

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

Date: 4/12/21

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 4/12/21 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.

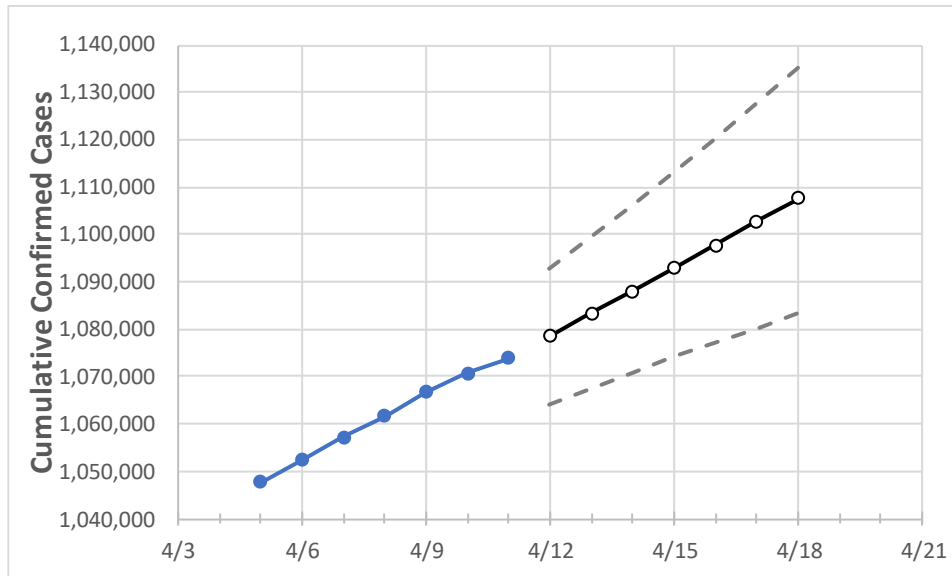
IEM's Modeling Lead

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:							
4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	

Pennsylvania 1,061,566 1,066,707 1,070,730 1,073,924 1,078,618 1,083,314 1,088,090 1,092,917 1,097,790 1,102,720 1,107,660

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:						
	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18
Allegheny	88,952	89,545	89,917	90,386	90,846	91,314	91,780	92,267	92,758	93,247	93,765
Berks	41,389	41,590	41,773	41,900	42,090	42,280	42,474	42,671	42,864	43,058	43,257
Bucks	53,179	53,486	53,806	54,003	54,292	54,587	54,885	55,190	55,491	55,796	56,115
Butler	15,715	15,797	15,849	15,899	15,962	16,025	16,089	16,153	16,216	16,279	16,344
Chester	32,561	32,726	32,726	32,726	32,894	33,062	33,233	33,404	33,582	33,760	33,938
Delaware	46,357	46,548	46,778	46,933	47,154	47,373	47,594	47,820	48,051	48,287	48,526
Lackawanna	16,174	16,245	16,329	16,375	16,450	16,526	16,605	16,682	16,763	16,843	16,926
Lancaster	49,282	49,469	49,665	49,812	50,010	50,208	50,407	50,609	50,810	51,014	51,216
Lehigh	35,238	35,433	35,608	35,699	35,858	36,014	36,168	36,325	36,484	36,644	36,804
Luzerne	27,923	28,033	28,186	28,289	28,411	28,537	28,664	28,795	28,925	29,058	29,192
Monroe	12,141	12,254	12,353	12,425	12,527	12,629	12,735	12,841	12,952	13,062	13,177
Montgomery	62,114	62,399	62,711	62,945	63,258	63,573	63,893	64,216	64,549	64,890	65,231
Northampton	31,711	31,882	32,051	32,118	32,269	32,427	32,578	32,733	32,888	33,043	33,198
Philadelphia	134,945	135,632	135,632	135,632	136,293	136,972	137,686	138,411	139,126	139,862	140,659
Westmoreland	30,135	30,300	30,418	30,605	30,745	30,890	31,034	31,184	31,336	31,492	31,651
York	40,691	40,851	41,076	41,220	41,378	41,536	41,691	41,848	41,996	42,149	42,299

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:											
	4/8	4/9	4/10	4/11	4/13			4/15			4/17					
Allegheny	88,952	89,545	89,917	90,386	91,314	(18,263)	[4,383]	{2,192}	92,267	(18,453)	[4,429]	{2,214}	93,247	(18,649)	[4,476]	{2,238}
Berks	41,389	41,590	41,773	41,900	42,280	(8,456)	[2,029]	{1,015}	42,671	(8,534)	[2,048]	{1,024}	43,058	(8,612)	[2,067]	{1,033}
Bucks	53,179	53,486	53,806	54,003	54,587	(10,917)	[2,620]	{1,310}	55,190	(11,038)	[2,649]	{1,325}	55,796	(11,159)	[2,678]	{1,339}
Butler	15,715	15,797	15,849	15,899	16,025	(3,205)	[769]	{385}	16,153	(3,231)	[775]	{388}	16,279	(3,256)	[781]	{391}
Chester	32,561	32,726	32,726	32,726	33,062	(6,612)	[1,587]	{793}	33,404	(6,681)	[1,603]	{802}	33,760	(6,752)	[1,620]	{810}
Delaware	46,357	46,548	46,778	46,933	47,373	(9,475)	[2,274]	{1,137}	47,820	(9,564)	[2,295]	{1,148}	48,287	(9,657)	[2,318]	{1,159}
Lackawanna	16,174	16,245	16,329	16,375	16,526	(3,305)	[793]	{397}	16,682	(3,336)	[801]	{400}	16,843	(3,369)	[808]	{404}
Lancaster	49,282	49,469	49,665	49,812	50,208	(10,042)	[2,410]	{1,205}	50,609	(10,122)	[2,429]	{1,215}	51,014	(10,203)	[2,449]	{1,224}
Lehigh	35,238	35,433	35,608	35,699	36,014	(7,203)	[1,729]	{864}	36,325	(7,265)	[1,744]	{872}	36,644	(7,329)	[1,759]	{879}
Luzerne	27,923	28,033	28,186	28,289	28,537	(5,707)	[1,370]	{685}	28,795	(5,759)	[1,382]	{691}	29,058	(5,812)	[1,395]	{697}
Monroe	12,141	12,254	12,353	12,425	12,629	(2,526)	[606]	{303}	12,841	(2,568)	[616]	{308}	13,062	(2,612)	[627]	{313}
Montgomery	62,114	62,399	62,711	62,945	63,573	(12,715)	[3,051]	{1,526}	64,216	(12,843)	[3,082]	{1,541}	64,890	(12,978)	[3,115]	{1,557}
Northampton	31,711	31,882	32,051	32,118	32,427	(6,485)	[1,556]	{778}	32,733	(6,547)	[1,571]	{786}	33,043	(6,609)	[1,586]	{793}
Philadelphia	134,945	135,632	135,632	135,632	136,972	(27,394)	[6,575]	{3,287}	138,411	(27,682)	[6,644]	{3,322}	139,862	(27,972)	[6,713]	{3,357}
Westmoreland	30,135	30,300	30,418	30,605	30,890	(6,178)	[1,483]	{741}	31,184	(6,237)	[1,497]	{748}	31,492	(6,298)	[1,512]	{756}
York	40,691	40,851	41,076	41,220	41,536	(8,307)	[1,994]	{997}	41,848	(8,370)	[2,009]	{1,004}	42,149	(8,430)	[2,023]	{1,012}

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.