IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/16/20

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 11/16/20 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
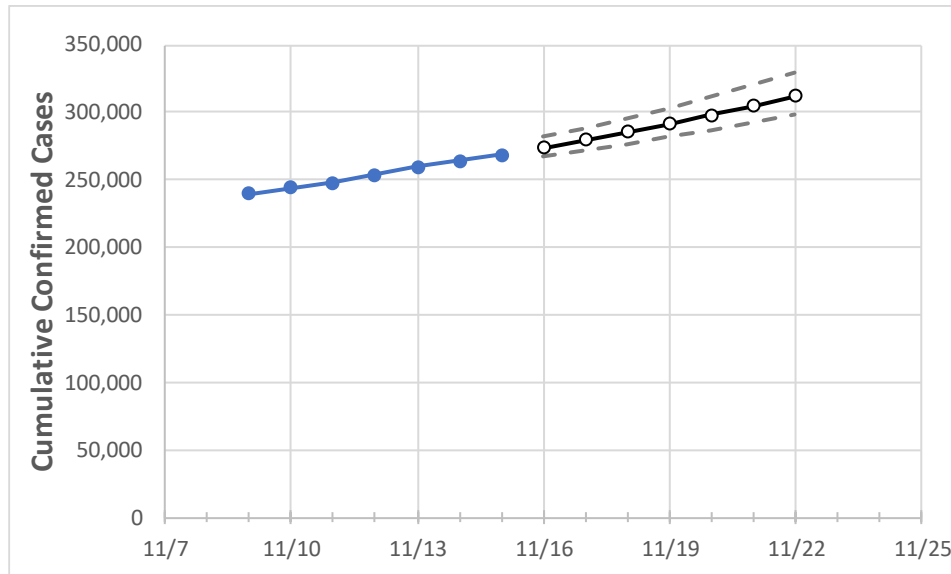
	Actual Confirmed Cases On:				Projected Cases For:						
	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22
Pennsylvania	254,155	259,988	264,222	268,696	274,009	279,591	285,455	291,616	298,087	304,884	312,023

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:						
	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22
Allegheny	18,751	19,129	19,499	20,026	20,488	20,984	21,518	22,091	22,707	23,368	24,078
Berks	10,899	11,036	11,191	11,359	11,494	11,632	11,772	11,916	12,062	12,212	12,365
Bucks	12,229	12,519	12,748	13,050	13,345	13,665	14,011	14,386	14,792	15,231	15,707
Butler	2,659	2,728	2,829	2,901	2,998	3,102	3,211	3,327	3,450	3,581	3,720
Chester	9,279	9,427	9,427	9,427	9,530	9,638	9,750	9,868	9,991	10,119	10,253
Delaware	15,832	16,056	16,340	16,595	16,866	17,152	17,455	17,775	18,114	18,473	18,852
Lackawanna	4,234	4,279	4,321	4,360	4,394	4,428	4,462	4,496	4,530	4,565	4,599
Lancaster	11,465	11,712	11,988	12,217	12,444	12,685	12,939	13,210	13,496	13,799	14,120
Lehigh	8,167	8,332	8,466	8,637	8,835	9,048	9,275	9,519	9,779	10,058	10,356
Luzerne	6,642	6,760	6,933	7,031	7,156	7,286	7,421	7,562	7,710	7,863	8,022
Monroe	2,413	2,479	2,525	2,572	2,630	2,692	2,761	2,835	2,915	3,003	3,098
Montgomery	16,455	16,773	17,051	17,446	17,787	18,152	18,545	18,967	19,419	19,905	20,427
Northampton	6,457	6,593	6,700	6,842	6,978	7,124	7,281	7,449	7,629	7,823	8,030
Philadelphia	51,513	52,723	52,723	52,723	53,292	53,882	54,492	55,125	55,779	56,457	57,160
Westmoreland	5,638	5,757	5,912	6,099	6,226	6,358	6,495	6,637	6,784	6,936	7,094
York	7,734	7,869	7,966	8,074	8,182	8,293	8,408	8,526	8,647	8,773	8,902

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:		
	11/12	11/13	11/14	11/15	11/17	11/19	11/21
Allegheny	18,751	19,129	19,499	20,026	20,984 (4,197) [1,007] {504}	22,091 (4,418) [1,060] {530}	23,368 (4,674) [1,122] {561}
Berks	10,899	11,036	11,191	11,359	11,632 (2,326) [558] {279}	11,916 (2,383) [572] {286}	12,212 (2,442) [586] {293}
Bucks	12,229	12,519	12,748	13,050	13,665 (2,733) [656] {328}	14,386 (2,877) [691] {345}	15,231 (3,046) [731] {366}
Butler	2,659	2,728	2,829	2,901	3,102 (620) [149] {74}	3,327 (665) [160] {80}	3,581 (716) [172] {86}
Chester	9,279	9,427	9,427	9,427	9,638 (1,928) [463] {231}	9,868 (1,974) [474] {237}	10,119 (2,024) [486] {243}
Delaware	15,832	16,056	16,340	16,595	17,152 (3,430) [823] {412}	17,775 (3,555) [853] {427}	18,473 (3,695) [887] {443}
Lackawanna	4,234	4,279	4,321	4,360	4,428 (886) [213] {106}	4,496 (899) [216] {108}	4,565 (913) [219] {110}
Lancaster	11,465	11,712	11,988	12,217	12,685 (2,537) [609] {304}	13,210 (2,642) [634] {317}	13,799 (2,760) [662] {331}
Lehigh	8,167	8,332	8,466	8,637	9,048 (1,810) [434] {217}	9,519 (1,904) [457] {228}	10,058 (2,012) [483] {241}
Luzerne	6,642	6,760	6,933	7,031	7,286 (1,457) [350] {175}	7,562 (1,512) [363] {181}	7,863 (1,573) [377] {189}
Monroe	2,413	2,479	2,525	2,572	2,692 (538) [129] {65}	2,835 (567) [136] {68}	3,003 (601) [144] {72}
Montgomery	16,455	16,773	17,051	17,446	18,152 (3,630) [871] {436}	18,967 (3,793) [910] {455}	19,905 (3,981) [955] {478}
Northampton	6,457	6,593	6,700	6,842	7,124 (1,425) [342] {171}	7,449 (1,490) [358] {179}	7,823 (1,565) [375] {188}
Philadelphia	51,513	52,723	52,723	52,723	53,882 (10,776) [2,586] {1,293}	55,125 (11,025) [2,646] {1,323}	56,457 (11,291) [2,710] {1,355}
Westmoreland	5,638	5,757	5,912	6,099	6,358 (1,272) [305] {153}	6,637 (1,327) [319] {159}	6,936 (1,387) [333] {166}
York	7,734	7,869	7,966	8,074	8,293 (1,659) [398] {199}	8,526 (1,705) [409] {205}	8,773 (1,755) [421] {211}

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.