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

Date: 10/6/20

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 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 10/6/20 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.

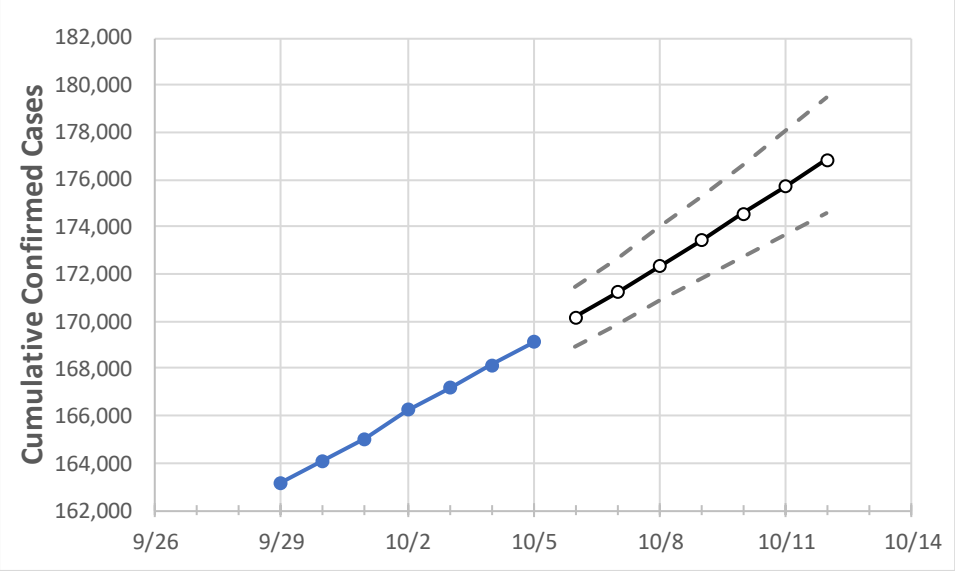
IEM's Modeling Lead

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:						
	10/2	10/3	10/4	10/5	10/6	10/7	10/8	10/9	10/10	10/11	10/12
Pennsylvania	166,238	167,182	168,126	169,101	170,155	171,226	172,314	173,420	174,544	175,687	176,848

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:						
	10/2	10/3	10/4	10/5	10/6	10/7	10/8	10/9	10/10	10/11	10/12
Allegheny	12,527	12,629	12,731	12,777	12,847	12,918	12,990	13,062	13,135	13,208	13,283
Berks	7,258	7,305	7,351	7,378	7,412	7,447	7,482	7,516	7,551	7,586	7,621
Bucks	8,984	9,011	9,037	9,066	9,101	9,136	9,172	9,208	9,244	9,280	9,316
Butler	1,101	1,115	1,128	1,136	1,145	1,154	1,162	1,172	1,181	1,190	1,200
Chester	7,040	7,072	7,103	7,135	7,168	7,201	7,234	7,266	7,299	7,330	7,362
Delaware	11,621	11,669	11,716	11,746	11,789	11,832	11,876	11,920	11,964	12,009	12,054
Lackawanna	2,656	2,685	2,713	2,731	2,760	2,791	2,823	2,858	2,894	2,933	2,974
Lancaster	8,102	8,149	8,195	8,218	8,263	8,309	8,355	8,402	8,449	8,497	8,545
Lehigh	5,731	5,751	5,770	5,781	5,802	5,824	5,847	5,869	5,892	5,916	5,939
Luzerne	4,157	4,175	4,193	4,209	4,223	4,238	4,253	4,269	4,284	4,300	4,317
Monroe	1,816	1,821	1,826	1,829	1,833	1,837	1,842	1,846	1,851	1,856	1,861
Montgomery	12,397	12,448	12,499	12,517	12,553	12,589	12,625	12,661	12,696	12,732	12,768
Northampton	4,554	4,576	4,597	4,606	4,620	4,634	4,648	4,662	4,676	4,690	4,704
Philadelphia	37,502	37,604	37,705	37,807	37,946	38,088	38,234	38,384	38,538	38,696	38,857
Westmoreland	2,353	2,385	2,416	2,461	2,494	2,529	2,565	2,604	2,644	2,686	2,730
York	5,008	5,058	5,107	5,125	5,160	5,194	5,229	5,262	5,296	5,329	5,362

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:		
	10/2	10/3	10/4	10/5	10/7	10/9	10/11
Allegheny	12,527	12,629	12,731	12,777	12,918 (2,584) [620] {310}	13,062 (2,612) [627] {313}	13,208 (2,642) [634] {317}
Berks	7,258	7,305	7,351	7,378	7,447 (1,489) [357] {179}	7,516 (1,503) [361] {180}	7,586 (1,517) [364] {182}
Bucks	8,984	9,011	9,037	9,066	9,136 (1,827) [439] {219}	9,208 (1,842) [442] {221}	9,280 (1,856) [445] {223}
Butler	1,101	1,115	1,128	1,136	1,154 (231) [55] {28}	1,172 (234) [56] {28}	1,190 (238) [57] {29}
Chester	7,040	7,072	7,103	7,135	7,201 (1,440) [346] {173}	7,266 (1,453) [349] {174}	7,330 (1,466) [352] {176}
Delaware	11,621	11,669	11,716	11,746	11,832 (2,366) [568] {284}	11,920 (2,384) [572] {286}	12,009 (2,402) [576] {288}
Lackawanna	2,656	2,685	2,713	2,731	2,791 (558) [134] {67}	2,858 (572) [137] {69}	2,933 (587) [141] {70}
Lancaster	8,102	8,149	8,195	8,218	8,309 (1,662) [399] {199}	8,402 (1,680) [403] {202}	8,497 (1,699) [408] {204}
Lehigh	5,731	5,751	5,770	5,781	5,824 (1,165) [280] {140}	5,869 (1,174) [282] {141}	5,916 (1,183) [284] {142}
Luzerne	4,157	4,175	4,193	4,209	4,238 (848) [203] {102}	4,269 (854) [205] {102}	4,300 (860) [206] {103}
Monroe	1,816	1,821	1,826	1,829	1,837 (367) [88] {44}	1,846 (369) [89] {44}	1,856 (371) [89] {45}
Montgomery	12,397	12,448	12,499	12,517	12,589 (2,518) [604] {302}	12,661 (2,532) [608] {304}	12,732 (2,546) [611] {306}
Northampton	4,554	4,576	4,597	4,606	4,634 (927) [222] {111}	4,662 (932) [224] {112}	4,690 (938) [225] {113}
Philadelphia	37,502	37,604	37,705	37,807	38,088 (7,618) [1,828] {914}	38,384 (7,677) [1,842] {921}	38,696 (7,739) [1,857] {929}
Westmoreland	2,353	2,385	2,416	2,461	2,529 (506) [121] {61}	2,604 (521) [125] {62}	2,686 (537) [129] {64}
York	5,008	5,058	5,107	5,125	5,194 (1,039) [249] {125}	5,262 (1,052) [253] {126}	5,329 (1,066) [256] {128}

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.