IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/2/22

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 3/2/22 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
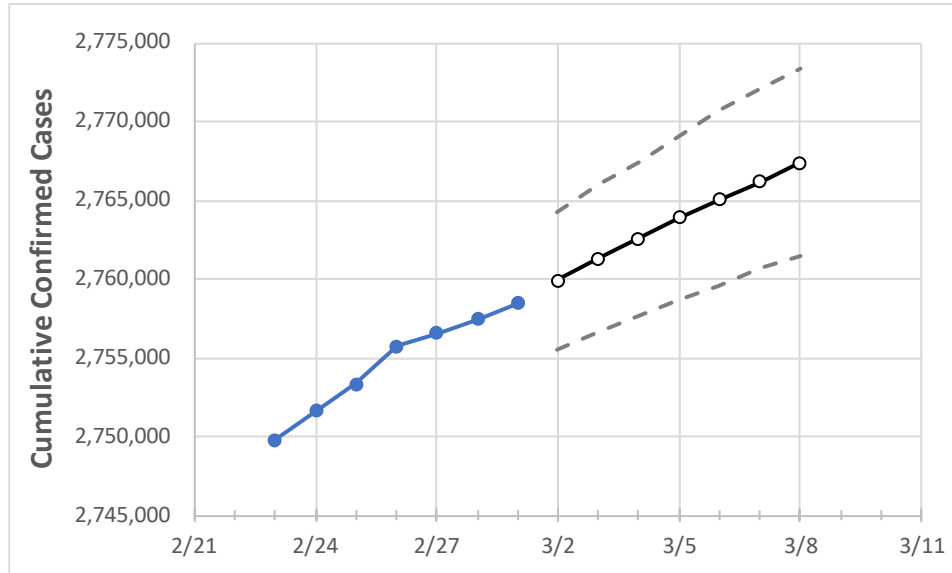
	Actual Confirmed Cases On:				Projected Cases For:						
	2/26	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8
Pennsylvania	2,755,730	2,756,546	2,757,425	2,758,482	2,759,914	2,761,319	2,762,605	2,763,892	2,765,059	2,766,196	2,767,387

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:						
	2/26	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8
Allegheny	260,530	260,642	260,712	260,868	261,018	261,156	261,296	261,424	261,544	261,671	261,785
Berks	101,525	101,541	101,556	101,580	101,613	101,648	101,676	101,709	101,735	101,763	101,789
Bucks	121,802	121,837	121,858	121,888	121,938	121,990	122,037	122,084	122,130	122,171	122,211
Butler	44,003	44,016	44,030	44,038	44,057	44,077	44,094	44,111	44,127	44,145	44,159
Chester	90,517	90,547	90,567	90,583	90,645	90,708	90,759	90,822	90,880	90,936	90,983
Delaware	108,768	108,791	108,809	108,839	108,878	108,914	108,946	108,979	109,010	109,039	109,068
Lackawanna	42,760	42,780	42,797	42,832	42,866	42,902	42,932	42,963	42,993	43,022	43,047
Lancaster	120,040	120,068	120,098	120,121	120,167	120,207	120,247	120,284	120,322	120,359	120,390
Lehigh	88,749	88,760	88,773	88,793	88,816	88,837	88,857	88,876	88,894	88,912	88,929
Luzerne	72,718	72,755	72,772	72,794	72,839	72,880	72,917	72,956	72,995	73,030	73,062
Monroe	36,622	36,635	36,642	36,649	36,662	36,674	36,686	36,696	36,707	36,719	36,728
Montgomery	149,717	149,771	149,812	149,843	149,920	149,994	150,070	150,138	150,204	150,276	150,337
Northampton	78,765	78,778	78,792	78,813	78,840	78,863	78,886	78,908	78,926	78,947	78,966
Philadelphia	304,379	304,474	304,568	304,700	304,868	305,054	305,237	305,392	305,566	305,726	305,908
Westmoreland	78,962	79,004	79,016	79,033	79,083	79,128	79,175	79,223	79,264	79,304	79,344
York	117,779	117,810	117,826	117,832	117,890	117,939	117,990	118,036	118,087	118,134	118,174

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:		
	2/26	2/27	2/28	3/1	3/3	3/5	3/7
Allegheny	260,530	260,642	260,712	260,868	261,156 (52,231) [12,536] {6,268}	261,424 (52,285) [12,548] {6,274}	261,671 (52,334) [12,560] {6,280}
Berks	101,525	101,541	101,556	101,580	101,648 (20,330) [4,879] {2,440}	101,709 (20,342) [4,882] {2,441}	101,763 (20,353) [4,885] {2,442}
Bucks	121,802	121,837	121,858	121,888	121,990 (24,398) [5,856] {2,928}	122,084 (24,417) [5,860] {2,930}	122,171 (24,434) [5,864] {2,932}
Butler	44,003	44,016	44,030	44,038	44,077 (8,815) [2,116] {1,058}	44,111 (8,822) [2,117] {1,059}	44,145 (8,829) [2,119] {1,059}
Chester	90,517	90,547	90,567	90,583	90,708 (18,142) [4,354] {2,177}	90,822 (18,164) [4,359] {2,180}	90,936 (18,187) [4,365] {2,182}
Delaware	108,768	108,791	108,809	108,839	108,914 (21,783) [5,228] {2,614}	108,979 (21,796) [5,231] {2,615}	109,039 (21,808) [5,234] {2,617}
Lackawanna	42,760	42,780	42,797	42,832	42,902 (8,580) [2,059] {1,030}	42,963 (8,593) [2,062] {1,031}	43,022 (8,604) [2,065] {1,033}
Lancaster	120,040	120,068	120,098	120,121	120,207 (24,041) [5,770] {2,885}	120,284 (24,057) [5,774] {2,887}	120,359 (24,072) [5,777] {2,889}
Lehigh	88,749	88,760	88,773	88,793	88,837 (17,767) [4,264] {2,132}	88,876 (17,775) [4,266] {2,133}	88,912 (17,782) [4,268] {2,134}
Luzerne	72,718	72,755	72,772	72,794	72,880 (14,576) [3,498] {1,749}	72,956 (14,591) [3,502] {1,751}	73,030 (14,606) [3,505] {1,753}
Monroe	36,622	36,635	36,642	36,649	36,674 (7,335) [1,760] {880}	36,696 (7,339) [1,761] {881}	36,719 (7,344) [1,763] {881}
Montgomery	149,717	149,771	149,812	149,843	149,994 (29,999) [7,200] {3,600}	150,138 (30,028) [7,207] {3,603}	150,276 (30,055) [7,213] {3,607}
Northampton	78,765	78,778	78,792	78,813	78,863 (15,773) [3,785] {1,893}	78,908 (15,782) [3,788] {1,894}	78,947 (15,789) [3,789] {1,895}
Philadelphia	304,379	304,474	304,568	304,700	305,054 (61,011) [14,643] {7,321}	305,392 (61,078) [14,659] {7,329}	305,726 (61,145) [14,675] {7,337}
Westmoreland	78,962	79,004	79,016	79,033	79,128 (15,826) [3,798] {1,899}	79,223 (15,845) [3,803] {1,901}	79,304 (15,861) [3,807] {1,903}
York	117,779	117,810	117,826	117,832	117,939 (23,588) [5,661] {2,831}	118,036 (23,607) [5,666] {2,833}	118,134 (23,627) [5,670] {2,835}

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.