

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

Date: 11/9/20

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 11/9/20 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.

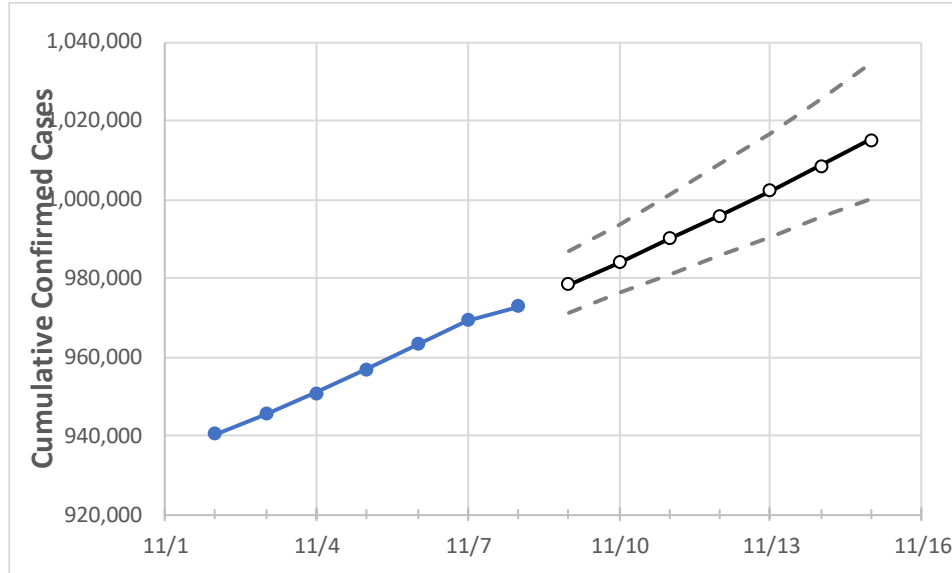
IEM's Modeling Lead

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:				
	11/5	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15
California	956,854	963,211	969,362	972,713	978,308	984,046	989,930	995,964	1,002,152	1,008,498	1,015,007

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 20%, and are often within 10%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	11/5	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15
Alameda	24,370	24,418	24,664	24,664	24,726	24,787	24,846	24,906	24,964	25,021	25,078
Contra Costa	19,517	19,685	19,785	19,943	20,062	20,185	20,313	20,446	20,584	20,727	20,875
Fresno	31,952	32,056	32,278	32,497	32,628	32,762	32,898	33,037	33,178	33,322	33,468
Kern	34,779	34,973	35,063	35,063	35,186	35,314	35,448	35,588	35,733	35,886	36,045
Los Angeles	315,564	317,656	319,977	319,977	322,253	324,651	327,176	329,837	332,640	335,591	338,701
Marin	7,197	7,205	7,232	7,232	7,242	7,252	7,262	7,272	7,282	7,292	7,303
Monterey	11,956	11,998	12,136	12,136	12,169	12,202	12,234	12,266	12,297	12,328	12,358
Orange	61,112	61,421	61,743	62,255	62,582	62,920	63,271	63,634	64,010	64,400	64,804
Placer	4,640	4,692	4,719	4,745	4,782	4,822	4,862	4,905	4,950	4,996	5,045
Riverside	70,309	70,696	70,925	71,153	71,436	71,727	72,024	72,328	72,639	72,958	73,285
Sacramento	27,043	27,278	27,530	27,773	28,012	28,263	28,527	28,804	29,096	29,402	29,724
San Bernardino	67,196	67,777	68,242	68,721	69,258	69,820	70,408	71,023	71,666	72,339	73,043
San Diego	58,636	59,116	59,656	59,682	59,962	60,238	60,510	60,777	61,041	61,300	61,556
San Francisco	12,666	12,753	12,860	12,980	13,068	13,161	13,260	13,365	13,475	13,592	13,716
San Joaquin	22,450	22,556	22,635	22,635	22,695	22,759	22,825	22,895	22,969	23,047	23,128
San Luis Obispo	4,422	4,496	4,568	4,668	4,696	4,725	4,755	4,786	4,819	4,854	4,890
San Mateo	11,629	11,710	11,810	11,810	11,872	11,936	12,002	12,070	12,141	12,213	12,288
Santa Barbara	10,042	10,089	10,128	10,157	10,180	10,203	10,226	10,250	10,273	10,296	10,320
Santa Clara	25,705	25,883	26,137	26,490	26,696	26,911	27,134	27,365	27,606	27,856	28,116
Santa Cruz	3,007	3,031	3,074	3,130	3,165	3,201	3,241	3,283	3,328	3,377	3,428
Solano	7,996	8,132	8,132	8,132	8,184	8,237	8,290	8,345	8,401	8,458	8,516
Sonoma	10,116	10,170	10,248	10,248	10,318	10,389	10,461	10,533	10,606	10,680	10,754
Ventura	14,936	15,113	15,222	15,364	15,466	15,574	15,688	15,808	15,934	16,067	16,207

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:											
	11/5	11/6	11/7	11/8	11/10			11/12			11/14					
Alameda	24,370	24,418	24,664	24,664	24,787	(4,957)	[1,190]	{595}	24,906	(4,981)	[1,195]	{598}	25,021	(5,004)	[1,201]	{601}
Contra Costa	19,517	19,685	19,785	19,943	20,185	(4,037)	[969]	{484}	20,446	(4,089)	[981]	{491}	20,727	(4,145)	[995]	{497}
Fresno	31,952	32,056	32,278	32,497	32,762	(6,552)	[1,573]	{786}	33,037	(6,607)	[1,586]	{793}	33,322	(6,664)	[1,599]	{800}
Kern	34,779	34,973	35,063	35,063	35,314	(7,063)	[1,695]	{848}	35,588	(7,118)	[1,708]	{854}	35,886	(7,177)	[1,723]	{861}
Los Angeles	315,564	317,656	319,977	319,977	324,651	(64,930)	[15,583]	{7,792}	329,837	(65,967)	[15,832]	{7,916}	335,591	(67,118)	[16,108]	{8,054}
Marin	7,197	7,205	7,232	7,232	7,252	(1,450)	[348]	{174}	7,272	(1,454)	[349]	{175}	7,292	(1,458)	[350]	{175}
Monterey	11,956	11,998	12,136	12,136	12,202	(2,440)	[586]	{293}	12,266	(2,453)	[589]	{294}	12,328	(2,466)	[592]	{296}
Orange	61,112	61,421	61,743	62,255	62,920	(12,584)	[3,020]	{1,510}	63,634	(12,727)	[3,054]	{1,527}	64,400	(12,880)	[3,091]	{1,546}
Placer	4,640	4,692	4,719	4,745	4,822	(964)	[231]	{116}	4,905	(981)	[235]	{118}	4,996	(999)	[240]	{120}
Riverside	70,309	70,696	70,925	71,153	71,727	(14,345)	[3,443]	{1,721}	72,328	(14,466)	[3,472]	{1,736}	72,958	(14,592)	[3,502]	{1,751}
Sacramento	27,043	27,278	27,530	27,773	28,263	(5,653)	[1,357]	{678}	28,804	(5,761)	[1,383]	{691}	29,402	(5,880)	[1,411]	{706}
San Bernardino	67,196	67,777	68,242	68,721	69,820	(13,964)	[3,351]	{1,676}	71,023	(14,205)	[3,409]	{1,705}	72,339	(14,468)	[3,472]	{1,736}
San Diego	58,636	59,116	59,656	59,682	60,238	(12,048)	[2,891]	{1,446}	60,777	(12,155)	[2,917]	{1,459}	61,300	(12,260)	[2,942]	{1,471}
San Francisco	12,666	12,753	12,860	12,980	13,161	(2,632)	[632]	{316}	13,365	(2,673)	[641]	{321}	13,592	(2,718)	[652]	{326}
San Joaquin	22,450	22,556	22,635	22,635	22,759	(4,552)	[1,092]	{546}	22,895	(4,579)	[1,099]	{549}	23,047	(4,609)	[1,106]	{553}
San Luis Obispo	4,422	4,496	4,568	4,668	4,725	(945)	[227]	{113}	4,786	(957)	[230]	{115}	4,854	(971)	[233]	{116}
San Mateo	11,629	11,710	11,810	11,810	11,936	(2,387)	[573]	{286}	12,070	(2,414)	[579]	{290}	12,213	(2,443)	[586]	{293}
Santa Barbara	10,042	10,089	10,128	10,157	10,203	(2,041)	[490]	{245}	10,250	(2,050)	[492]	{246}	10,296	(2,059)	[494]	{247}
Santa Clara	25,705	25,883	26,137	26,490	26,911	(5,382)	[1,292]	{646}	27,365	(5,473)	[1,314]	{657}	27,856	(5,571)	[1,337]	{669}
Santa Cruz	3,007	3,031	3,074	3,130	3,201	(640)	[154]	{77}	3,283	(657)	[158]	{79}	3,377	(675)	[162]	{81}
Solano	7,996	8,132	8,132	8,132	8,237	(1,647)	[395]	{198}	8,345	(1,669)	[401]	{200}	8,458	(1,692)	[406]	{203}
Sonoma	10,116	10,170	10,248	10,248	10,389	(2,078)	[499]	{249}	10,533	(2,107)	[506]	{253}	10,680	(2,136)	[513]	{256}
Ventura	14,936	15,113	15,222	15,364	15,574	(3,115)	[748]	{374}	15,808	(3,162)	[759]	{379}	16,067	(3,213)	[771]	{386}

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.