IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/26/21

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 7/26/21 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
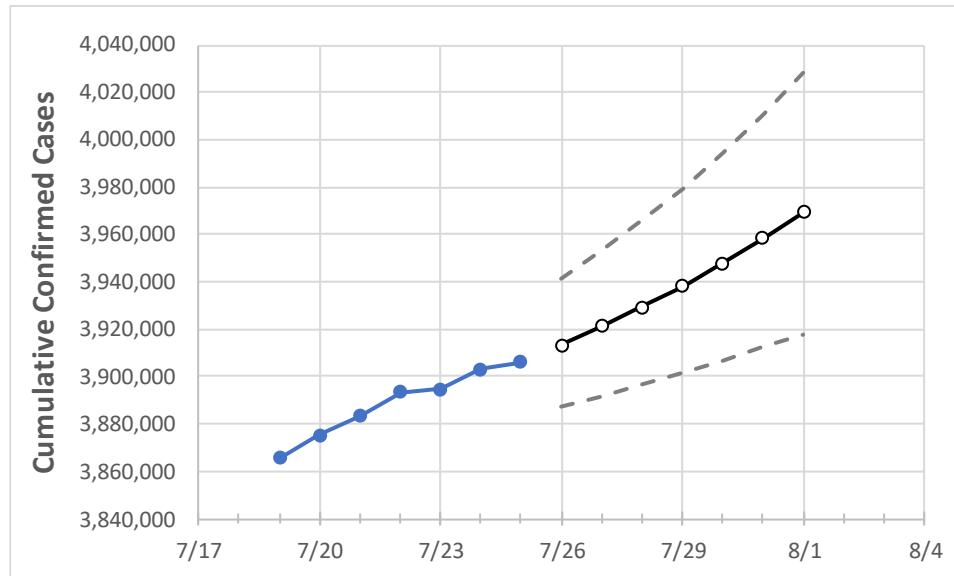
	Actual Confirmed Cases On:				Projected Cases For:						
	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1
California	3,893,526	3,894,556	3,903,052	3,905,990	3,913,231	3,921,132	3,929,499	3,938,376	3,947,998	3,958,471	3,969,302

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:						
	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1
Alameda	97,459	93,953	94,345	94,736	95,118	95,526	95,975	96,450	96,990	97,546	98,146
Contra Costa	74,030	74,348	74,666	74,985	75,304	75,638	76,002	76,392	76,812	77,268	77,747
Fresno	103,504	103,637	103,637	103,637	103,760	103,890	104,033	104,186	104,349	104,523	104,709
Kern	112,191	112,318	112,318	112,318	112,437	112,563	112,699	112,849	113,009	113,169	113,342
Lake	3,945	3,963	3,963	3,963	4,011	4,064	4,123	4,189	4,261	4,341	4,428
Los Angeles	1,276,254	1,279,007	1,281,760	1,283,844	1,287,060	1,290,550	1,294,289	1,298,403	1,302,802	1,307,580	1,312,928
Marin	14,589	14,611	14,633	14,676	14,715	14,756	14,801	14,849	14,901	14,956	15,015
Monterey	44,273	44,285	44,296	44,296	44,321	44,346	44,373	44,401	44,432	44,462	44,494
Orange	278,209	278,720	278,720	278,720	279,273	279,867	280,511	281,197	281,937	282,738	283,607
Placer	24,507	24,530	24,530	24,530	24,583	24,640	24,696	24,757	24,821	24,888	24,957
Riverside	304,438	304,817	305,195	305,195	305,662	306,159	306,698	307,277	307,886	308,525	309,193
Sacramento	112,501	112,896	112,896	112,896	113,245	113,627	114,031	114,450	114,892	115,351	115,837
San Bernardino	303,673	304,075	304,075	304,075	304,499	304,975	305,475	306,020	306,607	307,211	307,876
San Diego	289,367	290,625	290,625	290,625	291,699	292,904	294,152	295,577	297,196	298,984	300,903
San Francisco	38,699	38,954	38,993	39,031	39,179	39,339	39,510	39,699	39,898	40,108	40,347
San Joaquin	76,034	76,034	76,034	76,034	76,080	76,125	76,170	76,218	76,266	76,316	76,365
San Luis Obispo	21,717	21,717	21,717	21,717	21,728	21,739	21,750	21,761	21,772	21,784	21,796
San Mateo	43,755	43,880	43,880	43,880	43,989	44,103	44,222	44,350	44,482	44,623	44,775
Santa Barbara	35,189	35,222	35,254	35,254	35,320	35,394	35,475	35,561	35,655	35,757	35,867
Santa Clara	121,553	121,767	121,767	121,767	122,023	122,308	122,620	122,956	123,311	123,695	124,104
Santa Cruz	16,452	16,452	16,452	16,452	16,466	16,481	16,497	16,513	16,530	16,547	16,565
Solano	35,039	35,193	35,193	35,193	35,314	35,442	35,580	35,730	35,890	36,064	36,255
Sonoma	31,965	32,081	32,196	32,196	32,266	32,337	32,412	32,491	32,572	32,657	32,750
Ventura	82,855	82,975	82,975	82,975	83,111	83,261	83,430	83,608	83,800	84,010	84,241

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:		
	7/22	7/23	7/24	7/25	7/27	7/29	7/31
Alameda	97,459	93,953	94,345	94,736	95,526 (19,105) [4,585] {2,293}	96,450 (19,290) [4,630] {2,315}	97,546 (19,509) [4,682] {2,341}
Contra Costa	74,030	74,348	74,666	74,985	75,638 (15,128) [3,631] {1,815}	76,392 (15,278) [3,667] {1,833}	77,268 (15,454) [3,709] {1,854}
Fresno	103,504	103,637	103,637	103,637	103,890 (20,778) [4,987] {2,493}	104,186 (20,837) [5,001] {2,500}	104,523 (20,905) [5,017] {2,509}
Kern	112,191	112,318	112,318	112,318	112,563 (22,513) [5,403] {2,702}	112,849 (22,570) [5,417] {2,708}	113,169 (22,634) [5,432] {2,716}
Lake	3,945	3,963	3,963	3,963	4,064 (813) [195] {98}	4,189 (838) [201] {101}	4,341 (868) [208] {104}
Los Angeles	1,276,254	1,279,007	1,281,760	1,283,844	1,290,550 (258,110) [61,946] {30,973}	1,298,403 (259,681) [62,323] {31,162}	1,307,580 (261,516) [62,764] {31,382}
Marin	14,589	14,611	14,633	14,676	14,756 (2,951) [708] {354}	14,849 (2,970) [713] {356}	14,956 (2,991) [718] {359}
Monterey	44,273	44,285	44,296	44,296	44,346 (8,869) [2,129] {1,064}	44,401 (8,880) [2,131] {1,066}	44,462 (8,892) [2,134] {1,067}
Orange	278,209	278,720	278,720	278,720	279,867 (55,973) [13,434] {6,717}	281,197 (56,239) [13,497] {6,749}	282,738 (56,548) [13,571] {6,786}
Placer	24,507	24,530	24,530	24,530	24,640 (4,928) [1,183] {591}	24,757 (4,951) [1,188] {594}	24,888 (4,978) [1,195] {597}
Riverside	304,438	304,817	305,195	305,195	306,159 (61,232) [14,696] {7,348}	307,277 (61,455) [14,749] {7,375}	308,525 (61,705) [14,809] {7,405}
Sacramento	112,501	112,896	112,896	112,896	113,627 (22,725) [5,454] {2,727}	114,450 (22,890) [5,494] {2,747}	115,351 (23,070) [5,537] {2,768}
San Bernardino	303,673	304,075	304,075	304,075	304,975 (60,995) [14,639] {7,319}	306,020 (61,204) [14,689] {7,344}	307,211 (61,442) [14,746] {7,373}
San Diego	289,367	290,625	290,625	290,625	292,904 (58,581) [14,059] {7,030}	295,577 (59,115) [14,188] {7,094}	298,984 (59,797) [14,351] {7,176}
San Francisco	38,699	38,954	38,993	39,031	39,339 (7,868) [1,888] {944}	39,699 (7,940) [1,906] {953}	40,108 (8,022) [1,925] {963}
San Joaquin	76,034	76,034	76,034	76,034	76,125 (15,225) [3,654] {1,827}	76,218 (15,244) [3,658] {1,829}	76,316 (15,263) [3,663] {1,832}
San Luis Obispo	21,717	21,717	21,717	21,717	21,739 (4,348) [1,043] {522}	21,761 (4,352) [1,045] {522}	21,784 (4,357) [1,046] {523}
San Mateo	43,755	43,880	43,880	43,880	44,103 (8,821) [2,117] {1,058}	44,350 (8,870) [2,129] {1,064}	44,623 (8,925) [2,142] {1,071}
Santa Barbara	35,189	35,222	35,254	35,254	35,394 (7,079) [1,699] {849}	35,561 (7,112) [1,707] {853}	35,757 (7,151) [1,716] {858}
Santa Clara	121,553	121,767	121,767	121,767	122,308 (24,462) [5,871] {2,935}	122,956 (24,591) [5,902] {2,951}	123,695 (24,739) [5,937] {2,969}
Santa Cruz	16,452	16,452	16,452	16,452	16,481 (3,296) [791] {396}	16,513 (3,303) [793] {396}	16,547 (3,309) [794] {397}
Solano	35,039	35,193	35,193	35,193	35,442 (7,088) [1,701] {851}	35,730 (7,146) [1,715] {858}	36,064 (7,213) [1,731] {866}
Sonoma	31,965	32,081	32,196	32,196	32,337 (6,467) [1,552] {776}	32,491 (6,498) [1,560] {780}	32,657 (6,531) [1,568] {784}
Ventura	82,855	82,975	82,975	82,975	83,261 (16,652) [3,997] {1,998}	83,608 (16,722) [4,013] {2,007}	84,010 (16,802) [4,032] {2,016}

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.