

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

Date: 4/21/21

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 4/21/21 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.

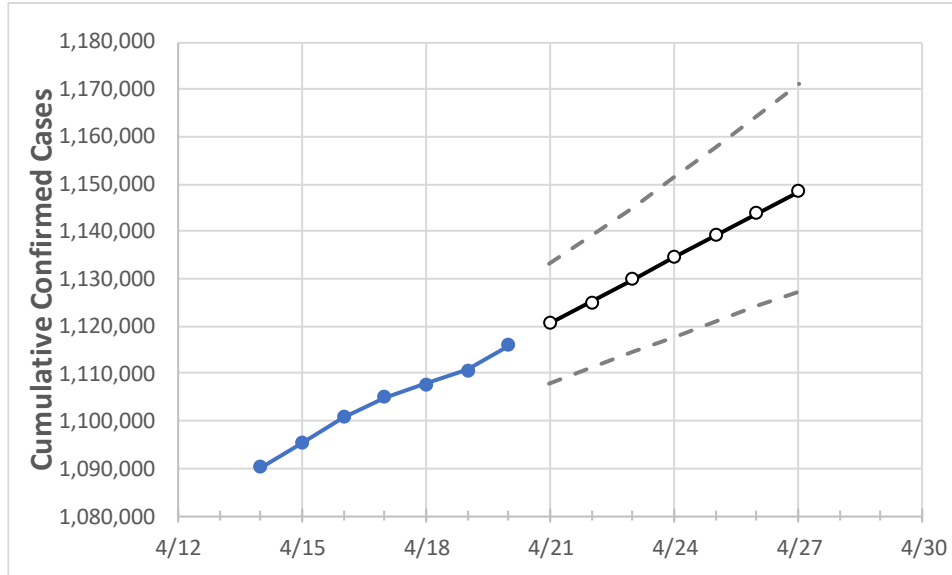
IEM's Modeling Lead

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:						
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27

Pennsylvania 1,105,061 1,107,673 1,110,675 1,116,044 1,120,643 1,125,178 1,129,833 1,134,554 1,139,174 1,143,836 1,148,470

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:						
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27
Allegheny	93,684	93,909	94,112	94,501	94,951	95,393	95,831	96,274	96,717	97,151	97,595
Berks	43,327	43,424	43,516	43,771	43,965	44,160	44,355	44,556	44,756	44,952	45,153
Bucks	55,782	55,988	56,123	56,408	56,671	56,936	57,198	57,449	57,706	57,963	58,221
Butler	16,256	16,268	16,290	16,338	16,386	16,433	16,479	16,525	16,570	16,615	16,659
Chester	33,883	34,008	34,133	34,258	34,395	34,531	34,666	34,800	34,935	35,066	35,199
Delaware	48,406	48,639	48,757	48,964	49,181	49,404	49,628	49,851	50,078	50,309	50,543
Lackawanna	16,886	16,958	16,978	17,067	17,137	17,208	17,281	17,354	17,429	17,507	17,583
Lancaster	51,164	51,347	51,426	51,619	51,807	51,996	52,185	52,368	52,557	52,750	52,933
Lehigh	36,639	36,703	36,758	36,947	37,078	37,207	37,342	37,465	37,593	37,721	37,845
Luzerne	29,021	29,089	29,136	29,256	29,365	29,475	29,588	29,698	29,809	29,920	30,032
Monroe	12,977	13,023	13,064	13,158	13,239	13,322	13,403	13,483	13,569	13,653	13,736
Montgomery	64,845	65,138	65,352	65,675	65,984	66,297	66,604	66,918	67,232	67,551	67,874
Northampton	33,099	33,168	33,225	33,388	33,510	33,632	33,752	33,871	33,987	34,101	34,213
Philadelphia	140,670	141,110	141,551	142,297	142,935	143,589	144,262	144,922	145,569	146,248	146,927
Westmoreland	31,420	31,490	31,535	31,693	31,818	31,944	32,071	32,197	32,321	32,443	32,565
York	42,335	42,464	42,532	42,693	42,857	43,023	43,186	43,350	43,515	43,678	43,843

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:											
	4/17	4/18	4/19	4/20	4/22			4/24			4/26					
Allegheny	93,684	93,909	94,112	94,501	95,393	(19,079)	[4,579]	{2,289}	96,274	(19,255)	[4,621]	{2,311}	97,151	(19,430)	[4,663]	{2,332}
Berks	43,327	43,424	43,516	43,771	44,160	(8,832)	[2,120]	{1,060}	44,556	(8,911)	[2,139]	{1,069}	44,952	(8,990)	[2,158]	{1,079}
Bucks	55,782	55,988	56,123	56,408	56,936	(11,387)	[2,733]	{1,366}	57,449	(11,490)	[2,758]	{1,379}	57,963	(11,593)	[2,782]	{1,391}
Butler	16,256	16,268	16,290	16,338	16,433	(3,287)	[789]	{394}	16,525	(3,305)	[793]	{397}	16,615	(3,323)	[798]	{399}
Chester	33,883	34,008	34,133	34,258	34,531	(6,906)	[1,658]	{829}	34,800	(6,960)	[1,670]	{835}	35,066	(7,013)	[1,683]	{842}
Delaware	48,406	48,639	48,757	48,964	49,404	(9,881)	[2,371]	{1,186}	49,851	(9,970)	[2,393]	{1,196}	50,309	(10,062)	[2,415]	{1,207}
Lackawanna	16,886	16,958	16,978	17,067	17,208	(3,442)	[826]	{413}	17,354	(3,471)	[833]	{416}	17,507	(3,501)	[840]	{420}
Lancaster	51,164	51,347	51,426	51,619	51,996	(10,399)	[2,496]	{1,248}	52,368	(10,474)	[2,514]	{1,257}	52,750	(10,550)	[2,532]	{1,266}
Lehigh	36,639	36,703	36,758	36,947	37,207	(7,441)	[1,786]	{893}	37,465	(7,493)	[1,798]	{899}	37,721	(7,544)	[1,811]	{905}
Luzerne	29,021	29,089	29,136	29,256	29,475	(5,895)	[1,415]	{707}	29,698	(5,940)	[1,426]	{713}	29,920	(5,984)	[1,436]	{718}
Monroe	12,977	13,023	13,064	13,158	13,322	(2,664)	[639]	{320}	13,483	(2,697)	[647]	{324}	13,653	(2,731)	[655]	{328}
Montgomery	64,845	65,138	65,352	65,675	66,297	(13,259)	[3,182]	{1,591}	66,918	(13,384)	[3,212]	{1,606}	67,551	(13,510)	[3,242]	{1,621}
Northampton	33,099	33,168	33,225	33,388	33,632	(6,726)	[1,614]	{807}	33,871	(6,774)	[1,626]	{813}	34,101	(6,820)	[1,637]	{818}
Philadelphia	140,670	141,110	141,551	142,297	143,589	(28,718)	[6,892]	{3,446}	144,922	(28,984)	[6,956]	{3,478}	146,248	(29,250)	[7,020]	{3,510}
Westmoreland	31,420	31,490	31,535	31,693	31,944	(6,389)	[1,533]	{767}	32,197	(6,439)	[1,545]	{773}	32,443	(6,489)	[1,557]	{779}
York	42,335	42,464	42,532	42,693	43,023	(8,605)	[2,065]	{1,033}	43,350	(8,670)	[2,081]	{1,040}	43,678	(8,736)	[2,097]	{1,048}

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.