

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

Date: 5/3/21

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 5/3/21 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.

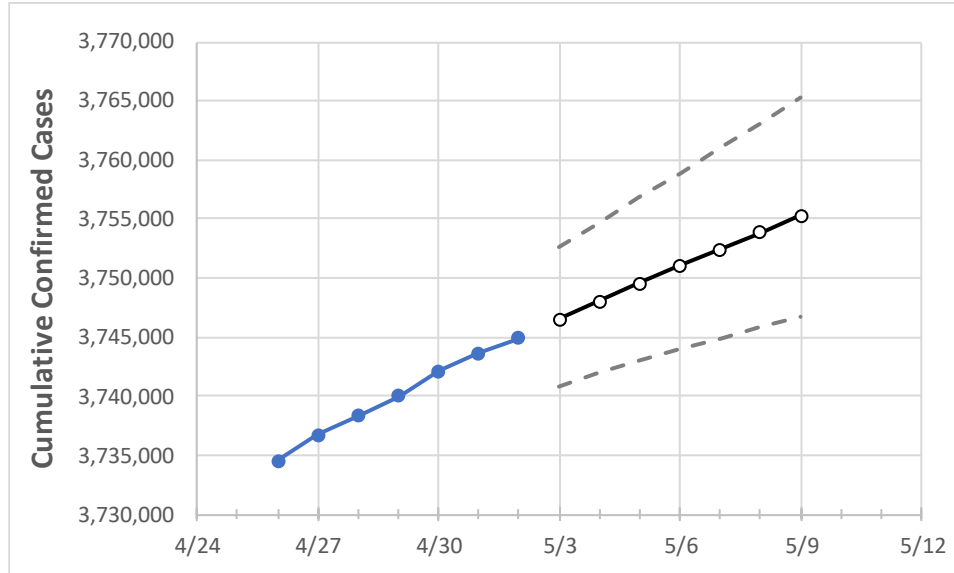
IEM's Modeling Lead

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:						
	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9

California 3,740,038 3,742,115 3,743,681 3,744,937 3,746,511 3,748,026 3,749,543 3,751,031 3,752,463 3,753,851 3,755,287

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:							
	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	
Alameda	86,390	86,490	86,602	86,704	86,801	86,897	86,996	87,093	87,186	87,282	87,376	
Contra Costa	67,880	67,957	68,051	68,115	68,189	68,264	68,337	68,411	68,484	68,556	68,628	
Fresno	101,161	101,189	101,263	101,326	101,372	101,418	101,463	101,507	101,551	101,594	101,635	
Kern	108,479	108,545	108,598	108,628	108,669	108,711	108,750	108,788	108,828	108,866	108,903	
Lake	3,433	3,438	3,440	3,441	3,443	3,444	3,446	3,448	3,449	3,450	3,452	
Los Angeles	1,232,751	1,233,091	1,233,505	1,233,772	1,234,074	1,234,365	1,234,656	1,234,942	1,235,228	1,235,504	1,235,780	
Marin	13,950	13,961	13,975	13,981	13,990	14,000	14,010	14,020	14,030	14,041	14,051	
Monterey	43,443	43,454	43,461	43,461	43,472	43,483	43,495	43,506	43,517	43,528	43,539	
Orange	270,014	270,101	270,194	270,284	270,363	270,443	270,521	270,597	270,672	270,745	270,817	
Placer	22,193	22,222	22,231	22,240	22,261	22,281	22,301	22,320	22,338	22,355	22,372	
Riverside	298,366	298,450	298,450	298,450	298,517	298,583	298,646	298,705	298,766	298,829	298,885	
Sacramento	102,793	102,959	103,001	103,043	103,140	103,235	103,331	103,425	103,518	103,608	103,698	
San Bernardino	295,806	295,899	296,009	296,089	296,161	296,230	296,297	296,363	296,425	296,486	296,546	
San Diego	275,960	276,156	276,366	276,520	276,639	276,757	276,873	276,989	277,094	277,202	277,302	
San Francisco	36,382	36,412	36,453	36,496	36,528	36,560	36,592	36,624	36,656	36,687	36,719	
San Joaquin	72,395	72,478	72,478	72,478	72,549	72,625	72,698	72,774	72,847	72,921	72,992	
San Luis Obispo	21,180	21,192	21,193	21,193	21,207	21,221	21,234	21,247	21,259	21,271	21,282	
San Mateo	41,498	41,538	41,583	41,617	41,651	41,684	41,718	41,750	41,782	41,815	41,846	
Santa Barbara	34,164	34,180	34,205	34,223	34,246	34,269	34,292	34,315	34,337	34,358	34,381	
Santa Clara	118,181	118,269	118,369	118,424	118,503	118,583	118,660	118,734	118,806	118,878	118,948	
Santa Cruz	15,984	15,999	15,999	15,999	16,034	16,071	16,108	16,145	16,184	16,224	16,260	
Solano	32,412	32,477	32,477	32,477	32,521	32,566	32,612	32,657	32,702	32,748	32,794	
Sonoma	29,832	29,856	29,876	29,886	29,897	29,907	29,917	29,926	29,936	29,945	29,954	
Ventura	80,597	80,617	80,617	80,617	80,642	80,667	80,691	80,716	80,741	80,764	80,788	

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:											
	4/29	4/30	5/1	5/2	5/4		5/6		5/8							
Alameda	86,390	86,490	86,602	86,704	86,897	(17,379)	[4,171]	{2,086}	87,093	(17,419)	[4,180]	{2,090}	87,282	(17,456)	[4,190]	{2,095}
Contra Costa	67,880	67,957	68,051	68,115	68,264	(13,653)	[3,277]	{1,638}	68,411	(13,682)	[3,284]	{1,642}	68,556	(13,711)	[3,291]	{1,645}
Fresno	101,161	101,189	101,263	101,326	101,418	(20,284)	[4,868]	{2,434}	101,507	(20,301)	[4,872]	{2,436}	101,594	(20,319)	[4,876]	{2,438}
Kern	108,479	108,545	108,598	108,628	108,711	(21,742)	[5,218]	{2,609}	108,788	(21,758)	[5,222]	{2,611}	108,866	(21,773)	[5,226]	{2,613}
Lake	3,433	3,438	3,440	3,441	3,444	(689)	[165]	{83}	3,448	(690)	[165]	{83}	3,450	(690)	[166]	{83}
Los Angeles	1,232,751	1,233,091	1,233,505	1,233,772	1,234,365	(246,873)	[59,250]	{29,625}	1,234,942	(246,988)	[59,277]	{29,639}	1,235,504	(247,101)	[59,304]	{29,652}
Marin	13,950	13,961	13,975	13,981	14,000	(2,800)	[672]	{336}	14,020	(2,804)	[673]	{336}	14,041	(2,808)	[674]	{337}
Monterey	43,443	43,454	43,461	43,461	43,483	(8,697)	[2,087]	{1,044}	43,506	(8,701)	[2,088]	{1,044}	43,528	(8,706)	[2,089]	{1,045}
Orange	270,014	270,101	270,194	270,284	270,443	(54,089)	[12,981]	{6,491}	270,597	(54,119)	[12,989]	{6,494}	270,745	(54,149)	[12,996]	{6,498}
Placer	22,193	22,222	22,231	22,240	22,281	(4,456)	[1,070]	{535}	22,320	(4,464)	[1,071]	{536}	22,355	(4,471)	[1,073]	{537}
Riverside	298,366	298,450	298,450	298,450	298,583	(59,717)	[14,332]	{7,166}	298,705	(59,741)	[14,338]	{7,169}	298,829	(59,766)	[14,344]	{7,172}
Sacramento	102,793	102,959	103,001	103,043	103,235	(20,647)	[4,955]	{2,478}	103,425	(20,685)	[4,964]	{2,482}	103,608	(20,722)	[4,973]	{2,487}
San Bernardino	295,806	295,899	296,009	296,089	296,230	(59,246)	[14,219]	{7,110}	296,363	(59,273)	[14,225]	{7,113}	296,486	(59,297)	[14,231]	{7,116}
San Diego	275,960	276,156	276,366	276,520	276,757	(55,351)	[13,284]	{6,642}	276,989	(55,398)	[13,295]	{6,648}	277,202	(55,440)	[13,306]	{6,653}
San Francisco	36,382	36,412	36,453	36,496	36,560	(7,312)	[1,755]	{877}	36,624	(7,325)	[1,758]	{879}	36,687	(7,337)	[1,761]	{880}
San Joaquin	72,395	72,478	72,478	72,478	72,625	(14,525)	[3,486]	{1,743}	72,774	(14,555)	[3,493]	{1,747}	72,921	(14,584)	[3,500]	{1,750}
San Luis Obispo	21,180	21,192	21,193	21,193	21,221	(4,244)	[1,019]	{509}	21,247	(4,249)	[1,020]	{510}	21,271	(4,254)	[1,021]	{511}
San Mateo	41,498	41,538	41,583	41,617	41,684	(8,337)	[2,001]	{1,000}	41,750	(8,350)	[2,004]	{1,002}	41,815	(8,363)	[2,007]	{1,004}
Santa Barbara	34,164	34,180	34,205	34,223	34,269	(6,854)	[1,645]	{822}	34,315	(6,863)	[1,647]	{824}	34,358	(6,872)	[1,649]	{825}
Santa Clara	118,181	118,269	118,369	118,424	118,583	(23,717)	[5,692]	{2,846}	118,734	(23,747)	[5,699]	{2,850}	118,878	(23,776)	[5,706]	{2,853}
Santa Cruz	15,984	15,999	15,999	15,999	16,071	(3,214)	[771]	{386}	16,145	(3,229)	[775]	{387}	16,224	(3,245)	[779]	{389}
Solano	32,412	32,477	32,477	32,477	32,566	(6,513)	[1,563]	{782}	32,657	(6,531)	[1,568]	{784}	32,748	(6,550)	[1,572]	{786}
Sonoma	29,832	29,856	29,876	29,886	29,907	(5,981)	[1,436]	{718}	29,926	(5,985)	[1,436]	{718}	29,945	(5,989)	[1,437]	{719}
Ventura	80,597	80,617	80,617	80,617	80,667	(16,133)	[3,872]	{1,936}	80,716	(16,143)	[3,874]	{1,937}	80,764	(16,153)	[3,877]	{1,938}

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.