Network Systems Science & Advanced Computing

Biocomplexity Institute & Initiative

University of Virginia

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

October 12th, 2023

(data current to Sept 30th – Oct 10th)

Biocomplexity Institute Technical report: TR BI-2023-247

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biocomplexity.virginia.edu

About Us

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

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Overview

- **Goal**: Understand impact of current and emerging Infectious Disease threats to the Commonwealth of Virginia using modeling and analytics

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

Key Takeaways

COVID-19 Activity levels continue to decline

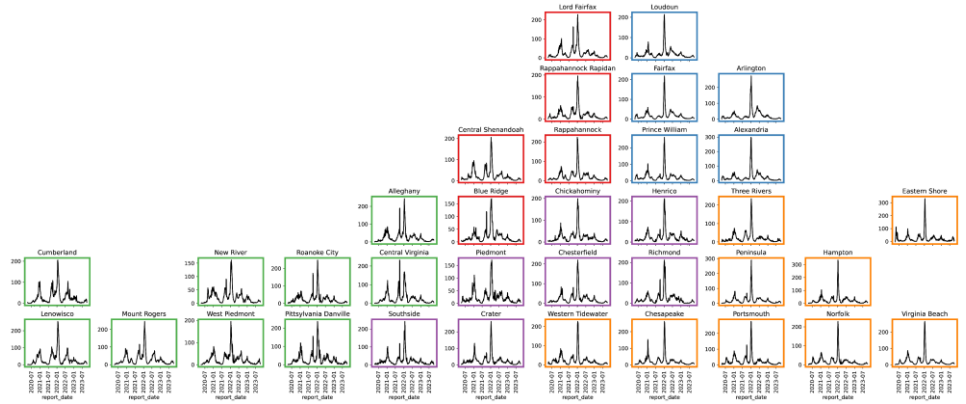
- Declines in cases and hospitalizations have continued
- Other indicators continue to point towards continued declines or suggest no major change
- Wastewater based indicators similar mix of viral loads as in previous weeks

Genomic Surveillance maintains high diversity with no dominating variant

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

COVID-19 Surveillance

Case Rates (per 100k)



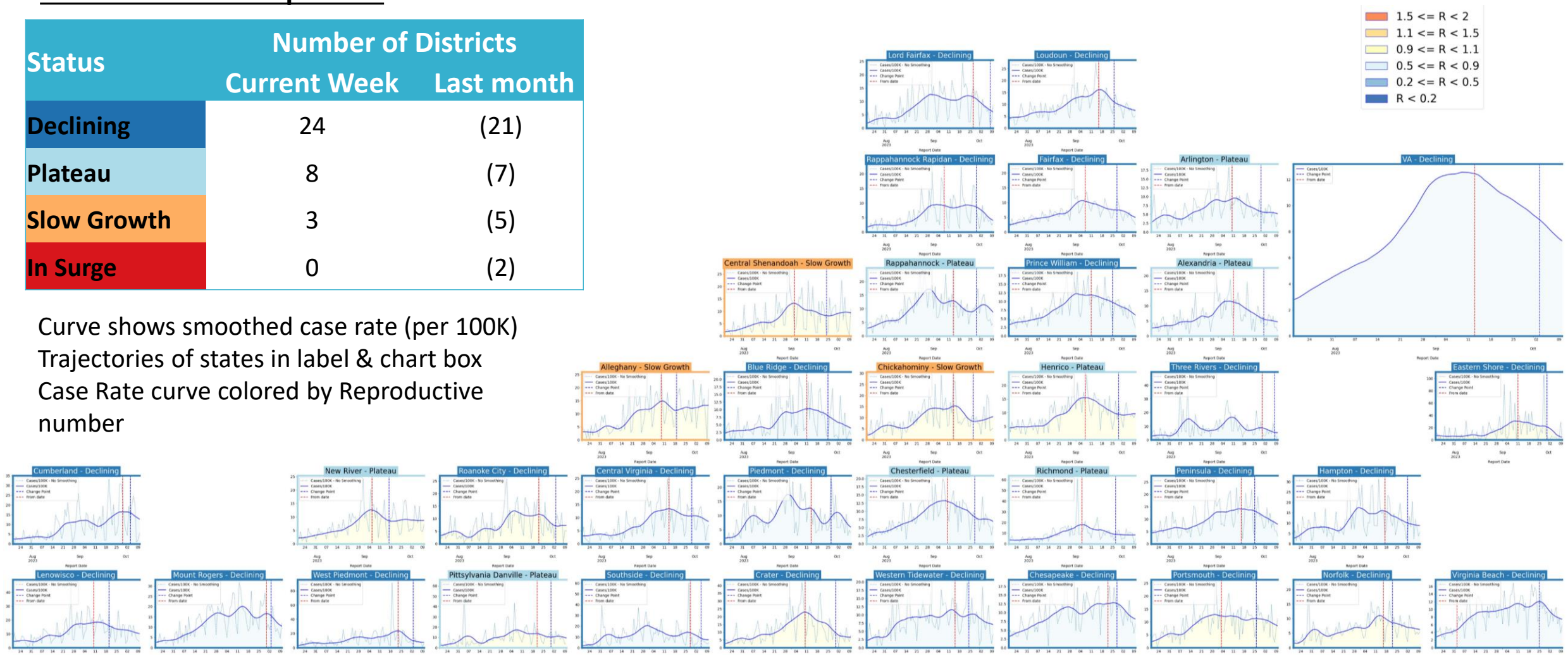
Whole pandemic

District Case Trajectories – last 10 weeks

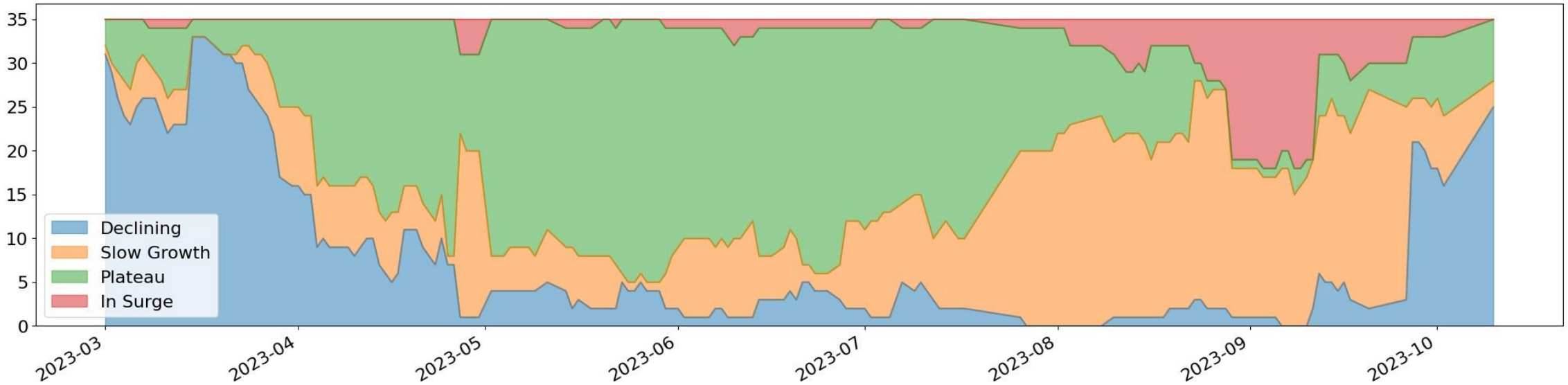
Rt estimates from EpiNow2

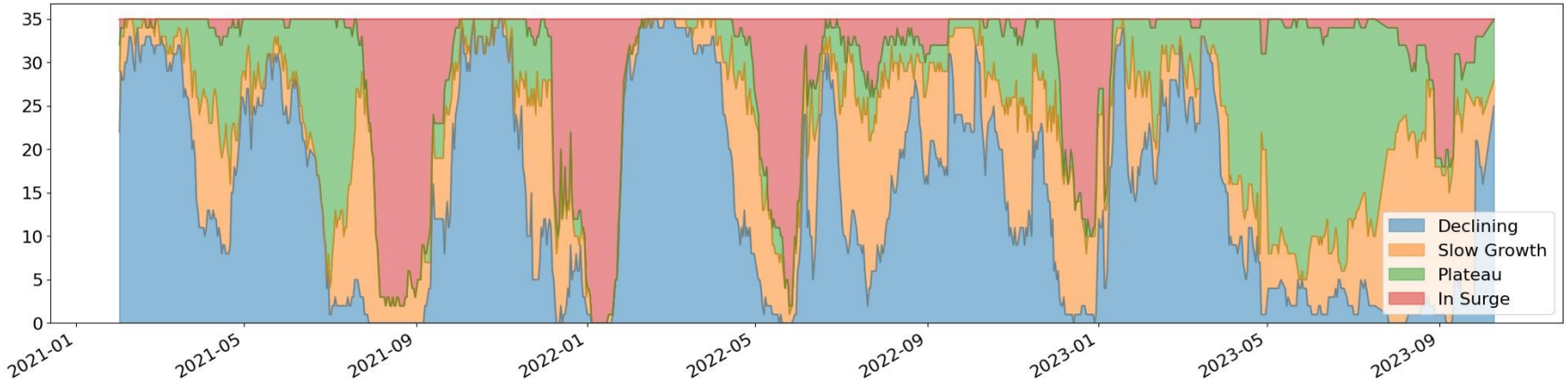
Status	Number of Districts	
	Current Week	Last month
Declining	24	(21)
Plateau	8	(7)
Slow Growth	3	(5)
In Surge	0	(2)

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





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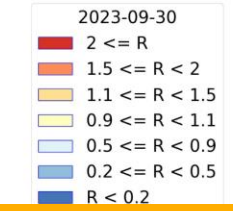
District Hospital Trajectories – last 10 weeks

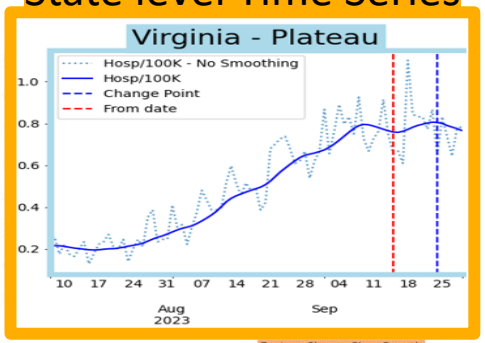
Status	Number of Districts	
	Current Week	Last week
Declining	2	(0)
Plateau	22	(14)
Slow Growth	11	(18)
In Surge	0	(3)

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

As of Sep 30th



State level Time Series



Rt estimates from EpiNow2

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

Hosp rate curve colored by R_e number

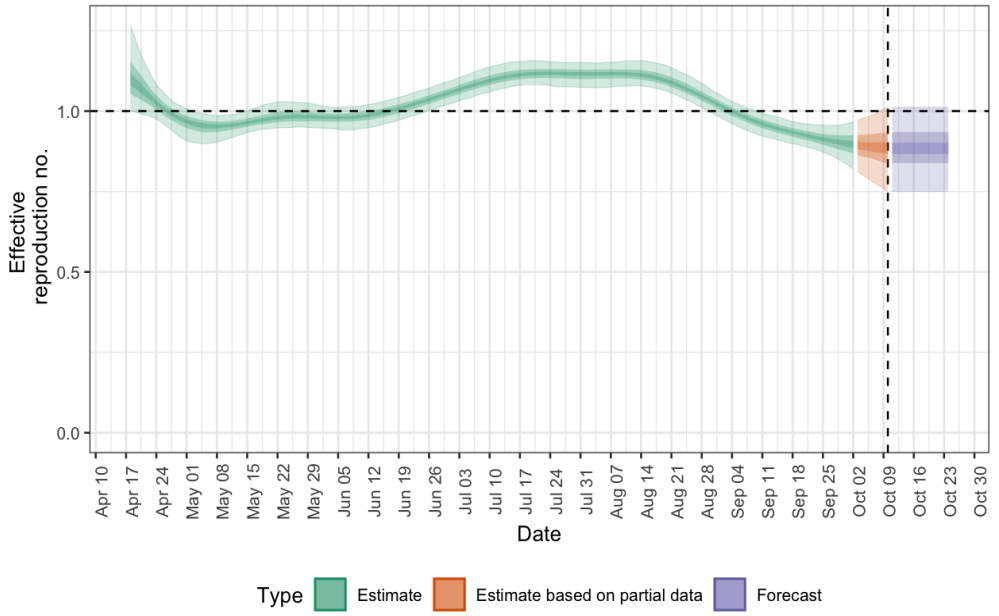
COVID-19 Growth Metrics

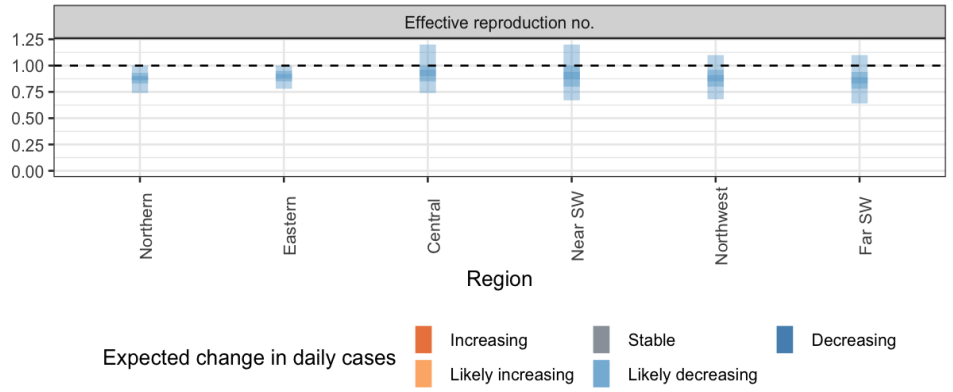
Estimating Daily Reproductive Number –
VDH report dates – EpiNow2 estimation

Reproductive Estimate Summary as of October 10, 2023

Region	Reproductive number estimate	IQR	Trend forecast
State-wide cases	0.89	0.71 - 1.0	Likely decreasing
State-wide hosp	0.97	0.88 - 1.1	Likely decreasing
Central	0.93	0.74 - 1.2	Likely decreasing
Eastern	0.90	0.78 - 1.0	Likely decreasing
Far SW	0.86	0.64 - 1.1	Likely decreasing
Near SW	0.90	0.67 - 1.2	Likely decreasing
Northern	0.87	0.74 - 1.0	Likely decreasing
Northwest	0.88	0.68 - 1.1	Likely decreasing

Re from VDH Cases (last 6 months)





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 10 days prior to that of cases (HHS hospitalization through 9/30/23 vs. VDH case data through 10/10/23).

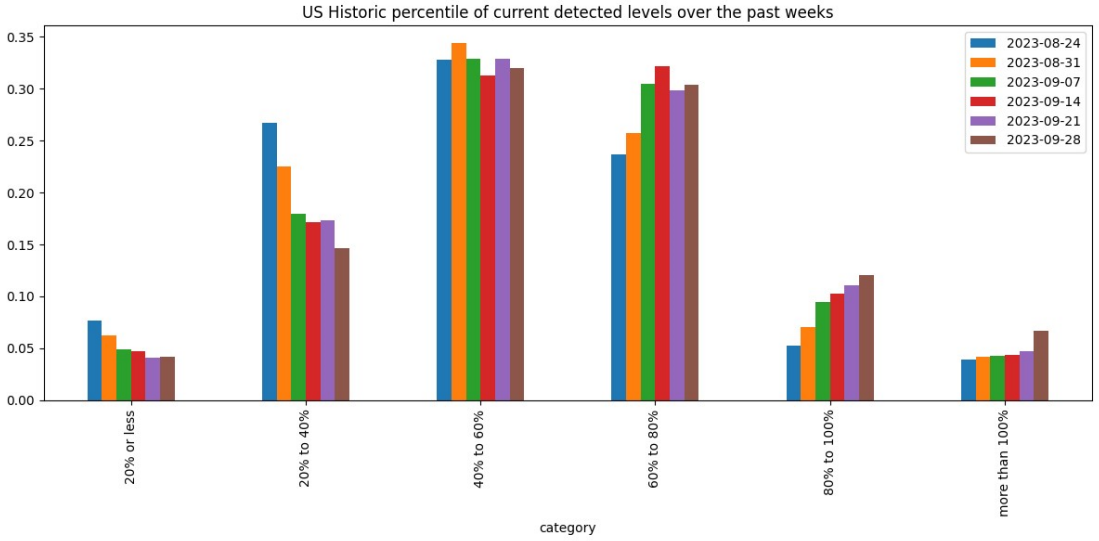
EpiNow2 home: https://epiforecasts.io/EpiNow2/

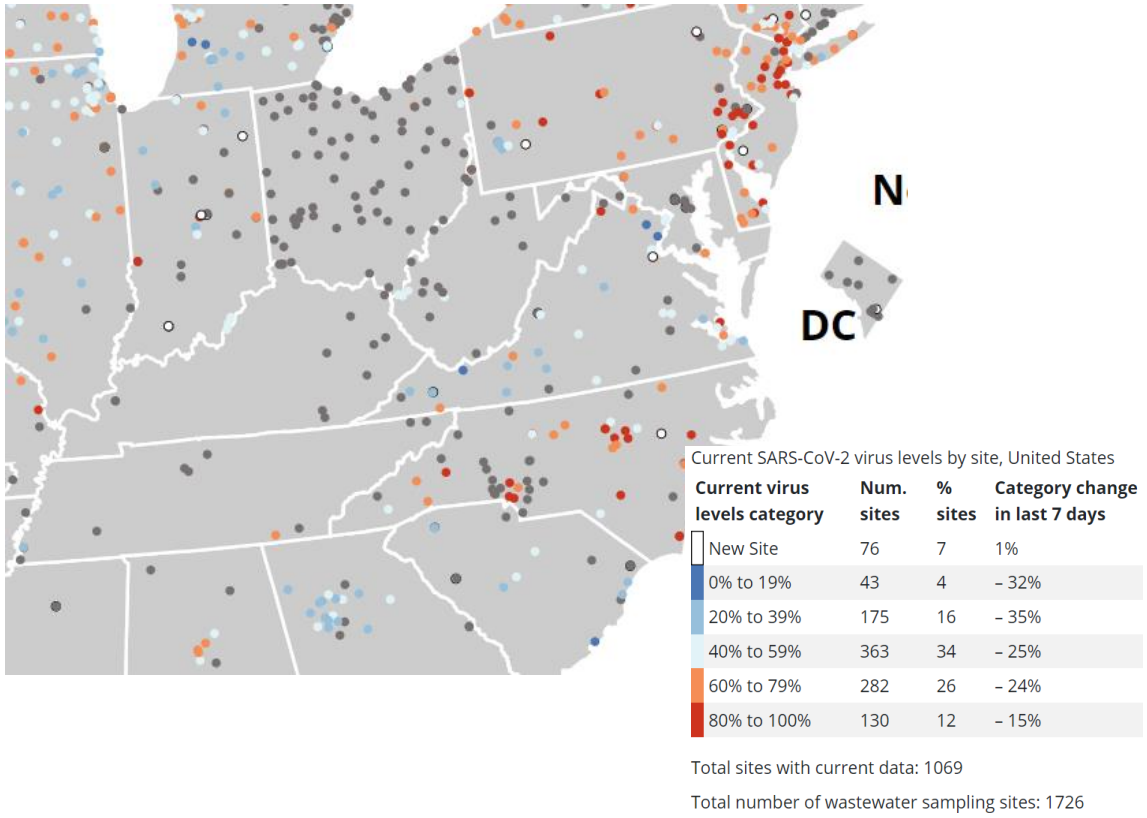
Wastewater Monitoring

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

USA



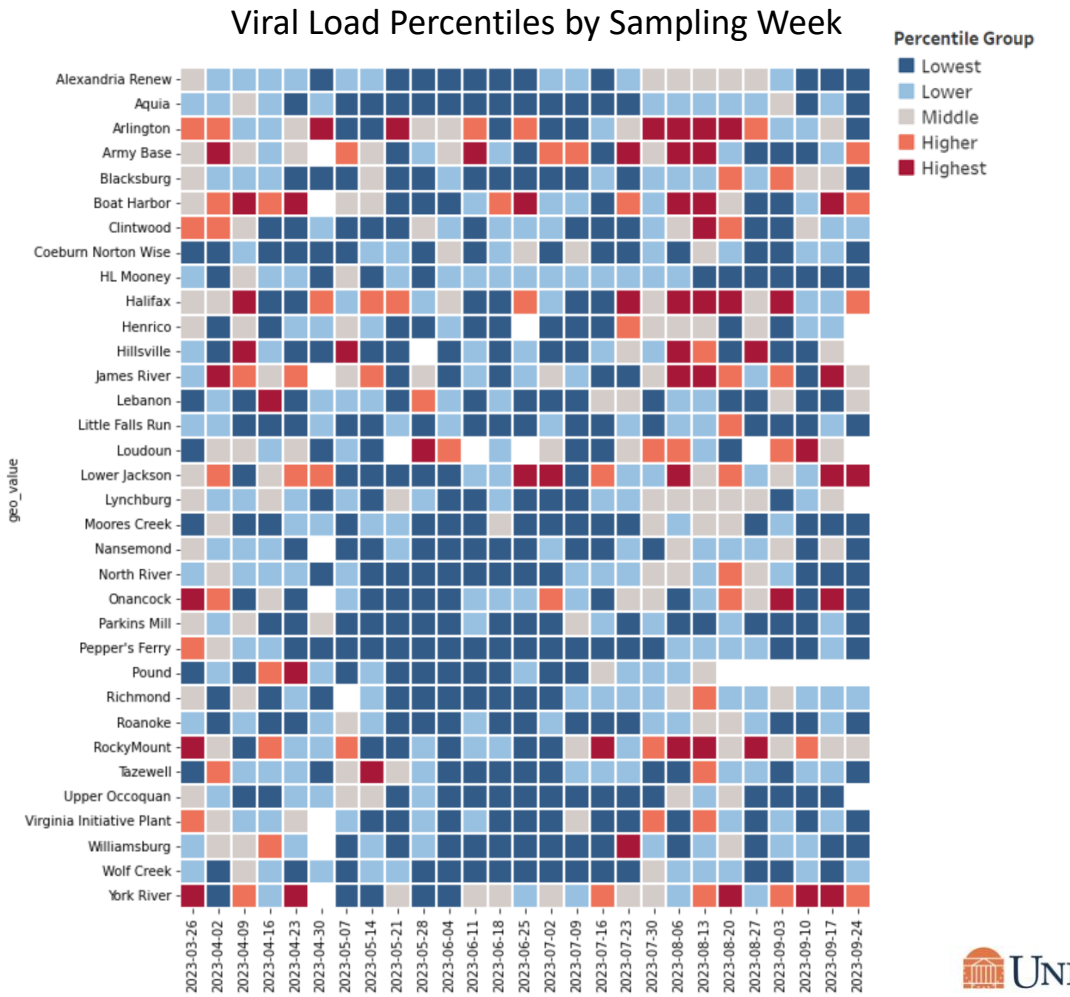


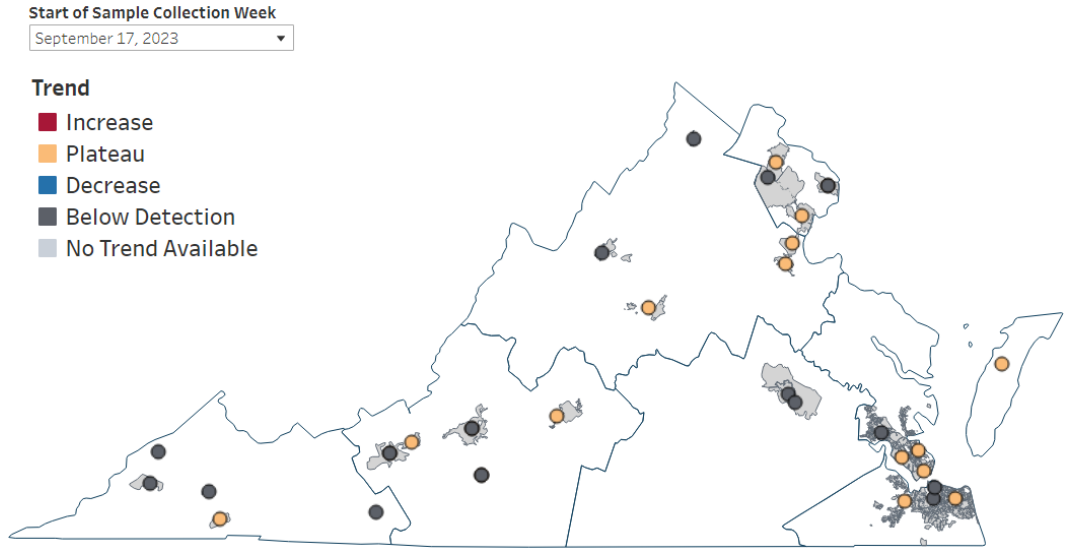
Data Source: [CDC Data Tracker]

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





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From: https://www.vdh.virginia.gov/coronavirus/see-the-numbers/covid-19-data-insights/sars-cov-2-in-wastewater/#surveillance-trend

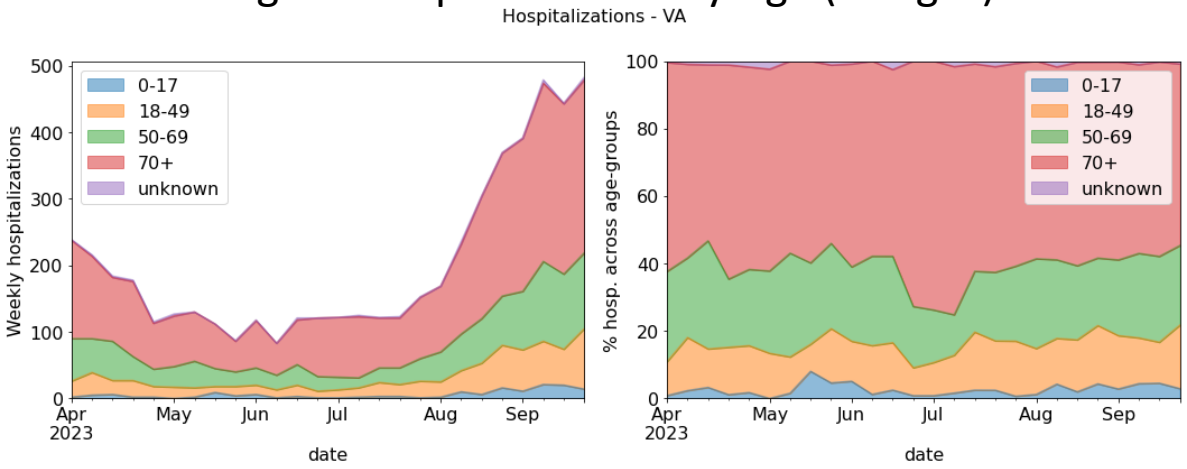
Hospitalizations in VA by Age

Age distribution in hospitals showing slight shift towards younger age groups

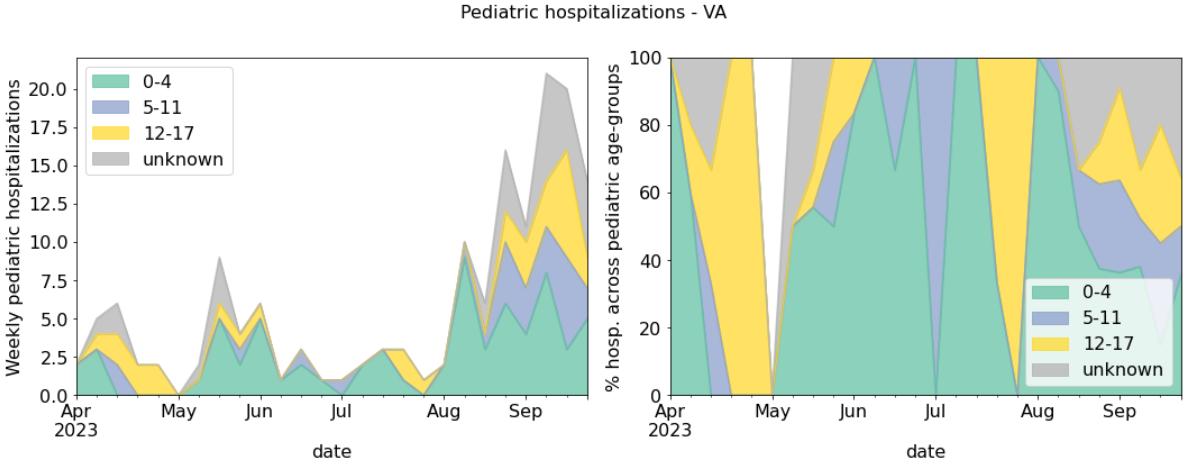
- Overall hospitalizations increasing across all age groups
- Increase in pediatric hospitalizations (0-4 age group), remain high, but have come down a little in last week

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

Virginia Hospitalizations by Age (all ages)



Pediatric Hospitalizations by Age (0-17yo)

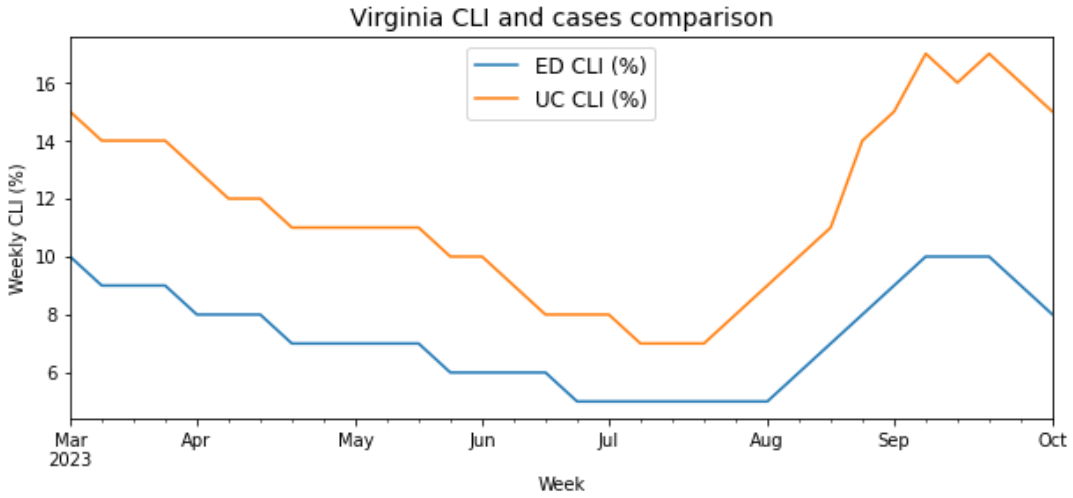


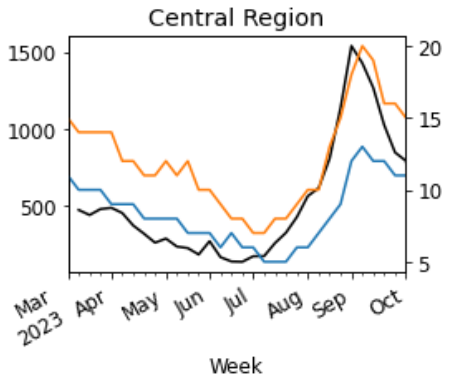
Data Source: Delphi and HHS

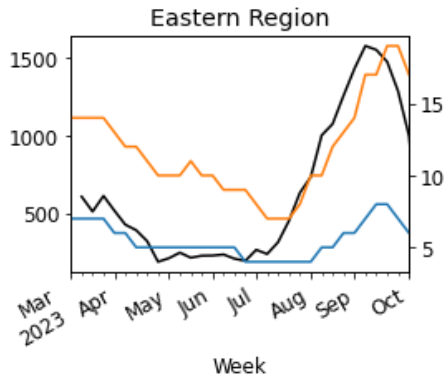
COVID-like Illness Activity

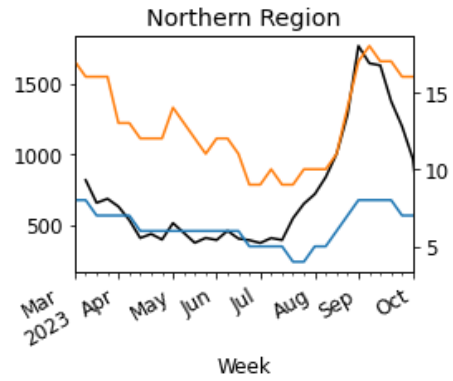
COVID-like Illness (CLI) gives a measure of COVID transmission in the community

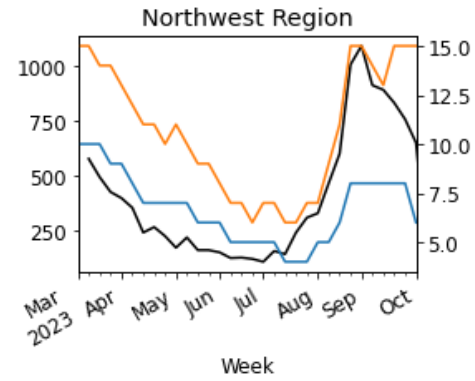
- Emergency Dept (ED) based CLI is more correlated with case reporting
- Urgent Care (UC) is a leading indicator but may be influenced by testing for other URIs
- **CLI continues to decline**
- **Levels now back to those seen last in late winter**

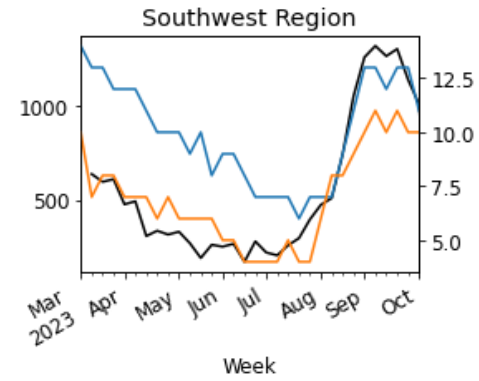




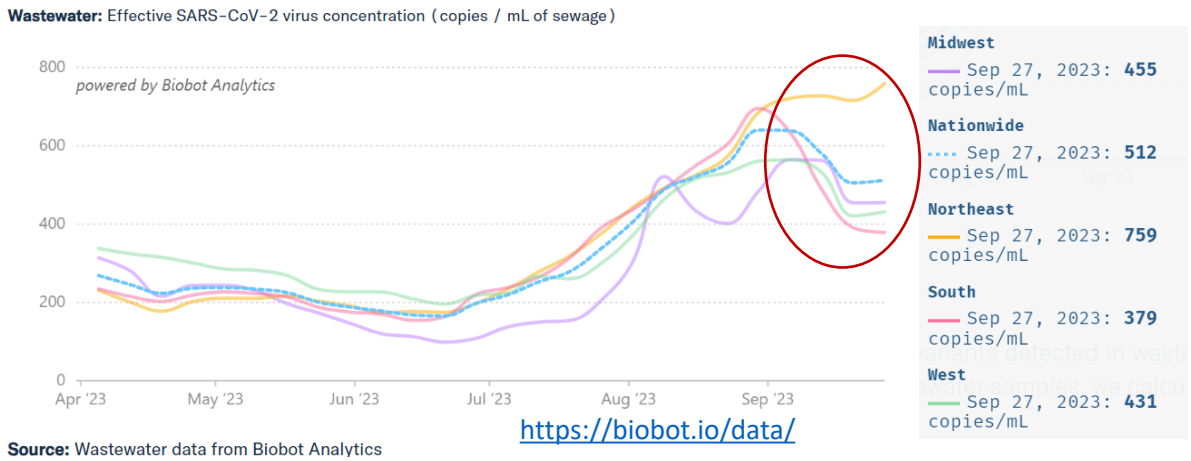




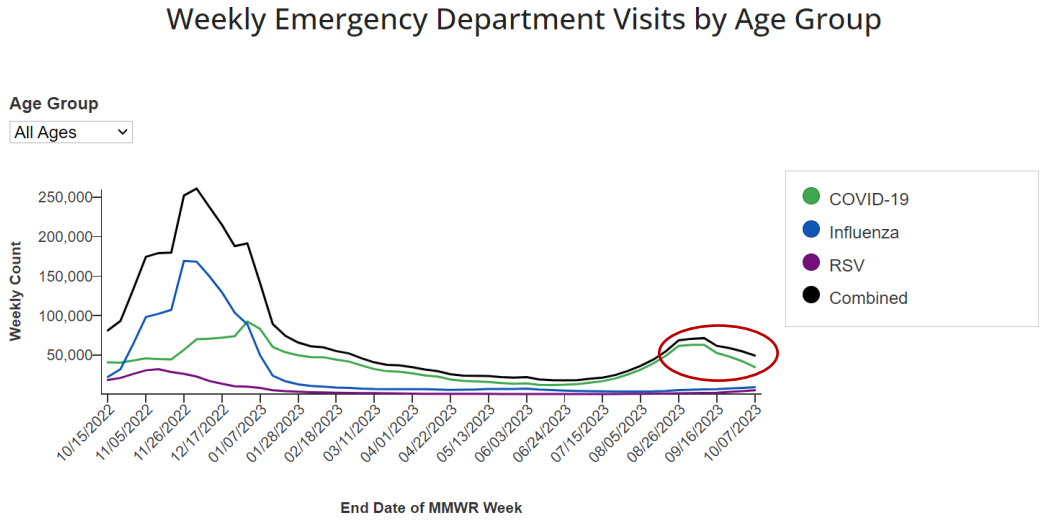




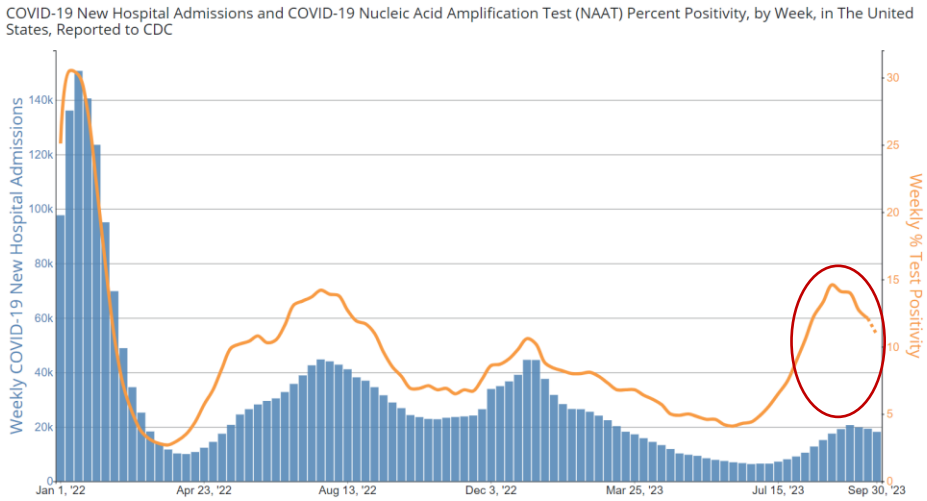
Wastewater, ED visits, and Test positivity



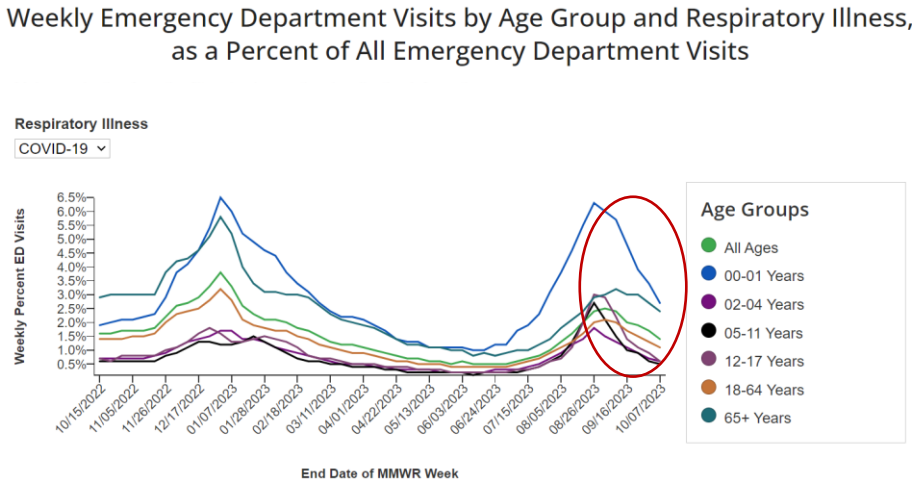
https://biobot.io/data/



- 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



https://covid.cdc.gov/covid-data-tracker/#trends_weeklyhospitaladmissions_testpositivity_00



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

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COVID-19 Spatial Epidemiology

ZIP Code level case rate since last meeting

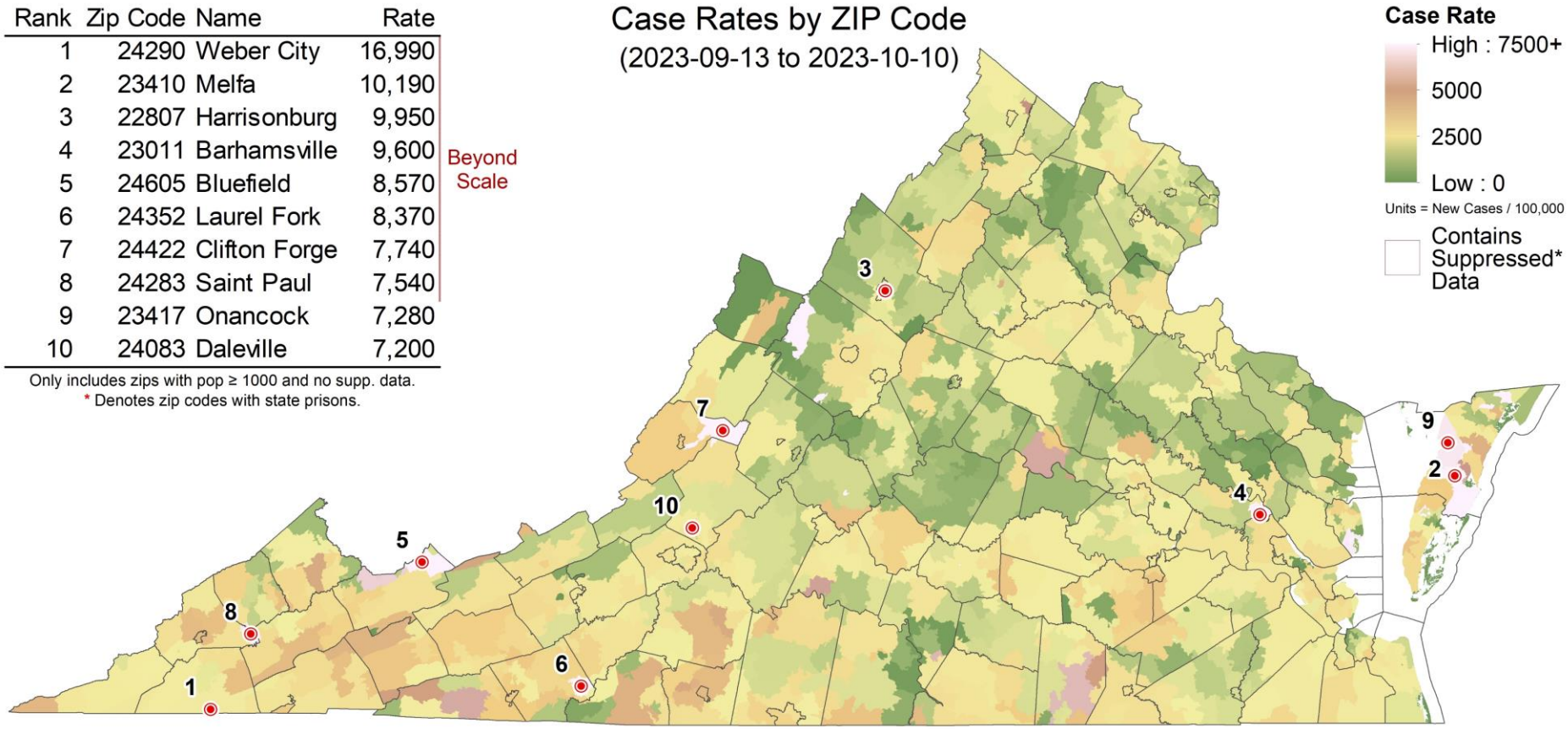
New cases per 100k in the last four weeks

- Statewide COVID-19 case rates have declined since the last meeting.
- Divide rates by four to calculate average weekly incidence.
- Rates remain elevated in the Southwest and near Richmond. Areas north of Richmond have seen significant declines.
- There are no prisons in this top 10. But two ZIPs from the Eastern Shore appear this week.

Rank	Zip Code	Name	Rate
1	24290	Weber City	16,990
2	23410	Melfa	10,190
3	22807	Harrisonburg	9,950
4	23011	Barhamsville	9,600
5	24605	Bluefield	8,570
6	24352	Laurel Fork	8,370
7	24422	Clifton Forge	7,740
8	24283	Saint Paul	7,540
9	23417	Onancock	7,280
10	24083	Daleville	7,200

Beyond Scale

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



Based on Spatial Empirical Bayes smoothed case rates, with an 8:1 ascertainment ratio, for five weeks ending 2023-10-10.

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Risk of Exposure and Hot Spots

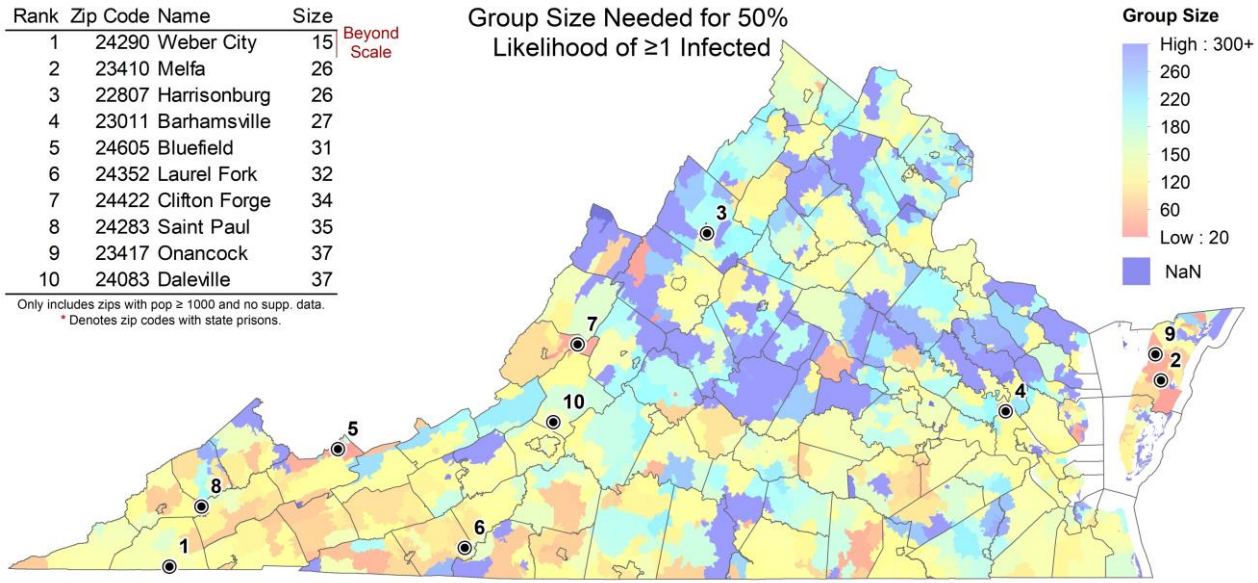
Case rates since last meeting by zip code used to calculate risk of encountering someone infected in a gathering of randomly selected people and find spatial hot spots

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

Rank	Zip Code	Name	Size
1	24290	Weber City	15
2	23410	Melfa	26
3	22807	Harrisonburg	26
4	23011	Barhamsville	27
5	24605	Bluefield	31
6	24352	Laurel Fork	32
7	24422	Clifton Forge	34
8	24283	Saint Paul	35
9	23417	Onancock	37
10	24083	Daleville	37

Beyond Scale

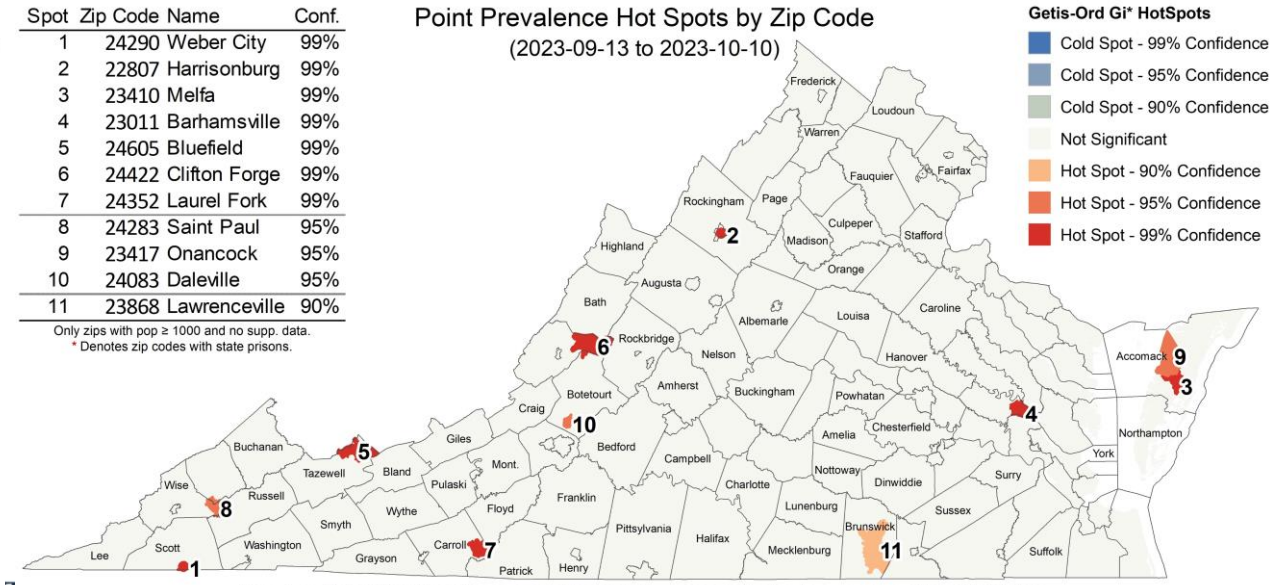
Only includes zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons.



Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for four weeks ending 2023-10-10

Spot	Zip Code	Name	Conf.
1	24290	Weber City	99%
2	22807	Harrisonburg	99%
3	23410	Melfa	99%
4	23011	Barhamsville	99%
5	24605	Bluefield	99%
6	24422	Clifton Forge	99%
7	24352	Laurel Fork	99%
8	24283	Saint Paul	95%
9	23417	Onancock	95%
10	24083	Daleville	95%
11	23868	Lawrenceville	90%

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



Based on Global Empirical Bayes smoothed point prevalence for the four weeks ending 2023-10-10.

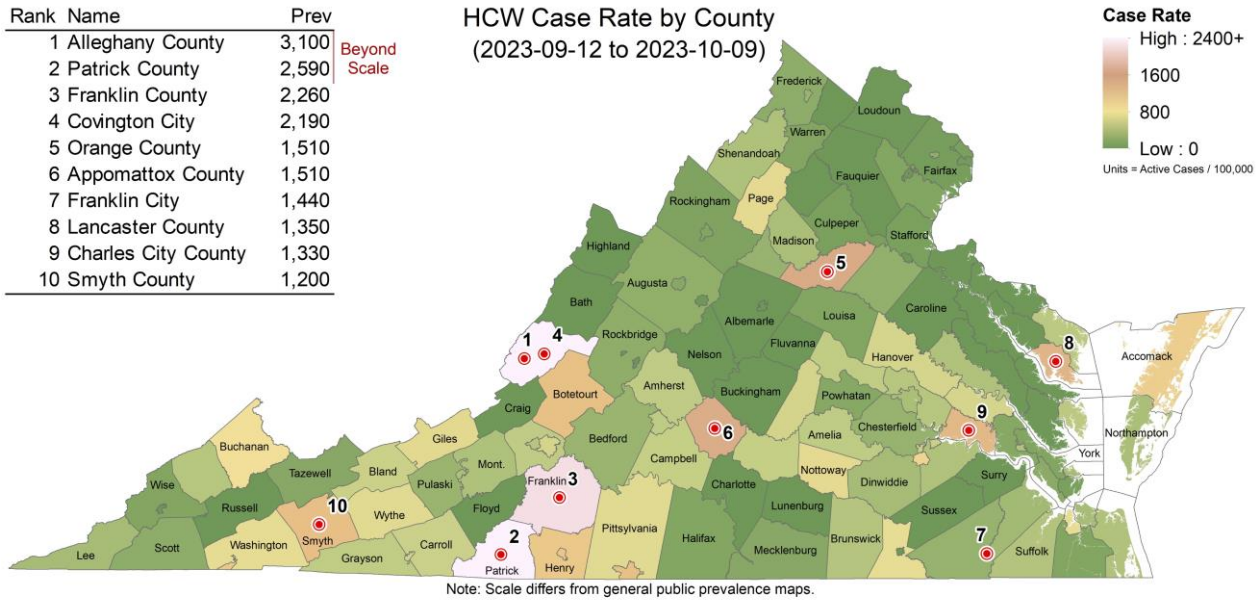
COVID-19 among Healthcare Workers

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 four weeks ending October 9
- **HCW Ratio**: Case rate among health care workers (HCW) over the same four weeks using patient facing health care workers as the numerator, and the population's case rate as the denominator.
- Unusual high rates and ratios are seen in the West Piedmont and Alleghany Health Districts.

Rank	Name	Prev
1	Alleghany County	3,100
2	Patrick County	2,590
3	Franklin County	2,260
4	Covington City	2,190
5	Orange County	1,510
6	Appomattox County	1,510
7	Franklin City	1,440
8	Lancaster County	1,350
9	Charles City County	1,330
10	Smyth County	1,200

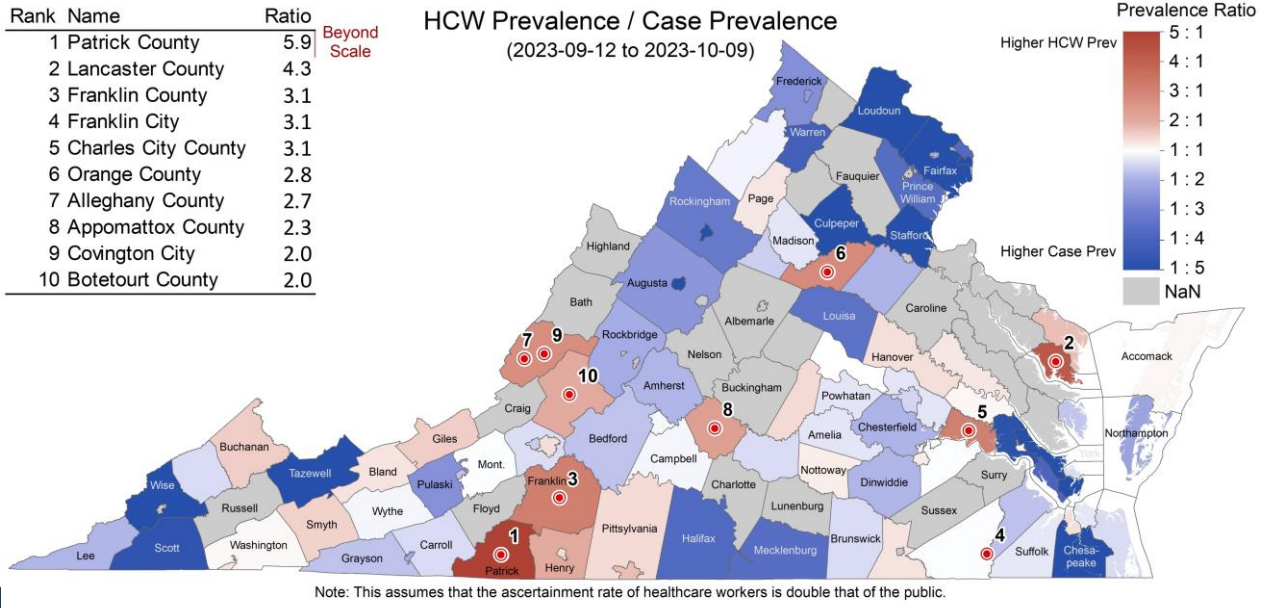
Beyond Scale



Note: Scale differs from general public prevalence maps.

Rank	Name	Ratio
1	Patrick County	5.9
2	Lancaster County	4.3
3	Franklin County	3.1
4	Franklin City	3.1
5	Charles City County	3.1
6	Orange County	2.8
7	Alleghany County	2.7
8	Appomattox County	2.3
9	Covington City	2.0
10	Botetourt County	2.0

Beyond Scale

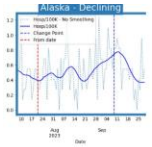


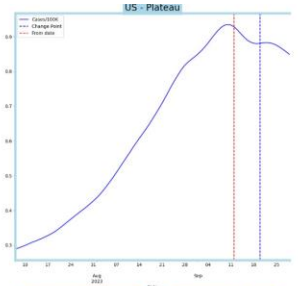
Note: This assumes that the ascertainment rate of healthcare workers is double that of the public.

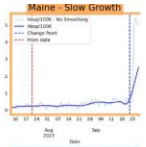
COVID-19 Broader Context

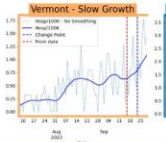
United States Hospitalizations

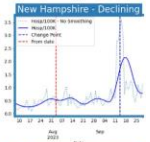
Status	Number of States	
	Current Week	Last Month
Declining	11	(4)
Plateau	26	(23)
Slow Growth	16	(26)
In Surge	0	(0)

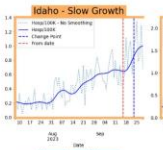


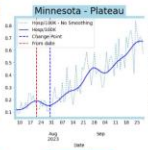


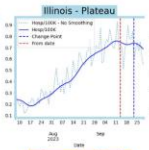


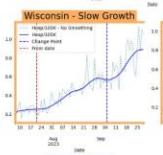


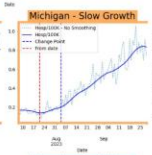


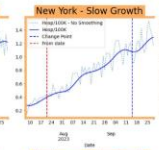


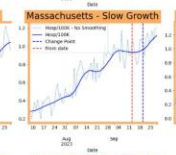


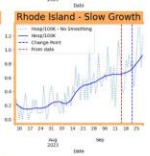


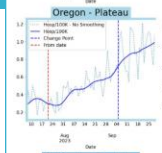


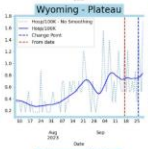


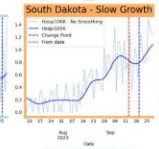


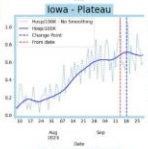


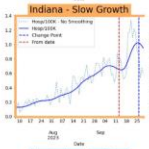


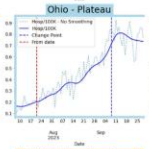


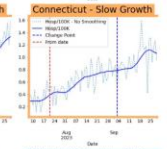


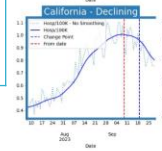


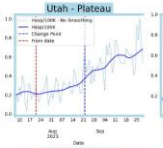


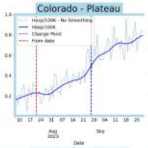


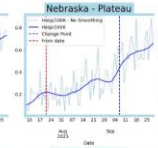


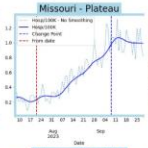


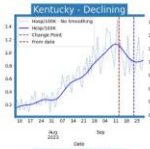


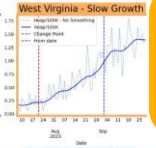


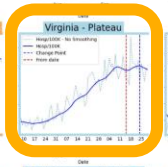


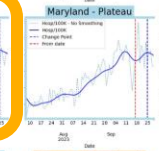


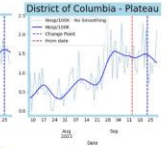


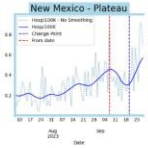


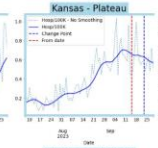


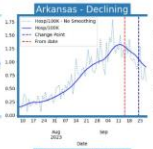








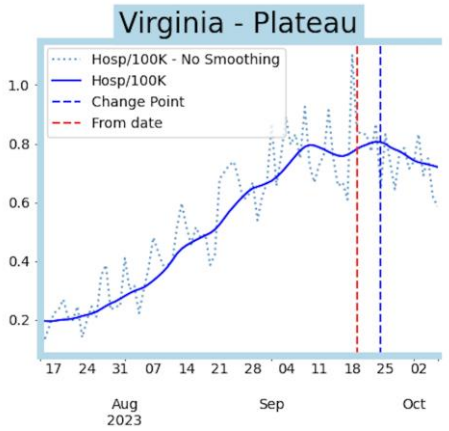




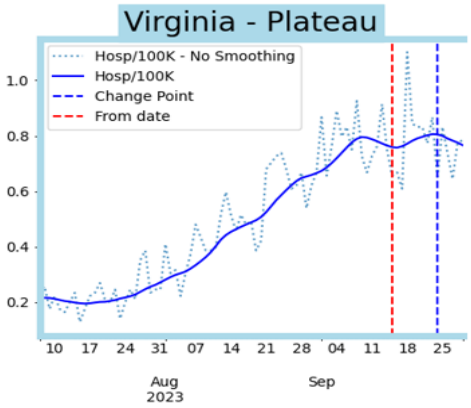
Whole Pandemic

United States Hospitalizations – Interim Update

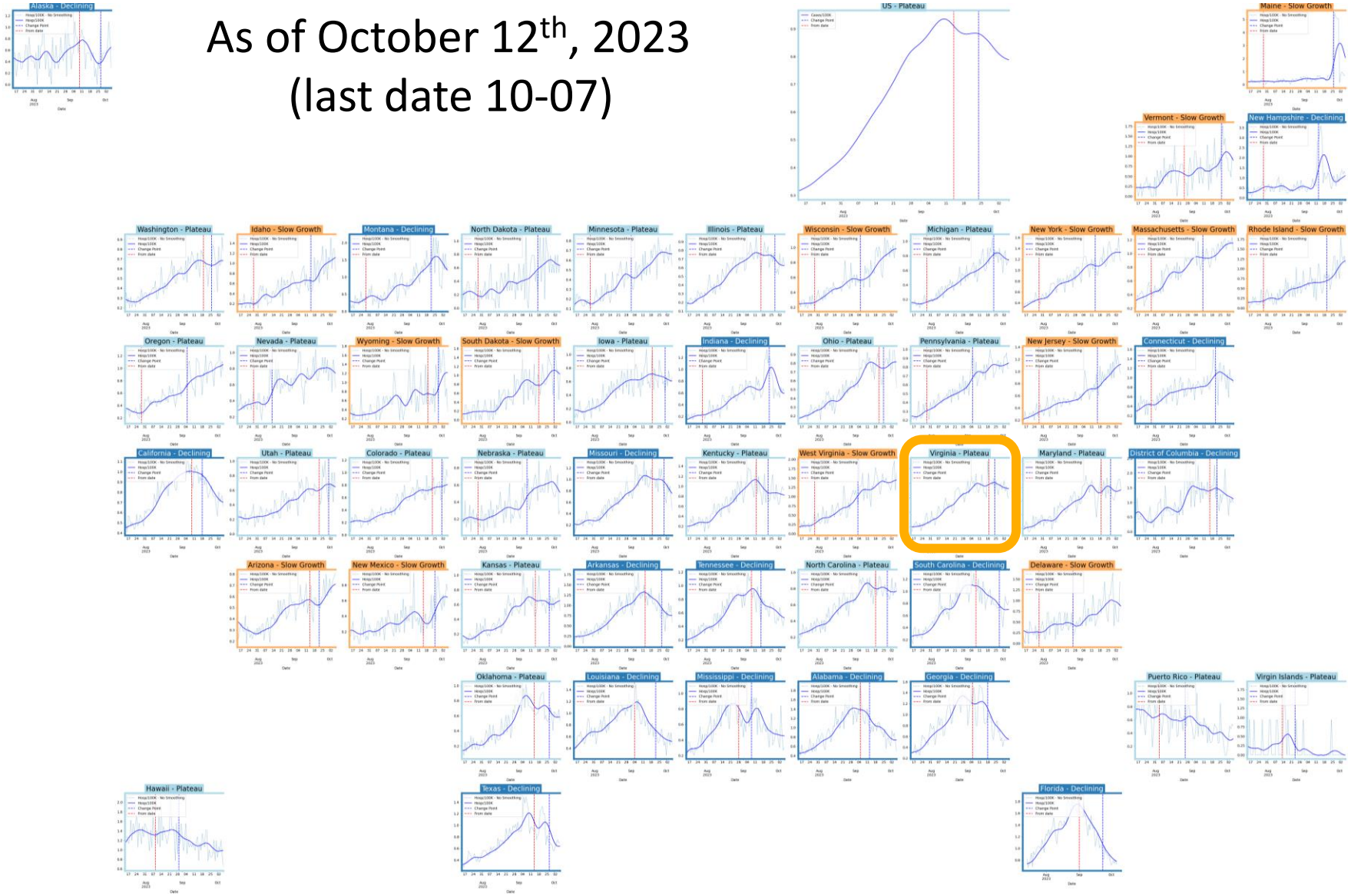
Interim Update
(last date 10-07)



Official Release
(last date 9-30)

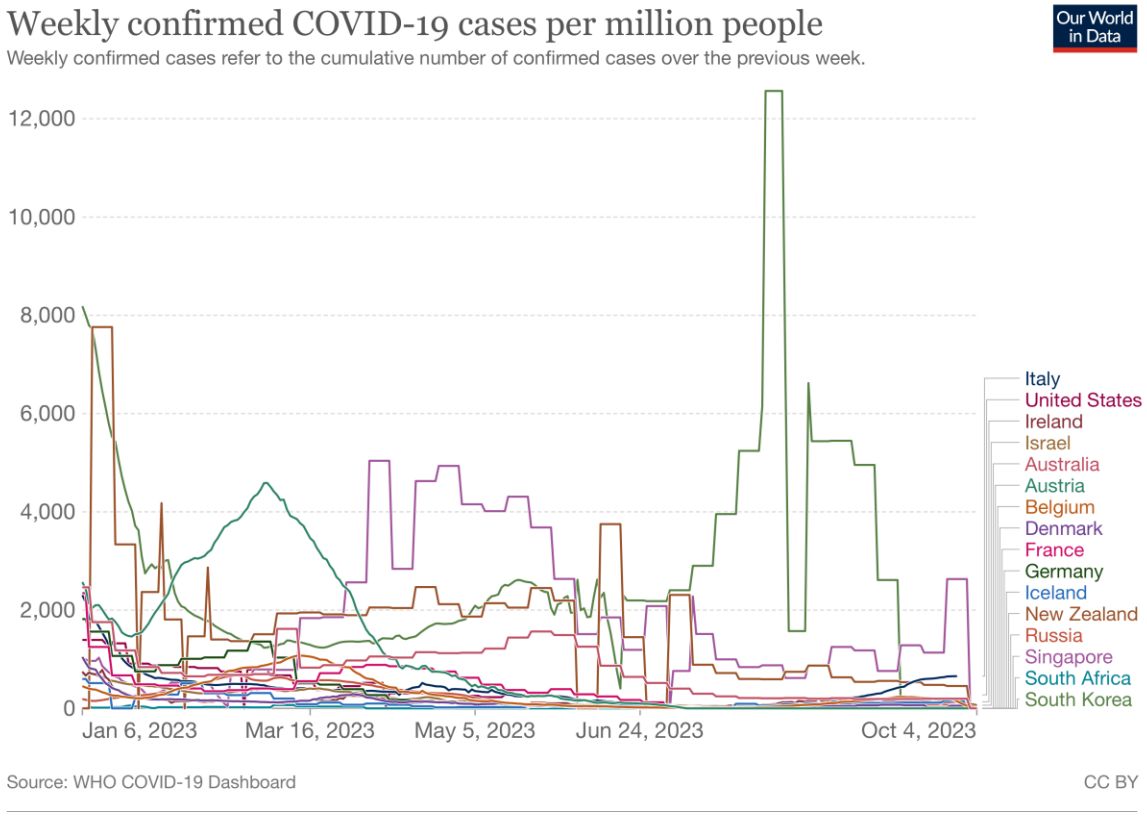


As of October 12th, 2023
(last date 10-07)

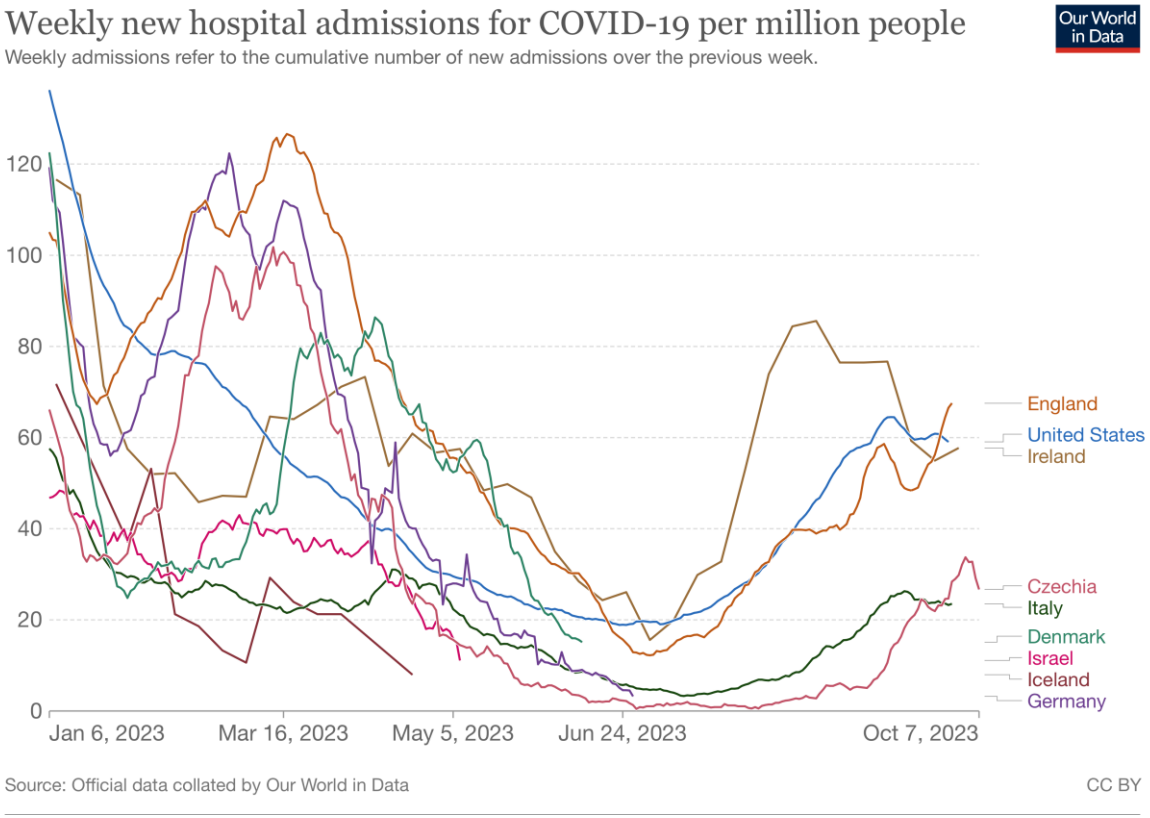


Around the World – Various trajectories

Confirmed cases



Hospitalizations



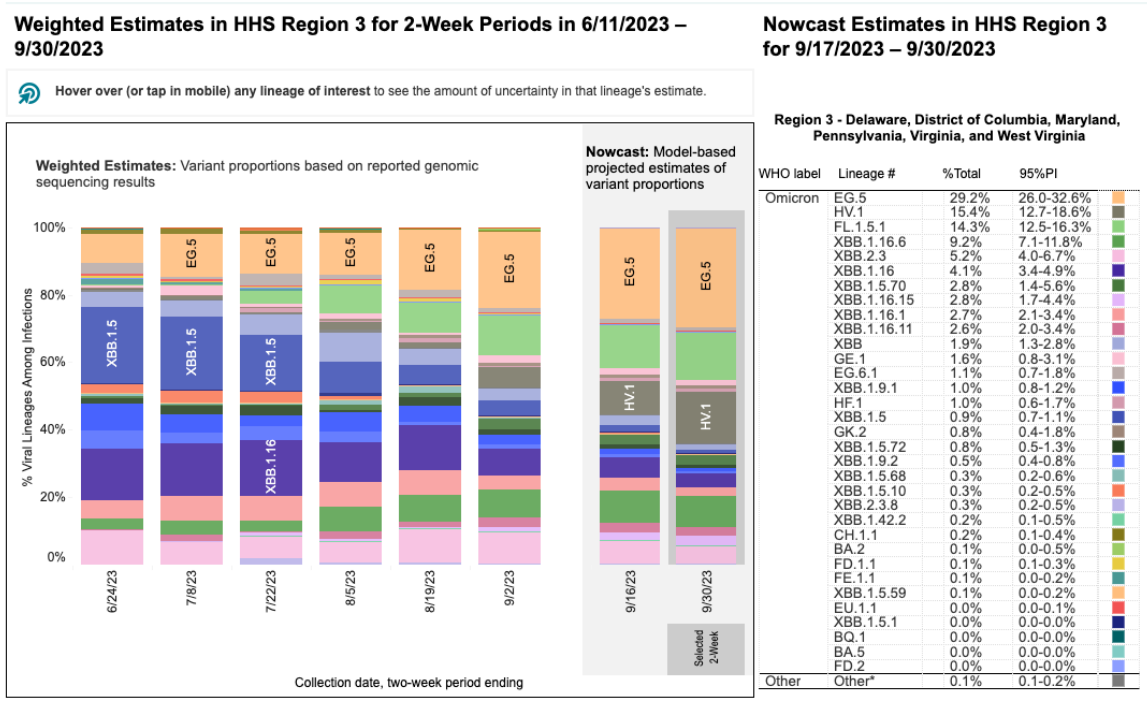
Our World in Data [Our World in Data]

COVID-19 Genomic Update

SARS-CoV2 Variants of Concern

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

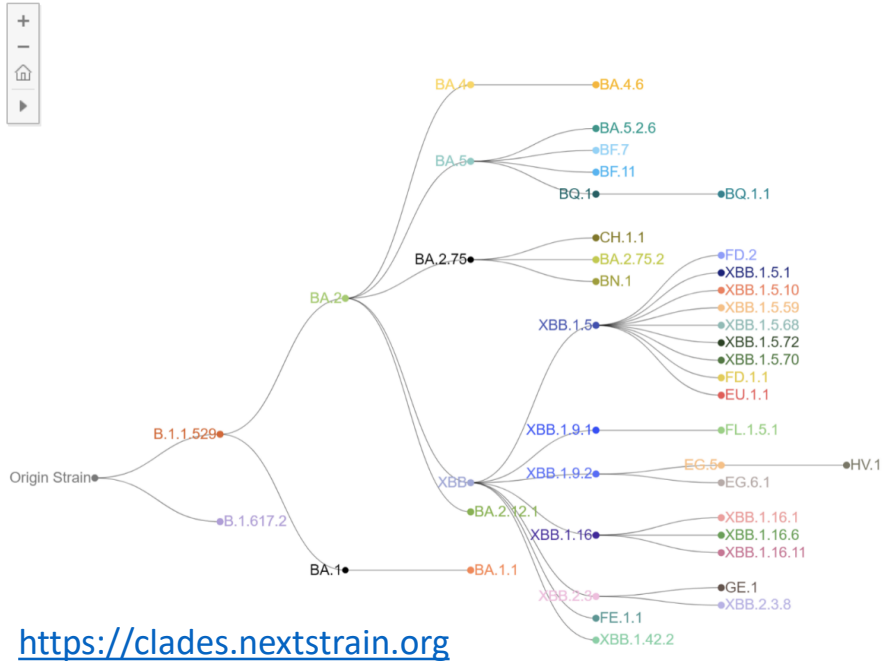
- **Variants have been observed to:** increase transmissibility, increase severity (more hospitalizations and/or deaths), and limit immunity provided by prior infection and vaccinations



Nowcast Estimates in HHS Region 3 for 9/17/2023 – 9/30/2023

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

WHO label	Lineage #	%Total	95%PI
Omicron	EG.5	29.2%	26.0-32.6%
	HV.1	15.4%	12.7-18.6%
	FL.1.5.1	14.3%	12.5-16.3%
	XBB.1.16.6	9.2%	7.1-11.8%
	XBB.2.3	5.2%	4.0-6.7%
	XBB.1.16	4.1%	3.4-4.9%
	XBB.1.5.70	2.8%	1.4-5.6%
	XBB.1.16.15	2.8%	1.7-4.4%
	XBB.1.16.1	2.7%	2.1-3.4%
	XBB.1.16.11	2.6%	2.0-3.4%
	XBB	1.9%	1.3-2.8%
	GE.1	1.6%	0.8-3.1%
	EG.6.1	1.1%	0.7-1.8%
	XBB.1.9.1	1.0%	0.8-1.2%
	HF.1	1.0%	0.6-1.7%
	XBB.1.5	0.9%	0.7-1.1%
	GK.2	0.8%	0.4-1.8%
	XBB.1.5.72	0.8%	0.5-1.3%
	XBB.1.9.2	0.5%	0.4-0.8%
	XBB.1.5.68	0.3%	0.2-0.6%
	XBB.1.5.10	0.3%	0.2-0.5%
	XBB.2.3.8	0.3%	0.2-0.5%
	XBB.1.42.2	0.2%	0.1-0.5%
	CH.1.1	0.2%	0.1-0.4%
	BA.2	0.1%	0.0-0.5%
	FD.1.1	0.1%	0.1-0.3%
	FE.1.1	0.1%	0.0-0.2%
	XBB.1.5.59	0.1%	0.0-0.2%
	EU.1.1	0.0%	0.0-0.1%
	XBB.1.5.1	0.0%	0.0-0.0%
	BQ.1	0.0%	0.0-0.0%
	BA.5	0.0%	0.0-0.0%
	FD.2	0.0%	0.0-0.0%
Other	Other*	0.1%	0.1-0.2%



https://clades.nextstrain.org

Omicron Updates*

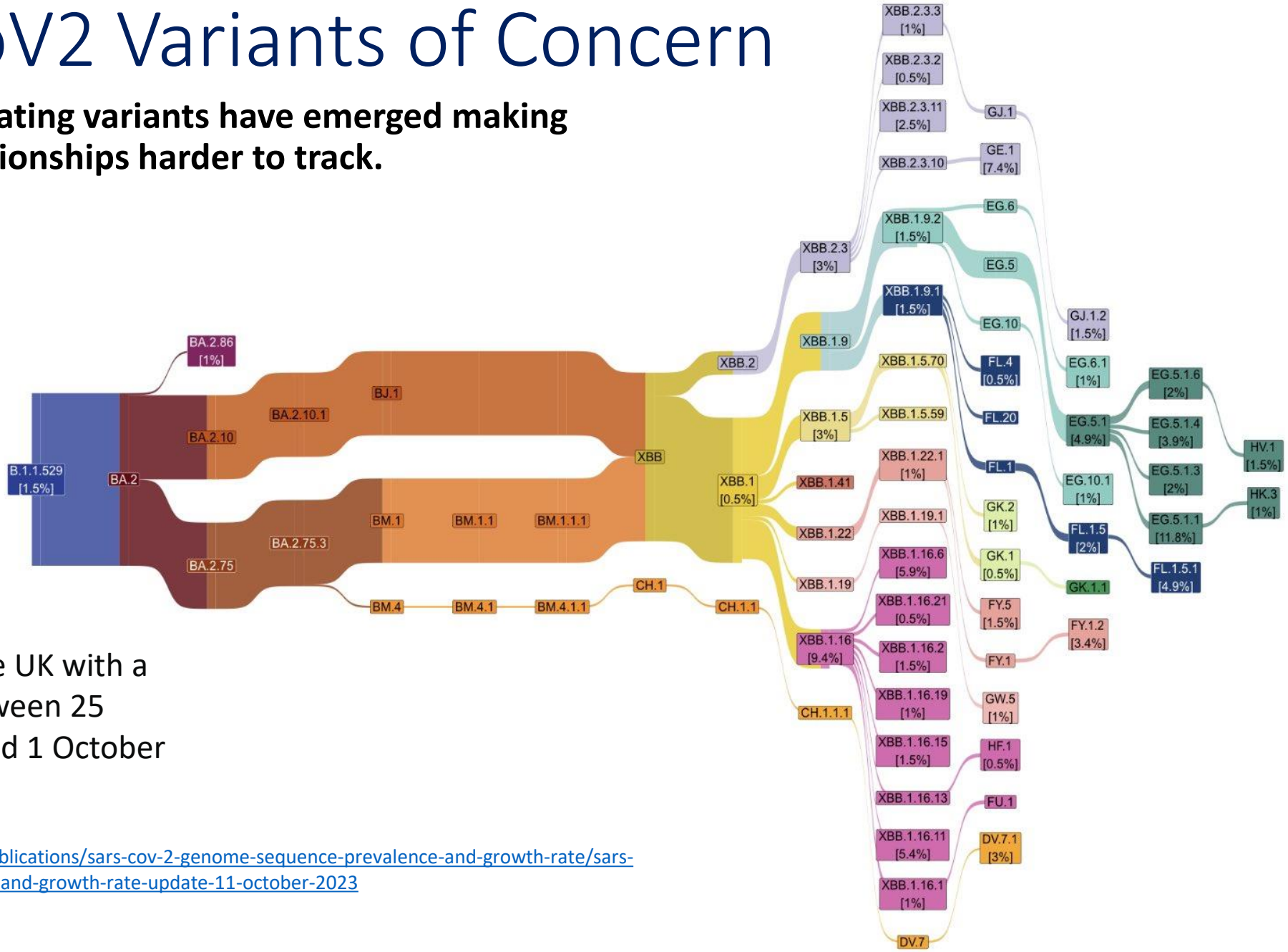
- HHS Region 3 estimates restored
- New lineage EG.5 (XBB.1.9*) up to 29.2 from 25.5%
- New lineage FL.1.5.1 (XBB.1.9*) up to 13.7 from 12%
- New lineage HV.1 (XBB.1.9*) up to 15.4%
- Most circulating variants are sublineages of XBB.1.9, XBB.1.16, XBB.1.5, and XBB.2.3

*percentages are CDC NowCast Estimates

CDC Variant Tracking

SARS-CoV2 Variants of Concern

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

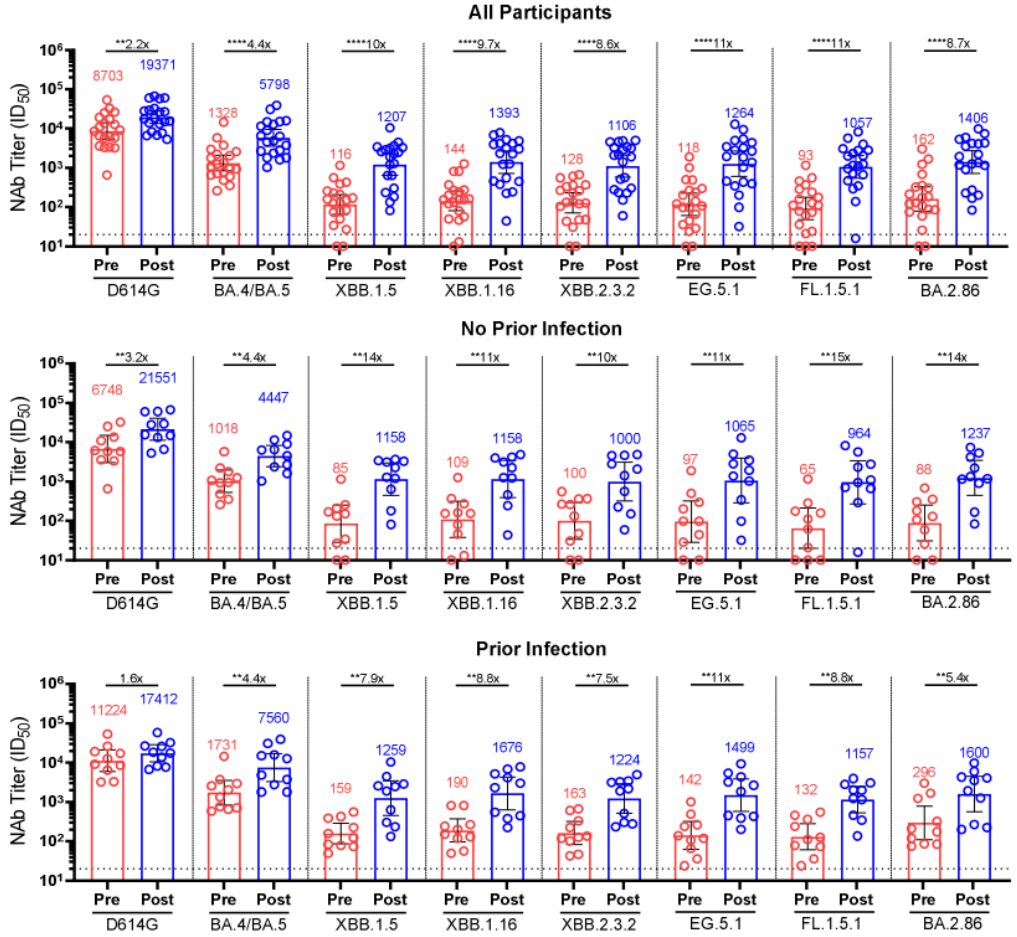


Sequences from the UK with a specimen date between 25 September 2023 and 1 October 2023.

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-11-october-2023

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.

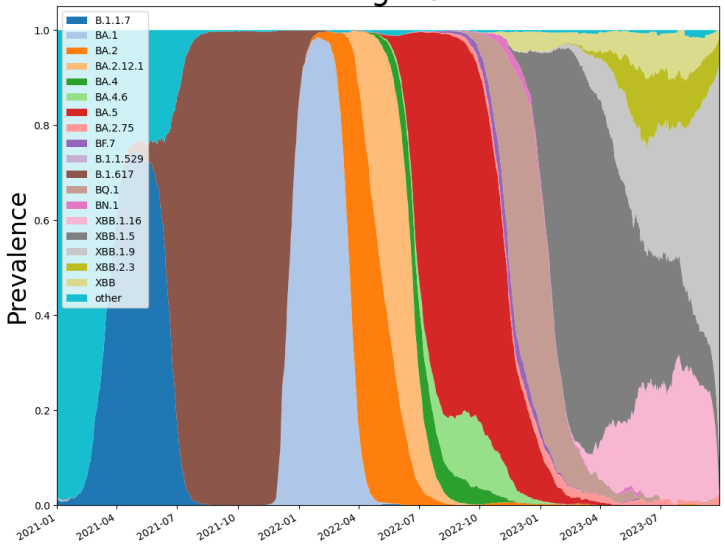
https://www.medrxiv.org/content/10.1101/2023.08.22.23293434v2

SARS-CoV2 Omicron Sub-Variants

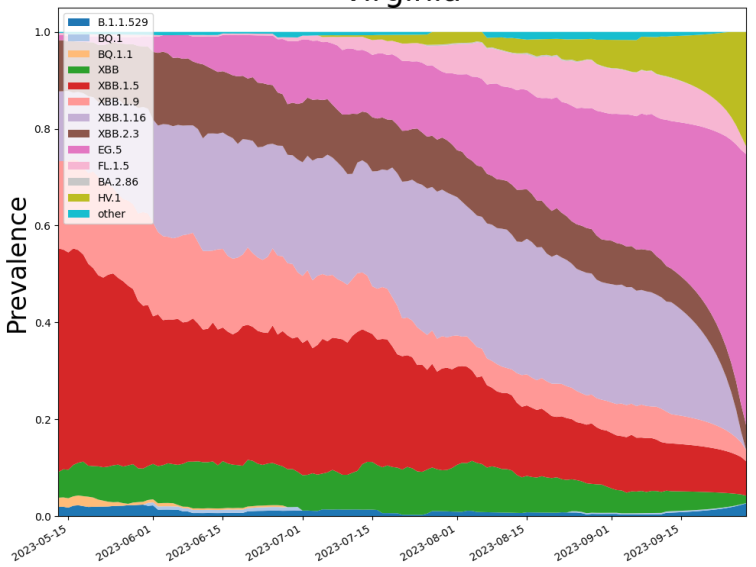
covSPECTRUM
Enabled by data from GISAID

As detected in whole Genomes in public repositories

Virginia

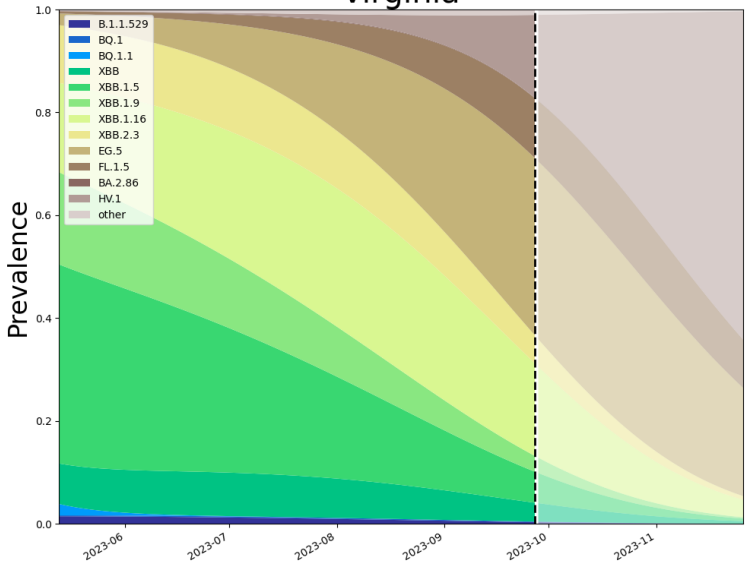


Virginia

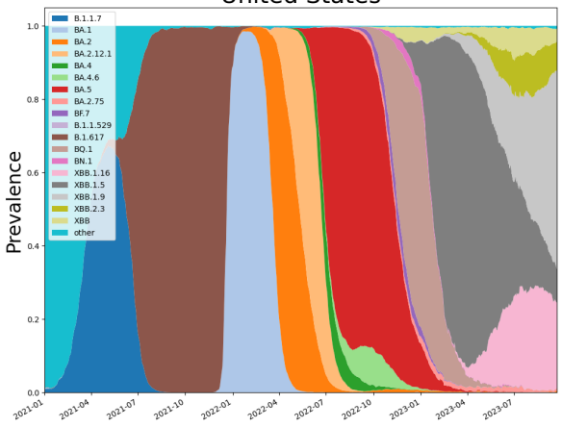


VoC Polynomial Fit Projections

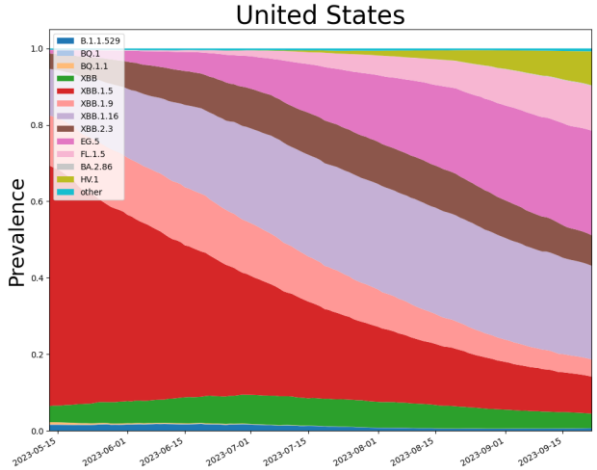
Virginia



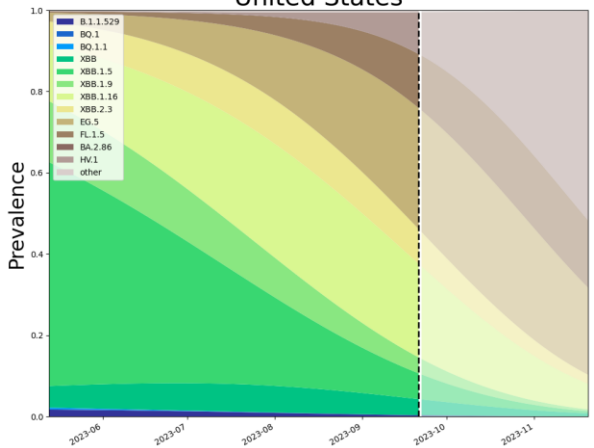
United States



United States

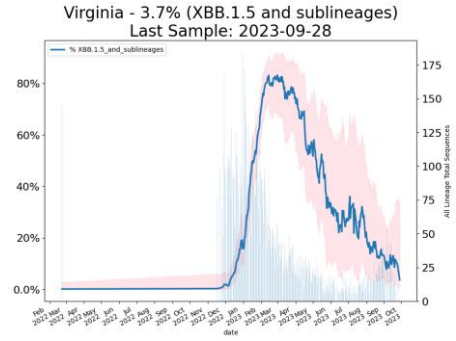


United States



Note: Everything from dotted line forward is a projection.

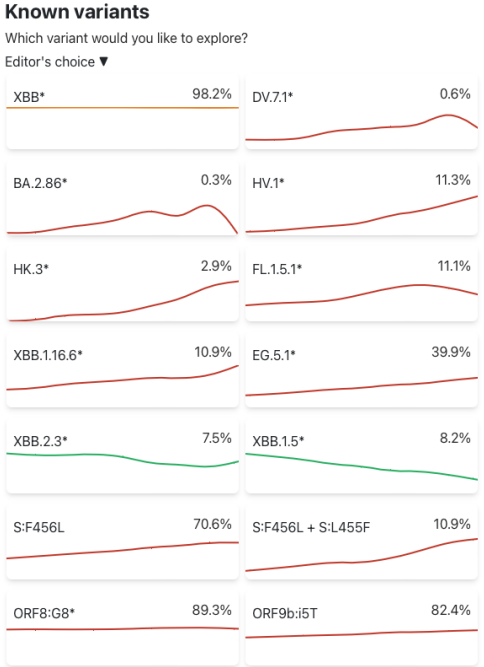
SARS-CoV2 Omicron Sub-Variants



[COV-spectrum](#)

"Editor's choice"

Variants to watch

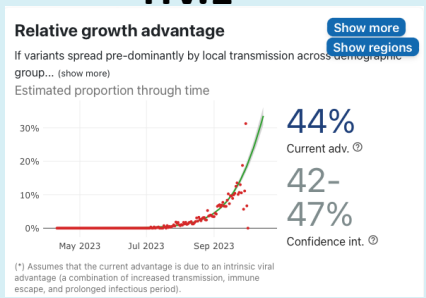


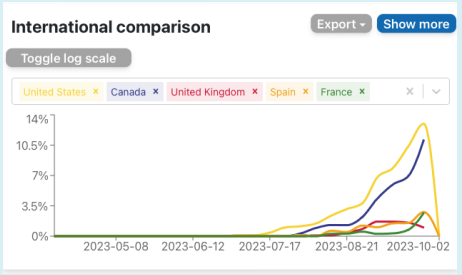
covSPECTRUM

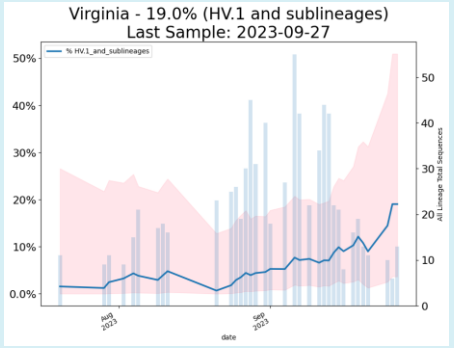
Enabled by data from GISAID

13-Oct-23

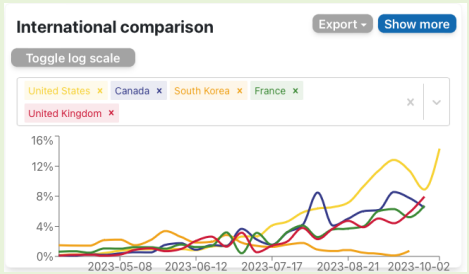
HV.1*

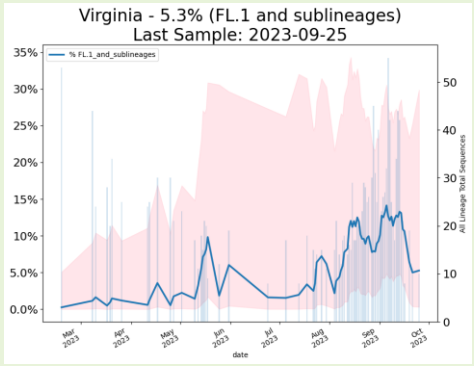




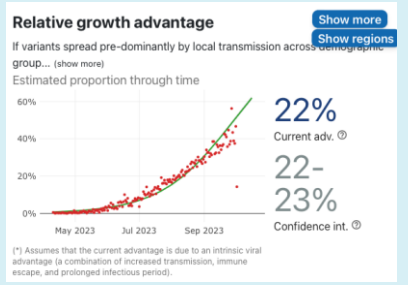


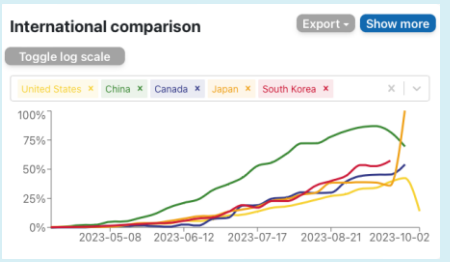
FL.1*

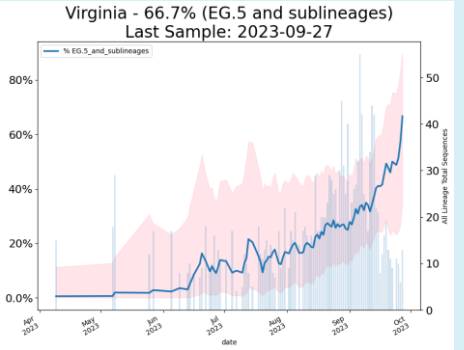




EG.5*

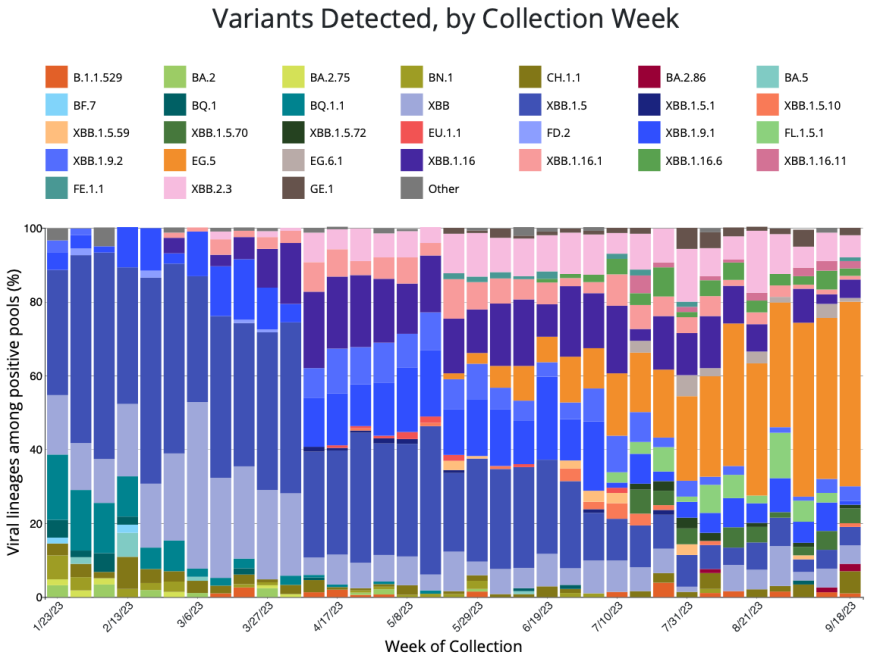


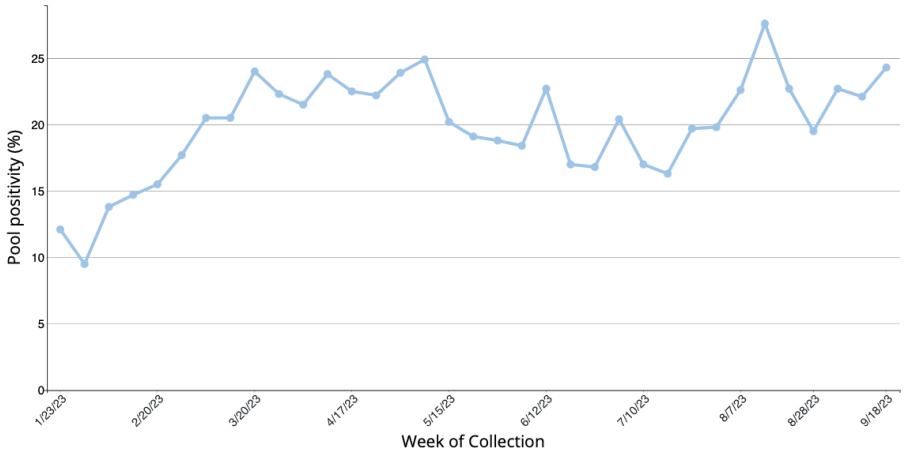


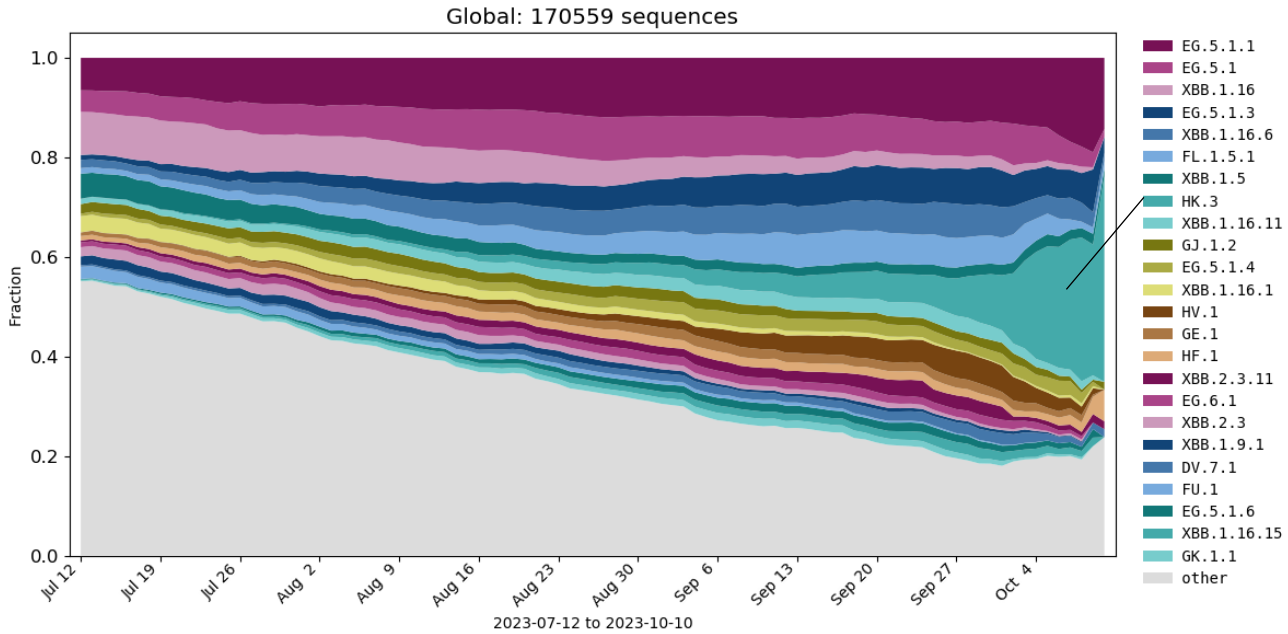


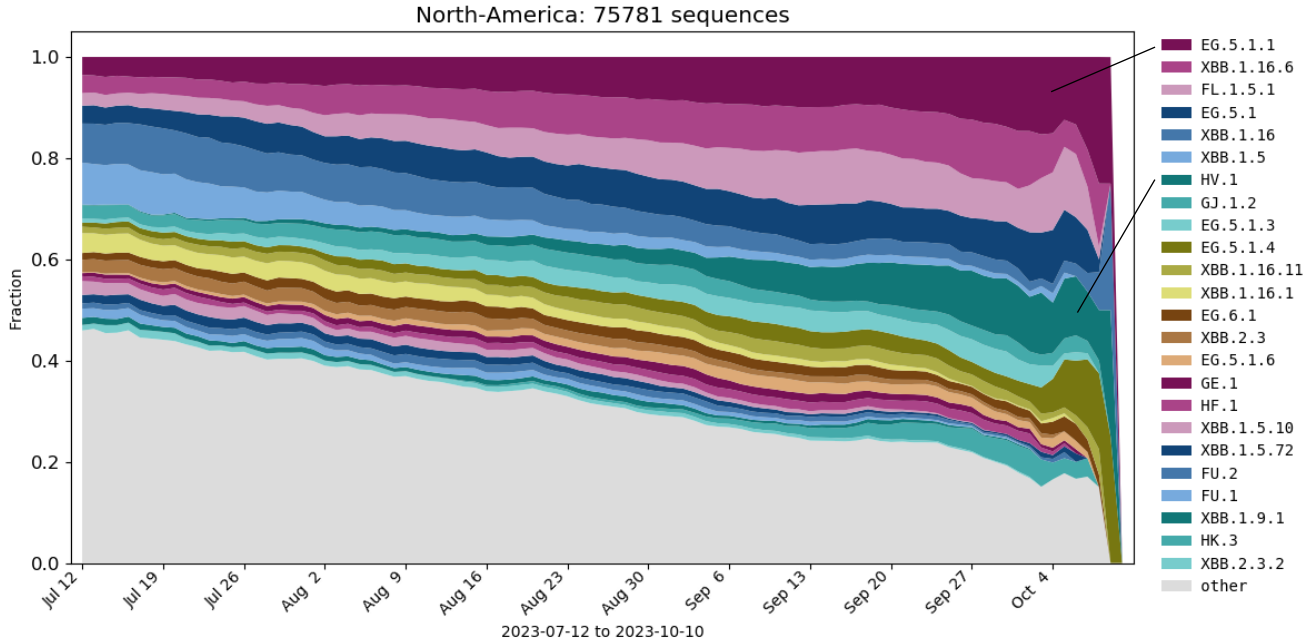
Global SARS-CoV2 Variant Status

Traveller Surveillance









https://cov.lanl.gov/components/sequence/COV/sparks.comp
https://covid.cdc.gov/covid-data-tracker/#traveler-genomic-surveillance

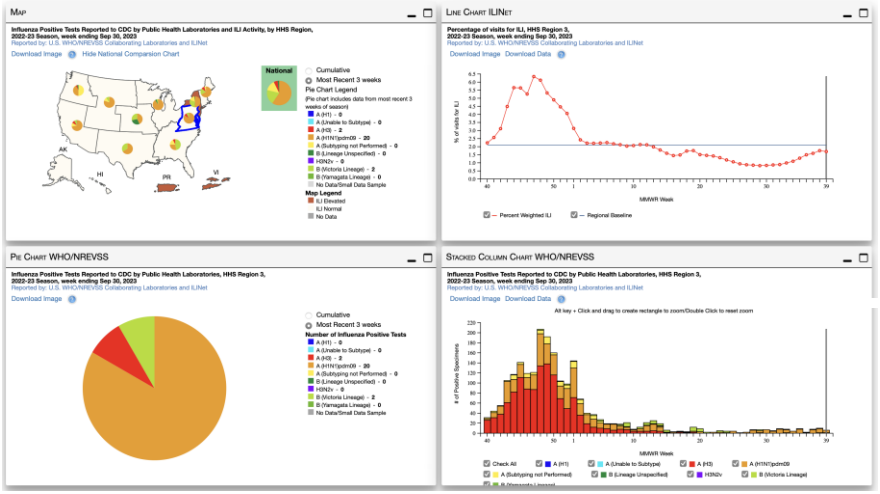
Influenza Update

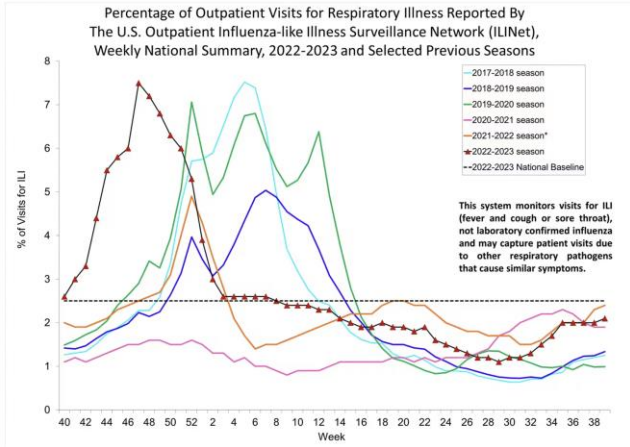
Current Influenza Situation – ILI Activity

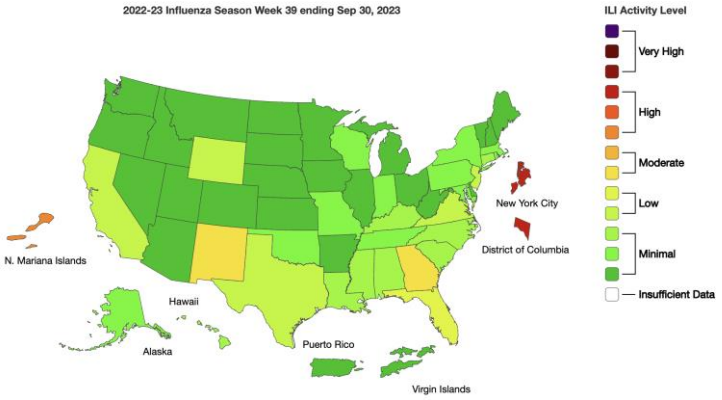
Influenza Activity is below threshold

- Virginia is in ”Low” level as some states and regions renew upward growth after a couple week pause.
- National ILI activity remains below threshold but has had some slight growth after 4 weeks of plateau
- Only Region 2 (NY, NJ, PR, VI) are over the seasonal threshold for ILI activity

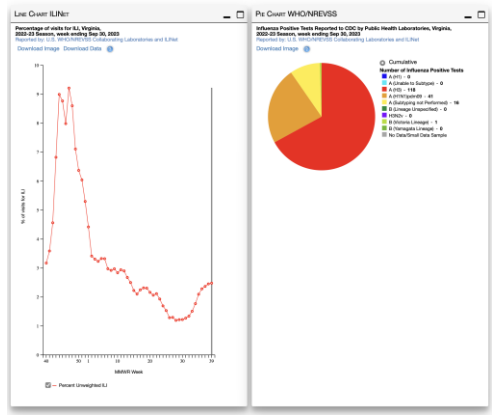
Region 3







Virginia



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FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

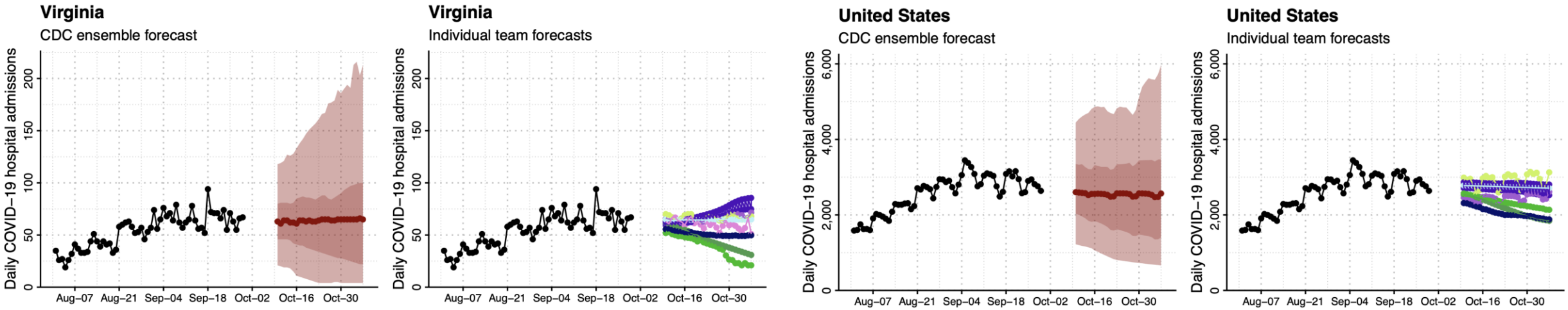
National Modeling Hub Updates

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)



Preliminary Influenza Hospitalization Forecast

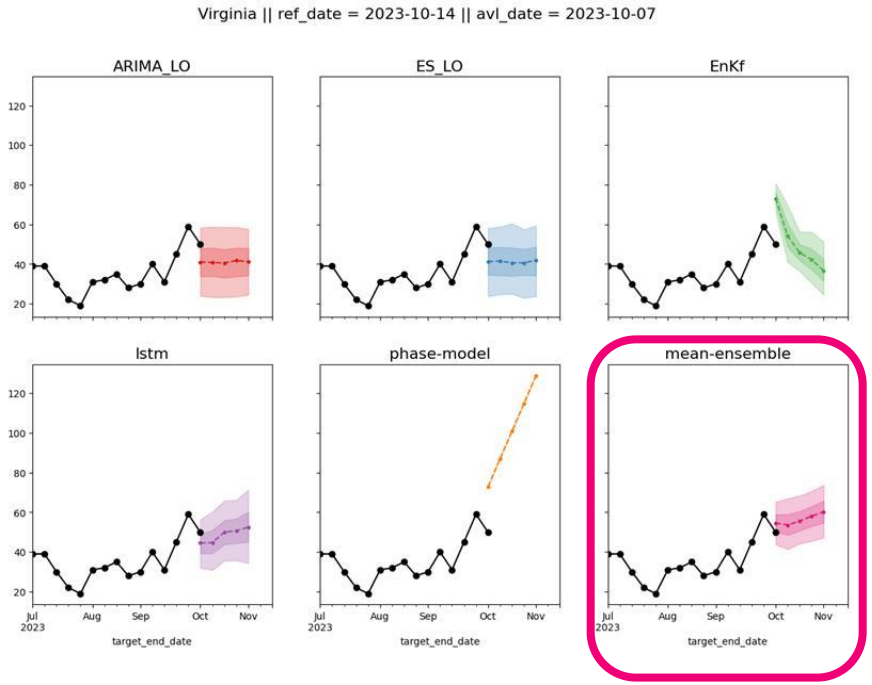
Statistical models for submitting to CDC Influenza Forecasting Hub

- 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

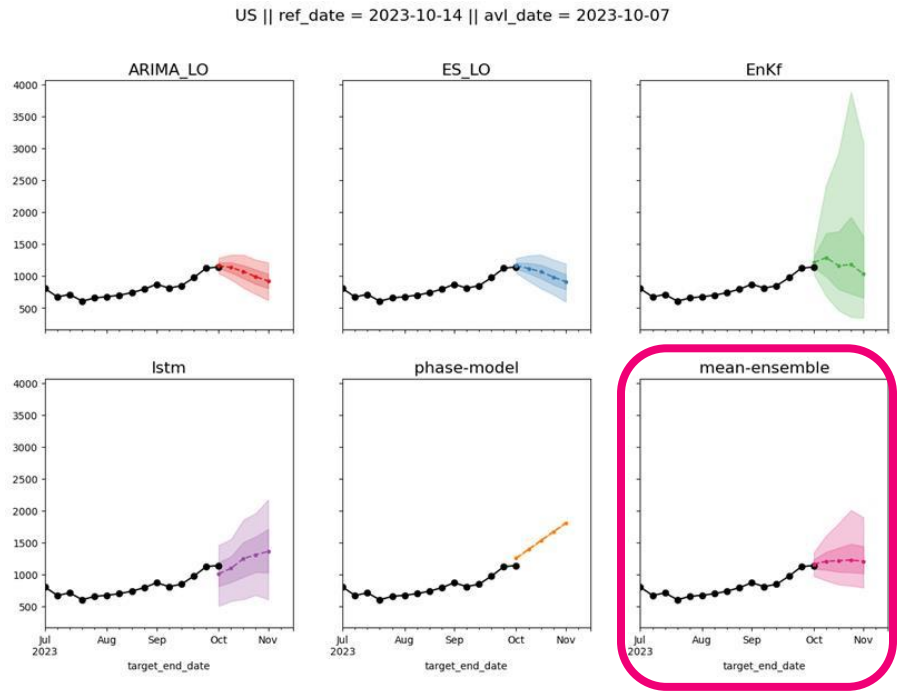
Virginia



Mean ensemble is official forecast (pink)

Last data point of ground truth is "interim" update

United States



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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 2nd, 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)

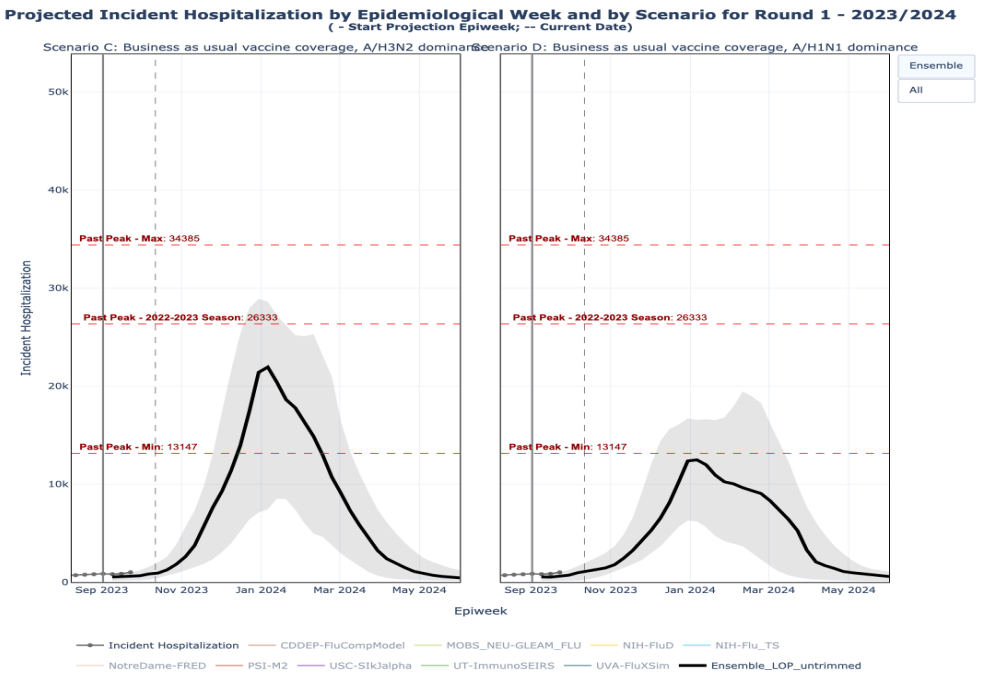
https://fluscenariomodelinghub.org/viz.html

	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**
Higher than Usual Vaccine Coverage • Vaccine coverage is **20% higher than in the 2021-22** flu season in all age groups and jurisdictions. (20% is a relative change, ie a 50% coverage for age group *a* and jurisdiction *j* in 2021-22 translates to a 50%*1.20=60% coverage for 2023-24). Overall, the US coverage is about 60% in this scenario.	**Scenario A**	**Scenario B**
Business as Usual Vaccine Coverage • Vaccine coverage is **the same as in the 2021-22** flu season in all age groups and jurisdictions. Overall, the US coverage is about 50% in this scenario.	**Scenario C**	**Scenario D**
Low Vaccine Coverage • Vaccine coverage is **20% lower than in the 2021-22** flu season in all age groups and jurisdictions. Overall, the US coverage is about 40% in this scenario.	**Scenario E**	**Scenario F**

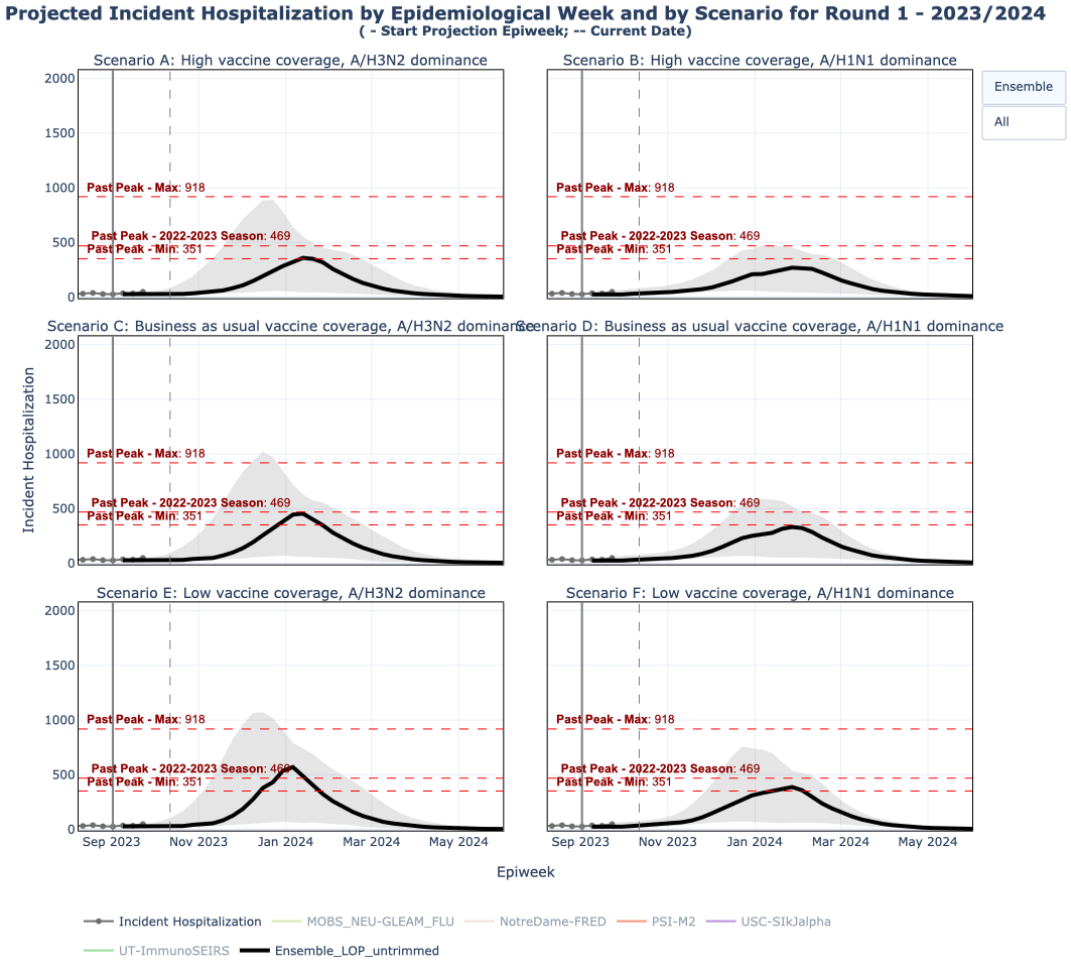
Scenario Modeling Hub – Influenza (Round 4)

- Severity of season has a strong influence.

United States Hospitalizations



Virginia Hospitalizations

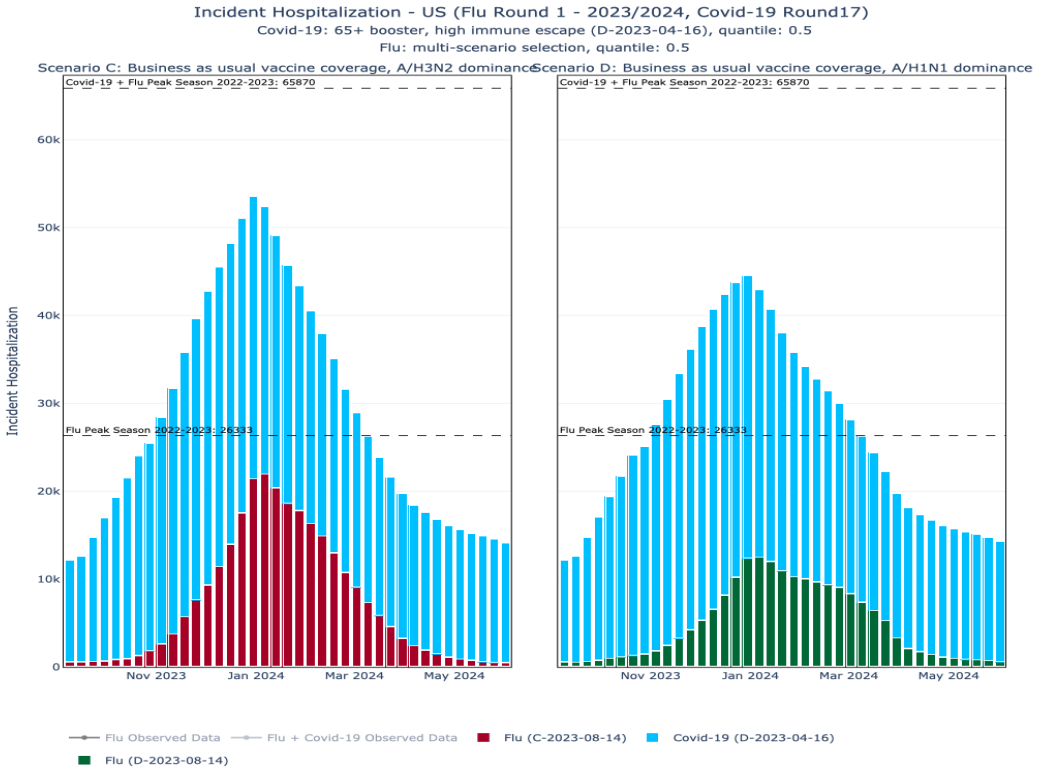


H3N2 dominated season (more severe)

H1N1 dominated season (less severe)

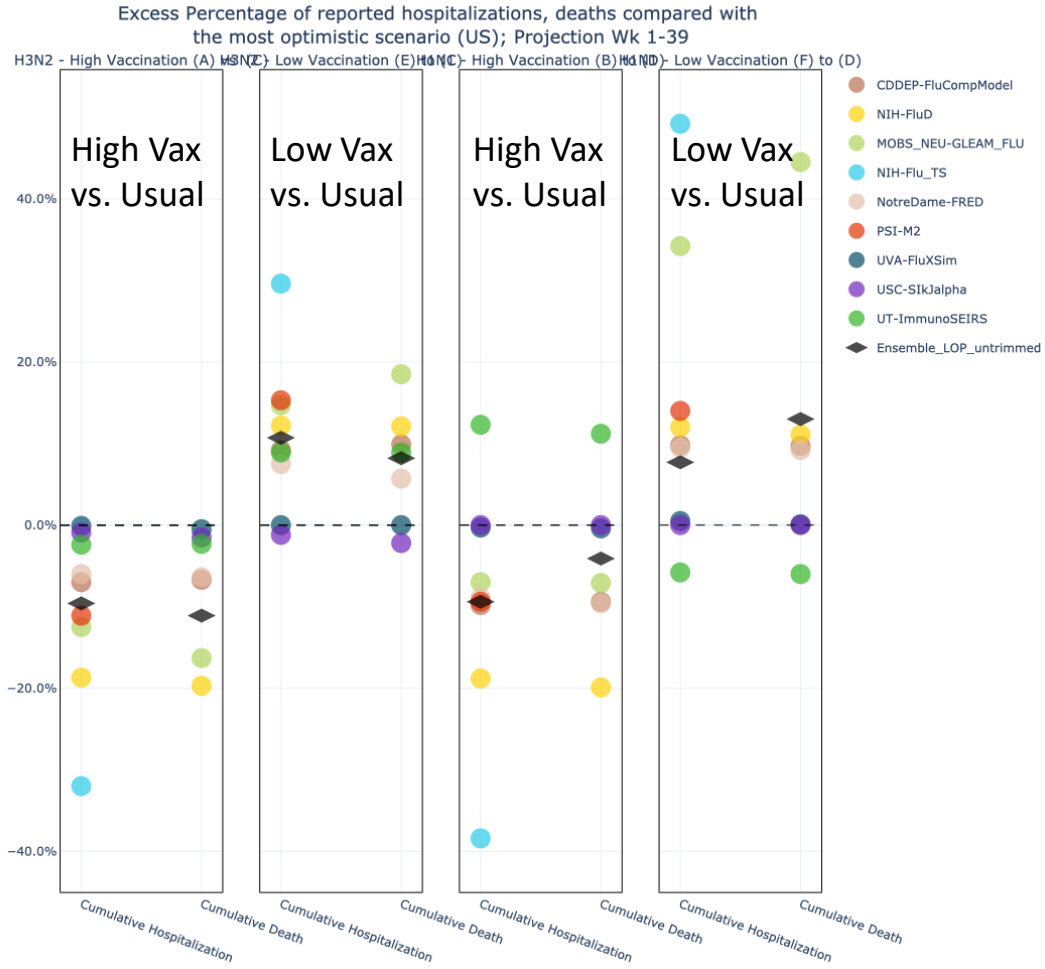
Scenario Modeling Hub – Influenza (Round 4)

- 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



More Pessimistic Scenario combinations

Virginia Hospitalizations



H3N2 dominated season (more severe)

H1N1 dominated season (less severe)

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)

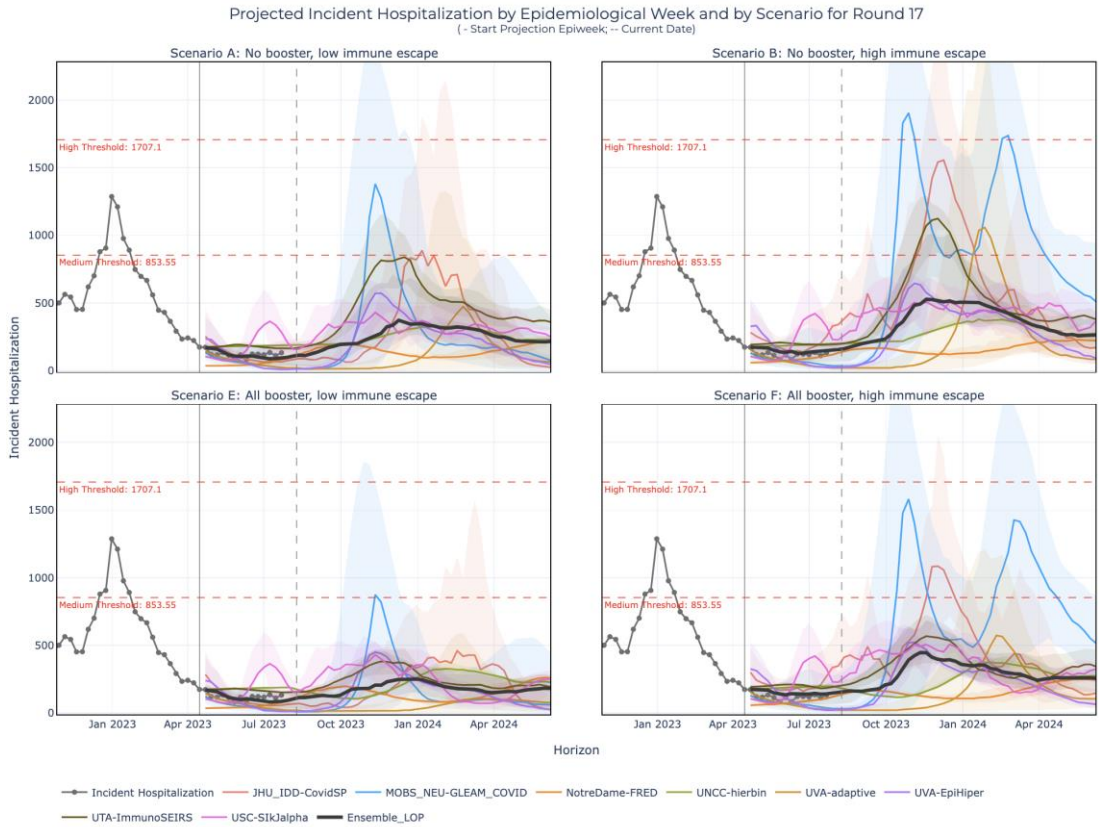
Vaccination levels:

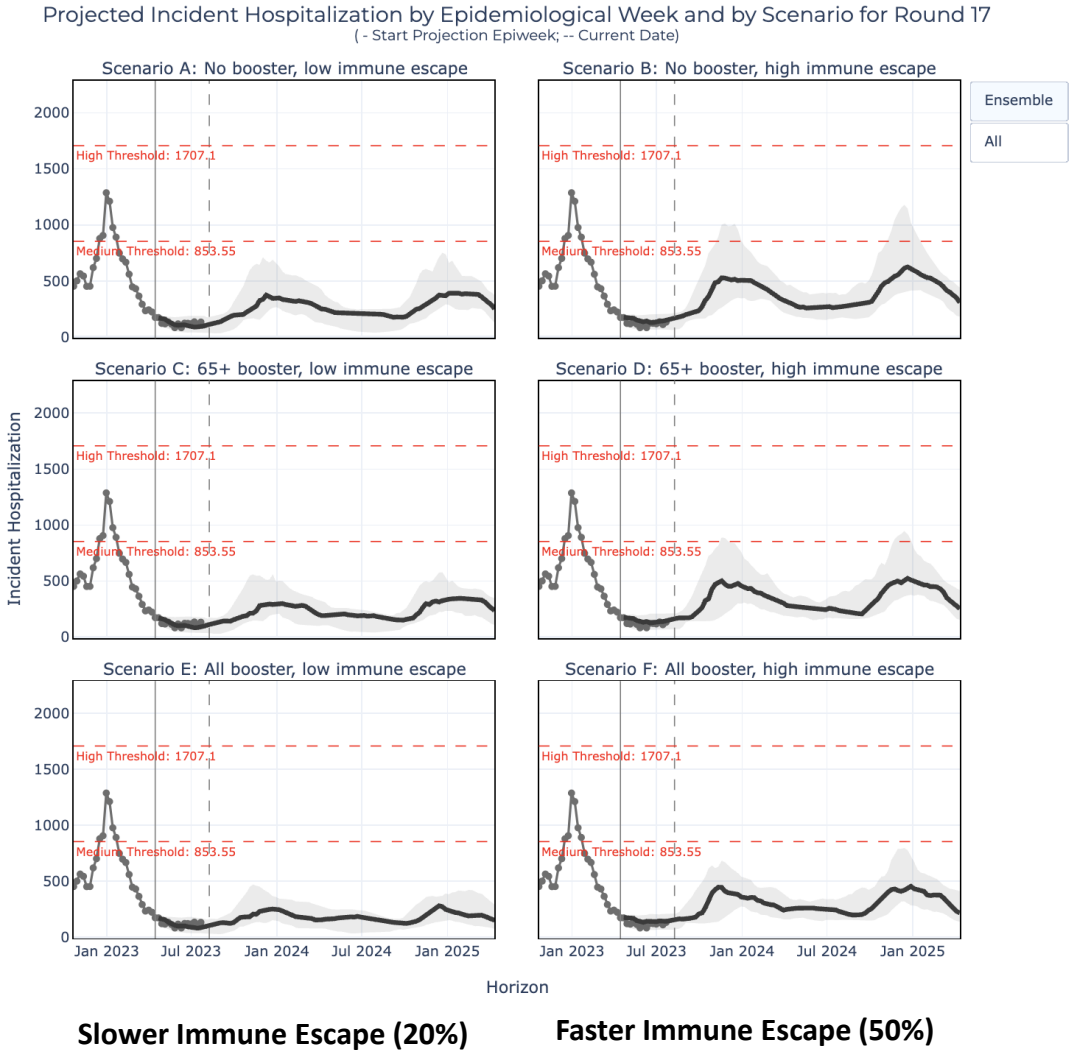
None vs.
Vulnerable and 65 + vs.
Broader population of eligible

	Low immune escape • Immune escape occurs at a constant rate of **20% per year**	**High immune escape** • Immune escape occurs at a constant rate of **50% per year**
No vaccine recommendation • Uptake negligible or continues at very slow levels based on existing 2022 booster trends	Scenario A	Scenario B
Reformulated annual vaccination recommended for 65+ and immunocompromised • Reformulated vaccine has **65% VE against variants circulating on June 15** • Vaccine becomes **available September 1** • Uptake in 65+ same as first booster dose recommended in September 2021 • Uptake in individuals under 65 negligible or continues to trickle based on 2022 booster trends	Scenario C	Scenario D
Reformulated annual vaccination recommended for all currently eligible groups • Reformulated vaccine has **65% VE against variants circulating on June 15** • Vaccine becomes **available September 1** • 65+ uptake same as first booster dose recommended in September 2021 • Coverage in individuals under 65+ saturates at levels of the 2021 booster (approximately 34% nationally)	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

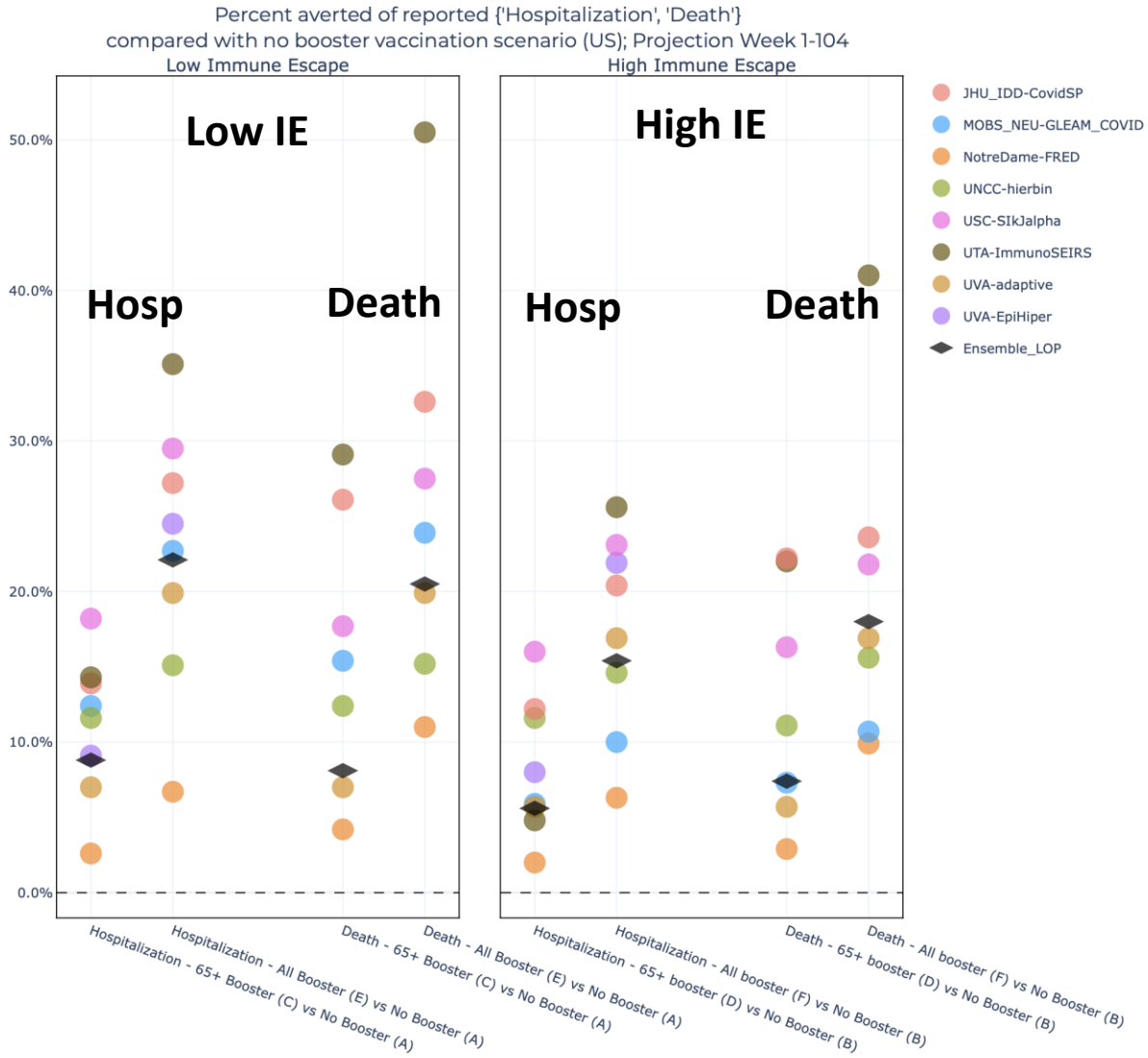




Slower Immune Escape (20%) **Faster Immune Escape (50%)**

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?

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