IEM's AI Modeling: Short-term COVID-19 Projections
Date: 9/10/21

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 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 9/10/21 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
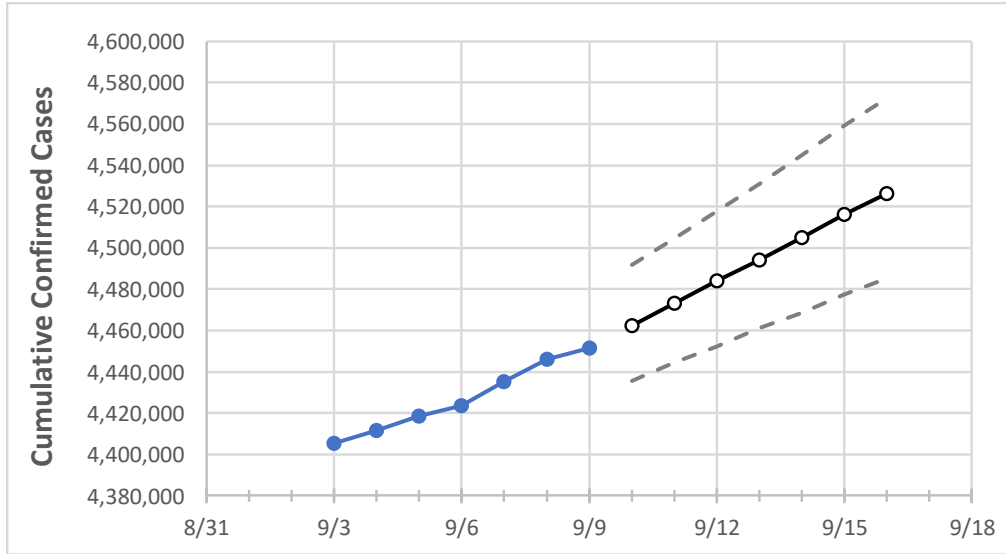
	Actual Confirmed Cases On:				Projected Cases For:						
	9/6	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16
California	4,423,696	4,435,277	4,445,862	4,451,347	4,462,186	4,473,210	4,483,944	4,494,142	4,505,101	4,516,217	4,526,415

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:						
	9/6	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16
Alameda	110,608	110,932	111,198	111,422	111,774	112,119	112,459	112,797	113,161	113,520	113,861
Contra Costa	90,862	90,971	91,167	91,471	91,848	92,218	92,569	92,928	93,307	93,721	94,063
Fresno	119,384	119,738	120,268	120,644	121,223	121,799	122,388	122,988	123,590	124,229	124,841
Kern	128,292	128,770	129,325	129,808	130,383	130,955	131,534	132,126	132,726	133,328	133,956
Lake	5,525	5,548	5,597	5,618	5,651	5,683	5,717	5,749	5,782	5,817	5,849
Los Angeles	1,420,560	1,421,616	1,423,620	1,423,620	1,425,474	1,427,255	1,428,986	1,430,660	1,432,338	1,434,026	1,435,630
Marin	16,377	16,380	16,383	16,386	16,401	16,414	16,427	16,440	16,453	16,465	16,477
Monterey	46,684	46,684	46,684	46,684	46,756	46,832	46,899	46,974	47,047	47,125	47,201
Orange	308,387	308,832	309,228	309,576	310,024	310,439	310,855	311,272	311,676	312,077	312,475
Placer	31,487	31,595	31,886	31,886	32,139	32,373	32,634	32,884	33,136	33,423	33,698
Riverside	337,921	337,921	337,921	337,921	338,869	339,815	340,778	341,730	342,664	343,624	344,559
Sacramento	141,276	141,730	142,364	142,448	143,488	144,512	145,542	146,615	147,735	148,830	150,004
San Bernardino	333,374	333,534	335,829	336,417	337,064	337,728	338,349	338,988	339,694	340,370	340,971
San Diego	340,222	340,709	341,437	342,149	343,042	343,923	344,799	345,676	346,535	347,397	348,197
San Francisco	48,035	48,120	48,175	48,263	48,404	48,547	48,678	48,819	48,958	49,093	49,229
San Joaquin	89,121	89,293	89,468	89,631	90,063	90,518	90,977	91,432	91,878	92,388	92,842
San Luis Obispo	26,098	26,183	26,253	26,303	26,400	26,485	26,576	26,675	26,752	26,842	26,931
San Mateo	49,809	49,859	49,913	50,051	50,195	50,327	50,462	50,608	50,741	50,883	51,018
Santa Barbara	39,762	39,876	39,957	40,000	40,083	40,171	40,254	40,337	40,423	40,508	40,593
Santa Clara	136,146	137,177	137,396	137,582	138,008	138,401	138,803	139,213	139,667	140,099	140,553
Santa Cruz	18,588	18,694	18,734	18,774	18,824	18,872	18,920	18,970	19,021	19,067	19,120
Solano	42,282	42,363	42,444	42,444	42,691	42,975	43,229	43,514	43,794	44,106	44,394
Sonoma	37,881	37,929	38,094	38,315	38,482	38,644	38,801	38,969	39,135	39,326	39,484
Ventura	91,004	91,330	91,414	91,563	91,704	91,838	91,962	92,083	92,206	92,330	92,458

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:		
	9/6	9/7	9/8	9/9	9/11	9/13	9/15
Alameda	110,608	110,932	111,198	111,422	112,119 (22,424) [5,382] {2,691}	112,797 (22,559) [5,414] {2,707}	113,520 (22,704) [5,449] {2,724}
Contra Costa	90,862	90,971	91,167	91,471	92,218 (18,444) [4,426] {2,213}	92,928 (18,586) [4,461] {2,230}	93,721 (18,744) [4,499] {2,249}
Fresno	119,384	119,738	120,268	120,644	121,799 (24,360) [5,846] {2,923}	122,988 (24,598) [5,903] {2,952}	124,229 (24,846) [5,963] {2,982}
Kern	128,292	128,770	129,325	129,808	130,955 (26,191) [6,286] {3,143}	132,126 (26,425) [6,342] {3,171}	133,328 (26,666) [6,400] {3,200}
Lake	5,525	5,548	5,597	5,618	5,683 (1,137) [273] {136}	5,749 (1,150) [276] {138}	5,817 (1,163) [279] {140}
Los Angeles	1,420,560	1,421,616	1,423,620	1,423,620	1,427,255 (285,451) [68,508] {34,254}	1,430,660 (286,132) [68,672] {34,336}	1,434,026 (286,805) [68,833] {34,417}
Marin	16,377	16,380	16,383	16,386	16,414 (3,283) [788] {394}	16,440 (3,288) [789] {395}	16,465 (3,293) [790] {395}
Monterey	46,684	46,684	46,684	46,684	46,832 (9,366) [2,248] {1,124}	46,974 (9,395) [2,255] {1,127}	47,125 (9,425) [2,262] {1,131}
Orange	308,387	308,832	309,228	309,576	310,439 (62,088) [14,901] {7,451}	311,272 (62,254) [14,941] {7,471}	312,077 (62,415) [14,980] {7,490}
Placer	31,487	31,595	31,886	31,886	32,373 (6,475) [1,554] {777}	32,884 (6,577) [1,578] {789}	33,423 (6,685) [1,604] {802}
Riverside	337,921	337,921	337,921	337,921	339,815 (67,963) [16,311] {8,156}	341,730 (68,346) [16,403] {8,202}	343,624 (68,725) [16,494] {8,247}
Sacramento	141,276	141,730	142,364	142,448	144,512 (28,902) [6,937] {3,468}	146,615 (29,323) [7,038] {3,519}	148,830 (29,766) [7,144] {3,572}
San Bernardino	333,374	333,534	335,829	336,417	337,728 (67,546) [16,211] {8,105}	338,988 (67,798) [16,271] {8,136}	340,370 (68,074) [16,338] {8,169}
San Diego	340,222	340,709	341,437	342,149	343,923 (68,785) [16,508] {8,254}	345,676 (69,135) [16,592] {8,296}	347,397 (69,479) [16,675] {8,338}
San Francisco	48,035	48,120	48,175	48,263	48,547 (9,709) [2,330] {1,165}	48,819 (9,764) [2,343] {1,172}	49,093 (9,819) [2,356] {1,178}
San Joaquin	89,121	89,293	89,468	89,631	90,518 (18,104) [4,345] {2,172}	91,432 (18,286) [4,389] {2,194}	92,388 (18,478) [4,435] {2,217}
San Luis Obispo	26,098	26,183	26,253	26,303	26,485 (5,297) [1,271] {636}	26,675 (5,335) [1,280] {640}	26,842 (5,368) [1,288] {644}
San Mateo	49,809	49,859	49,913	50,051	50,327 (10,065) [2,416] {1,208}	50,608 (10,122) [2,429] {1,215}	50,883 (10,177) [2,442] {1,221}
Santa Barbara	39,762	39,876	39,957	40,000	40,171 (8,034) [1,928] {964}	40,337 (8,067) [1,936] {968}	40,508 (8,102) [1,944] {972}
Santa Clara	136,146	137,177	137,396	137,582	138,401 (27,680) [6,643] {3,322}	139,213 (27,843) [6,682] {3,341}	140,099 (28,020) [6,725] {3,362}
Santa Cruz	18,588	18,694	18,734	18,774	18,872 (3,774) [906] {453}	18,970 (3,794) [911] {455}	19,067 (3,813) [915] {458}
Solano	42,282	42,363	42,444	42,444	42,975 (8,595) [2,063] {1,031}	43,514 (8,703) [2,089] {1,044}	44,106 (8,821) [2,117] {1,059}
Sonoma	37,881	37,929	38,094	38,315	38,644 (7,729) [1,855] {927}	38,969 (7,794) [1,871] {935}	39,326 (7,865) [1,888] {944}
Ventura	91,004	91,330	91,414	91,563	91,838 (18,368) [4,408] {2,204}	92,083 (18,417) [4,420] {2,210}	92,330 (18,466) [4,432] {2,216}

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.