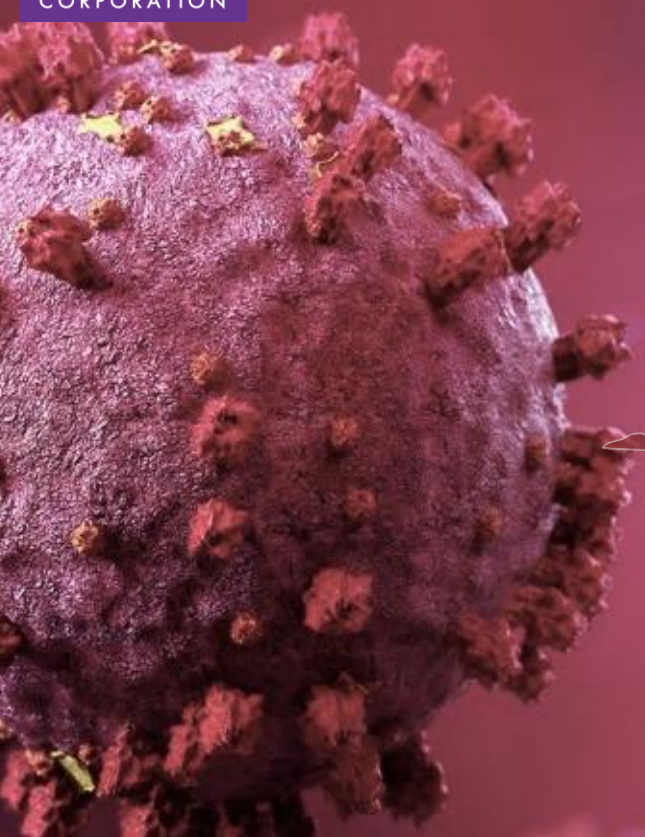

VIRGINIA

COVID-19 Update April 1st, 2021

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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 risen slightly to 1,530 per day (+6%)

- This is up 19 percent from the low two weeks ago and 28 percent from the summer highs

COVID hospitalizations have risen and are currently at 1,048 (+8%)

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

- The test positivity rate has increased from 7.5 percent last week to 8.3 percent

Vaccination is continuing to increase rapidly (+2.0 percentage points fully vaccinated and +2.1 percentage points partially vaccinated)

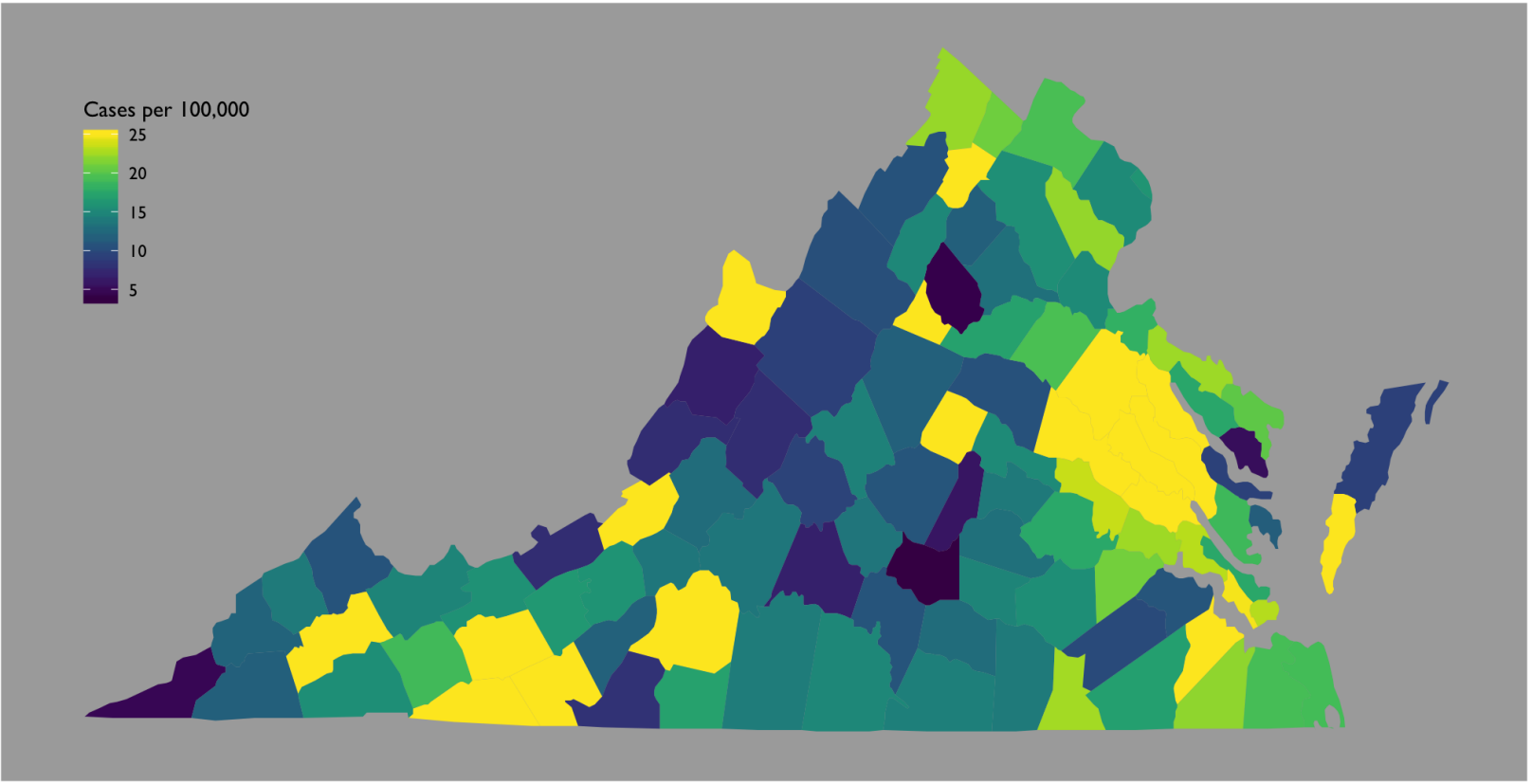
Despite growth in the share of the population vaccinated, case rates are increasing

- The variants of concern may be increasing the case numbers
- The linkage between case rates and hospitalizations may be changing as the elderly population is increasingly vaccinated

Case trends are mixed across the counties, but levels are drifting higher overall

CASE COUNT

Source: VDH



Yellow indicates at least 25 cases per 100,000

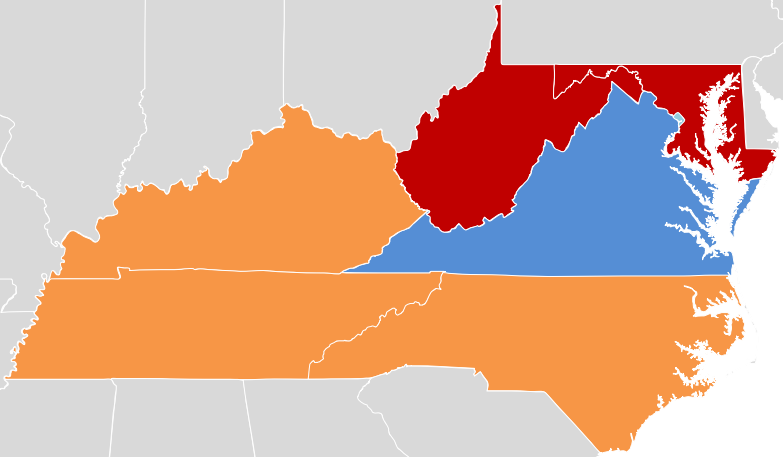
Case levels have increased across the Commonwealth

- 66 percent of counties have fewer than 20 cases per 100,000 (72 last week and 77 percent two weeks ago)
- 17 percent of counties have fewer than 10 cases per 100,000 (18 percent last week and 30 percent two weeks ago)

These data were updated March 31st and represent a seven-day average of the previous week

Trends in neighboring states' case levels are mixed

Over the last 7 days, Virginia had 17.9 new confirmed cases per day per 100,000 (+6% from last week)



Very high case loads (>20):

- West Virginia (23.1 new cases per 100k, +20% from last week)
- Maryland (20.2, +27%)

High case loads (10-20):

- District of Columbia (18.7, +22%)
- North Carolina (17.8, +10%)
- Tennessee (15.5, -17%)
- Kentucky (13.0, -11%)

Lower case loads (<10): None

These data were updated March 31st and represent a seven-day average of the previous week

Fifteen percent of Virginians are fully vaccinated, and an additional thirteen 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	8,349	95,398	137,778	157,191	189,348	281,139	289,966	153,877	1,313,046
% Full	0.0%	0.8%	8.3%	11.7%	14.6%	16.8%	28.8%	47.2%	49.4%	15.4%
Partially Vaccinated	0	22,456	105,861	145,843	167,643	223,364	257,468	148,940	65,431	1,137,006
% with Partial	0.0%	2.0%	9.2%	12.4%	15.6%	19.8%	26.4%	24.3%	21.0%	13.3%
Confirmed Cases	27,073	64,124	116,431	98,618	89,072	87,698	60,338	32,776	23,794	599,924
% Confirmed Cases	2.7%	5.8%	10.1%	8.4%	8.3%	7.8%	6.2%	5.3%	7.6%	7.0%

Source: VDH, March 31st

Vaccinations are being rolled out in Virginia

- As of March 31st, 3,987,865 doses have been distributed and 3,773,586 doses have been administered
- Over the last seven days, Virginia is averaging 65,046 doses per day

We may be seeing the effects of the vaccinations already

- More than 70 percent of people over the age of 70 are at least partially vaccinated
- That population only had 612 confirmed cases in the last week compared to 2,624 cases two months ago when only 30 percent had received at least one dose

At some point in the next month or two, vaccine supply will likely be less of a constraint, and growing the vaccination rates will rely on improving demand

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 immunity from vaccines or previous infection

- B.1.1.7 is also known as the U.K. variant and has been found in Virginia and all neighboring states
- B.1.351 ("South African variant") has been found in Virginia and most neighboring states
- P.1 ("Brazilian variant") has been found in Maryland and Tennessee but not in other neighboring states
- B.1.427/B.1.429 ("California variants") have been reported in Virginia and Maryland

Additionally, there are three variants of interest

- B.1.525/B.1.526 ("New York variants") are estimated to spread more quickly than the baseline
- P.2 is another Brazilian variant that is estimated to be similar to P.1

Testing will be key to tracking the variants

- Banada et al. produced an RT-PCR screen for a set of mutations common to the B.1.1.7, B.1.351, and P.1 variants
- Spurbeck et al. describe the successful implementation of a wastewater-based epidemiology approach to monitor viral load including a PCR approach capable of detecting the mutations of the S protein characteristic of the B.1.1.7 variant
- Similarly, Graber et al. developed an approach for estimating the prevalence of B.1.1.7 using wastewater

Contact tracing could be particularly useful in containing outbreaks of these variants when paired with better surveillance

We've been monitoring recent, relevant literature (1/2)

Chang et al. build on earlier work using mobility-data to identify places associated with the spread of COVID by developing a decision-support environment to inform policy

- The authors use cell phone mobility data and county level COVID data to identify points of interest
- These points of interest are classified and fed into a decision-support tool that allows policymakers to identify the implications of different targeted shutdown interventions

Rando et al. looked into the problems of measuring characteristics of "Long COVID"

- The lack of standardization in record-keeping related to COVID and even common definitions make studying the scope and scale of the long-term effects of COVID difficult
- The lack of information about these effects means that we do not understand what to expect for future health care demands and burdens

Vahratian et al. studied the prevalence of symptoms of anxiety and depression as well as mental health access

- Using survey data from August 2020 to February 2021, the authors found that adults with symptoms of an anxiety or depressive disorder increased from 36.4 percent to 41.5 percent
- They also noted that the share of the population with an unmet mental health care need rose from 9.2 to 11.7 percent
- Both increases were largest among adults aged 18 to 29 years and those without a high school education
- Given the potential long-term implications of these increases, policies should be considered to improve access to mental health care, particularly among vulnerable populations

We've been monitoring recent, relevant literature (2/2)

Holm Hansen et al. assessed the risk of reinfection based on PCR data from 4 million individuals in Denmark

- This population underwent 10.6 million tests over the course of two surges (one March to May and the other September to December)
- They assessed protection against repeat infection to be roughly 80 percent for the general population
- However, for the elderly, the protection was observed to be 47 percent

The American Psychological Association released the results of a survey of 3,013 U.S. adults on COVID stress

- They documented a general increase in stress across demographic groups and among young people in particular
- 61 percent of adults reported undesired weight changes during the pandemic (a median increase of 15 pounds)

The CDC released a series of papers on COVID in schools

- Verlenden et al. assessed how the well-being of children aged 5 to 12 and their parents varied based on the mode of schooling, and they found that those not in full-time, in-person school had lower mental and emotional well-being on average
- Dawson et al. studied the spread of COVID in 22 Missouri K-12 schools that implemented multiple mitigation strategies, and they found that schools with mask mandates, physical distancing, increased ventilation, and contact tracing had much lower levels of transmission than the broader community
- Hershow et al. examined the spread in 20 Utah elementary schools in December and January, and they found that the schools had high mask compliance (but 3ft instead of 6ft of spacing) and that there were only five cases of school-associated transmissions

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?

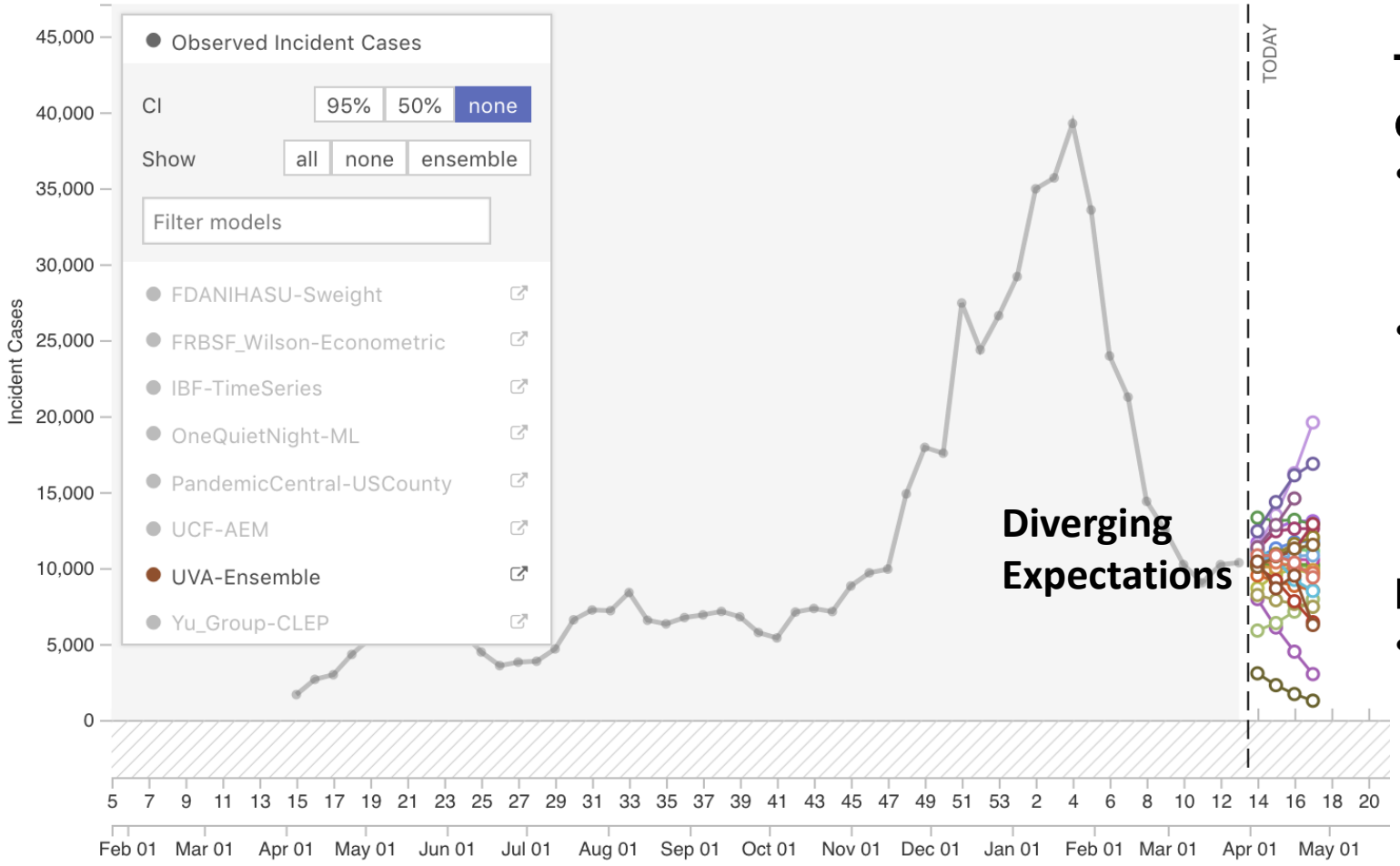
For other questions, surveillance is likely to be more useful:

- 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 are producing diverging forecasts



The models differ on whether the rates will decline, level off, or increase

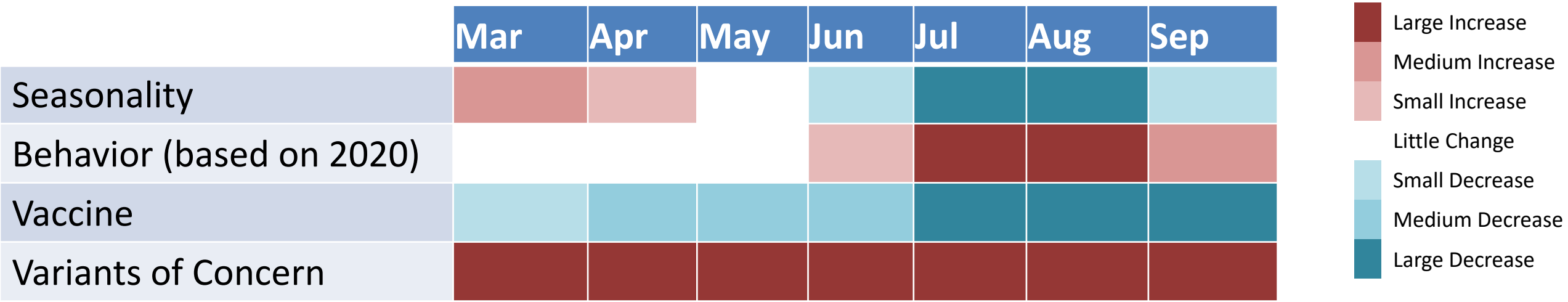
- These differences seem to be arising from different structural forms (SEIR-types predict declines, while others do not)
- It is not clear how the trade-off between the variants and vaccines is made in each model, and this will be particularly challenging for statistical models

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 March 31st

Future spread will be a race of vaccines versus variants



There are several factors that will continue to drive the spread for the next few months

- Seasonal effects for COVID-19 appear to increase/decrease spread with cooler/hotter weather
- Behavioral changes appear to have increased the rate of spread during the summer of 2020 and may have a similar effect this summer
- The vaccines may begin to meaningfully slow the spread for certain populations, but maintaining the rate of vaccine administration will require a continuation of the high acceptance rate
- The Variants of Concern may be increasing the rate of spread in Virginia, and future variants could also change the severity or the efficacy of vaccines

There are some key unknowns about the current spread

- How many people have been infected with COVID-19 and have lingering protection?
- To what degree are people complying with best practices for prevention?

Discussion and Questions