

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 3/26/21**

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 3/26/21 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.

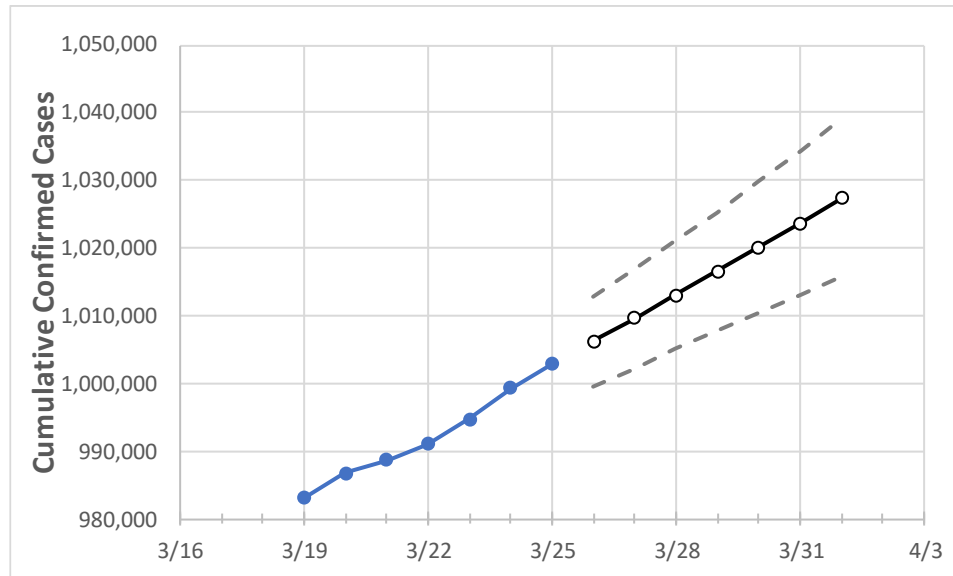
IEM's Modeling Lead

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:						
3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1

Pennsylvania 991,089 994,694 999,311 1,002,909 1,006,218 1,009,645 1,013,057 1,016,598 1,020,100 1,023,710 1,027,354

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:						
	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1
Allegheny	82,080	82,444	82,942	83,225	83,538	83,854	84,173	84,502	84,841	85,181	85,523
Berks	38,226	38,374	38,650	38,848	39,023	39,206	39,394	39,590	39,786	39,990	40,205
Bucks	48,633	48,801	49,132	49,342	49,543	49,752	49,958	50,167	50,386	50,602	50,818
Butler	14,730	14,795	14,869	14,902	14,949	14,997	15,047	15,095	15,146	15,199	15,251
Chester	30,149	30,259	30,384	30,496	30,607	30,720	30,836	30,956	31,075	31,195	31,318
Delaware	43,248	43,357	43,530	43,647	43,756	43,859	43,966	44,074	44,181	44,293	44,400
Lackawanna	14,908	14,976	15,076	15,148	15,200	15,253	15,308	15,362	15,420	15,475	15,530
Lancaster	46,275	46,403	46,596	46,758	46,887	47,014	47,140	47,274	47,408	47,542	47,674
Lehigh	32,671	32,828	32,996	33,159	33,292	33,427	33,570	33,713	33,861	34,013	34,170
Luzerne	26,204	26,254	26,376	26,479	26,558	26,639	26,721	26,802	26,883	26,970	27,059
Monroe	10,761	10,824	10,904	10,988	11,055	11,125	11,194	11,267	11,342	11,418	11,498
Montgomery	57,655	57,799	58,076	58,282	58,472	58,670	58,859	59,060	59,255	59,456	59,655
Northampton	28,955	29,150	29,341	29,543	29,692	29,847	30,003	30,164	30,330	30,498	30,678
Philadelphia	125,428	126,122	126,609	127,137	127,597	128,059	128,539	129,040	129,535	130,049	130,567
Westmoreland	28,221	28,326	28,429	28,494	28,577	28,662	28,747	28,835	28,924	29,014	29,106
York	38,027	38,120	38,367	38,521	38,653	38,790	38,928	39,068	39,211	39,357	39,509

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:											
	3/22	3/23	3/24	3/25	3/27			3/29			3/31					
Allegheny	82,080	82,444	82,942	83,225	83,854	(16,771)	[4,025]	{2,012}	84,502	(16,900)	[4,056]	{2,028}	85,181	(17,036)	[4,089]	{2,044}
Berks	38,226	38,374	38,650	38,848	39,206	(7,841)	[1,882]	{941}	39,590	(7,918)	[1,900]	{950}	39,990	(7,998)	[1,920]	{960}
Bucks	48,633	48,801	49,132	49,342	49,752	(9,950)	[2,388]	{1,194}	50,167	(10,033)	[2,408]	{1,204}	50,602	(10,120)	[2,429]	{1,214}
Butler	14,730	14,795	14,869	14,902	14,997	(2,999)	[720]	{360}	15,095	(3,019)	[725]	{362}	15,199	(3,040)	[730]	{365}
Chester	30,149	30,259	30,384	30,496	30,720	(6,144)	[1,475]	{737}	30,956	(6,191)	[1,486]	{743}	31,195	(6,239)	[1,497]	{749}
Delaware	43,248	43,357	43,530	43,647	43,859	(8,772)	[2,105]	{1,053}	44,074	(8,815)	[2,116]	{1,058}	44,293	(8,859)	[2,126]	{1,063}
Lackawanna	14,908	14,976	15,076	15,148	15,253	(3,051)	[732]	{366}	15,362	(3,072)	[737]	{369}	15,475	(3,095)	[743]	{371}
Lancaster	46,275	46,403	46,596	46,758	47,014	(9,403)	[2,257]	{1,128}	47,274	(9,455)	[2,269]	{1,135}	47,542	(9,508)	[2,282]	{1,141}
Lehigh	32,671	32,828	32,996	33,159	33,427	(6,685)	[1,604]	{802}	33,713	(6,743)	[1,618]	{809}	34,013	(6,803)	[1,633]	{816}
Luzerne	26,204	26,254	26,376	26,479	26,639	(5,328)	[1,279]	{639}	26,802	(5,360)	[1,286]	{643}	26,970	(5,394)	[1,295]	{647}
Monroe	10,761	10,824	10,904	10,988	11,125	(2,225)	[534]	{267}	11,267	(2,253)	[541]	{270}	11,418	(2,284)	[548]	{274}
Montgomery	57,655	57,799	58,076	58,282	58,670	(11,734)	[2,816]	{1,408}	59,060	(11,812)	[2,835]	{1,417}	59,456	(11,891)	[2,854]	{1,427}
Northampton	28,955	29,150	29,341	29,543	29,847	(5,969)	[1,433]	{716}	30,164	(6,033)	[1,448]	{724}	30,498	(6,100)	[1,464]	{732}
Philadelphia	125,428	126,122	126,609	127,137	128,059	(25,612)	[6,147]	{3,073}	129,040	(25,808)	[6,194]	{3,097}	130,049	(26,010)	[6,242]	{3,121}
Westmoreland	28,221	28,326	28,429	28,494	28,662	(5,732)	[1,376]	{688}	28,835	(5,767)	[1,384]	{692}	29,014	(5,803)	[1,393]	{696}
York	38,027	38,120	38,367	38,521	38,790	(7,758)	[1,862]	{931}	39,068	(7,814)	[1,875]	{938}	39,357	(7,871)	[1,889]	{945}

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.