IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/2/20

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 <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 12/2/20 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
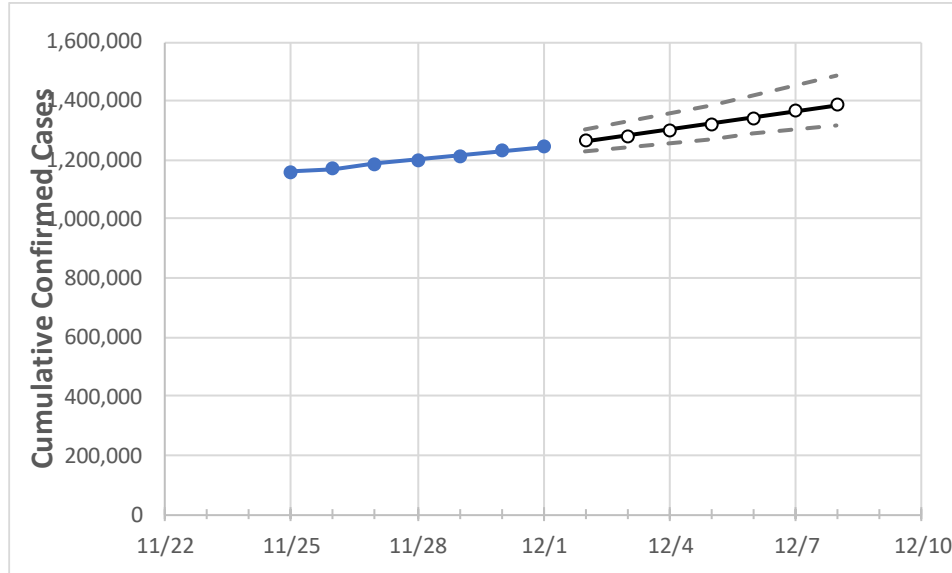
	Actual Confirmed Cases On:				Projected Cases For:						
	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8
California	1,200,624	1,215,455	1,230,264	1,246,042	1,264,047	1,282,724	1,302,101	1,322,201	1,343,051	1,364,675	1,387,101

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:						
	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8
Alameda	29,116	29,476	29,918	29,972	30,187	30,406	30,630	30,860	31,094	31,333	31,578
Contra Costa	23,733	23,895	24,275	24,475	24,702	24,935	25,172	25,415	25,662	25,915	26,174
Fresno	37,994	38,288	38,568	38,712	39,046	39,387	39,734	40,087	40,448	40,815	41,189
Kern	40,632	41,328	41,827	41,957	42,369	42,799	43,250	43,721	44,215	44,731	45,271
Los Angeles	390,891	395,843	400,919	408,396	414,161	420,165	426,417	432,927	439,706	446,763	454,109
Marin	7,704	7,755	7,777	7,808	7,840	7,873	7,907	7,943	7,979	8,017	8,057
Monterey	14,753	15,328	15,621	15,837	15,898	15,959	16,021	16,082	16,144	16,205	16,267
Orange	76,761	77,819	78,553	79,343	80,686	82,108	83,614	85,208	86,896	88,682	90,573
Placer	6,426	6,497	6,622	6,664	6,746	6,830	6,915	7,003	7,092	7,184	7,277
Riverside	85,769	86,854	87,383	87,722	88,666	89,638	90,640	91,673	92,736	93,832	94,962
Sacramento	36,579	36,905	37,415	37,884	38,374	38,876	39,390	39,915	40,452	41,001	41,562
San Bernardino	92,164	93,019	93,671	94,106	94,777	95,446	96,114	96,781	97,447	98,111	98,773
San Diego	80,018	81,084	82,043	83,421	84,328	85,262	86,226	87,219	88,243	89,299	90,387
San Francisco	15,377	15,450	15,571	15,639	15,768	15,900	16,033	16,168	16,306	16,445	16,587
San Joaquin	25,741	25,742	25,740	25,920	25,967	26,014	26,061	26,108	26,154	26,200	26,245
San Luis Obispo	6,129	6,137	6,145	6,311	6,343	6,375	6,407	6,437	6,467	6,497	6,526
San Mateo	14,148	14,303	14,458	14,614	14,669	14,723	14,776	14,829	14,881	14,932	14,984
Santa Barbara	11,340	11,481	11,520	11,602	11,681	11,763	11,847	11,935	12,027	12,122	12,220
Santa Clara	33,732	34,292	35,085	35,457	36,071	36,714	37,387	38,091	38,828	39,599	40,405
Santa Cruz	4,358	4,426	4,490	4,558	4,658	4,765	4,878	4,998	5,125	5,260	5,404
Solano	10,044	10,252	10,648	10,731	10,756	10,780	10,804	10,827	10,849	10,871	10,893
Sonoma	12,049	12,198	12,319	12,319	12,415	12,514	12,617	12,723	12,832	12,946	13,063
Ventura	19,379	19,510	19,952	20,308	20,605	20,914	21,238	21,575	21,927	22,294	22,676

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:		
	11/28	11/29	11/30	12/1	12/3	12/5	12/7
Alameda	29,116	29,476	29,918	29,972	30,406 (6,081) [1,459] {730}	30,860 (6,172) [1,481] {741}	31,333 (6,267) [1,504] {752}
Contra Costa	23,733	23,895	24,275	24,475	24,935 (4,987) [1,197] {598}	25,415 (5,083) [1,220] {610}	25,915 (5,183) [1,244] {622}
Fresno	37,994	38,288	38,568	38,712	39,387 (7,877) [1,891] {945}	40,087 (8,017) [1,924] {962}	40,815 (8,163) [1,959] {980}
Kern	40,632	41,328	41,827	41,957	42,799 (8,560) [2,054] {1,027}	43,721 (8,744) [2,099] {1,049}	44,731 (8,946) [2,147] {1,074}
Los Angeles	390,891	395,843	400,919	408,396	420,165 (84,033) [20,168] {10,084}	432,927 (86,585) [20,781] {10,390}	446,763 (89,353) [21,445] {10,722}
Marin	7,704	7,755	7,777	7,808	7,873 (1,575) [378] {189}	7,943 (1,589) [381] {191}	8,017 (1,603) [385] {192}
Monterey	14,753	15,328	15,621	15,837	15,959 (3,192) [766] {383}	16,082 (3,216) [772] {386}	16,205 (3,241) [778] {389}
Orange	76,761	77,819	78,553	79,343	82,108 (16,422) [3,941] {1,971}	85,208 (17,042) [4,090] {2,045}	88,682 (17,736) [4,257] {2,128}
Placer	6,426	6,497	6,622	6,664	6,830 (1,366) [328] {164}	7,003 (1,401) [336] {168}	7,184 (1,437) [345] {172}
Riverside	85,769	86,854	87,383	87,722	89,638 (17,928) [4,303] {2,151}	91,673 (18,335) [4,400] {2,200}	93,832 (18,766) [4,504] {2,252}
Sacramento	36,579	36,905	37,415	37,884	38,876 (7,775) [1,866] {933}	39,915 (7,983) [1,916] {958}	41,001 (8,200) [1,968] {984}
San Bernardino	92,164	93,019	93,671	94,106	95,446 (19,089) [4,581] {2,291}	96,781 (19,356) [4,646] {2,323}	98,111 (19,622) [4,709] {2,355}
San Diego	80,018	81,084	82,043	83,421	85,262 (17,052) [4,093] {2,046}	87,219 (17,444) [4,187] {2,093}	89,299 (17,860) [4,286] {2,143}
San Francisco	15,377	15,450	15,571	15,639	15,900 (3,180) [763] {382}	16,168 (3,234) [776] {388}	16,445 (3,289) [789] {395}
San Joaquin	25,741	25,742	25,740	25,920	26,014 (5,203) [1,249] {624}	26,108 (5,222) [1,253] {627}	26,200 (5,240) [1,258] {629}
San Luis Obispo	6,129	6,137	6,145	6,311	6,375 (1,275) [306] {153}	6,437 (1,287) [309] {154}	6,497 (1,299) [312] {156}
San Mateo	14,148	14,303	14,458	14,614	14,723 (2,945) [707] {353}	14,829 (2,966) [712] {356}	14,932 (2,986) [717] {358}
Santa Barbara	11,340	11,481	11,520	11,602	11,763 (2,353) [565] {282}	11,935 (2,387) [573] {286}	12,122 (2,424) [582] {291}
Santa Clara	33,732	34,292	35,085	35,457	36,714 (7,343) [1,762] {881}	38,091 (7,618) [1,828] {914}	39,599 (7,920) [1,901] {950}
Santa Cruz	4,358	4,426	4,490	4,558	4,765 (953) [229] {114}	4,998 (1,000) [240] {120}	5,260 (1,052) [252] {126}
Solano	10,044	10,252	10,648	10,731	10,780 (2,156) [517] {259}	10,827 (2,165) [520] {260}	10,871 (2,174) [522] {261}
Sonoma	12,049	12,198	12,319	12,319	12,514 (2,503) [601] {300}	12,723 (2,545) [611] {305}	12,946 (2,589) [621] {311}
Ventura	19,379	19,510	19,952	20,308	20,914 (4,183) [1,004] {502}	21,575 (4,315) [1,036] {518}	22,294 (4,459) [1,070] {535}

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.