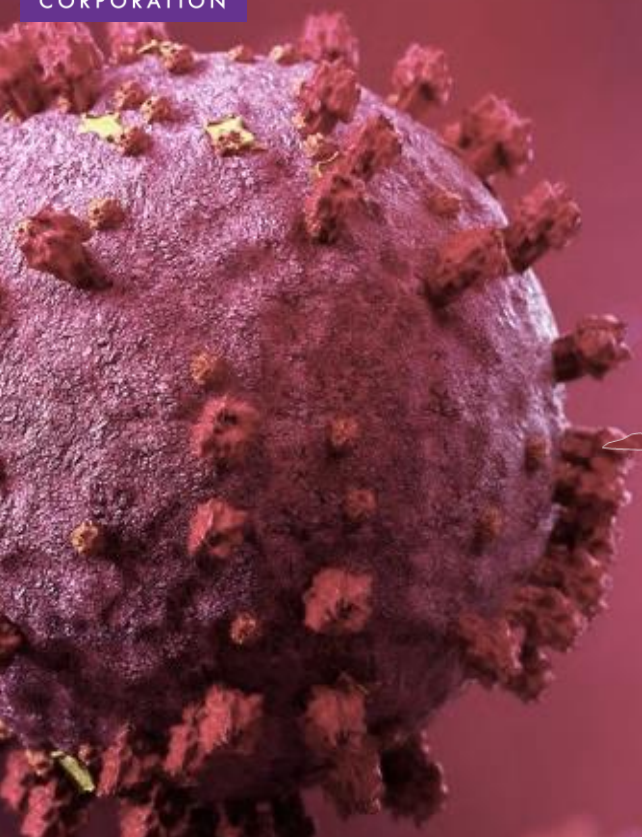
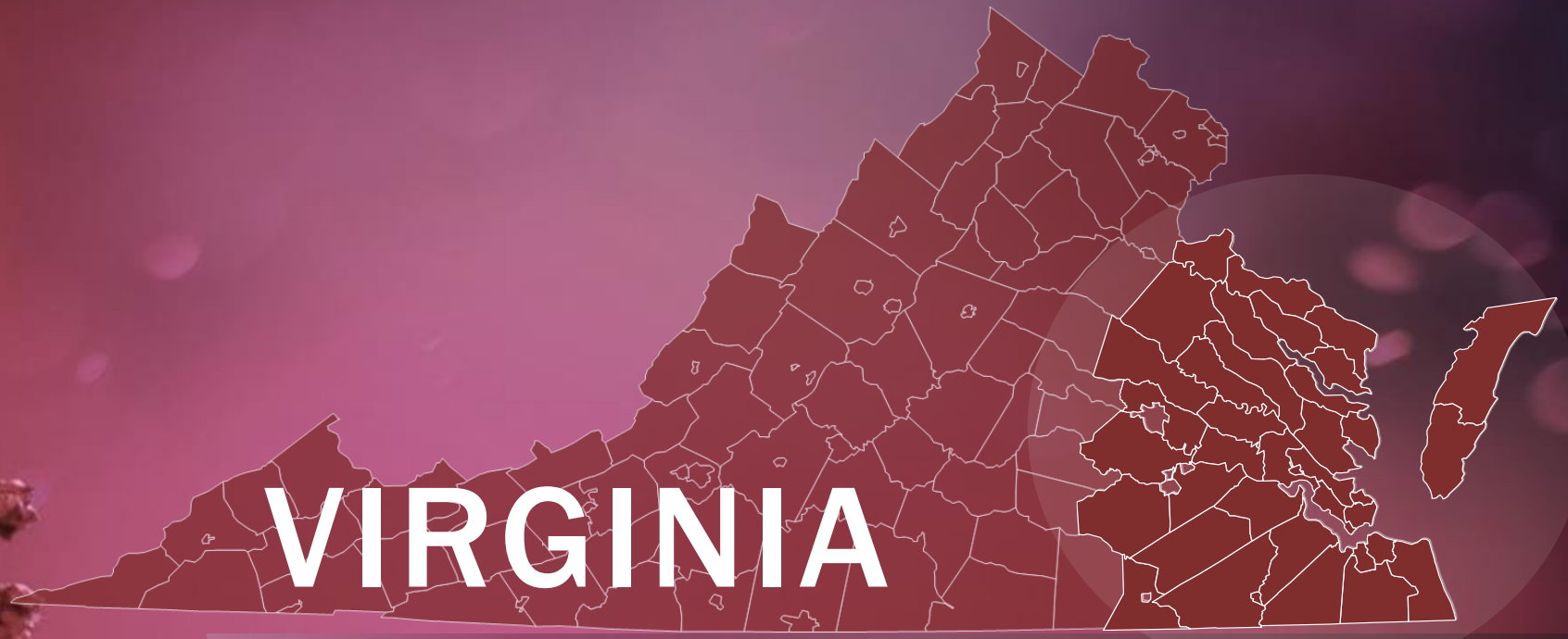




VIRGINIA

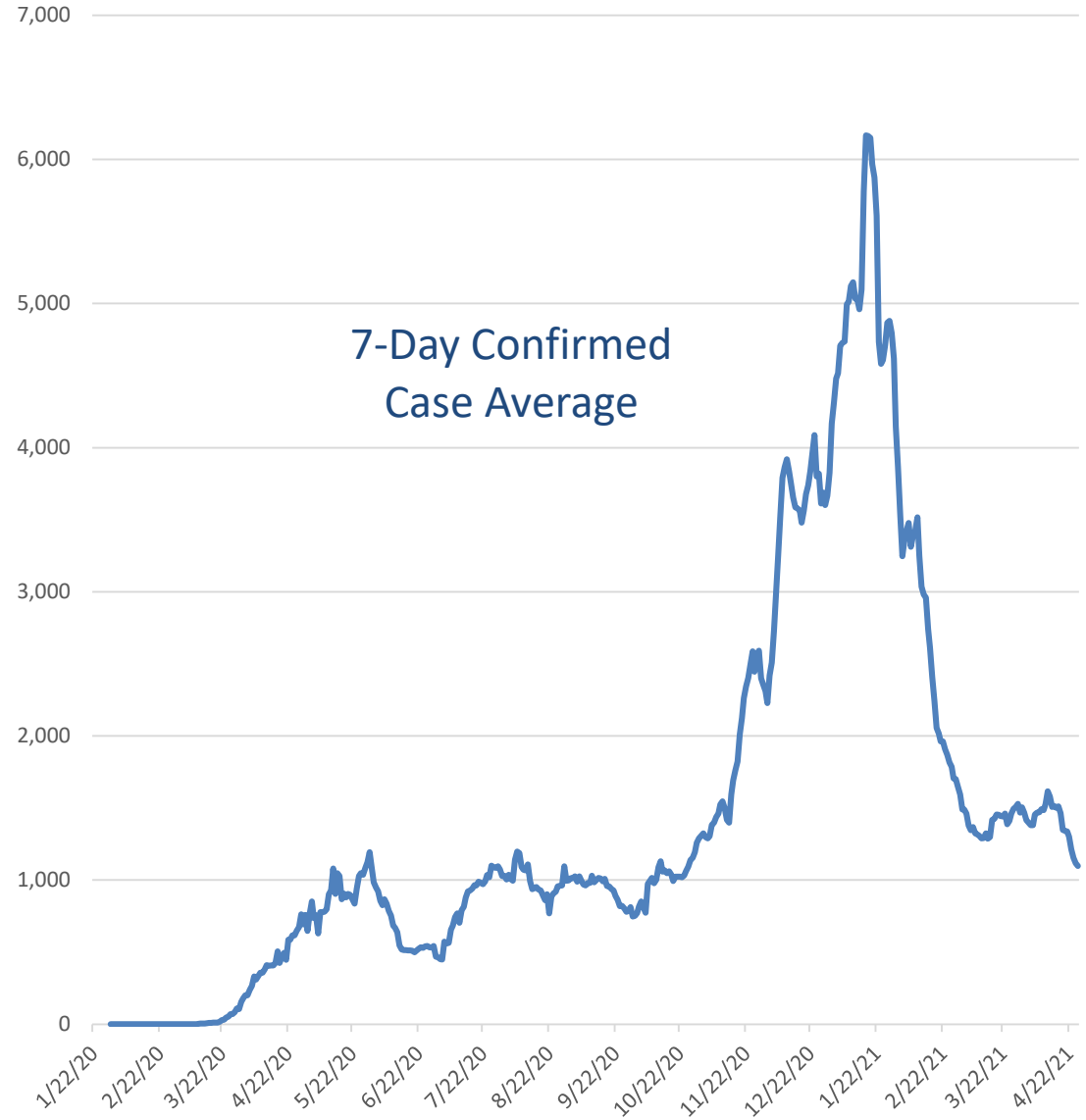
COVID-19 Update April 29th, 2021

Carter C. Price, Ph.D.

A team of RAND researchers was asked by the Commonwealth of Virginia to review available information on COVID-19 models of the Commonwealth to determine the strengths and weaknesses of each model and their relevance to decisionmaking. The information in this presentation is intended to keep policymakers abreast of the latest findings of the research team.

This research was sponsored by the Commonwealth of Virginia and conducted by the RAND Corporation. RAND is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest. For more information, visit www.rand.org.

Bottom Line Up Front



Confirmed cases have declined from last week to 1,098 per day (-19%)

- This is 15 percent lower than the previous low of 2021 and 8 percent below the summer highs of 2020

COVID hospitalizations have decreased slightly to 988 (-11%)

COVID tests have stabilized but at a lower level than in the winter

- The test positivity rate is down from 7.4 percent last week to 6.7 percent

Vaccination is continuing to increase rapidly with 29 percent of the population fully vaccinated (+3.5 percentage points)

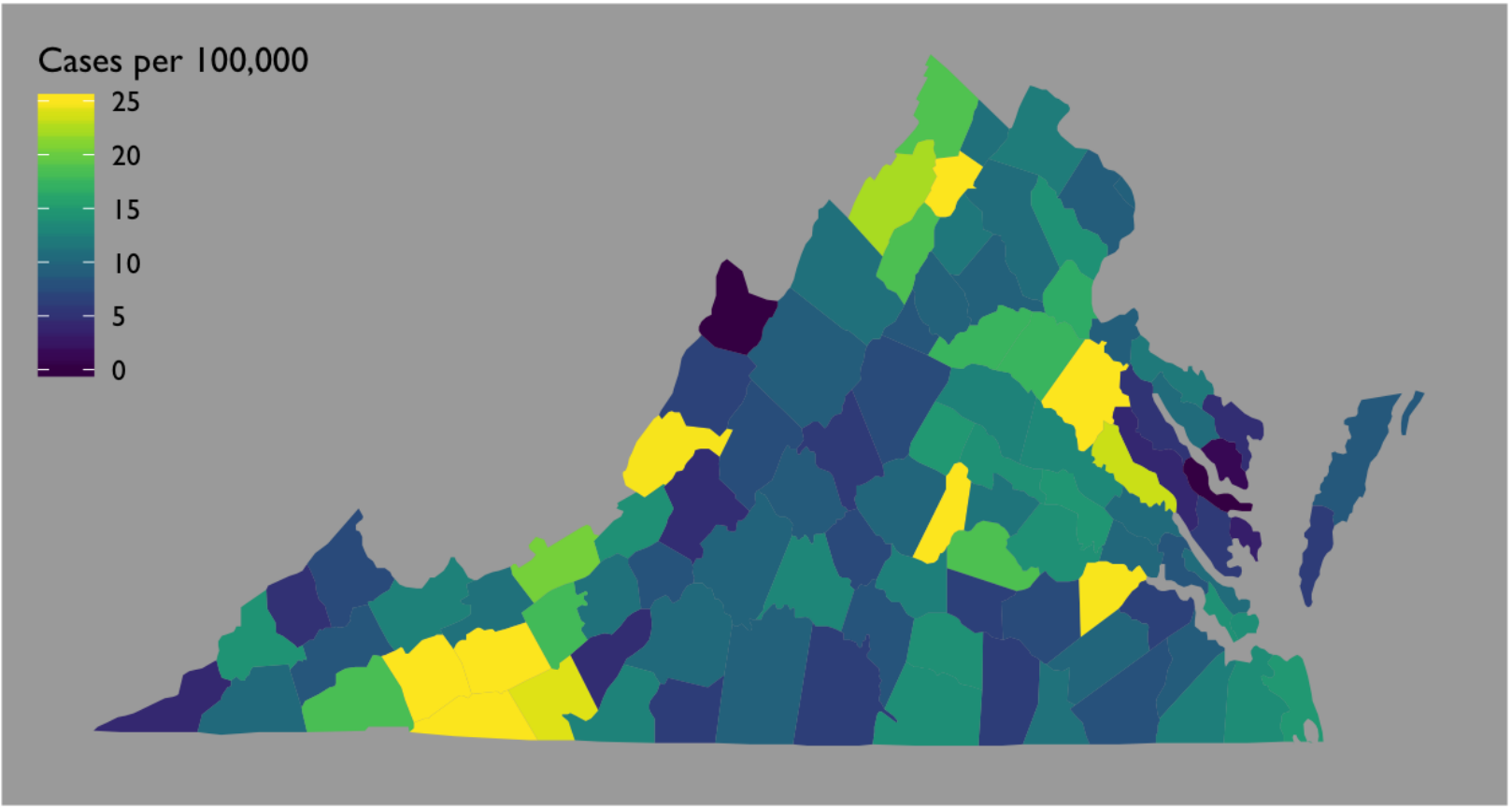
Case rates remain higher than most of 2020, but the decline over the last two weeks may indicate that the vaccines are slowing the spread

- Virginia may be trending toward a more sustained decline
- However, this trend may be fragile because the variants of concern and higher movement could still increase the case numbers among the unvaccinated

Cases generally declined but remain high in a few counties

CASE COUNT

Source: VDH



Yellow indicates at least 25 cases per 100,000

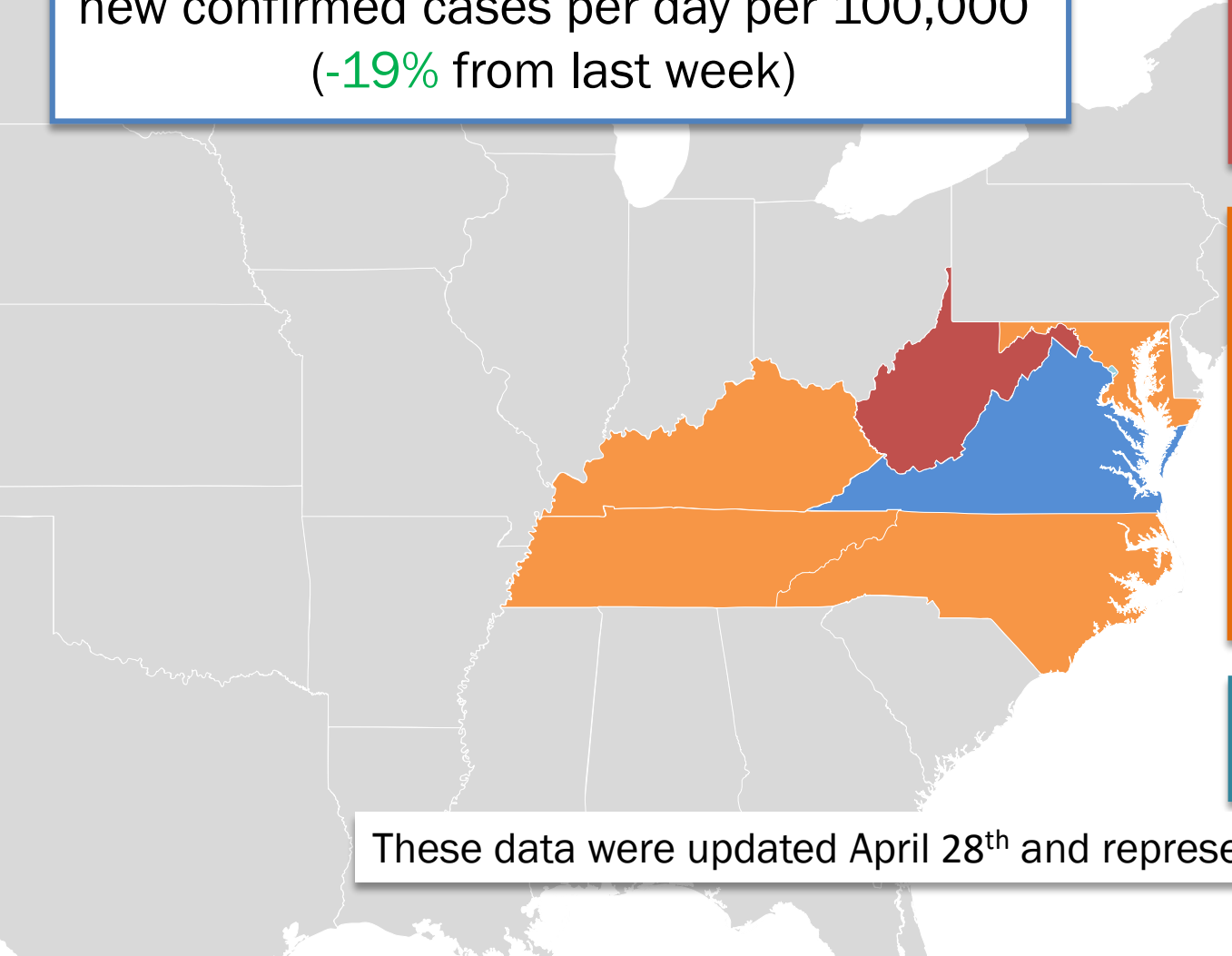
Case levels have drifted lower across the Commonwealth

- 85 percent of counties have fewer than 20 cases per 100,000 (80 percent last week)
- 41 percent of counties have fewer than 10 cases per 100,000 (32 percent last week)

These data were updated April 28th and represent a seven-day average of the previous week

Neighboring states' case levels declined to varying degrees over the last week

Over the last 7 days, Virginia had 12.9 new confirmed cases per day per 100,000 (-19% from last week)



Very high case loads (>20):

- West Virginia (20.1 new cases per 100k, -6% from last week)

High case loads (10-20):

- North Carolina (18.1, -7%)
- Maryland (16.3, -21%)
- Tennessee (15.1, -34%)
- District of Columbia (12.9, -24%)
- Kentucky (11.6, -14%)

Lower case loads (<10): None

These data were updated April 28th and represent a seven-day average of the previous week

Variants could increase the rate of spread

The CDC has Identified five variants of concern that spread more rapidly than the baseline variant and may also bypass immune protection from vaccines or previous infection

- All five variants of concern have been detected in Virginia

The CDC released estimates of the prevalence for HHS Region 3 (DE, DC, MD, PA, VA, and WV) based on genomic testing from March 28th to April 10th

- B.1.1.7 (U.K. variant) is estimated to be 60.2 percent of cases in the region
- B.1.351 ("South African variant") is estimated to be 1.3 percent of cases
- P.1 ("Brazilian variant") is estimated to be 2.1 percent of cases
- B.1.427/B.1.429 ("California variants") are estimated to be 0.9 percent and 1.9 percent, respectively

Additionally, there are three variants of interest that have been detected in the region

- B.1.525/B.1.526/B.1.526.1 ("New York variants") are estimated to be 1.3 percent, 10.7 percent, and 4.7 percent, respectively
- P.2 (a Brazilian variant) is estimated to be 0.3 percent of cases

29 percent of Virginians are fully vaccinated, and an additional fourteen percent are partially vaccinated

Age	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+	Total
Fully Vaccinated	0	36,713	210,900	291,331	334,098	422,694	527,830	416,770	200,858	2,441,194
% Full	0.0%	3.3%	18.3%	24.8%	31.0%	37.5%	54.0%	67.9%	64.5%	28.6%
Partially Vaccinated	0	81,858	187,833	197,992	199,619	221,130	163,649	73,291	39,047	1,164,419
% with Partial	0.0%	7.4%	16.3%	16.9%	18.5%	19.6%	16.8%	11.9%	12.5%	13.6%
Confirmed Cases	30,329	70,295	125,100	105,551	95,089	93,303	63,601	34,177	24,519	641,964
% Confirmed Cases	3.0%	6.4%	10.8%	9.0%	8.8%	8.3%	6.5%	5.6%	7.9%	7.5%

Source: VDH, April 28th

Vaccinations are being rolled out in Virginia very rapidly

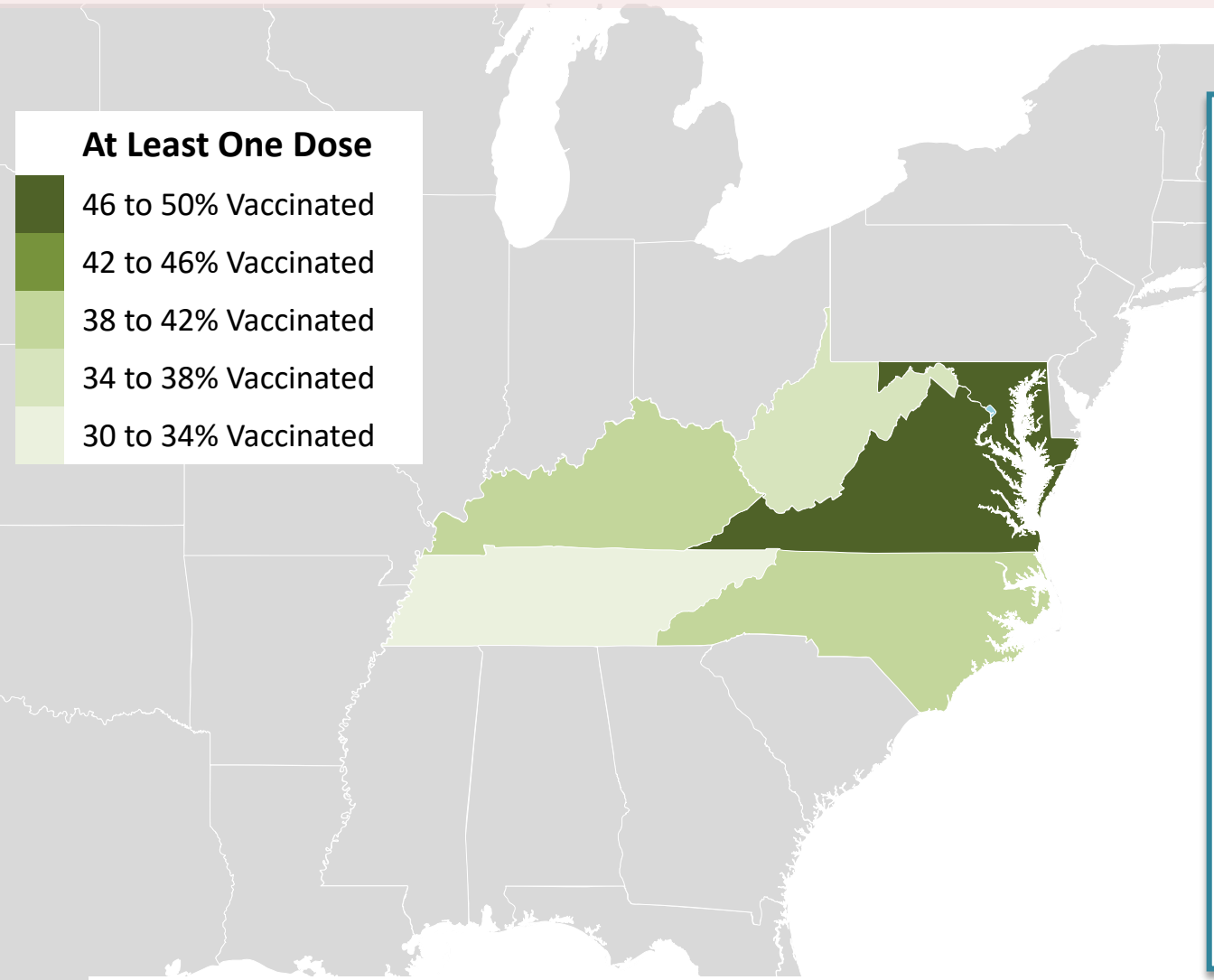
- As of April 28th, 7,504,885 doses have been distributed and 6,018,570 doses have been administered
- Over the last seven days, Virginia has averaged 73,264 doses per day

We may be seeing the effects of the vaccinations already

- More than 78 percent of people over the age of 70 are at least partially vaccinated
- That population only had 411 confirmed cases in the last week compared to 2,624 cases early February when only 30 percent had received at least one dose
- At the beginning of February, ten percent of the cumulative cases had been among those over the age of 70, but less than five percent of last week's cases were among the elderly

Efforts to improve demand may be required to reach the necessary levels of protection to end community spread

Vaccination rates among neighboring states vary substantially



	Partially Vaccinated*	Fully Vaccinated*
Nationwide	**18.2%**	**22.4%**
D.C.	18.2%	28.7%
Kentucky	9.6%	31.0%
Maryland	14.6%	32.9%
North Carolina	10.8%	27.9%
Tennessee	10.2%	23.7%
Virginia**	**14.7%**	**31.5%**
West Virginia	6.2%	29.3%

* Includes out-of-state vaccinations

**Differs from previous slide because all vaccination sources are included

Source: https://covid.cdc.gov/covid-data-tracker/#vaccinations
These data were updated April 28th

We've been monitoring recent, relevant literature

Farthing and Lanzas used an agent-based simulation to identify the vaccination prevalence that might be sufficient to safely relax nonpharmaceutical interventions

- The authors have a model with realistic patterns of movement that is calibrated to reproduce indoor transmission rates
- They assess the effect on the rate of spread of the relaxation of mask wearing and social distancing for different levels of vaccination
- Even at high vaccination levels, NPIs will meaningfully reduce the spread until the prevalence is very low

Misra et al. conducted a meta-analysis of 350 studies on the neurological effects of COVID

- The authors found that as many as one-third of COVID cases in the studies reviewed had at least one neurological issue
- Strokes were the most common neurological diagnosis and occurred in about two percent of the hospitalized patients

The Washington Post and Kaiser Family Foundation conducted a survey of frontline health care workers from February 11th to March 7th, 2021

- The survey found that 29 percent of the health care workers surveyed have considered leaving health care
- Additionally, approximately 45 percent of those surveyed had not been vaccinated and 30 percent do not plan on getting vaccinated in the near term

What is next for modeling and analysis?

Pandemic modeling has greatly evolved over the last year

- Initially, there was a dearth of high-quality data and the models were typically either SEIR-based or statistical
- As behaviors and policies changed, the models grew in complexity and hybrid/ensemble models are also used now
- Growing immunity, behavioral changes, and other factors will make modeling for the purpose of producing accurate forecasts particularly challenging in the coming months

At this stage of the pandemic, modeling and data analysis will be useful for addressing specific types of questions:

- How might the spread change as new variants enter Virginia?
- Which segments of the population remain the most vulnerable?
- As vaccinations increase and case levels decline, which NPIs can be relaxed and when?
- Are there early warnings or triggers that should be monitored to help inform policy?

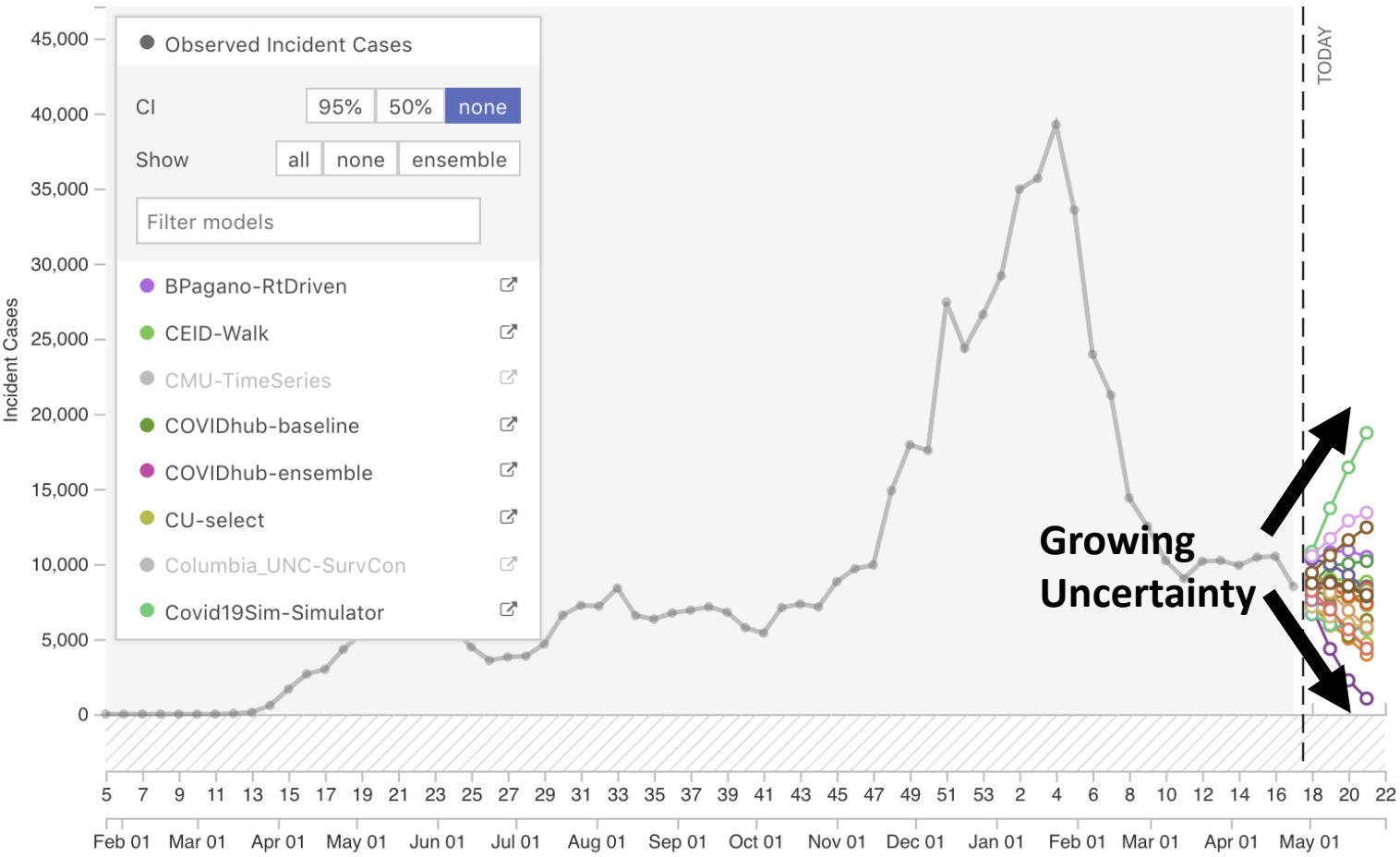
For other questions, surveillance is likely to be more useful:

- How widespread are the variants in Virginia?
- How many cases should we expect in the next few weeks?

Robust, integrated testing programs are necessary to conduct effective surveillance

- Data on the sampling approaches are useful to understand which areas and populations are well-covered versus under-covered
- Improving external access to data sources like wastewater testing or genomic sequencing could improve analysis

The models diverge somewhat over the next few weeks



The models increasingly diverge as time passes

- Some models, like the SEIR-type, are structurally incapable of producing a plateau at a relatively high level of cases
- It is not clear how the trade-off between the variants and vaccines is made in each model, and this will be particularly challenging for statistical models

Many of the model predictions lag the data

- This means that they match the trends in retrospect but not as forecasts

Source: COVID-19 Forecast Hub, https://viz.covid19forecasthub.org/
Accessed April 28th

What might a “new normal” look like and how might we influence it?

Some of the factors that will affect the “new normal” can be influenced by policy, but others cannot

- Efforts to maximize the vaccination rate will determine whether community immunity is feasible in Virginia
- Similarly, the variants will be a major factor in the feasibility of community immunity
- Even if community immunity is reached, outbreaks may still occur and require special interventions

Regardless of the local case levels, some policies may be advisable until the global pandemic has abated

- Efforts to monitor for outbreaks, track new variants of concern, and trace contacts may be useful to continue
- Similarly, low cost NPIs, such as masking, may be prudent to retain

There will likely be substantial long-term consequences that may require additional resources

- As of April 28th, 649,608 Virginians had been diagnosed with COVID, and 53,970 had been hospitalized for it
- Many of these people will have lingering physical and mental health consequences from their infections
- For example, based on the Mishra et al. study, we would expect 216,000 Virginians to have neurological issues and more than 1,000 strokes to occur due to COVID
- Patients with chronic conditions may suffer long-term consequences due to delayed care
- Stress among health care providers has substantially lowered morale and may lead to additional attrition
- Further, distress and mental illness have risen substantially in the broader public and may require additional capacity to treat appropriately

Efforts to ensure adequate capacity for timely care could mitigate the effects of these consequences

Discussion and Questions