IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/15/21

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 <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 4/15/21 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
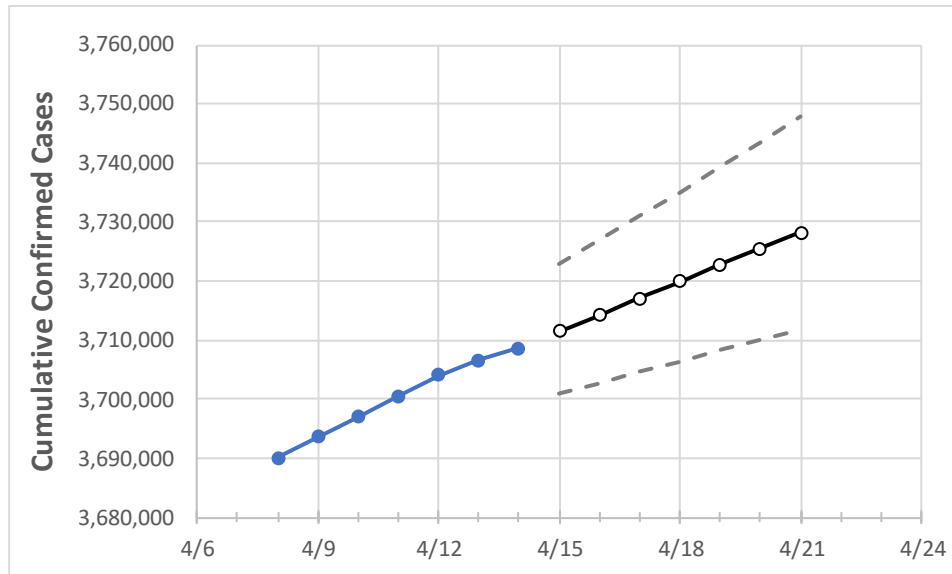
	Actual Confirmed Cases On:				Projected Cases For:						
	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
California	3,700,471	3,704,070	3,706,629	3,708,716	3,711,478	3,714,234	3,717,070	3,719,941	3,722,752	3,725,565	3,728,258

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:						
	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
Alameda	84,626	84,756	84,817	84,921	85,033	85,146	85,264	85,384	85,505	85,630	85,755
Contra Costa	66,369	66,442	66,567	66,567	66,665	66,766	66,867	66,971	67,074	67,183	67,290
Fresno	100,135	100,230	100,277	100,357	100,430	100,502	100,574	100,645	100,713	100,781	100,848
Kern	107,341	107,374	107,434	107,591	107,690	107,791	107,895	108,005	108,115	108,231	108,344
Lake	3,368	3,377	3,380	3,390	3,395	3,399	3,404	3,408	3,412	3,417	3,421
Los Angeles	1,225,796	1,226,219	1,226,627	1,226,964	1,227,447	1,227,913	1,228,379	1,228,837	1,229,285	1,229,752	1,230,198
Marin	13,806	13,813	13,815	13,815	13,823	13,831	13,839	13,847	13,855	13,862	13,870
Monterey	43,174	43,192	43,209	43,209	43,229	43,249	43,270	43,289	43,310	43,331	43,351
Orange	268,175	268,304	268,414	268,521	268,694	268,868	269,048	269,222	269,402	269,585	269,768
Placer	21,402	21,540	21,600	21,644	21,693	21,744	21,796	21,847	21,903	21,955	22,009
Riverside	296,453	296,635	296,801	296,908	297,089	297,270	297,455	297,642	297,830	298,022	298,219
Sacramento	100,048	100,365	100,587	100,726	100,954	101,185	101,423	101,671	101,924	102,181	102,437
San Bernardino	293,638	293,835	293,925	294,101	294,381	294,674	294,977	295,298	295,623	295,959	296,316
San Diego	273,286	273,430	273,708	273,968	274,222	274,471	274,717	274,963	275,210	275,463	275,708
San Francisco	35,774	35,815	35,841	35,869	35,908	35,946	35,985	36,026	36,066	36,107	36,147
San Joaquin	70,911	70,994	71,178	71,178	71,285	71,394	71,499	71,606	71,713	71,826	71,939
San Luis Obispo	20,744	20,754	20,827	20,827	20,854	20,882	20,910	20,937	20,964	20,993	21,021
San Mateo	40,878	40,901	40,920	40,955	40,994	41,032	41,071	41,109	41,146	41,185	41,222
Santa Barbara	33,704	33,727	33,736	33,736	33,782	33,828	33,875	33,924	33,972	34,021	34,073
Santa Clara	116,228	116,324	116,436	116,562	116,702	116,844	116,986	117,126	117,272	117,418	117,562
Santa Cruz	15,360	15,394	15,432	15,466	15,492	15,519	15,546	15,574	15,602	15,631	15,661
Solano	31,624	31,673	31,702	31,734	31,772	31,810	31,847	31,885	31,923	31,961	31,999
Sonoma	29,525	29,536	29,573	29,608	29,631	29,653	29,675	29,698	29,722	29,745	29,766
Ventura	80,040	80,078	80,112	80,156	80,186	80,216	80,246	80,275	80,304	80,332	80,360

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:		
	4/11	4/12	4/13	4/14	4/16	4/18	4/20
Alameda	84,626	84,756	84,817	84,921	85,146 (17,029) [4,087] {2,044}	85,384 (17,077) [4,098] {2,049}	85,630 (17,126) [4,110] {2,055}
Contra Costa	66,369	66,442	66,567	66,567	66,766 (13,353) [3,205] {1,602}	66,971 (13,394) [3,215] {1,607}	67,183 (13,437) [3,225] {1,612}
Fresno	100,135	100,230	100,277	100,357	100,502 (20,100) [4,824] {2,412}	100,645 (20,129) [4,831] {2,415}	100,781 (20,156) [4,837] {2,419}
Kern	107,341	107,374	107,434	107,591	107,791 (21,558) [5,174] {2,587}	108,005 (21,601) [5,184] {2,592}	108,231 (21,646) [5,195] {2,598}
Lake	3,368	3,377	3,380	3,390	3,399 (680) [163] {82}	3,408 (682) [164] {82}	3,417 (683) [164] {82}
Los Angeles	1,225,796	1,226,219	1,226,627	1,226,964	1,227,913 (245,583) [58,940] {29,470}	1,228,837 (245,767) [58,984] {29,492}	1,229,752 (245,950) [59,028] {29,514}
Marin	13,806	13,813	13,815	13,815	13,831 (2,766) [664] {332}	13,847 (2,769) [665] {332}	13,862 (2,772) [665] {333}
Monterey	43,174	43,192	43,209	43,209	43,249 (8,650) [2,076] {1,038}	43,289 (8,658) [2,078] {1,039}	43,331 (8,666) [2,080] {1,040}
Orange	268,175	268,304	268,414	268,521	268,868 (53,774) [12,906] {6,453}	269,222 (53,844) [12,923] {6,461}	269,585 (53,917) [12,940] {6,470}
Placer	21,402	21,540	21,600	21,644	21,744 (4,349) [1,044] {522}	21,847 (4,369) [1,049] {524}	21,955 (4,391) [1,054] {527}
Riverside	296,453	296,635	296,801	296,908	297,270 (59,454) [14,269] {7,134}	297,642 (59,528) [14,287] {7,143}	298,022 (59,604) [14,305] {7,153}
Sacramento	100,048	100,365	100,587	100,726	101,185 (20,237) [4,857] {2,428}	101,671 (20,334) [4,880] {2,440}	102,181 (20,436) [4,905] {2,452}
San Bernardino	293,638	293,835	293,925	294,101	294,674 (58,935) [14,144] {7,072}	295,298 (59,060) [14,174] {7,087}	295,959 (59,192) [14,206] {7,103}
San Diego	273,286	273,430	273,708	273,968	274,471 (54,894) [13,175] {6,587}	274,963 (54,993) [13,198] {6,599}	275,463 (55,093) [13,222] {6,611}
San Francisco	35,774	35,815	35,841	35,869	35,946 (7,189) [1,725] {863}	36,026 (7,205) [1,729] {865}	36,107 (7,221) [1,733] {867}
San Joaquin	70,911	70,994	71,178	71,178	71,394 (14,279) [3,427] {1,713}	71,606 (14,321) [3,437] {1,719}	71,826 (14,365) [3,448] {1,724}
San Luis Obispo	20,744	20,754	20,827	20,827	20,882 (4,176) [1,002] {501}	20,937 (4,187) [1,005] {502}	20,993 (4,199) [1,008] {504}
San Mateo	40,878	40,901	40,920	40,955	41,032 (8,206) [1,970] {985}	41,109 (8,222) [1,973] {987}	41,185 (8,237) [1,977] {988}
Santa Barbara	33,704	33,727	33,736	33,736	33,828 (6,766) [1,624] {812}	33,924 (6,785) [1,628] {814}	34,021 (6,804) [1,633] {817}
Santa Clara	116,228	116,324	116,436	116,562	116,844 (23,369) [5,609] {2,804}	117,126 (23,425) [5,622] {2,811}	117,418 (23,484) [5,636] {2,818}
Santa Cruz	15,360	15,394	15,432	15,466	15,519 (3,104) [745] {372}	15,574 (3,115) [748] {374}	15,631 (3,126) [750] {375}
Solano	31,624	31,673	31,702	31,734	31,810 (6,362) [1,527] {763}	31,885 (6,377) [1,530] {765}	31,961 (6,392) [1,534] {767}
Sonoma	29,525	29,536	29,573	29,608	29,653 (5,931) [1,423] {712}	29,698 (5,940) [1,426] {713}	29,745 (5,949) [1,428] {714}
Ventura	80,040	80,078	80,112	80,156	80,216 (16,043) [3,850] {1,925}	80,275 (16,055) [3,853] {1,927}	80,332 (16,066) [3,856] {1,928}

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.