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

Date: 1/20/21

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 1/20/21 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.

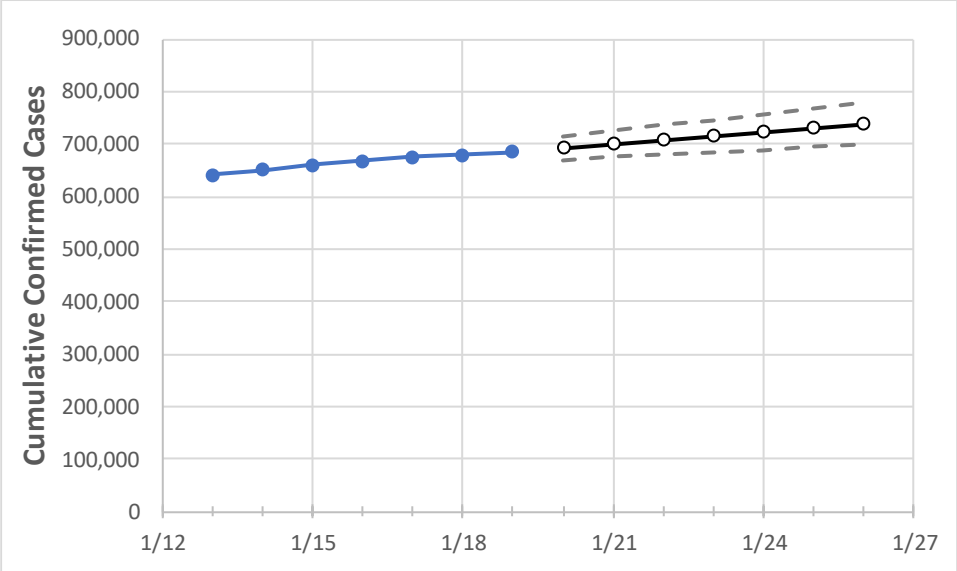
IEM's Modeling Lead

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
North Carolina	667,826	674,637	679,567	684,497	692,096	699,645	707,234	715,007	722,842	730,345	737,815

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
Cumberland	17,376	17,567	17,656	17,745	17,961	18,182	18,402	18,623	18,846	19,076	19,302
Durham	17,468	17,626	17,726	17,826	17,987	18,151	18,318	18,485	18,653	18,819	18,988
Guilford	30,594	30,942	31,167	31,391	31,766	32,143	32,523	32,911	33,292	33,667	34,050
Mecklenburg	76,167	76,895	77,316	77,736	78,553	79,373	80,205	81,030	81,872	82,721	83,563
Orange	6,016	6,079	6,098	6,117	6,169	6,220	6,272	6,324	6,374	6,425	6,475
Union	16,036	16,184	16,275	16,365	16,544	16,721	16,896	17,068	17,238	17,406	17,569
Wake	56,241	56,859	57,255	57,650	58,466	59,268	60,066	60,874	61,728	62,584	63,439

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:		
	1/16	1/17	1/18	1/19	1/21	1/23	1/25
Cumberland	17,376	17,567	17,656	17,745	18,182 (3,636) [873] {436}	18,623 (3,725) [894] {447}	19,076 (3,815) [916] {458}
Durham	17,468	17,626	17,726	17,826	18,151 (3,630) [871] {436}	18,485 (3,697) [887] {444}	18,819 (3,764) [903] {452}
Guilford	30,594	30,942	31,167	31,391	32,143 (6,429) [1,543] {771}	32,911 (6,582) [1,580] {790}	33,667 (6,733) [1,616] {808}
Mecklenburg	76,167	76,895	77,316	77,736	79,373 (15,875) [3,810] {1,905}	81,030 (16,206) [3,889] {1,945}	82,721 (16,544) [3,971] {1,985}
Orange	6,016	6,079	6,098	6,117	6,220 (1,244) [299] {149}	6,324 (1,265) [304] {152}	6,425 (1,285) [308] {154}
Union	16,036	16,184	16,275	16,365	16,721 (3,344) [803] {401}	17,068 (3,414) [819] {410}	17,406 (3,481) [836] {418}
Wake	56,241	56,859	57,255	57,650	59,268 (11,854) [2,845] {1,422}	60,874 (12,175) [2,922] {1,461}	62,584 (12,517) [3,004] {1,502}

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.