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

Date: 6/16/21

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 6/16/21 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.

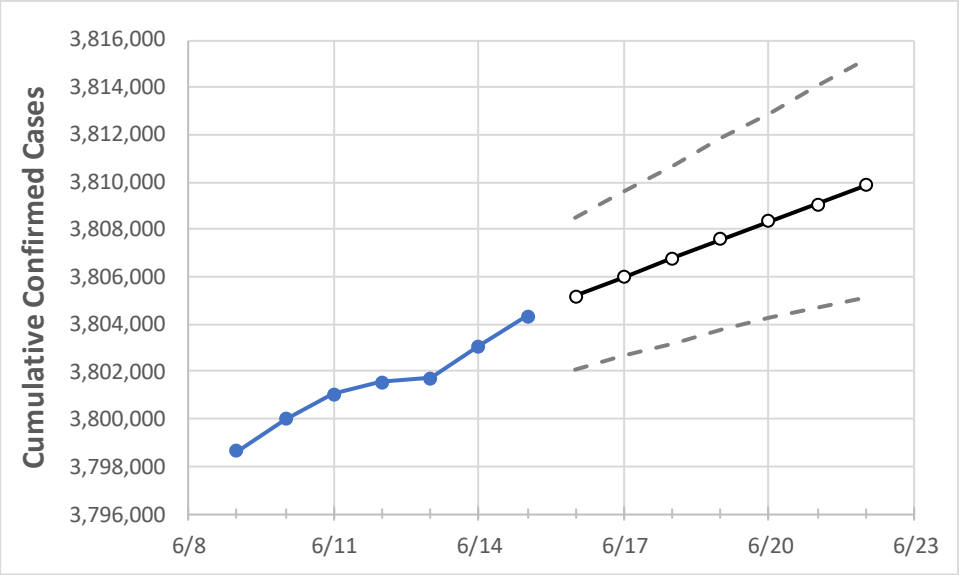
IEM's Modeling Lead

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:						
	6/12	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20	6/21	6/22
California	3,801,538	3,801,728	3,803,094	3,804,355	3,805,199	3,806,002	3,806,808	3,807,587	3,808,350	3,809,087	3,809,850

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:						
	6/12	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20	6/21	6/22
Alameda	89,340	89,393	89,446	89,499	89,533	89,565	89,598	89,630	89,662	89,694	89,725
Contra Costa	70,276	70,317	70,358	70,389	70,437	70,484	70,531	70,578	70,624	70,670	70,717
Fresno	102,770	102,783	102,795	102,812	102,829	102,846	102,863	102,879	102,895	102,912	102,926
Kern	110,593	110,604	110,617	110,673	110,706	110,738	110,769	110,800	110,831	110,860	110,889
Lake	3,551	3,552	3,556	3,557	3,560	3,562	3,565	3,568	3,571	3,574	3,577
Los Angeles	1,246,123	1,246,129	1,246,436	1,246,640	1,246,806	1,246,971	1,247,136	1,247,306	1,247,474	1,247,640	1,247,806
Marin	14,170	14,177	14,184	14,185	14,189	14,193	14,197	14,201	14,205	14,209	14,213
Monterey	43,795	43,800	43,804	43,818	43,823	43,827	43,831	43,836	43,840	43,844	43,848
Orange	272,682	272,713	272,745	272,787	272,825	272,864	272,901	272,938	272,974	273,009	273,043
Placer	23,342	23,345	23,383	23,410	23,436	23,461	23,488	23,514	23,541	23,569	23,597
Riverside	301,318	301,323	301,329	301,420	301,461	301,499	301,536	301,572	301,611	301,647	301,683
Sacramento	107,193	107,199	107,395	107,441	107,486	107,529	107,572	107,614	107,653	107,693	107,731
San Bernardino	298,939	298,976	299,014	299,049	299,081	299,113	299,147	299,178	299,208	299,237	299,267
San Diego	281,202	281,203	281,313	281,374	281,443	281,511	281,578	281,644	281,710	281,774	281,838
San Francisco	37,177	37,189	37,197	37,206	37,217	37,228	37,239	37,250	37,261	37,272	37,282
San Joaquin	74,407	74,413	74,419	74,559	74,603	74,646	74,690	74,737	74,783	74,829	74,873
San Luis Obispo	21,407	21,409	21,411	21,421	21,427	21,432	21,438	21,443	21,449	21,455	21,460
San Mateo	42,585	42,604	42,611	42,619	42,638	42,656	42,675	42,693	42,712	42,730	42,749
Santa Barbara	34,572	34,575	34,577	34,580	34,585	34,589	34,593	34,597	34,601	34,605	34,609
Santa Clara	119,860	119,894	119,946	119,957	119,986	120,015	120,044	120,073	120,102	120,131	120,159
Santa Cruz	16,203	16,205	16,206	16,216	16,219	16,222	16,224	16,227	16,230	16,232	16,235
Solano	33,588	33,606	33,625	33,636	33,651	33,665	33,679	33,693	33,706	33,719	33,733
Sonoma	30,688	30,709	30,731	30,752	30,782	30,812	30,844	30,876	30,908	30,941	30,974
Ventura	81,560	81,566	81,572	81,572	81,582	81,593	81,603	81,613	81,622	81,632	81,641

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:		
	6/12	6/13	6/14	6/15	6/17	6/19	6/21
Alameda	89,340	89,393	89,446	89,499	89,565 (17,913) [4,299] {2,150}	89,630 (17,926) [4,302] {2,151}	89,694 (17,939) [4,305] {2,153}
Contra Costa	70,276	70,317	70,358	70,389	70,484 (14,097) [3,383] {1,692}	70,578 (14,116) [3,388] {1,694}	70,670 (14,134) [3,392] {1,696}
Fresno	102,770	102,783	102,795	102,812	102,846 (20,569) [4,937] {2,468}	102,879 (20,576) [4,938] {2,469}	102,912 (20,582) [4,940] {2,470}
Kern	110,593	110,604	110,617	110,673	110,738 (22,148) [5,315] {2,658}	110,800 (22,160) [5,318] {2,659}	110,860 (22,172) [5,321] {2,661}
Lake	3,551	3,552	3,556	3,557	3,562 (712) [171] {85}	3,568 (714) [171] {86}	3,574 (715) [172] {86}
Los Angeles	1,246,123	1,246,129	1,246,436	1,246,640	1,246,971 (249,394) [59,855] {29,927}	1,247,306 (249,461) [59,871] {29,935}	1,247,640 (249,528) [59,887] {29,943}
Marin	14,170	14,177	14,184	14,185	14,193 (2,839) [681] {341}	14,201 (2,840) [682] {341}	14,209 (2,842) [682] {341}
Monterey	43,795	43,800	43,804	43,818	43,827 (8,765) [2,104] {1,052}	43,836 (8,767) [2,104] {1,052}	43,844 (8,769) [2,105] {1,052}
Orange	272,682	272,713	272,745	272,787	272,864 (54,573) [13,097] {6,549}	272,938 (54,588) [13,101] {6,551}	273,009 (54,602) [13,104] {6,552}
Placer	23,342	23,345	23,383	23,410	23,461 (4,692) [1,126] {563}	23,514 (4,703) [1,129] {564}	23,569 (4,714) [1,131] {566}
Riverside	301,318	301,323	301,329	301,420	301,499 (60,300) [14,472] {7,236}	301,572 (60,314) [14,475] {7,238}	301,647 (60,329) [14,479] {7,240}
Sacramento	107,193	107,199	107,395	107,441	107,529 (21,506) [5,161] {2,581}	107,614 (21,523) [5,165] {2,583}	107,693 (21,539) [5,169] {2,585}
San Bernardino	298,939	298,976	299,014	299,049	299,113 (59,823) [14,357] {7,179}	299,178 (59,836) [14,361] {7,180}	299,237 (59,847) [14,363] {7,182}
San Diego	281,202	281,203	281,313	281,374	281,511 (56,302) [13,513] {6,756}	281,644 (56,329) [13,519] {6,759}	281,774 (56,355) [13,525] {6,763}
San Francisco	37,177	37,189	37,197	37,206	37,228 (7,446) [1,787] {893}	37,250 (7,450) [1,788] {894}	37,272 (7,454) [1,789] {895}
San Joaquin	74,407	74,413	74,419	74,559	74,646 (14,929) [3,583] {1,791}	74,737 (14,947) [3,587] {1,794}	74,829 (14,966) [3,592] {1,796}
San Luis Obispo	21,407	21,409	21,411	21,421	21,432 (4,286) [1,029] {514}	21,443 (4,289) [1,029] {515}	21,455 (4,291) [1,030] {515}
San Mateo	42,585	42,604	42,611	42,619	42,656 (8,531) [2,048] {1,024}	42,693 (8,539) [2,049] {1,025}	42,730 (8,546) [2,051] {1,026}
Santa Barbara	34,572	34,575	34,577	34,580	34,589 (6,918) [1,660] {830}	34,597 (6,919) [1,661] {830}	34,605 (6,921) [1,661] {831}
Santa Clara	119,860	119,894	119,946	119,957	120,015 (24,003) [5,761] {2,880}	120,073 (24,015) [5,764] {2,882}	120,131 (24,026) [5,766] {2,883}
Santa Cruz	16,203	16,205	16,206	16,216	16,222 (3,244) [779] {389}	16,227 (3,245) [779] {389}	16,232 (3,246) [779] {390}
Solano	33,588	33,606	33,625	33,636	33,665 (6,733) [1,616] {808}	33,693 (6,739) [1,617] {809}	33,719 (6,744) [1,619] {809}
Sonoma	30,688	30,709	30,731	30,752	30,812 (6,162) [1,479] {739}	30,876 (6,175) [1,482] {741}	30,941 (6,188) [1,485] {743}
Ventura	81,560	81,566	81,572	81,572	81,593 (16,319) [3,916] {1,958}	81,613 (16,323) [3,917] {1,959}	81,632 (16,326) [3,918] {1,959}

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.