IEM's AI Modeling: Short-term COVID-19 Projections
Date: 10/4/21

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 10/4/21 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
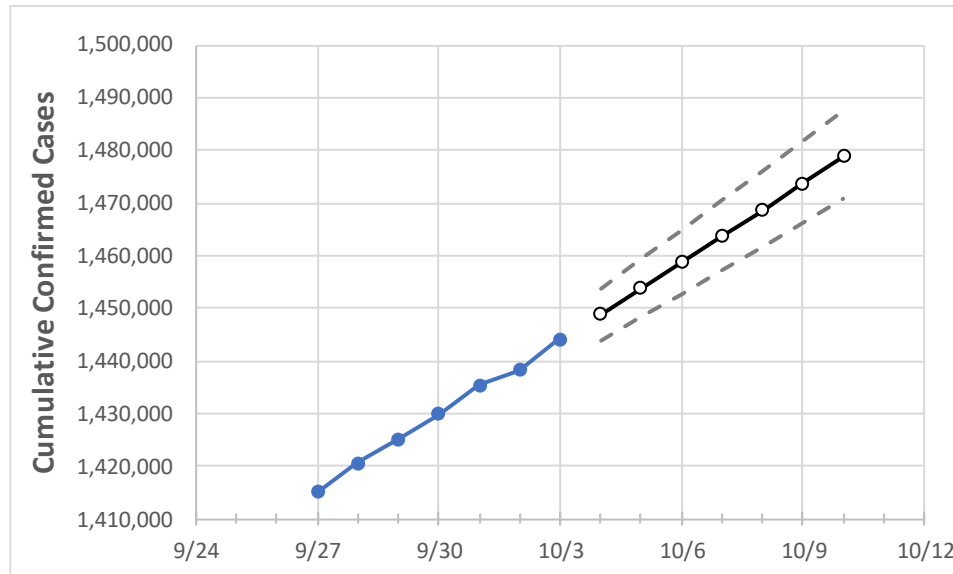
	Actual Confirmed Cases On:				Projected Cases For:						
	9/30	10/1	10/2	10/3	10/4	10/5	10/6	10/7	10/8	10/9	10/10
Pennsylvania	1,429,940	1,435,292	1,438,179	1,444,053	1,448,958	1,453,810	1,458,735	1,463,611	1,468,661	1,473,808	1,478,781

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:						
	9/30	10/1	10/2	10/3	10/4	10/5	10/6	10/7	10/8	10/9	10/10
Allegheny	120,934	121,400	121,604	122,150	122,558	122,974	123,386	123,808	124,220	124,650	125,075
Berks	54,648	54,839	54,921	55,072	55,213	55,356	55,498	55,643	55,791	55,936	56,084
Bucks	69,039	69,230	69,330	69,502	69,647	69,797	69,948	70,097	70,249	70,401	70,555
Butler	22,401	22,551	22,621	22,818	22,952	23,089	23,226	23,367	23,503	23,649	23,792
Chester	47,513	47,641	47,641	47,641	47,764	47,887	48,012	48,136	48,260	48,386	48,512
Delaware	59,157	59,323	59,376	59,477	59,579	59,680	59,779	59,882	59,980	60,085	60,185
Lackawanna	21,170	21,230	21,278	21,362	21,430	21,500	21,572	21,642	21,716	21,789	21,862
Lancaster	65,616	65,858	66,030	66,364	66,596	66,835	67,071	67,313	67,554	67,800	68,041
Lehigh	46,034	46,116	46,176	46,321	46,422	46,521	46,615	46,711	46,808	46,905	47,003
Luzerne	37,200	37,329	37,449	37,685	37,836	37,992	38,148	38,309	38,474	38,638	38,807
Monroe	18,202	18,256	18,283	18,350	18,412	18,473	18,534	18,595	18,658	18,717	18,782
Montgomery	80,719	80,896	81,012	81,195	81,357	81,517	81,675	81,837	81,994	82,157	82,316
Northampton	42,137	42,209	42,266	42,417	42,522	42,627	42,727	42,833	42,935	43,040	43,145
Philadelphia	174,478	174,860	174,860	174,860	175,184	175,518	175,847	176,166	176,511	176,866	177,207
Westmoreland	40,788	41,016	41,105	41,306	41,470	41,644	41,816	41,990	42,167	42,350	42,526
York	56,293	56,473	56,603	56,925	57,153	57,379	57,602	57,834	58,065	58,305	58,540

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:		
	9/30	10/1	10/2	10/3	10/5	10/7	10/9
Allegheny	120,934	121,400	121,604	122,150	122,974 (24,595) [5,903] {2,951}	123,808 (24,762) [5,943] {2,971}	124,650 (24,930) [5,983] {2,992}
Berks	54,648	54,839	54,921	55,072	55,356 (11,071) [2,657] {1,329}	55,643 (11,129) [2,671] {1,335}	55,936 (11,187) [2,685] {1,342}
Bucks	69,039	69,230	69,330	69,502	69,797 (13,959) [3,350] {1,675}	70,097 (14,019) [3,365] {1,682}	70,401 (14,080) [3,379] {1,690}
Butler	22,401	22,551	22,621	22,818	23,089 (4,618) [1,108] {554}	23,367 (4,673) [1,122] {561}	23,649 (4,730) [1,135] {568}
Chester	47,513	47,641	47,641	47,641	47,887 (9,577) [2,299] {1,149}	48,136 (9,627) [2,311] {1,155}	48,386 (9,677) [2,323] {1,161}
Delaware	59,157	59,323	59,376	59,477	59,680 (11,936) [2,865] {1,432}	59,882 (11,976) [2,874] {1,437}	60,085 (12,017) [2,884] {1,442}
Lackawanna	21,170	21,230	21,278	21,362	21,500 (4,300) [1,032] {516}	21,642 (4,328) [1,039] {519}	21,789 (4,358) [1,046] {523}
Lancaster	65,616	65,858	66,030	66,364	66,835 (13,367) [3,208] {1,604}	67,313 (13,463) [3,231] {1,616}	67,800 (13,560) [3,254] {1,627}
Lehigh	46,034	46,116	46,176	46,321	46,521 (9,304) [2,233] {1,116}	46,711 (9,342) [2,242] {1,121}	46,905 (9,381) [2,251] {1,126}
Luzerne	37,200	37,329	37,449	37,685	37,992 (7,598) [1,824] {912}	38,309 (7,662) [1,839] {919}	38,638 (7,728) [1,855] {927}
Monroe	18,202	18,256	18,283	18,350	18,473 (3,695) [887] {443}	18,595 (3,719) [893] {446}	18,717 (3,743) [898] {449}
Montgomery	80,719	80,896	81,012	81,195	81,517 (16,303) [3,913] {1,956}	81,837 (16,367) [3,928] {1,964}	82,157 (16,431) [3,944] {1,972}
Northampton	42,137	42,209	42,266	42,417	42,627 (8,525) [2,046] {1,023}	42,833 (8,567) [2,056] {1,028}	43,040 (8,608) [2,066] {1,033}
Philadelphia	174,478	174,860	174,860	174,860	175,518 (35,104) [8,425] {4,212}	176,166 (35,233) [8,456] {4,228}	176,866 (35,373) [8,490] {4,245}
Westmoreland	40,788	41,016	41,105	41,306	41,644 (8,329) [1,999] {999}	41,990 (8,398) [2,016] {1,008}	42,350 (8,470) [2,033] {1,016}
York	56,293	56,473	56,603	56,925	57,379 (11,476) [2,754] {1,377}	57,834 (11,567) [2,776] {1,388}	58,305 (11,661) [2,799] {1,399}

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.