

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/2/20**

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 12/2/20 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.

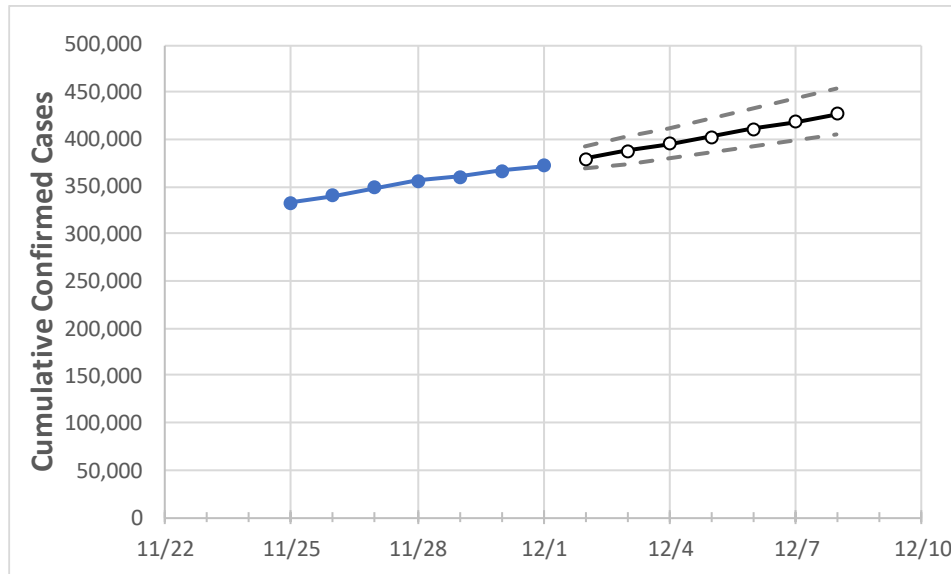
IEM's Modeling Lead

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:						
	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8
Pennsylvania	355,945	360,944	366,835	372,530	379,920	387,436	395,081	402,858	410,769	418,816	427,000

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:						
	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8
Allegheny	27,484	28,004	28,404	29,007	29,716	30,446	31,200	31,977	32,778	33,604	34,455
Berks	13,694	13,874	13,956	14,065	14,235	14,406	14,578	14,751	14,925	15,100	15,276
Bucks	17,146	17,410	17,733	17,936	18,298	18,668	19,046	19,434	19,830	20,235	20,650
Butler	4,355	4,484	4,532	4,665	4,776	4,888	5,003	5,119	5,237	5,358	5,480
Chester	11,844	11,977	12,110	12,263	12,441	12,622	12,807	12,994	13,184	13,378	13,574
Delaware	19,877	20,057	20,166	20,364	20,580	20,795	21,009	21,223	21,435	21,647	21,858
Lackawanna	5,122	5,173	5,214	5,269	5,344	5,421	5,501	5,583	5,669	5,757	5,848
Lancaster	16,157	16,470	16,702	17,012	17,381	17,760	18,152	18,555	18,970	19,397	19,837
Lehigh	11,279	11,412	11,512	11,579	11,767	11,957	12,149	12,344	12,542	12,743	12,946
Luzerne	9,435	9,656	9,760	9,886	10,076	10,268	10,464	10,664	10,866	11,072	11,281
Monroe	3,343	3,386	3,413	3,449	3,510	3,572	3,636	3,701	3,769	3,838	3,909
Montgomery	21,421	21,729	22,025	22,228	22,544	22,861	23,181	23,502	23,824	24,148	24,474
Northampton	8,903	9,000	9,104	9,199	9,362	9,527	9,694	9,864	10,037	10,212	10,389
Philadelphia	66,084	66,683	67,283	67,943	68,690	69,428	70,156	70,876	71,587	72,290	72,985
Westmoreland	8,959	9,132	9,261	9,460	9,713	9,972	10,236	10,507	10,784	11,067	11,356
York	10,806	11,001	11,202	11,338	11,569	11,807	12,053	12,306	12,566	12,834	13,110

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:											
	11/28	11/29	11/30	12/1	12/3				12/5				12/7			
Allegheny	27,484	28,004	28,404	29,007	30,446	(6,089)	[1,461]	{731}	31,977	(6,395)	[1,535]	{767}	33,604	(6,721)	[1,613]	{806}
Berks	13,694	13,874	13,956	14,065	14,406	(2,881)	[691]	{346}	14,751	(2,950)	[708]	{354}	15,100	(3,020)	[725]	{362}
Bucks	17,146	17,410	17,733	17,936	18,668	(3,734)	[896]	{448}	19,434	(3,887)	[933]	{466}	20,235	(4,047)	[971]	{486}
Butler	4,355	4,484	4,532	4,665	4,888	(978)	[235]	{117}	5,119	(1,024)	[246]	{123}	5,358	(1,072)	[257]	{129}
Chester	11,844	11,977	12,110	12,263	12,622	(2,524)	[606]	{303}	12,994	(2,599)	[624]	{312}	13,378	(2,676)	[642]	{321}
Delaware	19,877	20,057	20,166	20,364	20,795	(4,159)	[998]	{499}	21,223	(4,245)	[1,019]	{509}	21,647	(4,329)	[1,039]	{520}
Lackawanna	5,122	5,173	5,214	5,269	5,421	(1,084)	[260]	{130}	5,583	(1,117)	[268]	{134}	5,757	(1,151)	[276]	{138}
Lancaster	16,157	16,470	16,702	17,012	17,760	(3,552)	[853]	{426}	18,555	(3,711)	[891]	{445}	19,397	(3,879)	[931]	{466}
Lehigh	11,279	11,412	11,512	11,579	11,957	(2,391)	[574]	{287}	12,344	(2,469)	[593]	{296}	12,743	(2,549)	[612]	{306}
Luzerne	9,435	9,656	9,760	9,886	10,268	(2,054)	[493]	{246}	10,664	(2,133)	[512]	{256}	11,072	(2,214)	[531]	{266}
Monroe	3,343	3,386	3,413	3,449	3,572	(714)	[171]	{86}	3,701	(740)	[178]	{89}	3,838	(768)	[184]	{92}
Montgomery	21,421	21,729	22,025	22,228	22,861	(4,572)	[1,097]	{549}	23,502	(4,700)	[1,128]	{564}	24,148	(4,830)	[1,159]	{580}
Northampton	8,903	9,000	9,104	9,199	9,527	(1,905)	[457]	{229}	9,864	(1,973)	[473]	{237}	10,212	(2,042)	[490]	{245}
Philadelphia	66,084	66,683	67,283	67,943	69,428	(13,886)	[3,333]	{1,666}	70,876	(14,175)	[3,402]	{1,701}	72,290	(14,458)	[3,470]	{1,735}
Westmoreland	8,959	9,132	9,261	9,460	9,972	(1,994)	[479]	{239}	10,507	(2,101)	[504]	{252}	11,067	(2,213)	[531]	{266}
York	10,806	11,001	11,202	11,338	11,807	(2,361)	[567]	{283}	12,306	(2,461)	[591]	{295}	12,834	(2,567)	[616]	{308}

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.