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

Date: 2/19/21

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 2/19/21 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.

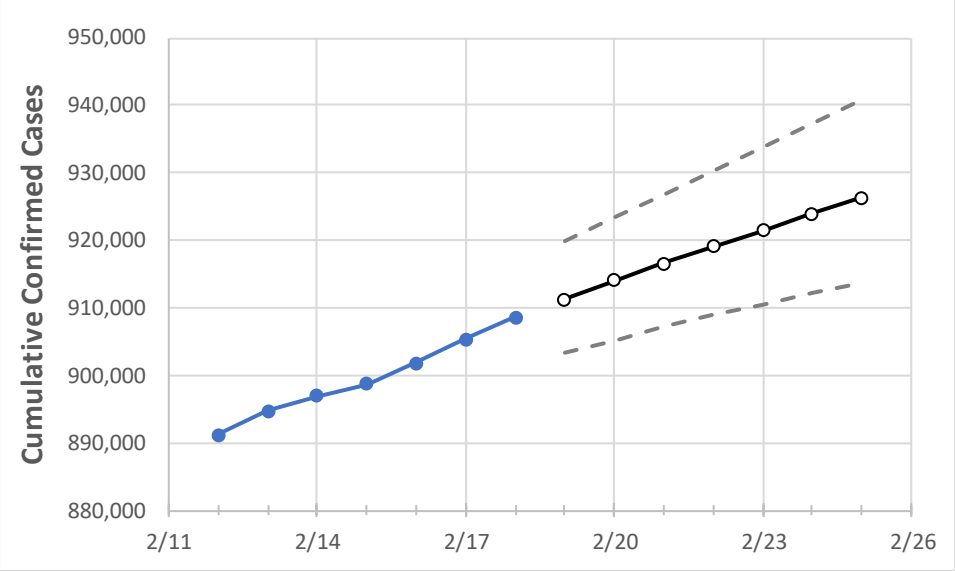
IEM's Modeling Lead

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:						
	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25
Pennsylvania	898,654	901,876	905,370	908,637	911,327	914,023	916,608	919,071	921,465	923,908	926,259

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:						
	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25
Allegheny	73,399	73,598	73,813	74,060	74,276	74,489	74,700	74,903	75,105	75,299	75,486
Berks	34,377	34,506	34,616	34,794	34,872	34,945	35,014	35,084	35,145	35,203	35,261
Bucks	43,112	43,224	43,413	43,662	43,829	43,994	44,155	44,316	44,472	44,626	44,777
Butler	13,456	13,489	13,530	13,569	13,601	13,633	13,665	13,695	13,723	13,751	13,778
Chester	27,000	27,089	27,194	27,297	27,387	27,476	27,564	27,650	27,735	27,820	27,902
Delaware	39,393	39,479	39,642	39,778	39,896	40,010	40,120	40,231	40,341	40,446	40,549
Lackawanna	13,262	13,314	13,386	13,427	13,480	13,533	13,584	13,636	13,689	13,739	13,789
Lancaster	41,851	41,955	42,180	42,361	42,541	42,717	42,889	43,052	43,216	43,371	43,522
Lehigh	29,681	29,773	29,873	29,969	30,049	30,129	30,206	30,279	30,347	30,416	30,486
Luzerne	24,114	24,185	24,263	24,317	24,376	24,433	24,488	24,541	24,592	24,639	24,686
Monroe	9,195	9,238	9,273	9,317	9,352	9,387	9,422	9,456	9,488	9,519	9,552
Montgomery	51,656	51,803	52,041	52,252	52,404	52,548	52,687	52,823	52,955	53,085	53,212
Northampton	25,433	25,546	25,694	25,837	25,962	26,088	26,208	26,326	26,444	26,560	26,675
Philadelphia	114,841	115,018	115,560	115,944	116,211	116,470	116,734	116,990	117,243	117,481	117,717
Westmoreland	25,895	25,993	26,040	26,132	26,202	26,272	26,340	26,410	26,477	26,543	26,609
York	34,504	34,582	34,721	34,870	34,997	35,118	35,237	35,350	35,462	35,569	35,677

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:		
	2/15	2/16	2/17	2/18	2/20	2/22	2/24
Allegheny	73,399	73,598	73,813	74,060	74,489 (14,898) [3,575] {1,788}	74,903 (14,981) [3,595] {1,798}	75,299 (15,060) [3,614] {1,807}
Berks	34,377	34,506	34,616	34,794	34,945 (6,989) [1,677] {839}	35,084 (7,017) [1,684] {842}	35,203 (7,041) [1,690] {845}
Bucks	43,112	43,224	43,413	43,662	43,994 (8,799) [2,112] {1,056}	44,316 (8,863) [2,127] {1,064}	44,626 (8,925) [2,142] {1,071}
Butler	13,456	13,489	13,530	13,569	13,633 (2,727) [654] {327}	13,695 (2,739) [657] {329}	13,751 (2,750) [660] {330}
Chester	27,000	27,089	27,194	27,297	27,476 (5,495) [1,319] {659}	27,650 (5,530) [1,327] {664}	27,820 (5,564) [1,335] {668}
Delaware	39,393	39,479	39,642	39,778	40,010 (8,002) [1,920] {960}	40,231 (8,046) [1,931] {966}	40,446 (8,089) [1,941] {971}
Lackawanna	13,262	13,314	13,386	13,427	13,533 (2,707) [650] {325}	13,636 (2,727) [655] {327}	13,739 (2,748) [659] {330}
Lancaster	41,851	41,955	42,180	42,361	42,717 (8,543) [2,050] {1,025}	43,052 (8,610) [2,067] {1,033}	43,371 (8,674) [2,082] {1,041}
Lehigh	29,681	29,773	29,873	29,969	30,129 (6,026) [1,446] {723}	30,279 (6,056) [1,453] {727}	30,416 (6,083) [1,460] {730}
Luzerne	24,114	24,185	24,263	24,317	24,433 (4,887) [1,173] {586}	24,541 (4,908) [1,178] {589}	24,639 (4,928) [1,183] {591}
Monroe	9,195	9,238	9,273	9,317	9,387 (1,877) [451] {225}	9,456 (1,891) [454] {227}	9,519 (1,904) [457] {228}
Montgomery	51,656	51,803	52,041	52,252	52,548 (10,510) [2,522] {1,261}	52,823 (10,565) [2,536] {1,268}	53,085 (10,617) [2,548] {1,274}
Northampton	25,433	25,546	25,694	25,837	26,088 (5,218) [1,252] {626}	26,326 (5,265) [1,264] {632}	26,560 (5,312) [1,275] {637}
Philadelphia	114,841	115,018	115,560	115,944	116,470 (23,294) [5,591] {2,795}	116,990 (23,398) [5,616] {2,808}	117,481 (23,496) [5,639] {2,820}
Westmoreland	25,895	25,993	26,040	26,132	26,272 (5,254) [1,261] {631}	26,410 (5,282) [1,268] {634}	26,543 (5,309) [1,274] {637}
York	34,504	34,582	34,721	34,870	35,118 (7,024) [1,686] {843}	35,350 (7,070) [1,697] {848}	35,569 (7,114) [1,707] {854}

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.