

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

Date: 2/23/22

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 2/23/22 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.

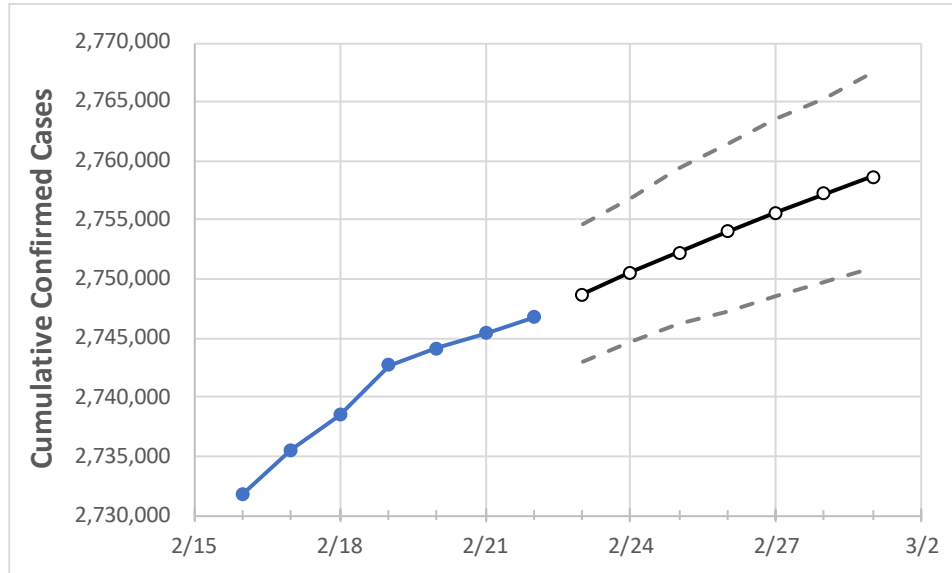
IEM's Modeling Lead

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:							
2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	

Pennsylvania 2,742,752 2,744,145 2,745,445 2,746,745 2,748,695 2,750,568 2,752,293 2,754,065 2,755,610 2,757,215 2,758,637

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:							
	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	
Allegheny	259,206	259,348	259,513	259,678	259,883	260,066	260,252	260,424	260,596	260,752	260,906	
Berks	101,231	101,272	101,310	101,347	101,402	101,456	101,508	101,557	101,602	101,647	101,690	
Bucks	121,365	121,420	121,472	121,524	121,593	121,664	121,724	121,784	121,844	121,907	121,953	
Butler	43,832	43,860	43,886	43,912	43,946	43,974	44,006	44,033	44,061	44,087	44,111	
Chester	90,104	90,156	90,197	90,237	90,325	90,409	90,492	90,572	90,643	90,727	90,791	
Delaware	108,416	108,479	108,518	108,557	108,609	108,658	108,704	108,748	108,786	108,830	108,862	
Lackawanna	42,478	42,501	42,529	42,556	42,605	42,654	42,699	42,741	42,786	42,830	42,868	
Lancaster	119,595	119,652	119,707	119,761	119,826	119,889	119,947	120,006	120,058	120,111	120,157	
Lehigh	88,560	88,584	88,605	88,625	88,659	88,691	88,721	88,752	88,779	88,805	88,831	
Luzerne	72,344	72,387	72,436	72,484	72,547	72,611	72,667	72,722	72,776	72,832	72,876	
Monroe	36,518	36,531	36,545	36,558	36,578	36,598	36,617	36,633	36,650	36,666	36,681	
Montgomery	149,152	149,230	149,296	149,362	149,484	149,590	149,681	149,781	149,881	149,983	150,065	
Northampton	78,545	78,576	78,597	78,617	78,653	78,690	78,722	78,755	78,784	78,814	78,840	
Philadelphia	302,482	302,595	302,614	302,632	302,805	302,963	303,121	303,271	303,408	303,555	303,681	
Westmoreland	78,527	78,579	78,626	78,672	78,751	78,825	78,896	78,964	79,028	79,094	79,151	
York	117,152	117,222	117,263	117,303	117,373	117,439	117,504	117,560	117,618	117,671	117,719	

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:											
	2/19	2/20	2/21	2/22	2/24			2/26			2/28					
Allegheny	259,206	259,348	259,513	259,678	260,066	(52,013)	[12,483]	{6,242}	260,424	(52,085)	[12,500]	{6,250}	260,752	(52,150)	[12,516]	{6,258}
Berks	101,231	101,272	101,310	101,347	101,456	(20,291)	[4,870]	{2,435}	101,557	(20,311)	[4,875]	{2,437}	101,647	(20,329)	[4,879]	{2,440}
Bucks	121,365	121,420	121,472	121,524	121,664	(24,333)	[5,840]	{2,920}	121,784	(24,357)	[5,846]	{2,923}	121,907	(24,381)	[5,852]	{2,926}
Butler	43,832	43,860	43,886	43,912	43,974	(8,795)	[2,111]	{1,055}	44,033	(8,807)	[2,114]	{1,057}	44,087	(8,817)	[2,116]	{1,058}
Chester	90,104	90,156	90,197	90,237	90,409	(18,082)	[4,340]	{2,170}	90,572	(18,114)	[4,347]	{2,174}	90,727	(18,145)	[4,355]	{2,177}
Delaware	108,416	108,479	108,518	108,557	108,658	(21,732)	[5,216]	{2,608}	108,748	(21,750)	[5,220]	{2,610}	108,830	(21,766)	[5,224]	{2,612}
Lackawanna	42,478	42,501	42,529	42,556	42,654	(8,531)	[2,047]	{1,024}	42,741	(8,548)	[2,052]	{1,026}	42,830	(8,566)	[2,056]	{1,028}
Lancaster	119,595	119,652	119,707	119,761	119,889	(23,978)	[5,755]	{2,877}	120,006	(24,001)	[5,760]	{2,880}	120,111	(24,022)	[5,765]	{2,883}
Lehigh	88,560	88,584	88,605	88,625	88,691	(17,738)	[4,257]	{2,129}	88,752	(17,750)	[4,260]	{2,130}	88,805	(17,761)	[4,263]	{2,131}
Luzerne	72,344	72,387	72,436	72,484	72,611	(14,522)	[3,485]	{1,743}	72,722	(14,544)	[3,491]	{1,745}	72,832	(14,566)	[3,496]	{1,748}
Monroe	36,518	36,531	36,545	36,558	36,598	(7,320)	[1,757]	{878}	36,633	(7,327)	[1,758]	{879}	36,666	(7,333)	[1,760]	{880}
Montgomery	149,152	149,230	149,296	149,362	149,590	(29,918)	[7,180]	{3,590}	149,781	(29,956)	[7,190]	{3,595}	149,983	(29,997)	[7,199]	{3,600}
Northampton	78,545	78,576	78,597	78,617	78,690	(15,738)	[3,777]	{1,889}	78,755	(15,751)	[3,780]	{1,890}	78,814	(15,763)	[3,783]	{1,892}
Philadelphia	302,482	302,595	302,614	302,632	302,963	(60,593)	[14,542]	{7,271}	303,271	(60,654)	[14,557]	{7,278}	303,555	(60,711)	[14,571]	{7,285}
Westmoreland	78,527	78,579	78,626	78,672	78,825	(15,765)	[3,784]	{1,892}	78,964	(15,793)	[3,790]	{1,895}	79,094	(15,819)	[3,797]	{1,898}
York	117,152	117,222	117,263	117,303	117,439	(23,488)	[5,637]	{2,819}	117,560	(23,512)	[5,643]	{2,821}	117,671	(23,534)	[5,648]	{2,824}

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.