IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/16/21

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 3/16/21 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
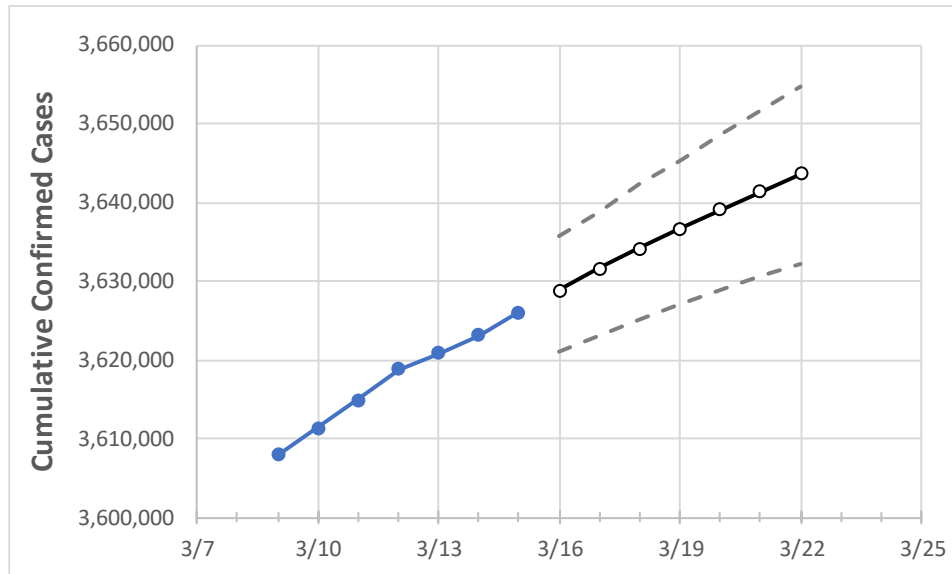
	Actual Confirmed Cases On:				Projected Cases For:						
	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22
California	3,618,777	3,620,890	3,623,063	3,626,027	3,628,823	3,631,552	3,634,144	3,636,626	3,639,031	3,641,356	3,643,647

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:						
	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22
Alameda	81,866	81,969	82,034	82,116	82,193	82,267	82,339	82,408	82,479	82,546	82,610
Contra Costa	63,830	63,943	64,056	64,096	64,179	64,259	64,339	64,417	64,493	64,570	64,641
Fresno	97,026	97,185	97,324	97,461	97,585	97,708	97,829	97,949	98,065	98,183	98,298
Kern	104,689	104,814	104,878	104,943	105,017	105,090	105,163	105,229	105,294	105,353	105,411
Lake	3,214	3,226	3,234	3,237	3,241	3,246	3,250	3,255	3,259	3,263	3,267
Los Angeles	1,209,849	1,209,661	1,210,270	1,210,663	1,211,733	1,212,765	1,213,772	1,214,774	1,215,709	1,216,654	1,217,588
Marin	13,434	13,445	13,450	13,462	13,474	13,486	13,498	13,509	13,519	13,530	13,540
Monterey	42,551	42,575	42,575	42,575	42,592	42,607	42,622	42,637	42,651	42,664	42,676
Orange	263,471	263,653	263,823	263,994	264,135	264,269	264,403	264,532	264,652	264,767	264,880
Placer	20,273	20,303	20,334	20,364	20,397	20,429	20,463	20,495	20,527	20,559	20,590
Riverside	291,866	292,008	292,151	292,293	292,416	292,535	292,648	292,760	292,873	292,976	293,078
Sacramento	95,088	95,140	95,192	95,441	95,551	95,660	95,766	95,872	95,974	96,075	96,177
San Bernardino	288,364	288,599	288,787	288,868	288,977	289,081	289,180	289,276	289,368	289,457	289,539
San Diego	264,900	265,273	265,471	265,649	265,927	266,190	266,442	266,689	266,928	267,151	267,373
San Francisco	34,722	34,758	34,784	34,810	34,836	34,860	34,884	34,907	34,929	34,952	34,973
San Joaquin	67,817	67,817	67,817	67,817	67,896	67,976	68,055	68,130	68,208	68,282	68,353
San Luis Obispo	20,041	20,053	20,066	20,078	20,098	20,118	20,137	20,156	20,174	20,190	20,206
San Mateo	39,590	39,638	39,689	39,744	39,782	39,819	39,856	39,891	39,925	39,957	39,988
Santa Barbara	32,573	32,595	32,621	32,634	32,664	32,693	32,721	32,747	32,772	32,796	32,819
Santa Clara	112,470	112,602	112,712	112,794	112,903	113,010	113,113	113,212	113,311	113,404	113,494
Santa Cruz	15,023	15,042	15,061	15,080	15,108	15,136	15,164	15,192	15,220	15,248	15,276
Solano	30,517	30,538	30,560	30,581	30,607	30,632	30,656	30,678	30,701	30,722	30,742
Sonoma	28,677	28,714	28,762	28,798	28,834	28,870	28,905	28,940	28,973	29,005	29,038
Ventura	78,713	78,739	78,766	78,792	78,840	78,886	78,930	78,973	79,013	79,051	79,087

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:		
	3/12	3/13	3/14	3/15	3/17	3/19	3/21
Alameda	81,866	81,969	82,034	82,116	82,267 (16,453) [3,949] {1,974}	82,408 (16,482) [3,956] {1,978}	82,546 (16,509) [3,962] {1,981}
Contra Costa	63,830	63,943	64,056	64,096	64,259 (12,852) [3,084] {1,542}	64,417 (12,883) [3,092] {1,546}	64,570 (12,914) [3,099] {1,550}
Fresno	97,026	97,185	97,324	97,461	97,708 (19,542) [4,690] {2,345}	97,949 (19,590) [4,702] {2,351}	98,183 (19,637) [4,713] {2,356}
Kern	104,689	104,814	104,878	104,943	105,090 (21,018) [5,044] {2,522}	105,229 (21,046) [5,051] {2,525}	105,353 (21,071) [5,057] {2,528}
Lake	3,214	3,226	3,234	3,237	3,246 (649) [156] {78}	3,255 (651) [156] {78}	3,263 (653) [157] {78}
Los Angeles	1,209,849	1,209,661	1,210,270	1,210,663	1,212,765 (242,553) [58,213] {29,106}	1,214,774 (242,955) [58,309] {29,155}	1,216,654 (243,331) [58,399] {29,200}
Marin	13,434	13,445	13,450	13,462	13,486 (2,697) [647] {324}	13,509 (2,702) [648] {324}	13,530 (2,706) [649] {325}
Monterey	42,551	42,575	42,575	42,575	42,607 (8,521) [2,045] {1,023}	42,637 (8,527) [2,047] {1,023}	42,664 (8,533) [2,048] {1,024}
Orange	263,471	263,653	263,823	263,994	264,269 (52,854) [12,685] {6,342}	264,532 (52,906) [12,698] {6,349}	264,767 (52,953) [12,709] {6,354}
Placer	20,273	20,303	20,334	20,364	20,429 (4,086) [981] {490}	20,495 (4,099) [984] {492}	20,559 (4,112) [987] {493}
Riverside	291,866	292,008	292,151	292,293	292,535 (58,507) [14,042] {7,021}	292,760 (58,552) [14,052] {7,026}	292,976 (58,595) [14,063] {7,031}
Sacramento	95,088	95,140	95,192	95,441	95,660 (19,132) [4,592] {2,296}	95,872 (19,174) [4,602] {2,301}	96,075 (19,215) [4,612] {2,306}
San Bernardino	288,364	288,599	288,787	288,868	289,081 (57,816) [13,876] {6,938}	289,276 (57,855) [13,885] {6,943}	289,457 (57,891) [13,894] {6,947}
San Diego	264,900	265,273	265,471	265,649	266,190 (53,238) [12,777] {6,389}	266,689 (53,338) [12,801] {6,401}	267,151 (53,430) [12,823] {6,412}
San Francisco	34,722	34,758	34,784	34,810	34,860 (6,972) [1,673] {837}	34,907 (6,981) [1,676] {838}	34,952 (6,990) [1,678] {839}
San Joaquin	67,817	67,817	67,817	67,817	67,976 (13,595) [3,263] {1,631}	68,130 (13,626) [3,270] {1,635}	68,282 (13,656) [3,278] {1,639}
San Luis Obispo	20,041	20,053	20,066	20,078	20,118 (4,024) [966] {483}	20,156 (4,031) [967] {484}	20,190 (4,038) [969] {485}
San Mateo	39,590	39,638	39,689	39,744	39,819 (7,964) [1,911] {956}	39,891 (7,978) [1,915] {957}	39,957 (7,991) [1,918] {959}
Santa Barbara	32,573	32,595	32,621	32,634	32,693 (6,539) [1,569] {785}	32,747 (6,549) [1,572] {786}	32,796 (6,559) [1,574] {787}
Santa Clara	112,470	112,602	112,712	112,794	113,010 (22,602) [5,424] {2,712}	113,212 (22,642) [5,434] {2,717}	113,404 (22,681) [5,443] {2,722}
Santa Cruz	15,023	15,042	15,061	15,080	15,136 (3,027) [727] {363}	15,192 (3,038) [729] {365}	15,248 (3,050) [732] {366}
Solano	30,517	30,538	30,560	30,581	30,632 (6,126) [1,470] {735}	30,678 (6,136) [1,473] {736}	30,722 (6,144) [1,475] {737}
Sonoma	28,677	28,714	28,762	28,798	28,870 (5,774) [1,386] {693}	28,940 (5,788) [1,389] {695}	29,005 (5,801) [1,392] {696}
Ventura	78,713	78,739	78,766	78,792	78,886 (15,777) [3,787] {1,893}	78,973 (15,795) [3,791] {1,895}	79,051 (15,810) [3,794] {1,897}

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.