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

Date: 1/24/22

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 1/24/22 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.

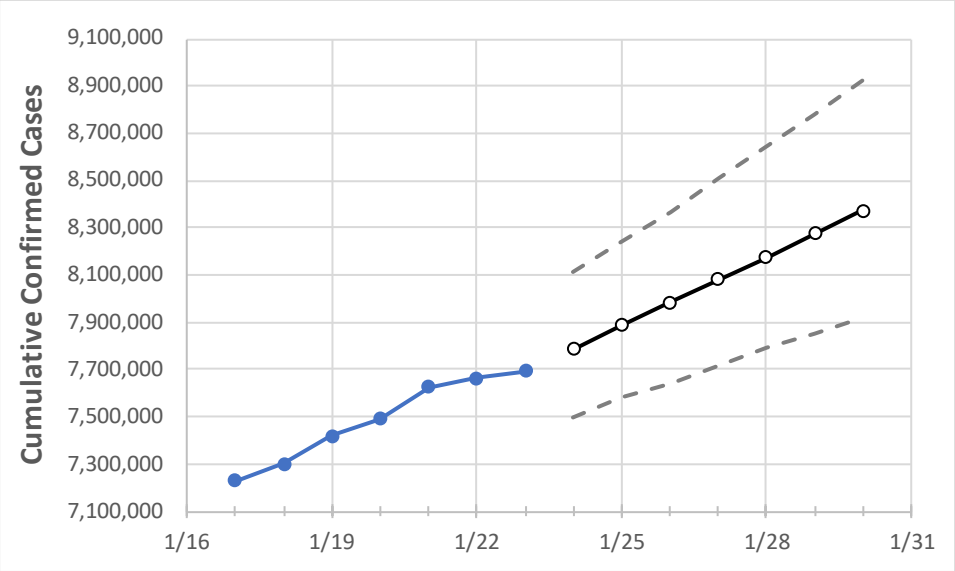
IEM's Modeling Lead

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:						
	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30
California	7,488,875	7,624,185	7,664,368	7,691,930	7,788,209	7,885,692	7,983,376	8,080,383	8,174,014	8,277,150	8,371,042

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:						
	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30
Alameda	210,751	214,939	214,939	214,939	218,311	222,762	226,196	230,270	234,017	238,228	242,442
Contra Costa	160,241	162,809	162,809	162,809	165,051	167,458	169,746	172,253	174,413	176,895	179,328
Fresno	197,314	201,080	201,080	201,080	204,114	207,044	210,222	213,395	216,865	220,247	224,108
Kern	193,774	196,125	196,125	196,125	198,993	201,934	205,061	208,370	211,691	215,190	218,916
Lake	8,597	8,639	8,639	8,639	8,709	8,780	8,852	8,918	8,998	9,065	9,137
Los Angeles	2,385,721	2,428,744	2,467,797	2,494,097	2,531,851	2,570,363	2,607,699	2,645,595	2,682,897	2,721,180	2,759,083
Marin	29,968	30,486	30,486	30,486	30,866	31,241	31,597	31,956	32,352	32,714	33,082
Monterey	69,758	70,370	70,370	70,370	70,977	71,558	72,158	72,746	73,353	73,957	74,510
Orange	498,022	509,891	509,891	509,891	518,506	527,428	536,243	545,416	554,272	563,516	572,632
Placer	57,362	58,374	58,374	58,374	59,144	59,873	60,622	61,354	62,160	62,949	63,880
Riverside	525,134	535,126	535,126	535,126	542,186	549,351	556,733	563,818	572,044	580,042	587,168
Sacramento	243,607	247,778	247,778	247,778	250,930	254,406	257,881	261,379	264,727	268,550	271,781
San Bernardino	506,485	513,848	513,848	513,848	519,005	525,007	530,811	536,589	542,448	548,521	554,360
San Diego	653,373	667,568	667,568	667,568	683,042	698,694	714,086	730,717	747,505	765,346	783,327
San Francisco	108,273	109,859	109,859	109,859	111,680	113,246	114,900	116,744	118,365	120,370	121,844
San Joaquin	144,415	146,726	146,726	146,726	148,711	150,927	152,733	154,740	157,084	159,323	161,429
San Luis Obispo	44,277	45,057	45,057	45,057	45,553	46,182	46,697	47,283	47,861	48,428	49,019
San Mateo	100,004	101,729	101,729	101,729	103,297	104,866	106,250	108,009	109,394	110,929	112,579
Santa Barbara	72,210	72,722	72,722	72,722	73,765	74,782	75,871	76,801	77,904	79,083	80,099
Santa Clara	253,711	257,994	257,994	257,994	261,957	267,041	270,790	275,148	279,686	284,104	288,689
Santa Cruz	35,236	35,593	35,593	35,593	36,255	36,987	37,696	38,390	39,134	39,864	40,617
Solano	66,448	67,327	67,327	67,327	68,151	68,982	69,841	70,765	71,590	72,493	73,376
Sonoma	66,259	67,646	68,776	70,038	71,194	72,464	73,691	74,996	76,305	77,665	78,900
Ventura	151,651	155,655	155,655	155,655	157,627	159,705	161,638	163,898	165,874	167,921	169,982

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:		
	1/20	1/21	1/22	1/23	1/25	1/27	1/29
Alameda	210,751	214,939	214,939	214,939	222,762 (44,552) [10,693] {5,346}	230,270 (46,054) [11,053] {5,526}	238,228 (47,646) [11,435] {5,717}
Contra Costa	160,241	162,809	162,809	162,809	167,458 (33,492) [8,038] {4,019}	172,253 (34,451) [8,268] {4,134}	176,895 (35,379) [8,491] {4,245}
Fresno	197,314	201,080	201,080	201,080	207,044 (41,409) [9,938] {4,969}	213,395 (42,679) [10,243] {5,121}	220,247 (44,049) [10,572] {5,286}
Kern	193,774	196,125	196,125	196,125	201,934 (40,387) [9,693] {4,846}	208,370 (41,674) [10,002] {5,001}	215,190 (43,038) [10,329] {5,165}
Lake	8,597	8,639	8,639	8,639	8,780 (1,756) [421] {211}	8,918 (1,784) [428] {214}	9,065 (1,813) [435] {218}
Los Angeles	2,385,721	2,428,744	2,467,797	2,494,097	2,570,363 (514,073) [123,377] {61,689}	2,645,595 (529,119) [126,989] {63,494}	2,721,180 (544,236) [130,617] {65,308}
Marin	29,968	30,486	30,486	30,486	31,241 (6,248) [1,500] {750}	31,956 (6,391) [1,534] {767}	32,714 (6,543) [1,570] {785}
Monterey	69,758	70,370	70,370	70,370	71,558 (14,312) [3,435] {1,717}	72,746 (14,549) [3,492] {1,746}	73,957 (14,791) [3,550] {1,775}
Orange	498,022	509,891	509,891	509,891	527,428 (105,486) [25,317] {12,658}	545,416 (109,083) [26,180] {13,090}	563,516 (112,703) [27,049] {13,524}
Placer	57,362	58,374	58,374	58,374	59,873 (11,975) [2,874] {1,437}	61,354 (12,271) [2,945] {1,472}	62,949 (12,590) [3,022] {1,511}
Riverside	525,134	535,126	535,126	535,126	549,351 (109,870) [26,369] {13,184}	563,818 (112,764) [27,063] {13,532}	580,042 (116,008) [27,842] {13,921}
Sacramento	243,607	247,778	247,778	247,778	254,406 (50,881) [12,211] {6,106}	261,379 (52,276) [12,546] {6,273}	268,550 (53,710) [12,890] {6,445}
San Bernardino	506,485	513,848	513,848	513,848	525,007 (105,001) [25,200] {12,600}	536,589 (107,318) [25,756] {12,878}	548,521 (109,704) [26,329] {13,165}
San Diego	653,373	667,568	667,568	667,568	698,694 (139,739) [33,537] {16,769}	730,717 (146,143) [35,074] {17,537}	765,346 (153,069) [36,737] {18,368}
San Francisco	108,273	109,859	109,859	109,859	113,246 (22,649) [5,436] {2,718}	116,744 (23,349) [5,604] {2,802}	120,370 (24,074) [5,778] {2,889}
San Joaquin	144,415	146,726	146,726	146,726	150,927 (30,185) [7,245] {3,622}	154,740 (30,948) [7,428] {3,714}	159,323 (31,865) [7,647] {3,824}
San Luis Obispo	44,277	45,057	45,057	45,057	46,182 (9,236) [2,217] {1,108}	47,283 (9,457) [2,270] {1,135}	48,428 (9,686) [2,325] {1,162}
San Mateo	100,004	101,729	101,729	101,729	104,866 (20,973) [5,034] {2,517}	108,009 (21,602) [5,184] {2,592}	110,929 (22,186) [5,325] {2,662}
Santa Barbara	72,210	72,722	72,722	72,722	74,782 (14,956) [3,590] {1,795}	76,801 (15,360) [3,686] {1,843}	79,083 (15,817) [3,796] {1,898}
Santa Clara	253,711	257,994	257,994	257,994	267,041 (53,408) [12,818] {6,409}	275,148 (55,030) [13,207] {6,604}	284,104 (56,821) [13,637] {6,819}
Santa Cruz	35,236	35,593	35,593	35,593	36,987 (7,397) [1,775] {888}	38,390 (7,678) [1,843] {921}	39,864 (7,973) [1,913] {957}
Solano	66,448	67,327	67,327	67,327	68,982 (13,796) [3,311] {1,656}	70,765 (14,153) [3,397] {1,698}	72,493 (14,499) [3,480] {1,740}
Sonoma	66,259	67,646	68,776	70,038	72,464 (14,493) [3,478] {1,739}	74,996 (14,999) [3,600] {1,800}	77,665 (15,533) [3,728] {1,864}
Ventura	151,651	155,655	155,655	155,655	159,705 (31,941) [7,666] {3,833}	163,898 (32,780) [7,867] {3,934}	167,921 (33,584) [8,060] {4,030}

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.