

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/23/20**

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 12/23/20 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.

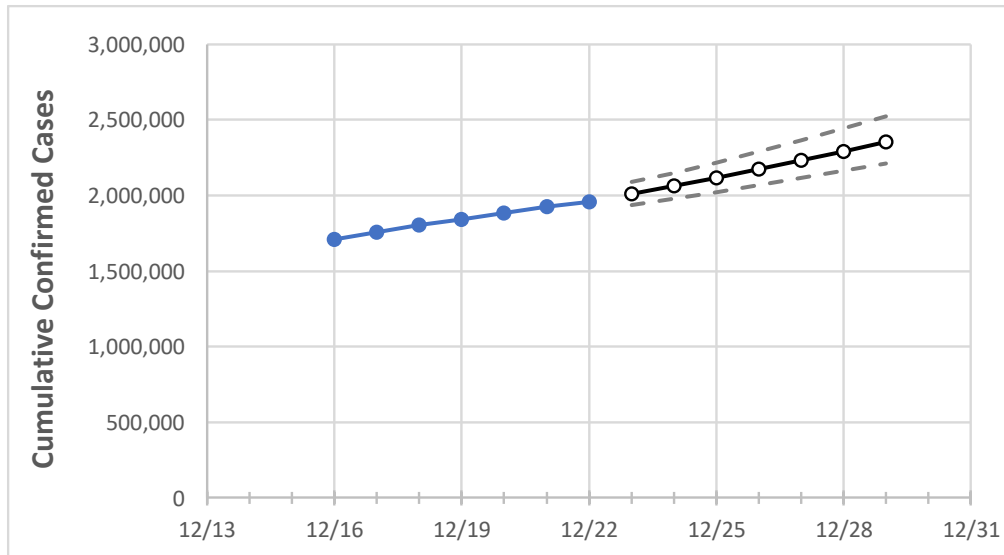
IEM's Modeling Lead

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:						
	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28	12/29
California	1,842,557	1,884,033	1,923,887	1,958,508	2,009,370	2,062,215	2,116,609	2,172,959	2,232,175	2,292,422	2,355,627

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:						
	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28	12/29
Alameda	42,196	43,109	44,004	44,756	45,742	46,746	47,792	48,862	49,955	51,092	52,257
Contra Costa	33,713	34,321	34,918	35,322	36,015	36,745	37,484	38,252	39,046	39,890	40,753
Fresno	52,643	55,428	57,616	58,568	60,620	62,865	65,357	68,001	71,011	74,243	77,738
Kern	56,687	57,205	58,200	59,148	60,375	61,653	62,990	64,357	65,789	67,267	68,772
Lake	1,399	1,438	1,463	1,538	1,582	1,627	1,674	1,724	1,777	1,832	1,888
Los Angeles	610,372	623,670	634,849	647,542	665,678	684,530	704,167	724,487	745,739	767,438	789,816
Marin	8,851	8,902	9,021	9,133	9,232	9,335	9,442	9,555	9,676	9,798	9,927
Monterey	22,336	22,799	23,250	23,673	24,327	24,981	25,691	26,475	27,270	28,135	29,037
Orange	121,681	125,574	128,780	130,444	134,313	138,242	142,483	146,809	151,440	156,175	161,224
Placer	10,995	11,246	11,541	11,761	12,074	12,381	12,692	13,023	13,371	13,713	14,090
Riverside	142,375	146,703	150,422	151,713	156,154	160,789	165,591	170,562	175,721	181,202	186,715
Sacramento	54,003	55,169	56,017	57,082	58,126	59,204	60,282	61,379	62,481	63,596	64,729
San Bernardino	157,655	159,883	163,945	168,307	174,108	180,106	186,537	193,116	200,195	207,714	215,417
San Diego	122,972	126,465	129,717	132,098	135,451	139,039	142,849	146,731	150,718	154,717	158,996
San Francisco	20,315	20,643	20,937	21,086	21,422	21,767	22,120	22,476	22,846	23,227	23,615
San Joaquin	36,484	37,340	38,268	38,811	39,823	40,843	41,958	43,147	44,356	45,654	46,998
San Luis Obispo	8,598	8,788	8,881	9,006	9,203	9,410	9,618	9,842	10,070	10,308	10,555
San Mateo	20,479	20,820	21,160	21,558	21,999	22,454	22,917	23,390	23,867	24,364	24,866
Santa Barbara	14,376	14,667	14,817	14,988	15,239	15,507	15,783	16,072	16,374	16,691	17,018
Santa Clara	54,905	56,334	57,452	58,637	60,048	61,534	63,038	64,564	66,172	67,843	69,591
Santa Cruz	6,838	7,054	7,178	7,315	7,499	7,688	7,889	8,098	8,307	8,527	8,761
Solano	15,106	15,204	16,224	16,568	16,971	17,375	17,821	18,300	18,773	19,352	19,852
Sonoma	16,261	16,553	16,802	17,075	17,359	17,661	17,965	18,291	18,639	18,992	19,357
Ventura	29,907	30,843	31,335	31,759	32,543	33,348	34,181	35,019	35,927	36,854	37,833

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:											
	12/19	12/20	12/21	12/22	12/24				12/26				12/28			
Alameda	42,196	43,109	44,004	44,756	46,746	(9,349)	[2,244]	{1,122}	48,862	(9,772)	[2,345]	{1,173}	51,092	(10,218)	[2,452]	{1,226}
Contra Costa	33,713	34,321	34,918	35,322	36,745	(7,349)	[1,764]	{882}	38,252	(7,650)	[1,836]	{918}	39,890	(7,978)	[1,915]	{957}
Fresno	52,643	55,428	57,616	58,568	62,865	(12,573)	[3,018]	{1,509}	68,001	(13,600)	[3,264]	{1,632}	74,243	(14,849)	[3,564]	{1,782}
Kern	56,687	57,205	58,200	59,148	61,653	(12,331)	[2,959]	{1,480}	64,357	(12,871)	[3,089]	{1,545}	67,267	(13,453)	[3,229]	{1,614}
Lake	1,399	1,438	1,463	1,538	1,627	(325)	[78]	{39}	1,724	(345)	[83]	{41}	1,832	(366)	[88]	{44}
Los Angeles	610,372	623,670	634,849	647,542	684,530	(136,906)	[32,857]	{16,429}	724,487	(144,897)	[34,775]	{17,388}	767,438	(153,488)	[36,837]	{18,419}
Marin	8,851	8,902	9,021	9,133	9,335	(1,867)	[448]	{224}	9,555	(1,911)	[459]	{229}	9,798	(1,960)	[470]	{235}
Monterey	22,336	22,799	23,250	23,673	24,981	(4,996)	[1,199]	{600}	26,475	(5,295)	[1,271]	{635}	28,135	(5,627)	[1,350]	{675}
Orange	121,681	125,574	128,780	130,444	138,242	(27,648)	[6,636]	{3,318}	146,809	(29,362)	[7,047]	{3,523}	156,175	(31,235)	[7,496]	{3,748}
Placer	10,995	11,246	11,541	11,761	12,381	(2,476)	[594]	{297}	13,023	(2,605)	[625]	{313}	13,713	(2,743)	[658]	{329}
Riverside	142,375	146,703	150,422	151,713	160,789	(32,158)	[7,718]	{3,859}	170,562	(34,112)	[8,187]	{4,093}	181,202	(36,240)	[8,698]	{4,349}
Sacramento	54,003	55,169	56,017	57,082	59,204	(11,841)	[2,842]	{1,421}	61,379	(12,276)	[2,946]	{1,473}	63,596	(12,719)	[3,053]	{1,526}
San Bernardino	157,655	159,883	163,945	168,307	180,106	(36,021)	[8,645]	{4,323}	193,116	(38,623)	[9,270]	{4,635}	207,714	(41,543)	[9,970]	{4,985}
San Diego	122,972	126,465	129,717	132,098	139,039	(27,808)	[6,674]	{3,337}	146,731	(29,346)	[7,043]	{3,522}	154,717	(30,943)	[7,426]	{3,713}
San Francisco	20,315	20,643	20,937	21,086	21,767	(4,353)	[1,045]	{522}	22,476	(4,495)	[1,079]	{539}	23,227	(4,645)	[1,115]	{557}
San Joaquin	36,484	37,340	38,268	38,811	40,843	(8,169)	[1,960]	{980}	43,147	(8,629)	[2,071]	{1,036}	45,654	(9,131)	[2,191]	{1,096}
San Luis Obispo	8,598	8,788	8,881	9,006	9,410	(1,882)	[452]	{226}	9,842	(1,968)	[472]	{236}	10,308	(2,062)	[495]	{247}
San Mateo	20,479	20,820	21,160	21,558	22,454	(4,491)	[1,078]	{539}	23,390	(4,678)	[1,123]	{561}	24,364	(4,873)	[1,169]	{585}
Santa Barbara	14,376	14,667	14,817	14,988	15,507	(3,101)	[744]	{372}	16,072	(3,214)	[771]	{386}	16,691	(3,338)	[801]	{401}
Santa Clara	54,905	56,334	57,452	58,637	61,534	(12,307)	[2,954]	{1,477}	64,564	(12,913)	[3,099]	{1,550}	67,843	(13,569)	[3,256]	{1,628}
Santa Cruz	6,838	7,054	7,178	7,315	7,688	(1,538)	[369]	{185}	8,098	(1,620)	[389]	{194}	8,527	(1,705)	[409]	{205}
Solano	15,106	15,204	16,224	16,568	17,375	(3,475)	[834]	{417}	18,300	(3,660)	[878]	{439}	19,352	(3,870)	[929]	{464}
Sonoma	16,261	16,553	16,802	17,075	17,661	(3,532)	[848]	{424}	18,291	(3,658)	[878]	{439}	18,992	(3,798)	[912]	{456}
Ventura	29,907	30,843	31,335	31,759	33,348	(6,670)	[1,601]	{800}	35,019	(7,004)	[1,681]	{840}	36,854	(7,371)	[1,769]	{884}

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.