IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/18/20

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 11/18/20 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
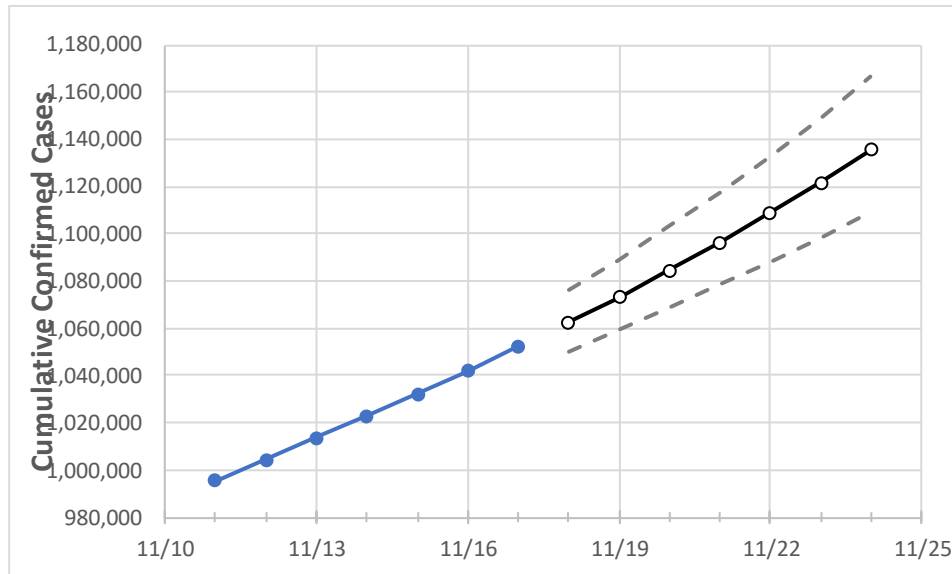
	Actual Confirmed Cases On:				Projected Cases For:						
	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24
California	1,023,067	1,032,095	1,041,690	1,052,285	1,062,557	1,073,324	1,084,611	1,096,439	1,108,833	1,121,821	1,135,429

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:						
	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24
Alameda	25,760	25,872	26,047	26,460	26,641	26,829	27,025	27,228	27,438	27,656	27,883
Contra Costa	20,868	21,046	21,250	21,458	21,647	21,846	22,053	22,271	22,498	22,737	22,986
Fresno	33,693	33,969	34,297	34,593	34,843	35,105	35,380	35,667	35,968	36,282	36,611
Kern	36,227	36,470	36,618	36,919	37,145	37,384	37,636	37,902	38,182	38,478	38,790
Los Angeles	336,549	339,560	342,343	344,523	347,622	350,853	354,223	357,737	361,400	365,220	369,201
Marin	7,344	7,358	7,378	7,409	7,431	7,454	7,477	7,502	7,528	7,555	7,583
Monterey	12,701	12,854	13,034	13,110	13,210	13,315	13,423	13,535	13,651	13,772	13,897
Orange	64,586	65,225	65,605	65,957	66,424	66,908	67,411	67,934	68,476	69,039	69,624
Placer	5,175	5,215	5,397	5,489	5,578	5,673	5,774	5,883	5,999	6,123	6,256
Riverside	74,545	74,910	75,848	76,724	77,428	78,171	78,958	79,789	80,667	81,595	82,575
Sacramento	29,837	30,298	30,601	30,999	31,414	31,854	32,318	32,809	33,328	33,877	34,457
San Bernardino	73,915	74,166	74,929	76,685	77,478	78,309	79,182	80,098	81,060	82,069	83,128
San Diego	63,681	64,768	65,601	66,319	66,746	67,182	67,627	68,082	68,546	69,020	69,504
San Francisco	13,516	13,665	13,757	13,847	13,970	14,099	14,233	14,374	14,522	14,676	14,838
San Joaquin	23,517	23,589	23,662	23,734	23,827	23,925	24,028	24,135	24,248	24,365	24,488
San Luis Obispo	5,038	5,073	5,120	5,250	5,337	5,430	5,531	5,638	5,754	5,878	6,011
San Mateo	12,465	12,515	12,565	12,684	12,784	12,888	12,995	13,106	13,222	13,341	13,465
Santa Barbara	10,415	10,482	10,516	10,577	10,625	10,675	10,727	10,781	10,837	10,896	10,956
Santa Clara	27,977	28,307	28,686	29,023	29,333	29,655	29,992	30,342	30,708	31,088	31,485
Santa Cruz	3,356	3,402	3,439	3,542	3,578	3,615	3,655	3,696	3,740	3,785	3,833
Solano	8,806	8,882	8,959	9,088	9,197	9,309	9,426	9,547	9,672	9,802	9,936
Sonoma	10,747	10,845	11,055	11,133	11,212	11,292	11,373	11,455	11,539	11,624	11,709
Ventura	16,172	16,297	16,564	16,691	16,861	17,040	17,230	17,429	17,640	17,863	18,097

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:		
	11/14	11/15	11/16	11/17	11/19	11/21	11/23
Alameda	25,760	25,872	26,047	26,460	26,829 (5,366) [1,288] {644}	27,228 (5,446) [1,307] {653}	27,656 (5,531) [1,328] {664}
Contra Costa	20,868	21,046	21,250	21,458	21,846 (4,369) [1,049] {524}	22,271 (4,454) [1,069] {535}	22,737 (4,547) [1,091] {546}
Fresno	33,693	33,969	34,297	34,593	35,105 (7,021) [1,685] {843}	35,667 (7,133) [1,712] {856}	36,282 (7,256) [1,742] {871}
Kern	36,227	36,470	36,618	36,919	37,384 (7,477) [1,794] {897}	37,902 (7,580) [1,819] {910}	38,478 (7,696) [1,847] {923}
Los Angeles	336,549	339,560	342,343	344,523	350,853 (70,171) [16,841] {8,420}	357,737 (71,547) [17,171] {8,586}	365,220 (73,044) [17,531] {8,765}
Marin	7,344	7,358	7,378	7,409	7,454 (1,491) [358] {179}	7,502 (1,500) [360] {180}	7,555 (1,511) [363] {181}
Monterey	12,701	12,854	13,034	13,110	13,315 (2,663) [639] {320}	13,535 (2,707) [650] {325}	13,772 (2,754) [661] {331}
Orange	64,586	65,225	65,605	65,957	66,908 (13,382) [3,212] {1,606}	67,934 (13,587) [3,261] {1,630}	69,039 (13,808) [3,314] {1,657}
Placer	5,175	5,215	5,397	5,489	5,673 (1,135) [272] {136}	5,883 (1,177) [282] {141}	6,123 (1,225) [294] {147}
Riverside	74,545	74,910	75,848	76,724	78,171 (15,634) [3,752] {1,876}	79,789 (15,958) [3,830] {1,915}	81,595 (16,319) [3,917] {1,958}
Sacramento	29,837	30,298	30,601	30,999	31,854 (6,371) [1,529] {764}	32,809 (6,562) [1,575] {787}	33,877 (6,775) [1,626] {813}
San Bernardino	73,915	74,166	74,929	76,685	78,309 (15,662) [3,759] {1,879}	80,098 (16,020) [3,845] {1,922}	82,069 (16,414) [3,939] {1,970}
San Diego	63,681	64,768	65,601	66,319	67,182 (13,436) [3,225] {1,612}	68,082 (13,616) [3,268] {1,634}	69,020 (13,804) [3,313] {1,656}
San Francisco	13,516	13,665	13,757	13,847	14,099 (2,820) [677] {338}	14,374 (2,875) [690] {345}	14,676 (2,935) [704] {352}
San Joaquin	23,517	23,589	23,662	23,734	23,925 (4,785) [1,148] {574}	24,135 (4,827) [1,158] {579}	24,365 (4,873) [1,170] {585}
San Luis Obispo	5,038	5,073	5,120	5,250	5,430 (1,086) [261] {130}	5,638 (1,128) [271] {135}	5,878 (1,176) [282] {141}
San Mateo	12,465	12,515	12,565	12,684	12,888 (2,578) [619] {309}	13,106 (2,621) [629] {315}	13,341 (2,668) [640] {320}
Santa Barbara	10,415	10,482	10,516	10,577	10,675 (2,135) [512] {256}	10,781 (2,156) [517] {259}	10,896 (2,179) [523] {261}
Santa Clara	27,977	28,307	28,686	29,023	29,655 (5,931) [1,423] {712}	30,342 (6,068) [1,456] {728}	31,088 (6,218) [1,492] {746}
Santa Cruz	3,356	3,402	3,439	3,542	3,615 (723) [174] {87}	3,696 (739) [177] {89}	3,785 (757) [182] {91}
Solano	8,806	8,882	8,959	9,088	9,309 (1,862) [447] {223}	9,547 (1,909) [458] {229}	9,802 (1,960) [470] {235}
Sonoma	10,747	10,845	11,055	11,133	11,292 (2,258) [542] {271}	11,455 (2,291) [550] {275}	11,624 (2,325) [558] {279}
Ventura	16,172	16,297	16,564	16,691	17,040 (3,408) [818] {409}	17,429 (3,486) [837] {418}	17,863 (3,573) [857] {429}

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.