

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

Date: 5/3/21

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 5/3/21 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.**

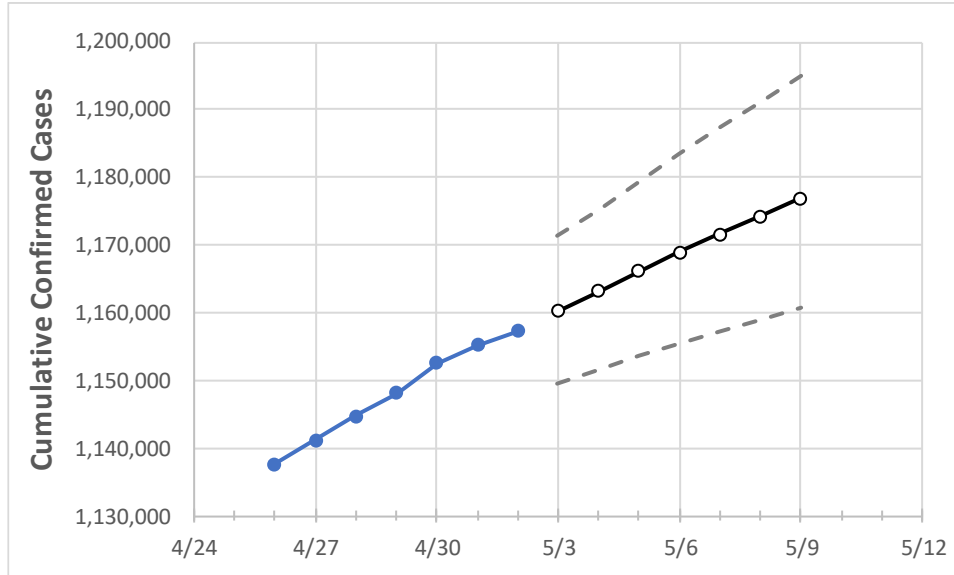
### IEM's Modeling Lead

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:							
4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	

Pennsylvania 1,148,121 1,152,536 1,155,140 1,157,285 1,160,261 1,163,235 1,166,122 1,168,874 1,171,598 1,174,260 1,176,920

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:							
	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	
Allegheny	96,884	97,250	97,521	97,760	97,970	98,174	98,372	98,564	98,744	98,917	99,082	
Berks	45,409	45,600	45,758	45,835	45,989	46,141	46,294	46,443	46,592	46,741	46,883	
Bucks	58,195	58,427	58,598	58,699	58,857	59,008	59,155	59,301	59,443	59,580	59,713	
Butler	16,700	16,762	16,801	16,840	16,879	16,915	16,953	16,989	17,025	17,062	17,097	
Chester	35,282	35,402	35,402	35,402	35,504	35,602	35,702	35,798	35,889	35,981	36,071	
Delaware	50,283	50,475	50,582	50,680	50,801	50,918	51,032	51,143	51,251	51,356	51,457	
Lackawanna	17,651	17,707	17,746	17,774	17,822	17,869	17,915	17,959	18,004	18,048	18,090	
Lancaster	53,029	53,202	53,334	53,445	53,569	53,696	53,822	53,943	54,063	54,179	54,290	
Lehigh	37,953	38,172	38,277	38,341	38,446	38,551	38,659	38,759	38,860	38,961	39,059	
Luzerne	30,207	30,343	30,428	30,485	30,578	30,672	30,763	30,851	30,940	31,030	31,120	
Monroe	13,787	13,891	13,970	14,009	14,071	14,135	14,198	14,261	14,322	14,381	14,443	
Montgomery	67,565	67,835	68,000	68,153	68,332	68,506	68,679	68,847	69,011	69,175	69,337	
Northampton	34,347	34,475	34,570	34,640	34,730	34,818	34,903	34,985	35,068	35,146	35,226	
Philadelphia	146,762	147,125	147,125	147,125	147,542	147,958	148,366	148,759	149,139	149,531	149,900	
Westmoreland	32,482	32,649	32,705	32,775	32,854	32,927	33,002	33,070	33,141	33,211	33,279	
York	43,963	44,127	44,286	44,398	44,525	44,649	44,771	44,889	45,007	45,123	45,239	

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:											
	4/29	4/30	5/1	5/2	5/4			5/6			5/8					
Allegheny	96,884	97,250	97,521	97,760	98,174	(19,635)	[4,712]	{2,356}	98,564	(19,713)	[4,731]	{2,366}	98,917	(19,783)	[4,748]	{2,374}
Berks	45,409	45,600	45,758	45,835	46,141	(9,228)	[2,215]	{1,107}	46,443	(9,289)	[2,229]	{1,115}	46,741	(9,348)	[2,244]	{1,122}
Bucks	58,195	58,427	58,598	58,699	59,008	(11,802)	[2,832]	{1,416}	59,301	(11,860)	[2,846]	{1,423}	59,580	(11,916)	[2,860]	{1,430}
Butler	16,700	16,762	16,801	16,840	16,915	(3,383)	[812]	{406}	16,989	(3,398)	[815]	{408}	17,062	(3,412)	[819]	{409}
Chester	35,282	35,402	35,402	35,402	35,602	(7,120)	[1,709]	{854}	35,798	(7,160)	[1,718]	{859}	35,981	(7,196)	[1,727]	{864}
Delaware	50,283	50,475	50,582	50,680	50,918	(10,184)	[2,444]	{1,222}	51,143	(10,229)	[2,455]	{1,227}	51,356	(10,271)	[2,465]	{1,233}
Lackawanna	17,651	17,707	17,746	17,774	17,869	(3,574)	[858]	{429}	17,959	(3,592)	[862]	{431}	18,048	(3,610)	[866]	{433}
Lancaster	53,029	53,202	53,334	53,445	53,696	(10,739)	[2,577]	{1,289}	53,943	(10,789)	[2,589]	{1,295}	54,179	(10,836)	[2,601]	{1,300}
Lehigh	37,953	38,172	38,277	38,341	38,551	(7,710)	[1,850]	{925}	38,759	(7,752)	[1,860]	{930}	38,961	(7,792)	[1,870]	{935}
Luzerne	30,207	30,343	30,428	30,485	30,672	(6,134)	[1,472]	{736}	30,851	(6,170)	[1,481]	{740}	31,030	(6,206)	[1,489]	{745}
Monroe	13,787	13,891	13,970	14,009	14,135	(2,827)	[678]	{339}	14,261	(2,852)	[685]	{342}	14,381	(2,876)	[690]	{345}
Montgomery	67,565	67,835	68,000	68,153	68,506	(13,701)	[3,288]	{1,644}	68,847	(13,769)	[3,305]	{1,652}	69,175	(13,835)	[3,320]	{1,660}
Northampton	34,347	34,475	34,570	34,640	34,818	(6,964)	[1,671]	{836}	34,985	(6,997)	[1,679]	{840}	35,146	(7,029)	[1,687]	{844}
Philadelphia	146,762	147,125	147,125	147,125	147,958	(29,592)	[7,102]	{3,551}	148,759	(29,752)	[7,140]	{3,570}	149,531	(29,906)	[7,178]	{3,589}
Westmoreland	32,482	32,649	32,705	32,775	32,927	(6,585)	[1,581]	{790}	33,070	(6,614)	[1,587]	{794}	33,211	(6,642)	[1,594]	{797}
York	43,963	44,127	44,286	44,398	44,649	(8,930)	[2,143]	{1,072}	44,889	(8,978)	[2,155]	{1,077}	45,123	(9,025)	[2,166]	{1,083}

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.