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

Date: 12/3/20

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 12/3/20 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.

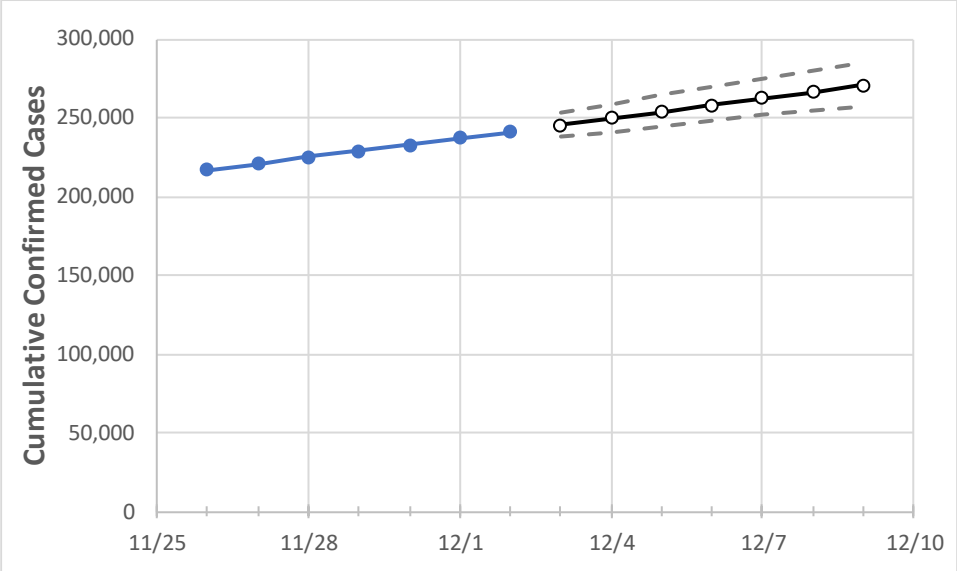
IEM's Modeling Lead

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:						
	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9
Colorado	228,772	232,905	237,310	241,172	245,440	249,685	253,905	258,101	262,272	266,419	270,541

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 20%, and are often within 10%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9
Adams	29,130	29,665	30,241	30,538	30,962	31,381	31,795	32,205	32,611	33,012	33,408
Arapahoe	26,753	27,228	27,727	28,064	28,481	28,893	29,300	29,703	30,101	30,495	30,884
Boulder	10,926	11,111	11,329	11,454	11,607	11,759	11,909	12,057	12,203	12,348	12,492
Denver	36,243	36,704	37,106	37,510	37,974	38,429	38,878	39,319	39,752	40,179	40,599
Douglas	10,560	10,782	11,037	11,188	11,413	11,637	11,860	12,082	12,303	12,524	12,743
Eagle	2,364	2,390	2,403	2,438	2,467	2,497	2,527	2,557	2,588	2,619	2,651
El Paso	26,639	27,197	27,829	28,394	29,015	29,639	30,268	30,900	31,536	32,176	32,820
Gunnison	471	473	476	477	479	482	484	486	489	491	493
Jefferson	20,358	20,710	21,156	21,476	21,848	22,217	22,584	22,948	23,310	23,669	24,027
Larimer	10,115	10,253	10,427	10,627	10,816	11,002	11,187	11,370	11,550	11,729	11,906
Pueblo	8,269	8,594	8,856	9,048	9,303	9,559	9,817	10,077	10,338	10,602	10,866
Weld	13,813	14,026	14,297	14,509	14,759	15,007	15,252	15,496	15,737	15,977	16,214

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:		
	11/29	11/30	12/1	12/2	12/4	12/6	12/8
Adams	29,130	29,665	30,241	30,538	31,381 (6,276) [1,506] {753}	32,205 (6,441) [1,546] {773}	33,012 (6,602) [1,585] {792}
Arapahoe	26,753	27,228	27,727	28,064	28,893 (5,779) [1,387] {693}	29,703 (5,941) [1,426] {713}	30,495 (6,099) [1,464] {732}
Boulder	10,926	11,111	11,329	11,454	11,759 (2,352) [564] {282}	12,057 (2,411) [579] {289}	12,348 (2,470) [593] {296}
Denver	36,243	36,704	37,106	37,510	38,429 (7,686) [1,845] {922}	39,319 (7,864) [1,887] {944}	40,179 (8,036) [1,929] {964}
Douglas	10,560	10,782	11,037	11,188	11,637 (2,327) [559] {279}	12,082 (2,416) [580] {290}	12,524 (2,505) [601] {301}
Eagle	2,364	2,390	2,403	2,438	2,497 (499) [120] {60}	2,557 (511) [123] {61}	2,619 (524) [126] {63}
El Paso	26,639	27,197	27,829	28,394	29,639 (5,928) [1,423] {711}	30,900 (6,180) [1,483] {742}	32,176 (6,435) [1,544] {772}
Gunnison	471	473	476	477	482 (96) [23] {12}	486 (97) [23] {12}	491 (98) [24] {12}
Jefferson	20,358	20,710	21,156	21,476	22,217 (4,443) [1,066] {533}	22,948 (4,590) [1,101] {551}	23,669 (4,734) [1,136] {568}
Larimer	10,115	10,253	10,427	10,627	11,002 (2,200) [528] {264}	11,370 (2,274) [546] {273}	11,729 (2,346) [563] {281}
Pueblo	8,269	8,594	8,856	9,048	9,559 (1,912) [459] {229}	10,077 (2,015) [484] {242}	10,602 (2,120) [509] {254}
Weld	13,813	14,026	14,297	14,509	15,007 (3,001) [720] {360}	15,496 (3,099) [744] {372}	15,977 (3,195) [767] {383}

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.