IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/28/21

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 7/28/21 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
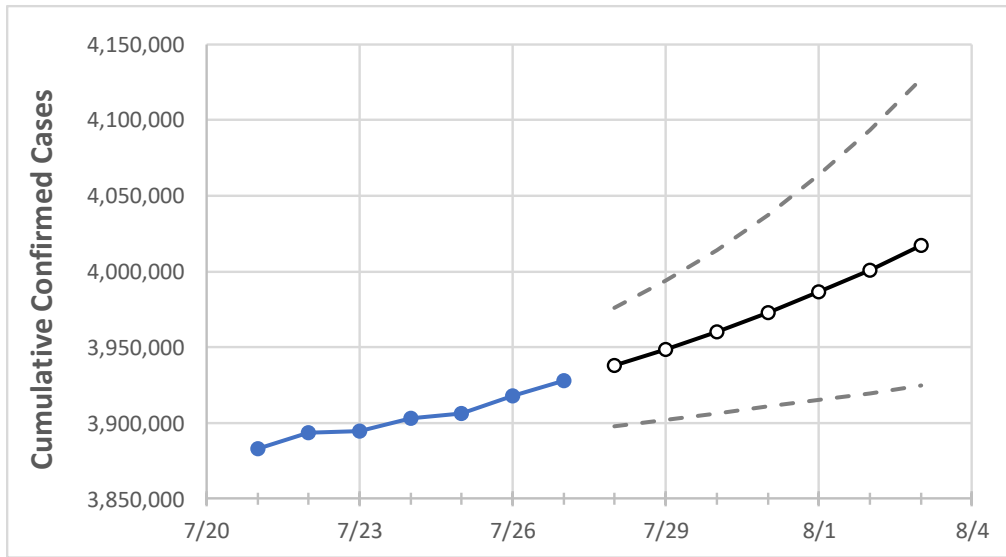
	Actual Confirmed Cases On:				Projected Cases For:						
	7/24	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1	8/2	8/3
California	3,903,052	3,905,990	3,917,610	3,927,901	3,937,738	3,948,514	3,960,128	3,972,574	3,986,292	4,001,072	4,016,955

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:						
	7/24	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1	8/2	8/3
Alameda	94,345	94,736	94,796	95,243	95,601	95,972	96,383	96,796	97,240	97,715	98,223
Contra Costa	74,666	74,985	75,283	75,580	75,965	76,377	76,829	77,316	77,838	78,389	78,986
Fresno	103,764	103,892	104,019	104,143	104,289	104,445	104,613	104,793	104,985	105,191	105,409
Kern	112,420	112,521	112,623	112,798	112,949	113,113	113,286	113,477	113,684	113,900	114,137
Lake	4,012	4,060	4,109	4,133	4,187	4,244	4,308	4,378	4,453	4,537	4,628
Los Angeles	1,281,760	1,283,844	1,285,771	1,288,090	1,291,063	1,294,187	1,297,488	1,301,039	1,304,832	1,308,776	1,313,039
Marin	14,633	14,676	14,713	14,750	14,793	14,841	14,893	14,949	15,009	15,073	15,142
Monterey	44,296	44,329	44,363	44,396	44,428	44,463	44,501	44,540	44,580	44,626	44,672
Orange	279,196	279,673	280,149	280,654	281,224	281,832	282,478	283,157	283,884	284,651	285,462
Placer	24,605	24,680	24,755	24,955	25,057	25,171	25,293	25,422	25,565	25,718	25,880
Riverside	305,195	305,742	306,289	306,836	307,406	308,002	308,646	309,326	310,038	310,800	311,612
Sacramento	113,291	113,687	114,082	114,415	114,863	115,344	115,862	116,414	117,009	117,640	118,311
San Bernardino	304,224	304,372	304,521	305,423	305,832	306,261	306,719	307,213	307,728	308,272	308,890
San Diego	291,313	292,000	292,688	293,408	294,434	295,555	296,769	298,075	299,489	301,086	302,826
San Francisco	38,993	39,031	39,663	39,800	40,063	40,348	40,669	41,019	41,402	41,821	42,275
San Joaquin	76,034	76,034	76,034	76,034	76,063	76,091	76,117	76,141	76,165	76,189	76,213
San Luis Obispo	21,733	21,737	21,741	21,970	21,982	21,994	22,006	22,020	22,033	22,047	22,062
San Mateo	43,983	44,086	44,189	44,297	44,422	44,554	44,694	44,844	45,002	45,171	45,349
Santa Barbara	35,254	35,258	35,261	35,473	35,569	35,674	35,794	35,927	36,075	36,237	36,418
Santa Clara	121,991	122,215	122,439	122,630	122,886	123,156	123,444	123,746	124,063	124,404	124,763
Santa Cruz	16,492	16,512	16,532	16,532	16,554	16,577	16,602	16,629	16,658	16,688	16,721
Solano	35,289	35,386	35,482	35,482	35,617	35,763	35,917	36,086	36,265	36,457	36,669
Sonoma	32,196	32,261	32,325	32,476	32,573	32,674	32,777	32,889	33,006	33,127	33,258
Ventura	83,068	83,162	83,255	83,255	83,392	83,540	83,699	83,865	84,043	84,236	84,437

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:		
	7/24	7/25	7/26	7/27	7/29	7/31	8/2
Alameda	94,345	94,736	94,796	95,243	95,972 (19,194) [4,607] {2,303}	96,796 (19,359) [4,646] {2,323}	97,715 (19,543) [4,690] {2,345}
Contra Costa	74,666	74,985	75,283	75,580	76,377 (15,275) [3,666] {1,833}	77,316 (15,463) [3,711] {1,856}	78,389 (15,678) [3,763] {1,881}
Fresno	103,764	103,892	104,019	104,143	104,445 (20,889) [5,013] {2,507}	104,793 (20,959) [5,030] {2,515}	105,191 (21,038) [5,049] {2,525}
Kern	112,420	112,521	112,623	112,798	113,113 (22,623) [5,429] {2,715}	113,477 (22,695) [5,447] {2,723}	113,900 (22,780) [5,467] {2,734}
Lake	4,012	4,060	4,109	4,133	4,244 (849) [204] {102}	4,378 (876) [210] {105}	4,537 (907) [218] {109}
Los Angeles	1,281,760	1,283,844	1,285,771	1,288,090	1,294,187 (258,837) [62,121] {31,060}	1,301,039 (260,208) [62,450] {31,225}	1,308,776 (261,755) [62,821] {31,411}
Marin	14,633	14,676	14,713	14,750	14,841 (2,968) [712] {356}	14,949 (2,990) [718] {359}	15,073 (3,015) [724] {362}
Monterey	44,296	44,329	44,363	44,396	44,463 (8,893) [2,134] {1,067}	44,540 (8,908) [2,138] {1,069}	44,626 (8,925) [2,142] {1,071}
Orange	279,196	279,673	280,149	280,654	281,832 (56,366) [13,528] {6,764}	283,157 (56,631) [13,592] {6,796}	284,651 (56,930) [13,663] {6,832}
Placer	24,605	24,680	24,755	24,955	25,171 (5,034) [1,208] {604}	25,422 (5,084) [1,220] {610}	25,718 (5,144) [1,234] {617}
Riverside	305,195	305,742	306,289	306,836	308,002 (61,600) [14,784] {7,392}	309,326 (61,865) [14,848] {7,424}	310,800 (62,160) [14,918] {7,459}
Sacramento	113,291	113,687	114,082	114,415	115,344 (23,069) [5,537] {2,768}	116,414 (23,283) [5,588] {2,794}	117,640 (23,528) [5,647] {2,823}
San Bernardino	304,224	304,372	304,521	305,423	306,261 (61,252) [14,701] {7,350}	307,213 (61,443) [14,746] {7,373}	308,272 (61,654) [14,797] {7,399}
San Diego	291,313	292,000	292,688	293,408	295,555 (59,111) [14,187] {7,093}	298,075 (59,615) [14,308] {7,154}	301,086 (60,217) [14,452] {7,226}
San Francisco	38,993	39,031	39,663	39,800	40,348 (8,070) [1,937] {968}	41,019 (8,204) [1,969] {984}	41,821 (8,364) [2,007] {1,004}
San Joaquin	76,034	76,034	76,034	76,034	76,091 (15,218) [3,652] {1,826}	76,141 (15,228) [3,655] {1,827}	76,189 (15,238) [3,657] {1,829}
San Luis Obispo	21,733	21,737	21,741	21,970	21,994 (4,399) [1,056] {528}	22,020 (4,404) [1,057] {528}	22,047 (4,409) [1,058] {529}
San Mateo	43,983	44,086	44,189	44,297	44,554 (8,911) [2,139] {1,069}	44,844 (8,969) [2,153] {1,076}	45,171 (9,034) [2,168] {1,084}
Santa Barbara	35,254	35,258	35,261	35,473	35,674 (7,135) [1,712] {856}	35,927 (7,185) [1,724] {862}	36,237 (7,247) [1,739] {870}
Santa Clara	121,991	122,215	122,439	122,630	123,156 (24,631) [5,911] {2,956}	123,746 (24,749) [5,940] {2,970}	124,404 (24,881) [5,971] {2,986}
Santa Cruz	16,492	16,512	16,532	16,532	16,577 (3,315) [796] {398}	16,629 (3,326) [798] {399}	16,688 (3,338) [801] {401}
Solano	35,289	35,386	35,482	35,482	35,763 (7,153) [1,717] {858}	36,086 (7,217) [1,732] {866}	36,457 (7,291) [1,750] {875}
Sonoma	32,196	32,261	32,325	32,476	32,674 (6,535) [1,568] {784}	32,889 (6,578) [1,579] {789}	33,127 (6,625) [1,590] {795}
Ventura	83,068	83,162	83,255	83,255	83,540 (16,708) [4,010] {2,005}	83,865 (16,773) [4,026] {2,013}	84,236 (16,847) [4,043] {2,022}

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.