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

Date: 2/2/21

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 2/2/21 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.

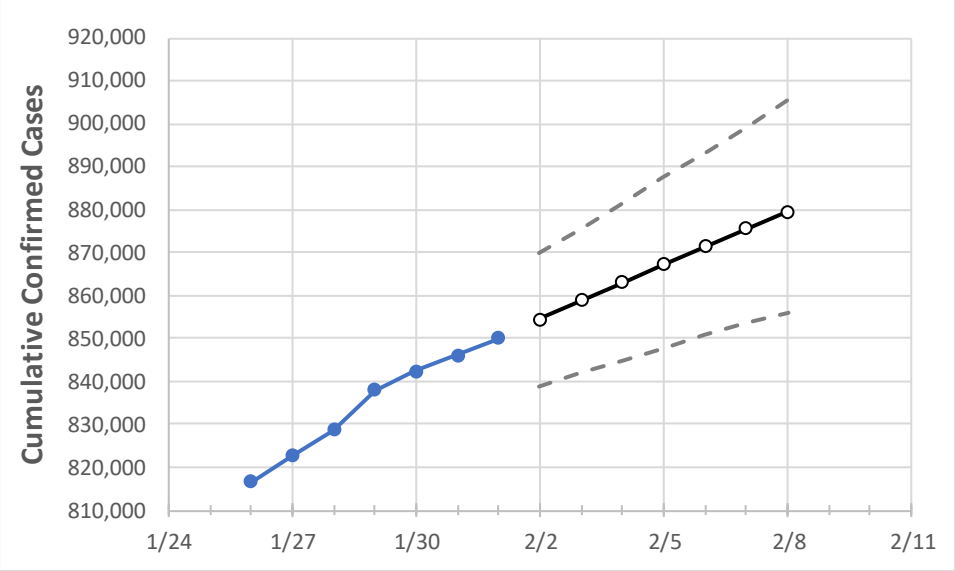
IEM's Modeling Lead

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:						
	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
Pennsylvania	838,016	842,475	846,046	849,966	854,398	858,825	863,090	867,362	871,471	875,551	879,527

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:						
	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
Allegheny	68,809	69,135	69,368	69,537	69,792	70,042	70,274	70,505	70,724	70,935	71,134
Berks	32,287	32,481	32,577	32,713	33,001	33,293	33,585	33,868	34,165	34,463	34,760
Bucks	39,657	39,925	40,193	40,349	40,625	40,901	41,174	41,454	41,730	42,008	42,286
Butler	12,651	12,695	12,736	12,773	12,825	12,874	12,923	12,968	13,013	13,057	13,097
Chester	25,207	25,329	25,452	25,574	25,688	25,800	25,909	26,016	26,120	26,221	26,318
Delaware	37,027	37,190	37,339	37,443	37,625	37,805	37,978	38,151	38,321	38,487	38,648
Lackawanna	12,285	12,367	12,398	12,433	12,499	12,560	12,619	12,677	12,733	12,789	12,840
Lancaster	37,912	38,168	38,485	38,660	38,974	39,294	39,605	39,920	40,233	40,547	40,863
Lehigh	27,820	28,015	28,135	28,240	28,394	28,546	28,692	28,841	28,983	29,127	29,266
Luzerne	22,542	22,725	22,882	22,951	23,097	23,239	23,386	23,524	23,664	23,804	23,942
Monroe	8,469	8,545	8,595	8,639	8,694	8,747	8,798	8,851	8,901	8,952	8,999
Montgomery	48,029	48,329	48,612	48,832	49,184	49,539	49,889	50,244	50,605	50,968	51,325
Northampton	23,135	23,315	23,443	23,585	23,787	23,980	24,175	24,366	24,562	24,756	24,951
Philadelphia	109,231	109,578	109,925	110,272	110,634	110,992	111,340	111,682	112,025	112,356	112,677
Westmoreland	24,576	24,661	24,703	24,766	24,833	24,899	24,962	25,021	25,077	25,126	25,177
York	31,670	31,889	32,142	32,263	32,492	32,724	32,948	33,168	33,391	33,623	33,837

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:		
	1/29	1/30	1/31	2/1	2/3	2/5	2/7
Allegheny	68,809	69,135	69,368	69,537	70,042 (14,008) [3,362] {1,681}	70,505 (14,101) [3,384] {1,692}	70,935 (14,187) [3,405] {1,702}
Berks	32,287	32,481	32,577	32,713	33,293 (6,659) [1,598] {799}	33,868 (6,774) [1,626] {813}	34,463 (6,893) [1,654] {827}
Bucks	39,657	39,925	40,193	40,349	40,901 (8,180) [1,963] {982}	41,454 (8,291) [1,990] {995}	42,008 (8,402) [2,016] {1,008}
Butler	12,651	12,695	12,736	12,773	12,874 (2,575) [618] {309}	12,968 (2,594) [622] {311}	13,057 (2,611) [627] {313}
Chester	25,207	25,329	25,452	25,574	25,800 (5,160) [1,238] {619}	26,016 (5,203) [1,249] {624}	26,221 (5,244) [1,259] {629}
Delaware	37,027	37,190	37,339	37,443	37,805 (7,561) [1,815] {907}	38,151 (7,630) [1,831] {916}	38,487 (7,697) [1,847] {924}
Lackawanna	12,285	12,367	12,398	12,433	12,560 (2,512) [603] {301}	12,677 (2,535) [608] {304}	12,789 (2,558) [614] {307}
Lancaster	37,912	38,168	38,485	38,660	39,294 (7,859) [1,886] {943}	39,920 (7,984) [1,916] {958}	40,547 (8,109) [1,946] {973}
Lehigh	27,820	28,015	28,135	28,240	28,546 (5,709) [1,370] {685}	28,841 (5,768) [1,384] {692}	29,127 (5,825) [1,398] {699}
Luzerne	22,542	22,725	22,882	22,951	23,239 (4,648) [1,115] {558}	23,524 (4,705) [1,129] {565}	23,804 (4,761) [1,143] {571}
Monroe	8,469	8,545	8,595	8,639	8,747 (1,749) [420] {210}	8,851 (1,770) [425] {212}	8,952 (1,790) [430] {215}
Montgomery	48,029	48,329	48,612	48,832	49,539 (9,908) [2,378] {1,189}	50,244 (10,049) [2,412] {1,206}	50,968 (10,194) [2,446] {1,223}
Northampton	23,135	23,315	23,443	23,585	23,980 (4,796) [1,151] {576}	24,366 (4,873) [1,170] {585}	24,756 (4,951) [1,188] {594}
Philadelphia	109,231	109,578	109,925	110,272	110,992 (22,198) [5,328] {2,664}	111,682 (22,336) [5,361] {2,680}	112,356 (22,471) [5,393] {2,697}
Westmoreland	24,576	24,661	24,703	24,766	24,899 (4,980) [1,195] {598}	25,021 (5,004) [1,201] {600}	25,126 (5,025) [1,206] {603}
York	31,670	31,889	32,142	32,263	32,724 (6,545) [1,571] {785}	33,168 (6,634) [1,592] {796}	33,623 (6,725) [1,614] {807}

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.