

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

Date: 1/13/21

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 1/13/21 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.

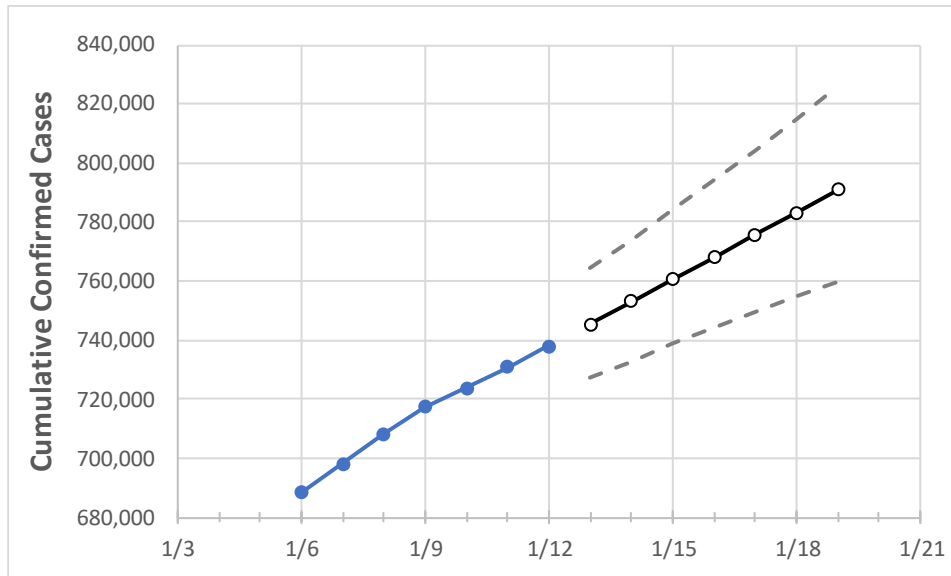
IEM's Modeling Lead

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
Pennsylvania	717,277	723,865	730,773	737,994	745,475	753,130	760,577	768,073	775,681	783,259	790,887

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
Allegheny	60,188	60,707	61,075	61,769	62,386	63,003	63,620	64,217	64,830	65,431	66,028
Berks	26,198	26,512	26,732	27,070	27,361	27,660	27,952	28,239	28,522	28,800	29,087
Bucks	33,843	34,178	34,438	34,847	35,210	35,574	35,946	36,310	36,682	37,050	37,431
Butler	10,757	10,863	10,937	11,056	11,192	11,330	11,469	11,609	11,749	11,887	12,027
Chester	21,761	21,967	22,172	22,413	22,637	22,859	23,083	23,310	23,533	23,757	23,987
Delaware	32,337	32,640	32,836	33,132	33,403	33,672	33,952	34,233	34,511	34,775	35,047
Lackawanna	10,100	10,229	10,319	10,462	10,601	10,741	10,883	11,023	11,167	11,309	11,450
Lancaster	31,300	31,672	31,951	32,231	32,585	32,947	33,301	33,658	34,016	34,381	34,752
Lehigh	23,311	23,595	23,815	24,010	24,312	24,616	24,921	25,224	25,538	25,853	26,158
Luzerne	19,192	19,428	19,608	19,723	19,920	20,120	20,314	20,519	20,717	20,917	21,118
Monroe	6,983	7,110	7,163	7,244	7,345	7,447	7,547	7,649	7,752	7,856	7,966
Montgomery	40,432	40,964	41,270	41,651	42,103	42,565	43,034	43,494	43,961	44,418	44,881
Northampton	18,990	19,205	19,334	19,508	19,740	19,975	20,198	20,425	20,657	20,889	21,123
Philadelphia	99,058	99,575	100,092	100,910	101,492	102,081	102,673	103,270	103,865	104,445	105,027
Westmoreland	21,622	21,853	22,026	22,233	22,452	22,670	22,885	23,096	23,300	23,511	23,712
York	26,155	26,494	26,759	27,005	27,313	27,630	27,943	28,246	28,551	28,855	29,156

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:											
	1/9	1/10	1/11	1/12	1/14			1/16			1/18					
Allegheny	60,188	60,707	61,075	61,769	63,003	(12,601)	[3,024]	{1,512}	64,217	(12,843)	[3,082]	{1,541}	65,431	(13,086)	[3,141]	{1,570}
Berks	26,198	26,512	26,732	27,070	27,660	(5,532)	[1,328]	{664}	28,239	(5,648)	[1,355]	{678}	28,800	(5,760)	[1,382]	{691}
Bucks	33,843	34,178	34,438	34,847	35,574	(7,115)	[1,708]	{854}	36,310	(7,262)	[1,743]	{871}	37,050	(7,410)	[1,778]	{889}
Butler	10,757	10,863	10,937	11,056	11,330	(2,266)	[544]	{272}	11,609	(2,322)	[557]	{279}	11,887	(2,377)	[571]	{285}
Chester	21,761	21,967	22,172	22,413	22,859	(4,572)	[1,097]	{549}	23,310	(4,662)	[1,119]	{559}	23,757	(4,751)	[1,140]	{570}
Delaware	32,337	32,640	32,836	33,132	33,672	(6,734)	[1,616]	{808}	34,233	(6,847)	[1,643]	{822}	34,775	(6,955)	[1,669]	{835}
Lackawanna	10,100	10,229	10,319	10,462	10,741	(2,148)	[516]	{258}	11,023	(2,205)	[529]	{265}	11,309	(2,262)	[543]	{271}
Lancaster	31,300	31,672	31,951	32,231	32,947	(6,589)	[1,581]	{791}	33,658	(6,732)	[1,616]	{808}	34,381	(6,876)	[1,650]	{825}
Lehigh	23,311	23,595	23,815	24,010	24,616	(4,923)	[1,182]	{591}	25,224	(5,045)	[1,211]	{605}	25,853	(5,171)	[1,241]	{620}
Luzerne	19,192	19,428	19,608	19,723	20,120	(4,024)	[966]	{483}	20,519	(4,104)	[985]	{492}	20,917	(4,183)	[1,004]	{502}
Monroe	6,983	7,110	7,163	7,244	7,447	(1,489)	[357]	{179}	7,649	(1,530)	[367]	{184}	7,856	(1,571)	[377]	{189}
Montgomery	40,432	40,964	41,270	41,651	42,565	(8,513)	[2,043]	{1,022}	43,494	(8,699)	[2,088]	{1,044}	44,418	(8,884)	[2,132]	{1,066}
Northampton	18,990	19,205	19,334	19,508	19,975	(3,995)	[959]	{479}	20,425	(4,085)	[980]	{490}	20,889	(4,178)	[1,003]	{501}
Philadelphia	99,058	99,575	100,092	100,910	102,081	(20,416)	[4,900]	{2,450}	103,270	(20,654)	[4,957]	{2,478}	104,445	(20,889)	[5,013]	{2,507}
Westmoreland	21,622	21,853	22,026	22,233	22,670	(4,534)	[1,088]	{544}	23,096	(4,619)	[1,109]	{554}	23,511	(4,702)	[1,129]	{564}
York	26,155	26,494	26,759	27,005	27,630	(5,526)	[1,326]	{663}	28,246	(5,649)	[1,356]	{678}	28,855	(5,771)	[1,385]	{693}

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.