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

Date: 4/6/21

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 4/6/21 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.

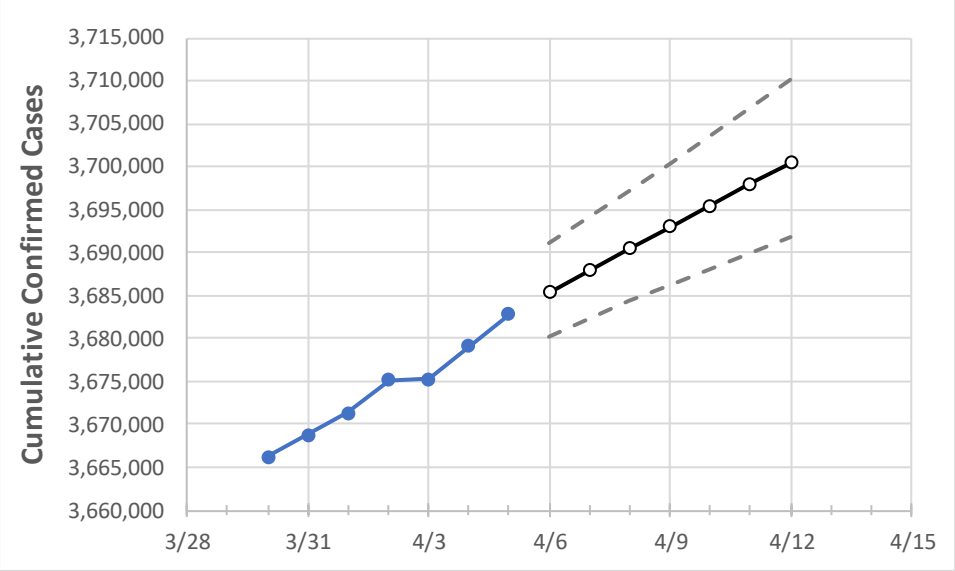
IEM's Modeling Lead

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:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
California	3,675,191	3,675,272	3,679,067	3,682,861	3,685,420	3,687,960	3,690,471	3,692,980	3,695,505	3,698,006	3,700,504

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:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Alameda	83,574	83,700	83,825	83,951	84,050	84,149	84,251	84,355	84,459	84,564	84,671
Contra Costa	65,559	65,612	65,665	65,718	65,785	65,852	65,918	65,983	66,048	66,112	66,173
Fresno	99,317	99,445	99,574	99,702	99,805	99,908	100,008	100,109	100,209	100,310	100,409
Kern	106,329	106,379	106,430	106,480	106,530	106,581	106,630	106,679	106,725	106,773	106,818
Lake	3,337	3,343	3,349	3,355	3,360	3,366	3,371	3,376	3,382	3,387	3,392
Los Angeles	1,220,893	1,221,422	1,221,950	1,222,479	1,222,925	1,223,380	1,223,813	1,224,228	1,224,633	1,225,043	1,225,454
Marin	13,713	13,719	13,724	13,730	13,741	13,752	13,762	13,772	13,783	13,793	13,804
Monterey	42,979	42,987	42,994	43,002	43,015	43,027	43,040	43,051	43,063	43,074	43,085
Orange	266,464	266,643	266,822	267,001	267,152	267,301	267,451	267,601	267,752	267,903	268,054
Placer	21,095	21,126	21,157	21,188	21,234	21,282	21,330	21,378	21,427	21,477	21,527
Riverside	294,736	294,966	295,196	295,426	295,584	295,743	295,903	296,065	296,228	296,389	296,558
Sacramento	98,488	98,608	98,728	98,848	99,045	99,247	99,451	99,663	99,877	100,093	100,315
San Bernardino	291,199	291,375	291,551	291,727	291,863	291,996	292,131	292,265	292,403	292,541	292,676
San Diego	271,035	271,241	271,448	271,654	271,898	272,139	272,380	272,621	272,863	273,101	273,341
San Francisco	35,386	35,432	35,479	35,525	35,557	35,591	35,623	35,658	35,690	35,724	35,758
San Joaquin	70,117	70,160	70,202	70,245	70,328	70,412	70,502	70,585	70,672	70,757	70,839
San Luis Obispo	20,547	20,567	20,586	20,606	20,627	20,647	20,669	20,691	20,711	20,733	20,752
San Mateo	40,462	40,542	40,569	40,595	40,634	40,672	40,711	40,749	40,788	40,826	40,862
Santa Barbara	33,270	33,299	33,329	33,358	33,391	33,424	33,458	33,491	33,524	33,557	33,590
Santa Clara	114,852	114,958	115,065	115,171	115,269	115,368	115,468	115,567	115,664	115,762	115,855
Santa Cruz	15,363	15,363	15,363	15,363	15,376	15,389	15,402	15,415	15,428	15,440	15,452
Solano	31,301	31,334	31,368	31,401	31,444	31,487	31,531	31,576	31,620	31,664	31,710
Sonoma	29,310	29,341	29,371	29,402	29,425	29,448	29,471	29,493	29,516	29,537	29,559
Ventura	79,774	79,789	79,805	79,820	79,853	79,885	79,916	79,947	79,977	80,006	80,034

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:		
	4/2	4/3	4/4	4/5	4/7	4/9	4/11
Alameda	83,574	83,700	83,825	83,951	84,149 (16,830) [4,039] {2,020}	84,355 (16,871) [4,049] {2,025}	84,564 (16,913) [4,059] {2,030}
Contra Costa	65,559	65,612	65,665	65,718	65,852 (13,170) [3,161] {1,580}	65,983 (13,197) [3,167] {1,584}	66,112 (13,222) [3,173] {1,587}
Fresno	99,317	99,445	99,574	99,702	99,908 (19,982) [4,796] {2,398}	100,109 (20,022) [4,805] {2,403}	100,310 (20,062) [4,815] {2,407}
Kern	106,329	106,379	106,430	106,480	106,581 (21,316) [5,116] {2,558}	106,679 (21,336) [5,121] {2,560}	106,773 (21,355) [5,125] {2,563}
Lake	3,337	3,343	3,349	3,355	3,366 (673) [162] {81}	3,376 (675) [162] {81}	3,387 (677) [163] {81}
Los Angeles	1,220,893	1,221,422	1,221,950	1,222,479	1,223,380 (244,676) [58,722] {29,361}	1,224,228 (244,846) [58,763] {29,381}	1,225,043 (245,009) [58,802] {29,401}
Marin	13,713	13,719	13,724	13,730	13,752 (2,750) [660] {330}	13,772 (2,754) [661] {331}	13,793 (2,759) [662] {331}
Monterey	42,979	42,987	42,994	43,002	43,027 (8,605) [2,065] {1,033}	43,051 (8,610) [2,066] {1,033}	43,074 (8,615) [2,068] {1,034}
Orange	266,464	266,643	266,822	267,001	267,301 (53,460) [12,830] {6,415}	267,601 (53,520) [12,845] {6,422}	267,903 (53,581) [12,859] {6,430}
Placer	21,095	21,126	21,157	21,188	21,282 (4,256) [1,022] {511}	21,378 (4,276) [1,026] {513}	21,477 (4,295) [1,031] {515}
Riverside	294,736	294,966	295,196	295,426	295,743 (59,149) [14,196] {7,098}	296,065 (59,213) [14,211] {7,106}	296,389 (59,278) [14,227] {7,113}
Sacramento	98,488	98,608	98,728	98,848	99,247 (19,849) [4,764] {2,382}	99,663 (19,933) [4,784] {2,392}	100,093 (20,019) [4,804] {2,402}
San Bernardino	291,199	291,375	291,551	291,727	291,996 (58,399) [14,016] {7,008}	292,265 (58,453) [14,029] {7,014}	292,541 (58,508) [14,042] {7,021}
San Diego	271,035	271,241	271,448	271,654	272,139 (54,428) [13,063] {6,531}	272,621 (54,524) [13,086] {6,543}	273,101 (54,620) [13,109] {6,554}
San Francisco	35,386	35,432	35,479	35,525	35,591 (7,118) [1,708] {854}	35,658 (7,132) [1,712] {856}	35,724 (7,145) [1,715] {857}
San Joaquin	70,117	70,160	70,202	70,245	70,412 (14,082) [3,380] {1,690}	70,585 (14,117) [3,388] {1,694}	70,757 (14,151) [3,396] {1,698}
San Luis Obispo	20,547	20,567	20,586	20,606	20,647 (4,129) [991] {496}	20,691 (4,138) [993] {497}	20,733 (4,147) [995] {498}
San Mateo	40,462	40,542	40,569	40,595	40,672 (8,134) [1,952] {976}	40,749 (8,150) [1,956] {978}	40,826 (8,165) [1,960] {980}
Santa Barbara	33,270	33,299	33,329	33,358	33,424 (6,685) [1,604] {802}	33,491 (6,698) [1,608] {804}	33,557 (6,711) [1,611] {805}
Santa Clara	114,852	114,958	115,065	115,171	115,368 (23,074) [5,538] {2,769}	115,567 (23,113) [5,547] {2,774}	115,762 (23,152) [5,557] {2,778}
Santa Cruz	15,363	15,363	15,363	15,363	15,389 (3,078) [739] {369}	15,415 (3,083) [740] {370}	15,440 (3,088) [741] {371}
Solano	31,301	31,334	31,368	31,401	31,487 (6,297) [1,511] {756}	31,576 (6,315) [1,516] {758}	31,664 (6,333) [1,520] {760}
Sonoma	29,310	29,341	29,371	29,402	29,448 (5,890) [1,414] {707}	29,493 (5,899) [1,416] {708}	29,537 (5,907) [1,418] {709}
Ventura	79,774	79,789	79,805	79,820	79,885 (15,977) [3,834] {1,917}	79,947 (15,989) [3,837] {1,919}	80,006 (16,001) [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.