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

Date: 9/11/20

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 9/11/20 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.

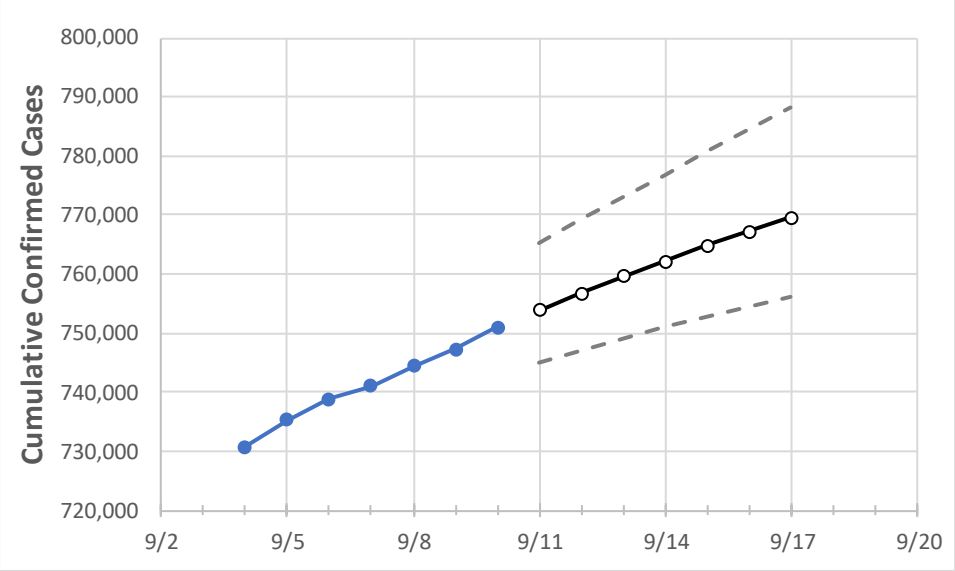
IEM's Modeling Lead

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:						
	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17
California	740,965	744,344	747,290	750,961	753,939	756,806	759,565	762,221	764,776	767,234	769,599

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:						
	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17
Alameda	19,350	19,496	19,596	19,710	19,824	19,936	20,046	20,154	20,259	20,362	20,464
Contra Costa	14,639	14,712	14,740	14,885	14,950	15,013	15,073	15,131	15,186	15,239	15,290
Fresno	26,471	26,565	26,640	26,724	26,832	26,935	27,032	27,123	27,210	27,291	27,368
Kern	30,080	30,179	30,202	30,371	30,438	30,501	30,562	30,619	30,674	30,726	30,775
Los Angeles	248,821	249,241	249,859	251,024	251,632	252,215	252,774	253,309	253,822	254,313	254,784
Marin	6,339	6,354	6,368	6,378	6,394	6,410	6,425	6,440	6,454	6,468	6,481
Monterey	8,570	8,629	8,661	8,698	8,754	8,808	8,861	8,913	8,963	9,013	9,061
Orange	49,845	49,996	50,190	50,471	50,596	50,716	50,831	50,941	51,047	51,148	51,246
Placer	3,201	3,220	3,238	3,249	3,270	3,290	3,311	3,330	3,350	3,368	3,387
Riverside	54,426	54,572	54,735	54,868	55,002	55,132	55,258	55,382	55,502	55,618	55,732
Sacramento	19,128	19,460	19,524	19,669	19,802	19,932	20,060	20,185	20,307	20,427	20,545
San Bernardino	49,691	49,800	49,909	50,210	50,368	50,518	50,660	50,794	50,921	51,042	51,156
San Diego	40,652	40,868	41,324	41,608	41,760	41,906	42,047	42,183	42,313	42,439	42,559
San Francisco	9,979	10,027	10,074	10,120	10,176	10,230	10,283	10,335	10,386	10,436	10,485
San Joaquin	18,558	18,558	18,558	18,558	18,627	18,694	18,759	18,822	18,883	18,942	18,999
San Luis Obispo	3,101	3,116	3,145	3,171	3,187	3,203	3,219	3,233	3,248	3,262	3,275
San Mateo	8,706	8,750	8,807	8,895	8,957	9,018	9,078	9,139	9,199	9,259	9,318
Santa Barbara	8,434	8,479	8,499	8,550	8,579	8,608	8,636	8,664	8,692	8,718	8,745
Santa Clara	18,664	18,717	18,854	18,854	18,977	19,098	19,216	19,332	19,445	19,557	19,666
Santa Cruz	1,947	1,962	1,978	1,993	2,007	2,020	2,035	2,049	2,064	2,080	2,095
Solano	5,739	5,762	5,778	5,805	5,825	5,844	5,862	5,879	5,895	5,910	5,925
Sonoma	6,360	6,488	6,516	6,561	6,609	6,655	6,700	6,744	6,788	6,830	6,871
Ventura	11,315	11,463	11,475	11,475	11,521	11,565	11,608	11,650	11,690	11,730	11,768

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:		
	9/7	9/8	9/9	9/10	9/12	9/14	9/16
Alameda	19,350	19,496	19,596	19,710	19,936 (3,987) [957] {478}	20,154 (4,031) [967] {484}	20,362 (4,072) [977] {489}
Contra Costa	14,639	14,712	14,740	14,885	15,013 (3,003) [721] {360}	15,131 (3,026) [726] {363}	15,239 (3,048) [731] {366}
Fresno	26,471	26,565	26,640	26,724	26,935 (5,387) [1,293] {646}	27,123 (5,425) [1,302] {651}	27,291 (5,458) [1,310] {655}
Kern	30,080	30,179	30,202	30,371	30,501 (6,100) [1,464] {732}	30,619 (6,124) [1,470] {735}	30,726 (6,145) [1,475] {737}
Los Angeles	248,821	249,241	249,859	251,024	252,215 (50,443) [12,106] {6,053}	253,309 (50,662) [12,159] {6,079}	254,313 (50,863) [12,207] {6,104}
Marin	6,339	6,354	6,368	6,378	6,410 (1,282) [308] {154}	6,440 (1,288) [309] {155}	6,468 (1,294) [310] {155}
Monterey	8,570	8,629	8,661	8,698	8,808 (1,762) [423] {211}	8,913 (1,783) [428] {214}	9,013 (1,803) [433] {216}
Orange	49,845	49,996	50,190	50,471	50,716 (10,143) [2,434] {1,217}	50,941 (10,188) [2,445] {1,223}	51,148 (10,230) [2,455] {1,228}
Placer	3,201	3,220	3,238	3,249	3,290 (658) [158] {79}	3,330 (666) [160] {80}	3,368 (674) [162] {81}
Riverside	54,426	54,572	54,735	54,868	55,132 (11,026) [2,646] {1,323}	55,382 (11,076) [2,658] {1,329}	55,618 (11,124) [2,670] {1,335}
Sacramento	19,128	19,460	19,524	19,669	19,932 (3,986) [957] {478}	20,185 (4,037) [969] {484}	20,427 (4,085) [981] {490}
San Bernardino	49,691	49,800	49,909	50,210	50,518 (10,104) [2,425] {1,212}	50,794 (10,159) [2,438] {1,219}	51,042 (10,208) [2,450] {1,225}
San Diego	40,652	40,868	41,324	41,608	41,906 (8,381) [2,011] {1,006}	42,183 (8,437) [2,025] {1,012}	42,439 (8,488) [2,037] {1,019}
San Francisco	9,979	10,027	10,074	10,120	10,230 (2,046) [491] {246}	10,335 (2,067) [496] {248}	10,436 (2,087) [501] {250}
San Joaquin	18,558	18,558	18,558	18,558	18,694 (3,739) [897] {449}	18,822 (3,764) [903] {452}	18,942 (3,788) [909] {455}
San Luis Obispo	3,101	3,116	3,145	3,171	3,203 (641) [154] {77}	3,233 (647) [155] {78}	3,262 (652) [157] {78}
San Mateo	8,706	8,750	8,807	8,895	9,018 (1,804) [433] {216}	9,139 (1,828) [439] {219}	9,259 (1,852) [444] {222}
Santa Barbara	8,434	8,479	8,499	8,550	8,608 (1,722) [413] {207}	8,664 (1,733) [416] {208}	8,718 (1,744) [418] {209}
Santa Clara	18,664	18,717	18,854	18,854	19,098 (3,820) [917] {458}	19,332 (3,866) [928] {464}	19,557 (3,911) [939] {469}
Santa Cruz	1,947	1,962	1,978	1,993	2,020 (404) [97] {48}	2,049 (410) [98] {49}	2,080 (416) [100] {50}
Solano	5,739	5,762	5,778	5,805	5,844 (1,169) [281] {140}	5,879 (1,176) [282] {141}	5,910 (1,182) [284] {142}
Sonoma	6,360	6,488	6,516	6,561	6,655 (1,331) [319] {160}	6,744 (1,349) [324] {162}	6,830 (1,366) [328] {164}
Ventura	11,315	11,463	11,475	11,475	11,565 (2,313) [555] {278}	11,650 (2,330) [559] {280}	11,730 (2,346) [563] {282}

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.