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

Date: 8/20/21

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 8/20/21 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.

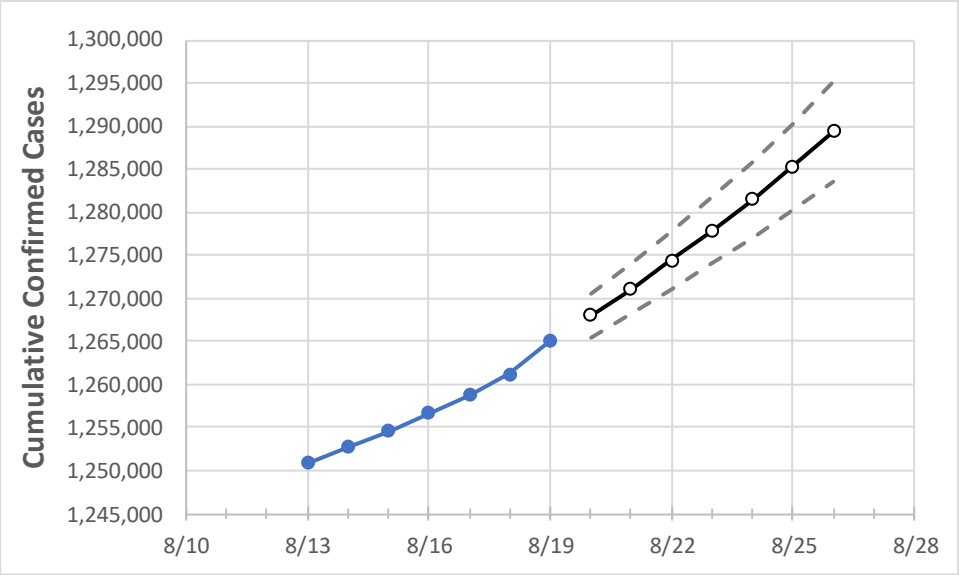
IEM's Modeling Lead

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:						
	8/16	8/17	8/18	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26
Pennsylvania	1,256,689	1,258,774	1,261,160	1,265,068	1,268,010	1,271,086	1,274,388	1,277,854	1,281,520	1,285,338	1,289,379

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:						
	8/16	8/17	8/18	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26
Allegheny	105,805	105,979	106,150	106,560	106,829	107,116	107,414	107,733	108,062	108,408	108,770
Berks	49,634	49,709	49,801	49,883	49,974	50,070	50,173	50,282	50,398	50,520	50,649
Bucks	62,895	62,986	63,107	63,228	63,350	63,476	63,608	63,747	63,892	64,041	64,194
Butler	18,221	18,245	18,286	18,364	18,416	18,470	18,529	18,592	18,658	18,730	18,806
Chester	42,388	42,476	42,565	42,652	42,764	42,881	43,001	43,128	43,261	43,400	43,546
Delaware	54,092	54,156	54,242	54,354	54,447	54,542	54,641	54,743	54,849	54,959	55,071
Lackawanna	19,015	19,047	19,081	19,103	19,132	19,162	19,194	19,227	19,261	19,297	19,335
Lancaster	57,282	57,360	57,499	57,653	57,786	57,926	58,075	58,230	58,393	58,560	58,742
Lehigh	41,186	41,271	41,371	41,473	41,577	41,689	41,806	41,933	42,065	42,203	42,349
Luzerne	33,050	33,095	33,142	33,214	33,265	33,318	33,372	33,427	33,485	33,545	33,606
Monroe	15,557	15,595	15,622	15,661	15,702	15,745	15,790	15,836	15,882	15,932	15,983
Montgomery	73,209	73,321	73,441	73,597	73,748	73,904	74,065	74,231	74,400	74,577	74,757
Northampton	37,422	37,516	37,604	37,739	37,848	37,962	38,080	38,204	38,333	38,470	38,612
Philadelphia	160,366	160,676	161,040	161,863	162,196	162,541	162,900	163,269	163,657	164,070	164,496
Westmoreland	35,371	35,407	35,458	35,638	35,736	35,839	35,954	36,077	36,210	36,356	36,517
York	48,557	48,632	48,746	48,862	48,986	49,119	49,258	49,407	49,566	49,736	49,915

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:		
	8/16	8/17	8/18	8/19	8/21	8/23	8/25
Allegheny	105,805	105,979	106,150	106,560	107,116 (21,423) [5,142] {2,571}	107,733 (21,547) [5,171] {2,586}	108,408 (21,682) [5,204] {2,602}
Berks	49,634	49,709	49,801	49,883	50,070 (10,014) [2,403] {1,202}	50,282 (10,056) [2,414] {1,207}	50,520 (10,104) [2,425] {1,212}
Bucks	62,895	62,986	63,107	63,228	63,476 (12,695) [3,047] {1,523}	63,747 (12,749) [3,060] {1,530}	64,041 (12,808) [3,074] {1,537}
Butler	18,221	18,245	18,286	18,364	18,470 (3,694) [887] {443}	18,592 (3,718) [892] {446}	18,730 (3,746) [899] {450}
Chester	42,388	42,476	42,565	42,652	42,881 (8,576) [2,058] {1,029}	43,128 (8,626) [2,070] {1,035}	43,400 (8,680) [2,083] {1,042}
Delaware	54,092	54,156	54,242	54,354	54,542 (10,908) [2,618] {1,309}	54,743 (10,949) [2,628] {1,314}	54,959 (10,992) [2,638] {1,319}
Lackawanna	19,015	19,047	19,081	19,103	19,162 (3,832) [920] {460}	19,227 (3,845) [923] {461}	19,297 (3,859) [926] {463}
Lancaster	57,282	57,360	57,499	57,653	57,926 (11,585) [2,780] {1,390}	58,230 (11,646) [2,795] {1,398}	58,560 (11,712) [2,811] {1,405}
Lehigh	41,186	41,271	41,371	41,473	41,689 (8,338) [2,001] {1,001}	41,933 (8,387) [2,013] {1,006}	42,203 (8,441) [2,026] {1,013}
Luzerne	33,050	33,095	33,142	33,214	33,318 (6,664) [1,599] {800}	33,427 (6,685) [1,605] {802}	33,545 (6,709) [1,610] {805}
Monroe	15,557	15,595	15,622	15,661	15,745 (3,149) [756] {378}	15,836 (3,167) [760] {380}	15,932 (3,186) [765] {382}
Montgomery	73,209	73,321	73,441	73,597	73,904 (14,781) [3,547] {1,774}	74,231 (14,846) [3,563] {1,782}	74,577 (14,915) [3,580] {1,790}
Northampton	37,422	37,516	37,604	37,739	37,962 (7,592) [1,822] {911}	38,204 (7,641) [1,834] {917}	38,470 (7,694) [1,847] {923}
Philadelphia	160,366	160,676	161,040	161,863	162,541 (32,508) [7,802] {3,901}	163,269 (32,654) [7,837] {3,918}	164,070 (32,814) [7,875] {3,938}
Westmoreland	35,371	35,407	35,458	35,638	35,839 (7,168) [1,720] {860}	36,077 (7,215) [1,732] {866}	36,356 (7,271) [1,745] {873}
York	48,557	48,632	48,746	48,862	49,119 (9,824) [2,358] {1,179}	49,407 (9,881) [2,372] {1,186}	49,736 (9,947) [2,387] {1,194}

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.