

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

Date: 3/25/21

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 3/25/21 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.

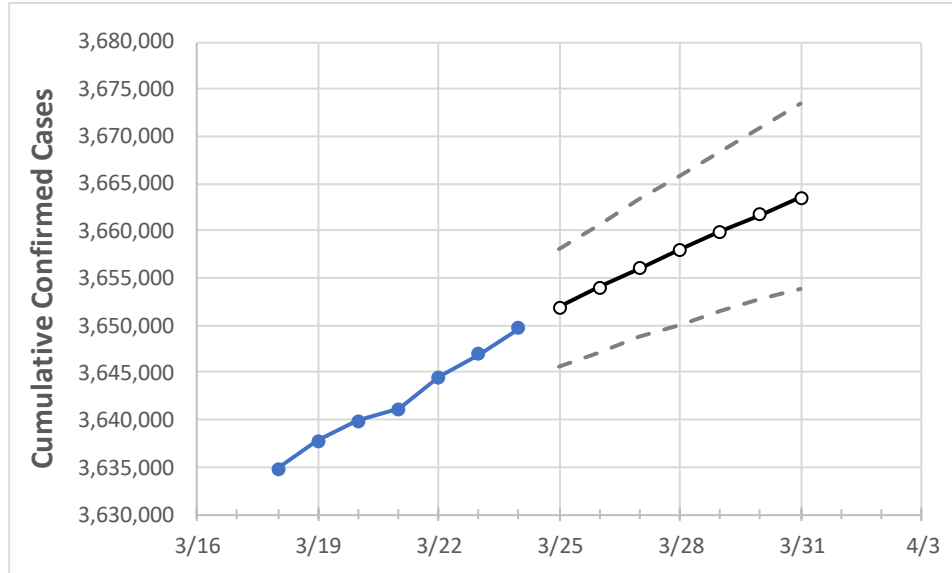
IEM's Modeling Lead

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:						
	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30	3/31

California 3,641,105 3,644,488 3,646,941 3,649,727 3,651,866 3,653,993 3,656,031 3,657,997 3,659,909 3,661,744 3,663,536

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:							
	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30	3/31	
Alameda	82,593	82,680	82,747	82,818	82,885	82,951	83,017	83,080	83,140	83,198	83,255	
Contra Costa	64,642	64,695	64,752	64,801	64,870	64,936	65,001	65,062	65,124	65,184	65,242	
Fresno	98,090	98,211	98,276	98,362	98,459	98,556	98,650	98,745	98,833	98,922	99,009	
Kern	105,499	105,542	105,625	105,810	105,890	105,968	106,044	106,118	106,193	106,270	106,340	
Lake	3,263	3,274	3,279	3,289	3,295	3,301	3,306	3,312	3,318	3,323	3,329	
Los Angeles	1,214,178	1,214,754	1,215,179	1,215,772	1,216,255	1,216,724	1,217,159	1,217,545	1,217,921	1,218,325	1,218,673	
Marin	13,545	13,552	13,564	13,572	13,581	13,590	13,599	13,608	13,616	13,624	13,631	
Monterey	42,754	42,774	42,794	42,817	42,837	42,856	42,876	42,895	42,914	42,933	42,951	
Orange	264,721	264,849	264,989	265,219	265,341	265,461	265,577	265,696	265,808	265,916	266,025	
Placer	20,566	20,603	20,627	20,665	20,696	20,727	20,758	20,789	20,820	20,849	20,879	
Riverside	293,088	293,149	293,436	293,600	293,715	293,828	293,939	294,042	294,144	294,247	294,347	
Sacramento	96,239	96,377	96,505	96,616	96,731	96,846	96,964	97,080	97,195	97,310	97,418	
San Bernardino	289,773	289,846	289,892	290,030	290,138	290,242	290,343	290,442	290,534	290,633	290,726	
San Diego	267,728	267,917	268,160	268,417	268,667	268,912	269,147	269,380	269,610	269,840	270,057	
San Francisco	34,833	34,835	34,838	34,840	34,846	34,852	34,857	34,862	34,866	34,870	34,874	
San Joaquin	68,808	68,855	69,112	69,187	69,289	69,393	69,497	69,601	69,703	69,817	69,926	
San Luis Obispo	20,236	20,260	20,303	20,309	20,328	20,347	20,366	20,384	20,402	20,420	20,438	
San Mateo	39,825	39,837	39,874	39,935	39,955	39,973	39,992	40,008	40,024	40,040	40,056	
Santa Barbara	32,859	32,873	32,895	32,933	32,957	32,981	33,004	33,026	33,048	33,069	33,090	
Santa Clara	113,552	113,641	113,700	113,814	113,905	113,992	114,078	114,161	114,238	114,317	114,391	
Santa Cruz	15,215	15,225	15,240	15,258	15,277	15,295	15,314	15,331	15,348	15,366	15,382	
Solano	30,804	30,834	30,865	30,907	30,937	30,966	30,996	31,025	31,053	31,082	31,110	
Sonoma	28,981	29,006	29,045	29,059	29,084	29,110	29,135	29,159	29,183	29,205	29,227	
Ventura	79,176	79,219	79,243	79,309	79,345	79,379	79,412	79,444	79,474	79,504	79,532	

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:											
	3/21	3/22	3/23	3/24	3/26			3/28			3/30					
Alameda	82,593	82,680	82,747	82,818	82,951	(16,590)	[3,982]	{1,991}	83,080	(16,616)	[3,988]	{1,994}	83,198	(16,640)	[3,994]	{1,997}
Contra Costa	64,642	64,695	64,752	64,801	64,936	(12,987)	[3,117]	{1,558}	65,062	(13,012)	[3,123]	{1,561}	65,184	(13,037)	[3,129]	{1,564}
Fresno	98,090	98,211	98,276	98,362	98,556	(19,711)	[4,731]	{2,365}	98,745	(19,749)	[4,740]	{2,370}	98,922	(19,784)	[4,748]	{2,374}
Kern	105,499	105,542	105,625	105,810	105,968	(21,194)	[5,086]	{2,543}	106,118	(21,224)	[5,094]	{2,547}	106,270	(21,254)	[5,101]	{2,550}
Lake	3,263	3,274	3,279	3,289	3,301	(660)	[158]	{79}	3,312	(662)	[159]	{79}	3,323	(665)	[160]	{80}
Los Angeles	1,214,178	1,214,754	1,215,179	1,215,772	1,216,724	(243,345)	[58,403]	{29,201}	1,217,545	(243,509)	[58,442]	{29,221}	1,218,325	(243,665)	[58,480]	{29,240}
Marin	13,545	13,552	13,564	13,572	13,590	(2,718)	[652]	{326}	13,608	(2,722)	[653]	{327}	13,624	(2,725)	[654]	{327}
Monterey	42,754	42,774	42,794	42,817	42,856	(8,571)	[2,057]	{1,029}	42,895	(8,579)	[2,059]	{1,029}	42,933	(8,587)	[2,061]	{1,030}
Orange	264,721	264,849	264,989	265,219	265,461	(53,092)	[12,742]	{6,371}	265,696	(53,139)	[12,753]	{6,377}	265,916	(53,183)	[12,764]	{6,382}
Placer	20,566	20,603	20,627	20,665	20,727	(4,145)	[995]	{497}	20,789	(4,158)	[998]	{499}	20,849	(4,170)	[1,001]	{500}
Riverside	293,088	293,149	293,436	293,600	293,828	(58,766)	[14,104]	{7,052}	294,042	(58,808)	[14,114]	{7,057}	294,247	(58,849)	[14,124]	{7,062}
Sacramento	96,239	96,377	96,505	96,616	96,846	(19,369)	[4,649]	{2,324}	97,080	(19,416)	[4,660]	{2,330}	97,310	(19,462)	[4,671]	{2,335}
San Bernardino	289,773	289,846	289,892	290,030	290,242	(58,048)	[13,932]	{6,966}	290,442	(58,088)	[13,941]	{6,971}	290,633	(58,127)	[13,950]	{6,975}
San Diego	267,728	267,917	268,160	268,417	268,912	(53,782)	[12,908]	{6,454}	269,380	(53,876)	[12,930]	{6,465}	269,840	(53,968)	[12,952]	{6,476}
San Francisco	34,833	34,835	34,838	34,840	34,852	(6,970)	[1,673]	{836}	34,862	(6,972)	[1,673]	{837}	34,870	(6,974)	[1,674]	{837}
San Joaquin	68,808	68,855	69,112	69,187	69,393	(13,879)	[3,331]	{1,665}	69,601	(13,920)	[3,341]	{1,670}	69,817	(13,963)	[3,351]	{1,676}
San Luis Obispo	20,236	20,260	20,303	20,309	20,347	(4,069)	[977]	{488}	20,384	(4,077)	[978]	{489}	20,420	(4,084)	[980]	{490}
San Mateo	39,825	39,837	39,874	39,935	39,973	(7,995)	[1,919]	{959}	40,008	(8,002)	[1,920]	{960}	40,040	(8,008)	[1,922]	{961}
Santa Barbara	32,859	32,873	32,895	32,933	32,981	(6,596)	[1,583]	{792}	33,026	(6,605)	[1,585]	{793}	33,069	(6,614)	[1,587]	{794}
Santa Clara	113,552	113,641	113,700	113,814	113,992	(22,798)	[5,472]	{2,736}	114,161	(22,832)	[5,480]	{2,740}	114,317	(22,863)	[5,487]	{2,744}
Santa Cruz	15,215	15,225	15,240	15,258	15,295	(3,059)	[734]	{367}	15,331	(3,066)	[736]	{368}	15,366	(3,073)	[738]	{369}
Solano	30,804	30,834	30,865	30,907	30,966	(6,193)	[1,486]	{743}	31,025	(6,205)	[1,489]	{745}	31,082	(6,216)	[1,492]	{746}
Sonoma	28,981	29,006	29,045	29,059	29,110	(5,822)	[1,397]	{699}	29,159	(5,832)	[1,400]	{700}	29,205	(5,841)	[1,402]	{701}
Ventura	79,176	79,219	79,243	79,309	79,379	(15,876)	[3,810]	{1,905}	79,444	(15,889)	[3,813]	{1,907}	79,504	(15,901)	[3,816]	{1,908}

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.