

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

Date: 9/22/21

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 9/22/21 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.

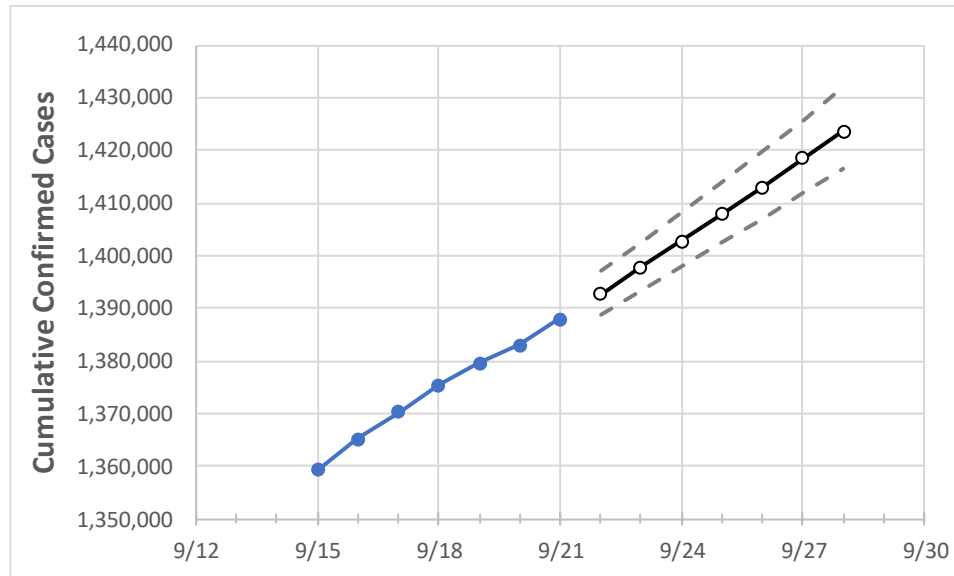
IEM's Modeling Lead

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:						
9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28	

Pennsylvania 1,375,431 1,379,478 1,382,933 1,387,872 1,392,753 1,397,781 1,402,797 1,407,865 1,413,022 1,418,400 1,423,646

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:							
	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28	
Allegheny	116,425	116,802	117,081	117,546	117,994	118,441	118,902	119,380	119,852	120,355	120,842	
Berks	53,073	53,228	53,313	53,455	53,583	53,714	53,844	53,976	54,109	54,246	54,381	
Bucks	67,377	67,503	67,577	67,732	67,868	68,002	68,133	68,271	68,401	68,539	68,678	
Butler	21,020	21,133	21,202	21,322	21,460	21,598	21,735	21,882	22,030	22,182	22,335	
Chester	46,100	46,204	46,308	46,439	46,577	46,714	46,852	46,990	47,130	47,274	47,418	
Delaware	57,938	58,042	58,109	58,208	58,318	58,430	58,536	58,646	58,754	58,865	58,972	
Lackawanna	20,421	20,492	20,530	20,596	20,665	20,732	20,801	20,874	20,946	21,020	21,096	
Lancaster	63,086	63,280	63,480	63,666	63,892	64,122	64,350	64,585	64,819	65,062	65,305	
Lehigh	44,792	44,883	44,963	45,117	45,243	45,368	45,496	45,622	45,754	45,883	46,013	
Luzerne	35,761	35,878	35,950	36,041	36,160	36,277	36,394	36,514	36,640	36,766	36,892	
Monroe	17,383	17,469	17,499	17,565	17,648	17,736	17,820	17,909	18,002	18,095	18,187	
Montgomery	78,767	78,972	79,075	79,239	79,414	79,595	79,776	79,952	80,134	80,312	80,500	
Northampton	40,812	40,926	40,972	41,093	41,215	41,340	41,460	41,585	41,710	41,840	41,965	
Philadelphia	170,921	171,138	171,356	171,729	172,003	172,277	172,537	172,813	173,083	173,371	173,636	
Westmoreland	39,057	39,216	39,288	39,487	39,658	39,829	40,005	40,180	40,366	40,554	40,741	
York	53,746	53,949	54,100	54,292	54,503	54,712	54,924	55,140	55,356	55,577	55,797	

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:											
	9/18	9/19	9/20	9/21	9/23			9/25			9/27					
Allegheny	116,425	116,802	117,081	117,546	118,441	(23,688)	[5,685]	{2,843}	119,380	(23,876)	[5,730]	{2,865}	120,355	(24,071)	[5,777]	{2,889}
Berks	53,073	53,228	53,313	53,455	53,714	(10,743)	[2,578]	{1,289}	53,976	(10,795)	[2,591]	{1,295}	54,246	(10,849)	[2,604]	{1,302}
Bucks	67,377	67,503	67,577	67,732	68,002	(13,600)	[3,264]	{1,632}	68,271	(13,654)	[3,277]	{1,639}	68,539	(13,708)	[3,290]	{1,645}
Butler	21,020	21,133	21,202	21,322	21,598	(4,320)	[1,037]	{518}	21,882	(4,376)	[1,050]	{525}	22,182	(4,436)	[1,065]	{532}
Chester	46,100	46,204	46,308	46,439	46,714	(9,343)	[2,242]	{1,121}	46,990	(9,398)	[2,256]	{1,128}	47,274	(9,455)	[2,269]	{1,135}
Delaware	57,938	58,042	58,109	58,208	58,430	(11,686)	[2,805]	{1,402}	58,646	(11,729)	[2,815]	{1,407}	58,865	(11,773)	[2,826]	{1,413}
Lackawanna	20,421	20,492	20,530	20,596	20,732	(4,146)	[995]	{498}	20,874	(4,175)	[1,002]	{501}	21,020	(4,204)	[1,009]	{504}
Lancaster	63,086	63,280	63,480	63,666	64,122	(12,824)	[3,078]	{1,539}	64,585	(12,917)	[3,100]	{1,550}	65,062	(13,012)	[3,123]	{1,561}
Lehigh	44,792	44,883	44,963	45,117	45,368	(9,074)	[2,178]	{1,089}	45,622	(9,124)	[2,190]	{1,095}	45,883	(9,177)	[2,202]	{1,101}
Luzerne	35,761	35,878	35,950	36,041	36,277	(7,255)	[1,741]	{871}	36,514	(7,303)	[1,753]	{876}	36,766	(7,353)	[1,765]	{882}
Monroe	17,383	17,469	17,499	17,565	17,736	(3,547)	[851]	{426}	17,909	(3,582)	[860]	{430}	18,095	(3,619)	[869]	{434}
Montgomery	78,767	78,972	79,075	79,239	79,595	(15,919)	[3,821]	{1,910}	79,952	(15,990)	[3,838]	{1,919}	80,312	(16,062)	[3,855]	{1,927}
Northampton	40,812	40,926	40,972	41,093	41,340	(8,268)	[1,984]	{992}	41,585	(8,317)	[1,996]	{998}	41,840	(8,368)	[2,008]	{1,004}
Philadelphia	170,921	171,138	171,356	171,729	172,277	(34,455)	[8,269]	{4,135}	172,813	(34,563)	[8,295]	{4,148}	173,371	(34,674)	[8,322]	{4,161}
Westmoreland	39,057	39,216	39,288	39,487	39,829	(7,966)	[1,912]	{956}	40,180	(8,036)	[1,929]	{964}	40,554	(8,111)	[1,947]	{973}
York	53,746	53,949	54,100	54,292	54,712	(10,942)	[2,626]	{1,313}	55,140	(11,028)	[2,647]	{1,323}	55,577	(11,115)	[2,668]	{1,334}

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.