

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

Date: 3/22/21

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 3/22/21 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.**

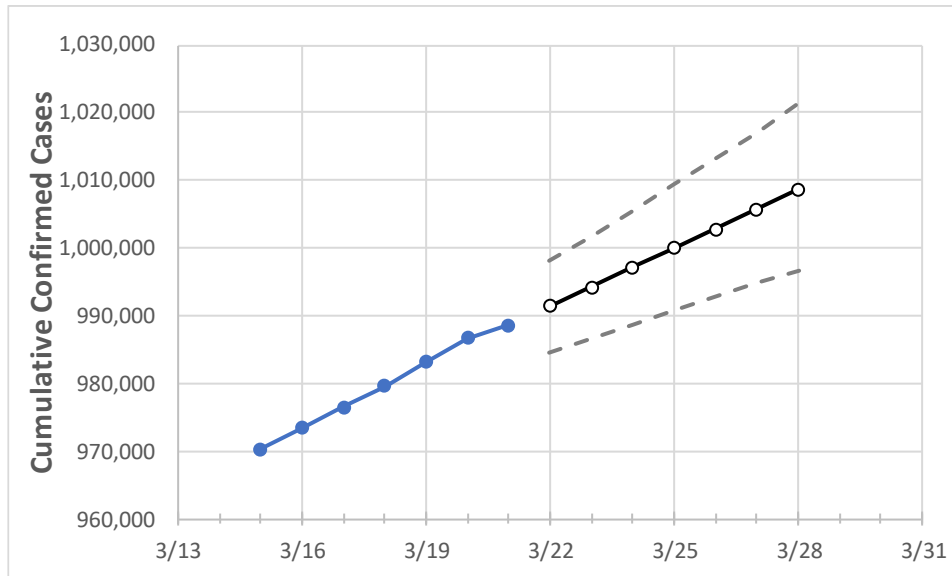
### IEM's Modeling Lead

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:							
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	

Pennsylvania 979,638 983,109 986,712 988,656 991,462 994,286 997,127 1,000,003 1,002,844 1,005,793 1,008,713

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:							
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	
Allegheny	80,941	81,287	81,655	81,912	82,193	82,479	82,770	83,062	83,352	83,651	83,944	
Berks	37,631	37,768	38,084	38,174	38,326	38,478	38,632	38,799	38,966	39,139	39,318	
Bucks	47,800	48,000	48,358	48,532	48,724	48,917	49,116	49,319	49,524	49,731	49,937	
Butler	14,602	14,645	14,684	14,708	14,753	14,800	14,846	14,893	14,939	14,988	15,038	
Chester	29,747	29,863	29,863	29,863	29,968	30,075	30,184	30,296	30,410	30,525	30,636	
Delaware	42,772	42,897	43,081	43,191	43,293	43,392	43,492	43,592	43,690	43,787	43,889	
Lackawanna	14,730	14,788	14,857	14,889	14,936	14,985	15,033	15,081	15,130	15,180	15,229	
Lancaster	45,838	45,968	46,125	46,207	46,328	46,452	46,574	46,696	46,820	46,945	47,069	
Lehigh	32,236	32,400	32,528	32,603	32,717	32,834	32,954	33,077	33,203	33,332	33,463	
Luzerne	25,922	25,972	26,092	26,158	26,228	26,300	26,371	26,444	26,519	26,595	26,675	
Monroe	10,546	10,634	10,688	10,738	10,804	10,873	10,942	11,015	11,088	11,162	11,239	
Montgomery	56,841	57,055	57,387	57,547	57,717	57,887	58,054	58,228	58,399	58,573	58,753	
Northampton	28,482	28,639	28,822	28,907	29,024	29,143	29,261	29,385	29,511	29,639	29,766	
Philadelphia	123,959	124,489	124,489	124,489	124,869	125,251	125,632	126,033	126,434	126,853	127,260	
Westmoreland	27,890	28,013	28,094	28,171	28,247	28,325	28,403	28,483	28,566	28,649	28,731	
York	37,544	37,680	37,881	37,964	38,086	38,213	38,341	38,470	38,604	38,741	38,882	

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:											
	3/18	3/19	3/20	3/21	3/23			3/25			3/27					
Allegheny	80,941	81,287	81,655	81,912	82,479	(16,496)	[3,959]	{1,979}	83,062	(16,612)	[3,987]	{1,993}	83,651	(16,730)	[4,015]	{2,008}
Berks	37,631	37,768	38,084	38,174	38,478	(7,696)	[1,847]	{923}	38,799	(7,760)	[1,862]	{931}	39,139	(7,828)	[1,879]	{939}
Bucks	47,800	48,000	48,358	48,532	48,917	(9,783)	[2,348]	{1,174}	49,319	(9,864)	[2,367]	{1,184}	49,731	(9,946)	[2,387]	{1,194}
Butler	14,602	14,645	14,684	14,708	14,800	(2,960)	[710]	{355}	14,893	(2,979)	[715]	{357}	14,988	(2,998)	[719]	{360}
Chester	29,747	29,863	29,863	29,863	30,075	(6,015)	[1,444]	{722}	30,296	(6,059)	[1,454]	{727}	30,525	(6,105)	[1,465]	{733}
Delaware	42,772	42,897	43,081	43,191	43,392	(8,678)	[2,083]	{1,041}	43,592	(8,718)	[2,092]	{1,046}	43,787	(8,757)	[2,102]	{1,051}
Lackawanna	14,730	14,788	14,857	14,889	14,985	(2,997)	[719]	{360}	15,081	(3,016)	[724]	{362}	15,180	(3,036)	[729]	{364}
Lancaster	45,838	45,968	46,125	46,207	46,452	(9,290)	[2,230]	{1,115}	46,696	(9,339)	[2,241]	{1,121}	46,945	(9,389)	[2,253]	{1,127}
Lehigh	32,236	32,400	32,528	32,603	32,834	(6,567)	[1,576]	{788}	33,077	(6,615)	[1,588]	{794}	33,332	(6,666)	[1,600]	{800}
Luzerne	25,922	25,972	26,092	26,158	26,300	(5,260)	[1,262]	{631}	26,444	(5,289)	[1,269]	{635}	26,595	(5,319)	[1,277]	{638}
Monroe	10,546	10,634	10,688	10,738	10,873	(2,175)	[522]	{261}	11,015	(2,203)	[529]	{264}	11,162	(2,232)	[536]	{268}
Montgomery	56,841	57,055	57,387	57,547	57,887	(11,577)	[2,779]	{1,389}	58,228	(11,646)	[2,795]	{1,397}	58,573	(11,715)	[2,812]	{1,406}
Northampton	28,482	28,639	28,822	28,907	29,143	(5,829)	[1,399]	{699}	29,385	(5,877)	[1,410]	{705}	29,639	(5,928)	[1,423]	{711}
Philadelphia	123,959	124,489	124,489	124,489	125,251	(25,050)	[6,012]	{3,006}	126,033	(25,207)	[6,050]	{3,025}	126,853	(25,371)	[6,089]	{3,044}
Westmoreland	27,890	28,013	28,094	28,171	28,325	(5,665)	[1,360]	{680}	28,483	(5,697)	[1,367]	{684}	28,649	(5,730)	[1,375]	{688}
York	37,544	37,680	37,881	37,964	38,213	(7,643)	[1,834]	{917}	38,470	(7,694)	[1,847]	{923}	38,741	(7,748)	[1,860]	{930}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.