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

Date: 7/10/20

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 7/10/20 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.

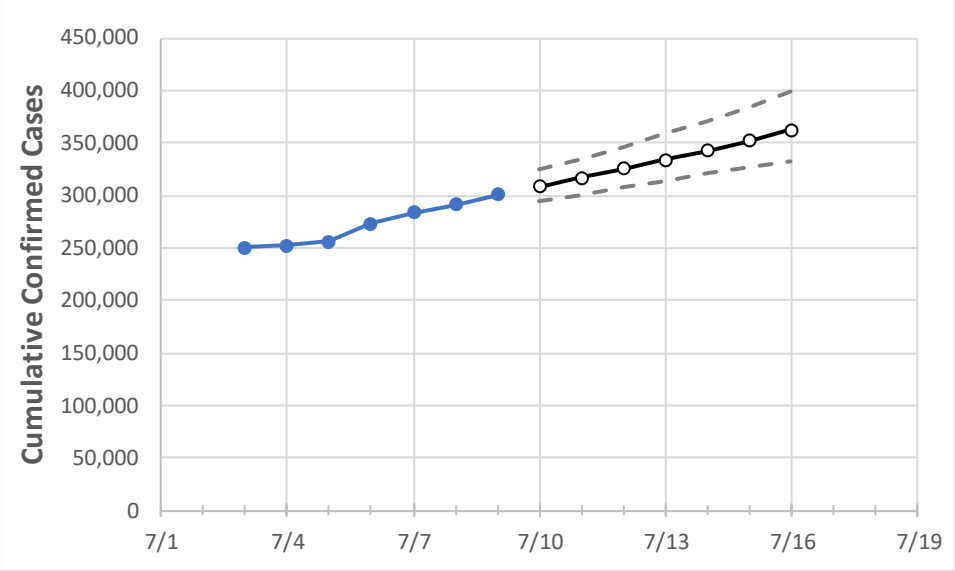
IEM's Modeling Lead

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:						
	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13	7/14	7/15	7/16
California	273,077	283,516	291,356	300,324	308,294	316,528	325,036	333,827	342,910	352,295	361,991

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:						
	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13	7/14	7/15	7/16
Alameda	6,887	7,066	7,245	7,407	7,553	7,702	7,854	8,009	8,168	8,329	8,495
Contra Costa	3,878	4,092	4,241	4,357	4,543	4,742	4,955	5,183	5,427	5,688	5,967
Fresno	6,599	6,924	7,276	7,627	7,971	8,338	8,727	9,142	9,583	10,052	10,552
Kern	5,369	5,543	5,759	5,979	6,142	6,313	6,491	6,676	6,869	7,071	7,281
Los Angeles	116,570	120,539	123,004	124,738	127,379	130,080	132,844	135,670	138,562	141,521	144,547
Marin	2,861	2,881	2,901	2,965	3,035	3,107	3,183	3,263	3,346	3,433	3,523
Monterey	2,151	2,239	2,270	2,343	2,434	2,532	2,635	2,744	2,861	2,984	3,115
Orange	17,882	18,892	20,225	21,517	22,738	23,712	24,650	25,595	26,542	27,596	28,568
Placer	911	938	970	993	1,032	1,073	1,116	1,160	1,207	1,256	1,307
Riverside	20,555	21,101	21,957	23,334	24,056	24,807	25,589	26,404	27,252	28,136	29,057
Sacramento	4,395	4,566	4,776	4,932	5,176	5,370	5,552	5,762	5,951	6,154	6,362
San Bernardino	15,345	15,932	16,586	17,414	18,051	18,719	19,421	20,159	20,933	21,747	22,603
San Diego	17,000	17,578	17,842	18,402	18,906	19,423	19,954	20,498	21,058	21,632	22,223
San Francisco	3,992	4,020	4,071	4,145	4,216	4,289	4,364	4,442	4,522	4,605	4,691
San Joaquin	5,319	5,600	5,817	6,065	6,361	6,675	7,006	7,358	7,730	8,123	8,540
San Luis Obispo	765	808	845	877	913	952	992	1,034	1,077	1,123	1,171
San Mateo	3,599	3,692	3,743	3,787	3,848	3,910	3,974	4,040	4,107	4,176	4,246
Santa Barbara	3,655	3,742	3,808	3,868	3,970	4,075	4,183	4,295	4,411	4,530	4,653
Santa Clara	5,408	5,478	5,552	5,678	5,823	5,954	6,093	6,229	6,369	6,512	6,639
Santa Cruz	459	501	503	506	512	519	525	531	537	543	549
Solano	1,740	1,826	1,922	1,985	2,049	2,114	2,187	2,262	2,339	2,405	2,480
Sonoma	1,430	1,466	1,487	1,519	1,557	1,596	1,636	1,677	1,719	1,762	1,806
Ventura	3,789	3,858	3,976	4,093	4,259	4,372	4,485	4,595	4,726	4,856	4,977

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:		
	7/6	7/7	7/8	7/9	7/11	7/13	7/15
Alameda	6,887	7,066	7,245	7,407	7,702 (1,540) [370] {185}	8,009 (1,602) [384] {192}	8,329 (1,666) [400] {200}
Contra Costa	3,878	4,092	4,241	4,357	4,742 (948) [228] {114}	5,183 (1,037) [249] {124}	5,688 (1,138) [273] {137}
Fresno	6,599	6,924	7,276	7,627	8,338 (1,668) [400] {200}	9,142 (1,828) [439] {219}	10,052 (2,010) [483] {241}
Kern	5,369	5,543	5,759	5,979	6,313 (1,263) [303] {152}	6,676 (1,335) [320] {160}	7,071 (1,414) [339] {170}
Los Angeles	116,570	120,539	123,004	124,738	30,080 (26,016) [6,244] {3,123	35,670 (27,134) [6,512] {3,256	41,521 (28,304) [6,793] {3,397
Marin	2,861	2,881	2,901	2,965	3,107 (621) [149] {75}	3,263 (653) [157] {78}	3,433 (687) [165] {82}
Monterey	2,151	2,239	2,270	2,343	2,532 (506) [122] {61}	2,744 (549) [132] {66}	2,984 (597) [143] {72}
Orange	17,882	18,892	20,225	21,517	23,712 (4,742) [1,138] {569}	25,595 (5,119) [1,229] {614}	27,596 (5,519) [1,325] {662}
Placer	911	938	970	993	1,073 (215) [52] {26}	1,160 (232) [56] {28}	1,256 (251) [60] {30}
Riverside	20,555	21,101	21,957	23,334	24,807 (4,961) [1,191] {595}	26,404 (5,281) [1,267] {634}	28,136 (5,627) [1,351] {675}
Sacramento	4,395	4,566	4,776	4,932	5,370 (1,074) [258] {129}	5,762 (1,152) [277] {138}	6,154 (1,231) [295] {148}
San Bernardino	15,345	15,932	16,586	17,414	18,719 (3,744) [899] {449}	20,159 (4,032) [968] {484}	21,747 (4,349) [1,044] {522}
San Diego	17,000	17,578	17,842	18,402	19,423 (3,885) [932] {466}	20,498 (4,100) [984] {492}	21,632 (4,326) [1,038] {519}
San Francisco	3,992	4,020	4,071	4,145	4,289 (858) [206] {103}	4,442 (888) [213] {107}	4,605 (921) [221] {111}
San Joaquin	5,319	5,600	5,817	6,065	6,675 (1,335) [320] {160}	7,358 (1,472) [353] {177}	8,123 (1,625) [390] {195}
San Luis Obispo	765	808	845	877	952 (190) [46] {23}	1,034 (207) [50] {25}	1,123 (225) [54] {27}
San Mateo	3,599	3,692	3,743	3,787	3,910 (782) [188] {94}	4,040 (808) [194] {97}	4,176 (835) [200] {100}
Santa Barbara	3,655	3,742	3,808	3,868	4,075 (815) [196] {98}	4,295 (859) [206] {103}	4,530 (906) [217] {109}
Santa Clara	5,408	5,478	5,552	5,678	5,954 (1,191) [286] {143}	6,229 (1,246) [299] {149}	6,512 (1,302) [313] {156}
Santa Cruz	459	501	503	506	519 (104) [25] {12}	531 (106) [25] {13}	543 (109) [26] {13}
Solano	1,740	1,826	1,922	1,985	2,114 (423) [101] {51}	2,262 (452) [109] {54}	2,405 (481) [115] {58}
Sonoma	1,430	1,466	1,487	1,519	1,596 (319) [77] {38}	1,677 (335) [80] {40}	1,762 (352) [85] {42}
Ventura	3,789	3,858	3,976	4,093	4,372 (874) [210] {105}	4,595 (919) [221] {110}	4,856 (971) [233] {117}

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.