IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/27/21

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 12/27/21 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
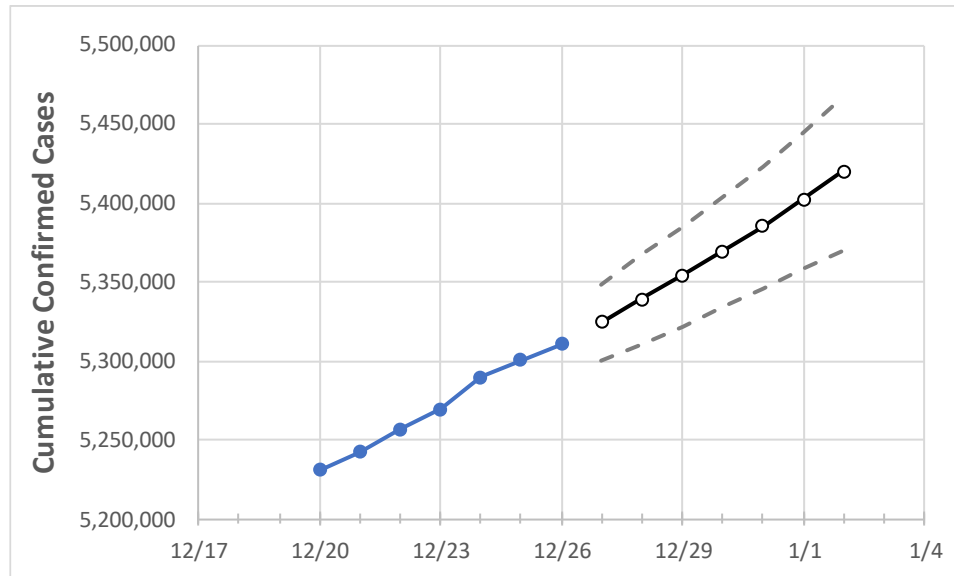
	Actual Confirmed Cases On:				Projected Cases For:						
	12/23	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2
California	5,269,446	5,289,904	5,300,301	5,310,698	5,324,713	5,339,155	5,354,094	5,369,185	5,385,467	5,402,523	5,419,766

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:						
	12/23	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2
Alameda	129,817	130,505	130,505	130,505	130,963	131,465	132,000	132,576	133,157	133,818	134,487
Contra Costa	107,324	107,555	107,555	107,555	107,823	108,099	108,399	108,704	109,017	109,386	109,731
Fresno	160,844	161,033	161,033	161,033	161,162	161,282	161,401	161,523	161,641	161,757	161,883
Kern	161,987	161,987	161,987	161,987	162,181	162,376	162,567	162,758	162,953	163,151	163,342
Lake	7,186	7,191	7,191	7,191	7,197	7,203	7,209	7,215	7,220	7,227	7,232
Los Angeles	1,585,313	1,595,239	1,605,636	1,616,033	1,625,847	1,636,465	1,647,641	1,660,040	1,673,433	1,687,752	1,703,219
Marin	19,607	19,686	19,686	19,686	19,779	19,875	19,978	20,085	20,194	20,319	20,442
Monterey	54,272	54,331	54,331	54,331	54,383	54,439	54,489	54,536	54,590	54,645	54,698
Orange	344,103	344,103	344,103	344,103	344,742	345,408	346,118	346,821	347,548	348,278	349,050
Placer	43,926	43,973	43,973	43,973	44,044	44,120	44,195	44,271	44,345	44,424	44,505
Riverside	401,038	402,286	402,286	402,286	403,017	403,794	404,547	405,296	406,197	406,957	407,811
Sacramento	174,204	174,653	174,653	174,653	174,960	175,242	175,543	175,847	176,187	176,490	176,819
San Bernardino	387,551	388,559	388,559	388,559	389,186	389,743	390,356	391,009	391,650	392,246	392,907
San Diego	427,629	429,976	429,976	429,976	431,667	433,451	435,211	437,100	439,036	441,295	443,379
San Francisco	60,960	61,314	61,314	61,314	61,898	62,531	63,188	63,896	64,710	65,577	66,532
San Joaquin	110,508	110,610	110,610	110,610	110,728	110,843	110,960	111,090	111,199	111,332	111,454
San Luis Obispo	32,675	32,732	32,732	32,732	32,796	32,862	32,929	33,002	33,069	33,145	33,220
San Mateo	58,867	59,051	59,051	59,051	59,276	59,512	59,747	60,002	60,271	60,565	60,873
Santa Barbara	49,279	49,369	49,369	49,369	49,477	49,598	49,709	49,837	49,955	50,097	50,222
Santa Clara	158,113	158,727	158,727	158,727	159,141	159,569	159,987	160,428	160,888	161,403	161,897
Santa Cruz	23,276	23,326	23,326	23,326	23,373	23,427	23,473	23,526	23,576	23,631	23,682
Solano	48,892	49,007	49,007	49,007	49,082	49,159	49,243	49,324	49,408	49,499	49,590
Sonoma	44,903	44,981	44,981	44,981	45,089	45,198	45,315	45,430	45,541	45,680	45,807
Ventura	107,792	108,201	108,201	108,201	108,532	108,871	109,234	109,616	110,025	110,434	110,872

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:		
	12/23	12/24	12/25	12/26	12/28	12/30	1/1
Alameda	129,817	130,505	130,505	130,505	131,465 (26,293) [6,310] {3,155}	132,576 (26,515) [6,364] {3,182}	133,818 (26,764) [6,423] {3,212}
Contra Costa	107,324	107,555	107,555	107,555	108,099 (21,620) [5,189] {2,594}	108,704 (21,741) [5,218] {2,609}	109,386 (21,877) [5,251] {2,625}
Fresno	160,844	161,033	161,033	161,033	161,282 (32,256) [7,742] {3,871}	161,523 (32,305) [7,753] {3,877}	161,757 (32,351) [7,764] {3,882}
Kern	161,987	161,987	161,987	161,987	162,376 (32,475) [7,794] {3,897}	162,758 (32,552) [7,812] {3,906}	163,151 (32,630) [7,831] {3,916}
Lake	7,186	7,191	7,191	7,191	7,203 (1,441) [346] {173}	7,215 (1,443) [346] {173}	7,227 (1,445) [347] {173}
Los Angeles	1,585,313	1,595,239	1,605,636	1,616,033	1,636,465 (327,293) [78,550] {39,275}	1,660,040 (332,008) [79,682] {39,841}	1,687,752 (337,550) [81,012] {40,506}
Marin	19,607	19,686	19,686	19,686	19,875 (3,975) [954] {477}	20,085 (4,017) [964] {482}	20,319 (4,064) [975] {488}
Monterey	54,272	54,331	54,331	54,331	54,439 (10,888) [2,613] {1,307}	54,536 (10,907) [2,618] {1,309}	54,645 (10,929) [2,623] {1,311}
Orange	344,103	344,103	344,103	344,103	345,408 (69,082) [16,580] {8,290}	346,821 (69,364) [16,647] {8,324}	348,278 (69,656) [16,717] {8,359}
Placer	43,926	43,973	43,973	43,973	44,120 (8,824) [2,118] {1,059}	44,271 (8,854) [2,125] {1,062}	44,424 (8,885) [2,132] {1,066}
Riverside	401,038	402,286	402,286	402,286	403,794 (80,759) [19,382] {9,691}	405,296 (81,059) [19,454] {9,727}	406,957 (81,391) [19,534] {9,767}
Sacramento	174,204	174,653	174,653	174,653	175,242 (35,048) [8,412] {4,206}	175,847 (35,169) [8,441] {4,220}	176,490 (35,298) [8,472] {4,236}
San Bernardino	387,551	388,559	388,559	388,559	389,743 (77,949) [18,708] {9,354}	391,009 (78,202) [18,768] {9,384}	392,246 (78,449) [18,828] {9,414}
San Diego	427,629	429,976	429,976	429,976	433,451 (86,690) [20,806] {10,403}	437,100 (87,420) [20,981] {10,490}	441,295 (88,259) [21,182] {10,591}
San Francisco	60,960	61,314	61,314	61,314	62,531 (12,506) [3,001] {1,501}	63,896 (12,779) [3,067] {1,534}	65,577 (13,115) [3,148] {1,574}
San Joaquin	110,508	110,610	110,610	110,610	110,843 (22,169) [5,320] {2,660}	111,090 (22,218) [5,332] {2,666}	111,332 (22,266) [5,344] {2,672}
San Luis Obispo	32,675	32,732	32,732	32,732	32,862 (6,572) [1,577] {789}	33,002 (6,600) [1,584] {792}	33,145 (6,629) [1,591] {795}
San Mateo	58,867	59,051	59,051	59,051	59,512 (11,902) [2,857] {1,428}	60,002 (12,000) [2,880] {1,440}	60,565 (12,113) [2,907] {1,454}
Santa Barbara	49,279	49,369	49,369	49,369	49,598 (9,920) [2,381] {1,190}	49,837 (9,967) [2,392] {1,196}	50,097 (10,019) [2,405] {1,202}
Santa Clara	158,113	158,727	158,727	158,727	159,569 (31,914) [7,659] {3,830}	160,428 (32,086) [7,701] {3,850}	161,403 (32,281) [7,747] {3,874}
Santa Cruz	23,276	23,326	23,326	23,326	23,427 (4,685) [1,124] {562}	23,526 (4,705) [1,129] {565}	23,631 (4,726) [1,134] {567}
Solano	48,892	49,007	49,007	49,007	49,159 (9,832) [2,360] {1,180}	49,324 (9,865) [2,368] {1,184}	49,499 (9,900) [2,376] {1,188}
Sonoma	44,903	44,981	44,981	44,981	45,198 (9,040) [2,170] {1,085}	45,430 (9,086) [2,181] {1,090}	45,680 (9,136) [2,193] {1,096}
Ventura	107,792	108,201	108,201	108,201	108,871 (21,774) [5,226] {2,613}	109,616 (21,923) [5,262] {2,631}	110,434 (22,087) [5,301] {2,650}

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.