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

Date: 1/14/21

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 1/14/21 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.

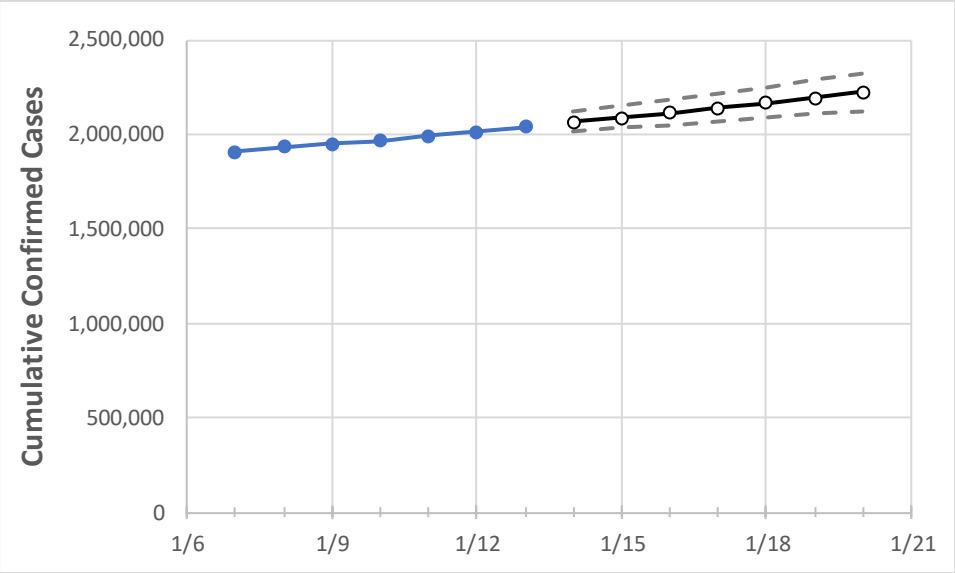
IEM's Modeling Lead

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Texas	1,968,189	1,990,204	2,014,645	2,040,751	2,064,680	2,089,293	2,114,532	2,140,690	2,166,972	2,194,248	2,222,700

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Bexar	133,519	135,104	137,407	138,785	140,666	142,575	144,493	146,446	148,473	150,521	152,639
Brazoria	24,013	24,112	24,381	24,753	25,048	25,353	25,663	25,969	26,289	26,611	26,945
Brazos	15,816	15,965	16,087	16,221	16,383	16,553	16,726	16,902	17,079	17,263	17,450
Collin	56,988	57,870	58,968	60,267	61,310	62,379	63,440	64,549	65,679	66,850	68,002
Dallas	217,219	219,086	222,635	225,629	228,620	231,663	234,772	238,004	241,277	244,760	248,140
Denton	43,344	43,580	44,158	44,808	45,271	45,750	46,226	46,706	47,197	47,691	48,176
El Paso	103,197	103,787	104,085	104,714	105,278	105,844	106,422	107,019	107,625	108,248	108,875
Ellis	15,215	15,445	15,676	15,799	16,017	16,237	16,454	16,672	16,890	17,108	17,336
Fort Bend	39,983	40,143	41,264	41,611	42,094	42,579	43,054	43,563	44,089	44,624	45,156
Galveston	24,028	24,288	24,548	24,804	25,069	25,337	25,606	25,878	26,145	26,416	26,688
Harris	262,525	266,525	267,729	269,089	271,834	274,584	277,557	280,575	283,527	286,594	289,771
Hidalgo	54,959	55,138	55,626	56,263	56,719	57,201	57,685	58,174	58,710	59,257	59,828
Johnson	13,075	13,238	13,401	13,744	13,982	14,225	14,467	14,718	14,986	15,252	15,524
Lubbock	44,238	44,411	44,547	44,757	44,945	45,131	45,316	45,497	45,674	45,847	46,015
McLennan	20,594	20,712	20,829	21,296	21,514	21,739	21,967	22,199	22,433	22,676	22,918
Montgomery	30,731	31,099	31,822	32,205	32,662	33,126	33,602	34,088	34,579	35,085	35,607
Tarrant	173,840	178,977	180,794	183,080	185,759	188,443	191,222	194,040	196,942	199,904	202,870
Travis	56,348	56,825	57,556	58,286	58,958	59,647	60,368	61,097	61,851	62,617	63,381
Williamson	27,267	27,645	28,187	28,573	29,058	29,550	30,046	30,566	31,095	31,626	32,191

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:		
	1/10	1/11	1/12	1/13	1/15	1/17	1/19
Bexar	133,519	135,104	137,407	138,785	142,575 (28,515) [6,844] {3,422}	146,446 (29,289) [7,029] {3,515}	150,521 (30,104) [7,225] {3,613}
Brazoria	24,013	24,112	24,381	24,753	25,353 (5,071) [1,217] {608}	25,969 (5,194) [1,247] {623}	26,611 (5,322) [1,277] {639}
Brazos	15,816	15,965	16,087	16,221	16,553 (3,311) [795] {397}	16,902 (3,380) [811] {406}	17,263 (3,453) [829] {414}
Collin	56,988	57,870	58,968	60,267	62,379 (12,476) [2,994] {1,497}	64,549 (12,910) [3,098] {1,549}	66,850 (13,370) [3,209] {1,604}
Dallas	217,219	219,086	222,635	225,629	231,663 (46,333) [11,120] {5,560}	238,004 (47,601) [11,424] {5,712}	244,760 (48,952) [11,748] {5,874}
Denton	43,344	43,580	44,158	44,808	45,750 (9,150) [2,196] {1,098}	46,706 (9,341) [2,242] {1,121}	47,691 (9,538) [2,289] {1,145}
El Paso	103,197	103,787	104,085	104,714	105,844 (21,169) [5,080] {2,540}	107,019 (21,404) [5,137] {2,568}	108,248 (21,650) [5,196] {2,598}
Ellis	15,215	15,445	15,676	15,799	16,237 (3,247) [779] {390}	16,672 (3,334) [800] {400}	17,108 (3,422) [821] {411}
Fort Bend	39,983	40,143	41,264	41,611	42,579 (8,516) [2,044] {1,022}	43,563 (8,713) [2,091] {1,046}	44,624 (8,925) [2,142] {1,071}
Galveston	24,028	24,288	24,548	24,804	25,337 (5,067) [1,216] {608}	25,878 (5,176) [1,242] {621}	26,416 (5,283) [1,268] {634}
Harris	262,525	266,525	267,729	269,089	274,584 (54,917) [13,180] {6,590}	280,575 (56,115) [13,468] {6,734}	286,594 (57,319) [13,757] {6,878}
Hidalgo	54,959	55,138	55,626	56,263	57,201 (11,440) [2,746] {1,373}	58,174 (11,635) [2,792] {1,396}	59,257 (11,851) [2,844] {1,422}
Johnson	13,075	13,238	13,401	13,744	14,225 (2,845) [683] {341}	14,718 (2,944) [706] {353}	15,252 (3,050) [732] {366}
Lubbock	44,238	44,411	44,547	44,757	45,131 (9,026) [2,166] {1,083}	45,497 (9,099) [2,184] {1,092}	45,847 (9,169) [2,201] {1,100}
McLennan	20,594	20,712	20,829	21,296	21,739 (4,348) [1,043] {522}	22,199 (4,440) [1,066] {533}	22,676 (4,535) [1,088] {544}
Montgomery	30,731	31,099	31,822	32,205	33,126 (6,625) [1,590] {795}	34,088 (6,818) [1,636] {818}	35,085 (7,017) [1,684] {842}
Tarrant	173,840	178,977	180,794	183,080	188,443 (37,689) [9,045] {4,523}	194,040 (38,808) [9,314] {4,657}	199,904 (39,981) [9,595] {4,798}
Travis	56,348	56,825	57,556	58,286	59,647 (11,929) [2,863] {1,432}	61,097 (12,219) [2,933] {1,466}	62,617 (12,523) [3,006] {1,503}
Williamson	27,267	27,645	28,187	28,573	29,550 (5,910) [1,418] {709}	30,566 (6,113) [1,467] {734}	31,626 (6,325) [1,518] {759}

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.