Network Systems Science & Advanced Computing

Biocomplexity Institute & Initiative

University of Virginia

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

January 19th, 2023

(data current to January 12th – January 19th)

Biocomplexity Institute Technical report: TR BI-2023-4

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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

Points of Contact

Bryan Lewis
brylew@virginia.edu

Srini Venkatramanan
srini@virginia.edu

Madhav Marathe
marathe@virginia.edu

Chris Barrett
ChrisBarrett@virginia.edu

Model Development, Outbreak Analytics, and Delivery Team

Przemyslaw Porebski, Joseph Outten, Brian Klahn, Alex Telionis, Srinivasan Venkatramanan, Bryan Lewis, Aniruddha Adiga, Hannah Baek, Chris Barrett, Jiangzhuo Chen, Patrick Corbett, Stephen Eubank, Galen Harrison, Ben Hurt, Dustin Machi, Achla Marathe, Madhav Marathe, Mark Orr, Akhil Peddireddy, Erin Raymond, James Schlitt, Anil Vullikanti, Lijing Wang, James Walke, Andrew Warren, Amanda Wilson, Dawen Xie

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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

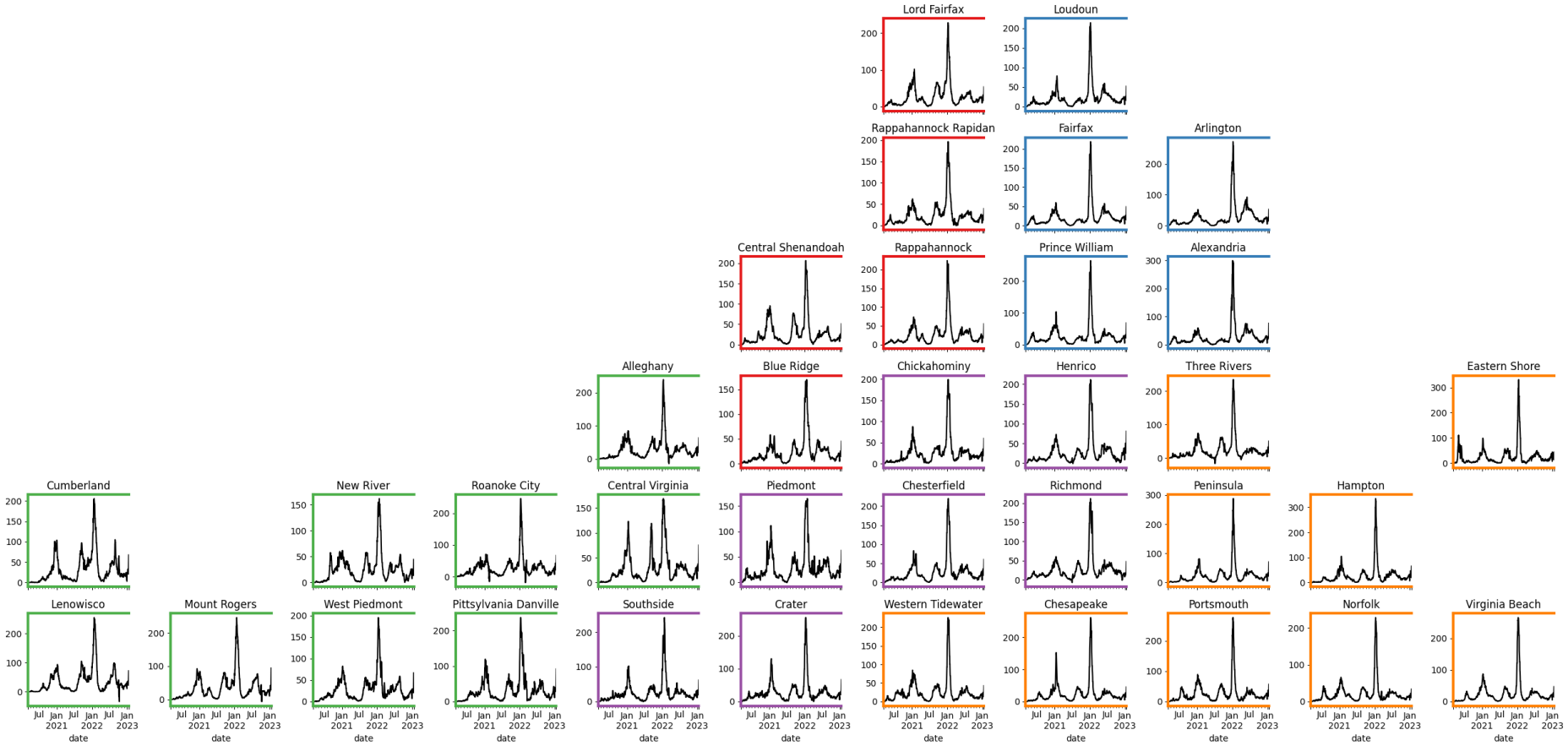
Projecting future cases precisely is impossible and unnecessary.
Even without perfect projections, we can confidently draw conclusions:

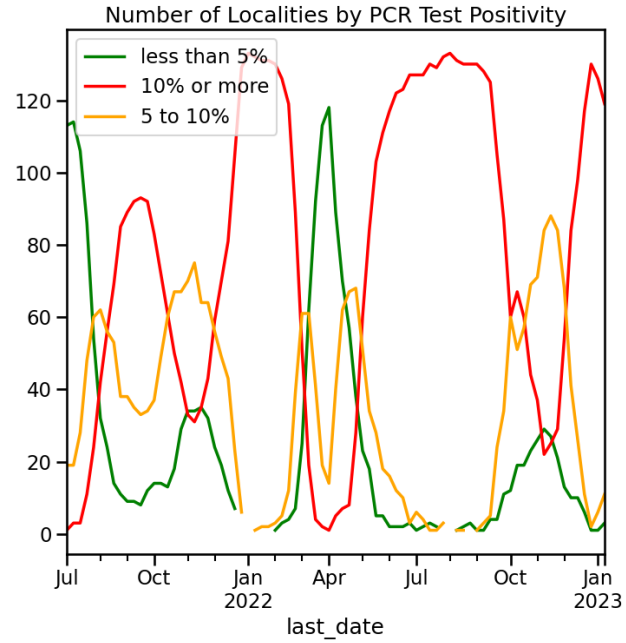
- Case rates and hospitalizations from COVID-19 are on the decline with some activity in isolated areas
- Case rates and hospitalizations from Influenza are also on the decline

- Model Updates
  - Projection model from Dec 9th remains roughly on track with current trajectory, however, the recent decline is occurring earlier than anticipated by the model
  - COVID-19 forecast models call for a plateau, with potential for rising hospital admission in the coming month
  - Influenza forecast models call for declines in Influenza hospital admissions to continue

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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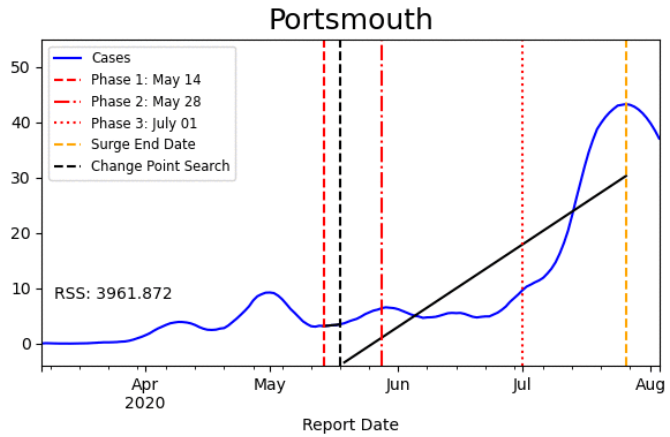
District Trajectories

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

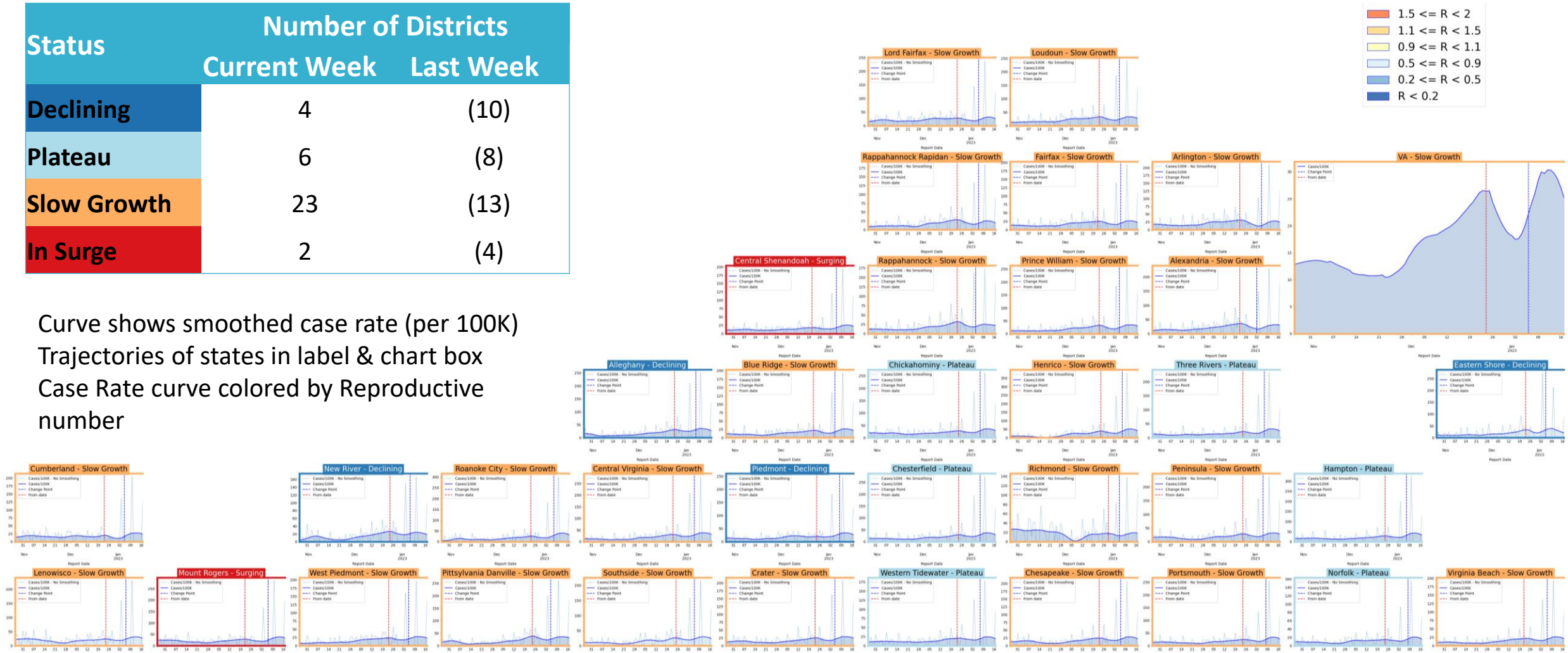


Trajectory	Description	Weekly Case Rate Slope (per 100k)	Weekly Hosp Rate Slope (per 100k)
Declining	Sustained decreases following a recent peak	slope < -0.88/day	slope < -0.07/day
Plateau	Steady level with minimal trend up or down	-0.88/day < slope < 0.42/day	-0.07/day < slope < 0.07/day
Slow Growth	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	4	(10)
Plateau	6	(8)
Slow Growth	23	(13)
In Surge	2	(4)

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



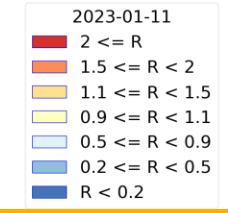
District Hospital Trajectories – last 10 weeks

Status	Number of Districts Current Week	Last Week
Declining	3	(0)
Plateau	5	(4)
Slow Growth	10	(11)
In Surge	17	(20)

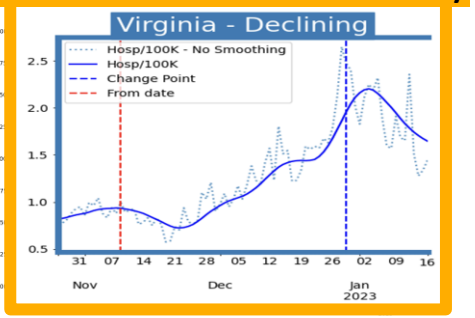
Curve shows smoothed hospitalization rate (per 100K) by district
Hosp rate curve colored by R_e number

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

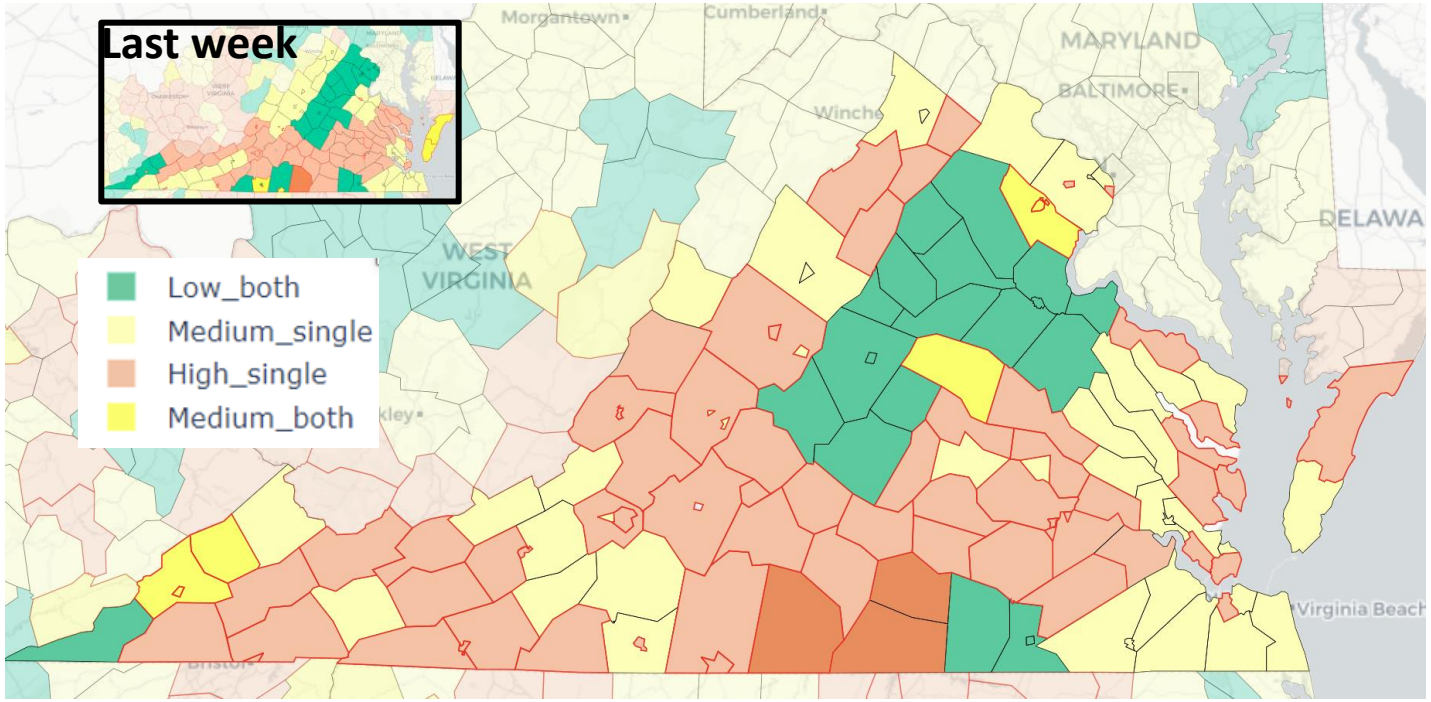
January 11th



State level without delay



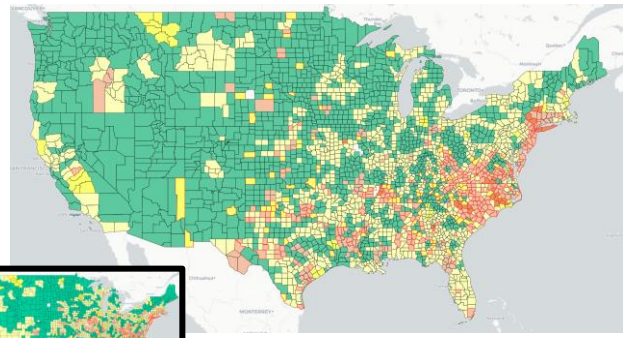
CDC's COVID-19 Community Levels

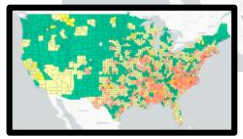


Red outline indicates county had 200 or more cases per 100k in last week

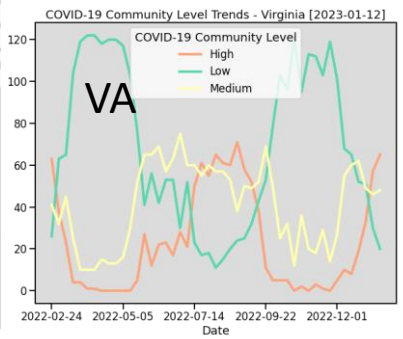
Pale color indicates either beds or occupancy set the level for this county

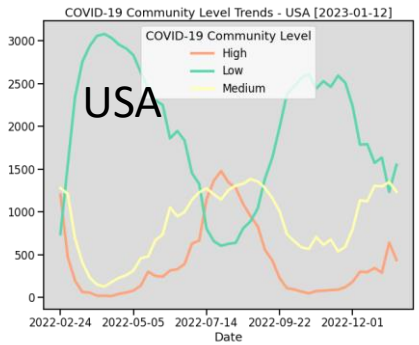
Dark color indicates both beds and occupancy set the level for this county





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

As of Jan 6th, 2023

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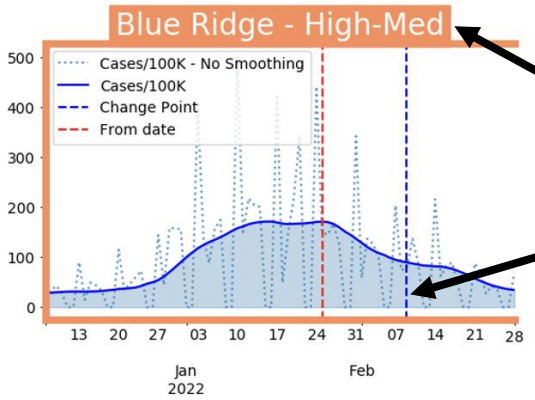
Data from: CDC Data Tracker Portal

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

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



District's Aggregate Community Level

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

Case rate Trajectory

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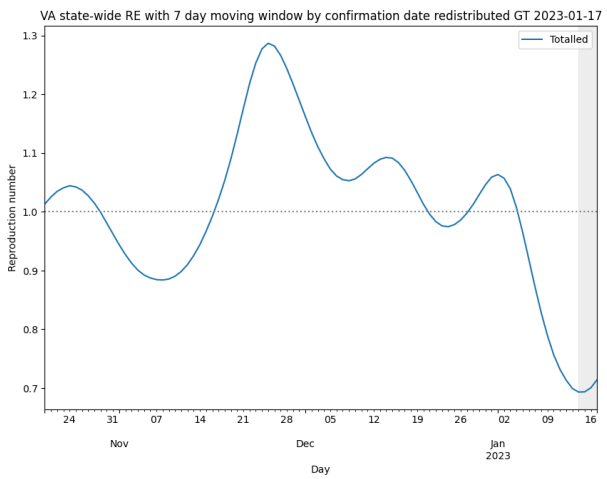
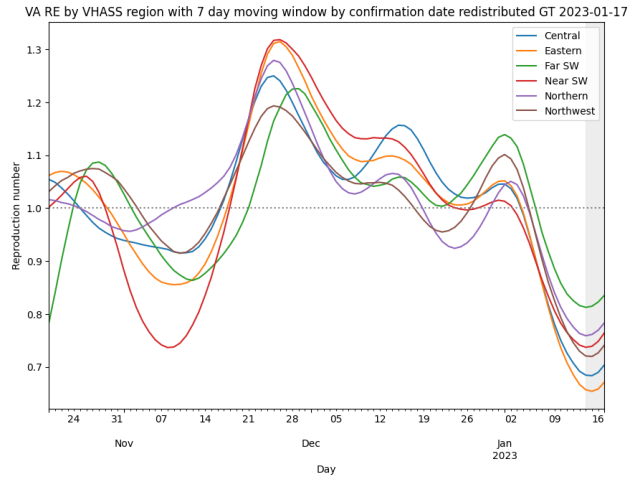
COVID-19 Growth Metrics

Estimating Daily Reproductive Number – Redistributed gap

Jan 17th Estimates

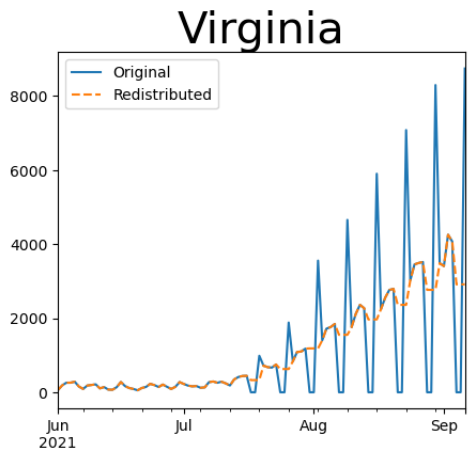
Region	Date Confirmed R_e	Date Confirmed Diff Last Week
State-wide	0.715	-0.206
Central	0.704	-0.224
Eastern	0.671	-0.269
Far SW	0.835	-0.135
Near SW	0.765	-0.132
Northern	0.783	-0.144
Northwest	0.741	-0.225





Skipping Weekend Reports & holidays biases estimates

Redistributed "big" report day to fill in gaps, and then estimate R from "smoothed" time series



Methodology

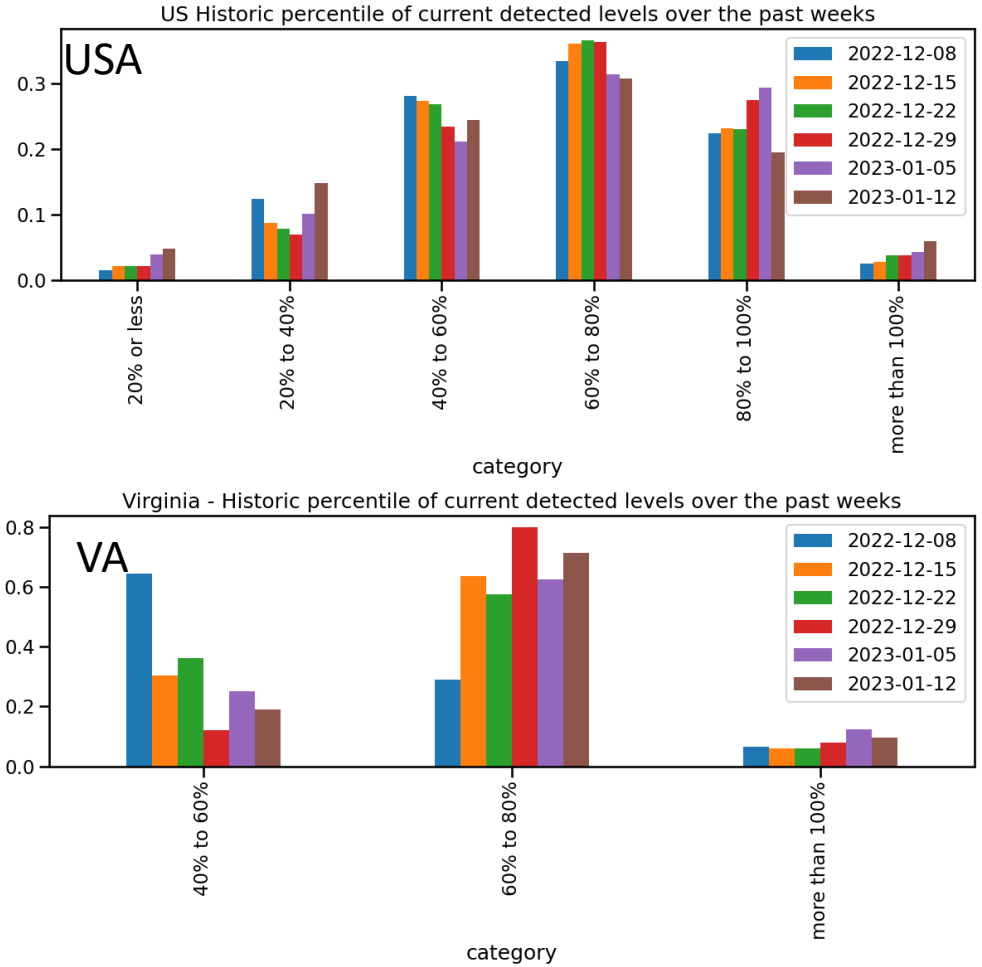
- Wallinga-Teunis method (EpiEstim[1]) for cases by **<u>confirmation date</u>**
- Serial interval: updated to discrete distribution from observations (mean=4.3, Flaxman et al, Nature 2020)
- Using Confirmation date since due to increasingly unstable estimates from onset date due to backfill

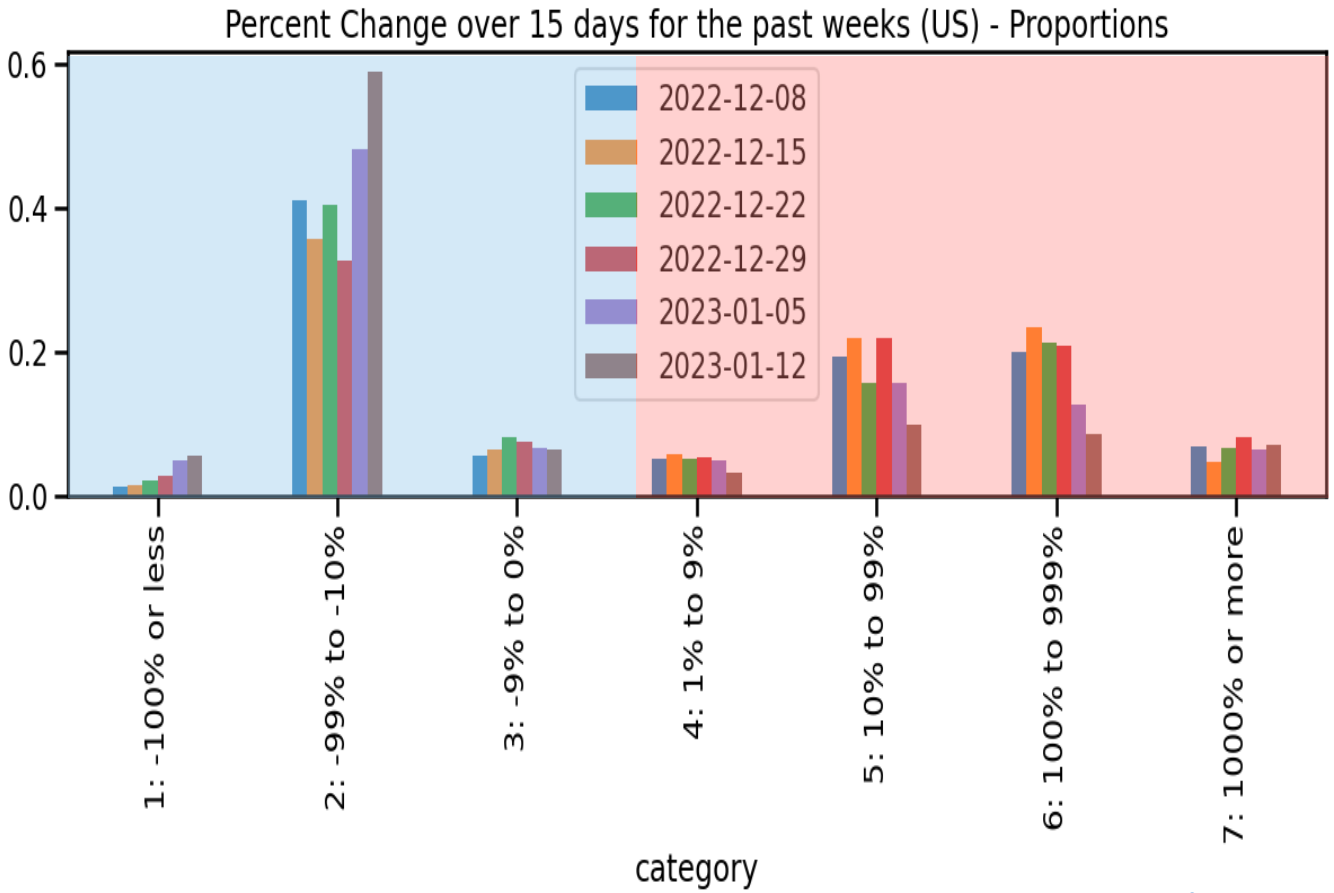
1. Anne Cori, Neil M. Ferguson, Christophe Fraser, Simon Cauchemez. A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics. American Journal of Epidemiology, Volume 178, Issue 9, 1 November 2013, Pages 1505–1512, https://doi.org/10.1093/aje/kwt133

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



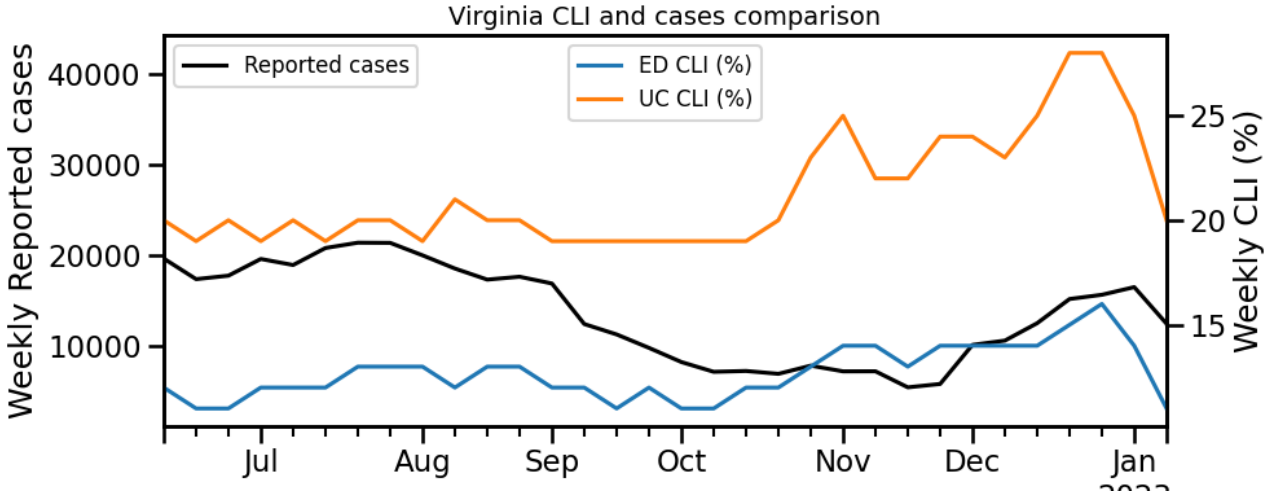


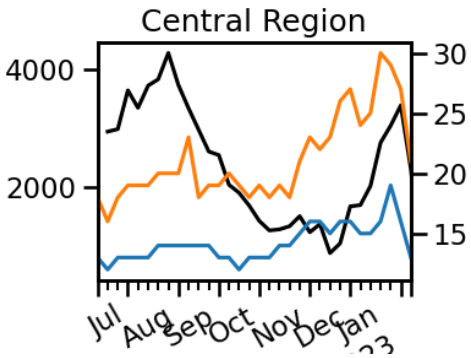
Data Source: [CDC Data Tracker]

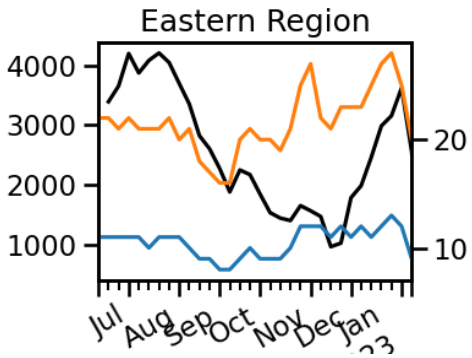
COVID-like Illness Activity

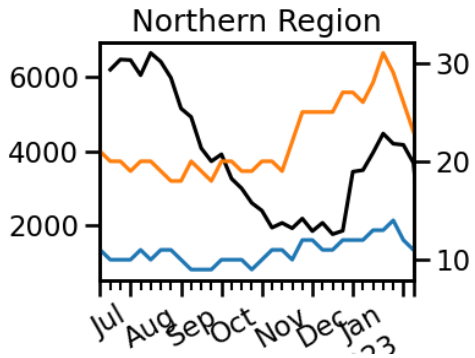
COVID-like Illness (CLI) gives a measure of COVID transmission in the community

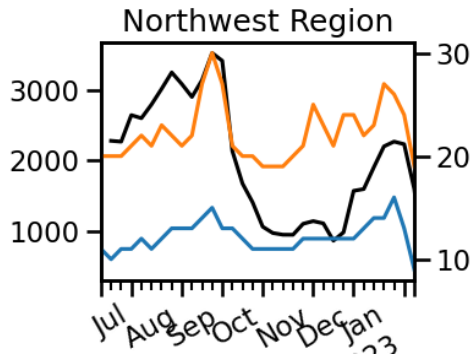
- Emergency Dept (ED) based CLI is more correlated with case reporting
- Urgent Care (UC) is a leading indicator but may be influenced by testing for other URIs
- **After 5 months of plateau, UC CLI remains higher than previous levels statewide**

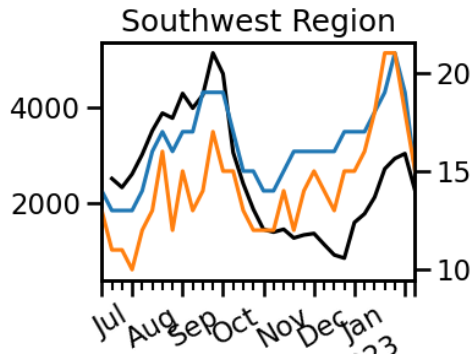












COVID-19 Spatial Epidemiology

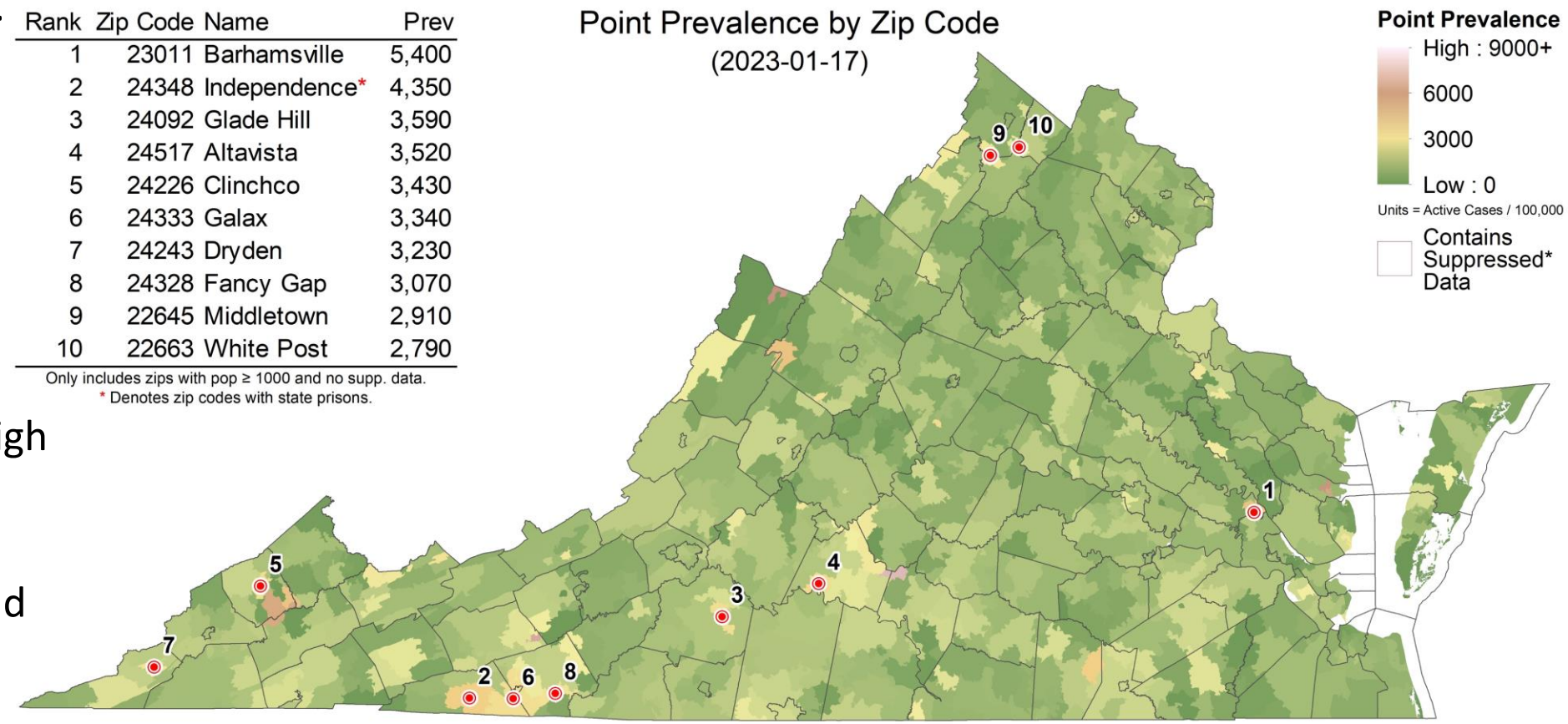
Zip code level weekly Case Rate (per 100K)

Case Rates in the last week by zip code

- Statewide prevalence peaked in early January. Current rates are comparable to rates from one month ago.
- Only one prison containing zip code appears in this week's top 10 (Independence).
- The only clustering of high values occurs in Far Southwest near Galax.
- Some counts are low and suppressed to protect anonymity. They are shown with a red outline.

Rank	Zip Code	Name	Prev
1	23011	Barhamsville	5,400
2	24348	Independence*	4,350
3	24092	Glade Hill	3,590
4	24517	Altavista	3,520
5	24226	Clinchco	3,430
6	24333	Galax	3,340
7	24243	Dryden	3,230
8	24328	Fancy Gap	3,070
9	22645	Middletown	2,910
10	22663	White Post	2,790

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 2023-01-17.

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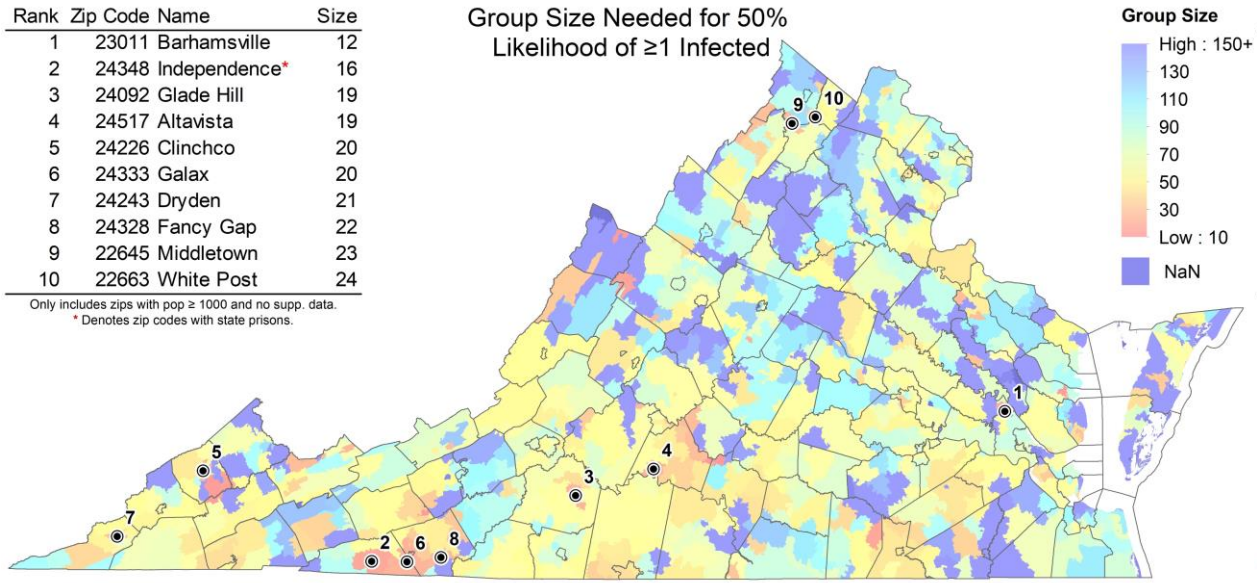
Risk of Exposure by Group Size and HCW prevalence

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 12 in Barhamsville, there is a 50% chance someone will be infected).
- **HCW ratio**: Case rate among health care workers (HCW) in the last week using patient facing health care workers as the numerator / population's case prevalence. Most listed counties have only one HCW infection.

Rank	Zip Code	Name	Size
1	23011	Barhamsville	12
2	24348	Independence*	16
3	24092	Glade Hill	19
4	24517	Altavista	19
5	24226	Clinchco	20
6	24333	Galax	20
7	24243	Dryden	21
8	24328	Fancy Gap	22
9	22645	Middletown	23
10	22663	White Post	24

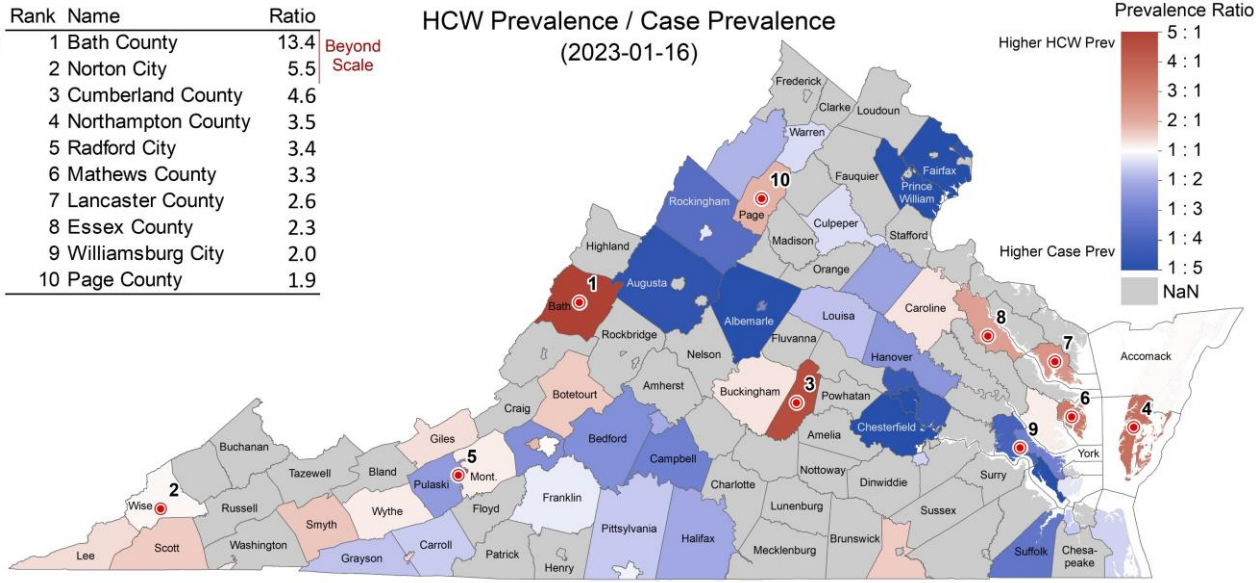
Only includes zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons.



Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for week ending 2023-01-17.

Rank	Name	Ratio
1	Bath County	13.4
2	Norton City	5.5
3	Cumberland County	4.6
4	Northampton County	3.5
5	Radford City	3.4
6	Mathews County	3.3
7	Lancaster County	2.6
8	Essex County	2.3
9	Williamsburg City	2.0
10	Page County	1.9

Beyond Scale



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

Current Hot-Spots

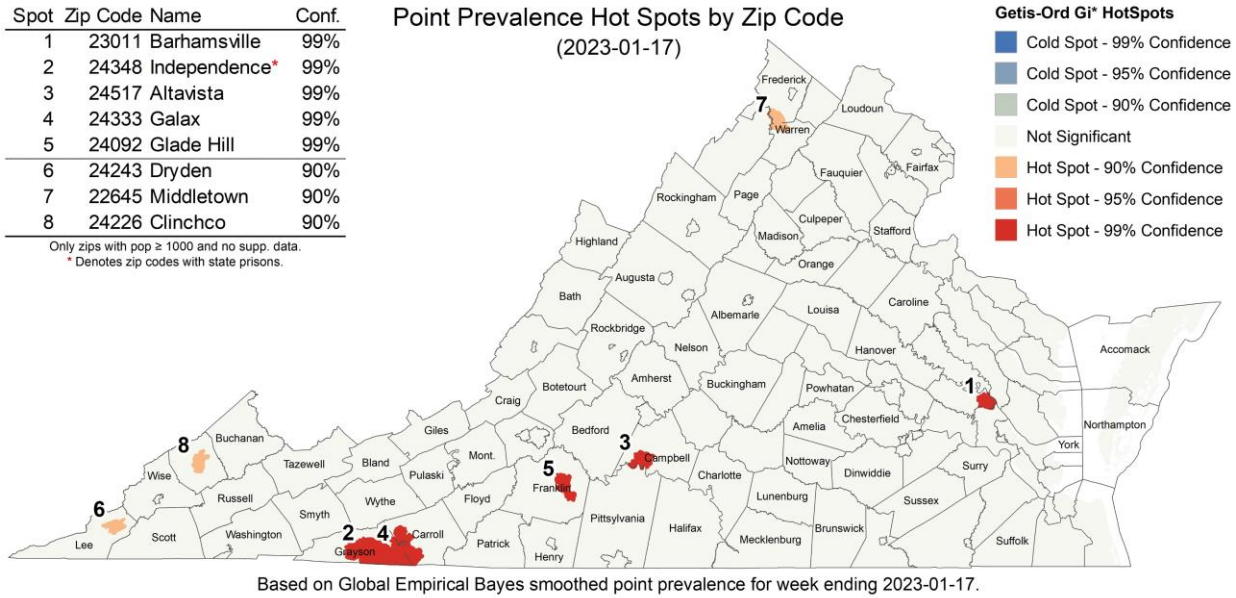
Case rates that are significantly different from neighboring areas or model projections

- **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.
- Aside from a small cluster in Far SW, hotspots are sporadic. Models overpredicted New River, Roanoke, and Piedmont. Mount Rodgers and Cumberland Plateau experienced more cases than models expected.

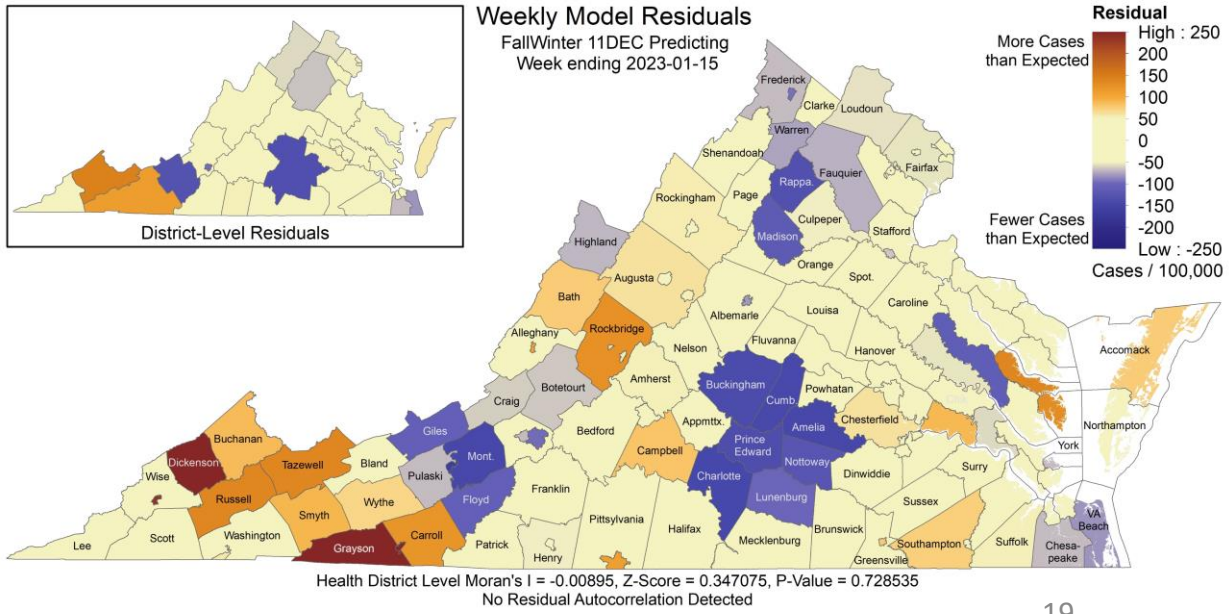
Spatial Hotspots

Spot	Zip Code	Name	Conf.
1	23011	Barhamsville	99%
2	24348	Independence*	99%
3	24517	Altavista	99%
4	24333	Galax	99%
5	24092	Glade Hill	99%
6	24243	Dryden	90%
7	22645	Middletown	90%
8	24226	Clinchco	90%

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



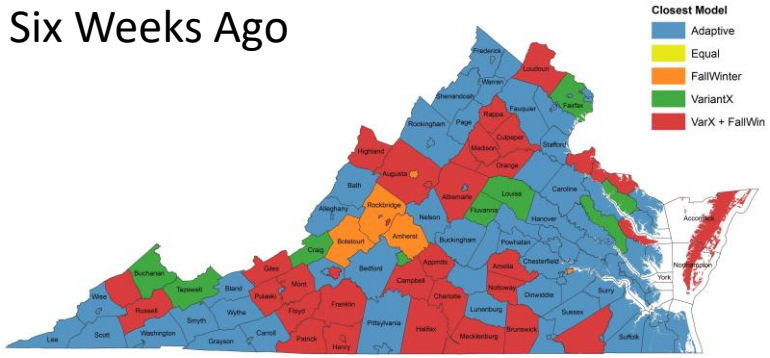
Clustered Temporal Hotspots



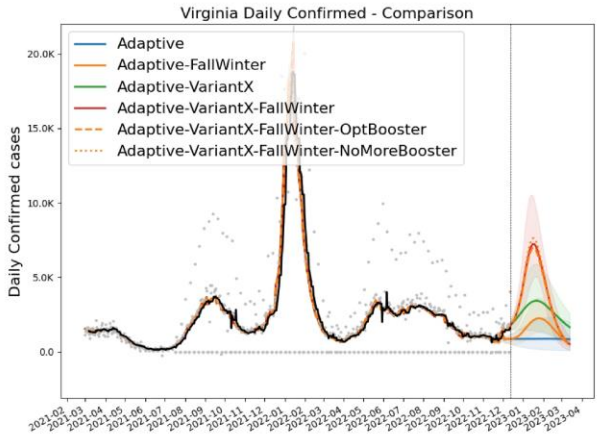
Scenario Trajectory Tracking

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

Six Weeks Ago



Four Weeks Ago



- One-month projections separate the scenarios more clearly and reveals larger overall patterns.
- Among models run in mid-December, the FallWinter scenario was most accurate in forecasting county level cases. This is a departure from models run in November, where VariantX scenarios dominated.

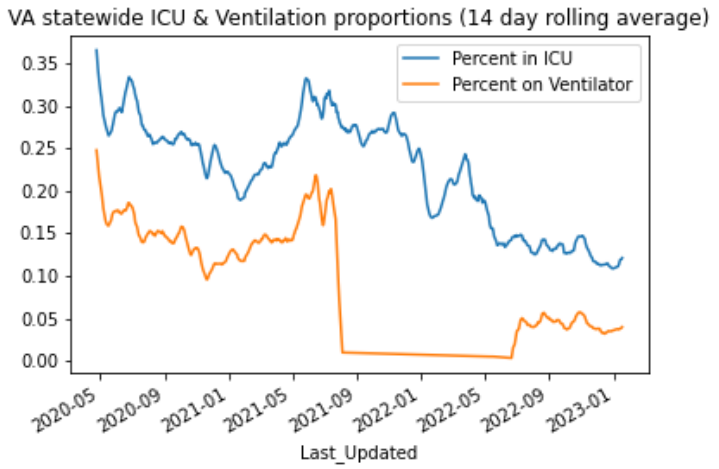
COVID-19 Severity Metrics

Hospitalizations and Severe Outcomes

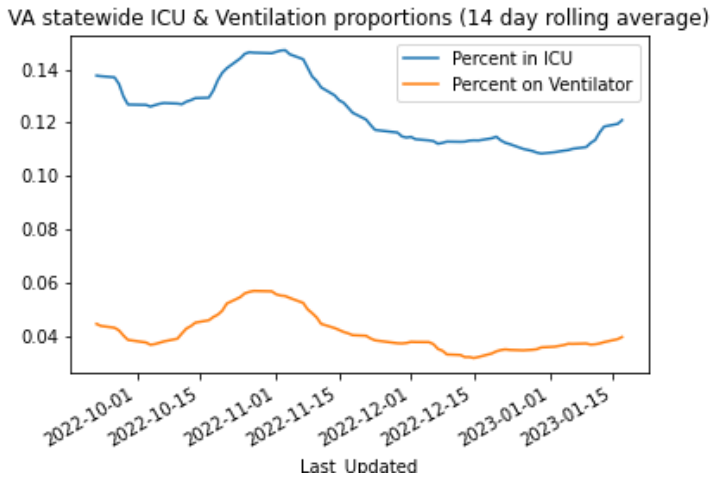
Proportion of most severe outcomes decreasing among those who are hospitalized

- ICU has declined from ~20% of hospitalized to 10-15% since initial Omicron wave
- Recent trend tipping up, though current levels near historic lows
- Regional variation tracks state-level

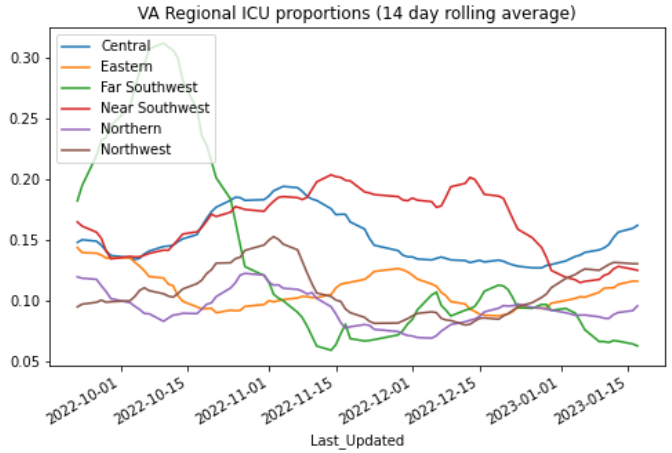
Virginia-wide – full pandemic



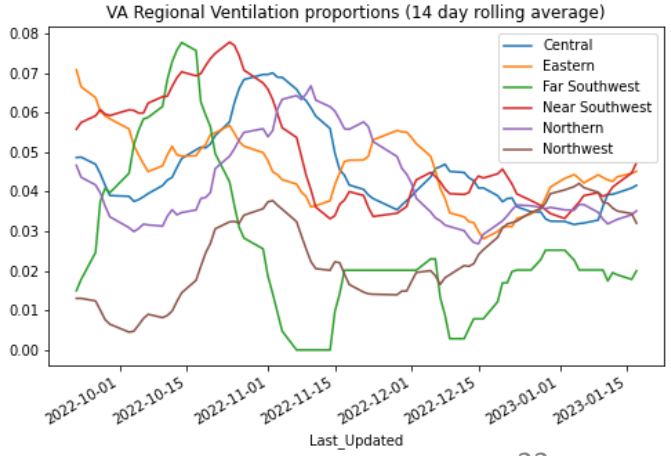
Virginia-wide – recent



Virginia Regional ICU percent



Virginia Regional Ventilation %



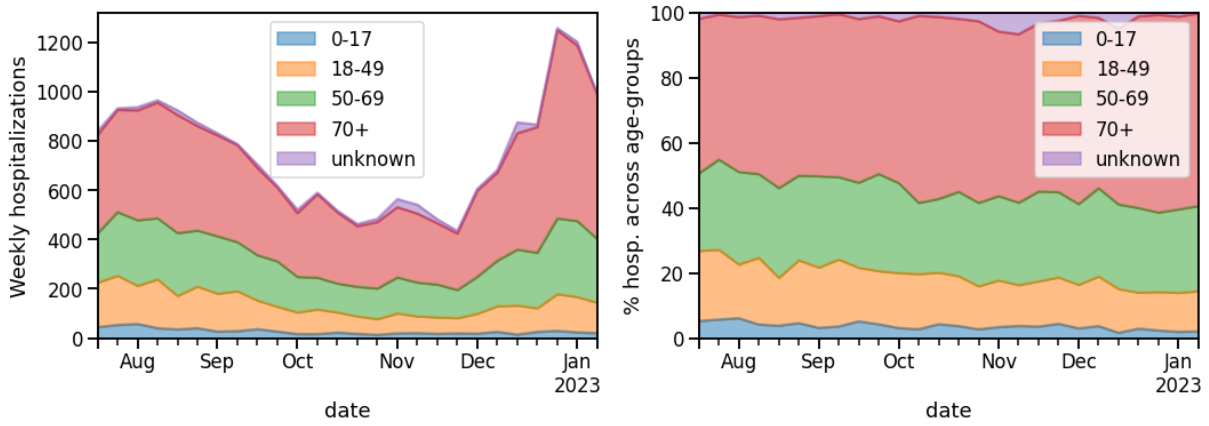
Hospitalizations in VA by Age

Age distribution in hospitals relatively stable

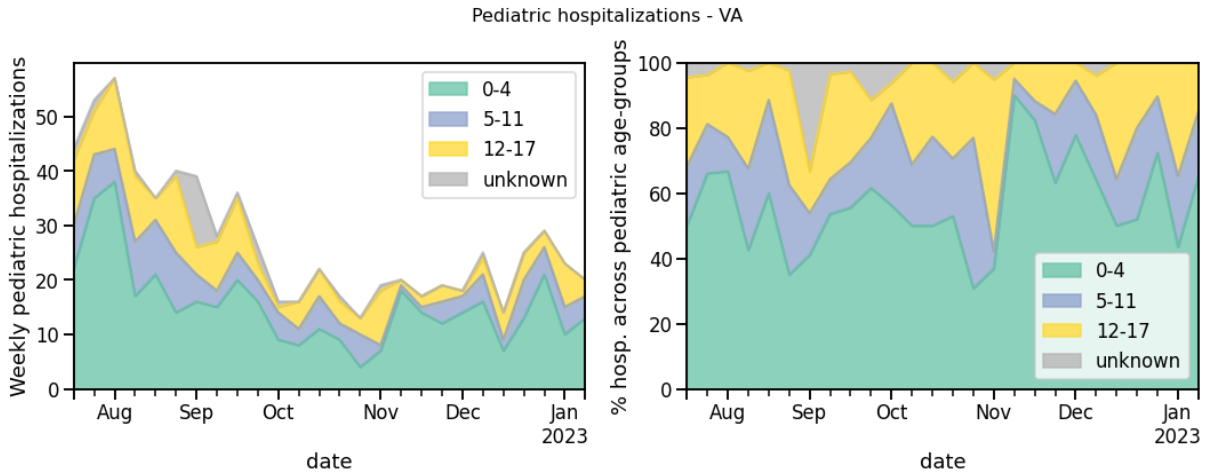
- Uptick in hospitalizations mostly fueled by 70+ age group
- Pediatric hospitalizations have been steady despite the surge in activity in other age-groups

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

Virginia Hospitalizations by Age (all ages)



Pediatric Hospitalizations by Age (0-17yo)



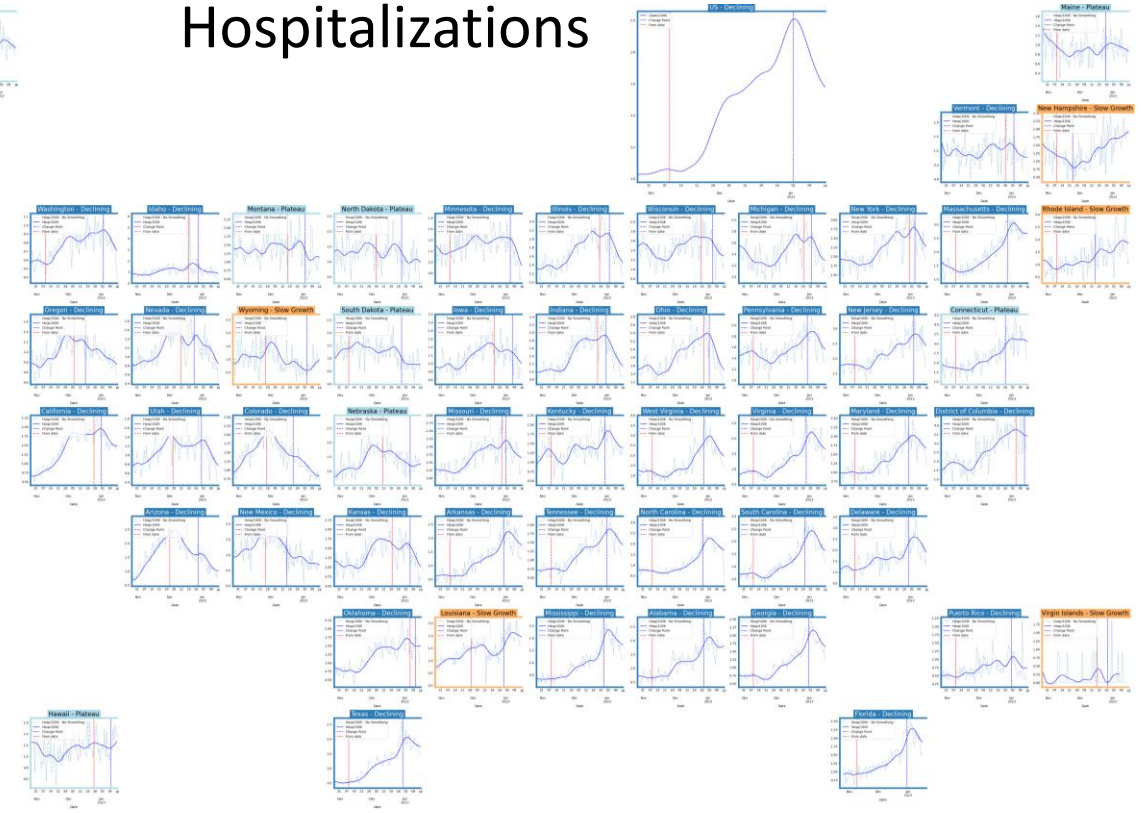
Data Source: Delphi and HHS

COVID-19 Broader Context

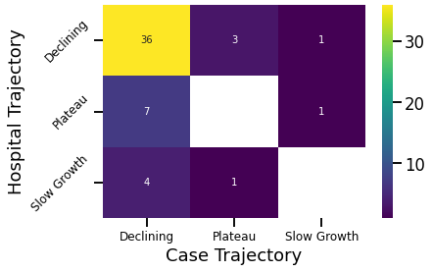
United States Cases & Hospitalizations

Cases

Hospitalizations



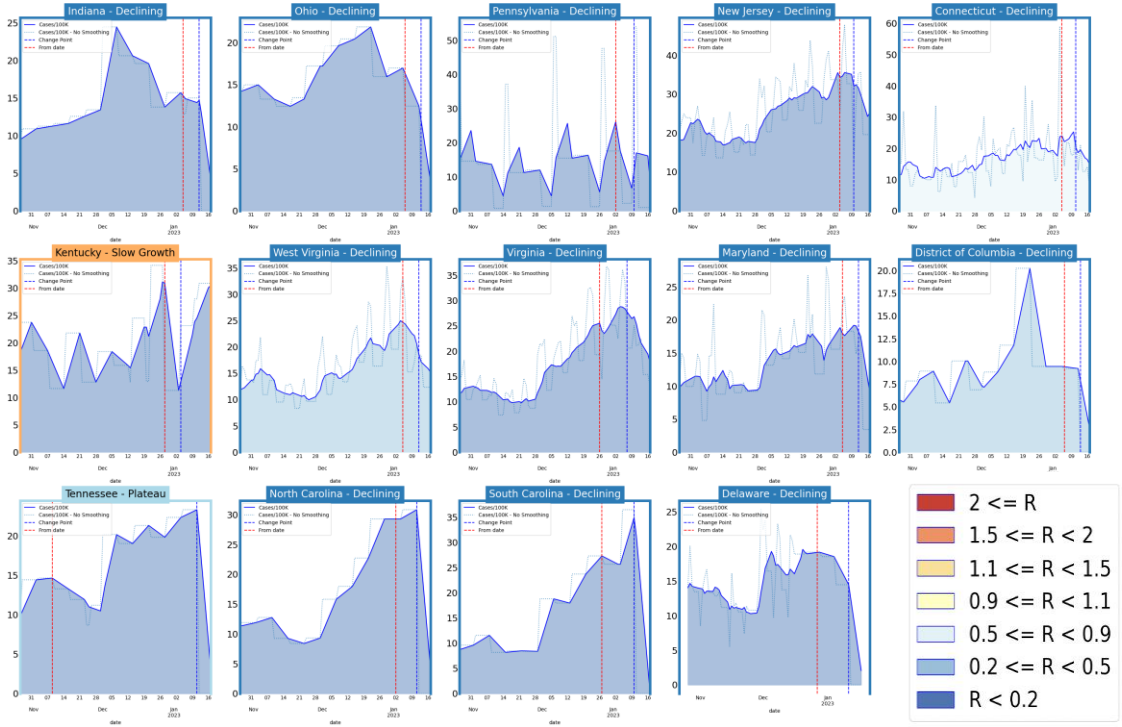
Status	Number of States	
	Current Week	Last Week
Declining	48	(37)
Plateau	4	(9)
Slow Growth	2	(5
In Surge	0	(3



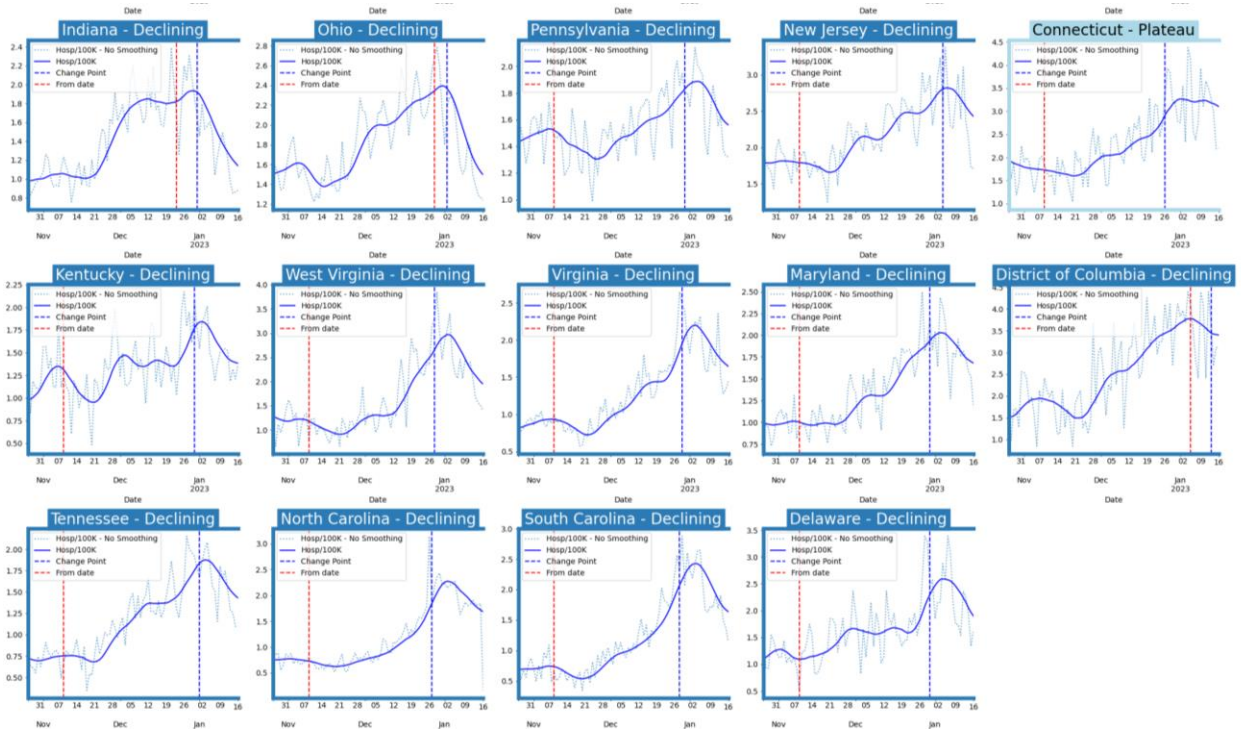
Status	Number of States	
	Current Week	Last Week
Declining	40	(17)
Plateau	8	(15)
Slow Growth	5	(9)
In Surge	0	(12)

Virginia and Her Neighbors

Cases

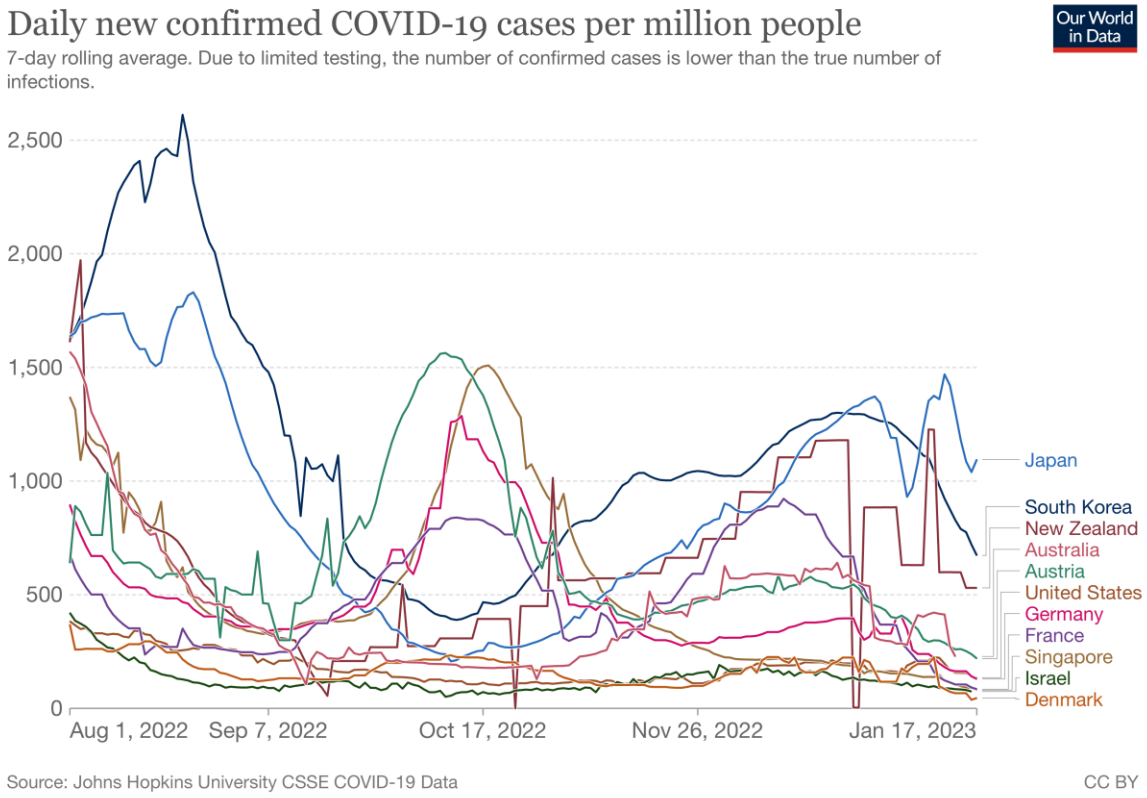


Hospitalizations

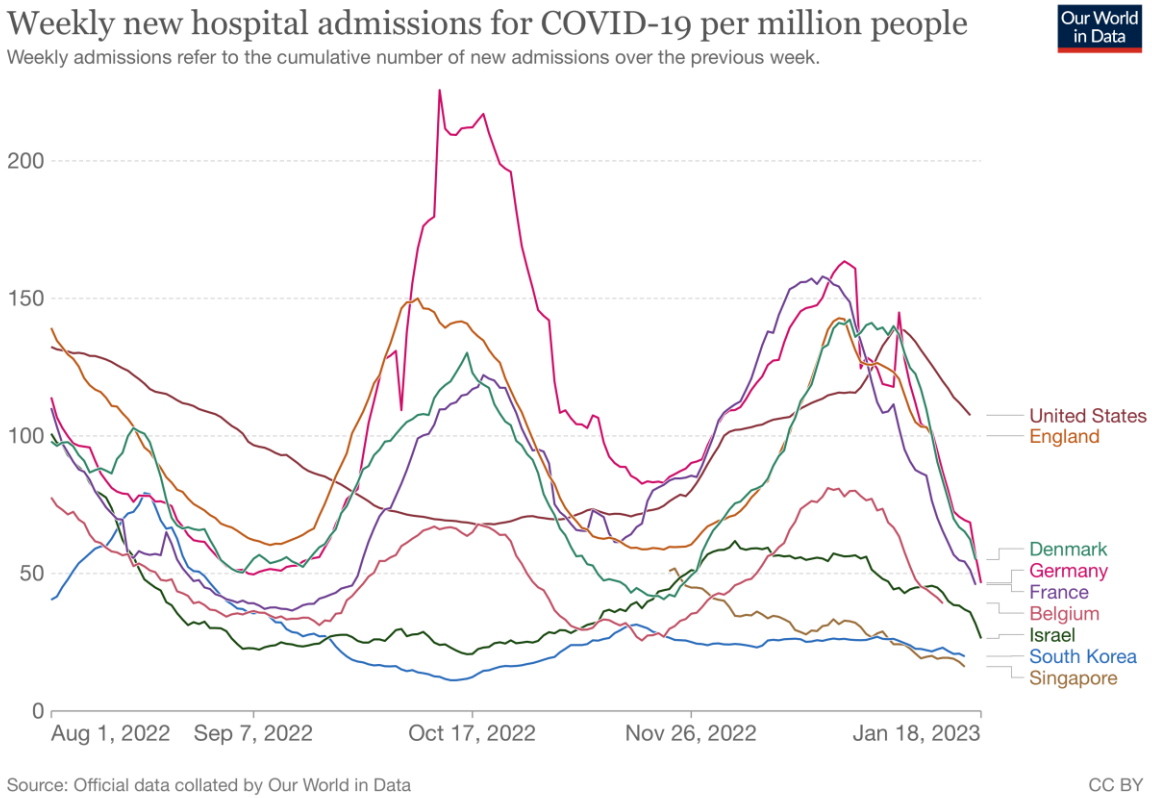


Around the World – Various trajectories

Confirmed cases



Hospitalizations



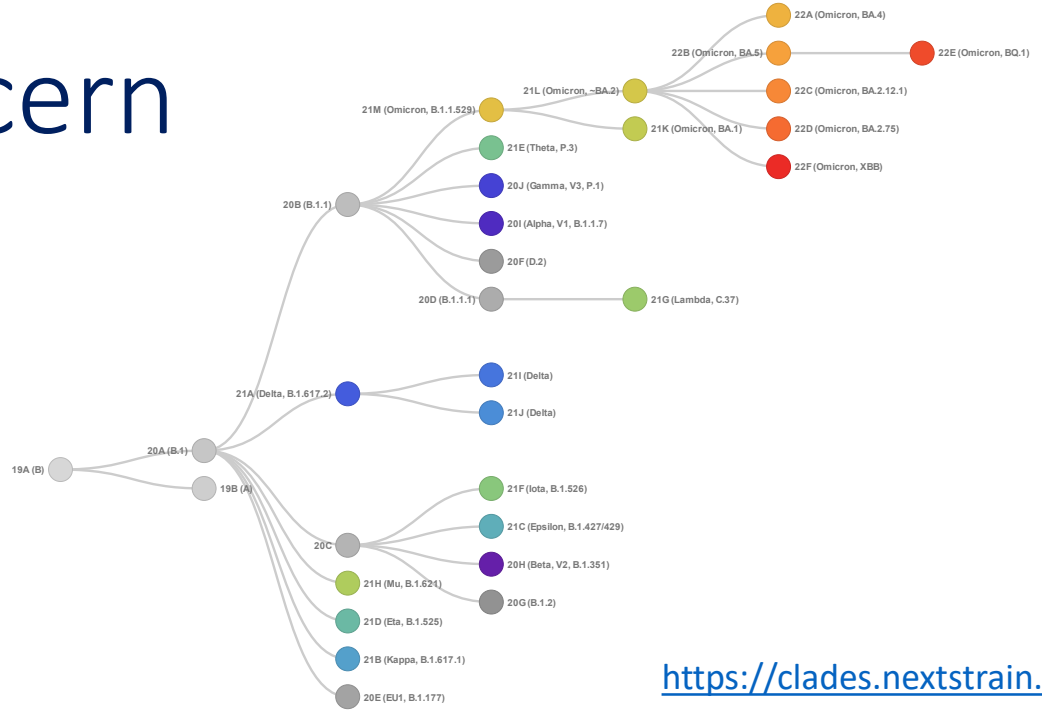
Our World in Data [Our World in Data]

COVID-19 Genomic Update

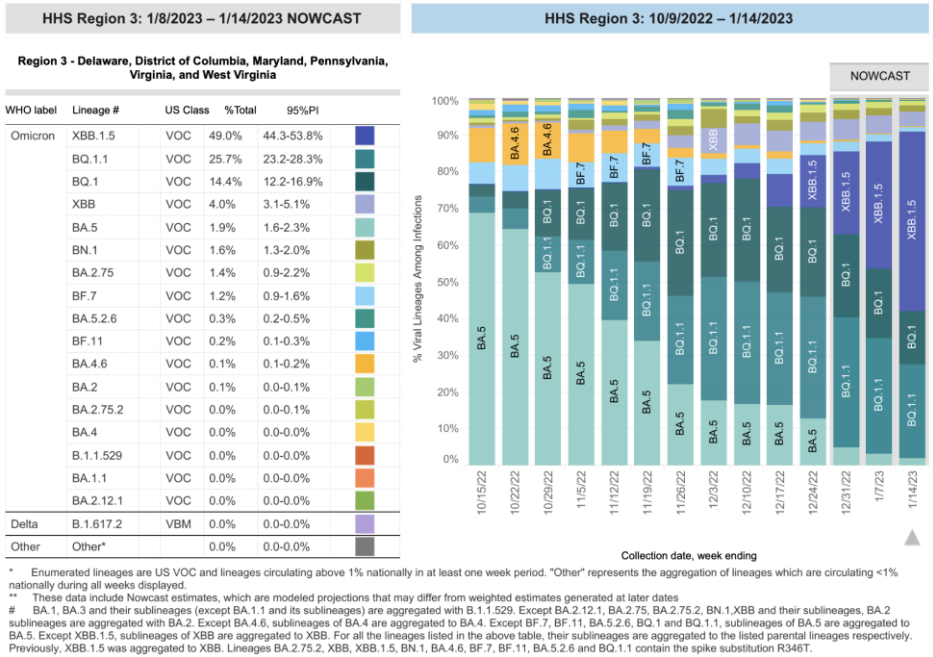
SARS-CoV2 Variants of Concern

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



* Enumerated lineages are US VOC and lineages circulating above 1% nationally in at least one week period. "Other" represents the aggregation of lineages which are circulating <1% nationally during all weeks displayed.
** These data include Nowcast estimates, which are modeled projections that may differ from weighted estimates generated at later dates
# 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, BA.2.75.2, BN.1,XBB and their sublineages, BA.2 sublineages are aggregated with BA.2. 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.1.5, sublineages of XBB are aggregated to XBB. For all the lineages listed in the above table, their sublineages are aggregated to the listed parental lineages respectively. Previously, XBB.1.5 was aggregated to XBB. Lineages BA.2.75.2, XBB, XBB.1.5, BN.1, BA.4.6, BF.7, BF.11, BA.5.2.6 and BQ.1.1 contain the spike substitution R346T.

Omicron Updates

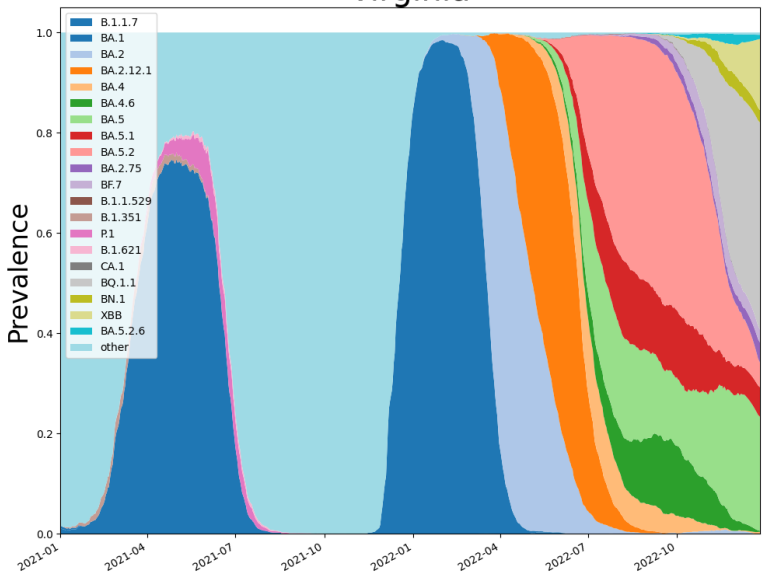
- XBB.1.5 has grown rapidly now accounting for 49%
- BQ.1 and BQ.1.1 are starting to lose ground to XBB to dominate at 14% and 26% respectively
- XBB not in XBB.1.5 remain significant at 4%
- BA.2.75.* family variants (includes BN.1) are shrinking to 3%
- BF.7 and BA.4.6 and others all now represent a very small fraction of sequenced virus

SARS-CoV2 Omicron Sub-Variants

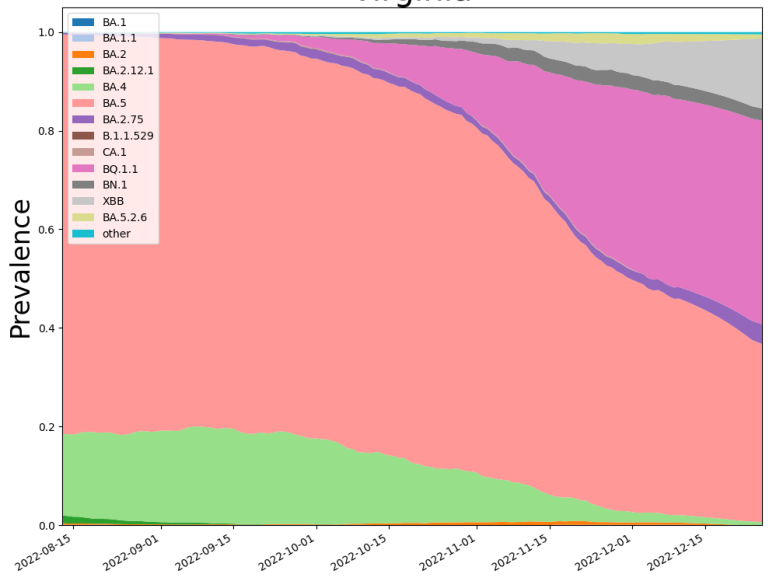
covSPECTRUM
Enabled by data from GISAID

As detected in whole Genomes in public repositories

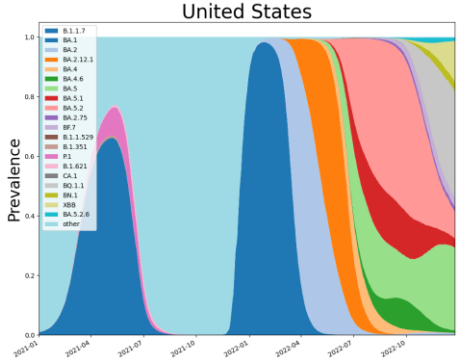
Virginia



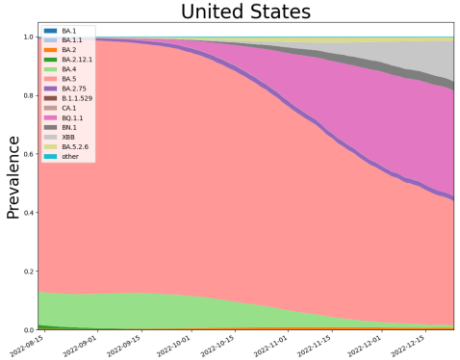
Virginia



United States

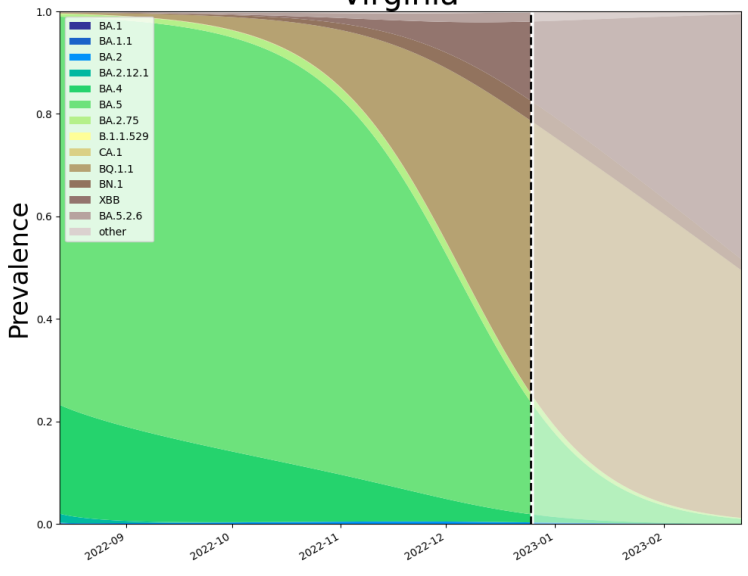


United States

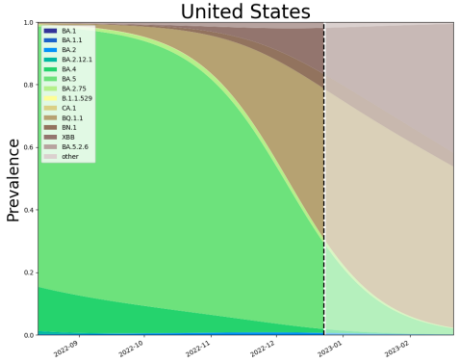


VoC Polynomial Fit Projections

Virginia



United States



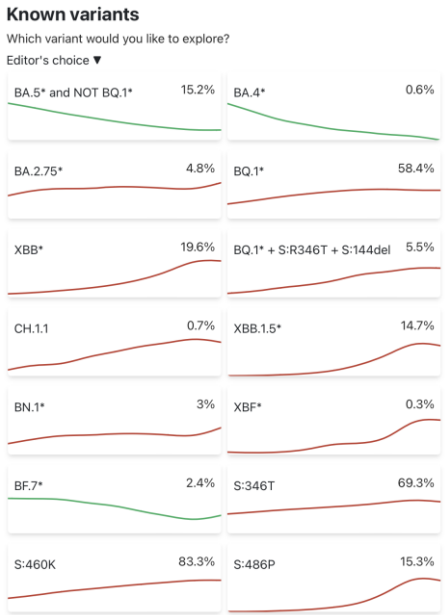
Note: Data lags force projections to start in past. Everything from dotted line forward is a projection.

SARS-CoV2 Omicron Sub-Variants

[COV-spectrum](#)

"Editor's choice"

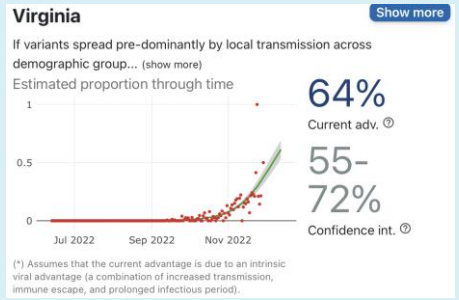
Variants to watch

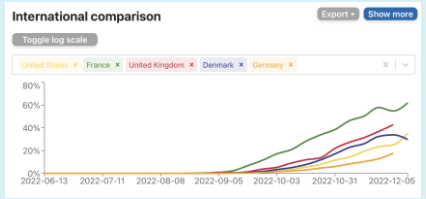


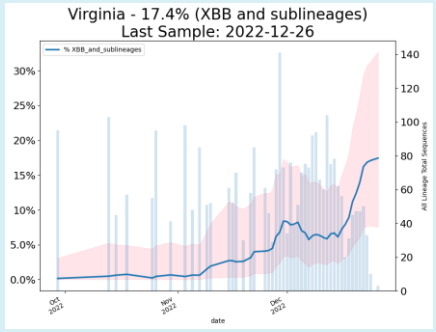
covSPECTRUM

Enabled by data from GISAID

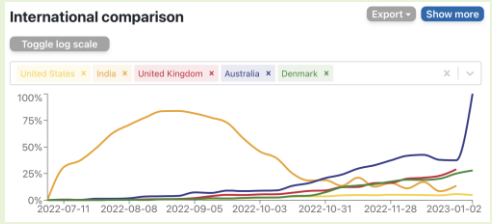
XB.1.5

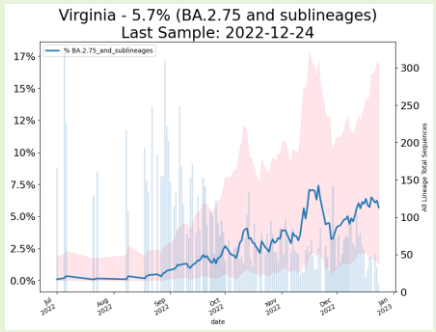




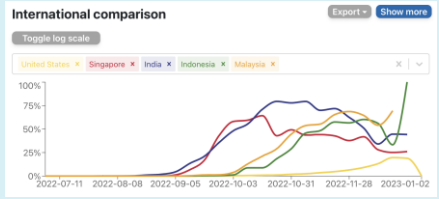


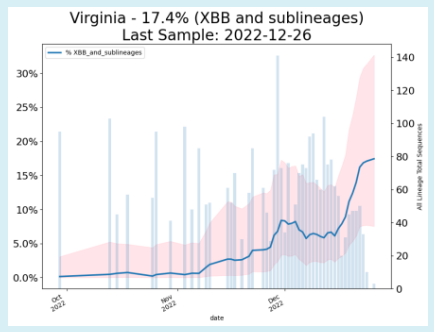
BA.2.75.*





XBB*





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Pandemic Pubs (Jan 11th, 2023)

1. Bivalent boosters are highly effective in in preventing hospitalization (81% reduction) and death (86% reduction) in adults over 65 yo.

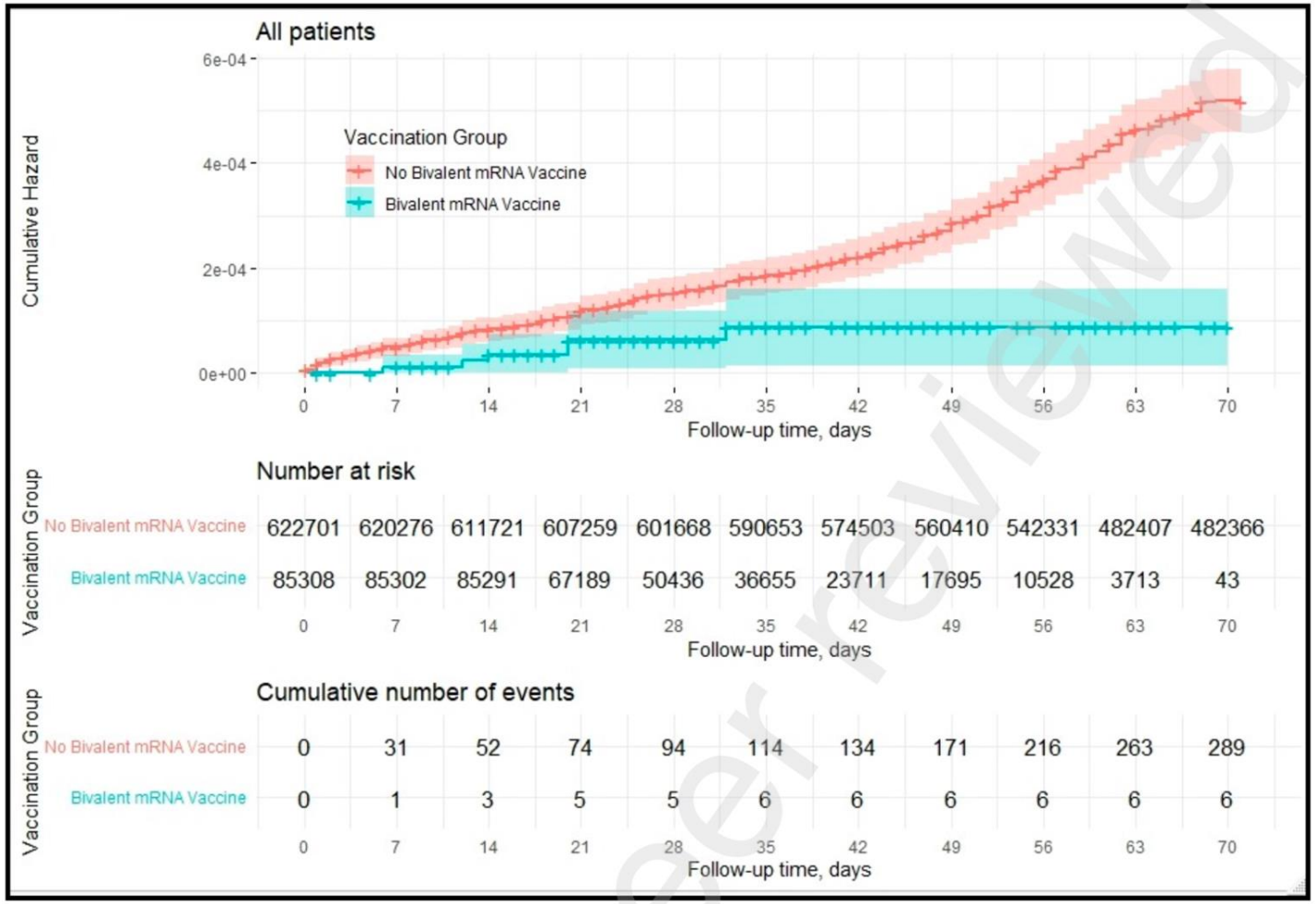


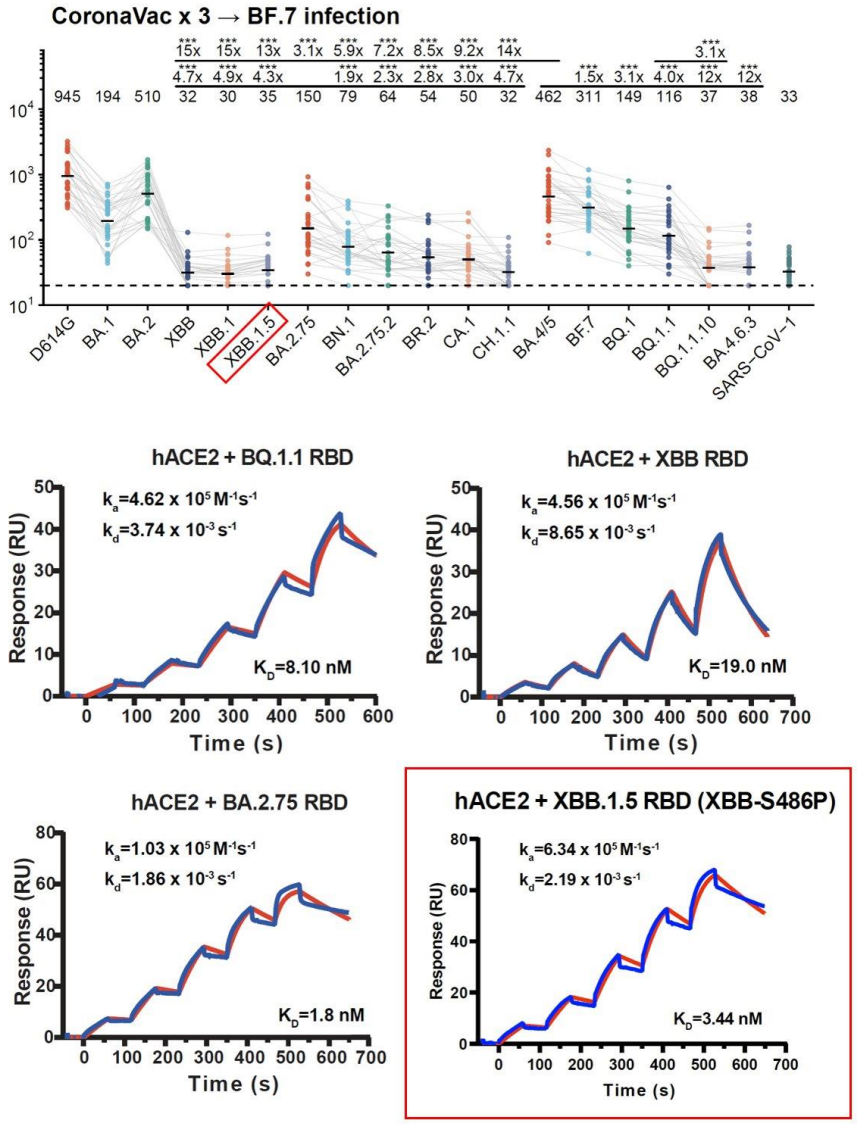
Figure 1: Cumulative hazard for Covid-19 hospitalization

Preprint in Lancet, included over 620K participants in Israel, while it was limited to 70 days of follow-up, was able to capture nearly 300 events in this largely well protected population. This study captured more of a population effect, whereas, previous publications (in MMWR in late Dec) were based on purely hospitalized patients and thus were limited to evaluating degrees of severity.

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4314067

Pandemic Pubs (Jan 11th, 2023)

2. XBB.1.5 has enhanced ACE binding efficiency which makes it likely to be more transmissible on top of being more immune evasive than BQ.1.1 and other BA.5 descended variants.



Using VSV psuedovirus neutralization assays along with surface plasmon resonance (SPR) assays to measure actual binding affinity to ACE2. They demonstrate that XBB.1.5 has stronger and more rapid binding to hACE2 in convalescent sera of individuals with 3 doses of CoronaVac with subsequent BA.1, BA.5, or BF.7 breakthrough infections. So despite vaccination and boosting of natural infection this affinity remained very strong for XBB.1.5

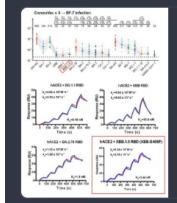
BioRxiv

https://www.biorxiv.org/content/10.1101/2023.01.03.522427v1

Bloom Lab
@jbloom_lab@mstdn.science

The difference between XBB.1.5 and its immediate parent XBB.1 is that it has traded the more costly F486S mutation for F486P. Therefore, XBB.1.5 isn't expected to have more antibody escape than XBB.1 (which already had mutated F486), but it should have greater ACE2 affinity.

And as @yunlong_cao nicely describes, this is exactly what is directly measured: twitter.com/yunlong_cao/status...

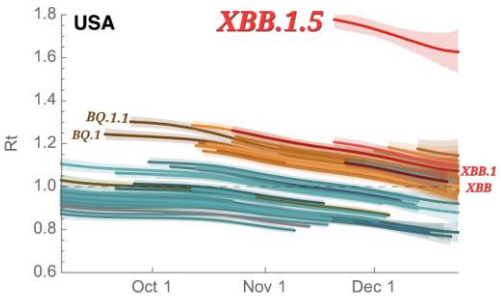


Yunlong Richard Cao on Twitter
"The superior growth advantage of XBB.1.5 has been...
Twitter

Jan 02, 2023, 15:15 · Web · 6 · 10

https://mstdn.science/@jbloom_lab/109621446854109094

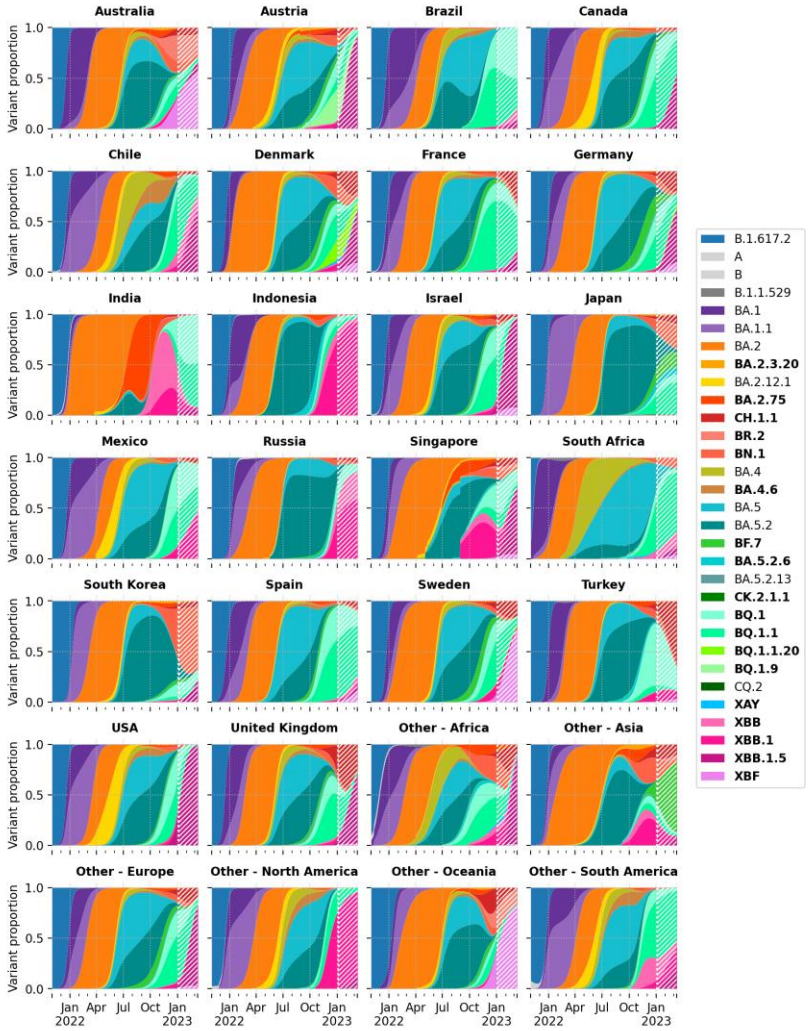
XBB.1.5 is more transmissible than other variants like BQ.1.1 that until recently dominated in US.



https://twitter.com/JPWeiland/status/1607835958388432896

Pandemic Pubs (Jan 11th, 2023)

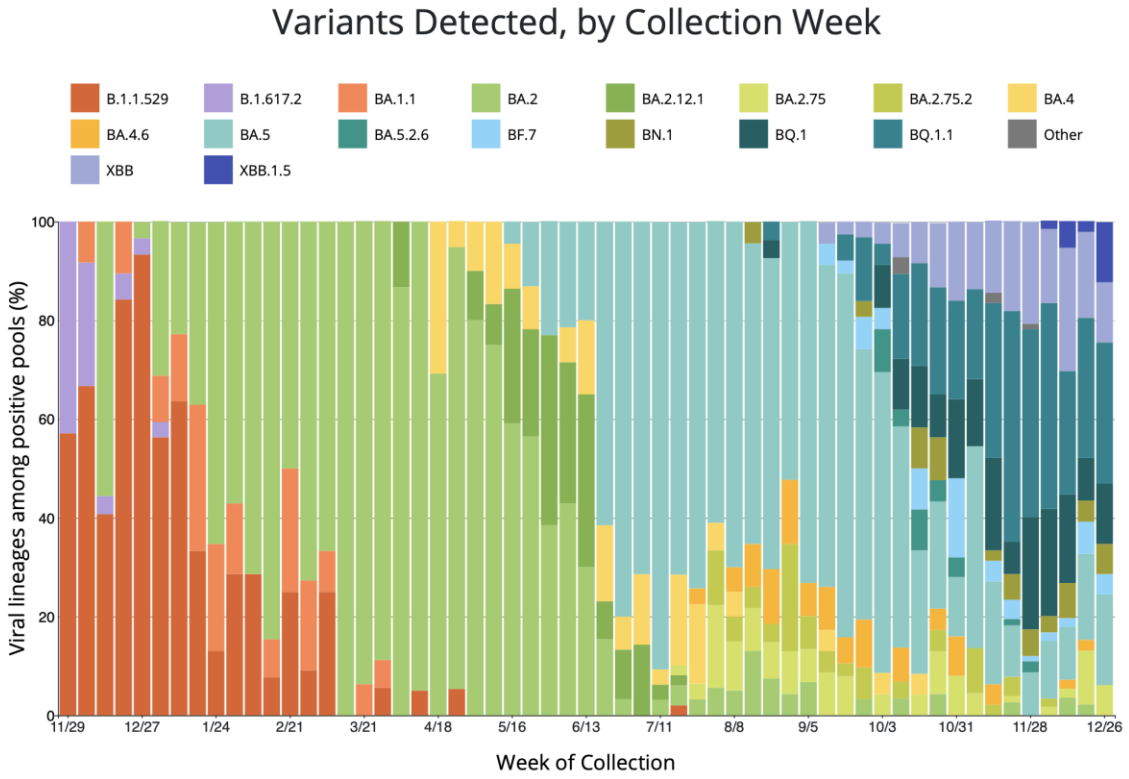
3. Wide Heterogeneity across the world in terms of variants. XBB.1.5 mainly focused in US and not very prevalent in travelers. US may be the exporter of the next variant to sweep the world.



Summary of Dominating Strains

Philippines BA.2.3.20
New Zealand CH.1.1
Russia CL.1
Australia XBF BR.2.1
India XBB
South Korea BN.1.3
Japan BF.5

[Frederico Gueli]



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

Pandemic Pubs (Jan 11th, 2023)

4. Op-Ed by Eric Topol, offers a compendium of reasons to remain vigilant as SARS-CoV2 continues to demonstrate that it will continue to evolve is likely to remain a significant threat in the coming years.

Opinion | The coronavirus is speaking. It's saying it's not done with us.

By Eric Topol

January 8, 2023 at 7:00 a.m. EST

There's no sugar-coating it: The world has let its guard down on covid-19. And the virus's latest dominant form, XBB.1.5, makes clear that we're doing so just as the virus finds new ways to hurt us. The new dominant strain shows that the virus is always evolving to spread more quickly and infect us more efficiently. That should serve as a wake-up call for the country to re-invest in new vaccines, treatments and pandemic monitoring. The XBB strain is the first fast-spreading recombinant variant — meaning it is a fusion of two omicron lineages. Its original version led to a wave of infections in Singapore. Then it added two critical mutations to become XBB.1.5, which was first detected in New York.

…

Worse, there's no coordinated, high-priority, accelerated or even funded efforts — either in the United States or globally — to develop the next-generation vaccines that will block infections, such as universal, variant-proof vaccines with extended duration of protection. Nor do we have drugs to replace the monoclonal antibodies that no longer work or for Paxlovid, in case resistance emerges to that treatment.

We've moved from complacency to frank capitulation at just the wrong time. If XBB.1.5 is telling us one thing, it's that we can't be oblivious. We're all tired, but we're up against a force that isn't. We have the intelligence, resourcefulness and ingenuity to finally get ahead of the virus, but politics and unwillingness to invest are holding us back. We cannot afford that gridlock.

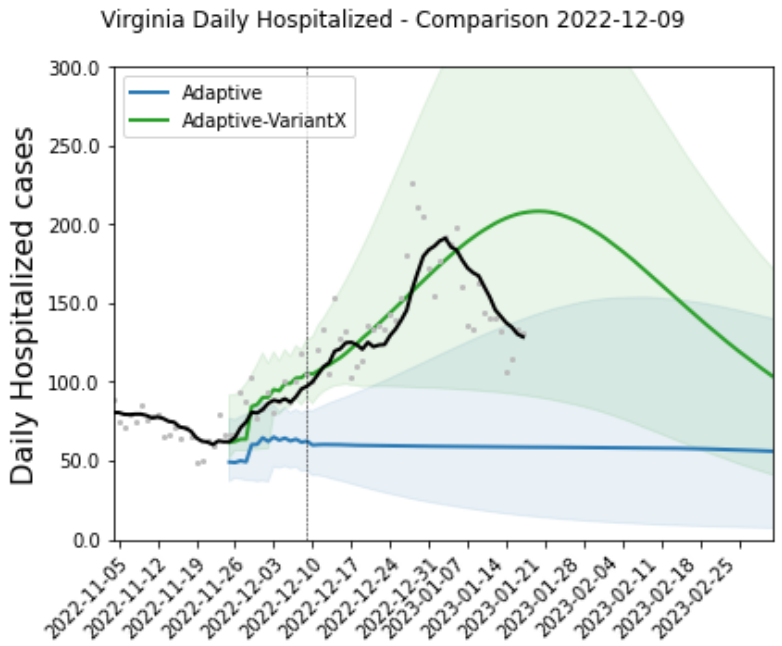
Washington Post: https://www.washingtonpost.com/opinions/2023/01/08/xbb-covid-variant-immune-evasive-pandemic/

Last Projection Model

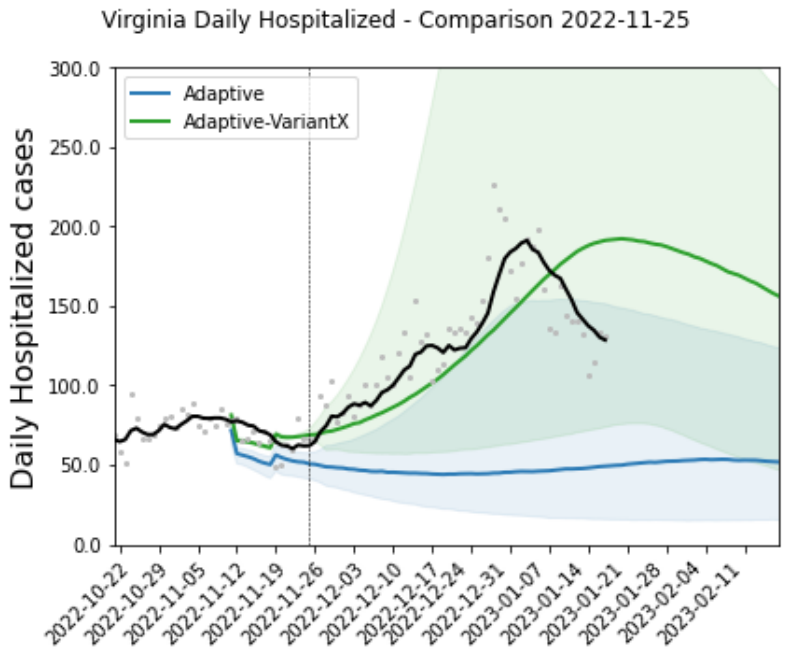
Previous projections comparison - Hospitalizations

- Previous projections have tracked observed hospitalizations reasonably well under the VariantX scenario, though the peak has occurred earlier than anticipated
- VariantX scenario assumed a high immune escape variant would continue to grow and was roughly aligned, though a little earlier than XBB.1.5
- Lab evidence suggests a high degree of immune escape and increased transmissibility, however, at the population level it appears immunity has been robust enough to limit the peak

Previous round (6 weeks ago)



Projection from 8 weeks ago



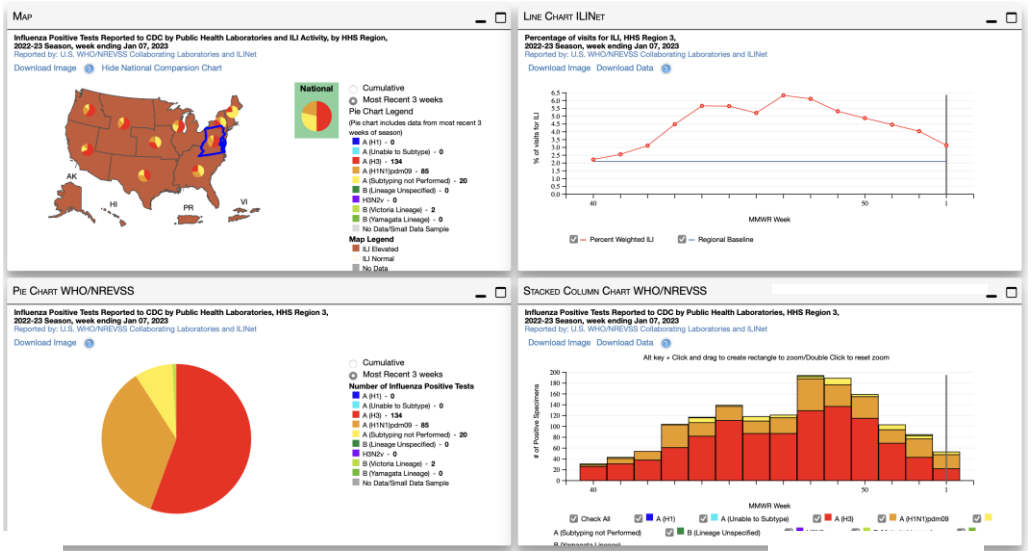
Influenza Update

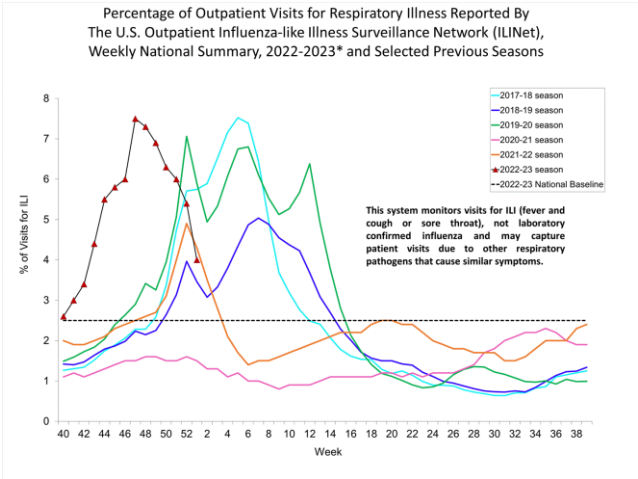
Current Influenza Situation – ILI Activity

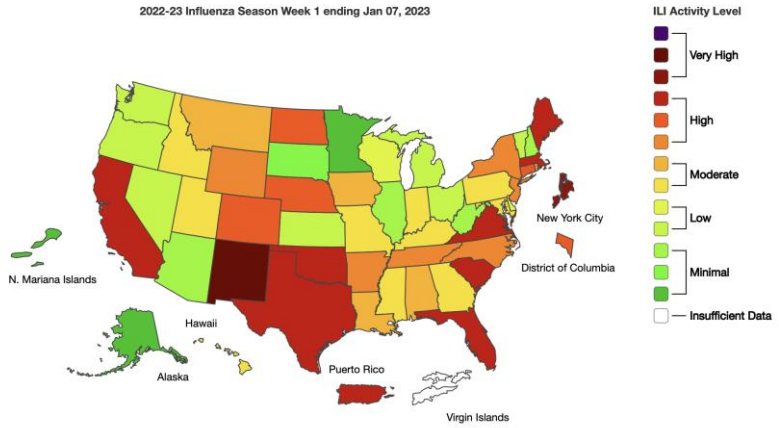
Influenza Activity is Higher than Usual

- Virginia has shifted to ”High” level as most states have receded to lower levels in the past several weeks.
- In VA ILI Activity has declined to 5-6% after over a month of declines
- National ILI activity has also consistently declined since a peak in late November
- After starting with high proportions of H3N2 typed influenza, H1N1pdm09 now represents ~1/4 of all infections nationally, though remain H3 dominates in VA

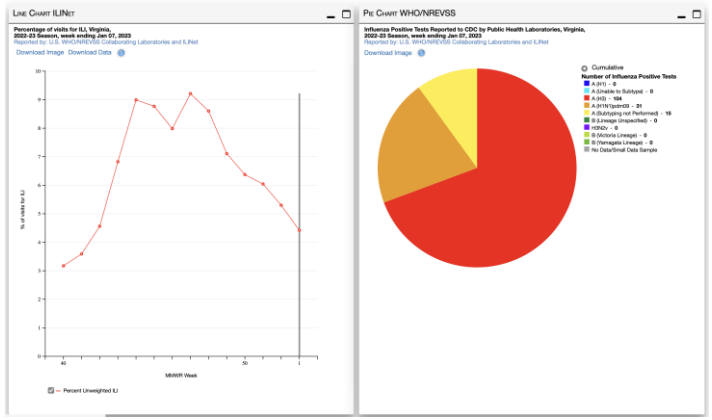
Region 3







Virginia



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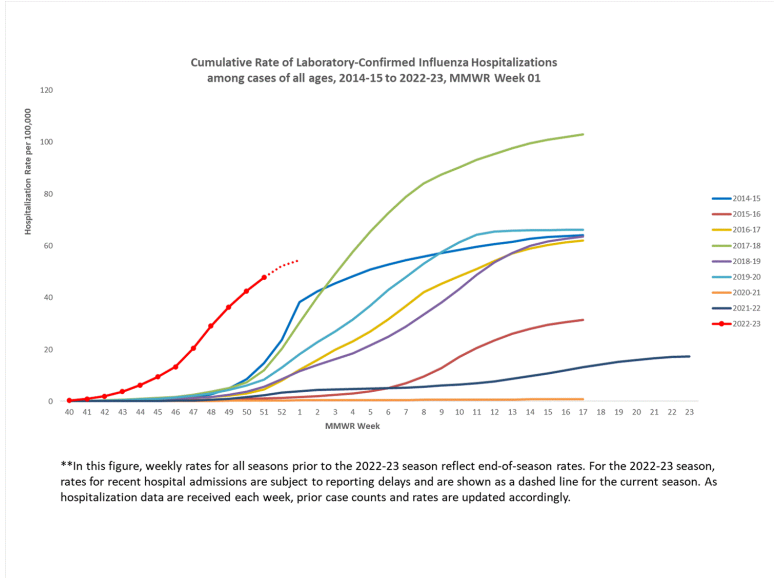
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

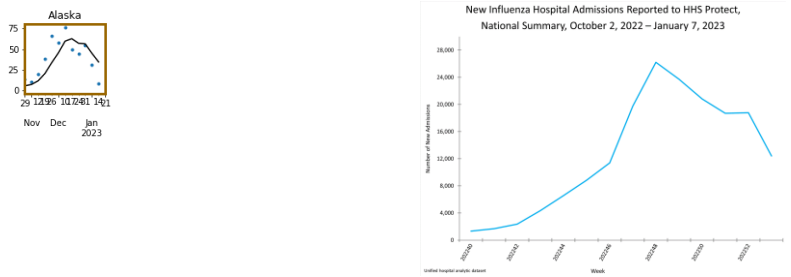
Current Influenza Situation - Hospitalizations

Influenza A hospitalizations continue rapid growth

- National level of influenza hospitalizations
- Nearly all states have doubled their hospitalizations due to influenza in the last couple weeks
- Virginia shows leveling off in the last weeks



**In this figure, weekly rates for all seasons prior to the 2022-23 season reflect end-of-season rates. For the 2022-23 season, rates for recent hospital admissions are subject to reporting delays and are shown as a dashed line for the current season. As hospitalization data are received each week, prior case counts and rates are updated accordingly.

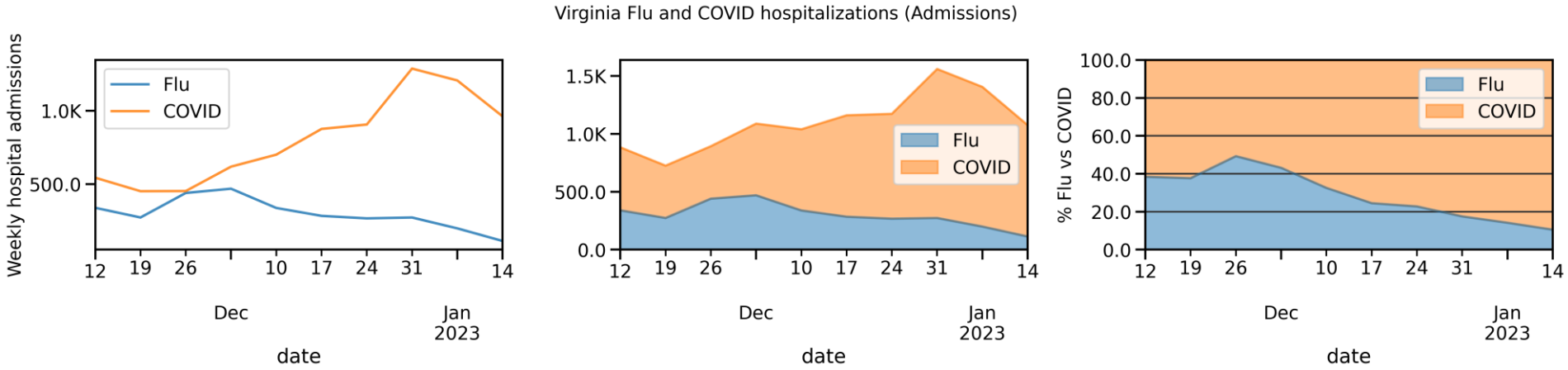


Influenza Hospital Admissions (HHS Protect)

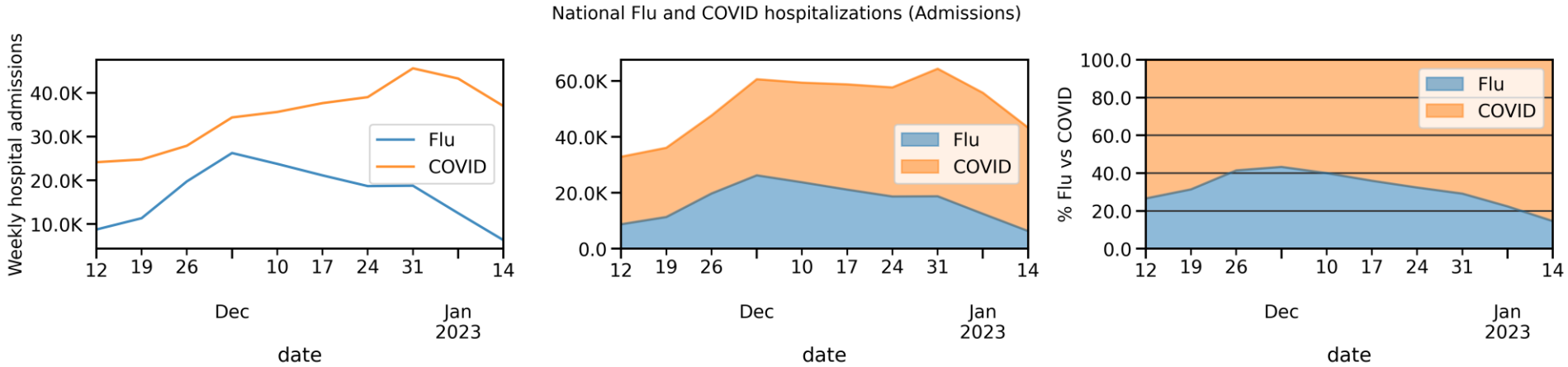
Current Combined Hospitalizations (COVID-19 & Influenza)

COVID-19 and Influenza Weekly Hospitalizations (HHS Protect)

Virginia



USA



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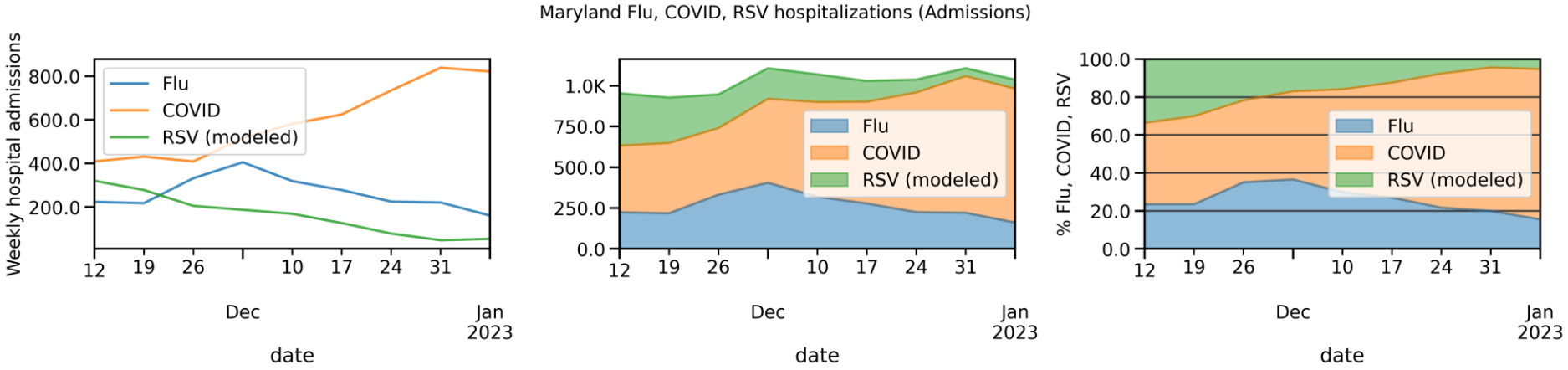
Current Combined Hospitalizations (COVID-19, Flu & RSV)

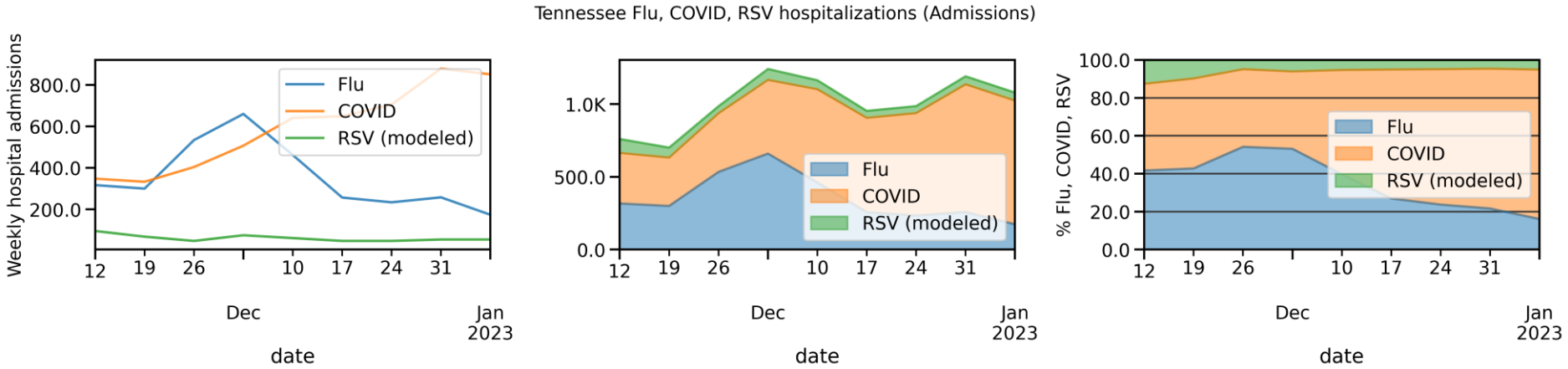
COVID-19, Influenza, and RSV Weekly Hospitalizations

RSV Hospitalizations captured by RSV-Net which has lagged reporting and does not cover Virginia, thus her closest neighbors are shown for comparison

Maryland



Tennessee



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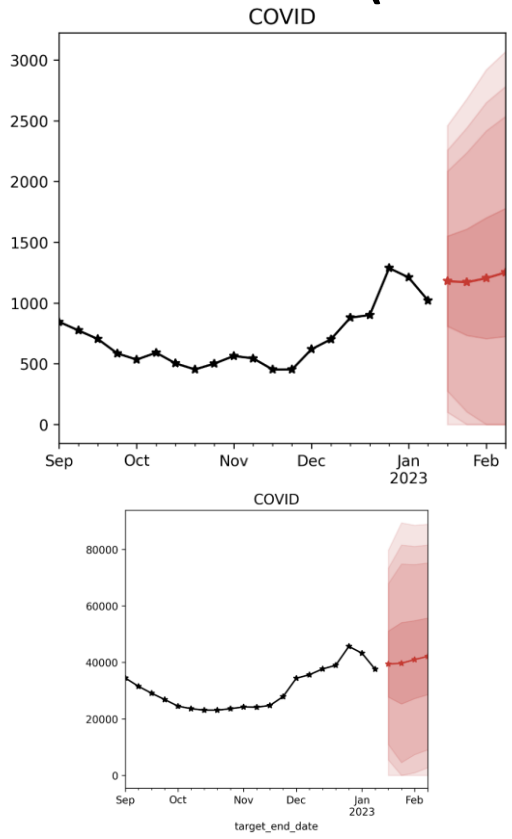
National Modeling Hub Updates

Current COVID-19 Hospitalization Forecast

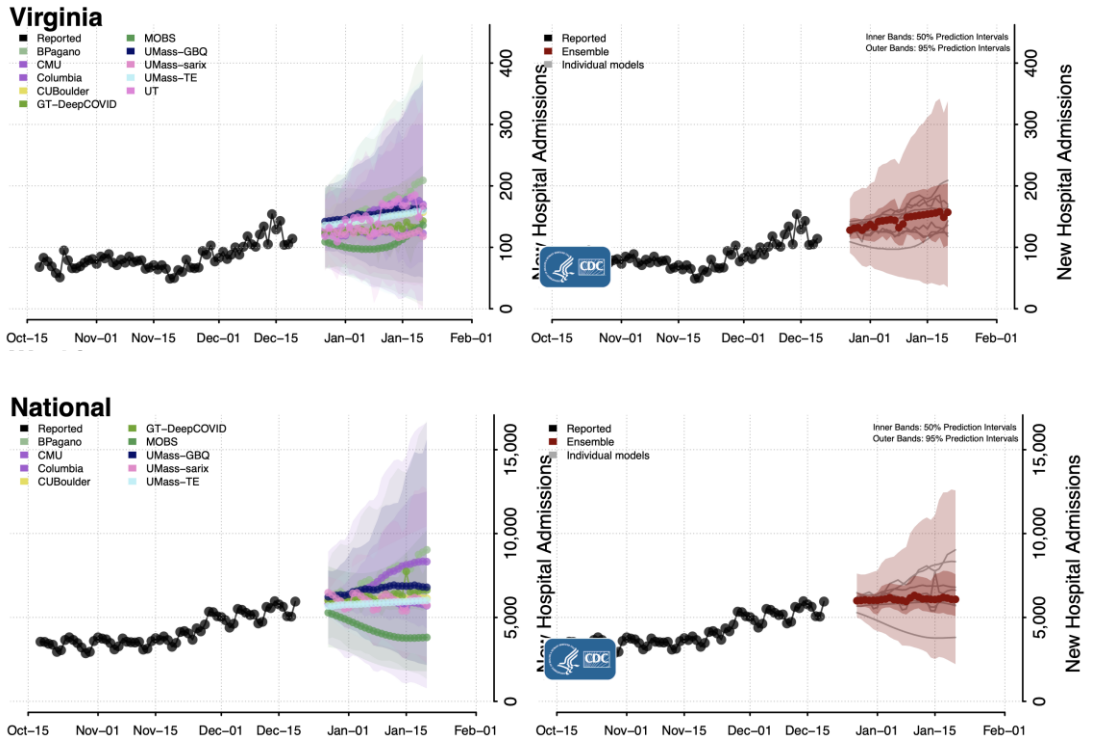
Statistical models for submitting to CDC FluSight forecasting challenge

- 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)

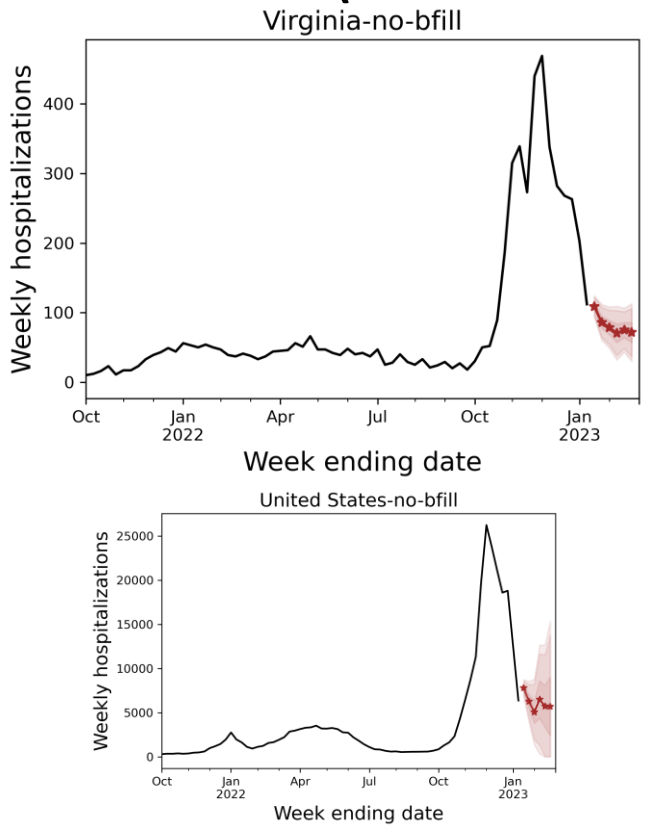


Current Influenza Hospitalization Forecast

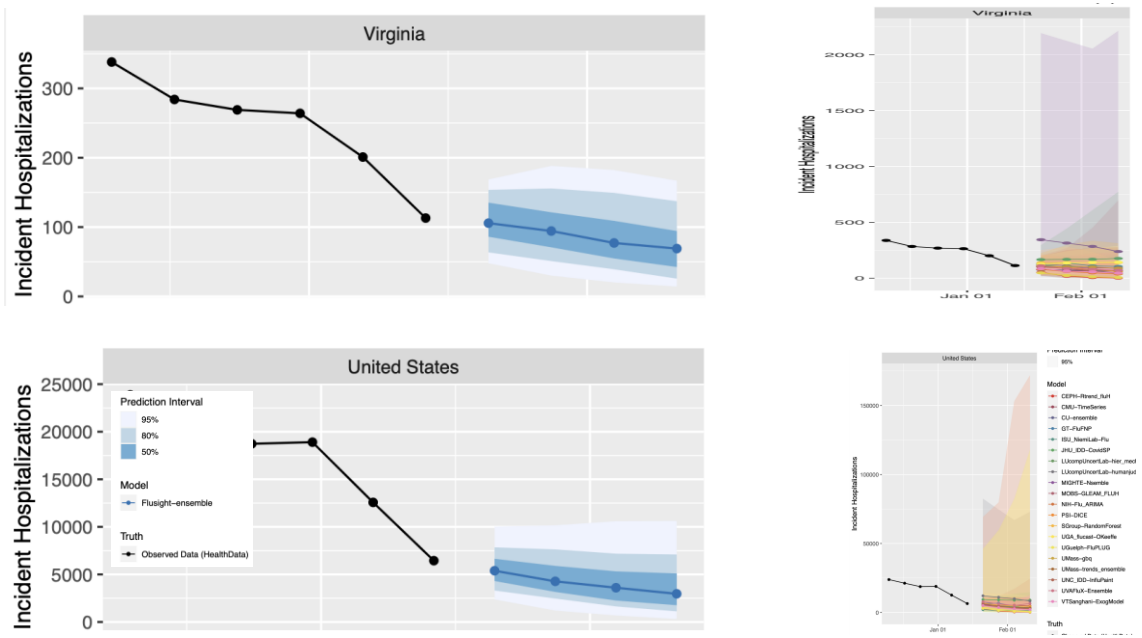
Statistical models for submitting to CDC FluSight forecasting challenge

- 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)



Combined ILI and COVID-19 Hospitalizations

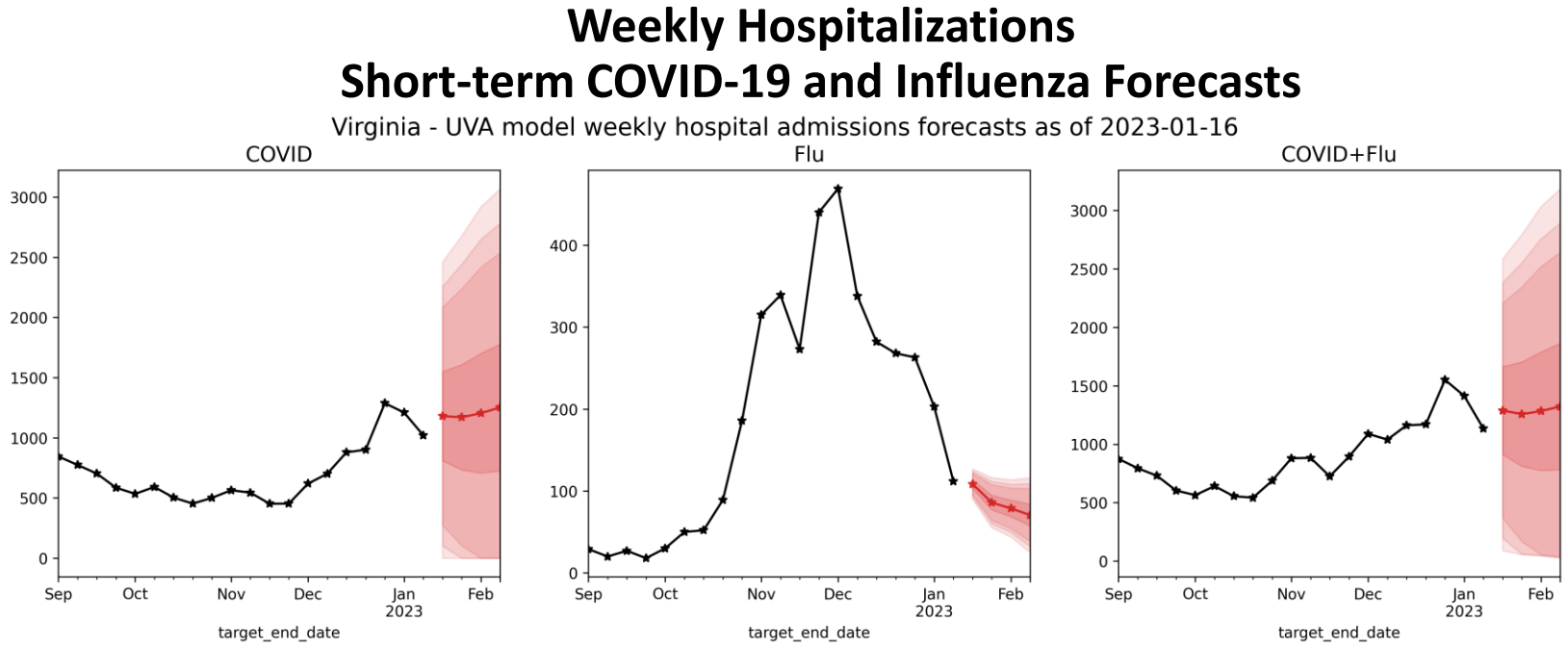
Ensemble methodology that combines the Adaptive with machine learning and statistical models such as:

- 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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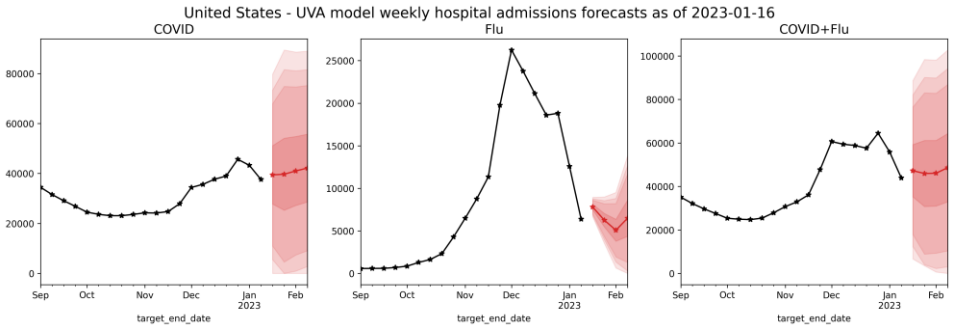
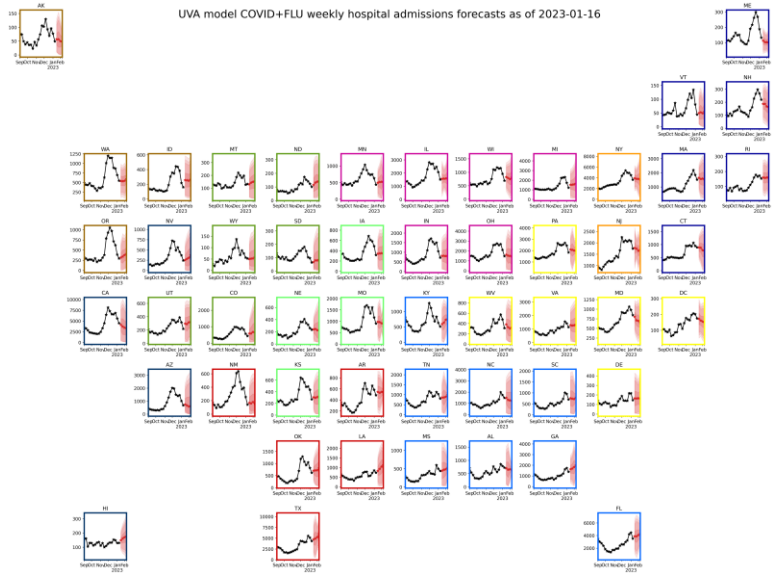
Combined ILI and COVID-19 Hospitalizations

National

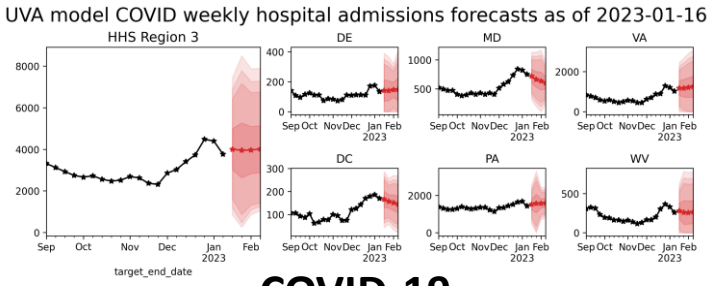
Short-term COVID-19 and Influenza Forecasts



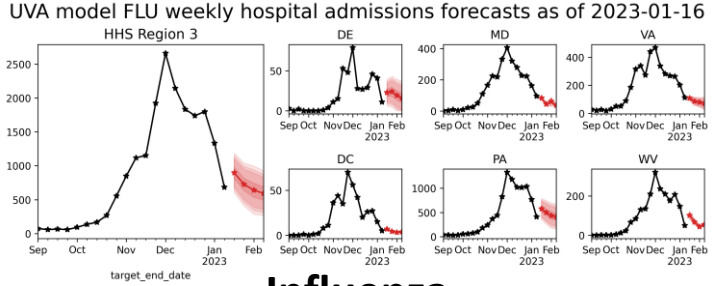


HHS Region 3

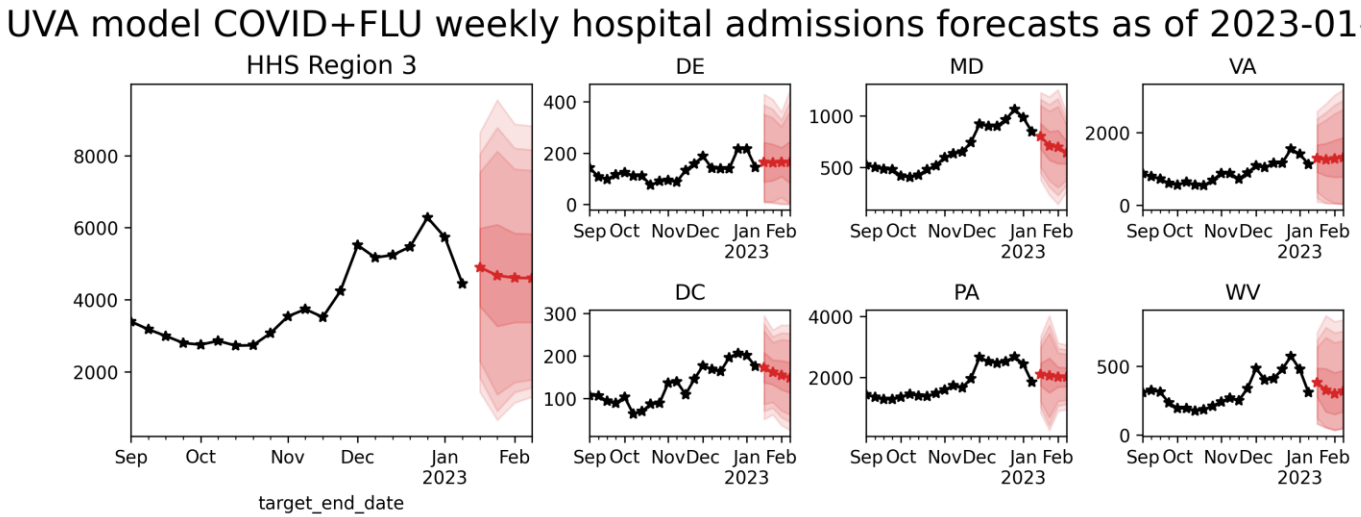
Short-term COVID-19 and Influenza Forecasts



COVID-19



Influenza



COVID-19 and Influenza

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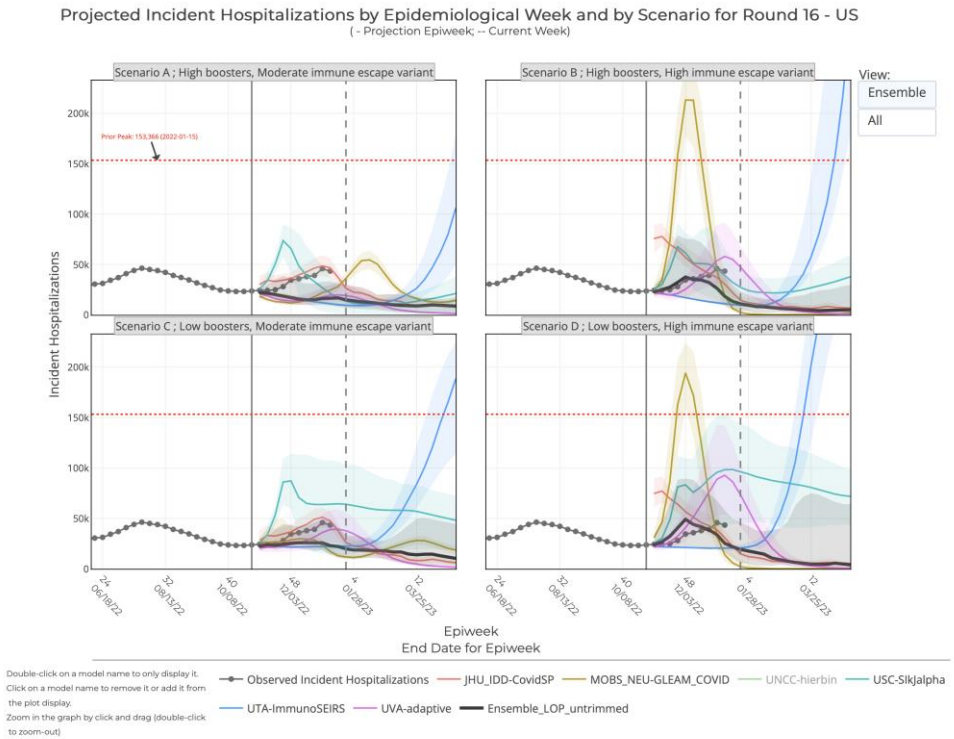
Scenario Modeling Hub – COVID-19 (Round 16)

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

https://covid19scenariomodelinghub.org/viz.html

	"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 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	"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 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	"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 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)	"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 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)



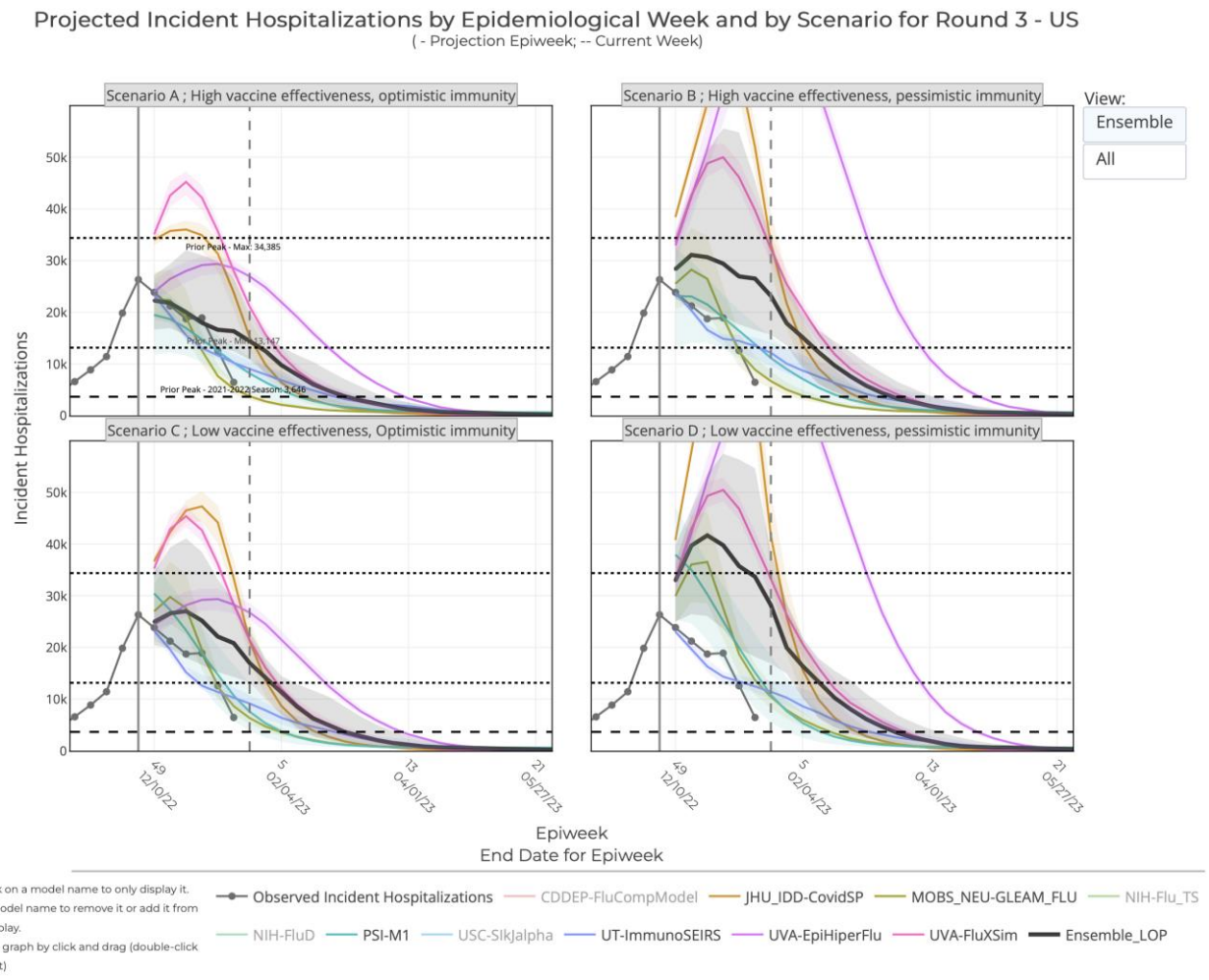
Scenario Modeling Hub – Influenza (Round 3)

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



Scenario Modeling Hub – Influenza
(UVA Update to Round 3)

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

- Update with more data (until Jan 7th)
- No scenarios seem to fully explain season's trajectory

	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).
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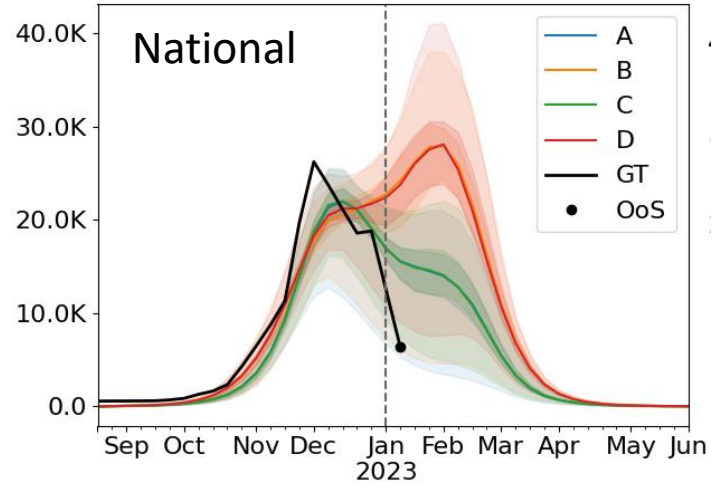

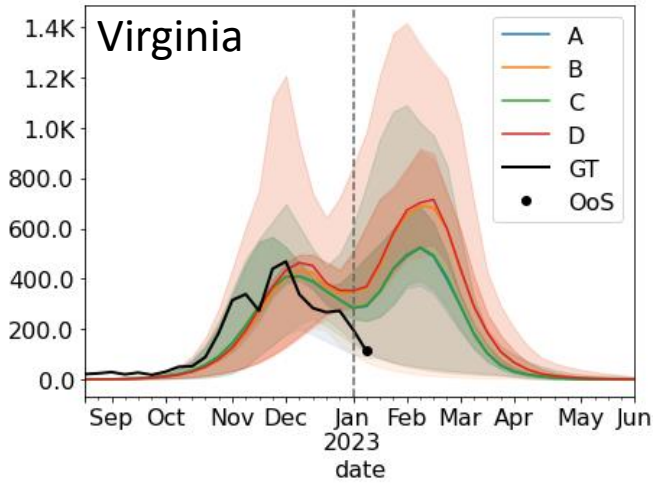

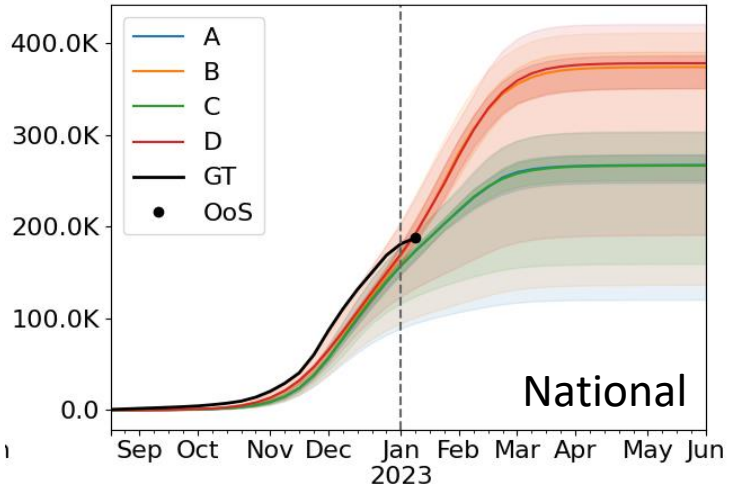

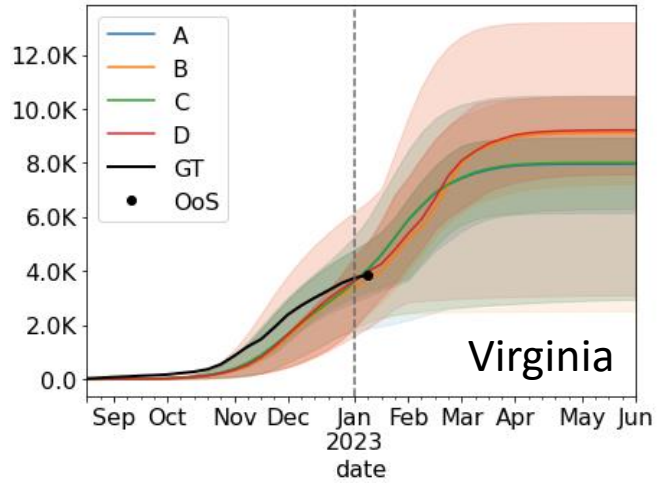

Key Takeaways

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

- Case rates and hospitalizations from COVID-19 are on the decline with some activity in isolated areas
- Case rates and hospitalizations from Influenza are also on the decline

- Model Updates
  - Projection model from Dec 9th remains roughly on track with current trajectory, however, the recent decline is occurring earlier than anticipated by the model
  - COVID-19 forecast models call for a plateau, with potential for rising hospital admission in the coming month
  - Influenza forecast models call for declines in Influenza hospital admissions to continue

Questions?

Points of Contact

Bryan Lewis
brylew@virginia.edu

Srini Venkatramanan
srini@virginia.edu

Madhav Marathe
marathe@virginia.edu

Chris Barrett
ChrisBarrett@virginia.edu

Biocomplexity COVID-19 Response Team

Aniruddha Adiga, Abhijin Adiga, Hannah Baek, Chris Barrett, Golda Barrow, Richard Beckman, Parantapa Bhattacharya, Jiangzhuo Chen, Clark Cucinell, Patrick Corbett, Allan Dickerman, Stephen Eubank, Stefan Hoops, Ben Hurt, Ron Kenyon, Brian Klahn, Bryan Lewis, Dustin Machi, Chunhong Mao, Achla Marathe, Madhav Marathe, Henning Mortveit, Mark Orr, Joseph Outten, Akhil Peddireddy, Przemyslaw Porebski, Erin Raymond, Jose Bayoan Santiago Calderon, James Schlitt, Samarth Swarup, Alex Telionis, Srinivasan Venkatramanan, Anil Vullikanti, James Walke, Andrew Warren, Amanda Wilson, Dawen Xie