

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

Date: 3/29/22

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 3/29/22 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.

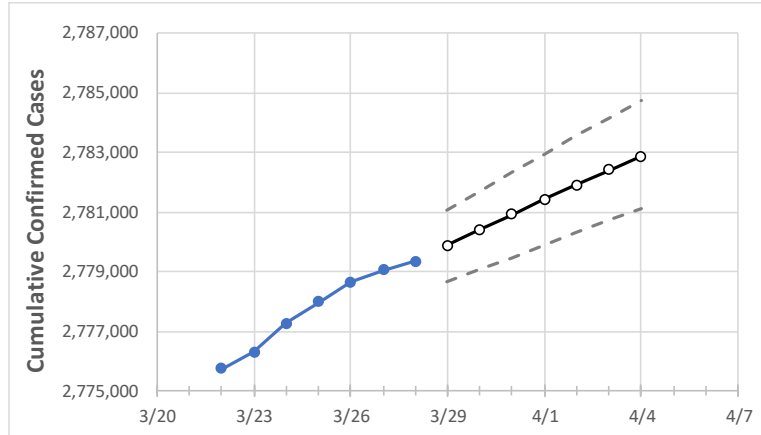
IEM's Modeling Lead

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:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Pennsylvania	2,777,986	2,778,646	2,779,049	2,779,328	2,779,868	2,780,401	2,780,906	2,781,412	2,781,909	2,782,399	2,782,866

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:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Allegheny	262,805	262,894	262,939	262,969	263,024	263,078	263,133	263,183	263,233	263,286	263,334
Berks	102,050	102,069	102,078	102,083	102,095	102,107	102,118	102,130	102,141	102,152	102,163
Bucks	122,722	122,758	122,777	122,796	122,826	122,857	122,888	122,917	122,948	122,978	123,008
Butler	44,334	44,336	44,343	44,345	44,351	44,357	44,362	44,368	44,373	44,378	44,383
Chester	91,305	91,338	91,357	91,382	91,406	91,431	91,456	91,479	91,504	91,529	91,551
Delaware	109,528	109,560	109,582	109,604	109,631	109,659	109,686	109,715	109,742	109,769	109,798
Lackawanna	43,271	43,281	43,291	43,294	43,304	43,314	43,324	43,334	43,343	43,353	43,361
Lancaster	120,648	120,664	120,676	120,684	120,696	120,708	120,719	120,730	120,742	120,752	120,763
Lehigh	89,159	89,175	89,179	89,190	89,202	89,212	89,222	89,234	89,244	89,255	89,265
Luzerne	73,309	73,322	73,324	73,330	73,339	73,348	73,356	73,364	73,371	73,379	73,386
Monroe	36,843	36,851	36,860	36,862	36,870	36,878	36,886	36,894	36,901	36,909	36,917
Montgomery	151,624	151,672	151,721	151,778	151,857	151,934	152,009	152,086	152,162	152,242	152,321
Northampton	79,254	79,276	79,291	79,299	79,315	79,332	79,347	79,363	79,378	79,395	79,410
Philadelphia	307,412	307,531	307,610	307,610	307,710	307,798	307,890	307,988	308,084	308,180	308,268
Westmoreland	79,514	79,518	79,523	79,529	79,541	79,551	79,561	79,572	79,582	79,592	79,601
York	118,330	118,348	118,359	118,367	118,379	118,390	118,400	118,411	118,421	118,432	118,441

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:											
	3/25	3/26	3/27	3/28	3/30				4/1				4/3			
Allegheny	262,805	262,894	262,939	262,969	263,078	(52,616)	[12,628]	{6,314}	263,183	(52,637)	[12,633]	{6,316}	263,286	(52,657)	[12,638]	{6,319}
Berks	102,050	102,069	102,078	102,083	102,107	(20,421)	[4,901]	{2,451}	102,130	(20,426)	[4,902]	{2,451}	102,152	(20,430)	[4,903]	{2,452}
Bucks	122,722	122,758	122,777	122,796	122,857	(24,571)	[5,897]	{2,949}	122,917	(24,583)	[5,900]	{2,950}	122,978	(24,596)	[5,903]	{2,951}
Butler	44,334	44,336	44,343	44,345	44,357	(8,871)	[2,129]	{1,065}	44,368	(8,874)	[2,130]	{1,065}	44,378	(8,876)	[2,130]	{1,065}
Chester	91,305	91,338	91,357	91,382	91,431	(18,286)	[4,389]	{2,194}	91,479	(18,296)	[4,391]	{2,196}	91,529	(18,306)	[4,393]	{2,197}
Delaware	109,528	109,560	109,582	109,604	109,659	(21,932)	[5,264]	{2,632}	109,715	(21,943)	[5,266]	{2,633}	109,769	(21,954)	[5,269]	{2,634}
Lackawanna	43,271	43,281	43,291	43,294	43,314	(8,663)	[2,079]	{1,040}	43,334	(8,667)	[2,080]	{1,040}	43,353	(8,671)	[2,081]	{1,040}
Lancaster	120,648	120,664	120,676	120,684	120,708	(24,142)	[5,794]	{2,897}	120,730	(24,146)	[5,795]	{2,898}	120,752	(24,150)	[5,796]	{2,898}
Lehigh	89,159	89,175	89,179	89,190	89,212	(17,842)	[4,282]	{2,141}	89,234	(17,847)	[4,283]	{2,142}	89,255	(17,851)	[4,284]	{2,142}
Luzerne	73,309	73,322	73,324	73,330	73,348	(14,670)	[3,521]	{1,760}	73,364	(14,673)	[3,521]	{1,761}	73,379	(14,676)	[3,522]	{1,761}
Monroe	36,843	36,851	36,860	36,862	36,878	(7,376)	[1,770]	{885}	36,894	(7,379)	[1,771]	{885}	36,909	(7,382)	[1,772]	{886}
Montgomery	151,624	151,672	151,721	151,778	151,934	(30,387)	[7,293]	{3,646}	152,086	(30,417)	[7,300]	{3,650}	152,242	(30,448)	[7,308]	{3,654}
Northampton	79,254	79,276	79,291	79,299	79,332	(15,866)	[3,808]	{1,904}	79,363	(15,873)	[3,809]	{1,905}	79,395	(15,879)	[3,811]	{1,905}
Philadelphia	307,412	307,531	307,610	307,610	307,798	(61,560)	[14,774]	{7,387}	307,988	(61,598)	[14,783]	{7,392}	308,180	(61,636)	[14,793]	{7,396}
Westmoreland	79,514	79,518	79,523	79,529	79,551	(15,910)	[3,818]	{1,909}	79,572	(15,914)	[3,819]	{1,910}	79,592	(15,918)	[3,820]	{1,910}
York	118,330	118,348	118,359	118,367	118,390	(23,678)	[5,683]	{2,841}	118,411	(23,682)	[5,684]	{2,842}	118,432	(23,686)	[5,685]	{2,842}

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.