IEM's AI Modeling: Short-term COVID-19 Projections

Date: 4/21/21

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 not 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 4/21/21 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.

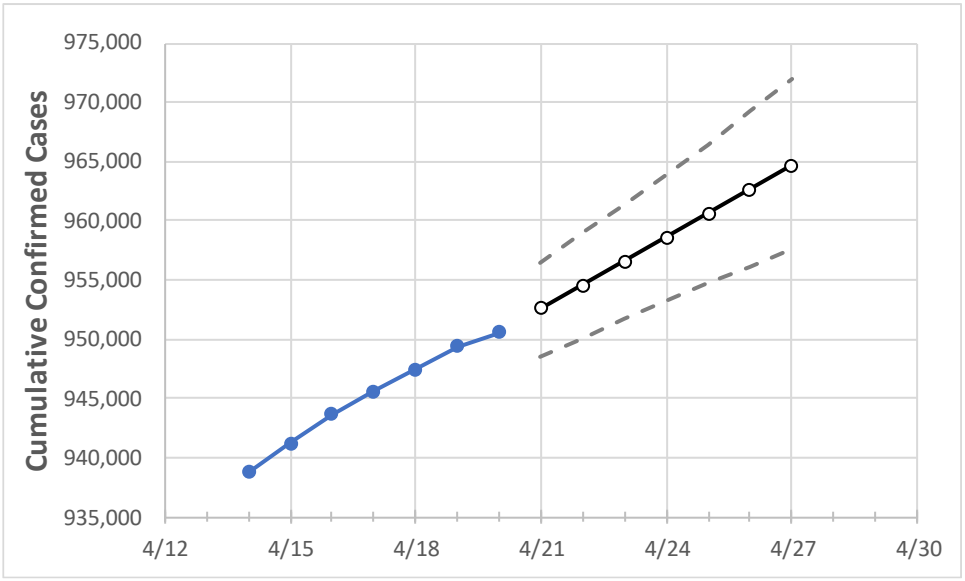
IEM's Modeling Lead

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:						
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27
North Carolina	945,584	947,475	949,366	950,566	952,586	954,586	956,598	958,612	960,600	962,631	964,672

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:						
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27
Cumberland	26,872	26,927	26,982	27,041	27,106	27,171	27,239	27,304	27,372	27,439	27,507
Durham	24,114	24,178	24,242	24,267	24,325	24,383	24,443	24,501	24,560	24,620	24,678
Guilford	45,042	45,158	45,274	45,347	45,476	45,604	45,733	45,861	45,988	46,120	46,249
Mecklenburg	106,991	107,245	107,500	107,698	107,971	108,242	108,515	108,789	109,079	109,349	109,632
Orange	8,316	8,336	8,355	8,361	8,377	8,394	8,411	8,428	8,445	8,461	8,479
Union	23,280	23,337	23,395	23,446	23,515	23,586	23,659	23,732	23,805	23,882	23,959
Wake	83,896	84,025	84,154	84,210	84,375	84,540	84,700	84,856	85,010	85,160	85,308

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:		
	4/17	4/18	4/19	4/20	4/22	4/24	4/26
Cumberland	26,872	26,927	26,982	27,041	27,171 (5,434) [1,304] {652}	27,304 (5,461) [1,311] {655}	27,439 (5,488) [1,317] {659}
Durham	24,114	24,178	24,242	24,267	24,383 (4,877) [1,170] {585}	24,501 (4,900) [1,176] {588}	24,620 (4,924) [1,182] {591}
Guilford	45,042	45,158	45,274	45,347	45,604 (9,121) [2,189] {1,095}	45,861 (9,172) [2,201] {1,101}	46,120 (9,224) [2,214] {1,107}
Mecklenburg	106,991	107,245	107,500	107,698	108,242 (21,648) [5,196] {2,598}	108,789 (21,758) [5,222] {2,611}	109,349 (21,870) [5,249] {2,624}
Orange	8,316	8,336	8,355	8,361	8,394 (1,679) [403] {201}	8,428 (1,686) [405] {202}	8,461 (1,692) [406] {203}
Union	23,280	23,337	23,395	23,446	23,586 (4,717) [1,132] {566}	23,732 (4,746) [1,139] {570}	23,882 (4,776) [1,146] {573}
Wake	83,896	84,025	84,154	84,210	84,540 (16,908) [4,058] {2,029}	84,856 (16,971) [4,073] {2,037}	85,160 (17,032) [4,088] {2,044}

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.