

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

Date: 1/7/21

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 1/7/21 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.

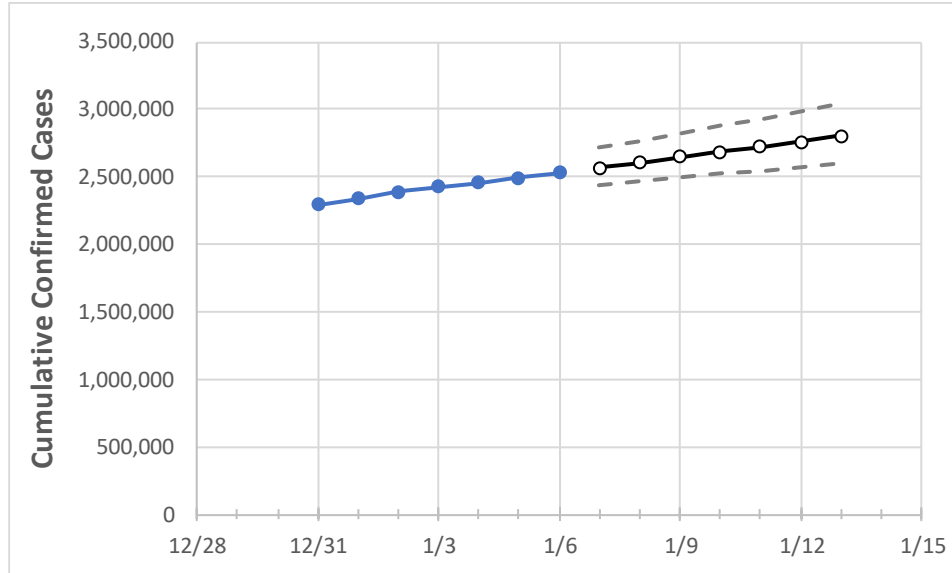
IEM's Modeling Lead

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:							
	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	
California	2,426,930	2,458,100	2,495,814	2,530,857	2,568,582	2,606,826	2,645,544	2,683,375	2,722,601	2,762,117	2,801,594	

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:						
	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13
Alameda	54,518	55,073	55,899	56,432	57,200	57,960	58,723	59,468	60,232	60,987	61,729
Contra Costa	41,993	42,628	43,019	43,442	44,004	44,563	45,120	45,699	46,278	46,862	47,448
Fresno	68,740	69,318	69,871	70,971	71,768	72,616	73,429	74,246	75,075	75,924	76,785
Kern	70,358	71,033	72,270	72,878	73,765	74,649	75,532	76,397	77,301	78,158	79,021
Lake	1,925	1,976	1,998	2,015	2,048	2,082	2,115	2,149	2,183	2,216	2,250
Los Angeles	818,639	827,498	840,611	852,165	865,404	878,889	892,555	906,599	920,183	934,534	948,213
Marin	10,012	10,119	10,182	10,287	10,373	10,462	10,552	10,643	10,735	10,828	10,922
Monterey	28,991	29,352	29,659	30,110	30,545	30,998	31,448	31,903	32,346	32,805	33,254
Orange	168,457	170,579	172,458	175,032	177,985	180,902	183,921	186,845	189,796	192,741	195,722
Placer	14,182	14,687	14,800	15,015	15,229	15,445	15,660	15,876	16,088	16,311	16,522
Riverside	192,069	198,236	200,056	203,957	207,437	210,976	214,519	218,090	221,724	225,343	228,977
Sacramento	67,810	68,551	70,164	70,677	71,545	72,387	73,228	74,030	74,833	75,662	76,497
San Bernardino	206,939	208,271	213,357	214,813	217,838	220,906	223,936	226,914	229,851	232,857	235,822
San Diego	168,020	171,033	172,847	176,662	179,962	183,349	186,737	190,195	193,621	197,289	200,933
San Francisco	24,414	24,588	24,753	24,989	25,256	25,524	25,794	26,060	26,333	26,605	26,871
San Joaquin	47,310	47,886	48,644	49,306	49,984	50,687	51,389	52,071	52,757	53,468	54,166
San Luis Obispo	11,467	11,635	11,945	12,027	12,246	12,480	12,716	12,967	13,229	13,468	13,728
San Mateo	25,483	25,767	26,150	26,497	26,832	27,166	27,498	27,831	28,168	28,507	28,838
Santa Barbara	18,135	18,265	18,735	19,063	19,411	19,764	20,134	20,511	20,905	21,312	21,726
Santa Clara	74,359	74,527	76,235	77,366	78,559	79,789	80,955	82,158	83,338	84,575	85,818
Santa Cruz	9,340	9,526	9,680	9,753	9,929	10,104	10,281	10,465	10,652	10,841	11,035
Solano	19,805	20,953	21,223	21,520	21,857	22,202	22,558	22,924	23,293	23,716	24,105
Sonoma	19,761	19,980	20,210	20,501	20,737	20,966	21,200	21,448	21,697	21,936	22,179
Ventura	43,397	43,747	45,014	46,456	47,678	48,966	50,289	51,687	53,099	54,523	55,986

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:											
	1/3	1/4	1/5	1/6	1/8				1/10				1/12			
Alameda	54,518	55,073	55,899	56,432	57,960	(11,592)	[2,782]	{1,391}	59,468	(11,894)	[2,854]	{1,427}	60,987	(12,197)	[2,927]	{1,464}
Contra Costa	41,993	42,628	43,019	43,442	44,563	(8,913)	[2,139]	{1,070}	45,699	(9,140)	[2,194]	{1,097}	46,862	(9,372)	[2,249]	{1,125}
Fresno	68,740	69,318	69,871	70,971	72,616	(14,523)	[3,486]	{1,743}	74,246	(14,849)	[3,564]	{1,782}	75,924	(15,185)	[3,644]	{1,822}
Kern	70,358	71,033	72,270	72,878	74,649	(14,930)	[3,583]	{1,792}	76,397	(15,279)	[3,667]	{1,834}	78,158	(15,632)	[3,752]	{1,876}
Lake	1,925	1,976	1,998	2,015	2,082	(416)	[100]	{50}	2,149	(430)	[103]	{52}	2,216	(443)	[106]	{53}
Los Angeles	818,639	827,498	840,611	852,165	878,889	(175,778)	[42,187]	{21,093}	906,599	(181,320)	[43,517]	{21,758}	934,534	(186,907)	[44,858]	{22,429}
Marin	10,012	10,119	10,182	10,287	10,462	(2,092)	[502]	{251}	10,643	(2,129)	[511]	{255}	10,828	(2,166)	[520]	{260}
Monterey	28,991	29,352	29,659	30,110	30,998	(6,200)	[1,488]	{744}	31,903	(6,381)	[1,531]	{766}	32,805	(6,561)	[1,575]	{787}
Orange	168,457	170,579	172,458	175,032	180,902	(36,180)	[8,683]	{4,342}	186,845	(37,369)	[8,969]	{4,484}	192,741	(38,548)	[9,252]	{4,626}
Placer	14,182	14,687	14,800	15,015	15,445	(3,089)	[741]	{371}	15,876	(3,175)	[762]	{381}	16,311	(3,262)	[783]	{391}
Riverside	192,069	198,236	200,056	203,957	210,976	(42,195)	[10,127]	{5,063}	218,090	(43,618)	[10,468]	{5,234}	225,343	(45,069)	[10,816]	{5,408}
Sacramento	67,810	68,551	70,164	70,677	72,387	(14,477)	[3,475]	{1,737}	74,030	(14,806)	[3,553]	{1,777}	75,662	(15,132)	[3,632]	{1,816}
San Bernardino	206,939	208,271	213,357	214,813	220,906	(44,181)	[10,603]	{5,302}	226,914	(45,383)	[10,892]	{5,446}	232,857	(46,571)	[11,177]	{5,589}
San Diego	168,020	171,033	172,847	176,662	183,349	(36,670)	[8,801]	{4,400}	190,195	(38,039)	[9,129]	{4,565}	197,289	(39,458)	[9,470]	{4,735}
San Francisco	24,414	24,588	24,753	24,989	25,524	(5,105)	[1,225]	{613}	26,060	(5,212)	[1,251]	{625}	26,605	(5,321)	[1,277]	{639}
San Joaquin	47,310	47,886	48,644	49,306	50,687	(10,137)	[2,433]	{1,216}	52,071	(10,414)	[2,499]	{1,250}	53,468	(10,694)	[2,566]	{1,283}
San Luis Obispo	11,467	11,635	11,945	12,027	12,480	(2,496)	[599]	{300}	12,967	(2,593)	[622]	{311}	13,468	(2,694)	[646]	{323}
San Mateo	25,483	25,767	26,150	26,497	27,166	(5,433)	[1,304]	{652}	27,831	(5,566)	[1,336]	{668}	28,507	(5,701)	[1,368]	{684}
Santa Barbara	18,135	18,265	18,735	19,063	19,764	(3,953)	[949]	{474}	20,511	(4,102)	[985]	{492}	21,312	(4,262)	[1,023]	{511}
Santa Clara	74,359	74,527	76,235	77,366	79,789	(15,958)	[3,830]	{1,915}	82,158	(16,432)	[3,944]	{1,972}	84,575	(16,915)	[4,060]	{2,030}
Santa Cruz	9,340	9,526	9,680	9,753	10,104	(2,021)	[485]	{243}	10,465	(2,093)	[502]	{251}	10,841	(2,168)	[520]	{260}
Solano	19,805	20,953	21,223	21,520	22,202	(4,440)	[1,066]	{533}	22,924	(4,585)	[1,100]	{550}	23,716	(4,743)	[1,138]	{569}
Sonoma	19,761	19,980	20,210	20,501	20,966	(4,193)	[1,006]	{503}	21,448	(4,290)	[1,030]	{515}	21,936	(4,387)	[1,053]	{526}
Ventura	43,397	43,747	45,014	46,456	48,966	(9,793)	[2,350]	{1,175}	51,687	(10,337)	[2,481]	{1,240}	54,523	(10,905)	[2,617]	{1,309}

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.