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

Date: 1/15/21

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 1/15/21 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.

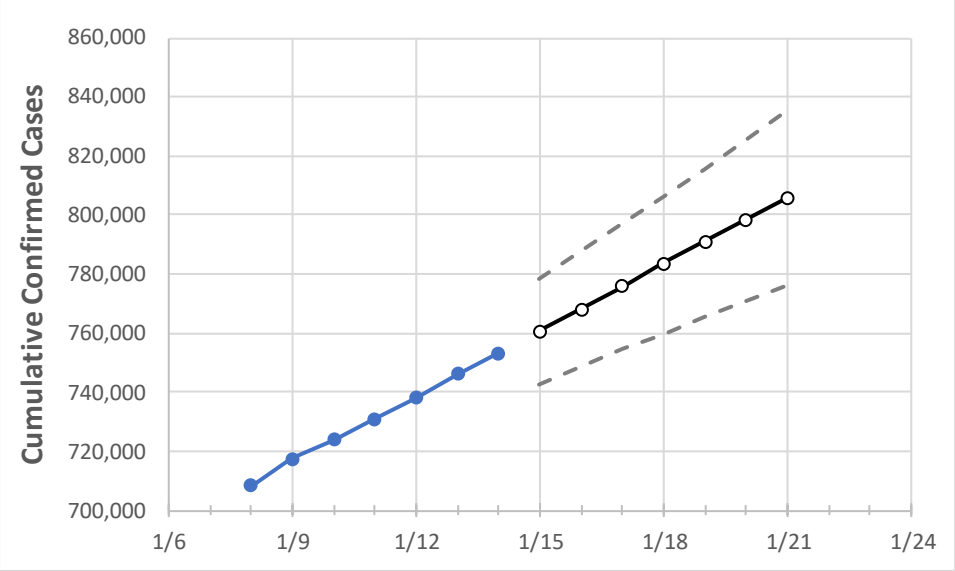
IEM's Modeling Lead

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:						
	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	1/21
Pennsylvania	730,773	737,994	746,002	753,164	760,619	768,246	775,814	783,444	791,039	798,471	805,867

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:						
	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	1/21
Allegheny	61,075	61,769	62,439	62,938	63,551	64,159	64,752	65,345	65,921	66,485	67,055
Berks	26,732	27,070	27,452	27,742	28,051	28,366	28,680	28,991	29,302	29,629	29,949
Bucks	34,438	34,847	35,125	35,424	35,762	36,108	36,454	36,804	37,154	37,494	37,844
Butler	10,937	11,056	11,222	11,338	11,473	11,609	11,743	11,880	12,017	12,154	12,290
Chester	22,172	22,413	22,671	22,863	23,085	23,304	23,526	23,747	23,969	24,193	24,423
Delaware	32,836	33,132	33,407	33,696	33,981	34,268	34,558	34,853	35,137	35,427	35,718
Lackawanna	10,319	10,462	10,627	10,793	10,943	11,094	11,244	11,392	11,548	11,698	11,854
Lancaster	31,951	32,231	32,641	33,017	33,392	33,764	34,144	34,523	34,896	35,281	35,670
Lehigh	23,815	24,010	24,383	24,667	24,973	25,275	25,580	25,894	26,202	26,511	26,825
Luzerne	19,608	19,723	19,913	20,151	20,341	20,537	20,729	20,924	21,116	21,310	21,501
Monroe	7,163	7,244	7,353	7,430	7,531	7,635	7,740	7,847	7,955	8,062	8,168
Montgomery	41,270	41,651	41,961	42,433	42,891	43,355	43,818	44,299	44,778	45,244	45,704
Northampton	19,334	19,508	19,753	19,981	20,208	20,438	20,667	20,897	21,130	21,366	21,596
Philadelphia	100,092	100,910	101,582	102,168	102,764	103,348	103,929	104,518	105,117	105,711	106,300
Westmoreland	22,026	22,233	22,510	22,713	22,929	23,147	23,367	23,582	23,800	24,013	24,230
York	26,759	27,005	27,275	27,663	27,979	28,288	28,600	28,907	29,223	29,529	29,836

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:		
	1/11	1/12	1/13	1/14	1/16	1/18	1/20
Allegheny	61,075	61,769	62,439	62,938	64,159 (12,832) [3,080] {1,540}	65,345 (13,069) [3,137] {1,568}	66,485 (13,297) [3,191] {1,596}
Berks	26,732	27,070	27,452	27,742	28,366 (5,673) [1,362] {681}	28,991 (5,798) [1,392] {696}	29,629 (5,926) [1,422] {711}
Bucks	34,438	34,847	35,125	35,424	36,108 (7,222) [1,733] {867}	36,804 (7,361) [1,767] {883}	37,494 (7,499) [1,800] {900}
Butler	10,937	11,056	11,222	11,338	11,609 (2,322) [557] {279}	11,880 (2,376) [570] {285}	12,154 (2,431) [583] {292}
Chester	22,172	22,413	22,671	22,863	23,304 (4,661) [1,119] {559}	23,747 (4,749) [1,140] {570}	24,193 (4,839) [1,161] {581}
Delaware	32,836	33,132	33,407	33,696	34,268 (6,854) [1,645] {822}	34,853 (6,971) [1,673] {836}	35,427 (7,085) [1,700] {850}
Lackawanna	10,319	10,462	10,627	10,793	11,094 (2,219) [533] {266}	11,392 (2,278) [547] {273}	11,698 (2,340) [561] {281}
Lancaster	31,951	32,231	32,641	33,017	33,764 (6,753) [1,621] {810}	34,523 (6,905) [1,657] {829}	35,281 (7,056) [1,693] {847}
Lehigh	23,815	24,010	24,383	24,667	25,275 (5,055) [1,213] {607}	25,894 (5,179) [1,243] {621}	26,511 (5,302) [1,273] {636}
Luzerne	19,608	19,723	19,913	20,151	20,537 (4,107) [986] {493}	20,924 (4,185) [1,004] {502}	21,310 (4,262) [1,023] {511}
Monroe	7,163	7,244	7,353	7,430	7,635 (1,527) [366] {183}	7,847 (1,569) [377] {188}	8,062 (1,612) [387] {193}
Montgomery	41,270	41,651	41,961	42,433	43,355 (8,671) [2,081] {1,041}	44,299 (8,860) [2,126] {1,063}	45,244 (9,049) [2,172] {1,086}
Northampton	19,334	19,508	19,753	19,981	20,438 (4,088) [981] {491}	20,897 (4,179) [1,003] {502}	21,366 (4,273) [1,026] {513}
Philadelphia	100,092	100,910	101,582	102,168	103,348 (20,670) [4,961] {2,480}	104,518 (20,904) [5,017] {2,508}	105,711 (21,142) [5,074] {2,537}
Westmoreland	22,026	22,233	22,510	22,713	23,147 (4,629) [1,111] {556}	23,582 (4,716) [1,132] {566}	24,013 (4,803) [1,153] {576}
York	26,759	27,005	27,275	27,663	28,288 (5,658) [1,358] {679}	28,907 (5,781) [1,388] {694}	29,529 (5,906) [1,417] {709}

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.