IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/6/21

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 4/6/21 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
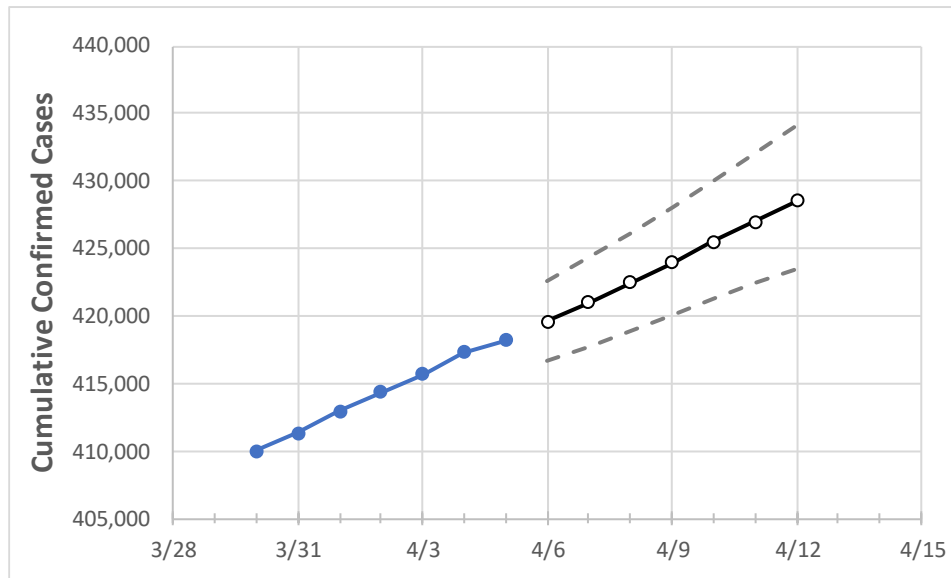
	Actual Confirmed Cases On:				Projected Cases For:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Maryland	414,385	415,660	417,329	418,188	419,592	421,010	422,464	423,958	425,482	427,019	428,556

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:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Anne Arundel	39,217	39,345	39,483	39,578	39,719	39,862	40,006	40,152	40,296	40,446	40,597
Baltimore City	45,097	45,318	45,660	45,825	46,095	46,374	46,664	46,959	47,264	47,579	47,907
Baltimore County	56,503	56,735	57,083	57,222	57,504	57,795	58,092	58,393	58,709	59,040	59,381
Charles	9,826	9,872	9,895	9,895	9,928	9,962	9,995	10,029	10,062	10,097	10,131
Frederick	18,347	18,384	18,425	18,425	18,477	18,529	18,581	18,636	18,689	18,743	18,800
Harford	14,259	14,330	14,437	14,490	14,589	14,690	14,793	14,899	15,010	15,126	15,243
Howard	17,405	17,470	17,567	17,605	17,672	17,740	17,809	17,881	17,955	18,030	18,108
Montgomery	67,061	67,212	67,303	67,303	67,428	67,553	67,681	67,810	67,938	68,068	68,195
Prince George's	78,633	78,840	78,948	78,948	79,144	79,340	79,532	79,723	79,918	80,115	80,314

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:		
	4/2	4/3	4/4	4/5	4/7	4/9	4/11
Anne Arundel	39,217	39,345	39,483	39,578	39,862 (7,972) [1,913] {957}	40,152 (8,030) [1,927] {964}	40,446 (8,089) [1,941] {971}
Baltimore City	45,097	45,318	45,660	45,825	46,374 (9,275) [2,226] {1,113}	46,959 (9,392) [2,254] {1,127}	47,579 (9,516) [2,284] {1,142}
Baltimore County	56,503	56,735	57,083	57,222	57,795 (11,559) [2,774] {1,387}	58,393 (11,679) [2,803] {1,401}	59,040 (11,808) [2,834] {1,417}
Charles	9,826	9,872	9,895	9,895	9,962 (1,992) [478] {239}	10,029 (2,006) [481] {241}	10,097 (2,019) [485] {242}
Frederick	18,347	18,384	18,425	18,425	18,529 (3,706) [889] {445}	18,636 (3,727) [895] {447}	18,743 (3,749) [900] {450}
Harford	14,259	14,330	14,437	14,490	14,690 (2,938) [705] {353}	14,899 (2,980) [715] {358}	15,126 (3,025) [726] {363}
Howard	17,405	17,470	17,567	17,605	17,740 (3,548) [852] {426}	17,881 (3,576) [858] {429}	18,030 (3,606) [865] {433}
Montgomery	67,061	67,212	67,303	67,303	67,553 (13,511) [3,243] {1,621}	67,810 (13,562) [3,255] {1,627}	68,068 (13,614) [3,267] {1,634}
Prince George's	78,633	78,840	78,948	78,948	79,340 (15,868) [3,808] {1,904}	79,723 (15,945) [3,827] {1,913}	80,115 (16,023) [3,845] {1,923}

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.