IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/5/21

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 11/5/21 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
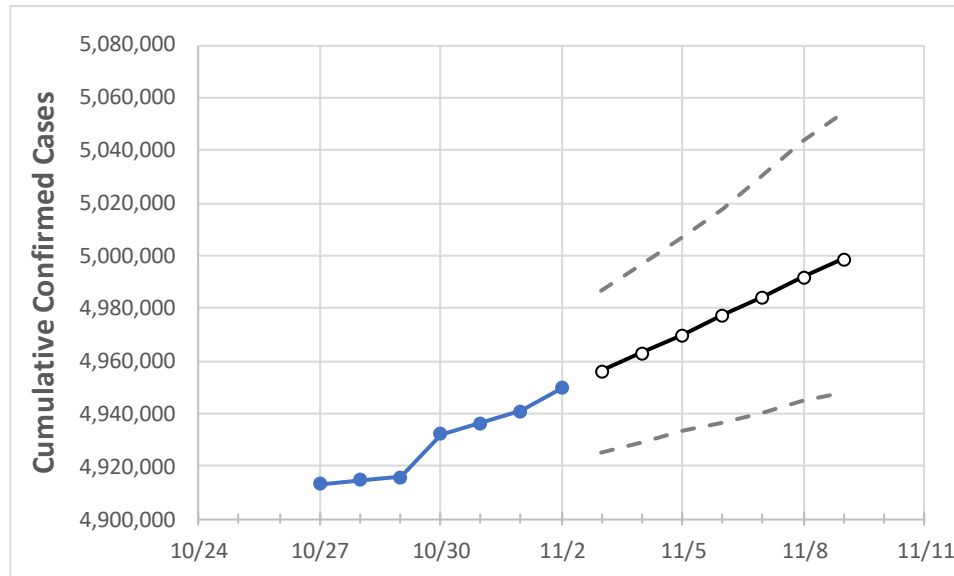
	Actual Confirmed Cases On:				Projected Cases For:						
	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
California	4,932,199	4,936,466	4,940,995	4,949,489	4,956,001	4,962,813	4,969,760	4,977,411	4,984,238	4,991,895	4,998,708

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	121,981	122,069	122,151	122,328	122,467	122,602	122,741	122,884	123,030	123,179	123,323
Contra Costa	101,131	101,206	101,275	101,433	101,547	101,662	101,778	101,893	102,013	102,128	102,247
Fresno	150,202	150,458	150,681	151,137	151,530	151,933	152,339	152,744	153,161	153,590	154,007
Kern	149,959	150,230	150,632	150,971	151,340	151,710	152,082	152,444	152,830	153,214	153,595
Lake	6,811	6,822	6,827	6,830	6,846	6,861	6,877	6,892	6,908	6,924	6,939
Los Angeles	1,494,119	1,495,014	1,496,593	1,498,393	1,499,736	1,501,076	1,502,432	1,503,862	1,505,263	1,506,733	1,508,179
Marin	17,890	17,907	17,929	17,947	17,967	17,988	18,009	18,031	18,052	18,074	18,097
Monterey	51,283	51,295	51,314	51,446	51,493	51,547	51,597	51,652	51,706	51,762	51,816
Orange	327,152	327,321	327,535	327,827	328,117	328,408	328,706	329,012	329,318	329,639	329,954
Placer	40,374	40,423	40,493	40,617	40,717	40,816	40,916	41,018	41,123	41,229	41,336
Riverside	376,072	376,330	376,653	377,219	377,678	378,145	378,618	379,095	379,587	380,081	380,578
Sacramento	162,364	162,590	162,809	163,190	163,451	163,718	163,970	164,240	164,508	164,770	165,025
San Bernardino	362,604	362,813	363,025	363,592	364,015	364,435	364,866	365,298	365,749	366,208	366,657
San Diego	393,068	393,508	393,905	394,591	395,163	395,681	396,246	396,761	397,301	397,872	398,508
San Francisco	55,021	55,069	55,101	55,200	55,261	55,324	55,383	55,444	55,507	55,572	55,633
San Joaquin	104,305	104,381	104,488	104,673	104,826	104,986	105,145	105,307	105,470	105,640	105,805
San Luis Obispo	30,414	30,437	30,462	30,540	30,585	30,632	30,679	30,727	30,774	30,822	30,870
San Mateo	54,780	54,810	54,847	54,977	55,052	55,128	55,203	55,282	55,360	55,443	55,525
Santa Barbara	45,791	45,824	45,855	45,915	45,966	46,017	46,067	46,117	46,168	46,219	46,269
Santa Clara	147,126	147,275	147,412	147,658	147,837	148,017	148,207	148,392	148,585	148,775	148,966
Santa Cruz	21,295	21,315	21,343	21,358	21,385	21,412	21,439	21,466	21,493	21,521	21,549
Solano	46,524	46,572	46,592	46,643	46,690	46,737	46,785	46,833	46,882	46,932	46,980
Sonoma	41,712	41,763	41,817	41,859	41,936	42,016	42,095	42,180	42,263	42,353	42,444
Ventura	101,854	101,901	101,968	102,107	102,196	102,286	102,373	102,465	102,555	102,649	102,741

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	121,981	122,069	122,151	122,328	122,602 (24,520) [5,885] {2,942}	122,884 (24,577) [5,898] {2,949}	123,179 (24,636) [5,913] {2,956}
Contra Costa	101,131	101,206	101,275	101,433	101,662 (20,332) [4,880] {2,440}	101,893 (20,379) [4,891] {2,445}	102,128 (20,426) [4,902] {2,451}
Fresno	150,202	150,458	150,681	151,137	151,933 (30,387) [7,293] {3,646}	152,744 (30,549) [7,332] {3,666}	153,590 (30,718) [7,372] {3,686}
Kern	149,959	150,230	150,632	150,971	151,710 (30,342) [7,282] {3,641}	152,444 (30,489) [7,317] {3,659}	153,214 (30,643) [7,354] {3,677}
Lake	6,811	6,822	6,827	6,830	6,861 (1,372) [329] {165}	6,892 (1,378) [331] {165}	6,924 (1,385) [332] {166}
Los Angeles	1,494,119	1,495,014	1,496,593	1,498,393	1,501,076 (300,215) [72,052] {36,026}	1,503,862 (300,772) [72,185] {36,093}	1,506,733 (301,347) [72,323] {36,162}
Marin	17,890	17,907	17,929	17,947	17,988 (3,598) [863] {432}	18,031 (3,606) [865] {433}	18,074 (3,615) [868] {434}
Monterey	51,283	51,295	51,314	51,446	51,547 (10,309) [2,474] {1,237}	51,652 (10,330) [2,479] {1,240}	51,762 (10,352) [2,485] {1,242}
Orange	327,152	327,321	327,535	327,827	328,408 (65,682) [15,764] {7,882}	329,012 (65,802) [15,793] {7,896}	329,639 (65,928) [15,823] {7,911}
Placer	40,374	40,423	40,493	40,617	40,816 (8,163) [1,959] {980}	41,018 (8,204) [1,969] {984}	41,229 (8,246) [1,979] {990}
Riverside	376,072	376,330	376,653	377,219	378,145 (75,629) [18,151] {9,075}	379,095 (75,819) [18,197] {9,098}	380,081 (76,016) [18,244] {9,122}
Sacramento	162,364	162,590	162,809	163,190	163,718 (32,744) [7,858] {3,929}	164,240 (32,848) [7,884] {3,942}	164,770 (32,954) [7,909] {3,954}
San Bernardino	362,604	362,813	363,025	363,592	364,435 (72,887) [17,493] {8,746}	365,298 (73,060) [17,534] {8,767}	366,208 (73,242) [17,578] {8,789}
San Diego	393,068	393,508	393,905	394,591	395,681 (79,136) [18,993] {9,496}	396,761 (79,352) [19,045] {9,522}	397,872 (79,574) [19,098] {9,549}
San Francisco	55,021	55,069	55,101	55,200	55,324 (11,065) [2,656] {1,328}	55,444 (11,089) [2,661] {1,331}	55,572 (11,114) [2,667] {1,334}
San Joaquin	104,305	104,381	104,488	104,673	104,986 (20,997) [5,039] {2,520}	105,307 (21,061) [5,055] {2,527}	105,640 (21,128) [5,071] {2,535}
San Luis Obispo	30,414	30,437	30,462	30,540	30,632 (6,126) [1,470] {735}	30,727 (6,145) [1,475] {737}	30,822 (6,164) [1,479] {740}
San Mateo	54,780	54,810	54,847	54,977	55,128 (11,026) [2,646] {1,323}	55,282 (11,056) [2,654] {1,327}	55,443 (11,089) [2,661] {1,331}
Santa Barbara	45,791	45,824	45,855	45,915	46,017 (9,203) [2,209] {1,104}	46,117 (9,223) [2,214] {1,107}	46,219 (9,244) [2,218] {1,109}
Santa Clara	147,126	147,275	147,412	147,658	148,017 (29,603) [7,105] {3,552}	148,392 (29,678) [7,123] {3,561}	148,775 (29,755) [7,141] {3,571}
Santa Cruz	21,295	21,315	21,343	21,358	21,412 (4,282) [1,028] {514}	21,466 (4,293) [1,030] {515}	21,521 (4,304) [1,033] {517}
Solano	46,524	46,572	46,592	46,643	46,737 (9,347) [2,243] {1,122}	46,833 (9,367) [2,248] {1,124}	46,932 (9,386) [2,253] {1,126}
Sonoma	41,712	41,763	41,817	41,859	42,016 (8,403) [2,017] {1,008}	42,180 (8,436) [2,025] {1,012}	42,353 (8,471) [2,033] {1,016}
Ventura	101,854	101,901	101,968	102,107	102,286 (20,457) [4,910] {2,455}	102,465 (20,493) [4,918] {2,459}	102,649 (20,530) [4,927] {2,464}

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.