IEM's AI Modeling: Short-term COVID-19 Projections
Date: 5/13/21

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 5/13/21 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
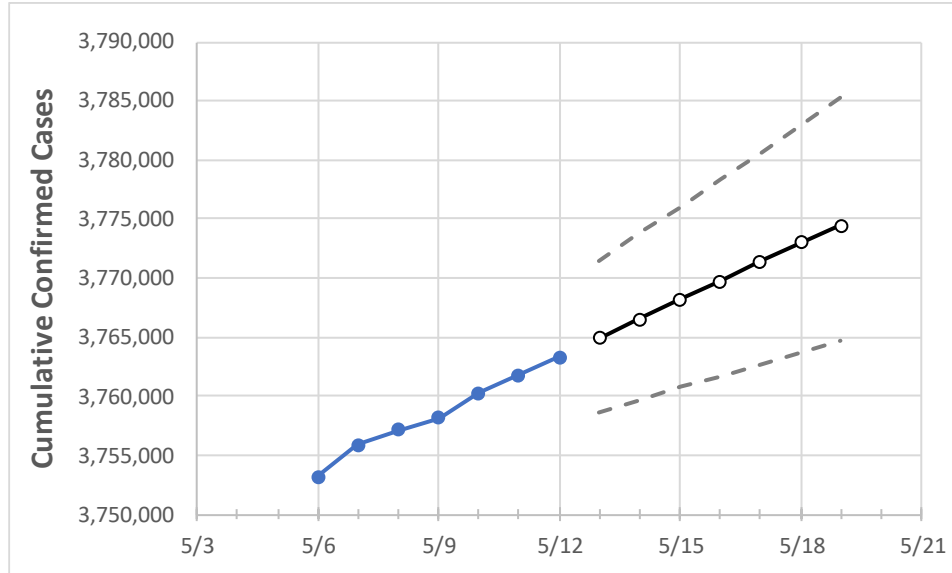
	Actual Confirmed Cases On:				Projected Cases For:						
	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
California	3,758,137	3,760,303	3,761,779	3,763,281	3,764,919	3,766,549	3,768,168	3,769,760	3,771,370	3,772,978	3,774,483

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:						
	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
Alameda	87,633	87,637	87,733	87,877	87,947	88,017	88,085	88,153	88,215	88,280	88,343
Contra Costa	68,582	68,638	68,689	68,741	68,799	68,856	68,913	68,970	69,026	69,081	69,136
Fresno	101,676	101,729	101,755	101,792	101,835	101,878	101,920	101,962	102,003	102,046	102,086
Kern	109,031	109,052	109,101	109,139	109,182	109,226	109,268	109,310	109,354	109,396	109,438
Lake	3,470	3,471	3,472	3,473	3,475	3,478	3,480	3,483	3,485	3,488	3,490
Los Angeles	1,235,651	1,235,828	1,235,999	1,236,256	1,236,474	1,236,688	1,236,897	1,237,098	1,237,301	1,237,496	1,237,690
Marin	14,037	14,040	14,054	14,056	14,064	14,071	14,079	14,087	14,094	14,102	14,109
Monterey	43,584	43,595	43,601	43,613	43,626	43,640	43,654	43,667	43,681	43,694	43,708
Orange	270,744	270,800	270,883	270,940	270,999	271,057	271,114	271,169	271,222	271,276	271,326
Placer	22,590	22,610	22,635	22,665	22,697	22,728	22,759	22,788	22,820	22,851	22,881
Riverside	299,137	299,173	299,376	299,455	299,526	299,597	299,667	299,737	299,809	299,875	299,946
Sacramento	104,208	104,491	104,610	104,720	104,854	104,980	105,114	105,245	105,374	105,501	105,626
San Bernardino	296,596	296,655	296,700	296,782	296,843	296,902	296,962	297,018	297,075	297,130	297,184
San Diego	277,949	278,182	278,307	278,401	278,592	278,785	278,983	279,180	279,376	279,575	279,778
San Francisco	36,642	36,669	36,683	36,707	36,726	36,746	36,764	36,783	36,800	36,819	36,837
San Joaquin	73,119	73,174	73,180	73,220	73,277	73,334	73,389	73,446	73,500	73,555	73,608
San Luis Obispo	21,289	21,293	21,307	21,308	21,315	21,323	21,329	21,336	21,342	21,347	21,353
San Mateo	41,871	41,903	41,926	41,985	42,022	42,058	42,095	42,132	42,169	42,206	42,242
Santa Barbara	34,317	34,323	34,328	34,337	34,347	34,357	34,366	34,375	34,384	34,392	34,399
Santa Clara	118,901	118,932	118,974	119,010	119,058	119,103	119,148	119,190	119,231	119,271	119,310
Santa Cruz	16,221	16,238	16,246	16,249	16,269	16,288	16,306	16,325	16,345	16,364	16,383
Solano	32,827	32,864	32,880	32,912	32,946	32,980	33,014	33,047	33,080	33,111	33,142
Sonoma	29,984	30,002	30,012	30,026	30,039	30,053	30,066	30,080	30,092	30,105	30,118
Ventura	80,884	80,905	80,949	80,978	81,007	81,035	81,063	81,092	81,122	81,151	81,180

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:		
	5/9	5/10	5/11	5/12	5/14	5/16	5/18
Alameda	87,633	87,637	87,733	87,877	88,017 (17,603) [4,225] {2,112}	88,153 (17,631) [4,231] {2,116}	88,280 (17,656) [4,237] {2,119}
Contra Costa	68,582	68,638	68,689	68,741	68,856 (13,771) [3,305] {1,653}	68,970 (13,794) [3,311] {1,655}	69,081 (13,816) [3,316] {1,658}
Fresno	101,676	101,729	101,755	101,792	101,878 (20,376) [4,890] {2,445}	101,962 (20,392) [4,894] {2,447}	102,046 (20,409) [4,898] {2,449}
Kern	109,031	109,052	109,101	109,139	109,226 (21,845) [5,243] {2,621}	109,310 (21,862) [5,247] {2,623}	109,396 (21,879) [5,251] {2,626}
Lake	3,470	3,471	3,472	3,473	3,478 (696) [167] {83}	3,483 (697) [167] {84}	3,488 (698) [167] {84}
Los Angeles	1,235,651	1,235,828	1,235,999	1,236,256	1,236,688 (247,338) [59,361] {29,681}	1,237,098 (247,420) [59,381] {29,690}	1,237,496 (247,499) [59,400] {29,700}
Marin	14,037	14,040	14,054	14,056	14,071 (2,814) [675] {338}	14,087 (2,817) [676] {338}	14,102 (2,820) [677] {338}
Monterey	43,584	43,595	43,601	43,613	43,640 (8,728) [2,095] {1,047}	43,667 (8,733) [2,096] {1,048}	43,694 (8,739) [2,097] {1,049}
Orange	270,744	270,800	270,883	270,940	271,057 (54,211) [13,011] {6,505}	271,169 (54,234) [13,016] {6,508}	271,276 (54,255) [13,021] {6,511}
Placer	22,590	22,610	22,635	22,665	22,728 (4,546) [1,091] {545}	22,788 (4,558) [1,094] {547}	22,851 (4,570) [1,097] {548}
Riverside	299,137	299,173	299,376	299,455	299,597 (59,919) [14,381] {7,190}	299,737 (59,947) [14,387] {7,194}	299,875 (59,975) [14,394] {7,197}
Sacramento	104,208	104,491	104,610	104,720	104,980 (20,996) [5,039] {2,520}	105,245 (21,049) [5,052] {2,526}	105,501 (21,100) [5,064] {2,532}
San Bernardino	296,596	296,655	296,700	296,782	296,902 (59,380) [14,251] {7,126}	297,018 (59,404) [14,257] {7,128}	297,130 (59,426) [14,262] {7,131}
San Diego	277,949	278,182	278,307	278,401	278,785 (55,757) [13,382] {6,691}	279,180 (55,836) [13,401] {6,700}	279,575 (55,915) [13,420] {6,710}
San Francisco	36,642	36,669	36,683	36,707	36,746 (7,349) [1,764] {882}	36,783 (7,357) [1,766] {883}	36,819 (7,364) [1,767] {884}
San Joaquin	73,119	73,174	73,180	73,220	73,334 (14,667) [3,520] {1,760}	73,446 (14,689) [3,525] {1,763}	73,555 (14,711) [3,531] {1,765}
San Luis Obispo	21,289	21,293	21,307	21,308	21,323 (4,265) [1,023] {512}	21,336 (4,267) [1,024] {512}	21,347 (4,269) [1,025] {512}
San Mateo	41,871	41,903	41,926	41,985	42,058 (8,412) [2,019] {1,009}	42,132 (8,426) [2,022] {1,011}	42,206 (8,441) [2,026] {1,013}
Santa Barbara	34,317	34,323	34,328	34,337	34,357 (6,871) [1,649] {825}	34,375 (6,875) [1,650] {825}	34,392 (6,878) [1,651] {825}
Santa Clara	118,901	118,932	118,974	119,010	119,103 (23,821) [5,717] {2,858}	119,190 (23,838) [5,721] {2,861}	119,271 (23,854) [5,725] {2,863}
Santa Cruz	16,221	16,238	16,246	16,249	16,288 (3,258) [782] {391}	16,325 (3,265) [784] {392}	16,364 (3,273) [785] {393}
Solano	32,827	32,864	32,880	32,912	32,980 (6,596) [1,583] {792}	33,047 (6,609) [1,586] {793}	33,111 (6,622) [1,589] {795}
Sonoma	29,984	30,002	30,012	30,026	30,053 (6,011) [1,443] {721}	30,080 (6,016) [1,444] {722}	30,105 (6,021) [1,445] {723}
Ventura	80,884	80,905	80,949	80,978	81,035 (16,207) [3,890] {1,945}	81,092 (16,218) [3,892] {1,946}	81,151 (16,230) [3,895] {1,948}

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.