IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/28/20

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 12/28/20 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
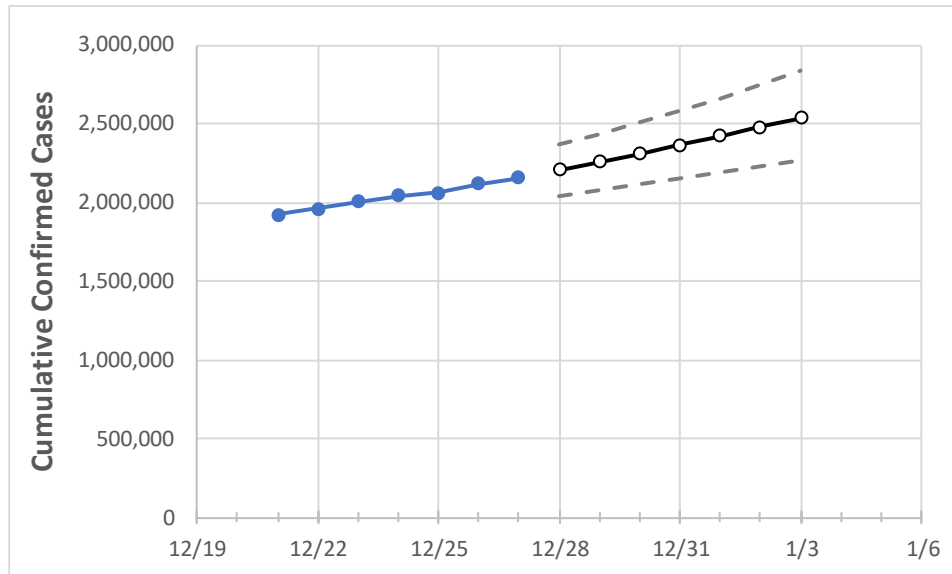
	Actual Confirmed Cases On:				Projected Cases For:						
	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3
California	2,040,188	2,060,797	2,120,610	2,156,389	2,206,423	2,257,717	2,311,281	2,366,690	2,423,781	2,480,410	2,539,209

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 20%, and are often within 10%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3
Alameda	46,753	47,527	48,365	49,084	50,048	51,034	52,015	53,041	54,051	55,086	56,145
Contra Costa	36,313	36,752	37,610	38,138	38,839	39,557	40,299	41,075	41,860	42,665	43,480
Fresno	60,488	61,435	62,251	63,080	64,899	66,818	68,844	71,016	73,244	75,714	78,193
Kern	61,324	62,439	63,044	63,557	64,642	65,724	66,846	67,986	69,156	70,337	71,531
Lake	1,602	1,629	1,688	1,710	1,753	1,797	1,842	1,889	1,937	1,986	2,038
Los Angeles	677,299	678,040	706,448	719,833	737,473	755,407	773,878	793,209	813,323	834,347	855,702
Marin	9,305	9,377	9,449	9,505	9,600	9,698	9,801	9,906	10,013	10,121	10,234
Monterey	24,856	25,131	25,788	26,010	26,613	27,229	27,848	28,509	29,177	29,856	30,572
Orange	138,310	141,205	144,542	147,463	151,749	156,182	160,707	165,469	170,354	175,374	180,634
Placer	12,262	12,457	12,660	12,816	13,081	13,347	13,624	13,895	14,174	14,460	14,746
Riverside	158,110	162,435	166,690	169,360	173,650	178,008	182,519	187,139	191,890	196,715	201,702
Sacramento	59,661	60,596	61,630	62,435	63,554	64,689	65,832	67,001	68,166	69,338	70,544
San Bernardino	174,091	176,866	181,812	185,111	189,956	195,072	200,215	205,756	211,360	217,062	222,819
San Diego	136,955	139,801	142,647	145,779	149,127	152,594	156,298	159,972	163,790	167,706	171,637
San Francisco	21,498	21,830	22,130	22,319	22,631	22,942	23,266	23,587	23,906	24,234	24,565
San Joaquin	40,695	41,324	42,089	42,887	43,919	44,932	46,022	47,129	48,265	49,501	50,693
San Luis Obispo	9,303	9,504	9,749	9,945	10,165	10,391	10,626	10,865	11,114	11,379	11,646
San Mateo	22,241	22,405	22,568	22,908	23,253	23,603	23,948	24,292	24,635	24,983	25,328
Santa Barbara	15,417	15,657	15,936	16,159	16,434	16,719	17,019	17,327	17,647	17,984	18,329
Santa Clara	61,090	61,742	63,302	64,974	66,423	67,931	69,450	71,014	72,604	74,219	75,888
Santa Cruz	7,637	7,856	8,018	8,113	8,297	8,488	8,686	8,888	9,088	9,298	9,512
Solano	17,330	17,396	17,462	17,528	17,934	18,328	18,751	19,179	19,634	20,126	20,615
Sonoma	17,723	17,879	18,035	18,539	18,861	19,199	19,556	19,926	20,316	20,706	21,124
Ventura	33,377	34,400	35,514	36,064	36,999	37,958	38,947	39,976	41,076	42,201	43,354

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:		
	12/24	12/25	12/26	12/27	12/29	12/31	1/2
Alameda	46,753	47,527	48,365	49,084	51,034 (10,207) [2,450] {1,225}	53,041 (10,608) [2,546] {1,273}	55,086 (11,017) [2,644] {1,322}
Contra Costa	36,313	36,752	37,610	38,138	39,557 (7,911) [1,899] {949}	41,075 (8,215) [1,972] {986}	42,665 (8,533) [2,048] {1,024}
Fresno	60,488	61,435	62,251	63,080	66,818 (13,364) [3,207] {1,604}	71,016 (14,203) [3,409] {1,704}	75,714 (15,143) [3,634] {1,817}
Kern	61,324	62,439	63,044	63,557	65,724 (13,145) [3,155] {1,577}	67,986 (13,597) [3,263] {1,632}	70,337 (14,067) [3,376] {1,688}
Lake	1,602	1,629	1,688	1,710	1,797 (359) [86] {43}	1,889 (378) [91] {45}	1,986 (397) [95] {48}
Los Angeles	677,299	678,040	706,448	719,833	755,407 (151,081) [36,260] {18,130}	793,209 (158,642) [38,074] {19,037}	834,347 (166,869) [40,049] {20,024}
Marin	9,305	9,377	9,449	9,505	9,698 (1,940) [466] {233}	9,906 (1,981) [475] {238}	10,121 (2,024) [486] {243}
Monterey	24,856	25,131	25,788	26,010	27,229 (5,446) [1,307] {653}	28,509 (5,702) [1,368] {684}	29,856 (5,971) [1,433] {717}
Orange	138,310	141,205	144,542	147,463	156,182 (31,236) [7,497] {3,748}	165,469 (33,094) [7,943] {3,971}	175,374 (35,075) [8,418] {4,209}
Placer	12,262	12,457	12,660	12,816	13,347 (2,669) [641] {320}	13,895 (2,779) [667] {333}	14,460 (2,892) [694] {347}
Riverside	158,110	162,435	166,690	169,360	178,008 (35,602) [8,544] {4,272}	187,139 (37,428) [8,983] {4,491}	196,715 (39,343) [9,442] {4,721}
Sacramento	59,661	60,596	61,630	62,435	64,689 (12,938) [3,105] {1,553}	67,001 (13,400) [3,216] {1,608}	69,338 (13,868) [3,328] {1,664}
San Bernardino	174,091	176,866	181,812	185,111	195,072 (39,014) [9,363] {4,682}	205,756 (41,151) [9,876] {4,938}	217,062 (43,412) [10,419] {5,209}
San Diego	136,955	139,801	142,647	145,779	152,594 (30,519) [7,325] {3,662}	159,972 (31,994) [7,679] {3,839}	167,706 (33,541) [8,050] {4,025}
San Francisco	21,498	21,830	22,130	22,319	22,942 (4,588) [1,101] {551}	23,587 (4,717) [1,132] {566}	24,234 (4,847) [1,163] {582}
San Joaquin	40,695	41,324	42,089	42,887	44,932 (8,986) [2,157] {1,078}	47,129 (9,426) [2,262] {1,131}	49,501 (9,900) [2,376] {1,188}
San Luis Obispo	9,303	9,504	9,749	9,945	10,391 (2,078) [499] {249}	10,865 (2,173) [522] {261}	11,379 (2,276) [546] {273}
San Mateo	22,241	22,405	22,568	22,908	23,603 (4,721) [1,133] {566}	24,292 (4,858) [1,166] {583}	24,983 (4,997) [1,199] {600}
Santa Barbara	15,417	15,657	15,936	16,159	16,719 (3,344) [803] {401}	17,327 (3,465) [832] {416}	17,984 (3,597) [863] {432}
Santa Clara	61,090	61,742	63,302	64,974	67,931 (13,586) [3,261] {1,630}	71,014 (14,203) [3,409] {1,704}	74,219 (14,844) [3,563] {1,781}
Santa Cruz	7,637	7,856	8,018	8,113	8,488 (1,698) [407] {204}	8,888 (1,778) [427] {213}	9,298 (1,860) [446] {223}
Solano	17,330	17,396	17,462	17,528	18,328 (3,666) [880] {440}	19,179 (3,836) [921] {460}	20,126 (4,025) [966] {483}
Sonoma	17,723	17,879	18,035	18,539	19,199 (3,840) [922] {461}	19,926 (3,985) [956] {478}	20,706 (4,141) [994] {497}
Ventura	33,377	34,400	35,514	36,064	37,958 (7,592) [1,822] {911}	39,976 (7,995) [1,919] {959}	42,201 (8,440) [2,026] {1,013}

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.