COVID-19 Disease Outbreak Outlook
Arizona State and Pima County
Updated April 23, 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.

As of April 23rd, 5459 COVID-19 cases and 208 deaths have been reported on the Arizona Department of Health Services (ADHS) website. When case counts are aggregated by week and test collection date, newly reported cases have not yet peaked (Figure 1). This observation conflicts with IHME forecasts that suggest peak hospitalizations and ICU utilization have already passed (Figures 3 and 4 on following page). This discrepancy could occur if testing was expanding thereby identifying milder cases. However, the number of tests being performed daily has been constant or decreasing with a rising percent of them being reported as positive (Figure 2). The only clear conclusion is that testing still falls short of clinical and surveillance demands.

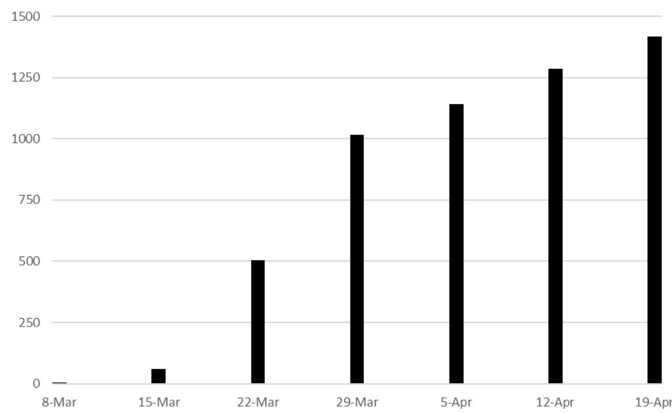

Figure 1. Weekly Arizona COVID-19 Cases through April 19 Presented by Test Collection Date.

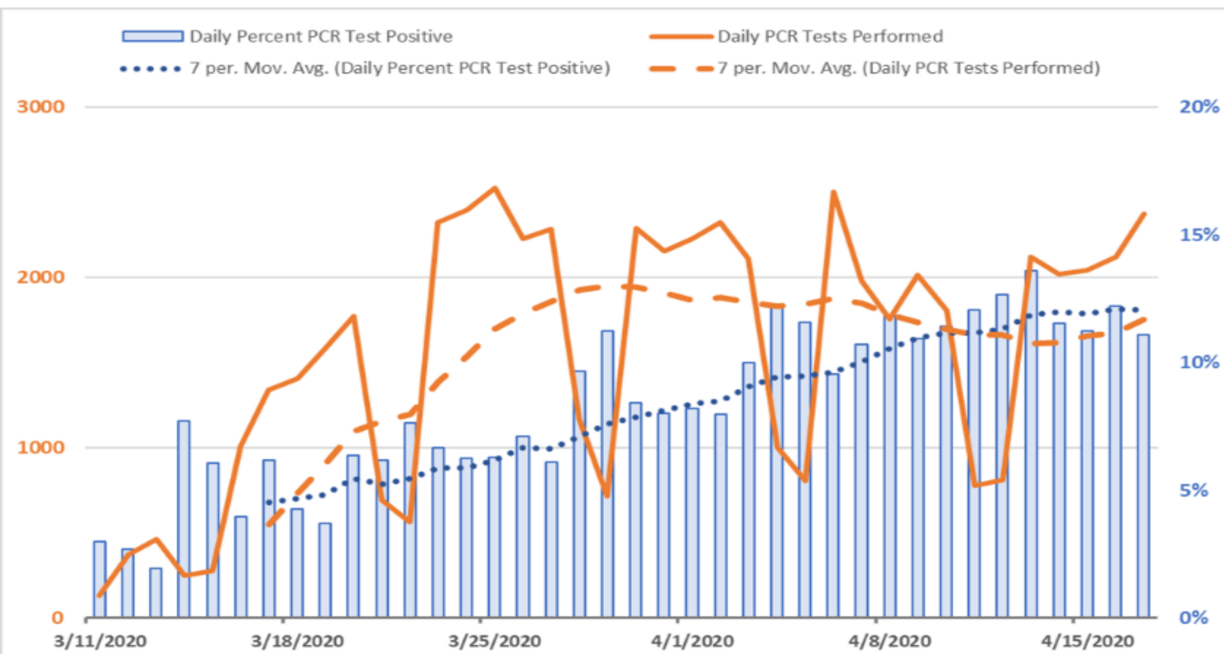

Figure 2. Daily Number of COVID-19 PCR Tests and Percent of Positive Tests March 11 – April 17.

Table 1. Arizona COVID-19 Reported Cases by Date of Test Collection, April 8 – Apr 17.

	Apr 8	Apr 9	Apr 10	Apr 11	Apr 12	Apr 13	Apr 14	Apr 15	Apr 16	Apr 17
Total Reported Cases	3390	3614	3815	3920	4013	4284	4527	4731	4972	5189
Newly Reported Cases	208	224	201	105	93	271	243	204	241	217
Doubling Time (days)*	10.3	10.7	11.4	11.9	12.3	13.2	13.5	14.3	15.0	15.6

*7-day moving average of doubling time based on day-to-day increases in cumulative cases. Because reporting lag spans more than a week, counts in newer updates will not match past updates.

Institute for Health Metrics and Evaluation (IHME) Models

On April 21, the IHME made another minor revision to their estimates. Hospitalizations are predicted to have peaked later than previously reported, April 22nd versus April 10th (Figure 3). Similarly, ICU utilization is predicted to have peaked on April 21st versus April 10th previously (Figure 4). Peak hospital usage increased from 313 beds to 439 beds and peak ICU utilization increased from 77 beds to 125 beds. These changes were driven by refitting the prediction curve to account for a greater number of observed deaths than previously projected. Since all model parameters are driven by fitting deaths to the projection curve, all were upwardly revised including total deaths by August 4th, 267 to 583. While these changes are disconcerting, they reflect the difficulty of accurately predicting a peak on a relatively "flat" curve.

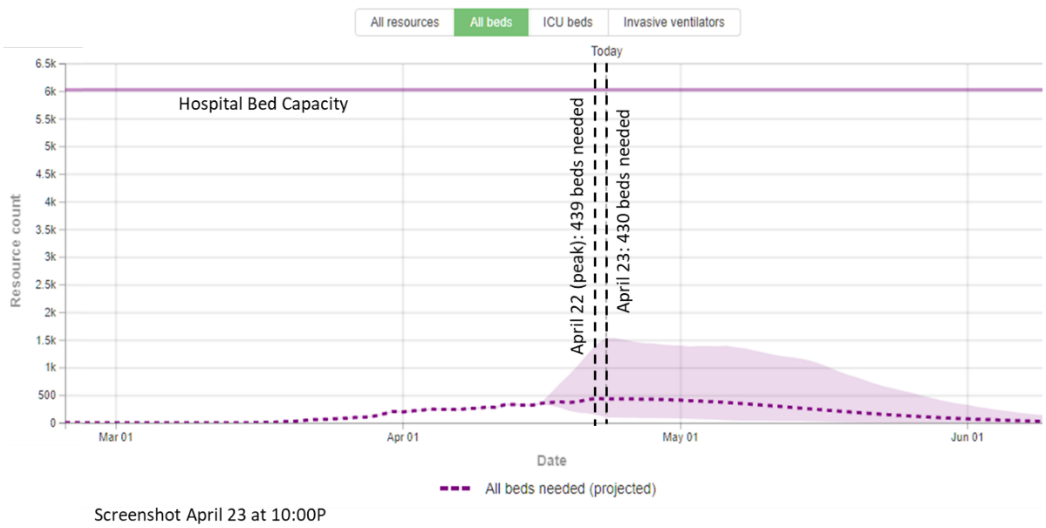

Figure 3. IHME Estimated COVID-19 Hospitalizations and Capacity (from https://covid19.healthdata.org).

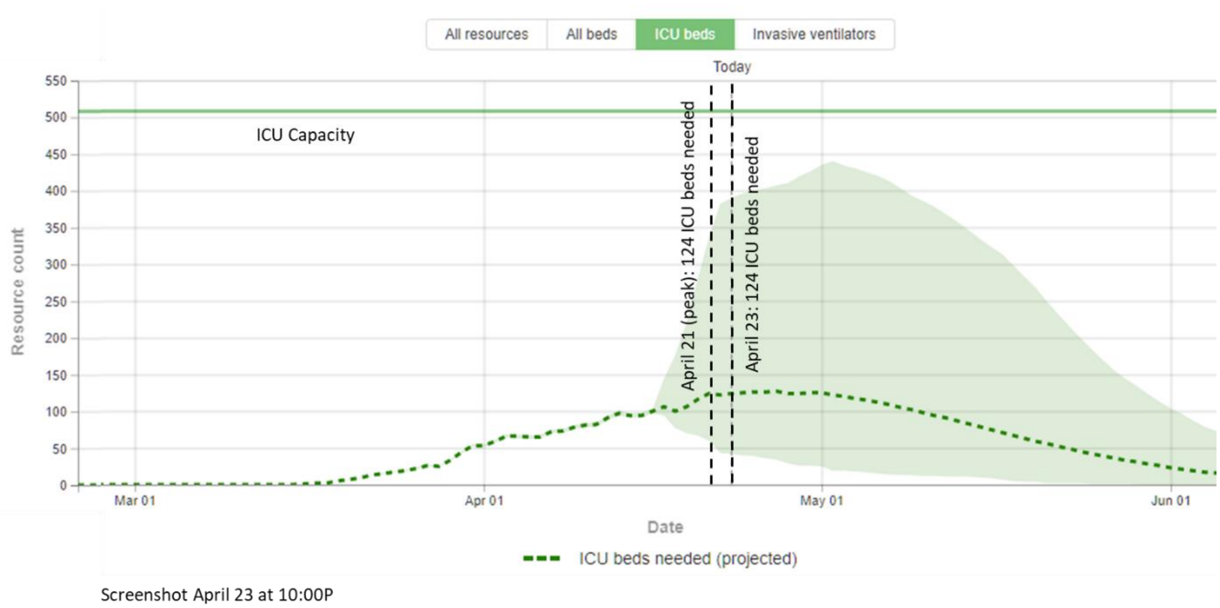

Figure 4. IHME Estimated COVID-19 ICU Utilization and Capacity (from https://covid19.healthdata.org).

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Several of my colleagues recommend a newly released model developed by the University of Texas COVID-19 Modeling Consortium. One of the advantages of this model is how it communicates the uncertainty surrounding future projections. Instead of showing predictions that become more accurate over time as the IHME model does, this model shows increasing uncertainty as projections are extended into the future (Figure 5). It also more clearly shows the variability in day-to-day reported deaths that challenge the model fitting process. The UT model projects that we have probably passed the peak in reported deaths, but at 62% this if far from certain.

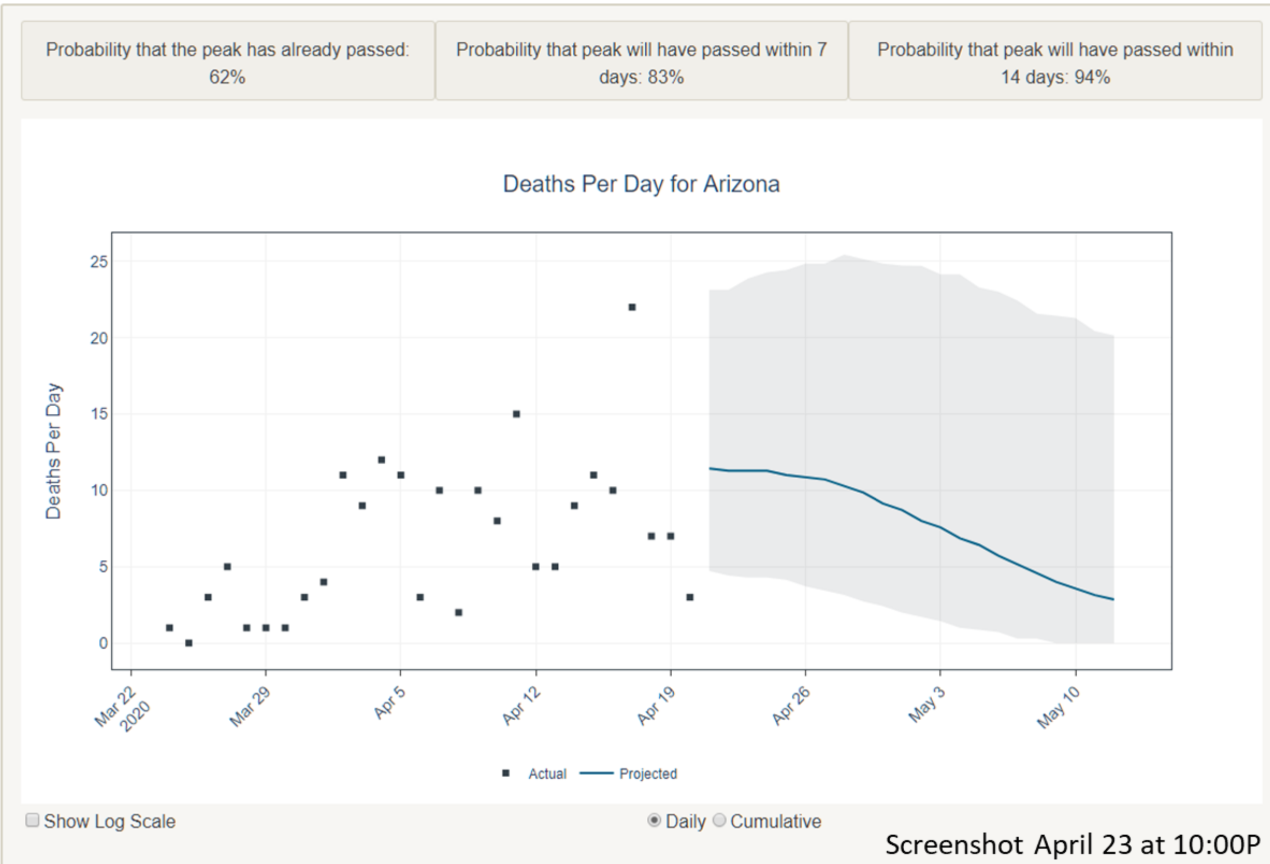

Figure 5. Projected Arizona COVID-19 Deaths from the University of Texas COVID-19 Modeling Consortium

Until I can disentangle the date of death from the date the death is announced, I will default to the announced date. As of April 23rd, 229 deaths have been reported (Table 2). What is most noticeable, is 3 consecutive days with 20 or more announced deaths. In all likelihood, many of these deaths actually occurred some days past. Nevertheless, given that the models are driven by announced deaths, it is likely that the model predictions will be upwardly revised in the near future. If these deaths represent a backlog of reporting, then there would be better alignment with a reported case count that has yet to clearly peak. This represents one of the challenges of interpreting changes in cases and deaths on the day they are announced rather than the day they occur.

Table 2. Arizona COVID-19 Deaths by Date of Announcement for April 13 – 22.

	Apr 13	Apr 14	Apr 15	Apr 16	Apr 17	Apr 18	Apr 19	Apr 20	Apr 21	Apr 22
Total Reported Deaths	131	142	150	169	177	184	187	208	229	249
Newly Reported Deaths	9	11	8	19	8	7	3	21	20	20
Doubling Time (days)*	8.0	8.2	9.0	8.5	9.5	10.0	11.0	10.2	9.8	9.2

*7-day moving average of doubling time based on day-to-day increases in cumulative deaths.

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Pima County

As of April 23rd, 1026 COVID-19 cases have been reported on the ADHS website for Pima County (Table 3). I am now able to report Pima County cases by test collection date as well. For this reason, reported counts in this update will not match those in past updates. However, general trends remain consistent such that the pace of newly reported cases in Pima County generally follow those of Arizona as a whole.

Table 3. Pima County COVID-19 Cases by Date of Test Collection for April 8 – Apr 17.

	Apr 8	Apr 9	Apr 10	Apr 11	Apr 12	Apr 13	Apr 14	Apr 15	Apr 16	Apr 17
Total Reported Cases	596	636	689	706	730	788	834	865	930	959
Newly Reported Cases	37	40	53	17	24	58	46	31	65	29
Doubling Time (days)*	8.8	9.5	10.0	10.3	10.7	11.5	11.9	12.8	12.5	14.4

*7-day moving average of doubling time based on day-to-day increass in cumulatives cases. Because reporting lag spans more than a week, counts in newer updates will not match past updates.

Summary:

- Social distancing has slowed / continues to slow viral transmission; however, reported cases, hospitalizations, or ICU utilizations have yet to clearly peak.
    - Community-driven viral transmission remains high as evidenced by substantial numbers of newly reported cases. Accordingly, maintaining or increasing social distancing should remain our highest priority or we risk a resurgence fueled by these active cases.
    - Lifting social distancing restrictions when the April 30 stay-at-home order expires poses a substantial risk of reigniting exponential growth as depicted by the modeling data graciously shared by Dr. Tim Lant of Arizona State University (Figures 6 and 7).
    - While current social distancing restrictions may be sufficient to prevent exponential growth, they may not be enough to extinguish viral transmission. If so, lifting restrictions will be difficult without reigniting viral transmission, but maintaining them will only worsen economic conditions.

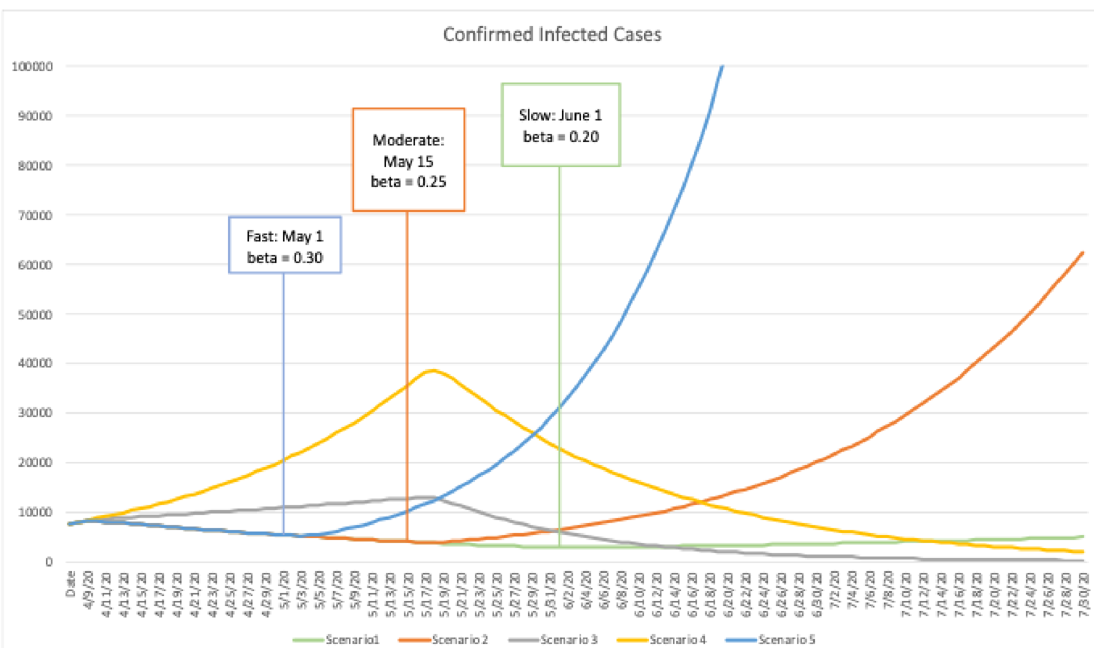

Figure 6. Simulated Scenarios of COVID-19 Infection in Response to Social Distancing Policy. ADHS COVID-19 Modeling Working Group 1, Arizona State University: Tim Lant, PhD, MAS (tim.lant@asu.edu); Megan Jehn, PhD; Esma Gel, PhD; Anna Muldoon, MPH; Heather Ross PhD, DNP, ANP-BC. April 20,

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Scenario	Description
Excursion 1.	**Fast re-opening.** Assumes continued social distancing with a low effective transmission rate (beta = 0.15) until May 1. On May 1, beta increases to "high" 0.30 to reflect re-opening, similar to estimates for beta prior to closures. Assumes a 4X multiple for undetected transmission. No summer effect!
Excursion 2.	**Moderate re-opening.** Assumes continued social distancing with a low effective transmission rate (beta = 0.15) until May 1. On May 15, beta increases to "moderate" 0.25 to reflect re-opening, similar to estimates for beta during the initial restrictions. Assumes a 4X multiple for undetected transmission. No summer effect!
Scenario 3.	**Best fit**: Assumes undetected cases are 4X known cases and can transmit asymptomatically (beta = .20). Summer effect is modeled by reducing S by half on May 15. Assumes no additional mitigation, but high compliance with current social distancing orders. This scenario is the current best fit to the data.
Scenario 4.	**Limited re-opening scenario with summer effect.** Limited asymptomatic transmission, limited re-opening. This scenario assumes a slightly increased transmission consistent with limited re-opening and congregation of small groups(beta = 0.25). Assumes 4X undetected cases as initial infections. Summer effect is modeled by reducing beta by half on May 15. Same as scenario 3 with increased transmission.
Excursion 5.	**Slow re-opening.** Assumes continued social distancing with a low effective transmission rate (beta = 0.15) until May 1. On May 15, beta increases to "low" 0.20 to reflect re-opening, slightly higher than current transmission. Assumes a 4X multiple for undetected transmission. No summer effect!

Figure 7. Scenario Assumptions and Parameter Estimates for Simulated Scenarios of COVID-19 Infection in Response to Social Distancing Policy.

- COVID-19 testing (Figure 2, Page 1 above) appears to be more constrained than reported in the April 18 Update. Testing has in fact been relatively flat over the past several weeks hampering our ability to fully understand the trajectory of viral transmission.
    - The lack of testing for both clinical diagnosis and public health surveillance is another challenge that must be overcome before social distancing restrictions can be safely lifted. Without greater access to testing, it will be impossible to identify cases, trace contacts, and isolate those newly infected in a timely manner.
- Over the coming weeks, serologic testing for antibodies against COVID-19 will become available thereby improving our ability gauge the burden of past viral transmission and inform future decisions regarding social distancing and risk of viral resurgence.
    - Testing representative samples of Arizonans should be a high priority to estimate the burden of unrecognized infections in the general population, health care workers, and other essential workers.
    - Validating the serologic tests in targeted populations with repeated testing in conjunction with PCR testing should also be a high priority to define test accuracy and the utility of using results to guide individual decision-making with regard to back-to-work or back-to-school safety.

Next update scheduled for April 28.

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