

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

Date: 2/24/21

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 2/24/21 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.

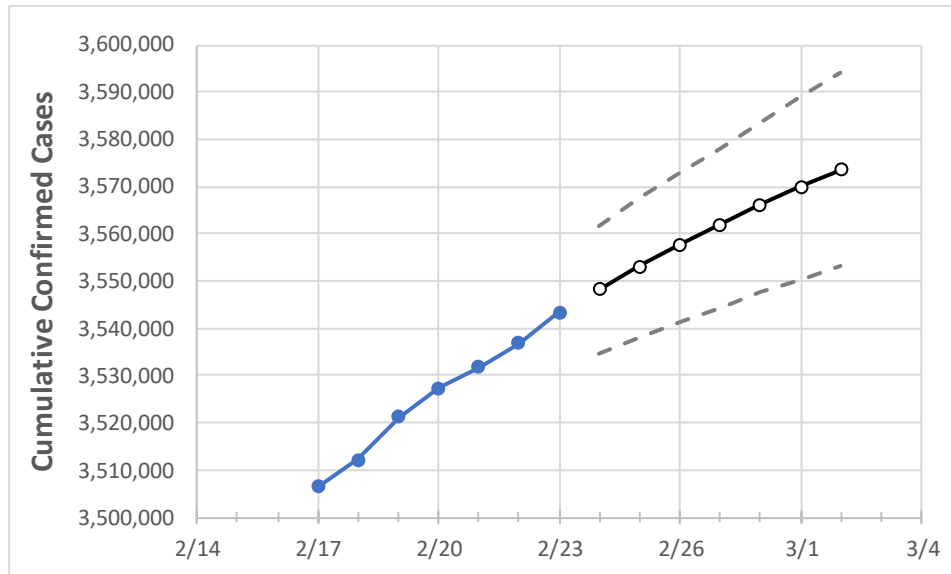
IEM's Modeling Lead

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
California	3,527,338	3,531,846	3,536,946	3,543,340	3,548,299	3,553,098	3,557,668	3,561,860	3,566,098	3,569,963	3,573,668

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
Alameda	79,471	79,539	79,649	79,796	79,917	80,026	80,130	80,225	80,321	80,414	80,495
Contra Costa	61,469	61,628	61,744	61,865	61,992	62,115	62,231	62,345	62,452	62,559	62,662
Fresno	93,973	94,234	94,374	94,584	94,760	94,931	95,095	95,253	95,408	95,556	95,702
Kern	101,613	101,738	101,849	102,137	102,327	102,508	102,680	102,848	103,006	103,156	103,300
Lake	3,078	3,089	3,100	3,107	3,116	3,125	3,133	3,142	3,150	3,157	3,165
Los Angeles	1,179,149	1,180,505	1,181,469	1,183,496	1,184,931	1,186,276	1,187,591	1,188,845	1,190,029	1,191,142	1,192,123
Marin	13,011	13,031	13,052	13,083	13,105	13,127	13,148	13,168	13,189	13,208	13,226
Monterey	41,884	41,928	41,972	42,016	42,070	42,117	42,161	42,206	42,251	42,291	42,327
Orange	258,991	259,305	259,581	259,857	260,128	260,381	260,626	260,857	261,076	261,275	261,470
Placer	19,562	19,604	19,646	19,661	19,695	19,728	19,761	19,792	19,824	19,854	19,885
Riverside	287,630	287,726	287,822	288,541	288,732	288,907	289,078	289,233	289,378	289,503	289,622
Sacramento	91,815	92,057	92,428	92,621	92,810	93,005	93,184	93,352	93,530	93,712	93,887
San Bernardino	284,280	284,639	284,866	285,081	285,344	285,587	285,823	286,037	286,245	286,450	286,648
San Diego	256,513	257,030	257,351	257,805	258,298	258,774	259,223	259,660	260,073	260,460	260,856
San Francisco	33,746	33,820	33,891	33,947	34,017	34,083	34,147	34,207	34,267	34,327	34,384
San Joaquin	65,943	65,994	66,046	66,290	66,391	66,487	66,583	66,678	66,767	66,849	66,924
San Luis Obispo	19,379	19,419	19,458	19,500	19,540	19,577	19,609	19,644	19,674	19,704	19,732
San Mateo	38,256	38,371	38,448	38,552	38,624	38,692	38,757	38,819	38,879	38,938	38,993
Santa Barbara	31,432	31,518	31,567	31,630	31,704	31,773	31,839	31,902	31,960	32,016	32,070
Santa Clara	108,800	109,054	109,276	109,506	109,702	109,892	110,075	110,256	110,429	110,597	110,760
Santa Cruz	14,457	14,476	14,495	14,516	14,538	14,558	14,578	14,597	14,615	14,632	14,649
Solano	29,797	29,828	29,859	29,882	29,919	29,954	29,986	30,017	30,046	30,073	30,100
Sonoma	27,606	27,703	27,793	27,845	27,894	27,942	27,993	28,039	28,084	28,127	28,169
Ventura	76,582	76,757	76,862	76,947	77,071	77,185	77,289	77,389	77,479	77,565	77,647

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:											
	2/20	2/21	2/22	2/23	2/25				2/27				3/1			
Alameda	79,471	79,539	79,649	79,796	80,026	(16,005)	[3,841]	{1,921}	80,225	(16,045)	[3,851]	{1,925}	80,414	(16,083)	[3,860]	{1,930}
Contra Costa	61,469	61,628	61,744	61,865	62,115	(12,423)	[2,982]	{1,491}	62,345	(12,469)	[2,993]	{1,496}	62,559	(12,512)	[3,003]	{1,501}
Fresno	93,973	94,234	94,374	94,584	94,931	(18,986)	[4,557]	{2,278}	95,253	(19,051)	[4,572]	{2,286}	95,556	(19,111)	[4,587]	{2,293}
Kern	101,613	101,738	101,849	102,137	102,508	(20,502)	[4,920]	{2,460}	102,848	(20,570)	[4,937]	{2,468}	103,156	(20,631)	[4,952]	{2,476}
Lake	3,078	3,089	3,100	3,107	3,125	(625)	[150]	{75}	3,142	(628)	[151]	{75}	3,157	(631)	[152]	{76}
Los Angeles	1,179,149	1,180,505	1,181,469	1,183,496	1,186,276	(237,255)	[56,941]	{28,471}	1,188,845	(237,769)	[57,065]	{28,532}	1,191,142	(238,228)	[57,175]	{28,587}
Marin	13,011	13,031	13,052	13,083	13,127	(2,625)	[630]	{315}	13,168	(2,634)	[632]	{316}	13,208	(2,642)	[634]	{317}
Monterey	41,884	41,928	41,972	42,016	42,117	(8,423)	[2,022]	{1,011}	42,206	(8,441)	[2,026]	{1,013}	42,291	(8,458)	[2,030]	{1,015}
Orange	258,991	259,305	259,581	259,857	260,381	(52,076)	[12,498]	{6,249}	260,857	(52,171)	[12,521]	{6,261}	261,275	(52,255)	[12,541]	{6,271}
Placer	19,562	19,604	19,646	19,661	19,728	(3,946)	[947]	{473}	19,792	(3,958)	[950]	{475}	19,854	(3,971)	[953]	{476}
Riverside	287,630	287,726	287,822	288,541	288,907	(57,781)	[13,868]	{6,934}	289,233	(57,847)	[13,883]	{6,942}	289,503	(57,901)	[13,896]	{6,948}
Sacramento	91,815	92,057	92,428	92,621	93,005	(18,601)	[4,464]	{2,232}	93,352	(18,670)	[4,481]	{2,240}	93,712	(18,742)	[4,498]	{2,249}
San Bernardino	284,280	284,639	284,866	285,081	285,587	(57,117)	[13,708]	{6,854}	286,037	(57,207)	[13,730]	{6,865}	286,450	(57,290)	[13,750]	{6,875}
San Diego	256,513	257,030	257,351	257,805	258,774	(51,755)	[12,421]	{6,211}	259,660	(51,932)	[12,464]	{6,232}	260,460	(52,092)	[12,502]	{6,251}
San Francisco	33,746	33,820	33,891	33,947	34,083	(6,817)	[1,636]	{818}	34,207	(6,841)	[1,642]	{821}	34,327	(6,865)	[1,648]	{824}
San Joaquin	65,943	65,994	66,046	66,290	66,487	(13,297)	[3,191]	{1,596}	66,678	(13,336)	[3,201]	{1,600}	66,849	(13,370)	[3,209]	{1,604}
San Luis Obispo	19,379	19,419	19,458	19,500	19,577	(3,915)	[940]	{470}	19,644	(3,929)	[943]	{471}	19,704	(3,941)	[946]	{473}
San Mateo	38,256	38,371	38,448	38,552	38,692	(7,738)	[1,857]	{929}	38,819	(7,764)	[1,863]	{932}	38,938	(7,788)	[1,869]	{935}
Santa Barbara	31,432	31,518	31,567	31,630	31,773	(6,355)	[1,525]	{763}	31,902	(6,380)	[1,531]	{766}	32,016	(6,403)	[1,537]	{768}
Santa Clara	108,800	109,054	109,276	109,506	109,892	(21,978)	[5,275]	{2,637}	110,256	(22,051)	[5,292]	{2,646}	110,597	(22,119)	[5,309]	{2,654}
Santa Cruz	14,457	14,476	14,495	14,516	14,558	(2,912)	[699]	{349}	14,597	(2,919)	[701]	{350}	14,632	(2,926)	[702]	{351}
Solano	29,797	29,828	29,859	29,882	29,954	(5,991)	[1,438]	{719}	30,017	(6,003)	[1,441]	{720}	30,073	(6,015)	[1,443]	{722}
Sonoma	27,606	27,703	27,793	27,845	27,942	(5,588)	[1,341]	{671}	28,039	(5,608)	[1,346]	{673}	28,127	(5,625)	[1,350]	{675}
Ventura	76,582	76,757	76,862	76,947	77,185	(15,437)	[3,705]	{1,852}	77,389	(15,478)	[3,715]	{1,857}	77,565	(15,513)	[3,723]	{1,862}

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.