

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

Date: 3/22/21

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 3/22/21 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.**

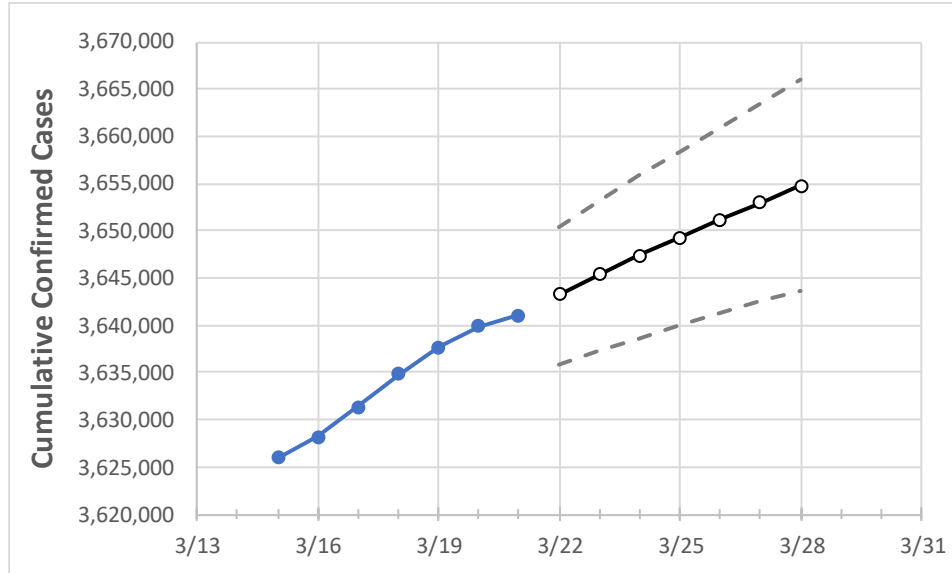
### IEM's Modeling Lead

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:							
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	

California 3,634,807 3,637,726 3,639,874 3,641,105 3,643,291 3,645,372 3,647,384 3,649,345 3,651,201 3,652,995 3,654,765

*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:						
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28
Alameda	82,368	82,460	82,540	82,593	82,664	82,733	82,801	82,865	82,930	82,992	83,051
Contra Costa	64,358	64,454	64,573	64,642	64,724	64,806	64,884	64,959	65,039	65,118	65,195
Fresno	97,727	97,848	97,969	97,969	98,076	98,181	98,289	98,392	98,496	98,593	98,692
Kern	105,222	105,368	105,441	105,499	105,569	105,635	105,701	105,767	105,828	105,886	105,944
Lake	3,239	3,240	3,240	3,240	3,243	3,246	3,248	3,251	3,253	3,256	3,258
Los Angeles	1,212,648	1,213,288	1,213,792	1,214,178	1,214,759	1,215,275	1,215,793	1,216,269	1,216,719	1,217,162	1,217,601
Marin	13,487	13,507	13,531	13,545	13,554	13,563	13,571	13,579	13,587	13,595	13,602
Monterey	42,667	42,712	42,734	42,734	42,753	42,771	42,789	42,807	42,824	42,841	42,858
Orange	264,335	264,478	264,600	264,721	264,839	264,949	265,058	265,162	265,266	265,363	265,455
Placer	20,460	20,493	20,493	20,493	20,520	20,549	20,577	20,604	20,633	20,661	20,688
Riverside	292,817	292,967	292,967	292,967	293,104	293,237	293,368	293,497	293,626	293,749	293,873
Sacramento	95,837	95,964	95,964	95,964	96,074	96,182	96,293	96,406	96,514	96,625	96,733
San Bernardino	289,242	289,405	289,610	289,773	289,874	289,972	290,068	290,164	290,254	290,344	290,432
San Diego	266,756	267,177	267,536	267,728	268,035	268,331	268,623	268,915	269,196	269,464	269,732
San Francisco	34,820	34,820	34,820	34,820	34,837	34,853	34,868	34,883	34,897	34,909	34,922
San Joaquin	68,551	68,714	68,714	68,714	68,829	68,939	69,057	69,175	69,296	69,420	69,541
San Luis Obispo	20,172	20,189	20,189	20,189	20,209	20,228	20,248	20,266	20,284	20,301	20,318
San Mateo	39,765	39,765	39,765	39,765	39,795	39,824	39,852	39,880	39,907	39,932	39,957
Santa Barbara	32,755	32,798	32,836	32,859	32,887	32,915	32,942	32,969	32,994	33,019	33,044
Santa Clara	113,173	113,292	113,446	113,552	113,656	113,758	113,859	113,955	114,050	114,142	114,231
Santa Cruz	15,169	15,196	15,196	15,196	15,224	15,252	15,279	15,307	15,334	15,361	15,389
Solano	30,710	30,745	30,745	30,745	30,773	30,800	30,826	30,853	30,879	30,904	30,930
Sonoma	28,882	28,914	28,943	28,981	29,009	29,037	29,064	29,092	29,117	29,142	29,166
Ventura	79,028	79,090	79,090	79,090	79,126	79,159	79,193	79,223	79,252	79,281	79,308

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:											
	3/18	3/19	3/20	3/21	3/23			3/25			3/27					
Alameda	82,368	82,460	82,540	82,593	82,733	(16,547)	[3,971]	{1,986}	82,865	(16,573)	[3,978]	{1,989}	82,992	(16,598)	[3,984]	{1,992}
Contra Costa	64,358	64,454	64,573	64,642	64,806	(12,961)	[3,111]	{1,555}	64,959	(12,992)	[3,118]	{1,559}	65,118	(13,024)	[3,126]	{1,563}
Fresno	97,727	97,848	97,969	97,969	98,181	(19,636)	[4,713]	{2,356}	98,392	(19,678)	[4,723]	{2,361}	98,593	(19,719)	[4,732]	{2,366}
Kern	105,222	105,368	105,441	105,499	105,635	(21,127)	[5,070]	{2,535}	105,767	(21,153)	[5,077]	{2,538}	105,886	(21,177)	[5,083]	{2,541}
Lake	3,239	3,240	3,240	3,240	3,246	(649)	[156]	{78}	3,251	(650)	[156]	{78}	3,256	(651)	[156]	{78}
Los Angeles	1,212,648	1,213,288	1,213,792	1,214,178	1,215,275	(243,055)	[58,333]	{29,167}	1,216,269	(243,254)	[58,381]	{29,190}	1,217,162	(243,432)	[58,424]	{29,212}
Marin	13,487	13,507	13,531	13,545	13,563	(2,713)	[651]	{326}	13,579	(2,716)	[652]	{326}	13,595	(2,719)	[653]	{326}
Monterey	42,667	42,712	42,734	42,734	42,771	(8,554)	[2,053]	{1,027}	42,807	(8,561)	[2,055]	{1,027}	42,841	(8,568)	[2,056]	{1,028}
Orange	264,335	264,478	264,600	264,721	264,949	(52,990)	[12,718]	{6,359}	265,162	(53,032)	[12,728]	{6,364}	265,363	(53,073)	[12,737]	{6,369}
Placer	20,460	20,493	20,493	20,493	20,549	(4,110)	[986]	{493}	20,604	(4,121)	[989]	{495}	20,661	(4,132)	[992]	{496}
Riverside	292,817	292,967	292,967	292,967	293,237	(58,647)	[14,075]	{7,038}	293,497	(58,699)	[14,088]	{7,044}	293,749	(58,750)	[14,100]	{7,050}
Sacramento	95,837	95,964	95,964	95,964	96,182	(19,236)	[4,617]	{2,308}	96,406	(19,281)	[4,627]	{2,314}	96,625	(19,325)	[4,638]	{2,319}
San Bernardino	289,242	289,405	289,610	289,773	289,972	(57,994)	[13,919]	{6,959}	290,164	(58,033)	[13,928]	{6,964}	290,344	(58,069)	[13,937]	{6,968}
San Diego	266,756	267,177	267,536	267,728	268,331	(53,666)	[12,880]	{6,440}	268,915	(53,783)	[12,908]	{6,454}	269,464	(53,893)	[12,934]	{6,467}
San Francisco	34,820	34,820	34,820	34,820	34,853	(6,971)	[1,673]	{836}	34,883	(6,977)	[1,674]	{837}	34,909	(6,982)	[1,676]	{838}
San Joaquin	68,551	68,714	68,714	68,714	68,939	(13,788)	[3,309]	{1,655}	69,175	(13,835)	[3,320]	{1,660}	69,420	(13,884)	[3,332]	{1,666}
San Luis Obispo	20,172	20,189	20,189	20,189	20,228	(4,046)	[971]	{485}	20,266	(4,053)	[973]	{486}	20,301	(4,060)	[974]	{487}
San Mateo	39,765	39,765	39,765	39,765	39,824	(7,965)	[1,912]	{956}	39,880	(7,976)	[1,914]	{957}	39,932	(7,986)	[1,917]	{958}
Santa Barbara	32,755	32,798	32,836	32,859	32,915	(6,583)	[1,580]	{790}	32,969	(6,594)	[1,583]	{791}	33,019	(6,604)	[1,585]	{792}
Santa Clara	113,173	113,292	113,446	113,552	113,758	(22,752)	[5,460]	{2,730}	113,955	(22,791)	[5,470]	{2,735}	114,142	(22,828)	[5,479]	{2,739}
Santa Cruz	15,169	15,196	15,196	15,196	15,252	(3,050)	[732]	{366}	15,307	(3,061)	[735]	{367}	15,361	(3,072)	[737]	{369}
Solano	30,710	30,745	30,745	30,745	30,800	(6,160)	[1,478]	{739}	30,853	(6,171)	[1,481]	{740}	30,904	(6,181)	[1,483]	{742}
Sonoma	28,882	28,914	28,943	28,981	29,037	(5,807)	[1,394]	{697}	29,092	(5,818)	[1,396]	{698}	29,142	(5,828)	[1,399]	{699}
Ventura	79,028	79,090	79,090	79,090	79,159	(15,832)	[3,800]	{1,900}	79,223	(15,845)	[3,803]	{1,901}	79,281	(15,856)	[3,806]	{1,903}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.