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

Date: 3/9/21

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 3/9/21 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.

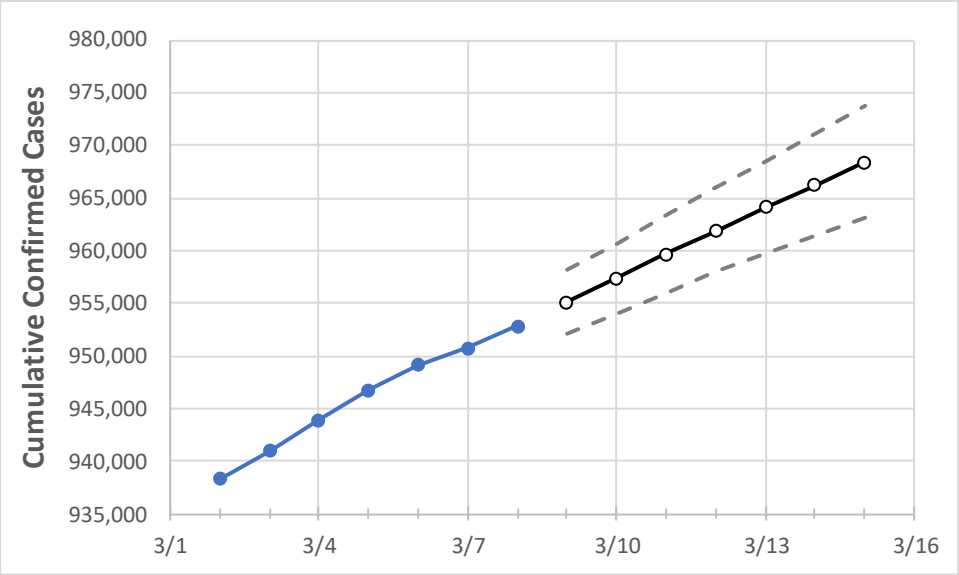
IEM's Modeling Lead

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:						
	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15
Pennsylvania	946,734	949,127	950,773	952,818	955,124	957,416	959,665	961,879	964,077	966,241	968,393

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:						
	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15
Allegheny	77,803	78,079	78,220	78,357	78,573	78,793	79,009	79,224	79,436	79,643	79,852
Berks	36,185	36,307	36,378	36,444	36,540	36,641	36,740	36,841	36,940	37,036	37,135
Bucks	45,826	46,019	46,156	46,264	46,419	46,576	46,732	46,889	47,046	47,202	47,356
Butler	14,085	14,106	14,121	14,141	14,167	14,193	14,218	14,243	14,267	14,291	14,315
Chester	28,576	28,641	28,707	28,772	28,856	28,937	29,019	29,100	29,179	29,259	29,339
Delaware	41,427	41,601	41,765	41,841	41,959	42,077	42,196	42,316	42,437	42,557	42,678
Lackawanna	14,157	14,205	14,228	14,265	14,306	14,347	14,387	14,427	14,466	14,506	14,544
Lancaster	44,249	44,383	44,480	44,556	44,664	44,772	44,877	44,980	45,085	45,188	45,287
Lehigh	31,137	31,223	31,262	31,304	31,372	31,440	31,507	31,574	31,641	31,708	31,776
Luzerne	25,165	25,209	25,248	25,268	25,313	25,356	25,398	25,438	25,478	25,518	25,557
Monroe	9,885	9,932	9,955	9,981	10,022	10,063	10,105	10,147	10,188	10,231	10,272
Montgomery	54,736	54,952	55,218	55,332	55,515	55,696	55,877	56,062	56,251	56,436	56,622
Northampton	27,286	27,389	27,446	27,483	27,557	27,631	27,701	27,769	27,837	27,903	27,970
Philadelphia	119,874	120,096	120,317	120,539	120,803	121,067	121,331	121,588	121,846	122,105	122,365
Westmoreland	27,089	27,150	27,172	27,203	27,255	27,307	27,356	27,405	27,452	27,500	27,547
York	36,256	36,355	36,413	36,466	36,543	36,618	36,690	36,763	36,833	36,903	36,971

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:		
	3/5	3/6	3/7	3/8	3/10	3/12	3/14
Allegheny	77,803	78,079	78,220	78,357	78,793 (15,759) [3,782] {1,891}	79,224 (15,845) [3,803] {1,901}	79,643 (15,929) [3,823] {1,911}
Berks	36,185	36,307	36,378	36,444	36,641 (7,328) [1,759] {879}	36,841 (7,368) [1,768] {884}	37,036 (7,407) [1,778] {889}
Bucks	45,826	46,019	46,156	46,264	46,576 (9,315) [2,236] {1,118}	46,889 (9,378) [2,251] {1,125}	47,202 (9,440) [2,266] {1,133}
Butler	14,085	14,106	14,121	14,141	14,193 (2,839) [681] {341}	14,243 (2,849) [684] {342}	14,291 (2,858) [686] {343}
Chester	28,576	28,641	28,707	28,772	28,937 (5,787) [1,389] {694}	29,100 (5,820) [1,397] {698}	29,259 (5,852) [1,404] {702}
Delaware	41,427	41,601	41,765	41,841	42,077 (8,415) [2,020] {1,010}	42,316 (8,463) [2,031] {1,016}	42,557 (8,511) [2,043] {1,021}
Lackawanna	14,157	14,205	14,228	14,265	14,347 (2,869) [689] {344}	14,427 (2,885) [692] {346}	14,506 (2,901) [696] {348}
Lancaster	44,249	44,383	44,480	44,556	44,772 (8,954) [2,149] {1,075}	44,980 (8,996) [2,159] {1,080}	45,188 (9,038) [2,169] {1,085}
Lehigh	31,137	31,223	31,262	31,304	31,440 (6,288) [1,509] {755}	31,574 (6,315) [1,516] {758}	31,708 (6,342) [1,522] {761}
Luzerne	25,165	25,209	25,248	25,268	25,356 (5,071) [1,217] {609}	25,438 (5,088) [1,221] {611}	25,518 (5,104) [1,225] {612}
Monroe	9,885	9,932	9,955	9,981	10,063 (2,013) [483] {242}	10,147 (2,029) [487] {244}	10,231 (2,046) [491] {246}
Montgomery	54,736	54,952	55,218	55,332	55,696 (11,139) [2,673] {1,337}	56,062 (11,212) [2,691] {1,345}	56,436 (11,287) [2,709] {1,354}
Northampton	27,286	27,389	27,446	27,483	27,631 (5,526) [1,326] {663}	27,769 (5,554) [1,333] {666}	27,903 (5,581) [1,339] {670}
Philadelphia	119,874	120,096	120,317	120,539	121,067 (24,213) [5,811] {2,906}	121,588 (24,318) [5,836] {2,918}	122,105 (24,421) [5,861] {2,931}
Westmoreland	27,089	27,150	27,172	27,203	27,307 (5,461) [1,311] {655}	27,405 (5,481) [1,315] {658}	27,500 (5,500) [1,320] {660}
York	36,256	36,355	36,413	36,466	36,618 (7,324) [1,758] {879}	36,763 (7,353) [1,765] {882}	36,903 (7,381) [1,771] {886}

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.