

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

Date: 1/3/22

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 1/3/22 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.

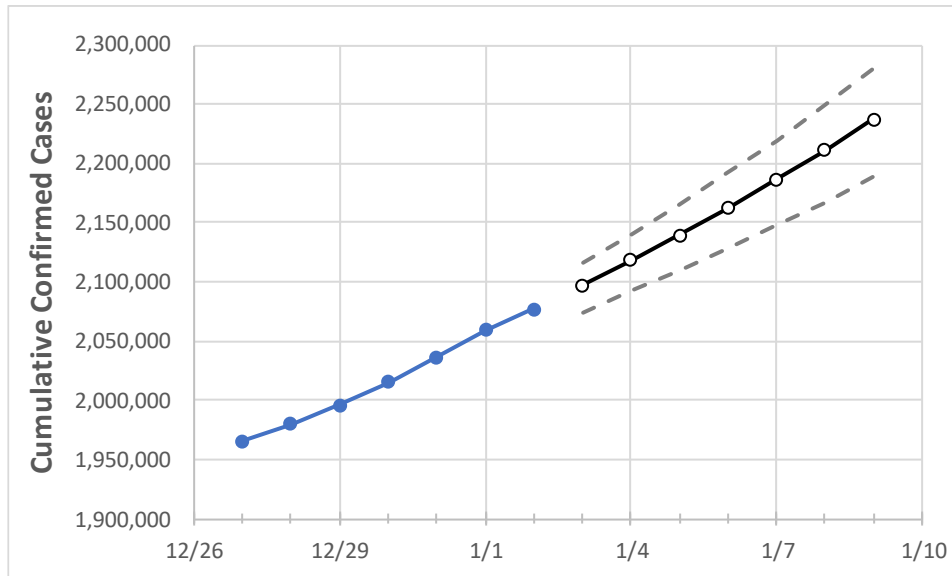
IEM's Modeling Lead

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:							
	12/30	12/31	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	

Pennsylvania 2,015,367 2,036,424 2,059,613 2,077,224 2,097,222 2,118,272 2,139,826 2,162,458 2,186,646 2,211,216 2,237,350

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:							
	12/30	12/31	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	
Allegheny	174,116	176,336	179,776	181,874	184,114	186,495	189,015	191,733	194,696	197,654	200,979	
Berks	75,542	76,376	77,311	78,112	78,851	79,629	80,443	81,282	82,179	83,119	84,086	
Bucks	90,889	91,995	92,854	93,942	94,932	95,987	97,095	98,280	99,509	100,833	102,214	
Butler	32,618	32,851	33,197	33,456	33,687	33,931	34,186	34,443	34,716	35,008	35,301	
Chester	65,963	66,965	67,755	68,556	69,414	70,317	71,276	72,275	73,334	74,451	75,597	
Delaware	77,947	79,520	80,991	82,044	83,512	85,097	86,780	88,597	90,566	92,644	94,909	
Lackawanna	29,398	29,690	30,022	30,356	30,622	30,904	31,183	31,477	31,784	32,107	32,441	
Lancaster	90,442	91,511	92,356	93,158	93,964	94,812	95,671	96,571	97,508	98,498	99,497	
Lehigh	62,899	63,964	64,637	65,466	66,219	67,012	67,844	68,691	69,610	70,542	71,548	
Luzerne	52,874	53,501	53,983	54,392	54,805	55,244	55,660	56,125	56,608	57,070	57,565	
Monroe	25,739	26,142	26,409	26,825	27,137	27,461	27,806	28,161	28,537	28,938	29,347	
Montgomery	108,900	110,575	112,007	113,906	115,565	117,320	119,215	121,220	123,351	125,635	128,045	
Northampton	57,829	58,875	59,540	60,175	60,825	61,498	62,190	62,910	63,664	64,441	65,266	
Philadelphia	224,017	225,031	228,936	228,936	232,701	236,786	240,857	245,467	250,293	255,658	261,201	
Westmoreland	58,808	59,161	59,832	60,200	60,537	60,866	61,193	61,556	61,904	62,267	62,656	
York	84,916	86,112	86,890	88,124	89,047	89,976	90,946	91,941	92,981	94,035	95,098	

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:											
	12/30	12/31	1/1	1/2	1/4			1/6			1/8					
Allegheny	174,116	176,336	179,776	181,874	186,495	(37,299)	[8,952]	{4,476}	191,733	(38,347)	[9,203]	{4,602}	197,654	(39,531)	[9,487]	{4,744}
Berks	75,542	76,376	77,311	78,112	79,629	(15,926)	[3,822]	{1,911}	81,282	(16,256)	[3,902]	{1,951}	83,119	(16,624)	[3,990]	{1,995}
Bucks	90,889	91,995	92,854	93,942	95,987	(19,197)	[4,607]	{2,304}	98,280	(19,656)	[4,717]	{2,359}	100,833	(20,167)	[4,840]	{2,420}
Butler	32,618	32,851	33,197	33,456	33,931	(6,786)	[1,629]	{814}	34,443	(6,889)	[1,653]	{827}	35,008	(7,002)	[1,680]	{840}
Chester	65,963	66,965	67,755	68,556	70,317	(14,063)	[3,375]	{1,688}	72,275	(14,455)	[3,469]	{1,735}	74,451	(14,890)	[3,574]	{1,787}
Delaware	77,947	79,520	80,991	82,044	85,097	(17,019)	[4,085]	{2,042}	88,597	(17,719)	[4,253]	{2,126}	92,644	(18,529)	[4,447]	{2,223}
Lackawanna	29,398	29,690	30,022	30,356	30,904	(6,181)	[1,483]	{742}	31,477	(6,295)	[1,511]	{755}	32,107	(6,421)	[1,541]	{771}
Lancaster	90,442	91,511	92,356	93,158	94,812	(18,962)	[4,551]	{2,275}	96,571	(19,314)	[4,635]	{2,318}	98,498	(19,700)	[4,728]	{2,364}
Lehigh	62,899	63,964	64,637	65,466	67,012	(13,402)	[3,217]	{1,608}	68,691	(13,738)	[3,297]	{1,649}	70,542	(14,108)	[3,386]	{1,693}
Luzerne	52,874	53,501	53,983	54,392	55,244	(11,049)	[2,652]	{1,326}	56,125	(11,225)	[2,694]	{1,347}	57,070	(11,414)	[2,739]	{1,370}
Monroe	25,739	26,142	26,409	26,825	27,461	(5,492)	[1,318]	{659}	28,161	(5,632)	[1,352]	{676}	28,938	(5,788)	[1,389]	{695}
Montgomery	108,900	110,575	112,007	113,906	117,320	(23,464)	[5,631]	{2,816}	121,220	(24,244)	[5,819]	{2,909}	125,635	(25,127)	[6,030]	{3,015}
Northampton	57,829	58,875	59,540	60,175	61,498	(12,300)	[2,952]	{1,476}	62,910	(12,582)	[3,020]	{1,510}	64,441	(12,888)	[3,093]	{1,547}
Philadelphia	224,017	225,031	228,936	228,936	236,786	(47,357)	[11,366]	{5,683}	245,467	(49,093)	[11,782]	{5,891}	255,658	(51,132)	[12,272]	{6,136}
Westmoreland	58,808	59,161	59,832	60,200	60,866	(12,173)	[2,922]	{1,461}	61,556	(12,311)	[2,955]	{1,477}	62,267	(12,453)	[2,989]	{1,494}
York	84,916	86,112	86,890	88,124	89,976	(17,995)	[4,319]	{2,159}	91,941	(18,388)	[4,413]	{2,207}	94,035	(18,807)	[4,514]	{2,257}

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.