IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/22/21

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 2/22/21 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
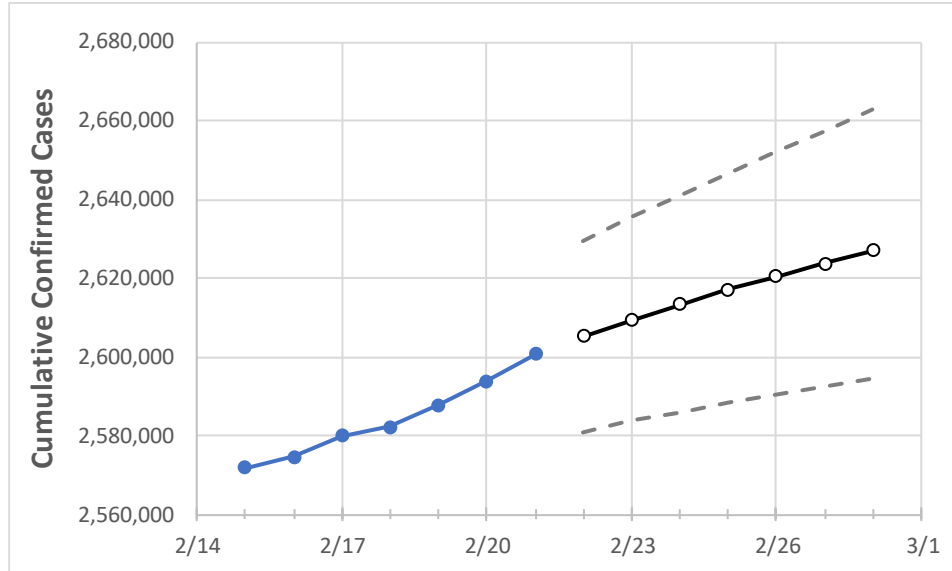
	Actual Confirmed Cases On:				Projected Cases For:						
	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28
Texas	2,582,111	2,587,712	2,593,816	2,600,660	2,605,220	2,609,409	2,613,376	2,617,118	2,620,492	2,623,714	2,626,948

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:						
	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28
Bexar	189,330	189,646	189,963	193,461	194,002	194,517	195,008	195,516	196,040	196,508	196,953
Brazoria	31,299	31,331	31,368	31,704	31,791	31,878	31,962	32,045	32,124	32,201	32,276
Brazos	20,258	20,282	20,307	20,331	20,361	20,387	20,412	20,436	20,458	20,476	20,495
Collin	80,947	81,062	81,130	81,208	81,416	81,601	81,781	81,953	82,118	82,271	82,419
Dallas	276,049	276,339	276,672	276,945	277,347	277,708	278,038	278,341	278,631	278,900	279,147
Denton	60,167	60,167	60,167	60,167	60,815	61,494	62,168	62,862	63,574	64,284	65,019
El Paso	120,556	120,769	120,982	121,503	121,801	122,098	122,377	122,658	122,935	123,201	123,461
Ellis	20,356	20,381	20,406	20,406	20,446	20,483	20,518	20,551	20,582	20,611	20,639
Fort Bend	55,509	55,548	56,104	56,104	56,265	56,421	56,566	56,710	56,854	56,982	57,120
Galveston	33,448	33,525	33,562	33,666	33,743	33,813	33,881	33,947	34,010	34,068	34,126
Harris	339,444	340,559	340,951	342,309	343,037	343,763	344,444	345,090	345,736	346,388	346,995
Hidalgo	72,213	72,723	72,723	72,723	73,001	73,254	73,503	73,752	73,985	74,218	74,434
Johnson	18,149	18,188	18,227	18,227	18,273	18,318	18,360	18,403	18,442	18,480	18,517
Lubbock	47,883	47,905	47,954	47,976	48,004	48,029	48,052	48,074	48,096	48,116	48,134
McLennan	24,268	24,268	24,268	24,268	24,323	24,377	24,433	24,487	24,540	24,589	24,643
Montgomery	43,920	44,060	44,060	44,060	44,184	44,301	44,418	44,523	44,626	44,727	44,823
Tarrant	236,911	237,676	238,077	238,077	238,528	238,942	239,323	239,676	240,038	240,361	240,655
Travis	73,719	73,749	73,779	73,809	73,872	73,927	73,977	74,021	74,064	74,104	74,135
Williamson	39,586	39,586	39,586	39,586	39,779	39,973	40,169	40,343	40,523	40,693	40,878

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:		
	2/18	2/19	2/20	2/21	2/23	2/25	2/27
Bexar	189,330	189,646	189,963	193,461	194,517 (38,903) [9,337] {4,668}	195,516 (39,103) [9,385] {4,692}	196,508 (39,302) [9,432] {4,716}
Brazoria	31,299	31,331	31,368	31,704	31,878 (6,376) [1,530] {765}	32,045 (6,409) [1,538] {769}	32,201 (6,440) [1,546] {773}
Brazos	20,258	20,282	20,307	20,331	20,387 (4,077) [979] {489}	20,436 (4,087) [981] {490}	20,476 (4,095) [983] {491}
Collin	80,947	81,062	81,130	81,208	81,601 (16,320) [3,917] {1,958}	81,953 (16,391) [3,934] {1,967}	82,271 (16,454) [3,949] {1,974}
Dallas	276,049	276,339	276,672	276,945	277,708 (55,542) [13,330] {6,665}	278,341 (55,668) [13,360] {6,680}	278,900 (55,780) [13,387] {6,694}
Denton	60,167	60,167	60,167	60,167	61,494 (12,299) [2,952] {1,476}	62,862 (12,572) [3,017] {1,509}	64,284 (12,857) [3,086] {1,543}
El Paso	120,556	120,769	120,982	121,503	122,098 (24,420) [5,861] {2,930}	122,658 (24,532) [5,888] {2,944}	123,201 (24,640) [5,914] {2,957}
Ellis	20,356	20,381	20,406	20,406	20,483 (4,097) [983] {492}	20,551 (4,110) [986] {493}	20,611 (4,122) [989] {495}
Fort Bend	55,509	55,548	56,104	56,104	56,421 (11,284) [2,708] {1,354}	56,710 (11,342) [2,722] {1,361}	56,982 (11,396) [2,735] {1,368}
Galveston	33,448	33,525	33,562	33,666	33,813 (6,763) [1,623] {812}	33,947 (6,789) [1,629] {815}	34,068 (6,814) [1,635] {818}
Harris	339,444	340,559	340,951	342,309	343,763 (68,753) [16,501] {8,250}	345,090 (69,018) [16,564] {8,282}	346,388 (69,278) [16,627] {8,313}
Hidalgo	72,213	72,723	72,723	72,723	73,254 (14,651) [3,516] {1,758}	73,752 (14,750) [3,540] {1,770}	74,218 (14,844) [3,562] {1,781}
Johnson	18,149	18,188	18,227	18,227	18,318 (3,664) [879] {440}	18,403 (3,681) [883] {442}	18,480 (3,696) [887] {444}
Lubbock	47,883	47,905	47,954	47,976	48,029 (9,606) [2,305] {1,153}	48,074 (9,615) [2,308] {1,154}	48,116 (9,623) [2,310] {1,155}
McLennan	24,268	24,268	24,268	24,268	24,377 (4,875) [1,170] {585}	24,487 (4,897) [1,175] {588}	24,589 (4,918) [1,180] {590}
Montgomery	43,920	44,060	44,060	44,060	44,301 (8,860) [2,126] {1,063}	44,523 (8,905) [2,137] {1,069}	44,727 (8,945) [2,147] {1,073}
Tarrant	236,911	237,676	238,077	238,077	238,942 (47,788) [11,469] {5,735}	239,676 (47,935) [11,504] {5,752}	240,361 (48,072) [11,537] {5,769}
Travis	73,719	73,749	73,779	73,809	73,927 (14,785) [3,548] {1,774}	74,021 (14,804) [3,553] {1,777}	74,104 (14,821) [3,557] {1,778}
Williamson	39,586	39,586	39,586	39,586	39,973 (7,995) [1,919] {959}	40,343 (8,069) [1,936] {968}	40,693 (8,139) [1,953] {977}

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.