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

Date: 10/18/21

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 10/18/21 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.

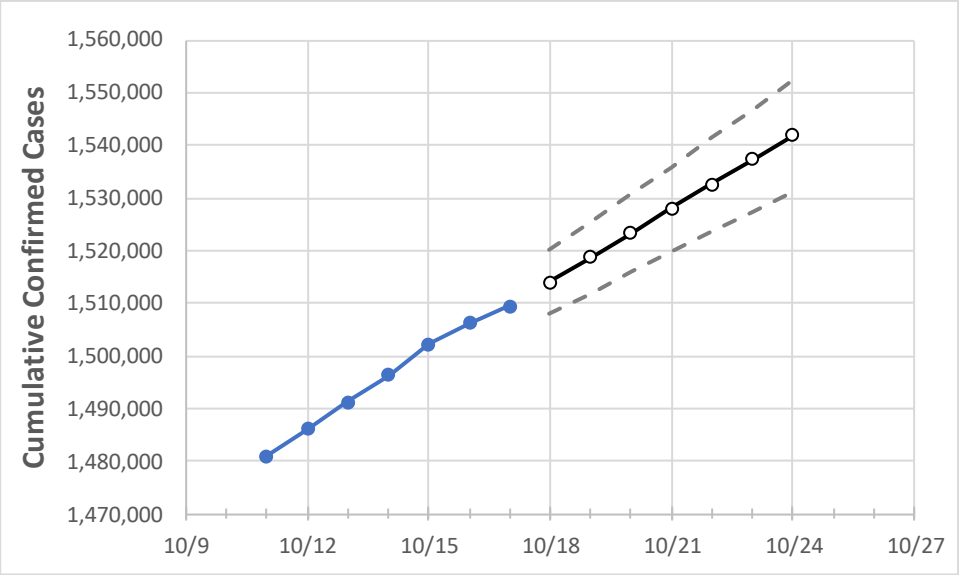
IEM's Modeling Lead

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:						
	10/14	10/15	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	10/24
Pennsylvania	1,496,399	1,502,124	1,506,111	1,509,486	1,514,084	1,518,718	1,523,367	1,527,994	1,532,586	1,537,305	1,541,903

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:						
	10/14	10/15	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	10/24
Allegheny	126,496	126,989	127,370	127,653	128,047	128,452	128,865	129,278	129,686	130,105	130,528
Berks	56,622	56,795	56,904	57,027	57,161	57,295	57,427	57,561	57,696	57,832	57,968
Bucks	71,400	71,590	71,731	71,862	72,034	72,198	72,367	72,538	72,710	72,881	73,051
Butler	23,953	24,096	24,153	24,244	24,341	24,434	24,528	24,626	24,716	24,810	24,903
Chester	49,250	49,427	49,427	49,427	49,555	49,685	49,813	49,942	50,074	50,207	50,338
Delaware	60,717	60,839	60,914	61,037	61,150	61,266	61,373	61,487	61,605	61,723	61,840
Lackawanna	22,082	22,141	22,194	22,271	22,338	22,406	22,471	22,537	22,606	22,675	22,744
Lancaster	68,722	68,976	69,169	69,367	69,582	69,793	70,006	70,221	70,432	70,649	70,868
Lehigh	47,385	47,461	47,549	47,612	47,699	47,786	47,871	47,955	48,042	48,128	48,210
Luzerne	39,208	39,367	39,515	39,672	39,819	39,968	40,117	40,268	40,419	40,572	40,722
Monroe	18,997	19,039	19,084	19,146	19,199	19,254	19,307	19,359	19,414	19,468	19,519
Montgomery	83,203	83,399	83,554	83,740	83,923	84,106	84,293	84,477	84,665	84,854	85,043
Northampton	43,443	43,507	43,591	43,670	43,749	43,831	43,910	43,988	44,067	44,144	44,220
Philadelphia	178,440	178,723	178,723	178,723	179,010	179,303	179,590	179,886	180,191	180,476	180,776
Westmoreland	42,943	43,187	43,323	43,419	43,577	43,733	43,891	44,056	44,219	44,382	44,546
York	59,415	59,671	59,833	60,078	60,308	60,538	60,772	61,001	61,236	61,471	61,708

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:		
	10/14	10/15	10/16	10/17	10/19	10/21	10/23
Allegheny	126,496	126,989	127,370	127,653	128,452 (25,690) [6,166] {3,083}	129,278 (25,856) [6,205] {3,103}	130,105 (26,021) [6,245] {3,123}
Berks	56,622	56,795	56,904	57,027	57,295 (11,459) [2,750] {1,375}	57,561 (11,512) [2,763] {1,381}	57,832 (11,566) [2,776] {1,388}
Bucks	71,400	71,590	71,731	71,862	72,198 (14,440) [3,465] {1,733}	72,538 (14,508) [3,482] {1,741}	72,881 (14,576) [3,498] {1,749}
Butler	23,953	24,096	24,153	24,244	24,434 (4,887) [1,173] {586}	24,626 (4,925) [1,182] {591}	24,810 (4,962) [1,191] {595}
Chester	49,250	49,427	49,427	49,427	49,685 (9,937) [2,385] {1,192}	49,942 (9,988) [2,397] {1,199}	50,207 (10,041) [2,410] {1,205}
Delaware	60,717	60,839	60,914	61,037	61,266 (12,253) [2,941] {1,470}	61,487 (12,297) [2,951] {1,476}	61,723 (12,345) [2,963] {1,481}
Lackawanna	22,082	22,141	22,194	22,271	22,406 (4,481) [1,075] {538}	22,537 (4,507) [1,082] {541}	22,675 (4,535) [1,088] {544}
Lancaster	68,722	68,976	69,169	69,367	69,793 (13,959) [3,350] {1,675}	70,221 (14,044) [3,371] {1,685}	70,649 (14,130) [3,391] {1,696}
Lehigh	47,385	47,461	47,549	47,612	47,786 (9,557) [2,294] {1,147}	47,955 (9,591) [2,302] {1,151}	48,128 (9,626) [2,310] {1,155}
Luzerne	39,208	39,367	39,515	39,672	39,968 (7,994) [1,918] {959}	40,268 (8,054) [1,933] {966}	40,572 (8,114) [1,947] {974}
Monroe	18,997	19,039	19,084	19,146	19,254 (3,851) [924] {462}	19,359 (3,872) [929] {465}	19,468 (3,894) [934] {467}
Montgomery	83,203	83,399	83,554	83,740	84,106 (16,821) [4,037] {2,019}	84,477 (16,895) [4,055] {2,027}	84,854 (16,971) [4,073] {2,036}
Northampton	43,443	43,507	43,591	43,670	43,831 (8,766) [2,104] {1,052}	43,988 (8,798) [2,111] {1,056}	44,144 (8,829) [2,119] {1,059}
Philadelphia	178,440	178,723	178,723	178,723	179,303 (35,861) [8,607] {4,303}	179,886 (35,977) [8,635] {4,317}	180,476 (36,095) [8,663] {4,331}
Westmoreland	42,943	43,187	43,323	43,419	43,733 (8,747) [2,099] {1,050}	44,056 (8,811) [2,115] {1,057}	44,382 (8,876) [2,130] {1,065}
York	59,415	59,671	59,833	60,078	60,538 (12,108) [2,906] {1,453}	61,001 (12,200) [2,928] {1,464}	61,471 (12,294) [2,951] {1,475}

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.