

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

Date: 7/9/21

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 7/9/21 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.

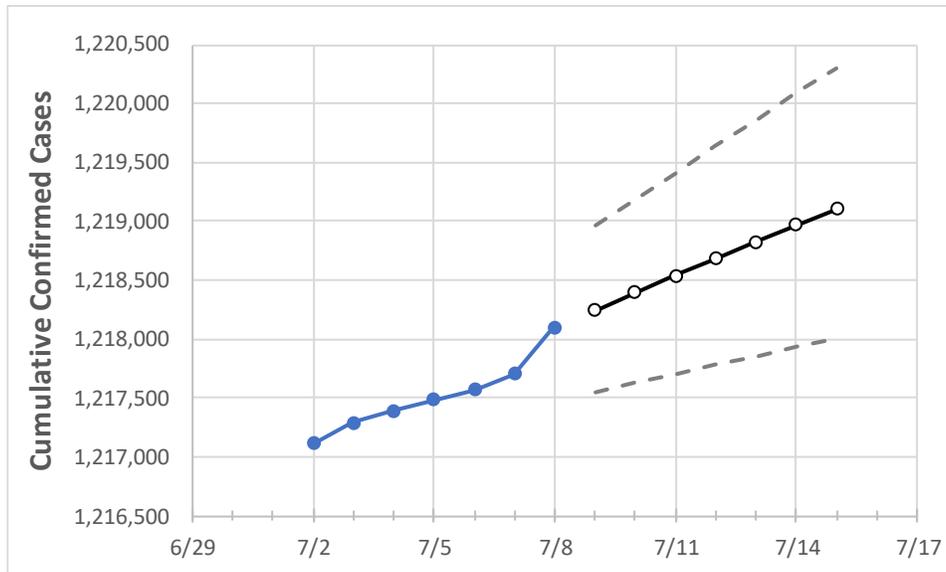
IEM's Modeling Lead

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:						
	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13	7/14	7/15

Pennsylvania 1,217,484 1,217,567 1,217,707 1,218,097 1,218,246 1,218,397 1,218,540 1,218,685 1,218,828 1,218,971 1,219,107

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:						
	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13	7/14	7/15
Allegheny	101,959	101,962	101,980	101,997	102,008	102,019	102,031	102,042	102,052	102,063	102,073
Berks	48,491	48,490	48,496	48,498	48,501	48,503	48,506	48,508	48,510	48,512	48,514
Bucks	60,848	60,855	60,860	60,877	60,882	60,887	60,892	60,898	60,903	60,909	60,914
Butler	17,633	17,636	17,639	17,640	17,642	17,643	17,644	17,646	17,647	17,649	17,650
Chester	40,847	40,851	40,861	40,872	40,877	40,881	40,886	40,890	40,894	40,898	40,903
Delaware	52,423	52,429	52,434	52,451	52,459	52,466	52,474	52,482	52,490	52,498	52,505
Lackawanna	18,568	18,572	18,575	18,576	18,577	18,579	18,580	18,582	18,583	18,584	18,585
Lancaster	55,447	55,449	55,451	55,451	55,455	55,459	55,463	55,466	55,470	55,474	55,477
Lehigh	39,869	39,871	39,880	39,889	39,893	39,897	39,901	39,905	39,909	39,913	39,917
Luzerne	32,141	32,142	32,143	32,151	32,154	32,157	32,160	32,163	32,166	32,169	32,171
Monroe	14,840	14,841	14,843	14,848	14,850	14,851	14,853	14,855	14,856	14,858	14,859
Montgomery	70,451	70,455	70,464	70,482	70,489	70,495	70,502	70,509	70,516	70,523	70,530
Northampton	35,915	35,919	35,923	35,927	35,931	35,935	35,939	35,943	35,946	35,950	35,954
Philadelphia	154,910	154,938	154,965	154,993	155,026	155,060	155,092	155,124	155,157	155,188	155,219
Westmoreland	34,445	34,448	34,452	34,455	34,458	34,460	34,462	34,465	34,467	34,469	34,471
York	47,070	47,074	47,078	47,088	47,094	47,100	47,105	47,111	47,116	47,120	47,125

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:											
	7/5	7/6	7/7	7/8	7/10			7/12			7/14					
Allegheny	101,959	101,962	101,980	101,997	102,019	(20,404)	[4,897]	{2,448}	102,042	(20,408)	[4,898]	{2,449}	102,063	(20,413)	[4,899]	{2,450}
Berks	48,491	48,490	48,496	48,498	48,503	(9,701)	[2,328]	{1,164}	48,508	(9,702)	[2,328]	{1,164}	48,512	(9,702)	[2,329]	{1,164}
Bucks	60,848	60,855	60,860	60,877	60,887	(12,177)	[2,923]	{1,461}	60,898	(12,180)	[2,923]	{1,462}	60,909	(12,182)	[2,924]	{1,462}
Butler	17,633	17,636	17,639	17,640	17,643	(3,529)	[847]	{423}	17,646	(3,529)	[847]	{424}	17,649	(3,530)	[847]	{424}
Chester	40,847	40,851	40,861	40,872	40,881	(8,176)	[1,962]	{981}	40,890	(8,178)	[1,963]	{981}	40,898	(8,180)	[1,963]	{982}
Delaware	52,423	52,429	52,434	52,451	52,466	(10,493)	[2,518]	{1,259}	52,482	(10,496)	[2,519]	{1,260}	52,498	(10,500)	[2,520]	{1,260}
Lackawanna	18,568	18,572	18,575	18,576	18,579	(3,716)	[892]	{446}	18,582	(3,716)	[892]	{446}	18,584	(3,717)	[892]	{446}
Lancaster	55,447	55,449	55,451	55,451	55,459	(11,092)	[2,662]	{1,331}	55,466	(11,093)	[2,662]	{1,331}	55,474	(11,095)	[2,663]	{1,331}
Lehigh	39,869	39,871	39,880	39,889	39,897	(7,979)	[1,915]	{958}	39,905	(7,981)	[1,915]	{958}	39,913	(7,983)	[1,916]	{958}
Luzerne	32,141	32,142	32,143	32,151	32,157	(6,431)	[1,544]	{772}	32,163	(6,433)	[1,544]	{772}	32,169	(6,434)	[1,544]	{772}
Monroe	14,840	14,841	14,843	14,848	14,851	(2,970)	[713]	{356}	14,855	(2,971)	[713]	{357}	14,858	(2,972)	[713]	{357}
Montgomery	70,451	70,455	70,464	70,482	70,495	(14,099)	[3,384]	{1,692}	70,509	(14,102)	[3,384]	{1,692}	70,523	(14,105)	[3,385]	{1,693}
Northampton	35,915	35,919	35,923	35,927	35,935	(7,187)	[1,725]	{862}	35,943	(7,189)	[1,725]	{863}	35,950	(7,190)	[1,726]	{863}
Philadelphia	154,910	154,938	154,965	154,993	155,060	(31,012)	[7,443]	{3,721}	155,124	(31,025)	[7,446]	{3,723}	155,188	(31,038)	[7,449]	{3,725}
Westmoreland	34,445	34,448	34,452	34,455	34,460	(6,892)	[1,654]	{827}	34,465	(6,893)	[1,654]	{827}	34,469	(6,894)	[1,654]	{827}
York	47,070	47,074	47,078	47,088	47,100	(9,420)	[2,261]	{1,130}	47,111	(9,422)	[2,261]	{1,131}	47,120	(9,424)	[2,262]	{1,131}

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.