IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/10/21

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 12/10/21 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
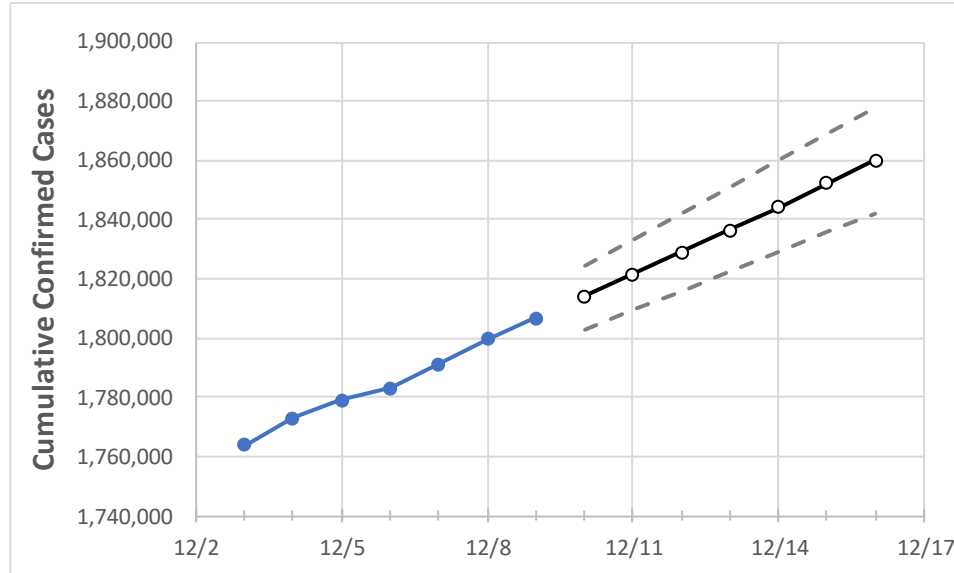
	Actual Confirmed Cases On:				Projected Cases For:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
Pennsylvania	1,783,118	1,791,030	1,799,753	1,806,671	1,814,129	1,821,683	1,829,103	1,836,590	1,844,307	1,852,201	1,859,963

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
Allegheny	154,363	155,212	155,979	156,669	157,378	158,073	158,750	159,440	160,168	160,904	161,619
Berks	66,691	66,962	67,310	67,533	67,865	68,198	68,531	68,880	69,242	69,601	69,976
Bucks	80,546	80,844	81,196	81,450	81,719	81,981	82,255	82,532	82,820	83,111	83,402
Butler	29,804	29,935	30,076	30,205	30,337	30,474	30,599	30,735	30,864	30,993	31,131
Chester	56,761	56,993	57,225	57,459	57,674	57,898	58,133	58,362	58,600	58,844	59,085
Delaware	67,302	67,576	67,754	68,028	68,221	68,427	68,634	68,848	69,062	69,288	69,507
Lackawanna	26,062	26,157	26,288	26,393	26,494	26,597	26,699	26,800	26,903	27,013	27,116
Lancaster	80,638	80,932	81,245	81,606	81,948	82,297	82,657	83,006	83,382	83,760	84,138
Lehigh	54,625	54,835	55,038	55,238	55,504	55,776	56,060	56,349	56,643	56,943	57,243
Luzerne	47,303	47,523	47,756	47,935	48,149	48,359	48,573	48,793	49,011	49,240	49,463
Monroe	22,449	22,567	22,624	22,719	22,821	22,922	23,025	23,131	23,238	23,346	23,453
Montgomery	94,677	94,973	95,511	95,838	96,195	96,565	96,930	97,308	97,691	98,079	98,474
Northampton	50,144	50,386	50,581	50,768	51,019	51,270	51,532	51,793	52,080	52,360	52,644
Philadelphia	194,090	194,343	195,633	195,644	196,088	196,561	197,027	197,469	197,999	198,503	199,009
Westmoreland	53,182	53,573	53,845	54,081	54,339	54,585	54,851	55,102	55,369	55,630	55,885
York	72,719	73,026	73,282	73,728	74,071	74,420	74,765	75,128	75,484	75,853	76,232

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:		
	12/6	12/7	12/8	12/9	12/11	12/13	12/15
Allegheny	154,363	155,212	155,979	156,669	158,073 (31,615) [7,588] {3,794}	159,440 (31,888) [7,653] {3,827}	160,904 (32,181) [7,723] {3,862}
Berks	66,691	66,962	67,310	67,533	68,198 (13,640) [3,274] {1,637}	68,880 (13,776) [3,306] {1,653}	69,601 (13,920) [3,341] {1,670}
Bucks	80,546	80,844	81,196	81,450	81,981 (16,396) [3,935] {1,968}	82,532 (16,506) [3,962] {1,981}	83,111 (16,622) [3,989] {1,995}
Butler	29,804	29,935	30,076	30,205	30,474 (6,095) [1,463] {731}	30,735 (6,147) [1,475] {738}	30,993 (6,199) [1,488] {744}
Chester	56,761	56,993	57,225	57,459	57,898 (11,580) [2,779] {1,390}	58,362 (11,672) [2,801] {1,401}	58,844 (11,769) [2,825] {1,412}
Delaware	67,302	67,576	67,754	68,028	68,427 (13,685) [3,285] {1,642}	68,848 (13,770) [3,305] {1,652}	69,288 (13,858) [3,326] {1,663}
Lackawanna	26,062	26,157	26,288	26,393	26,597 (5,319) [1,277] {638}	26,800 (5,360) [1,286] {643}	27,013 (5,403) [1,297] {648}
Lancaster	80,638	80,932	81,245	81,606	82,297 (16,459) [3,950] {1,975}	83,006 (16,601) [3,984] {1,992}	83,760 (16,752) [4,021] {2,010}
Lehigh	54,625	54,835	55,038	55,238	55,776 (11,155) [2,677] {1,339}	56,349 (11,270) [2,705] {1,352}	56,943 (11,389) [2,733] {1,367}
Luzerne	47,303	47,523	47,756	47,935	48,359 (9,672) [2,321] {1,161}	48,793 (9,759) [2,342] {1,171}	49,240 (9,848) [2,364] {1,182}
Monroe	22,449	22,567	22,624	22,719	22,922 (4,584) [1,100] {550}	23,131 (4,626) [1,110] {555}	23,346 (4,669) [1,121] {560}
Montgomery	94,677	94,973	95,511	95,838	96,565 (19,313) [4,635] {2,318}	97,308 (19,462) [4,671] {2,335}	98,079 (19,616) [4,708] {2,354}
Northampton	50,144	50,386	50,581	50,768	51,270 (10,254) [2,461] {1,230}	51,793 (10,359) [2,486] {1,243}	52,360 (10,472) [2,513] {1,257}
Philadelphia	194,090	194,343	195,633	195,644	196,561 (39,312) [9,435] {4,717}	197,469 (39,494) [9,479] {4,739}	198,503 (39,701) [9,528] {4,764}
Westmoreland	53,182	53,573	53,845	54,081	54,585 (10,917) [2,620] {1,310}	55,102 (11,020) [2,645] {1,322}	55,630 (11,126) [2,670] {1,335}
York	72,719	73,026	73,282	73,728	74,420 (14,884) [3,572] {1,786}	75,128 (15,026) [3,606] {1,803}	75,853 (15,171) [3,641] {1,820}

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.