IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/21/21

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 1/21/21 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
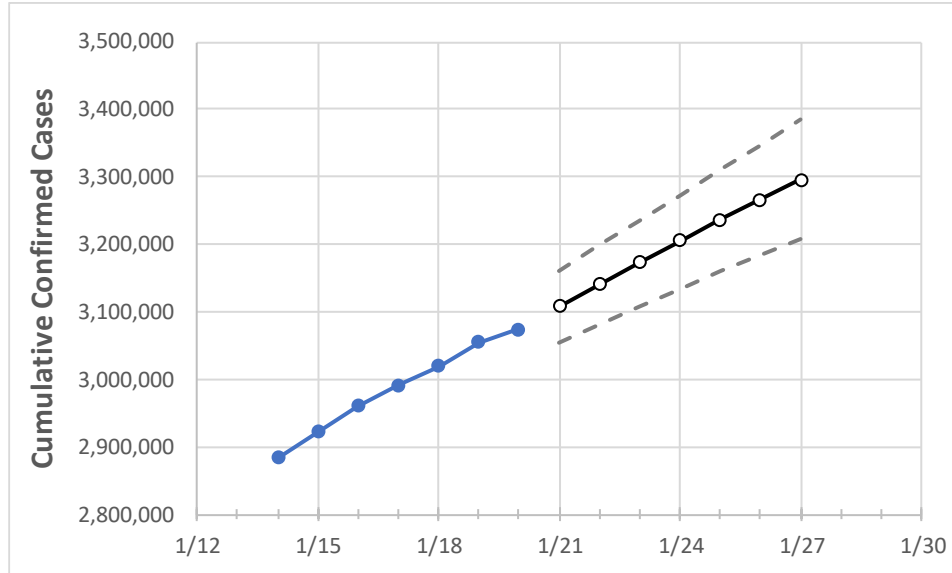
	Actual Confirmed Cases On:				Projected Cases For:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
California	2,991,731	3,019,758	3,055,568	3,074,812	3,108,061	3,140,708	3,173,047	3,204,967	3,236,066	3,266,157	3,295,648

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 10%, and are often within 5%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Alameda	68,016	67,375	67,952	68,649	69,766	70,889	72,009	73,182	74,381	75,618	76,873
Contra Costa	52,146	52,547	52,965	53,349	53,950	54,527	55,127	55,721	56,310	56,884	57,462
Fresno	81,294	82,039	82,485	83,200	84,088	84,969	85,841	86,729	87,599	88,491	89,366
Kern	85,362	86,188	86,718	87,240	88,044	88,835	89,595	90,349	91,086	91,793	92,473
Lake	2,504	2,572	2,612	2,625	2,701	2,780	2,864	2,951	3,036	3,133	3,230
Los Angeles	1,014,753	1,024,297	1,032,806	1,038,738	1,050,095	1,060,939	1,071,694	1,082,264	1,092,762	1,102,919	1,112,975
Marin	11,569	11,632	11,693	11,732	11,826	11,918	12,011	12,102	12,193	12,285	12,375
Monterey	35,654	35,890	36,126	36,464	36,802	37,160	37,501	37,844	38,176	38,495	38,800
Orange	210,813	212,389	214,808	216,509	219,137	221,719	224,244	226,687	229,169	231,632	234,116
Placer	16,995	17,194	17,380	17,490	17,648	17,800	17,954	18,105	18,253	18,397	18,540
Riverside	239,412	242,206	250,436	251,000	253,893	256,862	259,991	262,884	265,767	268,721	271,686
Sacramento	79,122	80,154	80,678	81,183	82,042	82,900	83,754	84,620	85,466	86,336	87,180
San Bernardino	251,213	254,094	256,109	256,914	259,632	262,294	264,908	267,485	269,985	272,571	275,061
San Diego	211,787	214,337	216,835	218,555	220,954	223,264	225,503	227,678	229,815	231,922	233,915
San Francisco	28,853	29,139	29,321	29,502	29,790	30,081	30,365	30,652	30,937	31,224	31,498
San Joaquin	56,642	57,094	58,290	58,843	59,427	60,014	60,586	61,173	61,764	62,313	62,862
San Luis Obispo	15,466	15,658	15,929	16,056	16,308	16,562	16,816	17,073	17,321	17,578	17,816
San Mateo	31,805	32,186	32,596	32,887	33,356	33,832	34,317	34,796	35,276	35,754	36,237
Santa Barbara	24,481	24,782	25,083	25,405	25,842	26,271	26,714	27,155	27,600	28,051	28,510
Santa Clara	92,625	93,557	94,366	94,905	96,066	97,182	98,313	99,433	100,549	101,666	102,736
Santa Cruz	12,026	12,196	12,298	12,461	12,639	12,810	12,989	13,159	13,334	13,509	13,681
Solano	24,732	25,216	25,806	25,983	26,285	26,576	26,872	27,153	27,433	27,716	28,007
Sonoma	23,607	23,871	24,068	24,184	24,447	24,707	24,973	25,245	25,509	25,778	26,044
Ventura	60,368	61,257	62,101	62,774	63,884	64,981	66,078	67,192	68,285	69,375	70,448

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:		
	1/17	1/18	1/19	1/20	1/22	1/24	1/26
Alameda	68,016	67,375	67,952	68,649	70,889 (14,178) [3,403] {1,701}	73,182 (14,636) [3,513] {1,756}	75,618 (15,124) [3,630] {1,815}
Contra Costa	52,146	52,547	52,965	53,349	54,527 (10,905) [2,617] {1,309}	55,721 (11,144) [2,675] {1,337}	56,884 (11,377) [2,730] {1,365}
Fresno	81,294	82,039	82,485	83,200	84,969 (16,994) [4,079] {2,039}	86,729 (17,346) [4,163] {2,082}	88,491 (17,698) [4,248] {2,124}
Kern	85,362	86,188	86,718	87,240	88,835 (17,767) [4,264] {2,132}	90,349 (18,070) [4,337] {2,168}	91,793 (18,359) [4,406] {2,203}
Lake	2,504	2,572	2,612	2,625	2,780 (556) [133] {67}	2,951 (590) [142] {71}	3,133 (627) [150] {75}
Los Angeles	1,014,753	1,024,297	1,032,806	1,038,738	1,060,939 (212,188) [50,925] {25,463}	1,082,264 (216,453) [51,949] {25,974}	1,102,919 (220,584) [52,940] {26,470}
Marin	11,569	11,632	11,693	11,732	11,918 (2,384) [572] {286}	12,102 (2,420) [581] {290}	12,285 (2,457) [590] {295}
Monterey	35,654	35,890	36,126	36,464	37,160 (7,432) [1,784] {892}	37,844 (7,569) [1,817] {908}	38,495 (7,699) [1,848] {924}
Orange	210,813	212,389	214,808	216,509	221,719 (44,344) [10,643] {5,321}	226,687 (45,337) [10,881] {5,440}	231,632 (46,326) [11,118] {5,559}
Placer	16,995	17,194	17,380	17,490	17,800 (3,560) [854] {427}	18,105 (3,621) [869] {435}	18,397 (3,679) [883] {442}
Riverside	239,412	242,206	250,436	251,000	256,862 (51,372) [12,329] {6,165}	262,884 (52,577) [12,618] {6,309}	268,721 (53,744) [12,899] {6,449}
Sacramento	79,122	80,154	80,678	81,183	82,900 (16,580) [3,979] {1,990}	84,620 (16,924) [4,062] {2,031}	86,336 (17,267) [4,144] {2,072}
San Bernardino	251,213	254,094	256,109	256,914	262,294 (52,459) [12,590] {6,295}	267,485 (53,497) [12,839] {6,420}	272,571 (54,514) [13,083] {6,542}
San Diego	211,787	214,337	216,835	218,555	223,264 (44,653) [10,717] {5,358}	227,678 (45,536) [10,929] {5,464}	231,922 (46,384) [11,132] {5,566}
San Francisco	28,853	29,139	29,321	29,502	30,081 (6,016) [1,444] {722}	30,652 (6,130) [1,471] {736}	31,224 (6,245) [1,499] {749}
San Joaquin	56,642	57,094	58,290	58,843	60,014 (12,003) [2,881] {1,440}	61,173 (12,235) [2,936] {1,468}	62,313 (12,463) [2,991] {1,496}
San Luis Obispo	15,466	15,658	15,929	16,056	16,562 (3,312) [795] {397}	17,073 (3,415) [819] {410}	17,578 (3,516) [844] {422}
San Mateo	31,805	32,186	32,596	32,887	33,832 (6,766) [1,624] {812}	34,796 (6,959) [1,670] {835}	35,754 (7,151) [1,716] {858}
Santa Barbara	24,481	24,782	25,083	25,405	26,271 (5,254) [1,261] {630}	27,155 (5,431) [1,303] {652}	28,051 (5,610) [1,346] {673}
Santa Clara	92,625	93,557	94,366	94,905	97,182 (19,436) [4,665] {2,332}	99,433 (19,887) [4,773] {2,386}	101,666 (20,333) [4,880] {2,440}
Santa Cruz	12,026	12,196	12,298	12,461	12,810 (2,562) [615] {307}	13,159 (2,632) [632] {316}	13,509 (2,702) [648] {324}
Solano	24,732	25,216	25,806	25,983	26,576 (5,315) [1,276] {638}	27,153 (5,431) [1,303] {652}	27,716 (5,543) [1,330] {665}
Sonoma	23,607	23,871	24,068	24,184	24,707 (4,941) [1,186] {593}	25,245 (5,049) [1,212] {606}	25,778 (5,156) [1,237] {619}
Ventura	60,368	61,257	62,101	62,774	64,981 (12,996) [3,119] {1,560}	67,192 (13,438) [3,225] {1,613}	69,375 (13,875) [3,330] {1,665}

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.