IEM's AI Modeling: Short-term COVID-19 Projections
Date: 5/26/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do <u>not</u> assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 5/26/21 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

California State Projections
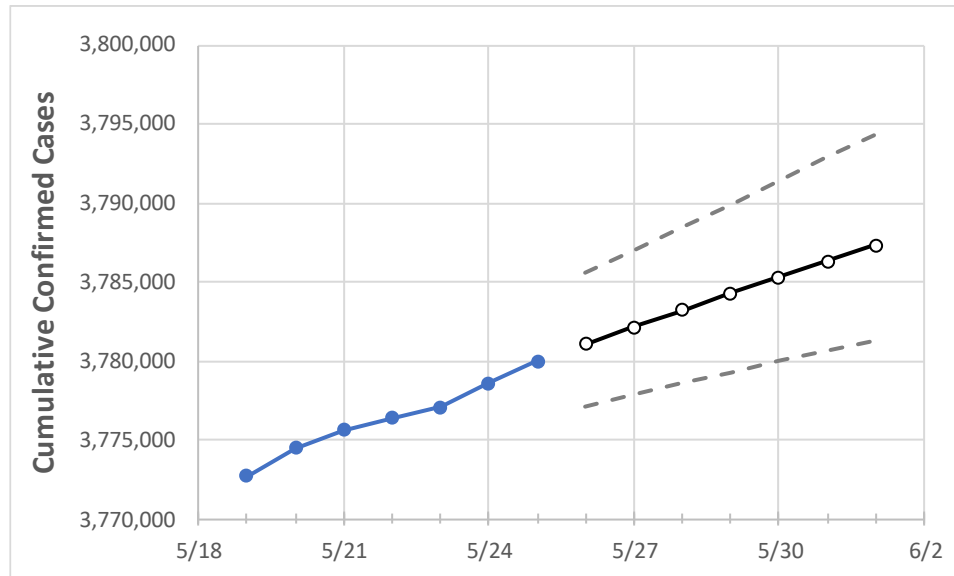
	Actual Confirmed Cases On:				Projected Cases For:						
	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1
California	3,776,346	3,777,077	3,778,555	3,779,998	3,781,084	3,782,151	3,783,235	3,784,280	3,785,305	3,786,313	3,787,292

Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1
Alameda	88,502	88,545	88,620	88,665	88,724	88,779	88,832	88,887	88,940	88,992	89,044
Contra Costa	69,288	69,357	69,392	69,454	69,503	69,552	69,600	69,648	69,696	69,744	69,791
Fresno	102,189	102,238	102,270	102,289	102,324	102,358	102,393	102,427	102,461	102,493	102,527
Kern	109,630	109,654	109,676	109,738	109,783	109,828	109,873	109,918	109,961	110,004	110,047
Lake	3,501	3,502	3,504	3,506	3,508	3,510	3,512	3,514	3,516	3,518	3,520
Los Angeles	1,238,607	1,238,781	1,238,932	1,239,127	1,239,307	1,239,486	1,239,658	1,239,832	1,240,000	1,240,165	1,240,328
Marin	14,106	14,110	14,114	14,115	14,118	14,122	14,125	14,128	14,131	14,134	14,136
Monterey	43,673	43,684	43,695	43,698	43,705	43,711	43,718	43,725	43,731	43,737	43,743
Orange	271,589	271,646	271,673	271,725	271,774	271,822	271,870	271,918	271,964	272,008	272,052
Placer	22,887	22,902	22,918	22,942	22,962	22,981	23,001	23,020	23,039	23,058	23,077
Riverside	300,271	300,296	300,321	300,476	300,545	300,616	300,686	300,755	300,825	300,896	300,962
Sacramento	105,684	105,765	105,845	105,963	106,054	106,145	106,231	106,319	106,406	106,492	106,581
San Bernardino	297,539	297,566	297,615	297,688	297,750	297,811	297,872	297,931	297,988	298,045	298,101
San Diego	279,613	279,689	279,714	279,785	279,869	279,950	280,027	280,104	280,177	280,249	280,317
San Francisco	36,879	36,906	36,927	36,934	36,949	36,964	36,978	36,992	37,006	37,019	37,032
San Joaquin	73,568	73,593	73,617	73,717	73,752	73,786	73,819	73,850	73,880	73,909	73,939
San Luis Obispo	21,258	21,261	21,263	21,284	21,290	21,296	21,302	21,308	21,314	21,320	21,325
San Mateo	42,163	42,218	42,248	42,249	42,270	42,292	42,312	42,333	42,353	42,374	42,393
Santa Barbara	34,439	34,443	34,446	34,462	34,469	34,477	34,483	34,490	34,497	34,503	34,509
Santa Clara	119,247	119,292	119,333	119,358	119,386	119,412	119,438	119,462	119,486	119,509	119,530
Santa Cruz	16,164	16,168	16,173	16,177	16,180	16,182	16,184	16,186	16,188	16,190	16,191
Solano	33,142	33,163	33,183	33,202	33,221	33,239	33,257	33,274	33,292	33,308	33,323
Sonoma	30,168	30,169	30,170	30,230	30,245	30,260	30,275	30,290	30,306	30,321	30,337
Ventura	81,222	81,239	81,257	81,280	81,301	81,321	81,341	81,362	81,381	81,400	81,419

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- *Beds: For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report (MMWR, March 18, 2020) and state reports of COVID-19 cases.*
- *ICU: The CDC report found that 24% of hospitalized cases require ICU care.*
- *Ventilators: Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.*

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

*The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.*

California Medical Demand by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	5/22	5/23	5/24	5/25	5/27	5/29	5/31
Alameda	88,502	88,545	88,620	88,665	88,779 (17,756) [4,261] {2,131}	88,887 (17,777) [4,267] {2,133}	88,992 (17,798) [4,272] {2,136}
Contra Costa	69,288	69,357	69,392	69,454	69,552 (13,910) [3,338] {1,669}	69,648 (13,930) [3,343] {1,672}	69,744 (13,949) [3,348] {1,674}
Fresno	102,189	102,238	102,270	102,289	102,358 (20,472) [4,913] {2,457}	102,427 (20,485) [4,916] {2,458}	102,493 (20,499) [4,920] {2,460}
Kern	109,630	109,654	109,676	109,738	109,828 (21,966) [5,272] {2,636}	109,918 (21,984) [5,276] {2,638}	110,004 (22,001) [5,280] {2,640}
Lake	3,501	3,502	3,504	3,506	3,510 (702) [168] {84}	3,514 (703) [169] {84}	3,518 (704) [169] {84}
Los Angeles	1,238,607	1,238,781	1,238,932	1,239,127	1,239,486 (247,897) [59,495] {29,748}	1,239,832 (247,966) [59,512] {29,756}	1,240,165 (248,033) [59,528] {29,764}
Marin	14,106	14,110	14,114	14,115	14,122 (2,824) [678] {339}	14,128 (2,826) [678] {339}	14,134 (2,827) [678] {339}
Monterey	43,673	43,684	43,695	43,698	43,711 (8,742) [2,098] {1,049}	43,725 (8,745) [2,099] {1,049}	43,737 (8,747) [2,099] {1,050}
Orange	271,589	271,646	271,673	271,725	271,822 (54,364) [13,047] {6,524}	271,918 (54,384) [13,052] {6,526}	272,008 (54,402) [13,056] {6,528}
Placer	22,887	22,902	22,918	22,942	22,981 (4,596) [1,103] {552}	23,020 (4,604) [1,105] {552}	23,058 (4,612) [1,107] {553}
Riverside	300,271	300,296	300,321	300,476	300,616 (60,123) [14,430] {7,215}	300,755 (60,151) [14,436] {7,218}	300,896 (60,179) [14,443] {7,222}
Sacramento	105,684	105,765	105,845	105,963	106,145 (21,229) [5,095] {2,547}	106,319 (21,264) [5,103] {2,552}	106,492 (21,298) [5,112] {2,556}
San Bernardino	297,539	297,566	297,615	297,688	297,811 (59,562) [14,295] {7,147}	297,931 (59,586) [14,301] {7,150}	298,045 (59,609) [14,306] {7,153}
San Diego	279,613	279,689	279,714	279,785	279,950 (55,990) [13,438] {6,719}	280,104 (56,021) [13,445] {6,723}	280,249 (56,050) [13,452] {6,726}
San Francisco	36,879	36,906	36,927	36,934	36,964 (7,393) [1,774] {887}	36,992 (7,398) [1,776] {888}	37,019 (7,404) [1,777] {888}
San Joaquin	73,568	73,593	73,617	73,717	73,786 (14,757) [3,542] {1,771}	73,850 (14,770) [3,545] {1,772}	73,909 (14,782) [3,548] {1,774}
San Luis Obispo	21,258	21,261	21,263	21,284	21,296 (4,259) [1,022] {511}	21,308 (4,262) [1,023] {511}	21,320 (4,264) [1,023] {512}
San Mateo	42,163	42,218	42,248	42,249	42,292 (8,458) [2,030] {1,015}	42,333 (8,467) [2,032] {1,016}	42,374 (8,475) [2,034] {1,017}
Santa Barbara	34,439	34,443	34,446	34,462	34,477 (6,895) [1,655] {827}	34,490 (6,898) [1,656] {828}	34,503 (6,901) [1,656] {828}
Santa Clara	119,247	119,292	119,333	119,358	119,412 (23,882) [5,732] {2,866}	119,462 (23,892) [5,734] {2,867}	119,509 (23,902) [5,736] {2,868}
Santa Cruz	16,164	16,168	16,173	16,177	16,182 (3,236) [777] {388}	16,186 (3,237) [777] {388}	16,190 (3,238) [777] {389}
Solano	33,142	33,163	33,183	33,202	33,239 (6,648) [1,595] {798}	33,274 (6,655) [1,597] {799}	33,308 (6,662) [1,599] {799}
Sonoma	30,168	30,169	30,170	30,230	30,260 (6,052) [1,452] {726}	30,290 (6,058) [1,454] {727}	30,321 (6,064) [1,455] {728}
Ventura	81,222	81,239	81,257	81,280	81,321 (16,264) [3,903] {1,952}	81,362 (16,272) [3,905] {1,953}	81,400 (16,280) [3,907] {1,954}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.