

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

Date: 3/25/21

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 3/25/21 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.

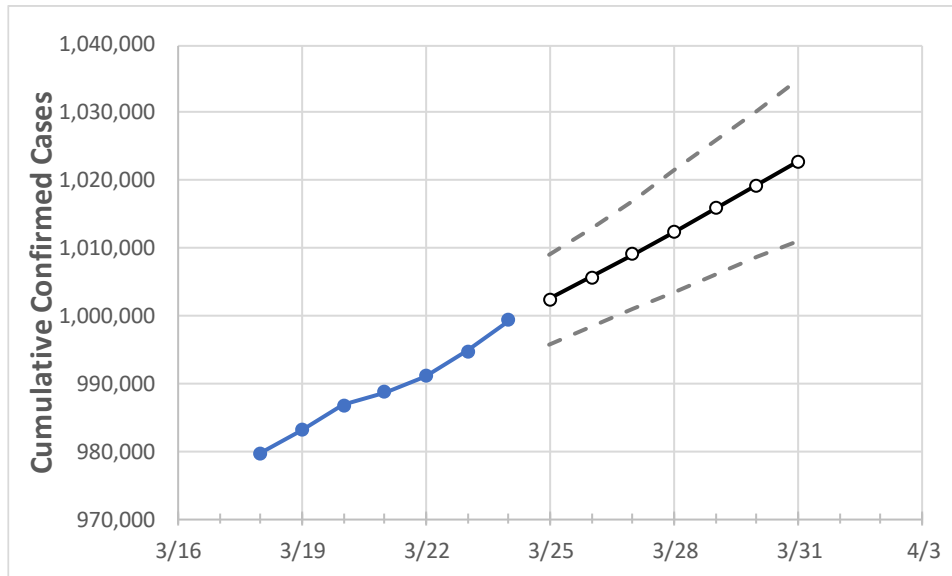
IEM's Modeling Lead

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:						
	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30	3/31

Pennsylvania 988,656 991,089 994,694 999,311 1,002,495 1,005,690 1,009,030 1,012,373 1,015,830 1,019,256 1,022,789

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:						
	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30	3/31
Allegheny	81,912	82,080	82,444	82,942	83,269	83,601	83,942	84,291	84,647	85,010	85,367
Berks	38,174	38,226	38,374	38,650	38,797	38,949	39,102	39,263	39,429	39,600	39,780
Bucks	48,532	48,633	48,801	49,132	49,325	49,517	49,712	49,909	50,111	50,313	50,527
Butler	14,708	14,730	14,795	14,869	14,919	14,968	15,021	15,072	15,124	15,177	15,233
Chester	30,054	30,149	30,259	30,384	30,496	30,609	30,724	30,838	30,957	31,076	31,194
Delaware	43,191	43,248	43,357	43,530	43,636	43,743	43,849	43,956	44,064	44,160	44,265
Lackawanna	14,889	14,908	14,976	15,076	15,128	15,182	15,235	15,289	15,344	15,401	15,458
Lancaster	46,207	46,275	46,403	46,596	46,723	46,849	46,977	47,101	47,225	47,356	47,482
Lehigh	32,603	32,671	32,828	32,996	33,123	33,255	33,392	33,530	33,671	33,817	33,965
Luzerne	26,158	26,204	26,254	26,376	26,454	26,532	26,611	26,691	26,776	26,862	26,949
Monroe	10,738	10,761	10,824	10,904	10,966	11,029	11,093	11,160	11,229	11,301	11,374
Montgomery	57,547	57,655	57,799	58,076	58,260	58,444	58,628	58,815	59,001	59,189	59,382
Northampton	28,907	28,955	29,150	29,341	29,479	29,625	29,770	29,921	30,077	30,233	30,391
Philadelphia	125,115	125,428	126,122	126,609	127,046	127,495	127,954	128,422	128,904	129,398	129,893
Westmoreland	28,171	28,221	28,326	28,429	28,513	28,597	28,684	28,770	28,856	28,944	29,036
York	37,964	38,027	38,120	38,367	38,495	38,623	38,752	38,887	39,022	39,164	39,305

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:											
	3/21	3/22	3/23	3/24	3/26			3/28			3/30					
Allegheny	81,912	82,080	82,444	82,942	83,601	(16,720)	[4,013]	{2,006}	84,291	(16,858)	[4,046]	{2,023}	85,010	(17,002)	[4,080]	{2,040}
Berks	38,174	38,226	38,374	38,650	38,949	(7,790)	[1,870]	{935}	39,263	(7,853)	[1,885]	{942}	39,600	(7,920)	[1,901]	{950}
Bucks	48,532	48,633	48,801	49,132	49,517	(9,903)	[2,377]	{1,188}	49,909	(9,982)	[2,396]	{1,198}	50,313	(10,063)	[2,415]	{1,208}
Butler	14,708	14,730	14,795	14,869	14,968	(2,994)	[718]	{359}	15,072	(3,014)	[723]	{362}	15,177	(3,035)	[728]	{364}
Chester	30,054	30,149	30,259	30,384	30,609	(6,122)	[1,469]	{735}	30,838	(6,168)	[1,480]	{740}	31,076	(6,215)	[1,492]	{746}
Delaware	43,191	43,248	43,357	43,530	43,743	(8,749)	[2,100]	{1,050}	43,956	(8,791)	[2,110]	{1,055}	44,160	(8,832)	[2,120]	{1,060}
Lackawanna	14,889	14,908	14,976	15,076	15,182	(3,036)	[729]	{364}	15,289	(3,058)	[734]	{367}	15,401	(3,080)	[739]	{370}
Lancaster	46,207	46,275	46,403	46,596	46,849	(9,370)	[2,249]	{1,124}	47,101	(9,420)	[2,261]	{1,130}	47,356	(9,471)	[2,273]	{1,137}
Lehigh	32,603	32,671	32,828	32,996	33,255	(6,651)	[1,596]	{798}	33,530	(6,706)	[1,609]	{805}	33,817	(6,763)	[1,623]	{812}
Luzerne	26,158	26,204	26,254	26,376	26,532	(5,306)	[1,274]	{637}	26,691	(5,338)	[1,281]	{641}	26,862	(5,372)	[1,289]	{645}
Monroe	10,738	10,761	10,824	10,904	11,029	(2,206)	[529]	{265}	11,160	(2,232)	[536]	{268}	11,301	(2,260)	[542]	{271}
Montgomery	57,547	57,655	57,799	58,076	58,444	(11,689)	[2,805]	{1,403}	58,815	(11,763)	[2,823]	{1,412}	59,189	(11,838)	[2,841]	{1,421}
Northampton	28,907	28,955	29,150	29,341	29,625	(5,925)	[1,422]	{711}	29,921	(5,984)	[1,436]	{718}	30,233	(6,047)	[1,451]	{726}
Philadelphia	125,115	125,428	126,122	126,609	127,495	(25,499)	[6,120]	{3,060}	128,422	(25,684)	[6,164]	{3,082}	129,398	(25,880)	[6,211]	{3,106}
Westmoreland	28,171	28,221	28,326	28,429	28,597	(5,719)	[1,373]	{686}	28,770	(5,754)	[1,381]	{690}	28,944	(5,789)	[1,389]	{695}
York	37,964	38,027	38,120	38,367	38,623	(7,725)	[1,854]	{927}	38,887	(7,777)	[1,867]	{933}	39,164	(7,833)	[1,880]	{940}

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.