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

Date: 5/13/21

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 5/13/21 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.

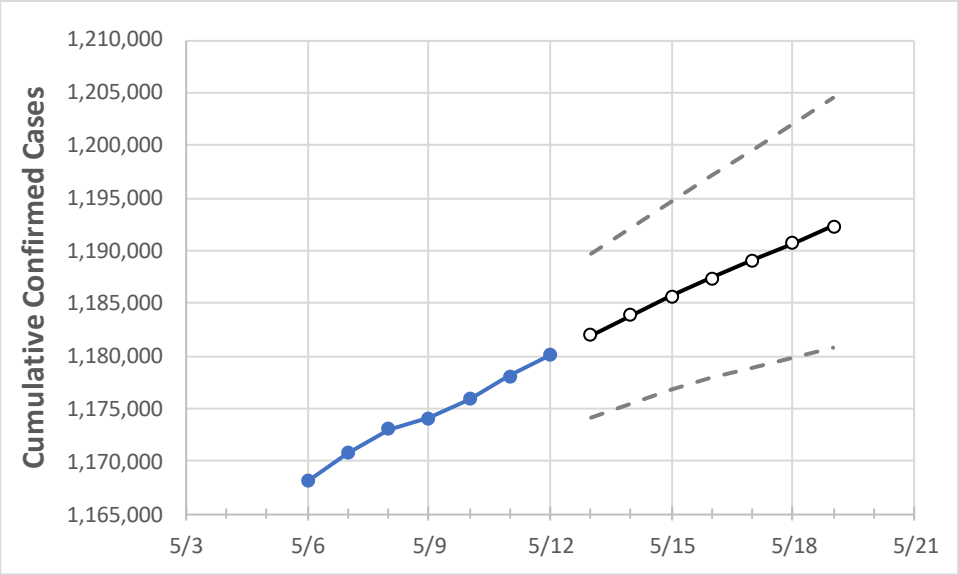
IEM's Modeling Lead

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:						
	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
Pennsylvania	1,174,067	1,175,850	1,178,083	1,180,020	1,181,965	1,183,863	1,185,652	1,187,385	1,189,058	1,190,727	1,192,285

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:						
	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
Allegheny	99,089	99,160	99,384	99,567	99,716	99,858	99,994	100,129	100,258	100,382	100,507
Berks	46,671	46,725	46,845	46,938	47,041	47,141	47,232	47,324	47,416	47,504	47,591
Bucks	59,478	59,531	59,613	59,744	59,827	59,907	59,985	60,057	60,126	60,192	60,254
Butler	17,052	17,064	17,110	17,137	17,165	17,192	17,219	17,246	17,273	17,299	17,324
Chester	36,065	36,112	36,179	36,282	36,343	36,404	36,463	36,520	36,576	36,630	36,682
Delaware	51,240	51,293	51,348	51,438	51,498	51,557	51,613	51,666	51,716	51,764	51,809
Lackawanna	18,034	18,045	18,087	18,111	18,137	18,161	18,184	18,206	18,227	18,248	18,267
Lancaster	54,098	54,145	54,211	54,308	54,384	54,454	54,523	54,587	54,650	54,712	54,770
Lehigh	38,813	38,838	38,911	38,955	39,011	39,064	39,116	39,165	39,214	39,259	39,303
Luzerne	30,942	30,974	31,055	31,132	31,191	31,248	31,304	31,358	31,411	31,462	31,512
Monroe	14,303	14,329	14,369	14,399	14,434	14,468	14,501	14,533	14,564	14,595	14,623
Montgomery	68,963	69,038	69,068	69,198	69,288	69,374	69,455	69,533	69,609	69,684	69,753
Northampton	35,039	35,065	35,132	35,172	35,216	35,259	35,299	35,339	35,376	35,412	35,446
Philadelphia	149,758	149,953	149,953	149,953	150,163	150,360	150,558	150,742	150,916	151,081	151,245
Westmoreland	33,329	33,347	33,426	33,471	33,532	33,590	33,646	33,701	33,753	33,804	33,856
York	45,139	45,183	45,255	45,339	45,424	45,506	45,586	45,665	45,743	45,816	45,886

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:		
	5/9	5/10	5/11	5/12	5/14	5/16	5/18
Allegheny	99,089	99,160	99,384	99,567	99,858 (19,972) [4,793] {2,397}	100,129 (20,026) [4,806] {2,403}	100,382 (20,076) [4,818] {2,409}
Berks	46,671	46,725	46,845	46,938	47,141 (9,428) [2,263] {1,131}	47,324 (9,465) [2,272] {1,136}	47,504 (9,501) [2,280] {1,140}
Bucks	59,478	59,531	59,613	59,744	59,907 (11,981) [2,876] {1,438}	60,057 (12,011) [2,883] {1,441}	60,192 (12,038) [2,889] {1,445}
Butler	17,052	17,064	17,110	17,137	17,192 (3,438) [825] {413}	17,246 (3,449) [828] {414}	17,299 (3,460) [830] {415}
Chester	36,065	36,112	36,179	36,282	36,404 (7,281) [1,747] {874}	36,520 (7,304) [1,753] {876}	36,630 (7,326) [1,758] {879}
Delaware	51,240	51,293	51,348	51,438	51,557 (10,311) [2,475] {1,237}	51,666 (10,333) [2,480] {1,240}	51,764 (10,353) [2,485] {1,242}
Lackawanna	18,034	18,045	18,087	18,111	18,161 (3,632) [872] {436}	18,206 (3,641) [874] {437}	18,248 (3,650) [876] {438}
Lancaster	54,098	54,145	54,211	54,308	54,454 (10,891) [2,614] {1,307}	54,587 (10,917) [2,620] {1,310}	54,712 (10,942) [2,626] {1,313}
Lehigh	38,813	38,838	38,911	38,955	39,064 (7,813) [1,875] {938}	39,165 (7,833) [1,880] {940}	39,259 (7,852) [1,884] {942}
Luzerne	30,942	30,974	31,055	31,132	31,248 (6,250) [1,500] {750}	31,358 (6,272) [1,505] {753}	31,462 (6,292) [1,510] {755}
Monroe	14,303	14,329	14,369	14,399	14,468 (2,894) [694] {347}	14,533 (2,907) [698] {349}	14,595 (2,919) [701] {350}
Montgomery	68,963	69,038	69,068	69,198	69,374 (13,875) [3,330] {1,665}	69,533 (13,907) [3,338] {1,669}	69,684 (13,937) [3,345] {1,672}
Northampton	35,039	35,065	35,132	35,172	35,259 (7,052) [1,692] {846}	35,339 (7,068) [1,696] {848}	35,412 (7,082) [1,700] {850}
Philadelphia	149,758	149,953	149,953	149,953	150,360 (30,072) [7,217] {3,609}	150,742 (30,148) [7,236] {3,618}	151,081 (30,216) [7,252] {3,626}
Westmoreland	33,329	33,347	33,426	33,471	33,590 (6,718) [1,612] {806}	33,701 (6,740) [1,618] {809}	33,804 (6,761) [1,623] {811}
York	45,139	45,183	45,255	45,339	45,506 (9,101) [2,184] {1,092}	45,665 (9,133) [2,192] {1,096}	45,816 (9,163) [2,199] {1,100}

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.