

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

Date: 3/4/21

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 3/4/21 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.

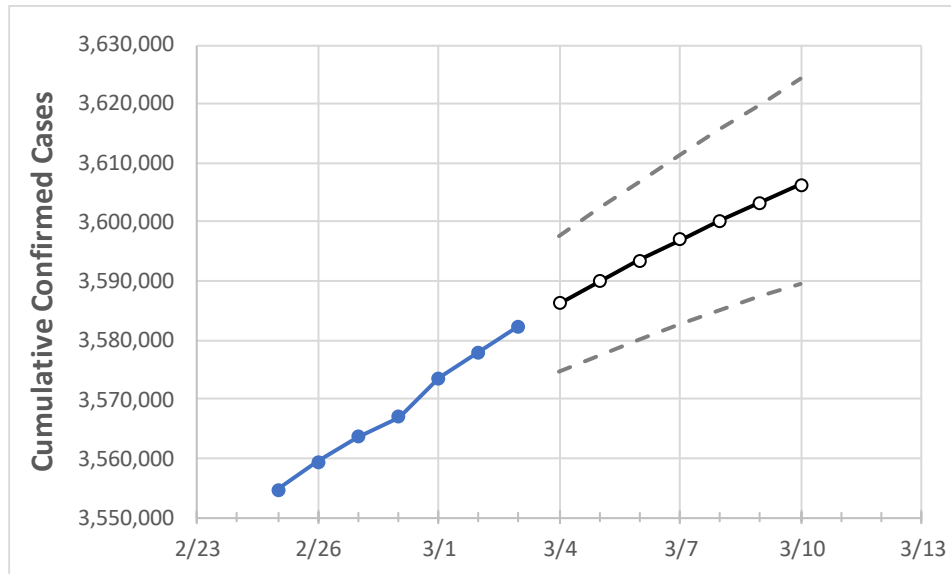
IEM's Modeling Lead

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:						
	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10
California	3,566,914	3,573,549	3,577,966	3,582,320	3,586,190	3,589,880	3,593,451	3,596,963	3,600,269	3,603,329	3,606,346

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:						
	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10
Alameda	80,668	80,777	80,873	80,950	81,039	81,123	81,202	81,278	81,351	81,418	81,485
Contra Costa	62,248	62,720	62,818	62,931	63,040	63,145	63,249	63,350	63,452	63,553	63,647
Fresno	95,393	95,548	95,677	95,785	95,917	96,044	96,166	96,285	96,400	96,512	96,618
Kern	103,223	103,422	103,622	103,756	103,901	104,038	104,172	104,295	104,419	104,534	104,648
Lake	3,156	3,164	3,167	3,169	3,176	3,182	3,188	3,194	3,199	3,205	3,210
Los Angeles	1,191,923	1,192,954	1,194,333	1,196,017	1,197,223	1,198,370	1,199,500	1,200,576	1,201,592	1,202,520	1,203,441
Marin	13,207	13,231	13,261	13,285	13,307	13,329	13,351	13,372	13,394	13,415	13,436
Monterey	42,230	42,261	42,316	42,335	42,365	42,394	42,422	42,448	42,473	42,495	42,517
Orange	261,220	261,408	261,608	261,798	261,972	262,137	262,296	262,446	262,582	262,716	262,849
Placer	19,828	19,861	19,882	19,911	19,937	19,963	19,988	20,014	20,039	20,063	20,085
Riverside	289,665	289,773	290,325	290,498	290,639	290,776	290,905	291,020	291,120	291,230	291,326
Sacramento	93,281	93,528	93,678	93,790	93,929	94,064	94,200	94,329	94,449	94,568	94,678
San Bernardino	286,607	286,755	286,814	287,055	287,257	287,452	287,643	287,825	287,994	288,152	288,309
San Diego	260,091	260,625	261,001	261,353	261,697	262,040	262,367	262,674	262,961	263,251	263,515
San Francisco	34,260	34,291	34,318	34,387	34,431	34,474	34,515	34,553	34,590	34,626	34,662
San Joaquin	66,764	66,829	67,040	67,123	67,199	67,272	67,342	67,414	67,483	67,550	67,616
San Luis Obispo	19,675	19,696	19,724	19,751	19,774	19,796	19,818	19,839	19,858	19,877	19,895
San Mateo	38,998	39,059	39,096	39,148	39,209	39,269	39,327	39,379	39,430	39,480	39,529
Santa Barbara	31,805	32,050	32,087	32,147	32,200	32,252	32,301	32,348	32,393	32,435	32,473
Santa Clara	110,621	110,755	110,911	111,076	111,242	111,409	111,565	111,715	111,861	112,008	112,150
Santa Cruz	14,650	14,671	14,700	14,736	14,756	14,776	14,795	14,813	14,831	14,848	14,865
Solano	30,085	30,115	30,163	30,216	30,245	30,272	30,299	30,325	30,350	30,374	30,396
Sonoma	28,141	28,193	28,222	28,261	28,312	28,360	28,409	28,457	28,504	28,549	28,593
Ventura	77,623	77,749	77,849	77,952	78,036	78,119	78,197	78,268	78,337	78,402	78,467

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:											
	2/28	3/1	3/2	3/3	3/5				3/7				3/9			
Alameda	80,668	80,777	80,873	80,950	81,123	(16,225)	[3,894]	{1,947}	81,278	(16,256)	[3,901]	{1,951}	81,418	(16,284)	[3,908]	{1,954}
Contra Costa	62,248	62,720	62,818	62,931	63,145	(12,629)	[3,031]	{1,515}	63,350	(12,670)	[3,041]	{1,520}	63,553	(12,711)	[3,051]	{1,525}
Fresno	95,393	95,548	95,677	95,785	96,044	(19,209)	[4,610]	{2,305}	96,285	(19,257)	[4,622]	{2,311}	96,512	(19,302)	[4,633]	{2,316}
Kern	103,223	103,422	103,622	103,756	104,038	(20,808)	[4,994]	{2,497}	104,295	(20,859)	[5,006]	{2,503}	104,534	(20,907)	[5,018]	{2,509}
Lake	3,156	3,164	3,167	3,169	3,182	(636)	[153]	{76}	3,194	(639)	[153]	{77}	3,205	(641)	[154]	{77}
Los Angeles	1,191,923	1,192,954	1,194,333	1,196,017	1,198,370	(239,674)	[57,522]	{28,761}	1,200,576	(240,115)	[57,628]	{28,814}	1,202,520	(240,504)	[57,721]	{28,860}
Marin	13,207	13,231	13,261	13,285	13,329	(2,666)	[640]	{320}	13,372	(2,674)	[642]	{321}	13,415	(2,683)	[644]	{322}
Monterey	42,230	42,261	42,316	42,335	42,394	(8,479)	[2,035]	{1,017}	42,448	(8,490)	[2,037]	{1,019}	42,495	(8,499)	[2,040]	{1,020}
Orange	261,220	261,408	261,608	261,798	262,137	(52,427)	[12,583]	{6,291}	262,446	(52,489)	[12,597]	{6,299}	262,716	(52,543)	[12,610]	{6,305}
Placer	19,828	19,861	19,882	19,911	19,963	(3,993)	[958]	{479}	20,014	(4,003)	[961]	{480}	20,063	(4,013)	[963]	{482}
Riverside	289,665	289,773	290,325	290,498	290,776	(58,155)	[13,957]	{6,979}	291,020	(58,204)	[13,969]	{6,984}	291,230	(58,246)	[13,979]	{6,990}
Sacramento	93,281	93,528	93,678	93,790	94,064	(18,813)	[4,515]	{2,258}	94,329	(18,866)	[4,528]	{2,264}	94,568	(18,914)	[4,539]	{2,270}
San Bernardino	286,607	286,755	286,814	287,055	287,452	(57,490)	[13,798]	{6,899}	287,825	(57,565)	[13,816]	{6,908}	288,152	(57,630)	[13,831]	{6,916}
San Diego	260,091	260,625	261,001	261,353	262,040	(52,408)	[12,578]	{6,289}	262,674	(52,535)	[12,608]	{6,304}	263,251	(52,650)	[12,636]	{6,318}
San Francisco	34,260	34,291	34,318	34,387	34,474	(6,895)	[1,655]	{827}	34,553	(6,911)	[1,659]	{829}	34,626	(6,925)	[1,662]	{831}
San Joaquin	66,764	66,829	67,040	67,123	67,272	(13,454)	[3,229]	{1,615}	67,414	(13,483)	[3,236]	{1,618}	67,550	(13,510)	[3,242]	{1,621}
San Luis Obispo	19,675	19,696	19,724	19,751	19,796	(3,959)	[950]	{475}	19,839	(3,968)	[952]	{476}	19,877	(3,975)	[954]	{477}
San Mateo	38,998	39,059	39,096	39,148	39,269	(7,854)	[1,885]	{942}	39,379	(7,876)	[1,890]	{945}	39,480	(7,896)	[1,895]	{948}
Santa Barbara	31,805	32,050	32,087	32,147	32,252	(6,450)	[1,548]	{774}	32,348	(6,470)	[1,553]	{776}	32,435	(6,487)	[1,557]	{778}
Santa Clara	110,621	110,755	110,911	111,076	111,409	(22,282)	[5,348]	{2,674}	111,715	(22,343)	[5,362]	{2,681}	112,008	(22,402)	[5,376]	{2,688}
Santa Cruz	14,650	14,671	14,700	14,736	14,776	(2,955)	[709]	{355}	14,813	(2,963)	[711]	{356}	14,848	(2,970)	[713]	{356}
Solano	30,085	30,115	30,163	30,216	30,272	(6,054)	[1,453]	{727}	30,325	(6,065)	[1,456]	{728}	30,374	(6,075)	[1,458]	{729}
Sonoma	28,141	28,193	28,222	28,261	28,360	(5,672)	[1,361]	{681}	28,457	(5,691)	[1,366]	{683}	28,549	(5,710)	[1,370]	{685}
Ventura	77,623	77,749	77,849	77,952	78,119	(15,624)	[3,750]	{1,875}	78,268	(15,654)	[3,757]	{1,878}	78,402	(15,680)	[3,763]	{1,882}

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.