Tower Health

COVID-19 Bed Demand & Surge Capacity Model

April 7, 2020

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COVID-19 Bed Demand & Surge Capacity Model

UPDATES FROM SUNDAY, 4/5 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 all Tower Health hospital doubling rates as of 4/6/2020.
- They are now between 3.5 – 6.5. <u>Much more optimistic</u>
- 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:

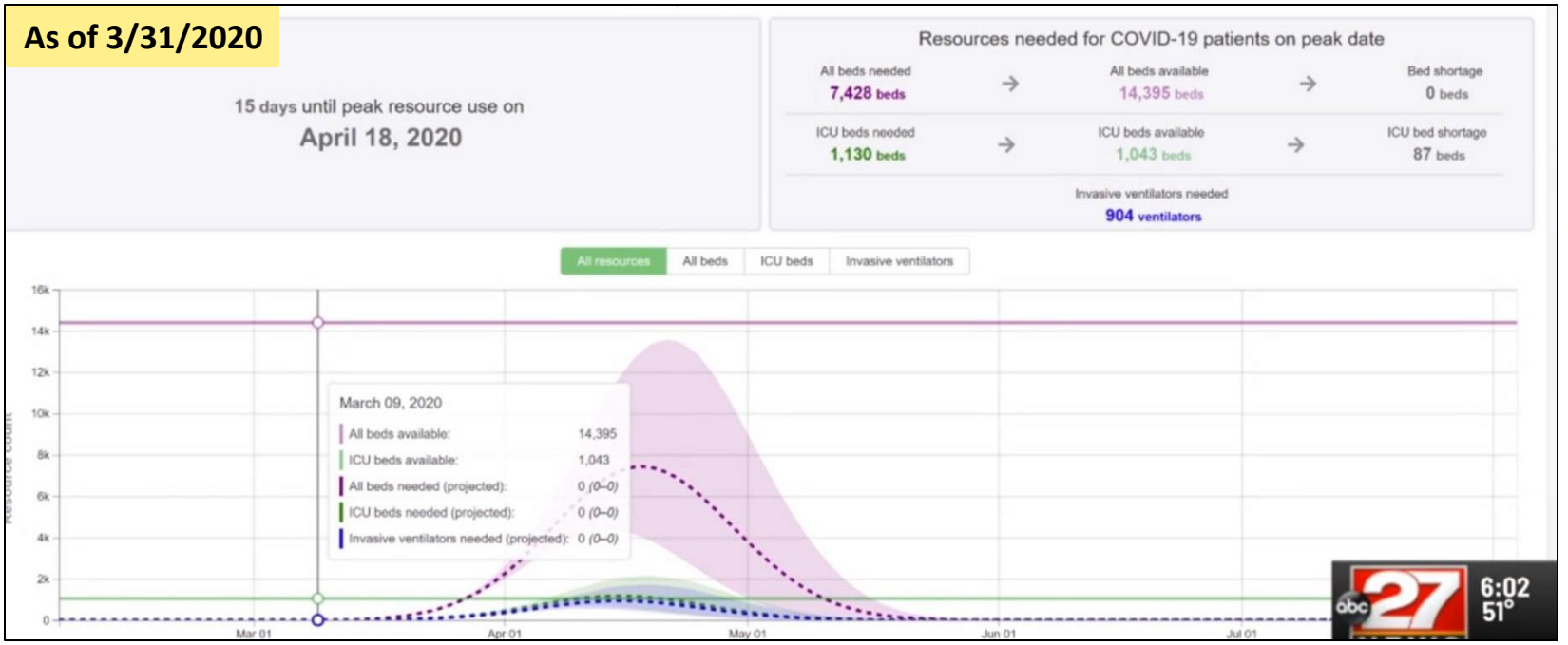
"We are starting to see that the early exponential increase in cases has given way to a much flatter curve, so the surge may not be as great as we once anticipated, that's our fervent hope…"

Declining Rates

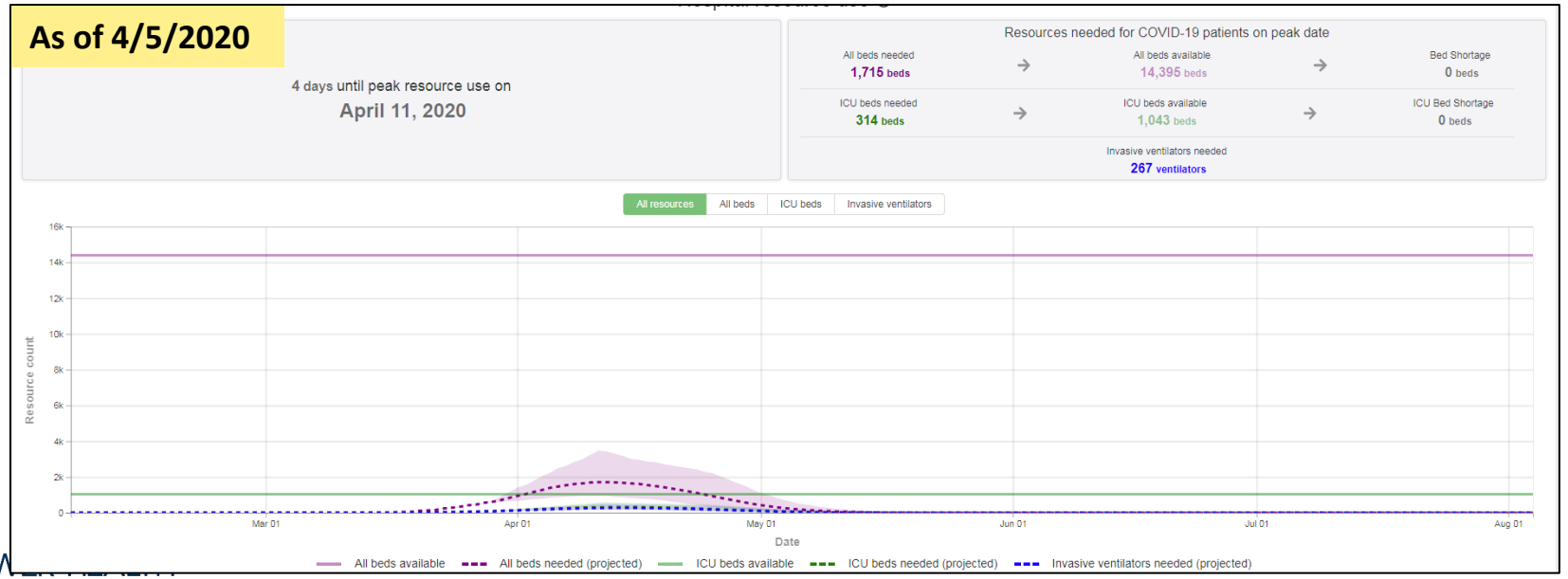
- Initial modeling from the University of Washington indicated that Pennsylvania would experience its peak surge on April 18th.
- We considered this when timing the decline in infection for each Tower Health market. We anticipate 3 waves, with Philadelphia on 4/18/2020; Montgomery county around 4/24/2018; and Chester and Berks counties around 4/30/2020.
- <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.
  - Tower Health kept some of their assumptions, and a clinical group at Tower Health provided some others.
  - 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 each Tower Health 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.

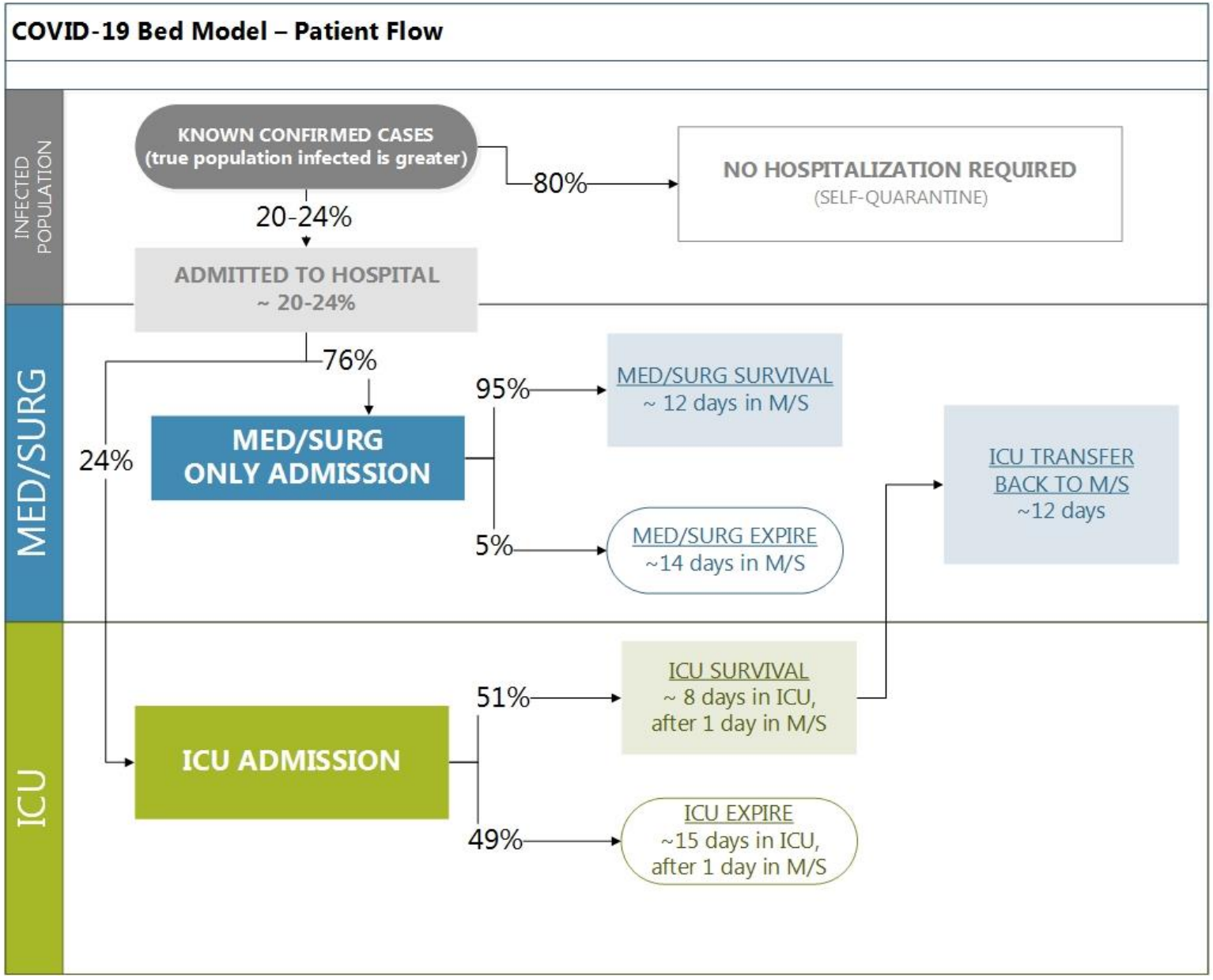
Doubling Rates

- Doubling rates are based on each Tower Health 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 the Tower Health 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 each Tower Health market. We anticipate 3 waves, with Philadelphia on 4/18/2020; Montgomery county around 4/24/2018; and Chester and Berks counties around 4/30/2020.

BED DEMAND AND SURGE MODEL



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CURRENT TRENDS

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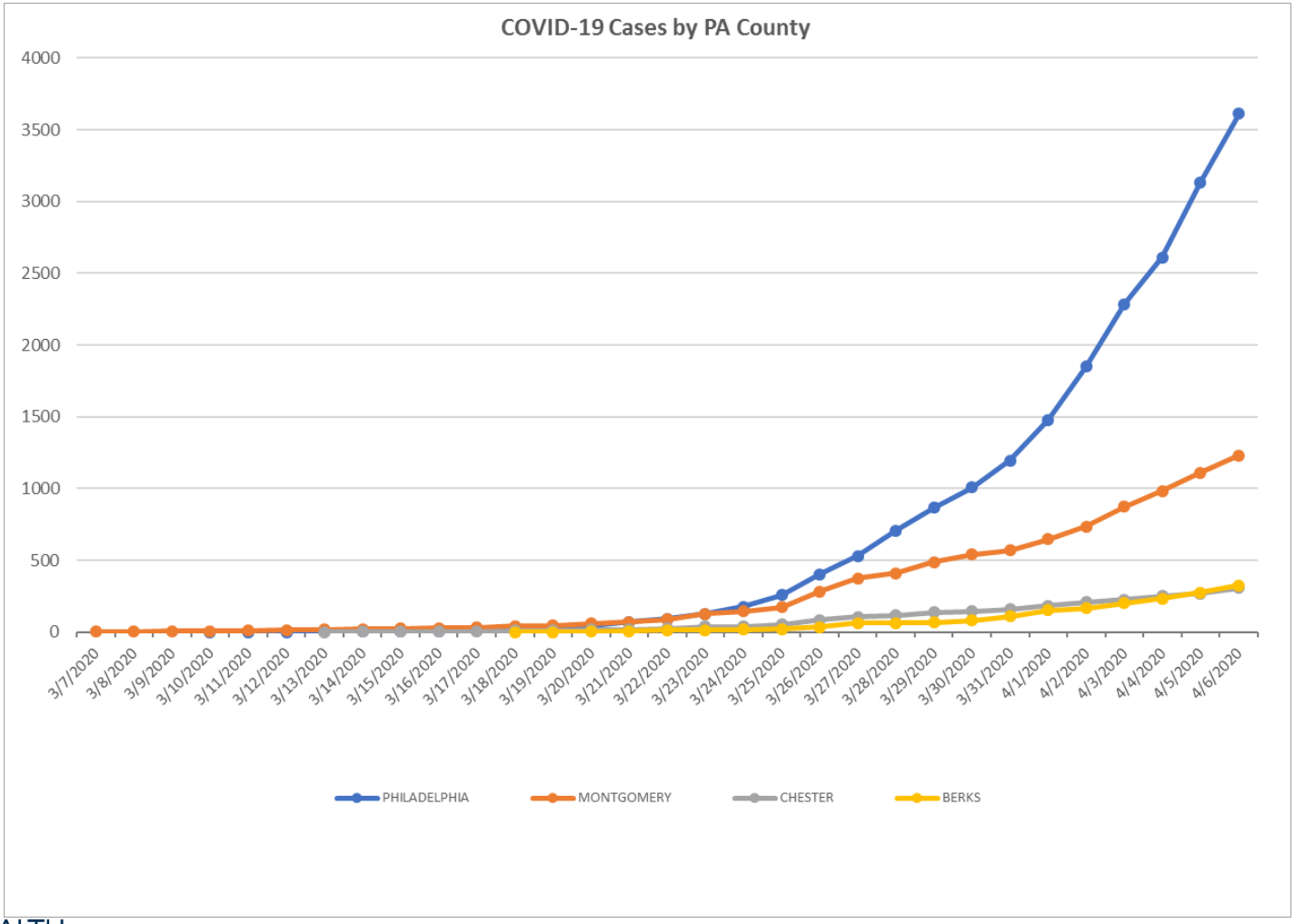
BED DEMAND AND SURGE MODEL

Total Confirmed Cases by County

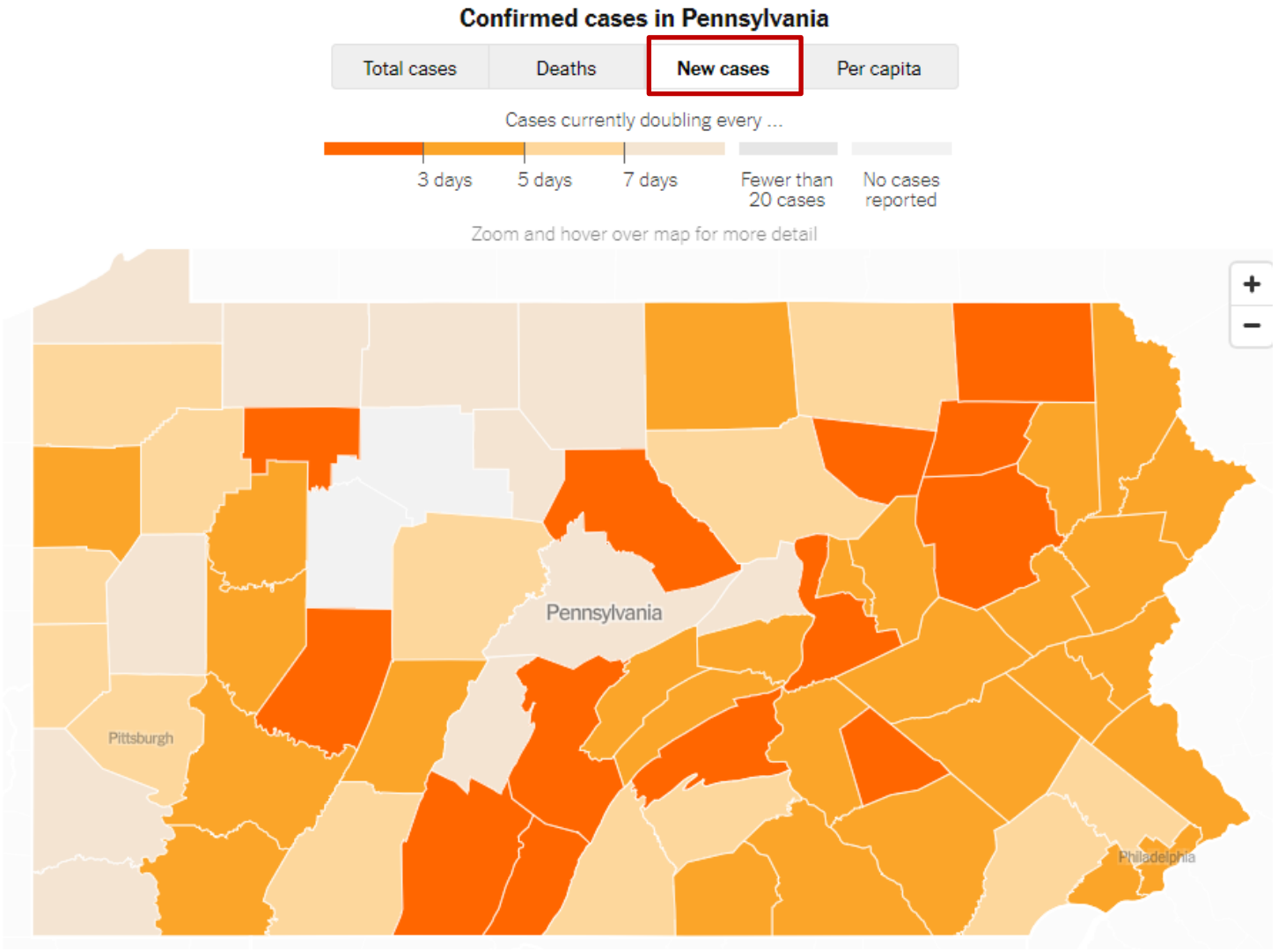
Total Confirmed Cases as of 4/6/2020			
Berks	Chester	Montgomery	Philadelphia
326	307	1230	3611



Source: PA Dept of Health

BED DEMAND AND SURGE MODEL

Doubling Rates by County



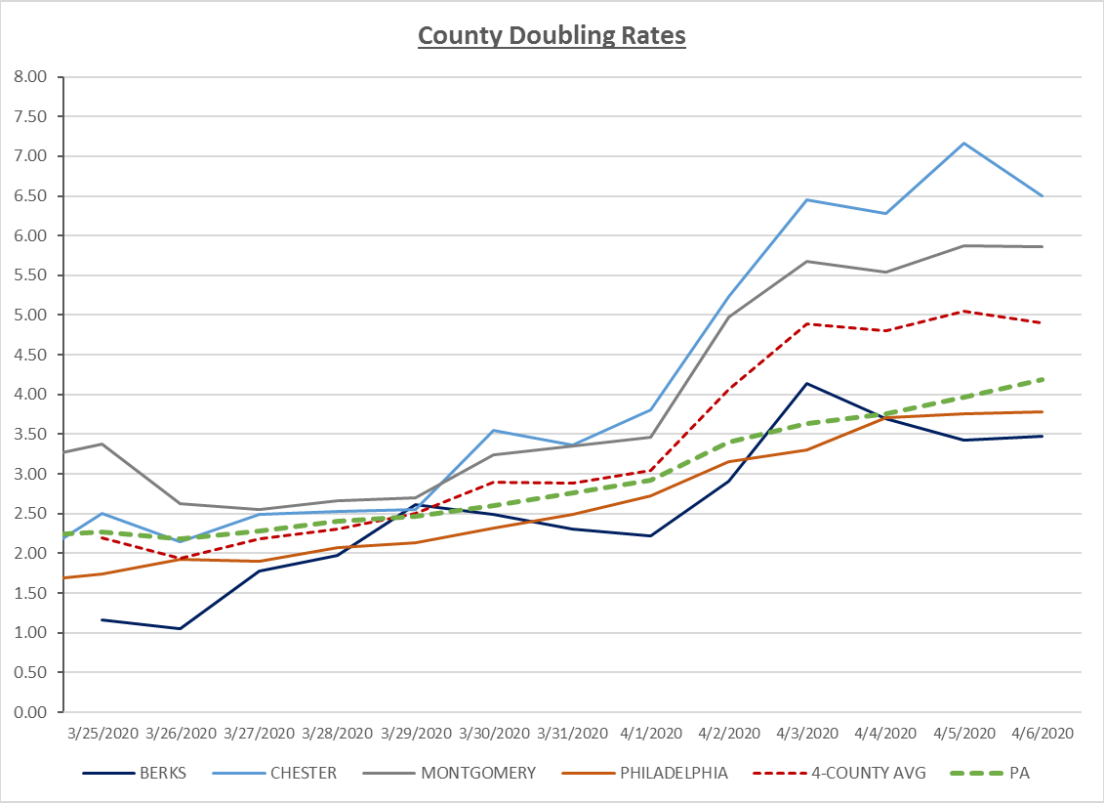
Source: New York Times, using state and local health agencies, hospitals and C.D.C. data.

BED DEMAND AND SURGE MODEL

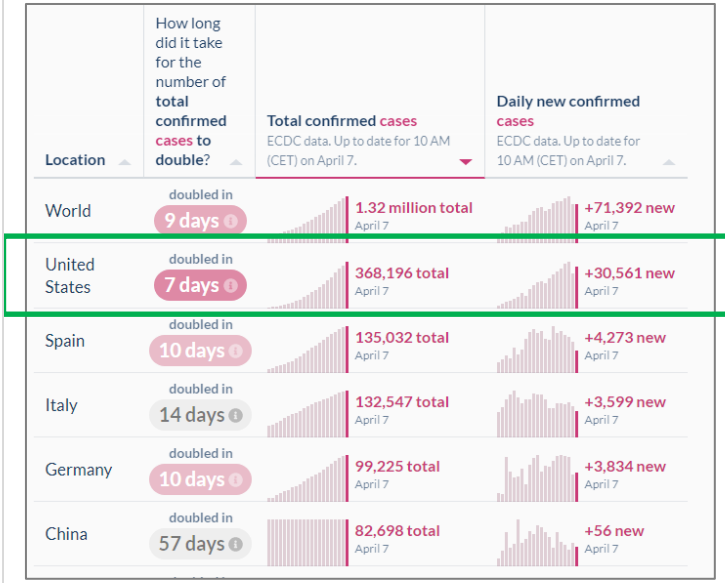
Doubling Rates by County

County Doubling Rates as of 4/6/2020					
Berks	**Chester**	**Montgomery**	**Philadelphia**	**PA***	**US***
3.5	**6.5**	**5.9**	**3.8**	**4.2**	**6.0**

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



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



Location	How long did it take for the number of total confirmed cases to double?	Total confirmed cases (ECDC data. Up to date for 10 AM (CET) on April 7.)	Daily new confirmed cases (ECDC data. Up to date for 10 AM (CET) on April 7.)
World	doubled in 9 days	1.32 million total April 7	+71,392 new April 7
United States	doubled in 7 days	368,196 total April 7	+30,561 new April 7
Spain	doubled in 10 days	135,032 total April 7	+4,273 new April 7
Italy	doubled in 14 days	132,547 total April 7	+3,599 new April 7
Germany	doubled in 10 days	99,225 total April 7	+3,834 new April 7
China	doubled in 57 days	82,698 total April 7	+56 new April 7

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

COVID-19 Bed Demand & Surge Capacity Model

MODEL ASSUMPTIONS (USING READING AS DEMO)

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BED DEMAND MODEL ASSUMPTIONS – READING

MODEL INPUTS FOR READING HOSPITAL						
CATEGORY	**VARIABLE**	**DEFINITION**	**ORIGINAL SUGGESTED VALUE**	**NOTES**	**SOURCE**	**AS OF DATE**
INFECTION	Day One	First day of model	4/6/2020	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	228	Based on current total cases by PA County, and weighted by each hospital's market share in that county - Best methodology to determine number of cases each Tower hospital might reasonably expect to care for	PA Department of Health	4/6/2020
INFECTION	Total population	Population in selected geography	321,364	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	3.50	Rate based on continued social distancing expected to slow infection; model provides outputs for 3.5, 4.0 and 5.0		4/2/2020
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 for 5 GAC hospitals; Age-adjusted for % pop 0-17 for St. Chris		-
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."	3/30/2020
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		3/30/2020
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		3/30/2020
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		3/30/2020
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		3/30/2020

BED DEMAND MODEL ASSUMPTIONS – READING

MODEL INPUTS FOR READING HOSPITAL						
CATEGORY	**VARIABLE**	**DEFINITION**	**ORIGINAL SUGGESTED VALUE**	**NOTES**	**SOURCE**	**AS OF DATE**
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		3/30/2020
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		3/30/2020
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 (based on average of 3 days spent in ICU for pneumonia patients with a total average stay of 7.2 days if ICU was required)		-
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 (based on average of 3 days spent in ICU for pneumonia patients with a total average stay of 7.2 days if ICU was required)		-
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		3/30/2020
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		3/30/2020
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		-
SUPPLY	ICU beds	Number of ICU beds in select geography	41	Current count of set-up and staffed beds; Assumes all beds can be staffed - Does not include Surge Plan beds or other measures	Internal data provided by Elizabeth Clark for each TH hospital, compiled for PA DOH hospital reports	4/6/2020
SUPPLY	Med/Surg beds	Number of Med/Surg beds in select geography	415	Current count of set-up and staffed beds; Assumes all beds can be staffed - Does not include Surge Plan beds or other measures	Internal data provided by Elizabeth Clark for each TH hospital, compiled for PA DOH hospital reports	4/6/2020
SUPPLY	ICU Utilization	Average % of ICU beds utilized in the select months of the year; Highest during flu season	**45%**	Current occupancy rate based on occupied beds from Daily Safety Huddle Report	***Update with subsequent iterations as this severely impacts available beds**	3/31/2020
SUPPLY	Med/Surg Utilization	Average % of Med/Surg beds utilized in the select months of the year; Med-surg utilization target (outside of peak flu season)	**35%**	Current occupancy rate based on occupied beds from Daily Safety Huddle Report	***Update with subsequent iterations as this severely impacts available beds**	3/31/2020
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	3/30/2020
INFECTION	Start Date for Decline	Declines will begin in waves about 6 days apart, starting with Philadelphia, then Montgomery, then Chester and Berks	4/18/2020-4/30/2020	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	3/30/2020

COVID-19 Bed Demand & Surge Capacity Model

READING HOSPITAL

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Reading Capacity Assumptions

Reading Hospital

Initial State		
Med/Surg Beds	415	Operational bed capacity
ICU Beds	41	

Surge Capacity		
Med/Surg Beds	446	Remove 30 beds from T1 (convert to ICU beds) and ADD 30 PACU beds (can be versatile for level of care) and ADD 31 surge beds MS level of care
ICU Beds	101	Add 30 from T1 conversion

BED DEMAND AND SURGE MODEL

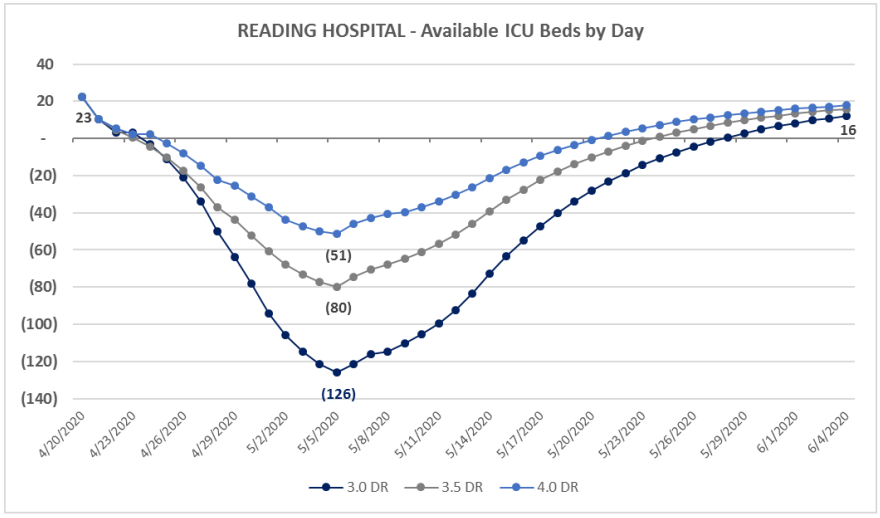
Outputs for Confirmed Cases as of 4/6/2020

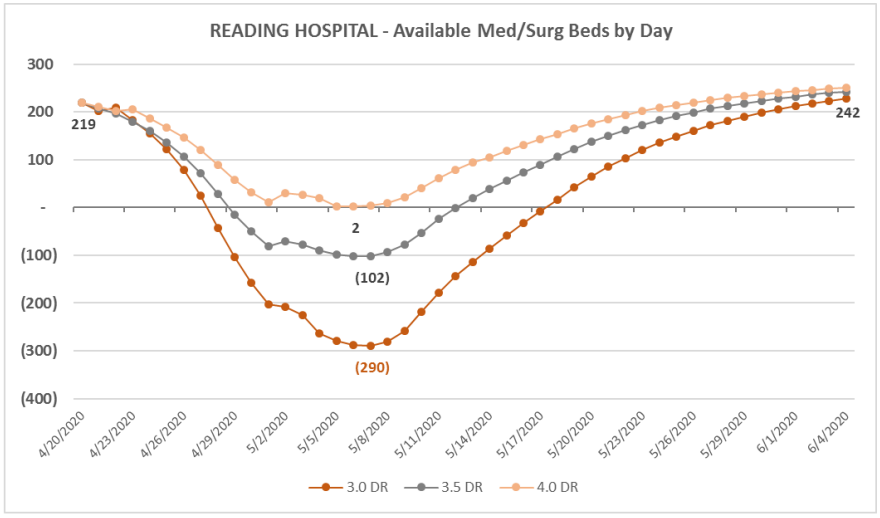
Selected Hospital:	READING HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	228	
First Day of ICU Bed Shortage:	4/24/2020	**2 weeks, 4 days from 4/6/2020**
First Day of Med/Surg Bed Shortage:	4/29/2020	**3 weeks, 2 days from 4/6/2020**

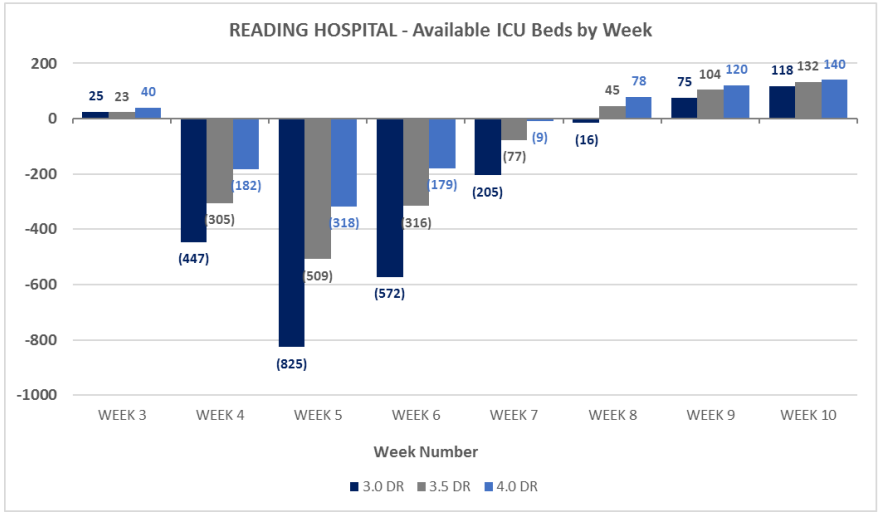
REGULAR OPERATING CAPACITY

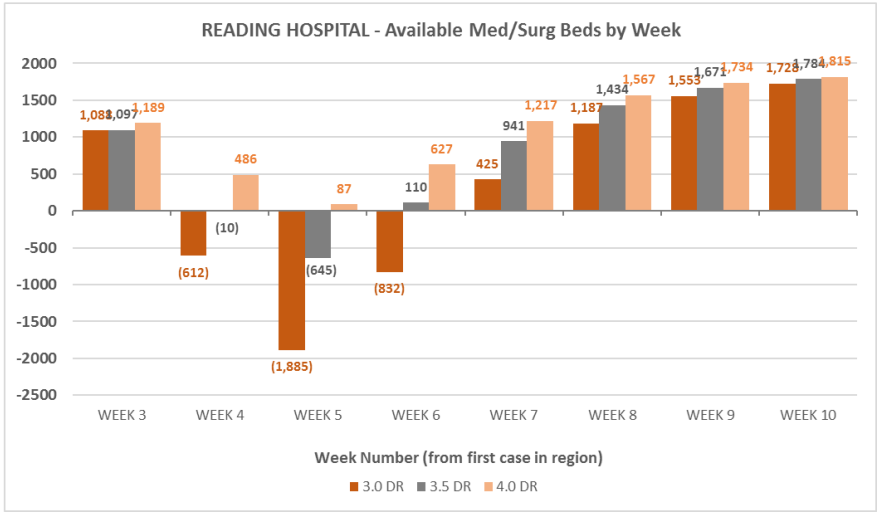
Model uses doubling rates of 3.0 DR, 3.5 DR and 4.0 DR to generate 3 potential scenarios

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









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The mid-range represents current doubling rate.

BED DEMAND AND SURGE MODEL

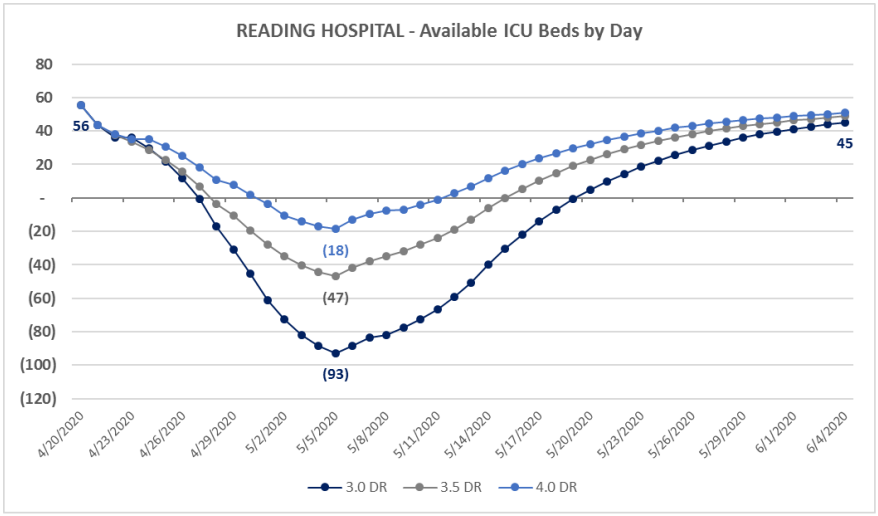
Outputs for Confirmed Cases as of 4/6/2020

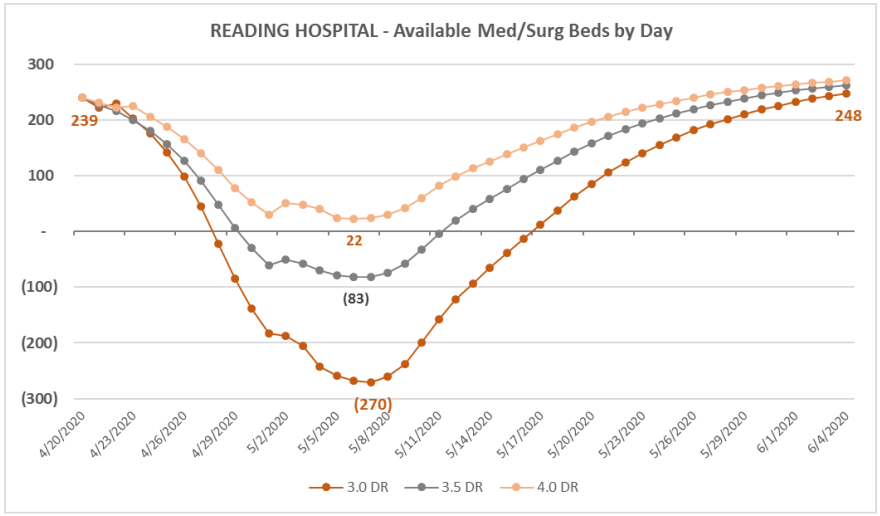
Selected Hospital:	READING HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	228	
First Day of ICU Bed Shortage:	4/28/2020	**3 weeks, 1 days from 4/6/2020**
First Day of Med/Surg Bed Shortage:	4/30/2020	**3 weeks, 3 days from 4/6/2020**

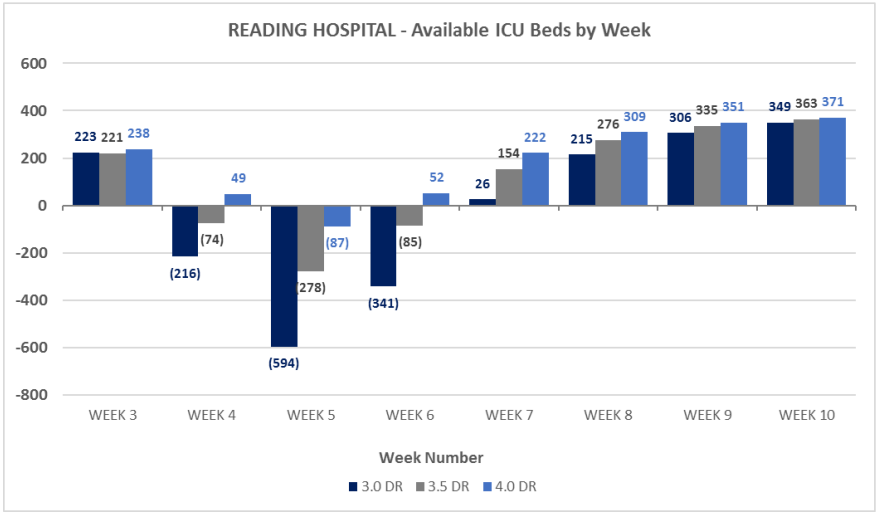
SURGE OPERATING CAPACITY

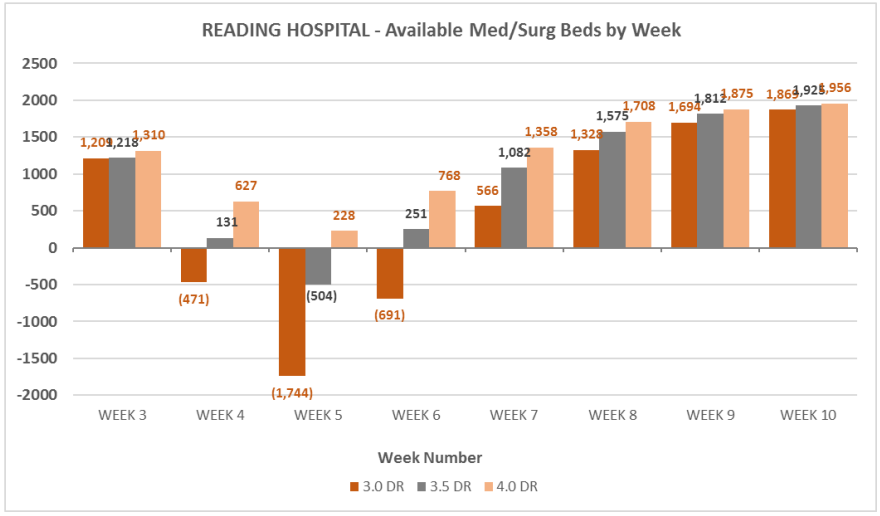
Model uses doubling rates of 3.0 DR, 3.5 DR and 4.0 DR to generate 3 potential scenarios

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









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The mid-range represents current doubling rate.

COVID-19 Bed Demand & Surge Capacity Model

BRANDYWINE HOSPITAL

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Brandywine Capacity Assumptions

Brandywine Hospital

Initial State		
Med/Surg Beds	92	Operational bed capacity
ICU Beds	15	

Surge Capacity		
Med/Surg Beds	184	Double occupancy
ICU Beds	30	Double occupancy

BED DEMAND AND SURGE MODEL

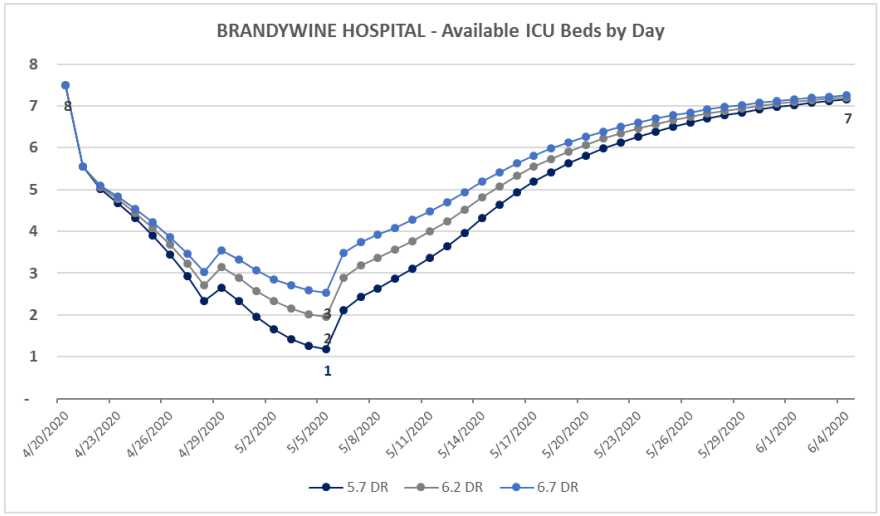
Outputs for Confirmed Cases as of 4/6/2020

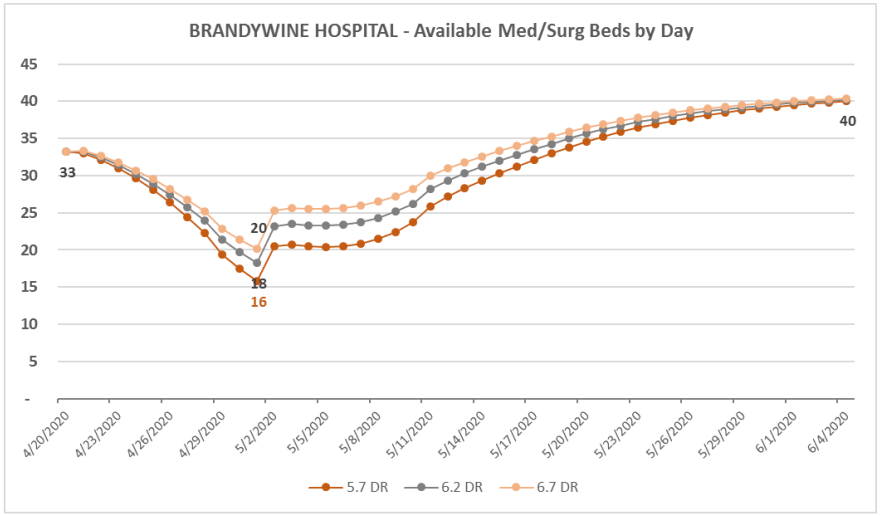
Selected Hospital:	BRANDYWINE HOSPITAL
First day of model:	4/6/2020
Number of confirmed cases on first day of model:	35
First Day of ICU Bed Shortage:	None -
First Day of Med/Surg Bed Shortage:	None -

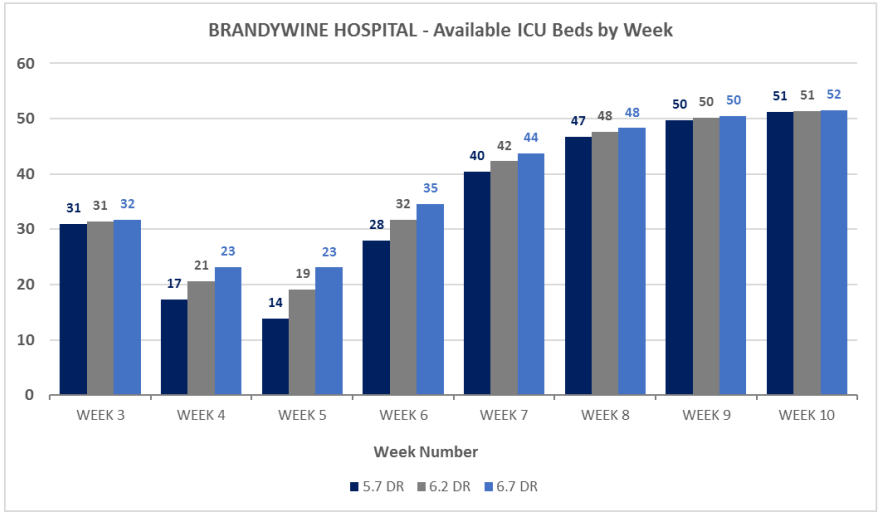
REGULAR OPERATING CAPACITY

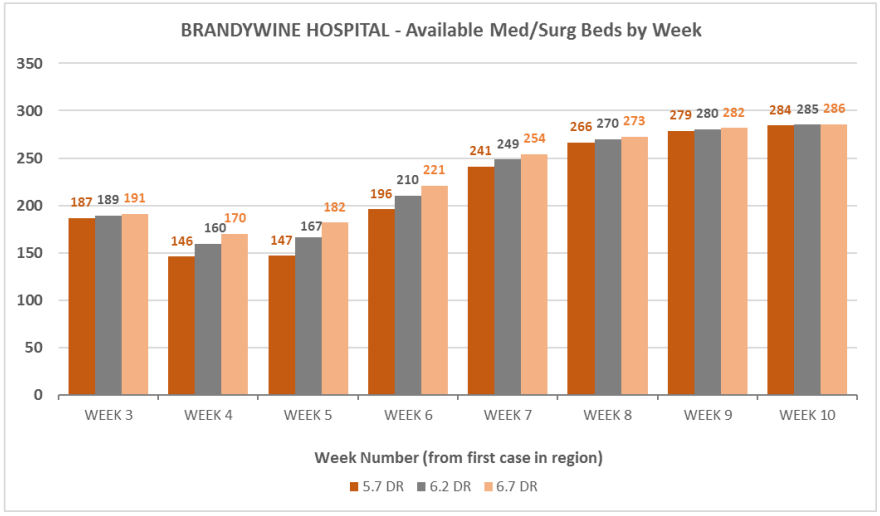
Model uses doubling rates of 5.7 DR, 6.2 DR and 6.7 DR to generate 3 potential scenarios

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









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The mid-range represents current doubling rate.

BED DEMAND AND SURGE MODEL

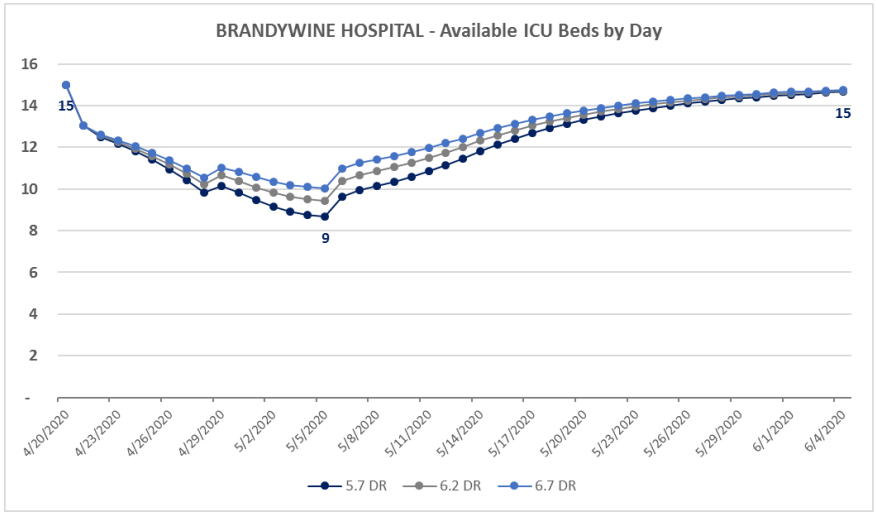
Outputs for Confirmed Cases as of 4/6/2020

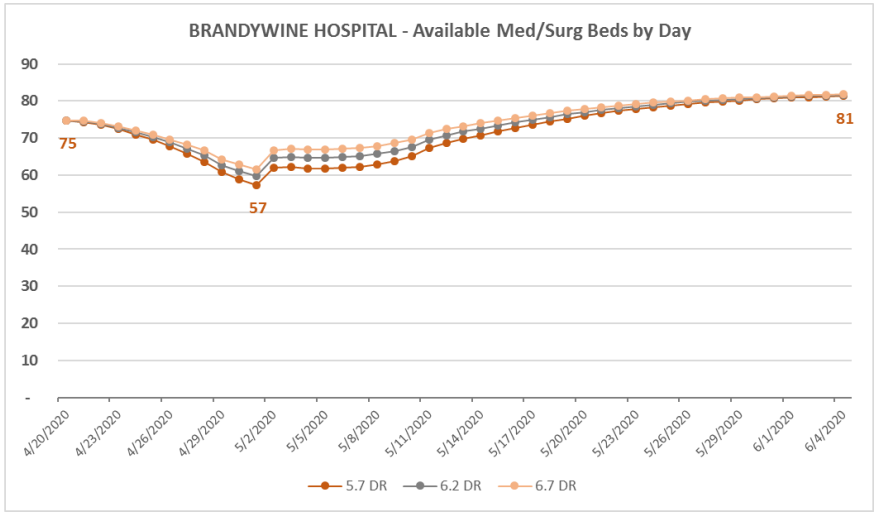
Selected Hospital:	BRANDYWINE HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	35	
First Day of ICU Bed Shortage:	None	-
First Day of Med/Surg Bed Shortage:	None	-

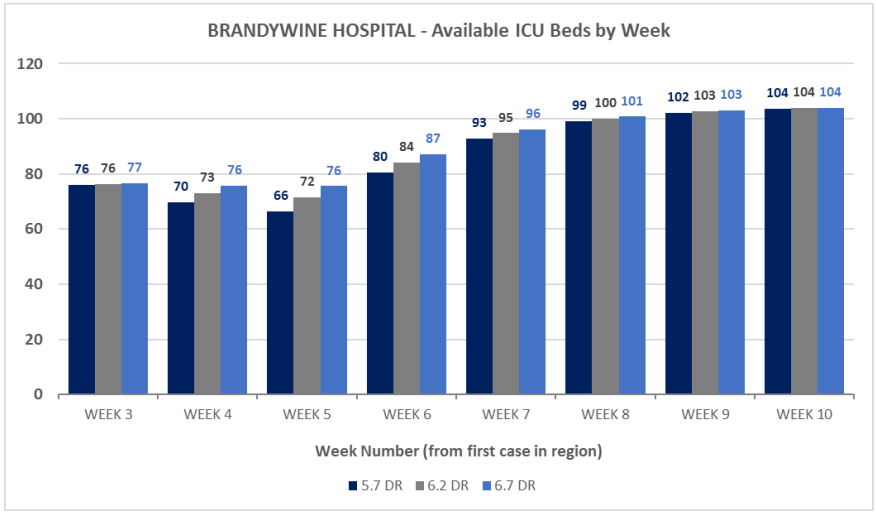
SURGE OPERATING CAPACITY

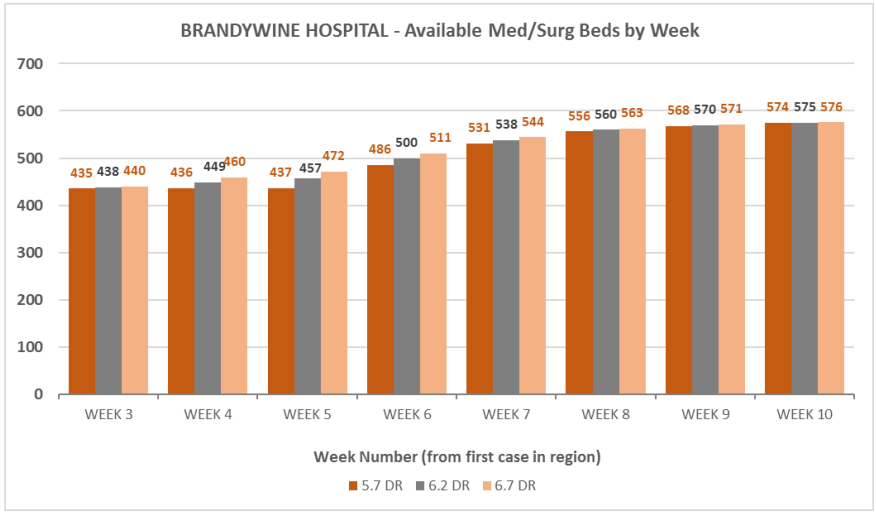
Model uses doubling rates of 5.7 DR, 6.2 DR and 6.7 DR to generate 3 potential scenarios

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









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The mid-range represents current doubling rate.

COVID-19 Bed Demand & Surge Capacity Model

CHESTNUT HILL HOSPITAL

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Chestnut Hill Capacity Assumptions

Chestnut Hill Hospital

Initial State		
Med/Surg Beds	114	Operational bed capacity
ICU Beds	14	

Surge Capacity		
Med/Surg Beds	96	Convert 30 medsurg beds from 5 South to 15 ICU beds and add 12 med surg beds in OLD ED
ICU Beds	29	ICU beds from converted 5 South

BED DEMAND AND SURGE MODEL

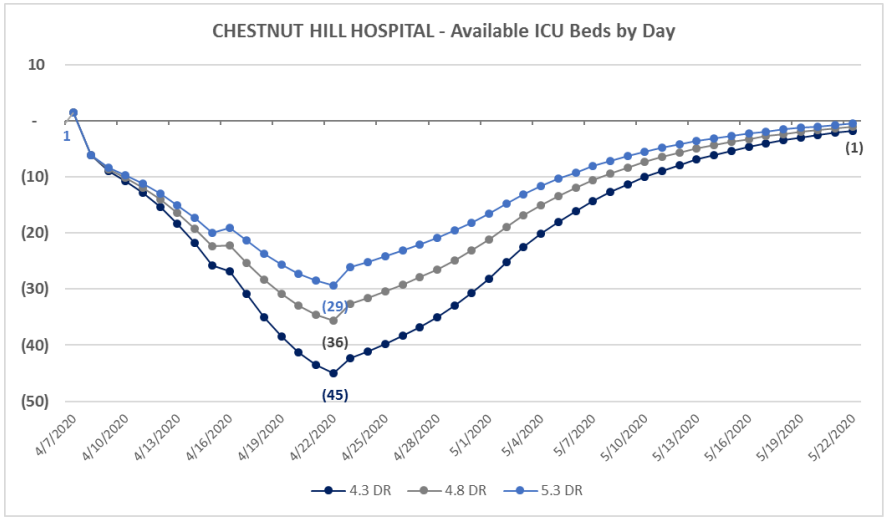
Outputs for Confirmed Cases as of 4/6/2020

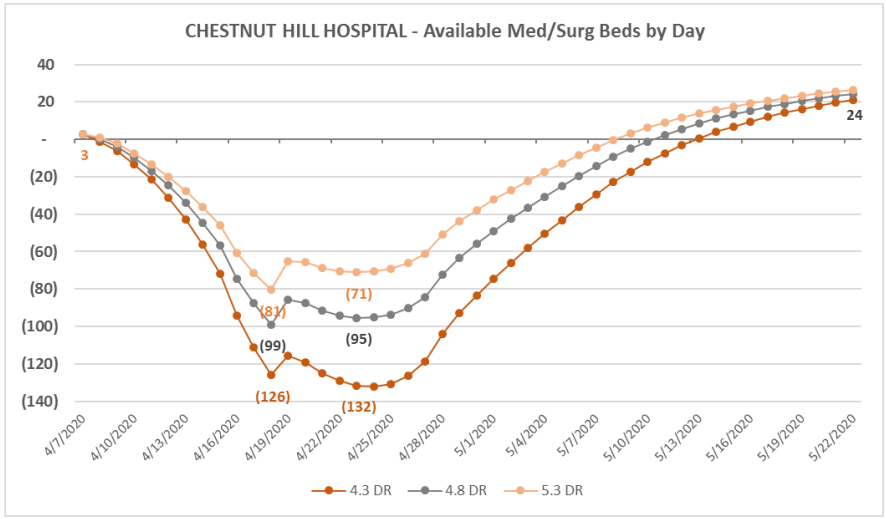
Selected Hospital:	CHESTNUT HILL HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	133	
First Day of ICU Bed Shortage:	4/8/2020	**0 weeks, 2 days from 4/6/2020**
First Day of Med/Surg Bed Shortage:	4/8/2020	**0 weeks, 2 days from 4/6/2020**

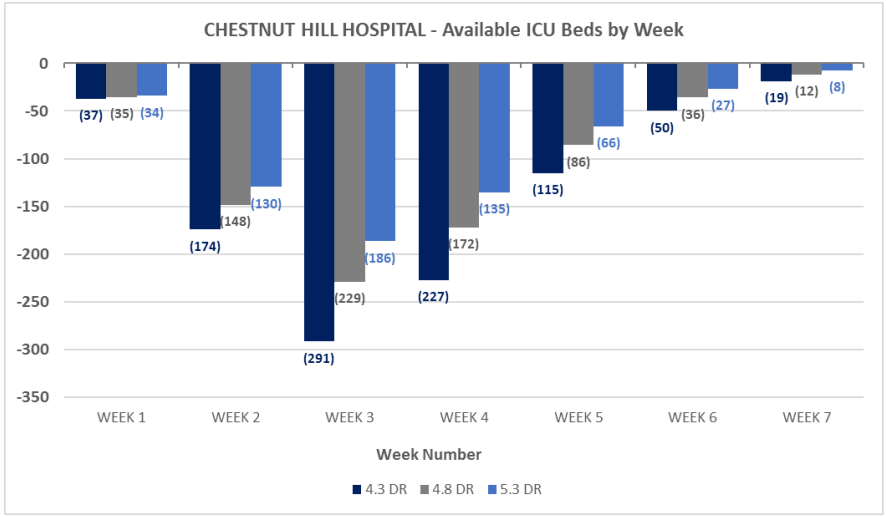
REGULAR OPERATING CAPACITY

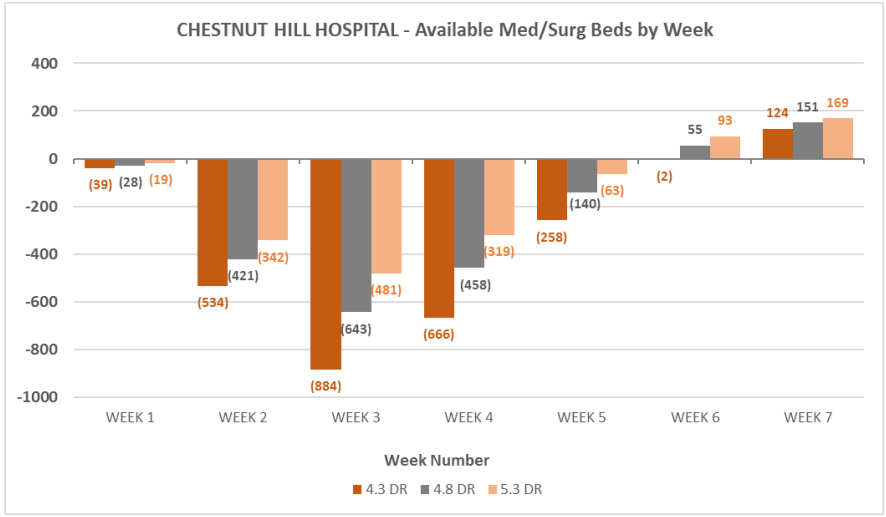
Model uses doubling rates of 4.3 DR, 4.8 DR and 5.3 DR to generate 3 potential scenarios

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









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The mid-range represents current doubling rate.

BED DEMAND AND SURGE MODEL

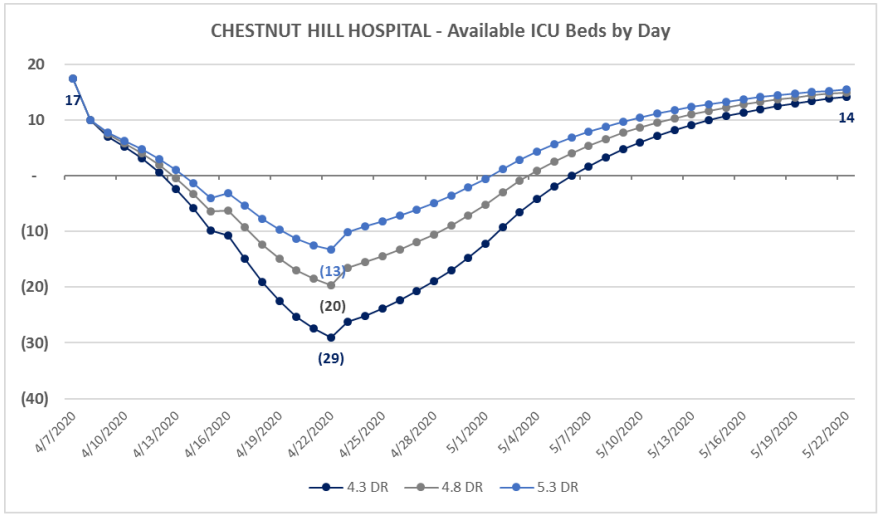
Outputs for Confirmed Cases as of 4/6/2020

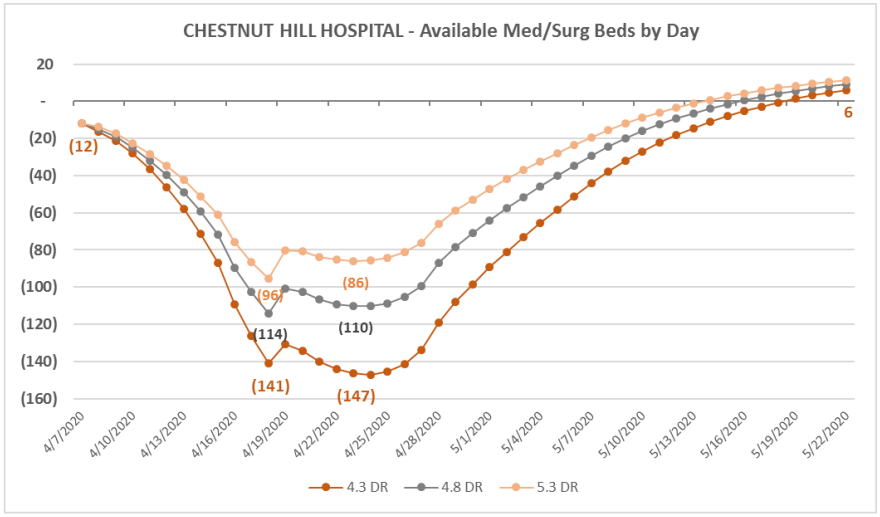
Selected Hospital:	CHESTNUT HILL HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	133	
First Day of ICU Bed Shortage:	4/13/2020	**1 weeks from 4/6/2020**
First Day of Med/Surg Bed Shortage:	4/7/2020	**0 weeks, 1 days from 4/6/2020**

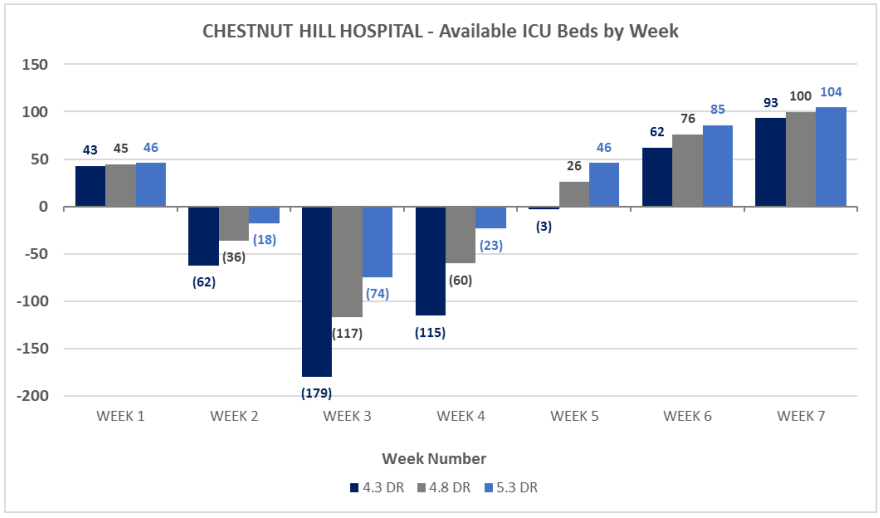
SURGE OPERATING CAPACITY

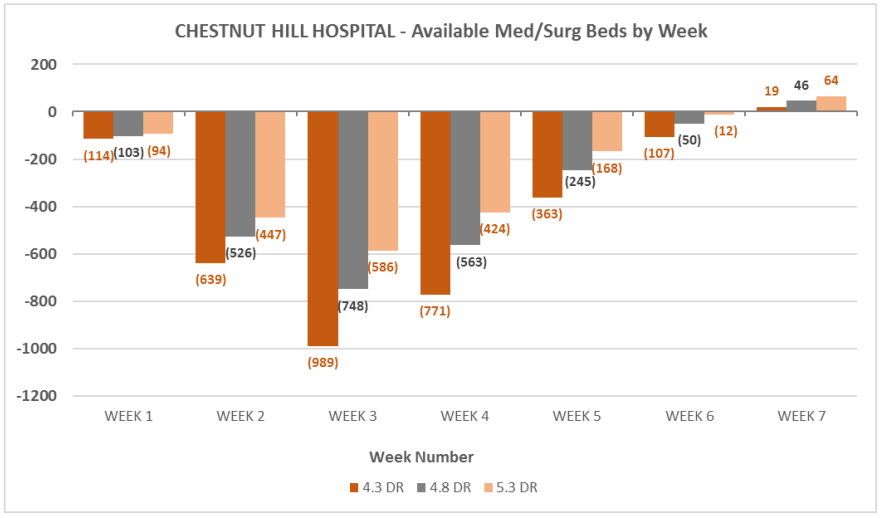
Model uses doubling rates of 4.3 DR, 4.8 DR and 5.3 DR to generate 3 potential scenarios

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









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COVID-19 Bed Demand & Surge Capacity Model

JENNERSVILLE HOSPITAL

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Jennersville Capacity Assumptions

Jennersville Hospital

Initial State		
Med/Surg Beds	43	Operational bed capacity
ICU Beds	9	

Surge Capacity		
Med/Surg Beds	57	
ICU Beds	13	

BED DEMAND AND SURGE MODEL

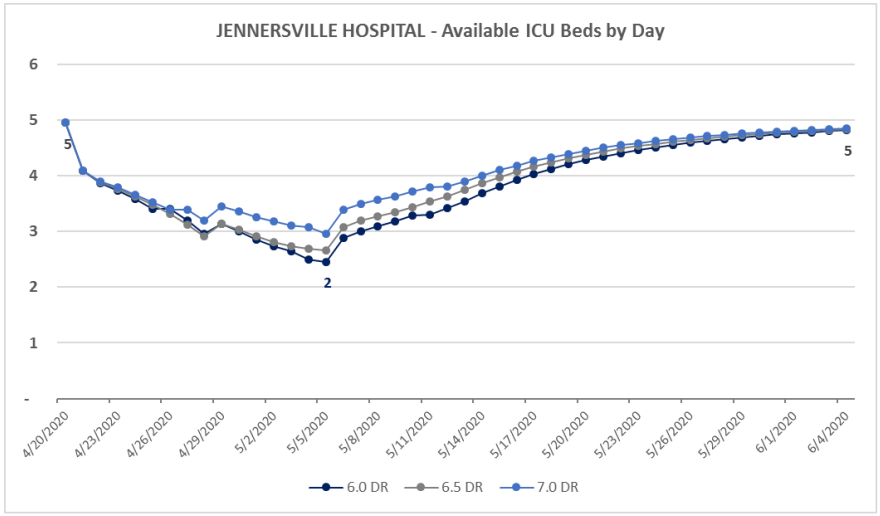
Outputs for Confirmed Cases as of 4/6/2020

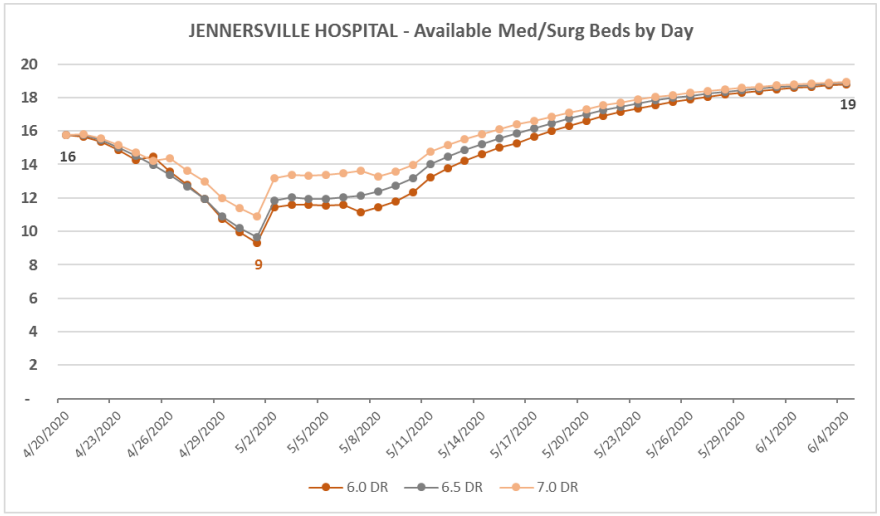
Selected Hospital:	JENNERSVILLE HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	15	
First Day of ICU Bed Shortage:	None	-
First Day of Med/Surg Bed Shortage:	None	-

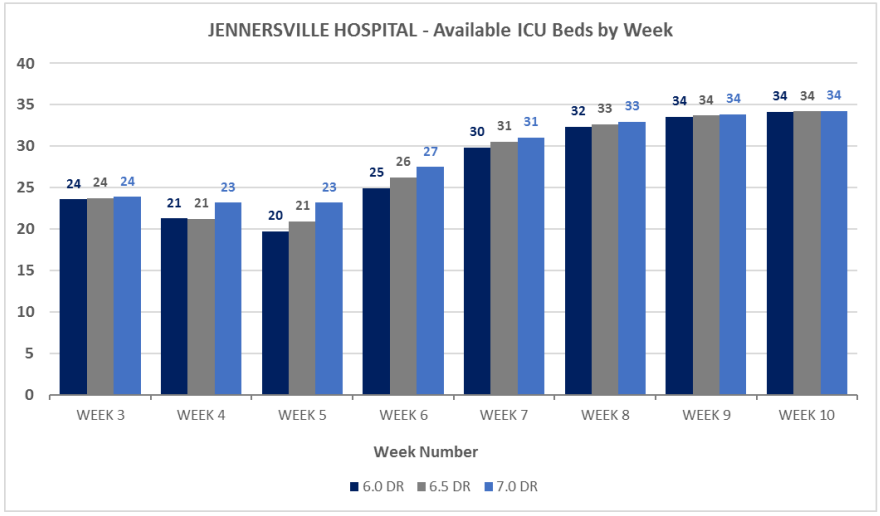
REGULAR OPERATING CAPACITY

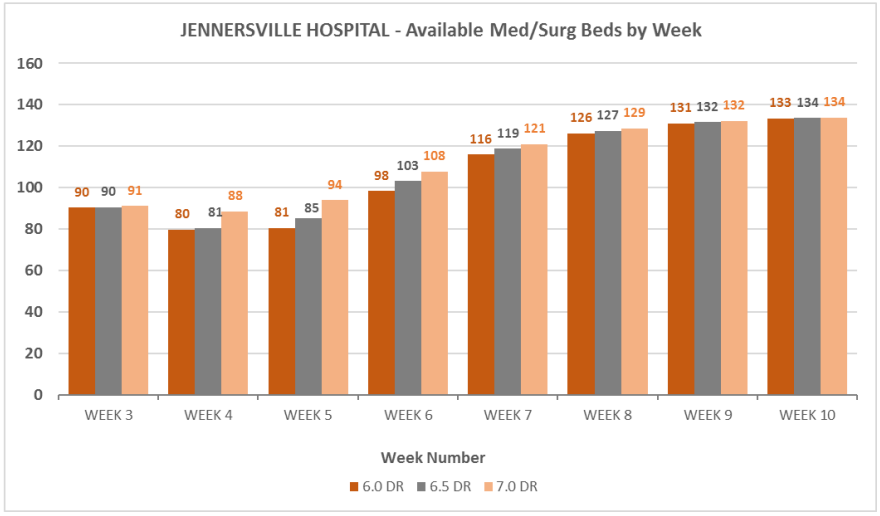
Model uses doubling rates of 6.0 DR, 6.5 DR and 7.0 DR to generate 3 potential scenarios

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









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BED DEMAND AND SURGE MODEL

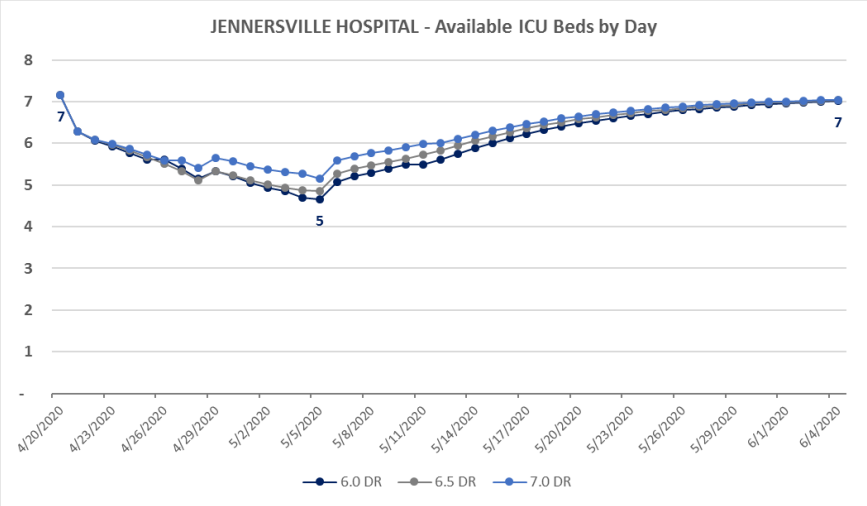
Outputs for Confirmed Cases as of 4/6/2020

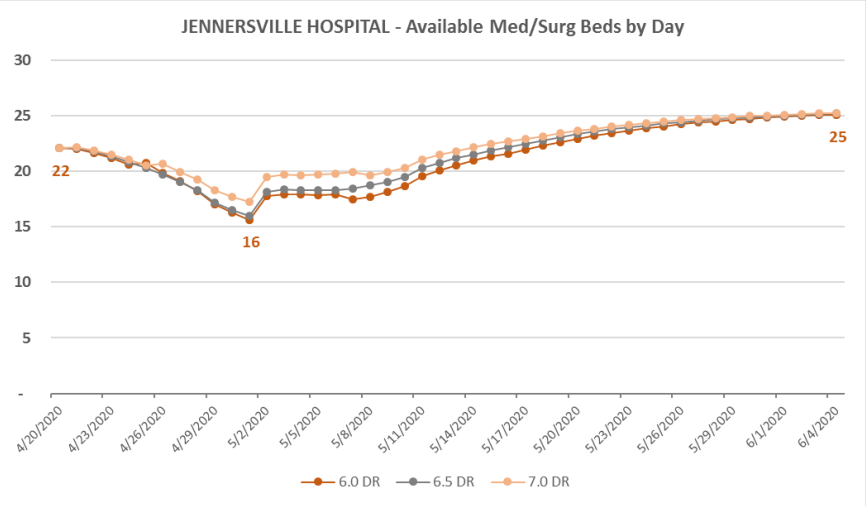
Selected Hospital:	JENNERSVILLE HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	15	
First Day of ICU Bed Shortage:	None	-
First Day of Med/Surg Bed Shortage:	None	-

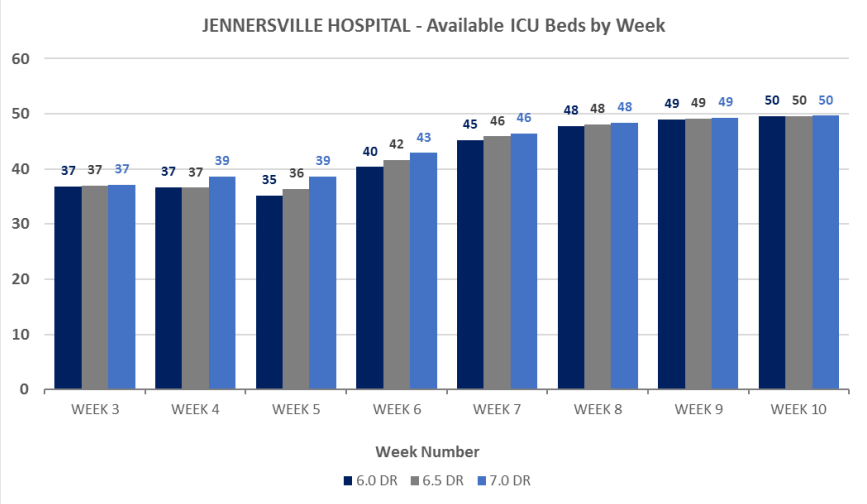
SURGE OPERATING CAPACITY

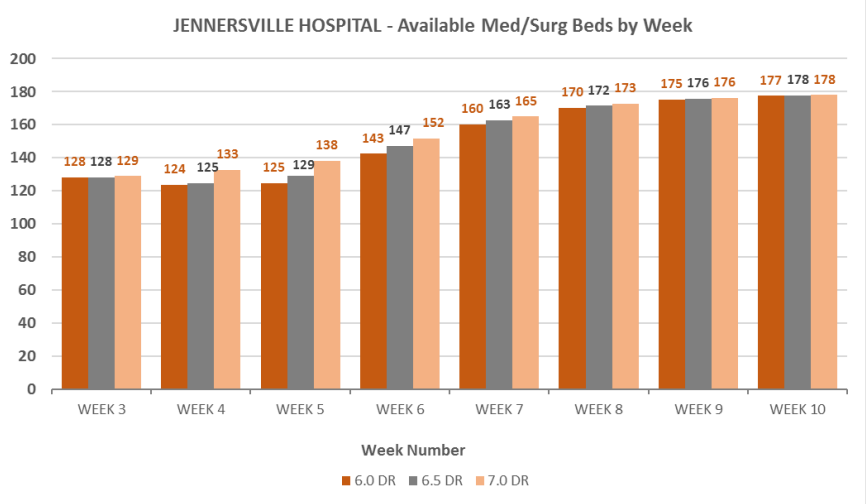
Model uses doubling rates of 6.0 DR, 6.5 DR and 7.0 DR to generate 3 potential scenarios

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









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COVID-19 Bed Demand & Surge Capacity Model

PHOENIXVILLE HOSPITAL

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Phoenixville Capacity Assumptions

Phoenixville Hospital

Initial State		
Med/Surg Beds	80	Operational bed capacity
ICU Beds	24	

Surge Capacity		
Med/Surg Beds	87	
ICU Beds	32	

BED DEMAND AND SURGE MODEL

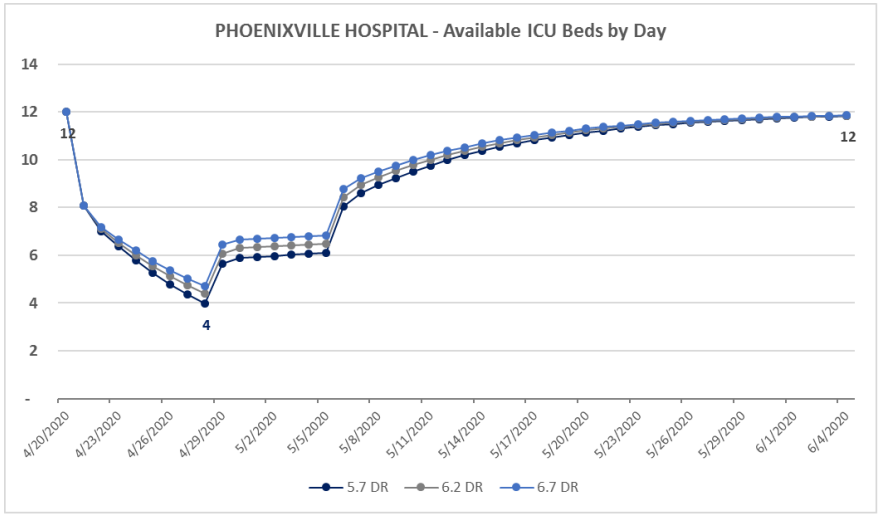
Outputs for Confirmed Cases as of 4/6/2020

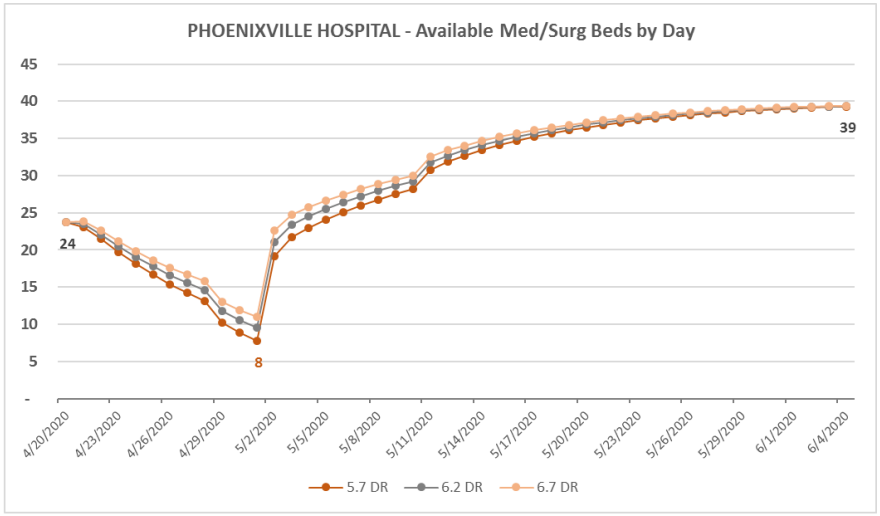
Selected Hospital:	PHOENIXVILLE HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	71	
First Day of ICU Bed Shortage:	None	-
First Day of Med/Surg Bed Shortage:	None	-

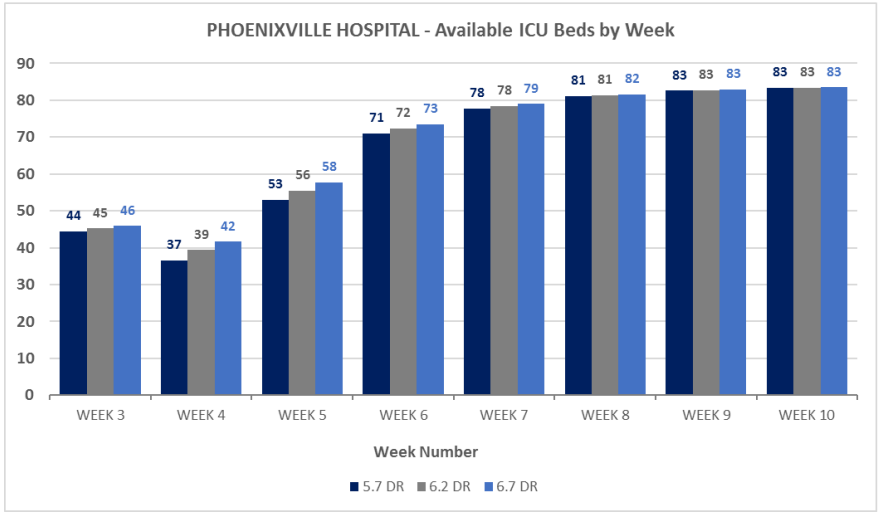
REGULAR OPERATING CAPACITY

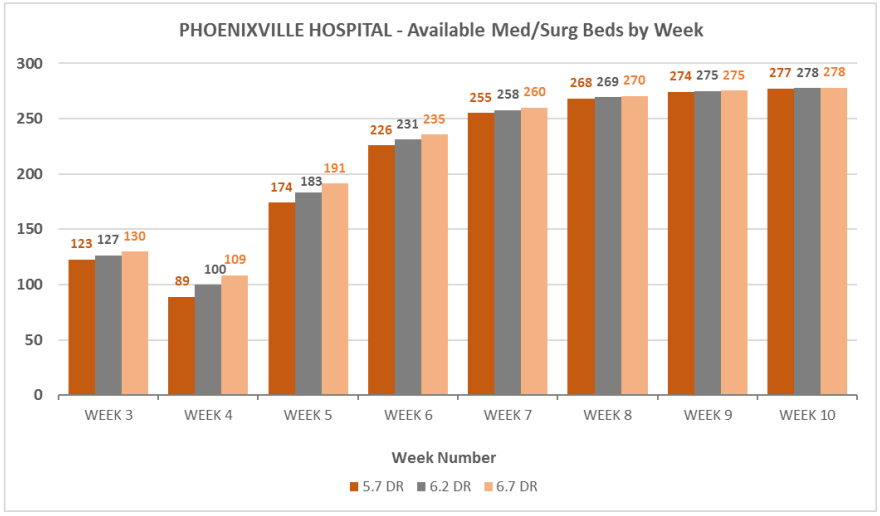
Model uses doubling rates of 5.7 DR, 6.2 DR and 6.7 DR to generate 3 potential scenarios

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









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The mid-range represents current doubling rate.

BED DEMAND AND SURGE MODEL

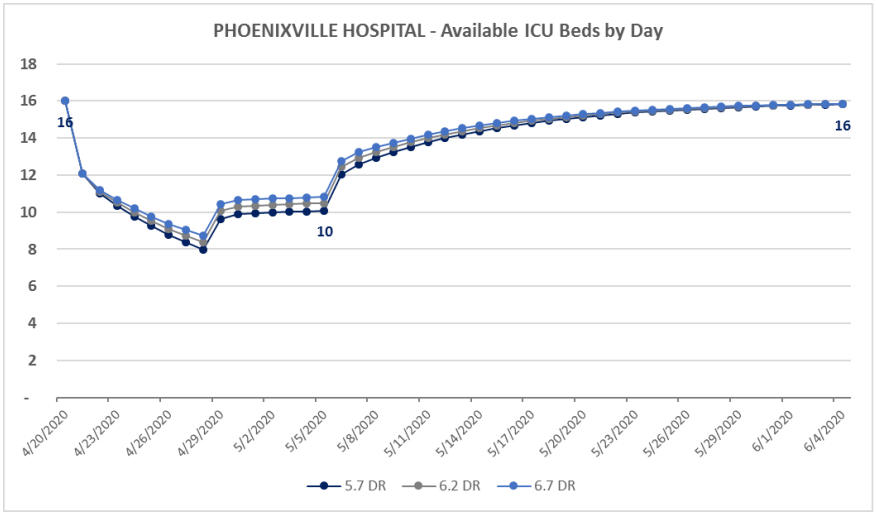
Outputs for Confirmed Cases as of 4/6/2020

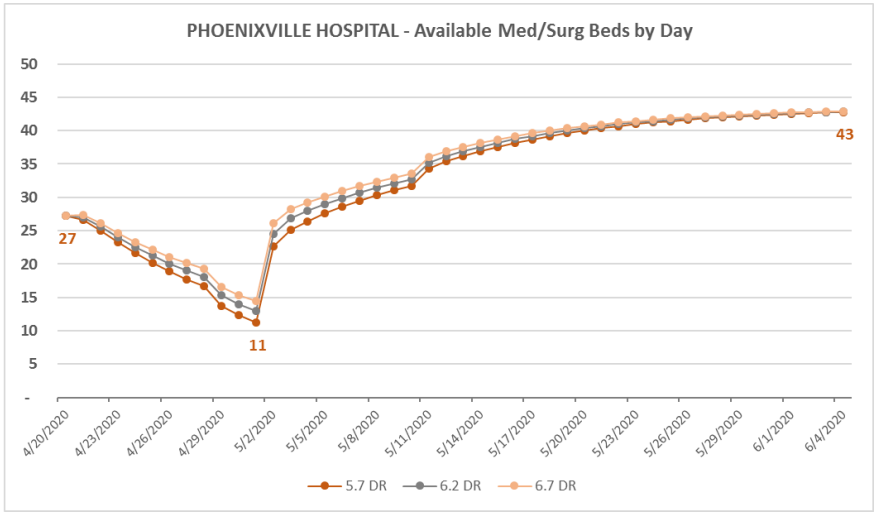
Selected Hospital:	PHOENIXVILLE HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	71	
First Day of ICU Bed Shortage:	None	-
First Day of Med/Surg Bed Shortage:	None	-

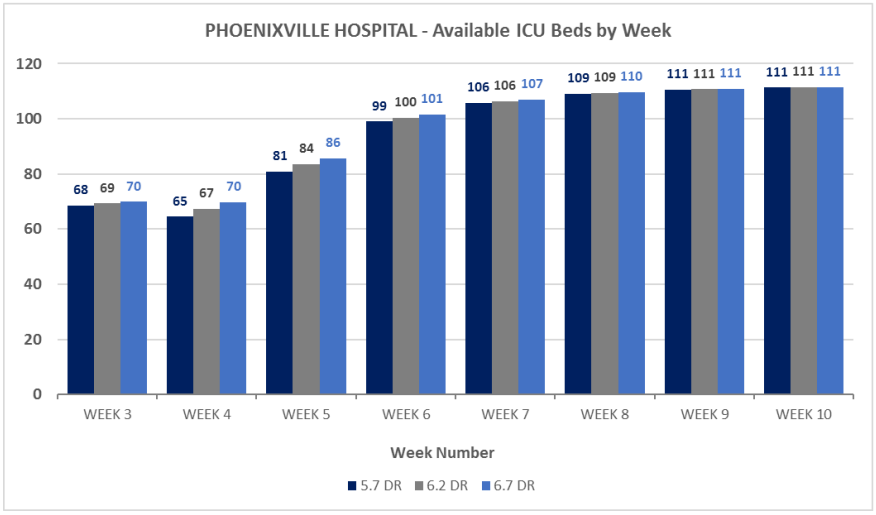
SURGE OPERATING CAPACITY

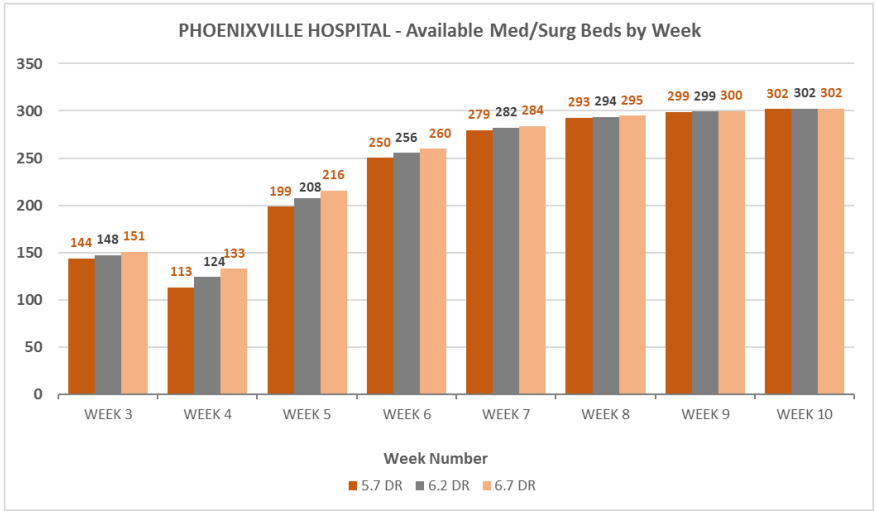
Model uses doubling rates of 5.7 DR, 6.2 DR and 6.7 DR to generate 3 potential scenarios

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









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COVID-19 Bed Demand & Surge Capacity Model

POTTSTOWN HOSPITAL

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Pottstown Capacity Assumptions

Pottstown Hospital

Initial State		
Med/Surg Beds	120	Operational bed capacity
ICU Beds	18	

Surge Capacity		
Med/Surg Beds	175	
ICU Beds	28	

BED DEMAND AND SURGE MODEL

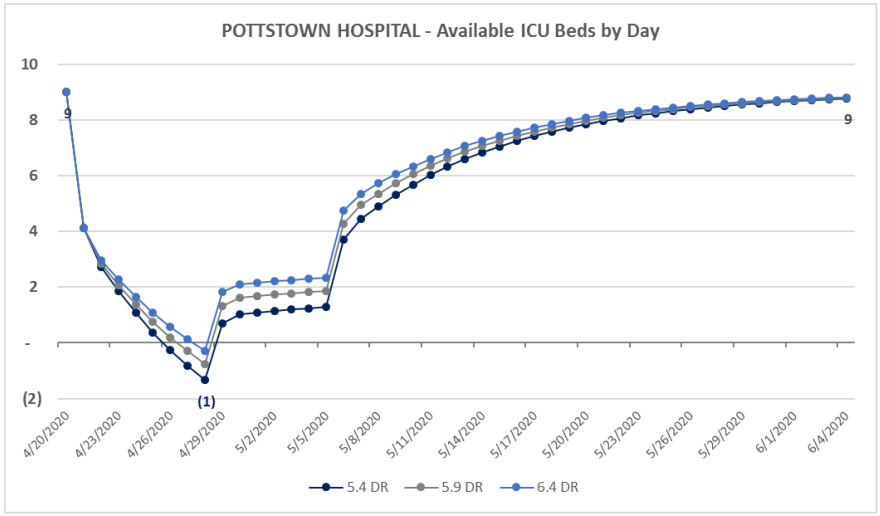
Outputs for Confirmed Cases as of 4/6/2020

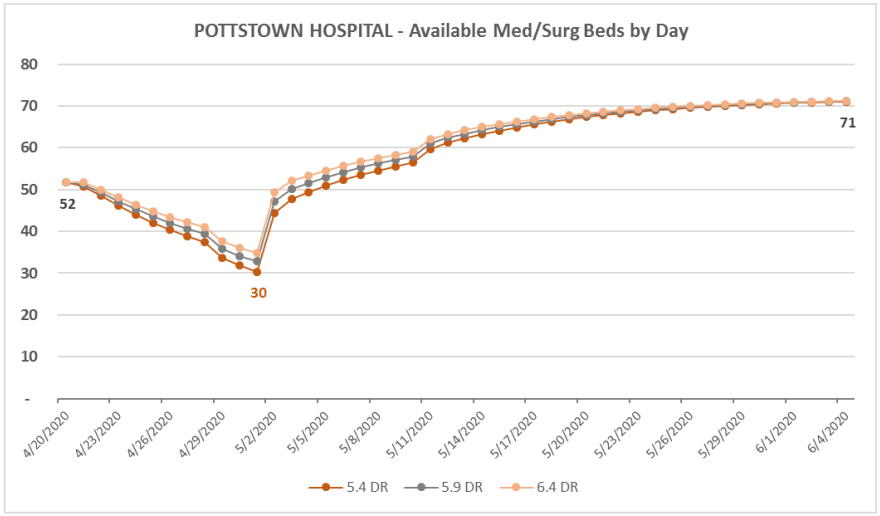
Selected Hospital:	POTTSTOWN HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	90	
First Day of ICU Bed Shortage:	4/27/2020	**3 weeks from 4/6/2020**
First Day of Med/Surg Bed Shortage:	None	-

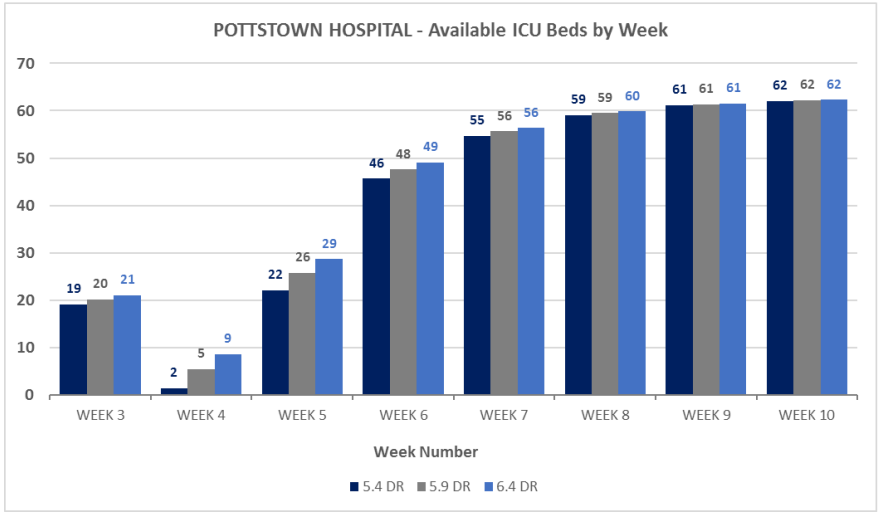
REGULAR OPERATING CAPACITY

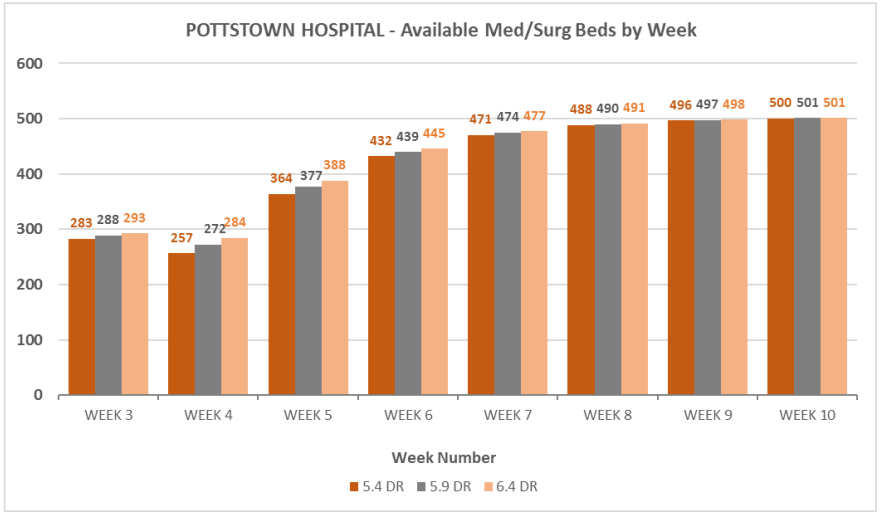
Model uses doubling rates of 5.4 DR, 5.9 DR and 6.4 DR to generate 3 potential scenarios

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









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BED DEMAND AND SURGE MODEL

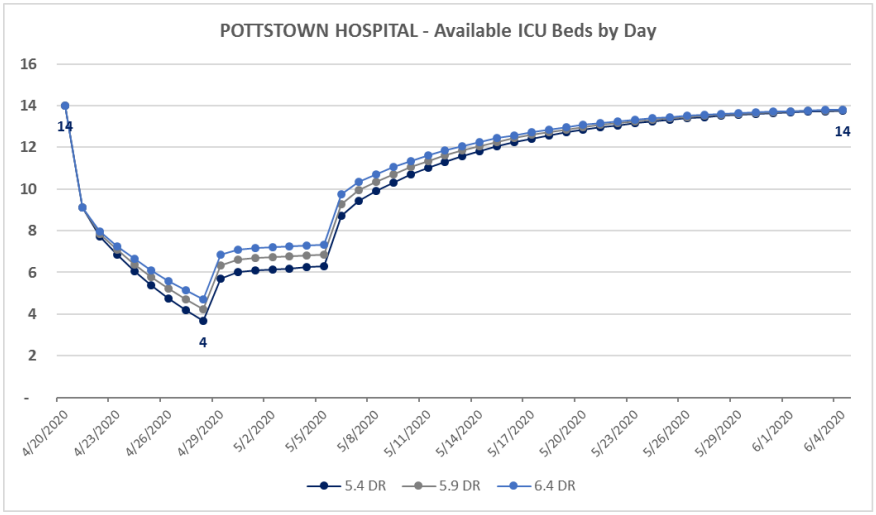
Outputs for Confirmed Cases as of 4/6/2020

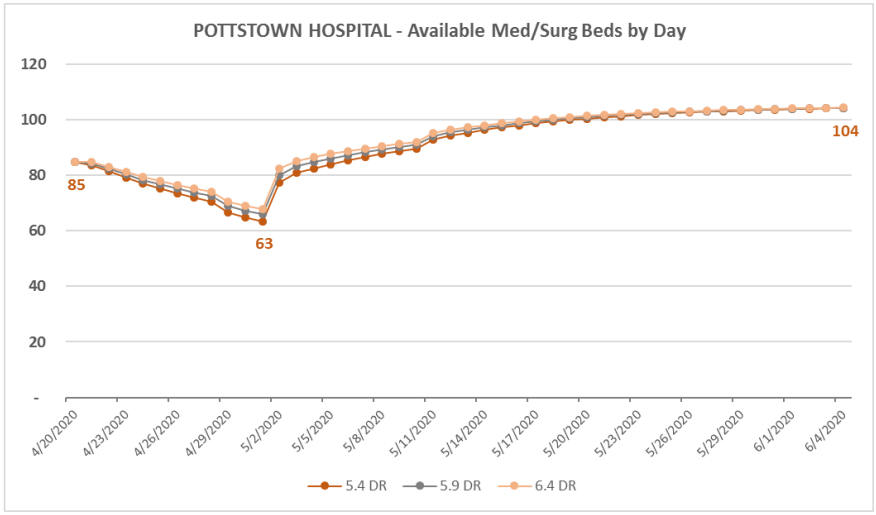
Selected Hospital:	POTTSTOWN HOSPITAL	
First day of model:	4/6/2020	
Number of confirmed cases on first day of model:	90	
First Day of ICU Bed Shortage:	4/27/2020	**3 weeks from 4/6/2020**
First Day of Med/Surg Bed Shortage:	None	-

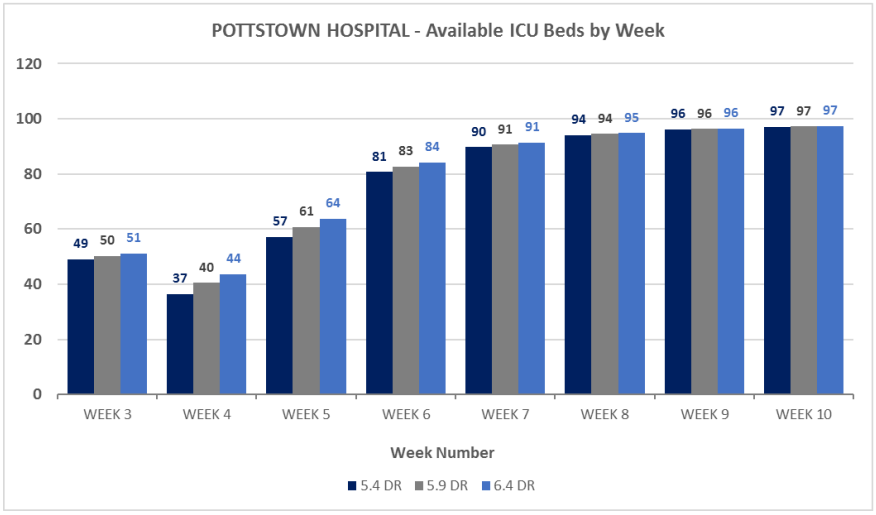
SURGE OPERATING CAPACITY

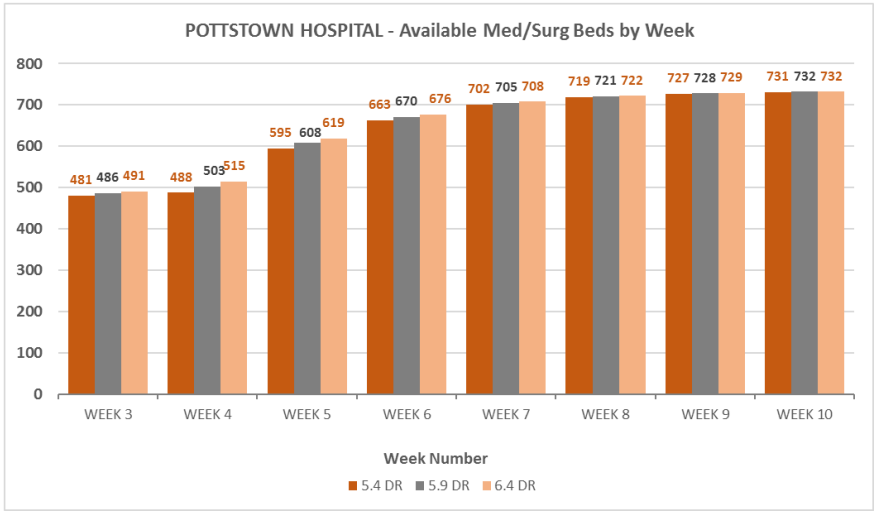
Model uses doubling rates of 5.4 DR, 5.9 DR and 6.4 DR to generate 3 potential scenarios

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









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