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

Date: 7/24/20

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 7/24/20 11 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.

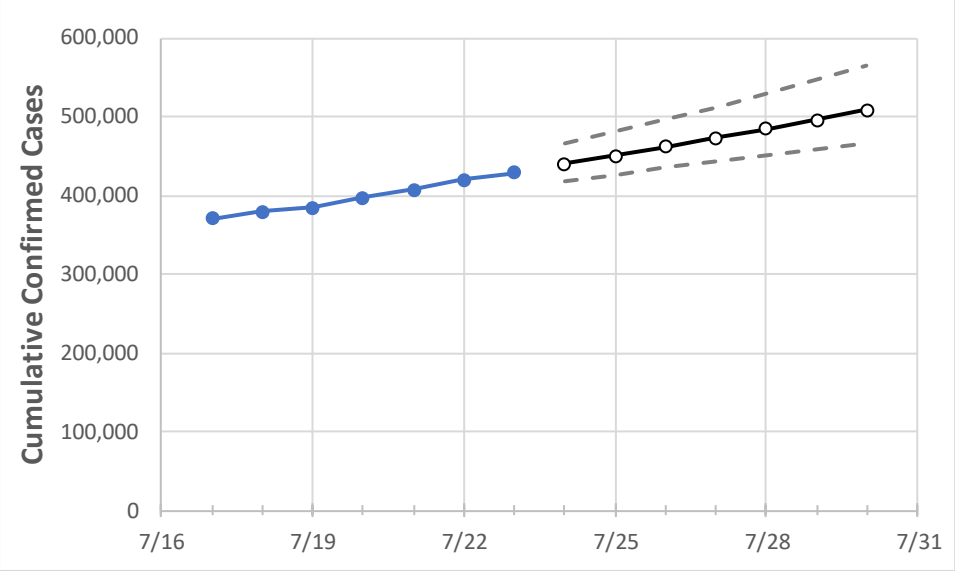
IEM's Modeling Lead

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:						
	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29	7/30
California	396,577	407,367	419,555	429,235	439,738	450,498	461,521	472,810	484,370	496,208	508,328

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:						
	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29	7/30
Alameda	9,256	9,383	9,643	9,869	10,018	10,167	10,318	10,471	10,624	10,779	10,935
Contra Costa	5,731	5,931	6,202	6,425	6,593	6,765	6,943	7,127	7,316	7,511	7,712
Fresno	10,639	10,970	11,412	11,756	12,124	12,508	12,908	13,324	13,757	14,209	14,679
Kern	9,234	10,068	11,188	12,323	13,155	14,094	15,151	16,341	17,681	19,188	20,882
Los Angeles	159,045	161,673	164,870	166,848	169,805	172,789	175,799	178,837	181,902	184,994	188,114
Marin	3,246	3,253	3,294	3,327	3,343	3,359	3,374	3,389	3,404	3,418	3,432
Monterey	3,353	3,379	3,545	3,726	3,826	3,929	4,035	4,146	4,260	4,379	4,502
Orange	29,986	30,976	31,743	32,648	33,331	34,009	34,684	35,356	36,027	36,698	37,369
Placer	1,403	1,442	1,479	1,531	1,574	1,619	1,666	1,714	1,764	1,815	1,869
Riverside	29,983	30,890	31,982	32,813	33,503	34,207	34,926	35,659	36,407	37,171	37,950
Sacramento	7,326	7,686	7,971	8,247	8,537	8,836	9,146	9,467	9,799	10,141	10,496
San Bernardino	24,099	25,067	25,775	26,185	26,781	27,392	28,019	28,664	29,325	30,004	30,701
San Diego	24,135	24,520	25,107	25,608	26,134	26,667	27,206	27,751	28,303	28,861	29,426
San Francisco	5,305	5,363	5,459	5,564	5,665	5,768	5,874	5,984	6,097	6,213	6,333
San Joaquin	8,321	8,799	9,595	9,826	10,112	10,405	10,708	11,020	11,340	11,670	12,010
San Luis Obispo	1,306	1,369	1,393	1,467	1,514	1,564	1,615	1,669	1,725	1,784	1,846
San Mateo	4,551	4,674	4,776	4,885	4,976	5,070	5,168	5,269	5,373	5,480	5,591
Santa Barbara	4,991	5,124	5,282	5,444	5,586	5,736	5,893	6,059	6,233	6,417	6,610
Santa Clara	7,795	8,046	8,321	8,533	8,759	8,994	9,236	9,487	9,746	10,015	10,293
Santa Cruz	810	829	848	878	904	931	960	991	1,025	1,061	1,099
Solano	2,759	2,857	2,982	3,070	3,170	3,274	3,384	3,499	3,619	3,745	3,878
Sonoma	2,169	2,241	2,271	2,300	2,345	2,391	2,437	2,484	2,531	2,578	2,626
Ventura	5,192	5,955	6,049	6,156	6,260	6,364	6,469	6,574	6,679	6,784	6,890

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:		
	7/20	7/21	7/22	7/23	7/25	7/27	7/29
Alameda	9,256	9,383	9,643	9,869	10,167 (2,033) [488] {244}	10,471 (2,094) [503] {251}	10,779 (2,156) [517] {259}
Contra Costa	5,731	5,931	6,202	6,425	6,765 (1,353) [325] {162}	7,127 (1,425) [342] {171}	7,511 (1,502) [361] {180}
Fresno	10,639	10,970	11,412	11,756	12,508 (2,502) [600] {300}	13,324 (2,665) [640] {320}	14,209 (2,842) [682] {341}
Kern	9,234	10,068	11,188	12,323	14,094 (2,819) [677] {338}	16,341 (3,268) [784] {392}	19,188 (3,838) [921] {461}
Los Angeles	159,045	161,673	164,870	166,848	172,789 (34,558) [8,294] {4,147}	178,837 (35,767) [8,584] {4,292}	184,994 (36,999) [8,880] {4,440}
Marin	3,246	3,253	3,294	3,327	3,359 (672) [161] {81}	3,389 (678) [163] {81}	3,418 (684) [164] {82}
Monterey	3,353	3,379	3,545	3,726	3,929 (786) [189] {94}	4,146 (829) [199] {100}	4,379 (876) [210] {105}
Orange	29,986	30,976	31,743	32,648	34,009 (6,802) [1,632] {816}	35,356 (7,071) [1,697] {849}	36,698 (7,340) [1,762] {881}
Placer	1,403	1,442	1,479	1,531	1,619 (324) [78] {39}	1,714 (343) [82] {41}	1,815 (363) [87] {44}
Riverside	29,983	30,890	31,982	32,813	34,207 (6,841) [1,642] {821}	35,659 (7,132) [1,712] {856}	37,171 (7,434) [1,784] {892}
Sacramento	7,326	7,686	7,971	8,247	8,836 (1,767) [424] {212}	9,467 (1,893) [454] {227}	10,141 (2,028) [487] {243}
San Bernardino	24,099	25,067	25,775	26,185	27,392 (5,478) [1,315] {657}	28,664 (5,733) [1,376] {688}	30,004 (6,001) [1,440] {720}
San Diego	24,135	24,520	25,107	25,608	26,667 (5,333) [1,280] {640}	27,751 (5,550) [1,332] {666}	28,861 (5,772) [1,385] {693}
San Francisco	5,305	5,363	5,459	5,564	5,768 (1,154) [277] {138}	5,984 (1,197) [287] {144}	6,213 (1,243) [298] {149}
San Joaquin	8,321	8,799	9,595	9,826	10,405 (2,081) [499] {250}	11,020 (2,204) [529] {264}	11,670 (2,334) [560] {280}
San Luis Obispo	1,306	1,369	1,393	1,467	1,564 (313) [75] {38}	1,669 (334) [80] {40}	1,784 (357) [86] {43}
San Mateo	4,551	4,674	4,776	4,885	5,070 (1,014) [243] {122}	5,269 (1,054) [253] {126}	5,480 (1,096) [263] {132}
Santa Barbara	4,991	5,124	5,282	5,444	5,736 (1,147) [275] {138}	6,059 (1,212) [291] {145}	6,417 (1,283) [308] {154}
Santa Clara	7,795	8,046	8,321	8,533	8,994 (1,799) [432] {216}	9,487 (1,897) [455] {228}	10,015 (2,003) [481] {240}
Santa Cruz	810	829	848	878	931 (186) [45] {22}	991 (198) [48] {24}	1,061 (212) [51] {25}
Solano	2,759	2,857	2,982	3,070	3,274 (655) [157] {79}	3,499 (700) [168] {84}	3,745 (749) [180] {90}
Sonoma	2,169	2,241	2,271	2,300	2,391 (478) [115] {57}	2,484 (497) [119] {60}	2,578 (516) [124] {62}
Ventura	5,192	5,955	6,049	6,156	6,364 (1,273) [305] {153}	6,574 (1,315) [316] {158}	6,784 (1,357) [326] {163}

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.