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

Date: 9/3/21

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 9/3/21 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.

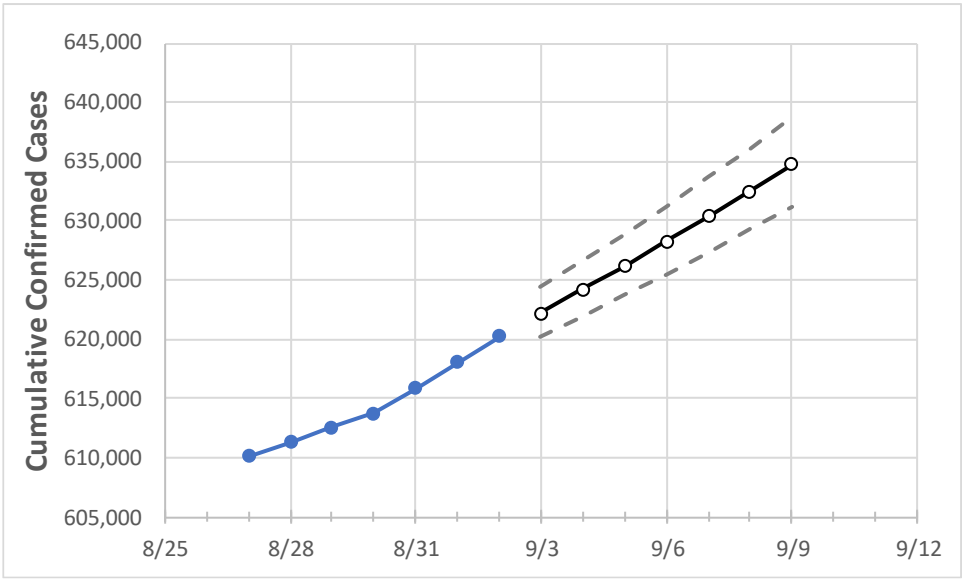
IEM's Modeling Lead

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:						
	8/30	8/31	9/1	9/2	9/3	9/4	9/5	9/6	9/7	9/8	9/9
Colorado	613,730	615,878	618,072	620,268	622,222	624,178	626,186	628,257	630,339	632,498	634,727

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:						
	8/30	8/31	9/1	9/2	9/3	9/4	9/5	9/6	9/7	9/8	9/9
Adams	66,212	66,413	66,580	66,753	66,942	67,131	67,320	67,517	67,720	67,926	68,142
Arapahoe	68,588	68,794	69,043	69,315	69,522	69,724	69,936	70,153	70,375	70,598	70,830
Boulder	26,261	26,363	26,481	26,552	26,626	26,701	26,777	26,853	26,931	27,011	27,093
Denver	80,551	80,760	81,008	81,229	81,431	81,630	81,833	82,041	82,256	82,475	82,692
Douglas	33,933	34,065	34,189	34,351	34,484	34,618	34,755	34,894	35,041	35,191	35,341
Eagle	7,160	7,220	7,260	7,304	7,336	7,368	7,402	7,435	7,471	7,508	7,543
El Paso	82,082	82,521	82,854	83,187	83,471	83,764	84,058	84,361	84,668	84,990	85,313
Gunnison	1,550	1,560	1,570	1,575	1,584	1,593	1,603	1,613	1,623	1,634	1,644
Jefferson	53,408	53,556	53,744	53,902	54,051	54,198	54,354	54,509	54,665	54,830	54,989
Larimer	31,512	31,620	31,731	31,892	32,027	32,166	32,306	32,449	32,595	32,748	32,899
Pueblo	20,785	20,846	20,907	20,963	21,010	21,058	21,107	21,158	21,210	21,265	21,319
Weld	37,416	37,539	37,702	37,890	38,053	38,220	38,389	38,566	38,744	38,929	39,120

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:		
	8/30	8/31	9/1	9/2	9/4	9/6	9/8
Adams	66,212	66,413	66,580	66,753	67,131 (13,426) [3,222] {1,611}	67,517 (13,503) [3,241] {1,620}	67,926 (13,585) [3,260] {1,630}
Arapahoe	68,588	68,794	69,043	69,315	69,724 (13,945) [3,347] {1,673}	70,153 (14,031) [3,367] {1,684}	70,598 (14,120) [3,389] {1,694}
Boulder	26,261	26,363	26,481	26,552	26,701 (5,340) [1,282] {641}	26,853 (5,371) [1,289] {644}	27,011 (5,402) [1,297] {648}
Denver	80,551	80,760	81,008	81,229	81,630 (16,326) [3,918] {1,959}	82,041 (16,408) [3,938] {1,969}	82,475 (16,495) [3,959] {1,979}
Douglas	33,933	34,065	34,189	34,351	34,618 (6,924) [1,662] {831}	34,894 (6,979) [1,675] {837}	35,191 (7,038) [1,689] {845}
Eagle	7,160	7,220	7,260	7,304	7,368 (1,474) [354] {177}	7,435 (1,487) [357] {178}	7,508 (1,502) [360] {180}
El Paso	82,082	82,521	82,854	83,187	83,764 (16,753) [4,021] {2,010}	84,361 (16,872) [4,049] {2,025}	84,990 (16,998) [4,080] {2,040}
Gunnison	1,550	1,560	1,570	1,575	1,593 (319) [76] {38}	1,613 (323) [77] {39}	1,634 (327) [78] {39}
Jefferson	53,408	53,556	53,744	53,902	54,198 (10,840) [2,602] {1,301}	54,509 (10,902) [2,616] {1,308}	54,830 (10,966) [2,632] {1,316}
Larimer	31,512	31,620	31,731	31,892	32,166 (6,433) [1,544] {772}	32,449 (6,490) [1,558] {779}	32,748 (6,550) [1,572] {786}
Pueblo	20,785	20,846	20,907	20,963	21,058 (4,212) [1,011] {505}	21,158 (4,232) [1,016] {508}	21,265 (4,253) [1,021] {510}
Weld	37,416	37,539	37,702	37,890	38,220 (7,644) [1,835] {917}	38,566 (7,713) [1,851] {926}	38,929 (7,786) [1,869] {934}

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.