

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 11/24/21**

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 11/24/21 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.

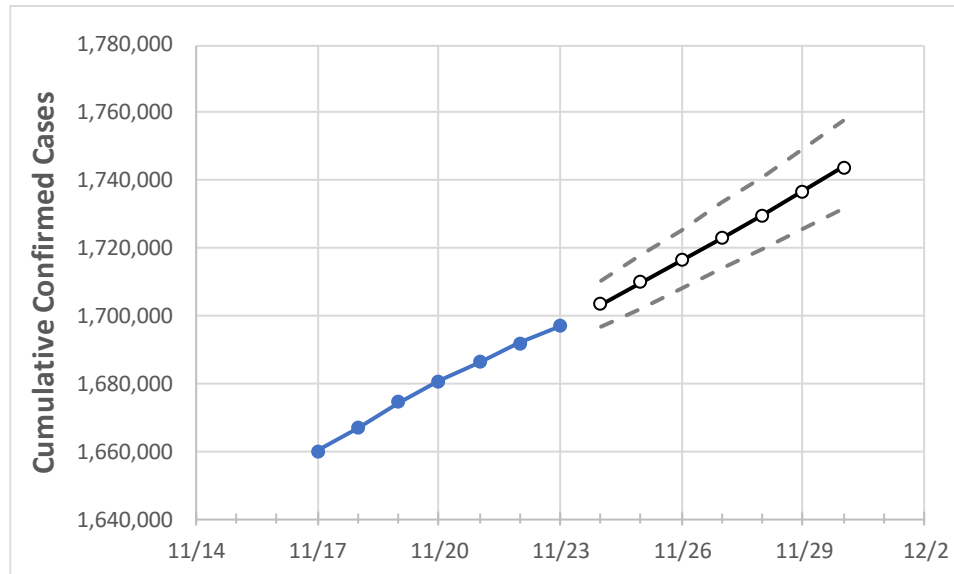
IEM's Modeling Lead

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:							
11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30	

Pennsylvania 1,680,752 1,686,169 1,691,773 1,696,959 1,703,352 1,709,848 1,716,356 1,723,001 1,729,848 1,736,852 1,743,960

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:						
	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
Allegheny	144,076	144,615	145,422	145,902	146,616	147,345	148,092	148,853	149,628	150,425	151,247
Berks	62,652	62,848	63,062	63,248	63,450	63,652	63,861	64,074	64,289	64,506	64,732
Bucks	77,278	77,424	77,574	77,767	77,946	78,125	78,306	78,494	78,675	78,864	79,055
Butler	27,731	27,882	28,007	28,064	28,205	28,353	28,501	28,652	28,803	28,960	29,120
Chester	53,944	54,083	54,218	54,377	54,542	54,703	54,874	55,045	55,220	55,402	55,585
Delaware	64,919	65,041	65,145	65,302	65,439	65,579	65,720	65,865	66,013	66,165	66,322
Lackawanna	24,544	24,629	24,682	24,791	24,895	24,994	25,100	25,207	25,315	25,429	25,542
Lancaster	76,288	76,495	76,751	76,919	77,155	77,397	77,641	77,891	78,144	78,399	78,658
Lehigh	51,176	51,318	51,454	51,670	51,858	52,058	52,265	52,482	52,702	52,935	53,175
Luzerne	44,283	44,478	44,627	44,769	44,953	45,138	45,335	45,531	45,733	45,939	46,153
Monroe	21,052	21,106	21,161	21,286	21,376	21,469	21,564	21,661	21,762	21,869	21,976
Montgomery	90,260	90,520	90,742	90,959	91,204	91,454	91,707	91,966	92,226	92,496	92,767
Northampton	47,162	47,261	47,373	47,586	47,744	47,903	48,069	48,239	48,416	48,598	48,782
Philadelphia	188,736	188,996	189,142	189,142	189,426	189,715	190,001	190,298	190,597	190,909	191,210
Westmoreland	49,576	49,730	50,074	50,198	50,462	50,730	51,004	51,289	51,578	51,881	52,188
York	67,957	68,294	68,544	68,764	69,026	69,287	69,558	69,823	70,096	70,374	70,661

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:											
	11/20	11/21	11/22	11/23	11/25			11/27			11/29					
Allegheny	144,076	144,615	145,422	145,902	147,345	(29,469)	[7,073]	{3,536}	148,853	(29,771)	[7,145]	{3,572}	150,425	(30,085)	[7,220]	{3,610}
Berks	62,652	62,848	63,062	63,248	63,652	(12,730)	[3,055]	{1,528}	64,074	(12,815)	[3,076]	{1,538}	64,506	(12,901)	[3,096]	{1,548}
Bucks	77,278	77,424	77,574	77,767	78,125	(15,625)	[3,750]	{1,875}	78,494	(15,699)	[3,768]	{1,884}	78,864	(15,773)	[3,785]	{1,893}
Butler	27,731	27,882	28,007	28,064	28,353	(5,671)	[1,361]	{680}	28,652	(5,730)	[1,375]	{688}	28,960	(5,792)	[1,390]	{695}
Chester	53,944	54,083	54,218	54,377	54,703	(10,941)	[2,626]	{1,313}	55,045	(11,009)	[2,642]	{1,321}	55,402	(11,080)	[2,659]	{1,330}
Delaware	64,919	65,041	65,145	65,302	65,579	(13,116)	[3,148]	{1,574}	65,865	(13,173)	[3,162]	{1,581}	66,165	(13,233)	[3,176]	{1,588}
Lackawanna	24,544	24,629	24,682	24,791	24,994	(4,999)	[1,200]	{600}	25,207	(5,041)	[1,210]	{605}	25,429	(5,086)	[1,221]	{610}
Lancaster	76,288	76,495	76,751	76,919	77,397	(15,479)	[3,715]	{1,858}	77,891	(15,578)	[3,739]	{1,869}	78,399	(15,680)	[3,763]	{1,882}
Lehigh	51,176	51,318	51,454	51,670	52,058	(10,412)	[2,499]	{1,249}	52,482	(10,496)	[2,519]	{1,260}	52,935	(10,587)	[2,541]	{1,270}
Luzerne	44,283	44,478	44,627	44,769	45,138	(9,028)	[2,167]	{1,083}	45,531	(9,106)	[2,185]	{1,093}	45,939	(9,188)	[2,205]	{1,103}
Monroe	21,052	21,106	21,161	21,286	21,469	(4,294)	[1,031]	{515}	21,661	(4,332)	[1,040]	{520}	21,869	(4,374)	[1,050]	{525}
Montgomery	90,260	90,520	90,742	90,959	91,454	(18,291)	[4,390]	{2,195}	91,966	(18,393)	[4,414]	{2,207}	92,496	(18,499)	[4,440]	{2,220}
Northampton	47,162	47,261	47,373	47,586	47,903	(9,581)	[2,299]	{1,150}	48,239	(9,648)	[2,315]	{1,158}	48,598	(9,720)	[2,333]	{1,166}
Philadelphia	188,736	188,996	189,142	189,142	189,715	(37,943)	[9,106]	{4,553}	190,298	(38,060)	[9,134]	{4,567}	190,909	(38,182)	[9,164]	{4,582}
Westmoreland	49,576	49,730	50,074	50,198	50,730	(10,146)	[2,435]	{1,218}	51,289	(10,258)	[2,462]	{1,231}	51,881	(10,376)	[2,490]	{1,245}
York	67,957	68,294	68,544	68,764	69,287	(13,857)	[3,326]	{1,663}	69,823	(13,965)	[3,351]	{1,676}	70,374	(14,075)	[3,378]	{1,689}

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.