

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

Date: 1/28/21

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 1/28/21 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.

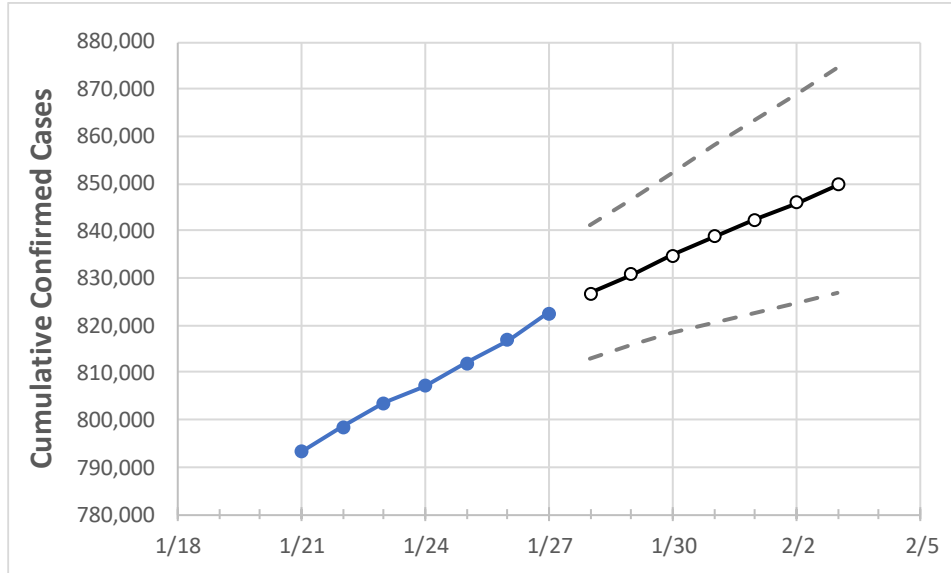
IEM's Modeling Lead

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:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
Pennsylvania	807,102	812,098	816,761	822,582	826,866	830,865	834,879	838,707	842,408	846,068	849,684

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:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
Allegheny	67,095	67,429	67,711	68,087	68,400	68,702	68,991	69,269	69,540	69,792	70,047
Berks	30,099	30,230	30,418	30,633	30,797	30,959	31,113	31,262	31,410	31,553	31,689
Bucks	38,025	38,206	38,443	38,692	38,907	39,118	39,321	39,527	39,724	39,913	40,101
Butler	12,263	12,327	12,399	12,489	12,553	12,617	12,680	12,740	12,795	12,849	12,902
Chester	24,542	24,682	24,811	24,946	25,071	25,192	25,310	25,426	25,536	25,642	25,743
Delaware	35,855	36,048	36,252	36,447	36,630	36,813	36,993	37,166	37,339	37,507	37,673
Lackawanna	11,860	11,917	11,971	12,120	12,206	12,292	12,372	12,453	12,530	12,608	12,685
Lancaster	35,871	36,083	36,283	36,657	36,897	37,132	37,367	37,590	37,808	38,023	38,241
Lehigh	26,786	26,866	27,105	27,284	27,437	27,587	27,738	27,880	28,017	28,152	28,280
Luzerne	21,656	21,726	21,817	22,285	22,438	22,594	22,752	22,897	23,045	23,196	23,346
Monroe	8,147	8,191	8,258	8,340	8,395	8,450	8,505	8,558	8,608	8,658	8,707
Montgomery	45,837	46,137	46,413	46,765	47,042	47,316	47,585	47,841	48,096	48,348	48,582
Northampton	21,929	22,026	22,277	22,485	22,657	22,823	22,994	23,161	23,328	23,504	23,669
Philadelphia	106,829	107,177	107,863	108,222	108,602	108,978	109,347	109,702	110,054	110,394	110,720
Westmoreland	24,019	24,175	24,227	24,368	24,451	24,529	24,604	24,673	24,739	24,805	24,866
York	30,002	30,224	30,363	30,646	30,831	31,011	31,189	31,356	31,518	31,681	31,836

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:											
	1/24	1/25	1/26	1/27	1/29			1/31			2/2					
Allegheny	67,095	67,429	67,711	68,087	68,702	(13,740)	[3,298]	{1,649}	69,269	(13,854)	[3,325]	{1,662}	69,792	(13,958)	[3,350]	{1,675}
Berks	30,099	30,230	30,418	30,633	30,959	(6,192)	[1,486]	{743}	31,262	(6,252)	[1,501]	{750}	31,553	(6,311)	[1,515]	{757}
Bucks	38,025	38,206	38,443	38,692	39,118	(7,824)	[1,878]	{939}	39,527	(7,905)	[1,897]	{949}	39,913	(7,983)	[1,916]	{958}
Butler	12,263	12,327	12,399	12,489	12,617	(2,523)	[606]	{303}	12,740	(2,548)	[612]	{306}	12,849	(2,570)	[617]	{308}
Chester	24,542	24,682	24,811	24,946	25,192	(5,038)	[1,209]	{605}	25,426	(5,085)	[1,220]	{610}	25,642	(5,128)	[1,231]	{615}
Delaware	35,855	36,048	36,252	36,447	36,813	(7,363)	[1,767]	{884}	37,166	(7,433)	[1,784]	{892}	37,507	(7,501)	[1,800]	{900}
Lackawanna	11,860	11,917	11,971	12,120	12,292	(2,458)	[590]	{295}	12,453	(2,491)	[598]	{299}	12,608	(2,522)	[605]	{303}
Lancaster	35,871	36,083	36,283	36,657	37,132	(7,426)	[1,782]	{891}	37,590	(7,518)	[1,804]	{902}	38,023	(7,605)	[1,825]	{913}
Lehigh	26,786	26,866	27,105	27,284	27,587	(5,517)	[1,324]	{662}	27,880	(5,576)	[1,338]	{669}	28,152	(5,630)	[1,351]	{676}
Luzerne	21,656	21,726	21,817	22,285	22,594	(4,519)	[1,085]	{542}	22,897	(4,579)	[1,099]	{550}	23,196	(4,639)	[1,113]	{557}
Monroe	8,147	8,191	8,258	8,340	8,450	(1,690)	[406]	{203}	8,558	(1,712)	[411]	{205}	8,658	(1,732)	[416]	{208}
Montgomery	45,837	46,137	46,413	46,765	47,316	(9,463)	[2,271]	{1,136}	47,841	(9,568)	[2,296]	{1,148}	48,348	(9,670)	[2,321]	{1,160}
Northampton	21,929	22,026	22,277	22,485	22,823	(4,565)	[1,096]	{548}	23,161	(4,632)	[1,112]	{556}	23,504	(4,701)	[1,128]	{564}
Philadelphia	106,829	107,177	107,863	108,222	108,978	(21,796)	[5,231]	{2,615}	109,702	(21,940)	[5,266]	{2,633}	110,394	(22,079)	[5,299]	{2,649}
Westmoreland	24,019	24,175	24,227	24,368	24,529	(4,906)	[1,177]	{589}	24,673	(4,935)	[1,184]	{592}	24,805	(4,961)	[1,191]	{595}
York	30,002	30,224	30,363	30,646	31,011	(6,202)	[1,489]	{744}	31,356	(6,271)	[1,505]	{753}	31,681	(6,336)	[1,521]	{760}

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.