IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/16/21

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 4/16/21 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
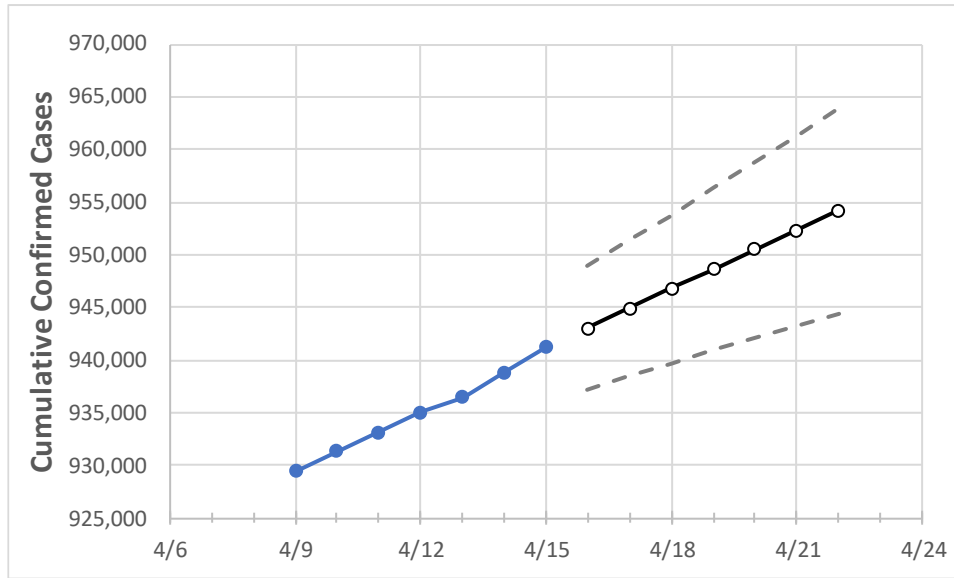
	Actual Confirmed Cases On:				Projected Cases For:						
	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22
North Carolina	935,061	936,425	938,784	941,218	943,045	944,908	946,764	948,618	950,489	952,335	954,216

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:						
	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22
Cumberland	26,532	26,580	26,650	26,744	26,804	26,865	26,927	26,989	27,052	27,115	27,176
Durham	23,802	23,835	23,910	23,971	24,022	24,074	24,125	24,176	24,227	24,278	24,330
Guilford	44,402	44,520	44,634	44,792	44,929	45,071	45,214	45,363	45,512	45,664	45,820
Mecklenburg	105,654	105,809	106,108	106,380	106,638	106,901	107,160	107,417	107,680	107,942	108,213
Orange	8,237	8,252	8,264	8,285	8,300	8,315	8,330	8,345	8,361	8,376	8,393
Union	22,916	22,974	23,073	23,147	23,198	23,251	23,305	23,358	23,412	23,467	23,524
Wake	82,833	82,949	83,239	83,518	83,716	83,913	84,106	84,308	84,510	84,711	84,920

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:		
	4/12	4/13	4/14	4/15	4/17	4/19	4/21
Cumberland	26,532	26,580	26,650	26,744	26,865 (5,373) [1,290] {645}	26,989 (5,398) [1,295] {648}	27,115 (5,423) [1,302] {651}
Durham	23,802	23,835	23,910	23,971	24,074 (4,815) [1,156] {578}	24,176 (4,835) [1,160] {580}	24,278 (4,856) [1,165] {583}
Guilford	44,402	44,520	44,634	44,792	45,071 (9,014) [2,163] {1,082}	45,363 (9,073) [2,177] {1,089}	45,664 (9,133) [2,192] {1,096}
Mecklenburg	105,654	105,809	106,108	106,380	106,901 (21,380) [5,131] {2,566}	107,417 (21,483) [5,156] {2,578}	107,942 (21,588) [5,181] {2,591}
Orange	8,237	8,252	8,264	8,285	8,315 (1,663) [399] {200}	8,345 (1,669) [401] {200}	8,376 (1,675) [402] {201}
Union	22,916	22,974	23,073	23,147	23,251 (4,650) [1,116] {558}	23,358 (4,672) [1,121] {561}	23,467 (4,693) [1,126] {563}
Wake	82,833	82,949	83,239	83,518	83,913 (16,783) [4,028] {2,014}	84,308 (16,862) [4,047] {2,023}	84,711 (16,942) [4,066] {2,033}

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.