IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/29/21

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 3/29/21 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
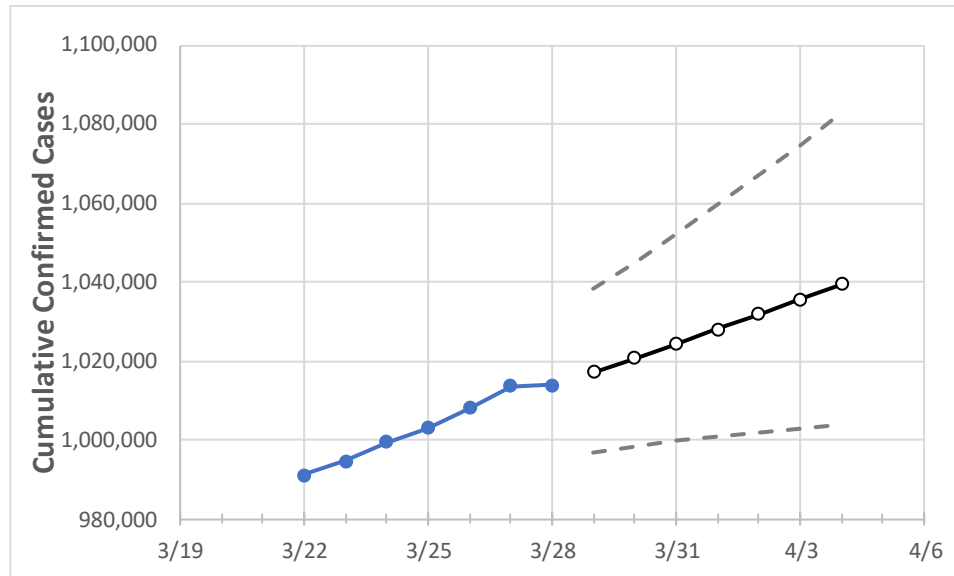
	Actual Confirmed Cases On:				Projected Cases For:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Pennsylvania	1,002,909	1,007,892	1,013,488	1,013,731	1,017,150	1,020,675	1,024,286	1,028,023	1,031,745	1,035,492	1,039,403

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

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Allegheny	83,225	83,811	84,210	84,522	84,932	85,359	85,805	86,243	86,712	87,186	87,678
Berks	38,848	39,062	39,204	39,328	39,517	39,710	39,911	40,116	40,321	40,558	40,792
Bucks	49,342	49,685	49,929	50,185	50,448	50,726	51,005	51,300	51,601	51,906	52,223
Butler	14,902	14,976	15,138	15,067	15,150	15,239	15,333	15,431	15,536	15,647	15,766
Chester	30,496	30,649	30,649	30,649	30,786	30,923	31,069	31,216	31,368	31,524	31,683
Delaware	43,647	43,859	44,040	44,208	44,370	44,537	44,707	44,884	45,065	45,251	45,449
Lackawanna	15,148	15,224	15,316	15,336	15,400	15,468	15,538	15,610	15,680	15,753	15,828
Lancaster	46,758	46,948	47,113	47,271	47,434	47,600	47,774	47,950	48,132	48,321	48,514
Lehigh	33,159	33,320	33,498	33,614	33,781	33,954	34,135	34,324	34,519	34,722	34,932
Luzerne	26,479	26,614	26,705	26,788	26,892	27,000	27,112	27,230	27,351	27,475	27,606
Monroe	10,988	11,057	11,144	11,192	11,263	11,336	11,410	11,486	11,564	11,643	11,723
Montgomery	58,282	58,534	58,804	59,046	59,297	59,551	59,813	60,077	60,349	60,624	60,909
Northampton	29,543	29,725	29,985	29,974	30,166	30,363	30,571	30,791	31,019	31,259	31,495
Philadelphia	127,137	127,770	127,770	127,770	128,406	129,069	129,744	130,447	131,195	131,972	132,794
Westmoreland	28,494	28,660	29,017	28,816	28,995	29,187	29,391	29,615	29,849	30,097	30,365
York	38,521	38,767	39,355	39,027	39,325	39,643	39,991	40,354	40,745	41,162	41,617

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:		
	3/25	3/26	3/27	3/28	3/30	4/1	4/3
Allegheny	83,225	83,811	84,210	84,522	85,359 (17,072) [4,097] {2,049}	86,243 (17,249) [4,140] {2,070}	87,186 (17,437) [4,185] {2,092}
Berks	38,848	39,062	39,204	39,328	39,710 (7,942) [1,906] {953}	40,116 (8,023) [1,926] {963}	40,558 (8,112) [1,947] {973}
Bucks	49,342	49,685	49,929	50,185	50,726 (10,145) [2,435] {1,217}	51,300 (10,260) [2,462] {1,231}	51,906 (10,381) [2,492] {1,246}
Butler	14,902	14,976	15,138	15,067	15,239 (3,048) [731] {366}	15,431 (3,086) [741] {370}	15,647 (3,129) [751] {376}
Chester	30,496	30,649	30,649	30,649	30,923 (6,185) [1,484] {742}	31,216 (6,243) [1,498] {749}	31,524 (6,305) [1,513] {757}
Delaware	43,647	43,859	44,040	44,208	44,537 (8,907) [2,138] {1,069}	44,884 (8,977) [2,154] {1,077}	45,251 (9,050) [2,172] {1,086}
Lackawanna	15,148	15,224	15,316	15,336	15,468 (3,094) [742] {371}	15,610 (3,122) [749] {375}	15,753 (3,151) [756] {378}
Lancaster	46,758	46,948	47,113	47,271	47,600 (9,520) [2,285] {1,142}	47,950 (9,590) [2,302] {1,151}	48,321 (9,664) [2,319] {1,160}
Lehigh	33,159	33,320	33,498	33,614	33,954 (6,791) [1,630] {815}	34,324 (6,865) [1,648] {824}	34,722 (6,944) [1,667] {833}
Luzerne	26,479	26,614	26,705	26,788	27,000 (5,400) [1,296] {648}	27,230 (5,446) [1,307] {654}	27,475 (5,495) [1,319] {659}
Monroe	10,988	11,057	11,144	11,192	11,336 (2,267) [544] {272}	11,486 (2,297) [551] {276}	11,643 (2,329) [559] {279}
Montgomery	58,282	58,534	58,804	59,046	59,551 (11,910) [2,858] {1,429}	60,077 (12,015) [2,884] {1,442}	60,624 (12,125) [2,910] {1,455}
Northampton	29,543	29,725	29,985	29,974	30,363 (6,073) [1,457] {729}	30,791 (6,158) [1,478] {739}	31,259 (6,252) [1,500] {750}
Philadelphia	127,137	127,770	127,770	127,770	129,069 (25,814) [6,195] {3,098}	130,447 (26,089) [6,261] {3,131}	131,972 (26,394) [6,335] {3,167}
Westmoreland	28,494	28,660	29,017	28,816	29,187 (5,837) [1,401] {700}	29,615 (5,923) [1,422] {711}	30,097 (6,019) [1,445] {722}
York	38,521	38,767	39,355	39,027	39,643 (7,929) [1,903] {951}	40,354 (8,071) [1,937] {968}	41,162 (8,232) [1,976] {988}

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.