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

Date: 11/9/20

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 11/9/20 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.

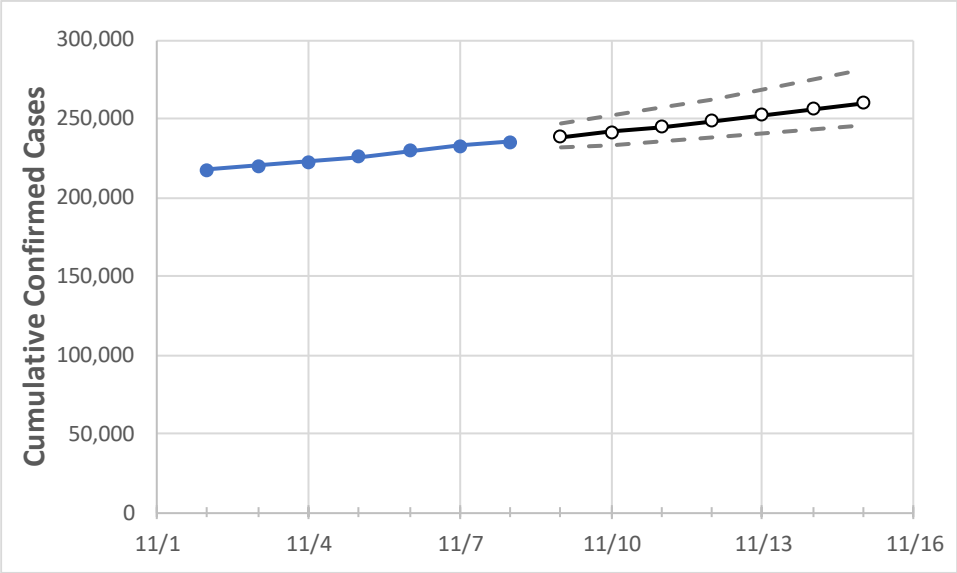
IEM's Modeling Lead

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:						
	11/5	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15
Pennsylvania	225,698	229,346	232,493	235,014	238,244	241,592	245,062	248,659	252,386	256,249	260,251

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:						
	11/5	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15
Allegheny	16,599	16,838	17,126	17,386	17,616	17,856	18,106	18,367	18,640	18,924	19,221
Berks	10,058	10,165	10,278	10,355	10,453	10,551	10,648	10,746	10,843	10,940	11,038
Bucks	10,895	11,051	11,193	11,340	11,489	11,649	11,819	12,002	12,198	12,407	12,631
Butler	2,036	2,102	2,226	2,308	2,373	2,441	2,514	2,590	2,671	2,757	2,848
Chester	8,581	8,669	8,669	8,669	8,721	8,773	8,826	8,880	8,936	8,992	9,049
Delaware	14,477	14,648	14,865	15,020	15,197	15,381	15,575	15,777	15,988	16,210	16,441
Lackawanna	3,987	4,031	4,066	4,080	4,102	4,123	4,143	4,163	4,181	4,199	4,217
Lancaster	10,372	10,562	10,705	10,861	11,019	11,187	11,365	11,553	11,753	11,965	12,189
Lehigh	7,180	7,290	7,439	7,544	7,668	7,800	7,942	8,095	8,258	8,433	8,621
Luzerne	5,861	5,948	6,045	6,125	6,204	6,284	6,366	6,449	6,534	6,620	6,708
Monroe	2,182	2,211	2,242	2,259	2,290	2,323	2,359	2,397	2,440	2,485	2,535
Montgomery	14,901	15,118	15,311	15,467	15,658	15,861	16,074	16,300	16,538	16,789	17,055
Northampton	5,826	5,911	6,004	6,058	6,136	6,217	6,303	6,393	6,488	6,589	6,694
Philadelphia	46,917	47,675	47,675	47,675	48,015	48,360	48,709	49,063	49,423	49,787	50,157
Westmoreland	4,817	4,899	4,975	5,078	5,157	5,236	5,316	5,396	5,478	5,560	5,643
York	7,026	7,072	7,218	7,301	7,377	7,453	7,531	7,610	7,691	7,772	7,855

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:		
	11/5	11/6	11/7	11/8	11/10	11/12	11/14
Allegheny	16,599	16,838	17,126	17,386	17,856 (3,571) [857] {429}	18,367 (3,673) [882] {441}	18,924 (3,785) [908] {454}
Berks	10,058	10,165	10,278	10,355	10,551 (2,110) [506] {253}	10,746 (2,149) [516] {258}	10,940 (2,188) [525] {263}
Bucks	10,895	11,051	11,193	11,340	11,649 (2,330) [559] {280}	12,002 (2,400) [576] {288}	12,407 (2,481) [596] {298}
Butler	2,036	2,102	2,226	2,308	2,441 (488) [117] {59}	2,590 (518) [124] {62}	2,757 (551) [132] {66}
Chester	8,581	8,669	8,669	8,669	8,773 (1,755) [421] {211}	8,880 (1,776) [426] {213}	8,992 (1,798) [432] {216}
Delaware	14,477	14,648	14,865	15,020	15,381 (3,076) [738] {369}	15,777 (3,155) [757] {379}	16,210 (3,242) [778] {389}
Lackawanna	3,987	4,031	4,066	4,080	4,123 (825) [198] {99}	4,163 (833) [200] {100}	4,199 (840) [202] {101}
Lancaster	10,372	10,562	10,705	10,861	11,187 (2,237) [537] {268}	11,553 (2,311) [555] {277}	11,965 (2,393) [574] {287}
Lehigh	7,180	7,290	7,439	7,544	7,800 (1,560) [374] {187}	8,095 (1,619) [389] {194}	8,433 (1,687) [405] {202}
Luzerne	5,861	5,948	6,045	6,125	6,284 (1,257) [302] {151}	6,449 (1,290) [310] {155}	6,620 (1,324) [318] {159}
Monroe	2,182	2,211	2,242	2,259	2,323 (465) [111] {56}	2,397 (479) [115] {58}	2,485 (497) [119] {60}
Montgomery	14,901	15,118	15,311	15,467	15,861 (3,172) [761] {381}	16,300 (3,260) [782] {391}	16,789 (3,358) [806] {403}
Northampton	5,826	5,911	6,004	6,058	6,217 (1,243) [298] {149}	6,393 (1,279) [307] {153}	6,589 (1,318) [316] {158}
Philadelphia	46,917	47,675	47,675	47,675	48,360 (9,672) [2,321] {1,161}	49,063 (9,813) [2,355] {1,178}	49,787 (9,957) [2,390] {1,195}
Westmoreland	4,817	4,899	4,975	5,078	5,236 (1,047) [251] {126}	5,396 (1,079) [259] {130}	5,560 (1,112) [267] {133}
York	7,026	7,072	7,218	7,301	7,453 (1,491) [358] {179}	7,610 (1,522) [365] {183}	7,772 (1,554) [373] {187}

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.