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

Date: 12/10/20

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 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 12/10/20 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.

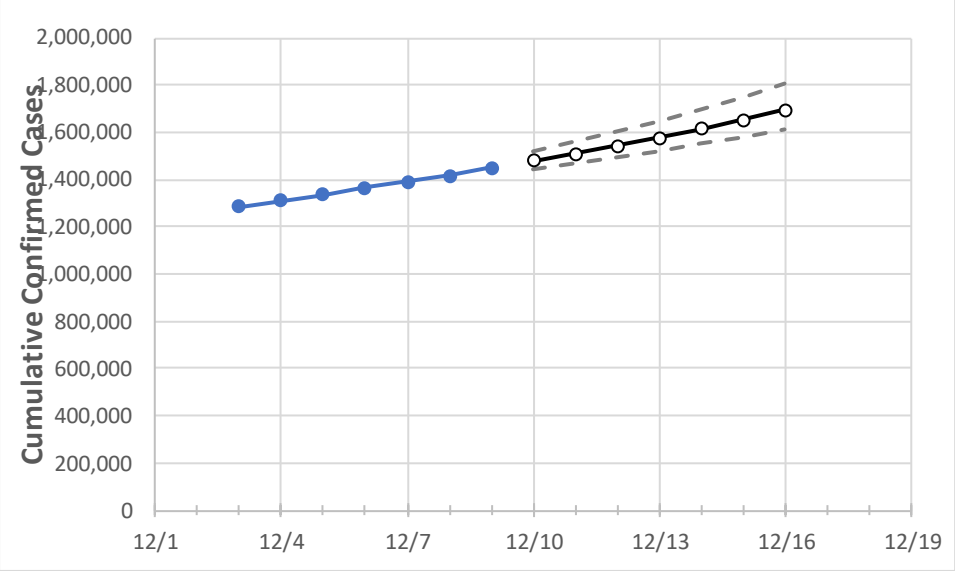
IEM's Modeling Lead

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
California	1,366,673	1,390,828	1,415,396	1,448,987	1,478,530	1,509,712	1,542,616	1,577,336	1,613,965	1,652,605	1,693,355

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
Alameda	32,781	33,477	33,887	34,373	34,973	35,615	36,301	37,035	37,820	38,659	39,556
Contra Costa	26,355	26,703	27,455	28,088	28,577	29,096	29,646	30,230	30,849	31,505	32,200
Fresno	40,568	40,869	41,098	41,574	41,885	42,198	42,513	42,829	43,146	43,466	43,786
Kern	44,327	45,078	45,342	46,397	46,891	47,401	47,927	48,470	49,030	49,607	50,203
Lake	1,069	1,075	1,092	1,131	1,152	1,175	1,199	1,226	1,254	1,285	1,319
Los Angeles	449,851	457,880	466,321	475,271	486,146	497,754	510,140	523,354	537,448	552,477	568,499
Marin	8,016	8,064	8,102	8,192	8,243	8,297	8,354	8,414	8,478	8,544	8,614
Monterey	17,077	17,426	17,746	17,752	17,861	17,972	18,087	18,205	18,327	18,452	18,581
Orange	86,878	88,842	90,513	93,126	95,091	97,167	99,360	101,676	104,122	106,705	109,432
Placer	7,811	7,979	8,173	8,544	8,773	9,020	9,286	9,573	9,882	10,216	10,575
Riverside	98,612	100,088	103,221	107,620	109,967	112,489	115,197	118,105	121,226	124,574	128,167
Sacramento	41,878	42,808	43,426	44,688	45,538	46,429	47,362	48,338	49,361	50,430	51,550
San Bernardino	106,770	107,928	108,946	111,518	113,509	115,647	117,942	120,405	123,048	125,883	128,925
San Diego	92,171	94,169	95,445	97,549	99,476	101,555	103,799	106,219	108,829	111,643	114,678
San Francisco	16,786	17,107	17,220	17,384	17,595	17,815	18,042	18,279	18,525	18,780	19,044
San Joaquin	28,105	28,188	29,207	30,225	30,386	30,558	30,743	30,942	31,156	31,385	31,631
San Luis Obispo	6,623	6,723	6,873	6,965	7,015	7,067	7,119	7,172	7,226	7,281	7,337
San Mateo	15,512	16,101	16,371	16,666	16,795	16,930	17,071	17,220	17,375	17,538	17,710
Santa Barbara	12,107	12,252	12,379	12,516	12,634	12,758	12,888	13,026	13,170	13,321	13,481
Santa Clara	39,193	40,624	41,316	43,001	44,114	45,297	46,554	47,890	49,309	50,817	52,418
Santa Cruz	4,997	5,069	5,157	5,374	5,465	5,558	5,654	5,752	5,853	5,956	6,063
Solano	11,636	11,747	11,950	12,123	12,202	12,287	12,376	12,470	12,570	12,676	12,788
Sonoma	13,369	13,439	13,719	13,719	13,930	14,152	14,386	14,633	14,893	15,168	15,457
Ventura	22,710	23,035	23,354	23,665	24,150	24,661	25,199	25,767	26,365	26,996	27,660

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:		
	12/6	12/7	12/8	12/9	12/11	12/13	12/15
Alameda	32,781	33,477	33,887	34,373	35,615 (7,123) [1,709] {855}	37,035 (7,407) [1,778] {889}	38,659 (7,732) [1,856] {928}
Contra Costa	26,355	26,703	27,455	28,088	29,096 (5,819) [1,397] {698}	30,230 (6,046) [1,451] {726}	31,505 (6,301) [1,512] {756}
Fresno	40,568	40,869	41,098	41,574	42,198 (8,440) [2,026] {1,013}	42,829 (8,566) [2,056] {1,028}	43,466 (8,693) [2,086] {1,043}
Kern	44,327	45,078	45,342	46,397	47,401 (9,480) [2,275] {1,138}	48,470 (9,694) [2,327] {1,163}	49,607 (9,921) [2,381] {1,191}
Lake	1,069	1,075	1,092	1,131	1,175 (235) [56] {28}	1,226 (245) [59] {29}	1,285 (257) [62] {31}
Los Angeles	449,851	457,880	466,321	475,271	497,754 (99,551) [23,892] {11,946}	523,354 (104,671) [25,121] {12,560}	552,477 (110,495) [26,519] {13,259}
Marin	8,016	8,064	8,102	8,192	8,297 (1,659) [398] {199}	8,414 (1,683) [404] {202}	8,544 (1,709) [410] {205}
Monterey	17,077	17,426	17,746	17,752	17,972 (3,594) [863] {431}	18,205 (3,641) [874] {437}	18,452 (3,690) [886] {443}
Orange	86,878	88,842	90,513	93,126	97,167 (19,433) [4,664] {2,332}	101,676 (20,335) [4,880] {2,440}	106,705 (21,341) [5,122] {2,561}
Placer	7,811	7,979	8,173	8,544	9,020 (1,804) [433] {216}	9,573 (1,915) [459] {230}	10,216 (2,043) [490] {245}
Riverside	98,612	100,088	103,221	107,620	112,489 (22,498) [5,399] {2,700}	118,105 (23,621) [5,669] {2,835}	124,574 (24,915) [5,980] {2,990}
Sacramento	41,878	42,808	43,426	44,688	46,429 (9,286) [2,229] {1,114}	48,338 (9,668) [2,320] {1,160}	50,430 (10,086) [2,421] {1,210}
San Bernardino	106,770	107,928	108,946	111,518	115,647 (23,129) [5,551] {2,776}	120,405 (24,081) [5,779] {2,890}	125,883 (25,177) [6,042] {3,021}
San Diego	92,171	94,169	95,445	97,549	101,555 (20,311) [4,875] {2,437}	106,219 (21,244) [5,099] {2,549}	111,643 (22,329) [5,359] {2,679}
San Francisco	16,786	17,107	17,220	17,384	17,815 (3,563) [855] {428}	18,279 (3,656) [877] {439}	18,780 (3,756) [901] {451}
San Joaquin	28,105	28,188	29,207	30,225	30,558 (6,112) [1,467] {733}	30,942 (6,188) [1,485] {743}	31,385 (6,277) [1,506] {753}
San Luis Obispo	6,623	6,723	6,873	6,965	7,067 (1,413) [339] {170}	7,172 (1,434) [344] {172}	7,281 (1,456) [350] {175}
San Mateo	15,512	16,101	16,371	16,666	16,930 (3,386) [813] {406}	17,220 (3,444) [827] {413}	17,538 (3,508) [842] {421}
Santa Barbara	12,107	12,252	12,379	12,516	12,758 (2,552) [612] {306}	13,026 (2,605) [625] {313}	13,321 (2,664) [639] {320}
Santa Clara	39,193	40,624	41,316	43,001	45,297 (9,059) [2,174] {1,087}	47,890 (9,578) [2,299] {1,149}	50,817 (10,163) [2,439] {1,220}
Santa Cruz	4,997	5,069	5,157	5,374	5,558 (1,112) [267] {133}	5,752 (1,150) [276] {138}	5,956 (1,191) [286] {143}
Solano	11,636	11,747	11,950	12,123	12,287 (2,457) [590] {295}	12,470 (2,494) [599] {299}	12,676 (2,535) [608] {304}
Sonoma	13,369	13,439	13,719	13,719	14,152 (2,830) [679] {340}	14,633 (2,927) [702] {351}	15,168 (3,034) [728] {364}
Ventura	22,710	23,035	23,354	23,665	24,661 (4,932) [1,184] {592}	25,767 (5,153) [1,237] {618}	26,996 (5,399) [1,296] {648}

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.