IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/5/21

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 <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 2/5/21 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
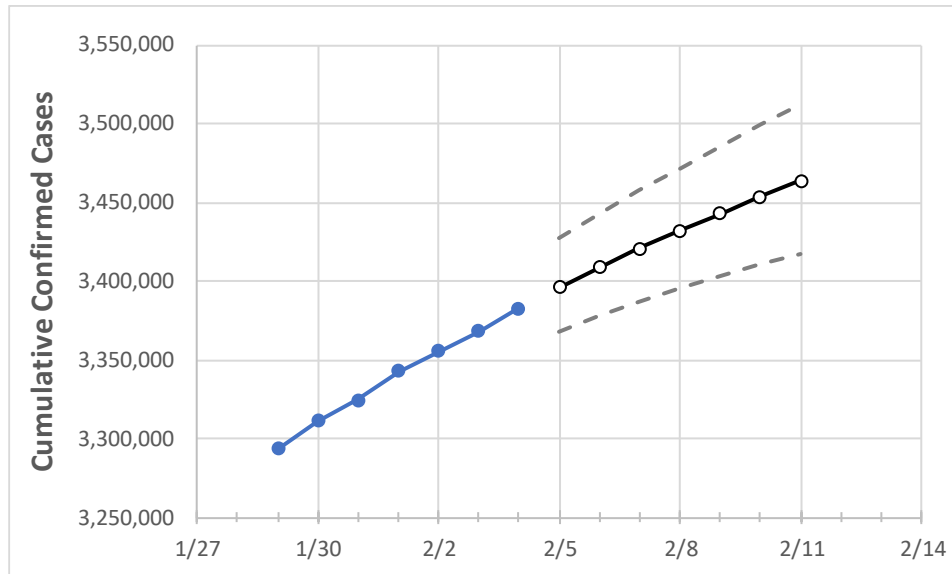
	Actual Confirmed Cases On:				Projected Cases For:						
	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11
California	3,342,647	3,355,781	3,368,281	3,382,932	3,395,923	3,408,465	3,420,431	3,431,826	3,443,054	3,453,690	3,463,877

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:						
	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11
Alameda	74,087	74,661	74,959	75,175	75,505	75,821	76,101	76,393	76,656	76,901	77,159
Contra Costa	57,580	57,812	58,021	58,248	58,475	58,698	58,915	59,112	59,313	59,507	59,695
Fresno	88,852	89,272	89,542	89,748	90,070	90,369	90,667	90,937	91,207	91,459	91,700
Kern	94,467	94,994	95,554	95,993	96,452	96,889	97,316	97,739	98,153	98,555	98,934
Lake	2,826	2,843	2,857	2,869	2,882	2,894	2,907	2,918	2,929	2,939	2,949
Los Angeles	1,121,107	1,124,975	1,129,730	1,134,595	1,138,812	1,142,701	1,146,464	1,150,014	1,153,394	1,156,676	1,159,785
Marin	12,372	12,408	12,448	12,520	12,558	12,597	12,634	12,670	12,705	12,738	12,771
Monterey	39,786	39,966	40,104	40,237	40,447	40,646	40,846	41,048	41,239	41,418	41,603
Orange	247,035	247,886	248,510	249,195	249,840	250,459	251,056	251,644	252,172	252,708	253,183
Placer	18,608	18,638	18,670	18,738	18,797	18,853	18,909	18,961	19,011	19,059	19,102
Riverside	275,872	276,931	277,724	279,189	280,346	281,414	282,469	283,490	284,452	285,420	286,325
Sacramento	86,560	86,856	87,107	87,415	87,684	87,940	88,193	88,430	88,649	88,863	89,064
San Bernardino	275,076	275,372	275,960	276,606	277,429	278,203	278,910	279,583	280,252	280,858	281,432
San Diego	239,142	240,050	241,018	242,616	243,804	244,949	246,010	247,064	248,094	249,052	250,018
San Francisco	31,563	31,703	31,788	31,983	32,110	32,235	32,356	32,464	32,570	32,676	32,776
San Joaquin	62,146	62,737	62,890	63,258	63,509	63,756	63,989	64,223	64,441	64,657	64,864
San Luis Obispo	17,887	18,038	18,186	18,353	18,475	18,593	18,708	18,817	18,927	19,034	19,138
San Mateo	35,882	36,052	36,214	36,451	36,630	36,805	36,972	37,132	37,289	37,445	37,590
Santa Barbara	28,830	29,009	29,191	29,431	29,637	29,840	30,045	30,236	30,421	30,611	30,790
Santa Clara	102,427	102,836	103,236	103,748	104,143	104,530	104,899	105,253	105,594	105,911	106,216
Santa Cruz	13,606	13,648	13,683	13,790	13,863	13,929	13,995	14,058	14,119	14,182	14,240
Solano	28,191	28,290	28,410	28,511	28,636	28,757	28,869	28,982	29,093	29,201	29,306
Sonoma	26,189	26,250	26,306	26,430	26,534	26,636	26,736	26,828	26,919	27,005	27,086
Ventura	70,799	71,212	71,557	72,124	72,597	73,052	73,487	73,904	74,323	74,718	75,096

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:		
	2/1	2/2	2/3	2/4	2/6	2/8	2/10
Alameda	74,087	74,661	74,959	75,175	75,821 (15,164) [3,639] {1,820}	76,393 (15,279) [3,667] {1,833}	76,901 (15,380) [3,691] {1,846}
Contra Costa	57,580	57,812	58,021	58,248	58,698 (11,740) [2,817] {1,409}	59,112 (11,822) [2,837] {1,419}	59,507 (11,901) [2,856] {1,428}
Fresno	88,852	89,272	89,542	89,748	90,369 (18,074) [4,338] {2,169}	90,937 (18,187) [4,365] {2,182}	91,459 (18,292) [4,390] {2,195}
Kern	94,467	94,994	95,554	95,993	96,889 (19,378) [4,651] {2,325}	97,739 (19,548) [4,691] {2,346}	98,555 (19,711) [4,731] {2,365}
Lake	2,826	2,843	2,857	2,869	2,894 (579) [139] {69}	2,918 (584) [140] {70}	2,939 (588) [141] {71}
Los Angeles	1,121,107	1,124,975	1,129,730	1,134,595	1,142,701 (228,540) [54,850] {27,425}	1,150,014 (230,003) [55,201] {27,600}	1,156,676 (231,335) [55,520] {27,760}
Marin	12,372	12,408	12,448	12,520	12,597 (2,519) [605] {302}	12,670 (2,534) [608] {304}	12,738 (2,548) [611] {306}
Monterey	39,786	39,966	40,104	40,237	40,646 (8,129) [1,951] {976}	41,048 (8,210) [1,970] {985}	41,418 (8,284) [1,988] {994}
Orange	247,035	247,886	248,510	249,195	250,459 (50,092) [12,022] {6,011}	251,644 (50,329) [12,079] {6,039}	252,708 (50,542) [12,130] {6,065}
Placer	18,608	18,638	18,670	18,738	18,853 (3,771) [905] {452}	18,961 (3,792) [910] {455}	19,059 (3,812) [915] {457}
Riverside	275,872	276,931	277,724	279,189	281,414 (56,283) [13,508] {6,754}	283,490 (56,698) [13,608] {6,804}	285,420 (57,084) [13,700] {6,850}
Sacramento	86,560	86,856	87,107	87,415	87,940 (17,588) [4,221] {2,111}	88,430 (17,686) [4,245] {2,122}	88,863 (17,773) [4,265] {2,133}
San Bernardino	275,076	275,372	275,960	276,606	278,203 (55,641) [13,354] {6,677}	279,583 (55,917) [13,420] {6,710}	280,858 (56,172) [13,481] {6,741}
San Diego	239,142	240,050	241,018	242,616	244,949 (48,990) [11,758] {5,879}	247,064 (49,413) [11,859] {5,930}	249,052 (49,810) [11,954] {5,977}
San Francisco	31,563	31,703	31,788	31,983	32,235 (6,447) [1,547] {774}	32,464 (6,493) [1,558] {779}	32,676 (6,535) [1,568] {784}
San Joaquin	62,146	62,737	62,890	63,258	63,756 (12,751) [3,060] {1,530}	64,223 (12,845) [3,083] {1,541}	64,657 (12,931) [3,104] {1,552}
San Luis Obispo	17,887	18,038	18,186	18,353	18,593 (3,719) [892] {446}	18,817 (3,763) [903] {452}	19,034 (3,807) [914] {457}
San Mateo	35,882	36,052	36,214	36,451	36,805 (7,361) [1,767] {883}	37,132 (7,426) [1,782] {891}	37,445 (7,489) [1,797] {899}
Santa Barbara	28,830	29,009	29,191	29,431	29,840 (5,968) [1,432] {716}	30,236 (6,047) [1,451] {726}	30,611 (6,122) [1,469] {735}
Santa Clara	102,427	102,836	103,236	103,748	104,530 (20,906) [5,017] {2,509}	105,253 (21,051) [5,052] {2,526}	105,911 (21,182) [5,084] {2,542}
Santa Cruz	13,606	13,648	13,683	13,790	13,929 (2,786) [669] {334}	14,058 (2,812) [675] {337}	14,182 (2,836) [681] {340}
Solano	28,191	28,290	28,410	28,511	28,757 (5,751) [1,380] {690}	28,982 (5,796) [1,391] {696}	29,201 (5,840) [1,402] {701}
Sonoma	26,189	26,250	26,306	26,430	26,636 (5,327) [1,279] {639}	26,828 (5,366) [1,288] {644}	27,005 (5,401) [1,296] {648}
Ventura	70,799	71,212	71,557	72,124	73,052 (14,610) [3,507] {1,753}	73,904 (14,781) [3,547] {1,774}	74,718 (14,944) [3,586] {1,793}

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.