

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

Date: 4/20/21

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 4/20/21 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.**

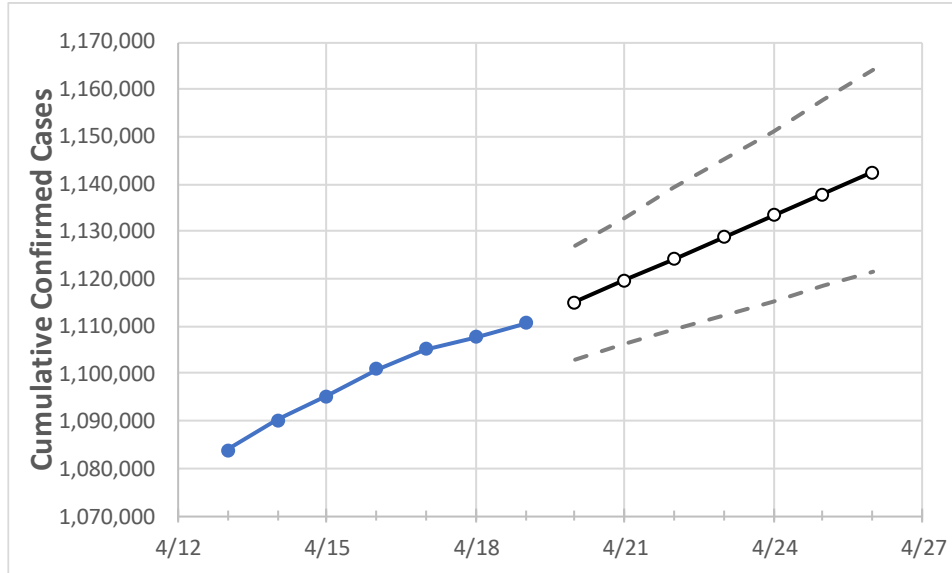
### IEM's Modeling Lead

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:						
	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26

Pennsylvania 1,100,857 1,105,061 1,107,673 1,110,675 1,115,182 1,119,753 1,124,233 1,128,801 1,133,356 1,137,840 1,142,428

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:						
	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26
Allegheny	93,279	93,684	93,909	94,112	94,579	95,048	95,521	95,998	96,473	96,947	97,435
Berks	43,132	43,327	43,424	43,516	43,701	43,885	44,070	44,256	44,434	44,624	44,807
Bucks	55,476	55,782	55,988	56,123	56,379	56,630	56,878	57,128	57,373	57,622	57,878
Butler	16,153	16,256	16,268	16,290	16,338	16,387	16,433	16,478	16,524	16,567	16,612
Chester	33,758	33,758	33,758	33,758	33,910	34,061	34,214	34,367	34,530	34,684	34,843
Delaware	48,136	48,406	48,639	48,757	48,979	49,205	49,430	49,659	49,897	50,135	50,364
Lackawanna	16,802	16,886	16,958	16,978	17,051	17,126	17,201	17,276	17,349	17,419	17,490
Lancaster	50,949	51,164	51,347	51,426	51,618	51,817	52,013	52,206	52,402	52,598	52,797
Lehigh	36,501	36,639	36,703	36,758	36,885	37,011	37,136	37,259	37,379	37,506	37,624
Luzerne	28,907	29,021	29,089	29,136	29,241	29,348	29,454	29,562	29,668	29,779	29,887
Monroe	12,865	12,977	13,023	13,064	13,148	13,229	13,314	13,397	13,479	13,560	13,643
Montgomery	64,562	64,845	65,138	65,352	65,655	65,955	66,265	66,569	66,877	67,183	67,490
Northampton	32,945	33,099	33,168	33,225	33,352	33,476	33,596	33,712	33,828	33,941	34,058
Philadelphia	140,229	140,670	141,110	141,551	142,203	142,826	143,466	144,140	144,796	145,429	146,108
Westmoreland	31,319	31,420	31,490	31,535	31,657	31,777	31,896	32,013	32,131	32,248	32,365
York	42,125	42,335	42,464	42,532	42,700	42,865	43,036	43,205	43,375	43,543	43,715

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:											
	4/16	4/17	4/18	4/19	4/21			4/23			4/25					
Allegheny	93,279	93,684	93,909	94,112	95,048	(19,010)	[4,562]	{2,281}	95,998	(19,200)	[4,608]	{2,304}	96,947	(19,389)	[4,653]	{2,327}
Berks	43,132	43,327	43,424	43,516	43,885	(8,777)	[2,106]	{1,053}	44,256	(8,851)	[2,124]	{1,062}	44,624	(8,925)	[2,142]	{1,071}
Bucks	55,476	55,782	55,988	56,123	56,630	(11,326)	[2,718]	{1,359}	57,128	(11,426)	[2,742]	{1,371}	57,622	(11,524)	[2,766]	{1,383}
Butler	16,153	16,256	16,268	16,290	16,387	(3,277)	[787]	{393}	16,478	(3,296)	[791]	{395}	16,567	(3,313)	[795]	{398}
Chester	33,758	33,758	33,758	33,758	34,061	(6,812)	[1,635]	{817}	34,367	(6,873)	[1,650]	{825}	34,684	(6,937)	[1,665]	{832}
Delaware	48,136	48,406	48,639	48,757	49,205	(9,841)	[2,362]	{1,181}	49,659	(9,932)	[2,384]	{1,192}	50,135	(10,027)	[2,406]	{1,203}
Lackawanna	16,802	16,886	16,958	16,978	17,126	(3,425)	[822]	{411}	17,276	(3,455)	[829]	{415}	17,419	(3,484)	[836]	{418}
Lancaster	50,949	51,164	51,347	51,426	51,817	(10,363)	[2,487]	{1,244}	52,206	(10,441)	[2,506]	{1,253}	52,598	(10,520)	[2,525]	{1,262}
Lehigh	36,501	36,639	36,703	36,758	37,011	(7,402)	[1,777]	{888}	37,259	(7,452)	[1,788]	{894}	37,506	(7,501)	[1,800]	{900}
Luzerne	28,907	29,021	29,089	29,136	29,348	(5,870)	[1,409]	{704}	29,562	(5,912)	[1,419]	{709}	29,779	(5,956)	[1,429]	{715}
Monroe	12,865	12,977	13,023	13,064	13,229	(2,646)	[635]	{318}	13,397	(2,679)	[643]	{322}	13,560	(2,712)	[651]	{325}
Montgomery	64,562	64,845	65,138	65,352	65,955	(13,191)	[3,166]	{1,583}	66,569	(13,314)	[3,195]	{1,598}	67,183	(13,437)	[3,225]	{1,612}
Northampton	32,945	33,099	33,168	33,225	33,476	(6,695)	[1,607]	{803}	33,712	(6,742)	[1,618]	{809}	33,941	(6,788)	[1,629]	{815}
Philadelphia	140,229	140,670	141,110	141,551	142,826	(28,565)	[6,856]	{3,428}	144,140	(28,828)	[6,919]	{3,459}	145,429	(29,086)	[6,981]	{3,490}
Westmoreland	31,319	31,420	31,490	31,535	31,777	(6,355)	[1,525]	{763}	32,013	(6,403)	[1,537]	{768}	32,248	(6,450)	[1,548]	{774}
York	42,125	42,335	42,464	42,532	42,865	(8,573)	[2,058]	{1,029}	43,205	(8,641)	[2,074]	{1,037}	43,543	(8,709)	[2,090]	{1,045}

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.