IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/22/21

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 2/22/21 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
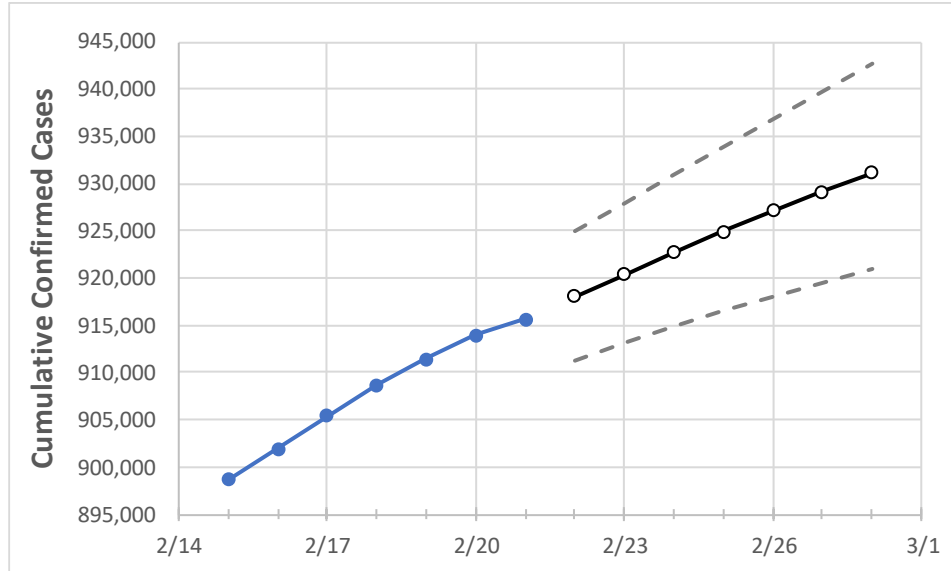
	Actual Confirmed Cases On:				Projected Cases For:						
	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28
Pennsylvania	908,637	911,421	913,912	915,639	918,070	920,385	922,696	924,941	927,091	929,174	931,161

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:						
	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28
Allegheny	74,060	74,317	74,602	74,866	75,095	75,320	75,546	75,764	75,978	76,200	76,414
Berks	34,794	34,859	34,960	35,025	35,097	35,167	35,234	35,296	35,357	35,415	35,469
Bucks	43,662	43,785	43,904	43,996	44,132	44,268	44,403	44,530	44,656	44,780	44,899
Butler	13,569	13,616	13,656	13,693	13,725	13,755	13,785	13,814	13,842	13,871	13,898
Chester	27,297	27,377	27,377	27,377	27,458	27,539	27,617	27,694	27,772	27,847	27,920
Delaware	39,778	39,905	39,983	40,052	40,152	40,250	40,342	40,436	40,525	40,613	40,702
Lackawanna	13,427	13,507	13,563	13,595	13,647	13,697	13,748	13,802	13,852	13,900	13,948
Lancaster	42,361	42,502	42,660	42,740	42,884	43,021	43,159	43,287	43,414	43,540	43,663
Lehigh	29,969	30,045	30,121	30,179	30,248	30,315	30,379	30,440	30,500	30,559	30,615
Luzerne	24,317	24,386	24,461	24,505	24,561	24,615	24,668	24,720	24,771	24,818	24,865
Monroe	9,317	9,353	9,390	9,417	9,450	9,482	9,513	9,546	9,576	9,606	9,635
Montgomery	52,252	52,427	52,637	52,748	52,886	53,019	53,143	53,270	53,395	53,513	53,626
Northampton	25,837	25,960	26,058	26,143	26,251	26,357	26,459	26,562	26,663	26,764	26,867
Philadelphia	115,944	116,242	116,242	116,242	116,506	116,767	117,030	117,278	117,527	117,775	118,012
Westmoreland	26,132	26,177	26,275	26,325	26,391	26,457	26,519	26,581	26,643	26,706	26,767
York	34,870	34,976	35,108	35,185	35,292	35,395	35,496	35,595	35,687	35,779	35,867

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:		
	2/18	2/19	2/20	2/21	2/23	2/25	2/27
Allegheny	74,060	74,317	74,602	74,866	75,320 (15,064) [3,615] {1,808}	75,764 (15,153) [3,637] {1,818}	76,200 (15,240) [3,658] {1,829}
Berks	34,794	34,859	34,960	35,025	35,167 (7,033) [1,688] {844}	35,296 (7,059) [1,694] {847}	35,415 (7,083) [1,700] {850}
Bucks	43,662	43,785	43,904	43,996	44,268 (8,854) [2,125] {1,062}	44,530 (8,906) [2,137] {1,069}	44,780 (8,956) [2,149] {1,075}
Butler	13,569	13,616	13,656	13,693	13,755 (2,751) [660] {330}	13,814 (2,763) [663] {332}	13,871 (2,774) [666] {333}
Chester	27,297	27,377	27,377	27,377	27,539 (5,508) [1,322] {661}	27,694 (5,539) [1,329] {665}	27,847 (5,569) [1,337] {668}
Delaware	39,778	39,905	39,983	40,052	40,250 (8,050) [1,932] {966}	40,436 (8,087) [1,941] {970}	40,613 (8,123) [1,949] {975}
Lackawanna	13,427	13,507	13,563	13,595	13,697 (2,739) [657] {329}	13,802 (2,760) [662] {331}	13,900 (2,780) [667] {334}
Lancaster	42,361	42,502	42,660	42,740	43,021 (8,604) [2,065] {1,033}	43,287 (8,657) [2,078] {1,039}	43,540 (8,708) [2,090] {1,045}
Lehigh	29,969	30,045	30,121	30,179	30,315 (6,063) [1,455] {728}	30,440 (6,088) [1,461] {731}	30,559 (6,112) [1,467] {733}
Luzerne	24,317	24,386	24,461	24,505	24,615 (4,923) [1,182] {591}	24,720 (4,944) [1,187] {593}	24,818 (4,964) [1,191] {596}
Monroe	9,317	9,353	9,390	9,417	9,482 (1,896) [455] {228}	9,546 (1,909) [458] {229}	9,606 (1,921) [461] {231}
Montgomery	52,252	52,427	52,637	52,748	53,019 (10,604) [2,545] {1,272}	53,270 (10,654) [2,557] {1,278}	53,513 (10,703) [2,569] {1,284}
Northampton	25,837	25,960	26,058	26,143	26,357 (5,271) [1,265] {633}	26,562 (5,312) [1,275] {637}	26,764 (5,353) [1,285] {642}
Philadelphia	115,944	116,242	116,242	116,242	116,767 (23,353) [5,605] {2,802}	117,278 (23,456) [5,629] {2,815}	117,775 (23,555) [5,653] {2,827}
Westmoreland	26,132	26,177	26,275	26,325	26,457 (5,291) [1,270] {635}	26,581 (5,316) [1,276] {638}	26,706 (5,341) [1,282] {641}
York	34,870	34,976	35,108	35,185	35,395 (7,079) [1,699] {849}	35,595 (7,119) [1,709] {854}	35,779 (7,156) [1,717] {859}

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.