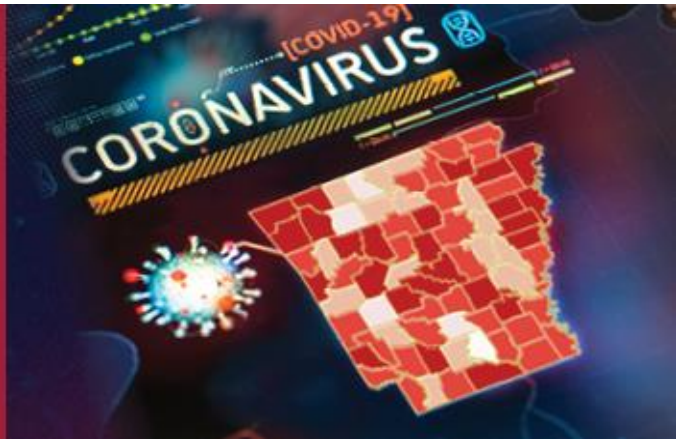
COVID-19 Forecasts in Arkansas



UAMS | Fay W. Boozman College of Public Health

Arkansas Public Health Pandemic Working Group
Mark L. Williams* and the COPH COVID-19 Research Team
August 23, 2021
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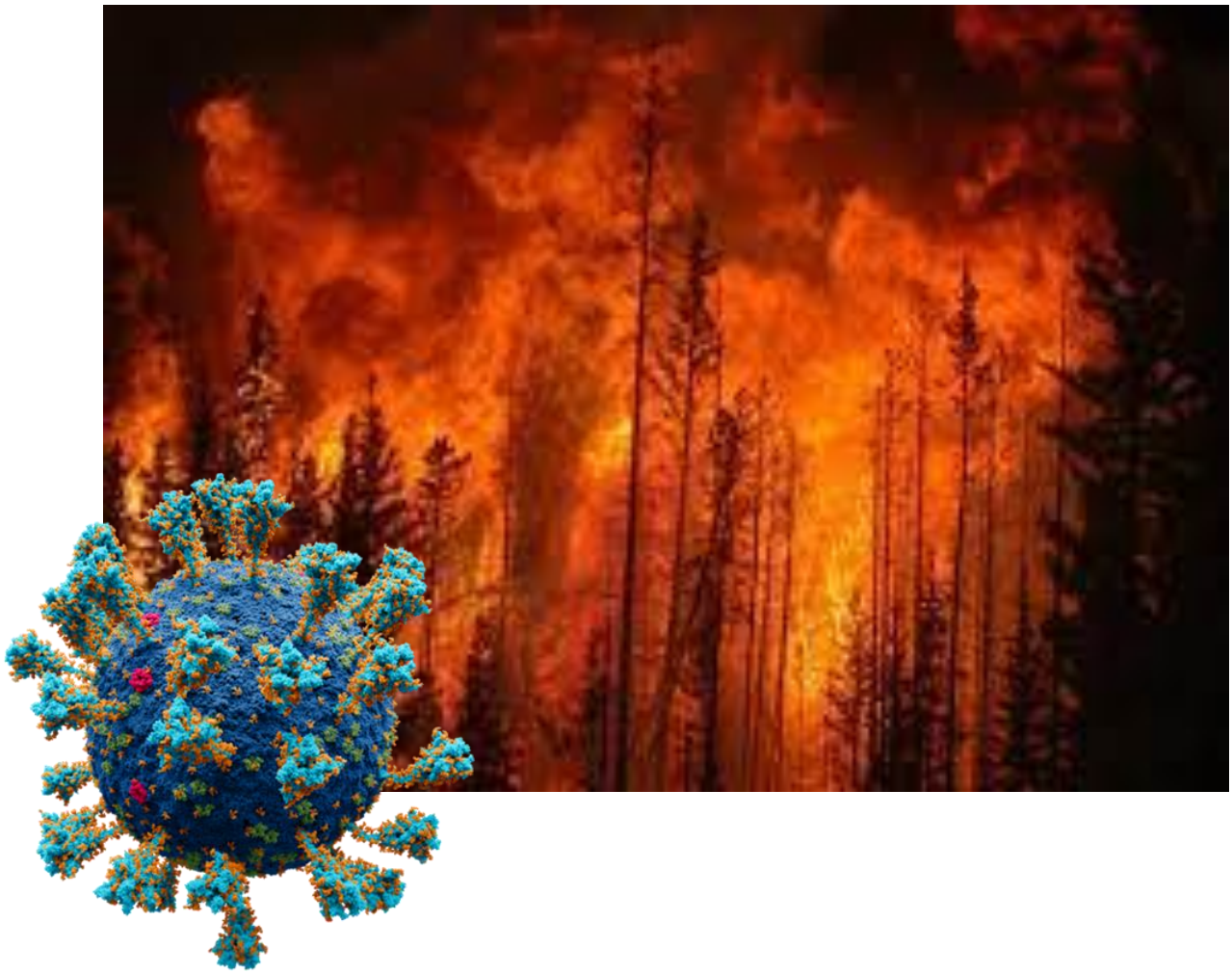


COVID-19 Forecasts, Projections, and Impact Assessments

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 and patients needing intensive care; 4) forecast model of COVID-19 deaths; and 5) status of COVID-19 vaccination.

All forecasts and projections were developed using COVID-19 data from the Arkansas Department of Health through Aug. 16

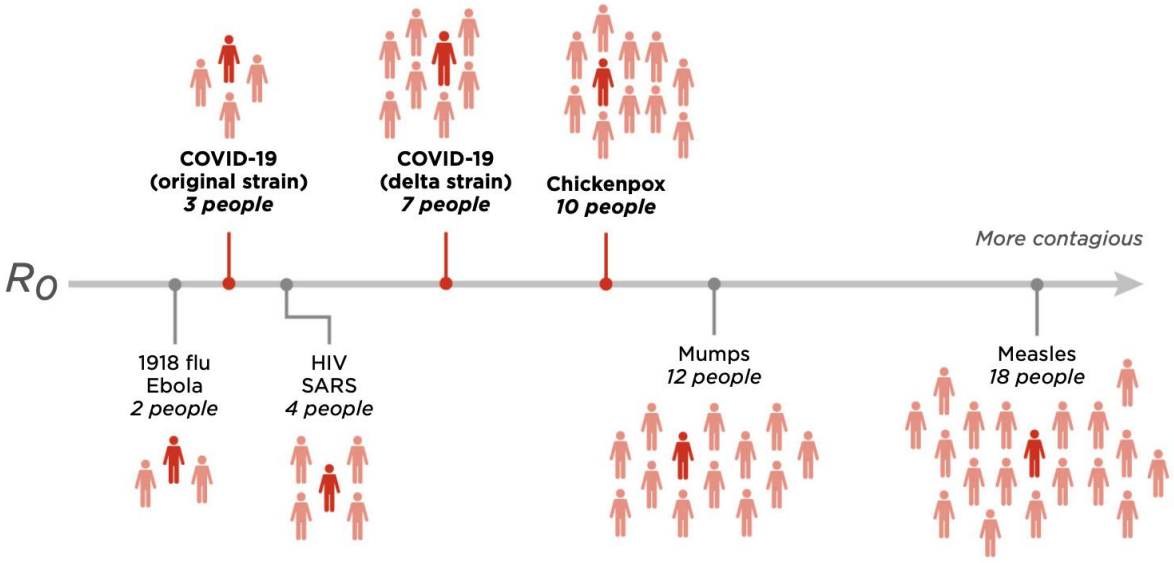
Summary points are:

- The COVID-19 positivity rate in the state remains over 20%, five times the national average. Although testing rates are low, this is evidence of wide community spread.
- The 15-day model is forecasting 4,523 new COVID-19 cases on Sept. 14. This represents almost a doubling of new daily cases in the next month.
- The 30-day models continue to show Arkansans between ages 35 and 59 have the highest number of COVID-19 diagnoses — forecast to increase by 19,610 cases, an average of 1,040 cases per day.
- The highest relative growth in cases will be in children 17 and under. The state will see an additional 10,784 children with COVID-19 by Aug. 30, an increase of 17% over the number reported on Aug. 15.
- Like cases, the 30-day model is forecasting 131 new hospitalizations in Arkansas on Sept. 14 due to COVID-19. This represent an increase of a third in daily hospitalization in the next month.
- The greatest number of patients hospitalized will be adults 35 to 59, increasing by 10% over the number on Aug. 15.
- The greatest relative increase in hospitalizations will be in children 17 and under, increasing by 120 hospitalizations or 20%.
- The 30-day model is forecasting 38 new deaths due to COVID-19 on Sept. 14. This represents just under a doubling of daily deaths over the number on Aug. 16.
- The 15-day model forecasts 7,017 cumulative COVID-19 deaths by Aug. 30, adding an additional 457 deaths. We should expect an average of 30 additional deaths per day.
- All counties in Arkansas continue to show low COVID-19 vaccination rates. The greatest increase in vaccinations in the state was 11% in Sebastian County. However, most counties increased vaccinations by 2% to 5%.

We said in our July report, Arkansas was on the verge of a new COVID-19 surge driven by the Delta variant. Well, here we are. The state is very close to equaling the numbers of cases recorded in December 2020/January 2021. Hospitalizations and patients requiring intensive cases have reached record numbers and put our hospital system in a precarious position. The entire hospital system has come close to having no beds for COVID-19 patients on a number of days. Young adults and children are being infected at very high numbers and many are requiring hospitalization. What is happening in Arkansas is playing itself out around the world, as many countries experience surges in infections and hospitalizations because of the Delta variant.

It is important to recognize the models are not able to accurately predict the number of cases, hospitalizations, and deaths on a given day. Numbers will likely vary from recorded cases, hospitalizations, and deaths. Forecast numbers on a given day are not as important as the trends forecast by the models. All of the models we have produced show an upward trend in cases, hospitalizations, and deaths due to COVID-19 for the next month.

How does Arkansas — or the world for that matter — find itself in this position? First, we are dealing with a COVID-19 variant that is far more infectious than the original virus or previous variants, such as the Alpha variant. Some scientists have even suggested we should consider the Delta strain of the virus almost as a new virus.



Source: *The Lancet (1918 flu, SARS), University of Michigan School of Public Health (COVID-19, Ebola, measles), Johns Hopkins School of Public Health(chickenpox), Proceedings of the National Academy of Sciences (HIV)), University of Leuven (COVID-19 delta variant), Australian Department of Health (mumps). Credit: Doucleff, Hurt and Cole/NPR. Icon by G.* Higgins, the Noun Project.

As is illustrated in the figure above, the Delta variant is far more infectious than the 1918 flu, the original COVID-19 strain, and HIV. A single person with the 1918 flu infected approximately two others. A person with the original COVID-19 strain could infect three others, and a person with HIV four others. The Delta variant can infect seven additional susceptible persons, making it more than twice as infectious as the original COVID-19 strain. In Arkansas, the last four weeks has seen a doubling of the seven-day average number of new cases being reported, increasing from 1,017 daily cases on July 18 to 2,103 on Aug. 18. According to the Mayo Clinic the average per capita daily cases rate on July 18 was 33; on. Aug. 16, the last date for which statistics were available, the average per capita case rate was 85. As of Aug. 19, 38% of Arkansas are fully vaccinated against COVID-19. If we turn the percentage of persons around to reflect those in Arkansas who are unvaccinated, 62%, or nearly two-thirds of Arkansans, are susceptible to infection by a highly infectious and dangerous virus.

Not only are numbers of cases increasing, but who is being infected with COVID-19 has changed with the advent of Delta in Arkansas. During the December/January surge, those most likely to be infected were individuals 50 and over. This is not the same with Delta. Evidence shows children and younger adults are more likely to be infected than older adults. This is true for at least two reasons. First, the Delta variant is much more infectious than the original strain of the virus. Persons infected with the Delta variant have 10,000 times more virus in their nasal cavity than was the case for the original strain. This is true even for people who are vaccinated. This literally means there is far more virus in the air around a person infected with Delta than previous strains. Second, viruses move in populations towards individuals they can infect. In the case of Delta, the

most susceptible individuals in Arkansas are those who are unvaccinated, the greatest numbers of whom are children and young adults. According to the Mayo Clinic, only 8% of children 13 to 17 in Arkansas are vaccinated. Of course, no child under 12 is vaccinated. Consequently, proportionately, larger numbers of children and young adults will be infected than in any other age group. And, some of those children are likely to become sick and hospitalized with COVID-19.

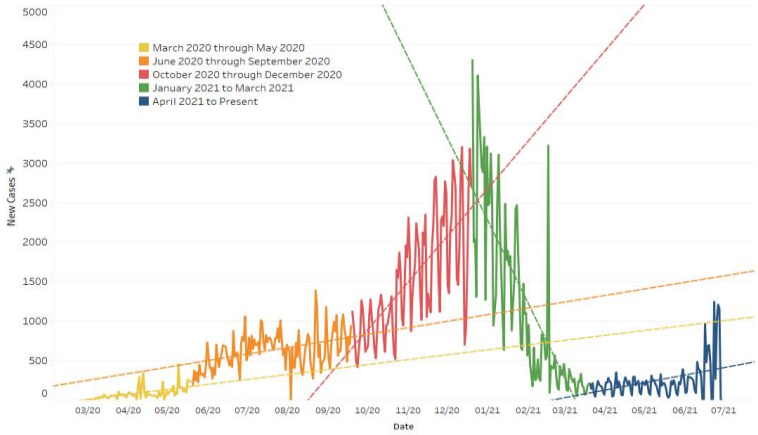
As we said in our June report, "COVID-19 is not over in Arkansas. It is, at best, smoldering." Well, COVID is no longer smoldering. It has broken out into a raging forest fire that will grow in size and strength. If our forecasts hold true, Arkansas will cross a new milestone. By Aug. 30, more than 7,000 Arkansans will have died of COVID-19. If this forecast holds true, COVID-19 will have killed more Arkansans than all the wars in the 20th and 21st centuries.

What the models cannot take into account are changing human behaviors. The major change in the last week is the opening of schools and colleges. Children and young adults are congregating in small spaces, some without masks. The other event in the next weeks is the Labor Day holiday weekend. If we have learned nothing else from the pandemic, COVID-19 loves a holiday party. Because of these two events, we should expect a first surge five to ten days after the beginning of the school year, and another five to ten days after the holiday weekend. To reduce the number of infections results from these two events, Arkansans should be encouraged to be protect themselves, their children, and grandchildren by getting vaccinated, if they have not already been vaccinated, wearing a mask in public, even if they are vaccinated, and thinking twice about going to that Labor Day party. We may not be able to avoid the all the pain and suffering that will happen in the next few weeks, but we certainly can lower it to some degree if we use the common-sense public health tools we already have.

The Pandemic in Arkansas

Data shown in this section examines the trajectory of the COVID-19 pandemic in Arkansas, changes in testing and COVID-19 positivity associated with test results, and the impact COVID-19 has had on Arkansas counties.

Figure 1 *Trajectory of COVID-19 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 five phases of the pandemic in the state as we have so far identified them. The pandemic in Arkansas did not begin with a significant epidemic curve, and infectious were largely limited to places of employment, such as meat processing plants. Infections did not begin to grow exponentially until September 2020, when there was significant growth in infections in a short period of time. The growth curve in the third phase peaked in mid-January. The fourth phase saw an exponential decline in cases to levels near those of the first phase of the pandemic. The fifth phase saw a stable low level of cases in April 2021 through June 2021. We are now entering a sixth phase related to a projected surge in new infections. Infections in the latest curve are related to the spread of the Delta variant throughout Arkansas.

Figure 2 is another view of the pandemic, showing 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 2 *Seven-Day Rolling Average of Daily COVID-19 Cases*

What is easily discernable from data plotted in Figure 2 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 infections. The curve flattened somewhat during March, when the state averaged around 385 new infections per day. The average of the seven-day rolling average of infections per day was around 192 in May and 227 in June. In the first 10 days of July, the seven-day rolling average jumped to 554, almost double the number just one month earlier.

As shown in Figure 3A, on the next page, testing for COVID-19 in the state peaked in September/October 2020. Since then, the overall testing rate gradually declined. On July 9, the state performed 1.1 tests per 1,000 persons, equivalent to the rate of testing during late-May 2020. Testing for COVID-19 in the state is almost at par with the national average of 1.54 per 1,000. However, coupled

with the higher positivity rate compared to the national average, relatively low testing rates raises concerns about surveillance. Without regular, large-scale testing, the best data for disease surveillance may be hospitalizations.

Broadly defined, the COVID-19 positivity rate is the number of people who test positive for COVID-19 as a proportion of the number of people who have been tested. The positivity rate is an indicator of viral transmission. A higher positivity rate is indicative of higher transmission relative to the number of tests.

Figure 3A *COVID-19 testing rate per 1,000 through July 9*

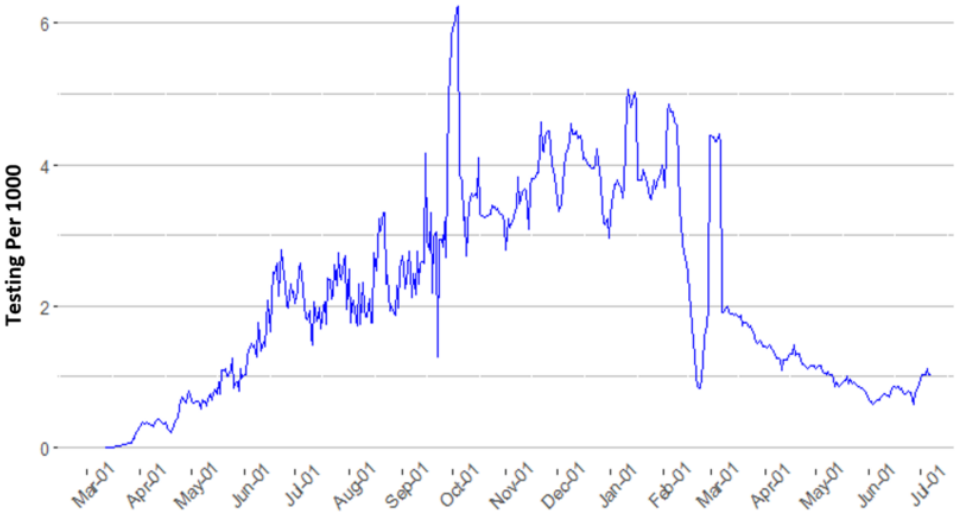


Figure 3B shows the seven-day moving average of the positivity rates for Arkansas and the United States. The positivity rate in Arkansas decreased from December through March. However, during the last month, it consistently increased and is currently almost at par with the rates in early-January, 2021. Currently, the positivity rate is at 21%, equivalent to almost five times the national average of 3.6%.

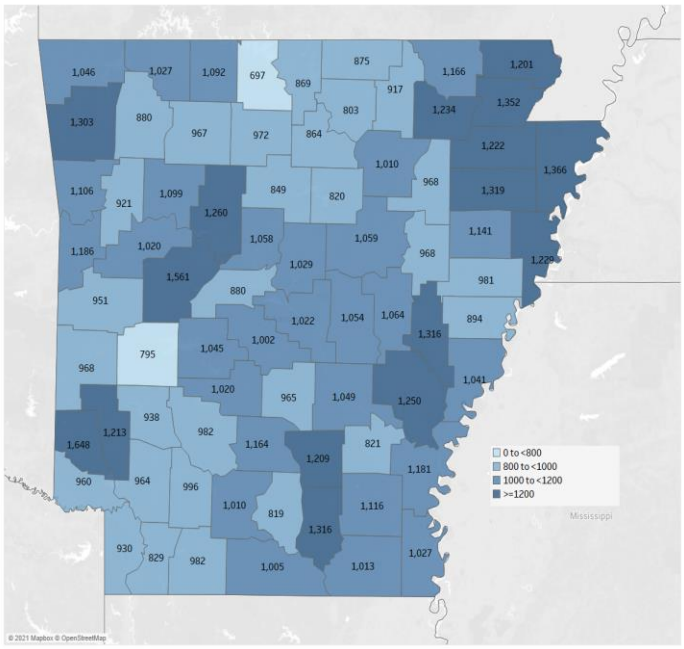
Figure 3B *COVID-19 positivity rates through July 9*

Community COVID-19 cases. Map 1 on the next page shows per capita rates of COVID-19 cases in Arkansas by county, from the beginning of the pandemic. These data provide a historical marker of the pandemic burden on Arkansas counties. Presently, all but one county in the state have per capita rates above 700 cases per 10,000 residents, meaning one in 20 residents have been infected with COVID-19 at some point during the pandemic. In the June report, 29 counties showed per capita rates greater than 1,000 per 10,000 residents. In this report that number is 44. Two counties — Sevier and Yell — have per capita rates above 1,500 per 10,000. In these two counties, one in seven residents have had COVID-19 sometime during the pandemic. Of note, all but one county with a per capita case rate greater than 1,200 per 10,000 is adjacent to another county with a rate greater than 1,200 per 100,000, with the same high rate.

Hospitalizations by county. Evaluating the distribution of hospitalizations across counties provides a sense of the burden COVID-19 placed on regional and county hospitals.

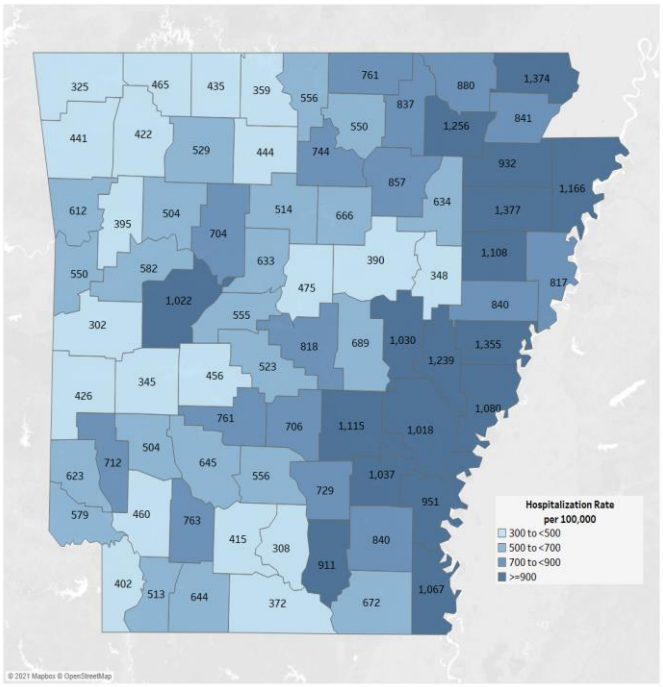
Map 2 shows the per capita hospitalization rates per 100,000 residents for March 2020. Fourteen counties have rates above 1,000 per 100,000, or one in 100 individuals hospitalized at some point during the pandemic. All Arkansas counties have per capita rates above 300. The highest hospitalization rates have been in eastern counties. Poinsett County has the highest hospitalization rate in the state.

Map 1 *COVID-19 cases per 10,000 population*



Understanding the percentage of COVID-19 positive patients in a county who have been hospitalized is an important measure of disease spread and an indicator of future hospitalizations when combined with the number of new local cases. Map 3, shown on the next page, provides the percent of COVID-19 cases hospitalized by county. A value of 5%, for example, means five out of 100 COVID-19 cases in a county have been hospitalized. Forty-six counties have hospitalization rates above 5%, meaning one of every 20 COVID-19 cases in these counties were hospitalized. Clay and Phillips County have rates above 10%.

Map 2 *COVID-19 per capita hospitalizations per 100,000*

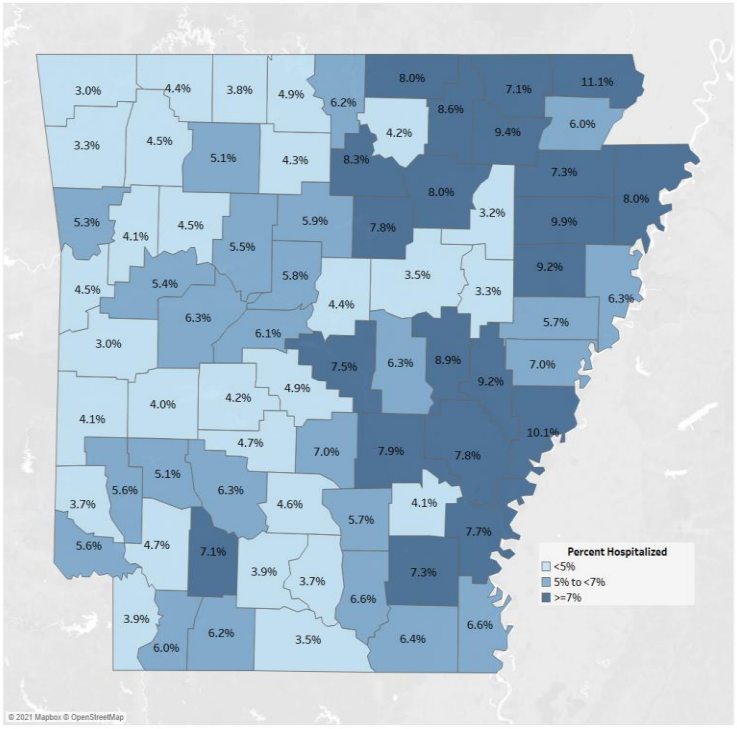


High hospitalization rates may indicate counties that have had less testing capacity or populations less willing to test. In these counties, cases may be identified later in the infection, when patients are symptomatic or perhaps ill. Areas shaded darkest blue have the highest percentage of positive cases requiring hospitalization. These counties should consider increasing community testing and early access to resources that may aid in preventing a COVID-19 case from requiring hospitalization.

Summary. Examining the COVID-19 pandemic over time can be instructive. As shown above, the pandemic in Arkansas has had at least five discernable phases, each showing different features. Arkansas is now entering a new surge due to the presence of the Delta variant of COVID-19, the summer social gatherings including summer camps, and the lack of mandated prevention measures, such as wearing face masks and social distancing. In this sixth phase, the positivity rate in

Arkansas is far above national average and is approaching the positivity rate at the height of the December/January surge.

Map 3 *Percent of positive cases hospitalized by county*



Per capita case rates and hospitalization rates at the county level show some counties have been disproportionately impacted by the pandemic. Per capita case rates may be indicators of possible problems with long-term COVID. We do not clearly understand the proportion of those infected with COVID-19 that will develop long-term effects of the disease, but we do know a substantial number will. This may be a long-term health problem in counties with high per capita rates, if vaccination rates remain low. Fortunately, although studies are in the first stages, vaccination appears to significantly improve long-term COVID by helping the body clear the virus.

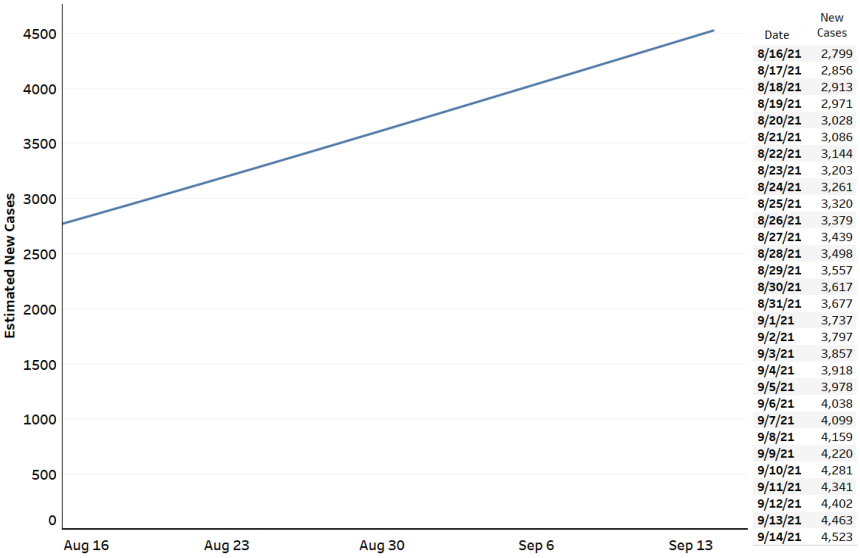
If we directly compare Maps 1 and 2, we can see there is an association between per capita COVID-19 cases and hospitalization rates. Counties with high per capita case rates and percentage of cases hospitalized tend to be located in the eastern half of the state.

COVID-19 per capita hospitalization rates at the county level are also instructive because they provide a sense of how prepared a county is to both prevent and deal with future public health emergencies. Counties with high COVID-19 per capita hospitalization rates tend to be rural and distant from urban centers. These counties tend to have high rates of other chronic and infectious disease and limited health care resources with which to deal with them. We can surmise these are the counties that will have significant problems protecting the health of their populations during future pandemics or the emerging “third wave” of COVID-infections associated with the Delta variant. With respect to planning how to meet future health crises, planning should focus on rural, resource constrained counties in Arkansas with an eye toward developing innovative strategies for providing public health and health care services.

COVID-19 Cases

Confirmed COVID-19 cases are those identified using a PCR test. Probable cases are cases diagnosed using an antigen test. Results of antigen tests have been reported by the Arkansas Department of Health (ADH) since Sept. 2, 2020. ADH continues to distinguish between confirmed and probable cases, but are combined in this report. We refer to confirmed and probable cases as "cases."

Figure 4a *New COVID-19 cases through Sept. 14*



Date	New Cases
8/16/21	2,799
8/17/21	2,856
8/18/21	2,913
8/19/21	2,971
8/20/21	3,028
8/21/21	3,086
8/22/21	3,144
8/23/21	3,203
8/24/21	3,261
8/25/21	3,320
8/26/21	3,379
8/27/21	3,439
8/28/21	3,498
8/29/21	3,557
8/30/21	3,617
8/31/21	3,677
9/1/21	3,737
9/2/21	3,797
9/3/21	3,857
9/4/21	3,918
9/5/21	3,978
9/6/21	4,038
9/7/21	4,099
9/8/21	4,159
9/9/21	4,220
9/10/21	4,281
9/11/21	4,341
9/12/21	4,402
9/13/21	4,463
9/14/21	4,523

15 & 30-day forecasts of COVID-19 cases in Arkansas. New daily cases for the period between Aug. 16 and Sept. 14 is shown in Figure 4a. Estimates are based on realized rates. During this time, the model is forecasting a linear progression in the number of new daily cases, culminating in 4,523 new cases on Sept. 14. This will represent a doubling of the number of new daily cases in the month between August and Sept.

Figure 4b shows the15-day forecast for Aug. 30 shows cumulative COVID-19 cases in Arkansas will reach **471,356**, or around 50,000 new cases between Aug. 15 and Aug. 30. This forecast is for an average of 3,334 cases per day.

Figure 4b *Cumulative COVID-19 cases through Aug. 30*

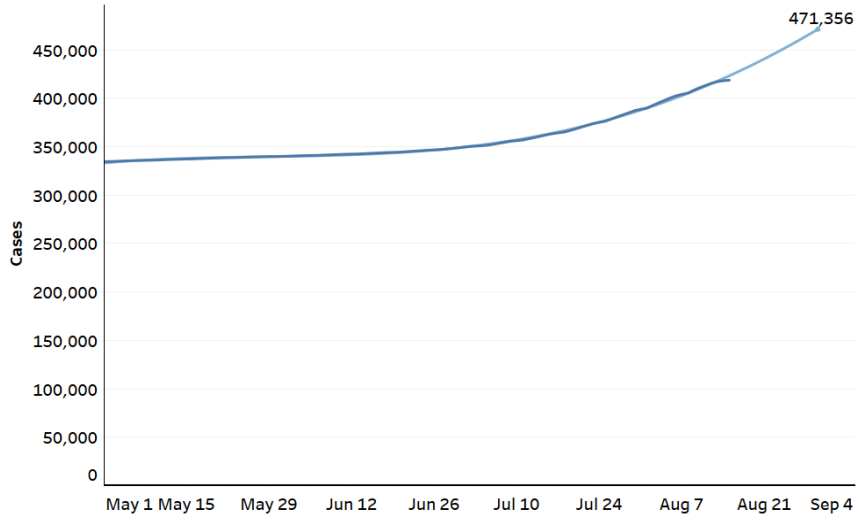
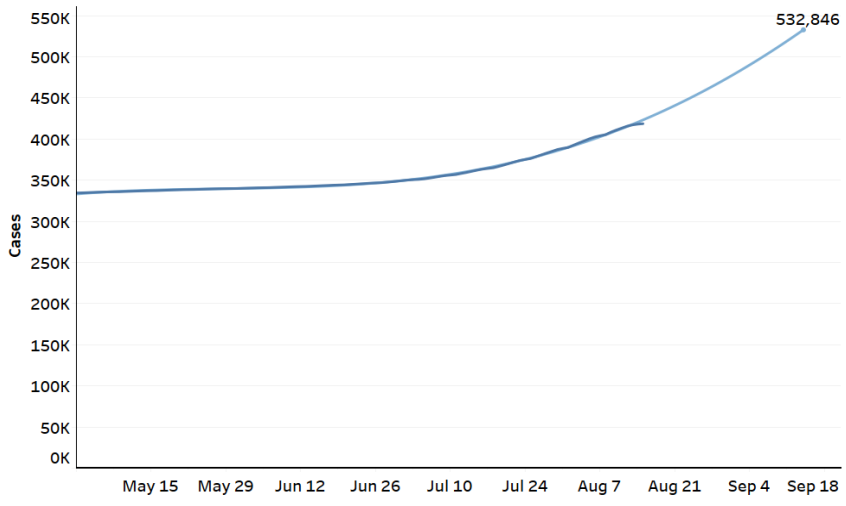


Figure 4c, on the next page, shows the forecast of COVID-19 cases in the next 30 days, through Sept. 13. The 30-day forecast shows Arkansas will have a cumulative caseload of around 532,846 cases. The 30-day model shows the state will add over 3,000 new COVID-19 cases per day over the next 30 days.

Forecasts by age. As shown in Figure 5a on the next page, forecast cases across age groups show increases in every age group. However, there are significant variations across groups. The age group with the highest forecast number of cases will continue to be those 35 to 59. This age group will add an average of 1,300 new cases per day for the next 15 days.

The group with the second highest growth will be young adults age 18 to 34. This age group will average just over 1,000 cases per day through Aug. 30.

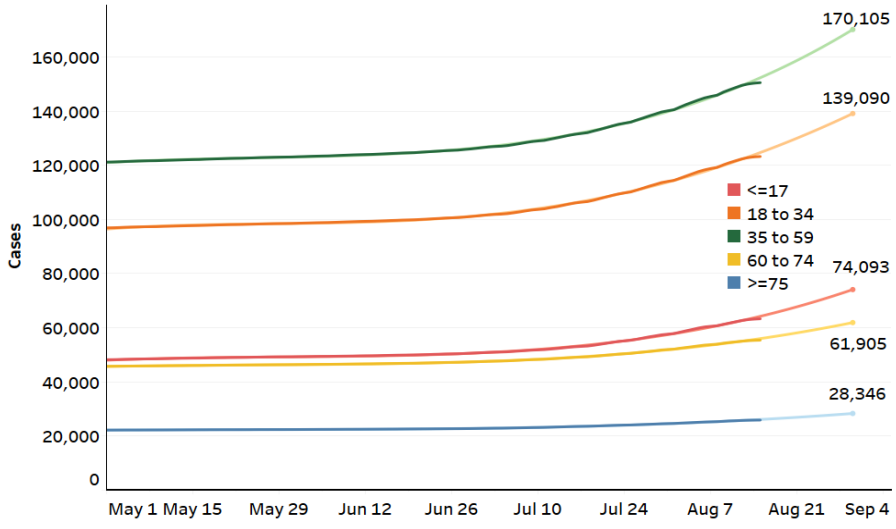
Figure 4c *Cumulative COVID-19 cases through Sept. 14*



Children 17 and under, although third in terms of absolute numbers, will show the greatest relative growth in cases. The model forecasts more than 10,000 new cases in children 17 and under between Aug. 15 and Aug. 30, a relative increase in cases of 20%.

The 30-day model of cases by age group, shown in Figure 5b on the next page, shows 18- to 34-year-olds will have greater daily growth in cases compared to adults aged 35 to 59. If this holds true, this will be the first-time growth in COVID-19 cases will be higher in younger adults than in any other age group. The model also forecasts children 17 and under will also have a substantial increase in cases, adding an additional 13,000 new cases between Aug. 30 and Sept. 14.

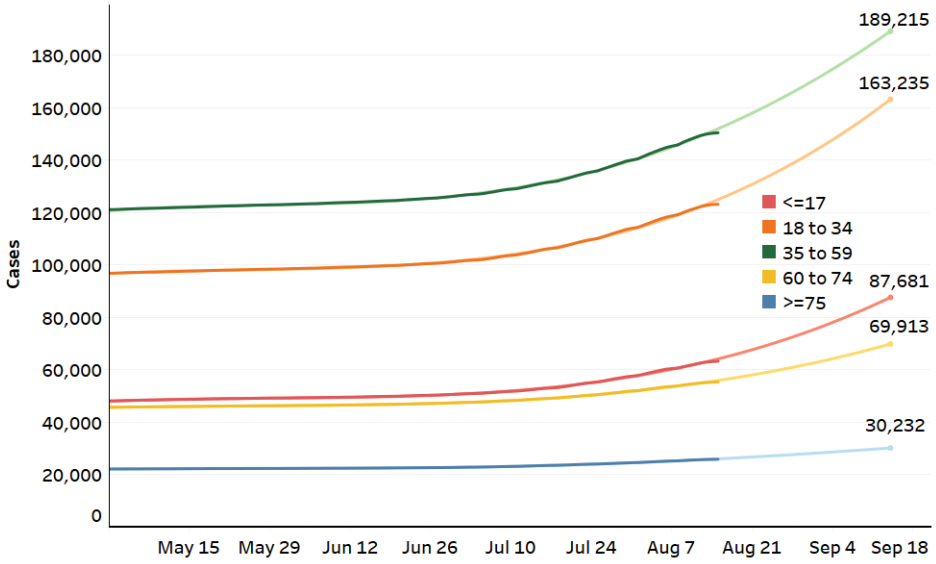
Figure 5a *Cumulative* *COVID-19 cases by age through Aug. 30*



Relative change in COVID-19 cases by county. Map 4, on the next page, shows the relative change in cases for each Arkansas county. Relative change is determined by calculating the percent change between cases during the most recent two-week period, Aug. 1 through Aug. 15, to cases from the prior two-weeks, July 16 through July 30.

During the most recent two weeks, the relative change in cases is somewhat mixed across the state, and similar to patterns we saw earlier in the pandemic. Fourteen counties had relative increases greater than 25%, shown in blue. Twenty counties had relative decreases in cases. However, this must be considered in light of the number of cases per county. For example, Pulaski County, which showed a 5% relative decrease in counties still has a very high caseload.

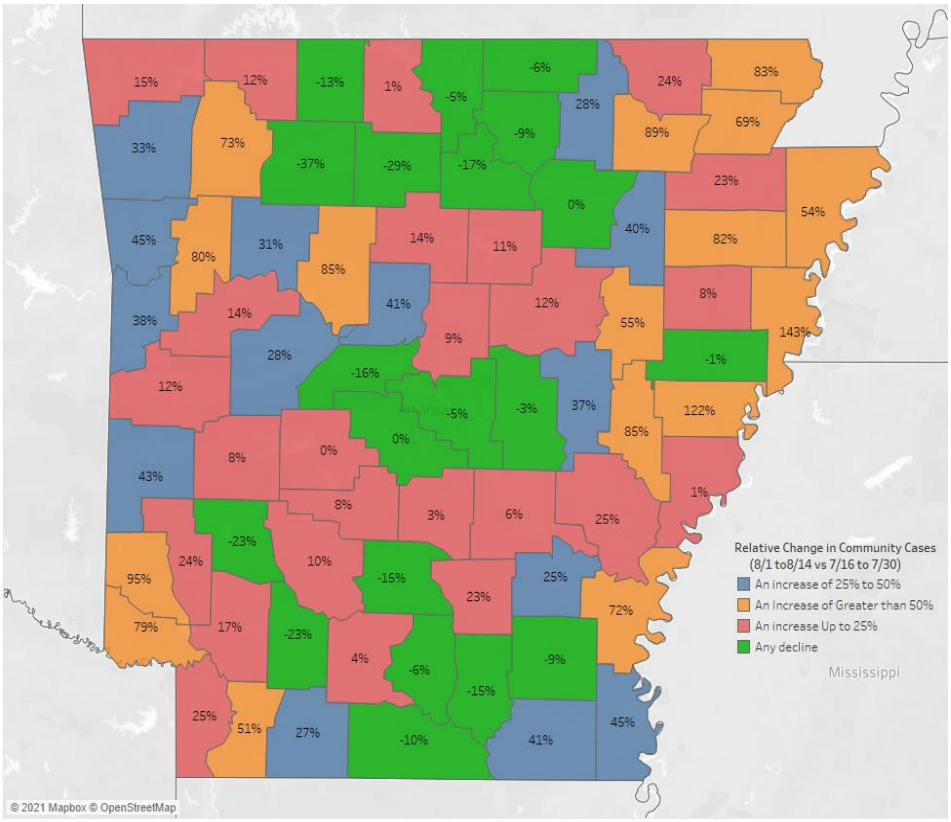
Figure 5b *Cumulative COVID-19 cases by age through Sept. 14*



As shown on Map 5, on the next page, all counties in Arkansas had substantial case rates per 10,000 in the last two weeks. Case rates range from 45 to 139 cases per 100,000. This is significantly different than what was seen in the July report, as only two counties had per capita case rates greater than 30 per 10,000.

Summary. The 15-day and 30-day models forecast increasing COVID-19 cases between Aug. 15 and Sept. 13 at a very high rate. Of course, the high average counts are due to the infectivity of the Delta variant. When considering the forecasts, it is important to not give less credence to the forecast numbers as to the trend of the cases. The forecast number on any given day is likely to vary from actual cases recorded. This is not particularly important. What is important is the overall trend. For the next month, the models are showing is sharply upward trends in cases.

Map 4 Relative change in *COVID-19 cases*

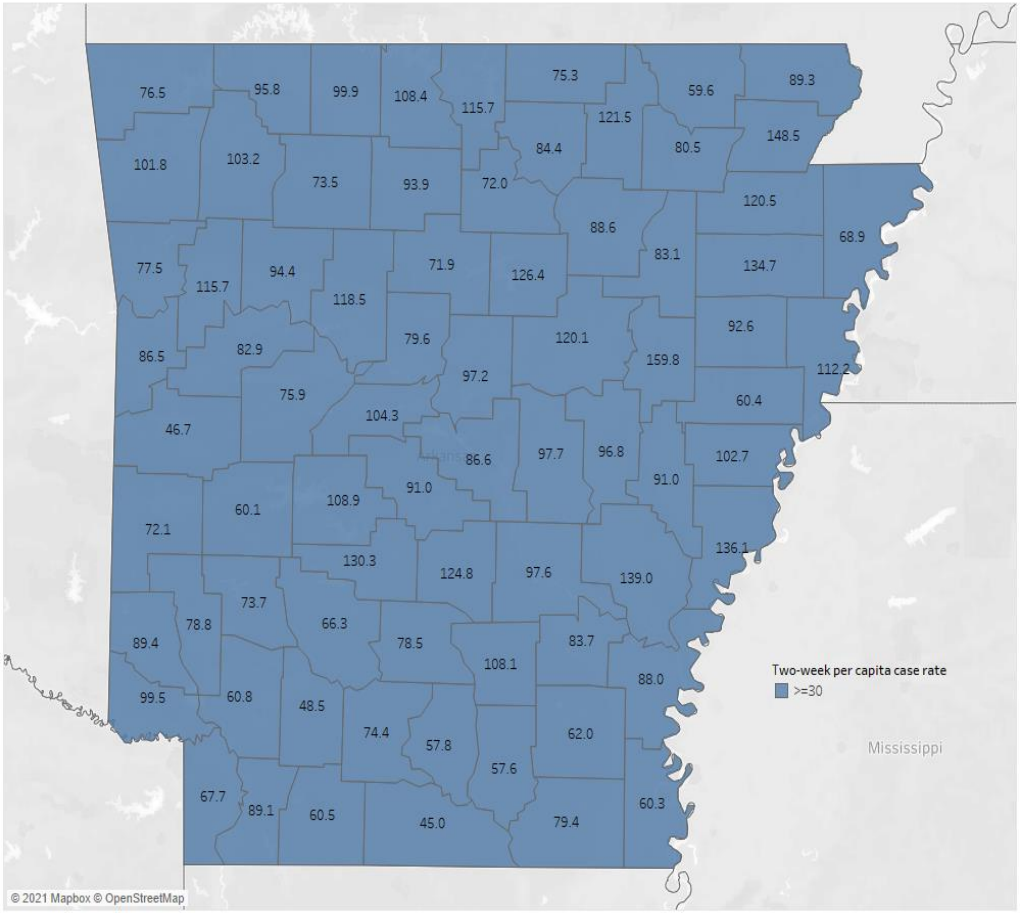


The greatest number of new cases will continue to be in adults between 34 and 59. However, all age groups are forecast to have growth. Forecasts are made based on existing data. What the data cannot take into account are changing conditions in the environment that influence growth or decline in cases. The major change in Arkansas' environment

in the last week has been the opening of schools and colleges. Given that young adults 18 to 34 and children under 17 are the least vaccinated groups in the state this could lead to higher growth in cases due to school exposure. There also is the Labor Day holiday weekend at the beginning of September. And, if we have learned nothing else since the beginning of the pandemic, COVID-19 loves holidays. Our expectation is there will be a surge of infections beginning five to 10 days after classes begin and another after the holiday weekend.

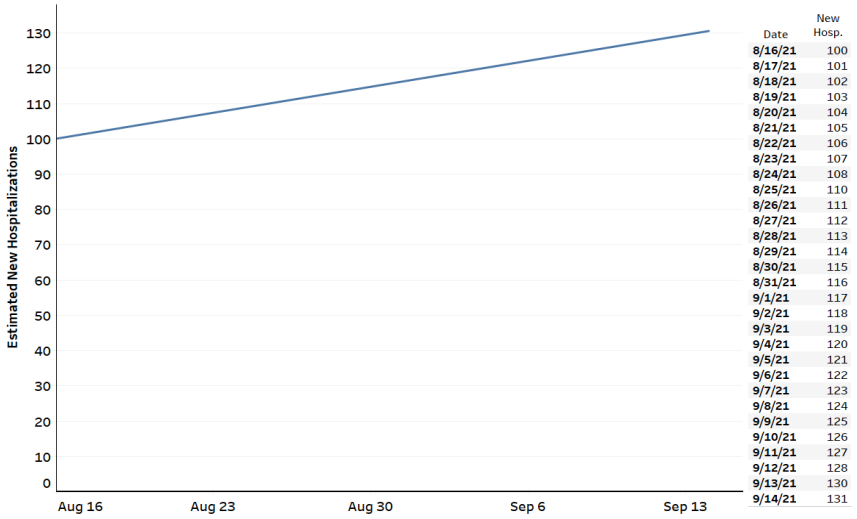
A large number of counties in the state report relative growth in cases greater than 100% in the past two weeks. This strongly suggests widespread community transmission throughout the state. There is no apparent difference between rural/urban counties. Given low vaccination rates in the state, as shown below, we cannot see a reason this rapid spread of COVID-19 in the state will change in the next two months.

Map 5 *COVID-19 two-week per capita case rate*



COVID-19 hospitalizations and need for ICU

Figure 6a *New daily hospitalizations through Sept. 14*



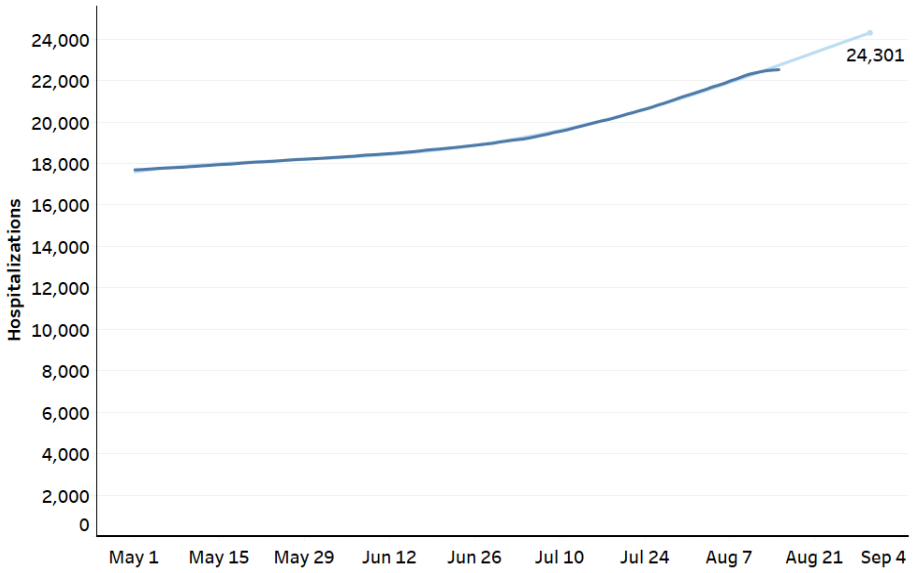
Date	New Hosp.
8/16/21	100
8/17/21	101
8/18/21	102
8/19/21	103
8/20/21	104
8/21/21	105
8/22/21	106
8/23/21	107
8/24/21	108
8/25/21	110
8/26/21	111
8/27/21	112
8/28/21	113
8/29/21	114
8/30/21	115
8/31/21	116
9/1/21	117
9/2/21	118
9/3/21	119
9/4/21	120
9/5/21	121
9/6/21	122
9/7/21	123
9/8/21	124
9/9/21	125
9/10/21	126
9/11/21	127
9/12/21	128
9/13/21	130
9/14/21	131

15 & 30-day forecasts of hospitalizations.

Figure 6a shows the realized rate of new hospitalizations in Arkansas between Aug. 16 and Sept. 14. As is easily discernable from the figure, there is a linear trend in daily new hospitalizations, increasing from approximately 100 new patients daily to 131 by Sept. 14.

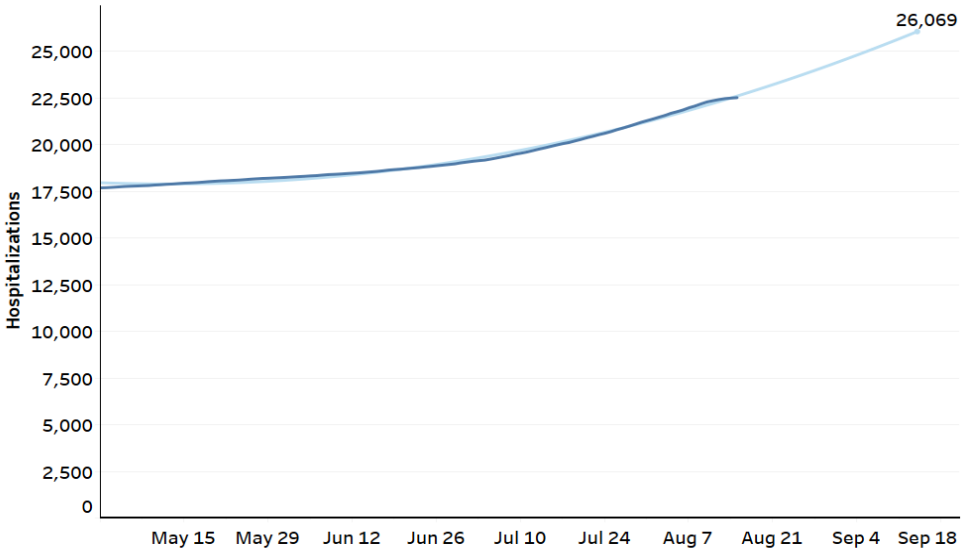
The value regularly cited and discussed in news articles includes the number of currently hospitalized COVID-19 patients. This is an important number for understanding the current utilization of hospital personnel and resources; however, an equally important number to focus on is the number of cumulative hospitalizations, noted as "ever hospitalized" in the daily reported values. This value is increasingly important to consider as hospitals reach maximum capacity. That is, current hospitalization counts will remain relatively stable — all beds are full, so the number of currently hospitalized cannot increase much farther. What is less discussed is the number of "ever hospitalized" patients, which is also continuing to increase. Let's consider Aug. 20-21. On Aug. 21, ADH indicated a decline of 35 currently hospitalized patients. That is excellent news for hospital capacity in Arkansas; however, the number of "ever hospitalized" (cumulative hospitalizations) changed from 20,423 to 20,545, suggesting 122 additional individuals who were hospitalized for COVID-19. As hospitals attempt to push less severe COVID patients out of the inpatient setting to treat more severe patients, there is more churn in the currently hospitalized patients, suggesting that we should consider to evaluate the cumulative hospitalization values to obtain an accurate picture of the disease burden in Arkansas.

Figure 6b *Cumulative Hospitalizations through August 30*



The 15-day forecast for COVID hospitalizations is shown in Figure 6b. The model forecasts a total of 24,301 cumulative

Figure 6c *Cumulative Hospitalizations through Sept. 14*

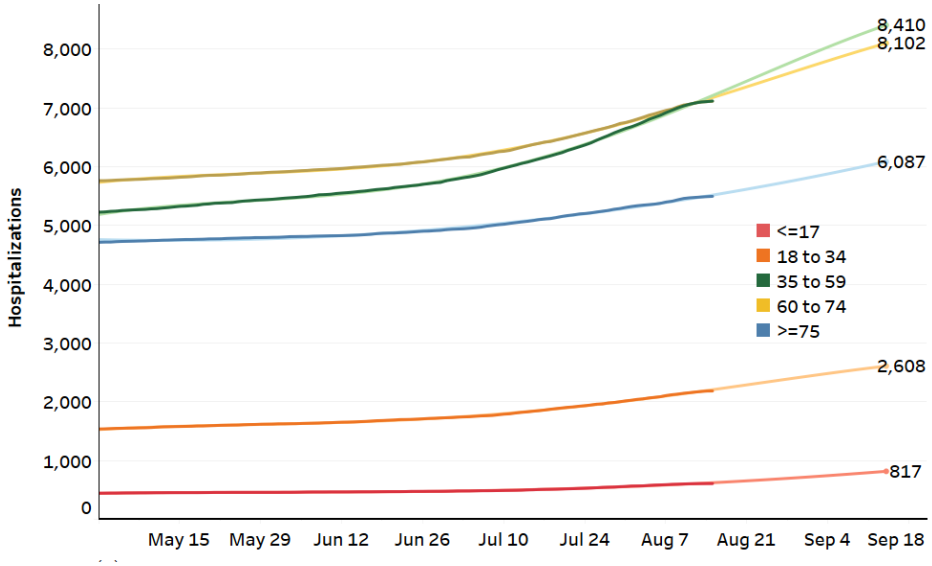


hospitalizations by Aug. 30. The model forecasts an increase of 4,106 hospitalizations by Aug. 30, or an average of 267 new hospitalizations per day. The 30-day model, shown in figure 6c, shows cumulative hospitalizations in the state will grow to approximately 26,000 by Sept. 14, an increase of approximately 2,000 hospitalizations over the Aug. 30 forecast.

There also is strong evidence that there will be an upward trend in the numbers of patients needing intensive care (data not shown). The 15-day model is forecasting 6,399 cumulative COVID-19 intensive care patients by Aug. 30, an increase of 287 over the number on Aug. 15.

Figures 7 shows the 15-day forecast of hospitalizations by age through Aug. 30. It is evident in the forecast that hospitalizations in all age groups will increase, although much more slowly in adults over 75.

Figure 7 *Cumulative hospitalizations by age group through Aug. 30*



The largest relative increase in hospitalizations will be in children. The 15-day model forecasts the number of children hospitalized will increase by 20% through Aug. 30 and 34% through Sept. 14. The smallest increase in hospitalizations will be in adults 74 and older, with relative increases of 5% and 11% respectively.

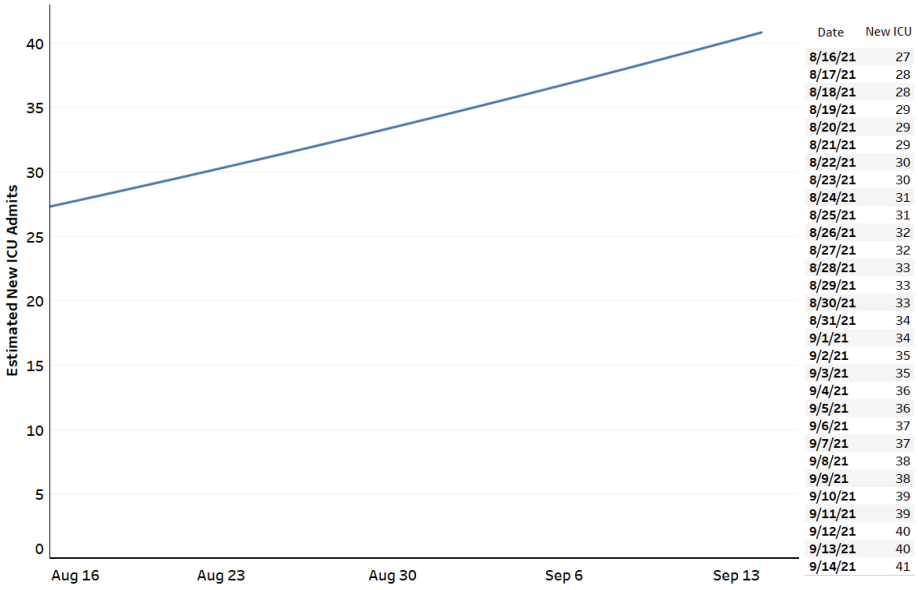
As shown in Figure 8 on the next page, new ICU admissions will continue to increase linearly between Aug. 16 and Sept. 14. The model suggest there will be 41 new ICU admissions on Sept. 14, almost doubling the number of Aug. 16.

Summary. The conclusion we reach from the 15-day models is that hospitalizations will continue to increase, and the slopes of the models show we are in the midst of exponential growth. The 15-day models forecast the greatest number of hospitalizations due to COVID-19 will be in adults 35 to 59. We

also should expect significant increase in the number of hospitalizations of young adults 18 to 35 and children. This is consistent with the expectation that the Delta variant is having a greater impact on younger adults.

We should expect to see greater numbers of young adults,18 to 34 and children under 17 hospitalized. Presently, numbers remain relatively small with respect to total hospitalizations. However, with the opening of classes and the lack of effective mask mandates at all schools and universities, we should expect hospitalizations to increase. As we said earlier, with the opening of schools and colleges, transmissions will increase.

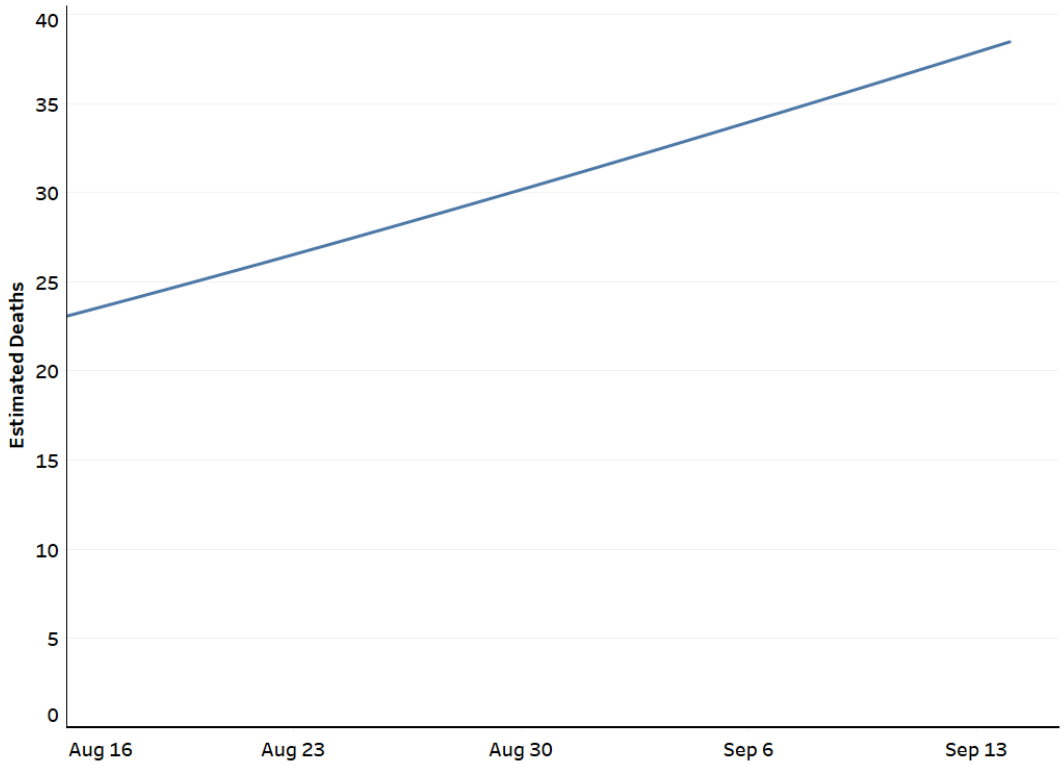
Figure 8 *New daily ICU admissions through Sept. 14*



Date	New ICU
8/16/21	27
8/17/21	28
8/18/21	28
8/19/21	29
8/20/21	29
8/21/21	29
8/22/21	30
8/23/21	30
8/24/21	31
8/25/21	31
8/26/21	32
8/27/21	32
8/28/21	33
8/29/21	33
8/30/21	33
8/31/21	34
9/1/21	34
9/2/21	35
9/3/21	35
9/4/21	36
9/5/21	36
9/6/21	37
9/7/21	37
9/8/21	38
9/9/21	38
9/10/21	39
9/11/21	39
9/12/21	40
9/13/21	40
9/14/21	41

COVID-19 Deaths

Figure 9a *New daily COVID-19 deaths through Aug. 19*

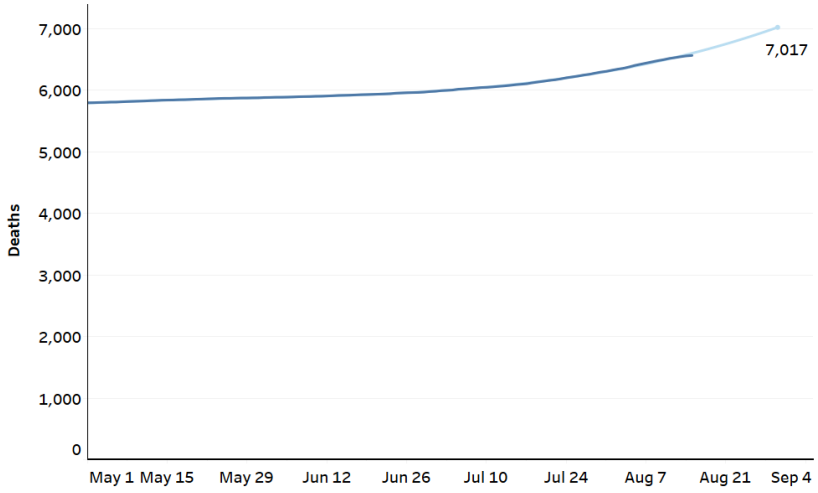


Date	Deaths
8/16/21	23
8/17/21	24
8/18/21	24
8/19/21	25
8/20/21	25
8/21/21	26
8/22/21	26
8/23/21	27
8/24/21	27
8/25/21	28
8/26/21	28
8/27/21	29
8/28/21	29
8/29/21	30
8/30/21	30
8/31/21	31
9/1/21	31
9/2/21	32
9/3/21	32
9/4/21	33
9/5/21	33
9/6/21	34
9/7/21	35
9/8/21	35
9/9/21	36
9/10/21	36
9/11/21	37
9/12/21	37
9/13/21	38
9/14/21	38

15-day forecast of COVID-19 deaths. The realized rate of new COVID-19 deaths in Arkansas from Aug. 16 to Sept. 14 shows the same linear trend as cases and hospitalizations. There is a clear linear upward trend in the two-week period. On Aug. 14, the model suggests Arkansas will have 38 new deaths due to COVID-19.

The 15-day model forecasts 7,017 cumulative deaths in Arkansas due to COVID-19 by Aug. 30, or approximately 30 deaths from COVID-19 per day.

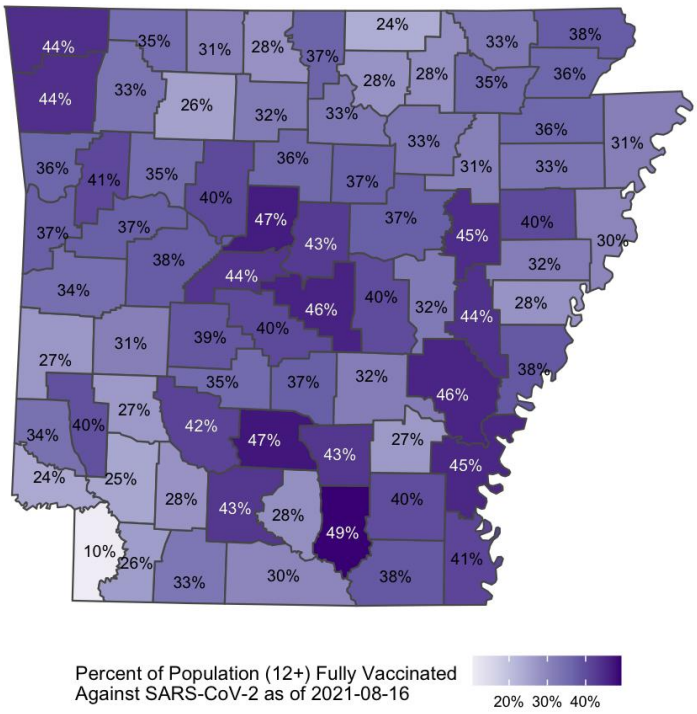
Figure 9b *Cumulative COVID-19 deaths through Aug. 30*



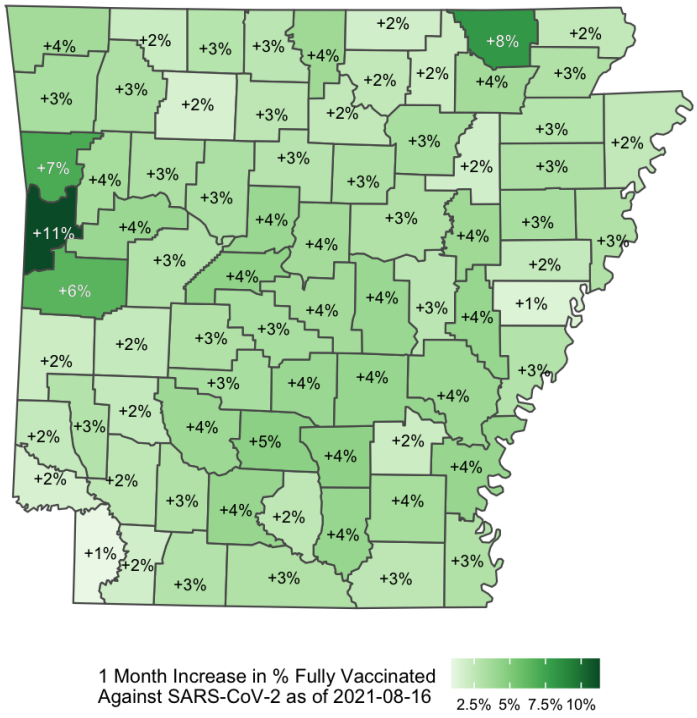
Summary. Consistent with cases and hospitalizations over the last two weeks, the number of daily deaths from COVID-19 is trending upward. Deaths lag both cases and hospitalizations. Increases in cases in the past two weeks will result in increases in deaths in the next two weeks. Despite deaths due to COVID-19 crossing the 7,000 threshold, the number of deaths due to COVID-19 could be much higher. Improvements in care of COVID-19 patients has significantly decreased the number of patients succumbing to the disease.

COVID-19 Vaccination.

Map 6 *Percent of the population (12+) fully vaccinated*



Map 7 *Percent change in fully vaccinated (12+) in the past month*



Map 6 shows the percentage of the fully vaccinated population age 12 and over in each Arkansas county as of Aug. 16. Vaccination data were processed by Haley Hale using data available from the Arkansas Department of Health's website. There is still close to a five-fold difference between the county with the highest vaccination rate — 49% in Bradley County — and the lowest — 10% in Miller County. Demographically, Miller County looks like many other counties in Arkansas with much higher vaccination rates. 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 in the state 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 in July, Map 7 shows the counties making the most rapid progress toward vaccinating their populations. The counties with the highest one-month increase were Sebastian, Randolph, Crawford, and Scott counties, each showing an addition of six percent or more of its population. Even so, the rate of vaccination across the state remains low, with many counties increasing the numbers of vaccinations by only 2% or 3%.

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, ICU admissions, 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%. Although an antibody seroprevalence student recently was completed in the state, we have not yet had time to incorporate it into our modeling.

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

ICU = intensive care unit admission

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