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

Date: 5/5/21

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 5/5/21 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.

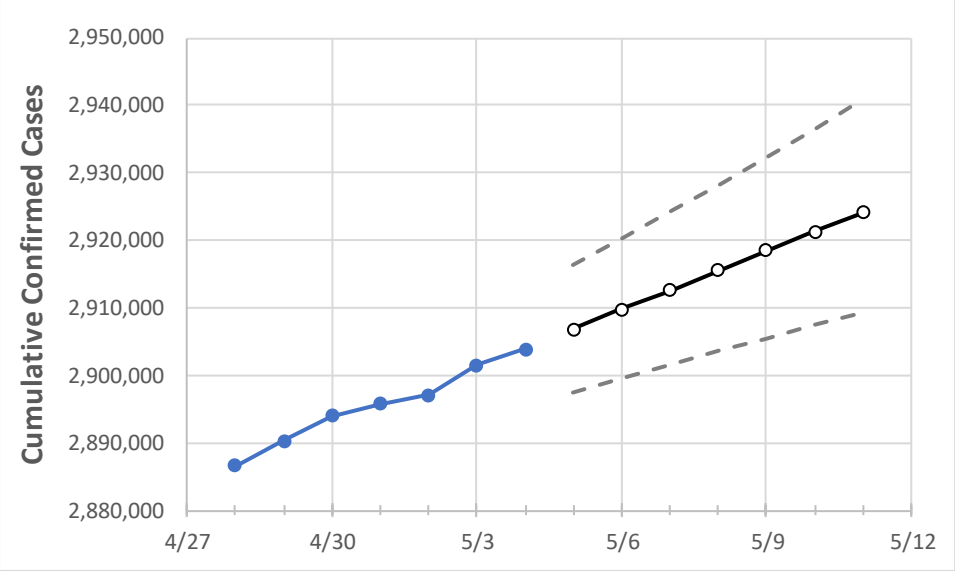
IEM's Modeling Lead

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:						
	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11
Texas	2,895,810	2,897,110	2,901,549	2,903,934	2,906,828	2,909,744	2,912,657	2,915,556	2,918,446	2,921,256	2,924,099

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:						
	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11
Bexar	217,840	218,193	218,547	218,712	219,029	219,344	219,644	219,940	220,259	220,559	220,871
Brazoria	37,266	37,306	37,345	37,330	37,375	37,420	37,466	37,510	37,553	37,597	37,640
Brazos	26,375	26,392	26,408	26,425	26,451	26,477	26,502	26,528	26,552	26,576	26,600
Collin	89,919	90,064	90,156	90,162	90,270	90,379	90,488	90,591	90,698	90,806	90,919
Dallas	298,875	298,959	299,411	299,581	299,802	300,027	300,252	300,475	300,697	300,926	301,149
Denton	74,388	74,437	74,485	74,580	74,646	74,712	74,779	74,841	74,906	74,968	75,031
El Paso	134,249	134,327	134,392	134,441	134,549	134,657	134,768	134,876	134,982	135,085	135,185
Ellis	22,677	22,691	22,706	22,720	22,745	22,771	22,797	22,824	22,850	22,879	22,908
Fort Bend	66,827	66,872	66,916	67,231	67,336	67,445	67,554	67,667	67,773	67,887	67,994
Galveston	39,033	39,096	39,143	39,189	39,248	39,308	39,367	39,427	39,487	39,547	39,608
Harris	392,664	392,976	393,355	393,587	393,997	394,399	394,799	395,190	395,586	395,951	396,332
Hidalgo	88,644	88,683	88,723	88,830	88,919	89,006	89,089	89,168	89,251	89,332	89,417
Johnson	19,714	19,724	19,735	19,745	19,762	19,778	19,795	19,812	19,830	19,848	19,866
Lubbock	48,910	48,925	48,941	48,956	48,975	48,995	49,016	49,038	49,059	49,082	49,107
McLennan	26,984	27,004	27,023	27,043	27,075	27,108	27,141	27,174	27,206	27,240	27,273
Montgomery	52,625	52,709	52,794	52,824	52,916	53,012	53,107	53,205	53,298	53,400	53,496
Tarrant	256,871	256,962	257,376	257,473	257,648	257,819	257,992	258,166	258,339	258,509	258,677
Travis	82,402	82,448	82,526	82,566	82,634	82,698	82,761	82,823	82,882	82,940	82,996
Williamson	45,488	45,568	45,648	45,706	45,779	45,853	45,926	45,997	46,072	46,145	46,220

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:		
	5/1	5/2	5/3	5/4	5/6	5/8	5/10
Bexar	217,840	218,193	218,547	218,712	219,344 (43,869) [10,528] {5,264}	219,940 (43,988) [10,557] {5,279}	220,559 (44,112) [10,587] {5,293}
Brazoria	37,266	37,306	37,345	37,330	37,420 (7,484) [1,796] {898}	37,510 (7,502) [1,800] {900}	37,597 (7,519) [1,805] {902}
Brazos	26,375	26,392	26,408	26,425	26,477 (5,295) [1,271] {635}	26,528 (5,306) [1,273] {637}	26,576 (5,315) [1,276] {638}
Collin	89,919	90,064	90,156	90,162	90,379 (18,076) [4,338] {2,169}	90,591 (18,118) [4,348] {2,174}	90,806 (18,161) [4,359] {2,179}
Dallas	298,875	298,959	299,411	299,581	300,027 (60,005) [14,401] {7,201}	300,475 (60,095) [14,423] {7,211}	300,926 (60,185) [14,444] {7,222}
Denton	74,388	74,437	74,485	74,580	74,712 (14,942) [3,586] {1,793}	74,841 (14,968) [3,592] {1,796}	74,968 (14,994) [3,598] {1,799}
El Paso	134,249	134,327	134,392	134,441	134,657 (26,931) [6,464] {3,232}	134,876 (26,975) [6,474] {3,237}	135,085 (27,017) [6,484] {3,242}
Ellis	22,677	22,691	22,706	22,720	22,771 (4,554) [1,093] {547}	22,824 (4,565) [1,096] {548}	22,879 (4,576) [1,098] {549}
Fort Bend	66,827	66,872	66,916	67,231	67,445 (13,489) [3,237] {1,619}	67,667 (13,533) [3,248] {1,624}	67,887 (13,577) [3,259] {1,629}
Galveston	39,033	39,096	39,143	39,189	39,308 (7,862) [1,887] {943}	39,427 (7,885) [1,893] {946}	39,547 (7,909) [1,898] {949}
Harris	392,664	392,976	393,355	393,587	394,399 (78,880) [18,931] {9,466}	395,190 (79,038) [18,969] {9,485}	395,951 (79,190) [19,006] {9,503}
Hidalgo	88,644	88,683	88,723	88,830	89,006 (17,801) [4,272] {2,136}	89,168 (17,834) [4,280] {2,140}	89,332 (17,866) [4,288] {2,144}
Johnson	19,714	19,724	19,735	19,745	19,778 (3,956) [949] {475}	19,812 (3,962) [951] {475}	19,848 (3,970) [953] {476}
Lubbock	48,910	48,925	48,941	48,956	48,995 (9,799) [2,352] {1,176}	49,038 (9,808) [2,354] {1,177}	49,082 (9,816) [2,356] {1,178}
McLennan	26,984	27,004	27,023	27,043	27,108 (5,422) [1,301] {651}	27,174 (5,435) [1,304] {652}	27,240 (5,448) [1,307] {654}
Montgomery	52,625	52,709	52,794	52,824	53,012 (10,602) [2,545] {1,272}	53,205 (10,641) [2,554] {1,277}	53,400 (10,680) [2,563] {1,282}
Tarrant	256,871	256,962	257,376	257,473	257,819 (51,564) [12,375] {6,188}	258,166 (51,633) [12,392] {6,196}	258,509 (51,702) [12,408] {6,204}
Travis	82,402	82,448	82,526	82,566	82,698 (16,540) [3,970] {1,985}	82,823 (16,565) [3,975] {1,988}	82,940 (16,588) [3,981] {1,991}
Williamson	45,488	45,568	45,648	45,706	45,853 (9,171) [2,201] {1,100}	45,997 (9,199) [2,208] {1,104}	46,145 (9,229) [2,215] {1,107}

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.