IEM's AI Modeling: Short-term COVID-19 Projections

Date: 7/16/21

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 7/16/21 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.

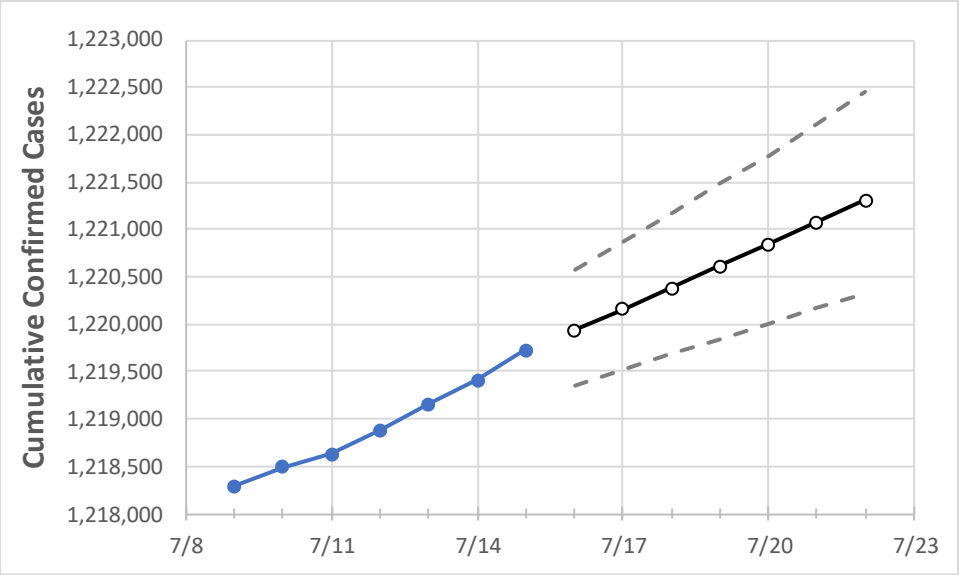
IEM's Modeling Lead

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:						
	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22
Pennsylvania	1,218,886	1,219,161	1,219,405	1,219,722	1,219,937	1,220,154	1,220,383	1,220,610	1,220,841	1,221,075	1,221,310

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:						
	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22
Allegheny	102,059	102,089	102,114	102,150	102,171	102,192	102,214	102,237	102,261	102,285	102,309
Berks	48,516	48,530	48,538	48,546	48,551	48,555	48,559	48,564	48,568	48,572	48,576
Bucks	60,927	60,940	60,954	60,986	61,000	61,014	61,029	61,045	61,062	61,079	61,097
Butler	17,649	17,654	17,660	17,664	17,667	17,669	17,672	17,675	17,677	17,680	17,682
Chester	40,897	40,910	40,922	40,936	40,945	40,954	40,963	40,972	40,982	40,991	41,001
Delaware	52,488	52,501	52,510	52,522	52,531	52,541	52,551	52,560	52,571	52,581	52,592
Lackawanna	18,595	18,603	18,612	18,616	18,621	18,625	18,630	18,636	18,641	18,646	18,652
Lancaster	55,477	55,488	55,497	55,513	55,520	55,527	55,534	55,541	55,549	55,556	55,564
Lehigh	39,927	39,936	39,950	39,959	39,968	39,977	39,987	39,996	40,006	40,016	40,027
Luzerne	32,171	32,176	32,180	32,185	32,189	32,192	32,196	32,200	32,203	32,207	32,210
Monroe	14,866	14,872	14,875	14,882	14,886	14,890	14,894	14,898	14,902	14,906	14,910
Montgomery	70,531	70,549	70,573	70,607	70,625	70,644	70,664	70,684	70,706	70,729	70,753
Northampton	35,947	35,956	35,965	35,978	35,985	35,992	35,999	36,006	36,013	36,021	36,029
Philadelphia	155,134	155,134	155,134	155,134	155,164	155,192	155,221	155,250	155,279	155,307	155,334
Westmoreland	34,475	34,482	34,484	34,490	34,494	34,497	34,501	34,504	34,508	34,511	34,514
York	47,123	47,138	47,149	47,161	47,170	47,179	47,187	47,196	47,205	47,214	47,223

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:		
	7/12	7/13	7/14	7/15	7/17	7/19	7/21
Allegheny	102,059	102,089	102,114	102,150	102,192 (20,438) [4,905] {2,453}	102,237 (20,447) [4,907] {2,454}	102,285 (20,457) [4,910] {2,455}
Berks	48,516	48,530	48,538	48,546	48,555 (9,711) [2,331] {1,165}	48,564 (9,713) [2,331] {1,166}	48,572 (9,714) [2,331] {1,166}
Bucks	60,927	60,940	60,954	60,986	61,014 (12,203) [2,929] {1,464}	61,045 (12,209) [2,930] {1,465}	61,079 (12,216) [2,932] {1,466}
Butler	17,649	17,654	17,660	17,664	17,669 (3,534) [848] {424}	17,675 (3,535) [848] {424}	17,680 (3,536) [849] {424}
Chester	40,897	40,910	40,922	40,936	40,954 (8,191) [1,966] {983}	40,972 (8,194) [1,967] {983}	40,991 (8,198) [1,968] {984}
Delaware	52,488	52,501	52,510	52,522	52,541 (10,508) [2,522] {1,261}	52,560 (10,512) [2,523] {1,261}	52,581 (10,516) [2,524] {1,262}
Lackawanna	18,595	18,603	18,612	18,616	18,625 (3,725) [894] {447}	18,636 (3,727) [895] {447}	18,646 (3,729) [895] {448}
Lancaster	55,477	55,488	55,497	55,513	55,527 (11,105) [2,665] {1,333}	55,541 (11,108) [2,666] {1,333}	55,556 (11,111) [2,667] {1,333}
Lehigh	39,927	39,936	39,950	39,959	39,977 (7,995) [1,919] {959}	39,996 (7,999) [1,920] {960}	40,016 (8,003) [1,921] {960}
Luzerne	32,171	32,176	32,180	32,185	32,192 (6,438) [1,545] {773}	32,200 (6,440) [1,546] {773}	32,207 (6,441) [1,546] {773}
Monroe	14,866	14,872	14,875	14,882	14,890 (2,978) [715] {357}	14,898 (2,980) [715] {358}	14,906 (2,981) [715] {358}
Montgomery	70,531	70,549	70,573	70,607	70,644 (14,129) [3,391] {1,695}	70,684 (14,137) [3,393] {1,696}	70,729 (14,146) [3,395] {1,698}
Northampton	35,947	35,956	35,965	35,978	35,992 (7,198) [1,728] {864}	36,006 (7,201) [1,728] {864}	36,021 (7,204) [1,729] {864}
Philadelphia	155,134	155,134	155,134	155,134	155,192 (31,038) [7,449] {3,725}	155,250 (31,050) [7,452] {3,726}	155,307 (31,061) [7,455] {3,727}
Westmoreland	34,475	34,482	34,484	34,490	34,497 (6,899) [1,656] {828}	34,504 (6,901) [1,656] {828}	34,511 (6,902) [1,657] {828}
York	47,123	47,138	47,149	47,161	47,179 (9,436) [2,265] {1,132}	47,196 (9,439) [2,265] {1,133}	47,214 (9,443) [2,266] {1,133}

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.