IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/18/22

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 3/18/22 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
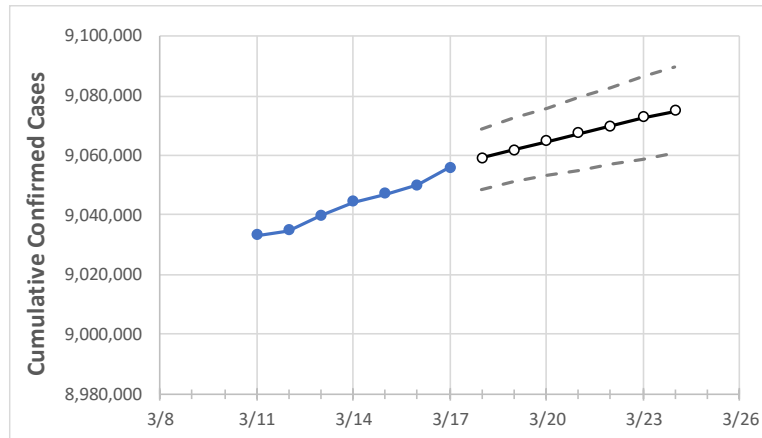
	Actual Confirmed Cases On:				Projected Cases For:						
	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24
California	9,044,440	9,047,116	9,050,081	9,055,973	9,059,132	9,061,888	9,064,647	9,067,419	9,069,879	9,072,659	9,074,878

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:						
	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24
Alameda	267,298	267,299	267,364	267,510	267,594	267,686	267,758	267,845	267,929	268,001	268,071
Contra Costa	199,993	200,019	200,045	200,216	200,301	200,376	200,446	200,518	200,586	200,659	200,721
Fresno	250,461	250,464	250,625	250,811	250,902	250,988	251,065	251,142	251,214	251,286	251,360
Kern	241,233	241,421	241,657	241,765	241,916	242,064	242,191	242,307	242,435	242,561	242,662
Lake	11,528	11,529	11,529	11,530	11,537	11,542	11,548	11,554	11,560	11,565	11,570
Los Angeles	2,813,689	2,814,409	2,815,379	2,817,190	2,818,172	2,819,127	2,820,049	2,820,917	2,821,806	2,822,670	2,823,494
Marin	35,291	35,297	35,303	35,339	35,360	35,381	35,399	35,418	35,437	35,456	35,475
Monterey	91,611	91,612	91,636	91,898	91,939	91,976	92,008	92,048	92,079	92,113	92,144
Orange	584,101	584,164	584,262	584,517	584,667	584,822	584,966	585,109	585,244	585,396	585,525
Placer	69,709	69,714	69,718	69,765	69,784	69,800	69,815	69,831	69,846	69,860	69,871
Riverside	616,541	616,544	616,635	616,829	616,932	617,038	617,126	617,209	617,307	617,386	617,480
Sacramento	301,478	301,480	301,431	301,530	301,608	301,687	301,758	301,820	301,897	301,962	302,026
San Bernardino	583,654	583,670	583,770	584,060	584,191	584,335	584,458	584,578	584,679	584,817	584,921
San Diego	795,115	795,595	796,074	797,420	797,953	798,480	798,985	799,493	799,998	800,484	800,984
San Francisco	132,100	132,076	132,051	131,761	131,794	131,815	131,838	131,865	131,884	131,912	131,927
San Joaquin	174,739	174,740	174,742	174,822	174,854	174,884	174,913	174,940	174,965	174,991	175,013
San Luis Obispo	55,775	55,776	55,790	55,866	55,889	55,911	55,928	55,951	55,970	55,989	56,007
San Mateo	126,547	126,558	126,569	126,686	126,744	126,802	126,855	126,906	126,960	127,013	127,064
Santa Barbara	90,209	90,210	90,167	90,138	90,150	90,164	90,175	90,185	90,196	90,206	90,215
Santa Clara	321,840	321,843	321,778	321,974	322,089	322,211	322,318	322,419	322,522	322,631	322,720
Santa Cruz	49,017	49,022	49,027	49,084	49,111	49,138	49,164	49,187	49,212	49,235	49,256
Solano	86,679	86,704	86,731	86,802	86,836	86,866	86,899	86,928	86,957	86,985	87,015
Sonoma	85,070	85,071	85,077	85,203	85,235	85,266	85,290	85,316	85,345	85,369	85,393
Ventura	181,331	181,332	181,375	181,459	181,499	181,528	181,562	181,596	181,626	181,659	181,683

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: | | |
	3/14	3/15	3/16	3/17	3/19	3/21	3/23
Alameda	267,298	267,299	267,364	267,510	267,686 (53,537) [12,849] {6,424}	267,845 (53,569) [12,857] {6,428}	268,001 (53,600) [12,864] {6,432}
Contra Costa	199,993	200,019	200,045	200,216	200,376 (40,075) [9,618] {4,809}	200,518 (40,104) [9,625] {4,812}	200,659 (40,132) [9,632] {4,816}
Fresno	250,461	250,464	250,625	250,811	250,988 (50,198) [12,047] {6,024}	251,142 (50,228) [12,055] {6,027}	251,286 (50,257) [12,062] {6,031}
Kern	241,233	241,421	241,657	241,765	242,064 (48,413) [11,619] {5,810}	242,307 (48,461) [11,631] {5,815}	242,561 (48,512) [11,643] {5,821}
Lake	11,528	11,529	11,529	11,530	11,542 (2,308) [554] {277}	11,554 (2,311) [555] {277}	11,565 (2,313) [555] {278}
Los Angeles	2,813,689	2,814,409	2,815,379	2,817,190	2,819,127 (563,825) [135,318] {67,659}	2,820,917 (564,183) [135,404] {67,702}	2,822,670 (564,534) [135,488] {67,744}
Marin	35,291	35,297	35,303	35,339	35,381 (7,076) [1,698] {849}	35,418 (7,084) [1,700] {850}	35,456 (7,091) [1,702] {851}
Monterey	91,611	91,612	91,636	91,898	91,976 (18,395) [4,415] {2,207}	92,048 (18,410) [4,418] {2,209}	92,113 (18,423) [4,421] {2,211}
Orange	584,101	584,164	584,262	584,517	584,822 (116,964) [28,071] {14,036}	585,109 (117,022) [28,085] {14,043}	585,396 (117,079) [28,099] {14,049}
Placer	69,709	69,714	69,718	69,765	69,800 (13,960) [3,350] {1,675}	69,831 (13,966) [3,352] {1,676}	69,860 (13,972) [3,353] {1,677}
Riverside	616,541	616,544	616,635	616,829	617,038 (123,408) [29,618] {14,809}	617,209 (123,442) [29,626] {14,813}	617,386 (123,477) [29,635] {14,817}
Sacramento	301,478	301,480	301,431	301,530	301,687 (60,337) [14,481] {7,240}	301,820 (60,364) [14,487] {7,244}	301,962 (60,392) [14,494] {7,247}
San Bernardino	583,654	583,670	583,770	584,060	584,335 (116,867) [28,048] {14,024}	584,578 (116,916) [28,060] {14,030}	584,817 (116,963) [28,071] {14,036}
San Diego	795,115	795,595	796,074	797,420	798,480 (159,696) [38,327] {19,164}	799,493 (159,899) [38,376] {19,188}	800,484 (160,097) [38,423] {19,212}
San Francisco	132,100	132,076	132,051	131,761	131,815 (26,363) [6,327] {3,164}	131,865 (26,373) [6,330] {3,165}	131,912 (26,382) [6,332] {3,166}
San Joaquin	174,739	174,740	174,742	174,822	174,884 (34,977) [8,394] {4,197}	174,940 (34,988) [8,397] {4,199}	174,991 (34,998) [8,400] {4,200}
San Luis Obispo	55,775	55,776	55,790	55,866	55,911 (11,182) [2,684] {1,342}	55,951 (11,190) [2,686] {1,343}	55,989 (11,198) [2,687] {1,344}
San Mateo	126,547	126,558	126,569	126,686	126,802 (25,360) [6,087] {3,043}	126,906 (25,381) [6,092] {3,046}	127,013 (25,403) [6,097] {3,048}
Santa Barbara	90,209	90,210	90,167	90,138	90,164 (18,033) [4,328] {2,164}	90,185 (18,037) [4,329] {2,164}	90,206 (18,041) [4,330] {2,165}
Santa Clara	321,840	321,843	321,778	321,974	322,211 (64,442) [15,466] {7,733}	322,419 (64,484) [15,476] {7,738}	322,631 (64,526) [15,486] {7,743}
Santa Cruz	49,017	49,022	49,027	49,084	49,138 (9,828) [2,359] {1,179}	49,187 (9,837) [2,361] {1,180}	49,235 (9,847) [2,363] {1,182}
Solano	86,679	86,704	86,731	86,802	86,866 (17,373) [4,170] {2,085}	86,928 (17,386) [4,173] {2,086}	86,985 (17,397) [4,175] {2,088}
Sonoma	85,070	85,071	85,077	85,203	85,266 (17,053) [4,093] {2,046}	85,316 (17,063) [4,095] {2,048}	85,369 (17,074) [4,098] {2,049}
Ventura	181,331	181,332	181,375	181,459	181,528 (36,306) [8,713] {4,357}	181,596 (36,319) [8,717] {4,358}	181,659 (36,332) [8,720] {4,360}

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.