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

Date: 5/12/21

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 5/12/21 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.

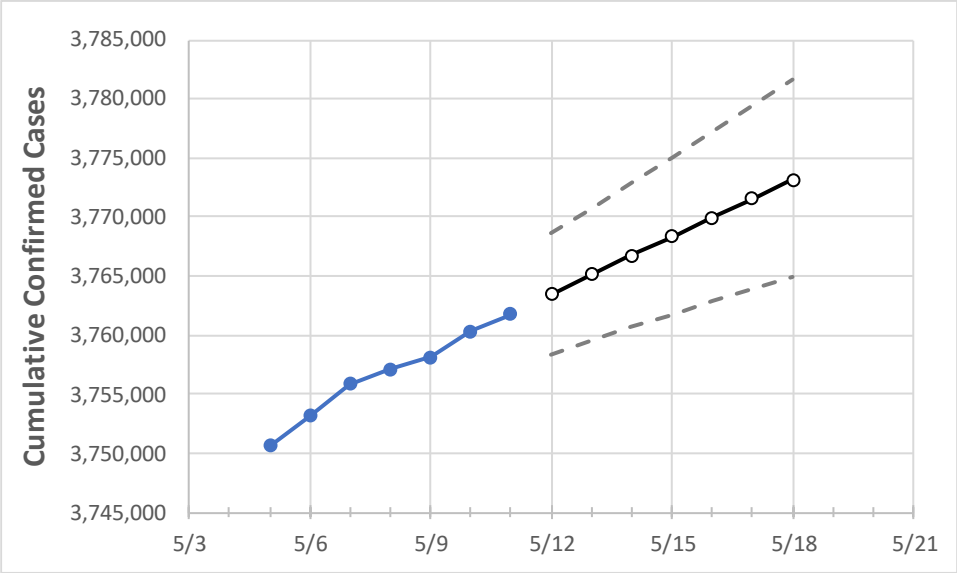
IEM's Modeling Lead

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:						
	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
California	3,757,115	3,758,137	3,760,303	3,761,779	3,763,459	3,765,134	3,766,780	3,768,388	3,769,985	3,771,582	3,773,156

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:						
	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Alameda	87,585	87,633	87,637	87,733	87,794	87,854	87,913	87,969	88,025	88,080	88,132
Contra Costa	68,503	68,582	68,638	68,689	68,750	68,810	68,870	68,929	68,987	69,043	69,100
Fresno	101,625	101,676	101,729	101,755	101,799	101,844	101,887	101,930	101,973	102,016	102,058
Kern	108,993	109,031	109,052	109,101	109,149	109,196	109,242	109,288	109,334	109,379	109,423
Lake	3,467	3,470	3,471	3,471	3,474	3,477	3,480	3,483	3,487	3,490	3,493
Los Angeles	1,235,422	1,235,651	1,235,828	1,235,999	1,236,223	1,236,440	1,236,654	1,236,858	1,237,056	1,237,250	1,237,440
Marin	14,034	14,037	14,040	14,054	14,063	14,071	14,080	14,089	14,097	14,106	14,115
Monterey	43,574	43,584	43,595	43,601	43,614	43,627	43,641	43,654	43,667	43,681	43,694
Orange	270,705	270,744	270,800	270,883	270,946	271,007	271,067	271,125	271,182	271,239	271,294
Placer	22,570	22,590	22,610	22,635	22,666	22,698	22,730	22,758	22,789	22,820	22,851
Riverside	299,100	299,137	299,173	299,376	299,445	299,514	299,583	299,650	299,717	299,783	299,848
Sacramento	104,192	104,208	104,491	104,610	104,745	104,882	105,022	105,166	105,309	105,447	105,588
San Bernardino	296,514	296,596	296,655	296,700	296,761	296,820	296,876	296,930	296,984	297,037	297,087
San Diego	277,759	277,949	278,182	278,307	278,520	278,737	278,957	279,182	279,413	279,648	279,886
San Francisco	36,616	36,642	36,669	36,683	36,703	36,723	36,741	36,759	36,778	36,796	36,813
San Joaquin	73,064	73,119	73,174	73,180	73,236	73,293	73,348	73,401	73,453	73,508	73,559
San Luis Obispo	21,286	21,289	21,293	21,307	21,315	21,324	21,332	21,339	21,346	21,353	21,360
San Mateo	41,844	41,871	41,903	41,926	41,959	41,992	42,025	42,058	42,090	42,123	42,157
Santa Barbara	34,306	34,317	34,323	34,328	34,339	34,350	34,361	34,371	34,381	34,391	34,400
Santa Clara	118,851	118,901	118,932	118,974	119,023	119,072	119,119	119,162	119,205	119,248	119,290
Santa Cruz	16,205	16,221	16,238	16,246	16,268	16,291	16,313	16,335	16,357	16,379	16,401
Solano	32,789	32,827	32,864	32,880	32,915	32,949	32,985	33,019	33,055	33,089	33,122
Sonoma	29,975	29,984	30,002	30,012	30,025	30,038	30,051	30,064	30,077	30,089	30,102
Ventura	80,863	80,884	80,905	80,949	80,978	81,006	81,034	81,063	81,091	81,119	81,147

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:		
	5/8	5/9	5/10	5/11	5/13	5/15	5/17
Alameda	87,585	87,633	87,637	87,733	87,854 (17,571) [4,217] {2,109}	87,969 (17,594) [4,223] {2,111}	88,080 (17,616) [4,228] {2,114}
Contra Costa	68,503	68,582	68,638	68,689	68,810 (13,762) [3,303] {1,651}	68,929 (13,786) [3,309] {1,654}	69,043 (13,809) [3,314] {1,657}
Fresno	101,625	101,676	101,729	101,755	101,844 (20,369) [4,889] {2,444}	101,930 (20,386) [4,893] {2,446}	102,016 (20,403) [4,897] {2,448}
Kern	108,993	109,031	109,052	109,101	109,196 (21,839) [5,241] {2,621}	109,288 (21,858) [5,246] {2,623}	109,379 (21,876) [5,250] {2,625}
Lake	3,467	3,470	3,471	3,471	3,477 (695) [167] {83}	3,483 (697) [167] {84}	3,490 (698) [168] {84}
Los Angeles	1,235,422	1,235,651	1,235,828	1,235,999	1,236,440 (247,288) [59,349] {29,675}	1,236,858 (247,372) [59,369] {29,685}	1,237,250 (247,450) [59,388] {29,694}
Marin	14,034	14,037	14,040	14,054	14,071 (2,814) [675] {338}	14,089 (2,818) [676] {338}	14,106 (2,821) [677] {339}
Monterey	43,574	43,584	43,595	43,601	43,627 (8,725) [2,094] {1,047}	43,654 (8,731) [2,095] {1,048}	43,681 (8,736) [2,097] {1,048}
Orange	270,705	270,744	270,800	270,883	271,007 (54,201) [13,008] {6,504}	271,125 (54,225) [13,014] {6,507}	271,239 (54,248) [13,019] {6,510}
Placer	22,570	22,590	22,610	22,635	22,698 (4,540) [1,089] {545}	22,758 (4,552) [1,092] {546}	22,820 (4,564) [1,095] {548}
Riverside	299,100	299,137	299,173	299,376	299,514 (59,903) [14,377] {7,188}	299,650 (59,930) [14,383] {7,192}	299,783 (59,957) [14,390] {7,195}
Sacramento	104,192	104,208	104,491	104,610	104,882 (20,976) [5,034] {2,517}	105,166 (21,033) [5,048] {2,524}	105,447 (21,089) [5,061] {2,531}
San Bernardino	296,514	296,596	296,655	296,700	296,820 (59,364) [14,247] {7,124}	296,930 (59,386) [14,253] {7,126}	297,037 (59,407) [14,258] {7,129}
San Diego	277,759	277,949	278,182	278,307	278,737 (55,747) [13,379] {6,690}	279,182 (55,836) [13,401] {6,700}	279,648 (55,930) [13,423] {6,712}
San Francisco	36,616	36,642	36,669	36,683	36,723 (7,345) [1,763] {881}	36,759 (7,352) [1,764] {882}	36,796 (7,359) [1,766] {883}
San Joaquin	73,064	73,119	73,174	73,180	73,293 (14,659) [3,518] {1,759}	73,401 (14,680) [3,523] {1,762}	73,508 (14,702) [3,528] {1,764}
San Luis Obispo	21,286	21,289	21,293	21,307	21,324 (4,265) [1,024] {512}	21,339 (4,268) [1,024] {512}	21,353 (4,271) [1,025] {512}
San Mateo	41,844	41,871	41,903	41,926	41,992 (8,398) [2,016] {1,008}	42,058 (8,412) [2,019] {1,009}	42,123 (8,425) [2,022] {1,011}
Santa Barbara	34,306	34,317	34,323	34,328	34,350 (6,870) [1,649] {824}	34,371 (6,874) [1,650] {825}	34,391 (6,878) [1,651] {825}
Santa Clara	118,851	118,901	118,932	118,974	119,072 (23,814) [5,715] {2,858}	119,162 (23,832) [5,720] {2,860}	119,248 (23,850) [5,724] {2,862}
Santa Cruz	16,205	16,221	16,238	16,246	16,291 (3,258) [782] {391}	16,335 (3,267) [784] {392}	16,379 (3,276) [786] {393}
Solano	32,789	32,827	32,864	32,880	32,949 (6,590) [1,582] {791}	33,019 (6,604) [1,585] {792}	33,089 (6,618) [1,588] {794}
Sonoma	29,975	29,984	30,002	30,012	30,038 (6,008) [1,442] {721}	30,064 (6,013) [1,443] {722}	30,089 (6,018) [1,444] {722}
Ventura	80,863	80,884	80,905	80,949	81,006 (16,201) [3,888] {1,944}	81,063 (16,213) [3,891] {1,946}	81,119 (16,224) [3,894] {1,947}

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.