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

Date: 9/8/20

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 9/8/20 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.

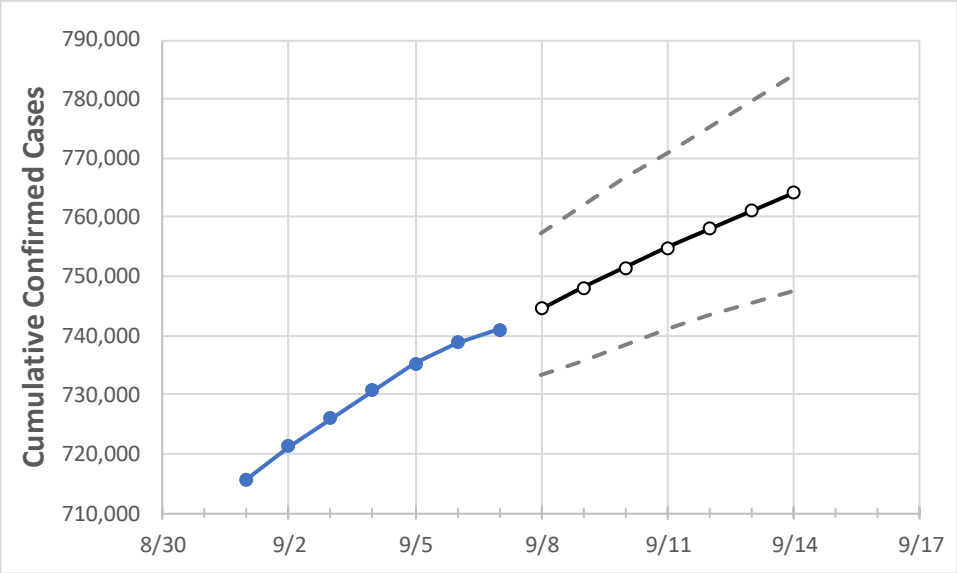
IEM's Modeling Lead

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:						
	9/4	9/5	9/6	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14
California	730,662	735,314	738,856	740,965	744,572	748,078	751,485	754,795	758,012	761,138	764,175

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:						
	9/4	9/5	9/6	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14
Alameda	18,977	19,131	19,241	19,350	19,494	19,636	19,777	19,917	20,056	20,193	20,329
Contra Costa	14,212	14,411	14,527	14,639	14,724	14,807	14,888	14,966	15,042	15,115	15,186
Fresno	25,978	26,147	26,325	26,471	26,631	26,786	26,935	27,080	27,219	27,354	27,484
Kern	29,763	29,858	30,040	30,080	30,158	30,233	30,304	30,371	30,436	30,497	30,555
Los Angeles	246,407	247,542	248,334	248,821	249,747	250,654	251,543	252,414	253,268	254,105	254,926
Marin	6,285	6,297	6,310	6,339	6,366	6,394	6,422	6,450	6,478	6,506	6,534
Monterey	8,244	8,326	8,439	8,570	8,653	8,736	8,819	8,902	8,986	9,069	9,153
Orange	49,258	49,509	49,732	49,845	49,984	50,118	50,246	50,370	50,488	50,602	50,712
Placer	3,115	3,154	3,182	3,182	3,209	3,236	3,263	3,290	3,316	3,343	3,370
Riverside	53,987	53,987	53,987	53,987	54,195	54,399	54,598	54,794	54,985	55,173	55,357
Sacramento	18,813	18,884	18,955	19,128	19,294	19,460	19,628	19,796	19,965	20,135	20,306
San Bernardino	48,970	49,325	49,558	49,691	49,906	50,112	50,310	50,500	50,682	50,857	51,025
San Diego	39,899	40,342	40,650	40,652	40,783	40,908	41,026	41,137	41,243	41,343	41,438
San Francisco	9,755	9,839	9,915	9,979	10,043	10,106	10,169	10,231	10,292	10,353	10,413
San Joaquin	18,331	18,438	18,557	18,558	18,625	18,689	18,751	18,810	18,867	18,922	18,975
San Luis Obispo	3,047	3,074	3,083	3,101	3,121	3,140	3,159	3,178	3,196	3,215	3,233
San Mateo	8,452	8,617	8,617	8,617	8,676	8,734	8,791	8,848	8,904	8,959	9,014
Santa Barbara	8,300	8,361	8,404	8,434	8,472	8,509	8,547	8,584	8,620	8,656	8,692
Santa Clara	18,190	18,401	18,611	18,611	18,798	18,987	19,180	19,375	19,574	19,775	19,980
Santa Cruz	1,896	1,923	1,931	1,931	1,945	1,959	1,973	1,987	2,001	2,015	2,030
Solano	5,671	5,671	5,671	5,671	5,705	5,739	5,772	5,805	5,838	5,870	5,902
Sonoma	6,196	6,249	6,303	6,360	6,416	6,472	6,526	6,580	6,633	6,685	6,737
Ventura	11,109	11,171	11,254	11,315	11,389	11,462	11,535	11,607	11,679	11,750	11,821

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:		
	9/4	9/5	9/6	9/7	9/9	9/11	9/13
Alameda	18,977	19,131	19,241	19,350	19,636 (3,927) [943] {471}	19,917 (3,983) [956] {478}	20,193 (4,039) [969] {485}
Contra Costa	14,212	14,411	14,527	14,639	14,807 (2,961) [711] {355}	14,966 (2,993) [718] {359}	15,115 (3,023) [726] {363}
Fresno	25,978	26,147	26,325	26,471	26,786 (5,357) [1,286] {643}	27,080 (5,416) [1,300] {650}	27,354 (5,471) [1,313] {657}
Kern	29,763	29,858	30,040	30,080	30,233 (6,047) [1,451] {726}	30,371 (6,074) [1,458] {729}	30,497 (6,099) [1,464] {732}
Los Angeles	246,407	247,542	248,334	248,821	250,654 (50,131) [12,031] {6,016}	252,414 (50,483) [12,116] {6,058}	254,105 (50,821) [12,197] {6,099}
Marin	6,285	6,297	6,310	6,339	6,394 (1,279) [307] {153}	6,450 (1,290) [310] {155}	6,506 (1,301) [312] {156}
Monterey	8,244	8,326	8,439	8,570	8,736 (1,747) [419] {210}	8,902 (1,780) [427] {214}	9,069 (1,814) [435] {218}
Orange	49,258	49,509	49,732	49,845	50,118 (10,024) [2,406] {1,203}	50,370 (10,074) [2,418] {1,209}	50,602 (10,120) [2,429] {1,214}
Placer	3,115	3,154	3,182	3,182	3,236 (647) [155] {78}	3,290 (658) [158] {79}	3,343 (669) [160] {80}
Riverside	53,987	53,987	53,987	53,987	54,399 (10,880) [2,611] {1,306}	54,794 (10,959) [2,630] {1,315}	55,173 (11,035) [2,648] {1,324}
Sacramento	18,813	18,884	18,955	19,128	19,460 (3,892) [934] {467}	19,796 (3,959) [950] {475}	20,135 (4,027) [967] {483}
San Bernardino	48,970	49,325	49,558	49,691	50,112 (10,022) [2,405] {1,203}	50,500 (10,100) [2,424] {1,212}	50,857 (10,171) [2,441] {1,221}
San Diego	39,899	40,342	40,650	40,652	40,908 (8,182) [1,964] {982}	41,137 (8,227) [1,975] {987}	41,343 (8,269) [1,984] {992}
San Francisco	9,755	9,839	9,915	9,979	10,106 (2,021) [485] {243}	10,231 (2,046) [491] {246}	10,353 (2,071) [497] {248}
San Joaquin	18,331	18,438	18,557	18,558	18,689 (3,738) [897] {449}	18,810 (3,762) [903] {451}	18,922 (3,784) [908] {454}
San Luis Obispo	3,047	3,074	3,083	3,101	3,140 (628) [151] {75}	3,178 (636) [153] {76}	3,215 (643) [154] {77}
San Mateo	8,452	8,617	8,617	8,617	8,734 (1,747) [419] {210}	8,848 (1,770) [425] {212}	8,959 (1,792) [430] {215}
Santa Barbara	8,300	8,361	8,404	8,434	8,509 (1,702) [408] {204}	8,584 (1,717) [412] {206}	8,656 (1,731) [416] {208}
Santa Clara	18,190	18,401	18,611	18,611	18,987 (3,797) [911] {456}	19,375 (3,875) [930] {465}	19,775 (3,955) [949] {475}
Santa Cruz	1,896	1,923	1,931	1,931	1,959 (392) [94] {47}	1,987 (397) [95] {48}	2,015 (403) [97] {48}
Solano	5,671	5,671	5,671	5,671	5,739 (1,148) [275] {138}	5,805 (1,161) [279] {139}	5,870 (1,174) [282] {141}
Sonoma	6,196	6,249	6,303	6,360	6,472 (1,294) [311] {155}	6,580 (1,316) [316] {158}	6,685 (1,337) [321] {160}
Ventura	11,109	11,171	11,254	11,315	11,462 (2,292) [550] {275}	11,607 (2,321) [557] {279}	11,750 (2,350) [564] {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.