IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/17/21

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 11/17/21 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
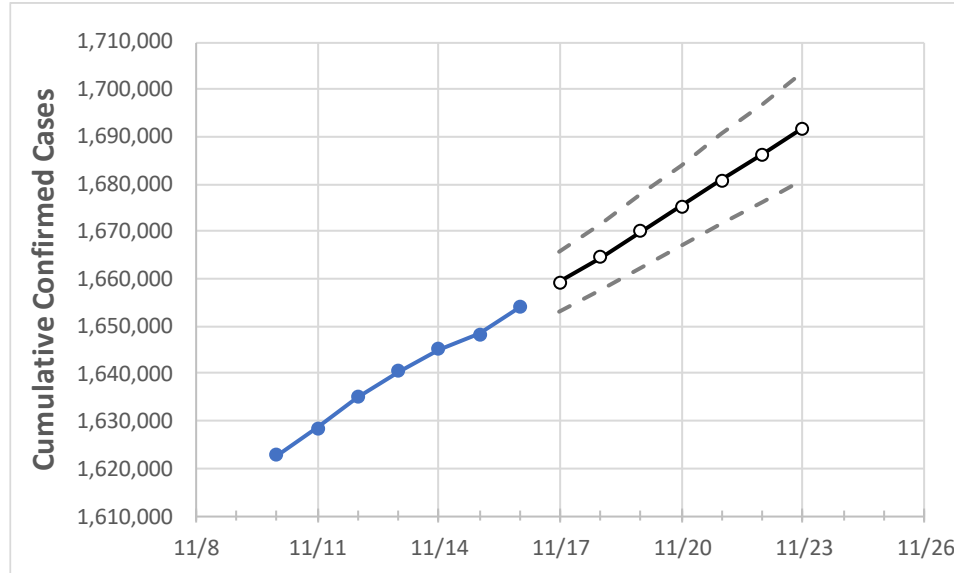
	Actual Confirmed Cases On:				Projected Cases For:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
Pennsylvania	1,640,594	1,645,244	1,648,285	1,654,063	1,659,369	1,664,572	1,669,965	1,675,292	1,680,727	1,686,354	1,691,882

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:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
Allegheny	139,767	140,294	140,678	141,336	141,885	142,446	143,016	143,592	144,193	144,782	145,403
Berks	61,463	61,598	61,705	61,878	62,039	62,203	62,366	62,530	62,695	62,867	63,035
Bucks	76,125	76,257	76,364	76,506	76,676	76,848	77,021	77,196	77,376	77,557	77,740
Butler	26,817	26,901	26,968	27,114	27,237	27,359	27,488	27,615	27,746	27,884	28,018
Chester	52,896	53,047	53,141	53,278	53,413	53,546	53,685	53,825	53,967	54,117	54,261
Delaware	64,110	64,217	64,267	64,385	64,485	64,586	64,685	64,788	64,889	64,992	65,095
Lackawanna	23,938	23,998	24,038	24,134	24,221	24,312	24,406	24,499	24,597	24,699	24,803
Lancaster	74,807	74,996	75,125	75,290	75,477	75,662	75,852	76,039	76,232	76,426	76,615
Lehigh	50,154	50,264	50,329	50,486	50,598	50,714	50,832	50,951	51,072	51,202	51,327
Luzerne	43,138	43,265	43,342	43,507	43,647	43,786	43,932	44,072	44,218	44,369	44,517
Monroe	20,544	20,601	20,623	20,708	20,770	20,835	20,898	20,963	21,032	21,102	21,170
Montgomery	88,756	88,950	89,124	89,346	89,559	89,775	89,996	90,215	90,445	90,675	90,909
Northampton	46,297	46,379	46,424	46,580	46,689	46,798	46,910	47,023	47,142	47,259	47,378
Philadelphia	186,970	187,161	187,219	187,219	187,443	187,673	187,896	188,135	188,361	188,602	188,840
Westmoreland	47,991	48,145	48,270	48,539	48,727	48,913	49,103	49,299	49,492	49,698	49,902
York	66,422	66,592	66,754	66,993	67,208	67,423	67,638	67,853	68,066	68,287	68,504

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:		
	11/13	11/14	11/15	11/16	11/18	11/20	11/22
Allegheny	139,767	140,294	140,678	141,336	142,446 (28,489) [6,837] {3,419}	143,592 (28,718) [6,892] {3,446}	144,782 (28,956) [6,950] {3,475}
Berks	61,463	61,598	61,705	61,878	62,203 (12,441) [2,986] {1,493}	62,530 (12,506) [3,001] {1,501}	62,867 (12,573) [3,018] {1,509}
Bucks	76,125	76,257	76,364	76,506	76,848 (15,370) [3,689] {1,844}	77,196 (15,439) [3,705] {1,853}	77,557 (15,511) [3,723] {1,861}
Butler	26,817	26,901	26,968	27,114	27,359 (5,472) [1,313] {657}	27,615 (5,523) [1,326] {663}	27,884 (5,577) [1,338] {669}
Chester	52,896	53,047	53,141	53,278	53,546 (10,709) [2,570] {1,285}	53,825 (10,765) [2,584] {1,292}	54,117 (10,823) [2,598] {1,299}
Delaware	64,110	64,217	64,267	64,385	64,586 (12,917) [3,100] {1,550}	64,788 (12,958) [3,110] {1,555}	64,992 (12,998) [3,120] {1,560}
Lackawanna	23,938	23,998	24,038	24,134	24,312 (4,862) [1,167] {583}	24,499 (4,900) [1,176] {588}	24,699 (4,940) [1,186] {593}
Lancaster	74,807	74,996	75,125	75,290	75,662 (15,132) [3,632] {1,816}	76,039 (15,208) [3,650] {1,825}	76,426 (15,285) [3,668] {1,834}
Lehigh	50,154	50,264	50,329	50,486	50,714 (10,143) [2,434] {1,217}	50,951 (10,190) [2,446] {1,223}	51,202 (10,240) [2,458] {1,229}
Luzerne	43,138	43,265	43,342	43,507	43,786 (8,757) [2,102] {1,051}	44,072 (8,814) [2,115] {1,058}	44,369 (8,874) [2,130] {1,065}
Monroe	20,544	20,601	20,623	20,708	20,835 (4,167) [1,000] {500}	20,963 (4,193) [1,006] {503}	21,102 (4,220) [1,013] {506}
Montgomery	88,756	88,950	89,124	89,346	89,775 (17,955) [4,309] {2,155}	90,215 (18,043) [4,330] {2,165}	90,675 (18,135) [4,352] {2,176}
Northampton	46,297	46,379	46,424	46,580	46,798 (9,360) [2,246] {1,123}	47,023 (9,405) [2,257] {1,129}	47,259 (9,452) [2,268] {1,134}
Philadelphia	186,970	187,161	187,219	187,219	187,673 (37,535) [9,008] {4,504}	188,135 (37,627) [9,030] {4,515}	188,602 (37,720) [9,053] {4,526}
Westmoreland	47,991	48,145	48,270	48,539	48,913 (9,783) [2,348] {1,174}	49,299 (9,860) [2,366] {1,183}	49,698 (9,940) [2,386] {1,193}
York	66,422	66,592	66,754	66,993	67,423 (13,485) [3,236] {1,618}	67,853 (13,571) [3,257] {1,628}	68,287 (13,657) [3,278] {1,639}

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.