

Covid-19 Disease Outbreak Outlook

Arizona State and Pima County

Updated June 26, 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 21st, 18476 new Covid-19 cases were reported in Arizona (Figure 1). Interestingly, more cases were identified this past week than during the 12 weeks between the outbreak’s start and the lifting of our stay-at-home order. Last week’s update reported 11862 new cases for the week ending June 14th, but that count has been revised upwards to 12732 cases which was smaller than last week’s revision indicating that reporting lag is about the same or slightly shorter.

Overall, 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 4.9% (May 17) to 20.0% this past week (Figure 2 following page). Unlike PCR testing, the number of patients undergoing serology testing is declining. The percent of patients testing positive this week was 2.6%. Because serology testing has not been deployed to yield representative results it is difficult to conclude anything except there is a small, but growing pool of recovered individuals.

Note: This week’s PCR and serology test positive values are reported by patient versus in previous updates when it was reported by specimen collected. This change did not impact general trends but did result in slightly higher values for the most recent weeks.

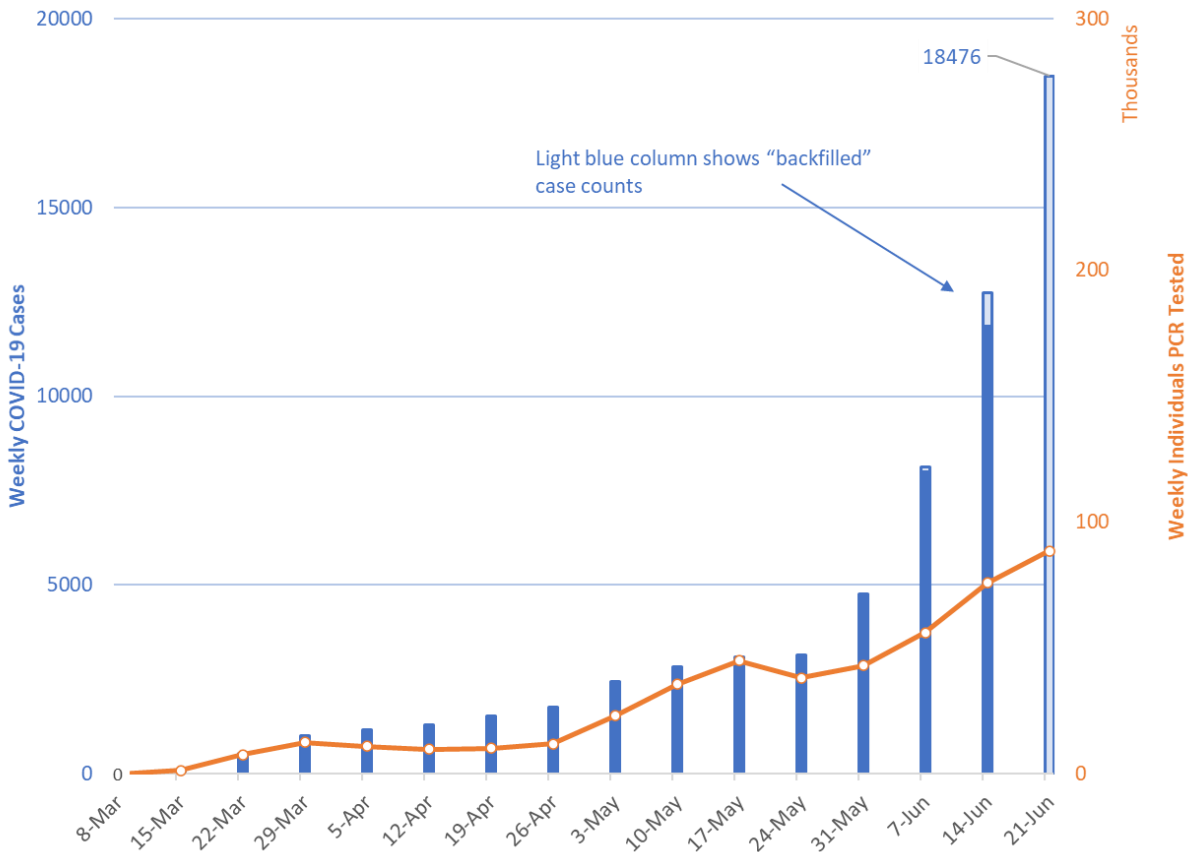


Figure 1. Newly Diagnosed Covid-19 Cases in Arizona and Number of Individuals Tested through June 21

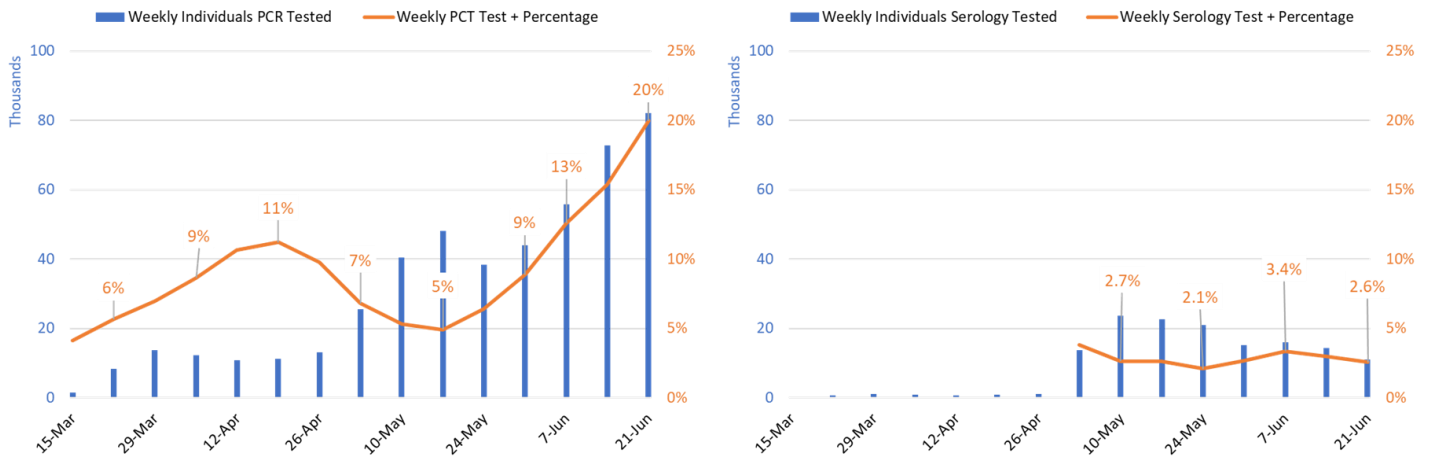


Figure 2. Patients Tested and Percent Specimens Positive for Covid-19 PCT and Serology Mar 15 - June 21.

The 7-day moving average of doubling time for cumulative Covid-19 cases has shortened from a peak of 29 days on May 25th to 14 days on June 21st (Figure 3). The same metric for cumulative deaths has shortened from a high-water mark of 45 days on June 5th to 38 days as of June 14th. A longer offset for deaths is needed because of longer reporting delays for them than new cases. This timing of this shortening, as well as the shortening itself, provides compelling evidence that community transmission is indeed increasing.

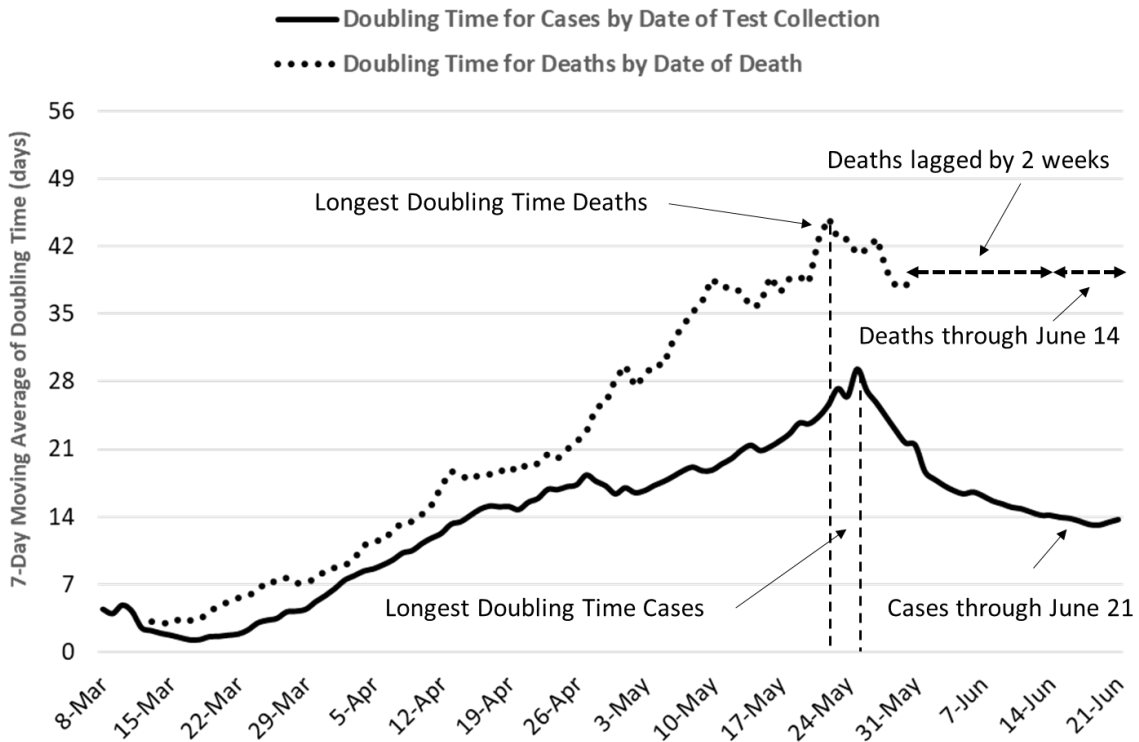


Figure 3. 7-Day Moving Average of Doubling Time of Cumulative Cases through June 21 Superimposed on Lagged (2-week) Doubling Time of Cumulative Deaths through June 14.

From a May 22 (plateau) to present (June 26), total Covid-19 hospitalization has increased 196% from 1093 to 3234 occupied beds (Figure 4). Increases in Covid-19 general ward occupancy have been greater than corresponding increases in ICU occupancy, 229% and 113%, respectively. Because of a decline in non-Covid hospitalizations, all-cause occupancy has only increased 22%, 7173 to 8082 occupied beds (not shown). Continued case counts increases are expected to drive additional hospitalizations for the foreseeable future.

As of June 26, 2577 (33.3%) of Arizona's 7734 general ward beds were occupied by patients with suspected or confirmed Covid-19 infection, a 33% increase from last week. An additional 1111 (14.3%) beds remain available which is down from last week's 1238 beds. Similarly, 647 (39.1%) of Arizona's 1681 ICU beds were occupied for Covid-19 care, a 20% increase from last week. An additional 222 (13.2%) beds remain available which is lower than the 257 beds available last week.

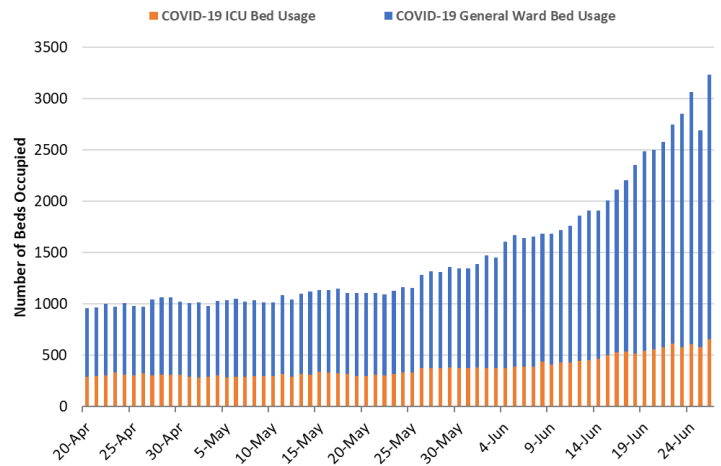


Figure 4. Arizona Daily Covid-19 General Ward and ICU Census April 20 – June 26.

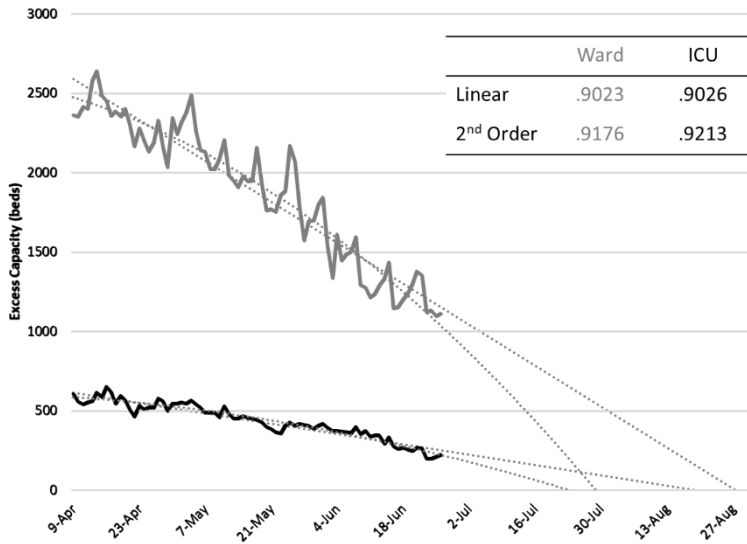


Figure 5. Observed and Projected Excess Non-Surge General Ward and ICU Capacity April 20 – August 31.

weeks to ensure further changes in clinical care do not compromise the quality of care. The possibility that Arizona might exceed its ICU capacity is supported by [CovidActNow](#) which shows markedly rising ICU utilization through early July. A similar projection is made by the [Institute of Health Metrics and Evaluation](#). Similarly, the latest [ASU Covid-19 Modeling Group](#) simulations suggest adequate short-term capacity, but similar trends.

As mentioned last week, focusing on “hard” capacity (e.g, ICU beds and ventilators) overlooks “soft” factors that are harder to measure, but may impose an equally important constraint (e.g., staffing, medications, and essential supplies). Furthermore, the reported capacity may overstate actual capacity. For example, hospitals with multiple ICU facilities have been “cohorting” patients with Covid-19 disease to minimize cross-infecting critically ill patients. Therefore, the hospital may report having some ICU bed availability, but this availability may apply to some patients but not others (e.g., a new Covid-19 patient cannot be admitted to a non-Covid ICU bed). Additionally, some critical care beds may be in units that are not staffed to provide care for general medical conditions (e.g., Covid-19) but rather to patients with special needs (e.g., trauma or neurosurgery). These factors may lead to the use of “surge” beds or rationing of care before reported capacity is exhausted.

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Simplistic projections of non-surge general ward and ICU capacity suggest Arizona could reach ward capacity by late-July (Figure 5). This is several weeks later than last week's estimate. A sharp decline in non-Covid care is mostly responsible for slowing the decline in excess capacity since total capacity is not expanding.

The clinical management of Covid-19 and non-Covid patients could be changing to conserve capacity. For example, patients could be discharged from the emergency department or hospital with greater severity of illness than before. Alternatively, some elective procedures could be postponed or shifted to outpatient facilities. Already [some hospitals are asking](#) the state to implement crisis standards of care.

Because mitigation efforts take 2 – 3 weeks to take effect, preventing a late-July overflow requires action be taken within the next several

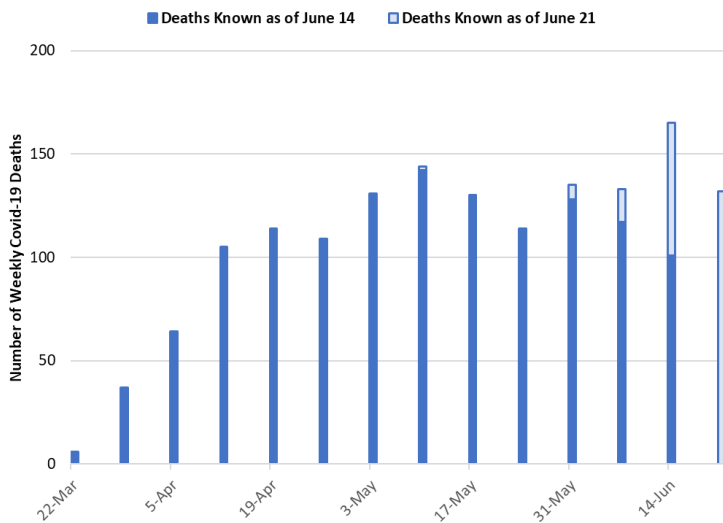


Figure 6. Weekly Arizona Covid-19 Deaths March 1 – June 21 by Date of Death

The week ending May 10th (142 deaths) is no longer the week with the largest number of reported deaths; it has been eclipsed by the week ending June 14th with 165 deaths (Figure 6). This is consistent with the shortening of the doubling time for cumulative deaths as illustrated in Figure 3. Given continued increases in case counts, 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 (Figure 7). These models predict cumulative deaths will continue to increase at roughly the same trajectory for the next 3 weeks.

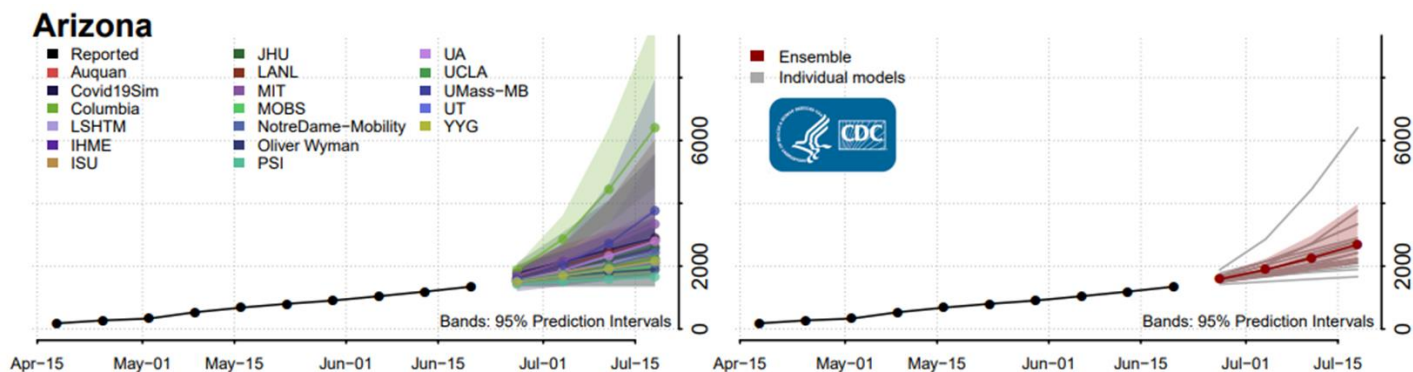


Figure 7. Centers for Disease Control and Prevention (CDC) Ensemble Forecast of Covid-19 Deaths in Arizona through July 15

Let us review some early-April projections from [CovidActNow](#) and [Institute of Health Metrics and Evaluation](#). While both organizations have dramatically changed their approach and presentation, it is worth evaluating how well their early hospital forecasts have fared over time (see also April 3rd and 8th Updates).

Figure 8 on the following page depicts 3 CovidActNow scenarios for Covid-19 hospitalizations: a limited social distancing (worst case) scenario and 3-months of sheltering-in-place with or without strict adherence. While most models performed poorly, the CovidActNow strict shelter-in-place scenario performed well until Arizona’s lifting of its stay-at-home order. On or about May 25th, there is a notable divergence between the CovidActNow strict adherence scenario and real life. The CovidActNow predicted a peak in hospitalizations on this date followed by a progressive decline assuming continued adherence with a 3-month shelter-in-place order. Instead, hospitalizations began a noticeable increase on this date following Governor Ducey lifting of the stay-at-home order 6-weeks earlier than recommended. We can only imagine what might have been if the order had been continued for the recommended duration.

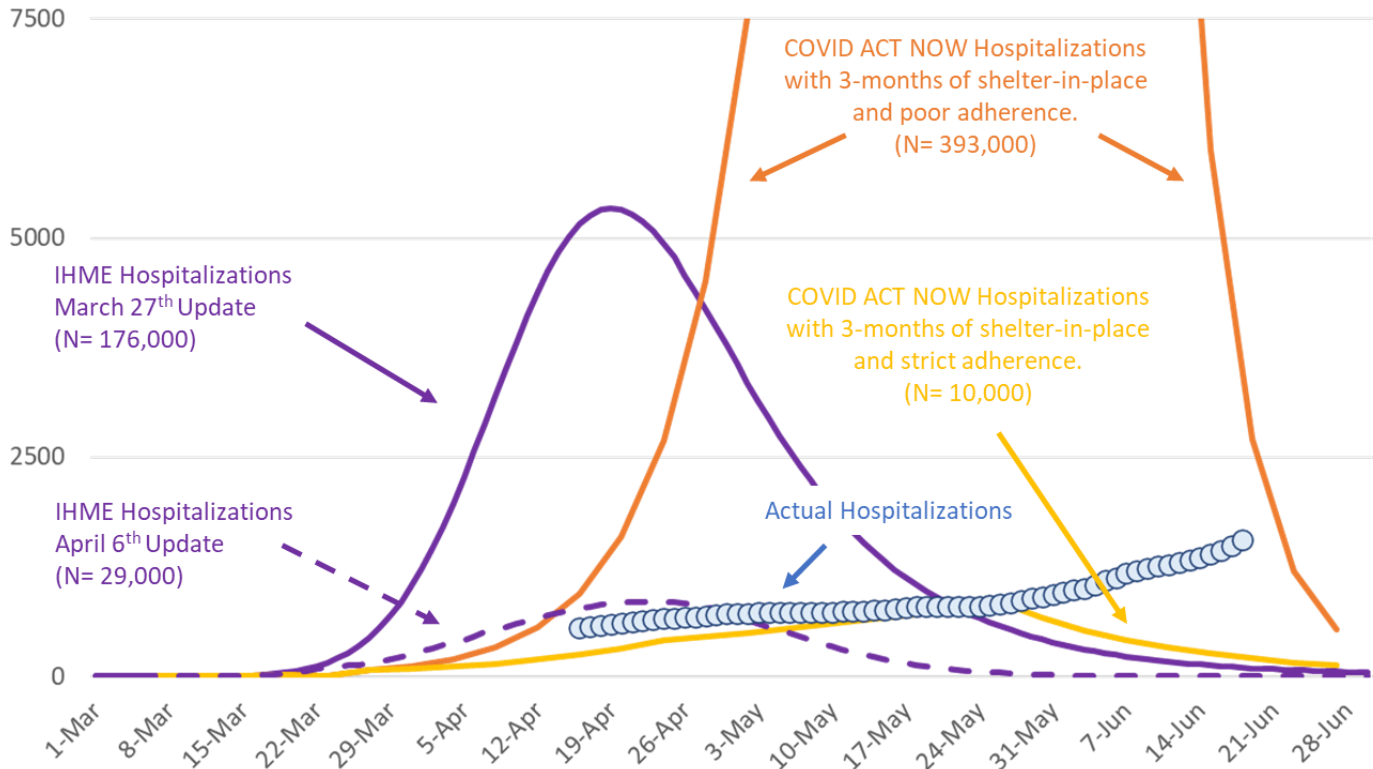


Figure 8. Arizona Covid-19 Hospitalizations as compared to Predicted Hospitalizations by Covid Act Now and the Institute of Health Metrics and Evaluation in Early April.

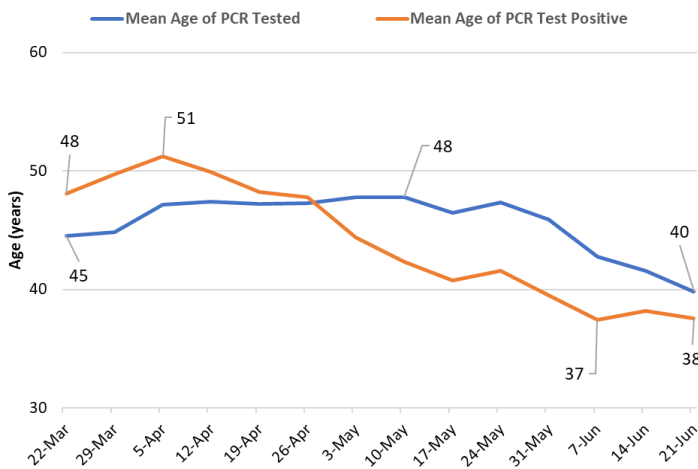


Figure 9. Mean Age at PCR Testing and Mean Age of those Testing Positive March 15 – June 21

Last week’s update discussed how the mean age newly identified cases has been declining over time, from 51 years in late March to 38 years in late June (Figure 9). The decline suggests different populations are at-risk now than before. Changes in cumulative incidence by age-group over time also demonstrate that infections among working-age adults has been driving the most recent surge (Figure 10, following page).

Cumulative incidence has grown fastest among working-age adults 20 – 59 years of age. While those age 20 – 29 have seen the largest increases in crude case counts, this growth is moderated somewhat when adjusted for population size. Of concern is the continued high age-adjusted rates among those 80+ years of age likely owing to spread within long-term care, skilled nursing, and

other residential settings. As reported elsewhere, crude and age-adjusted incidence are lowest among children. Somewhat unexpectedly, those aged 60 – 79 years of age seem to be faring better than average. This may be because they are better positioned to shelter-in-place than younger adults who must remain in the workforce.

Crude Covid-19 Cumulative Incidence by Age Group before and after May 24, 2020



Age-Adjusted Covid-19 Cumulative Incidence by Age Group before and after May 24, 2020

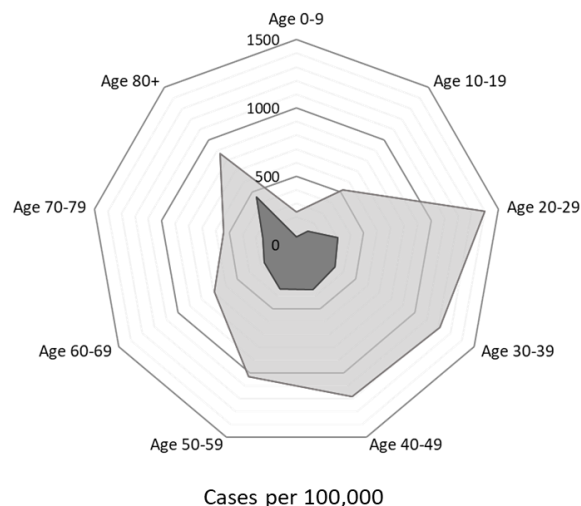


Figure 10. Crude and Age-Adjusted Covid-19 Cumulative Incidence in Arizona through June 21 bifurcated before (dark) and after (light) May 24, 2020.

Recently, [CDC Director Redfield suggested](#) that 10-times more people may have been infected than recognized by PCR testing. The UA / ASU / ADHS Covid-19 Modeling Group has discussed this factor and concluded that the multiple is likely to be lower, perhaps only 4X times known cases at this time. It is important to note that this multiple is not fixed; rather, it varies over time and is sensitive to changes in testing capacity relative to viral transmission.

Multiplying known cases by this factor can help gauge approximate prevalence and progress towards herd immunity. Once herd immunity is reached, perhaps 75% of the population infected and recovered, the outbreak's epidemic phase will end. No matter whether one used the lower or higher multiple, Arizona is far from achieving herd immunity. With such a large susceptible population remaining, conditions can get much worse than they are now (Figure 11).

Depending on which multiple is used (1X, 4X or 10X), the corresponding percentage of the population that has already been infected is 1%, 3% or 9%. While a colleague cautions against using serology to approximate prevalence, I'm going to throw caution to the wind. For the past 3 weeks, the percent of individuals testing positive after serology testing has been declining: June 7 (3.4%), June 14 (3.0%), and June 21 (2.6%). This suggests that a 10X multiple, yielding a 9% prevalence, is inconsistent with serology-estimated prevalence, about 3%, without a major flaw in our testing strategy (e.g., biased towards those least likely to be infected) and/or the test itself (e.g., low sensitivity).



Figure 11. Progress towards Herd Immunity (75%) with 4X and 10X Multiples of Cumulative Incidence

Examining deaths by age, both the numbers of deaths and the risk of death is concentrated among those 80 years and older as expected (Figure 12). To date, 43% of Arizona’s approximately 1500 Covid-19 deaths have occurred among those older than 80 years; the mortality rate for that age group is 222 per 100,000. This mortality rate is considerably higher than for those age 70 – 79 years (64 per 100,000) or age 60 – 69 years (28 per 100,000).



Figure 12. Number of Covid-19 Deaths and Age-Adjusted Mortality in Arizona through June 21

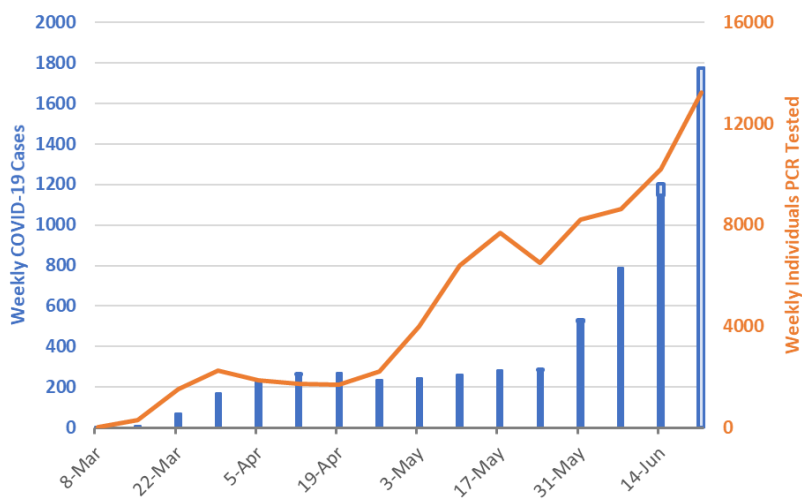


Figure 3. Newly Diagnosed COVID-19 Cases in Pima County and Individuals Tested through June 21

Pima County Outlook

For the week ending Sunday, June 21, weekly case counts again increased in Pima County, from 1201 the prior week to 1773 cases this week, a 48% increase (Figure 13). Because testing capacity has recently begun increasing again, at least some of the increase could be attributable to more testing.

Summary:

- Reported cases, hospitalizations, and now deaths are increasing signaling that community transmission has truly been increasing over the past 4 weeks. 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 are urgently needed to reduce the pace of community transmission.
 - The nature of the outbreak is changing such that new infections are shifting towards younger, working-age adults which has important implications for 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.
 - 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.

Next update scheduled for July 3.