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

Date: 1/10/22

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 1/10/22 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.

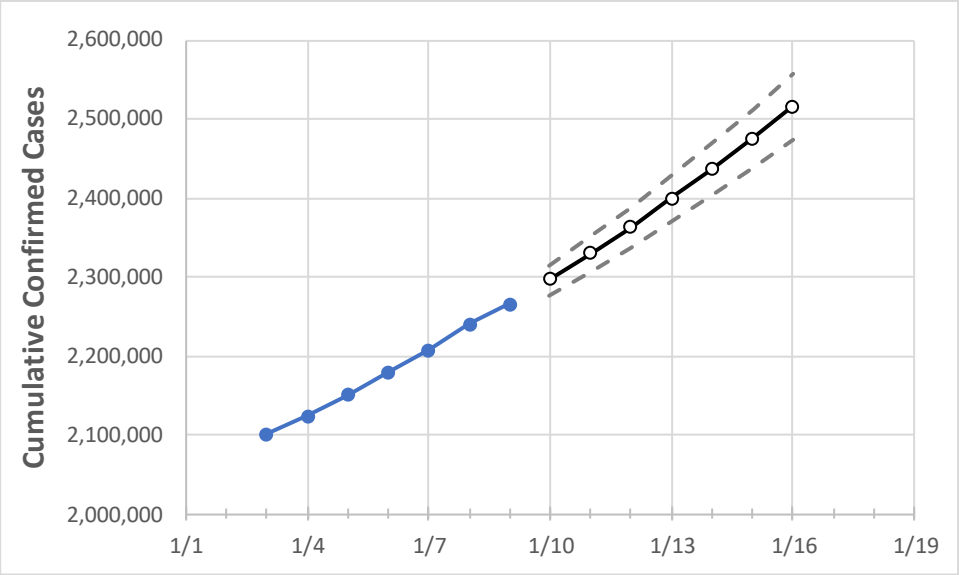
IEM's Modeling Lead

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
Pennsylvania	2,179,312	2,206,899	2,240,549	2,265,232	2,296,506	2,329,494	2,363,386	2,399,280	2,436,653	2,475,763	2,516,327

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
Allegheny	194,789	198,751	202,490	205,696	209,842	214,230	218,824	223,781	228,925	234,443	240,164
Berks	81,713	82,856	84,067	85,386	86,665	87,975	89,365	90,827	92,344	93,947	95,599
Bucks	98,415	100,744	102,042	103,196	104,700	106,280	107,934	109,654	111,462	113,356	115,329
Butler	34,737	35,167	35,671	36,158	36,629	37,129	37,656	38,212	38,805	39,426	40,079
Chester	72,122	73,168	74,137	75,216	76,335	77,510	78,726	79,981	81,290	82,675	84,091
Delaware	87,730	89,555	90,745	92,202	94,096	96,073	98,165	100,320	102,585	105,007	107,542
Lackawanna	31,711	32,210	32,861	33,253	33,712	34,189	34,697	35,228	35,760	36,346	36,935
Lancaster	97,017	98,090	99,490	100,833	102,136	103,494	104,890	106,366	107,890	109,500	111,154
Lehigh	69,438	70,687	72,327	73,591	74,955	76,382	77,883	79,467	81,138	82,896	84,670
Luzerne	56,701	57,579	58,408	59,397	60,215	61,093	61,996	62,962	63,946	64,995	66,075
Monroe	28,355	28,899	29,517	30,060	30,608	31,188	31,790	32,424	33,102	33,810	34,545
Montgomery	119,662	121,302	122,773	124,417	126,352	128,353	130,401	132,579	134,844	137,224	139,703
Northampton	63,189	64,193	65,337	66,238	67,199	68,191	69,221	70,318	71,437	72,587	73,773
Philadelphia	249,183	250,195	256,404	256,404	261,874	267,660	273,643	280,291	286,963	294,328	301,750
Westmoreland	62,037	62,736	63,379	64,047	64,626	65,209	65,823	66,474	67,119	67,820	68,522
York	91,847	92,838	94,303	95,186	96,347	97,552	98,757	99,996	101,292	102,625	103,975

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:											
	1/6	1/7	1/8	1/9	1/11				1/13				1/15			
Allegheny	194,789	198,751	202,490	205,696	214,230	(42,846)	[10,283]	{5,142}	223,781	(44,756)	[10,742]	{5,371}	234,443	(46,889)	[11,253]	{5,627}
Berks	81,713	82,856	84,067	85,386	87,975	(17,595)	[4,223]	{2,111}	90,827	(18,165)	[4,360]	{2,180}	93,947	(18,789)	[4,509]	{2,255}
Bucks	98,415	100,744	102,042	103,196	106,280	(21,256)	[5,101]	{2,551}	109,654	(21,931)	[5,263]	{2,632}	113,356	(22,671)	[5,441]	{2,721}
Butler	34,737	35,167	35,671	36,158	37,129	(7,426)	[1,782]	{891}	38,212	(7,642)	[1,834]	{917}	39,426	(7,885)	[1,892]	{946}
Chester	72,122	73,168	74,137	75,216	77,510	(15,502)	[3,720]	{1,860}	79,981	(15,996)	[3,839]	{1,920}	82,675	(16,535)	[3,968]	{1,984}
Delaware	87,730	89,555	90,745	92,202	96,073	(19,215)	[4,612]	{2,306}	100,320	(20,064)	[4,815]	{2,408}	105,007	(21,001)	[5,040]	{2,520}
Lackawanna	31,711	32,210	32,861	33,253	34,189	(6,838)	[1,641]	{821}	35,228	(7,046)	[1,691]	{845}	36,346	(7,269)	[1,745]	{872}
Lancaster	97,017	98,090	99,490	100,833	103,494	(20,699)	[4,968]	{2,484}	106,366	(21,273)	[5,106]	{2,553}	109,500	(21,900)	[5,256]	{2,628}
Lehigh	69,438	70,687	72,327	73,591	76,382	(15,276)	[3,666]	{1,833}	79,467	(15,893)	[3,814]	{1,907}	82,896	(16,579)	[3,979]	{1,990}
Luzerne	56,701	57,579	58,408	59,397	61,093	(12,219)	[2,932]	{1,466}	62,962	(12,592)	[3,022]	{1,511}	64,995	(12,999)	[3,120]	{1,560}
Monroe	28,355	28,899	29,517	30,060	31,188	(6,238)	[1,497]	{749}	32,424	(6,485)	[1,556]	{778}	33,810	(6,762)	[1,623]	{811}
Montgomery	119,662	121,302	122,773	124,417	128,353	(25,671)	[6,161]	{3,080}	132,579	(26,516)	[6,364]	{3,182}	137,224	(27,445)	[6,587]	{3,293}
Northampton	63,189	64,193	65,337	66,238	68,191	(13,638)	[3,273]	{1,637}	70,318	(14,064)	[3,375]	{1,688}	72,587	(14,517)	[3,484]	{1,742}
Philadelphia	249,183	250,195	256,404	256,404	267,660	(53,532)	[12,848]	{6,424}	280,291	(56,058)	[13,454]	{6,727}	294,328	(58,866)	[14,128]	{7,064}
Westmoreland	62,037	62,736	63,379	64,047	65,209	(13,042)	[3,130]	{1,565}	66,474	(13,295)	[3,191]	{1,595}	67,820	(13,564)	[3,255]	{1,628}
York	91,847	92,838	94,303	95,186	97,552	(19,510)	[4,682]	{2,341}	99,996	(19,999)	[4,800]	{2,400}	102,625	(20,525)	[4,926]	{2,463}

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.