

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 2/25/21**

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 2/25/21 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.

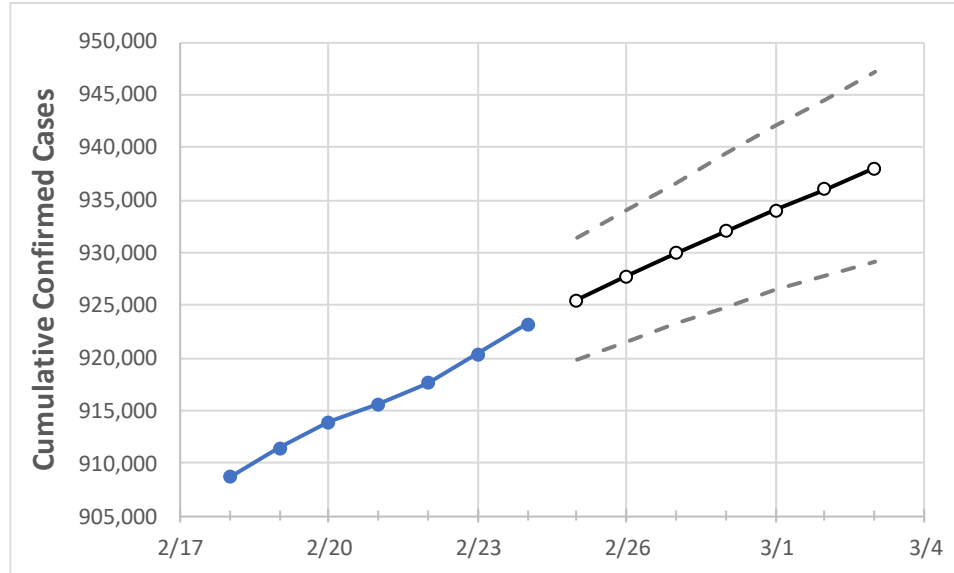
IEM's Modeling Lead

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:						
	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2	3/3
Pennsylvania	915,639	917,565	920,385	923,174	925,493	927,736	929,896	931,989	934,035	936,032	937,968

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:						
	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2	3/3
Allegheny	74,866	74,976	75,250	75,500	75,714	75,928	76,140	76,350	76,556	76,768	76,972
Berks	35,025	35,105	35,180	35,302	35,375	35,448	35,515	35,580	35,643	35,702	35,763
Bucks	43,996	44,105	44,251	44,413	44,545	44,668	44,788	44,907	45,021	45,130	45,238
Butler	13,693	13,705	13,741	13,789	13,818	13,846	13,874	13,901	13,927	13,954	13,979
Chester	27,488	27,544	27,636	27,732	27,804	27,874	27,944	28,012	28,078	28,141	28,205
Delaware	40,052	40,132	40,241	40,383	40,479	40,574	40,669	40,760	40,848	40,935	41,022
Lackawanna	13,595	13,629	13,670	13,725	13,774	13,821	13,867	13,912	13,956	14,001	14,043
Lancaster	42,740	42,843	42,945	43,120	43,248	43,368	43,487	43,602	43,710	43,812	43,914
Lehigh	30,179	30,230	30,315	30,391	30,454	30,515	30,571	30,630	30,685	30,739	30,789
Luzerne	24,505	24,543	24,593	24,666	24,718	24,767	24,814	24,861	24,907	24,951	24,991
Monroe	9,417	9,435	9,488	9,520	9,552	9,583	9,614	9,645	9,675	9,703	9,732
Montgomery	52,748	52,898	53,049	53,231	53,366	53,503	53,631	53,756	53,879	53,997	54,114
Northampton	26,143	26,208	26,356	26,453	26,555	26,660	26,760	26,858	26,952	27,045	27,139
Philadelphia	116,565	116,726	117,022	117,318	117,538	117,758	117,974	118,180	118,382	118,579	118,773
Westmoreland	26,325	26,351	26,429	26,497	26,557	26,618	26,677	26,735	26,792	26,848	26,903
York	35,185	35,231	35,332	35,447	35,540	35,629	35,718	35,804	35,888	35,965	36,042

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:											
	2/21	2/22	2/23	2/24	2/26			2/28			3/2					
Allegheny	74,866	74,976	75,250	75,500	75,928	(15,186)	[3,645]	{1,822}	76,350	(15,270)	[3,665]	{1,832}	76,768	(15,354)	[3,685]	{1,842}
Berks	35,025	35,105	35,180	35,302	35,448	(7,090)	[1,701]	{851}	35,580	(7,116)	[1,708]	{854}	35,702	(7,140)	[1,714]	{857}
Bucks	43,996	44,105	44,251	44,413	44,668	(8,934)	[2,144]	{1,072}	44,907	(8,981)	[2,156]	{1,078}	45,130	(9,026)	[2,166]	{1,083}
Butler	13,693	13,705	13,741	13,789	13,846	(2,769)	[665]	{332}	13,901	(2,780)	[667]	{334}	13,954	(2,791)	[670]	{335}
Chester	27,488	27,544	27,636	27,732	27,874	(5,575)	[1,338]	{669}	28,012	(5,602)	[1,345]	{672}	28,141	(5,628)	[1,351]	{675}
Delaware	40,052	40,132	40,241	40,383	40,574	(8,115)	[1,948]	{974}	40,760	(8,152)	[1,956]	{978}	40,935	(8,187)	[1,965]	{982}
Lackawanna	13,595	13,629	13,670	13,725	13,821	(2,764)	[663]	{332}	13,912	(2,782)	[668]	{334}	14,001	(2,800)	[672]	{336}
Lancaster	42,740	42,843	42,945	43,120	43,368	(8,674)	[2,082]	{1,041}	43,602	(8,720)	[2,093]	{1,046}	43,812	(8,762)	[2,103]	{1,051}
Lehigh	30,179	30,230	30,315	30,391	30,515	(6,103)	[1,465]	{732}	30,630	(6,126)	[1,470]	{735}	30,739	(6,148)	[1,475]	{738}
Luzerne	24,505	24,543	24,593	24,666	24,767	(4,953)	[1,189]	{594}	24,861	(4,972)	[1,193]	{597}	24,951	(4,990)	[1,198]	{599}
Monroe	9,417	9,435	9,488	9,520	9,583	(1,917)	[460]	{230}	9,645	(1,929)	[463]	{231}	9,703	(1,941)	[466]	{233}
Montgomery	52,748	52,898	53,049	53,231	53,503	(10,701)	[2,568]	{1,284}	53,756	(10,751)	[2,580]	{1,290}	53,997	(10,799)	[2,592]	{1,296}
Northampton	26,143	26,208	26,356	26,453	26,660	(5,332)	[1,280]	{640}	26,858	(5,372)	[1,289]	{645}	27,045	(5,409)	[1,298]	{649}
Philadelphia	116,565	116,726	117,022	117,318	117,758	(23,552)	[5,652]	{2,826}	118,180	(23,636)	[5,673]	{2,836}	118,579	(23,716)	[5,692]	{2,846}
Westmoreland	26,325	26,351	26,429	26,497	26,618	(5,324)	[1,278]	{639}	26,735	(5,347)	[1,283]	{642}	26,848	(5,370)	[1,289]	{644}
York	35,185	35,231	35,332	35,447	35,629	(7,126)	[1,710]	{855}	35,804	(7,161)	[1,719]	{859}	35,965	(7,193)	[1,726]	{863}

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.