

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 2/10/21**

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 2/10/21 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.

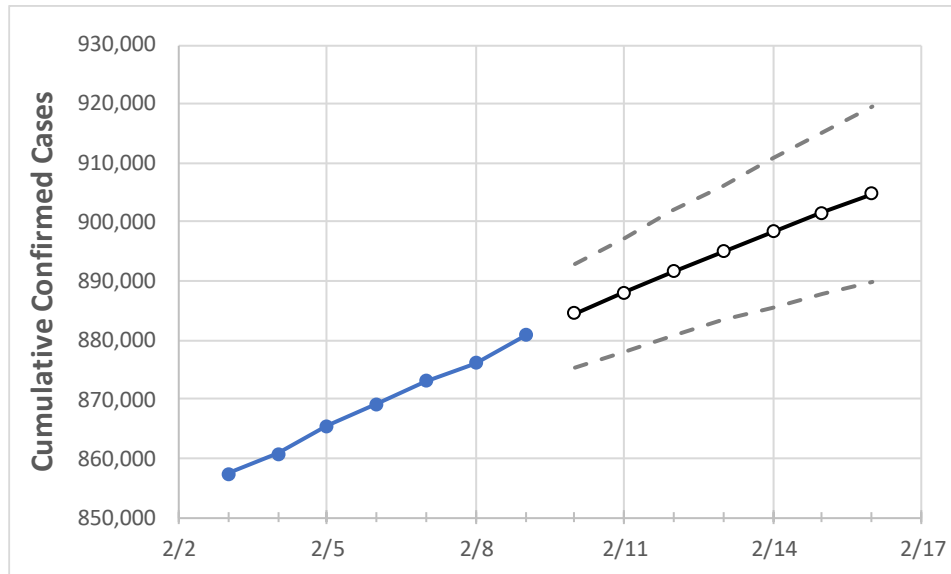
IEM's Modeling Lead

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:						
	2/6	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16
Pennsylvania	869,222	873,146	876,165	880,838	884,532	888,086	891,635	895,040	898,335	901,571	904,739

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:						
	2/6	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16
Allegheny	71,083	71,343	71,533	71,938	72,200	72,454	72,700	72,942	73,181	73,415	73,646
Berks	33,364	33,530	33,625	33,769	33,931	34,080	34,229	34,368	34,501	34,627	34,753
Bucks	41,319	41,597	41,767	41,946	42,155	42,365	42,563	42,761	42,954	43,140	43,323
Butler	13,083	13,121	13,150	13,215	13,259	13,302	13,342	13,383	13,422	13,460	13,497
Chester	26,105	26,223	26,340	26,457	26,564	26,670	26,775	26,879	26,981	27,082	27,183
Delaware	38,137	38,324	38,461	38,616	38,751	38,883	39,010	39,133	39,252	39,369	39,482
Lackawanna	12,706	12,784	12,838	12,893	12,939	12,984	13,027	13,068	13,108	13,145	13,180
Lancaster	39,798	40,175	40,309	40,554	40,827	41,093	41,355	41,624	41,891	42,145	42,405
Lehigh	28,757	28,894	28,955	29,130	29,236	29,337	29,434	29,525	29,619	29,708	29,791
Luzerne	23,419	23,527	23,602	23,662	23,755	23,844	23,932	24,018	24,097	24,179	24,257
Monroe	8,813	8,875	8,902	8,958	8,996	9,033	9,069	9,103	9,136	9,169	9,202
Montgomery	49,877	50,217	50,413	50,615	50,858	51,093	51,326	51,550	51,770	51,984	52,191
Northampton	24,147	24,327	24,388	24,613	24,746	24,880	25,008	25,136	25,267	25,389	25,507
Philadelphia	112,051	112,351	112,652	113,224	113,561	113,887	114,202	114,531	114,842	115,151	115,459
Westmoreland	25,202	25,280	25,339	25,432	25,497	25,562	25,622	25,681	25,735	25,789	25,842
York	33,074	33,314	33,466	33,618	33,800	33,984	34,153	34,320	34,487	34,643	34,805

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:											
	2/6	2/7	2/8	2/9	2/11				2/13				2/15			
Allegheny	71,083	71,343	71,533	71,938	72,454	(14,491)	[3,478]	{1,739}	72,942	(14,588)	[3,501]	{1,751}	73,415	(14,683)	[3,524]	{1,762}
Berks	33,364	33,530	33,625	33,769	34,080	(6,816)	[1,636]	{818}	34,368	(6,874)	[1,650]	{825}	34,627	(6,925)	[1,662]	{831}
Bucks	41,319	41,597	41,767	41,946	42,365	(8,473)	[2,034]	{1,017}	42,761	(8,552)	[2,053]	{1,026}	43,140	(8,628)	[2,071]	{1,035}
Butler	13,083	13,121	13,150	13,215	13,302	(2,660)	[638]	{319}	13,383	(2,677)	[642]	{321}	13,460	(2,692)	[646]	{323}
Chester	26,105	26,223	26,340	26,457	26,670	(5,334)	[1,280]	{640}	26,879	(5,376)	[1,290]	{645}	27,082	(5,416)	[1,300]	{650}
Delaware	38,137	38,324	38,461	38,616	38,883	(7,777)	[1,866]	{933}	39,133	(7,827)	[1,878]	{939}	39,369	(7,874)	[1,890]	{945}
Lackawanna	12,706	12,784	12,838	12,893	12,984	(2,597)	[623]	{312}	13,068	(2,614)	[627]	{314}	13,145	(2,629)	[631]	{315}
Lancaster	39,798	40,175	40,309	40,554	41,093	(8,219)	[1,972]	{986}	41,624	(8,325)	[1,998]	{999}	42,145	(8,429)	[2,023]	{1,011}
Lehigh	28,757	28,894	28,955	29,130	29,337	(5,867)	[1,408]	{704}	29,525	(5,905)	[1,417]	{709}	29,708	(5,942)	[1,426]	{713}
Luzerne	23,419	23,527	23,602	23,662	23,844	(4,769)	[1,145]	{572}	24,018	(4,804)	[1,153]	{576}	24,179	(4,836)	[1,161]	{580}
Monroe	8,813	8,875	8,902	8,958	9,033	(1,807)	[434]	{217}	9,103	(1,821)	[437]	{218}	9,169	(1,834)	[440]	{220}
Montgomery	49,877	50,217	50,413	50,615	51,093	(10,219)	[2,452]	{1,226}	51,550	(10,310)	[2,474]	{1,237}	51,984	(10,397)	[2,495]	{1,248}
Northampton	24,147	24,327	24,388	24,613	24,880	(4,976)	[1,194]	{597}	25,136	(5,027)	[1,207]	{603}	25,389	(5,078)	[1,219]	{609}
Philadelphia	112,051	112,351	112,652	113,224	113,887	(22,777)	[5,467]	{2,733}	114,531	(22,906)	[5,498]	{2,749}	115,151	(23,030)	[5,527]	{2,764}
Westmoreland	25,202	25,280	25,339	25,432	25,562	(5,112)	[1,227]	{613}	25,681	(5,136)	[1,233]	{616}	25,789	(5,158)	[1,238]	{619}
York	33,074	33,314	33,466	33,618	33,984	(6,797)	[1,631]	{816}	34,320	(6,864)	[1,647]	{824}	34,643	(6,929)	[1,663]	{831}

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.