

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

Date: 4/29/21

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 4/29/21 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.**

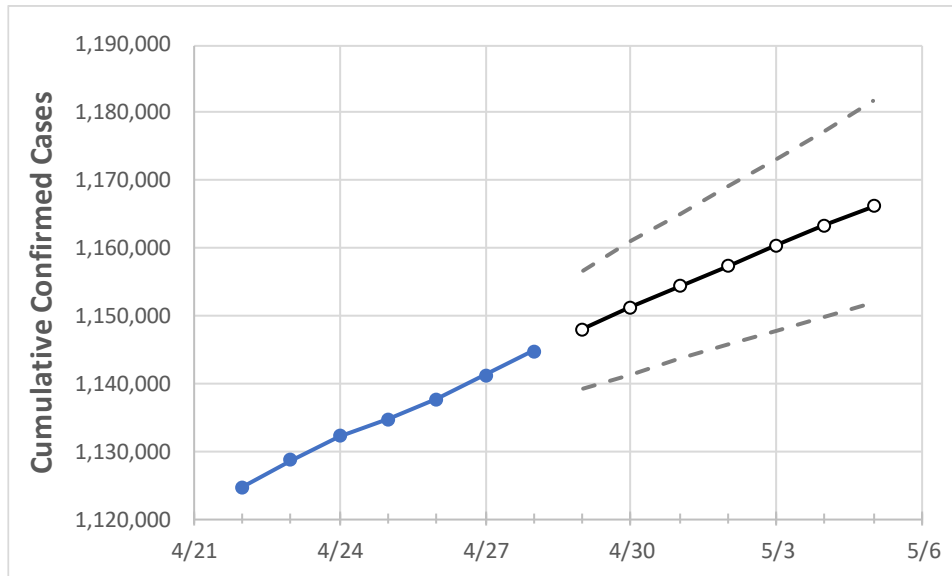
### IEM's Modeling Lead

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:							
4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5	

Pennsylvania 1,134,742 1,137,602 1,141,240 1,144,777 1,148,050 1,151,210 1,154,325 1,157,368 1,160,460 1,163,362 1,166,237

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:							
	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5	
Allegheny	96,074	96,168	96,428	96,670	96,883	97,086	97,284	97,469	97,638	97,802	97,953	
Berks	44,641	44,751	44,919	45,176	45,336	45,495	45,653	45,812	45,965	46,117	46,264	
Bucks	57,566	57,668	57,841	58,035	58,213	58,389	58,560	58,728	58,891	59,047	59,199	
Butler	16,551	16,565	16,615	16,663	16,697	16,731	16,765	16,799	16,832	16,863	16,892	
Chester	34,845	34,934	35,060	35,179	35,286	35,390	35,492	35,590	35,686	35,782	35,877	
Delaware	49,841	49,916	50,028	50,151	50,284	50,411	50,535	50,653	50,768	50,878	50,985	
Lackawanna	17,443	17,471	17,530	17,592	17,650	17,709	17,767	17,822	17,879	17,935	17,988	
Lancaster	52,510	52,602	52,725	52,895	53,041	53,181	53,319	53,454	53,588	53,713	53,848	
Lehigh	37,609	37,668	37,746	37,844	37,941	38,036	38,126	38,214	38,304	38,390	38,472	
Luzerne	29,852	29,895	29,981	30,107	30,204	30,302	30,399	30,495	30,588	30,685	30,776	
Monroe	13,541	13,577	13,667	13,736	13,800	13,865	13,925	13,986	14,047	14,107	14,167	
Montgomery	66,772	66,922	67,117	67,354	67,552	67,743	67,933	68,115	68,292	68,462	68,626	
Northampton	33,992	34,061	34,159	34,248	34,335	34,423	34,507	34,588	34,670	34,749	34,823	
Philadelphia	144,803	145,181	145,789	146,255	146,718	147,182	147,625	148,062	148,483	148,909	149,320	
Westmoreland	32,214	32,252	32,368	32,421	32,499	32,574	32,644	32,715	32,785	32,854	32,919	
York	43,493	43,576	43,700	43,821	43,941	44,061	44,176	44,289	44,400	44,504	44,610	

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:											
	4/25	4/26	4/27	4/28	4/30			5/2			5/4					
Allegheny	96,074	96,168	96,428	96,670	97,086	(19,417)	[4,660]	{2,330}	97,469	(19,494)	[4,679]	{2,339}	97,802	(19,560)	[4,695]	{2,347}
Berks	44,641	44,751	44,919	45,176	45,495	(9,099)	[2,184]	{1,092}	45,812	(9,162)	[2,199]	{1,099}	46,117	(9,223)	[2,214]	{1,107}
Bucks	57,566	57,668	57,841	58,035	58,389	(11,678)	[2,803]	{1,401}	58,728	(11,746)	[2,819]	{1,409}	59,047	(11,809)	[2,834]	{1,417}
Butler	16,551	16,565	16,615	16,663	16,731	(3,346)	[803]	{402}	16,799	(3,360)	[806]	{403}	16,863	(3,373)	[809]	{405}
Chester	34,845	34,934	35,060	35,179	35,390	(7,078)	[1,699]	{849}	35,590	(7,118)	[1,708]	{854}	35,782	(7,156)	[1,718]	{859}
Delaware	49,841	49,916	50,028	50,151	50,411	(10,082)	[2,420]	{1,210}	50,653	(10,131)	[2,431]	{1,216}	50,878	(10,176)	[2,442]	{1,221}
Lackawanna	17,443	17,471	17,530	17,592	17,709	(3,542)	[850]	{425}	17,822	(3,564)	[855]	{428}	17,935	(3,587)	[861]	{430}
Lancaster	52,510	52,602	52,725	52,895	53,181	(10,636)	[2,553]	{1,276}	53,454	(10,691)	[2,566]	{1,283}	53,713	(10,743)	[2,578]	{1,289}
Lehigh	37,609	37,668	37,746	37,844	38,036	(7,607)	[1,826]	{913}	38,214	(7,643)	[1,834]	{917}	38,390	(7,678)	[1,843]	{921}
Luzerne	29,852	29,895	29,981	30,107	30,302	(6,060)	[1,454]	{727}	30,495	(6,099)	[1,464]	{732}	30,685	(6,137)	[1,473]	{736}
Monroe	13,541	13,577	13,667	13,736	13,865	(2,773)	[666]	{333}	13,986	(2,797)	[671]	{336}	14,107	(2,821)	[677]	{339}
Montgomery	66,772	66,922	67,117	67,354	67,743	(13,549)	[3,252]	{1,626}	68,115	(13,623)	[3,270]	{1,635}	68,462	(13,692)	[3,286]	{1,643}
Northampton	33,992	34,061	34,159	34,248	34,423	(6,885)	[1,652]	{826}	34,588	(6,918)	[1,660]	{830}	34,749	(6,950)	[1,668]	{834}
Philadelphia	144,803	145,181	145,789	146,255	147,182	(29,436)	[7,065]	{3,532}	148,062	(29,612)	[7,107]	{3,553}	148,909	(29,782)	[7,148]	{3,574}
Westmoreland	32,214	32,252	32,368	32,421	32,574	(6,515)	[1,564]	{782}	32,715	(6,543)	[1,570]	{785}	32,854	(6,571)	[1,577]	{788}
York	43,493	43,576	43,700	43,821	44,061	(8,812)	[2,115]	{1,057}	44,289	(8,858)	[2,126]	{1,063}	44,504	(8,901)	[2,136]	{1,068}

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.