

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

Date: 9/27/21

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 9/27/21 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.

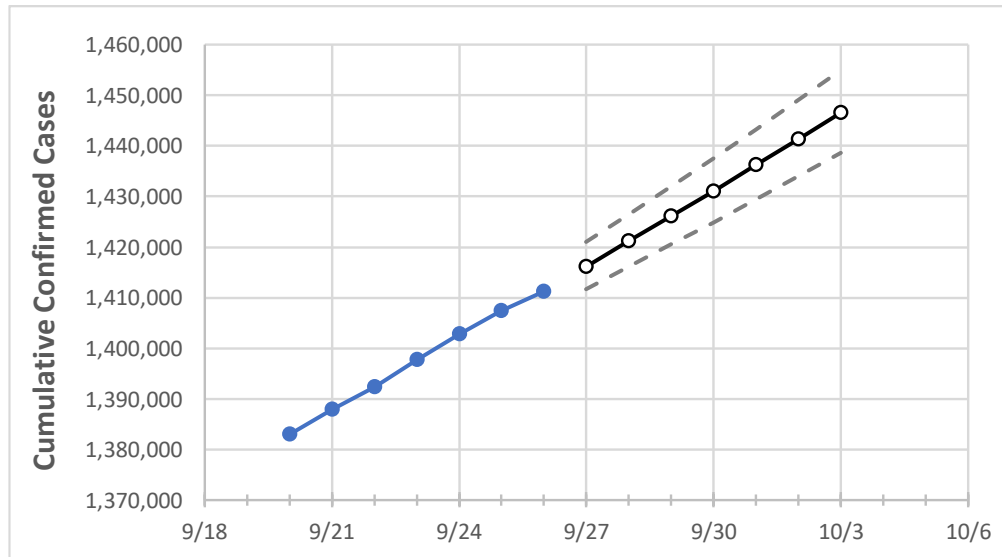
IEM's Modeling Lead

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:						
	9/23	9/24	9/25	9/26	9/27	9/28	9/29	9/30	10/1	10/2	10/3
Pennsylvania	1,397,755	1,402,826	1,407,328	1,411,231	1,416,155	1,421,138	1,426,131	1,431,048	1,436,185	1,441,291	1,446,489

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:						
	9/23	9/24	9/25	9/26	9/27	9/28	9/29	9/30	10/1	10/2	10/3
Allegheny	118,357	118,689	119,078	119,410	119,852	120,304	120,756	121,216	121,684	122,174	122,629
Berks	53,705	53,847	53,989	54,124	54,260	54,397	54,536	54,676	54,817	54,962	55,106
Bucks	68,042	68,200	68,410	68,544	68,698	68,857	69,011	69,174	69,330	69,497	69,660
Butler	21,561	21,680	21,742	21,903	22,024	22,150	22,274	22,402	22,533	22,665	22,797
Chester	46,667	46,804	46,804	46,804	46,937	47,066	47,198	47,330	47,466	47,600	47,733
Delaware	58,449	58,522	58,626	58,750	58,856	58,956	59,059	59,155	59,258	59,361	59,461
Lackawanna	20,711	20,787	20,857	20,943	21,016	21,094	21,171	21,251	21,330	21,415	21,499
Lancaster	64,140	64,405	64,634	64,830	65,069	65,308	65,547	65,790	66,037	66,286	66,534
Lehigh	45,382	45,508	45,626	45,694	45,812	45,929	46,045	46,162	46,282	46,402	46,519
Luzerne	36,294	36,436	36,566	36,717	36,854	36,988	37,128	37,269	37,415	37,561	37,712
Monroe	17,739	17,800	17,883	17,933	18,003	18,076	18,147	18,221	18,290	18,364	18,438
Montgomery	79,577	79,729	79,954	80,138	80,322	80,506	80,694	80,882	81,072	81,265	81,460
Northampton	41,353	41,499	41,640	41,716	41,826	41,940	42,048	42,160	42,273	42,389	42,500
Philadelphia	172,505	172,892	172,892	172,892	173,246	173,610	173,971	174,349	174,716	175,097	175,497
Westmoreland	39,792	39,967	40,088	40,189	40,361	40,541	40,710	40,885	41,069	41,259	41,440
York	54,722	55,000	55,256	55,486	55,721	55,959	56,202	56,445	56,697	56,950	57,205

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:											
	9/23	9/24	9/25	9/26	9/28				9/30				10/2			
Allegheny	118,357	118,689	119,078	119,410	120,304	(24,061)	{5,775}	{2,887}	121,216	(24,243)	[5,818]	{2,909}	122,174	(24,435)	[5,864]	{2,932}
Berks	53,705	53,847	53,989	54,124	54,397	(10,879)	[2,611]	{1,306}	54,676	(10,935)	[2,624]	{1,312}	54,962	(10,992)	[2,638]	{1,319}
Bucks	68,042	68,200	68,410	68,544	68,857	(13,771)	[3,305]	{1,653}	69,174	(13,835)	[3,320]	{1,660}	69,497	(13,899)	[3,336]	{1,668}
Butler	21,561	21,680	21,742	21,903	22,150	(4,430)	[1,063]	{532}	22,402	(4,480)	[1,075]	{538}	22,665	(4,533)	[1,088]	{544}
Chester	46,667	46,804	46,804	46,804	47,066	(9,413)	[2,259]	{1,130}	47,330	(9,466)	[2,272]	{1,136}	47,600	(9,520)	[2,285]	{1,142}
Delaware	58,449	58,522	58,626	58,750	58,956	(11,791)	[2,830]	{1,415}	59,155	(11,831)	[2,839]	{1,420}	59,361	(11,872)	[2,849]	{1,425}
Lackawanna	20,711	20,787	20,857	20,943	21,094	(4,219)	[1,013]	{506}	21,251	(4,250)	[1,020]	{510}	21,415	(4,283)	[1,028]	{514}
Lancaster	64,140	64,405	64,634	64,830	65,308	(13,062)	[3,135]	{1,567}	65,790	(13,158)	[3,158]	{1,579}	66,286	(13,257)	[3,182]	{1,591}
Lehigh	45,382	45,508	45,626	45,694	45,929	(9,186)	[2,205]	{1,102}	46,162	(9,232)	[2,216]	{1,108}	46,402	(9,280)	[2,227]	{1,114}
Luzerne	36,294	36,436	36,566	36,717	36,988	(7,398)	[1,775]	{888}	37,269	(7,454)	[1,789]	{894}	37,561	(7,512)	[1,803]	{901}
Monroe	17,739	17,800	17,883	17,933	18,076	(3,615)	[868]	{434}	18,221	(3,644)	[875]	{437}	18,364	(3,673)	[881]	{441}
Montgomery	79,577	79,729	79,954	80,138	80,506	(16,101)	[3,864]	{1,932}	80,882	(16,176)	[3,882]	{1,941}	81,265	(16,253)	[3,901]	{1,950}
Northampton	41,353	41,499	41,640	41,716	41,940	(8,388)	[2,013]	{1,007}	42,160	(8,432)	[2,024]	{1,012}	42,389	(8,478)	[2,035]	{1,017}
Philadelphia	172,505	172,892	172,892	172,892	173,610	(34,722)	[8,333]	{4,167}	174,349	(34,870)	[8,369]	{4,184}	175,097	(35,019)	[8,405]	{4,202}
Westmoreland	39,792	39,967	40,088	40,189	40,541	(8,108)	[1,946]	{973}	40,885	(8,177)	[1,962]	{981}	41,259	(8,252)	[1,980]	{990}
York	54,722	55,000	55,256	55,486	55,959	(11,192)	[2,686]	{1,343}	56,445	(11,289)	[2,709]	{1,355}	56,950	(11,390)	[2,734]	{1,367}

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.