Arkansas Public Health Pandemic Working Group  
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COVID-19 Forecasts, Projections, and Impact Assessments

The University of Arkansas for Medical Sciences’ (UAMS) Fay W. Boozman College of Public Health (COPH) faculty conducted five types of assessments for this month’s report: 1) a look at the pandemic in Arkansas from a longer-term perspective; 2) forecasts and projections of cases and maps of community spread; 3) forecast models of hospitalizations; 4) forecast model of COVID-19 deaths; and 5) status of COVID-19 vaccinations.

All forecasts and projections were developed using COVID-19 data from the Arkansas Department of Health through Dec. 12.

Summary points are:

- The models are forecasting an increase in new daily COVID-19 cases in the state — forecast to increase from 766 cases on Dec. 14 to 815 on Dec. 27.
- The 15-day models continue to show Arkansans between ages 35 and 59 will have the highest number of COVID-19 diagnoses — forecast to increase by 4,523 cumulative cases by Dec. 27.
- The highest relative growth in COVID-19 cases will be in children 17 and younger — forecast to increase nearly 3% by Dec. 27, adding 2,673 cumulative cases.
- The model forecasts an increase in daily hospitalizations over the next 15 days, from 39 to 46 new daily admissions.
- The 15-day model is forecasting an average of five COVID-19 deaths per day for the next two weeks.
- All counties in Arkansas continue to have low vaccination rates compared to the national average.
The models are showing we should expect COVID-19 cases, hospitalizations, and deaths to continue to slowly increase through Dec. 27. Models are based on past data, and do not account for increases or decreases occurring most recently. When viewing the figures in the report, what is important to focus on is the trends, not the numbers. Increases must be taken in light of patterns over the last few months. As shown in Figure A, cases have increased 46% during the last month compared to the previous month. The highest increase in cases was in adults 56 to 65, increasing by 48%. Almost all other age groups increased by more than one third. This is demonstrated by an increase in the average daily cases from 452 to 661. Only cases in children 17 and younger showed a modest increase in cases of 17%.

Similarly, hospitalizations increased by 19% in the last month over the previous month, as shown in Figure B. Hospitalizations decreased in children 17 and younger by more than a quarter and by 16% in adults 36 to 45. There was a modest 5% increase in hospitalizations in young adults 19 to 25. However, there were significant increases in hospitalizations, in adults 26 to 35, 56 to 65, and 66 and older. The reasons for the percentage decreases in hospitalizations in two age groups is unclear.

We should expect increasing numbers of COVID-19 cases, hospitalizations, and deaths, mostly because of increases in infections with the Delta variant and, quite possibly, the new Omicron variant. Studies show Omicron infections are doubling in the United States every two days. As of Dec. 19, Omicron infections have been detected in all but four states, including Arkansas. Given what we know about Omicron’s infectiousness, it is only a matter of time before it becomes the dominant COVID-19 strain in the state. This poses considerable risk to Arkansas’ hospital system. Because of its properties, Omicron has the potential to create a significant crisis for the state’s hospital and
emergency response systems. It also has the potential to have a significant impact on Arkansas’ economy.

Omicron is more infectious than Delta, suggesting a greater number of people could be infected much more quickly. The variant is believed to be better able to evade immunity, both natural and vaccine induced. Indeed, some research is suggesting those who have been vaccinated and boosted are the only ones who will have adequate immunity. Furthermore, new research suggests Omicron causes disease as serious Delta. As noted in an article published Dec. 15 in the Houston Chronicle, “[E]ven if omicron proves milder on the whole than delta, it may disarm some of the lifesaving tools available and put immune-compromised and elderly people at particular risk. And if it’s more transmissible, more infections overall raise the risk of more serious ones.”

![Graph showing the circulation of COVID-19 variants](image)

Once Omicron arrives in Arkansas, we should expect a pandemic of dual COVID-19 variants, Delta and Omicron. As shown in the figure above from the New York Times (Dec. 15), successive waves of COVID-19 variants have circulated throughout the United States over the last year. Variants that prove to be the most successful over time become the dominant variant and less successful variants die out. But, before a variant achieves dominance, it circulates through the population with other variants. As shown in the figure, Delta circulated in the U.S. with the Alpha, Iota, Gamma, Beta, and Mu variants. When Delta became dominant, the other variants died out.

What should Arkansas expect during the next month? We have often used the United Kingdom as a bellwether for Arkansas. Omicron is now the dominant strain in the U.K. COVID-19 have reached record levels of infections and hospitalizations in that country. If the bellwether proves good, we should expect another substantial surge in the state beginning in mid-January or early February driven by both the Delta and Omicron variants. As Omicron becomes dominant, hospitalizations will begin to surge, as well, perhaps beyond levels we have previously seen. The question is, can we avoid the next surge? Perhaps, but the prospects are not good. All COVID-19 immunity, whether natural or due to vaccination, wanes over time. Therefore, boosters are extremely important to increase immunity and may be the only way to avoid infection or serious disease on a population level. Getting vaccinated is crucial or those not vaccinated. For those vaccinated, getting boosted is essential. It may also become necessary for governments, businesses, and other places where people gather to implement face mask and social distancing mandates.
Arkansas will soon surpass the 10,000 COVID-19 deaths threshold, and 30,000 Arkansans soon will have been sufficiently ill with a COVID infection to have been hospitalized. Many of those 30,000 are suffering the effects of long-term COVID. The serious consequences of COVID-19 are preventable. To not be vaccinated or, if vaccinated, boosted is to play Russian roulette with this deadly virus.
The COVID-19 Pandemic in Arkansas

In April 2021, the statewide face mask mandate expired, and the state entered a new phase of the pandemic. Figure 1 shows the seven-day rolling average of new infections since March 2020. Daily numbers are often considered too “noisy” to accurately reflect an epidemic’s growth. To address this noise, we use a rolling average to smooth out meaningless daily differences in infections.

What is easily discernible from data plotted in Figure 1 is new COVID-19 cases increased over time until early January. February 2021 was the first month in Arkansas in which there was a consistent decline in new COVID-19 cases. The curve flattened during March, when the state averaged around 380 new infections per day. The seven-day rolling average of daily infections remained essentially flat in April (172), May (192), and June (227). However, by July new daily cases increased dramatically to over 1,000. In September, daily average cases spiked to 1,500, strongly indicating the state was experiencing a second COVID-19 surge. In October, daily average cases dropped as low as 595, and to approximately 509 in November. We have seen a a roughly 50% increase in average daily cases during the first two weeks of December. The seven-day rolling average of new COVID-19 cases in December has been 759.

Figure 2a shows the COVID-19 testing rate per 1,000 persons in Arkansas. Since September, the testing rate has significantly declined. On Dec. 7, the state performed 2.8 tests per 1,000 persons, which was lower than the national average of 6.7. Without regular, widespread testing, which is the best data for estimating the spread of disease in a population, forecasting future cases, hospitalizations, and deaths is difficult. The COVID-19 positivity rate is an indicator of viral transmission. Broadly defined, the positivity rate is the number of people who test positive for COVID-19 as a proportion of the number of people tested. A higher positivity rate is indicative of higher transmission relative to the number of tests. A higher state positivity rate and relatively low testing level raises serious concerns about our ability to know the “true” number of COVID-19 cases in the state.
Figure 2b shows the seven-day moving average of the positivity rates for Arkansas and the United States. The positivity rates in Arkansas and the U.S. have declined in recent weeks, both falling below 10%. Since the last report, the state’s positivity rate has increased to 8.2%, which is above the national average of 5.3%. However, both the per capita testing rate and the positivity rate should be considered in light of no active surveillance either statewide or nationally. With the new Omicron strain, it remains to be seen whether positivity rates will increase in coming days both at state and national levels.
COVID-19 cases are infections identified using a PCR test. Probable cases are diagnosed using an antigen test. Results of antigen tests have been reported by the ADH since Sept. 2, 2020. ADH continues to distinguish between confirmed and probable cases, but they are combined for this report. Throughout the report, confirmed and probable cases are “cases.” For this report, we used data from Sept. 1 to ensure more stable models.

**15-day forecasts of COVID-19 cases in Arkansas.** New daily cases for the period Dec. 13-27 are shown in Figure 3a. Estimates are realized rates. As shown in the figure, the model is forecasting a slight incline in new daily cases from 766 on Dec. 14 to 815 new cases on Dec. 27.

Figure 3b shows the forecast of cumulative COVID-19 cases through Dec. 27. The 15-day forecast shows Arkansas will reach a cumulative caseload of 548,019 cases.

**Forecasts by age.** As shown in Figure 4a on the next page, the forecast of cumulative cases across age groups will increase for every group. As shown in the figure, there are variations in the growth of cases across age groups. The age group with the highest forecast cases will continue to be those 35 to 59. This age group will add about 4,523 new cases by Dec. 27, or an average of 301 cases per day. The group with the second highest number of cases will be young adults age 18 to 34, adding 3,636 new cases by Dec. 27. This is an average of 243 cases per day.

Children 17 and under, although third in terms of absolute numbers, will show continued high growth in cases. The model forecasts around 2,673 new cases in children through Dec. 27, averaging 178 cases per day.
Figure 4b shows new daily cases in children 17 or younger as a percent of the total new daily cases. The growth in the percentage of cases among children beginning in late August has somewhat declined throughout November and early December.

**Relative change in COVID-19 cases by county.** Map 1 on the next page, shows the relative change in COVID-19 cases across Arkansas counties in the two weeks before the report. Relative change is calculated as the percent change between cases during the most recent two-week period (Nov. 29-Dec. 12) compared to cases from the prior two weeks (Nov. 15-28).

During the past two weeks, the relative change in cases is showing a more definite pattern across the state’s counties. Eleven counties showed relative increases above 50%, compared to none in October and five in November. Twelve counties showed relative increase over 100%, with the largest increase at 270% in Ashley County. Thirteen counties had relative decreases, compared to 44 in November, 67 in October, 53 in September, and 20 in August.

As shown on Map 2, on the next page, all counties in Arkansas had elevated COVID-19 cases per 10,000 population between Nov. 29 and Dec. 12. Per capita case rates ranged from two to 83 cases per 10,000 persons, with seven counties having case rates above 50. This is much different compared to county case rates in September, when only two counties had per capita case rates greater than 30 per 10,000.

**Summary.** The 15-day models are forecasting increasing COVID-19 cases in December. Daily cases appear to increase at high levels, between 760 and 815 new cases per day. The high rate of daily cases suggest a third wave is possible. Just under half of Arkansans are fully vaccinated, with vaccination rates lowest among those 17 and younger. Even with an optimistic rate of natural immunity, more than 1 million Arkansans are still at risk for infection.
There has been a clear shift in the pandemic toward younger adults and children. The number of cases in children is showing a continual increase, which is unlikely to decline in the next month. The approval of vaccines for children last month should have an impact on the number of cases in children, if parents are willing to have their children vaccinated. The highest number of new cases will continue to be in adults 34 and 59. However, cases in all age groups are forecast to increase through Dec. 27.

There have been widespread increases in COVID-19 cases in the past two weeks. Some counties in the state continue to show increasing relative growth in cases, as high as 285%, nearly triple the growth rates reported in last month’s report.
COVID-19 Hospitalizations

15-day forecasts of hospitalizations. Figure 5a shows the realized rate of new hospitalizations in Arkansas between Dec. 13-27. As is easily discernible from the figure, there is a relatively constant daily increase of around 40 new hospitalizations, increasing slightly over the next 15 days from 39 new daily patients on Dec. 14 to 46 on Dec. 27.

The 15-day forecast for cumulative COVID hospitalizations is shown in Figure 5b. The model forecasts a total of 29,576 cumulative hospitalizations by Dec. 27, an increase of about 709 patients.

Figure 6 shows the 15-day forecast of hospitalizations by age group through Dec. 27. As is evident, hospitalizations in all age groups continue to increase. The age group with the most hospitalizations continues to be adults 35 to 59. However, a large proportion of patients will be adults 60 to 74. The model forecasts this group will add 288 new patients by Dec. 27.

Summary. Hospitalizations will continue to increase during the next month, and there will be significant numbers of patients in each age group. The models forecast the greatest number of hospitalizations due to COVID-19 will be adults 35 to 59 followed by adults 60 to 74.

We also expect greater numbers of young adults 18 to 34 and children under 17 to be hospitalized. Actual numbers of young adult and pediatric patients will remain fairly low. The model forecasts 23 new pediatric patients by Dec. 27.
**COVID-19 Deaths**

**15-day forecast of COVID-19 deaths.** Figure 7a shows the realized rate of new COVID-19 deaths in Arkansas from Dec. 13-27. The model forecast four to six deaths per day through Dec. 27. 

Figure 7b shows the 15-day model forecast 8,847 cumulative deaths in Arkansas due to COVID-19 by Dec. 27. The model is forecasting 70 new COVID-19 deaths over the 15-day forecast.

**Summary.** The number of daily deaths from COVID-19 appears to be relatively stable at five deaths per day. Deaths lag both cases and hospitalizations, which suggests the number of deaths should begin to increase more rapidly, if the trend in cases and hospitalizations continues to increase.

The models forecasting daily and cumulative deaths are lagging behind the growing death count in the state, and illustrates the challenges of using modeling data. Forecast models use past data. They cannot use data which becomes available after the model is run. Consequently, these models are lagging behind actual data. As of Dec. 15, there have been 8,901 COVID-19 deaths in Arkansas. The reason for the discrepancy between the model and actual numbers is the substantial increase in deaths reported between Dec. 9 and Dec. 15. Recognizing the discrepancy, the increasing number of COVID-19 deaths is not unexpected, as indicated by the trend lines in both Figures 7a and 7b.
There was a significant change in the number of Arkansans eligible to be vaccinated between the last report and this report, as children between the ages of 5 and 11 became eligible for vaccination. Consequently, we have changed our denominator used to calculate percentages to include all Arkansans five years or older.

Map 3 shows the percentage of the population age 5 and above by county who have been fully vaccinated by Dec. 10. Vaccination data were processed by Haley Hale using data available from the Arkansas Department of Health’s website. There is still a greater than four-fold difference between the county with the highest vaccination rate — 58% in Dallas County — and the lowest — 15% in Miller County. Some of Miller County residents are being vaccinated across the border in Texas. These vaccinations are not recorded in Arkansas and, consequently, may be skewing the number of citizens vaccinated in Miller County. The same could be true for some of the other border counties.

Comparing current vaccination rates with those in the previous report, Map 4 shows the percent change in vaccination by county. It must be noted, the population now includes children 5 to 11 years old who are those eligible for the vaccine. The result is the denominator has increased compared to previous reports. As a result, change rates have negative values. All but two counties show a negative change compared to last month’s report. This is, of course, a statistical artifact. There have been increases in the number of citizens vaccinated in all counties. However, the percentages demonstrate vaccination in the state is increasing slowly, with a number of counties vaccinating 2% or less of their population in the last month.
Methodological Notes

Short-term forecasts. Time series forecasting is a method that uses observed data to predict future values. The purpose of the models is to fit the best curve to data and extend the curve into the future. To forecast aspects of the pandemic in Arkansans, the models used COVID-19 cases, hospitalizations, and death data reported to the Arkansas Department of Health. It should be noted the report defines a “case” as a COVID-19 test result reported and posted by the Department of Health. As indicated by recent research, the number of undiagnosed COVID-19 infections in the community may be higher by 40% to 50%.

Glossary of Terms

Active infection = a positive infection, with or without a COVID-19 test, that has not yet recovered or died
Case = a positive COVID-19 test result reported to the Arkansas Department of Health
Community = population not in a prison or population not in a prison or nursing home
Cumulative = total number of a given outcome (e.g., cases) up to date
Extended state-space SIR (eSIR) model = a model based on three components: susceptible (S), infected (I), and removed (R, including both recoveries and deaths)
Susceptible-Exposed-Infected-Recovered model (SEIR) = another variant of standard epidemiological model considering exposure as another factor controlling for disease dynamics
Hospitalization = a positive infection or case that was admitted to the hospital
Infection = a COVID-19 infection, with or without a test and regardless of having recovered or died
Positivity Rate = the number of people who test positive for covid-19 as a proportion of people have been tested
Projections = long-term predictions
Recovered = a positive infection that is no longer symptomatic or shedding virus
Susceptible = an individual who can be infected with the disease of interest
Time series forecast = short-term forecast of events through a sequence of time