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

Date: 7/22/20

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 7/22/20 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.

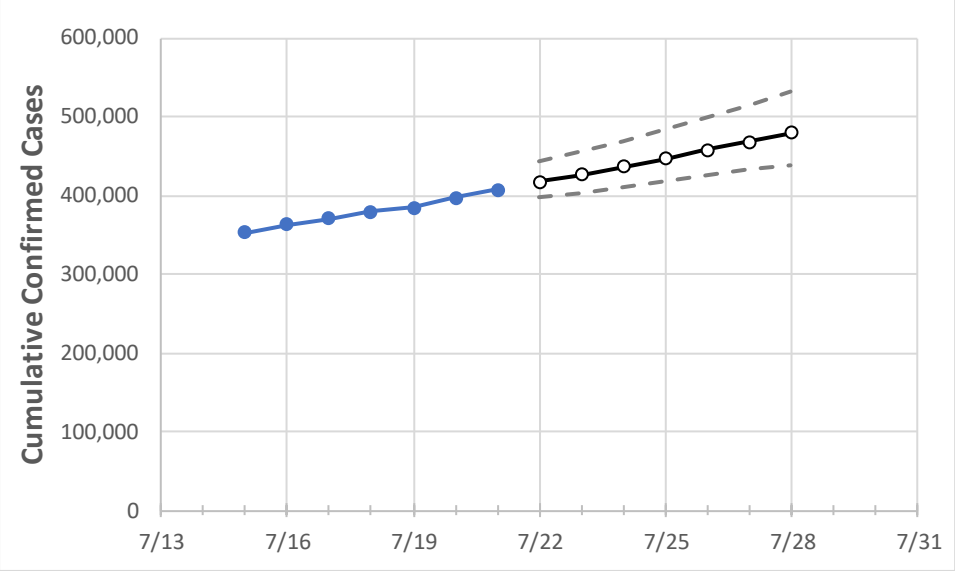
IEM's Modeling Lead

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:						
	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28
California	379,114	384,978	396,573	407,367	416,977	426,782	436,787	446,996	457,413	468,042	478,887

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:						
	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28
Alameda	9,110	9,237	9,256	9,383	9,497	9,609	9,720	9,829	9,937	10,044	10,149
Contra Costa	5,538	5,606	5,731	5,931	6,060	6,191	6,325	6,461	6,599	6,740	6,883
Fresno	9,954	10,297	10,639	10,970	11,286	11,612	11,949	12,296	12,654	13,024	13,404
Kern	7,728	8,447	9,234	10,068	10,571	11,123	11,729	12,394	13,124	13,924	14,802
Los Angeles	153,041	155,887	159,045	161,673	164,990	168,382	171,849	175,394	179,017	182,721	186,507
Marin	3,226	3,236	3,246	3,253	3,268	3,282	3,295	3,308	3,321	3,333	3,344
Monterey	3,157	3,255	3,353	3,379	3,453	3,528	3,605	3,683	3,763	3,844	3,928
Orange	29,011	29,426	29,986	30,976	31,622	32,263	32,899	33,531	34,158	34,781	35,399
Placer	1,280	1,363	1,403	1,442	1,484	1,527	1,573	1,619	1,668	1,719	1,771
Riverside	29,124	29,554	29,983	30,890	31,463	32,038	32,617	33,199	33,785	34,374	34,967
Sacramento	6,693	6,935	7,326	7,686	7,950	8,224	8,506	8,798	9,100	9,412	9,734
San Bernardino	23,566	23,772	24,099	25,067	25,638	26,221	26,818	27,427	28,050	28,688	29,340
San Diego	23,114	23,682	24,135	24,520	25,052	25,592	26,141	26,699	27,266	27,842	28,428
San Francisco	5,116	5,202	5,305	5,363	5,475	5,593	5,717	5,846	5,982	6,124	6,272
San Joaquin	7,986	8,154	8,321	8,799	9,024	9,253	9,485	9,722	9,962	10,205	10,453
San Luis Obispo	1,244	1,275	1,306	1,369	1,414	1,462	1,511	1,563	1,617	1,674	1,734
San Mateo	4,465	4,508	4,551	4,674	4,748	4,823	4,901	4,980	5,061	5,145	5,230
Santa Barbara	4,759	4,875	4,991	5,124	5,234	5,348	5,466	5,588	5,715	5,846	5,983
Santa Clara	7,300	7,456	7,795	8,046	8,276	8,517	8,768	9,030	9,303	9,588	9,886
Santa Cruz	772	772	772	772	802	834	869	908	951	997	1,048
Solano	2,622	2,691	2,759	2,857	2,943	3,032	3,124	3,220	3,320	3,423	3,531
Sonoma	2,068	2,121	2,169	2,241	2,312	2,387	2,466	2,549	2,636	2,728	2,826
Ventura	5,080	5,136	5,192	5,955	6,063	6,172	6,281	6,390	6,499	6,609	6,719

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:		
	7/18	7/19	7/20	7/21	7/23	7/25	7/27
Alameda	9,110	9,237	9,256	9,383	9,609 (1,922) [461] {231}	9,829 (1,966) [472] {236}	10,044 (2,009) [482] {241}
Contra Costa	5,538	5,606	5,731	5,931	6,191 (1,238) [297] {149}	6,461 (1,292) [310] {155}	6,740 (1,348) [324] {162}
Fresno	9,954	10,297	10,639	10,970	11,612 (2,322) [557] {279}	12,296 (2,459) [590] {295}	13,024 (2,605) [625] {313}
Kern	7,728	8,447	9,234	10,068	11,123 (2,225) [534] {267}	12,394 (2,479) [595] {297}	13,924 (2,785) [668] {334}
Los Angeles	153,041	155,887	159,045	161,673	168,382 (33,676) [8,082] {4,041}	175,394 (35,079) [8,419] {4,209}	182,721 (36,544) [8,771] {4,385}
Marin	3,226	3,236	3,246	3,253	3,282 (656) [158] {79}	3,308 (662) [159] {79}	3,333 (667) [160] {80}
Monterey	3,157	3,255	3,353	3,379	3,528 (706) [169] {85}	3,683 (737) [177] {88}	3,844 (769) [185] {92}
Orange	29,011	29,426	29,986	30,976	32,263 (6,453) [1,549] {774}	33,531 (6,706) [1,609] {805}	34,781 (6,956) [1,669] {835}
Placer	1,280	1,363	1,403	1,442	1,527 (305) [73] {37}	1,619 (324) [78] {39}	1,719 (344) [82] {41}
Riverside	29,124	29,554	29,983	30,890	32,038 (6,408) [1,538] {769}	33,199 (6,640) [1,594] {797}	34,374 (6,875) [1,650] {825}
Sacramento	6,693	6,935	7,326	7,686	8,224 (1,645) [395] {197}	8,798 (1,760) [422] {211}	9,412 (1,882) [452] {226}
San Bernardino	23,566	23,772	24,099	25,067	26,221 (5,244) [1,259] {629}	27,427 (5,485) [1,316] {658}	28,688 (5,738) [1,377] {689}
San Diego	23,114	23,682	24,135	24,520	25,592 (5,118) [1,228] {614}	26,699 (5,340) [1,282] {641}	27,842 (5,568) [1,336] {668}
San Francisco	5,116	5,202	5,305	5,363	5,593 (1,119) [268] {134}	5,846 (1,169) [281] {140}	6,124 (1,225) [294] {147}
San Joaquin	7,986	8,154	8,321	8,799	9,253 (1,851) [444] {222}	9,722 (1,944) [467] {233}	10,205 (2,041) [490] {245}
San Luis Obispo	1,244	1,275	1,306	1,369	1,462 (292) [70] {35}	1,563 (313) [75] {38}	1,674 (335) [80] {40}
San Mateo	4,465	4,508	4,551	4,674	4,823 (965) [232] {116}	4,980 (996) [239] {120}	5,145 (1,029) [247] {123}
Santa Barbara	4,759	4,875	4,991	5,124	5,348 (1,070) [257] {128}	5,588 (1,118) [268] {134}	5,846 (1,169) [281] {140}
Santa Clara	7,300	7,456	7,795	8,046	8,517 (1,703) [409] {204}	9,030 (1,806) [433] {217}	9,588 (1,918) [460] {230}
Santa Cruz	772	772	772	772	834 (167) [40] {20}	908 (182) [44] {22}	997 (199) [48] {24}
Solano	2,622	2,691	2,759	2,857	3,032 (606) [146] {73}	3,220 (644) [155] {77}	3,423 (685) [164] {82}
Sonoma	2,068	2,121	2,169	2,241	2,387 (477) [115] {57}	2,549 (510) [122] {61}	2,728 (546) [131] {65}
Ventura	5,080	5,136	5,192	5,955	6,172 (1,234) [296] {148}	6,390 (1,278) [307] {153}	6,609 (1,322) [317] {159}

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.