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

Date: 12/10/20

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 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 12/10/20 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.

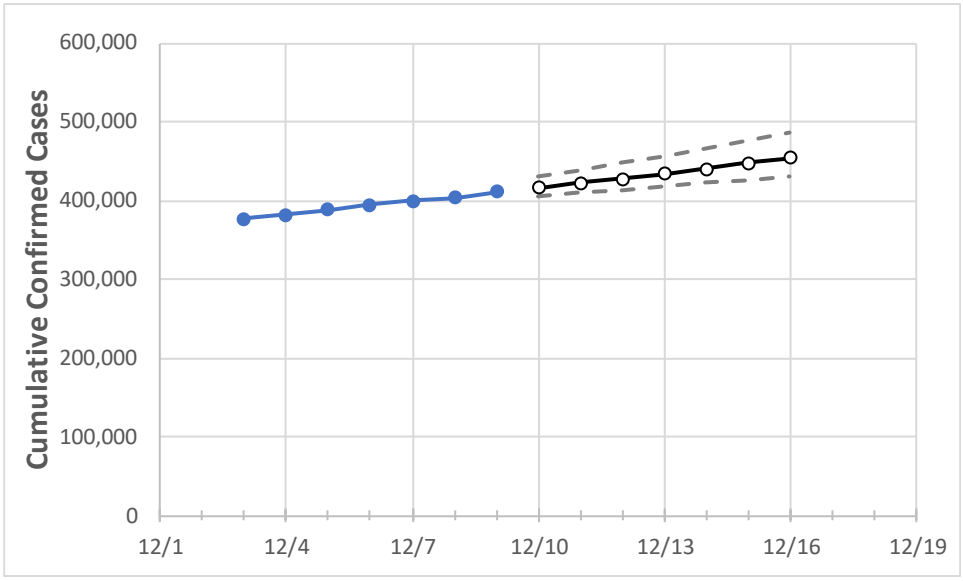
IEM's Modeling Lead

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
North Carolina	394,990	399,362	404,032	410,527	416,134	421,930	427,921	434,113	440,512	447,123	453,954

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
Cumberland	10,211	10,285	10,391	10,545	10,662	10,782	10,906	11,033	11,163	11,296	11,433
Durham	11,867	11,948	12,031	12,118	12,205	12,293	12,381	12,471	12,562	12,655	12,748
Guilford	18,149	18,417	18,682	19,009	19,278	19,556	19,843	20,139	20,445	20,760	21,086
Mecklenburg	46,983	47,547	47,986	48,637	49,242	49,868	50,515	51,184	51,876	52,592	53,331
Orange	4,132	4,163	4,191	4,215	4,249	4,284	4,319	4,355	4,392	4,429	4,467
Union	8,656	8,749	8,867	9,040	9,192	9,351	9,517	9,692	9,875	10,066	10,266
Wake	31,640	32,111	32,398	32,821	33,315	33,828	34,362	34,918	35,496	36,097	36,722

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:		
	12/6	12/7	12/8	12/9	12/11	12/13	12/15
Cumberland	10,211	10,285	10,391	10,545	10,782 (2,156) [518] {259}	11,033 (2,207) [530] {265}	11,296 (2,259) [542] {271}
Durham	11,867	11,948	12,031	12,118	12,293 (2,459) [590] {295}	12,471 (2,494) [599] {299}	12,655 (2,531) [607] {304}
Guilford	18,149	18,417	18,682	19,009	19,556 (3,911) [939] {469}	20,139 (4,028) [967] {483}	20,760 (4,152) [996] {498}
Mecklenburg	46,983	47,547	47,986	48,637	49,868 (9,974) [2,394] {1,197}	51,184 (10,237) [2,457] {1,228}	52,592 (10,518) [2,524] {1,262}
Orange	4,132	4,163	4,191	4,215	4,284 (857) [206] {103}	4,355 (871) [209] {105}	4,429 (886) [213] {106}
Union	8,656	8,749	8,867	9,040	9,351 (1,870) [449] {224}	9,692 (1,938) [465] {233}	10,066 (2,013) [483] {242}
Wake	31,640	32,111	32,398	32,821	33,828 (6,766) [1,624] {812}	34,918 (6,984) [1,676] {838}	36,097 (7,219) [1,733] {866}

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.