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

Date: 2/5/21

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 2/5/21 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.

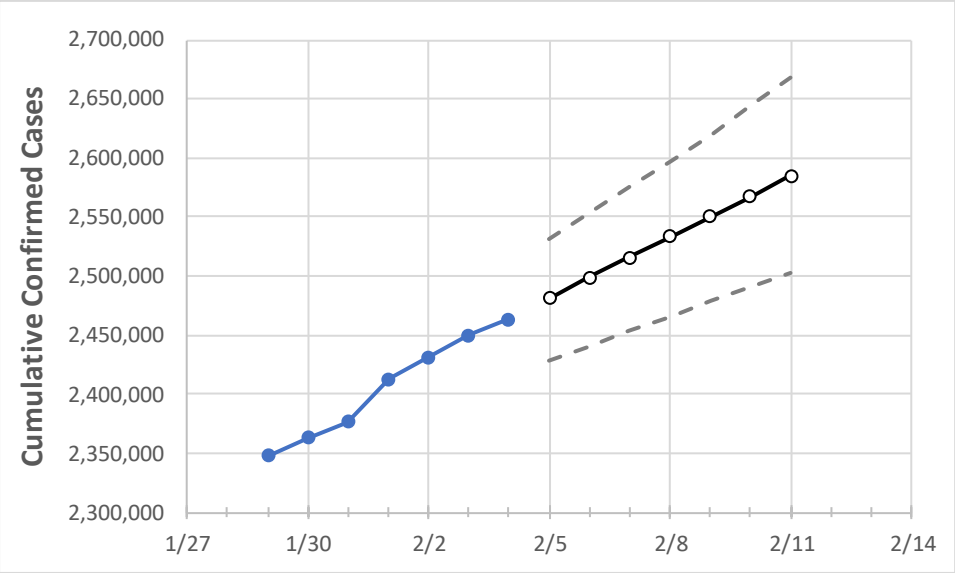
IEM's Modeling Lead

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.

Texas State Projections



	Actual Confirmed Cases On:				Projected Cases For:						
	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11
Texas	2,412,627	2,431,687	2,449,535	2,463,424	2,481,069	2,498,686	2,515,914	2,533,104	2,550,469	2,567,328	2,584,576

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.

Texas Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11
Bexar	175,530	176,790	177,802	178,662	180,230	181,781	183,286	184,860	186,391	187,923	189,431
Brazoria	29,105	29,343	29,736	29,900	30,103	30,311	30,523	30,729	30,937	31,141	31,341
Brazos	18,928	18,998	19,155	19,276	19,400	19,522	19,645	19,767	19,887	20,006	20,123
Collin	73,580	74,243	75,051	75,476	76,067	76,657	77,230	77,803	78,356	78,893	79,416
Dallas	259,944	261,382	262,738	263,887	265,184	266,466	267,695	268,901	270,072	271,216	272,324
Denton	54,154	54,742	55,363	55,820	56,330	56,844	57,347	57,849	58,368	58,873	59,382
El Paso	114,058	114,386	114,819	115,300	115,750	116,197	116,649	117,093	117,532	117,979	118,421
Ellis	18,843	18,984	19,104	19,234	19,353	19,473	19,589	19,706	19,817	19,925	20,035
Fort Bend	50,368	51,601	51,916	52,498	52,911	53,353	53,784	54,211	54,664	55,119	55,555
Galveston	30,717	30,904	31,273	31,468	31,688	31,903	32,106	32,313	32,520	32,720	32,923
Harris	319,800	320,744	323,408	325,010	327,125	329,188	331,259	333,270	335,332	337,324	339,323
Hidalgo	64,284	65,456	66,272	66,851	67,499	68,168	68,848	69,540	70,247	71,003	71,787
Johnson	16,720	16,838	16,940	17,141	17,254	17,368	17,476	17,582	17,689	17,794	17,893
Lubbock	46,942	47,020	47,132	47,195	47,264	47,332	47,396	47,458	47,521	47,580	47,638
McLennan	23,242	23,284	23,333	23,444	23,493	23,542	23,589	23,635	23,675	23,716	23,755
Montgomery	40,042	40,360	40,601	40,954	41,316	41,684	42,048	42,403	42,755	43,092	43,424
Tarrant	220,685	222,111	223,736	225,399	226,946	228,531	230,114	231,645	233,173	234,699	236,119
Travis	69,408	70,089	70,631	71,164	71,675	72,198	72,701	73,220	73,733	74,229	74,725
Williamson	36,848	37,189	37,448	37,674	38,007	38,328	38,651	38,966	39,280	39,590	39,902

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.*

Texas Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	2/1	2/2	2/3	2/4	2/6	2/8	2/10
Bexar	175,530	176,790	177,802	178,662	181,781 (36,356) [8,725] {4,363}	184,860 (36,972) [8,873] {4,437}	187,923 (37,585) [9,020] {4,510}
Brazoria	29,105	29,343	29,736	29,900	30,311 (6,062) [1,455] {727}	30,729 (6,146) [1,475] {737}	31,141 (6,228) [1,495] {747}
Brazos	18,928	18,998	19,155	19,276	19,522 (3,904) [937] {469}	19,767 (3,953) [949] {474}	20,006 (4,001) [960] {480}
Collin	73,580	74,243	75,051	75,476	76,657 (15,331) [3,680] {1,840}	77,803 (15,561) [3,735] {1,867}	78,893 (15,779) [3,787] {1,893}
Dallas	259,944	261,382	262,738	263,887	266,466 (53,293) [12,790] {6,395}	268,901 (53,780) [12,907] {6,454}	271,216 (54,243) [13,018] {6,509}
Denton	54,154	54,742	55,363	55,820	56,844 (11,369) [2,729] {1,364}	57,849 (11,570) [2,777] {1,388}	58,873 (11,775) [2,826] {1,413}
El Paso	114,058	114,386	114,819	115,300	116,197 (23,239) [5,577] {2,789}	117,093 (23,419) [5,620] {2,810}	117,979 (23,596) [5,663] {2,831}
Ellis	18,843	18,984	19,104	19,234	19,473 (3,895) [935] {467}	19,706 (3,941) [946] {473}	19,925 (3,985) [956] {478}
Fort Bend	50,368	51,601	51,916	52,498	53,353 (10,671) [2,561] {1,280}	54,211 (10,842) [2,602] {1,301}	55,119 (11,024) [2,646] {1,323}
Galveston	30,717	30,904	31,273	31,468	31,903 (6,381) [1,531] {766}	32,313 (6,463) [1,551] {776}	32,720 (6,544) [1,571] {785}
Harris	319,800	320,744	323,408	325,010	329,188 (65,838) [15,801] {7,901}	333,270 (66,654) [15,997] {7,998}	337,324 (67,465) [16,192] {8,096}
Hidalgo	64,284	65,456	66,272	66,851	68,168 (13,634) [3,272] {1,636}	69,540 (13,908) [3,338] {1,669}	71,003 (14,201) [3,408] {1,704}
Johnson	16,720	16,838	16,940	17,141	17,368 (3,474) [834] {417}	17,582 (3,516) [844] {422}	17,794 (3,559) [854] {427}
Lubbock	46,942	47,020	47,132	47,195	47,332 (9,466) [2,272] {1,136}	47,458 (9,492) [2,278] {1,139}	47,580 (9,516) [2,284] {1,142}
McLennan	23,242	23,284	23,333	23,444	23,542 (4,708) [1,130] {565}	23,635 (4,727) [1,134] {567}	23,716 (4,743) [1,138] {569}
Montgomery	40,042	40,360	40,601	40,954	41,684 (8,337) [2,001] {1,000}	42,403 (8,481) [2,035] {1,018}	43,092 (8,618) [2,068] {1,034}
Tarrant	220,685	222,111	223,736	225,399	228,531 (45,706) [10,970] {5,485}	231,645 (46,329) [11,119] {5,559}	234,699 (46,940) [11,266] {5,633}
Travis	69,408	70,089	70,631	71,164	72,198 (14,440) [3,466] {1,733}	73,220 (14,644) [3,515] {1,757}	74,229 (14,846) [3,563] {1,782}
Williamson	36,848	37,189	37,448	37,674	38,328 (7,666) [1,840] {920}	38,966 (7,793) [1,870] {935}	39,590 (7,918) [1,900] {950}

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.