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

Date: 1/13/21

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 1/13/21 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.

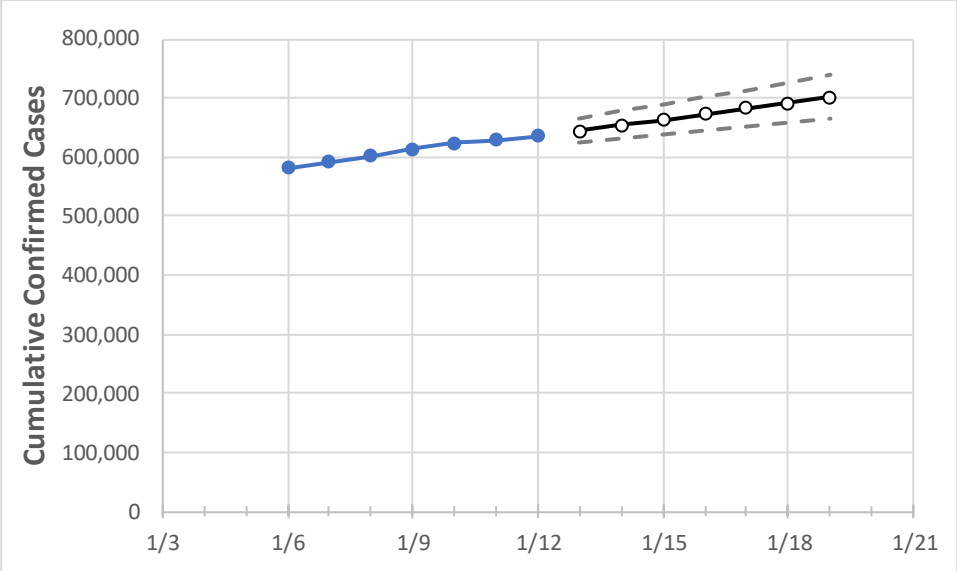
IEM's Modeling Lead

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
North Carolina	614,355	623,188	629,124	635,975	645,009	654,144	663,417	672,769	682,514	692,161	702,094

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
Cumberland	15,821	16,065	16,236	16,368	16,603	16,849	17,098	17,355	17,617	17,880	18,156
Durham	16,366	16,583	16,720	16,850	17,052	17,261	17,474	17,693	17,917	18,149	18,381
Guilford	28,076	28,475	28,775	29,125	29,556	29,996	30,456	30,926	31,404	31,899	32,409
Mecklenburg	70,128	71,437	72,177	72,968	73,953	74,979	76,012	77,076	78,148	79,268	80,414
Orange	5,614	5,682	5,744	5,792	5,865	5,939	6,018	6,099	6,182	6,266	6,356
Union	14,564	14,875	15,016	15,191	15,438	15,692	15,949	16,211	16,476	16,750	17,025
Wake	50,627	51,290	51,999	53,188	54,166	55,156	56,181	57,237	58,341	59,485	60,658

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:		
	1/9	1/10	1/11	1/12	1/14	1/16	1/18
Cumberland	15,821	16,065	16,236	16,368	16,849 (3,370) [809] {404}	17,355 (3,471) [833] {417}	17,880 (3,576) [858] {429}
Durham	16,366	16,583	16,720	16,850	17,261 (3,452) [829] {414}	17,693 (3,539) [849] {425}	18,149 (3,630) [871] {436}
Guilford	28,076	28,475	28,775	29,125	29,996 (5,999) [1,440] {720}	30,926 (6,185) [1,484] {742}	31,899 (6,380) [1,531] {766}
Mecklenburg	70,128	71,437	72,177	72,968	74,979 (14,996) [3,599] {1,799}	77,076 (15,415) [3,700] {1,850}	79,268 (15,854) [3,805] {1,902}
Orange	5,614	5,682	5,744	5,792	5,939 (1,188) [285] {143}	6,099 (1,220) [293] {146}	6,266 (1,253) [301] {150}
Union	14,564	14,875	15,016	15,191	15,692 (3,138) [753] {377}	16,211 (3,242) [778] {389}	16,750 (3,350) [804] {402}
Wake	50,627	51,290	51,999	53,188	55,156 (11,031) [2,647] {1,324}	57,237 (11,447) [2,747] {1,374}	59,485 (11,897) [2,855] {1,428}

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.