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

Date: 7/29/20

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 7/29/20 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.

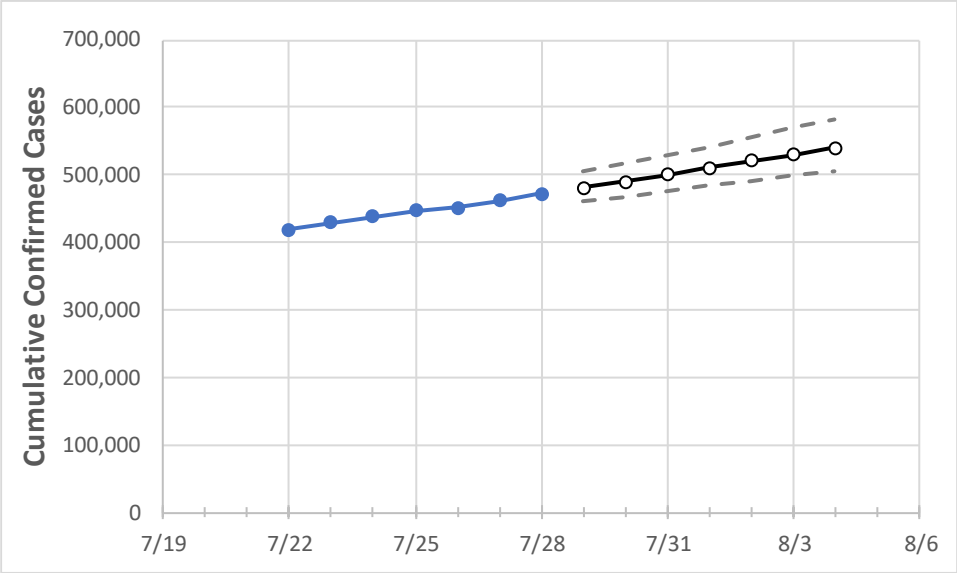
IEM's Modeling Lead

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:						
	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1	8/2	8/3	8/4
California	446,334	450,801	461,381	471,437	480,950	490,579	500,324	510,188	520,172	530,276	540,502

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:						
	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1	8/2	8/3	8/4
Alameda	10,330	10,370	10,438	10,633	10,759	10,884	11,009	11,135	11,260	11,384	11,509
Contra Costa	6,770	6,933	7,073	7,304	7,481	7,663	7,851	8,044	8,242	8,447	8,657
Fresno	12,564	12,887	13,209	13,336	13,672	14,016	14,367	14,726	15,093	15,468	15,851
Kern	14,192	14,561	15,003	16,896	17,928	18,888	19,817	20,822	21,781	22,748	23,822
Los Angeles	172,325	173,995	176,028	178,642	181,192	183,743	186,295	188,849	191,405	193,961	196,519
Marin	3,327	3,327	3,327	3,327	3,342	3,357	3,372	3,386	3,401	3,414	3,428
Monterey	3,937	4,010	4,082	4,140	4,224	4,309	4,396	4,486	4,577	4,670	4,766
Orange	33,953	34,373	34,646	34,833	35,291	35,740	36,183	36,617	37,045	37,465	37,878
Placer	1,605	1,648	1,685	1,753	1,798	1,844	1,892	1,941	1,992	2,045	2,099
Riverside	34,040	34,614	35,187	35,910	36,580	37,261	37,953	38,656	39,371	40,096	40,834
Sacramento	8,636	8,903	9,018	9,418	9,665	9,916	10,173	10,434	10,700	10,972	11,248
San Bernardino	27,555	27,992	29,131	29,962	30,613	31,281	31,967	32,671	33,394	34,135	34,896
San Diego	26,701	26,984	27,507	28,005	28,512	29,025	29,543	30,066	30,595	31,130	31,670
San Francisco	5,787	5,932	6,022	6,065	6,167	6,271	6,379	6,490	6,605	6,722	6,843
San Joaquin	10,309	10,492	10,675	10,923	11,162	11,404	11,651	11,902	12,156	12,415	12,678
San Luis Obispo	1,548	1,596	1,644	1,689	1,735	1,782	1,831	1,882	1,934	1,989	2,045
San Mateo	5,022	5,073	5,124	5,198	5,272	5,348	5,424	5,502	5,581	5,662	5,743
Santa Barbara	5,663	5,749	5,836	5,931	6,042	6,156	6,273	6,393	6,517	6,644	6,775
Santa Clara	8,833	9,041	9,215	9,359	9,559	9,763	9,971	10,185	10,403	10,625	10,853
Santa Cruz	898	907	920	980	1,003	1,027	1,053	1,080	1,108	1,138	1,169
Solano	3,180	3,232	3,283	3,388	3,468	3,549	3,632	3,717	3,803	3,892	3,982
Sonoma	2,466	2,559	2,570	2,617	2,663	2,710	2,758	2,807	2,857	2,907	2,959
Ventura	6,538	6,684	6,830	6,893	7,012	7,132	7,253	7,376	7,500	7,626	7,753

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:		
	7/25	7/26	7/27	7/28	7/30	8/1	8/3
Alameda	10,330	10,370	10,438	10,633	10,884 (2,177) [522] {261}	11,135 (2,227) [534] {267}	11,384 (2,277) [546] {273}
Contra Costa	6,770	6,933	7,073	7,304	7,663 (1,533) [368] {184}	8,044 (1,609) [386] {193}	8,447 (1,689) [405] {203}
Fresno	12,564	12,887	13,209	13,336	14,016 (2,803) [673] {336}	14,726 (2,945) [707] {353}	15,468 (3,094) [742] {371}
Kern	14,192	14,561	15,003	16,896	18,888 (3,778) [907] {453}	20,822 (4,164) [999] {500}	22,748 (4,550) [1,092] {546}
Los Angeles	172,325	173,995	176,028	178,642	183,743 (36,749) [8,820] {4,410}	188,849 (37,770) [9,065] {4,532}	193,961 (38,792) [9,310] {4,655}
Marin	3,327	3,327	3,327	3,327	3,357 (671) [161] {81}	3,386 (677) [163] {81}	3,414 (683) [164] {82}
Monterey	3,937	4,010	4,082	4,140	4,309 (862) [207] {103}	4,486 (897) [215] {108}	4,670 (934) [224] {112}
Orange	33,953	34,373	34,646	34,833	35,740 (7,148) [1,716] {858}	36,617 (7,323) [1,758] {879}	37,465 (7,493) [1,798] {899}
Placer	1,605	1,648	1,685	1,753	1,844 (369) [89] {44}	1,941 (388) [93] {47}	2,045 (409) [98] {49}
Riverside	34,040	34,614	35,187	35,910	37,261 (7,452) [1,789] {894}	38,656 (7,731) [1,855] {928}	40,096 (8,019) [1,925] {962}
Sacramento	8,636	8,903	9,018	9,418	9,916 (1,983) [476] {238}	10,434 (2,087) [501] {250}	10,972 (2,194) [527] {263}
San Bernardino	27,555	27,992	29,131	29,962	31,281 (6,256) [1,502] {751}	32,671 (6,534) [1,568] {784}	34,135 (6,827) [1,638] {819}
San Diego	26,701	26,984	27,507	28,005	29,025 (5,805) [1,393] {697}	30,066 (6,013) [1,443] {722}	31,130 (6,226) [1,494] {747}
San Francisco	5,787	5,932	6,022	6,065	6,271 (1,254) [301] {151}	6,490 (1,298) [312] {156}	6,722 (1,344) [323] {161}
San Joaquin	10,309	10,492	10,675	10,923	11,404 (2,281) [547] {274}	11,902 (2,380) [571] {286}	12,415 (2,483) [596] {298}
San Luis Obispo	1,548	1,596	1,644	1,689	1,782 (356) [86] {43}	1,882 (376) [90] {45}	1,989 (398) [95] {48}
San Mateo	5,022	5,073	5,124	5,198	5,348 (1,070) [257] {128}	5,502 (1,100) [264] {132}	5,662 (1,132) [272] {136}
Santa Barbara	5,663	5,749	5,836	5,931	6,156 (1,231) [295] {148}	6,393 (1,279) [307] {153}	6,644 (1,329) [319] {159}
Santa Clara	8,833	9,041	9,215	9,359	9,763 (1,953) [469] {234}	10,185 (2,037) [489] {244}	10,625 (2,125) [510] {255}
Santa Cruz	898	907	920	980	1,027 (205) [49] {25}	1,080 (216) [52] {26}	1,138 (228) [55] {27}
Solano	3,180	3,232	3,283	3,388	3,549 (710) [170] {85}	3,717 (743) [178] {89}	3,892 (778) [187] {93}
Sonoma	2,466	2,559	2,570	2,617	2,710 (542) [130] {65}	2,807 (561) [135] {67}	2,907 (581) [140] {70}
Ventura	6,538	6,684	6,830	6,893	7,132 (1,426) [342] {171}	7,376 (1,475) [354] {177}	7,626 (1,525) [366] {183}

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.