

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

Date: 1/14/22

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 1/14/22 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.

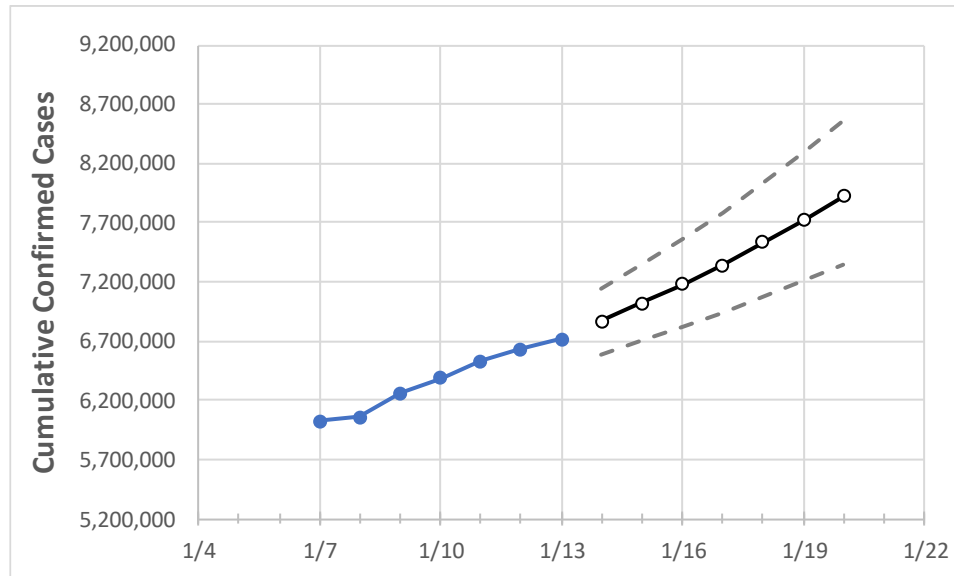
IEM's Modeling Lead

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
California	6,383,610	6,527,242	6,632,985	6,720,235	6,867,658	7,016,749	7,176,995	7,342,909	7,530,827	7,719,038	7,922,739

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Alameda	172,987	176,511	180,331	180,332	185,000	190,057	195,960	201,793	207,980	214,564	222,100
Contra Costa	135,280	137,739	139,908	139,908	143,672	147,479	151,683	156,257	161,037	166,297	171,727
Fresno	175,904	177,820	179,627	179,628	181,547	183,837	186,200	188,747	191,428	194,279	197,260
Kern	174,442	175,585	177,220	179,110	181,148	183,347	185,708	188,305	191,085	194,116	197,365
Lake	7,740	7,820	7,861	7,861	7,951	8,046	8,144	8,260	8,377	8,511	8,651
Los Angeles	2,010,964	2,046,208	2,086,581	2,131,523	2,182,457	2,236,587	2,293,281	2,352,970	2,416,959	2,484,254	2,554,658
Marin	25,347	25,711	26,028	26,028	26,571	27,169	27,785	28,452	29,139	29,871	30,665
Monterey	61,515	61,947	62,560	62,561	63,212	63,853	64,567	65,289	66,025	66,826	67,641
Orange	422,625	428,232	439,765	451,612	463,353	476,177	489,639	504,280	519,899	536,965	555,150
Placer	50,635	51,452	51,997	51,997	53,007	54,051	55,108	56,305	57,579	59,029	60,442
Riverside	464,978	473,209	478,324	478,326	485,043	492,814	500,067	508,396	516,988	525,222	534,639
Sacramento	209,326	212,361	215,999	216,001	219,872	224,016	228,487	233,260	238,264	243,538	249,353
San Bernardino	452,555	458,334	463,243	463,256	470,135	478,039	485,322	493,892	502,137	511,684	521,369
San Diego	504,317	556,617	563,065	587,704	609,480	631,123	655,047	681,227	708,925	739,749	771,298
San Francisco	89,076	90,546	92,568	92,568	95,617	98,729	102,108	105,751	109,251	113,215	117,607
San Joaquin	126,604	128,156	129,867	129,868	131,982	133,980	136,156	138,544	140,910	143,856	146,767
San Luis Obispo	38,814	39,385	39,929	39,929	40,786	41,644	42,629	43,657	44,745	46,067	47,272
San Mateo	81,904	83,451	85,171	85,171	87,741	90,702	93,394	96,488	99,841	103,342	106,892
Santa Barbara	61,412	62,213	63,270	63,270	64,868	66,643	68,461	70,620	72,804	74,953	77,382
Santa Clara	208,929	213,814	218,566	218,660	224,456	231,029	237,687	244,513	252,040	260,045	268,987
Santa Cruz	28,343	29,146	29,900	29,900	30,926	32,047	33,206	34,474	35,895	37,445	39,137
Solano	58,042	58,728	59,431	59,454	60,362	61,337	62,286	63,342	64,419	65,624	66,832
Sonoma	55,465	56,398	57,381	58,355	59,844	61,368	63,059	64,842	66,740	68,843	71,171
Ventura	132,262	135,570	138,202	138,203	141,058	143,870	147,117	150,389	154,212	157,886	162,001

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:											
	1/10	1/11	1/12	1/13	1/15				1/17				1/19			
Alameda	172,987	176,511	180,331	180,332	190,057	(38,011)	[9,123]	{4,561}	201,793	(40,359)	[9,686]	{4,843}	214,564	(42,913)	[10,299]	{5,150}
Contra Costa	135,280	137,739	139,908	139,908	147,479	(29,496)	[7,079]	{3,539}	156,257	(31,251)	[7,500]	{3,750}	166,297	(33,259)	[7,982]	{3,991}
Fresno	175,904	177,820	179,627	179,628	183,837	(36,767)	[8,824]	{4,412}	188,747	(37,749)	[9,060]	{4,530}	194,279	(38,856)	[9,325]	{4,663}
Kern	174,442	175,585	177,220	179,110	183,347	(36,669)	[8,801]	{4,400}	188,305	(37,661)	[9,039]	{4,519}	194,116	(38,823)	[9,318]	{4,659}
Lake	7,740	7,820	7,861	7,861	8,046	(1,609)	[386]	{193}	8,260	(1,652)	[396]	{198}	8,511	(1,702)	[409]	{204}
Los Angeles	2,010,964	2,046,208	2,086,581	2,131,523	2,236,587	(447,317)	[107,356]	{53,678}	2,352,970	(470,594)	[112,943]	{56,471}	2,484,254	(496,851)	[119,244]	{59,622}
Marin	25,347	25,711	26,028	26,028	27,169	(5,434)	[1,304]	{652}	28,452	(5,690)	[1,366]	{683}	29,871	(5,974)	[1,434]	{717}
Monterey	61,515	61,947	62,560	62,561	63,853	(12,771)	[3,065]	{1,532}	65,289	(13,058)	[3,134]	{1,567}	66,826	(13,365)	[3,208]	{1,604}
Orange	422,625	428,232	439,765	451,612	476,177	(95,235)	[22,857]	{11,428}	504,280	(100,856)	[24,205]	{12,103}	536,965	(107,393)	[25,774]	{12,887}
Placer	50,635	51,452	51,997	51,997	54,051	(10,810)	[2,594]	{1,297}	56,305	(11,261)	[2,703]	{1,351}	59,029	(11,806)	[2,833]	{1,417}
Riverside	464,978	473,209	478,324	478,326	492,814	(98,563)	[23,655]	{11,828}	508,396	(101,679)	[24,403]	{12,202}	525,222	(105,044)	[25,211]	{12,605}
Sacramento	209,326	212,361	215,999	216,001	224,016	(44,803)	[10,753]	{5,376}	233,260	(46,652)	[11,196]	{5,598}	243,538	(48,708)	[11,690]	{5,845}
San Bernardino	452,555	458,334	463,243	463,256	478,039	(95,608)	[22,946]	{11,473}	493,892	(98,778)	[23,707]	{11,853}	511,684	(102,337)	[24,561]	{12,280}
San Diego	504,317	556,617	563,065	587,704	631,123	(126,225)	[30,294]	{15,147}	681,227	(136,245)	[32,699]	{16,349}	739,749	(147,950)	[35,508]	{17,754}
San Francisco	89,076	90,546	92,568	92,568	98,729	(19,746)	[4,739]	{2,369}	105,751	(21,150)	[5,076]	{2,538}	113,215	(22,643)	[5,434]	{2,717}
San Joaquin	126,604	128,156	129,867	129,868	133,980	(26,796)	[6,431]	{3,216}	138,544	(27,709)	[6,650]	{3,325}	143,856	(28,771)	[6,905]	{3,453}
San Luis Obispo	38,814	39,385	39,929	39,929	41,644	(8,329)	[1,999]	{999}	43,657	(8,731)	[2,096]	{1,048}	46,067	(9,213)	[2,211]	{1,106}
San Mateo	81,904	83,451	85,171	85,171	90,702	(18,140)	[4,354]	{2,177}	96,488	(19,298)	[4,631]	{2,316}	103,342	(20,668)	[4,960]	{2,480}
Santa Barbara	61,412	62,213	63,270	63,270	66,643	(13,329)	[3,199]	{1,599}	70,620	(14,124)	[3,390]	{1,695}	74,953	(14,991)	[3,598]	{1,799}
Santa Clara	208,929	213,814	218,566	218,660	231,029	(46,206)	[11,089]	{5,545}	244,513	(48,903)	[11,737]	{5,868}	260,045	(52,009)	[12,482]	{6,241}
Santa Cruz	28,343	29,146	29,900	29,900	32,047	(6,409)	[1,538]	{769}	34,474	(6,895)	[1,655]	{827}	37,445	(7,489)	[1,797]	{899}
Solano	58,042	58,728	59,431	59,454	61,337	(12,267)	[2,944]	{1,472}	63,342	(12,668)	[3,040]	{1,520}	65,624	(13,125)	[3,150]	{1,575}
Sonoma	55,465	56,398	57,381	58,355	61,368	(12,274)	[2,946]	{1,473}	64,842	(12,968)	[3,112]	{1,556}	68,843	(13,769)	[3,304]	{1,652}
Ventura	132,262	135,570	138,202	138,203	143,870	(28,774)	[6,906]	{3,453}	150,389	(30,078)	[7,219]	{3,609}	157,886	(31,577)	[7,579]	{3,789}

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.