IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/17/20

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

The projections shown in this document are based on data pulled in as of 11/17/20 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
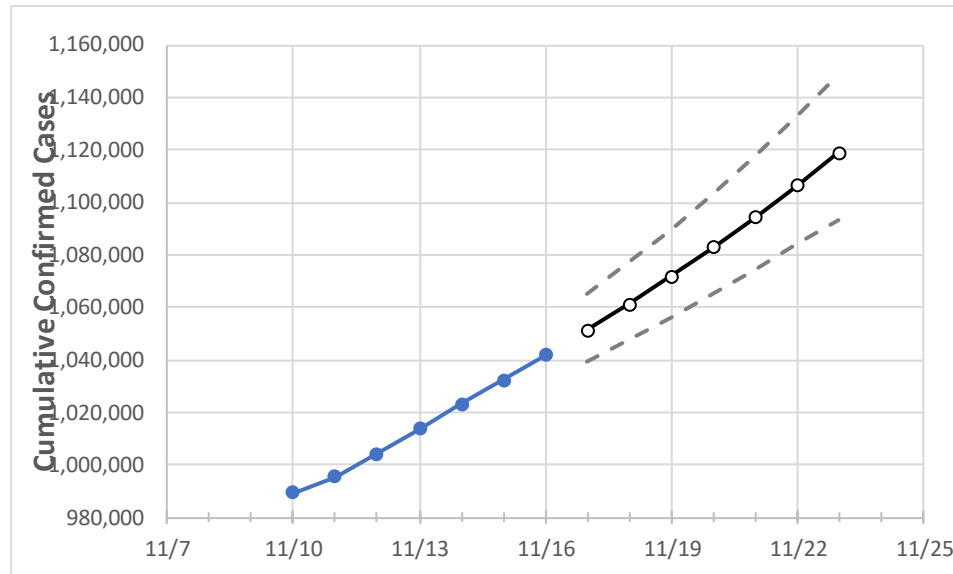
	Actual Confirmed Cases On:				Projected Cases For:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
California	1,013,566	1,023,067	1,032,095	1,041,690	1,051,270	1,061,300	1,071,800	1,082,790	1,094,291	1,106,329	1,118,925

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:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
Alameda	25,599	25,760	25,872	26,047	26,209	26,377	26,551	26,730	26,916	27,108	27,306
Contra Costa	20,619	20,868	21,046	21,250	21,427	21,612	21,805	22,007	22,218	22,438	22,667
Fresno	33,459	33,693	33,969	34,297	34,529	34,772	35,025	35,290	35,566	35,854	36,155
Kern	36,069	36,227	36,470	36,618	36,823	37,038	37,265	37,503	37,754	38,017	38,294
Los Angeles	332,865	336,549	339,560	342,343	345,532	348,888	352,418	356,133	360,041	364,151	368,473
Marin	7,326	7,344	7,358	7,378	7,396	7,415	7,435	7,455	7,477	7,498	7,521
Monterey	12,606	12,701	12,854	13,034	13,141	13,254	13,372	13,496	13,627	13,763	13,906
Orange	64,058	64,586	65,225	65,605	66,064	66,541	67,037	67,552	68,088	68,645	69,223
Placer	5,134	5,175	5,215	5,397	5,485	5,580	5,681	5,789	5,904	6,028	6,161
Riverside	74,180	74,545	74,910	75,848	76,481	77,146	77,845	78,580	79,352	80,163	81,015
Sacramento	29,510	29,837	30,298	30,601	30,995	31,411	31,851	32,314	32,803	33,320	33,864
San Bernardino	73,001	73,915	74,166	74,929	75,697	76,500	77,340	78,219	79,138	80,098	81,102
San Diego	62,945	63,681	64,768	65,601	65,987	66,380	66,779	67,184	67,596	68,014	68,439
San Francisco	13,404	13,516	13,665	13,757	13,877	14,003	14,135	14,274	14,420	14,573	14,734
San Joaquin	23,224	23,517	23,517	23,517	23,590	23,666	23,747	23,832	23,922	24,017	24,118
San Luis Obispo	4,972	5,038	5,073	5,120	5,198	5,282	5,372	5,467	5,570	5,679	5,796
San Mateo	12,332	12,465	12,515	12,565	12,656	12,751	12,848	12,949	13,054	13,162	13,273
Santa Barbara	10,339	10,415	10,482	10,516	10,560	10,606	10,654	10,703	10,754	10,807	10,862
Santa Clara	27,648	27,977	28,307	28,686	28,977	29,281	29,598	29,928	30,272	30,631	31,005
Santa Cruz	3,329	3,356	3,402	3,439	3,471	3,504	3,538	3,574	3,611	3,650	3,691
Solano	8,729	8,806	8,882	8,959	9,062	9,168	9,279	9,393	9,511	9,634	9,761
Sonoma	10,713	10,747	10,845	11,055	11,132	11,210	11,289	11,369	11,449	11,531	11,614
Ventura	16,013	16,172	16,297	16,564	16,730	16,905	17,090	17,286	17,493	17,712	17,943

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:		
	11/13	11/14	11/15	11/16	11/18	11/20	11/22
Alameda	25,599	25,760	25,872	26,047	26,377 (5,275) [1,266] {633}	26,730 (5,346) [1,283] {642}	27,108 (5,422) [1,301] {651}
Contra Costa	20,619	20,868	21,046	21,250	21,612 (4,322) [1,037] {519}	22,007 (4,401) [1,056] {528}	22,438 (4,488) [1,077] {539}
Fresno	33,459	33,693	33,969	34,297	34,772 (6,954) [1,669] {835}	35,290 (7,058) [1,694] {847}	35,854 (7,171) [1,721] {861}
Kern	36,069	36,227	36,470	36,618	37,038 (7,408) [1,778] {889}	37,503 (7,501) [1,800] {900}	38,017 (7,603) [1,825] {912}
Los Angeles	332,865	336,549	339,560	342,343	348,888 (69,778) [16,747] {8,373}	356,133 (71,227) [17,094] {8,547}	364,151 (72,830) [17,479] {8,740}
Marin	7,326	7,344	7,358	7,378	7,415 (1,483) [356] {178}	7,455 (1,491) [358] {179}	7,498 (1,500) [360] {180}
Monterey	12,606	12,701	12,854	13,034	13,254 (2,651) [636] {318}	13,496 (2,699) [648] {324}	13,763 (2,753) [661] {330}
Orange	64,058	64,586	65,225	65,605	66,541 (13,308) [3,194] {1,597}	67,552 (13,510) [3,243] {1,621}	68,645 (13,729) [3,295] {1,647}
Placer	5,134	5,175	5,215	5,397	5,580 (1,116) [268] {134}	5,789 (1,158) [278] {139}	6,028 (1,206) [289] {145}
Riverside	74,180	74,545	74,910	75,848	77,146 (15,429) [3,703] {1,852}	78,580 (15,716) [3,772] {1,886}	80,163 (16,033) [3,848] {1,924}
Sacramento	29,510	29,837	30,298	30,601	31,411 (6,282) [1,508] {754}	32,314 (6,463) [1,551] {776}	33,320 (6,664) [1,599] {800}
San Bernardino	73,001	73,915	74,166	74,929	76,500 (15,300) [3,672] {1,836}	78,219 (15,644) [3,755] {1,877}	80,098 (16,020) [3,845] {1,922}
San Diego	62,945	63,681	64,768	65,601	66,380 (13,276) [3,186] {1,593}	67,184 (13,437) [3,225] {1,612}	68,014 (13,603) [3,265] {1,632}
San Francisco	13,404	13,516	13,665	13,757	14,003 (2,801) [672] {336}	14,274 (2,855) [685] {343}	14,573 (2,915) [700] {350}
San Joaquin	23,224	23,517	23,517	23,517	23,666 (4,733) [1,136] {568}	23,832 (4,766) [1,144] {572}	24,017 (4,803) [1,153] {576}
San Luis Obispo	4,972	5,038	5,073	5,120	5,282 (1,056) [254] {127}	5,467 (1,093) [262] {131}	5,679 (1,136) [273] {136}
San Mateo	12,332	12,465	12,515	12,565	12,751 (2,550) [612] {306}	12,949 (2,590) [622] {311}	13,162 (2,632) [632] {316}
Santa Barbara	10,339	10,415	10,482	10,516	10,606 (2,121) [509] {255}	10,703 (2,141) [514] {257}	10,807 (2,161) [519] {259}
Santa Clara	27,648	27,977	28,307	28,686	29,281 (5,856) [1,405] {703}	29,928 (5,986) [1,437] {718}	30,631 (6,126) [1,470] {735}
Santa Cruz	3,329	3,356	3,402	3,439	3,504 (701) [168] {84}	3,574 (715) [172] {86}	3,650 (730) [175] {88}
Solano	8,729	8,806	8,882	8,959	9,168 (1,834) [440] {220}	9,393 (1,879) [451] {225}	9,634 (1,927) [462] {231}
Sonoma	10,713	10,747	10,845	11,055	11,210 (2,242) [538] {269}	11,369 (2,274) [546] {273}	11,531 (2,306) [554] {277}
Ventura	16,013	16,172	16,297	16,564	16,905 (3,381) [811] {406}	17,286 (3,457) [830] {415}	17,712 (3,542) [850] {425}

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.