Network Systems Science & Advanced Computing

Biocomplexity Institute & Initiative

University of Virginia

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

January 11th, 2024

(data current to Jan 3rd – Jan 10th)

Biocomplexity Institute Technical report: TR BI-2024-4

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

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

Bryan Lewis
brylew@virginia.edu

Srini Venkatramanan
srini@virginia.edu

Madhav Marathe
marathe@virginia.edu

Chris Barrett
ChrisBarrett@virginia.edu

Model Development, Outbreak Analytics, and Delivery Team

Abhijin Adiga, Aniruddha Adiga, Hannah Baek, Chris Barrett, Parantapa Bhattacharya, Chen Chen, Da Qi Chen, Jiangzhuo Chen, Baltazar Espinoza, Galen Harrison, Stefan Hoops, Ben Hurt, Gursharn Kaur, Brian Klahn, Chris Kuhlman, Bryan Lewis, Dustin Machi, Madhav Marathe, Sifat Moon, Henning Mortveit, Mark Orr, Przemyslaw Porebski, SS Ravi, Erin Raymond, Samarth Swarup, Pyrros Alexander Telionis, Srinivasan Venkatramanan, Anil Vullikanti, Andrew Warren, Amanda Wilson, Dawen Xie

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

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

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

Key Takeaways

Most COVID-19 indicators show signs of slowing growth

- Case and Hospitalization remain elevated but may be leveling off

- Other indicators also indicate high levels that may be leveling off as well

- Wastewater indicators are high but have show signs of stabilization

- This suggest we may be nearing the Peak of COVID-19 activity.

Influenza remains very high and growing, though the rate of growth may be slowing

RSV activity has leveled off and may be slowing

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

COVID-19 Surveillance

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

District Diagnosed COVID Trajectories – last 10 weeks

Status	Number of Districts	
	Current Week	Last week
Declining	4	NA
Plateau	7	NA
Slow Growth	13	NA
In Surge	11	NA

As of Jan 6th

Curve shows smoothed Emergency Dept and Urgent Care visits with Diagnosed COVID-19 rate (per 100K) in each District
Trajectories of states in label & chart box
Curve colored by Reproductive number

2024-01-06

- 2 <= R
- 1.5 <= R < 2
- 1.1 <= R < 1.5
- 0.9 <= R < 1.1
- 0.5 <= R < 0.9
- 0.2 <= R < 0.5
- R < 0.2

University of Virginia

BIOCOMPLEXITY INSTITUTE
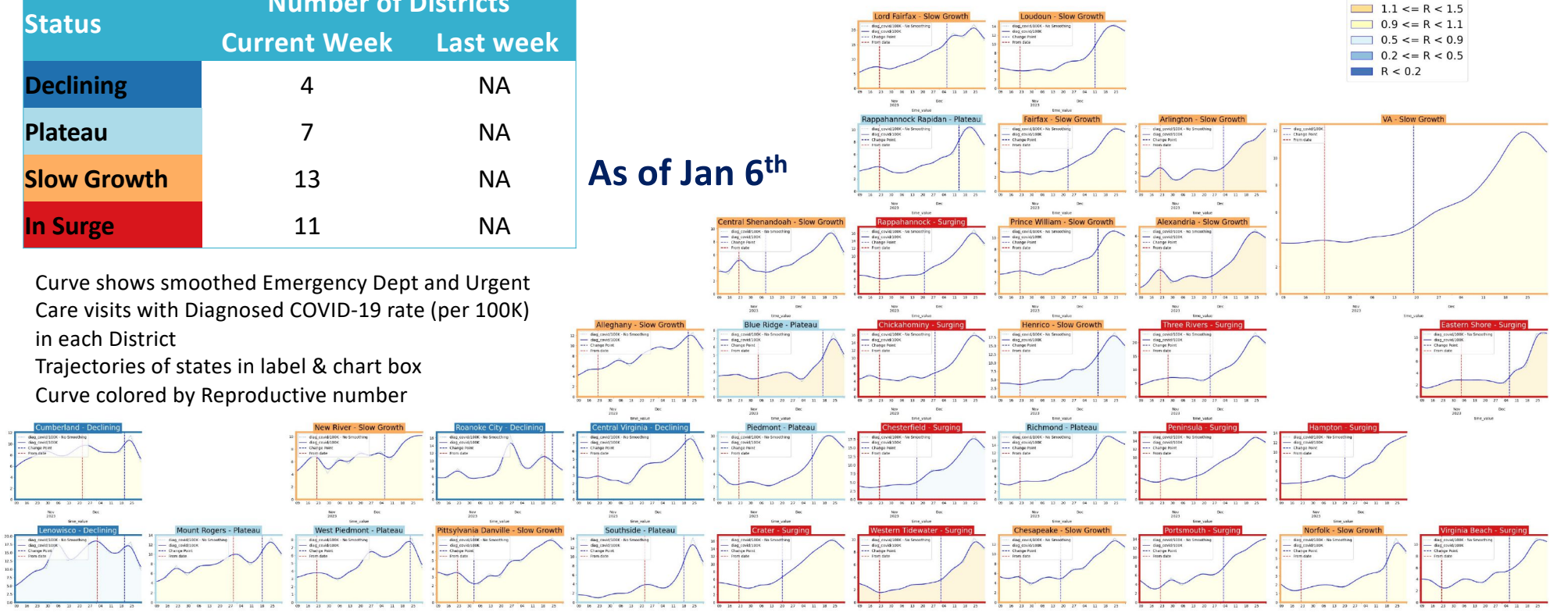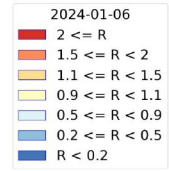
District Hospital Trajectories – last 10 weeks

Rt estimates from EpiNow2

Status	Number of Districts	
	Current Week	Last week
Declining	0	(3)
Plateau	3	(9)
Slow Growth	19	(14)
In Surge	13	(9)

Hospitalization by county inferred from Facility data mapped to counties through Hospital Referral Regions.
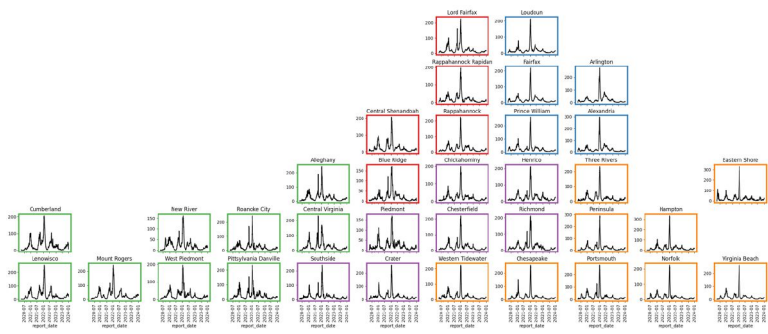
As of Dec 30th
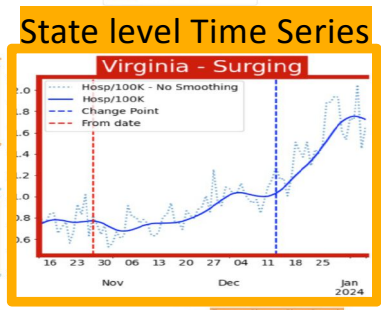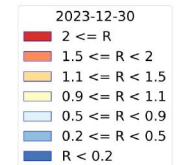
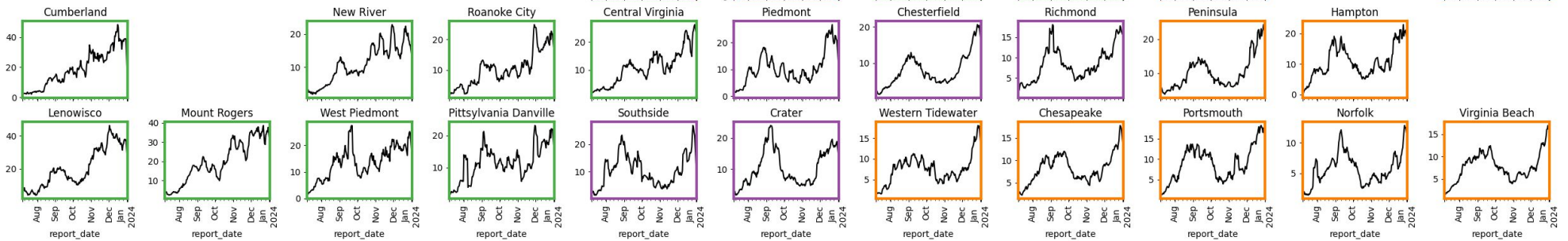Curve shows smoothed hospitalization rate (per 100K) by district
Hosp rate curve colored by R_e number

State level Time Series
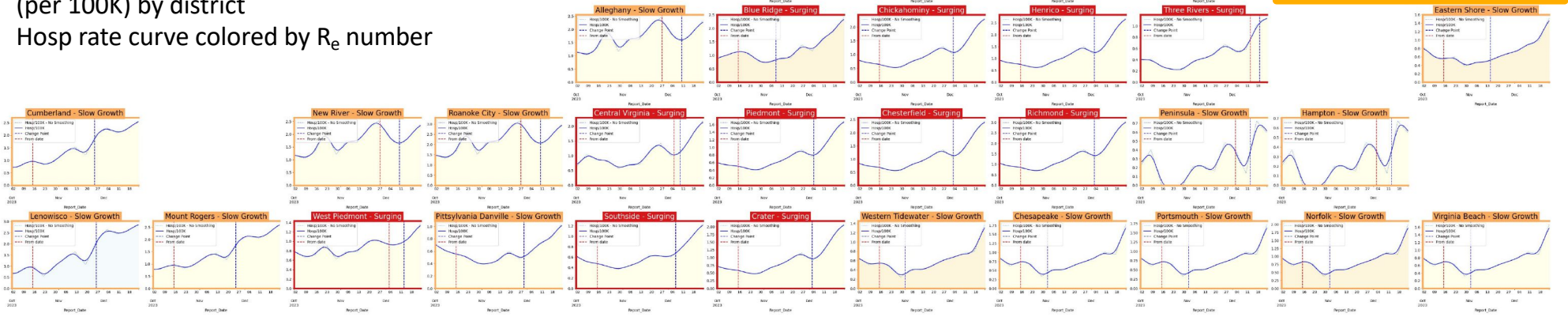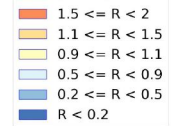
Case Rates (per 100k)

Whole pandemic

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

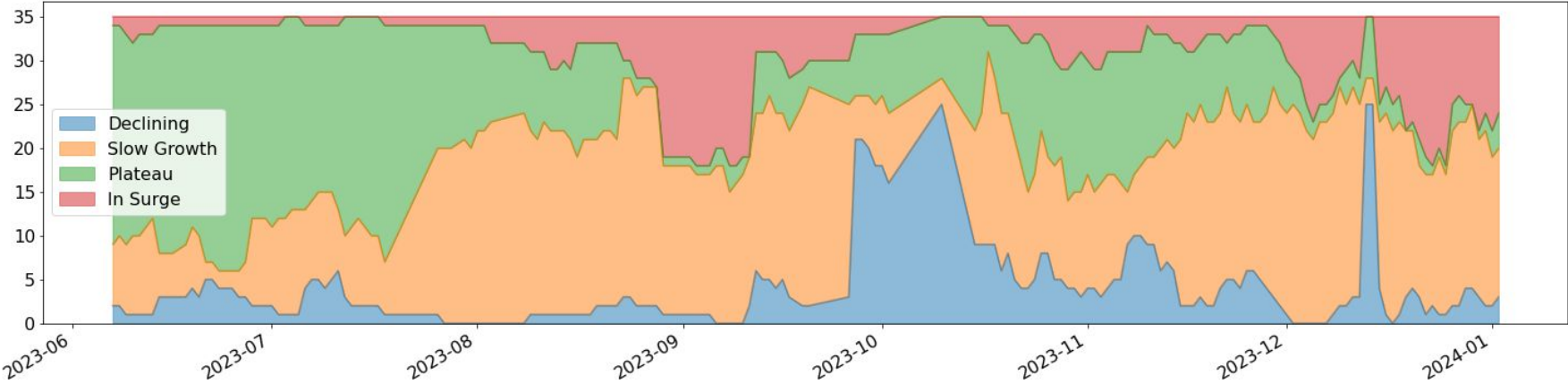# District Case Trajectories – last 10 weeks

Rt estimates from EpiNow2

Status	Number of Districts	
	Current Week	**Last week**
Declining	9	(3)
Plateau	1	(4)
Slow Growth	19	(17)
In Surge	5	(11)

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

University of Virginia

BIOCOMPLEXITY INSTITUTE
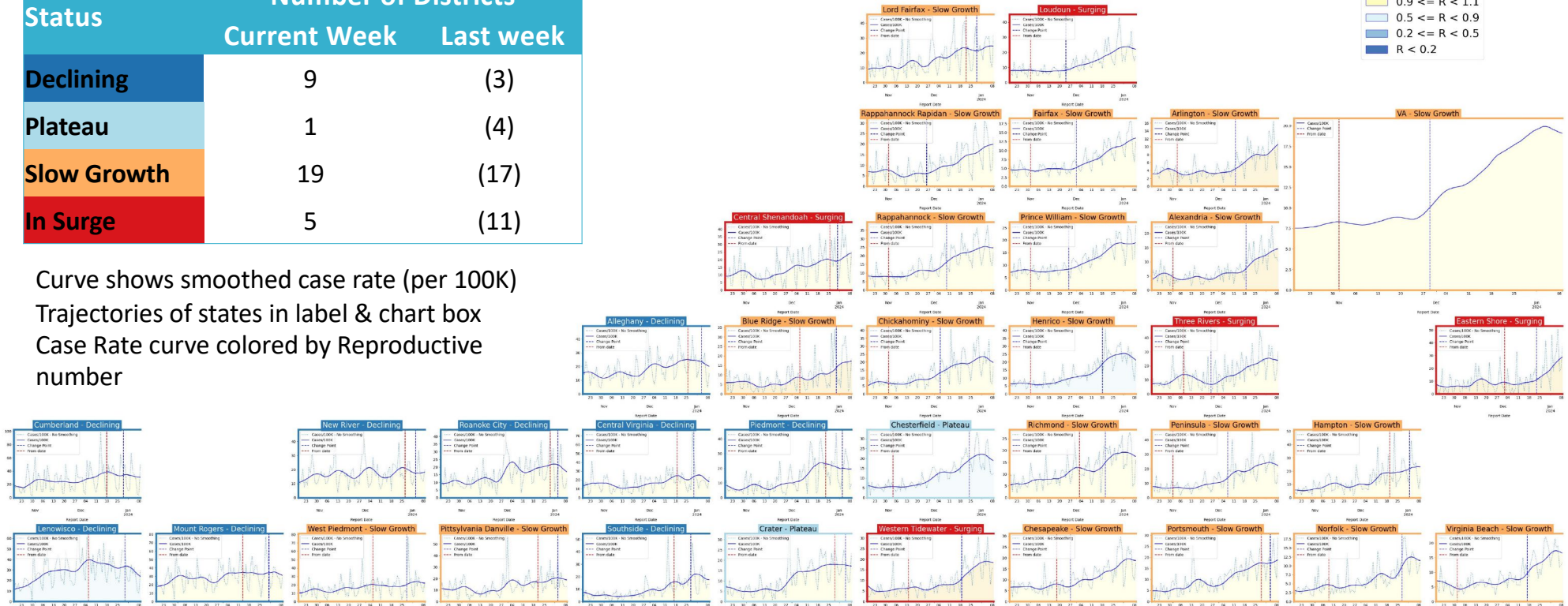
District Case Trajectories – Recent 6 months

University of Virginia

BIOCOMPLEXITY INSTITUTE
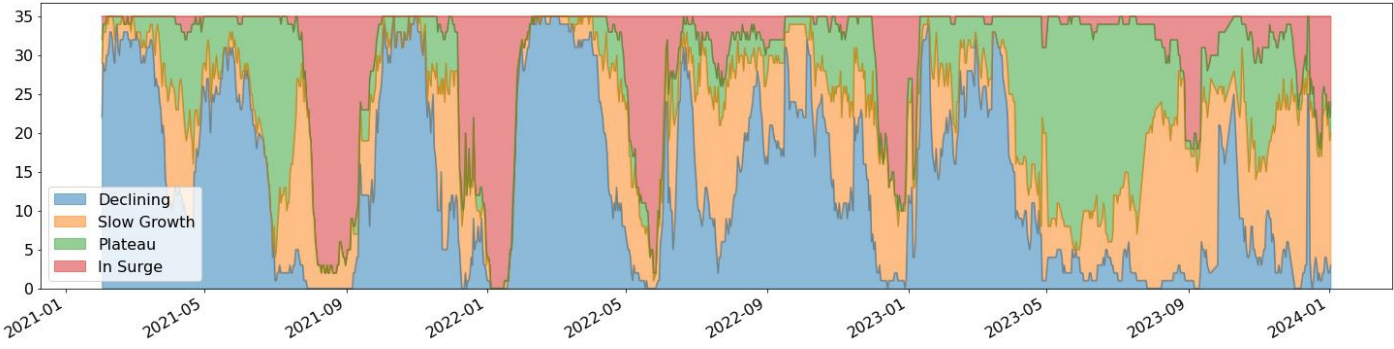
COVID-19 Spatial Epidemiology

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

ZIP Code Level Case Rates Since Last Meeting

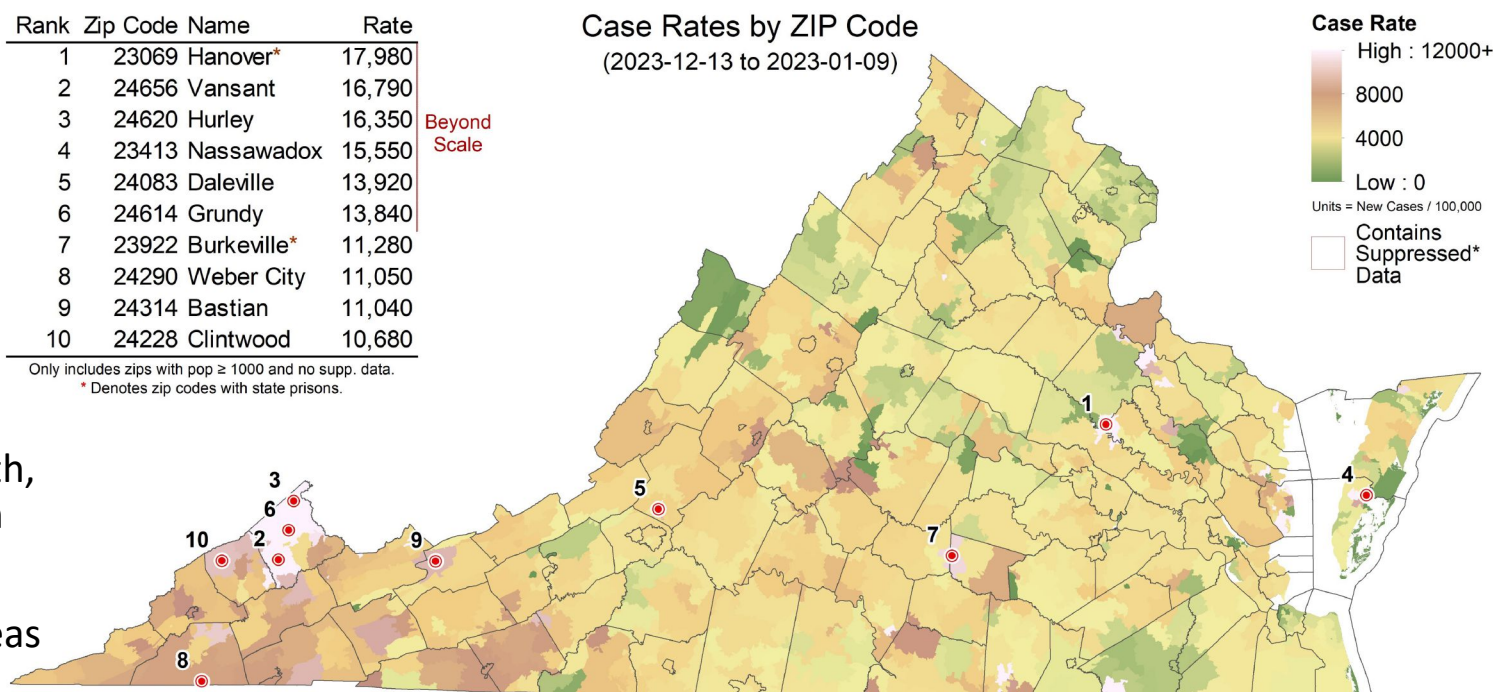**New cases per 100k in the last four weeks**

- Divide rates by four to calculate average weekly incidence.

- No change in color scale from last meeting.

- Hanover and Burkeville represent ZIP codes with state prisons.

- Case rates are elevated across the Commonwealth, most notably in Far SW in Buchanan County.

- Northern Virginia and areas around Hampton Roads have lower case rates.

Rank	Zip Code	Name	Rate	
1	23069	Hanover*	17,980	
2	24656	Vansant	16,790	
3	24620	Hurley	16,350	Beyond Scale
4	23413	Nassawadox	15,550	
5	24083	Daleville	13,920	
6	24614	Grundy	13,840	
7	23922	Burkeville*	11,280	
8	24290	Weber City	11,050	
9	24314	Bastian	11,040	
10	24228	Clintwood	10,680	

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

Case Rates by ZIP Code
(2023-12-13 to 2023-01-09)

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 four weeks ending 2024-01-09.

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

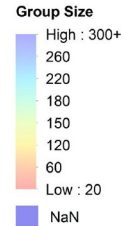# Risk of Exposure / Spatial Clusters and Hot Spots

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 14 in Hanover, 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. SaTScan was used to corroborate this analysis and determine relative risk for identified clusters.

Rank	Zip Code	Name	Size
1	23069	Hanover*	14
2	24656	Vansant	15
3	24620	Hurley	16
4	23413	Nassawadox	16
5	24083	Daleville	19
6	24614	Grundy	19
7	23922	Burkeville*	23
8	24290	Weber City	24
9	24314	Bastian	24
10	24228	Clintwood	25

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

Group Size	
High : 300+	
260	
220	
180	
150	
120	
60	
Low : 20	
NaN	

Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for four weeks ending 2024-01-09.

Cluster	Region	Rel. Risk
H1	Far SW	2.17
H2	Carroll Co.	1.71
L1	Norfolk	0.70
L2	Harrisonburg	0.65
L3	Fairfax	0.53
L4	Charlottesville	0.49

Case Rate Hot Spots and Spatial Clusters
(2023-12-13 to 2024-01-09)

Getis-Ord Gi* HotSpots
- Cold Spot - 99% Confidence
- Cold Spot - 95% Confidence
- Not Significant
- Hot Spot - 95% Confidence
- Hot Spot - 99% Confidence
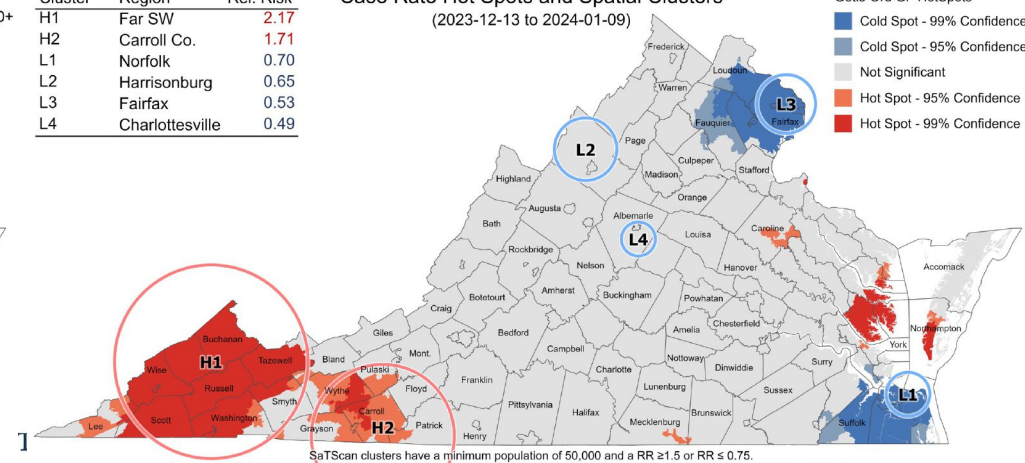
SaTScan clusters have a minimum population of 50,000 and a RR ≥1.5 or RR ≤ 0.75.
Optimized Hot Spots based on Global Empirical Bayes smoothed point prevalence for the four weeks ending 2024-01-09.
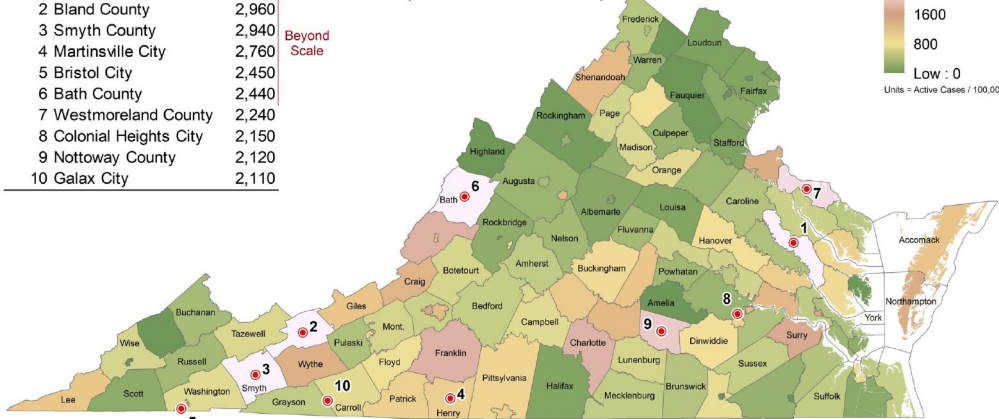
COVID-19 among Healthcare Workers

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 four-week period ending January 8, 2024.
- **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.
- An unusually small number of counties reported a high HCW/case prevalence ratio this month. This implies the public is generally experiencing higher rates of COVID19 than healthcare workers.

Rank	Name	Prev
1	King and Queen County	5,000
2	Bland County	2,960
3	Smyth County	2,940
4	Martinsville City	2,760
5	Bristol City	2,450
6	Bath County	2,440
7	Westmoreland County	2,240
8	Colonial Heights City	2,150
9	Nottoway County	2,120
10	Galax City	2,110

Rank	Name	Ratio
1	King and Queen County	4.9
2	Martinsville City	2.7
3	Bland County	2.3
4	Westmoreland County	2.1
5	Bath County	2.0
6	Colonial Heights City	1.9
7	Franklin County	1.8
8	Williamsburg City	1.8
9	Charles City County	1.7
10	Cumberland County	1.7

HCW Case Rate by County (2023-12-12 to 2024-01-08)

Case Rate: High : 2400+ / 1600 / 800 / Low : 0. Units = Active Cases / 100,000

Note: Scale differs from general public prevalence maps.

HCW Prevalence / Case Prevalence (2023-12-12 to 2024-01-08)

Prevalence Ratio: Higher HCW Prev 5:1, 4:1, 3:1, 2:1, 1:1, 1:2, 1:3, 1:4, 1:5 Higher Case Prev, NaN
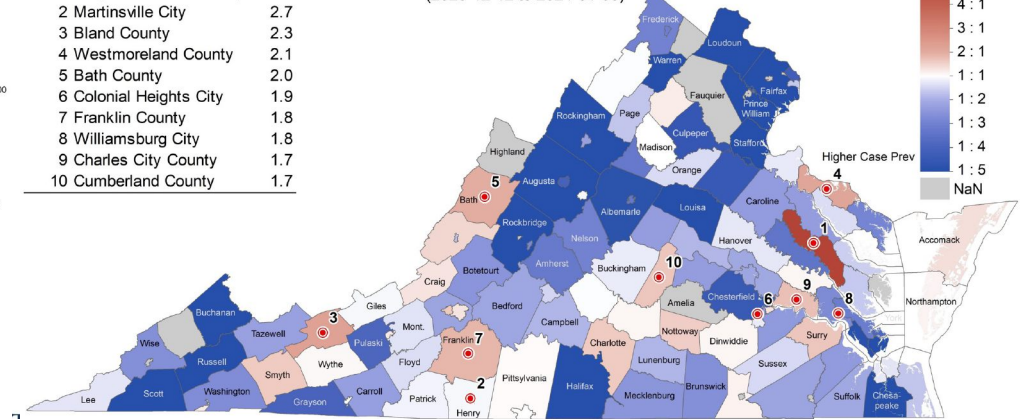
Note: This assumes that the ascertainment rate of healthcare workers is double that of the public.

BIOCOMPLEXITY INSTITUTE

COVID-19 Broader Context

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

United States Hospitalizations
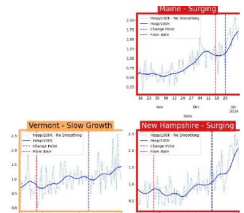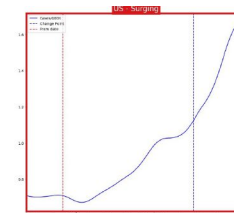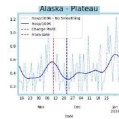
	Number of States	
Status	Current Week	Last Week
Declining	2	(2)
Plateau	9	(17)
Slow Growth	25	(28)
In Surge	17	(6)

Whole Pandemic
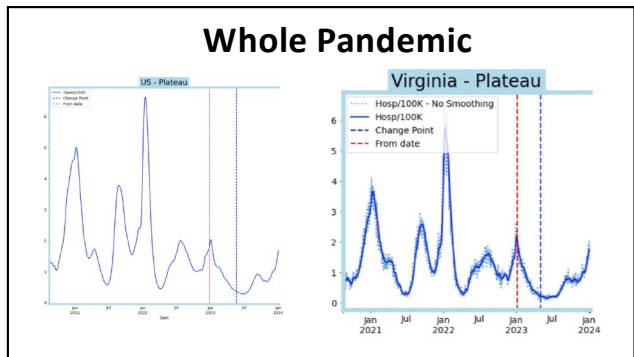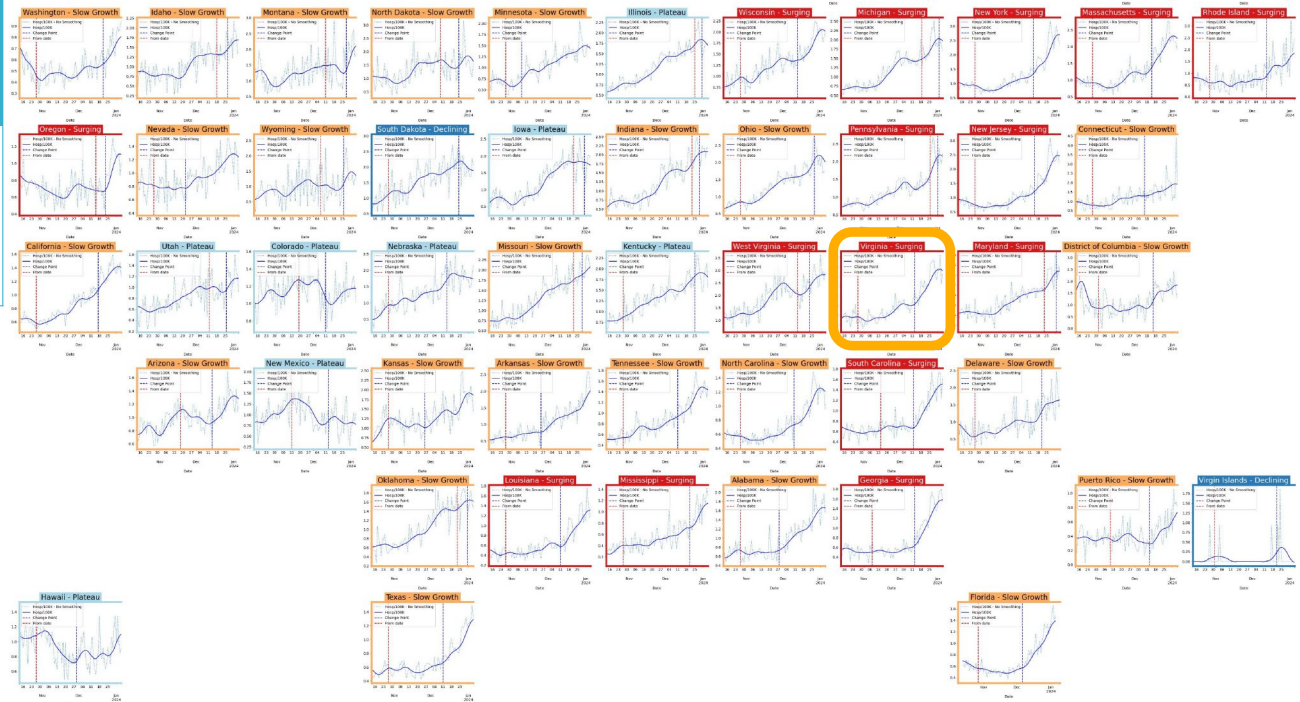
United States Hospitalizations – COVID Epidemic Growth
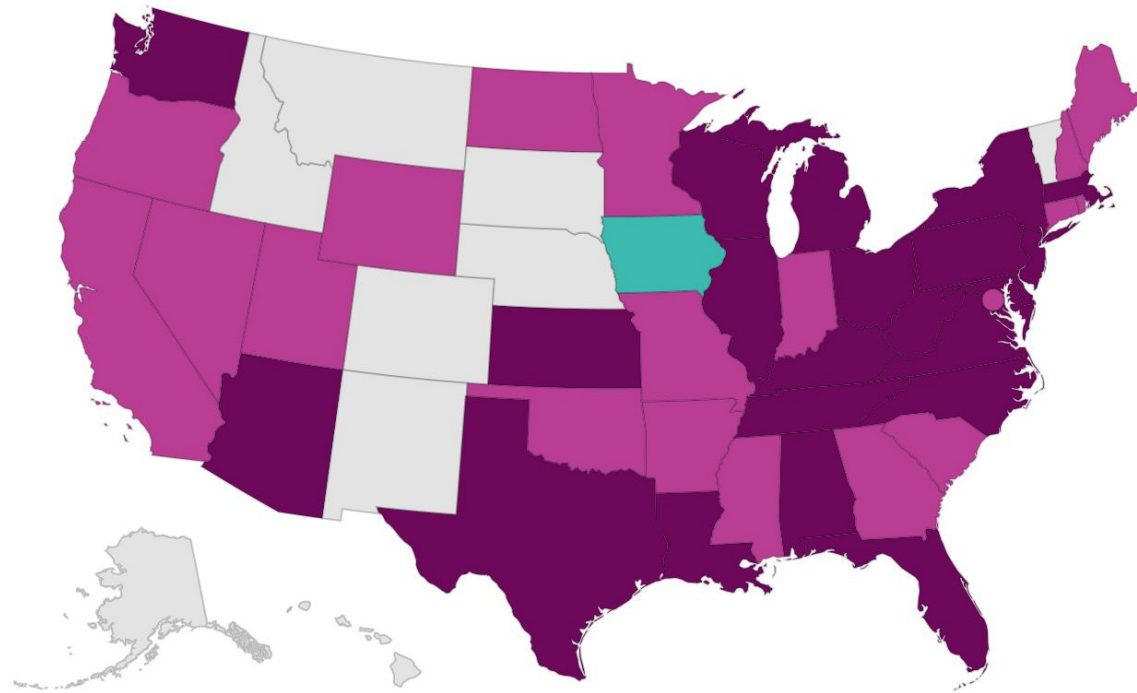
Virginia

Probability Epidemic Is Growing: 0.962

Epidemic Status: Growing

(Data as of 12-30-23)

Epidemic Status

- Growing
- Likely Growing
- Stable or Uncertain
- Likely Declining
- Declining
- Not Estimated

Territories PR VI

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

CDC – CFA Epidemic Growth

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.
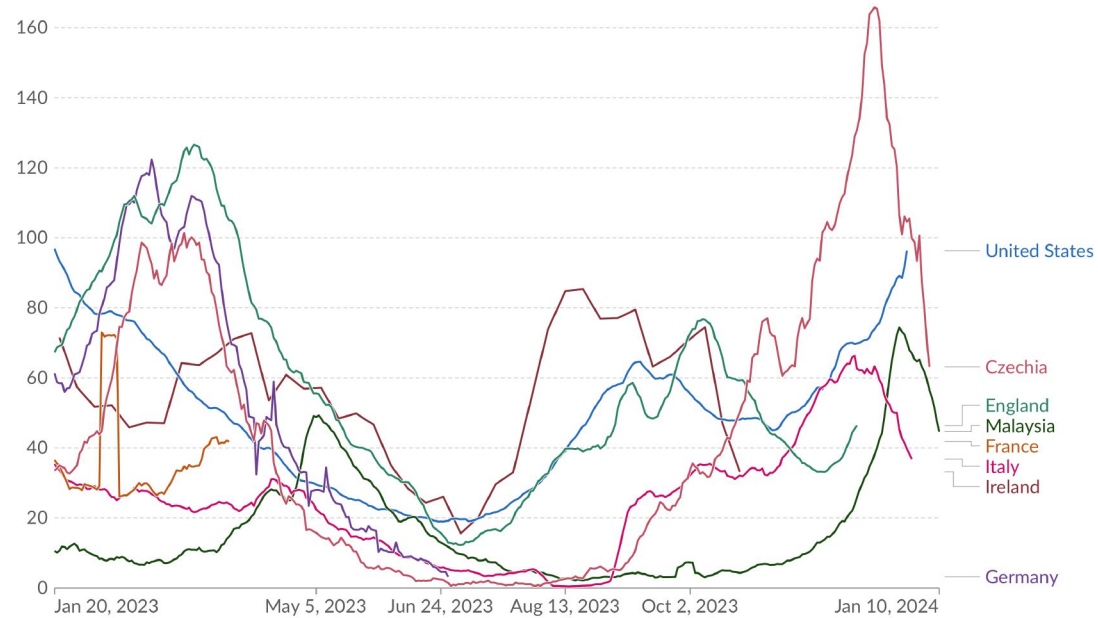
Data source: Official data collated by Our World in Data

CC BY

Our World in Data

COVID-19 Growth Metrics

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

Estimating Daily Reproductive Number –
VDH report dates – EpiNow2 estimation

Reproductive Estimate Summary as of January 9, 2024

Region	Reproductive number estimate	IQR	Trend forecast
State-wide cases	0.93	(0.81 - 1.1)	Likely decreasing
State-wide hosps	1.1	(0.95 – 1.1)	Likely increasing
Central	0.82	(0.67 - 0.96)	Decreasing
Eastern	1.0	(0.85 - 1.1)	Stable
Far SW	0.88	(0.72 – 1.1)	Likely decreasing
Near SW	0.92	(0.75 – 1.1)	Likely decreasing
Northern	1.0	(0.88 – 1.1)	Stable
Northwest	1.0	(0.84 – 1.2)	Likely increasing

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 COVID disease model via EpiNow2.

- Uses confirmation date but report date biases are better accounted for; estimated date of infection is inferred using Bayesian smoothing techniques and used to produce Rt estimates.

- Note: most recent data point for hospitalizations is 3 days prior to that of cases (HHS hospitalization through 1/6/24 vs. VDH case data through 1/9/24).

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

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

Viral Load Percentiles by Sampling Week

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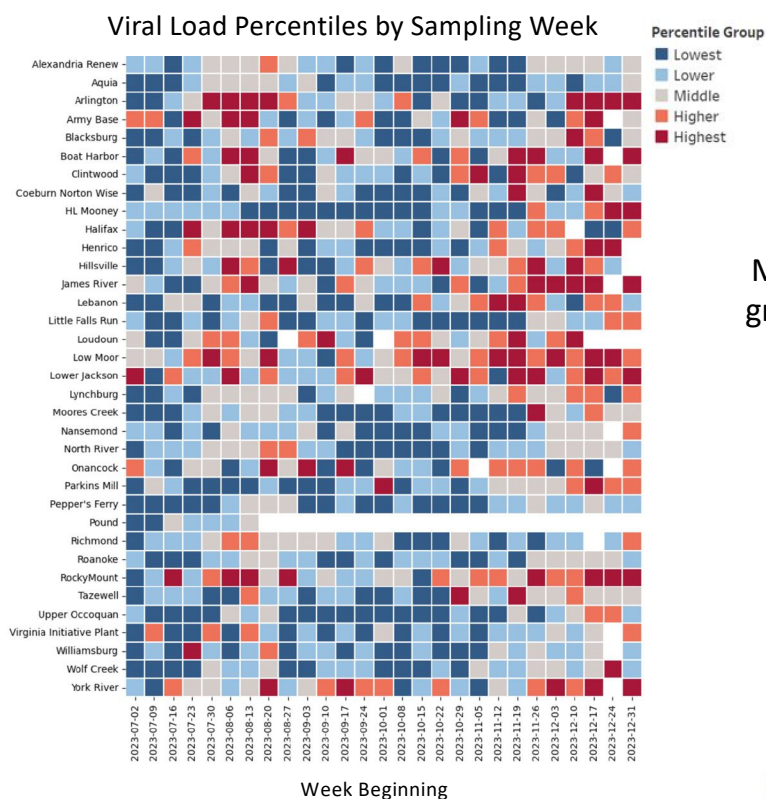
Quintile proportions over time
Middle and higher are growing in past couple weeks

Viral Load Quintiles Over Time

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

1/11/24

21
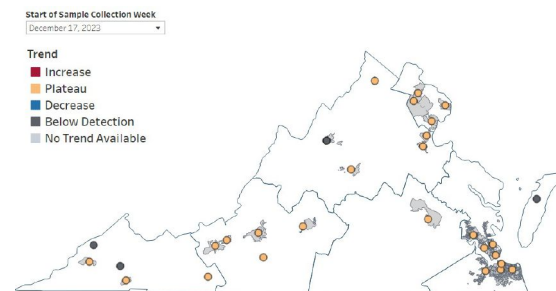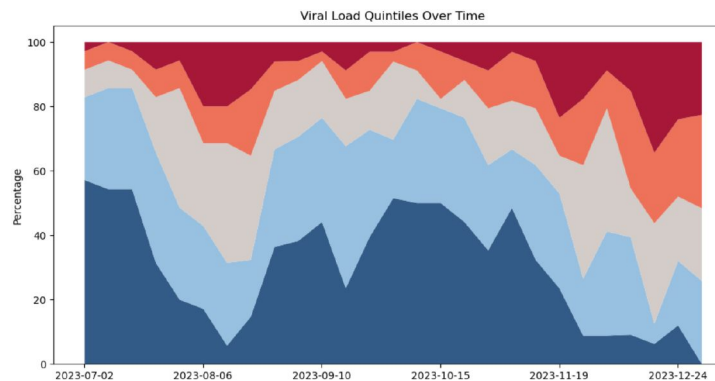
Wastewater Monitoring – NWSS

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

- VA back to "Moderate" after being "Very High" due to artifacts last week
- Pervious, well observed, levels below region and national levels

VA – Last 6 months

VA – Since 2022

Current SARS-CoV-2 Wastewater Viral Activity Level

Select a level to add or remove it from the visualization.

Very High   High   Moderate   Low   Minimal   Insufficient Data

Territories: GU PR VI

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE
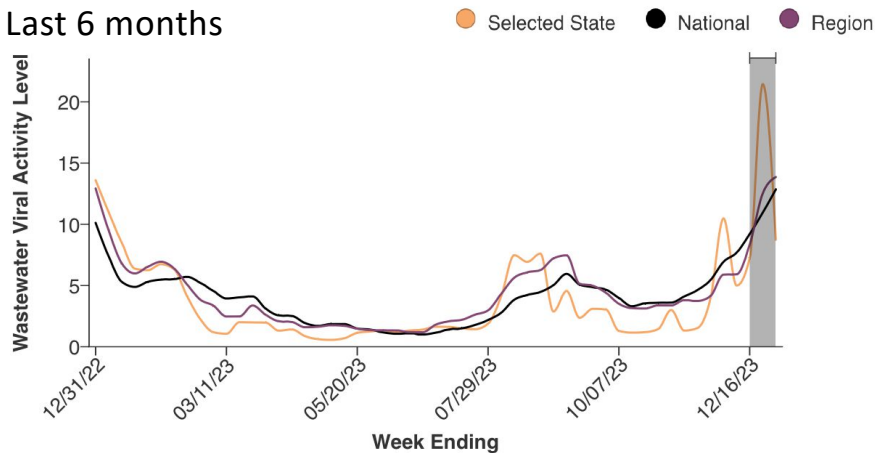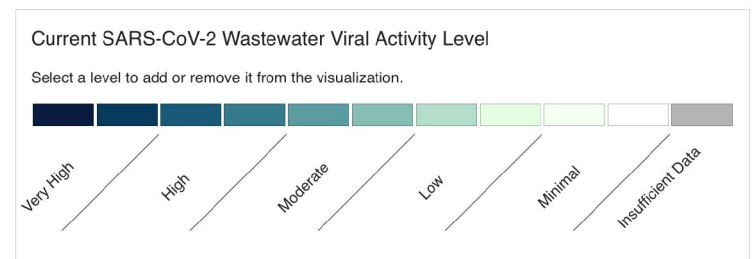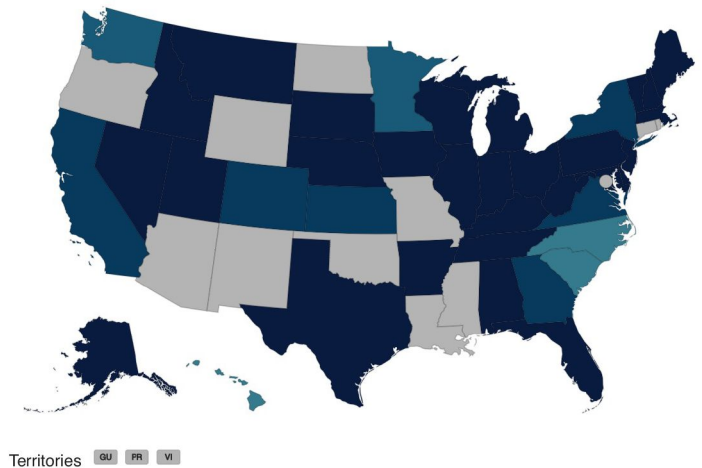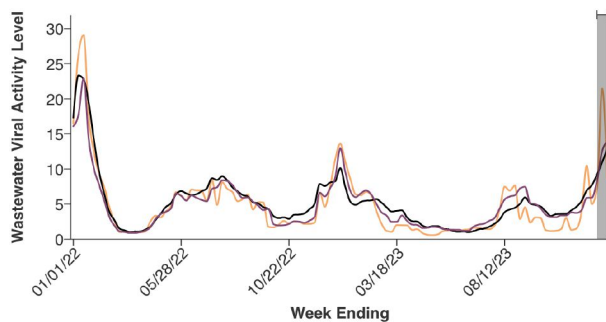
Data Source: CDC Data Tracker
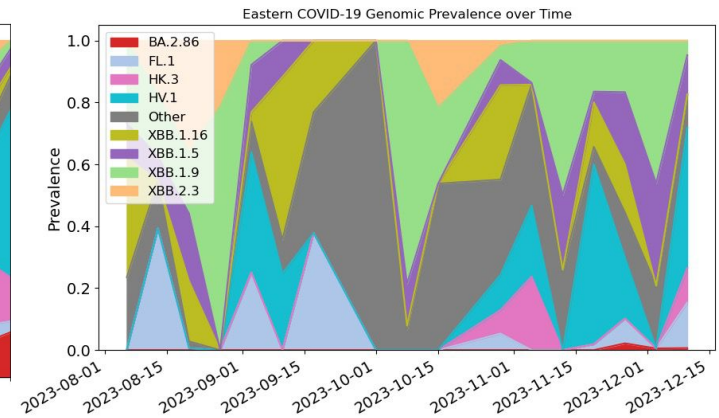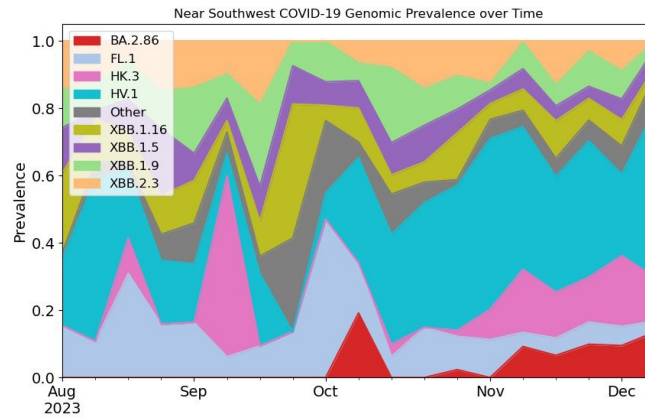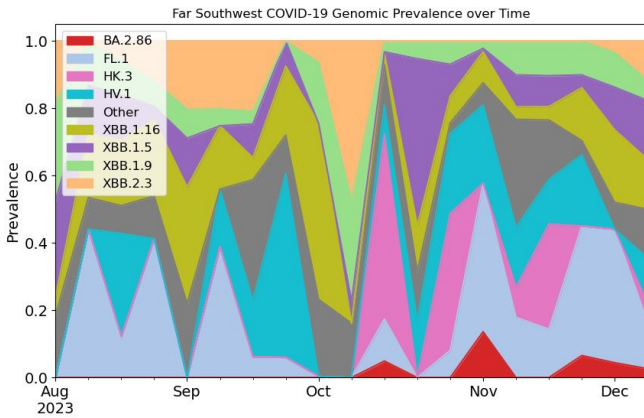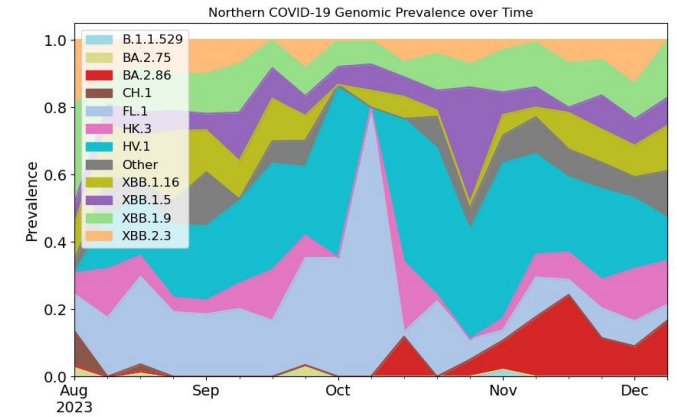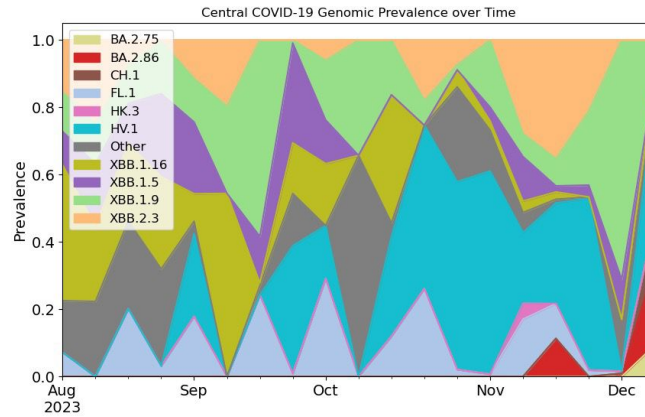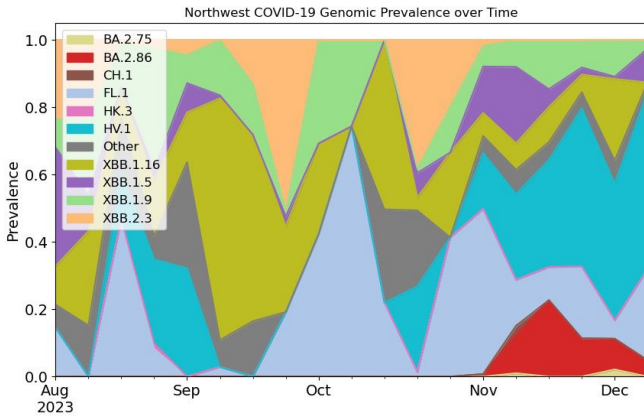
22

Virginia Regional Wastewater Variant Status (median)

Data updated through 12/10

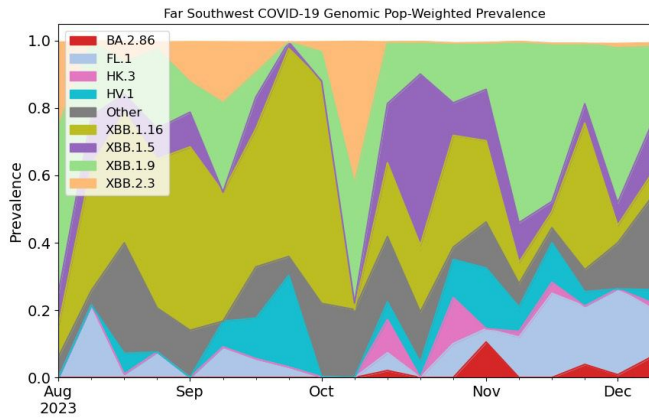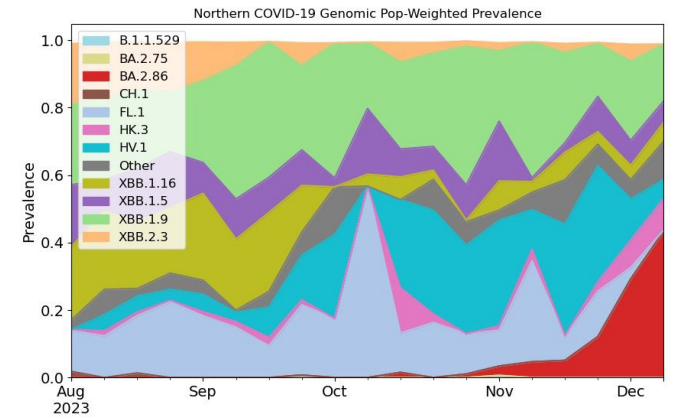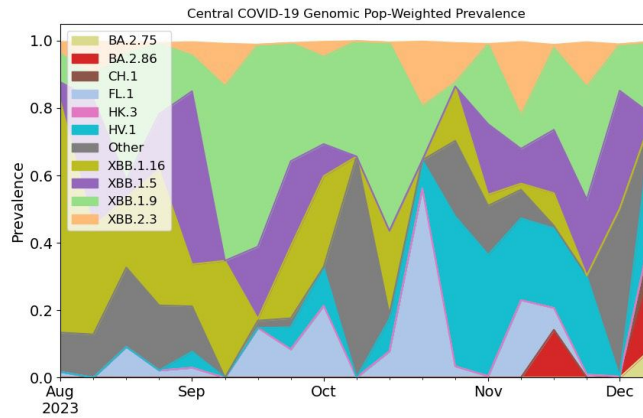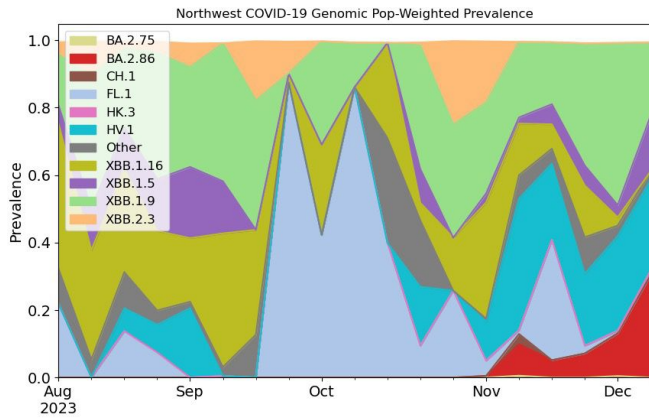# Virginia Regional Population-Weighted Wastewater Variant Status
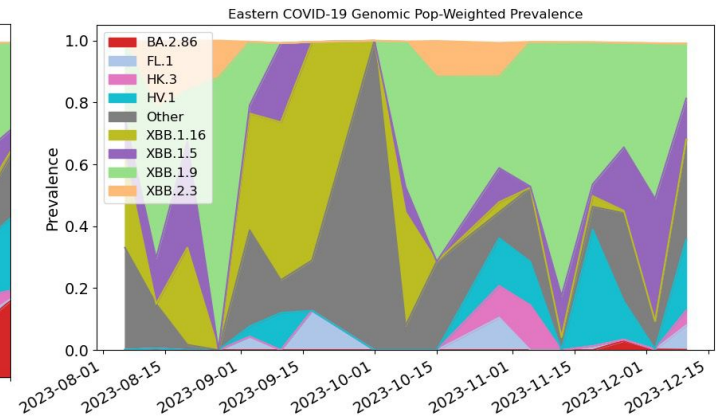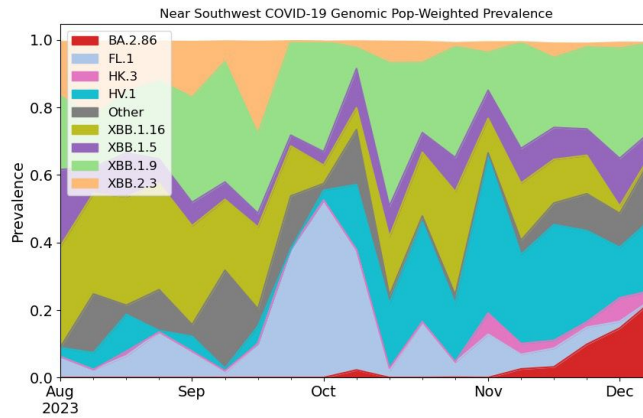
Data updated through 12/10

Virginia Wastewater BA.2.86* Progress

| VA Health Region	Site	Date	Prevalence of BA.2.86*
Central	Richmond	12/3/2023	0.18%
Central	Richmond	12/10/2023	**22.87%**
Eastern	Nansemond	12/10/2023	**0.36%**
Eastern	Williamsburg	12/3/2023	0.25%
Far Southwest	Coeburn Norton Wise	12/10/2023	**0.82%**
Far Southwest	Hillsville	12/10/2023	**7.49%**
Far Southwest	Wolf Creek	12/3/2023	1.74%
Far Southwest	Wolf Creek	12/10/2023	**10.67%**
Near Southwest	Blacksburg	12/3/2023	37.25%
Near Southwest	Blacksburg	12/10/2023	**52.83%**
Near Southwest	Lynchburg	12/3/2023	12.90%
Near Southwest	Lynchburg	12/10/2023	**23.18%**
Near Southwest	Pepper's Ferry	12/3/2023	23.94%
Near Southwest	Roanoke	12/3/2023	10.02%
Near Southwest	Roanoke	12/10/2023	**22.52%**
Northern	Alexandria Renew	12/3/2023	34.08%
Northern	Alexandria Renew	12/10/2023	**56.60%**
Northern	Aquia	12/3/2023	25.06%
Northern	Little Falls Run	12/10/2023	**22.93%**
Northern	Loudoun	12/3/2023	25.74%
Northern	HL Mooney	12/3/2023	30.77%
Northern	HL Mooney	12/10/2023	**23.27%**
Northern	Upper Occoquan	12/3/2023	28.45%
Northern	Upper Occoquan	12/10/2023	**36.42%**
Northwest	Moores Creek	12/3/2023	13.52%
Northwest	Moores Creek	12/10/2023	**29.82%**
Northwest	North River	12/3/2023	10.83%
Northwest	North River	12/10/2023	**36.87%**
Northwest	Parkins Mill	12/3/2023	13.49%
Northwest	Parkins Mill	12/10/2023	**1.89%**

Hospitalizations in VA by Age

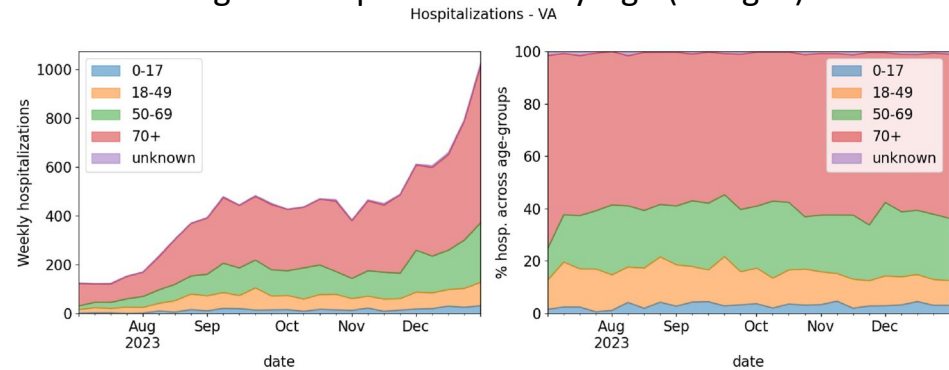**Age distribution in hospitalization remain relatively stable**

- Data up to end of December
- All age groups show increase in hospitalizations
- Pediatric hospitalizations achieve highest level since last winter

Note: These data are lagged and based on HHS hospital reporting
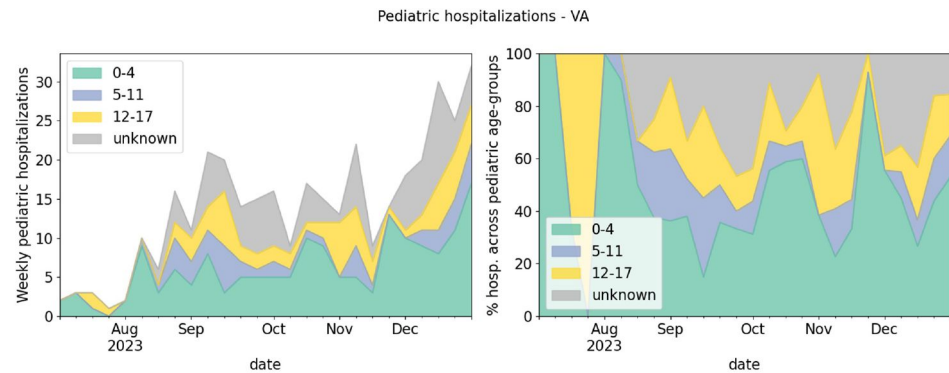
By Age-group rate (per 100K)
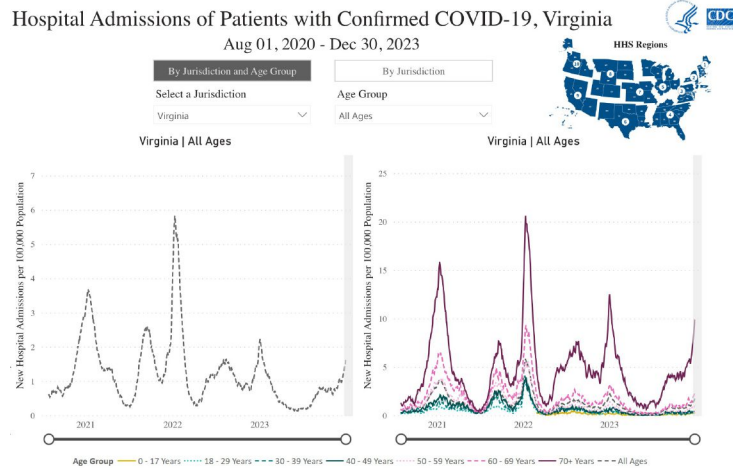

### Virginia Hospitalizations by Age (all ages)

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 remains reduced and plateaued in most regions, with Southwest showing slow continued growth**
- **Levels returning to spring-time levels in most regions**
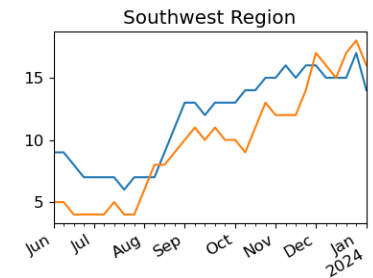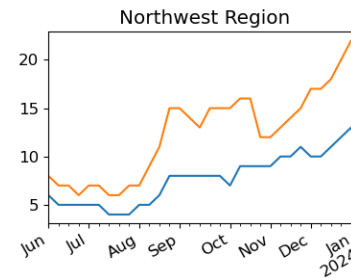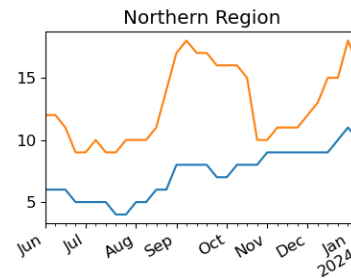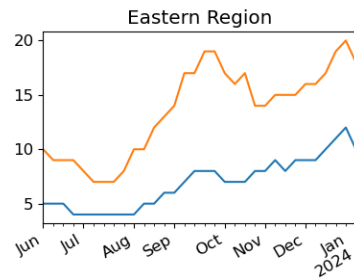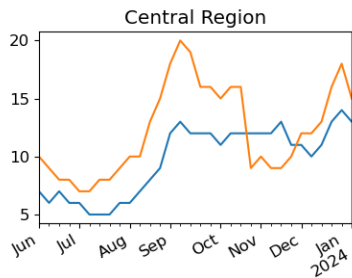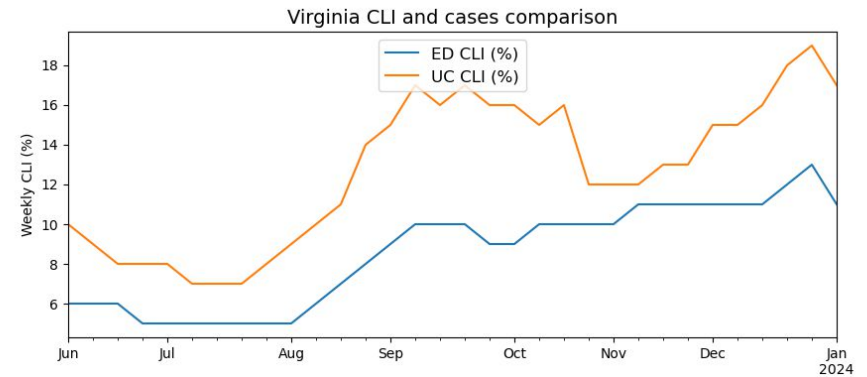
ED & UC Visits with Diagnosed COVID-19

National Syndromic Surveillance Program (NSSP) reports diagnosed COVID-19 from multiple healthcare settings

- Diagnosed visits are a smoother more specific indicator than COVID-like Illness
- **After 2 months of growth, Diagnosed visits show signs of receding**
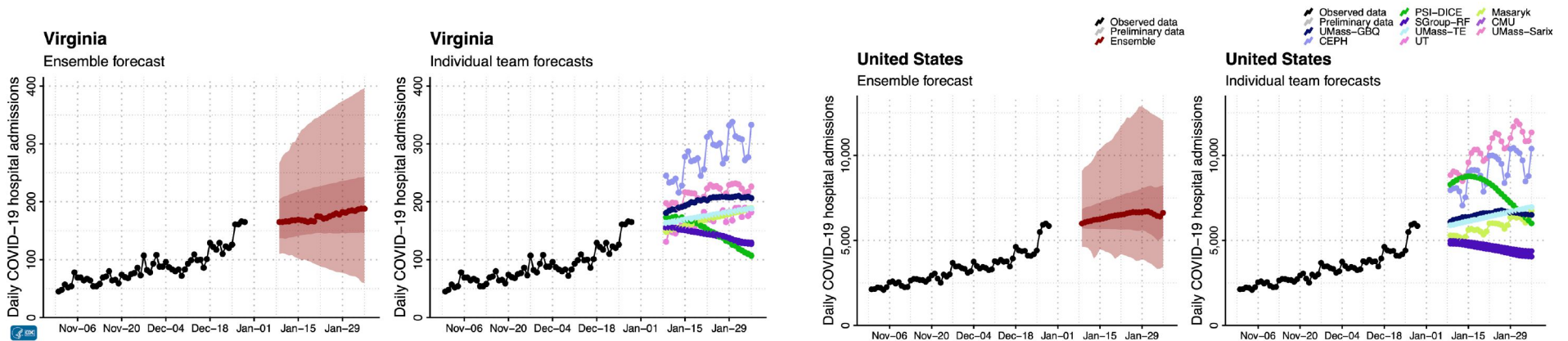

Virginia Visits with Diagnosed COVID-19

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE
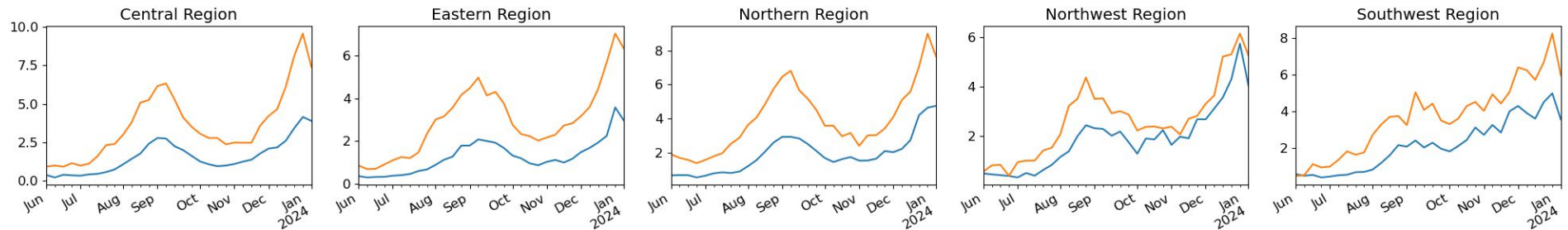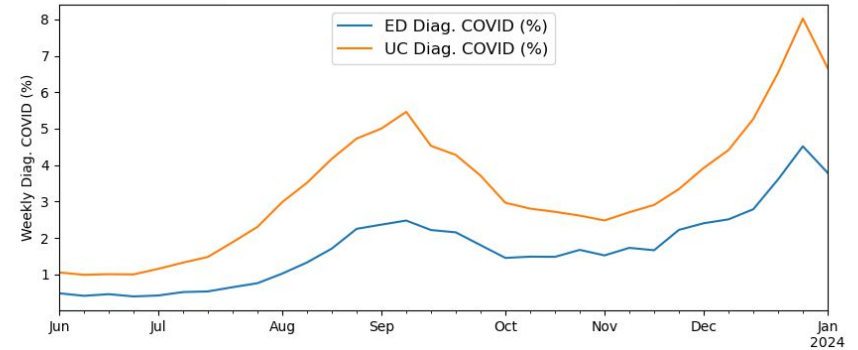
Current COVID-19 Hospitalization Forecast

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)**

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

CDC COVID Forecast

COVID-19 Genomic Update
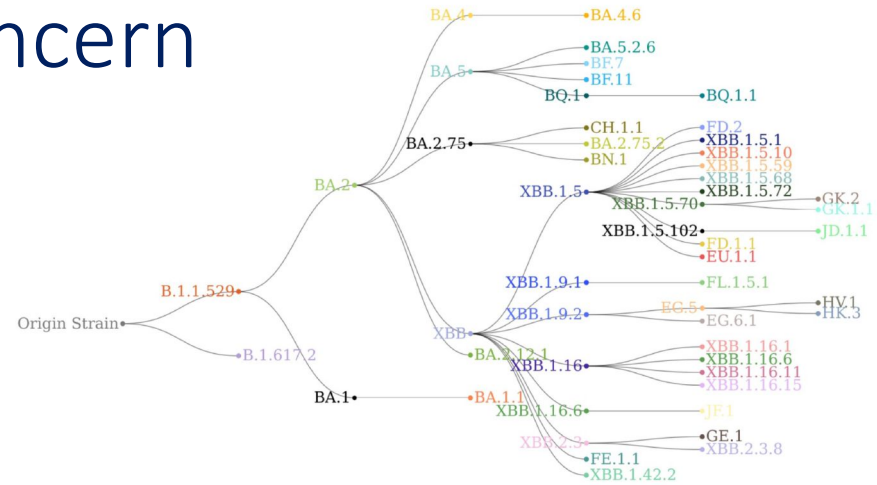
University of Virginia
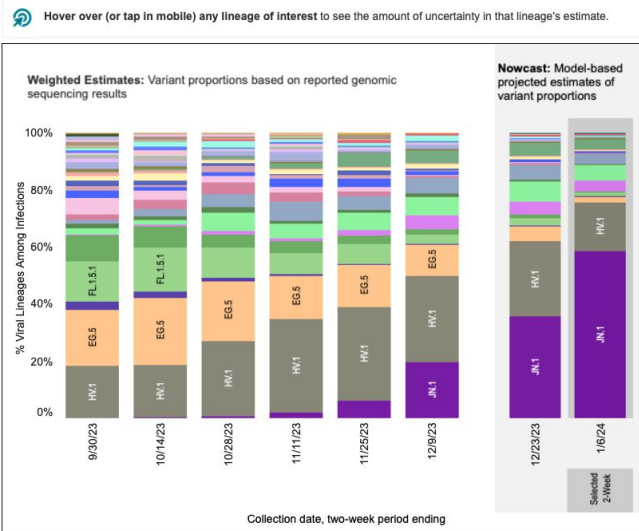
BIOCOMPLEXITY INSTITUTE

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 9/17/2023 – 1/6/2024

Hover over (or tap in mobile) any lineage of interest to see the amount of uncertainty in that lineage's estimate.

Weighted Estimates: Variant proportions based on reported genomic sequencing results

Nowcast: Model-based projected estimates of variant proportions

Collection date, two-week period ending

Nowcast Estimates in HHS Region 3 for 12/24/2023 – 1/6/2024

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

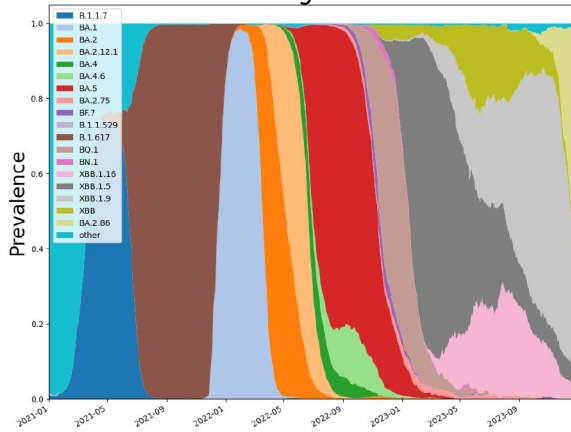| WHO label	Lineage #	%Total	95%PI
Omicron	JN.1	58.5%	52.7-64.1%
	HV.1	16.8%	14.1-20.0%
	JD.1.1	5.4%	3.6-7.9%
	JG.3	3.9%	3.0-5.2%
	BA.2.86	3.9%	2.4-6.1%
	HK.3	3.7%	3.0-4.5%
	EG.5	2.3%	1.8-2.9%
	FL.1.5.1	1.2%	0.9-1.6%
	JF.1	0.7%	0.5-1.0%
	EG.5.1.8	0.5%	0.2-1.1%
	XBB.1.16.6	0.5%	0.4-0.7%
	BA.2	0.3%	0.1-0.9%
	XBB.1.5.70	0.3%	0.2-0.5%
	GK.1.1	0.3%	0.2-0.4%
	XBB.1.16.11	0.3%	0.2-0.4%
	XBB.1.16.17	0.3%	0.1-0.6%
	XBB.1.16.15	0.2%	0.1-0.3%
	XBB	0.2%	0.1-0.3%
	XBB.1.9.1	0.2%	0.1-0.3%
	HF.1	0.2%	0.1-0.2%
	XBB.2.3	0.1%	0.1-0.2%
	GK.2	0.1%	0.0-0.1%
	GE.1	0.1%	0.0-0.1%
	XBB.1.16	0.1%	0.0-0.1%
	CH.1.1	0.0%	0.0-0.0%
	XBB.1.5	0.0%	0.0-0.0%
	EG.6.1	0.0%	0.0-0.0%
	XBB.2.3.8	0.0%	0.0-0.1%
	XBB.1.16.1	0.0%	0.0-0.0%
	XBB.1.9.2	0.0%	0.0-0.0%
	XBB.1.5.68	0.0%	0.0-0.0%
	XBB.1.42.2	0.0%	0.0-0.0%
	XBB.1.5.72	0.0%	0.0-0.0%
	XBB.1.5.59	0.0%	0.0-0.0%
	XBB.1.5.10	0.0%	0.0-0.0%
	FD.1.1	0.0%	0.0-0.0%
Other	Other*	0.0%	0.0-0.1%

Omicron Updates*

- BA.2.86* (JN.1) at 58.5% continues to displace XBB sublineages
- Lineage HV.1 (XBB.1.9*) down to 16.8 from 35%
- EG.5 (XBB.1.9*) downward 2.3 from 8%
- FL.1.5.1 (XBB.1.9*) downward 1.2 from 4.7
- HK.3 still holding down to 3.7 from 7%
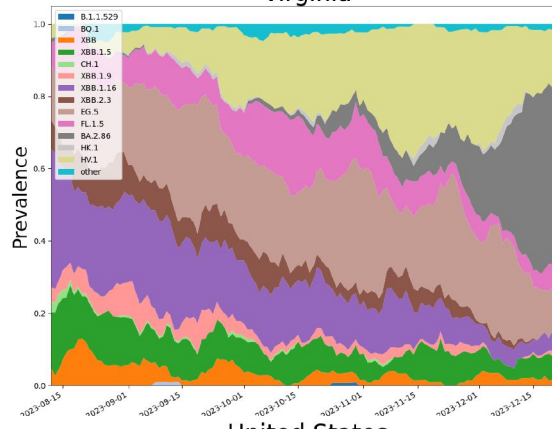
*percentages are CDC NowCast Estimates

CDC Variant Tracking

SARS-CoV2 Variants of Concern

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

Data shown as of December 6th, 2023. Proportions are given for lineages that are observed in sequences with a specimen date between 3 November 2023 and 19 November 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-6-december-2023

SARS-CoV2 Omicron Sub-Variants

covSPECTRUM
Enabled by data from GISAID

As detected in whole Genomes in public repositories

VoC Polynomial Fit Projections

BIOCOMPLEXITY INSTITUTE
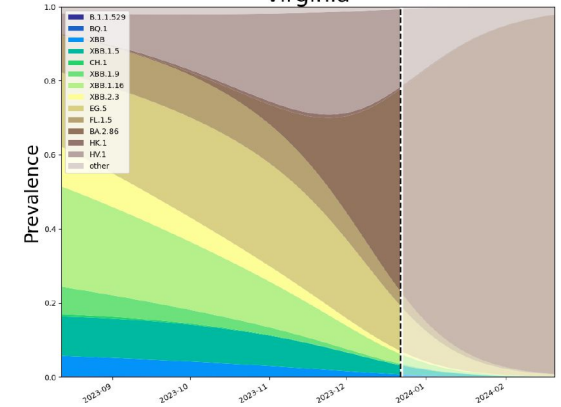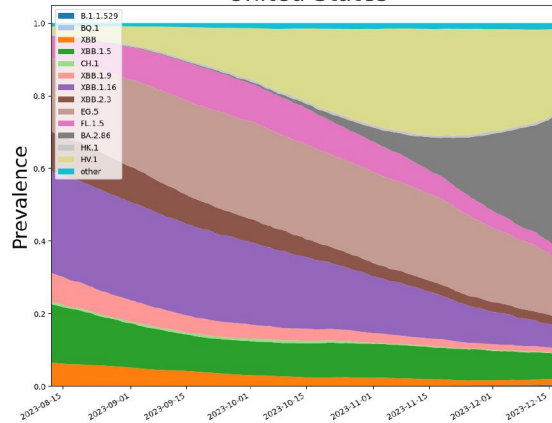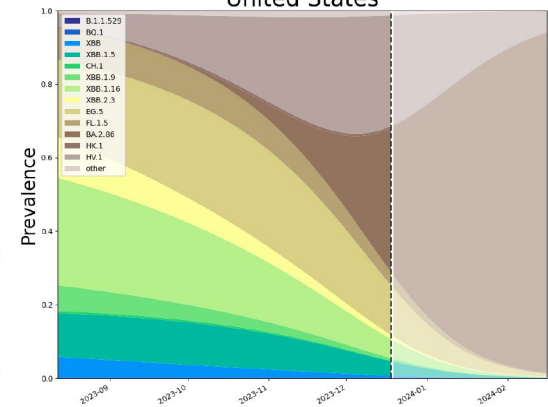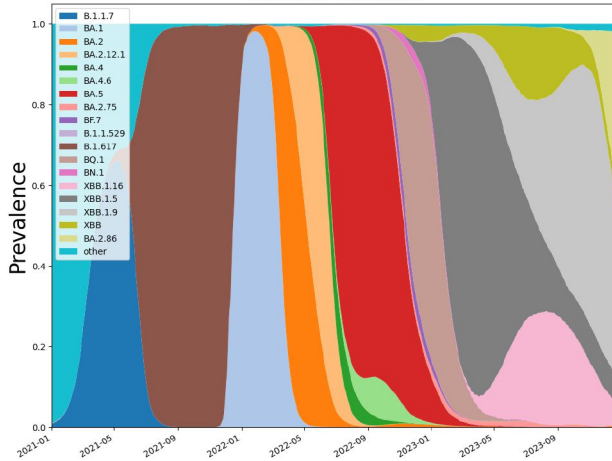
Note:
Everything
from dotted
line forward is
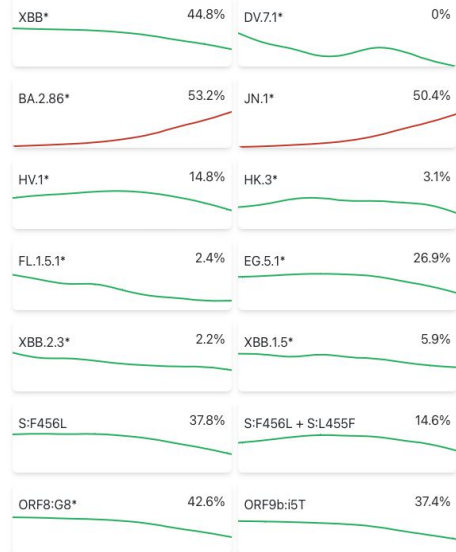a projection.

33

SARS-CoV2 Omicron Sub-Variants

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

Known variants

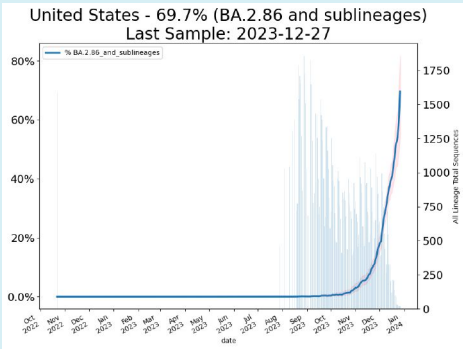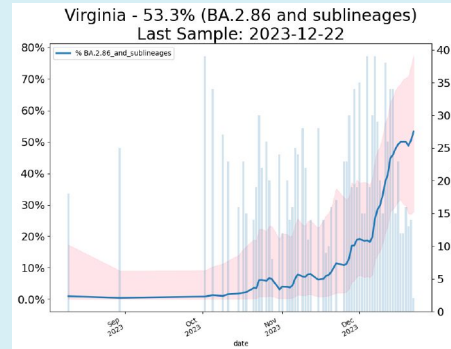Which variant would you like to explore?

Editor's choice ▼

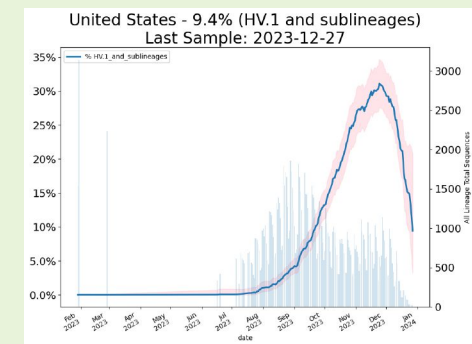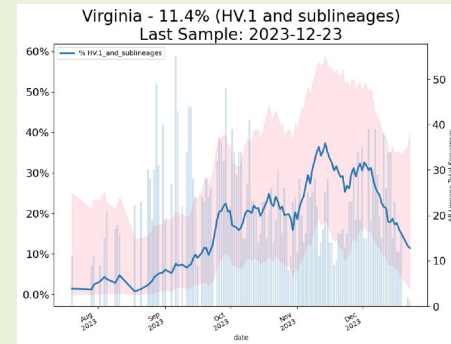|			
XBB*	44.8%	DV.7.1*	0%
BA.2.86*	53.2%	JN.1*	50.4%
HV.1*	14.8%	HK.3*	3.1%
FL.1.5.1*	2.4%	EG.5.1*	26.9%
XBB.2.3*	2.2%	XBB.1.5*	5.9%
S:F456L	37.8%	S:F456L + S:L455F	14.6%
ORF8:G8*	42.6%	ORF9b:i5T	37.4%

covSPECTRUM

Enabled by data from **GISAID**

BA.2.86* (JN.1*)

Virginia - 53.3% (BA.2.86 and sublineages)
Last Sample: 2023-12-22

United States - 69.7% (BA.2.86 and sublineages)
Last Sample: 2023-12-27

HV.1*

Virginia - 11.4% (HV.1 and sublineages)
Last Sample: 2023-12-23

United States - 9.4% (HV.1 and sublineages)
Last Sample: 2023-12-27

Global SARS-CoV2 Variant Status

Traveller Surveillance

Positivity Rate for Pooled Samples, by Collection Week
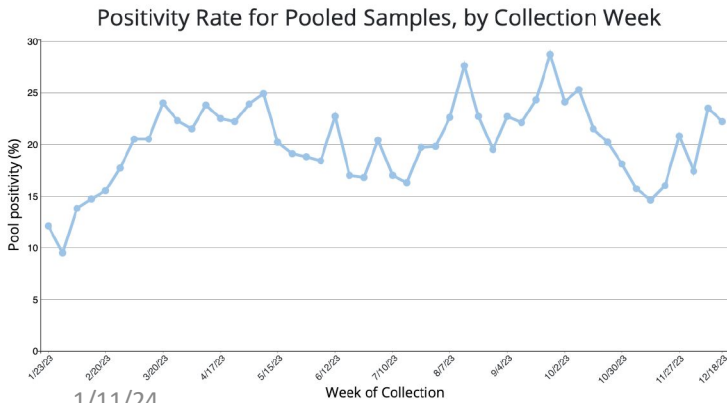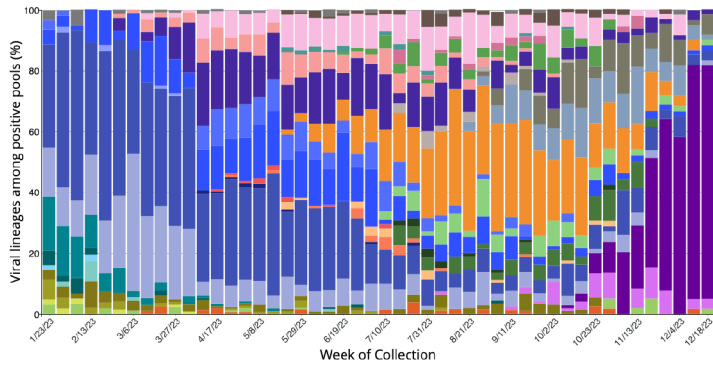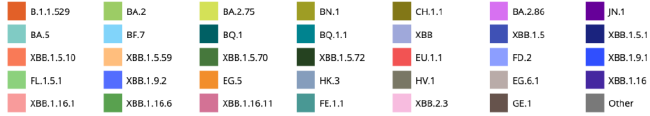
North-America: 82874 sequences

2023-10-11 to 2024-01-09

2023-10-11 to 2024-01-09

1/11/24

35

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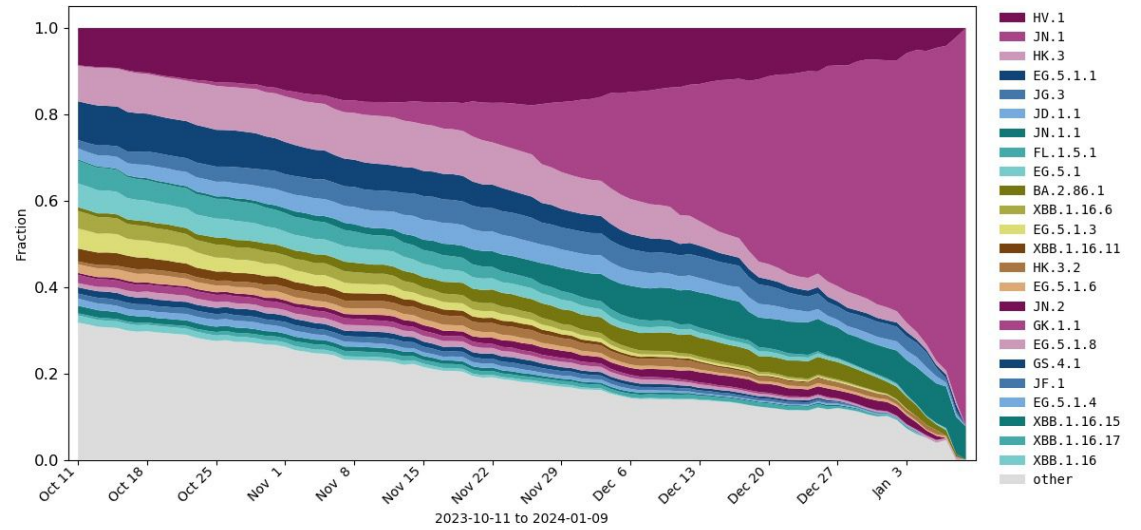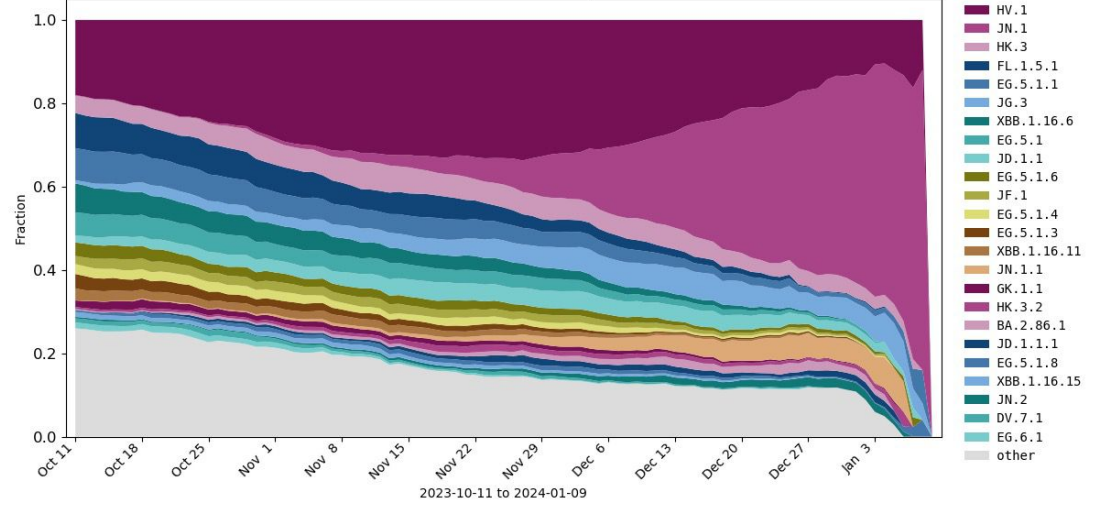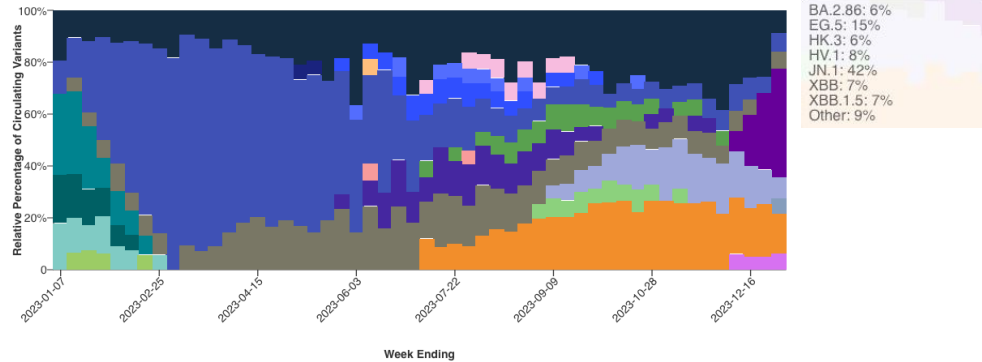
National Wastewater Variant Status

CDC Wastewater

The BA.2.86 variant category includes all JN.* sublineages except JN.1 which is separated out into its own callout group.

Week Ending: 2023-12-30
BA.2.86: 6%
EG.5: 15%
HK.3: 6%
HV.1: 8%
JN.1: 42%
XBB: 7%
XBB.1.5: 7%
Other: 9%

Select a variant to add or remove it from the visualization.
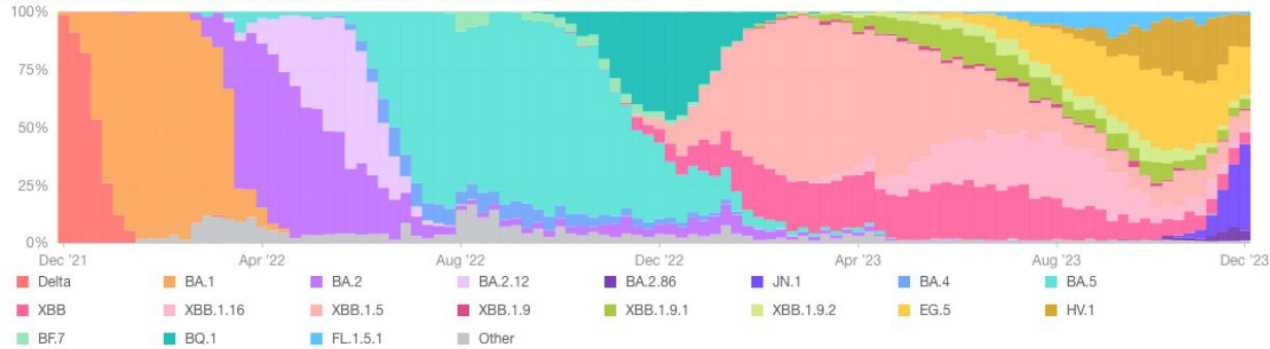BA.2 · BA.2.86 · BA.5 · BQ.1 · BQ.1.1 · EG.5 · FL.1.5.1 · HK.3 · HV.1 · JN.1 · XBB
XBB.1.16 · XBB.1.16.1 · XBB.1.16.6 · XBB.1.5 · XBB.1.5.1 · XBB.1.5.59 · XBB.1.9.1 · XBB.1.9.2
XBB.2.3 · Other

Biobot Wastewater

Variants: Percentage of variant lineage sequenced from SARS-CoV-2 genome found in wastewater
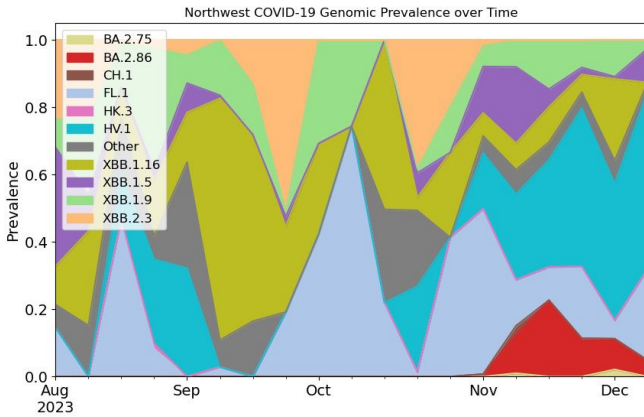
Delta · BA.1 · BA.2 · BA.2.12 · BA.2.86 · JN.1 · BA.4 · BA.5
XBB · XBB.1.16 · XBB.1.5 · XBB.1.9 · XBB.1.9.1 · XBB.1.9.2 · EG.5 · HV.1
BF.7 · BQ.1 · FL.1.5.1 · Other

December 20, 2023
JN.1: **37.3%**
EG.5: **20.7%**
HV.1: **14.1%**
XBB.1.5: **7.3%**
XBB: **5.0%**
BA.2.86: **4.4%**
XBB.1.9.1: **4.4%**
XBB.1.16: **2.2%**
XBB.1.9.2: **1.6%**
FL.1.5.1: **1.2%**
Other: **0.9%**
XBB.1.9: **0.8%**

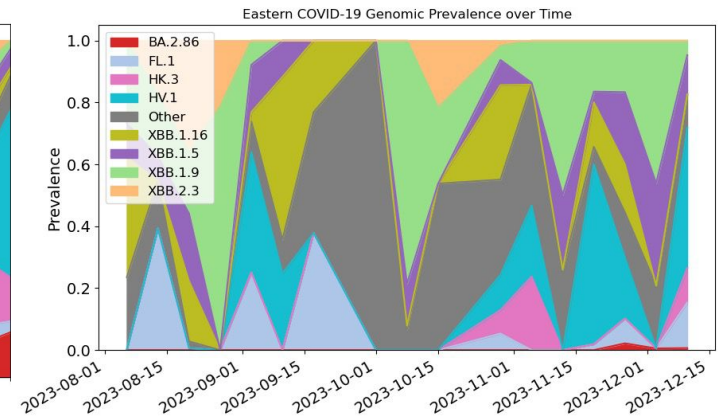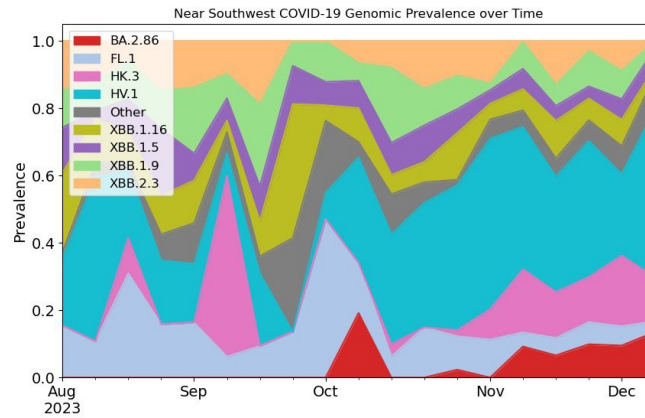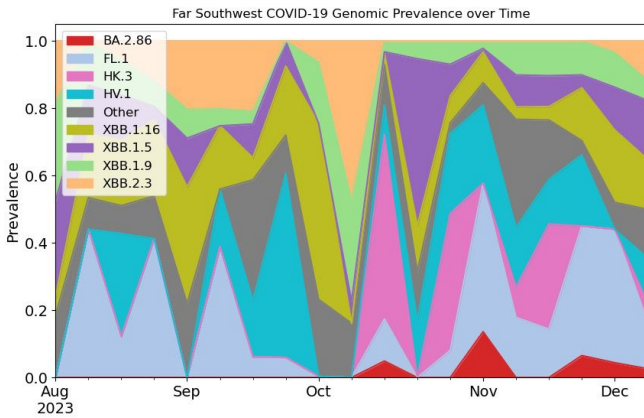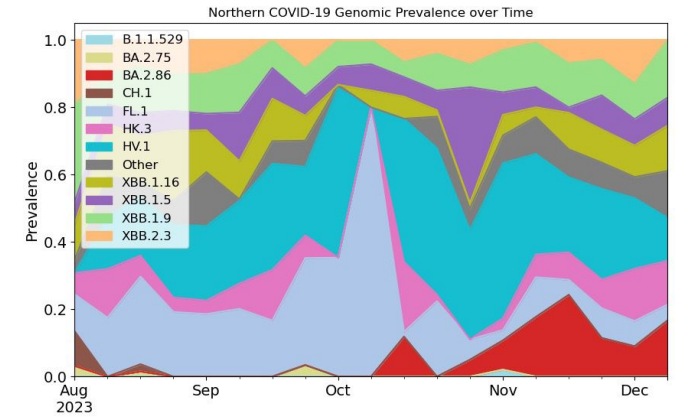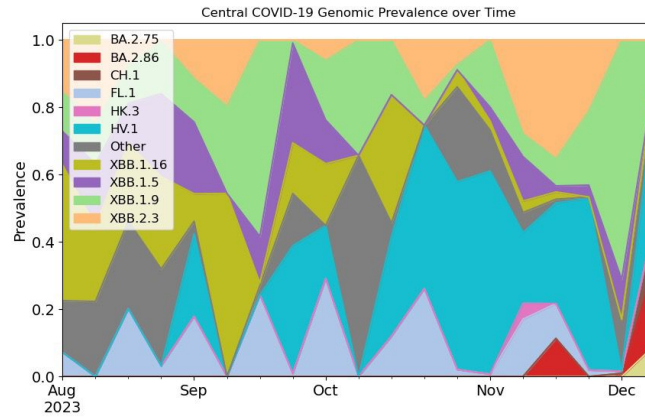https://www.cdc.gov/nwss/rv/COVID19-variants.html
https://biobot.io/data/

12/11/24

36

Virginia Regional Wastewater Variant Status (median)

Data updated through 12/10

Virginia Regional Population-Weighted Wastewater Variant Status
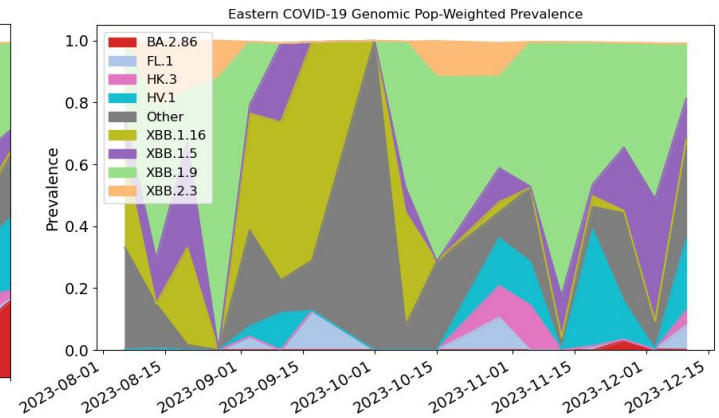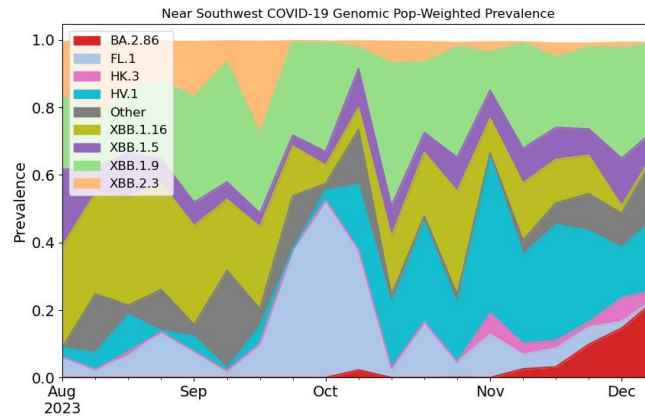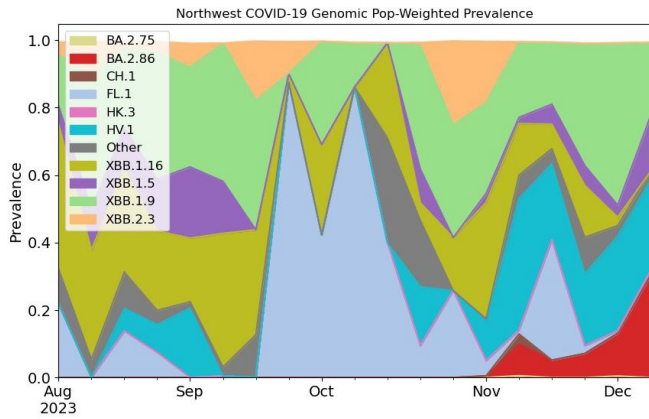
Data updated through 12/10

COVID-19 Literature Updates

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

Pandemic pubs

(a) 50-59 (b) 60-69 (c) 70-79 (d) 80+

Legend:
— Unvaccinated — Up to 6 months since last dose — Over 6 months since last dose

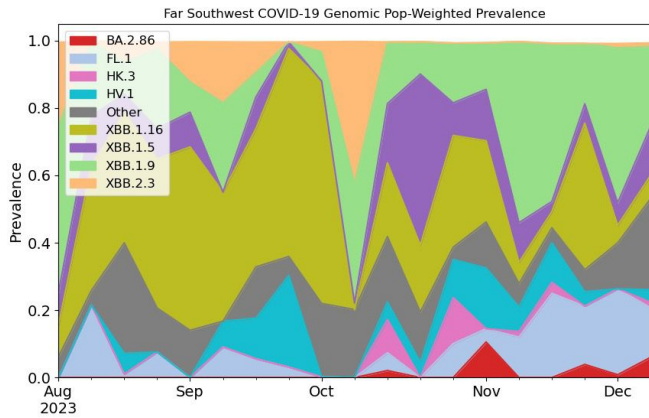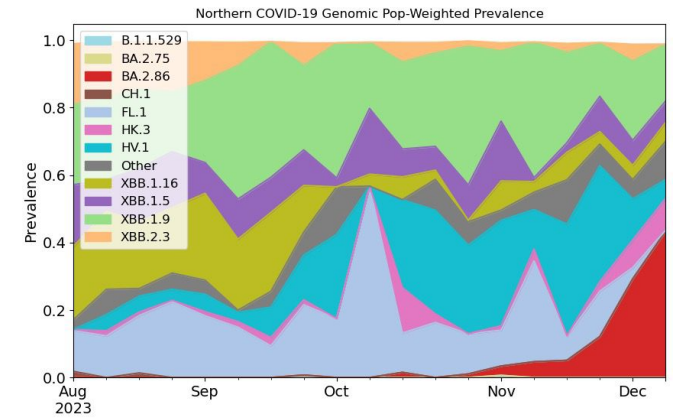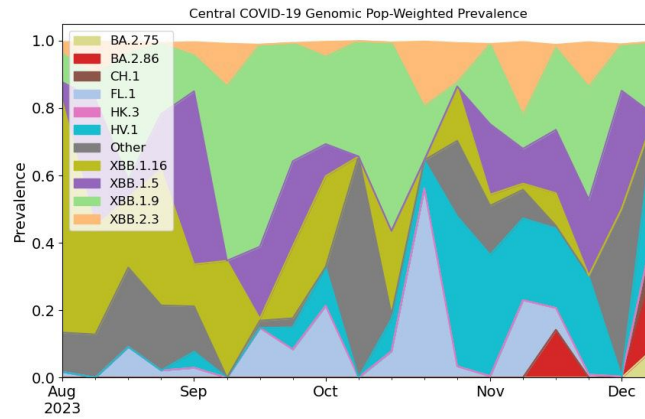Over 80s vaccine rollout | Over 70s and clinically vulnerable | Over 60s | Over 50s | Over 40s | Over 30s | All adults offered vaccine | Booster for over 50s rollout | Booster for over 40s | Booster offered to all adults
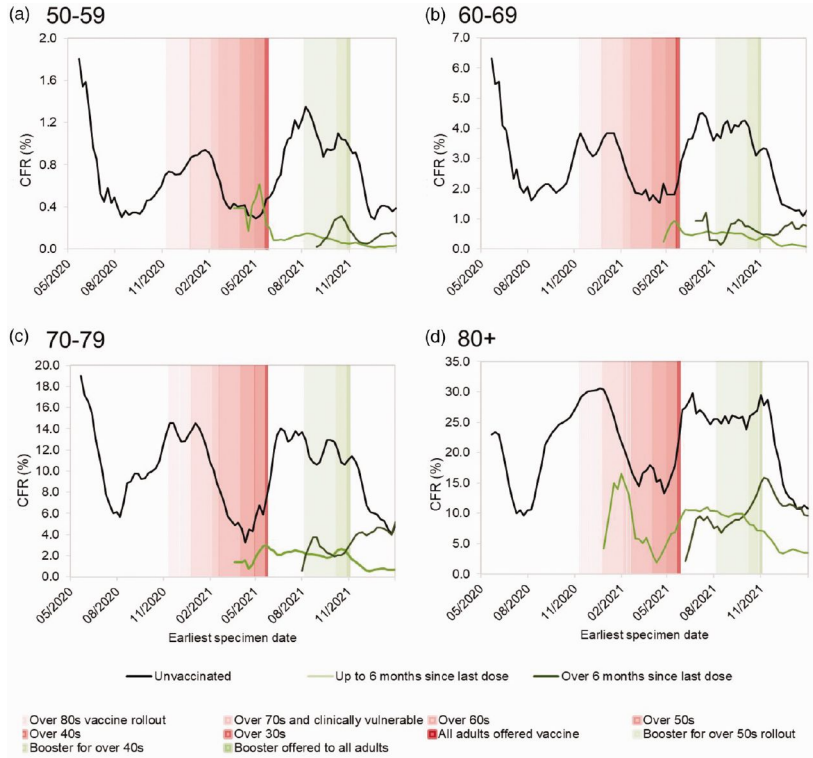
UKHSA study looked at the Case Fatality Risk by vaccination status and time since last dose for COVID-19 between 28 May 2020 and 28 February 2022. CFR was highest in unvaccinated 80+ group. CFR was lowest in vaccinated populations within 6 months of last dose.

1/11/24

https://journals.sagepub.com/doi/10.1177/01410768231216332

Pandemic pubs

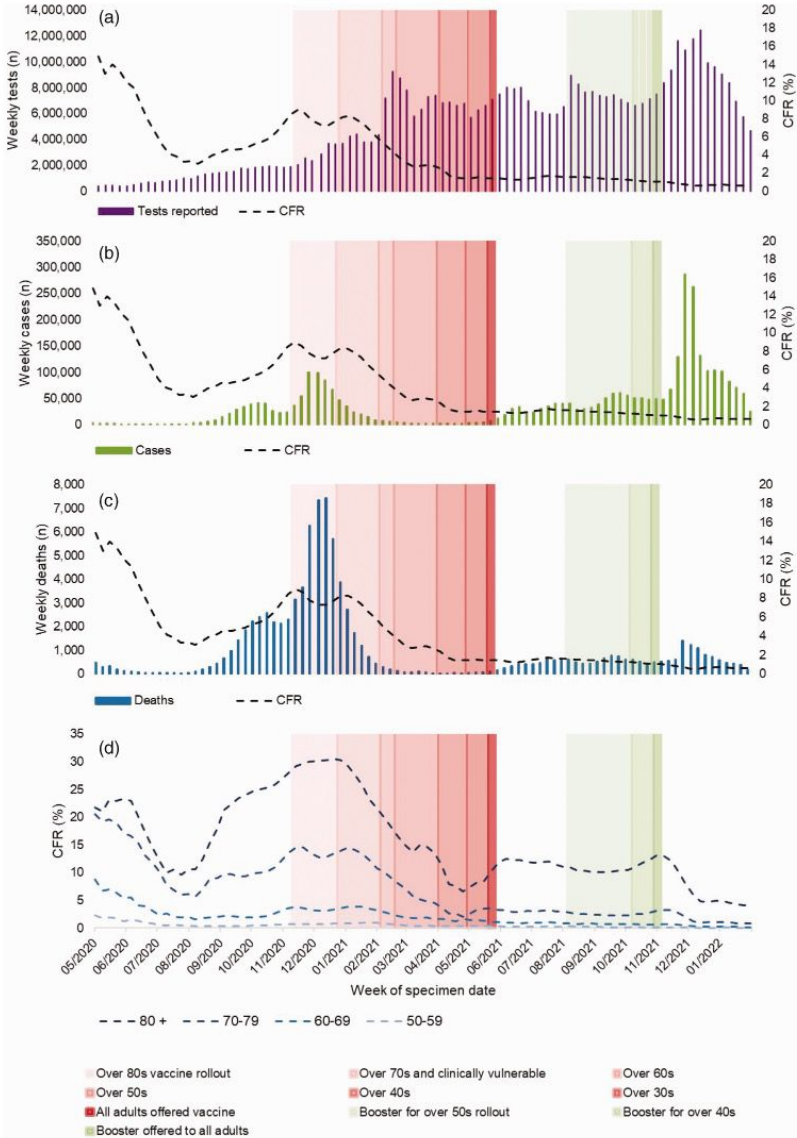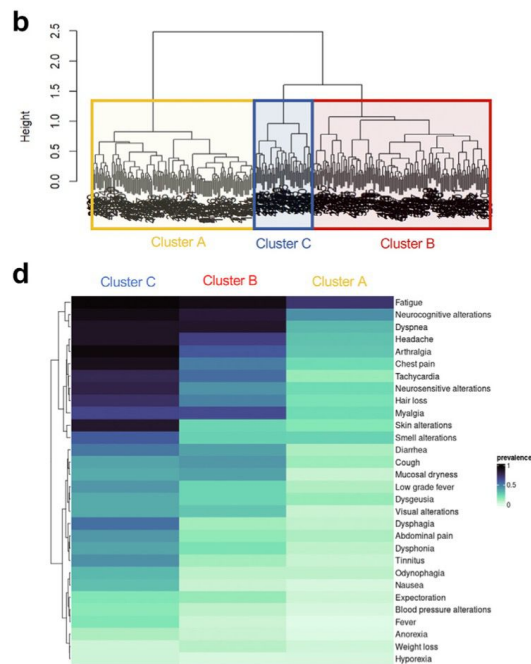An estimated 5–10% of subjects surviving COVID-19 develop "Long COVID" or PCC. Researchers in Spain conducted a 2-year prospective cohort study 548 individuals, 341 fulfilling the WHO PCC definition surviving COVID-19. Researchers found clusters of symptomology among those surveyed. "In the model with the best fit, subjects who were male and had tertiary studies were less likely to develop PCC, whereas a history of headache, or presence of tachycardia, fatigue, neurocognitive and neurosensitive complaints and dyspnea at COVID-19 diagnosis predicted the development of PCC."

1/11/24

https://www.thelancet.com/journals/lanepe/article/PIIS2666-7762(23)00143-6/fulltext#%20

Influenza Update

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE
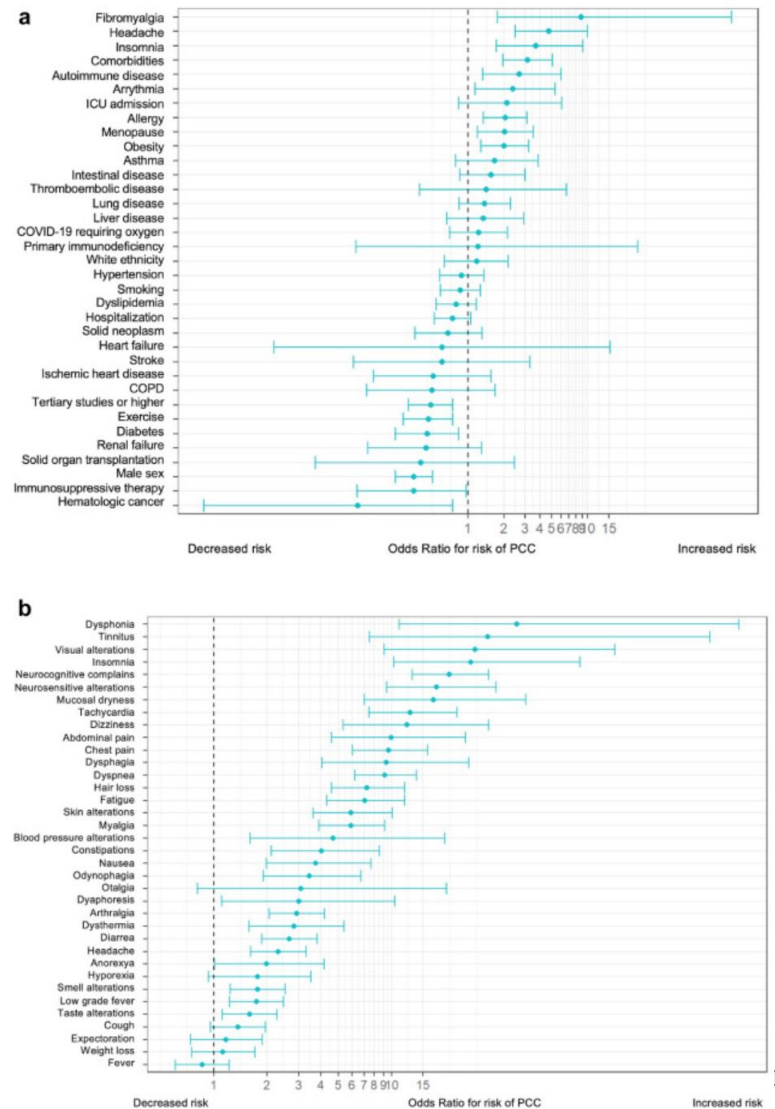
Current Influenza Situation – ILI Activity

Region 3 Influenza Activity is above threshold

- Virginia is now in "Moderate" level of Influenza activity
- National ILI activity remains above threshold after and continues to grow
- Most regions are over threshold, with the most activity in the southern states

Region 3

Virginia

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division
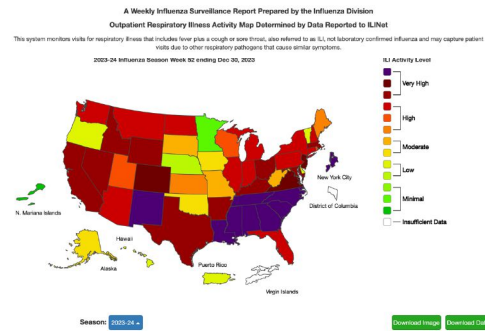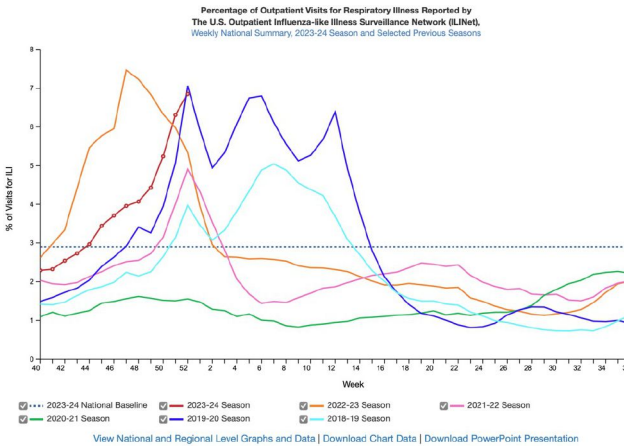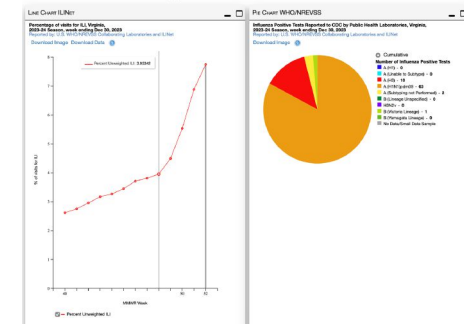
United States Hospitalizations – Influenza Epidemic Growth
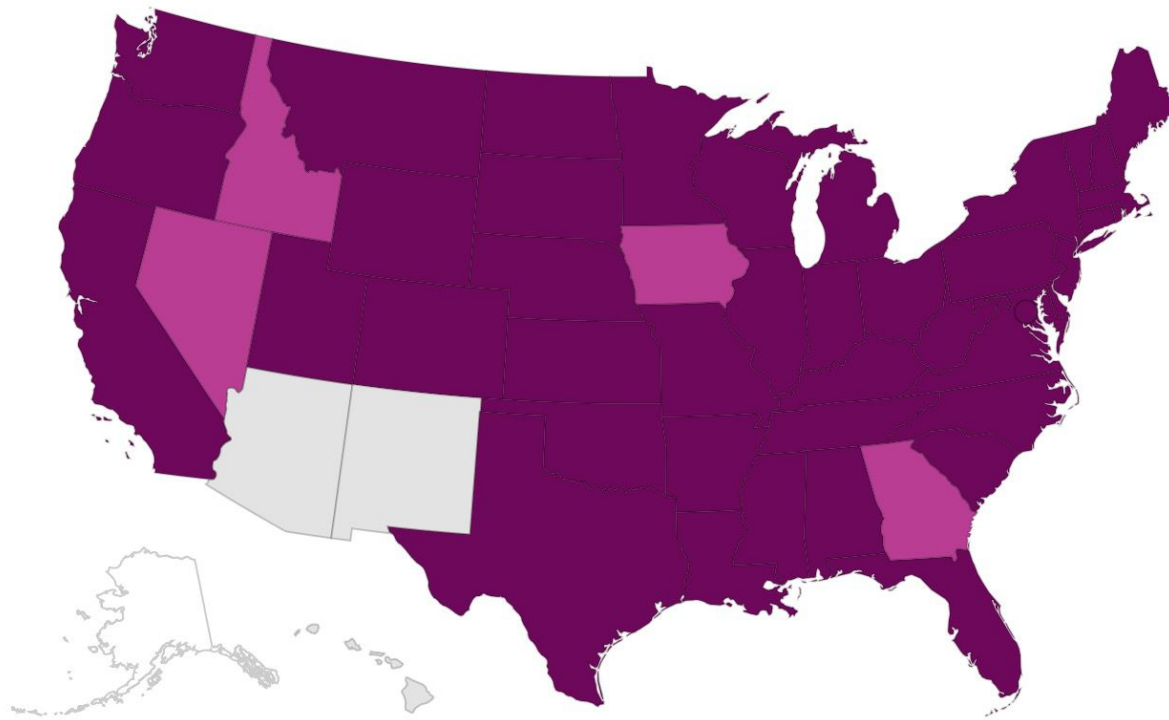
Virginia

Probability Epidemic Is Growing: 0.9995

Epidemic Status: Growing

(Data as of 12-30-23)

Epidemic Status

- Growing
- Likely Growing
- Stable or Uncertain
- Likely Declining
- Declining
- Not Estimated

Territories PR VI

CDC – CFA Epidemic Growth

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

1/11/24

44

Influenza Forecasts – Hospitalization Admissions

Forecast from Dec 30th

UVA forecast model only
Hospital Admissions for Influenza
and Forecast for next 4 weeks
http://flux-forecasting.pods.uvarc.io

Virginia

United States

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE
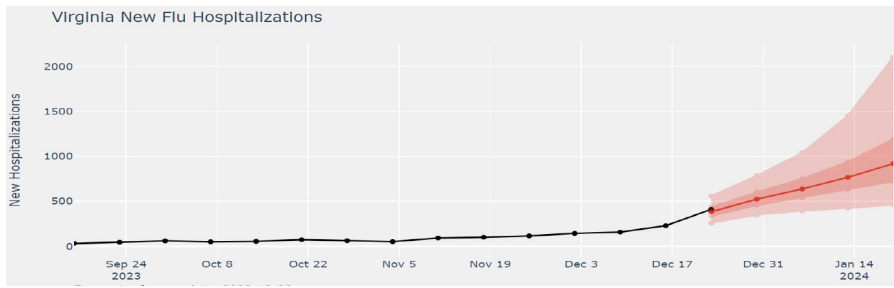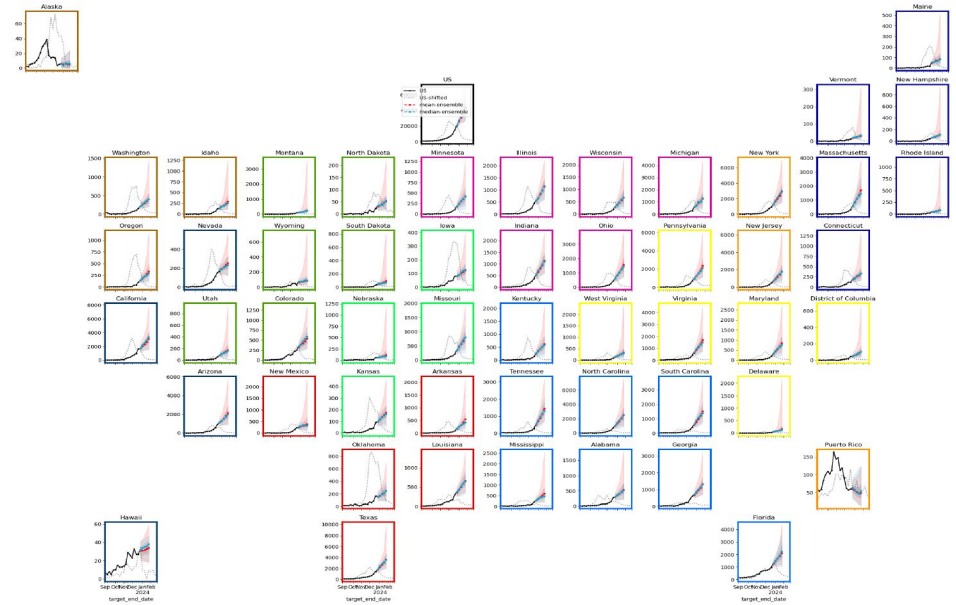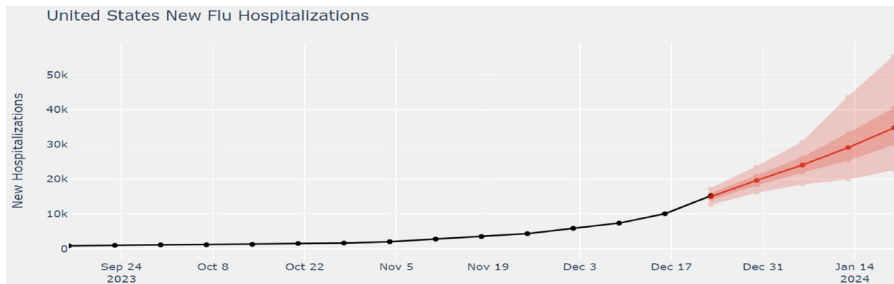
Current Influenza Hospitalization Forecast

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

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

From January 3rd

CDC Flu Activity Surveillance

https://www.cdc.gov/flu/weekly/fluactivitysurv.htm
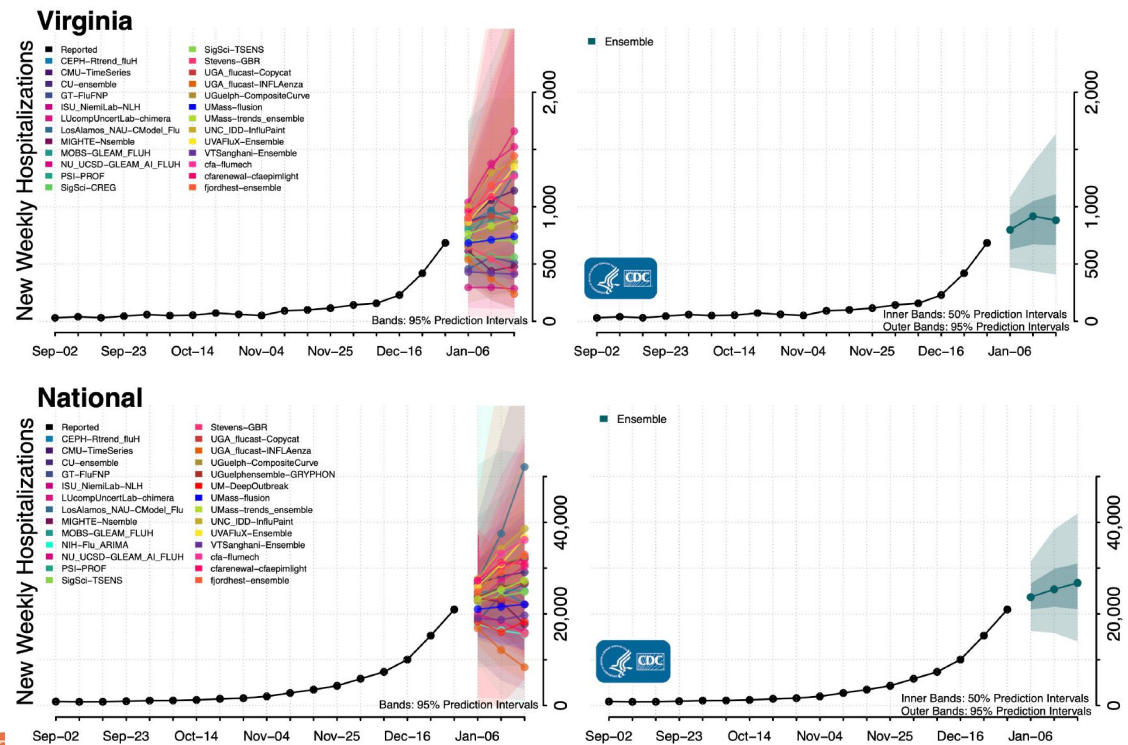
CDC Influenza Forecast

RSV Update

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

Current RSV Situation – Hospitalization Rates (RSV-Net)

Maryland (RSV-Net)
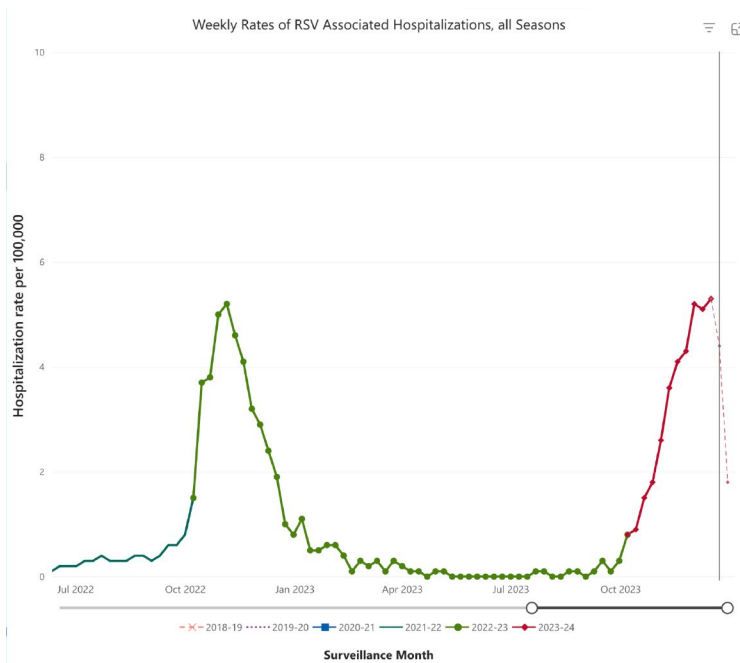
Tennessee (RSV-Net)

Surveillance data as of:
12/16 (last solid data)
12/30 (last recent but likely to be updated)
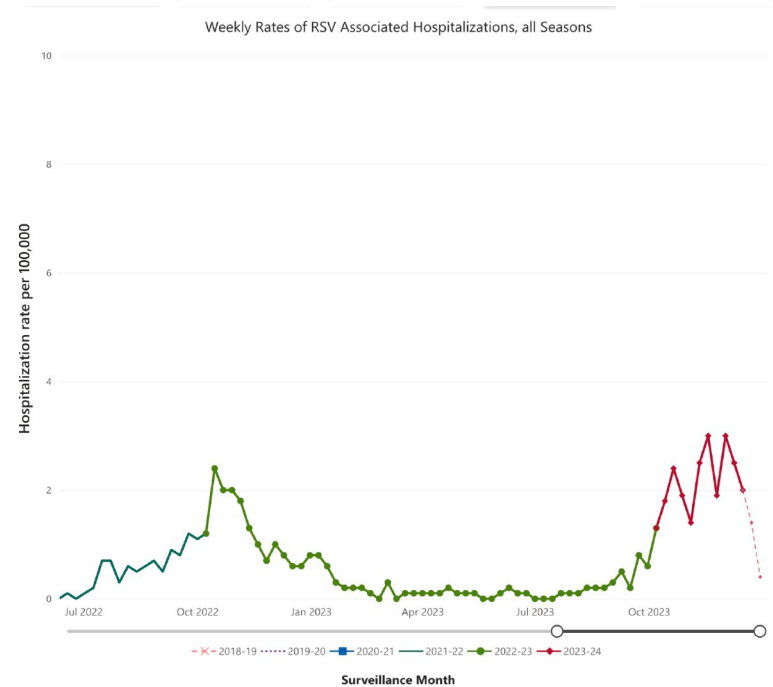
RSV-Net Dashboard

Current RSV Situation – Wastewater in VA

Virginia – RSV via Wastewater
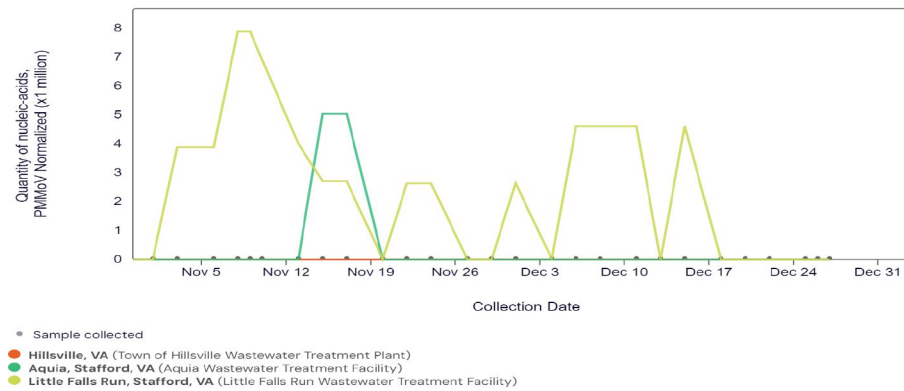
HHS Region 3 – RSV via Wastewater

Wasterwaterscan
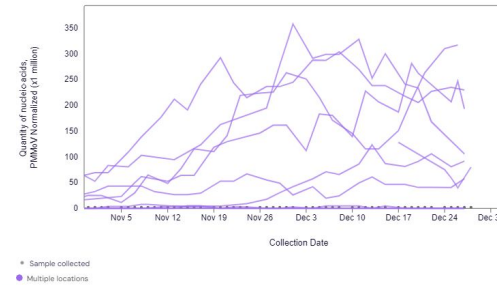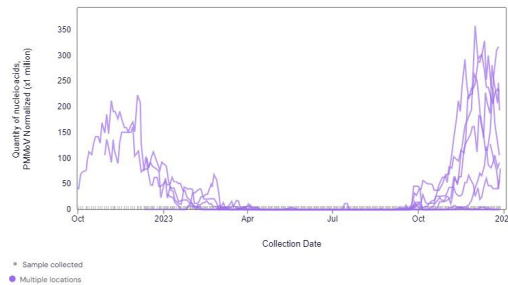
Current RSV Situation – Vaccinations

Figure 1A. Cumulative Percentage of Adults 60 Years and Older Vaccinated with RSV Vaccine, 2023-2024*,†,‡,±
Data Source: National Immunization Survey–Adult COVID Module
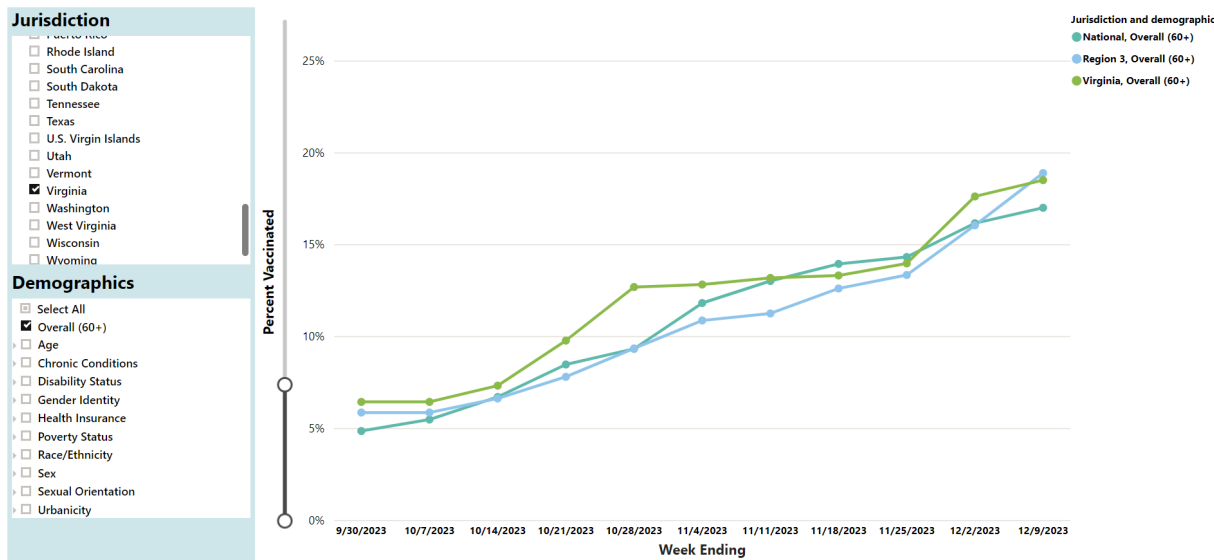
Demographics
Level: **Overall (60+)**
Name:

Jurisdiction	Vaccination & Intent	Estimate (%)	95% CI (%)
National	Vaccinated	17.0%	15.7 - 18.3
National	Definitely will get a vaccine	14.1%	12.1 - 16.2
National	Probably will get a vaccine or are unsure	38.7%	35.7 - 41.7
National	Definitely or probably will not get a vaccine	30.2%	27.1 - 33.3

- RSV Vaccination of 60+ nears 17% and exceeds National and Regional levels
- Another 14% still "definitely" intending to get vaccine
- Now 30% not planning on vaccinating

UNIVERSITY of VIRGINIA
BIOCOMPLEXITY INSTITUTE

CDC   RespVaxView

Combined Respiratory Disease

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

NSSP VA ED Visit Data as of 12-30-23

Virginia - COVID-19, Influenza, and RSV ED visits - Source: NSSP
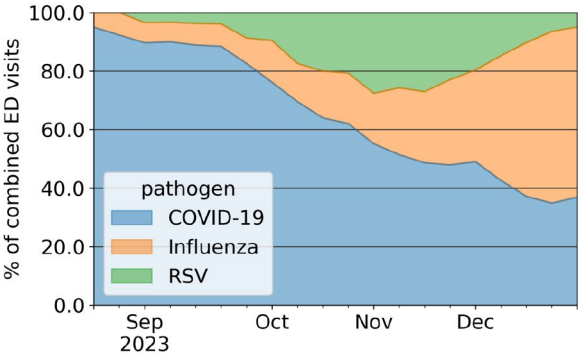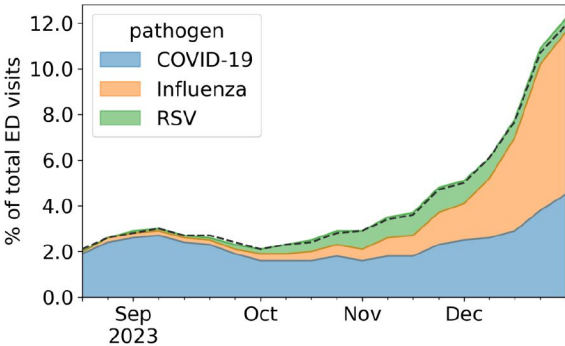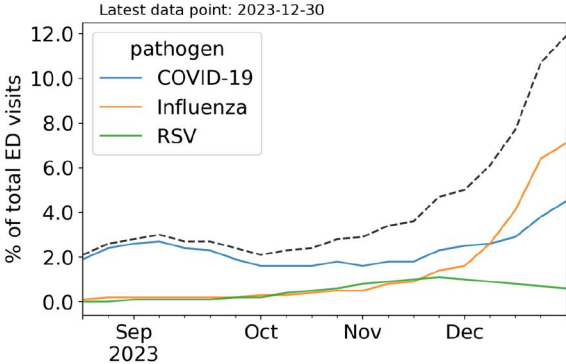
R$_t$ and Trend Estimates

COVID-19

measure	estimate
New confirmed cases by infection date	0 (0 – 1)
Expected change in daily cases	Likely increasing
Effective reproduction no.	1.1 (0.78 – 1.5)
Rate of growth	0.009 (-0.039 – 0.067)
Doubling/halving time (days)	77 (10 – -18)

Influenza

measure	estimate
New confirmed cases by infection date	1 (0 – 5)
Expected change in daily cases	Likely increasing
Effective reproduction no.	1.2 (0.83 – 1.8)
Rate of growth	0.037 (-0.046 – 0.15)
Doubling/halving time (days)	19 (4.5 – -15)

RSV

measure	estimate
New confirmed cases by infection date	0 (0 – 0)
Expected change in daily cases	Stable
Effective reproduction no.	1 (0.58 – 1.7)
Rate of growth	0.00022 (-0.067 – 0.071)
Doubling/halving time (days)	3100 (9.8 – -10)

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

National Modeling Hub

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

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 12th, 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

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

Scenario Modeling Hub – RSV (Round 1)

Preliminary Results based UVA-EpiHiper Model

- Hospitalizations of 0-1 year olds can be reduced 5-10% through high levels of treatments
- Hospitalization of 65+ year olds can be reduced 7-22%

Conservative assumptions

- Treatments and vaccinations don't interrupt transmission (unlikely, but no evidence yet to prove it)
- Vaccination coverage a fraction of seasonal influenza vaccines

US RSV
Hospitalizations
0-1 year olds
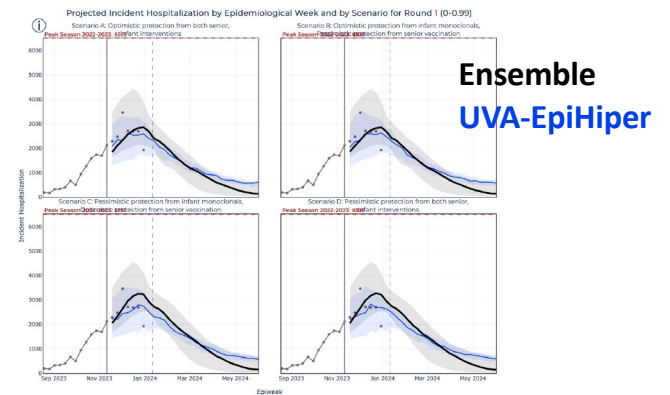
US RSV
Hospitalizations
65+ year olds

Ensemble
UVA-EpiHiper

Ensemble
UVA-EpiHiper

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

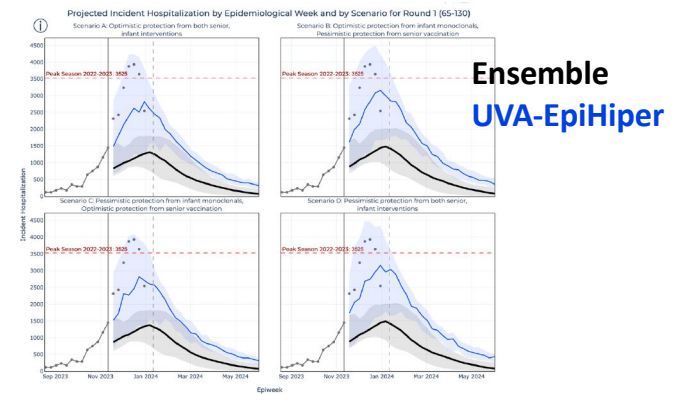- H1 lower hospitalization rates and efficacy even across age groups

Vaccination levels (compared to 2021-22 season):

<div style="margin-left:2em">
Low (20% less) vs.
Business as Usual (same) vs.
Higher (20% more)
</div>

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)

- H1N1 season seems to have emerged
- Projections remain relatively on track

Virginia Hospitalizations
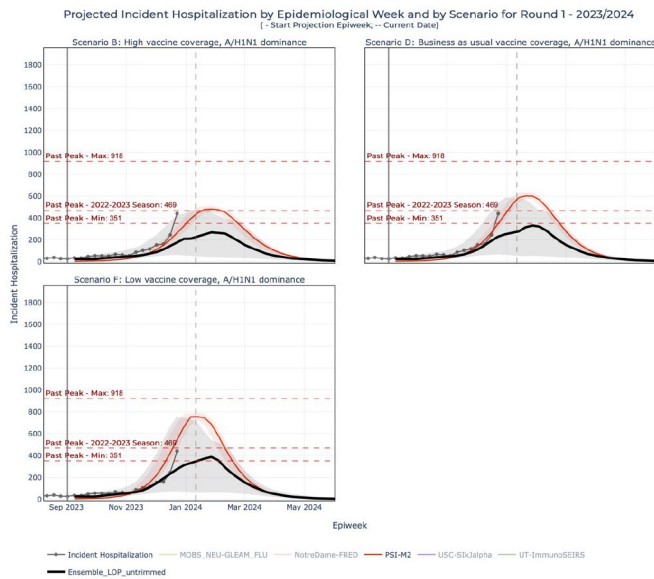
United States Hospitalizations
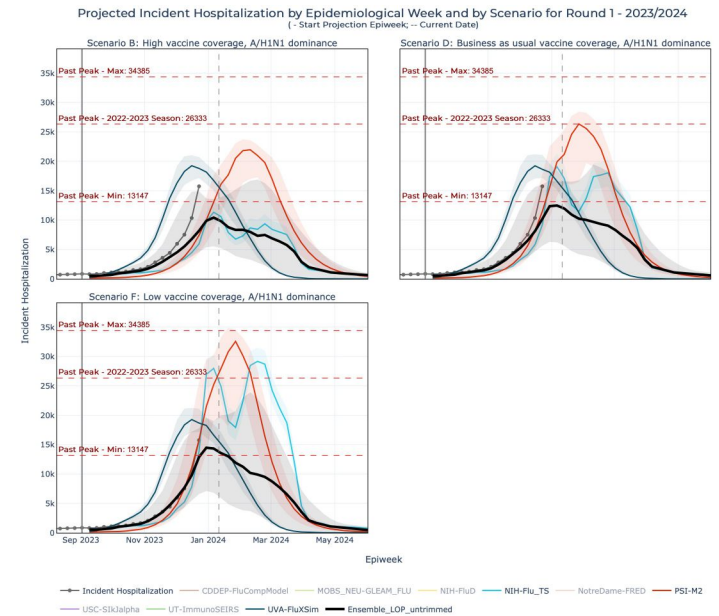
Scenario Modeling Hub – COVID-19 (Round 17)

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

- 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

https://covid19scenariomodelinghub.org/viz.html

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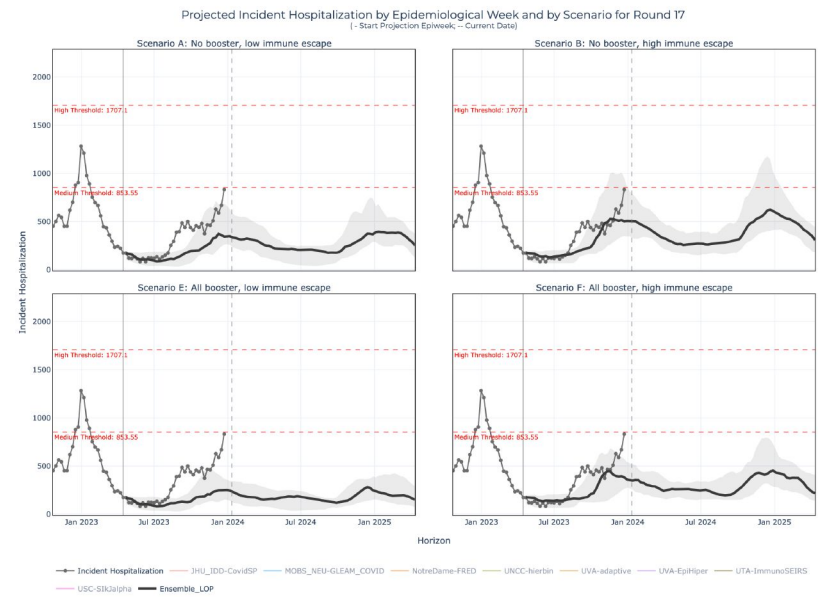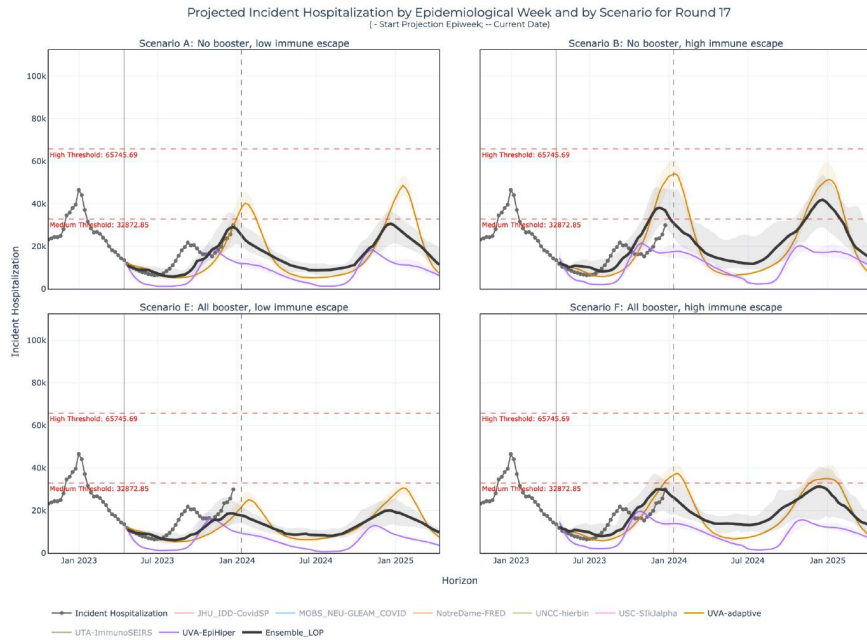
Slower Immune Escape (20%)   **Faster Immune Escape (50%)**

Key Takeaways

Most COVID-19 indicators show signs of slowing growth

- Case and Hospitalization remain elevated but may be leveling off

- Other indicators also indicate high levels that may be leveling off as well

- Wastewater indicators are high but have show signs of stabilization

- This suggest we may be nearing the Peak of COVID-19 activity.

Influenza remains very high and growing, though the rate of growth may be slowing

RSV activity has leveled off and may be slowing

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE

Questions?

Points of Contact

Bryan Lewis
brylew@virginia.edu

Srini Venkatramanan
srini@virginia.edu

Madhav Marathe
marathe@virginia.edu

Chris Barrett
ChrisBarrett@virginia.edu

Biocomplexity COVID-19 Response Team

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

UNIVERSITY *of* VIRGINIA

BIOCOMPLEXITY INSTITUTE