

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

Date: 4/16/21

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 4/16/21 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.

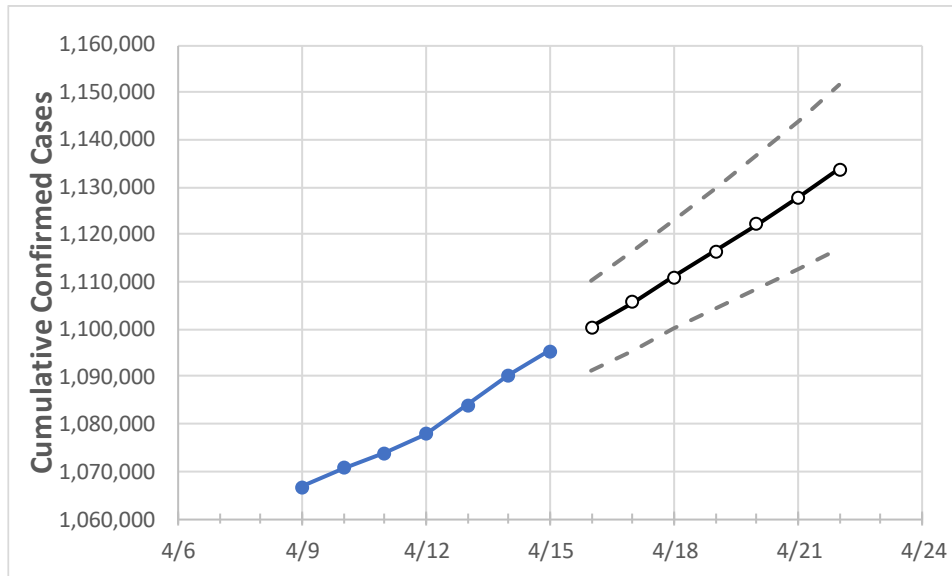
IEM's Modeling Lead

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:							
4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	

Pennsylvania 1,077,936 1,083,953 1,090,228 1,095,321 1,100,434 1,105,697 1,110,987 1,116,454 1,122,102 1,127,822 1,133,693

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:							
	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	
Allegheny	90,634	91,064	92,385	92,788	93,351	93,922	94,499	95,108	95,724	96,364	97,003	
Berks	41,991	42,541	42,692	42,915	43,140	43,367	43,605	43,839	44,082	44,334	44,582	
Bucks	54,186	54,603	54,881	55,150	55,449	55,754	56,049	56,350	56,643	56,947	57,257	
Butler	15,921	15,968	16,049	16,099	16,154	16,209	16,263	16,319	16,373	16,427	16,483	
Chester	33,135	33,296	33,443	33,594	33,744	33,895	34,049	34,202	34,357	34,513	34,670	
Delaware	47,049	47,427	47,653	47,885	48,129	48,373	48,629	48,888	49,154	49,427	49,701	
Lackawanna	16,406	16,539	16,614	16,692	16,770	16,848	16,927	17,009	17,087	17,165	17,249	
Lancaster	49,979	50,283	50,487	50,699	50,913	51,129	51,350	51,572	51,802	52,035	52,267	
Lehigh	35,781	36,025	36,160	36,322	36,479	36,640	36,799	36,960	37,129	37,291	37,458	
Luzerne	28,341	28,488	28,607	28,720	28,838	28,959	29,077	29,200	29,325	29,453	29,587	
Monroe	12,468	12,605	12,678	12,733	12,824	12,917	13,010	13,106	13,199	13,294	13,392	
Montgomery	63,131	63,593	63,910	64,214	64,556	64,906	65,261	65,622	65,982	66,358	66,735	
Northampton	32,197	32,445	32,586	32,743	32,895	33,045	33,196	33,346	33,499	33,646	33,802	
Philadelphia	137,201	137,331	138,643	139,486	140,142	140,815	141,504	142,222	142,951	143,704	144,482	
Westmoreland	30,666	30,837	31,001	31,153	31,298	31,447	31,598	31,750	31,904	32,060	32,220	
York	41,306	41,539	41,711	41,908	42,070	42,237	42,404	42,568	42,733	42,901	43,065	

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:											
	4/12	4/13	4/14	4/15	4/17			4/19			4/21					
Allegheny	90,634	91,064	92,385	92,788	93,922	(18,784)	[4,508]	{2,254}	95,108	(19,022)	[4,565]	{2,283}	96,364	(19,273)	[4,625]	{2,313}
Berks	41,991	42,541	42,692	42,915	43,367	(8,673)	[2,082]	{1,041}	43,839	(8,768)	[2,104]	{1,052}	44,334	(8,867)	[2,128]	{1,064}
Bucks	54,186	54,603	54,881	55,150	55,754	(11,151)	[2,676]	{1,338}	56,350	(11,270)	[2,705]	{1,352}	56,947	(11,389)	[2,733]	{1,367}
Butler	15,921	15,968	16,049	16,099	16,209	(3,242)	[778]	{389}	16,319	(3,264)	[783]	{392}	16,427	(3,285)	[788]	{394}
Chester	33,135	33,296	33,443	33,594	33,895	(6,779)	[1,627]	{813}	34,202	(6,840)	[1,642]	{821}	34,513	(6,903)	[1,657]	{828}
Delaware	47,049	47,427	47,653	47,885	48,373	(9,675)	[2,322]	{1,161}	48,888	(9,778)	[2,347]	{1,173}	49,427	(9,885)	[2,372]	{1,186}
Lackawanna	16,406	16,539	16,614	16,692	16,848	(3,370)	[809]	{404}	17,009	(3,402)	[816]	{408}	17,165	(3,433)	[824]	{412}
Lancaster	49,979	50,283	50,487	50,699	51,129	(10,226)	[2,454]	{1,227}	51,572	(10,314)	[2,475]	{1,238}	52,035	(10,407)	[2,498]	{1,249}
Lehigh	35,781	36,025	36,160	36,322	36,640	(7,328)	[1,759]	{879}	36,960	(7,392)	[1,774]	{887}	37,291	(7,458)	[1,790]	{895}
Luzerne	28,341	28,488	28,607	28,720	28,959	(5,792)	[1,390]	{695}	29,200	(5,840)	[1,402]	{701}	29,453	(5,891)	[1,414]	{707}
Monroe	12,468	12,605	12,678	12,733	12,917	(2,583)	[620]	{310}	13,106	(2,621)	[629]	{315}	13,294	(2,659)	[638]	{319}
Montgomery	63,131	63,593	63,910	64,214	64,906	(12,981)	[3,115]	{1,558}	65,622	(13,124)	[3,150]	{1,575}	66,358	(13,272)	[3,185]	{1,593}
Northampton	32,197	32,445	32,586	32,743	33,045	(6,609)	[1,586]	{793}	33,346	(6,669)	[1,601]	{800}	33,646	(6,729)	[1,615]	{808}
Philadelphia	137,201	137,331	138,643	139,486	140,815	(28,163)	[6,759]	{3,380}	142,222	(28,444)	[6,827]	{3,413}	143,704	(28,741)	[6,898]	{3,449}
Westmoreland	30,666	30,837	31,001	31,153	31,447	(6,289)	[1,509]	{755}	31,750	(6,350)	[1,524]	{762}	32,060	(6,412)	[1,539]	{769}
York	41,306	41,539	41,711	41,908	42,237	(8,447)	[2,027]	{1,014}	42,568	(8,514)	[2,043]	{1,022}	42,901	(8,580)	[2,059]	{1,030}

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.