

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

Date: 1/19/21

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 1/19/21 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.

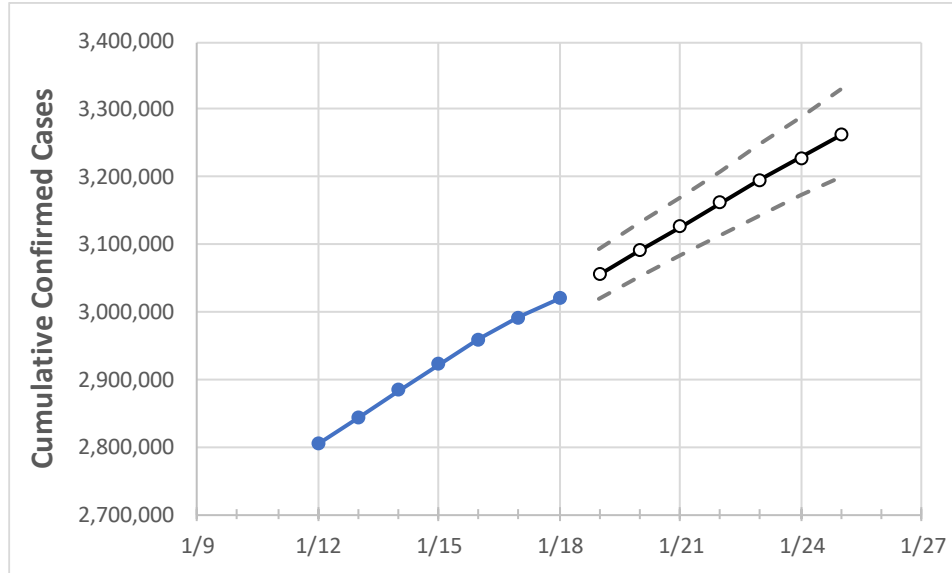
IEM's Modeling Lead

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:							
	1/15	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	

California	2,922,690	2,959,863	2,991,731	3,019,758	3,055,797	3,091,254	3,126,429	3,161,316	3,195,205	3,228,788	3,261,983
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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:						
	1/15	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25
Alameda	64,760	65,679	68,016	67,375	68,774	70,200	71,709	73,272	74,898	76,590	78,331
Contra Costa	50,627	51,573	52,146	52,547	53,270	53,994	54,718	55,432	56,161	56,901	57,637
Fresno	79,033	79,950	81,294	82,039	83,016	84,002	84,989	85,964	86,951	87,967	88,975
Kern	83,547	84,644	85,362	86,188	87,204	88,234	89,257	90,251	91,254	92,258	93,307
Lake	2,417	2,434	2,504	2,572	2,667	2,766	2,874	2,985	3,106	3,233	3,371
Los Angeles	990,632	1,004,693	1,014,753	1,024,297	1,037,766	1,051,038	1,064,312	1,077,236	1,089,937	1,102,651	1,115,503
Marin	11,345	11,462	11,569	11,632	11,747	11,861	11,978	12,097	12,218	12,339	12,458
Monterey	34,959	35,418	35,418	35,418	35,907	36,396	36,864	37,338	37,829	38,312	38,801
Orange	205,911	209,365	210,813	212,389	215,303	218,231	221,083	223,881	226,715	229,580	232,400
Placer	16,761	16,878	16,995	17,194	17,344	17,492	17,646	17,794	17,937	18,087	18,228
Riverside	233,899	235,235	239,412	242,206	244,937	247,653	250,340	253,090	255,862	258,733	261,326
Sacramento	79,137	80,279	79,122	80,154	81,197	82,230	83,274	84,349	85,415	86,474	87,550
San Bernardino	245,033	248,285	251,213	254,094	257,192	260,257	263,388	266,499	269,704	272,782	275,943
San Diego	206,870	209,897	211,787	214,337	217,192	220,017	222,758	225,518	228,218	230,919	233,517
San Francisco	28,200	28,574	28,853	29,139	29,472	29,815	30,166	30,522	30,881	31,231	31,590
San Joaquin	56,484	56,563	56,642	57,094	57,600	58,109	58,640	59,152	59,653	60,145	60,677
San Luis Obispo	15,102	15,129	15,466	15,658	15,921	16,203	16,492	16,773	17,070	17,361	17,659
San Mateo	30,694	31,291	31,805	32,186	32,695	33,226	33,752	34,305	34,857	35,419	35,990
Santa Barbara	23,538	24,149	24,481	24,481	25,044	25,628	26,211	26,825	27,433	28,071	28,734
Santa Clara	89,983	91,466	92,625	93,557	95,044	96,512	98,030	99,546	101,073	102,639	104,199
Santa Cruz	11,715	11,776	12,026	12,196	12,391	12,591	12,792	12,993	13,199	13,409	13,618
Solano	24,654	24,693	24,732	25,216	25,489	25,766	26,027	26,282	26,540	26,792	27,042
Sonoma	23,089	23,261	23,607	23,871	24,186	24,493	24,810	25,130	25,470	25,807	26,150
Ventura	57,941	59,061	60,368	61,257	62,538	63,807	65,079	66,364	67,654	68,925	70,220

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:											
	1/15	1/16	1/17	1/18	1/20		1/22		1/24							
Alameda	64,760	65,679	68,016	67,375	70,200	(14,040)	[3,370]	{1,685}	73,272	(14,654)	[3,517]	{1,759}	76,590	(15,318)	[3,676]	{1,838}
Contra Costa	50,627	51,573	52,146	52,547	53,994	(10,799)	[2,592]	{1,296}	55,432	(11,086)	[2,661]	{1,330}	56,901	(11,380)	[2,731]	{1,366}
Fresno	79,033	79,950	81,294	82,039	84,002	(16,800)	[4,032]	{2,016}	85,964	(17,193)	[4,126]	{2,063}	87,967	(17,593)	[4,222]	{2,111}
Kern	83,547	84,644	85,362	86,188	88,234	(17,647)	[4,235]	{2,118}	90,251	(18,050)	[4,332]	{2,166}	92,258	(18,452)	[4,428]	{2,214}
Lake	2,417	2,434	2,504	2,572	2,766	(553)	[133]	{66}	2,985	(597)	[143]	{72}	3,233	(647)	[155]	{78}
Los Angeles	990,632	1,004,693	1,014,753	1,024,297	1,051,038	(210,208)	[50,450]	{25,225}	1,077,236	(215,447)	[51,707]	{25,854}	1,102,651	(220,530)	[52,927]	{26,464}
Marin	11,345	11,462	11,569	11,632	11,861	(2,372)	[569]	{285}	12,097	(2,419)	[581]	{290}	12,339	(2,468)	[592]	{296}
Monterey	34,959	35,418	35,418	35,418	36,396	(7,279)	[1,747]	{874}	37,338	(7,468)	[1,792]	{896}	38,312	(7,662)	[1,839]	{919}
Orange	205,911	209,365	210,813	212,389	218,231	(43,646)	[10,475]	{5,238}	223,881	(44,776)	[10,746]	{5,373}	229,580	(45,916)	[11,020]	{5,510}
Placer	16,761	16,878	16,995	17,194	17,492	(3,498)	[840]	{420}	17,794	(3,559)	[854]	{427}	18,087	(3,617)	[868]	{434}
Riverside	233,899	235,235	239,412	242,206	247,653	(49,531)	[11,887]	{5,944}	253,090	(50,618)	[12,148]	{6,074}	258,733	(51,747)	[12,419]	{6,210}
Sacramento	79,137	80,279	79,122	80,154	82,230	(16,446)	[3,947]	{1,974}	84,349	(16,870)	[4,049]	{2,024}	86,474	(17,295)	[4,151]	{2,075}
San Bernardino	245,033	248,285	251,213	254,094	260,257	(52,051)	[12,492]	{6,246}	266,499	(53,300)	[12,792]	{6,396}	272,782	(54,556)	[13,094]	{6,547}
San Diego	206,870	209,897	211,787	214,337	220,017	(44,003)	[10,561]	{5,280}	225,518	(45,104)	[10,825]	{5,412}	230,919	(46,184)	[11,084]	{5,542}
San Francisco	28,200	28,574	28,853	29,139	29,815	(5,963)	[1,431]	{716}	30,522	(6,104)	[1,465]	{733}	31,231	(6,246)	[1,499]	{750}
San Joaquin	56,484	56,563	56,642	57,094	58,109	(11,622)	[2,789]	{1,395}	59,152	(11,830)	[2,839]	{1,420}	60,145	(12,029)	[2,887]	{1,443}
San Luis Obispo	15,102	15,129	15,466	15,658	16,203	(3,241)	[778]	{389}	16,773	(3,355)	[805]	{403}	17,361	(3,472)	[833]	{417}
San Mateo	30,694	31,291	31,805	32,186	33,226	(6,645)	[1,595]	{797}	34,305	(6,861)	[1,647]	{823}	35,419	(7,084)	[1,700]	{850}
Santa Barbara	23,538	24,149	24,481	24,481	25,628	(5,126)	[1,230]	{615}	26,825	(5,365)	[1,288]	{644}	28,071	(5,614)	[1,347]	{674}
Santa Clara	89,983	91,466	92,625	93,557	96,512	(19,302)	[4,633]	{2,316}	99,546	(19,909)	[4,778]	{2,389}	102,639	(20,528)	[4,927]	{2,463}
Santa Cruz	11,715	11,776	12,026	12,196	12,591	(2,518)	[604]	{302}	12,993	(2,599)	[624]	{312}	13,409	(2,682)	[644]	{322}
Solano	24,654	24,693	24,732	25,216	25,766	(5,153)	[1,237]	{618}	26,282	(5,256)	[1,262]	{631}	26,792	(5,358)	[1,286]	{643}
Sonoma	23,089	23,261	23,607	23,871	24,493	(4,899)	[1,176]	{588}	25,130	(5,026)	[1,206]	{603}	25,807	(5,161)	[1,239]	{619}
Ventura	57,941	59,061	60,368	61,257	63,807	(12,761)	[3,063]	{1,531}	66,364	(13,273)	[3,185]	{1,593}	68,925	(13,785)	[3,308]	{1,654}

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.