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

Date: 9/20/21

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 9/20/21 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.

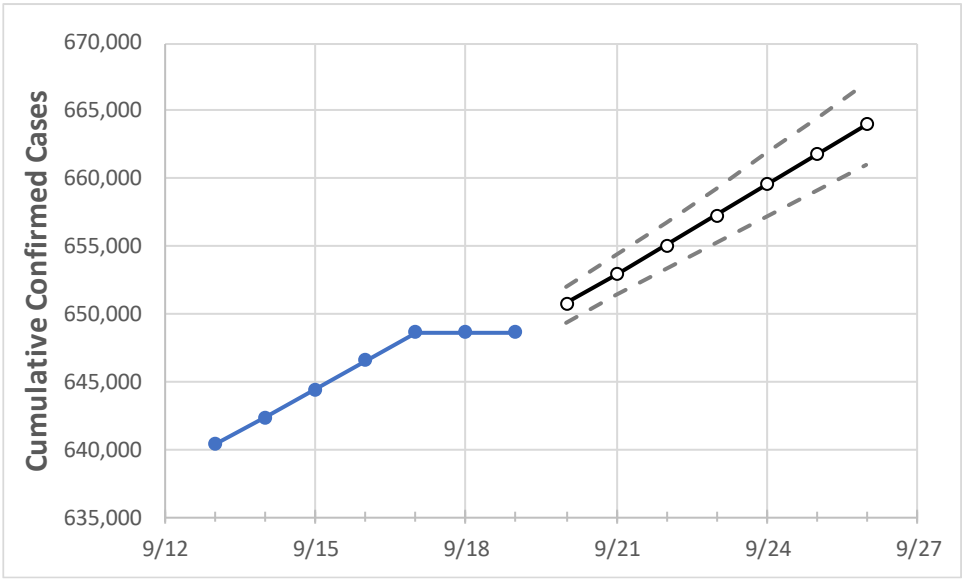
IEM's Modeling Lead

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:						
	9/16	9/17	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26
Colorado	646,605	648,642	648,642	648,642	650,771	652,920	655,082	657,295	659,535	661,764	664,035

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:						
	9/16	9/17	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26
Adams	68,943	69,094	69,094	69,094	69,249	69,406	69,561	69,719	69,875	70,033	70,193
Arapahoe	71,908	72,074	72,074	72,074	72,261	72,449	72,629	72,814	72,997	73,183	73,368
Boulder	27,673	27,759	27,759	27,759	27,842	27,926	28,010	28,094	28,178	28,263	28,349
Denver	83,560	83,741	83,741	83,741	83,927	84,115	84,305	84,490	84,683	84,881	85,073
Douglas	35,941	36,042	36,042	36,042	36,156	36,269	36,385	36,498	36,612	36,727	36,843
Eagle	7,685	7,715	7,715	7,715	7,739	7,763	7,788	7,812	7,836	7,860	7,884
El Paso	87,596	87,936	87,936	87,936	88,299	88,660	89,022	89,396	89,770	90,154	90,537
Gunnison	1,669	1,676	1,676	1,676	1,684	1,693	1,701	1,709	1,718	1,727	1,736
Jefferson	56,015	56,198	56,198	56,198	56,374	56,551	56,731	56,913	57,098	57,286	57,476
Larimer	33,599	33,762	33,762	33,762	33,896	34,031	34,168	34,307	34,445	34,586	34,729
Pueblo	21,763	21,831	21,831	21,831	21,905	21,978	22,053	22,129	22,208	22,290	22,373
Weld	40,037	40,189	40,189	40,189	40,353	40,519	40,687	40,853	41,023	41,195	41,370

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:		
	9/16	9/17	9/18	9/19	9/21	9/23	9/25
Adams	68,943	69,094	69,094	69,094	69,406 (13,881) [3,331] {1,666}	69,719 (13,944) [3,347] {1,673}	70,033 (14,007) [3,362] {1,681}
Arapahoe	71,908	72,074	72,074	72,074	72,449 (14,490) [3,478] {1,739}	72,814 (14,563) [3,495] {1,748}	73,183 (14,637) [3,513] {1,756}
Boulder	27,673	27,759	27,759	27,759	27,926 (5,585) [1,340] {670}	28,094 (5,619) [1,349] {674}	28,263 (5,653) [1,357] {678}
Denver	83,560	83,741	83,741	83,741	84,115 (16,823) [4,038] {2,019}	84,490 (16,898) [4,056] {2,028}	84,881 (16,976) [4,074] {2,037}
Douglas	35,941	36,042	36,042	36,042	36,269 (7,254) [1,741] {870}	36,498 (7,300) [1,752] {876}	36,727 (7,345) [1,763] {881}
Eagle	7,685	7,715	7,715	7,715	7,763 (1,553) [373] {186}	7,812 (1,562) [375] {187}	7,860 (1,572) [377] {189}
El Paso	87,596	87,936	87,936	87,936	88,660 (17,732) [4,256] {2,128}	89,396 (17,879) [4,291] {2,146}	90,154 (18,031) [4,327] {2,164}
Gunnison	1,669	1,676	1,676	1,676	1,693 (339) [81] {41}	1,709 (342) [82] {41}	1,727 (345) [83] {41}
Jefferson	56,015	56,198	56,198	56,198	56,551 (11,310) [2,714] {1,357}	56,913 (11,383) [2,732] {1,366}	57,286 (11,457) [2,750] {1,375}
Larimer	33,599	33,762	33,762	33,762	34,031 (6,806) [1,634] {817}	34,307 (6,861) [1,647] {823}	34,586 (6,917) [1,660] {830}
Pueblo	21,763	21,831	21,831	21,831	21,978 (4,396) [1,055] {527}	22,129 (4,426) [1,062] {531}	22,290 (4,458) [1,070] {535}
Weld	40,037	40,189	40,189	40,189	40,519 (8,104) [1,945] {972}	40,853 (8,171) [1,961] {980}	41,195 (8,239) [1,977] {989}

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.