

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 3/31/21**

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 3/31/21 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.

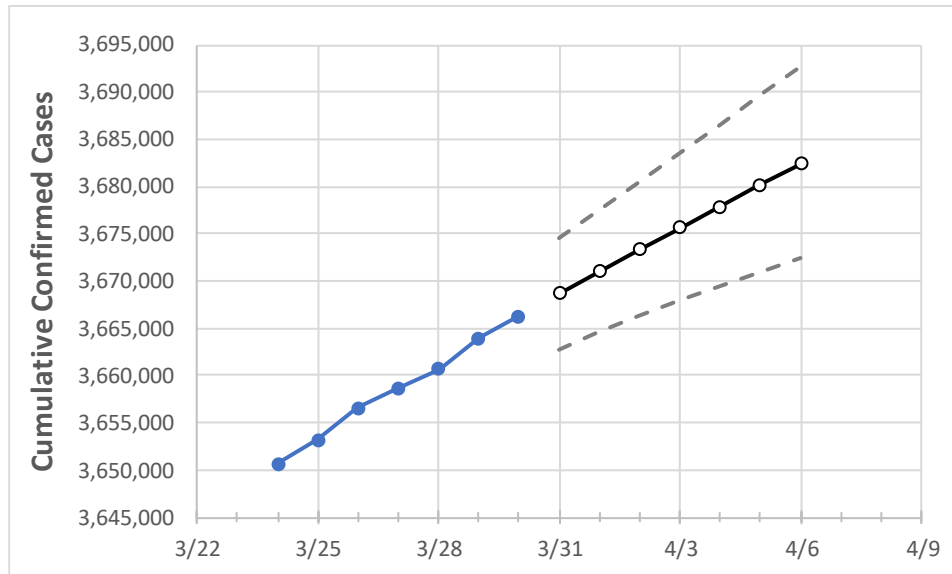
IEM's Modeling Lead

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:						
	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6
California	3,658,714	3,660,713	3,663,913	3,666,266	3,668,662	3,670,998	3,673,344	3,675,614	3,677,890	3,680,177	3,682,391

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:						
	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6
Alameda	83,043	83,169	83,243	83,338	83,417	83,495	83,570	83,647	83,723	83,800	83,877
Contra Costa	65,065	65,140	65,230	65,303	65,375	65,448	65,519	65,590	65,660	65,728	65,797
Fresno	98,731	98,901	99,004	99,085	99,186	99,289	99,391	99,494	99,596	99,692	99,789
Kern	105,994	106,074	106,127	106,155	106,223	106,290	106,354	106,417	106,478	106,540	106,598
Lake	3,314	3,317	3,320	3,325	3,331	3,338	3,344	3,351	3,358	3,365	3,372
Los Angeles	1,217,775	1,218,229	1,218,643	1,219,029	1,219,400	1,219,741	1,220,093	1,220,422	1,220,730	1,221,033	1,221,302
Marin	13,646	13,657	13,664	13,679	13,695	13,710	13,725	13,741	13,757	13,773	13,788
Monterey	42,890	42,905	42,919	42,934	42,953	42,972	42,990	43,008	43,026	43,043	43,060
Orange	265,653	265,787	265,926	266,057	266,195	266,331	266,461	266,589	266,718	266,846	266,980
Placer	20,787	20,837	20,888	20,929	20,974	21,020	21,067	21,115	21,163	21,214	21,265
Riverside	293,908	293,986	294,063	294,192	294,297	294,400	294,499	294,593	294,689	294,785	294,876
Sacramento	97,040	97,247	97,481	97,617	97,783	97,947	98,117	98,288	98,462	98,641	98,819
San Bernardino	290,505	290,630	290,715	290,803	290,918	291,030	291,140	291,250	291,358	291,465	291,566
San Diego	269,275	269,480	269,770	269,997	270,246	270,492	270,732	270,970	271,206	271,428	271,646
San Francisco	35,186	35,244	35,286	35,291	35,321	35,352	35,382	35,412	35,443	35,472	35,502
San Joaquin	69,482	69,516	69,550	69,796	69,908	70,020	70,141	70,250	70,357	70,470	70,580
San Luis Obispo	20,412	20,423	20,433	20,475	20,499	20,523	20,547	20,571	20,596	20,619	20,642
San Mateo	40,199	40,264	40,305	40,357	40,396	40,436	40,473	40,511	40,550	40,588	40,625
Santa Barbara	33,045	33,077	33,105	33,134	33,163	33,193	33,221	33,248	33,276	33,304	33,331
Santa Clara	114,183	114,294	114,398	114,482	114,576	114,670	114,762	114,854	114,941	115,026	115,110
Santa Cruz	15,322	15,338	15,354	15,363	15,377	15,390	15,403	15,415	15,426	15,438	15,449
Solano	31,046	31,084	31,121	31,165	31,209	31,252	31,297	31,343	31,388	31,435	31,482
Sonoma	29,169	29,199	29,219	29,235	29,260	29,285	29,309	29,331	29,354	29,376	29,397
Ventura	79,511	79,549	79,588	79,621	79,665	79,711	79,752	79,793	79,834	79,874	79,914

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:											
	3/27	3/28	3/29	3/30	4/1				4/3				4/5			
Alameda	83,043	83,169	83,243	83,338	83,495	(16,699)	[4,008]	{2,004}	83,647	(16,729)	[4,015]	{2,008}	83,800	(16,760)	[4,022]	{2,011}
Contra Costa	65,065	65,140	65,230	65,303	65,448	(13,090)	[3,142]	{1,571}	65,590	(13,118)	[3,148]	{1,574}	65,728	(13,146)	[3,155]	{1,577}
Fresno	98,731	98,901	99,004	99,085	99,289	(19,858)	[4,766]	{2,383}	99,494	(19,899)	[4,776]	{2,388}	99,692	(19,938)	[4,785]	{2,393}
Kern	105,994	106,074	106,127	106,155	106,290	(21,258)	[5,102]	{2,551}	106,417	(21,283)	[5,108]	{2,554}	106,540	(21,308)	[5,114]	{2,557}
Lake	3,314	3,317	3,320	3,325	3,338	(668)	[160]	{80}	3,351	(670)	[161]	{80}	3,365	(673)	[162]	{81}
Los Angeles	1,217,775	1,218,229	1,218,643	1,219,029	1,219,741	(243,948)	[58,548]	{29,274}	1,220,422	(244,084)	[58,580]	{29,290}	1,221,033	(244,207)	[58,610]	{29,305}
Marin	13,646	13,657	13,664	13,679	13,710	(2,742)	[658]	{329}	13,741	(2,748)	[660]	{330}	13,773	(2,755)	[661]	{331}
Monterey	42,890	42,905	42,919	42,934	42,972	(8,594)	[2,063]	{1,031}	43,008	(8,602)	[2,064]	{1,032}	43,043	(8,609)	[2,066]	{1,033}
Orange	265,653	265,787	265,926	266,057	266,331	(53,266)	[12,784]	{6,392}	266,589	(53,318)	[12,796]	{6,398}	266,846	(53,369)	[12,809]	{6,404}
Placer	20,787	20,837	20,888	20,929	21,020	(4,204)	[1,009]	{504}	21,115	(4,223)	[1,014]	{507}	21,214	(4,243)	[1,018]	{509}
Riverside	293,908	293,986	294,063	294,192	294,400	(58,880)	[14,131]	{7,066}	294,593	(58,919)	[14,140]	{7,070}	294,785	(58,957)	[14,150]	{7,075}
Sacramento	97,040	97,247	97,481	97,617	97,947	(19,589)	[4,701]	{2,351}	98,288	(19,658)	[4,718]	{2,359}	98,641	(19,728)	[4,735]	{2,367}
San Bernardino	290,505	290,630	290,715	290,803	291,030	(58,206)	[13,969]	{6,985}	291,250	(58,250)	[13,980]	{6,990}	291,465	(58,293)	[13,990]	{6,995}
San Diego	269,275	269,480	269,770	269,997	270,492	(54,098)	[12,984]	{6,492}	270,970	(54,194)	[13,007]	{6,503}	271,428	(54,286)	[13,029]	{6,514}
San Francisco	35,186	35,244	35,286	35,291	35,352	(7,070)	[1,697]	{848}	35,412	(7,082)	[1,700]	{850}	35,472	(7,094)	[1,703]	{851}
San Joaquin	69,482	69,516	69,550	69,796	70,020	(14,004)	[3,361]	{1,680}	70,250	(14,050)	[3,372]	{1,686}	70,470	(14,094)	[3,383]	{1,691}
San Luis Obispo	20,412	20,423	20,433	20,475	20,523	(4,105)	[985]	{493}	20,571	(4,114)	[987]	{494}	20,619	(4,124)	[990]	{495}
San Mateo	40,199	40,264	40,305	40,357	40,436	(8,087)	[1,941]	{970}	40,511	(8,102)	[1,945]	{972}	40,588	(8,118)	[1,948]	{974}
Santa Barbara	33,045	33,077	33,105	33,134	33,193	(6,639)	[1,593]	{797}	33,248	(6,650)	[1,596]	{798}	33,304	(6,661)	[1,599]	{799}
Santa Clara	114,183	114,294	114,398	114,482	114,670	(22,934)	[5,504]	{2,752}	114,854	(22,971)	[5,513]	{2,756}	115,026	(23,005)	[5,521]	{2,761}
Santa Cruz	15,322	15,338	15,354	15,363	15,390	(3,078)	[739]	{369}	15,415	(3,083)	[740]	{370}	15,438	(3,088)	[741]	{371}
Solano	31,046	31,084	31,121	31,165	31,252	(6,250)	[1,500]	{750}	31,343	(6,269)	[1,504]	{752}	31,435	(6,287)	[1,509]	{754}
Sonoma	29,169	29,199	29,219	29,235	29,285	(5,857)	[1,406]	{703}	29,331	(5,866)	[1,408]	{704}	29,376	(5,875)	[1,410]	{705}
Ventura	79,511	79,549	79,588	79,621	79,711	(15,942)	[3,826]	{1,913}	79,793	(15,959)	[3,830]	{1,915}	79,874	(15,975)	[3,834]	{1,917}

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.