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

Date: 10/29/20

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 10/29/20 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.

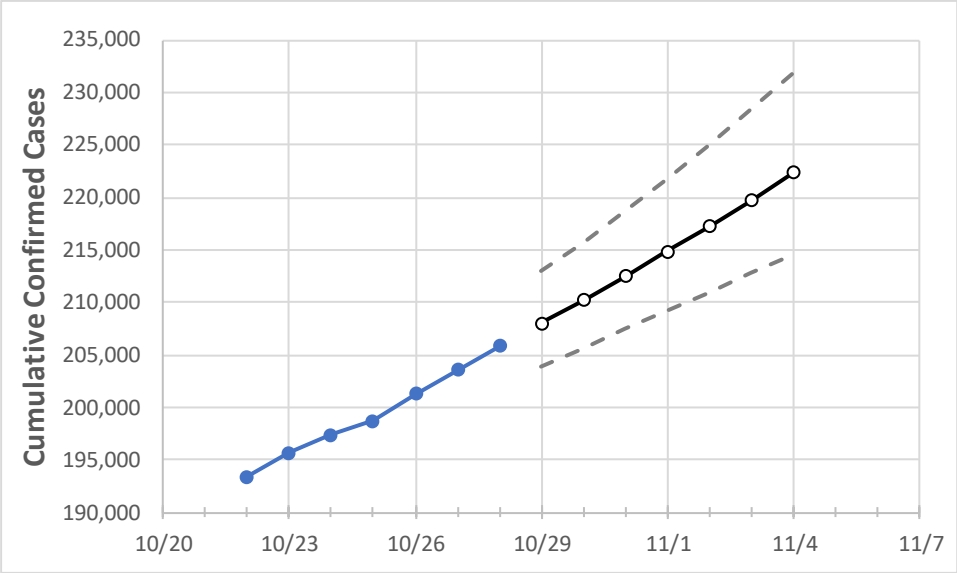
IEM's Modeling Lead

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:						
	10/25	10/26	10/27	10/28	10/29	10/30	10/31	11/1	11/2	11/3	11/4
Pennsylvania	198,713	201,248	203,520	205,852	207,991	210,197	212,472	214,817	217,235	219,729	222,299

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 20%, and are often within 10%, of actual confirmed cases.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	10/25	10/26	10/27	10/28	10/29	10/30	10/31	11/1	11/2	11/3	11/4
Allegheny	14,922	14,995	15,101	15,300	15,438	15,579	15,722	15,868	16,017	16,169	16,324
Berks	8,924	9,024	9,155	9,290	9,414	9,543	9,677	9,817	9,963	10,115	10,273
Bucks	10,008	10,053	10,112	10,171	10,231	10,292	10,355	10,419	10,486	10,554	10,624
Butler	1,602	1,623	1,661	1,701	1,735	1,769	1,806	1,844	1,884	1,925	1,968
Chester	7,935	7,986	8,039	8,093	8,141	8,189	8,239	8,290	8,342	8,395	8,449
Delaware	13,144	13,269	13,397	13,527	13,633	13,743	13,858	13,978	14,102	14,231	14,366
Lackawanna	3,629	3,653	3,702	3,746	3,803	3,861	3,921	3,982	4,045	4,110	4,177
Lancaster	9,338	9,413	9,483	9,573	9,640	9,709	9,780	9,852	9,926	10,001	10,079
Lehigh	6,411	6,496	6,541	6,593	6,643	6,696	6,752	6,810	6,871	6,935	7,002
Luzerne	5,141	5,195	5,273	5,337	5,426	5,521	5,621	5,728	5,842	5,962	6,089
Monroe	1,992	2,001	2,013	2,020	2,030	2,041	2,053	2,065	2,077	2,090	2,103
Montgomery	13,594	13,695	13,791	13,885	13,967	14,053	14,142	14,235	14,331	14,432	14,536
Northampton	5,269	5,304	5,341	5,393	5,433	5,475	5,518	5,563	5,609	5,657	5,706
Philadelphia	42,659	43,003	43,365	43,740	44,116	44,507	44,914	45,338	45,779	46,239	46,717
Westmoreland	4,031	4,097	4,169	4,260	4,372	4,488	4,608	4,731	4,858	4,989	5,124
York	6,243	6,315	6,405	6,484	6,556	6,630	6,705	6,783	6,862	6,943	7,027

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:		
	10/25	10/26	10/27	10/28	10/30	11/1	11/3
Allegheny	14,922	14,995	15,101	15,300	15,579 (3,116) [748] {374}	15,868 (3,174) [762] {381}	16,169 (3,234) [776] {388}
Berks	8,924	9,024	9,155	9,290	9,543 (1,909) [458] {229}	9,817 (1,963) [471] {236}	10,115 (2,023) [486] {243}
Bucks	10,008	10,053	10,112	10,171	10,292 (2,058) [494] {247}	10,419 (2,084) [500] {250}	10,554 (2,111) [507] {253}
Butler	1,602	1,623	1,661	1,701	1,769 (354) [85] {42}	1,844 (369) [89] {44}	1,925 (385) [92] {46}
Chester	7,935	7,986	8,039	8,093	8,189 (1,638) [393] {197}	8,290 (1,658) [398] {199}	8,395 (1,679) [403] {201}
Delaware	13,144	13,269	13,397	13,527	13,743 (2,749) [660] {330}	13,978 (2,796) [671] {335}	14,231 (2,846) [683] {342}
Lackawanna	3,629	3,653	3,702	3,746	3,861 (772) [185] {93}	3,982 (796) [191] {96}	4,110 (822) [197] {99}
Lancaster	9,338	9,413	9,483	9,573	9,709 (1,942) [466] {233}	9,852 (1,970) [473] {236}	10,001 (2,000) [480] {240}
Lehigh	6,411	6,496	6,541	6,593	6,696 (1,339) [321] {161}	6,810 (1,362) [327] {163}	6,935 (1,387) [333] {166}
Luzerne	5,141	5,195	5,273	5,337	5,521 (1,104) [265] {133}	5,728 (1,146) [275] {137}	5,962 (1,192) [286] {143}
Monroe	1,992	2,001	2,013	2,020	2,041 (408) [98] {49}	2,065 (413) [99] {50}	2,090 (418) [100] {50}
Montgomery	13,594	13,695	13,791	13,885	14,053 (2,811) [675] {337}	14,235 (2,847) [683] {342}	14,432 (2,886) [693] {346}
Northampton	5,269	5,304	5,341	5,393	5,475 (1,095) [263] {131}	5,563 (1,113) [267] {134}	5,657 (1,131) [272] {136}
Philadelphia	42,659	43,003	43,365	43,740	44,507 (8,901) [2,136] {1,068}	45,338 (9,068) [2,176] {1,088}	46,239 (9,248) [2,219] {1,110}
Westmoreland	4,031	4,097	4,169	4,260	4,488 (898) [215] {108}	4,731 (946) [227] {114}	4,989 (998) [239] {120}
York	6,243	6,315	6,405	6,484	6,630 (1,326) [318] {159}	6,783 (1,357) [326] {163}	6,943 (1,389) [333] {167}

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.