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

Date: 4/20/21

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 4/20/21 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.

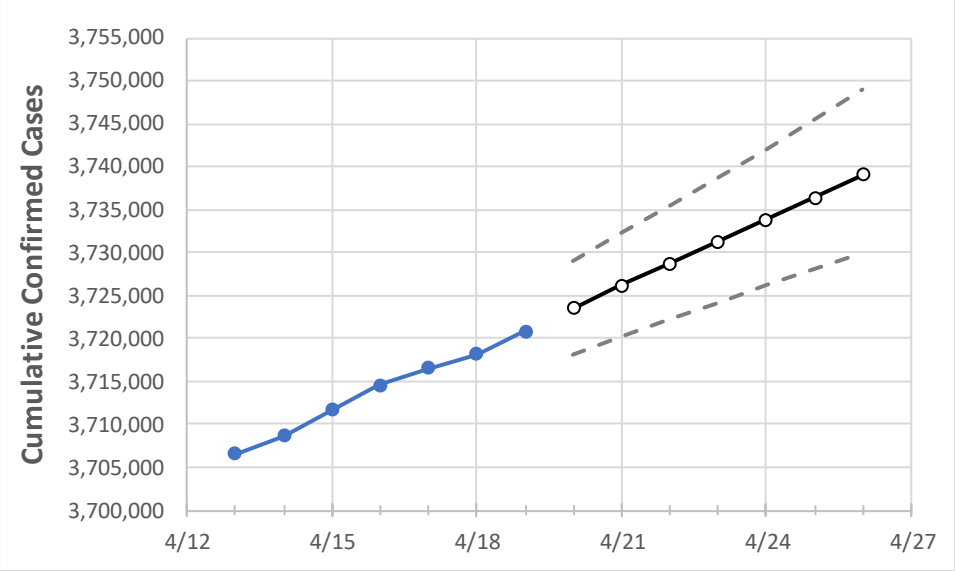
IEM's Modeling Lead

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:						
	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26
California	3,714,587	3,716,579	3,718,210	3,720,901	3,723,536	3,726,137	3,728,759	3,731,319	3,733,858	3,736,449	3,739,076

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:						
	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26
Alameda	85,089	85,256	85,367	85,481	85,600	85,722	85,839	85,960	86,091	86,219	86,347
Contra Costa	66,839	66,927	67,019	67,101	67,207	67,311	67,418	67,525	67,636	67,748	67,860
Fresno	100,431	100,500	100,562	100,621	100,671	100,720	100,764	100,810	100,854	100,896	100,937
Kern	107,764	107,825	107,859	107,879	107,975	108,070	108,167	108,268	108,365	108,461	108,559
Lake	3,399	3,406	3,409	3,413	3,418	3,423	3,428	3,433	3,438	3,443	3,448
Los Angeles	1,228,118	1,228,641	1,228,997	1,229,328	1,229,772	1,230,222	1,230,658	1,231,092	1,231,528	1,231,959	1,232,382
Marin	13,851	13,860	13,861	13,865	13,872	13,879	13,885	13,891	13,897	13,903	13,909
Monterey	43,260	43,267	43,267	43,267	43,287	43,307	43,327	43,346	43,367	43,386	43,408
Orange	268,762	268,869	268,962	269,036	269,168	269,302	269,431	269,562	269,690	269,814	269,939
Placer	21,751	21,793	21,836	21,878	21,932	21,986	22,043	22,101	22,156	22,216	22,278
Riverside	297,215	297,250	297,284	297,319	297,425	297,529	297,630	297,725	297,817	297,904	297,989
Sacramento	101,058	101,115	101,172	101,511	101,680	101,854	102,038	102,229	102,428	102,633	102,823
San Bernardino	294,464	294,577	294,779	294,883	295,056	295,230	295,404	295,575	295,750	295,930	296,110
San Diego	274,566	274,811	274,960	275,112	275,345	275,573	275,802	276,036	276,257	276,476	276,700
San Francisco	35,947	35,993	36,032	36,073	36,116	36,159	36,202	36,245	36,289	36,333	36,379
San Joaquin	71,431	71,463	71,495	71,527	71,600	71,668	71,740	71,807	71,874	71,938	72,003
San Luis Obispo	20,917	20,935	20,954	20,972	21,000	21,027	21,053	21,081	21,108	21,136	21,165
San Mateo	41,050	41,107	41,157	41,201	41,245	41,291	41,337	41,383	41,429	41,476	41,524
Santa Barbara	33,830	33,863	33,896	33,913	33,944	33,976	34,008	34,040	34,070	34,100	34,132
Santa Clara	116,772	116,971	117,081	117,186	117,332	117,477	117,625	117,772	117,926	118,069	118,219
Santa Cruz	15,554	15,563	15,571	15,615	15,646	15,678	15,711	15,745	15,779	15,817	15,854
Solano	31,875	31,926	31,976	32,027	32,079	32,133	32,187	32,244	32,300	32,360	32,419
Sonoma	29,656	29,679	29,696	29,715	29,738	29,761	29,783	29,805	29,828	29,850	29,874
Ventura	80,230	80,256	80,283	80,309	80,343	80,376	80,409	80,442	80,475	80,509	80,541

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:		
	4/16	4/17	4/18	4/19	4/21	4/23	4/25
Alameda	85,089	85,256	85,367	85,481	85,722 (17,144) [4,115] {2,057}	85,960 (17,192) [4,126] {2,063}	86,219 (17,244) [4,139] {2,069}
Contra Costa	66,839	66,927	67,019	67,101	67,311 (13,462) [3,231] {1,615}	67,525 (13,505) [3,241] {1,621}	67,748 (13,550) [3,252] {1,626}
Fresno	100,431	100,500	100,562	100,621	100,720 (20,144) [4,835] {2,417}	100,810 (20,162) [4,839] {2,419}	100,896 (20,179) [4,843] {2,422}
Kern	107,764	107,825	107,859	107,879	108,070 (21,614) [5,187] {2,594}	108,268 (21,654) [5,197] {2,598}	108,461 (21,692) [5,206] {2,603}
Lake	3,399	3,406	3,409	3,413	3,423 (685) [164] {82}	3,433 (687) [165] {82}	3,443 (689) [165] {83}
Los Angeles	1,228,118	1,228,641	1,228,997	1,229,328	1,230,222 (246,044) [59,051] {29,525}	1,231,092 (246,218) [59,092] {29,546}	1,231,959 (246,392) [59,134] {29,567}
Marin	13,851	13,860	13,861	13,865	13,879 (2,776) [666] {333}	13,891 (2,778) [667] {333}	13,903 (2,781) [667] {334}
Monterey	43,260	43,267	43,267	43,267	43,307 (8,661) [2,079] {1,039}	43,346 (8,669) [2,081] {1,040}	43,386 (8,677) [2,083] {1,041}
Orange	268,762	268,869	268,962	269,036	269,302 (53,860) [12,926] {6,463}	269,562 (53,912) [12,939] {6,469}	269,814 (53,963) [12,951] {6,476}
Placer	21,751	21,793	21,836	21,878	21,986 (4,397) [1,055] {528}	22,101 (4,420) [1,061] {530}	22,216 (4,443) [1,066] {533}
Riverside	297,215	297,250	297,284	297,319	297,529 (59,506) [14,281] {7,141}	297,725 (59,545) [14,291] {7,145}	297,904 (59,581) [14,299] {7,150}
Sacramento	101,058	101,115	101,172	101,511	101,854 (20,371) [4,889] {2,444}	102,229 (20,446) [4,907] {2,453}	102,633 (20,527) [4,926] {2,463}
San Bernardino	294,464	294,577	294,779	294,883	295,230 (59,046) [14,171] {7,086}	295,575 (59,115) [14,188] {7,094}	295,930 (59,186) [14,205] {7,102}
San Diego	274,566	274,811	274,960	275,112	275,573 (55,115) [13,227] {6,614}	276,036 (55,207) [13,250] {6,625}	276,476 (55,295) [13,271] {6,635}
San Francisco	35,947	35,993	36,032	36,073	36,159 (7,232) [1,736] {868}	36,245 (7,249) [1,740] {870}	36,333 (7,267) [1,744] {872}
San Joaquin	71,431	71,463	71,495	71,527	71,668 (14,334) [3,440] {1,720}	71,807 (14,361) [3,447] {1,723}	71,938 (14,388) [3,453] {1,727}
San Luis Obispo	20,917	20,935	20,954	20,972	21,027 (4,205) [1,009] {505}	21,081 (4,216) [1,012] {506}	21,136 (4,227) [1,015] {507}
San Mateo	41,050	41,107	41,157	41,201	41,291 (8,258) [1,982] {991}	41,383 (8,277) [1,986] {993}	41,476 (8,295) [1,991] {995}
Santa Barbara	33,830	33,863	33,896	33,913	33,976 (6,795) [1,631] {815}	34,040 (6,808) [1,634] {817}	34,100 (6,820) [1,637] {818}
Santa Clara	116,772	116,971	117,081	117,186	117,477 (23,495) [5,639] {2,819}	117,772 (23,554) [5,653] {2,827}	118,069 (23,614) [5,667] {2,834}
Santa Cruz	15,554	15,563	15,571	15,615	15,678 (3,136) [753] {376}	15,745 (3,149) [756] {378}	15,817 (3,163) [759] {380}
Solano	31,875	31,926	31,976	32,027	32,133 (6,427) [1,542] {771}	32,244 (6,449) [1,548] {774}	32,360 (6,472) [1,553] {777}
Sonoma	29,656	29,679	29,696	29,715	29,761 (5,952) [1,429] {714}	29,805 (5,961) [1,431] {715}	29,850 (5,970) [1,433] {716}
Ventura	80,230	80,256	80,283	80,309	80,376 (16,075) [3,858] {1,929}	80,442 (16,088) [3,861] {1,931}	80,509 (16,102) [3,864] {1,932}

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.