IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/3/21

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 2/3/21 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
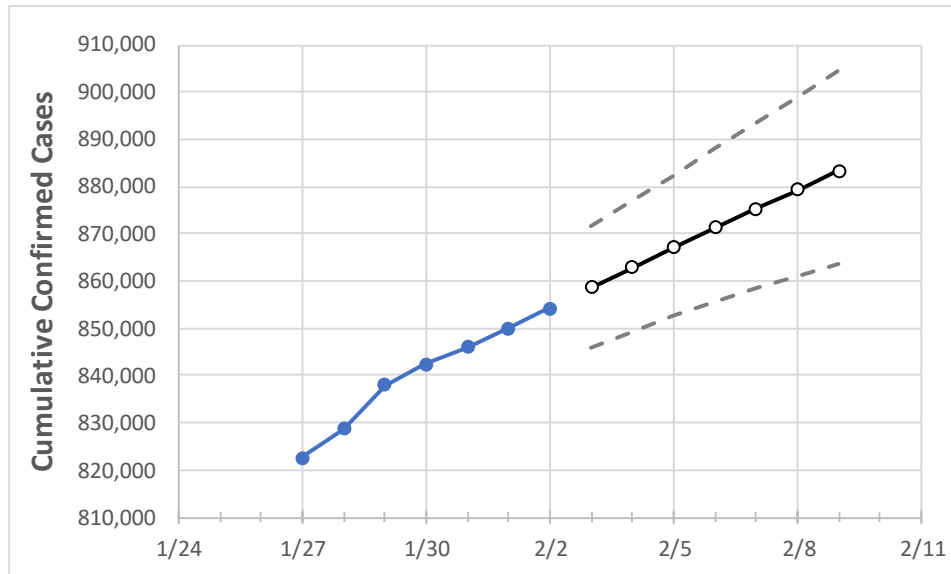
	Actual Confirmed Cases On:				Projected Cases For:						
	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9
Pennsylvania	842,475	846,046	849,966	854,197	858,586	862,880	867,162	871,342	875,433	879,433	883,388

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:						
	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9
Allegheny	69,135	69,368	69,537	69,837	70,090	70,339	70,577	70,808	71,027	71,242	71,442
Berks	32,481	32,577	32,713	32,843	33,112	33,382	33,654	33,924	34,191	34,466	34,741
Bucks	39,925	40,193	40,349	40,522	40,778	41,033	41,283	41,532	41,777	42,028	42,275
Butler	12,695	12,736	12,773	12,852	12,903	12,953	13,002	13,047	13,092	13,135	13,174
Chester	25,329	25,452	25,574	25,678	25,786	25,893	25,997	26,097	26,193	26,286	26,376
Delaware	37,190	37,339	37,443	37,617	37,794	37,967	38,137	38,303	38,468	38,627	38,782
Lackawanna	12,367	12,398	12,433	12,497	12,559	12,619	12,677	12,733	12,785	12,839	12,888
Lancaster	38,168	38,485	38,660	38,895	39,201	39,505	39,810	40,114	40,425	40,725	41,029
Lehigh	28,015	28,135	28,240	28,357	28,501	28,644	28,783	28,922	29,057	29,187	29,318
Luzerne	22,725	22,882	22,951	23,026	23,160	23,297	23,432	23,562	23,687	23,812	23,938
Monroe	8,545	8,595	8,639	8,683	8,735	8,787	8,836	8,885	8,931	8,979	9,025
Montgomery	48,329	48,612	48,832	49,117	49,456	49,789	50,126	50,456	50,794	51,132	51,466
Northampton	23,315	23,443	23,585	23,716	23,903	24,088	24,270	24,451	24,636	24,818	24,992
Philadelphia	109,578	109,925	110,272	110,793	111,177	111,554	111,930	112,300	112,659	113,023	113,376
Westmoreland	24,661	24,703	24,766	24,883	24,952	25,017	25,081	25,142	25,197	25,252	25,305
York	31,889	32,142	32,263	32,464	32,689	32,910	33,137	33,352	33,568	33,780	33,990

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:		
	1/30	1/31	2/1	2/2	2/4	2/6	2/8
Allegheny	69,135	69,368	69,537	69,837	70,339 (14,068) [3,376] {1,688}	70,808 (14,162) [3,399] {1,699}	71,242 (14,248) [3,420] {1,710}
Berks	32,481	32,577	32,713	32,843	33,382 (6,676) [1,602] {801}	33,924 (6,785) [1,628] {814}	34,466 (6,893) [1,654] {827}
Bucks	39,925	40,193	40,349	40,522	41,033 (8,207) [1,970] {985}	41,532 (8,306) [1,994] {997}	42,028 (8,406) [2,017] {1,009}
Butler	12,695	12,736	12,773	12,852	12,953 (2,591) [622] {311}	13,047 (2,609) [626] {313}	13,135 (2,627) [630] {315}
Chester	25,329	25,452	25,574	25,678	25,893 (5,179) [1,243] {621}	26,097 (5,219) [1,253] {626}	26,286 (5,257) [1,262] {631}
Delaware	37,190	37,339	37,443	37,617	37,967 (7,593) [1,822] {911}	38,303 (7,661) [1,839] {919}	38,627 (7,725) [1,854] {927}
Lackawanna	12,367	12,398	12,433	12,497	12,619 (2,524) [606] {303}	12,733 (2,547) [611] {306}	12,839 (2,568) [616] {308}
Lancaster	38,168	38,485	38,660	38,895	39,505 (7,901) [1,896] {948}	40,114 (8,023) [1,925] {963}	40,725 (8,145) [1,955] {977}
Lehigh	28,015	28,135	28,240	28,357	28,644 (5,729) [1,375] {687}	28,922 (5,784) [1,388] {694}	29,187 (5,837) [1,401] {700}
Luzerne	22,725	22,882	22,951	23,026	23,297 (4,659) [1,118] {559}	23,562 (4,712) [1,131] {565}	23,812 (4,762) [1,143] {571}
Monroe	8,545	8,595	8,639	8,683	8,787 (1,757) [422] {211}	8,885 (1,777) [426] {213}	8,979 (1,796) [431] {215}
Montgomery	48,329	48,612	48,832	49,117	49,789 (9,958) [2,390] {1,195}	50,456 (10,091) [2,422] {1,211}	51,132 (10,226) [2,454] {1,227}
Northampton	23,315	23,443	23,585	23,716	24,088 (4,818) [1,156] {578}	24,451 (4,890) [1,174] {587}	24,818 (4,964) [1,191] {596}
Philadelphia	109,578	109,925	110,272	110,793	111,554 (22,311) [5,355] {2,677}	112,300 (22,460) [5,390] {2,695}	113,023 (22,605) [5,425] {2,713}
Westmoreland	24,661	24,703	24,766	24,883	25,017 (5,003) [1,201] {600}	25,142 (5,028) [1,207] {603}	25,252 (5,050) [1,212] {606}
York	31,889	32,142	32,263	32,464	32,910 (6,582) [1,580] {790}	33,352 (6,670) [1,601] {800}	33,780 (6,756) [1,621] {811}

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.