COVID-19 Bed Demand & Surge Capacity Model for Berks County

REVISION FROM 4/4/2020

April 7, 2020

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COVID-19 Bed Demand & Surge Capacity Model

UPDATES FROM SATURDAY, 4/4 CONFERENCE CALL

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IMPORTANT UPDATES

<u>The surge outputs that follow have changed dramatically for all hospitals</u>

Doubling Rates

- The PA DOH uses a variation on the formula for calculating doubling rates that incorporates daily change (to account for the recency of growth) vs. looking at growth since Day 1.
- As such, we have adjusted the Berks County doubling rate as of 4/7/2020.
- These rates align with the visual trendlines for each county in the graph on **p. 9**.
- These have been verified by Dr. Jeff Miller at the PA DOH

Reading Eagle, 4/7/2020

From Gov. Wolf:

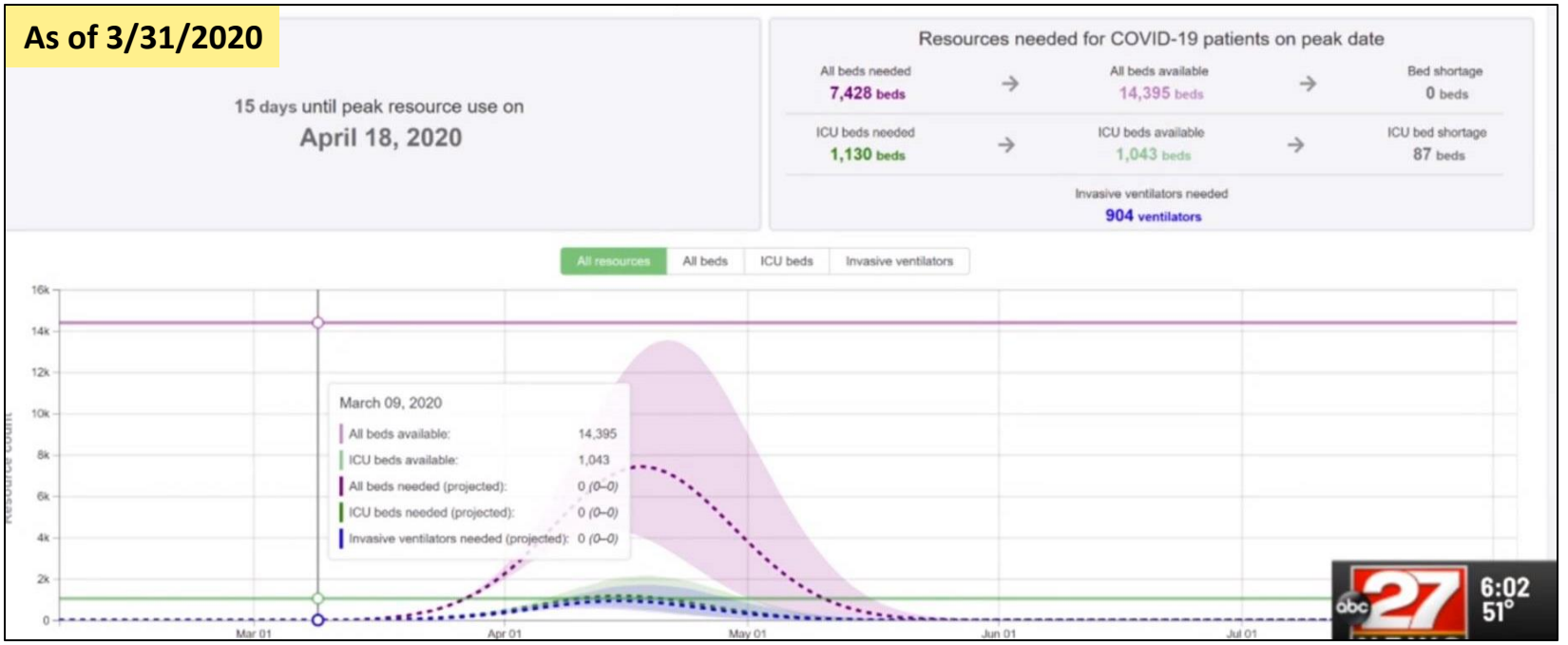
"We are starting to see that the early exponential increase in cases has given way to a much flatter curve, so the surge may not be as great as we once anticipated, that's our fervent hope…"

Declining Rates

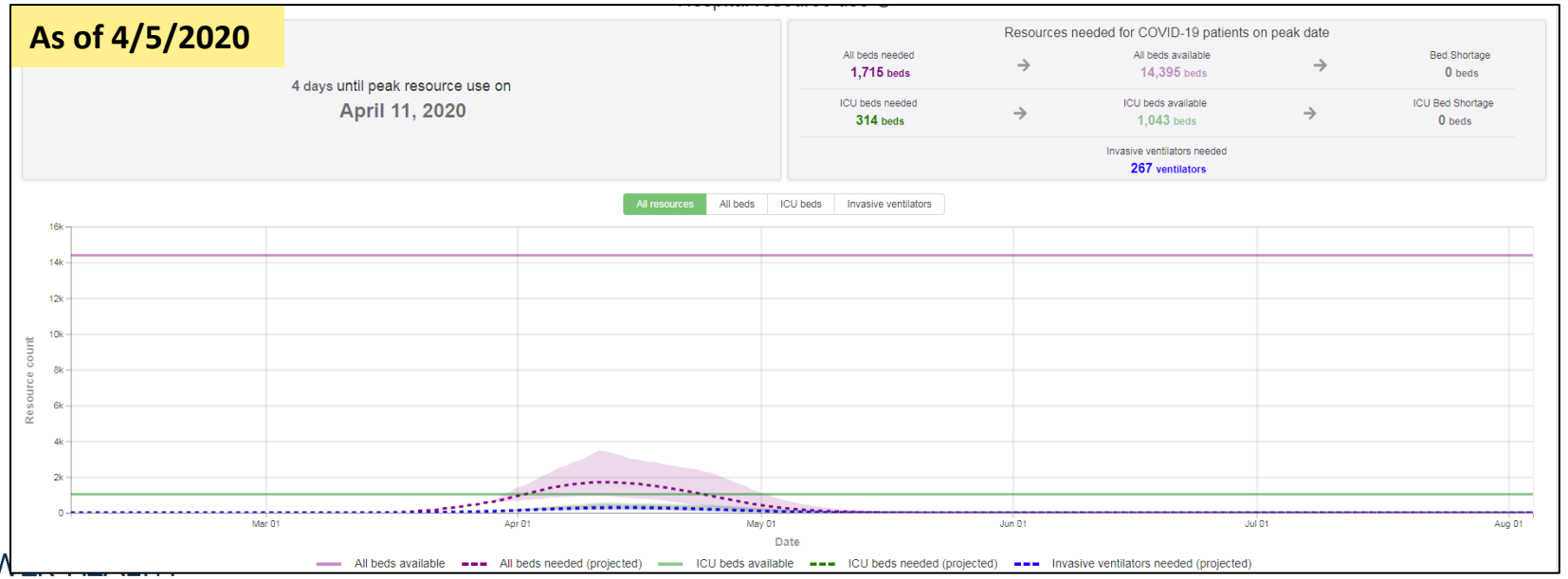
- Initial modeling from the University of Washington indicated that Pennsylvania would experience its peak surge on April 18th.
- We considered this when timing the decline in infection for Berks County around 4/27/2020, **<u>which is 3 days later than previously modeled</u>**
- <u>Update:</u> The University of Washington models were revised on 4/5/2020, and it has also altered the peak for PA to April 11th. We did not re-calibrate the model for this update. **(Comparison shown on next slide.)**

CHANGE IN UNIV OF WASHINGTON MODEL FOR PENNSYLVANIA

As of 3/31/2020



As of 4/5/2020



Source: University of Washington IHME, https://covid19.healthdata.org/united-states-of-america/pennsylvania

COVID-19 Bed Demand & Surge Capacity Model

MODEL INTRODUCTION

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BED DEMAND AND SURGE MODEL

Array Architects - COVID-19 Surge Capacity Assessment Tool https://array-architects.com/

General Overview and Design

- The Array model was adapted from their traditional bed capacity model, for clients to understand the impact of COVID-19.
  - Their model was initially built at the state level. Tower Health first tailored it to PA Counties, then took it a step further to customize it for each of our hospitals.
  - Initially, Array had included values based on research and data from WHO, CDC, JAMA, NEJM, etc. As newer information became more available, based on US experience, they edited some of those assumptions.
  - The inputs you see are the ones Tower Health used for the baseline models that we ran for each of our hospitals, outside of items specific to those hospitals. We kept LOS, admission rates, etc, the same across all.
  - These inputs were also used for the Berks County, outside of those specific to each hospital.

Confirmed Cases

- The first day of confirmed cases for Berks County are the starting point for the model's build, with a lag time built in to mimic the latency period between disease onset and the need for hospitalization.

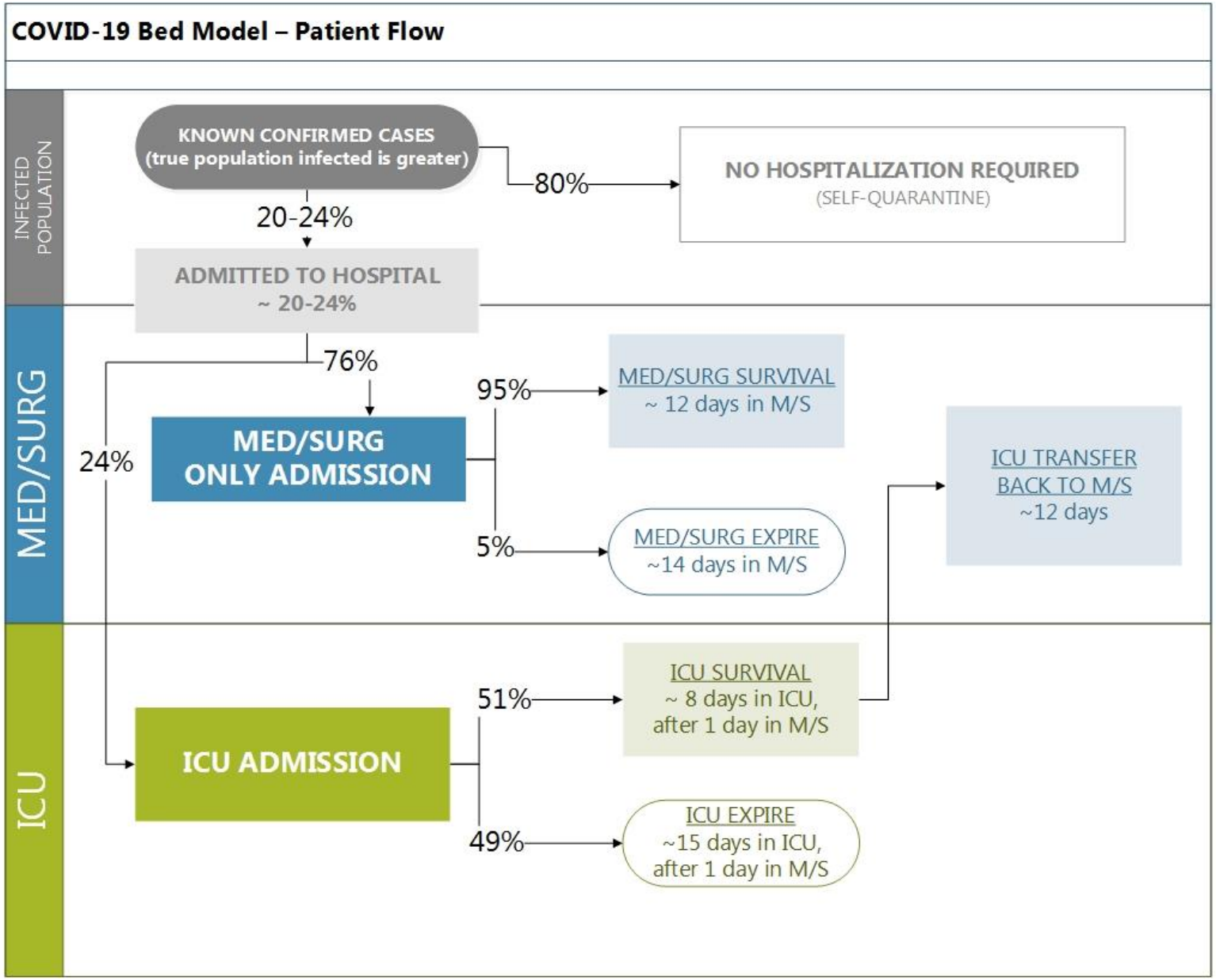
Doubling Rates

- Doubling rates are based on Berks county and represent the mid-range.
- The mid-range was incremented by +/-.5 to create the high and low ranges.
- Increasing doubling rates have been observed in adjacent counties.

Declining Rates

- Declining rates are based on South Korea's experience of approximately 30 days from tail-to-tail in the curve, with a 13% decrease in new infections after the peak. Our assumptions built in a slower decrease of 10%.
- University of Washington modeling indicates that Pennsylvania will experience its peak surge on April 18th.
- We considered this when timing the decline in infection for the Berks County.

BED DEMAND AND SURGE MODEL



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COVID-19 Bed Demand & Surge Capacity Model

MODEL ASSUMPTIONS

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MODEL ASSUMPTIONS

BERKS COUNTY

CATEGORY	VARIABLE	DEFINITION	INPUTS FOR BERKS	READING	PENN STATE ST. JOSEPH	NOTES	SOURCE
INFECTION	Day One	First day of model	4/3/2020			As shown **PULLS IN FROM ANOTHER TAB**	This date refreshes each time DOH cases are updated
INFECTION	Day One Confirmed Cases	Number of confirmed cases on first day of model	201			Based on current total cases in Berks County	PA Department of Health
INFECTION	Total population	Population in selected geography	422,357			As shown - Does not impact number of infections, but helps us calculate what % of the population has been infected by day	Environics Analytics, Claritas 2020 and 2025 Databases
INFECTION	Epidemic doubling time	Number of days it takes for cases to double	4.00			Rate based on current Berks doubling rate; model provides outputs for 3.5, 4.0, and 4.5 for regular and surge capacity	***Update with subsequent iterations as this severely impacts modeled growth by day*
INFECTION	Growth rate per day	% growth every day (today's cases - yesterday's cases)/yesterday's cases	37%			Calculated based on chosen epidemic doubling time	
INFECTION	Confirmation rate	% of infections tested and confirmed Does not affect model output; nice to know but not a need to know	30%			Does not impact number of infections, but helps us calculate what presumed % of the population has been infected by day	
DEMAND	Hospital Admission Rate	% of confirmed cases requiring any type of hospital admission	22%			Age-adjusted for % of pop over 65 in Berks	
DEMAND	Med/Surg Admission Rate	% of cases requiring a hospital admission that will utilize a Med/Surg bed ONLY (NO ICU) Calculated based on chosen % ICU number	76%			Calculated based on chosen % ICU number	
DEMAND	Med/Surg Survival	% of cases in Med/Surg bed ONLY that will survive Calculated based on % of Med/Surg cases likely to expire	95%			Calculated based on % of med/surg cases likely to expire	
DEMAND	Med/Surg Expire	% of cases in Med/Surg bed that will likely expire	5%			Consensus from TH Clinical Team, based on current knowledge	Wu: Cases are rated as mild, severe or critical. Case Fatality Rate (CFR) was 0% in mild and severe cases; 49% CFR for critical cases. "No deaths reported in mild and severe cases."

MODEL ASSUMPTIONS

Adapted from Array Architects Bed Demand Surge Capacity Model

CATEGORY	VARIABLE	DEFINITION	INPUTS FOR BERKS	READING	PENN STATE ST. JOSEPH	NOTES	SOURCE
DEMAND	ICU Admission Rate	% of cases requiring a hospital admission that will utilize an ICU bed	24%			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	ICU Admission Survival	% of cases admitted to ICU that will survive Calculated based on % of ICU cases likely to expire	51%			Calculated based on % of ICU patients likely to expire	
DEMAND	ICU Admission Mortality	% of cases admitted to ICU that will expire	49%			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	Med/Surg Survive: LOS	Average number of days that a patient requiring ONLY a Med/Surg bed (NO ICU) who will survive will need to be hospitalized	12			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	Med/Surg Expire: LOS	Average number of days that a patient requiring ONLY a Med/Surg bed (NO ICU) who will expire will need to be hospitalized	14			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	ICU Survive: Total LOS	Average number of days that a patient likely to survive will require an ICU bed will need to be hospitalized --MAKE SURE THE NEXT THREE ROWS ADD UP TO THIS NUMBER	21			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	ICU Survive: Initial M/S LOS	Average number of days that a patient who will be admitted to the ICU and survive will first spend in a M/S bed	1			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	ICU Survive: ICU LOS	Average number of days that a patient who will be admitted to the ICU and survive and will spend in an ICU bed	8			40% of stay	
DEMAND	ICU Survive: Final M/S LOS	Average number of days that a patient who was in the ICU and improves will then spend in a M/S bed	12			60% of stay	
DEMAND	ICU Death: Total LOS	Average number of days that a patient likely to expire will requiring an ICU bed will need to be hospitalized --MAKE SURE THE NEXT TWO ROWS ADD UP TO THIS NUMBER	16			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	ICU Death: Initial M/S LOS	Average number of days that a patient who will be admitted to the ICU and die will first spend in a M/S bed	1			Consensus from TH Clinical Team, based on current knowledge	
DEMAND	ICU Death: ICU LOS	Average number of days that a patient who will be admitted to the ICU and will expire will spend in an ICU bed Subtract 1 day from the total LOS	15			Subtract 1 day from the total LOS	

MODEL ASSUMPTIONS

Adapted from Array Architects Bed Demand Surge Capacity Model

CATEGORY	VARIABLE	DEFINITION	INPUTS FOR BERKS	READING	PENN STATE ST. JOSEPH	NOTES	SOURCE
SUPPLY	ICU beds	Number of ICU beds	71	41	30	Current count of set-up and staffed beds; Assumes all beds can be staffed	Reading - Internal Team St. Joseph – Internal Team
SUPPLY	Med/Surg beds	Number of Med/Surg beds in select geography	529	415	114	Current count of set-up and staffed beds; Assumes all beds can be staffed	Reading - Internal Team St. Joseph – Internal Team
SUPPLY	ICU Utilization	Current occupancy rate	**55%**	60%	50%		***Update with subsequent iterations as this severely impacts available beds***
SUPPLY	Med/Surg Utilization	Current occupancy rate	**45%**	45%	45%		***Update with subsequent iterations as this severely impacts available beds***
INFECTION	Decline in Growth	Daily Rate of Eventual Decline in Cases	-10%			Based on South Korea's experience	Can be revised with more known data
INFECTION	Start Date for Decline		4/27/2020			Univ of Wash anticipates PA will hit peak surge around April 18th; date is pushed out to be in alignment with local onset	Can be revised with more known data
SUPPLY	Ventilators	Number of ventilators	80	63	17	Current count	
LEVEL 1							
SURGE SUPPLY	ICU beds	Incremental number of ICU beds	60	60	0	Count of beds for surge plan	
SURGE SUPPLY	Med/Surg beds	Incremental number of Med/Surg beds	70	31	39	Count of beds for surge plan	
SURGE SUPPLY	Ventilators	Incremental number of ventilators	131	104	27	Includes converted, borrowed or shared	
LEVEL 2							
SURGE SUPPLY	ICU beds	Incremental number of ICU beds	10	0	10	Count of beds for surge plan	
SURGE SUPPLY	Med/Surg beds	Incremental number of Med/Surg beds	39	0	39	Count of beds for surge plan	
SURGE SUPPLY	Ventilators	Incremental number of ventilators	0	0	0	Includes converted, borrowed or shared	

SURGE TOTAL	**TOTAL ICU BEDS**	**70**	**60**	**10**
	TOTAL MED/SURG BEDS	**109**	**31**	**78**
	TOTAL VENTILATORS	**131**	**104**	**27**

OVERALL TOTAL	**TOTAL ICU BEDS**	**141**	**101**	**40**
	TOTAL MED/SURG BEDS	**638**	**446**	**192**
	TOTAL VENTILATORS	**211**	**167**	**44**

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CURRENT TRENDS

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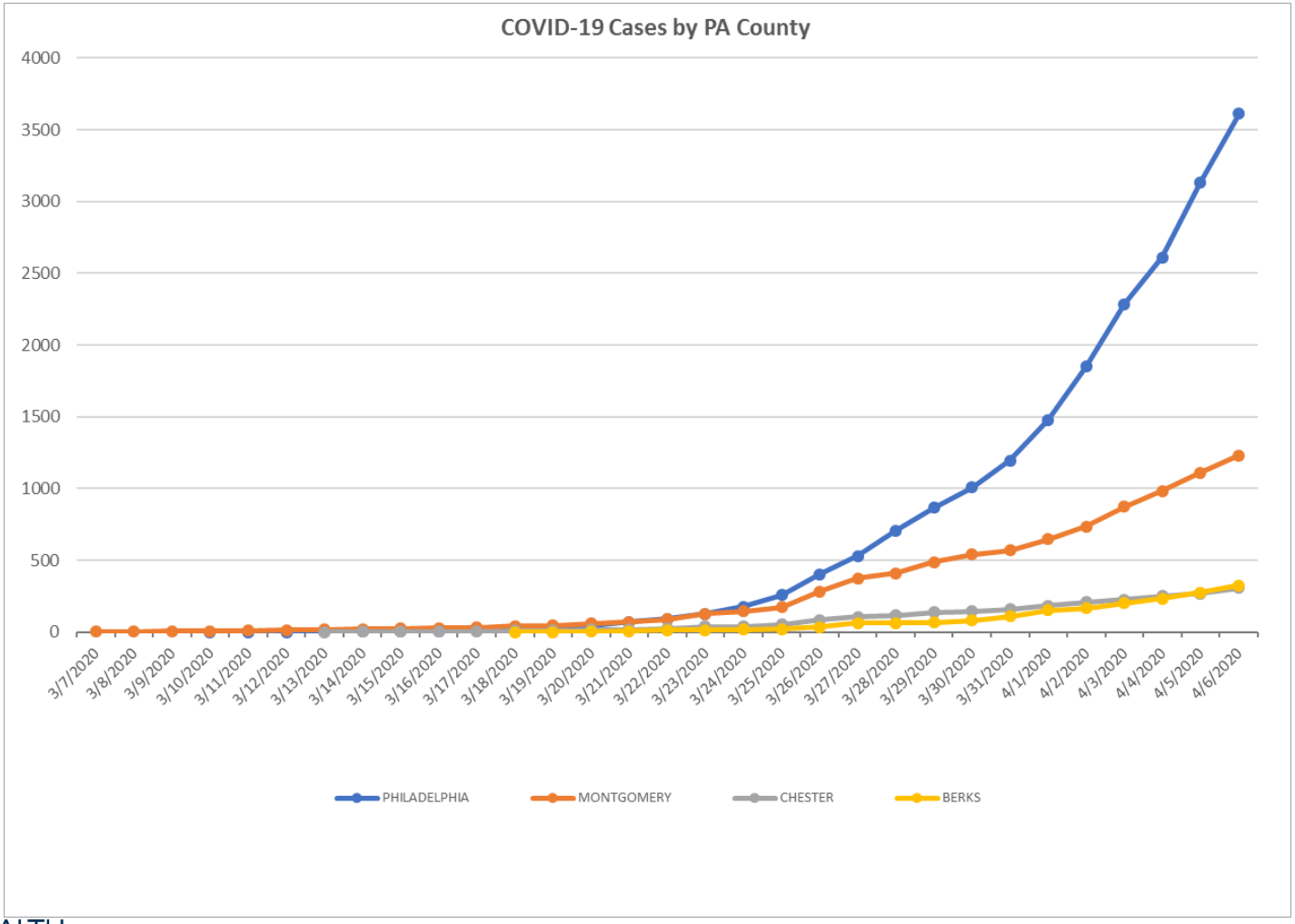
BED DEMAND AND SURGE MODEL

Total Confirmed Cases by County

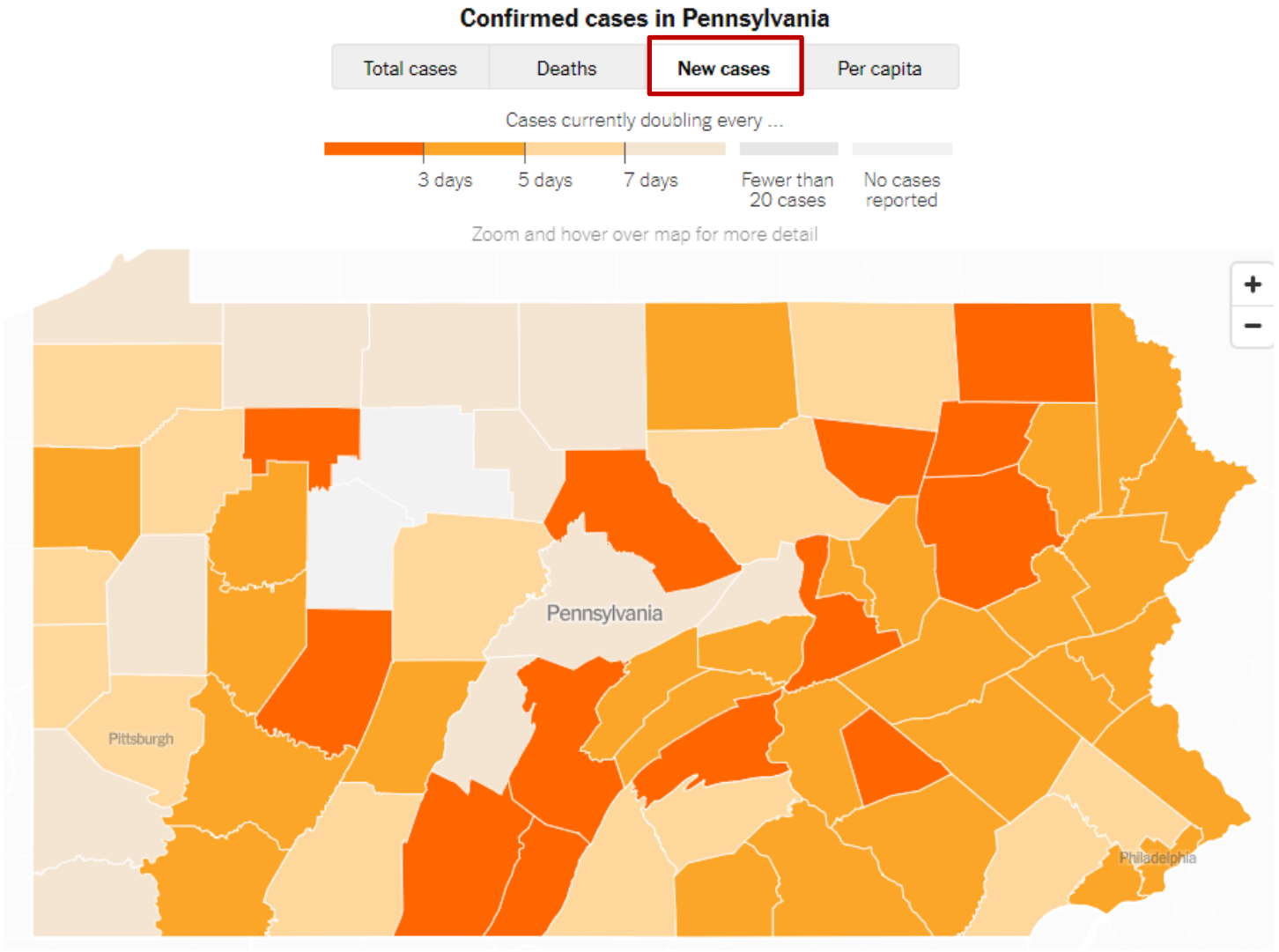
Total Confirmed Cases as of 4/6/2020			
Berks	Chester	Montgomery	Philadelphia
326	307	1230	3611



Source: PA Dept of Health

BED DEMAND AND SURGE MODEL

Doubling Rates by County



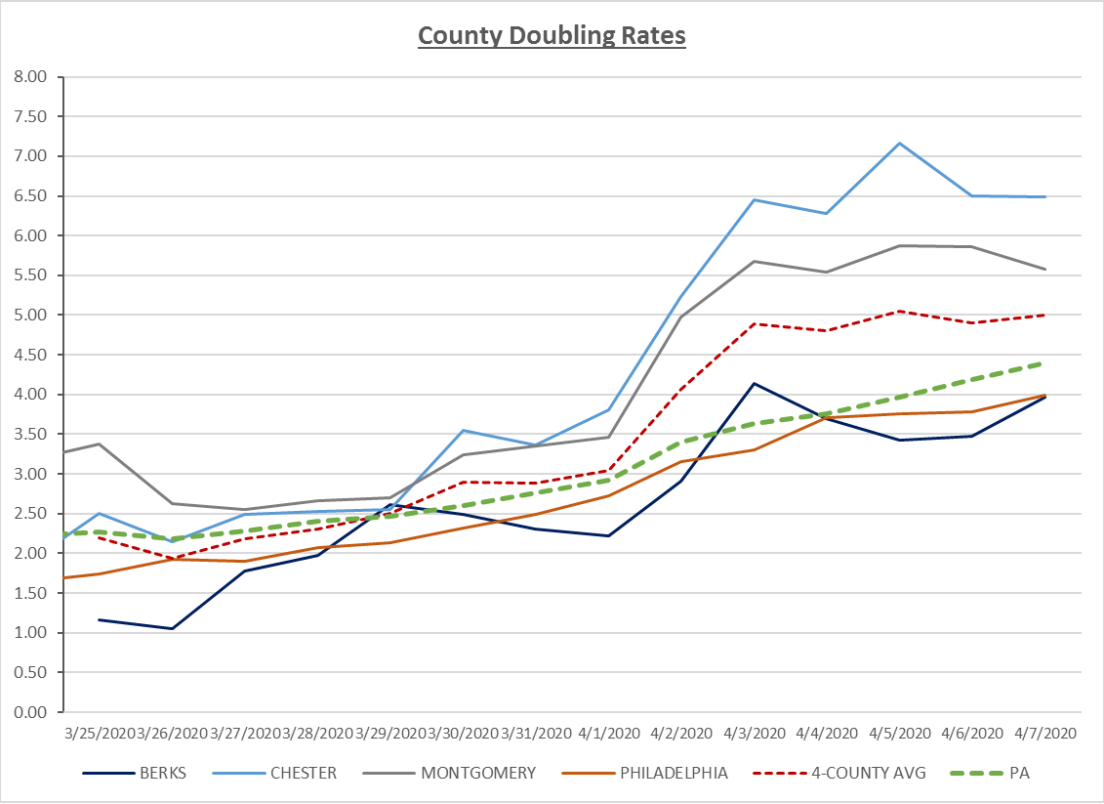
Source: New York Times, using state and local health agencies, hospitals and C.D.C. data.

BED DEMAND AND SURGE MODEL

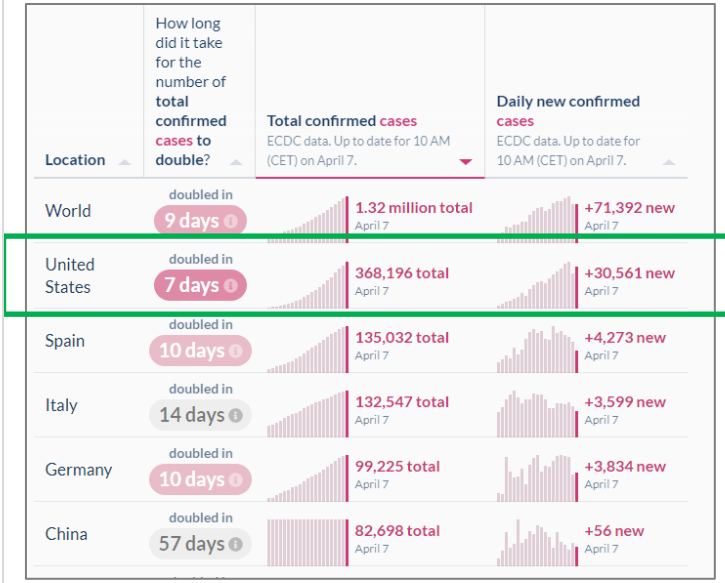
Doubling Rates by County

County Doubling Rates as of 4/6/2020					
Berks	Chester	Montgomery	Philadelphia	PA*	US*
4.0	6.5	5.6	4.0	4.4	6.0

*Using same PA DOH doubling formula for PA and US, data through 4/7/2020 and 4/6/2020 , respectively



"Our World in Data" calculates the US doubling rate at 7, data through 4/6/2020 from ECDC



https://ourworldindata.org/coronavirus

(Excellent, up-to-date charts and graphs)

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Source: PA Dept of Health, ECDC, and The COVID Tracking Project

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BERKS COUNTY

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BED DEMAND AND SURGE MODEL

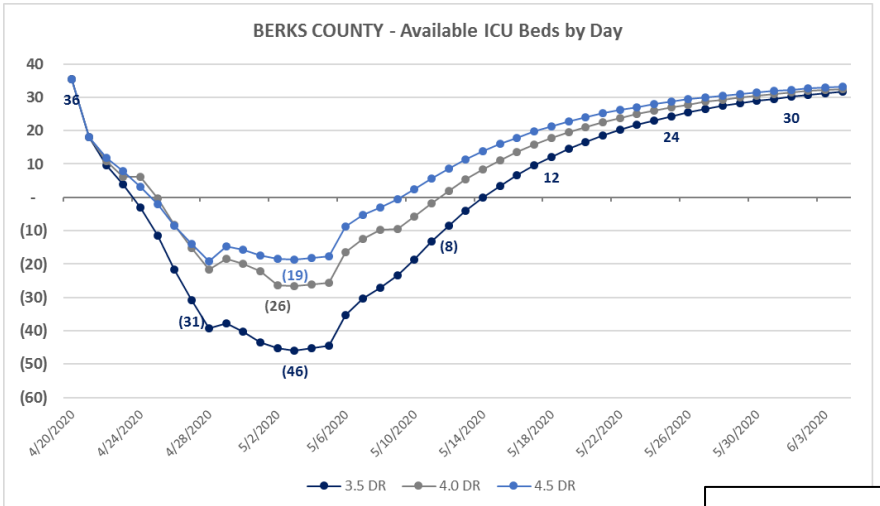
Outputs for Confirmed Cases as of 4/6/2020

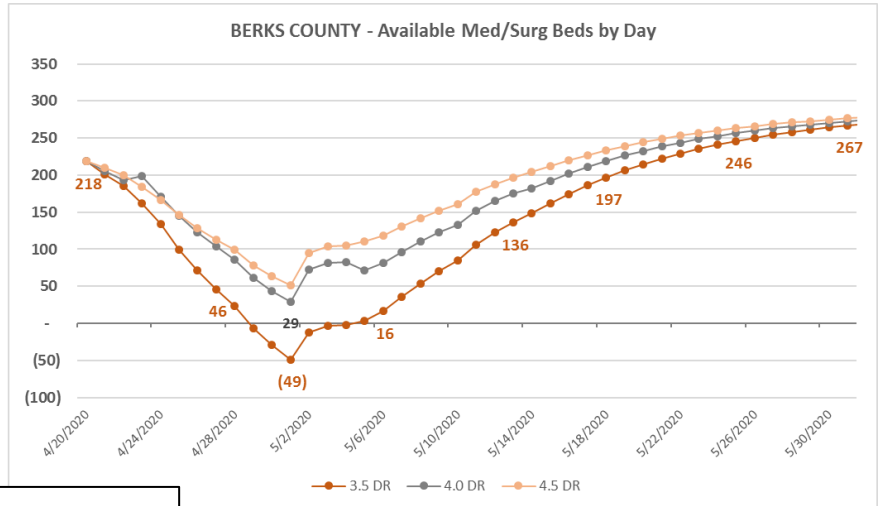
Selected Hospital:	BERKS COUNTY
First day of model:	4/6/2020
Number of confirmed cases on first day of model:	326
First Day of ICU Bed Shortage:	4/24/2020 **2 weeks, 4 days from 4/6/2020**
First Day of Med/Surg Bed Shortage:	4/29/2020 **3 weeks, 2 days from 4/6/2020**

REGULAR OPERATING CAPACITY

Model uses doubling rates of 3.0 DR, 3.5 DR and 4.0 DR to generate 3 potential scenarios

Lower = aggressive infection rate Higher = slowing infection rate due to public health interventions





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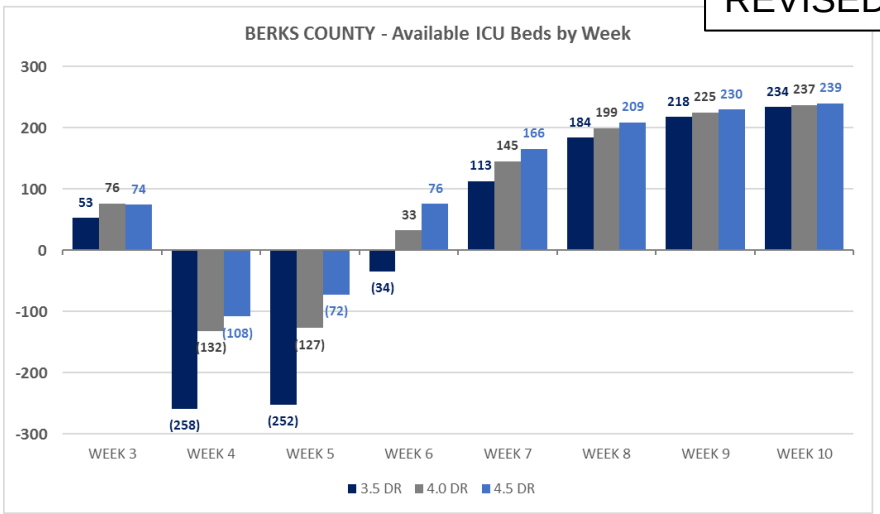

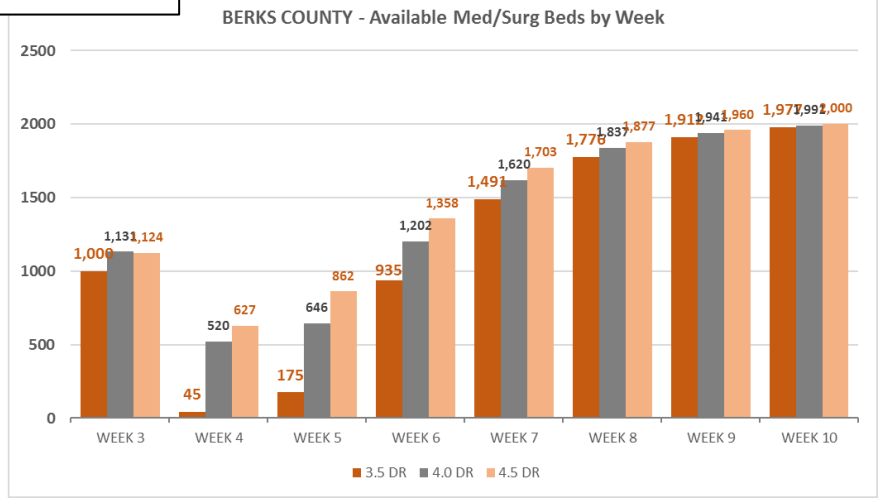

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The mid-range represents current doubling rate.

BED DEMAND AND SURGE MODEL

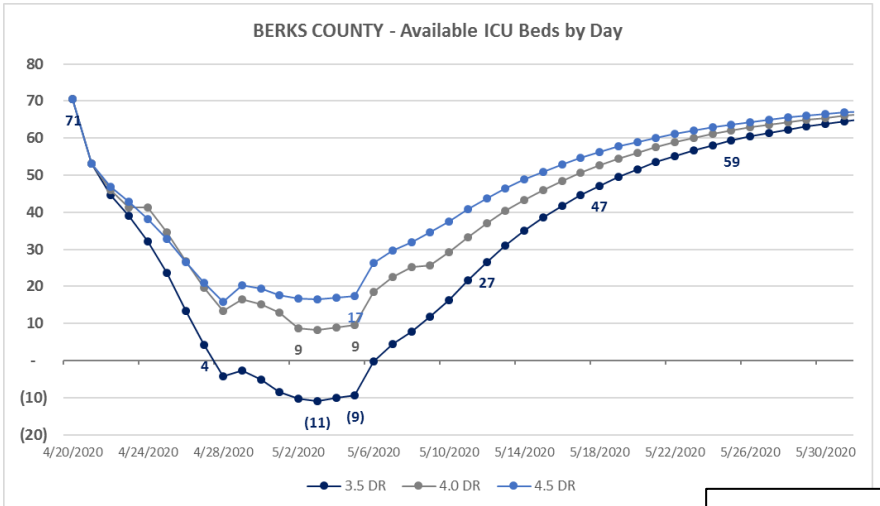
Outputs for Confirmed Cases as of 4/6/2020

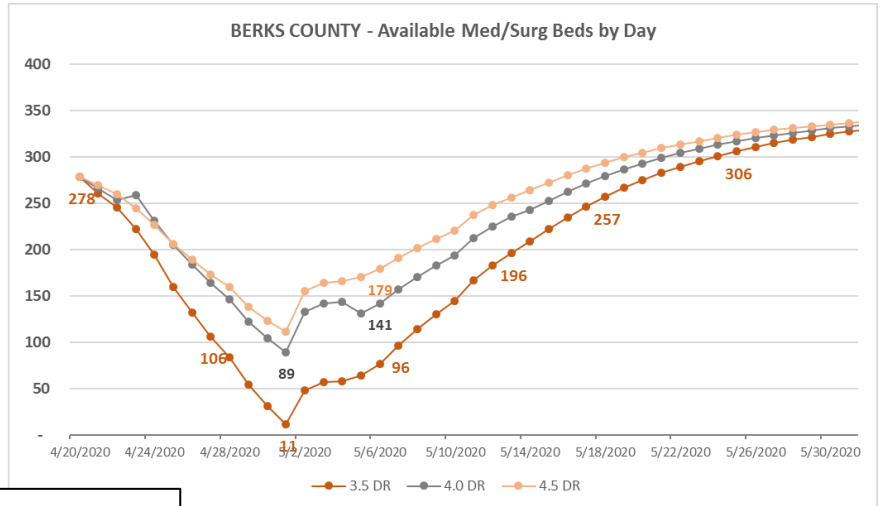
Selected Hospital:	BERKS COUNTY	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	326	
First Day of ICU Bed Shortage:	4/28/2020	**3 weeks, 1 days from 4/6/2020**
First Day of Med/Surg Bed Shortage:	None	-

SURGE OPERATING CAPACITY

Model uses doubling rates of 3.0 DR, 3.5 DR and 4.0 DR to generate 3 potential scenarios

Lower = aggressive infection rate Higher = slowing infection rate due to public health interventions





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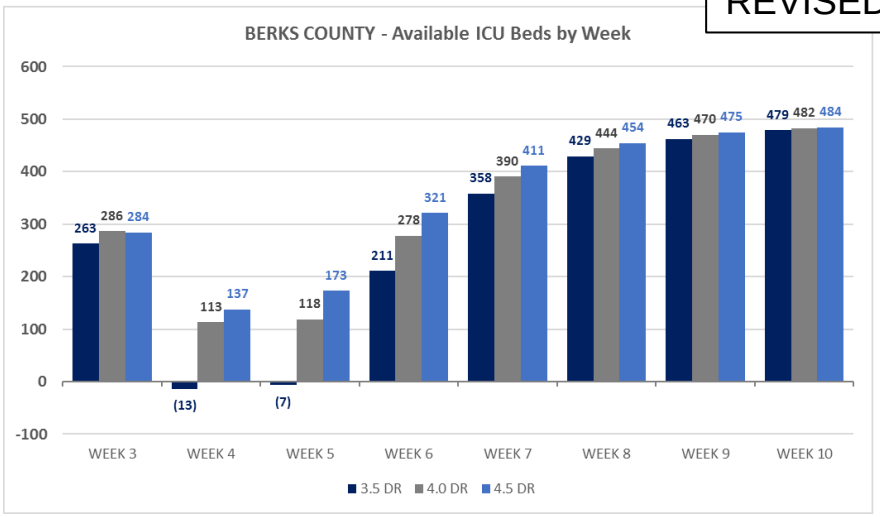

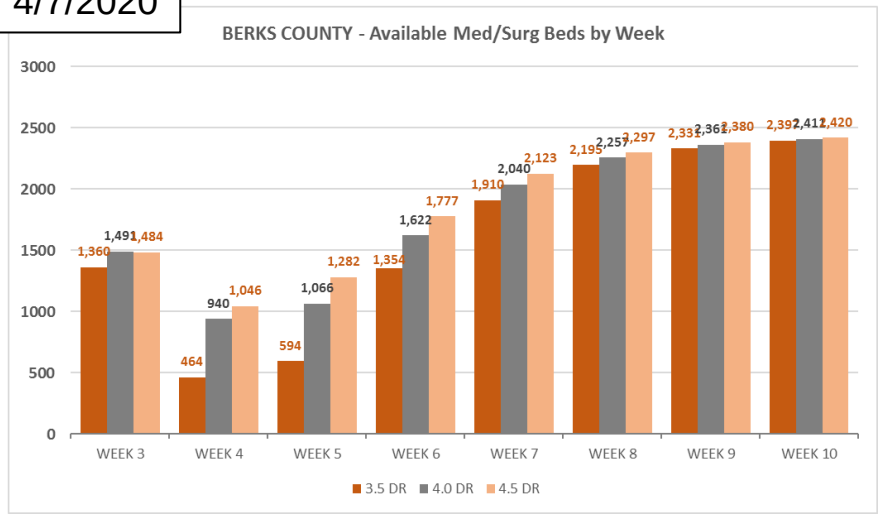

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