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

Date: 12/1/20

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 12/1/20 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.

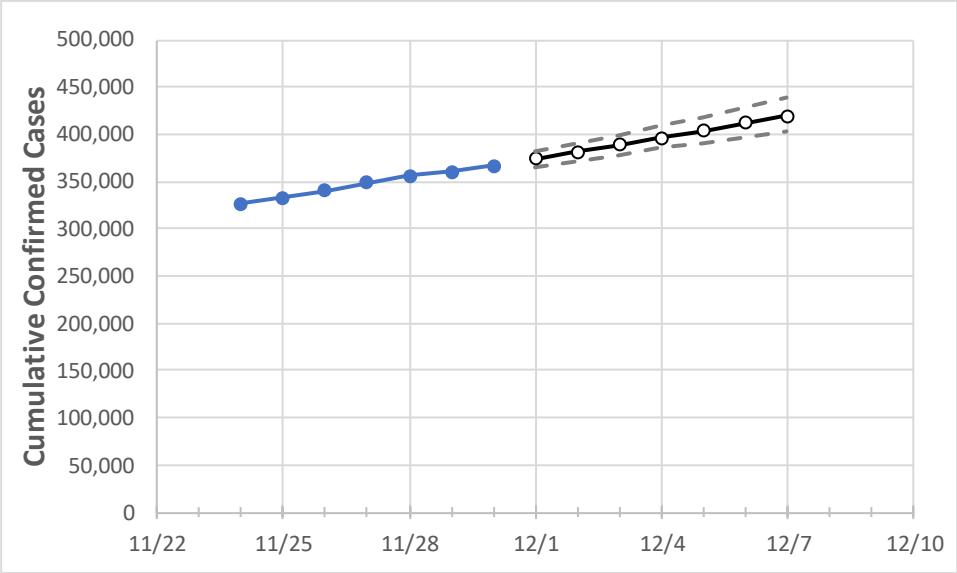
IEM's Modeling Lead

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Pennsylvania	349,238	355,945	360,944	366,835	374,071	381,418	388,881	396,463	404,165	411,990	419,938

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Allegheny	26,821	27,484	28,004	28,404	29,098	29,815	30,557	31,323	32,115	32,934	33,779
Berks	13,519	13,694	13,874	13,956	14,137	14,321	14,506	14,693	14,882	15,073	15,266
Bucks	16,709	17,146	17,410	17,733	18,122	18,523	18,936	19,362	19,802	20,255	20,722
Butler	4,246	4,355	4,484	4,532	4,645	4,760	4,878	4,997	5,118	5,242	5,367
Chester	11,711	11,844	11,977	12,110	12,290	12,473	12,660	12,850	13,045	13,243	13,445
Delaware	19,649	19,877	20,057	20,166	20,391	20,615	20,839	21,063	21,286	21,509	21,731
Lackawanna	5,043	5,122	5,173	5,214	5,290	5,369	5,452	5,537	5,627	5,719	5,816
Lancaster	15,890	16,157	16,470	16,702	17,076	17,464	17,865	18,281	18,712	19,158	19,619
Lehigh	10,981	11,279	11,412	11,512	11,733	11,959	12,192	12,430	12,674	12,925	13,183
Luzerne	9,238	9,435	9,656	9,760	9,967	10,179	10,396	10,619	10,847	11,081	11,320
Monroe	3,180	3,343	3,386	3,413	3,479	3,546	3,616	3,689	3,763	3,841	3,921
Montgomery	21,071	21,421	21,729	22,025	22,375	22,730	23,091	23,457	23,830	24,208	24,593
Northampton	8,667	8,903	9,000	9,104	9,280	9,460	9,644	9,833	10,027	10,224	10,427
Philadelphia	65,484	66,084	66,683	67,283	68,064	68,838	69,603	70,361	71,111	71,854	72,590
Westmoreland	8,675	8,959	9,132	9,261	9,515	9,776	10,043	10,318	10,599	10,888	11,185
York	10,604	10,806	11,001	11,202	11,449	11,706	11,972	12,248	12,535	12,833	13,142

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:		
	11/27	11/28	11/29	11/30	12/2	12/4	12/6
Allegheny	26,821	27,484	28,004	28,404	29,815 (5,963) [1,431] {716}	31,323 (6,265) [1,504] {752}	32,934 (6,587) [1,581] {790}
Berks	13,519	13,694	13,874	13,956	14,321 (2,864) [687] {344}	14,693 (2,939) [705] {353}	15,073 (3,015) [724] {362}
Bucks	16,709	17,146	17,410	17,733	18,523 (3,705) [889] {445}	19,362 (3,872) [929] {465}	20,255 (4,051) [972] {486}
Butler	4,246	4,355	4,484	4,532	4,760 (952) [228] {114}	4,997 (999) [240] {120}	5,242 (1,048) [252] {126}
Chester	11,711	11,844	11,977	12,110	12,473 (2,495) [599] {299}	12,850 (2,570) [617] {308}	13,243 (2,649) [636] {318}
Delaware	19,649	19,877	20,057	20,166	20,615 (4,123) [990] {495}	21,063 (4,213) [1,011] {506}	21,509 (4,302) [1,032] {516}
Lackawanna	5,043	5,122	5,173	5,214	5,369 (1,074) [258] {129}	5,537 (1,107) [266] {133}	5,719 (1,144) [275] {137}
Lancaster	15,890	16,157	16,470	16,702	17,464 (3,493) [838] {419}	18,281 (3,656) [877] {439}	19,158 (3,832) [920] {460}
Lehigh	10,981	11,279	11,412	11,512	11,959 (2,392) [574] {287}	12,430 (2,486) [597] {298}	12,925 (2,585) [620] {310}
Luzerne	9,238	9,435	9,656	9,760	10,179 (2,036) [489] {244}	10,619 (2,124) [510] {255}	11,081 (2,216) [532] {266}
Monroe	3,180	3,343	3,386	3,413	3,546 (709) [170] {85}	3,689 (738) [177] {89}	3,841 (768) [184] {92}
Montgomery	21,071	21,421	21,729	22,025	22,730 (4,546) [1,091] {546}	23,457 (4,691) [1,126] {563}	24,208 (4,842) [1,162] {581}
Northampton	8,667	8,903	9,000	9,104	9,460 (1,892) [454] {227}	9,833 (1,967) [472] {236}	10,224 (2,045) [491] {245}
Philadelphia	65,484	66,084	66,683	67,283	68,838 (13,768) [3,304] {1,652}	70,361 (14,072) [3,377] {1,689}	71,854 (14,371) [3,449] {1,725}
Westmoreland	8,675	8,959	9,132	9,261	9,776 (1,955) [469] {235}	10,318 (2,064) [495] {248}	10,888 (2,178) [523] {261}
York	10,604	10,806	11,001	11,202	11,706 (2,341) [562] {281}	12,248 (2,450) [588] {294}	12,833 (2,567) [616] {308}

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.