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

Date: 9/24/21

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 9/24/21 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.

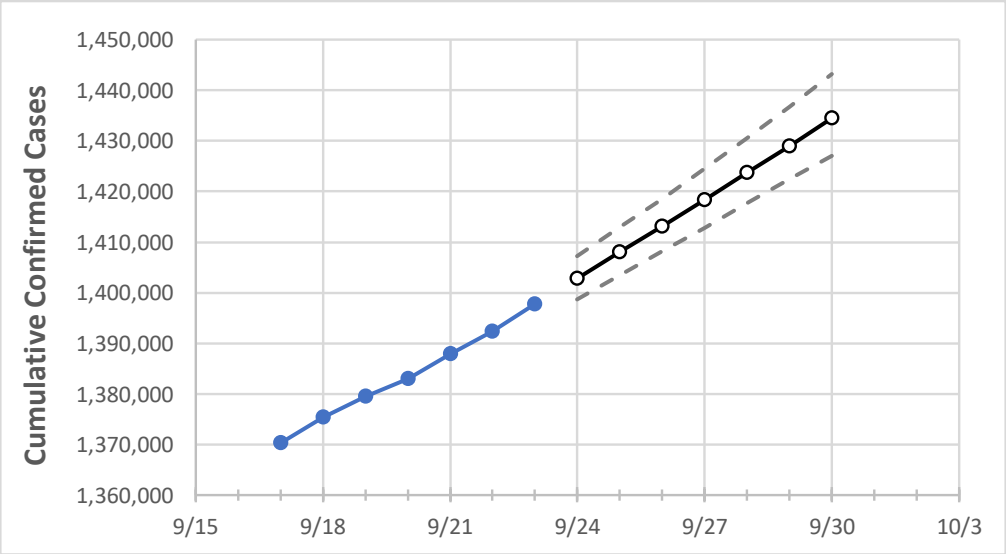
IEM's Modeling Lead

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:						
	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28	9/29	9/30
Pennsylvania	1,382,933	1,387,872	1,392,266	1,397,755	1,402,844	1,407,950	1,413,062	1,418,333	1,423,641	1,429,024	1,434,538

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:						
	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28	9/29	9/30
Allegheny	117,081	117,546	117,844	118,357	118,804	119,256	119,723	120,185	120,666	121,155	121,645
Berks	53,313	53,455	53,567	53,705	53,836	53,966	54,098	54,228	54,361	54,499	54,632
Bucks	67,577	67,732	67,889	68,042	68,182	68,323	68,462	68,602	68,746	68,887	69,030
Butler	21,202	21,322	21,424	21,561	21,697	21,837	21,974	22,116	22,262	22,410	22,561
Chester	46,308	46,439	46,545	46,667	46,798	46,931	47,063	47,197	47,334	47,470	47,608
Delaware	58,109	58,208	58,338	58,449	58,559	58,672	58,778	58,889	59,001	59,111	59,219
Lackawanna	20,530	20,596	20,664	20,711	20,779	20,844	20,914	20,983	21,055	21,127	21,200
Lancaster	63,480	63,666	63,878	64,140	64,374	64,609	64,847	65,091	65,333	65,581	65,834
Lehigh	44,963	45,117	45,244	45,382	45,512	45,637	45,767	45,898	46,027	46,166	46,298
Luzerne	35,950	36,041	36,140	36,294	36,413	36,538	36,663	36,790	36,921	37,055	37,187
Monroe	17,499	17,565	17,638	17,739	17,822	17,909	17,996	18,085	18,176	18,269	18,364
Montgomery	79,075	79,239	79,386	79,577	79,756	79,932	80,109	80,283	80,458	80,643	80,819
Northampton	40,972	41,093	41,208	41,353	41,479	41,604	41,727	41,857	41,985	42,114	42,247
Philadelphia	171,356	171,729	172,132	172,505	172,817	173,138	173,459	173,784	174,111	174,435	174,755
Westmoreland	39,288	39,487	39,604	39,792	39,963	40,138	40,313	40,491	40,674	40,867	41,054
York	54,100	54,292	54,476	54,722	54,934	55,152	55,368	55,585	55,807	56,034	56,261

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:		
	9/20	9/21	9/22	9/23	9/25	9/27	9/29
Allegheny	117,081	117,546	117,844	118,357	119,256 (23,851) [5,724] {2,862}	120,185 (24,037) [5,769] {2,884}	121,155 (24,231) [5,815] {2,908}
Berks	53,313	53,455	53,567	53,705	53,966 (10,793) [2,590] {1,295}	54,228 (10,846) [2,603] {1,301}	54,499 (10,900) [2,616] {1,308}
Bucks	67,577	67,732	67,889	68,042	68,323 (13,665) [3,280] {1,640}	68,602 (13,720) [3,293] {1,646}	68,887 (13,777) [3,307] {1,653}
Butler	21,202	21,322	21,424	21,561	21,837 (4,367) [1,048] {524}	22,116 (4,423) [1,062] {531}	22,410 (4,482) [1,076] {538}
Chester	46,308	46,439	46,545	46,667	46,931 (9,386) [2,253] {1,126}	47,197 (9,439) [2,265] {1,133}	47,470 (9,494) [2,279] {1,139}
Delaware	58,109	58,208	58,338	58,449	58,672 (11,734) [2,816] {1,408}	58,889 (11,778) [2,827] {1,413}	59,111 (11,822) [2,837] {1,419}
Lackawanna	20,530	20,596	20,664	20,711	20,844 (4,169) [1,001] {500}	20,983 (4,197) [1,007] {504}	21,127 (4,225) [1,014] {507}
Lancaster	63,480	63,666	63,878	64,140	64,609 (12,922) [3,101] {1,551}	65,091 (13,018) [3,124] {1,562}	65,581 (13,116) [3,148] {1,574}
Lehigh	44,963	45,117	45,244	45,382	45,637 (9,127) [2,191] {1,095}	45,898 (9,180) [2,203] {1,102}	46,166 (9,233) [2,216] {1,108}
Luzerne	35,950	36,041	36,140	36,294	36,538 (7,308) [1,754] {877}	36,790 (7,358) [1,766] {883}	37,055 (7,411) [1,779] {889}
Monroe	17,499	17,565	17,638	17,739	17,909 (3,582) [860] {430}	18,085 (3,617) [868] {434}	18,269 (3,654) [877] {438}
Montgomery	79,075	79,239	79,386	79,577	79,932 (15,986) [3,837] {1,918}	80,283 (16,057) [3,854] {1,927}	80,643 (16,129) [3,871] {1,935}
Northampton	40,972	41,093	41,208	41,353	41,604 (8,321) [1,997] {999}	41,857 (8,371) [2,009] {1,005}	42,114 (8,423) [2,021] {1,011}
Philadelphia	171,356	171,729	172,132	172,505	173,138 (34,628) [8,311] {4,155}	173,784 (34,757) [8,342] {4,171}	174,435 (34,887) [8,373] {4,186}
Westmoreland	39,288	39,487	39,604	39,792	40,138 (8,028) [1,927] {963}	40,491 (8,098) [1,944] {972}	40,867 (8,173) [1,962] {981}
York	54,100	54,292	54,476	54,722	55,152 (11,030) [2,647] {1,324}	55,585 (11,117) [2,668] {1,334}	56,034 (11,207) [2,690] {1,345}

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.