

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

Date: 4/8/21

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 4/8/21 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.**

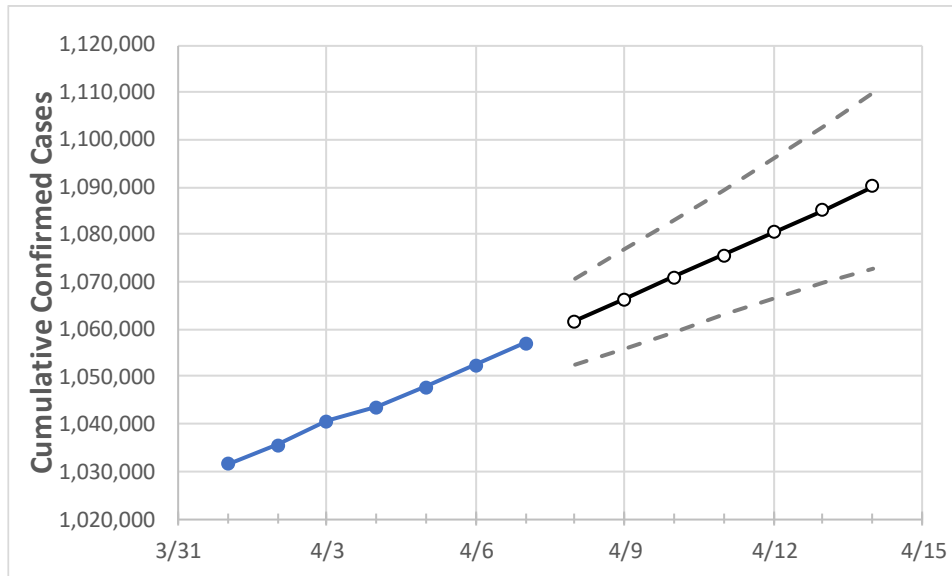
### IEM's Modeling Lead

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:							
4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	

Pennsylvania 1,043,524 1,047,728 1,052,450 1,057,126 1,061,691 1,066,261 1,070,937 1,075,616 1,080,382 1,085,159 1,090,097

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:							
	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	
Allegheny	87,403	87,623	88,155	88,573	89,017	89,461	89,912	90,375	90,848	91,326	91,800	
Berks	40,692	40,836	41,042	41,186	41,380	41,575	41,771	41,971	42,173	42,386	42,580	
Bucks	52,149	52,418	52,661	52,912	53,203	53,503	53,802	54,107	54,426	54,742	55,066	
Butler	15,482	15,513	15,568	15,638	15,698	15,759	15,822	15,884	15,946	16,008	16,068	
Chester	32,040	32,181	32,291	32,401	32,556	32,712	32,868	33,024	33,182	33,341	33,501	
Delaware	45,656	45,808	45,953	46,140	46,354	46,572	46,792	47,015	47,249	47,482	47,715	
Lackawanna	15,896	15,931	16,038	16,113	16,194	16,278	16,359	16,445	16,530	16,616	16,704	
Lancaster	48,681	48,771	48,920	49,099	49,295	49,493	49,692	49,897	50,105	50,319	50,531	
Lehigh	34,706	34,821	34,969	35,095	35,251	35,404	35,559	35,719	35,877	36,038	36,203	
Luzerne	27,532	27,593	27,701	27,822	27,935	28,049	28,163	28,280	28,400	28,519	28,641	
Monroe	11,795	11,841	11,977	12,034	12,124	12,218	12,315	12,414	12,514	12,613	12,719	
Montgomery	61,007	61,280	61,499	61,767	62,071	62,384	62,700	63,024	63,354	63,692	64,035	
Northampton	31,125	31,225	31,389	31,540	31,700	31,858	32,020	32,176	32,333	32,495	32,649	
Philadelphia	132,175	132,575	133,485	134,356	134,999	135,663	136,333	137,020	137,731	138,461	139,208	
Westmoreland	29,665	29,722	29,886	30,005	30,132	30,260	30,392	30,524	30,655	30,795	30,938	
York	40,118	40,198	40,322	40,526	40,685	40,843	41,001	41,159	41,313	41,469	41,619	

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:											
	4/4	4/5	4/6	4/7	4/9			4/11			4/13					
Allegheny	87,403	87,623	88,155	88,573	89,461	(17,892)	[4,294]	{2,147}	90,375	(18,075)	[4,338]	{2,169}	91,326	(18,265)	[4,384]	{2,192}
Berks	40,692	40,836	41,042	41,186	41,575	(8,315)	[1,996]	{998}	41,971	(8,394)	[2,015]	{1,007}	42,386	(8,477)	[2,035]	{1,017}
Bucks	52,149	52,418	52,661	52,912	53,503	(10,701)	[2,568]	{1,284}	54,107	(10,821)	[2,597]	{1,299}	54,742	(10,948)	[2,628]	{1,314}
Butler	15,482	15,513	15,568	15,638	15,759	(3,152)	[756]	{378}	15,884	(3,177)	[762]	{381}	16,008	(3,202)	[768]	{384}
Chester	32,040	32,181	32,291	32,401	32,712	(6,542)	[1,570]	{785}	33,024	(6,605)	[1,585]	{793}	33,341	(6,668)	[1,600]	{800}
Delaware	45,656	45,808	45,953	46,140	46,572	(9,314)	[2,235]	{1,118}	47,015	(9,403)	[2,257]	{1,128}	47,482	(9,496)	[2,279]	{1,140}
Lackawanna	15,896	15,931	16,038	16,113	16,278	(3,256)	[781]	{391}	16,445	(3,289)	[789]	{395}	16,616	(3,323)	[798]	{399}
Lancaster	48,681	48,771	48,920	49,099	49,493	(9,899)	[2,376]	{1,188}	49,897	(9,979)	[2,395]	{1,198}	50,319	(10,064)	[2,415]	{1,208}
Lehigh	34,706	34,821	34,969	35,095	35,404	(7,081)	[1,699]	{850}	35,719	(7,144)	[1,715]	{857}	36,038	(7,208)	[1,730]	{865}
Luzerne	27,532	27,593	27,701	27,822	28,049	(5,610)	[1,346]	{673}	28,280	(5,656)	[1,357]	{679}	28,519	(5,704)	[1,369]	{684}
Monroe	11,795	11,841	11,977	12,034	12,218	(2,444)	[586]	{293}	12,414	(2,483)	[596]	{298}	12,613	(2,523)	[605]	{303}
Montgomery	61,007	61,280	61,499	61,767	62,384	(12,477)	[2,994]	{1,497}	63,024	(12,605)	[3,025]	{1,513}	63,692	(12,738)	[3,057]	{1,529}
Northampton	31,125	31,225	31,389	31,540	31,858	(6,372)	[1,529]	{765}	32,176	(6,435)	[1,544]	{772}	32,495	(6,499)	[1,560]	{780}
Philadelphia	132,175	132,575	133,485	134,356	135,663	(27,133)	[6,512]	{3,256}	137,020	(27,404)	[6,577]	{3,288}	138,461	(27,692)	[6,646]	{3,323}
Westmoreland	29,665	29,722	29,886	30,005	30,260	(6,052)	[1,452]	{726}	30,524	(6,105)	[1,465]	{733}	30,795	(6,159)	[1,478]	{739}
York	40,118	40,198	40,322	40,526	40,843	(8,169)	[1,960]	{980}	41,159	(8,232)	[1,976]	{988}	41,469	(8,294)	[1,990]	{995}

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.