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

Date: 12/1/20

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 12/1/20 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.

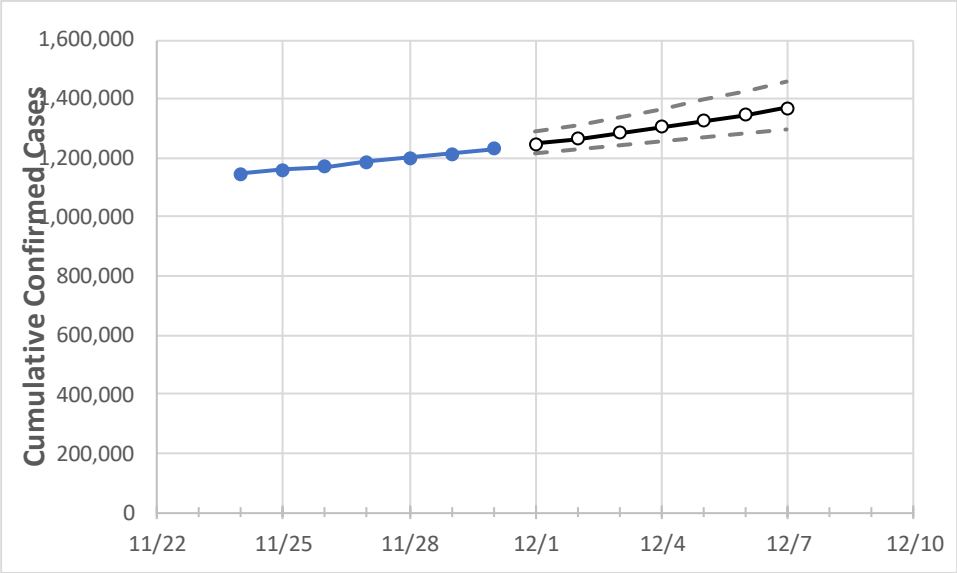
IEM's Modeling Lead

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
California	1,185,576	1,200,624	1,215,455	1,230,264	1,247,890	1,266,189	1,285,188	1,304,912	1,325,387	1,346,643	1,368,706

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Alameda	28,857	29,116	29,476	29,918	30,221	30,537	30,864	31,205	31,559	31,926	32,308
Contra Costa	23,571	23,733	23,895	24,275	24,507	24,745	24,989	25,239	25,494	25,756	26,024
Fresno	37,724	37,994	38,288	38,568	38,936	39,313	39,700	40,098	40,506	40,925	41,354
Kern	40,337	40,632	41,328	41,827	42,342	42,888	43,468	44,083	44,737	45,430	46,166
Los Angeles	387,793	390,891	395,843	400,919	406,226	411,735	417,452	423,387	429,546	435,938	442,571
Marin	7,666	7,704	7,755	7,777	7,807	7,839	7,871	7,905	7,939	7,975	8,011
Monterey	14,750	14,753	15,328	15,621	15,681	15,740	15,800	15,859	15,919	15,978	16,038
Orange	75,095	76,761	77,819	78,553	79,908	81,352	82,892	84,533	86,283	88,148	90,135
Placer	6,354	6,426	6,497	6,622	6,715	6,811	6,910	7,012	7,117	7,225	7,337
Riverside	85,774	85,769	86,854	87,383	88,534	89,739	90,998	92,316	93,693	95,133	96,639
Sacramento	35,854	36,579	36,905	37,415	37,896	38,387	38,890	39,403	39,928	40,464	41,012
San Bernardino	90,222	92,164	93,019	93,671	94,399	95,125	95,848	96,570	97,289	98,007	98,722
San Diego	76,359	80,018	81,084	82,043	82,853	83,683	84,536	85,410	86,308	87,229	88,174
San Francisco	15,156	15,377	15,450	15,571	15,709	15,849	15,993	16,139	16,289	16,441	16,597
San Joaquin	25,738	25,741	25,742	25,740	25,781	25,820	25,859	25,896	25,933	25,969	26,004
San Luis Obispo	5,964	6,129	6,137	6,145	6,173	6,201	6,227	6,253	6,278	6,302	6,326
San Mateo	13,715	14,148	14,303	14,458	14,513	14,567	14,620	14,673	14,725	14,776	14,827
Santa Barbara	11,277	11,340	11,481	11,520	11,594	11,670	11,749	11,831	11,915	12,003	12,094
Santa Clara	32,985	33,732	34,292	35,085	35,723	36,395	37,103	37,848	38,633	39,459	40,329
Santa Cruz	4,269	4,358	4,426	4,490	4,596	4,708	4,829	4,957	5,095	5,241	5,398
Solano	10,041	10,044	10,252	10,648	10,671	10,694	10,716	10,738	10,758	10,778	10,798
Sonoma	11,922	12,049	12,198	12,319	12,408	12,500	12,595	12,693	12,793	12,896	13,002
Ventura	19,058	19,379	19,510	19,952	20,226	20,511	20,808	21,117	21,439	21,774	22,123

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:		
	11/27	11/28	11/29	11/30	12/2	12/4	12/6
Alameda	28,857	29,116	29,476	29,918	30,537 (6,107) [1,466] {733}	31,205 (6,241) [1,498] {749}	31,926 (6,385) [1,532] {766}
Contra Costa	23,571	23,733	23,895	24,275	24,745 (4,949) [1,188] {594}	25,239 (5,048) [1,211] {606}	25,756 (5,151) [1,236] {618}
Fresno	37,724	37,994	38,288	38,568	39,313 (7,863) [1,887] {944}	40,098 (8,020) [1,925] {962}	40,925 (8,185) [1,964] {982}
Kern	40,337	40,632	41,328	41,827	42,888 (8,578) [2,059] {1,029}	44,083 (8,817) [2,116] {1,058}	45,430 (9,086) [2,181] {1,090}
Los Angeles	387,793	390,891	395,843	400,919	411,735 (82,347) [19,763] {9,882}	423,387 (84,677) [20,323] {10,161}	435,938 (87,188) [20,925] {10,463}
Marin	7,666	7,704	7,755	7,777	7,839 (1,568) [376] {188}	7,905 (1,581) [379] {190}	7,975 (1,595) [383] {191}
Monterey	14,750	14,753	15,328	15,621	15,740 (3,148) [756] {378}	15,859 (3,172) [761] {381}	15,978 (3,196) [767] {383}
Orange	75,095	76,761	77,819	78,553	81,352 (16,270) [3,905] {1,952}	84,533 (16,907) [4,058] {2,029}	88,148 (17,630) [4,231] {2,116}
Placer	6,354	6,426	6,497	6,622	6,811 (1,362) [327] {163}	7,012 (1,402) [337] {168}	7,225 (1,445) [347] {173}
Riverside	85,774	85,769	86,854	87,383	89,739 (17,948) [4,307] {2,154}	92,316 (18,463) [4,431] {2,216}	95,133 (19,027) [4,566] {2,283}
Sacramento	35,854	36,579	36,905	37,415	38,387 (7,677) [1,843] {921}	39,403 (7,881) [1,891] {946}	40,464 (8,093) [1,942] {971}
San Bernardino	90,222	92,164	93,019	93,671	95,125 (19,025) [4,566] {2,283}	96,570 (19,314) [4,635] {2,318}	98,007 (19,601) [4,704] {2,352}
San Diego	76,359	80,018	81,084	82,043	83,683 (16,737) [4,017] {2,008}	85,410 (17,082) [4,100] {2,050}	87,229 (17,446) [4,187] {2,093}
San Francisco	15,156	15,377	15,450	15,571	15,849 (3,170) [761] {380}	16,139 (3,228) [775] {387}	16,441 (3,288) [789] {395}
San Joaquin	25,738	25,741	25,742	25,740	25,820 (5,164) [1,239] {620}	25,896 (5,179) [1,243] {622}	25,969 (5,194) [1,247] {623}
San Luis Obispo	5,964	6,129	6,137	6,145	6,201 (1,240) [298] {149}	6,253 (1,251) [300] {150}	6,302 (1,260) [303] {151}
San Mateo	13,715	14,148	14,303	14,458	14,567 (2,913) [699] {350}	14,673 (2,935) [704] {352}	14,776 (2,955) [709] {355}
Santa Barbara	11,277	11,340	11,481	11,520	11,670 (2,334) [560] {280}	11,831 (2,366) [568] {284}	12,003 (2,401) [576] {288}
Santa Clara	32,985	33,732	34,292	35,085	36,395 (7,279) [1,747] {873}	37,848 (7,570) [1,817] {908}	39,459 (7,892) [1,894] {947}
Santa Cruz	4,269	4,358	4,426	4,490	4,708 (942) [226] {113}	4,957 (991) [238] {119}	5,241 (1,048) [252] {126}
Solano	10,041	10,044	10,252	10,648	10,694 (2,139) [513] {257}	10,738 (2,148) [515] {258}	10,778 (2,156) [517] {259}
Sonoma	11,922	12,049	12,198	12,319	12,500 (2,500) [600] {300}	12,693 (2,539) [609] {305}	12,896 (2,579) [619] {309}
Ventura	19,058	19,379	19,510	19,952	20,511 (4,102) [985] {492}	21,117 (4,223) [1,014] {507}	21,774 (4,355) [1,045] {523}

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.