



Contagious Comments

The Vaccine-Preventable Diseases Report



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- COVID, Influenza, RSV, and varicella were top causes of ED visits and hospitalizations with a Vaccine Preventable Disease (VPD) in Colorado children and adults in 2023 (Tables 1, 2).
- Re-emerging vaccine-preventable diseases: Be on the lookout for measles, pertussis, and mpox.
- Social vulnerability and vaccine-preventable diseases: Where Colorado children live associated with their risk of VPDs.

Protect Colorado Kids Against Measles

Everyone

- Check to see if you and your family are up to date on measles vaccine (MMR) – 2 doses needed
- Make sure your child receives their 4–6-year-old vaccines BEFORE starting kindergarten

Health care professionals

- Don't miss an opportunity to protect: check vaccine status at sick visits, well visits, and before travel
- Make a strong recommendation for vaccination and have empathy for people with vaccine questions

In the News:

Respiratory season reminders: Influenza and COVID remain the two most common reasons for hospitalizations and ED visits for a vaccine-preventable disease in Colorado. Among Colorado children, there were more hospitalizations with RSV than influenza or COVID in 2023. Now is the time to make sure you, your family members, and your patients are protected from COVID, influenza, and RSV.

Updated COVID and influenza vaccines are available and recommended for everyone 6 months of age and older starting this September. The 2024-25 COVID vaccines contain updated strains (JN.1, KP.2) that are more closely related to circulating variants of SARS-CoV-2.¹ The 2024-25 influenza

vaccines contain two strains of influenza A and one strain of influenza B from the Victoria lineage. Yamagata lineage influenza B is not included anymore as it has not been detected in global surveillance since 2020.²

RSV vaccination is recommended during pregnancy to prevent infant disease, for all adults 75 years and older and for adults 60-74 years old who are at increased risk of severe disease.³ Three RSV vaccines are licensed for older adults and one for pregnant people. RSV vaccine should be given during week 32-36 of pregnancy for pregnant people expected to deliver during RSV season (October-March). Nirsevimab is a long-lasting monoclonal antibody that protects against RSV and is recommended for all infants younger than 8 months born during or entering their first RSV season as well as children 8-19 months who are at increased risk of severe disease. After challenges last year, Nirsevimab supply is expected to be adequate for the 2024-2025 season. Either maternal immunization or Nirsevimab may be used to prevent RSV in infants. Compare each strategy and review timing for protection here: <https://www.cdc.gov/rsv/vaccines/protect-infants.html>.

Measles rising and our Colorado community protection is too low: Several vaccine preventable diseases are on the rise in the US and around the world. There have been over 264 cases of measles in the US through September 2024. This is the highest number since we had large outbreaks in New York and the Pacific Northwest in 2019. Think about measles if you see fever with rash and conjunctivitis or respiratory symptoms, especially in someone who has recently traveled or is under-vaccinated. Only 88% of Colorado children received two doses of MMR before kindergarten last year (2023-24). This is far below the 95% threshold needed to prevent one case of measles from causing an outbreak. The Colorado Department of Public Health and Environment is working to increase awareness, access, and uptake of kindergarten vaccines. Read more at: <https://childvaccineco.org/>.

Pertussis and mpox persist: Many US states have also reported high numbers of pertussis cases this year. Nationwide, there have been more cases of pertussis so far in 2024 compared to the same time in 2023 and in 2019 before the pandemic.⁴ Mpox has also re-emerged as a public health concern with a large outbreak of clade I mpox in Central and Eastern Africa. Mpox cases in the US have been from Clade II. Clade I has been associated with severe disease and has infection in children in Central Africa.⁵ Contact your public health department if you are concerned about measles, pertussis, or mpox.

Colorado Children:

In 2023, vaccine-preventable diseases (VPDs) resulted in over 28,000 hospitalizations and emergency department (ED) visits for Colorado children and over \$407 million in health care charges.

Table 1: Cases, rates, and charges for Colorado children <20 years of age with vaccine-preventable diseases, 2023

Vaccine Preventable Disease	Hospitalized Cases	Rate per 100,000	Hospital charges	ED Cases	Rate per 100,000	ED charges	Total charges
RSV	1,810	133.0	\$152,486,776	4,264	313.4	\$23,468,997	\$175,955,773
COVID (incl. Long COVID, MIS-C)	952	70.0	\$82,590,193	10,528	773.7	\$54,053,880	\$136,644,073
Influenza	350	25.7	\$25,289,264	8,860	651.1	\$36,536,017	\$61,825,281
Multiple viral respiratory VPDs ^a	139	10.2	\$7,006,668	484	35.6	\$2,650,904	\$9,657,572
Pneumococcal disease	93	6.8	\$13,442,673	71	5.2	\$239,253	\$13,681,926
Pertussis	20	1.5	\$1,677,106	159	11.7	\$745,911	\$2,423,017
Varicella/Zoster	13	1.0	\$878,616	239	17.6	\$379,733	\$1,258,349
HPV	7	0.5	\$353,245	85	6.2	\$192,598	\$545,843
Hepatitis A	4	0.3	\$204,143	4	0.3	\$61,965	\$266,108
Hepatitis B	4	0.3	\$2,107,334	84	6.2	\$250,542	\$2,357,876
H. influenzae	3	0.2	\$2,439,793	3	0.2	\$490	\$2,440,283
All other VPDs ^b	1	0.1	\$153,574	8	0.6	\$58,933	\$212,507
Total Vaccine Preventable Diseases	3,396	249.6	\$288,629,385	24,789	1,821.8	\$118,639,223	\$407,268,608

^aHospitalizations or ED visits with ≥2 VPD codes for COVID, influenza, or RSV.

^bDiphtheria, measles, meningococcal disease, mpox, mumps, polio/post-polio syndrome, rubella, and tetanus

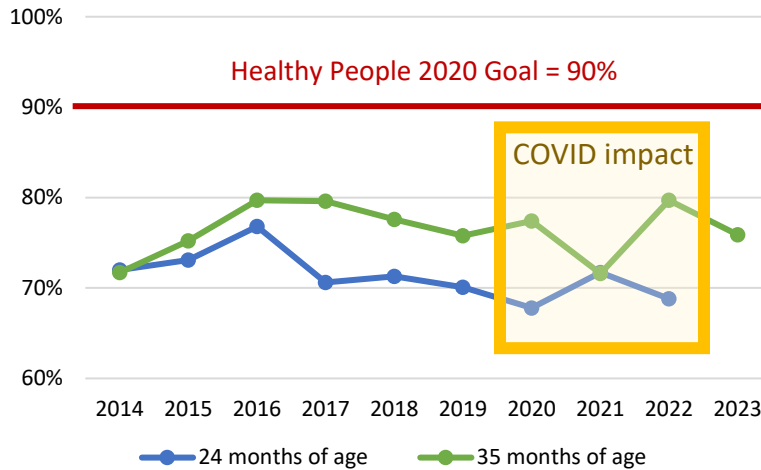
Table 1 shows hospitalizations and emergency department (ED) visits associated with vaccine-preventable disease (VPDs) in Colorado in 2023, and hospital-associated charges [Colorado Hospital Association data]. Diagnoses identified using ICD-10 codes. Population estimates from the Colorado Department of Local Affairs State Demography Office are used to calculate incidence rates. Data from cases with ≥2 VPD codes were reviewed to identify the more relevant VPD code and avoid double-counting; considerations included primary diagnosis code, acuity of conditions, frequency of diagnoses in the overall dataset, and accompanying ICD-10 codes.

Diphtheria, measles, polio, rubella, and tetanus: The mode and accuracy of these diagnoses were unable to be confirmed and these may not align with cases reported to the Colorado Department of Public Health and Environment (CDPHE).

Children’s VPDs: RSV, COVID, and influenza were the three most common reasons for hospitalization or an ED visit with a VPD among Colorado children in 2023 (Table 1). RSV was the most common VPD among hospitalized children and COVID was the most common for ED visits. Despite adding RSV to the list of VPDs, total pediatric hospitalizations and ED visits with VPDs were lower in 2023 compared to 2022, mostly due to fewer ED visits for influenza and COVID. The number of pediatric hospitalizations and ED visits with COVID remained higher than hospitalizations and ED visits and hospitalizations with influenza in 2023. The number of pediatric hospitalizations with pneumococcal disease was higher in 2022 and 2023 than during the early COVID pandemic.

Protection Among Young Coloradans: Only 69% of Coloradans born in 2020 received the recommended 7 vaccine series by 24 months of age.⁶ The CDC recommends series completion by 18 months, and it includes vaccinations to protect against measles, mumps, rubella, tetanus, diphtheria, pertussis, polio, *Haemophilus influenzae* B, hepatitis B, varicella, and pneumococcus. CDC data show about one in four Colorado toddlers have not received all the recommended early childhood vaccinations by 35 months of age. These children may receive these vaccinations late or not at all, leaving them vulnerable to diseases like sepsis, meningitis, or pneumonia from infections with pathogens like pneumococcus, *Haemophilus influenzae*, and pertussis.

Figure 1: Percentage of Coloradans Who Completed Recommended 7 Vaccine Series at 24 and 35 Months of Age



Among all 50 states, CO ranks

34th for 3-year-olds
and
28th for 2-year-olds

Our kids deserve better

Summary: On-time vaccination among pre-school aged children remains too low and has worsened recently. 1 in 4 young children in Colorado are still missing vaccines.

Colorado Adults:

Table 2: Cases, rates, and charges for Colorado adults ≥20 years of age with vaccine-preventable diseases, 2023

Vaccine Preventable Disease	Hospitalized Cases	Rate per 100,000	Hospital charges	ED Cases	Rate per 100,000	ED charges	Total charges
COVID (incl. Long COVID, MIS-C)	16,898	377.3	\$1,694,676,803	94,960	2,120.0	\$1,207,494,053	\$2,902,170,856
Influenza	1,859	41.5	\$185,823,368	9,919	221.4	\$84,867,000	\$270,690,368
Varicella/Zoster	935	20.9	\$106,981,923	6,743	150.5	\$39,542,151	\$146,524,074
Pneumococcal disease	918	20.5	\$166,630,361	223	5.0	\$2,889,729	\$169,520,090
RSV	663	14.8	\$58,722,241	1,535	34.3	\$15,199,654	\$73,921,895
Hepatitis B	445	9.9	\$76,328,225	3,954	88.3	\$18,233,096	\$94,561,321
HPV	443	9.9	\$37,742,509	15,293	341.4	\$124,006,989	\$161,749,498
Multiple viral respiratory VPDs ^a	220	4.9	\$27,222,253	574	12.8	\$5,338,458	\$32,560,711
Polio/post-polio syndrome	207	4.6	\$18,704,214	589	13.1	\$9,158,381	\$27,862,595
Hepatitis A	118	2.6	\$25,591,059	119	2.7	\$3,135,325	\$28,726,384
H. influenzae	69	1.5	\$14,842,644	1	0.0	\$158	\$14,842,802
All other VPDs ^b	79	1.8	\$8,755,044	107	2.4	\$1,053,050	\$9,808,094
Total Vaccine Preventable Diseases	22,859	864.4	\$2,422,020,644	134,017	5,067.5	\$1,510,918,044	\$3,932,938,688

^aHospitalizations or ED visits with ≥2 VPD codes for COVID, influenza, or RSV.

^bDiphtheria, measles, meningococcal disease, mpox, mumps, pertussis, rubella, and tetanus.

Table 2 shows hospitalizations and emergency department (ED) visits associated with vaccine-preventable disease (VPDs) in Colorado during in 2023, and hospital-associated charges [Colorado Hospital Association data]. Diagnoses identified using ICD-10 codes. Population estimates from the Colorado Department of Local Affairs State Demography Office are used to calculate incidence rates. Data from cases with ≥2 VPD codes were reviewed to identify the more relevant VPD code and avoid double-counting; considerations included primary diagnosis code, acuity of conditions, frequency of diagnoses in the overall dataset, and accompanying ICD-10 codes.

Diphtheria, measles, and tetanus: The mode and accuracy of these diagnoses were unable to be confirmed and these may not align with cases reported to the Colorado Department of Public Health and Environment (CDPHE).

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Polio/post-polio syndrome: Most adult encounters with polio/post-polio syndrome were among people born before polio elimination in the United States, demonstrating the long-term impacts of VPDs.

Rubella: Some adult rubella encounters were among older adults with history of congenital rubella and associated comorbidities, demonstrating the long-term impacts of a VPD. Some adult rubella encounters were among pregnant people who could have rubella disease or have an indication for rubella immunity testing; the mode and accuracy of rubella diagnoses were unable to be confirmed.

In 2023, Colorado adults had over 156,000 hospitalizations and ED visits with vaccine-preventable diseases (VPDs), resulting in over \$3.9 billion in health care charges.

Adult VPDs: COVID, influenza, and varicella were the three most common reasons for hospitalization with a VPD among Colorado adults in 2023 (Table 2). The most common reasons for ED visits with a VPD among Colorado adults were COVID, influenza, and HPV in 2023. Despite adding RSV to the list of VPDs, there were fewer total ED visits and hospitalizations with a VPD in 2023 compared to 2022, mostly due to decreased hospitalizations and ED visits with COVID and influenza.

COVID and RSV Again! COVID was the most common diagnosis for hospitalization or an ED visit with a VPD among Colorado adults in from 2020 through 2023 and among Colorado children in 2021 and 2022. This year, we included RSV as a vaccine preventable disease for the first time. Almost 6,000 Colorado children were hospitalized or had an ED visit with RSV in 2023. We hope to see these numbers decrease with wider availability of maternal RSV vaccines and the long-lasting monoclonal antibody nirsevimab. Adult rates of hospitalization and ED visits with RSV were lower, but over 2,100 Colorado adults sought ED or hospital care for a disease that can be prevented with vaccination, particularly among older adults.

Social Vulnerability, Race, Ethnicity, Insurance, and Economic Impact:

Social Vulnerability Index and Vaccine Preventable Disease:

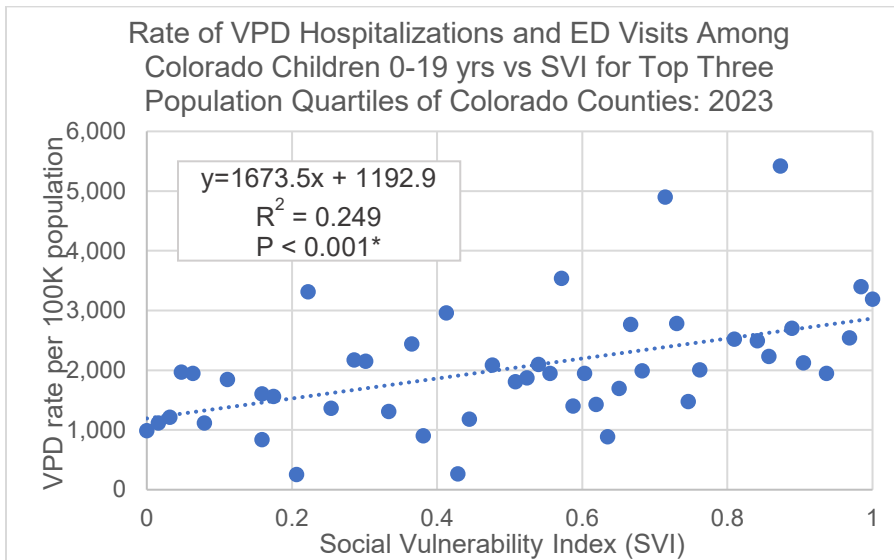


Figure 2: Correlation between Social Vulnerability Index (SVI) and rate of pediatric hospitalizations and ED visits for a vaccine-preventable disease (VPD) per 100,000 children in 2023 among the top three quartiles of Colorado counties by population. The smallest quartile of counties by population were excluded due to concern that small numbers of ED visits or hospitalizations in these small counties might vary significantly year to year and make it more difficult to detect any association between SVI and VPD rates. There were 174 ED visits or hospitalizations with a VPD in excluded counties; 28,011 in included counties.

*P-value determined using Pearson's Correlation

The Social Vulnerability Index (SVI) ranks counties from most vulnerable (score of 1) to least vulnerable (score of 0) using four items (Socioeconomic Status, Household Characteristics, Racial & Ethnic Minority Status, and Housing Type & Transportation). The SVI was developed by the CDC in 2011 and uses U.S. census variables from the American Community Survey (ACS). The initial purpose of the index was to aid public health officials to better prepare and respond to emergency events. The SVI has been used in research ranging from predicted COVID-19 case counts⁷ to natural disasters including hurricane and extreme-heat related mortality.⁸ The data in this report includes SVI comparing only Colorado counties. When comparing their SVI national rankings, the numbers may change to a minor extent. For example, Prowers County has an SVI of 1 in the Colorado county set, but it is ranked at 0.96 in the interactive SVI map that ranks the counties nationally.⁹ For children 0-19 years, the rate of ED visits and hospitalization with a VPD was higher in counties with a higher SVI (more vulnerable).

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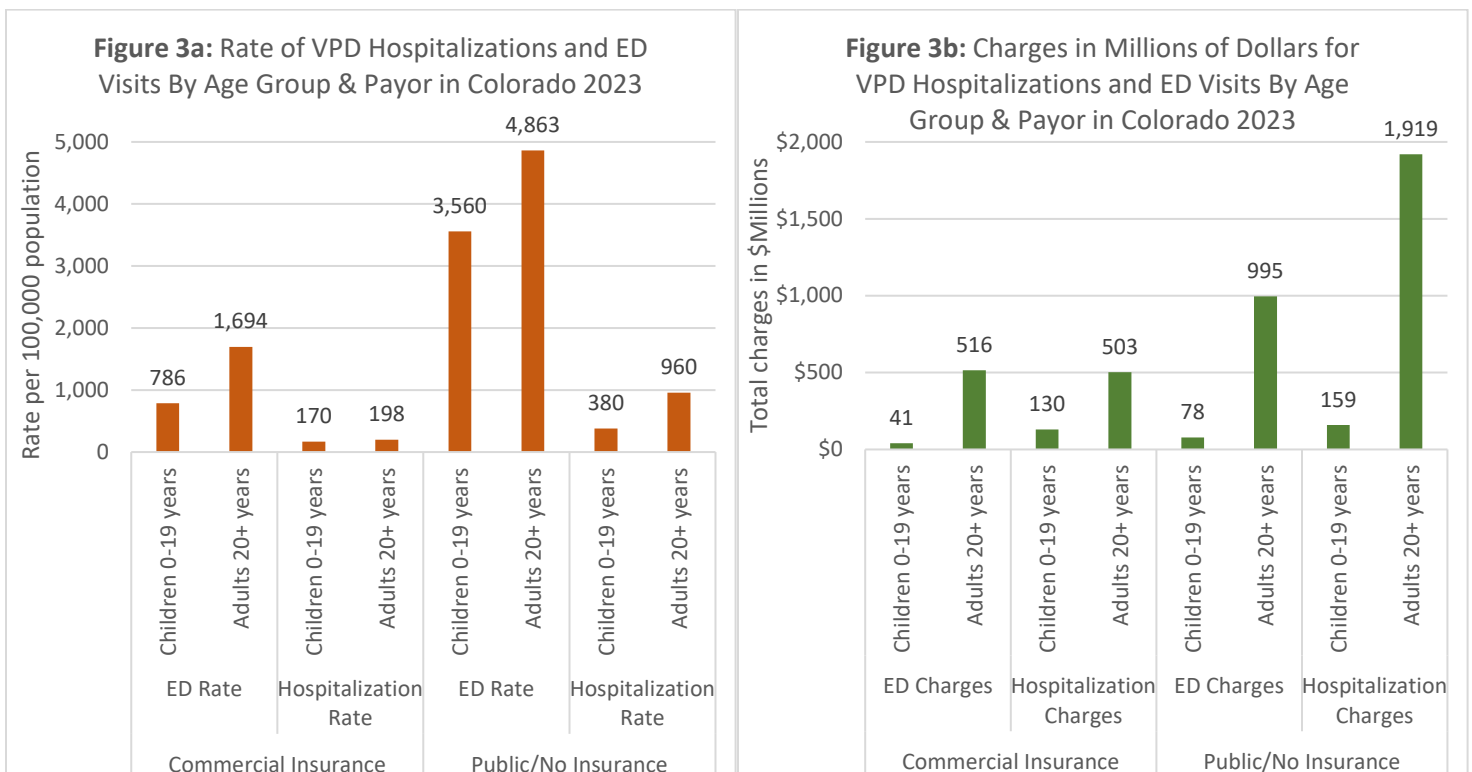
The association between SVI and rate of ED visits or hospitalization with a VPD was stronger for Colorado children than adults. The association between VPD rates and the composite SVI was stronger than any association with each individual SVI item or sub-score. The SVI illustrates the impact of Social Determinants of Health and how the most vulnerable Coloradans, especially those who come from a low socioeconomic status household and are of racial/ethnic minority status, are at higher risk of VPDs. To decrease the impact of VPDs across Colorado, we must advocate for change that will better protect and serve vulnerable communities such as reducing cost barriers to vaccination and increasing access to health care throughout the state.

Race, Ethnicity and Vaccine Preventable Disease: It is challenging to draw conclusions about associations between race/ethnicity and VPD hospitalizations in Colorado due to limitations of available data. Race/ethnicity was recorded as 'unknown' or not reported for about 4% of Coloradans hospitalized with a VPD. In addition, >10% of Coloradans hospitalized with a VPD had race listed as 'other', even though the Colorado Department of Labor estimates that <5% of Coloradans belong to a race/ethnicity group other than White Non-Hispanic (NH), Black NH, Asian NH, or Hispanic. Methods of capturing and reporting patient race/ethnicity also vary across different health care systems and are not always concordant with self-reported race/ethnicity.¹⁰⁻¹² Several studies have found that misclassification of race and ethnicity in electronic health records is worse among Hispanic patients.^{13,14}

With these limitations in mind, rates of hospitalization with a VPD in 2023 were higher among Black Coloradans (390 and 643 per 100,000 children and adults respectively) and Coloradans with race/ethnicity other than White NH, Black NH, Asian NH, or Hispanic (651 and 2641) compared to White Coloradans (298 and 545) and Asian Coloradans (194 and 329).

Summary: *Race and ethnicity data for hospitalization and ED visits has shortcomings that limit our ability to draw conclusions about race/ethnicity and VPDs.*

Economic and Practical Toll of VPDs: Charges for hospitalizations and ED visits associated with VPDs among publicly/un-insured Coloradans totaled almost \$3.2 billion in 2023. Most Colorado children and adults are commercially insured, but the majority of VPD hospitalizations and ED visits occurred among publicly/un-insured Coloradans. Numbers and rates of hospitalizations and ED visits with VPDs and the associated health care charges were higher among publicly/un-insured compared to commercially insured Coloradans. (Table 3). These higher case rates and total charges occur among older adults who are mostly covered by Medicare and children with Medicaid.



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Summary: Publicly insured and un-insured Coloradans bear a higher burden of ED visits and hospitalizations with VPDs. Total charges for VPD hospitalizations and ED visits are higher for publicly insured/un-insured populations.

What does it mean for the average patient or family?

Hospitalization with a vaccine-preventable disease for a child:

Median charge: \$35,748 (public or no insurance); \$38,783 (private insurance)

Hospitalization with a vaccine preventable disease for an adult:

Median charge: \$63,722 (public or no insurance); \$46,613 (private insurance)

These median charges mostly reflect hospitalizations with COVID, influenza, RSV (for children) and varicella (for adults). Median charges for VPD hospitalizations are much higher for diseases like *Haemophilus influenzae*, pneumococcal disease, and meningococcal disease. Hospital charges may overestimate the amount billed or paid, but they may underestimate the full economic impact of disease by failing to capture costs of missed work, lost wages, and outpatient care.

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