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

Date: 9/15/21

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 9/15/21 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.

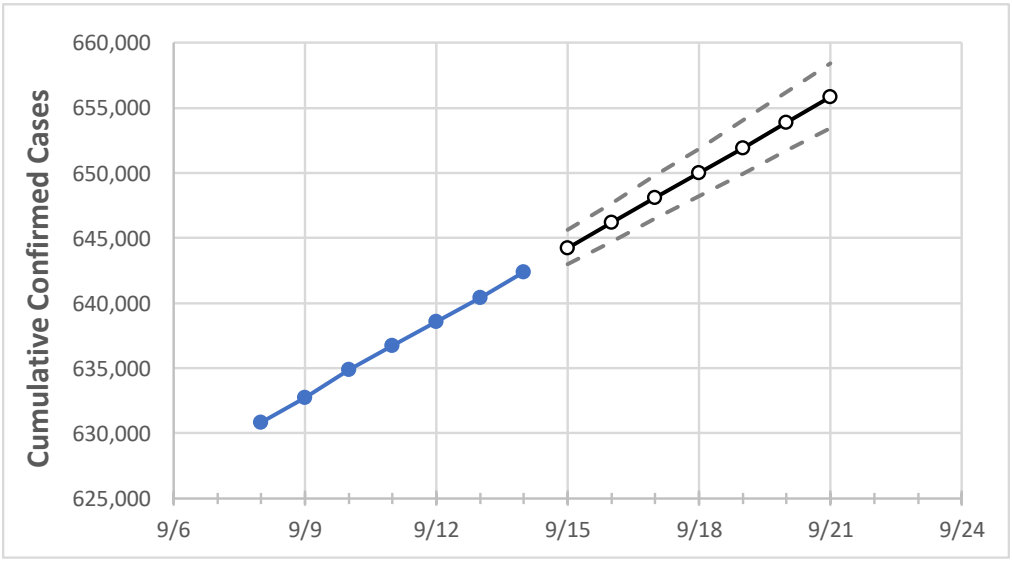
IEM's Modeling Lead

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:						
	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20	9/21
Colorado	636,719	638,549	640,380	642,360	644,252	646,163	648,086	649,990	651,920	653,883	655,823

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:						
	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20	9/21
Adams	68,164	68,317	68,469	68,629	68,782	68,933	69,083	69,234	69,383	69,532	69,680
Arapahoe	70,980	71,161	71,341	71,519	71,709	71,900	72,087	72,276	72,460	72,653	72,841
Boulder	27,290	27,360	27,430	27,503	27,584	27,664	27,745	27,827	27,909	27,992	28,075
Denver	82,636	82,798	82,961	83,127	83,291	83,448	83,610	83,770	83,933	84,091	84,254
Douglas	35,384	35,489	35,595	35,683	35,797	35,908	36,020	36,131	36,242	36,355	36,467
Eagle	7,581	7,601	7,621	7,640	7,666	7,692	7,719	7,744	7,770	7,796	7,820
El Paso	85,912	86,222	86,531	86,922	87,261	87,604	87,943	88,295	88,653	89,010	89,367
Gunnison	1,624	1,638	1,651	1,657	1,665	1,674	1,682	1,692	1,700	1,710	1,719
Jefferson	55,210	55,369	55,529	55,675	55,834	55,994	56,153	56,315	56,478	56,643	56,810
Larimer	32,998	33,124	33,250	33,364	33,486	33,612	33,734	33,860	33,982	34,109	34,233
Pueblo	21,433	21,500	21,568	21,636	21,700	21,768	21,836	21,907	21,978	22,052	22,125
Weld	39,242	39,386	39,531	39,720	39,883	40,043	40,205	40,369	40,536	40,704	40,873

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:		
	9/11	9/12	9/13	9/14	9/16	9/18	9/20
Adams	68,164	68,317	68,469	68,629	68,933 (13,787) [3,309] {1,654}	69,234 (13,847) [3,323] {1,662}	69,532 (13,906) [3,338] {1,669}
Arapahoe	70,980	71,161	71,341	71,519	71,900 (14,380) [3,451] {1,726}	72,276 (14,455) [3,469] {1,735}	72,653 (14,531) [3,487] {1,744}
Boulder	27,290	27,360	27,430	27,503	27,664 (5,533) [1,328] {664}	27,827 (5,565) [1,336] {668}	27,992 (5,598) [1,344] {672}
Denver	82,636	82,798	82,961	83,127	83,448 (16,690) [4,005] {2,003}	83,770 (16,754) [4,021] {2,010}	84,091 (16,818) [4,036] {2,018}
Douglas	35,384	35,489	35,595	35,683	35,908 (7,182) [1,724] {862}	36,131 (7,226) [1,734] {867}	36,355 (7,271) [1,745] {873}
Eagle	7,581	7,601	7,621	7,640	7,692 (1,538) [369] {185}	7,744 (1,549) [372] {186}	7,796 (1,559) [374] {187}
El Paso	85,912	86,222	86,531	86,922	87,604 (17,521) [4,205] {2,102}	88,295 (17,659) [4,238] {2,119}	89,010 (17,802) [4,272] {2,136}
Gunnison	1,624	1,638	1,651	1,657	1,674 (335) [80] {40}	1,692 (338) [81] {41}	1,710 (342) [82] {41}
Jefferson	55,210	55,369	55,529	55,675	55,994 (11,199) [2,688] {1,344}	56,315 (11,263) [2,703] {1,352}	56,643 (11,329) [2,719] {1,359}
Larimer	32,998	33,124	33,250	33,364	33,612 (6,722) [1,613] {807}	33,860 (6,772) [1,625] {813}	34,109 (6,822) [1,637] {819}
Pueblo	21,433	21,500	21,568	21,636	21,768 (4,354) [1,045] {522}	21,907 (4,381) [1,052] {526}	22,052 (4,410) [1,059] {529}
Weld	39,242	39,386	39,531	39,720	40,043 (8,009) [1,922] {961}	40,369 (8,074) [1,938] {969}	40,704 (8,141) [1,954] {977}

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.