

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 1/26/21**

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 1/26/21 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.

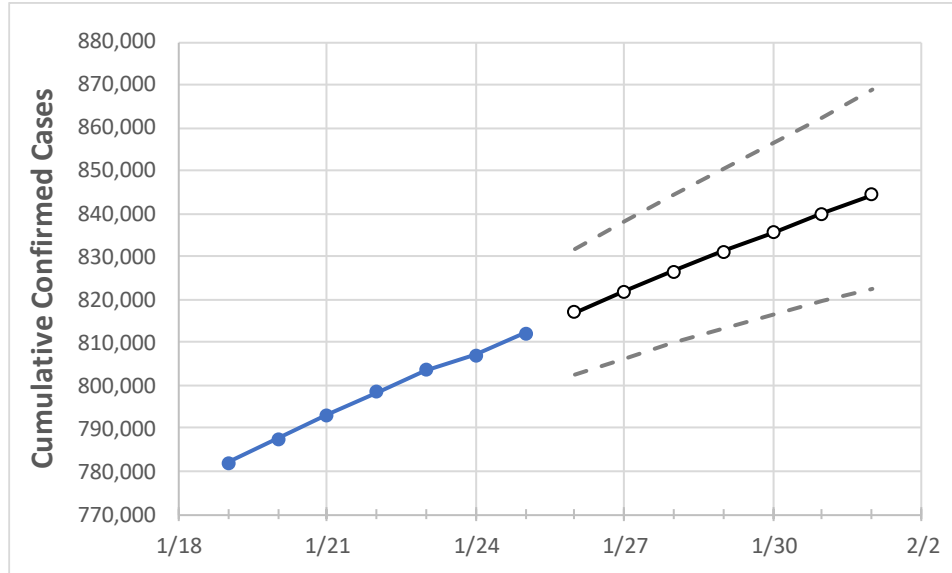
IEM's Modeling Lead

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:						
	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1
Pennsylvania	798,438	803,585	807,102	812,098	817,041	821,898	826,584	831,121	835,624	840,089	844,503

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:						
	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1
Allegheny	66,345	66,809	67,095	67,429	67,803	68,165	68,518	68,862	69,202	69,518	69,827
Berks	29,687	29,973	30,099	30,230	30,442	30,645	30,850	31,051	31,243	31,435	31,625
Bucks	37,508	37,784	38,025	38,206	38,435	38,657	38,875	39,087	39,298	39,502	39,700
Butler	12,112	12,195	12,263	12,327	12,409	12,487	12,567	12,643	12,717	12,791	12,862
Chester	24,261	24,401	24,542	24,682	24,824	24,962	25,097	25,225	25,351	25,471	25,591
Delaware	35,351	35,642	35,855	36,048	36,256	36,461	36,664	36,862	37,060	37,253	37,435
Lackawanna	11,653	11,783	11,860	11,917	12,015	12,111	12,206	12,300	12,391	12,485	12,572
Lancaster	35,297	35,670	35,871	36,083	36,349	36,609	36,860	37,106	37,344	37,590	37,826
Lehigh	26,371	26,655	26,786	26,866	27,052	27,232	27,410	27,593	27,763	27,941	28,112
Luzerne	21,367	21,533	21,656	21,726	21,865	22,004	22,139	22,272	22,403	22,533	22,660
Monroe	8,025	8,102	8,147	8,191	8,253	8,315	8,375	8,435	8,493	8,549	8,606
Montgomery	45,263	45,577	45,837	46,137	46,447	46,753	47,052	47,342	47,627	47,910	48,183
Northampton	21,553	21,800	21,929	22,026	22,199	22,367	22,530	22,694	22,854	23,009	23,163
Philadelphia	106,132	106,480	106,829	107,177	107,613	108,044	108,447	108,856	109,239	109,610	109,990
Westmoreland	23,822	23,962	24,019	24,175	24,291	24,399	24,506	24,609	24,706	24,802	24,894
York	29,618	29,812	30,002	30,224	30,452	30,671	30,889	31,103	31,319	31,529	31,729

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:											
	1/22	1/23	1/24	1/25	1/27				1/29				1/31			
Allegheny	66,345	66,809	67,095	67,429	68,165	(13,633)	[3,272]	{1,636}	68,862	(13,772)	[3,305]	{1,653}	69,518	(13,904)	[3,337]	{1,668}
Berks	29,687	29,973	30,099	30,230	30,645	(6,129)	[1,471]	{735}	31,051	(6,210)	[1,490]	{745}	31,435	(6,287)	[1,509]	{754}
Bucks	37,508	37,784	38,025	38,206	38,657	(7,731)	[1,856]	{928}	39,087	(7,817)	[1,876]	{938}	39,502	(7,900)	[1,896]	{948}
Butler	12,112	12,195	12,263	12,327	12,487	(2,497)	[599]	{300}	12,643	(2,529)	[607]	{303}	12,791	(2,558)	[614]	{307}
Chester	24,261	24,401	24,542	24,682	24,962	(4,992)	[1,198]	{599}	25,225	(5,045)	[1,211]	{605}	25,471	(5,094)	[1,223]	{611}
Delaware	35,351	35,642	35,855	36,048	36,461	(7,292)	[1,750]	{875}	36,862	(7,372)	[1,769]	{885}	37,253	(7,451)	[1,788]	{894}
Lackawanna	11,653	11,783	11,860	11,917	12,111	(2,422)	[581]	{291}	12,300	(2,460)	[590]	{295}	12,485	(2,497)	[599]	{300}
Lancaster	35,297	35,670	35,871	36,083	36,609	(7,322)	[1,757]	{879}	37,106	(7,421)	[1,781]	{891}	37,590	(7,518)	[1,804]	{902}
Lehigh	26,371	26,655	26,786	26,866	27,232	(5,446)	[1,307]	{654}	27,593	(5,519)	[1,324]	{662}	27,941	(5,588)	[1,341]	{671}
Luzerne	21,367	21,533	21,656	21,726	22,004	(4,401)	[1,056]	{528}	22,272	(4,454)	[1,069]	{535}	22,533	(4,507)	[1,082]	{541}
Monroe	8,025	8,102	8,147	8,191	8,315	(1,663)	[399]	{200}	8,435	(1,687)	[405]	{202}	8,549	(1,710)	[410]	{205}
Montgomery	45,263	45,577	45,837	46,137	46,753	(9,351)	[2,244]	{1,122}	47,342	(9,468)	[2,272]	{1,136}	47,910	(9,582)	[2,300]	{1,150}
Northampton	21,553	21,800	21,929	22,026	22,367	(4,473)	[1,074]	{537}	22,694	(4,539)	[1,089]	{545}	23,009	(4,602)	[1,104]	{552}
Philadelphia	106,132	106,480	106,829	107,177	108,044	(21,609)	[5,186]	{2,593}	108,856	(21,771)	[5,225]	{2,613}	109,610	(21,922)	[5,261]	{2,631}
Westmoreland	23,822	23,962	24,019	24,175	24,399	(4,880)	[1,171]	{586}	24,609	(4,922)	[1,181]	{591}	24,802	(4,960)	[1,190]	{595}
York	29,618	29,812	30,002	30,224	30,671	(6,134)	[1,472]	{736}	31,103	(6,221)	[1,493]	{746}	31,529	(6,306)	[1,513]	{757}

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.