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

Date: 1/10/22

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 1/10/22 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.

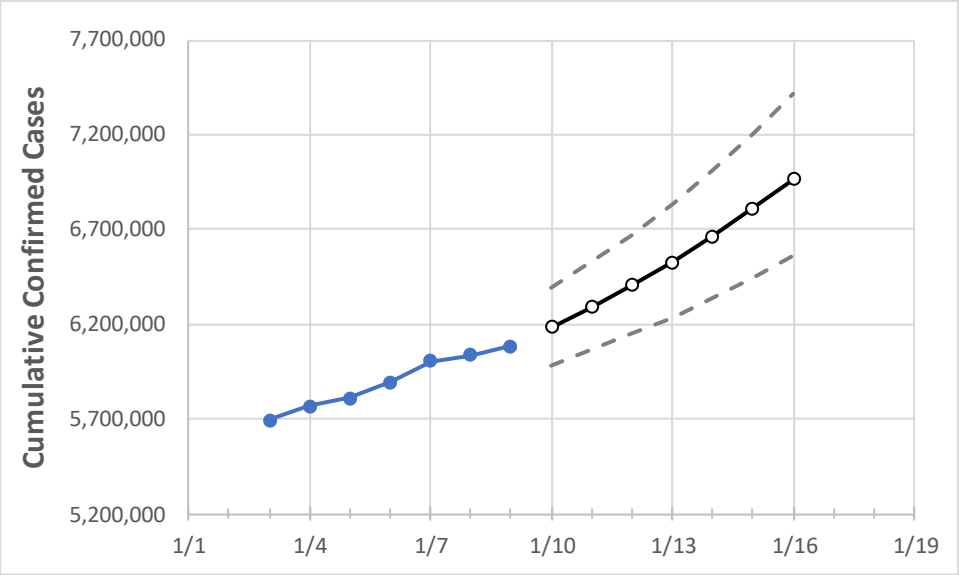
IEM's Modeling Lead

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
California	5,894,761	6,003,152	6,037,516	6,085,177	6,183,992	6,288,245	6,404,614	6,528,024	6,664,643	6,812,882	6,967,640

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
Alameda	149,601	153,337	153,337	153,337	157,385	161,703	166,290	171,535	177,334	183,684	190,430
Contra Costa	120,422	123,141	123,141	123,141	125,846	128,813	132,025	135,598	139,507	143,821	148,566
Fresno	166,504	168,865	168,865	168,865	169,966	171,128	172,402	173,753	175,138	176,688	178,306
Kern	167,686	169,213	169,213	169,213	170,077	170,994	171,910	172,949	173,972	175,093	176,253
Lake	7,326	7,406	7,406	7,406	7,445	7,488	7,529	7,575	7,626	7,679	7,732
Los Angeles	1,843,922	1,887,526	1,921,890	1,967,443	2,015,377	2,067,164	2,124,076	2,185,128	2,251,402	2,323,867	2,401,554
Marin	22,830	23,378	23,378	23,378	23,919	24,498	25,110	25,764	26,478	27,257	28,111
Monterey	57,127	57,607	57,607	57,607	58,116	58,659	59,264	59,886	60,574	61,319	62,122
Orange	389,985	397,186	397,186	397,186	407,065	417,986	429,868	443,066	457,539	473,692	491,502
Placer	46,908	47,624	47,624	47,624	48,152	48,700	49,306	49,926	50,609	51,345	52,115
Riverside	433,749	441,087	441,087	441,087	446,725	452,695	459,167	466,096	473,299	481,038	489,695
Sacramento	188,718	192,348	192,348	192,348	195,143	198,199	201,410	205,005	208,765	212,884	217,189
San Bernardino	418,718	425,119	425,119	425,119	430,242	435,952	441,919	448,207	455,081	462,282	470,043
San Diego	492,713	498,384	498,384	498,384	509,467	521,166	533,685	547,531	562,473	578,705	595,884
San Francisco	75,894	78,149	78,149	78,149	80,806	83,770	87,028	90,570	94,359	98,582	103,197
San Joaquin	116,957	118,974	118,974	118,974	120,331	121,816	123,394	125,085	126,951	129,044	131,248
San Luis Obispo	35,764	36,187	36,187	36,187	36,675	37,189	37,718	38,304	38,944	39,621	40,335
San Mateo	70,563	72,463	72,463	72,463	74,933	77,662	80,632	83,914	87,592	91,689	96,109
Santa Barbara	55,039	56,574	56,574	56,574	57,817	59,206	60,662	62,274	64,037	65,968	68,058
Santa Clara	183,551	188,711	188,711	188,711	194,202	200,280	206,941	214,258	222,376	231,293	240,995
Santa Cruz	25,689	25,973	25,973	25,973	26,377	26,801	27,259	27,759	28,293	28,878	29,489
Solano	53,216	54,163	54,163	54,163	55,010	55,905	56,890	57,928	59,096	60,373	61,741
Sonoma	49,868	50,878	51,932	52,986	54,036	55,185	56,424	57,800	59,305	60,946	62,692
Ventura	119,970	122,447	122,447	122,447	124,652	126,961	129,464	132,102	135,080	138,228	141,665

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:		
	1/6	1/7	1/8	1/9	1/11	1/13	1/15
Alameda	149,601	153,337	153,337	153,337	161,703 (32,341) [7,762] {3,881}	171,535 (34,307) [8,234] {4,117}	183,684 (36,737) [8,817] {4,408}
Contra Costa	120,422	123,141	123,141	123,141	128,813 (25,763) [6,183] {3,092}	135,598 (27,120) [6,509] {3,254}	143,821 (28,764) [6,903] {3,452}
Fresno	166,504	168,865	168,865	168,865	171,128 (34,226) [8,214] {4,107}	173,753 (34,751) [8,340] {4,170}	176,688 (35,338) [8,481] {4,241}
Kern	167,686	169,213	169,213	169,213	170,994 (34,199) [8,208] {4,104}	172,949 (34,590) [8,302] {4,151}	175,093 (35,019) [8,404] {4,202}
Lake	7,326	7,406	7,406	7,406	7,488 (1,498) [359] {180}	7,575 (1,515) [364] {182}	7,679 (1,536) [369] {184}
Los Angeles	1,843,922	1,887,526	1,921,890	1,967,443	2,067,164 (413,433) [99,224] {49,612}	2,185,128 (437,026) [104,886] {52,443}	2,323,867 (464,773) [111,546] {55,773}
Marin	22,830	23,378	23,378	23,378	24,498 (4,900) [1,176] {588}	25,764 (5,153) [1,237] {618}	27,257 (5,451) [1,308] {654}
Monterey	57,127	57,607	57,607	57,607	58,659 (11,732) [2,816] {1,408}	59,886 (11,977) [2,875] {1,437}	61,319 (12,264) [2,943] {1,472}
Orange	389,985	397,186	397,186	397,186	417,986 (83,597) [20,063] {10,032}	443,066 (88,613) [21,267] {10,634}	473,692 (94,738) [22,737] {11,369}
Placer	46,908	47,624	47,624	47,624	48,700 (9,740) [2,338] {1,169}	49,926 (9,985) [2,396] {1,198}	51,345 (10,269) [2,465] {1,232}
Riverside	433,749	441,087	441,087	441,087	452,695 (90,539) [21,729] {10,865}	466,096 (93,219) [22,373] {11,186}	481,038 (96,208) [23,090] {11,545}
Sacramento	188,718	192,348	192,348	192,348	198,199 (39,640) [9,514] {4,757}	205,005 (41,001) [9,840] {4,920}	212,884 (42,577) [10,218] {5,109}
San Bernardino	418,718	425,119	425,119	425,119	435,952 (87,190) [20,926] {10,463}	448,207 (89,641) [21,514] {10,757}	462,282 (92,456) [22,190] {11,095}
San Diego	492,713	498,384	498,384	498,384	521,166 (104,233) [25,016] {12,508}	547,531 (109,506) [26,281] {13,141}	578,705 (115,741) [27,778] {13,889}
San Francisco	75,894	78,149	78,149	78,149	83,770 (16,754) [4,021] {2,010}	90,570 (18,114) [4,347] {2,174}	98,582 (19,716) [4,732] {2,366}
San Joaquin	116,957	118,974	118,974	118,974	121,816 (24,363) [5,847] {2,924}	125,085 (25,017) [6,004] {3,002}	129,044 (25,809) [6,194] {3,097}
San Luis Obispo	35,764	36,187	36,187	36,187	37,189 (7,438) [1,785] {893}	38,304 (7,661) [1,839] {919}	39,621 (7,924) [1,902] {951}
San Mateo	70,563	72,463	72,463	72,463	77,662 (15,532) [3,728] {1,864}	83,914 (16,783) [4,028] {2,014}	91,689 (18,338) [4,401] {2,201}
Santa Barbara	55,039	56,574	56,574	56,574	59,206 (11,841) [2,842] {1,421}	62,274 (12,455) [2,989] {1,495}	65,968 (13,194) [3,166] {1,583}
Santa Clara	183,551	188,711	188,711	188,711	200,280 (40,056) [9,613] {4,807}	214,258 (42,852) [10,284] {5,142}	231,293 (46,259) [11,102] {5,551}
Santa Cruz	25,689	25,973	25,973	25,973	26,801 (5,360) [1,286] {643}	27,759 (5,552) [1,332] {666}	28,878 (5,776) [1,386] {693}
Solano	53,216	54,163	54,163	54,163	55,905 (11,181) [2,683] {1,342}	57,928 (11,586) [2,781] {1,390}	60,373 (12,075) [2,898] {1,449}
Sonoma	49,868	50,878	51,932	52,986	55,185 (11,037) [2,649] {1,324}	57,800 (11,560) [2,774] {1,387}	60,946 (12,189) [2,925] {1,463}
Ventura	119,970	122,447	122,447	122,447	126,961 (25,392) [6,094] {3,047}	132,102 (26,420) [6,341] {3,170}	138,228 (27,646) [6,635] {3,317}

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.