

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

Date: 12/8/20

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 12/8/20 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.

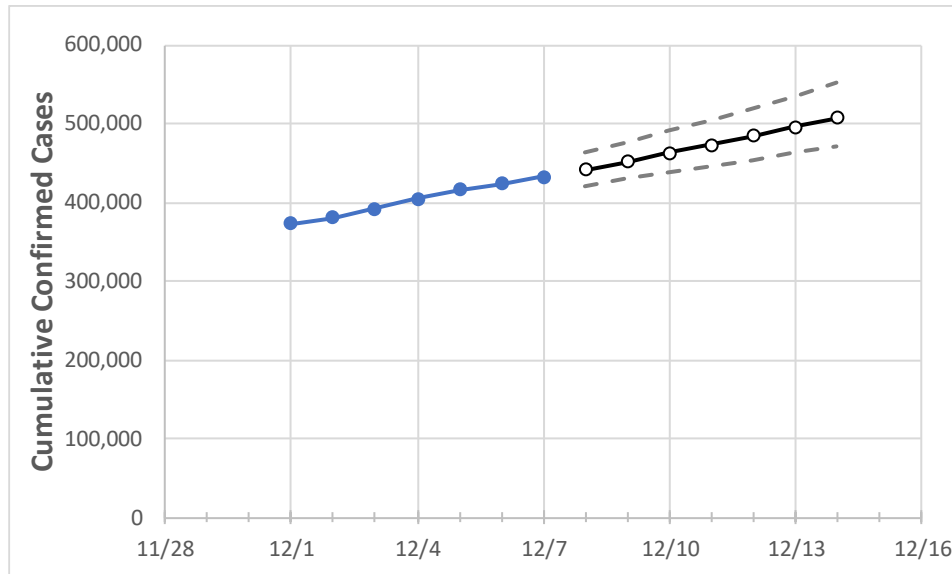
IEM's Modeling Lead

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:						
	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14
Pennsylvania	404,521	415,635	423,100	432,207	441,961	452,008	462,358	473,018	483,997	495,303	506,945

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 20%, and are often within 10%, of actual confirmed cases.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14
Allegheny	31,454	32,651	33,505	34,121	34,990	35,889	36,818	37,779	38,772	39,799	40,860
Berks	15,136	15,514	15,791	16,049	16,302	16,563	16,831	17,108	17,392	17,685	17,986
Bucks	19,654	20,128	20,619	21,146	21,654	22,181	22,728	23,296	23,885	24,497	25,131
Butler	5,087	5,255	5,368	5,462	5,595	5,731	5,869	6,010	6,153	6,299	6,448
Chester	13,248	13,490	13,733	13,975	14,232	14,499	14,774	15,060	15,355	15,660	15,976
Delaware	21,560	21,953	22,258	22,470	22,756	23,047	23,343	23,642	23,946	24,255	24,568
Lackawanna	5,588	5,729	5,789	5,856	5,953	6,054	6,160	6,269	6,383	6,502	6,625
Lancaster	18,478	18,904	19,182	19,426	19,844	20,272	20,712	21,163	21,627	22,102	22,590
Lehigh	12,554	12,930	13,200	13,455	13,716	13,985	14,261	14,545	14,837	15,137	15,446
Luzerne	10,758	11,071	11,292	11,476	11,724	11,980	12,243	12,514	12,793	13,079	13,374
Monroe	3,802	3,918	4,010	4,072	4,162	4,255	4,352	4,453	4,558	4,668	4,782
Montgomery	23,916	24,495	25,008	25,277	25,710	26,156	26,613	27,083	27,567	28,063	28,573
Northampton	10,036	10,327	10,539	10,767	11,002	11,245	11,498	11,759	12,031	12,312	12,603
Philadelphia	72,314	73,234	74,153	75,073	76,050	77,038	78,037	79,047	80,068	81,101	82,145
Westmoreland	10,455	10,892	11,177	11,414	11,735	12,066	12,407	12,759	13,121	13,494	13,879
York	12,777	13,573	13,845	13,967	14,310	14,668	15,044	15,436	15,847	16,277	16,726

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:											
	12/4	12/5	12/6	12/7	12/9			12/11			12/13					
Allegheny	31,454	32,651	33,505	34,121	35,889	(7,178)	[1,723]	{861}	37,779	(7,556)	[1,813]	{907}	39,799	(7,960)	[1,910]	{955}
Berks	15,136	15,514	15,791	16,049	16,563	(3,313)	[795]	{398}	17,108	(3,422)	[821]	{411}	17,685	(3,537)	[849]	{424}
Bucks	19,654	20,128	20,619	21,146	22,181	(4,436)	[1,065]	{532}	23,296	(4,659)	[1,118]	{559}	24,497	(4,899)	[1,176]	{588}
Butler	5,087	5,255	5,368	5,462	5,731	(1,146)	[275]	{138}	6,010	(1,202)	[288]	{144}	6,299	(1,260)	[302]	{151}
Chester	13,248	13,490	13,733	13,975	14,499	(2,900)	[696]	{348}	15,060	(3,012)	[723]	{361}	15,660	(3,132)	[752]	{376}
Delaware	21,560	21,953	22,258	22,470	23,047	(4,609)	[1,106]	{553}	23,642	(4,728)	[1,135]	{567}	24,255	(4,851)	[1,164]	{582}
Lackawanna	5,588	5,729	5,789	5,856	6,054	(1,211)	[291]	{145}	6,269	(1,254)	[301]	{150}	6,502	(1,300)	[312]	{156}
Lancaster	18,478	18,904	19,182	19,426	20,272	(4,054)	[973]	{487}	21,163	(4,233)	[1,016]	{508}	22,102	(4,420)	[1,061]	{530}
Lehigh	12,554	12,930	13,200	13,455	13,985	(2,797)	[671]	{336}	14,545	(2,909)	[698]	{349}	15,137	(3,027)	[727]	{363}
Luzerne	10,758	11,071	11,292	11,476	11,980	(2,396)	[575]	{288}	12,514	(2,503)	[601]	{300}	13,079	(2,616)	[628]	{314}
Monroe	3,802	3,918	4,010	4,072	4,255	(851)	[204]	{102}	4,453	(891)	[214]	{107}	4,668	(934)	[224]	{112}
Montgomery	23,916	24,495	25,008	25,277	26,156	(5,231)	[1,255]	{628}	27,083	(5,417)	[1,300]	{650}	28,063	(5,613)	[1,347]	{674}
Northampton	10,036	10,327	10,539	10,767	11,245	(2,249)	[540]	{270}	11,759	(2,352)	[564]	{282}	12,312	(2,462)	[591]	{295}
Philadelphia	72,314	73,234	74,153	75,073	77,038	(15,408)	[3,698]	{1,849}	79,047	(15,809)	[3,794]	{1,897}	81,101	(16,220)	[3,893]	{1,946}
Westmoreland	10,455	10,892	11,177	11,414	12,066	(2,413)	[579]	{290}	12,759	(2,552)	[612]	{306}	13,494	(2,699)	[648]	{324}
York	12,777	13,573	13,845	13,967	14,668	(2,934)	[704]	{352}	15,436	(3,087)	[741]	{370}	16,277	(3,255)	[781]	{391}

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.