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

Date: 5/24/21

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 5/24/21 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.

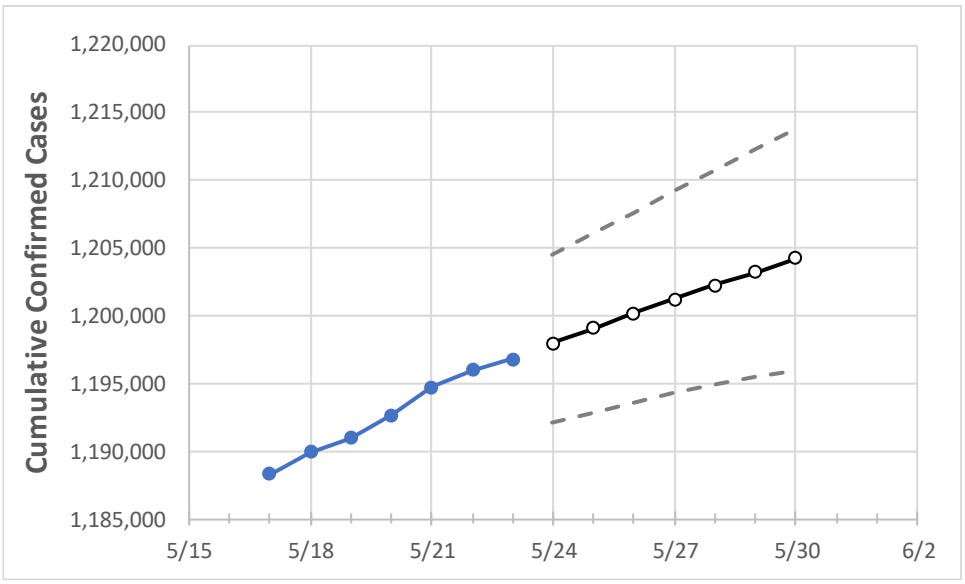
IEM's Modeling Lead

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:						
	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30
Pennsylvania	1,192,678	1,194,743	1,195,979	1,196,778	1,197,941	1,199,085	1,200,194	1,201,227	1,202,249	1,203,245	1,204,233

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:						
	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30
Allegheny	100,600	100,719	100,799	100,870	100,965	101,057	101,149	101,236	101,321	101,402	101,481
Berks	47,493	47,591	47,654	47,686	47,738	47,789	47,836	47,883	47,929	47,972	48,012
Bucks	60,222	60,307	60,358	60,388	60,430	60,470	60,510	60,547	60,583	60,616	60,649
Butler	17,301	17,325	17,339	17,351	17,367	17,383	17,398	17,413	17,427	17,441	17,454
Chester	36,838	37,047	37,047	37,047	37,112	37,177	37,243	37,307	37,372	37,437	37,502
Delaware	51,789	51,869	51,918	51,959	51,996	52,031	52,062	52,092	52,122	52,150	52,178
Lackawanna	18,258	18,276	18,333	18,337	18,353	18,368	18,382	18,397	18,410	18,423	18,436
Lancaster	54,738	54,797	54,851	54,897	54,938	54,979	55,019	55,055	55,089	55,122	55,152
Lehigh	39,310	39,388	39,446	39,466	39,500	39,534	39,567	39,597	39,628	39,658	39,687
Luzerne	31,483	31,542	31,596	31,629	31,668	31,705	31,740	31,776	31,810	31,844	31,876
Monroe	14,574	14,600	14,624	14,627	14,642	14,655	14,669	14,681	14,694	14,705	14,715
Montgomery	69,675	69,757	69,810	69,851	69,890	69,928	69,964	69,998	70,030	70,062	70,091
Northampton	35,451	35,509	35,545	35,564	35,590	35,614	35,638	35,661	35,682	35,703	35,725
Philadelphia	151,949	151,949	151,949	151,949	152,075	152,199	152,317	152,431	152,539	152,641	152,741
Westmoreland	33,827	33,877	33,909	33,955	33,990	34,025	34,058	34,090	34,122	34,151	34,182
York	45,868	45,968	46,034	46,066	46,117	46,169	46,218	46,265	46,311	46,356	46,399

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:		
	5/20	5/21	5/22	5/23	5/25	5/27	5/29
Allegheny	100,600	100,719	100,799	100,870	101,057 (20,211) [4,851] {2,425}	101,236 (20,247) [4,859] {2,430}	101,402 (20,280) [4,867] {2,434}
Berks	47,493	47,591	47,654	47,686	47,789 (9,558) [2,294] {1,147}	47,883 (9,577) [2,298] {1,149}	47,972 (9,594) [2,303] {1,151}
Bucks	60,222	60,307	60,358	60,388	60,470 (12,094) [2,903] {1,451}	60,547 (12,109) [2,906] {1,453}	60,616 (12,123) [2,910] {1,455}
Butler	17,301	17,325	17,339	17,351	17,383 (3,477) [834] {417}	17,413 (3,483) [836] {418}	17,441 (3,488) [837] {419}
Chester	36,838	37,047	37,047	37,047	37,177 (7,435) [1,785] {892}	37,307 (7,461) [1,791] {895}	37,437 (7,487) [1,797] {898}
Delaware	51,789	51,869	51,918	51,959	52,031 (10,406) [2,497] {1,249}	52,092 (10,418) [2,500] {1,250}	52,150 (10,430) [2,503] {1,252}
Lackawanna	18,258	18,276	18,333	18,337	18,368 (3,674) [882] {441}	18,397 (3,679) [883] {442}	18,423 (3,685) [884] {442}
Lancaster	54,738	54,797	54,851	54,897	54,979 (10,996) [2,639] {1,320}	55,055 (11,011) [2,643] {1,321}	55,122 (11,024) [2,646] {1,323}
Lehigh	39,310	39,388	39,446	39,466	39,534 (7,907) [1,898] {949}	39,597 (7,919) [1,901] {950}	39,658 (7,932) [1,904] {952}
Luzerne	31,483	31,542	31,596	31,629	31,705 (6,341) [1,522] {761}	31,776 (6,355) [1,525] {763}	31,844 (6,369) [1,528] {764}
Monroe	14,574	14,600	14,624	14,627	14,655 (2,931) [703] {352}	14,681 (2,936) [705] {352}	14,705 (2,941) [706] {353}
Montgomery	69,675	69,757	69,810	69,851	69,928 (13,986) [3,357] {1,678}	69,998 (14,000) [3,360] {1,680}	70,062 (14,012) [3,363] {1,681}
Northampton	35,451	35,509	35,545	35,564	35,614 (7,123) [1,709] {855}	35,661 (7,132) [1,712] {856}	35,703 (7,141) [1,714] {857}
Philadelphia	151,949	151,949	151,949	151,949	152,199 (30,440) [7,306] {3,653}	152,431 (30,486) [7,317] {3,658}	152,641 (30,528) [7,327] {3,663}
Westmoreland	33,827	33,877	33,909	33,955	34,025 (6,805) [1,633] {817}	34,090 (6,818) [1,636] {818}	34,151 (6,830) [1,639] {820}
York	45,868	45,968	46,034	46,066	46,169 (9,234) [2,216] {1,108}	46,265 (9,253) [2,221] {1,110}	46,356 (9,271) [2,225] {1,113}

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.