

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

Date: 4/14/21

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 4/14/21 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.

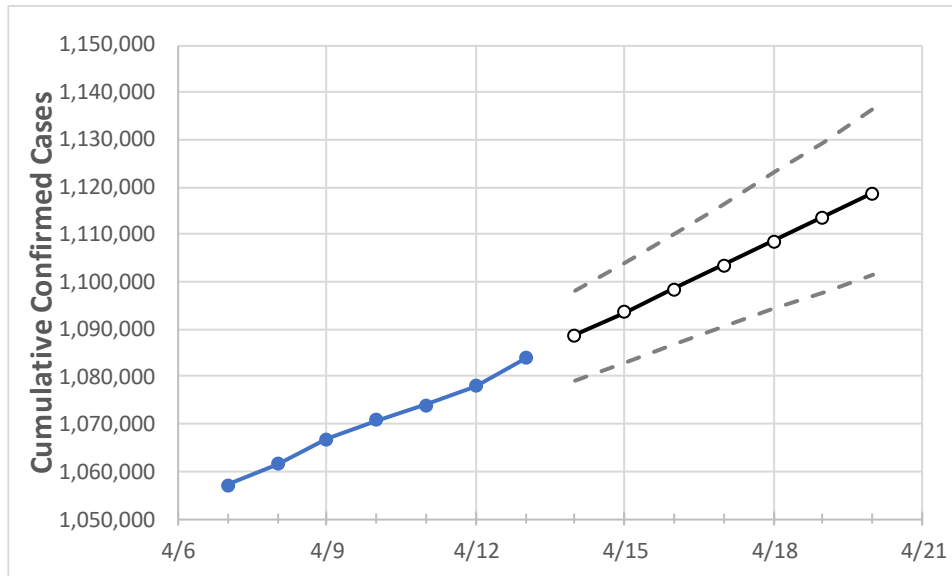
IEM's Modeling Lead

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:						
	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20

Pennsylvania 1,070,730 1,073,924 1,077,936 1,083,953 1,088,691 1,093,534 1,098,490 1,103,555 1,108,495 1,113,612 1,118,760

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:						
	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20
Allegheny	89,917	90,386	90,634	91,064	91,498	91,924	92,360	92,803	93,254	93,706	94,148
Berks	41,773	41,900	41,991	42,541	42,755	42,968	43,187	43,408	43,633	43,865	44,096
Bucks	53,806	54,003	54,186	54,603	54,896	55,193	55,501	55,806	56,113	56,425	56,752
Butler	15,849	15,899	15,921	15,968	16,021	16,074	16,131	16,184	16,237	16,291	16,345
Chester	32,862	32,999	33,135	33,296	33,446	33,599	33,748	33,902	34,056	34,211	34,369
Delaware	46,778	46,933	47,049	47,427	47,668	47,924	48,176	48,437	48,706	48,983	49,257
Lackawanna	16,329	16,375	16,406	16,539	16,617	16,696	16,774	16,854	16,938	17,021	17,105
Lancaster	49,665	49,812	49,979	50,283	50,494	50,707	50,923	51,143	51,368	51,597	51,829
Lehigh	35,608	35,699	35,781	36,025	36,185	36,345	36,509	36,674	36,840	37,009	37,180
Luzerne	28,186	28,289	28,341	28,488	28,608	28,734	28,860	28,984	29,116	29,244	29,375
Monroe	12,353	12,425	12,468	12,605	12,705	12,810	12,915	13,021	13,125	13,236	13,347
Montgomery	62,711	62,945	63,131	63,593	63,930	64,271	64,627	64,989	65,348	65,722	66,093
Northampton	32,051	32,118	32,197	32,445	32,600	32,755	32,909	33,065	33,217	33,371	33,526
Philadelphia	136,155	136,678	137,201	137,331	137,883	138,421	138,968	139,544	140,113	140,693	141,236
Westmoreland	30,418	30,605	30,666	30,837	30,973	31,120	31,265	31,412	31,565	31,715	31,864
York	41,076	41,220	41,306	41,539	41,697	41,852	42,010	42,168	42,324	42,488	42,643

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:											
	4/10	4/11	4/12	4/13	4/15			4/17			4/19					
Allegheny	89,917	90,386	90,634	91,064	91,924	(18,385)	[4,412]	{2,206}	92,803	(18,561)	[4,455]	{2,227}	93,706	(18,741)	[4,498]	{2,249}
Berks	41,773	41,900	41,991	42,541	42,968	(8,594)	[2,062]	{1,031}	43,408	(8,682)	[2,084]	{1,042}	43,865	(8,773)	[2,106]	{1,053}
Bucks	53,806	54,003	54,186	54,603	55,193	(11,039)	[2,649]	{1,325}	55,806	(11,161)	[2,679]	{1,339}	56,425	(11,285)	[2,708]	{1,354}
Butler	15,849	15,899	15,921	15,968	16,074	(3,215)	[772]	{386}	16,184	(3,237)	[777]	{388}	16,291	(3,258)	[782]	{391}
Chester	32,862	32,999	33,135	33,296	33,599	(6,720)	[1,613]	{806}	33,902	(6,780)	[1,627]	{814}	34,211	(6,842)	[1,642]	{821}
Delaware	46,778	46,933	47,049	47,427	47,924	(9,585)	[2,300]	{1,150}	48,437	(9,687)	[2,325]	{1,162}	48,983	(9,797)	[2,351]	{1,176}
Lackawanna	16,329	16,375	16,406	16,539	16,696	(3,339)	[801]	{401}	16,854	(3,371)	[809]	{404}	17,021	(3,404)	[817]	{409}
Lancaster	49,665	49,812	49,979	50,283	50,707	(10,141)	[2,434]	{1,217}	51,143	(10,229)	[2,455]	{1,227}	51,597	(10,319)	[2,477]	{1,238}
Lehigh	35,608	35,699	35,781	36,025	36,345	(7,269)	[1,745]	{872}	36,674	(7,335)	[1,760]	{880}	37,009	(7,402)	[1,776]	{888}
Luzerne	28,186	28,289	28,341	28,488	28,734	(5,747)	[1,379]	{690}	28,984	(5,797)	[1,391]	{696}	29,244	(5,849)	[1,404]	{702}
Monroe	12,353	12,425	12,468	12,605	12,810	(2,562)	[615]	{307}	13,021	(2,604)	[625]	{312}	13,236	(2,647)	[635]	{318}
Montgomery	62,711	62,945	63,131	63,593	64,271	(12,854)	[3,085]	{1,543}	64,989	(12,998)	[3,119]	{1,560}	65,722	(13,144)	[3,155]	{1,577}
Northampton	32,051	32,118	32,197	32,445	32,755	(6,551)	[1,572]	{786}	33,065	(6,613)	[1,587]	{794}	33,371	(6,674)	[1,602]	{801}
Philadelphia	136,155	136,678	137,201	137,331	138,421	(27,684)	[6,644]	{3,322}	139,544	(27,909)	[6,698]	{3,349}	140,693	(28,139)	[6,753]	{3,377}
Westmoreland	30,418	30,605	30,666	30,837	31,120	(6,224)	[1,494]	{747}	31,412	(6,282)	[1,508]	{754}	31,715	(6,343)	[1,522]	{761}
York	41,076	41,220	41,306	41,539	41,852	(8,370)	[2,009]	{1,004}	42,168	(8,434)	[2,024]	{1,012}	42,488	(8,498)	[2,039]	{1,020}

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.