IEM's AI Modeling: Short-term COVID-19 Projections
Date: 10/25/21

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 10/25/21 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
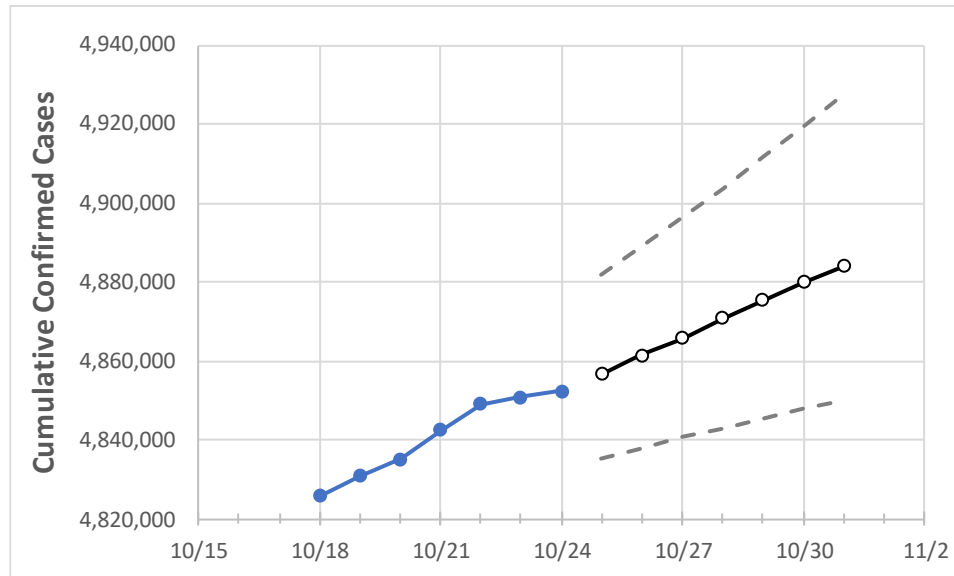
	Actual Confirmed Cases On:				Projected Cases For:						
	10/21	10/22	10/23	10/24	10/25	10/26	10/27	10/28	10/29	10/30	10/31
California	4,842,472	4,848,946	4,850,807	4,852,216	4,856,682	4,861,390	4,865,867	4,870,780	4,875,253	4,879,868	4,884,005

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:						
	10/21	10/22	10/23	10/24	10/25	10/26	10/27	10/28	10/29	10/30	10/31
Alameda	120,530	120,692	120,692	120,692	120,787	120,880	120,973	121,069	121,159	121,249	121,343
Contra Costa	99,884	100,018	100,018	100,018	100,120	100,214	100,312	100,408	100,503	100,598	100,693
Fresno	145,877	146,318	146,318	146,318	146,628	146,939	147,243	147,551	147,860	148,176	148,488
Kern	145,962	146,348	146,348	146,348	146,694	147,051	147,393	147,749	148,101	148,464	148,819
Lake	6,605	6,631	6,631	6,631	6,647	6,662	6,678	6,694	6,710	6,726	6,741
Los Angeles	1,481,814	1,483,031	1,484,192	1,485,105	1,486,164	1,487,258	1,488,297	1,489,427	1,490,485	1,491,661	1,492,729
Marin	17,692	17,706	17,706	17,706	17,722	17,739	17,755	17,771	17,788	17,804	17,820
Monterey	50,885	50,911	50,911	50,911	50,941	50,974	51,008	51,039	51,073	51,108	51,140
Orange	324,184	324,288	324,288	324,288	324,502	324,722	324,929	325,146	325,359	325,576	325,786
Placer	39,342	39,435	39,435	39,435	39,509	39,583	39,655	39,730	39,806	39,883	39,954
Riverside	371,293	371,670	371,670	371,670	371,973	372,279	372,581	372,875	373,170	373,471	373,776
Sacramento	159,333	159,636	159,636	159,636	159,921	160,211	160,501	160,800	161,099	161,403	161,701
San Bernardino	358,213	358,677	358,677	358,677	358,990	359,319	359,630	359,944	360,279	360,605	360,917
San Diego	366,056	366,661	367,361	367,857	368,349	368,838	369,341	369,849	370,351	370,861	371,384
San Francisco	54,375	54,440	54,440	54,440	54,494	54,546	54,595	54,645	54,695	54,744	54,792
San Joaquin	102,582	102,776	102,776	102,776	102,905	103,038	103,167	103,305	103,431	103,568	103,703
San Luis Obispo	29,945	29,973	29,973	29,973	30,017	30,061	30,104	30,147	30,193	30,236	30,279
San Mateo	54,112	54,168	54,168	54,168	54,212	54,257	54,302	54,346	54,393	54,437	54,480
Santa Barbara	45,160	45,223	45,223	45,223	45,277	45,329	45,383	45,437	45,489	45,543	45,599
Santa Clara	145,391	145,543	145,543	145,543	145,692	145,838	145,987	146,136	146,283	146,433	146,580
Santa Cruz	21,018	21,034	21,034	21,034	21,055	21,077	21,099	21,121	21,142	21,165	21,185
Solano	46,021	46,063	46,063	46,063	46,099	46,134	46,167	46,200	46,233	46,266	46,299
Sonoma	40,925	40,997	40,997	40,997	41,035	41,075	41,111	41,150	41,186	41,223	41,261
Ventura	100,984	101,038	101,038	101,038	101,112	101,185	101,251	101,320	101,391	101,461	101,526

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:		
	10/21	10/22	10/23	10/24	10/26	10/28	10/30
Alameda	120,530	120,692	120,692	120,692	120,880 (24,176) [5,802] {2,901}	121,069 (24,214) [5,811] {2,906}	121,249 (24,250) [5,820] {2,910}
Contra Costa	99,884	100,018	100,018	100,018	100,214 (20,043) [4,810] {2,405}	100,408 (20,082) [4,820] {2,410}	100,598 (20,120) [4,829] {2,414}
Fresno	145,877	146,318	146,318	146,318	146,939 (29,388) [7,053] {3,527}	147,551 (29,510) [7,082] {3,541}	148,176 (29,635) [7,112] {3,556}
Kern	145,962	146,348	146,348	146,348	147,051 (29,410) [7,058] {3,529}	147,749 (29,550) [7,092] {3,546}	148,464 (29,693) [7,126] {3,563}
Lake	6,605	6,631	6,631	6,631	6,662 (1,332) [320] {160}	6,694 (1,339) [321] {161}	6,726 (1,345) [323] {161}
Los Angeles	1,481,814	1,483,031	1,484,192	1,485,105	1,487,258 (297,452) [71,388] {35,694}	1,489,427 (297,885) [71,493] {35,746}	1,491,661 (298,332) [71,600] {35,800}
Marin	17,692	17,706	17,706	17,706	17,739 (3,548) [851] {426}	17,771 (3,554) [853] {426}	17,804 (3,561) [855] {427}
Monterey	50,885	50,911	50,911	50,911	50,974 (10,195) [2,447] {1,223}	51,039 (10,208) [2,450] {1,225}	51,108 (10,222) [2,453] {1,227}
Orange	324,184	324,288	324,288	324,288	324,722 (64,944) [15,587] {7,793}	325,146 (65,029) [15,607] {7,804}	325,576 (65,115) [15,628] {7,814}
Placer	39,342	39,435	39,435	39,435	39,583 (7,917) [1,900] {950}	39,730 (7,946) [1,907] {954}	39,883 (7,977) [1,914] {957}
Riverside	371,293	371,670	371,670	371,670	372,279 (74,456) [17,869] {8,935}	372,875 (74,575) [17,898] {8,949}	373,471 (74,694) [17,927] {8,963}
Sacramento	159,333	159,636	159,636	159,636	160,211 (32,042) [7,690] {3,845}	160,800 (32,160) [7,718] {3,859}	161,403 (32,281) [7,747] {3,874}
San Bernardino	358,213	358,677	358,677	358,677	359,319 (71,864) [17,247] {8,624}	359,944 (71,989) [17,277] {8,639}	360,605 (72,121) [17,309] {8,655}
San Diego	366,056	366,661	367,361	367,857	368,838 (73,768) [17,704] {8,852}	369,849 (73,970) [17,753] {8,876}	370,861 (74,172) [17,801] {8,901}
San Francisco	54,375	54,440	54,440	54,440	54,546 (10,909) [2,618] {1,309}	54,645 (10,929) [2,623] {1,311}	54,744 (10,949) [2,628] {1,314}
San Joaquin	102,582	102,776	102,776	102,776	103,038 (20,608) [4,946] {2,473}	103,305 (20,661) [4,959] {2,479}	103,568 (20,714) [4,971] {2,486}
San Luis Obispo	29,945	29,973	29,973	29,973	30,061 (6,012) [1,443] {721}	30,147 (6,029) [1,447] {724}	30,236 (6,047) [1,451] {726}
San Mateo	54,112	54,168	54,168	54,168	54,257 (10,851) [2,604] {1,302}	54,346 (10,869) [2,609] {1,304}	54,437 (10,887) [2,613] {1,306}
Santa Barbara	45,160	45,223	45,223	45,223	45,329 (9,066) [2,176] {1,088}	45,437 (9,087) [2,181] {1,090}	45,543 (9,109) [2,186] {1,093}
Santa Clara	145,391	145,543	145,543	145,543	145,838 (29,168) [7,000] {3,500}	146,136 (29,227) [7,015] {3,507}	146,433 (29,287) [7,029] {3,514}
Santa Cruz	21,018	21,034	21,034	21,034	21,077 (4,215) [1,012] {506}	21,121 (4,224) [1,014] {507}	21,165 (4,233) [1,016] {508}
Solano	46,021	46,063	46,063	46,063	46,134 (9,227) [2,214] {1,107}	46,200 (9,240) [2,218] {1,109}	46,266 (9,253) [2,221] {1,110}
Sonoma	40,925	40,997	40,997	40,997	41,075 (8,215) [1,972] {986}	41,150 (8,230) [1,975] {988}	41,223 (8,245) [1,979] {989}
Ventura	100,984	101,038	101,038	101,038	101,185 (20,237) [4,857] {2,428}	101,320 (20,264) [4,863] {2,432}	101,461 (20,292) [4,870] {2,435}

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.