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

Date: 9/15/20

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 20%, and are often within 10%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 9/15/20 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.

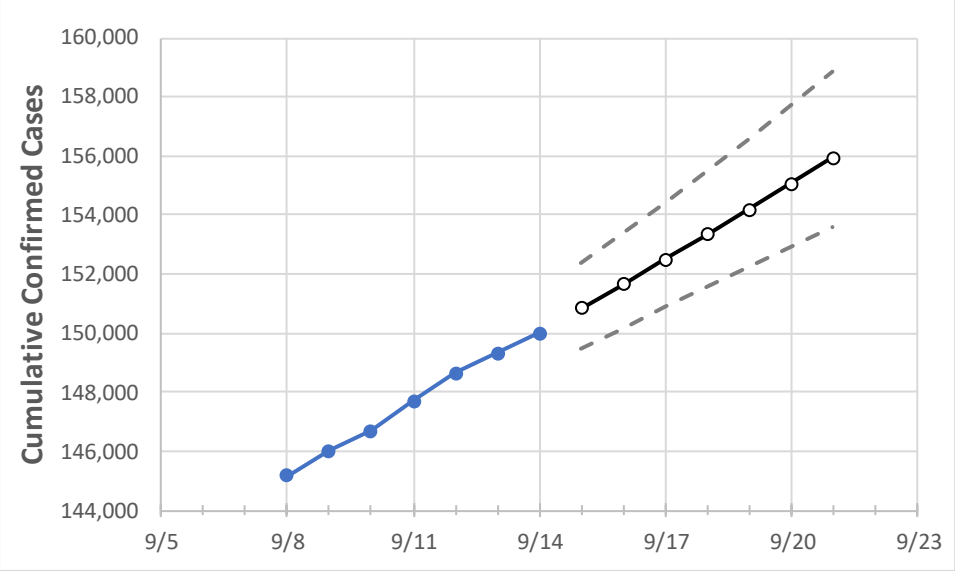
IEM's Modeling Lead

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:						
	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20	9/21
Pennsylvania	147,703	148,635	149,318	150,000	150,827	151,661	152,500	153,346	154,199	155,058	155,923

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 20%, and are often within 10%, of actual confirmed cases.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20	9/21
Allegheny	11,069	11,126	11,197	11,268	11,335	11,402	11,470	11,540	11,610	11,681	11,752
Berks	6,442	6,521	6,554	6,587	6,622	6,658	6,694	6,731	6,768	6,805	6,842
Bucks	8,198	8,229	8,262	8,294	8,329	8,365	8,401	8,438	8,475	8,513	8,552
Butler	923	932	935	938	946	953	961	969	977	985	994
Chester	6,187	6,223	6,258	6,294	6,350	6,408	6,468	6,530	6,594	6,660	6,729
Delaware	10,811	10,857	10,890	10,922	10,958	10,993	11,028	11,063	11,097	11,131	11,165
Lackawanna	2,262	2,301	2,311	2,321	2,338	2,356	2,375	2,395	2,416	2,439	2,462
Lancaster	7,238	7,273	7,299	7,325	7,364	7,402	7,440	7,478	7,516	7,553	7,591
Lehigh	5,348	5,366	5,380	5,393	5,409	5,425	5,441	5,458	5,476	5,494	5,513
Luzerne	3,926	3,941	3,946	3,951	3,958	3,965	3,972	3,979	3,985	3,992	3,998
Monroe	1,753	1,755	1,757	1,759	1,761	1,764	1,766	1,769	1,771	1,773	1,776
Montgomery	11,537	11,578	11,618	11,657	11,699	11,740	11,781	11,822	11,863	11,904	11,945
Northampton	4,210	4,224	4,241	4,258	4,271	4,285	4,299	4,314	4,330	4,347	4,365
Philadelphia	34,986	35,094	35,176	35,257	35,349	35,440	35,530	35,620	35,709	35,797	35,885
Westmoreland	1,945	1,962	1,974	1,985	1,995	2,006	2,016	2,026	2,037	2,047	2,058
York	3,995	4,124	4,170	4,216	4,278	4,341	4,407	4,475	4,545	4,616	4,691

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:		
	9/11	9/12	9/13	9/14	9/16	9/18	9/20
Allegheny	11,069	11,126	11,197	11,268	11,402 (2,280) [547] {274}	11,540 (2,308) [554] {277}	11,681 (2,336) [561] {280}
Berks	6,442	6,521	6,554	6,587	6,658 (1,332) [320] {160}	6,731 (1,346) [323] {162}	6,805 (1,361) [327] {163}
Bucks	8,198	8,229	8,262	8,294	8,365 (1,673) [402] {201}	8,438 (1,688) [405] {203}	8,513 (1,703) [409] {204}
Butler	923	932	935	938	953 (191) [46] {23}	969 (194) [47] {23}	985 (197) [47] {24}
Chester	6,187	6,223	6,258	6,294	6,408 (1,282) [308] {154}	6,530 (1,306) [313] {157}	6,660 (1,332) [320] {160}
Delaware	10,811	10,857	10,890	10,922	10,993 (2,199) [528] {264}	11,063 (2,213) [531] {266}	11,131 (2,226) [534] {267}
Lackawanna	2,262	2,301	2,311	2,321	2,356 (471) [113] {57}	2,395 (479) [115] {57}	2,439 (488) [117] {59}
Lancaster	7,238	7,273	7,299	7,325	7,402 (1,480) [355] {178}	7,478 (1,496) [359] {179}	7,553 (1,511) [363] {181}
Lehigh	5,348	5,366	5,380	5,393	5,425 (1,085) [260] {130}	5,458 (1,092) [262] {131}	5,494 (1,099) [264] {132}
Luzerne	3,926	3,941	3,946	3,951	3,965 (793) [190] {95}	3,979 (796) [191] {95}	3,992 (798) [192] {96}
Monroe	1,753	1,755	1,757	1,759	1,764 (353) [85] {42}	1,769 (354) [85] {42}	1,773 (355) [85] {43}
Montgomery	11,537	11,578	11,618	11,657	11,740 (2,348) [564] {282}	11,822 (2,364) [567] {284}	11,904 (2,381) [571] {286}
Northampton	4,210	4,224	4,241	4,258	4,285 (857) [206] {103}	4,314 (863) [207] {104}	4,347 (869) [209] {104}
Philadelphia	34,986	35,094	35,176	35,257	35,440 (7,088) [1,701] {851}	35,620 (7,124) [1,710] {855}	35,797 (7,159) [1,718] {859}
Westmoreland	1,945	1,962	1,974	1,985	2,006 (401) [96] {48}	2,026 (405) [97] {49}	2,047 (409) [98] {49}
York	3,995	4,124	4,170	4,216	4,341 (868) [208] {104}	4,475 (895) [215] {107}	4,616 (923) [222] {111}

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.