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

Date: 11/24/20

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 11/24/20 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.

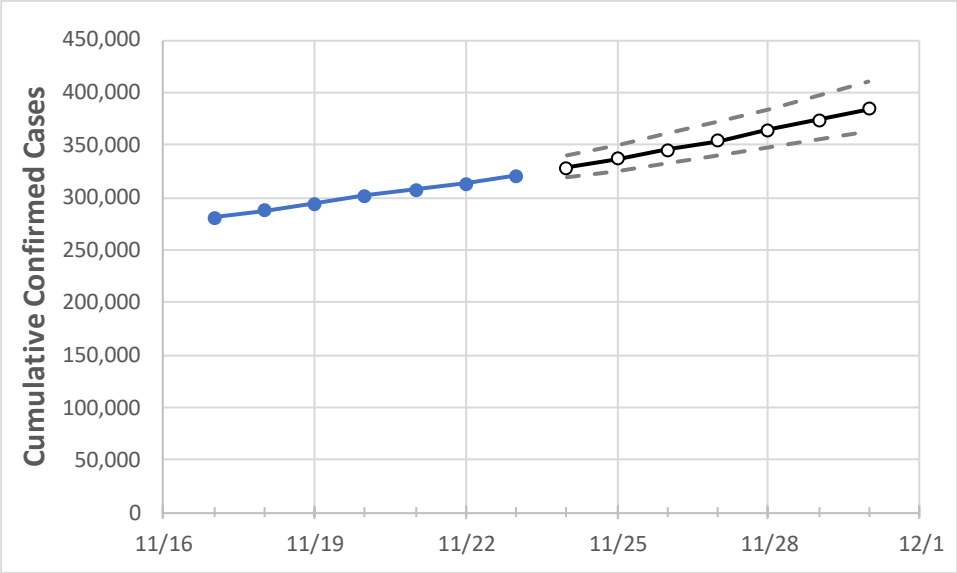
IEM's Modeling Lead

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.

Pennsylvania State Projections



	Actual Confirmed Cases On:				Projected Cases For:						
	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
Pennsylvania	301,304	306,988	313,358	320,158	328,108	336,432	345,146	354,269	363,820	373,816	384,278

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 20%, and are often within 10%, of actual confirmed cases.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
Allegheny	22,527	23,121	23,697	24,083	24,756	25,466	26,215	27,004	27,837	28,715	29,640
Berks	12,215	12,379	12,537	12,740	12,937	13,141	13,350	13,566	13,788	14,016	14,252
Bucks	14,465	14,794	15,126	15,405	15,841	16,306	16,800	17,327	17,888	18,485	19,121
Butler	3,426	3,536	3,638	3,681	3,790	3,903	4,018	4,136	4,258	4,383	4,512
Chester	10,505	10,666	10,827	10,988	11,199	11,421	11,653	11,897	12,153	12,422	12,704
Delaware	17,899	18,172	18,404	18,604	18,905	19,215	19,535	19,865	20,206	20,558	20,921
Lackawanna	4,597	4,665	4,726	4,770	4,823	4,878	4,935	4,993	5,053	5,115	5,178
Lancaster	13,564	13,770	14,235	14,416	14,758	15,119	15,500	15,901	16,325	16,772	17,243
Lehigh	9,453	9,694	9,912	10,059	10,290	10,532	10,786	11,052	11,331	11,624	11,931
Luzerne	7,966	8,156	8,314	8,396	8,597	8,807	9,028	9,258	9,499	9,752	10,016
Monroe	2,782	2,844	2,892	2,931	2,995	3,062	3,134	3,208	3,288	3,371	3,459
Montgomery	18,861	19,213	19,557	19,851	20,266	20,701	21,157	21,634	22,135	22,659	23,208
Northampton	7,472	7,666	7,840	7,984	8,175	8,377	8,590	8,815	9,052	9,303	9,568
Philadelphia	59,081	59,887	60,692	61,498	62,620	63,786	64,998	66,257	67,565	68,923	70,334
Westmoreland	7,097	7,315	7,490	7,646	7,891	8,149	8,420	8,705	9,005	9,320	9,652
York	8,975	9,103	9,662	9,755	9,972	10,202	10,444	10,699	10,968	11,253	11,552

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.*

Pennsylvania Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	11/20	11/21	11/22	11/23	11/25	11/27	11/29
Allegheny	22,527	23,121	23,697	24,083	25,466 (5,093) [1,222] {611}	27,004 (5,401) [1,296] {648}	28,715 (5,743) [1,378] {689}
Berks	12,215	12,379	12,537	12,740	13,141 (2,628) [631] {315}	13,566 (2,713) [651] {326}	14,016 (2,803) [673] {336}
Bucks	14,465	14,794	15,126	15,405	16,306 (3,261) [783] {391}	17,327 (3,465) [832] {416}	18,485 (3,697) [887] {444}
Butler	3,426	3,536	3,638	3,681	3,903 (781) [187] {94}	4,136 (827) [199] {99}	4,383 (877) [210] {105}
Chester	10,505	10,666	10,827	10,988	11,421 (2,284) [548] {274}	11,897 (2,379) [571] {286}	12,422 (2,484) [596] {298}
Delaware	17,899	18,172	18,404	18,604	19,215 (3,843) [922] {461}	19,865 (3,973) [954] {477}	20,558 (4,112) [987] {493}
Lackawanna	4,597	4,665	4,726	4,770	4,878 (976) [234] {117}	4,993 (999) [240] {120}	5,115 (1,023) [246] {123}
Lancaster	13,564	13,770	14,235	14,416	15,119 (3,024) [726] {363}	15,901 (3,180) [763] {382}	16,772 (3,354) [805] {403}
Lehigh	9,453	9,694	9,912	10,059	10,532 (2,106) [506] {253}	11,052 (2,210) [531] {265}	11,624 (2,325) [558] {279}
Luzerne	7,966	8,156	8,314	8,396	8,807 (1,761) [423] {211}	9,258 (1,852) [444] {222}	9,752 (1,950) [468] {234}
Monroe	2,782	2,844	2,892	2,931	3,062 (612) [147] {73}	3,208 (642) [154] {77}	3,371 (674) [162] {81}
Montgomery	18,861	19,213	19,557	19,851	20,701 (4,140) [994] {497}	21,634 (4,327) [1,038] {519}	22,659 (4,532) [1,088] {544}
Northampton	7,472	7,666	7,840	7,984	8,377 (1,675) [402] {201}	8,815 (1,763) [423] {212}	9,303 (1,861) [447] {223}
Philadelphia	59,081	59,887	60,692	61,498	63,786 (12,757) [3,062] {1,531}	66,257 (13,251) [3,180] {1,590}	68,923 (13,785) [3,308] {1,654}
Westmoreland	7,097	7,315	7,490	7,646	8,149 (1,630) [391] {196}	8,705 (1,741) [418] {209}	9,320 (1,864) [447] {224}
York	8,975	9,103	9,662	9,755	10,202 (2,040) [490] {245}	10,699 (2,140) [514] {257}	11,253 (2,251) [540] {270}

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.