IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/18/21

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 3/18/21 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
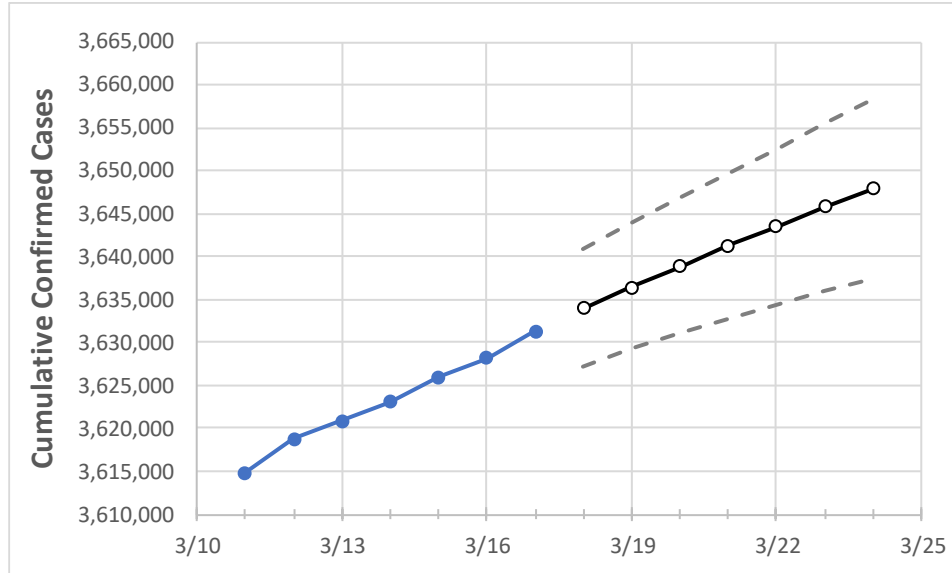
	Actual Confirmed Cases On:				Projected Cases For:						
	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24
California	3,623,063	3,626,027	3,628,171	3,631,320	3,633,960	3,636,457	3,638,905	3,641,267	3,643,534	3,645,768	3,647,877

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:						
	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24
Alameda	82,034	82,116	82,168	82,258	82,329	82,398	82,465	82,530	82,592	82,653	82,711
Contra Costa	64,056	64,096	64,203	64,280	64,360	64,441	64,519	64,596	64,674	64,750	64,822
Fresno	97,324	97,461	97,520	97,638	97,753	97,864	97,972	98,079	98,185	98,288	98,385
Kern	104,878	104,943	105,020	105,144	105,219	105,286	105,356	105,420	105,481	105,541	105,597
Lake	3,234	3,237	3,237	3,237	3,242	3,247	3,251	3,256	3,260	3,265	3,269
Los Angeles	1,210,270	1,210,663	1,210,961	1,211,739	1,212,663	1,213,532	1,214,373	1,215,228	1,216,026	1,216,776	1,217,493
Marin	13,450	13,462	13,470	13,477	13,487	13,498	13,508	13,518	13,527	13,535	13,543
Monterey	42,593	42,610	42,628	42,643	42,659	42,673	42,688	42,701	42,714	42,727	42,739
Orange	263,823	263,994	264,033	264,216	264,344	264,465	264,586	264,701	264,810	264,915	265,016
Placer	20,334	20,364	20,394	20,407	20,438	20,468	20,497	20,528	20,557	20,586	20,614
Riverside	292,151	292,293	292,403	292,606	292,723	292,838	292,949	293,058	293,166	293,272	293,376
Sacramento	95,192	95,441	95,556	95,667	95,781	95,894	96,003	96,111	96,213	96,315	96,412
San Bernardino	288,787	288,868	288,932	289,057	289,158	289,254	289,347	289,435	289,520	289,602	289,680
San Diego	265,471	265,649	265,906	266,317	266,597	266,876	267,147	267,410	267,667	267,911	268,156
San Francisco	34,784	34,810	34,820	34,820	34,842	34,863	34,883	34,902	34,920	34,938	34,954
San Joaquin	67,948	67,992	68,036	68,301	68,388	68,477	68,566	68,654	68,746	68,838	68,930
San Luis Obispo	20,066	20,078	20,115	20,136	20,157	20,178	20,197	20,216	20,234	20,252	20,269
San Mateo	39,689	39,744	39,765	39,765	39,800	39,833	39,865	39,896	39,926	39,954	39,984
Santa Barbara	32,621	32,634	32,669	32,703	32,733	32,761	32,788	32,816	32,841	32,867	32,891
Santa Clara	112,712	112,794	112,909	113,044	113,150	113,252	113,352	113,448	113,540	113,628	113,715
Santa Cruz	15,061	15,080	15,101	15,137	15,164	15,191	15,218	15,246	15,274	15,301	15,329
Solano	30,560	30,581	30,624	30,670	30,698	30,725	30,752	30,778	30,804	30,830	30,855
Sonoma	28,762	28,798	28,820	28,845	28,879	28,911	28,943	28,973	29,004	29,033	29,061
Ventura	78,766	78,792	78,871	78,968	79,017	79,064	79,108	79,150	79,191	79,227	79,263

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:		
	3/14	3/15	3/16	3/17	3/19	3/21	3/23
Alameda	82,034	82,116	82,168	82,258	82,398 (16,480) [3,955] {1,978}	82,530 (16,506) [3,961] {1,981}	82,653 (16,531) [3,967] {1,984}
Contra Costa	64,056	64,096	64,203	64,280	64,441 (12,888) [3,093] {1,547}	64,596 (12,919) [3,101] {1,550}	64,750 (12,950) [3,108] {1,554}
Fresno	97,324	97,461	97,520	97,638	97,864 (19,573) [4,697] {2,349}	98,079 (19,616) [4,708] {2,354}	98,288 (19,658) [4,718] {2,359}
Kern	104,878	104,943	105,020	105,144	105,286 (21,057) [5,054] {2,527}	105,420 (21,084) [5,060] {2,530}	105,541 (21,108) [5,066] {2,533}
Lake	3,234	3,237	3,237	3,237	3,247 (649) [156] {78}	3,256 (651) [156] {78}	3,265 (653) [157] {78}
Los Angeles	1,210,270	1,210,663	1,210,961	1,211,739	1,213,532 (242,706) [58,250] {29,125}	1,215,228 (243,046) [58,331] {29,165}	1,216,776 (243,355) [58,405] {29,203}
Marin	13,450	13,462	13,470	13,477	13,498 (2,700) [648] {324}	13,518 (2,704) [649] {324}	13,535 (2,707) [650] {325}
Monterey	42,593	42,610	42,628	42,643	42,673 (8,535) [2,048] {1,024}	42,701 (8,540) [2,050] {1,025}	42,727 (8,545) [2,051] {1,025}
Orange	263,823	263,994	264,033	264,216	264,465 (52,893) [12,694] {6,347}	264,701 (52,940) [12,706] {6,353}	264,915 (52,983) [12,716] {6,358}
Placer	20,334	20,364	20,394	20,407	20,468 (4,094) [982] {491}	20,528 (4,106) [985] {493}	20,586 (4,117) [988] {494}
Riverside	292,151	292,293	292,403	292,606	292,838 (58,568) [14,056] {7,028}	293,058 (58,612) [14,067] {7,033}	293,272 (58,654) [14,077] {7,039}
Sacramento	95,192	95,441	95,556	95,667	95,894 (19,179) [4,603] {2,301}	96,111 (19,222) [4,613] {2,307}	96,315 (19,263) [4,623] {2,312}
San Bernardino	288,787	288,868	288,932	289,057	289,254 (57,851) [13,884] {6,942}	289,435 (57,887) [13,893] {6,946}	289,602 (57,920) [13,901] {6,950}
San Diego	265,471	265,649	265,906	266,317	266,876 (53,375) [12,810] {6,405}	267,410 (53,482) [12,836] {6,418}	267,911 (53,582) [12,860] {6,430}
San Francisco	34,784	34,810	34,820	34,820	34,863 (6,973) [1,673] {837}	34,902 (6,980) [1,675] {838}	34,938 (6,988) [1,677] {839}
San Joaquin	67,948	67,992	68,036	68,301	68,477 (13,695) [3,287] {1,643}	68,654 (13,731) [3,295] {1,648}	68,838 (13,768) [3,304] {1,652}
San Luis Obispo	20,066	20,078	20,115	20,136	20,178 (4,036) [969] {484}	20,216 (4,043) [970] {485}	20,252 (4,050) [972] {486}
San Mateo	39,689	39,744	39,765	39,765	39,833 (7,967) [1,912] {956}	39,896 (7,979) [1,915] {958}	39,954 (7,991) [1,918] {959}
Santa Barbara	32,621	32,634	32,669	32,703	32,761 (6,552) [1,573] {786}	32,816 (6,563) [1,575] {788}	32,867 (6,573) [1,578] {789}
Santa Clara	112,712	112,794	112,909	113,044	113,252 (22,650) [5,436] {2,718}	113,448 (22,690) [5,446] {2,723}	113,628 (22,726) [5,454] {2,727}
Santa Cruz	15,061	15,080	15,101	15,137	15,191 (3,038) [729] {365}	15,246 (3,049) [732] {366}	15,301 (3,060) [734] {367}
Solano	30,560	30,581	30,624	30,670	30,725 (6,145) [1,475] {737}	30,778 (6,156) [1,477] {739}	30,830 (6,166) [1,480] {740}
Sonoma	28,762	28,798	28,820	28,845	28,911 (5,782) [1,388] {694}	28,973 (5,795) [1,391] {695}	29,033 (5,807) [1,394] {697}
Ventura	78,766	78,792	78,871	78,968	79,064 (15,813) [3,795] {1,898}	79,150 (15,830) [3,799] {1,900}	79,227 (15,845) [3,803] {1,901}

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.