

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

Date: 5/10/21

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 5/10/21 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.

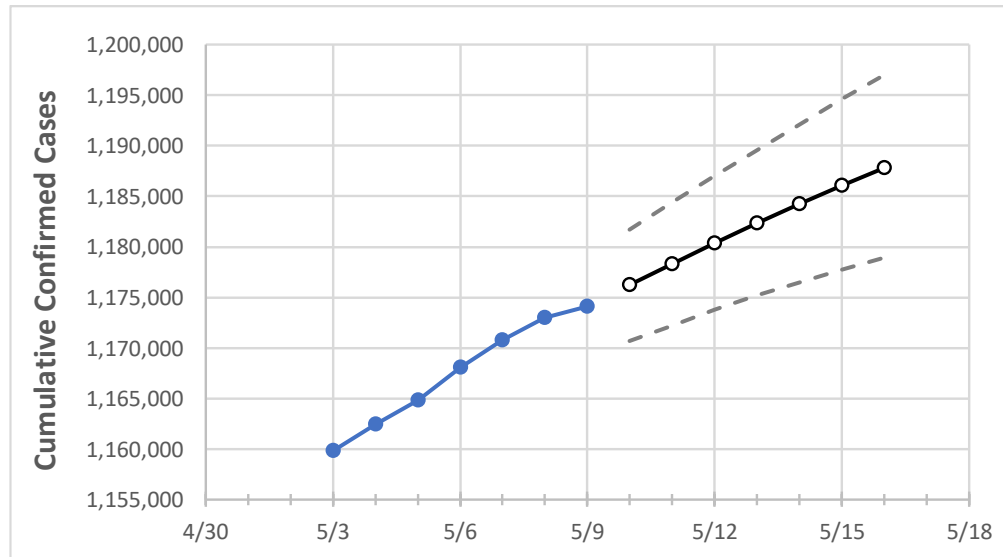
IEM's Modeling Lead

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:						
	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Pennsylvania	1,168,100	1,170,729	1,173,009	1,174,067	1,176,230	1,178,326	1,180,372	1,182,338	1,184,227	1,186,044	1,187,827

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:						
	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Allegheny	98,532	98,723	98,969	99,089	99,258	99,415	99,569	99,718	99,857	99,993	100,126
Berks	46,376	46,537	46,626	46,671	46,787	46,896	47,005	47,111	47,219	47,322	47,421
Bucks	59,142	59,285	59,403	59,478	59,578	59,677	59,770	59,860	59,946	60,024	60,101
Butler	16,958	16,991	17,034	17,052	17,083	17,115	17,146	17,176	17,206	17,234	17,262
Chester	35,882	35,971	35,971	35,971	36,044	36,115	36,183	36,251	36,316	36,380	36,441
Delaware	51,006	51,114	51,188	51,240	51,310	51,379	51,443	51,503	51,565	51,623	51,679
Lackawanna	17,943	17,993	18,027	18,034	18,065	18,095	18,123	18,150	18,176	18,201	18,225
Lancaster	53,815	53,924	54,036	54,098	54,185	54,269	54,349	54,429	54,506	54,579	54,652
Lehigh	38,607	38,733	38,769	38,813	38,879	38,944	39,006	39,067	39,127	39,181	39,237
Luzerne	30,751	30,827	30,910	30,942	31,006	31,067	31,126	31,183	31,240	31,296	31,349
Monroe	14,174	14,246	14,280	14,303	14,345	14,387	14,425	14,463	14,501	14,537	14,572
Montgomery	68,623	68,789	68,905	68,963	69,077	69,185	69,285	69,382	69,475	69,567	69,656
Northampton	34,876	34,967	35,012	35,039	35,093	35,143	35,191	35,236	35,282	35,326	35,366
Philadelphia	149,172	149,172	149,172	149,172	149,483	149,785	150,077	150,370	150,650	150,914	151,182
Westmoreland	33,111	33,179	33,295	33,329	33,398	33,466	33,534	33,604	33,669	33,736	33,803
York	44,837	44,970	45,087	45,139	45,240	45,342	45,439	45,537	45,630	45,721	45,813

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:											
	5/6	5/7	5/8	5/9	5/11				5/13				5/15			
Allegheny	98,532	98,723	98,969	99,089	99,415	(19,883)	[4,772]	{2,386}	99,718	(19,944)	[4,786]	{2,393}	99,993	(19,999)	[4,800]	{2,400}
Berks	46,376	46,537	46,626	46,671	46,896	(9,379)	[2,251]	{1,125}	47,111	(9,422)	[2,261]	{1,131}	47,322	(9,464)	[2,271]	{1,136}
Bucks	59,142	59,285	59,403	59,478	59,677	(11,935)	[2,865]	{1,432}	59,860	(11,972)	[2,873]	{1,437}	60,024	(12,005)	[2,881]	{1,441}
Butler	16,958	16,991	17,034	17,052	17,115	(3,423)	[822]	{411}	17,176	(3,435)	[824]	{412}	17,234	(3,447)	[827]	{414}
Chester	35,882	35,971	35,971	35,971	36,115	(7,223)	[1,734]	{867}	36,251	(7,250)	[1,740]	{870}	36,380	(7,276)	[1,746]	{873}
Delaware	51,006	51,114	51,188	51,240	51,379	(10,276)	[2,466]	{1,233}	51,503	(10,301)	[2,472]	{1,236}	51,623	(10,325)	[2,478]	{1,239}
Lackawanna	17,943	17,993	18,027	18,034	18,095	(3,619)	[869]	{434}	18,150	(3,630)	[871]	{436}	18,201	(3,640)	[874]	{437}
Lancaster	53,815	53,924	54,036	54,098	54,269	(10,854)	[2,605]	{1,302}	54,429	(10,886)	[2,613]	{1,306}	54,579	(10,916)	[2,620]	{1,310}
Lehigh	38,607	38,733	38,769	38,813	38,944	(7,789)	[1,869]	{935}	39,067	(7,813)	[1,875]	{938}	39,181	(7,836)	[1,881]	{940}
Luzerne	30,751	30,827	30,910	30,942	31,067	(6,213)	[1,491]	{746}	31,183	(6,237)	[1,497]	{748}	31,296	(6,259)	[1,502]	{751}
Monroe	14,174	14,246	14,280	14,303	14,387	(2,877)	[691]	{345}	14,463	(2,893)	[694]	{347}	14,537	(2,907)	[698]	{349}
Montgomery	68,623	68,789	68,905	68,963	69,185	(13,837)	[3,321]	{1,660}	69,382	(13,876)	[3,330]	{1,665}	69,567	(13,913)	[3,339]	{1,670}
Northampton	34,876	34,967	35,012	35,039	35,143	(7,029)	[1,687]	{843}	35,236	(7,047)	[1,691]	{846}	35,326	(7,065)	[1,696]	{848}
Philadelphia	149,172	149,172	149,172	149,172	149,785	(29,957)	[7,190]	{3,595}	150,370	(30,074)	[7,218]	{3,609}	150,914	(30,183)	[7,244]	{3,622}
Westmoreland	33,111	33,179	33,295	33,329	33,466	(6,693)	[1,606]	{803}	33,604	(6,721)	[1,613]	{806}	33,736	(6,747)	[1,619]	{810}
York	44,837	44,970	45,087	45,139	45,342	(9,068)	[2,176]	{1,088}	45,537	(9,107)	[2,186]	{1,093}	45,721	(9,144)	[2,195]	{1,097}

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.