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

Date: 5/24/21

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 5/24/21 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.

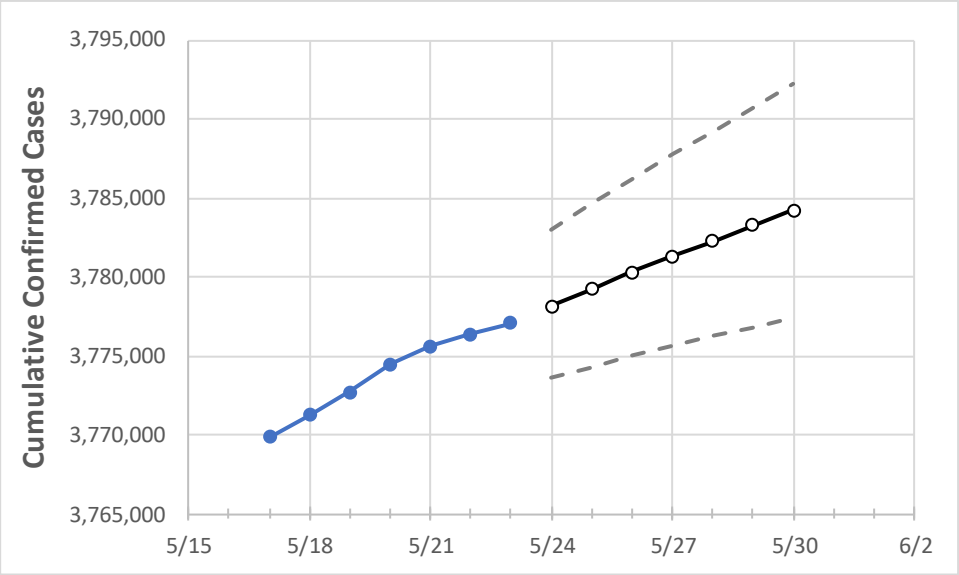
IEM's Modeling Lead

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:						
	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30
California	3,774,494	3,775,619	3,776,346	3,777,077	3,778,167	3,779,244	3,780,301	3,781,297	3,782,282	3,783,265	3,784,221

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:						
	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30
Alameda	88,408	88,483	88,502	88,545	88,600	88,655	88,713	88,768	88,822	88,871	88,920
Contra Costa	69,197	69,245	69,288	69,357	69,408	69,458	69,507	69,557	69,606	69,654	69,703
Fresno	102,085	102,135	102,189	102,238	102,277	102,316	102,355	102,394	102,433	102,472	102,512
Kern	109,506	109,566	109,630	109,654	109,696	109,737	109,780	109,822	109,863	109,903	109,946
Lake	3,497	3,500	3,501	3,502	3,504	3,506	3,508	3,510	3,512	3,514	3,516
Los Angeles	1,238,147	1,238,382	1,238,607	1,238,781	1,238,976	1,239,169	1,239,359	1,239,544	1,239,718	1,239,897	1,240,072
Marin	14,098	14,100	14,106	14,110	14,114	14,118	14,122	14,126	14,130	14,133	14,137
Monterey	43,678	43,662	43,662	43,662	43,669	43,677	43,685	43,692	43,699	43,706	43,714
Orange	271,496	271,537	271,589	271,646	271,700	271,754	271,807	271,859	271,910	271,958	272,007
Placer	22,841	22,871	22,871	22,871	22,895	22,918	22,940	22,962	22,985	23,007	23,029
Riverside	300,189	300,246	300,246	300,246	300,328	300,412	300,494	300,581	300,663	300,746	300,829
Sacramento	105,540	105,604	105,604	105,604	105,699	105,796	105,888	105,985	106,078	106,164	106,251
San Bernardino	297,417	297,479	297,539	297,566	297,631	297,693	297,755	297,816	297,878	297,940	297,998
San Diego	279,489	279,553	279,613	279,689	279,799	279,904	280,009	280,112	280,211	280,310	280,407
San Francisco	36,835	36,860	36,879	36,906	36,922	36,937	36,952	36,967	36,982	36,996	37,010
San Joaquin	73,476	73,544	73,544	73,544	73,575	73,603	73,630	73,657	73,683	73,709	73,732
San Luis Obispo	21,246	21,256	21,256	21,256	21,263	21,269	21,275	21,282	21,287	21,293	21,299
San Mateo	42,126	42,152	42,163	42,218	42,241	42,263	42,286	42,308	42,330	42,350	42,372
Santa Barbara	34,419	34,431	34,439	34,443	34,450	34,457	34,464	34,470	34,476	34,482	34,488
Santa Clara	119,176	119,222	119,247	119,292	119,320	119,348	119,375	119,399	119,424	119,449	119,471
Santa Cruz	16,188	16,159	16,159	16,159	16,164	16,168	16,172	16,176	16,179	16,182	16,186
Solano	33,111	33,122	33,122	33,122	33,141	33,159	33,177	33,194	33,211	33,227	33,243
Sonoma	30,130	30,150	30,168	30,169	30,181	30,192	30,204	30,216	30,228	30,240	30,251
Ventura	81,184	81,204	81,204	81,204	81,228	81,252	81,277	81,300	81,325	81,348	81,372

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:		
	5/20	5/21	5/22	5/23	5/25	5/27	5/29
Alameda	88,408	88,483	88,502	88,545	88,655 (17,731) [4,255] {2,128}	88,768 (17,754) [4,261] {2,130}	88,871 (17,774) [4,266] {2,133}
Contra Costa	69,197	69,245	69,288	69,357	69,458 (13,892) [3,334] {1,667}	69,557 (13,911) [3,339] {1,669}	69,654 (13,931) [3,343] {1,672}
Fresno	102,085	102,135	102,189	102,238	102,316 (20,463) [4,911] {2,456}	102,394 (20,479) [4,915] {2,457}	102,472 (20,494) [4,919] {2,459}
Kern	109,506	109,566	109,630	109,654	109,737 (21,947) [5,267] {2,634}	109,822 (21,964) [5,271] {2,636}	109,903 (21,981) [5,275] {2,638}
Lake	3,497	3,500	3,501	3,502	3,506 (701) [168] {84}	3,510 (702) [168] {84}	3,514 (703) [169] {84}
Los Angeles	1,238,147	1,238,382	1,238,607	1,238,781	1,239,169 (247,834) [59,480] {29,740}	1,239,544 (247,909) [59,498] {29,749}	1,239,897 (247,979) [59,515] {29,758}
Marin	14,098	14,100	14,106	14,110	14,118 (2,824) [678] {339}	14,126 (2,825) [678] {339}	14,133 (2,827) [678] {339}
Monterey	43,678	43,662	43,662	43,662	43,677 (8,735) [2,096] {1,048}	43,692 (8,738) [2,097] {1,049}	43,706 (8,741) [2,098] {1,049}
Orange	271,496	271,537	271,589	271,646	271,754 (54,351) [13,044] {6,522}	271,859 (54,372) [13,049] {6,525}	271,958 (54,392) [13,054] {6,527}
Placer	22,841	22,871	22,871	22,871	22,918 (4,584) [1,100] {550}	22,962 (4,592) [1,102] {551}	23,007 (4,601) [1,104] {552}
Riverside	300,189	300,246	300,246	300,246	300,412 (60,082) [14,420] {7,210}	300,581 (60,116) [14,428] {7,214}	300,746 (60,149) [14,436] {7,218}
Sacramento	105,540	105,604	105,604	105,604	105,796 (21,159) [5,078] {2,539}	105,985 (21,197) [5,087] {2,544}	106,164 (21,233) [5,096] {2,548}
San Bernardino	297,417	297,479	297,539	297,566	297,693 (59,539) [14,289] {7,145}	297,816 (59,563) [14,295] {7,148}	297,940 (59,588) [14,301] {7,151}
San Diego	279,489	279,553	279,613	279,689	279,904 (55,981) [13,435] {6,718}	280,112 (56,022) [13,445] {6,723}	280,310 (56,062) [13,455] {6,727}
San Francisco	36,835	36,860	36,879	36,906	36,937 (7,387) [1,773] {886}	36,967 (7,393) [1,774] {887}	36,996 (7,399) [1,776] {888}
San Joaquin	73,476	73,544	73,544	73,544	73,603 (14,721) [3,533] {1,766}	73,657 (14,731) [3,536] {1,768}	73,709 (14,742) [3,538] {1,769}
San Luis Obispo	21,246	21,256	21,256	21,256	21,269 (4,254) [1,021] {510}	21,282 (4,256) [1,022] {511}	21,293 (4,259) [1,022] {511}
San Mateo	42,126	42,152	42,163	42,218	42,263 (8,453) [2,029] {1,014}	42,308 (8,462) [2,031] {1,015}	42,350 (8,470) [2,033] {1,016}
Santa Barbara	34,419	34,431	34,439	34,443	34,457 (6,891) [1,654] {827}	34,470 (6,894) [1,655] {827}	34,482 (6,896) [1,655] {828}
Santa Clara	119,176	119,222	119,247	119,292	119,348 (23,870) [5,729] {2,864}	119,399 (23,880) [5,731] {2,866}	119,449 (23,890) [5,734] {2,867}
Santa Cruz	16,188	16,159	16,159	16,159	16,168 (3,234) [776] {388}	16,176 (3,235) [776] {388}	16,182 (3,236) [777] {388}
Solano	33,111	33,122	33,122	33,122	33,159 (6,632) [1,592] {796}	33,194 (6,639) [1,593] {797}	33,227 (6,645) [1,595] {797}
Sonoma	30,130	30,150	30,168	30,169	30,192 (6,038) [1,449] {725}	30,216 (6,043) [1,450] {725}	30,240 (6,048) [1,452] {726}
Ventura	81,184	81,204	81,204	81,204	81,252 (16,250) [3,900] {1,950}	81,300 (16,260) [3,902] {1,951}	81,348 (16,270) [3,905] {1,952}

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.