IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/16/20

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 12/16/20 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.

Maryland State Projections
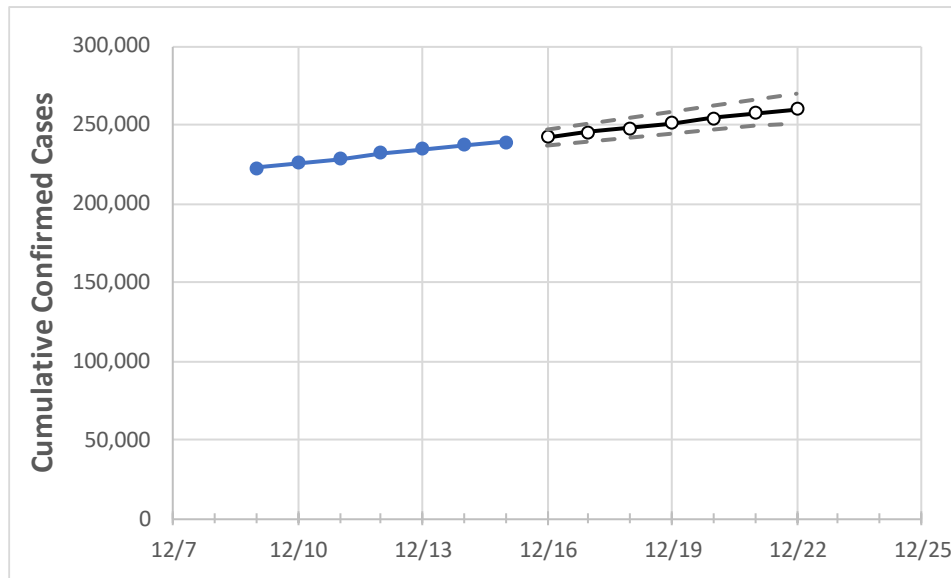
	Actual Confirmed Cases On:				Projected Cases For:						
	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22
Maryland	232,009	234,647	236,961	239,362	242,254	245,172	248,118	251,092	254,092	257,119	260,174

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 20%, and are often within 10%, of actual confirmed cases.

Maryland Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22
Anne Arundel	19,866	20,171	20,389	20,548	20,833	21,122	21,415	21,713	22,015	22,321	22,632
Baltimore City	27,796	28,046	28,270	28,407	28,662	28,918	29,174	29,430	29,686	29,943	30,199
Baltimore County	33,539	33,850	34,109	34,407	34,747	35,087	35,428	35,770	36,111	36,453	36,796
Charles	5,142	5,183	5,234	5,289	5,351	5,415	5,479	5,545	5,611	5,678	5,747
Frederick	8,687	8,820	8,966	9,081	9,242	9,407	9,575	9,747	9,923	10,103	10,286
Harford	7,096	7,192	7,256	7,357	7,436	7,514	7,592	7,671	7,748	7,826	7,903
Howard	9,536	9,633	9,711	9,783	9,897	10,012	10,127	10,244	10,362	10,481	10,600
Montgomery	39,316	39,721	40,062	40,500	41,007	41,524	42,050	42,585	43,130	43,685	44,250
Prince George's	47,288	47,682	48,232	48,718	49,241	49,773	50,314	50,863	51,420	51,987	52,562

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.*

Maryland Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	12/12	12/13	12/14	12/15	12/17	12/19	12/21
Anne Arundel	19,866	20,171	20,389	20,548	21,122 (4,224) [1,014] {507}	21,713 (4,343) [1,042] {521}	22,321 (4,464) [1,071] {536}
Baltimore City	27,796	28,046	28,270	28,407	28,918 (5,784) [1,388] {694}	29,430 (5,886) [1,413] {706}	29,943 (5,989) [1,437] {719}
Baltimore County	33,539	33,850	34,109	34,407	35,087 (7,017) [1,684] {842}	35,770 (7,154) [1,717] {858}	36,453 (7,291) [1,750] {875}
Charles	5,142	5,183	5,234	5,289	5,415 (1,083) [260] {130}	5,545 (1,109) [266] {133}	5,678 (1,136) [273] {136}
Frederick	8,687	8,820	8,966	9,081	9,407 (1,881) [452] {226}	9,747 (1,949) [468] {234}	10,103 (2,021) [485] {242}
Harford	7,096	7,192	7,256	7,357	7,514 (1,503) [361] {180}	7,671 (1,534) [368] {184}	7,826 (1,565) [376] {188}
Howard	9,536	9,633	9,711	9,783	10,012 (2,002) [481] {240}	10,244 (2,049) [492] {246}	10,481 (2,096) [503] {252}
Montgomery	39,316	39,721	40,062	40,500	41,524 (8,305) [1,993] {997}	42,585 (8,517) [2,044] {1,022}	43,685 (8,737) [2,097] {1,048}
Prince George's	47,288	47,682	48,232	48,718	49,773 (9,955) [2,389] {1,195}	50,863 (10,173) [2,441] {1,221}	51,987 (10,397) [2,495] {1,248}

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.