COVID-19 Disease Outbreak Outlook
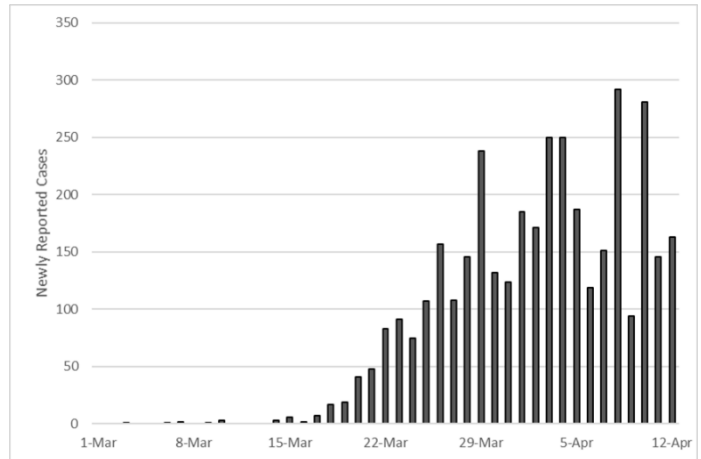## Arizona State and Pima County
Updated April 13, 2020

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 12th, 3702 COVID-19 cases and 122 deaths[1] have been reported in Arizona. Between April 3rd – 12th, the doubling time (7-day moving average) for the total number of reported cases (4.7 days to 11.5 days) and deaths (3.6 days to 7.4 days) has lengthened indicating that the pace of both are slowing (Table 1). Nevertheless, the largest single-day report of new cases occurred on April 8th with 292 cases indicating the potential for faster growth remains high (Figure 1). See discussion at the end of this document about new literature on COVID-19 disease and social distancing.

On April 9, the Institute for Health Metrics and Evaluation (IHME) revised their estimates of hospitalizations and ICU usage slightly upward. The IHME now predicts hospitalizations will peak on April 26th. The mid-range estimate calls for 1460 beds at the peak,

Figure 1. Newly Reported COVID-19 Cases in Arizona March 1 – April 12.

below the 6017 available (Figure 2, following page). The IHME now predicts ICU usage will peak on April 27th. The mid-range estimate calls for 293 beds at the peak, below the 508 available (Figure 3, following page).

Table 1. Reported COVID-19 Cases and Deaths in Arizona from April 3 – Apr 12.

	Apr 3	Apr 4	Apr 5	Apr 6	Apr 7	Apr 8	Apr 9	Apr 10	Apr 11	Apr 12
Total Reported Cases	2019	2269	2456	2575	2726	3018	3112	3393	3539	3702
Newly Reported Cases	250	250	187	119	151	292	94	281	146	163
Doubling Time (days)*	4.72	5.04	6.16	6.71	7.07	7.33	8.26	9.04	10.63	11.54
Total Reported Deaths	52	64	65	73	80	89	97	108	115	122
Newly Reported Deaths	11	12	1	8	7	9	8	11	7	7
Doubling Time (days)*	3.57	3.34	3.75	3.98	4.38	4.35	5.23	6.27	7.96	7.42

*7-day moving average of doubling time based on day-to-day increases in total reported case count.

Pima County

As of April 12th, 668 COVID-19 cases have been reported in Pima County (Table 2). Growth in Pima County has generally followed that of Arizona as a whole. Here too, the pace of newly reported cases is slowing. Unfortunately, I have not reliably captured Pima County deaths, so deaths are not reported in Table 2.

Table 2. Reported COVID-19 Cases in Pima County from April 3 – Apr 12.

|	Apr 3	Apr 4	Apr 5	Apr 6	Apr 7	Apr 8	Apr 9	Apr 10	Apr 11	Apr 12
Total Reported Cases	326	372	415	415	464	512	543	591	622	668
Newly Reported Cases	46	46	43	0	49	48	31	48	31	46
Doubling Time (days)*	4.50	5.13	5.77	6.37	6.03	5.95	6.97	7.81	9.10	9.86

*7-day moving average of doubling time based on day-to-day increase in total reported case count. †Likely a single-day error in my data capture.

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[1] The text of the April 8 Update incorrectly reported 151 deaths by April 7th; however, the actual number (n=80) was correctly reported in Table 1.
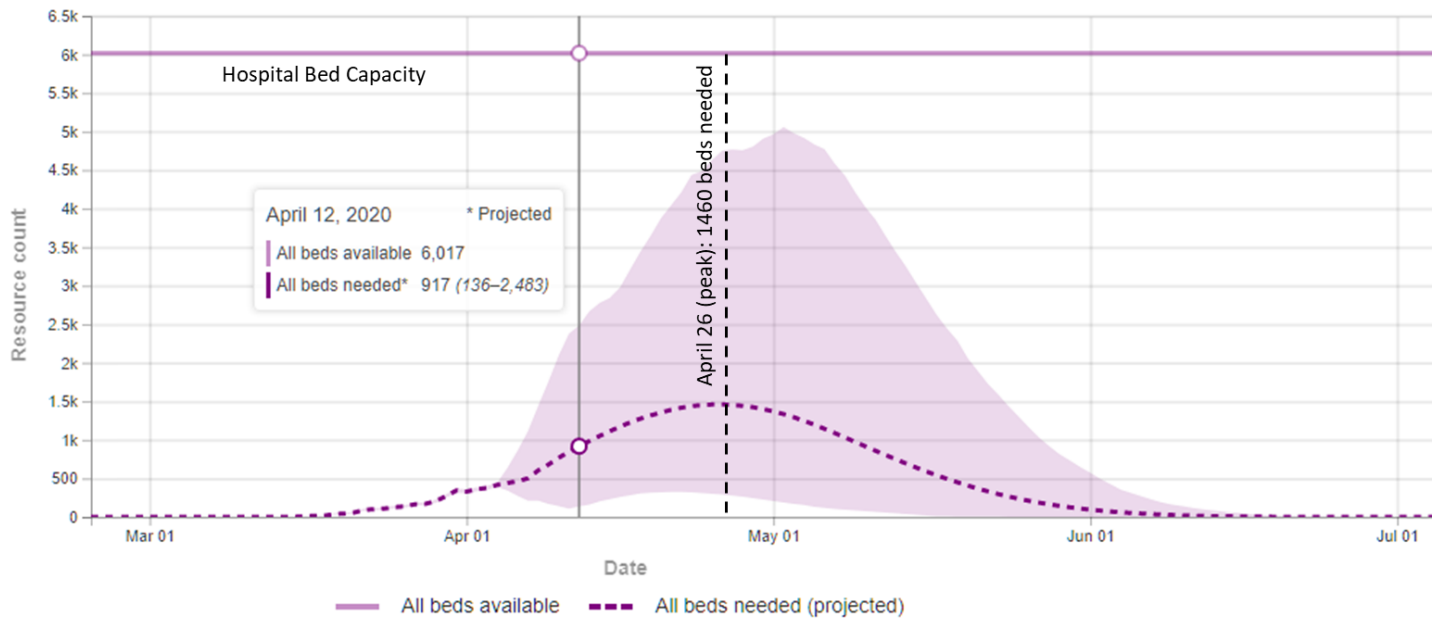
Screenshot April 13th at 10:45A

Figure 2. IHME Estimated COVID-19 Hospitalizations and Capacity (from https://covid19.healthdata.org).
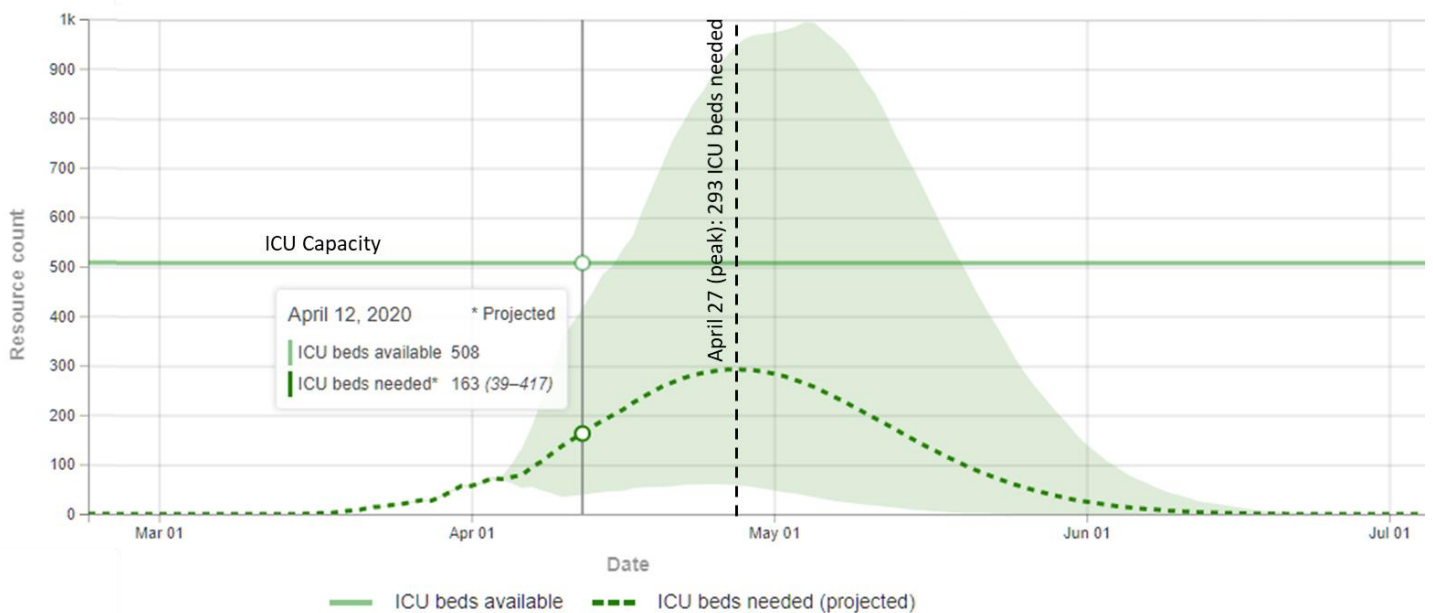

Screenshot April 13th at 10:45A

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

Created by: Joe K. Gerald, MD, PhD (Associate Professor, Zuckerman College of Public Health, geraldj@email.arizona.edu).

The Timing of COVID-19 Social Distancing Interventions and Decline in Newly Reported Cases

Pan et al. recently reported that it took 14 days for the effective R_0 to fall below 1.0 after a city-wide lock-down and travel restrictions were enacted in Wuhan, China (Figure 2). A $R_0<1.0$ indicates that viral transmission is no longer self-sustaining and disease eradication becomes a possible goal. Given that 14 days have passed since Arizona's stay-at-home order was issued, it is plausible that Arizona's social distancing measures could at least partially explain the lengthening doubling-time reported in Table 1. This timing is also biologically consistent with a presumed 5 – 6 day incubation period and a 5 – 10 day lag to obtain PCR testing.
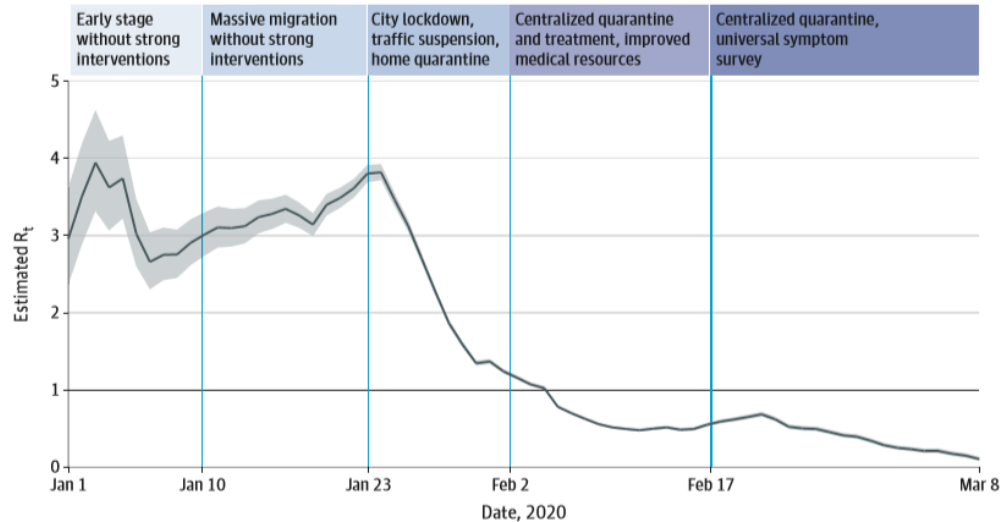
Figure 2. The Effective Reproduction Number (Rt) Estimates Based on Laboratory-Confirmed Coronavirus Disease 2019 (COVID-19) Cases in Wuhan, China (Figure 4. from Pan et al. JAMA. Published on-line April 10, 2020).

This supposition is also supported by new data from the Centers for Disease Control and Prevention (CDC) which show potential correlations between public policies to mitigate viral transmission and percent change in new case counts (Figure 3). While these data cannot establish cause and effect for any specific policy, they are at least consistent with the notion that public policy can reduce viral transmission via social distancing.
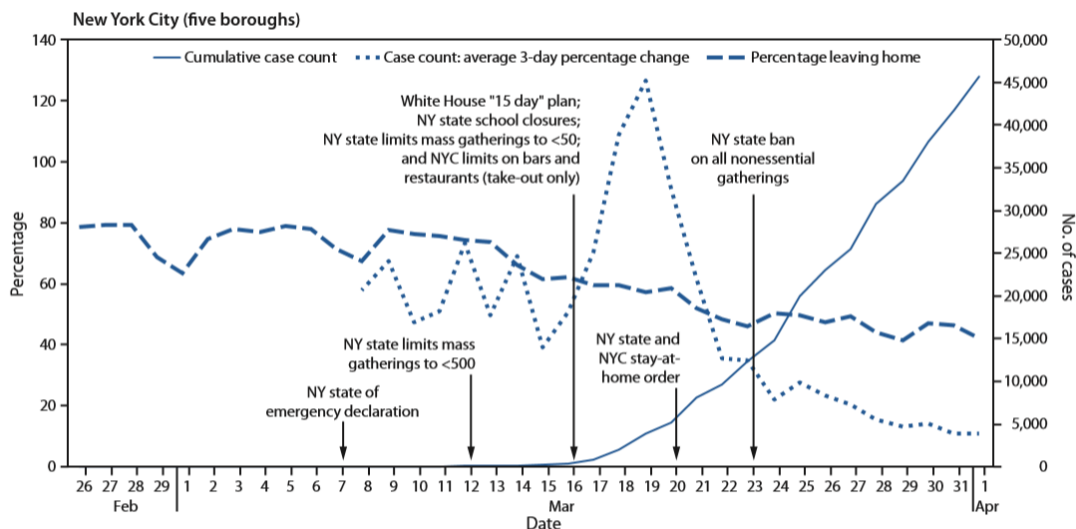
Figure 3. Selected Community Mitigate Interventions, Cumulative COVID-19 Case Counts, Average 3-day Percentage Change in Case Counts, and Percentage Leaving Home, February 26 – April 1, 2020 (Figure from MMWR Vol. 69 Early Release, April 13, 2020).

Created by: Joe K. Gerald, MD, PhD (Associate Professor, Zuckerman College of Public Health, geraldj@email.arizona.edu).

In summary,

- Mounting evidence continues to indicate that social distancing measures, including the current stay-at-home order, is slowing the spread of new infections. Given this success, maintaining or increasing our social distancing efforts over the coming weeks should remain our highest priority.
    - Even though the pace of new infections has slowed, the risk of being infected remains high as we are simply coming down the other side of the peak.
- The lag between new infections and hospitalizations and ICU admissions means that the pace of these outcomes will increase for the next 1 - 3 weeks before slowing.
    - Over the next 2 weeks, hospitalists and intensivists should prepare for a continued increase in admissions until a peak around April 27th. Admissions are predicted to be twice that of today but could be somewhat higher.
    - Given limited ICU capacity, the strain is likely to be greater in critical care settings than general floor beds, but adequate capacity to meet demand is still projected.

Next update scheduled for April 18.

Created by: Joe K. Gerald, MD, PhD (Associate Professor, Zuckerman College of Public Health, geraldj@email.arizona.edu).