

# Covid-19 Disease Outbreak Outlook

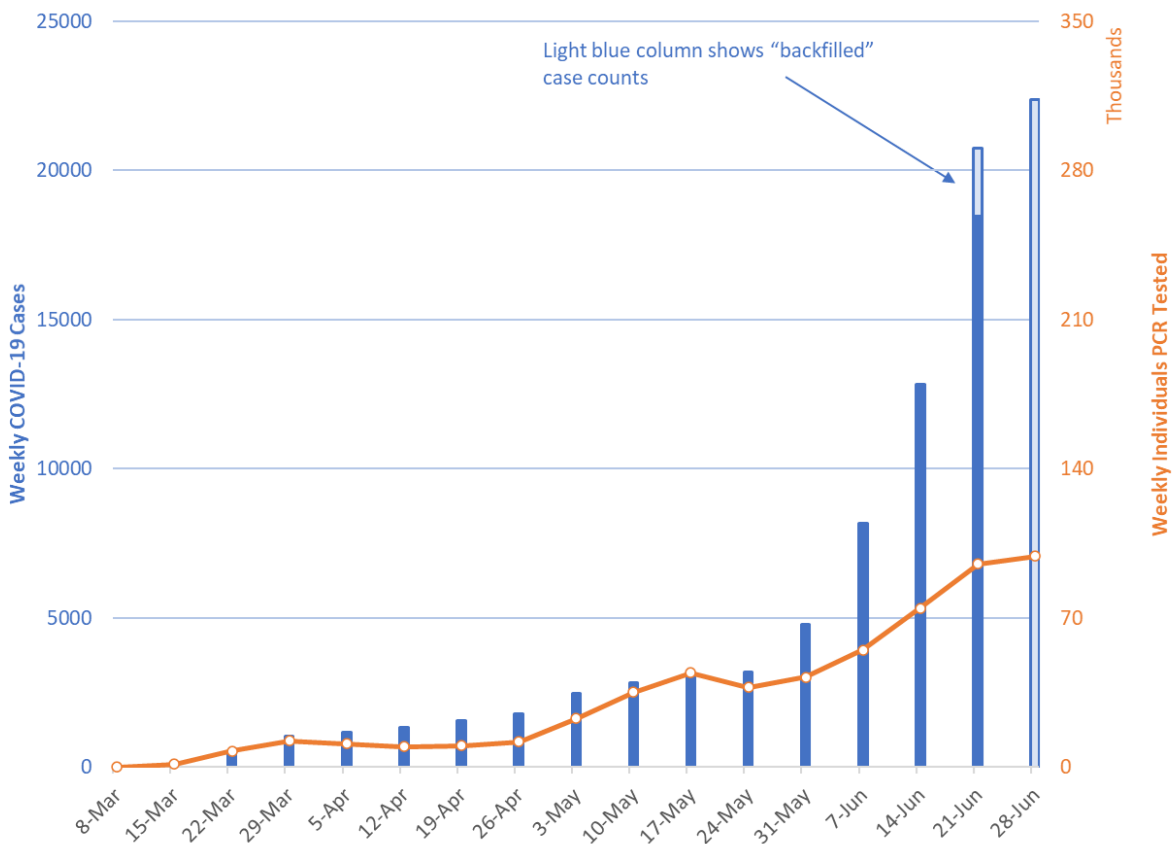
## Arizona State and Pima County

Updated July 3, 2020

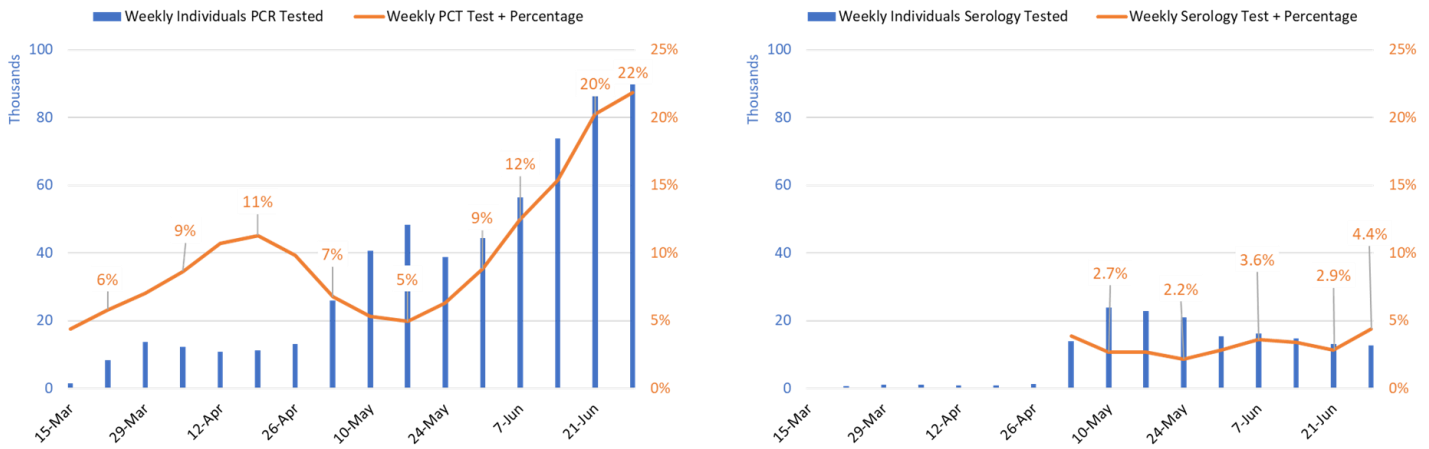
Disclaimer: This information represents my personal views and not those of The University of Arizona, the Zuckerman College of Public Health, or any other government entity. Any opinions, forecasts, or recommendations should be considered in conjunction with other corroborating and conflicting data. Updates can be accessed at <https://publichealth.arizona.edu/news/2020/covid-19-forecast-model>.

For the week ending June 28th, 22388 new Covid-19 cases were reported in Arizona (Figure 1). This is an 8% increase over last week’s revised tally of 20733 new cases. Assuming a similar revision or “backfill” next week, this marks the end of a 4-week period with 50 – 70% increases. Even with some “backfill,” this week’s smaller increase is unlikely to exceed 30% when revised. If sustained, this moderation of weekly increases provides evidence to substantiate that face mask ordinances are an effective public health response.

PCR testing capacity continues to increase; however, it is not keeping pace with viral transmission as the percent of patients testing positive has increased from a low 4.9% in mid-May to 21.8% this past week (Figure 2 following page). Unlike PCR testing, the number of patients undergoing serology testing is declining with the percent of patients testing positive increasing slightly to 4.5%. Because serology testing is not being conducted to capture a representative sample of Arizonans, these results are difficult to interpret except to note that there is a small, but growing pool of recovered individuals.

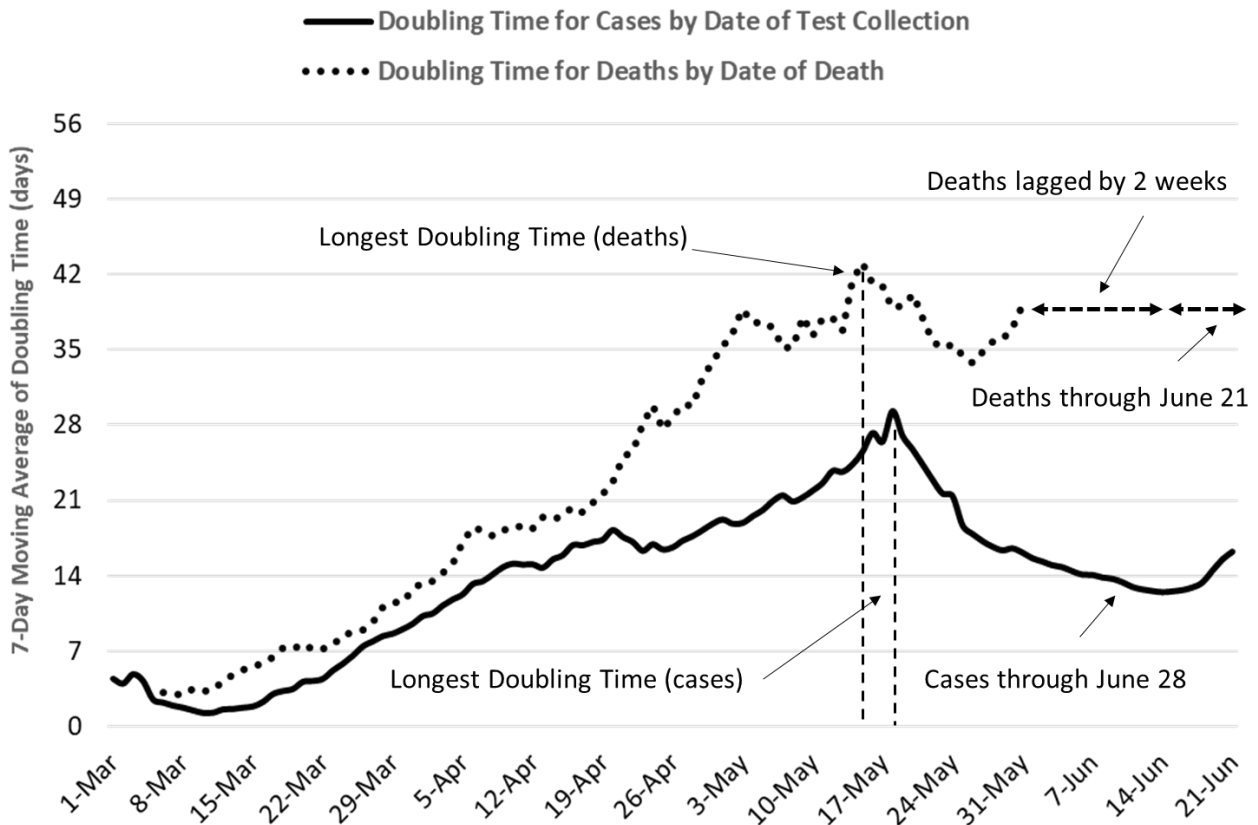


**Figure 1. Newly Diagnosed Covid-19 Cases in Arizona and Number of Individuals Tested through June 28**



**Figure 2. Weekly Number Patients Tested and Percent of Individuals with Positive Covid-19 PCR and Serology Results March 15 - June 28**

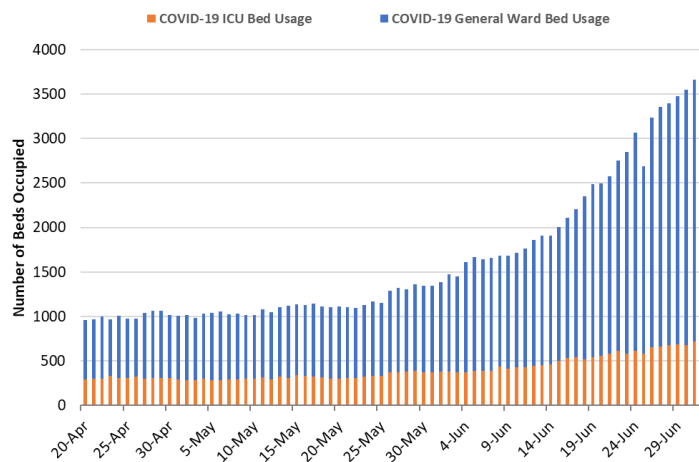
The 7-day moving average of doubling time for cumulative Covid-19 cases shortened from a peak of 29 days on May 25<sup>th</sup> to a trough of 14 days on June 21<sup>st</sup> (Figure 3). It is currently a bit longer at 16 days. The same metric for cumulative deaths has shortened from a high-water mark of 43 days on June 5<sup>th</sup> to a trough of 34 days on June 16<sup>th</sup>. It is currently a bit longer at 39 days. A longer offset for deaths is needed because of longer reporting delays for them than new cases. This week's lengthening of the doubling time for cases suggest that the pace of newly diagnosed cases, while still increasing, may not be increasing as quickly.



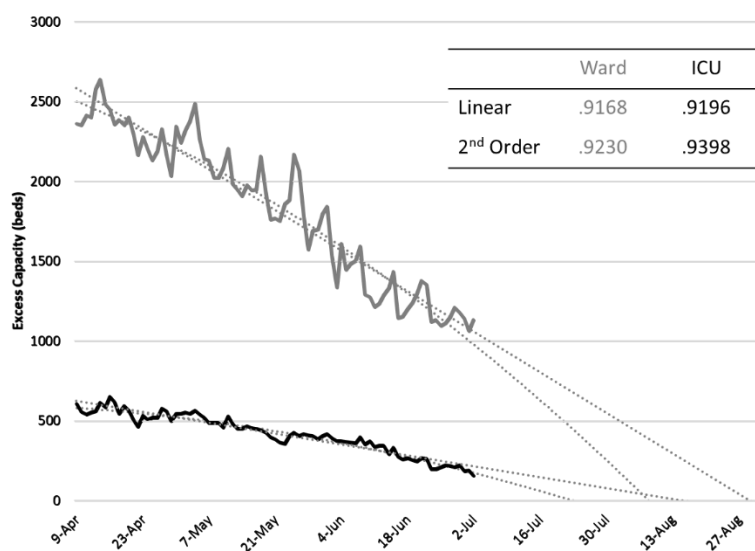
**Figure 3. 7-Day Moving Average of Doubling Time of Cumulative Cases through June 28 Superimposed on Lagged (2-week) Doubling Time of Cumulative Deaths through June 21.**

From a May 22 plateau to present, total Covid-19 hospitalization has increased 243% from 1093 to 3754 occupied beds (Figure 4). Increases in general ward occupancy have been greater than increases in ICU occupancy, 284% versus 140%, respectively. Because of a decline in non-Covid hospitalizations, all-cause occupancy has only increased 12% from 7173 to 8058 occupied beds (not shown). Continued increases in case counts are expected to drive additional hospitalizations for the foreseeable future.

As of July 2, 3013 (39%) of Arizona's 7673 general ward beds were occupied by patients with suspected or confirmed Covid-19 infection, a 19% increase from last week. An additional 1135 (15%) beds remain available which is up from last week's 1111 beds. Similarly, 741 (44%) of Arizona's 1676



**Figure 4. Arizona Daily Covid-19 General Ward and ICU Census April 20 – July 2.**



**Figure 5. Observed and Projected Excess Non-Surge General Ward and ICU Capacity April 20 – August 31.**

Hospital capacity is difficult to project because it can change in response to clinical efforts to conserve or “ration” capacity. For example, patients can be discharged from the ED or hospital with greater severity of illness or elective procedures could be postponed or shifted to outpatient facilities. On June 29th, [ADHS allowed hospitals to implement](#) crisis standards of care making these changes a bit easier to implement.

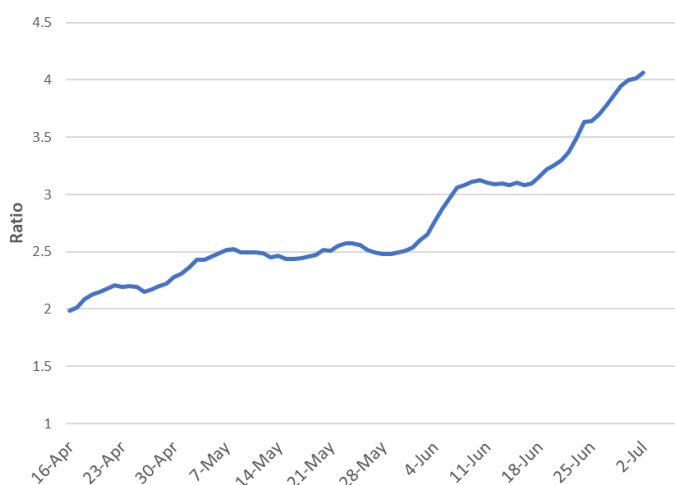
Alternatively, the younger age of patients during this second wave could shift care to lower acuity settings as suggested by greater increases in ward utilization relative to ICU utilization (Figure 6). Together, these factors mean that the relationship between bed capacity and new Covid-19 infections is changing over time.

Created by: Joe K. Gerald, MD, PhD (Associate Professor, Zuckerman College of Public Health, [geraldj@email.arizona.edu](mailto:geraldj@email.arizona.edu)) with gratitude to Patrick Wightman, PhD, MPP from the UA Center for Population Health Sciences for assistance with data analysis.

ICU beds were occupied for Covid-19 care, a 15% increase from last week. An additional 156 (9%) beds remain available which is lower than the 222 beds available last week. July 4<sup>th</sup> marked the first time that there were more Covid-19 occupied ICU beds (54%) than non-Covid beds.

Simplistic projections of non-surge general ward and ICU capacity suggest Arizona could reach ward capacity by mid-August (Figure 5). This projection is about two weeks later than estimated last week. Essentially, non-Covid admissions are falling somewhat faster than Covid-19 admissions are increasing as total ward capacity is relatively constant.

While the safety margin in ward beds is being better preserved, ICU capacity is now under greater strain. If current trends persist, excess ICU capacity could be exhausted by late July.

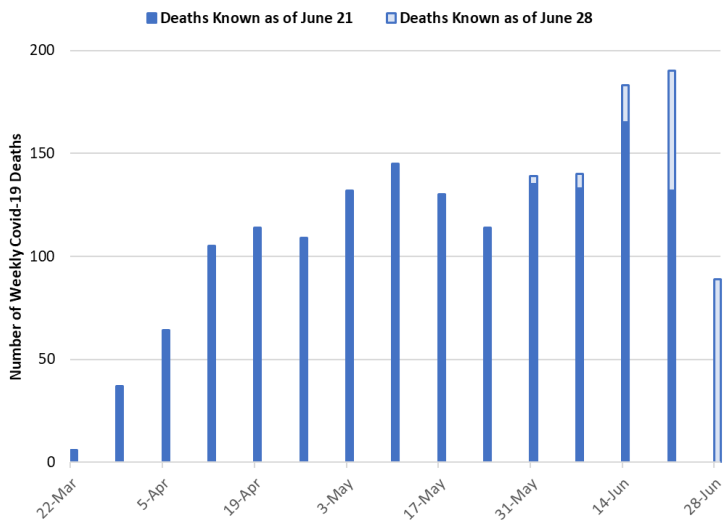


**Figure 6. Ratio of Daily Covid-19 General Ward and ICU Census April 20 – July 2.**

Because hospital capacity is difficult to predict and the effects of our most recent mitigation efforts (e.g., face mask ordinances, bar closures) are uncertain, hospital capacity could be exceeded on or before the projected date or not at all. Nevertheless, the possibility of doing so is supported by [CovidActNow](#), the [Institute of Health Metrics and Evaluation](#), and the [ASU Covid-19 Modeling Group](#). Given the profound consequences of exceeding our capacity to care for critically ill patients, our actions should be directed at preventing it from happening.

With 190 deaths reported to date, the week ending June 21<sup>st</sup> is now the week with the largest number of reported deaths (Figure 7). This is consistent with the recent increases in newly diagnosed cases. Given that case counts are continuing to increase, a larger number of deaths in the coming weeks is expected.

The Centers for Disease Control and Prevention (CDC) [aggregates various models](#) to provide a consensus view of the trajectory of new Covid-19 deaths nationally and in Arizona. These models also predict that cumulative deaths will continue to increase at roughly the same trajectory for the next 3 weeks.

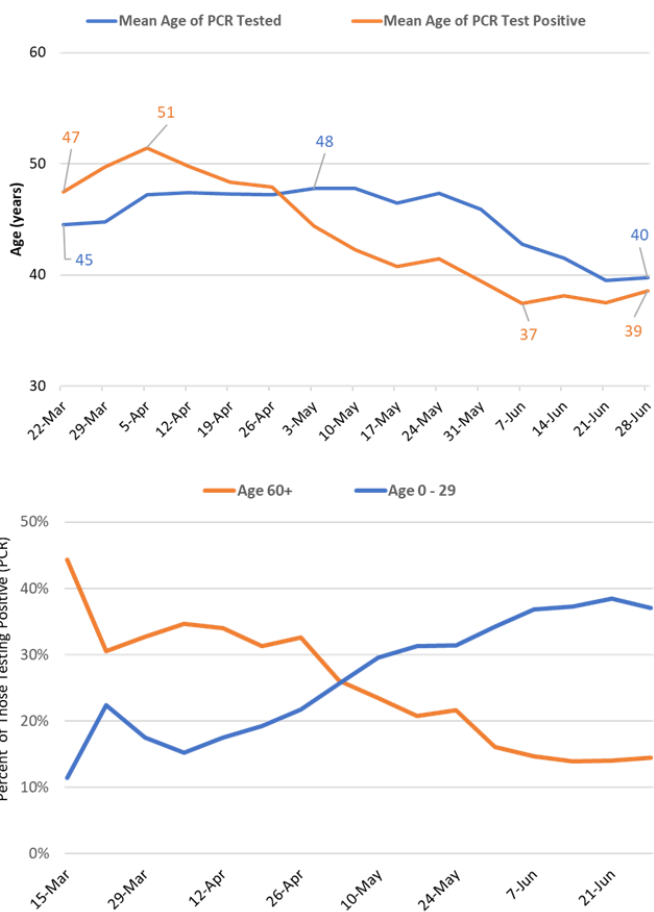


**Figure 7. Weekly Arizona Covid-19 Deaths March 1 – June 28 by Date of Death**

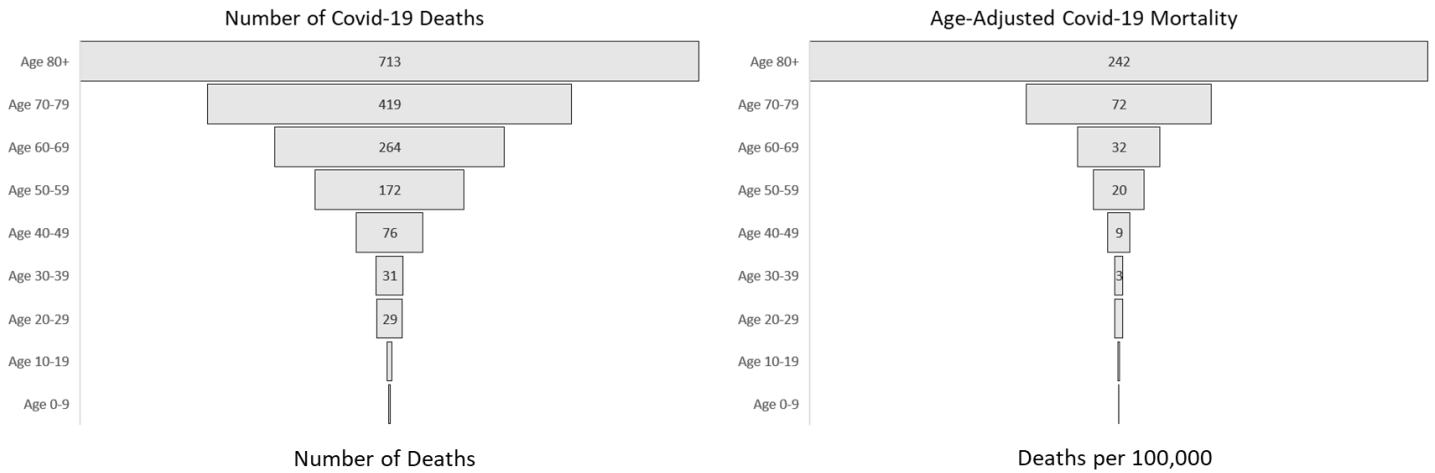
The mean age of newly identified cases declined from 51 years to 37 years from March to June; however, this trend has waned (Figure 8, top panel). Since the stay-at-home order was lifted, new cases have grown fastest among working-age adults 20 – 59 years of age, particularly among those 20 – 29 years. This change has meaningfully impacted the distribution of new cases by age. For every new diagnosis among someone under 30 years in March there were 4 diagnoses among those older than 60 years. Now, that ratio has essentially reversed (Figure 8, bottom panel).

This shift to a younger population has mitigated increases in deaths, and to a lesser degree, hospitalizations during this second wave. Now that this trend is waning, it will no longer ameliorate the impact of cases on deaths and hospitalizations going forward.

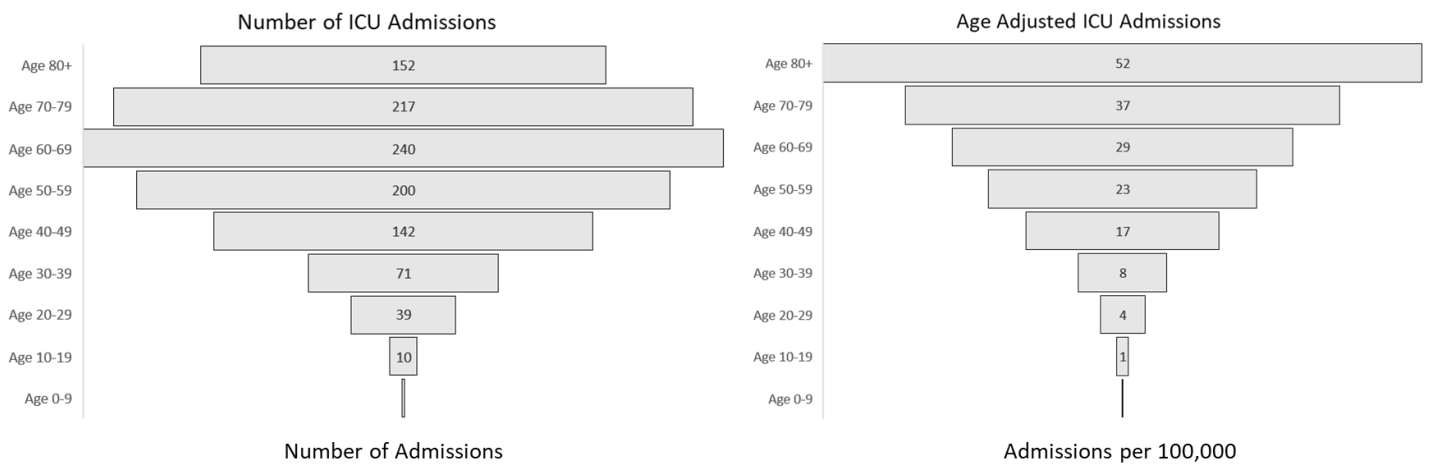
As mentioned in the last update, deaths and the risk of death has been concentrated among those 80 years and older with more than 40% of deaths occurring in that age demographic (Figure 9). However, age-related risk is weaker for ICU admissions and hospitalizations (Figures 10 and 11). This helps explain why hospital utilization, but not deaths, increased largely in parallel with high case counts during the second wave. Note: significant amounts of missing data underly Figures 9 – 11 making the numbers and rates unreliable; the comparisons across age groups are less affected.



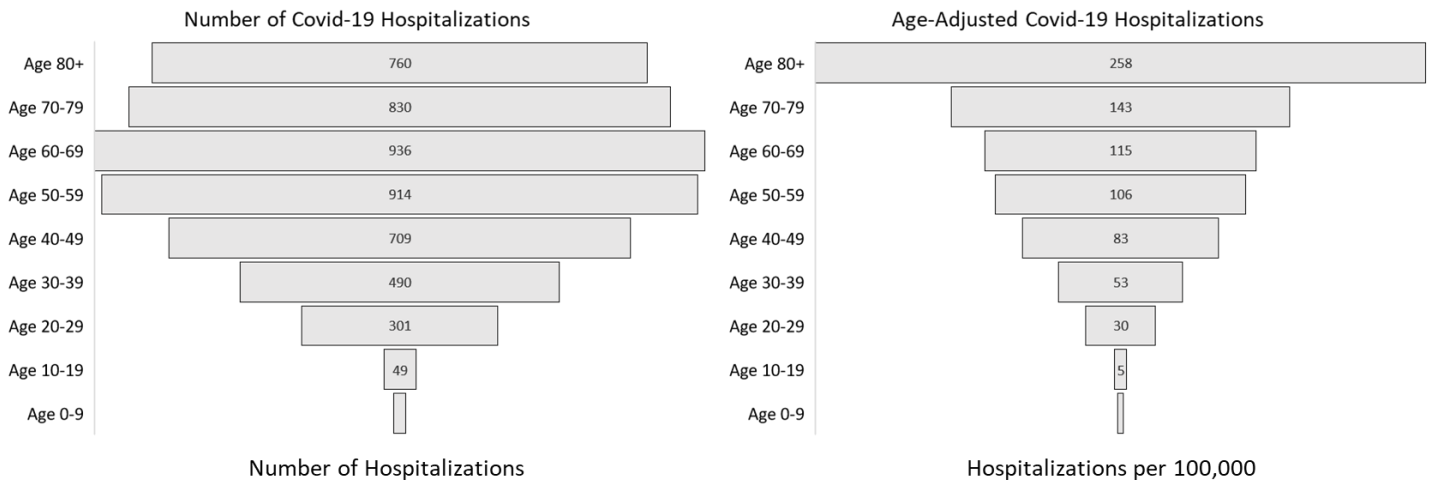
**Figure 8. Mean Age at PCR Testing and Mean Age of those Testing Positive (top) Proportion Testing Positive by Age (bottom) March 15 – June 21**



**Figure 9. Number of Covid-19 Deaths and Age-Adjusted Mortality in Arizona through June 28**



**Figure 10. Number of Covid-19 ICU Admissions and Age-Adjusted Admission Rate through June 28**



**Figure 11. Number of Covid-19 Hospitalizations and Age-Adjusted Hospitalization Rate through June 28**

**Note:** The numbers of deaths, ICU admissions, and hospitalizations are based on incomplete information obtained for case surveillance files; therefore, they significantly undercount actual events. However, the relative comparisons between age-groups should be mostly unaffected as missingness is not correlated with age.

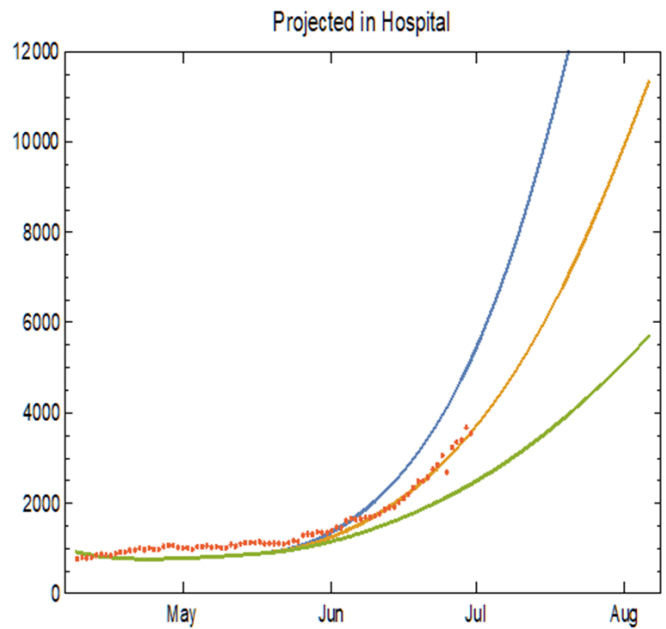
## Arizona State University Covid-19 Modeling and Evaluation Team (METAz) July 1 Update

A special thanks to my METAz colleagues who provided selected findings from their July 1st update. Updates can be found on the [ASU Biodesign Institute webpage](#). A [preprint](#) of their work with specific model specifications and additional results is also available.

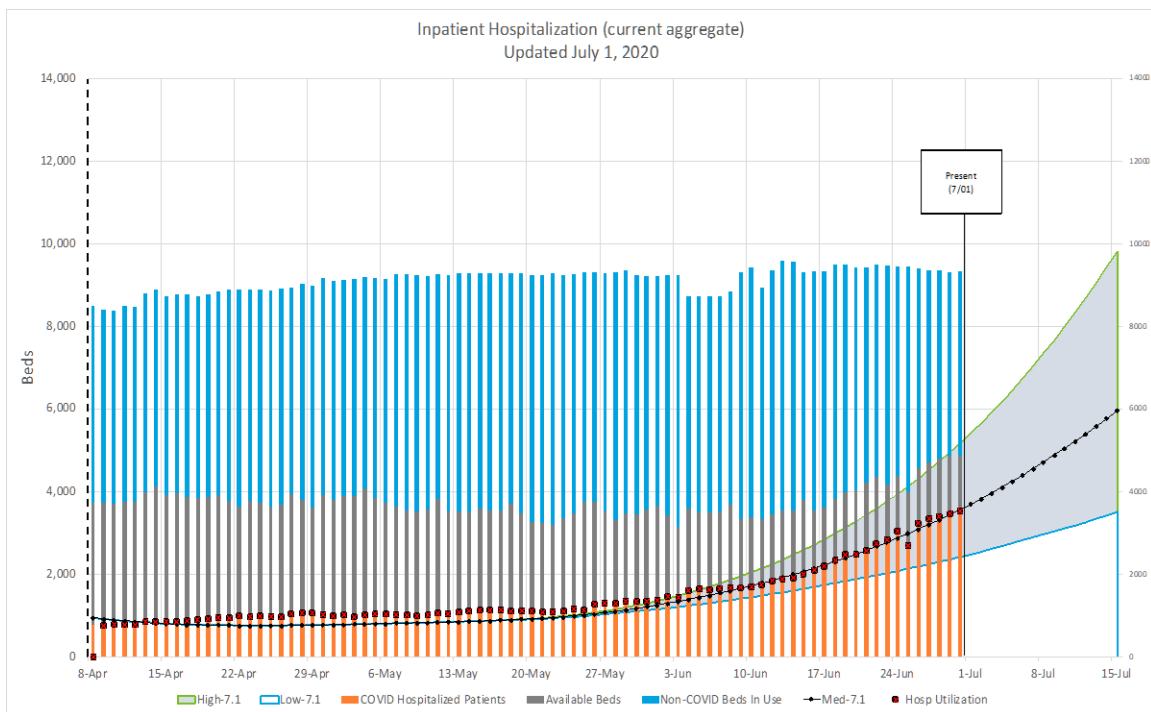
The METAz group has been using confirmed Covid-19 cases, hospitalizations, and deaths to inform an outbreak model. While these data have limitations, the ASU team has successfully developed an Arizona-specific epidemiological model to project future outcomes of interest (e.g., hospitalizations) and examine certain “what if” scenarios.

Their model assumes there is an underlying time-dependent viral transmission rate that can be discovered by “fitting” or calibrating their model to past events (e.g., case counts and mortality). This novel “backcasting” technique, which they developed, can then be used to estimate viral transmission rates during important historical periods.

For example, using Covid-19 mortality, they estimated that the viral transmission rate during Arizona’s stay-at-home order was 0.18. After reopening, it increased to 0.23. The transmission rate was similar, but slightly higher, 0.25, when fitted against new cases. Alternatively, it was slightly lower, 0.21, when fit against ICU admissions. When these rates (low, mid, high) are used to project future hospitalizations (Figure 12) they track quite well with existing hospitalizations to date (Figure 13).

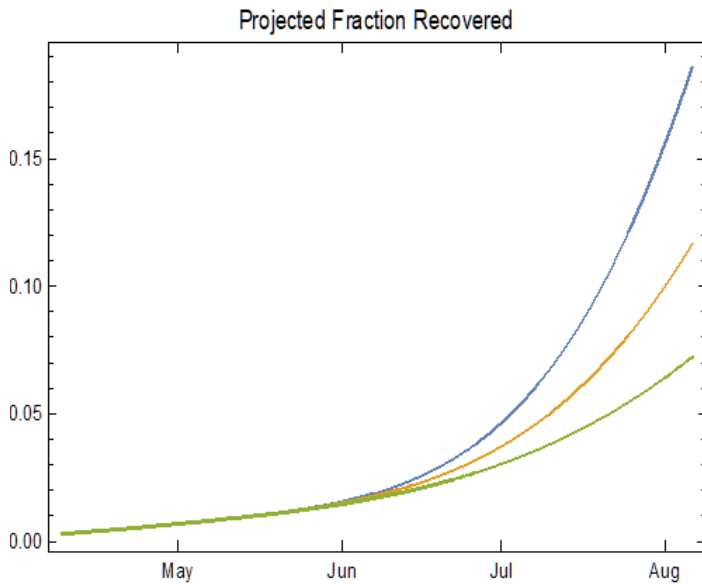


**Figure 12. Projected Hospital Occupancy based on Low (green), Mid (orange), and High (blue) Viral Transmission Rates (orange dots are actual**



**Figure 13. METAz Projections of Covid-19 Hospitalization through July 15 Overlaid on Actual Covid-19 Hospitalizations (orange columns) Thru June 28.**





**Figure 14. Projected Fraction Recovered from SARS-Cov-2 Infection based on Low (green), Mid (orange), and High (blue) Viral Transmission Rates**

The METAz team projects Arizona will reach 100% of existing hospital capacity in early-to-mid July absent further reductions in non-Covid hospitalizations or increased bed capacity. Regardless of the estimated viral transmission rate (low, mid, or high), Arizona hospitals will experience significant capacity constraints throughout July.

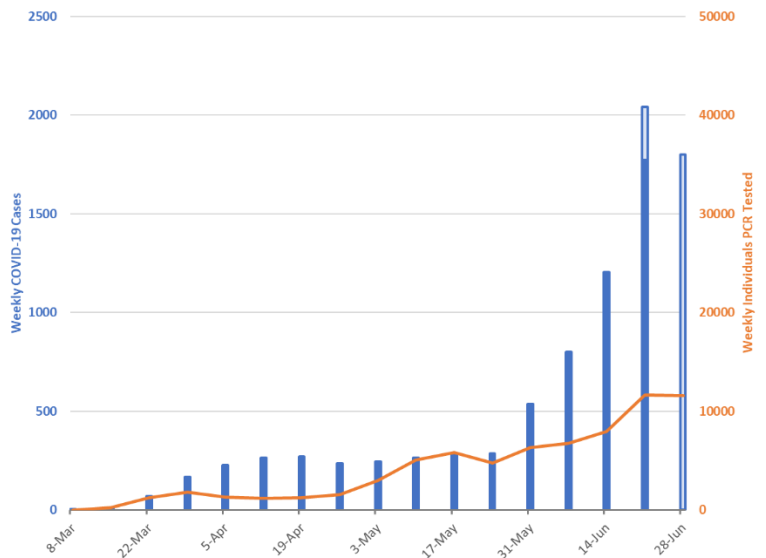
Their model can also estimate the fraction of Arizonans who have been infected with and recovered from Covid-19. At present, about 1.3% of Arizonans are actively infected including those who are asymptomatic; another 3.7% have recovered. Therefore, only about 3 - 5% of Arizonans have been infected as of July 1 (Figure 14).

These estimates can inform progress towards herd-immunity and the utility of using it as a policy response to the current outbreak. Their model estimates that at minimum 60% of Arizonans would need to have recovered from and been rendered immune to subsequent infection to slow viral transmission through herd immunity alone. At current transmission rates, it will take another year (350 days) to reach that point.

### Pima County Outlook

For the week ending June 28, there were 1799 newly diagnosed Pima County residents. This count is slightly lower than the prior week's revised count of 2042 new cases. However, last week's "backfill" represents 15% of the prior week's original total (Figure 15). If backfill is similar in the coming week, then the week ending June 28 could still exceed the prior week's count.

Nevertheless, there is still an indication that the pace of new case counts is slowing from prior trends. Given that Pima County and Tucson instituted face mask ordinances quickly after being permitted, it is additional evidence that they could be an important component of our public health response to coronavirus.



**Figure 15. Newly Diagnosed Covid-19 Cases in Pima County and Individuals PCR Tested through June 28.**

## Summary:

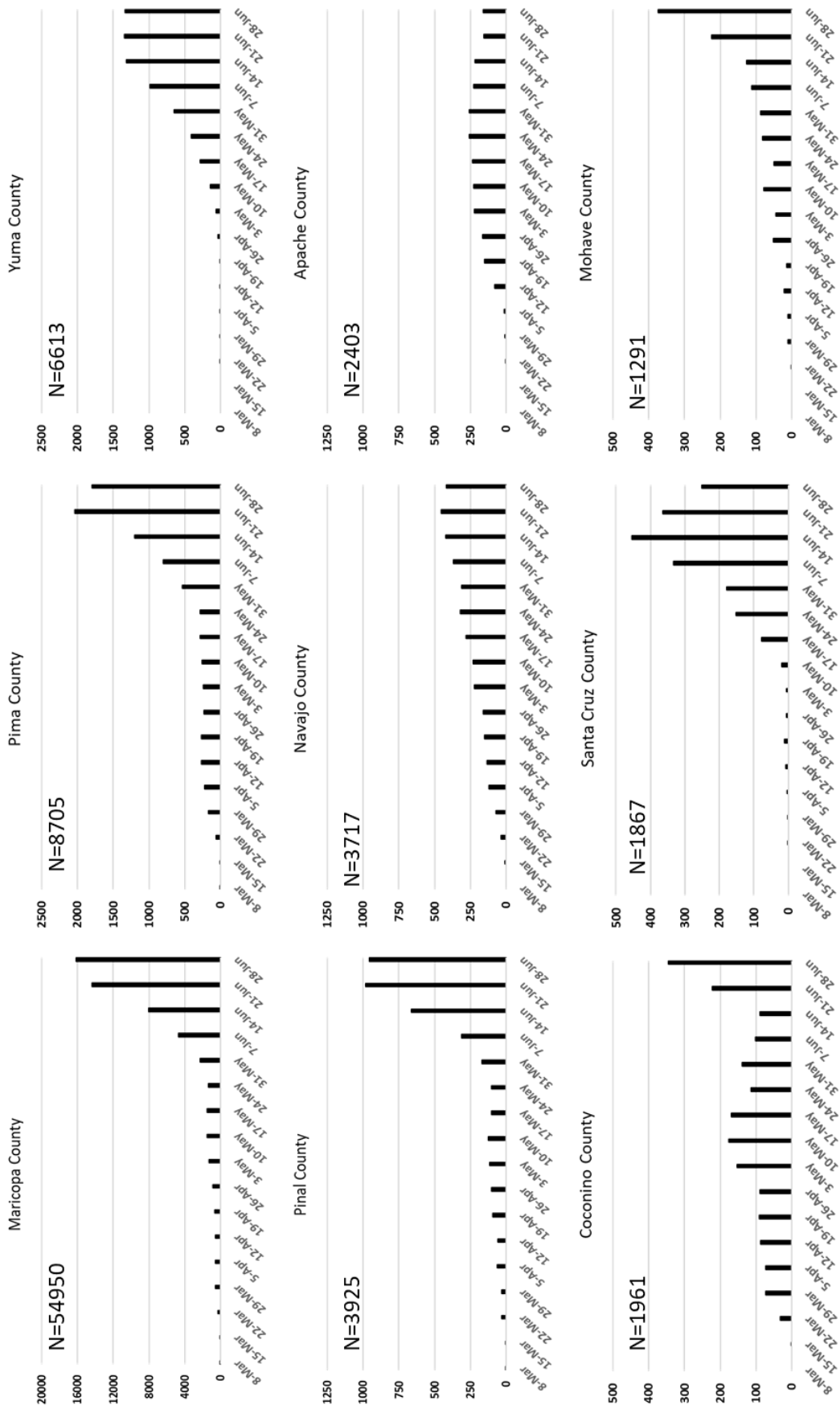
- While reported cases, hospitalizations, and deaths are increasing, there is evidence that the pace of community transmission is now slowing. This means that these metrics will continue to increase, but not as fast as before. While these trends differ somewhat by geographic region, Covid-19 remains widespread in Arizona.
  - Absolute levels of community-driven viral transmission have never been higher as evidenced by frequent daily and weekly record-setting numbers of newly reported cases.
  - For most locales, additional government-mandated social distancing restrictions and/or mask-wearing seem to be slowing the pace of community transmission. However, cases continue to increase indicating continued need for these restrictions for the foreseeable future.
  - While the outbreak had been changing such that new infections were shifting towards younger, working-age adults, this trend has abated. Therefore, future increases in cases will be more directly tied to increases in hospital utilization and deaths.
- Covid-related hospital utilization continues to increase while excess capacity is declining. Adequate capacity currently exists, but excess capacity could be depleted by mid-to-late July.
  - While past trends suggested general ward capacity might be reached before ICU capacity, the reverse appears to be true now. The greatest resource constraint is now ICU beds.
  - Some hospitals are already near or at capacity for ICU care; therefore, local conditions will provide a better indicator of capacity than state-wide trends.
  - Stated capacity may over-estimate actual capacity for structural reasons; therefore, surge beds may be needed sooner than expected.
- The number of Covid-19 tests is not keeping pace with rising case counts as evidenced by increasing PCR test positive rates. Positivity rates remain >3% indicating capacity is likely inadequate to meet clinical and public health demands. Test reporting lags appear to be about the same.

County-by-county trends in weekly Covid-19 diagnoses appear on the following page (Appendix Figure 1)

Next update scheduled for July 10.



Appendix Figure 1. Weekly Covid-19 Cases by County March 1 – June 28



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