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

Date: 10/22/21

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 10/22/21 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.

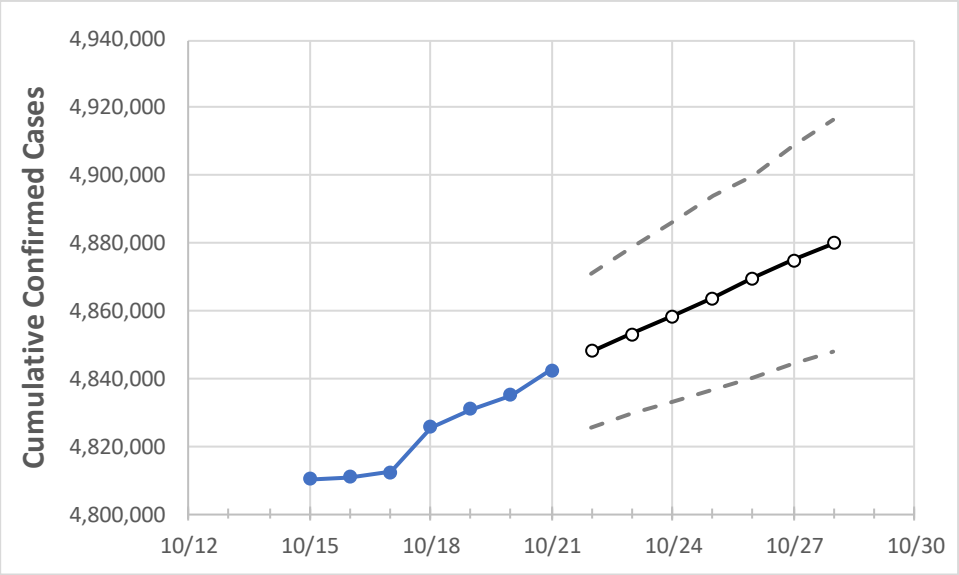
IEM's Modeling Lead

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:						
	10/18	10/19	10/20	10/21	10/22	10/23	10/24	10/25	10/26	10/27	10/28
California	4,825,708	4,830,872	4,835,022	4,842,472	4,848,073	4,852,996	4,858,278	4,863,720	4,869,546	4,874,843	4,880,082

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:						
	10/18	10/19	10/20	10/21	10/22	10/23	10/24	10/25	10/26	10/27	10/28
Alameda	120,283	120,366	120,402	120,530	120,637	120,749	120,853	120,957	121,063	121,167	121,268
Contra Costa	99,612	99,712	99,740	99,884	99,991	100,099	100,204	100,309	100,414	100,523	100,626
Fresno	145,119	145,378	145,503	145,877	146,185	146,494	146,798	147,103	147,406	147,721	148,023
Kern	144,914	145,227	145,589	145,962	146,296	146,621	146,947	147,274	147,602	147,932	148,255
Lake	6,565	6,583	6,593	6,605	6,620	6,635	6,650	6,664	6,679	6,693	6,707
Los Angeles	1,477,686	1,479,421	1,480,656	1,481,814	1,482,785	1,483,755	1,484,735	1,485,717	1,486,658	1,487,632	1,488,609
Marin	17,644	17,665	17,674	17,692	17,708	17,724	17,739	17,755	17,770	17,786	17,802
Monterey	50,772	50,792	50,815	50,885	50,912	50,940	50,967	50,993	51,019	51,046	51,070
Orange	323,407	323,569	323,788	324,184	324,408	324,632	324,859	325,079	325,299	325,533	325,743
Placer	39,118	39,157	39,222	39,342	39,414	39,488	39,558	39,629	39,699	39,771	39,838
Riverside	370,409	370,608	370,800	371,293	371,595	371,892	372,193	372,489	372,785	373,071	373,354
Sacramento	158,437	158,785	158,927	159,333	159,611	159,888	160,163	160,442	160,717	160,996	161,286
San Bernardino	357,421	357,639	357,711	358,213	358,494	358,784	359,056	359,335	359,621	359,901	360,183
San Diego	364,912	365,253	365,670	366,056	366,462	366,849	367,225	367,623	368,005	368,379	368,764
San Francisco	54,220	54,266	54,299	54,375	54,438	54,502	54,559	54,623	54,681	54,742	54,801
San Joaquin	102,250	102,341	102,405	102,582	102,707	102,830	102,955	103,078	103,198	103,321	103,441
San Luis Obispo	29,797	29,837	29,863	29,945	29,985	30,024	30,063	30,104	30,143	30,182	30,223
San Mateo	53,970	54,023	54,046	54,112	54,155	54,200	54,242	54,285	54,327	54,371	54,412
Santa Barbara	45,005	45,047	45,074	45,160	45,214	45,269	45,323	45,376	45,430	45,484	45,540
Santa Clara	145,004	145,127	145,225	145,391	145,535	145,678	145,818	145,961	146,106	146,254	146,398
Santa Cruz	20,928	20,943	20,962	21,018	21,041	21,065	21,089	21,112	21,136	21,160	21,182
Solano	45,898	45,934	45,958	46,021	46,061	46,101	46,139	46,177	46,215	46,252	46,286
Sonoma	40,822	40,865	40,895	40,925	40,968	41,011	41,052	41,094	41,137	41,179	41,219
Ventura	100,801	100,849	100,882	100,984	101,065	101,145	101,224	101,301	101,381	101,461	101,537

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:		
	10/18	10/19	10/20	10/21	10/23	10/25	10/27
Alameda	120,283	120,366	120,402	120,530	120,749 (24,150) [5,796] {2,898}	120,957 (24,191) [5,806] {2,903}	121,167 (24,233) [5,816] {2,908}
Contra Costa	99,612	99,712	99,740	99,884	100,099 (20,020) [4,805] {2,402}	100,309 (20,062) [4,815] {2,407}	100,523 (20,105) [4,825] {2,413}
Fresno	145,119	145,378	145,503	145,877	146,494 (29,299) [7,032] {3,516}	147,103 (29,421) [7,061] {3,530}	147,721 (29,544) [7,091] {3,545}
Kern	144,914	145,227	145,589	145,962	146,621 (29,324) [7,038] {3,519}	147,274 (29,455) [7,069] {3,535}	147,932 (29,586) [7,101] {3,550}
Lake	6,565	6,583	6,593	6,605	6,635 (1,327) [318] {159}	6,664 (1,333) [320] {160}	6,693 (1,339) [321] {161}
Los Angeles	1,477,686	1,479,421	1,480,656	1,481,814	1,483,755 (296,751) [71,220] {35,610}	1,485,717 (297,143) [71,314] {35,657}	1,487,632 (297,526) [71,406] {35,703}
Marin	17,644	17,665	17,674	17,692	17,724 (3,545) [851] {425}	17,755 (3,551) [852] {426}	17,786 (3,557) [854] {427}
Monterey	50,772	50,792	50,815	50,885	50,940 (10,188) [2,445] {1,223}	50,993 (10,199) [2,448] {1,224}	51,046 (10,209) [2,450] {1,225}
Orange	323,407	323,569	323,788	324,184	324,632 (64,926) [15,582] {7,791}	325,079 (65,016) [15,604] {7,802}	325,533 (65,107) [15,626] {7,813}
Placer	39,118	39,157	39,222	39,342	39,488 (7,898) [1,895] {948}	39,629 (7,926) [1,902] {951}	39,771 (7,954) [1,909] {955}
Riverside	370,409	370,608	370,800	371,293	371,892 (74,378) [17,851] {8,925}	372,489 (74,498) [17,879] {8,940}	373,071 (74,614) [17,907] {8,954}
Sacramento	158,437	158,785	158,927	159,333	159,888 (31,978) [7,675] {3,837}	160,442 (32,088) [7,701] {3,851}	160,996 (32,199) [7,728] {3,864}
San Bernardino	357,421	357,639	357,711	358,213	358,784 (71,757) [17,222] {8,611}	359,335 (71,867) [17,248] {8,624}	359,901 (71,980) [17,275] {8,638}
San Diego	364,912	365,253	365,670	366,056	366,849 (73,370) [17,609] {8,804}	367,623 (73,525) [17,646] {8,823}	368,379 (73,676) [17,682] {8,841}
San Francisco	54,220	54,266	54,299	54,375	54,502 (10,900) [2,616] {1,308}	54,623 (10,925) [2,622] {1,311}	54,742 (10,948) [2,628] {1,314}
San Joaquin	102,250	102,341	102,405	102,582	102,830 (20,566) [4,936] {2,468}	103,078 (20,616) [4,948] {2,474}	103,321 (20,664) [4,959] {2,480}
San Luis Obispo	29,797	29,837	29,863	29,945	30,024 (6,005) [1,441] {721}	30,104 (6,021) [1,445] {722}	30,182 (6,036) [1,449] {724}
San Mateo	53,970	54,023	54,046	54,112	54,200 (10,840) [2,602] {1,301}	54,285 (10,857) [2,606] {1,303}	54,371 (10,874) [2,610] {1,305}
Santa Barbara	45,005	45,047	45,074	45,160	45,269 (9,054) [2,173] {1,086}	45,376 (9,075) [2,178] {1,089}	45,484 (9,097) [2,183] {1,092}
Santa Clara	145,004	145,127	145,225	145,391	145,678 (29,136) [6,993] {3,496}	145,961 (29,192) [7,006] {3,503}	146,254 (29,251) [7,020] {3,510}
Santa Cruz	20,928	20,943	20,962	21,018	21,065 (4,213) [1,011] {506}	21,112 (4,222) [1,013] {507}	21,160 (4,232) [1,016] {508}
Solano	45,898	45,934	45,958	46,021	46,101 (9,220) [2,213] {1,106}	46,177 (9,235) [2,216] {1,108}	46,252 (9,250) [2,220] {1,110}
Sonoma	40,822	40,865	40,895	40,925	41,011 (8,202) [1,969] {984}	41,094 (8,219) [1,973] {986}	41,179 (8,236) [1,977] {988}
Ventura	100,801	100,849	100,882	100,984	101,145 (20,229) [4,855] {2,427}	101,301 (20,260) [4,862] {2,431}	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.