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

Date: 11/12/20

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 11/12/20 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.

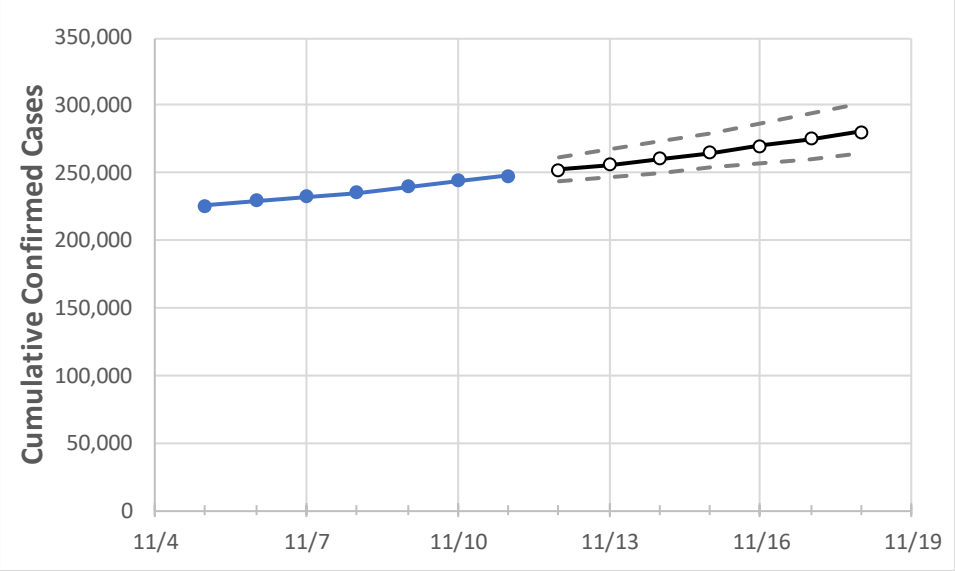
IEM's Modeling Lead

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:						
	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18
Pennsylvania	235,014	239,724	244,046	248,015	252,023	256,210	260,582	265,147	269,913	274,889	280,084

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:						
	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18
Allegheny	17,386	17,656	17,973	18,339	18,654	18,988	19,341	19,716	20,112	20,531	20,975
Berks	10,355	10,447	10,595	10,767	10,882	11,000	11,119	11,240	11,363	11,488	11,614
Bucks	11,340	11,519	11,676	11,921	12,120	12,334	12,564	12,810	13,075	13,360	13,665
Butler	2,308	2,375	2,476	2,566	2,646	2,732	2,822	2,918	3,020	3,128	3,243
Chester	8,842	8,928	9,040	9,040	9,139	9,243	9,352	9,465	9,584	9,708	9,838
Delaware	15,020	15,232	15,402	15,592	15,797	16,013	16,239	16,477	16,727	16,989	17,265
Lackawanna	4,080	4,106	4,147	4,185	4,212	4,239	4,266	4,292	4,318	4,343	4,369
Lancaster	10,861	10,951	11,069	11,271	11,436	11,609	11,791	11,982	12,183	12,394	12,616
Lehigh	7,544	7,657	7,775	7,965	8,122	8,290	8,471	8,666	8,875	9,100	9,342
Luzerne	6,125	6,206	6,339	6,450	6,546	6,646	6,748	6,854	6,963	7,076	7,192
Monroe	2,259	2,287	2,318	2,367	2,406	2,448	2,493	2,542	2,596	2,654	2,717
Montgomery	15,467	15,660	15,857	16,115	16,347	16,594	16,854	17,130	17,423	17,732	18,060
Northampton	6,058	6,131	6,207	6,324	6,416	6,512	6,614	6,721	6,834	6,953	7,078
Philadelphia	48,862	49,456	50,354	50,354	51,029	51,735	52,474	53,247	54,055	54,900	55,783
Westmoreland	5,078	5,174	5,293	5,431	5,528	5,628	5,731	5,837	5,945	6,057	6,171
York	7,301	7,388	7,477	7,608	7,695	7,783	7,874	7,967	8,061	8,158	8,258

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:		
	11/8	11/9	11/10	11/11	11/13	11/15	11/17
Allegheny	17,386	17,656	17,973	18,339	18,988 (3,798) [911] {456}	19,716 (3,943) [946] {473}	20,531 (4,106) [986] {493}
Berks	10,355	10,447	10,595	10,767	11,000 (2,200) [528] {264}	11,240 (2,248) [540] {270}	11,488 (2,298) [551] {276}
Bucks	11,340	11,519	11,676	11,921	12,334 (2,467) [592] {296}	12,810 (2,562) [615] {307}	13,360 (2,672) [641] {321}
Butler	2,308	2,375	2,476	2,566	2,732 (546) [131] {66}	2,918 (584) [140] {70}	3,128 (626) [150] {75}
Chester	8,842	8,928	9,040	9,040	9,243 (1,849) [444] {222}	9,465 (1,893) [454] {227}	9,708 (1,942) [466] {233}
Delaware	15,020	15,232	15,402	15,592	16,013 (3,203) [769] {384}	16,477 (3,295) [791] {395}	16,989 (3,398) [815] {408}
Lackawanna	4,080	4,106	4,147	4,185	4,239 (848) [203] {102}	4,292 (858) [206] {103}	4,343 (869) [208] {104}
Lancaster	10,861	10,951	11,069	11,271	11,609 (2,322) [557] {279}	11,982 (2,396) [575] {288}	12,394 (2,479) [595] {297}
Lehigh	7,544	7,657	7,775	7,965	8,290 (1,658) [398] {199}	8,666 (1,733) [416] {208}	9,100 (1,820) [437] {218}
Luzerne	6,125	6,206	6,339	6,450	6,646 (1,329) [319] {159}	6,854 (1,371) [329] {164}	7,076 (1,415) [340] {170}
Monroe	2,259	2,287	2,318	2,367	2,448 (490) [117] {59}	2,542 (508) [122] {61}	2,654 (531) [127] {64}
Montgomery	15,467	15,660	15,857	16,115	16,594 (3,319) [796] {398}	17,130 (3,426) [822] {411}	17,732 (3,546) [851] {426}
Northampton	6,058	6,131	6,207	6,324	6,512 (1,302) [313] {156}	6,721 (1,344) [323] {161}	6,953 (1,391) [334] {167}
Philadelphia	48,862	49,456	50,354	50,354	51,735 (10,347) [2,483] {1,242}	53,247 (10,649) [2,556] {1,278}	54,900 (10,980) [2,635] {1,318}
Westmoreland	5,078	5,174	5,293	5,431	5,628 (1,126) [270] {135}	5,837 (1,167) [280] {140}	6,057 (1,211) [291] {145}
York	7,301	7,388	7,477	7,608	7,783 (1,557) [374] {187}	7,967 (1,593) [382] {191}	8,158 (1,632) [392] {196}

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.