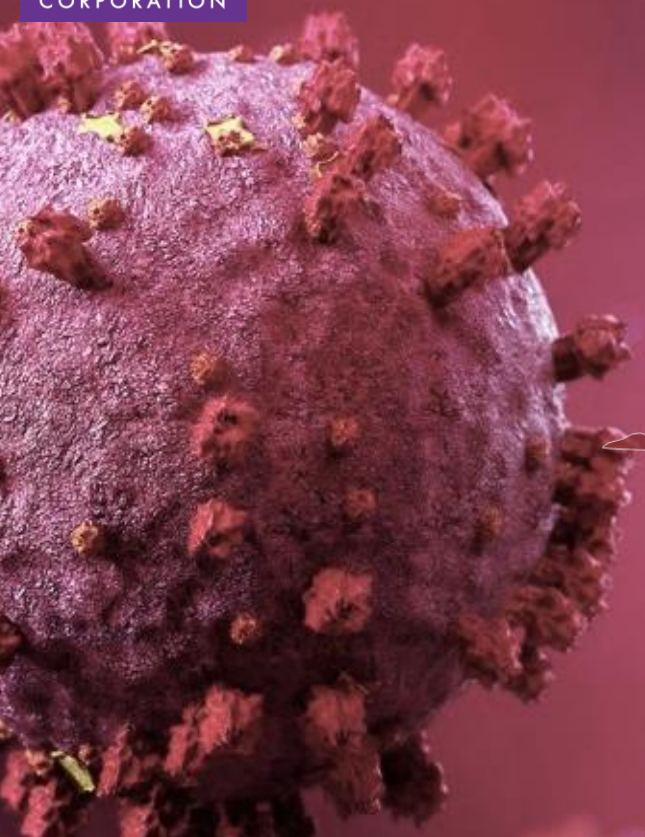


VIRGINIA

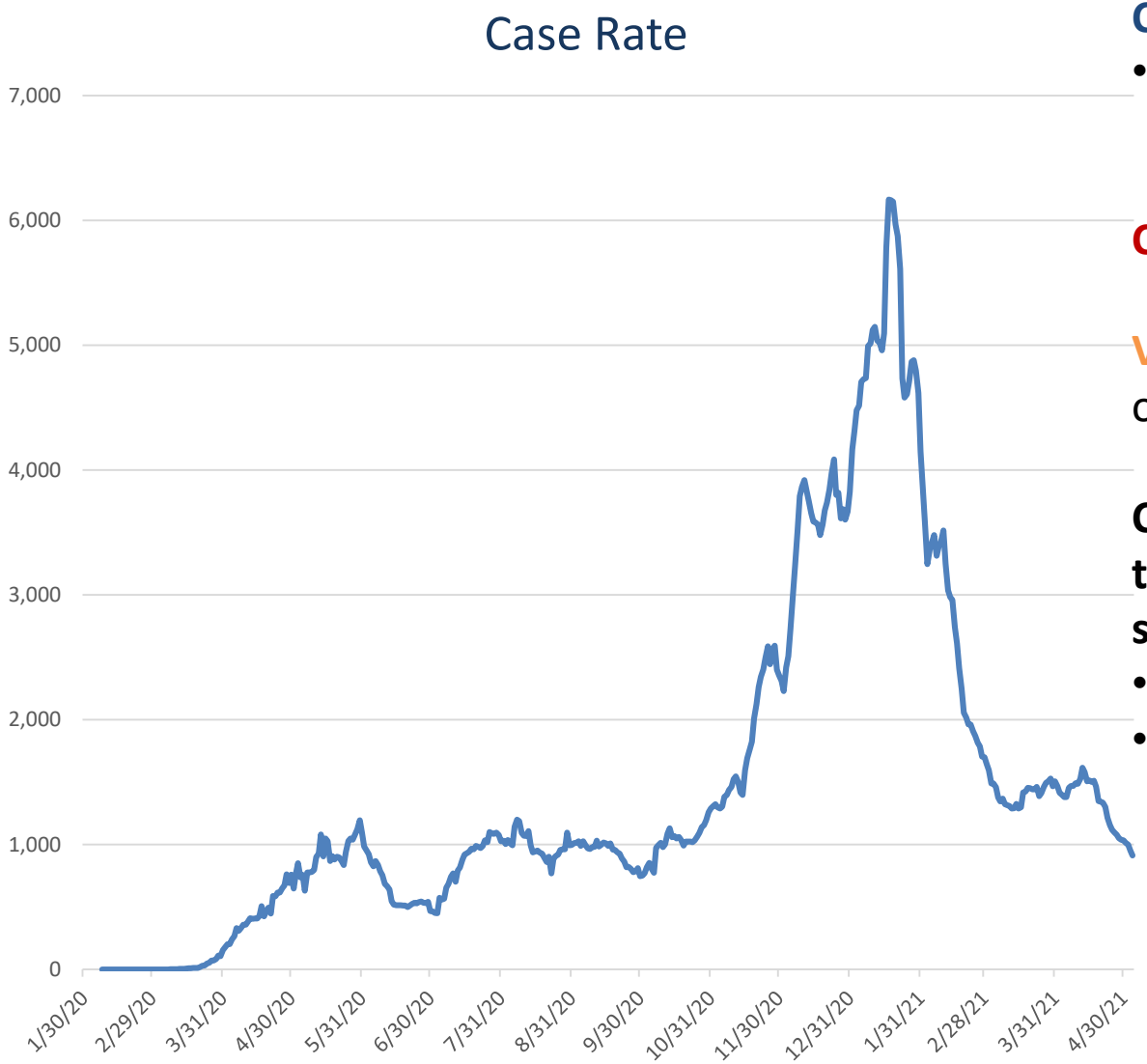
COVID-19 Update May 6th, 2021

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 912 per day (-15%)

- This is 29 percent lower than the previous low of 2021 and 24 percent below the summer highs of 2020

COVID hospitalizations have decreased to 896 (-10%)

Vaccination is continuing to increase rapidly with at least 32 percent of the population fully vaccinated (+3.2 percentage points)

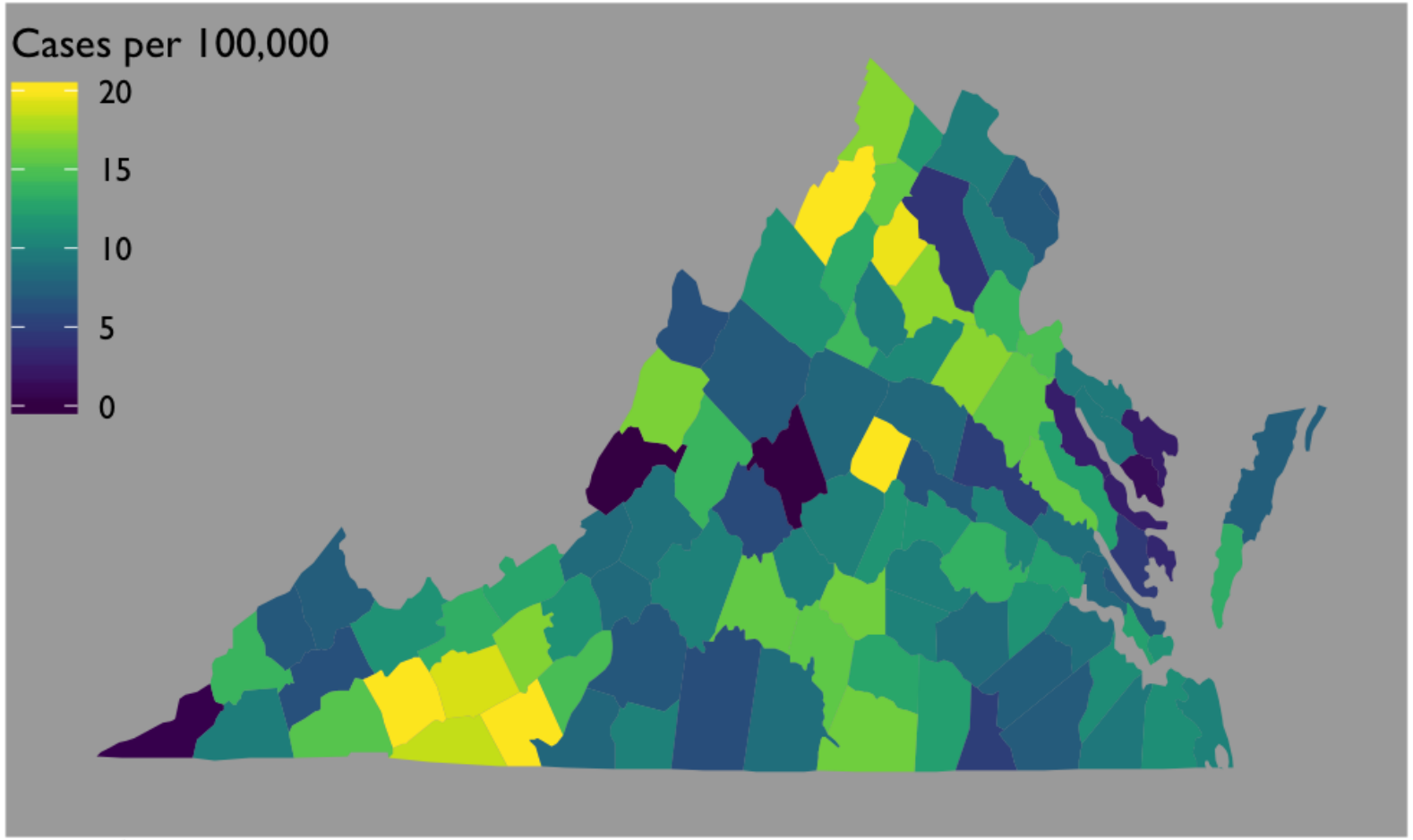
Case rates remain higher than most of 2020, but the decline over the last few weeks may indicate that the vaccines are slowing the spread

- Virginia appears to be 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 generally declined but remain high in a few counties

CASE COUNT

Source: VDH



Yellow indicates at least 20 cases per 100,000

- This range has decreased from 25 cases per 100,000 last week

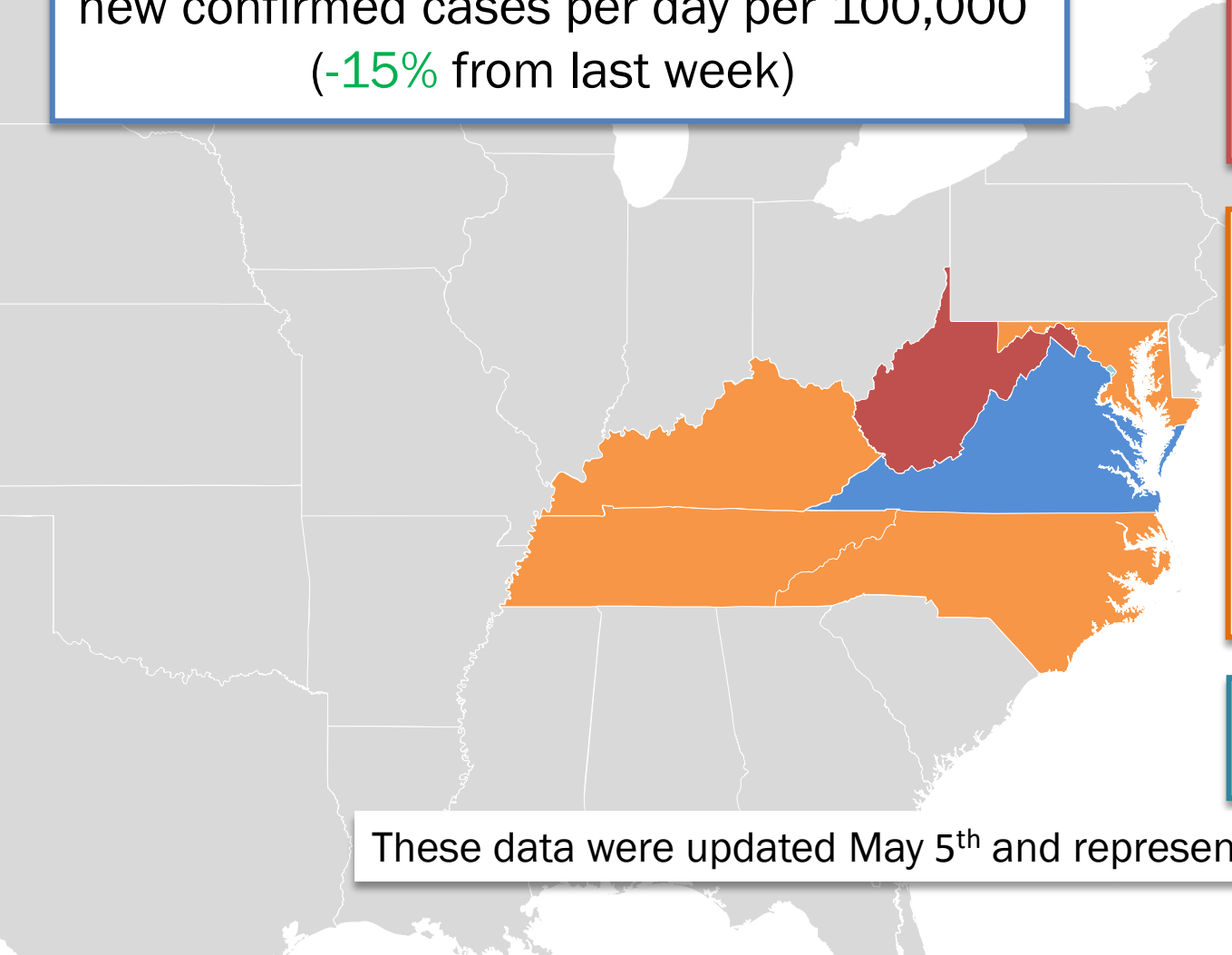
Case levels have drifted lower across the Commonwealth

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

These data were updated May 5th and represent a seven-day average of the previous week

Case level trends for neighboring states were mixed last week

Over the last 7 days, Virginia had 10.7 new confirmed cases per day per 100,000 (-15% from last week)



Very high case loads (>20):

- West Virginia (21.5 new cases per 100k, +13% from last week)

High case loads (10-20):

- North Carolina (17.7, -2%)
- Kentucky (13.9, +16%)
- Maryland (12.3, -22%)
- Tennessee (12.0, -25%)
- District of Columbia (10.4, -14%)

Lower case loads (<10): None

These data were updated May 5th 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

32 percent of Virginians are fully vaccinated, and an additional 13 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	52,772	253,180	338,749	384,094	479,893	566,622	429,525	206,119	2,710,954
% Full	0.0%	4.8%	21.9%	28.9%	35.7%	42.6%	58.0%	69.9%	66.2%	31.8%
Partially Vaccinated	0	85,370	176,235	181,124	178,949	193,986	144,040	67,191	36,410	1,063,305
% with Partial	0.0%	7.8%	15.3%	15.4%	16.6%	17.2%	14.7%	10.9%	11.7%	12.5%
Confirmed Cases	30,969	71,463	126,576	106,818	96,146	94,247	64,158	34,424	24,631	649,432
% Confirmed Cases	3.1%	6.5%	11.0%	9.1%	8.9%	8.4%	6.6%	5.6%	7.9%	7.6%

Source: VDH, May 5th

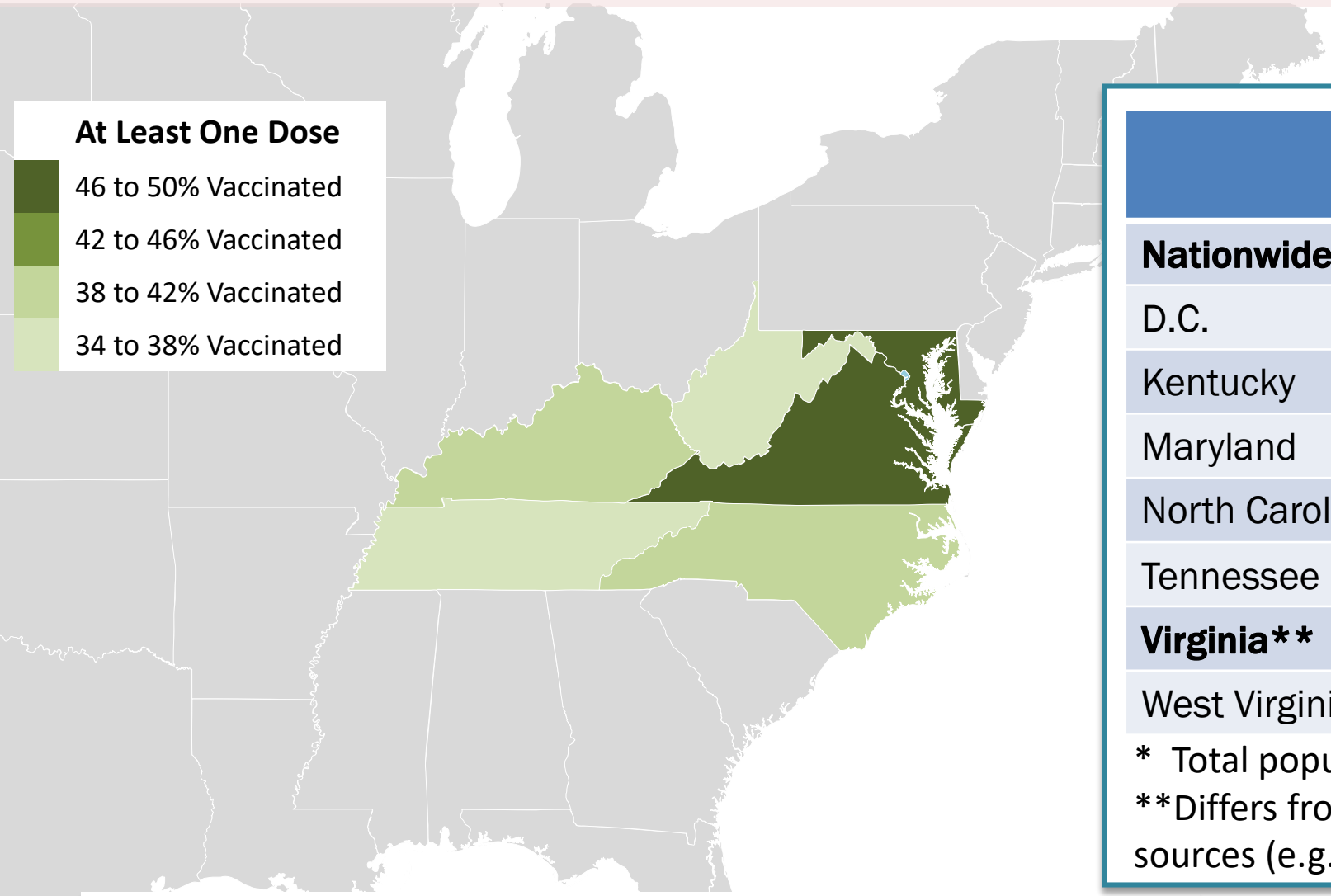
Vaccinations are being rolled out in Virginia very rapidly

- As of May 5th, 7,504,885 doses have been distributed and 6,460,376 doses have been administered
- Over the last seven days, Virginia has averaged 64,622 doses per day (-12% from last week)
- If access to vaccinations is a barrier, targeted vaccination sites may be more useful than mass vaccination sites

We may be seeing the effects of the vaccinations already

- More than 79 percent of people over the age of 70 are at least partially vaccinated
- That population only had 359 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

Vaccination rates among neighboring states vary substantially



	Partially Vaccinated*	Fully Vaccinated*
Nationwide	**12.4%**	**32.3%**
D.C.	17.7%	31.8%
Kentucky	8.7%	32.9%
Maryland	13.8%	36.1%
North Carolina	9.0%	30.9%
Tennessee	9.1%	25.8%
Virginia**	**13.4%**	**35.0%**
West Virginia	5.0%	31.0%

* 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 5th

We've been monitoring recent, relevant literature

Lima et al. applied a robust decision-making approach to help California find robust strategies to relax the nonpharmaceutical interventions (NPIs)

- The authors find that strategies that gradually relax NPIs based on vaccination milestones result in outcomes that have fewer deaths and/or days of restrictions than alternative strategies
- Alternatively, a strategy with a fixed timeline can approximate the performance of vaccination milestones strategy if the rate of vaccinations is stable

Purdy et al. reviewed 1,368 resident case logs from 16 U.S. general surgery residency programs to assess any effect on training or experience

- For March through June of 2020, general surgery resident operative volume declined by a third compared to the average for those months in 2018 and 2019 (the full year decline was about 20 percent)
- There may be a need to supplement their experience if this decline persists

Ferguson et al. looked at racial and ethnic differences in COVID cases over the three waves using Department of Veteran's Affairs electronic health record data for more than 950,000 individuals

- In the initial wave, in case rates for Black and Hispanic populations were much higher than for the white population
- In later waves, the gap between white and Black populations closed but the gap only narrowed for the Hispanic population
- There was regional variation in the race/ethnic gaps with the Western states having the highest gap between the white and Hispanic populations

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?

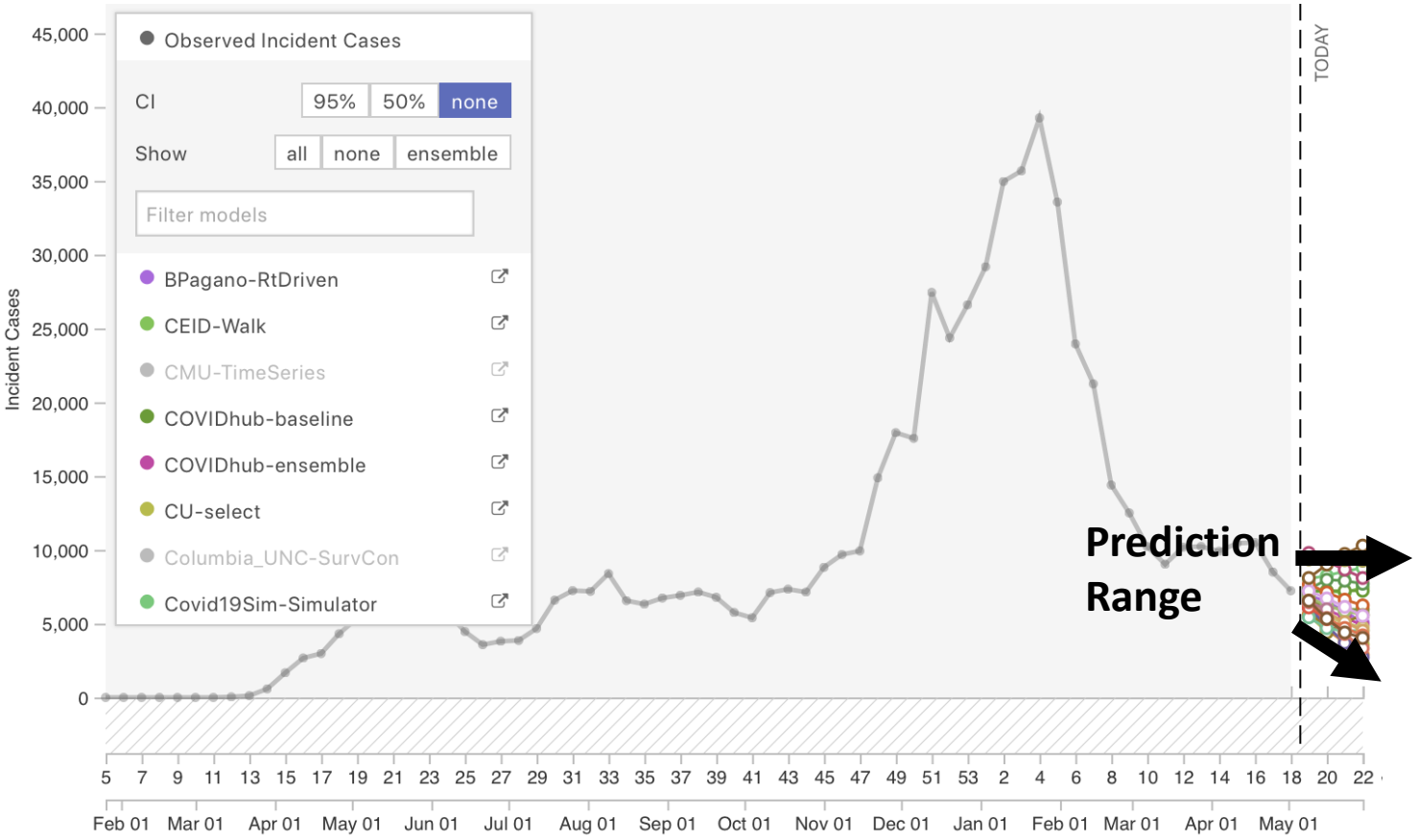
For other questions, surveillance is likely to be more useful:

- 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 model forecasts for case levels over the next few weeks range from flat to down substantially



The model estimates range from flat to substantial decrease

- 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 May 5th

What are the tradeoffs of resuming in-person schooling?

Children have historically 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 (ex. In Israel, see Stein-Zamir 2020), but in-school transmission is generally less than in the surrounding community (Lessler 2021; ECDC 2020)

However, the increased transmissibility of B.1.1.7 variant of concern could qualitatively change the nature of the spread (Day 2021; Ratmann 2021)

- Proportion of cases occurring in children in the U.S. has risen from ~3% a year ago to ~22% today (Chappell 2021)
- More research and surveillance is required to determine the degree to which the age distribution of cases is shifting due to dominance of B.1.1.7 or other factors (e.g., vaccination rates in older adults)

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 Canada has approved Pfizer for this population (the U.S. may do this soon too)
- 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)

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

- The vaccination strategy and outreach may need to evolve to maximize the take-up of the vaccine
- 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 May 5th, 663,538 Virginians had been diagnosed with COVID, and 54,882 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 217,000 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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