

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

Date: 1/13/21

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 1/13/21 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.

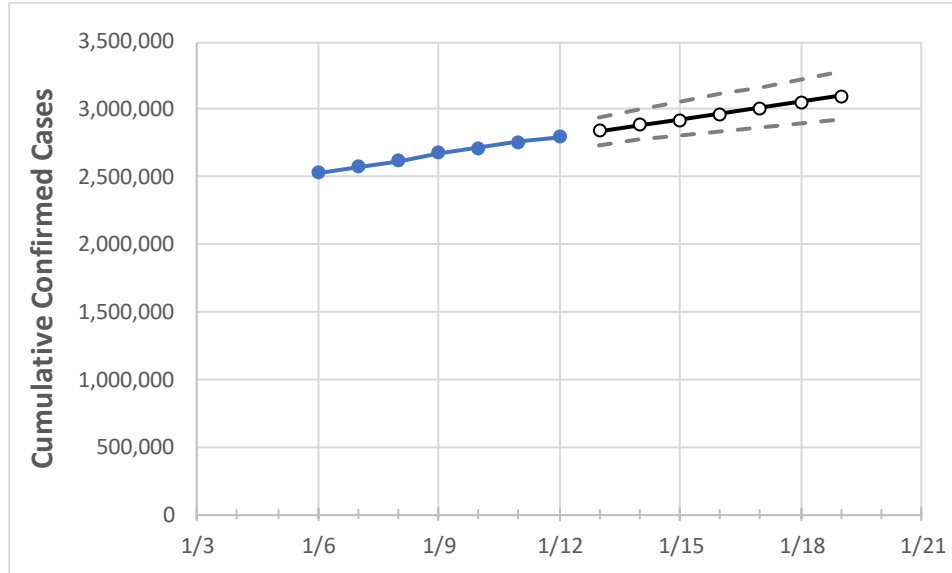
IEM's Modeling Lead

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
California	2,675,262	2,717,862	2,758,021	2,795,978	2,838,800	2,881,617	2,924,639	2,968,622	3,013,048	3,056,256	3,100,419

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:							
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	
Alameda	59,172	60,125	61,111	62,046	62,878	63,732	64,560	65,400	66,246	67,117	68,031	
Contra Costa	46,618	47,315	47,940	47,940	48,735	49,558	50,400	51,259	52,146	53,036	53,991	
Fresno	73,689	74,816	75,621	76,581	77,450	78,328	79,209	80,080	80,970	81,872	82,742	
Kern	77,875	78,832	79,728	79,728	80,777	81,825	82,929	84,017	85,111	86,182	87,258	
Lake	2,120	2,144	2,194	2,205	2,234	2,262	2,292	2,321	2,351	2,380	2,409	
Los Angeles	907,077	920,324	932,901	944,319	958,881	973,586	988,183	1,003,398	1,018,721	1,033,848	1,049,064	
Marin	10,696	10,811	10,928	10,928	11,046	11,168	11,291	11,418	11,548	11,674	11,812	
Monterey	32,394	32,483	32,571	32,858	33,286	33,705	34,142	34,568	34,983	35,405	35,831	
Orange	186,608	191,004	193,766	196,340	199,568	202,789	206,005	209,225	212,543	215,758	219,117	
Placer	15,532	15,609	15,978	16,135	16,334	16,525	16,712	16,895	17,075	17,261	17,451	
Riverside	212,122	216,076	219,486	227,827	231,540	235,340	239,270	243,136	247,116	251,083	255,201	
Sacramento	73,245	74,482	75,394	76,009	76,750	77,488	78,224	78,956	79,653	80,368	81,082	
San Bernardino	224,350	228,857	232,171	235,543	238,659	241,833	244,941	248,062	251,029	254,044	257,139	
San Diego	188,600	191,888	194,795	198,319	202,149	206,057	210,043	214,011	218,063	222,157	226,333	
San Francisco	26,378	26,708	27,054	27,264	27,607	27,950	28,297	28,649	29,003	29,360	29,728	
San Joaquin	51,523	51,927	52,535	53,002	53,557	54,096	54,647	55,197	55,699	56,227	56,740	
San Luis Obispo	13,286	13,647	13,968	14,213	14,583	14,958	15,347	15,744	16,158	16,590	17,047	
San Mateo	28,072	28,512	28,972	29,355	29,796	30,239	30,703	31,175	31,650	32,126	32,613	
Santa Barbara	20,550	21,323	21,767	21,767	22,267	22,775	23,307	23,864	24,473	25,061	25,687	
Santa Clara	82,170	83,655	84,726	85,929	87,186	88,473	89,749	91,045	92,394	93,717	95,052	
Santa Cruz	10,486	10,717	10,951	11,093	11,301	11,511	11,730	11,951	12,173	12,390	12,630	
Solano	22,593	22,953	23,314	23,554	23,947	24,343	24,743	25,149	25,573	26,014	26,461	
Sonoma	21,264	21,463	21,925	22,191	22,471	22,753	23,036	23,321	23,617	23,912	24,227	
Ventura	50,553	51,988	53,095	54,202	55,660	57,155	58,726	60,332	61,985	63,668	65,469	

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:											
	1/9	1/10	1/11	1/12	1/14			1/16			1/18					
Alameda	59,172	60,125	61,111	62,046	63,732 (12,746)	[3,059]	{1,530}	65,400 (13,080)	[3,139]	{1,570}	67,117 (13,423)	[3,222]	{1,611}			
Contra Costa	46,618	47,315	47,940	47,940	49,558 (9,912)	[2,379]	{1,189}	51,259 (10,252)	[2,460]	{1,230}	53,036 (10,607)	[2,546]	{1,273}			
Fresno	73,689	74,816	75,621	76,581	78,328 (15,666)	[3,760]	{1,880}	80,080 (16,016)	[3,844]	{1,922}	81,872 (16,374)	[3,930]	{1,965}			
Kern	77,875	78,832	79,728	79,728	81,825 (16,365)	[3,928]	{1,964}	84,017 (16,803)	[4,033]	{2,016}	86,182 (17,236)	[4,137]	{2,068}			
Lake	2,120	2,144	2,194	2,205	2,262 (452)	[109]	{54}	2,321 (464)	[111]	{56}	2,380 (476)	[114]	{57}			
Los Angeles	907,077	920,324	932,901	944,319	973,586 (194,717)	[46,732]	{23,366}	1,003,398 (200,680)	[48,163]	{24,082}	1,033,848 (206,770)	[49,625]	{24,812}			
Marin	10,696	10,811	10,928	10,928	11,168 (2,234)	[536]	{268}	11,418 (2,284)	[548]	{274}	11,674 (2,335)	[560]	{280}			
Monterey	32,394	32,483	32,571	32,858	33,705 (6,741)	[1,618]	{809}	34,568 (6,914)	[1,659]	{830}	35,405 (7,081)	[1,699]	{850}			
Orange	186,608	191,004	193,766	196,340	202,789 (40,558)	[9,734]	{4,867}	209,225 (41,845)	[10,043]	{5,021}	215,758 (43,152)	[10,356]	{5,178}			
Placer	15,532	15,609	15,978	16,135	16,525 (3,305)	[793]	{397}	16,895 (3,379)	[811]	{405}	17,261 (3,452)	[829]	{414}			
Riverside	212,122	216,076	219,486	227,827	235,340 (47,068)	[11,296]	{5,648}	243,136 (48,627)	[11,671]	{5,835}	251,083 (50,217)	[12,052]	{6,026}			
Sacramento	73,245	74,482	75,394	76,009	77,488 (15,498)	[3,719]	{1,860}	78,956 (15,791)	[3,790]	{1,895}	80,368 (16,074)	[3,858]	{1,929}			
San Bernardino	224,350	228,857	232,171	235,543	241,833 (48,367)	[11,608]	{5,804}	248,062 (49,612)	[11,907]	{5,953}	254,044 (50,809)	[12,194]	{6,097}			
San Diego	188,600	191,888	194,795	198,319	206,057 (41,211)	[9,891]	{4,945}	214,011 (42,802)	[10,273]	{5,136}	222,157 (44,431)	[10,664]	{5,332}			
San Francisco	26,378	26,708	27,054	27,264	27,950 (5,590)	[1,342]	{671}	28,649 (5,730)	[1,375]	{688}	29,360 (5,872)	[1,409]	{705}			
San Joaquin	51,523	51,927	52,535	53,002	54,096 (10,819)	[2,597]	{1,298}	55,197 (11,039)	[2,649]	{1,325}	56,227 (11,245)	[2,699]	{1,349}			
San Luis Obispo	13,286	13,647	13,968	14,213	14,958 (2,992)	[718]	{359}	15,744 (3,149)	[756]	{378}	16,590 (3,318)	[796]	{398}			
San Mateo	28,072	28,512	28,972	29,355	30,239 (6,048)	[1,451]	{726}	31,175 (6,235)	[1,496]	{748}	32,126 (6,425)	[1,542]	{771}			
Santa Barbara	20,550	21,323	21,767	21,767	22,775 (4,555)	[1,093]	{547}	23,864 (4,773)	[1,145]	{573}	25,061 (5,012)	[1,203]	{601}			
Santa Clara	82,170	83,655	84,726	85,929	88,473 (17,695)	[4,247]	{2,123}	91,045 (18,209)	[4,370]	{2,185}	93,717 (18,743)	[4,498]	{2,249}			
Santa Cruz	10,486	10,717	10,951	11,093	11,511 (2,302)	[553]	{276}	11,951 (2,390)	[574]	{287}	12,390 (2,478)	[595]	{297}			
Solano	22,593	22,953	23,314	23,554	24,343 (4,869)	[1,168]	{584}	25,149 (5,030)	[1,207]	{604}	26,014 (5,203)	[1,249]	{624}			
Sonoma	21,264	21,463	21,925	22,191	22,753 (4,551)	[1,092]	{546}	23,321 (4,664)	[1,119]	{560}	23,912 (4,782)	[1,148]	{574}			
Ventura	50,553	51,988	53,095	54,202	57,155 (11,431)	[2,743]	{1,372}	60,332 (12,066)	[2,896]	{1,448}	63,668 (12,734)	[3,056]	{1,528}			

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.