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

Date: 5/4/21

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 5/4/21 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.

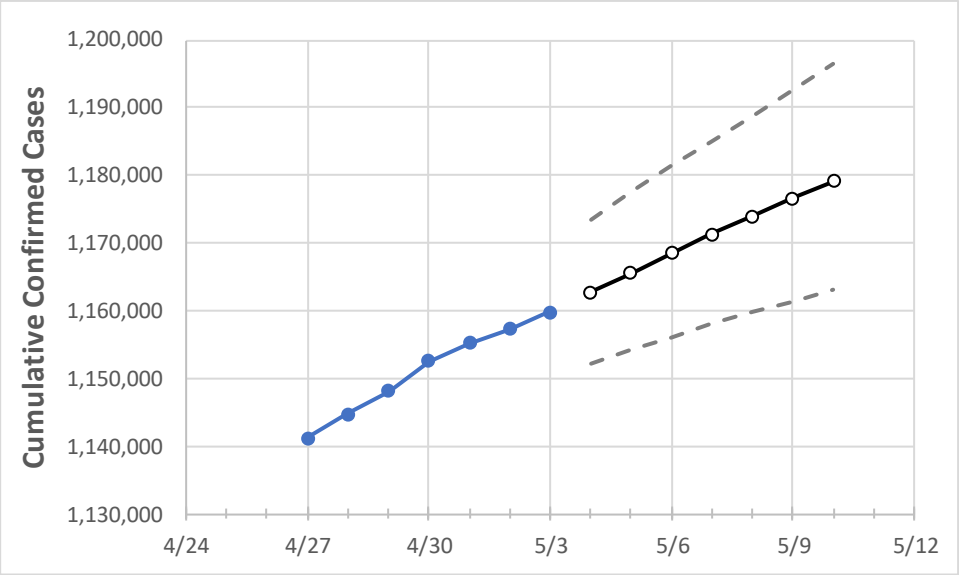
IEM's Modeling Lead

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:						
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10
Pennsylvania	1,152,536	1,155,140	1,157,285	1,159,816	1,162,676	1,165,596	1,168,503	1,171,278	1,173,925	1,176,570	1,179,152

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:						
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10
Allegheny	97,250	97,521	97,760	97,975	98,177	98,378	98,567	98,750	98,925	99,097	99,258
Berks	45,600	45,758	45,835	45,865	46,006	46,146	46,279	46,418	46,554	46,686	46,811
Bucks	58,427	58,598	58,699	58,791	58,943	59,088	59,230	59,366	59,492	59,619	59,746
Butler	16,762	16,801	16,840	16,860	16,896	16,931	16,965	16,999	17,032	17,064	17,095
Chester	35,402	35,470	35,539	35,607	35,694	35,779	35,861	35,941	36,018	36,095	36,169
Delaware	50,475	50,582	50,680	50,743	50,854	50,962	51,067	51,171	51,269	51,368	51,462
Lackawanna	17,707	17,746	17,774	17,809	17,856	17,904	17,951	17,996	18,040	18,085	18,128
Lancaster	53,202	53,334	53,445	53,501	53,622	53,739	53,858	53,969	54,076	54,181	54,289
Lehigh	38,172	38,277	38,341	38,386	38,482	38,575	38,670	38,763	38,853	38,945	39,033
Luzerne	30,343	30,428	30,485	30,527	30,616	30,703	30,790	30,874	30,958	31,039	31,123
Monroe	13,891	13,970	14,009	14,038	14,096	14,155	14,213	14,269	14,326	14,379	14,433
Montgomery	67,835	68,000	68,153	68,241	68,408	68,568	68,723	68,878	69,025	69,173	69,313
Northampton	34,475	34,570	34,640	34,674	34,756	34,834	34,911	34,986	35,061	35,128	35,197
Philadelphia	147,125	147,427	147,729	148,031	148,399	148,755	149,097	149,428	149,761	150,073	150,380
Westmoreland	32,649	32,705	32,775	32,828	32,902	32,973	33,044	33,110	33,174	33,236	33,299
York	44,127	44,286	44,398	44,485	44,604	44,723	44,839	44,953	45,065	45,176	45,284

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:		
	4/30	5/1	5/2	5/3	5/5	5/7	5/9
Allegheny	97,250	97,521	97,760	97,975	98,378 (19,676) [4,722] {2,361}	98,750 (19,750) [4,740] {2,370}	99,097 (19,819) [4,757] {2,378}
Berks	45,600	45,758	45,835	45,865	46,146 (9,229) [2,215] {1,108}	46,418 (9,284) [2,228] {1,114}	46,686 (9,337) [2,241] {1,120}
Bucks	58,427	58,598	58,699	58,791	59,088 (11,818) [2,836] {1,418}	59,366 (11,873) [2,850] {1,425}	59,619 (11,924) [2,862] {1,431}
Butler	16,762	16,801	16,840	16,860	16,931 (3,386) [813] {406}	16,999 (3,400) [816] {408}	17,064 (3,413) [819] {410}
Chester	35,402	35,470	35,539	35,607	35,779 (7,156) [1,717] {859}	35,941 (7,188) [1,725] {863}	36,095 (7,219) [1,733] {866}
Delaware	50,475	50,582	50,680	50,743	50,962 (10,192) [2,446] {1,223}	51,171 (10,234) [2,456] {1,228}	51,368 (10,274) [2,466] {1,233}
Lackawanna	17,707	17,746	17,774	17,809	17,904 (3,581) [859] {430}	17,996 (3,599) [864] {432}	18,085 (3,617) [868] {434}
Lancaster	53,202	53,334	53,445	53,501	53,739 (10,748) [2,579] {1,290}	53,969 (10,794) [2,591] {1,295}	54,181 (10,836) [2,601] {1,300}
Lehigh	38,172	38,277	38,341	38,386	38,575 (7,715) [1,852] {926}	38,763 (7,753) [1,861] {930}	38,945 (7,789) [1,869] {935}
Luzerne	30,343	30,428	30,485	30,527	30,703 (6,141) [1,474] {737}	30,874 (6,175) [1,482] {741}	31,039 (6,208) [1,490] {745}
Monroe	13,891	13,970	14,009	14,038	14,155 (2,831) [679] {340}	14,269 (2,854) [685] {342}	14,379 (2,876) [690] {345}
Montgomery	67,835	68,000	68,153	68,241	68,568 (13,714) [3,291] {1,646}	68,878 (13,776) [3,306] {1,653}	69,173 (13,835) [3,320] {1,660}
Northampton	34,475	34,570	34,640	34,674	34,834 (6,967) [1,672] {836}	34,986 (6,997) [1,679] {840}	35,128 (7,026) [1,686] {843}
Philadelphia	147,125	147,427	147,729	148,031	148,755 (29,751) [7,140] {3,570}	149,428 (29,886) [7,173] {3,586}	150,073 (30,015) [7,204] {3,602}
Westmoreland	32,649	32,705	32,775	32,828	32,973 (6,595) [1,583] {791}	33,110 (6,622) [1,589] {795}	33,236 (6,647) [1,595] {798}
York	44,127	44,286	44,398	44,485	44,723 (8,945) [2,147] {1,073}	44,953 (8,991) [2,158] {1,079}	45,176 (9,035) [2,168] {1,084}

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.