

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

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 11/19/21 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.

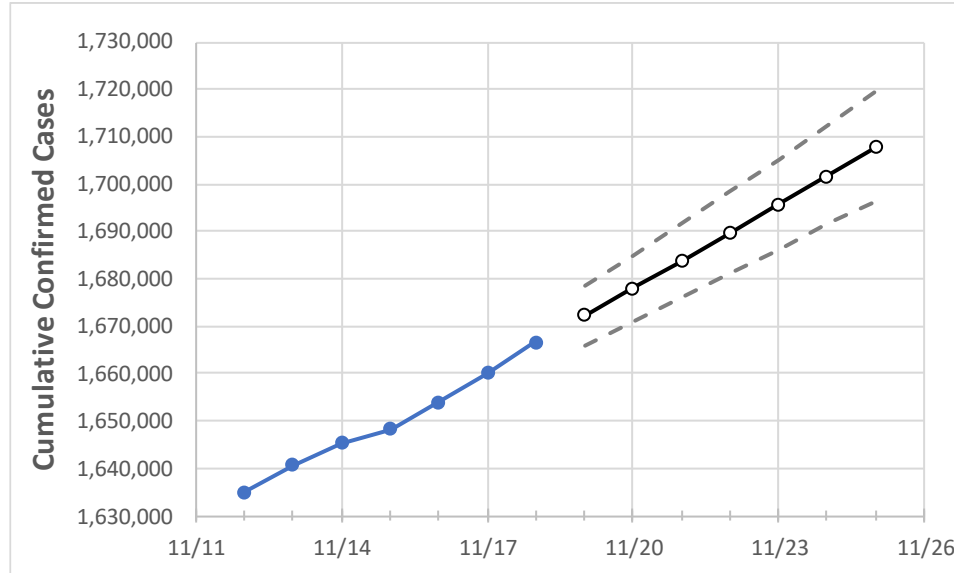
IEM's Modeling Lead

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:						
	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25
Pennsylvania	1,648,285	1,654,063	1,660,087	1,666,724	1,672,347	1,678,055	1,683,793	1,689,681	1,695,660	1,701,716	1,707,786

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:						
	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25
Allegheny	140,678	141,336	141,833	142,527	143,102	143,695	144,273	144,901	145,521	146,155	146,799
Berks	61,705	61,878	62,041	62,287	62,462	62,639	62,817	62,998	63,186	63,374	63,558
Bucks	76,364	76,506	76,698	76,934	77,118	77,309	77,499	77,690	77,887	78,089	78,291
Butler	26,968	27,114	27,226	27,374	27,500	27,631	27,758	27,893	28,028	28,165	28,309
Chester	53,141	53,278	53,475	53,655	53,813	53,978	54,140	54,313	54,488	54,666	54,849
Delaware	64,267	64,385	64,481	64,640	64,747	64,857	64,963	65,076	65,187	65,302	65,415
Lackawanna	24,038	24,134	24,236	24,359	24,458	24,561	24,663	24,771	24,884	25,000	25,120
Lancaster	75,125	75,290	75,530	75,754	75,954	76,156	76,357	76,563	76,773	76,985	77,190
Lehigh	50,329	50,486	50,662	50,839	50,975	51,119	51,263	51,412	51,567	51,725	51,888
Luzerne	43,342	43,507	43,737	43,905	44,057	44,218	44,377	44,545	44,711	44,884	45,056
Monroe	20,623	20,708	20,787	20,889	20,962	21,034	21,109	21,186	21,266	21,346	21,430
Montgomery	89,124	89,346	89,560	89,848	90,085	90,327	90,574	90,825	91,089	91,352	91,624
Northampton	46,424	46,580	46,724	46,886	47,007	47,133	47,263	47,395	47,529	47,668	47,806
Philadelphia	187,219	187,486	187,752	188,101	188,346	188,606	188,857	189,115	189,381	189,649	189,916
Westmoreland	48,270	48,539	48,723	48,945	49,143	49,339	49,544	49,751	49,957	50,167	50,388
York	66,754	66,993	67,238	67,519	67,748	67,979	68,208	68,447	68,687	68,929	69,170

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:											
	11/15	11/16	11/17	11/18	11/20				11/22				11/24			
Allegheny	140,678	141,336	141,833	142,527	143,695	(28,739)	[6,897]	{3,449}	144,901	(28,980)	[6,955]	{3,478}	146,155	(29,231)	[7,015]	{3,508}
Berks	61,705	61,878	62,041	62,287	62,639	(12,528)	[3,007]	{1,503}	62,998	(12,600)	[3,024]	{1,512}	63,374	(12,675)	[3,042]	{1,521}
Bucks	76,364	76,506	76,698	76,934	77,309	(15,462)	[3,711]	{1,855}	77,690	(15,538)	[3,729]	{1,865}	78,089	(15,618)	[3,748]	{1,874}
Butler	26,968	27,114	27,226	27,374	27,631	(5,526)	[1,326]	{663}	27,893	(5,579)	[1,339]	{669}	28,165	(5,633)	[1,352]	{676}
Chester	53,141	53,278	53,475	53,655	53,978	(10,796)	[2,591]	{1,295}	54,313	(10,863)	[2,607]	{1,304}	54,666	(10,933)	[2,624]	{1,312}
Delaware	64,267	64,385	64,481	64,640	64,857	(12,971)	[3,113]	{1,557}	65,076	(13,015)	[3,124]	{1,562}	65,302	(13,060)	[3,134]	{1,567}
Lackawanna	24,038	24,134	24,236	24,359	24,561	(4,912)	[1,179]	{589}	24,771	(4,954)	[1,189]	{595}	25,000	(5,000)	[1,200]	{600}
Lancaster	75,125	75,290	75,530	75,754	76,156	(15,231)	[3,655]	{1,828}	76,563	(15,313)	[3,675]	{1,838}	76,985	(15,397)	[3,695]	{1,848}
Lehigh	50,329	50,486	50,662	50,839	51,119	(10,224)	[2,454]	{1,227}	51,412	(10,282)	[2,468]	{1,234}	51,725	(10,345)	[2,483]	{1,241}
Luzerne	43,342	43,507	43,737	43,905	44,218	(8,844)	[2,122]	{1,061}	44,545	(8,909)	[2,138]	{1,069}	44,884	(8,977)	[2,154]	{1,077}
Monroe	20,623	20,708	20,787	20,889	21,034	(4,207)	[1,010]	{505}	21,186	(4,237)	[1,017]	{508}	21,346	(4,269)	[1,025]	{512}
Montgomery	89,124	89,346	89,560	89,848	90,327	(18,065)	[4,336]	{2,168}	90,825	(18,165)	[4,360]	{2,180}	91,352	(18,270)	[4,385]	{2,192}
Northampton	46,424	46,580	46,724	46,886	47,133	(9,427)	[2,262]	{1,131}	47,395	(9,479)	[2,275]	{1,137}	47,668	(9,534)	[2,288]	{1,144}
Philadelphia	187,219	187,486	187,752	188,101	188,606	(37,721)	[9,053]	{4,527}	189,115	(37,823)	[9,077]	{4,539}	189,649	(37,930)	[9,103]	{4,552}
Westmoreland	48,270	48,539	48,723	48,945	49,339	(9,868)	[2,368]	{1,184}	49,751	(9,950)	[2,388]	{1,194}	50,167	(10,033)	[2,408]	{1,204}
York	66,754	66,993	67,238	67,519	67,979	(13,596)	[3,263]	{1,632}	68,447	(13,689)	[3,285]	{1,643}	68,929	(13,786)	[3,309]	{1,654}

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.