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

Date: 4/7/21

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

The projections shown in this document are based on data pulled in as of 4/7/21 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.

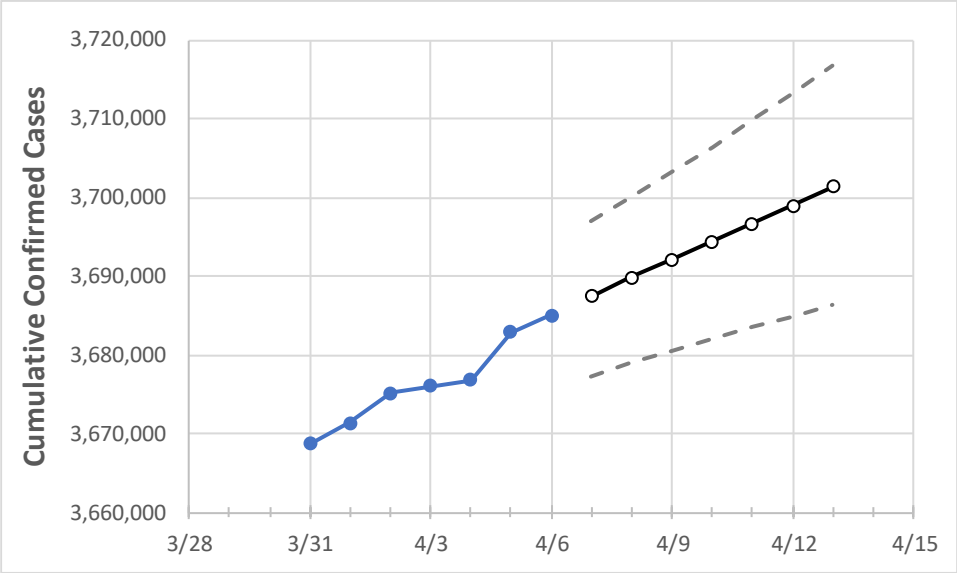
IEM's Modeling Lead

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:						
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13
California	3,676,092	3,676,742	3,682,861	3,685,045	3,687,468	3,689,785	3,692,117	3,694,404	3,696,707	3,698,978	3,701,292

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

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13
Alameda	83,776	83,861	83,951	84,007	84,098	84,192	84,285	84,377	84,471	84,562	84,655
Contra Costa	65,612	65,665	65,718	65,835	65,907	65,979	66,050	66,119	66,188	66,258	66,325
Fresno	99,551	99,602	99,702	99,755	99,848	99,941	100,033	100,125	100,215	100,305	100,395
Kern	106,379	106,430	106,480	106,543	106,595	106,643	106,691	106,737	106,782	106,827	106,868
Lake	3,348	3,350	3,355	3,359	3,364	3,369	3,374	3,380	3,385	3,390	3,395
Los Angeles	1,221,422	1,221,950	1,222,479	1,222,802	1,223,242	1,223,674	1,224,102	1,224,525	1,224,929	1,225,318	1,225,708
Marin	13,719	13,724	13,730	13,743	13,754	13,764	13,774	13,785	13,795	13,805	13,816
Monterey	42,987	42,994	43,002	43,038	43,053	43,067	43,081	43,095	43,109	43,123	43,137
Orange	266,643	266,822	267,001	267,143	267,292	267,443	267,596	267,746	267,897	268,052	268,205
Placer	21,126	21,157	21,188	21,239	21,287	21,336	21,386	21,436	21,488	21,541	21,592
Riverside	294,966	295,196	295,426	295,631	295,810	295,996	296,181	296,370	296,563	296,764	296,967
Sacramento	98,648	98,660	98,848	99,042	99,236	99,436	99,638	99,848	100,059	100,273	100,497
San Bernardino	291,375	291,551	291,727	291,728	291,846	291,967	292,084	292,204	292,319	292,436	292,548
San Diego	271,036	271,335	271,654	271,866	272,098	272,329	272,552	272,787	273,016	273,249	273,468
San Francisco	35,451	35,488	35,525	35,538	35,569	35,600	35,632	35,663	35,695	35,727	35,759
San Joaquin	70,160	70,202	70,245	70,465	70,563	70,662	70,766	70,867	70,970	71,075	71,174
San Luis Obispo	20,567	20,586	20,606	20,649	20,673	20,696	20,720	20,745	20,769	20,793	20,817
San Mateo	40,542	40,560	40,595	40,618	40,656	40,692	40,729	40,766	40,803	40,840	40,876
Santa Barbara	33,299	33,329	33,358	33,381	33,413	33,445	33,477	33,509	33,541	33,571	33,602
Santa Clara	114,859	114,865	115,171	115,266	115,367	115,461	115,559	115,656	115,749	115,841	115,935
Santa Cruz	15,306	15,292	15,278	15,264	15,278	15,292	15,305	15,318	15,331	15,343	15,356
Solano	31,334	31,368	31,401	31,432	31,473	31,515	31,557	31,599	31,641	31,684	31,728
Sonoma	29,313	29,315	29,402	29,423	29,445	29,467	29,488	29,512	29,533	29,554	29,576
Ventura	79,789	79,805	79,820	79,830	79,861	79,891	79,919	79,945	79,972	79,998	80,024

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:		
	4/3	4/4	4/5	4/6	4/8	4/10	4/12
Alameda	83,776	83,861	83,951	84,007	84,192 (16,838) [4,041] {2,021}	84,377 (16,875) [4,050] {2,025}	84,562 (16,912) [4,059] {2,029}
Contra Costa	65,612	65,665	65,718	65,835	65,979 (13,196) [3,167] {1,583}	66,119 (13,224) [3,174] {1,587}	66,258 (13,252) [3,180] {1,590}
Fresno	99,551	99,602	99,702	99,755	99,941 (19,988) [4,797] {2,399}	100,125 (20,025) [4,806] {2,403}	100,305 (20,061) [4,815] {2,407}
Kern	106,379	106,430	106,480	106,543	106,643 (21,329) [5,119] {2,559}	106,737 (21,347) [5,123] {2,562}	106,827 (21,365) [5,128] {2,564}
Lake	3,348	3,350	3,355	3,359	3,369 (674) [162] {81}	3,380 (676) [162] {81}	3,390 (678) [163] {81}
Los Angeles	1,221,422	1,221,950	1,222,479	1,222,802	1,223,674 (244,735) [58,736] {29,368}	1,224,525 (244,905) [58,777] {29,389}	1,225,318 (245,064) [58,815] {29,408}
Marin	13,719	13,724	13,730	13,743	13,764 (2,753) [661] {330}	13,785 (2,757) [662] {331}	13,805 (2,761) [663] {331}
Monterey	42,987	42,994	43,002	43,038	43,067 (8,613) [2,067] {1,034}	43,095 (8,619) [2,069] {1,034}	43,123 (8,625) [2,070] {1,035}
Orange	266,643	266,822	267,001	267,143	267,443 (53,489) [12,837] {6,419}	267,746 (53,549) [12,852] {6,426}	268,052 (53,610) [12,866] {6,433}
Placer	21,126	21,157	21,188	21,239	21,336 (4,267) [1,024] {512}	21,436 (4,287) [1,029] {514}	21,541 (4,308) [1,034] {517}
Riverside	294,966	295,196	295,426	295,631	295,996 (59,199) [14,208] {7,104}	296,370 (59,274) [14,226] {7,113}	296,764 (59,353) [14,245] {7,122}
Sacramento	98,648	98,660	98,848	99,042	99,436 (19,887) [4,773] {2,386}	99,848 (19,970) [4,793] {2,396}	100,273 (20,055) [4,813] {2,407}
San Bernardino	291,375	291,551	291,727	291,728	291,967 (58,393) [14,014] {7,007}	292,204 (58,441) [14,026] {7,013}	292,436 (58,487) [14,037] {7,018}
San Diego	271,036	271,335	271,654	271,866	272,329 (54,466) [13,072] {6,536}	272,787 (54,557) [13,094] {6,547}	273,249 (54,650) [13,116] {6,558}
San Francisco	35,451	35,488	35,525	35,538	35,600 (7,120) [1,709] {854}	35,663 (7,133) [1,712] {856}	35,727 (7,145) [1,715] {857}
San Joaquin	70,160	70,202	70,245	70,465	70,662 (14,132) [3,392] {1,696}	70,867 (14,173) [3,402] {1,701}	71,075 (14,215) [3,412] {1,706}
San Luis Obispo	20,567	20,586	20,606	20,649	20,696 (4,139) [993] {497}	20,745 (4,149) [996] {498}	20,793 (4,159) [998] {499}
San Mateo	40,542	40,560	40,595	40,618	40,692 (8,138) [1,953] {977}	40,766 (8,153) [1,957] {978}	40,840 (8,168) [1,960] {980}
Santa Barbara	33,299	33,329	33,358	33,381	33,445 (6,689) [1,605] {803}	33,509 (6,702) [1,608] {804}	33,571 (6,714) [1,611] {806}
Santa Clara	114,859	114,865	115,171	115,266	115,461 (23,092) [5,542] {2,771}	115,656 (23,131) [5,551] {2,776}	115,841 (23,168) [5,560] {2,780}
Santa Cruz	15,306	15,292	15,278	15,264	15,292 (3,058) [734] {367}	15,318 (3,064) [735] {368}	15,343 (3,069) [736] {368}
Solano	31,334	31,368	31,401	31,432	31,515 (6,303) [1,513] {756}	31,599 (6,320) [1,517] {758}	31,684 (6,337) [1,521] {760}
Sonoma	29,313	29,315	29,402	29,423	29,467 (5,893) [1,414] {707}	29,512 (5,902) [1,417] {708}	29,554 (5,911) [1,419] {709}
Ventura	79,789	79,805	79,820	79,830	79,891 (15,978) [3,835] {1,917}	79,945 (15,989) [3,837] {1,919}	79,998 (16,000) [3,840] {1,920}

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.