

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

Date: 3/12/21

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 3/12/21 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.

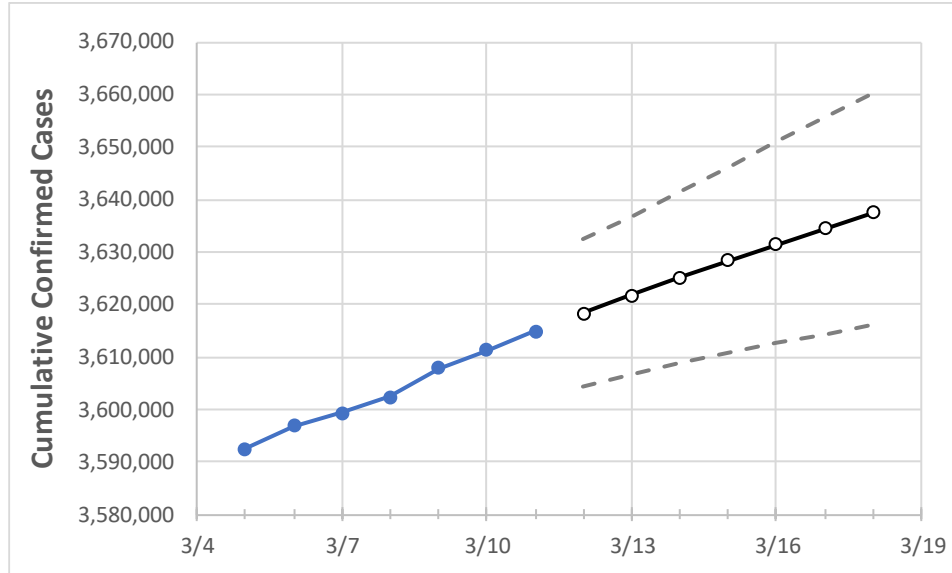
IEM's Modeling Lead

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:						
	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18	
California	3,602,380	3,607,891	3,611,295	3,614,852	3,618,326	3,621,751	3,625,090	3,628,277	3,631,366	3,634,443	3,637,465	

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:						
	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18
Alameda	81,433	81,573	81,658	81,747	81,836	81,919	81,996	82,073	82,150	82,219	82,289
Contra Costa	63,400	63,567	63,626	63,712	63,805	63,895	63,986	64,076	64,160	64,244	64,330
Fresno	96,549	96,665	96,744	96,866	96,984	97,099	97,213	97,325	97,434	97,540	97,646
Kern	104,242	104,443	104,509	104,564	104,654	104,739	104,819	104,896	104,970	105,039	105,105
Lake	3,192	3,195	3,202	3,207	3,210	3,214	3,217	3,220	3,223	3,225	3,227
Los Angeles	1,204,018	1,205,327	1,206,740	1,208,024	1,209,307	1,210,526	1,211,732	1,212,925	1,214,125	1,215,273	1,216,398
Marin	13,368	13,388	13,406	13,416	13,432	13,447	13,462	13,477	13,491	13,505	13,519
Monterey	42,455	42,481	42,508	42,523	42,540	42,556	42,571	42,586	42,601	42,612	42,624
Orange	262,849	262,995	263,111	263,279	263,426	263,563	263,697	263,828	263,947	264,067	264,187
Placer	20,162	20,183	20,204	20,242	20,279	20,316	20,355	20,393	20,431	20,468	20,507
Riverside	291,040	291,492	291,675	291,675	291,811	291,938	292,074	292,196	292,314	292,428	292,543
Sacramento	94,513	94,699	94,770	94,907	95,013	95,117	95,218	95,315	95,405	95,497	95,585
San Bernardino	288,044	288,045	288,135	288,297	288,421	288,546	288,664	288,773	288,872	288,963	289,058
San Diego	262,968	263,748	264,097	264,527	264,818	265,108	265,368	265,622	265,869	266,105	266,343
San Francisco	34,594	34,634	34,654	34,688	34,719	34,750	34,779	34,807	34,835	34,860	34,884
San Joaquin	67,564	67,657	67,754	67,817	67,901	67,984	68,068	68,149	68,232	68,312	68,394
San Luis Obispo	19,904	19,927	19,966	20,017	20,042	20,065	20,089	20,111	20,134	20,155	20,177
San Mateo	39,436	39,492	39,535	39,571	39,613	39,654	39,693	39,732	39,769	39,803	39,836
Santa Barbara	32,347	32,436	32,474	32,519	32,561	32,601	32,640	32,679	32,716	32,752	32,787
Santa Clara	111,952	112,036	112,174	112,325	112,456	112,584	112,706	112,829	112,943	113,056	113,164
Santa Cruz	14,879	14,908	14,937	14,982	15,015	15,048	15,082	15,117	15,152	15,189	15,226
Solano	30,404	30,425	30,453	30,488	30,519	30,549	30,579	30,607	30,635	30,663	30,691
Sonoma	28,533	28,571	28,601	28,638	28,678	28,719	28,757	28,796	28,832	28,869	28,906
Ventura	78,487	78,526	78,568	78,609	78,677	78,741	78,802	78,862	78,916	78,968	79,017

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:											
	3/8	3/9	3/10	3/11	3/13				3/15				3/17			
Alameda	81,433	81,573	81,658	81,747	81,919	(16,384)	[3,932]	{1,966}	82,073	(16,415)	[3,940]	{1,970}	82,219	(16,444)	[3,947]	{1,973}
Contra Costa	63,400	63,567	63,626	63,712	63,895	(12,779)	[3,067]	{1,533}	64,076	(12,815)	[3,076]	{1,538}	64,244	(12,849)	[3,084]	{1,542}
Fresno	96,549	96,665	96,744	96,866	97,099	(19,420)	[4,661]	{2,330}	97,325	(19,465)	[4,672]	{2,336}	97,540	(19,508)	[4,682]	{2,341}
Kern	104,242	104,443	104,509	104,564	104,739	(20,948)	[5,027]	{2,514}	104,896	(20,979)	[5,035]	{2,517}	105,039	(21,008)	[5,042]	{2,521}
Lake	3,192	3,195	3,202	3,207	3,214	(643)	[154]	{77}	3,220	(644)	[155]	{77}	3,225	(645)	[155]	{77}
Los Angeles	1,204,018	1,205,327	1,206,740	1,208,024	1,210,526	(242,105)	[58,105]	{29,053}	1,212,925	(242,585)	[58,220]	{29,110}	1,215,273	(243,055)	[58,333]	{29,167}
Marin	13,368	13,388	13,406	13,416	13,447	(2,689)	[645]	{323}	13,477	(2,695)	[647]	{323}	13,505	(2,701)	[648]	{324}
Monterey	42,455	42,481	42,508	42,523	42,556	(8,511)	[2,043]	{1,021}	42,586	(8,517)	[2,044]	{1,022}	42,612	(8,522)	[2,045]	{1,023}
Orange	262,849	262,995	263,111	263,279	263,563	(52,713)	[12,651]	{6,326}	263,828	(52,766)	[12,664]	{6,332}	264,067	(52,813)	[12,675]	{6,338}
Placer	20,162	20,183	20,204	20,242	20,316	(4,063)	[975]	{488}	20,393	(4,079)	[979]	{489}	20,468	(4,094)	[982]	{491}
Riverside	291,040	291,492	291,675	291,675	291,938	(58,388)	[14,013]	{7,007}	292,196	(58,439)	[14,025]	{7,013}	292,428	(58,486)	[14,037]	{7,018}
Sacramento	94,513	94,699	94,770	94,907	95,117	(19,023)	[4,566]	{2,283}	95,315	(19,063)	[4,575]	{2,288}	95,497	(19,099)	[4,584]	{2,292}
San Bernardino	288,044	288,045	288,135	288,297	288,546	(57,709)	[13,850]	{6,925}	288,773	(57,755)	[13,861]	{6,931}	288,963	(57,793)	[13,870]	{6,935}
San Diego	262,968	263,748	264,097	264,527	265,108	(53,022)	[12,725]	{6,363}	265,622	(53,124)	[12,750]	{6,375}	266,105	(53,221)	[12,773]	{6,387}
San Francisco	34,594	34,634	34,654	34,688	34,750	(6,950)	[1,668]	{834}	34,807	(6,961)	[1,671]	{835}	34,860	(6,972)	[1,673]	{837}
San Joaquin	67,564	67,657	67,754	67,817	67,984	(13,597)	[3,263]	{1,632}	68,149	(13,630)	[3,271]	{1,636}	68,312	(13,662)	[3,279]	{1,639}
San Luis Obispo	19,904	19,927	19,966	20,017	20,065	(4,013)	[963]	{482}	20,111	(4,022)	[965]	{483}	20,155	(4,031)	[967]	{484}
San Mateo	39,436	39,492	39,535	39,571	39,654	(7,931)	[1,903]	{952}	39,732	(7,946)	[1,907]	{954}	39,803	(7,961)	[1,911]	{955}
Santa Barbara	32,347	32,436	32,474	32,519	32,601	(6,520)	[1,565]	{782}	32,679	(6,536)	[1,569]	{784}	32,752	(6,550)	[1,572]	{786}
Santa Clara	111,952	112,036	112,174	112,325	112,584	(22,517)	[5,404]	{2,702}	112,829	(22,566)	[5,416]	{2,708}	113,056	(22,611)	[5,427]	{2,713}
Santa Cruz	14,879	14,908	14,937	14,982	15,048	(3,010)	[722]	{361}	15,117	(3,023)	[726]	{363}	15,189	(3,038)	[729]	{365}
Solano	30,404	30,425	30,453	30,488	30,549	(6,110)	[1,466]	{733}	30,607	(6,121)	[1,469]	{735}	30,663	(6,133)	[1,472]	{736}
Sonoma	28,533	28,571	28,601	28,638	28,719	(5,744)	[1,378]	{689}	28,796	(5,759)	[1,382]	{691}	28,869	(5,774)	[1,386]	{693}
Ventura	78,487	78,526	78,568	78,609	78,741	(15,748)	[3,780]	{1,890}	78,862	(15,772)	[3,785]	{1,893}	78,968	(15,794)	[3,790]	{1,895}

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.