

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

Date: 3/5/21

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 3/5/21 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.

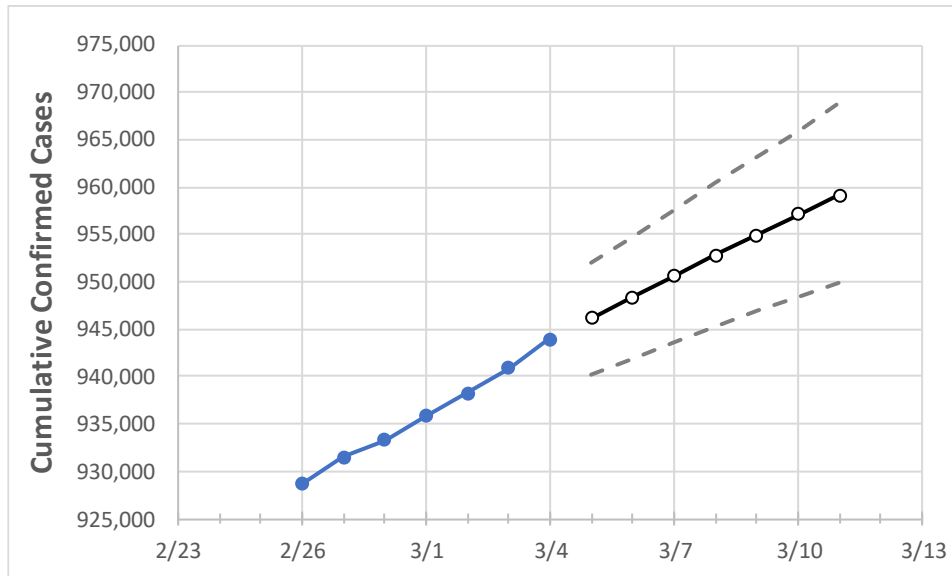
IEM's Modeling Lead

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:						
	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11
Pennsylvania	935,822	938,296	940,923	943,933	946,205	948,417	950,615	952,787	954,977	957,099	959,162

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:						
	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11
Allegheny	76,853	77,053	77,239	77,515	77,745	77,973	78,202	78,429	78,653	78,878	79,104
Berks	35,699	35,791	35,888	36,077	36,157	36,236	36,315	36,390	36,464	36,539	36,611
Bucks	45,176	45,320	45,456	45,668	45,802	45,939	46,073	46,205	46,337	46,467	46,595
Butler	13,939	13,978	14,013	14,049	14,079	14,108	14,139	14,168	14,197	14,224	14,252
Chester	28,201	28,261	28,353	28,447	28,523	28,599	28,675	28,751	28,822	28,895	28,968
Delaware	41,033	41,132	41,224	41,315	41,414	41,511	41,608	41,703	41,799	41,892	41,983
Lackawanna	13,964	14,009	14,072	14,104	14,146	14,187	14,227	14,267	14,307	14,345	14,384
Lancaster	43,705	43,809	43,951	44,116	44,216	44,313	44,407	44,497	44,584	44,667	44,753
Lehigh	30,811	30,897	30,975	31,060	31,132	31,205	31,276	31,345	31,415	31,485	31,552
Luzerne	24,928	24,973	25,033	25,097	25,144	25,190	25,235	25,279	25,322	25,364	25,405
Monroe	9,679	9,732	9,783	9,835	9,870	9,905	9,940	9,975	10,010	10,046	10,082
Montgomery	54,030	54,217	54,364	54,580	54,731	54,881	55,028	55,173	55,321	55,465	55,612
Northampton	26,855	26,969	27,090	27,207	27,288	27,367	27,448	27,525	27,601	27,672	27,745
Philadelphia	118,594	118,906	119,245	119,562	119,811	120,059	120,311	120,556	120,799	121,041	121,288
Westmoreland	26,817	26,864	26,938	26,994	27,048	27,102	27,157	27,210	27,263	27,316	27,369
York	35,878	35,938	36,033	36,136	36,208	36,280	36,348	36,416	36,481	36,546	36,607

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:											
	3/1	3/2	3/3	3/4	3/6			3/8			3/10					
Allegheny	76,853	77,053	77,239	77,515	77,973	(15,595)	[3,743]	{1,871}	78,429	(15,686)	[3,765]	{1,882}	78,878	(15,776)	[3,786]	{1,893}
Berks	35,699	35,791	35,888	36,077	36,236	(7,247)	[1,739]	{870}	36,390	(7,278)	[1,747]	{873}	36,539	(7,308)	[1,754]	{877}
Bucks	45,176	45,320	45,456	45,668	45,939	(9,188)	[2,205]	{1,103}	46,205	(9,241)	[2,218]	{1,109}	46,467	(9,293)	[2,230]	{1,115}
Butler	13,939	13,978	14,013	14,049	14,108	(2,822)	[677]	{339}	14,168	(2,834)	[680]	{340}	14,224	(2,845)	[683]	{341}
Chester	28,201	28,261	28,353	28,447	28,599	(5,720)	[1,373]	{686}	28,751	(5,750)	[1,380]	{690}	28,895	(5,779)	[1,387]	{693}
Delaware	41,033	41,132	41,224	41,315	41,511	(8,302)	[1,993]	{996}	41,703	(8,341)	[2,002]	{1,001}	41,892	(8,378)	[2,011]	{1,005}
Lackawanna	13,964	14,009	14,072	14,104	14,187	(2,837)	[681]	{340}	14,267	(2,853)	[685]	{342}	14,345	(2,869)	[689]	{344}
Lancaster	43,705	43,809	43,951	44,116	44,313	(8,863)	[2,127]	{1,064}	44,497	(8,899)	[2,136]	{1,068}	44,667	(8,933)	[2,144]	{1,072}
Lehigh	30,811	30,897	30,975	31,060	31,205	(6,241)	[1,498]	{749}	31,345	(6,269)	[1,505]	{752}	31,485	(6,297)	[1,511]	{756}
Luzerne	24,928	24,973	25,033	25,097	25,190	(5,038)	[1,209]	{605}	25,279	(5,056)	[1,213]	{607}	25,364	(5,073)	[1,217]	{609}
Monroe	9,679	9,732	9,783	9,835	9,905	(1,981)	[475]	{238}	9,975	(1,995)	[479]	{239}	10,046	(2,009)	[482]	{241}
Montgomery	54,030	54,217	54,364	54,580	54,881	(10,976)	[2,634]	{1,317}	55,173	(11,035)	[2,648]	{1,324}	55,465	(11,093)	[2,662]	{1,331}
Northampton	26,855	26,969	27,090	27,207	27,367	(5,473)	[1,314]	{657}	27,525	(5,505)	[1,321]	{661}	27,672	(5,534)	[1,328]	{664}
Philadelphia	118,594	118,906	119,245	119,562	120,059	(24,012)	[5,763]	{2,881}	120,556	(24,111)	[5,787]	{2,893}	121,041	(24,208)	[5,810]	{2,905}
Westmoreland	26,817	26,864	26,938	26,994	27,102	(5,420)	[1,301]	{650}	27,210	(5,442)	[1,306]	{653}	27,316	(5,463)	[1,311]	{656}
York	35,878	35,938	36,033	36,136	36,280	(7,256)	[1,741]	{871}	36,416	(7,283)	[1,748]	{874}	36,546	(7,309)	[1,754]	{877}

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.