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

Date: 10/2/20

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 10/2/20 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.

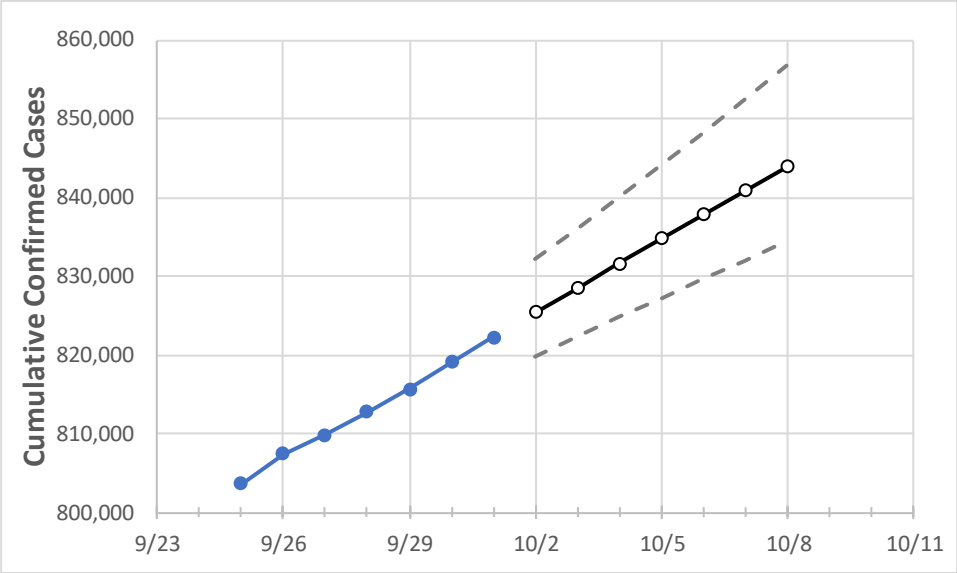
IEM's Modeling Lead

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:						
	9/28	9/29	9/30	10/1	10/2	10/3	10/4	10/5	10/6	10/7	10/8
California	812,711	815,654	819,115	822,205	825,363	828,503	831,623	834,726	837,810	840,877	843,926

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:						
	9/28	9/29	9/30	10/1	10/2	10/3	10/4	10/5	10/6	10/7	10/8
Alameda	21,240	21,323	21,383	21,458	21,531	21,604	21,677	21,749	21,820	21,891	21,961
Contra Costa	16,640	16,702	16,793	16,896	16,989	17,083	17,176	17,270	17,365	17,459	17,554
Fresno	28,441	28,517	28,621	28,706	28,799	28,892	28,986	29,079	29,173	29,266	29,360
Kern	31,994	32,019	32,073	32,128	32,175	32,221	32,264	32,305	32,345	32,383	32,419
Los Angeles	268,455	269,284	270,299	271,371	272,404	273,448	274,501	275,565	276,639	277,724	278,819
Marin	6,730	6,727	6,734	6,742	6,755	6,768	6,781	6,794	6,806	6,819	6,831
Monterey	9,953	10,008	10,050	10,087	10,132	10,177	10,221	10,265	10,308	10,351	10,393
Orange	53,448	53,557	53,751	53,909	54,074	54,239	54,404	54,569	54,735	54,901	55,067
Placer	3,587	3,596	3,604	3,617	3,626	3,636	3,644	3,653	3,661	3,669	3,676
Riverside	58,932	59,173	59,405	59,488	59,688	59,888	60,088	60,288	60,487	60,687	60,887
Sacramento	22,356	22,438	22,590	22,654	22,736	22,816	22,894	22,970	23,044	23,116	23,186
San Bernardino	54,482	54,849	55,203	55,394	55,547	55,698	55,849	55,998	56,146	56,293	56,439
San Diego	46,734	46,985	47,180	47,485	47,749	48,014	48,280	48,547	48,816	49,086	49,357
San Francisco	11,195	11,238	11,275	11,332	11,380	11,427	11,474	11,521	11,567	11,612	11,657
San Joaquin	20,245	20,357	20,411	20,457	20,487	20,515	20,543	20,570	20,596	20,621	20,645
San Luis Obispo	3,562	3,597	3,612	3,629	3,645	3,661	3,676	3,692	3,707	3,722	3,737
San Mateo	9,897	9,950	9,990	10,069	10,111	10,153	10,194	10,234	10,274	10,314	10,353
Santa Barbara	9,090	9,133	9,164	9,197	9,226	9,255	9,285	9,314	9,344	9,374	9,404
Santa Clara	21,241	21,294	21,379	21,457	21,542	21,626	21,708	21,788	21,867	21,945	22,022
Santa Cruz	2,360	2,379	2,394	2,423	2,436	2,449	2,462	2,475	2,488	2,500	2,512
Solano	6,400	6,419	6,445	6,475	6,504	6,532	6,561	6,589	6,618	6,647	6,675
Sonoma	7,467	7,523	7,578	7,578	7,620	7,661	7,703	7,745	7,787	7,829	7,872
Ventura	12,775	12,812	12,875	12,968	13,018	13,067	13,115	13,163	13,210	13,256	13,302

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:		
	9/28	9/29	9/30	10/1	10/3	10/5	10/7
Alameda	21,240	21,323	21,383	21,458	21,604 (4,321) [1,037] {519}	21,749 (4,350) [1,044] {522}	21,891 (4,378) [1,051] {525}
Contra Costa	16,640	16,702	16,793	16,896	17,083 (3,417) [820] {410}	17,270 (3,454) [829] {414}	17,459 (3,492) [838] {419}
Fresno	28,441	28,517	28,621	28,706	28,892 (5,778) [1,387] {693}	29,079 (5,816) [1,396] {698}	29,266 (5,853) [1,405] {702}
Kern	31,994	32,019	32,073	32,128	32,221 (6,444) [1,547] {773}	32,305 (6,461) [1,551] {775}	32,383 (6,477) [1,554] {777}
Los Angeles	268,455	269,284	270,299	271,371	273,448 (54,690) [13,125] {6,563}	275,565 (55,113) [13,227] {6,614}	277,724 (55,545) [13,331] {6,665}
Marin	6,730	6,727	6,734	6,742	6,768 (1,354) [325] {162}	6,794 (1,359) [326] {163}	6,819 (1,364) [327] {164}
Monterey	9,953	10,008	10,050	10,087	10,177 (2,035) [488] {244}	10,265 (2,053) [493] {246}	10,351 (2,070) [497] {248}
Orange	53,448	53,557	53,751	53,909	54,239 (10,848) [2,603] {1,302}	54,569 (10,914) [2,619] {1,310}	54,901 (10,980) [2,635] {1,318}
Placer	3,587	3,596	3,604	3,617	3,636 (727) [175] {87}	3,653 (731) [175] {88}	3,669 (734) [176] {88}
Riverside	58,932	59,173	59,405	59,488	59,888 (11,978) [2,875] {1,437}	60,288 (12,058) [2,894] {1,447}	60,687 (12,137) [2,913] {1,456}
Sacramento	22,356	22,438	22,590	22,654	22,816 (4,563) [1,095] {548}	22,970 (4,594) [1,103] {551}	23,116 (4,623) [1,110] {555}
San Bernardino	54,482	54,849	55,203	55,394	55,698 (11,140) [2,674] {1,337}	55,998 (11,200) [2,688] {1,344}	56,293 (11,259) [2,702] {1,351}
San Diego	46,734	46,985	47,180	47,485	48,014 (9,603) [2,305] {1,152}	48,547 (9,709) [2,330] {1,165}	49,086 (9,817) [2,356] {1,178}
San Francisco	11,195	11,238	11,275	11,332	11,427 (2,285) [549] {274}	11,521 (2,304) [553] {276}	11,612 (2,322) [557] {279}
San Joaquin	20,245	20,357	20,411	20,457	20,515 (4,103) [985] {492}	20,570 (4,114) [987] {494}	20,621 (4,124) [990] {495}
San Luis Obispo	3,562	3,597	3,612	3,629	3,661 (732) [176] {88}	3,692 (738) [177] {89}	3,722 (744) [179] {89}
San Mateo	9,897	9,950	9,990	10,069	10,153 (2,031) [487] {244}	10,234 (2,047) [491] {246}	10,314 (2,063) [495] {248}
Santa Barbara	9,090	9,133	9,164	9,197	9,255 (1,851) [444] {222}	9,314 (1,863) [447] {224}	9,374 (1,875) [450] {225}
Santa Clara	21,241	21,294	21,379	21,457	21,626 (4,325) [1,038] {519}	21,788 (4,358) [1,046] {523}	21,945 (4,389) [1,053] {527}
Santa Cruz	2,360	2,379	2,394	2,423	2,449 (490) [118] {59}	2,475 (495) [119] {59}	2,500 (500) [120] {60}
Solano	6,400	6,419	6,445	6,475	6,532 (1,306) [314] {157}	6,589 (1,318) [316] {158}	6,647 (1,329) [319] {160}
Sonoma	7,467	7,523	7,578	7,578	7,661 (1,532) [368] {184}	7,745 (1,549) [372] {186}	7,829 (1,566) [376] {188}
Ventura	12,775	12,812	12,875	12,968	13,067 (2,613) [627] {314}	13,163 (2,633) [632] {316}	13,256 (2,651) [636] {318}

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.