

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

Date: 2/4/21

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 2/4/21 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.

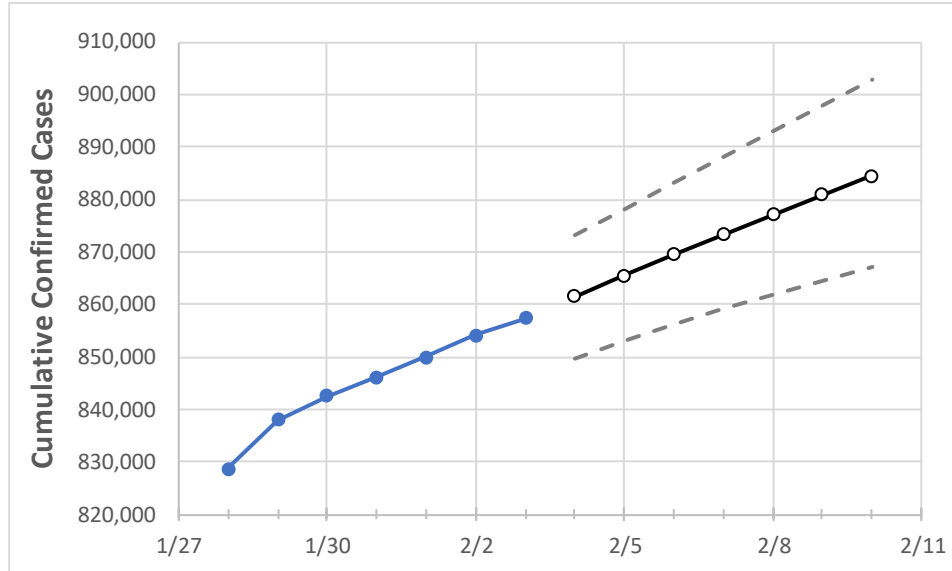
IEM's Modeling Lead

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:						
	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10
Pennsylvania	846,046	849,966	854,197	857,332	861,466	865,509	869,466	873,327	877,105	880,850	884,585

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:						
	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10
Allegheny	69,368	69,537	69,837	70,165	70,419	70,668	70,905	71,138	71,359	71,579	71,786
Berks	32,577	32,713	32,843	32,957	33,205	33,454	33,694	33,933	34,174	34,410	34,645
Bucks	40,193	40,349	40,522	40,698	40,942	41,185	41,428	41,665	41,905	42,132	42,358
Butler	12,736	12,773	12,852	12,906	12,957	13,005	13,051	13,098	13,142	13,185	13,227
Chester	25,452	25,574	25,678	25,762	25,862	25,958	26,052	26,142	26,229	26,315	26,397
Delaware	37,339	37,443	37,617	37,727	37,890	38,047	38,202	38,356	38,504	38,649	38,792
Lackawanna	12,398	12,433	12,497	12,544	12,603	12,657	12,710	12,764	12,811	12,859	12,904
Lancaster	38,485	38,660	38,895	39,065	39,355	39,642	39,933	40,216	40,507	40,791	41,074
Lehigh	28,135	28,240	28,357	28,427	28,563	28,702	28,835	28,962	29,087	29,209	29,327
Luzerne	22,882	22,951	23,026	23,068	23,187	23,304	23,423	23,538	23,650	23,758	23,865
Monroe	8,595	8,639	8,683	8,713	8,761	8,808	8,854	8,898	8,943	8,985	9,027
Montgomery	48,612	48,832	49,117	49,270	49,573	49,872	50,166	50,454	50,737	51,024	51,301
Northampton	23,443	23,585	23,716	23,799	23,967	24,137	24,305	24,475	24,637	24,797	24,956
Philadelphia	109,925	110,272	110,793	111,098	111,455	111,802	112,150	112,490	112,819	113,146	113,469
Westmoreland	24,703	24,766	24,883	24,998	25,070	25,135	25,197	25,255	25,313	25,369	25,425
York	32,142	32,263	32,464	32,578	32,797	33,005	33,216	33,424	33,632	33,835	34,026

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:											
	1/31	2/1	2/2	2/3	2/5			2/7			2/9					
Allegheny	69,368	69,537	69,837	70,165	70,668	(14,134)	[3,392]	{1,696}	71,138	(14,228)	[3,415]	{1,707}	71,579	(14,316)	[3,436]	{1,718}
Berks	32,577	32,713	32,843	32,957	33,454	(6,691)	[1,606]	{803}	33,933	(6,787)	[1,629]	{814}	34,410	(6,882)	[1,652]	{826}
Bucks	40,193	40,349	40,522	40,698	41,185	(8,237)	[1,977]	{988}	41,665	(8,333)	[2,000]	{1,000}	42,132	(8,426)	[2,022]	{1,011}
Butler	12,736	12,773	12,852	12,906	13,005	(2,601)	[624]	{312}	13,098	(2,620)	[629]	{314}	13,185	(2,637)	[633]	{316}
Chester	25,452	25,574	25,678	25,762	25,958	(5,192)	[1,246]	{623}	26,142	(5,228)	[1,255]	{627}	26,315	(5,263)	[1,263]	{632}
Delaware	37,339	37,443	37,617	37,727	38,047	(7,609)	[1,826]	{913}	38,356	(7,671)	[1,841]	{921}	38,649	(7,730)	[1,855]	{928}
Lackawanna	12,398	12,433	12,497	12,544	12,657	(2,531)	[608]	{304}	12,764	(2,553)	[613]	{306}	12,859	(2,572)	[617]	{309}
Lancaster	38,485	38,660	38,895	39,065	39,642	(7,928)	[1,903]	{951}	40,216	(8,043)	[1,930]	{965}	40,791	(8,158)	[1,958]	{979}
Lehigh	28,135	28,240	28,357	28,427	28,702	(5,740)	[1,378]	{689}	28,962	(5,792)	[1,390]	{695}	29,209	(5,842)	[1,402]	{701}
Luzerne	22,882	22,951	23,026	23,068	23,304	(4,661)	[1,119]	{559}	23,538	(4,708)	[1,130]	{565}	23,758	(4,752)	[1,140]	{570}
Monroe	8,595	8,639	8,683	8,713	8,808	(1,762)	[423]	{211}	8,898	(1,780)	[427]	{214}	8,985	(1,797)	[431]	{216}
Montgomery	48,612	48,832	49,117	49,270	49,872	(9,974)	[2,394]	{1,197}	50,454	(10,091)	[2,422]	{1,211}	51,024	(10,205)	[2,449]	{1,225}
Northampton	23,443	23,585	23,716	23,799	24,137	(4,827)	[1,159]	{579}	24,475	(4,895)	[1,175]	{587}	24,797	(4,959)	[1,190]	{595}
Philadelphia	109,925	110,272	110,793	111,098	111,802	(22,360)	[5,366]	{2,683}	112,490	(22,498)	[5,400]	{2,700}	113,146	(22,629)	[5,431]	{2,716}
Westmoreland	24,703	24,766	24,883	24,998	25,135	(5,027)	[1,206]	{603}	25,255	(5,051)	[1,212]	{606}	25,369	(5,074)	[1,218]	{609}
York	32,142	32,263	32,464	32,578	33,005	(6,601)	[1,584]	{792}	33,424	(6,685)	[1,604]	{802}	33,835	(6,767)	[1,624]	{812}

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.