IEM's AI Modeling: Short-term COVID-19 Projections

Date: 6/23/21

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 not 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 6/23/21 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.

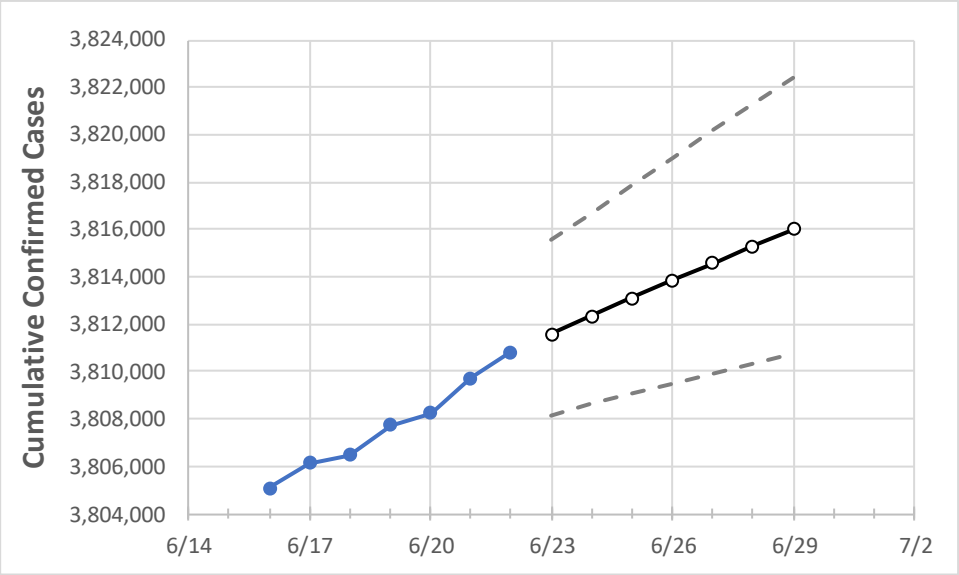
IEM's Modeling Lead

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:						
	6/19	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29
California	3,807,726	3,808,258	3,809,710	3,810,808	3,811,584	3,812,358	3,813,112	3,813,840	3,814,562	3,815,275	3,815,992

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:						
	6/19	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29
Alameda	89,592	89,626	89,659	89,756	89,791	89,828	89,864	89,899	89,934	89,972	90,009
Contra Costa	70,561	70,646	70,730	70,770	70,826	70,882	70,939	70,997	71,056	71,114	71,172
Fresno	102,894	102,922	102,947	102,971	102,991	103,011	103,031	103,051	103,070	103,090	103,108
Kern	110,762	110,782	110,799	110,799	110,818	110,837	110,855	110,872	110,889	110,906	110,922
Lake	3,563	3,563	3,563	3,563	3,564	3,566	3,567	3,568	3,570	3,571	3,572
Los Angeles	1,247,361	1,247,618	1,247,744	1,247,909	1,248,089	1,248,269	1,248,444	1,248,629	1,248,809	1,248,982	1,249,167
Marin	14,200	14,203	14,206	14,208	14,211	14,215	14,218	14,221	14,225	14,228	14,231
Monterey	43,834	43,835	43,836	43,842	43,846	43,849	43,853	43,856	43,860	43,863	43,866
Orange	272,967	273,012	273,057	273,105	273,148	273,190	273,232	273,273	273,315	273,356	273,398
Placer	23,518	23,537	23,589	23,604	23,631	23,659	23,689	23,717	23,746	23,776	23,807
Riverside	301,603	301,636	301,668	301,799	301,845	301,891	301,938	301,985	302,032	302,080	302,129
Sacramento	107,638	107,730	107,821	107,872	107,917	107,961	108,005	108,046	108,086	108,127	108,167
San Bernardino	299,243	299,289	299,305	299,320	299,355	299,390	299,424	299,457	299,489	299,522	299,554
San Diego	281,681	281,749	281,810	281,886	281,951	282,015	282,082	282,145	282,210	282,275	282,339
San Francisco	37,246	37,256	37,269	37,275	37,285	37,294	37,303	37,313	37,321	37,330	37,339
San Joaquin	74,686	74,707	74,727	74,808	74,847	74,886	74,924	74,965	75,005	75,047	75,086
San Luis Obispo	21,436	21,440	21,444	21,448	21,452	21,455	21,459	21,463	21,466	21,469	21,473
San Mateo	42,630	42,646	42,681	42,685	42,701	42,717	42,733	42,748	42,764	42,781	42,798
Santa Barbara	34,596	34,605	34,613	34,621	34,626	34,631	34,636	34,641	34,646	34,650	34,656
Santa Clara	120,081	120,110	120,163	120,192	120,225	120,260	120,294	120,330	120,364	120,400	120,435
Santa Cruz	16,235	16,241	16,246	16,246	16,251	16,256	16,261	16,266	16,271	16,276	16,281
Solano	33,707	33,735	33,762	33,762	33,779	33,795	33,812	33,829	33,846	33,862	33,879
Sonoma	30,868	30,876	30,884	30,957	30,988	31,018	31,050	31,081	31,113	31,147	31,180
Ventura	81,638	81,650	81,661	81,661	81,670	81,679	81,688	81,696	81,704	81,712	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:		
	6/19	6/20	6/21	6/22	6/24	6/26	6/28
Alameda	89,592	89,626	89,659	89,756	89,828 (17,966) [4,312] {2,156}	89,899 (17,980) [4,315] {2,158}	89,972 (17,994) [4,319] {2,159}
Contra Costa	70,561	70,646	70,730	70,770	70,882 (14,176) [3,402] {1,701}	70,997 (14,199) [3,408] {1,704}	71,114 (14,223) [3,413] {1,707}
Fresno	102,894	102,922	102,947	102,971	103,011 (20,602) [4,945] {2,472}	103,051 (20,610) [4,946] {2,473}	103,090 (20,618) [4,948] {2,474}
Kern	110,762	110,782	110,799	110,799	110,837 (22,167) [5,320] {2,660}	110,872 (22,174) [5,322] {2,661}	110,906 (22,181) [5,323] {2,662}
Lake	3,563	3,563	3,563	3,563	3,566 (713) [171] {86}	3,568 (714) [171] {86}	3,571 (714) [171] {86}
Los Angeles	1,247,361	1,247,618	1,247,744	1,247,909	1,248,269 (249,654) [59,917] {29,958}	1,248,629 (249,726) [59,934] {29,967}	1,248,982 (249,796) [59,951] {29,976}
Marin	14,200	14,203	14,206	14,208	14,215 (2,843) [682] {341}	14,221 (2,844) [683] {341}	14,228 (2,846) [683] {341}
Monterey	43,834	43,835	43,836	43,842	43,849 (8,770) [2,105] {1,052}	43,856 (8,771) [2,105] {1,053}	43,863 (8,773) [2,105] {1,053}
Orange	272,967	273,012	273,057	273,105	273,190 (54,638) [13,113] {6,557}	273,273 (54,655) [13,117] {6,559}	273,356 (54,671) [13,121] {6,561}
Placer	23,518	23,537	23,589	23,604	23,659 (4,732) [1,136] {568}	23,717 (4,743) [1,138] {569}	23,776 (4,755) [1,141] {571}
Riverside	301,603	301,636	301,668	301,799	301,891 (60,378) [14,491] {7,245}	301,985 (60,397) [14,495] {7,248}	302,080 (60,416) [14,500] {7,250}
Sacramento	107,638	107,730	107,821	107,872	107,961 (21,592) [5,182] {2,591}	108,046 (21,609) [5,186] {2,593}	108,127 (21,625) [5,190] {2,595}
San Bernardino	299,243	299,289	299,305	299,320	299,390 (59,878) [14,371] {7,185}	299,457 (59,891) [14,374] {7,187}	299,522 (59,904) [14,377] {7,189}
San Diego	281,681	281,749	281,810	281,886	282,015 (56,403) [13,537] {6,768}	282,145 (56,429) [13,543] {6,771}	282,275 (56,455) [13,549] {6,775}
San Francisco	37,246	37,256	37,269	37,275	37,294 (7,459) [1,790] {895}	37,313 (7,463) [1,791] {896}	37,330 (7,466) [1,792] {896}
San Joaquin	74,686	74,707	74,727	74,808	74,886 (14,977) [3,595] {1,797}	74,965 (14,993) [3,598] {1,799}	75,047 (15,009) [3,602] {1,801}
San Luis Obispo	21,436	21,440	21,444	21,448	21,455 (4,291) [1,030] {515}	21,463 (4,293) [1,030] {515}	21,469 (4,294) [1,031] {515}
San Mateo	42,630	42,646	42,681	42,685	42,717 (8,543) [2,050] {1,025}	42,748 (8,550) [2,052] {1,026}	42,781 (8,556) [2,054] {1,027}
Santa Barbara	34,596	34,605	34,613	34,621	34,631 (6,926) [1,662] {831}	34,641 (6,928) [1,663] {831}	34,650 (6,930) [1,663] {832}
Santa Clara	120,081	120,110	120,163	120,192	120,260 (24,052) [5,772] {2,886}	120,330 (24,066) [5,776] {2,888}	120,400 (24,080) [5,779] {2,890}
Santa Cruz	16,235	16,241	16,246	16,246	16,256 (3,251) [780] {390}	16,266 (3,253) [781] {390}	16,276 (3,255) [781] {391}
Solano	33,707	33,735	33,762	33,762	33,795 (6,759) [1,622] {811}	33,829 (6,766) [1,624] {812}	33,862 (6,772) [1,625] {813}
Sonoma	30,868	30,876	30,884	30,957	31,018 (6,204) [1,489] {744}	31,081 (6,216) [1,492] {746}	31,147 (6,229) [1,495] {748}
Ventura	81,638	81,650	81,661	81,661	81,679 (16,336) [3,921] {1,960}	81,696 (16,339) [3,921] {1,961}	81,712 (16,342) [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.