

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

Date: 1/31/22

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 1/31/22 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.

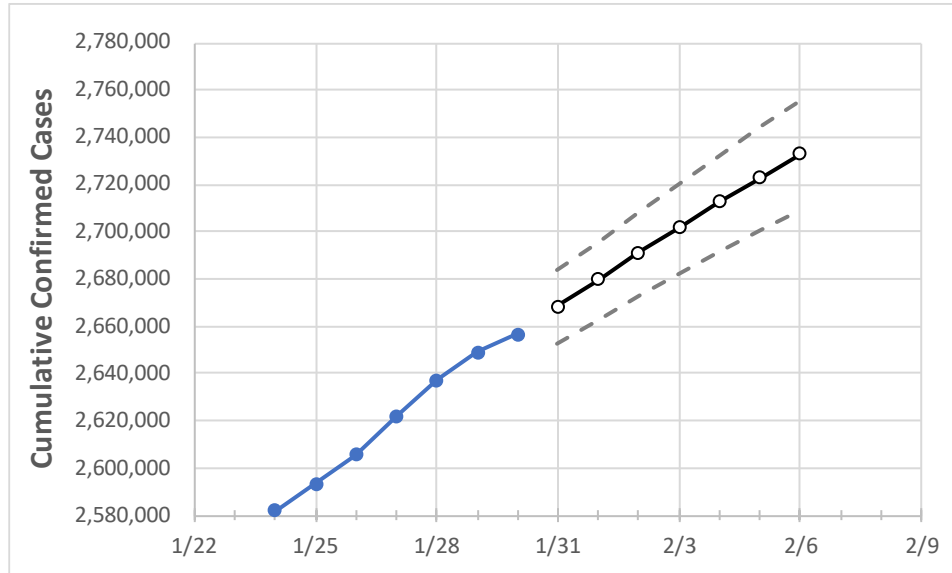
IEM's Modeling Lead

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:							
	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	

Pennsylvania 2,622,134 2,637,080 2,649,247 2,656,587 2,668,556 2,679,993 2,691,084 2,701,894 2,712,578 2,722,788 2,733,129

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:							
	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	
Allegheny	245,213	246,575	250,058	250,741	252,178	253,536	254,951	256,295	257,593	258,880	260,087	
Berks	98,002	98,455	98,678	98,904	99,248	99,602	99,929	100,244	100,549	100,852	101,122	
Bucks	117,418	117,858	118,174	118,387	118,773	119,142	119,516	119,861	120,192	120,535	120,840	
Butler	41,726	42,012	42,221	42,358	42,585	42,799	43,006	43,215	43,421	43,621	43,817	
Chester	86,490	86,923	87,147	87,343	87,678	87,992	88,300	88,588	88,886	89,163	89,440	
Delaware	105,135	105,558	105,820	106,039	106,354	106,679	106,980	107,257	107,530	107,794	108,057	
Lackawanna	39,952	40,199	40,338	40,455	40,717	40,963	41,235	41,476	41,727	41,969	42,209	
Lancaster	114,997	115,670	115,969	116,228	116,672	117,099	117,509	117,918	118,299	118,687	119,050	
Lehigh	86,118	86,489	86,662	86,820	87,065	87,299	87,536	87,763	87,971	88,180	88,382	
Luzerne	69,118	69,556	69,785	69,965	70,285	70,598	70,884	71,176	71,462	71,737	71,997	
Monroe	35,226	35,428	35,503	35,583	35,708	35,828	35,936	36,045	36,148	36,252	36,350	
Montgomery	143,308	143,989	144,458	144,767	145,338	145,884	146,404	146,912	147,397	147,891	148,356	
Northampton	76,210	76,508	76,664	76,847	77,075	77,294	77,487	77,677	77,866	78,049	78,227	
Philadelphia	293,487	294,277	295,307	295,837	296,745	297,589	298,394	299,233	299,981	300,735	301,435	
Westmoreland	73,973	74,625	75,040	75,350	75,804	76,264	76,681	77,132	77,558	78,015	78,448	
York	112,082	112,762	113,100	113,620	114,171	114,700	115,199	115,688	116,184	116,664	117,124	

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:											
	1/27	1/28	1/29	1/30	2/1				2/3				2/5			
Allegheny	245,213	246,575	250,058	250,741	253,536	(50,707)	[12,170]	{6,085}	256,295	(51,259)	[12,302]	{6,151}	258,880	(51,776)	[12,426]	{6,213}
Berks	98,002	98,455	98,678	98,904	99,602	(19,920)	[4,781]	{2,390}	100,244	(20,049)	[4,812]	{2,406}	100,852	(20,170)	[4,841]	{2,420}
Bucks	117,418	117,858	118,174	118,387	119,142	(23,828)	[5,719]	{2,859}	119,861	(23,972)	[5,753]	{2,877}	120,535	(24,107)	[5,786]	{2,893}
Butler	41,726	42,012	42,221	42,358	42,799	(8,560)	[2,054]	{1,027}	43,215	(8,643)	[2,074]	{1,037}	43,621	(8,724)	[2,094]	{1,047}
Chester	86,490	86,923	87,147	87,343	87,992	(17,598)	[4,224]	{2,112}	88,588	(17,718)	[4,252]	{2,126}	89,163	(17,833)	[4,280]	{2,140}
Delaware	105,135	105,558	105,820	106,039	106,679	(21,336)	[5,121]	{2,560}	107,257	(21,451)	[5,148]	{2,574}	107,794	(21,559)	[5,174]	{2,587}
Lackawanna	39,952	40,199	40,338	40,455	40,963	(8,193)	[1,966]	{983}	41,476	(8,295)	[1,991]	{995}	41,969	(8,394)	[2,014]	{1,007}
Lancaster	114,997	115,670	115,969	116,228	117,099	(23,420)	[5,621]	{2,810}	117,918	(23,584)	[5,660]	{2,830}	118,687	(23,737)	[5,697]	{2,848}
Lehigh	86,118	86,489	86,662	86,820	87,299	(17,460)	[4,190]	{2,095}	87,763	(17,553)	[4,213]	{2,106}	88,180	(17,636)	[4,233]	{2,116}
Luzerne	69,118	69,556	69,785	69,965	70,598	(14,120)	[3,389]	{1,694}	71,176	(14,235)	[3,416]	{1,708}	71,737	(14,347)	[3,443]	{1,722}
Monroe	35,226	35,428	35,503	35,583	35,828	(7,166)	[1,720]	{860}	36,045	(7,209)	[1,730]	{865}	36,252	(7,250)	[1,740]	{870}
Montgomery	143,308	143,989	144,458	144,767	145,884	(29,177)	[7,002]	{3,501}	146,912	(29,382)	[7,052]	{3,526}	147,891	(29,578)	[7,099]	{3,549}
Northampton	76,210	76,508	76,664	76,847	77,294	(15,459)	[3,710]	{1,855}	77,677	(15,535)	[3,729]	{1,864}	78,049	(15,610)	[3,746]	{1,873}
Philadelphia	293,487	294,277	295,307	295,837	297,589	(59,518)	[14,284]	{7,142}	299,233	(59,847)	[14,363]	{7,182}	300,735	(60,147)	[14,435]	{7,218}
Westmoreland	73,973	74,625	75,040	75,350	76,264	(15,253)	[3,661]	{1,830}	77,132	(15,426)	[3,702]	{1,851}	78,015	(15,603)	[3,745]	{1,872}
York	112,082	112,762	113,100	113,620	114,700	(22,940)	[5,506]	{2,753}	115,688	(23,138)	[5,553]	{2,777}	116,664	(23,333)	[5,600]	{2,800}

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.