

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

Date: 9/2/20

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 9/2/20 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.

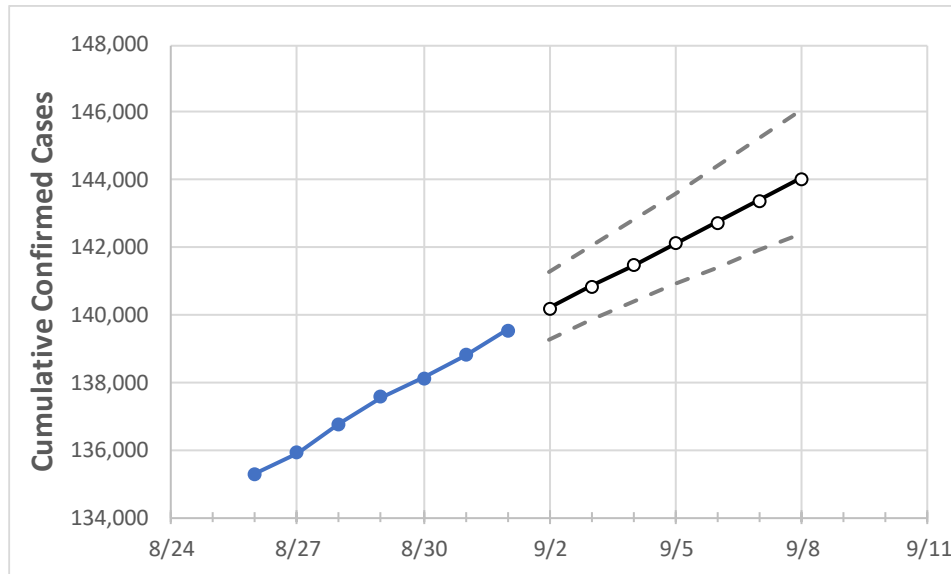
IEM's Modeling Lead

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.

Pennsylvania State Projections



	Actual Confirmed Cases On:				Projected Cases For:							
	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5	9/6	9/7	9/8	
Pennsylvania	137,576	138,134	138,795	139,548	140,188	140,829	141,469	142,109	142,748	143,388	144,027	

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.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:							
	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5	9/6	9/7	9/8	
Allegheny	10,211	10,310	10,347	10,376	10,412	10,448	10,482	10,515	10,547	10,578	10,608	
Berks	6,012	6,041	6,056	6,095	6,127	6,158	6,191	6,223	6,256	6,288	6,321	
Bucks	7,744	7,777	7,805	7,824	7,848	7,872	7,896	7,920	7,944	7,968	7,992	
Butler	778	780	785	789	793	796	800	804	807	811	815	
Chester	5,629	5,653	5,678	5,719	5,744	5,770	5,796	5,822	5,849	5,876	5,904	
Delaware	10,281	10,317	10,357	10,429	10,466	10,501	10,537	10,572	10,606	10,640	10,673	
Lackawanna	2,061	2,079	2,085	2,093	2,103	2,113	2,124	2,136	2,149	2,162	2,175	
Lancaster	6,660	6,697	6,731	6,789	6,826	6,864	6,902	6,941	6,980	7,019	7,058	
Lehigh	5,184	5,196	5,204	5,212	5,219	5,225	5,232	5,238	5,245	5,251	5,257	
Luzerne	3,768	3,771	3,778	3,788	3,795	3,802	3,809	3,815	3,821	3,827	3,833	
Monroe	1,713	1,712	1,714	1,716	1,719	1,721	1,723	1,726	1,728	1,731	1,733	
Montgomery	10,947	10,996	11,035	11,093	11,137	11,181	11,226	11,270	11,315	11,361	11,406	
Northampton	4,112	4,114	4,117	4,120	4,124	4,127	4,131	4,134	4,137	4,140	4,143	
Philadelphia	33,607	33,693	33,778	33,909	34,004	34,100	34,195	34,289	34,383	34,477	34,571	
Westmoreland	1,802	1,809	1,815	1,819	1,827	1,836	1,844	1,851	1,859	1,866	1,873	
York	3,301	3,328	3,368	3,442	3,478	3,515	3,551	3,589	3,627	3,665	3,704	

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.

Pennsylvania Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:											
	8/29	8/30	8/31	9/1	9/3				9/5				9/7			
Allegheny	10,211	10,310	10,347	10,376	10,448	(2,090)	[501]	{251}	10,515	(2,103)	[505]	{252}	10,578	(2,116)	[508]	{254}
Berks	6,012	6,041	6,056	6,095	6,158	(1,232)	[296]	{148}	6,223	(1,245)	[299]	{149}	6,288	(1,258)	[302]	{151}
Bucks	7,744	7,777	7,805	7,824	7,872	(1,574)	[378]	{189}	7,920	(1,584)	[380]	{190}	7,968	(1,594)	[382]	{191}
Butler	778	780	785	789	796	(159)	[38]	{19}	804	(161)	[39]	{19}	811	(162)	[39]	{19}
Chester	5,629	5,653	5,678	5,719	5,770	(1,154)	[277]	{138}	5,822	(1,164)	[279]	{140}	5,876	(1,175)	[282]	{141}
Delaware	10,281	10,317	10,357	10,429	10,501	(2,100)	[504]	{252}	10,572	(2,114)	[507]	{254}	10,640	(2,128)	[511]	{255}
Lackawanna	2,061	2,079	2,085	2,093	2,113	(423)	[101]	{51}	2,136	(427)	[103]	{51}	2,162	(432)	[104]	{52}
Lancaster	6,660	6,697	6,731	6,789	6,864	(1,373)	[329]	{165}	6,941	(1,388)	[333]	{167}	7,019	(1,404)	[337]	{168}
Lehigh	5,184	5,196	5,204	5,212	5,225	(1,045)	[251]	{125}	5,238	(1,048)	[251]	{126}	5,251	(1,050)	[252]	{126}
Luzerne	3,768	3,771	3,778	3,788	3,802	(760)	[182]	{91}	3,815	(763)	[183]	{92}	3,827	(765)	[184]	{92}
Monroe	1,713	1,712	1,714	1,716	1,721	(344)	[83]	{41}	1,726	(345)	[83]	{41}	1,731	(346)	[83]	{42}
Montgomery	10,947	10,996	11,035	11,093	11,181	(2,236)	[537]	{268}	11,270	(2,254)	[541]	{270}	11,361	(2,272)	[545]	{273}
Northampton	4,112	4,114	4,117	4,120	4,127	(825)	[198]	{99}	4,134	(827)	[198]	{99}	4,140	(828)	[199]	{99}
Philadelphia	33,607	33,693	33,778	33,909	34,100	(6,820)	[1,637]	{818}	34,289	(6,858)	[1,646]	{823}	34,477	(6,895)	[1,655]	{827}
Westmoreland	1,802	1,809	1,815	1,819	1,836	(367)	[88]	{44}	1,851	(370)	[89]	{44}	1,866	(373)	[90]	{45}
York	3,301	3,328	3,368	3,442	3,515	(703)	[169]	{84}	3,589	(718)	[172]	{86}	3,665	(733)	[176]	{88}

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.