

Network Systems  
Science & Advanced  
Computing  
Biocomplexity Institute  
& Initiative  
University of Virginia

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

November 16<sup>th</sup>, 2023

(data current to Nov 1<sup>st</sup> – Nov 14<sup>th</sup>)

Biocomplexity Institute Technical report: TR BI-2023-274



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**BIOCOMPLEXITY** INSTITUTE

[biocomplexity.virginia.edu](https://biocomplexity.virginia.edu)

# About Us

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



## Points of Contact

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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 broad overview of other emerging threats

# Key Takeaways

## **COVID-19 Activity levels remain in an undulating plateau**

- Cases and hospitalizations have remained flat for a month
- Other indicators continue to point towards this continuing but with some increased activity in Southwest
- Wastewater based indicators similar mix of viral loads as in previous weeks

## **Genomic Surveillance maintains high diversity with no dominating variant**

## **Influenza Activity is picking up Nationally, still low in Virginia**

- Recent hospitalization surveillance from the 15th shows growth

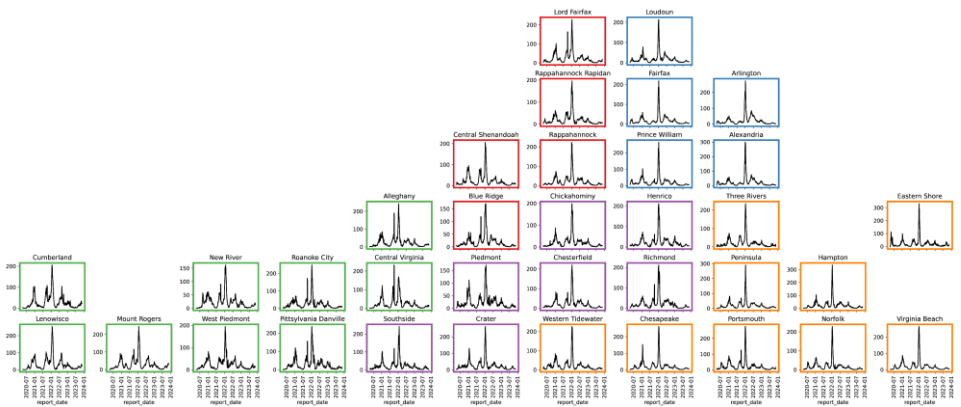
Together this suggests continued COVID-19 plateaus in near term



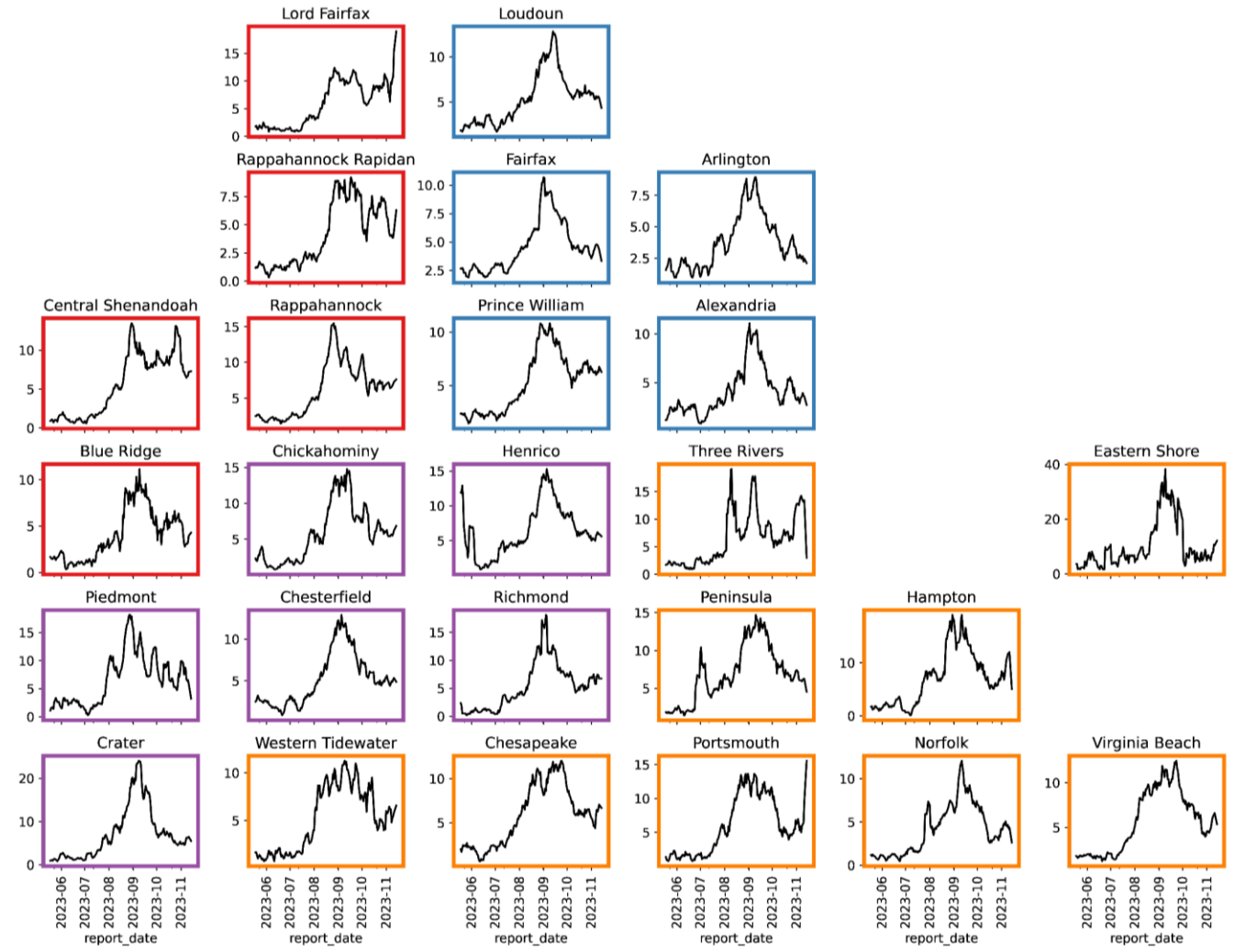
# COVID-19 Surveillance

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# Case Rates (per 100k)



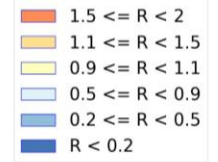
Whole pandemic



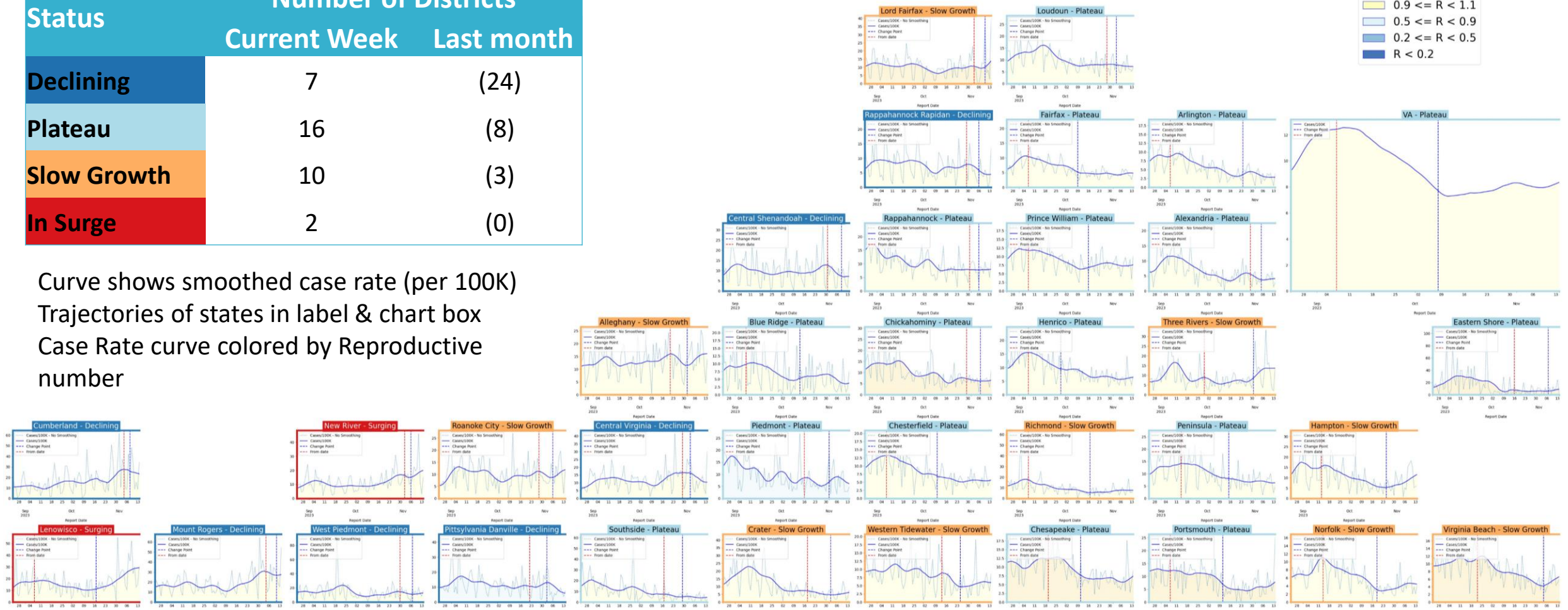
# District Case Trajectories – last 10 weeks

## Rt estimates from EpiNow2

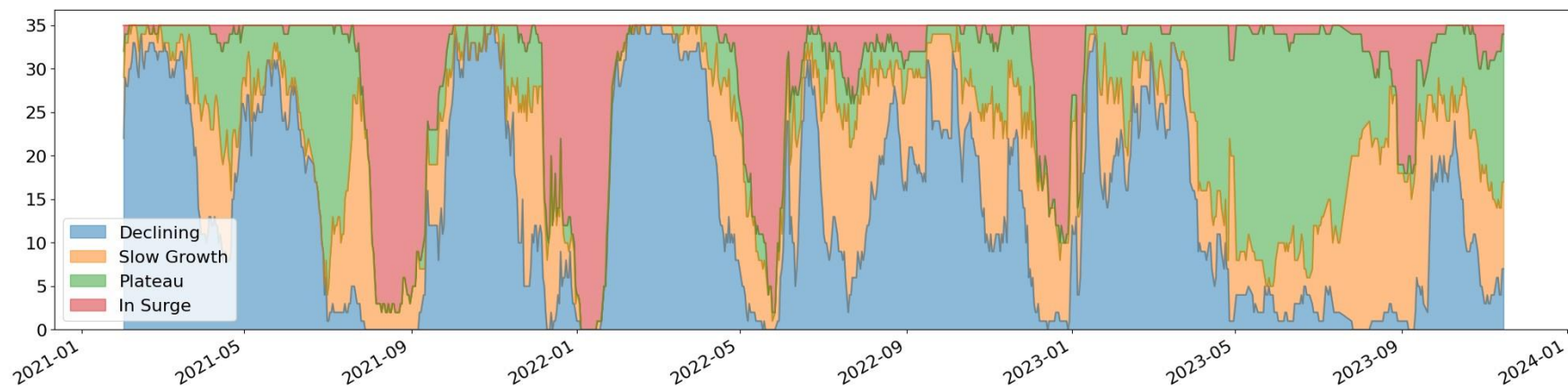
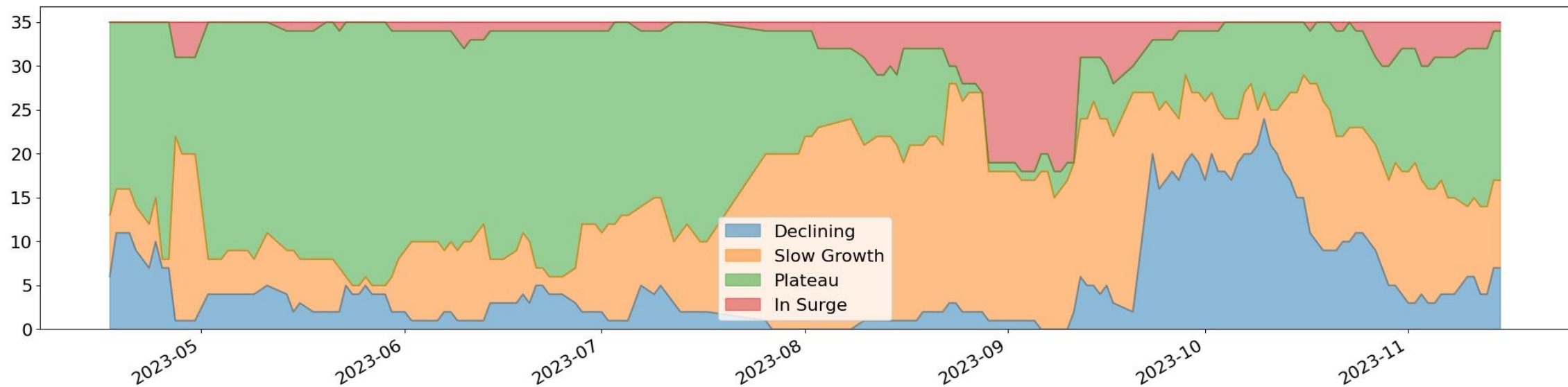
Status	Number of Districts	
	Current Week	Last month
Declining	7	(24)
Plateau	16	(8)
Slow Growth	10	(3)
In Surge	2	(0)



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



# District Case Trajectories – Recent 6 months





# District Hospital Trajectories – last 10 weeks

Status	Number of Districts	
	Current Week	Last Month
Declining	19	(2)
Plateau	13	(22)
Slow Growth	3	(11)
In Surge	0	(0)

Hospitalization by county inferred from Facility data mapped to counties through Hospital Referral Regions.

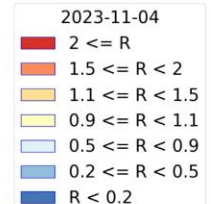
**As of Nov 4<sup>th</sup>**

## Rt estimates from EpiNow2

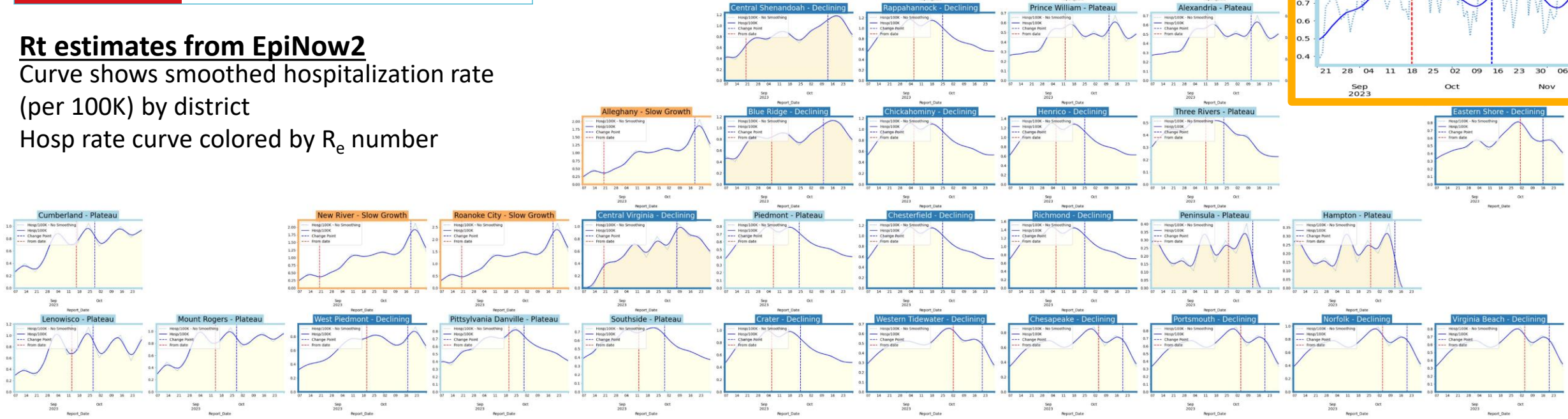
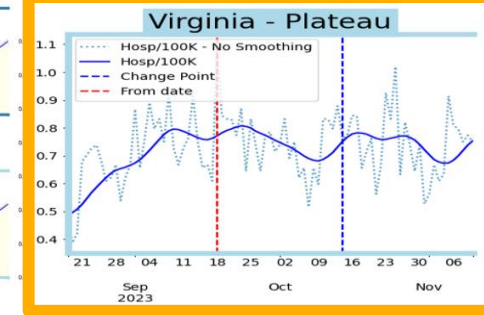
Curve shows smoothed hospitalization rate

(per 100K) by district

Hosp rate curve colored by R<sub>e</sub> number



## State level Time Series



# COVID-19 Growth Metrics

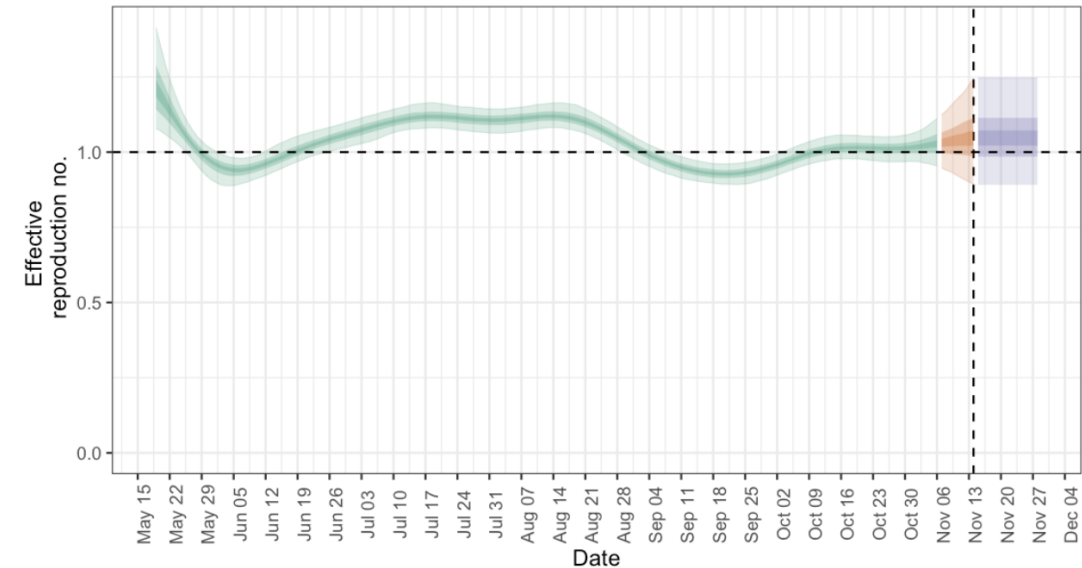
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# Estimating Daily Reproductive Number – VDH report dates – EpiNow2 estimation

Re from VDH Cases (last 6 months)

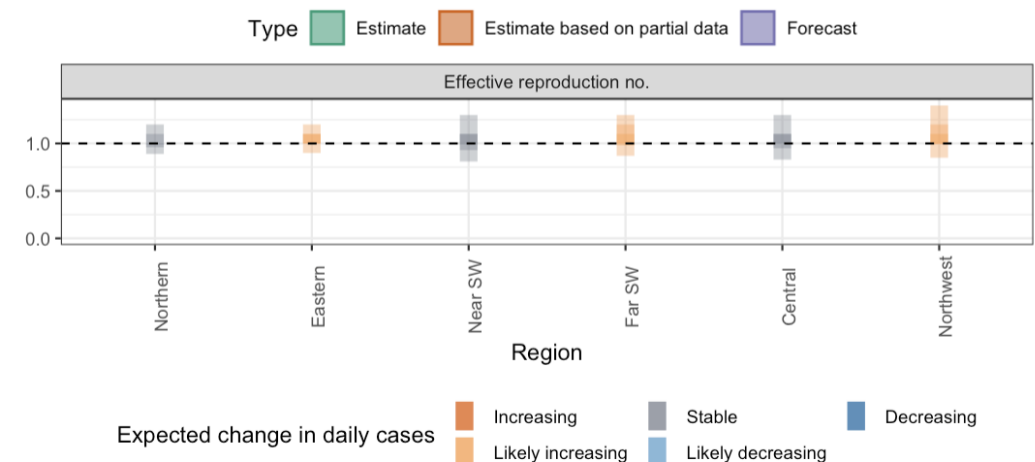
Reproductive Estimate Summary as of November 14, 2023

Region	Reproductive number estimate	IQR	Trend forecast
State-wide cases	1.00	0.89 – 1.2	Likely increasing
State-wide hosp	1.00	0.93 – 1.2	Likely increasing
Central	1.00	0.83 – 1.3	Stable
Eastern	1.10	0.9 – 1.2	Likely increasing
Far SW	1.10	0.87 – 1.3	Likely increasing
Near SW	1.00	0.81 – 1.3	Stable
Northern	1.00	0.89 – 1.2	Stable
Northwest	1.10	0.85 – 1.4	Likely increasing



## Methodology

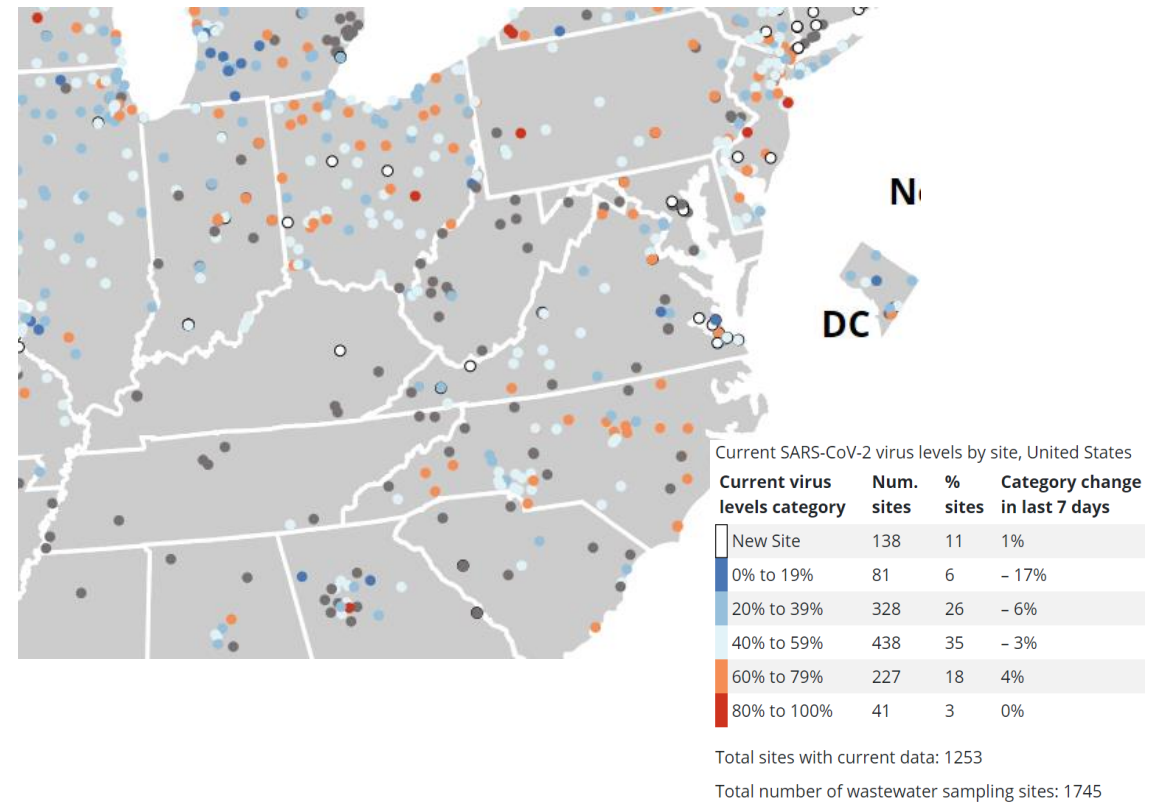
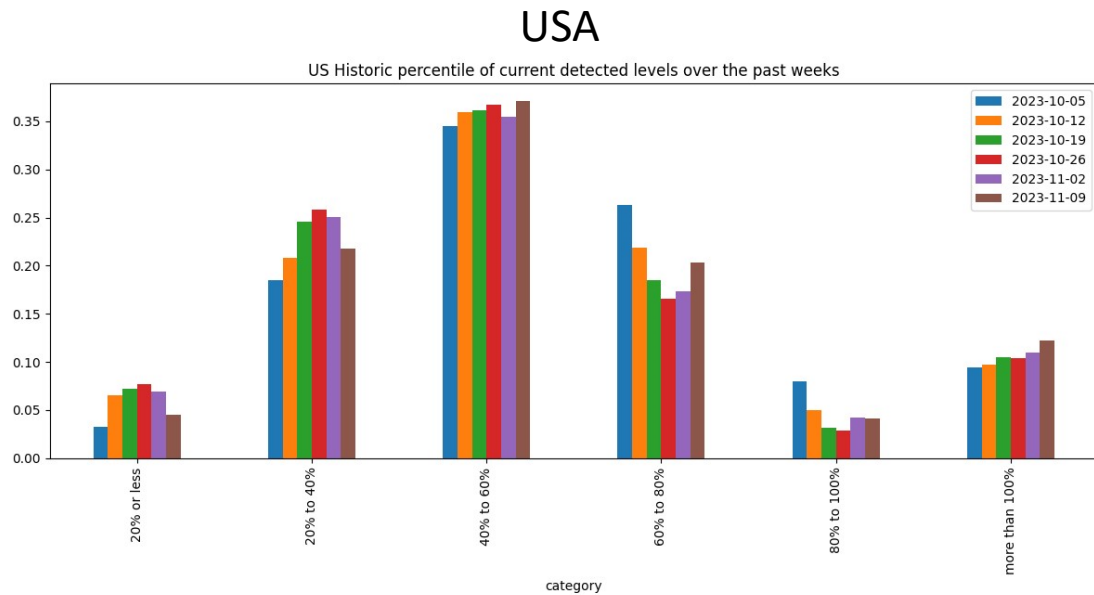
- Sam Abbott, Joel Hellewell, Katharine Sherratt, Katelyn Gostic, Joe Hickson, Hamada S. Badr, Michael DeWitt, Robin Thompson, EpiForecasts, Sebastian Funk (2020). **EpiNow2**: Estimate Real-Time Case Counts and Time-Varying Epidemiological Parameters. doi:10.5281/zenodo.3957489.
- Serial interval, generation time, and incubation period built into disease model via EpiNow2.
- Uses confirmation date but report date biases are better accounted for.
- Note: most recent data point for hospitalizations is 3 days prior to that of cases (HHS hospitalization through 11/11/23 vs. VDH case data through 11/14/23).



# Wastewater Monitoring

## Wastewater provides a coarse estimate of COVID-19 levels in communities

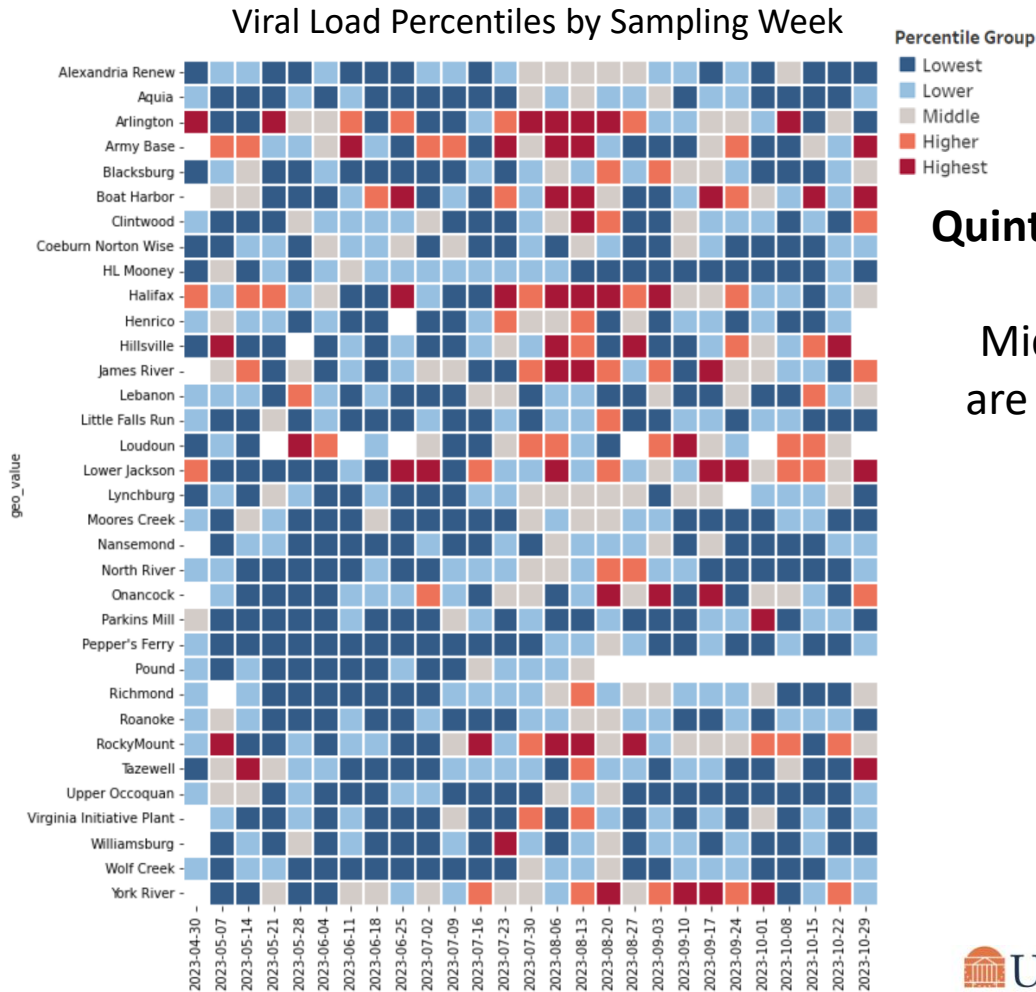
- Nationwide and in VA, sites have shifted from lower trend categories to higher trend categories



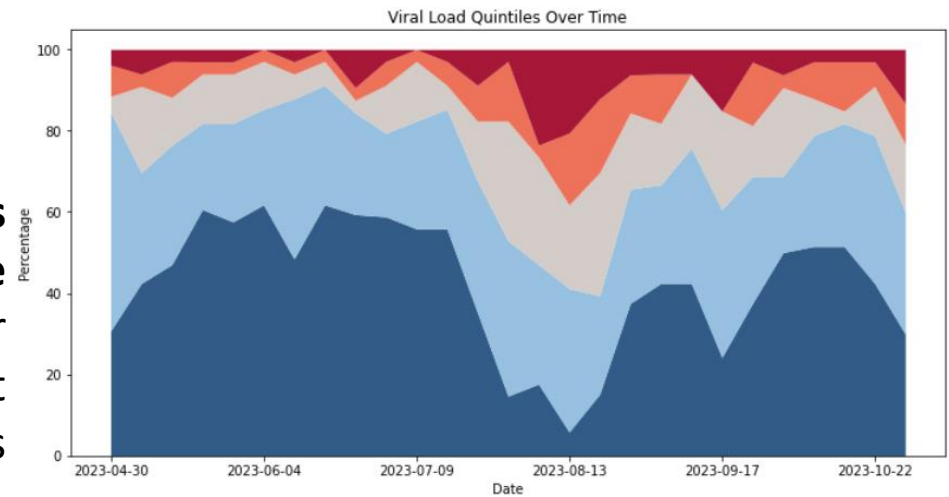
# Wastewater Monitoring – VA Sites

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

- Some VA sites (esp. Eastern) are starting to shift to higher quintiles in wastewater percentile groups



Quintile proportions over time  
Middle and higher are growing in past couple weeks



Start of Sample Collection Week  
October 29, 2023

Trend

- Increase
- Plateau
- Decrease
- Below Detection
- No Trend Available



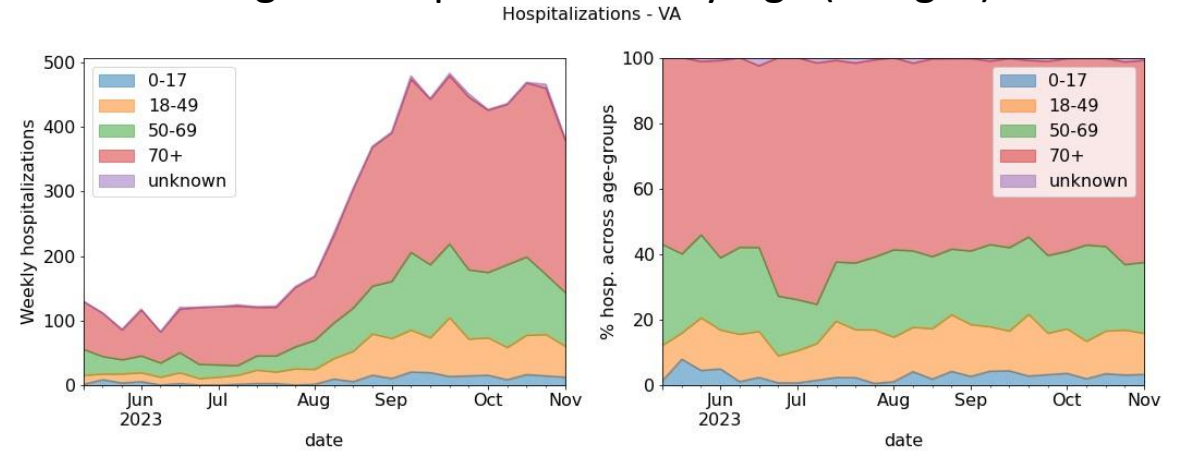
# Hospitalizations in VA by Age

## Age distribution in hospitals showing slight shift towards younger age groups

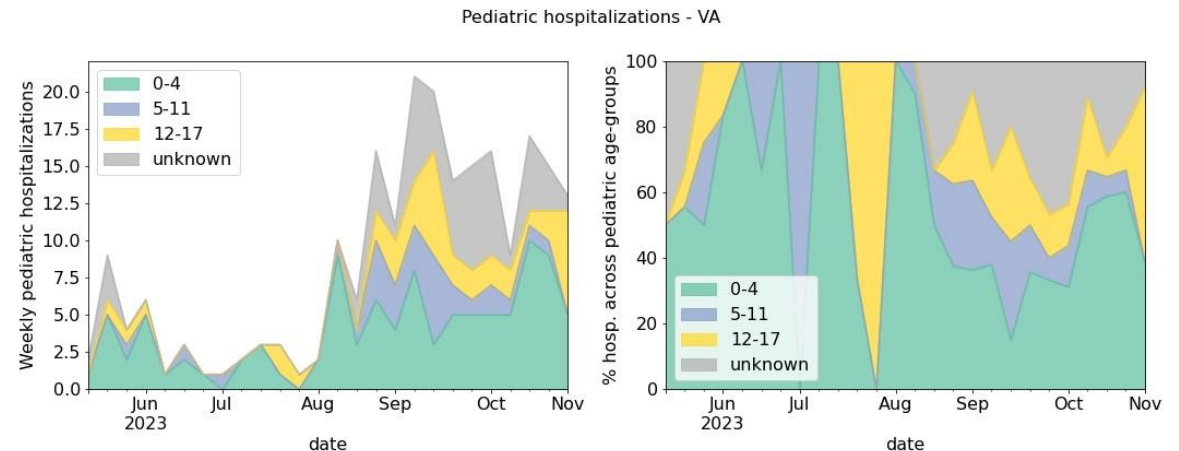
- Overall hospitalizations increasing across all age groups
- Increase in pediatric hospitalizations (0-4 age group), remain high, but have come down a little in last week

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

### Virginia Hospitalizations by Age (all ages)



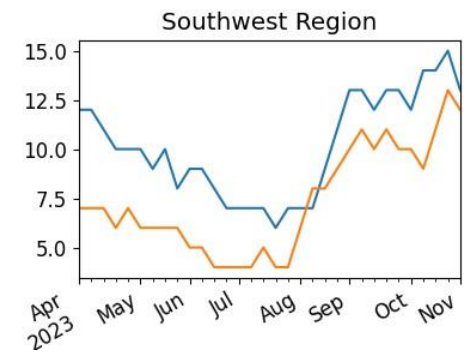
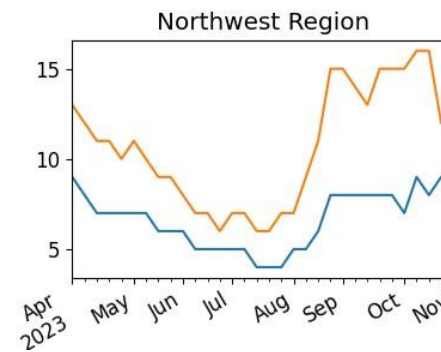
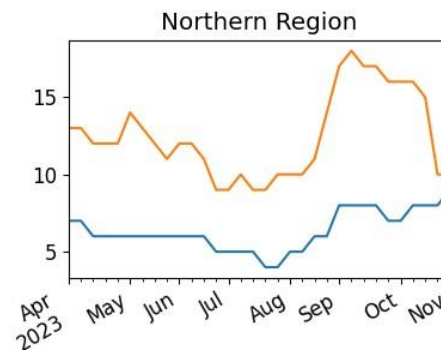
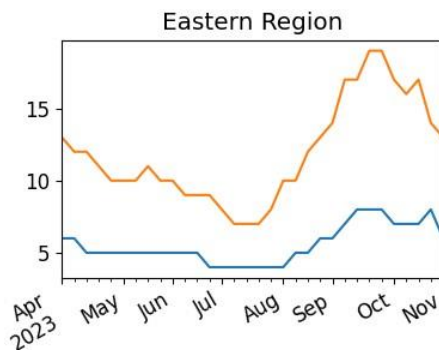
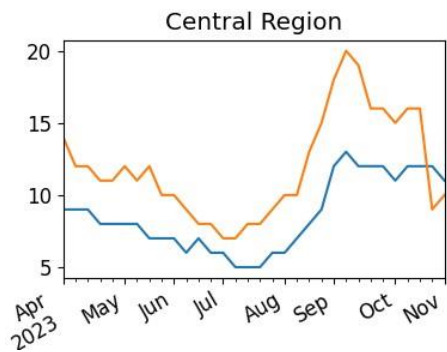
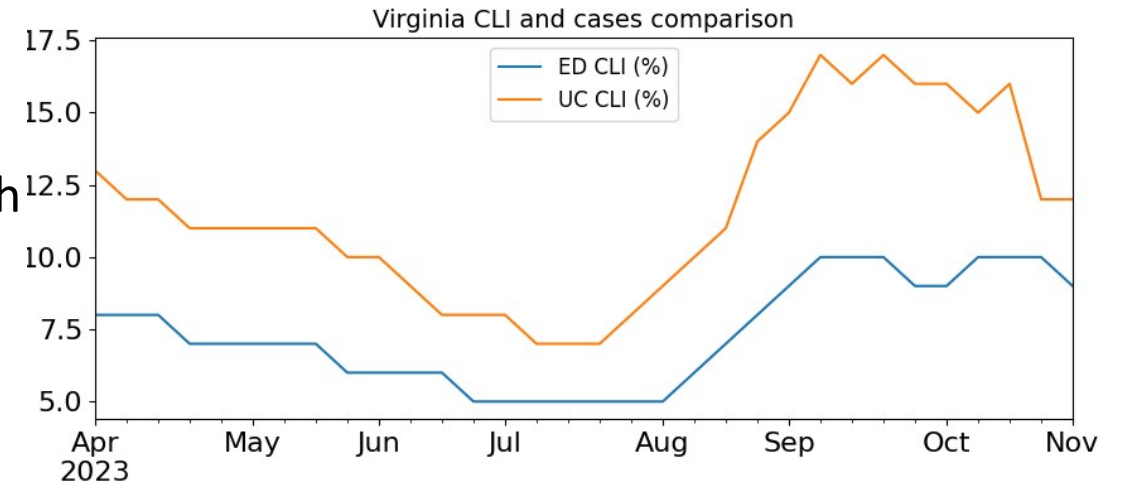
### Pediatric Hospitalizations by Age (0-17yo)



# COVID-like Illness Activity

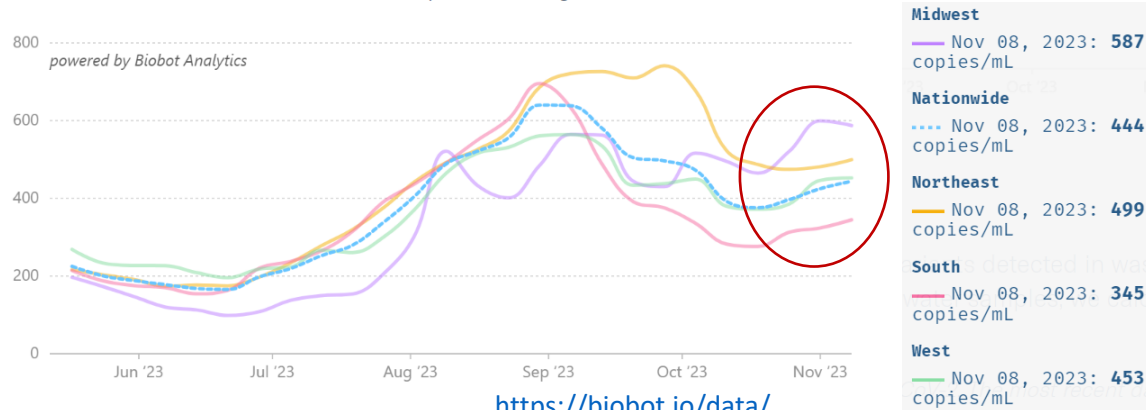
## COVID-like Illness (CLI) gives a measure of COVID transmission in the community

- 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
- **CLI continues to decline**
- **Levels now back to those seen last in late winter**



# Wastewater, ED visits, and Test positivity

**Wastewater:** Effective SARS-CoV-2 virus concentration (copies / mL of sewage)

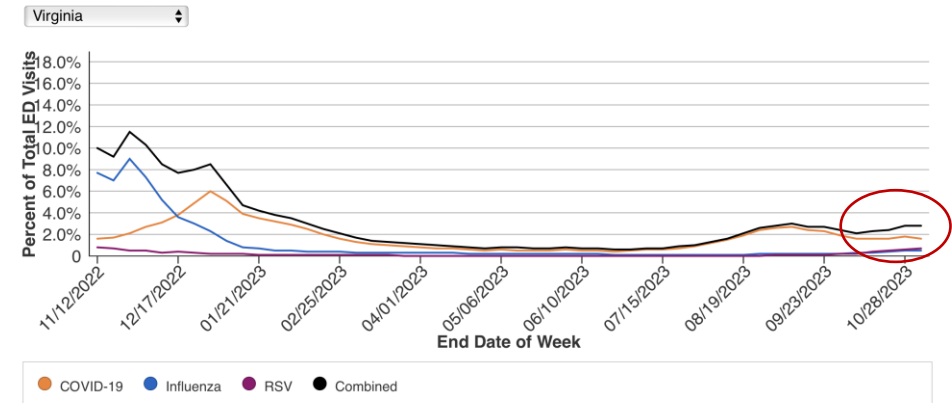


Source: Wastewater data from Biobot Analytics

<https://biobot.io/data/>

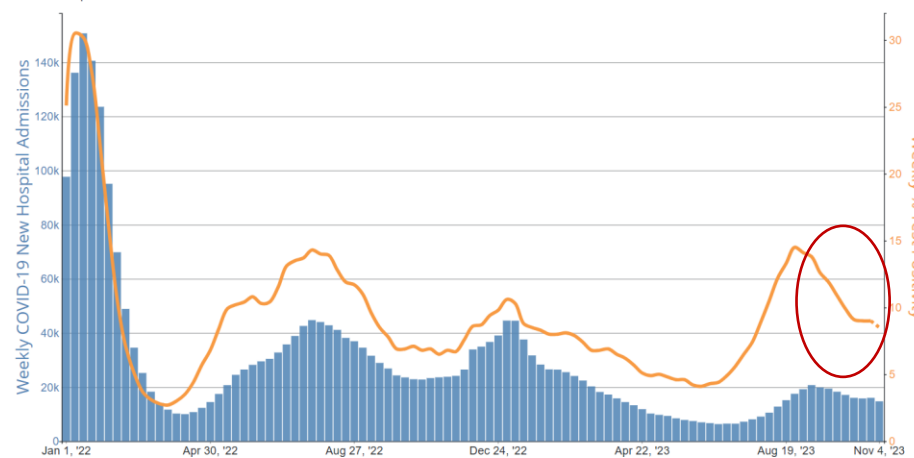
**Weekly Emergency Department Visits by Viral Respiratory Illness Type and State, as a Percent of All Emergency Department Visits**

Make a selection from the filters to change the visualization information.



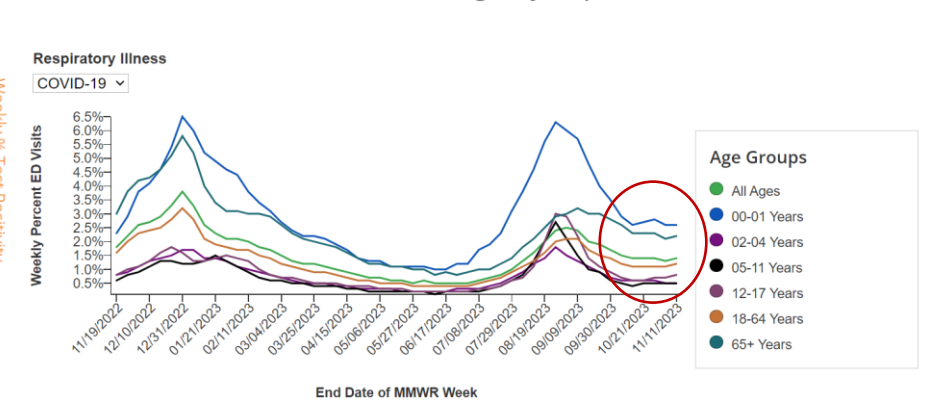
- WW signals are all in decline but the Northeast which seems to have peaked recently
- ED visits for COVID also are all in decline now

COVID-19 New Hospital Admissions and COVID-19 Nucleic Acid Amplification Test (NAAT) Percent Positivity, by Week, in The United States, Reported to CDC



[https://covid.cdc.gov/covid-data-tracker/#trends\\_weeklyhospitaladmissions\\_testpositivity\\_00](https://covid.cdc.gov/covid-data-tracker/#trends_weeklyhospitaladmissions_testpositivity_00)

**Weekly Emergency Department Visits by Age Group and Respiratory Illness, as a Percent of All Emergency Department Visits**



<https://www.cdc.gov/ncird/surveillance/respiratory-illnesses/index.html>



# COVID-19 Spatial Epidemiology

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# ZIP Code level case rate since last meeting

## New cases per 100k in the last five weeks

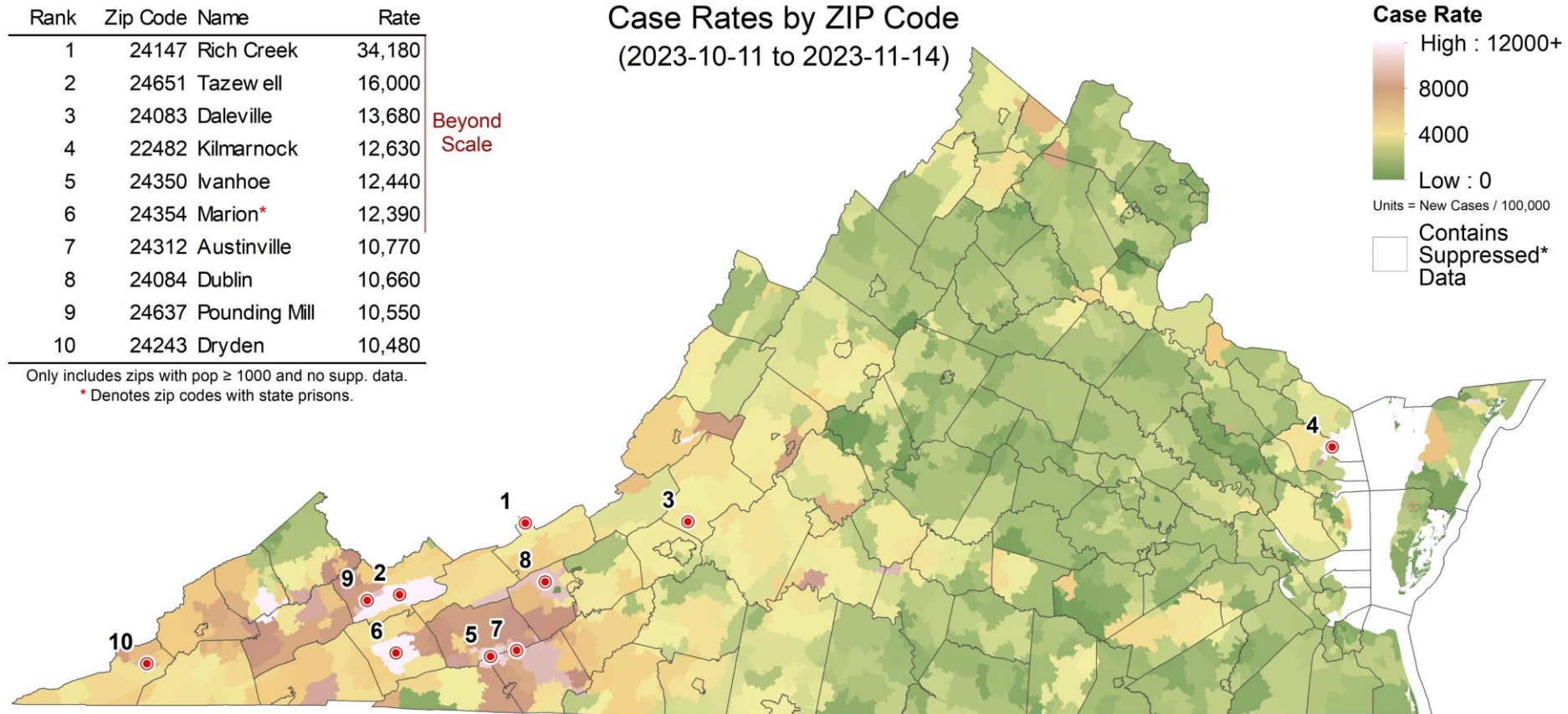
- Rates are for the weeks since last meeting. Divide rates by five to calculate average weekly incidence.
- Note the **new color scale** as Southwest has gone beyond the 0 to 7,500 range used previously.
- Rates remain elevated in the Southwest. Areas west of Lynchburg have seen significant declines.
- Marion is the only prison containing ZIP code in the top 10.

Rank	Zip Code	Name	Rate
1	24147	Rich Creek	34,180
2	24651	Tazewell	16,000
3	24083	Daleville	13,680
4	22482	Kilmarnock	12,630
5	24350	Ivanhoe	12,440
6	24354	Marion*	12,390
7	24312	Austinville	10,770
8	24084	Dublin	10,660
9	24637	Pounding Mill	10,550
10	24243	Dryden	10,480

Beyond Scale

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

Case Rates by ZIP Code  
(2023-10-11 to 2023-11-14)



**Case Rate**  
High : 12000+  
8000  
4000  
Low : 0  
Units = New Cases / 100,000  
Contains Suppressed\* Data

Based on Spatial Empirical Bayes smoothed case rates, with an 8:1 ascertainment ratio, for five weeks ending 2023-11-14.

# Risk of Exposure and Hot Spots

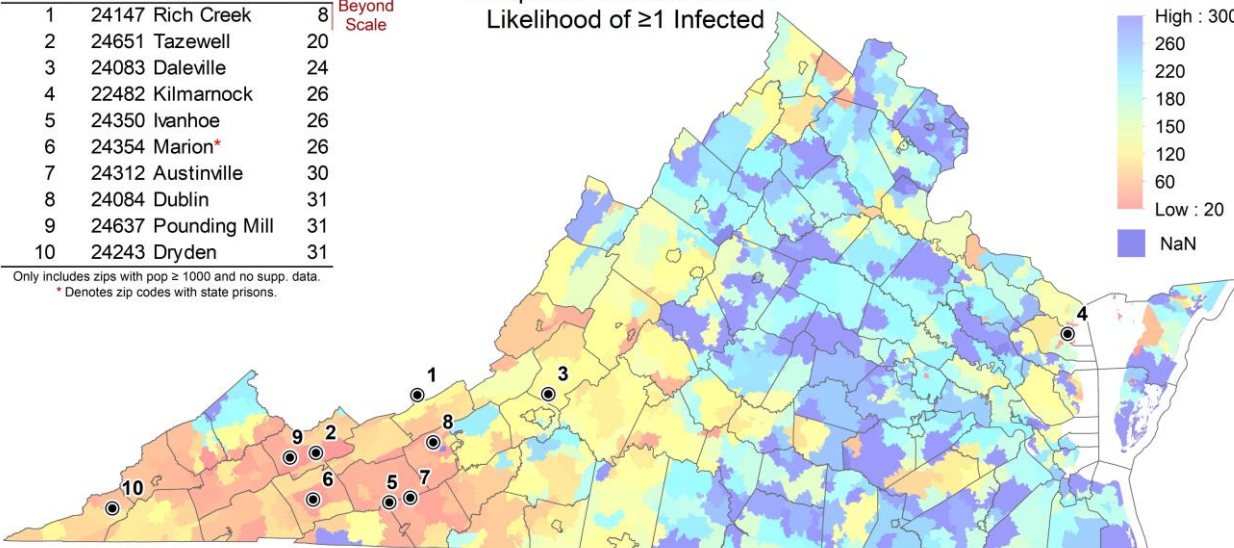
**Case rates since last meeting by zip code used to calculate risk of encountering someone infected in a gathering of randomly selected people and find spatial hot spots**

- **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 8 in Rich Creek, there is a 50% chance someone will be infected).
- **Spatial Clustering:** Getis-Ord Gi\* based hot spots compare clusters of zip codes with **five-week** case rates higher than nearby zip codes to identify larger areas with statistically significant deviations.

Rank	Zip Code	Name	Size
1	24147	Rich Creek	8 <small>Beyond Scale</small>
2	24651	Tazewell	20
3	24083	Daleville	24
4	22482	Kilmarnock	26
5	24350	Ivanhoe	26
6	24354	Marion*	26
7	24312	Austinville	30
8	24084	Dublin	31
9	24637	Pounding Mill	31
10	24243	Dryden	31

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

Group Size Needed for 50% Likelihood of ≥1 Infected

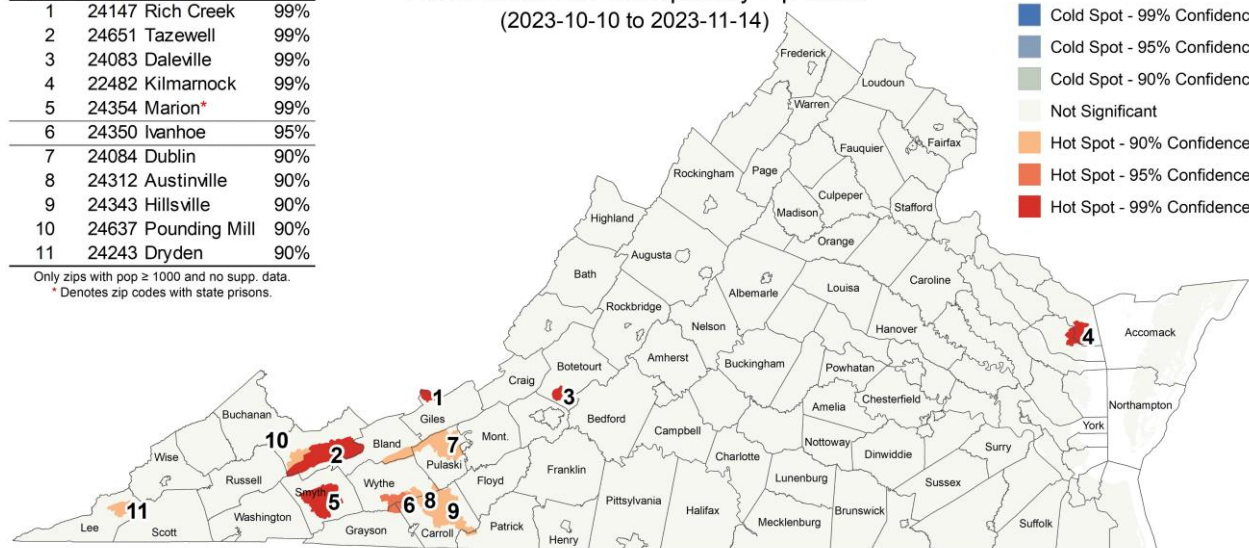
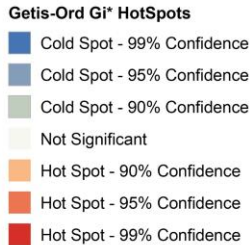


Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for four weeks ending 2023-11-14.

Spot	Zip Code	Name	Conf.
1	24147	Rich Creek	99%
2	24651	Tazewell	99%
3	24083	Daleville	99%
4	22482	Kilmarnock	99%
5	24354	Marion*	99%
6	24350	Ivanhoe	95%
7	24084	Dublin	90%
8	24312	Austinville	90%
9	24343	Hillsville	90%
10	24637	Pounding Mill	90%
11	24243	Dryden	90%

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

Point Prevalence Hot Spots by Zip Code (2023-10-10 to 2023-11-14)



Based on Global Empirical Bayes smoothed point prevalence for the four weeks ending 2023-11-14.

# COVID-19 among Healthcare Workers

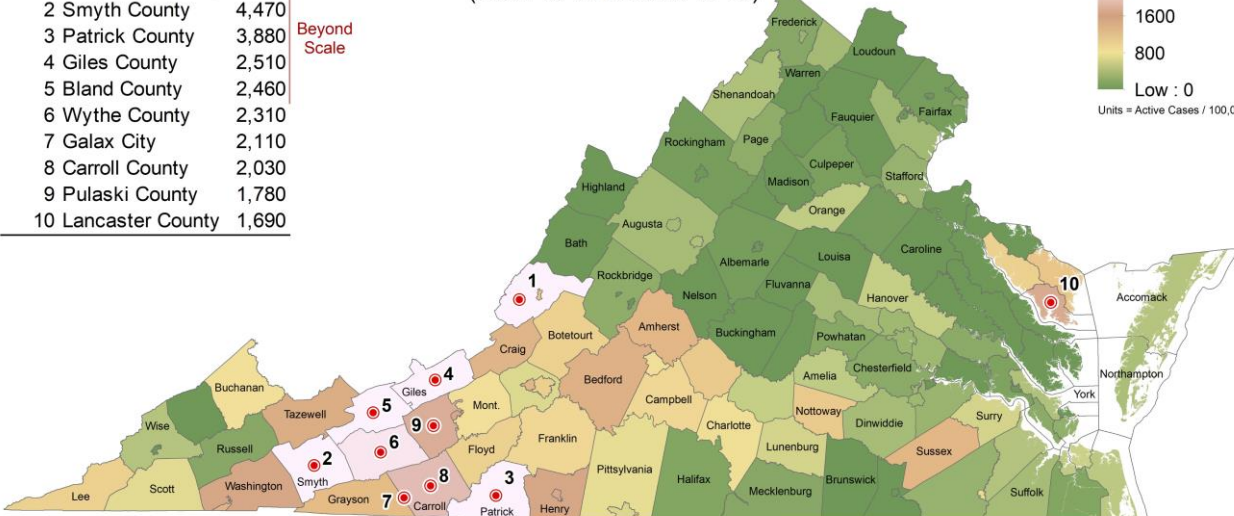
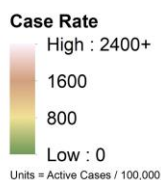
**COVID-19 case rates for the public and for healthcare workers (HCW) were compared to find regions where HCW suffered unusually high burdens of disease**

- **HCW Rate:** Case rate among health care workers (HCW) over a five-week period November 13
- **HCW Ratio:** Case rate among health care workers (HCW) over the same period using patient facing health care workers as the numerator, and the population's case rate as the denominator.
- Unusual high HCW rates seen in the far Southwest; high ratios west of Lynchburg and south of Richmond.

Rank	Name	Prev
1	Alleghany County	4,950
2	Smyth County	4,470
3	Patrick County	3,880
4	Giles County	2,510
5	Bland County	2,460
6	Wythe County	2,310
7	Galax City	2,110
8	Carroll County	2,030
9	Pulaski County	1,780
10	Lancaster County	1,690

Beyond Scale

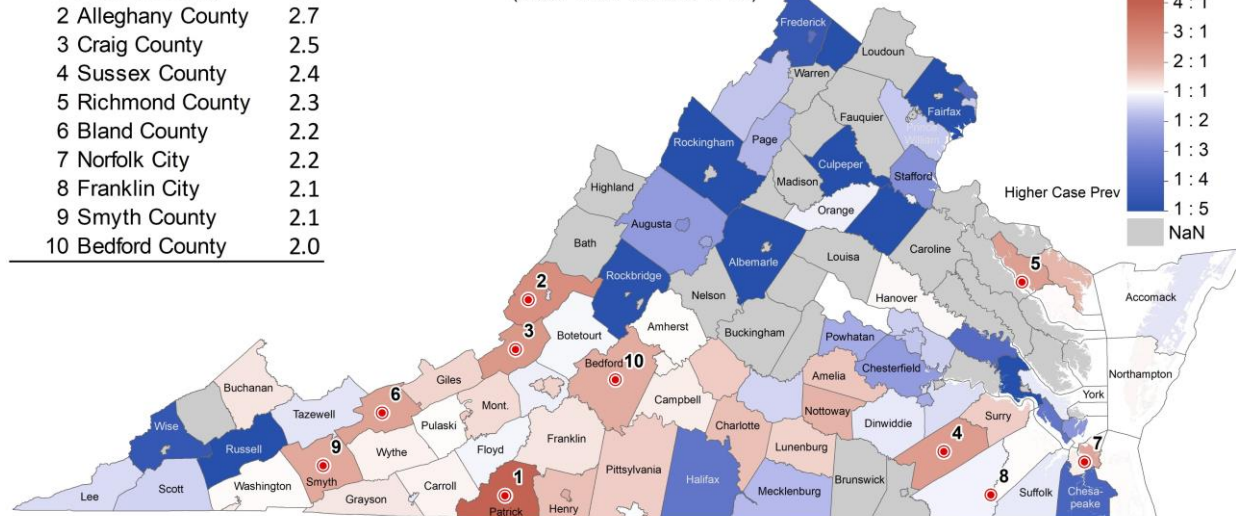
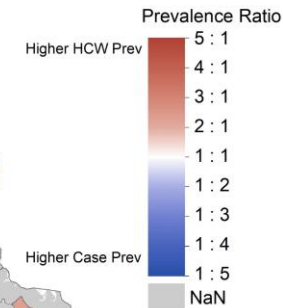
HCW Case Rate by County  
(2023-10-09 to 2023-11-13)



Note: Scale differs from general public prevalence maps.

Rank	Name	Ratio
1	Patrick County	3.9
2	Alleghany County	2.7
3	Craig County	2.5
4	Sussex County	2.4
5	Richmond County	2.3
6	Bland County	2.2
7	Norfolk City	2.2
8	Franklin City	2.1
9	Smyth County	2.1
10	Bedford County	2.0

HCW Prevalence / Case Prevalence  
(2023-10-09 to 2023-11-13)

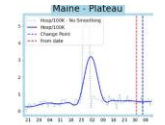
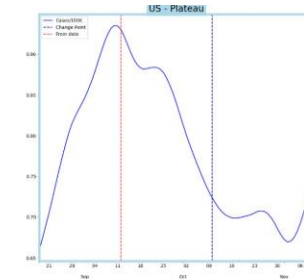
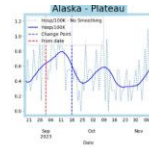


Note: This assumes that the ascertainment rate of healthcare workers is double that of the public.

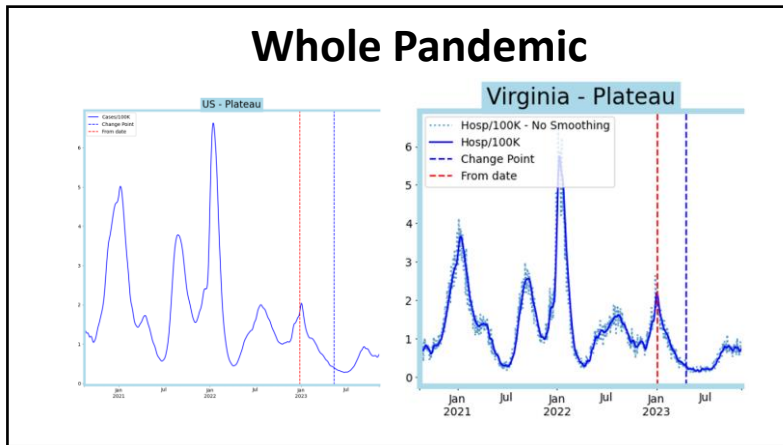
# COVID-19 Broader Context

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# United States Hospitalizations



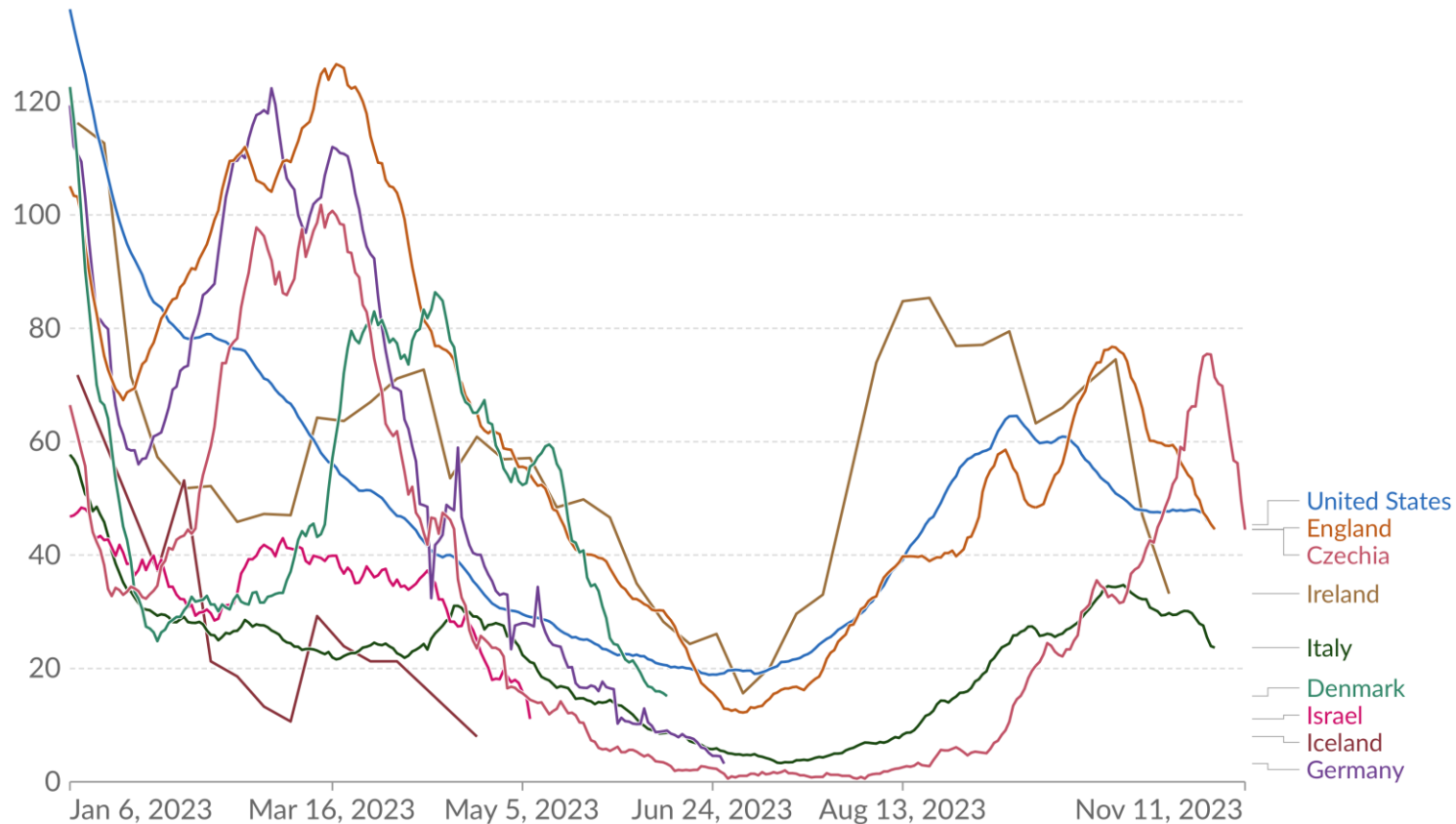
Status	Current Week	Last Month
Declining	4	(1)
Plateau	40	(26)
Slow Growth	9	(16)
In Surge	0	(0)



# Around the World – Hospital Admissions

## Weekly new hospital admissions for COVID-19 per million people

Weekly admissions refer to the cumulative number of new admissions over the previous week.



Data source: Official data collated by Our World in Data

CC BY



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[Our World in Data](https://ourworldindata.org)

# COVID-19 Genomic Update

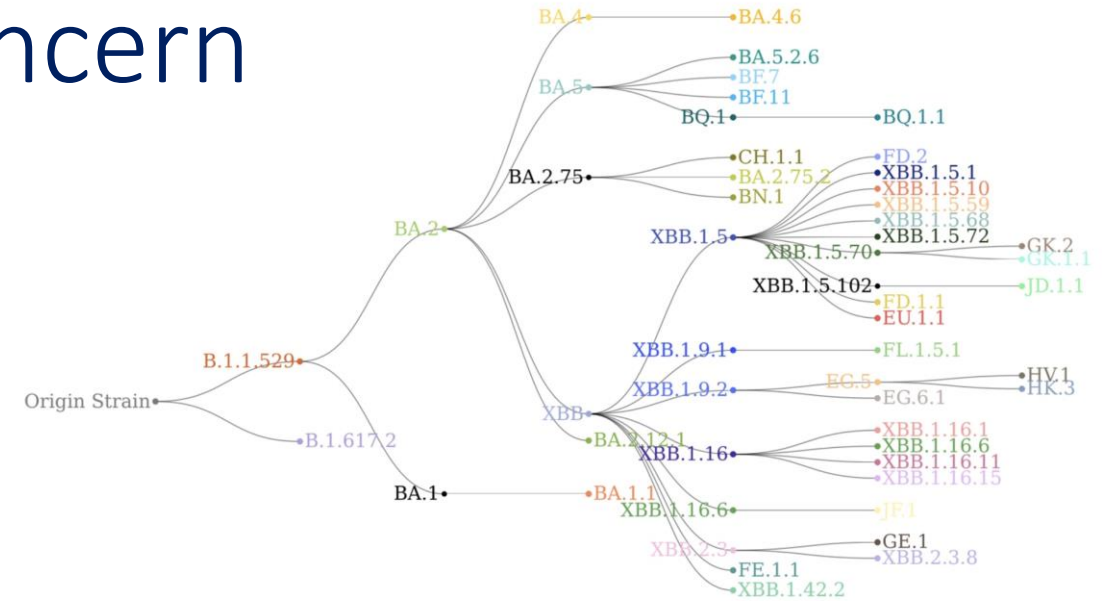
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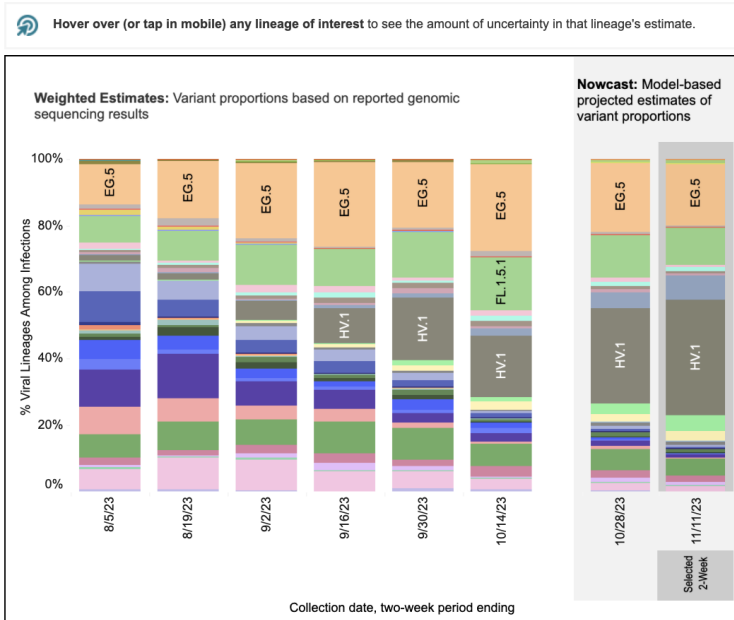
# SARS-CoV2 Variants of Concern

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



Weighted Estimates in HHS Region 3 for 2-Week Periods in 7/23/2023 – 11/11/2023



Nowcast Estimates in HHS Region 3 for 10/29/2023 – 11/11/2023

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

WHO label	Lineage #	%Total	95%PI
Omicron	HV.1	34.7%	29.5-40.3%
	EG.5	18.5%	15.3-22.1%
	FL.1.5.1	11.3%	9.5-13.2%
	HK.3	7.1%	4.3-11.4%
	XBB.1.16.6	4.8%	4.0-5.8%
	JD.1.1	4.7%	2.5-8.5%
	JF.1	3.0%	1.8-5.0%
	XBB.1.16.11	1.9%	1.4-2.5%
	XBB.2.3	1.5%	1.1-2.2%
	BA.2	1.4%	0.6-3.3%
	XBB.1.16.15	1.3%	0.8-1.9%
	EG.6.1	1.2%	0.9-1.8%
	XBB.1.9.1	1.1%	0.6-1.9%
	XBB.1.16	1.0%	0.7-1.3%
	GE.1	0.8%	0.4-1.4%
	HF.1	0.8%	0.5-1.1%
	XBB	0.7%	0.4-1.1%
	GK.2	0.7%	0.4-1.2%
	XBB.1.16.1	0.6%	0.5-0.7%
	EG.6.1	0.4%	0.3-0.6%
	XBB.1.9.1	0.2%	0.2-0.3%
	XBB.1.5	0.2%	0.2-0.3%
	XBB.1.5.72	0.2%	0.1-0.3%
	CH.1.1	0.2%	0.1-0.3%
	XBB.2.3.8	0.1%	0.1-0.3%
	XBB.1.9.2	0.1%	0.1-0.2%
	XBB.1.5.68	0.1%	0.1-0.2%
	XBB.1.42.2	0.1%	0.0-0.1%
	XBB.1.5.10	0.0%	0.0-0.1%
	FD.1.1	0.0%	0.0-0.1%
	XBB.1.5.59	0.0%	0.0-0.0%
	XBB.1.5.1	0.0%	0.0-0.0%
	EU.1.1	0.0%	0.0-0.0%
	FE.1.1	0.0%	0.0-0.0%
Other	Other*	1.2%	0.6-2.5%

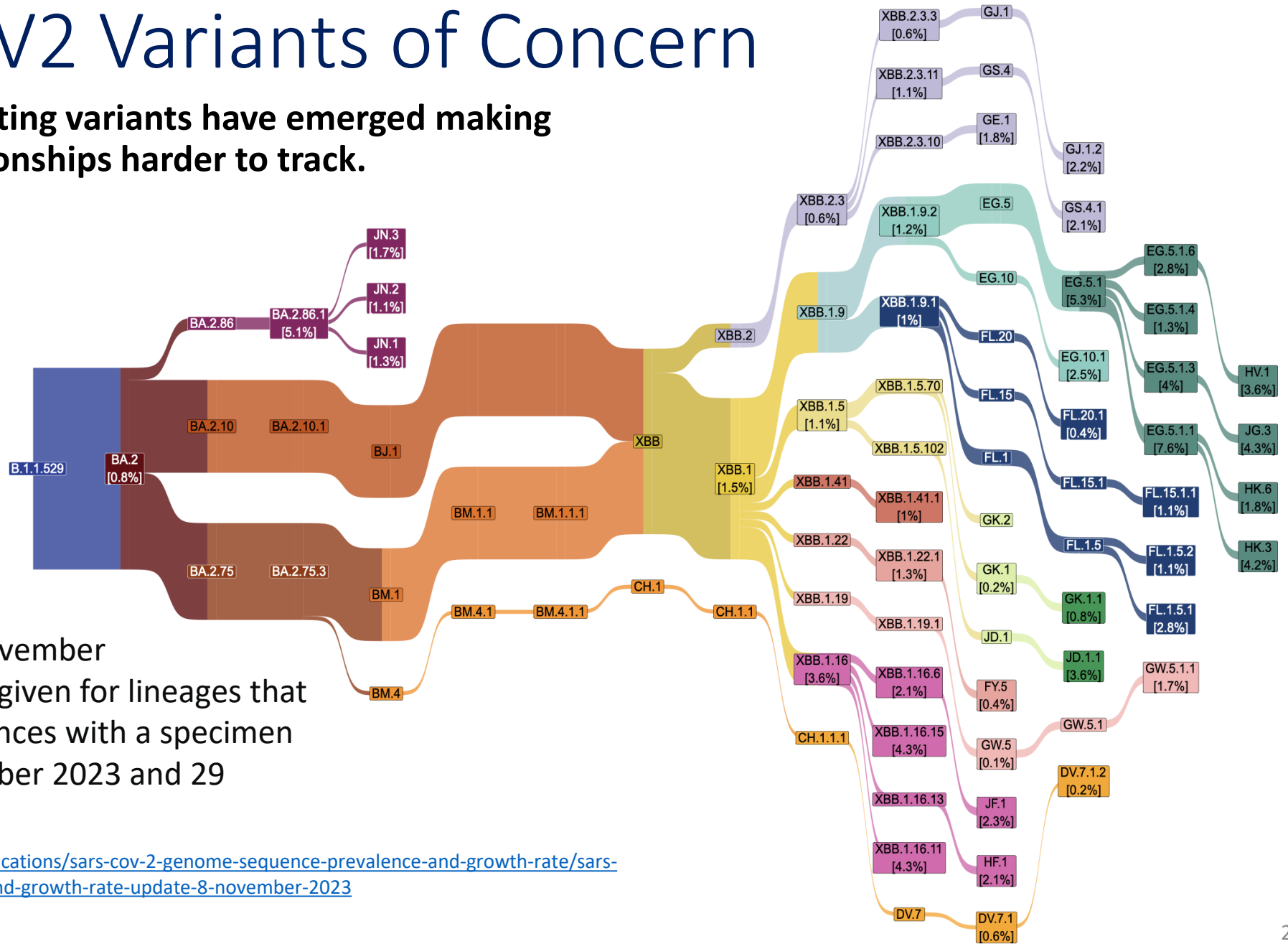
## Omicron Updates\*

- New lineage HV.1 (XBB.1.9\*) up to 34% from 31%
- EG.5 (XBB.1.9\*) slightly down to 18%
- FL.1.5.1 (XBB.1.9\*) still at 13%
- HK.3 now at 7% up from 5%
- Most circulating variants are sublineages of XBB.1.9, XBB.1.16, XBB.1.5, and XBB.2.3

\*percentages are CDC NowCast Estimates

# SARS-CoV2 Variants of Concern

A variety of co-circulating variants have emerged making differences and relationships harder to track.



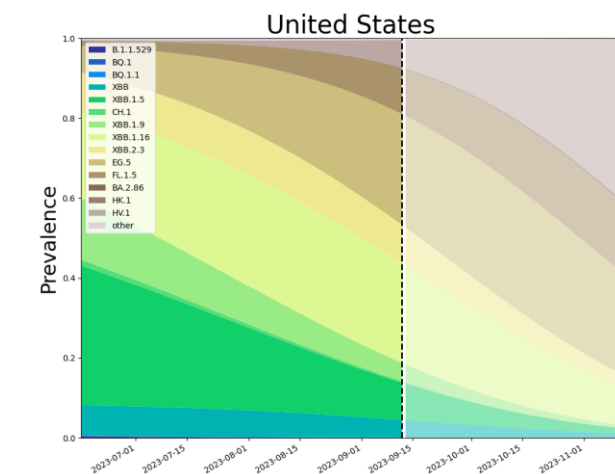
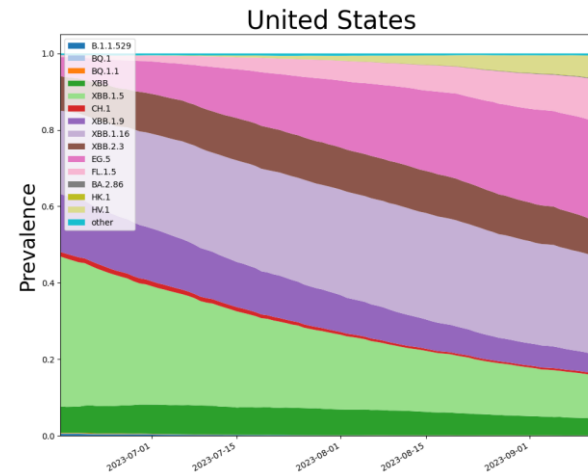
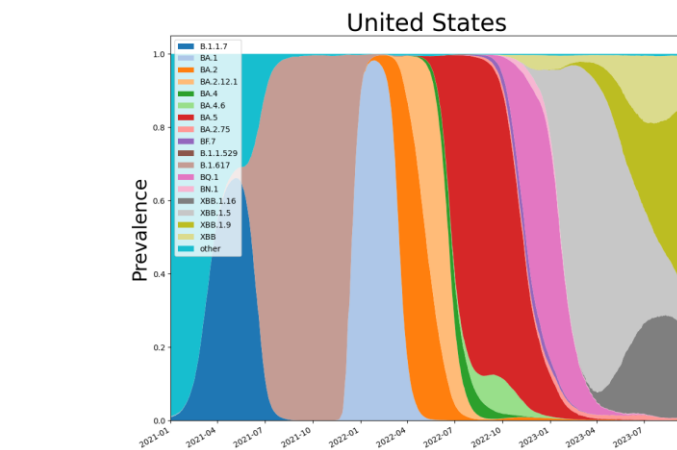
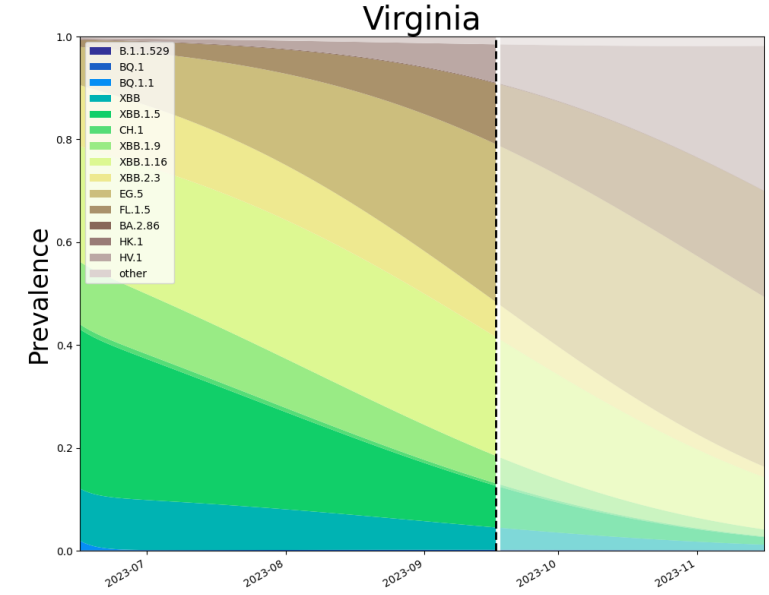
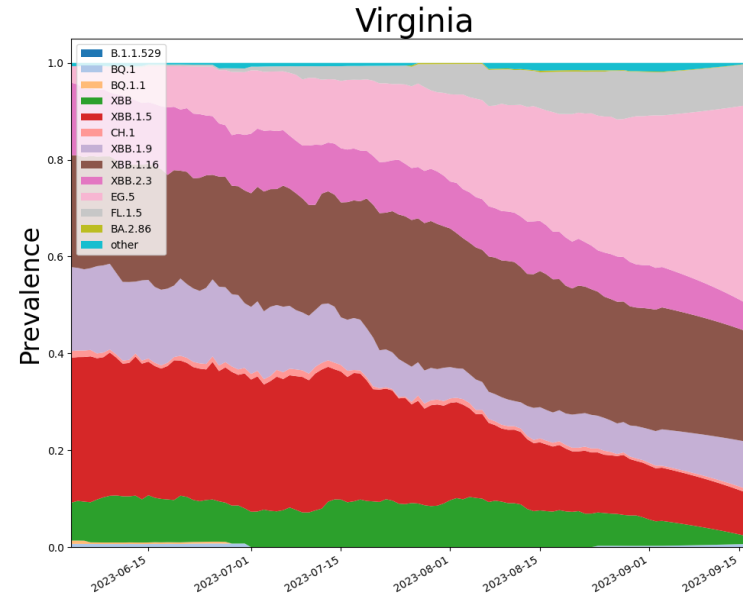
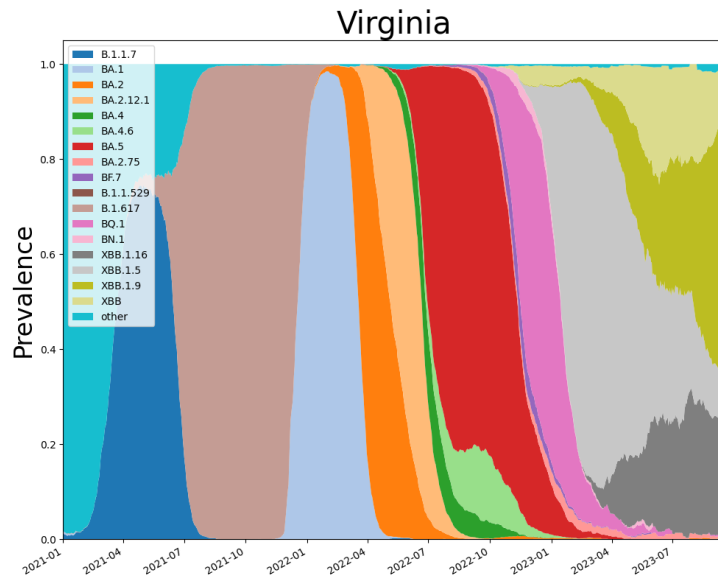
Data shown as of 6 November 2023. Proportions are given for lineages that are observed in sequences with a specimen date between 23 October 2023 and 29 October 2023.

<https://www.gov.uk/government/publications/sars-cov-2-genome-sequence-prevalence-and-growth-rate/sars-cov-2-genome-sequence-prevalence-and-growth-rate-update-8-november-2023>

# SARS-CoV2 Omicron Sub-Variants

As detected in whole Genomes in public repositories

VoC Polynomial Fit Projections



Note:  
Everything from dotted line forward is a projection.

# SARS-CoV2 Omicron Sub-Variants

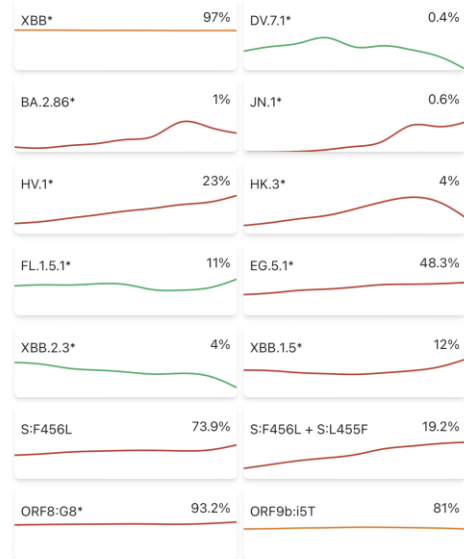
## COV-spectrum

“Editor’s choice”  
Variants to watch

### Known variants

Which variant would you like to explore?

Editor's choice ▼

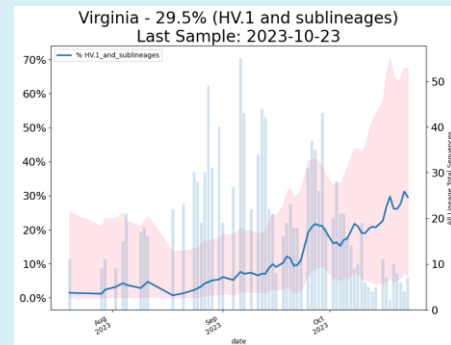


covSPECTRUM

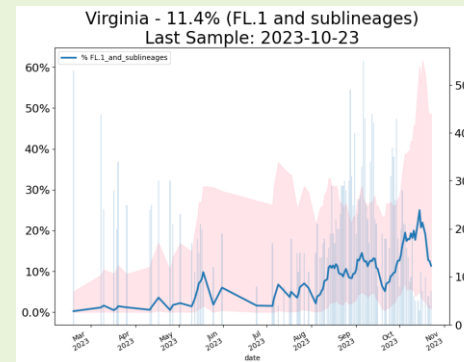
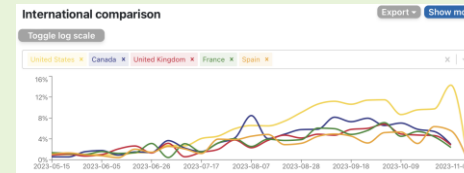
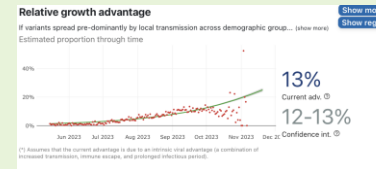
Enabled by data from 

16-Nov-23

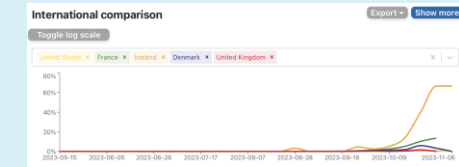
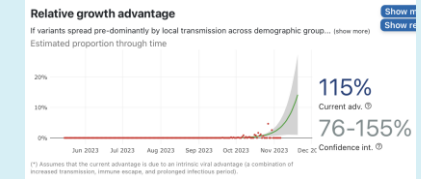
## HV.1\*



## FL.1\*



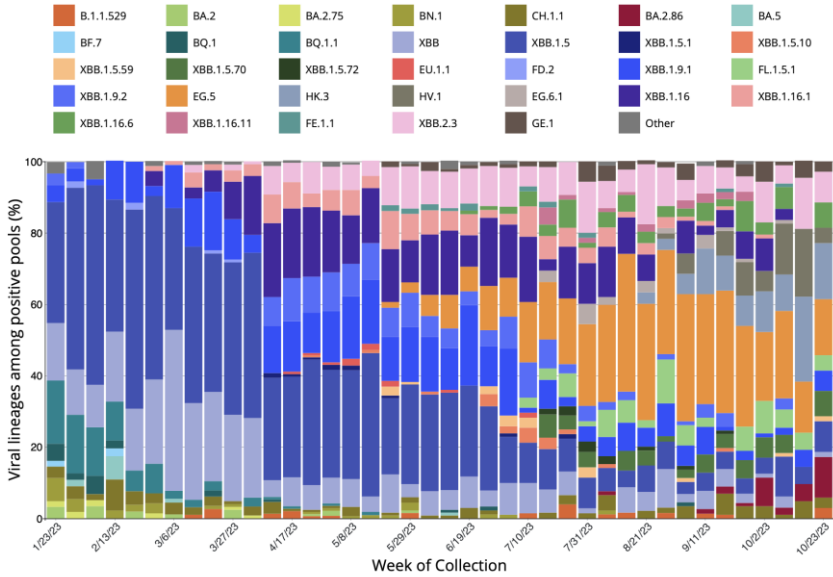
## JN.1\*



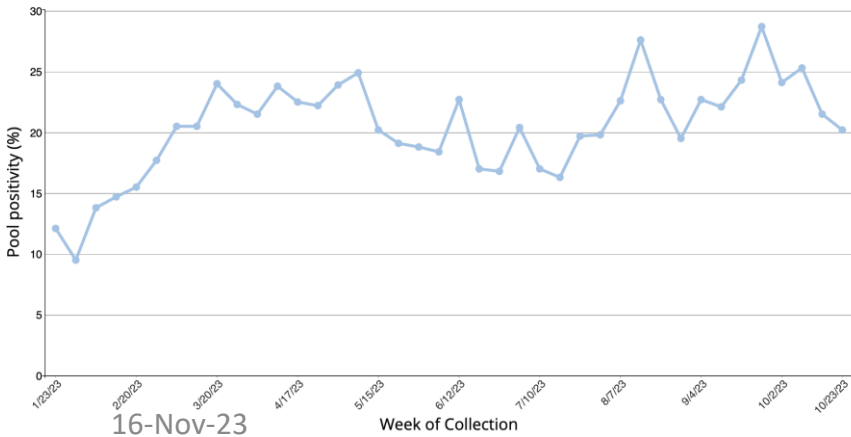
# Global SARS-CoV-2 Variant Status

## Traveller Surveillance

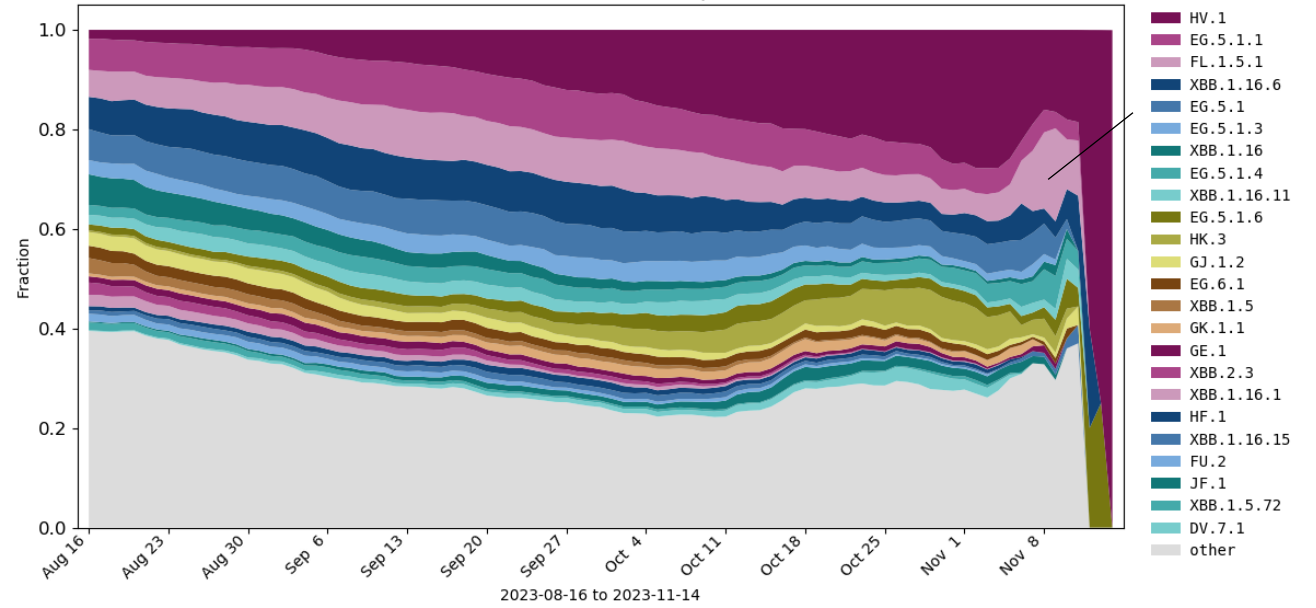
Variants Detected, by Collection Week



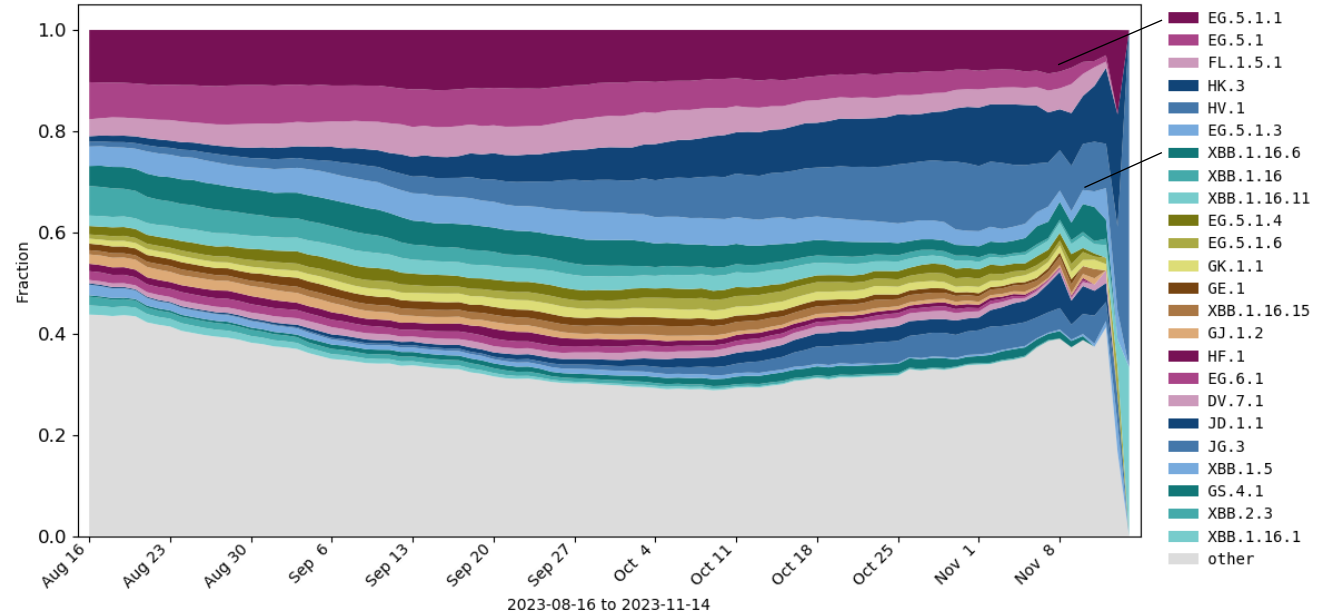
Positivity Rate for Pooled Samples, by Collection Week



North-America: 90350 sequences



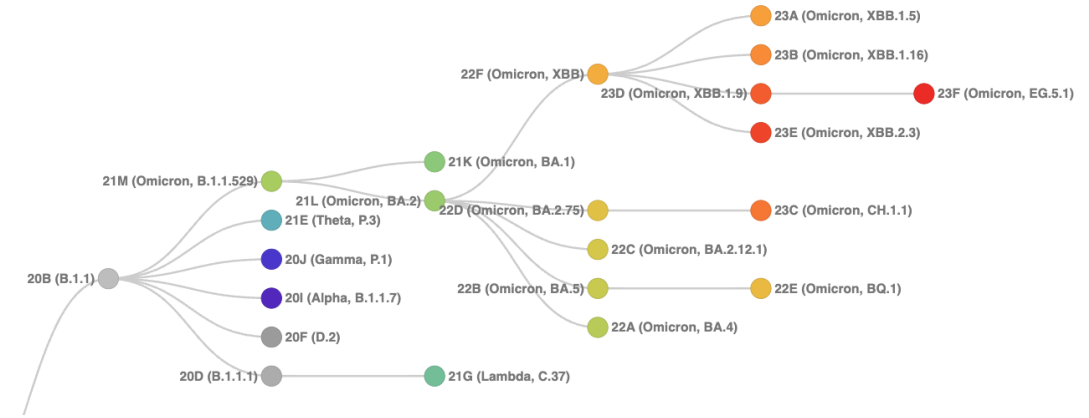
Global: 210941 sequences



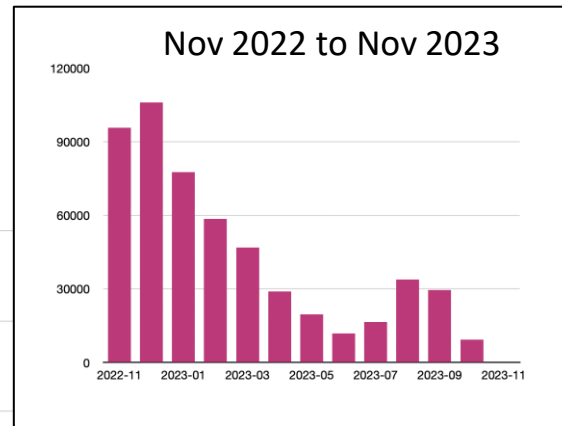
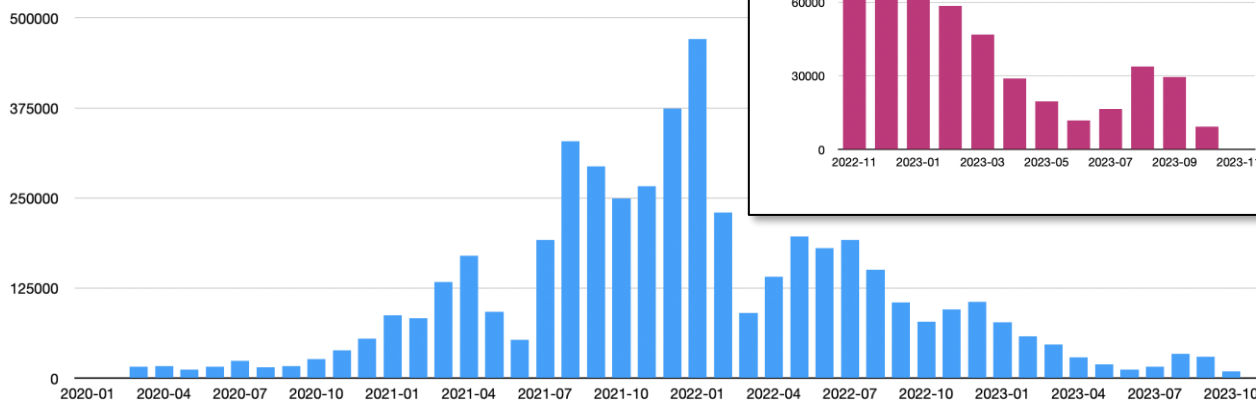
# SARS-CoV2 Sequencing

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

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



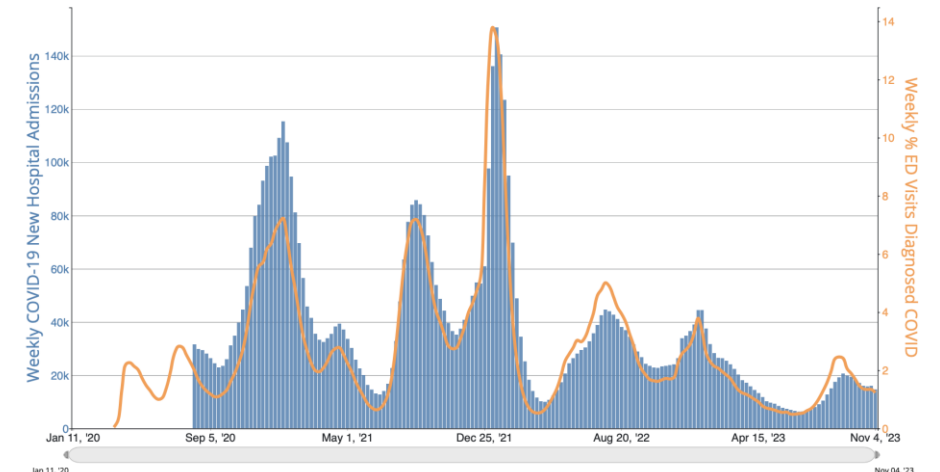
Sequences by Month in US



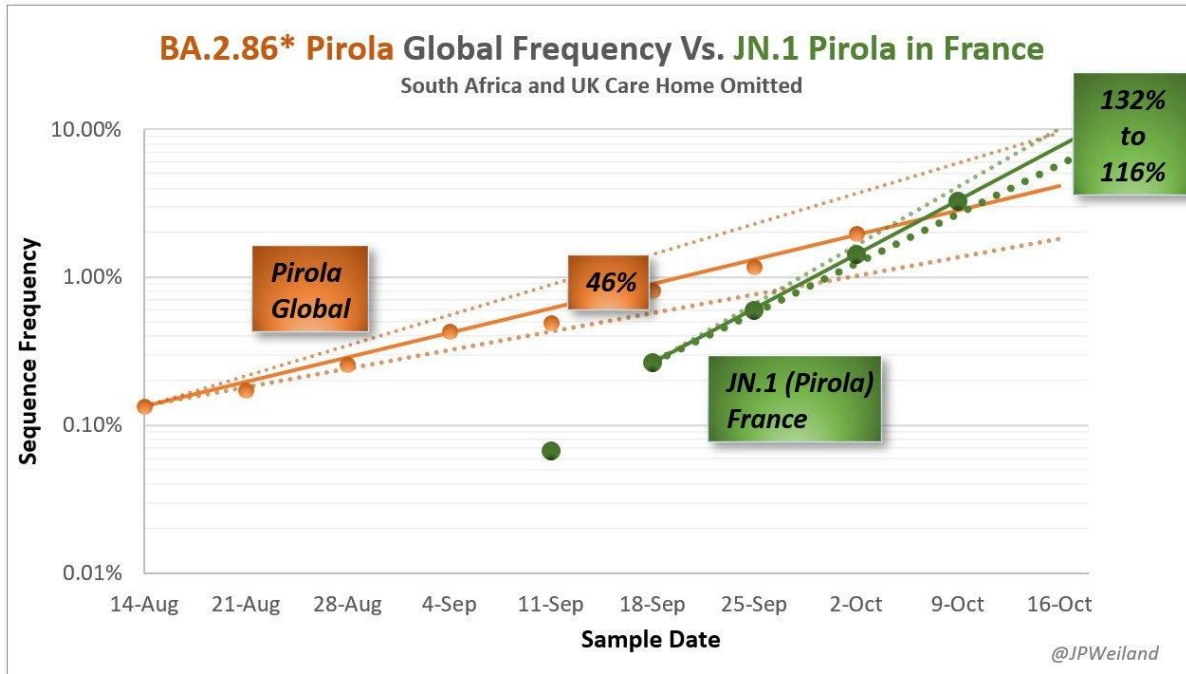
## United States

<https://clades.nextstrain.org>

COVID-19 New Hospital Admissions and Percentage of Emergency Department (ED) Visits Diagnosed as COVID-19, by Week, in The United States, Reported to CDC

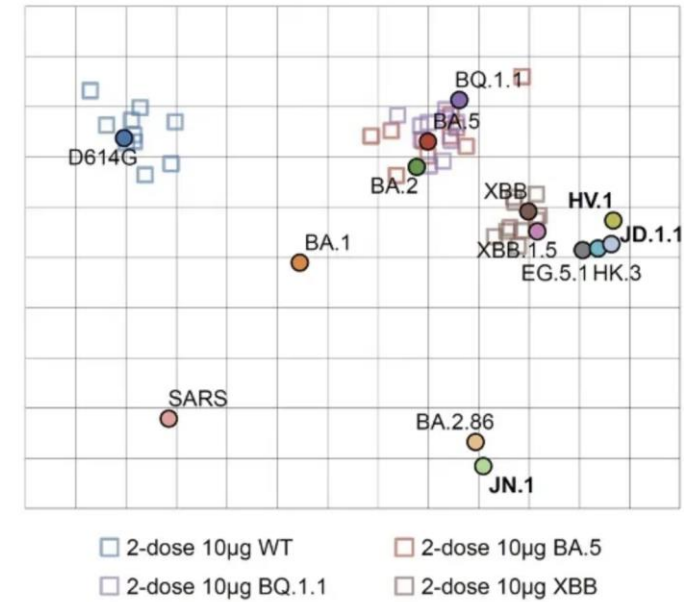


# Pandemic pubs

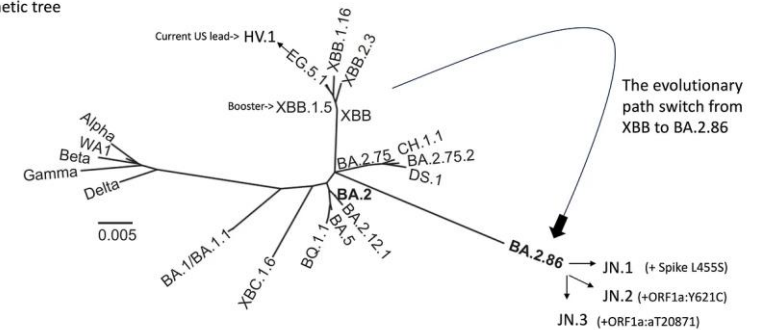


JN.1 sublineage of BA.2.86 bears watching due to immune escape, displayed growth, and mutation profile

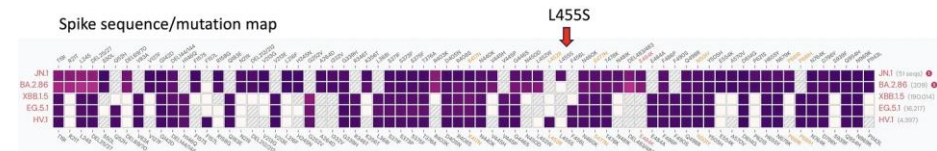
Antigenic Cartography  
(Mouse immunized by Spike mRNA)



Phylogenetic tree

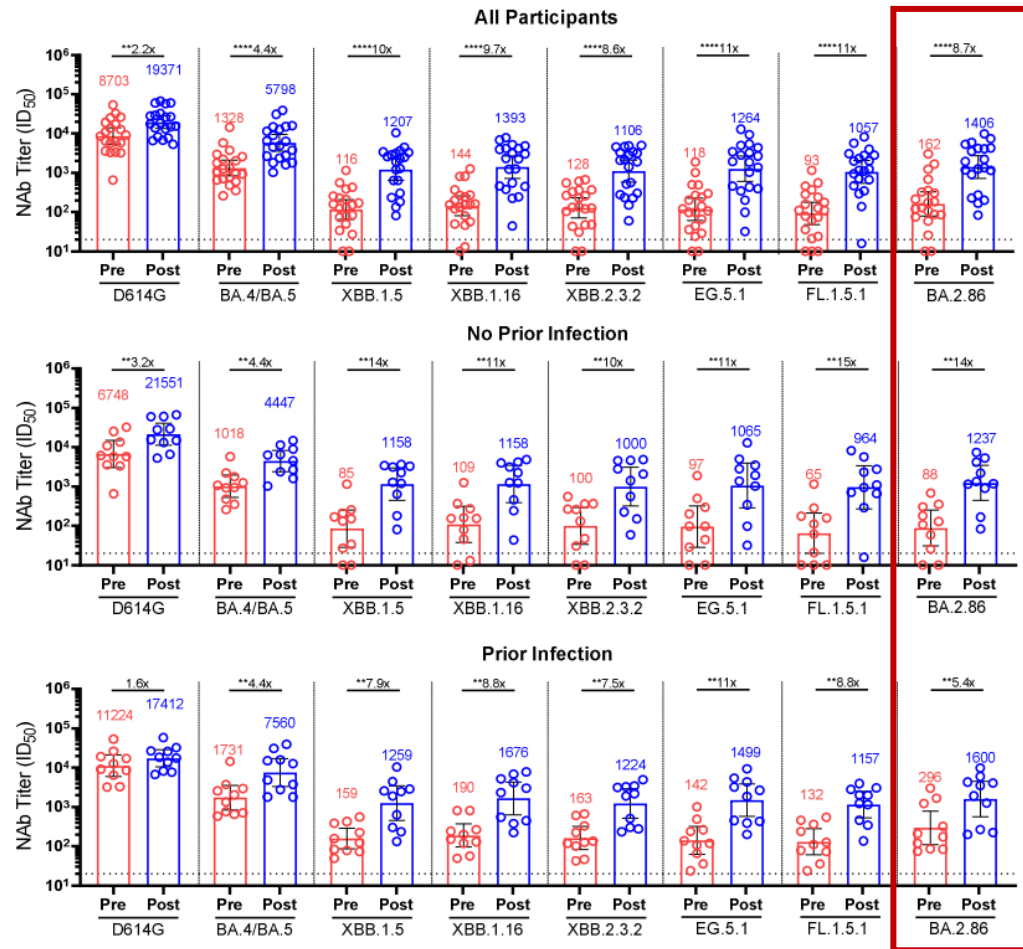


Spike sequence/mutation map



# Updated Booster & Variants of Concern

**Figure 2. Analysis of Neutralizing Antibody Titers Against Ancestral SARS-CoV-2 (D614G) and BA.4/BA.5, XBB.1.5, XBB.1.16, XBB.2.3.2, EG.5.1, FL.1.5.1 and BA.2.86 Variants in a Randomly-selected Subset of Participants Who Received Monovalent mRNA-1273.815**



Phase 2/3 participants in updated booster trial show significantly increased neutralization levels for XBB.2.3.2, EG.5.1, FL.1.5.1 and BA.2.86.

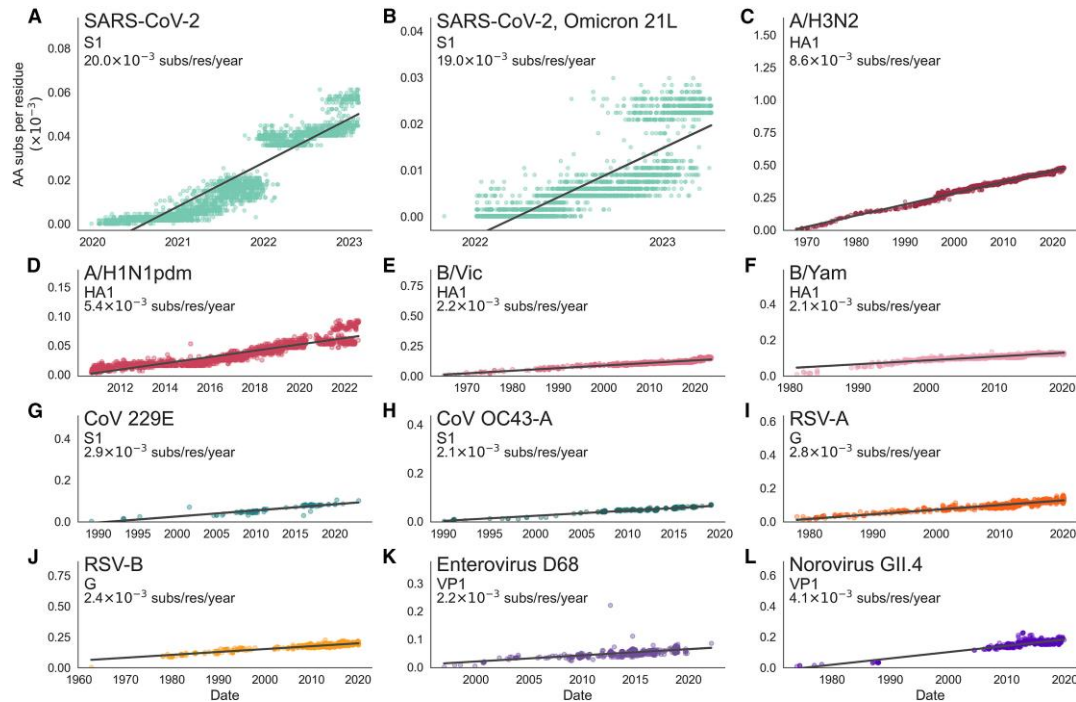
The occurrence of solicited adverse reactions and unsolicited adverse events were overall similar to those previously reported for the original mRNA-1273 50-µg and omicron BA.4/BA.5-containing bivalent mRNA-1273 vaccines.



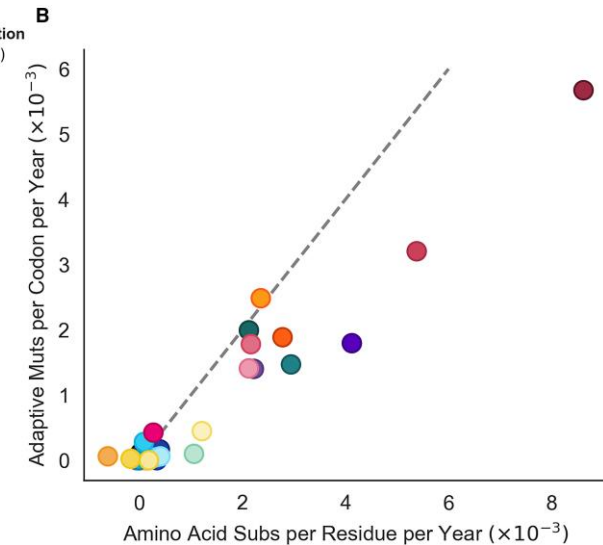
# Pandemic Pubs

Recent publication in [Cell](#), compares human viruses and their relative speed of mutation and thus adaptability

- Ongoing adaptive evolution in human endemic viruses is largely in surface proteins
- Immune evasion drives continuous adaptive evolution in many endemic human viruses
- Antigenic evolution occurs in several viral families
- SARS-CoV-2 is accumulating protein-coding changes faster than other endemic viruses



Virus	Rate AA Subs ( $\times 10^{-3}$ )	Rate Adaptation ( $\times 10^{-3}$ )
Influenza A/H3N2	8.6	5.7
Influenza A/H1N1pdm	5.4	3.2
Influenza B/Vic	2.2	1.8
Influenza B/Yam	2.1	1.4
Influenza C/Yamagata	0.3	0.4
RSV-B	2.4	2.5
RSV-A	2.8	1.9
Parainfluenza-1	1.2	0.4
Measles	-0.6	0.1
Mumps	-0.2	0.0
Parainfluenza-3	0.2	0.0
Dengue 2-AA	0.1	0.3
Dengue 4-II	0.4	0.1
Dengue 3-III	0.3	0.1
Dengue 1-V	0.0	0.0
CoV OC43-A	2.1	2.0
CoV 229E	2.9	1.5
CoV NL63	1.1	0.1
Rotavirus A/P[8]	0.4	0.2
Rotavirus A/P[4]	0.3	0.0
Norovirus GII.4	4.1	1.8
Enterovirus D68	2.2	1.4
Hepatitis A-IA	0.0	0.0
Hepatitis B-A2	0.1	0.0
Hepatitis B-D3	0.1	0.0
Parvovirus B19-1A	0.2	0.0
Adenovirus B-7	0.0	0.1
Adenovirus B-3	0.0	0.0



SARS-CoV2 at  $\sim 19-20$  AA subs/res/yr is off this chart

[Kistler & Bedford](#)  
[https://www.cell.com/cell-host-microbe/fulltext/S1931-3128\(23\)00380-3](https://www.cell.com/cell-host-microbe/fulltext/S1931-3128(23)00380-3)

# Pandemic Updates

Recent presentation on National SPHERES call reports on HV.1 severity

## **Design:**

- 3 Health systems across 5 states, with nearly 10K total sequenced samples linked to clinical outcomes
- Study restricted to period of time after HV.1 emergence (~2700 samples, of which 286 were of HV.1)

## **Results:**

- More HV.1 samples were gathered in Outpatient setting than Inpatient (consistent over time)
- HV.1 was associated with lower hospitalization likelihood compared to EG.5, XBB.1.16, and XBB.2.3

## **Conclusions:**

- These findings hold even when controlling for other demographic features, further suggesting HV.1 is associated with less severe illness than other co-circulating variants

# Influenza Update

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# Current Influenza Situation – ILI Activity

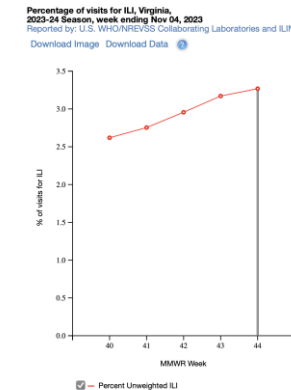
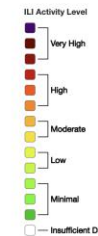
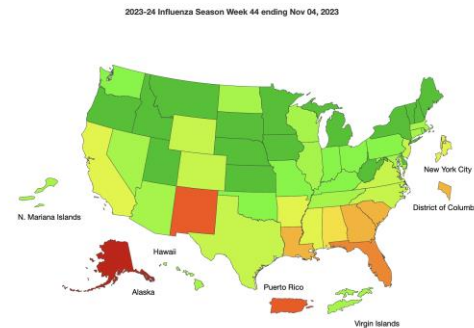
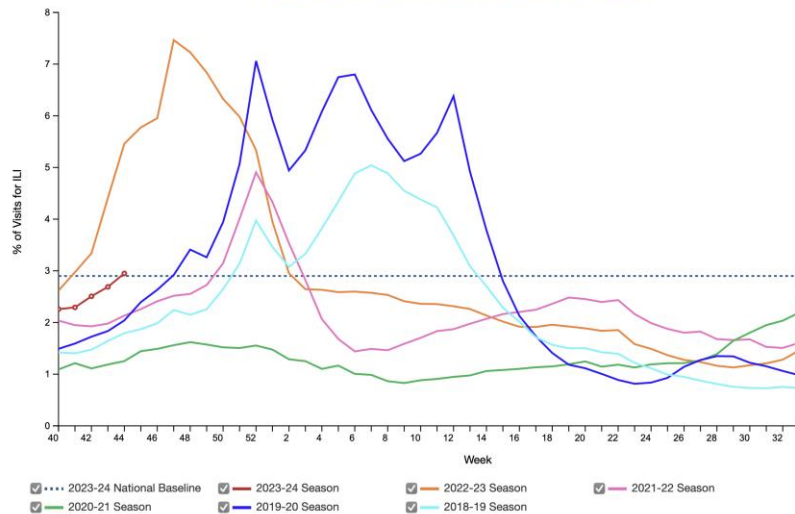
## Region 3 Influenza Activity is below threshold

- Virginia is still in "Low" level as some states and regions renew upward growth after a couple week pause.
- National ILI activity reaches threshold after several weeks of steady growth
- Three regions are over threshold, while Region 3 remains just below.

## Region 3

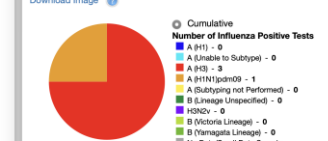


Percentage of Outpatient Visits for Respiratory Illness Reported by The U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), Weekly National Summary, 2023-24 Season and Selected Previous Seasons



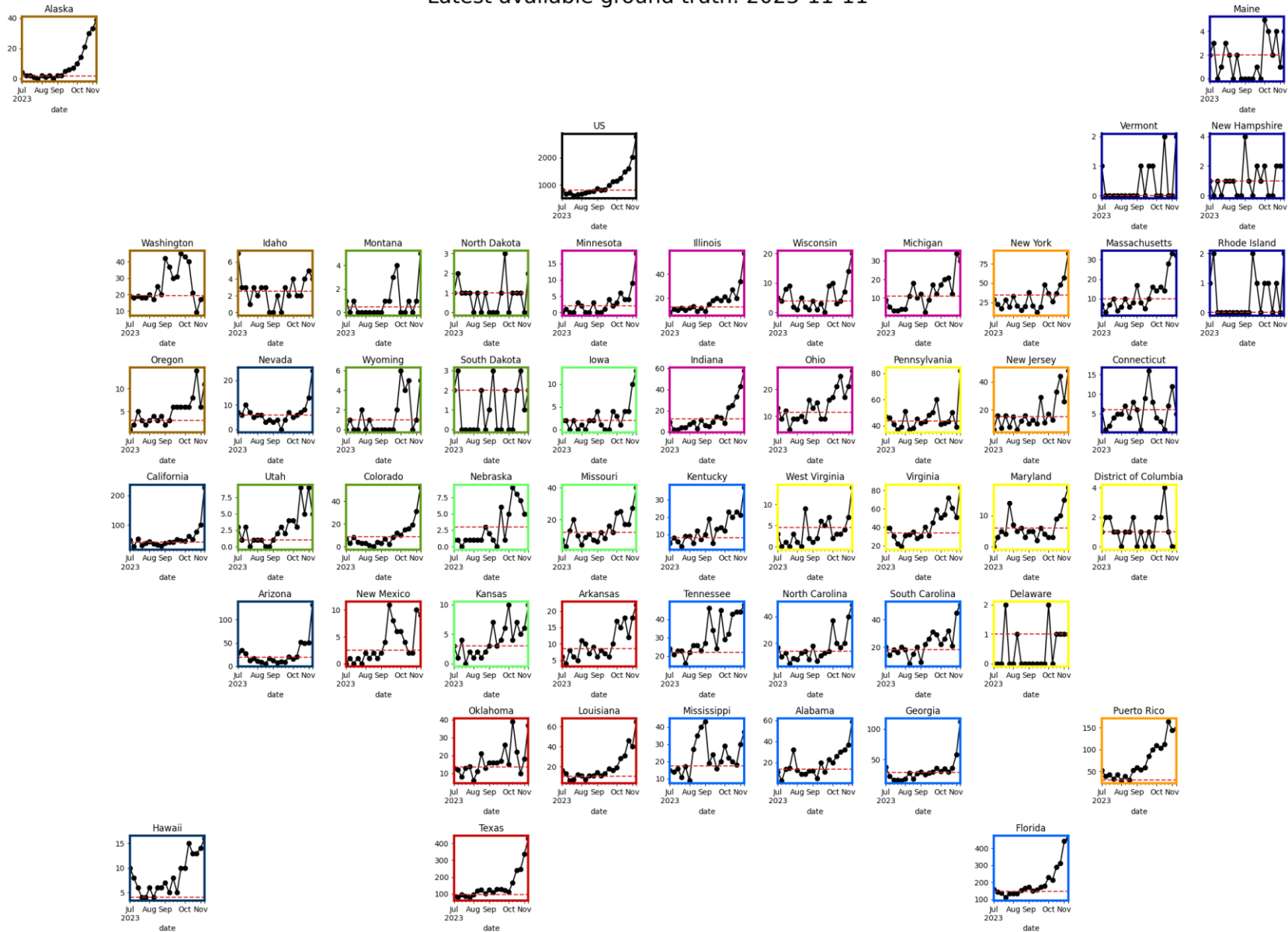
## Virginia

Influenza Positive Tests Reported to CDC by Public Health Laboratories, Virginia, 2023-24 Season, week ending Nov 04, 2023



# Current Influenza Situation – Hospitalization Admissions

Latest available ground truth: 2023-11-11

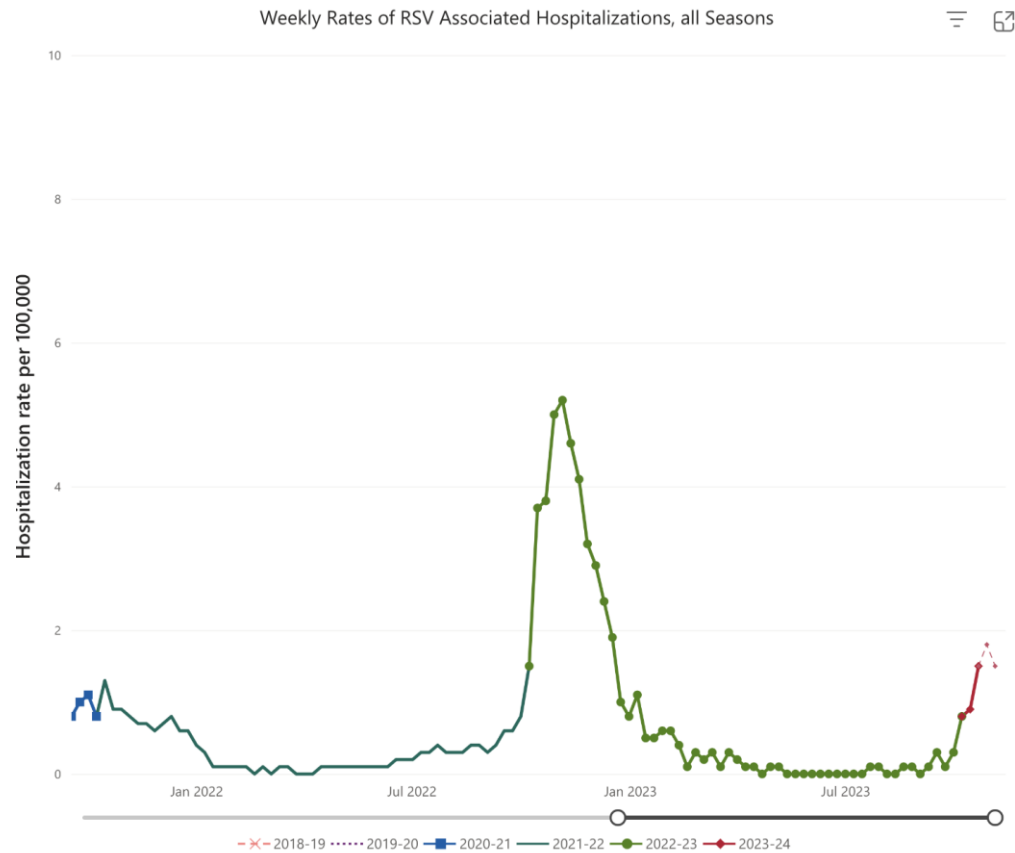


# RSV Update

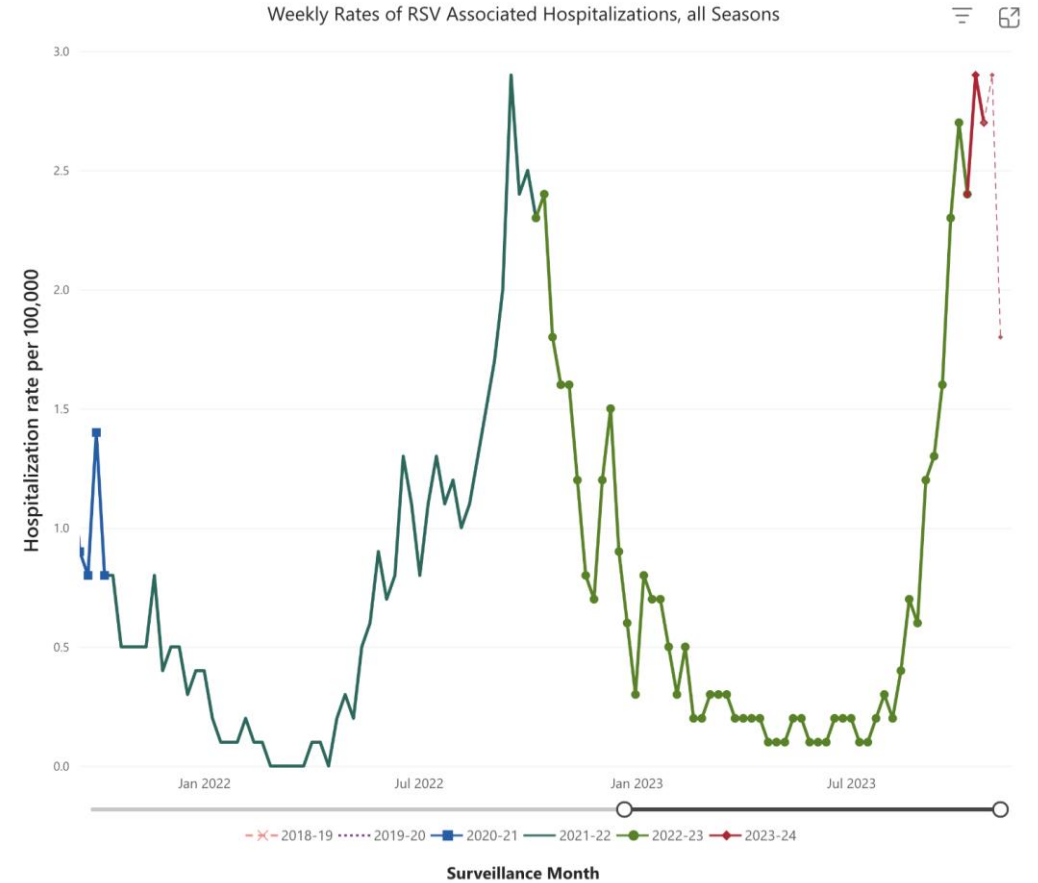
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# Current RSV Situation – Hospitalization Rates (RSV-Net)

## Maryland (RSV-Net)



## Georgia (RSV-Net)



Surveillance data as of:

October 21 (last solid data)

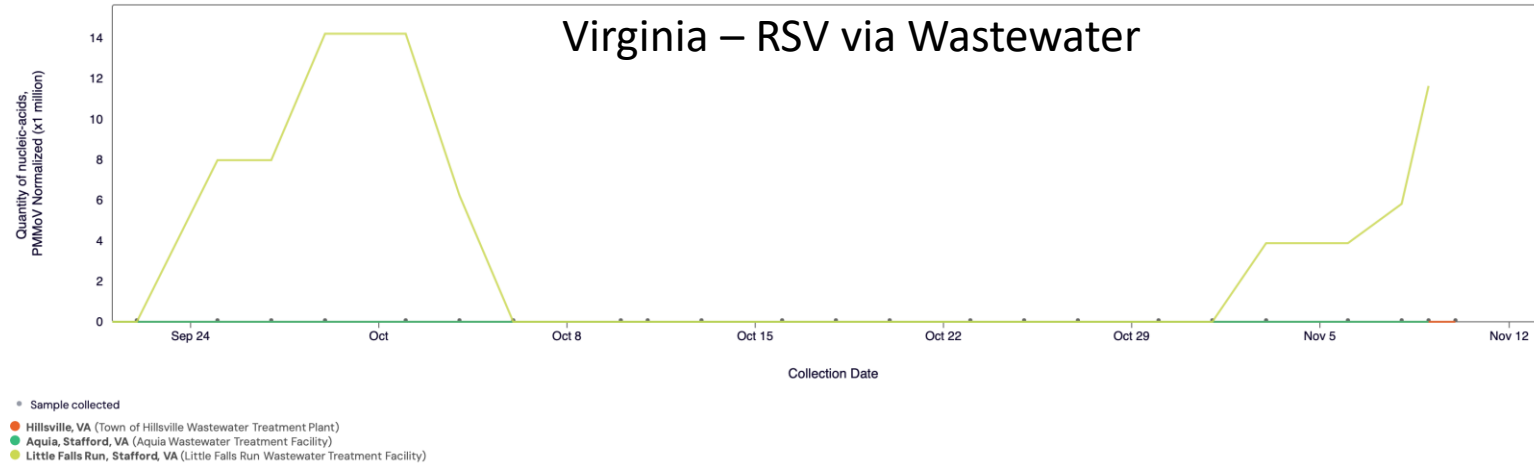
November 4 (last recent but likely to be updated)



[RSV-Net Dashboard](#)

# Current RSV Situation – Wastewater in VA

RSV, Virginia



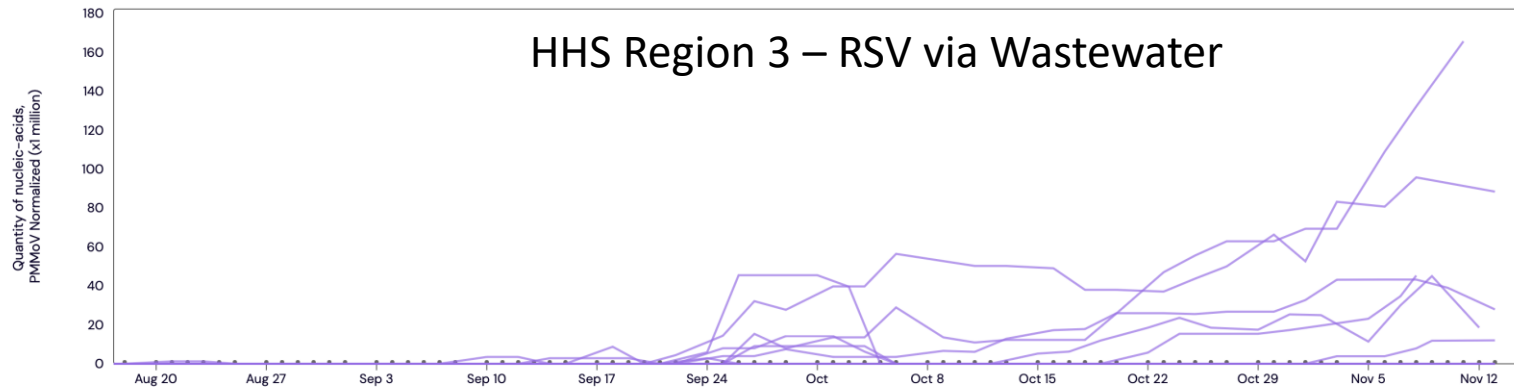
RSV, Region 3: DE, MD, PA, VA, WV [🔗](#)

Line Chart Heat Map



Save to Grid

Share Chart





# National Modeling Hub Updates

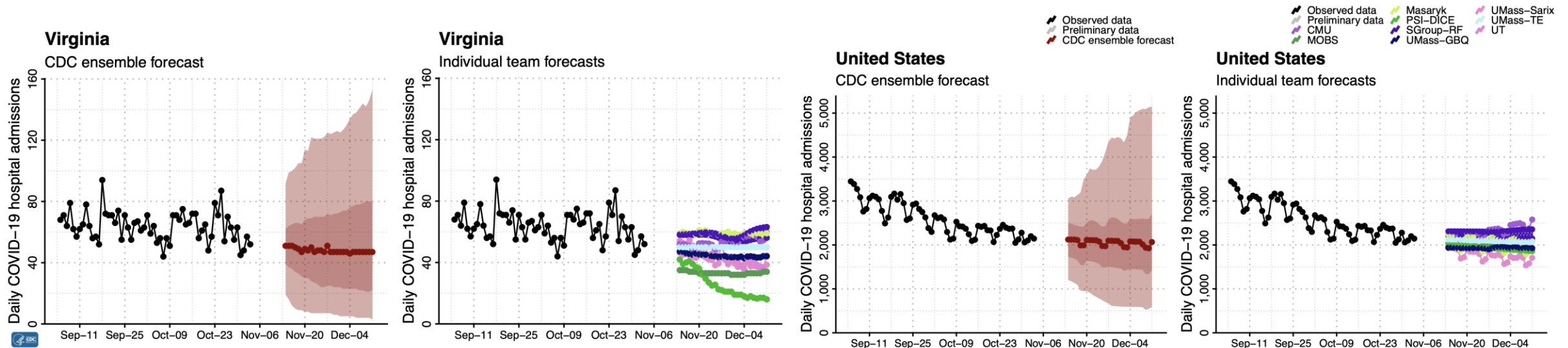
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# Current COVID-19 Hospitalization Forecast

## Statistical models for submitting to CDC COVID Forecasting Hub

- 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 (CDC COVID Ensemble)



# Current Influenza Hospitalization Forecast

## Statistical models for submitting to [CDC Influenza Forecasting Hub](https://www.cdc.gov/flu/forecasting/)

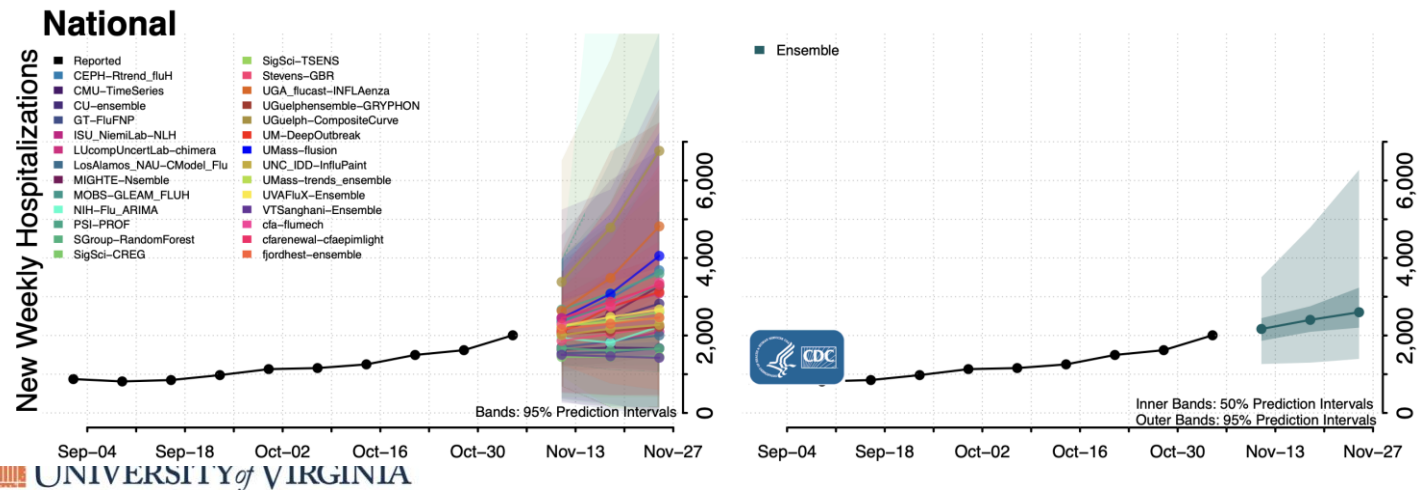
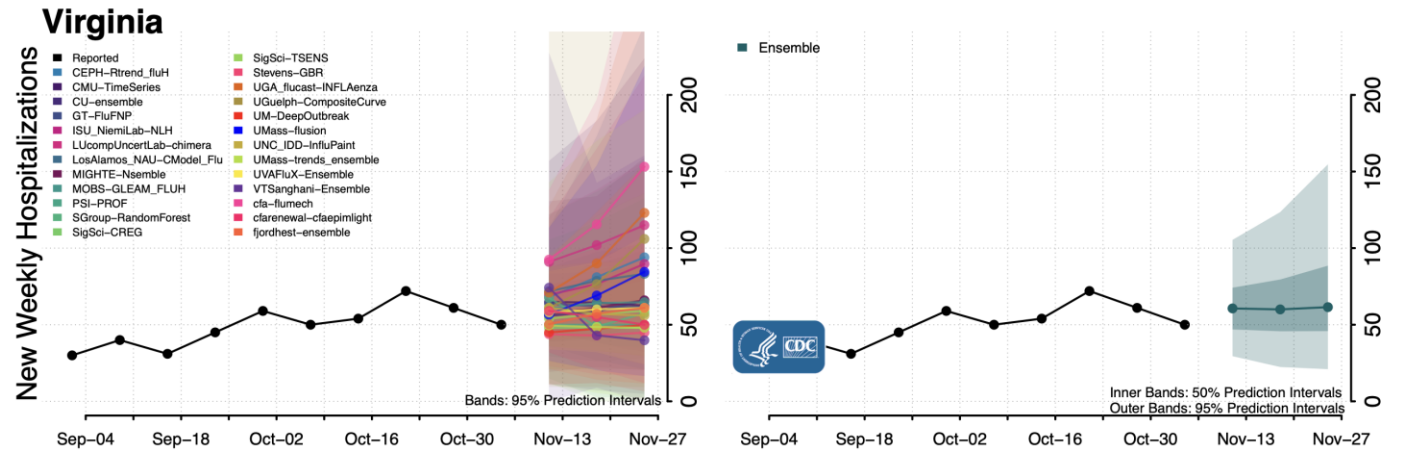
- Uses a variety of statistical and ML approaches to forecast weekly hospital admissions for the next 4 weeks for all states in the US

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

From November 8<sup>th</sup>

### CDC Flu Activity Surveillance

<https://www.cdc.gov/flu/weekly/fluactivitysurv.htm>



# Preliminary Influenza Hospitalization Forecast Sneak Peek

## Statistical models for submitting to CDC Influenza Forecasting Hub

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

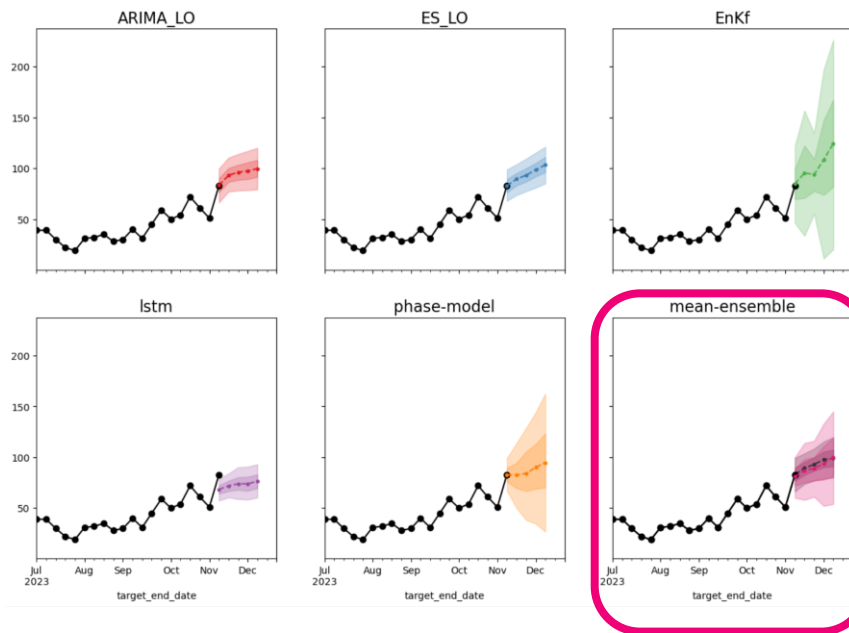
### UVA models only

## Hospital Admissions for Influenza and Forecast for next 4 weeks

**From November 15<sup>th</sup>**

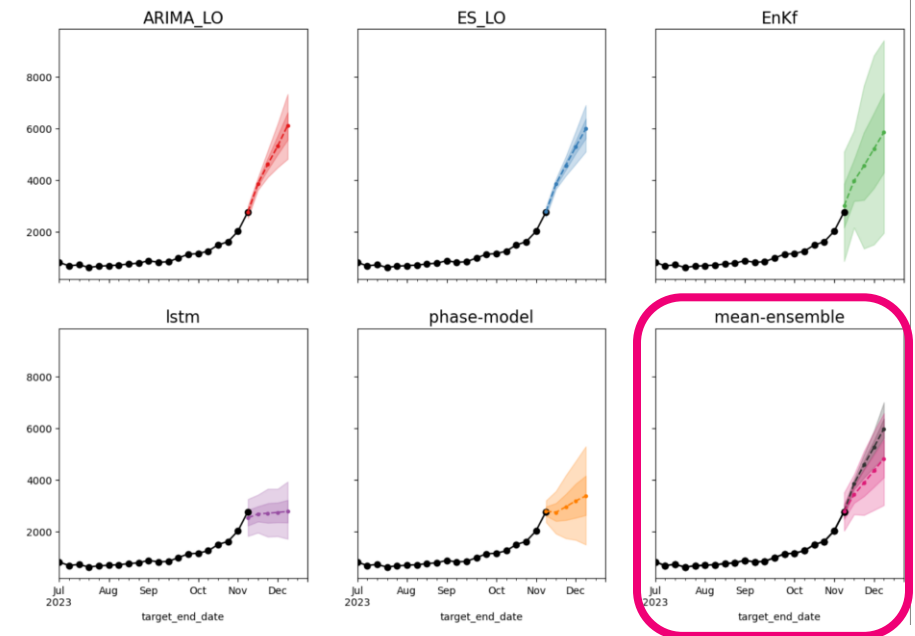
### Virginia

Virginia || ref\_date = 2023-11-18 || avl\_date = 2023-11-11



### United States

US || ref\_date = 2023-11-18 || avl\_date = 2023-11-11



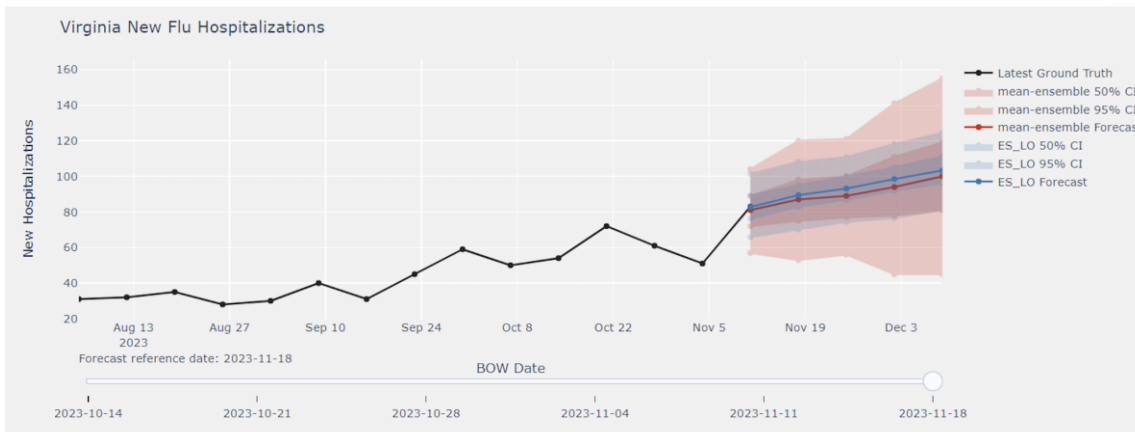
Mean ensemble is  
official forecast  
(pink)

Last data point of  
ground truth is  
“interim” update



# Preliminary Influenza Hospitalization Forecast Sneek Peak

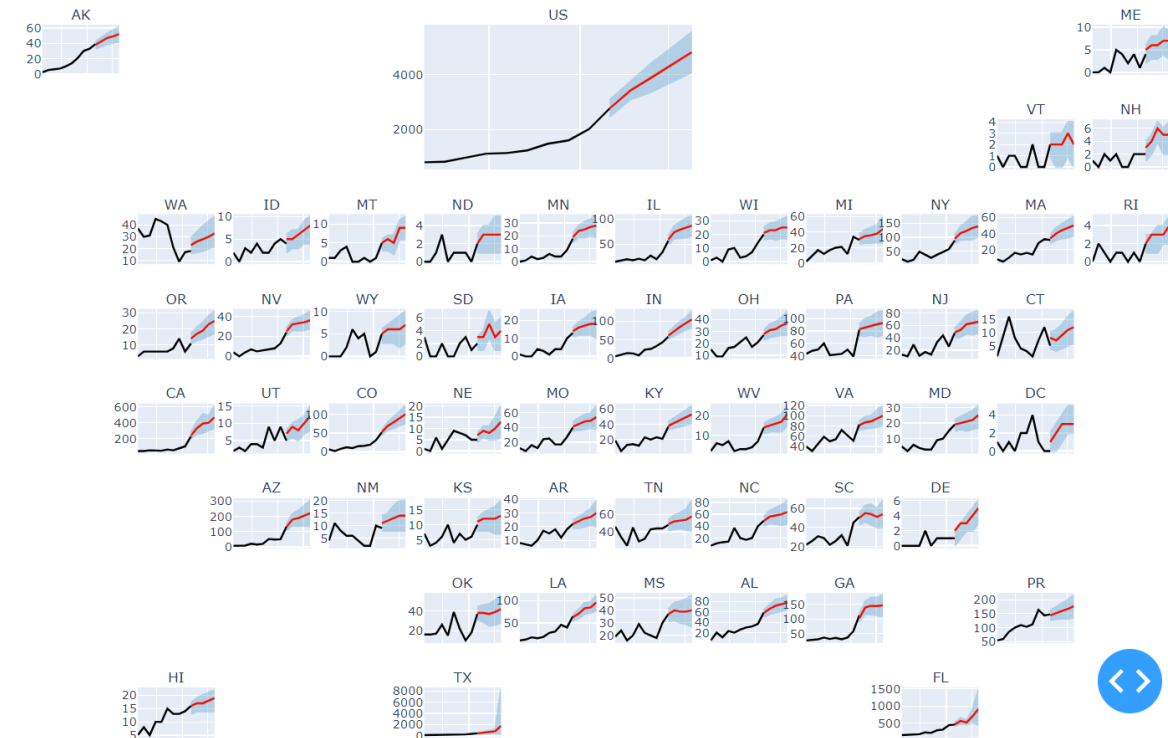
Model Selection  
 mean-ensemble  ARIMA\_LO  ES\_LO  EnKf  Median-ensemble  phase-model  Istm  
 Show CIs  
 95% CI  50% CI



## Dashboard for UVA model

### Hospital Admissions for Influenza and Forecast for next 4 weeks

US New Flu Hospitalizations and Forecasts



# Scenario Modeling Hub – RSV (Round 1) in prep

Collaboration of multiple academic teams to provide national and state-by-state level projections for 6 aligned scenarios

- Round Designed to explore impacts of newly available treatments (monoclonal antibodies and vaccines)
- Based on data till **November 12<sup>th</sup>, 2023**

## Scenario Dimensions:

No interventions vs. levels of treatments for infants vs. seniors:

Infants: Optimistic vs. Pessimistic - coverage (80% vs. 20%) and VE (80% vs, 60%)

Seniors: Optimistic vs. Pessimistic - coverage (40% vs. 20%) and VE (90% vs. 70%)

<https://github.com/midas-network/rsv-scenario-modeling-hub>

	<b>Optimistic senior protection</b> Vaccine is administered from Sep-June to seniors <b>60+ yrs</b> - coverage saturates at <b>40%</b> of the 2021-22 state- and age-specific flu vaccine coverage - VE against hospitalization is <b>90%</b>	<b>Pessimistic senior protection</b> Vaccine is administered from Sep-June to seniors <b>60+ yrs</b> - coverage saturates at <b>20%</b> of the 2021-22 state- and age-specific flu vaccine coverage - VE against hospitalization is <b>70%</b>	<b>No senior intervention</b>
<b>Optimistic infant protection</b> Long-acting monoclonals target infants < <b>6 months</b> during RSV season (Oct-Mar) - coverage saturates at <b>60%</b> of the 2021-22 state- and age-specific flu vaccine coverage - VE against hospitalization is <b>80%</b>	<b>Scenario A</b>	<b>Scenario B</b>	
<b>Pessimistic infant protection</b> Long-acting monoclonals target infants < <b>6 months</b> during RSV season (Oct-Mar) -coverage saturates at <b>20%</b> of the 2021-22 state- and age-specific flu vaccine coverage - VE against hospitalization is <b>60%</b>	<b>Scenario C</b>	<b>Scenario D</b>	
<b>No infant intervention beyond what was used in prior years (limited supply of palivizumab, targeting ~2% of birth cohort at high risk)</b>			<b>Scenario E (counterfactual)</b>

# Scenario Modeling Hub – Influenza (Round 4)

Collaboration of multiple academic teams to provide national and state-by-state level projections for 6 aligned scenarios

- Round Designed to explore a season dominated by H3 vs. H1 with different levels of seasonal flu vaccination coverage
- Based on data till **September 2<sup>nd</sup>, 2023**

## Scenario Dimensions:

Influenza type A/H3 vs. A/H1:

- H3 higher hospitalization rates with vax efficacy weaker in older groups
- H1 lower hospitalization rates and efficacy even across age groups

Vaccination levels (compared to 2021-22 season):

Low (20% less) vs.  
Business as Usual (same) vs.  
Higher (20% more)

<https://fluscenariomodelinghub.org/viz.html>

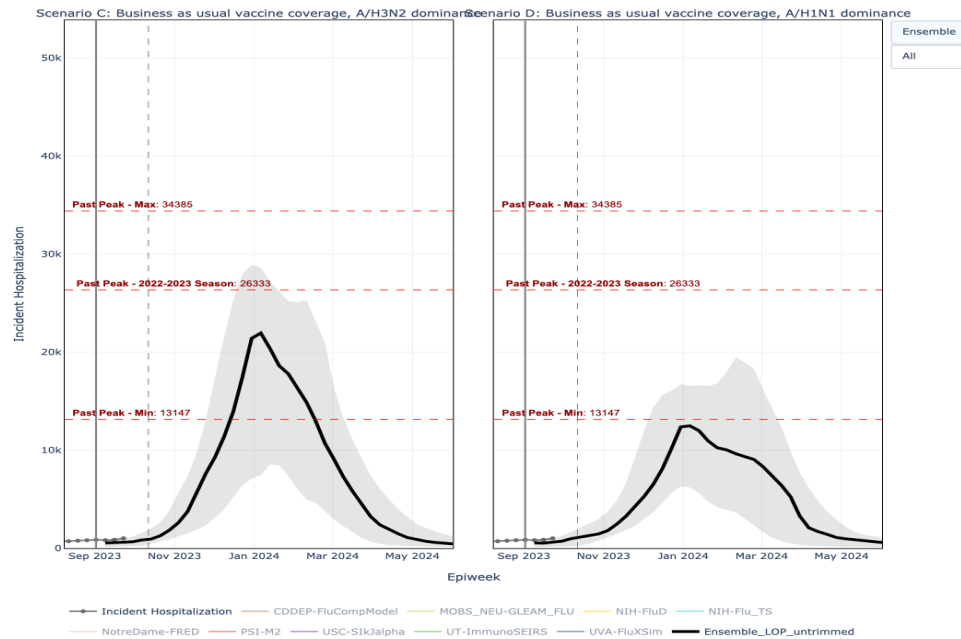
	Season dominated by influenza A/H3N2, indexed on age distribution of 2017-18 season.  VE = 40% against medically attended illnesses and hospitalizations, VE drops in older age groups	Season dominated by influenza A/H1N1, indexed on age distribution of 2019-20 season.  VE = 40% against medically attended illnesses and hospitalizations, similar VE across all age groups
<b>Higher than Usual Vaccine Coverage</b> <ul style="list-style-type: none"> <li>• Vaccine coverage is <b>20% higher than in the 2021-22</b> flu season in all age groups and jurisdictions. (20% is a relative change, ie a 50% coverage for age group <i>a</i> and jurisdiction <i>j</i> in 2021-22 translates to a 50%*1.20=60% coverage for 2023-24). Overall, the US coverage is about 60% in this scenario.</li> </ul>	<b>Scenario A</b>	<b>Scenario B</b>
<b>Business as Usual Vaccine Coverage</b> <ul style="list-style-type: none"> <li>• Vaccine coverage is <b>the same as in the 2021-22</b> flu season in all age groups and jurisdictions. Overall, the US coverage is about 50% in this scenario.</li> </ul>	<b>Scenario C</b>	<b>Scenario D</b>
<b>Low Vaccine Coverage</b> <ul style="list-style-type: none"> <li>• Vaccine coverage is <b>20% lower than in the 2021-22</b> flu season in all age groups and jurisdictions. Overall, the US coverage is about 40% in this scenario.</li> </ul>	<b>Scenario E</b>	<b>Scenario F</b>

# Scenario Modeling Hub – Influenza (Round 4)

- Severity of season has a strong influence.

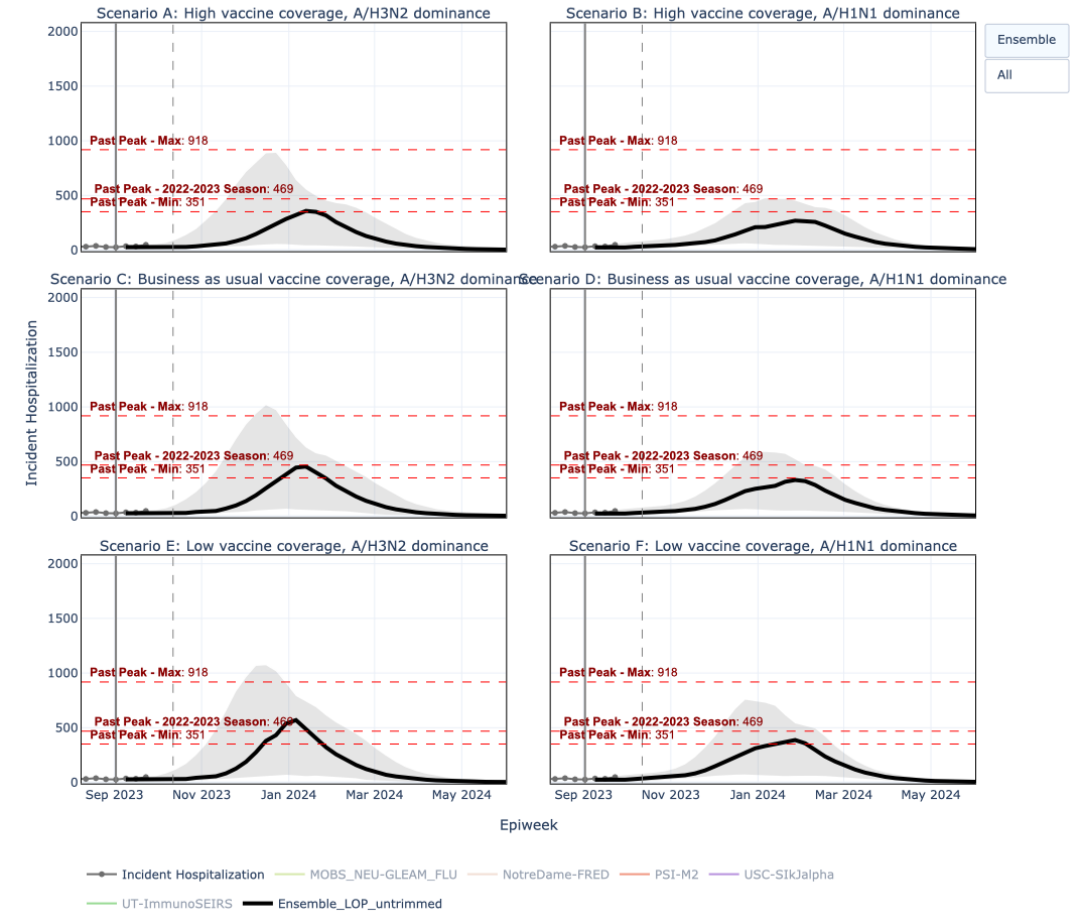
## United States Hospitalizations

Projected Incident Hospitalization by Epidemiological Week and by Scenario for Round 1 - 2023/2024  
( - Start Projection Epiweek; -- Current Date)



## Virginia Hospitalizations

Projected Incident Hospitalization by Epidemiological Week and by Scenario for Round 1 - 2023/2024  
( - Start Projection Epiweek; -- Current Date)



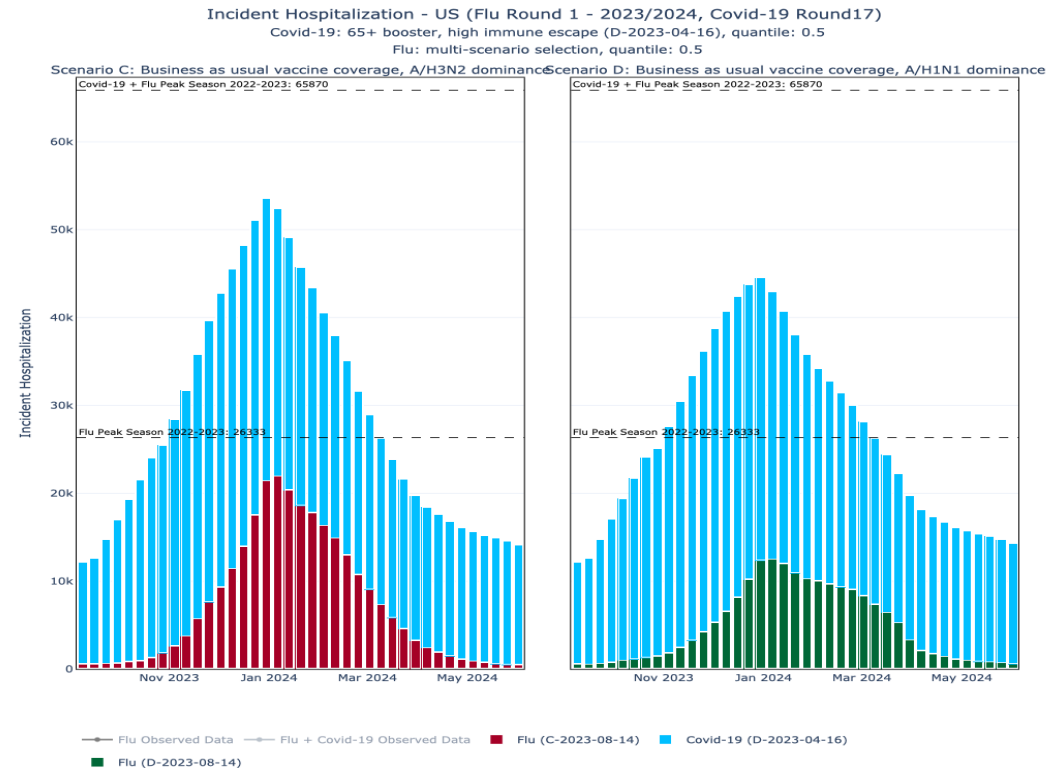
H3N2 dominated season  
(more severe)

H1N1 dominated season  
(less severe)

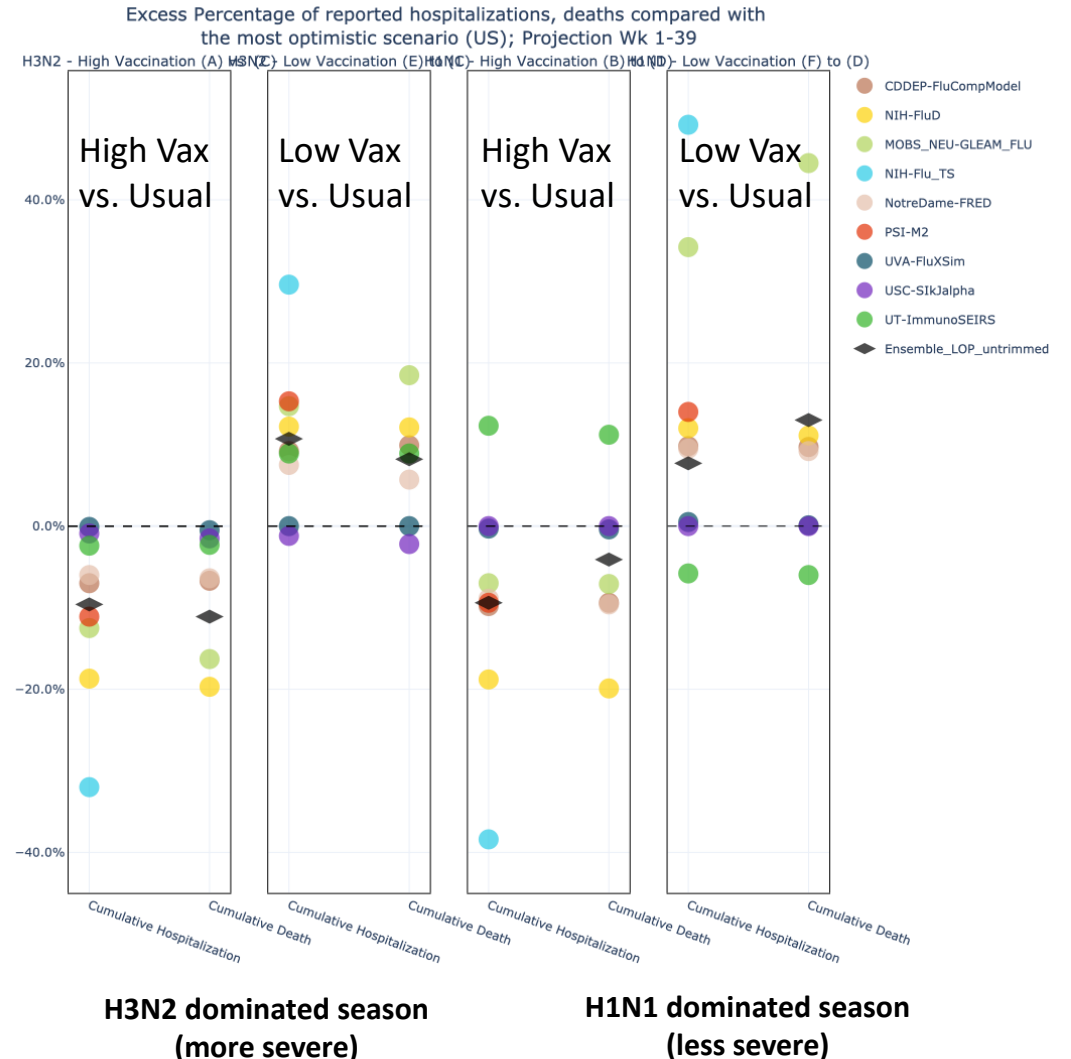


# Scenario Modeling Hub – Influenza (Round 4)

- Higher coverage can reduce hospitalizations significantly, more so in an H3N2 season
- Projected COVID and Influenza hospitalizations could exceed 50k with serious influenza season aligned with high immune escape COVID



## Virginia Hospitalizations



# Scenario Modeling Hub – COVID-19 (Round 17)

Collaboration of multiple academic teams to provide national and state-by-state level projections for 6 aligned scenarios

<https://covid19scenariomodelinghub.org/viz.html>

- Preliminary Results
- Round Designed to explore different seasonal vaccination levels and the impact of Immune Escape

## Scenario Dimensions:

Immune Escape (IE):

Slower IE (20%/yr) vs.  
Faster IE (50%/yr)

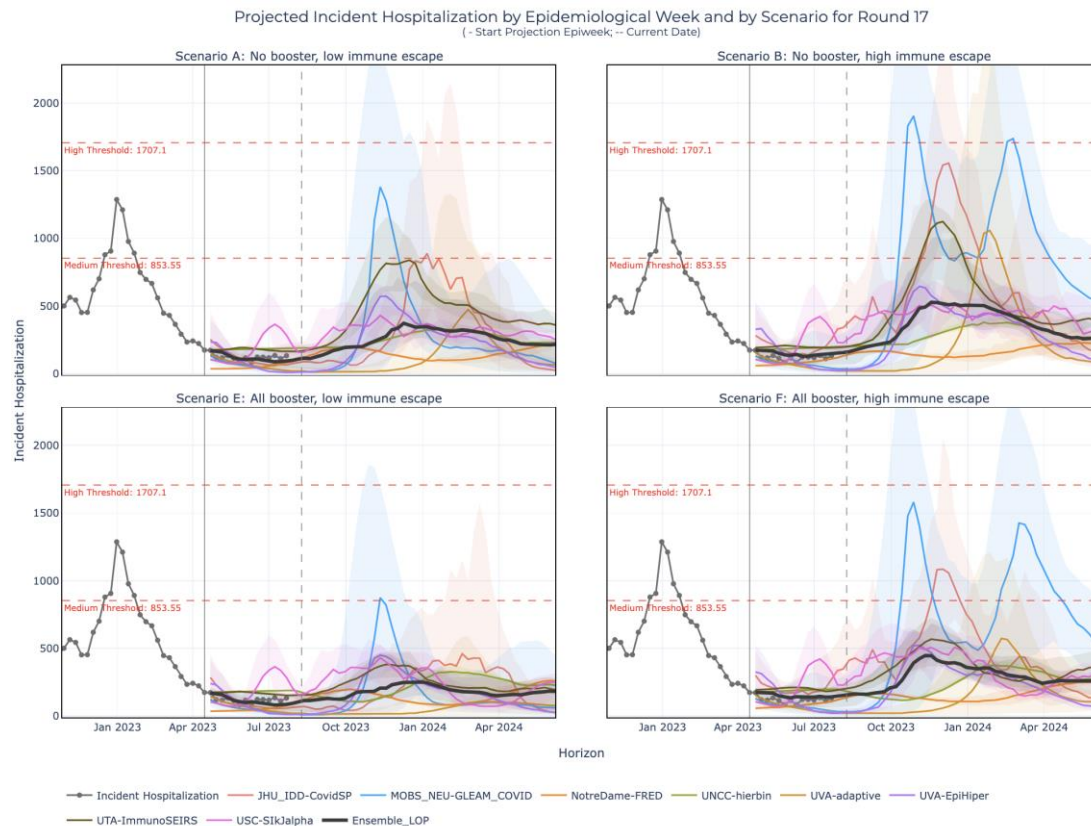
Vaccination levels:

None vs.  
Vulnerable and 65 + vs.  
Broader population of eligible

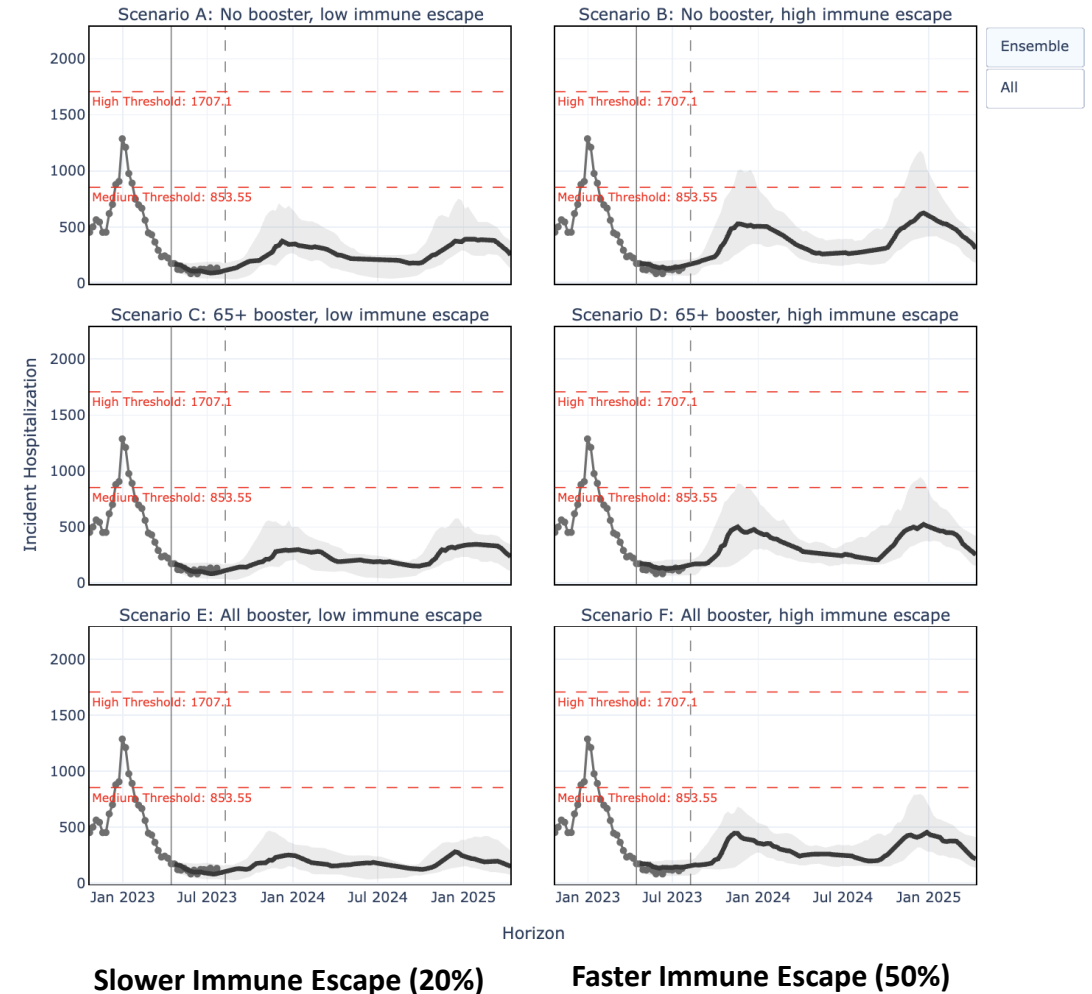
	<b>Low immune escape</b> <ul style="list-style-type: none"> <li>• Immune escape occurs at a constant rate of <b>20% per year</b></li> </ul>	<b>High immune escape</b> <ul style="list-style-type: none"> <li>• Immune escape occurs at a constant rate of <b>50% per year</b></li> </ul>
<b>No vaccine recommendation</b> <ul style="list-style-type: none"> <li>• Uptake negligible or continues at very slow levels based on existing 2022 booster trends</li> </ul>	Scenario A	Scenario B
<b>Reformulated annual vaccination recommended for 65+ and immunocompromised</b> <ul style="list-style-type: none"> <li>• Reformulated vaccine has <b>65% VE against variants circulating on June 15</b></li> <li>• Vaccine becomes <b>available September 1</b></li> <li>• Uptake in 65+ same as first booster dose recommended in September 2021</li> <li>• Uptake in individuals under 65 negligible or continues to trickle based on 2022 booster trends</li> </ul>	Scenario C	Scenario D
<b>Reformulated annual vaccination recommended for all currently eligible groups</b> <ul style="list-style-type: none"> <li>• Reformulated vaccine has <b>65% VE against variants circulating on June 15</b></li> <li>• Vaccine becomes <b>available September 1</b></li> <li>• 65+ uptake same as first booster dose recommended in September 2021</li> <li>• Coverage in individuals under 65+ saturates at levels of the 2021 booster (approximately 34% nationally)</li> </ul>	Scenario E	Scenario F

# SMH – COVID-19 (Round 17) – Virginia Results

- To date, immune escape evolution has been slow. Booster campaign size remains unknown.
- Significant variation in Fall-Winter 2023 outlook across models

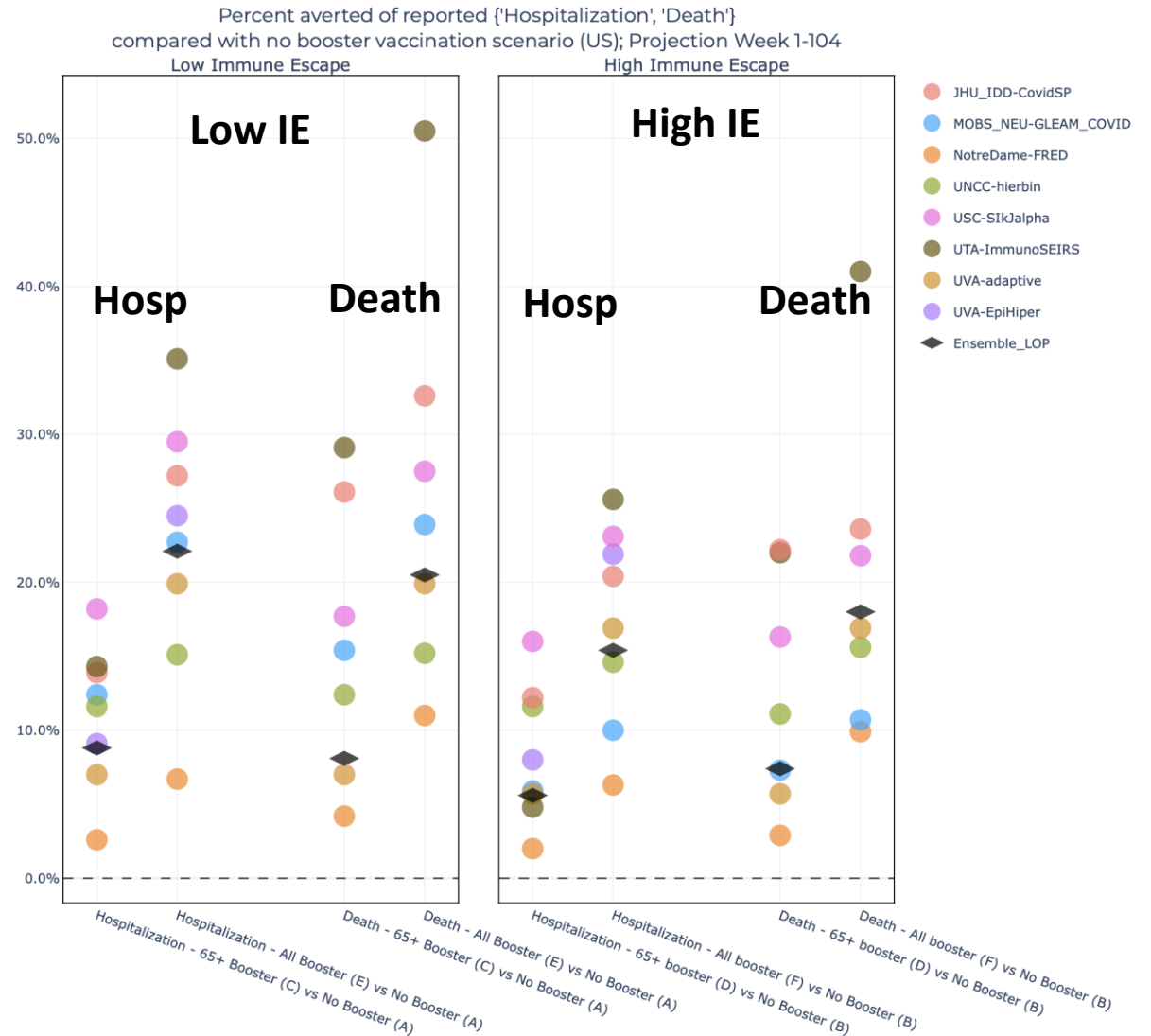


Projected Incident Hospitalization by Epidemiological Week and by Scenario for Round 17  
(- Start Projection Epiweek; -- Current Date)



# SMH – COVID-19 (Round 17) – Results – Booster Impact

- Models estimate potential reduction in hospitalizations ranging from 2% - 18% for a 65+ only campaign to 5% - 35% for a whole population campaign
- Reductions in deaths are similar with ensemble estimates of 8% reduction for 65+ campaign and 22% reduction for whole population campaign
- For high immune escape scenarios, the reductions are smaller and more pronounced for deaths than hospitalizations



# Key Takeaways

## **COVID-19 Activity levels continue to decline**

- Declines in cases and hospitalizations have continued
- Other indicators continue to point towards continued declines or suggest no major change
- Wastewater based indicators similar mix of viral loads as in previous weeks

## **Genomic Surveillance maintains high diversity with no dominating variant**

Together this suggests continued declines or easing into a plateau in near term

# Questions?

## Biocomplexity COVID-19 Response Team

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