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

Date: 6/28/21

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 6/28/21 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.

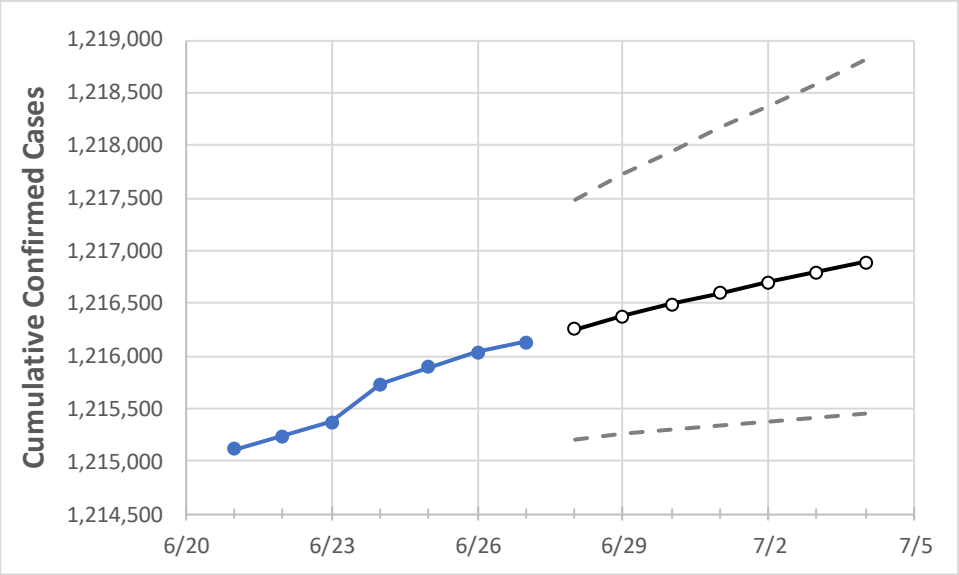
IEM's Modeling Lead

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:						
	6/24	6/25	6/26	6/27	6/28	6/29	6/30	7/1	7/2	7/3	7/4
Pennsylvania	1,215,735	1,215,889	1,216,037	1,216,133	1,216,258	1,216,376	1,216,488	1,216,596	1,216,698	1,216,798	1,216,892

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:						
	6/24	6/25	6/26	6/27	6/28	6/29	6/30	7/1	7/2	7/3	7/4
Allegheny	101,821	101,837	101,854	101,864	101,875	101,885	101,896	101,905	101,915	101,924	101,933
Berks	48,435	48,439	48,442	48,449	48,456	48,462	48,467	48,473	48,478	48,482	48,486
Bucks	60,797	60,803	60,804	60,804	60,807	60,810	60,812	60,815	60,817	60,819	60,821
Butler	17,607	17,608	17,611	17,614	17,616	17,618	17,620	17,622	17,624	17,625	17,627
Chester	40,793	40,805	40,805	40,805	40,812	40,820	40,827	40,834	40,841	40,849	40,856
Delaware	52,358	52,367	52,370	52,379	52,383	52,388	52,392	52,395	52,399	52,402	52,405
Lackawanna	18,545	18,548	18,553	18,556	18,559	18,562	18,565	18,568	18,571	18,574	18,576
Lancaster	55,380	55,386	55,394	55,402	55,406	55,410	55,413	55,417	55,420	55,423	55,426
Lehigh	39,845	39,846	39,846	39,846	39,849	39,852	39,855	39,858	39,861	39,863	39,866
Luzerne	32,085	32,088	32,096	32,101	32,106	32,111	32,115	32,120	32,124	32,127	32,131
Monroe	14,814	14,818	14,820	14,821	14,824	14,826	14,829	14,831	14,833	14,835	14,837
Montgomery	70,371	70,381	70,382	70,390	70,395	70,399	70,403	70,406	70,410	70,413	70,417
Northampton	35,865	35,867	35,875	35,875	35,880	35,884	35,889	35,893	35,897	35,901	35,905
Philadelphia	154,473	154,473	154,473	154,473	154,502	154,531	154,559	154,588	154,616	154,641	154,664
Westmoreland	34,398	34,405	34,409	34,410	34,416	34,421	34,425	34,430	34,435	34,439	34,443
York	46,976	46,989	47,004	47,010	47,016	47,023	47,028	47,034	47,038	47,043	47,047

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:		
	6/24	6/25	6/26	6/27	6/29	7/1	7/3
Allegheny	101,821	101,837	101,854	101,864	101,885 (20,377) [4,890] {2,445}	101,905 (20,381) [4,891] {2,446}	101,924 (20,385) [4,892] {2,446}
Berks	48,435	48,439	48,442	48,449	48,462 (9,692) [2,326] {1,163}	48,473 (9,695) [2,327] {1,163}	48,482 (9,696) [2,327] {1,164}
Bucks	60,797	60,803	60,804	60,804	60,810 (12,162) [2,919] {1,459}	60,815 (12,163) [2,919] {1,460}	60,819 (12,164) [2,919] {1,460}
Butler	17,607	17,608	17,611	17,614	17,618 (3,524) [846] {423}	17,622 (3,524) [846] {423}	17,625 (3,525) [846] {423}
Chester	40,793	40,805	40,805	40,805	40,820 (8,164) [1,959] {980}	40,834 (8,167) [1,960] {980}	40,849 (8,170) [1,961] {980}
Delaware	52,358	52,367	52,370	52,379	52,388 (10,478) [2,515] {1,257}	52,395 (10,479) [2,515] {1,257}	52,402 (10,480) [2,515] {1,258}
Lackawanna	18,545	18,548	18,553	18,556	18,562 (3,712) [891] {445}	18,568 (3,714) [891] {446}	18,574 (3,715) [892] {446}
Lancaster	55,380	55,386	55,394	55,402	55,410 (11,082) [2,660] {1,330}	55,417 (11,083) [2,660] {1,330}	55,423 (11,085) [2,660] {1,330}
Lehigh	39,845	39,846	39,846	39,846	39,852 (7,970) [1,913] {956}	39,858 (7,972) [1,913] {957}	39,863 (7,973) [1,913] {957}
Luzerne	32,085	32,088	32,096	32,101	32,111 (6,422) [1,541] {771}	32,120 (6,424) [1,542] {771}	32,127 (6,425) [1,542] {771}
Monroe	14,814	14,818	14,820	14,821	14,826 (2,965) [712] {356}	14,831 (2,966) [712] {356}	14,835 (2,967) [712] {356}
Montgomery	70,371	70,381	70,382	70,390	70,399 (14,080) [3,379] {1,690}	70,406 (14,081) [3,380] {1,690}	70,413 (14,083) [3,380] {1,690}
Northampton	35,865	35,867	35,875	35,875	35,884 (7,177) [1,722] {861}	35,893 (7,179) [1,723] {861}	35,901 (7,180) [1,723] {862}
Philadelphia	154,473	154,473	154,473	154,473	154,531 (30,906) [7,417] {3,709}	154,588 (30,918) [7,420] {3,710}	154,641 (30,928) [7,423] {3,711}
Westmoreland	34,398	34,405	34,409	34,410	34,421 (6,884) [1,652] {826}	34,430 (6,886) [1,653] {826}	34,439 (6,888) [1,653] {827}
York	46,976	46,989	47,004	47,010	47,023 (9,405) [2,257] {1,129}	47,034 (9,407) [2,258] {1,129}	47,043 (9,409) [2,258] {1,129}

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.