IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/17/21

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 2/17/21 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
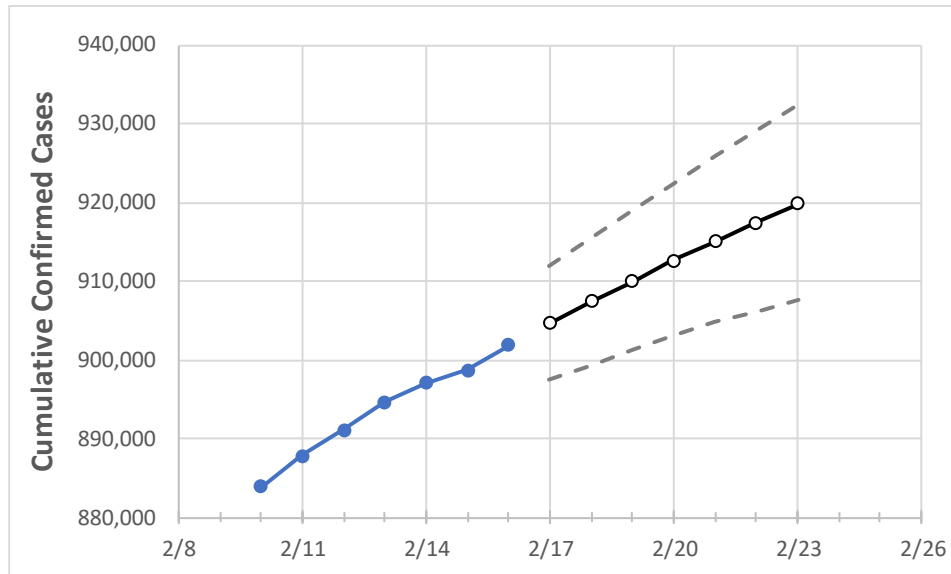
	Actual Confirmed Cases On:				Projected Cases For:						
	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23
Pennsylvania	894,660	896,996	898,654	901,876	904,634	907,372	909,999	912,577	915,040	917,481	919,842

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:						
	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23
Allegheny	73,005	73,217	73,399	73,598	73,825	74,048	74,272	74,487	74,702	74,916	75,131
Berks	34,284	34,325	34,377	34,506	34,584	34,661	34,732	34,798	34,864	34,928	34,984
Bucks	42,819	42,985	43,112	43,224	43,390	43,554	43,714	43,870	44,026	44,177	44,324
Butler	13,392	13,432	13,456	13,489	13,523	13,556	13,587	13,617	13,646	13,674	13,701
Chester	26,823	26,912	27,000	27,089	27,176	27,262	27,346	27,428	27,509	27,590	27,668
Delaware	39,222	39,312	39,393	39,479	39,594	39,704	39,813	39,918	40,021	40,121	40,222
Lackawanna	13,196	13,237	13,262	13,314	13,370	13,425	13,478	13,533	13,588	13,640	13,694
Lancaster	41,546	41,722	41,851	41,955	42,136	42,310	42,475	42,644	42,803	42,962	43,113
Lehigh	29,586	29,640	29,681	29,773	29,859	29,945	30,025	30,105	30,184	30,261	30,334
Luzerne	24,005	24,076	24,114	24,185	24,249	24,312	24,370	24,428	24,483	24,536	24,586
Monroe	9,149	9,179	9,195	9,238	9,276	9,314	9,353	9,390	9,428	9,464	9,500
Montgomery	51,429	51,555	51,656	51,803	51,943	52,082	52,211	52,338	52,457	52,577	52,685
Northampton	25,250	25,386	25,433	25,546	25,672	25,797	25,919	26,039	26,159	26,283	26,403
Philadelphia	114,486	114,663	114,841	115,018	115,257	115,492	115,713	115,932	116,151	116,356	116,561
Westmoreland	25,766	25,843	25,895	25,993	26,067	26,139	26,211	26,283	26,354	26,422	26,492
York	34,254	34,423	34,504	34,582	34,716	34,849	34,979	35,106	35,229	35,350	35,467

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:		
	2/13	2/14	2/15	2/16	2/18	2/20	2/22
Allegheny	73,005	73,217	73,399	73,598	74,048 (14,810) [3,554] {1,777}	74,487 (14,897) [3,575] {1,788}	74,916 (14,983) [3,596] {1,798}
Berks	34,284	34,325	34,377	34,506	34,661 (6,932) [1,664] {832}	34,798 (6,960) [1,670] {835}	34,928 (6,986) [1,677] {838}
Bucks	42,819	42,985	43,112	43,224	43,554 (8,711) [2,091] {1,045}	43,870 (8,774) [2,106] {1,053}	44,177 (8,835) [2,120] {1,060}
Butler	13,392	13,432	13,456	13,489	13,556 (2,711) [651] {325}	13,617 (2,723) [654] {327}	13,674 (2,735) [656] {328}
Chester	26,823	26,912	27,000	27,089	27,262 (5,452) [1,309] {654}	27,428 (5,486) [1,317] {658}	27,590 (5,518) [1,324] {662}
Delaware	39,222	39,312	39,393	39,479	39,704 (7,941) [1,906] {953}	39,918 (7,984) [1,916] {958}	40,121 (8,024) [1,926] {963}
Lackawanna	13,196	13,237	13,262	13,314	13,425 (2,685) [644] {322}	13,533 (2,707) [650] {325}	13,640 (2,728) [655] {327}
Lancaster	41,546	41,722	41,851	41,955	42,310 (8,462) [2,031] {1,015}	42,644 (8,529) [2,047] {1,023}	42,962 (8,592) [2,062] {1,031}
Lehigh	29,586	29,640	29,681	29,773	29,945 (5,989) [1,437] {719}	30,105 (6,021) [1,445] {723}	30,261 (6,052) [1,453] {726}
Luzerne	24,005	24,076	24,114	24,185	24,312 (4,862) [1,167] {583}	24,428 (4,886) [1,173] {586}	24,536 (4,907) [1,178] {589}
Monroe	9,149	9,179	9,195	9,238	9,314 (1,863) [447] {224}	9,390 (1,878) [451] {225}	9,464 (1,893) [454] {227}
Montgomery	51,429	51,555	51,656	51,803	52,082 (10,416) [2,500] {1,250}	52,338 (10,468) [2,512] {1,256}	52,577 (10,515) [2,524] {1,262}
Northampton	25,250	25,386	25,433	25,546	25,797 (5,159) [1,238] {619}	26,039 (5,208) [1,250] {625}	26,283 (5,257) [1,262] {631}
Philadelphia	114,486	114,663	114,841	115,018	115,492 (23,098) [5,544] {2,772}	115,932 (23,186) [5,565] {2,782}	116,356 (23,271) [5,585] {2,793}
Westmoreland	25,766	25,843	25,895	25,993	26,139 (5,228) [1,255] {627}	26,283 (5,257) [1,262] {631}	26,422 (5,284) [1,268] {634}
York	34,254	34,423	34,504	34,582	34,849 (6,970) [1,673] {836}	35,106 (7,021) [1,685] {843}	35,350 (7,070) [1,697] {848}

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.