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

Date: 5/12/21

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 5/12/21 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.

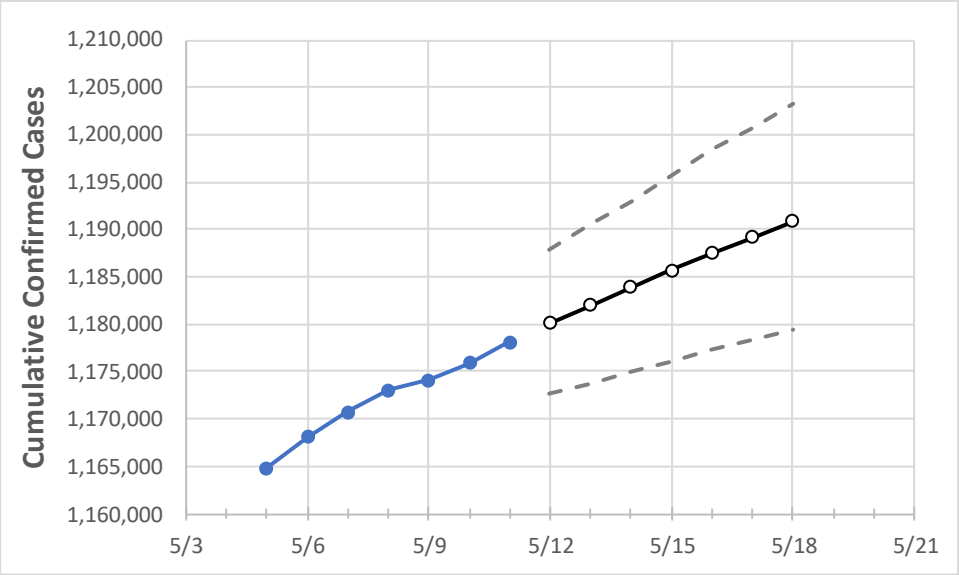
IEM's Modeling Lead

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:						
	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Pennsylvania	1,173,009	1,174,067	1,175,850	1,178,083	1,180,087	1,182,017	1,183,917	1,185,697	1,187,486	1,189,177	1,190,829

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:						
	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Allegheny	98,969	99,089	99,160	99,384	99,543	99,698	99,849	99,987	100,122	100,256	100,382
Berks	46,626	46,671	46,725	46,845	46,954	47,062	47,163	47,260	47,355	47,447	47,537
Bucks	59,403	59,478	59,531	59,613	59,697	59,777	59,855	59,928	59,998	60,064	60,126
Butler	17,034	17,052	17,064	17,110	17,140	17,168	17,197	17,225	17,252	17,279	17,304
Chester	36,018	36,065	36,112	36,179	36,238	36,295	36,351	36,404	36,455	36,505	36,552
Delaware	51,188	51,240	51,293	51,348	51,408	51,468	51,524	51,575	51,622	51,670	51,715
Lackawanna	18,027	18,034	18,045	18,087	18,114	18,140	18,164	18,188	18,211	18,231	18,251
Lancaster	54,036	54,098	54,145	54,211	54,285	54,355	54,419	54,483	54,543	54,601	54,656
Lehigh	38,769	38,813	38,838	38,911	38,971	39,030	39,087	39,143	39,196	39,247	39,297
Luzerne	30,910	30,942	30,974	31,055	31,114	31,172	31,227	31,280	31,332	31,382	31,432
Monroe	14,280	14,303	14,329	14,369	14,408	14,445	14,484	14,518	14,554	14,585	14,617
Montgomery	68,905	68,963	69,038	69,068	69,163	69,252	69,336	69,414	69,491	69,562	69,630
Northampton	35,012	35,039	35,065	35,132	35,180	35,226	35,269	35,312	35,352	35,389	35,425
Philadelphia	149,563	149,758	149,953	149,953	150,181	150,395	150,599	150,799	150,992	151,172	151,353
Westmoreland	33,295	33,329	33,347	33,426	33,487	33,546	33,603	33,660	33,716	33,770	33,824
York	45,087	45,139	45,183	45,255	45,340	45,423	45,501	45,578	45,654	45,727	45,799

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:		
	5/8	5/9	5/10	5/11	5/13	5/15	5/17
Allegheny	98,969	99,089	99,160	99,384	99,698 (19,940) [4,785] {2,393}	99,987 (19,997) [4,799] {2,400}	100,256 (20,051) [4,812] {2,406}
Berks	46,626	46,671	46,725	46,845	47,062 (9,412) [2,259] {1,129}	47,260 (9,452) [2,268] {1,134}	47,447 (9,489) [2,277] {1,139}
Bucks	59,403	59,478	59,531	59,613	59,777 (11,955) [2,869] {1,435}	59,928 (11,986) [2,877] {1,438}	60,064 (12,013) [2,883] {1,442}
Butler	17,034	17,052	17,064	17,110	17,168 (3,434) [824] {412}	17,225 (3,445) [827] {413}	17,279 (3,456) [829] {415}
Chester	36,018	36,065	36,112	36,179	36,295 (7,259) [1,742] {871}	36,404 (7,281) [1,747] {874}	36,505 (7,301) [1,752] {876}
Delaware	51,188	51,240	51,293	51,348	51,468 (10,294) [2,470] {1,235}	51,575 (10,315) [2,476] {1,238}	51,670 (10,334) [2,480] {1,240}
Lackawanna	18,027	18,034	18,045	18,087	18,140 (3,628) [871] {435}	18,188 (3,638) [873] {437}	18,231 (3,646) [875] {438}
Lancaster	54,036	54,098	54,145	54,211	54,355 (10,871) [2,609] {1,305}	54,483 (10,897) [2,615] {1,308}	54,601 (10,920) [2,621] {1,310}
Lehigh	38,769	38,813	38,838	38,911	39,030 (7,806) [1,873] {937}	39,143 (7,829) [1,879] {939}	39,247 (7,849) [1,884] {942}
Luzerne	30,910	30,942	30,974	31,055	31,172 (6,234) [1,496] {748}	31,280 (6,256) [1,501] {751}	31,382 (6,276) [1,506] {753}
Monroe	14,280	14,303	14,329	14,369	14,445 (2,889) [693] {347}	14,518 (2,904) [697] {348}	14,585 (2,917) [700] {350}
Montgomery	68,905	68,963	69,038	69,068	69,252 (13,850) [3,324] {1,662}	69,414 (13,883) [3,332] {1,666}	69,562 (13,912) [3,339] {1,669}
Northampton	35,012	35,039	35,065	35,132	35,226 (7,045) [1,691] {845}	35,312 (7,062) [1,695] {847}	35,389 (7,078) [1,699] {849}
Philadelphia	149,563	149,758	149,953	149,953	150,395 (30,079) [7,219] {3,609}	150,799 (30,160) [7,238] {3,619}	151,172 (30,234) [7,256] {3,628}
Westmoreland	33,295	33,329	33,347	33,426	33,546 (6,709) [1,610] {805}	33,660 (6,732) [1,616] {808}	33,770 (6,754) [1,621] {810}
York	45,087	45,139	45,183	45,255	45,423 (9,085) [2,180] {1,090}	45,578 (9,116) [2,188] {1,094}	45,727 (9,145) [2,195] {1,097}

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.