

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

Date: 2/16/21

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 2/16/21 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.**

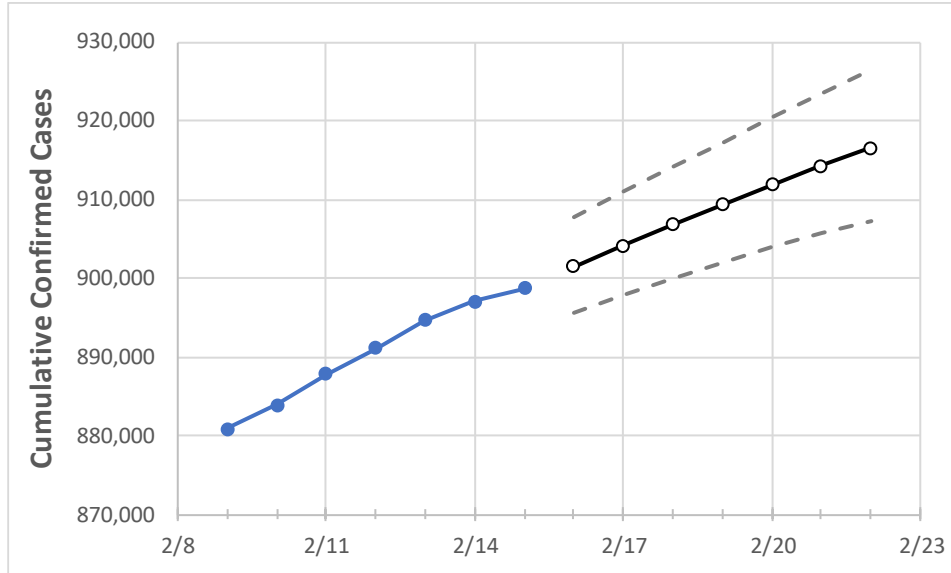
### IEM's Modeling Lead

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:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Pennsylvania	891,135	894,660	896,996	898,654	901,480	904,122	906,781	909,340	911,809	914,225	916,525

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:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Allegheny	72,699	73,005	73,217	73,399	73,626	73,848	74,063	74,274	74,482	74,690	74,889
Berks	34,140	34,284	34,325	34,377	34,464	34,547	34,626	34,702	34,770	34,838	34,901
Bucks	42,605	42,819	42,985	43,112	43,288	43,462	43,631	43,797	43,961	44,119	44,280
Butler	13,351	13,392	13,432	13,456	13,492	13,527	13,561	13,594	13,626	13,655	13,685
Chester	26,734	26,734	26,734	26,734	26,820	26,903	26,985	27,065	27,146	27,224	27,298
Delaware	39,041	39,222	39,312	39,393	39,507	39,619	39,730	39,838	39,941	40,044	40,141
Lackawanna	13,095	13,196	13,237	13,262	13,312	13,362	13,411	13,459	13,507	13,553	13,598
Lancaster	41,254	41,546	41,722	41,851	42,068	42,270	42,470	42,671	42,871	43,061	43,254
Lehigh	29,464	29,586	29,640	29,681	29,762	29,841	29,916	29,989	30,059	30,129	30,194
Luzerne	23,882	24,005	24,076	24,114	24,183	24,247	24,311	24,374	24,433	24,489	24,545
Monroe	9,075	9,149	9,179	9,195	9,229	9,262	9,294	9,325	9,356	9,387	9,416
Montgomery	51,197	51,429	51,555	51,656	51,818	51,971	52,124	52,267	52,409	52,547	52,676
Northampton	25,060	25,250	25,386	25,433	25,551	25,666	25,780	25,891	26,003	26,112	26,218
Philadelphia	114,308	114,308	114,308	114,308	114,630	114,949	115,267	115,583	115,888	116,190	116,479
Westmoreland	25,668	25,766	25,843	25,895	25,964	26,030	26,096	26,159	26,221	26,281	26,340
York	34,087	34,254	34,423	34,504	34,641	34,776	34,908	35,036	35,163	35,286	35,403

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:											
	2/12	2/13	2/14	2/15	2/17			2/19			2/21					
Allegheny	72,699	73,005	73,217	73,399	73,848	(14,770)	[3,545]	{1,772}	74,274	(14,855)	[3,565]	{1,783}	74,690	(14,938)	[3,585]	{1,793}
Berks	34,140	34,284	34,325	34,377	34,547	(6,909)	[1,658]	{829}	34,702	(6,940)	[1,666]	{833}	34,838	(6,968)	[1,672]	{836}
Bucks	42,605	42,819	42,985	43,112	43,462	(8,692)	[2,086]	{1,043}	43,797	(8,759)	[2,102]	{1,051}	44,119	(8,824)	[2,118]	{1,059}
Butler	13,351	13,392	13,432	13,456	13,527	(2,705)	[649]	{325}	13,594	(2,719)	[653]	{326}	13,655	(2,731)	[655]	{328}
Chester	26,734	26,734	26,734	26,734	26,903	(5,381)	[1,291]	{646}	27,065	(5,413)	[1,299]	{650}	27,224	(5,445)	[1,307]	{653}
Delaware	39,041	39,222	39,312	39,393	39,619	(7,924)	[1,902]	{951}	39,838	(7,968)	[1,912]	{956}	40,044	(8,009)	[1,922]	{961}
Lackawanna	13,095	13,196	13,237	13,262	13,362	(2,672)	[641]	{321}	13,459	(2,692)	[646]	{323}	13,553	(2,711)	[651]	{325}
Lancaster	41,254	41,546	41,722	41,851	42,270	(8,454)	[2,029]	{1,014}	42,671	(8,534)	[2,048]	{1,024}	43,061	(8,612)	[2,067]	{1,033}
Lehigh	29,464	29,586	29,640	29,681	29,841	(5,968)	[1,432]	{716}	29,989	(5,998)	[1,439]	{720}	30,129	(6,026)	[1,446]	{723}
Luzerne	23,882	24,005	24,076	24,114	24,247	(4,849)	[1,164]	{582}	24,374	(4,875)	[1,170]	{585}	24,489	(4,898)	[1,175]	{588}
Monroe	9,075	9,149	9,179	9,195	9,262	(1,852)	[445]	{222}	9,325	(1,865)	[448]	{224}	9,387	(1,877)	[451]	{225}
Montgomery	51,197	51,429	51,555	51,656	51,971	(10,394)	[2,495]	{1,247}	52,267	(10,453)	[2,509]	{1,254}	52,547	(10,509)	[2,522]	{1,261}
Northampton	25,060	25,250	25,386	25,433	25,666	(5,133)	[1,232]	{616}	25,891	(5,178)	[1,243]	{621}	26,112	(5,222)	[1,253]	{627}
Philadelphia	114,308	114,308	114,308	114,308	114,949	(22,990)	[5,518]	{2,759}	115,583	(23,117)	[5,548]	{2,774}	116,190	(23,238)	[5,577]	{2,789}
Westmoreland	25,668	25,766	25,843	25,895	26,030	(5,206)	[1,249]	{625}	26,159	(5,232)	[1,256]	{628}	26,281	(5,256)	[1,262]	{631}
York	34,087	34,254	34,423	34,504	34,776	(6,955)	[1,669]	{835}	35,036	(7,007)	[1,682]	{841}	35,286	(7,057)	[1,694]	{847}

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.