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

Date: 12/29/21

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 12/29/21 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.

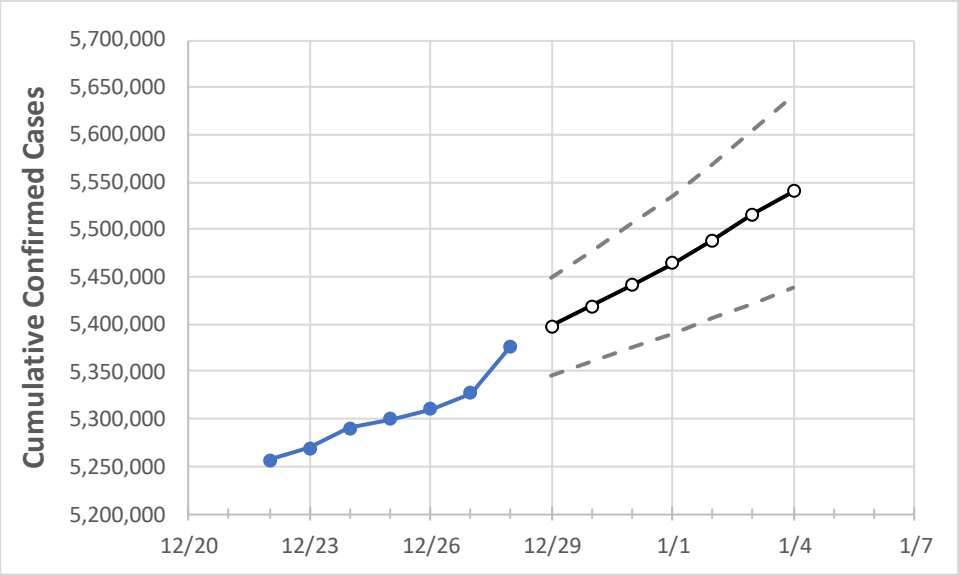
IEM's Modeling Lead

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:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
California	5,300,301	5,310,698	5,327,107	5,377,245	5,397,927	5,419,064	5,440,943	5,463,932	5,489,128	5,515,818	5,540,652

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:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Alameda	131,177	131,850	132,522	133,194	133,906	134,670	135,454	136,307	137,246	138,271	139,284
Contra Costa	107,973	108,390	108,808	109,225	109,635	110,053	110,510	111,000	111,505	112,044	112,614
Fresno	161,233	161,433	161,632	161,832	161,986	162,150	162,314	162,476	162,636	162,805	162,976
Kern	162,455	162,611	162,767	162,767	162,936	163,100	163,264	163,431	163,594	163,761	163,926
Lake	7,196	7,200	7,205	7,209	7,214	7,219	7,224	7,229	7,234	7,239	7,244
Los Angeles	1,605,636	1,616,033	1,623,442	1,632,893	1,643,321	1,654,627	1,666,605	1,679,555	1,693,468	1,708,804	1,724,729
Marin	19,815	19,944	20,073	20,202	20,340	20,480	20,639	20,801	20,979	21,166	21,363
Monterey	54,383	54,436	54,488	54,540	54,593	54,646	54,698	54,746	54,799	54,856	54,903
Orange	347,341	348,959	350,578	351,565	352,886	354,251	355,693	357,264	358,847	360,506	362,352
Placer	44,076	44,179	44,281	44,384	44,476	44,568	44,665	44,760	44,858	44,968	45,076
Riverside	403,418	404,551	405,683	406,815	407,807	408,859	409,960	411,074	412,196	413,433	414,608
Sacramento	175,082	175,510	175,939	176,367	176,740	177,151	177,552	177,962	178,401	178,809	179,293
San Bernardino	389,678	390,796	391,915	393,033	393,922	394,894	395,846	396,865	397,920	399,019	400,154
San Diego	432,064	434,152	436,240	438,328	440,384	442,579	444,847	447,154	449,725	452,302	455,025
San Francisco	61,987	62,660	63,332	64,005	64,800	65,661	66,599	67,623	68,735	69,946	71,290
San Joaquin	110,816	111,022	111,227	111,433	111,604	111,777	111,945	112,131	112,326	112,518	112,714
San Luis Obispo	32,827	32,923	33,018	33,113	33,203	33,292	33,388	33,484	33,588	33,697	33,806
San Mateo	59,407	59,763	60,119	60,475	60,835	61,221	61,630	62,071	62,546	63,062	63,614
Santa Barbara	49,533	49,697	49,861	50,025	50,176	50,333	50,497	50,664	50,841	51,019	51,214
Santa Clara	159,146	159,566	159,985	161,759	162,424	163,092	163,805	164,575	165,385	166,198	167,122
Santa Cruz	23,396	23,466	23,536	23,606	23,667	23,728	23,791	23,853	23,919	23,982	24,055
Solano	49,139	49,270	49,402	49,533	49,651	49,776	49,911	50,049	50,192	50,347	50,511
Sonoma	45,139	45,297	45,455	45,613	45,755	45,913	46,068	46,237	46,406	46,587	46,771
Ventura	108,630	109,058	109,487	109,915	110,367	110,862	111,371	111,933	112,489	113,115	113,771

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:		
	12/25	12/26	12/27	12/28	12/30	1/1	1/3
Alameda	131,177	131,850	132,522	133,194	134,670 (26,934) [6,464] {3,232}	136,307 (27,261) [6,543] {3,271}	138,271 (27,654) [6,637] {3,319}
Contra Costa	107,973	108,390	108,808	109,225	110,053 (22,011) [5,283] {2,641}	111,000 (22,200) [5,328] {2,664}	112,044 (22,409) [5,378] {2,689}
Fresno	161,233	161,433	161,632	161,832	162,150 (32,430) [7,783] {3,892}	162,476 (32,495) [7,799] {3,899}	162,805 (32,561) [7,815] {3,907}
Kern	162,455	162,611	162,767	162,767	163,100 (32,620) [7,829] {3,914}	163,431 (32,686) [7,845] {3,922}	163,761 (32,752) [7,861] {3,930}
Lake	7,196	7,200	7,205	7,209	7,219 (1,444) [347] {173}	7,229 (1,446) [347] {174}	7,239 (1,448) [347] {174}
Los Angeles	1,605,636	1,616,033	1,623,442	1,632,893	1,654,627 (330,925) [79,422] {39,711}	1,679,555 (335,911) [80,619] {40,309}	1,708,804 (341,761) [82,023] {41,011}
Marin	19,815	19,944	20,073	20,202	20,480 (4,096) [983] {492}	20,801 (4,160) [998] {499}	21,166 (4,233) [1,016] {508}
Monterey	54,383	54,436	54,488	54,540	54,646 (10,929) [2,623] {1,312}	54,746 (10,949) [2,628] {1,314}	54,856 (10,971) [2,633] {1,317}
Orange	347,341	348,959	350,578	351,565	354,251 (70,850) [17,004] {8,502}	357,264 (71,453) [17,149] {8,574}	360,506 (72,101) [17,304] {8,652}
Placer	44,076	44,179	44,281	44,384	44,568 (8,914) [2,139] {1,070}	44,760 (8,952) [2,148] {1,074}	44,968 (8,994) [2,158] {1,079}
Riverside	403,418	404,551	405,683	406,815	408,859 (81,772) [19,625] {9,813}	411,074 (82,215) [19,732] {9,866}	413,433 (82,687) [19,845] {9,922}
Sacramento	175,082	175,510	175,939	176,367	177,151 (35,430) [8,503] {4,252}	177,962 (35,592) [8,542] {4,271}	178,809 (35,762) [8,583] {4,291}
San Bernardino	389,678	390,796	391,915	393,033	394,894 (78,979) [18,955] {9,477}	396,865 (79,373) [19,049] {9,525}	399,019 (79,804) [19,153] {9,576}
San Diego	432,064	434,152	436,240	438,328	442,579 (88,516) [21,244] {10,622}	447,154 (89,431) [21,463] {10,732}	452,302 (90,460) [21,710] {10,855}
San Francisco	61,987	62,660	63,332	64,005	65,661 (13,132) [3,152] {1,576}	67,623 (13,525) [3,246] {1,623}	69,946 (13,989) [3,357] {1,679}
San Joaquin	110,816	111,022	111,227	111,433	111,777 (22,355) [5,365] {2,683}	112,131 (22,426) [5,382] {2,691}	112,518 (22,504) [5,401] {2,700}
San Luis Obispo	32,827	32,923	33,018	33,113	33,292 (6,658) [1,598] {799}	33,484 (6,697) [1,607] {804}	33,697 (6,739) [1,617] {809}
San Mateo	59,407	59,763	60,119	60,475	61,221 (12,244) [2,939] {1,469}	62,071 (12,414) [2,979] {1,490}	63,062 (12,612) [3,027] {1,513}
Santa Barbara	49,533	49,697	49,861	50,025	50,333 (10,067) [2,416] {1,208}	50,664 (10,133) [2,432] {1,216}	51,019 (10,204) [2,449] {1,224}
Santa Clara	159,146	159,566	159,985	161,759	163,092 (32,618) [7,828] {3,914}	164,575 (32,915) [7,900] {3,950}	166,198 (33,240) [7,978] {3,989}
Santa Cruz	23,396	23,466	23,536	23,606	23,728 (4,746) [1,139] {569}	23,853 (4,771) [1,145] {572}	23,982 (4,796) [1,151] {576}
Solano	49,139	49,270	49,402	49,533	49,776 (9,955) [2,389] {1,195}	50,049 (10,010) [2,402] {1,201}	50,347 (10,069) [2,417] {1,208}
Sonoma	45,139	45,297	45,455	45,613	45,913 (9,183) [2,204] {1,102}	46,237 (9,247) [2,219] {1,110}	46,587 (9,317) [2,236] {1,118}
Ventura	108,630	109,058	109,487	109,915	110,862 (22,172) [5,321] {2,661}	111,933 (22,387) [5,373] {2,686}	113,115 (22,623) [5,430] {2,715}

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.