

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

Date: 1/15/21

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 1/15/21 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.

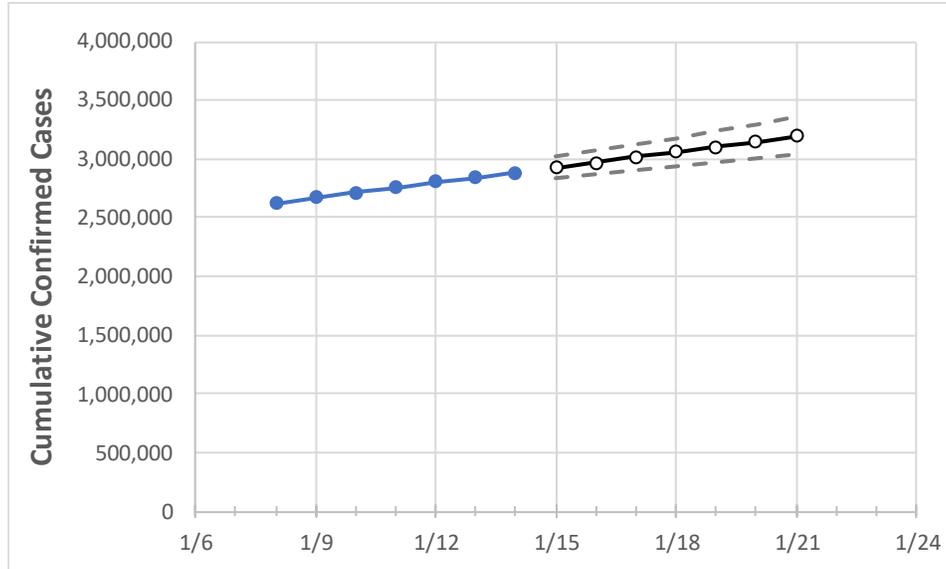
IEM's Modeling Lead

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:						
	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	1/21
California	2,758,021	2,804,663	2,843,062	2,883,699	2,926,858	2,970,997	3,014,880	3,060,058	3,104,206	3,149,232	3,194,488

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:							
	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	1/21	
Alameda	61,111	62,046	62,943	63,866	64,750	65,634	66,517	67,407	68,300	69,204	70,108	
Contra Costa	47,940	48,449	49,082	49,759	50,496	51,259	52,017	52,777	53,548	54,311	55,099	
Fresno	75,621	76,581	77,651	78,278	79,134	80,023	80,868	81,723	82,604	83,485	84,336	
Kern	79,728	80,674	81,490	82,398	83,452	84,485	85,518	86,565	87,638	88,693	89,806	
Lake	2,194	2,526	2,321	2,343	2,439	2,543	2,653	2,770	2,894	3,029	3,172	
Los Angeles	932,901	947,035	959,156	976,075	991,209	1,006,635	1,021,935	1,037,348	1,052,734	1,068,535	1,084,214	
Marin	10,928	11,038	11,126	11,244	11,368	11,497	11,629	11,762	11,903	12,047	12,192	
Monterey	32,571	33,761	34,072	34,482	34,940	35,409	35,901	36,402	36,890	37,387	37,853	
Orange	193,766	196,340	199,532	202,753	205,949	209,238	212,532	215,789	219,094	222,418	225,735	
Placer	15,978	16,135	16,317	16,532	16,715	16,898	17,084	17,265	17,444	17,625	17,802	
Riverside	219,486	227,827	230,600	233,480	237,012	240,754	244,504	248,262	251,995	255,809	259,553	
Sacramento	75,394	76,009	77,201	78,268	79,126	80,017	80,879	81,748	82,610	83,504	84,358	
San Bernardino	232,171	235,543	239,786	241,523	244,650	247,715	250,799	253,931	256,912	259,961	262,944	
San Diego	194,795	198,319	201,580	204,175	207,740	211,256	214,875	218,409	221,982	225,642	229,334	
San Francisco	27,054	27,264	27,531	27,863	28,209	28,567	28,924	29,296	29,653	30,019	30,390	
San Joaquin	52,535	53,994	54,796	55,580	56,304	57,017	57,774	58,502	59,246	59,969	60,706	
San Luis Obispo	13,968	14,233	14,425	14,778	15,139	15,521	15,906	16,317	16,746	17,171	17,636	
San Mateo	28,972	29,355	29,747	30,196	30,648	31,102	31,565	32,035	32,519	33,010	33,503	
Santa Barbara	21,767	22,237	22,769	23,184	23,750	24,343	24,948	25,587	26,242	26,916	27,608	
Santa Clara	84,726	85,929	87,045	88,379	89,725	91,082	92,467	93,858	95,217	96,608	97,966	
Santa Cruz	10,951	11,093	11,275	11,447	11,659	11,883	12,099	12,321	12,548	12,778	13,012	
Solano	23,314	23,554	23,889	24,291	24,696	25,109	25,528	25,957	26,389	26,813	27,263	
Sonoma	21,925	22,191	22,531	22,840	23,147	23,460	23,775	24,108	24,442	24,784	25,127	
Ventura	53,095	54,202	55,342	56,453	57,890	59,371	60,885	62,437	64,006	65,650	67,268	

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:											
	1/11	1/12	1/13	1/14	1/16			1/18			1/20					
Alameda	61,111	62,046	62,943	63,866	65,634	(13,127)	[3,150]	{1,575}	67,407	(13,481)	[3,236]	{1,618}	69,204	(13,841)	[3,322]	{1,661}
Contra Costa	47,940	48,449	49,082	49,759	51,259	(10,252)	[2,460]	{1,230}	52,777	(10,555)	[2,533]	{1,267}	54,311	(10,862)	[2,607]	{1,303}
Fresno	75,621	76,581	77,651	78,278	80,023	(16,005)	[3,841]	{1,921}	81,723	(16,345)	[3,923]	{1,961}	83,485	(16,697)	[4,007]	{2,004}
Kern	79,728	80,674	81,490	82,398	84,485	(16,897)	[4,055]	{2,028}	86,565	(17,313)	[4,155]	{2,078}	88,693	(17,739)	[4,257]	{2,129}
Lake	2,194	2,526	2,321	2,343	2,543	(509)	[122]	{61}	2,770	(554)	[133]	{66}	3,029	(606)	[145]	{73}
Los Angeles	932,901	947,035	959,156	976,075	1,006,635	(201,327)	[48,319]	{24,159}	1,037,348	(207,470)	[49,793]	{24,896}	1,068,535	(213,707)	[51,290]	{25,645}
Marin	10,928	11,038	11,126	11,244	11,497	(2,299)	[552]	{276}	11,762	(2,352)	[565]	{282}	12,047	(2,409)	[578]	{289}
Monterey	32,571	33,761	34,072	34,482	35,409	(7,082)	[1,700]	{850}	36,402	(7,280)	[1,747]	{874}	37,387	(7,477)	[1,795]	{897}
Orange	193,766	196,340	199,532	202,753	209,238	(41,848)	[10,043]	{5,022}	215,789	(43,158)	[10,358]	{5,179}	222,418	(44,484)	[10,676]	{5,338}
Placer	15,978	16,135	16,317	16,532	16,898	(3,380)	[811]	{406}	17,265	(3,453)	[829]	{414}	17,625	(3,525)	[846]	{423}
Riverside	219,486	227,827	230,600	233,480	240,754	(48,151)	[11,556]	{5,778}	248,262	(49,652)	[11,917]	{5,958}	255,809	(51,162)	[12,279]	{6,139}
Sacramento	75,394	76,009	77,201	78,268	80,017	(16,003)	[3,841]	{1,920}	81,748	(16,350)	[3,924]	{1,962}	83,504	(16,701)	[4,008]	{2,004}
San Bernardino	232,171	235,543	239,786	241,523	247,715	(49,543)	[11,890]	{5,945}	253,931	(50,786)	[12,189]	{6,094}	259,961	(51,992)	[12,478]	{6,239}
San Diego	194,795	198,319	201,580	204,175	211,256	(42,251)	[10,140]	{5,070}	218,409	(43,682)	[10,484]	{5,242}	225,642	(45,128)	[10,831]	{5,415}
San Francisco	27,054	27,264	27,531	27,863	28,567	(5,713)	[1,371]	{686}	29,296	(5,859)	[1,406]	{703}	30,019	(6,004)	[1,441]	{720}
San Joaquin	52,535	53,994	54,796	55,580	57,017	(11,403)	[2,737]	{1,368}	58,502	(11,700)	[2,808]	{1,404}	59,969	(11,994)	[2,879]	{1,439}
San Luis Obispo	13,968	14,233	14,425	14,778	15,521	(3,104)	[745]	{372}	16,317	(3,263)	[783]	{392}	17,171	(3,434)	[824]	{412}
San Mateo	28,972	29,355	29,747	30,196	31,102	(6,220)	[1,493]	{746}	32,035	(6,407)	[1,538]	{769}	33,010	(6,602)	[1,584]	{792}
Santa Barbara	21,767	22,237	22,769	23,184	24,343	(4,869)	[1,168]	{584}	25,587	(5,117)	[1,228]	{614}	26,916	(5,383)	[1,292]	{646}
Santa Clara	84,726	85,929	87,045	88,379	91,082	(18,216)	[4,372]	{2,186}	93,858	(18,772)	[4,505]	{2,253}	96,608	(19,322)	[4,637]	{2,319}
Santa Cruz	10,951	11,093	11,275	11,447	11,883	(2,377)	[570]	{285}	12,321	(2,464)	[591]	{296}	12,778	(2,556)	[613]	{307}
Solano	23,314	23,554	23,889	24,291	25,109	(5,022)	[1,205]	{603}	25,957	(5,191)	[1,246]	{623}	26,813	(5,363)	[1,287]	{644}
Sonoma	21,925	22,191	22,531	22,840	23,460	(4,692)	[1,126]	{563}	24,108	(4,822)	[1,157]	{579}	24,784	(4,957)	[1,190]	{595}
Ventura	53,095	54,202	55,342	56,453	59,371	(11,874)	[2,850]	{1,425}	62,437	(12,487)	[2,997]	{1,498}	65,650	(13,130)	[3,151]	{1,576}

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.