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

Date: 8/26/20

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 8/26/20 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.

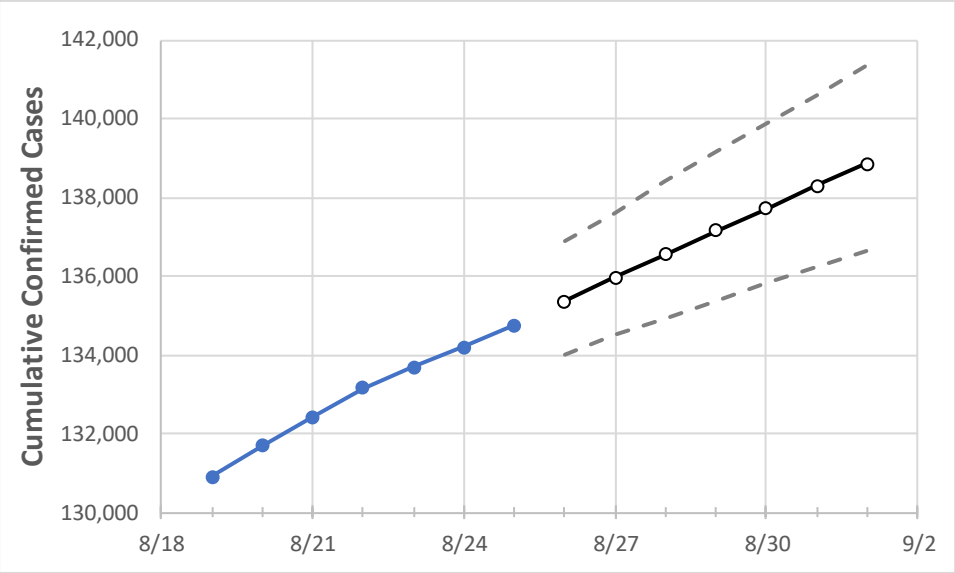
IEM's Modeling Lead

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:						
	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	8/31	9/1
Pennsylvania	133,160	133,679	134,204	134,760	135,369	135,969	136,562	137,146	137,723	138,293	138,855

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:						
	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	8/31	9/1
Allegheny	9,817	9,903	9,932	9,990	10,036	10,080	10,123	10,165	10,206	10,245	10,284
Berks	5,781	5,814	5,847	5,889	5,920	5,952	5,985	6,018	6,052	6,087	6,123
Bucks	7,562	7,580	7,607	7,623	7,644	7,664	7,684	7,704	7,723	7,742	7,760
Butler	744	746	745	750	753	757	760	763	766	769	772
Chester	5,461	5,483	5,505	5,527	5,543	5,558	5,573	5,587	5,601	5,615	5,628
Delaware	10,011	10,045	10,078	10,109	10,151	10,192	10,233	10,272	10,312	10,350	10,388
Lackawanna	1,987	1,995	1,999	2,002	2,005	2,009	2,012	2,015	2,019	2,022	2,025
Lancaster	6,428	6,465	6,479	6,518	6,547	6,576	6,604	6,632	6,660	6,688	6,715
Lehigh	5,119	5,128	5,132	5,135	5,141	5,146	5,151	5,156	5,161	5,166	5,170
Luzerne	3,678	3,690	3,698	3,712	3,722	3,733	3,743	3,753	3,763	3,772	3,782
Monroe	1,688	1,690	1,694	1,701	1,704	1,706	1,709	1,711	1,714	1,716	1,719
Montgomery	10,667	10,713	10,755	10,784	10,825	10,866	10,907	10,948	10,989	11,031	11,072
Northampton	4,050	4,059	4,066	4,068	4,072	4,076	4,080	4,083	4,087	4,090	4,093
Philadelphia	32,936	32,995	33,054	33,139	33,226	33,312	33,397	33,480	33,562	33,643	33,722
Westmoreland	1,716	1,731	1,740	1,748	1,759	1,770	1,781	1,792	1,803	1,813	1,824
York	3,086	3,119	3,136	3,158	3,189	3,220	3,251	3,282	3,313	3,345	3,376

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:		
	8/22	8/23	8/24	8/25	8/27	8/29	8/31
Allegheny	9,817	9,903	9,932	9,990	10,080 (2,016) [484] {242}	10,165 (2,033) [488] {244}	10,245 (2,049) [492] {246}
Berks	5,781	5,814	5,847	5,889	5,952 (1,190) [286] {143}	6,018 (1,204) [289] {144}	6,087 (1,217) [292] {146}
Bucks	7,562	7,580	7,607	7,623	7,664 (1,533) [368] {184}	7,704 (1,541) [370] {185}	7,742 (1,548) [372] {186}
Butler	744	746	745	750	757 (151) [36] {18}	763 (153) [37] {18}	769 (154) [37] {18}
Chester	5,461	5,483	5,505	5,527	5,558 (1,112) [267] {133}	5,587 (1,117) [268] {134}	5,615 (1,123) [270] {135}
Delaware	10,011	10,045	10,078	10,109	10,192 (2,038) [489] {245}	10,272 (2,054) [493] {247}	10,350 (2,070) [497] {248}
Lackawanna	1,987	1,995	1,999	2,002	2,009 (402) [96] {48}	2,015 (403) [97] {48}	2,022 (404) [97] {49}
Lancaster	6,428	6,465	6,479	6,518	6,576 (1,315) [316] {158}	6,632 (1,326) [318] {159}	6,688 (1,338) [321] {161}
Lehigh	5,119	5,128	5,132	5,135	5,146 (1,029) [247] {124}	5,156 (1,031) [248] {124}	5,166 (1,033) [248] {124}
Luzerne	3,678	3,690	3,698	3,712	3,733 (747) [179] {90}	3,753 (751) [180] {90}	3,772 (754) [181] {91}
Monroe	1,688	1,690	1,694	1,701	1,706 (341) [82] {41}	1,711 (342) [82] {41}	1,716 (343) [82] {41}
Montgomery	10,667	10,713	10,755	10,784	10,866 (2,173) [522] {261}	10,948 (2,190) [525] {263}	11,031 (2,206) [529] {265}
Northampton	4,050	4,059	4,066	4,068	4,076 (815) [196] {98}	4,083 (817) [196] {98}	4,090 (818) [196] {98}
Philadelphia	32,936	32,995	33,054	33,139	33,312 (6,662) [1,599] {799}	33,480 (6,696) [1,607] {804}	33,643 (6,729) [1,615] {807}
Westmoreland	1,716	1,731	1,740	1,748	1,770 (354) [85] {42}	1,792 (358) [86] {43}	1,813 (363) [87] {44}
York	3,086	3,119	3,136	3,158	3,220 (644) [155] {77}	3,282 (656) [158] {79}	3,345 (669) [161] {80}

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.