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

Date: 9/23/20

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 9/23/20 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.

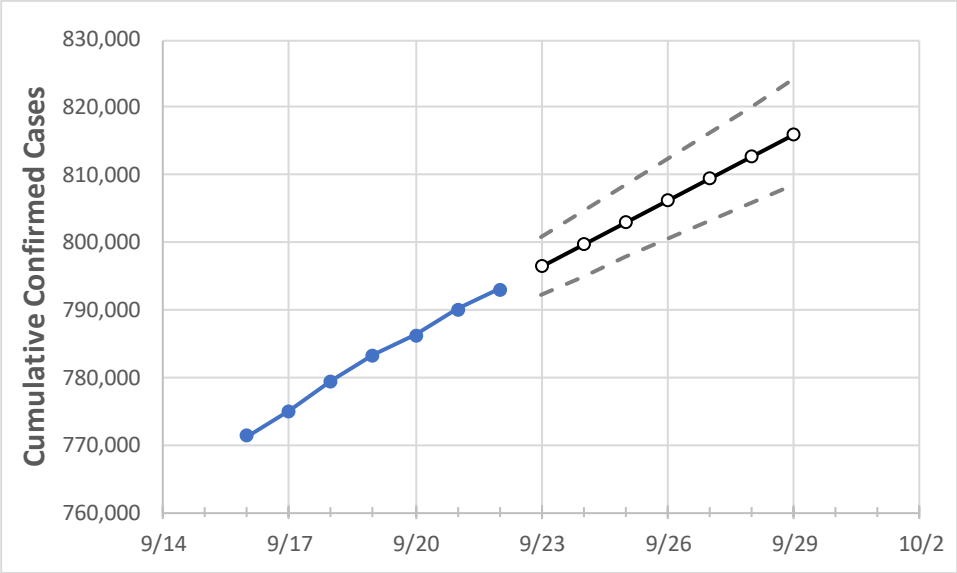
IEM's Modeling Lead

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:						
	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28	9/29
California	783,313	786,168	790,096	793,065	796,360	799,645	802,917	806,176	809,422	812,656	815,877

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

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28	9/29
Alameda	20,494	20,558	20,641	20,748	20,799	20,848	20,896	20,941	20,986	21,028	21,069
Contra Costa	15,734	15,837	15,958	16,056	16,131	16,206	16,279	16,351	16,423	16,493	16,563
Fresno	27,560	27,668	27,769	27,843	27,903	27,961	28,016	28,069	28,120	28,168	28,214
Kern	31,261	31,379	31,509	31,572	31,659	31,746	31,832	31,918	32,004	32,090	32,175
Los Angeles	259,817	260,797	261,446	262,133	262,948	263,760	264,569	265,376	266,180	266,981	267,779
Marin	6,557	6,574	6,591	6,613	6,626	6,639	6,651	6,664	6,676	6,687	6,699
Monterey	9,360	9,467	9,550	9,568	9,610	9,651	9,691	9,731	9,770	9,808	9,845
Orange	51,873	52,063	52,201	52,382	52,533	52,683	52,833	52,982	53,130	53,278	53,426
Placer	3,428	3,466	3,488	3,507	3,523	3,539	3,554	3,569	3,584	3,599	3,613
Riverside	56,927	57,173	57,419	57,482	57,685	57,890	58,095	58,302	58,509	58,717	58,927
Sacramento	21,234	21,297	21,628	21,628	21,737	21,845	21,952	22,058	22,162	22,266	22,368
San Bernardino	52,287	52,471	52,649	52,873	53,018	53,162	53,303	53,442	53,579	53,714	53,846
San Diego	44,293	44,577	44,925	45,147	45,444	45,746	46,053	46,366	46,684	47,008	47,338
San Francisco	10,696	10,745	10,807	10,865	10,923	10,982	11,040	11,098	11,156	11,215	11,273
San Joaquin	19,809	19,825	19,841	20,019	20,066	20,112	20,156	20,198	20,238	20,277	20,314
San Luis Obispo	3,360	3,369	3,393	3,438	3,457	3,476	3,495	3,514	3,533	3,551	3,570
San Mateo	9,522	9,560	9,598	9,625	9,670	9,714	9,757	9,799	9,841	9,882	9,921
Santa Barbara	8,846	8,862	8,880	8,930	8,954	8,978	9,002	9,024	9,047	9,069	9,091
Santa Clara	20,252	20,410	20,511	20,587	20,688	20,787	20,885	20,982	21,077	21,171	21,264
Santa Cruz	2,189	2,218	2,247	2,276	2,302	2,329	2,358	2,387	2,418	2,451	2,485
Solano	6,115	6,145	6,175	6,194	6,221	6,248	6,275	6,302	6,329	6,355	6,382
Sonoma	6,998	7,060	7,112	7,160	7,190	7,219	7,248	7,275	7,302	7,328	7,354
Ventura	12,236	12,328	12,406	12,477	12,543	12,610	12,677	12,744	12,812	12,881	12,949

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:		
	9/19	9/20	9/21	9/22	9/24	9/26	9/28
Alameda	20,494	20,558	20,641	20,748	20,848 (4,170) [1,001] {500}	20,941 (4,188) [1,005] {503}	21,028 (4,206) [1,009] {505}
Contra Costa	15,734	15,837	15,958	16,056	16,206 (3,241) [778] {389}	16,351 (3,270) [785] {392}	16,493 (3,299) [792] {396}
Fresno	27,560	27,668	27,769	27,843	27,961 (5,592) [1,342] {671}	28,069 (5,614) [1,347] {674}	28,168 (5,634) [1,352] {676}
Kern	31,261	31,379	31,509	31,572	31,746 (6,349) [1,524] {762}	31,918 (6,384) [1,532] {766}	32,090 (6,418) [1,540] {770}
Los Angeles	259,817	260,797	261,446	262,133	263,760 (52,752) [12,660] {6,330}	265,376 (53,075) [12,738] {6,369}	266,981 (53,396) [12,815] {6,408}
Marin	6,557	6,574	6,591	6,613	6,639 (1,328) [319] {159}	6,664 (1,333) [320] {160}	6,687 (1,337) [321] {160}
Monterey	9,360	9,467	9,550	9,568	9,651 (1,930) [463] {232}	9,731 (1,946) [467] {234}	9,808 (1,962) [471] {235}
Orange	51,873	52,063	52,201	52,382	52,683 (10,537) [2,529] {1,264}	52,982 (10,596) [2,543] {1,272}	53,278 (10,656) [2,557] {1,279}
Placer	3,428	3,466	3,488	3,507	3,539 (708) [170] {85}	3,569 (714) [171] {86}	3,599 (720) [173] {86}
Riverside	56,927	57,173	57,419	57,482	57,890 (11,578) [2,779] {1,389}	58,302 (11,660) [2,798] {1,399}	58,717 (11,743) [2,818] {1,409}
Sacramento	21,234	21,297	21,628	21,628	21,845 (4,369) [1,049] {524}	22,058 (4,412) [1,059] {529}	22,266 (4,453) [1,069] {534}
San Bernardino	52,287	52,471	52,649	52,873	53,162 (10,632) [2,552] {1,276}	53,442 (10,688) [2,565] {1,283}	53,714 (10,743) [2,578] {1,289}
San Diego	44,293	44,577	44,925	45,147	45,746 (9,149) [2,196] {1,098}	46,366 (9,273) [2,226] {1,113}	47,008 (9,402) [2,256] {1,128}
San Francisco	10,696	10,745	10,807	10,865	10,982 (2,196) [527] {264}	11,098 (2,220) [533] {266}	11,215 (2,243) [538] {269}
San Joaquin	19,809	19,825	19,841	20,019	20,112 (4,022) [965] {483}	20,198 (4,040) [969] {485}	20,277 (4,055) [973] {487}
San Luis Obispo	3,360	3,369	3,393	3,438	3,476 (695) [167] {83}	3,514 (703) [169] {84}	3,551 (710) [170] {85}
San Mateo	9,522	9,560	9,598	9,625	9,714 (1,943) [466] {233}	9,799 (1,960) [470] {235}	9,882 (1,976) [474] {237}
Santa Barbara	8,846	8,862	8,880	8,930	8,978 (1,796) [431] {215}	9,024 (1,805) [433] {217}	9,069 (1,814) [435] {218}
Santa Clara	20,252	20,410	20,511	20,587	20,787 (4,157) [998] {499}	20,982 (4,196) [1,007] {504}	21,171 (4,234) [1,016] {508}
Santa Cruz	2,189	2,218	2,247	2,276	2,329 (466) [112] {56}	2,387 (477) [115] {57}	2,451 (490) [118] {59}
Solano	6,115	6,145	6,175	6,194	6,248 (1,250) [300] {150}	6,302 (1,260) [303] {151}	6,355 (1,271) [305] {153}
Sonoma	6,998	7,060	7,112	7,160	7,219 (1,444) [347] {173}	7,275 (1,455) [349] {175}	7,328 (1,466) [352] {176}
Ventura	12,236	12,328	12,406	12,477	12,610 (2,522) [605] {303}	12,744 (2,549) [612] {306}	12,881 (2,576) [618] {309}

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.