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.

Washington State Projections
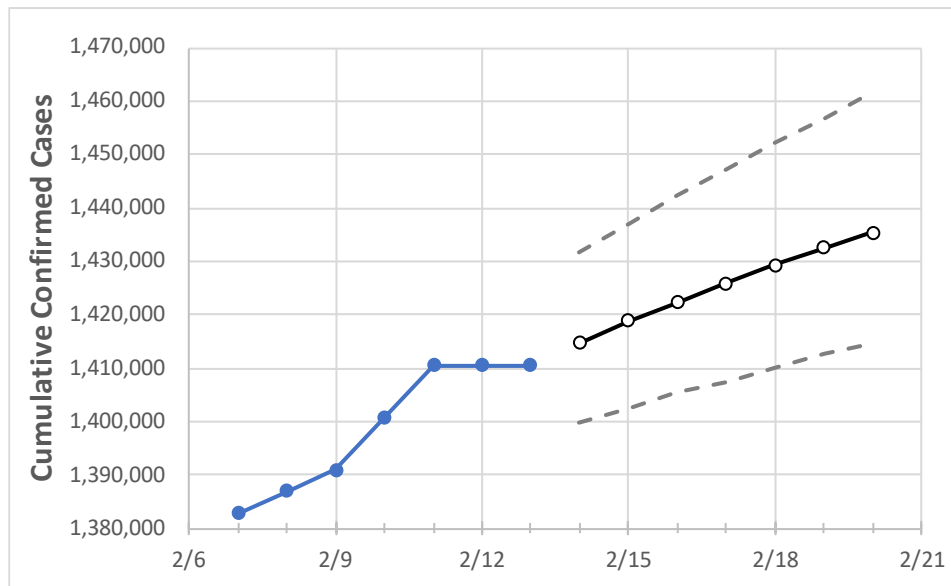
	Actual Confirmed Cases On:				Projected Cases For:						
	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20
Washington	1,400,811	1,410,596	1,410,596	1,410,596	1,414,664	1,418,795	1,422,292	1,425,876	1,429,264	1,432,494	1,435,363

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.

Washington 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
Benton	50,778	51,082	51,082	51,082	51,228	51,374	51,501	51,633	51,749	51,877	51,977
Clark	81,262	81,937	81,937	81,937	82,363	82,772	83,180	83,562	83,955	84,305	84,669
Grant	24,922	25,055	25,055	25,055	25,132	25,203	25,268	25,335	25,397	25,460	25,516
Island	9,521	9,601	9,601	9,601	9,642	9,679	9,717	9,755	9,790	9,825	9,856
King	359,103	360,956	360,956	360,956	361,878	362,820	363,610	364,446	365,193	365,949	366,643
Kitsap	37,422	37,827	37,827	37,827	37,954	38,068	38,182	38,288	38,394	38,496	38,594
Pierce	182,490	183,707	183,707	183,707	184,196	184,641	185,042	185,447	185,837	186,222	186,573
Skagit	21,346	21,511	21,511	21,511	21,590	21,662	21,734	21,807	21,870	21,936	22,002
Snohomish	147,268	148,223	148,223	148,223	148,714	149,188	149,585	150,018	150,393	150,780	151,167
Spokane	119,630	120,576	120,576	120,576	120,930	121,224	121,521	121,827	122,109	122,350	122,559
Thurston	44,972	45,445	45,445	45,445	45,605	45,778	45,933	46,076	46,239	46,368	46,498
Whatcom	35,770	36,154	36,154	36,154	36,317	36,462	36,610	36,758	36,892	37,028	37,164
Yakima	70,074	70,581	70,581	70,581	70,745	70,897	71,055	71,187	71,312	71,450	71,544

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.*

Washington 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
Benton	50,778	51,082	51,082	51,082	51,374 (10,275) [2,466] {1,233}	51,633 (10,327) [2,478] {1,239}	51,877 (10,375) [2,490] {1,245}
Clark	81,262	81,937	81,937	81,937	82,772 (16,554) [3,973] {1,987}	83,562 (16,712) [4,011] {2,005}	84,305 (16,861) [4,047] {2,023}
Grant	24,922	25,055	25,055	25,055	25,203 (5,041) [1,210] {605}	25,335 (5,067) [1,216] {608}	25,460 (5,092) [1,222] {611}
Island	9,521	9,601	9,601	9,601	9,679 (1,936) [465] {232}	9,755 (1,951) [468] {234}	9,825 (1,965) [472] {236}
King	359,103	360,956	360,956	360,956	362,820 (72,564) [17,415] {8,708}	364,446 (72,889) [17,493] {8,747}	365,949 (73,190) [17,566] {8,783}
Kitsap	37,422	37,827	37,827	37,827	38,068 (7,614) [1,827] {914}	38,288 (7,658) [1,838] {919}	38,496 (7,699) [1,848] {924}
Pierce	182,490	183,707	183,707	183,707	184,641 (36,928) [8,863] {4,431}	185,447 (37,089) [8,901] {4,451}	186,222 (37,244) [8,939] {4,469}
Skagit	21,346	21,511	21,511	21,511	21,662 (4,332) [1,040] {520}	21,807 (4,361) [1,047] {523}	21,936 (4,387) [1,053] {526}
Snohomish	147,268	148,223	148,223	148,223	149,188 (29,838) [7,161] {3,581}	150,018 (30,004) [7,201] {3,600}	150,780 (30,156) [7,237] {3,619}
Spokane	119,630	120,576	120,576	120,576	121,224 (24,245) [5,819] {2,909}	121,827 (24,365) [5,848] {2,924}	122,350 (24,470) [5,873] {2,936}
Thurston	44,972	45,445	45,445	45,445	45,778 (9,156) [2,197] {1,099}	46,076 (9,215) [2,212] {1,106}	46,368 (9,274) [2,226] {1,113}
Whatcom	35,770	36,154	36,154	36,154	36,462 (7,292) [1,750] {875}	36,758 (7,352) [1,764] {882}	37,028 (7,406) [1,777] {889}
Yakima	70,074	70,581	70,581	70,581	70,897 (14,179) [3,403] {1,702}	71,187 (14,237) [3,417] {1,708}	71,450 (14,290) [3,430] {1,715}

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.