IEM's AI Modeling: Short-term COVID-19 Projections
Date: 9/22/20

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 <u>not</u> 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 9/22/20 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
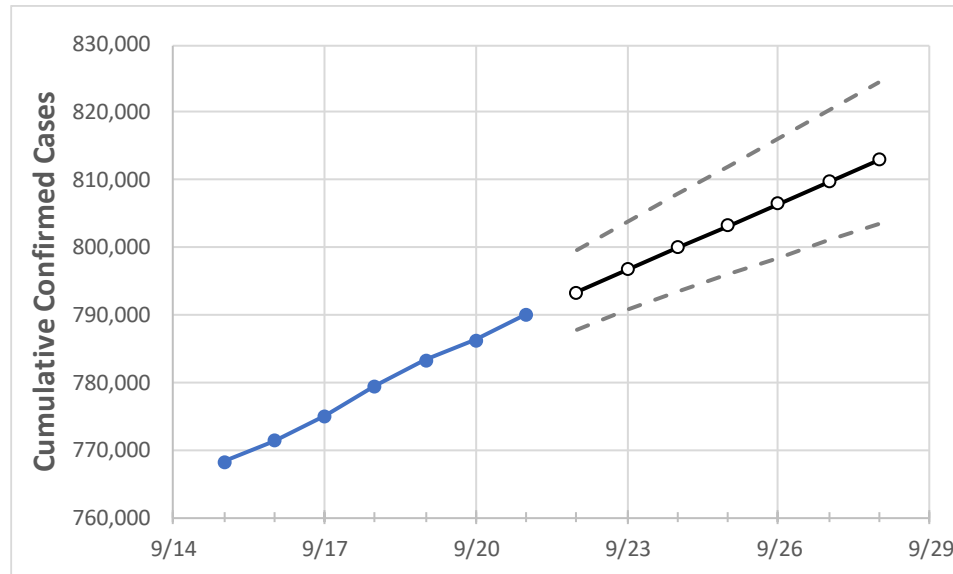
	Actual Confirmed Cases On:				Projected Cases For:						
	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28
California	779,491	783,313	786,168	790,096	793,402	796,692	799,968	803,229	806,474	809,705	812,922

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:						
	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28
Alameda	20,364	20,494	20,558	20,641	20,691	20,740	20,786	20,830	20,873	20,914	20,953
Contra Costa	15,640	15,734	15,837	15,958	16,039	16,120	16,200	16,279	16,358	16,436	16,513
Fresno	27,487	27,560	27,668	27,769	27,830	27,887	27,942	27,995	28,044	28,092	28,137
Kern	31,148	31,261	31,379	31,509	31,596	31,682	31,767	31,852	31,937	32,021	32,104
Los Angeles	258,516	259,817	260,797	261,446	262,280	263,113	263,946	264,779	265,611	266,443	267,274
Marin	6,522	6,557	6,574	6,591	6,604	6,617	6,630	6,643	6,655	6,667	6,679
Monterey	9,337	9,360	9,467	9,550	9,599	9,648	9,697	9,744	9,792	9,838	9,885
Orange	51,646	51,873	52,063	52,201	52,347	52,493	52,637	52,781	52,923	53,064	53,205
Placer	3,407	3,428	3,466	3,488	3,503	3,518	3,533	3,548	3,562	3,576	3,589
Riverside	56,681	56,927	57,173	57,419	57,687	57,965	58,251	58,547	58,853	59,169	59,495
Sacramento	21,171	21,234	21,297	21,628	21,766	21,905	22,043	22,181	22,319	22,458	22,596
San Bernardino	51,750	52,287	52,471	52,649	52,793	52,934	53,072	53,209	53,343	53,474	53,603
San Diego	44,007	44,293	44,577	44,925	45,227	45,535	45,849	46,169	46,497	46,830	47,170
San Francisco	10,640	10,696	10,745	10,807	10,866	10,926	10,985	11,045	11,105	11,165	11,225
San Joaquin	19,793	19,809	19,825	19,841	19,881	19,920	19,957	19,992	20,025	20,056	20,086
San Luis Obispo	3,332	3,360	3,369	3,393	3,409	3,424	3,440	3,455	3,470	3,485	3,500
San Mateo	9,427	9,522	9,560	9,598	9,648	9,697	9,745	9,793	9,840	9,886	9,931
Santa Barbara	8,803	8,846	8,862	8,880	8,902	8,924	8,945	8,965	8,984	9,003	9,022
Santa Clara	20,129	20,252	20,410	20,511	20,616	20,719	20,822	20,925	21,026	21,126	21,226
Santa Cruz	2,175	2,189	2,218	2,218	2,242	2,266	2,291	2,318	2,345	2,374	2,404
Solano	6,085	6,115	6,145	6,175	6,204	6,232	6,261	6,289	6,318	6,346	6,375
Sonoma	6,987	6,998	7,060	7,112	7,142	7,171	7,199	7,227	7,253	7,279	7,304
Ventura	12,167	12,236	12,328	12,406	12,471	12,536	12,601	12,666	12,731	12,797	12,862

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:		
	9/18	9/19	9/20	9/21	9/23	9/25	9/27
Alameda	20,364	20,494	20,558	20,641	20,740 (4,148) [995] {498}	20,830 (4,166) [1,000] {500}	20,914 (4,183) [1,004] {502}
Contra Costa	15,640	15,734	15,837	15,958	16,120 (3,224) [774] {387}	16,279 (3,256) [781] {391}	16,436 (3,287) [789] {394}
Fresno	27,487	27,560	27,668	27,769	27,887 (5,577) [1,339] {669}	27,995 (5,599) [1,344] {672}	28,092 (5,618) [1,348] {674}
Kern	31,148	31,261	31,379	31,509	31,682 (6,336) [1,521] {760}	31,852 (6,370) [1,529] {764}	32,021 (6,404) [1,537] {768}
Los Angeles	258,516	259,817	260,797	261,446	263,113 (52,623) [12,629] {6,315}	264,779 (52,956) [12,709] {6,355}	266,443 (53,289) [12,789] {6,395}
Marin	6,522	6,557	6,574	6,591	6,617 (1,323) [318] {159}	6,643 (1,329) [319] {159}	6,667 (1,333) [320] {160}
Monterey	9,337	9,360	9,467	9,550	9,648 (1,930) [463] {232}	9,744 (1,949) [468] {234}	9,838 (1,968) [472] {236}
Orange	51,646	51,873	52,063	52,201	52,493 (10,499) [2,520] {1,260}	52,781 (10,556) [2,533] {1,267}	53,064 (10,613) [2,547] {1,274}
Placer	3,407	3,428	3,466	3,488	3,518 (704) [169] {84}	3,548 (710) [170] {85}	3,576 (715) [172] {86}
Riverside	56,681	56,927	57,173	57,419	57,965 (11,593) [2,782] {1,391}	58,547 (11,709) [2,810] {1,405}	59,169 (11,834) [2,840] {1,420}
Sacramento	21,171	21,234	21,297	21,628	21,905 (4,381) [1,051] {526}	22,181 (4,436) [1,065] {532}	22,458 (4,492) [1,078] {539}
San Bernardino	51,750	52,287	52,471	52,649	52,934 (10,587) [2,541] {1,270}	53,209 (10,642) [2,554] {1,277}	53,474 (10,695) [2,567] {1,283}
San Diego	44,007	44,293	44,577	44,925	45,535 (9,107) [2,186] {1,093}	46,169 (9,234) [2,216] {1,108}	46,830 (9,366) [2,248] {1,124}
San Francisco	10,640	10,696	10,745	10,807	10,926 (2,185) [524] {262}	11,045 (2,209) [530] {265}	11,165 (2,233) [536] {268}
San Joaquin	19,793	19,809	19,825	19,841	19,920 (3,984) [956] {478}	19,992 (3,998) [960] {480}	20,056 (4,011) [963] {481}
San Luis Obispo	3,332	3,360	3,369	3,393	3,424 (685) [164] {82}	3,455 (691) [166] {83}	3,485 (697) [167] {84}
San Mateo	9,427	9,522	9,560	9,598	9,697 (1,939) [465] {233}	9,793 (1,959) [470] {235}	9,886 (1,977) [475] {237}
Santa Barbara	8,803	8,846	8,862	8,880	8,924 (1,785) [428] {214}	8,965 (1,793) [430] {215}	9,003 (1,801) [432] {216}
Santa Clara	20,129	20,252	20,410	20,511	20,719 (4,144) [995] {497}	20,925 (4,185) [1,004] {502}	21,126 (4,225) [1,014] {507}
Santa Cruz	2,175	2,189	2,218	2,218	2,266 (453) [109] {54}	2,318 (464) [111] {56}	2,374 (475) [114] {57}
Solano	6,085	6,115	6,145	6,175	6,232 (1,246) [299] {150}	6,289 (1,258) [302] {151}	6,346 (1,269) [305] {152}
Sonoma	6,987	6,998	7,060	7,112	7,171 (1,434) [344] {172}	7,227 (1,445) [347] {173}	7,279 (1,456) [349] {175}
Ventura	12,167	12,236	12,328	12,406	12,536 (2,507) [602] {301}	12,666 (2,533) [608] {304}	12,797 (2,559) [614] {307}

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.