IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/2/21

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 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 6/2/21 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
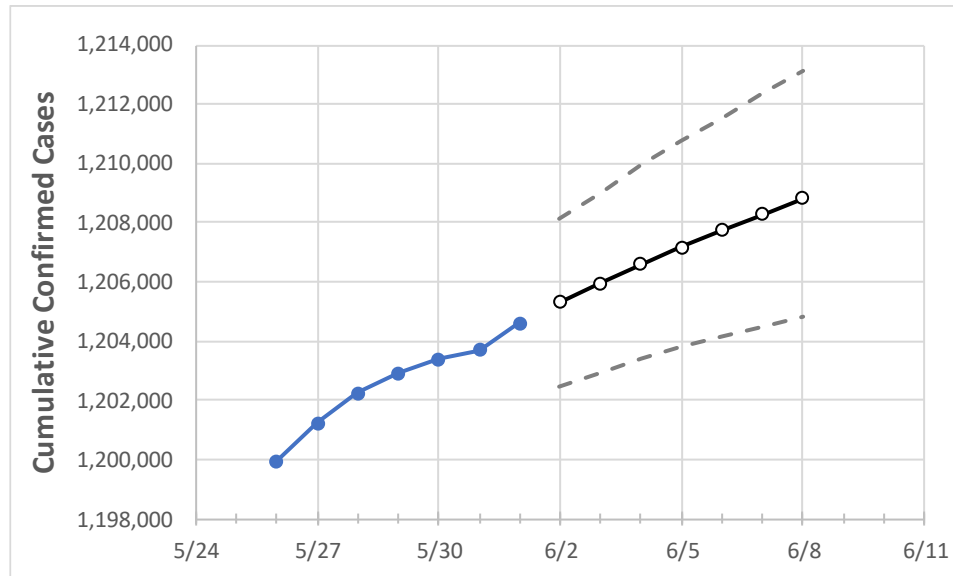
	Actual Confirmed Cases On:				Projected Cases For:						
	5/29	5/30	5/31	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8
Pennsylvania	1,202,912	1,203,378	1,203,685	1,204,598	1,205,303	1,205,964	1,206,592	1,207,183	1,207,749	1,208,292	1,208,818

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:						
	5/29	5/30	5/31	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8
Allegheny	101,223	101,262	101,287	101,336	101,376	101,415	101,449	101,483	101,515	101,544	101,571
Berks	47,950	47,978	48,003	48,017	48,045	48,071	48,096	48,119	48,141	48,161	48,182
Bucks	60,554	60,572	60,585	60,593	60,612	60,628	60,645	60,661	60,675	60,688	60,700
Butler	17,446	17,458	17,465	17,481	17,493	17,505	17,516	17,527	17,538	17,548	17,558
Chester	37,606	37,627	37,647	37,668	37,729	37,789	37,847	37,908	37,970	38,027	38,090
Delaware	52,113	52,131	52,146	52,164	52,184	52,202	52,220	52,238	52,254	52,269	52,283
Lackawanna	18,436	18,438	18,439	18,443	18,454	18,464	18,473	18,482	18,491	18,500	18,508
Lancaster	55,090	55,120	55,136	55,146	55,168	55,188	55,206	55,224	55,241	55,257	55,272
Lehigh	39,609	39,622	39,633	39,644	39,664	39,683	39,701	39,719	39,735	39,749	39,765
Luzerne	31,777	31,796	31,802	31,811	31,829	31,848	31,866	31,882	31,897	31,912	31,926
Monroe	14,688	14,696	14,697	14,702	14,708	14,714	14,720	14,725	14,730	14,734	14,738
Montgomery	70,006	70,039	70,054	70,086	70,109	70,131	70,152	70,172	70,190	70,208	70,225
Northampton	35,676	35,694	35,700	35,702	35,715	35,727	35,738	35,749	35,758	35,768	35,777
Philadelphia	153,097	153,167	153,238	153,308	153,389	153,464	153,534	153,602	153,665	153,726	153,785
Westmoreland	34,091	34,104	34,109	34,129	34,147	34,165	34,182	34,198	34,213	34,228	34,241
York	46,318	46,346	46,362	46,392	46,424	46,455	46,484	46,511	46,538	46,562	46,586

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:		
	5/29	5/30	5/31	6/1	6/3	6/5	6/7
Allegheny	101,223	101,262	101,287	101,336	101,415 (20,283) [4,868] {2,434}	101,483 (20,297) [4,871] {2,436}	101,544 (20,309) [4,874] {2,437}
Berks	47,950	47,978	48,003	48,017	48,071 (9,614) [2,307] {1,154}	48,119 (9,624) [2,310] {1,155}	48,161 (9,632) [2,312] {1,156}
Bucks	60,554	60,572	60,585	60,593	60,628 (12,126) [2,910] {1,455}	60,661 (12,132) [2,912] {1,456}	60,688 (12,138) [2,913] {1,457}
Butler	17,446	17,458	17,465	17,481	17,505 (3,501) [840] {420}	17,527 (3,505) [841] {421}	17,548 (3,510) [842] {421}
Chester	37,606	37,627	37,647	37,668	37,789 (7,558) [1,814] {907}	37,908 (7,582) [1,820] {910}	38,027 (7,605) [1,825] {913}
Delaware	52,113	52,131	52,146	52,164	52,202 (10,440) [2,506] {1,253}	52,238 (10,448) [2,507] {1,254}	52,269 (10,454) [2,509] {1,254}
Lackawanna	18,436	18,438	18,439	18,443	18,464 (3,693) [886] {443}	18,482 (3,696) [887] {444}	18,500 (3,700) [888] {444}
Lancaster	55,090	55,120	55,136	55,146	55,188 (11,038) [2,649] {1,325}	55,224 (11,045) [2,651] {1,325}	55,257 (11,051) [2,652] {1,326}
Lehigh	39,609	39,622	39,633	39,644	39,683 (7,937) [1,905] {952}	39,719 (7,944) [1,907] {953}	39,749 (7,950) [1,908] {954}
Luzerne	31,777	31,796	31,802	31,811	31,848 (6,370) [1,529] {764}	31,882 (6,376) [1,530] {765}	31,912 (6,382) [1,532] {766}
Monroe	14,688	14,696	14,697	14,702	14,714 (2,943) [706] {353}	14,725 (2,945) [707] {353}	14,734 (2,947) [707] {354}
Montgomery	70,006	70,039	70,054	70,086	70,131 (14,026) [3,366] {1,683}	70,172 (14,034) [3,368] {1,684}	70,208 (14,042) [3,370] {1,685}
Northampton	35,676	35,694	35,700	35,702	35,727 (7,145) [1,715] {857}	35,749 (7,150) [1,716] {858}	35,768 (7,154) [1,717] {858}
Philadelphia	153,097	153,167	153,238	153,308	153,464 (30,693) [7,366] {3,683}	153,602 (30,720) [7,373] {3,686}	153,726 (30,745) [7,379] {3,689}
Westmoreland	34,091	34,104	34,109	34,129	34,165 (6,833) [1,640] {820}	34,198 (6,840) [1,641] {821}	34,228 (6,846) [1,643] {821}
York	46,318	46,346	46,362	46,392	46,455 (9,291) [2,230] {1,115}	46,511 (9,302) [2,233] {1,116}	46,562 (9,312) [2,235] {1,117}

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.