IEM's AI Modeling: Short-term COVID-19 Projections
Date: 9/13/21

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 <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 9/13/21 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.

Colorado State Projections
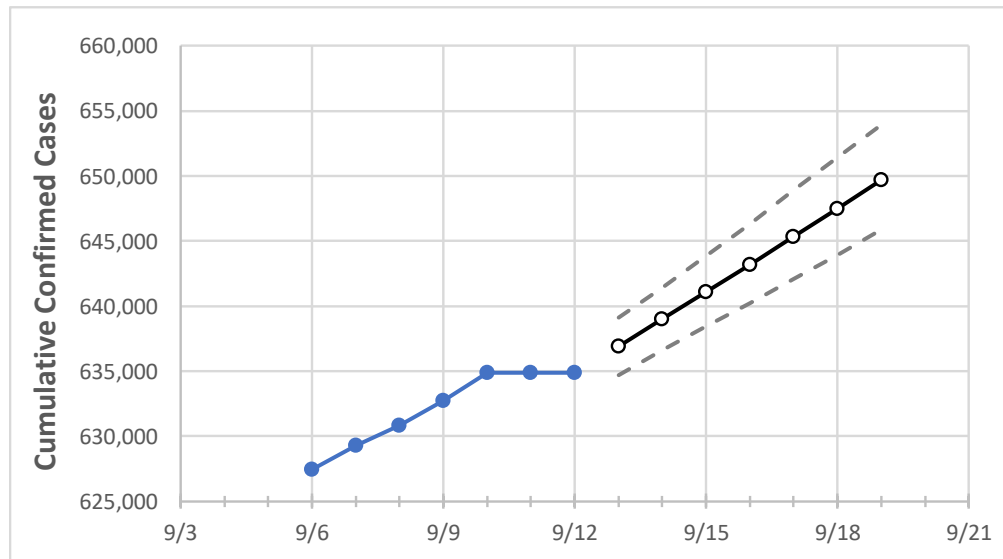
	Actual Confirmed Cases On:				Projected Cases For:						
	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19
Colorado	632,699	634,888	634,888	634,888	636,920	638,984	641,081	643,166	645,314	647,475	649,700

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:						
	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19
Adams	67,839	68,012	68,012	68,012	68,171	68,330	68,492	68,655	68,815	68,977	69,144
Arapahoe	70,610	70,800	70,800	70,800	71,009	71,217	71,428	71,640	71,857	72,070	72,294
Boulder	27,138	27,220	27,220	27,220	27,315	27,406	27,503	27,599	27,699	27,799	27,902
Denver	82,281	82,473	82,473	82,473	82,643	82,810	82,981	83,154	83,325	83,503	83,675
Douglas	35,126	35,278	35,278	35,278	35,408	35,540	35,672	35,806	35,943	36,083	36,223
Eagle	7,517	7,561	7,561	7,561	7,600	7,638	7,677	7,718	7,757	7,798	7,841
El Paso	85,222	85,603	85,603	85,603	85,952	86,316	86,693	87,064	87,453	87,850	88,251
Gunnison	1,610	1,611	1,611	1,611	1,618	1,624	1,630	1,636	1,642	1,649	1,656
Jefferson	54,880	55,050	55,050	55,050	55,205	55,363	55,520	55,678	55,842	56,008	56,171
Larimer	32,741	32,872	32,872	32,872	33,001	33,126	33,259	33,388	33,519	33,651	33,788
Pueblo	21,289	21,365	21,365	21,365	21,427	21,489	21,551	21,616	21,682	21,752	21,820
Weld	38,929	39,097	39,097	39,097	39,266	39,432	39,602	39,773	39,949	40,125	40,305

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:		
	9/9	9/10	9/11	9/12	9/14	9/16	9/18
Adams	67,839	68,012	68,012	68,012	68,330 (13,666) [3,280] {1,640}	68,655 (13,731) [3,295] {1,648}	68,977 (13,795) [3,311] {1,655}
Arapahoe	70,610	70,800	70,800	70,800	71,217 (14,243) [3,418] {1,709}	71,640 (14,328) [3,439] {1,719}	72,070 (14,414) [3,459] {1,730}
Boulder	27,138	27,220	27,220	27,220	27,406 (5,481) [1,316] {658}	27,599 (5,520) [1,325] {662}	27,799 (5,560) [1,334] {667}
Denver	82,281	82,473	82,473	82,473	82,810 (16,562) [3,975] {1,987}	83,154 (16,631) [3,991] {1,996}	83,503 (16,701) [4,008] {2,004}
Douglas	35,126	35,278	35,278	35,278	35,540 (7,108) [1,706] {853}	35,806 (7,161) [1,719] {859}	36,083 (7,217) [1,732] {866}
Eagle	7,517	7,561	7,561	7,561	7,638 (1,528) [367] {183}	7,718 (1,544) [370] {185}	7,798 (1,560) [374] {187}
El Paso	85,222	85,603	85,603	85,603	86,316 (17,263) [4,143] {2,072}	87,064 (17,413) [4,179] {2,090}	87,850 (17,570) [4,217] {2,108}
Gunnison	1,610	1,611	1,611	1,611	1,624 (325) [78] {39}	1,636 (327) [79] {39}	1,649 (330) [79] {40}
Jefferson	54,880	55,050	55,050	55,050	55,363 (11,073) [2,657] {1,329}	55,678 (11,136) [2,673] {1,336}	56,008 (11,202) [2,688] {1,344}
Larimer	32,741	32,872	32,872	32,872	33,126 (6,625) [1,590] {795}	33,388 (6,678) [1,603] {801}	33,651 (6,730) [1,615] {808}
Pueblo	21,289	21,365	21,365	21,365	21,489 (4,298) [1,031] {516}	21,616 (4,323) [1,038] {519}	21,752 (4,350) [1,044] {522}
Weld	38,929	39,097	39,097	39,097	39,432 (7,886) [1,893] {946}	39,773 (7,955) [1,909] {955}	40,125 (8,025) [1,926] {963}

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.