RHODE ISLAND COVID-19 ISSUE BRIEF

COVID-19 Hospitalizations: Trends, Demographics, and Risk Factors for Critical Illness

July 2020

Introduction

As of July 31, 2020, there were a total of 19,143 laboratory confirmed cases of COVID-19 in Rhode Island out of 207,772 patients tested. While the actual prevalence of the virus in Rhode Island is not known with certainty, it is estimated to be approximately 4% as of the end of July, and there is good evidence that rates are significantly higher in the Black and Hispanic populations.[1] Overall, 2,227 (11.6% of confirmed cases) patients have been hospitalized, 454 (20.4%) of hospitalized patients were admitted to the intensive care unit (ICU) and 303 patients (13.6%) were placed on a ventilator. In terms of acuity, 594 (26.7%) became critically ill,[2,3] 313 (14.1%) of hospitalized patients died, 176 (38.8%) of ICU patients died, and 153 (50.5%) of ventilated patients died.

This paper illustrates trends in relevant hospitalization stays, presents the demographic and clinical characteristics of hospitalized patients, and identifies risk factors for critical illness among COVID-19 patients. Further, this paper provides useful information to the public and healthcare community on the relevant characteristics of hospital stays for COVID-19 in Rhode Island.

Methods

Data for this analysis were taken from Rhode Island Department of Health (RIDOH) COVID-19 datasets:

1. **COVID-19 Rhode Island Data** contains aggregate data on new and cumulative cases, hospitalizations, ICU beds, ventilators, and deaths. It is publicly available on RIDOH's website.
2. Detailed information on hospitalizations was provided by the **Hospital and Freestanding Emergency Care Facility Incidents and Adverse Event Reporting System** (HIRS). Hospitals collect and submit reports to RIDOH in conjunction with daily reporting for the Centers for Disease Control and Prevention's (CDC) National Healthcare Safety Network. Hospital records are linked to confirmed case investigation databases using hierarchical matching schemes based on name and date of birth. RIDOH provided this deidentified information for these analyses.

Analysis was performed using SAS 9.4.

KEY FINDINGS

Average length of stay for all hospitalized patients is **10.4 days and 18.8 days for ICU patients. Average time on a ventilator is 11.9 days.**

11.6% of confirmed cases are hospitalized.

Only one **in three** COVID-19 deaths occurred in the hospital.

Mortality among hospitalized patients is **14.1%.** It is **38.8%** among ICU patients, and **50%** among patients on ventilators.

35% of currently hospitalized patients have been in the hospital for 30 days or more.

Most metrics **plunged in June** but trended upward in July.

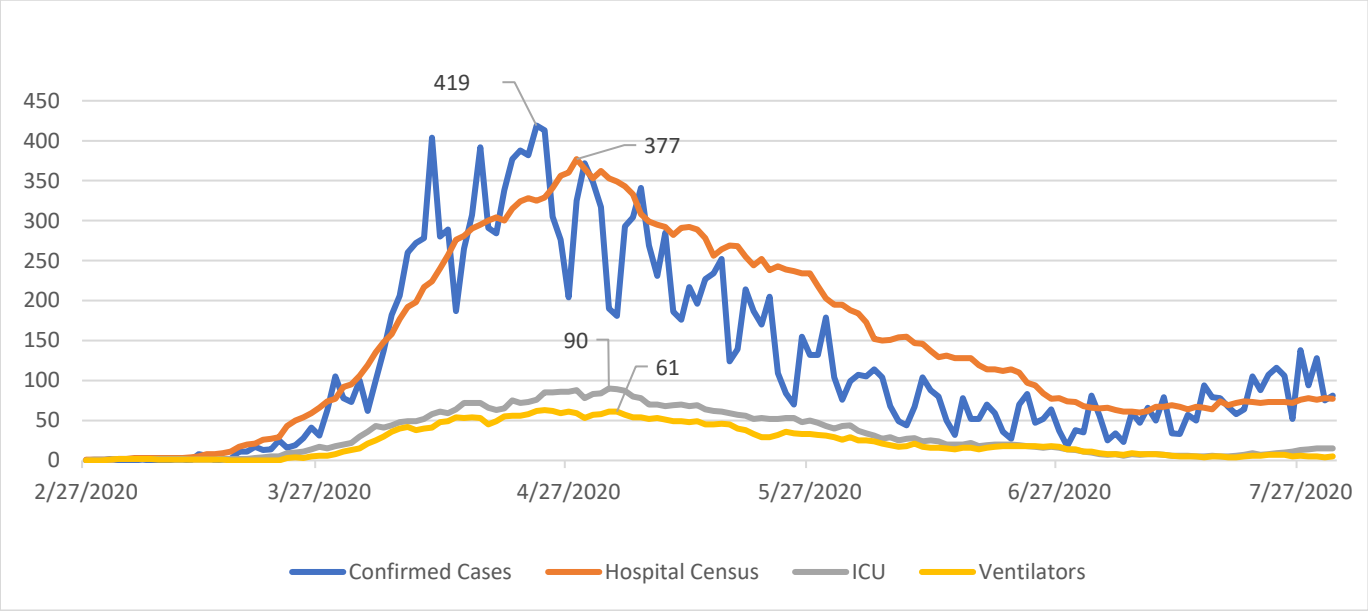
General statistics and trends

Figure 1 illustrates the correlation between newly confirmed cases of COVID-19 and the daily census of hospital beds occupied by COVID-19 patients. Note that newly confirmed cases peaked at 419 on April 23, 2020, while the hospital census peaked five days later, on April 28, at 377. Similarly, ICU beds and ventilators peaked at 90 and 61, respectively, on May 3—five days after the peak hospital census.

All parameters declined steadily throughout May and June though there was some visible day-to-day variation especially in the number of confirmed cases. The three-day average of newly confirmed cases dipped to a low of 30 on July 1, hospital census dropped to 60 on July 7, ICU beds were down to five on July 14, and only four patients were on ventilators on July 15 (these points may not be visible in Figure 1).

Since early July, all metrics of interest are trending upward. This may be due to several factors (reopening the economy, Fourth of July celebrations, social justice rallies, summer recreation patterns). Regardless of the cause, we need to be especially vigilant in monitoring these recent trends.

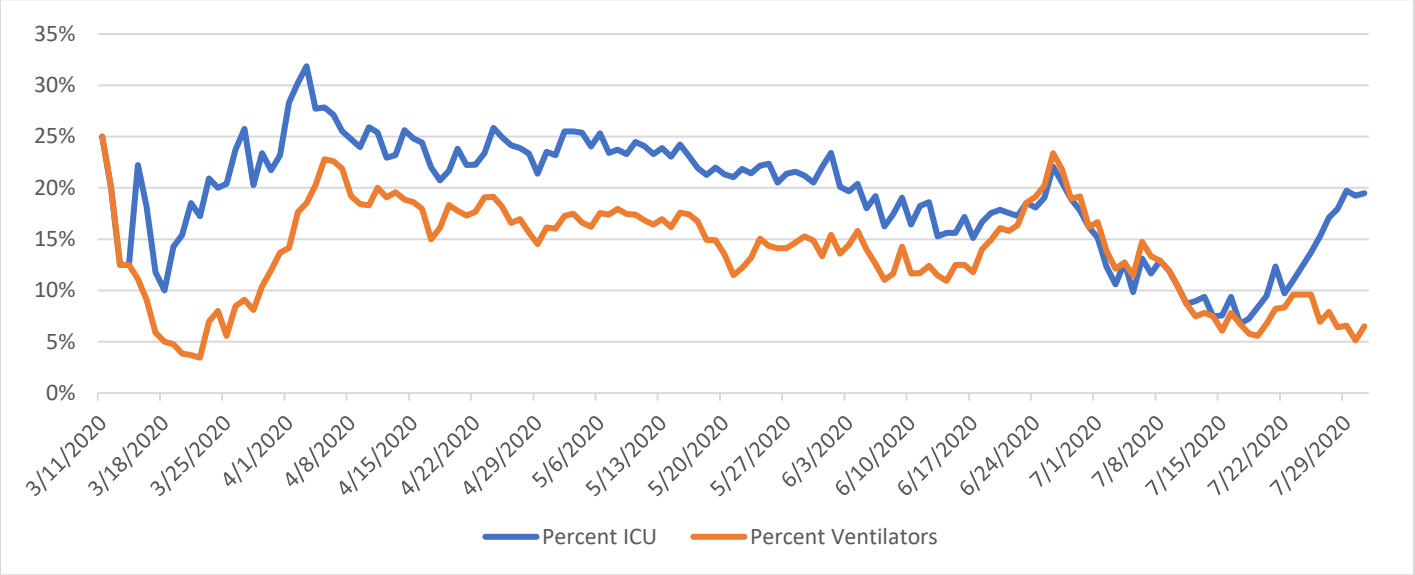
Figure 1: *Daily Confirmed Cases, Current Hospital Beds Occupied, ICU Beds, and Ventilators*



As seen in Figure 2, during April and May, the percent of all COVID-19 hospital admissions requiring ICU beds varied between 20% and 30%. By early June, just less than 20% of all COVID-19 hospitalizations required ICU beds. There was an increase in the percent of COVID-19 hospital patients in the ICU in late June, and another decline in mid-July. However, since mid-July, ICU beds as a percent of COVID-19 hospitalizations has been increasing steadily. The percent of hospitalized COVID-19 patients on ventilators varied between 10% and 20% from April to mid-June, when it spiked. Since then, the percent of hospitalized COVID-19 patients on ventilators has declined to a low of approximately 5%.

Note that throughout the epidemic, ICU beds and ventilators have followed a similar up and down trend but appear to diverge in late July.

Figure 2: *Percent of COVID-19 Hospital Patients in the ICU or on Ventilators*



The percent of all tests with positive results and the percent of newly confirmed cases admitted to the hospital are markers for community spread[4] and disease severity. Figure 3 plots daily trends in these variables since April 1, 2020 (day-to-day variation prior to April 1 was somewhat erratic so it is not shown in this figure).

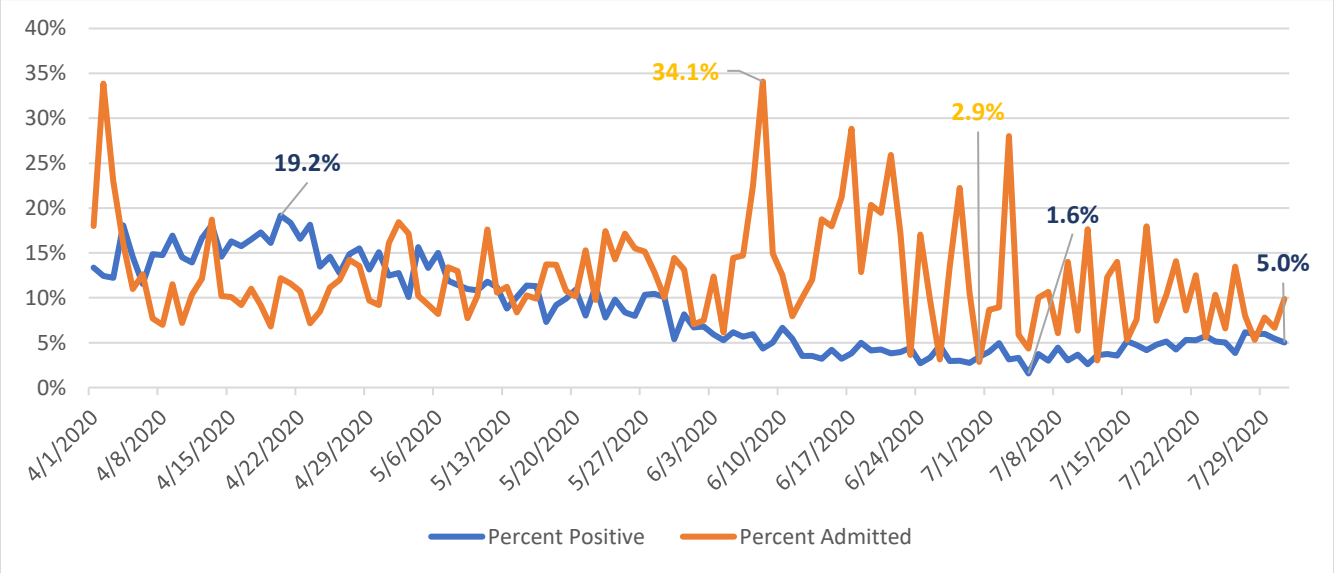
During the course of the epidemic, 19,143 people have tested positive out of a total of 207,772 people tested—which results in a rate of 9.2%. During April, the positivity rate varied between 15% and 20%. The positivity rate began a steady decline in May and reached a low of 1.6% on July 5. Since mid-July, the positivity rate has increased and reached **5%** at the end of July.

Overall, 11.6% of **incident confirmed cases** have been hospitalized during the course of the epidemic (Figure 3). While overall COVID-19 hospitalization rates declined steadily during April and May, these rates began to increase in June from a low of 6.1% on June 3 to a high of 34.1% on June 8. Considerable day-to-day variation continued through June but dipped to an all-time low of **2.9%** on July 1. Hospitalization rates continued to fluctuate during July and the month ended at 10%.

Many factors contribute to the hospitalization rate, including the extent of testing and the severity of disease among tested patients. Also, newly confirmed cases do not include undiagnosed cases in the community and therefore underestimate the prevalence of disease. As such, the **true** hospitalization rate (based on all cases not just confirmed cases) is estimated at less than 10%.

Turnaround time between specimen collection and results is an important variable in assessing the effectiveness of our testing initiatives.[5] While complete data on these parameters are not currently available, provisional estimates suggest that the average time between specimen collection and results is 4.3 days and 67% of tests are returned within five days (data not shown). RIDOH is currently developing analytics on daily turnaround times by collection site, lab, and reason for testing.

Figure 3: *Percent Tests Positive and Percent of New Confirmed Cases Admitted to the Hospital*



Note: 20% of hospital admissions occur an average of 14.2 days after the confirmatory test.

Characteristics of Hospitalized Patients

Patients discharged from the hospital include people who recovered and went home as well as people who died in the hospital. Similarly, current hospital patients are a mixture of newly admitted as well as patients who have been hospitalized for some time. All groups are represented in Table 1.

Through July 31, 2020, 1,053 (47.3%) hospitalized patients were age 65 or older, and 1,195 (53.7%) were male. While Blacks and Hispanics are both over-represented among hospitalized patients, it should be noted that race and ethnicity data is missing for approximately one third of Rhode Island's COVID-19 hospitalizations. RIDOH expects that more complete data are likely to show even more disparity by race and ethnicity.

At least 86% of hospitalized patients came from Providence County, with 7.0% from Kent County, and 4.2% from Washington County. Less than 3% came from Bristol and Newport counties.

Patients admitted from nursing homes (and assisted living facilities) constituted 23.6% of all hospital admissions related to COVID-19. About 73% of hospitalized patients had a pre-existing condition recognized by the CDC as a COVID-19 risk factor. See Table 3 for a list of pre-existing conditions recognized as COVID-19 risk factors.

Only 20.6% of hospitalized patients had a positive result for an outpatient COVID-19 test prior to admission, **suggesting that many patients did not get tested until they were sick enough to be hospitalized.** On the other hand, 7.3% of hospitalized patients were considered asymptomatic upon hospital admission (a potential marker for hospital acquired infections). Since the rates are significantly different for discharged and current patients, RIDOH will look more closely at intake procedures that populate this variable.

There were 454 (20.4%) patients admitted to the ICU and 303 (13.6%) placed on ventilators. Just less than half (46.5%) of ICU patients were admitted directly to the ICU while 53.5% were transferred to the ICU from another unit. The death rate among hospitalized patients was 14.1%. The death rate among COVID-19 patients in ICU beds and placed on ventilators was 38.8% and 50.5% respectively.

Only 313 of the 1,007 (31.1% or approximately one in three) COVID-19 deaths as of July 31, 2020, occurred in the hospital. Most of the remaining deaths occurred in nursing homes and will be explored in future Issue Briefs.

Critically ill patients are defined as any patient going to the ICU, being placed on a ventilator, or who has died. There were 594 (26.7%) hospitalized patients defined as critically ill.

Relevant differences between current and discharged patients include ICU and ventilator rates, both of which are higher among current patients. Current patients are also more likely to be chronically ill which contributes to the evidence that many current patients require extended stays. Also, a lower percentage of current patients were admitted from a nursing home compared to discharged patients, which suggests that Rhode Island may be making progress in controlling the spread of COVID-19 in nursing homes.

Table 1: *Characteristics of Patients Admitted to Acute Care Hospitals for COVID-19 by Discharge Status*

	Discharged (n=2,149)		Current (n=78)		Total (n=2,227)		
Categorical Variables	n	Percent	n	Percent	n	Percent	Percent Unknown
Age 65 or older	1,018	47.4	35	44.9	1,053	47.3	0.00
Male	1,159	53.9	36	46.2	1,195	53.7	0.00
County							
Providence	1,724	86.2	54	83.1	1,778	86.1	7.30
Kent	135	6.8	9	13.9	144	7.0	
Washington	85	4.3	<5	-	86	4.2	
Bristol/Newport	56	2.8	<5	-	57	2.8	
Black	475	33.6	23	41.1	498	33.9	34.00
Hispanic	593	38.7	12	23.1	605	38.2	28.80
Admitted from Nursing Home/Assisted Living Facility	516	24.1	9	11.5	525	23.6	<1
Tested Positive Prior to Admission	370	20.8	13	16.7	383	20.6	16.40
Asymptomatic upon Admission	138	6.4	25	32.1	163	7.3	24.60
History of Chronic Illness	1,569	73.0	57	73.1	1,626	73.0	0.00
Ventilated	290	13.5	13	16.7	303	13.6	0.0
Ventilator Mortality*	153	52.8	NA	NA	153	50.5	0.0
ICU Stays	431	20.1	23	29.5	454	20.4	0.0
Admitted to ICU	201	46.6	10	43.5	211	46.5	0.0
Transferred to ICU	230	53.4	13	56.5	243	53.5	0.0
ICU Mortality**	176	40.8	NA	NA	176	38.8	0.0
Hospital Mortality	313	14.6	NA	NA	313	14.1	0.0
Critically Ill	571	26.6	23	29.5	594	26.7	0.0

Admissions through July 31, 2020
Run Date: August 6, 2020
Due to confidentiality issues RIDOH does not report cells with fewer than five events.
Note: Percentages are calculated based on the total number of valid responses to each question (excluding missing and unknown entries).
**Ventilator Mortality Rate is based on patient ever placed on a ventilator.*
***ICU Mortality Rate is based on patient ever in the ICU (admitted plus transferred).*

Characteristics of Hospital Stays

Relevant characteristics of hospital stays are illustrated in Table 2**,** stratified by discharge status, and include the following:

- The average age of hospitalized patients was 61.4 years old.
- The average length of stay (LOS) among all hospitalized patients was 10.4 days and varied significantly by discharge status (i.e., current patients have an average LOS of 41.1 days compared to 9.2 days for discharged patients. This suggests that many current patients have been in the hospital for an extended period of time).
- ICU patients spend an average of 18.8 days in the hospital including an average of 2.2 days prior to ICU transfer, 11.0 days concurrent in the ICU, and 5.6 days in the hospital after they were discharged from the ICU. Currently hospitalized patients have considerably longer lengths of ICU stays than discharged patients.
- Patients on ventilators spend an average of 11.9 days on a ventilator. Again, current patients have spent more time on a ventilator than discharged patients.
- Among patients who died in the hospital, there was an average of 10.8 days between admission and death.

Table 2: *Characteristics of Patients Admitted to Acute Care Hospitals for COVID-19*

	Discharged		Current		Total		
Interval Variables	n	Mean (STDV)	n	Mean (STDV)	n	Mean (STDV)	Percent Unknown
Age	2,143	61.5 (19.6)	78	58.8 (17.2)	2,221	61.4 (19.5)	0.0
Average LOS	2,149	9.2 (10.9)	78	41.1 (47.5)	2,227	10.4 (15.0)	0.0
ICU LOS							
Days Prior to ICU	431	2.2 (4.2)	23	2.5 (3.6)	454	2.2 (4.2)	0.0
Days Concurrent	431	10.8 (11.5)	23	13.9(22.2)	454	11.0 (12.3)	0.0
Days Post ICU	431	5.3 (7.9)	23	11.2 (28.4)	454	5.6 (10.0)	0.0
Total	431	18.3 (14.7)	23	27.4 (38.3)	454	18.8 (16.7)	0.0
Days on Vent	290	11.5 (11.9)	13	19.5 (27.6)	303	11.9 (13.0)	0.0
Days until Death	313	10.8 (10.7)			313	10.8 (10.7)	0.0

Admissions through July 31, 2020
Run Date: August 6, 2020

Pre-existing Conditions

Table 3 illustrates the co-occurrence of selected pre-existing conditions among hospitalized COVID-19 patients compared with CDC estimates of prevalence in the adult population. Note that Rhode Island's conditions were not defined exactly according to CDC specifications, but RIDOH hopes that they will be useful for broad comparisons.

Hypertension, diabetes, and obesity are the leading pre-existing conditions among hospitalized COVID-19 patients with rates of 48.9%, 29.7%, and 25.2% respectively. Cardiac disease (24.6%) and renal disease (24.3%) are disproportionately prominent among COVID-19 patients. Moreover, immunocompromised patients are more than 2.5 times more common in COVID-19 hospitalizations than in the general population.

Surprisingly, lung disease and hypercholesterolemia were detected more frequently in hospitalized populations than in the general population. Perhaps the occurrence of lung disease and hypercholesterolemia are perceived as complications of the virus and not recognized as pre-existing conditions.

There have been 38 pregnant women hospitalized with COVID-19. All have been discharged and none became critically ill. All were admitted to Women & Infants Hospital and the average length of stay was 3.1 days (data not shown). It is not clear how many admissions resulted in a delivery. Further investigation is underway.

Only 27.0% of hospitalized patients had no co-occurring illnesses and just less than 50% had two or more. No one had more than six pre-existing conditions.

Table 3: *Pre-exisitng Conditions among COVID-19 Patients*

	Discharged (n=2,149)		Current (n=78)		Total (n=2,227)		
Categorical Variables	n	Percent	n	Percent	n	Percent	
Pre-existing Conditions							National Prevalence*
Obesity	548	25.5	13	16.7	561	25.2	42
Lung Disease	393	18.3	21	26.9	414	18.6	22
Cardiac**	520	24.2	27	34.6	547	24.6	12
Diabetes**	643	29.9	19	24.4	662	29.7	15
Hypertension**	1,050	48.9	40	51.3	1,090	48.9	33
Hypercholesterolemia	145	6.8	18	23.1	163	7.3	12
Immunocompromised**	174	8.1	5	6.4	179	8.0	3
Renal Disease**	524	24.4	18	23.1	542	24.3	2
Pregnancy	38	1.8	0	0.0	38	1.7	
Number of Pre-existing Conditions							
0	580	27.0	21	26.9	601	27.0	
1	528	24.6	14	18.0	542	24.3	
2	464	21.6	16	20.5	480	21.6	
3	283	13.2	15	19.2	298	13.4	
4	220	10.2	6	7.7	226	10.2	
5	63	2.9	<5	-	67	3.0	
6	11	0.5	<5	-	13	0.6	

**Source: https://cdc.gov*
Source: https://www.cdc.gov/chronicdisease/data/index.htm..
***Indicates prevalence in COVID-19 hospitalizations is higher than national prevalence*
Admissions through July 31, 2020
Run Date: August 6, 2020
Due to confidentiality issues RIDOH does not report cells with fewer than five events.

Demographic Characteristics

Table 4 illustrates the distribution of age among confirmed cases, hospital beds occupied, and deaths. Note that rates for confirmed cases are expressed per 1,000 population while hospitalization rates are per 10,000 and death rates are per 100,000.

Rates of confirmed cases increase with age from the 0 to 9 age group to the 40 to 49 age group and then begin to decline at age 50. Note that the case rates are very similar among the younger adult populations (20 to 59 years old). The confirmed case rate is highest among people 80 and older, at about 40 cases per 1,000 population.

On the other hand, hospitalization rates increase almost linearly with age starting at 1.6 per 10,000 in the 0 to 9 age group and climbing to 83.9 by age 80 and older.

Mortality remains fairly low until age 70 and then increases significantly.

Table 4: *Prevalent COVID-19 Confirmed Cases, Hospitalizations, and Deaths*

Age Group	Population	Confirmed Cases		Hospitalizations		Deaths	
		Number	Rate/ 1,000	Number	Rate /10,000	Number	Rate/ 100,000
0-9	111,121	500	4.5	18	1.6	0	0
10-19	129,978	1,030	7.9	27	2.1	<5	--
20-29	152,382	2,926	19.2	110	7.2	<5	--
30-39	135,047	2,905	21.5	157	11.6	7	5.2
40-49	123,877	2,686	21.7	248	20.0	15	12.1
50-59	146,916	2,724	18.5	351	23.9	45	30.6
60-69	131,777	1,948	14.8	441	33.5	102	77.4
70-79	77,923	1,279	16.4	413	53.0	243	311.8
80 or older	48,294	1,952	40.4	405	83.9	588	1,217.5
Total	**1,057,315**	**17,950**		**2,170**		**1,000**	

Includes events through July 29, 2020
Note: Cases are presented as a rate per 1,000. Hospitalizations are rates per 10,000, and deaths are rates per 100,000.

Geographic Distribution of Hospitalizations

Figures 4a and 4b shows the distribution of the COVID-19 hospitalization rate (per 10,000 population) by the reported ZIP code of resident and illustrates the spread of the virus from June to July. As shown in both charts, the virus is most concentrated in neighborhoods in and around Providence (particularly the central corridor of Providence County, including Central Falls, Elmhurst, Elmwood, Washington Park, Olneyville, and North End as well as parts of Pawtucket reaching down to East Providence and Riverside). It appears that hospitalization rates increase across the state in July, as areas north and west of Providence appear darker than in June. Going forward, it will be important to monitor hospitalization rate increases (in terms of degree of increase and location) as RIDOH assesses the impact of mitigation policies.

Figure 4: *Hospitalization Rates by ZIP Code of Resident and Month, June and July 2020*

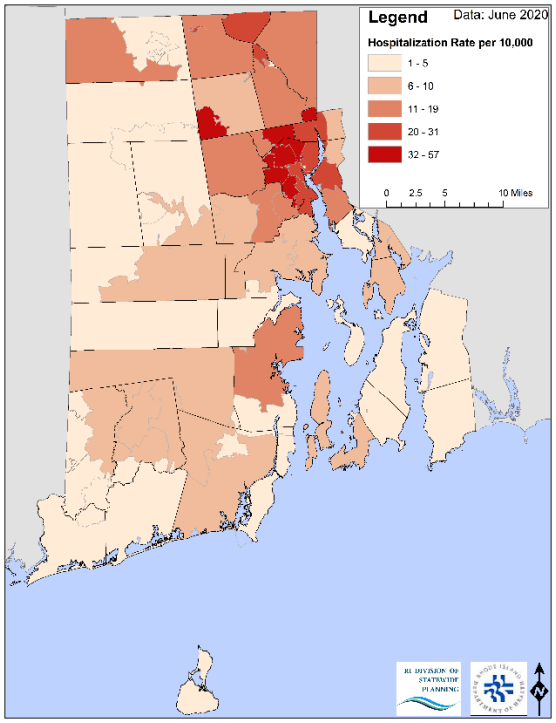


Figure 4a

June 2020

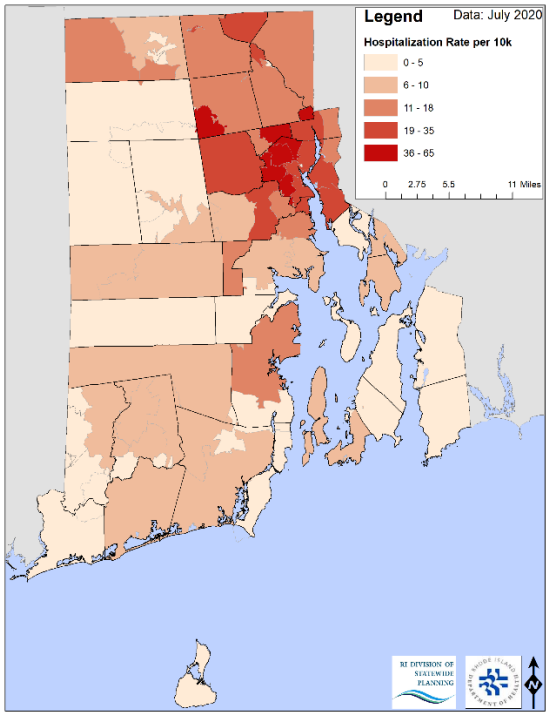


Figure 4b

July 2020

Risk Factors for Critical Illness

Approximately 26.7% (594 of 2,227) of hospitalized patients became critically ill (i.e., entered ICU, placed on a ventilator, or died). Independent risk factors for critical illness[1] include age 65 or older (OR=1.86, 95% CI: 1.54, 2.25), admission from a nursing home or assisted living facility (OR=2.09, 95% CI: 1.69, 2.57), history of selected chronic disease—particularly compromised immune systems (OR=1.64, 95% CI: 1.19, 2.26) and hypercholesterolemia (OR=1.62, 95% CI: 1.16, 2.26). Patients tested prior to hospitalization were somewhat less likely to become critically ill (suggesting that early detection may have an important protective effect) but fell just outside statistical significance. Other notable characteristics of critically ill patients include:

- At least one co-occurring condition significantly increases the odds of becoming critically ill from COVID-19 with an odds ratio of 1.52 (95% CI: 1.22, 1.91).
- Among the other specific conditions most strongly associated with critical illness are:
  - Renal disease (OR=1.53, 95% CI: 1.24, 1.88)
  - Cardiac disease (OR=1.37, 95% CI: 1.11, 1.69)
  - Diabetes (OR=1.40, 95% CI: 1.15, 1.71)
  - Hypertension (OR=1.36, 95% CI: 1.12, 1.64)
- Lung disease, which has been linked to COVID-19 deaths in many studies, was not significantly associated with critical illness in these data and may be due to misclassification of lung symptoms being considered as a complication of treatment as opposed to a pre-existing condition.
- Obesity, on the other hand, was marginally associated with critical illness but was not a statistically significant independent risk factor.
- Asymptomatic (on admission) patients were significantly less likely to be critically ill with an odds ratio of 0.18 (95% CI: 0.10, 0.34).
- As previously noted, there were 38 pregnant women hospitalized and none became critically ill.

Table 5: *Independent Risks of Critical Illness among COVID-19 Patients Admitted to Acute Care Hospitals*

	Critical Illness				Total (n=2,227)	
	Yes (n=594)		No (n=1,633)			
	Number	Percent	Number	Percent	OR**	95% CI***
Age 65 or older	348	58.6	705	43.2	1.86	1.54, 2.25
Male	354	59.6	841	51.5	1.39	1.15, 1.68
Tested Prior to Admission	83	17.7	300	21.5	0.79	0.60, 1.03
Asymptomatic	11	1.9	152	9.3	0.18	0.10, 0.34
Black	126	30.1	372	35.3	0.79	0.62, 1.01
Hispanic	146	34.3	459	39.6	0.80	0.63, 1.00
Nursing Home or Assisted Living Patient	202	34.1	323	19.8	2.09	1.69, 2.57
Any Co-occurring Conditions	468	78.8	1,158	70.9	1.52	1.22, 1.91
Obesity	165	27.8	396	24.3	1.20	0.97, 1.49
Diabetes	208	35.0	454	27.8	1.40	1.15, 1.71
Immunocompromised	65	10.9	114	7.0	1.64	1.19, 2.26
Hypercholesterolemia	59	9.9	104	6.40	1.62	1.16, 2.26
Hypertension	324	54.6	766	46.9	1.36	1.12, 1.64
Cardiac Disease	172	29.0	375	23.0	1.37	1.11, 1.69
Any CVD*	373	62.8	881	54.0	1.44	1.19, 1.75
Renal Disease	180	30.3	362	22.2	1.53	1.24, 1.88
Lung Disease	113	19.0	301	18.4	1.04	0.82, 1.32
Pregnant	0	0	38	2.3		

Admissions through July 31, 2020
Run date: August 6, 2020
**Any Cardiovascular Disease (CVD) is a composite variable including hypercholesterolemia, hypertension, or cardiac disease.*
***Odds Ratio*
****Confidence Interval*

Multivariate Model

This model was constructed to be statistically sound as well as clinically and programmatically useful.

Admission from a nursing home, age 65 or older, and male sex all were significant risk factors of critical illness in the multivariate logistic model. In particular, patients admitted from nursing homes were 2.57 times more likely to be critically ill than community admissions (95% CI: 1.87, 3.52). Age (OR=1.49, 95% CI: 1.12, 1.97) and male sex (OR=1.47, 95% CI: 1.31, 1.90) were both significantly associated with critical illness. Ethnicity, on the other hand, was not significantly associated with critical illness but was retained in the model because the magnitude and the direction of the odds ratio changed from the independent risk factor analysis to the multivariate analysis. Also, there is other evidence of statistical interaction between race, ethnicity, and risk factors for critical illness that is worthy of further investigation.

Among the pre-existing condition risk factors, immunocompromised patients had the highest adjusted odds ratio for critical illness (OR=1.77, 95% CI: 1.15, 2.74). As previously mentioned, immunocompromised conditions were among the least common pre-existing conditions but had the strongest adjusted effect.

Finally, obesity, which was only marginally associated with critical illness in the independent model, became a significant predictor in the adjusted model (OR=1.45, 95% CI: 1.09, 1.94). Conversely, renal disease, which had been a strong predictor in the independent analysis, became mitigated in the adjusted model and is not included in the final model.

Table 6: *Adjusted Odds Ratios of Selected Risks for Critical Illness among Patients Admitted for Treatment of COVID-19*

Risk Factor	Adjusted Odds ratio	95 % CI
Age 65 or older	1.49	1.12, 1.97
Sex=Male	1.47	1.13, 1.90
Race=Black	0.88	0.66, 1.17
Ethnicity=Hispanic	1.29	0.94, 1.77
Admitted from Nursing Home or Assisted Living Facility	2.57	1.87, 3.52
Obesity	1.45	1.09, 1.94
Immunocompromised	1.77	1.15, 2.74

Admissions through July 31, 2020
Run Date: August 6, 2020
Race and ethnicity are included in the model to assess potential interaction.

Limitations

COVID-19 is a new virus that did not exist in Rhode Island until late February 2020. Everything learned about the presentation of the virus in new cases needs to be cataloged. The body of knowledge on COVID-19 evolves daily as new information is acquired.

From a practical perspective, RIDOH has devoted enormous resources to assure that it is developing precision public health[6] datasets to identify cases and contacts, track utilization of services, and monitor outcomes as the epidemic progresses. Special care has been taken to assure that RIDOH is collecting the right variables, operationalizing their definition precisely, and offering relevant interpretations of results to the clinical and

programmatic community. While RIDOH is confident in the precision of the results it reports here, we are mindful that interpretations may change as we acquire new information and learn more about the epidemiology of this disease.

Conclusions and Recommendations

- Major trends declined steadily toward zero through May and June but began to shift upward in July.
- ICU rates increased in late July, which suggests a high acuity among current admissions.
- Many currently hospitalized patients have been in the hospital for more than 30 days, which suggests that some patients have a prolonged convalescence. Further research into contributing factors to, and effects of, prolonged convalescence should be carried out.
- Rates of newly confirmed cases are comparable among most adult population groups, but hospitalization rates increase incrementally with age (especially after 60), and mortality rates spike at age 70.
- Demographic risks for critical illness include being age 65 or older, male sex, and admission from a nursing home. Medical risk factors include any CDC-recognized chronic disease—especially compromised immune systems, hypercholesterolemia, and renal disease.
- Hospitalization rates are increasing in ZIP codes outside of Providence.
- Multivariate analysis identifies admission from nursing homes, age, male sex, obesity, and a compromised immune system as adjusted risks of critical illness. Additionally, there appears to be considerable interaction between race and ethnicity and risk factors for critical illness.
- Additional data need to be collected on hospital stays to fully assess the impact of co-occurring conditions on critical illness.

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