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

Date: 12/15/20

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 12/15/20 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.

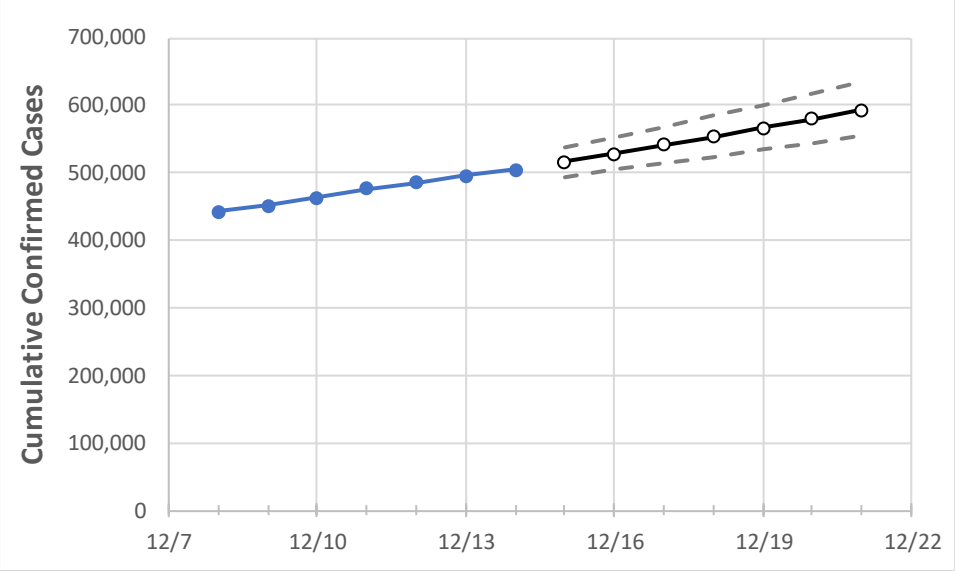
IEM's Modeling Lead

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:						
	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21
Pennsylvania	476,249	485,330	495,099	505,174	516,836	528,793	541,051	553,614	566,489	579,681	593,196

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:						
	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21
Allegheny	38,029	39,227	40,124	40,874	41,958	43,073	44,222	45,405	46,622	47,874	49,162
Berks	17,441	17,803	18,056	18,418	18,793	19,178	19,571	19,975	20,388	20,811	21,244
Bucks	23,071	23,638	24,067	24,462	25,043	25,639	26,250	26,878	27,522	28,183	28,861
Butler	6,150	6,320	6,533	6,643	6,819	7,000	7,186	7,375	7,570	7,769	7,973
Chester	15,043	15,314	15,586	15,857	16,175	16,502	16,838	17,182	17,536	17,899	18,272
Delaware	23,810	24,126	24,420	24,627	24,964	25,305	25,651	26,002	26,357	26,717	27,082
Lackawanna	6,358	6,444	6,541	6,638	6,766	6,899	7,037	7,180	7,328	7,482	7,640
Lancaster	21,192	21,563	22,075	22,290	22,726	23,169	23,618	24,073	24,534	25,002	25,476
Lehigh	14,678	14,948	15,288	15,583	15,928	16,283	16,647	17,021	17,404	17,796	18,199
Luzerne	12,478	12,640	12,984	13,259	13,546	13,840	14,140	14,447	14,761	15,081	15,408
Monroe	4,475	4,563	4,646	4,737	4,849	4,964	5,082	5,204	5,329	5,457	5,589
Montgomery	27,434	28,019	28,468	28,851	29,425	30,015	30,622	31,245	31,885	32,542	33,217
Northampton	11,908	12,151	12,446	12,672	12,986	13,309	13,643	13,987	14,342	14,707	15,084
Philadelphia	79,646	80,357	81,068	81,779	82,795	83,816	84,840	85,870	86,903	87,941	88,983
Westmoreland	13,026	13,594	13,965	14,260	14,706	15,168	15,646	16,139	16,649	17,176	17,720
York	15,879	16,344	17,077	17,522	18,124	18,758	19,427	20,131	20,873	21,654	22,476

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:		
	12/11	12/12	12/13	12/14	12/16	12/18	12/20
Allegheny	38,029	39,227	40,124	40,874	43,073 (8,615) [2,068] {1,034}	45,405 (9,081) [2,179] {1,090}	47,874 (9,575) [2,298] {1,149}
Berks	17,441	17,803	18,056	18,418	19,178 (3,836) [921] {460}	19,975 (3,995) [959] {479}	20,811 (4,162) [999] {499}
Bucks	23,071	23,638	24,067	24,462	25,639 (5,128) [1,231] {615}	26,878 (5,376) [1,290] {645}	28,183 (5,637) [1,353] {676}
Butler	6,150	6,320	6,533	6,643	7,000 (1,400) [336] {168}	7,375 (1,475) [354] {177}	7,769 (1,554) [373] {186}
Chester	15,043	15,314	15,586	15,857	16,502 (3,300) [792] {396}	17,182 (3,436) [825] {412}	17,899 (3,580) [859] {430}
Delaware	23,810	24,126	24,420	24,627	25,305 (5,061) [1,215] {607}	26,002 (5,200) [1,248] {624}	26,717 (5,343) [1,282] {641}
Lackawanna	6,358	6,444	6,541	6,638	6,899 (1,380) [331] {166}	7,180 (1,436) [345] {172}	7,482 (1,496) [359] {180}
Lancaster	21,192	21,563	22,075	22,290	23,169 (4,634) [1,112] {556}	24,073 (4,815) [1,155] {578}	25,002 (5,000) [1,200] {600}
Lehigh	14,678	14,948	15,288	15,583	16,283 (3,257) [782] {391}	17,021 (3,404) [817] {408}	17,796 (3,559) [854] {427}
Luzerne	12,478	12,640	12,984	13,259	13,840 (2,768) [664] {332}	14,447 (2,889) [693] {347}	15,081 (3,016) [724] {362}
Monroe	4,475	4,563	4,646	4,737	4,964 (993) [238] {119}	5,204 (1,041) [250] {125}	5,457 (1,091) [262] {131}
Montgomery	27,434	28,019	28,468	28,851	30,015 (6,003) [1,441] {720}	31,245 (6,249) [1,500] {750}	32,542 (6,508) [1,562] {781}
Northampton	11,908	12,151	12,446	12,672	13,309 (2,662) [639] {319}	13,987 (2,797) [671] {336}	14,707 (2,941) [706] {353}
Philadelphia	79,646	80,357	81,068	81,779	83,816 (16,763) [4,023] {2,012}	85,870 (17,174) [4,122] {2,061}	87,941 (17,588) [4,221] {2,111}
Westmoreland	13,026	13,594	13,965	14,260	15,168 (3,034) [728] {364}	16,139 (3,228) [775] {387}	17,176 (3,435) [824] {412}
York	15,879	16,344	17,077	17,522	18,758 (3,752) [900] {450}	20,131 (4,026) [966] {483}	21,654 (4,331) [1,039] {520}

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.