IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/8/22

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 3/8/22 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
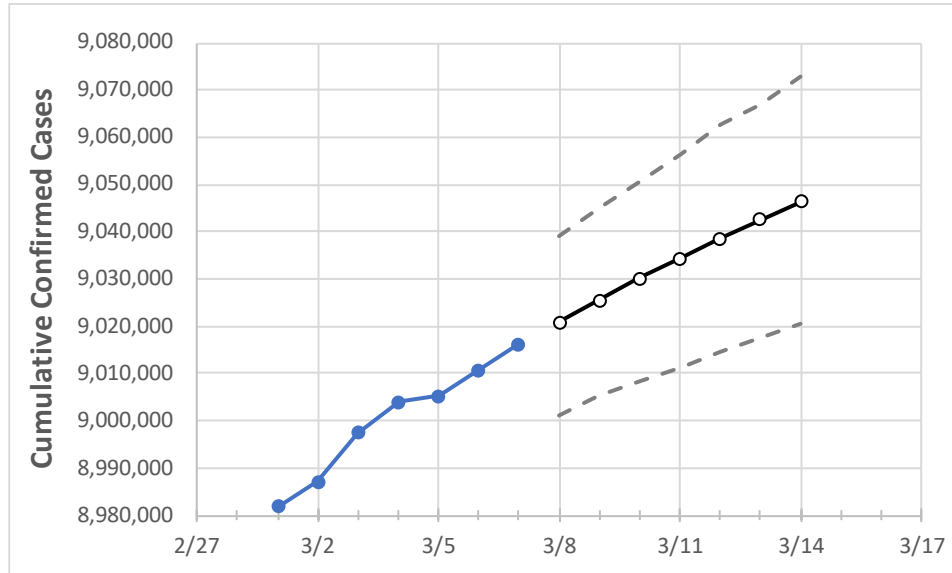
	Actual Confirmed Cases On:				Projected Cases For:						
	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14
California	9,003,969	9,005,322	9,010,720	9,016,117	9,020,798	9,025,518	9,030,167	9,034,330	9,038,511	9,042,688	9,046,371

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:						
	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14
Alameda	265,590	265,747	265,905	266,062	266,315	266,674	266,885	267,160	267,442	267,713	267,865
Contra Costa	198,614	198,694	198,774	198,854	198,978	199,100	199,203	199,312	199,415	199,518	199,626
Fresno	249,081	249,201	249,321	249,441	249,597	249,744	249,881	250,004	250,143	250,277	250,392
Kern	239,635	239,856	240,078	240,299	240,709	241,141	241,529	241,909	242,296	242,672	243,040
Lake	11,377	11,386	11,395	11,404	11,414	11,424	11,434	11,443	11,452	11,461	11,468
Los Angeles	2,802,123	2,803,476	2,804,298	2,805,119	2,806,165	2,807,152	2,808,097	2,808,997	2,809,892	2,810,709	2,811,473
Marin	35,007	35,024	35,040	35,057	35,077	35,098	35,117	35,136	35,154	35,173	35,190
Monterey	91,051	91,093	91,135	91,177	91,226	91,271	91,318	91,354	91,402	91,437	91,478
Orange	582,267	582,414	582,560	582,707	582,886	583,045	583,208	583,351	583,508	583,658	583,795
Placer	69,395	69,418	69,440	69,463	69,492	69,521	69,548	69,574	69,598	69,622	69,644
Riverside	614,693	614,894	615,095	615,296	615,495	615,695	615,864	616,037	616,213	616,367	616,515
Sacramento	300,181	300,330	300,480	300,629	300,747	300,870	300,975	301,085	301,181	301,286	301,373
San Bernardino	581,401	581,640	581,880	582,119	582,300	582,495	582,667	582,853	583,018	583,187	583,352
San Diego	789,812	790,325	790,839	791,352	791,980	792,547	793,148	793,702	794,259	794,804	795,358
San Francisco	132,120	132,188	132,257	132,325	132,434	132,535	132,620	132,716	132,818	132,926	132,983
San Joaquin	174,117	174,173	174,228	174,284	174,351	174,413	174,465	174,523	174,575	174,627	174,674
San Luis Obispo	55,406	55,436	55,465	55,495	55,529	55,566	55,595	55,623	55,655	55,684	55,713
San Mateo	125,568	125,658	125,748	125,838	125,927	126,015	126,100	126,174	126,248	126,331	126,401
Santa Barbara	90,039	90,062	90,084	90,107	90,144	90,178	90,210	90,240	90,271	90,300	90,327
Santa Clara	319,886	320,073	320,260	320,447	320,625	320,785	320,949	321,110	321,244	321,390	321,534
Santa Cruz	48,507	48,551	48,596	48,640	48,679	48,717	48,748	48,786	48,814	48,848	48,880
Solano	86,117	86,165	86,212	86,260	86,306	86,350	86,390	86,431	86,466	86,505	86,537
Sonoma	84,380	84,428	84,477	84,525	84,592	84,653	84,711	84,768	84,822	84,883	84,933
Ventura	180,858	180,909	180,960	181,011	181,072	181,129	181,185	181,234	181,288	181,339	181,382

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:		
	3/4	3/5	3/6	3/7	3/9	3/11	3/13
Alameda	265,590	265,747	265,905	266,062	266,674 (53,335) [12,800] {6,400}	267,160 (53,432) [12,824] {6,412}	267,713 (53,543) [12,850] {6,425}
Contra Costa	198,614	198,694	198,774	198,854	199,100 (39,820) [9,557] {4,778}	199,312 (39,862) [9,567] {4,783}	199,518 (39,904) [9,577] {4,788}
Fresno	249,081	249,201	249,321	249,441	249,744 (49,949) [11,988] {5,994}	250,004 (50,001) [12,000] {6,000}	250,277 (50,055) [12,013] {6,007}
Kern	239,635	239,856	240,078	240,299	241,141 (48,228) [11,575] {5,787}	241,909 (48,382) [11,612] {5,806}	242,672 (48,534) [11,648] {5,824}
Lake	11,377	11,386	11,395	11,404	11,424 (2,285) [548] {274}	11,443 (2,289) [549] {275}	11,461 (2,292) [550] {275}
Los Angeles	2,802,123	2,803,476	2,804,298	2,805,119	2,807,152 (561,430) [134,743] {67,372}	2,808,997 (561,799) [134,832] {67,416}	2,810,709 (562,142) [134,914] {67,457}
Marin	35,007	35,024	35,040	35,057	35,098 (7,020) [1,685] {842}	35,136 (7,027) [1,687] {843}	35,173 (7,035) [1,688] {844}
Monterey	91,051	91,093	91,135	91,177	91,271 (18,254) [4,381] {2,191}	91,354 (18,271) [4,385] {2,193}	91,437 (18,287) [4,389] {2,194}
Orange	582,267	582,414	582,560	582,707	583,045 (116,609) [27,986] {13,993}	583,351 (116,670) [28,001] {14,000}	583,658 (116,732) [28,016] {14,008}
Placer	69,395	69,418	69,440	69,463	69,521 (13,904) [3,337] {1,668}	69,574 (13,915) [3,340] {1,670}	69,622 (13,924) [3,342] {1,671}
Riverside	614,693	614,894	615,095	615,296	615,695 (123,139) [29,553] {14,777}	616,037 (123,207) [29,570] {14,785}	616,367 (123,273) [29,586] {14,793}
Sacramento	300,181	300,330	300,480	300,629	300,870 (60,174) [14,442] {7,221}	301,085 (60,217) [14,452] {7,226}	301,286 (60,257) [14,462] {7,231}
San Bernardino	581,401	581,640	581,880	582,119	582,495 (116,499) [27,960] {13,980}	582,853 (116,571) [27,977] {13,988}	583,187 (116,637) [27,993] {13,996}
San Diego	789,812	790,325	790,839	791,352	792,547 (158,509) [38,042] {19,021}	793,702 (158,740) [38,098] {19,049}	794,804 (158,961) [38,151] {19,075}
San Francisco	132,120	132,188	132,257	132,325	132,535 (26,507) [6,362] {3,181}	132,716 (26,543) [6,370] {3,185}	132,926 (26,585) [6,380] {3,190}
San Joaquin	174,117	174,173	174,228	174,284	174,413 (34,883) [8,372] {4,186}	174,523 (34,905) [8,377] {4,189}	174,627 (34,925) [8,382] {4,191}
San Luis Obispo	55,406	55,436	55,465	55,495	55,566 (11,113) [2,667] {1,334}	55,623 (11,125) [2,670] {1,335}	55,684 (11,137) [2,673] {1,336}
San Mateo	125,568	125,658	125,748	125,838	126,015 (25,203) [6,049] {3,024}	126,174 (25,235) [6,056] {3,028}	126,331 (25,266) [6,064] {3,032}
Santa Barbara	90,039	90,062	90,084	90,107	90,178 (18,036) [4,329] {2,164}	90,240 (18,048) [4,332] {2,166}	90,300 (18,060) [4,334] {2,167}
Santa Clara	319,886	320,073	320,260	320,447	320,785 (64,157) [15,398] {7,699}	321,110 (64,222) [15,413] {7,707}	321,390 (64,278) [15,427] {7,713}
Santa Cruz	48,507	48,551	48,596	48,640	48,717 (9,743) [2,338] {1,169}	48,786 (9,757) [2,342] {1,171}	48,848 (9,770) [2,345] {1,172}
Solano	86,117	86,165	86,212	86,260	86,350 (17,270) [4,145] {2,072}	86,431 (17,286) [4,149] {2,074}	86,505 (17,301) [4,152] {2,076}
Sonoma	84,380	84,428	84,477	84,525	84,653 (16,931) [4,063] {2,032}	84,768 (16,954) [4,069] {2,034}	84,883 (16,977) [4,074] {2,037}
Ventura	180,858	180,909	180,960	181,011	181,129 (36,226) [8,694] {4,347}	181,234 (36,247) [8,699] {4,350}	181,339 (36,268) [8,704] {4,352}

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.