IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/3/21

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 11/3/21 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
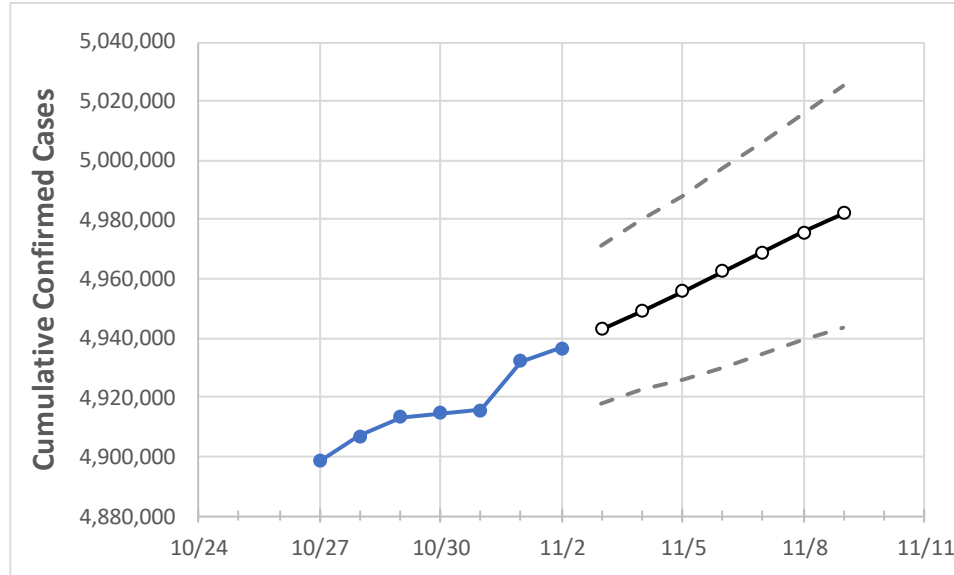
	Actual Confirmed Cases On:				Projected Cases For:						
	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
California	4,914,732	4,915,796	4,932,199	4,936,466	4,943,137	4,949,180	4,955,827	4,962,561	4,968,979	4,975,709	4,982,233

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:						
	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
Alameda	121,688	121,835	121,981	122,069	122,191	122,310	122,432	122,550	122,677	122,803	122,922
Contra Costa	100,882	101,006	101,131	101,206	101,313	101,414	101,522	101,624	101,732	101,837	101,938
Fresno	149,359	149,781	150,202	150,458	150,839	151,228	151,606	151,997	152,393	152,793	153,201
Kern	149,313	149,636	149,959	150,230	150,587	150,940	151,293	151,648	152,003	152,361	152,721
Lake	6,774	6,793	6,811	6,822	6,839	6,856	6,873	6,891	6,908	6,926	6,943
Los Angeles	1,492,106	1,493,170	1,494,119	1,495,014	1,496,140	1,497,288	1,498,421	1,499,546	1,500,661	1,501,827	1,502,988
Marin	17,848	17,869	17,890	17,907	17,926	17,945	17,965	17,984	18,004	18,024	18,045
Monterey	51,220	51,251	51,283	51,295	51,331	51,367	51,400	51,434	51,472	51,511	51,546
Orange	326,548	326,850	327,152	327,321	327,597	327,865	328,148	328,432	328,711	328,998	329,287
Placer	40,175	40,275	40,374	40,423	40,515	40,608	40,703	40,797	40,893	40,988	41,084
Riverside	375,165	375,619	376,072	376,330	376,743	377,158	377,574	377,989	378,413	378,841	379,265
Sacramento	162,003	162,183	162,364	162,590	162,862	163,130	163,393	163,657	163,930	164,194	164,464
San Bernardino	361,714	362,159	362,604	362,813	363,199	363,582	363,974	364,367	364,764	365,170	365,587
San Diego	392,003	392,536	393,068	393,508	393,981	394,456	394,956	395,484	395,929	396,412	396,927
San Francisco	54,882	54,951	55,021	55,069	55,125	55,180	55,235	55,290	55,346	55,401	55,456
San Joaquin	103,919	104,112	104,305	104,381	104,524	104,669	104,817	104,967	105,108	105,260	105,407
San Luis Obispo	30,332	30,373	30,414	30,437	30,478	30,523	30,565	30,609	30,650	30,695	30,741
San Mateo	54,646	54,713	54,780	54,810	54,869	54,927	54,985	55,046	55,105	55,167	55,227
Santa Barbara	45,697	45,744	45,791	45,824	45,877	45,930	45,982	46,035	46,087	46,141	46,192
Santa Clara	146,748	146,937	147,126	147,275	147,438	147,601	147,765	147,936	148,104	148,270	148,444
Santa Cruz	21,239	21,267	21,295	21,315	21,341	21,367	21,393	21,420	21,447	21,474	21,501
Solano	46,415	46,469	46,524	46,572	46,617	46,663	46,707	46,751	46,798	46,843	46,889
Sonoma	41,539	41,626	41,712	41,763	41,832	41,903	41,975	42,049	42,124	42,201	42,275
Ventura	101,669	101,761	101,854	101,901	101,977	102,050	102,124	102,197	102,272	102,348	102,421

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:		
	10/30	10/31	11/1	11/2	11/4	11/6	11/8
Alameda	121,688	121,835	121,981	122,069	122,310 (24,462) [5,871] {2,935}	122,550 (24,510) [5,882] {2,941}	122,803 (24,561) [5,895] {2,947}
Contra Costa	100,882	101,006	101,131	101,206	101,414 (20,283) [4,868] {2,434}	101,624 (20,325) [4,878] {2,439}	101,837 (20,367) [4,888] {2,444}
Fresno	149,359	149,781	150,202	150,458	151,228 (30,246) [7,259] {3,629}	151,997 (30,399) [7,296] {3,648}	152,793 (30,559) [7,334] {3,667}
Kern	149,313	149,636	149,959	150,230	150,940 (30,188) [7,245] {3,623}	151,648 (30,330) [7,279] {3,640}	152,361 (30,472) [7,313] {3,657}
Lake	6,774	6,793	6,811	6,822	6,856 (1,371) [329] {165}	6,891 (1,378) [331] {165}	6,926 (1,385) [332] {166}
Los Angeles	1,492,106	1,493,170	1,494,119	1,495,014	1,497,288 (299,458) [71,870] {35,935}	1,499,546 (299,909) [71,978] {35,989}	1,501,827 (300,365) [72,088] {36,044}
Marin	17,848	17,869	17,890	17,907	17,945 (3,589) [861] {431}	17,984 (3,597) [863] {432}	18,024 (3,605) [865] {433}
Monterey	51,220	51,251	51,283	51,295	51,367 (10,273) [2,466] {1,233}	51,434 (10,287) [2,469] {1,234}	51,511 (10,302) [2,473] {1,236}
Orange	326,548	326,850	327,152	327,321	327,865 (65,573) [15,738] {7,869}	328,432 (65,686) [15,765] {7,882}	328,998 (65,800) [15,792] {7,896}
Placer	40,175	40,275	40,374	40,423	40,608 (8,122) [1,949] {975}	40,797 (8,159) [1,958] {979}	40,988 (8,198) [1,967] {984}
Riverside	375,165	375,619	376,072	376,330	377,158 (75,432) [18,104] {9,052}	377,989 (75,598) [18,143] {9,072}	378,841 (75,768) [18,184] {9,092}
Sacramento	162,003	162,183	162,364	162,590	163,130 (32,626) [7,830] {3,915}	163,657 (32,731) [7,856] {3,928}	164,194 (32,839) [7,881] {3,941}
San Bernardino	361,714	362,159	362,604	362,813	363,582 (72,716) [17,452] {8,726}	364,367 (72,873) [17,490] {8,745}	365,170 (73,034) [17,528] {8,764}
San Diego	392,003	392,536	393,068	393,508	394,456 (78,891) [18,934] {9,467}	395,484 (79,097) [18,983] {9,492}	396,412 (79,282) [19,028] {9,514}
San Francisco	54,882	54,951	55,021	55,069	55,180 (11,036) [2,649] {1,324}	55,290 (11,058) [2,654] {1,327}	55,401 (11,080) [2,659] {1,330}
San Joaquin	103,919	104,112	104,305	104,381	104,669 (20,934) [5,024] {2,512}	104,967 (20,993) [5,038] {2,519}	105,260 (21,052) [5,053] {2,526}
San Luis Obispo	30,332	30,373	30,414	30,437	30,523 (6,105) [1,465] {733}	30,609 (6,122) [1,469] {735}	30,695 (6,139) [1,473] {737}
San Mateo	54,646	54,713	54,780	54,810	54,927 (10,985) [2,636] {1,318}	55,046 (11,009) [2,642] {1,321}	55,167 (11,033) [2,648] {1,324}
Santa Barbara	45,697	45,744	45,791	45,824	45,930 (9,186) [2,205] {1,102}	46,035 (9,207) [2,210] {1,105}	46,141 (9,228) [2,215] {1,107}
Santa Clara	146,748	146,937	147,126	147,275	147,601 (29,520) [7,085] {3,542}	147,936 (29,587) [7,101] {3,550}	148,270 (29,654) [7,117] {3,558}
Santa Cruz	21,239	21,267	21,295	21,315	21,367 (4,273) [1,026] {513}	21,420 (4,284) [1,028] {514}	21,474 (4,295) [1,031] {515}
Solano	46,415	46,469	46,524	46,572	46,663 (9,333) [2,240] {1,120}	46,751 (9,350) [2,244] {1,122}	46,843 (9,369) [2,248] {1,124}
Sonoma	41,539	41,626	41,712	41,763	41,903 (8,381) [2,011] {1,006}	42,049 (8,410) [2,018] {1,009}	42,201 (8,440) [2,026] {1,013}
Ventura	101,669	101,761	101,854	101,901	102,050 (20,410) [4,898] {2,449}	102,197 (20,439) [4,905] {2,453}	102,348 (20,470) [4,913] {2,456}

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.