Network Systems Science & Advanced Computing

Biocomplexity Institute & Initiative

University of Virginia

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

March 16th, 2023

(data current to March 9th – March 15th)

Biocomplexity Institute Technical report: TR BI-2023-30

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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

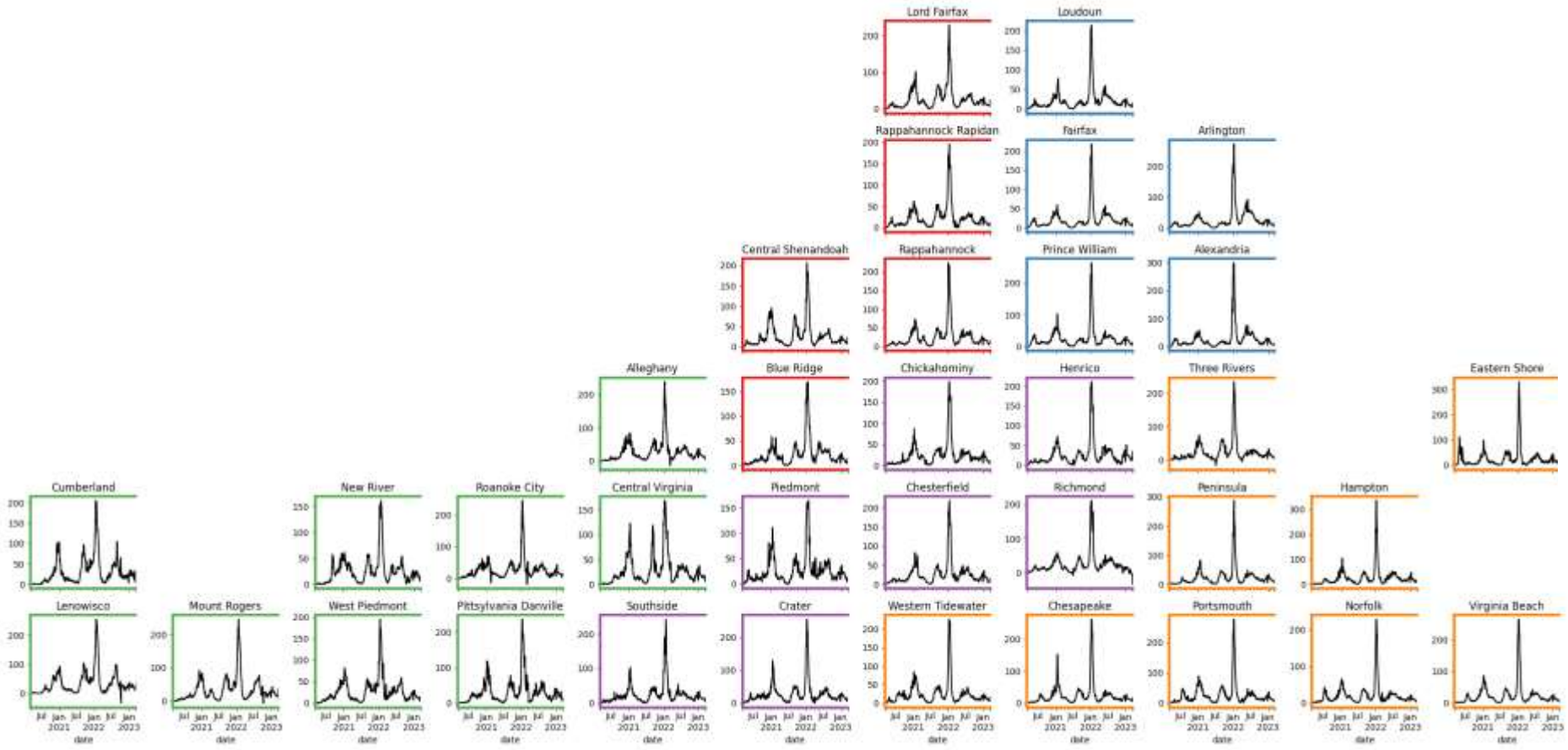
Projecting future cases precisely is impossible and unnecessary.
Even without perfect projections, we can confidently draw conclusions:

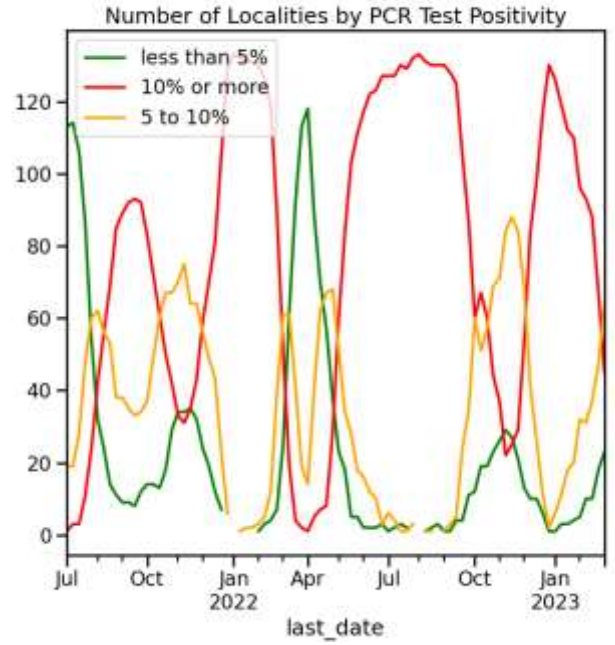
- Case rates and hospitalizations from COVID-19 continue to decline
  - Hospital occupancy down to levels last seen in mid-May of 2022
- Case rates and hospitalizations from Influenza are very low

- **Model Updates**
  - Model updated to fit hospital admissions as opposed to cases
    - New technique used to determine hospitalization to infection ratio
  - Projection model updated this week, two non-specific scenarios related to increases in transmissibility.
  - Boosted transmissibility can generate new surge in activity which does not exceed levels from Summer of 2022

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")

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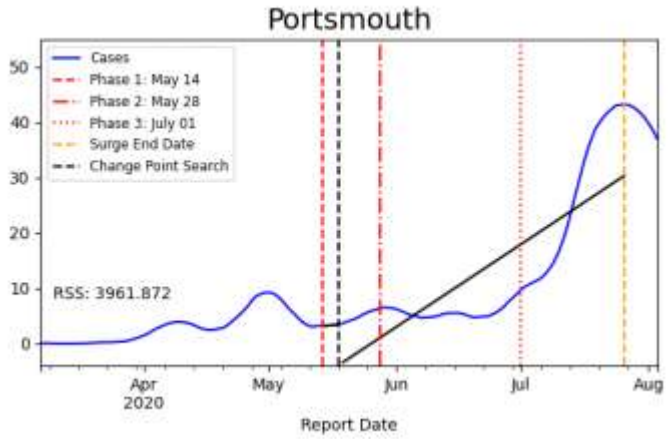
District Trajectories

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

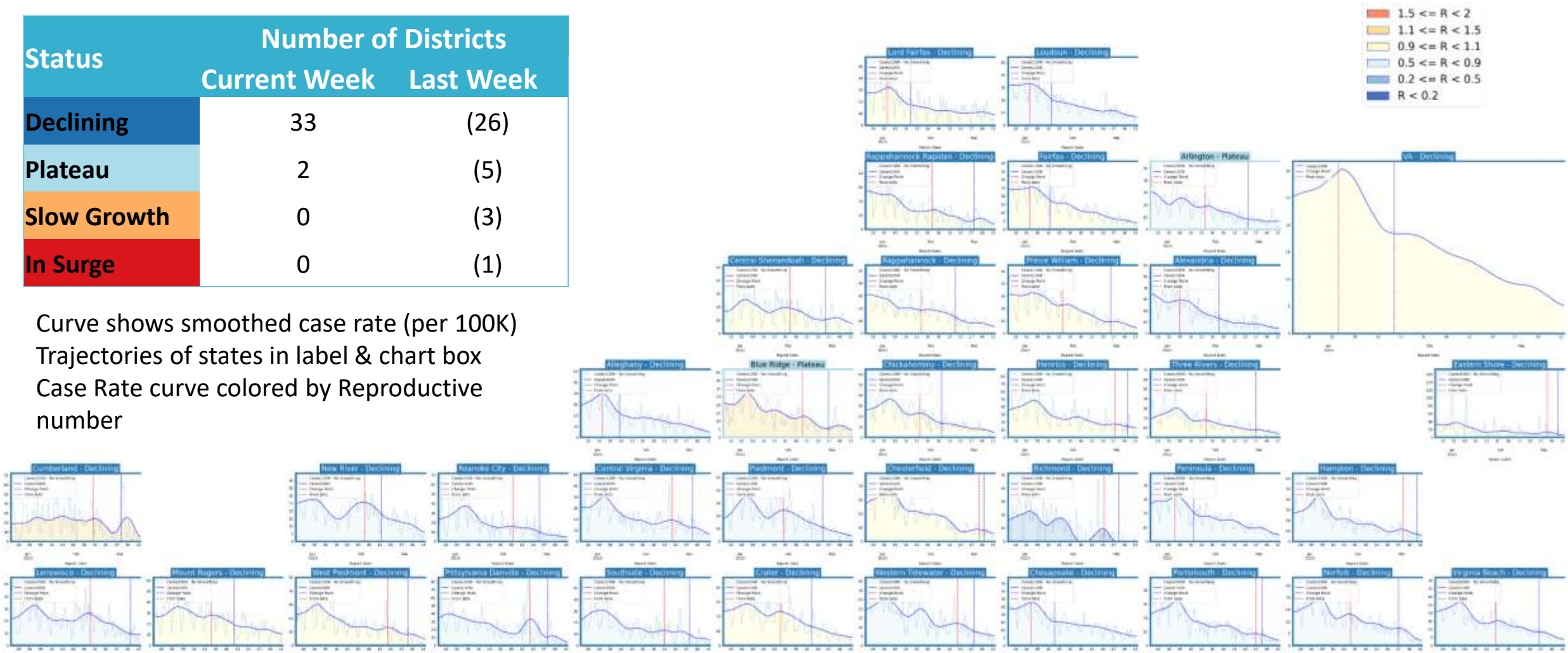


Trajectory	Description	Weekly Case Rate Slope (per 100k)	Weekly Hosp Rate Slope (per 100k)
Declining	Sustained decreases following a recent peak	slope < -0.88/day	slope < -0.07/day
Plateau	Steady level with minimal trend up or down	-0.88/day < slope < 0.42/day	-0.07/day < slope < 0.07/day
Slow Growth	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

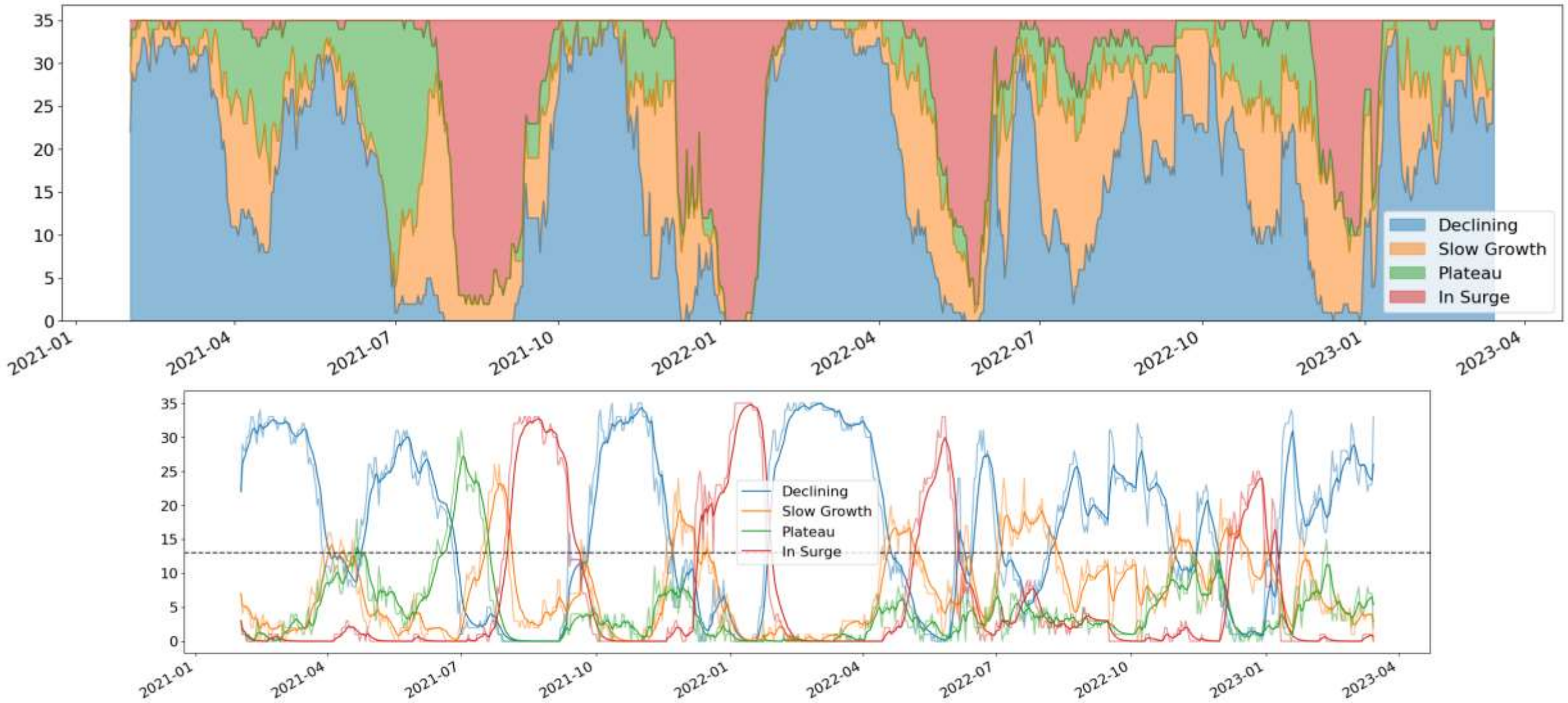
District Case Trajectories – last 10 weeks

Status	Number of Districts	
	Current Week	Last Week
Declining	33	(26)
Plateau	2	(5)
Slow Growth	0	(3)
In Surge	0	(1)

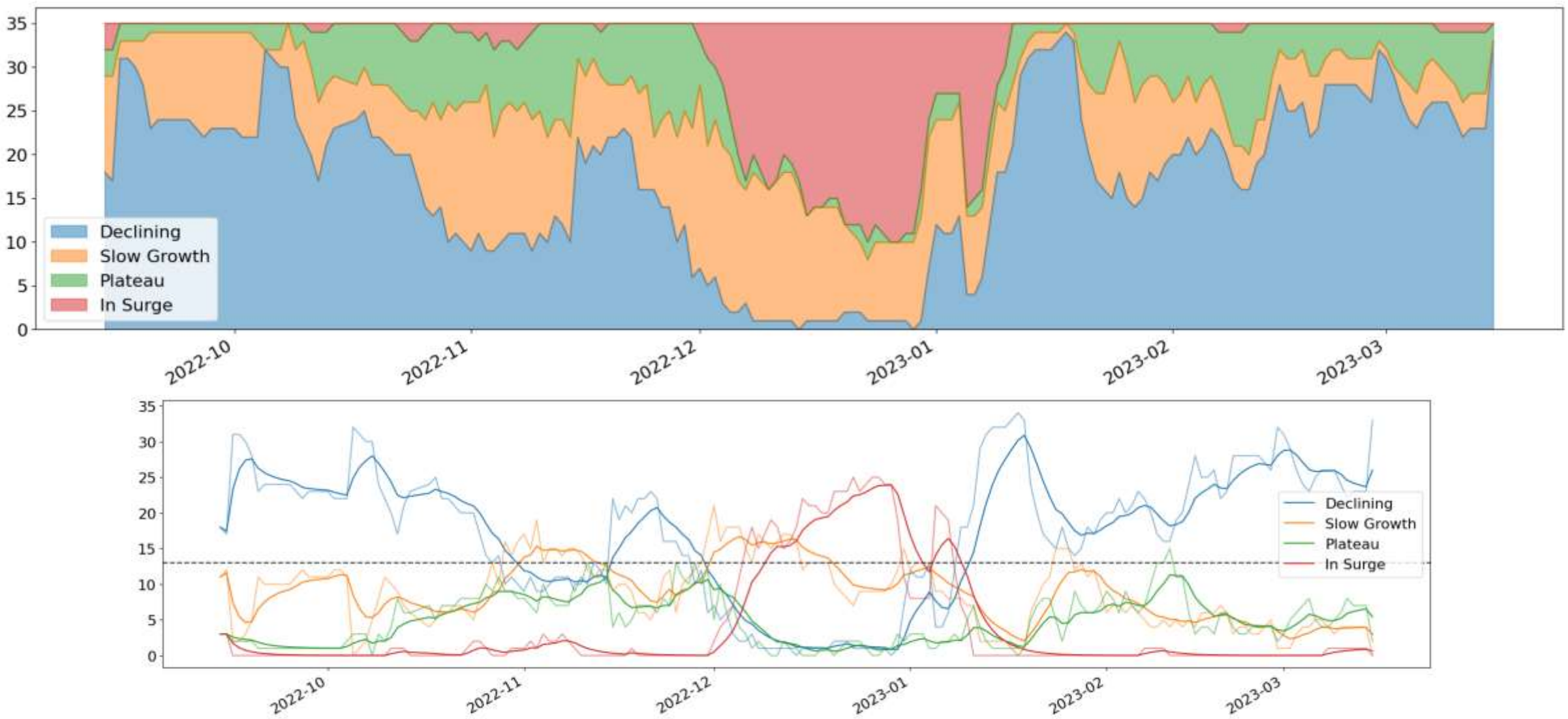
Curve shows smoothed case rate (per 100K)
Trajectories of states in label & chart box
Case Rate curve colored by Reproductive number



District Case Trajectories – Full History



District Case Trajectories – Recent 6 months



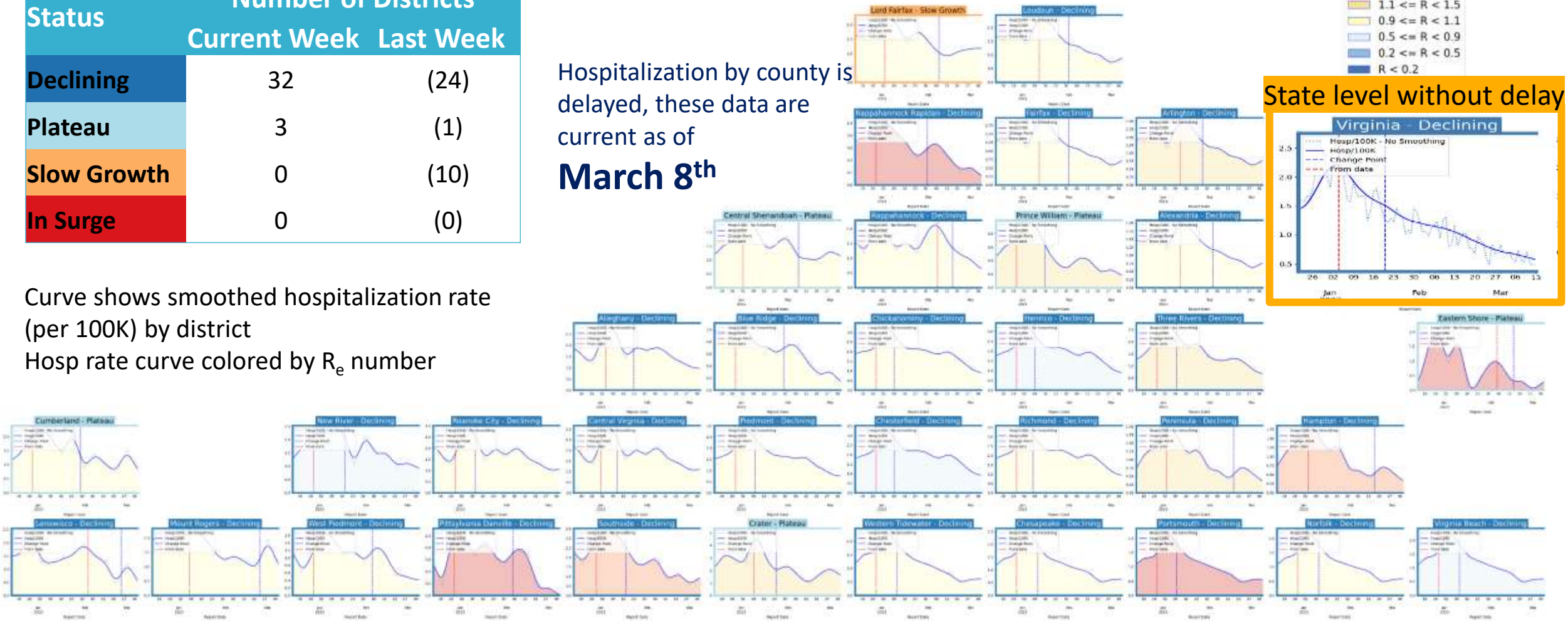
District Hospital Trajectories – last 10 weeks

Status	Number of Districts	
	Current Week	Last Week
Declining	32	(24)
Plateau	3	(1)
Slow Growth	0	(10)
In Surge	0	(0)

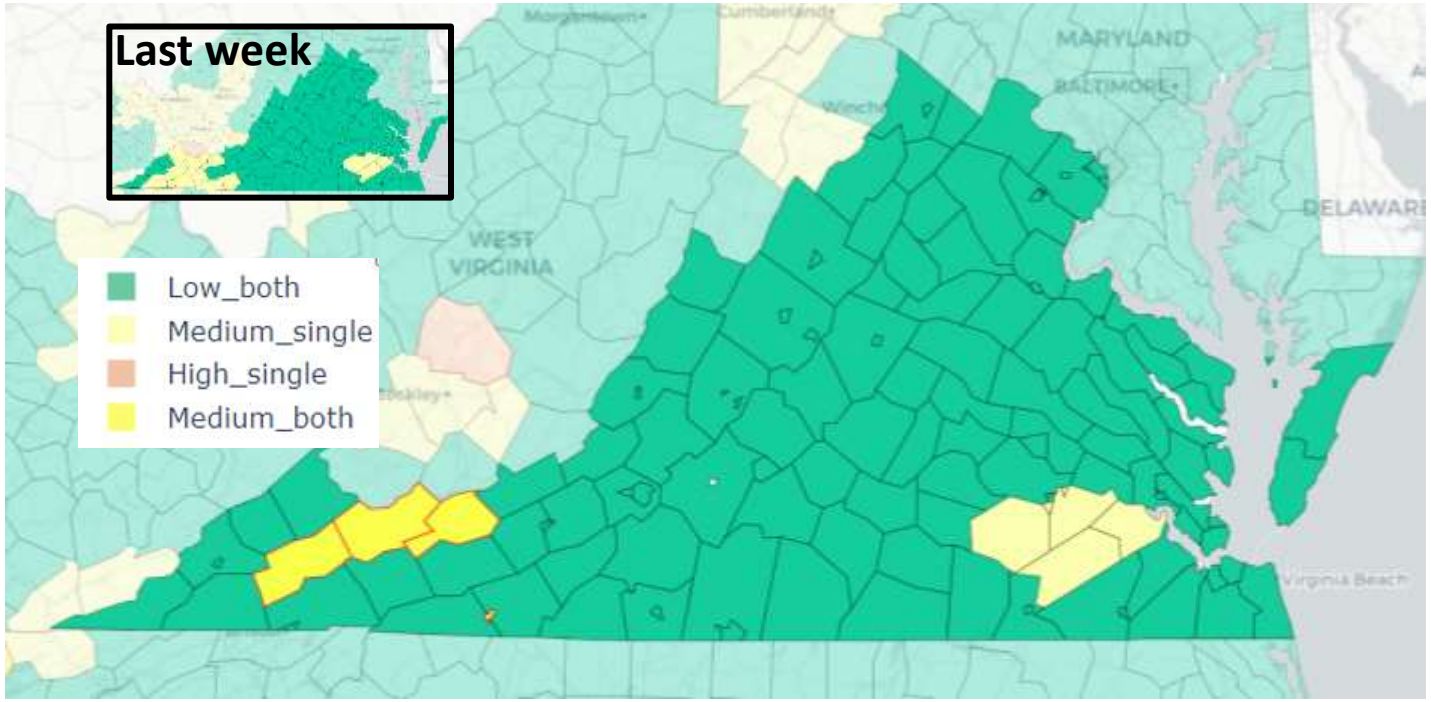
Curve shows smoothed hospitalization rate (per 100K) by district
Hosp rate curve colored by R_e number

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

March 8th



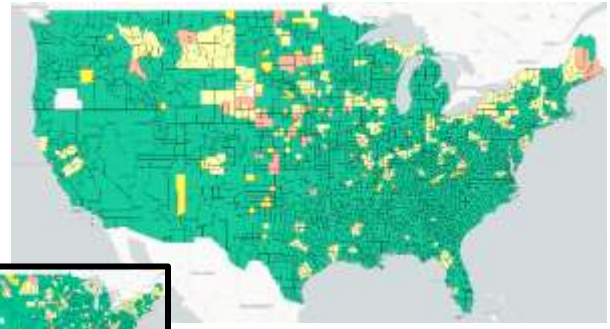
CDC's COVID-19 Community Levels



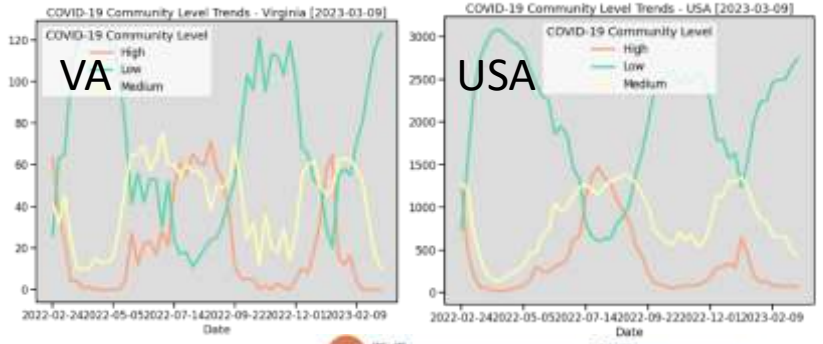
Red outline indicates county had 200 or more cases per 100k in last week

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



Last week



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

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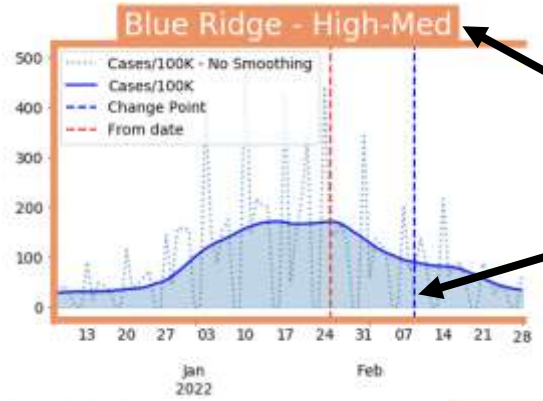
Data from: [CDC Data Tracker Portal]

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



District's Aggregate Community Level

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

Case rate Trajectory

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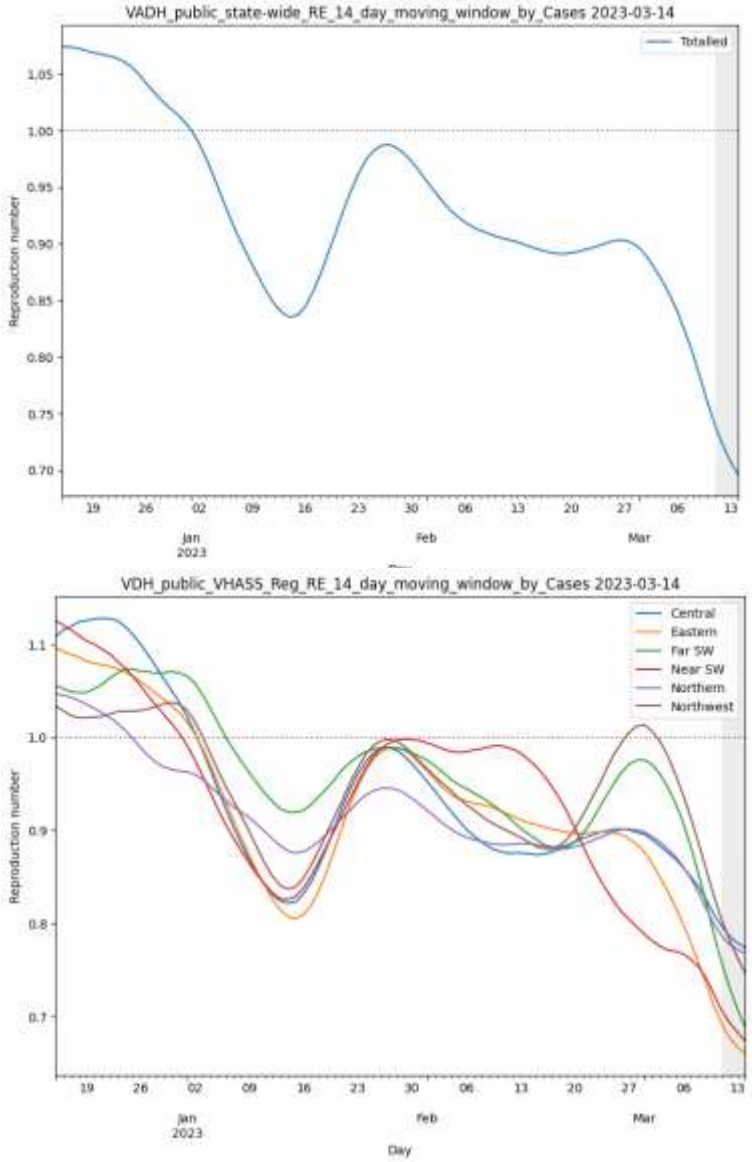
COVID-19 Growth Metrics

Estimating Daily Reproductive Number –
VDH report dates

March 14th Estimates

Region	Date Confirmed R_e	Date Confirmed Diff Last Week
State-wide	0.696	-0.205
Central	0.774	-0.142
Eastern	0.660	-0.161
Far SW	0.688	-0.357
Near SW	0.673	-0.164
Northern	0.768	-0.119
Northwest	0.746	-0.296



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

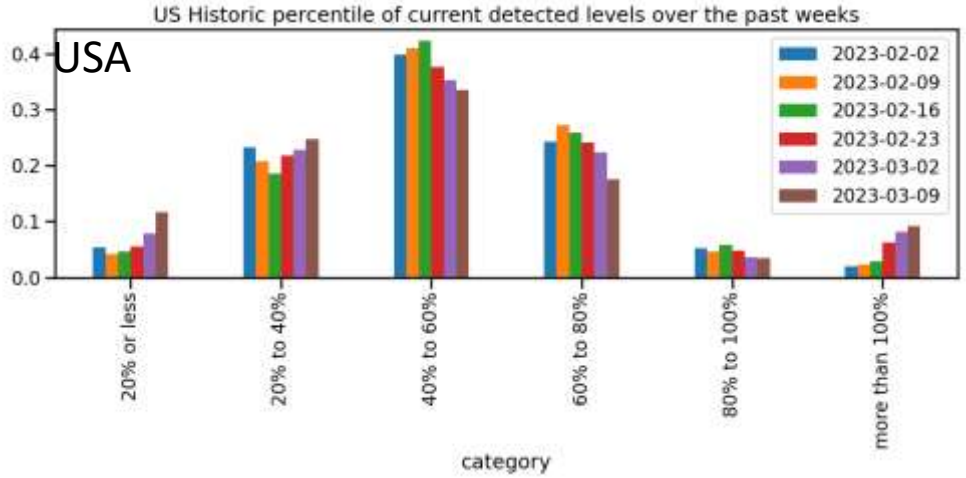
1. Anne Cori, Neil M. Ferguson, Christophe Fraser, Simon Cauchemez. A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics. American Journal of Epidemiology, Volume 178, Issue 9, 1 November 2013, Pages 1505–1512, https://doi.org/10.1093/aje/kwt133

Wastewater Monitoring

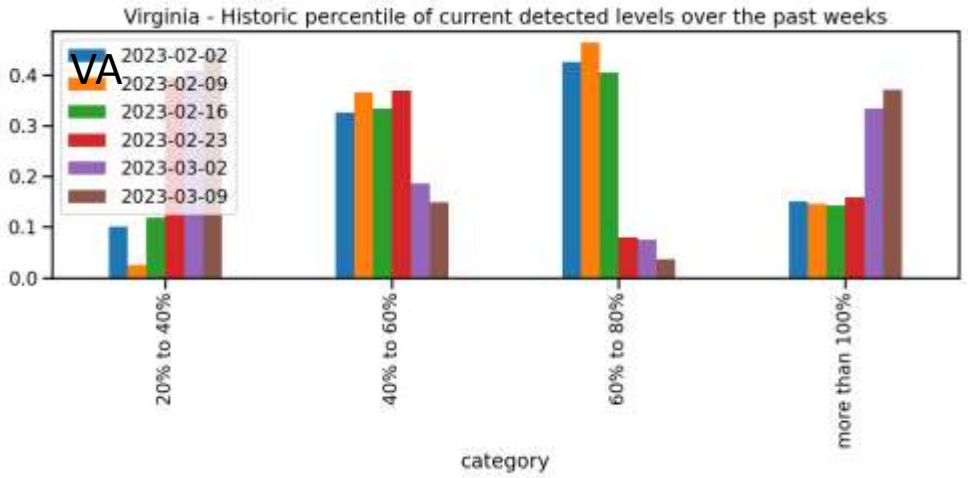
Wastewater provides a coarse early warning of COVID-19 levels in communities

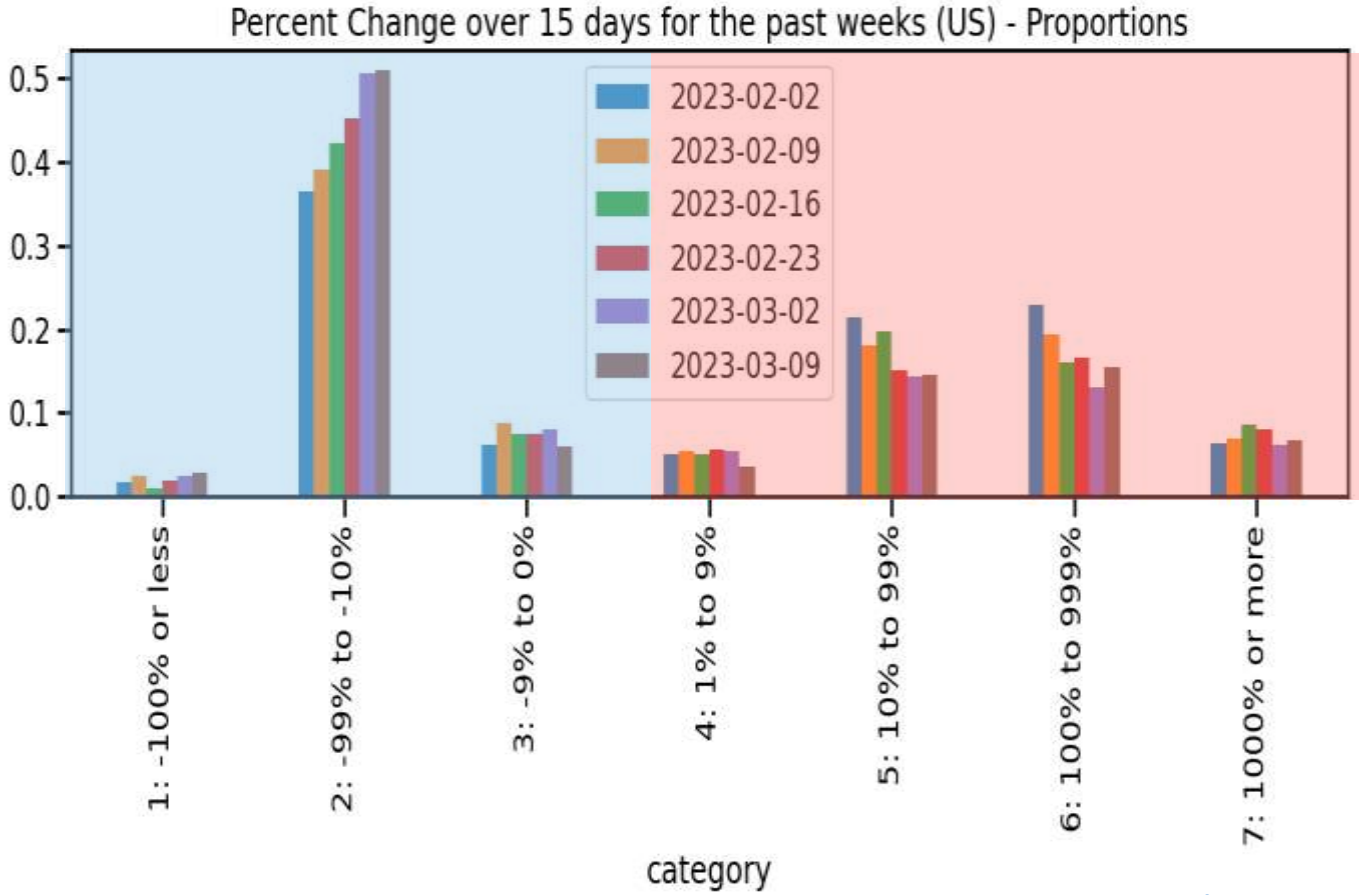
- Overall in the US, there is an increase in sites with increased levels of virus compared to 15 days ago
- Growth seen in the category where current virus levels are at or exceeding max of previous historical levels

USA



VA



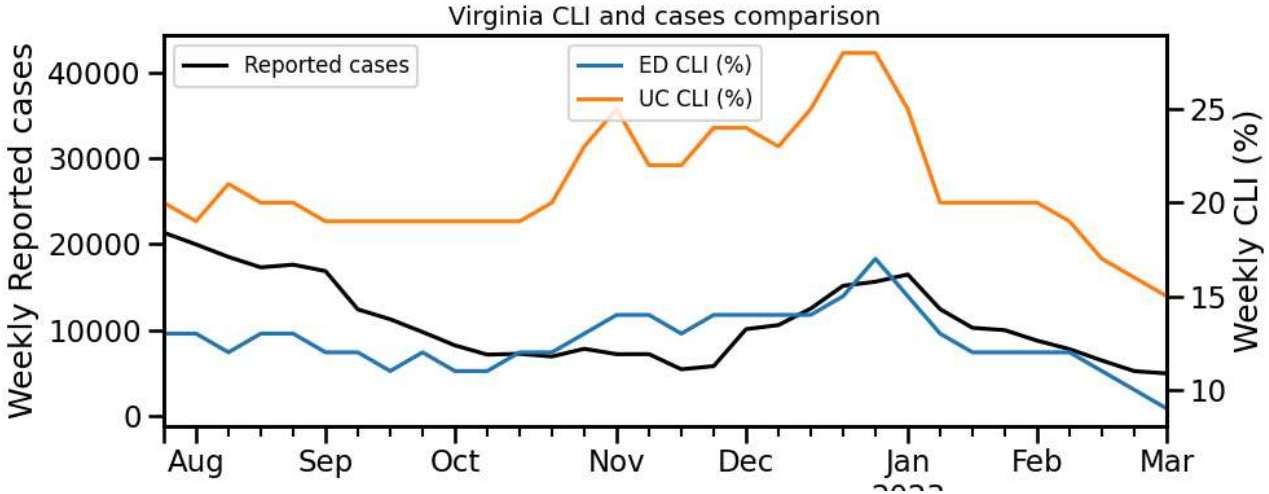


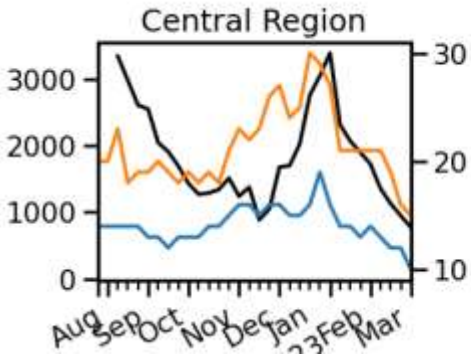
Data Source: [CDC Data Tracker]

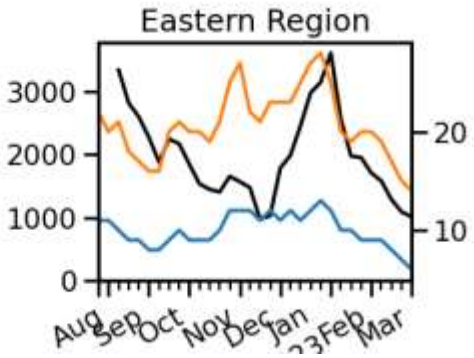
COVID-like Illness Activity

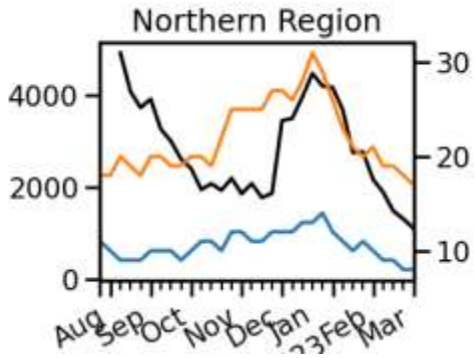
COVID-like Illness (CLI) gives a measure of COVID transmission in the community

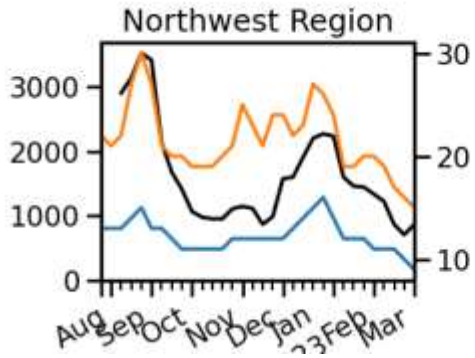
- Emergency Dept (ED) based CLI is more correlated with case reporting
- Urgent Care (UC) is a leading indicator but may be influenced by testing for other URIs
- **After recent surges, levels are now at lowest point in past 7 months**

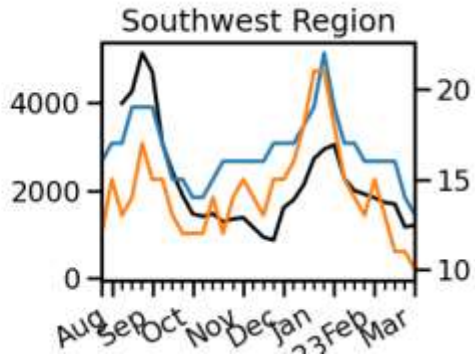












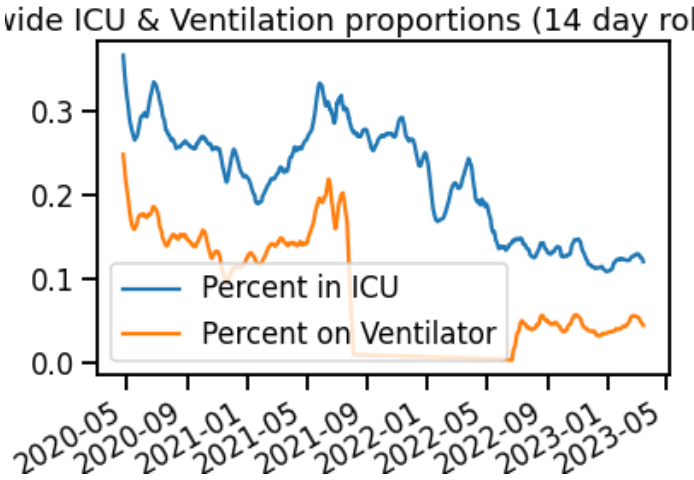
COVID-19 Severity Metrics

Hospitalizations and Severe Outcomes

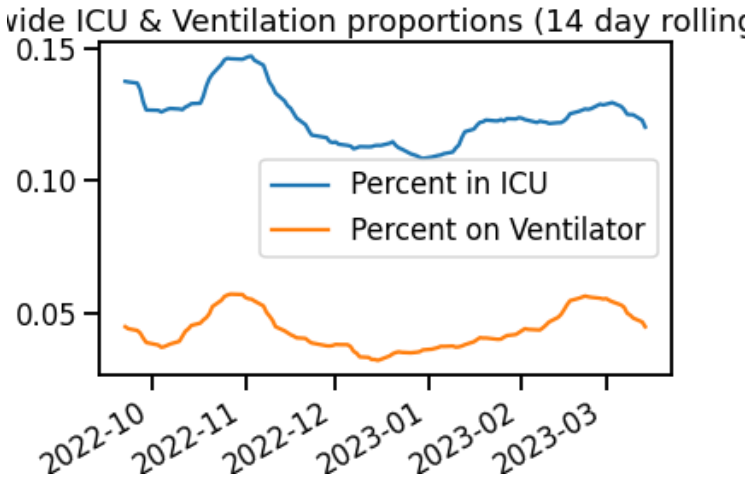
Proportion of most severe outcomes decreasing among those who are hospitalized

- ICU has declined from ~20% of hospitalized to 10-15% since initial Omicron wave
- Recent trend up continues, with nearly reaching late-summer levels now
- Regional variation tracks state-level

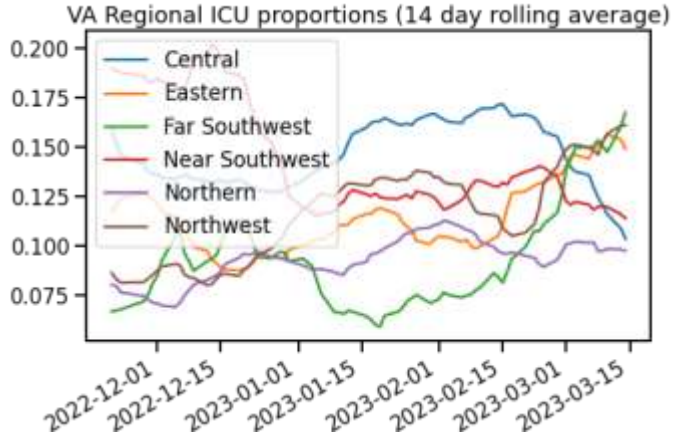
Virginia-wide – full pandemic



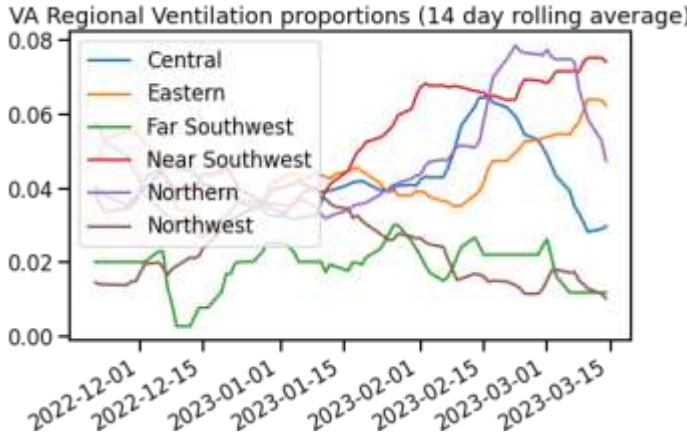
Virginia-wide – recent



Virginia Regional ICU percent



Virginia Regional Ventilation %



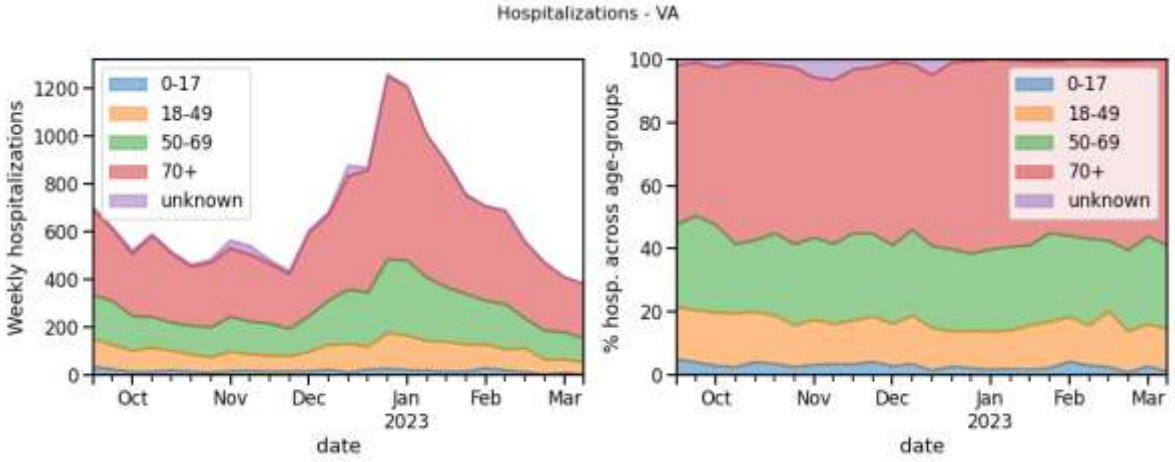
Hospitalizations in VA by Age

Age distribution in hospitals relatively stable

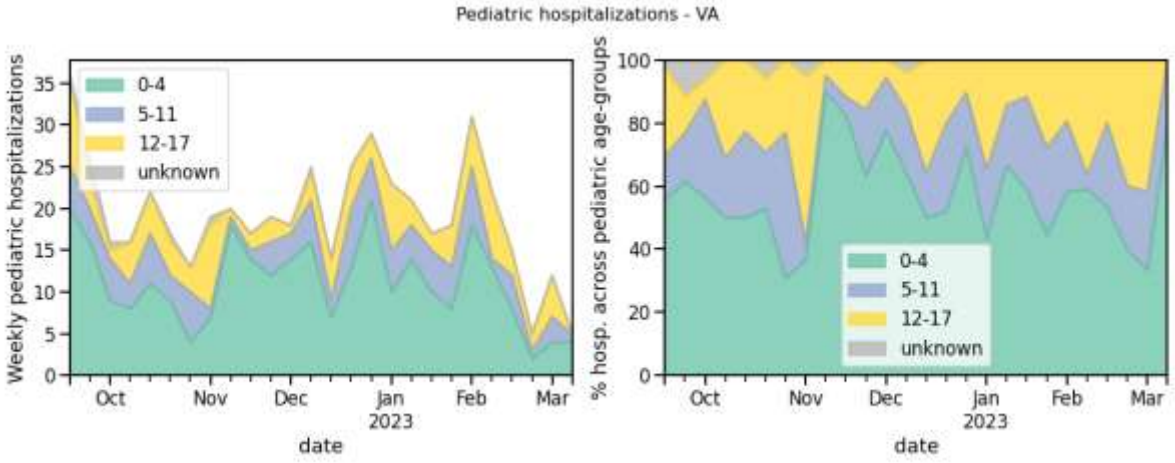
- Uptick in hospitalizations mostly fueled by 70+ age group
- Pediatric hospitalizations level off after uptick last week

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

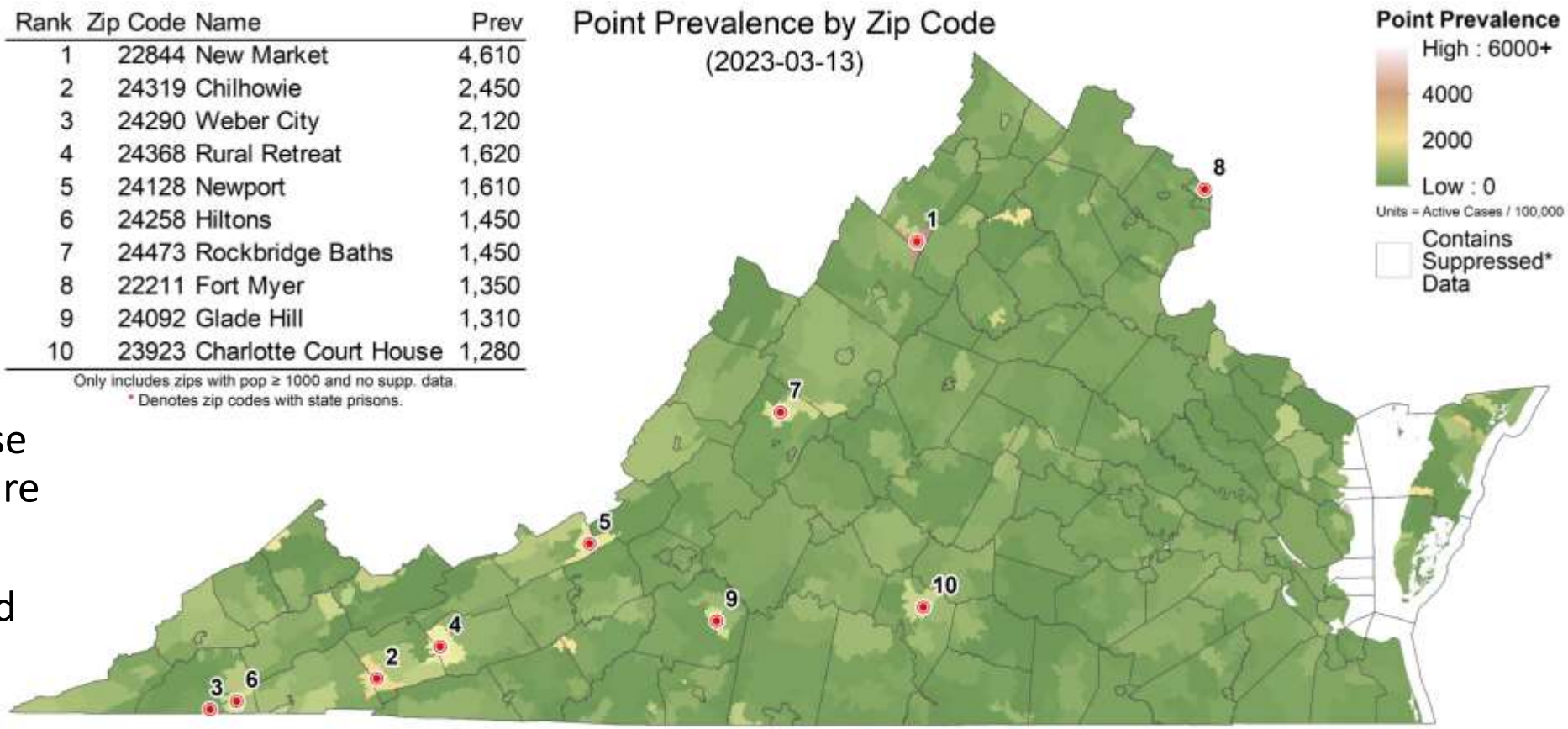
Zip code level weekly Case Rate (per 100K)

Case Rates in the last week by zip code

- Statewide prevalence peaked in January. Case rates are at the lowest levels seen since April 2022.
- No zip codes containing a prison appear in this week's top 10.
- Fort Myer is the only urban area with high case rates. Most top 10 zips are found in Southwest VA.
- Some counts are low and suppressed to protect anonymity. They are shown with a red outline.

Rank	Zip Code	Name	Prev
1	22844	New Market	4,610
2	24319	Chilhowie	2,450
3	24290	Weber City	2,120
4	24368	Rural Retreat	1,620
5	24128	Newport	1,610
6	24258	Hiltons	1,450
7	24473	Rockbridge Baths	1,450
8	22211	Fort Myer	1,350
9	24092	Glade Hill	1,310
10	23923	Charlotte Court House	1,280

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 2023-03-13.

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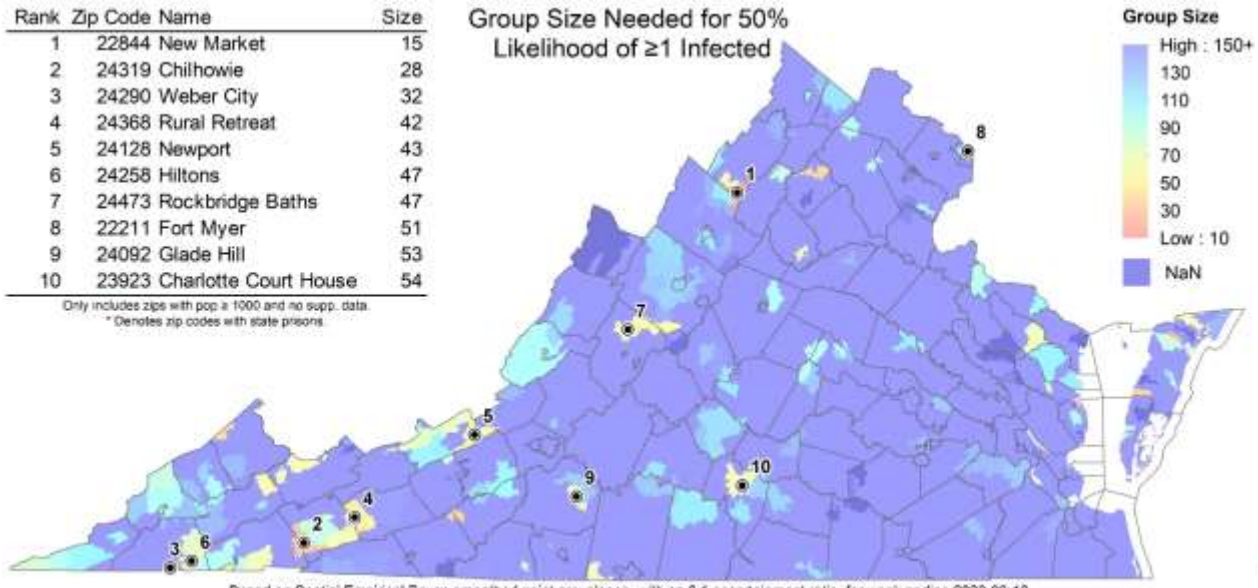
Risk of Exposure by Group Size and HCW prevalence

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 15 in New Market, 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 HCW as the numerator / population's case prevalence. Smyth County reports 14 HCW cases; another nine in Roanoke.

Rank	Zip Code	Name	Size
1	22844	New Market	15
2	24319	Chilhowie	28
3	24290	Weber City	32
4	24368	Rural Retreat	42
5	24128	Newport	43
6	24258	Hiltons	47
7	24473	Rockbridge Baths	47
8	22211	Fort Myer	51
9	24092	Glade Hill	53
10	23923	Charlotte Court House	54

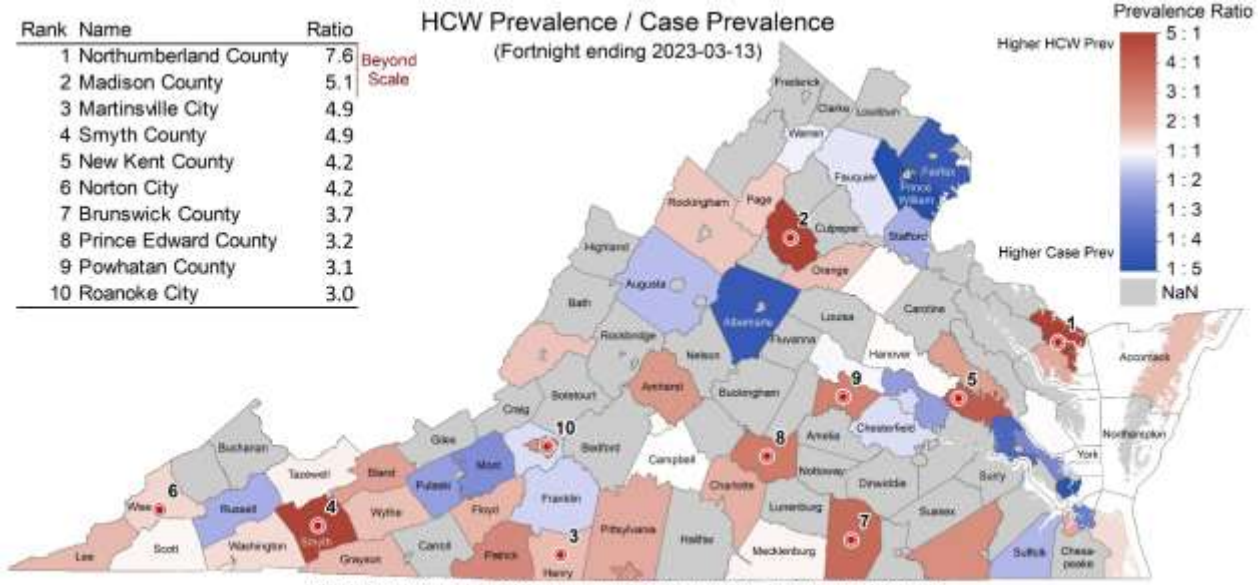
Only includes zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons



Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for week ending 2023-03-13.

Rank	Name	Ratio
1	Northumberland County	7.6
2	Madison County	5.1
3	Martinsville City	4.9
4	Smyth County	4.9
5	New Kent County	4.2
6	Norton City	4.2
7	Brunswick County	3.7
8	Prince Edward County	3.2
9	Powhatan County	3.1
10	Roanoke City	3.0

Beyond Scale



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

Current Hot-Spots

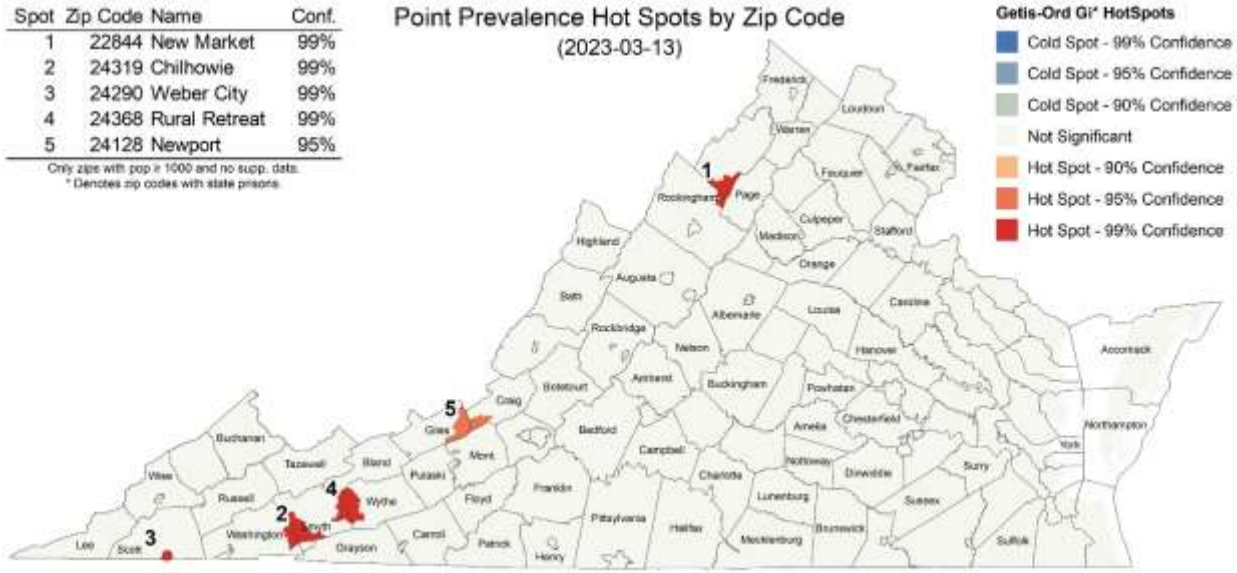
Case rates that are significantly different from neighboring areas or model projections

- **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.
- Most hotspots are found in Southwest Virginia along Interstate 81. Models underpredicted Lenowisco, and overpredicted Cumberland Plateau. Otherwise, models were accurate with minimal residual autocorrelation.

Spatial Hotspots

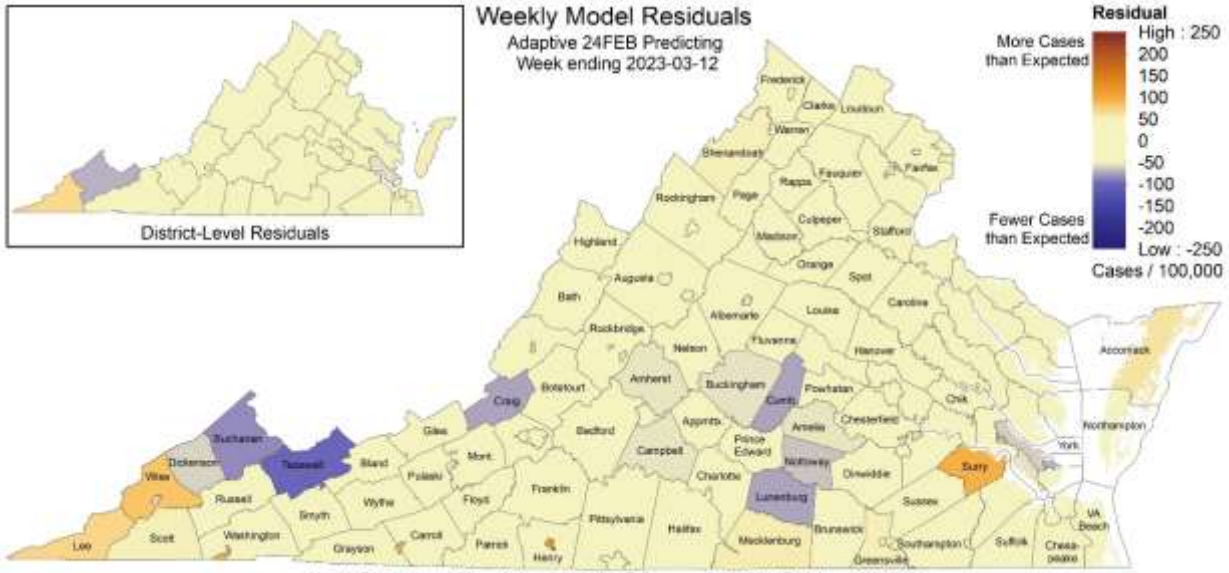
Spot	Zip Code	Name	Conf.
1	22844	New Market	99%
2	24319	Chilhowie	99%
3	24290	Weber City	99%
4	24368	Rural Retreat	99%
5	24128	Newport	95%

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



Based on Global Empirical Bayes smoothed point prevalence for week ending 2023-03-13.

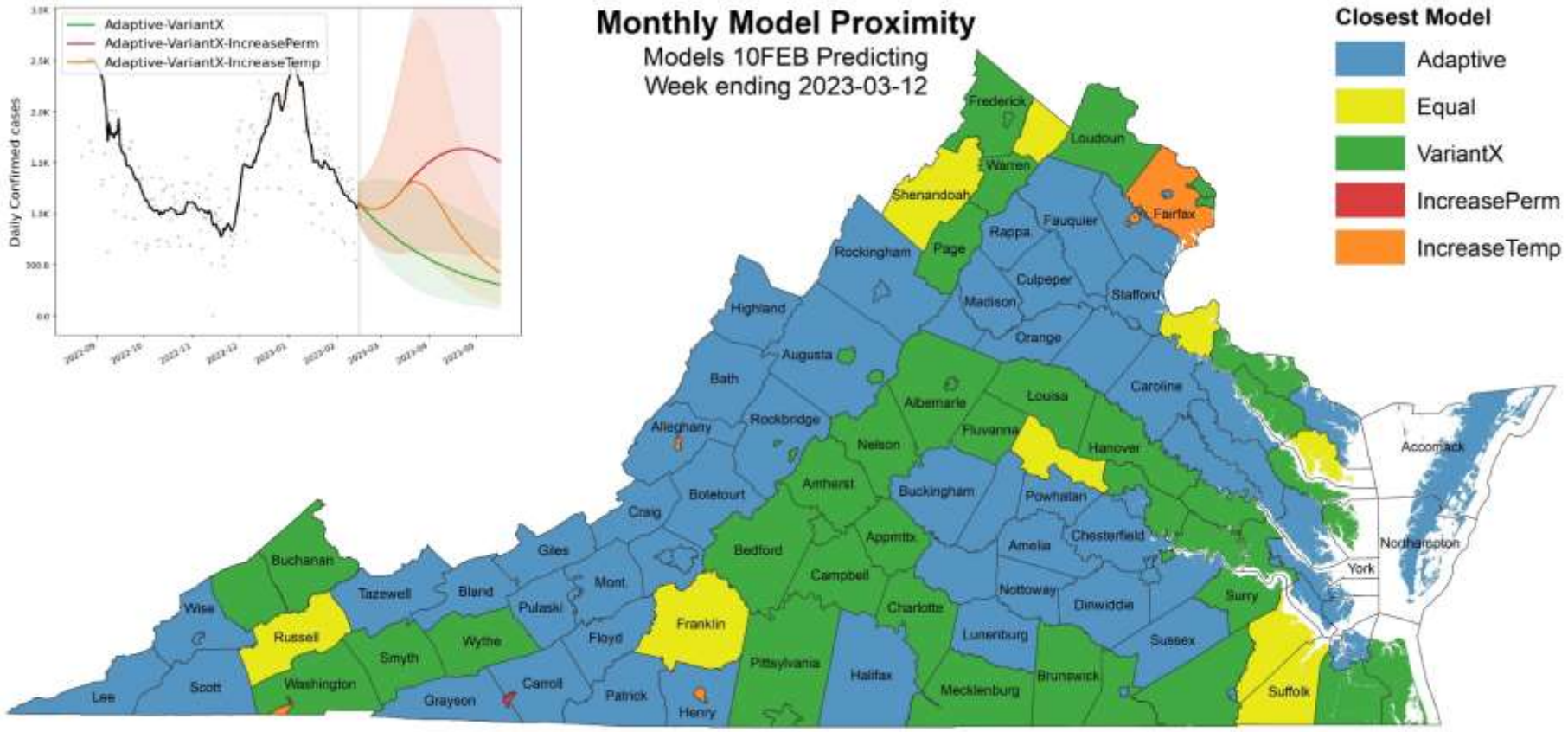
Clustered Temporal Hotspots



Health District Level Moran's I = -0.050983, Z-Score = -0.361821, P-Value = 0.717486
No Residual Autocorrelation Detected

Scenario Trajectory Tracking

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

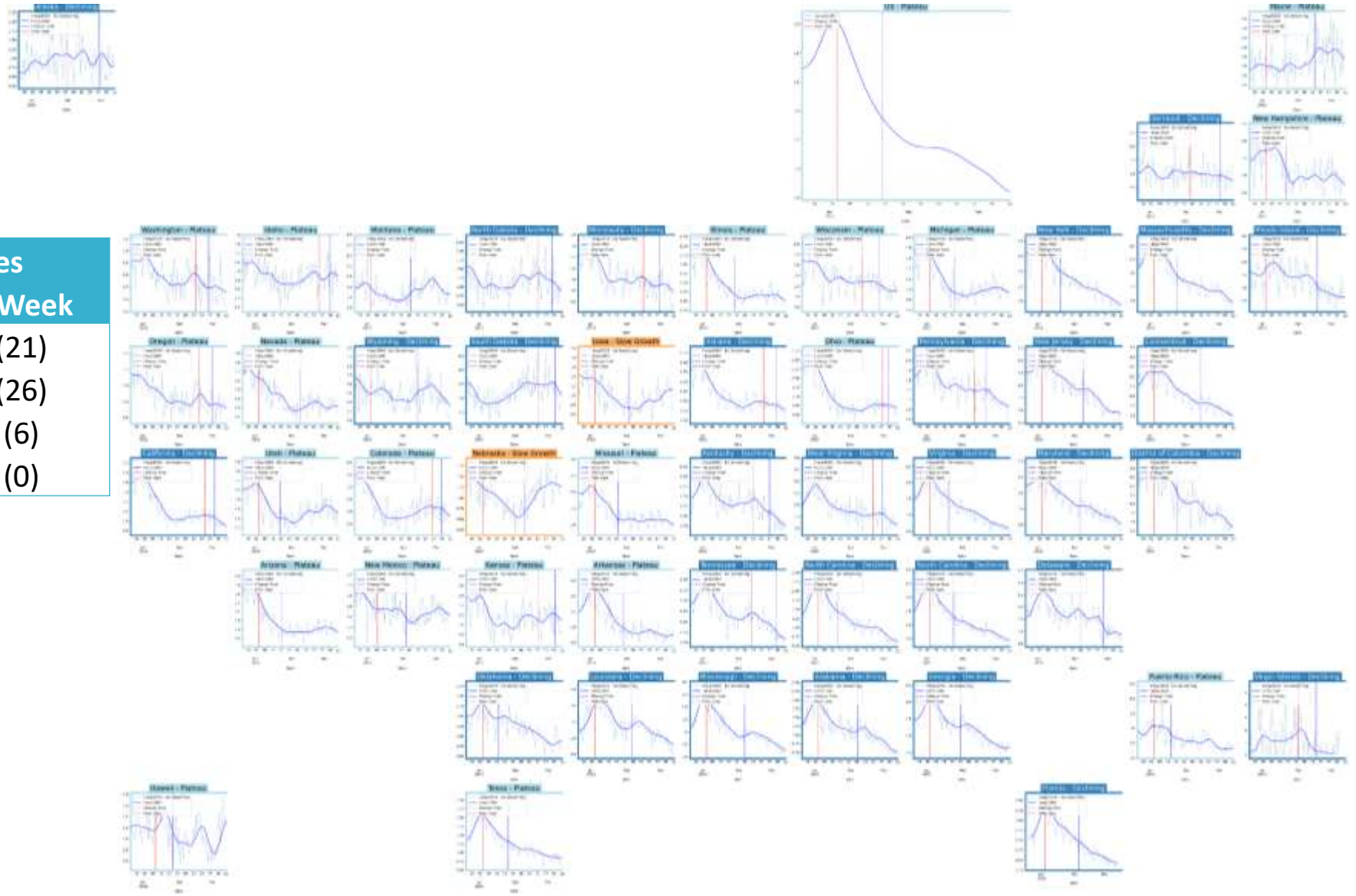


- One-month projections separate the scenarios more clearly and reveals larger overall patterns.
- Among models run in early February, the Adaptive and Variant X scenarios were most accurate in forecasting county level cases. Only a handful of locales tracked the Increased Transmission scenarios.

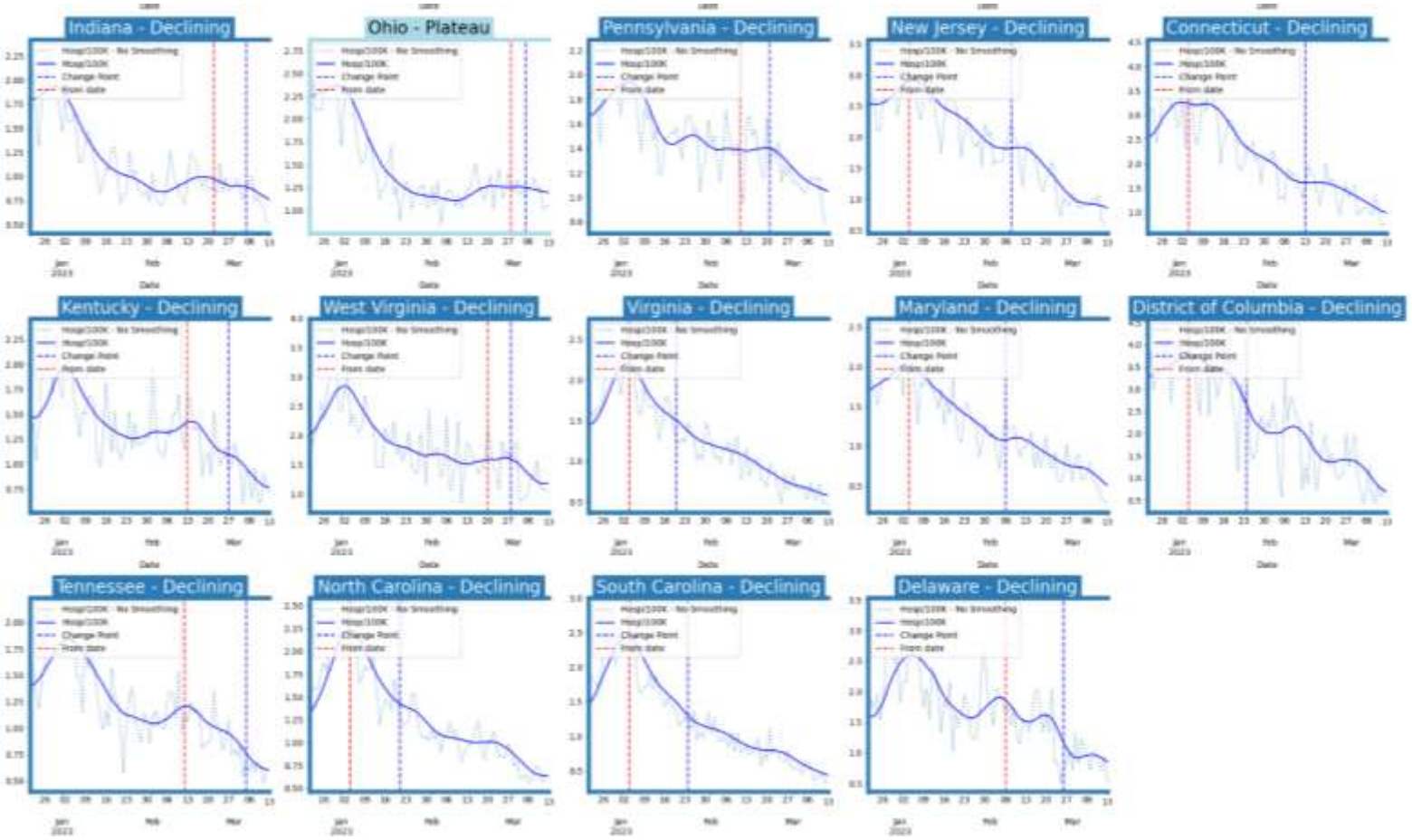
COVID-19 Broader Context

United States Hospitalizations

Status	Number of States	
	Current Week	Last Week
Declining	30	(21)
Plateau	21	(26)
Slow Growth	2	(6)
In Surge	0	(0)

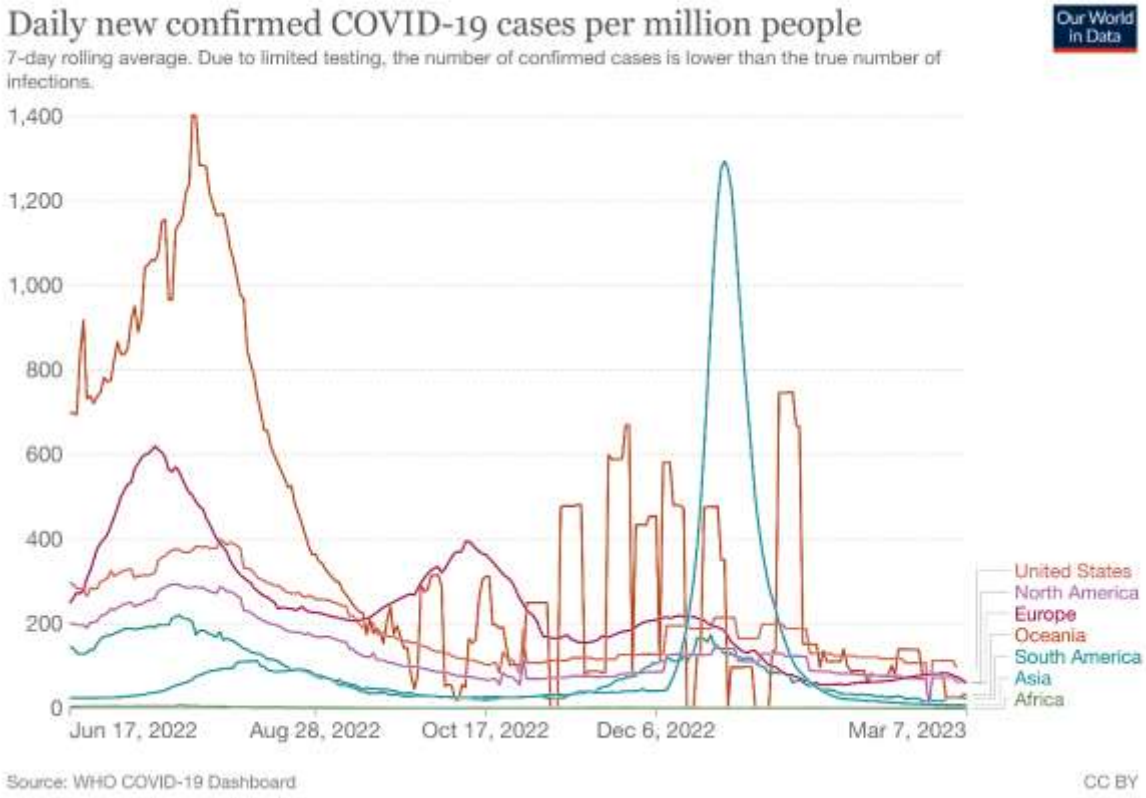


Virginia and Her Neighbors

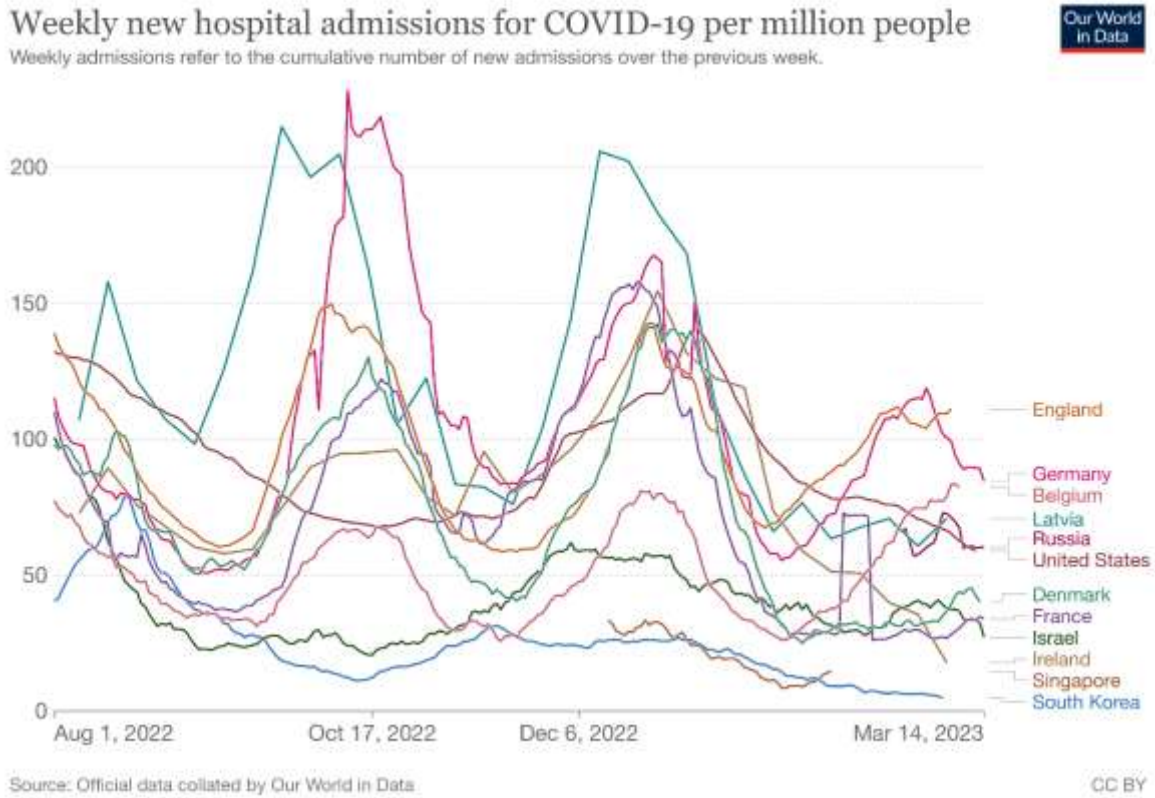


Around the World – Various trajectories

Confirmed cases



Hospitalizations



Our World in Data

[Our World in Data]

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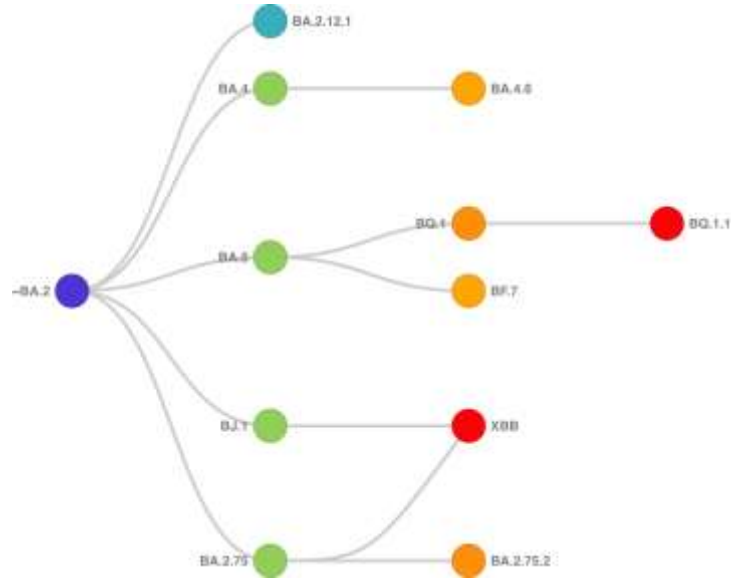
COVID-19 Genomic Update

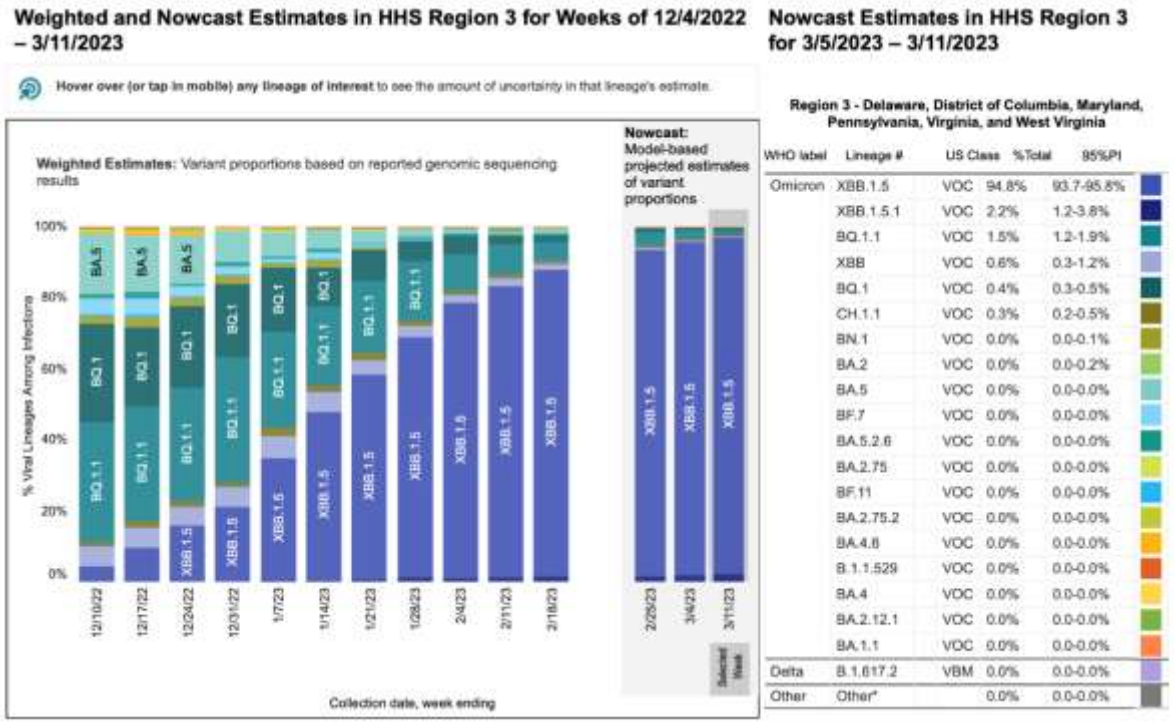
SARS-CoV2 Variants of Concern

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



https://clades.nextstrain.org



Omicron Updates*

- XBB.1.5 continues to dominate accounting for 94%
- XBB.1.5.1 is now being tracked, and is at 1.5%
- XBB not in XBB.1.5* has fallen below 1%
- BQ.1 and BQ.1.1 continue to lose ground combing for just under 2%

*percentages are CDC NowCast Estimates

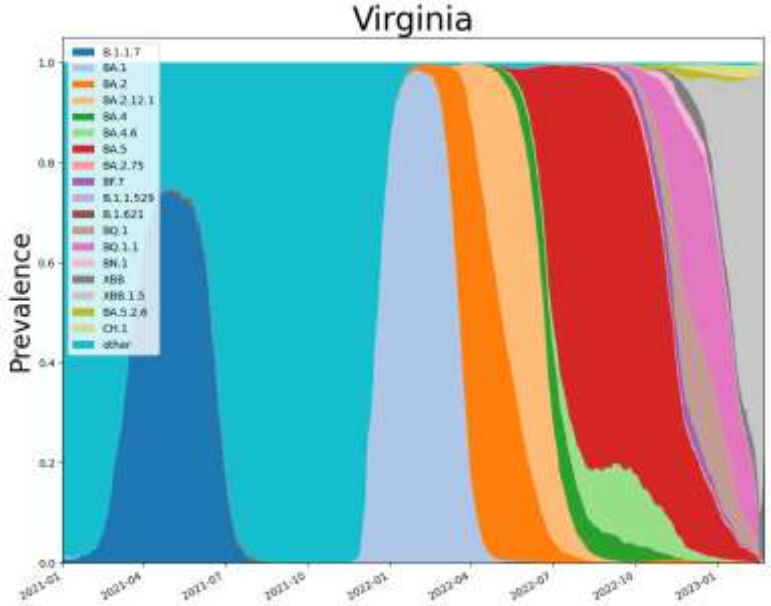
CDC Variant Tracking

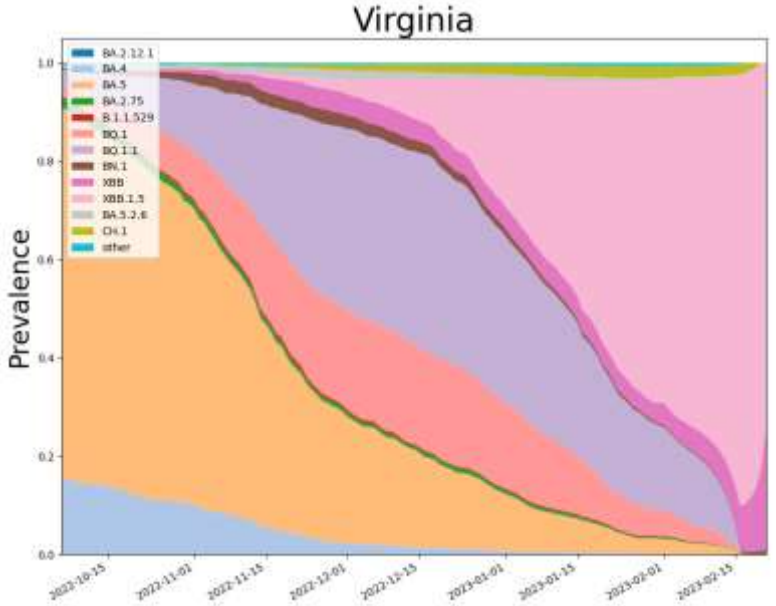
SARS-CoV2 Omicron Sub-Variants

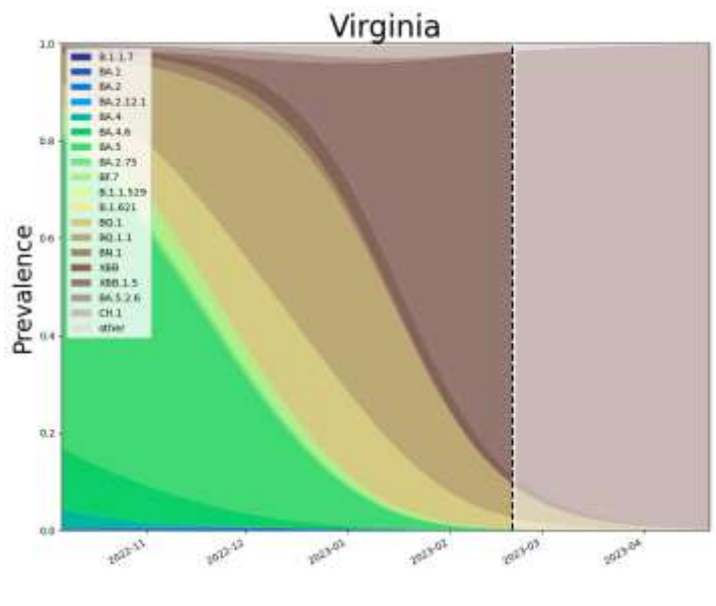
covSPECTRUM
Enabled by data from GISAID

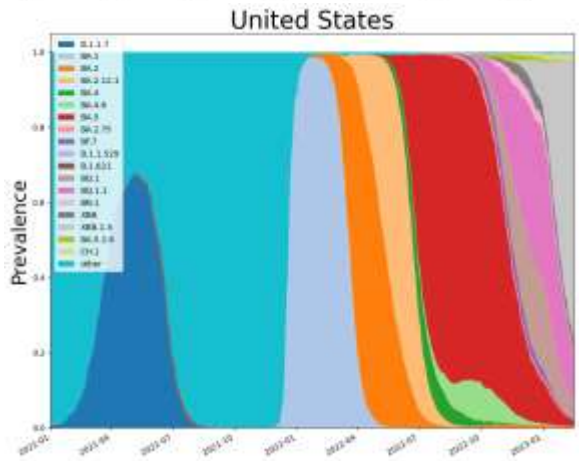
As detected in whole Genomes in public repositories

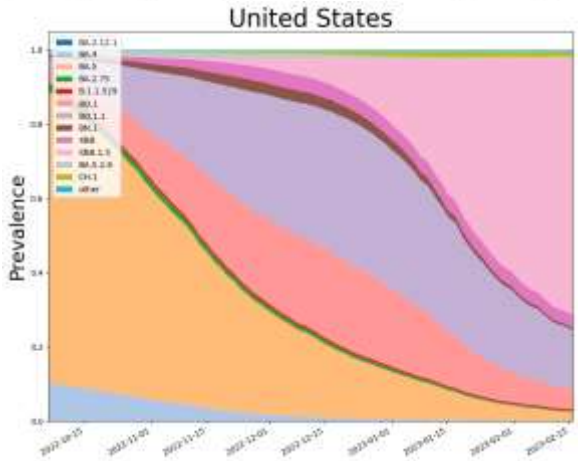
VoC Polynomial Fit Projections

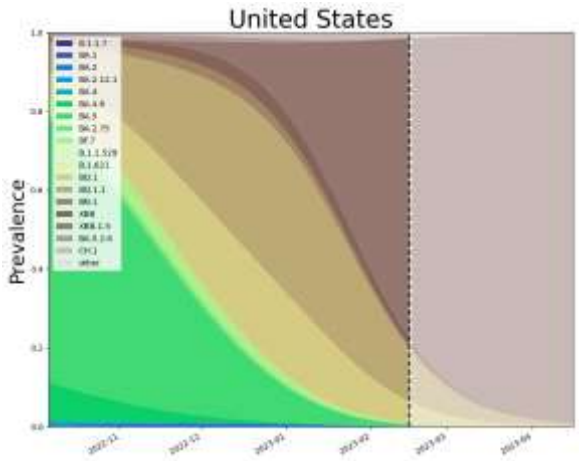












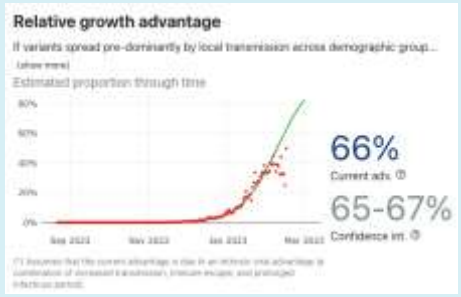
Note: Everything from dotted line forward is a projection.

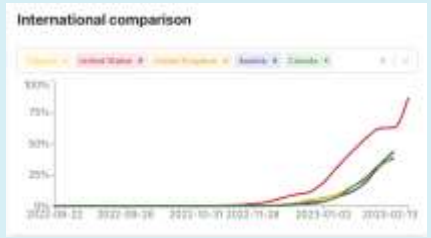
SARS-CoV2 Omicron Sub-Variants

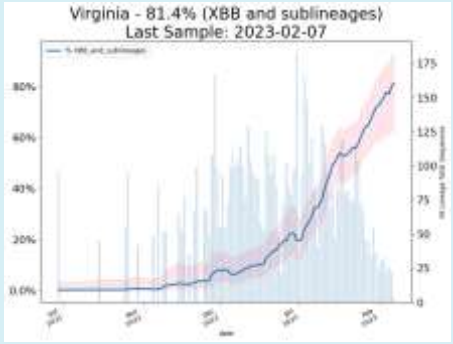
[COV-spectrum](#)
"Editor's choice"
Variants to watch

covSPECTRUM
Enabled by data from GISAID

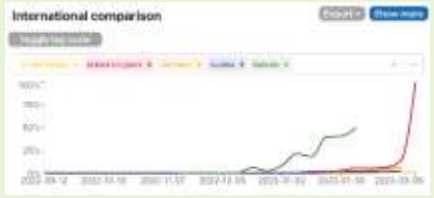
XBB.1.5



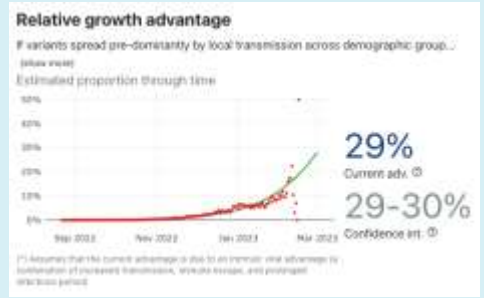


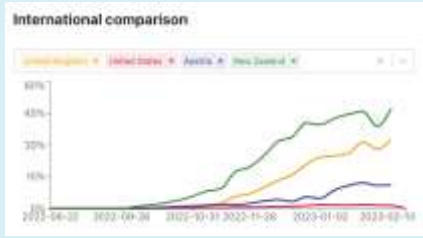


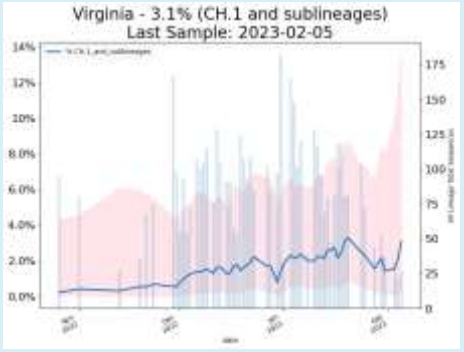
XBB.1.9.1*



CH.1.1*







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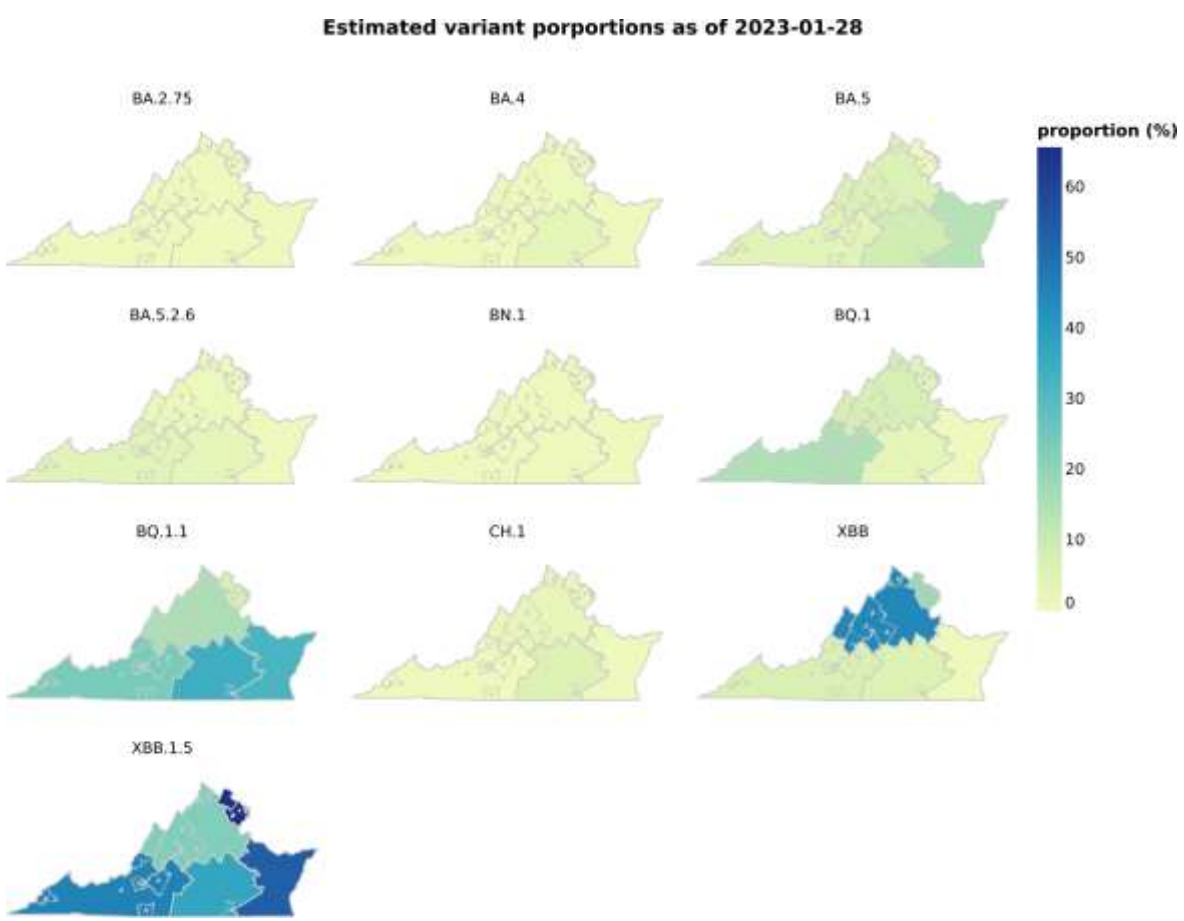
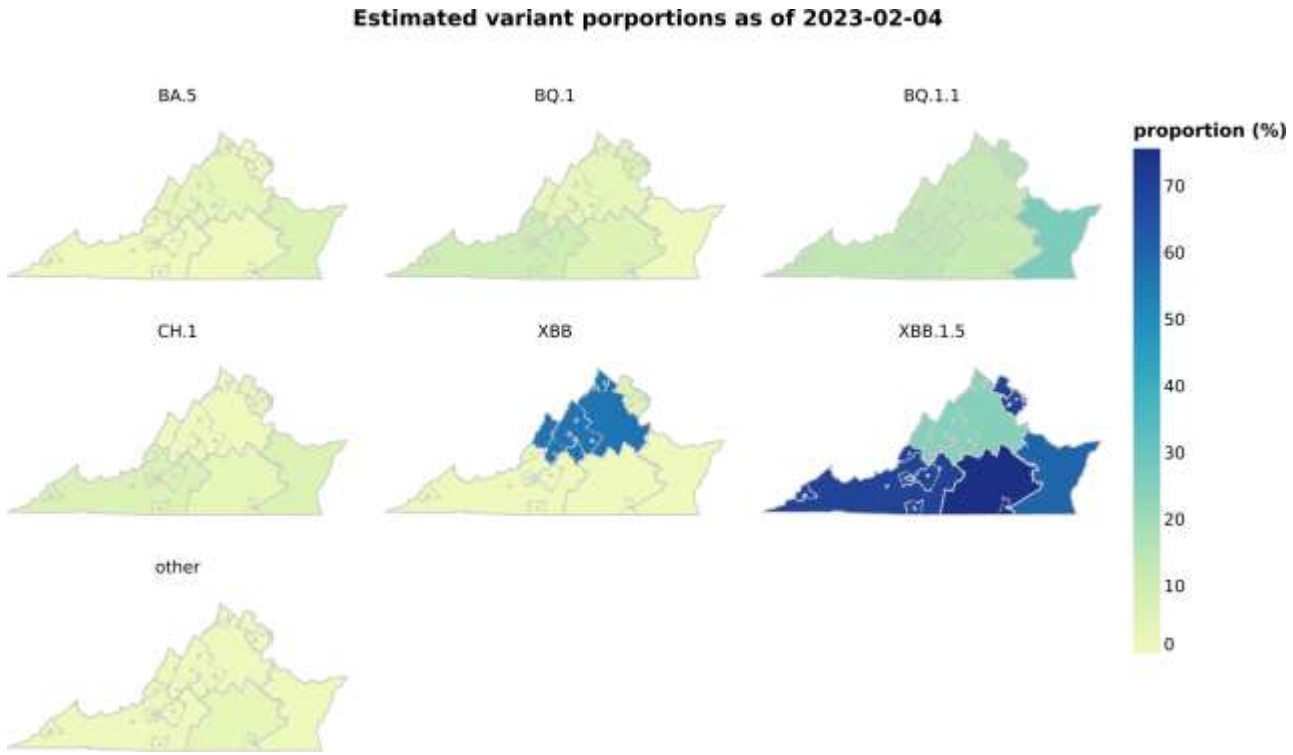
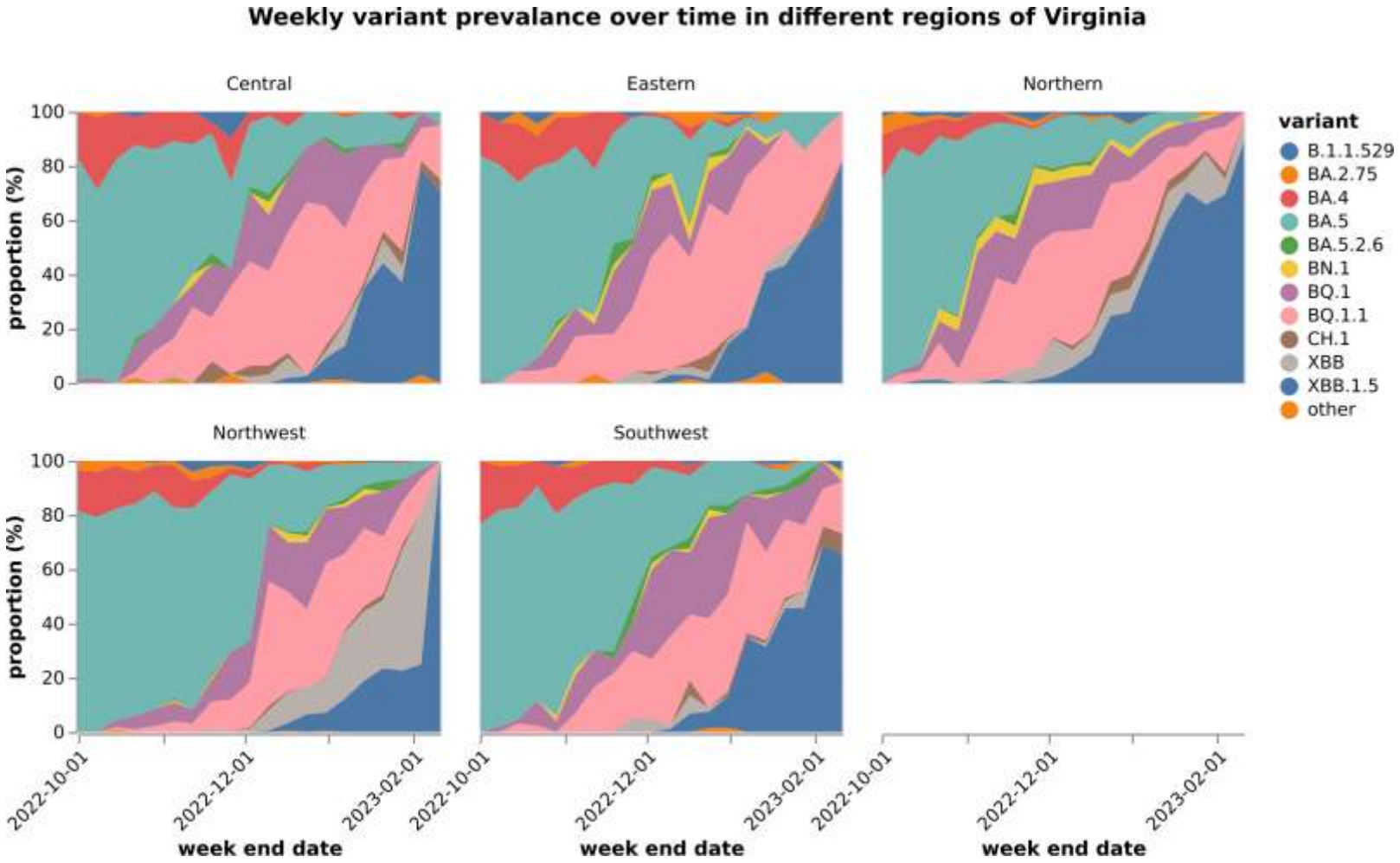
SARS-CoV2 Omicron Sub-Variants





SARS-CoV2 Omicron Sub-Variants



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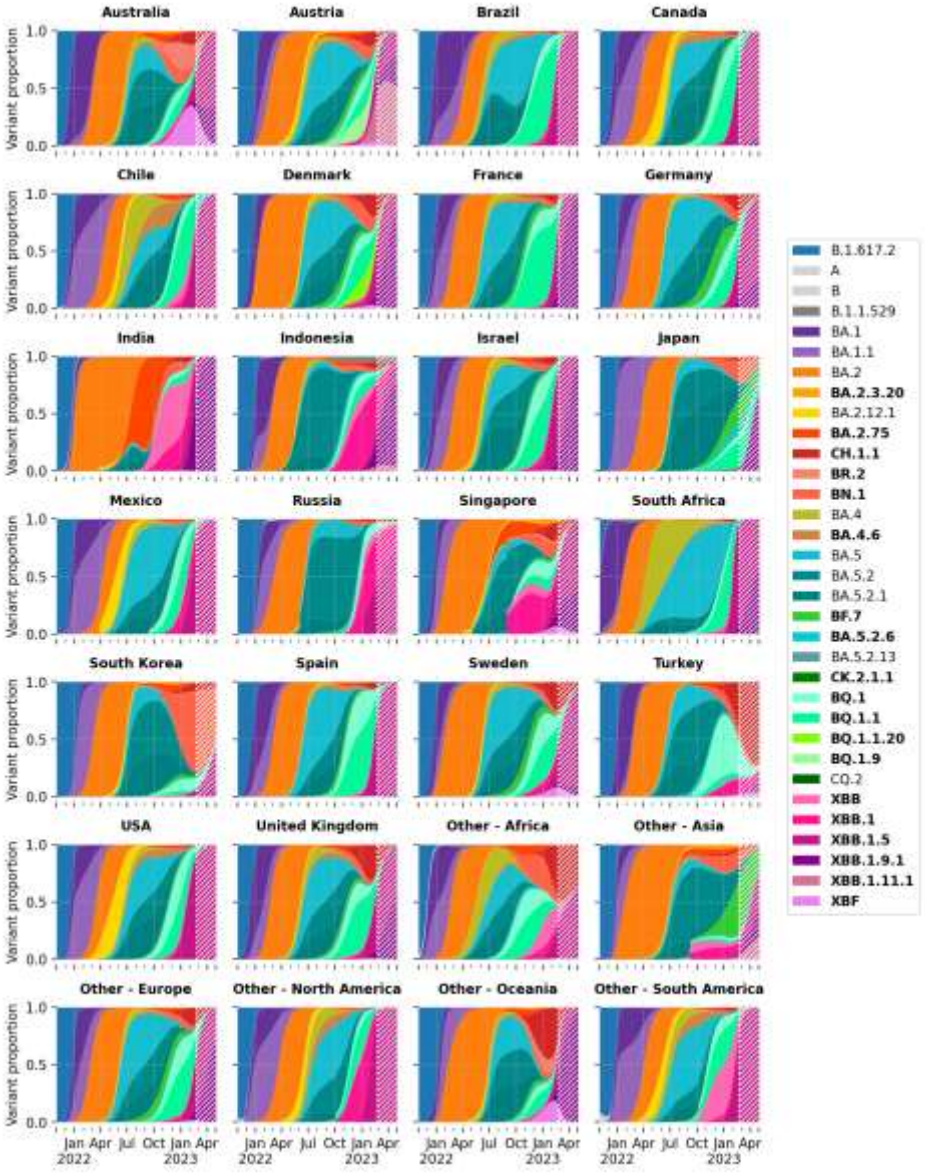
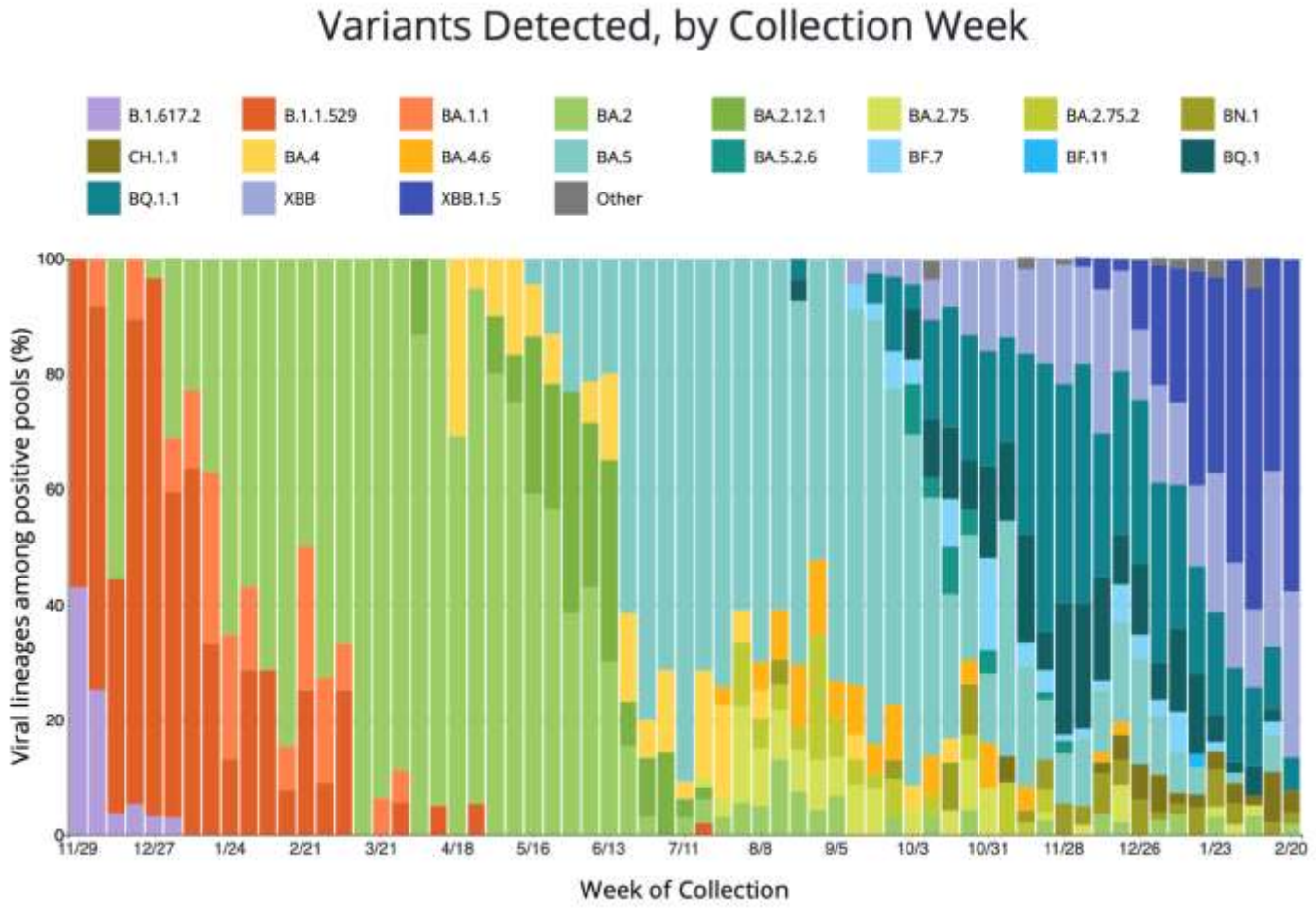
Global SARS-CoV2 Variant Status



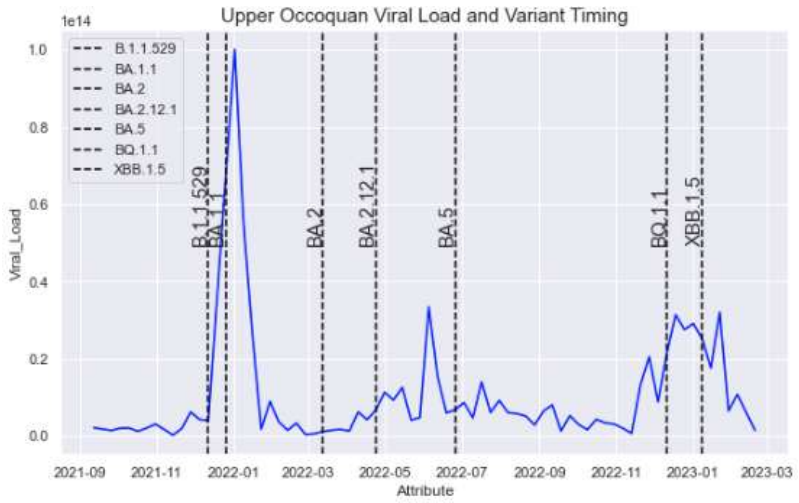


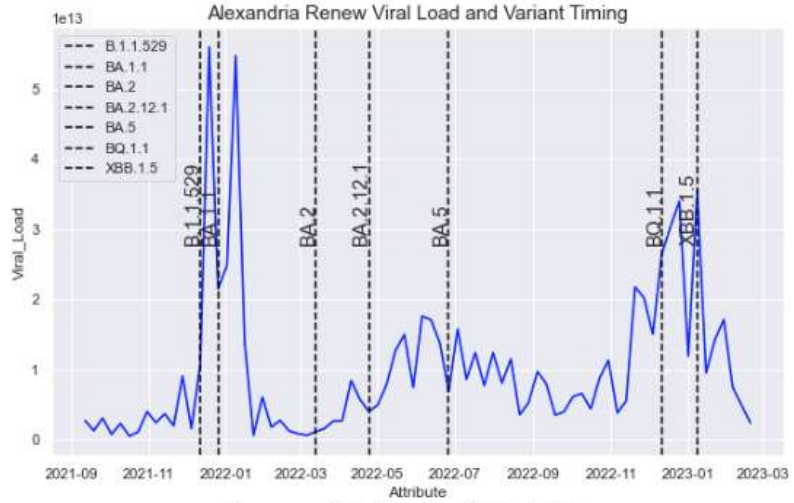
https://covid.cdc.gov/covid-data-tracker/#traveler-genomic-surveillance
https://github.com/gerstung-lab/SARS-CoV-2-International (02/09/23)

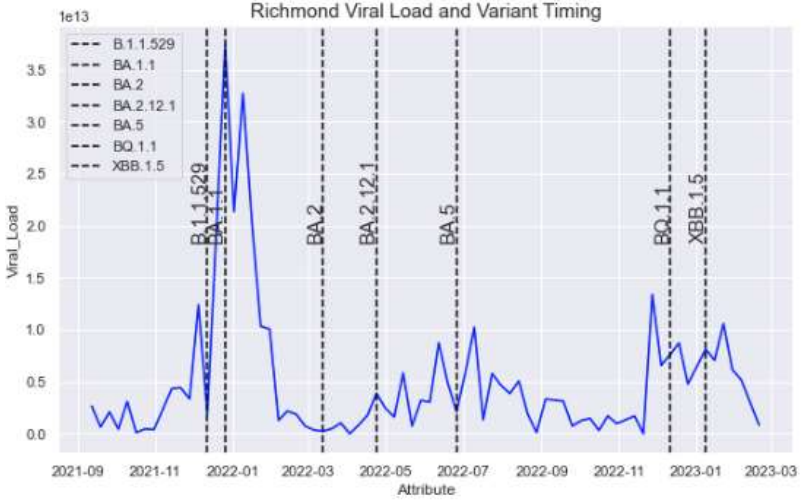
Wastewater as Early Indicator of new Variants

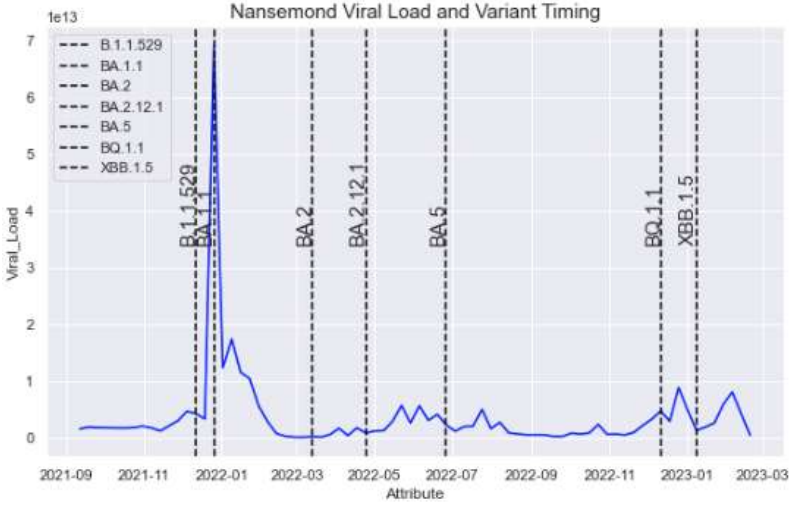
Initial exploration of Wastewater signal aligned with Variant dominance

- Initial mapping of when a new major variant crossed the 40% prevalence level (dotted lines labelled by variant), based on CDC variant levels for HHS Region 3
- Wastewater Viral Loads per Sewershed from VDH Environmental Health
- Often Viral Load spikes before a new variant reaches dominance (eg in the initial growth stages)
- Wastewater may be a good indicator for directing targeted genomic surveillance









Pandemic Pubs (March 8th, 2023)

1. Two studies recently published in BMJ show effectiveness of vaccination in reducing risk of long COVID. Byambasuren et al. conducted a systematic review based on 16 studies and over 600K patients show a consistent pattern of protection with higher levels of vaccination. Tran et al. Conducted a paired cohort study of long COVID sufferers and measured a significant reduction in symptoms following vaccination.

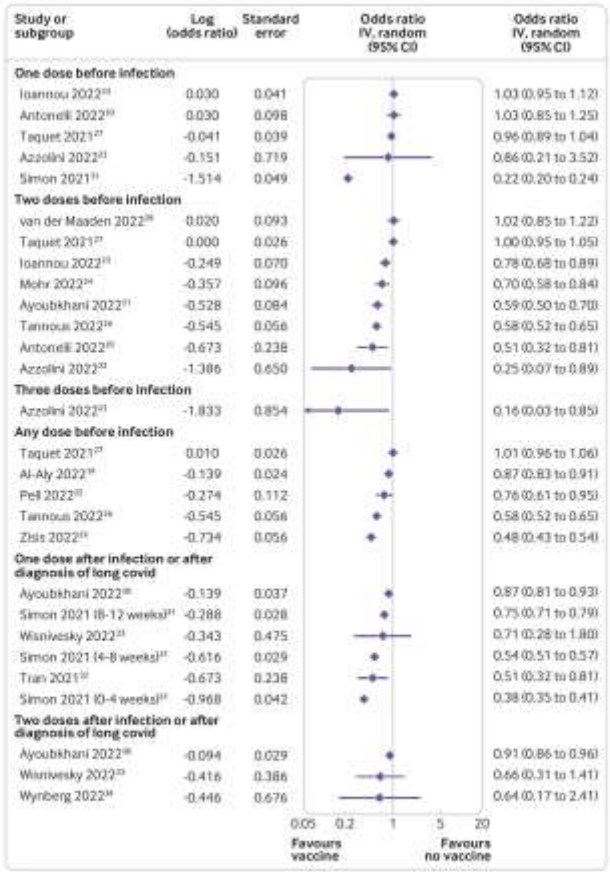
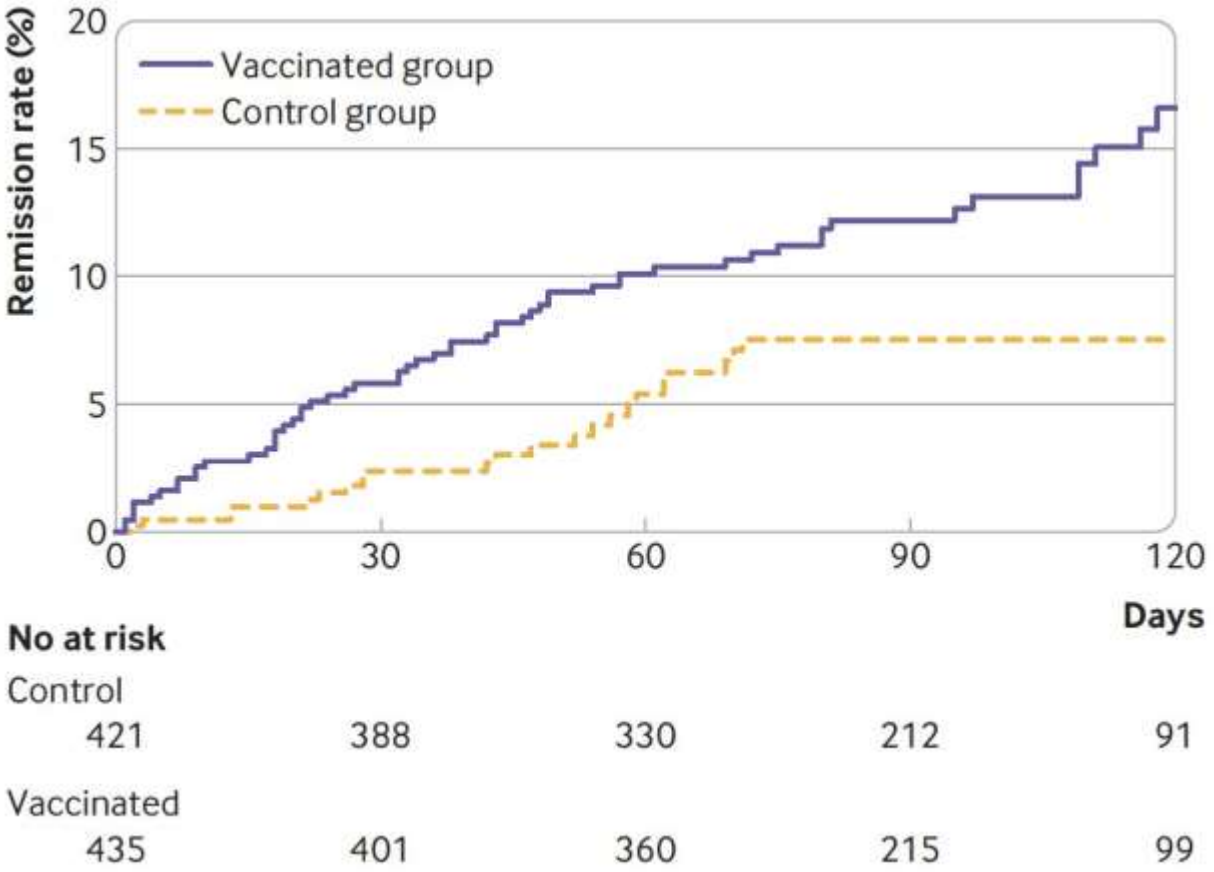


Figure 2 | Forest plot of the effect of covid-19 vaccine doses on long covid. Only relevant outcomes from all reported outcomes in individual studies were chosen. The ratios have a range of time frames (tables 1 and 2, and online supplemental file 3). IV=inverse variance

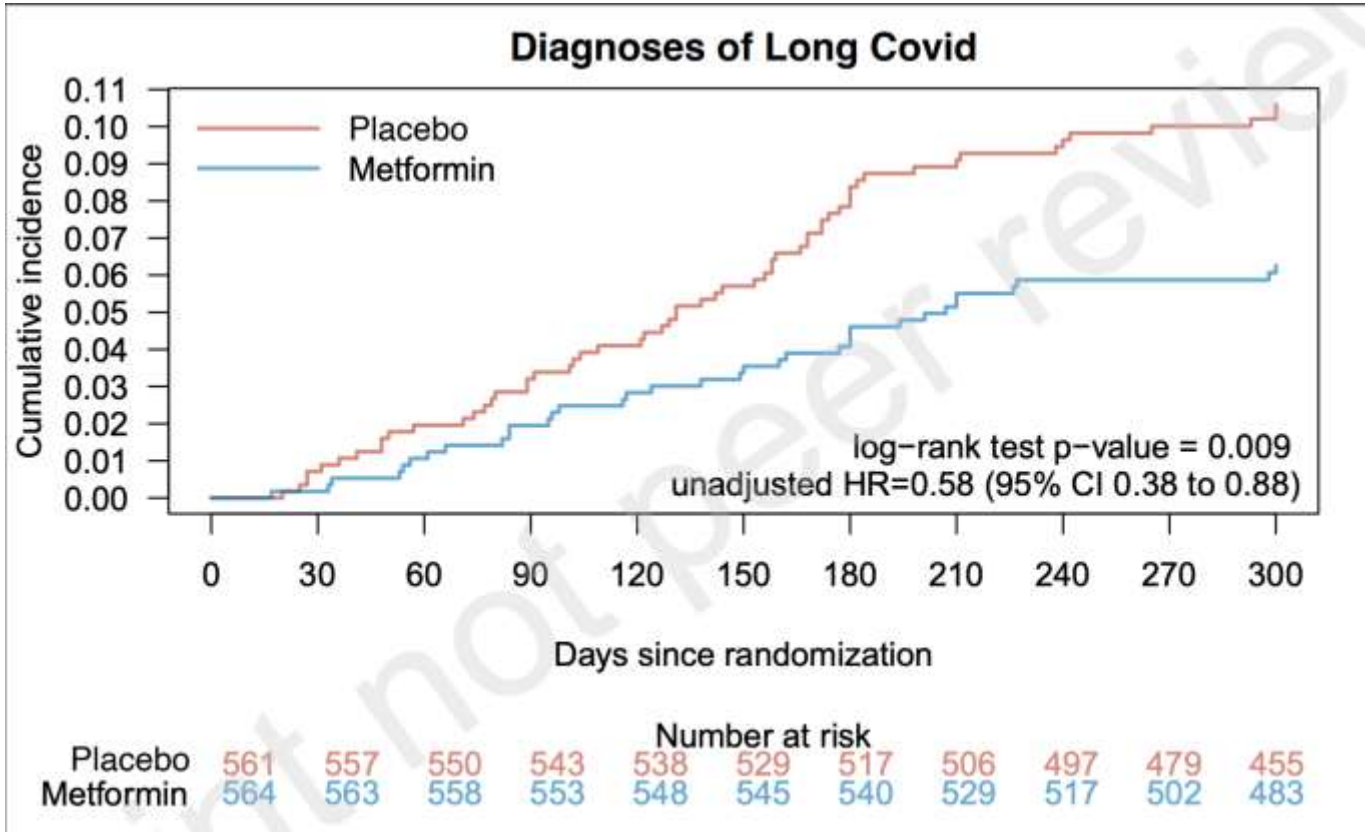
Effect of covid-19 vaccination on long covid: systematic review



Efficacy of first dose of covid-19 vaccine versus no vaccination on symptoms of patients with long covid: target trial emulation based on ComPaRe e-cohort

Pandemic Pubs (March 8th, 2023)

2. Study in Lancet demonstrates significant reduction in risk for developing long COVID through a randomized controlled trial of treatment with 6 days of Metformin (traditionally used to treat high blood sugar in diabetes) following COVID diagnosis



[Outpatient Treatment of COVID-19 and the Development of Long COVID Over 10 Months: A Multi-Center, Quadruple-Blind, Parallel Group Randomized Phase 3 Trial]

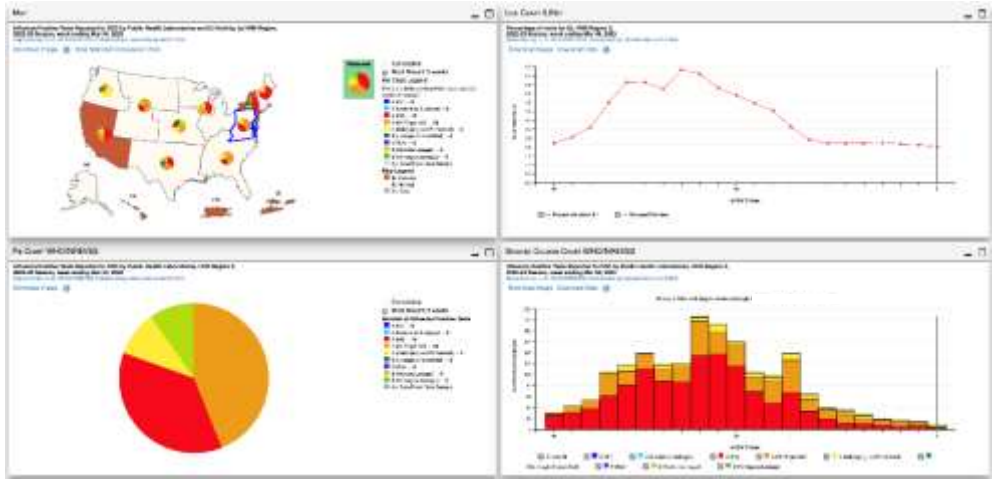
Influenza Update

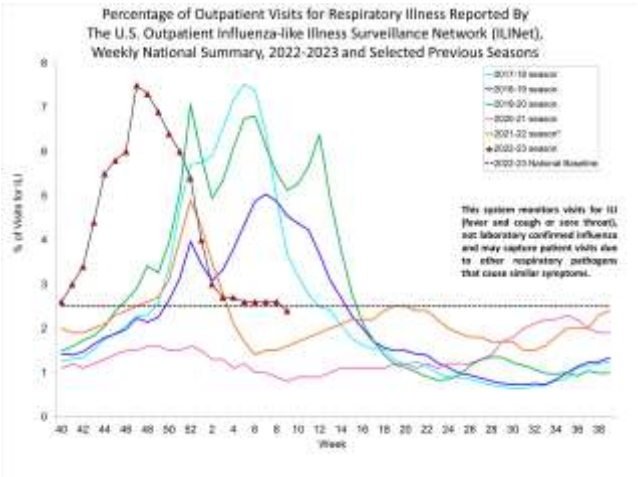
Current Influenza Situation – ILI Activity

Influenza Activity finally falls below threshold

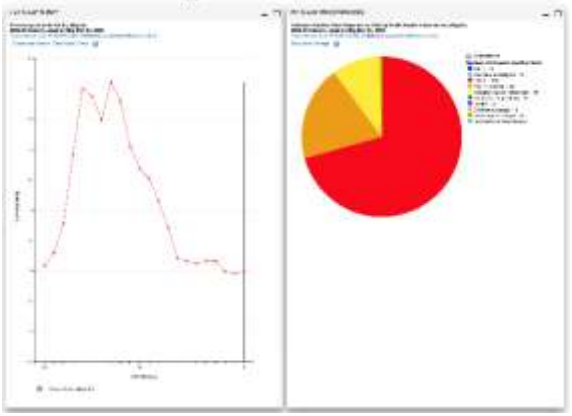
- Virginia remains at the ”Moderate” level as most states have receded to Low and Minimal levels in the past couple weeks.
- In VA ILI Activity has declined to 3-4% which is the same as in early October at the beginning of the season
- National ILI activity has also consistently declined since a peak in late November, yet remains above threshold
- Over half of the HHS regions are now below the seasonal threshold for ILI activity

Region 3





Virginia



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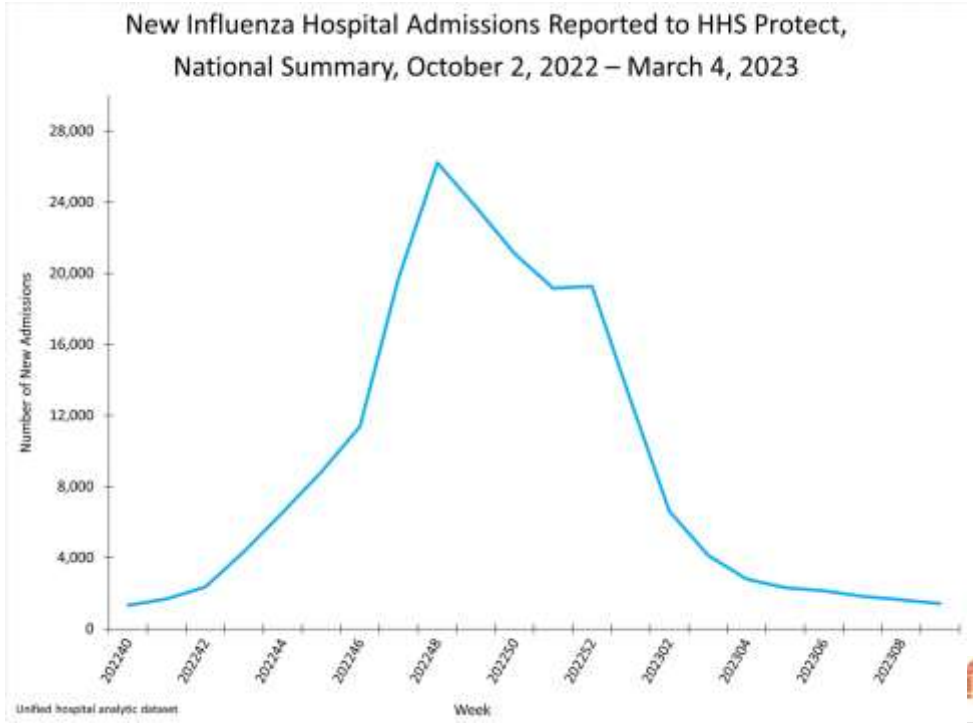
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

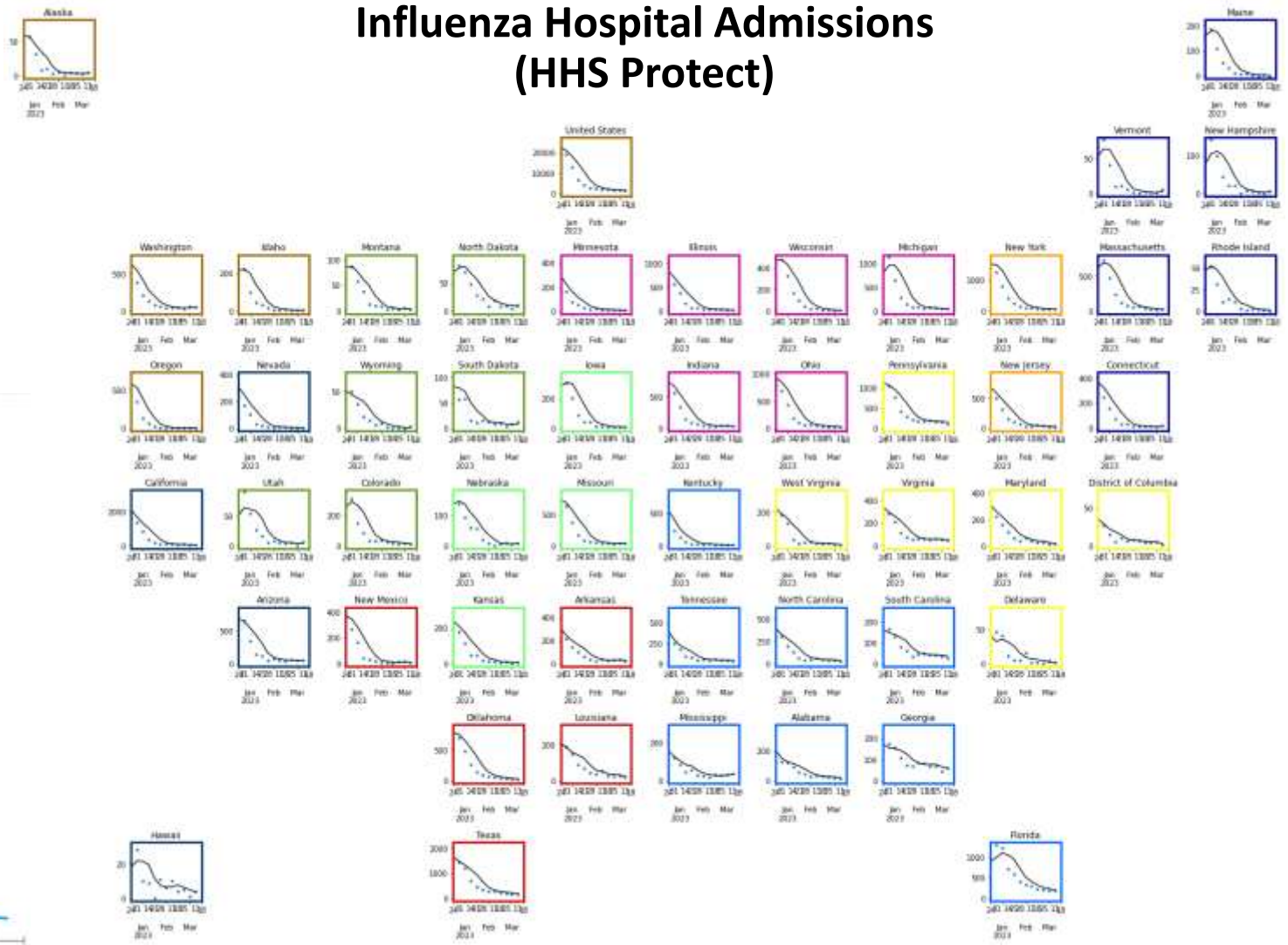
Current Influenza Situation - Hospitalizations

Influenza A hospitalizations continue decline

- National level of influenza hospitalizations have dropped to nearly pre-season levels
- Nearly all states have returned to levels below early December before the initial rise to to the peak



Influenza Hospital Admissions (HHS Protect)



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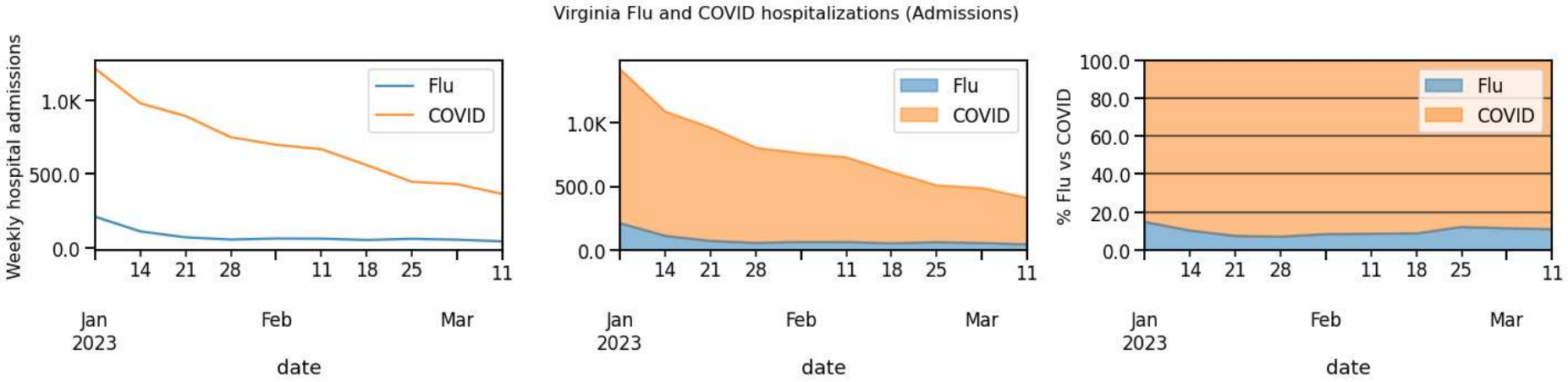
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

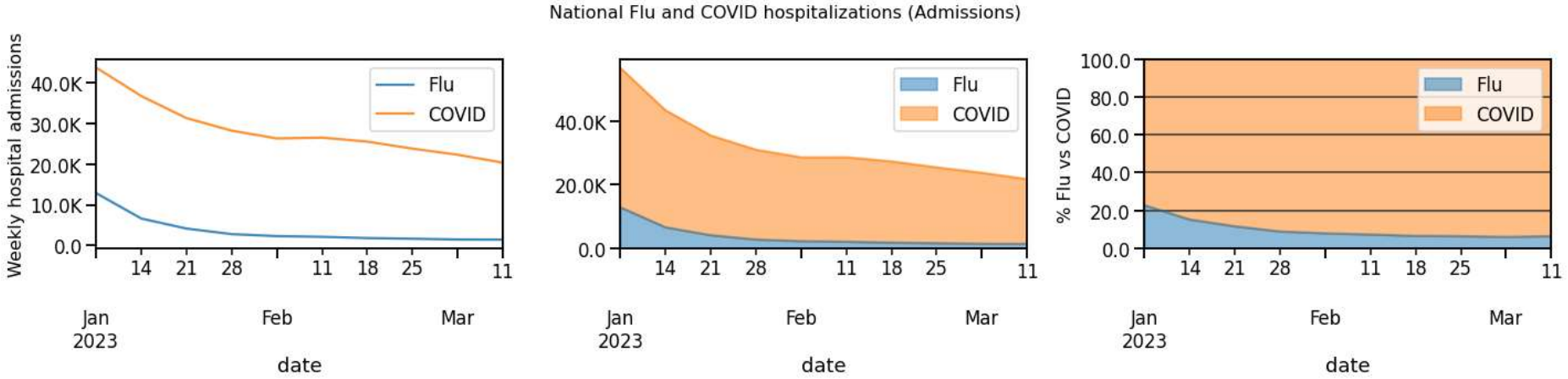
Current Combined Hospitalizations (COVID-19 & Influenza)

COVID-19 and Influenza Weekly Hospitalizations (HHS Protect)

Virginia



USA



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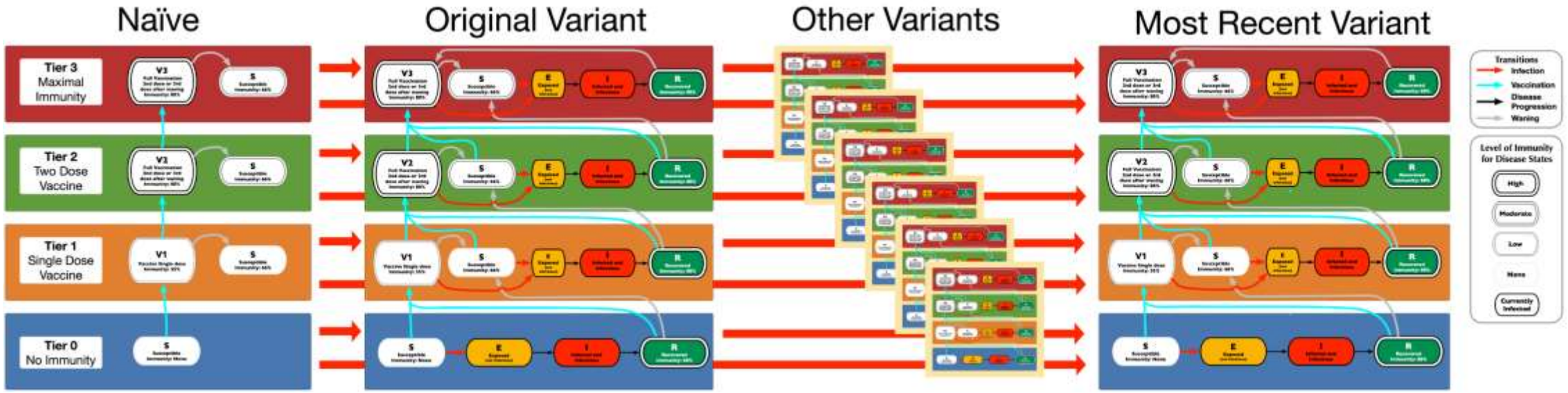
Model Update – Adaptive Fitting

Model Structure Extended for more sub-variants

Omicron sub-variants escape immunity induced by previous sub-variants

- Multiple strain support allows representation of differential protection based on immunological history (BA.1, BA.2, BA.2.12.1, BA.4/5, and future variants (VariantX))
- Each sub-variant has differing levels of immune escape to previous sub-variants, the prevalences are based on observations for fitting purposes, and projections use estimated future prevalences
- Adaptive fitting approach continues to use simulation to generate the full distribution of immune states across the population



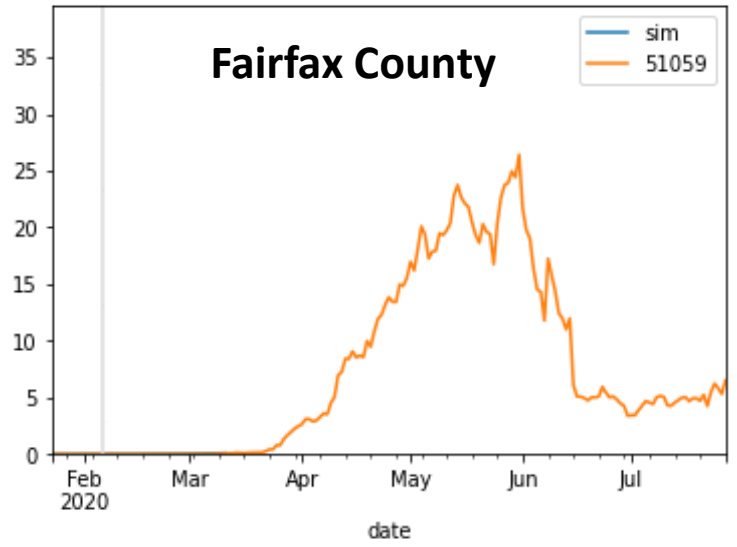
Adaptive Fitting Approach

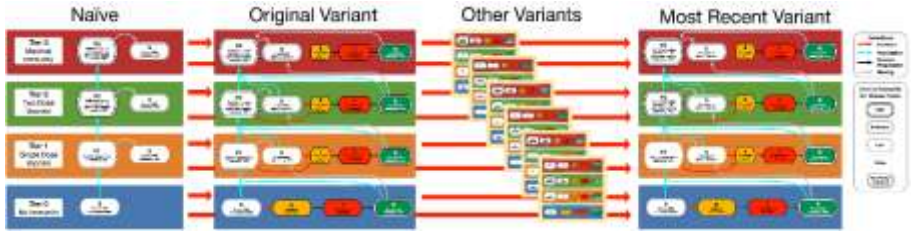
Each district fit precisely, with recent trends used for future projection

- Allows history to be precisely captured, and used to guide bounds on projections

Model: An alternative use of the same meta-population model, PatchSim with multiple tiers of immunity

- Allows for future "what-if" Scenarios to be layered on top of calibrated model
- Allows for waning of immunity and for partial immunity against different outcomes (eg lower protection for infection than death)
- Incorporation of new variants with different levels of immune escape and transmission advantage





Adaptive Fitting Approach

Hospitalization risk for different tiers of immunity calibrated to US-wide data

- Using modeled infections from past state-level projections from Scenario Modeling Hub – using periods with reasonable confidence in ascertainment ratio (before Omicron – based on seroprevalence data, after first Omicron wave – adjusted using surveys about home test usage)
- Using all US states and bootstrapping to reduce bias and overfitting

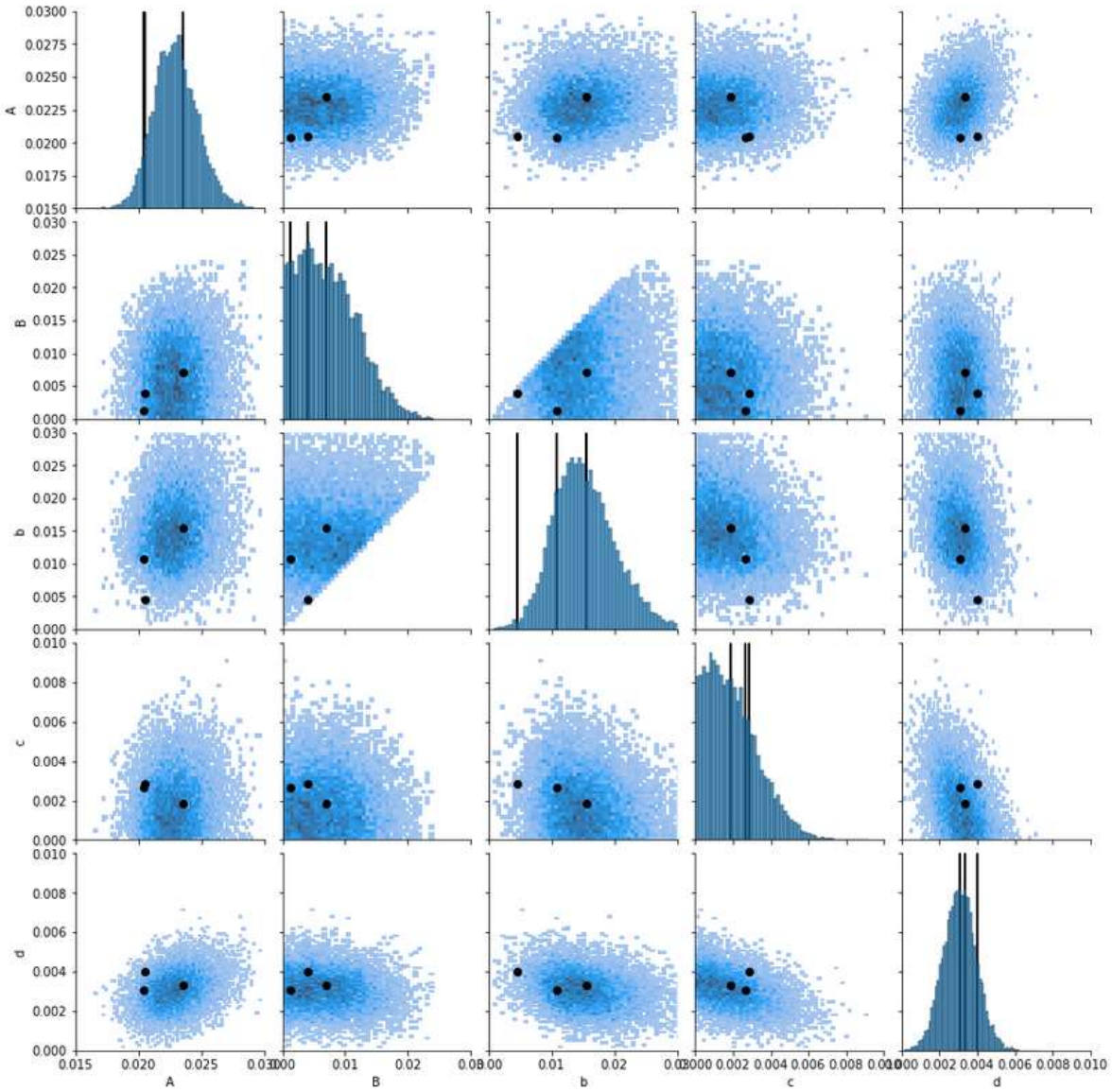
Selected representative risk of hospitalization per infection:

1 in 42-49 for unprotected (A); 1 in 142-770 for vaccinated (B);

1 in 64-220 for waned vaccinated (b);

1 in 350-540 for waned reinfection or booster(no reinfection) (c)

1 in 250-320 for waned vaccination/booster with reinfection (d)



Scenarios – Transmission Conditions

- Variety of factors continue to drive transmission rates
  - Seasonal impact of weather patterns, travel and gatherings, fatigue and premature relaxation of infection control practices
- **Waning Immunity**: Omicron waning with a mean of 4 months
- **Projection Condition Ingredients**:
  - **Adaptive:** Controls remain as currently experienced into the future with NO influence from other conditions (eg seasonal, variants, etc.)
  - **Seasonal:** Controls remain the same, however, seasonal forcing or other seasonal behavior patterns
  - **New Variants (VariantX)**: As of yet unidentified novel sub-variant with similar immune escape but no transmission advantage emerges 4 months after the last significant sub-variant and grows at a similar rate

Projection Scenarios – Combined Conditions

Name	Txm	Variant	Booster	Description
Adaptive-VariantX	C	X	Current	Like Adaptive, with emergence of a Variant like XBB.1.5 that tracks its prevalence
Adaptive-VariantX-IncreasePerm	Increase	X	Current	Like Adaptive-VariantX but with an increase of 30% over the course of 4 weeks, that remains constant thereafter
Adaptive-VariantX-IncreaseTemp	Increase	X	Current	Like Adaptive-VariantX but with an increase of 30% over the course of 4 weeks and then recedes over the course of 4 weeks

Transmission: C = Current levels persist into the future
Increase = Transmission rates increase a total of 30% over 4 weeks representing a delayed seasonally or variant driven bump, this in effect returns transmission rates to similar levels as last summer

Variant: SQ = Status quo prevalences remain the same (e.g. no significant major driving of transmission anticipated)
X = Novel sub-variant scenario, new variant emerges reaches dominance in near term, 30% immune escape

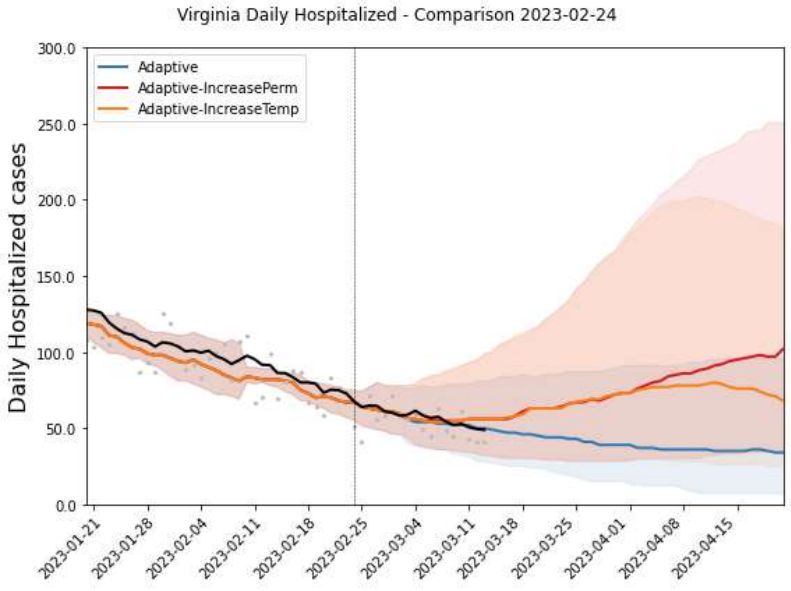
Booster: Current = Current pace relative to 3rd dose rollout is maintained in the future

Model Results

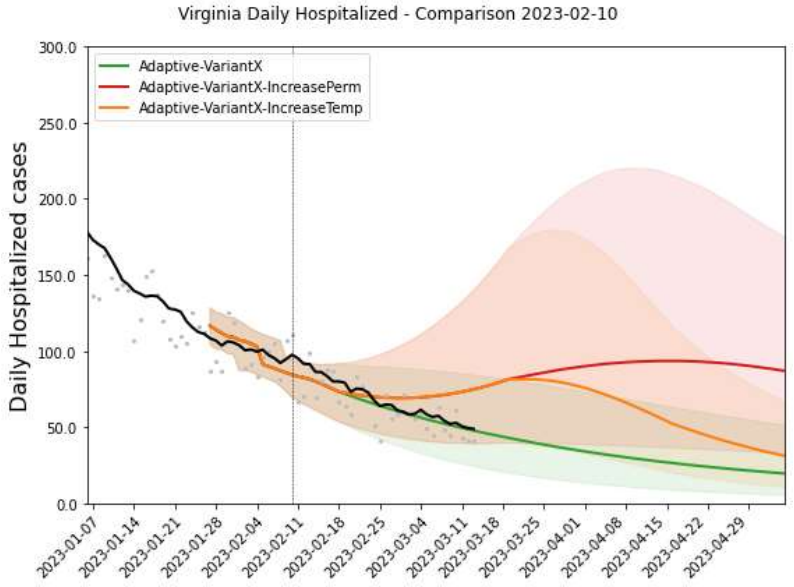
Previous projections comparison - Hospitalizations

- Previous projections have tracked observed hospitalizations well
- Projection from 2 weeks ago had enough growth in hospitalizations to track well
- Projection from 4 weeks ago had declines which delayed the growth
- Projection from early July anticipated a Fall-Winter rise that has tracked well

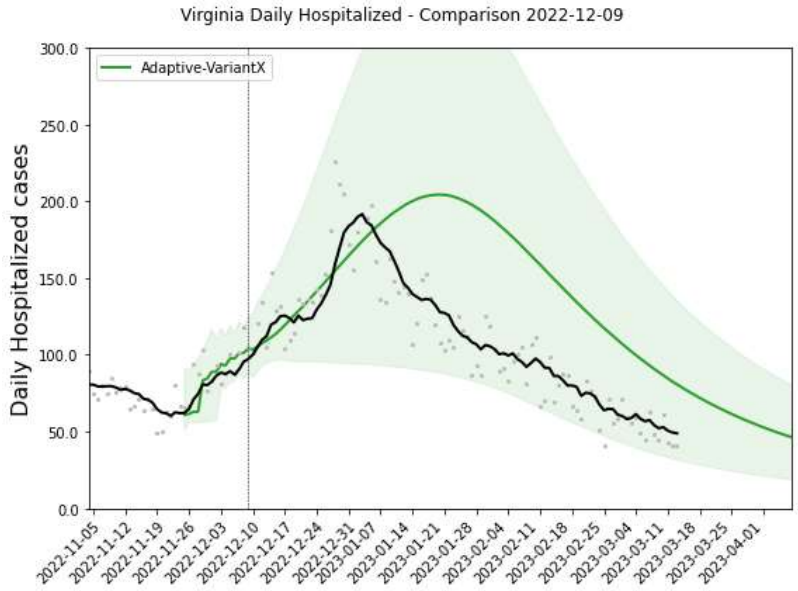
Previous round – 2 weeks ago



Previous round – 4 weeks ago

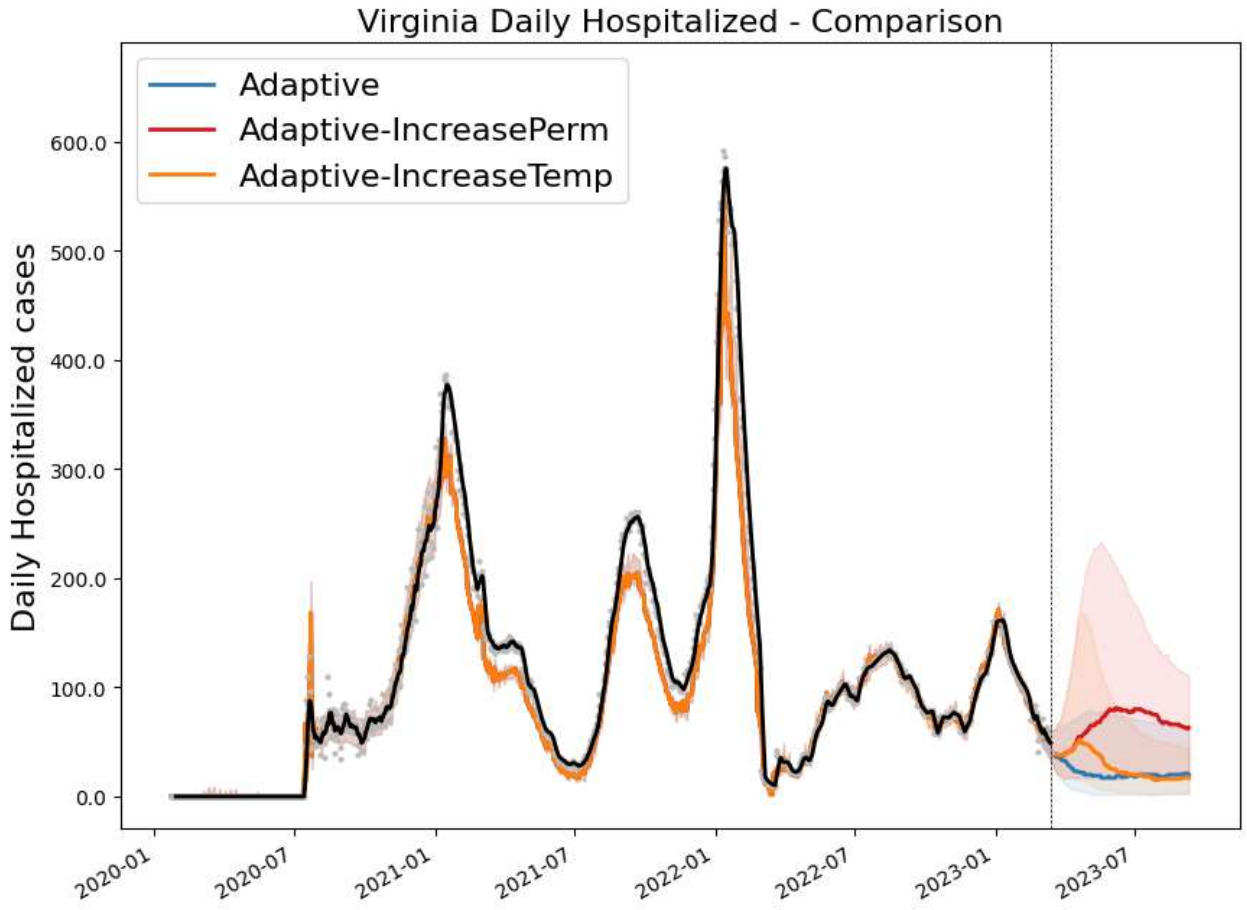


Previous round – mid December



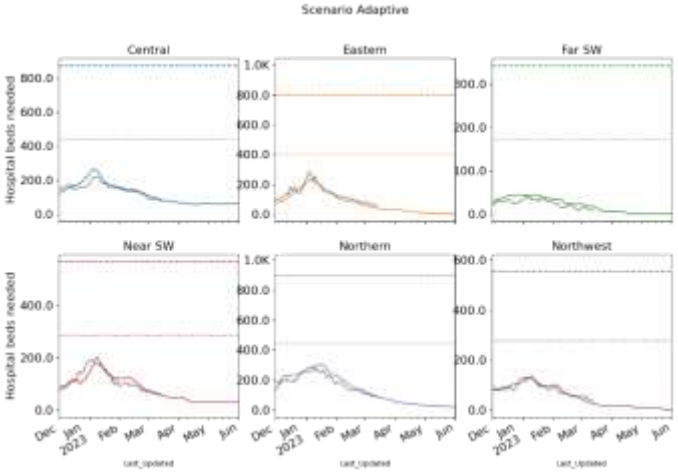
Outcome Projections

Daily Hospitalized

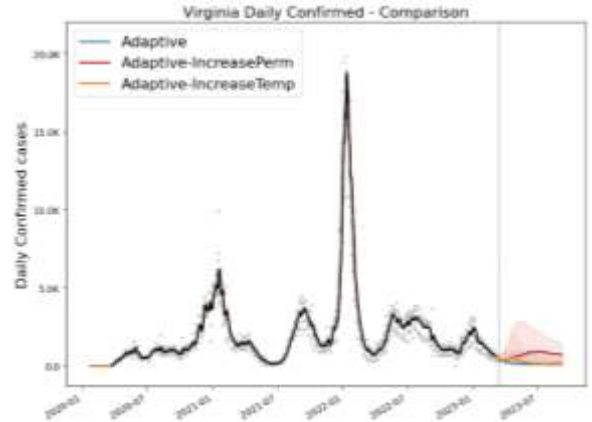


* without surveillance correction VariantBA2 peaked over 10K in July

Estimated Hospital Occupancy



Confirmed cases



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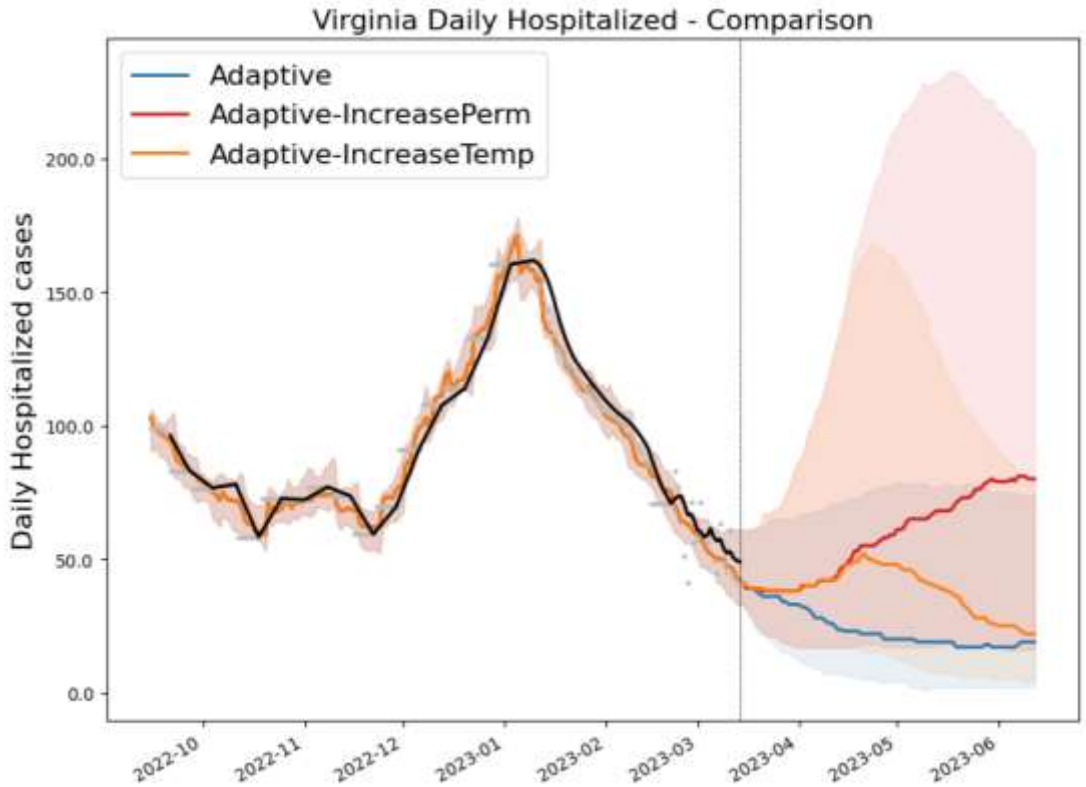
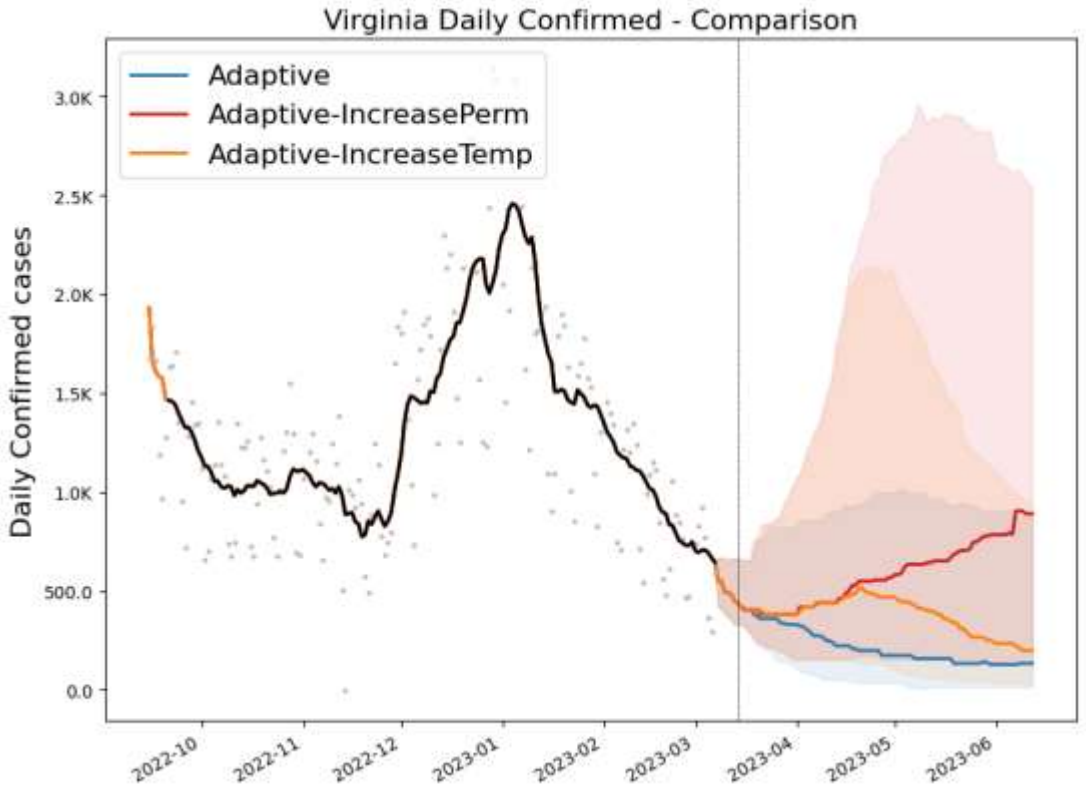
Outcome Projections – Closer Look

Daily Hospitalized

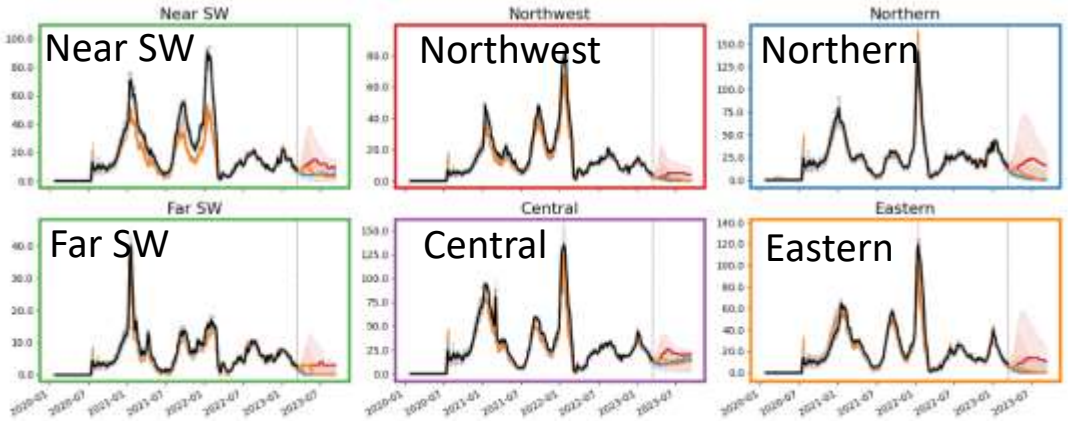


Confirmed cases



Detailed Projections: Hosps for All Scenarios

Projections by Region



Projections by District

Daily confirmed hospitalizations District (grey with 7-day average in black) with simulation colored by scenario

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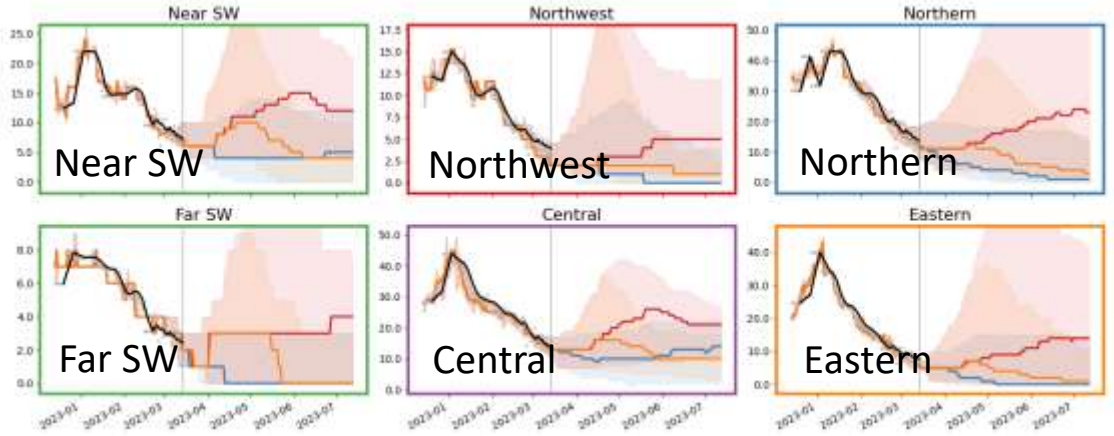
Detailed Projections: Hosps for All Scenarios - Closer Look

Projections by Region



Projections by District

Daily confirmed hospitalizations
District (grey with 7-day average in black) with simulation colored by scenario

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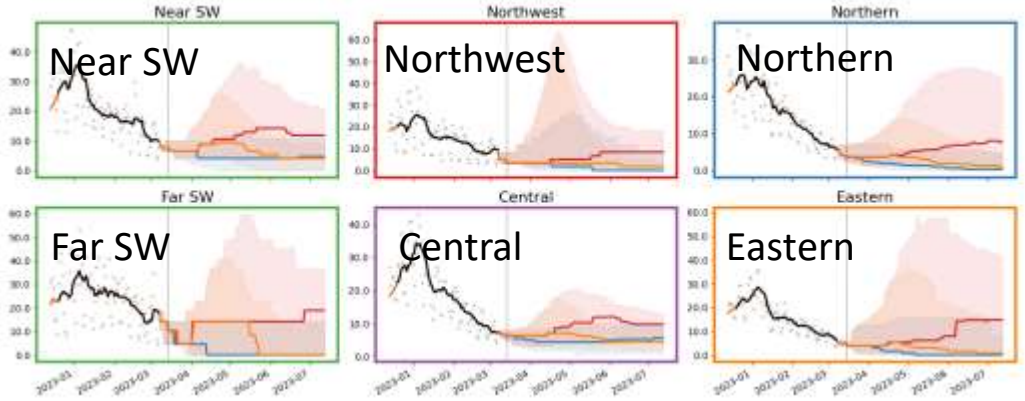
Detailed Projections: Cases for All Scenarios - Closer Look

Projections by Region



Projections by District

Daily confirmed cases by rate (per 100K) District (grey with 7-day average in black) with simulation colored by scenario

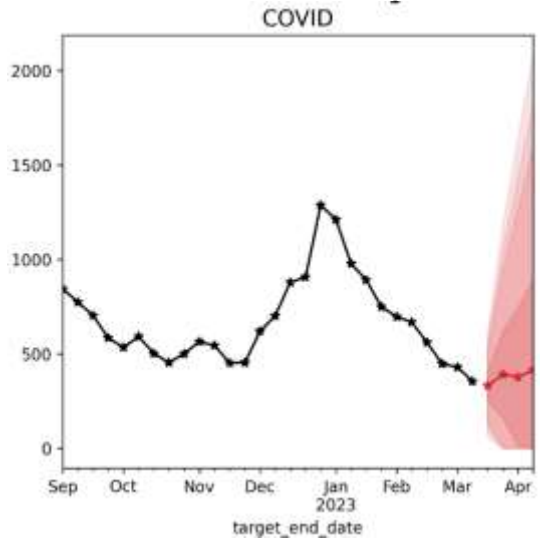
National Modeling Hub Updates

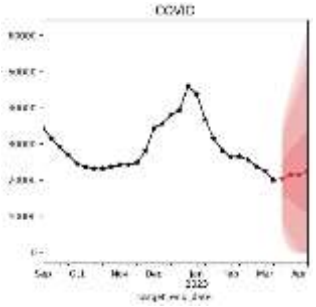
Current COVID-19 Hospitalization Forecast

Statistical models for submitting to CDC FluSight forecasting challenge

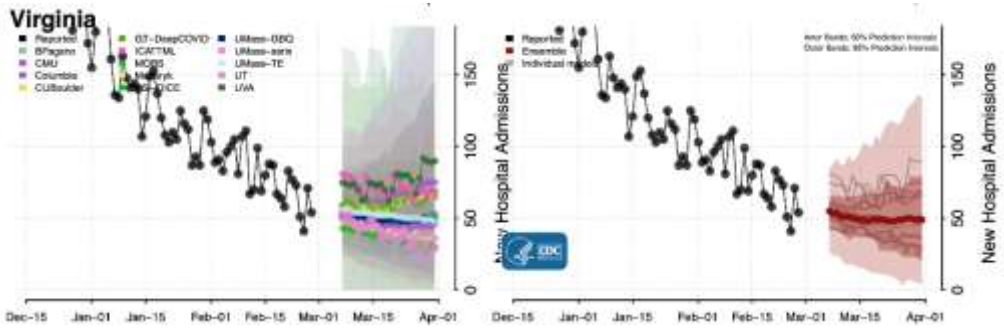
- Uses a variety of statistical and ML approaches to forecast weekly hospital admissions for the next 4 weeks for all states in the US

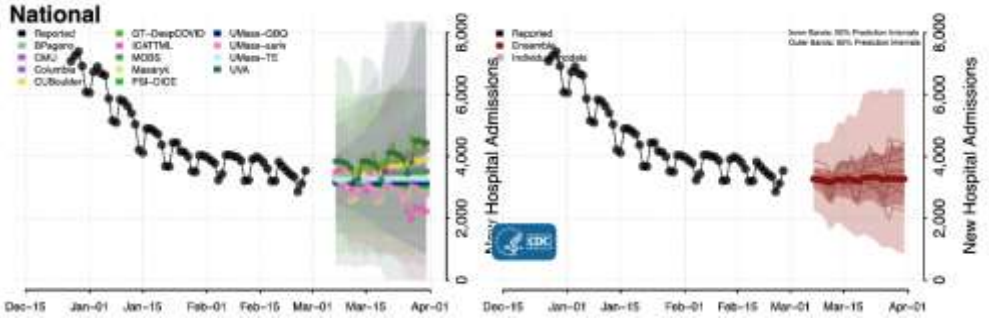
Hospital Admissions for COVID-19 and Forecast for next 4 weeks (UVA ensemble)





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





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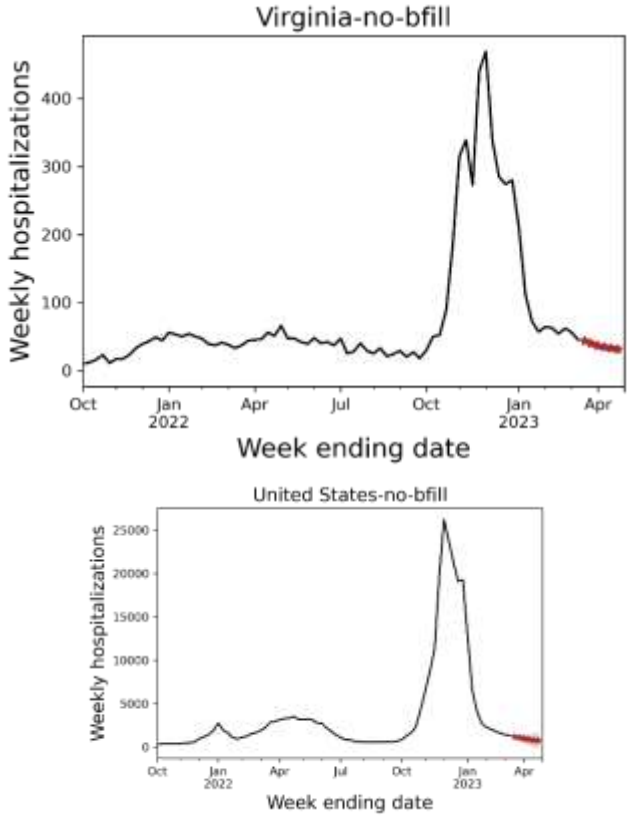
CDC COVID Forecast

Current Influenza Hospitalization Forecast

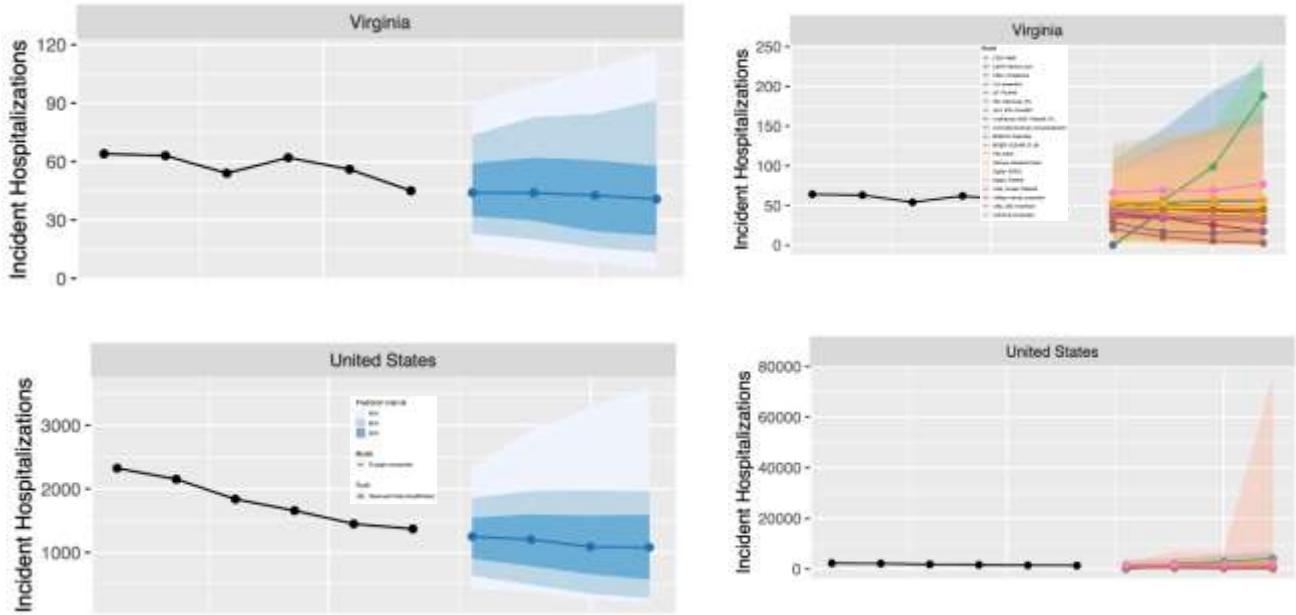
Statistical models for submitting to CDC FluSight forecasting challenge

- Similar to COVID-19 case forecasts, 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 Influenza and Forecast for next 4 weeks (UVA ensemble)



Hospital Admissions for Influenza and Forecast for next 4 weeks (CDC FluSight Ensemble)



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CDC FluSight

Combined ILI and COVID-19 Hospitalizations

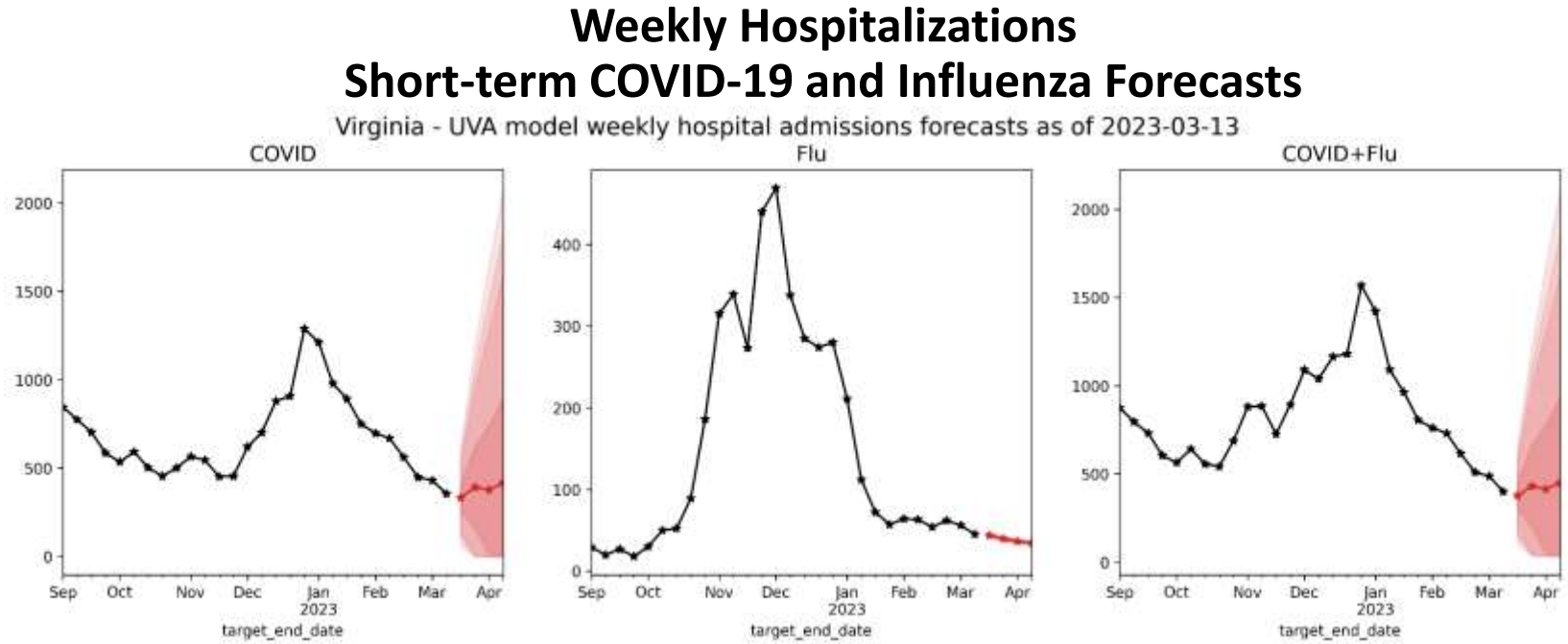
Ensemble methodology that combines the Adaptive with machine learning and statistical models such as:

- 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



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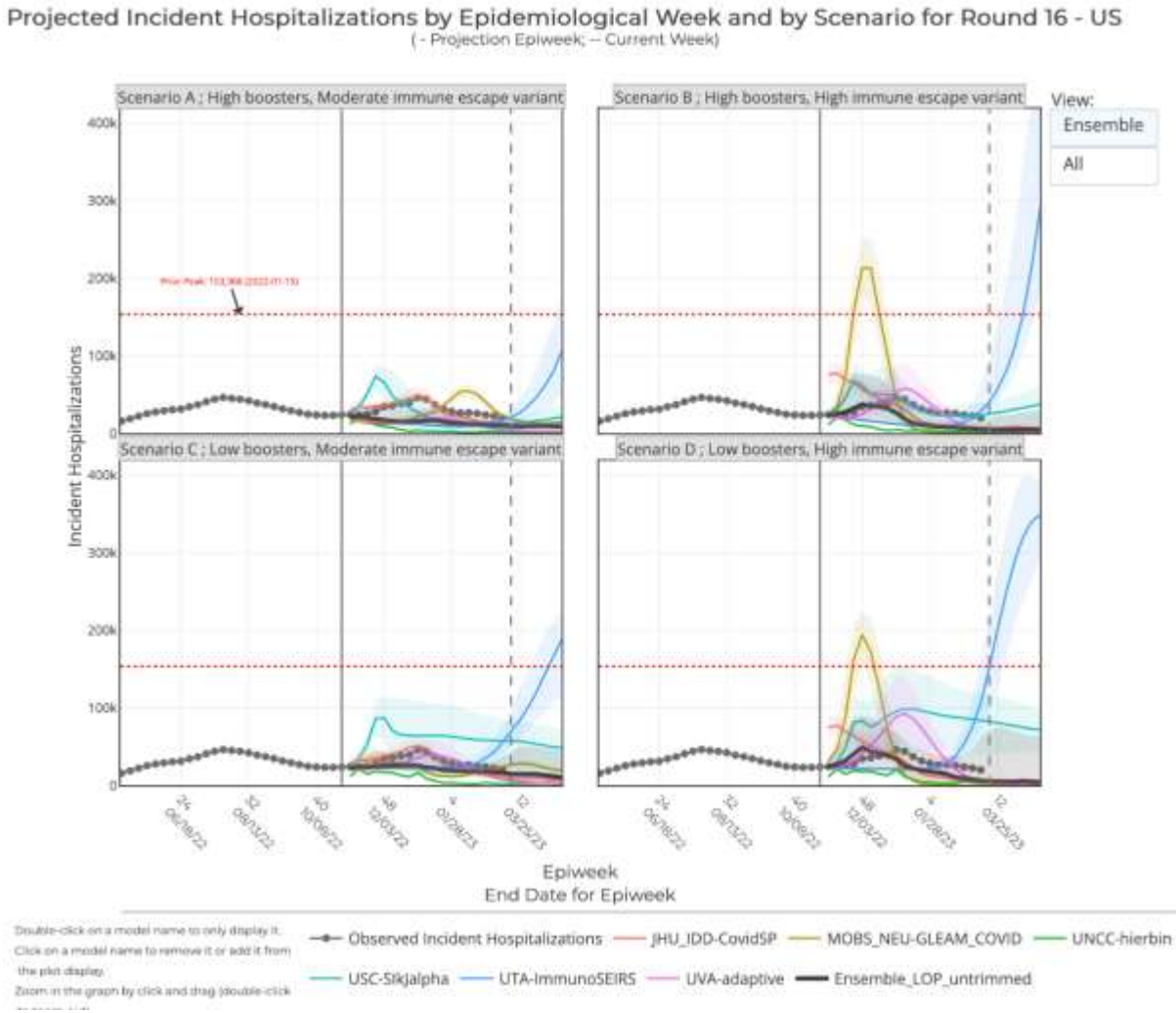
Scenario Modeling Hub – COVID-19 (Round 16)

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

	"Level 5" Variants	"Level 6/7" Variants
Accelerating uptake levels of reformulated boosters	"Level 5" Variants — Scenario A - 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 they see fit to define rates - Teams should assume increasing uptake through October and November as necessary to reach the projected February 1st, 2023 plateau	"Level 6/7" Variants — Scenario B - 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 they see fit to define rates - Teams should assume increasing uptake through October and November as necessary to reach the projected February 1st, 2023 plateau
Current uptake levels of reformulated boosters	"Level 5" Variants — Scenario C - 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 l levels by the end of the simulation - Teams are free to use available data and information from current and previous rollouts as they 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)	"Level 6/7" Variants — Scenario D - 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 l levels by the end of the simulation - Teams are free to use available data and information from current and previous rollouts as they 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)

https://covid19scenariomodelinghub.org/viz.html



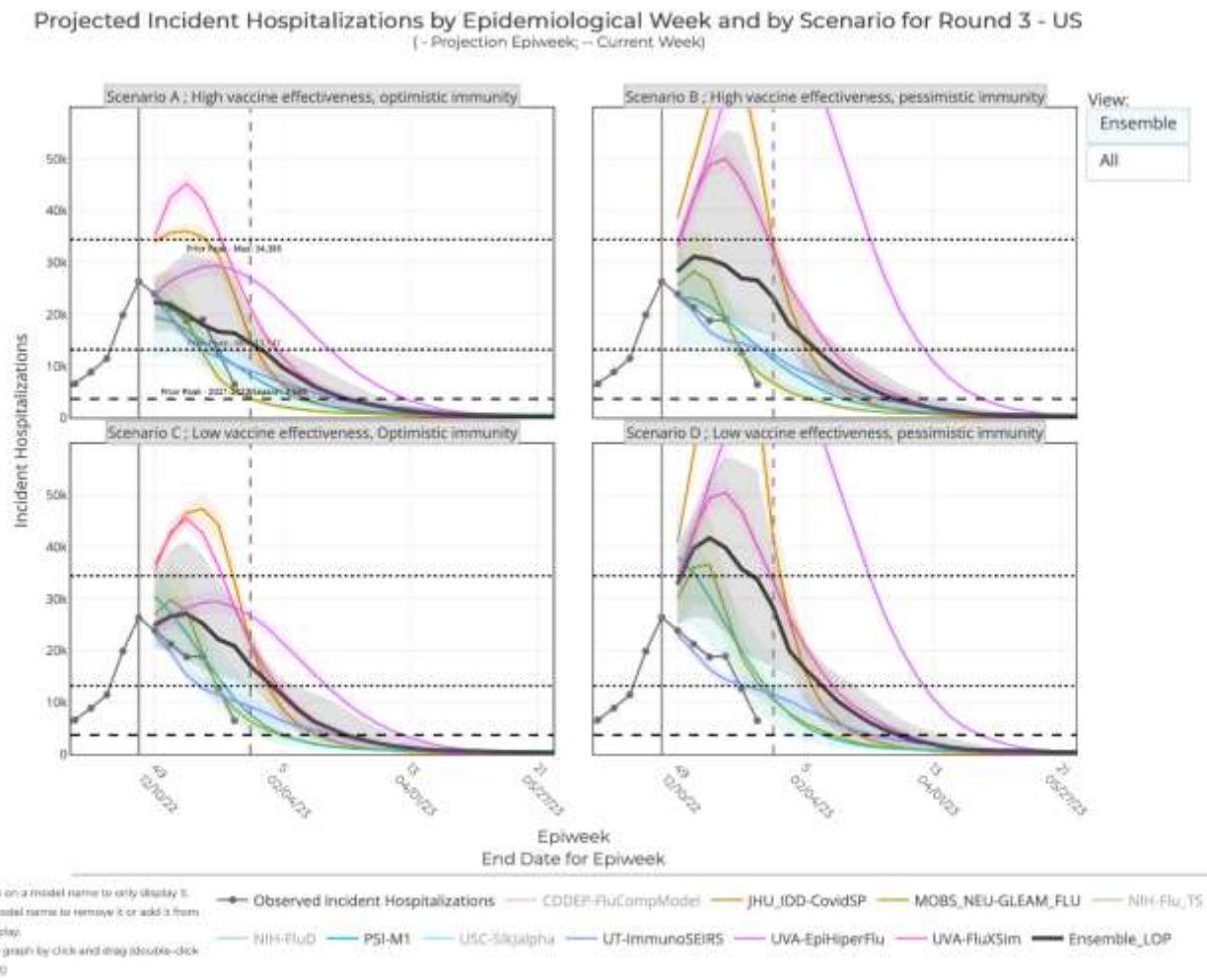
Scenario Modeling Hub – Influenza (Round 3)

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 to decline
- Case rates and hospitalizations from Influenza are very low

- **Model Updates**
  - Model updated to fit hospital admissions as opposed to cases
    - New technique used to determine hospitalization to infection rate
  - Projection model updated this week, two non-specific scenarios related to increases in transmissibility.
  - Boosted transmissibility can generate new surge in activity which does not exceed levels from Summer of 2022

Questions?

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