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

Date: 3/12/21

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 3/12/21 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.

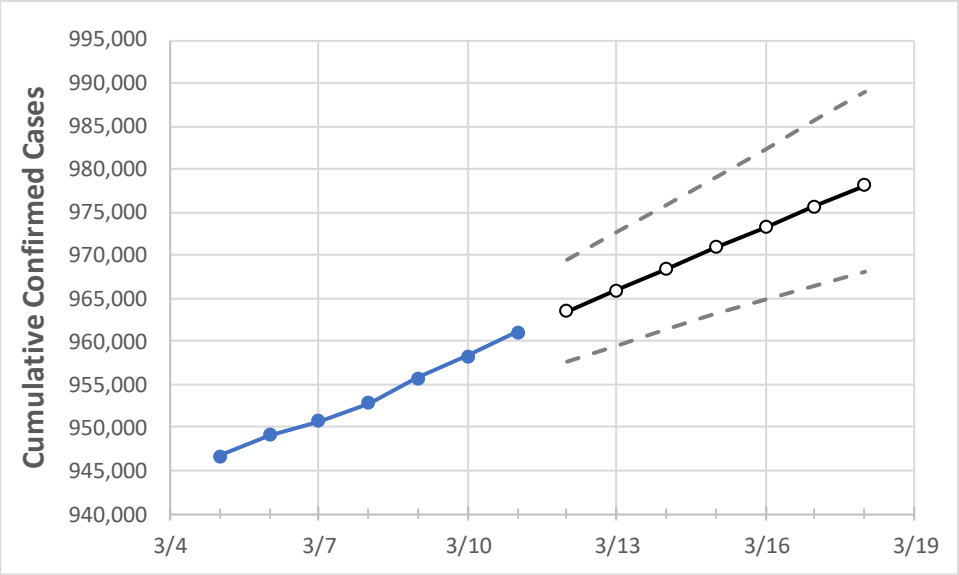
IEM's Modeling Lead

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:						
	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18
Pennsylvania	952,818	955,743	958,349	961,092	963,527	965,992	968,429	970,895	973,288	975,756	978,157

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:						
	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18
Allegheny	78,357	78,705	78,914	79,154	79,389	79,620	79,852	80,083	80,311	80,536	80,764
Berks	36,444	36,529	36,611	36,740	36,839	36,937	37,038	37,138	37,238	37,340	37,441
Bucks	46,264	46,408	46,559	46,714	46,867	47,020	47,174	47,324	47,480	47,632	47,785
Butler	14,141	14,192	14,240	14,296	14,331	14,367	14,404	14,440	14,478	14,515	14,553
Chester	28,772	28,849	28,932	29,068	29,157	29,243	29,331	29,419	29,508	29,597	29,686
Delaware	41,841	41,923	42,015	42,118	42,228	42,333	42,438	42,542	42,648	42,754	42,857
Lackawanna	14,265	14,325	14,374	14,415	14,458	14,499	14,542	14,584	14,626	14,666	14,707
Lancaster	44,556	44,684	44,833	44,965	45,078	45,192	45,304	45,417	45,525	45,637	45,744
Lehigh	31,304	31,382	31,470	31,576	31,650	31,725	31,801	31,876	31,949	32,023	32,098
Luzerne	25,268	25,335	25,390	25,461	25,507	25,553	25,599	25,644	25,687	25,731	25,775
Monroe	9,981	10,044	10,100	10,154	10,203	10,253	10,305	10,357	10,410	10,463	10,519
Montgomery	55,332	55,442	55,594	55,716	55,877	56,040	56,203	56,363	56,525	56,679	56,837
Northampton	27,483	27,564	27,650	27,765	27,841	27,914	27,989	28,060	28,126	28,198	28,266
Philadelphia	120,539	120,966	121,242	121,583	121,900	122,218	122,539	122,866	123,199	123,533	123,878
Westmoreland	27,203	27,303	27,369	27,428	27,485	27,540	27,594	27,650	27,704	27,757	27,812
York	36,466	36,540	36,669	36,781	36,868	36,951	37,035	37,119	37,201	37,284	37,366

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:		
	3/8	3/9	3/10	3/11	3/13	3/15	3/17
Allegheny	78,357	78,705	78,914	79,154	79,620 (15,924) [3,822] {1,911}	80,083 (16,017) [3,844] {1,922}	80,536 (16,107) [3,866] {1,933}
Berks	36,444	36,529	36,611	36,740	36,937 (7,387) [1,773] {886}	37,138 (7,428) [1,783] {891}	37,340 (7,468) [1,792] {896}
Bucks	46,264	46,408	46,559	46,714	47,020 (9,404) [2,257] {1,128}	47,324 (9,465) [2,272] {1,136}	47,632 (9,526) [2,286] {1,143}
Butler	14,141	14,192	14,240	14,296	14,367 (2,873) [690] {345}	14,440 (2,888) [693] {347}	14,515 (2,903) [697] {348}
Chester	28,772	28,849	28,932	29,068	29,243 (5,849) [1,404] {702}	29,419 (5,884) [1,412] {706}	29,597 (5,919) [1,421] {710}
Delaware	41,841	41,923	42,015	42,118	42,333 (8,467) [2,032] {1,016}	42,542 (8,508) [2,042] {1,021}	42,754 (8,551) [2,052] {1,026}
Lackawanna	14,265	14,325	14,374	14,415	14,499 (2,900) [696] {348}	14,584 (2,917) [700] {350}	14,666 (2,933) [704] {352}
Lancaster	44,556	44,684	44,833	44,965	45,192 (9,038) [2,169] {1,085}	45,417 (9,083) [2,180] {1,090}	45,637 (9,127) [2,191] {1,095}
Lehigh	31,304	31,382	31,470	31,576	31,725 (6,345) [1,523] {761}	31,876 (6,375) [1,530] {765}	32,023 (6,405) [1,537] {769}
Luzerne	25,268	25,335	25,390	25,461	25,553 (5,111) [1,227] {613}	25,644 (5,129) [1,231] {615}	25,731 (5,146) [1,235] {618}
Monroe	9,981	10,044	10,100	10,154	10,253 (2,051) [492] {246}	10,357 (2,071) [497] {249}	10,463 (2,093) [502] {251}
Montgomery	55,332	55,442	55,594	55,716	56,040 (11,208) [2,690] {1,345}	56,363 (11,273) [2,705] {1,353}	56,679 (11,336) [2,721] {1,360}
Northampton	27,483	27,564	27,650	27,765	27,914 (5,583) [1,340] {670}	28,060 (5,612) [1,347] {673}	28,198 (5,640) [1,353] {677}
Philadelphia	120,539	120,966	121,242	121,583	122,218 (24,444) [5,866] {2,933}	122,866 (24,573) [5,898] {2,949}	123,533 (24,707) [5,930] {2,965}
Westmoreland	27,203	27,303	27,369	27,428	27,540 (5,508) [1,322] {661}	27,650 (5,530) [1,327] {664}	27,757 (5,551) [1,332] {666}
York	36,466	36,540	36,669	36,781	36,951 (7,390) [1,774] {887}	37,119 (7,424) [1,782] {891}	37,284 (7,457) [1,790] {895}

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.