IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/22/21

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 6/22/21 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
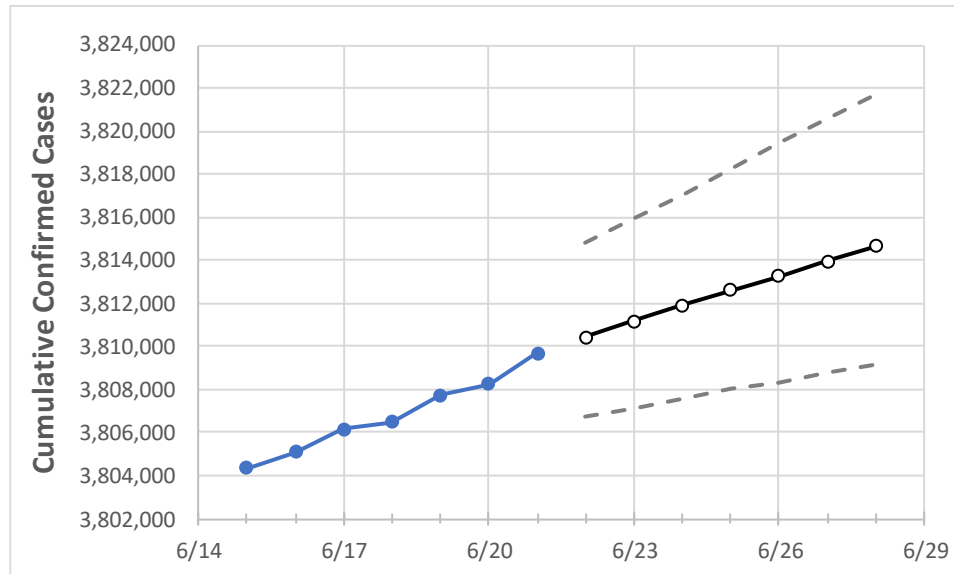
	Actual Confirmed Cases On:				Projected Cases For:						
	6/18	6/19	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28
California	3,806,465	3,807,726	3,808,258	3,809,710	3,810,442	3,811,167	3,811,905	3,812,618	3,813,281	3,813,956	3,814,644

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:						
	6/18	6/19	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28
Alameda	89,577	89,592	89,626	89,659	89,689	89,719	89,748	89,778	89,806	89,835	89,864
Contra Costa	70,520	70,561	70,646	70,730	70,788	70,846	70,904	70,964	71,026	71,088	71,151
Fresno	102,867	102,894	102,922	102,947	102,967	102,986	103,006	103,024	103,043	103,061	103,080
Kern	110,734	110,762	110,782	110,799	110,819	110,839	110,858	110,876	110,893	110,910	110,927
Lake	3,563	3,563	3,563	3,563	3,565	3,568	3,570	3,573	3,575	3,578	3,580
Los Angeles	1,247,197	1,247,361	1,247,618	1,247,744	1,247,925	1,248,110	1,248,293	1,248,474	1,248,656	1,248,833	1,249,008
Marin	14,196	14,200	14,203	14,206	14,210	14,213	14,217	14,220	14,224	14,228	14,231
Monterey	43,832	43,834	43,835	43,836	43,839	43,843	43,846	43,849	43,853	43,856	43,859
Orange	272,922	272,967	273,012	273,057	273,096	273,134	273,172	273,210	273,246	273,284	273,320
Placer	23,498	23,518	23,537	23,589	23,619	23,650	23,682	23,714	23,746	23,781	23,814
Riverside	301,573	301,603	301,636	301,668	301,704	301,740	301,777	301,812	301,849	301,883	301,916
Sacramento	107,599	107,638	107,730	107,821	107,863	107,907	107,950	107,991	108,031	108,071	108,110
San Bernardino	299,186	299,243	299,289	299,289	299,331	299,374	299,416	299,460	299,502	299,546	299,589
San Diego	281,531	281,681	281,749	281,810	281,873	281,936	281,998	282,062	282,122	282,182	282,242
San Francisco	37,243	37,246	37,256	37,269	37,279	37,288	37,298	37,307	37,317	37,326	37,335
San Joaquin	74,658	74,686	74,707	74,727	74,761	74,793	74,828	74,861	74,891	74,923	74,958
San Luis Obispo	21,421	21,421	21,421	21,421	21,423	21,426	21,428	21,430	21,431	21,433	21,435
San Mateo	42,615	42,630	42,646	42,681	42,699	42,718	42,736	42,755	42,773	42,793	42,812
Santa Barbara	34,595	34,596	34,605	34,613	34,618	34,622	34,627	34,632	34,636	34,641	34,645
Santa Clara	120,032	120,081	120,110	120,163	120,197	120,233	120,268	120,303	120,338	120,374	120,411
Santa Cruz	16,234	16,235	16,241	16,246	16,250	16,254	16,259	16,263	16,267	16,272	16,276
Solano	33,690	33,707	33,735	33,762	33,783	33,805	33,827	33,850	33,873	33,897	33,922
Sonoma	30,847	30,868	30,876	30,884	30,909	30,934	30,958	30,982	31,007	31,031	31,054
Ventura	81,628	81,638	81,650	81,661	81,670	81,679	81,687	81,696	81,705	81,713	81,720

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:		
	6/18	6/19	6/20	6/21	6/23	6/25	6/27
Alameda	89,577	89,592	89,626	89,659	89,719 (17,944) [4,307] {2,153}	89,778 (17,956) [4,309] {2,155}	89,835 (17,967) [4,312] {2,156}
Contra Costa	70,520	70,561	70,646	70,730	70,846 (14,169) [3,401] {1,700}	70,964 (14,193) [3,406] {1,703}	71,088 (14,218) [3,412] {1,706}
Fresno	102,867	102,894	102,922	102,947	102,986 (20,597) [4,943] {2,472}	103,024 (20,605) [4,945] {2,473}	103,061 (20,612) [4,947] {2,473}
Kern	110,734	110,762	110,782	110,799	110,839 (22,168) [5,320] {2,660}	110,876 (22,175) [5,322] {2,661}	110,910 (22,182) [5,324] {2,662}
Lake	3,563	3,563	3,563	3,563	3,568 (714) [171] {86}	3,573 (715) [171] {86}	3,578 (716) [172] {86}
Los Angeles	1,247,197	1,247,361	1,247,618	1,247,744	1,248,110 (249,622) [59,909] {29,955}	1,248,474 (249,695) [59,927] {29,963}	1,248,833 (249,767) [59,944] {29,972}
Marin	14,196	14,200	14,203	14,206	14,213 (2,843) [682] {341}	14,220 (2,844) [683] {341}	14,228 (2,846) [683] {341}
Monterey	43,832	43,834	43,835	43,836	43,843 (8,769) [2,104] {1,052}	43,849 (8,770) [2,105] {1,052}	43,856 (8,771) [2,105] {1,053}
Orange	272,922	272,967	273,012	273,057	273,134 (54,627) [13,110] {6,555}	273,210 (54,642) [13,114] {6,557}	273,284 (54,657) [13,118] {6,559}
Placer	23,498	23,518	23,537	23,589	23,650 (4,730) [1,135] {568}	23,714 (4,743) [1,138] {569}	23,781 (4,756) [1,141] {571}
Riverside	301,573	301,603	301,636	301,668	301,740 (60,348) [14,484] {7,242}	301,812 (60,362) [14,487] {7,243}	301,883 (60,377) [14,490] {7,245}
Sacramento	107,599	107,638	107,730	107,821	107,907 (21,581) [5,180] {2,590}	107,991 (21,598) [5,184] {2,592}	108,071 (21,614) [5,187] {2,594}
San Bernardino	299,186	299,243	299,289	299,289	299,374 (59,875) [14,370] {7,185}	299,460 (59,892) [14,374] {7,187}	299,546 (59,909) [14,378] {7,189}
San Diego	281,531	281,681	281,749	281,810	281,936 (56,387) [13,533] {6,766}	282,062 (56,412) [13,539] {6,769}	282,182 (56,436) [13,545] {6,772}
San Francisco	37,243	37,246	37,256	37,269	37,288 (7,458) [1,790] {895}	37,307 (7,461) [1,791] {895}	37,326 (7,465) [1,792] {896}
San Joaquin	74,658	74,686	74,707	74,727	74,793 (14,959) [3,590] {1,795}	74,861 (14,972) [3,593] {1,797}	74,923 (14,985) [3,596] {1,798}
San Luis Obispo	21,421	21,421	21,421	21,421	21,426 (4,285) [1,028] {514}	21,430 (4,286) [1,029] {514}	21,433 (4,287) [1,029] {514}
San Mateo	42,615	42,630	42,646	42,681	42,718 (8,544) [2,050] {1,025}	42,755 (8,551) [2,052] {1,026}	42,793 (8,559) [2,054] {1,027}
Santa Barbara	34,595	34,596	34,605	34,613	34,622 (6,924) [1,662] {831}	34,632 (6,926) [1,662] {831}	34,641 (6,928) [1,663] {831}
Santa Clara	120,032	120,081	120,110	120,163	120,233 (24,047) [5,771] {2,886}	120,303 (24,061) [5,775] {2,887}	120,374 (24,075) [5,778] {2,889}
Santa Cruz	16,234	16,235	16,241	16,246	16,254 (3,251) [780] {390}	16,263 (3,253) [781] {390}	16,272 (3,254) [781] {391}
Solano	33,690	33,707	33,735	33,762	33,805 (6,761) [1,623] {811}	33,850 (6,770) [1,625] {812}	33,897 (6,779) [1,627] {814}
Sonoma	30,847	30,868	30,876	30,884	30,934 (6,187) [1,485] {742}	30,982 (6,196) [1,487] {744}	31,031 (6,206) [1,489] {745}
Ventura	81,628	81,638	81,650	81,661	81,679 (16,336) [3,921] {1,960}	81,696 (16,339) [3,921] {1,961}	81,713 (16,343) [3,922] {1,961}

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.