

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

Date: 3/23/21

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 3/23/21 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.

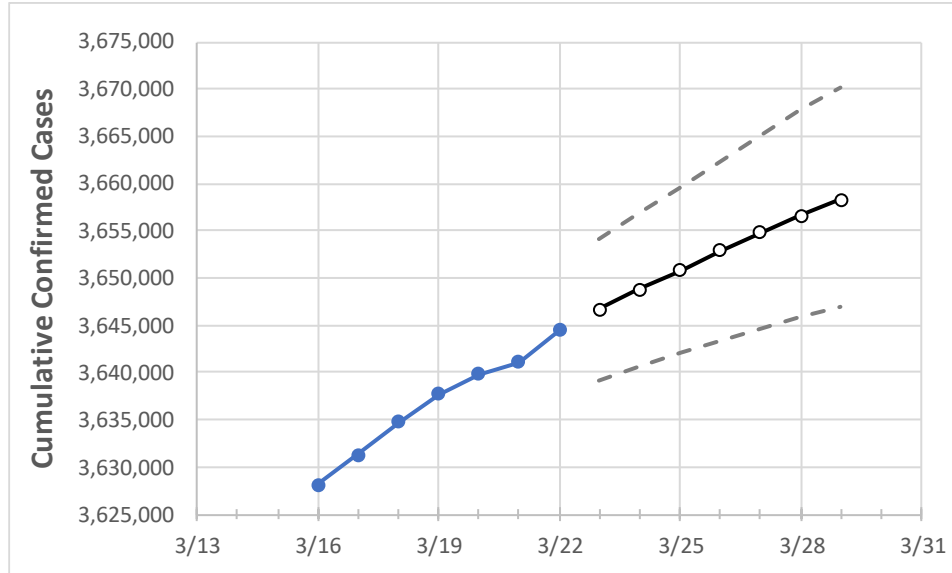
IEM's Modeling Lead

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:						
	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29

California 3,637,726 3,639,874 3,641,105 3,644,488 3,646,676 3,648,788 3,650,852 3,652,876 3,654,797 3,656,607 3,658,352

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:						
	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29
Alameda	82,460	82,540	82,593	82,680	82,750	82,820	82,887	82,951	83,014	83,077	83,138
Contra Costa	64,454	64,573	64,642	64,695	64,770	64,844	64,917	64,989	65,059	65,130	65,199
Fresno	97,848	97,969	98,090	98,211	98,321	98,429	98,532	98,636	98,737	98,837	98,934
Kern	105,368	105,441	105,499	105,542	105,608	105,673	105,734	105,791	105,849	105,903	105,957
Lake	3,240	3,251	3,263	3,274	3,279	3,285	3,290	3,295	3,301	3,306	3,311
Los Angeles	1,213,288	1,213,792	1,214,178	1,214,754	1,215,297	1,215,817	1,216,315	1,216,762	1,217,210	1,217,660	1,218,068
Marin	13,507	13,531	13,545	13,552	13,562	13,571	13,580	13,589	13,597	13,605	13,613
Monterey	42,712	42,734	42,734	42,734	42,753	42,772	42,791	42,809	42,827	42,845	42,862
Orange	264,478	264,600	264,721	264,849	264,963	265,074	265,179	265,282	265,382	265,477	265,573
Placer	20,493	20,530	20,566	20,603	20,633	20,663	20,694	20,723	20,752	20,781	20,810
Riverside	292,967	293,028	293,088	293,149	293,252	293,351	293,449	293,544	293,636	293,724	293,814
Sacramento	95,964	96,102	96,239	96,377	96,494	96,611	96,727	96,844	96,953	97,065	97,179
San Bernardino	289,405	289,610	289,773	289,846	289,951	290,054	290,157	290,260	290,359	290,456	290,551
San Diego	267,177	267,536	267,728	267,917	268,197	268,479	268,748	269,007	269,271	269,528	269,781
San Francisco	34,820	34,820	34,820	34,820	34,837	34,853	34,869	34,883	34,897	34,910	34,923
San Joaquin	68,714	68,761	68,808	68,855	68,946	69,034	69,121	69,210	69,300	69,386	69,471
San Luis Obispo	20,189	20,213	20,236	20,260	20,281	20,300	20,320	20,338	20,356	20,375	20,392
San Mateo	39,801	39,813	39,825	39,837	39,855	39,871	39,886	39,900	39,913	39,927	39,939
Santa Barbara	32,798	32,836	32,859	32,873	32,898	32,923	32,948	32,972	32,995	33,018	33,039
Santa Clara	113,292	113,446	113,552	113,641	113,736	113,830	113,921	114,009	114,094	114,179	114,259
Santa Cruz	15,196	15,206	15,215	15,225	15,246	15,267	15,287	15,307	15,327	15,346	15,364
Solano	30,745	30,775	30,804	30,834	30,862	30,890	30,917	30,944	30,970	30,996	31,022
Sonoma	28,914	28,943	28,981	29,006	29,034	29,061	29,087	29,112	29,136	29,161	29,184
Ventura	79,090	79,133	79,176	79,219	79,253	79,285	79,314	79,343	79,371	79,397	79,422

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:											
	3/19	3/20	3/21	3/22	3/24			3/26			3/28					
Alameda	82,460	82,540	82,593	82,680	82,820	(16,564)	[3,975]	{1,988}	82,951	(16,590)	[3,982]	{1,991}	83,077	(16,615)	[3,988]	{1,994}
Contra Costa	64,454	64,573	64,642	64,695	64,844	(12,969)	[3,113]	{1,556}	64,989	(12,998)	[3,119]	{1,560}	65,130	(13,026)	[3,126]	{1,563}
Fresno	97,848	97,969	98,090	98,211	98,429	(19,686)	[4,725]	{2,362}	98,636	(19,727)	[4,735]	{2,367}	98,837	(19,767)	[4,744]	{2,372}
Kern	105,368	105,441	105,499	105,542	105,673	(21,135)	[5,072]	{2,536}	105,791	(21,158)	[5,078]	{2,539}	105,903	(21,181)	[5,083]	{2,542}
Lake	3,240	3,251	3,263	3,274	3,285	(657)	[158]	{79}	3,295	(659)	[158]	{79}	3,306	(661)	[159]	{79}
Los Angeles	1,213,288	1,213,792	1,214,178	1,214,754	1,215,817	(243,163)	[58,359]	{29,180}	1,216,762	(243,352)	[58,405]	{29,202}	1,217,660	(243,532)	[58,448]	{29,224}
Marin	13,507	13,531	13,545	13,552	13,571	(2,714)	[651]	{326}	13,589	(2,718)	[652]	{326}	13,605	(2,721)	[653]	{327}
Monterey	42,712	42,734	42,734	42,734	42,772	(8,554)	[2,053]	{1,027}	42,809	(8,562)	[2,055]	{1,027}	42,845	(8,569)	[2,057]	{1,028}
Orange	264,478	264,600	264,721	264,849	265,074	(53,015)	[12,724]	{6,362}	265,282	(53,056)	[12,734]	{6,367}	265,477	(53,095)	[12,743]	{6,371}
Placer	20,493	20,530	20,566	20,603	20,663	(4,133)	[992]	{496}	20,723	(4,145)	[995]	{497}	20,781	(4,156)	[997]	{499}
Riverside	292,967	293,028	293,088	293,149	293,351	(58,670)	[14,081]	{7,040}	293,544	(58,709)	[14,090]	{7,045}	293,724	(58,745)	[14,099]	{7,049}
Sacramento	95,964	96,102	96,239	96,377	96,611	(19,322)	[4,637]	{2,319}	96,844	(19,369)	[4,649]	{2,324}	97,065	(19,413)	[4,659]	{2,330}
San Bernardino	289,405	289,610	289,773	289,846	290,054	(58,011)	[13,923]	{6,961}	290,260	(58,052)	[13,932]	{6,966}	290,456	(58,091)	[13,942]	{6,971}
San Diego	267,177	267,536	267,728	267,917	268,479	(53,696)	[12,887]	{6,443}	269,007	(53,801)	[12,912]	{6,456}	269,528	(53,906)	[12,937]	{6,469}
San Francisco	34,820	34,820	34,820	34,820	34,853	(6,971)	[1,673]	{836}	34,883	(6,977)	[1,674]	{837}	34,910	(6,982)	[1,676]	{838}
San Joaquin	68,714	68,761	68,808	68,855	69,034	(13,807)	[3,314]	{1,657}	69,210	(13,842)	[3,322]	{1,661}	69,386	(13,877)	[3,331]	{1,665}
San Luis Obispo	20,189	20,213	20,236	20,260	20,300	(4,060)	[974]	{487}	20,338	(4,068)	[976]	{488}	20,375	(4,075)	[978]	{489}
San Mateo	39,801	39,813	39,825	39,837	39,871	(7,974)	[1,914]	{957}	39,900	(7,980)	[1,915]	{958}	39,927	(7,985)	[1,916]	{958}
Santa Barbara	32,798	32,836	32,859	32,873	32,923	(6,585)	[1,580]	{790}	32,972	(6,594)	[1,583]	{791}	33,018	(6,604)	[1,585]	{792}
Santa Clara	113,292	113,446	113,552	113,641	113,830	(22,766)	[5,464]	{2,732}	114,009	(22,802)	[5,472]	{2,736}	114,179	(22,836)	[5,481]	{2,740}
Santa Cruz	15,196	15,206	15,215	15,225	15,267	(3,053)	[733]	{366}	15,307	(3,061)	[735]	{367}	15,346	(3,069)	[737]	{368}
Solano	30,745	30,775	30,804	30,834	30,890	(6,178)	[1,483]	{741}	30,944	(6,189)	[1,485]	{743}	30,996	(6,199)	[1,488]	{744}
Sonoma	28,914	28,943	28,981	29,006	29,061	(5,812)	[1,395]	{697}	29,112	(5,822)	[1,397]	{699}	29,161	(5,832)	[1,400]	{700}
Ventura	79,090	79,133	79,176	79,219	79,285	(15,857)	[3,806]	{1,903}	79,343	(15,869)	[3,808]	{1,904}	79,397	(15,879)	[3,811]	{1,906}

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.