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

Date: 1/28/22

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 1/28/22 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.

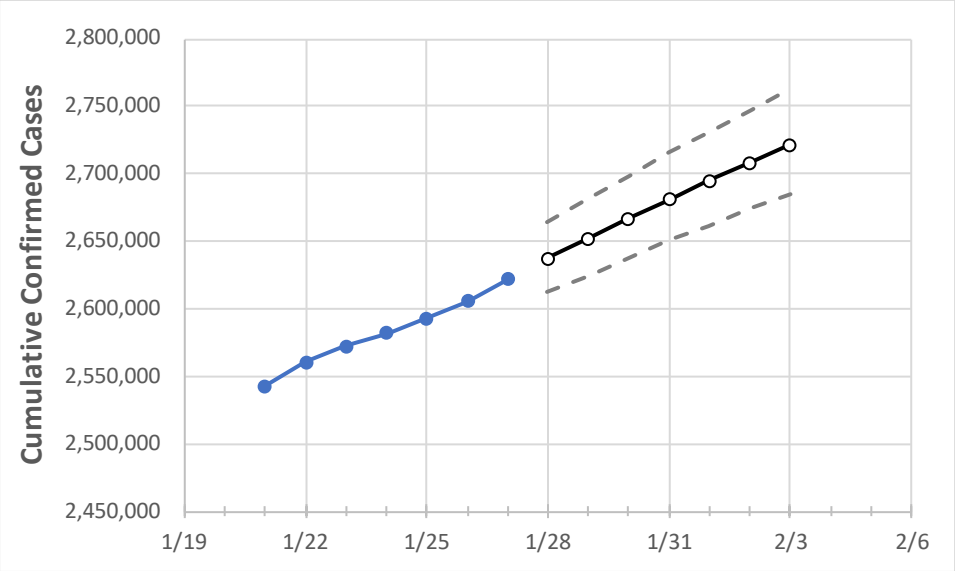
IEM's Modeling Lead

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:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
Pennsylvania	2,581,831	2,593,360	2,605,439	2,622,134	2,637,324	2,652,088	2,666,663	2,680,710	2,694,767	2,708,364	2,721,457

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:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
Allegheny	241,621	242,555	243,543	245,213	246,844	248,421	249,925	251,373	252,790	254,288	255,628
Berks	96,616	96,990	97,412	98,002	98,524	99,008	99,503	99,976	100,448	100,938	101,358
Bucks	115,922	116,279	116,780	117,418	117,958	118,477	119,003	119,510	119,989	120,465	120,930
Butler	41,094	41,246	41,416	41,726	41,998	42,260	42,527	42,783	43,029	43,289	43,514
Chester	85,307	85,615	85,999	86,490	86,991	87,466	87,937	88,401	88,823	89,273	89,683
Delaware	103,940	104,297	104,675	105,135	105,599	106,008	106,430	106,837	107,206	107,589	107,967
Lackawanna	38,859	39,048	39,464	39,952	40,276	40,606	40,927	41,249	41,585	41,880	42,213
Lancaster	113,629	114,058	114,383	114,997	115,589	116,170	116,712	117,267	117,794	118,326	118,842
Lehigh	85,096	85,361	85,673	86,118	86,530	86,874	87,228	87,579	87,874	88,206	88,530
Luzerne	67,858	68,200	68,595	69,118	69,527	69,936	70,328	70,724	71,094	71,481	71,853
Monroe	34,714	34,804	34,951	35,226	35,409	35,577	35,738	35,909	36,067	36,218	36,365
Montgomery	141,158	141,785	142,373	143,308	144,109	144,887	145,649	146,363	147,112	147,816	148,543
Northampton	75,269	75,544	75,826	76,210	76,546	76,843	77,130	77,432	77,734	78,006	78,271
Philadelphia	290,754	291,747	292,767	293,487	294,509	295,553	296,408	297,365	298,272	299,113	299,890
Westmoreland	72,744	73,082	73,423	73,973	74,494	75,015	75,524	76,042	76,559	77,058	77,557
York	110,402	110,891	111,392	112,082	112,832	113,624	114,339	115,085	115,785	116,501	117,146

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:		
	1/24	1/25	1/26	1/27	1/29	1/31	2/2
Allegheny	241,621	242,555	243,543	245,213	248,421 (49,684) [11,924] {5,962}	251,373 (50,275) [12,066] {6,033}	254,288 (50,858) [12,206] {6,103}
Berks	96,616	96,990	97,412	98,002	99,008 (19,802) [4,752] {2,376}	99,976 (19,995) [4,799] {2,399}	100,938 (20,188) [4,845] {2,423}
Bucks	115,922	116,279	116,780	117,418	118,477 (23,695) [5,687] {2,843}	119,510 (23,902) [5,736] {2,868}	120,465 (24,093) [5,782] {2,891}
Butler	41,094	41,246	41,416	41,726	42,260 (8,452) [2,028] {1,014}	42,783 (8,557) [2,054] {1,027}	43,289 (8,658) [2,078] {1,039}
Chester	85,307	85,615	85,999	86,490	87,466 (17,493) [4,198] {2,099}	88,401 (17,680) [4,243] {2,122}	89,273 (17,855) [4,285] {2,143}
Delaware	103,940	104,297	104,675	105,135	106,008 (21,202) [5,088] {2,544}	106,837 (21,367) [5,128] {2,564}	107,589 (21,518) [5,164] {2,582}
Lackawanna	38,859	39,048	39,464	39,952	40,606 (8,121) [1,949] {975}	41,249 (8,250) [1,980] {990}	41,880 (8,376) [2,010] {1,005}
Lancaster	113,629	114,058	114,383	114,997	116,170 (23,234) [5,576] {2,788}	117,267 (23,453) [5,629] {2,814}	118,326 (23,665) [5,680] {2,840}
Lehigh	85,096	85,361	85,673	86,118	86,874 (17,375) [4,170] {2,085}	87,579 (17,516) [4,204] {2,102}	88,206 (17,641) [4,234] {2,117}
Luzerne	67,858	68,200	68,595	69,118	69,936 (13,987) [3,357] {1,678}	70,724 (14,145) [3,395] {1,697}	71,481 (14,296) [3,431] {1,716}
Monroe	34,714	34,804	34,951	35,226	35,577 (7,115) [1,708] {854}	35,909 (7,182) [1,724] {862}	36,218 (7,244) [1,738] {869}
Montgomery	141,158	141,785	142,373	143,308	144,887 (28,977) [6,955] {3,477}	146,363 (29,273) [7,025] {3,513}	147,816 (29,563) [7,095] {3,548}
Northampton	75,269	75,544	75,826	76,210	76,843 (15,369) [3,688] {1,844}	77,432 (15,486) [3,717] {1,858}	78,006 (15,601) [3,744] {1,872}
Philadelphia	290,754	291,747	292,767	293,487	295,553 (59,111) [14,187] {7,093}	297,365 (59,473) [14,274] {7,137}	299,113 (59,823) [14,357] {7,179}
Westmoreland	72,744	73,082	73,423	73,973	75,015 (15,003) [3,601] {1,800}	76,042 (15,208) [3,650] {1,825}	77,058 (15,412) [3,699] {1,849}
York	110,402	110,891	111,392	112,082	113,624 (22,725) [5,454] {2,727}	115,085 (23,017) [5,524] {2,762}	116,501 (23,300) [5,592] {2,796}

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.