IEM's AI Modeling: Short-term COVID-19 Projections
Date: 5/11/21

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 5/11/21 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
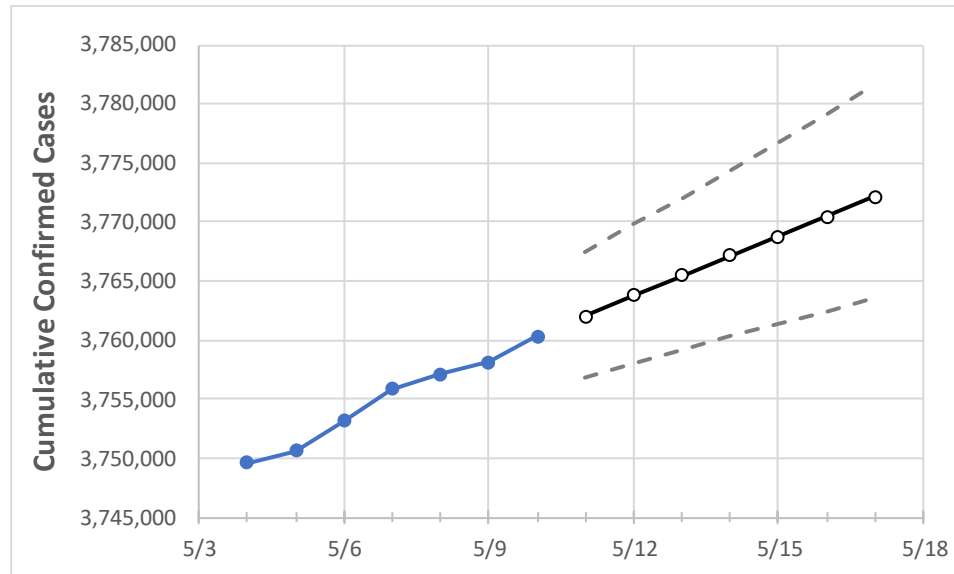
	Actual Confirmed Cases On:				Projected Cases For:						
	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17
California	3,755,869	3,757,115	3,758,137	3,760,303	3,762,051	3,763,759	3,765,454	3,767,134	3,768,797	3,770,473	3,772,127

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:						
	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17
Alameda	87,485	87,585	87,633	87,637	87,702	87,766	87,829	87,891	87,951	88,010	88,066
Contra Costa	68,437	68,503	68,582	68,638	68,700	68,762	68,824	68,884	68,946	69,005	69,064
Fresno	101,536	101,625	101,676	101,729	101,773	101,817	101,861	101,905	101,948	101,992	102,035
Kern	108,968	108,993	109,031	109,052	109,098	109,143	109,187	109,231	109,273	109,316	109,358
Lake	3,465	3,467	3,470	3,471	3,474	3,477	3,480	3,483	3,485	3,488	3,491
Los Angeles	1,235,150	1,235,422	1,235,651	1,235,828	1,236,064	1,236,293	1,236,520	1,236,739	1,236,957	1,237,168	1,237,374
Marin	14,030	14,034	14,037	14,040	14,048	14,056	14,064	14,072	14,080	14,087	14,095
Monterey	43,563	43,574	43,584	43,595	43,609	43,623	43,637	43,652	43,666	43,681	43,695
Orange	270,625	270,705	270,744	270,800	270,861	270,918	270,975	271,029	271,083	271,135	271,184
Placer	22,550	22,570	22,590	22,610	22,640	22,672	22,703	22,733	22,762	22,793	22,822
Riverside	299,064	299,100	299,137	299,173	299,237	299,295	299,355	299,412	299,469	299,527	299,586
Sacramento	104,176	104,192	104,208	104,491	104,625	104,758	104,901	105,043	105,188	105,337	105,488
San Bernardino	296,425	296,514	296,596	296,655	296,721	296,786	296,850	296,912	296,973	297,034	297,095
San Diego	277,533	277,759	277,949	278,182	278,423	278,672	278,924	279,185	279,456	279,737	280,030
San Francisco	36,599	36,616	36,642	36,669	36,690	36,710	36,730	36,748	36,768	36,787	36,805
San Joaquin	73,009	73,064	73,119	73,174	73,239	73,306	73,370	73,441	73,511	73,587	73,657
San Luis Obispo	21,282	21,286	21,289	21,293	21,301	21,308	21,315	21,323	21,329	21,336	21,341
San Mateo	41,802	41,844	41,871	41,903	41,936	41,971	42,005	42,039	42,072	42,107	42,141
Santa Barbara	34,291	34,306	34,317	34,323	34,336	34,348	34,360	34,371	34,382	34,393	34,403
Santa Clara	118,792	118,851	118,901	118,932	118,985	119,036	119,084	119,131	119,177	119,223	119,267
Santa Cruz	16,188	16,205	16,221	16,238	16,264	16,290	16,316	16,342	16,368	16,394	16,420
Solano	32,752	32,789	32,827	32,864	32,904	32,944	32,982	33,022	33,060	33,099	33,139
Sonoma	29,966	29,975	29,984	30,002	30,016	30,030	30,044	30,058	30,072	30,086	30,100
Ventura	80,842	80,863	80,884	80,905	80,931	80,956	80,981	81,007	81,032	81,058	81,083

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: | | |
	5/7	5/8	5/9	5/10	5/12	5/14	5/16
Alameda	87,485	87,585	87,633	87,637	87,766 (17,553) [4,213] {2,106}	87,891 (17,578) [4,219] {2,109}	88,010 (17,602) [4,224] {2,112}
Contra Costa	68,437	68,503	68,582	68,638	68,762 (13,752) [3,301] {1,650}	68,884 (13,777) [3,306] {1,653}	69,005 (13,801) [3,312] {1,656}
Fresno	101,536	101,625	101,676	101,729	101,817 (20,363) [4,887] {2,444}	101,905 (20,381) [4,891] {2,446}	101,992 (20,398) [4,896] {2,448}
Kern	108,968	108,993	109,031	109,052	109,143 (21,829) [5,239] {2,619}	109,231 (21,846) [5,243] {2,622}	109,316 (21,863) [5,247] {2,624}
Lake	3,465	3,467	3,470	3,471	3,477 (695) [167] {83}	3,483 (697) [167] {84}	3,488 (698) [167] {84}
Los Angeles	1,235,150	1,235,422	1,235,651	1,235,828	1,236,293 (247,259) [59,342] {29,671}	1,236,739 (247,348) [59,363] {29,682}	1,237,168 (247,434) [59,384] {29,692}
Marin	14,030	14,034	14,037	14,040	14,056 (2,811) [675] {337}	14,072 (2,814) [675] {338}	14,087 (2,817) [676] {338}
Monterey	43,563	43,574	43,584	43,595	43,623 (8,725) [2,094] {1,047}	43,652 (8,730) [2,095] {1,048}	43,681 (8,736) [2,097] {1,048}
Orange	270,625	270,705	270,744	270,800	270,918 (54,184) [13,004] {6,502}	271,029 (54,206) [13,009] {6,505}	271,135 (54,227) [13,014] {6,507}
Placer	22,550	22,570	22,590	22,610	22,672 (4,534) [1,088] {544}	22,733 (4,547) [1,091] {546}	22,793 (4,559) [1,094] {547}
Riverside	299,064	299,100	299,137	299,173	299,295 (59,859) [14,366] {7,183}	299,412 (59,882) [14,372] {7,186}	299,527 (59,905) [14,377] {7,189}
Sacramento	104,176	104,192	104,208	104,491	104,758 (20,952) [5,028] {2,514}	105,043 (21,009) [5,042] {2,521}	105,337 (21,067) [5,056] {2,528}
San Bernardino	296,425	296,514	296,596	296,655	296,786 (59,357) [14,246] {7,123}	296,912 (59,382) [14,252] {7,126}	297,034 (59,407) [14,258] {7,129}
San Diego	277,533	277,759	277,949	278,182	278,672 (55,734) [13,376] {6,688}	279,185 (55,837) [13,401] {6,700}	279,737 (55,947) [13,427] {6,714}
San Francisco	36,599	36,616	36,642	36,669	36,710 (7,342) [1,762] {881}	36,748 (7,350) [1,764] {882}	36,787 (7,357) [1,766] {883}
San Joaquin	73,009	73,064	73,119	73,174	73,306 (14,661) [3,519] {1,759}	73,441 (14,688) [3,525] {1,763}	73,587 (14,717) [3,532] {1,766}
San Luis Obispo	21,282	21,286	21,289	21,293	21,308 (4,262) [1,023] {511}	21,323 (4,265) [1,023] {512}	21,336 (4,267) [1,024] {512}
San Mateo	41,802	41,844	41,871	41,903	41,971 (8,394) [2,015] {1,007}	42,039 (8,408) [2,018] {1,009}	42,107 (8,421) [2,021] {1,011}
Santa Barbara	34,291	34,306	34,317	34,323	34,348 (6,870) [1,649] {824}	34,371 (6,874) [1,650] {825}	34,393 (6,879) [1,651] {825}
Santa Clara	118,792	118,851	118,901	118,932	119,036 (23,807) [5,714] {2,857}	119,131 (23,826) [5,718] {2,859}	119,223 (23,845) [5,723] {2,861}
Santa Cruz	16,188	16,205	16,221	16,238	16,290 (3,258) [782] {391}	16,342 (3,268) [784] {392}	16,394 (3,279) [787] {393}
Solano	32,752	32,789	32,827	32,864	32,944 (6,589) [1,581] {791}	33,022 (6,604) [1,585] {793}	33,099 (6,620) [1,589] {794}
Sonoma	29,966	29,975	29,984	30,002	30,030 (6,006) [1,441] {721}	30,058 (6,012) [1,443] {721}	30,086 (6,017) [1,444] {722}
Ventura	80,842	80,863	80,884	80,905	80,956 (16,191) [3,886] {1,943}	81,007 (16,201) [3,888] {1,944}	81,058 (16,212) [3,891] {1,945}

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.