

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/18/20**

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 12/18/20 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.

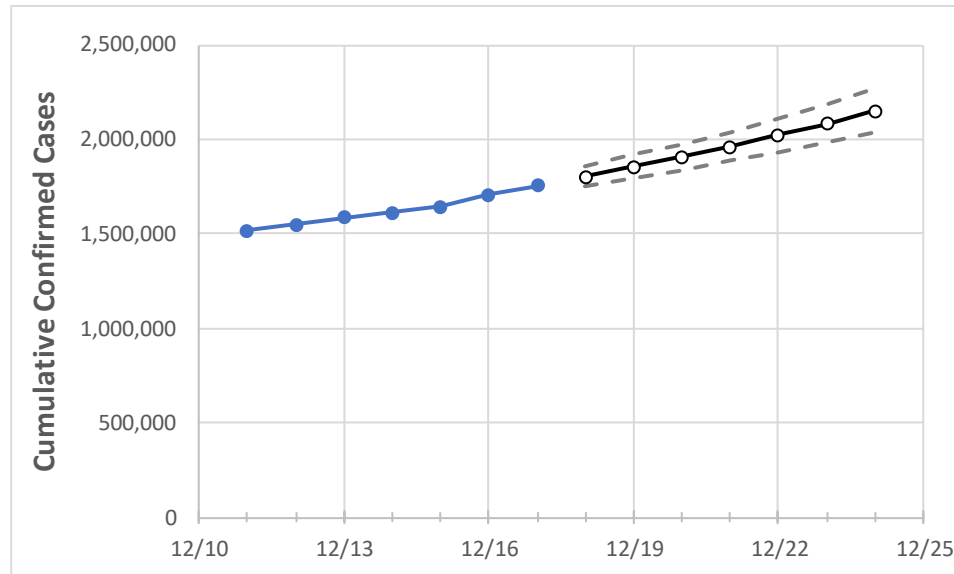
IEM's Modeling Lead

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:							
	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25
California	1,611,493	1,644,742	1,708,559	1,753,974	1,801,915	1,852,493	1,905,839	1,962,092	2,021,392	2,083,887	2,149,733	

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 20%, and are often within 10%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:							
	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	
Alameda	38,218	39,252	40,026	40,751	41,751	42,808	43,925	45,105	46,351	47,668	49,058	
Contra Costa	29,760	30,685	31,516	32,526	33,215	33,941	34,706	35,513	36,362	37,257	38,200	
Fresno	44,114	44,726	47,316	49,173	50,064	51,004	51,995	53,042	54,145	55,308	56,535	
Kern	50,624	51,612	53,694	54,681	55,948	57,295	58,727	60,249	61,864	63,578	65,396	
Lake	1,271	1,306	1,341	1,364	1,400	1,437	1,475	1,516	1,558	1,602	1,647	
Los Angeles	532,730	543,769	566,005	580,325	596,581	613,737	631,837	650,927	671,053	692,265	714,611	
Marin	8,491	8,539	8,615	8,751	8,836	8,926	9,021	9,120	9,225	9,335	9,452	
Monterey	18,913	19,154	19,905	21,107	21,742	22,430	23,175	23,982	24,855	25,797	26,814	
Orange	105,764	108,602	112,893	115,260	118,795	122,539	126,505	130,703	135,146	139,847	144,819	
Placer	9,549	9,722	10,301	10,554	10,929	11,327	11,749	12,197	12,672	13,175	13,707	
Riverside	119,691	123,715	131,822	135,751	140,788	146,185	151,965	158,149	164,763	171,832	179,381	
Sacramento	49,480	50,304	51,076	52,182	53,282	54,414	55,581	56,781	58,017	59,289	60,597	
San Bernardino	127,791	129,522	137,548	144,455	148,951	153,736	158,825	164,233	169,976	176,072	182,538	
San Diego	109,578	111,441	114,248	116,852	119,469	122,197	125,041	128,004	131,091	134,306	137,654	
San Francisco	18,686	18,904	19,283	19,624	19,948	20,285	20,635	20,999	21,377	21,771	22,179	
San Joaquin	32,170	32,522	33,849	35,010	36,007	37,087	38,256	39,520	40,888	42,365	43,961	
San Luis Obispo	7,625	7,791	8,074	8,252	8,448	8,656	8,876	9,108	9,354	9,613	9,886	
San Mateo	18,584	18,875	19,330	19,645	20,105	20,590	21,102	21,642	22,212	22,812	23,444	
Santa Barbara	13,249	13,587	13,782	13,966	14,190	14,424	14,671	14,930	15,201	15,486	15,784	
Santa Clara	49,216	50,315	51,233	52,414	53,925	55,508	57,166	58,901	60,717	62,618	64,607	
Santa Cruz	5,986	6,049	6,361	6,536	6,690	6,850	7,016	7,189	7,370	7,557	7,752	
Solano	13,734	13,897	14,269	14,713	15,083	15,474	15,889	16,328	16,793	17,284	17,803	
Sonoma	14,782	14,859	15,406	15,768	16,036	16,317	16,612	16,921	17,245	17,585	17,941	
Ventura	26,588	27,436	27,936	28,566	29,282	30,034	30,826	31,657	32,532	33,450	34,416	

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:											
	12/14	12/15	12/16	12/17	12/19				12/21				12/23			
Alameda	38,218	39,252	40,026	40,751	42,808	(8,562)	[2,055]	{1,027}	45,105	(9,021)	[2,165]	{1,083}	47,668	(9,534)	[2,288]	{1,144}
Contra Costa	29,760	30,685	31,516	32,526	33,941	(6,788)	[1,629]	{815}	35,513	(7,103)	[1,705]	{852}	37,257	(7,451)	[1,788]	{894}
Fresno	44,114	44,726	47,316	49,173	51,004	(10,201)	[2,448]	{1,224}	53,042	(10,608)	[2,546]	{1,273}	55,308	(11,062)	[2,655]	{1,327}
Kern	50,624	51,612	53,694	54,681	57,295	(11,459)	[2,750]	{1,375}	60,249	(12,050)	[2,892]	{1,446}	63,578	(12,716)	[3,052]	{1,526}
Lake	1,271	1,306	1,341	1,364	1,437	(287)	[69]	{34}	1,516	(303)	[73]	{36}	1,602	(320)	[77]	{38}
Los Angeles	532,730	543,769	566,005	580,325	613,737	(122,747)	[29,459]	{14,730}	650,927	(130,185)	[31,245]	{15,622}	692,265	(138,453)	[33,229]	{16,614}
Marin	8,491	8,539	8,615	8,751	8,926	(1,785)	[428]	{214}	9,120	(1,824)	[438]	{219}	9,335	(1,867)	[448]	{224}
Monterey	18,913	19,154	19,905	21,107	22,430	(4,486)	[1,077]	{538}	23,982	(4,796)	[1,151]	{576}	25,797	(5,159)	[1,238]	{619}
Orange	105,764	108,602	112,893	115,260	122,539	(24,508)	[5,882]	{2,941}	130,703	(26,141)	[6,274]	{3,137}	139,847	(27,969)	[6,713]	{3,356}
Placer	9,549	9,722	10,301	10,554	11,327	(2,265)	[544]	{272}	12,197	(2,439)	[585]	{293}	13,175	(2,635)	[632]	{316}
Riverside	119,691	123,715	131,822	135,751	146,185	(29,237)	[7,017]	{3,508}	158,149	(31,630)	[7,591]	{3,796}	171,832	(34,366)	[8,248]	{4,124}
Sacramento	49,480	50,304	51,076	52,182	54,414	(10,883)	[2,612]	{1,306}	56,781	(11,356)	[2,726]	{1,363}	59,289	(11,858)	[2,846]	{1,423}
San Bernardino	127,791	129,522	137,548	144,455	153,736	(30,747)	[7,379]	{3,690}	164,233	(32,847)	[7,883]	{3,942}	176,072	(35,214)	[8,451]	{4,226}
San Diego	109,578	111,441	114,248	116,852	122,197	(24,439)	[5,865]	{2,933}	128,004	(25,601)	[6,144]	{3,072}	134,306	(26,861)	[6,447]	{3,223}
San Francisco	18,686	18,904	19,283	19,624	20,285	(4,057)	[974]	{487}	20,999	(4,200)	[1,008]	{504}	21,771	(4,354)	[1,045]	{522}
San Joaquin	32,170	32,522	33,849	35,010	37,087	(7,417)	[1,780]	{890}	39,520	(7,904)	[1,897]	{948}	42,365	(8,473)	[2,034]	{1,017}
San Luis Obispo	7,625	7,791	8,074	8,252	8,656	(1,731)	[416]	{208}	9,108	(1,822)	[437]	{219}	9,613	(1,923)	[461]	{231}
San Mateo	18,584	18,875	19,330	19,645	20,590	(4,118)	[988]	{494}	21,642	(4,328)	[1,039]	{519}	22,812	(4,562)	[1,095]	{547}
Santa Barbara	13,249	13,587	13,782	13,966	14,424	(2,885)	[692]	{346}	14,930	(2,986)	[717]	{358}	15,486	(3,097)	[743]	{372}
Santa Clara	49,216	50,315	51,233	52,414	55,508	(11,102)	[2,664]	{1,332}	58,901	(11,780)	[2,827]	{1,414}	62,618	(12,524)	[3,006]	{1,503}
Santa Cruz	5,986	6,049	6,361	6,536	6,850	(1,370)	[329]	{164}	7,189	(1,438)	[345]	{173}	7,557	(1,511)	[363]	{181}
Solano	13,734	13,897	14,269	14,713	15,474	(3,095)	[743]	{371}	16,328	(3,266)	[784]	{392}	17,284	(3,457)	[830]	{415}
Sonoma	14,782	14,859	15,406	15,768	16,317	(3,263)	[783]	{392}	16,921	(3,384)	[812]	{406}	17,585	(3,517)	[844]	{422}
Ventura	26,588	27,436	27,936	28,566	30,034	(6,007)	[1,442]	{721}	31,657	(6,331)	[1,520]	{760}	33,450	(6,690)	[1,606]	{803}

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.