

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

Date: 4/27/21

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 4/27/21 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.

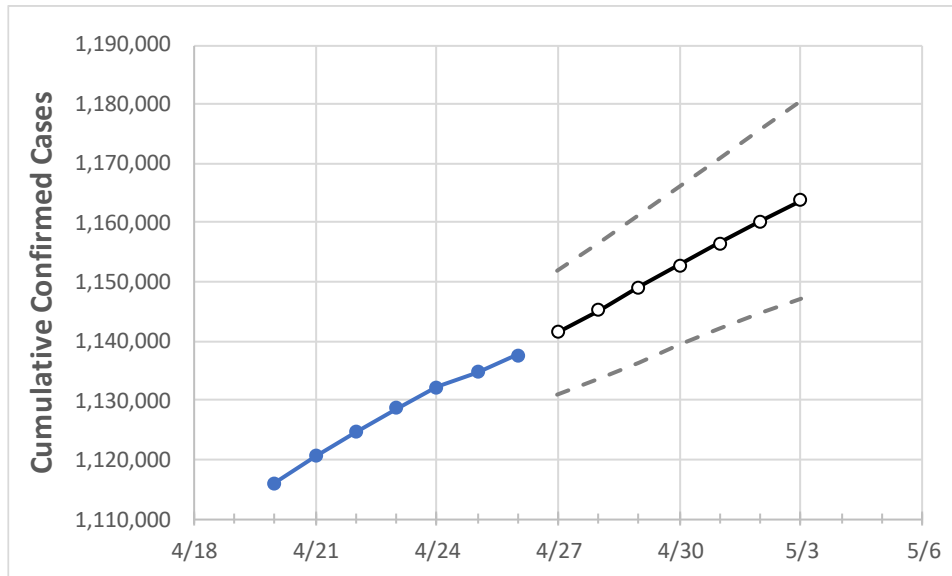
IEM's Modeling Lead

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:							
4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	

Pennsylvania 1,128,688 1,132,248 1,134,742 1,137,602 1,141,494 1,145,295 1,149,037 1,152,874 1,156,561 1,160,250 1,163,770

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:							
	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	
Allegheny	95,490	95,857	96,074	96,168	96,489	96,801	97,098	97,398	97,689	97,966	98,250	
Berks	44,296	44,497	44,641	44,751	44,928	45,108	45,280	45,454	45,629	45,799	45,974	
Bucks	57,135	57,375	57,566	57,668	57,892	58,114	58,335	58,554	58,763	58,970	59,177	
Butler	16,473	16,524	16,551	16,565	16,605	16,643	16,680	16,717	16,752	16,788	16,822	
Chester	34,668	34,757	34,845	34,934	35,040	35,144	35,246	35,345	35,443	35,537	35,628	
Delaware	49,544	49,713	49,841	49,916	50,113	50,313	50,508	50,701	50,897	51,092	51,285	
Lackawanna	17,329	17,400	17,443	17,471	17,542	17,612	17,683	17,754	17,824	17,900	17,969	
Lancaster	52,209	52,360	52,510	52,602	52,773	52,938	53,100	53,270	53,440	53,607	53,772	
Lehigh	37,357	37,512	37,609	37,668	37,789	37,907	38,026	38,140	38,257	38,375	38,490	
Luzerne	29,659	29,769	29,852	29,895	30,000	30,100	30,204	30,308	30,413	30,517	30,622	
Monroe	13,379	13,471	13,541	13,577	13,649	13,721	13,792	13,863	13,934	14,005	14,074	
Montgomery	66,333	66,562	66,772	66,922	67,173	67,416	67,666	67,908	68,146	68,375	68,609	
Northampton	33,763	33,895	33,992	34,061	34,173	34,285	34,391	34,502	34,611	34,716	34,819	
Philadelphia	144,048	144,426	144,803	145,181	145,742	146,279	146,816	147,347	147,868	148,396	148,904	
Westmoreland	32,021	32,136	32,214	32,252	32,350	32,446	32,541	32,640	32,731	32,823	32,913	
York	43,204	43,372	43,493	43,576	43,727	43,877	44,026	44,173	44,320	44,466	44,613	

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:											
	4/23	4/24	4/25	4/26	4/28			4/30			5/2					
Allegheny	95,490	95,857	96,074	96,168	96,801	(19,360)	[4,646]	{2,323}	97,398	(19,480)	[4,675]	{2,338}	97,966	(19,593)	[4,702]	{2,351}
Berks	44,296	44,497	44,641	44,751	45,108	(9,022)	[2,165]	{1,083}	45,454	(9,091)	[2,182]	{1,091}	45,799	(9,160)	[2,198]	{1,099}
Bucks	57,135	57,375	57,566	57,668	58,114	(11,623)	[2,789]	{1,395}	58,554	(11,711)	[2,811]	{1,405}	58,970	(11,794)	[2,831]	{1,415}
Butler	16,473	16,524	16,551	16,565	16,643	(3,329)	[799]	{399}	16,717	(3,343)	[802]	{401}	16,788	(3,358)	[806]	{403}
Chester	34,668	34,757	34,845	34,934	35,144	(7,029)	[1,687]	{843}	35,345	(7,069)	[1,697]	{848}	35,537	(7,107)	[1,706]	{853}
Delaware	49,544	49,713	49,841	49,916	50,313	(10,063)	[2,415]	{1,208}	50,701	(10,140)	[2,434]	{1,217}	51,092	(10,218)	[2,452]	{1,226}
Lackawanna	17,329	17,400	17,443	17,471	17,612	(3,522)	[845]	{423}	17,754	(3,551)	[852]	{426}	17,900	(3,580)	[859]	{430}
Lancaster	52,209	52,360	52,510	52,602	52,938	(10,588)	[2,541]	{1,271}	53,270	(10,654)	[2,557]	{1,278}	53,607	(10,721)	[2,573]	{1,287}
Lehigh	37,357	37,512	37,609	37,668	37,907	(7,581)	[1,820]	{910}	38,140	(7,628)	[1,831]	{915}	38,375	(7,675)	[1,842]	{921}
Luzerne	29,659	29,769	29,852	29,895	30,100	(6,020)	[1,445]	{722}	30,308	(6,062)	[1,455]	{727}	30,517	(6,103)	[1,465]	{732}
Monroe	13,379	13,471	13,541	13,577	13,721	(2,744)	[659]	{329}	13,863	(2,773)	[665]	{333}	14,005	(2,801)	[672]	{336}
Montgomery	66,333	66,562	66,772	66,922	67,416	(13,483)	[3,236]	{1,618}	67,908	(13,582)	[3,260]	{1,630}	68,375	(13,675)	[3,282]	{1,641}
Northampton	33,763	33,895	33,992	34,061	34,285	(6,857)	[1,646]	{823}	34,502	(6,900)	[1,656]	{828}	34,716	(6,943)	[1,666]	{833}
Philadelphia	144,048	144,426	144,803	145,181	146,279	(29,256)	[7,021]	{3,511}	147,347	(29,469)	[7,073]	{3,536}	148,396	(29,679)	[7,123]	{3,562}
Westmoreland	32,021	32,136	32,214	32,252	32,446	(6,489)	[1,557]	{779}	32,640	(6,528)	[1,567]	{783}	32,823	(6,565)	[1,575]	{788}
York	43,204	43,372	43,493	43,576	43,877	(8,775)	[2,106]	{1,053}	44,173	(8,835)	[2,120]	{1,060}	44,466	(8,893)	[2,134]	{1,067}

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.