IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/15/22

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 3/15/22 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
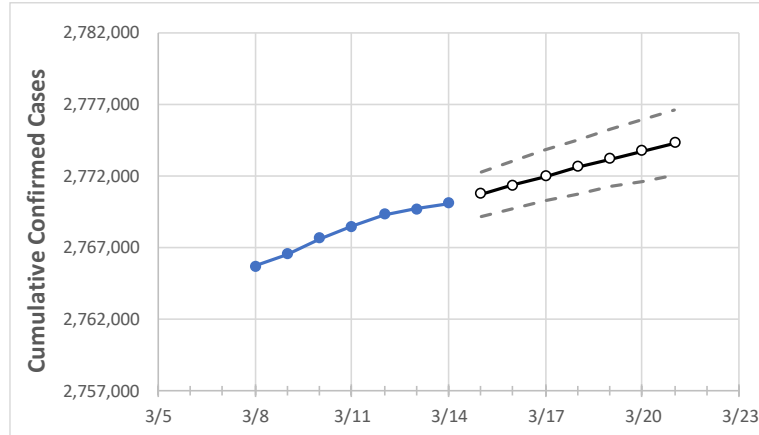
	Actual Confirmed Cases On:				Projected Cases For:						
	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21
Pennsylvania	2,768,513	2,769,336	2,769,702	2,770,077	2,770,755	2,771,382	2,772,006	2,772,639	2,773,196	2,773,777	2,774,316

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:						
	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21
Allegheny	261,882	261,957	262,010	262,042	262,111	262,173	262,236	262,297	262,353	262,410	262,464
Berks	101,839	101,857	101,863	101,871	101,888	101,904	101,919	101,933	101,947	101,962	101,975
Bucks	122,228	122,297	122,312	122,326	122,350	122,377	122,401	122,424	122,449	122,471	122,493
Butler	44,207	44,221	44,228	44,234	44,246	44,256	44,266	44,276	44,286	44,296	44,305
Chester	90,946	90,979	90,992	91,002	91,026	91,052	91,077	91,103	91,125	91,148	91,170
Delaware	109,144	109,163	109,176	109,184	109,205	109,225	109,244	109,262	109,280	109,298	109,314
Lackawanna	43,071	43,083	43,093	43,109	43,125	43,141	43,155	43,169	43,183	43,196	43,210
Lancaster	120,413	120,442	120,453	120,466	120,485	120,502	120,520	120,536	120,552	120,568	120,582
Lehigh	88,974	88,994	89,002	89,009	89,023	89,035	89,048	89,059	89,072	89,083	89,094
Luzerne	73,116	73,138	73,153	73,158	73,178	73,196	73,215	73,232	73,248	73,265	73,280
Monroe	36,731	36,738	36,744	36,746	36,751	36,757	36,761	36,766	36,771	36,775	36,780
Montgomery	150,477	150,568	150,609	150,637	150,692	150,749	150,804	150,859	150,912	150,967	151,020
Northampton	79,014	79,039	79,045	79,052	79,066	79,079	79,092	79,104	79,116	79,128	79,139
Philadelphia	306,006	306,049	306,091	306,134	306,227	306,305	306,384	306,470	306,545	306,633	306,703
Westmoreland	79,290	79,316	79,323	79,326	79,340	79,354	79,367	79,380	79,391	79,402	79,415
York	118,110	118,139	118,151	118,162	118,179	118,197	118,213	118,228	118,244	118,258	118,271

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:		
	3/11	3/12	3/13	3/14	3/16	3/18	3/20
Allegheny	261,882	261,957	262,010	262,042	262,173 (52,435) [12,584] {6,292}	262,297 (52,459) [12,590] {6,295}	262,410 (52,482) [12,596] {6,298}
Berks	101,839	101,857	101,863	101,871	101,904 (20,381) [4,891] {2,446}	101,933 (20,387) [4,893] {2,446}	101,962 (20,392) [4,894] {2,447}
Bucks	122,228	122,297	122,312	122,326	122,377 (24,475) [5,874] {2,937}	122,424 (24,485) [5,876] {2,938}	122,471 (24,494) [5,879] {2,939}
Butler	44,207	44,221	44,228	44,234	44,256 (8,851) [2,124] {1,062}	44,276 (8,855) [2,125] {1,063}	44,296 (8,859) [2,126] {1,063}
Chester	90,946	90,979	90,992	91,002	91,052 (18,210) [4,371] {2,185}	91,103 (18,221) [4,373] {2,186}	91,148 (18,230) [4,375] {2,188}
Delaware	109,144	109,163	109,176	109,184	109,225 (21,845) [5,243] {2,621}	109,262 (21,852) [5,245] {2,622}	109,298 (21,860) [5,246] {2,623}
Lackawanna	43,071	43,083	43,093	43,109	43,141 (8,628) [2,071] {1,035}	43,169 (8,634) [2,072] {1,036}	43,196 (8,639) [2,073] {1,037}
Lancaster	120,413	120,442	120,453	120,466	120,502 (24,100) [5,784] {2,892}	120,536 (24,107) [5,786] {2,893}	120,568 (24,114) [5,787] {2,894}
Lehigh	88,974	88,994	89,002	89,009	89,035 (17,807) [4,274] {2,137}	89,059 (17,812) [4,275] {2,137}	89,083 (17,817) [4,276] {2,138}
Luzerne	73,116	73,138	73,153	73,158	73,196 (14,639) [3,513] {1,757}	73,232 (14,646) [3,515] {1,758}	73,265 (14,653) [3,517] {1,758}
Monroe	36,731	36,738	36,744	36,746	36,757 (7,351) [1,764] {882}	36,766 (7,353) [1,765] {882}	36,775 (7,355) [1,765] {883}
Montgomery	150,477	150,568	150,609	150,637	150,749 (30,150) [7,236] {3,618}	150,859 (30,172) [7,241] {3,621}	150,967 (30,193) [7,246] {3,623}
Northampton	79,014	79,039	79,045	79,052	79,079 (15,816) [3,796] {1,898}	79,104 (15,821) [3,797] {1,899}	79,128 (15,826) [3,798] {1,899}
Philadelphia	306,006	306,049	306,091	306,134	306,305 (61,261) [14,703] {7,351}	306,470 (61,294) [14,711] {7,355}	306,633 (61,327) [14,718] {7,359}
Westmoreland	79,290	79,316	79,323	79,326	79,354 (15,871) [3,809] {1,904}	79,380 (15,876) [3,810] {1,905}	79,402 (15,880) [3,811] {1,906}
York	118,110	118,139	118,151	118,162	118,197 (23,639) [5,673] {2,837}	118,228 (23,646) [5,675] {2,837}	118,258 (23,652) [5,676] {2,838}

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.