



September 2023

Highlights:

- New tools are available to prevent RSV in older adults and pneumococcal disease in people of all ages.
- COVID, long COVID, and influenza were top causes of ED visits and hospitalizations with a Vaccine Preventable Disease (VPD) in among Colorado children and adults in 2022. (Tables 1 and 2)
- Rates of hospitalizations and ED visits for VPDs (including COVID) are higher among children 0-2 years of age compared to school-aged children and adolescents. (Figures 2 and 3)
- Many young kids in Colorado do not get routine vaccines on time; most are not vaccinated for COVID. (Figure 1)
- Long COVID and mpox were added to our list of VPDs, with RSV joining soon.

In the News:

Investing in vaccination: The Colorado legislature approved an investment of more than \$3 billion in immunizations for the 2023-24 budget and committed to continued support in future years. The money will be used for a statewide communications campaign to promote routine immunizations and to expand vaccinations for uninsured and under-insured adults. It will also support mobile vaccination clinics, building on the state health department's experience delivering COVID and mpox vaccination in recent years.¹

Advances in RSV prevention: In June 2023, the Advisory Committee on Immunization Practices (ACIP) recommended, with shared clinical decision making, vaccination to protect against RSV in adults ≥ 60 years of age. In August, ACIP recommended a new long-acting monoclonal antibody for RSV prevention in infants. All infants < 8 months of age and some children in the second year of life should receive a single dose of nirsevimab, which provides 5 months of protection from RSV. In September, ACIP recommended maternal RSV vaccine to be given at 32-36 weeks gestation using seasonal administration. After a historically severe respiratory virus season last year, these additional strategies for preventing RSV have the potential to greatly improve children's health and to prevent severe disease among older adults.

What's new with Pneumococcal vaccines? PCV15 and PCV20 have now both been approved by the FDA and recommended by ACIP for use in children and adults. For adults ≥ 65 and adults 19-64 years old with certain medical conditions and risk factors, PCV20 is recommended or PCV15 plus PPSV23. For children younger than 5 years and children 5-18 years old with certain medical conditions, PCV15 or PCV20 is recommended. PPSV23 should also be given for children 2-18 years old with certain medical conditions if they receive PCV15 (but not if they receive PCV20). CDC recommendations and lists of conditions associated with higher risk of pneumococcal disease and are available here: <https://www.cdc.gov/vaccines/vpd/pneumo/index.html>

Polio: New York State has continued testing wastewater for polio after an unvaccinated young man in Rockland County developed paralysis from circulating vaccine-derived poliovirus (from the Sabin oral poliovirus vaccine) in 2022. From August 2022 through June 2023, poliovirus was detected in wastewater from five of nine counties in southern New York with the most recent detection in February 2023.² ACIP now recommends that adults or children who are known or suspected to be unvaccinated or incompletely vaccinated against polio should complete a primary vaccination series.

Colorado kids are still behind on vaccines

What you can do to help:

Parents

- Call your pediatrician or primary care provider
- Make sure children and adolescents are up to date on their vaccinations, including flu and COVID

Health care professionals

- Check immunization status at sick and well visits
- Use standing orders for routine vaccinations
- Use reminder/recall systems to notify patients who are due or overdue for vaccinations

The Vaccine-Preventable Diseases Report

Children: In 2022, vaccine-preventable diseases (VPDs) resulted in over 56,000 hospitalizations and emergency department (ED) visits for Colorado children and over \$446 million in health care charges.

Table 1: Cases, rates, and charges for Colorado children 0-19 years of age with vaccine-preventable diseases, 2022

Vaccine Preventable Disease (VPD)	Hospitalized Cases	Rate per 100,000	Hospital charges	ED Cases	Rate per 100,000	ED charges	Total charges
COVID	2,359	168.9	\$162,875,091	32,351	2,316.9	\$120,396,369	\$283,271,460
Influenza	902	64.6	\$59,682,726	19,553	1,400.3	\$71,230,826	\$130,913,553
Pneumococcal disease	83	5.9	\$16,448,415	43	3.1	\$92,499	\$16,540,915
MIS-C	45	3.2	\$5,460,842	203	14.5	\$569,266	\$6,030,108
Long COVID	36	2.6	\$3,298,574	543	38.9	\$1,351,300	\$4,649,874
Varicella/Zoster	11	0.8	\$2,978,680	137	9.8	\$232,657	\$3,211,337
Pertussis	10	0.7	\$707,830	27	1.9	\$66,358	\$774,188
<i>H. influenzae</i>	5	0.4	\$450,656	0	0		\$450,656
HPV	4	0.3	\$120,828	60	4.3	\$101,941	\$222,769
Hepatitis A	1	0.1	\$104,541	3	0.2	\$35,697	\$140,238
Meningococcal disease	1	0.1	\$119,683	5	0.4	\$5,584	\$125,267
Mpox	1	0.1	\$35,714	7	0.5	\$17,241	\$52,955
Diphtheria	0	0		0	0		
Hepatitis B	0	0		89	6.4	\$193,183	\$193,183
Measles	0	0		3	0.2	\$5,262	\$5,262
Mumps	0	0		4	0.3	\$21,196	\$21,196
Polio/post-polio syndrome	0	0		1	0.1	\$5,068	\$5,068
Rubella	0	0		3	0.2	\$1,656	\$1,656
Tetanus	0	0		3	0.2	\$46,010	\$46,010
Total, all VPDs	3,458	247.7	\$252,283,581	53,035	3,798.3	\$194,372,114	\$446,655,695

Deaths: 3 influenza, 10 COVID, 1 varicella/zoster

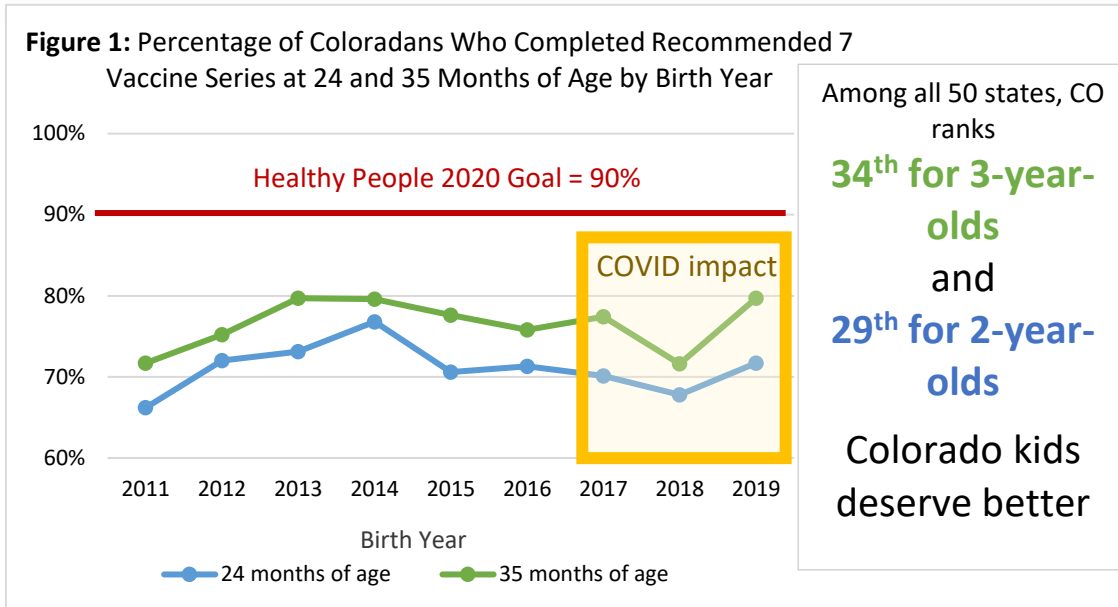
Table 1 shows hospitalizations and emergency department (ED) visits associated with vaccine-preventable disease (VPDs) in Colorado in 2022, and hospital-associated charges for these cases [Colorado Hospital Association data]. Diagnoses identified using ICD-10 codes. Population estimates from the Colorado 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 to avoid double-counting ED visits and hospitalizations; considerations included primary diagnosis code, acuity of conditions, frequency of diagnoses in the overall dataset, and accompanying ICD-10 codes.

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

Children: COVID, influenza, pneumococcal disease and MIS-C were the four most common reasons for hospitalization with a VPD among Colorado children in 2022. COVID, influenza, long COVID and MIS-C were the four most common VPDs associated with ED visits in 2022 (Table 1). Even with the return of influenza circulation in late 2022, the number of children who had a hospitalizations or ED visits with COVID was higher than for influenza. The number of pediatric hospitalizations with pneumococcal disease was higher in 2022 than during the early pandemic period.

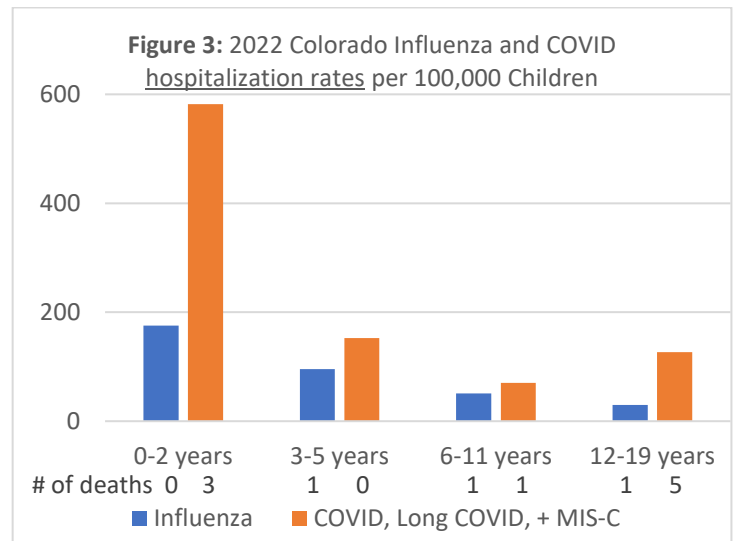
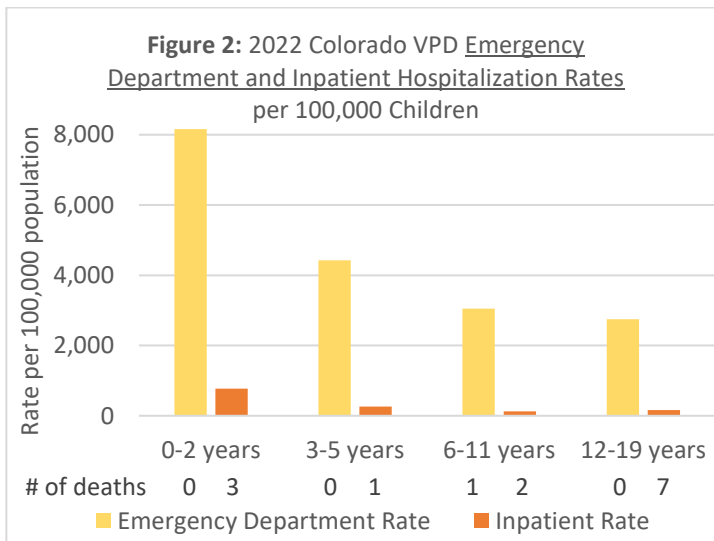
Young Coloradans: Only 72% of Coloradans born in 2019 received the recommended 7 vaccine series by 24 months of age.³ The CDC recommends series completion by 18 months, and it includes vaccinations to protect against measles, mumps, rubella, tetanus, diphtheria, pertussis, polio, *Haemophilus influenzae* B, hepatitis B, varicella, and pneumococcus. CDC data show about one in five Colorado toddlers have not received all the recommended early childhood vaccinations by 35 months of age. These children either receive these vaccinations late or not at all, leaving them vulnerable to sepsis and meningitis from infection with pneumococcus or *Haemophilus influenzae* and serious respiratory illness from pertussis or measles.

The Vaccine-Preventable Diseases Report



Summary: *The COVID pandemic had a significant impact on childhood vaccination rates. While rates have recovered somewhat, 1 in every 5 Colorado children are still missing vaccines.*

Vaccine Preventable Diseases throughout Childhood: Rates of pediatric ED visits and hospitalizations for VPDs remain highest during the first two years of life when on-time vaccination rates are lowest. Even if these children catch up on vaccinations before starting school, under-vaccination early in life leaves the youngest children vulnerable to serious diseases at an age when these diseases are most common and most dangerous.



In 2022, COVID hospitalizations and ED visits in very young Colorado children occurred at higher rates than among older children and adolescents. This follows the same trend seen in Colorado in 2021 and children ≤ 2 years of age still have the lowest COVID vaccination rates of any age group. While some pediatric hospitalizations and ED visits with COVID are among children with another primary diagnosis, COVID is more often their primary acute problem or a complicating factor for other medical issues. COVID vaccination reduces the risk of hospitalization with acute COVID and reduces the risk of sequelae like MIS-C and long COVID.^{4,5}

Summary: *Infants and pre-school-aged children have high rates of COVID-19 hospitalization and very few of them have been protected by vaccination even as COVID vaccines for young children have been available for over a year.*

The Vaccine-Preventable Diseases Report

Adults: In 2022, Colorado adults had over 282,000 hospitalizations and ED visits with vaccine-preventable diseases, resulting in over \$5.6 billion in health care charges.

Table 2: Cases, rates, and charges for Colorado adults ≥ 20 years of age with vaccine-preventable diseases, 2022

Vaccine Preventable Disease (VPD)	Hospitalized Cases	Rate per 100,000	Hospital charges	ED Cases	Rate per 100,000	ED charges	Total charges
COVID	31,172	698.7	\$3,012,801,215	187,262	4,197.6	\$1,508,488,263	\$4,521,289,478
Influenza	3,555	79.7	\$295,024,142	17,419	390.5	\$134,805,876	\$429,830,018
Long COVID	1,119	25.1	\$102,963,215	13,321	298.6	\$42,401,819	\$145,365,033
Pneumococcal disease	904	20.3	\$154,622,069	176	3.9	\$2,245,956	\$156,868,026
Varicella/Zoster	862	19.3	\$98,954,190	6,382	143.1	\$36,496,534	\$135,450,724
Hepatitis B	450	10.1	\$55,680,293	3,861	86.5	\$18,383,186	\$74,063,478
HPV	383	8.6	\$33,377,756	13,850	310.5	\$107,108,250	\$140,486,006
Polio/post-polio syndrome	215	4.8	\$19,035,377	540	12.1	\$8,562,727	\$27,598,105
Hepatitis A	93	2.1	\$14,116,410	185	4.1	\$4,256,212	\$18,372,622
<i>H. influenzae</i>	37	0.8	\$9,089,979	7	0.2	\$45,323	\$9,135,302
Mpox	22	0.5	\$2,657,175	227	5.1	\$410,168	\$3,067,343
MIS-C	9	0.2	\$2,121,120	15	0.3	\$125,850	\$2,246,970
Rubella	9	0.2	\$403,955	27	0.6	\$125,474	\$529,429
Mumps	7	0.2	\$277,861	4	0.1	\$5,379	\$283,240
Pertussis	7	0.2	\$289,309	31	0.7	\$64,142	\$353,451
Meningococcal disease	5	0.1	\$1,229,206	8	0.2	\$20,655	\$1,249,861
Tetanus	5	0.1	\$894,035	19	0.4	\$404,111	\$1,298,146
Diphtheria	2	0.0	\$123,058	4	0.1	\$153,368	\$276,426
Measles	0			5	0.1	\$9,858	\$9,858
Total, all VPDs	38,856	871.0	\$3,803,660,364	243,343	5,454.6	\$1,864,113,153	\$5,667,773,517

Deaths: 6 *H. influenzae*, 2 hepatitis A, 11 hepatitis B, 7 HPV, 117 influenza, 69 pneumococcal disease, 3 polio/post-polio syndrome, 1,447 COVID, 45 long COVID, 3 MIS-C, 16 varicella/zoster, 1 meningococcal disease, and 1 rubella

Table 2 shows hospitalizations and emergency department (ED) visits associated with vaccine-preventable disease (VPDs) in Colorado during in 2022, and hospital-associated charges for these cases [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 to avoid double-counting ED visits and hospitalizations; considerations included primary diagnosis code, acuity of conditions, frequency of diagnoses in the overall dataset, and accompanying ICD-10 codes.

Diphtheria and measles: The mode and accuracy of diagnoses for adult diphtheria encounters were unable to be confirmed.

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 vaccine-preventable diseases.

Rubella: Some adult rubella encounters were among older adults with history of congenital rubella and associated comorbidities, demonstrating the long-term impacts of a vaccine-preventable disease. More than half of 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.

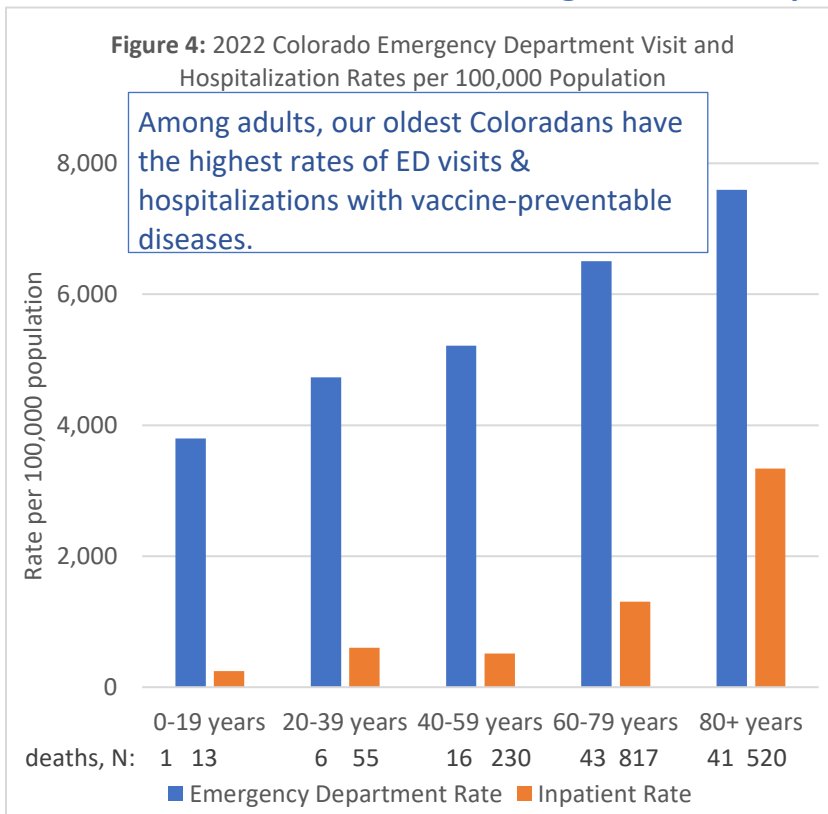
Tetanus: Most adult tetanus encounters had diagnoses suggestive of an injury requiring tetanus vaccination for post-exposure prophylaxis, rather than actual tetanus disease. The mode and accuracy of adult tetanus diagnoses were unable to be confirmed.

The Vaccine-Preventable Diseases Report

Adults: COVID, influenza, long COVID, and pneumococcal disease were the four most common reasons for hospitalizations due to a VPD among Colorado adults in 2022. The four most common reasons for ED visits with a VPD among Colorado adults were COVID, influenza, HPV, and long COVID in 2022 (Table 2).

Specific Vaccine Preventable Diseases: COVID was the most common diagnosis for hospitalization, or an ED visit with a VPD among Colorado adults in 2020, 2021 and 2022 and among Colorado children in 2021 and 2022. This year we included long COVID and mpox in this report for the first time. Long COVID ED visits and hospitalizations were more common among Colorado adults than children and long COVID was one of the top causes of an ED visit or hospitalization with a VPD, highlighting the risks associated with COVID beyond acute infection. The number of adult hospitalizations with pneumococcal disease was higher in 2022 than during the early pandemic period.

Vaccine Preventable Diseases Throughout the Lifespan: Rates of hospitalizations and ED visits with VPDs



Among adults, our oldest Coloradans have the highest rates of ED visits & hospitalizations with vaccine-preventable diseases.

were highest among senior Coloradans in 2022. Older adults are more vulnerable to respiratory infections including the most common reasons for hospitalization with a VPD: COVID, influenza, and pneumococcal disease. Older adults are also more vulnerable to severe disease from RSV compared to younger adults, a disease for which there is now an effective and safe vaccine that offers protection.

Economic Toll of VPDs and Length of Stay:

Charges for hospitalizations and ED visits associated with VPDs among publicly/un-insured Coloradans totaled almost \$4.3 billion in 2022. Numbers and rates of hospitalizations and ED visits with VPDs and the associated hospital charges were higher among publicly/un-insured compared to commercially insured Coloradans. The majority of Colorado children and adults are commercially insured, but the majority of VPD hospitalizations and ED visits occurred among publicly/un-insured Coloradans (Table 3).

Table 3: Hospitalization and emergency department visits with a vaccine-preventable disease by payer type in Colorado, 2022

	Children 0-19 years			Adults ≥20 years		
	Total	Commercially Insured	Publicly/Un-insured	Total	Commercially Insured	Publicly/Un-insured
Population, N (%)	1,393,274 (100%)	850,062 (61%)	543,212 (39%)	4,418,795 (100%)	2,566,199 (58%)	1,852,596 (42%)
Hospitalizations, N (%)	3,458 (100%)	1,277 (37%)	2,181 (63%)	38,856 (100%)	10,586 (27%)	28,270 (73%)
Rate per 100k	248	150	402	879	413	1,526
Total charges, \$M	\$252.3M	\$95.4M	\$156.8M	\$3,803.7M	\$905.4M	\$2,898.3M
ED visits, N (%)	53,035 (100%)	16,807 (32%)	36,208 (68%)	243,343 (100%)	95,414 (39%)	147,929 (61%)
Rate per 100k	3,807	1,977	6,666	5,507	3,718	7,985
Total charges, \$M	\$194.4M	\$68.3M	\$126.0M	\$1,864.1M	\$654.4M	\$1,209.6M

Table 3 shows hospitalization and emergency department visits with a vaccine-preventable disease by payer type in Colorado in 2022. Charges and diagnoses from Colorado Hospital Association (CHA) data. M=million, k=thousand.

Summary: Publicly insured and un-insured Coloradans bear a higher burden of ED visits and hospitalizations with vaccine-preventable diseases.

The Vaccine-Preventable Diseases Report

Total charges for ED visits and hospitalizations are presented in Tables 1 and 2; however, the median charge for a hospitalization is a more relevant number when considering the economic impact of vaccine preventable disease for one patient or one family. The median charges for a hospitalization with influenza or COVID were just over \$30,000 for Colorado children and around \$50,000 for adults. Hospitalizations with Long COVID or MIS-C were less common but more expensive for children (median charge of \$70,000 for Long COVID and \$115,000 for MIS-C) and adults (\$60,000 and \$80,000). Median charges for a hospitalization with some vaccine preventable diseases exceeded \$100,000 including pneumococcal disease and varicella among Colorado children and meningococcal disease and *Haemophilus influenzae* infection in adults. Hospital charges may overestimate the amount billed or paid, but they may underestimate the economic impact of disease by failing to capture costs associated missed work, lost wages, and the cost of outpatient care.

The median duration of a hospitalization with meningococcal disease, *Haemophilus influenzae*, or pneumococcal disease was close to a week for both children and adults. The median length of stay for the VPDs most commonly causing hospitalization, including COVID, long COVID, and influenza, was 2-3 days for children and 3-4 days for adults. For the many Coloradans hospitalized with COVID, long COVID, or influenza, this means 2-4 days stuck in the hospital, missing work or school, and likely needing more time to recover at home.

References

1. State of Colorado Joint Budget Committee. Budget Package & Long Bill, FY 2023-24. 2023; <https://leg.colorado.gov/sites/default/files/231bnarrative.pdf>. Accessed June 20, 2023.
2. New York State Department of Health. Poliovirus Wastewater Surveillance Report. 2023; https://www.health.ny.gov/diseases/communicable/polio/docs/waste_water_surveillance_report.pdf. Accessed June 20, 2023.
3. Centers for Disease Control and Prevention. ChildVaxView: Vaccination Coverage among Young Children (0 – 35 Months). 2023; <https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/interactive-reports/index.html>. Accessed June 15, 2023.
4. Tran VT, Perrodeau E, Saldanha J, Pane I, Ravaud P. Efficacy of first dose of covid-19 vaccine versus no vaccination on symptoms of patients with long covid: target trial emulation based on ComPaRe e-cohort. *BMJ Med.* 2023;2(1):e000229.
5. Zambrano LD, Newhams MM, Olson SM, et al. Effectiveness of BNT162b2 (Pfizer-BioNTech) mRNA Vaccination Against Multisystem Inflammatory Syndrome in Children Among Persons Aged 12-18 Years - United States, July-December 2021. *MMWR Morb Mortal Wkly Rep.* 2022;71(2):52-58.

If you wish to receive this publication, please provide us with your E-mail address below.

Name: _____ E-mail Address: _____

The Vaccine Preventable Diseases Report publications are always posted on Children's Hospital Colorado website at:

<https://www.childrenscolorado.org/health-professionals/stay-informed/>

Please return your E-mail address to: Maggie Bay, Children's Hospital Colorado, Epidemiology – Box B276, 13123 E. 16th Avenue, Aurora, CO 80045 or E-mail address: maggie.bay@childrenscolorado.org

Thank you for your interest in our publication.