

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/8/21**

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 12/8/21 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.

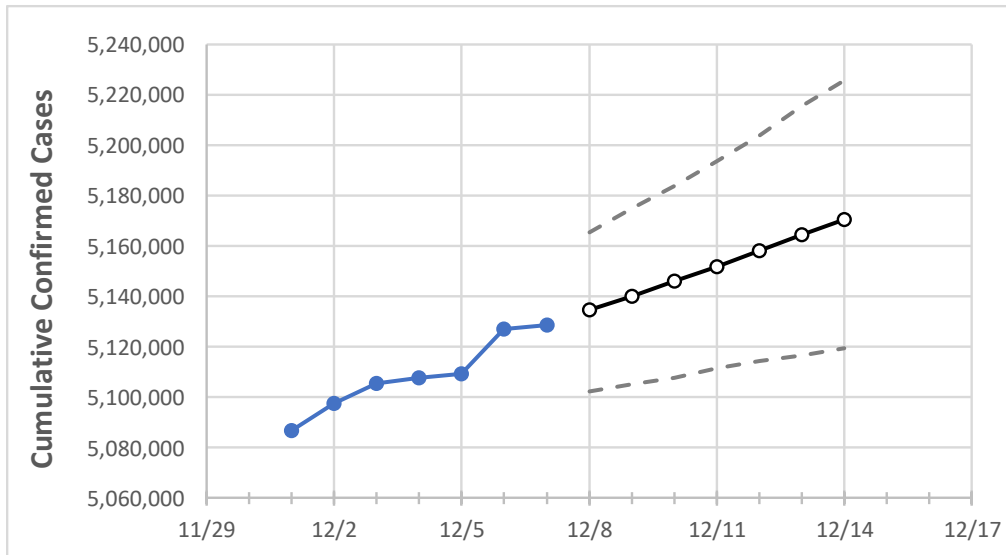
IEM's Modeling Lead

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:						
	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	
California	5,107,717	5,109,348	5,127,121	5,128,725	5,134,781	5,140,140	5,146,009	5,151,824	5,158,052	5,164,423	5,170,431	

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:						
	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14
Alameda	125,827	126,025	126,224	126,224	126,356	126,498	126,635	126,772	126,916	127,062	127,212
Contra Costa	104,360	104,503	104,645	104,645	104,798	104,964	105,135	105,316	105,507	105,702	105,903
Fresno	157,708	157,948	158,187	158,187	158,472	158,778	159,110	159,457	159,828	160,214	160,615
Kern	158,458	158,646	158,834	159,023	159,204	159,384	159,559	159,735	159,911	160,091	160,256
Lake	7,062	7,068	7,073	7,073	7,078	7,084	7,089	7,095	7,100	7,105	7,110
Los Angeles	1,534,720	1,536,351	1,537,450	1,538,451	1,539,742	1,541,053	1,542,317	1,543,595	1,544,967	1,546,314	1,547,637
Marin	18,634	18,681	18,728	18,728	18,787	18,852	18,924	19,001	19,085	19,177	19,274
Monterey	52,886	52,929	52,973	52,973	53,031	53,093	53,151	53,213	53,277	53,345	53,411
Orange	335,777	336,258	336,739	337,045	337,432	337,833	338,240	338,651	339,075	339,506	339,929
Placer	42,551	42,643	42,736	42,736	42,829	42,924	43,025	43,127	43,236	43,349	43,461
Riverside	389,922	390,609	391,295	391,295	391,862	392,439	393,017	393,617	394,230	394,857	395,489
Sacramento	169,369	169,642	169,916	169,916	170,203	170,510	170,827	171,165	171,517	171,888	172,272
San Bernardino	376,989	377,699	378,408	378,408	379,015	379,643	380,275	380,952	381,634	382,322	383,044
San Diego	409,605	410,028	410,451	410,451	410,980	411,535	412,064	412,642	413,185	413,800	414,384
San Francisco	57,247	57,352	57,458	57,458	57,560	57,670	57,788	57,913	58,047	58,193	58,333
San Joaquin	108,216	108,354	108,491	108,491	108,621	108,751	108,880	109,015	109,149	109,281	109,424
San Luis Obispo	31,712	31,758	31,803	31,803	31,845	31,889	31,932	31,977	32,020	32,067	32,113
San Mateo	56,677	56,769	56,861	56,861	56,955	57,059	57,165	57,279	57,400	57,527	57,652
Santa Barbara	47,631	47,738	47,846	47,846	47,924	48,006	48,090	48,175	48,263	48,351	48,441
Santa Clara	153,137	153,416	153,696	153,696	153,963	154,242	154,526	154,824	155,129	155,449	155,771
Santa Cruz	22,448	22,494	22,540	22,540	22,585	22,628	22,673	22,719	22,765	22,814	22,860
Solano	47,890	47,952	48,014	48,014	48,070	48,129	48,188	48,250	48,311	48,375	48,439
Sonoma	43,436	43,522	43,609	43,609	43,700	43,799	43,906	44,020	44,142	44,270	44,404
Ventura	104,514	104,720	104,925	104,925	105,042	105,164	105,282	105,416	105,543	105,683	105,817

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:											
	12/4	12/5	12/6	12/7	12/9				12/11				12/13			
Alameda	125,827	126,025	126,224	126,224	126,498	(25,300)	[6,072]	{3,036}	126,772	(25,354)	[6,085]	{3,043}	127,062	(25,412)	[6,099]	{3,049}
Contra Costa	104,360	104,503	104,645	104,645	104,964	(20,993)	[5,038]	{2,519}	105,316	(21,063)	[5,055]	{2,528}	105,702	(21,140)	[5,074]	{2,537}
Fresno	157,708	157,948	158,187	158,187	158,778	(31,756)	[7,621]	{3,811}	159,457	(31,891)	[7,654]	{3,827}	160,214	(32,043)	[7,690]	{3,845}
Kern	158,458	158,646	158,834	159,023	159,384	(31,877)	[7,650]	{3,825}	159,735	(31,947)	[7,667]	{3,834}	160,091	(32,018)	[7,684]	{3,842}
Lake	7,062	7,068	7,073	7,073	7,084	(1,417)	[340]	{170}	7,095	(1,419)	[341]	{170}	7,105	(1,421)	[341]	{171}
Los Angeles	1,534,720	1,536,351	1,537,450	1,538,451	1,541,053	(308,211)	[73,971]	{36,985}	1,543,595	(308,719)	[74,093]	{37,046}	1,546,314	(309,263)	[74,223]	{37,112}
Marin	18,634	18,681	18,728	18,728	18,852	(3,770)	[905]	{452}	19,001	(3,800)	[912]	{456}	19,177	(3,835)	[920]	{460}
Monterey	52,886	52,929	52,973	52,973	53,093	(10,619)	[2,548]	{1,274}	53,213	(10,643)	[2,554]	{1,277}	53,345	(10,669)	[2,561]	{1,280}
Orange	335,777	336,258	336,739	337,045	337,833	(67,567)	[16,216]	{8,108}	338,651	(67,730)	[16,255]	{8,128}	339,506	(67,901)	[16,296]	{8,148}
Placer	42,551	42,643	42,736	42,736	42,924	(8,585)	[2,060]	{1,030}	43,127	(8,625)	[2,070]	{1,035}	43,349	(8,670)	[2,081]	{1,040}
Riverside	389,922	390,609	391,295	391,295	392,439	(78,488)	[18,837]	{9,419}	393,617	(78,723)	[18,894]	{9,447}	394,857	(78,971)	[18,953]	{9,477}
Sacramento	169,369	169,642	169,916	169,916	170,510	(34,102)	[8,184]	{4,092}	171,165	(34,233)	[8,216]	{4,108}	171,888	(34,378)	[8,251]	{4,125}
San Bernardino	376,989	377,699	378,408	378,408	379,643	(75,929)	[18,223]	{9,111}	380,952	(76,190)	[18,286]	{9,143}	382,322	(76,464)	[18,351]	{9,176}
San Diego	409,605	410,028	410,451	410,451	411,535	(82,307)	[19,754]	{9,877}	412,642	(82,528)	[19,807]	{9,903}	413,800	(82,760)	[19,862]	{9,931}
San Francisco	57,247	57,352	57,458	57,458	57,670	(11,534)	[2,768]	{1,384}	57,913	(11,583)	[2,780]	{1,390}	58,193	(11,639)	[2,793]	{1,397}
San Joaquin	108,216	108,354	108,491	108,491	108,751	(21,750)	[5,220]	{2,610}	109,015	(21,803)	[5,233]	{2,616}	109,281	(21,856)	[5,245]	{2,623}
San Luis Obispo	31,712	31,758	31,803	31,803	31,889	(6,378)	[1,531]	{765}	31,977	(6,395)	[1,535]	{767}	32,067	(6,413)	[1,539]	{770}
San Mateo	56,677	56,769	56,861	56,861	57,059	(11,412)	[2,739]	{1,369}	57,279	(11,456)	[2,749]	{1,375}	57,527	(11,505)	[2,761]	{1,381}
Santa Barbara	47,631	47,738	47,846	47,846	48,006	(9,601)	[2,304]	{1,152}	48,175	(9,635)	[2,312]	{1,156}	48,351	(9,670)	[2,321]	{1,160}
Santa Clara	153,137	153,416	153,696	153,696	154,242	(30,848)	[7,404]	{3,702}	154,824	(30,965)	[7,432]	{3,716}	155,449	(31,090)	[7,462]	{3,731}
Santa Cruz	22,448	22,494	22,540	22,540	22,628	(4,526)	[1,086]	{543}	22,719	(4,544)	[1,091]	{545}	22,814	(4,563)	[1,095]	{548}
Solano	47,890	47,952	48,014	48,014	48,129	(9,626)	[2,310]	{1,155}	48,250	(9,650)	[2,316]	{1,158}	48,375	(9,675)	[2,322]	{1,161}
Sonoma	43,436	43,522	43,609	43,609	43,799	(8,760)	[2,102]	{1,051}	44,020	(8,804)	[2,113]	{1,056}	44,270	(8,854)	[2,125]	{1,062}
Ventura	104,514	104,720	104,925	104,925	105,164	(21,033)	[5,048]	{2,524}	105,416	(21,083)	[5,060]	{2,530}	105,683	(21,137)	[5,073]	{2,536}

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.