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

Date: 1/20/21

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 1/20/21 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.

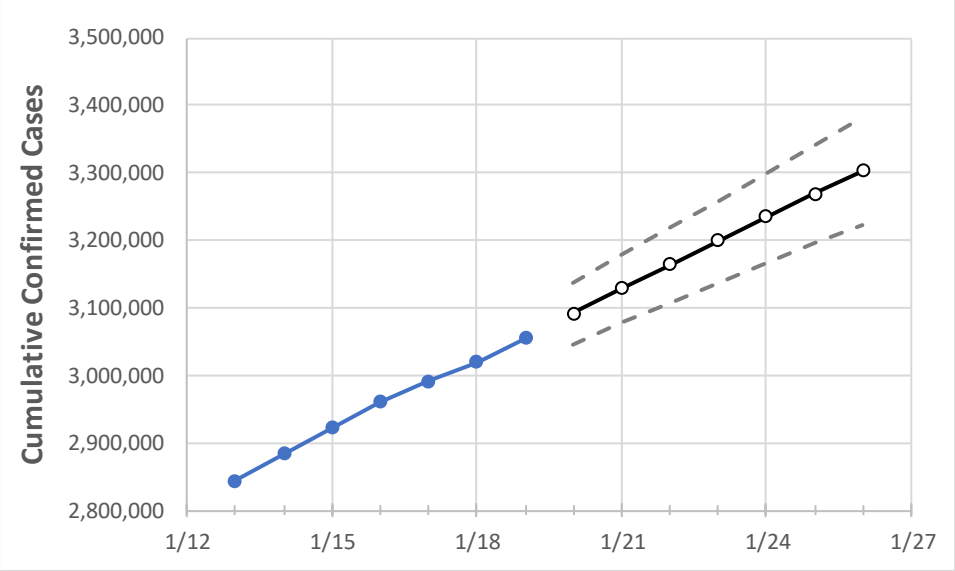
IEM's Modeling Lead

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
California	2,959,863	2,991,731	3,019,758	3,055,568	3,092,153	3,128,326	3,164,191	3,199,628	3,234,829	3,269,796	3,303,864

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
Alameda	65,679	68,016	67,375	67,952	69,144	70,337	71,567	72,848	74,177	75,514	76,893
Contra Costa	51,573	52,146	52,547	52,965	53,592	54,246	54,878	55,529	56,180	56,822	57,464
Fresno	79,950	81,294	82,039	82,485	83,371	84,253	85,152	86,069	86,949	87,851	88,747
Kern	84,644	85,362	86,188	86,718	87,591	88,465	89,328	90,168	90,998	91,807	92,617
Lake	2,434	2,504	2,572	2,612	2,696	2,786	2,879	2,976	3,078	3,186	3,301
Los Angeles	1,004,693	1,014,753	1,024,297	1,032,806	1,045,341	1,057,799	1,070,083	1,082,285	1,094,088	1,105,894	1,117,615
Marin	11,462	11,569	11,632	11,693	11,794	11,899	12,003	12,108	12,212	12,318	12,424
Monterey	35,418	35,654	35,890	36,126	36,442	36,759	37,084	37,402	37,714	38,018	38,320
Orange	209,365	210,813	212,389	214,808	217,631	220,416	223,209	225,938	228,691	231,495	234,122
Placer	16,878	16,995	17,194	17,380	17,549	17,712	17,880	18,046	18,210	18,368	18,527
Riverside	235,235	239,412	242,206	250,436	253,792	257,150	260,485	263,938	267,470	271,064	274,756
Sacramento	80,279	79,122	80,154	80,678	81,614	82,563	83,500	84,469	85,397	86,342	87,301
San Bernardino	248,285	251,213	254,094	256,109	259,028	262,020	265,008	268,027	270,987	274,055	277,133
San Diego	209,897	211,787	214,337	216,835	219,451	222,059	224,594	227,100	229,556	231,973	234,361
San Francisco	28,574	28,853	29,139	29,321	29,647	29,973	30,295	30,613	30,932	31,258	31,584
San Joaquin	56,563	56,642	57,094	58,290	58,888	59,495	60,075	60,670	61,260	61,863	62,451
San Luis Obispo	15,129	15,466	15,658	15,929	16,208	16,492	16,779	17,060	17,347	17,636	17,920
San Mateo	31,291	31,805	32,186	32,596	33,104	33,613	34,131	34,656	35,194	35,746	36,311
Santa Barbara	24,149	24,481	24,782	25,083	25,545	26,009	26,474	26,946	27,417	27,901	28,390
Santa Clara	91,466	92,625	93,557	94,366	95,613	96,888	98,164	99,436	100,711	101,951	103,183
Santa Cruz	11,776	12,026	12,196	12,298	12,476	12,648	12,825	12,996	13,179	13,351	13,523
Solano	24,693	24,732	25,216	25,806	26,113	26,419	26,729	27,032	27,334	27,624	27,912
Sonoma	23,261	23,607	23,871	24,068	24,360	24,652	24,943	25,238	25,543	25,845	26,139
Ventura	59,061	60,368	61,257	62,101	63,299	64,488	65,679	66,885	68,075	69,275	70,455

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:		
	1/16	1/17	1/18	1/19	1/21	1/23	1/25
Alameda	65,679	68,016	67,375	67,952	70,337 (14,067) [3,376] {1,688}	72,848 (14,570) [3,497] {1,748}	75,514 (15,103) [3,625] {1,812}
Contra Costa	51,573	52,146	52,547	52,965	54,246 (10,849) [2,604] {1,302}	55,529 (11,106) [2,665] {1,333}	56,822 (11,364) [2,727] {1,364}
Fresno	79,950	81,294	82,039	82,485	84,253 (16,851) [4,044] {2,022}	86,069 (17,214) [4,131] {2,066}	87,851 (17,570) [4,217] {2,108}
Kern	84,644	85,362	86,188	86,718	88,465 (17,693) [4,246] {2,123}	90,168 (18,034) [4,328] {2,164}	91,807 (18,361) [4,407] {2,203}
Lake	2,434	2,504	2,572	2,612	2,786 (557) [134] {67}	2,976 (595) [143] {71}	3,186 (637) [153] {76}
Los Angeles	1,004,693	1,014,753	1,024,297	1,032,806	1,057,799 (211,560) [50,774] {25,387}	1,082,285 (216,457) [51,950] {25,975}	1,105,894 (221,179) [53,083] {26,541}
Marin	11,462	11,569	11,632	11,693	11,899 (2,380) [571] {286}	12,108 (2,422) [581] {291}	12,318 (2,464) [591] {296}
Monterey	35,418	35,654	35,890	36,126	36,759 (7,352) [1,764] {882}	37,402 (7,480) [1,795] {898}	38,018 (7,604) [1,825] {912}
Orange	209,365	210,813	212,389	214,808	220,416 (44,083) [10,580] {5,290}	225,938 (45,188) [10,845] {5,423}	231,495 (46,299) [11,112] {5,556}
Placer	16,878	16,995	17,194	17,380	17,712 (3,542) [850] {425}	18,046 (3,609) [866] {433}	18,368 (3,674) [882] {441}
Riverside	235,235	239,412	242,206	250,436	257,150 (51,430) [12,343] {6,172}	263,938 (52,788) [12,669] {6,335}	271,064 (54,213) [13,011] {6,506}
Sacramento	80,279	79,122	80,154	80,678	82,563 (16,513) [3,963] {1,982}	84,469 (16,894) [4,055] {2,027}	86,342 (17,268) [4,144] {2,072}
San Bernardino	248,285	251,213	254,094	256,109	262,020 (52,404) [12,577] {6,288}	268,027 (53,605) [12,865] {6,433}	274,055 (54,811) [13,155] {6,577}
San Diego	209,897	211,787	214,337	216,835	222,059 (44,412) [10,659] {5,329}	227,100 (45,420) [10,901] {5,450}	231,973 (46,395) [11,135] {5,567}
San Francisco	28,574	28,853	29,139	29,321	29,973 (5,995) [1,439] {719}	30,613 (6,123) [1,469] {735}	31,258 (6,252) [1,500] {750}
San Joaquin	56,563	56,642	57,094	58,290	59,495 (11,899) [2,856] {1,428}	60,670 (12,134) [2,912] {1,456}	61,863 (12,373) [2,969] {1,485}
San Luis Obispo	15,129	15,466	15,658	15,929	16,492 (3,298) [792] {396}	17,060 (3,412) [819] {409}	17,636 (3,527) [847] {423}
San Mateo	31,291	31,805	32,186	32,596	33,613 (6,723) [1,613] {807}	34,656 (6,931) [1,663] {832}	35,746 (7,149) [1,716] {858}
Santa Barbara	24,149	24,481	24,782	25,083	26,009 (5,202) [1,248] {624}	26,946 (5,389) [1,293] {647}	27,901 (5,580) [1,339] {670}
Santa Clara	91,466	92,625	93,557	94,366	96,888 (19,378) [4,651] {2,325}	99,436 (19,887) [4,773] {2,386}	101,951 (20,390) [4,894] {2,447}
Santa Cruz	11,776	12,026	12,196	12,298	12,648 (2,530) [607] {304}	12,996 (2,599) [624] {312}	13,351 (2,670) [641] {320}
Solano	24,693	24,732	25,216	25,806	26,419 (5,284) [1,268] {634}	27,032 (5,406) [1,298] {649}	27,624 (5,525) [1,326] {663}
Sonoma	23,261	23,607	23,871	24,068	24,652 (4,930) [1,183] {592}	25,238 (5,048) [1,211] {606}	25,845 (5,169) [1,241] {620}
Ventura	59,061	60,368	61,257	62,101	64,488 (12,898) [3,095] {1,548}	66,885 (13,377) [3,210] {1,605}	69,275 (13,855) [3,325] {1,663}

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.