

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 4/30/21**

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 4/30/21 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.

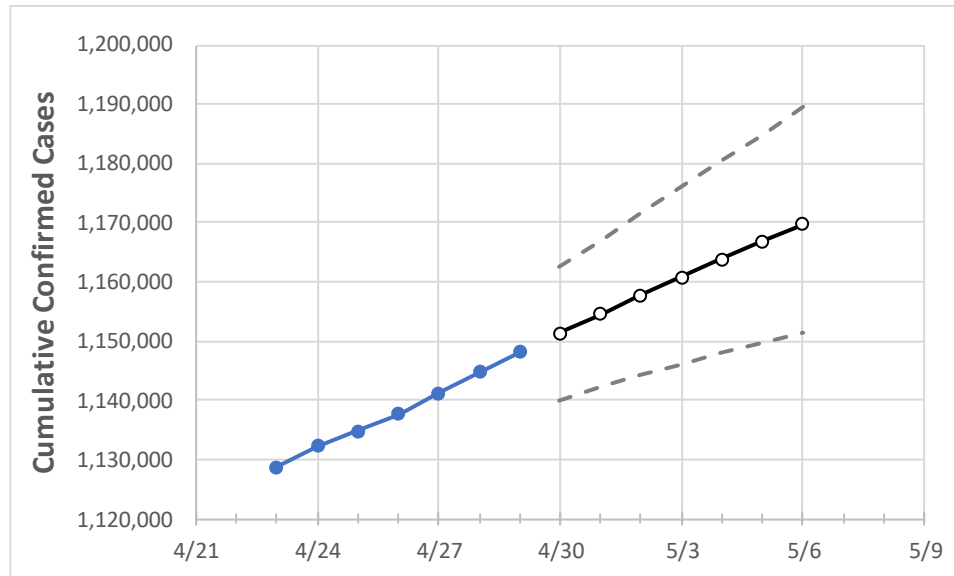
IEM's Modeling Lead

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:							
4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	

Pennsylvania 1,137,602 1,141,240 1,144,777 1,148,121 1,151,365 1,154,615 1,157,723 1,160,841 1,163,896 1,166,791 1,169,729

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:							
	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	
Allegheny	96,168	96,428	96,670	96,884	97,085	97,283	97,466	97,649	97,818	97,983	98,138	
Berks	44,751	44,919	45,176	45,409	45,566	45,719	45,876	46,031	46,184	46,331	46,478	
Bucks	57,668	57,841	58,035	58,195	58,369	58,536	58,705	58,862	59,018	59,170	59,314	
Butler	16,565	16,615	16,663	16,700	16,734	16,768	16,801	16,833	16,865	16,895	16,926	
Chester	34,934	35,060	35,179	35,282	35,385	35,485	35,584	35,681	35,777	35,869	35,959	
Delaware	49,916	50,028	50,151	50,283	50,410	50,534	50,652	50,768	50,881	50,992	51,096	
Lackawanna	17,471	17,530	17,592	17,651	17,710	17,767	17,823	17,877	17,932	17,985	18,037	
Lancaster	52,602	52,725	52,895	53,029	53,167	53,303	53,436	53,563	53,692	53,821	53,941	
Lehigh	37,668	37,746	37,844	37,953	38,049	38,143	38,238	38,328	38,417	38,507	38,593	
Luzerne	29,895	29,981	30,107	30,207	30,301	30,397	30,490	30,582	30,672	30,763	30,856	
Monroe	13,577	13,667	13,736	13,787	13,848	13,908	13,966	14,025	14,083	14,139	14,192	
Montgomery	66,922	67,117	67,354	67,565	67,760	67,949	68,134	68,315	68,488	68,660	68,829	
Northampton	34,061	34,159	34,248	34,347	34,436	34,520	34,605	34,689	34,770	34,854	34,929	
Philadelphia	145,181	145,789	146,255	146,762	147,219	147,661	148,109	148,562	148,997	149,422	149,837	
Westmoreland	32,252	32,368	32,421	32,482	32,553	32,620	32,691	32,756	32,820	32,881	32,940	
York	43,576	43,700	43,821	43,963	44,087	44,208	44,329	44,448	44,565	44,683	44,794	

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:											
	4/26	4/27	4/28	4/29	5/1				5/3				5/5			
Allegheny	96,168	96,428	96,670	96,884	97,283	(19,457)	[4,670]	{2,335}	97,649	(19,530)	[4,687]	{2,344}	97,983	(19,597)	[4,703]	{2,352}
Berks	44,751	44,919	45,176	45,409	45,719	(9,144)	[2,195]	{1,097}	46,031	(9,206)	[2,209]	{1,105}	46,331	(9,266)	[2,224]	{1,112}
Bucks	57,668	57,841	58,035	58,195	58,536	(11,707)	[2,810]	{1,405}	58,862	(11,772)	[2,825]	{1,413}	59,170	(11,834)	[2,840]	{1,420}
Butler	16,565	16,615	16,663	16,700	16,768	(3,354)	[805]	{402}	16,833	(3,367)	[808]	{404}	16,895	(3,379)	[811]	{405}
Chester	34,934	35,060	35,179	35,282	35,485	(7,097)	[1,703]	{852}	35,681	(7,136)	[1,713]	{856}	35,869	(7,174)	[1,722]	{861}
Delaware	49,916	50,028	50,151	50,283	50,534	(10,107)	[2,426]	{1,213}	50,768	(10,154)	[2,437]	{1,218}	50,992	(10,198)	[2,448]	{1,224}
Lackawanna	17,471	17,530	17,592	17,651	17,767	(3,553)	[853]	{426}	17,877	(3,575)	[858]	{429}	17,985	(3,597)	[863]	{432}
Lancaster	52,602	52,725	52,895	53,029	53,303	(10,661)	[2,559]	{1,279}	53,563	(10,713)	[2,571]	{1,286}	53,821	(10,764)	[2,583]	{1,292}
Lehigh	37,668	37,746	37,844	37,953	38,143	(7,629)	[1,831]	{915}	38,328	(7,666)	[1,840]	{920}	38,507	(7,701)	[1,848]	{924}
Luzerne	29,895	29,981	30,107	30,207	30,397	(6,079)	[1,459]	{730}	30,582	(6,116)	[1,468]	{734}	30,763	(6,153)	[1,477]	{738}
Monroe	13,577	13,667	13,736	13,787	13,908	(2,782)	[668]	{334}	14,025	(2,805)	[673]	{337}	14,139	(2,828)	[679]	{339}
Montgomery	66,922	67,117	67,354	67,565	67,949	(13,590)	[3,262]	{1,631}	68,315	(13,663)	[3,279]	{1,640}	68,660	(13,732)	[3,296]	{1,648}
Northampton	34,061	34,159	34,248	34,347	34,520	(6,904)	[1,657]	{828}	34,689	(6,938)	[1,665]	{833}	34,854	(6,971)	[1,673]	{837}
Philadelphia	145,181	145,789	146,255	146,762	147,661	(29,532)	[7,088]	{3,544}	148,562	(29,712)	[7,131]	{3,565}	149,422	(29,884)	[7,172]	{3,586}
Westmoreland	32,252	32,368	32,421	32,482	32,620	(6,524)	[1,566]	{783}	32,756	(6,551)	[1,572]	{786}	32,881	(6,576)	[1,578]	{789}
York	43,576	43,700	43,821	43,963	44,208	(8,842)	[2,122]	{1,061}	44,448	(8,890)	[2,134]	{1,067}	44,683	(8,937)	[2,145]	{1,072}

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