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

Date: 12/23/20

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 12/23/20 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.

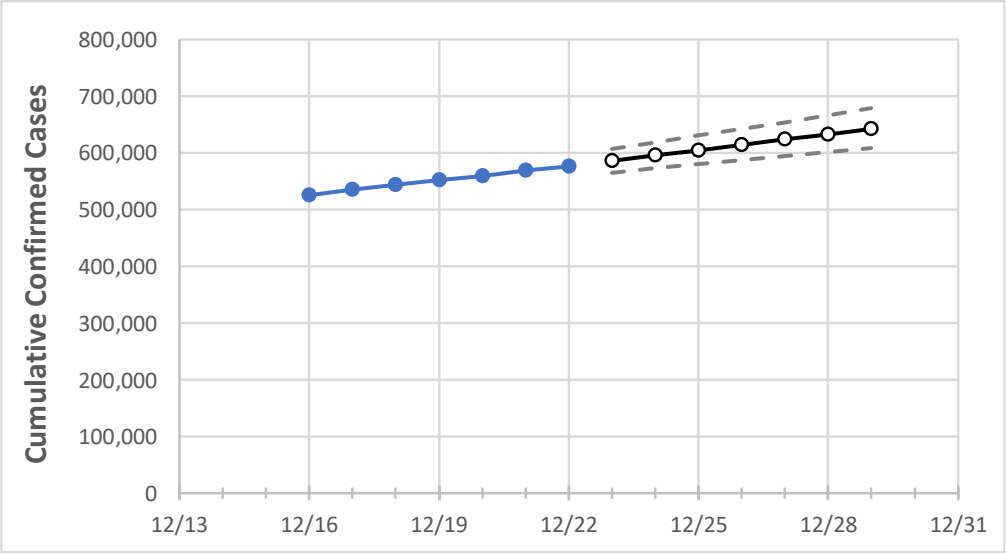
IEM's Modeling Lead

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:						
	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28	12/29
Pennsylvania	552,895	559,256	569,099	576,787	586,260	595,688	604,993	614,347	623,854	633,197	642,561

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:						
	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28	12/29
Allegheny	45,699	46,330	47,111	47,908	48,832	49,761	50,688	51,621	52,563	53,495	54,429
Berks	19,988	20,259	20,546	20,796	21,109	21,422	21,735	22,041	22,353	22,669	22,981
Bucks	26,387	26,706	27,009	27,411	27,797	28,178	28,548	28,909	29,271	29,637	29,984
Butler	7,577	7,709	7,853	7,997	8,187	8,378	8,573	8,770	8,969	9,173	9,378
Chester	17,263	17,474	17,685	17,885	18,144	18,406	18,662	18,917	19,167	19,427	19,685
Delaware	26,061	26,299	26,639	26,905	27,193	27,476	27,766	28,053	28,329	28,609	28,891
Lackawanna	7,286	7,386	7,499	7,614	7,750	7,888	8,027	8,167	8,309	8,456	8,606
Lancaster	24,293	24,613	24,899	25,093	25,438	25,784	26,122	26,467	26,792	27,122	27,447
Lehigh	17,000	17,286	17,668	17,883	18,180	18,491	18,789	19,088	19,392	19,691	19,998
Luzerne	14,983	15,135	15,340	15,426	15,702	15,986	16,263	16,549	16,834	17,124	17,420
Monroe	5,125	5,206	5,293	5,366	5,443	5,520	5,597	5,675	5,751	5,827	5,901
Montgomery	31,092	31,421	31,711	32,268	32,711	33,151	33,591	34,031	34,467	34,905	35,344
Northampton	13,855	14,123	14,443	14,638	14,905	15,172	15,442	15,719	15,991	16,264	16,540
Philadelphia	86,287	86,841	87,395	88,420	89,159	89,872	90,584	91,286	91,975	92,637	93,279
Westmoreland	16,203	16,416	16,777	17,079	17,489	17,904	18,313	18,730	19,156	19,587	20,020
York	19,439	19,760	20,128	20,332	20,718	21,097	21,489	21,874	22,265	22,644	23,034

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:		
	12/19	12/20	12/21	12/22	12/24	12/26	12/28
Allegheny	45,699	46,330	47,111	47,908	49,761 (9,952) [2,389] {1,194}	51,621 (10,324) [2,478] {1,239}	53,495 (10,699) [2,568] {1,284
Berks	19,988	20,259	20,546	20,796	21,422 (4,284) [1,028] {514}	22,041 (4,408) [1,058] {529}	22,669 (4,534) [1,088] {544}
Bucks	26,387	26,706	27,009	27,411	28,178 (5,636) [1,353] {676}	28,909 (5,782) [1,388] {694}	29,637 (5,927) [1,423] {711}
Butler	7,577	7,709	7,853	7,997	8,378 (1,676) [402] {201}	8,770 (1,754) [421] {210}	9,173 (1,835) [440] {220}
Chester	17,263	17,474	17,685	17,885	18,406 (3,681) [883] {442}	18,917 (3,783) [908] {454}	19,427 (3,885) [932] {466}
Delaware	26,061	26,299	26,639	26,905	27,476 (5,495) [1,319] {659}	28,053 (5,611) [1,347] {673}	28,609 (5,722) [1,373] {687}
Lackawanna	7,286	7,386	7,499	7,614	7,888 (1,578) [379] {189}	8,167 (1,633) [392] {196}	8,456 (1,691) [406] {203}
Lancaster	24,293	24,613	24,899	25,093	25,784 (5,157) [1,238] {619}	26,467 (5,293) [1,270] {635}	27,122 (5,424) [1,302] {651}
Lehigh	17,000	17,286	17,668	17,883	18,491 (3,698) [888] {444}	19,088 (3,818) [916] {458}	19,691 (3,938) [945] {473}
Luzerne	14,983	15,135	15,340	15,426	15,986 (3,197) [767] {384}	16,549 (3,310) [794] {397}	17,124 (3,425) [822] {411}
Monroe	5,125	5,206	5,293	5,366	5,520 (1,104) [265] {132}	5,675 (1,135) [272] {136}	5,827 (1,165) [280] {140}
Montgomery	31,092	31,421	31,711	32,268	33,151 (6,630) [1,591] {796}	34,031 (6,806) [1,633] {817}	34,905 (6,981) [1,675] {838}
Northampton	13,855	14,123	14,443	14,638	15,172 (3,034) [728] {364}	15,719 (3,144) [754] {377}	16,264 (3,253) [781] {390}
Philadelphia	86,287	86,841	87,395	88,420	89,872 (17,974) [4,314] {2,157}	91,286 (18,257) [4,382] {2,191}	92,637 (18,527) [4,447] {2,223
Westmoreland	16,203	16,416	16,777	17,079	17,904 (3,581) [859] {430}	18,730 (3,746) [899] {450}	19,587 (3,917) [940] {470}
York	19,439	19,760	20,128	20,332	21,097 (4,219) [1,013] {506}	21,874 (4,375) [1,050] {525}	22,644 (4,529) [1,087] {543}

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.