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

Date: 1/6/21

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 1/6/21 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.

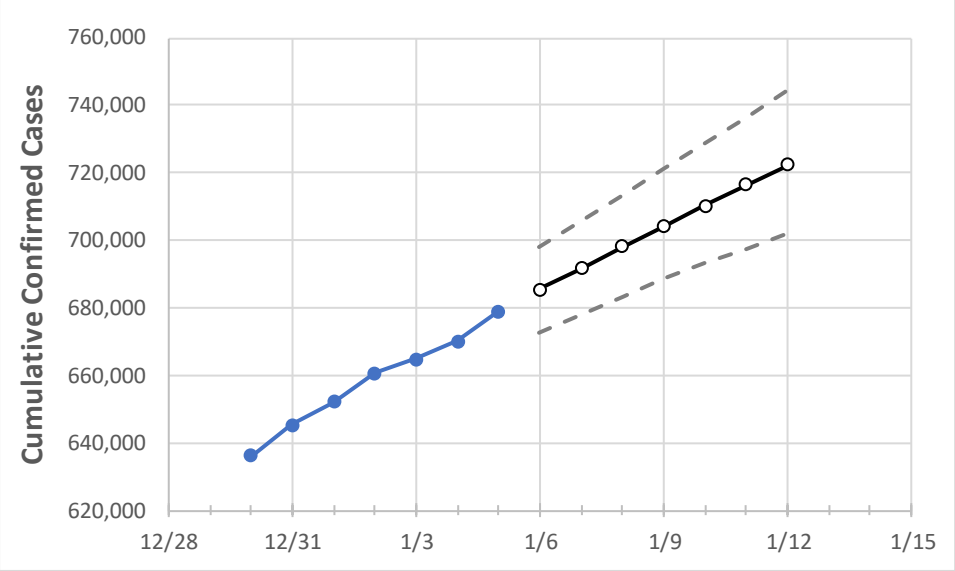
IEM's Modeling Lead

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:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Pennsylvania	660,580	664,913	670,039	678,998	685,394	691,722	698,051	704,178	710,237	716,387	722,361

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:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Allegheny	55,410	55,790	56,262	56,827	57,342	57,829	58,314	58,783	59,246	59,718	60,200
Berks	24,052	24,232	24,318	24,820	25,075	25,339	25,589	25,848	26,099	26,343	26,594
Bucks	31,224	31,468	31,562	32,070	32,361	32,649	32,926	33,204	33,474	33,749	34,009
Butler	9,644	9,746	9,850	9,997	10,130	10,262	10,391	10,519	10,644	10,776	10,905
Chester	20,097	20,252	20,407	20,767	20,957	21,146	21,333	21,520	21,707	21,889	22,072
Delaware	30,182	30,337	30,443	30,786	31,039	31,294	31,553	31,802	32,043	32,298	32,555
Lackawanna	9,130	9,224	9,283	9,452	9,585	9,725	9,862	10,000	10,139	10,281	10,422
Lancaster	28,725	28,930	29,047	29,476	29,752	30,021	30,296	30,554	30,813	31,081	31,345
Lehigh	21,107	21,231	21,370	21,720	21,977	22,231	22,488	22,744	23,000	23,247	23,499
Luzerne	17,820	17,929	17,973	18,197	18,367	18,532	18,704	18,865	19,028	19,186	19,339
Monroe	6,344	6,379	6,414	6,513	6,593	6,671	6,750	6,830	6,908	6,985	7,063
Montgomery	37,109	37,427	37,560	38,101	38,494	38,886	39,276	39,665	40,046	40,426	40,789
Northampton	17,261	17,358	17,430	17,738	17,946	18,145	18,337	18,533	18,727	18,918	19,110
Philadelphia	94,694	95,099	95,503	96,419	96,858	97,286	97,696	98,119	98,516	98,931	99,307
Westmoreland	19,806	19,933	20,165	20,393	20,585	20,767	20,946	21,121	21,301	21,478	21,643
York	23,874	24,086	24,158	24,608	24,871	25,116	25,373	25,629	25,872	26,114	26,352

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:		
	1/2	1/3	1/4	1/5	1/7	1/9	1/11
Allegheny	55,410	55,790	56,262	56,827	57,829 (11,566) [2,776] {1,388}	58,783 (11,757) [2,822] {1,411}	59,718 (11,944) [2,866] {1,433}
Berks	24,052	24,232	24,318	24,820	25,339 (5,068) [1,216] {608}	25,848 (5,170) [1,241] {620}	26,343 (5,269) [1,264] {632}
Bucks	31,224	31,468	31,562	32,070	32,649 (6,530) [1,567] {784}	33,204 (6,641) [1,594] {797}	33,749 (6,750) [1,620] {810}
Butler	9,644	9,746	9,850	9,997	10,262 (2,052) [493] {246}	10,519 (2,104) [505] {252}	10,776 (2,155) [517] {259}
Chester	20,097	20,252	20,407	20,767	21,146 (4,229) [1,015] {507}	21,520 (4,304) [1,033] {516}	21,889 (4,378) [1,051] {525}
Delaware	30,182	30,337	30,443	30,786	31,294 (6,259) [1,502] {751}	31,802 (6,360) [1,527] {763}	32,298 (6,460) [1,550] {775}
Lackawanna	9,130	9,224	9,283	9,452	9,725 (1,945) [467] {233}	10,000 (2,000) [480] {240}	10,281 (2,056) [493] {247}
Lancaster	28,725	28,930	29,047	29,476	30,021 (6,004) [1,441] {720}	30,554 (6,111) [1,467] {733}	31,081 (6,216) [1,492] {746}
Lehigh	21,107	21,231	21,370	21,720	22,231 (4,446) [1,067] {534}	22,744 (4,549) [1,092] {546}	23,247 (4,649) [1,116] {558}
Luzerne	17,820	17,929	17,973	18,197	18,532 (3,706) [890] {445}	18,865 (3,773) [906] {453}	19,186 (3,837) [921] {460}
Monroe	6,344	6,379	6,414	6,513	6,671 (1,334) [320] {160}	6,830 (1,366) [328] {164}	6,985 (1,397) [335] {168}
Montgomery	37,109	37,427	37,560	38,101	38,886 (7,777) [1,867] {933}	39,665 (7,933) [1,904] {952}	40,426 (8,085) [1,940] {970}
Northampton	17,261	17,358	17,430	17,738	18,145 (3,629) [871] {435}	18,533 (3,707) [890] {445}	18,918 (3,784) [908] {454}
Philadelphia	94,694	95,099	95,503	96,419	97,286 (19,457) [4,670] {2,335}	98,119 (19,624) [4,710] {2,355}	98,931 (19,786) [4,749] {2,374}
Westmoreland	19,806	19,933	20,165	20,393	20,767 (4,153) [997] {498}	21,121 (4,224) [1,014] {507}	21,478 (4,296) [1,031] {515}
York	23,874	24,086	24,158	24,608	25,116 (5,023) [1,206] {603}	25,629 (5,126) [1,230] {615}	26,114 (5,223) [1,253] {627}

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.