

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

Date: 5/7/21

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 5/7/21 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.

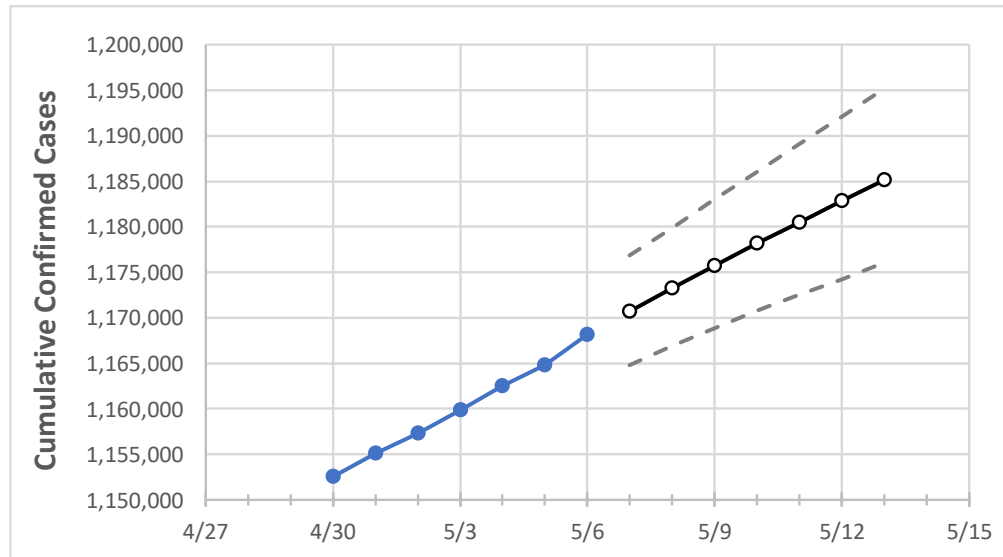
IEM's Modeling Lead

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:						
	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13
Pennsylvania	1,159,816	1,162,457	1,164,827	1,168,100	1,170,686	1,173,243	1,175,750	1,178,152	1,180,480	1,182,864	1,185,094

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:						
	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13
Allegheny	97,975	98,197	98,355	98,532	98,706	98,871	99,031	99,195	99,344	99,495	99,638
Berks	45,865	46,102	46,236	46,376	46,518	46,660	46,802	46,938	47,074	47,207	47,345
Bucks	58,791	58,922	59,050	59,142	59,260	59,377	59,489	59,594	59,700	59,799	59,892
Butler	16,860	16,900	16,929	16,958	16,990	17,021	17,054	17,084	17,114	17,143	17,172
Chester	35,607	35,725	35,810	35,882	35,963	36,041	36,118	36,191	36,261	36,333	36,401
Delaware	50,743	50,814	50,908	51,006	51,095	51,183	51,265	51,345	51,420	51,493	51,564
Lackawanna	17,809	17,853	17,880	17,943	17,985	18,025	18,062	18,101	18,139	18,174	18,208
Lancaster	53,501	53,603	53,703	53,815	53,920	54,023	54,120	54,213	54,305	54,394	54,484
Lehigh	38,386	38,470	38,546	38,607	38,688	38,765	38,841	38,917	38,989	39,059	39,127
Luzerne	30,527	30,610	30,687	30,751	30,828	30,905	30,981	31,055	31,129	31,203	31,271
Monroe	14,038	14,094	14,136	14,174	14,226	14,275	14,323	14,371	14,417	14,464	14,510
Montgomery	68,241	68,399	68,508	68,623	68,760	68,896	69,023	69,154	69,276	69,395	69,508
Northampton	34,674	34,759	34,822	34,876	34,943	35,009	35,076	35,136	35,196	35,253	35,306
Philadelphia	148,031	148,411	148,792	149,172	149,502	149,830	150,153	150,464	150,758	151,051	151,344
Westmoreland	32,828	32,915	33,058	33,111	33,183	33,253	33,319	33,387	33,454	33,520	33,583
York	44,485	44,608	44,732	44,837	44,948	45,059	45,167	45,274	45,377	45,479	45,583

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:							
	5/3	5/4	5/5	5/6	5/8		5/10		5/12			
Allegheny	97,975	98,197	98,355	98,532	98,871	(19,774) [4,746] {2,373}	99,195	(19,839) [4,761] {2,381}	99,495	(19,899) [4,776] {2,388}		
Berks	45,865	46,102	46,236	46,376	46,660	(9,332) [2,240] {1,120}	46,938	(9,388) [2,253] {1,127}	47,207	(9,441) [2,266] {1,133}		
Bucks	58,791	58,922	59,050	59,142	59,377	(11,875) [2,850] {1,425}	59,594	(11,919) [2,860] {1,430}	59,799	(11,960) [2,870] {1,435}		
Butler	16,860	16,900	16,929	16,958	17,021	(3,404) [817] {409}	17,084	(3,417) [820] {410}	17,143	(3,429) [823] {411}		
Chester	35,607	35,725	35,810	35,882	36,041	(7,208) [1,730] {865}	36,191	(7,238) [1,737] {869}	36,333	(7,267) [1,744] {872}		
Delaware	50,743	50,814	50,908	51,006	51,183	(10,237) [2,457] {1,228}	51,345	(10,269) [2,465] {1,232}	51,493	(10,299) [2,472] {1,236}		
Lackawanna	17,809	17,853	17,880	17,943	18,025	(3,605) [865] {433}	18,101	(3,620) [869] {434}	18,174	(3,635) [872] {436}		
Lancaster	53,501	53,603	53,703	53,815	54,023	(10,805) [2,593] {1,297}	54,213	(10,843) [2,602] {1,301}	54,394	(10,879) [2,611] {1,305}		
Lehigh	38,386	38,470	38,546	38,607	38,765	(7,753) [1,861] {930}	38,917	(7,783) [1,868] {934}	39,059	(7,812) [1,875] {937}		
Luzerne	30,527	30,610	30,687	30,751	30,905	(6,181) [1,483] {742}	31,055	(6,211) [1,491] {745}	31,203	(6,241) [1,498] {749}		
Monroe	14,038	14,094	14,136	14,174	14,275	(2,855) [685] {343}	14,371	(2,874) [690] {345}	14,464	(2,893) [694] {347}		
Montgomery	68,241	68,399	68,508	68,623	68,896	(13,779) [3,307] {1,654}	69,154	(13,831) [3,319] {1,660}	69,395	(13,879) [3,331] {1,665}		
Northampton	34,674	34,759	34,822	34,876	35,009	(7,002) [1,680] {840}	35,136	(7,027) [1,687] {843}	35,253	(7,051) [1,692] {846}		
Philadelphia	148,031	148,411	148,792	149,172	149,830	(29,966) [7,192] {3,596}	150,464	(30,093) [7,222] {3,611}	151,051	(30,210) [7,250] {3,625}		
Westmoreland	32,828	32,915	33,058	33,111	33,253	(6,651) [1,596] {798}	33,387	(6,677) [1,603] {801}	33,520	(6,704) [1,609] {804}		
York	44,485	44,608	44,732	44,837	45,059	(9,012) [2,163] {1,081}	45,274	(9,055) [2,173] {1,087}	45,479	(9,096) [2,183] {1,091}		

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.