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

Date: 1/8/21

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 1/8/21 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.

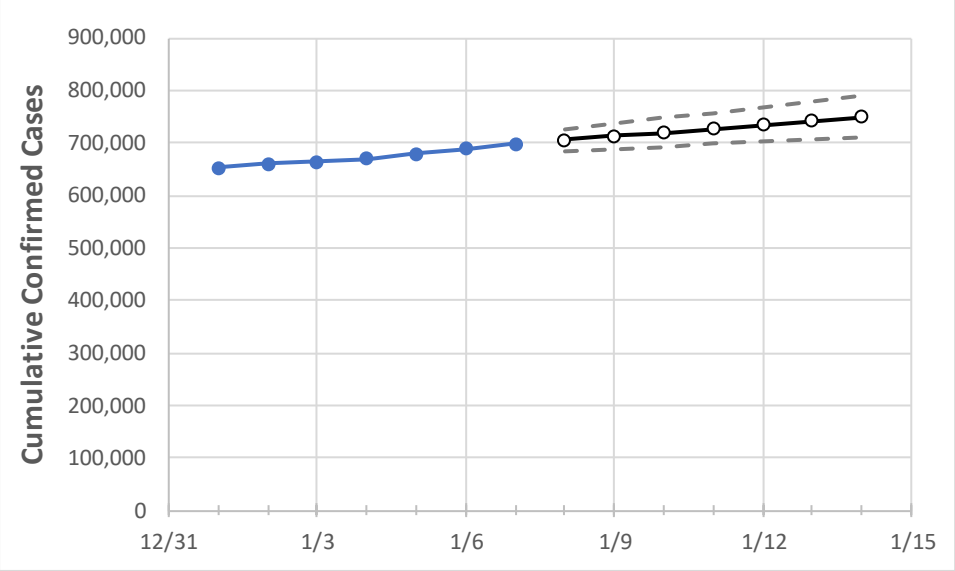
IEM's Modeling Lead

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:						
	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14
Pennsylvania	670,039	678,998	688,398	698,005	705,372	712,649	719,964	727,211	734,590	741,914	749,197

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:						
	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14
Allegheny	56,262	56,827	57,708	58,372	58,898	59,409	59,924	60,426	60,905	61,400	61,888
Berks	24,318	24,820	25,180	25,523	25,793	26,068	26,333	26,599	26,879	27,153	27,422
Bucks	31,562	32,070	32,484	32,988	33,341	33,690	34,046	34,407	34,773	35,131	35,478
Butler	9,850	9,997	10,212	10,349	10,500	10,653	10,806	10,961	11,114	11,271	11,425
Chester	20,407	20,767	21,032	21,267	21,472	21,679	21,885	22,095	22,296	22,498	22,703
Delaware	30,443	30,786	31,063	31,675	31,986	32,276	32,579	32,877	33,175	33,476	33,782
Lackawanna	9,283	9,452	9,597	9,747	9,880	10,015	10,148	10,280	10,412	10,549	10,683
Lancaster	29,047	29,476	29,935	30,347	30,677	31,015	31,356	31,696	32,038	32,389	32,741
Lehigh	21,370	21,720	22,015	22,433	22,705	22,976	23,260	23,542	23,815	24,101	24,389
Luzerne	17,973	18,197	18,378	18,654	18,826	19,010	19,190	19,359	19,534	19,697	19,863
Monroe	6,414	6,513	6,605	6,736	6,832	6,932	7,025	7,123	7,223	7,324	7,425
Montgomery	37,560	38,101	38,549	39,388	39,857	40,351	40,836	41,324	41,810	42,307	42,813
Northampton	17,430	17,738	18,017	18,331	18,533	18,752	18,961	19,166	19,372	19,584	19,794
Philadelphia	95,503	96,419	97,099	97,891	98,432	98,952	99,477	100,009	100,525	101,047	101,546
Westmoreland	20,165	20,393	20,724	21,003	21,219	21,427	21,642	21,858	22,064	22,267	22,471
York	24,158	24,608	25,040	25,349	25,650	25,950	26,247	26,547	26,846	27,143	27,437

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:		
	1/4	1/5	1/6	1/7	1/9	1/11	1/13
Allegheny	56,262	56,827	57,708	58,372	59,409 (11,882) [2,852] {1,426}	60,426 (12,085) [2,900] {1,450}	61,400 (12,280) [2,947] {1,474}
Berks	24,318	24,820	25,180	25,523	26,068 (5,214) [1,251] {626}	26,599 (5,320) [1,277] {638}	27,153 (5,431) [1,303] {652}
Bucks	31,562	32,070	32,484	32,988	33,690 (6,738) [1,617] {809}	34,407 (6,881) [1,652] {826}	35,131 (7,026) [1,686] {843}
Butler	9,850	9,997	10,212	10,349	10,653 (2,131) [511] {256}	10,961 (2,192) [526] {263}	11,271 (2,254) [541] {271}
Chester	20,407	20,767	21,032	21,267	21,679 (4,336) [1,041] {520}	22,095 (4,419) [1,061] {530}	22,498 (4,500) [1,080] {540}
Delaware	30,443	30,786	31,063	31,675	32,276 (6,455) [1,549] {775}	32,877 (6,575) [1,578] {789}	33,476 (6,695) [1,607] {803}
Lackawanna	9,283	9,452	9,597	9,747	10,015 (2,003) [481] {240}	10,280 (2,056) [493] {247}	10,549 (2,110) [506] {253}
Lancaster	29,047	29,476	29,935	30,347	31,015 (6,203) [1,489] {744}	31,696 (6,339) [1,521] {761}	32,389 (6,478) [1,555] {777}
Lehigh	21,370	21,720	22,015	22,433	22,976 (4,595) [1,103] {551}	23,542 (4,708) [1,130] {565}	24,101 (4,820) [1,157] {578}
Luzerne	17,973	18,197	18,378	18,654	19,010 (3,802) [912] {456}	19,359 (3,872) [929] {465}	19,697 (3,939) [945] {473}
Monroe	6,414	6,513	6,605	6,736	6,932 (1,386) [333] {166}	7,123 (1,425) [342] {171}	7,324 (1,465) [352] {176}
Montgomery	37,560	38,101	38,549	39,388	40,351 (8,070) [1,937] {968}	41,324 (8,265) [1,984] {992}	42,307 (8,461) [2,031] {1,015}
Northampton	17,430	17,738	18,017	18,331	18,752 (3,750) [900] {450}	19,166 (3,833) [920] {460}	19,584 (3,917) [940] {470}
Philadelphia	95,503	96,419	97,099	97,891	98,952 (19,790) [4,750] {2,375}	100,009 (20,002) [4,800] {2,400}	101,047 (20,209) [4,850] {2,425}
Westmoreland	20,165	20,393	20,724	21,003	21,427 (4,285) [1,028] {514}	21,858 (4,372) [1,049] {525}	22,267 (4,453) [1,069] {534}
York	24,158	24,608	25,040	25,349	25,950 (5,190) [1,246] {623}	26,547 (5,309) [1,274] {637}	27,143 (5,429) [1,303] {651}

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.