

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

Date: 4/16/21

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 4/16/21 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.

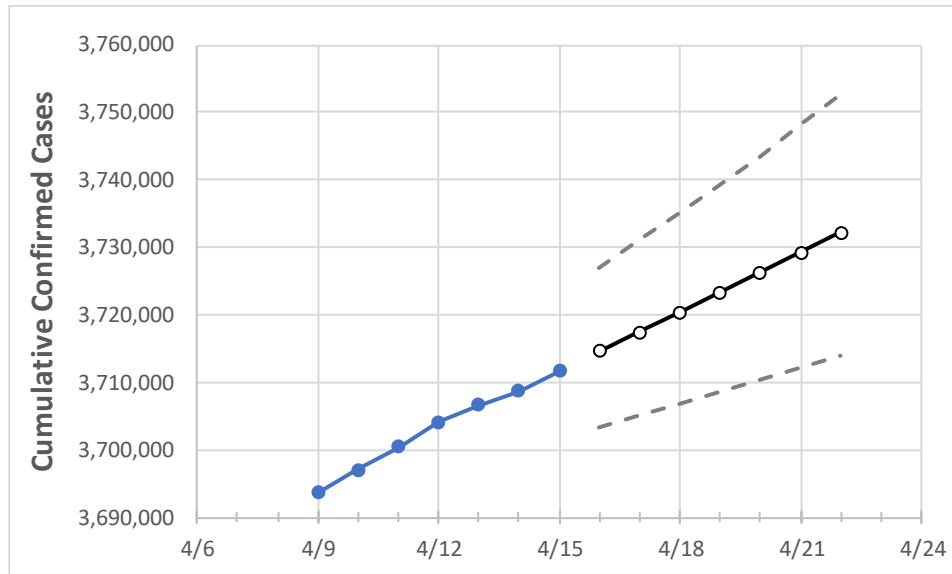
IEM's Modeling Lead

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:							
	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	

California 3,704,070 3,706,629 3,708,716 3,711,723 3,714,556 3,717,491 3,720,396 3,723,329 3,726,313 3,729,254 3,732,260

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:							
	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	
Alameda	84,756	84,817	84,921	85,009	85,120	85,236	85,349	85,469	85,586	85,704	85,826	
Contra Costa	66,442	66,567	66,659	66,750	66,848	66,946	67,047	67,149	67,249	67,350	67,459	
Fresno	100,230	100,277	100,357	100,376	100,440	100,502	100,564	100,624	100,682	100,740	100,796	
Kern	107,374	107,434	107,591	107,648	107,746	107,844	107,948	108,051	108,154	108,258	108,364	
Lake	3,377	3,380	3,390	3,396	3,401	3,405	3,410	3,415	3,420	3,425	3,430	
Los Angeles	1,226,219	1,226,627	1,226,964	1,227,537	1,227,999	1,228,475	1,228,929	1,229,390	1,229,841	1,230,278	1,230,728	
Marin	13,813	13,815	13,830	13,845	13,854	13,863	13,872	13,882	13,891	13,900	13,909	
Monterey	43,192	43,209	43,227	43,245	43,264	43,282	43,300	43,319	43,338	43,357	43,375	
Orange	268,304	268,414	268,521	268,622	268,785	268,953	269,118	269,282	269,448	269,614	269,782	
Placer	21,540	21,600	21,644	21,686	21,739	21,791	21,847	21,905	21,961	22,018	22,079	
Riverside	296,635	296,801	296,908	297,078	297,259	297,441	297,626	297,815	298,000	298,190	298,380	
Sacramento	100,365	100,587	100,726	100,857	101,076	101,303	101,531	101,761	101,996	102,237	102,476	
San Bernardino	293,835	293,925	294,101	294,262	294,543	294,831	295,140	295,450	295,775	296,101	296,444	
San Diego	273,430	273,708	273,968	274,249	274,495	274,743	274,988	275,243	275,481	275,727	275,969	
San Francisco	35,815	35,841	35,869	35,898	35,937	35,977	36,016	36,055	36,097	36,138	36,179	
San Joaquin	70,994	71,178	71,258	71,338	71,436	71,531	71,632	71,730	71,832	71,929	72,029	
San Luis Obispo	20,754	20,827	20,853	20,878	20,904	20,930	20,958	20,985	21,012	21,040	21,067	
San Mateo	40,901	40,920	40,955	41,015	41,055	41,097	41,138	41,178	41,218	41,259	41,301	
Santa Barbara	33,727	33,736	33,766	33,796	33,842	33,889	33,935	33,982	34,030	34,079	34,125	
Santa Clara	116,324	116,436	116,562	116,678	116,812	116,953	117,095	117,236	117,381	117,529	117,675	
Santa Cruz	15,394	15,432	15,466	15,495	15,522	15,550	15,580	15,610	15,640	15,671	15,702	
Solano	31,673	31,702	31,734	31,804	31,846	31,888	31,931	31,974	32,018	32,063	32,107	
Sonoma	29,536	29,573	29,608	29,632	29,655	29,678	29,701	29,725	29,747	29,768	29,790	
Ventura	80,078	80,112	80,156	80,186	80,216	80,245	80,273	80,302	80,332	80,360	80,386	

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:											
	4/12	4/13	4/14	4/15	4/17			4/19			4/21					
Alameda	84,756	84,817	84,921	85,009	85,236	(17,047)	[4,091]	{2,046}	85,469	(17,094)	[4,102]	{2,051}	85,704	(17,141)	[4,114]	{2,057}
Contra Costa	66,442	66,567	66,659	66,750	66,946	(13,389)	[3,213]	{1,607}	67,149	(13,430)	[3,223]	{1,612}	67,350	(13,470)	[3,233]	{1,616}
Fresno	100,230	100,277	100,357	100,376	100,502	(20,100)	[4,824]	{2,412}	100,624	(20,125)	[4,830]	{2,415}	100,740	(20,148)	[4,836]	{2,418}
Kern	107,374	107,434	107,591	107,648	107,844	(21,569)	[5,177]	{2,588}	108,051	(21,610)	[5,186]	{2,593}	108,258	(21,652)	[5,196]	{2,598}
Lake	3,377	3,380	3,390	3,396	3,405	(681)	[163]	{82}	3,415	(683)	[164]	{82}	3,425	(685)	[164]	{82}
Los Angeles	1,226,219	1,226,627	1,226,964	1,227,537	1,228,475	(245,695)	[58,967]	{29,483}	1,229,390	(245,878)	[59,011]	{29,505}	1,230,278	(246,056)	[59,053]	{29,527}
Marin	13,813	13,815	13,830	13,845	13,863	(2,773)	[665]	{333}	13,882	(2,776)	[666]	{333}	13,900	(2,780)	[667]	{334}
Monterey	43,192	43,209	43,227	43,245	43,282	(8,656)	[2,078]	{1,039}	43,319	(8,664)	[2,079]	{1,040}	43,357	(8,671)	[2,081]	{1,041}
Orange	268,304	268,414	268,521	268,622	268,953	(53,791)	[12,910]	{6,455}	269,282	(53,856)	[12,926]	{6,463}	269,614	(53,923)	[12,941]	{6,471}
Placer	21,540	21,600	21,644	21,686	21,791	(4,358)	[1,046]	{523}	21,905	(4,381)	[1,051]	{526}	22,018	(4,404)	[1,057]	{528}
Riverside	296,635	296,801	296,908	297,078	297,441	(59,488)	[14,277]	{7,139}	297,815	(59,563)	[14,295]	{7,148}	298,190	(59,638)	[14,313]	{7,157}
Sacramento	100,365	100,587	100,726	100,857	101,303	(20,261)	[4,863]	{2,431}	101,761	(20,352)	[4,885]	{2,442}	102,237	(20,447)	[4,907]	{2,454}
San Bernardino	293,835	293,925	294,101	294,262	294,831	(58,966)	[14,152]	{7,076}	295,450	(59,090)	[14,182]	{7,091}	296,101	(59,220)	[14,213]	{7,106}
San Diego	273,430	273,708	273,968	274,249	274,743	(54,949)	[13,188]	{6,594}	275,243	(55,049)	[13,212]	{6,606}	275,727	(55,145)	[13,235]	{6,617}
San Francisco	35,815	35,841	35,869	35,898	35,977	(7,195)	[1,727]	{863}	36,055	(7,211)	[1,731]	{865}	36,138	(7,228)	[1,735]	{867}
San Joaquin	70,994	71,178	71,258	71,338	71,531	(14,306)	[3,433]	{1,717}	71,730	(14,346)	[3,443]	{1,722}	71,929	(14,386)	[3,453]	{1,726}
San Luis Obispo	20,754	20,827	20,853	20,878	20,930	(4,186)	[1,005]	{502}	20,985	(4,197)	[1,007]	{504}	21,040	(4,208)	[1,010]	{505}
San Mateo	40,901	40,920	40,955	41,015	41,097	(8,219)	[1,973]	{986}	41,178	(8,236)	[1,977]	{988}	41,259	(8,252)	[1,980]	{990}
Santa Barbara	33,727	33,736	33,766	33,796	33,889	(6,778)	[1,627]	{813}	33,982	(6,796)	[1,631]	{816}	34,079	(6,816)	[1,636]	{818}
Santa Clara	116,324	116,436	116,562	116,678	116,953	(23,391)	[5,614]	{2,807}	117,236	(23,447)	[5,627]	{2,814}	117,529	(23,506)	[5,641]	{2,821}
Santa Cruz	15,394	15,432	15,466	15,495	15,550	(3,110)	[746]	{373}	15,610	(3,122)	[749]	{375}	15,671	(3,134)	[752]	{376}
Solano	31,673	31,702	31,734	31,804	31,888	(6,378)	[1,531]	{765}	31,974	(6,395)	[1,535]	{767}	32,063	(6,413)	[1,539]	{770}
Sonoma	29,536	29,573	29,608	29,632	29,678	(5,936)	[1,425]	{712}	29,725	(5,945)	[1,427]	{713}	29,768	(5,954)	[1,429]	{714}
Ventura	80,078	80,112	80,156	80,186	80,245	(16,049)	[3,852]	{1,926}	80,302	(16,060)	[3,855]	{1,927}	80,360	(16,072)	[3,857]	{1,929}

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.