IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/15/21

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 4/15/21 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.

Maryland State Projections
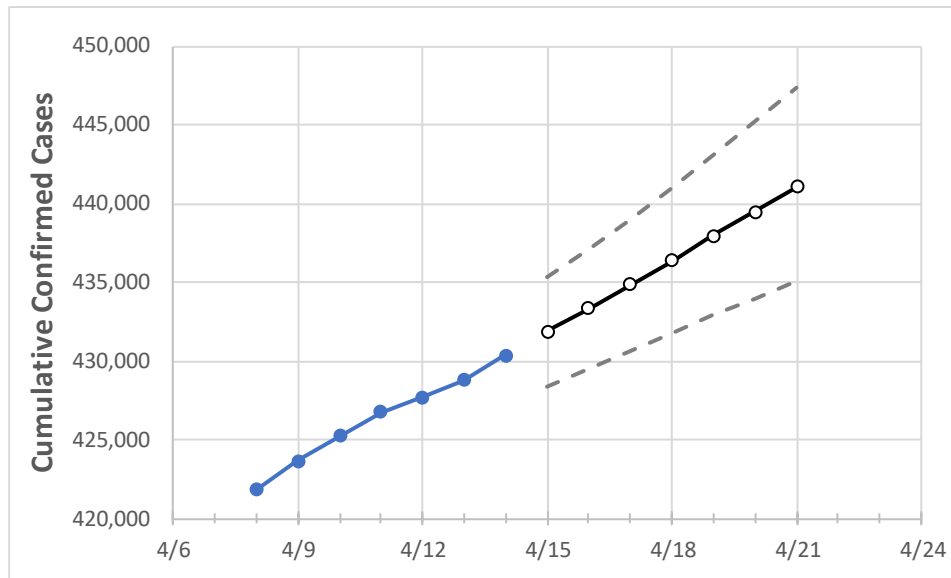
	Actual Confirmed Cases On:				Projected Cases For:						
	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
Maryland	426,730	427,715	428,799	430,351	431,859	433,340	434,869	436,386	437,927	439,478	441,051

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.

Maryland Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
Anne Arundel	40,427	40,489	40,587	40,740	40,870	41,003	41,135	41,271	41,410	41,546	41,683
Baltimore City	47,368	47,579	47,749	48,045	48,326	48,615	48,906	49,202	49,505	49,818	50,130
Baltimore County	58,992	59,201	59,421	59,751	60,069	60,395	60,726	61,063	61,413	61,769	62,120
Charles	10,094	10,125	10,150	10,150	10,180	10,209	10,239	10,269	10,299	10,329	10,358
Frederick	18,791	18,847	18,903	18,903	18,959	19,015	19,070	19,127	19,184	19,242	19,300
Harford	15,044	15,107	15,138	15,225	15,315	15,403	15,495	15,590	15,685	15,782	15,877
Howard	17,933	17,967	18,059	18,156	18,227	18,299	18,372	18,447	18,523	18,603	18,685
Montgomery	68,144	68,260	68,377	68,377	68,496	68,614	68,732	68,851	68,971	69,089	69,207
Prince George's	80,228	80,370	80,598	80,598	80,788	80,971	81,158	81,347	81,543	81,737	81,928

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:		
	4/11	4/12	4/13	4/14	4/16	4/18	4/20
Anne Arundel	40,427	40,489	40,587	40,740	41,003 (8,201) [1,968] {984}	41,271 (8,254) [1,981] {991}	41,546 (8,309) [1,994] {997}
Baltimore City	47,368	47,579	47,749	48,045	48,615 (9,723) [2,334] {1,167}	49,202 (9,840) [2,362] {1,181}	49,818 (9,964) [2,391] {1,196}
Baltimore County	58,992	59,201	59,421	59,751	60,395 (12,079) [2,899] {1,449}	61,063 (12,213) [2,931] {1,466}	61,769 (12,354) [2,965] {1,482}
Charles	10,094	10,125	10,150	10,150	10,209 (2,042) [490] {245}	10,269 (2,054) [493] {246}	10,329 (2,066) [496] {248}
Frederick	18,791	18,847	18,903	18,903	19,015 (3,803) [913] {456}	19,127 (3,825) [918] {459}	19,242 (3,848) [924] {462}
Harford	15,044	15,107	15,138	15,225	15,403 (3,081) [739] {370}	15,590 (3,118) [748] {374}	15,782 (3,156) [758] {379}
Howard	17,933	17,967	18,059	18,156	18,299 (3,660) [878] {439}	18,447 (3,689) [885] {443}	18,603 (3,721) [893] {446}
Montgomery	68,144	68,260	68,377	68,377	68,614 (13,723) [3,293] {1,647}	68,851 (13,770) [3,305] {1,652}	69,089 (13,818) [3,316] {1,658}
Prince George's	80,228	80,370	80,598	80,598	80,971 (16,194) [3,887] {1,943}	81,347 (16,269) [3,905] {1,952}	81,737 (16,347) [3,923] {1,962}

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.