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

Date: 7/15/20

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 20%, and are often within 10%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 7/15/20 11 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.

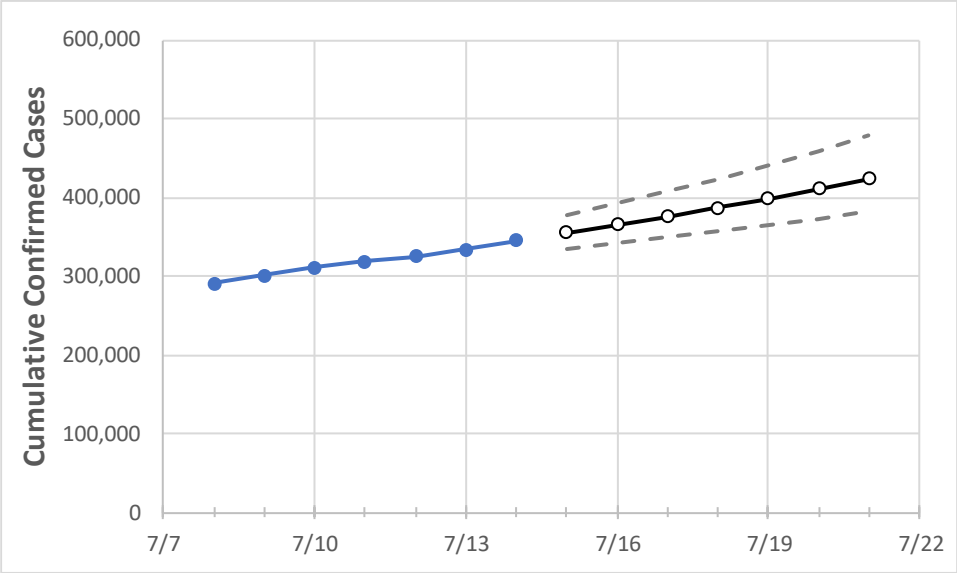
IEM's Modeling Lead

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:						
	7/11	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21
California	318,356	324,444	333,630	344,967	354,837	365,116	375,817	386,959	398,558	410,631	423,198

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 20%, and are often within 10%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	7/11	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21
Alameda	7,725	7,851	7,976	8,321	8,489	8,661	8,838	9,020	9,206	9,397	9,594
Contra Costa	4,605	4,661	4,852	5,023	5,194	5,374	5,562	5,758	5,963	6,176	6,400
Fresno	8,282	8,440	8,598	8,756	9,014	9,278	9,548	9,824	10,107	10,396	10,692
Kern	6,339	6,502	6,631	6,759	6,937	7,122	7,315	7,516	7,726	7,944	8,172
Los Angeles	130,242	133,549	136,129	140,307	143,440	146,664	149,981	153,393	156,903	160,513	164,226
Marin	3,097	3,171	3,244	3,296	3,353	3,410	3,467	3,523	3,579	3,635	3,690
Monterey	2,543	2,666	2,790	2,835	2,936	3,041	3,151	3,265	3,385	3,510	3,640
Orange	23,901	24,715	25,255	26,120	27,121	28,071	29,064	30,136	31,107	32,133	33,278
Placer	1,055	1,077	1,114	1,151	1,183	1,216	1,249	1,283	1,317	1,352	1,388
Riverside	25,093	25,420	25,748	26,481	27,061	27,650	28,250	28,860	29,480	30,110	30,751
Sacramento	5,339	5,489	5,714	5,938	6,169	6,406	6,652	6,906	7,168	7,438	7,717
San Bernardino	18,912	19,043	19,502	20,456	21,105	21,783	22,489	23,227	23,997	24,800	25,639
San Diego	19,371	19,929	20,348	20,887	21,377	21,875	22,381	22,897	23,420	23,953	24,495
San Francisco	4,426	4,522	4,590	4,640	4,727	4,817	4,911	5,008	5,109	5,213	5,322
San Joaquin	6,515	6,752	6,988	7,216	7,501	7,797	8,105	8,426	8,759	9,105	9,465
San Luis Obispo	939	972	1,006	1,078	1,119	1,161	1,206	1,253	1,302	1,353	1,408
San Mateo	3,949	3,997	4,045	4,168	4,236	4,305	4,376	4,448	4,522	4,598	4,675
Santa Barbara	4,001	4,070	4,140	4,323	4,413	4,504	4,596	4,690	4,785	4,880	4,977
Santa Clara	5,983	6,298	6,542	6,725	6,912	7,104	7,304	7,510	7,723	7,944	8,172
Santa Cruz	568	569	585	600	608	617	625	634	642	650	659
Solano	2,123	2,171	2,219	2,313	2,396	2,459	2,529	2,591	2,656	2,725	2,791
Sonoma	1,650	1,703	1,819	1,886	1,944	2,004	2,067	2,133	2,202	2,273	2,348
Ventura	4,339	4,433	4,526	4,619	4,713	4,805	4,896	4,986	5,074	5,162	5,248

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:		
	7/11	7/12	7/13	7/14	7/16	7/18	7/20
Alameda	7,725	7,851	7,976	8,321	8,661 (1,732) [416] {208}	9,020 (1,804) [433] {216}	9,397 (1,879) [451] {226}
Contra Costa	4,605	4,661	4,852	5,023	5,374 (1,075) [258] {129}	5,758 (1,152) [276] {138}	6,176 (1,235) [296] {148}
Fresno	8,282	8,440	8,598	8,756	9,278 (1,856) [445] {223}	9,824 (1,965) [472] {236}	10,396 (2,079) [499] {250}
Kern	6,339	6,502	6,631	6,759	7,122 (1,424) [342] {171}	7,516 (1,503) [361] {180}	7,944 (1,589) [381] {191}
Los Angeles	130,242	133,549	136,129	140,307	146,664 (29,333) [7,040] {3,520}	153,393 (30,679) [7,363] {3,681}	160,513 (32,103) [7,705] {3,852}
Marin	3,097	3,171	3,244	3,296	3,410 (682) [164] {82}	3,523 (705) [169] {85}	3,635 (727) [174] {87}
Monterey	2,543	2,666	2,790	2,835	3,041 (608) [146] {73}	3,265 (653) [157] {78}	3,510 (702) [168] {84}
Orange	23,901	24,715	25,255	26,120	28,071 (5,614) [1,347] {674}	30,136 (6,027) [1,447] {723}	32,133 (6,427) [1,542] {771}
Placer	1,055	1,077	1,114	1,151	1,216 (243) [58] {29}	1,283 (257) [62] {31}	1,352 (270) [65] {32}
Riverside	25,093	25,420	25,748	26,481	27,650 (5,530) [1,327] {664}	28,860 (5,772) [1,385] {693}	30,110 (6,022) [1,445] {723}
Sacramento	5,339	5,489	5,714	5,938	6,406 (1,281) [308] {154}	6,906 (1,381) [331] {166}	7,438 (1,488) [357] {179}
San Bernardino	18,912	19,043	19,502	20,456	21,783 (4,357) [1,046] {523}	23,227 (4,645) [1,115] {557}	24,800 (4,960) [1,190] {595}
San Diego	19,371	19,929	20,348	20,887	21,875 (4,375) [1,050] {525}	22,897 (4,579) [1,099] {550}	23,953 (4,791) [1,150] {575}
San Francisco	4,426	4,522	4,590	4,640	4,817 (963) [231] {116}	5,008 (1,002) [240] {120}	5,213 (1,043) [250] {125}
San Joaquin	6,515	6,752	6,988	7,216	7,797 (1,559) [374] {187}	8,426 (1,685) [404] {202}	9,105 (1,821) [437] {219}
San Luis Obispo	939	972	1,006	1,078	1,161 (232) [56] {28}	1,253 (251) [60] {30}	1,353 (271) [65] {32}
San Mateo	3,949	3,997	4,045	4,168	4,305 (861) [207] {103}	4,448 (890) [213] {107}	4,598 (920) [221] {110}
Santa Barbara	4,001	4,070	4,140	4,323	4,504 (901) [216] {108}	4,690 (938) [225] {113}	4,880 (976) [234] {117}
Santa Clara	5,983	6,298	6,542	6,725	7,104 (1,421) [341] {171}	7,510 (1,502) [360] {180}	7,944 (1,589) [381] {191}
Santa Cruz	568	569	585	600	617 (123) [30] {15}	634 (127) [30] {15}	650 (130) [31] {16}
Solano	2,123	2,171	2,219	2,313	2,459 (492) [118] {59}	2,591 (518) [124] {62}	2,725 (545) [131] {65}
Sonoma	1,650	1,703	1,819	1,886	2,004 (401) [96] {48}	2,133 (427) [102] {51}	2,273 (455) [109] {55}
Ventura	4,339	4,433	4,526	4,619	4,805 (961) [231] {115}	4,986 (997) [239] {120}	5,162 (1,032) [248] {124}

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.