IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/12/21

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 <u>not</u> 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 1/12/21 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
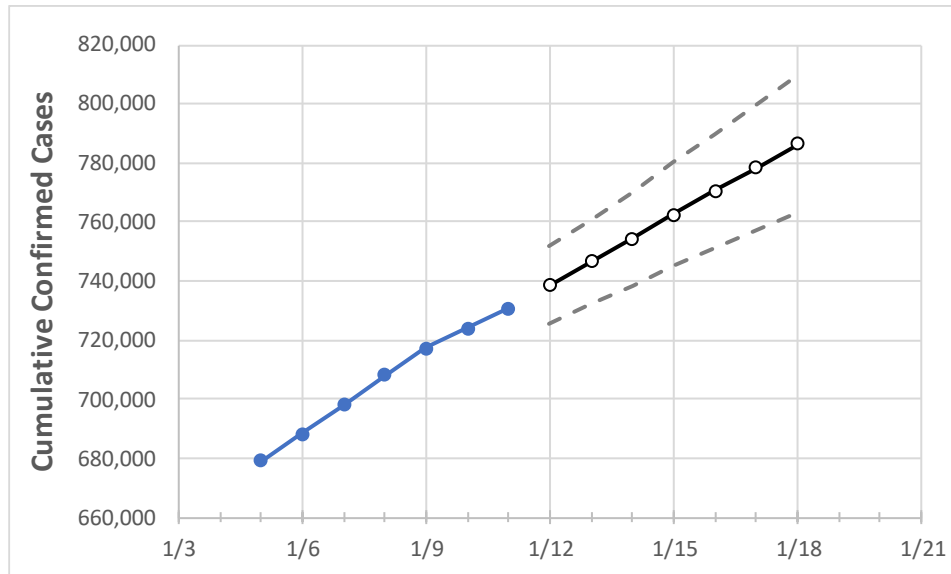
	Actual Confirmed Cases On:				Projected Cases For:						
	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18
Pennsylvania	708,221	717,277	723,865	730,773	738,677	746,524	754,490	762,404	770,480	778,377	786,566

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:						
	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18
Allegheny	59,339	60,188	60,707	61,075	61,675	62,280	62,890	63,511	64,102	64,692	65,261
Berks	25,874	26,198	26,512	26,732	27,023	27,301	27,582	27,863	28,152	28,431	28,719
Bucks	33,463	33,843	34,178	34,438	34,805	35,159	35,522	35,886	36,256	36,632	36,995
Butler	10,557	10,757	10,863	10,937	11,082	11,231	11,379	11,528	11,673	11,815	11,964
Chester	21,556	21,761	21,967	22,172	22,387	22,602	22,819	23,039	23,254	23,470	23,690
Delaware	32,008	32,337	32,640	32,836	33,129	33,410	33,708	34,000	34,290	34,576	34,872
Lackawanna	9,954	10,100	10,229	10,319	10,460	10,597	10,741	10,886	11,035	11,182	11,322
Lancaster	30,786	31,300	31,672	31,951	32,318	32,690	33,063	33,443	33,829	34,223	34,609
Lehigh	22,784	23,311	23,595	23,815	24,114	24,428	24,744	25,056	25,361	25,676	25,983
Luzerne	18,903	19,192	19,428	19,608	19,814	20,011	20,212	20,413	20,609	20,807	21,002
Monroe	6,846	6,983	7,110	7,163	7,265	7,368	7,471	7,573	7,681	7,787	7,893
Montgomery	39,939	40,432	40,964	41,270	41,744	42,205	42,662	43,125	43,597	44,051	44,531
Northampton	18,653	18,990	19,205	19,334	19,573	19,807	20,040	20,269	20,496	20,723	20,950
Philadelphia	98,541	99,058	99,575	100,092	100,655	101,218	101,759	102,293	102,833	103,374	103,898
Westmoreland	21,349	21,622	21,853	22,026	22,263	22,495	22,734	22,953	23,189	23,411	23,640
York	25,710	26,155	26,494	26,759	27,076	27,379	27,699	28,012	28,329	28,652	28,970

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:		
	1/8	1/9	1/10	1/11	1/13	1/15	1/17
Allegheny	59,339	60,188	60,707	61,075	62,280 (12,456) [2,989] {1,495}	63,511 (12,702) [3,049] {1,524}	64,692 (12,938) [3,105] {1,553}
Berks	25,874	26,198	26,512	26,732	27,301 (5,460) [1,310] {655}	27,863 (5,573) [1,337] {669}	28,431 (5,686) [1,365] {682}
Bucks	33,463	33,843	34,178	34,438	35,159 (7,032) [1,688] {844}	35,886 (7,177) [1,723] {861}	36,632 (7,326) [1,758] {879}
Butler	10,557	10,757	10,863	10,937	11,231 (2,246) [539] {270}	11,528 (2,306) [553] {277}	11,815 (2,363) [567] {284}
Chester	21,556	21,761	21,967	22,172	22,602 (4,520) [1,085] {542}	23,039 (4,608) [1,106] {553}	23,470 (4,694) [1,127] {563}
Delaware	32,008	32,337	32,640	32,836	33,410 (6,682) [1,604] {802}	34,000 (6,800) [1,632] {816}	34,576 (6,915) [1,660] {830}
Lackawanna	9,954	10,100	10,229	10,319	10,597 (2,119) [509] {254}	10,886 (2,177) [523] {261}	11,182 (2,236) [537] {268}
Lancaster	30,786	31,300	31,672	31,951	32,690 (6,538) [1,569] {785}	33,443 (6,689) [1,605] {803}	34,223 (6,845) [1,643] {821}
Lehigh	22,784	23,311	23,595	23,815	24,428 (4,886) [1,173] {586}	25,056 (5,011) [1,203] {601}	25,676 (5,135) [1,232] {616}
Luzerne	18,903	19,192	19,428	19,608	20,011 (4,002) [961] {480}	20,413 (4,083) [980] {490}	20,807 (4,161) [999] {499}
Monroe	6,846	6,983	7,110	7,163	7,368 (1,474) [354] {177}	7,573 (1,515) [364] {182}	7,787 (1,557) [374] {187}
Montgomery	39,939	40,432	40,964	41,270	42,205 (8,441) [2,026] {1,013}	43,125 (8,625) [2,070] {1,035}	44,051 (8,810) [2,114] {1,057}
Northampton	18,653	18,990	19,205	19,334	19,807 (3,961) [951] {475}	20,269 (4,054) [973] {486}	20,723 (4,145) [995] {497}
Philadelphia	98,541	99,058	99,575	100,092	101,218 (20,244) [4,858] {2,429}	102,293 (20,459) [4,910] {2,455}	103,374 (20,675) [4,962] {2,481}
Westmoreland	21,349	21,622	21,853	22,026	22,495 (4,499) [1,080] {540}	22,953 (4,591) [1,102] {551}	23,411 (4,682) [1,124] {562}
York	25,710	26,155	26,494	26,759	27,379 (5,476) [1,314] {657}	28,012 (5,602) [1,345] {672}	28,652 (5,730) [1,375] {688}

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.