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 monthly 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 Oct. 10.

Summary points are:

- The COVID-19 positivity rate in the state has declined below 10% and is only marginally above the national average.
- The models are forecasting a significant decline in new daily COVID-19 cases in the state — forecast to decrease from 464 cases on Oct. 12 to 50 on Oct. 25. However, we must caution the model reflects trends, and actual numbers may vary.
- 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 2,744 cumulative cases by Oct. 25.
- The highest relative growth in COVID-19 cases will be in children 17 and younger — forecast to increase nearly 4% by Oct. 25.
- Like cases, the model forecasts a decline in new hospitalizations over the next 15 days, dropping from 27 to seven new daily admissions.
- Hospitalizations are stabilizing; but, the greatest relative increase in hospitalizations will be in children 17 and younger, increasing by 2.4% by the end of October.
- The 15-day model is forecasting an average of nearly seven deaths per day for the next two weeks.
- The 15-day model is forecasting 8,316 cumulative COVID-19 deaths by Oct. 25.

- All counties in Arkansas continue to have low vaccination rates. Most counties increased vaccinations by 2% to 3% in the past month.

The models are showing we should expect COVID-19 cases, hospitalizations, and deaths to continue to decline through Oct. 25. The media has reported cases, in particular, are decreasing in the last few days. Data for the last five days are not included in the data for this report, which were downloaded on Oct. 11. Models are based on past data, and do not account for increases or decreases occurring after datasets are created. When viewing the figures in the report, what is important to focus on is the trends, not the numbers. The models — especially the daily models — are not forecasting actual numbers of a given day. For example, we do not expect 50 new cases on Oct. 25. What the models are telling us to expect is a decline in daily cases from now until Oct. 25. The only exception to the declining trends is pediatric COVID-19 cases. Pediatric cases are continuing to increase at a faster rate than adult cases, and are making up a larger proportion of the caseload. Hopefully, this trend can be brought under control once vaccines are fully approved for children under 12. However, if vaccination rates among Arkansas children 12 to 17 year are indicative of what to expect in children under 12, then we are not optimistic enough children will be vaccinated to control infections.

We wrote in our last report that Arkansas would cross the 8,000-deaths threshold due to COVID-19 about Oct. 9. We did not expect the state would cross that marker in one day because of data corrections. Even so, this important marker was crossed with little notice. We should have paid more attention. On Sept. 2, the state had just crossed the 7,000-deaths marker. One thousand Arkansans were killed by COVID-19 in little more than one month. It can be argued the 8,000-deaths threshold was crossed only because the Arkansas Department of Health made a data correction. The argument has some merit. Nevertheless, 1,000 additional deaths due to COVID-19 were recorded in five weeks. By any account, this tragedy deserves more recognition than the cumulative yawn it seemed to have elicited. We should not, as a state, be willing to accept the death of 1,000 of our fellow citizens in little more than a month. Some would suggest there is nothing we can do about it. COVID-19 is a disease and some are going to die. This rationale may have had some merit early in the pandemic, but no longer. Collectively, we have a tool that is being woefully underused in our state.

The rate of new vaccinations in the Arkansas over the last month was extremely low. The average county vaccination rate was about 3%. With declining COVID-19 cases, hospitalizations, and deaths there is a natural tendency to believe the Arkansas pandemic is over, we can quit wearing masks and social distancing, vaccinations can be put off, and life is returning to normal. While we, too, want to be optimistic, the COVID-19 pandemic in Arkansas is not over. About 47% of Arkansans have been vaccinated for COVID-19. This means almost 1.5 million have not been vaccinated. Even if we unrealistically allow that everyone who has had a COVID-19 infection has developed natural immunity to future infection, then this leaves 1 million Arkansans still susceptible to the disease. Many of these 1 million are children.
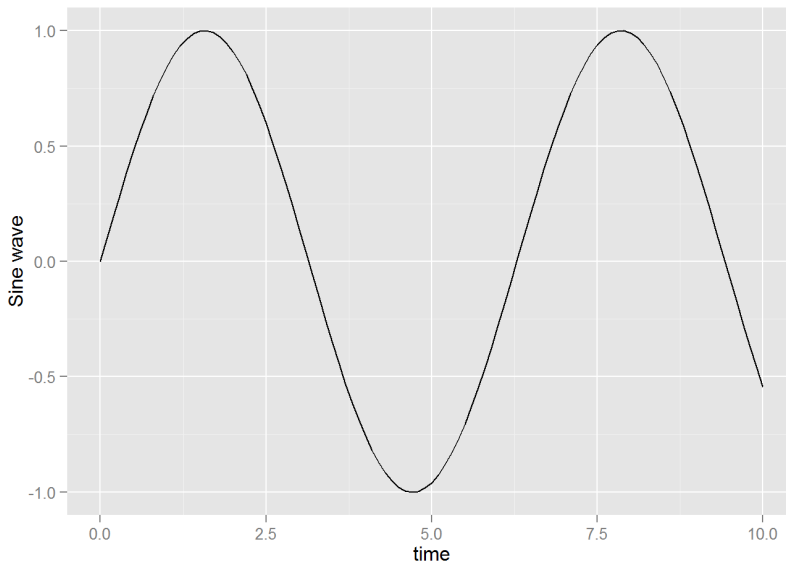
As we have reported before, Arkansas seems to have its own peculiar COVID-19 pandemic. It took the state much longer to get to its first surge than other parts of the country. The reason for this seems to be the pandemic is following a wave pattern, both geographically and in time, as illustrated in the figure on the left. Like a wave, the pandemic rolls across the globe, causing surges at different places at different times. For example, the northwest plains states are currently experiencing a surge in COVID-19 cases, while cases in southern states are declining. Like a wave in the ocean, locally, the pandemic will build, crest, recede, and begin again. This is exactly what COVID-19 has done in Arkansas. The first wave crested in December and receded. The second crested in August, and is now receding. If the past is the best predictor of the future, we should expect a third wave in three to four months.

Unlike waves in an ocean, we do not need to experience a third COVID-19 wave in the same way we have the first two. We have effective vaccines that will, at least, prevent serious disease, hospitalization, and death. While the current wave is at its lull, now is the time to get vaccinated. None of us would wait to buy home owners' insurance until our house is burning. Why wait to be vaccinated?

The COVID-19 Pandemic in Arkansas

Data shown in this section examines the trajectory of the COVID-19 pandemic in Arkansas, differences in daily cases between urban/rural areas in the state, changes in testing and COVID-19 positivity associated with test results, and urban/rural differences in Arkansas COVID-19 death rates since June 1.

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.

Figure 1 *Seven-Day Rolling Average of Daily COVID-19 Cases*

What is easily discernable 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 increase dramatically to over 1,000. In September, daily cases averaged 1,500, strongly indicating the state was experiencing a second COVID-19 surge. Cases began to decline in October, with the average daily cases dropping to 720.

National trends suggest COVID-19 cases are increasing faster in rural compared to urban areas. We assessed daily case rates by rural/urban county in Arkansas. As shown in Figure 2, case rates per 100,000 persons were greater in urban areas through August 2021. However, case rates have been higher in rural areas since late August, despite similar downward slopes.

Figure 2 *Seven-day rolling average of daily cases by rural/urban status*
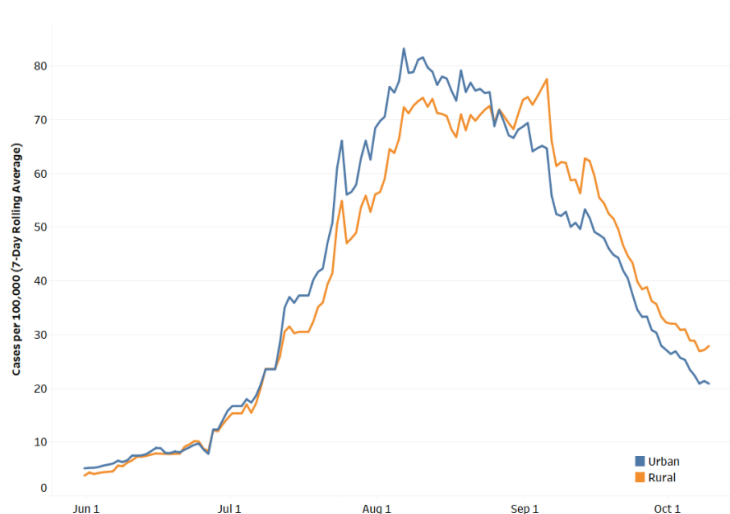
Figure 3a shows the COVID-19 testing rate per 1,000 persons in Arkansas. Since September, the testing rate has gradually declined. On Oct. 10, the state performed 2.2 tests per 1,000 persons, which was lower than the national average of 4.7. A higher state positivity rate and relatively low testing level raises serious concerns about our ability to know the "true" number of COVID-19 cases in the state. Without regular, widespread testing, which is

Figure 3a *COVID-19 testing rate per 1,000 through Oct. 10*

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.

Figure 3b 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%. The state's positivity rate is 6%, which is only marginally above the national average of 5.8%. However, both the per capita testing rate and the positivity rate should be considered in light of no active surveillance either statewide or nationally.

Finally, as shown in Figure 4, we assessed COVID death rates across rural and urban counties in the state. Death rates were relatively equal across urban and rural counties through August 2021. However, since late August and early September, COVID-19 death rates in rural counties have exceeded those in urban counties. The large spike in deaths on Oct. 10 is due to a data clean up by ADH and does not represent deaths on that date.

Figure 3b *COVID-19 positivity rates through Oct. 10*

Figure 4 *Seven-day rolling average of deaths by rural/urban status*
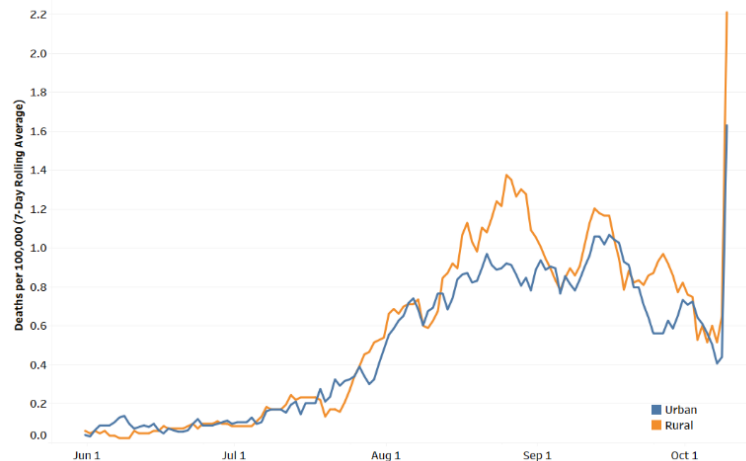
COVID-19 Cases

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 Aug. 1 to ensure more stable models.

15-day forecasts of COVID-19 cases in Arkansas. New daily cases for the period Oct. 11-25 are shown in Figure 5a. Estimates are realized rates. As shown in the figure, the model is forecasting a linear decline in new daily cases from 464 on Oct. 12 to 50 new cases on Oct. 25.

Figure 5a *New COVID-19 cases through Oct. 25*

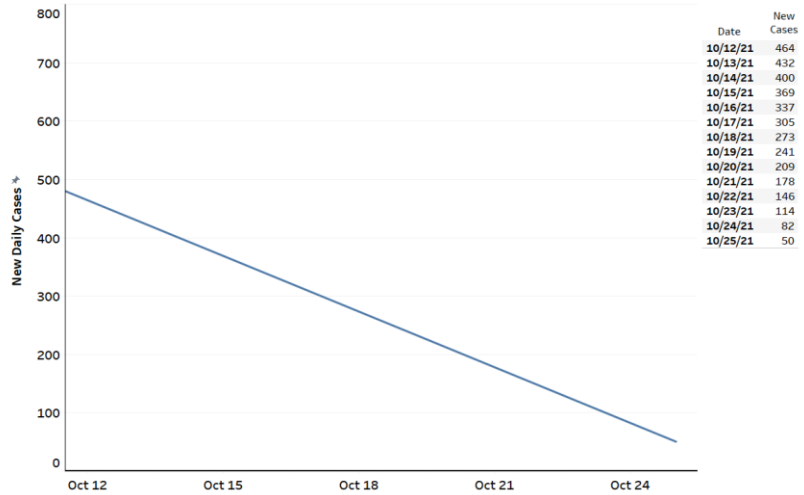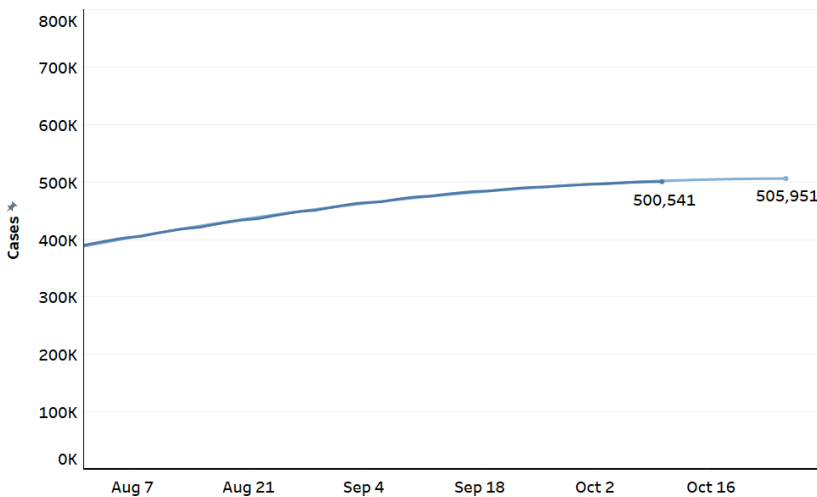| Date	New Cases
10/12/21	464
10/13/21	432
10/14/21	400
10/15/21	369
10/16/21	337
10/17/21	305
10/18/21	273
10/19/21	241
10/20/21	209
10/21/21	178
10/22/21	146
10/23/21	114
10/24/21	82
10/25/21	50

Figure 5b shows the forecast of cumulative COVID-19 cases through Oct. 25. The 15-day forecast shows Arkansas will reach a cumulative caseload of 505,951 cases.

Forecasts by age. As shown in Figure 6a on the next page, the forecast of cumulative cases across age groups shows increases in every group, but at a slower rate. 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 2,744 new cases by Oct. 25, or an average of 183 cases per day. The group with the second highest number of cases will be young adults age 18 to 34, adding 2,175 new cases by Oct. 25. This is an average of 145 cases per day.

Figure 5b *Cumulative COVID-19 cases through Oct. 25*

Children 17 and under, although third in terms of absolute numbers, will show continued high growth in cases. The model forecasts around 3,252 new cases in children through Oct. 25.

Figure 6b shows new daily cases in children 17 or younger as a percent of the total new daily cases. Studies report children under 17 make up around 25% of the new cases nationally. In Arkansas, over 30% of new cases since Aug. 1 have been in children. Figure 6b shows a growth in the percentage of cases among the children beginning in late August that while still high has dropped slightly in late September and early October.

Figure 6a *Cumulative COVID-19 cases by age through Oct. 25*

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 (Sept. 27-Oct. 10) compared to cases from the prior two weeks (Sept. 13-26).

**Figure 6b** *Percent of daily cases among those aged ≤17*

During past two weeks, the relative change in cases is somewhat mixed across the state's counties. Three counties showed relative increases, compared to five in September and 14 in August. Sixty-seven counties had relative decreases, compared to 53 in September and 20 in August.

Relative numbers must be considered in light of per capita cases, shown in Map 2. For example, Nevada County had a 55% decline in its relative cases in the past two weeks; however, the county still has a very high per capita case rate of 51 cases per 10,000 population.

As shown on Map 2, on the next page, all counties in Arkansas had elevated COVID-19 cases per 10,000 population between Sept. 27 and Oct. 10. Per capita case rates ranged from 27 to 113 cases per 10,000 persons, with six counties having case rates above 100. This is significantly 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 decreasing COVID-19 cases in October. It is too early to determine whether the downward trend in cases will continue through November. It is apparent the most recent exponential growth in COVID-19 cases is now on the downward side of the curve. As we have witnessed, the decline in cases after the surge reached its apex has been almost as rapid as its growth. What we are unable to tell at this time is at what point the decline will bottom out and if the lull will continue or continue until a third surge. A third surge is possible. Vaccination rates in Arkansas are
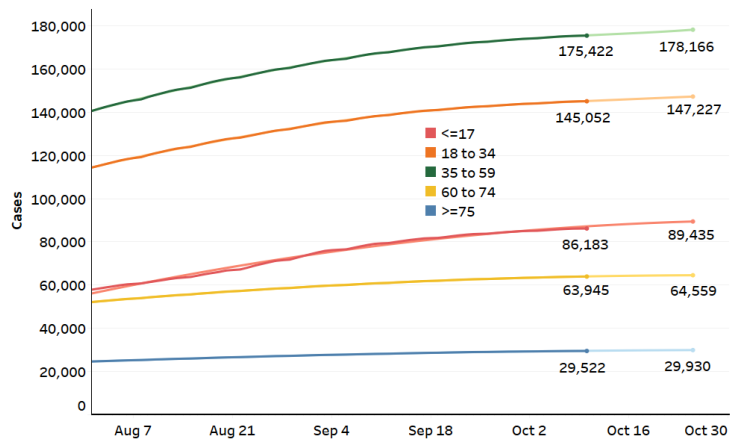
low, with less than half of the population vaccinated. Even with an optimistic rate of natural immunity, more than 1 million Arkansans are still at risk for infection.
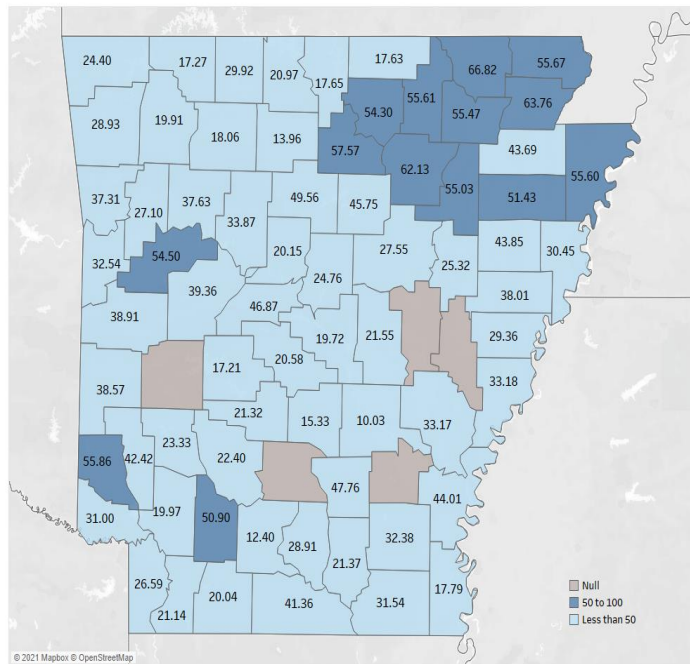
There has been a clear shift in the pandemic toward younger adults and children. The number of cases in children is showing a continual increase, which does not appear will decline in the next month. The approval of vaccines for children expected by the middle of November should have an impact on the number of cases in children. The highest number of new cases will continue to be in adults 34 and 59. However, all age groups are forecast to have some growth in new cases through Oct. 25.

There have been widespread declines in COVID-19 cases in the past two weeks. However, some counties in the state continue to show increasing relative growth in cases, as high as 36%.
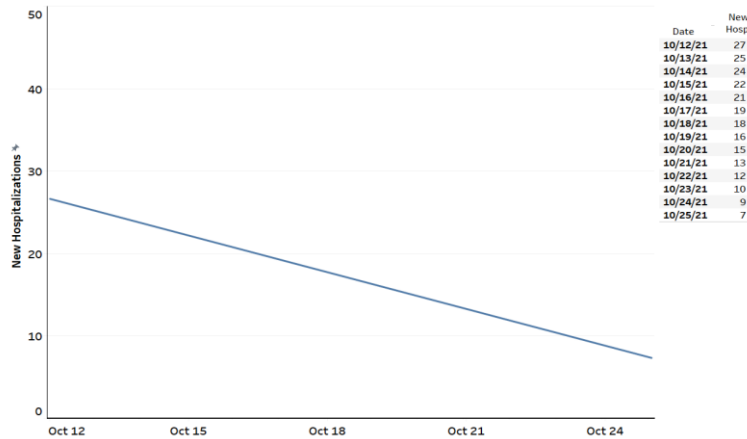
Map 1 Relative change in *COVID-19 cases*
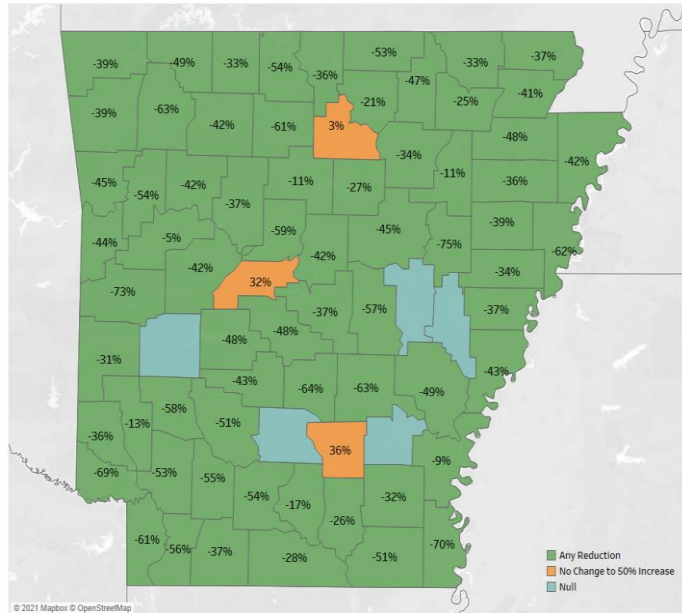
Map 2 *COVID-19 two-week per capita case rate*

COVID-19 Hospitalizations

Figure 7a *New daily hospitalizations through Oct. 25*

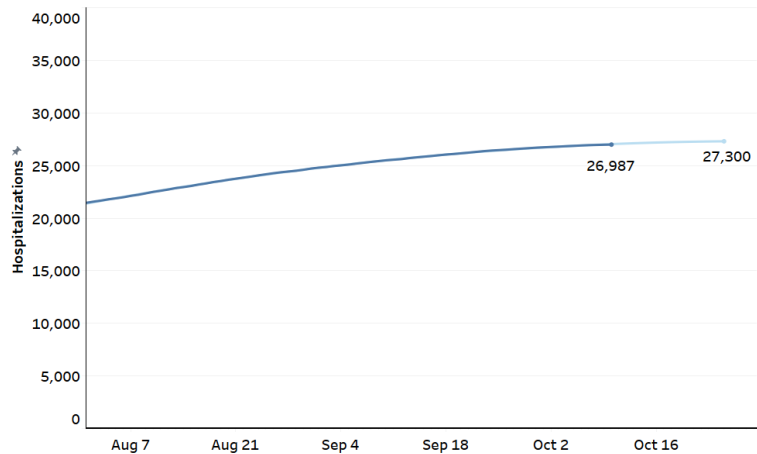| Date	New Hosp.
10/12/21	27
10/13/21	25
10/14/21	24
10/15/21	22
10/16/21	21
10/17/21	19
10/18/21	18
10/19/21	16
10/20/21	15
10/21/21	13
10/22/21	12
10/23/21	10
10/24/21	9
10/25/21	7

15-day forecasts of hospitalizations. Figure 7a shows the realized rate of new hospitalizations in Arkansas between Oct. 11-25. As is easily discernible from the figure, there is a linear trend in daily new hospitalizations, declining over the next 15 days from 27 new daily patients on Oct. 12 to seven on Oct. 25.

The 15-day forecast for cumulative COVID hospitalizations are shown in Figure 7b. The model forecasts a total of 27,300 cumulative hospitalizations by Oct 25, an increase of about 313 patients.

Figure 8, on the next page, shows the 15-day forecast of hospitalizations by age through Oct. 25. As is evident in the forecast, hospitalizations in all age groups are stabilizing. 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 83 new patients by Oct. 25.

Summary. The conclusion we reach from the models is that hospitalizations will decline during the next month. Nevertheless, there will be significant numbers of patients in each age category. The models forecast the greatest number of hospitalizations due to COVID-19 will continue to be in adults 35 to 59. We should expect significant increases in the number of hospitalizations of adults 60 to 74.

We also should 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 forecast 19 new pediatric patients by Oct. 25.

Figure 7b *Cumulative hospitalizations through Oct. 25*
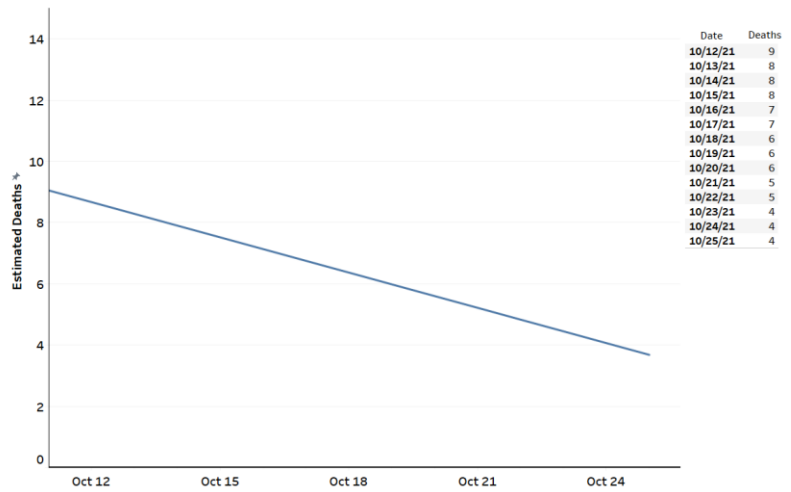

Figure 8 *Cumulative hospitalizations by age group*
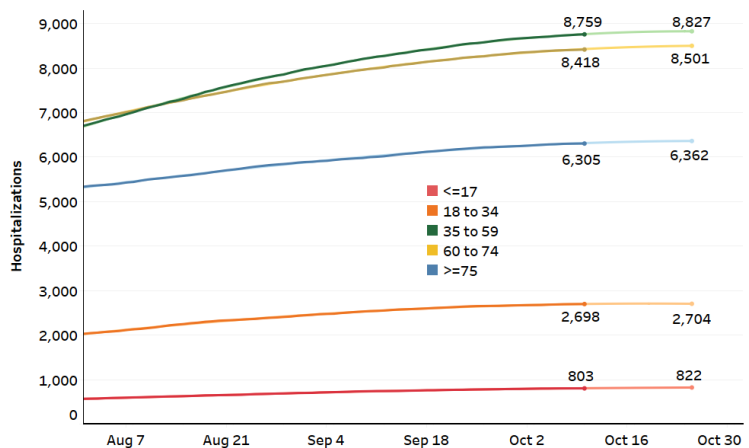
COVID-19 Deaths

15-day forecast of COVID-19 deaths. Figure 9a shows the realized rate of new COVID-19 deaths in Arkansas from Oct. 11-25 shows a relatively flat linear downward trend. On Oct. 11, the model suggests Arkansas will have nine new deaths due to COVID-19.
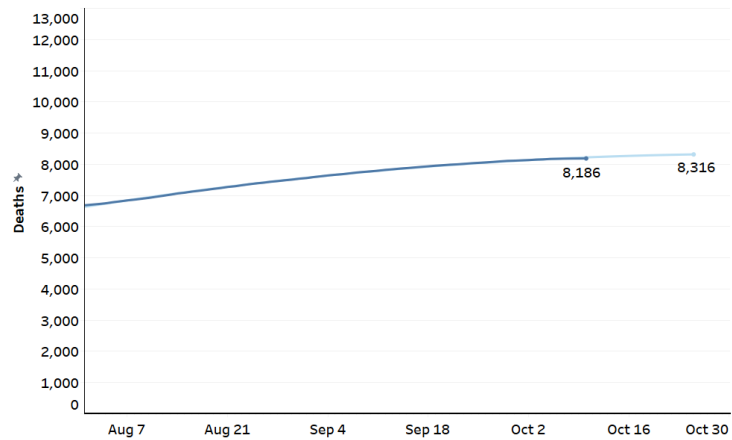
Figure 9b shows the 15-day model forecast 8,316 cumulative deaths in Arkansas due to COVID-19 by Oct. 25. The model is forecasting 130 new COVID-19 deaths.

Summary. The number of daily deaths from COVID-19 appears to be relatively stable at nearly seven deaths per day. Deaths lag both cases and hospitalizations, which suggests that the number of deaths should begin to decrease more rapidly, if the trend in cases and hospitalizations continues to decline. However, even with a relatively stable rate, the models suggest Arkansas will pass the 8,300 COVID-19 deaths threshold around Oct. 22.

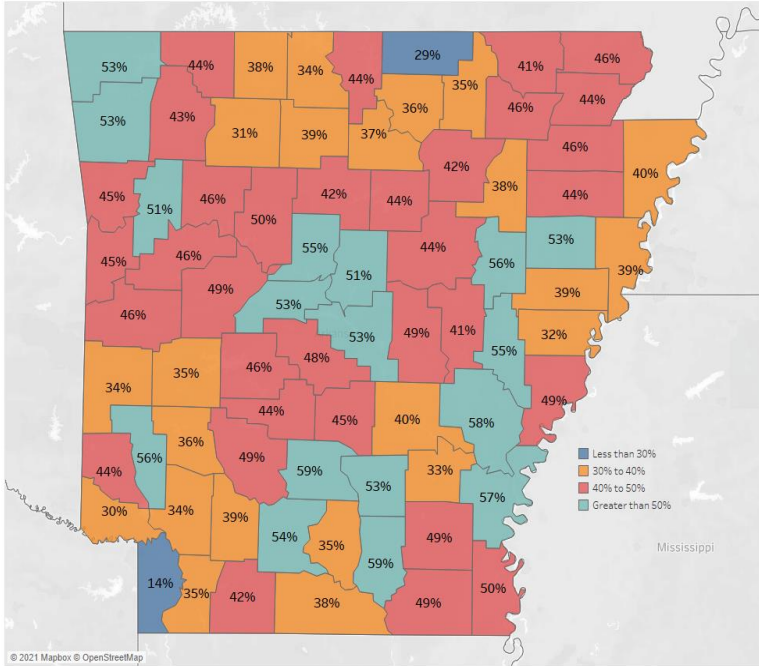**Figure 9a** *New daily COVID-19 deaths through October 25*

Date	Deaths
10/12/21	9
10/13/21	8
10/14/21	8
10/15/21	8
10/16/21	7
10/17/21	7
10/18/21	6
10/19/21	6
10/20/21	6
10/21/21	5
10/22/21	5
10/23/21	4
10/24/21	4
10/25/21	4

Figure 9b *Cumulative COVID-19 deaths through Oct. 25*

COVID-19 Vaccinations

**Map 3** *Percent of the population (12+) fully vaccinated*

Map 3 shows the percentage of the population age 12 and above by county who have been fully vaccinated by Oct. 11. 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 — 59% in Dallas and Bradley Counties — and the lowest — 14% in Miller County. It has been anecdotally reported that many Miller County residents received their vaccinations across the border in Texas. These vaccinations are not being recorded in Arkansas and, consequently, may be skewing the number of adults vaccinated in Miller County. The same could be true for other border counties. It must be noted, with the introduction of the Delta variant into the state and the beginning of classes in schools and colleges, a more accurate picture of vaccinations would include all citizens in Arkansas, including children under 12. If all citizens were included in the denominator, vaccination rates would be lower.

Comparing current vaccination rates with those in the previous report, Map 4 shows the percent change in vaccination by county. The counties with the highest one-month increase were Howard and Scott counties, each increasing vaccinations by 5% or more. Even so, the rate of vaccination across the state was very slow in the last month, with a number of counties vaccinating 3% or less of their population.

Map 4 *Percent change in fully vaccinated (12+) in the past month*
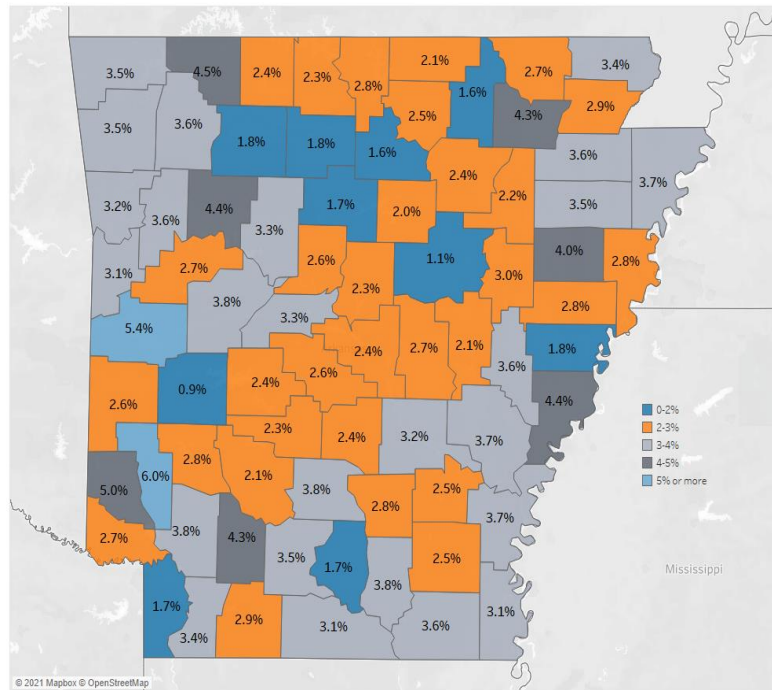
Methodological Notes

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