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

Date: 10/20/21

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 10/20/21 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.

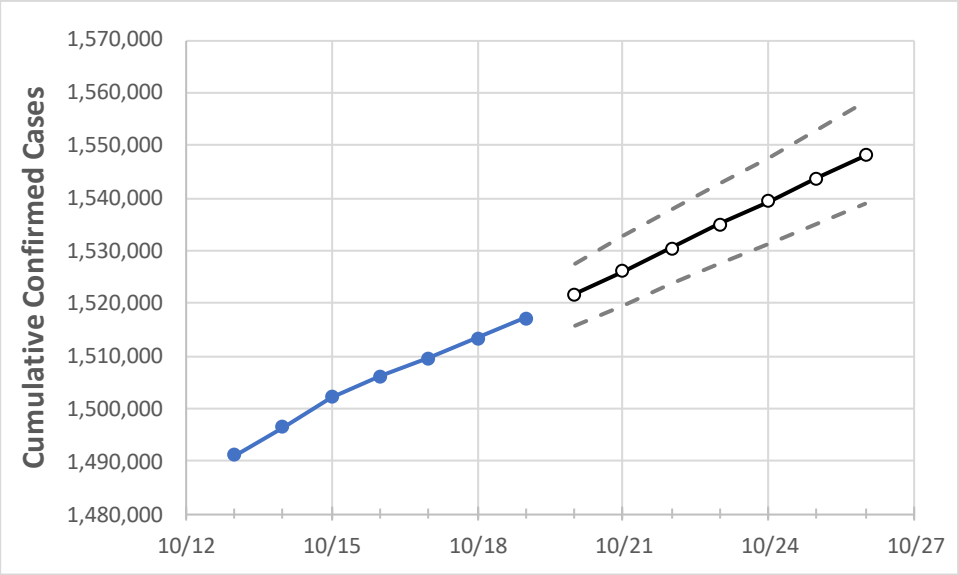
IEM's Modeling Lead

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:						
	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	10/24	10/25	10/26
Pennsylvania	1,506,111	1,509,486	1,513,332	1,517,231	1,521,733	1,526,097	1,530,536	1,534,946	1,539,404	1,543,731	1,548,148

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:						
	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	10/24	10/25	10/26
Allegheny	127,370	127,653	127,983	128,202	128,583	128,964	129,343	129,721	130,104	130,498	130,876
Berks	56,904	57,027	57,123	57,240	57,365	57,490	57,610	57,736	57,857	57,978	58,100
Bucks	71,731	71,862	71,963	72,108	72,263	72,419	72,570	72,728	72,882	73,039	73,195
Butler	24,153	24,244	24,327	24,366	24,455	24,541	24,627	24,713	24,795	24,881	24,961
Chester	49,520	49,612	49,705	49,843	49,961	50,079	50,195	50,313	50,428	50,548	50,664
Delaware	60,914	61,037	61,104	61,206	61,315	61,423	61,529	61,640	61,749	61,859	61,969
Lackawanna	22,194	22,271	22,311	22,347	22,409	22,469	22,530	22,589	22,651	22,712	22,772
Lancaster	69,169	69,367	69,535	69,689	69,891	70,093	70,287	70,488	70,685	70,883	71,081
Lehigh	47,549	47,612	47,643	47,712	47,791	47,871	47,946	48,025	48,100	48,179	48,255
Luzerne	39,515	39,672	39,750	39,828	39,961	40,091	40,227	40,357	40,487	40,624	40,753
Monroe	19,084	19,146	19,174	19,227	19,279	19,330	19,381	19,432	19,484	19,535	19,586
Montgomery	83,554	83,740	83,861	84,069	84,248	84,427	84,603	84,784	84,963	85,147	85,328
Northampton	43,591	43,670	43,715	43,804	43,882	43,959	44,032	44,108	44,180	44,253	44,327
Philadelphia	178,966	179,208	179,451	179,899	180,193	180,496	180,784	181,089	181,398	181,702	182,002
Westmoreland	43,323	43,419	43,568	43,667	43,820	43,973	44,121	44,273	44,428	44,584	44,733
York	59,833	60,078	60,259	60,440	60,653	60,870	61,081	61,296	61,514	61,728	61,947

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:		
	10/16	10/17	10/18	10/19	10/21	10/23	10/25
Allegheny	127,370	127,653	127,983	128,202	128,964 (25,793) [6,190] {3,095}	129,721 (25,944) [6,227] {3,113}	130,498 (26,100) [6,264] {3,132}
Berks	56,904	57,027	57,123	57,240	57,490 (11,498) [2,760] {1,380}	57,736 (11,547) [2,771] {1,386}	57,978 (11,596) [2,783] {1,391}
Bucks	71,731	71,862	71,963	72,108	72,419 (14,484) [3,476] {1,738}	72,728 (14,546) [3,491] {1,745}	73,039 (14,608) [3,506] {1,753}
Butler	24,153	24,244	24,327	24,366	24,541 (4,908) [1,178] {589}	24,713 (4,943) [1,186] {593}	24,881 (4,976) [1,194] {597}
Chester	49,520	49,612	49,705	49,843	50,079 (10,016) [2,404] {1,202}	50,313 (10,063) [2,415] {1,208}	50,548 (10,110) [2,426] {1,213}
Delaware	60,914	61,037	61,104	61,206	61,423 (12,285) [2,948] {1,474}	61,640 (12,328) [2,959] {1,479}	61,859 (12,372) [2,969] {1,485}
Lackawanna	22,194	22,271	22,311	22,347	22,469 (4,494) [1,078] {539}	22,589 (4,518) [1,084] {542}	22,712 (4,542) [1,090] {545}
Lancaster	69,169	69,367	69,535	69,689	70,093 (14,019) [3,364] {1,682}	70,488 (14,098) [3,383] {1,692}	70,883 (14,177) [3,402] {1,701}
Lehigh	47,549	47,612	47,643	47,712	47,871 (9,574) [2,298] {1,149}	48,025 (9,605) [2,305] {1,153}	48,179 (9,636) [2,313] {1,156}
Luzerne	39,515	39,672	39,750	39,828	40,091 (8,018) [1,924] {962}	40,357 (8,071) [1,937] {969}	40,624 (8,125) [1,950] {975}
Monroe	19,084	19,146	19,174	19,227	19,330 (3,866) [928] {464}	19,432 (3,886) [933] {466}	19,535 (3,907) [938] {469}
Montgomery	83,554	83,740	83,861	84,069	84,427 (16,885) [4,052] {2,026}	84,784 (16,957) [4,070] {2,035}	85,147 (17,029) [4,087] {2,044}
Northampton	43,591	43,670	43,715	43,804	43,959 (8,792) [2,110] {1,055}	44,108 (8,822) [2,117] {1,059}	44,253 (8,851) [2,124] {1,062}
Philadelphia	178,966	179,208	179,451	179,899	180,496 (36,099) [8,664] {4,332}	181,089 (36,218) [8,692] {4,346}	181,702 (36,340) [8,722] {4,361}
Westmoreland	43,323	43,419	43,568	43,667	43,973 (8,795) [2,111] {1,055}	44,273 (8,855) [2,125] {1,063}	44,584 (8,917) [2,140] {1,070}
York	59,833	60,078	60,259	60,440	60,870 (12,174) [2,922] {1,461}	61,296 (12,259) [2,942] {1,471}	61,728 (12,346) [2,963] {1,481}

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.