IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/14/22

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 1/14/22 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
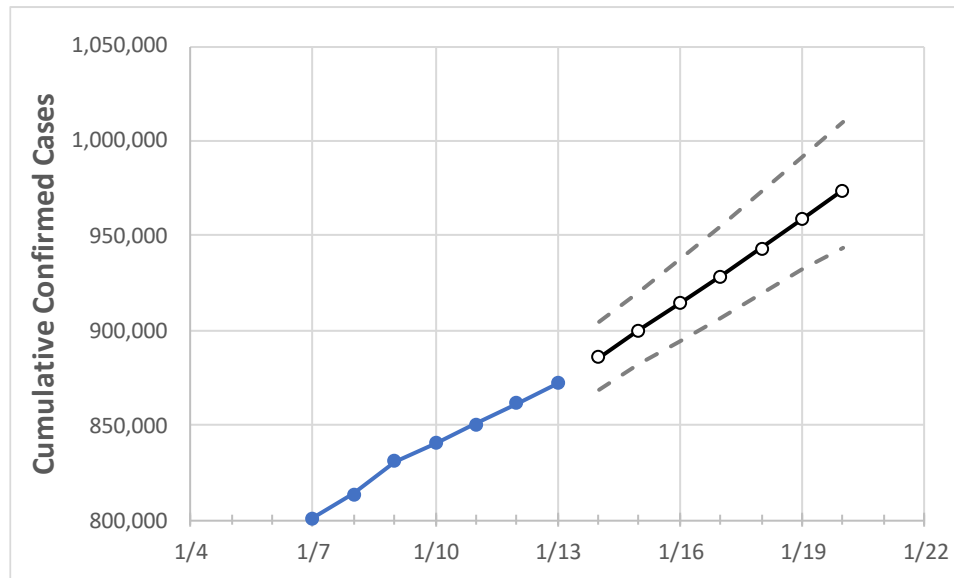
	Actual Confirmed Cases On:				Projected Cases For:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Maryland	840,623	850,316	861,349	871,936	885,916	899,827	914,452	928,654	943,349	958,522	973,729

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Anne Arundel	75,426	76,128	76,851	77,658	78,614	79,585	80,556	81,528	82,506	83,520	84,538
Baltimore City	94,716	95,391	96,349	97,434	98,725	100,031	101,330	102,658	103,976	105,341	106,640
Baltimore County	113,088	114,099	115,317	116,464	118,540	120,648	122,729	124,918	127,155	129,471	131,780
Charles	22,858	23,238	23,559	23,815	24,171	24,519	24,867	25,226	25,584	25,953	26,312
Frederick	37,451	38,319	38,842	39,217	39,880	40,532	41,201	41,891	42,588	43,319	44,029
Harford	31,715	32,159	32,529	32,936	33,504	34,073	34,646	35,256	35,889	36,561	37,197
Howard	35,372	35,850	36,370	36,775	37,357	37,941	38,523	39,135	39,717	40,347	40,956
Montgomery	136,368	138,825	141,272	143,107	146,435	149,887	153,284	156,783	160,485	164,168	168,052
Prince George's	148,509	150,072	151,654	153,045	154,920	156,798	158,613	160,490	162,355	164,233	166,085

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:		
	1/10	1/11	1/12	1/13	1/15	1/17	1/19
Anne Arundel	75,426	76,128	76,851	77,658	79,585 (15,917) [3,820] {1,910}	81,528 (16,306) [3,913] {1,957}	83,520 (16,704) [4,009] {2,004}
Baltimore City	94,716	95,391	96,349	97,434	100,031 (20,006) [4,801] {2,401}	102,658 (20,532) [4,928] {2,464}	105,341 (21,068) [5,056] {2,528}
Baltimore County	113,088	114,099	115,317	116,464	120,648 (24,130) [5,791] {2,896}	124,918 (24,984) [5,996] {2,998}	129,471 (25,894) [6,215] {3,107}
Charles	22,858	23,238	23,559	23,815	24,519 (4,904) [1,177] {588}	25,226 (5,045) [1,211] {605}	25,953 (5,191) [1,246] {623}
Frederick	37,451	38,319	38,842	39,217	40,532 (8,106) [1,946] {973}	41,891 (8,378) [2,011] {1,005}	43,319 (8,664) [2,079] {1,040}
Harford	31,715	32,159	32,529	32,936	34,073 (6,815) [1,635] {818}	35,256 (7,051) [1,692] {846}	36,561 (7,312) [1,755] {877}
Howard	35,372	35,850	36,370	36,775	37,941 (7,588) [1,821] {911}	39,135 (7,827) [1,878] {939}	40,347 (8,069) [1,937] {968}
Montgomery	136,368	138,825	141,272	143,107	149,887 (29,977) [7,195] {3,597}	156,783 (31,357) [7,526] {3,763}	164,168 (32,834) [7,880] {3,940}
Prince George's	148,509	150,072	151,654	153,045	156,798 (31,360) [7,526] {3,763}	160,490 (32,098) [7,704] {3,852}	164,233 (32,847) [7,883] {3,942}

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.