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

Date: 1/24/22

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 1/24/22 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.

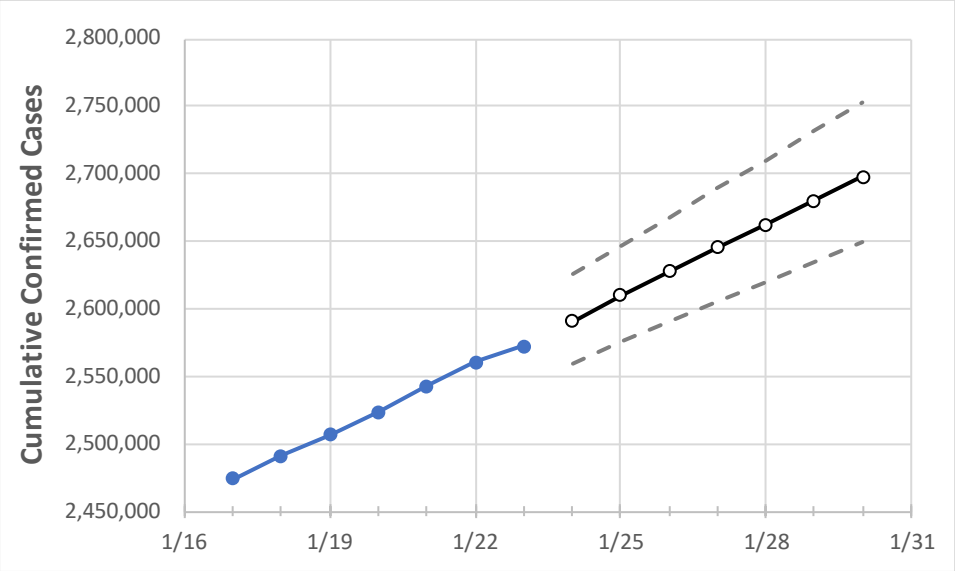
IEM's Modeling Lead

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:						
	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30
Pennsylvania	2,523,956	2,542,816	2,560,167	2,572,500	2,590,970	2,609,672	2,627,409	2,645,082	2,662,618	2,680,369	2,697,634

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:						
	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30
Allegheny	235,185	237,334	239,215	240,260	242,401	244,533	246,514	248,607	250,511	252,518	254,426
Berks	94,959	95,469	95,960	96,384	97,055	97,730	98,338	98,984	99,593	100,201	100,793
Bucks	113,785	114,655	115,193	115,650	116,372	117,047	117,695	118,358	119,014	119,659	120,248
Butler	40,035	40,362	40,712	40,889	41,209	41,532	41,852	42,171	42,499	42,816	43,134
Chester	83,698	84,183	84,628	85,030	85,658	86,257	86,837	87,407	87,953	88,537	89,083
Delaware	102,339	102,747	103,272	103,646	104,232	104,813	105,359	105,879	106,397	106,914	107,385
Lackawanna	37,698	38,089	38,617	38,776	39,151	39,510	39,876	40,248	40,615	40,978	41,335
Lancaster	111,284	112,108	112,792	113,233	113,978	114,726	115,447	116,128	116,841	117,514	118,216
Lehigh	83,616	84,113	84,612	84,946	85,551	86,129	86,718	87,212	87,809	88,274	88,826
Luzerne	66,449	66,916	67,329	67,678	68,205	68,722	69,223	69,735	70,241	70,738	71,207
Monroe	34,098	34,266	34,504	34,643	34,896	35,136	35,365	35,606	35,819	36,052	36,256
Montgomery	138,469	139,224	140,065	140,802	141,817	142,797	143,735	144,686	145,607	146,543	147,461
Northampton	73,982	74,410	74,876	75,154	75,654	76,112	76,570	76,989	77,432	77,866	78,267
Philadelphia	286,526	287,817	288,836	290,207	291,797	293,306	294,755	296,084	297,419	298,801	299,998
Westmoreland	70,561	71,312	71,837	72,100	72,700	73,289	73,889	74,446	75,059	75,655	76,263
York	107,537	108,394	109,201	109,889	110,875	111,825	112,783	113,706	114,700	115,600	116,527

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:		
	1/20	1/21	1/22	1/23	1/25	1/27	1/29
Allegheny	235,185	237,334	239,215	240,260	244,533 (48,907) [11,738] {5,869}	248,607 (49,721) [11,933] {5,967}	252,518 (50,504) [12,121] {6,060}
Berks	94,959	95,469	95,960	96,384	97,730 (19,546) [4,691] {2,346}	98,984 (19,797) [4,751] {2,376}	100,201 (20,040) [4,810] {2,405}
Bucks	113,785	114,655	115,193	115,650	117,047 (23,409) [5,618] {2,809}	118,358 (23,672) [5,681] {2,841}	119,659 (23,932) [5,744] {2,872}
Butler	40,035	40,362	40,712	40,889	41,532 (8,306) [1,994] {997}	42,171 (8,434) [2,024] {1,012}	42,816 (8,563) [2,055] {1,028}
Chester	83,698	84,183	84,628	85,030	86,257 (17,251) [4,140] {2,070}	87,407 (17,481) [4,196] {2,098}	88,537 (17,707) [4,250] {2,125}
Delaware	102,339	102,747	103,272	103,646	104,813 (20,963) [5,031] {2,516}	105,879 (21,176) [5,082] {2,541}	106,914 (21,383) [5,132] {2,566}
Lackawanna	37,698	38,089	38,617	38,776	39,510 (7,902) [1,896] {948}	40,248 (8,050) [1,932] {966}	40,978 (8,196) [1,967] {983}
Lancaster	111,284	112,108	112,792	113,233	114,726 (22,945) [5,507] {2,753}	116,128 (23,226) [5,574] {2,787}	117,514 (23,503) [5,641] {2,820}
Lehigh	83,616	84,113	84,612	84,946	86,129 (17,226) [4,134] {2,067}	87,212 (17,442) [4,186] {2,093}	88,274 (17,655) [4,237] {2,119}
Luzerne	66,449	66,916	67,329	67,678	68,722 (13,744) [3,299] {1,649}	69,735 (13,947) [3,347] {1,674}	70,738 (14,148) [3,395] {1,698}
Monroe	34,098	34,266	34,504	34,643	35,136 (7,027) [1,687] {843}	35,606 (7,121) [1,709] {855}	36,052 (7,210) [1,731] {865}
Montgomery	138,469	139,224	140,065	140,802	142,797 (28,559) [6,854] {3,427}	144,686 (28,937) [6,945] {3,472}	146,543 (29,309) [7,034] {3,517}
Northampton	73,982	74,410	74,876	75,154	76,112 (15,222) [3,653] {1,827}	76,989 (15,398) [3,695] {1,848}	77,866 (15,573) [3,738] {1,869}
Philadelphia	286,526	287,817	288,836	290,207	293,306 (58,661) [14,079] {7,039}	296,084 (59,217) [14,212] {7,106}	298,801 (59,760) [14,342] {7,171}
Westmoreland	70,561	71,312	71,837	72,100	73,289 (14,658) [3,518] {1,759}	74,446 (14,889) [3,573] {1,787}	75,655 (15,131) [3,631] {1,816}
York	107,537	108,394	109,201	109,889	111,825 (22,365) [5,368] {2,684}	113,706 (22,741) [5,458] {2,729}	115,600 (23,120) [5,549] {2,774}

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.