IEM's AI Modeling: Short-term COVID-19 Projections

Date: 8/23/21

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 not 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 8/23/21 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.

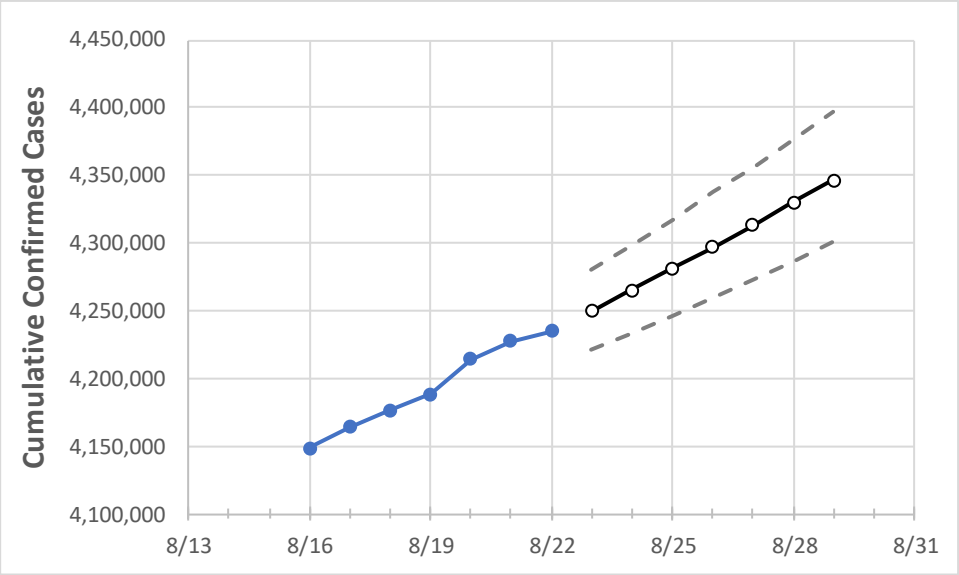
IEM's Modeling Lead

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:						
	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29
California	4,188,640	4,214,548	4,227,429	4,234,699	4,249,689	4,264,997	4,281,382	4,296,655	4,313,506	4,329,883	4,346,483

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:						
	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29
Alameda	103,503	104,082	104,661	104,819	105,228	105,642	106,050	106,474	106,898	107,350	107,768
Contra Costa	83,384	83,651	84,491	84,729	85,094	85,444	85,817	86,187	86,559	86,942	87,298
Fresno	110,523	110,947	111,315	111,765	112,215	112,673	113,155	113,649	114,161	114,684	115,243
Kern	119,277	119,708	119,708	119,708	120,172	120,641	121,133	121,630	122,153	122,690	123,240
Lake	4,957	4,991	5,024	5,055	5,085	5,117	5,147	5,177	5,208	5,238	5,268
Los Angeles	1,362,848	1,376,551	1,380,415	1,383,186	1,387,859	1,392,184	1,397,092	1,402,369	1,407,067	1,412,128	1,417,164
Marin	15,804	15,829	15,917	15,956	16,011	16,066	16,120	16,175	16,232	16,288	16,345
Monterey	45,641	45,662	45,753	45,753	45,829	45,905	45,986	46,072	46,156	46,242	46,330
Orange	297,785	298,667	298,667	298,667	299,580	300,516	301,455	302,421	303,397	304,370	305,407
Placer	28,008	28,082	28,156	28,289	28,462	28,629	28,799	28,986	29,168	29,342	29,532
Riverside	324,159	324,739	325,944	325,944	326,925	327,967	329,003	330,047	331,121	332,276	333,330
Sacramento	126,002	126,720	127,226	127,751	128,397	129,062	129,729	130,411	131,100	131,817	132,541
San Bernardino	321,155	322,112	322,112	322,112	323,336	324,542	325,823	327,142	328,528	329,966	331,391
San Diego	319,582	321,102	322,620	323,591	325,003	326,460	327,919	329,435	330,960	332,491	334,022
San Francisco	44,957	45,220	45,432	45,637	45,832	46,023	46,229	46,423	46,611	46,812	47,000
San Joaquin	81,601	82,047	82,419	82,825	83,234	83,677	84,128	84,598	85,065	85,552	86,066
San Luis Obispo	23,831	23,878	24,162	24,169	24,299	24,440	24,568	24,709	24,855	25,001	25,159
San Mateo	47,255	47,431	47,561	47,685	47,829	47,970	48,114	48,257	48,405	48,554	48,698
Santa Barbara	37,757	37,813	37,913	37,951	38,068	38,189	38,316	38,445	38,570	38,701	38,836
Santa Clara	129,630	130,007	130,007	130,007	130,419	130,834	131,264	131,699	132,151	132,601	133,052
Santa Cruz	17,663	17,682	17,701	17,763	17,825	17,894	17,959	18,030	18,102	18,171	18,246
Solano	38,529	38,764	38,764	38,764	38,938	39,114	39,300	39,488	39,675	39,866	40,067
Sonoma	35,210	35,340	35,558	35,582	35,705	35,827	35,959	36,085	36,215	36,340	36,475
Ventura	87,835	88,279	88,285	88,558	88,837	89,139	89,411	89,721	90,039	90,331	90,666

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:		
	8/19	8/20	8/21	8/22	8/24	8/26	8/28
Alameda	103,503	104,082	104,661	104,819	105,642 (21,128) [5,071] {2,535}	106,474 (21,295) [5,111] {2,555}	107,350 (21,470) [5,153] {2,576}
Contra Costa	83,384	83,651	84,491	84,729	85,444 (17,089) [4,101] {2,051}	86,187 (17,237) [4,137] {2,068}	86,942 (17,388) [4,173] {2,087}
Fresno	110,523	110,947	111,315	111,765	112,673 (22,535) [5,408] {2,704}	113,649 (22,730) [5,455] {2,728}	114,684 (22,937) [5,505] {2,752}
Kern	119,277	119,708	119,708	119,708	120,641 (24,128) [5,791] {2,895}	121,630 (24,326) [5,838] {2,919}	122,690 (24,538) [5,889] {2,945}
Lake	4,957	4,991	5,024	5,055	5,117 (1,023) [246] {123}	5,177 (1,035) [249] {124}	5,238 (1,048) [251] {126}
Los Angeles	1,362,848	1,376,551	1,380,415	1,383,186	1,392,184 (278,437) [66,825] {33,412}	1,402,369 (280,474) [67,314] {33,657}	1,412,128 (282,426) [67,782] {33,891}
Marin	15,804	15,829	15,917	15,956	16,066 (3,213) [771] {386}	16,175 (3,235) [776] {388}	16,288 (3,258) [782] {391}
Monterey	45,641	45,662	45,753	45,753	45,905 (9,181) [2,203] {1,102}	46,072 (9,214) [2,211] {1,106}	46,242 (9,248) [2,220] {1,110}
Orange	297,785	298,667	298,667	298,667	300,516 (60,103) [14,425] {7,212}	302,421 (60,484) [14,516] {7,258}	304,370 (60,874) [14,610] {7,305}
Placer	28,008	28,082	28,156	28,289	28,629 (5,726) [1,374] {687}	28,986 (5,797) [1,391] {696}	29,342 (5,868) [1,408] {704}
Riverside	324,159	324,739	325,944	325,944	327,967 (65,593) [15,742] {7,871}	330,047 (66,009) [15,842] {7,921}	332,276 (66,455) [15,949] {7,975}
Sacramento	126,002	126,720	127,226	127,751	129,062 (25,812) [6,195] {3,097}	130,411 (26,082) [6,260] {3,130}	131,817 (26,363) [6,327] {3,164}
San Bernardino	321,155	322,112	322,112	322,112	324,542 (64,908) [15,578] {7,789}	327,142 (65,428) [15,703] {7,851}	329,966 (65,993) [15,838] {7,919}
San Diego	319,582	321,102	322,620	323,591	326,460 (65,292) [15,670] {7,835}	329,435 (65,887) [15,813] {7,906}	332,491 (66,498) [15,960] {7,980}
San Francisco	44,957	45,220	45,432	45,637	46,023 (9,205) [2,209] {1,105}	46,423 (9,285) [2,228] {1,114}	46,812 (9,362) [2,247] {1,123}
San Joaquin	81,601	82,047	82,419	82,825	83,677 (16,735) [4,017] {2,008}	84,598 (16,920) [4,061] {2,030}	85,552 (17,110) [4,107] {2,053}
San Luis Obispo	23,831	23,878	24,162	24,169	24,440 (4,888) [1,173] {587}	24,709 (4,942) [1,186] {593}	25,001 (5,000) [1,200] {600}
San Mateo	47,255	47,431	47,561	47,685	47,970 (9,594) [2,303] {1,151}	48,257 (9,651) [2,316] {1,158}	48,554 (9,711) [2,331] {1,165}
Santa Barbara	37,757	37,813	37,913	37,951	38,189 (7,638) [1,833] {917}	38,445 (7,689) [1,845] {923}	38,701 (7,740) [1,858] {929}
Santa Clara	129,630	130,007	130,007	130,007	130,834 (26,167) [6,280] {3,140}	131,699 (26,340) [6,322] {3,161}	132,601 (26,520) [6,365] {3,182}
Santa Cruz	17,663	17,682	17,701	17,763	17,894 (3,579) [859] {429}	18,030 (3,606) [865] {433}	18,171 (3,634) [872] {436}
Solano	38,529	38,764	38,764	38,764	39,114 (7,823) [1,877] {939}	39,488 (7,898) [1,895] {948}	39,866 (7,973) [1,914] {957}
Sonoma	35,210	35,340	35,558	35,582	35,827 (7,165) [1,720] {860}	36,085 (7,217) [1,732] {866}	36,340 (7,268) [1,744] {872}
Ventura	87,835	88,279	88,285	88,558	89,139 (17,828) [4,279] {2,139}	89,721 (17,944) [4,307] {2,153}	90,331 (18,066) [4,336] {2,168}

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.