IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/6/21

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 1/6/21 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
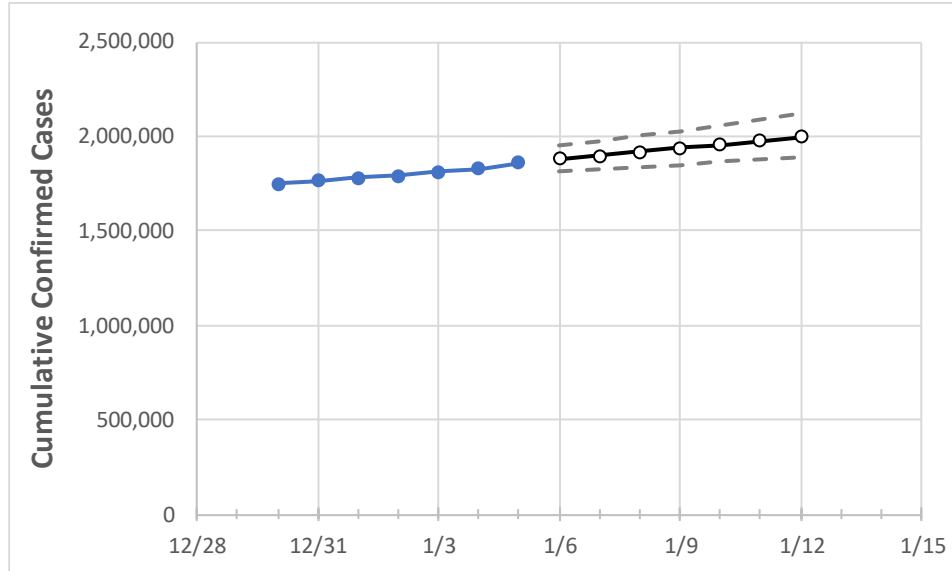
	Actual Confirmed Cases On:				Projected Cases For:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Texas	1,793,453	1,810,320	1,829,199	1,860,763	1,879,110	1,898,430	1,917,658	1,937,376	1,956,948	1,977,061	1,997,633

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:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Bexar	119,355	121,591	122,648	124,800	126,383	128,025	129,661	131,307	132,985	134,709	136,474
Brazoria	21,736	21,918	22,111	22,432	22,645	22,860	23,079	23,304	23,526	23,748	23,973
Brazos	14,577	14,628	14,733	14,902	15,006	15,111	15,216	15,321	15,429	15,535	15,642
Collin	50,012	50,954	51,408	52,695	53,519	54,342	55,193	56,049	56,907	57,751	58,637
Dallas	196,160	200,011	201,581	204,374	206,376	208,408	210,444	212,507	214,581	216,712	218,869
Denton	39,792	39,997	40,202	40,763	41,068	41,364	41,653	41,930	42,230	42,505	42,771
El Paso	99,327	99,672	99,889	100,421	100,720	101,021	101,313	101,617	101,912	102,205	102,516
Ellis	13,480	13,699	13,917	14,136	14,341	14,547	14,758	14,971	15,190	15,416	15,634
Fort Bend	36,375	36,425	36,476	36,526	36,776	37,033	37,260	37,496	37,730	37,963	38,195
Galveston	22,032	22,338	22,518	22,697	23,030	23,359	23,693	24,045	24,396	24,767	25,133
Harris	243,059	245,551	247,458	249,488	251,699	253,991	256,283	258,622	261,049	263,413	265,933
Hidalgo	51,886	51,998	52,110	52,657	52,907	53,155	53,410	53,677	53,938	54,198	54,454
Johnson	11,283	11,431	11,578	11,726	11,867	12,007	12,150	12,296	12,436	12,580	12,724
Lubbock	42,379	42,624	42,689	42,951	43,168	43,382	43,587	43,791	43,985	44,183	44,378
McLennan	19,160	19,294	19,427	19,561	19,714	19,866	20,021	20,174	20,330	20,485	20,645
Montgomery	27,656	27,992	28,327	28,812	29,187	29,567	29,948	30,337	30,720	31,102	31,494
Tarrant	151,685	153,365	159,931	161,878	163,933	166,058	168,258	170,490	172,778	175,153	177,436
Travis	51,558	51,956	52,708	53,272	53,820	54,370	54,937	55,493	56,091	56,668	57,265
Williamson	23,683	24,083	24,482	25,233	25,672	26,134	26,615	27,103	27,590	28,098	28,602

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:		
	1/2	1/3	1/4	1/5	1/7	1/9	1/11
Bexar	119,355	121,591	122,648	124,800	128,025 (25,605) [6,145] {3,073}	131,307 (26,261) [6,303] {3,151}	134,709 (26,942) [6,466] {3,233}
Brazoria	21,736	21,918	22,111	22,432	22,860 (4,572) [1,097] {549}	23,304 (4,661) [1,119] {559}	23,748 (4,750) [1,140] {570}
Brazos	14,577	14,628	14,733	14,902	15,111 (3,022) [725] {363}	15,321 (3,064) [735] {368}	15,535 (3,107) [746] {373}
Collin	50,012	50,954	51,408	52,695	54,342 (10,868) [2,608] {1,304}	56,049 (11,210) [2,690] {1,345}	57,751 (11,550) [2,772] {1,386}
Dallas	196,160	200,011	201,581	204,374	208,408 (41,682) [10,004] {5,002}	212,507 (42,501) [10,200] {5,100}	216,712 (43,342) [10,402] {5,201}
Denton	39,792	39,997	40,202	40,763	41,364 (8,273) [1,985] {993}	41,930 (8,386) [2,013] {1,006}	42,505 (8,501) [2,040] {1,020}
El Paso	99,327	99,672	99,889	100,421	101,021 (20,204) [4,849] {2,425}	101,617 (20,323) [4,878] {2,439}	102,205 (20,441) [4,906] {2,453}
Ellis	13,480	13,699	13,917	14,136	14,547 (2,909) [698] {349}	14,971 (2,994) [719] {359}	15,416 (3,083) [740] {370}
Fort Bend	36,375	36,425	36,476	36,526	37,033 (7,407) [1,778] {889}	37,496 (7,499) [1,800] {900}	37,963 (7,593) [1,822] {911}
Galveston	22,032	22,338	22,518	22,697	23,359 (4,672) [1,121] {561}	24,045 (4,809) [1,154] {577}	24,767 (4,953) [1,189] {594}
Harris	243,059	245,551	247,458	249,488	253,991 (50,798) [12,192] {6,096}	258,622 (51,724) [12,414] {6,207}	263,413 (52,683) [12,644] {6,322}
Hidalgo	51,886	51,998	52,110	52,657	53,155 (10,631) [2,551] {1,276}	53,677 (10,735) [2,576] {1,288}	54,198 (10,840) [2,602] {1,301}
Johnson	11,283	11,431	11,578	11,726	12,007 (2,401) [576] {288}	12,296 (2,459) [590] {295}	12,580 (2,516) [604] {302}
Lubbock	42,379	42,624	42,689	42,951	43,382 (8,676) [2,082] {1,041}	43,791 (8,758) [2,102] {1,051}	44,183 (8,837) [2,121] {1,060}
McLennan	19,160	19,294	19,427	19,561	19,866 (3,973) [954] {477}	20,174 (4,035) [968] {484}	20,485 (4,097) [983] {492}
Montgomery	27,656	27,992	28,327	28,812	29,567 (5,913) [1,419] {710}	30,337 (6,067) [1,456] {728}	31,102 (6,220) [1,493] {746}
Tarrant	151,685	153,365	159,931	161,878	166,058 (33,212) [7,971] {3,985}	170,490 (34,098) [8,183] {4,092}	175,153 (35,031) [8,407] {4,204}
Travis	51,558	51,956	52,708	53,272	54,370 (10,874) [2,610] {1,305}	55,493 (11,099) [2,664] {1,332}	56,668 (11,334) [2,720] {1,360}
Williamson	23,683	24,083	24,482	25,233	26,134 (5,227) [1,254] {627}	27,103 (5,421) [1,301] {650}	28,098 (5,620) [1,349] {674}

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.