

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 11/22/21**

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 11/22/21 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.

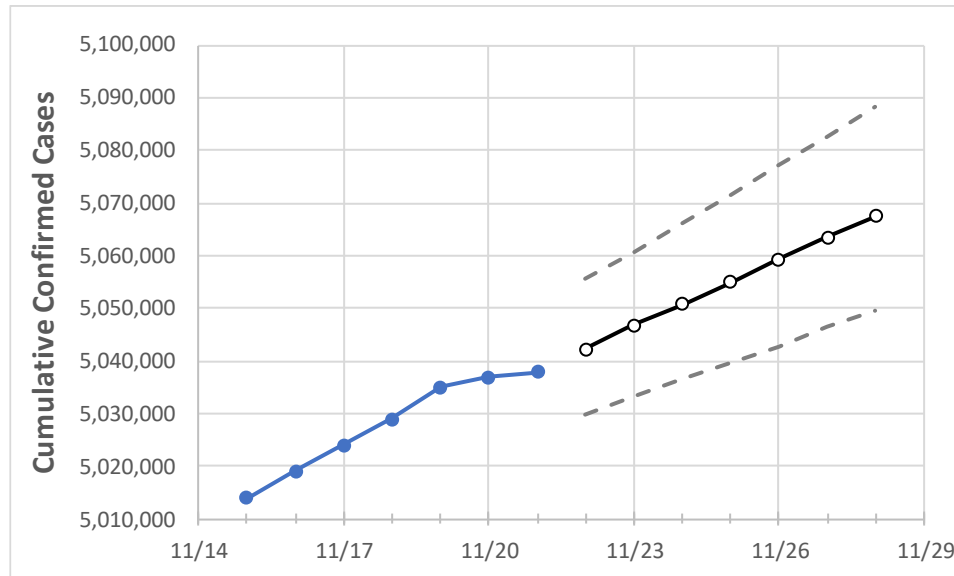
IEM's Modeling Lead

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:						
	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28
California	5,028,939	5,035,053	5,036,884	5,037,933	5,042,256	5,046,748	5,050,816	5,054,982	5,059,279	5,063,502	5,067,469

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:						
	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28
Alameda	123,953	124,099	124,099	124,099	124,198	124,294	124,392	124,489	124,587	124,685	124,779
Contra Costa	102,718	102,822	102,822	102,822	102,892	102,963	103,032	103,102	103,170	103,238	103,307
Fresno	154,879	155,092	155,092	155,092	155,265	155,435	155,607	155,764	155,930	156,090	156,245
Kern	155,118	155,451	155,451	155,451	155,719	155,986	156,236	156,500	156,764	157,018	157,270
Lake	6,949	6,962	6,962	6,962	6,968	6,974	6,979	6,985	6,990	6,996	7,001
Los Angeles	1,515,324	1,516,901	1,518,732	1,519,781	1,521,086	1,522,365	1,523,659	1,524,961	1,526,282	1,527,596	1,528,969
Marin	18,242	18,259	18,259	18,259	18,275	18,290	18,305	18,319	18,334	18,350	18,365
Monterey	52,161	52,200	52,200	52,200	52,243	52,290	52,332	52,377	52,425	52,476	52,521
Orange	331,522	331,850	331,850	331,850	332,110	332,370	332,628	332,888	333,148	333,416	333,678
Placer	41,605	41,680	41,680	41,680	41,740	41,801	41,861	41,922	41,982	42,045	42,107
Riverside	382,750	383,153	383,153	383,153	383,448	383,752	384,058	384,341	384,632	384,924	385,218
Sacramento	166,341	166,605	166,605	166,605	166,772	166,937	167,092	167,255	167,412	167,565	167,723
San Bernardino	369,796	370,171	370,171	370,171	370,505	370,831	371,160	371,495	371,823	372,161	372,492
San Diego	401,843	402,221	402,221	402,221	402,724	403,223	403,724	404,229	404,734	405,231	405,740
San Francisco	56,253	56,309	56,309	56,309	56,359	56,410	56,459	56,508	56,556	56,606	56,651
San Joaquin	106,396	106,554	106,554	106,554	106,662	106,764	106,870	106,972	107,074	107,183	107,286
San Luis Obispo	31,042	31,126	31,126	31,126	31,160	31,195	31,227	31,260	31,295	31,330	31,364
San Mateo	55,790	55,830	55,830	55,830	55,877	55,925	55,973	56,020	56,067	56,116	56,162
Santa Barbara	46,717	46,791	46,791	46,791	46,842	46,891	46,938	46,987	47,038	47,088	47,136
Santa Clara	150,095	150,298	150,298	150,298	150,448	150,602	150,754	150,909	151,063	151,221	151,373
Santa Cruz	21,799	21,855	21,855	21,855	21,888	21,922	21,955	21,989	22,023	22,062	22,097
Solano	47,207	47,265	47,265	47,265	47,305	47,345	47,385	47,426	47,466	47,509	47,547
Sonoma	42,637	42,695	42,695	42,695	42,734	42,771	42,807	42,842	42,876	42,912	42,947
Ventura	103,295	103,376	103,376	103,376	103,447	103,515	103,583	103,650	103,718	103,787	103,854

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:											
	11/18	11/19	11/20	11/21	11/23				11/25				11/27			
Alameda	123,953	124,099	124,099	124,099	124,294	(24,859)	[5,966]	{2,983}	124,489	(24,898)	[5,975]	{2,988}	124,685	(24,937)	[5,985]	{2,992}
Contra Costa	102,718	102,822	102,822	102,822	102,963	(20,593)	[4,942]	{2,471}	103,102	(20,620)	[4,949]	{2,474}	103,238	(20,648)	[4,955]	{2,478}
Fresno	154,879	155,092	155,092	155,092	155,435	(31,087)	[7,461]	{3,730}	155,764	(31,153)	[7,477]	{3,738}	156,090	(31,218)	[7,492]	{3,746}
Kern	155,118	155,451	155,451	155,451	155,986	(31,197)	[7,487]	{3,744}	156,500	(31,300)	[7,512]	{3,756}	157,018	(31,404)	[7,537]	{3,768}
Lake	6,949	6,962	6,962	6,962	6,974	(1,395)	[335]	{167}	6,985	(1,397)	[335]	{168}	6,996	(1,399)	[336]	{168}
Los Angeles	1,515,324	1,516,901	1,518,732	1,519,781	1,522,365	(304,473)	[73,074]	{36,537}	1,524,961	(304,992)	[73,198]	{36,599}	1,527,596	(305,519)	[73,325]	{36,662}
Marin	18,242	18,259	18,259	18,259	18,290	(3,658)	[878]	{439}	18,319	(3,664)	[879]	{440}	18,350	(3,670)	[881]	{440}
Monterey	52,161	52,200	52,200	52,200	52,290	(10,458)	[2,510]	{1,255}	52,377	(10,475)	[2,514]	{1,257}	52,476	(10,495)	[2,519]	{1,259}
Orange	331,522	331,850	331,850	331,850	332,370	(66,474)	[15,954]	{7,977}	332,888	(66,578)	[15,979]	{7,989}	333,416	(66,683)	[16,004]	{8,002}
Placer	41,605	41,680	41,680	41,680	41,801	(8,360)	[2,006]	{1,003}	41,922	(8,384)	[2,012]	{1,006}	42,045	(8,409)	[2,018]	{1,009}
Riverside	382,750	383,153	383,153	383,153	383,752	(76,750)	[18,420]	{9,210}	384,341	(76,868)	[18,448]	{9,224}	384,924	(76,985)	[18,476]	{9,238}
Sacramento	166,341	166,605	166,605	166,605	166,937	(33,387)	[8,013]	{4,006}	167,255	(33,451)	[8,028]	{4,014}	167,565	(33,513)	[8,043]	{4,022}
San Bernardino	369,796	370,171	370,171	370,171	370,831	(74,166)	[17,800]	{8,900}	371,495	(74,299)	[17,832]	{8,916}	372,161	(74,432)	[17,864]	{8,932}
San Diego	401,843	402,221	402,221	402,221	403,223	(80,645)	[19,355]	{9,677}	404,229	(80,846)	[19,403]	{9,701}	405,231	(81,046)	[19,451]	{9,726}
San Francisco	56,253	56,309	56,309	56,309	56,410	(11,282)	[2,708]	{1,354}	56,508	(11,302)	[2,712]	{1,356}	56,606	(11,321)	[2,717]	{1,359}
San Joaquin	106,396	106,554	106,554	106,554	106,764	(21,353)	[5,125]	{2,562}	106,972	(21,394)	[5,135]	{2,567}	107,183	(21,437)	[5,145]	{2,572}
San Luis Obispo	31,042	31,126	31,126	31,126	31,195	(6,239)	[1,497]	{749}	31,260	(6,252)	[1,500]	{750}	31,330	(6,266)	[1,504]	{752}
San Mateo	55,790	55,830	55,830	55,830	55,925	(11,185)	[2,684]	{1,342}	56,020	(11,204)	[2,689]	{1,344}	56,116	(11,223)	[2,694]	{1,347}
Santa Barbara	46,717	46,791	46,791	46,791	46,891	(9,378)	[2,251]	{1,125}	46,987	(9,397)	[2,255]	{1,128}	47,088	(9,418)	[2,260]	{1,130}
Santa Clara	150,095	150,298	150,298	150,298	150,602	(30,120)	[7,229]	{3,614}	150,909	(30,182)	[7,244]	{3,622}	151,221	(30,244)	[7,259]	{3,629}
Santa Cruz	21,799	21,855	21,855	21,855	21,922	(4,384)	[1,052]	{526}	21,989	(4,398)	[1,055]	{528}	22,062	(4,412)	[1,059]	{529}
Solano	47,207	47,265	47,265	47,265	47,345	(9,469)	[2,273]	{1,136}	47,426	(9,485)	[2,276]	{1,138}	47,509	(9,502)	[2,280]	{1,140}
Sonoma	42,637	42,695	42,695	42,695	42,771	(8,554)	[2,053]	{1,026}	42,842	(8,568)	[2,056]	{1,028}	42,912	(8,582)	[2,060]	{1,030}
Ventura	103,295	103,376	103,376	103,376	103,515	(20,703)	[4,969]	{2,484}	103,650	(20,730)	[4,975]	{2,488}	103,787	(20,757)	[4,982]	{2,491}

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.