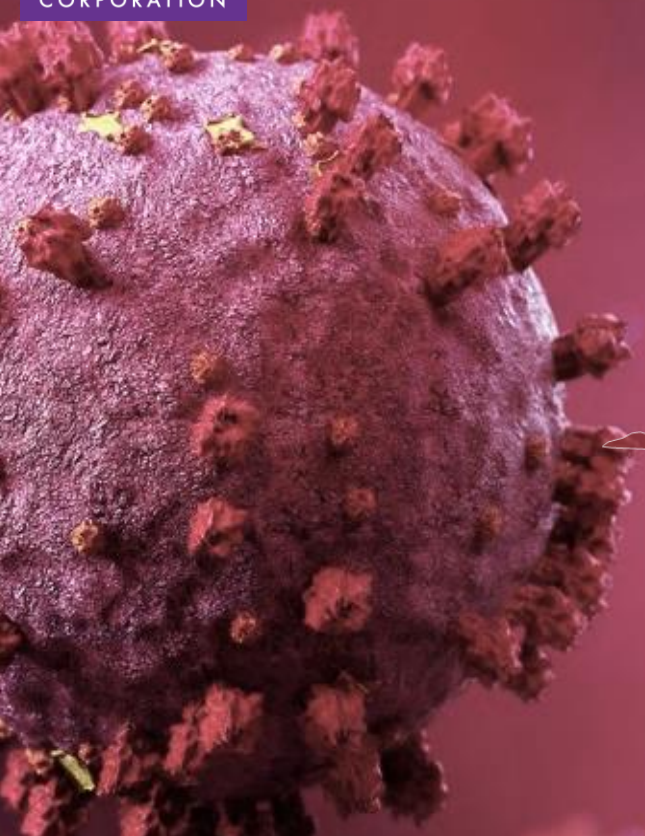
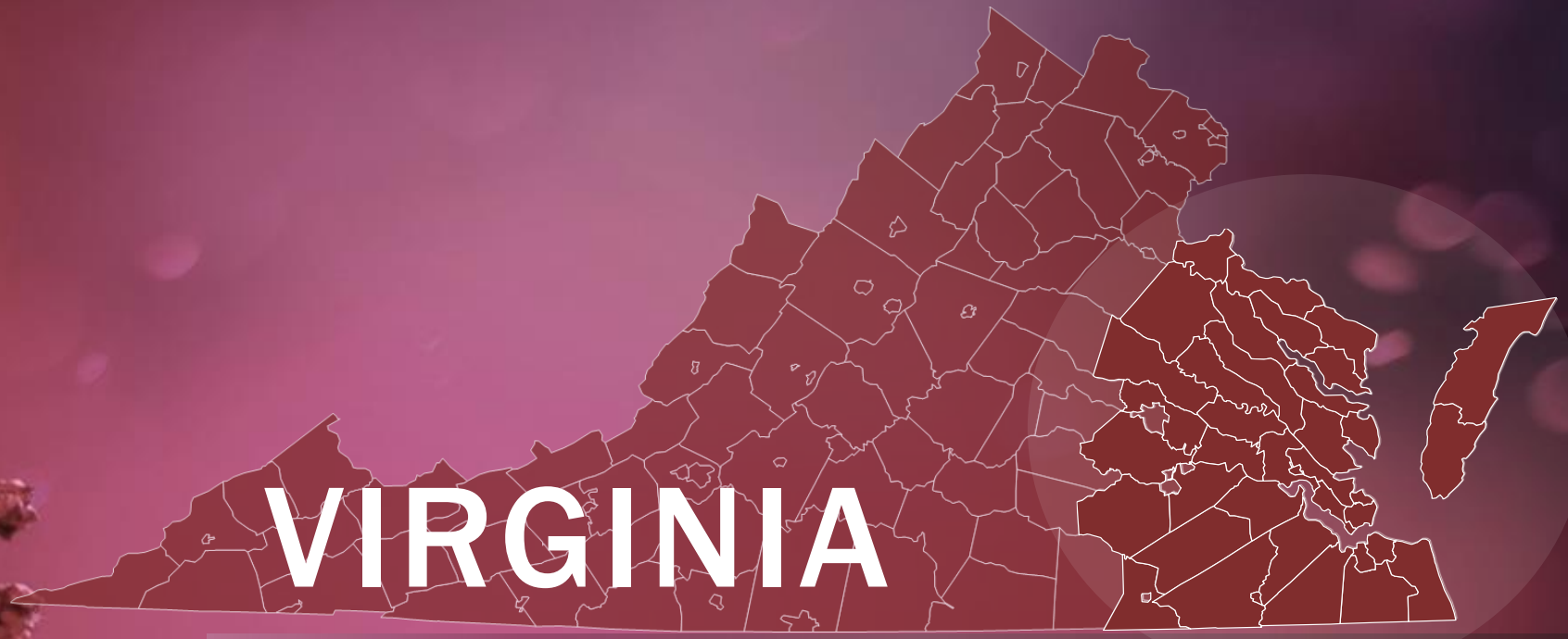




VIRGINIA

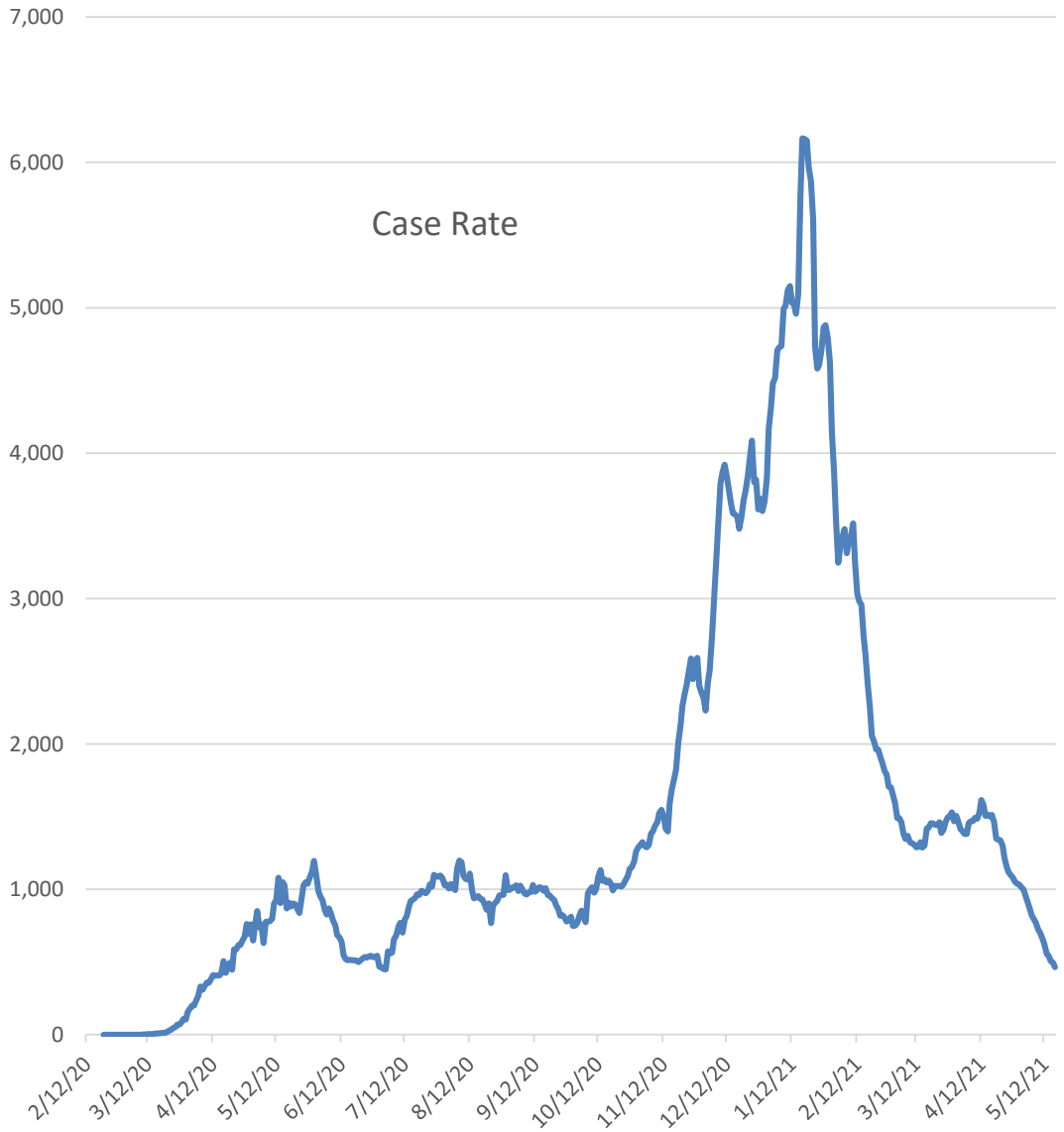
COVID-19 Update May 20th, 2021

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 464 per day (-34%)

- This is 64 percent lower than the previous low of 2021 and 61 percent below the summer highs of 2020

COVID hospitalizations have decreased to 615 (-23%)

Vaccination is continuing to increase rapidly with at least 37 percent of the population fully vaccinated (+2.1 percentage points)

- With the current trend, community immunity will not be reached before the fall

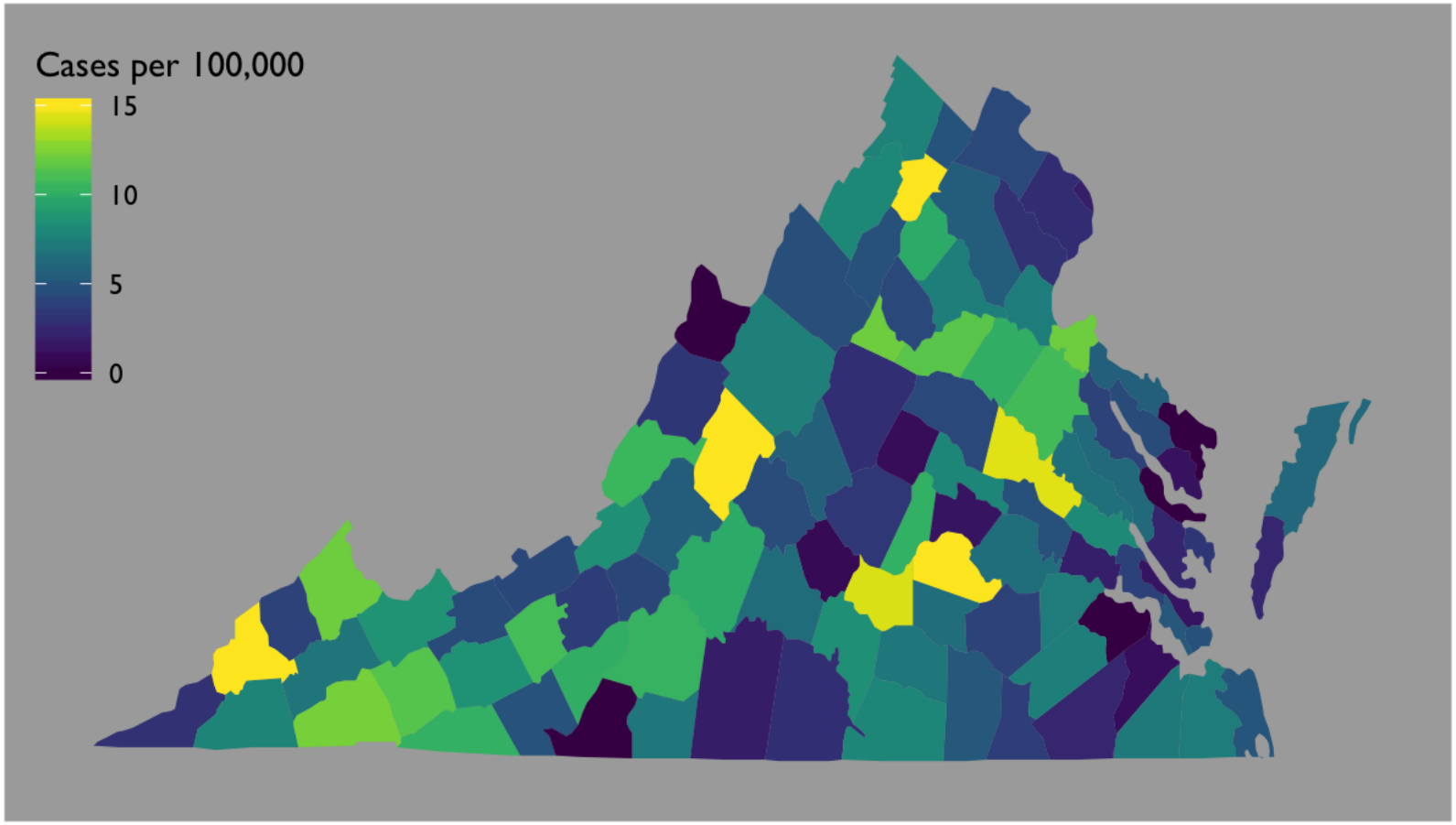
Case rates are approaching the lows of 2020, and the decline over the last few weeks may indicate that the vaccines are slowing the spread

- Virginia has been trending toward a 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 broadly declined across the Commonwealth

CASE COUNT

Source: VDH



Yellow indicates at least 15 cases per 100,000

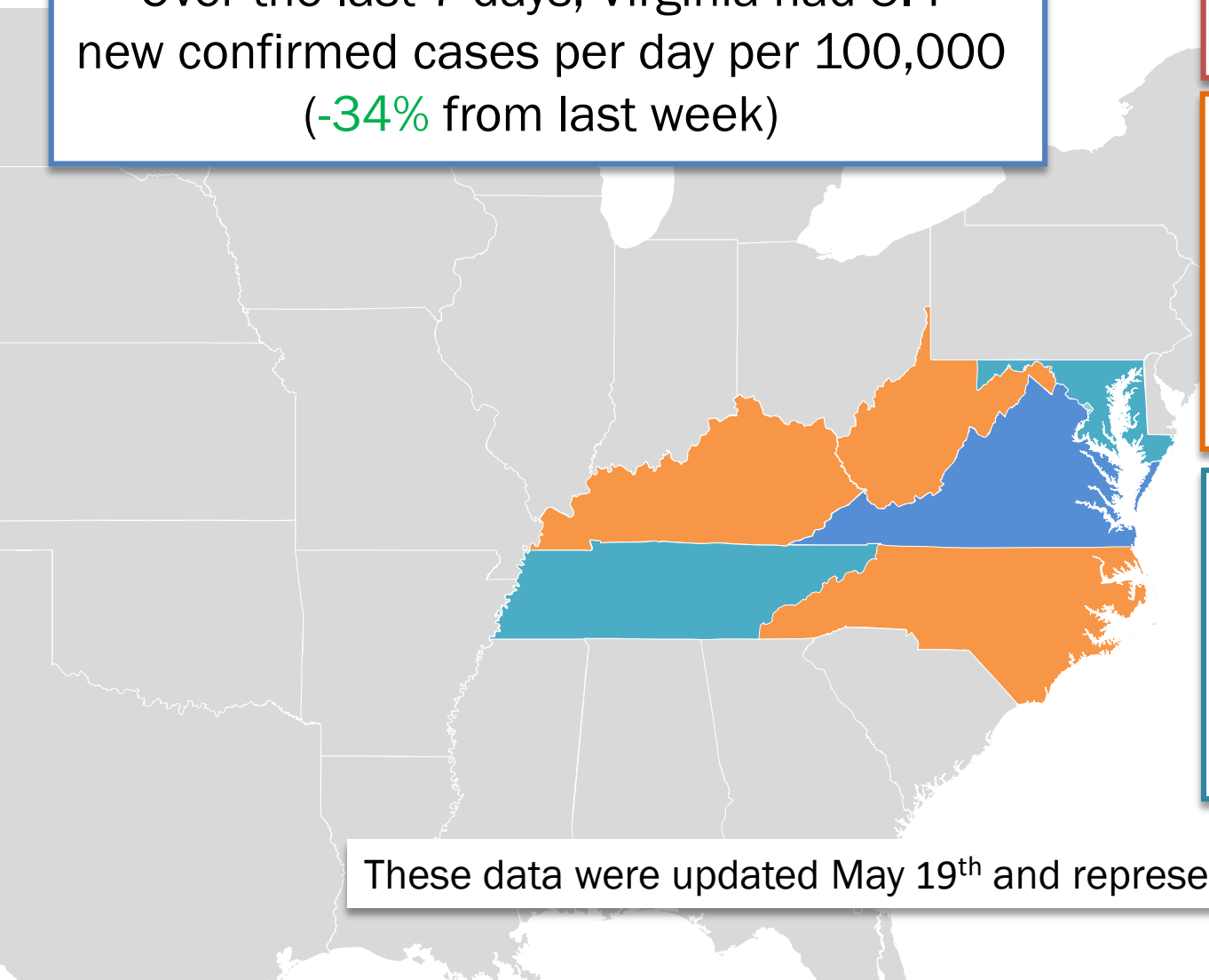
Case levels have drifted lower across the Commonwealth

- 98 percent of counties have fewer than 20 cases per 100,000 (98 percent last week)
- 78 percent of counties have fewer than 10 cases per 100,000 (71 percent last week)

These data were updated May 19th and represent a seven-day average of the previous week

Case level trends for most neighboring states were down last week

Over the last 7 days, Virginia had 5.4 new confirmed cases per day per 100,000 (-34% from last week)



Very high case loads (>20):

High case loads (10-20):

- West Virginia (16.1 new cases per 100k, -16% from last week)
- Kentucky (11.6, +2%)
- North Carolina (10.0, -28%)

Lower case loads (<10): None

- District of Columbia (8.0, +35%)
- Tennessee (7.6, -31%)
- Maryland (6.2, -31%)

These data were updated May 19th 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 lead to more reinfection

- All five variants of concern have been detected in Virginia

The CDC has projections of the current prevalence for HHS Region 3 (DE, DC, MD, PA, VA, and WV) based on genomic testing from April 11th to April 24th

- B.1.1.7 (“U.K. variant”) is estimated to be 66.1 percent of cases in the region
- P.1 (“Brazilian variant”) is estimated to be 1.7 percent of cases
- B.1.351 (“South African variant”) is estimated to be 1.0 percent of cases
- B.1.427/B.1.429 (“California variants”) are estimated to be 0.9 percent taken together

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

- B.1.526/B.1.526.1 /B.1.526.2 (“New York variants”) are estimated to total 19.6 percent
- B.1.617.1-3 (”Indian variants”) are estimated to be 0.6 percent of the cases in the region

37 percent of Virginians are fully vaccinated, and an additional 10 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	95,206	333,300	418,291	462,606	566,884	621,730	446,937	213,269	3,158,223
% Full	0.0%	8.7%	28.9%	35.7%	43.0%	50.3%	63.6%	72.8%	68.5%	37.0%
Partially Vaccinated	0	94,105	139,832	143,631	139,755	147,540	116,179	60,574	33,625	875,241
% with Partial	0.0%	8.6%	12.1%	12.2%	13.0%	13.1%	11.9%	9.9%	10.8%	10.3%
Confirmed Cases	31,797	72,907	128,566	108,415	97,427	95,420	64,865	34,806	24,802	659,005
% Confirmed Cases	3.2%	6.6%	11.1%	9.2%	9.1%	8.5%	6.6%	5.7%	8.0%	7.7%

Source: VDH, May 19th

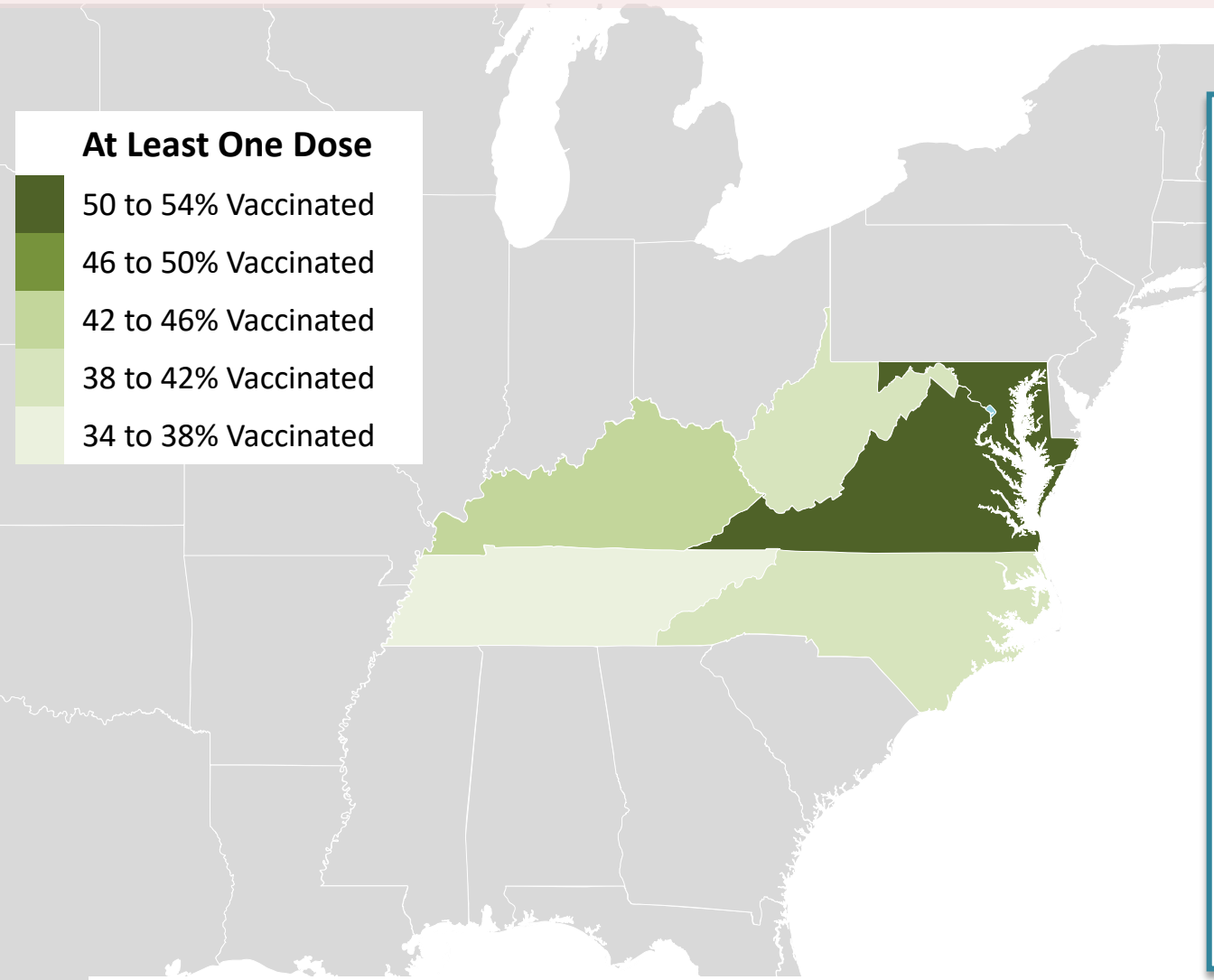
Vaccinations are slowing

- As of May 19th, 8,686,805 doses have been distributed and 7,158,336 doses have been administered
- Over the last seven days, Virginia has averaged 41,982 doses per day (-12% from last week and -45% from last month)
- At this pace, the vaccination levels needed for community immunity will not be reached before September of 2021

A Kaiser Family Foundation poll from April indicated hesitancy has declined

- There is a small but consistent portion of the population resistant to receiving a vaccine (roughly 19 percent)
- The gaps in vaccination rates and hesitancy have closed between white, Black, and Hispanic populations
- If access to vaccinations is a barrier, targeted vaccination sites with extended hours and no requirement for an appointment may be more useful than mass vaccination sites

Vaccination rates among neighboring states vary substantially



	Partially Vaccinated*	Fully Vaccinated*
Nationwide	**10.2%**	**37.5%**
D.C.	13.2%	41.1%
Kentucky	7.4%	36.4%
Maryland	10.8%	42.9%
North Carolina	7.2%	34.3%
Tennessee	7.3%	30.0%
Virginia**	**10.9%**	**40.8%**
West Virginia	5.3%	32.9%

* Total population, includes out-of-state vaccinations
**Differs from previous slide because all vaccination sources (e.g., out-of-state) are included

Source: https://covid.cdc.gov/covid-data-tracker/#vaccinations
These data were updated May 19th

We've been monitoring recent, relevant literature

Murthy et al. examined vaccination rates from December to April by urbanicity and found significant gaps between urban and rural areas

- For Virginia, the vaccination rate in urban areas was 5.9 percentage points higher than rural areas
- While most of the vaccinated people in rural counties received their vaccine in their county of residence, they disproportionately travel outside their home county to receive the vaccine
- Broader distribution could improve take up rates in rural areas

Arino et al. modeled the importation of variants to test travel control measures

- They find that quarantine and travel interruptions can delay the introduction of variants
- However, once a variant is spreading within a community, the restrictions have minimal effect on reducing the spread

Aaronson et al. tracked mask usage among 104 children 5-13 years old with autism spectrum disorders and/or attention deficit/hyperactivity disorders attending a summer day treatment program

- They found that, with monitoring, encouragement, and a reward system, 86 percent of the children wore their masks over their mouths and noses at least 75 percent of the time
- In the fall, if the pandemic status necessitates masking, this study demonstrates a protocol that can effectively encourage the proper use of face masks among children with special needs

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?
- Are there early warnings or triggers that should be monitored to help inform policy?

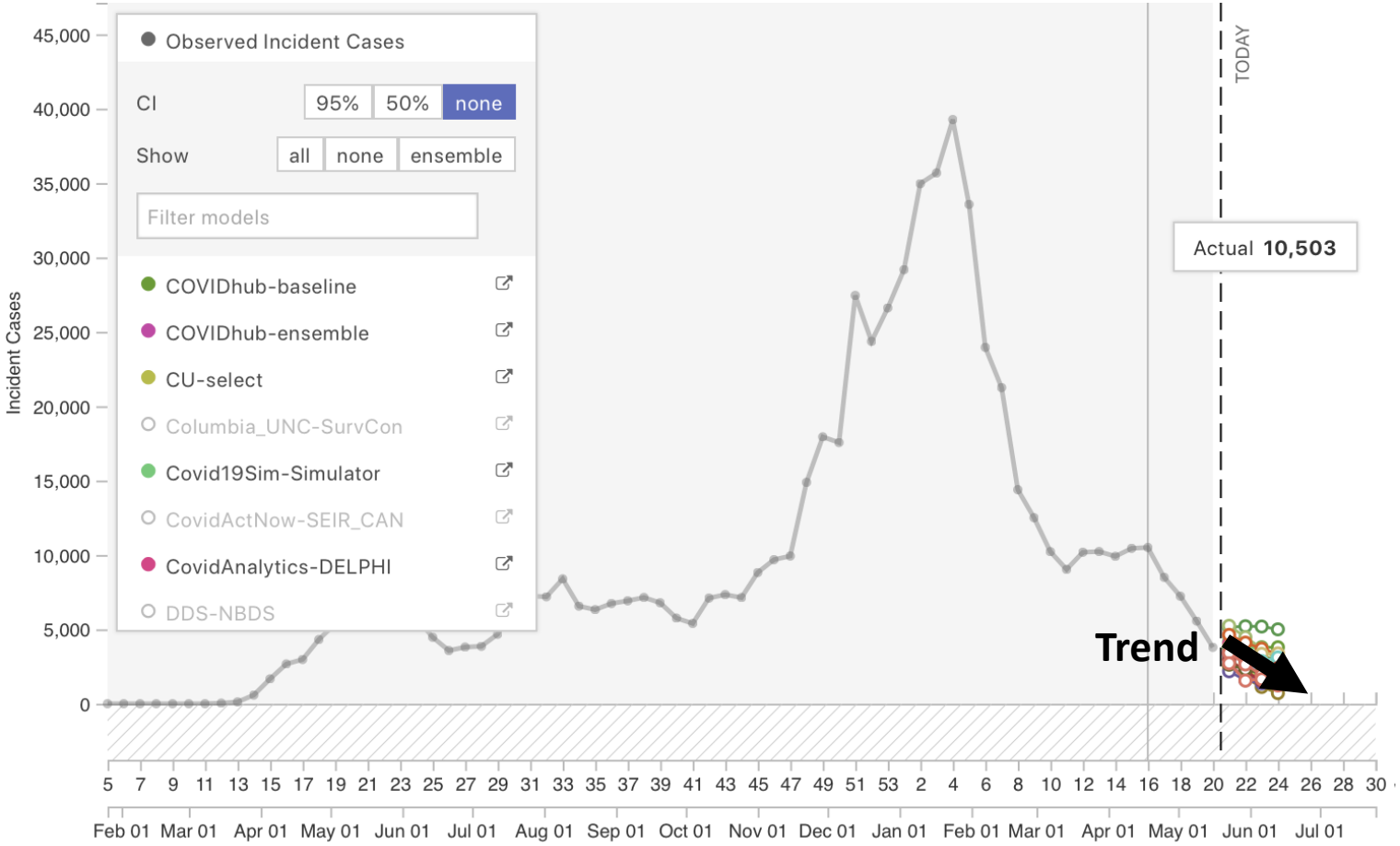
For other questions, surveillance is likely to be more useful:

- 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 model forecasts broadly agree on a sustained decline in cases



The model estimates generally forecast a substantial decrease

- With a couple of exceptions, the models broadly agree there will be a substantial decline in cases

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 May 19th

What are the tradeoffs of resuming in-person schooling?

Children have been less severely affected by COVID than older age cohorts (Zimmermann 2020; CDC 2021)

- Also likely pose low risk to the broader community – outbreaks in schools have occurred in the absence of NPIs (e.g., in Israel, see Stein-Zamir 2020), but in-school transmission generally occurs less frequently than in the surrounding community (Lessler 2021; ECDC 2020)

COVID has the potential to cause serious physical and mental consequences in children

- Multisystem inflammatory syndrome in children (MIS-C, resembling Kasawaki Disease; Ionescu 2021), myocarditis (Witz 2020), and long COVID (Ludvigsson 2020) have been reported, but are not yet well understood
- The pandemic, and school closures in particular, have been associated with increased rates of depression, anxiety, and social isolation (Krass 2021)

Vaccination for children may be possible before the new school year, but measures such as targeted testing (Moghadas 2021), vaccination of school staff, and continuation of in-school NPIs could allow in-person schooling to resume safely

- Clinical trials in children are under way; 100% efficacy with Pfizer demonstrated in children 12-15 (Mahase 2021; Callaway 2021; Pfizer 2021) and the FDA has issued an Emergency Use Authorization for its use in that population
- Greatest risk of transmission seems to be to and from staff rather than students; encouraging vaccination for school staff could be an effective strategy (Ismail 2020; Vlachos 2021)

The pandemic characteristics will change over the summer and fall

The state of the pandemic in Virginia this summer and fall will depend on vaccination take up

- The number of hospitalizations and deaths will likely not surpass last year's levels because the elderly, the most vulnerable population, have a vaccination rate near 80 percent
- The rate of take up among the 18-to-65-year-old population is not currently on track for community immunity targets to be reached by the summer
- Virginia's counties with the lowest vaccination rates generally border states with low vaccination rates
- Thus, there will continue to be a risk of community spread in the Far Southwest and among those under 30 years of age

Previous infection offers some protection, but it does not appear to be as effective as vaccination

- Several studies (e.g., Hansen, 2021 and Letizia, 2021) indicate that prior infection is about 80 percent effective in preventing future infection versus 94 percent or higher for Pfizer and Moderna (Tenforde, 2021)
- The durability of naturally acquired antibodies is not yet known, but they may wane (Hansen, 2021)
- Further, the efficacy of naturally acquired antibodies may be lower against the new variants

In this environment, there will be occasional waves of COVID cases, potentially tied to super-spreader events and seasonal changes/events (e.g., holidays or school calendars), but deaths and hospitalizations are not likely to spike

- Activities that increase vaccination take up (Bogart, 2021) make community immunity more attainable
- Decisionmakers should monitor variants that might break out of the immune protection in case a new strategy is needed
- If the durability of naturally acquired antibodies is only a few months, long-run cases could be reduced by encouraging those who have recovered from COVID to get vaccinated

There will be long-term consequences from COVID

As of May 19th, 671,325 Virginians had been diagnosed with COVID, and 55,669 had been hospitalized for it

- Based on the Mishra et al. study, we would expect 200,000 Virginians to have had neurological issues associated with their case and more than 1,100 strokes to have occurred due to COVID
- Many of these people will have lingering physical and mental health consequences from their infections
- As many as one third of cases (224,000) result in “long COVID” with a range of physical effects

Beyond those who survived COVID infections, there will be long-term repercussions from the pandemic

- 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

- Access to telemedicine could be improved by additional training for providers and family members and broadband access in rural areas (Cantor, 2021)
- Increased investment in mental health care and substance abuse programs may be necessary to meet demand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