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

Date: 9/21/20

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 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 9/21/20 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.

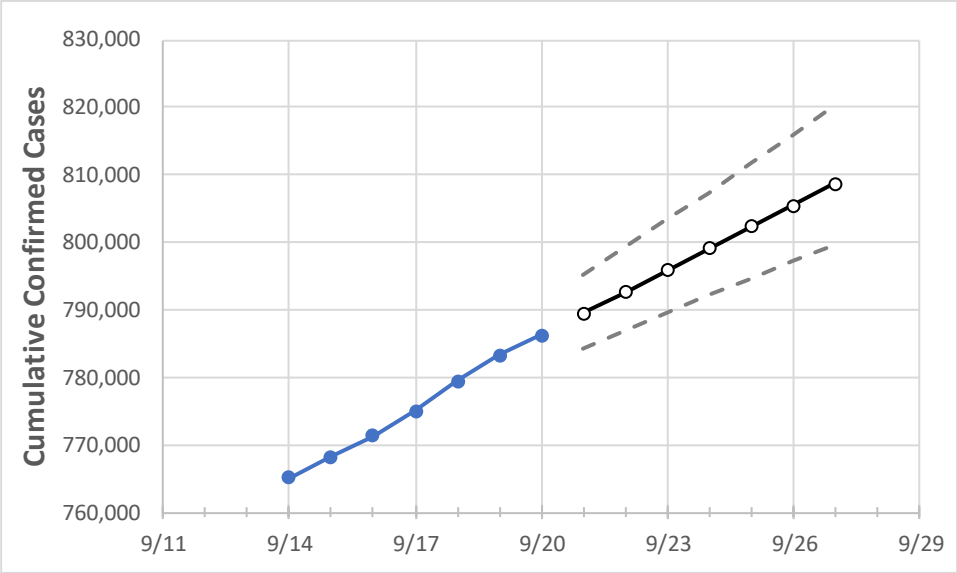
IEM's Modeling Lead

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:						
	9/17	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27
California	775,037	779,491	783,313	786,168	789,421	792,661	795,886	799,096	802,292	805,474	808,640

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:						
	9/17	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27
Alameda	20,162	20,364	20,494	20,558	20,609	20,657	20,704	20,748	20,791	20,832	20,871
Contra Costa	15,544	15,640	15,734	15,837	15,916	15,994	16,071	16,148	16,223	16,298	16,372
Fresno	27,381	27,487	27,560	27,668	27,727	27,783	27,836	27,886	27,934	27,979	28,021
Kern	31,076	31,148	31,261	31,379	31,456	31,532	31,608	31,682	31,755	31,828	31,899
Los Angeles	257,271	258,516	259,817	260,797	261,679	262,565	263,455	264,350	265,249	266,152	267,060
Marin	6,505	6,522	6,557	6,557	6,571	6,585	6,598	6,612	6,625	6,637	6,650
Monterey	9,197	9,337	9,360	9,467	9,514	9,560	9,605	9,650	9,693	9,736	9,778
Orange	51,399	51,646	51,873	52,063	52,210	52,357	52,503	52,648	52,793	52,936	53,079
Placer	3,385	3,407	3,428	3,466	3,482	3,497	3,512	3,527	3,542	3,556	3,570
Riverside	56,374	56,681	56,681	56,681	56,868	57,057	57,248	57,442	57,638	57,836	58,037
Sacramento	20,961	21,171	21,234	21,297	21,418	21,537	21,655	21,770	21,885	21,998	22,109
San Bernardino	51,467	51,750	52,287	52,471	52,608	52,742	52,873	53,002	53,128	53,252	53,373
San Diego	43,619	44,007	44,293	44,577	44,852	45,135	45,426	45,724	46,030	46,345	46,668
San Francisco	10,569	10,640	10,696	10,745	10,802	10,858	10,915	10,971	11,027	11,083	11,139
San Joaquin	19,701	19,793	19,793	19,793	19,867	19,941	20,014	20,087	20,160	20,233	20,306
San Luis Obispo	3,316	3,332	3,360	3,369	3,384	3,398	3,412	3,425	3,439	3,452	3,465
San Mateo	9,332	9,427	9,522	9,522	9,562	9,601	9,639	9,676	9,713	9,748	9,783
Santa Barbara	8,785	8,803	8,846	8,862	8,887	8,911	8,935	8,958	8,981	9,003	9,025
Santa Clara	19,891	20,129	20,252	20,410	20,516	20,622	20,728	20,832	20,937	21,041	21,144
Santa Cruz	2,108	2,175	2,189	2,218	2,242	2,266	2,292	2,318	2,346	2,375	2,405
Solano	6,054	6,085	6,085	6,085	6,109	6,133	6,157	6,180	6,203	6,226	6,248
Sonoma	6,827	6,987	6,998	7,060	7,089	7,118	7,145	7,172	7,197	7,222	7,246
Ventura	12,073	12,167	12,236	12,328	12,391	12,454	12,517	12,580	12,643	12,707	12,770

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:		
	9/17	9/18	9/19	9/20	9/22	9/24	9/26
Alameda	20,162	20,364	20,494	20,558	20,657 (4,131) [992] {496}	20,748 (4,150) [996] {498}	20,832 (4,166) [1,000] {500}
Contra Costa	15,544	15,640	15,734	15,837	15,994 (3,199) [768] {384}	16,148 (3,230) [775] {388}	16,298 (3,260) [782] {391}
Fresno	27,381	27,487	27,560	27,668	27,783 (5,557) [1,334] {667}	27,886 (5,577) [1,339] {669}	27,979 (5,596) [1,343] {671}
Kern	31,076	31,148	31,261	31,379	31,532 (6,306) [1,514] {757}	31,682 (6,336) [1,521] {760}	31,828 (6,366) [1,528] {764}
Los Angeles	257,271	258,516	259,817	260,797	262,565 (52,513) [12,603] {6,302}	264,350 (52,870) [12,689] {6,344}	266,152 (53,230) [12,775] {6,388}
Marin	6,505	6,522	6,557	6,557	6,585 (1,317) [316] {158}	6,612 (1,322) [317] {159}	6,637 (1,327) [319] {159}
Monterey	9,197	9,337	9,360	9,467	9,560 (1,912) [459] {229}	9,650 (1,930) [463] {232}	9,736 (1,947) [467] {234}
Orange	51,399	51,646	51,873	52,063	52,357 (10,471) [2,513] {1,257}	52,648 (10,530) [2,527] {1,264}	52,936 (10,587) [2,541] {1,270}
Placer	3,385	3,407	3,428	3,466	3,497 (699) [168] {84}	3,527 (705) [169] {85}	3,556 (711) [171] {85}
Riverside	56,374	56,681	56,681	56,681	57,057 (11,411) [2,739] {1,369}	57,442 (11,488) [2,757] {1,379}	57,836 (11,567) [2,776] {1,388}
Sacramento	20,961	21,171	21,234	21,297	21,537 (4,307) [1,034] {517}	21,770 (4,354) [1,045] {522}	21,998 (4,400) [1,056] {528}
San Bernardino	51,467	51,750	52,287	52,471	52,742 (10,548) [2,532] {1,266}	53,002 (10,600) [2,544] {1,272}	53,252 (10,650) [2,556] {1,278}
San Diego	43,619	44,007	44,293	44,577	45,135 (9,027) [2,166] {1,083}	45,724 (9,145) [2,195] {1,097}	46,345 (9,269) [2,225] {1,112}
San Francisco	10,569	10,640	10,696	10,745	10,858 (2,172) [521] {261}	10,971 (2,194) [527] {263}	11,083 (2,217) [532] {266}
San Joaquin	19,701	19,793	19,793	19,793	19,941 (3,988) [957] {479}	20,087 (4,017) [964] {482}	20,233 (4,047) [971] {486}
San Luis Obispo	3,316	3,332	3,360	3,369	3,398 (680) [163] {82}	3,425 (685) [164] {82}	3,452 (690) [166] {83}
San Mateo	9,332	9,427	9,522	9,522	9,601 (1,920) [461] {230}	9,676 (1,935) [464] {232}	9,748 (1,950) [468] {234}
Santa Barbara	8,785	8,803	8,846	8,862	8,911 (1,782) [428] {214}	8,958 (1,792) [430] {215}	9,003 (1,801) [432] {216}
Santa Clara	19,891	20,129	20,252	20,410	20,622 (4,124) [990] {495}	20,832 (4,166) [1,000] {500}	21,041 (4,208) [1,010] {505}
Santa Cruz	2,108	2,175	2,189	2,218	2,266 (453) [109] {54}	2,318 (464) [111] {56}	2,375 (475) [114] {57}
Solano	6,054	6,085	6,085	6,085	6,133 (1,227) [294] {147}	6,180 (1,236) [297] {148}	6,226 (1,245) [299] {149}
Sonoma	6,827	6,987	6,998	7,060	7,118 (1,424) [342] {171}	7,172 (1,434) [344] {172}	7,222 (1,444) [347] {173}
Ventura	12,073	12,167	12,236	12,328	12,454 (2,491) [598] {299}	12,580 (2,516) [604] {302}	12,707 (2,541) [610] {305}

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.