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

Date: 11/3/21

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 11/3/21 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.

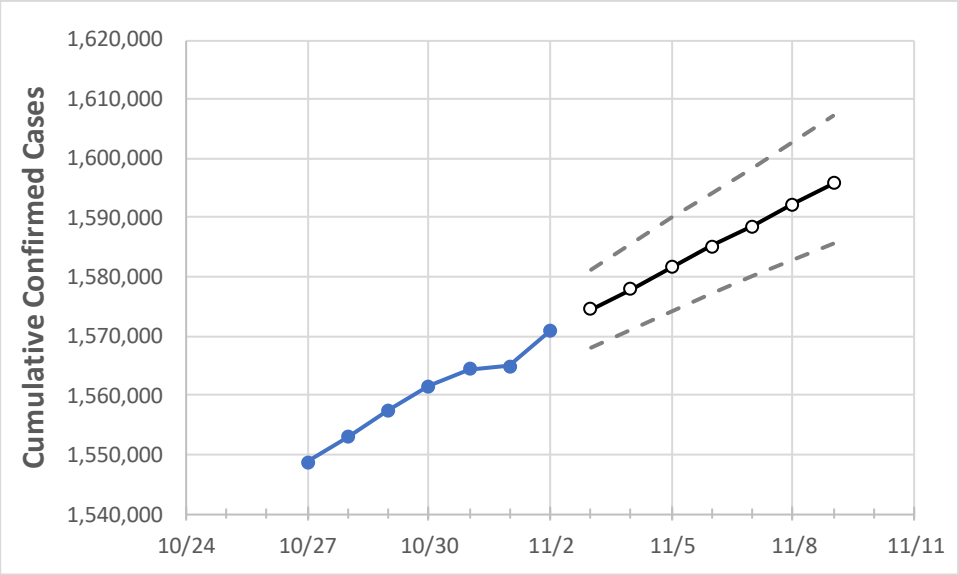
IEM's Modeling Lead

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:						
	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
Pennsylvania	1,561,523	1,564,451	1,564,939	1,570,819	1,574,466	1,577,994	1,581,571	1,585,158	1,588,506	1,592,249	1,595,823

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:						
	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
Allegheny	132,348	132,673	132,965	133,256	133,610	133,962	134,326	134,674	135,028	135,384	135,739
Berks	58,742	58,840	58,959	59,078	59,201	59,325	59,449	59,573	59,697	59,819	59,943
Bucks	73,475	73,566	73,685	73,803	73,919	74,034	74,145	74,258	74,372	74,484	74,596
Butler	25,116	25,189	25,275	25,360	25,427	25,492	25,556	25,619	25,685	25,748	25,811
Chester	50,913	50,976	51,038	51,038	51,122	51,204	51,285	51,365	51,448	51,525	51,601
Delaware	62,298	62,391	62,462	62,533	62,624	62,715	62,801	62,893	62,982	63,071	63,159
Lackawanna	22,787	22,841	22,877	22,912	22,951	22,988	23,027	23,064	23,101	23,138	23,177
Lancaster	71,663	71,858	71,960	72,061	72,216	72,369	72,516	72,665	72,813	72,959	73,098
Lehigh	48,544	48,618	48,693	48,768	48,838	48,909	48,979	49,049	49,121	49,189	49,260
Luzerne	41,071	41,168	41,245	41,322	41,420	41,516	41,612	41,705	41,801	41,895	41,987
Monroe	19,680	19,709	19,753	19,796	19,833	19,870	19,907	19,943	19,977	20,015	20,050
Montgomery	85,832	85,922	86,051	86,180	86,322	86,460	86,597	86,734	86,867	87,002	87,136
Northampton	44,645	44,694	44,775	44,856	44,928	45,001	45,073	45,144	45,217	45,292	45,361
Philadelphia	182,122	182,223	182,323	182,323	182,482	182,638	182,790	182,941	183,093	183,239	183,382
Westmoreland	45,178	45,286	45,387	45,487	45,616	45,738	45,863	45,984	46,108	46,233	46,354
York	62,751	62,909	63,067	63,225	63,416	63,604	63,789	63,976	64,161	64,349	64,532

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:		
	10/30	10/31	11/1	11/2	11/4	11/6	11/8
Allegheny	132,348	132,673	132,965	133,256	133,962 (26,792) [6,430] {3,215}	134,674 (26,935) [6,464] {3,232}	135,384 (27,077) [6,498] {3,249}
Berks	58,742	58,840	58,959	59,078	59,325 (11,865) [2,848] {1,424}	59,573 (11,915) [2,859] {1,430}	59,819 (11,964) [2,871] {1,436}
Bucks	73,475	73,566	73,685	73,803	74,034 (14,807) [3,554] {1,777}	74,258 (14,852) [3,564] {1,782}	74,484 (14,897) [3,575] {1,788}
Butler	25,116	25,189	25,275	25,360	25,492 (5,098) [1,224] {612}	25,619 (5,124) [1,230] {615}	25,748 (5,150) [1,236] {618}
Chester	50,913	50,976	51,038	51,038	51,204 (10,241) [2,458] {1,229}	51,365 (10,273) [2,466] {1,233}	51,525 (10,305) [2,473] {1,237}
Delaware	62,298	62,391	62,462	62,533	62,715 (12,543) [3,010] {1,505}	62,893 (12,579) [3,019] {1,509}	63,071 (12,614) [3,027] {1,514}
Lackawanna	22,787	22,841	22,877	22,912	22,988 (4,598) [1,103] {552}	23,064 (4,613) [1,107] {554}	23,138 (4,628) [1,111] {555}
Lancaster	71,663	71,858	71,960	72,061	72,369 (14,474) [3,474] {1,737}	72,665 (14,533) [3,488] {1,744}	72,959 (14,592) [3,502] {1,751}
Lehigh	48,544	48,618	48,693	48,768	48,909 (9,782) [2,348] {1,174}	49,049 (9,810) [2,354] {1,177}	49,189 (9,838) [2,361] {1,181}
Luzerne	41,071	41,168	41,245	41,322	41,516 (8,303) [1,993] {996}	41,705 (8,341) [2,002] {1,001}	41,895 (8,379) [2,011] {1,005}
Monroe	19,680	19,709	19,753	19,796	19,870 (3,974) [954] {477}	19,943 (3,989) [957] {479}	20,015 (4,003) [961] {480}
Montgomery	85,832	85,922	86,051	86,180	86,460 (17,292) [4,150] {2,075}	86,734 (17,347) [4,163] {2,082}	87,002 (17,400) [4,176] {2,088}
Northampton	44,645	44,694	44,775	44,856	45,001 (9,000) [2,160] {1,080}	45,144 (9,029) [2,167] {1,083}	45,292 (9,058) [2,174] {1,087}
Philadelphia	182,122	182,223	182,323	182,323	182,638 (36,528) [8,767] {4,383}	182,941 (36,588) [8,781] {4,391}	183,239 (36,648) [8,795] {4,398}
Westmoreland	45,178	45,286	45,387	45,487	45,738 (9,148) [2,195] {1,098}	45,984 (9,197) [2,207] {1,104}	46,233 (9,247) [2,219] {1,110}
York	62,751	62,909	63,067	63,225	63,604 (12,721) [3,053] {1,526}	63,976 (12,795) [3,071] {1,535}	64,349 (12,870) [3,089] {1,544}

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.