

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

Date: 2/11/21

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 2/11/21 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.

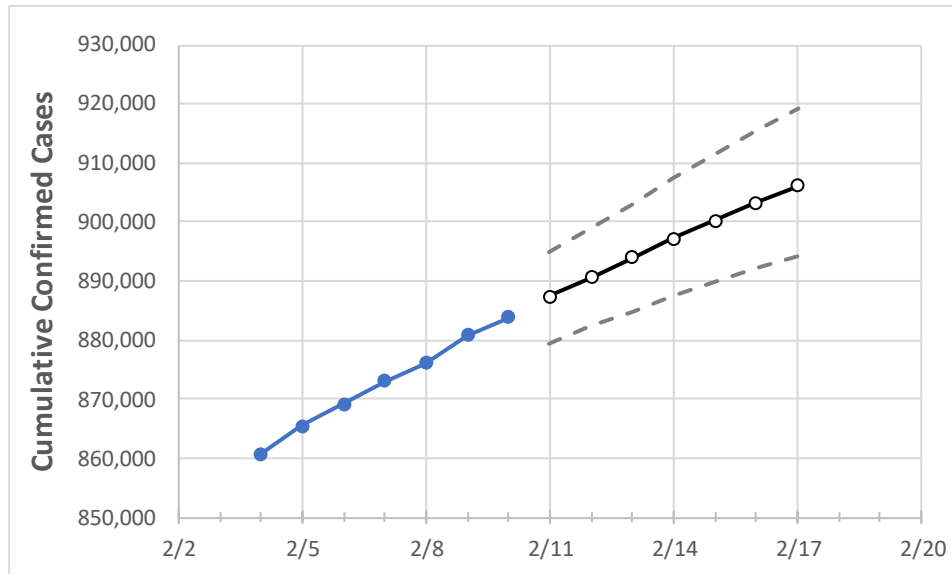
IEM's Modeling Lead

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:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
Pennsylvania	873,146	876,165	880,838	883,928	887,389	890,704	894,018	897,214	900,308	903,335	906,236

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:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
Allegheny	71,343	71,533	71,938	72,177	72,415	72,647	72,877	73,108	73,322	73,538	73,745
Berks	33,530	33,625	33,769	33,874	34,028	34,168	34,306	34,437	34,564	34,681	34,794
Bucks	41,597	41,767	41,946	42,162	42,371	42,576	42,776	42,969	43,161	43,348	43,535
Butler	13,121	13,150	13,215	13,268	13,311	13,353	13,394	13,434	13,472	13,509	13,545
Chester	26,223	26,340	26,457	26,536	26,631	26,723	26,814	26,904	26,991	27,074	27,156
Delaware	38,324	38,461	38,616	38,751	38,880	39,007	39,130	39,250	39,362	39,477	39,588
Lackawanna	12,784	12,838	12,893	12,961	13,006	13,049	13,092	13,132	13,170	13,208	13,243
Lancaster	40,175	40,309	40,554	40,750	41,001	41,248	41,493	41,731	41,980	42,213	42,447
Lehigh	28,894	28,955	29,130	29,211	29,307	29,401	29,486	29,572	29,654	29,734	29,810
Luzerne	23,527	23,602	23,662	23,742	23,825	23,907	23,985	24,064	24,136	24,206	24,272
Monroe	8,875	8,902	8,958	8,981	9,016	9,049	9,081	9,112	9,140	9,170	9,198
Montgomery	50,217	50,413	50,615	50,815	51,048	51,275	51,494	51,709	51,916	52,120	52,317
Northampton	24,327	24,388	24,613	24,719	24,843	24,969	25,091	25,210	25,326	25,438	25,548
Philadelphia	112,351	112,652	113,224	113,519	113,854	114,181	114,507	114,821	115,139	115,445	115,749
Westmoreland	25,280	25,339	25,432	25,516	25,577	25,635	25,694	25,748	25,801	25,854	25,906
York	33,314	33,466	33,618	33,750	33,929	34,097	34,260	34,424	34,588	34,739	34,900

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:											
	2/7	2/8	2/9	2/10	2/12			2/14			2/16					
Allegheny	71,343	71,533	71,938	72,177	72,647	(14,529)	[3,487]	{1,744}	73,108	(14,622)	[3,509]	{1,755}	73,538	(14,708)	[3,530]	{1,765}
Berks	33,530	33,625	33,769	33,874	34,168	(6,834)	[1,640]	{820}	34,437	(6,887)	[1,653]	{826}	34,681	(6,936)	[1,665]	{832}
Bucks	41,597	41,767	41,946	42,162	42,576	(8,515)	[2,044]	{1,022}	42,969	(8,594)	[2,063]	{1,031}	43,348	(8,670)	[2,081]	{1,040}
Butler	13,121	13,150	13,215	13,268	13,353	(2,671)	[641]	{320}	13,434	(2,687)	[645]	{322}	13,509	(2,702)	[648]	{324}
Chester	26,223	26,340	26,457	26,536	26,723	(5,345)	[1,283]	{641}	26,904	(5,381)	[1,291]	{646}	27,074	(5,415)	[1,300]	{650}
Delaware	38,324	38,461	38,616	38,751	39,007	(7,801)	[1,872]	{936}	39,250	(7,850)	[1,884]	{942}	39,477	(7,895)	[1,895]	{947}
Lackawanna	12,784	12,838	12,893	12,961	13,049	(2,610)	[626]	{313}	13,132	(2,626)	[630]	{315}	13,208	(2,642)	[634]	{317}
Lancaster	40,175	40,309	40,554	40,750	41,248	(8,250)	[1,980]	{990}	41,731	(8,346)	[2,003]	{1,002}	42,213	(8,443)	[2,026]	{1,013}
Lehigh	28,894	28,955	29,130	29,211	29,401	(5,880)	[1,411]	{706}	29,572	(5,914)	[1,419]	{710}	29,734	(5,947)	[1,427]	{714}
Luzerne	23,527	23,602	23,662	23,742	23,907	(4,781)	[1,148]	{574}	24,064	(4,813)	[1,155]	{578}	24,206	(4,841)	[1,162]	{581}
Monroe	8,875	8,902	8,958	8,981	9,049	(1,810)	[434]	{217}	9,112	(1,822)	[437]	{219}	9,170	(1,834)	[440]	{220}
Montgomery	50,217	50,413	50,615	50,815	51,275	(10,255)	[2,461]	{1,231}	51,709	(10,342)	[2,482]	{1,241}	52,120	(10,424)	[2,502]	{1,251}
Northampton	24,327	24,388	24,613	24,719	24,969	(4,994)	[1,198]	{599}	25,210	(5,042)	[1,210]	{605}	25,438	(5,088)	[1,221]	{611}
Philadelphia	112,351	112,652	113,224	113,519	114,181	(22,836)	[5,481]	{2,740}	114,821	(22,964)	[5,511]	{2,756}	115,445	(23,089)	[5,541]	{2,771}
Westmoreland	25,280	25,339	25,432	25,516	25,635	(5,127)	[1,230]	{615}	25,748	(5,150)	[1,236]	{618}	25,854	(5,171)	[1,241]	{621}
York	33,314	33,466	33,618	33,750	34,097	(6,819)	[1,637]	{818}	34,424	(6,885)	[1,652]	{826}	34,739	(6,948)	[1,667]	{834}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.