IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/23/20

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

The projections shown in this document are based on data pulled in as of 7/23/20 11 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.

Massachusetts State Projections
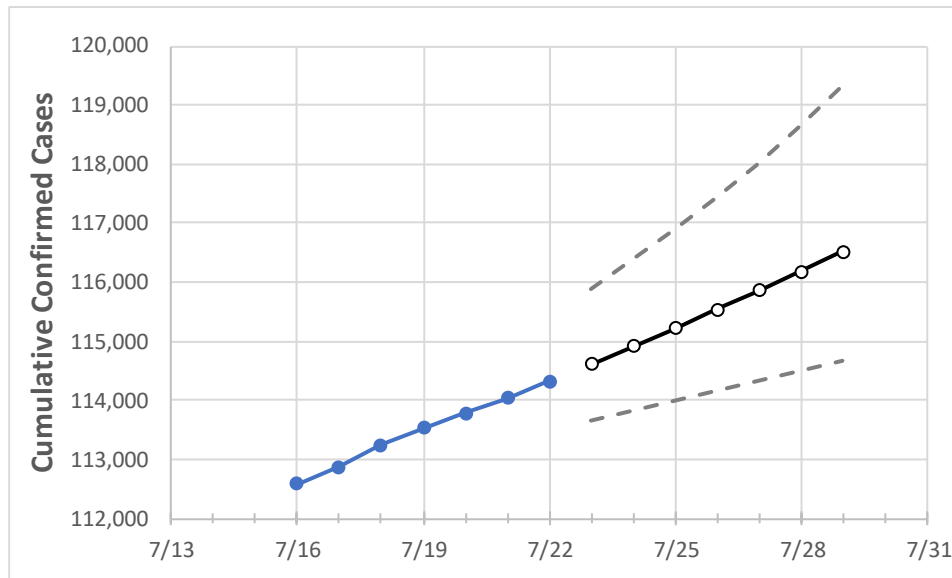
	Actual Confirmed Cases On:				Projected Cases For:						
	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29
Massachusetts	113,533	113,789	114,033	114,320	114,614	114,915	115,222	115,537	115,858	116,187	116,523

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.

Massachusetts Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29
Barnstable	1,622	1,635	1,639	1,644	1,652	1,661	1,670	1,681	1,691	1,703	1,715
Berkshire	623	624	625	626	627	628	629	630	631	632	633
Bristol	8,681	8,719	8,745	8,761	8,788	8,816	8,844	8,872	8,902	8,932	8,962
Essex	16,733	16,757	16,784	16,815	16,846	16,877	16,909	16,940	16,972	17,004	17,036
Franklin	390	390	390	390	391	392	392	393	394	395	396
Hampden	7,140	7,141	7,152	7,180	7,193	7,205	7,218	7,230	7,241	7,253	7,264
Hampshire	1,039	1,049	1,057	1,063	1,070	1,076	1,084	1,092	1,100	1,109	1,119
Middlesex	24,886	24,958	25,011	25,084	25,153	25,224	25,298	25,374	25,453	25,535	25,620
Norfolk	9,699	9,737	9,779	9,821	9,863	9,908	9,954	10,002	10,053	10,106	10,161
Plymouth	8,889	8,894	8,903	8,917	8,925	8,934	8,942	8,951	8,959	8,968	8,976
Suffolk	20,601	20,621	20,650	20,678	20,711	20,744	20,776	20,809	20,841	20,873	20,906
Worcester	12,830	12,859	12,894	12,933	12,961	12,990	13,019	13,049	13,079	13,110	13,141

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.

Massachusetts Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	7/19	7/20	7/21	7/22	7/24	7/26	7/28
Barnstable	1,622	1,635	1,639	1,644	1,661 (332) [80] {40}	1,681 (336) [81] {40}	1,703 (341) [82] {41}
Berkshire	623	624	625	626	628 (126) [30] {15}	630 (126) [30] {15}	632 (126) [30] {15}
Bristol	8,681	8,719	8,745	8,761	8,816 (1,763) [423] {212}	8,872 (1,774) [426] {213}	8,932 (1,786) [429] {214}
Essex	16,733	16,757	16,784	16,815	16,877 (3,375) [810] {405}	16,940 (3,388) [813] {407}	17,004 (3,401) [816] {408}
Franklin	390	390	390	390	392 (78) [19] {9}	393 (79) [19] {9}	395 (79) [19] {9}
Hampden	7,140	7,141	7,152	7,180	7,205 (1,441) [346] {173}	7,230 (1,446) [347] {174}	7,253 (1,451) [348] {174}
Hampshire	1,039	1,049	1,057	1,063	1,076 (215) [52] {26}	1,092 (218) [52] {26}	1,109 (222) [53] {27}
Middlesex	24,886	24,958	25,011	25,084	25,224 (5,045) [1,211] {605}	25,374 (5,075) [1,218] {609}	25,535 (5,107) [1,226] {613}
Norfolk	9,699	9,737	9,779	9,821	9,908 (1,982) [476] {238}	10,002 (2,000) [480] {240}	10,106 (2,021) [485] {243}
Plymouth	8,889	8,894	8,903	8,917	8,934 (1,787) [429] {214}	8,951 (1,790) [430] {215}	8,968 (1,794) [430] {215}
Suffolk	20,601	20,621	20,650	20,678	20,744 (4,149) [996] {498}	20,809 (4,162) [999] {499}	20,873 (4,175) [1,002] {501}
Worcester	12,830	12,859	12,894	12,933	12,990 (2,598) [624] {312}	13,049 (2,610) [626] {313}	13,110 (2,622) [629] {315}

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.