

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

**Date: 11/2/20**

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 11/2/20 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.**

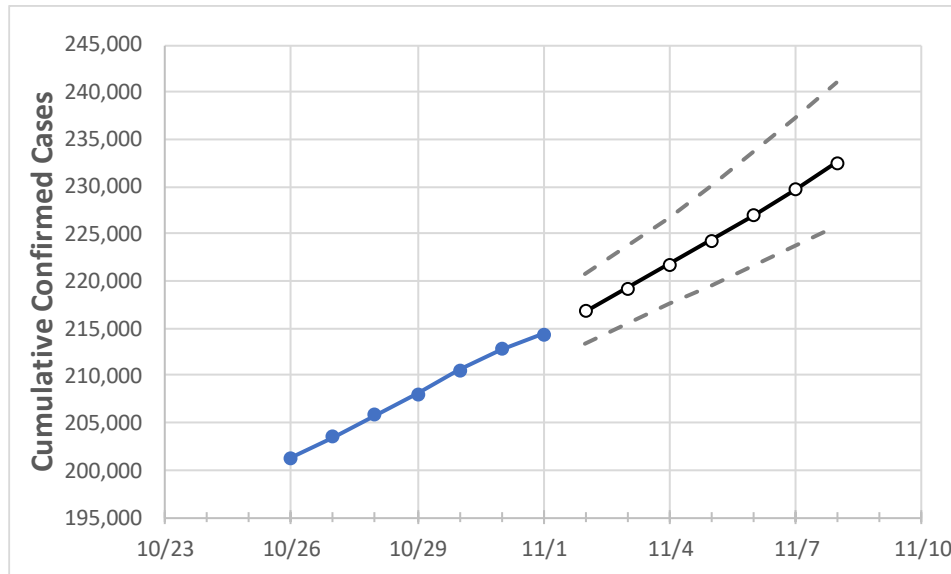
### **IEM's Modeling Lead**

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:							
	10/29	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	
Pennsylvania	208,087	210,586	212,791	214,416	216,789	219,230	221,740	224,321	226,976	229,707	232,516	

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 20%, and are often within 10%, of actual confirmed cases.

## Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:							
	10/29	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	
Allegheny	15,449	15,622	15,796	15,940	16,094	16,251	16,412	16,577	16,746	16,919	17,096	
Berks	9,388	9,481	9,562	9,648	9,758	9,871	9,986	10,104	10,224	10,346	10,471	
Bucks	10,254	10,337	10,445	10,513	10,596	10,683	10,773	10,868	10,966	11,069	11,176	
Butler	1,746	1,794	1,840	1,892	1,938	1,986	2,037	2,091	2,149	2,209	2,273	
Chester	8,163	8,198	8,198	8,198	8,240	8,282	8,325	8,369	8,413	8,457	8,502	
Delaware	13,618	13,754	13,888	14,001	14,129	14,263	14,403	14,549	14,702	14,861	15,028	
Lackawanna	3,780	3,817	3,846	3,875	3,913	3,951	3,989	4,027	4,064	4,102	4,139	
Lancaster	9,647	9,764	9,877	9,929	10,016	10,105	10,198	10,295	10,394	10,497	10,604	
Lehigh	6,643	6,698	6,811	6,863	6,937	7,017	7,101	7,191	7,287	7,389	7,498	
Luzerne	5,412	5,467	5,545	5,624	5,708	5,795	5,885	5,980	6,078	6,180	6,287	
Monroe	2,029	2,042	2,069	2,081	2,094	2,108	2,123	2,138	2,154	2,171	2,189	
Montgomery	14,008	14,157	14,301	14,421	14,568	14,725	14,895	15,077	15,273	15,484	15,710	
Northampton	5,439	5,481	5,568	5,619	5,672	5,728	5,787	5,848	5,913	5,980	6,051	
Philadelphia	44,139	44,505	44,505	44,505	44,794	45,091	45,395	45,707	46,028	46,358	46,697	
Westmoreland	4,334	4,402	4,472	4,538	4,609	4,679	4,750	4,820	4,890	4,960	5,029	
York	6,545	6,630	6,716	6,742	6,809	6,877	6,946	7,016	7,087	7,159	7,232	

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:											
	10/29	10/30	10/31	11/1	11/3			11/5			11/7					
Allegheny	15,449	15,622	15,796	15,940	16,251	(3,250)	[780]	{390}	16,577	(3,315)	[796]	{398}	16,919	(3,384)	[812]	{406}
Berks	9,388	9,481	9,562	9,648	9,871	(1,974)	[474]	{237}	10,104	(2,021)	[485]	{242}	10,346	(2,069)	[497]	{248}
Bucks	10,254	10,337	10,445	10,513	10,683	(2,137)	[513]	{256}	10,868	(2,174)	[522]	{261}	11,069	(2,214)	[531]	{266}
Butler	1,746	1,794	1,840	1,892	1,986	(397)	[95]	{48}	2,091	(418)	[100]	{50}	2,209	(442)	[106]	{53}
Chester	8,163	8,198	8,198	8,198	8,282	(1,656)	[398]	{199}	8,369	(1,674)	[402]	{201}	8,457	(1,691)	[406]	{203}
Delaware	13,618	13,754	13,888	14,001	14,263	(2,853)	[685]	{342}	14,549	(2,910)	[698]	{349}	14,861	(2,972)	[713]	{357}
Lackawanna	3,780	3,817	3,846	3,875	3,951	(790)	[190]	{95}	4,027	(805)	[193]	{97}	4,102	(820)	[197]	{98}
Lancaster	9,647	9,764	9,877	9,929	10,105	(2,021)	[485]	{243}	10,295	(2,059)	[494]	{247}	10,497	(2,099)	[504]	{252}
Lehigh	6,643	6,698	6,811	6,863	7,017	(1,403)	[337]	{168}	7,191	(1,438)	[345]	{173}	7,389	(1,478)	[355]	{177}
Luzerne	5,412	5,467	5,545	5,624	5,795	(1,159)	[278]	{139}	5,980	(1,196)	[287]	{144}	6,180	(1,236)	[297]	{148}
Monroe	2,029	2,042	2,069	2,081	2,108	(422)	[101]	{51}	2,138	(428)	[103]	{51}	2,171	(434)	[104]	{52}
Montgomery	14,008	14,157	14,301	14,421	14,725	(2,945)	[707]	{353}	15,077	(3,015)	[724]	{362}	15,484	(3,097)	[743]	{372}
Northampton	5,439	5,481	5,568	5,619	5,728	(1,146)	[275]	{137}	5,848	(1,170)	[281]	{140}	5,980	(1,196)	[287]	{144}
Philadelphia	44,139	44,505	44,505	44,505	45,091	(9,018)	[2,164]	{1,082}	45,707	(9,141)	[2,194]	{1,097}	46,358	(9,272)	[2,225]	{1,113}
Westmoreland	4,334	4,402	4,472	4,538	4,679	(936)	[225]	{112}	4,820	(964)	[231]	{116}	4,960	(992)	[238]	{119}
York	6,545	6,630	6,716	6,742	6,877	(1,375)	[330]	{165}	7,016	(1,403)	[337]	{168}	7,159	(1,432)	[344]	{172}

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.