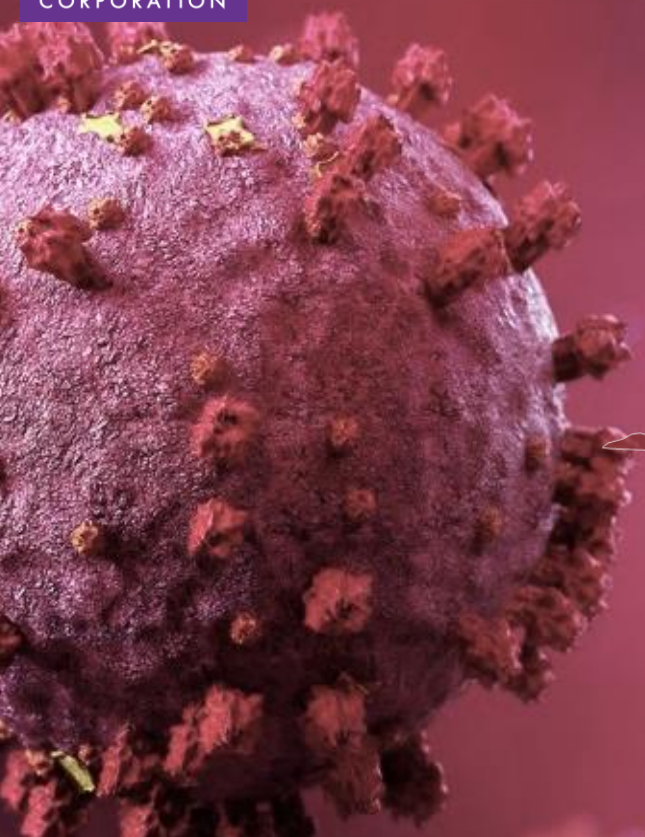


VIRGINIA

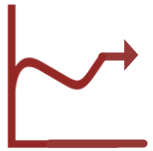
COVID-19 Update January 21st, 2021

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



Virginia's total case levels remain very high and are rising

- In particular, the Central region has seen very high growth
- Hospitalizations remain high
- Testing has plateaued

Key triggers are likely to continue to drive high case levels for the coming months

- Seasonal changes
- COVID-fatigue
- New COVID variants

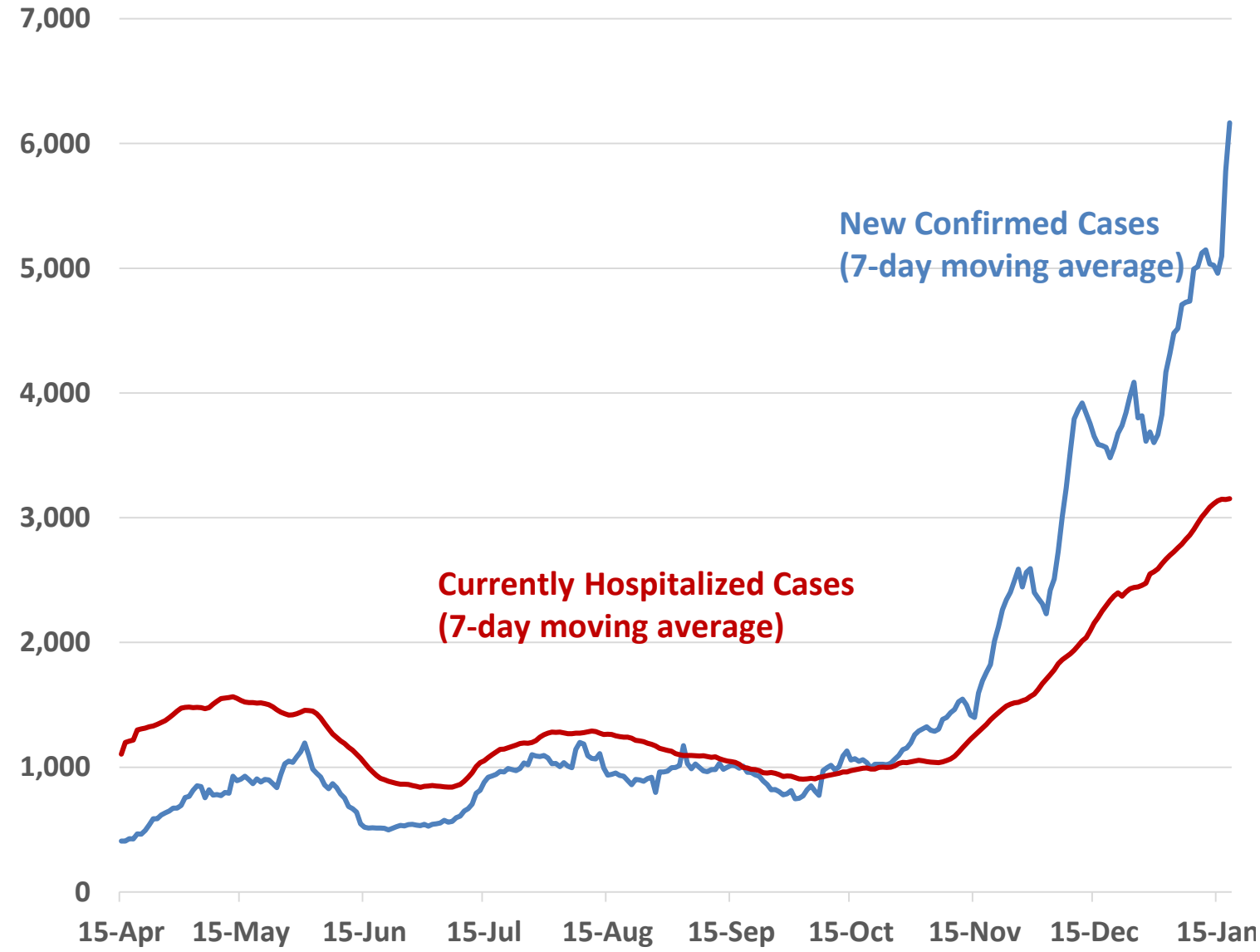
Cheaper, faster testing or a vaccine could reduce the spread upon widespread deployment

Model forecasts may be less accurate because behavior is driving growth

- Models will continue to be useful for comparing policies and exploring scenarios

Model based analysis could be very useful in informing policies related to vaccine distribution and the post-pandemic recovery

Cases remain high and hospitalization is growing rapidly

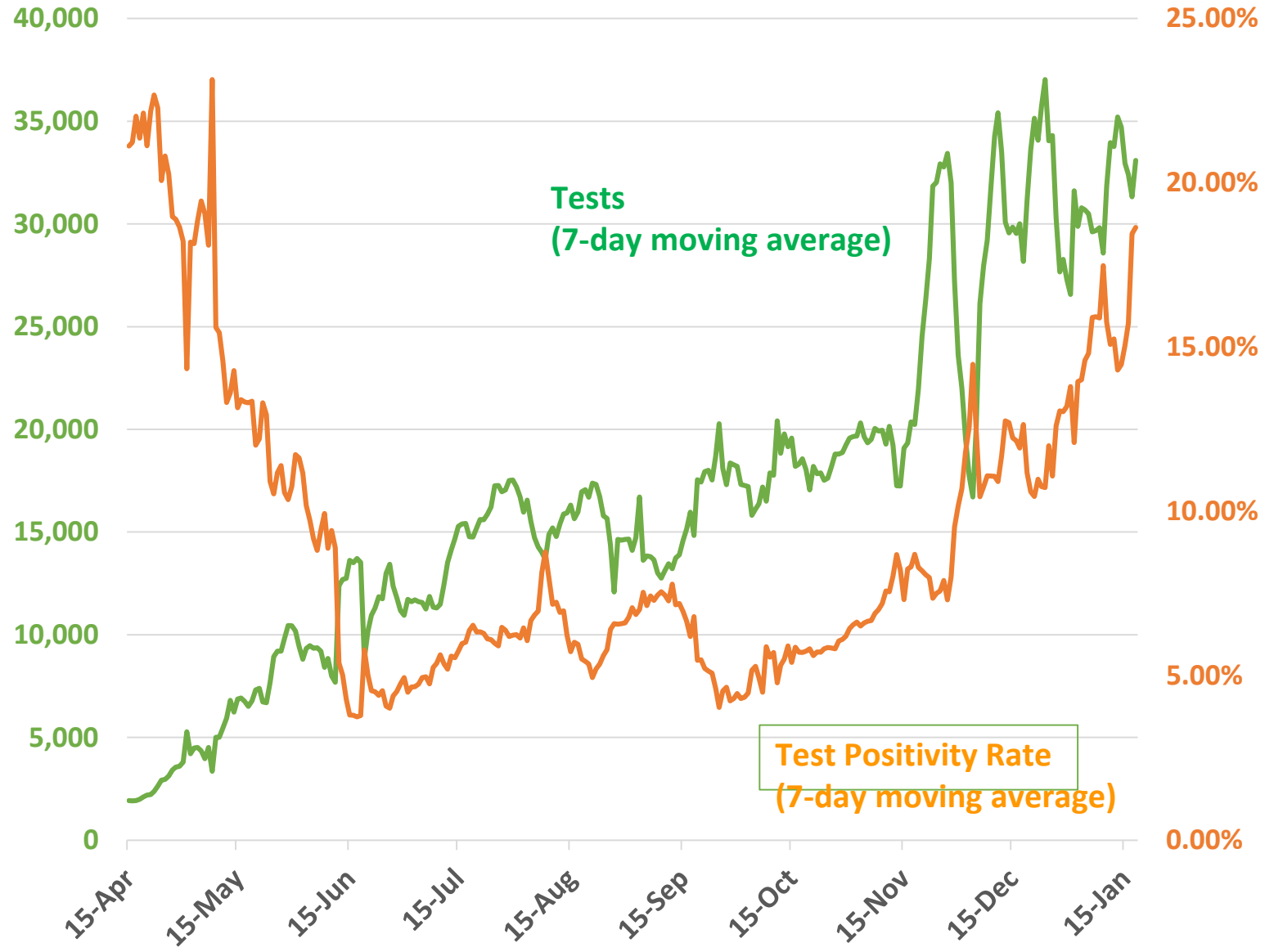


New confirmed cases are above 6,000/day on average

Currently hospitalized cases are rising

- Hospitalizations have been steadily increasing 11 percent/week since the start of November
- However, hospitalizations seem to have plateaued for the last five days at around 3,100
- The confirmed case trend indicates hospitalizations could increase by around 20 percent over the next two or three weeks

Testing remains high but is not keeping up with case growth



Tests per day have averaged around 35,000

- Testing increased substantially beginning at the end of October
- However, testing has been in the 30,000 to 35,000 range for months

The test positivity rate is roughly 18 percent

- Five percent is a suggested target
- This would require close to 120,000 tests per day
- At a rate of eighteen percent, the case count levels are likely to be slightly less reliable

Three percent of Virginians have received the first shot

Age	0-9	10--19	20-29	30-39	40-49	50-59	60-69	70-79	80+	Total
Fully Vaccinated	0	45	4,999	9,625	8,258	7,928	5,072	815	84	36,826
% Full	0.0%	0.0%	0.4%	0.8%	0.8%	0.7%	0.5%	0.1%	0.0%	0.4%
Partially Vaccinated	0	1,101	31,738	47,175	49,701	51,741	37,307	23,465	25,508	267,736
% with Partial	0.0%	0.1%	2.7%	4.0%	4.6%	4.6%	3.8%	3.8%	8.2%	3.1%
Confirmed Cases	17,947	43,787	84,864	72,529	65,549	64,238	43,992	24,636	18,410	435,952
% Confirmed Cases	1.8%	4.0%	7.4%	6.2%	6.1%	5.7%	4.5%	4.0%	5.9%	5.1%

Source: VDH, January 19th

Vaccinations are being rolled out in Virginia

- 943,400 doses have been distributed, which is enough for 471,700 people (six percent of Virginians) assuming no spoilage
- 341,388 (36 percent of the doses distributed to Virginia thus far) have been administered as of January 19th and, per FDA guidance, 36,826 have been administered the second dose (0.4 percent of Virginians)

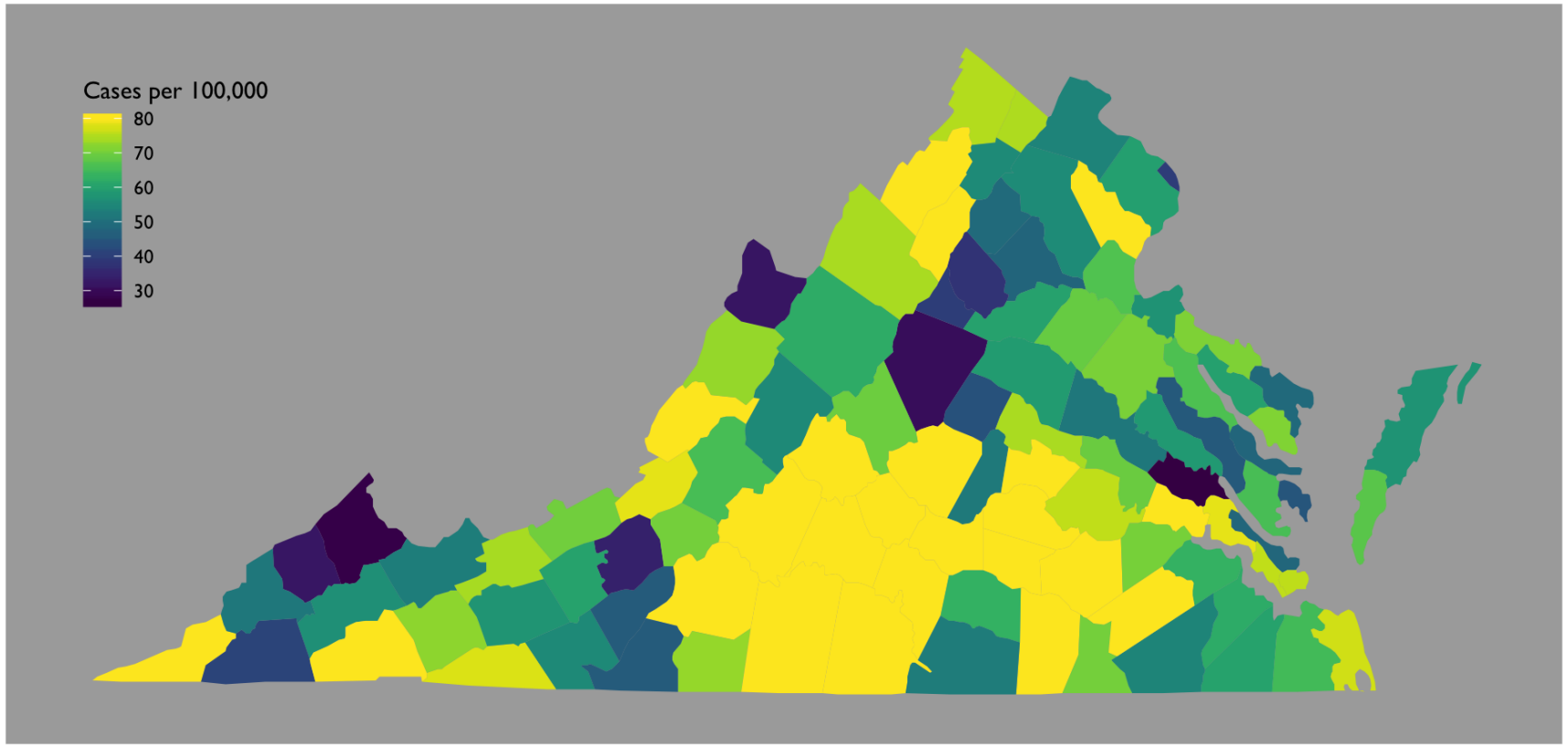
As of January 19th, there is a stockpile of 602,012 doses in Virginia

- Stockpiles have a risk of spoilage and the risk increases with time in storage
- Accelerating administration to the population will shorten the pandemic

Case levels continue to rise but are shifting to the Central and Near Southwest regions

CASE COUNT

Source: VDH



Yellow indicates at least 80 cases per 100,000

Case levels across the Commonwealth rose substantially

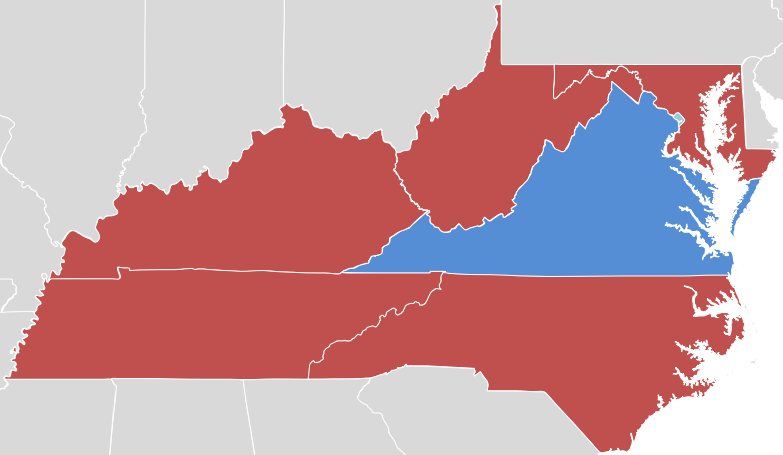
- 89 percent of counties have more than 40 cases per 100,000
- 18 percent have more than 100 cases per 100,000

Cases in the Far Southwest region have started to decline, but are rising rapidly in the Near Southwest and Central regions

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

The spread has declined in neighboring states

Over the last 7 days, Virginia had 72.2 (+20% from last week) new confirmed cases per day per 100,000



Very high case loads (>20):

- Kentucky (73.4 new cases per 100k, -14% from last week)*
- Tennessee (63.5, -33%) *
- North Carolina (62.0, -23%)*
- West Virginia (60.0, -28%)
- Maryland (43.8, -7%)
- District of Columbia (41.3, -2%)

*Test positivity rates above 10%

High case loads (10-20): None

Lower case loads (<10): None

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

We've been monitoring recent, relevant literature (1/3)

Abu-Raddad et al. followed 43,000 antibody-positive people in Qatar for up to 35 weeks

- Among their sample of antibody-positive people, they estimate the reinfection rate to be 0.66 per 10,000 person weeks (roughly 1 case per 100,000 per day)
- None of the cases were critical and most were asymptomatic and detected through routine testing
- Relatedly, Dan et al. updated their paper on the duration of the immunological response with two months of additional observations
- Dan et al. found that among 185 individuals confirmed to have had COVID-19, the immunological protection appears to last at least eight months typically

Lavine et al. model the immunological characteristics of COVID-19 to estimate the post-pandemic spread

- Based on data from other human coronaviruses, they note infection-blocking immunity is generally short-lived but that disease-reducing immunity can last a long time
- Their model finds the current strategy of behavioral containment while vaccination is occurring to be effective in reducing spread and ending the pandemic
- Once the pandemic has abated, vaccinations will need to continue indefinitely to prevent reemergence

A few papers looked at the potential longer-term consequences of the pandemic and response

- Wang et al. studied 194,904 eye exams of elementary school students before and after the in-home confinement and found a substantial increase in the share with myopia (10 to 15 percent of children)
- Using a longitudinal survey of 1,870 people, Breslau et al. found significant increases in psychological distress during the first month of the pandemic

CDC also released several short research notes (2/3)

Galloway et al. modelled the spread of the B.1.1.7 variant of concern (VOC) in the United States

- Based on the modelled trajectory, they estimate that by March this VOC will be the predominant strain
- They note that efforts to increase compliance with current policies could limit the spread of this variant and allow for vaccination to increase population-level immunity

Fuller et al. studied the implications for mortality of mitigation policies deployed by European countries for the first half of 2020

- The authors examined both the timing and the nature of the mitigation policies in 37 countries
- Stricter policies and earlier implementation resulted in less spread and lower cumulative mortality
- Earlier interventions tended to result in a lower level of initial infections and slower growth from this lower level

Prestel et al. examined an outbreak of Candida auris in a COVID-19 specialty care unit in Florida

- C. auris is a multidrug-resistant yeast that is a frequent hospital-acquired infection
- PPE shortages led to conservation strategies (e.g., extended use of an underlayer of PPE, PPE reuse, and inadequate hand hygiene) that may have facilitated more spread of C. auris

CDC also released several short research notes (3/3)

Atherstone et al. studied the likelihood of a positive test during quarantine for college athletes

- CDC partnered with the NCAA to examine retrospective data for 1,830 student athletes following a 14-day quarantine with routine testing in the summer of 2020
- For students who had not tested positive by the fifth day, 27 percent tested positive before the end of the quarantine; among those without a positive test by the 10th day, fewer than five percent tested positive before the end of the quarantine

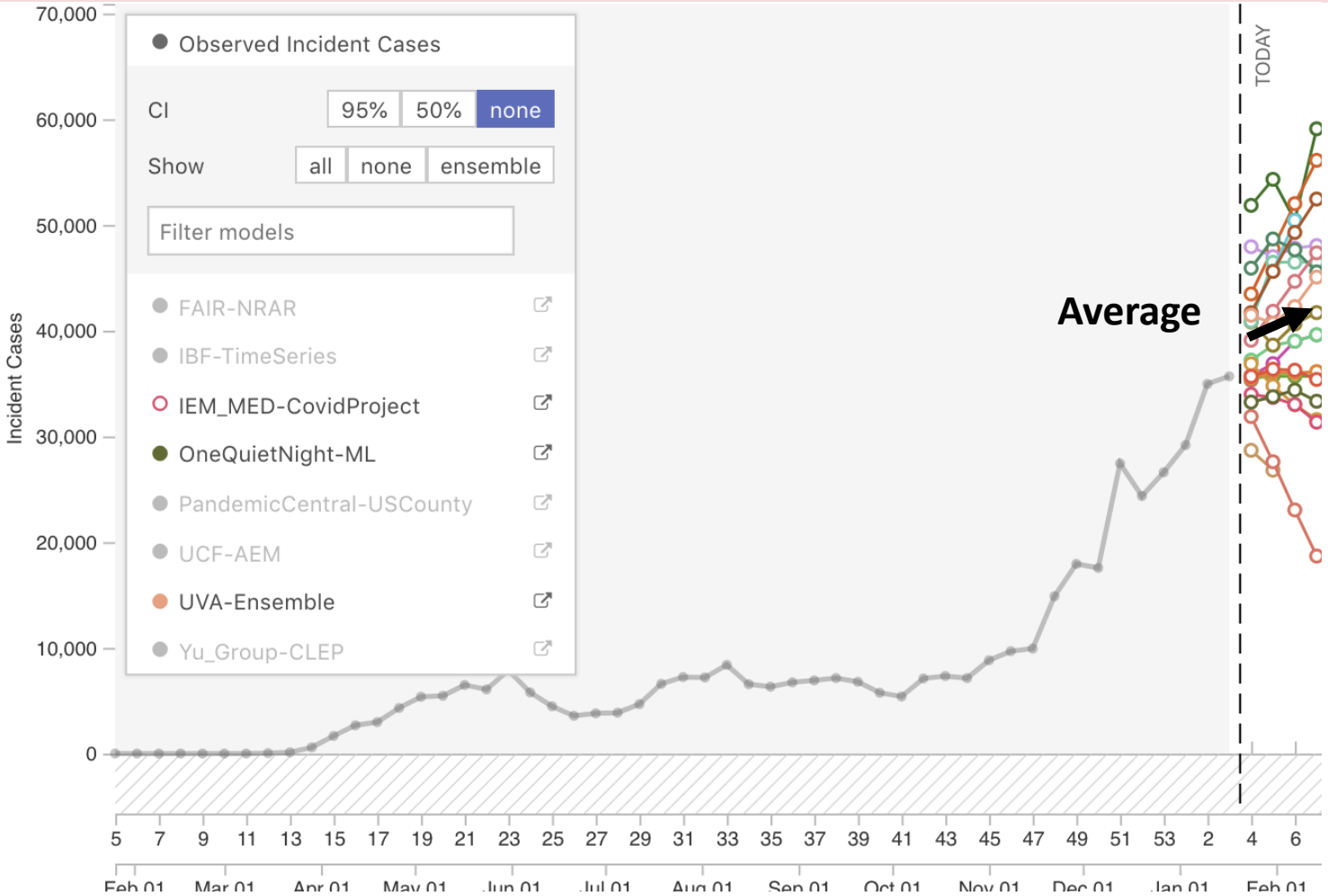
Leidner et al. compared COVID incidence from July to September for counties with large universities or colleges based on whether remote instruction was being used

- The 22 counties with large higher education institutions relying on remote instruction saw an 18 percent decline in cases and the 3,009 counties without large institutions saw a 6 percent decline in cases
- For the 79 counties containing institutions using in-person instruction, cases increased 56 percent

Vang et al. used network analysis to study the role of fraternity and sorority activities in the spread of COVID among university communities in Arkansas

- Sorority rush week began a week before fraternity rush week and included outdoor in-person activities
- Over the next two weeks, there were 965 cases associated with the university
- 72 percent of the gatherings linked to cases were associated with fraternities or sororities and women made up 70 percent of the confirmed and probable cases among students
- This implies that the sorority activities were a major source of the spread

Forecasts for cases vary but average to a small increase



Note: SEIR-type models have been cut from this figure due to poor fit
Source: COVID-19 Forecast Hub, https://viz.covid19forecasthub.org/
Accessed January 20th

There is substantial variation in the case forecasts

- The model "average" is for a small increase in the coming weeks

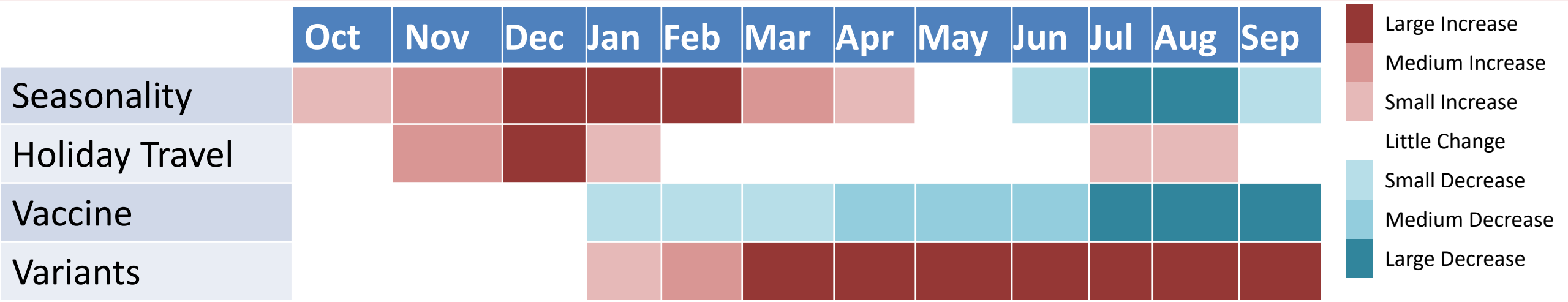
The mechanisms driving the spread at this stage are very different than in the early stage

- Initially, people did not change their behavior, so COVID spread exponentially
- Increased tele-work, changing weather, the return of in-person instruction, and other factors changed the pattern of spread
- These new patterns require the models to evolve

These models don't typically account for events such as Thanksgiving, Christmas, or New Year's and the related changes to behavior patterns

- Many models are not accounting for disruptions in testing data

There are several triggers that could lead to increased spread



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

- Seasonal effects for COVID-19 appear to be driving spread as it gets colder
- Holiday activities appear to have increased spread but are largely over for now
- The vaccines are becoming available but are not being delivered in quantities sufficient to meaningfully reduce the spread for now
- The B.1.1.7 Variant of Concern may increase the rate of spread as it enters Virginia and future variants could also change the severity or the efficacy of vaccines

There are likely to be long-term repercussions that need planning and preparation to mitigate

- Several studies have documented long term negative health effects associated with COVID

Discussion and Questions