IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/9/21

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 6/9/21 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.

North Carolina State Projections
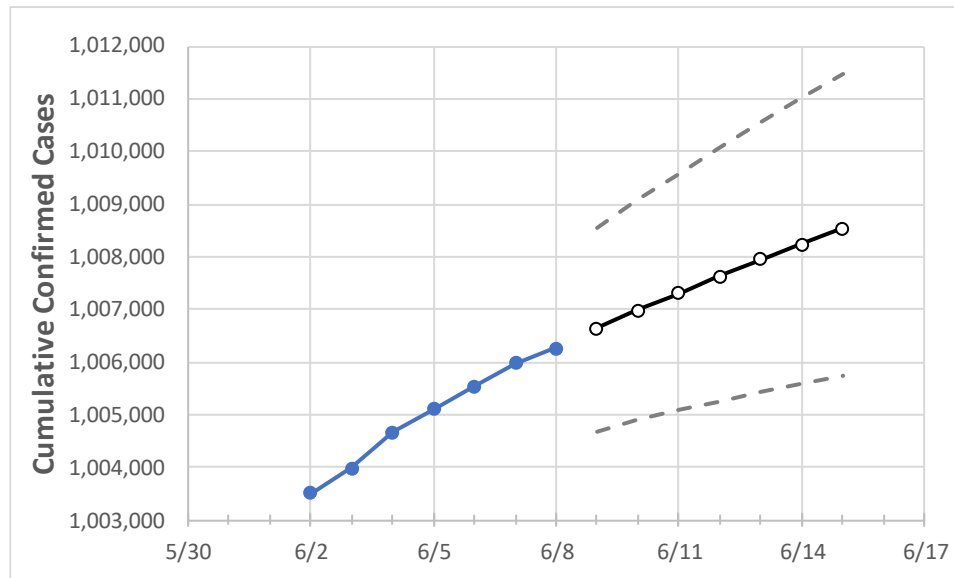
	Actual Confirmed Cases On:				Projected Cases For:						
	6/5	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15
North Carolina	1,005,101	1,005,534	1,005,966	1,006,265	1,006,631	1,006,979	1,007,312	1,007,635	1,007,942	1,008,237	1,008,533

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.

North Carolina Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	6/5	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15
Cumberland	29,792	29,827	29,863	29,874	29,896	29,918	29,940	29,961	29,981	30,001	30,020
Durham	25,596	25,605	25,613	25,616	25,622	25,628	25,633	25,638	25,643	25,647	25,652
Guilford	48,371	48,382	48,393	48,397	48,412	48,426	48,440	48,453	48,466	48,477	48,488
Mecklenburg	113,667	113,712	113,758	113,775	113,812	113,847	113,881	113,913	113,943	113,975	114,004
Orange	8,572	8,574	8,576	8,578	8,579	8,581	8,582	8,583	8,584	8,585	8,587
Union	24,720	24,728	24,736	24,740	24,745	24,749	24,753	24,756	24,760	24,763	24,766
Wake	89,045	89,068	89,091	89,115	89,142	89,167	89,191	89,214	89,235	89,254	89,272

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:		
	6/5	6/6	6/7	6/8	6/10	6/12	6/14
Cumberland	29,792	29,827	29,863	29,874	29,918 (5,984) [1,436] {718}	29,961 (5,992) [1,438] {719}	30,001 (6,000) [1,440] {720}
Durham	25,596	25,605	25,613	25,616	25,628 (5,126) [1,230] {615}	25,638 (5,128) [1,231] {615}	25,647 (5,129) [1,231] {616}
Guilford	48,371	48,382	48,393	48,397	48,426 (9,685) [2,324] {1,162}	48,453 (9,691) [2,326] {1,163}	48,477 (9,695) [2,327] {1,163}
Mecklenburg	113,667	113,712	113,758	113,775	113,847 (22,769) [5,465] {2,732}	113,913 (22,783) [5,468] {2,734}	113,975 (22,795) [5,471] {2,735}
Orange	8,572	8,574	8,576	8,578	8,581 (1,716) [412] {206}	8,583 (1,717) [412] {206}	8,585 (1,717) [412] {206}
Union	24,720	24,728	24,736	24,740	24,749 (4,950) [1,188] {594}	24,756 (4,951) [1,188] {594}	24,763 (4,953) [1,189] {594}
Wake	89,045	89,068	89,091	89,115	89,167 (17,833) [4,280] {2,140}	89,214 (17,843) [4,282] {2,141}	89,254 (17,851) [4,284] {2,142}

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.