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

Date: 9/14/20

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 9/14/20 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.

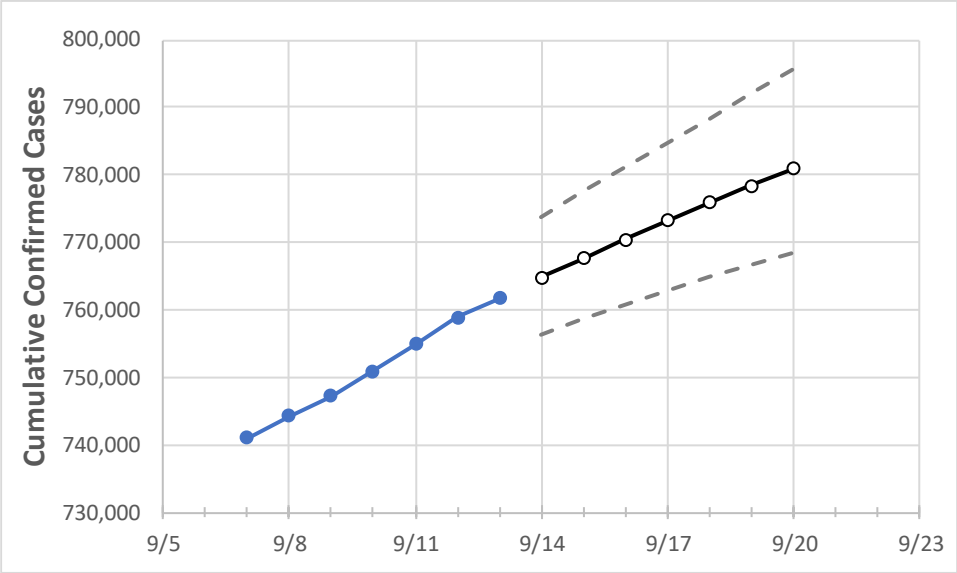
IEM's Modeling Lead

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:						
	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20
California	750,961	754,905	758,933	761,728	764,733	767,648	770,476	773,219	775,880	778,462	780,966

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:						
	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20
Alameda	19,710	19,819	19,837	19,991	20,071	20,147	20,221	20,291	20,358	20,422	20,484
Contra Costa	14,885	14,966	15,058	15,203	15,268	15,331	15,392	15,450	15,507	15,562	15,614
Fresno	26,724	26,783	26,917	27,076	27,167	27,253	27,334	27,411	27,484	27,553	27,618
Kern	30,371	30,440	30,563	30,622	30,681	30,738	30,792	30,843	30,892	30,939	30,984
Los Angeles	251,024	252,066	253,176	253,985	254,687	255,371	256,038	256,687	257,320	257,936	258,537
Marin	6,378	6,407	6,429	6,450	6,467	6,484	6,500	6,515	6,531	6,546	6,560
Monterey	8,698	8,738	8,761	8,904	8,952	8,999	9,044	9,089	9,132	9,174	9,215
Orange	50,471	50,613	50,760	50,930	51,042	51,150	51,253	51,353	51,449	51,542	51,631
Placer	3,249	3,276	3,301	3,316	3,336	3,355	3,374	3,393	3,411	3,429	3,447
Riverside	54,868	55,073	55,073	55,073	55,258	55,441	55,623	55,802	55,979	56,155	56,328
Sacramento	19,669	19,866	20,063	20,184	20,317	20,447	20,575	20,701	20,825	20,947	21,067
San Bernardino	50,210	50,385	50,543	50,699	50,834	50,963	51,085	51,201	51,312	51,416	51,516
San Diego	41,608	41,969	42,414	42,679	42,886	43,092	43,296	43,499	43,700	43,900	44,099
San Francisco	10,120	10,188	10,263	10,302	10,355	10,406	10,457	10,506	10,555	10,603	10,649
San Joaquin	18,780	18,854	19,019	19,108	19,162	19,214	19,264	19,311	19,356	19,399	19,440
San Luis Obispo	3,171	3,194	3,222	3,222	3,240	3,258	3,276	3,294	3,311	3,329	3,346
San Mateo	8,895	8,966	9,077	9,077	9,138	9,199	9,259	9,319	9,379	9,439	9,498
Santa Barbara	8,550	8,579	8,608	8,642	8,671	8,699	8,727	8,754	8,781	8,808	8,833
Santa Clara	18,999	19,143	19,417	19,549	19,684	19,819	19,953	20,086	20,219	20,352	20,484
Santa Cruz	1,993	2,013	2,021	2,043	2,060	2,077	2,095	2,113	2,131	2,149	2,168
Solano	5,805	5,820	5,820	5,820	5,840	5,859	5,877	5,895	5,912	5,928	5,944
Sonoma	6,561	6,623	6,666	6,701	6,745	6,787	6,828	6,868	6,907	6,945	6,982
Ventura	11,538	11,600	11,700	11,759	11,811	11,863	11,913	11,963	12,011	12,058	12,105

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:		
	9/10	9/11	9/12	9/13	9/15	9/17	9/19
Alameda	19,710	19,819	19,837	19,991	20,147 (4,029) [967] {484}	20,291 (4,058) [974] {487}	20,422 (4,084) [980] {490}
Contra Costa	14,885	14,966	15,058	15,203	15,331 (3,066) [736] {368}	15,450 (3,090) [742] {371}	15,562 (3,112) [747] {373}
Fresno	26,724	26,783	26,917	27,076	27,253 (5,451) [1,308] {654}	27,411 (5,482) [1,316] {658}	27,553 (5,511) [1,323] {661}
Kern	30,371	30,440	30,563	30,622	30,738 (6,148) [1,475] {738}	30,843 (6,169) [1,480] {740}	30,939 (6,188) [1,485] {743}
Los Angeles	251,024	252,066	253,176	253,985	255,371 (51,074) [12,258] {6,129}	256,687 (51,337) [12,321] {6,160}	257,936 (51,587) [12,381] {6,190}
Marin	6,378	6,407	6,429	6,450	6,484 (1,297) [311] {156}	6,515 (1,303) [313] {156}	6,546 (1,309) [314] {157}
Monterey	8,698	8,738	8,761	8,904	8,999 (1,800) [432] {216}	9,089 (1,818) [436] {218}	9,174 (1,835) [440] {220}
Orange	50,471	50,613	50,760	50,930	51,150 (10,230) [2,455] {1,228}	51,353 (10,271) [2,465] {1,232}	51,542 (10,308) [2,474] {1,237}
Placer	3,249	3,276	3,301	3,316	3,355 (671) [161] {81}	3,393 (679) [163] {81}	3,429 (686) [165] {82}
Riverside	54,868	55,073	55,073	55,073	55,441 (11,088) [2,661] {1,331}	55,802 (11,160) [2,678] {1,339}	56,155 (11,231) [2,695] {1,348}
Sacramento	19,669	19,866	20,063	20,184	20,447 (4,089) [981] {491}	20,701 (4,140) [994] {497}	20,947 (4,189) [1,005] {503}
San Bernardino	50,210	50,385	50,543	50,699	50,963 (10,193) [2,446] {1,223}	51,201 (10,240) [2,458] {1,229}	51,416 (10,283) [2,468] {1,234}
San Diego	41,608	41,969	42,414	42,679	43,092 (8,618) [2,068] {1,034}	43,499 (8,700) [2,088] {1,044}	43,900 (8,780) [2,107] {1,054}
San Francisco	10,120	10,188	10,263	10,302	10,406 (2,081) [500] {250}	10,506 (2,101) [504] {252}	10,603 (2,121) [509] {254}
San Joaquin	18,780	18,854	19,019	19,108	19,214 (3,843) [922] {461}	19,311 (3,862) [927] {463}	19,399 (3,880) [931] {466}
San Luis Obispo	3,171	3,194	3,222	3,222	3,258 (652) [156] {78}	3,294 (659) [158] {79}	3,329 (666) [160] {80}
San Mateo	8,895	8,966	9,077	9,077	9,199 (1,840) [442] {221}	9,319 (1,864) [447] {224}	9,439 (1,888) [453] {227}
Santa Barbara	8,550	8,579	8,608	8,642	8,699 (1,740) [418] {209}	8,754 (1,751) [420] {210}	8,808 (1,762) [423] {211}
Santa Clara	18,999	19,143	19,417	19,549	19,819 (3,964) [951] {476}	20,086 (4,017) [964] {482}	20,352 (4,070) [977] {488}
Santa Cruz	1,993	2,013	2,021	2,043	2,077 (415) [100] {50}	2,113 (423) [101] {51}	2,149 (430) [103] {52}
Solano	5,805	5,820	5,820	5,820	5,859 (1,172) [281] {141}	5,895 (1,179) [283] {141}	5,928 (1,186) [285] {142}
Sonoma	6,561	6,623	6,666	6,701	6,787 (1,357) [326] {163}	6,868 (1,374) [330] {165}	6,945 (1,389) [333] {167}
Ventura	11,538	11,600	11,700	11,759	11,863 (2,373) [569] {285}	11,963 (2,393) [574] {287}	12,058 (2,412) [579] {289}

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.