IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/2/22

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 3/2/22 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.

Colorado State Projections
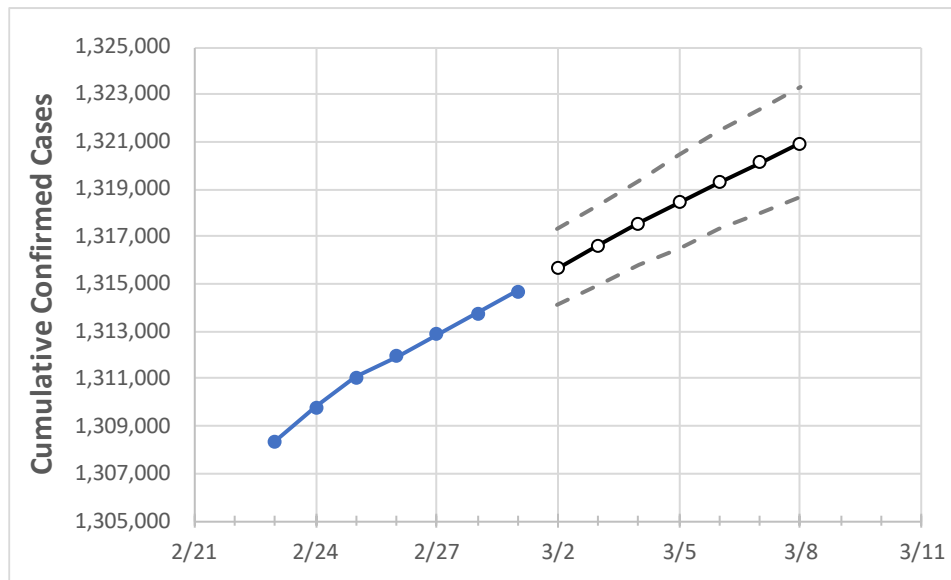
	Actual Confirmed Cases On:				Projected Cases For:						
	2/26	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8
Colorado	1,311,967	1,312,873	1,313,779	1,314,678	1,315,672	1,316,637	1,317,566	1,318,445	1,319,289	1,320,129	1,320,925

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.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	2/26	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8
Adams	128,559	128,610	128,660	128,725	128,791	128,853	128,913	128,971	129,026	129,081	129,132
Arapahoe	146,543	146,654	146,766	146,841	146,941	147,037	147,128	147,217	147,304	147,388	147,471
Boulder	60,607	60,667	60,727	60,768	60,819	60,869	60,914	60,961	61,007	61,049	61,092
Denver	164,375	164,475	164,575	164,683	164,791	164,895	164,994	165,088	165,185	165,278	165,364
Douglas	75,252	75,295	75,337	75,381	75,436	75,491	75,542	75,593	75,642	75,693	75,738
Eagle	15,605	15,612	15,618	15,625	15,635	15,644	15,652	15,660	15,668	15,677	15,684
El Paso	178,545	178,663	178,781	178,907	179,044	179,180	179,308	179,433	179,549	179,669	179,778
Gunnison	3,255	3,258	3,262	3,270	3,278	3,286	3,293	3,300	3,308	3,316	3,324
Jefferson	117,967	118,035	118,103	118,193	118,289	118,383	118,475	118,564	118,648	118,731	118,814
Larimer	73,610	73,690	73,769	73,856	73,942	74,025	74,103	74,183	74,258	74,331	74,405
Pueblo	43,940	43,965	43,991	44,036	44,073	44,107	44,140	44,172	44,204	44,232	44,265
Weld	80,330	80,392	80,455	80,491	80,549	80,600	80,651	80,700	80,748	80,794	80,836

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.*

Colorado Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	2/26	2/27	2/28	3/1	3/3	3/5	3/7
Adams	128,559	128,610	128,660	128,725	128,853 (25,771) [6,185] {3,092}	128,971 (25,794) [6,191] {3,095}	129,081 (25,816) [6,196] {3,098}
Arapahoe	146,543	146,654	146,766	146,841	147,037 (29,407) [7,058] {3,529}	147,217 (29,443) [7,066] {3,533}	147,388 (29,478) [7,075] {3,537}
Boulder	60,607	60,667	60,727	60,768	60,869 (12,174) [2,922] {1,461}	60,961 (12,192) [2,926] {1,463}	61,049 (12,210) [2,930] {1,465}
Denver	164,375	164,475	164,575	164,683	164,895 (32,979) [7,915] {3,957}	165,088 (33,018) [7,924] {3,962}	165,278 (33,056) [7,933] {3,967}
Douglas	75,252	75,295	75,337	75,381	75,491 (15,098) [3,624] {1,812}	75,593 (15,119) [3,628] {1,814}	75,693 (15,139) [3,633] {1,817}
Eagle	15,605	15,612	15,618	15,625	15,644 (3,129) [751] {375}	15,660 (3,132) [752] {376}	15,677 (3,135) [752] {376}
El Paso	178,545	178,663	178,781	178,907	179,180 (35,836) [8,601] {4,300}	179,433 (35,887) [8,613] {4,306}	179,669 (35,934) [8,624] {4,312}
Gunnison	3,255	3,258	3,262	3,270	3,286 (657) [158] {79}	3,300 (660) [158] {79}	3,316 (663) [159] {80}
Jefferson	117,967	118,035	118,103	118,193	118,383 (23,677) [5,682] {2,841}	118,564 (23,713) [5,691] {2,846}	118,731 (23,746) [5,699] {2,850}
Larimer	73,610	73,690	73,769	73,856	74,025 (14,805) [3,553] {1,777}	74,183 (14,837) [3,561] {1,780}	74,331 (14,866) [3,568] {1,784}
Pueblo	43,940	43,965	43,991	44,036	44,107 (8,821) [2,117] {1,059}	44,172 (8,834) [2,120] {1,060}	44,232 (8,846) [2,123] {1,062}
Weld	80,330	80,392	80,455	80,491	80,600 (16,120) [3,869] {1,934}	80,700 (16,140) [3,874] {1,937}	80,794 (16,159) [3,878] {1,939}

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.