

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

Date: 5/4/21

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 5/4/21 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.

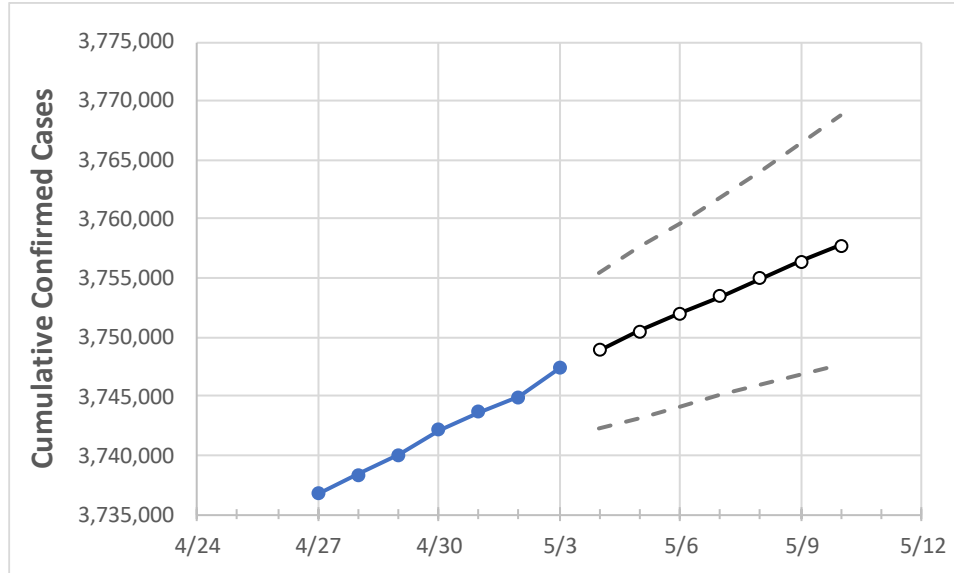
IEM's Modeling Lead

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:						
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10

California 3,742,115 3,743,681 3,744,937 3,747,337 3,748,917 3,750,495 3,751,998 3,753,466 3,754,936 3,756,403 3,757,795

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:							
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	
Alameda	86,490	86,602	86,704	86,784	86,879	86,974	87,067	87,161	87,255	87,348	87,442	
Contra Costa	67,957	68,051	68,115	68,167	68,237	68,305	68,374	68,442	68,508	68,572	68,638	
Fresno	101,189	101,263	101,326	101,372	101,417	101,462	101,506	101,549	101,592	101,633	101,675	
Kern	108,545	108,598	108,628	108,652	108,691	108,730	108,769	108,809	108,845	108,880	108,914	
Lake	3,438	3,440	3,441	3,443	3,445	3,446	3,448	3,450	3,451	3,453	3,454	
Los Angeles	1,233,091	1,233,505	1,233,772	1,233,998	1,234,283	1,234,559	1,234,832	1,235,099	1,235,357	1,235,612	1,235,860	
Marin	13,961	13,975	13,981	13,989	13,998	14,008	14,018	14,028	14,038	14,048	14,058	
Monterey	43,454	43,461	43,469	43,476	43,487	43,497	43,508	43,518	43,529	43,538	43,548	
Orange	270,101	270,194	270,284	270,345	270,422	270,497	270,570	270,642	270,711	270,779	270,847	
Placer	22,222	22,231	22,240	22,323	22,352	22,379	22,407	22,434	22,460	22,486	22,513	
Riverside	298,450	298,491	298,531	298,572	298,626	298,679	298,731	298,782	298,827	298,872	298,922	
Sacramento	102,959	103,001	103,043	103,386	103,506	103,626	103,757	103,880	104,006	104,134	104,255	
San Bernardino	295,899	296,009	296,089	296,146	296,213	296,280	296,344	296,405	296,464	296,523	296,578	
San Diego	276,156	276,366	276,520	276,692	276,818	276,942	277,060	277,171	277,283	277,393	277,500	
San Francisco	36,412	36,453	36,496	36,522	36,553	36,584	36,615	36,646	36,677	36,707	36,738	
San Joaquin	72,478	72,543	72,607	72,672	72,738	72,804	72,870	72,932	73,001	73,065	73,129	
San Luis Obispo	21,192	21,193	21,195	21,196	21,208	21,218	21,229	21,239	21,249	21,259	21,268	
San Mateo	41,538	41,583	41,617	41,656	41,690	41,724	41,756	41,790	41,821	41,854	41,888	
Santa Barbara	34,180	34,205	34,223	34,238	34,260	34,281	34,302	34,323	34,344	34,363	34,384	
Santa Clara	118,269	118,369	118,424	118,479	118,555	118,629	118,702	118,772	118,838	118,903	118,966	
Santa Cruz	15,999	16,005	16,011	16,017	16,039	16,062	16,085	16,108	16,132	16,154	16,175	
Solano	32,477	32,514	32,551	32,588	32,629	32,670	32,710	32,750	32,791	32,831	32,871	
Sonoma	29,856	29,876	29,886	29,897	29,908	29,918	29,928	29,938	29,948	29,957	29,966	
Ventura	80,617	80,642	80,668	80,693	80,718	80,742	80,766	80,790	80,814	80,836	80,860	

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:											
	4/30	5/1	5/2	5/3	5/5			5/7			5/9					
Alameda	86,490	86,602	86,704	86,784	86,974	(17,395)	[4,175]	{2,087}	87,161	(17,432)	[4,184]	{2,092}	87,348	(17,470)	[4,193]	{2,096}
Contra Costa	67,957	68,051	68,115	68,167	68,305	(13,661)	[3,279]	{1,639}	68,442	(13,688)	[3,285]	{1,643}	68,572	(13,714)	[3,291]	{1,646}
Fresno	101,189	101,263	101,326	101,372	101,462	(20,292)	[4,870]	{2,435}	101,549	(20,310)	[4,874]	{2,437}	101,633	(20,327)	[4,878]	{2,439}
Kern	108,545	108,598	108,628	108,652	108,730	(21,746)	[5,219]	{2,610}	108,809	(21,762)	[5,223]	{2,611}	108,880	(21,776)	[5,226]	{2,613}
Lake	3,438	3,440	3,441	3,443	3,446	(689)	[165]	{83}	3,450	(690)	[166]	{83}	3,453	(691)	[166]	{83}
Los Angeles	1,233,091	1,233,505	1,233,772	1,233,998	1,234,559	(246,912)	[59,259]	{29,629}	1,235,099	(247,020)	[59,285]	{29,642}	1,235,612	(247,122)	[59,309]	{29,655}
Marin	13,961	13,975	13,981	13,989	14,008	(2,802)	[672]	{336}	14,028	(2,806)	[673]	{337}	14,048	(2,810)	[674]	{337}
Monterey	43,454	43,461	43,469	43,476	43,497	(8,699)	[2,088]	{1,044}	43,518	(8,704)	[2,089]	{1,044}	43,538	(8,708)	[2,090]	{1,045}
Orange	270,101	270,194	270,284	270,345	270,497	(54,099)	[12,984]	{6,492}	270,642	(54,128)	[12,991]	{6,495}	270,779	(54,156)	[12,997]	{6,499}
Placer	22,222	22,231	22,240	22,323	22,379	(4,476)	[1,074]	{537}	22,434	(4,487)	[1,077]	{538}	22,486	(4,497)	[1,079]	{540}
Riverside	298,450	298,491	298,531	298,572	298,679	(59,736)	[14,337]	{7,168}	298,782	(59,756)	[14,342]	{7,171}	298,872	(59,774)	[14,346]	{7,173}
Sacramento	102,959	103,001	103,043	103,386	103,626	(20,725)	[4,974]	{2,487}	103,880	(20,776)	[4,986]	{2,493}	104,134	(20,827)	[4,998]	{2,499}
San Bernardino	295,899	296,009	296,089	296,146	296,280	(59,256)	[14,221]	{7,111}	296,405	(59,281)	[14,227]	{7,114}	296,523	(59,305)	[14,233]	{7,117}
San Diego	276,156	276,366	276,520	276,692	276,942	(55,388)	[13,293]	{6,647}	277,171	(55,434)	[13,304]	{6,652}	277,393	(55,479)	[13,315]	{6,657}
San Francisco	36,412	36,453	36,496	36,522	36,584	(7,317)	[1,756]	{878}	36,646	(7,329)	[1,759]	{879}	36,707	(7,341)	[1,762]	{881}
San Joaquin	72,478	72,543	72,607	72,672	72,804	(14,561)	[3,495]	{1,747}	72,932	(14,586)	[3,501]	{1,750}	73,065	(14,613)	[3,507]	{1,754}
San Luis Obispo	21,192	21,193	21,195	21,196	21,218	(4,244)	[1,018]	{509}	21,239	(4,248)	[1,019]	{510}	21,259	(4,252)	[1,020]	{510}
San Mateo	41,538	41,583	41,617	41,656	41,724	(8,345)	[2,003]	{1,001}	41,790	(8,358)	[2,006]	{1,003}	41,854	(8,371)	[2,009]	{1,004}
Santa Barbara	34,180	34,205	34,223	34,238	34,281	(6,856)	[1,645]	{823}	34,323	(6,865)	[1,648]	{824}	34,363	(6,873)	[1,649]	{825}
Santa Clara	118,269	118,369	118,424	118,479	118,629	(23,726)	[5,694]	{2,847}	118,772	(23,754)	[5,701]	{2,851}	118,903	(23,781)	[5,707]	{2,854}
Santa Cruz	15,999	16,005	16,011	16,017	16,062	(3,212)	[771]	{385}	16,108	(3,222)	[773]	{387}	16,154	(3,231)	[775]	{388}
Solano	32,477	32,514	32,551	32,588	32,670	(6,534)	[1,568]	{784}	32,750	(6,550)	[1,572]	{786}	32,831	(6,566)	[1,576]	{788}
Sonoma	29,856	29,876	29,886	29,897	29,918	(5,984)	[1,436]	{718}	29,938	(5,988)	[1,437]	{719}	29,957	(5,991)	[1,438]	{719}
Ventura	80,617	80,642	80,668	80,693	80,742	(16,148)	[3,876]	{1,938}	80,790	(16,158)	[3,878]	{1,939}	80,836	(16,167)	[3,880]	{1,940}

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.