IEM's AI Modeling: Short-term COVID-19 Projections
Date: 8/10/20

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 <u>not</u> 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 8/10/20 12 p.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
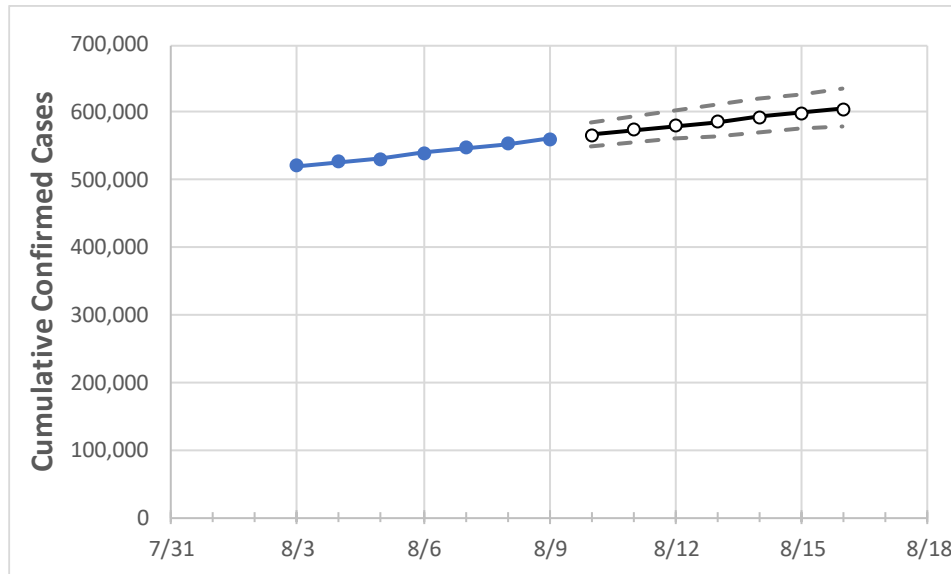
	Actual Confirmed Cases On:				Projected Cases For:						
	8/6	8/7	8/8	8/9	8/10	8/11	8/12	8/13	8/14	8/15	8/16
California	539,980	547,943	554,022	560,266	566,969	573,584	580,114	586,559	592,921	599,201	605,401

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:						
	8/6	8/7	8/8	8/9	8/10	8/11	8/12	8/13	8/14	8/15	8/16
Alameda	12,402	12,668	12,933	13,199	13,388	13,581	13,779	13,981	14,188	14,399	14,615
Contra Costa	8,532	8,760	9,022	9,182	9,330	9,480	9,632	9,786	9,942	10,099	10,259
Fresno	16,625	17,031	17,290	17,290	17,612	17,938	18,267	18,599	18,935	19,275	19,617
Kern	21,724	22,009	22,626	23,583	24,140	24,709	25,293	25,890	26,501	27,126	27,767
Los Angeles	201,106	204,167	206,761	208,528	210,727	212,915	215,092	217,258	219,413	221,558	223,691
Marin	5,250	5,286	5,286	5,286	5,361	5,439	5,520	5,604	5,691	5,781	5,875
Monterey	5,120	5,156	5,156	5,156	5,235	5,315	5,396	5,477	5,560	5,642	5,726
Orange	38,711	38,754	39,076	39,641	39,856	40,063	40,261	40,451	40,633	40,808	40,975
Placer	2,039	2,099	2,186	2,282	2,321	2,361	2,402	2,443	2,485	2,528	2,572
Riverside	39,741	40,452	40,452	40,452	40,854	41,253	41,649	42,042	42,432	42,819	43,202
Sacramento	10,544	10,795	10,795	10,795	10,894	10,992	11,086	11,179	11,269	11,357	11,443
San Bernardino	34,635	34,939	35,452	35,712	36,057	36,398	36,735	37,067	37,394	37,717	38,036
San Diego	31,127	31,779	32,330	32,747	33,110	33,472	33,831	34,189	34,544	34,898	35,250
San Francisco	7,228	7,326	7,432	7,548	7,655	7,764	7,874	7,987	8,101	8,218	8,336
San Joaquin	12,119	12,303	12,303	12,303	12,405	12,504	12,600	12,694	12,786	12,875	12,962
San Luis Obispo	2,047	2,093	2,093	2,093	2,135	2,178	2,222	2,267	2,313	2,360	2,408
San Mateo	5,891	5,978	6,110	6,110	6,167	6,223	6,279	6,335	6,391	6,447	6,503
Santa Barbara	6,652	6,704	6,704	6,704	6,774	6,843	6,913	6,983	7,052	7,122	7,191
Santa Clara	11,336	11,475	11,687	11,954	12,164	12,376	12,592	12,811	13,032	13,257	13,485
Santa Cruz	1,213	1,229	1,238	1,238	1,256	1,275	1,293	1,312	1,332	1,351	1,371
Solano	3,959	4,029	4,029	4,029	4,090	4,152	4,213	4,275	4,337	4,399	4,461
Sonoma	3,320	3,431	3,556	3,670	3,751	3,834	3,921	4,011	4,105	4,201	4,302
Ventura	8,050	8,146	8,146	8,146	8,249	8,352	8,456	8,559	8,662	8,766	8,869

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:		
	8/6	8/7	8/8	8/9	8/11	8/13	8/15
Alameda	12,402	12,668	12,933	13,199	13,581 (2,716) [652] {326}	13,981 (2,796) [671] {336}	14,399 (2,880) [691] {346}
Contra Costa	8,532	8,760	9,022	9,182	9,480 (1,896) [455] {228}	9,786 (1,957) [470] {235}	10,099 (2,020) [485] {242}
Fresno	16,625	17,031	17,290	17,290	17,938 (3,588) [861] {431}	18,599 (3,720) [893] {446}	19,275 (3,855) [925] {463}
Kern	21,724	22,009	22,626	23,583	24,709 (4,942) [1,186] {593}	25,890 (5,178) [1,243] {621}	27,126 (5,425) [1,302] {651}
Los Angeles	201,106	204,167	206,761	208,528	212,915 (42,583) [10,220] {5,110}	217,258 (43,452) [10,428] {5,214}	221,558 (44,312) [10,635] {5,317}
Marin	5,250	5,286	5,286	5,286	5,439 (1,088) [261] {131}	5,604 (1,121) [269] {134}	5,781 (1,156) [278] {139}
Monterey	5,120	5,156	5,156	5,156	5,315 (1,063) [255] {128}	5,477 (1,095) [263] {131}	5,642 (1,128) [271] {135}
Orange	38,711	38,754	39,076	39,641	40,063 (8,013) [1,923] {962}	40,451 (8,090) [1,942] {971}	40,808 (8,162) [1,959] {979}
Placer	2,039	2,099	2,186	2,282	2,361 (472) [113] {57}	2,443 (489) [117] {59}	2,528 (506) [121] {61}
Riverside	39,741	40,452	40,452	40,452	41,253 (8,251) [1,980] {990}	42,042 (8,408) [2,018] {1,009}	42,819 (8,564) [2,055] {1,028}
Sacramento	10,544	10,795	10,795	10,795	10,992 (2,198) [528] {264}	11,179 (2,236) [537] {268}	11,357 (2,271) [545] {273}
San Bernardino	34,635	34,939	35,452	35,712	36,398 (7,280) [1,747] {874}	37,067 (7,413) [1,779] {890}	37,717 (7,543) [1,810] {905}
San Diego	31,127	31,779	32,330	32,747	33,472 (6,694) [1,607] {803}	34,189 (6,838) [1,641] {821}	34,898 (6,980) [1,675] {838}
San Francisco	7,228	7,326	7,432	7,548	7,764 (1,553) [373] {186}	7,987 (1,597) [383] {192}	8,218 (1,644) [394] {197}
San Joaquin	12,119	12,303	12,303	12,303	12,504 (2,501) [600] {300}	12,694 (2,539) [609] {305}	12,875 (2,575) [618] {309}
San Luis Obispo	2,047	2,093	2,093	2,093	2,178 (436) [105] {52}	2,267 (453) [109] {54}	2,360 (472) [113] {57}
San Mateo	5,891	5,978	6,110	6,110	6,223 (1,245) [299] {149}	6,335 (1,267) [304] {152}	6,447 (1,289) [309] {155}
Santa Barbara	6,652	6,704	6,704	6,704	6,843 (1,369) [328] {164}	6,983 (1,397) [335] {168}	7,122 (1,424) [342] {171}
Santa Clara	11,336	11,475	11,687	11,954	12,376 (2,475) [594] {297}	12,811 (2,562) [615] {307}	13,257 (2,651) [636] {318}
Santa Cruz	1,213	1,229	1,238	1,238	1,275 (255) [61] {31}	1,312 (262) [63] {31}	1,351 (270) [65] {32}
Solano	3,959	4,029	4,029	4,029	4,152 (830) [199] {100}	4,275 (855) [205] {103}	4,399 (880) [211] {106}
Sonoma	3,320	3,431	3,556	3,670	3,834 (767) [184] {92}	4,011 (802) [193] {96}	4,201 (840) [202] {101}
Ventura	8,050	8,146	8,146	8,146	8,352 (1,670) [401] {200}	8,559 (1,712) [411] {205}	8,766 (1,753) [421] {210}

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.