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

Date: 2/17/21

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 2/17/21 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.

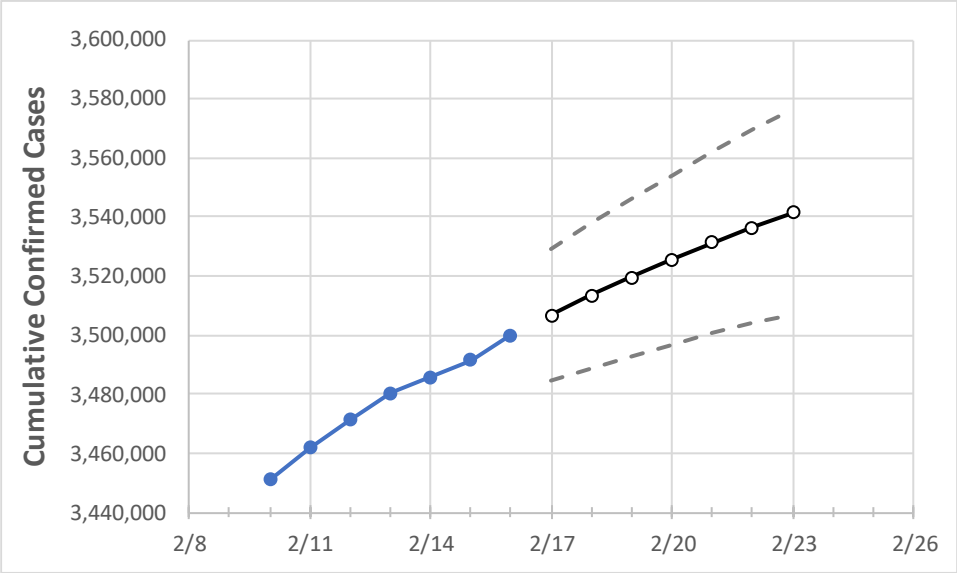
IEM's Modeling Lead

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:						
	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23
California	3,480,228	3,485,841	3,491,392	3,499,871	3,506,844	3,513,436	3,519,614	3,525,524	3,531,208	3,536,523	3,541,622

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:						
	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23
Alameda	78,285	78,356	78,714	78,883	79,221	79,537	79,840	80,134	80,408	80,687	80,942
Contra Costa	60,365	60,537	60,710	60,834	61,007	61,171	61,334	61,495	61,651	61,798	61,937
Fresno	92,520	92,807	93,065	93,231	93,458	93,677	93,886	94,092	94,289	94,483	94,668
Kern	100,025	100,290	100,434	100,586	100,880	101,179	101,460	101,728	101,989	102,246	102,492
Lake	3,012	3,025	3,030	3,030	3,042	3,055	3,067	3,079	3,091	3,102	3,113
Los Angeles	1,164,880	1,166,552	1,168,372	1,169,688	1,171,626	1,173,405	1,175,118	1,176,739	1,178,249	1,179,677	1,181,019
Marin	12,823	12,843	12,876	12,920	12,948	12,975	13,002	13,030	13,054	13,079	13,103
Monterey	41,341	41,421	41,500	41,580	41,652	41,720	41,786	41,846	41,902	41,960	42,012
Orange	256,510	256,889	257,239	257,589	258,106	258,600	259,085	259,538	259,977	260,396	260,809
Placer	19,201	19,214	19,313	19,433	19,482	19,531	19,579	19,624	19,669	19,711	19,756
Riverside	285,708	286,002	286,296	286,590	286,946	287,279	287,577	287,851	288,110	288,337	288,541
Sacramento	90,252	90,401	90,856	91,091	91,341	91,587	91,827	92,065	92,290	92,507	92,740
San Bernardino	281,604	282,169	282,494	282,494	282,865	283,229	283,587	283,921	284,240	284,537	284,814
San Diego	251,682	252,250	252,943	253,641	254,334	254,990	255,617	256,201	256,783	257,319	257,846
San Francisco	33,179	33,291	33,374	33,454	33,559	33,660	33,758	33,852	33,946	34,035	34,122
San Joaquin	65,067	65,164	65,262	65,359	65,473	65,579	65,679	65,778	65,879	65,961	66,041
San Luis Obispo	18,889	18,996	19,103	19,210	19,265	19,315	19,361	19,405	19,449	19,489	19,529
San Mateo	37,621	37,745	37,859	37,969	38,063	38,148	38,234	38,314	38,388	38,457	38,522
Santa Barbara	30,728	30,862	30,927	30,991	31,087	31,176	31,259	31,338	31,416	31,486	31,556
Santa Clara	107,110	107,397	107,619	107,769	108,025	108,272	108,511	108,740	108,954	109,160	109,356
Santa Cruz	14,260	14,288	14,316	14,344	14,377	14,409	14,440	14,470	14,497	14,524	14,548
Solano	29,383	29,448	29,514	29,580	29,642	29,703	29,761	29,818	29,872	29,924	29,970
Sonoma	27,143	27,249	27,361	27,361	27,419	27,473	27,525	27,575	27,623	27,667	27,716
Ventura	75,210	75,481	75,742	75,889	76,105	76,309	76,501	76,688	76,866	77,027	77,179

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:		
	2/13	2/14	2/15	2/16	2/18	2/20	2/22
Alameda	78,285	78,356	78,714	78,883	79,537 (15,907) [3,818] {1,909}	80,134 (16,027) [3,846] {1,923}	80,687 (16,137) [3,873] {1,936}
Contra Costa	60,365	60,537	60,710	60,834	61,171 (12,234) [2,936] {1,468}	61,495 (12,299) [2,952] {1,476}	61,798 (12,360) [2,966] {1,483}
Fresno	92,520	92,807	93,065	93,231	93,677 (18,735) [4,496] {2,248}	94,092 (18,818) [4,516] {2,258}	94,483 (18,897) [4,535] {2,268}
Kern	100,025	100,290	100,434	100,586	101,179 (20,236) [4,857] {2,428}	101,728 (20,346) [4,883] {2,441}	102,246 (20,449) [4,908] {2,454}
Lake	3,012	3,025	3,030	3,030	3,055 (611) [147] {73}	3,079 (616) [148] {74}	3,102 (620) [149] {74}
Los Angeles	1,164,880	1,166,552	1,168,372	1,169,688	1,173,405 (234,681) [56,323] {28,162}	1,176,739 (235,348) [56,483] {28,242}	1,179,677 (235,935) [56,624] {28,312}
Marin	12,823	12,843	12,876	12,920	12,975 (2,595) [623] {311}	13,030 (2,606) [625] {313}	13,079 (2,616) [628] {314}
Monterey	41,341	41,421	41,500	41,580	41,720 (8,344) [2,003] {1,001}	41,846 (8,369) [2,009] {1,004}	41,960 (8,392) [2,014] {1,007}
Orange	256,510	256,889	257,239	257,589	258,600 (51,720) [12,413] {6,206}	259,538 (51,908) [12,458] {6,229}	260,396 (52,079) [12,499] {6,250}
Placer	19,201	19,214	19,313	19,433	19,531 (3,906) [937] {469}	19,624 (3,925) [942] {471}	19,711 (3,942) [946] {473}
Riverside	285,708	286,002	286,296	286,590	287,279 (57,456) [13,789] {6,895}	287,851 (57,570) [13,817] {6,908}	288,337 (57,667) [13,840] {6,920}
Sacramento	90,252	90,401	90,856	91,091	91,587 (18,317) [4,396] {2,198}	92,065 (18,413) [4,419] {2,210}	92,507 (18,501) [4,440] {2,220}
San Bernardino	281,604	282,169	282,494	282,494	283,229 (56,646) [13,595] {6,797}	283,921 (56,784) [13,628] {6,814}	284,537 (56,907) [13,658] {6,829}
San Diego	251,682	252,250	252,943	253,641	254,990 (50,998) [12,240] {6,120}	256,201 (51,240) [12,298] {6,149}	257,319 (51,464) [12,351] {6,176}
San Francisco	33,179	33,291	33,374	33,454	33,660 (6,732) [1,616] {808}	33,852 (6,770) [1,625] {812}	34,035 (6,807) [1,634] {817}
San Joaquin	65,067	65,164	65,262	65,359	65,579 (13,116) [3,148] {1,574}	65,778 (13,156) [3,157] {1,579}	65,961 (13,192) [3,166] {1,583}
San Luis Obispo	18,889	18,996	19,103	19,210	19,315 (3,863) [927] {464}	19,405 (3,881) [931] {466}	19,489 (3,898) [935] {468}
San Mateo	37,621	37,745	37,859	37,969	38,148 (7,630) [1,831] {916}	38,314 (7,663) [1,839] {920}	38,457 (7,691) [1,846] {923}
Santa Barbara	30,728	30,862	30,927	30,991	31,176 (6,235) [1,496] {748}	31,338 (6,268) [1,504] {752}	31,486 (6,297) [1,511] {756}
Santa Clara	107,110	107,397	107,619	107,769	108,272 (21,654) [5,197] {2,599}	108,740 (21,748) [5,220] {2,610}	109,160 (21,832) [5,240] {2,620}
Santa Cruz	14,260	14,288	14,316	14,344	14,409 (2,882) [692] {346}	14,470 (2,894) [695] {347}	14,524 (2,905) [697] {349}
Solano	29,383	29,448	29,514	29,580	29,703 (5,941) [1,426] {713}	29,818 (5,964) [1,431] {716}	29,924 (5,985) [1,436] {718}
Sonoma	27,143	27,249	27,361	27,361	27,473 (5,495) [1,319] {659}	27,575 (5,515) [1,324] {662}	27,667 (5,533) [1,328] {664}
Ventura	75,210	75,481	75,742	75,889	76,309 (15,262) [3,663] {1,831}	76,688 (15,338) [3,681] {1,841}	77,027 (15,405) [3,697] {1,849}

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.