IEM's AI Modeling: Short-term COVID-19 Projections
Date: 214/22

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 <u>not</u> 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 2/14/22 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.

New Jersey State Projections
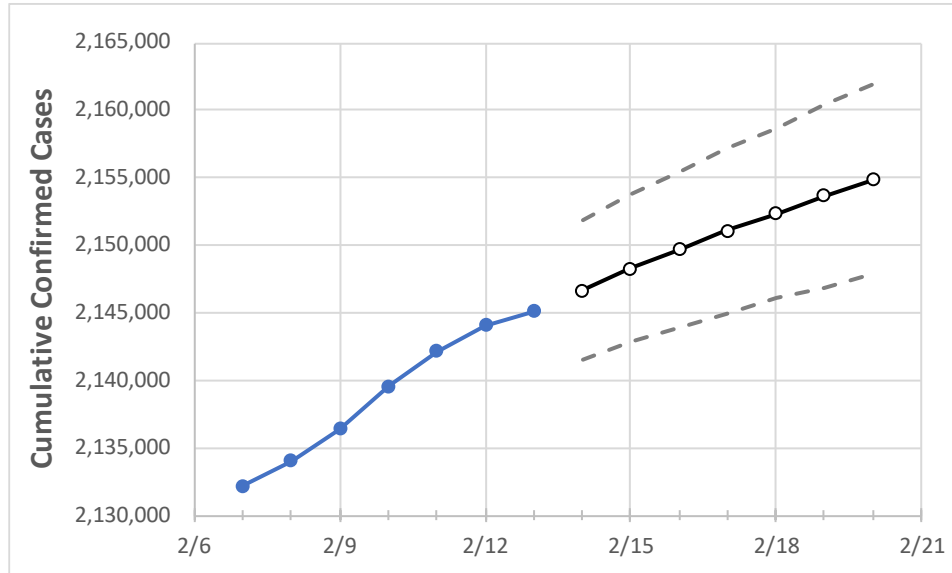
	Actual Confirmed Cases On:				Projected Cases For:						
	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20
New Jersey	2,139,579	2,142,157	2,144,050	2,145,147	2,146,694	2,148,291	2,149,686	2,151,076	2,152,361	2,153,648	2,154,871

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.

New Jersey Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20
Bergen	215,633	215,856	215,997	216,141	216,298	216,463	216,608	216,744	216,885	217,022	217,147
Burlington	99,292	99,579	99,715	99,797	99,924	100,051	100,176	100,291	100,404	100,513	100,614
Camden	122,783	122,962	123,075	123,162	123,279	123,381	123,483	123,582	123,674	123,763	123,847
Essex	206,962	207,128	207,221	207,297	207,399	207,488	207,572	207,660	207,743	207,817	207,888
Gloucester	68,153	68,249	68,322	68,353	68,424	68,492	68,559	68,618	68,680	68,736	68,789
Hudson	165,780	165,916	166,062	166,112	166,206	166,291	166,373	166,446	166,523	166,587	166,655
Hunterdon	23,771	23,797	23,838	23,858	23,883	23,906	23,928	23,950	23,969	23,990	24,008
Mercer	73,554	73,663	73,744	73,805	73,879	73,948	74,021	74,085	74,148	74,210	74,267
Middlesex	185,811	186,050	186,256	186,353	186,501	186,640	186,769	186,888	187,009	187,125	187,238
Monmouth	159,626	159,812	159,938	160,068	160,181	160,295	160,400	160,501	160,597	160,695	160,777
Morris	114,795	114,944	115,042	115,107	115,201	115,285	115,368	115,448	115,526	115,604	115,670
Ocean	158,118	158,301	158,424	158,424	158,552	158,665	158,780	158,889	158,987	159,086	159,170
Passaic	140,991	141,107	141,215	141,255	141,336	141,403	141,474	141,536	141,597	141,661	141,716
Somerset	65,474	65,574	65,639	65,663	65,711	65,758	65,802	65,842	65,883	65,920	65,959
Sussex	32,976	33,030	33,045	33,074	33,098	33,119	33,139	33,158	33,180	33,199	33,215
Union	138,905	139,105	139,284	139,355	139,460	139,557	139,647	139,730	139,824	139,911	139,989
Warren	23,226	23,257	23,281	23,297	23,316	23,335	23,352	23,370	23,386	23,401	23,415

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.*

New Jersey Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	2/10	2/11	2/12	2/13	2/15	2/17	2/19
Bergen	215,633	215,856	215,997	216,141	216,463 (43,293) [10,390] {5,195}	216,744 (43,349) [10,404] {5,202}	217,022 (43,404) [10,417] {5,209}
Burlington	99,292	99,579	99,715	99,797	100,051 (20,010) [4,802] {2,401}	100,291 (20,058) [4,814] {2,407}	100,513 (20,103) [4,825] {2,412}
Camden	122,783	122,962	123,075	123,162	123,381 (24,676) [5,922] {2,961}	123,582 (24,716) [5,932] {2,966}	123,763 (24,753) [5,941] {2,970}
Essex	206,962	207,128	207,221	207,297	207,488 (41,498) [9,959] {4,980}	207,660 (41,532) [9,968] {4,984}	207,817 (41,563) [9,975] {4,988}
Gloucester	68,153	68,249	68,322	68,353	68,492 (13,698) [3,288] {1,644}	68,618 (13,724) [3,294] {1,647}	68,736 (13,747) [3,299] {1,650}
Hudson	165,780	165,916	166,062	166,112	166,291 (33,258) [7,982] {3,991}	166,446 (33,289) [7,989] {3,995}	166,587 (33,317) [7,996] {3,998}
Hunterdon	23,771	23,797	23,838	23,858	23,906 (4,781) [1,147] {574}	23,950 (4,790) [1,150] {575}	23,990 (4,798) [1,152] {576}
Mercer	73,554	73,663	73,744	73,805	73,948 (14,790) [3,550] {1,775}	74,085 (14,817) [3,556] {1,778}	74,210 (14,842) [3,562] {1,781}
Middlesex	185,811	186,050	186,256	186,353	186,640 (37,328) [8,959] {4,479}	186,888 (37,378) [8,971] {4,485}	187,125 (37,425) [8,982] {4,491}
Monmouth	159,626	159,812	159,938	160,068	160,295 (32,059) [7,694] {3,847}	160,501 (32,100) [7,704] {3,852}	160,695 (32,139) [7,713] {3,857}
Morris	114,795	114,944	115,042	115,107	115,285 (23,057) [5,534] {2,767}	115,448 (23,090) [5,541] {2,771}	115,604 (23,121) [5,549] {2,774}
Ocean	158,118	158,301	158,424	158,424	158,665 (31,733) [7,616] {3,808}	158,889 (31,778) [7,627] {3,813}	159,086 (31,817) [7,636] {3,818}
Passaic	140,991	141,107	141,215	141,255	141,403 (28,281) [6,787] {3,394}	141,536 (28,307) [6,794] {3,397}	141,661 (28,332) [6,800] {3,400}
Somerset	65,474	65,574	65,639	65,663	65,758 (13,152) [3,156] {1,578}	65,842 (13,168) [3,160] {1,580}	65,920 (13,184) [3,164] {1,582}
Sussex	32,976	33,030	33,045	33,074	33,119 (6,624) [1,590] {795}	33,158 (6,632) [1,592] {796}	33,199 (6,640) [1,594] {797}
Union	138,905	139,105	139,284	139,355	139,557 (27,911) [6,699] {3,349}	139,730 (27,946) [6,707] {3,354}	139,911 (27,982) [6,716] {3,358}
Warren	23,226	23,257	23,281	23,297	23,335 (4,667) [1,120] {560}	23,370 (4,674) [1,122] {561}	23,401 (4,680) [1,123] {562}

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.