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

Date: 4/26/21

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 4/26/21 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.

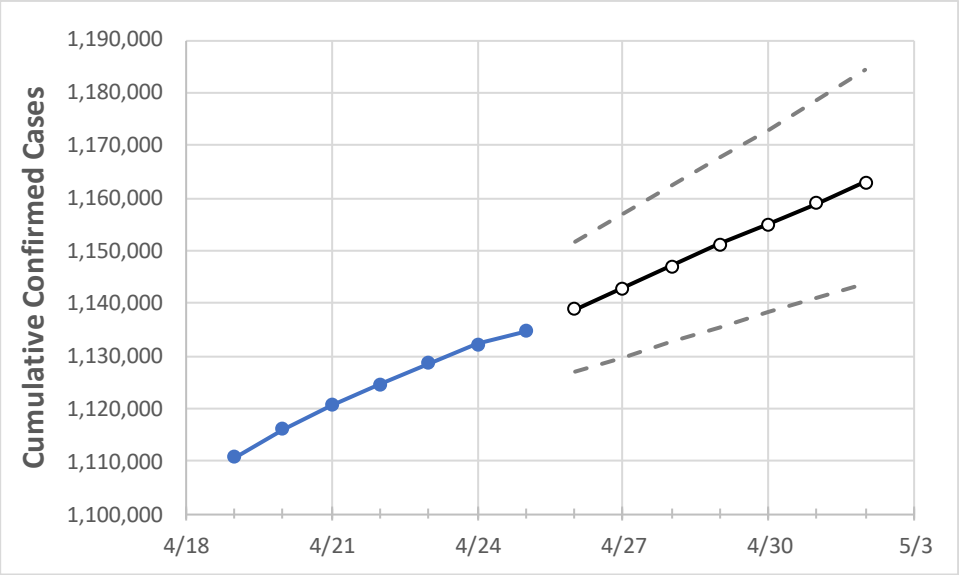
IEM's Modeling Lead

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:						
	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2
Pennsylvania	1,124,659	1,128,688	1,132,248	1,134,742	1,138,837	1,142,927	1,147,102	1,151,140	1,155,073	1,159,080	1,163,072

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:						
	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2
Allegheny	95,140	95,490	95,857	96,074	96,419	96,766	97,098	97,429	97,752	98,065	98,373
Berks	44,134	44,296	44,497	44,641	44,825	45,009	45,194	45,379	45,563	45,750	45,933
Bucks	56,904	57,135	57,375	57,566	57,806	58,047	58,278	58,513	58,747	58,976	59,203
Butler	16,421	16,473	16,524	16,551	16,593	16,633	16,672	16,713	16,749	16,788	16,827
Chester	34,546	34,668	34,668	34,668	34,800	34,931	35,063	35,192	35,319	35,447	35,575
Delaware	49,343	49,544	49,713	49,841	50,051	50,262	50,470	50,681	50,887	51,095	51,305
Lackawanna	17,225	17,329	17,400	17,443	17,517	17,590	17,665	17,745	17,820	17,901	17,979
Lancaster	52,041	52,209	52,360	52,510	52,694	52,880	53,065	53,250	53,430	53,614	53,795
Lehigh	37,198	37,357	37,512	37,609	37,740	37,866	37,994	38,119	38,247	38,372	38,496
Luzerne	29,521	29,659	29,769	29,852	29,966	30,080	30,193	30,308	30,422	30,537	30,656
Monroe	13,306	13,379	13,471	13,541	13,617	13,693	13,771	13,847	13,923	13,997	14,073
Montgomery	66,088	66,333	66,562	66,772	67,027	67,275	67,522	67,764	67,996	68,231	68,462
Northampton	33,630	33,763	33,895	33,992	34,109	34,225	34,335	34,447	34,558	34,663	34,768
Philadelphia	143,574	144,048	144,048	144,048	144,669	145,299	145,922	146,558	147,194	147,832	148,462
Westmoreland	31,924	32,021	32,136	32,214	32,320	32,427	32,532	32,636	32,740	32,839	32,941
York	43,072	43,204	43,372	43,493	43,648	43,801	43,957	44,117	44,276	44,430	44,589

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:		
	4/22	4/23	4/24	4/25	4/27	4/29	5/1
Allegheny	95,140	95,490	95,857	96,074	96,766 (19,353) [4,645] {2,322}	97,429 (19,486) [4,677] {2,338}	98,065 (19,613) [4,707] {2,354}
Berks	44,134	44,296	44,497	44,641	45,009 (9,002) [2,160] {1,080}	45,379 (9,076) [2,178] {1,089}	45,750 (9,150) [2,196] {1,098}
Bucks	56,904	57,135	57,375	57,566	58,047 (11,609) [2,786] {1,393}	58,513 (11,703) [2,809] {1,404}	58,976 (11,795) [2,831] {1,415}
Butler	16,421	16,473	16,524	16,551	16,633 (3,327) [798] {399}	16,713 (3,343) [802] {401}	16,788 (3,358) [806] {403}
Chester	34,546	34,668	34,668	34,668	34,931 (6,986) [1,677] {838}	35,192 (7,038) [1,689] {845}	35,447 (7,089) [1,701] {851}
Delaware	49,343	49,544	49,713	49,841	50,262 (10,052) [2,413] {1,206}	50,681 (10,136) [2,433] {1,216}	51,095 (10,219) [2,453] {1,226}
Lackawanna	17,225	17,329	17,400	17,443	17,590 (3,518) [844] {422}	17,745 (3,549) [852] {426}	17,901 (3,580) [859] {430}
Lancaster	52,041	52,209	52,360	52,510	52,880 (10,576) [2,538] {1,269}	53,250 (10,650) [2,556] {1,278}	53,614 (10,723) [2,573] {1,287}
Lehigh	37,198	37,357	37,512	37,609	37,866 (7,573) [1,818] {909}	38,119 (7,624) [1,830] {915}	38,372 (7,674) [1,842] {921}
Luzerne	29,521	29,659	29,769	29,852	30,080 (6,016) [1,444] {722}	30,308 (6,062) [1,455] {727}	30,537 (6,107) [1,466] {733}
Monroe	13,306	13,379	13,471	13,541	13,693 (2,739) [657] {329}	13,847 (2,769) [665] {332}	13,997 (2,799) [672] {336}
Montgomery	66,088	66,333	66,562	66,772	67,275 (13,455) [3,229] {1,615}	67,764 (13,553) [3,253] {1,626}	68,231 (13,646) [3,275] {1,638}
Northampton	33,630	33,763	33,895	33,992	34,225 (6,845) [1,643] {821}	34,447 (6,889) [1,653] {827}	34,663 (6,933) [1,664] {832}
Philadelphia	143,574	144,048	144,048	144,048	145,299 (29,060) [6,974] {3,487}	146,558 (29,312) [7,035] {3,517}	147,832 (29,566) [7,096] {3,548}
Westmoreland	31,924	32,021	32,136	32,214	32,427 (6,485) [1,556] {778}	32,636 (6,527) [1,567] {783}	32,839 (6,568) [1,576] {788}
York	43,072	43,204	43,372	43,493	43,801 (8,760) [2,102] {1,051}	44,117 (8,823) [2,118] {1,059}	44,430 (8,886) [2,133] {1,066}

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.