

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/17/20**

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 12/17/20 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.

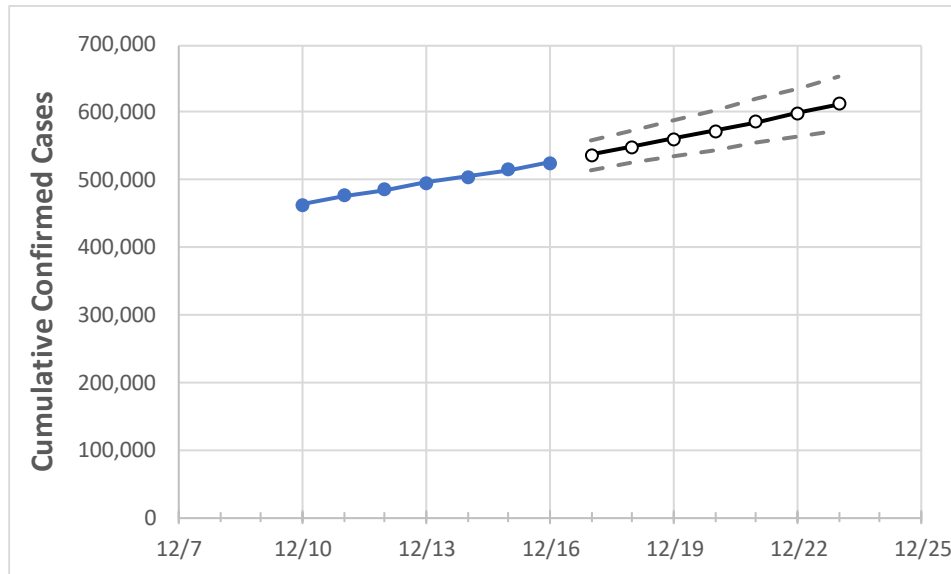
IEM's Modeling Lead

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:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Pennsylvania	495,099	505,174	514,749	524,940	536,680	548,651	560,858	573,300	585,982	598,905	612,073

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 20%, and are often within 10%, of actual confirmed cases.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Allegheny	40,124	40,874	41,933	43,007	44,148	45,321	46,525	47,761	49,031	50,334	51,672
Berks	18,056	18,418	18,730	19,047	19,425	19,811	20,206	20,608	21,019	21,438	21,865
Bucks	24,067	24,462	24,813	25,183	25,728	26,281	26,843	27,415	27,995	28,584	29,182
Butler	6,533	6,643	6,820	7,036	7,224	7,416	7,613	7,815	8,022	8,233	8,450
Chester	15,586	15,857	16,154	16,437	16,750	17,069	17,394	17,725	18,063	18,408	18,759
Delaware	24,420	24,627	24,917	25,218	25,543	25,871	26,201	26,534	26,870	27,208	27,549
Lackawanna	6,541	6,638	6,749	6,862	6,992	7,127	7,265	7,408	7,555	7,706	7,863
Lancaster	22,075	22,290	22,615	23,025	23,451	23,882	24,316	24,755	25,198	25,645	26,096
Lehigh	15,288	15,583	15,789	16,105	16,432	16,764	17,101	17,443	17,790	18,142	18,499
Luzerne	12,984	13,259	13,398	13,883	14,191	14,507	14,829	15,158	15,494	15,837	16,188
Monroe	4,646	4,737	4,796	4,871	4,971	5,074	5,177	5,283	5,390	5,499	5,610
Montgomery	28,468	28,851	29,234	29,656	30,217	30,790	31,375	31,973	32,583	33,205	33,841
Northampton	12,446	12,672	12,818	13,151	13,460	13,778	14,104	14,438	14,782	15,134	15,496
Philadelphia	81,068	81,779	83,113	84,061	85,075	86,094	87,117	88,145	89,176	90,212	91,252
Westmoreland	13,965	14,260	14,802	15,148	15,627	16,120	16,627	17,150	17,688	18,242	18,812
York	17,077	17,522	17,811	18,232	18,793	19,379	19,990	20,627	21,291	21,984	22,705

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:											
	12/13	12/14	12/15	12/16	12/18				12/20				12/22			
Allegheny	40,124	40,874	41,933	43,007	45,321	(9,064)	[2,175]	{1,088}	47,761	(9,552)	[2,293]	{1,146}	50,334	(10,067)	[2,416]	{1,208}
Berks	18,056	18,418	18,730	19,047	19,811	(3,962)	[951]	{475}	20,608	(4,122)	[989]	{495}	21,438	(4,288)	[1,029]	{515}
Bucks	24,067	24,462	24,813	25,183	26,281	(5,256)	[1,261]	{631}	27,415	(5,483)	[1,316]	{658}	28,584	(5,717)	[1,372]	{686}
Butler	6,533	6,643	6,820	7,036	7,416	(1,483)	[356]	{178}	7,815	(1,563)	[375]	{188}	8,233	(1,647)	[395]	{198}
Chester	15,586	15,857	16,154	16,437	17,069	(3,414)	[819]	{410}	17,725	(3,545)	[851]	{425}	18,408	(3,682)	[884]	{442}
Delaware	24,420	24,627	24,917	25,218	25,871	(5,174)	[1,242]	{621}	26,534	(5,307)	[1,274]	{637}	27,208	(5,442)	[1,306]	{653}
Lackawanna	6,541	6,638	6,749	6,862	7,127	(1,425)	[342]	{171}	7,408	(1,482)	[356]	{178}	7,706	(1,541)	[370]	{185}
Lancaster	22,075	22,290	22,615	23,025	23,882	(4,776)	[1,146]	{573}	24,755	(4,951)	[1,188]	{594}	25,645	(5,129)	[1,231]	{615}
Lehigh	15,288	15,583	15,789	16,105	16,764	(3,353)	[805]	{402}	17,443	(3,489)	[837]	{419}	18,142	(3,628)	[871]	{435}
Luzerne	12,984	13,259	13,398	13,883	14,507	(2,901)	[696]	{348}	15,158	(3,032)	[728]	{364}	15,837	(3,167)	[760]	{380}
Monroe	4,646	4,737	4,796	4,871	5,074	(1,015)	[244]	{122}	5,283	(1,057)	[254]	{127}	5,499	(1,100)	[264]	{132}
Montgomery	28,468	28,851	29,234	29,656	30,790	(6,158)	[1,478]	{739}	31,973	(6,395)	[1,535]	{767}	33,205	(6,641)	[1,594]	{797}
Northampton	12,446	12,672	12,818	13,151	13,778	(2,756)	[661]	{331}	14,438	(2,888)	[693]	{347}	15,134	(3,027)	[726]	{363}
Philadelphia	81,068	81,779	83,113	84,061	86,094	(17,219)	[4,133]	{2,066}	88,145	(17,629)	[4,231]	{2,115}	90,212	(18,042)	[4,330]	{2,165}
Westmoreland	13,965	14,260	14,802	15,148	16,120	(3,224)	[774]	{387}	17,150	(3,430)	[823]	{412}	18,242	(3,648)	[876]	{438}
York	17,077	17,522	17,811	18,232	19,379	(3,876)	[930]	{465}	20,627	(4,125)	[990]	{495}	21,984	(4,397)	[1,055]	{528}

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.