IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/10/21

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 <u>not</u> 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 6/10/21 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
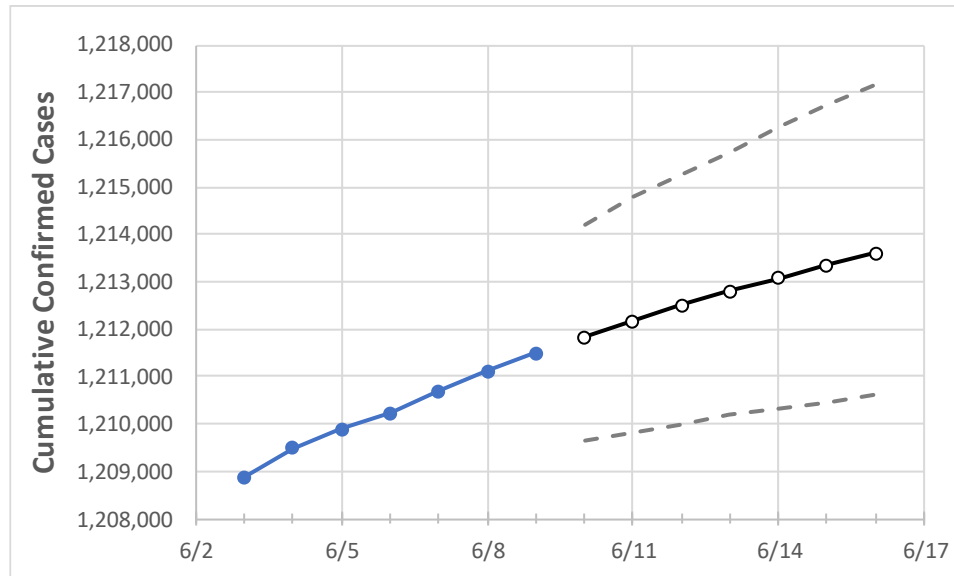
	Actual Confirmed Cases On:				Projected Cases For:						
	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16
Pennsylvania	1,210,224	1,210,691	1,211,114	1,211,487	1,211,838	1,212,177	1,212,498	1,212,794	1,213,078	1,213,349	1,213,601

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 10%, and are often within 5%, of actual confirmed cases.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16
Allegheny	101,492	101,522	101,546	101,561	101,581	101,601	101,618	101,634	101,650	101,664	101,678
Berks	48,135	48,147	48,188	48,213	48,230	48,246	48,262	48,277	48,292	48,306	48,319
Bucks	60,667	60,682	60,687	60,704	60,713	60,721	60,729	60,736	60,742	60,748	60,754
Butler	17,523	17,529	17,535	17,543	17,550	17,557	17,563	17,569	17,575	17,581	17,586
Chester	40,699	40,700	40,697	40,705	40,710	40,714	40,718	40,722	40,725	40,729	40,732
Delaware	52,255	52,269	52,283	52,309	52,322	52,335	52,348	52,359	52,370	52,381	52,391
Lackawanna	18,472	18,475	18,477	18,480	18,484	18,488	18,492	18,495	18,499	18,502	18,505
Lancaster	55,236	55,249	55,262	55,271	55,282	55,293	55,303	55,312	55,321	55,329	55,337
Lehigh	39,699	39,710	39,726	39,735	39,744	39,753	39,761	39,769	39,777	39,785	39,791
Luzerne	31,908	31,918	31,933	31,942	31,952	31,961	31,969	31,978	31,986	31,993	32,001
Monroe	14,729	14,731	14,743	14,749	14,753	14,756	14,760	14,763	14,765	14,768	14,771
Montgomery	70,201	70,219	70,232	70,243	70,258	70,273	70,286	70,298	70,311	70,322	70,334
Northampton	35,734	35,742	35,763	35,767	35,773	35,778	35,783	35,787	35,791	35,795	35,799
Philadelphia	153,673	153,724	153,724	153,724	153,769	153,811	153,852	153,890	153,927	153,959	153,992
Westmoreland	34,221	34,228	34,236	34,239	34,248	34,257	34,265	34,273	34,280	34,287	34,293
York	46,554	46,573	46,626	46,717	46,743	46,768	46,790	46,814	46,837	46,859	46,881

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:		
	6/6	6/7	6/8	6/9	6/11	6/13	6/15
Allegheny	101,492	101,522	101,546	101,561	101,601 (20,320) [4,877] {2,438}	101,634 (20,327) [4,878] {2,439}	101,664 (20,333) [4,880] {2,440}
Berks	48,135	48,147	48,188	48,213	48,246 (9,649) [2,316] {1,158}	48,277 (9,655) [2,317] {1,159}	48,306 (9,661) [2,319] {1,159}
Bucks	60,667	60,682	60,687	60,704	60,721 (12,144) [2,915] {1,457}	60,736 (12,147) [2,915] {1,458}	60,748 (12,150) [2,916] {1,458}
Butler	17,523	17,529	17,535	17,543	17,557 (3,511) [843] {421}	17,569 (3,514) [843] {422}	17,581 (3,516) [844] {422}
Chester	40,699	40,700	40,697	40,705	40,714 (8,143) [1,954] {977}	40,722 (8,144) [1,955] {977}	40,729 (8,146) [1,955] {977}
Delaware	52,255	52,269	52,283	52,309	52,335 (10,467) [2,512] {1,256}	52,359 (10,472) [2,513] {1,257}	52,381 (10,476) [2,514] {1,257}
Lackawanna	18,472	18,475	18,477	18,480	18,488 (3,698) [887] {444}	18,495 (3,699) [888] {444}	18,502 (3,700) [888] {444}
Lancaster	55,236	55,249	55,262	55,271	55,293 (11,059) [2,654] {1,327}	55,312 (11,062) [2,655] {1,327}	55,329 (11,066) [2,656] {1,328}
Lehigh	39,699	39,710	39,726	39,735	39,753 (7,951) [1,908] {954}	39,769 (7,954) [1,909] {954}	39,785 (7,957) [1,910] {955}
Luzerne	31,908	31,918	31,933	31,942	31,961 (6,392) [1,534] {767}	31,978 (6,396) [1,535] {767}	31,993 (6,399) [1,536] {768}
Monroe	14,729	14,731	14,743	14,749	14,756 (2,951) [708] {354}	14,763 (2,953) [709] {354}	14,768 (2,954) [709] {354}
Montgomery	70,201	70,219	70,232	70,243	70,273 (14,055) [3,373] {1,687}	70,298 (14,060) [3,374] {1,687}	70,322 (14,064) [3,375] {1,688}
Northampton	35,734	35,742	35,763	35,767	35,778 (7,156) [1,717] {859}	35,787 (7,157) [1,718] {859}	35,795 (7,159) [1,718] {859}
Philadelphia	153,673	153,724	153,724	153,724	153,811 (30,762) [7,383] {3,691}	153,890 (30,778) [7,387] {3,693}	153,959 (30,792) [7,390] {3,695}
Westmoreland	34,221	34,228	34,236	34,239	34,257 (6,851) [1,644] {822}	34,273 (6,855) [1,645] {823}	34,287 (6,857) [1,646] {823}
York	46,554	46,573	46,626	46,717	46,768 (9,354) [2,245] {1,122}	46,814 (9,363) [2,247] {1,124}	46,859 (9,372) [2,249] {1,125}

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.