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Interim Evaluation of Respiratory Syncytial Virus Hospitalization Rates Among Infants and Young Children After Introduction of Respiratory Syncytial Virus Prevention Products — United States, October 2024–February 2025

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Abstract

Maternal respiratory syncytial virus (RSV) vaccine and nirsevimab, a long-acting monoclonal antibody for infants aged 0–7 months and children aged 8–19 months who are at increased risk for severe RSV disease, became widely available for prevention of severe RSV disease among infants and young children during the 2024–25 RSV season. To evaluate the association between availability of these products and infant and child RSV-associated hospitalization rates, the rates among children aged <5 years were compared for the 2024–25 and 2018–20 RSV seasons using data from the RSV-Associated Hospitalization Surveillance Network (RSV-NET) and New Vaccine Surveillance Network (NVSN). Among infants aged 0–7 months (eligible for protection with maternal vaccination or nirsevimab), 2024–25 RSV-associated hospitalization rates were lower compared with 2018–20 pooled rates (estimated relative rate reductions of 43% [RSV-NET: 95% CI = 40%–46%] and 28% [NVSN: 95% CI = 18%–36%]). The largest estimated rate reduction was observed among infants aged 0–2 months (RSV-NET: 52%, 95% CI = 49%–56%; NVSN: 45%, 95% CI = 32%–57%) and during peak hospitalization periods (December–February). These findings support Advisory Committee on Immunization Practices' recommendations for maternal vaccination or nirsevimab to protect against severe RSV disease in infants and highlight the importance of implementing the recommendations to protect infants as early in the RSV season as possible, before peak transmission, and for infants born during the RSV season, within the first week of life, ideally during the birth hospitalization.

Introduction

Respiratory syncytial virus (RSV) is the leading cause of hospitalization among U.S. infants, with infants aged 0–2 months at the highest risk for hospitalization (*1*). Two effective products for preventing infant RSV hospitalizations, maternal RSV vaccine[§] (*2*) (administered during weeks 32–36 of pregnancy

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§ Maternal RSV vaccine should be administered to pregnant women at 32–36 weeks' gestation during September–January in most of the continental United States to protect infants during their first months of life when maternal vaccination protection is highest and during the RSV season when RSV circulation is highest. Administering vaccine starting in September (1–2 months before anticipated RSV season start) through January (2–3 months before anticipated RSV season end) maximizes cost-effectiveness and benefits. In jurisdictions with RSV seasonality that differs from the continental United States, providers should follow state, local, or territorial guidance on timing.

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during September–January in most of the United States) and nirsevimab[¶] (*3*) (a long-acting monoclonal antibody for all infants aged 0–7 months in their first RSV season and children aged 8–19 months in their second RSV season at increased risk for severe RSV disease) were introduced during the 2023–24 U.S. RSV season[**,††] (*2–5*). To assess a possible association between availability of these products and RSV-associated hospitalizations, this ecologic analysis compared pediatric RSV-associated hospitalization rates from two U.S. active surveillance systems, the RSV-Associated Hospitalization Surveillance Network (RSV-NET) and New Vaccine Surveillance Network (NVSN), during 2024–25 and 2018–20.

Methods

Data Sources

RSV-NET conducts active population-based surveillance for laboratory-confirmed[§§] RSV-associated hospitalizations identified through clinical testing among catchment-area residents of all ages in approximately 300 hospitals in 161 counties across 13 states.[¶¶,***] NVSN conducts active, population-based surveillance for acute respiratory illness (ARI) among hospitalized children aged <18 years at seven U.S. medical centers[†††] (*4*); respiratory specimens from all enrolled children are tested for RSV.[§§§] RSV-NET and NVSN have both used standardized case definitions and active case finding since 2016 and 2000, respectively (*4*,*6*), and both collect demographic data through medical record abstraction. NVSN also conducts parent interviews.

[¶] Beginning shortly before the RSV season starts, providers should administer nirsevimab to infants aged <8 months and to children aged 8–19 months at increased risk for severe RSV disease. Nirsevimab could be administered in most of the continental United States from October through the end of March. Because timing of onset, peak, and decline of RSV activity might vary geographically, providers can adjust administration schedules based on local epidemiology. Providers should consult state, local, or territorial guidance on timing of nirsevimab administration.

[**] Nirsevimab Coverage, Children 0 to 7 months, United States | RSVVaxView | CDC

[††] Infant Protection Against Respiratory Syncytial Virus (RSV) by Maternal RSV Vaccination or Receipt of Nirsevimab, and Intent for Nirsevimab Receipt, United States

[§§] RSV-associated hospitalizations are defined as those among persons who have received a positive RSV reverse transcription–polymerase chain reaction (RT-PCR) or rapid antigen detection test result ≤14 days before or after hospital admission.

[¶¶] RSV-NET population-based RSV-associated hospitalization rates were generated for the 2018–19 and 2019–20 seasons for residents in 65 and 72 selected counties and county equivalents, respectively, in California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, Oregon, Tennessee, and Utah; for the 2024–25 season, rates were generated for residents from 161 selected counties and county equivalents in these states and North Carolina.

[***] RSV-NET | RSV | CDC

[†††] NVSN population-based RSV-associated hospitalization rates were generated using actively enrolled residents of defined catchment area counties for the seven sites that were included: Cincinnati (Hamilton County, Ohio); Houston (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties, Texas); Kansas City (Jackson County, Missouri); Nashville (Davidson County, Tennessee); Pittsburgh (Allegheny County, Pennsylvania); Rochester (Monroe County, New York); and Seattle (King County, Washington).

[§§§] Systematically collected respiratory specimens were tested by real-time RT-PCR.

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This analysis included RSV-NET and NVSN RSV-associated hospitalization data from children aged <5 years during the 2018–19 and 2019–20 RSV seasons (October–April, representing typical RSV seasons before the COVID-19 pandemic) and the 2024–25 season (October–February data); 2018–19 and 2019–20 data were pooled to generate 2018–20 data. The 2020–21 through 2023–24 RSV seasons were excluded because the COVID-19 pandemic resulted in atypical RSV seasonality and circulation (*7*).

Data Analysis

Hospitalization rates for three groups with varying eligibility for RSV prevention products were analyzed: 1) infants aged 0–7 months eligible for protection through maternal RSV vaccine or nirsevimab, overall and in prespecified subgroups of infants aged 0–2 months, who are at highest risk for RSV-associated hospitalization (*1*) and infants aged 3–7 months; 2) children aged 8–19 months entering their second RSV season, some of whom might have been nirsevimab-eligible based on risk conditions[¶¶¶]; and 3) children aged 20–59 months, who were ineligible for either product. Weekly (RSV-NET)[****] or monthly (NVSN)[††††] RSV-associated hospitalizations per 1,000 children aged <5 years were calculated using U.S. population denominators (*4*,*6*); cumulative rates for all seasons were estimated through February to ensure consistent comparisons. RSV-NET rates were adjusted to account for RSV underdetection related to testing practices and test sensitivity using an established multiplier approach[§§§§] (*6*,*8*). NVSN rates were adjusted for enrollment rates, weeks with <7 surveillance days, test sensitivity, and hospital market share[¶¶¶¶] (*4*). A sensitivity analysis excluding the Houston, Texas site from NVSN data (approximately 20% of overall enrolled children) was performed because RSV circulation and associated hospitalizations increased in Houston in September 2024, before RSV prevention products were widely administered there (Supplementary Figure).

Rate ratios (RRs) and 95% CIs were estimated, and differences were assessed with Z-tests or *t*-tests comparing cumulative 2024–25 hospitalization rates with pooled 2018–20 rates.[*****] Relative hospitalization rate reduction (RRR) was estimated as (1 – RR) x 100. Trends and differences by age were compared using Cochran-Armitage trends and Pearson's chi-square tests, respectively. Data were analyzed using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed not research, and conducted consistent with applicable federal law and CDC policy.[†††††]

Results

Characteristics of Children Hospitalized for RSV

Overall, 18,389 RSV-associated hospitalizations (15,405 in RSV-NET and 2,984 in NVSN) were identified among children aged <5 years; these included 11,681 during 2018–20 and 6,708 during 2024–25. Median patient age was 6.7 months and 14.7 months in RSV-NET (p<0.001) and 6.3 months and 12.7 months in NVSN (p<0.04), in the earlier versus later seasons, respectively (Supplementary Table 1).

[¶¶¶] Infants and children aged 8–19 months at increased risk for severe RSV disease include those with chronic lung disease of prematurity who require medical support (chronic corticosteroid therapy, diuretic therapy, or supplemental oxygen), severe immunocompromise, or cystic fibrosis who have manifestations of severe lung disease or weight-for-length <10th percentile; and children of American Indian or Alaska Native descent.

[****] Unadjusted RSV-NET hospitalization rates (hospitalizations per 1,000 children aged <5 years) were estimated by dividing total catchment-area RSV hospitalizations by National Center for Health Statistics (NCHS) population estimates; population estimates were divided by 12 to estimate rates by month of life. NCHS vintage 2020 bridge-race postcensal population estimates were used for seasons 2018–19 to 2019–20; U.S. Census Bureau vintage unbridged-race postcensal estimates were used for October 2020 and later.

[††††] For the NVSN 2018–20 rate analysis, county-specific population denominator data were obtained from the 2020 U.S. bridged-race population estimates. The 2024–25 rate analysis used 2022 interim population estimates because these were the most recent available data. Children with inconclusive RSV testing results were excluded. Children with RSV detection from a rapid test but no detection from a molecular test were excluded because of poor rapid test specificity. Population-based numerators were calculated by adjusting the observed number of hospitalizations to account for weeks with <7 days of surveillance, the percentage of eligible children not enrolled, sensitivity of RSV RT-PCR testing (87.6%, using serology as the standard relative to RT-PCR), and the market share of each enrollment hospital site. Rates were estimated per 1,000 children aged <5 years, and 95% CIs were determined by bootstrap percentiles based on 1,000 bootstrap samples for each rate.

[§§§§] RSV-NET only captures children hospitalized with RSV if they were tested for RSV and if tests accurately detect RSV. To correct for RSV hospitalization underascertainment, each RSV-NET site identified all children aged <5 years hospitalized during 2018–2023 with ARI in select hospitals, as identified by *International Classification of Diseases, Tenth Revision, Clinical Modification* codes, and determined the proportion of those children who received testing for RSV and type of RSV test used among a stratified random sample. Adjustment multipliers, the inverse of RSV testing frequency times the average test sensitivity (using 74% sensitivity for rapid antigen tests and 96% for molecular diagnosis), were estimated for each season using testing data from hospitalizations in each age group. Adjusted hospitalization rates were calculated by multiplying unadjusted rates by adjustment multipliers and presented with 95% CIs to account for multiplier uncertainty; 2022–23 adjustment multipliers were the most recent available data and applied to 2024–25. Rate ratios, 95% CIs, and Z-tests were used to identify significant differences between rates.

[¶¶¶¶] NVSN population-based numerators are calculated by adjusting the observed number of hospitalizations to account for weeks with <7 days of surveillance, the percentage of eligible children not enrolled, sensitivity of RSV RT-PCR testing (87.6%), and the market share of each enrollment hospital site for the estimated proportion of catchment-area ARI hospitalizations captured.

[*****] Pooled rates from 2018 through 2020 were estimated by dividing total RSV hospitalizations in the 2018–19 and 2019–20 seasons by pooled population estimates.

[†††††] 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE. Hospitalization rates among U.S. children aged <5 years with laboratory-confirmed respiratory syncytial virus — Respiratory Syncytial Virus–Associated Hospitalization Surveillance Network and New Vaccine Surveillance Network, United States, 2018–20 and 2024–25

	Age group, mos				
		0–7			
Surveillance system/RSV season/Hospitalization metrics	All (0–7)	0–2	3–7	8–19	20–59
RSV-NET*					
2018–20					
Hospitalizations† (n = 9,547), no. (%)	4,857 (51)	2,694 (28)	2,163 (23)	2,428 (25)	2,262 (24)
Pooled hospitalization rate§ (95% CI)	15.0 (14.7 to 15.4)	22.2 (21.5 to 22.9)	10.7 (10.3 to 11.1)	5.0 (4.9 to 5.2)	1.5 (1.5 to 1.6)
2024–25					
Hospitalizations† (n = 5,858), no. (%)	1,623 (28)	755 (13)	868 (15)	1,935 (33)	2,300 (39)
Hospitalization rate§ (95% CI)	8.5 (8.1 to 8.9)	10.6 (9.9 to 11.3)	7.3 (6.8 to 7.8)	6.7 (6.4 to 7.0)	2.5 (2.4 to 2.6)
Rate ratio (95% CI)¶	0.57 (0.54 to 0.60)	0.48 (0.44 to 0.51)	0.68 (0.63 to 0.73)	1.33 (1.26 to 1.41)	1.64 (1.56 to 1.72)
P-value¶	<0.001	<0.001	<0.001	<0.001	<0.001
RRR, % (95% CI)**,††	43 (40 to 46)	52 (49 to 56)	32 (27 to 37)	−33 (−41 to −26)	−64 (−72 to −56)
NVSN§§					
2018–20					
Hospitalizations† (n = 2,134), no. (%)	1,204 (56)	659 (31)	545 (25)	517 (24)	413 (20)
Pooled hospitalization rate§ (95% CI)	14.8 (14.0 to 15.6)	21.7 (20.0 to 23.3)	10.6 (9.7 to 11.5)	4.7 (4.3 to 5.1)	1.1 (1.0 to 1.2)
2024–25					
Hospitalizations† (n = 850), no. (%)	311 (37)	128 (15)	183 (22)	295 (35)	244 (28)
Hospitalization rate§ (95% CI)	10.7 (9.4 to 12.0)	12 (9.8 to 14.4)	9.9 (8.5 to 11.3)	5.9 (5.2 to 6.7)	1.7 (1.5 to 1.9)
Rate ratio (95% CI)¶	0.72 (0.64 to 0.82)	0.55 (0.43 to 0.68)	0.93 (0.77 to 1.10)	1.26 (1.08 to 1.46)	1.63 (1.36 to 1.90)
P-value¶	<0.001	<0.001	0.56	0.02	<0.001
RRR, % (95% CI)**,††	28 (18 to 36)	45 (32 to 57)	7 (−10 to 23)	−26 (−46 to −8)	−63 (−90 to −36)
NVSN excluding Houston, Texas					
2018–20					
Hospitalizations† (n = 1,721), no. (%)	978 (57)	530 (31)	448 (26)	405 (23)	338 (20)
Pooled hospitalization rate§ (95% CI)	19 (17.8 to 20.1)	26.4 (24.4 to 28.6)	14.6 (13.3 to 15.8)	6.0 (5.4 to 6.6)	1.6 (1.5 to 1.8)
2024–25					
Hospitalizations† (n = 698), no. (%)	223 (32)	87 (13)	136 (19)	237 (34)	238 (34)
Hospitalization rate§ (95% CI)	8.4 (7.3 to 9.6)	7.6 (5.8 to 9.6)	8.9 (7.5 to 10.3)	6.4 (5.6 to 7.2)	2.3 (2.0 to 2.6)
Rate ratio (95% CI)¶	0.44 (0.38 to 0.51)	0.29 (0.22 to 0.36)	0.62 (0.50 to 0.73)	1.07 (0.90 to 1.24)	1.42 (1.19 to 1.67)
P-value¶	<0.001	<0.001	<0.001	0.51	<0.001
RRR, % (95% CI)**,††	56 (49 to 62)	71 (64 to 78)	38 (27 to 50)	−7 (−24 to 10)	−42 (−67 to −19)

Abbreviations: NVSN = New Vaccine Surveillance Network; RRR = relative hospitalization rate reduction; RSV = respiratory syncytial virus; RSV-NET = Respiratory Syncytial Virus–Associated Hospitalization Surveillance Network.

* RSV-NET conducts active population-based surveillance for laboratory-confirmed RSV-associated hospitalizations identified through clinical testing among catchment-area residents of all ages in approximately 300 hospitals in 161 selected counties in California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, North Carolina, Oregon, Tennessee, and Utah.

† Hospitalization data were included from October–April 2018–20 and October–February 2024–25.

§ Cumulative laboratory-confirmed RSV-associated hospitalizations per 1,000 children aged <5 years as of February 28 each season. Rates use U.S. population denominators and are adjusted to account for RSV underdetection because of testing practices and test sensitivity.

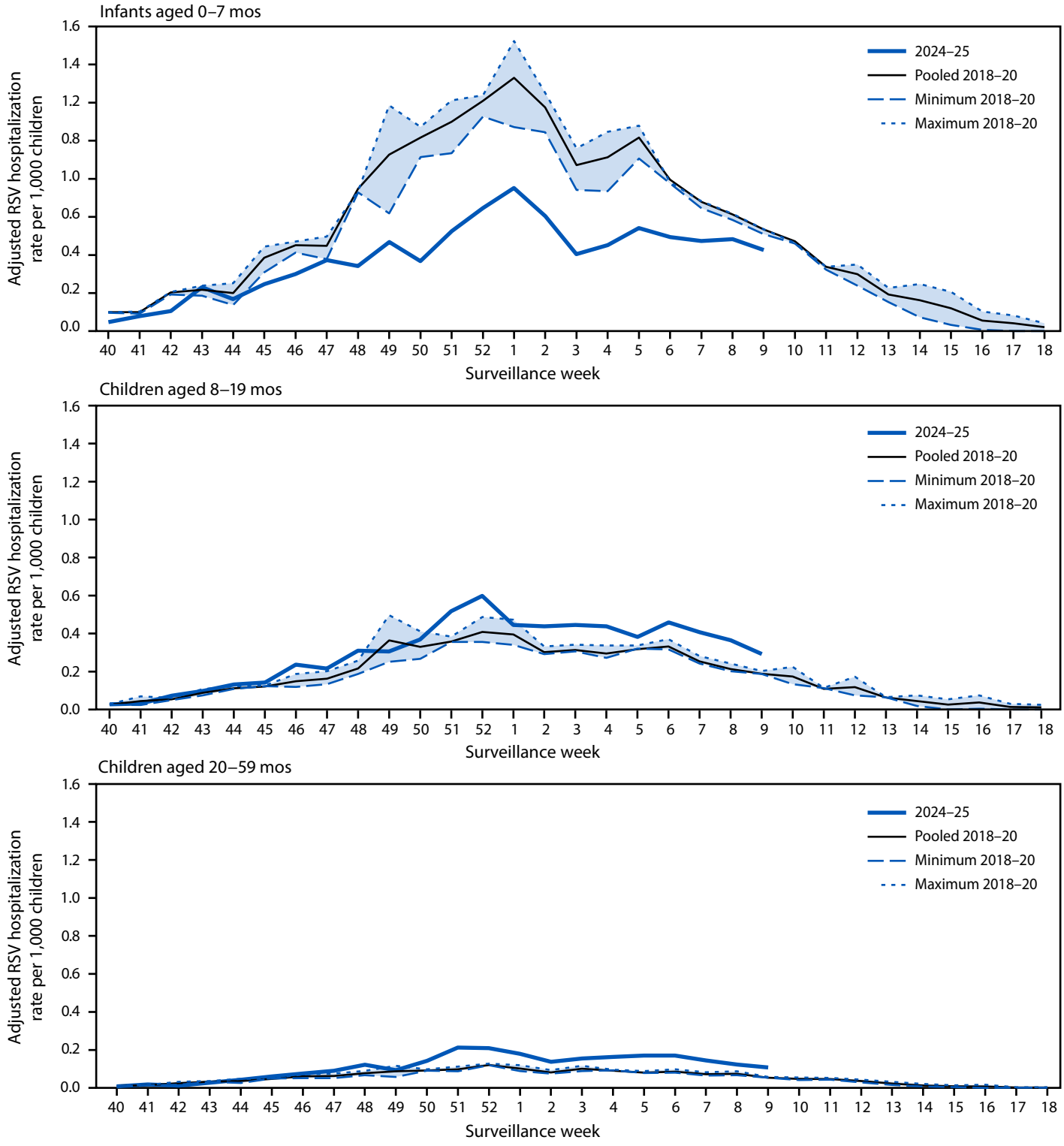
¶ Z-tests (RSV-NET) or *t*-tests (NVSN) were used to assess whether rate ratios differed from 1, with p<0.05 considered statistically significant.

** RRR was estimated as (1 – rate ratio) x 100%.

†† RRR 95% CIs that excluded 0 were considered statistically significant, corresponding to rate ratio 95% CIs excluding 1 and p<0.05.

§§ NVSN conducts active, population-based surveillance for acute respiratory illness among hospitalized children aged <18 years at seven U.S. medical centers. NVSN population-based RSV-associated hospitalization rates were generated using actively enrolled residents of defined catchment-area counties for the seven sites that were included: Cincinnati (Hamilton County, Ohio); Houston (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties, Texas); Kansas City (Jackson County, Missouri); Nashville (Davidson County, Tennessee); Pittsburgh (Allegheny County, Pennsylvania); Rochester (Monroe County, New York); and Seattle (King County, Washington).

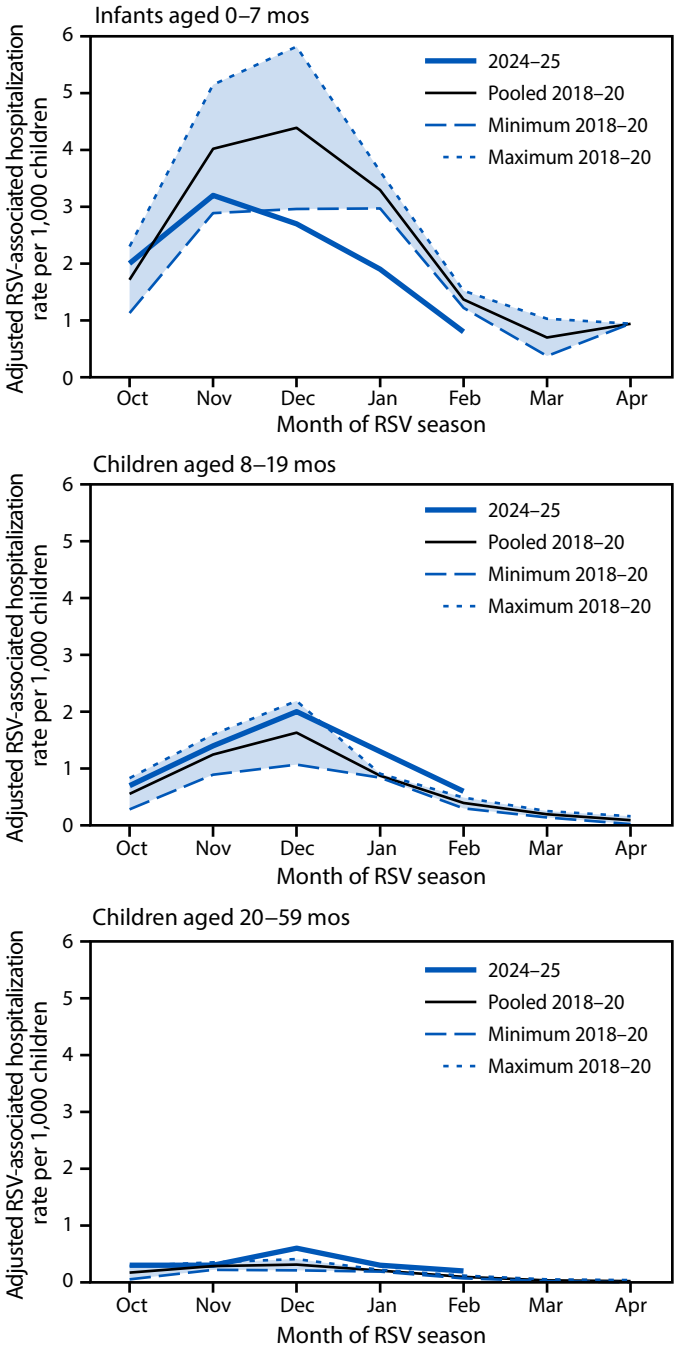
FIGURE 1. Respiratory syncytial virus–associated hospitalization rates* among children aged <5 years, by age group and surveillance week — Respiratory Syncytial Virus–Associated Hospitalization Surveillance Network, United States, October–April 2018–20 and October–February 2024–25



Abbreviation: RSV = respiratory syncytial virus.

* Rate of laboratory-confirmed RSV–associated hospitalizations identified through clinical testing among catchment-area residents per 1,000 children aged <5 years. Rates use U.S. population denominators and are adjusted to account for RSV underdetection because of testing practices and test sensitivity. Pooled rates from 2018 through 2020 were estimated by dividing total RSV hospitalizations in the 2018–19 and 2019–20 RSV seasons by pooled population estimates; minimum and maximum weekly rates reflect the lowest and highest observed rates, respectively, for each week across the 2018–19 and 2019–20 seasons. Data for the 2024–25 RSV season were only available through February 2025.

FIGURE 2. Respiratory syncytial virus–associated hospitalization rates* among children aged <5 years, by age group and month of respiratory syncytial virus season — New Vaccine Surveillance Network, United States, October–April 2018–20 and October–February 2024–25



Abbreviation: RSV = respiratory syncytial virus.

* Rate of laboratory-confirmed RSV-associated hospitalizations among all catchment-area residents, including Houston, per 1,000 children aged <5 years. Rates use U.S. population denominators and are adjusted for enrollment rates, weeks with <7 surveillance days, test sensitivity, and hospital market share. Pooled rates from 2018 through 2020 were estimated by dividing total RSV hospitalizations in the 2018–19 and 2019–20 RSV seasons by pooled population estimates; minimum and maximum monthly rates reflect the lowest and highest observed rates, respectively, for each month across the 2018–19 and 2019–20 seasons. Data for the 2024–25 RSV season were only available through February 2025.

RSV-Associated Hospitalization Rates Among Infants Aged 0–7 Months

Cumulative RSV-associated hospitalization rates among infants aged 0–7 months were lower during 2024–25 compared with 2018–20: 8.5 versus 15.0 per 1,000 children in RSV-NET, and 10.7 versus 14.8 per 1,000 children in NVSN (Table). These differences were associated with estimated hospitalization rate reductions of 43% in RSV-NET and 28% in NVSN during 2024–25 ($p<0.001$ for both). Estimated rate reductions were largest during December–February (Supplementary Table 2). In a sensitivity analysis of NVSN data excluding Houston (because of earlier RSV season onset before prevention product availability), the apparent reduction in RSV-associated hospitalization rates among infants aged 0–7 months during 2024–25 was larger (56%) (Table).

The largest cumulative rate differences during 2024–25 compared with 2018–20 were observed among infants aged 0–2 months. Estimated reductions in RSV-associated hospitalization rates among infants aged 0–2 months were 52% for RSV-NET and 45% for NVSN ($p<0.001$ for all); the NVSN rate reduction was larger (71%) with Houston excluded.

RSV-Associated Hospitalization Rates Among Children Aged 8–19 and 20–59 Months

Among children aged 8–19 and 20–59 months, RSV-associated hospitalization rates were higher during 2024–25 than during 2018–20. Differences in weekly and monthly rates between 2024–25 and 2018–20 among all age groups were comparable to observed differences in cumulative rates (Figure 1) (Figure 2).

Discussion

In 2024–25, the first U.S. RSV season with widespread availability of maternal RSV vaccine and nirsevimab, analyses of two population-based surveillance networks demonstrated significantly lower RSV-associated hospitalization rates among infants aged 0–7 months who were eligible for RSV prevention products, with estimated rate reductions of 28% and 43% compared with rates during the pooled 2018–20 RSV seasons. The largest estimated rate reductions in hospitalization occurred among infants aged 0–2 months (*1*).

Higher RSV-associated hospitalization rates during 2024–25 compared with 2018–20 among children in older age groups, who were largely ineligible for RSV prevention products, suggest a more severe 2024–25 season overall and indicate that observed reductions in hospitalization rates among younger infants might be underestimated. Increased hospitalization rates among these older children also suggest that reduced infant hospitalization rates were likely due to RSV prevention products, rather than to changes in RSV circulation, testing

Summary

What is already known about this topic?

Maternal respiratory syncytial virus (RSV) vaccine and nirsevimab, a long-acting monoclonal antibody, help prevent infant RSV-associated hospitalizations; these products became widely available in the United States during the 2024–25 RSV season.

What is added by this report?

In this ecologic analysis comparing RSV-associated hospitalization rates among infants aged 0–7 months during 2024–25 with those during pre–COVID-19 pandemic RSV seasons in two surveillance networks, rates during 2024–25 were lower by an estimated 28% and 43%.

What are the implications for public health practice?

In the first RSV season with widespread availability of maternal vaccine and nirsevimab, RSV-associated hospitalization rates among infants were lower than in prepandemic seasons. Effective health care planning is needed to protect infants as early in the RSV season as possible through maternal vaccination during pregnancy or infant receipt of nirsevimab.

practices, or health care–seeking behavior. The apparent reduction in RSV-associated infant hospitalization rates temporally associated with widespread availability of two options to protect eligible infants (i.e., maternal RSV vaccination and nirsevimab administration to eligible infants) suggests that most severe RSV disease among infants aged 0–7 months is preventable, consistent with findings in European countries (*9*,*10*). In this analysis, rate decreases were largest among infants aged 0–2 months, the group at highest risk for RSV-associated hospitalization (*1*). The findings suggest the importance of protecting infants born during the RSV season through either maternal vaccination during pregnancy or nirsevimab administration in the first week of life, ideally during the birth hospitalization (*2*).

National immunization survey data indicate the estimated proportion of U.S. infants aged 0–7 months protected by either maternal vaccination or nirsevimab increased during the 2024–25 RSV season, from 30% in October 2024 to 66% in February 2025,§§§§§ coinciding with the 2024–25 RSV-associated hospitalization rate reductions in both surveillance networks, with the largest monthly reductions occurring during peak hospitalization periods. In addition, reduction in hospitalization rates among NVSN infants aged 0–7 months were larger after excluding Houston, where prevention products were not widely available before RSV season onset. These results support the recommendations of the Advisory Committee on Immunization Practices to optimize population-level impact by administering RSV prevention products as early as possible in the season (i.e., before peak RSV transmission) on the basis of local epidemiology (*3*). Increased and earlier use of RSV prevention products during future seasons might lead to even larger reductions in pediatric RSV–associated hospitalizations.

§§§§§ Infant Protection Against Respiratory Syncytial Virus (RSV) by Maternal RSV Vaccination or Receipt of Nirsevimab, and Intent for Nirsevimab Receipt, United States

Limitations

The findings in this report are subject to at least four limitations. First, this was an ecologic analysis and does not include individual-level data on coverage with RSV prevention products; therefore, causality could not be assessed. Second, hospitalization rate adjustments accounting for RSV underdetection or underenrollment might be insufficient. Third, RSV-NET and NVSN catchment areas might not be nationally representative. Finally, interim results might underestimate changes during complete RSV seasons or seasons with higher product coverage. However, relatively consistent findings from two geographically diverse, population-based surveillance networks provide reliable support for the population-level impacts of RSV prevention products on U.S. pediatric RSV-associated hospitalizations.

Implications for Public Health Practice

During the first RSV season with widespread availability of prevention products, RSV-associated hospitalization rates were significantly lower compared with those during pre–COVID-19 pandemic seasons among infants aged 0–7 months. Reductions were largest during peak hospitalization periods. These findings highlight the importance of effective annual health care planning to implement Advisory Committee on Immunization Practices' recommendations for RSV prevention products and ensure parents can protect infants as early as possible in the RSV season, either through maternal vaccination during pregnancy or infant receipt of nirsevimab. For infants born during the RSV season who are not protected through maternal vaccination, nirsevimab should be administered within the first week of life, ideally during the birth hospitalization.

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Trends in Suspected Fentanyl-Involved Nonfatal Overdose Emergency Department Visits, by Age Group, Sex, and Race and Ethnicity — United States, October 2020–March 2024

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Abstract

Fatal overdoses involving synthetic opioids such as fentanyl increased sharply during the past decade. Recent data indicate declines in deaths with illegally manufactured fentanyls detected beginning in mid-2023. However, timely data on nonfatal overdoses involving fentanyl are limited. Emergency department (ED) data from CDC's National Syndromic Surveillance Program during October 2020–March 2024 were analyzed. Quarterly trends in rates of suspected nonfatal overdose of unintentional or undetermined intent involving fentanyl or fentanyl analogs (fentanyl-involved nonfatal overdoses) (i.e., the number of ED visits for fentanyl-involved nonfatal overdose per 10,000 total ED visits) were analyzed overall and by age group, sex, and race and ethnicity. During quarter (Q) 4 (October–December) 2020 to Q3 (July–September) 2023, rates of fentanyl-involved nonfatal overdose ED visits increased 8.7% per quarter, from 1.4 to 3.5 per 10,000 ED visits, then declined 11.0% per quarter, to 2.9 per 10,000 ED visits, from Q3 2023 to Q1 (January–March) 2024. Trends increased among a majority of demographic groups through mid-2023, with the highest rates and the largest increases among non-Hispanic American Indian or Alaska Native persons (e.g., 11.9 per 10,000 ED visits in Q3 2023, and an average quarterly increase of 9.0%, respectively). Providers in EDs have an important role in preventing fentanyl-involved nonfatal overdoses. Buprenorphine, a medication used to treat opioid use disorder that can be initiated in an ED, might benefit persons who use EDs as a main source of medical care. In addition, comprehensive services, including screening and treatment of co-occurring mental health conditions, as well as evidence-based prevention, treatment, and recovery support services, might be initiated in EDs because these might be particularly important in communities at high risk for fentanyl overdoses.

Introduction

Drug overdose remains a substantial public health concern in the United States. Overdose deaths involving synthetic opioids such as fentanyl have increased substantially during the past decade (*1*). However, more recent data indicate that, beginning in mid-2023, deaths with illegally manufactured fentanyl and fentanyl analogs detected have declined (*2*). Less is known about trends in fentanyl-involved nonfatal overdoses. Persons who experience a nonfatal overdose are more likely to experience a future fatal overdose (*3*); therefore, identifying populations affected by fentanyl-involved nonfatal overdoses might provide information that could guide prevention strategies and enhance recovery support. A study examining discharge diagnosis codes in emergency department (ED) data found increases in synthetic opioid-involved nonfatal overdoses, primarily driven by fentanyl, during October 2019–September 2021 (*4*). Using more recent ED visit data, including the reported chief complaint field, CDC identified trends in suspected* nonfatal overdose of unintentional or undetermined intent involving fentanyl or fentanyl analogs (fentanyl-involved nonfatal overdose), overall and by patient demographic characteristics.

Methods

Data Source

Fentanyl-involved nonfatal overdose ED visits were identified using data from CDC's National Syndromic Surveillance Program (NSSP), which provides near real-time electronic health record data on ED visits, often within 24–48 hours. NSSP involves collaboration among state and local health departments, CDC, and other partners, and currently includes 80% of U.S. EDs.† ED visits for fentanyl-involved nonfatal overdoses were queried using CDC's fentanyl overdose syndrome definition,§ which identifies visits using free-text chief complaint fields and discharge diagnosis codes. Data from Q4 (October–December) 2020 through Q1 (January–March) 2024 were queried.

Data Classification and Inclusion and Exclusion Criteria

The analysis was restricted to 3,056 of 4,969 (62%) U.S. EDs reporting consistent and complete data during the study

* The term suspected is used because discharge diagnosis codes (i.e., codes that indicate fentanyl-involved poisoning) might be preliminary or missing in syndromic surveillance data. ED visits are classified using chief complaint data and discharge diagnosis codes (the discharge diagnosis codes might be preliminary).

† About NSSP | National Syndromic Surveillance Program (NSSP) | CDC

§ CDC Fentanyl Overdose v2 Parsed Technical Brief and Factsheet

period.[¶] Counts of fentanyl-involved nonfatal overdoses and total ED visits for any cause were aggregated quarterly, overall and by age group, sex, and race and ethnicity. Persons aged 0–14 years were excluded from the age-specific analysis because of data suppression criteria (fewer than 20 cases per quarter). Persons of Hispanic or Latino (Hispanic) ethnicity, irrespective of race, were classified as Hispanic. For the remaining categories, non-Hispanic persons were reported by their indicated single race classification (i.e., American Indian or Alaska Native [AI/AN], Black or African American [Black], White, or other race). Asian, multiple race, other race, and Native Hawaiian or Pacific Islander persons were aggregated into the other race category because of small counts. Although a majority of the race and ethnicity data in NSSP are likely based on self-report, reporting source is not indicated. Visits with missing or unknown values for certain variables were excluded from analyses of that variable.

Data Analysis

Quarterly rates of fentanyl-involved nonfatal overdose ED visits (fentanyl-involved nonfatal overdoses per 10,000 total ED visits of any cause) and average quarterly percent change (AQPC) in rates, were analyzed overall and by age group, sex, and race and ethnicity. Analyses were conducted using Joinpoint regression (version 5.0.2; National Cancer Institute). Quarterly percent change (QPC) estimates for trend segments were calculated when trend changes were identified. P-values <0.05 were considered statistically significant. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[**]

Results

Overall Trends in Fentanyl-Involved Nonfatal Overdoses

During October 2020–March 2024, a total of 86,404 fentanyl-involved nonfatal overdose ED visits were identified. The rate of ED visits for fentanyl-involved nonfatal overdoses increased an average of 5.4% per quarter (Table). The overall rate increased from 1.4 (Q4 2020) to 2.9 (Q1 2024) per 10,000 ED visits and peaked in Q3 2023 at 3.5 per 10,000 ED visits (Figure). From Q4 2020 to Q3 2023, rates increased at a constant rate of 8.7% per quarter, subsequently declining 11.0% per quarter, from Q3 2023 to Q1 2024.

Age-Specific Trends

Fentanyl-involved nonfatal overdose rates were highest among adults aged 25–34 years and lowest among those aged ≥55 years (Figure). The AQPC ranged from 3.3% among persons aged 15–24 years to 7.7% among those aged 35–54 years (Table). Among adults aged ≥25 years, rates increased from Q4 2020 through mid-2023, with QPCs ranging from 9.3% to 11.7% among adults aged 25–34, 35–54, and ≥55 years. Among persons aged 15–24 years, rates remained stable from Q4 2020 through Q4 2021 and subsequently increased 9.8% per quarter from Q4 2021 to Q2 2023. Rates significantly declined from mid-2023 to Q1 2024 among those aged 15–24, 25–34, and ≥55 years.

Sex-Specific Trends

Among males, fentanyl-involved nonfatal overdose rates increased from 2.1 to 4.4 per 10,000 ED visits during the study period, peaking at 5.4 per 10,000 ED visits in mid-2023 (Figure). In females, the rate increased from 0.7 per 10,000 ED visits in Q4 2020 to 1.6 in Q1 2024, with the highest rate of 1.9 occurring in mid-2023. The AQPC was similar among males and females (5.4%) (Table). Fentanyl-involved nonfatal overdose rates increased from Q4 2020 to Q3 2023 among both males (QPC = 8.7%) and females (QPC = 8.5%). Among males, this trend was followed by a quarterly decline of 11.2% from Q3 2023 to Q1 2024. The decline among females during this period was not statistically significant.

Race- and Ethnicity-Specific Trends

Among racial and ethnic groups, the highest rate of fentanyl-involved nonfatal overdose ED visits (e.g., 11.9 per 10,000 visits in Q3 2023 (Figure), and the highest AQPC (9.0%) were among AI/AN persons (Table). Among all racial and ethnic groups (except persons in the combined other race category), statistically significant increasing trends were observed from Q4 2020 through mid-2023, with QPCs ranging from 6.8% among Hispanic persons to 11.6% among AI/AN persons. Among persons in the combined other race group, rates remained stable from Q4 2020 through Q1 2022 and increased by 12.4% quarterly from Q1 2022 to Q2 2023. From mid-2023 to Q1 2024, statistically significant QPCs were observed among those who were Black (9.4% decline), White (6.5% decline), and other races (7.3% decline); declines among AI/AN and Hispanic persons were not statistically significant.

[¶] To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with more consistent reporting of more complete data (coefficient of variation ≤45% and average weekly informative discharge diagnosis ≥75% complete during the study period); How Data Quality Filters Work | National Syndromic Surveillance Program (NSSP) | CDC. A total of 3,056 facilities were included in this analysis (out of 4,969 ED facilities with at least one visit during this time). Fatal overdoses were not excluded but comprised approximately 1% of fentanyl-involved overdose ED visits in NSSP during the study period.

[**] 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE. Trends* in rates of suspected fentanyl-involved nonfatal overdose emergency department visits,† overall and by demographic characteristics and quarter§ — United States, October 2020–March 2024

Characteristic	Average quarterly % change (95% CI)	Trend segments, quarterly % change (95% CI)		
		Segment 1	Segment 2	Segment 3
Overall	**5.4 (4.4 to 6.5)¶**	**Q4 2020–Q3 2023 8.7 (7.9 to 10.1)¶**	**Q3 2023–Q1 2024 −11.0 (−16.9 to −2.8)¶**	**NA**
Age group, yrs**				
15–24	3.3 (2.0 to 4.7)¶	Q4 2020–Q4 2021 2.1 (−7.5 to 7.2)	Q4 2021–Q2 2023 9.8 (7.4 to 16.4)¶	Q2 2023–Q1 2024 −7.1 (−14.0 to −2.2)¶
25–34	5.5 (4.5 to 6.5)¶	Q4 2020–Q2 2023 9.3 (8.3 to 10.8)¶	Q2 2023–Q1 2024 −6.3 (−11.5 to −1.6)¶	NA
35–54	7.7 (6.9 to 8.7)¶	Q4 2020–Q2 2023 11.7 (10.6 to 13.3)¶	Q2 2023–Q1 2024 −4.6 (−8.9 to 0.1)	NA
≥55	6.7 (5.9 to 7.6)¶	Q4 2020–Q3 2023 9.8 (9.0 to 11.0)¶	Q3 2023–Q1 2024 −9.0 (−13.7 to −2.0)¶	NA
Sex††				
Female	5.4 (4.0 to 7.2)¶	Q4 2020–Q3 2023 8.5 (7.5 to 11.0)¶	Q3 2023–Q1 2024 −9.8 (−19.2 to 0.5)	NA
Male	5.4 (4.4 to 6.4)¶	Q4 2020–Q3 2023 8.7 (7.9 to 10.1)¶	Q3 2023–Q1 2024 −11.2 (−17.2 to −3.1)¶	NA
Race and ethnicity§§				
AI/AN	9.0 (7.3 to 12.7)¶	Q4 2020–Q3 2023 11.6 (10.3 to 25.5)¶	Q3 2023–Q1 2024 −4.5 (−14.6 to 8.3)	NA
Black or African American	6.9 (6.1 to 7.8)¶	Q4 2020–Q3 2023 10.2 (9.4 to 11.4)¶	Q3 2023–Q1 2024 −9.4 (−14.1 to −2.2)¶	NA
White	4.9 (3.9 to 5.9)¶	Q4 2020–Q2 2023 8.5 (7.4 to 10.1)¶	Q2 2023–Q1 2024 −6.5 (−12.6 to −1.8)¶	NA
Hispanic or Latino	3.9 (2.6 to 5.7)¶	Q4 2020–Q3 2023 6.8 (5.7 to 9.5)¶	Q3 2023–Q1 2024 −10.6 (−18.9 to 0.1)	NA
Other race¶¶	1.9 (0 to 3.8)	Q4 2020–Q1 2022 −2.2 (−15.1 to 3.8)	Q1 2022–Q2 2023 12.4 (8.1 to 23.7)¶	Q2 2023–Q1 2024 −7.3 (−20.0 to −0.5)¶

Abbreviations: AI/AN = American Indian or Alaska Native; ED = emergency department; NA = not applicable; NH = non-Hispanic; Q = quarter.

* Joinpoint Regression Program

† Fentanyl-involved nonfatal overdoses per 10,000 ED visits.

§ Q1 = Jan–Mar; Q2 = Apr–Jun; Q3 = Jul–Sep; Q4 = Oct–Dec.

¶ The average quarterly percent change or quarterly percent change is significantly different from zero at p<0.05.

** Children and adolescents aged 0–14 years were excluded from the age-specific analysis because of low case count and suppression rules (i.e., fewer than 20 cases per quarter). Sample sizes (the number of total ED visits for any cause) by age group were as follows: 15–24 years, 41,237,765; 25–34 years, 49,743,218; 35–54 years, 83,551,045; and ≥55 years, 121,955,122.

†† Sample sizes (the number of total ED visits of any cause) were 189,880,424 for females and 157,665,771 for males.

§§ Persons of Hispanic or Latino (Hispanic) ethnicity, regardless of race, were classified as Hispanic. For the remaining categories, persons who were NH are reported by their indicated single race classification (e.g., AI/AN, Black or African American [Black], White, or other race). Several groups were aggregated into the other race category because of small counts (i.e., to avoid data suppression). The other race category includes NH Asian, NH Native Hawaiian or Pacific Islander, and NH multiple race or other race persons. Sample sizes (the number of total ED visits of any cause) by race and ethnicity were as follows: NH AI/AN, 2,319,488; NH Black, 60,789,083; NH White, 165,152,596; Hispanic, 50,915,083; and NH other race, 19,032,780.

¶¶ Sample sizes (the number of total ED visits for any cause among groups in the other race category were as follows: NH Asian, 4,885,812; NH Native Hawaiian or Pacific Islander, 642,315; and NH multiple or other race, 13,504,653.

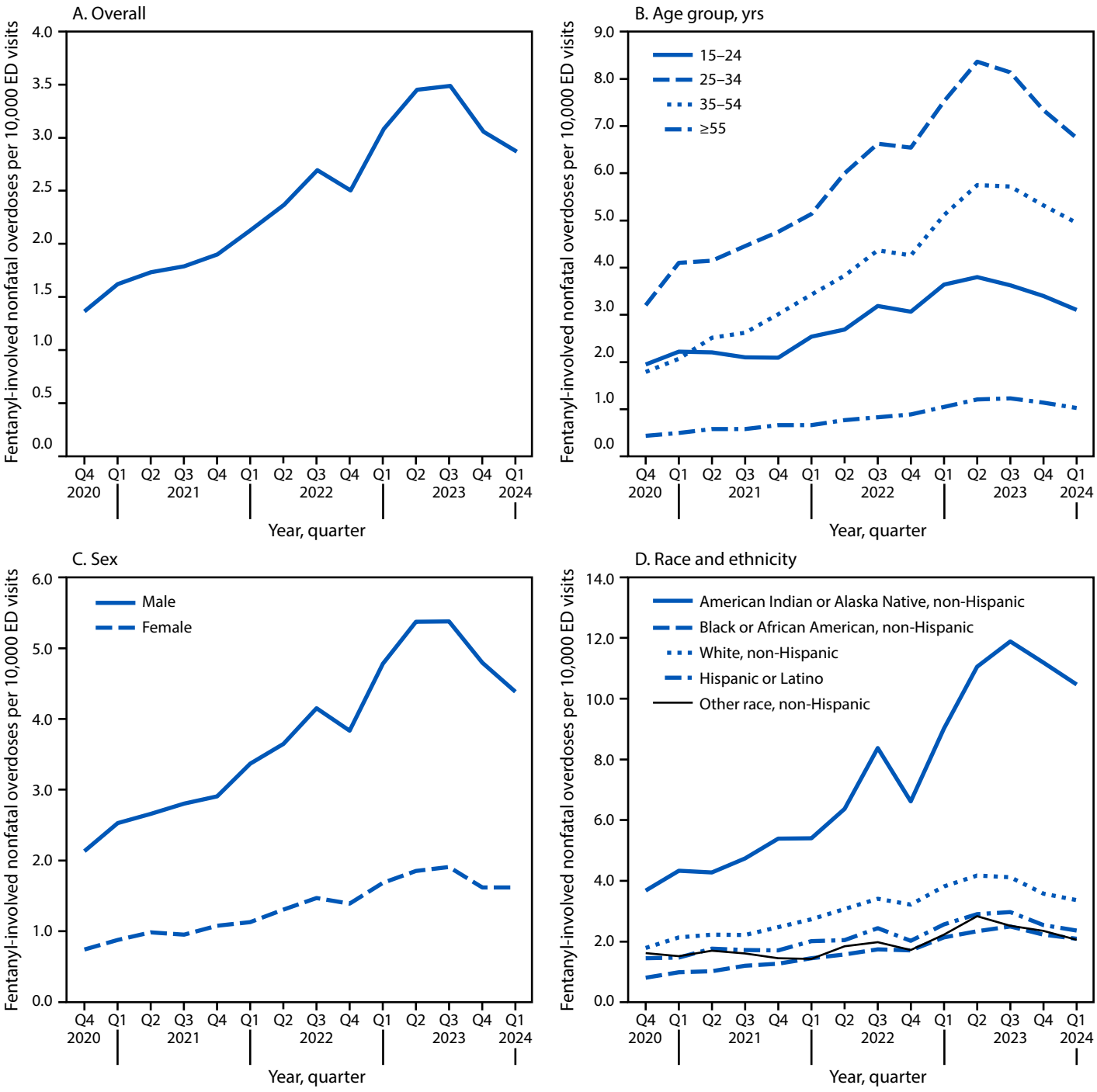
Discussion

From Q4 2020 through mid-2023, rates of fentanyl-involved nonfatal overdose ED visits increased. Rates subsequently declined through Q1 2024; the declines were observed overall and across a majority of demographic groups. These findings are consistent with recent mortality data, which indicate that overdose deaths with illegally manufactured fentanyl and fentanyl analogs detected peaked in mid-2023 and started to decline thereafter (*2*). The overall declines in both nonfatal and fatal overdoses involving fentanyl are encouraging; however, more time is needed to determine whether these observed decreases will be sustained and to identify factors responsible for the observed declines.

EDs are critical locations for implementing strategies that might prevent future or repeat fentanyl-involved overdoses among patients with substance use disorder, with a history of drug use, or who experienced a recent nonfatal overdose, particularly among those persons for whom an ED is the primary contact with the health care system. EDs can introduce overdose prevention strategies, initiate treatment, and link persons who have opioid use disorder to care. Initiating buprenorphine and other medications for opioid use disorder in EDs can offer a pathway to recovery by quickly stabilizing withdrawal symptoms and connecting patients to ongoing treatment.†† Other ED-based response strategies include providing naloxone

†† Initiating Buprenorphine Treatment in the Emergency Department | National Institute on Drug Abuse (NIDA)

FIGURE. Quarterly rates* of suspected fentanyl-involved nonfatal overdose emergency department visits,†,§ overall and by demographic characteristics¶, — United States, October 2020–March 2024**



Abbreviations: AI/AN = American Indian or Alaska Native; ED = emergency department; Q = quarter.

* The y-axis ranges are different in each panel.

† Visits with missing or unknown values for certain variables were excluded from analyses of that variable only (e.g., visits with missing sex were excluded from the sex-specific analysis).

§ Q1 = Jan–Mar; Q2 = Apr–Jun; Q3 = Jul–Sep; Q4 = Oct–Dec.

¶ Children aged 0–14 years were excluded from the age-specific analysis because of low case counts and suppression rules (i.e., fewer than 20 cases per quarter).

** Persons of Hispanic or Latino (Hispanic) ethnicity, regardless of race, were classified as Hispanic. For the remaining categories, persons who were non-Hispanic are reported by their indicated single race classification (e.g., AI/AN, Black or African American, White, or other race). Several groups were aggregated into the other race category because of small counts (i.e., to avoid data suppression). The other race category includes non-Hispanic Asian, non-Hispanic Native Hawaiian or Pacific Islander, and non-Hispanic multiple race or other race persons.

Summary

What is already known about this topic?

Overdose deaths involving synthetic opioids including fentanyl increased during the past decade, with declines beginning in mid-2023. Data on nonfatal overdoses involving fentanyl are limited.

What is added by this report?

Fentanyl-involved nonfatal overdose emergency department (ED) visit rates increased in a majority of demographic groups from late 2020 through mid-2023, with highest rates and largest increases among non-Hispanic American Indian or Alaska Native persons. Overall rates increased 8.7% per quarter from quarter (Q) 4 2020 to Q3 2023, then declined 11.0% per quarter from Q3 2023 to Q1 2024.

What are the implications for public health practice?

Despite recent declining trends, fentanyl-involved nonfatal overdose ED visits remain high (a rate of 2.9 per 10,000 ED visits in Q1 2024, versus 1.4 in Q4 2020). ED interventions to increase naloxone access and availability and linkage to and retention in evidence-based care of persons who have experienced an overdose could reduce future nonfatal and fatal overdoses.

to persons who recently experienced an overdose or to their families; naloxone reverses opioid overdose and can be used at home (*5*). Some recent data suggest that patient refusals of transport to an ED via emergency medical service (EMS) are increasing (*6*); training first responders (e.g., EMS personnel) and equipping them with naloxone and methods to link persons who experience overdoses to health care resources might also be important. Administration of naloxone can mean the difference between a nonfatal and fatal fentanyl-involved overdose. This dataset does not include information about the proportion of fentanyl-involved nonfatal overdose ED visits for which naloxone was administered or what proportion of visits were by persons who experienced a previous overdose. However, recent mortality data from 38 U.S. jurisdictions demonstrate that approximately two thirds (65.9%) of fatal overdoses (from any drug) in 2023 had at least one opportunity for intervention, such as having a potential bystander present (42.6%), a mental health diagnosis (28.7%), or a previous overdose (13.5%), whereas fewer than one quarter (23.7%) of fatal overdoses had documentation that naloxone was administered.[§§]

These findings highlight an urgent need to expand interventions, including naloxone distribution and training, as well as linkage to treatment services, which have the potential to not only reduce the likelihood of fatal overdoses but also to help prevent recurrent overdoses among those who survive. In addition, screening, treating, or referring patients for co-occurring mental health conditions can be done in an ED or any other setting, aligning with the Substance Abuse and Mental Health Services Administration's "No Wrong Door" policy for treatment access, which states that effective systems must ensure that persons needing treatment will be identified, evaluated, and receive treatment, either directly or through appropriate referral, no matter where they seek services.[¶¶] ED-based recovery support programs can include peer recovery specialists who share similar lived experience, such as treatment for addiction, to help facilitate linkage to care and recovery support services.[***]

This study found that the highest rates of fentanyl-involved nonfatal overdose ED visits were among younger adults aged 25–34 years, males, and AI/AN persons. Although information on fentanyl-involved nonfatal overdoses by demographic categories is limited, other drug overdose data such as EMS or mortality data can provide useful context. In a recent analysis using EMS encounter data, the highest rates of opioid-involved nonfatal EMS encounters were among males and adults aged 25–34 years (*6*). Moreover, in 2021 and 2022, the highest age-adjusted rates of all drug overdose mortality were among males (45.1 and 45.6 per 100,000 population, respectively) and AI/AN persons (56.6 and 65.2, respectively) (*1*). In the current study, the sharpest increase in rates of fentanyl-involved nonfatal overdoses was among AI/AN persons, similar to recent trends among all drug overdose deaths from 2021 to 2022, which increased 15.0% among this group (*1*). AI/AN communities are at increased risk for substance use related injury and harm (*7*). Tailored prevention measures might help reduce exposure to substance use.

Limitations

The findings in this report are subject to at least six limitations. First, fentanyl-involved nonfatal overdoses might be underreported or misclassified because of hospital drug testing practices (*8*); however, some jurisdictions recently mandated testing for fentanyl as part of ED urine toxicology screens, which might improve ascertainment.[†††] Second, the syndrome definition used in this study cannot distinguish between illegally manufactured fentanyl (or fentanyl analogs) and prescription fentanyl; however, a majority of fentanyl-involved overdose deaths are caused by illegally manufactured fentanyl (*2*). Third, ED data quality and completeness, including demographic data, vary by facility. Fourth, this dataset only captures nonfatal overdoses treated in EDs and might

[§§] SUDORS Dashboard: Fatal Drug Overdose Data | Overdose Prevention | CDC

[¶¶] Screening and Treatment of Co-Occurring Disorders | SAMHSA

[***] ED based substance use response toolkit

[†††] For example, in October 2023, Maryland mandated that fentanyl be added to toxicology screens (Legislation - SB0914). As of December 2023, Pennsylvania also mandated that fentanyl (and xylazine) be added to ED toxicology screens Senate Bill 683 Information; 2023-2024 Regular Session - The Official Website of the Pennsylvania General Assembly

not represent persons who overdose in community settings and are not transported to an ED. Fifth, there could be a small number of fatal overdoses in this study; approximately 1% of fentanyl-involved overdose ED visits in this study were marked as ending in death. Finally, rates of fentanyl-involved nonfatal overdoses among AI/AN persons could be underestimated because of racial misclassification of AI/AN persons (*9*); further, data from a majority of tribal-specific health facilities are not included in NSSP.

Implications for Public Health Practice

ED interventions to increase access to and availability of naloxone and to expand linkage to and retention in evidence-based care, including medications for opioid use disorder, are important. Focusing activities in communities with high or rising rates of fentanyl overdose, such as AI/AN communities, might help decrease both nonfatal and fatal overdoses. Ongoing monitoring of trends in fentanyl-involved nonfatal overdoses by state and local jurisdictions can identify areas in need of evidence-based prevention, treatment, and recovery support services.

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