IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/18/21

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 <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 2/18/21 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
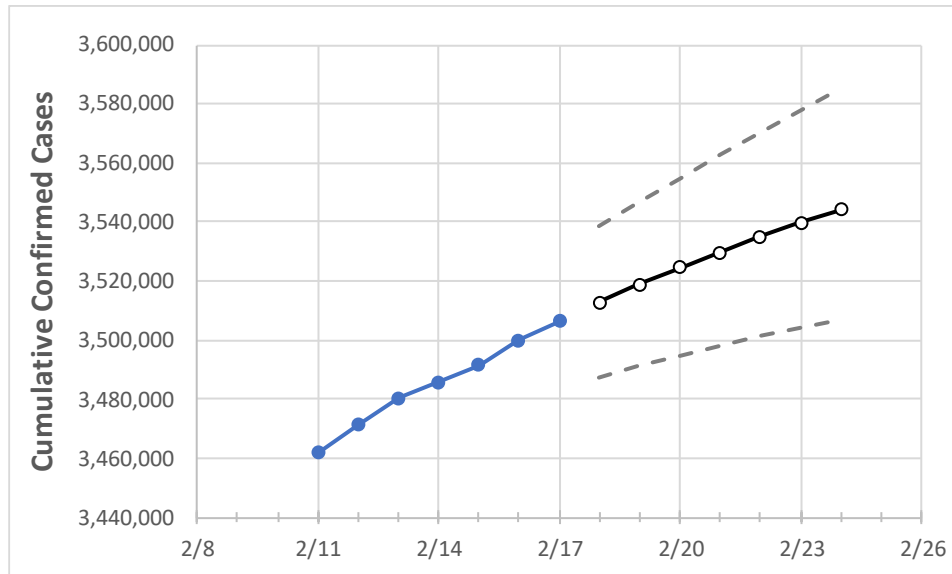
	Actual Confirmed Cases On:				Projected Cases For:						
	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24
California	3,485,841	3,491,392	3,499,871	3,506,402	3,512,700	3,518,813	3,524,552	3,529,766	3,535,031	3,539,877	3,544,343

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:						
	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24
Alameda	78,356	78,714	78,883	79,016	79,310	79,589	79,858	80,112	80,346	80,572	80,782
Contra Costa	60,537	60,710	60,834	60,996	61,157	61,313	61,466	61,614	61,752	61,890	62,024
Fresno	92,807	93,065	93,231	93,363	93,573	93,771	93,965	94,149	94,330	94,503	94,675
Kern	100,290	100,434	100,586	100,849	101,141	101,421	101,693	101,950	102,198	102,437	102,672
Lake	3,025	3,030	3,036	3,041	3,051	3,061	3,070	3,079	3,088	3,097	3,106
Los Angeles	1,166,552	1,168,372	1,169,688	1,171,865	1,173,751	1,175,501	1,177,122	1,178,664	1,180,080	1,181,472	1,182,759
Marin	12,843	12,876	12,920	12,946	12,972	12,997	13,021	13,046	13,070	13,093	13,114
Monterey	41,421	41,500	41,580	41,632	41,697	41,754	41,809	41,864	41,913	41,963	42,005
Orange	256,889	257,239	257,589	257,816	258,269	258,709	259,125	259,525	259,905	260,266	260,613
Placer	19,214	19,313	19,433	19,457	19,502	19,545	19,588	19,632	19,671	19,710	19,749
Riverside	286,002	286,296	286,590	287,063	287,433	287,767	288,079	288,369	288,633	288,886	289,122
Sacramento	90,401	90,856	91,091	91,246	91,484	91,705	91,925	92,140	92,360	92,569	92,783
San Bernardino	282,169	282,494	282,615	282,736	283,052	283,347	283,628	283,888	284,145	284,385	284,618
San Diego	252,250	252,943	253,641	254,180	254,850	255,458	256,067	256,649	257,192	257,725	258,211
San Francisco	33,291	33,374	33,454	33,491	33,585	33,675	33,765	33,850	33,934	34,017	34,092
San Joaquin	65,164	65,262	65,359	65,659	65,786	65,910	66,024	66,128	66,232	66,330	66,425
San Luis Obispo	18,996	19,103	19,210	19,248	19,296	19,341	19,384	19,424	19,462	19,498	19,532
San Mateo	37,745	37,859	37,969	38,041	38,127	38,212	38,292	38,369	38,441	38,514	38,578
Santa Barbara	30,862	30,927	30,991	31,067	31,150	31,228	31,303	31,372	31,439	31,502	31,561
Santa Clara	107,397	107,619	107,769	107,980	108,224	108,458	108,672	108,878	109,074	109,260	109,438
Santa Cruz	14,288	14,316	14,344	14,359	14,385	14,411	14,435	14,458	14,480	14,500	14,519
Solano	29,448	29,514	29,580	29,643	29,701	29,757	29,812	29,863	29,911	29,959	30,002
Sonoma	27,249	27,361	27,388	27,414	27,463	27,511	27,555	27,598	27,638	27,678	27,718
Ventura	75,481	75,742	75,889	76,043	76,239	76,419	76,595	76,755	76,909	77,055	77,187

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:		
	2/14	2/15	2/16	2/17	2/19	2/21	2/23
Alameda	78,356	78,714	78,883	79,016	79,589 (15,918) [3,820] {1,910}	80,112 (16,022) [3,845] {1,923}	80,572 (16,114) [3,867] {1,934}
Contra Costa	60,537	60,710	60,834	60,996	61,313 (12,263) [2,943] {1,472}	61,614 (12,323) [2,957] {1,479}	61,890 (12,378) [2,971] {1,485}
Fresno	92,807	93,065	93,231	93,363	93,771 (18,754) [4,501] {2,250}	94,149 (18,830) [4,519] {2,260}	94,503 (18,901) [4,536] {2,268}
Kern	100,290	100,434	100,586	100,849	101,421 (20,284) [4,868] {2,434}	101,950 (20,390) [4,894] {2,447}	102,437 (20,487) [4,917] {2,458}
Lake	3,025	3,030	3,036	3,041	3,061 (612) [147] {73}	3,079 (616) [148] {74}	3,097 (619) [149] {74}
Los Angeles	1,166,552	1,168,372	1,169,688	1,171,865	1,175,501 (235,100) [56,424] {28,212}	1,178,664 (235,733) [56,576] {28,288}	1,181,472 (236,294) [56,711] {28,355}
Marin	12,843	12,876	12,920	12,946	12,997 (2,599) [624] {312}	13,046 (2,609) [626] {313}	13,093 (2,619) [628] {314}
Monterey	41,421	41,500	41,580	41,632	41,754 (8,351) [2,004] {1,002}	41,864 (8,373) [2,009] {1,005}	41,963 (8,393) [2,014] {1,007}
Orange	256,889	257,239	257,589	257,816	258,709 (51,742) [12,418] {6,209}	259,525 (51,905) [12,457] {6,229}	260,266 (52,053) [12,493] {6,246}
Placer	19,214	19,313	19,433	19,457	19,545 (3,909) [938] {469}	19,632 (3,926) [942] {471}	19,710 (3,942) [946] {473}
Riverside	286,002	286,296	286,590	287,063	287,767 (57,553) [13,813] {6,906}	288,369 (57,674) [13,842] {6,921}	288,886 (57,777) [13,867] {6,933}
Sacramento	90,401	90,856	91,091	91,246	91,705 (18,341) [4,402] {2,201}	92,140 (18,428) [4,423] {2,211}	92,569 (18,514) [4,443] {2,222}
San Bernardino	282,169	282,494	282,615	282,736	283,347 (56,669) [13,601] {6,800}	283,888 (56,778) [13,627] {6,813}	284,385 (56,877) [13,650] {6,825}
San Diego	252,250	252,943	253,641	254,180	255,458 (51,092) [12,262] {6,131}	256,649 (51,330) [12,319] {6,160}	257,725 (51,545) [12,371] {6,185}
San Francisco	33,291	33,374	33,454	33,491	33,675 (6,735) [1,616] {808}	33,850 (6,770) [1,625] {812}	34,017 (6,803) [1,633] {816}
San Joaquin	65,164	65,262	65,359	65,659	65,910 (13,182) [3,164] {1,582}	66,128 (13,226) [3,174] {1,587}	66,330 (13,266) [3,184] {1,592}
San Luis Obispo	18,996	19,103	19,210	19,248	19,341 (3,868) [928] {464}	19,424 (3,885) [932] {466}	19,498 (3,900) [936] {468}
San Mateo	37,745	37,859	37,969	38,041	38,212 (7,642) [1,834] {917}	38,369 (7,674) [1,842] {921}	38,514 (7,703) [1,849] {924}
Santa Barbara	30,862	30,927	30,991	31,067	31,228 (6,246) [1,499] {749}	31,372 (6,274) [1,506] {753}	31,502 (6,300) [1,512] {756}
Santa Clara	107,397	107,619	107,769	107,980	108,458 (21,692) [5,206] {2,603}	108,878 (21,776) [5,226] {2,613}	109,260 (21,852) [5,244] {2,622}
Santa Cruz	14,288	14,316	14,344	14,359	14,411 (2,882) [692] {346}	14,458 (2,892) [694] {347}	14,500 (2,900) [696] {348}
Solano	29,448	29,514	29,580	29,643	29,757 (5,951) [1,428] {714}	29,863 (5,973) [1,433] {717}	29,959 (5,992) [1,438] {719}
Sonoma	27,249	27,361	27,388	27,414	27,511 (5,502) [1,321] {660}	27,598 (5,520) [1,325] {662}	27,678 (5,536) [1,329] {664}
Ventura	75,481	75,742	75,889	76,043	76,419 (15,284) [3,668] {1,834}	76,755 (15,351) [3,684] {1,842}	77,055 (15,411) [3,699] {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.