

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

Date: 5/25/21

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 5/25/21 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.

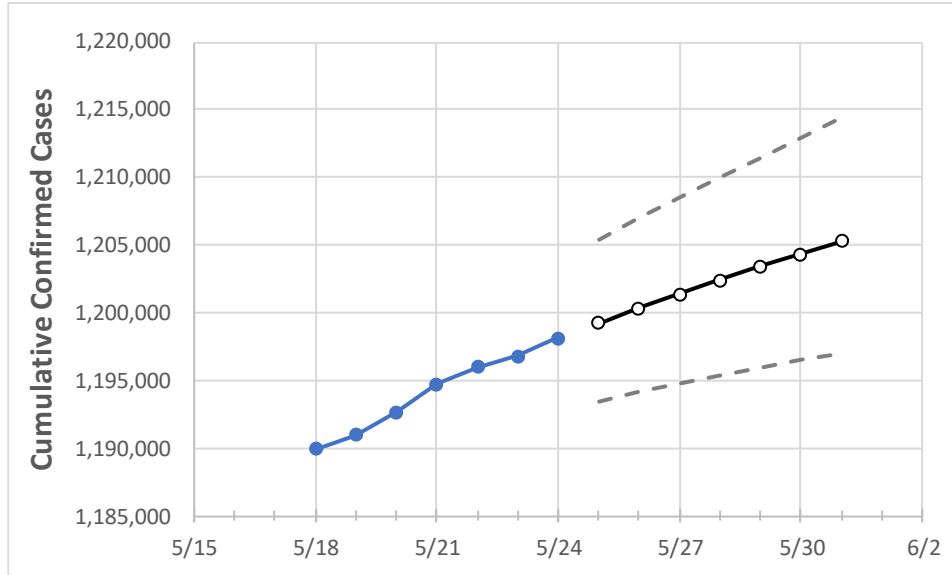
IEM's Modeling Lead

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:						
	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31

Pennsylvania 1,194,743 1,195,979 1,196,778 1,198,084 1,199,206 1,200,311 1,201,395 1,202,399 1,203,427 1,204,356 1,205,292

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:						
	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31
Allegheny	100,719	100,799	100,870	100,922	101,011	101,097	101,180	101,259	101,333	101,402	101,473
Berks	47,591	47,654	47,686	47,725	47,776	47,825	47,871	47,915	47,958	47,999	48,038
Bucks	60,307	60,358	60,388	60,427	60,467	60,507	60,543	60,578	60,612	60,644	60,672
Butler	17,325	17,339	17,351	17,362	17,378	17,393	17,408	17,422	17,435	17,448	17,461
Chester	37,047	37,097	37,148	37,198	37,257	37,315	37,373	37,432	37,486	37,541	37,596
Delaware	51,869	51,918	51,959	51,978	52,012	52,044	52,075	52,104	52,134	52,162	52,188
Lackawanna	18,276	18,333	18,337	18,353	18,369	18,385	18,400	18,414	18,428	18,442	18,455
Lancaster	54,797	54,851	54,897	54,931	54,971	55,008	55,044	55,078	55,110	55,140	55,170
Lehigh	39,388	39,446	39,466	39,484	39,516	39,548	39,579	39,609	39,638	39,666	39,693
Luzerne	31,542	31,596	31,629	31,655	31,692	31,730	31,764	31,799	31,832	31,864	31,894
Monroe	14,600	14,624	14,627	14,634	14,648	14,661	14,673	14,684	14,695	14,705	14,715
Montgomery	69,757	69,810	69,851	69,882	69,919	69,954	69,987	70,017	70,046	70,074	70,101
Northampton	35,509	35,545	35,564	35,578	35,602	35,625	35,647	35,669	35,690	35,711	35,730
Philadelphia	152,094	152,240	152,385	152,530	152,657	152,777	152,900	153,011	153,118	153,220	153,322
Westmoreland	33,877	33,909	33,955	33,964	33,997	34,028	34,058	34,087	34,118	34,145	34,173
York	45,968	46,034	46,066	46,099	46,148	46,195	46,240	46,284	46,325	46,366	46,406

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:											
	5/21	5/22	5/23	5/24	5/26			5/28			5/30					
Allegheny	100,719	100,799	100,870	100,922	101,097	(20,219)	[4,853]	{2,426}	101,259	(20,252)	[4,860]	{2,430}	101,402	(20,280)	[4,867]	{2,434}
Berks	47,591	47,654	47,686	47,725	47,825	(9,565)	[2,296]	{1,148}	47,915	(9,583)	[2,300]	{1,150}	47,999	(9,600)	[2,304]	{1,152}
Bucks	60,307	60,358	60,388	60,427	60,507	(12,101)	[2,904]	{1,452}	60,578	(12,116)	[2,908]	{1,454}	60,644	(12,129)	[2,911]	{1,455}
Butler	17,325	17,339	17,351	17,362	17,393	(3,479)	[835]	{417}	17,422	(3,484)	[836]	{418}	17,448	(3,490)	[838]	{419}
Chester	37,047	37,097	37,148	37,198	37,315	(7,463)	[1,791]	{896}	37,432	(7,486)	[1,797]	{898}	37,541	(7,508)	[1,802]	{901}
Delaware	51,869	51,918	51,959	51,978	52,044	(10,409)	[2,498]	{1,249}	52,104	(10,421)	[2,501]	{1,251}	52,162	(10,432)	[2,504]	{1,252}
Lackawanna	18,276	18,333	18,337	18,353	18,385	(3,677)	[882]	{441}	18,414	(3,683)	[884]	{442}	18,442	(3,688)	[885]	{443}
Lancaster	54,797	54,851	54,897	54,931	55,008	(11,002)	[2,640]	{1,320}	55,078	(11,016)	[2,644]	{1,322}	55,140	(11,028)	[2,647]	{1,323}
Lehigh	39,388	39,446	39,466	39,484	39,548	(7,910)	[1,898]	{949}	39,609	(7,922)	[1,901]	{951}	39,666	(7,933)	[1,904]	{952}
Luzerne	31,542	31,596	31,629	31,655	31,730	(6,346)	[1,523]	{762}	31,799	(6,360)	[1,526]	{763}	31,864	(6,373)	[1,529]	{765}
Monroe	14,600	14,624	14,627	14,634	14,661	(2,932)	[704]	{352}	14,684	(2,937)	[705]	{352}	14,705	(2,941)	[706]	{353}
Montgomery	69,757	69,810	69,851	69,882	69,954	(13,991)	[3,358]	{1,679}	70,017	(14,003)	[3,361]	{1,680}	70,074	(14,015)	[3,364]	{1,682}
Northampton	35,509	35,545	35,564	35,578	35,625	(7,125)	[1,710]	{855}	35,669	(7,134)	[1,712]	{856}	35,711	(7,142)	[1,714]	{857}
Philadelphia	152,094	152,240	152,385	152,530	152,777	(30,555)	[7,333]	{3,667}	153,011	(30,602)	[7,345]	{3,672}	153,220	(30,644)	[7,355]	{3,677}
Westmoreland	33,877	33,909	33,955	33,964	34,028	(6,806)	[1,633]	{817}	34,087	(6,817)	[1,636]	{818}	34,145	(6,829)	[1,639]	{819}
York	45,968	46,034	46,066	46,099	46,195	(9,239)	[2,217]	{1,109}	46,284	(9,257)	[2,222]	{1,111}	46,366	(9,273)	[2,226]	{1,113}

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.