Network Systems Science & Advanced Computing

Biocomplexity Institute & Initiative

University of Virginia

Estimation of COVID-19 Impact in Virginia

December 7th, 2022

data current to December 3rd – 6th

Biocomplexity Institute Technical report: TR BI-2022-1889

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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

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Overview

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

Key Takeaways

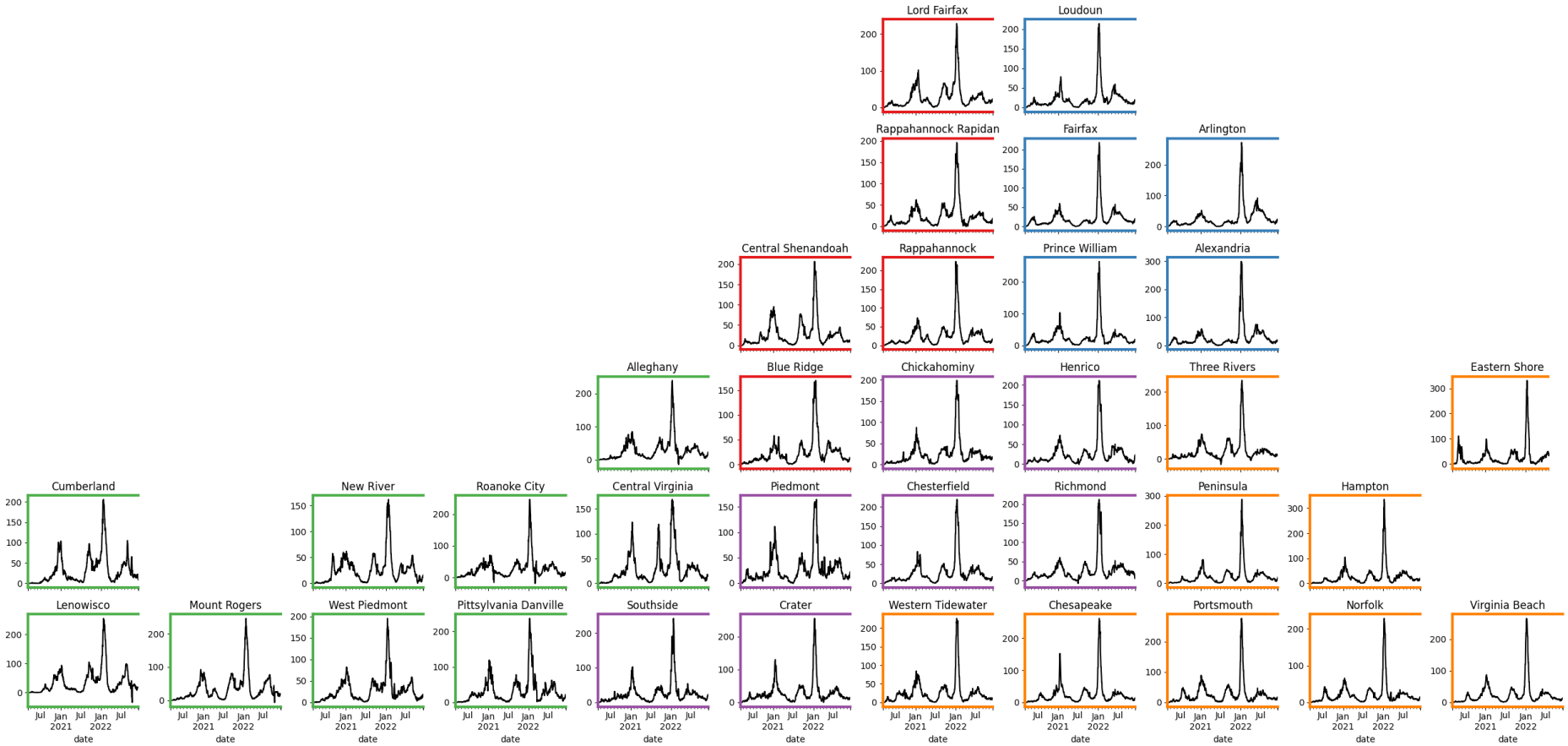
Projecting future cases precisely is impossible and unnecessary.
Even without perfect projections, we can confidently draw conclusions:

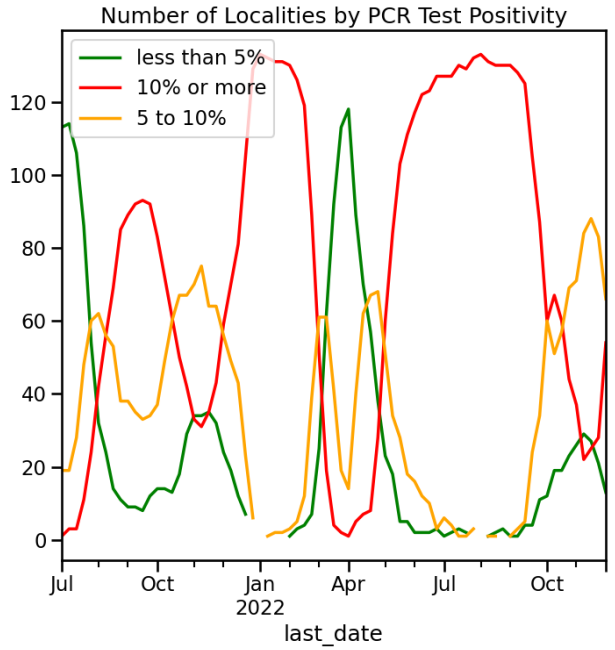
- **Case rates have continued to decline though hospitalizations have shown some recent growth**
- VA weekly case rate is slightly down at 81 per 100K from 84 per 100K
  - US weekly case rate is flat remaining at 74 per 100K from 74 per 100K
  - VA hospital occupancy (rolling 7 day mean of 455 slightly down from 482 a week ago) down but experiencing recent activity
- Sub-variant prevalence has started to grow rapidly, BA.5 subvariants seem to be accelerating
- Projections from last week remain largely on target with limited impact of Fall Winter scenario, however hospitalization trajectories

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

Situation Assessment

Case Rates (per 100k) and Test Positivity





County level RT-PCR test positivity

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

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

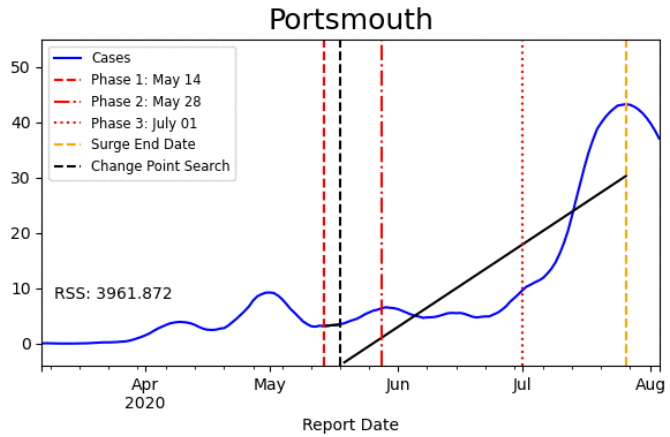
Red: >10.0% (and not "Green" or "Yellow")

District Trajectories

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

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

Hockey stick fit

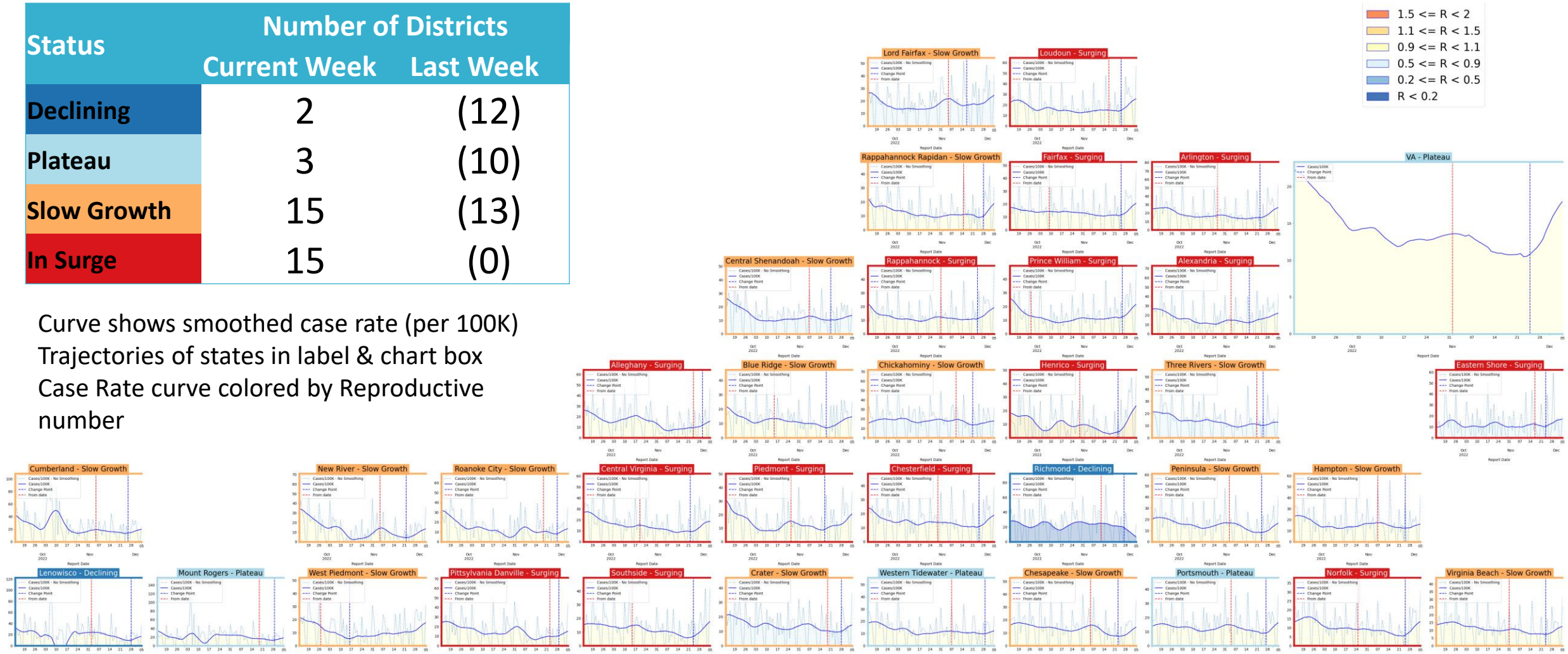


Trajectory	Description	Weekly Case Rate Slope (per 100k)	Weekly Hosp Rate Slope (per 100k)
Declining	Sustained decreases following a recent peak	slope < -0.88/day	slope < -0.07/day
Plateau	Steady level with minimal trend up or down	-0.88/day < slope < 0.42/day	-0.07/day < slope < 0.07/day
Slow Growth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

District Case Trajectories – last 10 weeks

Status	Number of Districts	
	Current Week	Last Week
Declining	2	(12)
Plateau	3	(10)
Slow Growth	15	(13)
In Surge	15	(0)

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

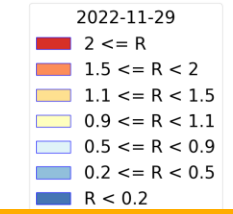


District Hospital Trajectories – last 10 weeks

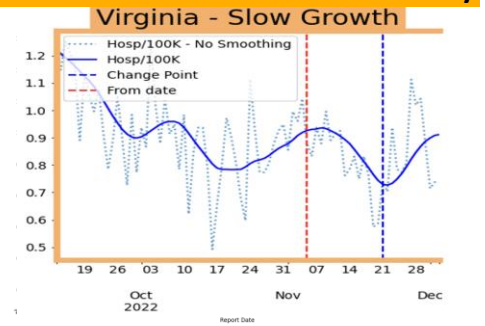
Status	Number of Districts	
	Current Week	Last Week
Declining	23	(18)
Plateau	5	(12)
Slow Growth	7	(4)
In Surge	0	(1)

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

November 29th



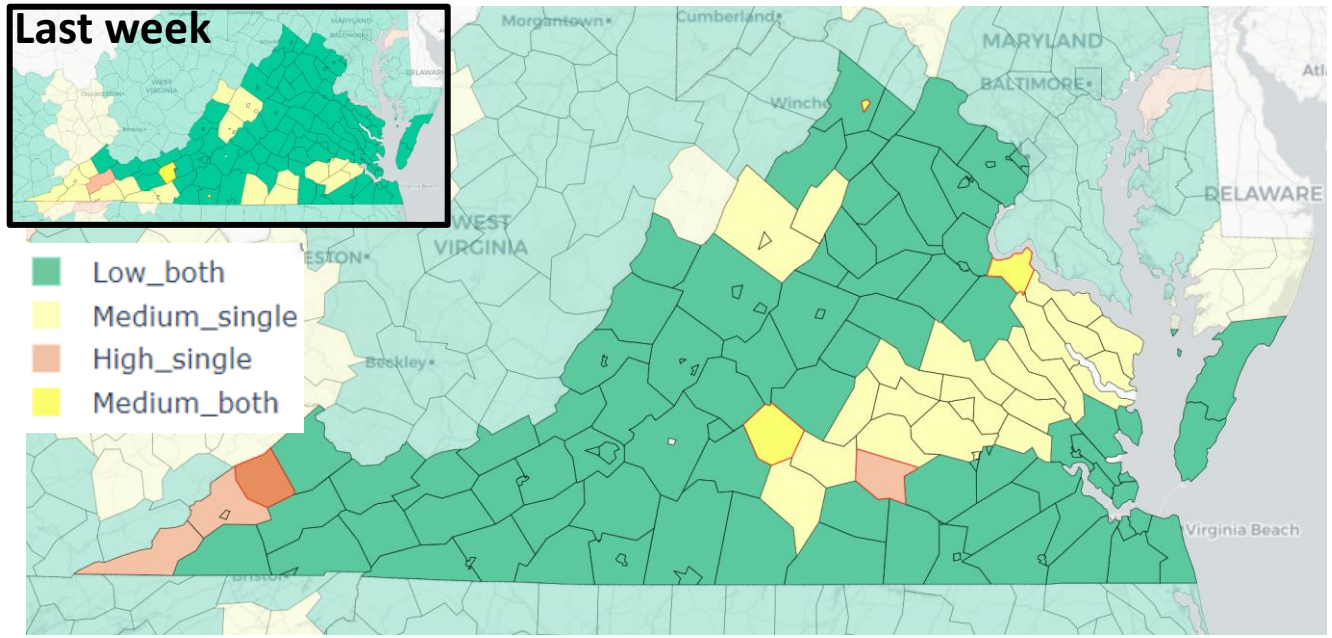
State level without delay



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

Hosp rate curve colored by Re number

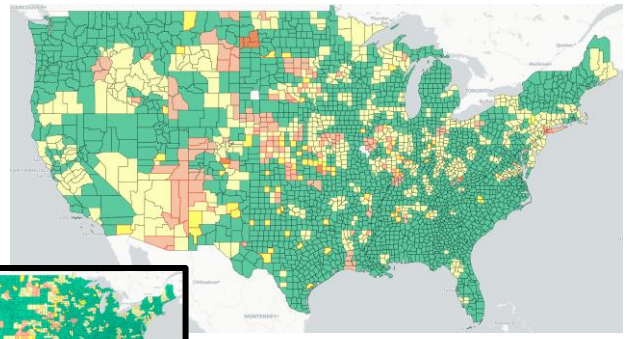
CDC's COVID-19 Community Levels

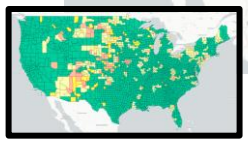


Red outline indicates county had 200 or more cases per 100k in last week

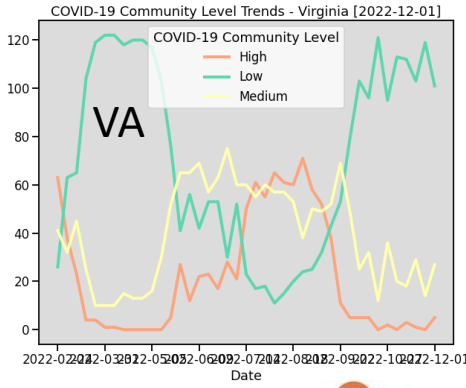
Pale color indicates either beds or occupancy set the level for this county

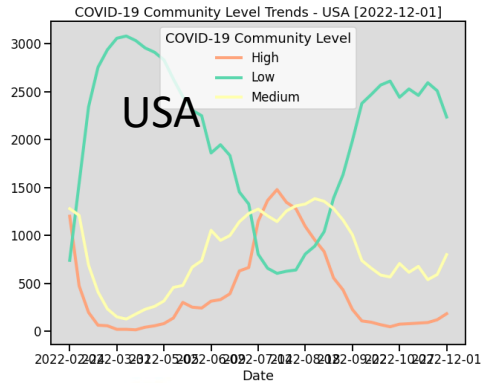
Dark color indicates both beds and occupancy set the level for this county





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

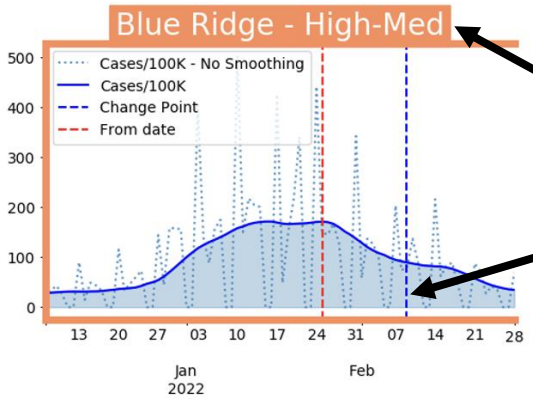
Data from: [CDC Data Tracker Portal]

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

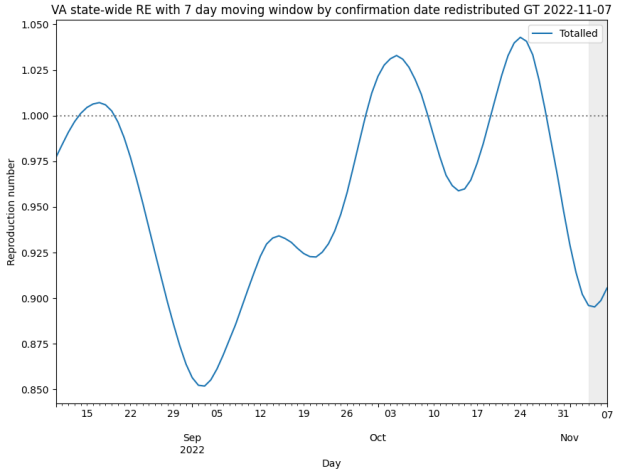
Aggregate level a simple mean of all levels for counties in district

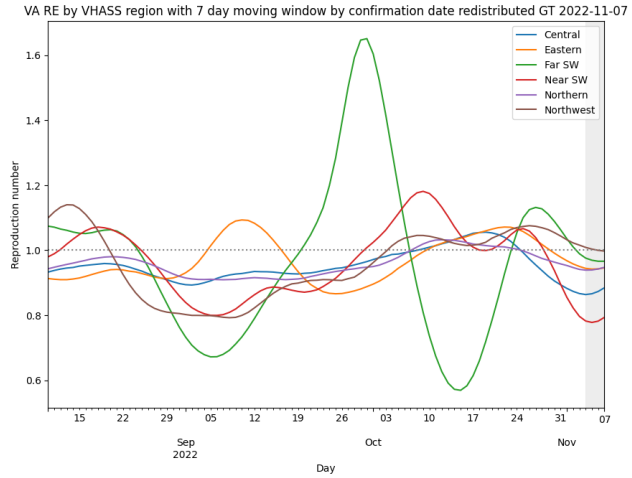
Case rate Trajectory

Estimating Daily Reproductive Number –
Redistributed gap

December 5th Estimates

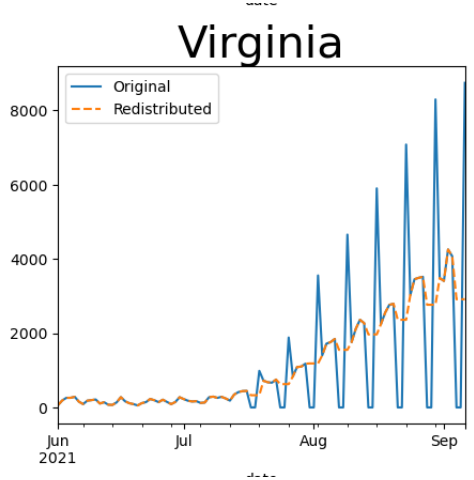
Region	Date Confirmed R_e	Date Confirmed Diff Last Week
State-wide	1.067	0.066
Central	1.043	0.030
Eastern	1.104	0.080
Far SW	1.088	0.325
Near SW	1.105	0.032
Northern	1.085	0.078
Northwest	0.995	0.053





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 **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

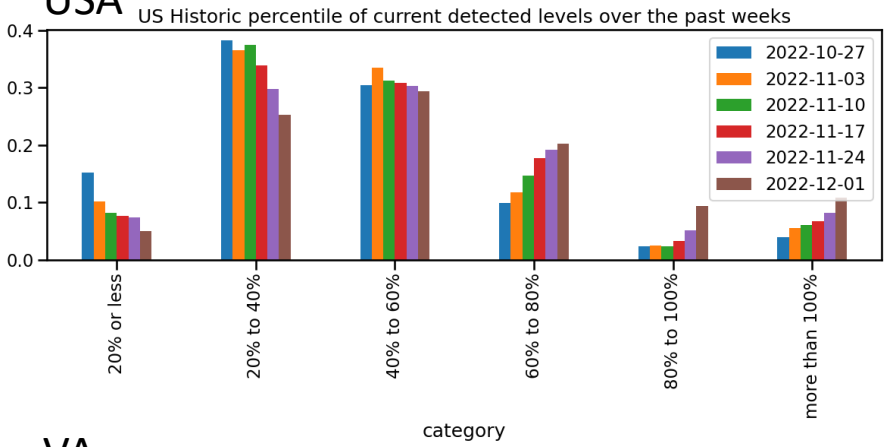
1. Anne Cori, Neil M. Ferguson, Christophe Fraser, Simon Cauchemez. A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics. American Journal of Epidemiology, Volume 178, Issue 9, 1 November 2013, Pages 1505–1512, https://doi.org/10.1093/aje/kwt133

Wastewater Monitoring

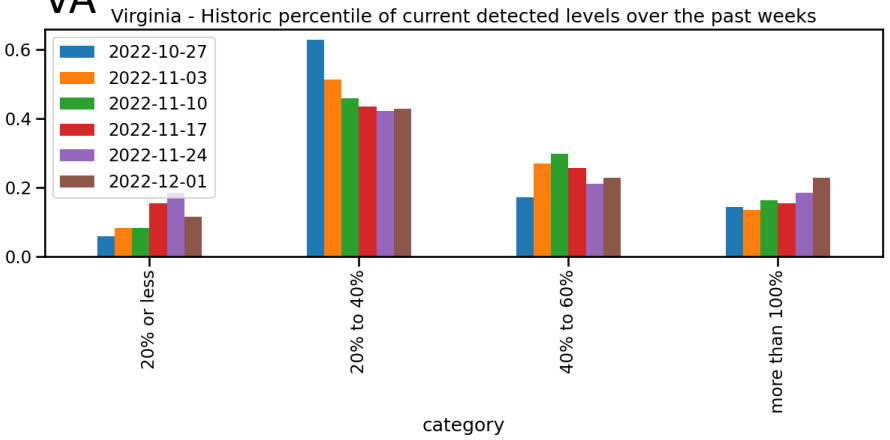
Wastewater provides a coarse early warning of COVID-19 levels in communities

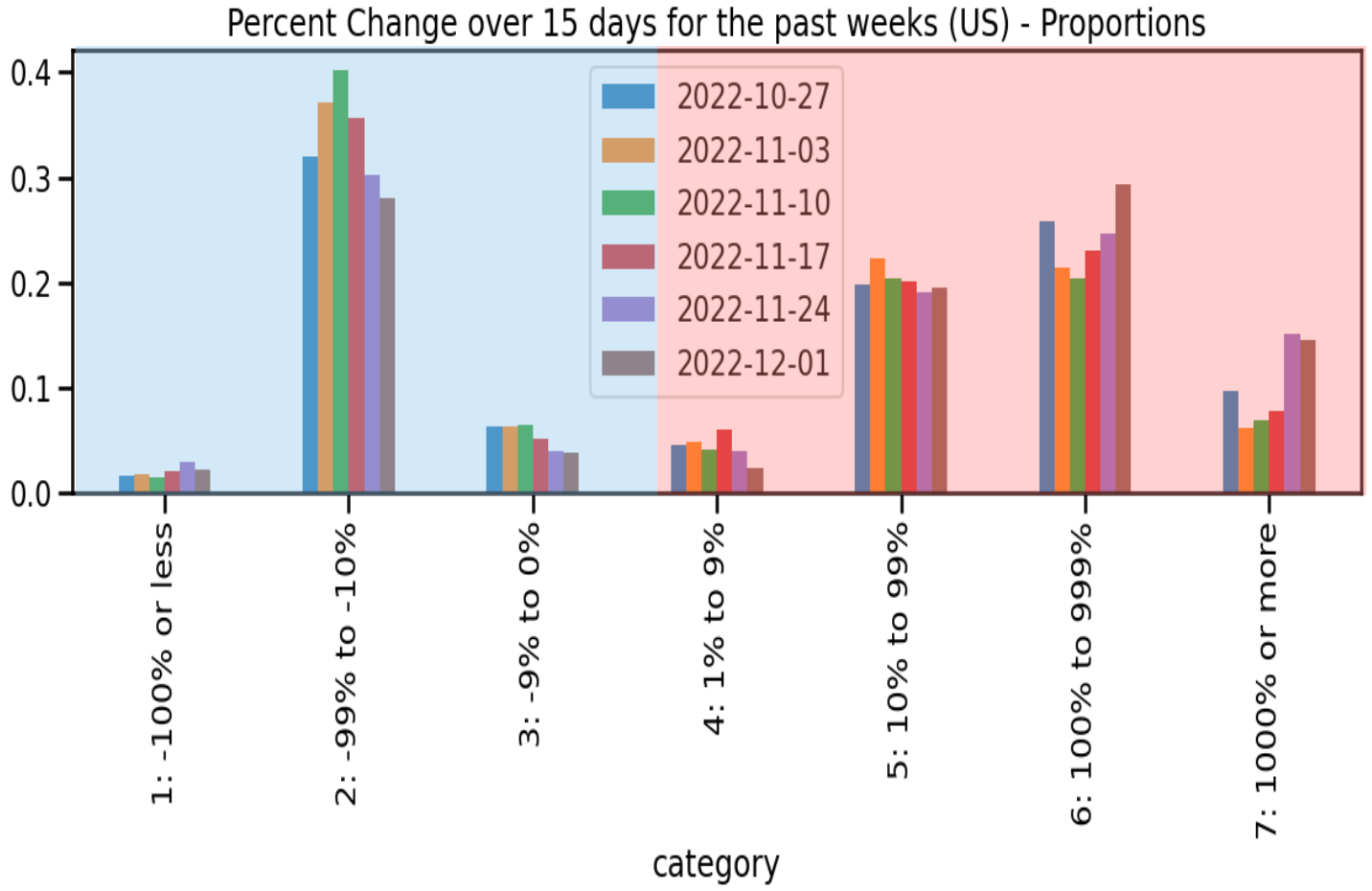
- Overall in the US, there is an increase in sites with increased levels of virus compared to 15 days ago
- Current virus levels are at or exceeding max of previous historical levels, has slowed, though more sites are entering upper quintiles

USA



VA



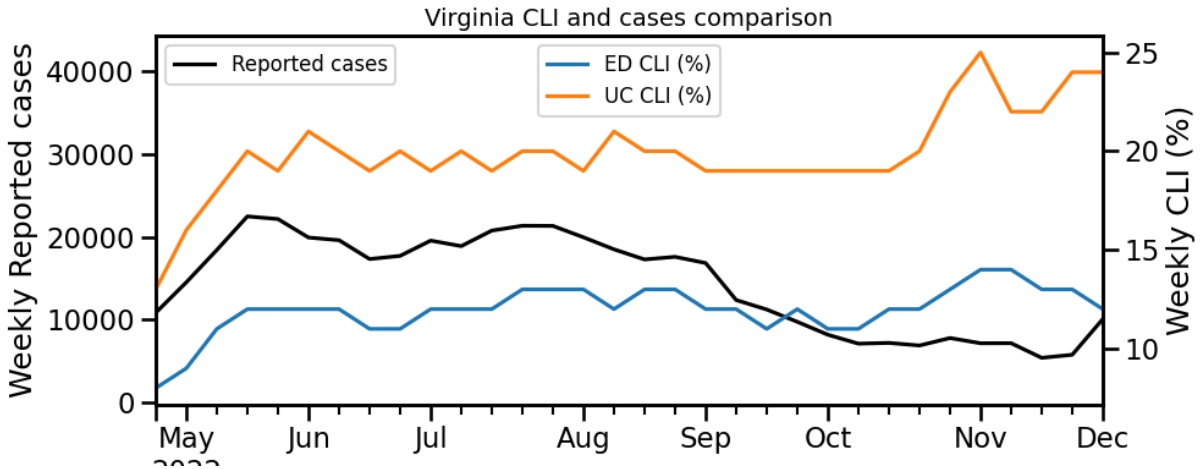


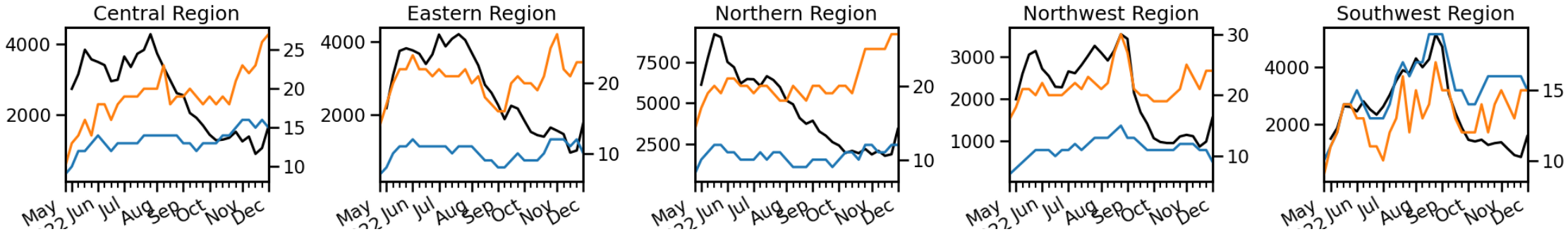
Data Source: [CDC Data Tracker]

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 prone to some false positives
- **Current trends in UC CLI are higher statewide and most regions than seen in previous 6 months**



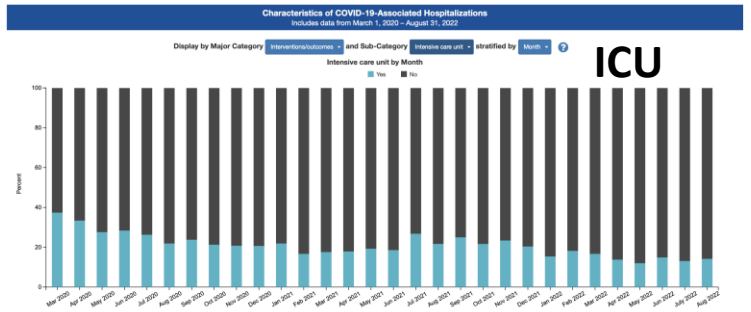


Hospitalizations and Severe Outcomes

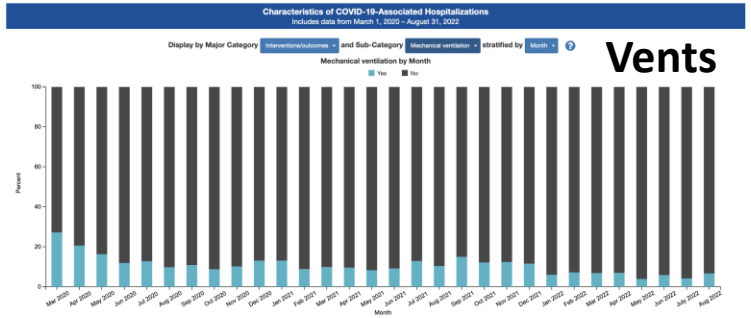
Data Source: [CDC Data Tracker]

Proportion of most severe outcomes decreasing among those who are hospitalized

- ICU has declined from ~20% of hospitalized to nearly 10% since initial Omicron wave
- Also seen across all age-groups
- Similar levels of decline seen in VA
- Regionally more variation

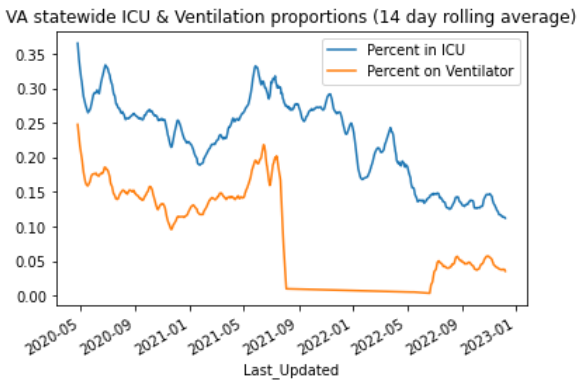


ICU

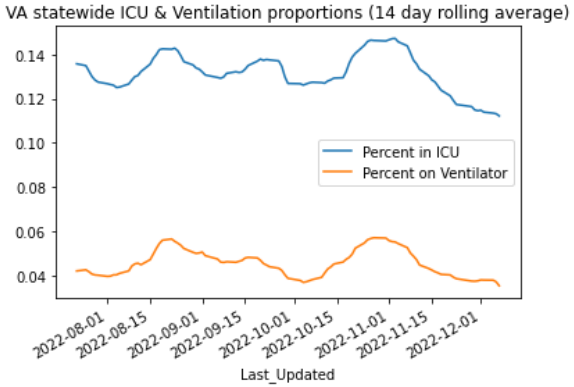


Vents

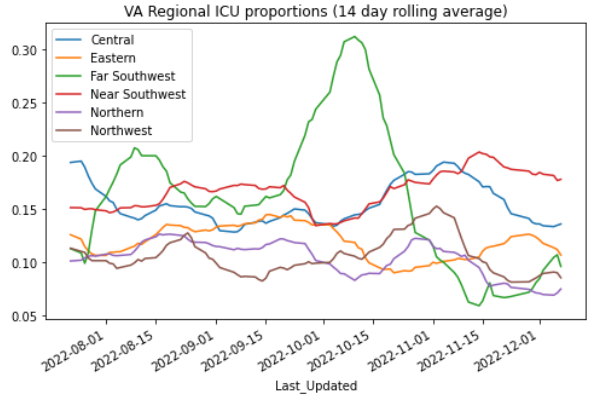
Virginia wide – full pandemic



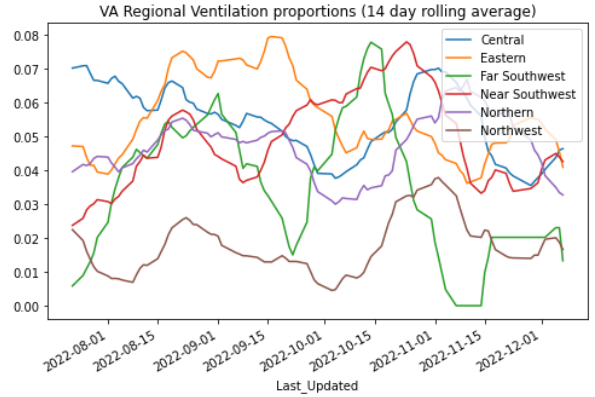
Virginia wide – recent



Virginia Regional ICU percent



Virginia Regional Ventilation %



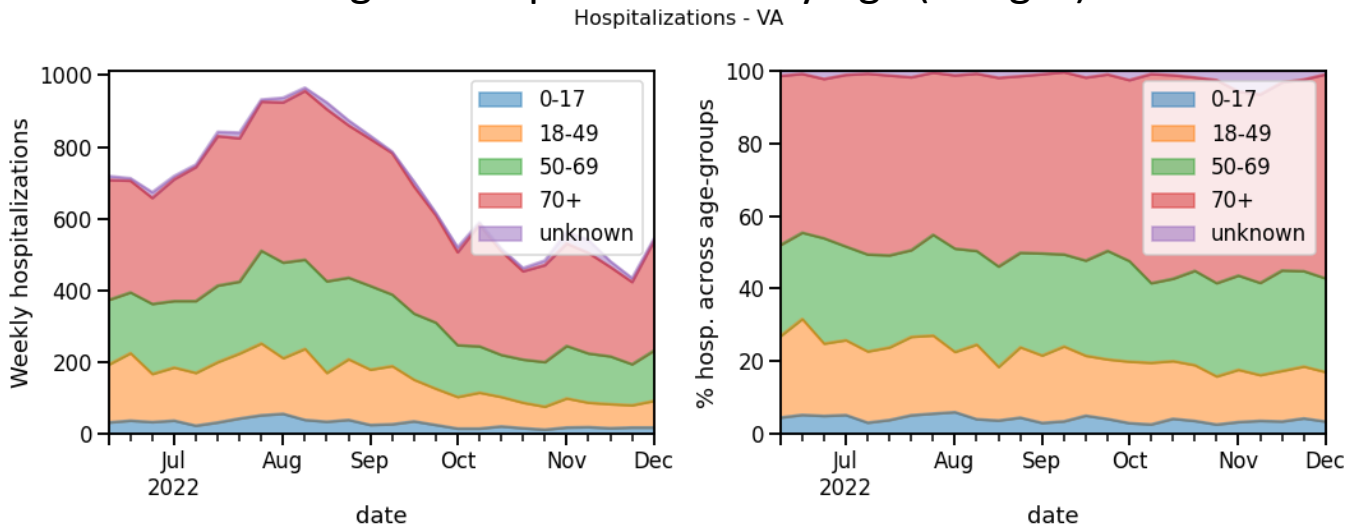
Hospitalizations in VA by Age

Age distribution in hospitals relatively stable

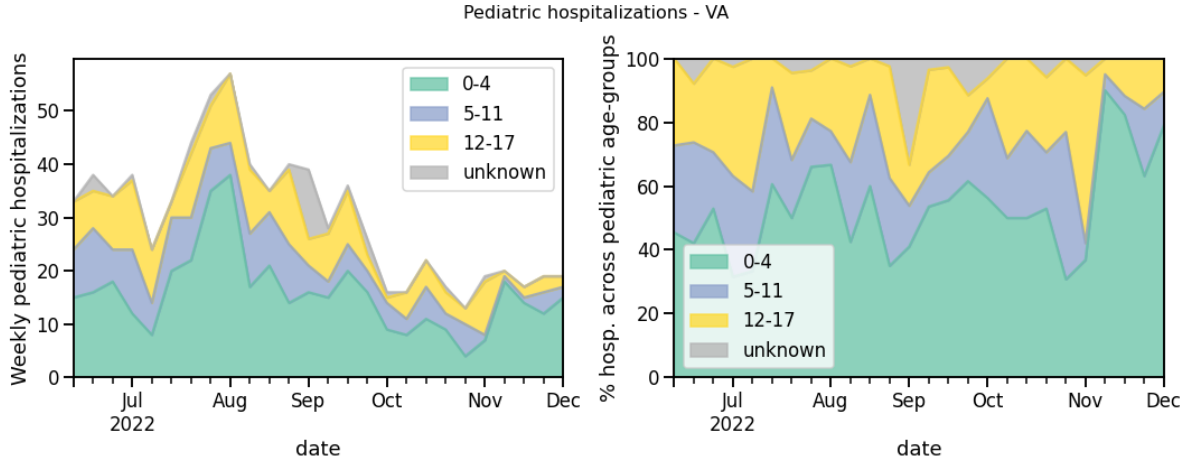
- Recent change in pediatric hospitalizations, though not higher than in previous months

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

Virginia Hospitalizations by Age (all ages)



Pediatric Hospitalizations by Age (0-17yo)

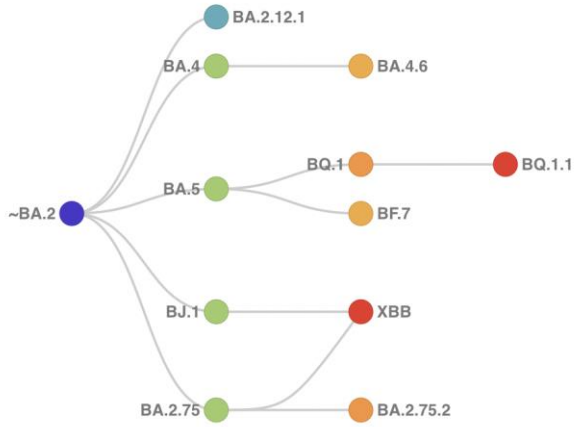


Data Source: Delphi and HHS

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



Omicron Updates

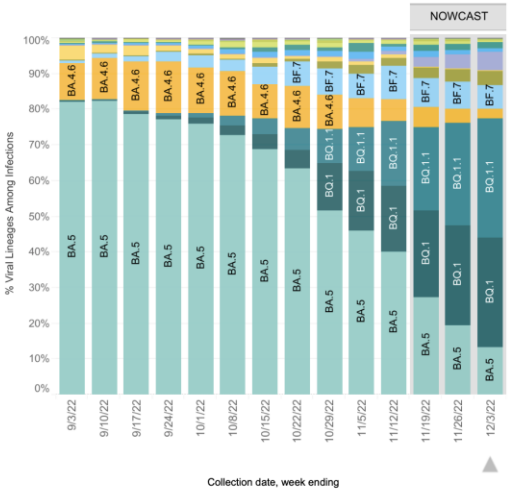
- BQ.1 and BQ.1.1 continue to dominate at 31% and 34% respecitively
- BA.2.75.* family variants (includes BN.1) remain stead at nearly a 6%
- BF.7 and BA.4.6 have been slowly shrinking to 7% and 3%
- BA.5.2.6 and BN.1 are now broken out by CDC nowcast, and account for relatively smaller shares (2% and 4% respectively)
- XBB and subvariants have started grown, now at 5% (up from 2%)

HHS Region 3: 11/27/2022 – 12/3/2022 NOWCAST

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

WHO label	Lineage #	US Class	%Total	95%PI
Omicron	BQ.1.1	VOC	33.5%	28.8-38.6%
	BQ.1	VOC	30.6%	27.7-33.6%
	BA.5	VOC	13.4%	11.5-15.5%
	BF.7	VOC	6.5%	5.2-8.1%
	XBB	VOC	5.2%	2.4-10.3%
	BN.1	VOC	4.2%	2.8-6.1%
	BA.4.6	VOC	2.7%	2.3-3.3%
	BA.5.2.6	VOC	1.5%	1.1-2.2%
	BF.11	VOC	1.1%	0.9-1.4%
	BA.2.75	VOC	0.6%	0.4-0.8%
	BA.2.75.2	VOC	0.4%	0.2-0.6%
	BA.2	VOC	0.3%	0.2-0.5%
	BA.4	VOC	0.0%	0.0-0.0%
	B.1.1.529	VOC	0.0%	0.0-0.0%
	BA.1.1	VOC	0.0%	0.0-0.0%
	BA.2.12.1	VOC	0.0%	0.0-0.0%
Delta	B.1.617.2	VBM	0.0%	0.0-0.0%
Other	Other*		0.0%	0.0-0.1%

HHS Region 3: 8/28/2022 – 12/3/2022



* 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. For all the lineages listed in the above table, their sublineages are aggregated to the listed parental lineages respectively. Previously, XBB was aggregated with other. Lineages BA.2.75.2, XBB, BN.1, BA.4.6, BF.7, BF.11, BA.5.2.6 and BQ.1.1 contain the spike substitution R346T.

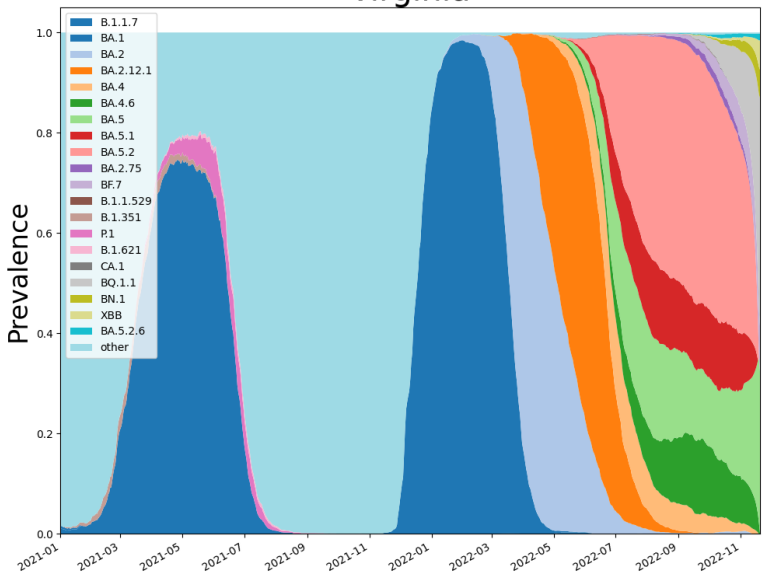
CDC Variant Tracking

SARS-CoV2 Omicron Sub-Variants

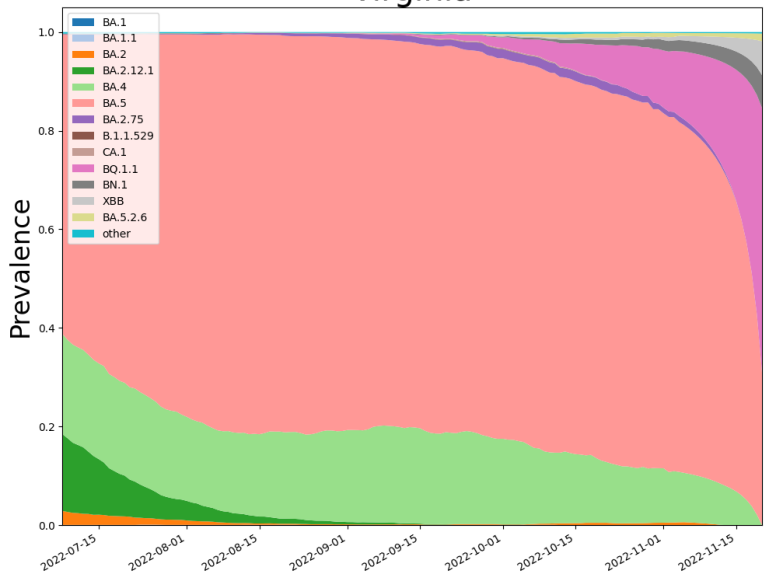
covSPECTRUM
Enabled by data from GISAID

As detected in whole Genomes in public repositories

Virginia

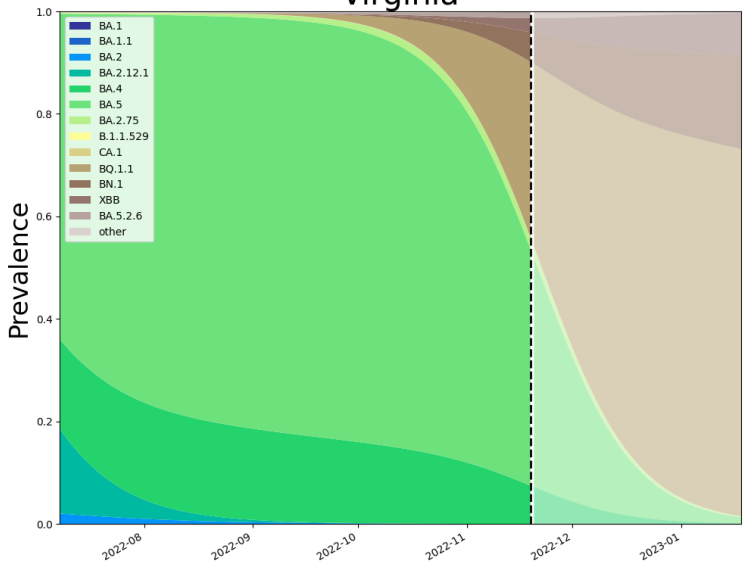


Virginia

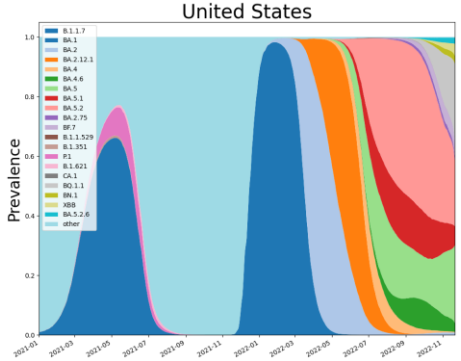


VoC Polynomial Fit Projections

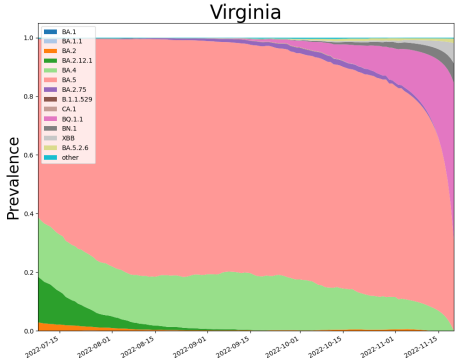
Virginia



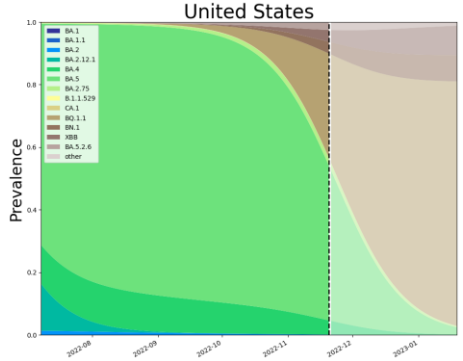
United States



Virginia



United States



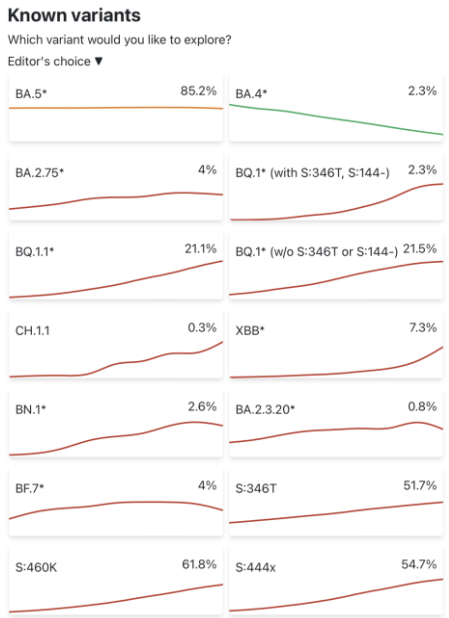
Note: Data lags force projections to start in past. Everything from dotted line forward is a projection.

SARS-CoV2 Omicron Sub-Variants

[COV-spectrum](#)

"Editor's choice"

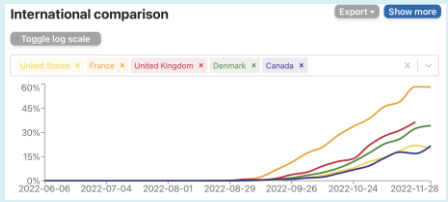
Variants to watch

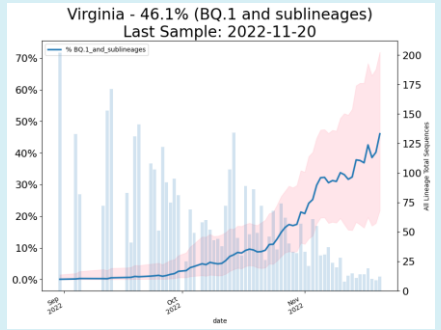


covSPECTRUM

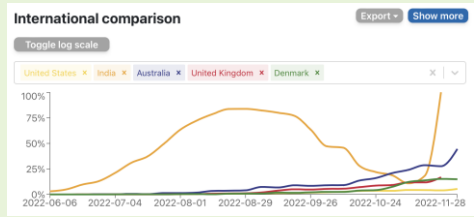
Enabled by data from GISAID

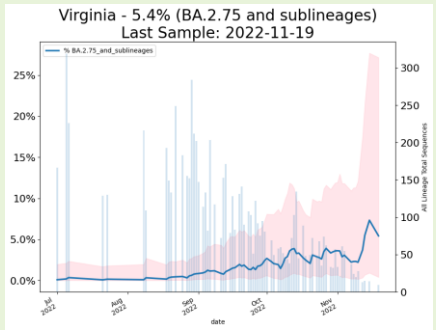
BQ.1.*



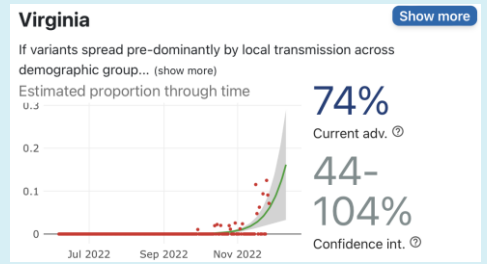


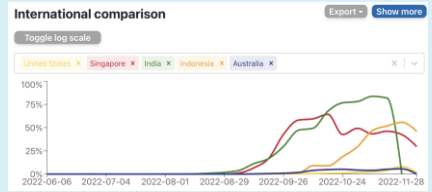
BA.2.75.*

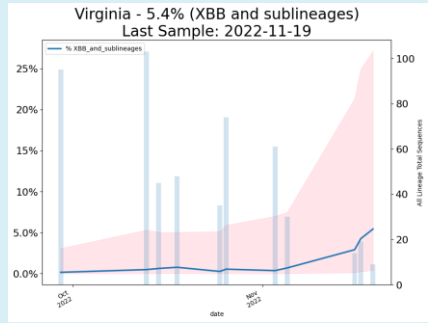




XBB*







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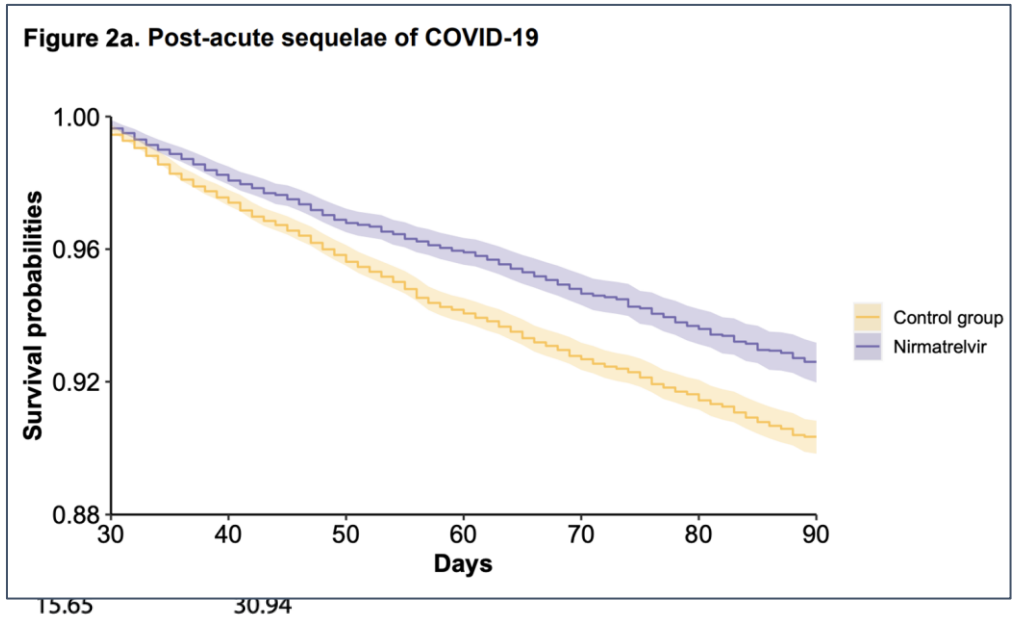
Pandemic Pubs (Dec 7th, 2022)

1. Recent studies highlight the benefit of Paxlovid in reduction of risk associated with hospitalization and long term symptoms

TABLE 2. Adjusted hazard ratios for COVID-19–associated hospitalization based on Paxlovid prescription receipt (exposure) — Cosmos,* United States, April–September 2022

Characteristic	Adjusted HR (95% CI)†	No. of participants	No. hospitalized	Events per 100,000 person-days		
				Overall	Exposed§	Unexposed§
Total	**0.49 (0.46–0.53)**	**693,084**	**5,229**	**25.31**	**15.88**	**29.05**
COVID-19 vaccination status¶						
Vaccinated (≥3 mRNA doses)	**0.50 (0.45–0.55)**	310,196	2,126	**22.98**		
Vaccinated (2 mRNA doses)	**0.50 (0.42–0.58)**	149,498	1,086	**24.37**		
Unvaccinated	**0.50 (0.43–0.59)**	170,789	1,477	**29.05**		
UHC**						
0	**0.89 (0.58–1.36)**	52,592	106	**6.73**		
1	**0.57 (0.45–0.71)**	200,116	503	**8.40**		
≥2	**0.47 (0.44–0.51)**	440,376	4,620	**35.29**		
Previous infection††						
No	**0.48 (0.44–0.51)**	589,147	4,715	**26.86**		
Yes	**0.76 (0.60–0.98)**	103,937	514	**16.56**		
Immunocompromised§§						
No	**0.49 (0.45–0.53)**	628,706	3,770	**20.09**		
Yes	**0.50 (0.44–0.58)**	64,378	1,459	**77.01**		
Month of COVID-19 diagnosis						
Apr 2022	**0.54 (0.40–0.71)**	60,001	450	**25.16**		
May 2022	**0.57 (0.48–0.67)**	139,062	979	**23.61**		
Jun 2022	**0.51 (0.43–0.60)**	143,706	1,006	**23.48**		
Jul 2022	**0.46 (0.40–0.53)**	184,153	1,432	**26.09**	15.65	30.94
Aug 2022	**0.44 (0.38–0.51)**	166,162	1,362	**27.52**	15.60	32.93



Two recent studies:

1) Researchers at the CDC found that **"persons who were prescribed Paxlovid within 5 days of diagnosis had a 51% lower hospitalization rate within 30 days after diagnosis than those who were not prescribed Paxlovid".**

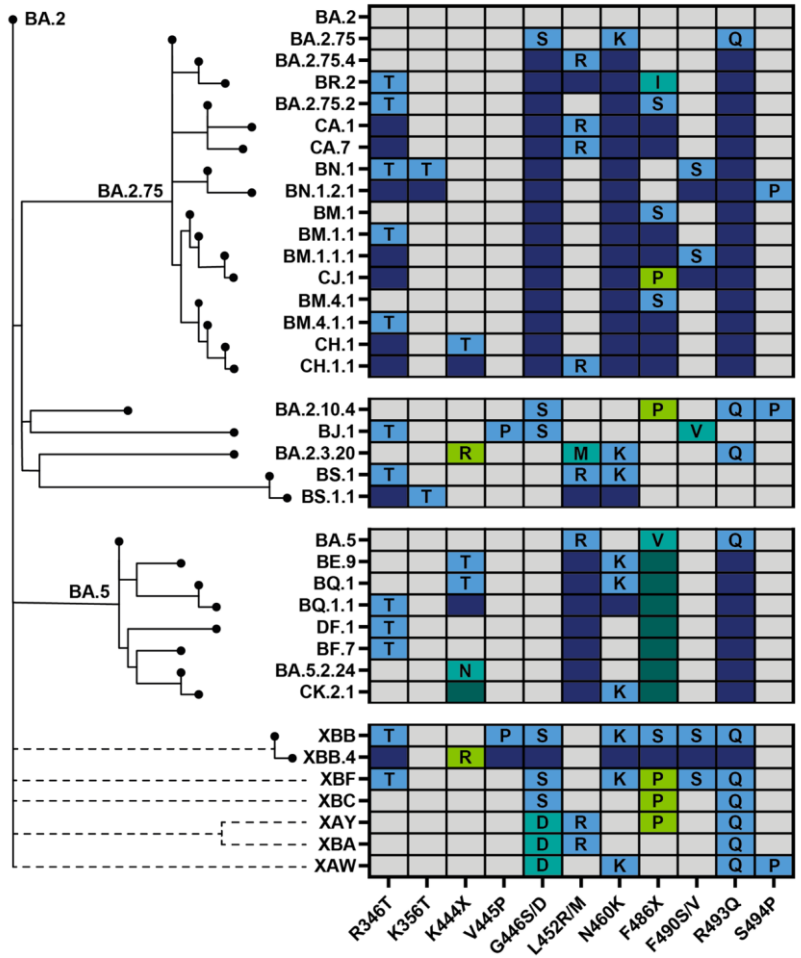
2) Researchers at Veterans Research and Education Foundation used the healthcare databases of the US Department of Veterans Affairs to identify users of the health system who had a SARS-CoV-2 positive test between March 01, 2022 and June 30, 2022, were not hospitalized on the day of the positive test, had at least 1 risk factor for progression to severe COVID-19 illness and survived the first 30 days after SARS-CoV-2 diagnosis. Compared to the control group, **treatment was associated with reduced risk of PASC (HR 0.74 95% CI (0.69, 0.81), including reduced risk of sequelae in the cardiovascular system**

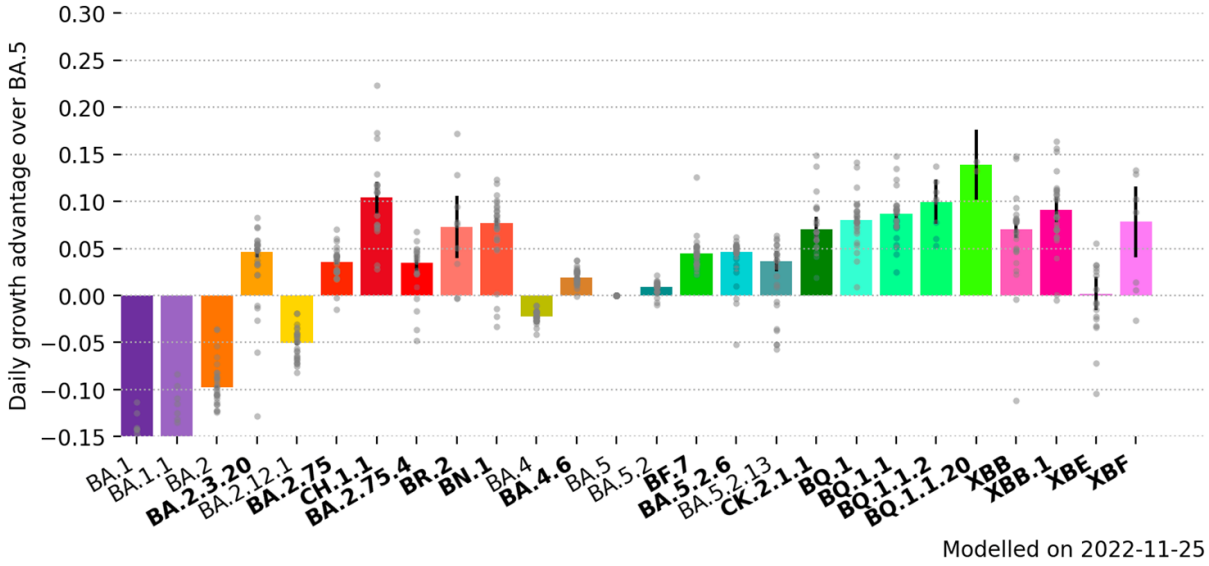
https://www.medrxiv.org/content/10.1101/2022.11.03.22281783v1

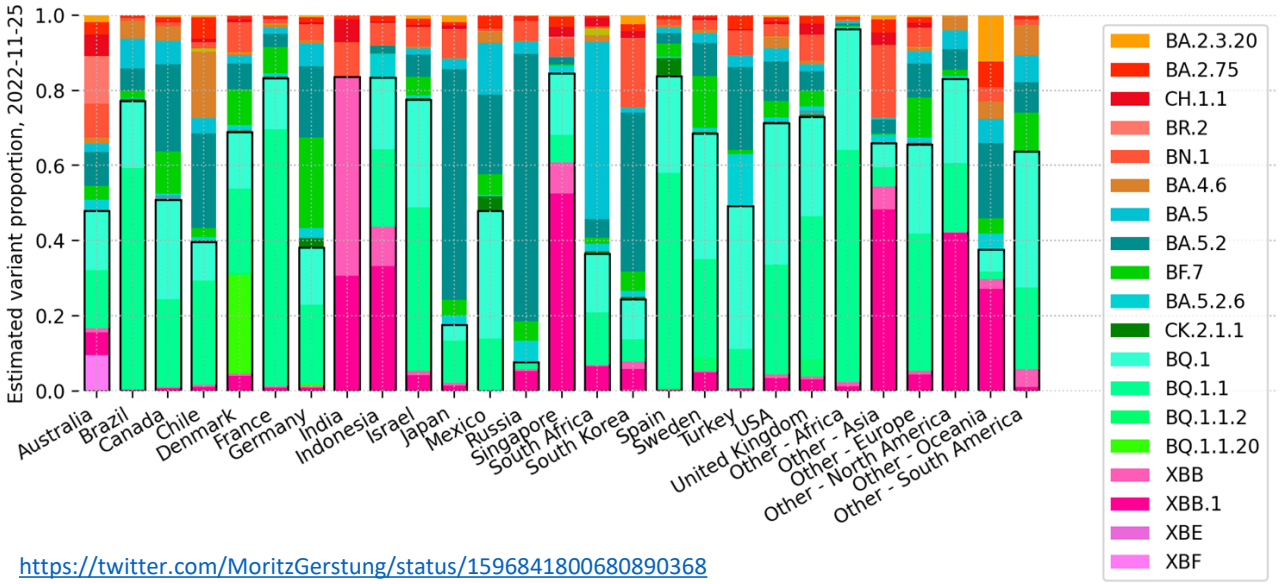
https://www.cdc.gov/mmwr/volumes/71/wr/mm7148e2.htm?s_cid=mm7148e2_w

Pandemic Pubs (Nov 29th, 2022)

1. SARS-CoV-2 surveillance yields both long phylogenetic branch lengths and ladder-like mutational patterns, implicating both chronic infection and antigenic drift as likely contributors to fitness, resulting in multiple, potentially antigenically distinct lineages





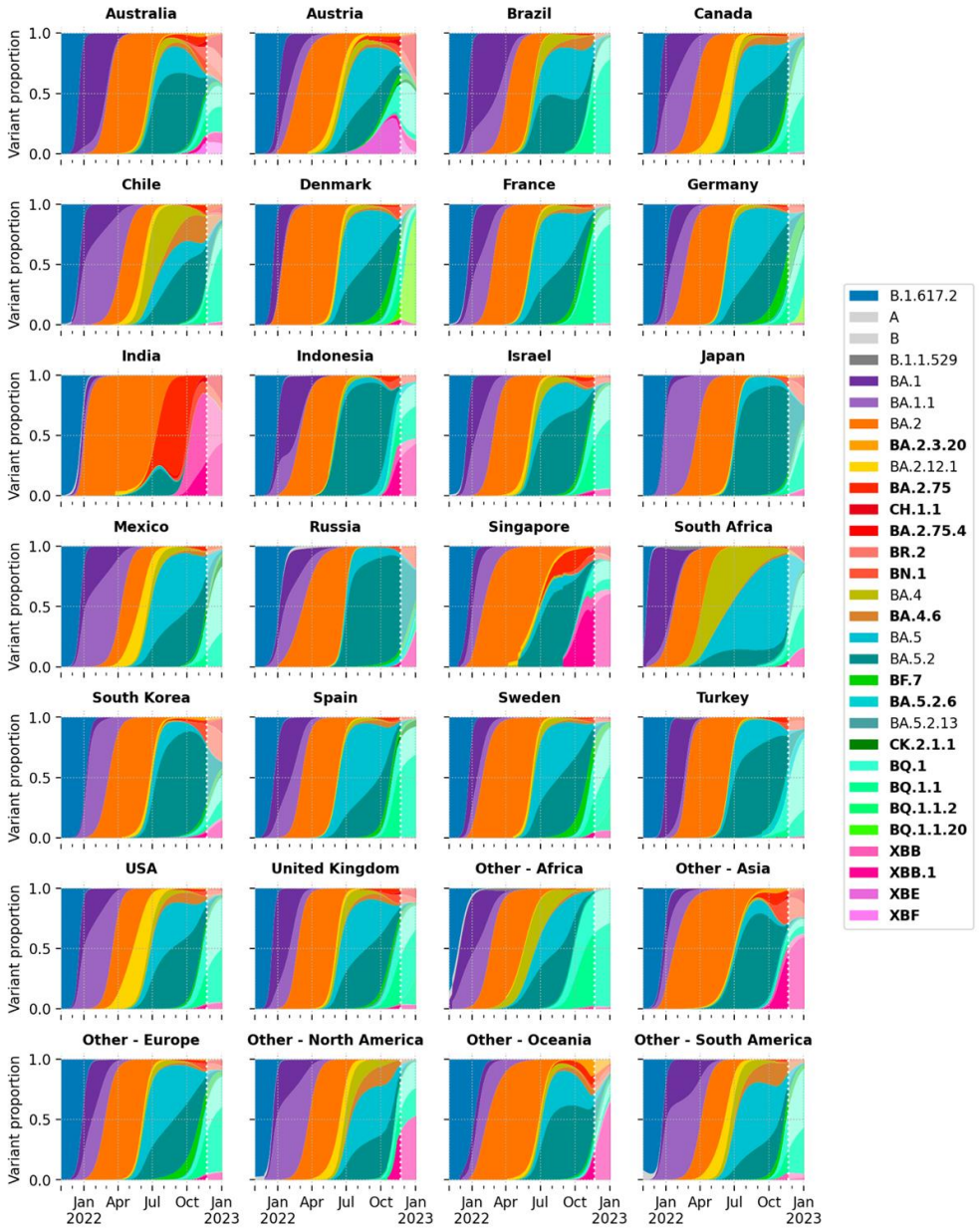


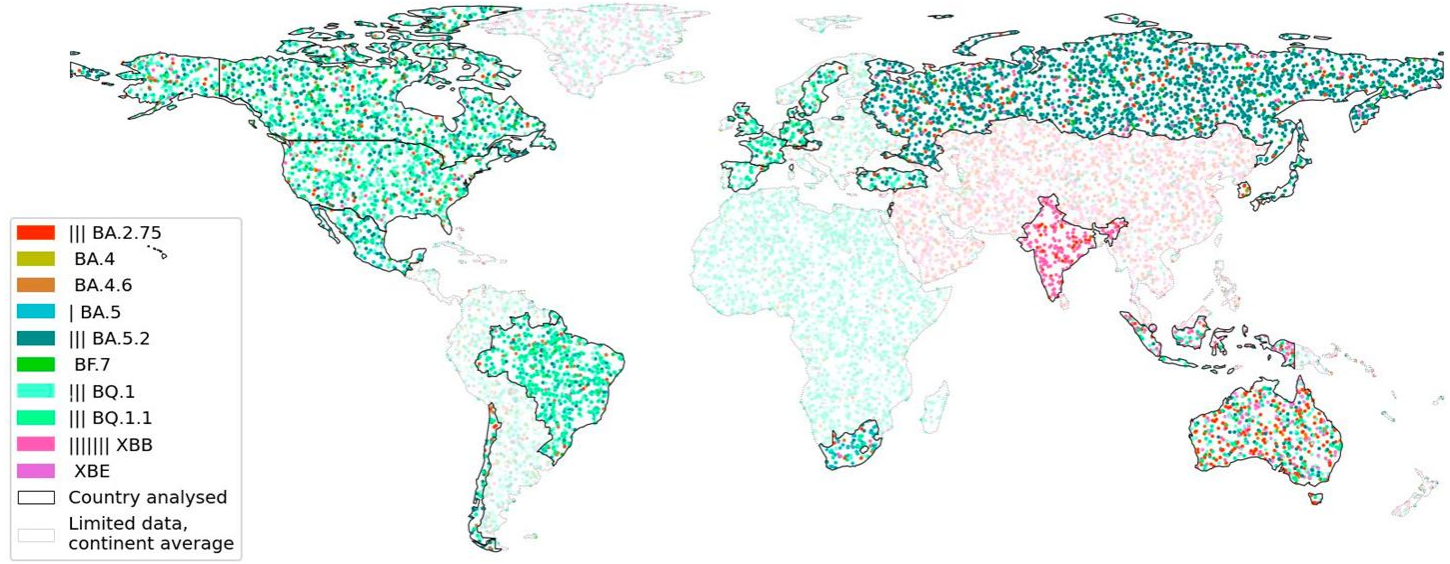
Authors from multiple countries highlight continued evidence that SARS-CoV-2 continues to diversify combinations of antigenically relevant mutations. **Authors raise the possibility that "several lineages could have similar enough growth rates, and enough antigenic distance from one another that they co-circulate, at least until a fitter lineage or variant emerges".**
https://virological.org/t/sars-cov-2-evolution-post-omicron/911#post_1

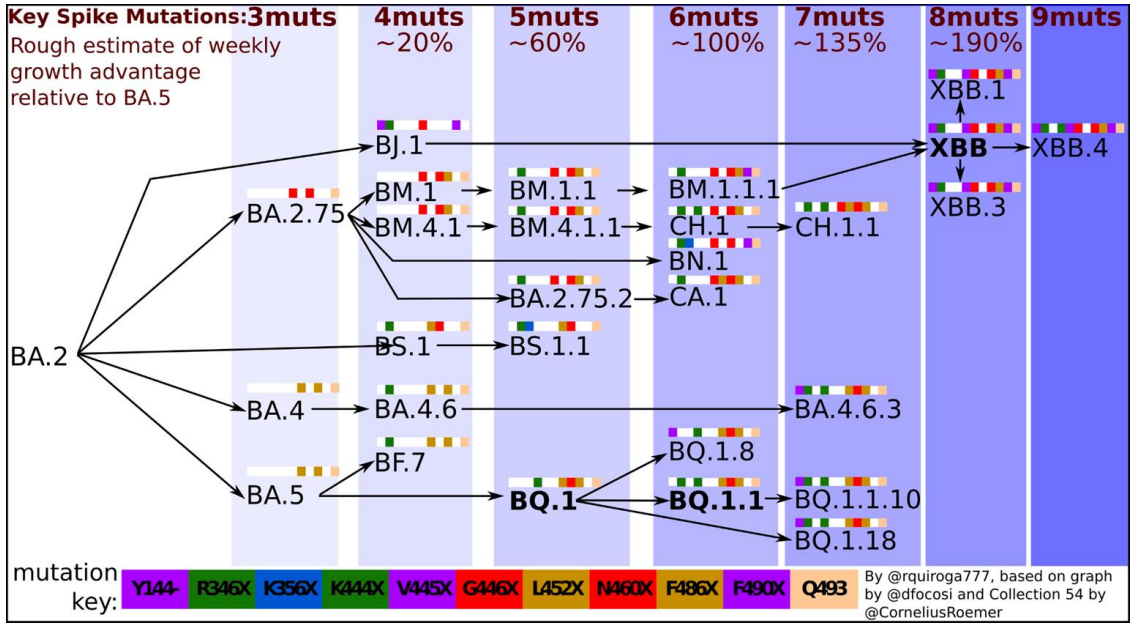
https://twitter.com/MoritzGerstung/status/1596841800680890368

Pandemic Pubs (Nov 29th, 2022)

2. Variants around the world





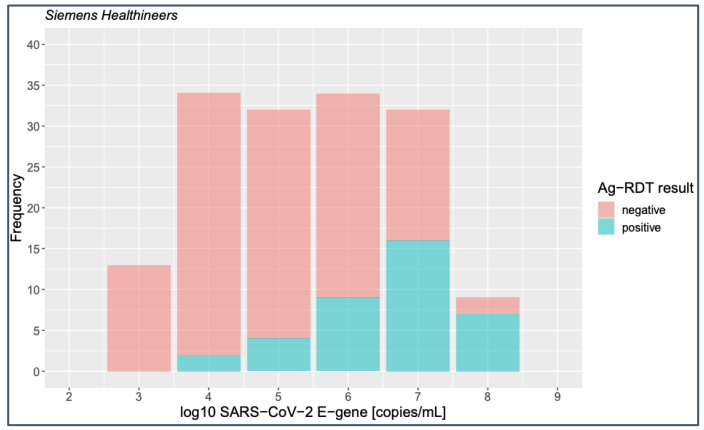


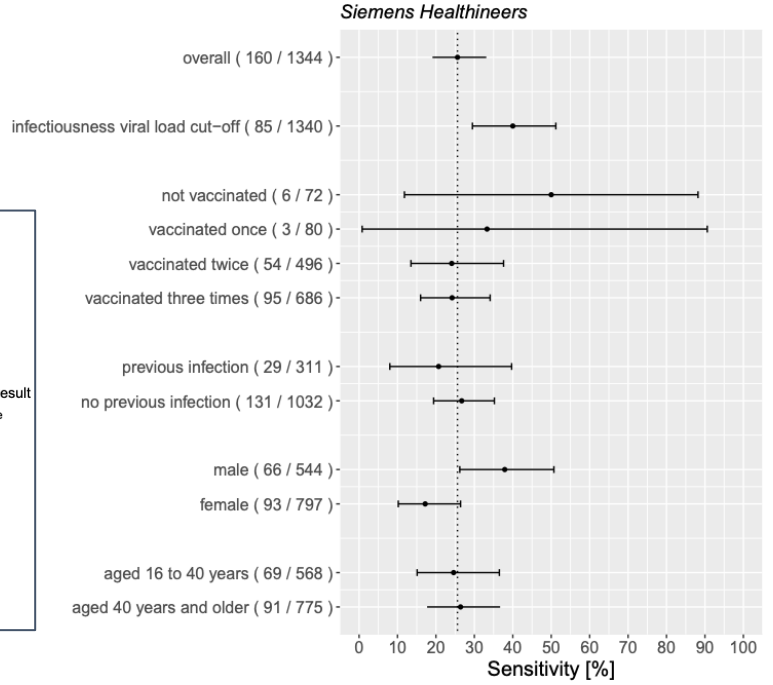
https://twitter.com/MoritzGerstung/status/1596841800680890368
https://twitter.com/PeacockFlu/status/1596492725171675136

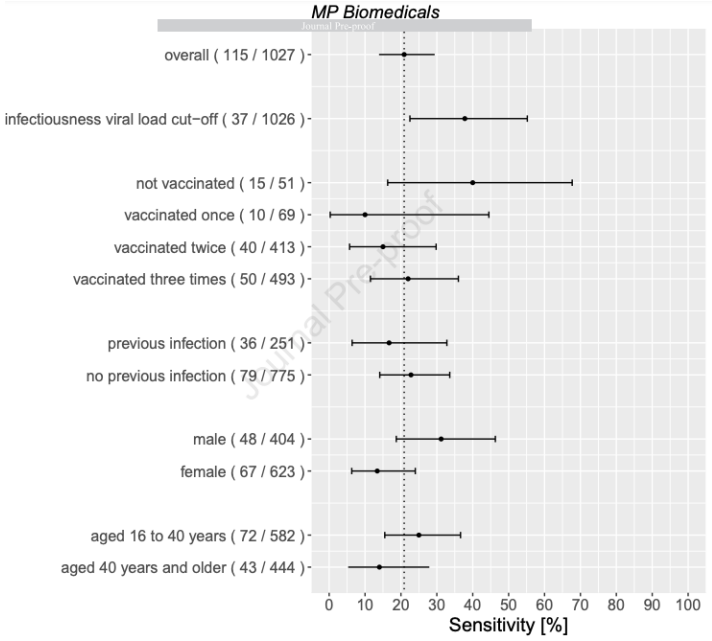
Pandemic Pubs (Nov 29th, 2022)

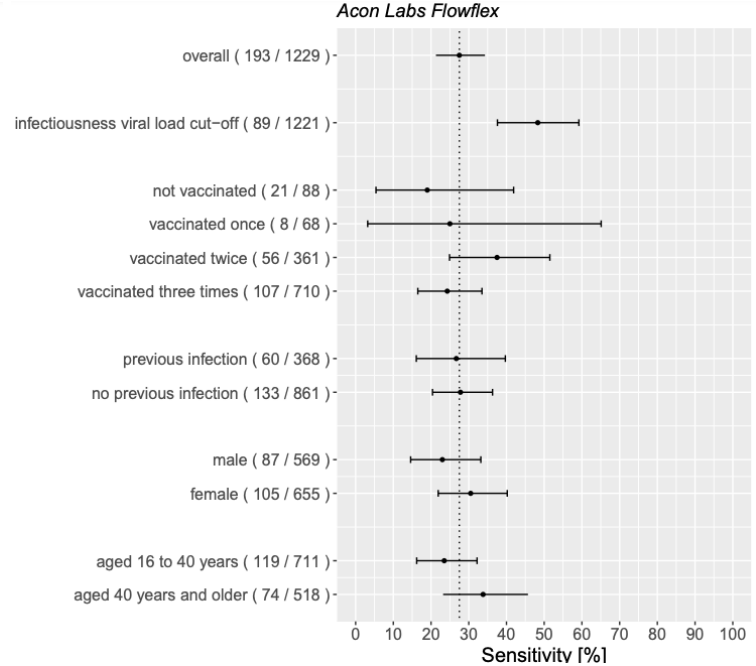
3. Netherlands study advocates, provides evidence for, repeated self-testing when asymptomatic testing to protect vulnerable individuals.

	N	RT-PCR test positivity* [%]	Sensitivity [%] (95%CI)	Specificity [%] (95%CI)	PPV [%] (95%CI)	NPV [%] (95%CI)
Flowflex						
Primary analysis	1229	15.7	27.5 (21.3-34.3)	99.8 (99.3-100)	96.4 (87.5-99.6)	88.1 (86.1-89.9)
Secondary (stratified) analyses:						
Viral load cut-off¶	1221	7.3	48.3 (37.6-59.2)	99.2 (98.5-99.6)	82.7 (69.7-91.8)	96.1 (94.8-97.1)
Vaccinated (at least once):						
Yes	1140	15.1	28.5 (21.9-35.9)	99.8 (99.3-100)	96.1 (86.5-99.5)	88.7 (86.7-90.5)
No	88	23.9	19.0 (5.4-41.9)	100 (94.6-100)	100 (39.8-100)	79.8 (69.6-87.7)
Previous SARS-CoV-2 infection:						
Yes	368	16.3	26.7 (16.1-39.7)	99.7 (98.2-100)	94.1 (71.3-99.9)	87.5 (83.5-90.7)
No	861	15.4	27.8 (20.4-36.3)	99.9 (99.2-100)	97.4 (86.2-99.9)	88.3 (85.9-90.4)
Sex:						
Female	655	16.0	30.5 (21.9-40.2)	99.8 (99.0-100)	97.0 (84.2-99.9)	88.3 (85.5-90.7)
Male	569	15.3	23.0 (14.6-33.2)	99.8 (98.8-100)	95.2 (76.2-99.9)	87.8 (84.7-90.4)
Age [years]:						
16-40	711	16.7	23.5 (16.2-32.2)	99.8 (99.1-100)	96.6 (82.2-99.9)	86.7 (83.9-89.1)
>40	518	14.3	33.8 (23.2-45.7)	99.8 (98.8-100)	96.2 (80.4-99.9)	90.0 (87.0-92.5)
MPBio						
Primary analysis	1027	11.2	20.9 (13.9-29.4)	99.8 (99.2-100)	92.3 (74.9-99.1)	90.9 (89.0-92.6)
Secondary (stratified) analyses:						
Viral load cut-off¶	1026	3.6	37.8 (22.5-55.2)	98.8 (97.9-99.4)	53.8 (33.4-73.4)	97.7 (96.6-98.5)
Vaccinated (at least one):						
Yes	975	10.3	18.0 (11.0-26.9)	99.8 (99.2-100)	90.0 (68.3-98.8)	91.4 (89.5-93.1)
No	51	29.4	40.0 (16.3-67.7)	100 (90.3-100)	100 (54.1-100)	80.0 (65.4-90.4)
Previous SARS-CoV-2 infection:						
Yes	251	14.3	16.7 (6.4-32.8)	100 (98.3-100)	100 (54.1-100)	87.8 (83.0-91.6)
No	775	10.2	22.8 (14.1-33.6)	99.7 (99.0-100)	90.0 (68.3-98.8)	91.9 (89.7-93.8)
Sex:						
Female	623	10.8	13.4 (6.3-24.0)	99.8 (99.0-100)	90.0 (55.5-99.7)	90.5 (87.9-92.7)
Male	404	11.9	31.2 (18.7-46.3)	99.7 (98.4-100)	93.8 (69.8-99.8)	91.5 (88.3-94.1)
Age [years]:						
16-40	582	12.4	25.0 (15.5-36.6)	99.8 (98.9-100)	94.7 (74.0-99.9)	90.4 (87.7-92.7)
>40	444	9.7	14.0 (5.3-27.9)	99.8 (98.6-100)	85.7 (42.1-99.6)	91.5 (88.5-94.0)
Clinitest						
Primary analysis	1344	11.9	25.6 (19.1-33.1)	99.9 (99.5-100)	97.6 (87.4-99.9)	90.9 (89.2-92.4)
Secondary (stratified) analyses:						
Viral load cut-off¶	1340	6.3	40.0 (29.5-51.2)	99.5 (99.0-99.8)	85.0 (70.2-94.3)	96.1 (94.9-97.1)
Vaccinated (at least one):						
Yes	1271	12.0	24.8 (18.2-32.5)	99.9 (99.5-100)	97.4 (86.5-99.9)	90.7 (88.9-92.2)
No	72	8.3	50.0 (11.8-88.2)	100 (94.6-100)	100 (29.2-100)	95.7 (87.8-99.1)
Previous SARS-CoV-2 infection:						
Yes	311	9.3	20.7 (8.0-39.7)	99.6 (98.0-100)	85.7 (42.1-99.6)	92.4 (88.9-95.1)
No	1032	12.7	26.7 (19.4-35.2)	100 (99.6-100)	100 (90.0-100)	90.4 (88.4-92.1)
Sex:						
Female	797	11.7	17.2 (10.2-26.4)	100 (99.5-100)	100 (79.4-100)	90.1 (87.8-92.1)
Male	544	12.1	37.9 (26.2-50.7)	99.8 (98.8-100)	96.2 (80.4-99.9)	92.1 (89.4-94.3)
Age [years]:						
16-40	568	12.1	24.6 (15.1-36.5)	99.8 (98.9-100)	94.4 (72.7-99.9)	90.5 (87.8-92.9)
>40	775	11.7	26.4 (17.7-36.7)	100 (99.5-100)	100 (85.8-100)	91.1 (88.8-93.0)







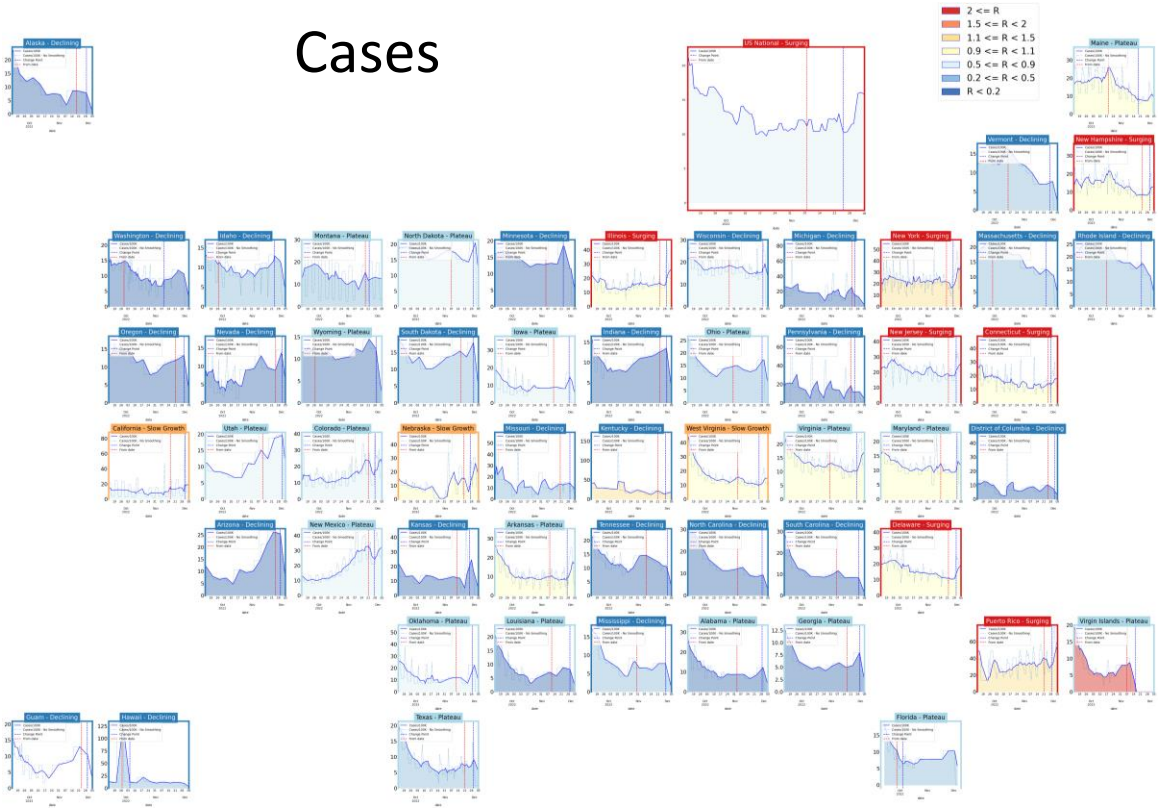


Researchers in the Netherlands performed a cross-sectional study in the Omicron period in three public health service covid-19 test sites in the **Netherlands including 3,600 asymptomatic individuals presenting for SARS-CoV-2 testing for any reason except confirmatory testing after a positive self-test. Sensitivities of three commonly used SARS-CoV-2 Ag-RDTs when used as self-tests in asymptomatic individuals in the Omicron period were very low**. Authors state "self-testing has limited value for asymptomatic individuals wishing to protect vulnerable persons and may even lead to a false sense of security." Applying a viral load cut-off (≥5.2 log10 SARS-CoV-2 E-gene copies/mL), sensitivities increased to 48.3% (37.6 to 59.2%), 37.8% (22.5 to 55.2%), and 40.0% (29.5 to 51.2%), Acon Flowflex (Flowflex), MP Biomedicals (MPBio), and Siemens-Healthineers Clinitest (Clinitest) respectively. Cut-off established above which 95% of people with a positive RT-PCR test result had a positive virus culture in that previous study

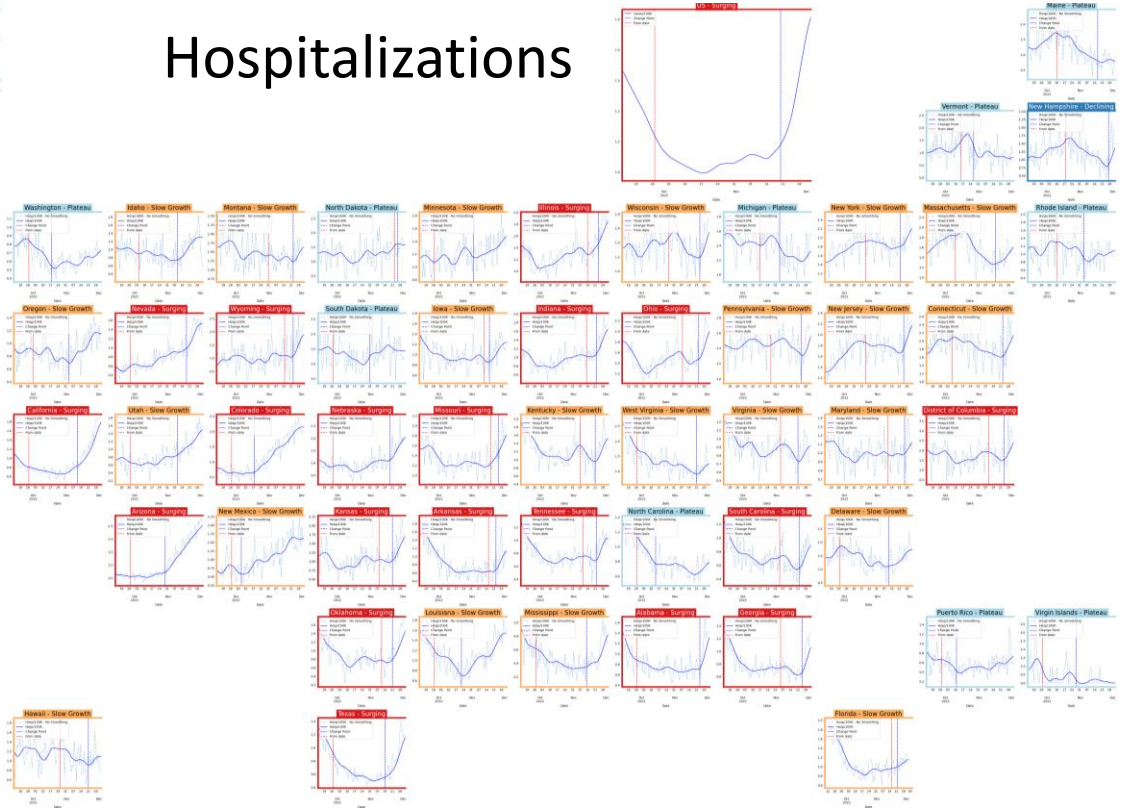
https://www.clinicalmicrobiologyandinfection.com/article/S1198-743X(22)00570-5/fulltext#gr2

United States Case & Hospitalizations

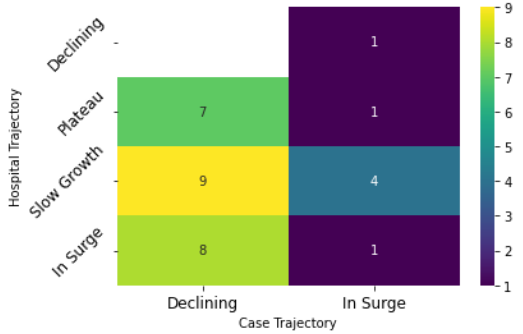
Cases



Hospitalizations



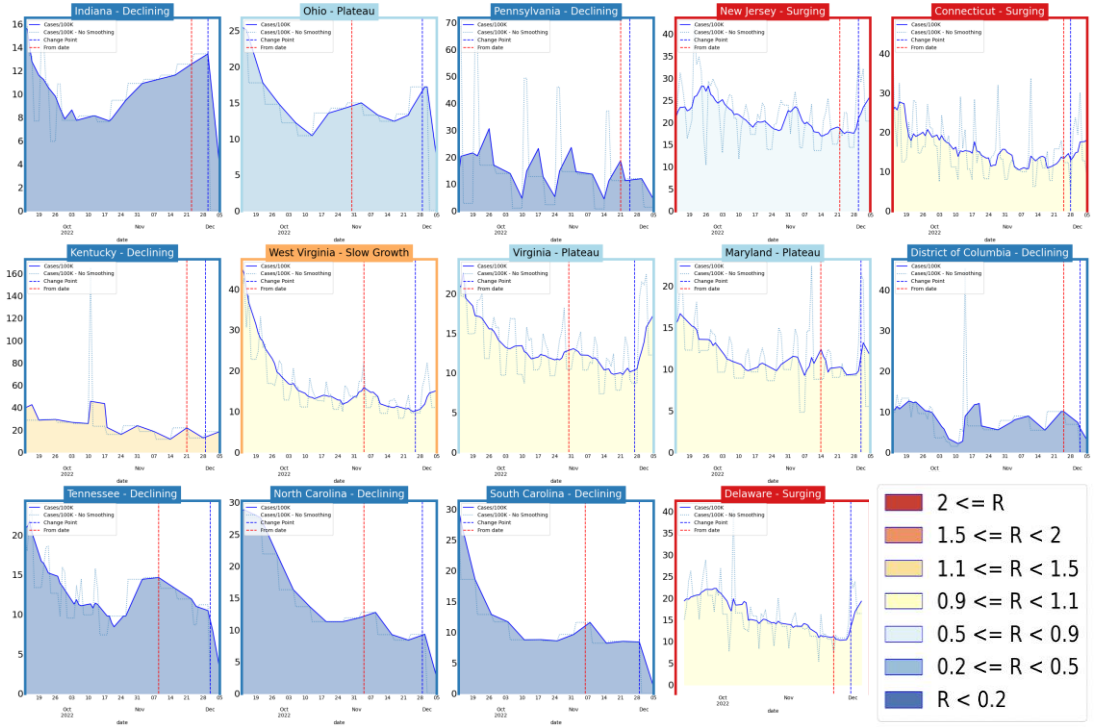
Status	Number of States	
	Current Week	Last Week
Declining	25	(42)
Plateau	19	(11)
Slow Growth	0	(1)
In Surge	7	(0)



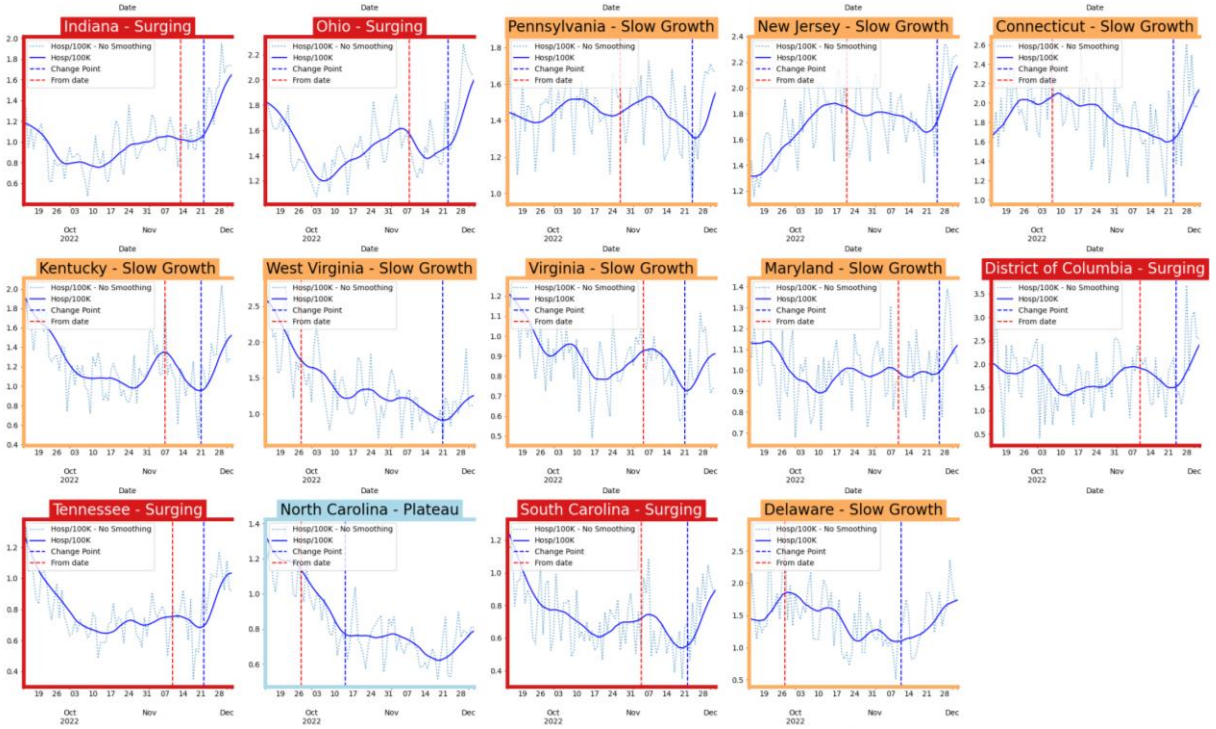
Status	Number of States	
	Current Week	Last Week
Declining	1	(5)
Plateau	11	(29)
Slow Growth	22	(15)
In Surge	19	(4)

Virginia and Her Neighbors

Cases

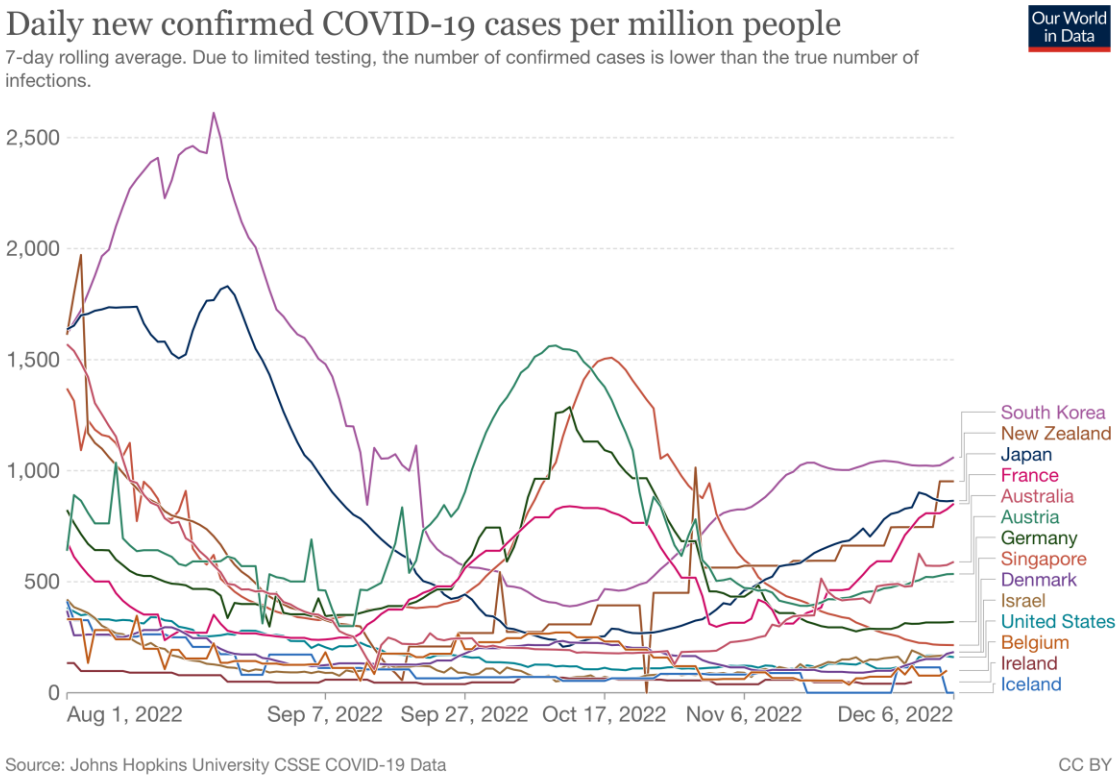


Hospitalizations

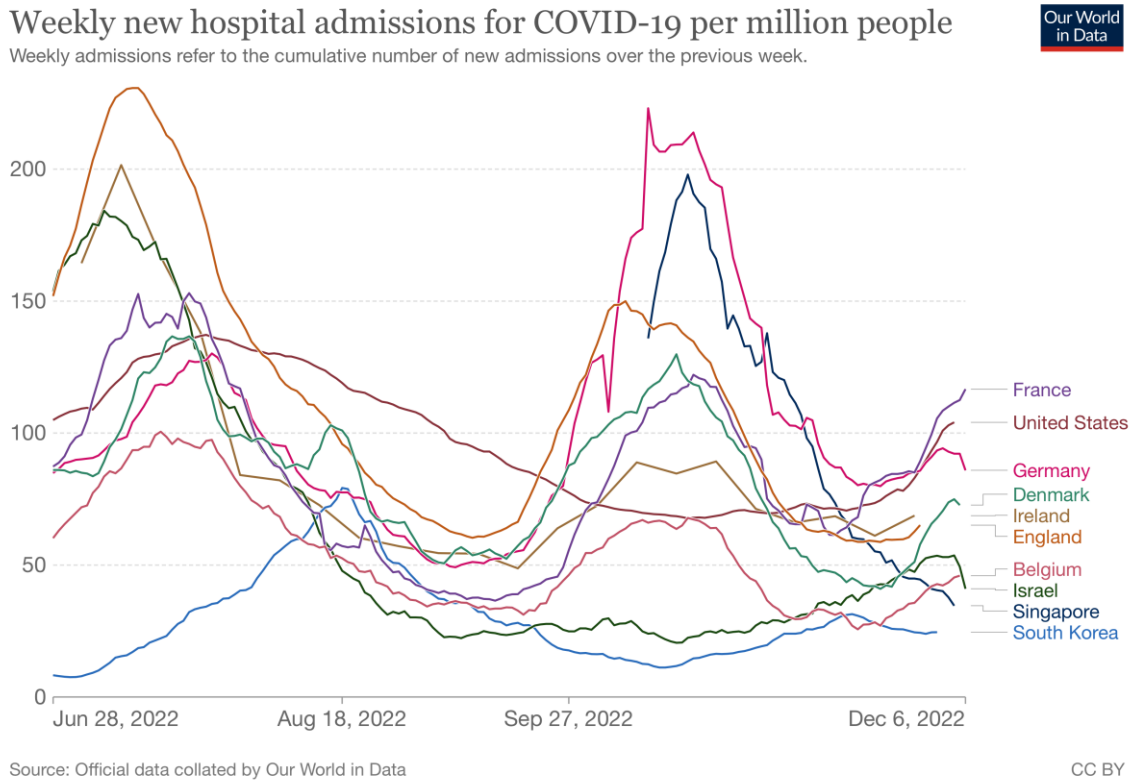


Around the World – Various trajectories

Confirmed cases



Hospitalizations

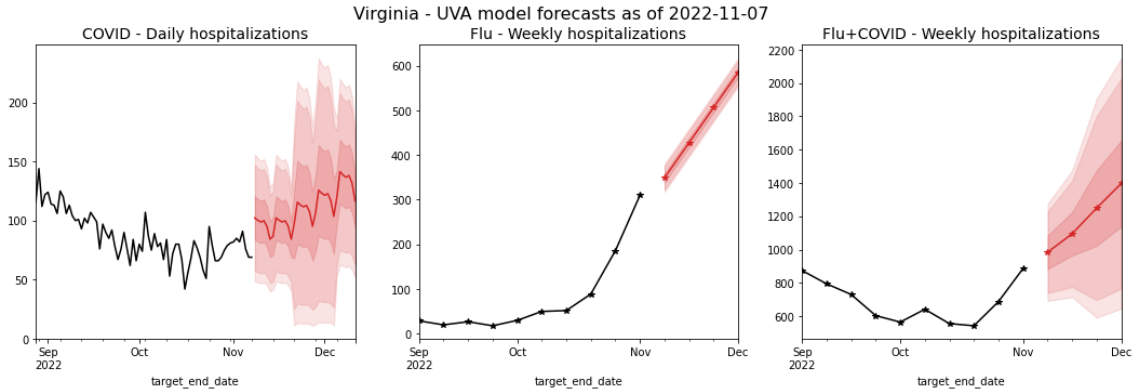


[Our World in Data]

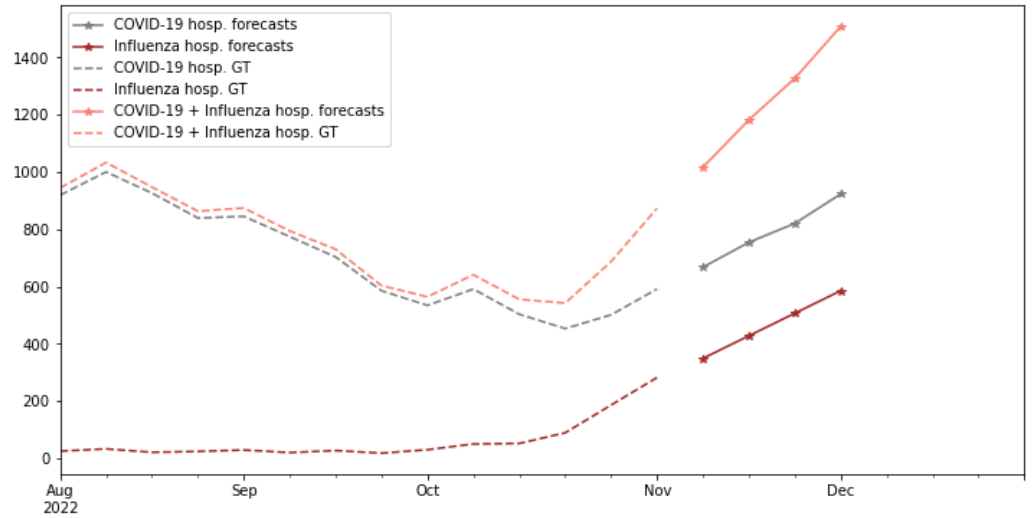
Statistical Ensemble Models - Hospitalizations

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 Hospitalizations
Short-term COVID-19 and Influenza Forecasts



<u>Weekly forecasts of hospitalizations</u> done at state level.

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

Ensemble forecast provides additional ‘surveillance’ for making scenario-based projections.

Also submitted to CDC Forecast Hub.

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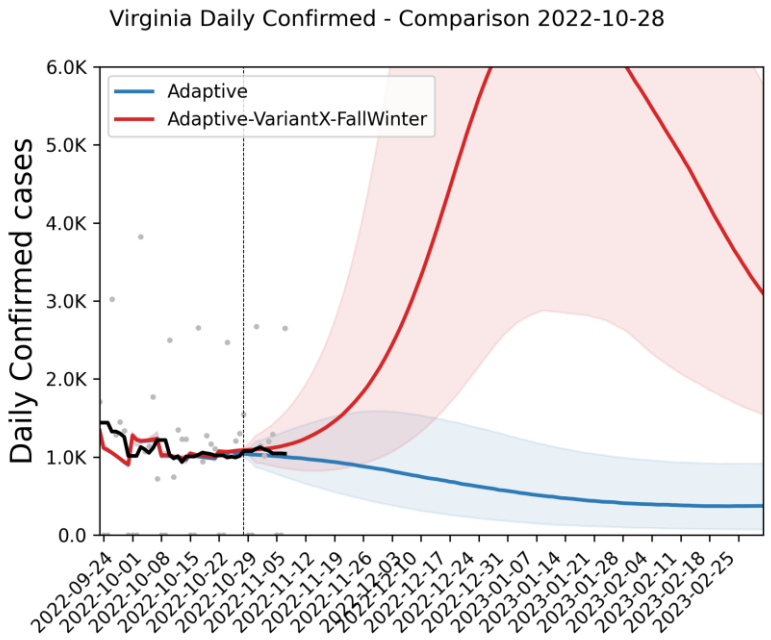
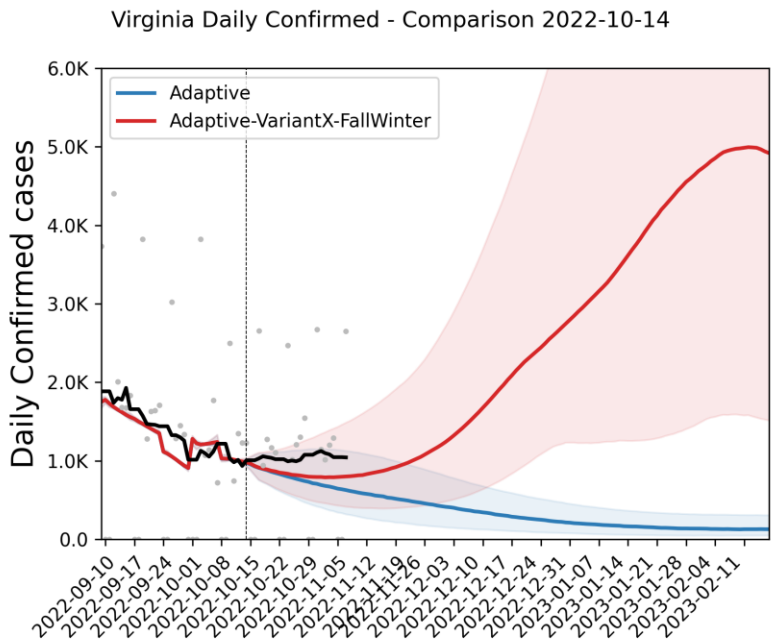
Previous projections comparison - Cases

- Previous projections continue to track observed cases
- Projection from 2 weeks ago projected continued decline but cases plateaued
- Projection from 4 weeks ago projected slower decline better capturing recent plateau

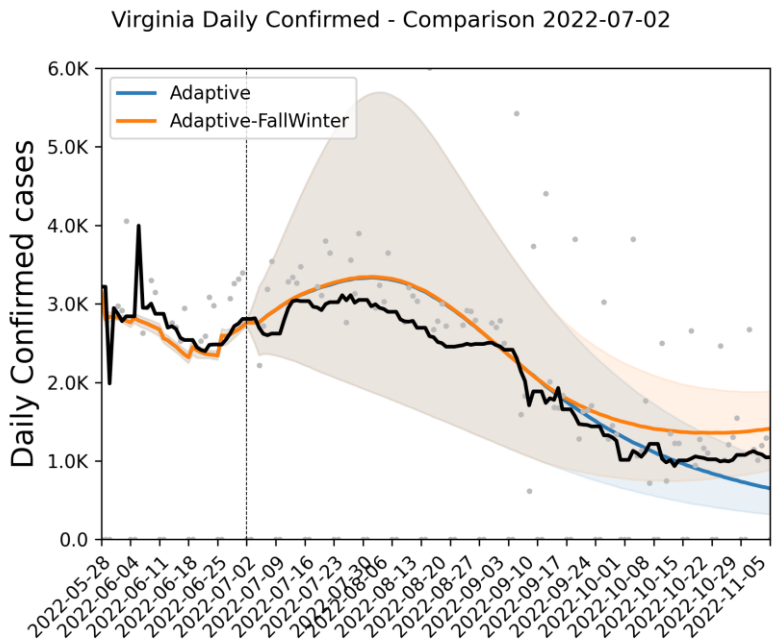
Projection from 1 week ago



Projection from 3 weeks ago



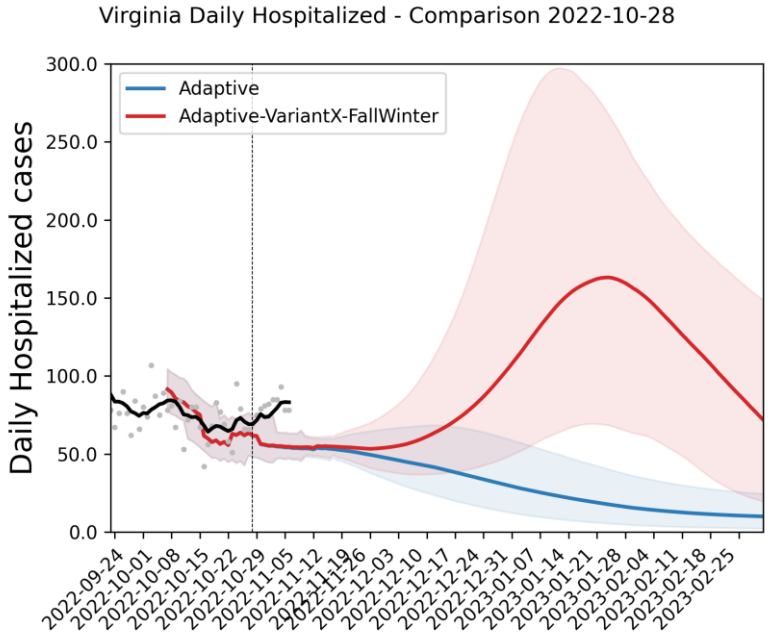
Projection from 3 months ago



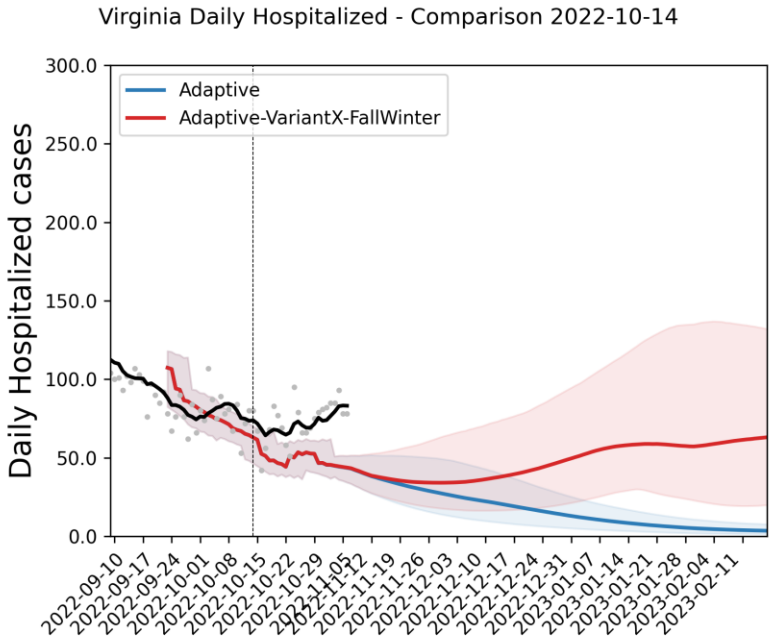
Previous projections comparison - Hospitalizations

- Previous projections have tracked observed hospitalizations reasonably well, though the case to hospitalization ratios may be shifting as model is under predicting

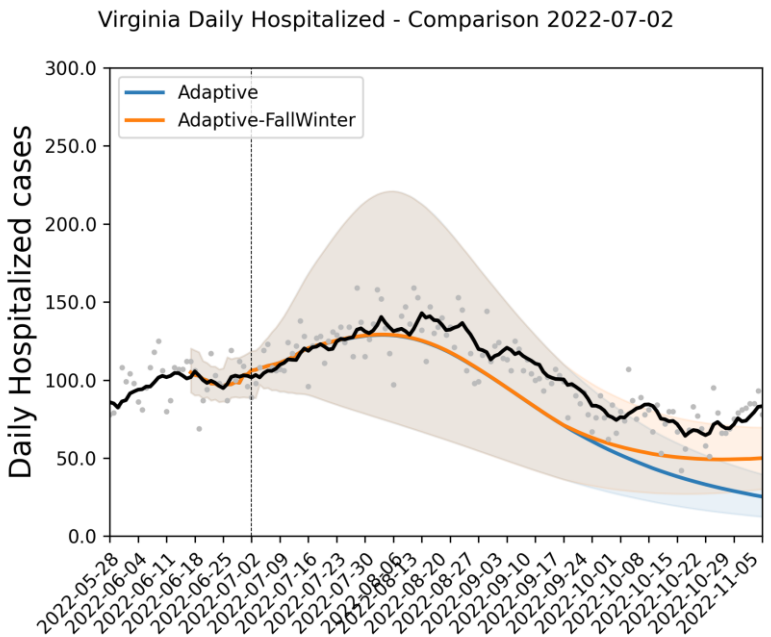
Projection from 1 week ago



Projection from 3 weeks ago



Projection from 3 months ago

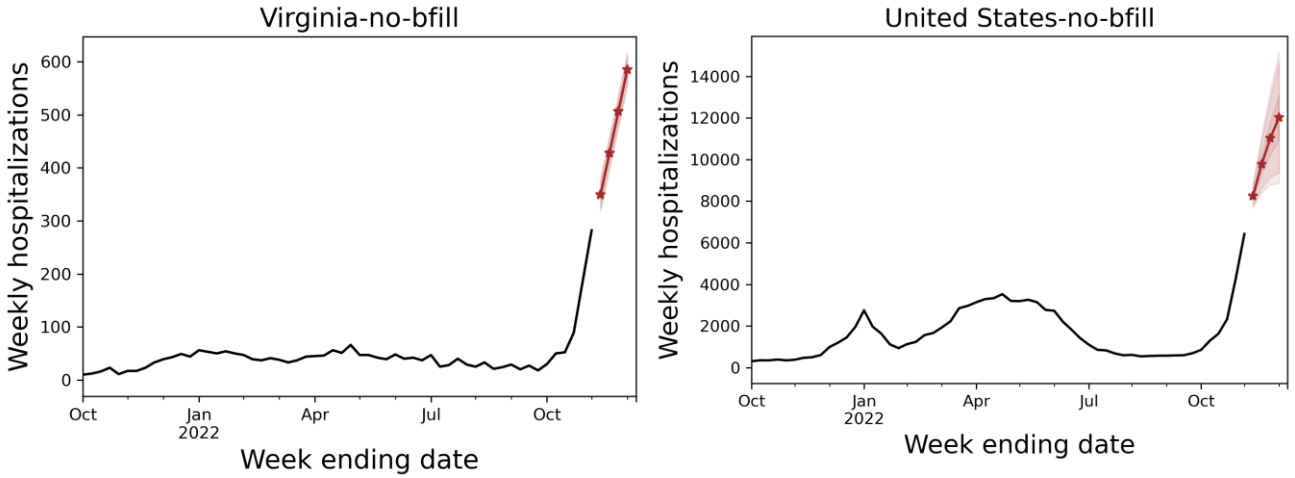


Current Influenza Hospitalization Forecast

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)



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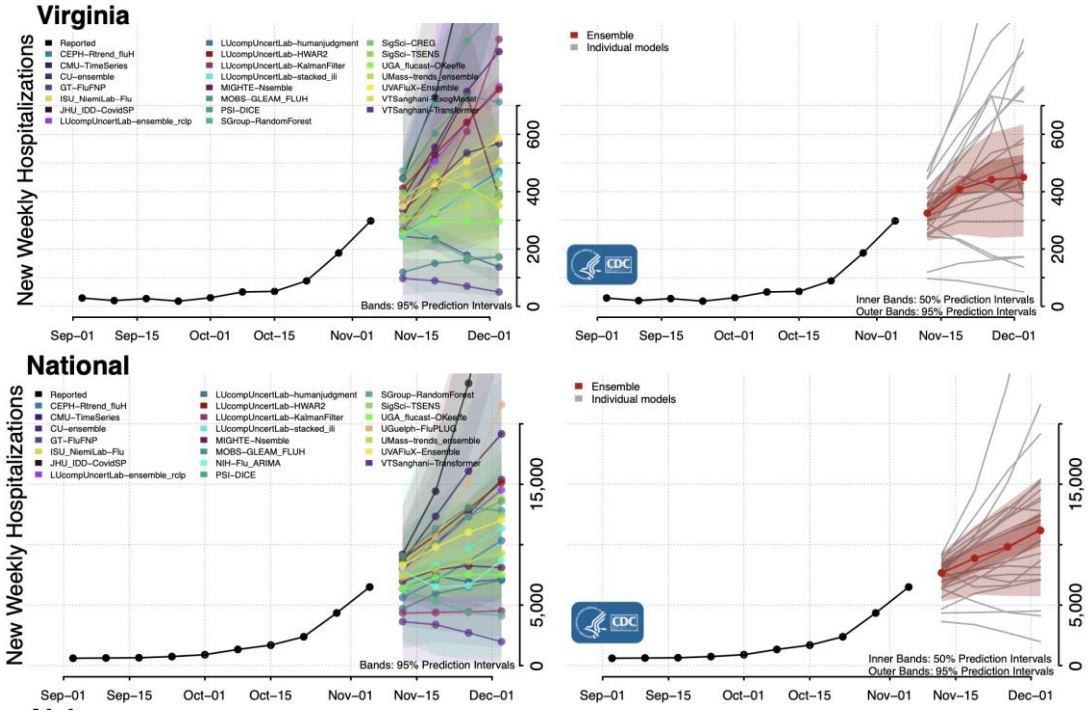


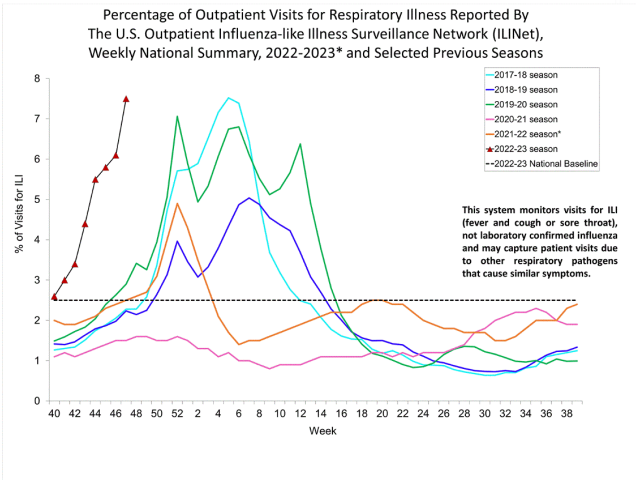
Influenza Update

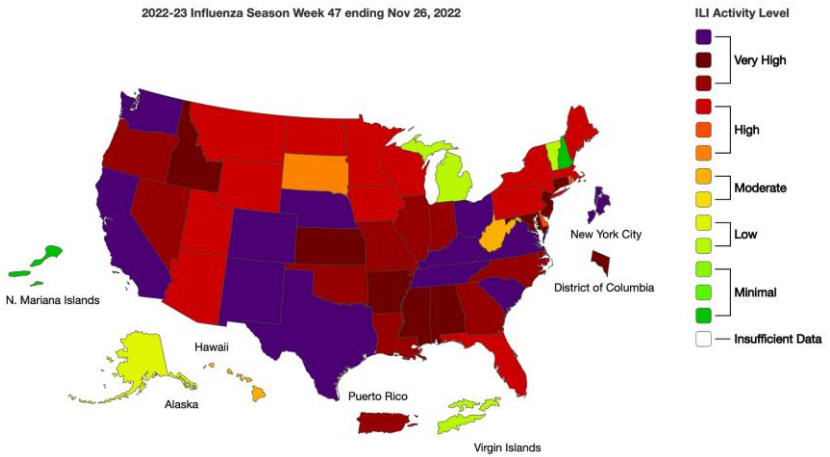
Current Influenza Situation – ILI Activity

Influenza Activity is Higher than Usual

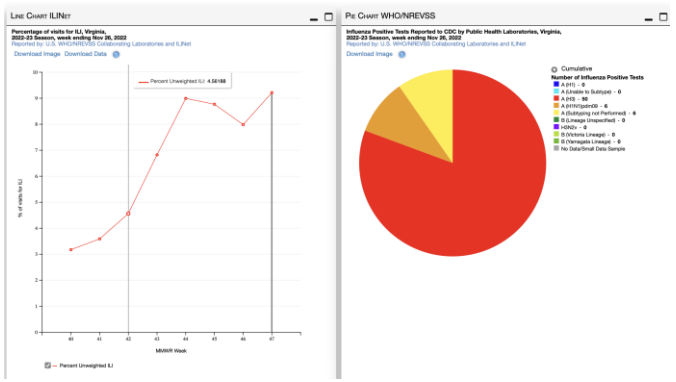
- Virginia at “Very High” activity along with many more of the states across the US
- In VA ILI Activity has receded from a high near ~12% of visits for ILI back to 7% this past week
- National ILI activity has reached the peak of the previous most significant season in the past decade (2017-18)
- H3 continues to dominate VA infections, though H1N1pdm09 starting to represent a small proportion

Region 3





Virginia



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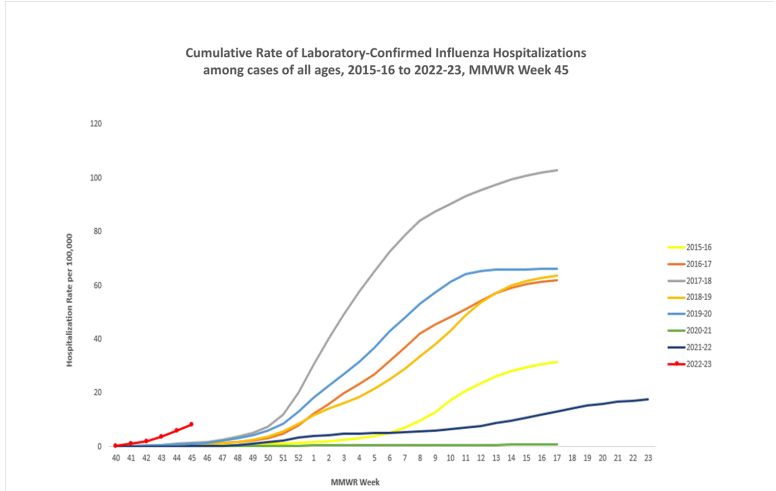
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

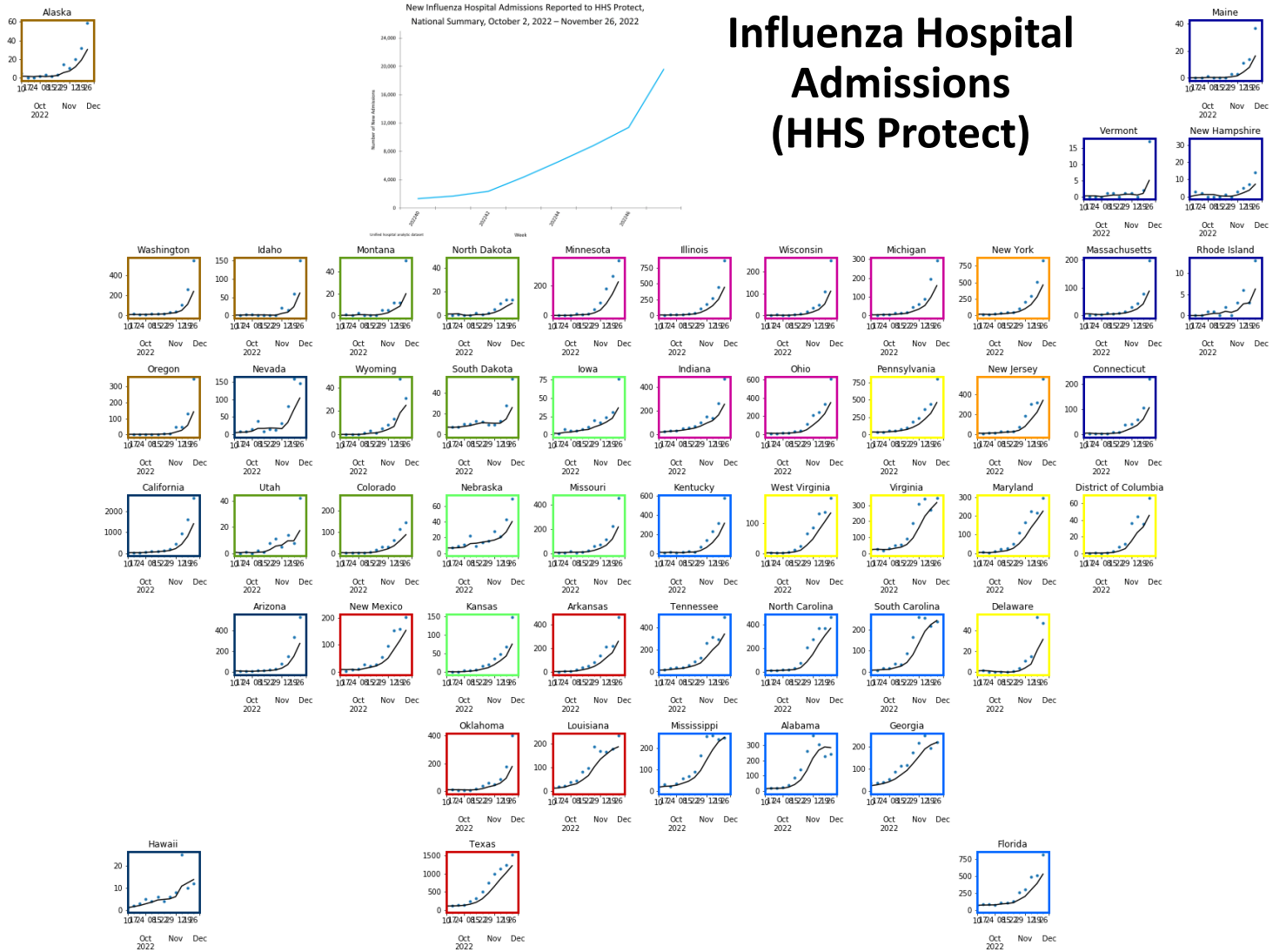
Current Influenza Situation - Hospitalizations

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, cumulative 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. As hospitalization data are received each week, prior case counts and rates are updated accordingly.



Influenza Hospital Admissions (HHS Protect)

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FLUVIEW
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Current Influenza Hospitalization Forecast

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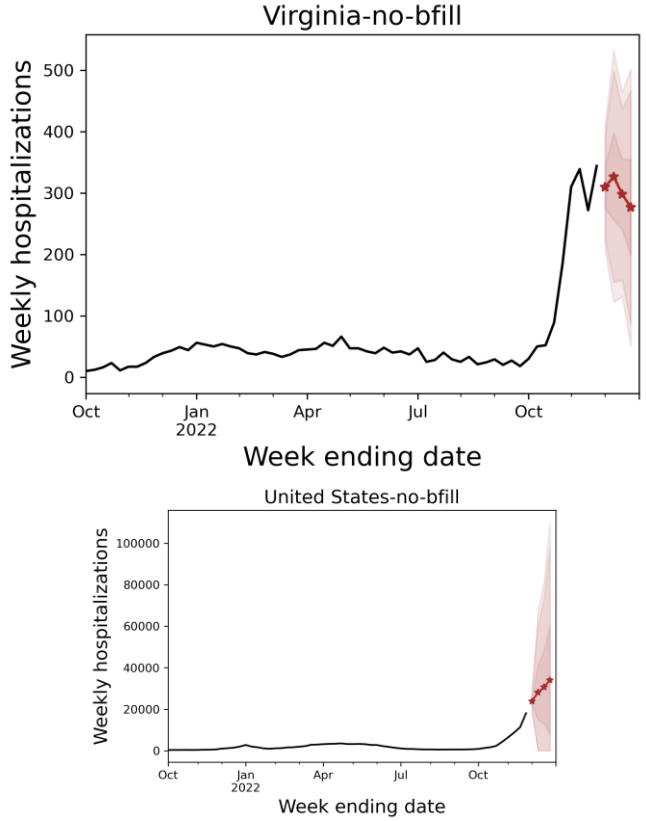
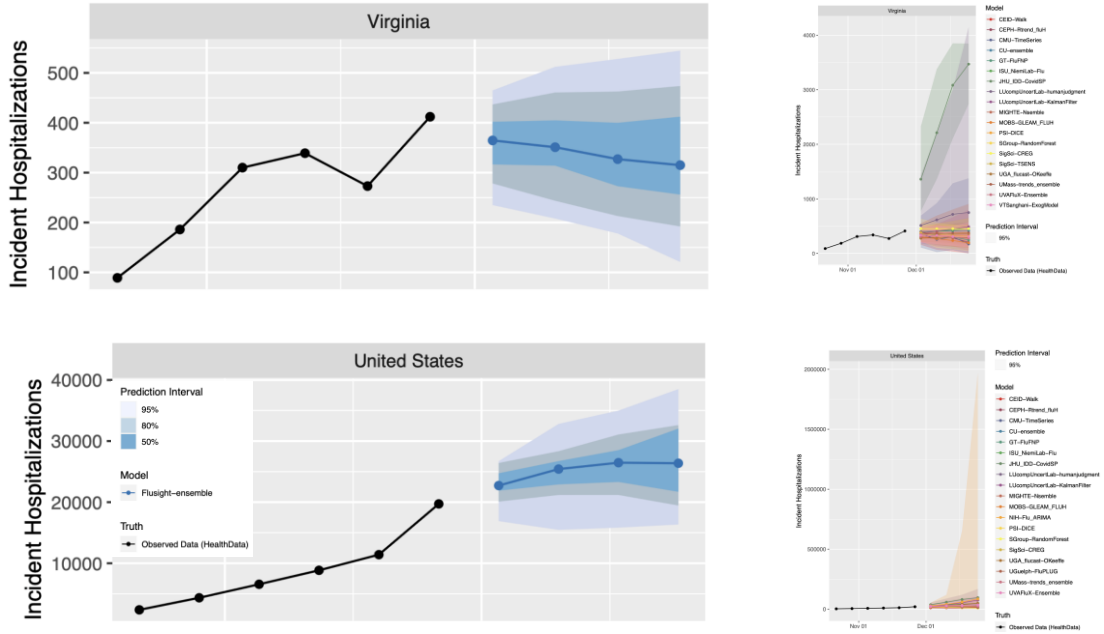


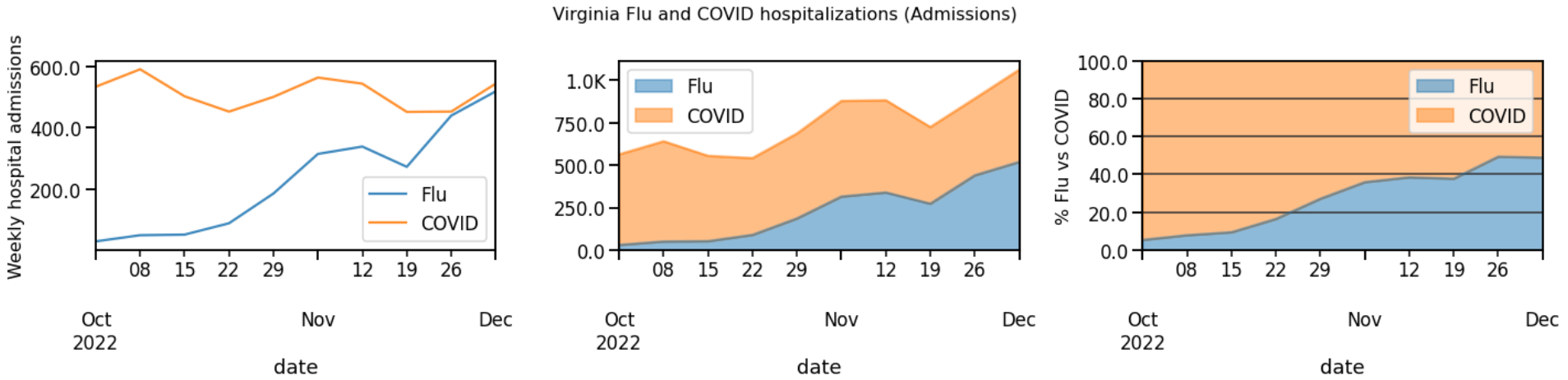
Hospital Admissions for Influenza and Forecast for next 4 weeks (CDC FluSight Ensemble)



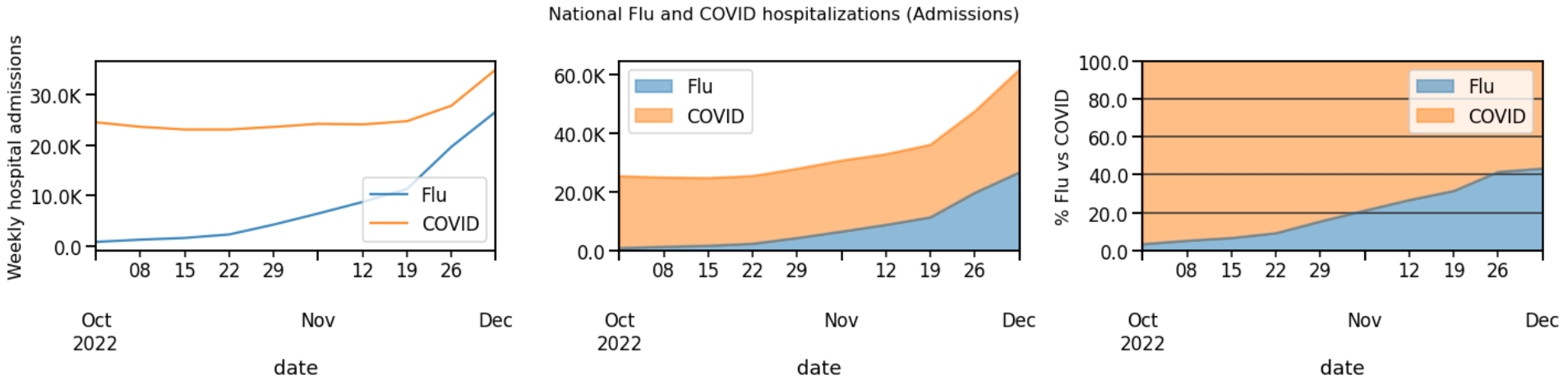
Current Combined Hospitalizations (COVID-19 & Influenza)

COVID-19 and Influenza Weekly Hospitalizations (HHS Protect)

Virginia



USA



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Combined ILI and COVID-19 Hospitalizations

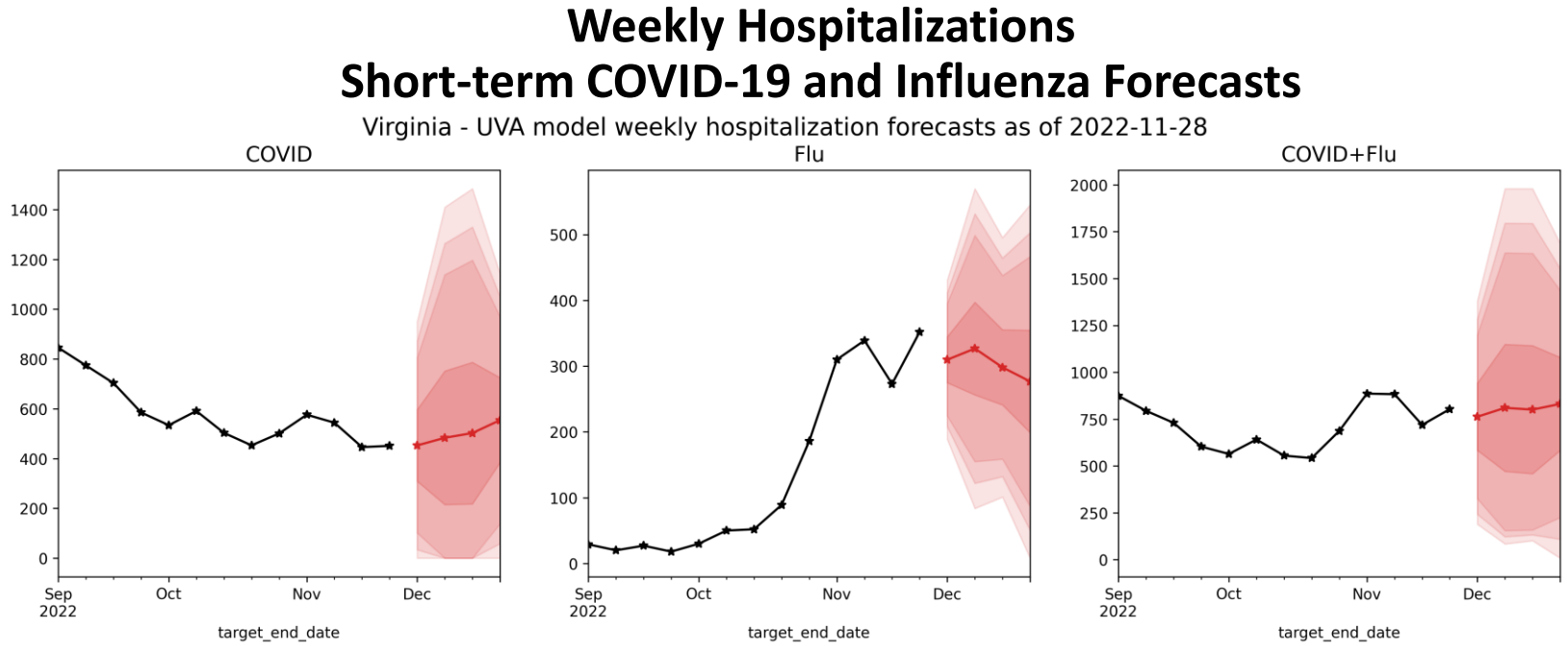
Ensemble methodology that combines the Adaptive with machine learning and statistical models such as:

- 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 and Influenza

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

- COVID-19 Scenarios

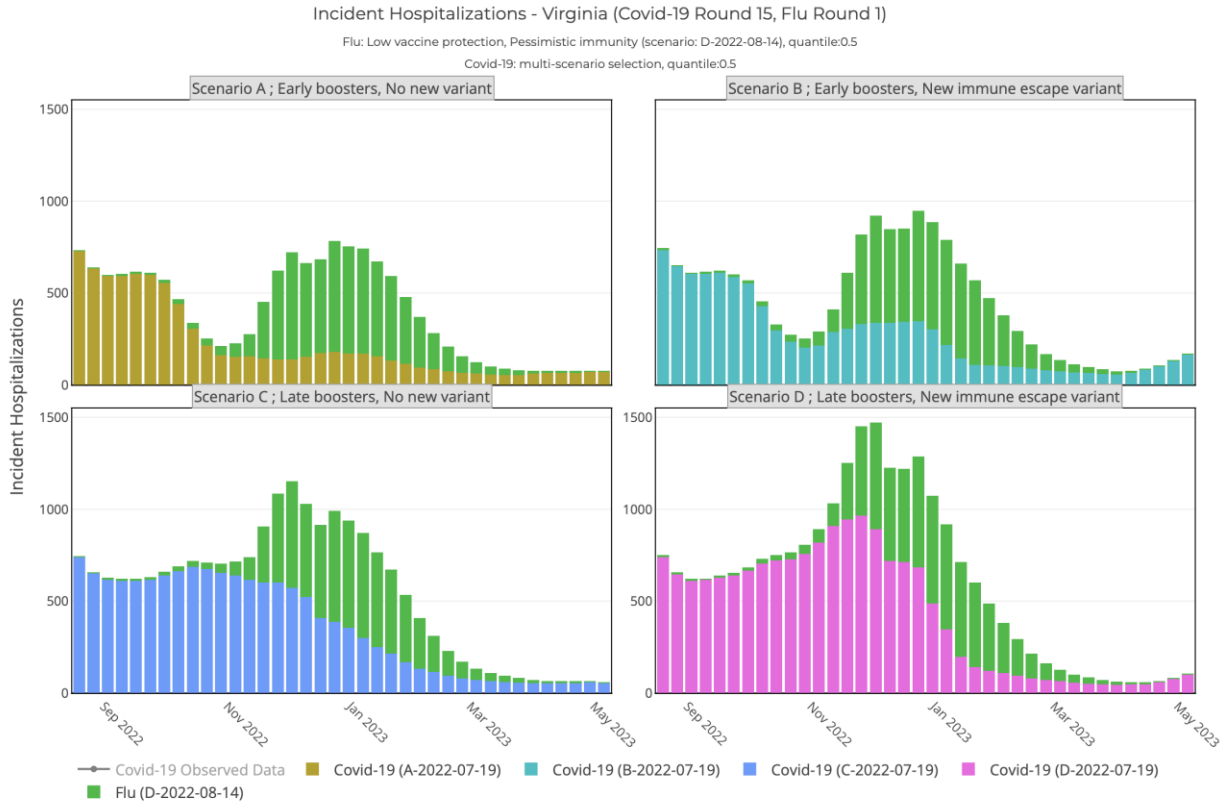
  - ☑ **Scenario A**
    Early boosters
    No new variant
    (A-2022-07-19)
  - ☑ **Scenario B**
    Early boosters
    New immune escape variant
    (B-2022-07-19)
  - ☑ **Scenario C**
    Late boosters
    No new variant
    (C-2022-07-19)
  - ☑ **Scenario D**
    Late boosters
    New immune escape variant
    (D-2022-07-19)

- Influenza Scenarios

  - ○ High vaccine protection, Optimistic immunity (A-2022-08-14)
  - ○ High vaccine protection, Pessimistic immunity (B-2022-08-14)
  - ○ Low vaccine protection, Optimistic immunity (C-2022-08-14)
  - ◉ Low vaccine protection, Pessimistic immunity (D-2022-08-14)

Round 16 of COVID-19 in progress, Round 2 of Influenza in planning stages

Combined Hospitalizations (VA)
Interactive visualization – MultiPathogen Plot
https://covid19scenariomodelinghub.org/viz.html



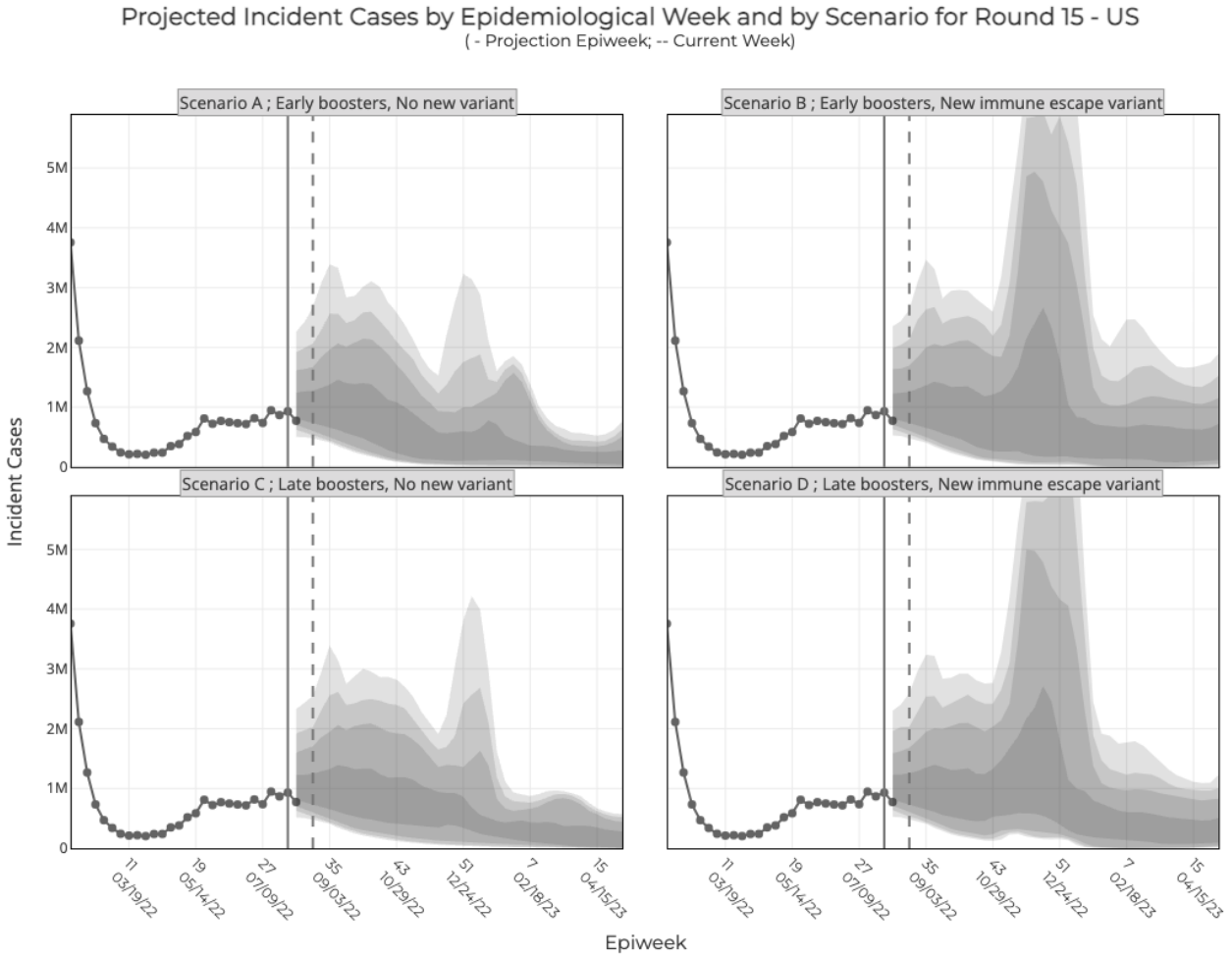
COVID -19 scenarios and most “pessimistic” influenza scenarios combined

Scenario Modeling Hub – COVID-19 (Round 15)

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

- Round 15 results published
  - Scenarios: Test benefits of reformulated fall boosters w/ and w/out a new variant
  - Timing of reformulated boosters is one of the axes

https://covid19scenariomodelinghub.org/viz.html

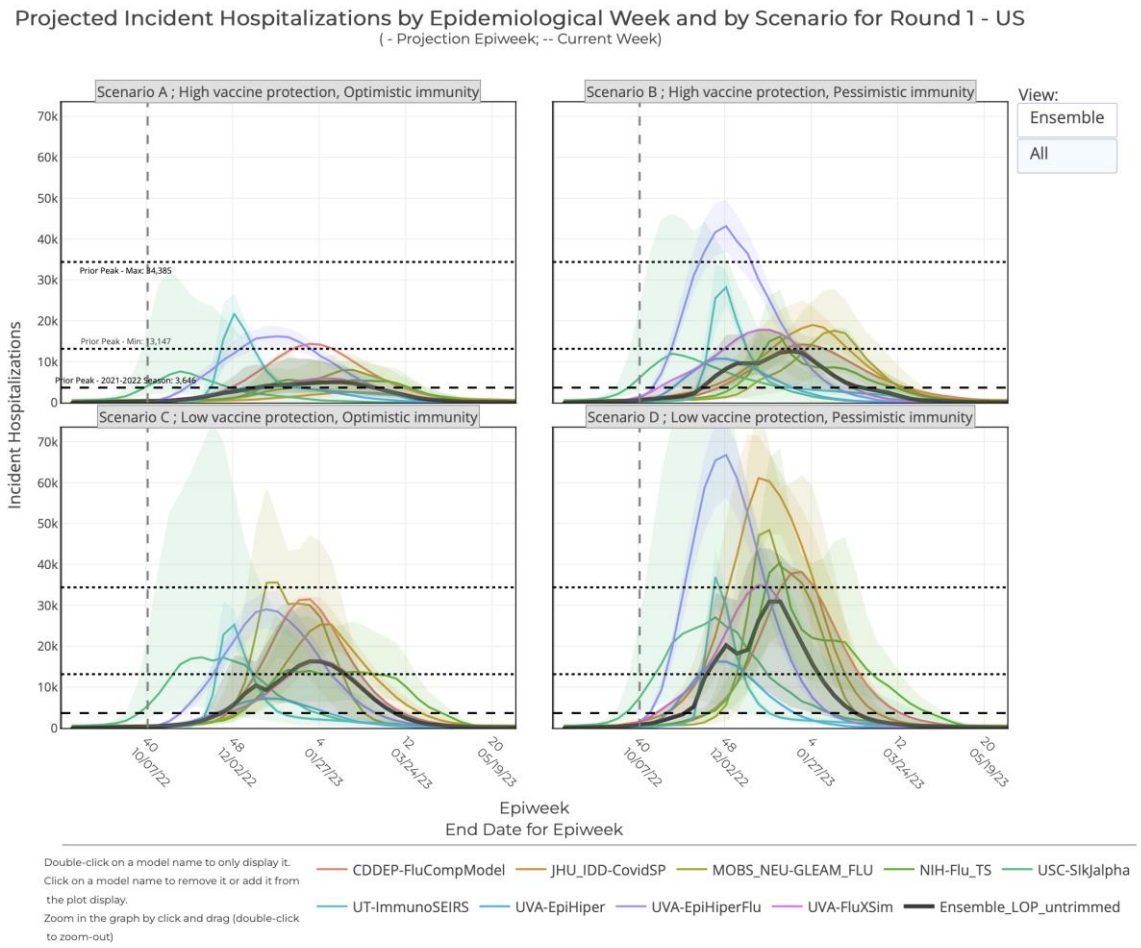


Scenario Modeling Hub – Influenza (Round 1)

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

- Round 1 results recently published
  - Impact of missed flu seasons on pre-season immunity
  - Testing different seasonal vaccine coverage and efficacy
  - Projected from Aug 14th 2022
- High degree of uncertainty as previous 2 seasons have been irregular and there is still limited data for this season available
- Demonstrates importance of good vaccine coverage especially if previous immunity is weak

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 have continued to decline though hospitalizations have shown some recent growth**
- VA weekly case rate is slightly down at 81 per 100K from 84 per 100K
  - US weekly case rate is flat remaining at 74 per 100K from 74 per 100K
  - VA hospital occupancy (rolling 7 day mean of 455 slightly down from 482 a week ago) down but experiencing recent activity
- Sub-variant prevalence has started to grow rapidly, BA.5 subvariants seem to be accelerating
- Projections from last week remain largely on target with limited impact of Fall Winter scenario, however hospitalization trajectories

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

Additional Analyses

References

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Biocomplexity Institute. COVID-19 Surveillance Dashboard. https://nssac.bii.virginia.edu/covid-19/dashboard/

Google. COVID-19 community mobility reports. https://www.google.com/covid19/mobility/

Biocomplexity page for data and other resources related to COVID-19: https://covid19.biocomplexity.virginia.edu/

Questions?

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