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

Date: 8/27/21

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 8/27/21 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.

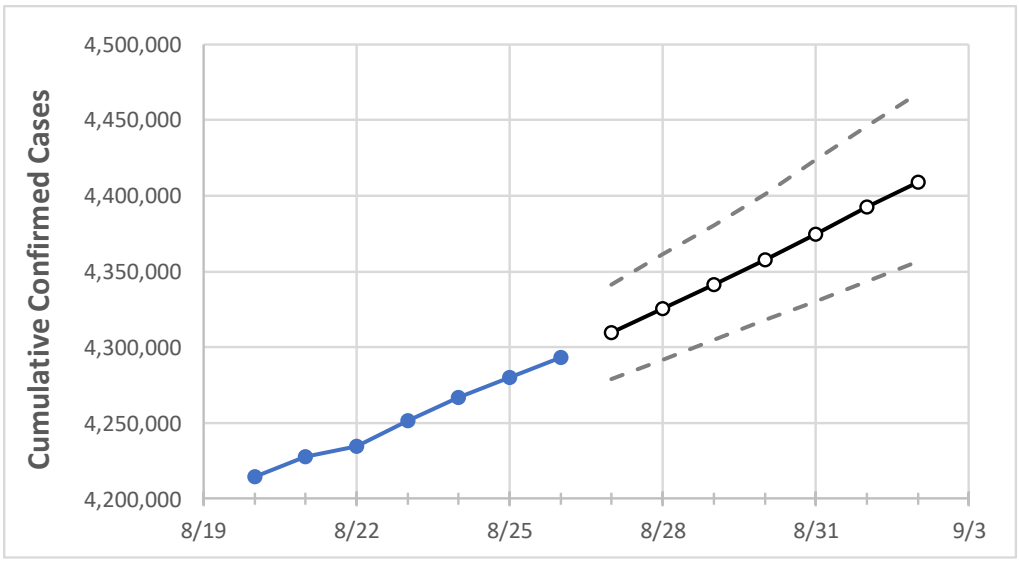
IEM's Modeling Lead

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:						
	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	8/31	9/1	9/2
California	4,251,704	4,266,957	4,280,215	4,293,363	4,309,340	4,325,286	4,341,294	4,357,818	4,374,673	4,392,356	4,409,071

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:						
	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	8/31	9/1	9/2
Alameda	104,859	105,471	105,988	106,431	106,898	107,342	107,794	108,258	108,752	109,231	109,724
Contra Costa	85,019	85,338	85,699	86,188	86,582	86,989	87,372	87,780	88,204	88,613	89,027
Fresno	112,057	112,445	113,024	113,384	113,843	114,310	114,794	115,276	115,792	116,298	116,825
Kern	120,857	121,299	121,898	122,386	122,892	123,411	123,947	124,500	125,061	125,653	126,240
Lake	5,069	5,099	5,135	5,163	5,189	5,216	5,243	5,268	5,295	5,320	5,345
Los Angeles	1,385,784	1,388,672	1,391,513	1,394,632	1,398,929	1,403,500	1,407,677	1,412,247	1,416,902	1,421,557	1,425,943
Marin	15,977	16,033	16,080	16,128	16,174	16,220	16,263	16,310	16,356	16,400	16,447
Monterey	45,945	46,035	46,106	46,197	46,276	46,359	46,444	46,532	46,621	46,712	46,804
Orange	300,665	301,251	301,891	302,419	303,157	303,908	304,629	305,368	306,099	306,855	307,576
Placer	28,395	28,665	28,807	28,948	29,126	29,285	29,448	29,632	29,800	29,995	30,176
Riverside	327,971	329,184	330,327	331,416	332,488	333,538	334,612	335,727	336,877	338,029	339,216
Sacramento	128,340	128,969	129,542	130,125	130,782	131,462	132,129	132,816	133,521	134,245	134,956
San Bernardino	323,047	325,337	326,393	326,982	327,952	328,953	329,896	330,944	331,917	333,090	334,164
San Diego	324,537	325,823	327,166	328,276	329,571	330,879	332,201	333,549	334,882	336,202	337,585
San Francisco	45,831	45,945	46,010	46,107	46,262	46,412	46,562	46,711	46,864	47,013	47,147
San Joaquin	83,121	83,466	83,684	84,002	84,342	84,676	85,020	85,367	85,716	86,076	86,432
San Luis Obispo	24,250	24,622	24,622	24,622	24,788	24,955	25,121	25,293	25,479	25,674	25,855
San Mateo	47,821	47,935	48,050	48,153	48,282	48,412	48,540	48,670	48,801	48,930	49,064
Santa Barbara	38,302	38,414	38,561	38,682	38,806	38,933	39,064	39,183	39,313	39,455	39,582
Santa Clara	130,978	131,272	131,504	131,941	132,321	132,688	133,067	133,441	133,827	134,216	134,611
Santa Cruz	17,823	17,871	17,928	18,095	18,163	18,242	18,313	18,386	18,466	18,548	18,630
Solano	39,002	39,166	39,329	39,329	39,487	39,649	39,808	39,978	40,150	40,320	40,495
Sonoma	35,676	35,816	35,987	36,158	36,289	36,422	36,549	36,687	36,817	36,949	37,091
Ventura	88,980	89,239	89,435	89,683	89,979	90,307	90,632	90,949	91,296	91,649	91,995

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:		
	8/23	8/24	8/25	8/26	8/28	8/30	9/1
Alameda	104,859	105,471	105,988	106,431	107,342 (21,468) [5,152] {2,576}	108,258 (21,652) [5,196] {2,598}	109,231 (21,846) [5,243] {2,622}
Contra Costa	85,019	85,338	85,699	86,188	86,989 (17,398) [4,175] {2,088}	87,780 (17,556) [4,213] {2,107}	88,613 (17,723) [4,253] {2,127}
Fresno	112,057	112,445	113,024	113,384	114,310 (22,862) [5,487] {2,743}	115,276 (23,055) [5,533] {2,767}	116,298 (23,260) [5,582] {2,791}
Kern	120,857	121,299	121,898	122,386	123,411 (24,682) [5,924] {2,962}	124,500 (24,900) [5,976] {2,988}	125,653 (25,131) [6,031] {3,016}
Lake	5,069	5,099	5,135	5,163	5,216 (1,043) [250] {125}	5,268 (1,054) [253] {126}	5,320 (1,064) [255] {128}
Los Angeles	1,385,784	1,388,672	1,391,513	1,394,632	1,403,500 (280,700) [67,368] {33,684}	1,412,247 (282,449) [67,788] {33,894}	1,421,557 (284,311) [68,235] {34,117}
Marin	15,977	16,033	16,080	16,128	16,220 (3,244) [779] {389}	16,310 (3,262) [783] {391}	16,400 (3,280) [787] {394}
Monterey	45,945	46,035	46,106	46,197	46,359 (9,272) [2,225] {1,113}	46,532 (9,306) [2,234] {1,117}	46,712 (9,342) [2,242] {1,121}
Orange	300,665	301,251	301,891	302,419	303,908 (60,782) [14,588] {7,294}	305,368 (61,074) [14,658] {7,329}	306,855 (61,371) [14,729] {7,365}
Placer	28,395	28,665	28,807	28,948	29,285 (5,857) [1,406] {703}	29,632 (5,926) [1,422] {711}	29,995 (5,999) [1,440] {720}
Riverside	327,971	329,184	330,327	331,416	333,538 (66,708) [16,010] {8,005}	335,727 (67,145) [16,115] {8,057}	338,029 (67,606) [16,225] {8,113}
Sacramento	128,340	128,969	129,542	130,125	131,462 (26,292) [6,310] {3,155}	132,816 (26,563) [6,375] {3,188}	134,245 (26,849) [6,444] {3,222}
San Bernardino	323,047	325,337	326,393	326,982	328,953 (65,791) [15,790] {7,895}	330,944 (66,189) [15,885] {7,943}	333,090 (66,618) [15,988] {7,994}
San Diego	324,537	325,823	327,166	328,276	330,879 (66,176) [15,882] {7,941}	333,549 (66,710) [16,010] {8,005}	336,202 (67,240) [16,138] {8,069}
San Francisco	45,831	45,945	46,010	46,107	46,412 (9,282) [2,228] {1,114}	46,711 (9,342) [2,242] {1,121}	47,013 (9,403) [2,257] {1,128}
San Joaquin	83,121	83,466	83,684	84,002	84,676 (16,935) [4,064] {2,032}	85,367 (17,073) [4,098] {2,049}	86,076 (17,215) [4,132] {2,066}
San Luis Obispo	24,250	24,622	24,622	24,622	24,955 (4,991) [1,198] {599}	25,293 (5,059) [1,214] {607}	25,674 (5,135) [1,232] {616}
San Mateo	47,821	47,935	48,050	48,153	48,412 (9,682) [2,324] {1,162}	48,670 (9,734) [2,336] {1,168}	48,930 (9,786) [2,349] {1,174}
Santa Barbara	38,302	38,414	38,561	38,682	38,933 (7,787) [1,869] {934}	39,183 (7,837) [1,881] {940}	39,455 (7,891) [1,894] {947}
Santa Clara	130,978	131,272	131,504	131,941	132,688 (26,538) [6,369] {3,185}	133,441 (26,688) [6,405] {3,203}	134,216 (26,843) [6,442] {3,221}
Santa Cruz	17,823	17,871	17,928	18,095	18,242 (3,648) [876] {438}	18,386 (3,677) [883] {441}	18,548 (3,710) [890] {445}
Solano	39,002	39,166	39,329	39,329	39,649 (7,930) [1,903] {952}	39,978 (7,996) [1,919] {959}	40,320 (8,064) [1,935] {968}
Sonoma	35,676	35,816	35,987	36,158	36,422 (7,284) [1,748] {874}	36,687 (7,337) [1,761] {880}	36,949 (7,390) [1,774] {887}
Ventura	88,980	89,239	89,435	89,683	90,307 (18,061) [4,335] {2,167}	90,949 (18,190) [4,366] {2,183}	91,649 (18,330) [4,399] {2,200}

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.