IEM's AI Modeling: Short-term COVID-19 Projections
Date: 8/2/21

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 8/2/21 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
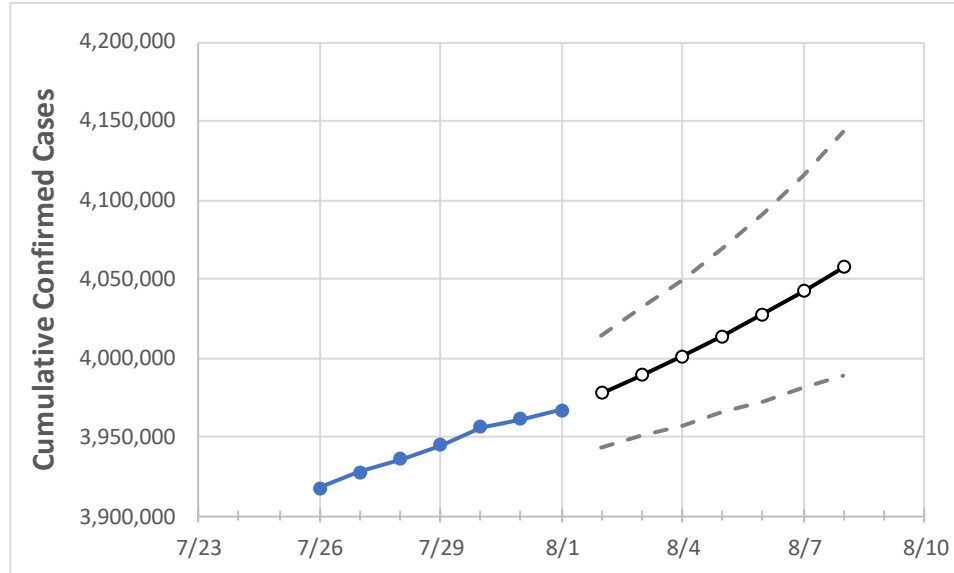
	Actual Confirmed Cases On:				Projected Cases For:						
	7/29	7/30	7/31	8/1	8/2	8/3	8/4	8/5	8/6	8/7	8/8
California	3,944,933	3,956,303	3,961,190	3,966,943	3,977,626	3,988,928	4,001,058	4,013,943	4,027,576	4,042,115	4,057,342

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:						
	7/29	7/30	7/31	8/1	8/2	8/3	8/4	8/5	8/6	8/7	8/8
Alameda	95,826	96,258	96,689	97,121	97,550	98,007	98,488	98,998	99,551	100,148	100,754
Contra Costa	76,259	76,676	77,271	77,708	78,247	78,832	79,462	80,135	80,863	81,651	82,482
Fresno	104,458	104,639	104,639	104,639	104,835	105,049	105,277	105,523	105,785	106,073	106,376
Kern	113,071	113,216	113,216	113,216	113,401	113,604	113,819	114,046	114,288	114,555	114,832
Lake	4,238	4,238	4,238	4,238	4,317	4,404	4,496	4,598	4,711	4,830	4,959
Los Angeles	1,293,583	1,297,087	1,300,313	1,303,343	1,306,922	1,310,733	1,314,719	1,318,920	1,323,372	1,328,044	1,333,011
Marin	14,825	14,874	14,920	14,958	15,009	15,063	15,121	15,182	15,245	15,313	15,385
Monterey	44,484	44,523	44,523	44,523	44,567	44,614	44,665	44,717	44,773	44,833	44,897
Orange	281,790	282,426	282,426	282,426	283,171	283,959	284,791	285,687	286,649	287,647	288,708
Placer	25,146	25,146	25,146	25,146	25,292	25,453	25,619	25,805	26,009	26,230	26,458
Riverside	307,922	308,546	308,546	308,546	309,286	310,077	310,894	311,780	312,701	313,669	314,700
Sacramento	115,200	115,732	115,732	115,732	116,290	116,888	117,498	118,175	118,910	119,661	120,476
San Bernardino	306,273	306,769	306,769	306,769	307,299	307,867	308,491	309,169	309,899	310,687	311,472
San Diego	295,054	296,345	297,226	298,002	299,172	300,474	301,840	303,287	304,873	306,515	308,326
San Francisco	40,144	40,412	40,478	40,544	40,761	40,989	41,231	41,498	41,778	42,074	42,387
San Joaquin	76,915	76,915	76,915	76,915	76,987	77,059	77,132	77,205	77,279	77,350	77,425
San Luis Obispo	21,970	21,970	21,970	21,970	22,001	22,032	22,065	22,099	22,133	22,169	22,205
San Mateo	44,477	44,622	44,622	44,622	44,768	44,922	45,083	45,251	45,431	45,619	45,816
Santa Barbara	35,647	35,741	35,741	35,741	35,826	35,920	36,022	36,130	36,251	36,380	36,520
Santa Clara	123,083	123,404	123,404	123,404	123,745	124,104	124,484	124,890	125,332	125,795	126,288
Santa Cruz	16,616	16,616	16,616	16,616	16,649	16,684	16,722	16,763	16,807	16,854	16,904
Solano	35,854	36,004	36,004	36,004	36,186	36,384	36,587	36,807	37,035	37,290	37,562
Sonoma	32,665	32,817	32,880	32,880	32,997	33,122	33,252	33,387	33,530	33,682	33,841
Ventura	83,696	83,869	83,869	83,869	84,073	84,299	84,550	84,822	85,114	85,436	85,765

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:		
	7/29	7/30	7/31	8/1	8/3	8/5	8/7
Alameda	95,826	96,258	96,689	97,121	98,007 (19,601) [4,704] {2,352}	98,998 (19,800) [4,752] {2,376}	100,148 (20,030) [4,807] {2,404}
Contra Costa	76,259	76,676	77,271	77,708	78,832 (15,766) [3,784] {1,892}	80,135 (16,027) [3,846] {1,923}	81,651 (16,330) [3,919] {1,960}
Fresno	104,458	104,639	104,639	104,639	105,049 (21,010) [5,042] {2,521}	105,523 (21,105) [5,065] {2,533}	106,073 (21,215) [5,091] {2,546}
Kern	113,071	113,216	113,216	113,216	113,604 (22,721) [5,453] {2,726}	114,046 (22,809) [5,474] {2,737}	114,555 (22,911) [5,499] {2,749}
Lake	4,238	4,238	4,238	4,238	4,404 (881) [211] {106}	4,598 (920) [221] {110}	4,830 (966) [232] {116}
Los Angeles	1,293,583	1,297,087	1,300,313	1,303,343	1,310,733 (262,147) [62,915] {31,458}	1,318,920 (263,784) [63,308] {31,654}	1,328,044 (265,609) [63,746] {31,873}
Marin	14,825	14,874	14,920	14,958	15,063 (3,013) [723] {362}	15,182 (3,036) [729] {364}	15,313 (3,063) [735] {368}
Monterey	44,484	44,523	44,523	44,523	44,614 (8,923) [2,141] {1,071}	44,717 (8,943) [2,146] {1,073}	44,833 (8,967) [2,152] {1,076}
Orange	281,790	282,426	282,426	282,426	283,959 (56,792) [13,630] {6,815}	285,687 (57,137) [13,713] {6,856}	287,647 (57,529) [13,807] {6,904}
Placer	25,146	25,146	25,146	25,146	25,453 (5,091) [1,222] {611}	25,805 (5,161) [1,239] {619}	26,230 (5,246) [1,259] {630}
Riverside	307,922	308,546	308,546	308,546	310,077 (62,015) [14,884] {7,442}	311,780 (62,356) [14,965] {7,483}	313,669 (62,734) [15,056] {7,528}
Sacramento	115,200	115,732	115,732	115,732	116,888 (23,378) [5,611] {2,805}	118,175 (23,635) [5,672] {2,836}	119,661 (23,932) [5,744] {2,872}
San Bernardino	306,273	306,769	306,769	306,769	307,867 (61,573) [14,778] {7,389}	309,169 (61,834) [14,840] {7,420}	310,687 (62,137) [14,913] {7,456}
San Diego	295,054	296,345	297,226	298,002	300,474 (60,095) [14,423] {7,211}	303,287 (60,657) [14,558] {7,279}	306,515 (61,303) [14,713] {7,356}
San Francisco	40,144	40,412	40,478	40,544	40,989 (8,198) [1,967] {984}	41,498 (8,300) [1,992] {996}	42,074 (8,415) [2,020] {1,010}
San Joaquin	76,915	76,915	76,915	76,915	77,059 (15,412) [3,699] {1,849}	77,205 (15,441) [3,706] {1,853}	77,350 (15,470) [3,713] {1,856}
San Luis Obispo	21,970	21,970	21,970	21,970	22,032 (4,406) [1,058] {529}	22,099 (4,420) [1,061] {530}	22,169 (4,434) [1,064] {532}
San Mateo	44,477	44,622	44,622	44,622	44,922 (8,984) [2,156] {1,078}	45,251 (9,050) [2,172] {1,086}	45,619 (9,124) [2,190] {1,095}
Santa Barbara	35,647	35,741	35,741	35,741	35,920 (7,184) [1,724] {862}	36,130 (7,226) [1,734] {867}	36,380 (7,276) [1,746] {873}
Santa Clara	123,083	123,404	123,404	123,404	124,104 (24,821) [5,957] {2,979}	124,890 (24,978) [5,995] {2,997}	125,795 (25,159) [6,038] {3,019}
Santa Cruz	16,616	16,616	16,616	16,616	16,684 (3,337) [801] {400}	16,763 (3,353) [805] {402}	16,854 (3,371) [809] {404}
Solano	35,854	36,004	36,004	36,004	36,384 (7,277) [1,746] {873}	36,807 (7,361) [1,767] {883}	37,290 (7,458) [1,790] {895}
Sonoma	32,665	32,817	32,880	32,880	33,122 (6,624) [1,590] {795}	33,387 (6,677) [1,603] {801}	33,682 (6,736) [1,617] {808}
Ventura	83,696	83,869	83,869	83,869	84,299 (16,860) [4,046] {2,023}	84,822 (16,964) [4,071] {2,036}	85,436 (17,087) [4,101] {2,050}

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.