IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/2/21

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 7/2/21 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
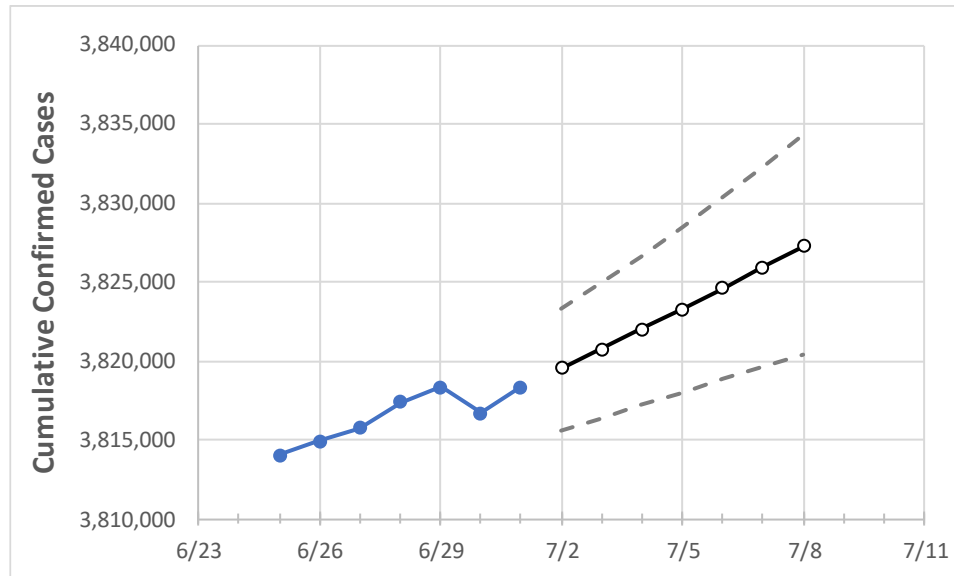
	Actual Confirmed Cases On:				Projected Cases For:						
	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8
California	3,817,372	3,818,303	3,816,659	3,818,326	3,819,521	3,820,739	3,821,993	3,823,275	3,824,594	3,825,915	3,827,257

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:						
	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8
Alameda	90,165	90,211	90,276	90,281	90,343	90,404	90,467	90,529	90,595	90,663	90,732
Contra Costa	71,093	71,150	71,235	71,319	71,385	71,451	71,519	71,587	71,657	71,728	71,800
Fresno	103,110	103,121	103,121	103,121	103,143	103,163	103,184	103,204	103,225	103,245	103,265
Kern	111,049	111,055	111,060	111,060	111,085	111,110	111,135	111,159	111,183	111,207	111,231
Lake	3,581	3,591	3,594	3,601	3,605	3,610	3,615	3,620	3,625	3,630	3,636
Los Angeles	1,249,572	1,249,875	1,250,240	1,250,740	1,251,112	1,251,497	1,251,899	1,252,321	1,252,763	1,253,225	1,253,706
Marin	14,227	14,236	14,245	14,253	14,259	14,265	14,271	14,278	14,285	14,292	14,300
Monterey	43,875	43,885	43,889	43,892	43,897	43,902	43,907	43,912	43,917	43,923	43,928
Orange	273,427	273,482	273,561	273,636	273,704	273,775	273,848	273,923	274,000	274,082	274,166
Placer	23,751	23,756	23,755	23,793	23,816	23,840	23,863	23,887	23,911	23,935	23,959
Riverside	301,691	301,673	301,655	301,774	301,864	301,958	302,054	302,155	302,256	302,364	302,478
Sacramento	108,411	108,505	108,571	108,688	108,793	108,902	109,014	109,130	109,251	109,375	109,505
San Bernardino	299,672	299,730	299,763	299,883	299,942	300,004	300,065	300,126	300,191	300,258	300,325
San Diego	282,416	282,498	282,582	282,583	282,659	282,734	282,810	282,887	282,962	283,038	283,115
San Francisco	37,360	37,372	37,041	37,065	37,078	37,091	37,104	37,117	37,131	37,144	37,157
San Joaquin	74,887	74,900	74,900	74,900	74,913	74,926	74,938	74,950	74,961	74,971	74,981
San Luis Obispo	21,477	21,482	21,482	21,482	21,486	21,491	21,495	21,499	21,504	21,508	21,513
San Mateo	42,925	42,927	42,540	42,599	42,634	42,671	42,710	42,749	42,793	42,837	42,882
Santa Barbara	34,659	34,626	34,639	34,652	34,661	34,671	34,681	34,691	34,701	34,712	34,723
Santa Clara	120,352	120,377	119,357	119,388	119,421	119,455	119,490	119,525	119,560	119,597	119,634
Santa Cruz	16,269	16,276	16,282	16,289	16,294	16,298	16,303	16,308	16,313	16,318	16,323
Solano	33,898	33,936	33,973	33,973	33,998	34,024	34,050	34,077	34,105	34,133	34,162
Sonoma	31,129	31,137	31,026	31,090	31,118	31,146	31,175	31,203	31,231	31,260	31,288
Ventura	81,776	81,830	81,884	81,884	81,907	81,932	81,957	81,982	82,009	82,037	82,065

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: | | |
	6/28	6/29	6/30	7/1	7/3	7/5	7/7
Alameda	90,165	90,211	90,276	90,281	90,404 (18,081) [4,339] {2,170}	90,529 (18,106) [4,345] {2,173}	90,663 (18,133) [4,352] {2,176}
Contra Costa	71,093	71,150	71,235	71,319	71,451 (14,290) [3,430] {1,715}	71,587 (14,317) [3,436] {1,718}	71,728 (14,346) [3,443] {1,721}
Fresno	103,110	103,121	103,121	103,121	103,163 (20,633) [4,952] {2,476}	103,204 (20,641) [4,954] {2,477}	103,245 (20,649) [4,956] {2,478}
Kern	111,049	111,055	111,060	111,060	111,110 (22,222) [5,333] {2,667}	111,159 (22,232) [5,336] {2,668}	111,207 (22,241) [5,338] {2,669}
Lake	3,581	3,591	3,594	3,601	3,610 (722) [173] {87}	3,620 (724) [174] {87}	3,630 (726) [174] {87}
Los Angeles	1,249,572	1,249,875	1,250,240	1,250,740	1,251,497 (250,299) [60,072] {30,036}	1,252,321 (250,464) [60,111] {30,056}	1,253,225 (250,645) [60,155] {30,077}
Marin	14,227	14,236	14,245	14,253	14,265 (2,853) [685] {342}	14,278 (2,856) [685] {343}	14,292 (2,858) [686] {343}
Monterey	43,875	43,885	43,889	43,892	43,902 (8,780) [2,107] {1,054}	43,912 (8,782) [2,108] {1,054}	43,923 (8,785) [2,108] {1,054}
Orange	273,427	273,482	273,561	273,636	273,775 (54,755) [13,141] {6,571}	273,923 (54,785) [13,148] {6,574}	274,082 (54,816) [13,156] {6,578}
Placer	23,751	23,756	23,755	23,793	23,840 (4,768) [1,144] {572}	23,887 (4,777) [1,147] {573}	23,935 (4,787) [1,149] {574}
Riverside	301,691	301,673	301,655	301,774	301,958 (60,392) [14,494] {7,247}	302,155 (60,431) [14,503] {7,252}	302,364 (60,473) [14,513] {7,257}
Sacramento	108,411	108,505	108,571	108,688	108,902 (21,780) [5,227] {2,614}	109,130 (21,826) [5,238] {2,619}	109,375 (21,875) [5,250] {2,625}
San Bernardino	299,672	299,730	299,763	299,883	300,004 (60,001) [14,400] {7,200}	300,126 (60,025) [14,406] {7,203}	300,258 (60,052) [14,412] {7,206}
San Diego	282,416	282,498	282,582	282,583	282,734 (56,547) [13,571] {6,786}	282,887 (56,577) [13,579] {6,789}	283,038 (56,608) [13,586] {6,793}
San Francisco	37,360	37,372	37,041	37,065	37,091 (7,418) [1,780] {890}	37,117 (7,423) [1,782] {891}	37,144 (7,429) [1,783] {891}
San Joaquin	74,887	74,900	74,900	74,900	74,926 (14,985) [3,596] {1,798}	74,950 (14,990) [3,598] {1,799}	74,971 (14,994) [3,599] {1,799}
San Luis Obispo	21,477	21,482	21,482	21,482	21,491 (4,298) [1,032] {516}	21,499 (4,300) [1,032] {516}	21,508 (4,302) [1,032] {516}
San Mateo	42,925	42,927	42,540	42,599	42,671 (8,534) [2,048] {1,024}	42,749 (8,550) [2,052] {1,026}	42,837 (8,567) [2,056] {1,028}
Santa Barbara	34,659	34,626	34,639	34,652	34,671 (6,934) [1,664] {832}	34,691 (6,938) [1,665] {833}	34,712 (6,942) [1,666] {833}
Santa Clara	120,352	120,377	119,357	119,388	119,455 (23,891) [5,734] {2,867}	119,525 (23,905) [5,737] {2,869}	119,597 (23,919) [5,741] {2,870}
Santa Cruz	16,269	16,276	16,282	16,289	16,298 (3,260) [782] {391}	16,308 (3,262) [783] {391}	16,318 (3,264) [783] {392}
Solano	33,898	33,936	33,973	33,973	34,024 (6,805) [1,633] {817}	34,077 (6,815) [1,636] {818}	34,133 (6,827) [1,638] {819}
Sonoma	31,129	31,137	31,026	31,090	31,146 (6,229) [1,495] {748}	31,203 (6,241) [1,498] {749}	31,260 (6,252) [1,500] {750}
Ventura	81,776	81,830	81,884	81,884	81,932 (16,386) [3,933] {1,966}	81,982 (16,396) [3,935] {1,968}	82,037 (16,407) [3,938] {1,969}

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.