IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/18/21

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 <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 2/18/21 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.

Virginia State Projections
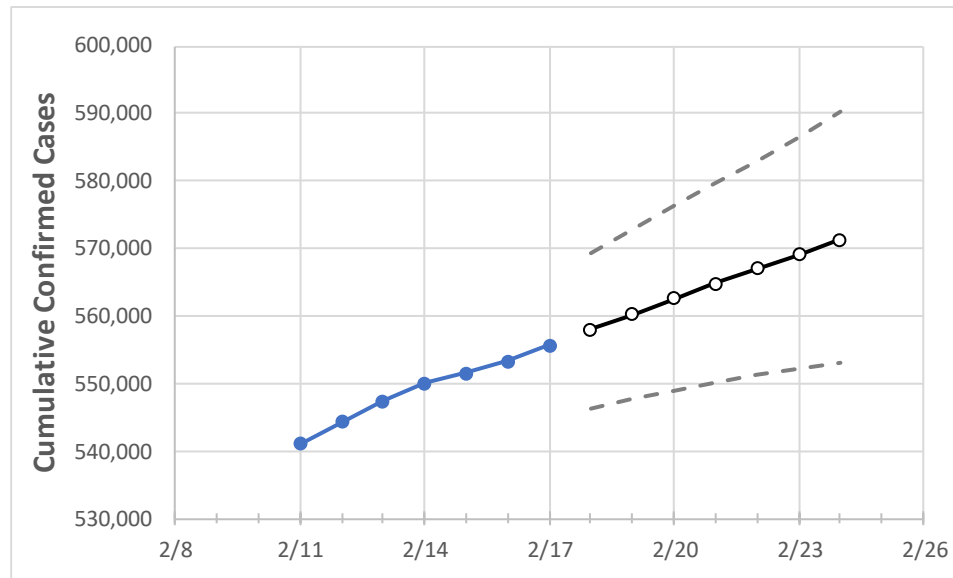
	Actual Confirmed Cases On:				Projected Cases For:						
	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24
Virginia	549,999	551,538	553,308	555,592	557,956	560,280	562,555	564,878	567,063	569,151	571,337

Note: The Commonwealth'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.

Virginia Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24
Alexandria City	10,006	10,037	10,056	10,092	10,120	10,149	10,175	10,202	10,228	10,253	10,278
Arlington	12,611	12,653	12,684	12,726	12,766	12,804	12,842	12,878	12,912	12,946	12,978
Fairfax	64,756	64,950	65,154	65,374	65,607	65,836	66,064	66,290	66,501	66,711	66,924
Henrico	20,315	20,392	20,473	20,599	20,692	20,784	20,874	20,963	21,051	21,135	21,216
James City	3,708	3,721	3,731	3,735	3,744	3,752	3,760	3,768	3,774	3,781	3,786
Loudoun	22,246	22,310	22,351	22,405	22,458	22,506	22,550	22,591	22,633	22,671	22,704
Prince William	42,997	43,104	43,237	43,365	43,502	43,636	43,766	43,893	44,013	44,130	44,239
Virginia Beach City	28,975	29,081	29,186	29,308	29,450	29,591	29,729	29,859	29,984	30,111	30,232

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.*

Virginia Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	2/14	2/15	2/16	2/17	2/19	2/21	2/23
Alexandria City	10,006	10,037	10,056	10,092	10,149 (2,030) [487] {244}	10,202 (2,040) [490] {245}	10,253 (2,051) [492] {246}
Arlington	12,611	12,653	12,684	12,726	12,804 (2,561) [615] {307}	12,878 (2,576) [618] {309}	12,946 (2,589) [621] {311}
Fairfax	64,756	64,950	65,154	65,374	65,836 (13,167) [3,160] {1,580}	66,290 (13,258) [3,182] {1,591}	66,711 (13,342) [3,202] {1,601}
Henrico	20,315	20,392	20,473	20,599	20,784 (4,157) [998] {499}	20,963 (4,193) [1,006] {503}	21,135 (4,227) [1,014] {507}
James City	3,708	3,721	3,731	3,735	3,752 (750) [180] {90}	3,768 (754) [181] {90}	3,781 (756) [181] {91}
Loudoun	22,246	22,310	22,351	22,405	22,506 (4,501) [1,080] {540}	22,591 (4,518) [1,084] {542}	22,671 (4,534) [1,088] {544}
Prince William	42,997	43,104	43,237	43,365	43,636 (8,727) [2,095] {1,047}	43,893 (8,779) [2,107] {1,053}	44,130 (8,826) [2,118] {1,059}
Virginia Beach City	28,975	29,081	29,186	29,308	29,591 (5,918) [1,420] {710}	29,859 (5,972) [1,433] {717}	30,111 (6,022) [1,445] {723}

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.