IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/10/21

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 3/10/21 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
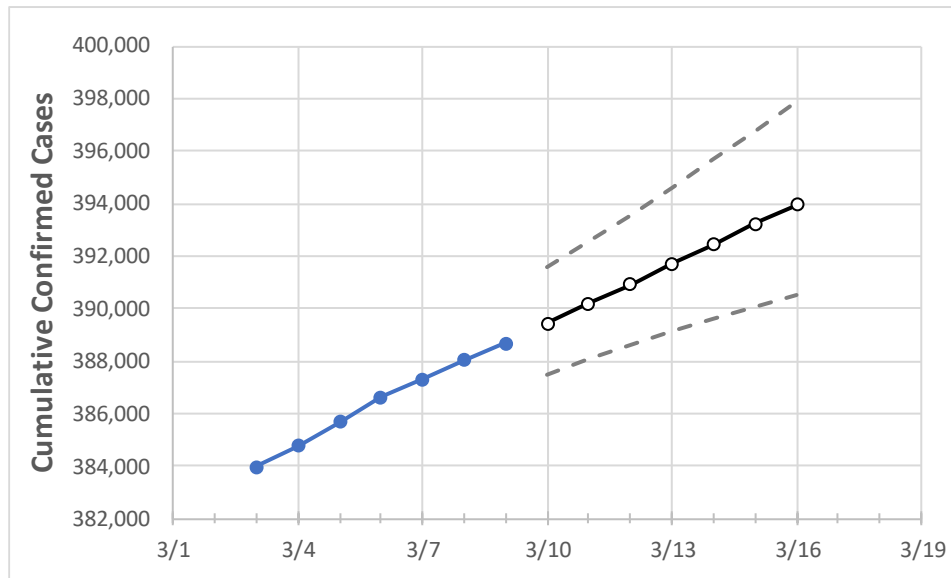
	Actual Confirmed Cases On:				Projected Cases For:						
	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16
Maryland	386,610	387,319	388,035	388,666	389,424	390,184	390,930	391,698	392,450	393,214	393,969

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:						
	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16
Anne Arundel	36,241	36,331	36,385	36,440	36,524	36,606	36,689	36,770	36,852	36,932	37,012
Baltimore City	40,817	40,892	41,000	41,047	41,125	41,204	41,283	41,363	41,443	41,526	41,605
Baltimore County	51,639	51,730	51,862	51,966	52,094	52,225	52,354	52,489	52,624	52,758	52,895
Charles	9,074	9,104	9,116	9,132	9,154	9,176	9,198	9,219	9,240	9,262	9,283
Frederick	17,196	17,219	17,247	17,282	17,315	17,347	17,378	17,409	17,441	17,471	17,502
Harford	12,679	12,700	12,750	12,771	12,801	12,831	12,861	12,890	12,918	12,947	12,975
Howard	16,057	16,088	16,114	16,202	16,250	16,297	16,347	16,399	16,451	16,506	16,560
Montgomery	63,987	64,081	64,166	64,273	64,361	64,448	64,532	64,614	64,695	64,772	64,849
Prince George's	74,327	74,452	74,571	74,704	74,838	74,967	75,098	75,225	75,351	75,476	75,599

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:		
	3/6	3/7	3/8	3/9	3/11	3/13	3/15
Anne Arundel	36,241	36,331	36,385	36,440	36,606 (7,321) [1,757] {879}	36,770 (7,354) [1,765] {882}	36,932 (7,386) [1,773] {886}
Baltimore City	40,817	40,892	41,000	41,047	41,204 (8,241) [1,978] {989}	41,363 (8,273) [1,985] {993}	41,526 (8,305) [1,993] {997}
Baltimore County	51,639	51,730	51,862	51,966	52,225 (10,445) [2,507] {1,253}	52,489 (10,498) [2,519] {1,260}	52,758 (10,552) [2,532] {1,266}
Charles	9,074	9,104	9,116	9,132	9,176 (1,835) [440] {220}	9,219 (1,844) [443] {221}	9,262 (1,852) [445] {222}
Frederick	17,196	17,219	17,247	17,282	17,347 (3,469) [833] {416}	17,409 (3,482) [836] {418}	17,471 (3,494) [839] {419}
Harford	12,679	12,700	12,750	12,771	12,831 (2,566) [616] {308}	12,890 (2,578) [619] {309}	12,947 (2,589) [621] {311}
Howard	16,057	16,088	16,114	16,202	16,297 (3,259) [782] {391}	16,399 (3,280) [787] {394}	16,506 (3,301) [792] {396}
Montgomery	63,987	64,081	64,166	64,273	64,448 (12,890) [3,093] {1,547}	64,614 (12,923) [3,101] {1,551}	64,772 (12,954) [3,109] {1,555}
Prince George's	74,327	74,452	74,571	74,704	74,967 (14,993) [3,598] {1,799}	75,225 (15,045) [3,611] {1,805}	75,476 (15,095) [3,623] {1,811}

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.