

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

Date: 4/9/21

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 4/9/21 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.

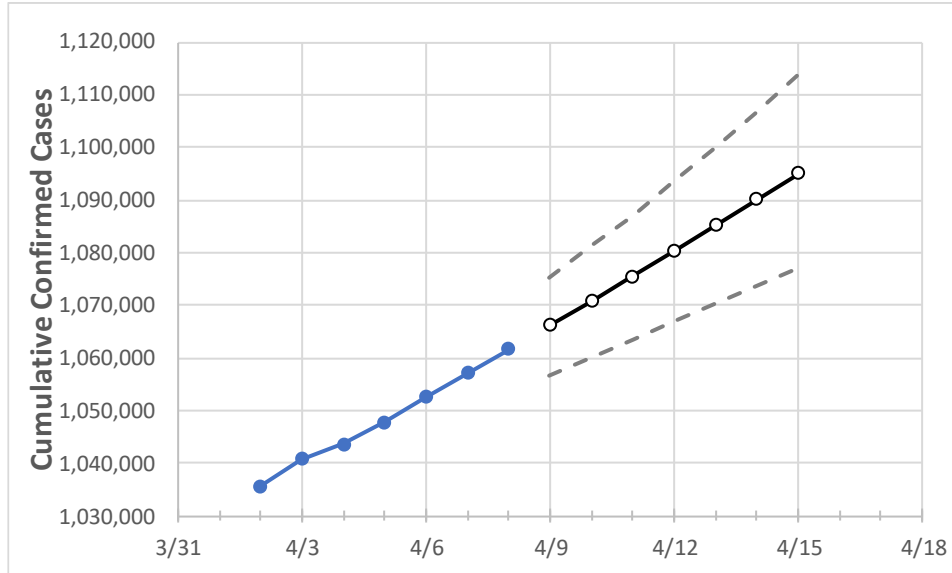
IEM's Modeling Lead

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:							
4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	

Pennsylvania 1,047,728 1,052,450 1,057,126 1,061,566 1,066,155 1,070,775 1,075,498 1,080,248 1,085,148 1,090,086 1,095,070

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:							
	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	
Allegheny	87,623	88,155	88,573	88,952	89,386	89,821	90,280	90,736	91,200	91,672	92,145	
Berks	40,836	41,042	41,186	41,389	41,588	41,787	41,987	42,196	42,402	42,607	42,825	
Bucks	52,418	52,661	52,912	53,179	53,474	53,769	54,073	54,375	54,680	54,989	55,302	
Butler	15,513	15,568	15,638	15,715	15,779	15,844	15,908	15,970	16,036	16,100	16,169	
Chester	32,181	32,291	32,401	32,561	32,715	32,872	33,033	33,193	33,357	33,524	33,692	
Delaware	45,808	45,953	46,140	46,357	46,572	46,792	47,018	47,244	47,476	47,712	47,951	
Lackawanna	15,931	16,038	16,113	16,174	16,254	16,331	16,415	16,497	16,581	16,668	16,759	
Lancaster	48,771	48,920	49,099	49,282	49,477	49,675	49,874	50,080	50,286	50,495	50,706	
Lehigh	34,821	34,969	35,095	35,238	35,392	35,548	35,708	35,867	36,026	36,185	36,350	
Luzerne	27,593	27,701	27,822	27,923	28,037	28,152	28,269	28,385	28,504	28,626	28,751	
Monroe	11,841	11,977	12,034	12,141	12,237	12,336	12,442	12,544	12,649	12,758	12,867	
Montgomery	61,280	61,499	61,767	62,114	62,429	62,755	63,089	63,432	63,782	64,134	64,494	
Northampton	31,225	31,389	31,540	31,711	31,878	32,039	32,206	32,370	32,534	32,700	32,865	
Philadelphia	132,575	133,485	134,356	134,945	135,590	136,244	136,922	137,597	138,283	139,002	139,727	
Westmoreland	29,722	29,886	30,005	30,135	30,268	30,405	30,538	30,669	30,803	30,943	31,082	
York	40,198	40,322	40,526	40,691	40,848	40,999	41,150	41,297	41,452	41,601	41,745	

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:											
	4/5	4/6	4/7	4/8	4/10			4/12			4/14					
Allegheny	87,623	88,155	88,573	88,952	89,821	(17,964)	[4,311]	{2,156}	90,736	(18,147)	[4,355]	{2,178}	91,672	(18,334)	[4,400]	{2,200}
Berks	40,836	41,042	41,186	41,389	41,787	(8,357)	[2,006]	{1,003}	42,196	(8,439)	[2,025]	{1,013}	42,607	(8,521)	[2,045]	{1,023}
Bucks	52,418	52,661	52,912	53,179	53,769	(10,754)	[2,581]	{1,290}	54,375	(10,875)	[2,610]	{1,305}	54,989	(10,998)	[2,639]	{1,320}
Butler	15,513	15,568	15,638	15,715	15,844	(3,169)	[761]	{380}	15,970	(3,194)	[767]	{383}	16,100	(3,220)	[773]	{386}
Chester	32,181	32,291	32,401	32,561	32,872	(6,574)	[1,578]	{789}	33,193	(6,639)	[1,593]	{797}	33,524	(6,705)	[1,609]	{805}
Delaware	45,808	45,953	46,140	46,357	46,792	(9,358)	[2,246]	{1,123}	47,244	(9,449)	[2,268]	{1,134}	47,712	(9,542)	[2,290]	{1,145}
Lackawanna	15,931	16,038	16,113	16,174	16,331	(3,266)	[784]	{392}	16,497	(3,299)	[792]	{396}	16,668	(3,334)	[800]	{400}
Lancaster	48,771	48,920	49,099	49,282	49,675	(9,935)	[2,384]	{1,192}	50,080	(10,016)	[2,404]	{1,202}	50,495	(10,099)	[2,424]	{1,212}
Lehigh	34,821	34,969	35,095	35,238	35,548	(7,110)	[1,706]	{853}	35,867	(7,173)	[1,722]	{861}	36,185	(7,237)	[1,737]	{868}
Luzerne	27,593	27,701	27,822	27,923	28,152	(5,630)	[1,351]	{676}	28,385	(5,677)	[1,362]	{681}	28,626	(5,725)	[1,374]	{687}
Monroe	11,841	11,977	12,034	12,141	12,336	(2,467)	[592]	{296}	12,544	(2,509)	[602]	{301}	12,758	(2,552)	[612]	{306}
Montgomery	61,280	61,499	61,767	62,114	62,755	(12,551)	[3,012]	{1,506}	63,432	(12,686)	[3,045]	{1,522}	64,134	(12,827)	[3,078]	{1,539}
Northampton	31,225	31,389	31,540	31,711	32,039	(6,408)	[1,538]	{769}	32,370	(6,474)	[1,554]	{777}	32,700	(6,540)	[1,570]	{785}
Philadelphia	132,575	133,485	134,356	134,945	136,244	(27,249)	[6,540]	{3,270}	137,597	(27,519)	[6,605]	{3,302}	139,002	(27,800)	[6,672]	{3,336}
Westmoreland	29,722	29,886	30,005	30,135	30,405	(6,081)	[1,459]	{730}	30,669	(6,134)	[1,472]	{736}	30,943	(6,189)	[1,485]	{743}
York	40,198	40,322	40,526	40,691	40,999	(8,200)	[1,968]	{984}	41,297	(8,259)	[1,982]	{991}	41,601	(8,320)	[1,997]	{998}

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.