IEM's AI Modeling: Short-term COVID-19 Projections
Date: 8/30/21

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 <u>not</u> 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 8/30/21 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
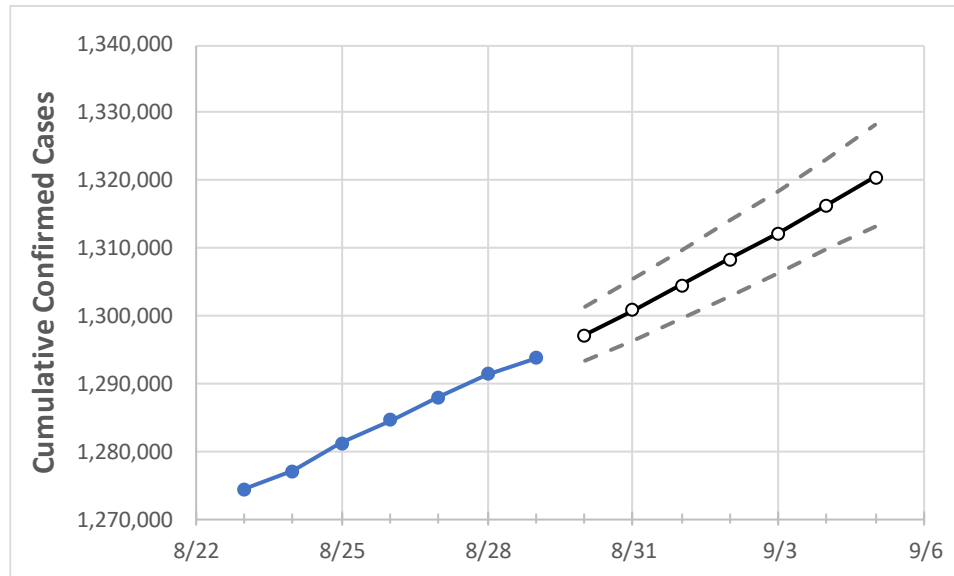
	Actual Confirmed Cases On:				Projected Cases For:					
	8/26	8/27	8/28	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5
Pennsylvania	1,284,532	1,288,041	1,291,324	1,293,764	1,297,190	1,300,838	1,304,473	1,308,310	1,312,204	1,316,325	1,320,445

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:						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5
Allegheny	108,318	108,589	108,989	109,226	109,548	109,868	110,201	110,550	110,902	111,277	111,645
Berks	50,443	50,554	50,654	50,757	50,863	50,973	51,086	51,201	51,323	51,445	51,574
Bucks	64,111	64,294	64,429	64,607	64,771	64,940	65,112	65,291	65,478	65,666	65,862
Butler	18,728	18,801	18,895	18,949	19,025	19,105	19,188	19,275	19,366	19,462	19,561
Chester	43,250	43,389	43,389	43,389	43,499	43,608	43,723	43,839	43,957	44,077	44,199
Delaware	55,128	55,287	55,450	55,554	55,694	55,840	55,990	56,147	56,305	56,474	56,646
Lackawanna	19,303	19,346	19,392	19,424	19,462	19,501	19,541	19,584	19,628	19,672	19,719
Lancaster	58,611	58,788	59,005	59,164	59,345	59,534	59,727	59,926	60,132	60,348	60,568
Lehigh	42,178	42,311	42,431	42,499	42,622	42,751	42,878	43,012	43,151	43,294	43,441
Luzerne	33,643	33,727	33,812	33,904	33,988	34,075	34,166	34,260	34,355	34,457	34,561
Monroe	15,919	15,978	16,021	16,040	16,082	16,123	16,164	16,207	16,250	16,296	16,340
Montgomery	74,699	74,913	75,103	75,293	75,484	75,680	75,880	76,080	76,294	76,500	76,725
Northampton	38,323	38,418	38,511	38,584	38,682	38,781	38,880	38,979	39,085	39,189	39,299
Philadelphia	164,447	164,729	164,729	164,729	165,205	165,721	166,233	166,760	167,330	167,886	168,464
Westmoreland	36,252	36,333	36,446	36,501	36,613	36,731	36,850	36,977	37,108	37,246	37,387
York	49,670	49,830	49,972	50,118	50,274	50,431	50,597	50,768	50,946	51,129	51,319

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:		
	8/26	8/27	8/28	8/29	8/31	9/2	9/4
Allegheny	108,318	108,589	108,989	109,226	109,868 (21,974) [5,274] {2,637}	110,550 (22,110) [5,306] {2,653}	111,277 (22,255) [5,341] {2,671}
Berks	50,443	50,554	50,654	50,757	50,973 (10,195) [2,447] {1,223}	51,201 (10,240) [2,458] {1,229}	51,445 (10,289) [2,469] {1,235}
Bucks	64,111	64,294	64,429	64,607	64,940 (12,988) [3,117] {1,559}	65,291 (13,058) [3,134] {1,567}	65,666 (13,133) [3,152] {1,576}
Butler	18,728	18,801	18,895	18,949	19,105 (3,821) [917] {459}	19,275 (3,855) [925] {463}	19,462 (3,892) [934] {467}
Chester	43,250	43,389	43,389	43,389	43,608 (8,722) [2,093] {1,047}	43,839 (8,768) [2,104] {1,052}	44,077 (8,815) [2,116] {1,058}
Delaware	55,128	55,287	55,450	55,554	55,840 (11,168) [2,680] {1,340}	56,147 (11,229) [2,695] {1,348}	56,474 (11,295) [2,711] {1,355}
Lackawanna	19,303	19,346	19,392	19,424	19,501 (3,900) [936] {468}	19,584 (3,917) [940] {470}	19,672 (3,934) [944] {472}
Lancaster	58,611	58,788	59,005	59,164	59,534 (11,907) [2,858] {1,429}	59,926 (11,985) [2,876] {1,438}	60,348 (12,070) [2,897] {1,448}
Lehigh	42,178	42,311	42,431	42,499	42,751 (8,550) [2,052] {1,026}	43,012 (8,602) [2,065] {1,032}	43,294 (8,659) [2,078] {1,039}
Luzerne	33,643	33,727	33,812	33,904	34,075 (6,815) [1,636] {818}	34,260 (6,852) [1,644] {822}	34,457 (6,891) [1,654] {827}
Monroe	15,919	15,978	16,021	16,040	16,123 (3,225) [774] {387}	16,207 (3,241) [778] {389}	16,296 (3,259) [782] {391}
Montgomery	74,699	74,913	75,103	75,293	75,680 (15,136) [3,633] {1,816}	76,080 (15,216) [3,652] {1,826}	76,500 (15,300) [3,672] {1,836}
Northampton	38,323	38,418	38,511	38,584	38,781 (7,756) [1,861] {931}	38,979 (7,796) [1,871] {936}	39,189 (7,838) [1,881] {941}
Philadelphia	164,447	164,729	164,729	164,729	165,721 (33,144) [7,955] {3,977}	166,760 (33,352) [8,004] {4,002}	167,886 (33,577) [8,059] {4,029}
Westmoreland	36,252	36,333	36,446	36,501	36,731 (7,346) [1,763] {882}	36,977 (7,395) [1,775] {887}	37,246 (7,449) [1,788] {894}
York	49,670	49,830	49,972	50,118	50,431 (10,086) [2,421] {1,210}	50,768 (10,154) [2,437] {1,218}	51,129 (10,226) [2,454] {1,227}

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.