IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/21/20

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 12/21/20 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.

North Carolina State Projections
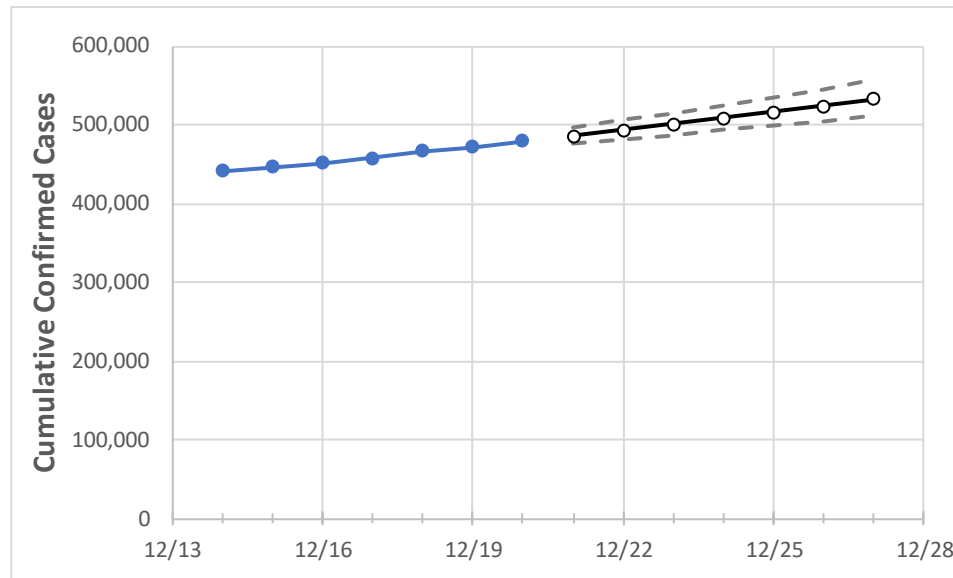
	Actual Confirmed Cases On:				Projected Cases For:						
	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27
North Carolina	457,660	466,104	472,268	479,168	486,248	493,489	500,892	508,461	516,199	524,108	532,192

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.

North Carolina Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27
Cumberland	11,782	12,050	12,308	12,509	12,739	12,981	13,233	13,497	13,773	14,062	14,364
Durham	13,162	13,323	13,441	13,543	13,685	13,832	13,982	14,136	14,294	14,457	14,624
Guilford	21,086	21,420	21,642	22,002	22,302	22,607	22,916	23,229	23,547	23,869	24,195
Mecklenburg	53,526	54,463	55,175	55,944	56,697	57,468	58,257	59,065	59,891	60,737	61,603
Orange	4,528	4,593	4,604	4,660	4,699	4,738	4,777	4,817	4,857	4,898	4,939
Union	10,201	10,401	10,541	10,711	10,882	11,056	11,233	11,415	11,600	11,789	11,982
Wake	36,338	37,328	37,903	38,605	39,203	39,819	40,452	41,103	41,772	42,460	43,166

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.*

North Carolina Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	12/17	12/18	12/19	12/20	12/22	12/24	12/26
Cumberland	11,782	12,050	12,308	12,509	12,981 (2,596) [623] {312}	13,497 (2,699) [648] {324}	14,062 (2,812) [675] {337}
Durham	13,162	13,323	13,441	13,543	13,832 (2,766) [664] {332}	14,136 (2,827) [679] {339}	14,457 (2,891) [694] {347}
Guilford	21,086	21,420	21,642	22,002	22,607 (4,521) [1,085] {543}	23,229 (4,646) [1,115] {558}	23,869 (4,774) [1,146] {573}
Mecklenburg	53,526	54,463	55,175	55,944	57,468 (11,494) [2,758] {1,379}	59,065 (11,813) [2,835] {1,418}	60,737 (12,147) [2,915] {1,458}
Orange	4,528	4,593	4,604	4,660	4,738 (948) [227] {114}	4,817 (963) [231] {116}	4,898 (980) [235] {118}
Union	10,201	10,401	10,541	10,711	11,056 (2,211) [531] {265}	11,415 (2,283) [548] {274}	11,789 (2,358) [566] {283}
Wake	36,338	37,328	37,903	38,605	39,819 (7,964) [1,911] {956}	41,103 (8,221) [1,973] {986}	42,460 (8,492) [2,038] {1,019}

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.