IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/28/22

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 <u>not</u> 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 1/28/22 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
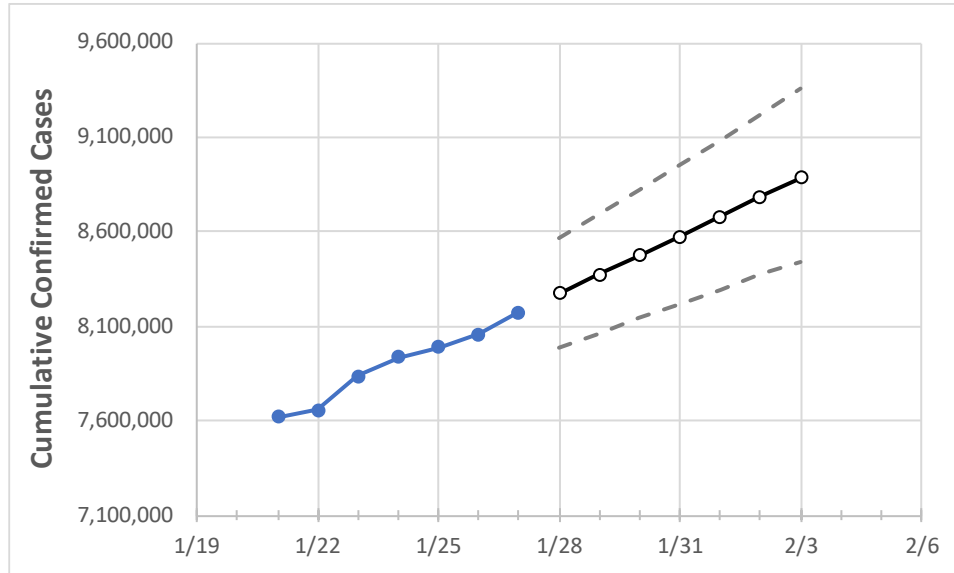
	Actual Confirmed Cases On:				Projected Cases For:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
California	7,937,896	7,991,072	8,057,587	8,174,883	8,275,515	8,376,160	8,474,253	8,576,566	8,678,266	8,784,702	8,884,643

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:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
Alameda	227,260	227,264	230,765	235,503	238,839	242,120	245,598	248,942	252,868	256,349	259,822
Contra Costa	170,857	170,859	172,490	176,554	178,791	181,015	183,261	185,483	187,637	190,055	192,159
Fresno	211,879	211,880	214,050	217,179	220,235	223,121	226,163	229,287	232,473	235,813	239,034
Kern	203,066	204,686	207,114	208,859	211,606	214,302	217,048	219,964	222,772	225,793	229,006
Lake	9,006	9,066	9,126	9,475	9,591	9,713	9,836	9,960	10,099	10,231	10,373
Los Angeles	2,519,778	2,540,075	2,560,768	2,586,739	2,619,233	2,650,310	2,681,633	2,712,861	2,743,584	2,774,296	2,804,989
Marin	31,893	31,894	32,182	32,777	33,139	33,497	33,867	34,226	34,566	34,950	35,310
Monterey	73,302	73,307	73,830	78,920	80,050	81,242	82,364	83,648	84,965	86,310	87,559
Orange	528,530	531,196	533,836	538,115	544,678	550,899	557,449	563,632	569,835	576,301	582,692
Placer	60,749	60,750	61,282	62,166	62,862	63,527	64,146	64,828	65,540	66,173	66,856
Riverside	557,519	557,521	562,282	566,883	572,924	579,098	584,490	591,086	596,713	602,708	609,101
Sacramento	259,090	259,094	262,040	268,215	271,565	274,810	278,307	281,632	284,637	288,177	291,623
San Bernardino	534,230	534,243	537,789	542,214	546,927	551,804	556,982	561,856	566,383	571,012	576,033
San Diego	678,879	702,244	708,774	719,436	730,240	740,691	751,569	762,714	773,704	784,604	795,733
San Francisco	115,037	115,039	115,875	118,443	119,810	121,261	122,722	124,088	125,617	126,996	128,415
San Joaquin	154,444	154,446	155,733	157,929	159,805	161,672	163,598	165,693	167,608	169,542	171,409
San Luis Obispo	47,518	47,519	48,033	48,980	49,597	50,221	50,805	51,457	52,075	52,769	53,398
San Mateo	107,256	107,257	108,299	112,765	114,370	116,138	117,664	119,164	120,944	122,676	124,290
Santa Barbara	77,033	77,443	77,853	79,395	80,459	81,526	82,531	83,533	84,612	85,669	86,732
Santa Clara	274,127	274,130	276,820	281,662	285,833	289,752	293,791	297,770	301,666	306,187	310,071
Santa Cruz	39,040	39,371	39,702	40,194	40,960	41,698	42,430	43,147	43,942	44,744	45,541
Solano	71,516	71,539	72,102	73,482	74,429	75,398	76,408	77,364	78,335	79,406	80,413
Sonoma	72,262	72,263	73,163	74,273	75,397	76,610	77,662	78,873	80,075	81,334	82,439
Ventura	163,463	163,464	164,884	166,353	168,265	169,966	171,615	173,352	175,044	176,853	178,582

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:		
	1/24	1/25	1/26	1/27	1/29	1/31	2/2
Alameda	227,260	227,264	230,765	235,503	242,120 (48,424) [11,622] {5,811}	248,942 (49,788) [11,949] {5,975}	256,349 (51,270) [12,305] {6,152}
Contra Costa	170,857	170,859	172,490	176,554	181,015 (36,203) [8,689] {4,344}	185,483 (37,097) [8,903] {4,452}	190,055 (38,011) [9,123] {4,561}
Fresno	211,879	211,880	214,050	217,179	223,121 (44,624) [10,710] {5,355}	229,287 (45,857) [11,006] {5,503}	235,813 (47,163) [11,319] {5,660}
Kern	203,066	204,686	207,114	208,859	214,302 (42,860) [10,287] {5,143}	219,964 (43,993) [10,558] {5,279}	225,793 (45,159) [10,838] {5,419}
Lake	9,006	9,066	9,126	9,475	9,713 (1,943) [466] {233}	9,960 (1,992) [478] {239}	10,231 (2,046) [491] {246}
Los Angeles	2,519,778	2,540,075	2,560,768	2,586,739	2,650,310 (530,062) [127,215] {63,607}	2,712,861 (542,572) [130,217] {65,109}	2,774,296 (554,859) [133,166] {66,583}
Marin	31,893	31,894	32,182	32,777	33,497 (6,699) [1,608] {804}	34,226 (6,845) [1,643] {821}	34,950 (6,990) [1,678] {839}
Monterey	73,302	73,307	73,830	78,920	81,242 (16,248) [3,900] {1,950}	83,648 (16,730) [4,015] {2,008}	86,310 (17,262) [4,143] {2,071}
Orange	528,530	531,196	533,836	538,115	550,899 (110,180) [26,443] {13,222}	563,632 (112,726) [27,054] {13,527}	576,301 (115,260) [27,662] {13,831}
Placer	60,749	60,750	61,282	62,166	63,527 (12,705) [3,049] {1,525}	64,828 (12,966) [3,112] {1,556}	66,173 (13,235) [3,176] {1,588}
Riverside	557,519	557,521	562,282	566,883	579,098 (115,820) [27,797] {13,898}	591,086 (118,217) [28,372] {14,186}	602,708 (120,542) [28,930] {14,465}
Sacramento	259,090	259,094	262,040	268,215	274,810 (54,962) [13,191] {6,595}	281,632 (56,326) [13,518] {6,759}	288,177 (57,635) [13,833] {6,916}
San Bernardino	534,230	534,243	537,789	542,214	551,804 (110,361) [26,487] {13,243}	561,856 (112,371) [26,969] {13,485}	571,012 (114,202) [27,409] {13,704}
San Diego	678,879	702,244	708,774	719,436	740,691 (148,138) [35,553] {17,777}	762,714 (152,543) [36,610] {18,305}	784,604 (156,921) [37,661] {18,831}
San Francisco	115,037	115,039	115,875	118,443	121,261 (24,252) [5,821] {2,910}	124,088 (24,818) [5,956] {2,978}	126,996 (25,399) [6,096] {3,048}
San Joaquin	154,444	154,446	155,733	157,929	161,672 (32,334) [7,760] {3,880}	165,693 (33,139) [7,953] {3,977}	169,542 (33,908) [8,138] {4,069}
San Luis Obispo	47,518	47,519	48,033	48,980	50,221 (10,044) [2,411] {1,205}	51,457 (10,291) [2,470] {1,235}	52,769 (10,554) [2,533] {1,266}
San Mateo	107,256	107,257	108,299	112,765	116,138 (23,228) [5,575] {2,787}	119,164 (23,833) [5,720] {2,860}	122,676 (24,535) [5,888] {2,944}
Santa Barbara	77,033	77,443	77,853	79,395	81,526 (16,305) [3,913] {1,957}	83,533 (16,707) [4,010] {2,005}	85,669 (17,134) [4,112] {2,056}
Santa Clara	274,127	274,130	276,820	281,662	289,752 (57,950) [13,908] {6,954}	297,770 (59,554) [14,293] {7,146}	306,187 (61,237) [14,697] {7,348}
Santa Cruz	39,040	39,371	39,702	40,194	41,698 (8,340) [2,002] {1,001}	43,147 (8,629) [2,071] {1,036}	44,744 (8,949) [2,148] {1,074}
Solano	71,516	71,539	72,102	73,482	75,398 (15,080) [3,619] {1,810}	77,364 (15,473) [3,713] {1,857}	79,406 (15,881) [3,811] {1,906}
Sonoma	72,262	72,263	73,163	74,273	76,610 (15,322) [3,677] {1,839}	78,873 (15,775) [3,786] {1,893}	81,334 (16,267) [3,904] {1,952}
Ventura	163,463	163,464	164,884	166,353	169,966 (33,993) [8,158] {4,079}	173,352 (34,670) [8,321] {4,160}	176,853 (35,371) [8,489] {4,244}

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.