

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

Date: 3/23/21

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 3/23/21 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.**

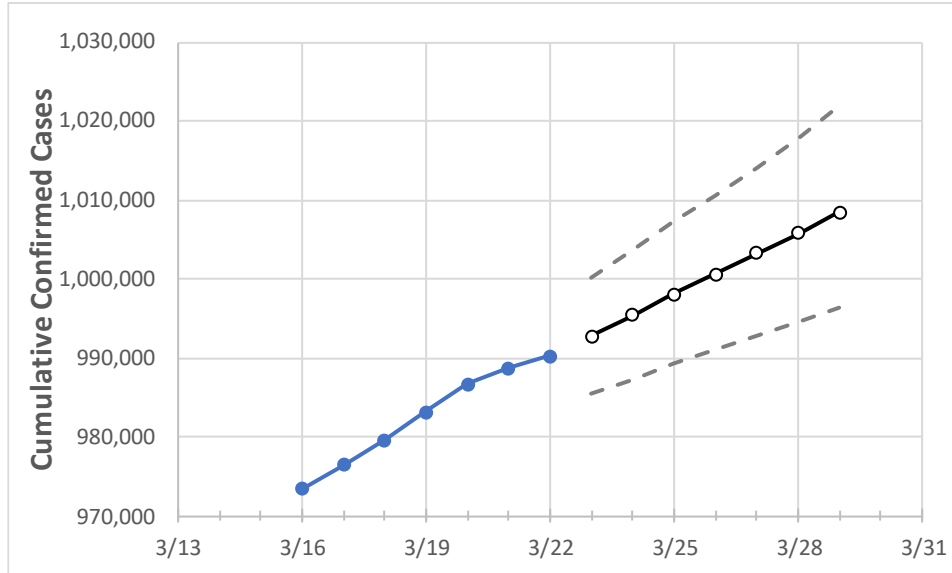
### IEM's Modeling Lead

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:						
	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29

Pennsylvania 983,109 986,712 988,656 990,150 992,736 995,436 998,010 1,000,623 1,003,228 1,005,833 1,008,410

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:						
	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29
Allegheny	81,287	81,655	81,912	82,080	82,350	82,628	82,921	83,201	83,483	83,765	84,064
Berks	37,768	38,084	38,174	38,226	38,368	38,512	38,661	38,812	38,964	39,118	39,273
Bucks	48,000	48,358	48,532	48,633	48,816	48,998	49,182	49,370	49,560	49,754	49,941
Butler	14,645	14,684	14,708	14,730	14,772	14,814	14,858	14,903	14,946	14,990	15,035
Chester	29,863	29,958	30,054	30,149	30,254	30,360	30,468	30,578	30,689	30,801	30,913
Delaware	42,897	43,081	43,191	43,248	43,346	43,445	43,543	43,640	43,738	43,836	43,931
Lackawanna	14,788	14,857	14,889	14,908	14,953	14,997	15,041	15,085	15,129	15,173	15,218
Lancaster	45,968	46,125	46,207	46,275	46,390	46,501	46,614	46,728	46,841	46,956	47,067
Lehigh	32,400	32,528	32,603	32,671	32,782	32,893	33,005	33,118	33,236	33,354	33,476
Luzerne	25,972	26,092	26,158	26,204	26,272	26,342	26,415	26,489	26,561	26,637	26,714
Monroe	10,634	10,688	10,738	10,761	10,822	10,883	10,945	11,009	11,072	11,140	11,207
Montgomery	57,055	57,387	57,547	57,655	57,829	58,002	58,177	58,354	58,533	58,712	58,894
Northampton	28,639	28,822	28,907	28,955	29,062	29,172	29,284	29,397	29,512	29,629	29,743
Philadelphia	124,489	124,489	124,489	124,489	124,855	125,216	125,606	125,975	126,367	126,771	127,170
Westmoreland	28,013	28,094	28,171	28,221	28,294	28,367	28,443	28,518	28,593	28,668	28,743
York	37,680	37,881	37,964	38,027	38,146	38,268	38,391	38,515	38,639	38,768	38,901

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:											
	3/19	3/20	3/21	3/22	3/24			3/26			3/28					
Allegheny	81,287	81,655	81,912	82,080	82,628	(16,526)	[3,966]	{1,983}	83,201	(16,640)	[3,994]	{1,997}	83,765	(16,753)	[4,021]	{2,010}
Berks	37,768	38,084	38,174	38,226	38,512	(7,702)	[1,849]	{924}	38,812	(7,762)	[1,863]	{931}	39,118	(7,824)	[1,878]	{939}
Bucks	48,000	48,358	48,532	48,633	48,998	(9,800)	[2,352]	{1,176}	49,370	(9,874)	[2,370]	{1,185}	49,754	(9,951)	[2,388]	{1,194}
Butler	14,645	14,684	14,708	14,730	14,814	(2,963)	[711]	{356}	14,903	(2,981)	[715]	{358}	14,990	(2,998)	[720]	{360}
Chester	29,863	29,958	30,054	30,149	30,360	(6,072)	[1,457]	{729}	30,578	(6,116)	[1,468]	{734}	30,801	(6,160)	[1,478]	{739}
Delaware	42,897	43,081	43,191	43,248	43,445	(8,689)	[2,085]	{1,043}	43,640	(8,728)	[2,095]	{1,047}	43,836	(8,767)	[2,104]	{1,052}
Lackawanna	14,788	14,857	14,889	14,908	14,997	(2,999)	[720]	{360}	15,085	(3,017)	[724]	{362}	15,173	(3,035)	[728]	{364}
Lancaster	45,968	46,125	46,207	46,275	46,501	(9,300)	[2,232]	{1,116}	46,728	(9,346)	[2,243]	{1,121}	46,956	(9,391)	[2,254]	{1,127}
Lehigh	32,400	32,528	32,603	32,671	32,893	(6,579)	[1,579]	{789}	33,118	(6,624)	[1,590]	{795}	33,354	(6,671)	[1,601]	{800}
Luzerne	25,972	26,092	26,158	26,204	26,342	(5,268)	[1,264]	{632}	26,489	(5,298)	[1,271]	{636}	26,637	(5,327)	[1,279]	{639}
Monroe	10,634	10,688	10,738	10,761	10,883	(2,177)	[522]	{261}	11,009	(2,202)	[528]	{264}	11,140	(2,228)	[535]	{267}
Montgomery	57,055	57,387	57,547	57,655	58,002	(11,600)	[2,784]	{1,392}	58,354	(11,671)	[2,801]	{1,400}	58,712	(11,742)	[2,818]	{1,409}
Northampton	28,639	28,822	28,907	28,955	29,172	(5,834)	[1,400]	{700}	29,397	(5,879)	[1,411]	{706}	29,629	(5,926)	[1,422]	{711}
Philadelphia	124,489	124,489	124,489	124,489	125,216	(25,043)	[6,010]	{3,005}	125,975	(25,195)	[6,047]	{3,023}	126,771	(25,354)	[6,085]	{3,042}
Westmoreland	28,013	28,094	28,171	28,221	28,367	(5,673)	[1,362]	{681}	28,518	(5,704)	[1,369]	{684}	28,668	(5,734)	[1,376]	{688}
York	37,680	37,881	37,964	38,027	38,268	(7,654)	[1,837]	{918}	38,515	(7,703)	[1,849]	{924}	38,768	(7,754)	[1,861]	{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.