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

Date: 12/13/21

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 12/13/21 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.

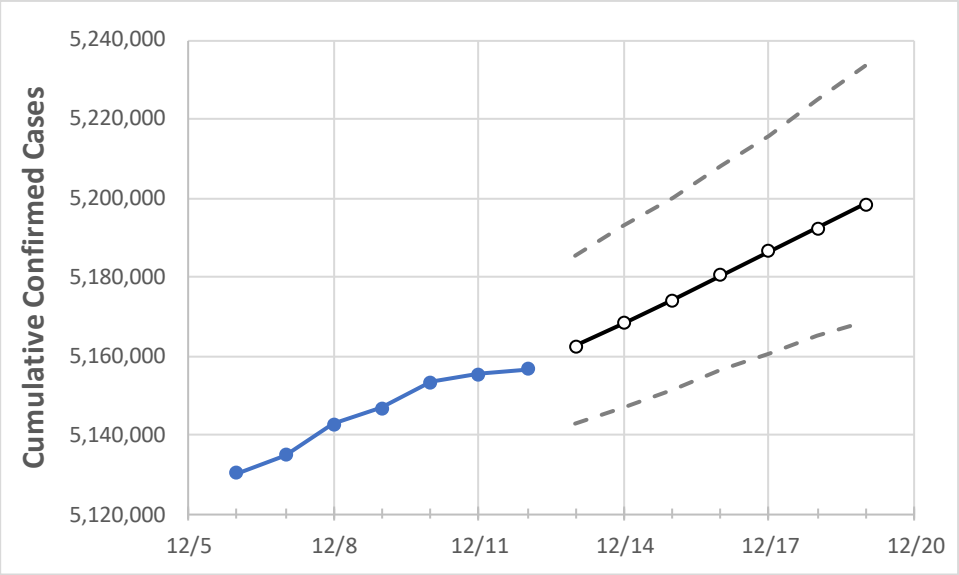
IEM's Modeling Lead

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:						
	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19
California	5,146,771	5,153,434	5,155,233	5,156,692	5,162,568	5,168,366	5,174,206	5,180,390	5,186,448	5,192,246	5,198,500

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:						
	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19
Alameda	126,607	126,741	126,741	126,741	126,882	127,010	127,134	127,257	127,391	127,526	127,668
Contra Costa	105,018	105,074	105,074	105,074	105,190	105,309	105,404	105,527	105,641	105,770	105,881
Fresno	158,644	158,802	158,802	158,802	158,950	159,100	159,242	159,398	159,541	159,706	159,852
Kern	159,493	159,721	159,721	159,721	159,914	160,108	160,303	160,494	160,691	160,882	161,074
Lake	7,088	7,090	7,090	7,090	7,093	7,097	7,100	7,103	7,106	7,109	7,112
Los Angeles	1,541,886	1,543,784	1,545,583	1,547,042	1,548,678	1,550,343	1,552,010	1,553,703	1,555,457	1,557,292	1,559,051
Marin	18,878	18,895	18,895	18,895	18,938	18,984	19,029	19,073	19,124	19,172	19,224
Monterey	53,277	53,328	53,328	53,328	53,385	53,446	53,504	53,567	53,629	53,696	53,763
Orange	337,623	337,937	337,937	337,937	338,304	338,673	339,055	339,443	339,826	340,229	340,621
Placer	42,990	43,002	43,002	43,002	43,063	43,126	43,192	43,255	43,325	43,396	43,464
Riverside	392,645	393,195	393,195	393,195	393,715	394,240	394,723	395,274	395,768	396,307	396,916
Sacramento	170,585	170,837	170,837	170,837	171,041	171,245	171,482	171,692	171,942	172,169	172,396
San Bernardino	379,756	380,385	380,385	380,385	380,940	381,470	382,028	382,559	383,116	383,737	384,278
San Diego	414,408	415,006	415,006	415,006	415,963	416,959	417,878	418,882	419,960	421,066	422,135
San Francisco	57,732	57,770	57,770	57,770	57,843	57,916	57,981	58,062	58,140	58,216	58,292
San Joaquin	108,808	108,876	108,876	108,876	108,971	109,056	109,154	109,252	109,337	109,445	109,542
San Luis Obispo	31,916	31,940	31,940	31,940	31,978	32,015	32,050	32,088	32,122	32,164	32,200
San Mateo	57,160	57,192	57,192	57,192	57,273	57,343	57,416	57,489	57,571	57,650	57,720
Santa Barbara	48,061	48,090	48,090	48,090	48,163	48,230	48,299	48,362	48,434	48,510	48,581
Santa Clara	154,364	154,536	154,536	154,536	154,760	154,971	155,177	155,409	155,622	155,880	156,078
Santa Cruz	22,658	22,684	22,684	22,684	22,723	22,761	22,801	22,838	22,881	22,923	22,964
Solano	48,157	48,211	48,211	48,211	48,259	48,306	48,353	48,404	48,456	48,509	48,561
Sonoma	43,787	43,811	43,811	43,811	43,869	43,922	43,982	44,035	44,096	44,154	44,220
Ventura	105,247	105,311	105,311	105,311	105,416	105,541	105,638	105,767	105,890	106,003	106,140

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:		
	12/9	12/10	12/11	12/12	12/14	12/16	12/18
Alameda	126,607	126,741	126,741	126,741	127,010 (25,402) [6,096] {3,048}	127,257 (25,451) [6,108] {3,054}	127,526 (25,505) [6,121] {3,061}
Contra Costa	105,018	105,074	105,074	105,074	105,309 (21,062) [5,055] {2,527}	105,527 (21,105) [5,065] {2,533}	105,770 (21,154) [5,077] {2,538}
Fresno	158,644	158,802	158,802	158,802	159,100 (31,820) [7,637] {3,818}	159,398 (31,880) [7,651] {3,826}	159,706 (31,941) [7,666] {3,833}
Kern	159,493	159,721	159,721	159,721	160,108 (32,022) [7,685] {3,843}	160,494 (32,099) [7,704] {3,852}	160,882 (32,176) [7,722] {3,861}
Lake	7,088	7,090	7,090	7,090	7,097 (1,419) [341] {170}	7,103 (1,421) [341] {170}	7,109 (1,422) [341] {171}
Los Angeles	1,541,886	1,543,784	1,545,583	1,547,042	1,550,343 (310,069) [74,416] {37,208}	1,553,703 (310,741) [74,578] {37,289}	1,557,292 (311,458) [74,750] {37,375}
Marin	18,878	18,895	18,895	18,895	18,984 (3,797) [911] {456}	19,073 (3,815) [915] {458}	19,172 (3,834) [920] {460}
Monterey	53,277	53,328	53,328	53,328	53,446 (10,689) [2,565] {1,283}	53,567 (10,713) [2,571] {1,286}	53,696 (10,739) [2,577] {1,289}
Orange	337,623	337,937	337,937	337,937	338,673 (67,735) [16,256] {8,128}	339,443 (67,889) [16,293] {8,147}	340,229 (68,046) [16,331] {8,166}
Placer	42,990	43,002	43,002	43,002	43,126 (8,625) [2,070] {1,035}	43,255 (8,651) [2,076] {1,038}	43,396 (8,679) [2,083] {1,041}
Riverside	392,645	393,195	393,195	393,195	394,240 (78,848) [18,923] {9,462}	395,274 (79,055) [18,973] {9,487}	396,307 (79,261) [19,023] {9,511}
Sacramento	170,585	170,837	170,837	170,837	171,245 (34,249) [8,220] {4,110}	171,692 (34,338) [8,241] {4,121}	172,169 (34,434) [8,264] {4,132}
San Bernardino	379,756	380,385	380,385	380,385	381,470 (76,294) [18,311] {9,155}	382,559 (76,512) [18,363] {9,181}	383,737 (76,747) [18,419] {9,210}
San Diego	414,408	415,006	415,006	415,006	416,959 (83,392) [20,014] {10,007}	418,882 (83,776) [20,106] {10,053}	421,066 (84,213) [20,211] {10,106}
San Francisco	57,732	57,770	57,770	57,770	57,916 (11,583) [2,780] {1,390}	58,062 (11,612) [2,787] {1,393}	58,216 (11,643) [2,794] {1,397}
San Joaquin	108,808	108,876	108,876	108,876	109,056 (21,811) [5,235] {2,617}	109,252 (21,850) [5,244] {2,622}	109,445 (21,889) [5,253] {2,627}
San Luis Obispo	31,916	31,940	31,940	31,940	32,015 (6,403) [1,537] {768}	32,088 (6,418) [1,540] {770}	32,164 (6,433) [1,544] {772}
San Mateo	57,160	57,192	57,192	57,192	57,343 (11,469) [2,752] {1,376}	57,489 (11,498) [2,759] {1,380}	57,650 (11,530) [2,767] {1,384}
Santa Barbara	48,061	48,090	48,090	48,090	48,230 (9,646) [2,315] {1,158}	48,362 (9,672) [2,321] {1,161}	48,510 (9,702) [2,328] {1,164}
Santa Clara	154,364	154,536	154,536	154,536	154,971 (30,994) [7,439] {3,719}	155,409 (31,082) [7,460] {3,730}	155,880 (31,176) [7,482] {3,741}
Santa Cruz	22,658	22,684	22,684	22,684	22,761 (4,552) [1,093] {546}	22,838 (4,568) [1,096] {548}	22,923 (4,585) [1,100] {550}
Solano	48,157	48,211	48,211	48,211	48,306 (9,661) [2,319] {1,159}	48,404 (9,681) [2,323] {1,162}	48,509 (9,702) [2,328] {1,164}
Sonoma	43,787	43,811	43,811	43,811	43,922 (8,784) [2,108] {1,054}	44,035 (8,807) [2,114] {1,057}	44,154 (8,831) [2,119] {1,060}
Ventura	105,247	105,311	105,311	105,311	105,541 (21,108) [5,066] {2,533}	105,767 (21,153) [5,077] {2,538}	106,003 (21,201) [5,088] {2,544}

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.