IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/29/20

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 12/29/20 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
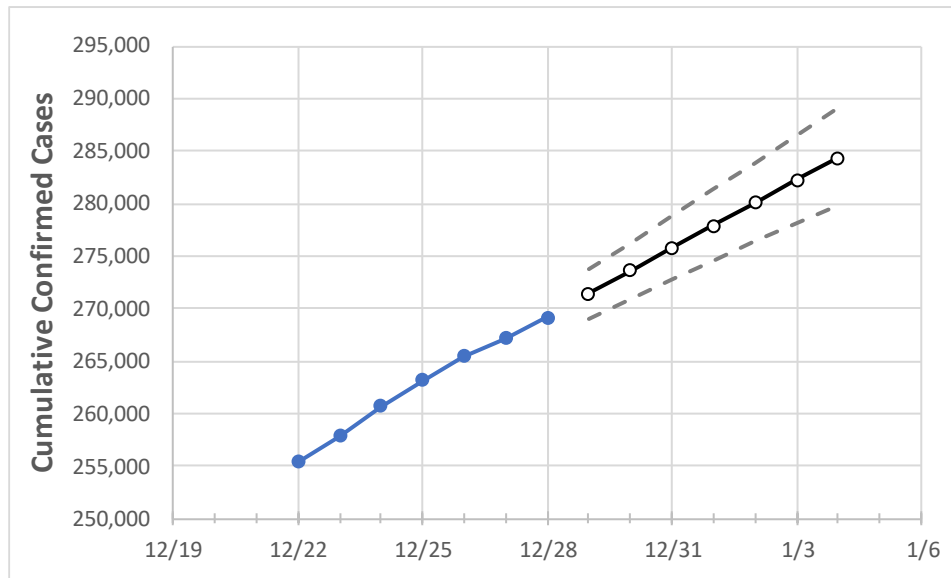
	Actual Confirmed Cases On:				Projected Cases For:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Maryland	263,160	265,440	267,198	269,183	271,394	273,580	275,768	277,901	280,061	282,222	284,361

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:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Anne Arundel	22,981	23,253	23,408	23,634	23,869	24,111	24,353	24,584	24,822	25,066	25,301
Baltimore City	30,440	30,612	30,777	30,989	31,176	31,370	31,554	31,741	31,922	32,103	32,287
Baltimore County	37,098	37,356	37,549	37,799	38,028	38,254	38,478	38,699	38,918	39,133	39,341
Charles	5,809	5,853	5,892	5,922	5,967	6,011	6,056	6,100	6,145	6,187	6,230
Frederick	10,575	10,670	10,788	10,891	11,035	11,180	11,323	11,469	11,612	11,755	11,900
Harford	8,112	8,194	8,253	8,323	8,391	8,459	8,525	8,589	8,654	8,718	8,781
Howard	10,719	10,769	10,822	10,898	10,981	11,063	11,146	11,229	11,311	11,391	11,473
Montgomery	44,287	44,640	45,050	45,341	45,719	46,097	46,472	46,849	47,219	47,587	47,957
Prince George's	52,767	53,043	53,338	53,692	54,026	54,352	54,666	54,981	55,287	55,591	55,882

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:		
	12/25	12/26	12/27	12/28	12/30	1/1	1/3
Anne Arundel	22,981	23,253	23,408	23,634	24,111 (4,822) [1,157] {579}	24,584 (4,917) [1,180] {590}	25,066 (5,013) [1,203] {602}
Baltimore City	30,440	30,612	30,777	30,989	31,370 (6,274) [1,506] {753}	31,741 (6,348) [1,524] {762}	32,103 (6,421) [1,541] {770}
Baltimore County	37,098	37,356	37,549	37,799	38,254 (7,651) [1,836] {918}	38,699 (7,740) [1,858] {929}	39,133 (7,827) [1,878] {939}
Charles	5,809	5,853	5,892	5,922	6,011 (1,202) [289] {144}	6,100 (1,220) [293] {146}	6,187 (1,237) [297] {148}
Frederick	10,575	10,670	10,788	10,891	11,180 (2,236) [537] {268}	11,469 (2,294) [551] {275}	11,755 (2,351) [564] {282}
Harford	8,112	8,194	8,253	8,323	8,459 (1,692) [406] {203}	8,589 (1,718) [412] {206}	8,718 (1,744) [418] {209}
Howard	10,719	10,769	10,822	10,898	11,063 (2,213) [531] {266}	11,229 (2,246) [539] {269}	11,391 (2,278) [547] {273}
Montgomery	44,287	44,640	45,050	45,341	46,097 (9,219) [2,213] {1,106}	46,849 (9,370) [2,249] {1,124}	47,587 (9,517) [2,284] {1,142}
Prince George's	52,767	53,043	53,338	53,692	54,352 (10,870) [2,609] {1,304}	54,981 (10,996) [2,639] {1,320}	55,591 (11,118) [2,668] {1,334}

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.