

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

**Date: 4/1/21**

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 4/1/21 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.**

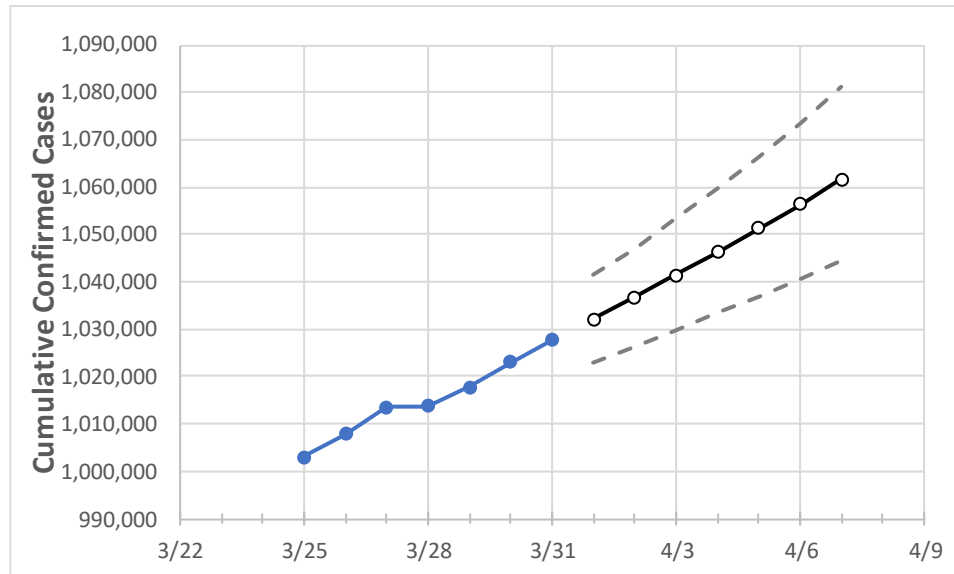
### **IEM's Modeling Lead**

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:							
3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6	4/7	

Pennsylvania 1,013,731 1,017,881 1,022,992 1,027,678 1,032,192 1,036,829 1,041,494 1,046,284 1,051,289 1,056,451 1,061,757

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:							
	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6	4/7	
Allegheny	84,522	84,850	85,262	85,680	86,117	86,558	87,001	87,483	87,964	88,458	88,986	
Berks	39,328	39,419	39,706	39,895	40,091	40,290	40,496	40,706	40,930	41,158	41,381	
Bucks	50,185	50,345	50,726	51,005	51,290	51,586	51,888	52,198	52,524	52,859	53,199	
Butler	15,067	15,108	15,183	15,262	15,342	15,429	15,517	15,610	15,704	15,805	15,909	
Chester	30,913	31,045	31,247	31,448	31,622	31,801	31,991	32,184	32,384	32,590	32,808	
Delaware	44,208	44,363	44,618	44,791	44,981	45,176	45,377	45,584	45,802	46,023	46,252	
Lackawanna	15,336	15,365	15,491	15,567	15,641	15,715	15,791	15,870	15,952	16,035	16,119	
Lancaster	47,271	47,420	47,656	47,817	47,995	48,178	48,363	48,554	48,746	48,946	49,151	
Lehigh	33,614	33,695	33,915	34,045	34,213	34,391	34,572	34,763	34,959	35,158	35,364	
Luzerne	26,788	26,869	26,975	27,080	27,191	27,303	27,419	27,537	27,659	27,784	27,915	
Monroe	11,192	11,244	11,366	11,446	11,529	11,614	11,703	11,796	11,886	11,983	12,083	
Montgomery	59,046	59,243	59,562	59,801	60,066	60,338	60,622	60,911	61,200	61,495	61,805	
Northampton	29,974	30,082	30,312	30,460	30,662	30,876	31,096	31,327	31,571	31,827	32,084	
Philadelphia	128,641	129,077	129,790	130,405	131,035	131,687	132,367	133,065	133,783	134,528	135,300	
Westmoreland	28,816	28,930	29,052	29,178	29,348	29,529	29,710	29,905	30,113	30,330	30,556	
York	39,027	39,111	39,298	39,481	39,729	39,988	40,248	40,526	40,828	41,134	41,448	

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:											
	3/28	3/29	3/30	3/31	4/2			4/4			4/6					
Allegheny	84,522	84,850	85,262	85,680	86,558	(17,312)	[4,155]	{2,077}	87,483	(17,497)	[4,199]	{2,100}	88,458	(17,692)	[4,246]	{2,123}
Berks	39,328	39,419	39,706	39,895	40,290	(8,058)	[1,934]	{967}	40,706	(8,141)	[1,954]	{977}	41,158	(8,232)	[1,976]	{988}
Bucks	50,185	50,345	50,726	51,005	51,586	(10,317)	[2,476]	{1,238}	52,198	(10,440)	[2,505]	{1,253}	52,859	(10,572)	[2,537]	{1,269}
Butler	15,067	15,108	15,183	15,262	15,429	(3,086)	[741]	{370}	15,610	(3,122)	[749]	{375}	15,805	(3,161)	[759]	{379}
Chester	30,913	31,045	31,247	31,448	31,801	(6,360)	[1,526]	{763}	32,184	(6,437)	[1,545]	{772}	32,590	(6,518)	[1,564]	{782}
Delaware	44,208	44,363	44,618	44,791	45,176	(9,035)	[2,168]	{1,084}	45,584	(9,117)	[2,188]	{1,094}	46,023	(9,205)	[2,209]	{1,105}
Lackawanna	15,336	15,365	15,491	15,567	15,715	(3,143)	[754]	{377}	15,870	(3,174)	[762]	{381}	16,035	(3,207)	[770]	{385}
Lancaster	47,271	47,420	47,656	47,817	48,178	(9,636)	[2,313]	{1,156}	48,554	(9,711)	[2,331]	{1,165}	48,946	(9,789)	[2,349]	{1,175}
Lehigh	33,614	33,695	33,915	34,045	34,391	(6,878)	[1,651]	{825}	34,763	(6,953)	[1,669]	{834}	35,158	(7,032)	[1,688]	{844}
Luzerne	26,788	26,869	26,975	27,080	27,303	(5,461)	[1,311]	{655}	27,537	(5,507)	[1,322]	{661}	27,784	(5,557)	[1,334]	{667}
Monroe	11,192	11,244	11,366	11,446	11,614	(2,323)	[557]	{279}	11,796	(2,359)	[566]	{283}	11,983	(2,397)	[575]	{288}
Montgomery	59,046	59,243	59,562	59,801	60,338	(12,068)	[2,896]	{1,448}	60,911	(12,182)	[2,924]	{1,462}	61,495	(12,299)	[2,952]	{1,476}
Northampton	29,974	30,082	30,312	30,460	30,876	(6,175)	[1,482]	{741}	31,327	(6,265)	[1,504]	{752}	31,827	(6,365)	[1,528]	{764}
Philadelphia	128,641	129,077	129,790	130,405	131,687	(26,337)	[6,321]	{3,160}	133,065	(26,613)	[6,387]	{3,194}	134,528	(26,906)	[6,457]	{3,229}
Westmoreland	28,816	28,930	29,052	29,178	29,529	(5,906)	[1,417]	{709}	29,905	(5,981)	[1,435]	{718}	30,330	(6,066)	[1,456]	{728}
York	39,027	39,111	39,298	39,481	39,988	(7,998)	[1,919]	{960}	40,526	(8,105)	[1,945]	{973}	41,134	(8,227)	[1,974]	{987}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.