

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

Date: 1/25/21

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 1/25/21 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.**

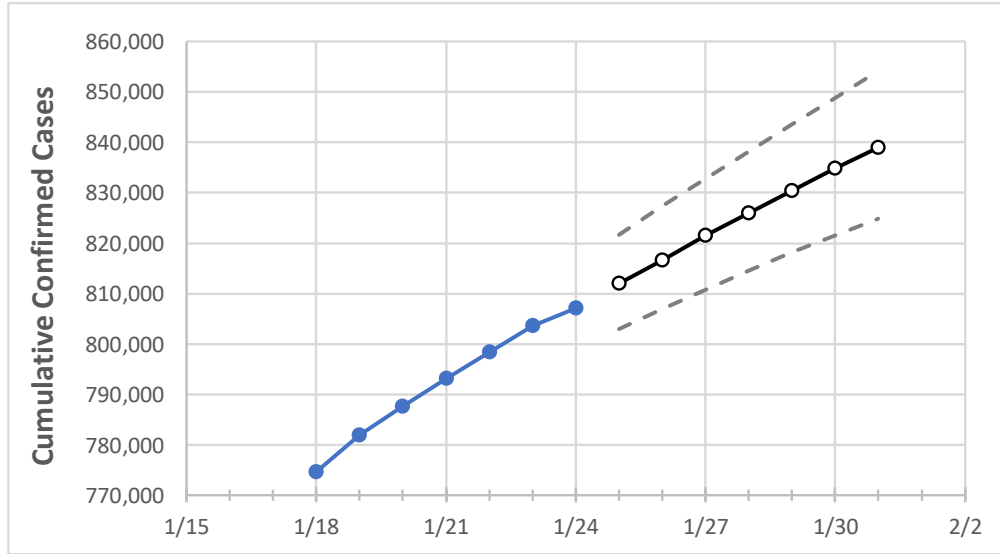
### IEM's Modeling Lead

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:						
	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31
Pennsylvania	793,138	798,438	803,585	807,102	811,937	816,667	821,452	825,994	830,399	834,775	839,003

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:						
	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31
Allegheny	66,002	66,345	66,809	67,095	67,482	67,868	68,235	68,601	68,944	69,283	69,620
Berks	29,433	29,687	29,973	30,099	30,340	30,576	30,805	31,035	31,261	31,486	31,705
Bucks	37,215	37,508	37,784	38,025	38,266	38,507	38,744	38,976	39,203	39,432	39,657
Butler	12,040	12,112	12,195	12,263	12,347	12,431	12,509	12,586	12,663	12,740	12,810
Chester	24,085	24,261	24,261	24,261	24,432	24,601	24,763	24,927	25,086	25,241	25,396
Delaware	35,169	35,351	35,642	35,855	36,068	36,280	36,489	36,691	36,894	37,097	37,297
Lackawanna	11,535	11,653	11,783	11,860	11,969	12,078	12,184	12,288	12,389	12,489	12,592
Lancaster	34,992	35,297	35,670	35,871	36,150	36,425	36,700	36,975	37,238	37,499	37,759
Lehigh	26,133	26,371	26,655	26,786	26,988	27,188	27,383	27,574	27,765	27,966	28,151
Luzerne	21,195	21,367	21,533	21,656	21,804	21,954	22,100	22,249	22,390	22,528	22,668
Monroe	7,940	8,025	8,102	8,147	8,215	8,283	8,351	8,418	8,485	8,550	8,613
Montgomery	44,865	45,263	45,577	45,837	46,151	46,466	46,770	47,069	47,360	47,649	47,933
Northampton	21,337	21,553	21,800	21,929	22,115	22,301	22,487	22,672	22,855	23,033	23,214
Philadelphia	105,713	106,132	106,132	106,132	106,631	107,116	107,602	108,087	108,562	109,033	109,500
Westmoreland	23,731	23,822	23,962	24,019	24,145	24,267	24,384	24,496	24,606	24,711	24,809
York	29,360	29,618	29,812	30,002	30,228	30,451	30,674	30,888	31,104	31,320	31,524

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:											
	1/21	1/22	1/23	1/24	1/26				1/28				1/30			
Allegheny	66,002	66,345	66,809	67,095	67,868	(13,574)	[3,258]	{1,629}	68,601	(13,720)	[3,293]	{1,646}	69,283	(13,857)	[3,326]	{1,663}
Berks	29,433	29,687	29,973	30,099	30,576	(6,115)	[1,468]	{734}	31,035	(6,207)	[1,490]	{745}	31,486	(6,297)	[1,511]	{756}
Bucks	37,215	37,508	37,784	38,025	38,507	(7,701)	[1,848]	{924}	38,976	(7,795)	[1,871]	{935}	39,432	(7,886)	[1,893]	{946}
Butler	12,040	12,112	12,195	12,263	12,431	(2,486)	[597]	{298}	12,586	(2,517)	[604]	{302}	12,740	(2,548)	[612]	{306}
Chester	24,085	24,261	24,261	24,261	24,601	(4,920)	[1,181]	{590}	24,927	(4,985)	[1,197]	{598}	25,241	(5,048)	[1,212]	{606}
Delaware	35,169	35,351	35,642	35,855	36,280	(7,256)	[1,741]	{871}	36,691	(7,338)	[1,761]	{881}	37,097	(7,419)	[1,781]	{890}
Lackawanna	11,535	11,653	11,783	11,860	12,078	(2,416)	[580]	{290}	12,288	(2,458)	[590]	{295}	12,489	(2,498)	[599]	{300}
Lancaster	34,992	35,297	35,670	35,871	36,425	(7,285)	[1,748]	{874}	36,975	(7,395)	[1,775]	{887}	37,499	(7,500)	[1,800]	{900}
Lehigh	26,133	26,371	26,655	26,786	27,188	(5,438)	[1,305]	{653}	27,574	(5,515)	[1,324]	{662}	27,966	(5,593)	[1,342]	{671}
Luzerne	21,195	21,367	21,533	21,656	21,954	(4,391)	[1,054]	{527}	22,249	(4,450)	[1,068]	{534}	22,528	(4,506)	[1,081]	{541}
Monroe	7,940	8,025	8,102	8,147	8,283	(1,657)	[398]	{199}	8,418	(1,684)	[404]	{202}	8,550	(1,710)	[410]	{205}
Montgomery	44,865	45,263	45,577	45,837	46,466	(9,293)	[2,230]	{1,115}	47,069	(9,414)	[2,259]	{1,130}	47,649	(9,530)	[2,287]	{1,144}
Northampton	21,337	21,553	21,800	21,929	22,301	(4,460)	[1,070]	{535}	22,672	(4,534)	[1,088]	{544}	23,033	(4,607)	[1,106]	{553}
Philadelphia	105,713	106,132	106,132	106,132	107,116	(21,423)	[5,142]	{2,571}	108,087	(21,617)	[5,188]	{2,594}	109,033	(21,807)	[5,234]	{2,617}
Westmoreland	23,731	23,822	23,962	24,019	24,267	(4,853)	[1,165]	{582}	24,496	(4,899)	[1,176]	{588}	24,711	(4,942)	[1,186]	{593}
York	29,360	29,618	29,812	30,002	30,451	(6,090)	[1,462]	{731}	30,888	(6,178)	[1,483]	{741}	31,320	(6,264)	[1,503]	{752}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.