

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

Date: 3/16/21

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 3/16/21 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.

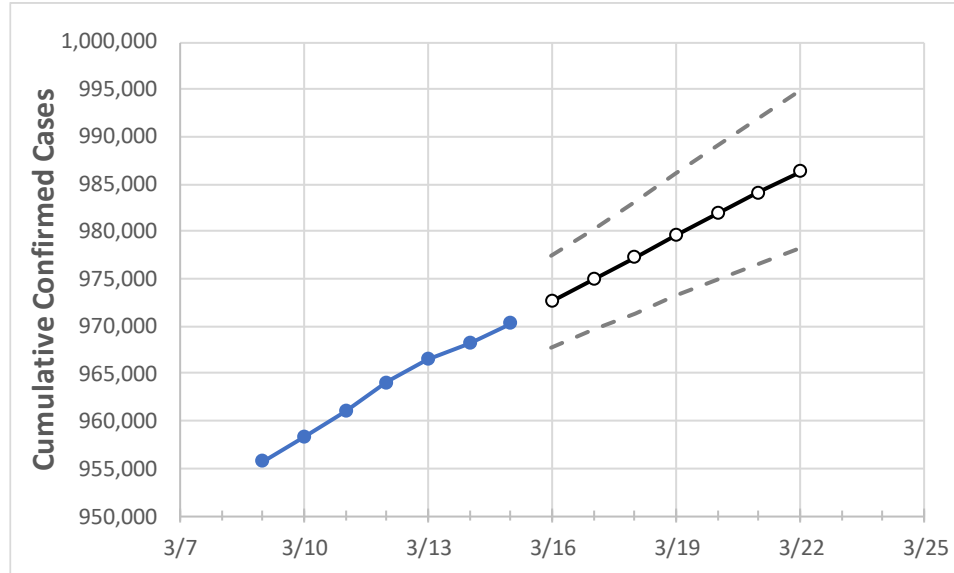
IEM's Modeling Lead

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:						
	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22
Pennsylvania	964,147	966,538	968,259	970,281	972,616	974,955	977,283	979,611	981,902	984,130	986,326

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:						
	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22
Allegheny	79,450	79,779	79,930	80,054	80,276	80,499	80,714	80,937	81,156	81,377	81,593
Berks	36,951	37,061	37,166	37,228	37,333	37,437	37,541	37,650	37,760	37,868	37,973
Bucks	46,894	47,060	47,183	47,280	47,428	47,574	47,720	47,866	48,010	48,152	48,292
Butler	14,341	14,405	14,434	14,445	14,481	14,517	14,553	14,589	14,625	14,660	14,696
Chester	29,164	29,238	29,313	29,387	29,469	29,548	29,631	29,714	29,797	29,880	29,962
Delaware	42,232	42,325	42,429	42,502	42,600	42,697	42,789	42,883	42,976	43,070	43,165
Lackawanna	14,457	14,512	14,541	14,555	14,592	14,628	14,664	14,702	14,737	14,772	14,807
Lancaster	45,127	45,247	45,335	45,397	45,508	45,612	45,717	45,819	45,921	46,021	46,122
Lehigh	31,683	31,791	31,867	31,926	32,005	32,087	32,164	32,245	32,325	32,404	32,483
Luzerne	25,530	25,614	25,687	25,713	25,765	25,817	25,869	25,920	25,971	26,022	26,074
Monroe	10,209	10,257	10,326	10,346	10,397	10,449	10,502	10,554	10,608	10,661	10,718
Montgomery	55,927	56,065	56,232	56,338	56,495	56,650	56,805	56,956	57,101	57,252	57,397
Northampton	27,898	28,001	28,076	28,136	28,217	28,299	28,375	28,454	28,532	28,609	28,686
Philadelphia	121,881	122,120	122,359	122,598	122,873	123,150	123,429	123,705	123,980	124,258	124,535
Westmoreland	27,494	27,570	27,612	27,646	27,699	27,753	27,807	27,857	27,910	27,960	28,011
York	36,923	37,029	37,115	37,166	37,252	37,336	37,418	37,500	37,582	37,666	37,746

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:											
	3/12	3/13	3/14	3/15	3/17				3/19				3/21			
Allegheny	79,450	79,779	79,930	80,054	80,499	(16,100)	[3,864]	{1,932}	80,937	(16,187)	[3,885]	{1,942}	81,377	(16,275)	[3,906]	{1,953}
Berks	36,951	37,061	37,166	37,228	37,437	(7,487)	[1,797]	{898}	37,650	(7,530)	[1,807]	{904}	37,868	(7,574)	[1,818]	{909}
Bucks	46,894	47,060	47,183	47,280	47,574	(9,515)	[2,284]	{1,142}	47,866	(9,573)	[2,298]	{1,149}	48,152	(9,630)	[2,311]	{1,156}
Butler	14,341	14,405	14,434	14,445	14,517	(2,903)	[697]	{348}	14,589	(2,918)	[700]	{350}	14,660	(2,932)	[704]	{352}
Chester	29,164	29,238	29,313	29,387	29,548	(5,910)	[1,418]	{709}	29,714	(5,943)	[1,426]	{713}	29,880	(5,976)	[1,434]	{717}
Delaware	42,232	42,325	42,429	42,502	42,697	(8,539)	[2,049]	{1,025}	42,883	(8,577)	[2,058]	{1,029}	43,070	(8,614)	[2,067]	{1,034}
Lackawanna	14,457	14,512	14,541	14,555	14,628	(2,926)	[702]	{351}	14,702	(2,940)	[706]	{353}	14,772	(2,954)	[709]	{355}
Lancaster	45,127	45,247	45,335	45,397	45,612	(9,122)	[2,189]	{1,095}	45,819	(9,164)	[2,199]	{1,100}	46,021	(9,204)	[2,209]	{1,104}
Lehigh	31,683	31,791	31,867	31,926	32,087	(6,417)	[1,540]	{770}	32,245	(6,449)	[1,548]	{774}	32,404	(6,481)	[1,555]	{778}
Luzerne	25,530	25,614	25,687	25,713	25,817	(5,163)	[1,239]	{620}	25,920	(5,184)	[1,244]	{622}	26,022	(5,204)	[1,249]	{625}
Monroe	10,209	10,257	10,326	10,346	10,449	(2,090)	[502]	{251}	10,554	(2,111)	[507]	{253}	10,661	(2,132)	[512]	{256}
Montgomery	55,927	56,065	56,232	56,338	56,650	(11,330)	[2,719]	{1,360}	56,956	(11,391)	[2,734]	{1,367}	57,252	(11,450)	[2,748]	{1,374}
Northampton	27,898	28,001	28,076	28,136	28,299	(5,660)	[1,358]	{679}	28,454	(5,691)	[1,366]	{683}	28,609	(5,722)	[1,373]	{687}
Philadelphia	121,881	122,120	122,359	122,598	123,150	(24,630)	[5,911]	{2,956}	123,705	(24,741)	[5,938]	{2,969}	124,258	(24,852)	[5,964]	{2,982}
Westmoreland	27,494	27,570	27,612	27,646	27,753	(5,551)	[1,332]	{666}	27,857	(5,571)	[1,337]	{669}	27,960	(5,592)	[1,342]	{671}
York	36,923	37,029	37,115	37,166	37,336	(7,467)	[1,792]	{896}	37,500	(7,500)	[1,800]	{900}	37,666	(7,533)	[1,808]	{904}

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.