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

Date: 9/17/21

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 9/17/21 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.

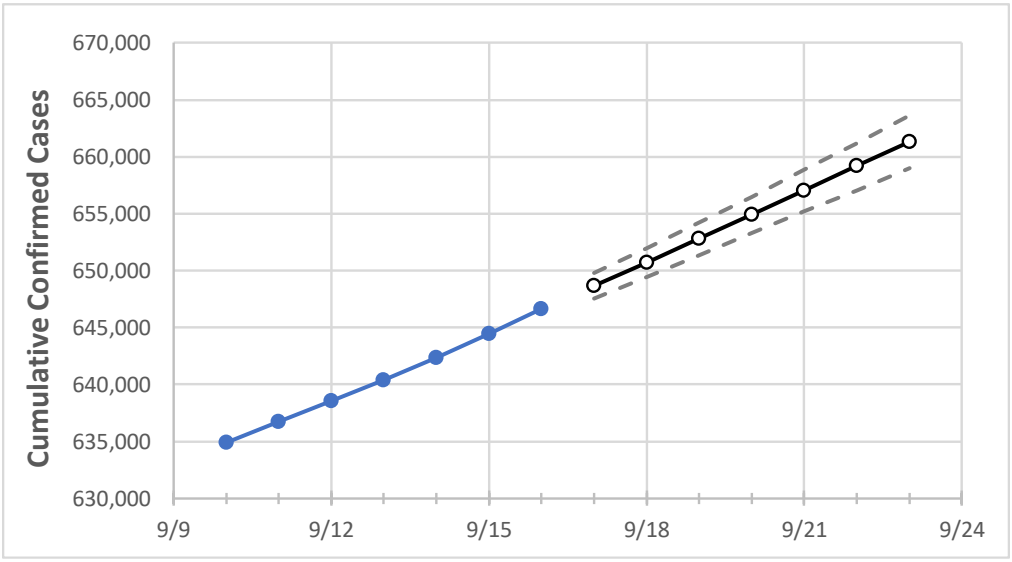
IEM's Modeling Lead

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:						
	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20	9/21	9/22	9/23
Colorado	640,380	642,360	644,419	646,605	648,635	650,685	652,795	654,903	657,011	659,170	661,324

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:						
	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20	9/21	9/22	9/23
Adams	68,469	68,629	68,769	68,943	69,097	69,252	69,406	69,558	69,714	69,867	70,019
Arapahoe	71,341	71,519	71,704	71,908	72,093	72,283	72,468	72,660	72,847	73,035	73,226
Boulder	27,430	27,503	27,577	27,673	27,754	27,834	27,917	27,998	28,080	28,163	28,248
Denver	82,961	83,127	83,326	83,560	83,739	83,920	84,103	84,291	84,474	84,663	84,848
Douglas	35,595	35,683	35,819	35,941	36,058	36,173	36,290	36,406	36,523	36,641	36,760
Eagle	7,621	7,640	7,670	7,685	7,709	7,733	7,758	7,780	7,806	7,829	7,853
El Paso	86,531	86,922	87,249	87,596	87,943	88,291	88,641	88,999	89,351	89,721	90,092
Gunnison	1,651	1,657	1,659	1,669	1,677	1,685	1,694	1,702	1,711	1,720	1,729
Jefferson	55,529	55,675	55,849	56,015	56,177	56,346	56,513	56,684	56,855	57,029	57,206
Larimer	33,250	33,364	33,473	33,599	33,721	33,844	33,966	34,090	34,213	34,336	34,458
Pueblo	21,568	21,636	21,704	21,763	21,831	21,900	21,970	22,042	22,116	22,190	22,268
Weld	39,531	39,720	39,853	40,037	40,200	40,363	40,528	40,696	40,863	41,033	41,201

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:		
	9/13	9/14	9/15	9/16	9/18	9/20	9/22
Adams	68,469	68,629	68,769	68,943	69,252 (13,850) [3,324] {1,662}	69,558 (13,912) [3,339] {1,669}	69,867 (13,973) [3,354] {1,677}
Arapahoe	71,341	71,519	71,704	71,908	72,283 (14,457) [3,470] {1,735}	72,660 (14,532) [3,488] {1,744}	73,035 (14,607) [3,506] {1,753}
Boulder	27,430	27,503	27,577	27,673	27,834 (5,567) [1,336] {668}	27,998 (5,600) [1,344] {672}	28,163 (5,633) [1,352] {676}
Denver	82,961	83,127	83,326	83,560	83,920 (16,784) [4,028] {2,014}	84,291 (16,858) [4,046] {2,023}	84,663 (16,933) [4,064] {2,032}
Douglas	35,595	35,683	35,819	35,941	36,173 (7,235) [1,736] {868}	36,406 (7,281) [1,747] {874}	36,641 (7,328) [1,759] {879}
Eagle	7,621	7,640	7,670	7,685	7,733 (1,547) [371] {186}	7,780 (1,556) [373] {187}	7,829 (1,566) [376] {188}
El Paso	86,531	86,922	87,249	87,596	88,291 (17,658) [4,238] {2,119}	88,999 (17,800) [4,272] {2,136}	89,721 (17,944) [4,307] {2,153}
Gunnison	1,651	1,657	1,659	1,669	1,685 (337) [81] {40}	1,702 (340) [82] {41}	1,720 (344) [83] {41}
Jefferson	55,529	55,675	55,849	56,015	56,346 (11,269) [2,705] {1,352}	56,684 (11,337) [2,721] {1,360}	57,029 (11,406) [2,737] {1,369}
Larimer	33,250	33,364	33,473	33,599	33,844 (6,769) [1,625] {812}	34,090 (6,818) [1,636] {818}	34,336 (6,867) [1,648] {824}
Pueblo	21,568	21,636	21,704	21,763	21,900 (4,380) [1,051] {526}	22,042 (4,408) [1,058] {529}	22,190 (4,438) [1,065] {533}
Weld	39,531	39,720	39,853	40,037	40,363 (8,073) [1,937] {969}	40,696 (8,139) [1,953] {977}	41,033 (8,207) [1,970] {985}

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.