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

Date: 4/13/21

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 4/13/21 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.

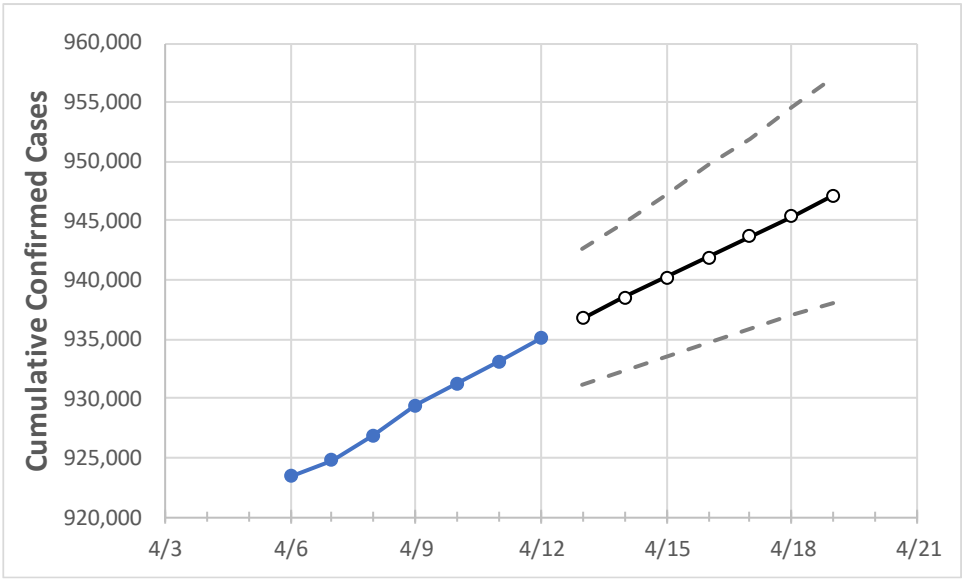
IEM's Modeling Lead

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:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
North Carolina	929,406	931,291	933,176	935,061	936,783	938,513	940,204	941,931	943,700	945,407	947,124

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:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
Cumberland	26,355	26,414	26,473	26,532	26,589	26,646	26,704	26,761	26,819	26,877	26,933
Durham	23,650	23,701	23,751	23,802	23,854	23,906	23,958	24,011	24,062	24,114	24,167
Guilford	43,946	44,098	44,250	44,402	44,530	44,658	44,788	44,923	45,056	45,192	45,333
Mecklenburg	104,865	105,128	105,391	105,654	105,912	106,170	106,430	106,690	106,955	107,218	107,484
Orange	8,185	8,202	8,220	8,237	8,250	8,262	8,275	8,288	8,301	8,314	8,326
Union	22,771	22,819	22,868	22,916	22,957	22,996	23,037	23,074	23,112	23,150	23,186
Wake	82,172	82,392	82,613	82,833	83,035	83,239	83,444	83,651	83,857	84,065	84,278

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:		
	4/9	4/10	4/11	4/12	4/14	4/16	4/18
Cumberland	26,355	26,414	26,473	26,532	26,646 (5,329) [1,279] {640}	26,761 (5,352) [1,285] {642}	26,877 (5,375) [1,290] {645}
Durham	23,650	23,701	23,751	23,802	23,906 (4,781) [1,148] {574}	24,011 (4,802) [1,153] {576}	24,114 (4,823) [1,157] {579}
Guilford	43,946	44,098	44,250	44,402	44,658 (8,932) [2,144] {1,072}	44,923 (8,985) [2,156] {1,078}	45,192 (9,038) [2,169] {1,085}
Mecklenburg	104,865	105,128	105,391	105,654	106,170 (21,234) [5,096] {2,548}	106,690 (21,338) [5,121] {2,561}	107,218 (21,444) [5,146] {2,573}
Orange	8,185	8,202	8,220	8,237	8,262 (1,652) [397] {198}	8,288 (1,658) [398] {199}	8,314 (1,663) [399] {200}
Union	22,771	22,819	22,868	22,916	22,996 (4,599) [1,104] {552}	23,074 (4,615) [1,108] {554}	23,150 (4,630) [1,111] {556}
Wake	82,172	82,392	82,613	82,833	83,239 (16,648) [3,995] {1,998}	83,651 (16,730) [4,015] {2,008}	84,065 (16,813) [4,035] {2,018}

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.