IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/10/21

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 6/10/21 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
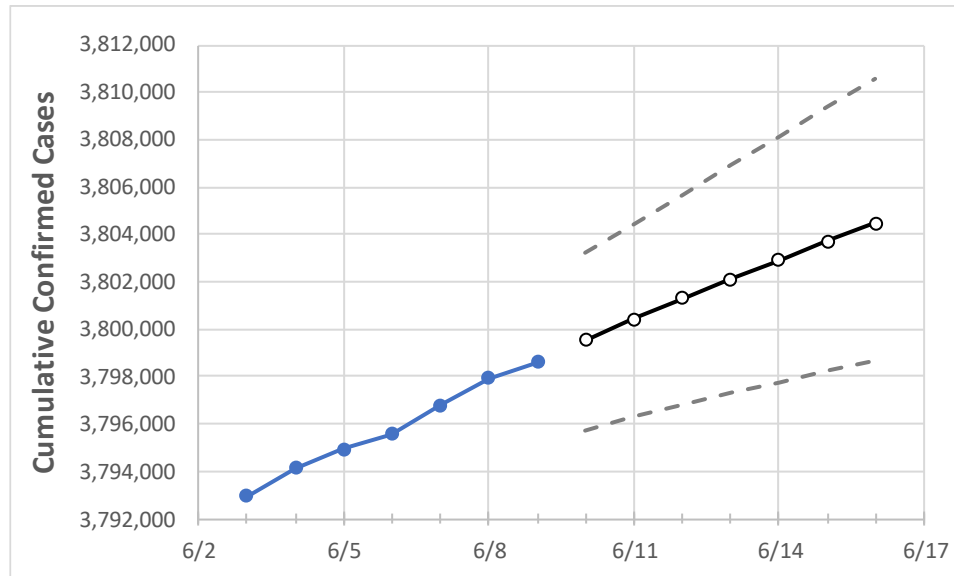
	Actual Confirmed Cases On:				Projected Cases For:						
	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16
California	3,795,580	3,796,776	3,797,937	3,798,631	3,799,550	3,800,446	3,801,301	3,802,108	3,802,908	3,803,718	3,804,471

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:						
	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16
Alameda	89,141	89,147	89,201	89,201	89,228	89,255	89,280	89,305	89,331	89,353	89,376
Contra Costa	69,945	70,003	70,048	70,048	70,084	70,120	70,155	70,190	70,225	70,259	70,294
Fresno	102,626	102,642	102,659	102,680	102,698	102,715	102,731	102,747	102,762	102,777	102,791
Kern	110,372	110,395	110,458	110,522	110,565	110,609	110,652	110,695	110,739	110,783	110,823
Lake	3,534	3,535	3,540	3,540	3,543	3,547	3,550	3,554	3,557	3,561	3,565
Los Angeles	1,245,120	1,245,254	1,245,429	1,245,588	1,245,750	1,245,905	1,246,058	1,246,209	1,246,360	1,246,514	1,246,666
Marin	14,156	14,157	14,160	14,160	14,164	14,167	14,171	14,174	14,178	14,181	14,184
Monterey	43,771	43,774	43,777	43,777	43,780	43,784	43,787	43,790	43,793	43,796	43,798
Orange	272,426	272,447	272,504	272,552	272,599	272,646	272,692	272,739	272,783	272,828	272,872
Placer	23,133	23,196	23,228	23,257	23,279	23,302	23,327	23,351	23,375	23,399	23,424
Riverside	300,985	301,013	301,128	301,128	301,166	301,205	301,243	301,281	301,316	301,351	301,386
Sacramento	106,879	106,961	107,030	107,103	107,171	107,240	107,306	107,371	107,436	107,500	107,565
San Bernardino	298,676	298,697	298,728	298,808	298,853	298,899	298,939	298,978	299,014	299,050	299,083
San Diego	280,742	280,807	280,878	280,940	281,007	281,074	281,139	281,203	281,266	281,328	281,389
San Francisco	37,111	37,118	37,122	37,134	37,146	37,158	37,170	37,181	37,192	37,203	37,214
San Joaquin	74,145	74,161	74,257	74,257	74,294	74,333	74,372	74,411	74,450	74,490	74,532
San Luis Obispo	21,367	21,369	21,383	21,383	21,389	21,396	21,402	21,408	21,415	21,421	21,427
San Mateo	42,433	42,457	42,479	42,488	42,500	42,513	42,524	42,535	42,545	42,555	42,565
Santa Barbara	34,536	34,541	34,547	34,547	34,551	34,556	34,560	34,564	34,569	34,573	34,577
Santa Clara	119,676	119,711	119,743	119,770	119,795	119,819	119,843	119,867	119,891	119,915	119,939
Santa Cruz	16,197	16,200	16,199	16,199	16,201	16,204	16,206	16,208	16,210	16,212	16,214
Solano	33,504	33,511	33,518	33,533	33,550	33,568	33,584	33,601	33,617	33,633	33,649
Sonoma	30,518	30,544	30,569	30,586	30,615	30,644	30,674	30,706	30,737	30,770	30,804
Ventura	81,490	81,507	81,511	81,528	81,541	81,554	81,565	81,577	81,588	81,599	81,611

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: | | |
	6/6	6/7	6/8	6/9	6/11	6/13	6/15
Alameda	89,141	89,147	89,201	89,201	89,255 (17,851) [4,284] {2,142}	89,305 (17,861) [4,287] {2,143}	89,353 (17,871) [4,289] {2,144}
Contra Costa	69,945	70,003	70,048	70,048	70,120 (14,024) [3,366] {1,683}	70,190 (14,038) [3,369] {1,685}	70,259 (14,052) [3,372] {1,686}
Fresno	102,626	102,642	102,659	102,680	102,715 (20,543) [4,930] {2,465}	102,747 (20,549) [4,932] {2,466}	102,777 (20,555) [4,933] {2,467}
Kern	110,372	110,395	110,458	110,522	110,609 (22,122) [5,309] {2,655}	110,695 (22,139) [5,313] {2,657}	110,783 (22,157) [5,318] {2,659}
Lake	3,534	3,535	3,540	3,540	3,547 (709) [170] {85}	3,554 (711) [171] {85}	3,561 (712) [171] {85}
Los Angeles	1,245,120	1,245,254	1,245,429	1,245,588	1,245,905 (249,181) [59,803] {29,902}	1,246,209 (249,242) [59,818] {29,909}	1,246,514 (249,303) [59,833] {29,916}
Marin	14,156	14,157	14,160	14,160	14,167 (2,833) [680] {340}	14,174 (2,835) [680] {340}	14,181 (2,836) [681] {340}
Monterey	43,771	43,774	43,777	43,777	43,784 (8,757) [2,102] {1,051}	43,790 (8,758) [2,102] {1,051}	43,796 (8,759) [2,102] {1,051}
Orange	272,426	272,447	272,504	272,552	272,646 (54,529) [13,087] {6,544}	272,739 (54,548) [13,091] {6,546}	272,828 (54,566) [13,096] {6,548}
Placer	23,133	23,196	23,228	23,257	23,302 (4,660) [1,119] {559}	23,351 (4,670) [1,121] {560}	23,399 (4,680) [1,123] {562}
Riverside	300,985	301,013	301,128	301,128	301,205 (60,241) [14,458] {7,229}	301,281 (60,256) [14,461] {7,231}	301,351 (60,270) [14,465] {7,232}
Sacramento	106,879	106,961	107,030	107,103	107,240 (21,448) [5,148] {2,574}	107,371 (21,474) [5,154] {2,577}	107,500 (21,500) [5,160] {2,580}
San Bernardino	298,676	298,697	298,728	298,808	298,899 (59,780) [14,347] {7,174}	298,978 (59,796) [14,351] {7,175}	299,050 (59,810) [14,354] {7,177}
San Diego	280,742	280,807	280,878	280,940	281,074 (56,215) [13,492] {6,746}	281,203 (56,241) [13,498] {6,749}	281,328 (56,266) [13,504] {6,752}
San Francisco	37,111	37,118	37,122	37,134	37,158 (7,432) [1,784] {892}	37,181 (7,436) [1,785] {892}	37,203 (7,441) [1,786] {893}
San Joaquin	74,145	74,161	74,257	74,257	74,333 (14,867) [3,568] {1,784}	74,411 (14,882) [3,572] {1,786}	74,490 (14,898) [3,576] {1,788}
San Luis Obispo	21,367	21,369	21,383	21,383	21,396 (4,279) [1,027] {513}	21,408 (4,282) [1,028] {514}	21,421 (4,284) [1,028] {514}
San Mateo	42,433	42,457	42,479	42,488	42,513 (8,503) [2,041] {1,020}	42,535 (8,507) [2,042] {1,021}	42,555 (8,511) [2,043] {1,021}
Santa Barbara	34,536	34,541	34,547	34,547	34,556 (6,911) [1,659] {829}	34,564 (6,913) [1,659] {830}	34,573 (6,915) [1,659] {830}
Santa Clara	119,676	119,711	119,743	119,770	119,819 (23,964) [5,751] {2,876}	119,867 (23,973) [5,754] {2,877}	119,915 (23,983) [5,756] {2,878}
Santa Cruz	16,197	16,200	16,199	16,199	16,204 (3,241) [778] {389}	16,208 (3,242) [778] {389}	16,212 (3,242) [778] {389}
Solano	33,504	33,511	33,518	33,533	33,568 (6,714) [1,611] {806}	33,601 (6,720) [1,613] {806}	33,633 (6,727) [1,614] {807}
Sonoma	30,518	30,544	30,569	30,586	30,644 (6,129) [1,471] {735}	30,706 (6,141) [1,474] {737}	30,770 (6,154) [1,477] {738}
Ventura	81,490	81,507	81,511	81,528	81,554 (16,311) [3,915] {1,957}	81,577 (16,315) [3,916] {1,958}	81,599 (16,320) [3,917] {1,958}

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.