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

Date: 1/14/22

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 1/14/22 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.

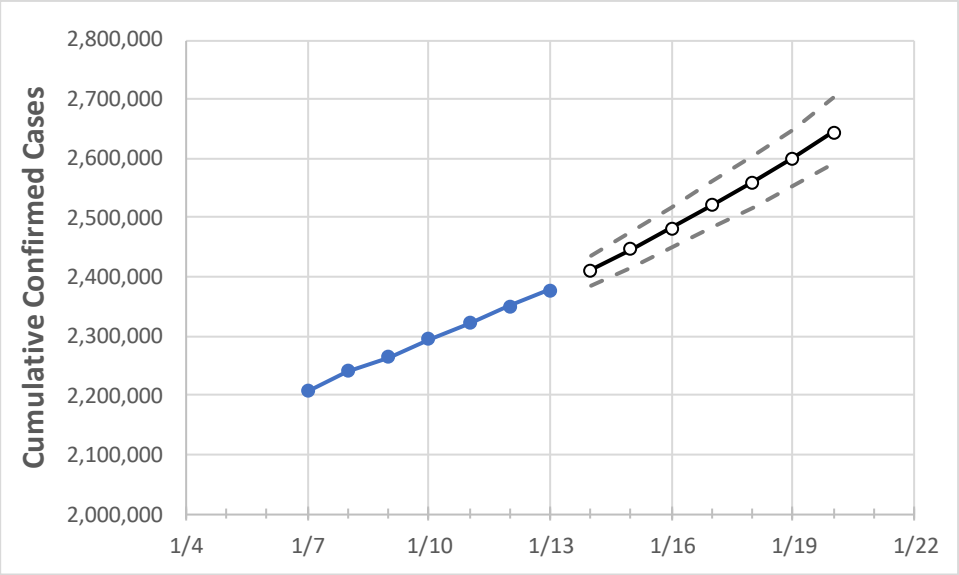
IEM's Modeling Lead

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Pennsylvania	2,295,089	2,321,087	2,351,028	2,377,252	2,411,384	2,446,345	2,482,456	2,520,282	2,559,522	2,600,570	2,643,425

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Allegheny	208,603	210,625	214,887	218,117	222,276	226,678	231,219	236,014	240,941	246,102	251,506
Berks	86,639	87,571	88,551	89,418	90,772	92,177	93,622	95,133	96,730	98,405	100,100
Bucks	104,758	105,763	107,249	108,176	109,807	111,494	113,233	115,086	117,006	118,965	121,045
Butler	36,467	36,700	37,133	37,593	38,082	38,599	39,129	39,676	40,258	40,866	41,500
Chester	76,043	76,863	77,666	78,535	79,598	80,682	81,785	82,935	84,101	85,302	86,560
Delaware	93,468	94,598	95,870	96,870	98,710	100,596	102,506	104,518	106,547	108,656	110,872
Lackawanna	33,546	34,038	34,610	35,071	35,641	36,228	36,840	37,490	38,153	38,862	39,603
Lancaster	102,154	103,273	104,297	105,474	106,834	108,224	109,668	111,136	112,689	114,271	115,917
Lehigh	75,139	76,767	78,188	79,301	80,981	82,707	84,504	86,380	88,337	90,416	92,526
Luzerne	60,101	60,718	61,650	62,483	63,446	64,430	65,489	66,579	67,711	68,908	70,159
Monroe	30,697	31,247	31,747	32,165	32,800	33,458	34,150	34,867	35,619	36,409	37,239
Montgomery	125,898	127,060	128,804	130,027	131,702	133,446	135,162	136,980	138,794	140,665	142,525
Northampton	67,302	68,678	69,717	70,436	71,619	72,826	74,069	75,365	76,727	78,089	79,545
Philadelphia	261,739	267,300	271,062	274,256	278,756	283,420	288,004	292,918	297,860	303,100	308,329
Westmoreland	64,381	64,784	65,710	66,502	67,248	68,012	68,846	69,692	70,577	71,511	72,433
York	97,191	97,888	98,796	99,967	101,244	102,534	103,806	105,145	106,500	107,891	109,288

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:											
	1/10	1/11	1/12	1/13	1/15				1/17				1/19			
Allegheny	208,603	210,625	214,887	218,117	226,678	(45,336)	[10,881]	{5,440}	236,014	(47,203)	[11,329]	{5,664}	246,102	(49,220)	[11,813]	{5,906}
Berks	86,639	87,571	88,551	89,418	92,177	(18,435)	[4,424]	{2,212}	95,133	(19,027)	[4,566]	{2,283}	98,405	(19,681)	[4,723]	{2,362}
Bucks	104,758	105,763	107,249	108,176	111,494	(22,299)	[5,352]	{2,676}	115,086	(23,017)	[5,524]	{2,762}	118,965	(23,793)	[5,710]	{2,855}
Butler	36,467	36,700	37,133	37,593	38,599	(7,720)	[1,853]	{926}	39,676	(7,935)	[1,904]	{952}	40,866	(8,173)	[1,962]	{981}
Chester	76,043	76,863	77,666	78,535	80,682	(16,136)	[3,873]	{1,936}	82,935	(16,587)	[3,981]	{1,990}	85,302	(17,060)	[4,095]	{2,047}
Delaware	93,468	94,598	95,870	96,870	100,596	(20,119)	[4,829]	{2,414}	104,518	(20,904)	[5,017]	{2,508}	108,656	(21,731)	[5,216]	{2,608}
Lackawanna	33,546	34,038	34,610	35,071	36,228	(7,246)	[1,739]	{869}	37,490	(7,498)	[1,800]	{900}	38,862	(7,772)	[1,865]	{933}
Lancaster	102,154	103,273	104,297	105,474	108,224	(21,645)	[5,195]	{2,597}	111,136	(22,227)	[5,335]	{2,667}	114,271	(22,854)	[5,485]	{2,743}
Lehigh	75,139	76,767	78,188	79,301	82,707	(16,541)	[3,970]	{1,985}	86,380	(17,276)	[4,146]	{2,073}	90,416	(18,083)	[4,340]	{2,170}
Luzerne	60,101	60,718	61,650	62,483	64,430	(12,886)	[3,093]	{1,546}	66,579	(13,316)	[3,196]	{1,598}	68,908	(13,782)	[3,308]	{1,654}
Monroe	30,697	31,247	31,747	32,165	33,458	(6,692)	[1,606]	{803}	34,867	(6,973)	[1,674]	{837}	36,409	(7,282)	[1,748]	{874}
Montgomery	125,898	127,060	128,804	130,027	133,446	(26,689)	[6,405]	{3,203}	136,980	(27,396)	[6,575]	{3,288}	140,665	(28,133)	[6,752]	{3,376}
Northampton	67,302	68,678	69,717	70,436	72,826	(14,565)	[3,496]	{1,748}	75,365	(15,073)	[3,618]	{1,809}	78,089	(15,618)	[3,748]	{1,874}
Philadelphia	261,739	267,300	271,062	274,256	283,420	(56,684)	[13,604]	{6,802}	292,918	(58,584)	[14,060]	{7,030}	303,100	(60,620)	[14,549]	{7,274}
Westmoreland	64,381	64,784	65,710	66,502	68,012	(13,602)	[3,265]	{1,632}	69,692	(13,938)	[3,345]	{1,673}	71,511	(14,302)	[3,433]	{1,716}
York	97,191	97,888	98,796	99,967	102,534	(20,507)	[4,922]	{2,461}	105,145	(21,029)	[5,047]	{2,523}	107,891	(21,578)	[5,179]	{2,589}

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.