

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

Date: 3/3/21

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 3/3/21 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.**

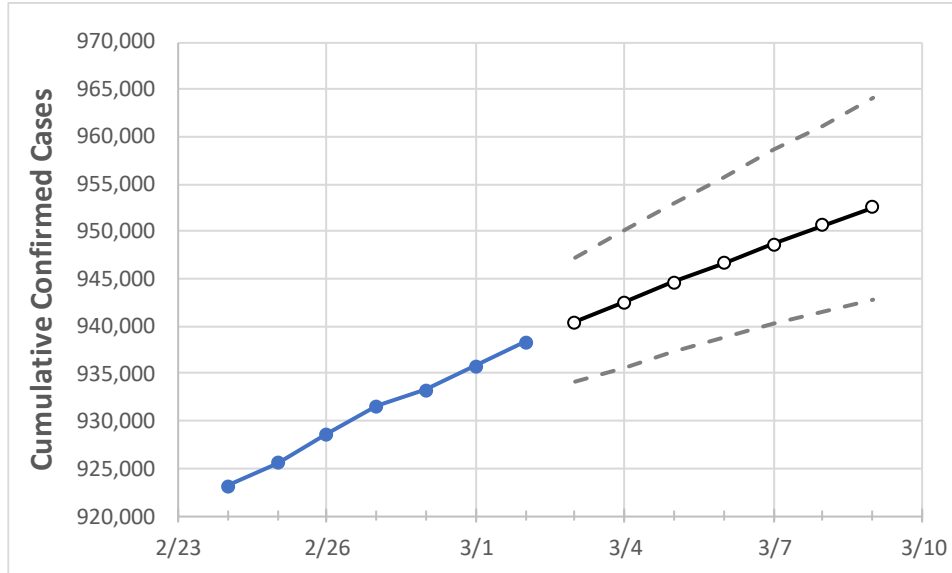
### IEM's Modeling Lead

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:						
	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9
Pennsylvania	931,531	933,261	935,822	938,296	940,458	942,565	944,650	946,691	948,678	950,635	952,578

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:						
	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9
Allegheny	76,449	76,669	76,853	77,053	77,281	77,513	77,731	77,954	78,174	78,393	78,616
Berks	35,577	35,658	35,699	35,791	35,865	35,940	36,012	36,080	36,147	36,211	36,272
Bucks	44,914	45,046	45,176	45,320	45,442	45,562	45,682	45,799	45,915	46,028	46,139
Butler	13,893	13,916	13,939	13,978	14,008	14,038	14,067	14,096	14,124	14,151	14,178
Chester	28,053	28,127	28,201	28,261	28,334	28,405	28,476	28,547	28,617	28,684	28,751
Delaware	40,849	40,957	41,033	41,132	41,237	41,342	41,445	41,544	41,646	41,744	41,841
Lackawanna	13,888	13,934	13,964	14,009	14,051	14,092	14,133	14,173	14,214	14,252	14,291
Lancaster	43,527	43,630	43,705	43,809	43,903	43,993	44,077	44,158	44,237	44,315	44,387
Lehigh	30,696	30,755	30,811	30,897	30,970	31,042	31,112	31,182	31,250	31,319	31,388
Luzerne	24,849	24,905	24,928	24,973	25,017	25,060	25,101	25,142	25,181	25,220	25,257
Monroe	9,631	9,656	9,679	9,732	9,764	9,796	9,827	9,860	9,890	9,921	9,952
Montgomery	53,760	53,921	54,030	54,217	54,367	54,516	54,663	54,811	54,955	55,100	55,242
Northampton	26,747	26,814	26,855	26,969	27,050	27,128	27,205	27,276	27,349	27,420	27,488
Philadelphia	118,118	118,356	118,594	118,906	119,145	119,383	119,623	119,857	120,088	120,319	120,537
Westmoreland	26,742	26,767	26,817	26,864	26,915	26,965	27,016	27,065	27,113	27,161	27,208
York	35,739	35,812	35,878	35,938	36,011	36,079	36,149	36,211	36,273	36,333	36,392

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:											
	2/27	2/28	3/1	3/2	3/4			3/6			3/8					
Allegheny	76,449	76,669	76,853	77,053	77,513	(15,503)	[3,721]	{1,860}	77,954	(15,591)	[3,742]	{1,871}	78,393	(15,679)	[3,763]	{1,881}
Berks	35,577	35,658	35,699	35,791	35,940	(7,188)	[1,725]	{863}	36,080	(7,216)	[1,732]	{866}	36,211	(7,242)	[1,738]	{869}
Bucks	44,914	45,046	45,176	45,320	45,562	(9,112)	[2,187]	{1,093}	45,799	(9,160)	[2,198]	{1,099}	46,028	(9,206)	[2,209]	{1,105}
Butler	13,893	13,916	13,939	13,978	14,038	(2,808)	[674]	{337}	14,096	(2,819)	[677]	{338}	14,151	(2,830)	[679]	{340}
Chester	28,053	28,127	28,201	28,261	28,405	(5,681)	[1,363]	{682}	28,547	(5,709)	[1,370]	{685}	28,684	(5,737)	[1,377]	{688}
Delaware	40,849	40,957	41,033	41,132	41,342	(8,268)	[1,984]	{992}	41,544	(8,309)	[1,994]	{997}	41,744	(8,349)	[2,004]	{1,002}
Lackawanna	13,888	13,934	13,964	14,009	14,092	(2,818)	[676]	{338}	14,173	(2,835)	[680]	{340}	14,252	(2,850)	[684]	{342}
Lancaster	43,527	43,630	43,705	43,809	43,993	(8,799)	[2,112]	{1,056}	44,158	(8,832)	[2,120]	{1,060}	44,315	(8,863)	[2,127]	{1,064}
Lehigh	30,696	30,755	30,811	30,897	31,042	(6,208)	[1,490]	{745}	31,182	(6,236)	[1,497]	{748}	31,319	(6,264)	[1,503]	{752}
Luzerne	24,849	24,905	24,928	24,973	25,060	(5,012)	[1,203]	{601}	25,142	(5,028)	[1,207]	{603}	25,220	(5,044)	[1,211]	{605}
Monroe	9,631	9,656	9,679	9,732	9,796	(1,959)	[470]	{235}	9,860	(1,972)	[473]	{237}	9,921	(1,984)	[476]	{238}
Montgomery	53,760	53,921	54,030	54,217	54,516	(10,903)	[2,617]	{1,308}	54,811	(10,962)	[2,631]	{1,315}	55,100	(11,020)	[2,645]	{1,322}
Northampton	26,747	26,814	26,855	26,969	27,128	(5,426)	[1,302]	{651}	27,276	(5,455)	[1,309]	{655}	27,420	(5,484)	[1,316]	{658}
Philadelphia	118,118	118,356	118,594	118,906	119,383	(23,877)	[5,730]	{2,865}	119,857	(23,971)	[5,753]	{2,877}	120,319	(24,064)	[5,775]	{2,888}
Westmoreland	26,742	26,767	26,817	26,864	26,965	(5,393)	[1,294]	{647}	27,065	(5,413)	[1,299]	{650}	27,161	(5,432)	[1,304]	{652}
York	35,739	35,812	35,878	35,938	36,079	(7,216)	[1,732]	{866}	36,211	(7,242)	[1,738]	{869}	36,333	(7,267)	[1,744]	{872}

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.