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

Date: 1/29/21

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 1/29/21 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.

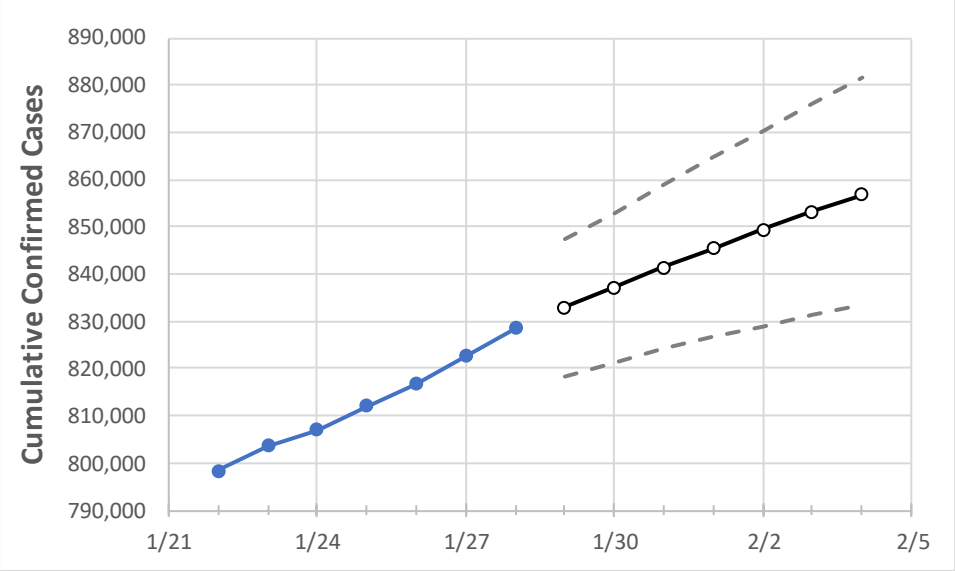
IEM's Modeling Lead

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.

Pennsylvania State Projections



	Actual Confirmed Cases On:				Projected Cases For:						
	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4
Pennsylvania	812,098	816,761	822,582	828,632	833,003	837,220	841,324	845,382	849,352	853,203	856,900

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.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4
Allegheny	67,429	67,711	68,087	68,445	68,750	69,050	69,342	69,623	69,897	70,159	70,422
Berks	30,230	30,418	30,633	30,822	30,986	31,143	31,298	31,443	31,583	31,723	31,855
Bucks	38,206	38,443	38,692	38,977	39,197	39,416	39,633	39,848	40,056	40,266	40,467
Butler	12,327	12,399	12,489	12,566	12,631	12,693	12,753	12,810	12,865	12,920	12,972
Chester	24,682	24,811	24,946	25,081	25,208	25,330	25,448	25,564	25,677	25,786	25,891
Delaware	36,048	36,252	36,447	36,636	36,811	36,982	37,151	37,312	37,472	37,629	37,782
Lackawanna	11,917	11,971	12,120	12,201	12,285	12,368	12,448	12,526	12,603	12,674	12,749
Lancaster	36,083	36,283	36,657	36,945	37,194	37,432	37,671	37,909	38,138	38,368	38,587
Lehigh	26,866	27,105	27,284	27,532	27,686	27,834	27,979	28,122	28,265	28,406	28,538
Luzerne	21,726	21,817	22,285	22,412	22,565	22,722	22,872	23,024	23,179	23,331	23,478
Monroe	8,191	8,258	8,340	8,401	8,457	8,512	8,565	8,618	8,668	8,716	8,764
Montgomery	46,137	46,413	46,765	47,100	47,377	47,650	47,922	48,190	48,452	48,710	48,953
Northampton	22,026	22,277	22,485	22,687	22,864	23,043	23,222	23,394	23,569	23,743	23,913
Philadelphia	107,177	107,863	108,222	108,760	109,160	109,549	109,929	110,302	110,661	111,020	111,378
Westmoreland	24,175	24,227	24,368	24,456	24,536	24,611	24,682	24,756	24,824	24,884	24,942
York	30,224	30,363	30,646	31,218	31,419	31,616	31,806	31,989	32,173	32,357	32,532

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:		
	1/25	1/26	1/27	1/28	1/30	2/1	2/3
Allegheny	67,429	67,711	68,087	68,445	69,050 (13,810) [3,314] {1,657}	69,623 (13,925) [3,342] {1,671}	70,159 (14,032) [3,368] {1,684}
Berks	30,230	30,418	30,633	30,822	31,143 (6,229) [1,495] {747}	31,443 (6,289) [1,509] {755}	31,723 (6,345) [1,523] {761}
Bucks	38,206	38,443	38,692	38,977	39,416 (7,883) [1,892] {946}	39,848 (7,970) [1,913] {956}	40,266 (8,053) [1,933] {966}
Butler	12,327	12,399	12,489	12,566	12,693 (2,539) [609] {305}	12,810 (2,562) [615] {307}	12,920 (2,584) [620] {310}
Chester	24,682	24,811	24,946	25,081	25,330 (5,066) [1,216] {608}	25,564 (5,113) [1,227] {614}	25,786 (5,157) [1,238] {619}
Delaware	36,048	36,252	36,447	36,636	36,982 (7,396) [1,775] {888}	37,312 (7,462) [1,791] {895}	37,629 (7,526) [1,806] {903}
Lackawanna	11,917	11,971	12,120	12,201	12,368 (2,474) [594] {297}	12,526 (2,505) [601] {301}	12,674 (2,535) [608] {304}
Lancaster	36,083	36,283	36,657	36,945	37,432 (7,486) [1,797] {898}	37,909 (7,582) [1,820] {910}	38,368 (7,674) [1,842] {921}
Lehigh	26,866	27,105	27,284	27,532	27,834 (5,567) [1,336] {668}	28,122 (5,624) [1,350] {675}	28,406 (5,681) [1,364] {682}
Luzerne	21,726	21,817	22,285	22,412	22,722 (4,544) [1,091] {545}	23,024 (4,605) [1,105] {553}	23,331 (4,666) [1,120] {560}
Monroe	8,191	8,258	8,340	8,401	8,512 (1,702) [409] {204}	8,618 (1,724) [414] {207}	8,716 (1,743) [418] {209}
Montgomery	46,137	46,413	46,765	47,100	47,650 (9,530) [2,287] {1,144}	48,190 (9,638) [2,313] {1,157}	48,710 (9,742) [2,338] {1,169}
Northampton	22,026	22,277	22,485	22,687	23,043 (4,609) [1,106] {553}	23,394 (4,679) [1,123] {561}	23,743 (4,749) [1,140] {570}
Philadelphia	107,177	107,863	108,222	108,760	109,549 (21,910) [5,258] {2,629}	110,302 (22,060) [5,295] {2,647}	111,020 (22,204) [5,329] {2,664}
Westmoreland	24,175	24,227	24,368	24,456	24,611 (4,922) [1,181] {591}	24,756 (4,951) [1,188] {594}	24,884 (4,977) [1,194] {597}
York	30,224	30,363	30,646	31,218	31,616 (6,323) [1,518] {759}	31,989 (6,398) [1,535] {768}	32,357 (6,471) [1,553] {777}

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.