

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 11/30/20**

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 11/30/20 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.

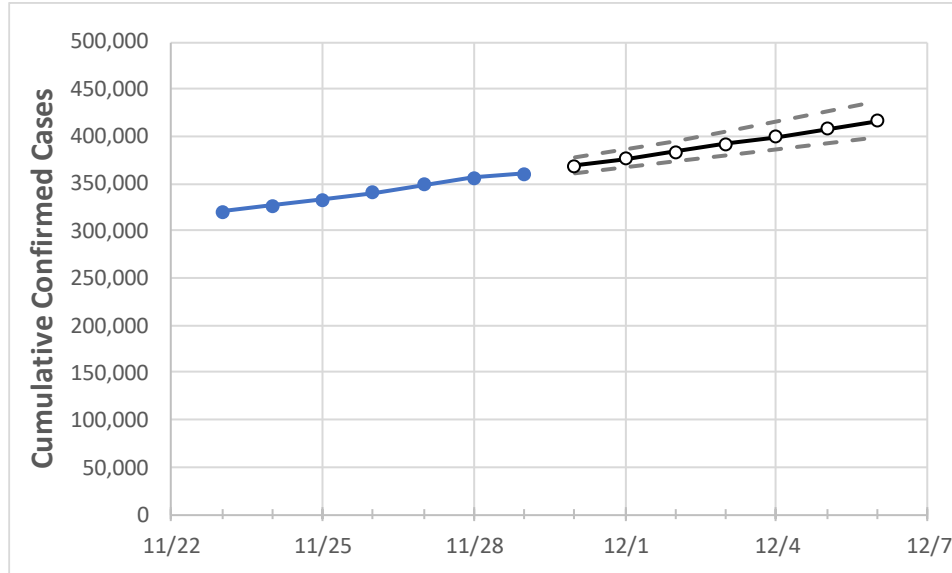
IEM's Modeling Lead

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:					
	11/26	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6
Pennsylvania	340,642	349,238	355,945	360,944	368,397	375,995	383,741	391,638	399,690	407,900	416,270

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:					
	11/26	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6
Allegheny	25,952	26,821	27,484	28,004	28,726	29,475	30,253	31,060	31,898	32,768	33,670
Berks	13,347	13,519	13,694	13,874	14,076	14,282	14,492	14,705	14,923	15,145	15,371
Bucks	16,297	16,709	17,146	17,410	17,791	18,185	18,592	19,011	19,444	19,891	20,353
Butler	4,146	4,246	4,355	4,484	4,612	4,742	4,877	5,014	5,156	5,301	5,450
Chester	11,487	11,711	11,711	11,711	11,875	12,043	12,215	12,390	12,570	12,755	12,944
Delaware	19,401	19,649	19,877	20,057	20,315	20,576	20,840	21,106	21,375	21,647	21,922
Lackawanna	4,960	5,043	5,122	5,173	5,256	5,343	5,435	5,532	5,635	5,744	5,859
Lancaster	15,408	15,890	16,157	16,470	16,858	17,262	17,683	18,122	18,579	19,055	19,550
Lehigh	10,666	10,981	11,279	11,412	11,664	11,926	12,199	12,483	12,779	13,086	13,405
Luzerne	8,988	9,238	9,435	9,656	9,880	10,112	10,353	10,602	10,860	11,126	11,402
Monroe	3,109	3,180	3,343	3,386	3,464	3,545	3,632	3,723	3,818	3,919	4,026
Montgomery	20,766	21,071	21,421	21,729	22,081	22,440	22,806	23,179	23,559	23,947	24,342
Northampton	8,478	8,667	8,903	9,000	9,197	9,402	9,615	9,836	10,066	10,305	10,552
Philadelphia	64,673	65,484	65,484	65,484	66,358	67,245	68,147	69,063	69,995	70,943	71,908
Westmoreland	8,412	8,675	8,959	9,132	9,405	9,687	9,978	10,280	10,592	10,915	11,248
York	10,428	10,604	10,806	11,001	11,253	11,516	11,791	12,078	12,379	12,692	13,020

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:											
	11/26	11/27	11/28	11/29	12/1				12/3				12/5			
Allegheny	25,952	26,821	27,484	28,004	29,475	(5,895)	[1,415]	{707}	31,060	(6,212)	[1,491]	{745}	32,768	(6,554)	[1,573]	{786}
Berks	13,347	13,519	13,694	13,874	14,282	(2,856)	[686]	{343}	14,705	(2,941)	[706]	{353}	15,145	(3,029)	[727]	{363}
Bucks	16,297	16,709	17,146	17,410	18,185	(3,637)	[873]	{436}	19,011	(3,802)	[913]	{456}	19,891	(3,978)	[955]	{477}
Butler	4,146	4,246	4,355	4,484	4,742	(948)	[228]	{114}	5,014	(1,003)	[241]	{120}	5,301	(1,060)	[254]	{127}
Chester	11,487	11,711	11,711	11,711	12,043	(2,409)	[578]	{289}	12,390	(2,478)	[595]	{297}	12,755	(2,551)	[612]	{306}
Delaware	19,401	19,649	19,877	20,057	20,576	(4,115)	[988]	{494}	21,106	(4,221)	[1,013]	{507}	21,647	(4,329)	[1,039]	{520}
Lackawanna	4,960	5,043	5,122	5,173	5,343	(1,069)	[256]	{128}	5,532	(1,106)	[266]	{133}	5,744	(1,149)	[276]	{138}
Lancaster	15,408	15,890	16,157	16,470	17,262	(3,452)	[829]	{414}	18,122	(3,624)	[870]	{435}	19,055	(3,811)	[915]	{457}
Lehigh	10,666	10,981	11,279	11,412	11,926	(2,385)	[572]	{286}	12,483	(2,497)	[599]	{300}	13,086	(2,617)	[628]	{314}
Luzerne	8,988	9,238	9,435	9,656	10,112	(2,022)	[485]	{243}	10,602	(2,120)	[509]	{254}	11,126	(2,225)	[534]	{267}
Monroe	3,109	3,180	3,343	3,386	3,545	(709)	[170]	{85}	3,723	(745)	[179]	{89}	3,919	(784)	[188]	{94}
Montgomery	20,766	21,071	21,421	21,729	22,440	(4,488)	[1,077]	{539}	23,179	(4,636)	[1,113]	{556}	23,947	(4,789)	[1,149]	{575}
Northampton	8,478	8,667	8,903	9,000	9,402	(1,880)	[451]	{226}	9,836	(1,967)	[472]	{236}	10,305	(2,061)	[495]	{247}
Philadelphia	64,673	65,484	65,484	65,484	67,245	(13,449)	[3,228]	{1,614}	69,063	(13,813)	[3,315]	{1,658}	70,943	(14,189)	[3,405]	{1,703}
Westmoreland	8,412	8,675	8,959	9,132	9,687	(1,937)	[465]	{232}	10,280	(2,056)	[493]	{247}	10,915	(2,183)	[524]	{262}
York	10,428	10,604	10,806	11,001	11,516	(2,303)	[553]	{276}	12,078	(2,416)	[580]	{290}	12,692	(2,538)	[609]	{305}

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.