IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/16/22

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 <u>not</u> 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 2/16/22 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
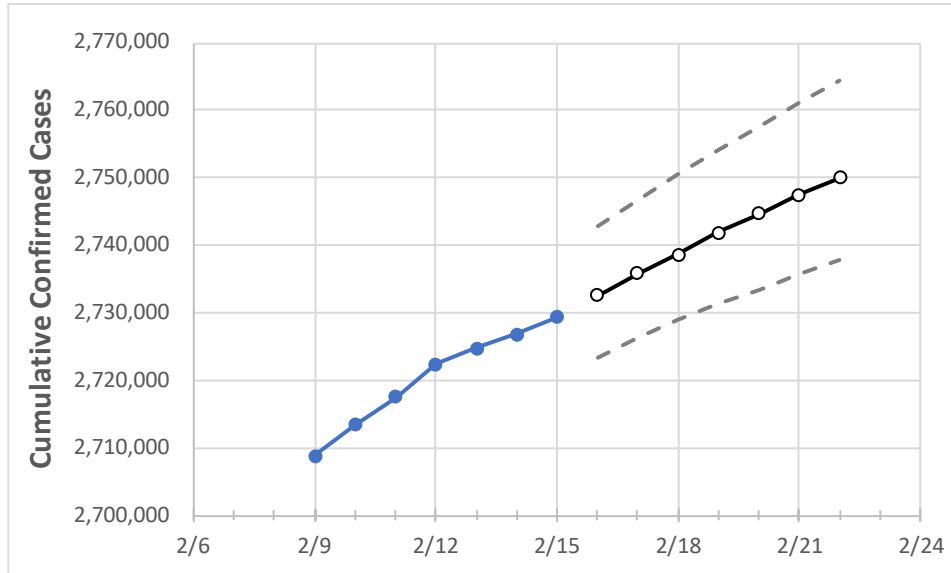
	Actual Confirmed Cases On:				Projected Cases For:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Pennsylvania	2,722,395	2,724,802	2,726,796	2,729,277	2,732,639	2,735,871	2,738,693	2,741,848	2,744,696	2,747,494	2,749,958

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:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Allegheny	257,052	257,293	257,594	257,812	258,123	258,424	258,717	258,993	259,246	259,492	259,730
Berks	100,671	100,765	100,820	100,893	100,983	101,067	101,140	101,221	101,296	101,360	101,433
Bucks	120,600	120,659	120,716	120,812	120,974	121,127	121,274	121,411	121,551	121,690	121,810
Butler	43,526	43,551	43,591	43,632	43,681	43,731	43,777	43,822	43,861	43,900	43,937
Chester	89,152	89,213	89,276	89,366	89,475	89,587	89,694	89,796	89,891	89,991	90,082
Delaware	107,890	107,946	107,988	108,048	108,165	108,278	108,385	108,489	108,596	108,692	108,793
Lackawanna	42,018	42,064	42,094	42,149	42,232	42,306	42,381	42,449	42,523	42,592	42,654
Lancaster	118,889	118,976	119,046	119,153	119,309	119,463	119,613	119,755	119,880	120,034	120,160
Lehigh	88,195	88,227	88,266	88,309	88,380	88,453	88,522	88,587	88,650	88,714	88,767
Luzerne	71,739	71,803	71,851	71,927	72,011	72,096	72,174	72,250	72,325	72,397	72,461
Monroe	36,315	36,348	36,368	36,382	36,422	36,458	36,494	36,529	36,562	36,593	36,623
Montgomery	147,932	148,017	148,141	148,270	148,471	148,662	148,836	149,005	149,175	149,340	149,512
Northampton	78,160	78,193	78,235	78,275	78,345	78,413	78,473	78,537	78,598	78,654	78,709
Philadelphia	300,817	301,219	301,283	301,381	301,610	301,843	302,055	302,261	302,464	302,666	302,819
Westmoreland	77,791	77,875	77,991	78,083	78,188	78,292	78,383	78,483	78,572	78,656	78,732
York	116,425	116,532	116,598	116,703	116,828	116,942	117,052	117,154	117,252	117,352	117,436

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: | | |
	2/12	2/13	2/14	2/15	2/17	2/19	2/21
Allegheny	257,052	257,293	257,594	257,812	258,424 (51,685) [12,404] {6,202}	258,993 (51,799) [12,432] {6,216}	259,492 (51,898) [12,456] {6,228}
Berks	100,671	100,765	100,820	100,893	101,067 (20,213) [4,851] {2,426}	101,221 (20,244) [4,859] {2,429}	101,360 (20,272) [4,865] {2,433}
Bucks	120,600	120,659	120,716	120,812	121,127 (24,225) [5,814] {2,907}	121,411 (24,282) [5,828] {2,914}	121,690 (24,338) [5,841] {2,921}
Butler	43,526	43,551	43,591	43,632	43,731 (8,746) [2,099] {1,050}	43,822 (8,764) [2,103] {1,052}	43,900 (8,780) [2,107] {1,054}
Chester	89,152	89,213	89,276	89,366	89,587 (17,917) [4,300] {2,150}	89,796 (17,959) [4,310] {2,155}	89,991 (17,998) [4,320] {2,160}
Delaware	107,890	107,946	107,988	108,048	108,278 (21,656) [5,197] {2,599}	108,489 (21,698) [5,207] {2,604}	108,692 (21,738) [5,217] {2,609}
Lackawanna	42,018	42,064	42,094	42,149	42,306 (8,461) [2,031] {1,015}	42,449 (8,490) [2,038] {1,019}	42,592 (8,518) [2,044] {1,022}
Lancaster	118,889	118,976	119,046	119,153	119,463 (23,893) [5,734] {2,867}	119,755 (23,951) [5,748] {2,874}	120,034 (24,007) [5,762] {2,881}
Lehigh	88,195	88,227	88,266	88,309	88,453 (17,691) [4,246] {2,123}	88,587 (17,717) [4,252] {2,126}	88,714 (17,743) [4,258] {2,129}
Luzerne	71,739	71,803	71,851	71,927	72,096 (14,419) [3,461] {1,730}	72,250 (14,450) [3,468] {1,734}	72,397 (14,479) [3,475] {1,738}
Monroe	36,315	36,348	36,368	36,382	36,458 (7,292) [1,750] {875}	36,529 (7,306) [1,753] {877}	36,593 (7,319) [1,756] {878}
Montgomery	147,932	148,017	148,141	148,270	148,662 (29,732) [7,136] {3,568}	149,005 (29,801) [7,152] {3,576}	149,340 (29,868) [7,168] {3,584}
Northampton	78,160	78,193	78,235	78,275	78,413 (15,683) [3,764] {1,882}	78,537 (15,707) [3,770] {1,885}	78,654 (15,731) [3,775] {1,888}
Philadelphia	300,817	301,219	301,283	301,381	301,843 (60,369) [14,488] {7,244}	302,261 (60,452) [14,509] {7,254}	302,666 (60,533) [14,528] {7,264}
Westmoreland	77,791	77,875	77,991	78,083	78,292 (15,658) [3,758] {1,879}	78,483 (15,697) [3,767] {1,884}	78,656 (15,731) [3,775] {1,888}
York	116,425	116,532	116,598	116,703	116,942 (23,388) [5,613] {2,807}	117,154 (23,431) [5,623] {2,812}	117,352 (23,470) [5,633] {2,816}

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.