IEM's AI Modeling: Short-term COVID-19 Projections

Date: 10/1/21

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 not 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 10/1/21 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.

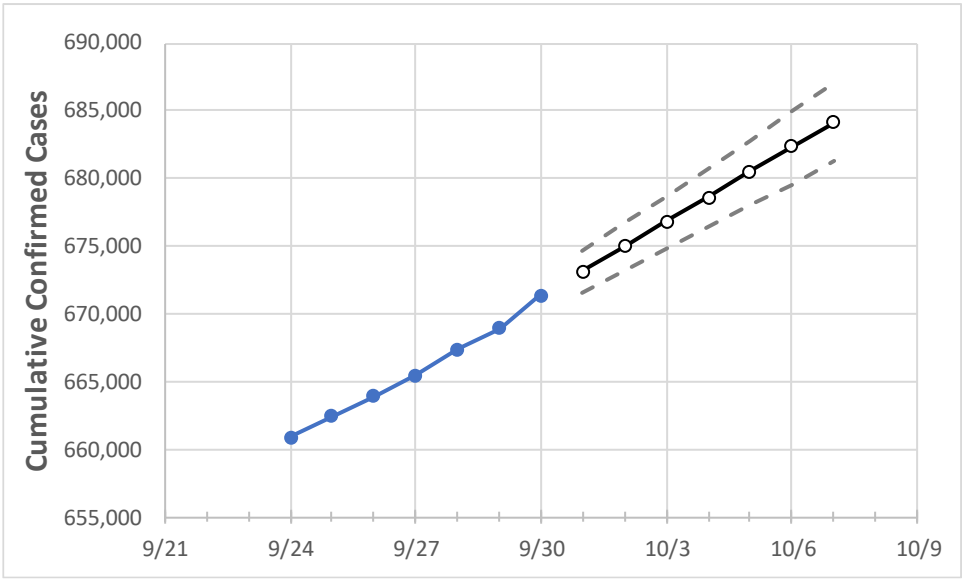
IEM's Modeling Lead

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:						
	9/27	9/28	9/29	9/30	10/1	10/2	10/3	10/4	10/5	10/6	10/7
Colorado	665,469	667,366	668,958	671,363	673,177	674,988	676,823	678,637	680,495	682,337	684,166

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:						
	9/27	9/28	9/29	9/30	10/1	10/2	10/3	10/4	10/5	10/6	10/7
Adams	70,396	70,493	70,609	70,792	70,919	71,046	71,170	71,296	71,419	71,546	71,669
Arapahoe	73,509	73,654	73,747	73,954	74,094	74,235	74,376	74,513	74,653	74,791	74,928
Boulder	28,370	28,426	28,477	28,558	28,620	28,681	28,741	28,801	28,862	28,923	28,983
Denver	85,315	85,477	85,608	85,836	86,006	86,175	86,344	86,514	86,685	86,864	87,031
Douglas	36,970	37,077	37,140	37,247	37,336	37,425	37,513	37,601	37,687	37,776	37,861
Eagle	7,848	7,871	7,886	7,899	7,911	7,924	7,935	7,946	7,958	7,969	7,979
El Paso	90,704	91,095	91,375	91,824	92,145	92,456	92,781	93,093	93,420	93,747	94,068
Gunnison	1,730	1,734	1,735	1,737	1,741	1,746	1,750	1,754	1,758	1,762	1,766
Jefferson	57,728	57,866	57,990	58,191	58,352	58,507	58,664	58,819	58,979	59,148	59,304
Larimer	34,896	34,996	35,105	35,270	35,389	35,509	35,630	35,748	35,870	35,992	36,113
Pueblo	22,415	22,479	22,509	22,587	22,648	22,708	22,770	22,832	22,894	22,957	23,019
Weld	41,479	41,625	41,747	41,930	42,066	42,202	42,338	42,476	42,612	42,748	42,884

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:		
	9/27	9/28	9/29	9/30	10/2	10/4	10/6
Adams	70,396	70,493	70,609	70,792	71,046 (14,209) [3,410] {1,705}	71,296 (14,259) [3,422] {1,711}	71,546 (14,309) [3,434] {1,717}
Arapahoe	73,509	73,654	73,747	73,954	74,235 (14,847) [3,563] {1,782}	74,513 (14,903) [3,577] {1,788}	74,791 (14,958) [3,590] {1,795}
Boulder	28,370	28,426	28,477	28,558	28,681 (5,736) [1,377] {688}	28,801 (5,760) [1,382] {691}	28,923 (5,785) [1,388] {694}
Denver	85,315	85,477	85,608	85,836	86,175 (17,235) [4,136] {2,068}	86,514 (17,303) [4,153] {2,076}	86,864 (17,373) [4,169] {2,085}
Douglas	36,970	37,077	37,140	37,247	37,425 (7,485) [1,796] {898}	37,601 (7,520) [1,805] {902}	37,776 (7,555) [1,813] {907}
Eagle	7,848	7,871	7,886	7,899	7,924 (1,585) [380] {190}	7,946 (1,589) [381] {191}	7,969 (1,594) [382] {191}
El Paso	90,704	91,095	91,375	91,824	92,456 (18,491) [4,438] {2,219}	93,093 (18,619) [4,468] {2,234}	93,747 (18,749) [4,500] {2,250}
Gunnison	1,730	1,734	1,735	1,737	1,746 (349) [84] {42}	1,754 (351) [84] {42}	1,762 (352) [85] {42}
Jefferson	57,728	57,866	57,990	58,191	58,507 (11,701) [2,808] {1,404}	58,819 (11,764) [2,823] {1,412}	59,148 (11,830) [2,839] {1,420}
Larimer	34,896	34,996	35,105	35,270	35,509 (7,102) [1,704] {852}	35,748 (7,150) [1,716] {858}	35,992 (7,198) [1,728] {864}
Pueblo	22,415	22,479	22,509	22,587	22,708 (4,542) [1,090] {545}	22,832 (4,566) [1,096] {548}	22,957 (4,591) [1,102] {551}
Weld	41,479	41,625	41,747	41,930	42,202 (8,440) [2,026] {1,013}	42,476 (8,495) [2,039] {1,019}	42,748 (8,550) [2,052] {1,026}

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.