IEM's AI Modeling: Short-term COVID-19 Projections

Date: 2/11/22

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 2/11/22 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.

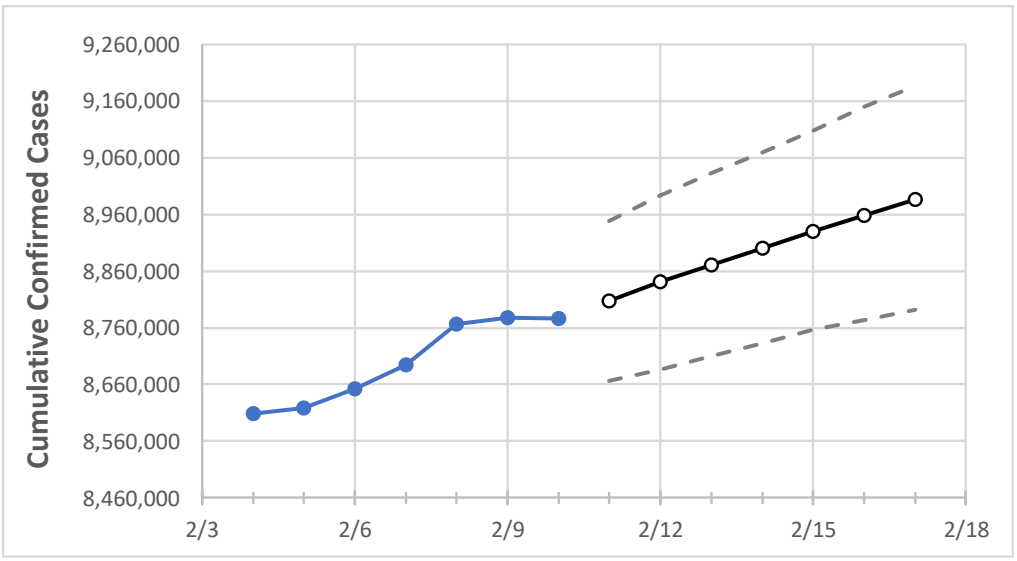
IEM's Modeling Lead

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:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
California	8,695,185	8,765,730	8,778,067	8,775,650	8,806,736	8,841,293	8,870,542	8,899,917	8,930,495	8,958,106	8,986,041

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:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
Alameda	253,741	255,650	256,204	255,969	256,996	258,176	259,140	260,089	261,061	262,180	263,114
Contra Costa	190,594	191,905	192,522	192,753	193,540	194,340	194,983	195,773	196,418	197,184	197,791
Fresno	236,212	238,133	238,706	239,589	240,809	241,924	242,979	244,232	245,072	246,445	247,283
Kern	221,944	222,651	224,771	225,509	226,538	227,461	228,423	229,359	230,227	231,107	232,002
Lake	10,466	10,753	10,827	10,623	10,717	10,814	10,905	10,997	11,094	11,187	11,283
Los Angeles	2,731,409	2,735,688	2,740,700	2,746,866	2,755,114	2,762,972	2,769,834	2,777,043	2,783,982	2,790,385	2,796,796
Marin	35,114	35,322	35,409	35,401	35,528	35,661	35,781	35,892	36,003	36,134	36,241
Monterey	87,161	92,044	92,228	87,421	88,275	89,210	90,146	91,019	91,932	92,962	93,887
Orange	567,448	570,984	573,049	574,435	576,448	578,694	580,554	582,396	584,209	586,038	587,941
Placer	66,916	67,323	67,512	67,664	67,942	68,195	68,432	68,650	68,925	69,161	69,415
Riverside	596,526	599,544	601,559	601,081	602,644	604,200	605,836	607,484	608,914	610,355	611,619
Sacramento	288,676	290,321	291,466	292,106	293,287	294,385	295,407	296,543	297,555	298,665	299,510
San Bernardino	566,667	568,479	571,589	571,655	573,297	574,308	575,583	576,785	578,121	579,181	580,475
San Diego	755,534	761,840	763,492	764,556	767,287	769,741	771,914	774,047	776,572	778,474	780,440
San Francisco	126,052	130,049	130,657	127,287	128,062	128,753	129,457	130,215	130,891	131,443	132,260
San Joaquin	168,885	169,674	170,145	170,046	170,847	171,504	172,186	172,839	173,370	174,032	174,656
San Luis Obispo	52,659	53,221	53,498	53,668	53,920	54,190	54,418	54,639	54,856	55,089	55,325
San Mateo	122,085	129,566	129,915	122,346	123,510	124,628	125,706	126,721	127,731	128,867	130,075
Santa Barbara	86,028	86,881	87,250	87,363	87,816	88,213	88,616	88,949	89,366	89,755	90,068
Santa Clara	306,234	308,553	310,031	309,945	311,483	313,163	314,572	316,163	317,430	319,003	320,400
Santa Cruz	45,321	45,961	46,277	46,241	46,590	46,991	47,266	47,656	48,012	48,357	48,681
Solano	79,089	82,186	82,454	82,542	83,149	83,620	84,152	84,636	85,205	85,707	86,245
Sonoma	80,440	80,942	81,309	81,316	81,658	82,041	82,394	82,708	83,069	83,390	83,722
Ventura	176,159	177,085	177,508	177,527	178,016	178,417	178,898	179,367	179,720	180,151	180,471

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:		
	2/7	2/8	2/9	2/10	2/12	2/14	2/16
Alameda	253,741	255,650	256,204	255,969	258,176 (51,635) [12,392] {6,196}	260,089 (52,018) [12,484] {6,242}	262,180 (52,436) [12,585] {6,292}
Contra Costa	190,594	191,905	192,522	192,753	194,340 (38,868) [9,328] {4,664}	195,773 (39,155) [9,397] {4,699}	197,184 (39,437) [9,465] {4,732}
Fresno	236,212	238,133	238,706	239,589	241,924 (48,385) [11,612] {5,806}	244,232 (48,846) [11,723] {5,862}	246,445 (49,289) [11,829] {5,915}
Kern	221,944	222,651	224,771	225,509	227,461 (45,492) [10,918] {5,459}	229,359 (45,872) [11,009] {5,505}	231,107 (46,221) [11,093] {5,547}
Lake	10,466	10,753	10,827	10,623	10,814 (2,163) [519] {260}	10,997 (2,199) [528] {264}	11,187 (2,237) [537] {268}
Los Angeles	2,731,409	2,735,688	2,740,700	2,746,866	2,762,972 (552,594) [132,623] {66,311}	2,777,043 (555,409) [133,298] {66,649}	2,790,385 (558,077) [133,938] {66,969}
Marin	35,114	35,322	35,409	35,401	35,661 (7,132) [1,712] {856}	35,892 (7,178) [1,723] {861}	36,134 (7,227) [1,734] {867}
Monterey	87,161	92,044	92,228	87,421	89,210 (17,842) [4,282] {2,141}	91,019 (18,204) [4,369] {2,184}	92,962 (18,592) [4,462] {2,231}
Orange	567,448	570,984	573,049	574,435	578,694 (115,739) [27,777] {13,889}	582,396 (116,479) [27,955] {13,977}	586,038 (117,208) [28,130] {14,065}
Placer	66,916	67,323	67,512	67,664	68,195 (13,639) [3,273] {1,637}	68,650 (13,730) [3,295] {1,648}	69,161 (13,832) [3,320] {1,660}
Riverside	596,526	599,544	601,559	601,081	604,200 (120,840) [29,002] {14,501}	607,484 (121,497) [29,159] {14,580}	610,355 (122,071) [29,297] {14,649}
Sacramento	288,676	290,321	291,466	292,106	294,385 (58,877) [14,130] {7,065}	296,543 (59,309) [14,234] {7,117}	298,665 (59,733) [14,336] {7,168}
San Bernardino	566,667	568,479	571,589	571,655	574,308 (114,862) [27,567] {13,783}	576,785 (115,357) [27,686] {13,843}	579,181 (115,836) [27,801] {13,900}
San Diego	755,534	761,840	763,492	764,556	769,741 (153,948) [36,948] {18,474}	774,047 (154,809) [37,154] {18,577}	778,474 (155,695) [37,367] {18,683}
San Francisco	126,052	130,049	130,657	127,287	128,753 (25,751) [6,180] {3,090}	130,215 (26,043) [6,250] {3,125}	131,443 (26,289) [6,309] {3,155}
San Joaquin	168,885	169,674	170,145	170,046	171,504 (34,301) [8,232] {4,116}	172,839 (34,568) [8,296] {4,148}	174,032 (34,806) [8,354] {4,177}
San Luis Obispo	52,659	53,221	53,498	53,668	54,190 (10,838) [2,601] {1,301}	54,639 (10,928) [2,623] {1,311}	55,089 (11,018) [2,644] {1,322}
San Mateo	122,085	129,566	129,915	122,346	124,628 (24,926) [5,982] {2,991}	126,721 (25,344) [6,083] {3,041}	128,867 (25,773) [6,186] {3,093}
Santa Barbara	86,028	86,881	87,250	87,363	88,213 (17,643) [4,234] {2,117}	88,949 (17,790) [4,270] {2,135}	89,755 (17,951) [4,308] {2,154}
Santa Clara	306,234	308,553	310,031	309,945	313,163 (62,633) [15,032] {7,516}	316,163 (63,233) [15,176] {7,588}	319,003 (63,801) [15,312] {7,656}
Santa Cruz	45,321	45,961	46,277	46,241	46,991 (9,398) [2,256] {1,128}	47,656 (9,531) [2,288] {1,144}	48,357 (9,671) [2,321] {1,161}
Solano	79,089	82,186	82,454	82,542	83,620 (16,724) [4,014] {2,007}	84,636 (16,927) [4,063] {2,031}	85,707 (17,141) [4,114] {2,057}
Sonoma	80,440	80,942	81,309	81,316	82,041 (16,408) [3,938] {1,969}	82,708 (16,542) [3,970] {1,985}	83,390 (16,678) [4,003] {2,001}
Ventura	176,159	177,085	177,508	177,527	178,417 (35,683) [8,564] {4,282}	179,367 (35,873) [8,610] {4,305}	180,151 (36,030) [8,647] {4,324}

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.