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

Date: 1/21/22

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 1/21/22 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.

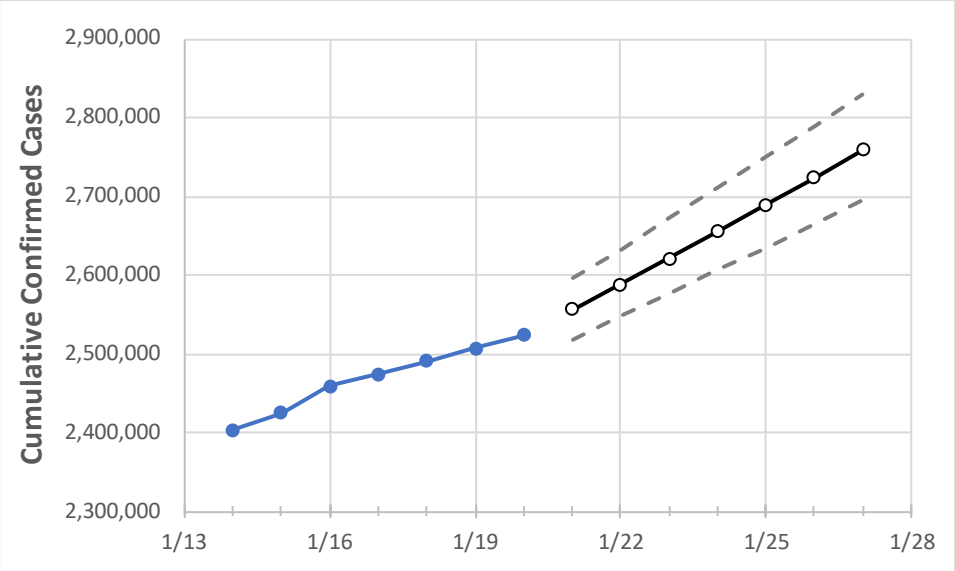
IEM's Modeling Lead

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:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Pennsylvania	2,474,466	2,490,929	2,506,602	2,523,956	2,556,044	2,588,473	2,621,618	2,655,261	2,688,993	2,723,288	2,759,594

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:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Allegheny	230,108	231,810	233,419	235,185	238,735	242,351	245,911	249,671	253,378	257,179	260,868
Berks	93,092	93,761	94,342	94,959	96,200	97,393	98,607	99,864	101,093	102,406	103,691
Bucks	112,097	112,536	113,169	113,785	115,116	116,434	117,791	119,170	120,472	121,941	123,349
Butler	39,247	39,446	39,669	40,035	40,518	41,021	41,536	42,055	42,589	43,133	43,684
Chester	82,080	82,556	83,005	83,698	84,643	85,610	86,566	87,507	88,468	89,455	90,470
Delaware	100,388	100,923	101,525	102,339	103,545	104,751	105,885	107,078	108,280	109,504	110,677
Lackawanna	36,845	37,049	37,381	37,698	38,252	38,793	39,367	39,924	40,514	41,137	41,742
Lancaster	109,284	109,890	110,532	111,284	112,546	113,785	115,030	116,290	117,611	118,930	120,266
Lehigh	82,488	82,766	83,194	83,616	84,879	86,193	87,483	88,758	90,135	91,440	92,791
Luzerne	65,117	65,500	65,931	66,449	67,324	68,198	69,119	70,024	70,962	71,900	72,881
Monroe	33,712	33,831	33,929	34,098	34,608	35,145	35,665	36,208	36,754	37,297	37,864
Montgomery	135,713	136,689	137,628	138,469	139,925	141,389	142,802	144,282	145,739	147,238	148,755
Northampton	73,080	73,365	73,679	73,982	74,927	75,844	76,743	77,698	78,604	79,562	80,533
Philadelphia	280,648	283,652	285,140	286,526	289,462	292,273	295,315	298,172	301,177	303,974	306,864
Westmoreland	69,220	69,706	70,126	70,561	71,303	72,079	72,845	73,640	74,448	75,282	76,120
York	105,307	106,101	106,721	107,537	108,798	110,047	111,298	112,569	113,879	115,164	116,434

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:		
	1/17	1/18	1/19	1/20	1/22	1/24	1/26
Allegheny	230,108	231,810	233,419	235,185	242,351 (48,470) [11,633] {5,816}	249,671 (49,934) [11,984] {5,992}	257,179 (51,436) [12,345] {6,172}
Berks	93,092	93,761	94,342	94,959	97,393 (19,479) [4,675] {2,337}	99,864 (19,973) [4,793] {2,397}	102,406 (20,481) [4,915] {2,458}
Bucks	112,097	112,536	113,169	113,785	116,434 (23,287) [5,589] {2,794}	119,170 (23,834) [5,720] {2,860}	121,941 (24,388) [5,853] {2,927}
Butler	39,247	39,446	39,669	40,035	41,021 (8,204) [1,969] {985}	42,055 (8,411) [2,019] {1,009}	43,133 (8,627) [2,070] {1,035}
Chester	82,080	82,556	83,005	83,698	85,610 (17,122) [4,109] {2,055}	87,507 (17,501) [4,200] {2,100}	89,455 (17,891) [4,294] {2,147}
Delaware	100,388	100,923	101,525	102,339	104,751 (20,950) [5,028] {2,514}	107,078 (21,416) [5,140] {2,570}	109,504 (21,901) [5,256] {2,628}
Lackawanna	36,845	37,049	37,381	37,698	38,793 (7,759) [1,862] {931}	39,924 (7,985) [1,916] {958}	41,137 (8,227) [1,975] {987}
Lancaster	109,284	109,890	110,532	111,284	113,785 (22,757) [5,462] {2,731}	116,290 (23,258) [5,582] {2,791}	118,930 (23,786) [5,709] {2,854}
Lehigh	82,488	82,766	83,194	83,616	86,193 (17,239) [4,137] {2,069}	88,758 (17,752) [4,260] {2,130}	91,440 (18,288) [4,389] {2,195}
Luzerne	65,117	65,500	65,931	66,449	68,198 (13,640) [3,273] {1,637}	70,024 (14,005) [3,361] {1,681}	71,900 (14,380) [3,451] {1,726}
Monroe	33,712	33,831	33,929	34,098	35,145 (7,029) [1,687] {843}	36,208 (7,242) [1,738] {869}	37,297 (7,459) [1,790] {895}
Montgomery	135,713	136,689	137,628	138,469	141,389 (28,278) [6,787] {3,393}	144,282 (28,856) [6,926] {3,463}	147,238 (29,448) [7,067] {3,534}
Northampton	73,080	73,365	73,679	73,982	75,844 (15,169) [3,641] {1,820}	77,698 (15,540) [3,730] {1,865}	79,562 (15,912) [3,819] {1,909}
Philadelphia	280,648	283,652	285,140	286,526	292,273 (58,455) [14,029] {7,015}	298,172 (59,634) [14,312] {7,156}	303,974 (60,795) [14,591] {7,295}
Westmoreland	69,220	69,706	70,126	70,561	72,079 (14,416) [3,460] {1,730}	73,640 (14,728) [3,535] {1,767}	75,282 (15,056) [3,614] {1,807}
York	105,307	106,101	106,721	107,537	110,047 (22,009) [5,282] {2,641}	112,569 (22,514) [5,403] {2,702}	115,164 (23,033) [5,528] {2,764}

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.