

A Comparison of COVID-19 Associated Hospitalization Rates Among Unvaccinated Versus Vaccinated Residents in Rhode Island, September 2022 to March 2024

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ABSTRACT

While the burden of COVID-19 in Rhode Island has diminished since 2020, Rhode Islanders' health continues to be severely impacted. We compared COVID-19 hospitalization rates among Rhode Islanders who did and did not receive the latest COVID-19 vaccination for the 2022–2023 and 2023–2024 COVID-19 seasons (November through March). Crude and age-adjusted rate ratios were calculated for each season comparing hospitalization rates of unvaccinated and vaccinated individuals. During the 2022–2023 season, individuals who were not vaccinated with the bivalent COVID-19 vaccine were 3.6 times (95% CI=2.8-4.6) more likely to be hospitalized for COVID-19 than individuals who received the vaccine, whereas during the 2023–2024 season, not receiving the updated vaccine was associated with a 2.4 times (95% CI=1.8-3.3) higher risk of hospitalization. The study provides the first assessment of the protection from hospitalization provided by COVID-19 vaccinations among Rhode Islanders and highlights the importance of continued vaccination for COVID-19.

KEYWORDS: Vaccine effectiveness, COVID-19, hospitalizations, Rhode Island, public health

BACKGROUND

Since March 2020, there have been more than 470,099 cases, 23,583 hospitalizations, and 4,364 deaths in Rhode Island as a result of the COVID-19 pandemic.¹ The widespread introduction of COVID-19 vaccines in 2021 had noticeable effects in reducing hospitalizations and deaths.²⁻⁴ While the burden of COVID-19 in Rhode Island has diminished since 2020, Rhode Islanders' health continues to be severely impacted, as seen with the 2,547 hospitalizations and 262 deaths in Rhode Island in 2023 alone.¹

The CDC's Advisory Committee on Immunization Practices recommends that eligible individuals receive the most recently released COVID-19 vaccines to protect against serious illness: in 2022–2023, bivalent vaccines were recommended, and in 2023–2024, the updated monovalent XBB.1.5 vaccines were recommended.^{5,6} Studies have shown that individuals who receive the most up-to-date vaccine

have a lower risk of hospitalization when compared to individuals who did not receive the latest vaccine.⁷⁻¹²

This analysis evaluated rates of hospitalization with a SARS-CoV-2 infection among Rhode Island residents who were either vaccinated or unvaccinated with an updated vaccine during periods of increased COVID-19 activity from November 2022 through March 2024. This study provides the first assessment the protection from hospitalization provided by COVID-19 vaccinations among Rhode Island residents in the peer-reviewed literature.

METHODS

Study Design, Setting, and Data

We compared risk of COVID-19 associated hospitalizations among Rhode Island residents who did and did not receive the latest COVID-19 vaccine separately for the 2022–2023 and 2023–2024 COVID-19 seasons. We defined the COVID-19 seasons as November 1 through March 31 due to increased COVID-19 activity during this period.

Hospitalization data were obtained from the Rhode Island Department of Health (RIDOH), to which all hospitals in Rhode Island are required to report COVID-19-associated hospitalizations. Vaccination data were obtained using the Rhode Island Child and Adult Immunization Registry (RIC-AIR), which includes Rhode Island residents vaccinated in Rhode Island, Massachusetts, Connecticut, New Jersey, New York City, and residents vaccinated at a Veterans Affairs facility in Rhode Island on or after November 14, 2022. Residents vaccinated in a state or federal facility not listed above were not identified as vaccinated unless they submitted their vaccination record to RIDOH. Population estimates were obtained from the US Census Bureau's 2020 5-year American Community Survey.

Hospitalization Definitions (Numerators)

A COVID-19-associated hospital admission was defined by RIDOH as any Rhode Island residents admitted to an acute care or psychiatric inpatient facility for at least one night with COVID-19. After January 1, 2023, people were included once per COVID-19 infection if they had a laboratory-confirmed positive SARS-CoV-2 test either: (1) within 30 days prior to hospital admission if COVID-19 was a primary or contributing cause of hospitalization (patient admitted with

respiratory or other COVID-19 symptoms or for a reason that is directly related to COVID-19, e.g., patient is admitted with dizziness and found to be dehydrated due to COVID-19); (2) within 14 days prior to hospital admission if COVID-19 was not a primary or contributing cause of hospitalization; or (3) within three days after hospital admission, regardless of the cause of hospitalization. Prior to January 1, 2023, patients were counted more than once if they were re-admitted during the course of a single COVID-19 infection, consistent with the RIDOH COVID-19 hospitalization definition.¹³

A hospitalized individual was considered vaccinated for COVID-19 if they received the most recent up-to-date vaccine recommended prior to the specimen collection date for their positive COVID-19 test linked to their hospitalization. Hospitalized individuals who did not receive the most up-to-date recommended vaccine prior to the specimen collection date for their positive COVID-19 test linked to their hospitalization were considered unvaccinated, regardless of whether they had received an earlier COVID-19 vaccine.

Population Definitions (Denominators)

For each month of the 2022–2023 and 2023–2024 COVID-19 season, we defined the vaccinated population as Rhode Island residents who had received the up-to-date COVID-19 vaccine as of the mid-point of the month, per the RICAIR database (vaccinated population). The unvaccinated population was then calculated as the Rhode Island population minus the number of vaccinated individuals.

Statistical Analysis

We compared hospitalization rates for Rhode Island residents who did and did not receive an up-to-date vaccine, separately for the 2022–2023 and the 2023–2024 COVID-19 seasons. For the vaccinated and unvaccinated populations, monthly hospitalization rates were calculated and then summarized as an average monthly rate for each season. We age-standardized the monthly hospitalization rates using direct methods, because age is known to be associated with vaccination status and hospitalization risk. We used 2020 U.S. population estimates from the U.S. Census Bureau's 5-year American Community Survey as the reference population and standardized across six age groups: 0–17, 18–44, 45–54, 55–64, 65–74, ≥75.

Crude and age-adjusted rate ratios were calculated for each season comparing unvaccinated individuals to vaccinated individuals, using vaccinated individuals as the reference group. We calculated 95% confidence intervals (CIs) for crude rate ratios using methods described by Rothman et al.¹⁴ Keyfitz found that the variance for a crude rate is a reasonable approximation for the variance of an age-adjusted rate,¹⁵ so the standard deviation for the crude rate was also used to calculate 95% CIs for age-adjusted rate ratios. All analyses were conducted using SAS Analytical software (Version 9.4), except that Microsoft Excel was used to calculate 95% CIs using the methods described above.

RESULTS

A total of 3,246 hospitalizations met the RIDOH definition of COVID-19 hospitalizations for the period of study; 1,961 hospitalizations occurred from 11/1/22 to 3/31/23 and 1,285 hospitalizations occurred from 11/1/23 to 3/31/24 (Tables 1 and 2). From 11/1/22 to 3/31/23, an average of 78 individuals who were vaccinated with the 2022-2023 vaccine were hospitalized per month, while an average of 314 individuals who did not receive the 2022-2023 vaccine were hospitalized per month (Table 1). A total of 252,648 individuals received the COVID-19 vaccine by 3/16/23 (the midpoint of March 2023), for a cumulative average of 224,720 individuals vaccinated across the five months included in the 2022–2023 season (Table 1).

From 11/1/23 to 3/31/24, an average of 49 individuals who were vaccinated with the 2023–2024 vaccine were hospitalized per month, and an average of 208 individuals who did not receive the 2023–2024 vaccine were hospitalized per month (Table 2). A total of 188,333 individuals received the COVID-19 vaccine by 3/16/24 (the midpoint of March 2024), for a cumulative average of 169,138 individuals vaccinated

Table 1. COVID-19 Hospitalization Counts by Vaccine Status for November 2022 to March 2023

	Number of COVID-19 Hospitalizations		Number of Rhode Island Residents	
	Received Updated Vaccine	Did Not Receive Updated Vaccine	Received Updated Vaccine	Did Not Receive Updated Vaccine
Nov '22	53	373	173348	884450
Dec '22	98	468	213938	843860
Jan '23	116	399	236281	821517
Feb '23	71	210	247386	810412
Mar '23	52	121	252648	805150
Total Average	78	314	224,720	833,078

Table 2. COVID-19 Hospitalization Counts by Vaccine Status for November 2023 to March 2024

	Number of COVID-19 Hospitalizations		Number of Rhode Island Residents	
	Received Updated Vaccine	Did Not Receive Updated Vaccine	Received Updated Vaccine	Did not Receive Updated Vaccine
Nov '23	41	189	135054	922744
Dec '23	87	316	161204	896594
Jan '24	77	339	176546	881252
Feb '24	24	121	184551	873247
Mar '24	17	74	188333	869465
Total Average	49	208	169,138	888,660

across the five months included in the 2023–2024 season (Table 2). Hospitalization counts for both the 2022–2023 and 2023–2024 COVID-19 seasons can be found in Table 3, showing that hospitalization counts are most heavily found in the older age groups.

Crude and age-adjusted hospitalization rates for the 2022–2023 season can be found in (Table 4). After age-adjustment, the hospitalization rate among the vaccinated was 13.1 hospitalizations per 100,000 residents, while the hospitalization rate for the unvaccinated was 46.6 hospitalizations per 100,000 residents (Table 4). After age-adjustment, the rate

Table 3. COVID-19 Hospitalization Counts by Vaccine Status and By Age Group for the 2022–2023 and 2023–2024 COVID-19 Seasons.

Age Group	Hospitalization Counts from November 2022 to March 2023		Hospitalization Counts from November 2023 to March 2024	
	Received Updated Vaccine	Did Not Receive Updated Vaccine	Received Updated Vaccine	Did Not Receive Updated Vaccine
0–17	0	51	<5*	40
18–44	10	223	6	98
45–54	12	92	7	48
55–64	46	178	27	106
65–74	83	307	65	217
75+	239	720	140	530
Total	390	1571	246	1039

*Counts of 1–4 are suppressed in accordance with the RIDOH Small Numbers Reporting Policy.

Table 4. COVID-19 Hospitalization Rates per 100,000 Residents, Rate Ratios, and 95% Confidence Intervals for November 2022 to March 2023

	Received Updated Vaccine	Did Not Receive Updated Vaccine	Rate Ratio	95% Confidence Interval
Crude Hospitalization Rate	35.0	37.4	1.1	0.9, 1.4
Age-Adjusted Hospitalization Rate	13.1	46.6	3.6	2.8, 4.6

Table 5. COVID-19 Hospitalization Rates per 100,000 Residents, Rate Ratios, and 95% Confidence Intervals for November 2023 to March 2024

	Received Updated Vaccine	Did Not Receive Updated Vaccine	Rate Ratio	95% Confidence Interval
Crude Hospitalization Rate	30.0	23.3	0.8	0.6, 1.1
Age-Adjusted Hospitalization Rate	11.2	27.0	2.4	1.8, 3.3

ratio was 3.6 (95% CI=2.8–4.6), indicating that there was a 3.6 times greater risk of hospitalization for the unvaccinated compared to the vaccinated (Table 4).

For the 2023–2024 season, crude and age-adjusted hospitalization rates can be found in Table 5. After age-adjustment, the hospitalization rate among the vaccinated was 11.2 hospitalizations per 100,000 residents, while the hospitalization rate for the unvaccinated was 27.0 hospitalizations per 100,000 residents (Table 5). After age-adjustment, the rate ratio was 2.4 (95% CI=1.8–3.3), indicating that there was a 2.4 times greater risk of hospitalization for the unvaccinated compared to the vaccinated (Table 5).

DISCUSSION

During the 2022–2023 season, individuals who were not vaccinated with the bivalent COVID-19 vaccine were 3.6 times more likely to be hospitalized for COVID-19 than individuals who received the vaccine. During the subsequent season (2023–2024), unvaccinated individuals faced a 2.4 times higher risk of hospitalization from COVID-19 compared to individuals who had received the updated vaccine. Although the crude rates for unvaccinated and vaccinated individuals were similar in both seasons, the substantially higher risk among unvaccinated individuals was apparent in both seasons after age adjusting. This highlights the critical importance of age-adjusting the hospitalization rates since older individuals are both more likely to be hospitalized from COVID-19 and more likely to receive a COVID-19 vaccination. In 2023, the hospitalization rate for those 65 years and older was at least six times higher than younger age groups,¹⁶ and 50% of Rhode Islanders who are 65 years and older received the most recent vaccine while only 10% and 18% of Rhode Islanders ages 22–49 and 50–64, respectively, were vaccinated.¹⁷

Overall, it appears that the protection from the latest vaccine was lower in 2023–2024 compared to the 2022–2023 season. This could be due to several factors, including the type of variants circulating during a season, and the effectiveness of the respective vaccines against these particular variants.¹⁸

The CDC recommends that all individuals aged six months and older receive an updated COVID-19 vaccine once after at least two months have passed since they received the previous COVID-19 vaccine.¹⁹ It is also recommended that individuals 65 years and older receive a second dose of the 2023–2024 COVID-19 vaccine if they have not received a dose within the past four months, highlighting the vulnerability of this group.¹⁹ In our study, Rhode Island residents who received an updated COVID-19 vaccine had increased protection against COVID-19 hospitalizations compared to residents who did not receive an updated vaccine, consistent with the rationale behind these CDC recommendations. However, despite these benefits, vaccine coverage in Rhode

Island has been decreasing and remains low, particularly in comparison to uptake of the influenza vaccine.²⁰

There are several limitations to this study. First, immune-compromising conditions may have been a confounder that we were unable to adjust for.¹⁸ Confounding due to immune-compromising conditions may have biased results towards the null. Second, hospitalization data does not reflect whether individuals were hospitalized due to COVID-19 or concurrently with COVID-19. Confounding due to cause of hospitalization may have also biased results towards the null. We did not have the ability to look into the specific reasons why individuals may choose not to be vaccinated, including medical contraindications, which in and of themselves may lead to increased risk of hospitalization. Additionally, this analysis did not have the statistical power to stratify by racial/ethnic group or residence in long-term care facilities, both of which are factors which could lead to increased risk of hospitalization.¹⁸ Finally, we did not account for previous infection status, which may have conferred additional protection against hospitalization thus influencing vaccine effectiveness.¹⁸ This means that results should be interpreted as the additional risk of not receiving the most up-to-date vaccine in a population that has various levels of immunity from prior COVID-19 infections.

The current analysis presents hospitalization rates and rate ratios during the 2022–2023 and 2023–2024 COVID-19 seasons for individuals who did and did not receive the most up-to-date COVID-19 vaccination. The results document the ongoing burden of severe disease that Rhode Islanders face from COVID-19 and highlight the effectiveness and continued importance of annual COVID-19 vaccination.

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Disclosure

The authors have no conflicts of interest to disclose.

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