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

Date: 9/1/20

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 20%, and are often within 10%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 9/1/20 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.

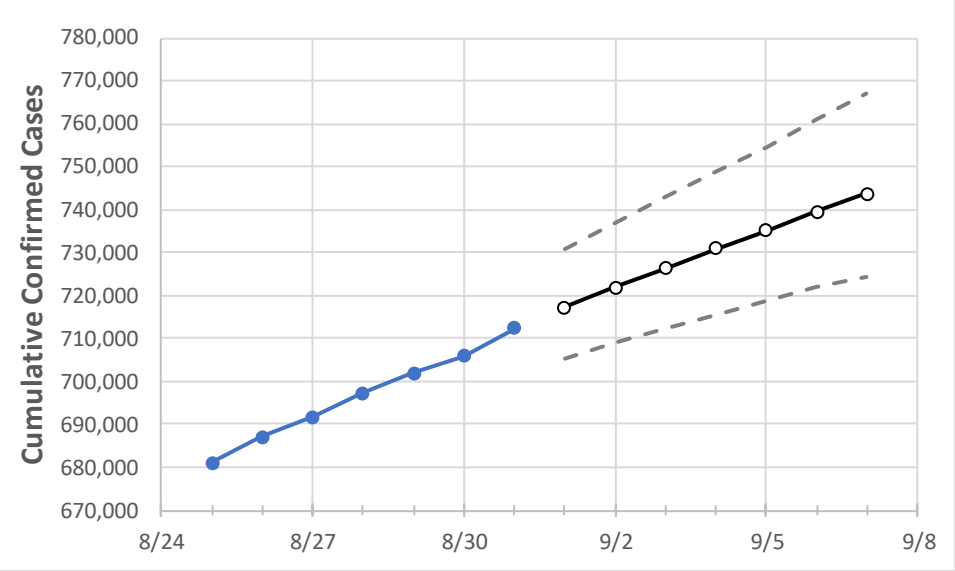
IEM's Modeling Lead

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:						
	8/28	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5	9/6	9/7
California	697,385	702,038	705,951	712,475	717,223	721,873	726,426	730,883	735,247	739,519	743,700

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 20%, and are often within 10%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	8/28	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5	9/6	9/7
Alameda	17,847	17,944	18,040	18,187	18,310	18,431	18,548	18,663	18,774	18,883	18,990
Contra Costa	13,398	13,562	13,700	13,938	14,057	14,174	14,288	14,400	14,510	14,617	14,723
Fresno	24,367	24,612	24,821	24,963	25,142	25,312	25,473	25,624	25,768	25,903	26,031
Kern	28,854	28,961	29,105	29,324	29,441	29,552	29,659	29,761	29,859	29,953	30,042
Los Angeles	238,458	239,756	240,749	241,768	243,033	244,293	245,549	246,801	248,049	249,294	250,534
Marin	6,054	6,068	6,116	6,164	6,187	6,210	6,232	6,255	6,278	6,301	6,324
Monterey	7,522	7,619	7,685	7,980	8,069	8,158	8,247	8,337	8,426	8,516	8,606
Orange	47,782	48,190	48,444	48,538	48,781	49,018	49,250	49,476	49,698	49,914	50,125
Placer	2,899	2,947	2,973	3,003	3,027	3,051	3,074	3,098	3,121	3,144	3,167
Riverside	51,860	51,889	51,918	52,909	53,080	53,241	53,394	53,539	53,675	53,805	53,927
Sacramento	17,150	17,369	17,588	18,052	18,172	18,294	18,418	18,543	18,670	18,799	18,930
San Bernardino	46,892	47,145	47,373	47,642	47,897	48,138	48,366	48,582	48,787	48,981	49,165
San Diego	37,784	38,047	38,300	38,604	38,880	39,156	39,432	39,709	39,987	40,264	40,542
San Francisco	9,215	9,349	9,428	9,494	9,562	9,629	9,695	9,761	9,825	9,888	9,951
San Joaquin	16,989	17,114	17,493	17,637	17,763	17,887	18,010	18,131	18,251	18,370	18,487
San Luis Obispo	2,842	2,882	2,917	2,981	3,003	3,025	3,046	3,068	3,090	3,112	3,134
San Mateo	7,978	8,074	8,122	8,169	8,225	8,279	8,332	8,384	8,434	8,482	8,529
Santa Barbara	7,951	8,014	8,052	8,143	8,197	8,251	8,306	8,361	8,418	8,474	8,532
Santa Clara	16,607	17,013	17,181	17,349	17,497	17,644	17,790	17,934	18,078	18,219	18,360
Santa Cruz	1,734	1,747	1,746	1,744	1,757	1,770	1,783	1,796	1,809	1,821	1,834
Solano	5,388	5,429	5,471	5,512	5,553	5,594	5,633	5,672	5,711	5,748	5,785
Sonoma	5,588	5,654	5,686	5,718	5,769	5,819	5,866	5,912	5,955	5,997	6,037
Ventura	10,483	10,606	10,705	10,775	10,874	10,973	11,073	11,174	11,275	11,377	11,480

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:		
	8/28	8/29	8/30	8/31	9/2	9/4	9/6
Alameda	17,847	17,944	18,040	18,187	18,431 (3,686) [885] {442}	18,663 (3,733) [896] {448}	18,883 (3,777) [906] {453}
Contra Costa	13,398	13,562	13,700	13,938	14,174 (2,835) [680] {340}	14,400 (2,880) [691] {346}	14,617 (2,923) [702] {351}
Fresno	24,367	24,612	24,821	24,963	25,312 (5,062) [1,215] {607}	25,624 (5,125) [1,230] {615}	25,903 (5,181) [1,243] {622}
Kern	28,854	28,961	29,105	29,324	29,552 (5,910) [1,419] {709}	29,761 (5,952) [1,429] {714}	29,953 (5,991) [1,438] {719}
Los Angeles	238,458	239,756	240,749	241,768	244,293 (48,859) [11,726] {5,863}	246,801 (49,360) [11,846] {5,923}	249,294 (49,859) [11,966] {5,983}
Marin	6,054	6,068	6,116	6,164	6,210 (1,242) [298] {149}	6,255 (1,251) [300] {150}	6,301 (1,260) [302] {151}
Monterey	7,522	7,619	7,685	7,980	8,158 (1,632) [392] {196}	8,337 (1,667) [400] {200}	8,516 (1,703) [409] {204}
Orange	47,782	48,190	48,444	48,538	49,018 (9,804) [2,353] {1,176}	49,476 (9,895) [2,375] {1,187}	49,914 (9,983) [2,396] {1,198}
Placer	2,899	2,947	2,973	3,003	3,051 (610) [146] {73}	3,098 (620) [149] {74}	3,144 (629) [151] {75}
Riverside	51,860	51,889	51,918	52,909	53,241 (10,648) [2,556] {1,278}	53,539 (10,708) [2,570] {1,285}	53,805 (10,761) [2,583] {1,291}
Sacramento	17,150	17,369	17,588	18,052	18,294 (3,659) [878] {439}	18,543 (3,709) [890] {445}	18,799 (3,760) [902] {451}
San Bernardino	46,892	47,145	47,373	47,642	48,138 (9,628) [2,311] {1,155}	48,582 (9,716) [2,332] {1,166}	48,981 (9,796) [2,351] {1,176}
San Diego	37,784	38,047	38,300	38,604	39,156 (7,831) [1,879] {940}	39,709 (7,942) [1,906] {953}	40,264 (8,053) [1,933] {966}
San Francisco	9,215	9,349	9,428	9,494	9,629 (1,926) [462] {231}	9,761 (1,952) [469] {234}	9,888 (1,978) [475] {237}
San Joaquin	16,989	17,114	17,493	17,637	17,887 (3,577) [859] {429}	18,131 (3,626) [870] {435}	18,370 (3,674) [882] {441}
San Luis Obispo	2,842	2,882	2,917	2,981	3,025 (605) [145] {73}	3,068 (614) [147] {74}	3,112 (622) [149] {75}
San Mateo	7,978	8,074	8,122	8,169	8,279 (1,656) [397] {199}	8,384 (1,677) [402] {201}	8,482 (1,696) [407] {204}
Santa Barbara	7,951	8,014	8,052	8,143	8,251 (1,650) [396] {198}	8,361 (1,672) [401] {201}	8,474 (1,695) [407] {203}
Santa Clara	16,607	17,013	17,181	17,349	17,644 (3,529) [847] {423}	17,934 (3,587) [861] {430}	18,219 (3,644) [875] {437}
Santa Cruz	1,734	1,747	1,746	1,744	1,770 (354) [85] {42}	1,796 (359) [86] {43}	1,821 (364) [87] {44}
Solano	5,388	5,429	5,471	5,512	5,594 (1,119) [268] {134}	5,672 (1,134) [272] {136}	5,748 (1,150) [276] {138}
Sonoma	5,588	5,654	5,686	5,718	5,819 (1,164) [279] {140}	5,912 (1,182) [284] {142}	5,997 (1,199) [288] {144}
Ventura	10,483	10,606	10,705	10,775	10,973 (2,195) [527] {263}	11,174 (2,235) [536] {268}	11,377 (2,275) [546] {273}

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.