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

Date: 11/19/20

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 11/19/20 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.

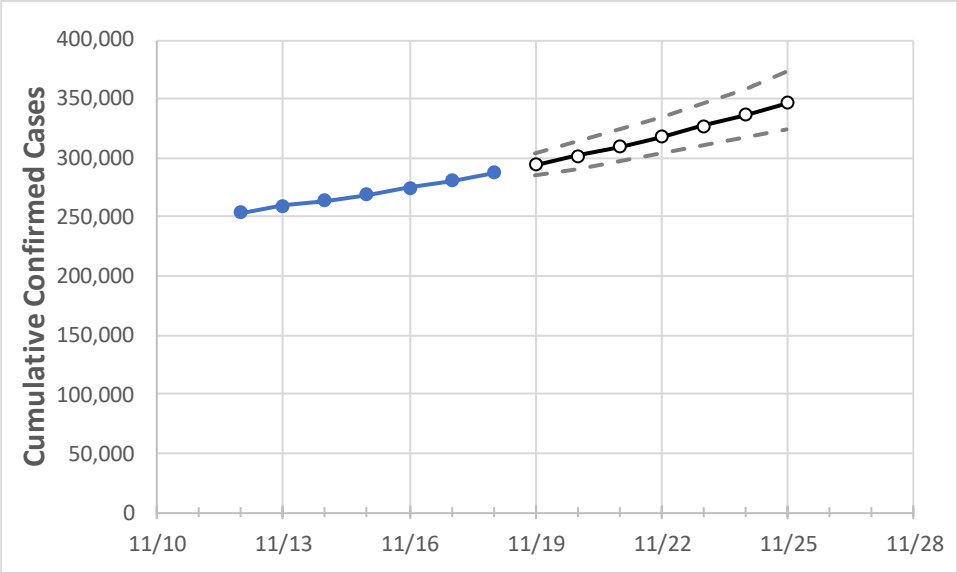
IEM's Modeling Lead

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:						
	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25
Pennsylvania	268,696	275,235	280,957	287,425	294,396	301,799	309,662	318,010	326,874	336,283	346,270

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:						
	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25
Allegheny	20,026	20,526	20,814	21,434	22,010	22,627	23,287	23,995	24,752	25,564	26,432
Berks	11,359	11,518	11,709	11,888	12,066	12,251	12,442	12,642	12,848	13,063	13,286
Bucks	13,050	13,285	13,518	13,686	14,025	14,387	14,776	15,193	15,640	16,119	16,632
Butler	2,901	2,983	3,108	3,218	3,349	3,488	3,638	3,799	3,971	4,155	4,352
Chester	9,724	9,873	9,999	10,141	10,318	10,507	10,706	10,917	11,142	11,379	11,631
Delaware	16,595	16,736	16,963	17,294	17,579	17,877	18,188	18,514	18,855	19,212	19,586
Lackawanna	4,360	4,369	4,415	4,465	4,499	4,532	4,566	4,600	4,634	4,669	4,703
Lancaster	12,217	12,434	12,603	12,853	13,123	13,409	13,713	14,036	14,378	14,742	15,127
Lehigh	8,637	8,725	8,831	8,970	9,140	9,316	9,499	9,689	9,885	10,089	10,301
Luzerne	7,031	7,104	7,327	7,555	7,728	7,910	8,103	8,306	8,521	8,748	8,987
Monroe	2,572	2,598	2,631	2,659	2,710	2,764	2,821	2,881	2,945	3,012	3,083
Montgomery	17,446	17,631	17,892	18,155	18,512	18,890	19,291	19,717	20,168	20,646	21,153
Northampton	6,842	6,918	7,013	7,143	7,283	7,429	7,584	7,746	7,917	8,096	8,284
Philadelphia	54,442	55,302	56,372	57,201	58,313	59,490	60,736	62,054	63,449	64,925	66,486
Westmoreland	6,099	6,266	6,421	6,649	6,855	7,074	7,308	7,557	7,823	8,106	8,408
York	8,074	8,216	8,454	8,632	8,803	8,984	9,176	9,379	9,594	9,822	10,063

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:		
	11/15	11/16	11/17	11/18	11/20	11/22	11/24
Allegheny	20,026	20,526	20,814	21,434	22,627 (4,525) [1,086] {543}	23,995 (4,799) [1,152] {576}	25,564 (5,113) [1,227] {614}
Berks	11,359	11,518	11,709	11,888	12,251 (2,450) [588] {294}	12,642 (2,528) [607] {303}	13,063 (2,613) [627] {314}
Bucks	13,050	13,285	13,518	13,686	14,387 (2,877) [691] {345}	15,193 (3,039) [729] {365}	16,119 (3,224) [774] {387}
Butler	2,901	2,983	3,108	3,218	3,488 (698) [167] {84}	3,799 (760) [182] {91}	4,155 (831) [199] {100}
Chester	9,724	9,873	9,999	10,141	10,507 (2,101) [504] {252}	10,917 (2,183) [524] {262}	11,379 (2,276) [546] {273}
Delaware	16,595	16,736	16,963	17,294	17,877 (3,575) [858] {429}	18,514 (3,703) [889] {444}	19,212 (3,842) [922] {461}
Lackawanna	4,360	4,369	4,415	4,465	4,532 (906) [218] {109}	4,600 (920) [221] {110}	4,669 (934) [224] {112}
Lancaster	12,217	12,434	12,603	12,853	13,409 (2,682) [644] {322}	14,036 (2,807) [674] {337}	14,742 (2,948) [708] {354}
Lehigh	8,637	8,725	8,831	8,970	9,316 (1,863) [447] {224}	9,689 (1,938) [465] {233}	10,089 (2,018) [484] {242}
Luzerne	7,031	7,104	7,327	7,555	7,910 (1,582) [380] {190}	8,306 (1,661) [399] {199}	8,748 (1,750) [420] {210}
Monroe	2,572	2,598	2,631	2,659	2,764 (553) [133] {66}	2,881 (576) [138] {69}	3,012 (602) [145] {72}
Montgomery	17,446	17,631	17,892	18,155	18,890 (3,778) [907] {453}	19,717 (3,943) [946] {473}	20,646 (4,129) [991] {496}
Northampton	6,842	6,918	7,013	7,143	7,429 (1,486) [357] {178}	7,746 (1,549) [372] {186}	8,096 (1,619) [389] {194}
Philadelphia	54,442	55,302	56,372	57,201	59,490 (11,898) [2,856] {1,428}	62,054 (12,411) [2,979] {1,489}	64,925 (12,985) [3,116] {1,558}
Westmoreland	6,099	6,266	6,421	6,649	7,074 (1,415) [340] {170}	7,557 (1,511) [363] {181}	8,106 (1,621) [389] {195}
York	8,074	8,216	8,454	8,632	8,984 (1,797) [431] {216}	9,379 (1,876) [450] {225}	9,822 (1,964) [471] {236}

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.