

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

Date: 1/14/21

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 1/14/21 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.

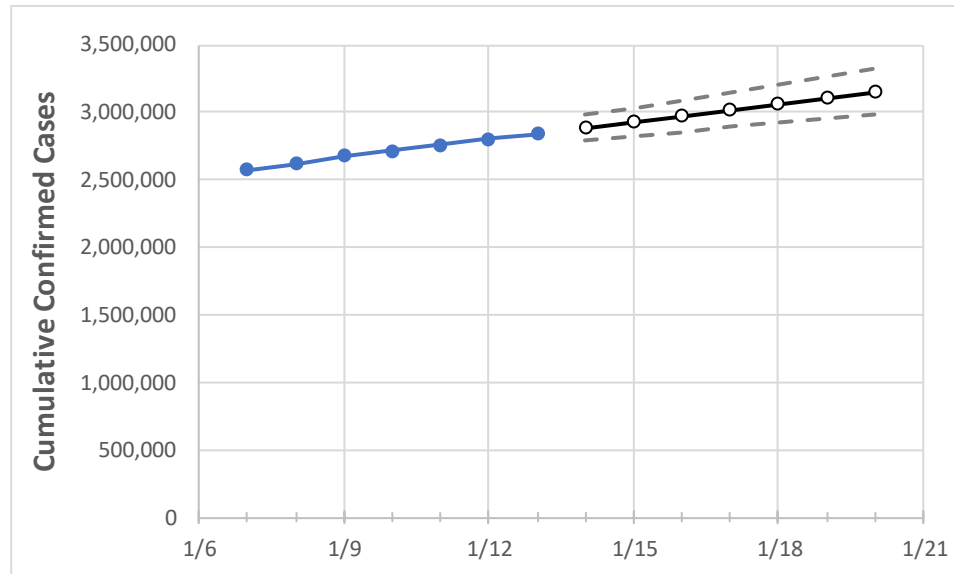
IEM's Modeling Lead

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:							
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	
California	2,717,862	2,758,021	2,804,663	2,843,062	2,886,412	2,929,667	2,974,418	3,018,188	3,061,626	3,105,458	3,149,838	

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Alameda	60,125	61,111	62,046	62,943	63,794	64,656	65,526	66,389	67,281	68,170	69,076
Contra Costa	47,315	47,940	48,449	49,082	49,804	50,552	51,303	52,095	52,890	53,687	54,486
Fresno	74,816	75,621	76,581	77,651	78,570	79,515	80,413	81,356	82,277	83,218	84,179
Kern	78,832	79,728	80,674	81,490	82,580	83,675	84,765	85,877	87,000	88,116	89,256
Lake	2,144	2,194	2,526	2,321	2,423	2,535	2,657	2,790	2,936	3,093	3,267
Los Angeles	920,324	932,901	947,035	959,156	973,860	988,558	1,003,286	1,017,915	1,032,788	1,047,818	1,062,675
Marin	10,811	10,928	11,038	11,126	11,247	11,370	11,496	11,626	11,761	11,897	12,035
Monterey	32,483	32,571	33,761	34,072	34,556	35,054	35,548	36,049	36,522	37,045	37,557
Orange	191,004	193,766	196,340	199,532	202,659	205,813	209,039	212,301	215,475	218,719	222,000
Placer	15,609	15,978	16,135	16,317	16,504	16,691	16,881	17,061	17,242	17,426	17,603
Riverside	216,076	219,486	227,827	230,600	234,062	237,725	241,330	244,955	248,771	252,422	256,291
Sacramento	74,482	75,394	76,009	77,201	78,047	78,903	79,749	80,579	81,392	82,228	83,056
San Bernardino	228,857	232,171	235,543	239,786	242,995	246,248	249,438	252,528	255,725	258,988	262,207
San Diego	191,888	194,795	198,319	201,580	205,337	209,154	212,970	216,863	220,837	224,809	228,829
San Francisco	26,708	27,054	27,264	27,531	27,873	28,219	28,570	28,934	29,286	29,641	30,005
San Joaquin	51,927	52,535	53,994	54,796	55,477	56,172	56,864	57,555	58,249	58,959	59,696
San Luis Obispo	13,647	13,968	14,233	14,425	14,780	15,142	15,517	15,906	16,306	16,729	17,151
San Mateo	28,512	28,972	29,355	29,747	30,186	30,644	31,099	31,559	32,023	32,495	32,977
Santa Barbara	21,323	21,767	22,237	22,769	23,313	23,893	24,494	25,085	25,747	26,412	27,119
Santa Clara	83,655	84,726	85,929	87,045	88,376	89,676	91,003	92,353	93,659	94,982	96,304
Santa Cruz	10,717	10,951	11,093	11,275	11,490	11,703	11,925	12,154	12,386	12,617	12,858
Solano	22,953	23,314	23,554	23,889	24,277	24,673	25,088	25,500	25,933	26,367	26,821
Sonoma	21,463	21,925	22,191	22,531	22,821	23,109	23,421	23,727	24,039	24,359	24,688
Ventura	51,988	53,095	54,202	55,342	56,772	58,257	59,754	61,287	62,893	64,530	66,224

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:											
	1/10	1/11	1/12	1/13	1/15				1/17				1/19			
Alameda	60,125	61,111	62,046	62,943	64,656	(12,931)	[3,103]	{1,552}	66,389	(13,278)	[3,187]	{1,593}	68,170	(13,634)	[3,272]	{1,636}
Contra Costa	47,315	47,940	48,449	49,082	50,552	(10,110)	[2,427]	{1,213}	52,095	(10,419)	[2,501]	{1,250}	53,687	(10,737)	[2,577]	{1,288}
Fresno	74,816	75,621	76,581	77,651	79,515	(15,903)	[3,817]	{1,908}	81,356	(16,271)	[3,905]	{1,953}	83,218	(16,644)	[3,994]	{1,997}
Kern	78,832	79,728	80,674	81,490	83,675	(16,735)	[4,016]	{2,008}	85,877	(17,175)	[4,122]	{2,061}	88,116	(17,623)	[4,230]	{2,115}
Lake	2,144	2,194	2,526	2,321	2,535	(507)	[122]	{61}	2,790	(558)	[134]	{67}	3,093	(619)	[148]	{74}
Los Angeles	920,324	932,901	947,035	959,156	988,558	(197,712)	[47,451]	{23,725}	1,017,915	(203,583)	[48,860]	{24,430}	1,047,818	(209,564)	[50,295]	{25,148}
Marin	10,811	10,928	11,038	11,126	11,370	(2,274)	[546]	{273}	11,626	(2,325)	[558]	{279}	11,897	(2,379)	[571]	{286}
Monterey	32,483	32,571	33,761	34,072	35,054	(7,011)	[1,683]	{841}	36,049	(7,210)	[1,730]	{865}	37,045	(7,409)	[1,778]	{889}
Orange	191,004	193,766	196,340	199,532	205,813	(41,163)	[9,879]	{4,940}	212,301	(42,460)	[10,190]	{5,095}	218,719	(43,744)	[10,499]	{5,249}
Placer	15,609	15,978	16,135	16,317	16,691	(3,338)	[801]	{401}	17,061	(3,412)	[819]	{409}	17,426	(3,485)	[836]	{418}
Riverside	216,076	219,486	227,827	230,600	237,725	(47,545)	[11,411]	{5,705}	244,955	(48,991)	[11,758]	{5,879}	252,422	(50,484)	[12,116]	{6,058}
Sacramento	74,482	75,394	76,009	77,201	78,903	(15,781)	[3,787]	{1,894}	80,579	(16,116)	[3,868]	{1,934}	82,228	(16,446)	[3,947]	{1,973}
San Bernardino	228,857	232,171	235,543	239,786	246,248	(49,250)	[11,820]	{5,910}	252,528	(50,506)	[12,121]	{6,061}	258,988	(51,798)	[12,431]	{6,216}
San Diego	191,888	194,795	198,319	201,580	209,154	(41,831)	[10,039]	{5,020}	216,863	(43,373)	[10,409]	{5,205}	224,809	(44,962)	[10,791]	{5,395}
San Francisco	26,708	27,054	27,264	27,531	28,219	(5,644)	[1,355]	{677}	28,934	(5,787)	[1,389]	{694}	29,641	(5,928)	[1,423]	{711}
San Joaquin	51,927	52,535	53,994	54,796	56,172	(11,234)	[2,696]	{1,348}	57,555	(11,511)	[2,763]	{1,381}	58,959	(11,792)	[2,830]	{1,415}
San Luis Obispo	13,647	13,968	14,233	14,425	15,142	(3,028)	[727]	{363}	15,906	(3,181)	[764]	{382}	16,729	(3,346)	[803]	{401}
San Mateo	28,512	28,972	29,355	29,747	30,644	(6,129)	[1,471]	{735}	31,559	(6,312)	[1,515]	{757}	32,495	(6,499)	[1,560]	{780}
Santa Barbara	21,323	21,767	22,237	22,769	23,893	(4,779)	[1,147]	{573}	25,085	(5,017)	[1,204]	{602}	26,412	(5,282)	[1,268]	{634}
Santa Clara	83,655	84,726	85,929	87,045	89,676	(17,935)	[4,304]	{2,152}	92,353	(18,471)	[4,433]	{2,216}	94,982	(18,996)	[4,559]	{2,280}
Santa Cruz	10,717	10,951	11,093	11,275	11,703	(2,341)	[562]	{281}	12,154	(2,431)	[583]	{292}	12,617	(2,523)	[606]	{303}
Solano	22,953	23,314	23,554	23,889	24,673	(4,935)	[1,184]	{592}	25,500	(5,100)	[1,224]	{612}	26,367	(5,273)	[1,266]	{633}
Sonoma	21,463	21,925	22,191	22,531	23,109	(4,622)	[1,109]	{555}	23,727	(4,745)	[1,139]	{569}	24,359	(4,872)	[1,169]	{585}
Ventura	51,988	53,095	54,202	55,342	58,257	(11,651)	[2,796]	{1,398}	61,287	(12,257)	[2,942]	{1,471}	64,530	(12,906)	[3,097]	{1,549}

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.