

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

Date: 4/21/21

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 4/21/21 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.**

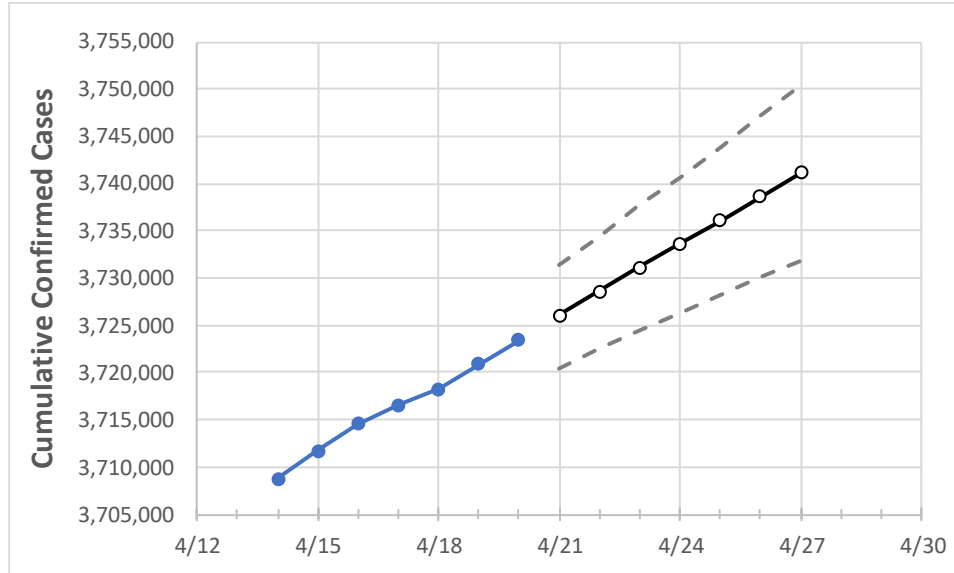
### IEM's Modeling Lead

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:						
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27

California 3,716,579 3,718,210 3,720,901 3,723,446 3,726,017 3,728,568 3,731,150 3,733,661 3,736,103 3,738,643 3,741,144

*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:							
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	
Alameda	85,256	85,367	85,481	85,583	85,700	85,821	85,942	86,066	86,192	86,318	86,454	
Contra Costa	66,927	67,019	67,101	67,157	67,251	67,348	67,444	67,541	67,638	67,739	67,839	
Fresno	100,500	100,562	100,621	100,702	100,755	100,809	100,859	100,908	100,957	101,004	101,049	
Kern	107,825	107,859	107,879	108,013	108,110	108,209	108,307	108,406	108,506	108,605	108,708	
Lake	3,406	3,409	3,413	3,416	3,421	3,425	3,429	3,434	3,438	3,442	3,447	
Los Angeles	1,228,641	1,228,997	1,229,328	1,229,641	1,230,074	1,230,500	1,230,911	1,231,327	1,231,724	1,232,111	1,232,494	
Marin	13,860	13,861	13,865	13,868	13,874	13,881	13,886	13,893	13,899	13,904	13,909	
Monterey	43,267	43,278	43,290	43,301	43,316	43,331	43,347	43,362	43,376	43,393	43,407	
Orange	268,869	268,962	269,036	269,176	269,310	269,444	269,575	269,705	269,839	269,968	270,093	
Placer	21,793	21,836	21,878	21,908	21,958	22,007	22,058	22,108	22,158	22,210	22,264	
Riverside	297,250	297,284	297,319	297,620	297,744	297,869	297,989	298,105	298,220	298,336	298,448	
Sacramento	101,115	101,172	101,511	101,665	101,837	102,001	102,183	102,356	102,528	102,698	102,866	
San Bernardino	294,577	294,779	294,883	294,973	295,131	295,286	295,446	295,606	295,764	295,927	296,087	
San Diego	274,811	274,960	275,112	275,368	275,611	275,851	276,084	276,321	276,555	276,784	277,014	
San Francisco	35,993	36,032	36,073	36,094	36,133	36,171	36,209	36,247	36,285	36,324	36,362	
San Joaquin	71,463	71,495	71,527	71,735	71,814	71,894	71,974	72,053	72,127	72,200	72,277	
San Luis Obispo	20,935	20,954	20,972	20,991	21,016	21,041	21,066	21,092	21,117	21,143	21,169	
San Mateo	41,107	41,157	41,201	41,226	41,269	41,313	41,356	41,399	41,442	41,484	41,528	
Santa Barbara	33,863	33,896	33,913	33,926	33,954	33,985	34,014	34,042	34,074	34,102	34,133	
Santa Clara	116,971	117,081	117,186	117,317	117,457	117,596	117,736	117,877	118,024	118,169	118,317	
Santa Cruz	15,563	15,571	15,615	15,666	15,701	15,738	15,777	15,818	15,859	15,902	15,946	
Solano	31,926	31,976	32,027	32,047	32,096	32,144	32,194	32,243	32,294	32,345	32,398	
Sonoma	29,679	29,696	29,715	29,720	29,740	29,760	29,780	29,799	29,819	29,838	29,857	
Ventura	80,256	80,283	80,309	80,332	80,363	80,392	80,423	80,453	80,483	80,511	80,540	

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:											
	4/17	4/18	4/19	4/20	4/22			4/24			4/26					
Alameda	85,256	85,367	85,481	85,583	85,821	(17,164)	[4,119]	{2,060}	86,066	(17,213)	[4,131]	{2,066}	86,318	(17,264)	[4,143]	{2,072}
Contra Costa	66,927	67,019	67,101	67,157	67,348	(13,470)	[3,233]	{1,616}	67,541	(13,508)	[3,242]	{1,621}	67,739	(13,548)	[3,251]	{1,626}
Fresno	100,500	100,562	100,621	100,702	100,809	(20,162)	[4,839]	{2,419}	100,908	(20,182)	[4,844]	{2,422}	101,004	(20,201)	[4,848]	{2,424}
Kern	107,825	107,859	107,879	108,013	108,209	(21,642)	[5,194]	{2,597}	108,406	(21,681)	[5,203]	{2,602}	108,605	(21,721)	[5,213]	{2,607}
Lake	3,406	3,409	3,413	3,416	3,425	(685)	[164]	{82}	3,434	(687)	[165]	{82}	3,442	(688)	[165]	{83}
Los Angeles	1,228,641	1,228,997	1,229,328	1,229,641	1,230,500	(246,100)	[59,064]	{29,532}	1,231,327	(246,265)	[59,104]	{29,552}	1,232,111	(246,422)	[59,141]	{29,571}
Marin	13,860	13,861	13,865	13,868	13,881	(2,776)	[666]	{333}	13,893	(2,779)	[667]	{333}	13,904	(2,781)	[667]	{334}
Monterey	43,267	43,278	43,290	43,301	43,331	(8,666)	[2,080]	{1,040}	43,362	(8,672)	[2,081]	{1,041}	43,393	(8,679)	[2,083]	{1,041}
Orange	268,869	268,962	269,036	269,176	269,444	(53,889)	[12,933]	{6,467}	269,705	(53,941)	[12,946]	{6,473}	269,968	(53,994)	[12,958]	{6,479}
Placer	21,793	21,836	21,878	21,908	22,007	(4,401)	[1,056]	{528}	22,108	(4,422)	[1,061]	{531}	22,210	(4,442)	[1,066]	{533}
Riverside	297,250	297,284	297,319	297,620	297,869	(59,574)	[14,298]	{7,149}	298,105	(59,621)	[14,309]	{7,155}	298,336	(59,667)	[14,320]	{7,160}
Sacramento	101,115	101,172	101,511	101,665	102,001	(20,400)	[4,896]	{2,448}	102,356	(20,471)	[4,913]	{2,457}	102,698	(20,540)	[4,930]	{2,465}
San Bernardino	294,577	294,779	294,883	294,973	295,286	(59,057)	[14,174]	{7,087}	295,606	(59,121)	[14,189]	{7,095}	295,927	(59,185)	[14,204]	{7,102}
San Diego	274,811	274,960	275,112	275,368	275,851	(55,170)	[13,241]	{6,620}	276,321	(55,264)	[13,263]	{6,632}	276,784	(55,357)	[13,286]	{6,643}
San Francisco	35,993	36,032	36,073	36,094	36,171	(7,234)	[1,736]	{868}	36,247	(7,249)	[1,740]	{870}	36,324	(7,265)	[1,744]	{872}
San Joaquin	71,463	71,495	71,527	71,735	71,894	(14,379)	[3,451]	{1,725}	72,053	(14,411)	[3,459]	{1,729}	72,200	(14,440)	[3,466]	{1,733}
San Luis Obispo	20,935	20,954	20,972	20,991	21,041	(4,208)	[1,010]	{505}	21,092	(4,218)	[1,012]	{506}	21,143	(4,229)	[1,015]	{507}
San Mateo	41,107	41,157	41,201	41,226	41,313	(8,263)	[1,983]	{992}	41,399	(8,280)	[1,987]	{994}	41,484	(8,297)	[1,991]	{996}
Santa Barbara	33,863	33,896	33,913	33,926	33,985	(6,797)	[1,631]	{816}	34,042	(6,808)	[1,634]	{817}	34,102	(6,820)	[1,637]	{818}
Santa Clara	116,971	117,081	117,186	117,317	117,596	(23,519)	[5,645]	{2,822}	117,877	(23,575)	[5,658]	{2,829}	118,169	(23,634)	[5,672]	{2,836}
Santa Cruz	15,563	15,571	15,615	15,666	15,738	(3,148)	[755]	{378}	15,818	(3,164)	[759]	{380}	15,902	(3,180)	[763]	{382}
Solano	31,926	31,976	32,027	32,047	32,144	(6,429)	[1,543]	{771}	32,243	(6,449)	[1,548]	{774}	32,345	(6,469)	[1,553]	{776}
Sonoma	29,679	29,696	29,715	29,720	29,760	(5,952)	[1,428]	{714}	29,799	(5,960)	[1,430]	{715}	29,838	(5,968)	[1,432]	{716}
Ventura	80,256	80,283	80,309	80,332	80,392	(16,078)	[3,859]	{1,929}	80,453	(16,091)	[3,862]	{1,931}	80,511	(16,102)	[3,865]	{1,932}

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.