IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/31/22

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 1/31/22 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
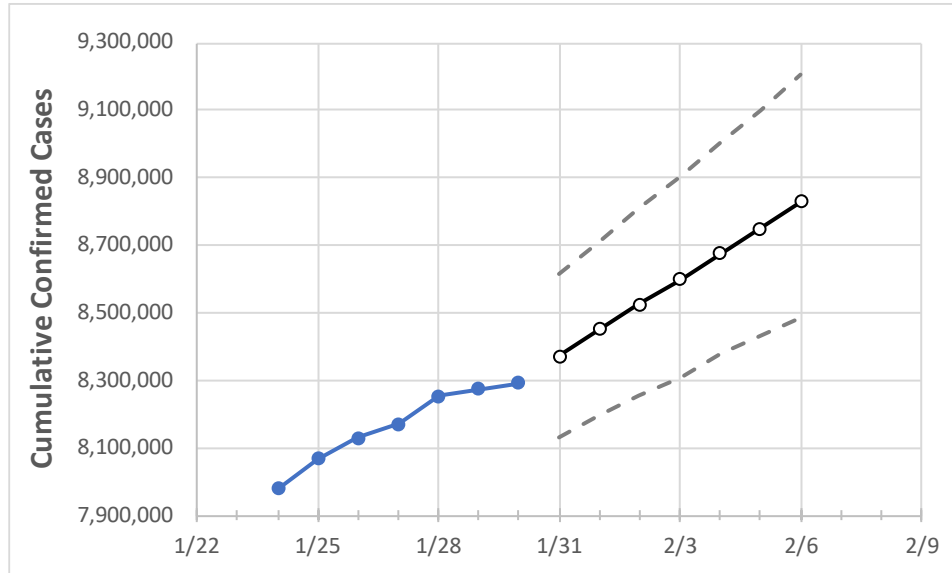
	Actual Confirmed Cases On:				Projected Cases For:						
	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6
California	8,171,803	8,253,359	8,275,373	8,292,735	8,370,928	8,451,163	8,524,519	8,599,334	8,675,962	8,749,522	8,829,414

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:						
	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6
Alameda	236,962	238,425	238,425	238,425	241,575	244,655	247,639	250,681	253,881	256,991	259,938
Contra Costa	177,569	178,585	178,585	178,585	180,507	182,526	184,355	186,304	188,228	190,215	192,247
Fresno	218,680	220,181	220,181	220,181	223,234	225,970	228,801	231,767	234,899	237,888	240,963
Kern	208,859	210,736	210,736	210,736	213,554	216,292	219,213	222,114	225,053	228,153	231,464
Lake	9,526	9,577	9,577	9,577	9,693	9,804	9,912	10,033	10,143	10,264	10,387
Los Angeles	2,586,739	2,610,385	2,631,994	2,648,751	2,675,889	2,702,791	2,728,285	2,754,162	2,779,527	2,804,635	2,829,258
Marin	32,939	33,101	33,101	33,101	33,475	33,787	34,108	34,441	34,776	35,101	35,425
Monterey	79,331	79,746	79,746	79,746	80,707	81,609	82,527	83,510	84,417	85,404	86,373
Orange	538,115	542,951	542,951	542,951	548,883	554,576	560,387	565,947	571,547	577,207	582,864
Placer	62,501	62,836	62,836	62,836	63,460	64,063	64,680	65,311	65,877	66,555	67,193
Riverside	569,049	571,216	571,216	571,216	576,740	582,290	587,874	592,998	598,305	604,421	609,988
Sacramento	269,570	270,929	270,929	270,929	273,989	277,227	280,050	282,969	286,383	289,097	292,287
San Bernardino	543,983	545,764	545,764	545,764	550,512	554,365	558,694	562,846	566,923	571,058	575,092
San Diego	719,436	726,071	726,071	726,071	736,220	747,370	758,410	768,783	779,347	790,722	801,780
San Francisco	118,988	119,534	119,534	119,534	120,782	121,934	123,097	124,278	125,467	126,634	127,731
San Joaquin	158,968	160,008	160,008	160,008	161,761	163,473	165,475	167,204	168,847	170,664	172,503
San Luis Obispo	49,309	49,638	49,638	49,638	50,235	50,847	51,450	52,016	52,630	53,244	53,894
San Mateo	113,410	114,055	114,055	114,055	115,341	116,741	117,938	119,110	120,492	121,802	123,066
Santa Barbara	79,894	80,393	80,393	80,393	81,401	82,459	83,360	84,330	85,340	86,310	87,406
Santa Clara	283,365	285,071	285,071	285,071	288,614	291,970	295,502	298,786	302,160	305,663	309,074
Santa Cruz	40,659	41,124	41,124	41,124	41,918	42,683	43,471	44,275	45,088	45,866	46,689
Solano	73,827	74,194	74,194	74,194	75,088	75,922	76,773	77,661	78,612	79,553	80,404
Sonoma	74,738	75,203	75,608	76,213	77,199	78,079	78,990	80,066	80,985	82,010	82,892
Ventura	167,047	167,742	167,742	167,742	169,471	171,089	172,669	174,290	176,060	177,670	179,213

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: | | |
	1/27	1/28	1/29	1/30	2/1	2/3	2/5
Alameda	236,962	238,425	238,425	238,425	244,655 (48,931) [11,743] {5,872}	250,681 (50,136) [12,033] {6,016}	256,991 (51,398) [12,336] {6,168}
Contra Costa	177,569	178,585	178,585	178,585	182,526 (36,505) [8,761] {4,381}	186,304 (37,261) [8,943] {4,471}	190,215 (38,043) [9,130] {4,565}
Fresno	218,680	220,181	220,181	220,181	225,970 (45,194) [10,847] {5,423}	231,767 (46,353) [11,125] {5,562}	237,888 (47,578) [11,419] {5,709}
Kern	208,859	210,736	210,736	210,736	216,292 (43,258) [10,382] {5,191}	222,114 (44,423) [10,661] {5,331}	228,153 (45,631) [10,951] {5,476}
Lake	9,526	9,577	9,577	9,577	9,804 (1,961) [471] {235}	10,033 (2,007) [482] {241}	10,264 (2,053) [493] {246}
Los Angeles	2,586,739	2,610,385	2,631,994	2,648,751	2,702,791 (540,558) [129,734] {64,867}	2,754,162 (550,832) [132,200] {66,100}	2,804,635 (560,927) [134,622] {67,311}
Marin	32,939	33,101	33,101	33,101	33,787 (6,757) [1,622] {811}	34,441 (6,888) [1,653] {827}	35,101 (7,020) [1,685] {842}
Monterey	79,331	79,746	79,746	79,746	81,609 (16,322) [3,917] {1,959}	83,510 (16,702) [4,008] {2,004}	85,404 (17,081) [4,099] {2,050}
Orange	538,115	542,951	542,951	542,951	554,576 (110,915) [26,620] {13,310}	565,947 (113,189) [27,165] {13,583}	577,207 (115,441) [27,706] {13,853}
Placer	62,501	62,836	62,836	62,836	64,063 (12,813) [3,075] {1,538}	65,311 (13,062) [3,135] {1,567}	66,555 (13,311) [3,195] {1,597}
Riverside	569,049	571,216	571,216	571,216	582,290 (116,458) [27,950] {13,975}	592,998 (118,600) [28,464] {14,232}	604,421 (120,884) [29,012] {14,506}
Sacramento	269,570	270,929	270,929	270,929	277,227 (55,445) [13,307] {6,653}	282,969 (56,594) [13,582] {6,791}	289,097 (57,819) [13,877] {6,938}
San Bernardino	543,983	545,764	545,764	545,764	554,365 (110,873) [26,610] {13,305}	562,846 (112,569) [27,017] {13,508}	571,058 (114,212) [27,411] {13,705}
San Diego	719,436	726,071	726,071	726,071	747,370 (149,474) [35,874] {17,937}	768,783 (153,757) [36,902] {18,451}	790,722 (158,144) [37,955] {18,977}
San Francisco	118,988	119,534	119,534	119,534	121,934 (24,387) [5,853] {2,926}	124,278 (24,856) [5,965] {2,983}	126,634 (25,327) [6,078] {3,039}
San Joaquin	158,968	160,008	160,008	160,008	163,473 (32,695) [7,847] {3,923}	167,204 (33,441) [8,026] {4,013}	170,664 (34,133) [8,192] {4,096}
San Luis Obispo	49,309	49,638	49,638	49,638	50,847 (10,169) [2,441] {1,220}	52,016 (10,403) [2,497] {1,248}	53,244 (10,649) [2,556] {1,278}
San Mateo	113,410	114,055	114,055	114,055	116,741 (23,348) [5,604] {2,802}	119,110 (23,822) [5,717] {2,859}	121,802 (24,360) [5,846] {2,923}
Santa Barbara	79,894	80,393	80,393	80,393	82,459 (16,492) [3,958] {1,979}	84,330 (16,866) [4,048] {2,024}	86,310 (17,262) [4,143] {2,071}
Santa Clara	283,365	285,071	285,071	285,071	291,970 (58,394) [14,015] {7,007}	298,786 (59,757) [14,342] {7,171}	305,663 (61,133) [14,672] {7,336}
Santa Cruz	40,659	41,124	41,124	41,124	42,683 (8,537) [2,049] {1,024}	44,275 (8,855) [2,125] {1,063}	45,866 (9,173) [2,202] {1,101}
Solano	73,827	74,194	74,194	74,194	75,922 (15,184) [3,644] {1,822}	77,661 (15,532) [3,728] {1,864}	79,553 (15,911) [3,819] {1,909}
Sonoma	74,738	75,203	75,608	76,213	78,079 (15,616) [3,748] {1,874}	80,066 (16,013) [3,843] {1,922}	82,010 (16,402) [3,936] {1,968}
Ventura	167,047	167,742	167,742	167,742	171,089 (34,218) [8,212] {4,106}	174,290 (34,858) [8,366] {4,183}	177,670 (35,534) [8,528] {4,264}

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.