IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/22/21

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 <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 4/22/21 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.

Washington State Projections
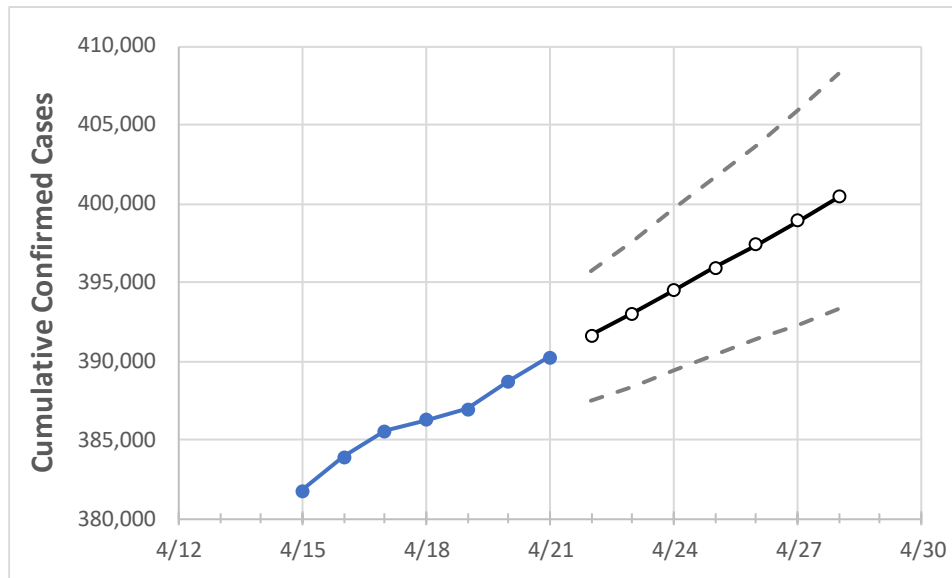
	Actual Confirmed Cases On:				Projected Cases For:						
	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28
Washington	386,235	386,920	388,718	390,214	391,614	393,017	394,448	395,910	397,367	398,899	400,449

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:						
	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28
Benton	16,220	16,233	16,281	16,323	16,361	16,400	16,439	16,480	16,522	16,567	16,610
Clark	21,394	21,453	21,521	21,601	21,686	21,774	21,862	21,952	22,047	22,141	22,242
Grant	8,284	8,297	8,402	8,414	8,447	8,484	8,522	8,563	8,607	8,653	8,702
Island	1,552	1,555	1,563	1,568	1,574	1,581	1,587	1,595	1,602	1,609	1,616
King	97,019	97,230	97,712	98,159	98,544	98,926	99,316	99,705	100,109	100,503	100,916
Kitsap	7,072	7,089	7,150	7,189	7,233	7,277	7,323	7,369	7,416	7,465	7,516
Pierce	46,151	46,351	46,602	46,866	47,105	47,347	47,594	47,849	48,109	48,372	48,636
Skagit	5,061	5,074	5,103	5,140	5,168	5,197	5,228	5,260	5,294	5,328	5,364
Snohomish	34,287	34,337	34,524	34,719	34,871	35,030	35,198	35,361	35,535	35,709	35,887
Spokane	40,111	40,153	40,357	40,452	40,576	40,700	40,826	40,957	41,093	41,230	41,370
Thurston	8,397	8,407	8,441	8,474	8,510	8,547	8,586	8,624	8,664	8,706	8,747
Whatcom	8,015	8,011	8,049	8,091	8,126	8,162	8,200	8,238	8,276	8,316	8,356
Yakima	28,944	28,961	29,008	29,028	29,073	29,117	29,161	29,204	29,248	29,290	29,333

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:		
	4/18	4/19	4/20	4/21	4/23	4/25	4/27
Benton	16,220	16,233	16,281	16,323	16,400 (3,280) [787] {394}	16,480 (3,296) [791] {396}	16,567 (3,313) [795] {398}
Clark	21,394	21,453	21,521	21,601	21,774 (4,355) [1,045] {523}	21,952 (4,390) [1,054] {527}	22,141 (4,428) [1,063] {531}
Grant	8,284	8,297	8,402	8,414	8,484 (1,697) [407] {204}	8,563 (1,713) [411] {206}	8,653 (1,731) [415] {208}
Island	1,552	1,555	1,563	1,568	1,581 (316) [76] {38}	1,595 (319) [77] {38}	1,609 (322) [77] {39}
King	97,019	97,230	97,712	98,159	98,926 (19,785) [4,748] {2,374}	99,705 (19,941) [4,786] {2,393}	100,503 (20,101) [4,824] {2,412}
Kitsap	7,072	7,089	7,150	7,189	7,277 (1,455) [349] {175}	7,369 (1,474) [354] {177}	7,465 (1,493) [358] {179}
Pierce	46,151	46,351	46,602	46,866	47,347 (9,469) [2,273] {1,136}	47,849 (9,570) [2,297] {1,148}	48,372 (9,674) [2,322] {1,161}
Skagit	5,061	5,074	5,103	5,140	5,197 (1,039) [249] {125}	5,260 (1,052) [252] {126}	5,328 (1,066) [256] {128}
Snohomish	34,287	34,337	34,524	34,719	35,030 (7,006) [1,681] {841}	35,361 (7,072) [1,697] {849}	35,709 (7,142) [1,714] {857}
Spokane	40,111	40,153	40,357	40,452	40,700 (8,140) [1,954] {977}	40,957 (8,191) [1,966] {983}	41,230 (8,246) [1,979] {990}
Thurston	8,397	8,407	8,441	8,474	8,547 (1,709) [410] {205}	8,624 (1,725) [414] {207}	8,706 (1,741) [418] {209}
Whatcom	8,015	8,011	8,049	8,091	8,162 (1,632) [392] {196}	8,238 (1,648) [395] {198}	8,316 (1,663) [399] {200}
Yakima	28,944	28,961	29,008	29,028	29,117 (5,823) [1,398] {699}	29,204 (5,841) [1,402] {701}	29,290 (5,858) [1,406] {703}

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.