

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

Date: 4/7/21

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 4/7/21 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.**

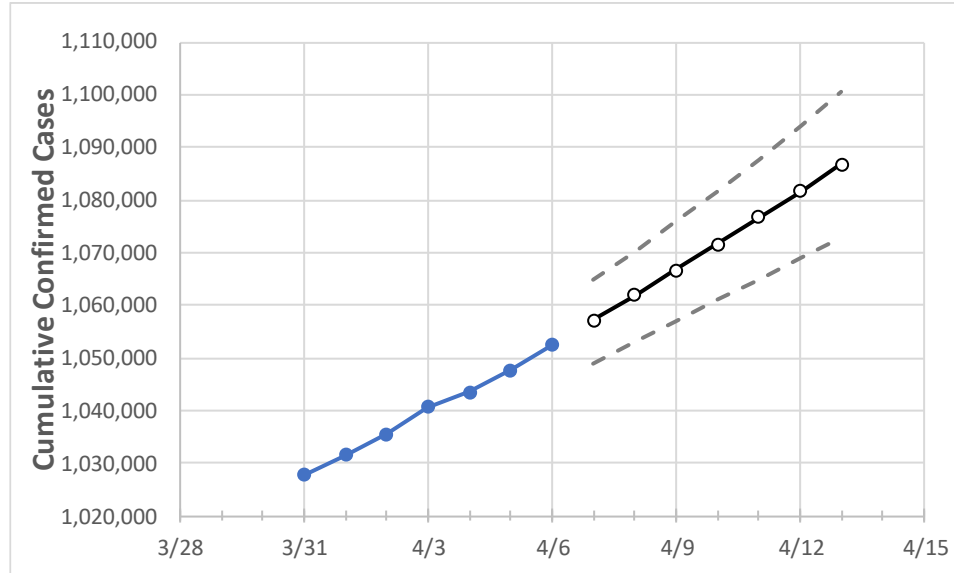
### IEM's Modeling Lead

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:							
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	
Pennsylvania	1,040,692	1,043,524	1,047,728	1,052,450	1,057,100	1,061,886	1,066,741	1,071,683	1,076,661	1,081,701	1,086,830	

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:							
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	
Allegheny	87,101	87,403	87,623	88,155	88,622	89,101	89,590	90,078	90,587	91,108	91,631	
Berks	40,559	40,692	40,836	41,042	41,257	41,477	41,697	41,927	42,164	42,399	42,641	
Bucks	51,920	52,149	52,418	52,661	52,973	53,297	53,619	53,946	54,277	54,627	54,967	
Butler	15,451	15,482	15,513	15,568	15,638	15,708	15,781	15,856	15,932	16,009	16,086	
Chester	31,900	32,040	32,181	32,181	32,354	32,529	32,711	32,894	33,080	33,274	33,473	
Delaware	45,443	45,656	45,808	45,953	46,165	46,382	46,604	46,830	47,065	47,301	47,543	
Lackawanna	15,827	15,896	15,931	16,038	16,121	16,208	16,299	16,391	16,486	16,582	16,679	
Lancaster	48,481	48,681	48,771	48,920	49,113	49,315	49,517	49,721	49,928	50,137	50,355	
Lehigh	34,584	34,706	34,821	34,969	35,147	35,326	35,510	35,700	35,894	36,091	36,296	
Luzerne	27,434	27,532	27,593	27,701	27,820	27,940	28,062	28,188	28,316	28,445	28,579	
Monroe	11,716	11,795	11,841	11,977	12,073	12,173	12,271	12,374	12,482	12,594	12,705	
Montgomery	60,687	61,007	61,280	61,499	61,804	62,118	62,436	62,757	63,093	63,427	63,776	
Northampton	31,002	31,125	31,225	31,389	31,578	31,769	31,964	32,160	32,366	32,574	32,784	
Philadelphia	131,775	132,175	132,575	133,485	134,100	134,721	135,357	136,015	136,684	137,357	138,049	
Westmoreland	29,609	29,665	29,722	29,886	30,043	30,209	30,373	30,544	30,718	30,896	31,078	
York	39,993	40,118	40,198	40,322	40,520	40,724	40,936	41,155	41,367	41,590	41,815	

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:											
	4/3	4/4	4/5	4/6	4/8				4/10				4/12			
Allegheny	87,101	87,403	87,623	88,155	89,101	(17,820)	[4,277]	{2,138}	90,078	(18,016)	[4,324]	{2,162}	91,108	(18,222)	[4,373]	{2,187}
Berks	40,559	40,692	40,836	41,042	41,477	(8,295)	[1,991]	{995}	41,927	(8,385)	[2,012]	{1,006}	42,399	(8,480)	[2,035]	{1,018}
Bucks	51,920	52,149	52,418	52,661	53,297	(10,659)	[2,558]	{1,279}	53,946	(10,789)	[2,589]	{1,295}	54,627	(10,925)	[2,622]	{1,311}
Butler	15,451	15,482	15,513	15,568	15,708	(3,142)	[754]	{377}	15,856	(3,171)	[761]	{381}	16,009	(3,202)	[768]	{384}
Chester	31,900	32,040	32,181	32,181	32,529	(6,506)	[1,561]	{781}	32,894	(6,579)	[1,579]	{789}	33,274	(6,655)	[1,597]	{799}
Delaware	45,443	45,656	45,808	45,953	46,382	(9,276)	[2,226]	{1,113}	46,830	(9,366)	[2,248]	{1,124}	47,301	(9,460)	[2,270]	{1,135}
Lackawanna	15,827	15,896	15,931	16,038	16,208	(3,242)	[778]	{389}	16,391	(3,278)	[787]	{393}	16,582	(3,316)	[796]	{398}
Lancaster	48,481	48,681	48,771	48,920	49,315	(9,863)	[2,367]	{1,184}	49,721	(9,944)	[2,387]	{1,193}	50,137	(10,027)	[2,407]	{1,203}
Lehigh	34,584	34,706	34,821	34,969	35,326	(7,065)	[1,696]	{848}	35,700	(7,140)	[1,714]	{857}	36,091	(7,218)	[1,732]	{866}
Luzerne	27,434	27,532	27,593	27,701	27,940	(5,588)	[1,341]	{671}	28,188	(5,638)	[1,353]	{677}	28,445	(5,689)	[1,365]	{683}
Monroe	11,716	11,795	11,841	11,977	12,173	(2,435)	[584]	{292}	12,374	(2,475)	[594]	{297}	12,594	(2,519)	[604]	{302}
Montgomery	60,687	61,007	61,280	61,499	62,118	(12,424)	[2,982]	{1,491}	62,757	(12,551)	[3,012]	{1,506}	63,427	(12,685)	[3,045]	{1,522}
Northampton	31,002	31,125	31,225	31,389	31,769	(6,354)	[1,525]	{762}	32,160	(6,432)	[1,544]	{772}	32,574	(6,515)	[1,564]	{782}
Philadelphia	131,775	132,175	132,575	133,485	134,721	(26,944)	[6,467]	{3,233}	136,015	(27,203)	[6,529]	{3,264}	137,357	(27,471)	[6,593]	{3,297}
Westmoreland	29,609	29,665	29,722	29,886	30,209	(6,042)	[1,450]	{725}	30,544	(6,109)	[1,466]	{733}	30,896	(6,179)	[1,483]	{742}
York	39,993	40,118	40,198	40,322	40,724	(8,145)	[1,955]	{977}	41,155	(8,231)	[1,975]	{988}	41,590	(8,318)	[1,996]	{998}

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.