IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/14/21

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 7/14/21 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
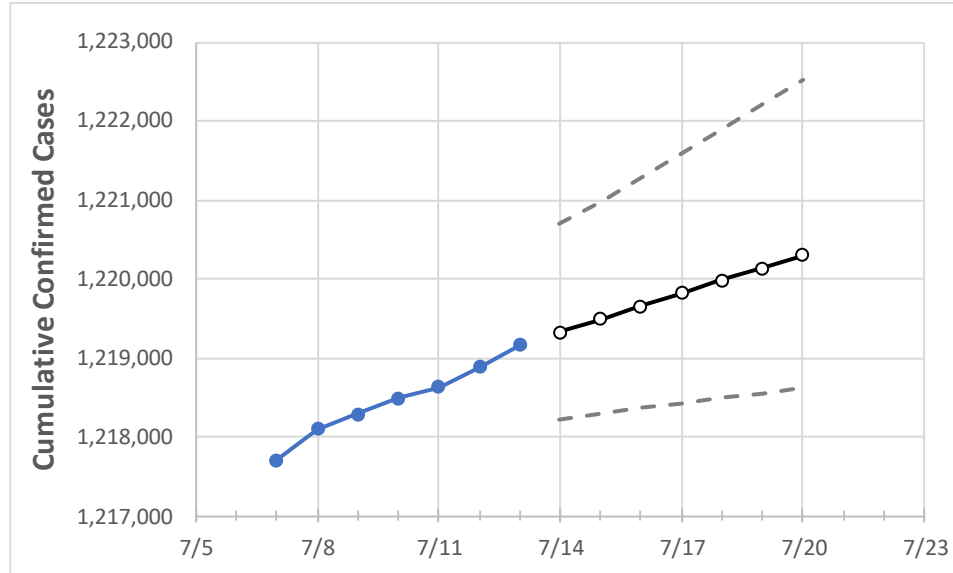
Actual Confirmed Cases On:				Projected Cases For:						
7/10	7/11	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20
Pennsylvania 1,218,490	1,218,631	1,218,886	1,219,161	1,219,329	1,219,495	1,219,652	1,219,817	1,219,980	1,220,140	1,220,297

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:						
	7/10	7/11	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20
Allegheny	102,036	102,050	102,059	102,089	102,103	102,117	102,131	102,145	102,160	102,175	102,190
Berks	48,510	48,513	48,516	48,530	48,533	48,537	48,540	48,544	48,547	48,550	48,553
Bucks	60,912	60,921	60,927	60,940	60,951	60,962	60,973	60,984	60,996	61,008	61,021
Butler	17,645	17,648	17,649	17,654	17,656	17,658	17,660	17,662	17,663	17,665	17,667
Chester	40,883	40,890	40,897	40,910	40,916	40,923	40,930	40,936	40,942	40,949	40,956
Delaware	52,474	52,483	52,488	52,501	52,510	52,519	52,528	52,537	52,547	52,555	52,565
Lackawanna	18,585	18,590	18,595	18,603	18,607	18,610	18,614	18,618	18,621	18,625	18,629
Lancaster	55,467	55,470	55,477	55,488	55,493	55,497	55,502	55,506	55,510	55,515	55,519
Lehigh	39,907	39,920	39,927	39,936	39,943	39,951	39,959	39,967	39,975	39,983	39,992
Luzerne	32,165	32,169	32,171	32,176	32,180	32,183	32,187	32,190	32,193	32,197	32,200
Monroe	14,855	14,865	14,866	14,872	14,875	14,878	14,882	14,885	14,888	14,892	14,895
Montgomery	70,513	70,525	70,531	70,549	70,559	70,570	70,582	70,593	70,605	70,617	70,629
Northampton	35,938	35,943	35,947	35,956	35,961	35,966	35,971	35,976	35,981	35,986	35,992
Philadelphia	155,064	155,099	155,134	155,134	155,167	155,199	155,232	155,262	155,294	155,325	155,356
Westmoreland	34,465	34,470	34,475	34,482	34,486	34,489	34,493	34,496	34,499	34,502	34,505
York	47,112	47,122	47,123	47,138	47,146	47,153	47,160	47,168	47,175	47,182	47,189

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:		
	7/10	7/11	7/12	7/13	7/15	7/17	7/19
Allegheny	102,036	102,050	102,059	102,089	102,117 (20,423) [4,902] {2,451}	102,145 (20,429) [4,903] {2,451}	102,175 (20,435) [4,904] {2,452}
Berks	48,510	48,513	48,516	48,530	48,537 (9,707) [2,330] {1,165}	48,544 (9,709) [2,330] {1,165}	48,550 (9,710) [2,330] {1,165}
Bucks	60,912	60,921	60,927	60,940	60,962 (12,192) [2,926] {1,463}	60,984 (12,197) [2,927] {1,464}	61,008 (12,202) [2,928] {1,464}
Butler	17,645	17,648	17,649	17,654	17,658 (3,532) [848] {424}	17,662 (3,532) [848] {424}	17,665 (3,533) [848] {424}
Chester	40,883	40,890	40,897	40,910	40,923 (8,185) [1,964] {982}	40,936 (8,187) [1,965] {982}	40,949 (8,190) [1,966] {983}
Delaware	52,474	52,483	52,488	52,501	52,519 (10,504) [2,521] {1,260}	52,537 (10,507) [2,522] {1,261}	52,555 (10,511) [2,523] {1,261}
Lackawanna	18,585	18,590	18,595	18,603	18,610 (3,722) [893] {447}	18,618 (3,724) [894] {447}	18,625 (3,725) [894] {447}
Lancaster	55,467	55,470	55,477	55,488	55,497 (11,099) [2,664] {1,332}	55,506 (11,101) [2,664] {1,332}	55,515 (11,103) [2,665] {1,332}
Lehigh	39,907	39,920	39,927	39,936	39,951 (7,990) [1,918] {959}	39,967 (7,993) [1,918] {959}	39,983 (7,997) [1,919] {960}
Luzerne	32,165	32,169	32,171	32,176	32,183 (6,437) [1,545] {772}	32,190 (6,438) [1,545] {773}	32,197 (6,439) [1,545] {773}
Monroe	14,855	14,865	14,866	14,872	14,878 (2,976) [714] {357}	14,885 (2,977) [714] {357}	14,892 (2,978) [715] {357}
Montgomery	70,513	70,525	70,531	70,549	70,570 (14,114) [3,387] {1,694}	70,593 (14,119) [3,388] {1,694}	70,617 (14,123) [3,390] {1,695}
Northampton	35,938	35,943	35,947	35,956	35,966 (7,193) [1,726] {863}	35,976 (7,195) [1,727] {863}	35,986 (7,197) [1,727] {864}
Philadelphia	155,064	155,099	155,134	155,134	155,199 (31,040) [7,450] {3,725}	155,262 (31,052) [7,453] {3,726}	155,325 (31,065) [7,456] {3,728}
Westmoreland	34,465	34,470	34,475	34,482	34,489 (6,898) [1,655] {828}	34,496 (6,899) [1,656] {828}	34,502 (6,900) [1,656] {828}
York	47,112	47,122	47,123	47,138	47,153 (9,431) [2,263] {1,132}	47,168 (9,434) [2,264] {1,132}	47,182 (9,436) [2,265] {1,132}

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.