

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 3/22/22**

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 3/22/22 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.

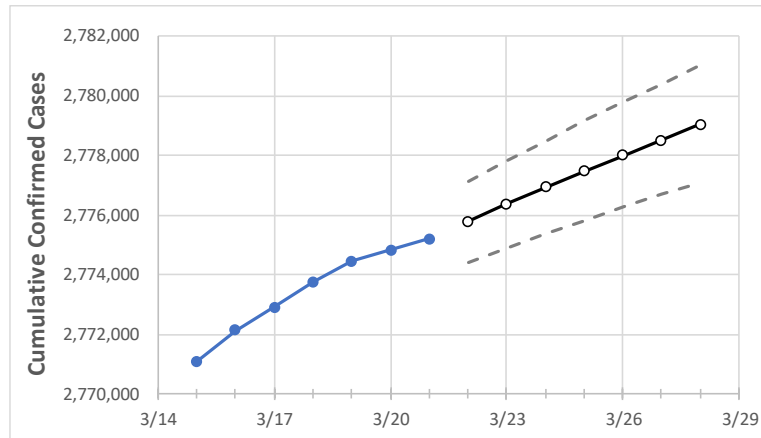
IEM's Modeling Lead

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:						
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28
Pennsylvania	2,773,762	2,774,453	2,774,815	2,775,183	2,775,774	2,776,358	2,776,921	2,777,464	2,777,997	2,778,516	2,779,034

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:						
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28
Allegheny	262,340	262,410	262,456	262,514	262,569	262,625	262,677	262,729	262,780	262,830	262,876
Berks	101,937	101,958	101,964	101,976	101,989	102,001	102,013	102,025	102,035	102,046	102,057
Bucks	122,499	122,528	122,559	122,574	122,602	122,630	122,658	122,683	122,710	122,738	122,763
Butler	44,278	44,289	44,293	44,296	44,304	44,312	44,319	44,326	44,333	44,340	44,347
Chester	91,100	91,136	91,149	91,172	91,195	91,218	91,238	91,259	91,279	91,300	91,319
Delaware	109,344	109,361	109,375	109,393	109,415	109,436	109,455	109,476	109,495	109,515	109,535
Lackawanna	43,183	43,195	43,205	43,212	43,225	43,237	43,248	43,260	43,271	43,282	43,292
Lancaster	120,546	120,558	120,566	120,575	120,589	120,602	120,615	120,627	120,640	120,652	120,663
Lehigh	89,064	89,076	89,083	89,090	89,101	89,111	89,121	89,130	89,140	89,149	89,158
Luzerne	73,210	73,226	73,233	73,246	73,257	73,268	73,278	73,288	73,297	73,306	73,315
Monroe	36,782	36,786	36,791	36,799	36,804	36,811	36,816	36,821	36,826	36,832	36,836
Montgomery	151,211	151,273	151,303	151,349	151,428	151,501	151,577	151,649	151,725	151,800	151,877
Northampton	79,114	79,129	79,153	79,166	79,180	79,192	79,206	79,218	79,231	79,243	79,255
Philadelphia	306,860	306,978	307,048	307,048	307,162	307,268	307,370	307,480	307,580	307,691	307,788
Westmoreland	79,410	79,426	79,433	79,450	79,463	79,475	79,488	79,500	79,511	79,523	79,534
York	118,235	118,250	118,255	118,264	118,277	118,288	118,300	118,312	118,322	118,333	118,343

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:											
	3/18	3/19	3/20	3/21	3/23				3/25				3/27			
Allegheny	262,340	262,410	262,456	262,514	262,625	(52,525)	[12,606]	{6,303}	262,729	(52,546)	[12,611]	{6,305}	262,830	(52,566)	[12,616]	{6,308}
Berks	101,937	101,958	101,964	101,976	102,001	(20,400)	[4,896]	{2,448}	102,025	(20,405)	[4,897]	{2,449}	102,046	(20,409)	[4,898]	{2,449}
Bucks	122,499	122,528	122,559	122,574	122,630	(24,526)	[5,886]	{2,943}	122,683	(24,537)	[5,889]	{2,944}	122,738	(24,548)	[5,891]	{2,946}
Butler	44,278	44,289	44,293	44,296	44,312	(8,862)	[2,127]	{1,063}	44,326	(8,865)	[2,128]	{1,064}	44,340	(8,868)	[2,128]	{1,064}
Chester	91,100	91,136	91,149	91,172	91,218	(18,244)	[4,378]	{2,189}	91,259	(18,252)	[4,380]	{2,190}	91,300	(18,260)	[4,382]	{2,191}
Delaware	109,344	109,361	109,375	109,393	109,436	(21,887)	[5,253]	{2,626}	109,476	(21,895)	[5,255]	{2,627}	109,515	(21,903)	[5,257]	{2,628}
Lackawanna	43,183	43,195	43,205	43,212	43,237	(8,647)	[2,075]	{1,038}	43,260	(8,652)	[2,076]	{1,038}	43,282	(8,656)	[2,078]	{1,039}
Lancaster	120,546	120,558	120,566	120,575	120,602	(24,120)	[5,789]	{2,894}	120,627	(24,125)	[5,790]	{2,895}	120,652	(24,130)	[5,791]	{2,896}
Lehigh	89,064	89,076	89,083	89,090	89,111	(17,822)	[4,277]	{2,139}	89,130	(17,826)	[4,278]	{2,139}	89,149	(17,830)	[4,279]	{2,140}
Luzerne	73,210	73,226	73,233	73,246	73,268	(14,654)	[3,517]	{1,758}	73,288	(14,658)	[3,518]	{1,759}	73,306	(14,661)	[3,519]	{1,759}
Monroe	36,782	36,786	36,791	36,799	36,811	(7,362)	[1,767]	{883}	36,821	(7,364)	[1,767]	{884}	36,832	(7,366)	[1,768]	{884}
Montgomery	151,211	151,273	151,303	151,349	151,501	(30,300)	[7,272]	{3,636}	151,649	(30,330)	[7,279]	{3,640}	151,800	(30,360)	[7,286]	{3,643}
Northampton	79,114	79,129	79,153	79,166	79,192	(15,838)	[3,801]	{1,901}	79,218	(15,844)	[3,802]	{1,901}	79,243	(15,849)	[3,804]	{1,902}
Philadelphia	306,860	306,978	307,048	307,048	307,268	(61,454)	[14,749]	{7,374}	307,480	(61,496)	[14,759]	{7,380}	307,691	(61,538)	[14,769]	{7,385}
Westmoreland	79,410	79,426	79,433	79,450	79,475	(15,895)	[3,815]	{1,907}	79,500	(15,900)	[3,816]	{1,908}	79,523	(15,905)	[3,817]	{1,909}
York	118,235	118,250	118,255	118,264	118,288	(23,658)	[5,678]	{2,839}	118,312	(23,662)	[5,679]	{2,839}	118,333	(23,667)	[5,680]	{2,840}

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.