IEM's AI Modeling: Short-term COVID-19 Projections
Date: 10/27/21

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 10/27/21 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
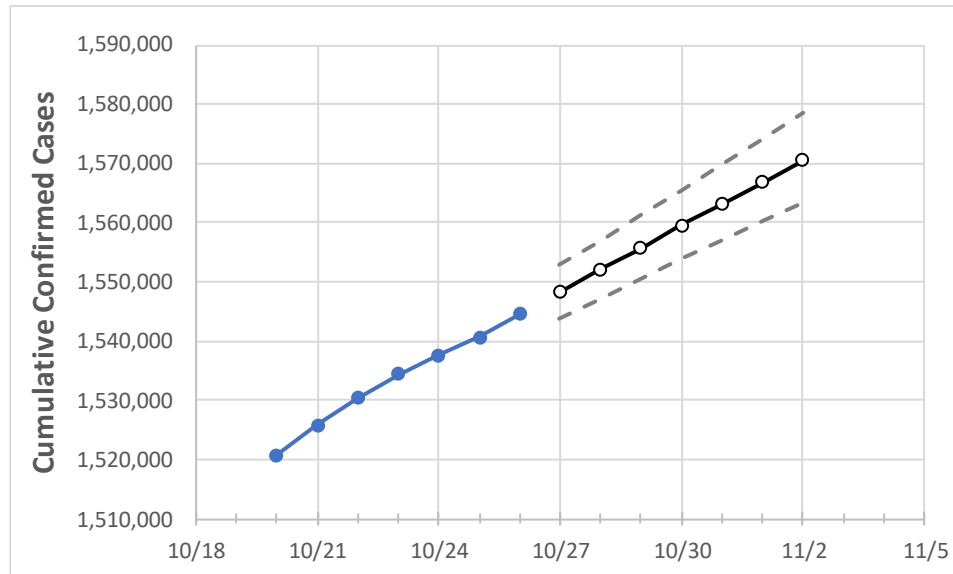
	Actual Confirmed Cases On:				Projected Cases For:						
	10/23	10/24	10/25	10/26	10/27	10/28	10/29	10/30	10/31	11/1	11/2
Pennsylvania	1,534,495	1,537,668	1,540,721	1,544,463	1,548,258	1,552,068	1,555,733	1,559,486	1,563,195	1,566,867	1,570,498

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:						
	10/23	10/24	10/25	10/26	10/27	10/28	10/29	10/30	10/31	11/1	11/2
Allegheny	129,734	129,997	130,274	130,624	130,955	131,288	131,611	131,935	132,266	132,602	132,915
Berks	57,860	57,978	58,070	58,181	58,307	58,431	58,558	58,683	58,808	58,932	59,056
Bucks	72,642	72,754	72,824	72,930	73,048	73,161	73,272	73,381	73,492	73,600	73,704
Butler	24,698	24,753	24,791	24,856	24,920	24,985	25,045	25,106	25,170	25,227	25,286
Chester	50,322	50,392	50,463	50,555	50,656	50,762	50,862	50,963	51,066	51,163	51,266
Delaware	61,635	61,759	61,810	61,932	62,037	62,138	62,238	62,336	62,440	62,541	62,641
Lackawanna	22,512	22,549	22,575	22,604	22,644	22,684	22,722	22,761	22,800	22,837	22,872
Lancaster	70,505	70,666	70,800	70,932	71,099	71,264	71,426	71,586	71,745	71,906	72,064
Lehigh	48,060	48,121	48,154	48,225	48,290	48,356	48,419	48,484	48,546	48,609	48,669
Luzerne	40,346	40,464	40,521	40,601	40,707	40,814	40,916	41,023	41,123	41,227	41,326
Monroe	19,430	19,472	19,484	19,525	19,567	19,609	19,650	19,690	19,731	19,771	19,809
Montgomery	84,851	85,018	85,120	85,240	85,409	85,575	85,744	85,913	86,079	86,247	86,412
Northampton	44,138	44,191	44,225	44,320	44,389	44,460	44,527	44,596	44,666	44,733	44,799
Philadelphia	180,797	180,992	181,187	181,389	181,643	181,899	182,146	182,402	182,647	182,898	183,149
Westmoreland	44,251	44,363	44,451	44,630	44,770	44,907	45,043	45,181	45,325	45,458	45,594
York	61,293	61,574	61,707	61,846	62,047	62,238	62,428	62,627	62,819	63,016	63,204

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:		
	10/23	10/24	10/25	10/26	10/28	10/30	11/1
Allegheny	129,734	129,997	130,274	130,624	131,288 (26,258) [6,302] {3,151}	131,935 (26,387) [6,333] {3,166}	132,602 (26,520) [6,365] {3,182}
Berks	57,860	57,978	58,070	58,181	58,431 (11,686) [2,805] {1,402}	58,683 (11,737) [2,817] {1,408}	58,932 (11,786) [2,829] {1,414}
Bucks	72,642	72,754	72,824	72,930	73,161 (14,632) [3,512] {1,756}	73,381 (14,676) [3,522] {1,761}	73,600 (14,720) [3,533] {1,766}
Butler	24,698	24,753	24,791	24,856	24,985 (4,997) [1,199] {600}	25,106 (5,021) [1,205] {603}	25,227 (5,045) [1,211] {605}
Chester	50,322	50,392	50,463	50,555	50,762 (10,152) [2,437] {1,218}	50,963 (10,193) [2,446] {1,223}	51,163 (10,233) [2,456] {1,228}
Delaware	61,635	61,759	61,810	61,932	62,138 (12,428) [2,983] {1,491}	62,336 (12,467) [2,992] {1,496}	62,541 (12,508) [3,002] {1,501}
Lackawanna	22,512	22,549	22,575	22,604	22,684 (4,537) [1,089] {544}	22,761 (4,552) [1,093] {546}	22,837 (4,567) [1,096] {548}
Lancaster	70,505	70,666	70,800	70,932	71,264 (14,253) [3,421] {1,710}	71,586 (14,317) [3,436] {1,718}	71,906 (14,381) [3,451] {1,726}
Lehigh	48,060	48,121	48,154	48,225	48,356 (9,671) [2,321] {1,161}	48,484 (9,697) [2,327] {1,164}	48,609 (9,722) [2,333] {1,167}
Luzerne	40,346	40,464	40,521	40,601	40,814 (8,163) [1,959] {980}	41,023 (8,205) [1,969] {985}	41,227 (8,245) [1,979] {989}
Monroe	19,430	19,472	19,484	19,525	19,609 (3,922) [941] {471}	19,690 (3,938) [945] {473}	19,771 (3,954) [949] {474}
Montgomery	84,851	85,018	85,120	85,240	85,575 (17,115) [4,108] {2,054}	85,913 (17,183) [4,124] {2,062}	86,247 (17,249) [4,140] {2,070}
Northampton	44,138	44,191	44,225	44,320	44,460 (8,892) [2,134] {1,067}	44,596 (8,919) [2,141] {1,070}	44,733 (8,947) [2,147] {1,074}
Philadelphia	180,797	180,992	181,187	181,389	181,899 (36,380) [8,731] {4,366}	182,402 (36,480) [8,755] {4,378}	182,898 (36,580) [8,779] {4,390}
Westmoreland	44,251	44,363	44,451	44,630	44,907 (8,981) [2,156] {1,078}	45,181 (9,036) [2,169] {1,084}	45,458 (9,092) [2,182] {1,091}
York	61,293	61,574	61,707	61,846	62,238 (12,448) [2,987] {1,494}	62,627 (12,525) [3,006] {1,503}	63,016 (12,603) [3,025] {1,512}

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.