

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

Date: 4/12/21

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 4/12/21 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.

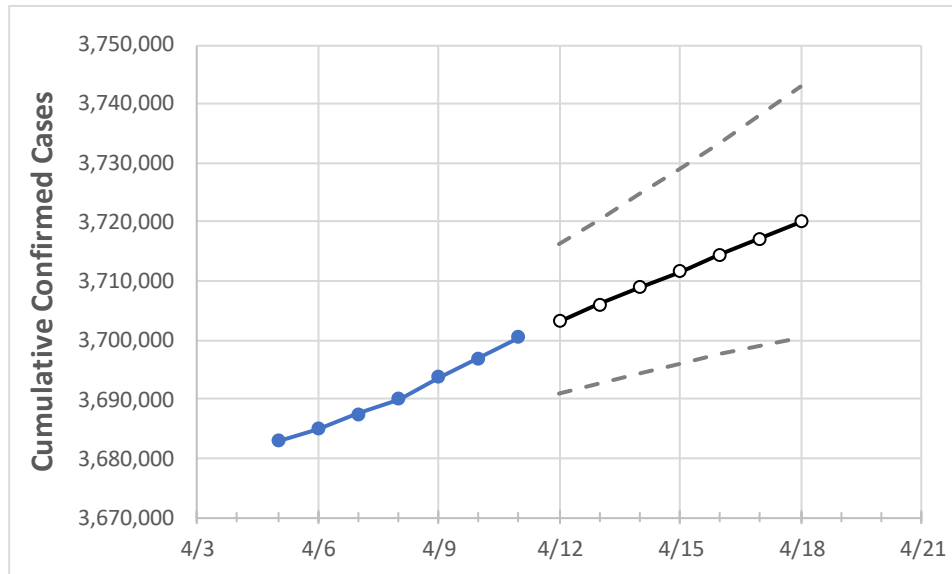
IEM's Modeling Lead

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:							
	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	
California	3,690,031	3,693,674	3,696,980	3,700,471	3,703,257	3,706,036	3,708,856	3,711,628	3,714,427	3,717,208	3,720,042	

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:							
	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	
Alameda	84,130	84,213	84,448	84,626	84,734	84,842	84,953	85,069	85,185	85,303	85,422	
Contra Costa	65,967	66,118	66,262	66,369	66,465	66,562	66,659	66,757	66,855	66,957	67,059	
Fresno	99,865	99,935	100,027	100,135	100,212	100,288	100,362	100,434	100,506	100,576	100,646	
Kern	106,724	106,984	107,172	107,341	107,467	107,598	107,735	107,878	108,025	108,178	108,335	
Lake	3,359	3,360	3,362	3,368	3,371	3,374	3,377	3,380	3,383	3,385	3,388	
Los Angeles	1,223,821	1,224,547	1,225,299	1,225,796	1,226,319	1,226,840	1,227,365	1,227,890	1,228,405	1,228,933	1,229,449	
Marin	13,777	13,787	13,797	13,806	13,816	13,826	13,835	13,845	13,855	13,864	13,874	
Monterey	43,063	43,104	43,157	43,157	43,176	43,195	43,214	43,233	43,252	43,271	43,290	
Orange	267,383	267,492	267,957	268,175	268,376	268,584	268,796	269,014	269,236	269,466	269,700	
Placer	21,317	21,389	21,396	21,402	21,441	21,481	21,521	21,561	21,601	21,643	21,684	
Riverside	295,896	296,090	296,090	296,090	296,284	296,486	296,696	296,907	297,127	297,349	297,580	
Sacramento	99,268	99,668	99,722	100,048	100,252	100,463	100,686	100,905	101,146	101,381	101,613	
San Bernardino	292,160	292,358	292,558	293,638	293,967	294,315	294,695	295,095	295,498	295,940	296,391	
San Diego	272,494	272,696	273,057	273,286	273,543	273,800	274,068	274,334	274,588	274,854	275,114	
San Francisco	35,618	35,657	35,716	35,774	35,812	35,851	35,892	35,933	35,974	36,016	36,059	
San Joaquin	70,609	70,746	70,746	70,746	70,848	70,951	71,052	71,148	71,250	71,352	71,461	
San Luis Obispo	20,704	20,723	20,723	20,723	20,748	20,773	20,798	20,823	20,848	20,872	20,898	
San Mateo	40,708	40,754	40,800	40,878	40,928	40,979	41,030	41,083	41,137	41,191	41,246	
Santa Barbara	33,427	33,545	33,655	33,704	33,755	33,808	33,859	33,916	33,971	34,028	34,088	
Santa Clara	115,569	115,825	116,084	116,228	116,377	116,529	116,685	116,839	116,999	117,163	117,329	
Santa Cruz	15,301	15,334	15,347	15,360	15,377	15,394	15,409	15,425	15,442	15,458	15,474	
Solano	31,489	31,527	31,527	31,527	31,562	31,598	31,633	31,668	31,703	31,739	31,773	
Sonoma	29,448	29,475	29,501	29,525	29,544	29,563	29,582	29,600	29,619	29,638	29,655	
Ventura	79,894	79,963	79,963	79,963	79,989	80,013	80,038	80,060	80,082	80,105	80,126	

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:											
	4/8	4/9	4/10	4/11	4/13				4/15				4/17			
Alameda	84,130	84,213	84,448	84,626	84,842	(16,968)	[4,072]	{2,036}	85,069	(17,014)	[4,083]	{2,042}	85,303	(17,061)	[4,095]	{2,047}
Contra Costa	65,967	66,118	66,262	66,369	66,562	(13,312)	[3,195]	{1,597}	66,757	(13,351)	[3,204]	{1,602}	66,957	(13,391)	[3,214]	{1,607}
Fresno	99,865	99,935	100,027	100,135	100,288	(20,058)	[4,814]	{2,407}	100,434	(20,087)	[4,821]	{2,410}	100,576	(20,115)	[4,828]	{2,414}
Kern	106,724	106,984	107,172	107,341	107,598	(21,520)	[5,165]	{2,582}	107,878	(21,576)	[5,178]	{2,589}	108,178	(21,636)	[5,193]	{2,596}
Lake	3,359	3,360	3,362	3,368	3,374	(675)	[162]	{81}	3,380	(676)	[162]	{81}	3,385	(677)	[162]	{81}
Los Angeles	1,223,821	1,224,547	1,225,299	1,225,796	1,226,840	(245,368)	[58,888]	{29,444}	1,227,890	(245,578)	[58,939]	{29,469}	1,228,933	(245,787)	[58,989]	{29,494}
Marin	13,777	13,787	13,797	13,806	13,826	(2,765)	[664]	{332}	13,845	(2,769)	[665]	{332}	13,864	(2,773)	[665]	{333}
Monterey	43,063	43,104	43,157	43,157	43,195	(8,639)	[2,073]	{1,037}	43,233	(8,647)	[2,075]	{1,038}	43,271	(8,654)	[2,077]	{1,039}
Orange	267,383	267,492	267,957	268,175	268,584	(53,717)	[12,892]	{6,446}	269,014	(53,803)	[12,913]	{6,456}	269,466	(53,893)	[12,934]	{6,467}
Placer	21,317	21,389	21,396	21,402	21,481	(4,296)	[1,031]	{516}	21,561	(4,312)	[1,035]	{517}	21,643	(4,329)	[1,039]	{519}
Riverside	295,896	296,090	296,090	296,090	296,486	(59,297)	[14,231]	{7,116}	296,907	(59,381)	[14,252]	{7,126}	297,349	(59,470)	[14,273]	{7,136}
Sacramento	99,268	99,668	99,722	100,048	100,463	(20,093)	[4,822]	{2,411}	100,905	(20,181)	[4,843]	{2,422}	101,381	(20,276)	[4,866]	{2,433}
San Bernardino	292,160	292,358	292,558	293,638	294,315	(58,863)	[14,127]	{7,064}	295,095	(59,019)	[14,165]	{7,082}	295,940	(59,188)	[14,205]	{7,103}
San Diego	272,494	272,696	273,057	273,286	273,800	(54,760)	[13,142]	{6,571}	274,334	(54,867)	[13,168]	{6,584}	274,854	(54,971)	[13,193]	{6,596}
San Francisco	35,618	35,657	35,716	35,774	35,851	(7,170)	[1,721]	{860}	35,933	(7,187)	[1,725]	{862}	36,016	(7,203)	[1,729]	{864}
San Joaquin	70,609	70,746	70,746	70,746	70,951	(14,190)	[3,406]	{1,703}	71,148	(14,230)	[3,415]	{1,708}	71,352	(14,270)	[3,425]	{1,712}
San Luis Obispo	20,704	20,723	20,723	20,723	20,773	(4,155)	[997]	{499}	20,823	(4,165)	[999]	{500}	20,872	(4,174)	[1,002]	{501}
San Mateo	40,708	40,754	40,800	40,878	40,979	(8,196)	[1,967]	{983}	41,083	(8,217)	[1,972]	{986}	41,191	(8,238)	[1,977]	{989}
Santa Barbara	33,427	33,545	33,655	33,704	33,808	(6,762)	[1,623]	{811}	33,916	(6,783)	[1,628]	{814}	34,028	(6,806)	[1,633]	{817}
Santa Clara	115,569	115,825	116,084	116,228	116,529	(23,306)	[5,593]	{2,797}	116,839	(23,368)	[5,608]	{2,804}	117,163	(23,433)	[5,624]	{2,812}
Santa Cruz	15,301	15,334	15,347	15,360	15,394	(3,079)	[739]	{369}	15,425	(3,085)	[740]	{370}	15,458	(3,092)	[742]	{371}
Solano	31,489	31,527	31,527	31,527	31,598	(6,320)	[1,517]	{758}	31,668	(6,334)	[1,520]	{760}	31,739	(6,348)	[1,523]	{762}
Sonoma	29,448	29,475	29,501	29,525	29,563	(5,913)	[1,419]	{710}	29,600	(5,920)	[1,421]	{710}	29,638	(5,928)	[1,423]	{711}
Ventura	79,894	79,963	79,963	79,963	80,013	(16,003)	[3,841]	{1,920}	80,060	(16,012)	[3,843]	{1,921}	80,105	(16,021)	[3,845]	{1,923}

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.