IEM's AI Modeling: Short-term COVID-19 Projections
Date: 10/29/21

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 10/29/21 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
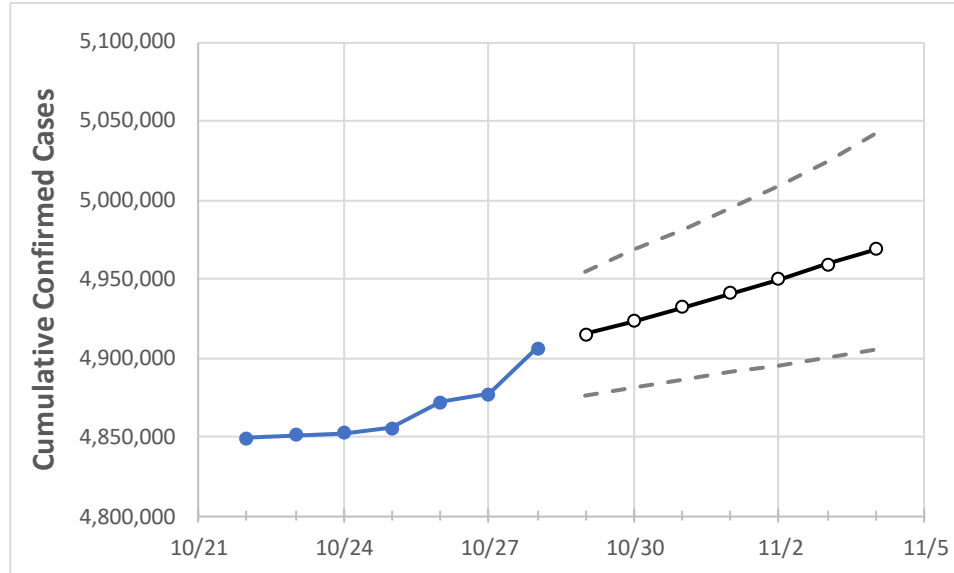
	Actual Confirmed Cases On:				Projected Cases For:						
	10/25	10/26	10/27	10/28	10/29	10/30	10/31	11/1	11/2	11/3	11/4
California	4,855,616	4,872,001	4,876,777	4,906,317	4,914,750	4,923,306	4,932,015	4,940,928	4,949,856	4,959,371	4,969,018

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:						
	10/25	10/26	10/27	10/28	10/29	10/30	10/31	11/1	11/2	11/3	11/4
Alameda	121,069	121,195	121,236	121,397	121,504	121,609	121,717	121,823	121,928	122,032	122,136
Contra Costa	100,327	100,430	100,515	100,637	100,738	100,840	100,938	101,039	101,139	101,239	101,336
Fresno	147,449	147,826	148,063	148,484	148,838	149,184	149,551	149,907	150,264	150,640	151,004
Kern	147,294	147,784	148,261	148,507	148,868	149,238	149,594	149,966	150,339	150,720	151,092
Lake	6,684	6,701	6,714	6,735	6,752	6,770	6,787	6,804	6,821	6,839	6,857
Los Angeles	1,485,769	1,486,614	1,487,502	1,489,380	1,490,476	1,491,536	1,492,629	1,493,704	1,494,835	1,495,966	1,497,048
Marin	17,759	17,776	17,796	17,809	17,826	17,843	17,860	17,877	17,895	17,912	17,929
Monterey	50,979	51,002	51,027	51,149	51,186	51,223	51,258	51,294	51,332	51,368	51,410
Orange	325,123	325,252	325,607	325,921	326,176	326,426	326,678	326,936	327,190	327,455	327,719
Placer	39,683	39,766	39,858	39,972	40,062	40,152	40,241	40,332	40,424	40,518	40,616
Riverside	372,940	373,363	373,757	374,219	374,609	375,009	375,406	375,803	376,225	376,628	377,043
Sacramento	160,679	161,027	161,154	161,527	161,835	162,149	162,457	162,766	163,091	163,424	163,751
San Bernardino	359,723	360,071	360,342	360,817	361,182	361,542	361,905	362,278	362,658	363,033	363,395
San Diego	368,267	368,826	369,361	391,044	391,558	392,072	392,609	393,122	393,658	394,200	394,738
San Francisco	54,606	54,661	54,683	54,759	54,809	54,859	54,910	54,959	55,007	55,056	55,101
San Joaquin	103,181	103,316	103,372	103,580	103,714	103,845	103,980	104,112	104,244	104,377	104,512
San Luis Obispo	30,087	30,125	30,146	30,240	30,284	30,326	30,372	30,416	30,461	30,508	30,552
San Mateo	54,324	54,376	54,423	54,528	54,584	54,641	54,696	54,756	54,813	54,873	54,932
Santa Barbara	45,390	45,446	45,506	45,579	45,638	45,696	45,755	45,813	45,873	45,932	45,992
Santa Clara	146,007	146,162	146,199	146,378	146,525	146,666	146,810	146,953	147,096	147,246	147,389
Santa Cruz	21,099	21,120	21,134	21,168	21,191	21,214	21,237	21,259	21,283	21,305	21,329
Solano	46,184	46,224	46,246	46,303	46,339	46,376	46,410	46,445	46,481	46,515	46,549
Sonoma	41,200	41,267	41,315	41,358	41,411	41,464	41,515	41,570	41,624	41,679	41,733
Ventura	101,239	101,306	101,388	101,502	101,574	101,644	101,712	101,783	101,851	101,919	101,987

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:		
	10/25	10/26	10/27	10/28	10/30	11/1	11/3
Alameda	121,069	121,195	121,236	121,397	121,609 (24,322) [5,837] {2,919}	121,823 (24,365) [5,848] {2,924}	122,032 (24,406) [5,858] {2,929}
Contra Costa	100,327	100,430	100,515	100,637	100,840 (20,168) [4,840] {2,420}	101,039 (20,208) [4,850] {2,425}	101,239 (20,248) [4,859] {2,430}
Fresno	147,449	147,826	148,063	148,484	149,184 (29,837) [7,161] {3,580}	149,907 (29,981) [7,196] {3,598}	150,640 (30,128) [7,231] {3,615}
Kern	147,294	147,784	148,261	148,507	149,238 (29,848) [7,163] {3,582}	149,966 (29,993) [7,198] {3,599}	150,720 (30,144) [7,235] {3,617}
Lake	6,684	6,701	6,714	6,735	6,770 (1,354) [325] {162}	6,804 (1,361) [327] {163}	6,839 (1,368) [328] {164}
Los Angeles	1,485,769	1,486,614	1,487,502	1,489,380	1,491,536 (298,307) [71,594] {35,797}	1,493,704 (298,741) [71,698] {35,849}	1,495,966 (299,193) [71,806] {35,903}
Marin	17,759	17,776	17,796	17,809	17,843 (3,569) [856] {428}	17,877 (3,575) [858] {429}	17,912 (3,582) [860] {430}
Monterey	50,979	51,002	51,027	51,149	51,223 (10,245) [2,459] {1,229}	51,294 (10,259) [2,462] {1,231}	51,368 (10,274) [2,466] {1,233}
Orange	325,123	325,252	325,607	325,921	326,426 (65,285) [15,668] {7,834}	326,936 (65,387) [15,693] {7,846}	327,455 (65,491) [15,718] {7,859}
Placer	39,683	39,766	39,858	39,972	40,152 (8,030) [1,927] {964}	40,332 (8,066) [1,936] {968}	40,518 (8,104) [1,945] {972}
Riverside	372,940	373,363	373,757	374,219	375,009 (75,002) [18,000] {9,000}	375,803 (75,161) [18,039] {9,019}	376,628 (75,326) [18,078] {9,039}
Sacramento	160,679	161,027	161,154	161,527	162,149 (32,430) [7,783] {3,892}	162,766 (32,553) [7,813] {3,906}	163,424 (32,685) [7,844] {3,922}
San Bernardino	359,723	360,071	360,342	360,817	361,542 (72,308) [17,354] {8,677}	362,278 (72,456) [17,389] {8,695}	363,033 (72,607) [17,426] {8,713}
San Diego	368,267	368,826	369,361	391,044	392,072 (78,414) [18,819] {9,410}	393,122 (78,624) [18,870] {9,435}	394,200 (78,840) [18,922] {9,461}
San Francisco	54,606	54,661	54,683	54,759	54,859 (10,972) [2,633] {1,317}	54,959 (10,992) [2,638] {1,319}	55,056 (11,011) [2,643] {1,321}
San Joaquin	103,181	103,316	103,372	103,580	103,845 (20,769) [4,985] {2,492}	104,112 (20,822) [4,997] {2,499}	104,377 (20,875) [5,010] {2,505}
San Luis Obispo	30,087	30,125	30,146	30,240	30,326 (6,065) [1,456] {728}	30,416 (6,083) [1,460] {730}	30,508 (6,102) [1,464] {732}
San Mateo	54,324	54,376	54,423	54,528	54,641 (10,928) [2,623] {1,311}	54,756 (10,951) [2,628] {1,314}	54,873 (10,975) [2,634] {1,317}
Santa Barbara	45,390	45,446	45,506	45,579	45,696 (9,139) [2,193] {1,097}	45,813 (9,163) [2,199] {1,100}	45,932 (9,186) [2,205] {1,102}
Santa Clara	146,007	146,162	146,199	146,378	146,666 (29,333) [7,040] {3,520}	146,953 (29,391) [7,054] {3,527}	147,246 (29,449) [7,068] {3,534}
Santa Cruz	21,099	21,120	21,134	21,168	21,214 (4,243) [1,018] {509}	21,259 (4,252) [1,020] {510}	21,305 (4,261) [1,023] {511}
Solano	46,184	46,224	46,246	46,303	46,376 (9,275) [2,226] {1,113}	46,445 (9,289) [2,229] {1,115}	46,515 (9,303) [2,233] {1,116}
Sonoma	41,200	41,267	41,315	41,358	41,464 (8,293) [1,990] {995}	41,570 (8,314) [1,995] {998}	41,679 (8,336) [2,001] {1,000}
Ventura	101,239	101,306	101,388	101,502	101,644 (20,329) [4,879] {2,439}	101,783 (20,357) [4,886] {2,443}	101,919 (20,384) [4,892] {2,446}

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.