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

Date: 6/17/21

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 6/17/21 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.

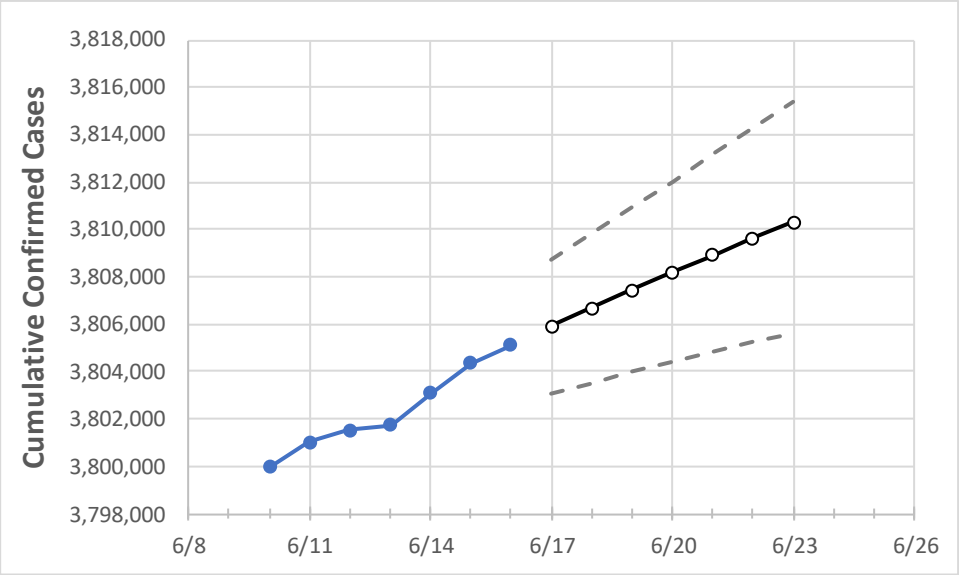
IEM's Modeling Lead

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:						
	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20	6/21	6/22	6/23
California	3,801,728	3,803,094	3,804,355	3,805,098	3,805,908	3,806,685	3,807,451	3,808,202	3,808,927	3,809,627	3,810,328

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:						
	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20	6/21	6/22	6/23
Alameda	89,393	89,446	89,499	89,536	89,574	89,611	89,649	89,686	89,723	89,761	89,797
Contra Costa	70,317	70,358	70,389	70,428	70,474	70,519	70,565	70,608	70,653	70,697	70,741
Fresno	102,783	102,795	102,812	102,828	102,846	102,864	102,882	102,899	102,915	102,931	102,948
Kern	110,604	110,617	110,673	110,687	110,710	110,734	110,756	110,777	110,798	110,818	110,838
Lake	3,552	3,556	3,557	3,559	3,561	3,564	3,567	3,569	3,571	3,574	3,576
Los Angeles	1,246,129	1,246,436	1,246,640	1,246,832	1,247,012	1,247,190	1,247,368	1,247,549	1,247,728	1,247,910	1,248,087
Marin	14,177	14,184	14,185	14,185	14,189	14,192	14,196	14,200	14,203	14,207	14,211
Monterey	43,800	43,804	43,818	43,821	43,825	43,830	43,834	43,838	43,842	43,847	43,851
Orange	272,713	272,745	272,787	272,827	272,865	272,902	272,938	272,974	273,008	273,042	273,074
Placer	23,345	23,383	23,410	23,438	23,462	23,486	23,511	23,535	23,560	23,585	23,609
Riverside	301,323	301,329	301,420	301,482	301,520	301,559	301,598	301,635	301,672	301,710	301,747
Sacramento	107,199	107,395	107,441	107,494	107,530	107,564	107,599	107,632	107,661	107,690	107,717
San Bernardino	298,976	299,014	299,049	299,096	299,137	299,179	299,222	299,265	299,307	299,350	299,392
San Diego	281,203	281,313	281,374	281,422	281,488	281,553	281,618	281,680	281,742	281,804	281,865
San Francisco	37,189	37,197	37,206	37,210	37,220	37,229	37,239	37,247	37,256	37,265	37,274
San Joaquin	74,413	74,419	74,559	74,596	74,638	74,679	74,720	74,762	74,805	74,848	74,889
San Luis Obispo	21,409	21,411	21,421	21,421	21,426	21,430	21,435	21,439	21,443	21,448	21,452
San Mateo	42,604	42,611	42,619	42,593	42,615	42,637	42,661	42,685	42,709	42,734	42,760
Santa Barbara	34,575	34,577	34,580	34,587	34,591	34,595	34,600	34,603	34,607	34,611	34,615
Santa Clara	119,894	119,946	119,957	119,963	119,993	120,024	120,053	120,084	120,114	120,145	120,176
Santa Cruz	16,205	16,206	16,216	16,222	16,225	16,229	16,232	16,236	16,239	16,243	16,246
Solano	33,606	33,625	33,636	33,651	33,661	33,670	33,679	33,687	33,696	33,704	33,712
Sonoma	30,709	30,731	30,752	30,783	30,812	30,841	30,869	30,898	30,928	30,958	30,988
Ventura	81,566	81,572	81,591	81,609	81,619	81,629	81,637	81,646	81,655	81,663	81,670

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:		
	6/13	6/14	6/15	6/16	6/18	6/20	6/22
Alameda	89,393	89,446	89,499	89,536	89,611 (17,922) [4,301] {2,151}	89,686 (17,937) [4,305] {2,152}	89,761 (17,952) [4,309] {2,154}
Contra Costa	70,317	70,358	70,389	70,428	70,519 (14,104) [3,385] {1,692}	70,608 (14,122) [3,389] {1,695}	70,697 (14,139) [3,393] {1,697}
Fresno	102,783	102,795	102,812	102,828	102,864 (20,573) [4,937] {2,469}	102,899 (20,580) [4,939] {2,470}	102,931 (20,586) [4,941] {2,470}
Kern	110,604	110,617	110,673	110,687	110,734 (22,147) [5,315] {2,658}	110,777 (22,155) [5,317] {2,659}	110,818 (22,164) [5,319] {2,660}
Lake	3,552	3,556	3,557	3,559	3,564 (713) [171] {86}	3,569 (714) [171] {86}	3,574 (715) [172] {86}
Los Angeles	1,246,129	1,246,436	1,246,640	1,246,832	1,247,190 (249,438) [59,865] {29,933}	1,247,549 (249,510) [59,882] {29,941}	1,247,910 (249,582) [59,900] {29,950}
Marin	14,177	14,184	14,185	14,185	14,192 (2,838) [681] {341}	14,200 (2,840) [682] {341}	14,207 (2,841) [682] {341}
Monterey	43,800	43,804	43,818	43,821	43,830 (8,766) [2,104] {1,052}	43,838 (8,768) [2,104] {1,052}	43,847 (8,769) [2,105] {1,052}
Orange	272,713	272,745	272,787	272,827	272,902 (54,580) [13,099] {6,550}	272,974 (54,595) [13,103] {6,551}	273,042 (54,608) [13,106] {6,553}
Placer	23,345	23,383	23,410	23,438	23,486 (4,697) [1,127] {564}	23,535 (4,707) [1,130] {565}	23,585 (4,717) [1,132] {566}
Riverside	301,323	301,329	301,420	301,482	301,559 (60,312) [14,475] {7,237}	301,635 (60,327) [14,478] {7,239}	301,710 (60,342) [14,482] {7,241}
Sacramento	107,199	107,395	107,441	107,494	107,564 (21,513) [5,163] {2,582}	107,632 (21,526) [5,166] {2,583}	107,690 (21,538) [5,169] {2,585}
San Bernardino	298,976	299,014	299,049	299,096	299,179 (59,836) [14,361] {7,180}	299,265 (59,853) [14,365] {7,182}	299,350 (59,870) [14,369] {7,184}
San Diego	281,203	281,313	281,374	281,422	281,553 (56,311) [13,515] {6,757}	281,680 (56,336) [13,521] {6,760}	281,804 (56,361) [13,527] {6,763}
San Francisco	37,189	37,197	37,206	37,210	37,229 (7,446) [1,787] {893}	37,247 (7,449) [1,788] {894}	37,265 (7,453) [1,789] {894}
San Joaquin	74,413	74,419	74,559	74,596	74,679 (14,936) [3,585] {1,792}	74,762 (14,952) [3,589] {1,794}	74,848 (14,970) [3,593] {1,796}
San Luis Obispo	21,409	21,411	21,421	21,421	21,430 (4,286) [1,029] {514}	21,439 (4,288) [1,029] {515}	21,448 (4,290) [1,029] {515}
San Mateo	42,604	42,611	42,619	42,593	42,637 (8,527) [2,047] {1,023}	42,685 (8,537) [2,049] {1,024}	42,734 (8,547) [2,051] {1,026}
Santa Barbara	34,575	34,577	34,580	34,587	34,595 (6,919) [1,661] {830}	34,603 (6,921) [1,661] {830}	34,611 (6,922) [1,661] {831}
Santa Clara	119,894	119,946	119,957	119,963	120,024 (24,005) [5,761] {2,881}	120,084 (24,017) [5,764] {2,882}	120,145 (24,029) [5,767] {2,883}
Santa Cruz	16,205	16,206	16,216	16,222	16,229 (3,246) [779] {389}	16,236 (3,247) [779] {390}	16,243 (3,249) [780] {390}
Solano	33,606	33,625	33,636	33,651	33,670 (6,734) [1,616] {808}	33,687 (6,737) [1,617] {808}	33,704 (6,741) [1,618] {809}
Sonoma	30,709	30,731	30,752	30,783	30,841 (6,168) [1,480] {740}	30,898 (6,180) [1,483] {742}	30,958 (6,192) [1,486] {743}
Ventura	81,566	81,572	81,591	81,609	81,629 (16,326) [3,918] {1,959}	81,646 (16,329) [3,919] {1,960}	81,663 (16,333) [3,920] {1,960}

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.