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Progress Toward Measles and Rubella Elimination — India, 2005–2021

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In 2019, India, along with other countries in the World Health Organization (WHO) South-East Asia Region,* adopted the goal of measles and rubella elimination by 2023,† a revision of the previous goal of measles elimination and control of rubella and congenital rubella syndrome (CRS) by 2020§ (*1*–*3*). During 2017–2021, India adopted a national strategic plan for measles and rubella elimination (*4*), introduced rubella-containing vaccine (RCV) into the routine immunization program, launched a nationwide measles-rubella supplementary immunization activity (SIA) catch-up campaign, transitioned from outbreak-based surveillance to case-based acute fever and rash surveillance, and more than doubled the number of laboratories in the measles-rubella network, from 13 to 27. Strategies included 1) achieving and maintaining high population immunity with at least 95% vaccination coverage by providing 2 doses of measles- and rubella-containing vaccines; 2) ensuring a sensitive and timely case-based measles, rubella and CRS surveillance system; 3) maintaining an accredited measles and rubella laboratory network; 4) ensuring adequate outbreak preparedness and rapid response to measles and rubella outbreaks; and 5) strengthening support and linkages to achieve these strategies, including planning and progress monitoring, advocacy, social mobilization and communication, identification and utilization of synergistic linkages of integrated program efforts, research, and development. This report describes India's progress toward the elimination of measles and rubella during 2005–2021, with a focus on the years 2017–2021.¶ During 2005–2021, coverage with the first dose of a measles-containing vaccine (MCV) administered through routine immunization increased 31%, from 68% to 89%. During 2011–2021, coverage with a second MCV dose (MCV2) increased by 204%, from 27% to 82%. During 2017–2021, coverage with a first dose of RCV (RCV1) increased almost 14-fold, from 6% to 89%. More than 324 million children received a measles- and rubella-containing vaccine (MRCV) during measles-rubella SIAs completed in 34 (94%) of 36 states and union territories

*WHO South-East Asia Region includes 11 countries: Bangladesh, Bhutan, Burma, India, Indonesia, Maldives, Nepal, North Korea, Sri Lanka, Thailand, and Timor-Leste.

†Measles elimination is defined as the absence of endemic measles cases for ≥12 months in the presence of adequate surveillance. Rubella elimination is defined as the absence of endemic rubella cases for ≥12 months in the presence of adequate surveillance.

§Rubella and congenital rubella syndrome control is defined as a 95% reduction in disease incidence from the 2013 level.

¶Although India conducts sentinel site surveillance for CRS, national CRS incidence is not regularly reported. Modeled incidence of CRS in India has been published elsewhere and is beyond the scope of this report.

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(states) during 2017–2019. During 2017–2021, annual measles incidence decreased 62%, from 10.4 to 4.0 cases per 1 million population, and rubella incidence decreased 48%, from 2.3 to 1.2 cases per 1 million population. India has made substantial progress toward measles and rubella elimination; however, urgent and intensified efforts are required to achieve measles and rubella elimination by 2023.

Immunization Activities

India has one of the world's largest immunization programs, targeting a birth cohort of 27 million children annually (*5*). In 1985, coverage with a first dose of MCV (MCV1), administered at age 9–12 months, was introduced into the routine immunization program and MCV2, administered at age 16–24 months, was introduced in 2011. In 2017, India introduced RCV, and measles- and rubella-containing vaccine (MRCV) replaced MCV1 and MCV2 in the routine immunization schedule.** Administrative vaccination coverage (the number of vaccine doses administered divided by the estimated target population) is reported each year from all districts in India to the national immunization program, where data are aggregated and reported to WHO and UNICEF through the Joint Reporting Form. WHO and UNICEF use reported administrative coverage, country estimates, and vaccination coverage survey data to generate annual estimates of vaccination coverage through routine immunization services (*6*). Estimated MCV1 coverage increased 31%, from 68% in 2005 to 89% in 2021, and estimated MCV2 coverage increased 204%, from 27% in 2011 to 82% in 2021 (Table) (Figure 1). Estimated RCV1 coverage increased 1,383%, from 6% in 2017 to 89% in 2021 (Figure 2). The Fifth National Family Health Survey, conducted nationwide during 2019–2020, estimated the MCV1 coverage for children aged 12–23 months to be 88% compared with the 2005–2007 Third National Family Health Survey–estimated MCV1 coverage of 59% (*7*). Estimated coverage with the first MRCV dose (MRCV1) peaked at 95% in 2019 before the COVID-19 pandemic; coverage declined by 6 percentage points during the pandemic to 89% in 2020 and 2021. Similarly, the estimated MCV2 coverage declined from 84% in 2019 to 82% in 2021.

During 2010–2013, India conducted a phased measles catch-up SIA for children aged 9 months–10 years in 14 states, vaccinating approximately 119 million children with MCV. In December 2014, India launched Mission Indradhanush (https://www.nhp.gov.in/mission-indradhanush1_pg) as a special immunization drive to vaccinate unvaccinated and partially vaccinated children aged <2 years living in selected districts. During 2015–2021, India completed four Mission Indradhanush rounds (periodic intensification of routine immunization activity), vaccinating approximately 39 million children who had previously missed

** India introduced a second RCV dose (RCV2) at the same time as RCV1, with MRCV replacing MCV in the routine schedule. However, there are no WHO and UNICEF estimates for RCV2 because RCV2 coverage data are not regularly reported.

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TABLE. Reported number of measles and rubella cases, by case classification, age group and vaccination status, and surveillance indicators — India, 2017–2021

Characteristic	No. (%)				
	2017	2018	2019	2020	2021
Measles					
All cases, no.	**13,854**	**20,925**	**10,485**	**5,497**	**5,697**
Laboratory-confirmed*	3,487 (25)	5,795 (28)	4,829 (46)	2,572 (47)	1,863 (33)
Epidemiologically linked†	9,569 (69)	13,470 (64)	3,291 (31)	629 (11)	448 (8)
Clinically compatible§	798 (6)	1,660 (8)	2,365 (23)	2,296 (42)	3,386 (59)
Incidence¶	10.4	15.4	7.7	3.9	4.0
Measles genotypes, no.	D4 (4), D8 (204)	D4 (1), D8 (333)	B3 (2), D4 (5), D8 (553)	B3 (4), D4 (64), D8 (510)	D8 (23)
Age group of patients with laboratory-confirmed and epidemiologically linked measles					
<9 mos	602 (5)	1.140 (6)	752 (9)	357 (11)	166 (7)
9 mos–4 yrs	5,255 (40)	7,579 (39)	2,840 (35)	1,371 (43)	981 (42)
5–9 yrs	5,144 (39)	7,449 (39)	2,177 (27)	743 (23)	552 (24)
10–14 yrs	1,466 (11)	1,944 (10)	960 (12)	295 (9)	291 (13)
≥15 yrs	589 (5)	1,153 (6)	1,391 (17)	435 (14)	321 (14)
Unknown or missing	NA	NA	NA	NA	NA
MCV doses received by patients with laboratory-confirmed and epidemiologically linked measles					
≥2	1,619 (12)	3,467 (18)	1,319 (16)	700 (22)	876 (38)
1	1,926 (15)	1,923 (10)	995 (12)	406 (13)	321 (14)
0	6,073 (47)	7,978 (41)	3,311 (41)	1,019 (32)	382 (17)
Unknown	3,438 (26)	5,897 (31)	2,495 (31)	1,076 (34)	732 (32)
Rubella					
All cases, no.	**3,097**	**2,381**	**3,487**	**1,397**	**1,681**
Laboratory-confirmed**	888 (29)	1,032 (43)	2,088 (60)	1,293 (93)	1,636 (97)
Epidemiologically linked††	2,209 (71)	1,349 (57)	1,399 (40)	104 (7)	45 (3)
Incidence¶	2.3	1.8	2.5	1.0	1.2
Rubella genotypes, no.	2B (9)	2B (9)	2B (19)	2B (6)	NA
Age group of patients with laboratory-confirmed and epidemiologically linked rubella					
<9 mos	115 (4)	92 (4)	169 (5)	109 (8)	82 (5)
9 mos–4 yrs	742 (24)	629 (26)	1,277 (37)	665 (48)	977 (58)
5–9 yrs	1,198 (39)	874 (37)	1,098 (32)	330 (24)	283 (17)
10–14 yrs	652 (21)	457 (19)	513 (15)	164 (12)	151 (9)
≥15 yrs	390 (13)	328 (14)	430 (12)	129 (9)	188 (11)
Unknown or missing	NA	1 (0)	NA	NA	NA
RCV doses received by patients with laboratory-confirmed and epidemiologically linked rubella					
≥2	64 (2)	108 (5)	187 (5)	157 (11)	345 (21)
1	74 (2)	52 (2)	489 (14)	342 (24)	464 (28)
0	1,801 (58)	1,323 (56)	1,882 (54)	608 (44)	524 (31)
Unknown	1,158 (37)	898 (38)	929 (27)	290 (21)	348 (21)
Surveillance and program implementation					
States with case-based or fever and rash surveillance					
Case-based surveillance§§	6 (17)	17 (47)	29 (81)	32 (89)	0 (0)
Fever and rash surveillance¶¶	0 (—)	4 (11)	4 (11)	4 (11)	36 (100)
WHO-accredited measles and rubella laboratories, no.	13	17	21	20	27
States completing measles-rubella SIA	10 (28)	26 (72)	34 (94)	34 (94)	34 (94)
Surveillance performance indicators					
No. of discarded NMNR cases***	3,581	7,196	14,514	11,039	25,654
No. of discarded NMNR cases per 100,000, national level (target ≥2)	0.3	0.5	1.1	0.8	1.8
Districts with NMNR discard rate ≥2	20 (3)	20 (3)	107 (15)	84 (11)	321 (42)
% of suspected cases adequately investigated††† ≤48 hours after notification (target ≥80)	83	89	87	89	92
% of suspected cases with adequate specimens§§§ tested for measles and rubella in a proficient laboratory¶¶¶ (target ≥80)	100	100	100	100	99
% of samples tested ≤4 days after specimen receipt in laboratory (target ≥80)****	89	39	85	84	94
% of results received by program ≤4 days after specimen receipt (target ≥80)††††	67	22	47	53	72
% of weekly surveillance units reporting to national level on time (target ≥80)	92	92	94	94	93

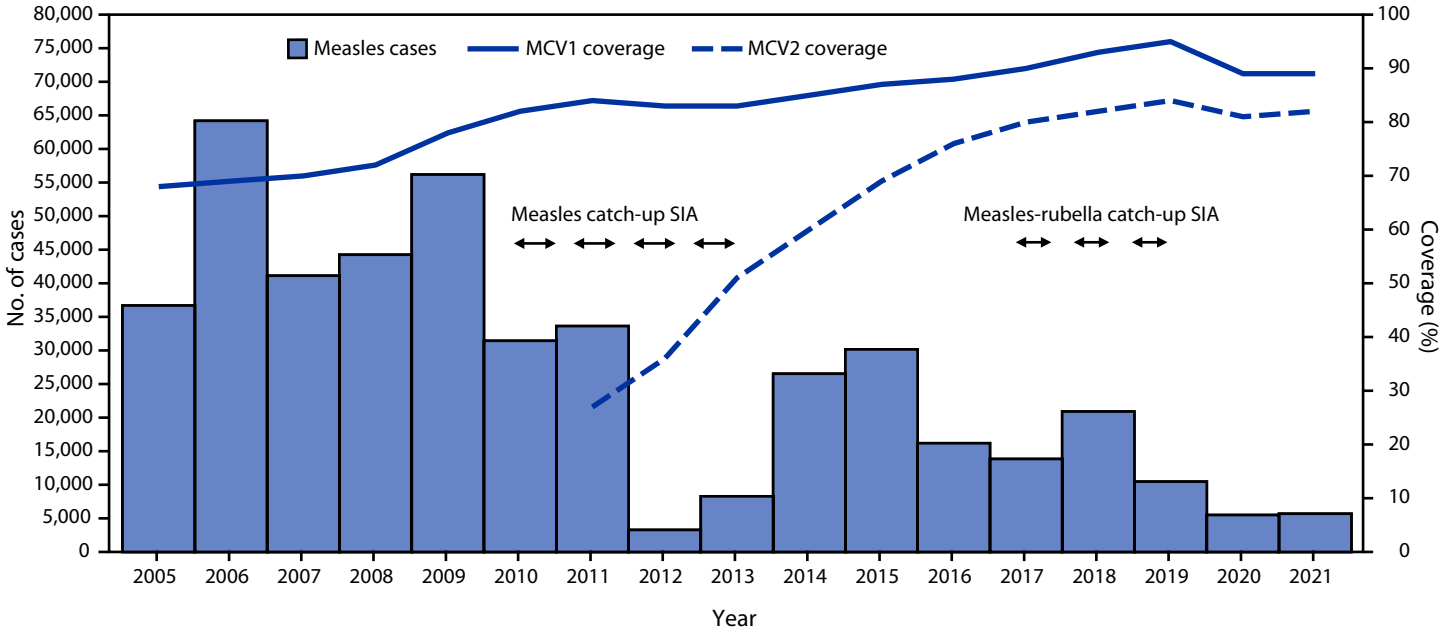
See table footnotes on the next page.

TABLE. (*Continued*) Reported number of measles and rubella cases by case classification, age group and vaccination status, and surveillance indicators — India, 2017–2021

Abbreviations: IgM = immunoglobulin M; MCV = measles-containing vaccine; NA = not applicable; NMNR = nonmeasles, nonrubella; RCV = rubella-containing vaccine; SIA = supplementary immunization activity; WHO = World Health Organization.

* Defined as a case that meets the suspected case definition and is laboratory-confirmed (serologically or virologically) as measles.
† As a part of an outbreak investigation, additional suspected cases captured by online-listing forms but without specimens collected are epidemiologically linked if they are part of a laboratory-confirmed measles outbreak.
§ Defined as a suspected case for which no adequate laboratory specimen could be collected and is not epidemiologically linked to a laboratory-confirmed case of measles or rubella and not epidemiologically linked to another laboratory-confirmed communicable disease.
¶ Cases per 1 million population.
** Defined as a case that meets the suspected case definition and is laboratory-confirmed (serologically or virologically) as rubella.
†† As a part of an outbreak investigation, additional suspected cases captured by online-listing forms but without specimens collected are epidemiologically linked if they are part of a laboratory-confirmed rubella outbreak.
§§ A case-based surveillance suspected case is defined as illness in any person with fever and maculopapular (nonvesicular) rash and any one of cough, coryza (runny nose), or conjunctivitis (red eyes); or in any person in whom a clinician or health worker suspects measles infection.
¶¶ A fever and rash surveillance suspected case is defined as illness in any person with fever and maculopapular (nonvesicular) rash or in any person in whom a clinician or health worker suspects measles or rubella infection.
*** Suspected cases that have been investigated and discarded as nonmeasles and nonrubella by 1) laboratory result negative for measles and rubella through serum sample testing in a proficient laboratory and 2) no epidemiological linkage to another confirmed measles or rubella case.
††† Suspected cases investigated ≤48 hours after notification.
§§§ Serum specimen collected ≤28 days (for serology) and throat swab/urine samples collected ≤7 days (for virology) after rash onset.
¶¶¶ A WHO-accredited laboratory that has an established quality assurance program or one with oversight by a WHO-accredited laboratory.
**** Samples tested for measles and rubella IgM ≤4 days after samples received in laboratory.
†††† Laboratory results for measles and rubella IgM received by program ≤4 days after sample receipt by laboratory.

FIGURE 1. Number of reported measles cases,* estimated percentage of children who received their first and second doses of measles-containing vaccine,† and supplementary immunization activities, by year§,¶ — India, 2005–2021



Abbreviations: MCV1 = first dose of measles-containing vaccine in routine immunization; MCV2 = second dose of measles-containing vaccine in routine immunization; SIA = supplementary immunization activity.

* During 2005–2016, India's Joint Reporting Form for measles and rubella included data from outbreak-based surveillance and additional sources. During 2017–2019, cases included data from outbreak-based surveillance and case-based measles and rubella surveillance. During 2019–2021, cases included data from cased-based measles and rubella surveillance and acute fever and rash surveillance.
† Vaccination coverage data were from World Health Organization and UNICEF estimates of national immunization coverage; MCV1 was introduced into routine immunization in 1985, and MCV2 was introduced in 2011.
§ Measles catch-up SIA targeted children aged 9 months–10 years, implemented in three phases in 14 states: 2010–2011, 2011–2012, and 2012–2013.
¶ Measles-rubella catch-up SIA targeted children aged 9 months–15 years, conducted by state during 2017–2019 in 34 of 36 states and union territories.

any doses of vaccines provided through routine immunization, including measles and rubella (the latter during 2018–2021). During 2017–2019, India conducted measles-rubella SIAs in a phased manner in 34 (94%) of 36 states, vaccinating approximately 324 million children with MRCV. Of the two states that did not participate in the measles-rubella SIA, West Bengal has scheduled a measles-rubella SIA for early 2023, and Delhi has yet to confirm a date for the campaign.

Surveillance Activities and Measles and Rubella Incidence

In 2005, India began using the WHO-supported acute flaccid paralysis polio surveillance platform for laboratory-supported measles and rubella outbreak-based surveillance in the state of Tamil Nadu. During the following 10 years, additional states began measles and rubella outbreak-based surveillance,[††] which was implemented in all states by 2015, resulting in increased reporting of rubella cases in 2016 (Figure 2). During this period, India lowered the threshold for investigation of a suspected measles or rubella outbreak by 94%, from 20 cases per week in 2005 to five cases per 4 weeks in 2015. During 2005–2015, India's Joint Reporting Form for measles and rubella cases included data from outbreak-based surveillance and additional sources. During 2017–2019, India transitioned from outbreak-based to case-based measles and rubella surveillance.[§§] Furthermore, in 2021, after a pilot conducted in three states, India transitioned to case-based acute fever and rash surveillance[¶¶] in all states (Table). To support this scale-up, the network of WHO-accredited laboratories expanded from three in 2005 to 13 in 2017; during 2017–2021, 14 additional laboratories were added to the network, for a total of 27.

Measles and rubella surveillance system indicators estimate sensitivity, timeliness, and function. During 2017–2021, the discarded nonmeasles and nonrubella cases rate,[***] a measure of surveillance sensitivity, increased fivefold, from 0.30 to

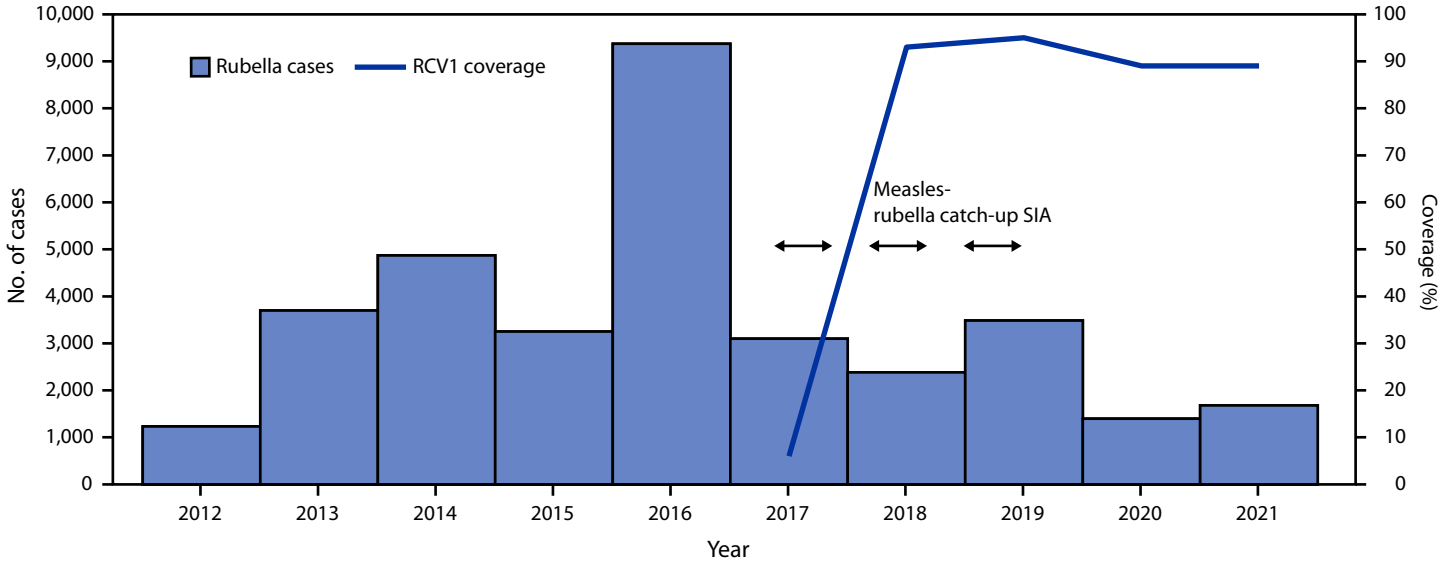
[††] Measles and rubella outbreak-based surveillance started in 2005 with outbreak definition of 20 cases per week. The outbreak threshold was changed in 2012 to 10 cases per week and in 2014 to five cases per week. In 2015, the outbreak threshold was changed to five cases per 4 weeks.

[§§] For case-based measles and rubella surveillance, a suspected case was defined as a person with fever and maculopapular (nonvesicular) rash with cough, coryza or conjunctivitis, or any person in whom a clinician or health worker suspects measles infection.

[¶¶] For case-based acute fever and rash surveillance, a suspected case was defined as a person with fever and maculopapular (nonvesicular) rash, or any person in whom a clinician or health worker suspects measles or rubella infection.

[***] A discarded case is defined as a suspected case that has been investigated and determined to be neither measles nor rubella by 1) laboratory testing in a proficient laboratory or 2) epidemiologic investigation with no linkage to another confirmed measles or rubella case.

FIGURE 2. Number of reported rubella cases,* estimated percentage of children who received their first dose of rubella-containing vaccine,† and supplementary immunization activities, by year,§ — India, 2012–2021



Abbreviations: RCV1 = first dose of rubella-containing vaccine in routine immunization; SIA = supplementary immunization activity.

* During 2012–2016, India's Joint Reporting Form for rubella cases included data from outbreak-based surveillance and additional sources. During 2017–2019, cases included data from outbreak-based surveillance and case-based measles and rubella surveillance. During 2019–2021, cases included data from cased-based measles and rubella surveillance and acute fever and rash surveillance.

† Vaccination coverage data were from World Health Organization and UNICEF estimates of national immunization coverage; RCV1 was introduced into routine immunization in 2017.

§ Measles-rubella catch-up SIA targeted children aged 9 months–15 years, conducted by state during 2017–2019 in 34 of 36 states and union territories.

1.81 per 100,000 population, and the percentage of districts with a discarded case rate ≥2 increased thirteenfold, from 3% to 42%. The timeliness of case investigations (≤48 hours of notification) improved from 83% in 2017 to 92% in 2021, and 100% of suspected cases with adequate specimens were tested in a WHO-accredited laboratory. In 2021, 94% of samples were tested ≤4 days of receipt by the laboratory; however, only 72% of laboratory results were submitted to the immunization program within 4 days of specimen receipt, potentially delaying public health action.

During 2017–2021, the incidence of measles decreased 62%, from 10.4 to 4.0 cases per million population, and the incidence of rubella declined 48%, from 2.3 to 1.2.††† During this period, among the laboratory-confirmed and epidemiologically linked measles cases, 71% of patients had received no MCV doses or had an unknown vaccination history. Similarly, 81% of persons with laboratory-confirmed and epidemiologically linked rubella had received no RCV doses or had an unknown vaccination history. In 2021, among the laboratory-confirmed and epidemiologically linked cases, 42% of measles and 58% of rubella cases were reported in children aged 9 months–4 years.

Among isolates from patients during 2017–2021, measles virus genotypes detected and reported included B3, D4, and D8; D8 accounted for 1,623 (95%) of 1,703 isolates reported. Rubella virus genotype 2B was detected and reported from 43 patients during 2017–2021. However, genotype information is available for a small proportion of measles (3%) and rubella (0.4%) cases during this period.

Discussion

During 2005–2021, India made substantial progress toward measles and rubella elimination. Through implementation of national and regional strategies, including Mission Indradhanush and two SIAs conducted in phases during several years each (2010–2013 and 2017–2019), to strengthen both routine and supplementary immunization, estimated MCV1, MCV2, and RCV1 coverage increased 31%, 204% and 1,383%, respectively. Reported measles and rubella incidence declined by 62% and 49%, respectively, during 2017–2021.

Despite this progress, India continues to face challenges in its goal to achieve measles and rubella elimination by 2023. During the COVID-19 pandemic, national routine MRCV1 coverage decreased from a peak of 95% in 2019 to 89% in 2021, and MCV2 coverage decreased from a peak of 84% (2019) to 82% (2021). In addition, the surveillance indicators demonstrated declines in sensitivity of measles and rubella surveillance from 2019 to 2020. India initiated various measures to mitigate the impact of the pandemic on immunization delivery and surveillance, including the dissemination of updated guidance for the continuation of immunization and surveillance, as well as state-level reviews to discuss challenges and track progress. During the second half of 2021, while continuing to respond to the COVID-19 pandemic, India trained approximately 240,000 persons in fever and rash surveillance at workshops throughout the country. In 2021, 42% of districts reached the surveillance performance target of two or more discarded nonmeasles and nonrubella cases per 100,000 population, an increase of approximately 280% from 11% of districts in 2020. To address challenges with data quality and laboratory and surveillance reporting delays, India is transitioning to a new, real-time, integrated Vaccine-Preventable Disease Surveillance Information Management System.

The findings in this report are subject to at least three limitations. First, coverage estimates are based on administrative data and might be inaccurate because of errors in recording doses administered or in estimating the target population. Second, surveillance data might underestimate actual disease incidence because surveillance sensitivity was low: children who had measles or rubella might not have been brought in for care and not all cases in patients who sought care might have been reported. Finally, given the small number of samples

Summary

What is already known about this topic?

In 2019, India adopted the goal of measles and rubella elimination by 2023, a revision of the goal of measles elimination and control of rubella and congenital rubella syndrome by 2020.

What is added by this report?

Estimated coverage with the first dose of a measles- and rubella-containing vaccine increased from 68% to 89% in 2021. Estimated coverage with the second dose of a measles-containing vaccine increased from 27% to 82% in 2021. During 2017–2021, measles and rubella incidence declined 62% and 48%, respectively.

What are the implications for public health practice?

India has made substantial progress toward measles and rubella elimination; urgent and intensified efforts are required to achieve elimination goals by 2023.

††† Measles cases include laboratory-confirmed, epidemiologically linked, or clinically compatible (a suspected case for which no adequate laboratory specimen could be collected) cases. Rubella cases include those that are laboratory-confirmed and epidemiologically linked.

sequenced, genotype data might not reflect the predominant circulating genotypes.

In September 2022, recognizing the urgent and intensified work required to achieve measles and rubella elimination by 2023, India adopted a "Roadmap to Measles and Rubella Elimination in India by 2023" (*8*). Given subnational variations in immunization coverage and surveillance sensitivity, the roadmap includes an action plan to intensify and monitor progress toward measles and rubella elimination with a focus on district-level implementation, tracking, and program review. With an annual birth cohort of 27 million children in India, the measles and rubella elimination program represents a remarkable opportunity to prevent death and illness from these diseases.

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Drug Overdose Deaths Among Persons Aged 10–19 Years — United States, July 2019–December 2021

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U.S. drug overdose deaths increased 30% from 2019 to 2020 and 15% in 2021, resulting in an estimated 108,000 deaths in 2021.* Among persons aged 14–18 years, overdose deaths increased 94% from 2019 to 2020 and 20% from 2020 to 2021 (*1*), although illicit drug use declined overall among surveyed middle and high school students during 2019–2020 (*2*). Widespread availability of illicitly manufactured fentanyls (IMFs),† proliferation of counterfeit pills resembling prescription drugs but containing IMFs or other illicit drugs,§ and ease of purchasing pills through social media¶ have increased fatal overdose risk among adolescents (*1*,*3*). Using CDC's State Unintentional Drug Overdose Reporting System (SUDORS), this report describes trends and characteristics of overdose deaths during July 2019–December 2021 among persons aged 10–19 years (hereafter referred to as adolescents). From July–December 2019 to July–December 2021, median monthly overdose deaths increased 109%, and deaths involving IMFs increased 182%. Approximately 90% of overdose deaths involved opioids, and 83.9% involved IMFs; however, only 35% of decedents had documented opioid use history. Counterfeit pill evidence was present in 24.5% of overdose deaths, and 40.9% of decedents had evidence of mental health conditions or treatment. To prevent overdose deaths among adolescents, urgent efforts are needed, including preventing substance use initiation, strengthening partnerships between public health and public safety to reduce availability of illicit drugs, expanding efforts focused on resilience and connectedness of adolescents to prevent substance misuse and related harms, increasing education regarding IMFs and counterfeit pills, expanding naloxone training and access, and ensuring access to treatment for substance use and mental health disorders.

Funded jurisdictions entered data from death certificates, postmortem toxicology testing, and medical examiner or coroner reports into SUDORS for both unintentional and undetermined intent drug overdose deaths. Monthly trends in all overdose deaths and deaths involving IMFs** (*4*) among decedents aged 10–19 years during July 1, 2019–December 31, 2021 and percent change in the median number of monthly deaths, comparing subsequent 6-month periods, were calculated among 32 jurisdictions.†† Percentages of overdose deaths were calculated by demographic characteristics and drugs involved in 47 jurisdictions,§§ and by circumstances in 43 jurisdictions,¶¶ overall and for decedents within two age groups:

* https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm (Accessed November 4, 2022).

† https://www.dea.gov/sites/default/files/2021-02/DIR-008-21%202020%20National%20Drug%20Threat%20Assessment_WEB.pdf

§ https://www.dea.gov/alert/sharp-increase-fake-prescription-pills-containing-fentanyl-and-meth

¶ https://www.dea.gov/sites/default/files/2022-03/20220208-DEA_Social%20Media%20Drug%20Trafficking%20Threat%20Overview.pdf

** Fentanyl was classified as likely illicitly manufactured using toxicology, scene, and witness evidence. In the absence of sufficient evidence to classify fentanyl as illicit or prescription (16% of deaths involving fentanyl), fentanyl was classified as illicit because the vast majority of fentanyl overdose deaths involve illicit fentanyl. All fentanyl analogs except alfentanil, remifentanil, and sufentanil (which have legitimate human medical use) were included as illicitly manufactured fentanyls.

†† Alaska, Arizona, Colorado, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Kansas, Kentucky, Maine, Massachusetts, Minnesota, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, and West Virginia. Illinois, Missouri, and Washington reported deaths from counties that accounted for ≥75% of drug overdose deaths in the state in 2017, per SUDORS funding requirements; all other jurisdictions reported deaths from the full jurisdiction. Jurisdictions reported deaths for all 6-month periods from July 2019 to December 2021.

§§ Alabama, Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin. Alabama, Arkansas, Florida, Hawaii, Illinois, Indiana, Louisiana, Missouri, New York, and Washington reported deaths from counties that accounted for ≥75% of drug overdose deaths in the state in 2017, per SUDORS funding requirements; all other jurisdictions reported deaths from the full jurisdiction. Jurisdictions were included if data were available for at least one 6-month period (July–December 2019, January–June 2020, July–December 2020, January–June 2021, or July–December 2021).

¶¶ Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin. Arkansas, Florida, Hawaii, Illinois, Indiana, Louisiana, Missouri, and Washington reported deaths from counties that accounted for ≥75% of drug overdose deaths in the state in 2017, per SUDORS funding requirements; all other jurisdictions reported deaths from the full jurisdiction. Jurisdictions were included if data were available for at least one 6-month period (July–December 2019, January–June 2020, July–December 2020, January–June 2021, or July–December 2021), and coroner and medical examiner reports were available for ≥75% of deaths in the included period or periods. Analysis was restricted to decedents with an available coroner or medical examiner report.

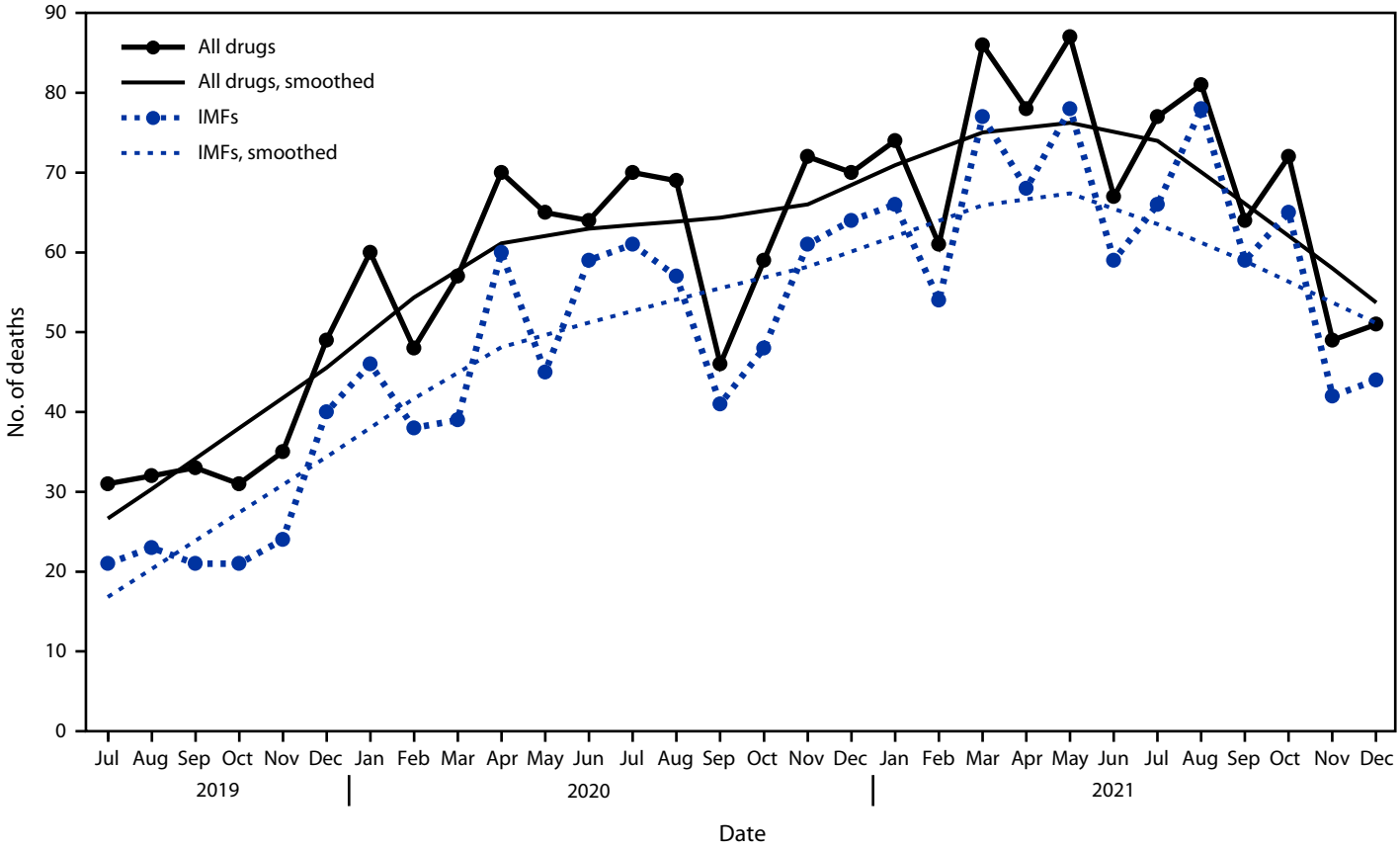
10–14 years and 15–19 years. Analyses were performed using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC and conducted consistent with applicable federal law and CDC policy.***

During July 2019–December 2021, a total of 1,808 adolescent overdose deaths occurred in 32 jurisdictions with available trend data. The number of monthly overdose deaths increased 65% overall, from 31 in July 2019 to 51 in December 2021, peaking at 87 in May 2021 (Figure 1). The number of deaths involving IMFs more than doubled, from 21 to 44 during this period, peaking at 78 in May and August 2021. Median monthly overdose deaths among adolescents increased 109%, from 32.5 during July–December 2019 to 68 during July–December 2021; during the same period, deaths involving IMFs increased 182%, from 22 to 62. Median monthly deaths increased during each 6-month period from July–December 2019 through January–June 2021 and decreased during July–December 2021 but remained approximately twice as high as during July–December 2019.

During July 2019–December 2021, among 2,231 adolescent overdose decedents in 47 jurisdictions with available data, more than two thirds (69.0%) were male, and a majority (59.9%) were non-Hispanic White persons (Table). Overall, 2,037 (91.3%) deaths involved at least one opioid; 1,871 (83.9%) involved IMFs, and 1,313 (58.9%) involved IMFs with no

*** 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.

FIGURE 1. Number of drug overdose deaths and deaths involving* illicitly manufactured fentanyls† among persons aged 10–19 years (N = 1,808), by month — State Unintentional Drug Overdose Reporting System, 32 jurisdictions,§ July 2019–December 2021¶



Abbreviations: IMF = illicitly manufactured fentanyl; SUDORS = State Unintentional Drug Overdose Reporting System.

* A drug was considered involved if it was listed as a cause of death on the death certificate or medical examiner or coroner report.

† Includes IMF and fentanyl analogs, which were identified using both toxicology and scene evidence because toxicology alone cannot distinguish between pharmaceutical fentanyl and IMFs.

§ Alaska, Arizona, Colorado, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Kansas, Kentucky, Maine, Massachusetts, Minnesota, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, and West Virginia. Illinois, Missouri, and Washington reported deaths from counties that accounted for ≥75% of drug overdose deaths in the state in 2017 per SUDORS funding requirements; all other jurisdictions reported deaths from the full jurisdiction. Jurisdictions reported deaths for all 6-month periods from July 2019 to December 2021.

¶ Overdose deaths were smoothed using locally weighted smoothing. The smoothing parameter with the lowest Akaike information criterion was used.

TABLE. Characteristics of drug overdose deaths among persons aged 10–19 years (N = 2,231; 47 jurisdictions*) and circumstances surrounding death (N = 1,871; 43 jurisdictions†) , by age group — State Unintentional Drug Overdose Reporting System, United States, July 2019–December 2021

Characteristic	Age group, yrs, no. (%)		
	10–14 (n = 89)	15–19 (n = 2,142)	Total (N = 2,231)
Sex			
Female	40 (44.9)	652 (30.4)	**692 (31.0)**
Male	49 (55.1)	1,490 (69.6)	**1,539 (69.0)**
Race and ethnicity§			
American Indian or Alaska Native, non-Hispanic	4 (4.5)	38 (1.8)	**42 (1.9)**
Asian or other Pacific Islander, non-Hispanic	1 (1.1)	26 (1.2)	**27 (1.2)**
Black or African American, non-Hispanic	26 (29.2)	268 (12.6)	**294 (13.3)**
Hispanic or Latino	12 (13.5)	462 (21.7)	**474 (21.4)**
White, non-Hispanic	43 (48.3)	1,285 (60.4)	**1,328 (59.9)**
Multiple races, non-Hispanic	3 (3.4)	49 (2.3)	**52 (2.3)**
Drugs involved¶			
Antidepressants	7 (7.9)	79 (3.7)	**86 (3.9)**
Benzodiazepines	5 (5.6)	324 (15.1)	**329 (14.7)**
Any opioids	71 (79.8)	1,966 (91.8)	**2,037 (91.3)**
Heroin**	5 (5.6)	122 (5.7)	**127 (5.7)**
IMFs††	56 (62.9)	1,815 (84.7)	**1,871 (83.9)**
Prescription opioids§§	15 (16.9)	202 (9.4)	**217 (9.7)**
Any stimulants	11 (12.4)	537 (25.1)	**548 (24.6)**
Cocaine	4 (4.5)	243 (11.3)	**247 (11.1)**
Methamphetamine	4 (4.5)	255 (11.9)	**259 (11.6)**
Combinations of opioids and stimulants involved			
IMFs and stimulants¶¶	7 (7.9)	410 (19.1)	**417 (18.7)**
IMFs with no other opioids or stimulants¶¶	43 (48.3)	1,270 (59.3)	**1,313 (58.9)**
Prescription opioids with no other opioids or stimulants¶¶	15 (16.9)	97 (4.5)	**112 (5.0)**
Neither opioids nor stimulants***	14 (15.7)	79 (3.7)	**93 (4.2)**
No. of decedents with data from coroner or medical examiner reports (43 jurisdictions)†	68	1,803	**1,871**
Evidence of overdose circumstances			
Overdosed at home§	45 (66.2)	1,045 (60.2)	**1,090 (60.4)**
Overdosed in house or apartment, not own home§	13 (19.1)	378 (21.8)	**391 (21.7)**
Potential bystander present†††	54 (79.4)	1,198 (66.4)	**1,252 (66.9)**
No documented overdose response by bystander§§§	35 (64.8)	814 (67.9)	**849 (67.8)**
Drug use witnessed	13 (19.1)	357 (19.8)	**370 (19.8)**
Naloxone administered§	20 (29.9)	543 (30.4)	**563 (30.3)**
Documentation of no pulse at first responder arrival§	38 (55.9)	1,051 (59.5)	**1,089 (59.4)**
Route of drug use¶¶¶			
Ingestion	19 (27.9)	427 (23.7)	**446 (23.8)**
Injection	0 (—)	146 (8.1)	**146 (7.8)**
Smoking	12 (17.6)	428 (23.7)	**440 (23.5)**
Snorting	10 (14.7)	421 (23.3)	**431 (23.0)**
No reported route of drug use	38 (55.9)	789 (43.8)	**827 (44.2)**
Evidence of counterfeit pills**	8 (11.8)	451 (25.0)	**459 (24.5)**
Evidence of drug use history and treatment			
Alcohol dependence or problem	3 (4.4)	175 (9.7)	**178 (9.5)**
Current treatment for substance use disorders	0 (—)	61 (3.4)	**61 (3.3)**
Ever treated for substance use disorders	1 (1.5)	203 (11.3)	**204 (10.9)**
History of opioid use	9 (13.2)	646 (35.8)	**655 (35.0)**
Previous nonfatal overdose	1 (1.5)	263 (14.6)	**264 (14.1)**

See table footnotes on the next page.

other opioids or stimulants. Approximately 10% of deaths involved prescription opioids, and 24.6% involved stimulants. Ninety-three (4.2%) deaths involved neither opioids nor stimulants.

Among 1,871 overdose deaths in 43 jurisdictions with available data on circumstances, 1,090 (60.4%) occurred at the decedent's home. Potential bystanders††† were present in 1,252 (66.9%) deaths, and 1,089 (59.4%) decedents had

††† For SUDORS, a potential bystander is defined as a person aged ≥11 years who was physically nearby either during or shortly preceding a drug overdose and potentially had an opportunity to intervene or respond to the overdose. This includes any persons in the same structure (e.g., same room or same building, but different room) as the decedent during that time; a family member who was in another room during the fatal incident would be considered a potential bystander if they might have had an opportunity to provide lifesaving measures (e.g., naloxone administration), if adequate resources were available, and if they were aware that an overdose event could occur. Persons in different self-contained parts of larger buildings (e.g., a different apartment in the same apartment building) would not be considered potential bystanders.

TABLE. (*Continued*) Characteristics of drug overdose deaths among persons aged 10–19 years (N = 2,231; 47 jurisdictions*) and circumstances surrounding death (N = 1,871; 43 jurisdictions†), by age group — State Unintentional Drug Overdose Reporting System, United States, July 2019–December 2021

Abbreviations: IMF = illicitly manufactured fentanyl; SUDORS = State Unintentional Drug Overdose Reporting System.

* Alabama, Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin. Alabama, Arkansas, Florida, Hawaii, Illinois, Indiana, Louisiana, Missouri, New York, and Washington reported deaths from counties that accounted for ≥75% of drug overdose deaths in the state in 2017, per SUDORS funding requirements; all other jurisdictions reported deaths from the full jurisdiction. Jurisdictions were included if data were available for at least one 6-month period (July–December 2019, January–June 2020, July–December 2020, January–June 2021, or July–December 2021).

† Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin. Arkansas, Florida, Hawaii, Illinois, Indiana, Louisiana, Missouri, and Washington reported deaths from counties that accounted for ≥75% of drug overdose deaths in the state in 2017, per SUDORS funding requirements; all other jurisdictions reported deaths from the full jurisdiction. Jurisdictions were included if data were available for at least one 6-month period (July–December 2019, January–June 2020, July–December 2020, January–June 2021, or July–December 2021) and coroner and medical examiner reports were available for ≥75% of deaths in the included period or periods. Analysis was restricted to decedents with an available coroner or medical examiner report.

§ Missing values were excluded from calculations of percentages. Percentages might not sum to 100% because of rounding.

¶ A drug was considered involved if it was listed as a cause of death on the death certificate or in the medical examiner or coroner report. Percentages sum to >100% because drug categories are not mutually exclusive.

** Drug entries coded as heroin were heroin and 6-acetylmorphine. In addition, morphine was coded as heroin if detected along with 6-acetylmorphine or if scene, toxicology, or witness evidence indicated presence of known heroin adulterants or impurities (including quinine, procaine, xylazine, noscapine, papaverine, thebaine, or acetylcodeine), injection, illicit drug use, or a history of heroin use.

†† Includes IMF and fentanyl analogs, which were identified using both toxicology and scene evidence because toxicology alone cannot distinguish between pharmaceutical fentanyl and IMFs.

§§ Drug entries coded as prescription opioids were alfentanil, buprenorphine, butorphanol, codeine, dextrorphan, dihydrocodeine, hydrocodone, hydromorphone, levorphanol, loperamide, meperidine, methadone, morphine, nalbuphine, noscapine, oxycodone, oxymorphone, pentazocine, prescription fentanyl, propoxyphene, sufentanil, tapentadol, and tramadol. Also included as prescription opioids were brand names and metabolites (e.g., nortramadol) of these drugs and combinations of these drugs and nonopioids (e.g., acetaminophen-oxycodone). Morphine was included as prescription only if scene or witness evidence did not indicate likely heroin use and if 6-acetylmorphine was not also detected. Fentanyl was coded as a prescription opioid based on scene, toxicology, or witness evidence.

¶¶ Deaths could have involved drugs other than opioids and stimulants (e.g., benzodiazepines).

*** Primarily includes deaths involving antidepressants, antihistamines, and benzodiazepines.

††† For SUDORS, a potential bystander is defined as a person aged ≥11 years who was physically nearby either during or shortly preceding a drug overdose and potentially had an opportunity to intervene or respond to the overdose. This includes any persons in the same structure (e.g., same room or same building, but different room) as the decedent during that time; a family member who was in another room during the fatal incident would be considered a potential bystander if they might have had an opportunity to provide lifesaving measures (e.g., naloxone administration), if adequate resources were available, and if they were aware that an overdose event could occur. Persons in different self-contained parts of larger buildings (e.g., a different apartment in the same apartment building) would not be considered potential bystanders.

§§§ Percentages are calculated among decedents with a potential bystander present.

¶¶¶ Evidence of injection, smoking, snorting, and ingestion are not mutually exclusive; a death could have evidence of more than one of these routes.

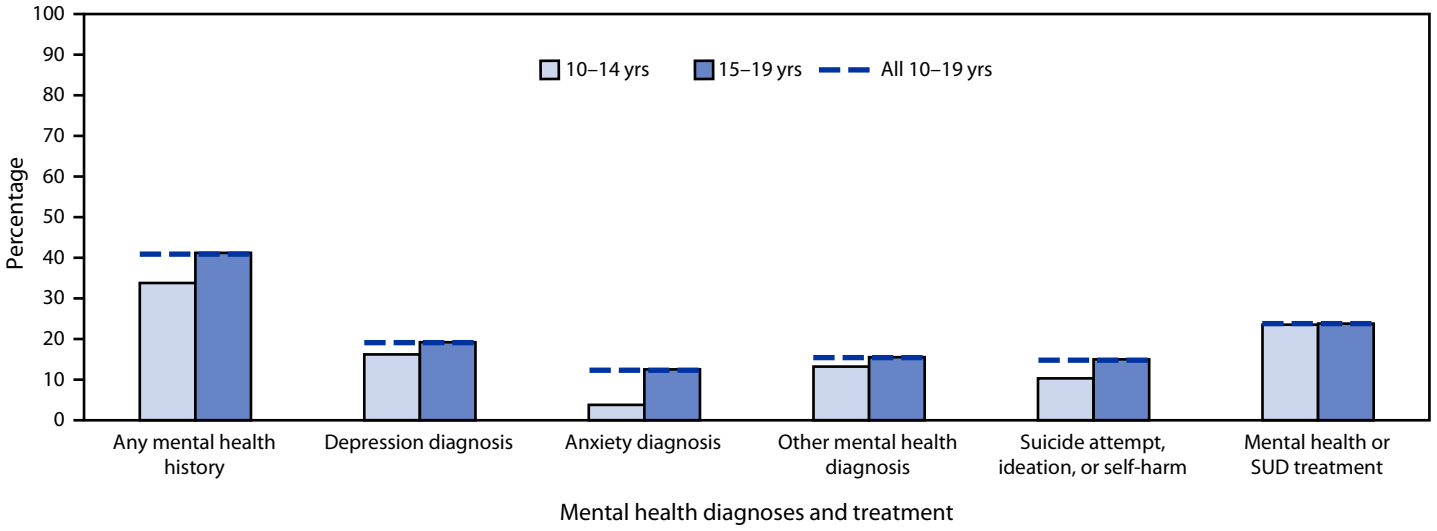
**** Evidence of counterfeit pills included evidence that potential counterfeit pills were found at the scene of the fatal overdose or were consumed by the decedent (according to witness report). Evidence consistent with counterfeit pills included unmarked pills; pills marked with M30 or otherwise appearing like oxycodone pills, with no oxycodone detected by postmortem toxicology testing; pills appearing like alprazolam pills, with no alprazolam detected; pills noted to be counterfeit or potentially counterfeit in the medical examiner or coroner report; pills noted to have contained fentanyl or tested positive for fentanyl; and evidence that the decedent ingested pills with no legitimate pharmaceutical drugs that come in pill form detected by postmortem toxicology testing. Detail regarding potential counterfeit pills in medical examiner or coroner reports varies widely, and certain evidence was likely included in error and certain evidence missed. Counterfeit pills could also possibly be on scene but not consumed by the decedent.

no pulse when first responders arrived. Among deaths with one or more potential bystanders present, no documented bystander response was reported for 849 (67.8%), primarily because of spatial separation from decedents (52.9%) and lack of awareness that decedents were using drugs (22.4%). Naloxone administration was documented in 563 (30.3%) deaths. Approximately one quarter of deaths had documentation of ingestion (23.8%), smoking (23.5%), and snorting (23.0%); evidence of injection was documented in 7.8% of deaths. Evidence of counterfeit pills was documented in 24.5% of adolescent deaths. Thirty-five percent of adolescent decedents had documented opioid use history, and 14.1% had evidence of a previous overdose; 10.9% had evidence of substance use disorder treatment, and 3.3% had evidence of current treatment. Approximately 41% of decedents had documented mental health history, including mental health treatment (23.8%), diagnosed depression (19.1%), or suicidal or self-harm behaviors (14.8%) (Figure 2).

Discussion

This report describes five main findings related to overdose deaths among adolescents (persons aged 10–19 years): 1) deaths have increased substantially since the end of 2019; 2) a majority of deaths involved IMFs; 3) nearly one quarter of deaths included evidence of counterfeit pills; 4) two thirds of decedents had a potential bystander present, although most provided no overdose response; and 5) approximately 41% of decedents had a history of mental health conditions or

FIGURE 2. Mental health conditions and treatment history of drug overdose decedents aged 10–19 years (N = 1,871), overall and by age group — State Unintentional Drug Overdose Reporting System, 43 jurisdictions,* July 2019–December 2021†,§



Abbreviations: SUD = substance use disorders; SUDORS = State Unintentional Drug Overdose Reporting System.

* Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin. Arkansas, Florida, Hawaii, Illinois, Indiana, Louisiana, Missouri, and Washington reported deaths from counties that accounted for ≥75% of drug overdose deaths in the state in 2017, per SUDORS funding requirements; all other jurisdictions reported deaths from the full jurisdiction. Jurisdictions were included if data were available for at least one 6-month period (July–December 2019, January–June 2020, July–December 2020, January–June 2021, or July–December 2021) and coroner and medical examiner reports were available for ≥75% of deaths in the included period or periods. Analysis was restricted to decedents with an available coroner and medical examiner report.

† Any mental health history includes at least one of the following: depression diagnosis; anxiety diagnosis; other mental health diagnosis; suicide attempt, ideation, or self-harm; or mental health or SUD treatment.

§ Diagnoses are not mutually exclusive.

treatment. Overdose prevention efforts promoting awareness of dangers of IMFs and aiming to treat underlying mental health and substance use disorders might help reduce adolescent overdose deaths.

From July–December 2019 to July–December 2021, median monthly overdose deaths among adolescents increased 109%. This increase occurred in the context of decreasing illicit drug use among adolescents during 2019–2020, suggesting that more potent drugs rather than increased use accounted for the increase (*2*). In 2021, among the general population, 73% of overdose deaths involved IMFs (*5*); among adolescents, a higher proportion (84%) involved IMFs, nearly all involved an opioid, and approximately 20% involved both IMFs and stimulants. Overdose prevention messaging aimed toward adolescents that highlights the dangers of IMFs and co-use of opioids and stimulants, and the expansion of naloxone access and training, are essential (*6*). Community-based coalitions, in collaboration with public health entities, can work with schools, physicians, youth-serving organizations, faith-based institutions, and the media to emphasize these messages, support naloxone training and access, and address stigma.§§§

Approximately 25% of adolescent deaths had evidence of counterfeit pills, which often mimic the appearance of oxycodone or alprazolam but frequently contain IMFs or other illicit drugs.¶¶¶ This percentage is likely underestimated because pills found at scenes were rarely noted as having been tested, and identifying pills as counterfeit based on appearance alone is challenging. The proliferation of counterfeit pills is particularly concerning for adolescents given marketing aimed toward this population and the availability of such pills via social media.****,†††† Whether adolescents intended to take legitimate pharmaceutical medications or were aware pills were counterfeit is unclear. Regardless, messages that highlight the potential presence of illicit drugs in pills and emphasize that pills should only be used if they are prescribed are important to include in prevention materials for adolescents. Local public health and safety officials should consider issuing warnings

§§§ https://www.cdc.gov/drugoverdose/featured-topics/drug-free-communities.html (Accessed November 4, 2022).

¶¶¶ https://www.dea.gov/alert/sharp-increase-fake-prescription-pills-containing-fentanyl-and-meth (Accessed November 4, 2022).

**** https://www.dea.gov/sites/default/files/2022-03/20220208-DEA_Social%20Media%20Drug%20Trafficking%20Threat%20Overview.pdf

†††† https://www.dea.gov/stories/2021/2021-07/2021-07-23/counterfeit-drugs-social-media

Summary

What is already known about this topic?

From 2019 to 2021, overdose deaths among persons aged 14–18 years increased.

What is added by this report?

Median monthly overdose deaths among persons aged 10–19 years (adolescents) increased 109% from July–December 2019 to July–December 2021; deaths involving illicitly manufactured fentanyls (IMFs) increased 182%. Approximately 90% of deaths involved opioids and 84% involved IMFs. Counterfeit pills were present in nearly 25% of deaths. Two thirds of decedents had one or more potential bystanders present, but most provided no overdose response. Approximately 41% of decedents had evidence of mental health conditions or treatment.

What are the implications for public health practice?

Educating adolescents about the dangers of IMFs and counterfeit pills, working with public safety to reduce availability of illicit drugs, and ensuring access to evidence-based substance use and mental health treatment could save lives.

regarding counterfeit pills and IMFs to schools, and parents and guardians.[§§§§]

Potential bystanders were present during two thirds of overdose deaths among adolescents; a majority of deaths occurred at home, where bystanders were often family or friends. However, bystanders responded infrequently to the overdose because they were spatially separated (e.g., in another room) or were not aware that the decedent used drugs. Although nearly all deaths involved opioids, just 35% of decedents had documented opioid use history, suggesting recent initiation or lack of awareness by family and friends. In addition, 30% of deaths had evidence that naloxone was administered, suggesting that naloxone might not have been administered soon enough or at a sufficient dosage, or its effectiveness was affected by polydrug use. Educating family and friends to recognize warning signs of drug use, effectively respond to overdose, and monitor adolescents exhibiting risk behaviors associated with drug use might improve bystander response and prevent deaths. Educating adolescents on mitigating practices can also be beneficial, including emphasis on not initiating drug use, not using drugs while alone, using fentanyl test strips,[¶¶¶¶] and having naloxone readily available for rapid use.

Approximately 41% of decedents had evidence of mental health conditions or treatment; mental health conditions are known risk factors for substance use (*7*). Adolescent mental health was declared a national emergency in 2021 by multiple professional organizations,[*****] and approximately one third of adolescents reported poor mental health during the COVID-19 pandemic (*8*). Coinciding with the pandemic's onset, overdose deaths among adolescents continued to increase during January–June 2020, possibly related to declining mental health. Known mental health conditions represent important opportunities for parents, guardians, clinicians, teachers, or other care providers to prevent initiation or recognize signs of substance use (*7*). Protective factors for substance use in adolescents include family engagement, parent and guardian disapproval of substance use, and school connectedness; promoting these might help prevent overdoses (*7*). In addition, implementing programs to prevent adverse childhood experiences that predispose adolescents to risk for substance use should be considered.[†††††] Among decedents, substance use disorder treatment was rare. Effective substance use disorder treatments for adolescents include psychosocial treatments, such as family-based and cognitive behavioral therapy (*9*) and medications for opioid use disorder (*10*). Given the potential for co-occurring mental health conditions and substance use disorders, integrated treatment approaches might reduce overdose risk (*9*,*10*).

The findings in this report are subject to at least three limitations. First, analyses included 32 to 47 jurisdictions; results might not be generalizable to the entire United States or to other jurisdictions. Second, toxicology testing might differ over time and across jurisdictions; thus, emerging drugs, including new IMFs, might not have been identified. Finally, circumstances surrounding overdose deaths are likely underascertained because of limited investigative information.

Drug overdose deaths among adolescents increased substantially beginning in late 2019. Although deaths appear to have begun declining in late 2021, they are still alarmingly higher than in 2019. Urgent efforts to prevent overdose deaths among adolescents are needed and include 1) preventing substance use initiation and promoting protective factors; 2) strengthening partnerships between public health and public safety to reduce availability of illicit drugs; 3) expanding efforts focused on resilience and connectedness of adolescents to help prevent substance misuse and related harms; 4) educating about dangers of IMFs and counterfeit pills; 5) promoting safer drug use for those who use drugs, such as not using drugs while alone and having naloxone readily available; 6) expanding naloxone access and training family and friends in overdose

[§§§§] https://www.dea.gov/sites/default/files/2022-09/DEA-OPCK_Parent%20flyer_V6.pdf

[¶¶¶¶] https://www.cdc.gov/stopoverdose/fentanyl/fentanyl-test-strips.html

[*****] https://www.aap.org/en/advocacy/child-and-adolescent-healthy-mental-development/aap-aacap-cha-declaration-of-a-national-emergency-in-child-and-adolescent-mental-health/?_ga = 2.148070580.226118470.1666026568-1362783567.1666026568 (Accessed November 4, 2022).

[†††††] https://www.cdc.gov/violenceprevention/pdf/preventingACES.pdf

recognition and response; and 7) ensuring access to effective, evidence-based substance use disorder and mental health treatment. Collaboration among public health and safety agencies, physicians, mental health and substance use treatment providers, and educators to implement these efforts could save lives.

Acknowledgments

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COVID-19 and Other Underlying Causes of Cancer Deaths — United States, January 2018–July 2022

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Cancer survivors (persons who have received a diagnosis of cancer, from the time of diagnosis throughout their lifespan)* have increased risk for severe COVID-19 illness and mortality (*1*). This report describes characteristics of deaths reported to CDC's National Vital Statistics System (NVSS), for which cancer was listed as the underlying or a contributing cause (cancer deaths) during January 1, 2018–July 2, 2022. The underlying causes of death, including cancer and COVID-19, were examined by week, age, sex, race and ethnicity, and cancer type. Among an average of approximately 13,000 weekly cancer deaths, the percentage with cancer as the underlying cause was 90% in 2018 and 2019, 88% in 2020, and 87% in 2021. The percentage of cancer deaths with COVID-19 as the underlying cause differed by time (2.0% overall in 2020 and 2.4% in 2021, ranging from 0.2% to 7.2% by week), with higher percentages during peaks in the COVID-19 pandemic. The percentage of cancer deaths with COVID-19 as the underlying cause also differed by the characteristics examined, with higher percentages observed in 2021 among persons aged ≥65 years (2.4% among persons aged 65–74 years, 2.6% among persons aged 75–84 years, and 2.4% among persons aged ≥85 years); males (2.6%); persons categorized as non-Hispanic American Indian or Alaska Native (AI/AN) (3.4%), Hispanic or Latino (Hispanic) (3.2%), or non-Hispanic Black or African American (Black) (2.5%); and persons with hematologic cancers, including leukemia (7.4%), lymphoma (7.3%), and myeloma (5.8%). This report found differences by age, sex, race and ethnicity, and cancer type in the percentage of cancer deaths with COVID-19 as the underlying cause. These results might guide multicomponent COVID-19 prevention interventions and ongoing, cross-cutting efforts to reduce health disparities and address structural and social determinants of health among cancer survivors, which might help protect those at disproportionate and increased risk for death from COVID-19.

Final mortality data for 2018–2020 and provisional mortality data for 2021–2022, reported to NVSS as of September 4, 2022, were used to assess deaths occurring among U.S. residents in the 50 states and District of Columbia during January 1, 2018–July 2, 2022.† The underlying cause of death and any contributing causes were coded according to the *International Classification of Diseases, Tenth Revision* (ICD-10) (*2*). A single underlying cause of death is listed on the death certificate as the disease or injury initiating the chain of morbid events leading directly to death. Other diseases or conditions might be listed as contributing causes of death if they increased susceptibility to or exacerbated an existing disease or contributed to death in some way but did not initiate the chain of events leading to death.§ Cancer deaths were defined as those with malignant neoplasm (ICD-10 codes C00–C97) listed as either the underlying or a contributing cause of death. The weekly numbers of cancer deaths, and their underlying causes, were tabulated.¶ The percentages (and 95% Wilson CIs) of cancer deaths with cancer or COVID-19 as the underlying cause of death were examined by year, age, sex, race and ethnicity, and cancer type.** This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.††

On average, approximately 13,000 deaths each week listed cancer as an underlying or contributing cause (range = 12,221–14,845) during January 7, 2018–July 2, 2022, with peaks occurring in January 2021 (14,284) and January 2022 (14,845) (Figure 1) (Supplementary Table, https://stacks.cdc.gov/view/cdc/122581). Approximately 11,500 cancer deaths with cancer as the underlying cause occurred each week during this period, ranging from 10,891 in June 2020 to 12,408 in January 2018. From 2018 to 2021, the annual number of cancer deaths increased 4.7%, and the number with cancer as the underlying cause increased 1.0%. During 2020–2022, the weekly number of cancer deaths with COVID-19 as the underlying cause ranged from 28 to 1,055, peaking in January 2021 (953) and January 2022 (1,055). The weekly number of cancer deaths with COVID-19 as a

* https://www.cdc.gov/cancer/ncccp/priorities/cancer-survivor-caregiver.htm

† NVSS final and provisional mortality data are available at https://wonder.cdc.gov. Data were obtained from the CDC WONDER Provisional Multiple Cause of Death data file based on records received and processed as of September 4, 2022.

§ https://www.cdc.gov/nchs/nvss/revisions-of-the-us-standard-certificates-and-reports.htm; https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg03-508.pdf; https://www.cdc.gov/nchs/pressroom/podcasts/2022/20220107/20220107.htm

¶ Underlying cause of death was coded as follows by using ICD-10: malignant neoplasms (cancer) (ICD-10 codes C00–C97); diseases of the circulatory system (I00–I99), including heart disease and stroke; mental and behavioral disorders and diseases of the nervous system (F00–G99), including Alzheimer disease; endocrine, nutritional, metabolic, and digestive system diseases (E00–E99 and K00–K99), including diabetes and cirrhosis; diseases of the respiratory system (J00–J99), including chronic obstructive pulmonary disease, influenza, and pneumonia; confirmed or presumed COVID-19 (U07.1); and all other causes.

** Race and ethnicity were reported separately on the death certificate and combined for this analysis. https://wonder.cdc.gov/wonder/help/mcd-provisional.html#Racial%20Differences

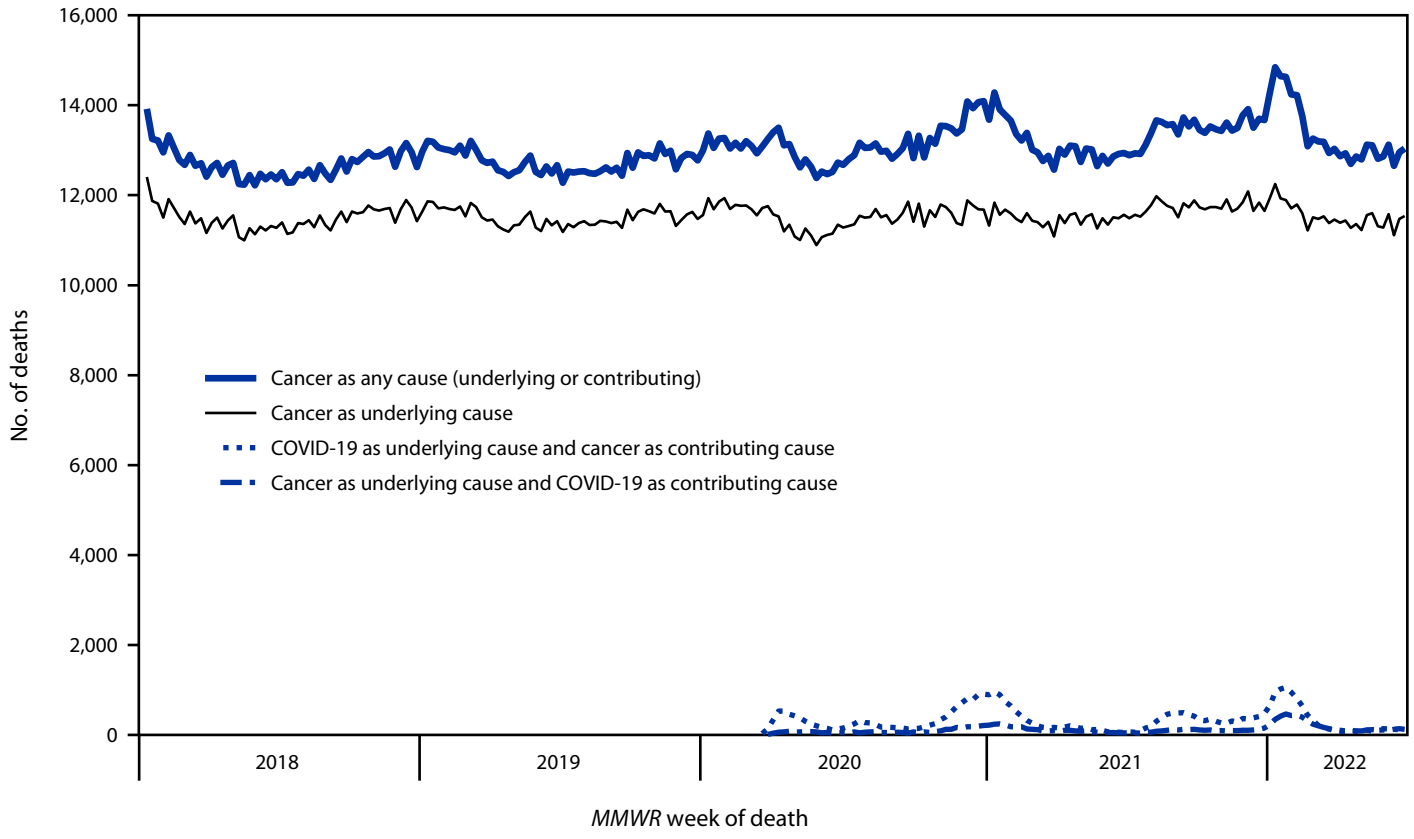
†† 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

contributing cause ranged from 10 to 463 during 2020–2022 and was highest in January 2021 (242) and January 2022 (463).

Among cancer deaths, the percentage with cancer as the underlying cause was 90% in 2018 and 2019 (weekly range = 89%–91%), 88% (83%–90%) in 2020, and 87% (83%–89%) in 2021 (Table); during the first half of 2022, this percentage ranged from 81% to 89%. Among deaths with cancer as a contributing cause, common noncancer underlying causes included diseases of the circulatory system, including heart disease and stroke; mental and behavioral disorders and diseases of the nervous system, including Alzheimer disease; endocrine, nutritional, metabolic, and digestive system diseases, including diabetes and cirrhosis; diseases of the respiratory system, including chronic obstructive pulmonary disease, influenza, and pneumonia; and COVID-19 (Figure 2). During November 22, 2020–February 6, 2021, and January 9–February 19, 2022, the number of cancer deaths with COVID-19 as underlying cause exceeded the number for any other underlying cause, except cancer. The percentage of cancer deaths with COVID-19 as the underlying cause was 2.0% in 2020 (weekly range = 0.2%–6.4%) and 2.4% in 2021 (range = 0.4%–6.7%) (Table); during the first half of 2022, this percentage ranged from 1.0% to 7.2%.

The percentage of cancer deaths with COVID-19 as the underlying cause differed by demographic characteristics and type of malignancy. In 2021, a higher percentage of cancer deaths with COVID-19 as the underlying cause occurred among males (2.6%) than females (2.1%); persons aged ≥65 years (2.4% among persons aged 65–74 years, 2.6% among persons aged 75–84 years, and 2.4% among persons aged ≥85 years) than among those aged 15–64 years (ranging from 1.5% to 2.1% by age group); and AI/AN persons (3.4%), Hispanic persons (3.2%), and Black persons (2.5%) compared with a range from 1.5% to 2.3% among persons of other racial and ethnic groups. A higher percentage of hematologic cancer deaths had COVID-19 as the underlying cause (7.4%

FIGURE 1. Number* of cancer deaths† with cancer or COVID-19§ as underlying or contributing cause of death, by *MMWR* week of death — United States, January 7, 2018–July 2, 2022



Abbreviation: ICD-10 = *International Classification of Diseases, Tenth Revision*.

* National Vital Statistics System data for 2018–2020 are final. Provisional data for 2021 and 2022 are incomplete. These data exclude deaths that occurred in the United States among residents of U.S. territories and foreign countries. Based on records received and processed as of September 4, 2022.

† Deaths with malignant neoplasm (cancer), coded to ICD-10 codes C00–C97, as an underlying or contributing cause of death.

§ Deaths with confirmed or presumed COVID-19, coded to ICD-10 code U07.1.

TABLE. Number* of cancer deaths† and percentage of these deaths with cancer§ or COVID-19¶ as underlying cause of death, by year, sex, age group, race and ethnicity, and cancer type — United States, 2018–2021

	No. of deaths				% of deaths (95% CI)					
	Cancer as underlying or contributing cause				Cancer as underlying cause				COVID-19 as underlying cause and cancer as contributing cause	
Characteristic	2018**	2019	2020	2021	2018††	2019	2020	2021	2020§§	2021
Overall	**662,636**	**664,763**	**685,859**	**693,782**	**90 (90–91)**	**90 (90–90)**	**88 (88–88)**	**87 (87–87)**	**2.0 (1.9–2.0)**	**2.4 (2.3–2.4)**
Sex										
Female	310,566	310,857	319,595	323,598	91 (91–91)	91 (91–91)	89 (89–89)	89 (88–89)	1.7 (1.7–1.8)	2.1 (2.1–2.2)
Male	352,070	353,906	366,264	370,184	90 (90–90)	89 (89–89)	87 (87–87)	86 (86–86)	2.2 (2.1–2.2)	2.6 (2.6–2.7)
Age group, yrs										
<1	55	59	62	59	93 (83–97)	93 (84–97)	87 (77–93)	88 (77–94)	—¶¶	—
1–4	344	306	325	300	95 (92–97)	93 (90–95)	94 (91–96)	94 (91–96)	—	—
5–14	897	817	836	843	94 (92–95)	95 (93–96)	95 (93–96)	94 (93–96)	—	—
15–24	1,455	1,474	1,385	1,430	94 (93–95)	94 (93–95)	94 (93–95)	93 (91–94)	1.4 (1.0–2.2)	1.5 (1.0–2.3)
25–34	3,907	3,812	3,858	3,936	94 (94–95)	94 (93–95)	93 (92–93)	92 (91–93)	1.1 (0.8–1.4)	1.9 (1.5–2.3)
35–44	11,161	11,269	11,476	12,034	95 (95–96)	95 (94–95)	93 (93–94)	93 (93–93)	1.3 (1.1–1.5)	1.7 (1.4–1.9)
45–54	39,187	37,351	36,938	36,289	95 (95–95)	95 (95–95)	94 (93–94)	92 (92–93)	1.2 (1.1–1.3)	2.1 (1.9–2.2)
55–64	121,157	119,048	119,738	118,602	94 (94–94)	94 (94–94)	92 (92–92)	91 (91–91)	1.3 (1.3–1.4)	2.1 (2.0–2.2)
65–74	183,456	186,016	195,426	201,367	92 (92–92)	92 (92–92)	90 (90–90)	89 (89–89)	1.8 (1.8–1.9)	2.4 (2.4–2.5)
75–84	177,829	180,146	188,349	191,954	89 (89–89)	89 (89–89)	86 (86–87)	86 (86–86)	2.2 (2.2–2.3)	2.6 (2.5–2.7)
≥85	123,176	124,452	127,462	126,958	84 (84–84)	83 (83–84)	80 (80–81)	81 (80–81)	2.7 (2.6–2.8)	2.4 (2.3–2.5)
Race and ethnicity* **										
AI/AN, NH	3,304	3,323	3,575	3,708	90 (89–91)	90 (89–91)	85 (84–87)	85 (84–86)	3.3 (2.7–4.0)	3.4 (2.9–4.1)
Asian, NH	18,513	19,113	20,320	21,385	93 (93–93)	93 (92–93)	90 (90–90)	90 (90–91)	1.8 (1.6–2.0)	2.0 (1.8–2.2)
Black or African American, NH	76,389	77,312	80,592	79,983	91 (91–91)	91 (91–91)	88 (87–88)	88 (87–88)	2.6 (2.5–2.7)	2.5 (2.4–2.6)
Hispanic or Latino	45,562	46,876	49,708	51,451	92 (92–93)	92 (92–92)	88 (88–89)	89 (88–89)	3.4 (3.2–3.6)	3.2 (3.0–3.4)
NH/OPI, NH	773	809	868	928	93 (91–94)	93 (91–95)	89 (87–91)	91 (88–92)	2.1 (1.3–3.3)	1.5 (0.8–2.6)
White, NH	513,965	513,319	526,665	532,025	90 (90–90)	90 (90–90)	88 (88–88)	87 (87–87)	1.7 (1.7–1.7)	2.3 (2.2–2.3)
Multiracial, NH	2,693	2,761	2,884	3,034	91 (90–92)	91 (90–92)	89 (88–90)	89 (88–90)	1.4 (1.0–1.9)	2.3 (1.8–2.9)
Cancer type (ICD-10 code)										
Bladder (C67)	21,443	21,868	22,644	22,933	85 (84–85)	84 (84–85)	81 (81–82)	81 (81–82)	2.3 (2.1–2.5)	2.4 (2.2–2.6)
Breast (C50)	52,571	52,938	55,068	55,660	86 (86–86)	85 (85–86)	82 (82–83)	82 (81–82)	2.6 (2.4–2.7)	2.8 (2.7–3.0)
Cervix uteri (C53)	4,688	4,687	4,922	5,088	93 (92–93)	93 (92–94)	91 (91–92)	90 (89–91)	0.7 (0.5–0.9)	1.4 (1.1–1.8)
Colon, rectum, and anus (C18–C21)	61,234	61,175	62,803	64,003	90 (90–90)	90 (90–91)	88 (88–88)	88 (88–89)	1.7 (1.6–1.8)	1.9 (1.8–2.0)
Corpus uteri and uterus, part unspecified (C54–C55)	12,706	13,035	13,919	14,214	93 (92–93)	93 (93–93)	91 (90–91)	90 (90–91)	1.4 (1.2–1.6)	1.3 (1.1–1.5)
Esophagus (C15)	16,867	17,480	17,432	17,634	94 (94–94)	94 (94–94)	93 (92–93)	92 (92–93)	1.0 (0.9–1.2)	1.2 (1.0–1.3)
Hematologic cancers (C81–C96)	70,368	70,594	75,577	77,437	86 (86–86)	86 (86–86)	81 (81–81)	78 (78–79)	4.5 (4.4–4.7)	7.0 (6.9–7.2)
Hodgkin disease (C81)	1,508	1,446	1,592	1,636	79 (77–81)	78 (75–80)	75 (73–77)	71 (69–73)	3.0 (2.3–4.0)	6.4 (5.2–7.7)
Kidney and renal pelvis (C64–C65)	16,918	16,919	18,007	17,925	89 (89–90)	89 (88–89)	86 (86–87)	85 (84–85)	2.1 (1.9–2.3)	2.5 (2.3–2.7)
Larynx (C32)	4,885	4,949	5,077	5,212	85 (84–86)	85 (84–86)	82 (81–83)	82 (81–83)	1.9 (1.5–2.3)	2.4 (2.0–2.8)
Leukemia (C91–C95)	28,817	28,777	31,177	31,882	86 (86–87)	86 (86–86)	81 (80–81)	78 (78–79)	5.0 (4.7–5.2)	7.4 (7.1–7.7)
Lip, oral cavity, and pharynx (C00–C14)	12,391	12,793	13,447	14,351	89 (88–89)	89 (89–90)	87 (86–88)	86 (86–87)	1.4 (1.2–1.6)	1.4 (1.3–1.7)
Liver and intrahepatic bile ducts (C22)	30,481	30,898	31,660	32,359	93 (93–93)	93 (92–93)	92 (91–92)	91 (91–92)	1.0 (0.9–1.1)	1.0 (0.9–1.1)
Malignant melanoma of skin (C43)	9,621	9,548	9,906	10,085	89 (89–90)	89 (89–90)	87 (87–88)	86 (86–87)	1.5 (1.3–1.7)	1.8 (1.6–2.1)
Meninges, brain, and other CNS (C70–C72)	17,972	18,084	19,073	18,934	97 (97–97)	97 (97–97)	96 (96–96)	96 (96–96)	0.9 (0.8–1.0)	0.9 (0.7–1.0)
Multiple myeloma and immunoproliferative neoplasms (C88 and C90)	15,542	15,842	16,867	17,024	86 (86–87)	86 (85–86)	81 (81–82)	80 (80–81)	4.7 (4.4–5.1)	5.8 (5.5–6.2)
Non-Hodgkin lymphoma (C82–C85)	25,448	25,490	26,964	27,915	86 (86–86)	86 (86–86)	82 (81–82)	78 (78–79)	3.9 (3.7–4.2)	7.3 (7.0–7.6)
Ovary (C56)	14,943	14,620	14,862	14,859	95 (95–95)	95 (95–96)	94 (94–94)	94 (93–94)	0.9 (0.7–1.0)	1.0 (0.8–1.2)
Pancreas (C25)	47,245	48,250	49,690	50,922	97 (97–97)	97 (97–97)	96 (96–96)	96 (96–96)	0.5 (0.5–0.6)	0.6 (0.5–0.7)
Prostate (C61)	43,442	44,395	48,501	48,472	79 (79–80)	78 (78–79)	74 (74–75)	74 (74–75)	3.8 (3.6–4.0)	3.6 (3.4–3.8)
Stomach (C16)	12,016	12,030	12,377	12,135	95 (94–95)	95 (95–96)	93 (93–94)	93 (93–94)	1.1 (0.9–1.3)	1.2 (1.0–1.4)
Trachea, bronchus, and lung (C33–C34)	153,078	150,898	150,053	149,224	94 (94–94)	94 (93–94)	92 (92–92)	91 (91–92)	1.5 (1.5–1.6)	1.8 (1.8–1.9)

See table footnotes on the next page.

TABLE. (*Continued*) Number* of cancer deaths† and percentage of these deaths with cancer§ or COVID-19¶ as underlying cause of death, by year, sex, age group, race and ethnicity, and cancer type — United States, 2018–2021

Abbreviation: AI/AN = American Indian or Alaska Native; CNS = central nervous system; ICD-10 = *International Classification of Diseases, Tenth Revision*; NH = non-Hispanic; NH/OPI = Native Hawaiian or other Pacific Islander.

* National Vital Statistics System data for 2019–2020 are final. Provisional data for 2021 are incomplete. These data exclude deaths that occurred in the United States among residents of U.S. territories and foreign countries. Based on records received and processed as of September 4, 2022.

† Deaths with malignant neoplasm (cancer), coded to ICD-10 codes C00–C97, as an underlying or contributing cause of death.

§ Deaths with cancer, coded to ICD-10 codes C00–C97, as an underlying cause of death.

¶ Deaths with cancer, coded to ICD-10 codes C00–C97, as a contributing cause of death and confirmed or presumed COVID-19, coded to ICD-10 code U07.1, as an underlying cause of death.

** The overall weekly range of cancer deaths was 12,221–13,923 during 2018; 12,280–13,212 during 2019; 12,381–14,090 during 2020; and 12,569–14,284 during 2021.

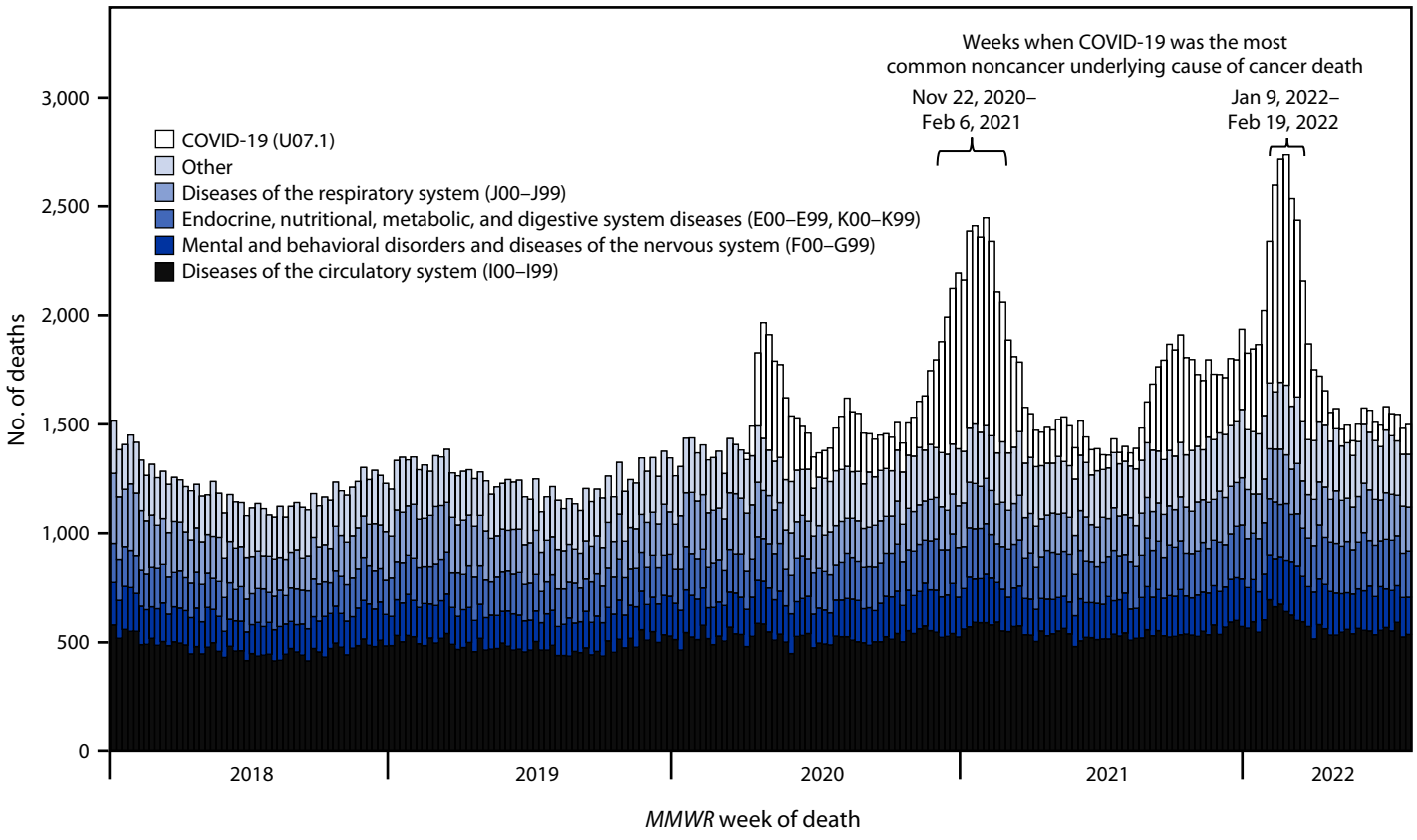
†† The overall weekly range of percentage of deaths with cancer as underlying cause was 89%–91% during 2018, 89%–91% during 2019, 83%–90% during 2020, and 83%–89% during 2021.

§§ The overall weekly range of percentage of deaths with COVID-19 as underlying cause and cancer as contributing cause was 0.2%–6.4% during 2020, and 0.4%–6.7% during 2021.

¶¶ Percentages are not reported for cells with <20 deaths.

*** Race and ethnicity were reported separately on the death certificate and combined for this analysis. Hispanic or Latino persons could be of any race. Deaths of persons with Hispanic or Latino ethnicity "Not Stated" were included in overall counts but were not included in specific racial and ethnic group counts. https://wonder.cdc.gov/wonder/help/mcd-provisional.html#Racial%20Differences

FIGURE 2. Number* of deaths with cancer as a contributing cause of death,† by noncancer underlying cause of death§ and *MMWR* week of death — United States, January 7, 2018–July 2, 2022



Abbreviation: ICD-10 = *International Classification of Diseases, Tenth Revision*.

* National Vital Statistics System data for 2018–2020 are final. Provisional data for 2021 and 2022 are incomplete. These data exclude deaths that occurred in the United States among residents of U.S. territories and foreign countries. Based on records received and processed as of September 4, 2022.

† Deaths with malignant neoplasm (cancer), coded to ICD-10 codes C00–C97, as a contributing cause of death.

§ Deaths with cancer as a contributing cause of death and the underlying cause of death attributed to other diseases or conditions, including diseases of the circulatory system (ICD-10 codes I00–I99), including heart disease and stroke; mental and behavioral disorders and diseases of the nervous system (F00–G99), including Alzheimer disease; endocrine, nutritional, metabolic, and digestive system diseases (E00–E99, K00–K99), including diabetes and cirrhosis; diseases of the respiratory system (J00–J99), including chronic obstructive pulmonary disease, influenza, and pneumonia; confirmed or presumed COVID-19 (U07.1); and all other causes. Together, these deaths accounted for <20% of all cancer deaths (weekly range = 9%–19%).

of leukemia, 7.3% of non-Hodgkin lymphoma, and 5.8% of myeloma deaths) compared with 0.6% of pancreatic cancer deaths, 2.8% of breast cancer deaths, and 3.6% of prostate cancer deaths.

Discussion

Cancer was one of the first conditions to be linked with increased risk for severe COVID-19 morbidity and mortality (*1*). This report showed that the number of cancer deaths with cancer as the underlying cause increased slightly from 2018 to 2021, but relatively less than the increase in the number of deaths from cancer as any cause of death, indicating that an excess number of persons with cancer died from COVID-19 and other diseases. The number of cancer deaths that were due to noncancer underlying conditions was highest during winter months in 2021 and 2022, which correspond to peaks in COVID-19 infection.[§§] Whereas many of these cancer deaths listed COVID-19 as the underlying cause, other cancer deaths during this time might have had underlying conditions (e.g., heart disease) exacerbated by unreported COVID-19 illness or underlying conditions (e.g., drug overdose or cirrhosis) exacerbated by changes in health behaviors during the pandemic (*3*).

Some persons might be moderately or severely immunocompromised because of their cancer or cancer treatment, such as active treatment for solid tumors or blood cancers or high-dose corticosteroids or other drugs that suppress the immune system.[¶¶] Because hematologic cancers develop in the immune system, persons living with these cancers tend to have weakened immune systems and might be particularly susceptible to COVID-19 infection and disease progression (*4*). This report found that a disproportionately high percentage of persons with leukemia, lymphoma, myeloma, and other hematologic cancers died from COVID-19.

Up-to-date COVID-19 vaccination reduces the risk of severe COVID-19 illness (*5*). Additional doses in the primary series and boosters are generally recommended for persons who are moderately or severely immunocompromised.[***] Health care providers can inform their cancer patients about the recommended COVID-19 vaccination series and the timing of COVID-19 vaccination administration relative to their cancer treatment (*6*). Up-to-date COVID-19 vaccination for close contacts has been shown to protect cancer patients from infection (*7*). Other interventions, such as mask use, physical distancing, good hand hygiene, and adequate indoor ventilation, are shown to prevent infection.[†††] Some cancer patients might benefit from monoclonal antibodies as preexposure prophylaxis or from anti–SARS-CoV-2 therapies such as Paxlovid and molnupiravir (*7*).

This report found a disproportionately high percentage of cancer deaths with COVID-19 as the underlying cause among Hispanic, AI/AN, and Black persons compared with the percentage in other racial and ethnic groups. Similar disparities have been observed for COVID-19 mortality (*8*) as well as cancer mortality (*9*). Health inequities are driven, in part, by structural racism, discrimination, stigma, and longstanding disenfranchisement (*10*). CDC is collaborating with local, state, tribal, and national partners to address environmental, place-based, occupational, policy, and systemic factors that affect health outcomes.[§§§] For example, national cancer programs funded by CDC are required to include activities to identify drivers of cancer health disparities and address inequities in populations disproportionately affected by the increased risk for cancer or by the lack of adequate health care options for prevention or treatment.[¶¶¶] Disproportionately affected populations can be defined by sex, race, religion, ethnicity, culture, disability, sexual orientation, gender identity, geographic location, socioeconomic status, insurance status, literacy level, or the intersection of several of these factors that collectively affect health outcomes.

Summary

What is already known about this topic?

Persons with cancer are at increased risk for dying from COVID-19.

What is added by this report?

Among persons who died with cancer, 2.0% in 2020 and 2.4% in 2021 had COVID-19 listed as the underlying cause of death, with higher percentages during COVID-19 peaks and among persons who were older, male, Hispanic or Latino, non-Hispanic American Indian or Alaska Native, non-Hispanic Black or African American, or living with leukemia, lymphoma, or myeloma.

What are the implications for public health practice?

These results might guide COVID-19 prevention interventions and efforts focusing on reducing health disparities and addressing structural and social determinants of health among cancer survivors, which might help protect those at disproportionately increased risk for dying from COVID-19.

[§§] https://covid.cdc.gov/covid-data-tracker/?CDC_AA_refVal%20=%20https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fcases-updates%2Fcases-in-us.html#trends_weeklycases_select_00

[¶¶] https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html

[***] https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/immuno.html

[†††] https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html

[§§§] https://www.cdc.gov/healthequity/core/index.html; https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/index.html

[¶¶¶] https://www.cdc.gov/media/releases/2022/p0608-cancer-award.html; https://www.cdc.gov/cancer/health-equity/

The findings in this report are subject to at least three limitations. First, 2021 and 2022 data are provisional, and numbers might change as additional information is received. Second, ethnicity, race, or both might have been inaccurately recorded on death certificates,**** which might result in under- or overestimates of death counts in some groups. Finally, information about cancer diagnosis that might be related to prognosis, such as date of diagnosis, screening status, treatment status, or barriers to cancer care, was not available in the death certificate; some cancer survivors might have been in treatment when they died, whereas others might have had a remote history of cancer.

This report found disproportionately higher percentage of cancer deaths with COVID-19 as the underlying cause of death among persons who were older; male; categorized as Hispanic, AI/AN, and Black; or living with certain cancers, such as leukemia, lymphoma, and myeloma. These results could guide multicomponent COVID-19 prevention interventions and ongoing, cross-cutting efforts to reduce health disparities and address structural and social determinants of health among cancer survivors, which might help protect those at disproportionately increased risk for dying from COVID-19.

**** https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf

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Prevalence of SARS-CoV-2 and Influenza Coinfection and Clinical Characteristics Among Children and Adolescents Aged <18 Years Who Were Hospitalized or Died with Influenza — United States, 2021–22 Influenza Season

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The 2022–23 influenza season shows an early rise in pediatric influenza-associated hospitalizations (*1*). SARS-CoV-2 viruses also continue to circulate (*2*). The current influenza season is the first with substantial co-circulation of influenza viruses and SARS-CoV-2 (*3*). Although both seasonal influenza viruses and SARS-CoV-2 can contribute to substantial pediatric morbidity (*3*–*5*), whether coinfection increases disease severity compared with that associated with infection with one virus alone is unknown. This report describes characteristics and prevalence of laboratory-confirmed influenza virus and SARS-CoV-2 coinfections among patients aged <18 years who had been hospitalized or died with influenza as reported to three CDC surveillance platforms during the 2021–22 influenza season. Data from two Respiratory Virus Hospitalizations Surveillance Network (RESP-NET) platforms (October 1, 2021–April 30, 2022),[§] and notifiable pediatric deaths associated[¶] with influenza virus and SARS-CoV-2 coinfection (October 3, 2021–October 1, 2022)[**] were analyzed. SARS-CoV-2 coinfections occurred in 6% (32 of 575) of pediatric influenza-associated hospitalizations and in 16% (seven of 44) of pediatric influenza-associated deaths. Compared with patients without coinfection, a higher proportion of those hospitalized with coinfection received invasive mechanical ventilation (4% versus 13%; p = 0.03) and bilevel positive airway pressure or continuous positive airway pressure (BiPAP/CPAP) (6% versus 16%; p = 0.05). Among seven coinfected patients who died, none had completed influenza vaccination, and only one received influenza antivirals.[††] To help prevent severe outcomes, clinicians should follow recommended respiratory virus testing algorithms to guide treatment decisions and consider early antiviral treatment initiation for pediatric patients with suspected or confirmed influenza, including those with SARS-CoV-2 coinfection who are hospitalized or at increased risk for severe illness. The public and parents should adopt prevention strategies including considering wearing well-fitted, high-quality masks when respiratory virus circulation is high and staying up-to-date with recommended influenza and COVID-19 vaccinations for persons aged ≥6 months.

CDC collects data on influenza-associated hospitalizations through the Influenza Hospitalization Surveillance Network (FluSurv-NET), a population-based RESP-NET system that includes more than 250 acute care hospitals.[§§] Since March 2020, CDC has also collected data on COVID-19–associated hospitalizations through another RESP-NET platform, the COVID-19–associated Hospitalization Surveillance Network (COVID-NET). Influenza and SARS-CoV-2 testing[¶¶] is driven by clinician decisions or hospital testing policies, with laboratory, clinical, and notifiable disease database sources used to identify patients.[***] A FluSurv-NET patient was defined as a person who 1) was a resident of the surveillance catchment area, 2) had a hospital admission during October 1, 2021–April 30, 2022, and 3) had a positive influenza test result within 14 days before or anytime during hospitalization. Coinfected patients were those who met the FluSurv-NET definition and who also 1) had laboratory-confirmed influenza and SARS-CoV-2 infections during the same hospitalization,

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† These senior authors contributed equally to this report.
§ Data from FluSurv-NET beyond April 30, 2022, did not include variables required to determine influenza and SARS-CoV-2 coinfection status.
¶ https://www.cdc.gov/flu/weekly/overview.htm#PediatricMortality
** The 2021–22 influenza season was defined as *MMWR* week 40 of 2021 through *MMWR* week 39 of 2022 (October 3, 2021–October 1, 2022). https://ndc.services.cdc.gov/wp-content/uploads/MMWR_Week_overview.pdf
†† Receipt of COVID-19 treatment was not collected on patients in this report.
§§ FluSurv-NET data from the 2021–22 influenza season included county data from 13 U.S. states: California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, Oregon, Tennessee, and Utah. Data from Iowa were excluded from FluSurv-NET during this season because of lack of capture of all required variables. COVID-NET data included all contributing FluSurv-NET counties as well as statewide surveillance data from Maryland.
¶¶ Influenza testing for FluSurv-NET includes rapid antigen, molecular assay, rapid molecular assay, immunofluorescence assay, viral culture, or serology. COVID-19 testing includes rapid antigen, molecular assay, or serology.
*** Trained staff members reviewed laboratory records, medical charts, and reportable conditions databases to identify eligible patients. Data on demographics, clinical characteristics, in-hospital interventions, and clinical outcomes were abstracted using standardized case report forms.

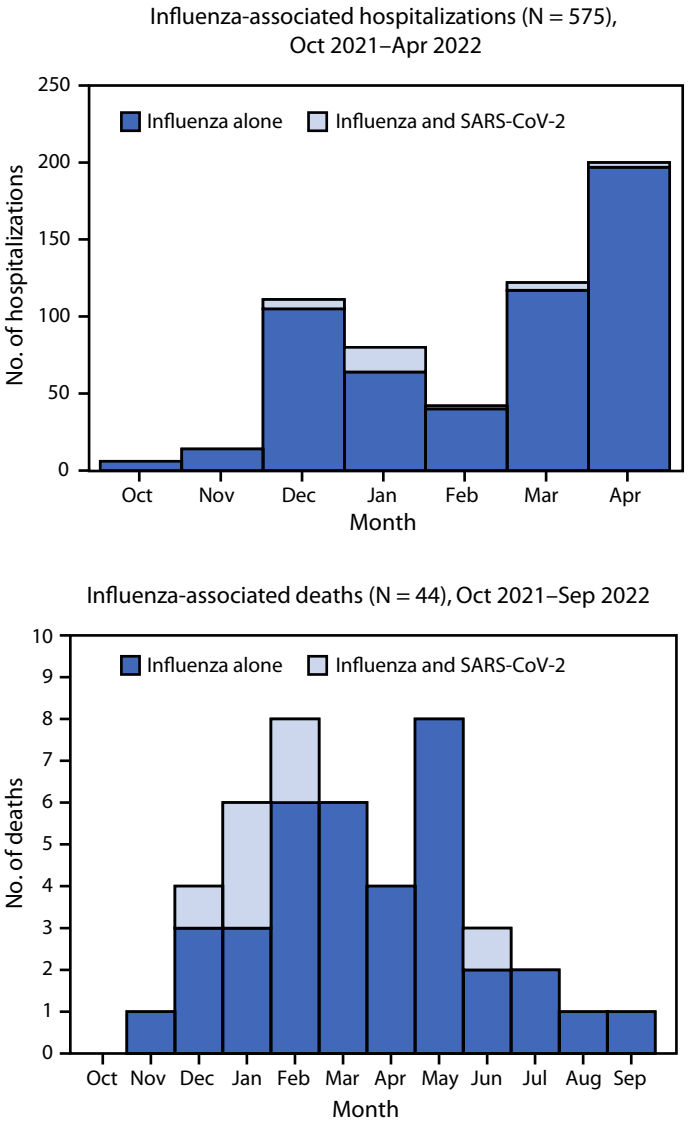
or 2) were identified through COVID-NET and had a COVID-19–associated hospital admission occurring within 14 days before or after an influenza-associated hospitalization. A patient was considered to have received the current seasonal influenza vaccine if ≥1 dose was administered ≥14 days before the positive influenza test result.[†††]

Data on influenza-associated pediatric deaths that occurred during October 3, 2021–October 1, 2022, were obtained from the Influenza-Associated Pediatric Mortality Surveillance System. A notifiable death is defined as a death in a person aged <18 years resulting from a clinically compatible illness confirmed to be influenza by laboratory testing[§§§] without a period of complete recovery between illness onset and death. State and local health departments report investigations of these deaths to CDC using a standardized case report form, which includes data on demographic characteristics, influenza testing, bacterial and viral co-detections, clinical diagnoses and complications, medication use, and influenza vaccination. Coinfections with SARS-CoV-2 were identified using the "viral coinfection" field, with either COVID-19 or SARS-CoV-2 indicated in free text.

Across all data sources, patients were eligible to be included in this analysis if they were aged <18 years and had evidence of influenza virus infection. Information on COVID-19 vaccination and antiviral treatment was not included because of lack of systematic ascertainment for patients across data sources. Demographic and clinical characteristics, in-hospital interventions, and outcomes are reported by illness status (influenza and SARS-CoV-2 coinfection and influenza infection alone) as frequencies and proportions, with between-group comparisons analyzed using Pearson's chi-square tests for hospitalizations and Fisher's exact tests for deaths. Medians and IQRs are presented for continuous variables, with between-group comparisons analyzed using a Wilcoxon rank sum test. Data were analyzed using SAS software (version 9.4, SAS Institute). These activities were reviewed by CDC and were consistent with applicable federal law and CDC policy.[¶¶¶]

Hospitalizations. During October 1, 2021–April 30, 2022, FluSurv-NET identified 575 pediatric influenza-associated hospitalizations, including 32 (6%) patients who were coinfected with SARS-CoV-2 and 543 (94%) who had influenza alone (hereafter, influenza) (Figure). Underlying medical conditions were reported for the majority of hospitalized patients with coinfection (56%) and with influenza (58%) (p = 0.81), whereas receipt of seasonal influenza vaccination was less prevalent among those with coinfections (17%) than among those with influenza (42%) (p = 0.02) (Table 1). A higher proportion of patients with coinfection than with influenza received invasive mechanical ventilation (13% versus 4%; p = 0.03) and BiPAP or CPAP (16% versus 6%; p = 0.05). No significant differences were found between patients with

FIGURE. Number of children and adolescents aged <18 years who were hospitalized* or died† with influenza alone and influenza and SARS-CoV-2 coinfections, by month — United States, 2021–22 influenza season



* Influenza Hospitalization Surveillance Network; data beyond April 30, 2022, did not include variables required to determine influenza and SARS-CoV-2 coinfection status.

† Influenza-Associated Pediatric Mortality Surveillance System.

††† Ascertainment of vaccination status was performed using hospital records, state immunization registries, primary care provider surveys, and patient or proxy interview.

§§§ Influenza testing for influenza-associated pediatric mortality includes commercial rapid diagnostic tests, viral culture, fluorescent antibody, enzyme immunoassay, reverse transcription–polymerase chain reaction, and immunohistochemistry.

¶¶¶ 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 1. Characteristics of children and adolescents aged <18 years hospitalized with laboratory-confirmed influenza and influenza and SARS-CoV-2 coinfections (N = 575) — Influenza Hospitalization Surveillance Network, United States, October 1, 2021–April 30, 2022*

Characteristic	No. of patients (%) with influenza and SARS-CoV-2 coinfection (n = 32)	No. of patients (%) with only influenza (n = 543)	p-value†
Age, yrs, median (IQR)	3 (1–12)	5 (2–11)	0.27
Age group, yrs			
0–4	18 (56.3)	245 (45.1)	0.31
5–11	6 (18.8)	169 (31.1)	
12–17	8 (25.0)	129 (23.8)	
Sex			
Male	14 (43.8)	313 (57.6)	0.12
Female	18 (56.3)	230 (42.4)	
Race and ethnicity			
American Indian or Alaska Native, non-Hispanic	0 (—)	6 (1.2)	0.84
Asian or Pacific Islander, non-Hispanic	1 (3.3)	23 (4.5)	
Black or African American, non-Hispanic	8 (26.7)	149 (29.4)	
Hispanic or Latino	7 (23.3)	139 (27.5)	
White, non-Hispanic	13 (43.3)	183 (36.2)	
Multiracial	1 (3.3)	6 (1.2)	
Influenza vaccination status§			
Vaccinated	4 (17.4)	190 (42.4)	0.02
Not vaccinated	19 (82.6)	258 (57.6)	
Ineligible	5 (0.0)	46	
Influenza test type¶			
Rapid antigen	0 (—)	8 (1.5)	0.77
RT-PCR	32 (100.0)	517 (95.2)	
Rapid PCR	1 (3.1)	19 (3.5)	
Influenza type			
A	30 (93.8)	530 (97.6)	<0.01
B	0 (—)	11 (2.0)	
A and B	2 (6.3)	2 (0.4)	
RSV test result			
Positive	3 (10.7)	6 (1.3)	<0.01
Negative	25 (89.3)	460 (98.7)	
Reason for admission			
Influenza-related illness	26 (83.9)	436 (81.2)	0.68
Obstetrics or labor and delivery admission	0 (—)	4 (0.7)	
Inpatient surgery procedures	0 (—)	3 (0.6)	
Psychiatric admission needing acute medical care	1 (3.2)	4 (0.7)	
Trauma	0 (—)	10 (1.9)	
Other	4 (12.9)	80 (14.9)	
Any underlying medical condition	18 (56.3)	317 (58.4)	0.81
Chronic lung disorder	1 (3.2)	35 (6.8)	0.49
Chronic metabolic disorder	4 (12.9)	30 (5.9)	0.10
Blood disorder	0 (—)	35 (6.8)	0.14
Cardiovascular disorder	2 (6.5)	25 (4.9)	0.67
Neurologic disorder	4 (12.9)	88 (17.2)	0.58
Immunocompromised condition	0 (—)	38 (7.4)	0.12
Renal disease	0 (—)	9 (1.8)	0.46
Gastrointestinal or liver disease	0 (—)	5 (1.0)	0.59
Rheumatologic, autoimmune, or inflammatory conditions	0 (—)	2 (0.4)	0.73
Hypertension	0 (—)	7 (1.4)	0.52
Obesity	1 (5.0)	57 (13.8)	0.18
Pregnant**	0 (—)	0 (—)	—
Received influenza antiviral treatment††	17 (53.1)	326 (60.0)	0.44
Admitted to ICU	10 (31.3)	117 (21.5)	0.20
Invasive mechanical ventilation	4 (12.5)	23 (4.2)	0.03
BiPAP or CPAP use	5 (15.6)	35 (6.4)	0.05
High flow nasal cannula	5 (15.6)	57 (10.5)	0.36
Vasopressor use	3 (9.4)	20 (3.7)	0.11
Renal replacement therapy or dialysis	0 (—)	2 (0.4)	0.73
In-hospital deaths	0 (—)	0 (—)	—

See table footnotes on the next page.

TABLE 1. (*Continued*) Characteristics of children and adolescents aged <18 years hospitalized with laboratory-confirmed influenza and influenza and SARS-CoV-2 coinfections (N = 575) — Influenza Hospitalization Surveillance Network, United States, October 1, 2021–April 30, 2022*

Abbreviations: BiPAP = bilevel positive airway pressure; CPAP = continuous positive airway pressure; ICU = intensive care unit; PCR = polymerase chain reaction; RSV = respiratory syncytial virus; RT-PCR = reverse transcription–polymerase chain reaction.

* Data on race and ethnicity were unknown for two (6.3%) patients with influenza and SARS-CoV-2 coinfection and 37 (6.8%) patients with only influenza; data on current season influenza vaccine were unknown for four (12.5%) patients with influenza and SARS-CoV-2 coinfection and 49 (9.0%) with only influenza; data on RSV test results were unknown or missing for four (12.5%) patients with influenza and SARS-CoV-2 coinfection and 77 (14.2%) patients with only influenza; and data on reason for admission were unknown or missing for one (3.1%) patient with influenza and SARS-CoV-2 coinfection and six (1.1%) patients with only influenza.

† Medians were compared using a Wilcoxon rank sum test. Proportions were compared using Pearson's chi-square tests.

§ Vaccinated is defined as immunization in a person aged ≥6 months who received ≥1 dose of the current season's vaccine ≥14 days before positive influenza test date; a person is considered ineligible if aged <6 months.

¶ Proportions for test types are not mutually exclusive.

** Only among adolescents aged 15–17 years.

†† Influenza antiviral treatments included oseltamivir, peramivir, or zanamivir.

coinfection and with influenza in the prevalence of intensive care unit (ICU) admission (p = 0.20). No in-hospital deaths were identified with FluSurv-NET in either group.

Deaths. Forty-four influenza-associated pediatric deaths were reported to the Influenza-Associated Pediatric Mortality Surveillance System during the 2021–22 influenza season, including seven (16%) decedents who had SARS-CoV-2 coinfection (Figure). Among influenza vaccine–eligible children who died and for whom data were available, zero of six with coinfections and five (16%) of 31 with influenza had been vaccinated against influenza (p = 0.57) (Table 2). The most common complications among decedents with coinfections were pneumonia, acute respiratory distress syndrome, and bronchiolitis. Among decedents with influenza, the most common complications were pneumonia, seizures, and acute respiratory distress syndrome. Cardiomyopathy or myocarditis occurred in five (16%) of 32 decedents with influenza and none with coinfection (p = 0.57). One or more underlying medical conditions were reported for four of five children with coinfections who died and 21 (58%) of 36 with influenza (p = 0.63). Influenza antiviral therapy was administered to one child with a coinfection who died and 17 (46%) decedents with influenza (p = 0.21).

Discussion

The 2020–21 influenza season, which occurred during the COVID-19 pandemic, was characterized by historically low influenza circulation (*6*). However, an unusually late increase in influenza activity occurred in April 2022 during the 2021–22 season (*7*). In this analysis of 2021–22 influenza data from three CDC surveillance systems, among all pediatric patients who received testing for both influenza and SARS-CoV-2 viruses and who were hospitalized or died with influenza, most had underlying medical conditions and were not fully vaccinated against seasonal influenza. Influenza and SARS-CoV-2 coinfections were infrequent (representing 6% of hospitalizations and 16% of deaths within these populations), likely in part because of lower-than-usual influenza virus circulation. However, these data identified increased use of invasive and noninvasive mechanical ventilation among coinfected patients, indicating potentially more severe disease among children and adolescents with influenza and SARS-CoV-2 coinfection. These findings also highlight the underuse of influenza antivirals and seasonal influenza vaccines, particularly among persons aged <18 years with influenza virus and SARS-CoV-2 coinfections who died.

These findings represent a small number of cases of influenza and SARS-CoV-2 coinfection, thereby limiting the ability to draw firm conclusions. The high degree of cocirculation of multiple respiratory viruses during the current season (*1,2*), and the higher-than-usual early-season influenza activity, underscore the importance of increasing awareness among parents and providers that influenza and SARS-CoV-2 coinfections occur in pediatric patients and that coinfection can potentially cause more severe illness. For pediatric patients with acute respiratory illness symptoms with suspected severe illness, testing for both influenza and SARS-CoV-2, and other respiratory viruses is critical to facilitate early detection of coinfections and help guide clinical treatment and management (*8*).

The findings in this report are subject to at least six limitations. First, viral testing was performed at the clinician's discretion or according to hospital policy and might have been influenced by factors including clinical presentation, severity of illness, and previous testing. Both influenza-only and SARS-CoV-2 coinfection cases were not detected if testing for influenza virus and SARS-CoV-2 was not performed for patients with acute respiratory illness. However, coinfected patients might be overrepresented in these results among patients with more severe disease (e.g., on respiratory support) if they were more likely to have been tested for both influenza virus and SARS-CoV-2. Second, information on COVID-19 vaccination and SARS-CoV-2 antiviral treatment was not included because this information could not be systematically ascertained for patients across all data sources. Third, whereas the Influenza-Associated Pediatric Mortality Surveillance System reflects data across all U.S. states and

TABLE 2. Characteristics of children and adolescents aged <18 years who died with influenza and influenza and SARS-CoV-2 coinfections (N = 44) — Influenza-Associated Pediatric Mortality Surveillance System, United States, October 3, 2021–October 1, 2022*

Characteristic	No. of patients (%) with influenza and SARS-CoV-2 coinfection (n = 7)	No. of patients (%) with only influenza (n = 37)	p-value†
Age, yrs, median (IQR)	6 (2–13)	4 (1–8)	0.34
Age group, yrs			
0–4	2 (28.6)	21 (56.8)	0.41
5–11	3 (42.9)	9 (24.3)	
12–17	2 (28.6)	7 (18.9)	
Sex			
Male	4 (51.7)	15 (40.5)	0.44
Female	3 (42.9)	22 (59.5)	
Race and ethnicity			
American Indian or Alaska Native, non-Hispanic	0 (—)	1 (2.8)	0.66
Asian or Pacific Islander, non-Hispanic	0 (—)	1 (2.8)	
Black or African American, non-Hispanic	0 (—)	6 (16.7)	
Hispanic or Latino	2 (33.3)	8 (22.2)	
White, non-Hispanic	4 (66.7)	18 (50.0)	
Multiracial	0 (—)	2 (5.6)	
Influenza vaccination status§			
Fully vaccinated	0 (—)	5 (16.1)	0.57
Not fully vaccinated	6 (100.0)	26 (83.9)	
Ineligible	0 (—)	2	
Influenza test type¶			
Rapid antigen	2 (28.6)	9 (24.3)	0.66
RT-PCR	5 (71.4)	31 (83.8)	
Influenza type			
A	6 (85.7)	36 (97.3)	0.30
B	1 (14.3)	1 (2.7)	
A and B	0 (—)	0 (—)	—
Other viral coinfection**	1 (14.3)	1 (2.7)	0.33
ACIP-defined high-risk condition††			
Yes	4 (80.0)	21 (58.3)	0.63
No	1 (20.0)	15 (41.7)	
Type of ACIP-defined high-risk condition§§			
Neurologic disorders	2 (40.0)	12 (33.3)	—
Cardiac and congenital heart diseases	0 (—)	4 (11.1)	—
Pulmonary diseases (including asthma and cystic fibrosis)	3 (60.0)	5 (13.9)	—
Endocrine diseases (including diabetes mellitus)	1 (20.0)	2 (5.6)	—
Premature at birth	0 (—)	2 (5.6)	—
Immunosuppressive conditions	0 (—)	1 (2.8)	—
Renal diseases	1 (20.0)	0 (—)	—
Genetic disorders	2 (40.0)	6 (16.7)	—
Mitochondrial disorders	0 (—)	1 (2.8)	—
Obesity	0 (—)	2 (5.6)	—
Received influenza antiviral treatment¶¶	1 (14.3)	17 (45.9)	0.21
Hospitalized			
Yes	4 (57.1)	21 (56.8)	1.00
No	3 (42.9)	16 (43.2)	
Invasive mechanical ventilation			
Yes	2 (50.0)	20 (95.2)	0.06
No	2 (50.0)	1 (4.8)	
Any complication			
Yes	7 (100.0)	27 (84.4)	0.56
No	0 (—)	5 (15.6)	
Complications			
Pneumonia	3 (42.9)	9 (28.1)	0.41
Acute respiratory distress syndrome	2 (28.6)	6 (18.8)	0.61
Croup	0 (—)	2 (6.3)	1.00
Seizures	0 (—)	7 (21.9)	0.32
Bronchiolitis	2 (28.6)	4 (12.5)	0.28
Encephalopathy or encephalitis	0 (—)	4 (12.5)	1.00
Cardiomyopathy or myocarditis	0 (—)	5 (15.6)	0.57

See table footnotes on the next page.

TABLE 2. (*Continued*) Characteristics of children and adolescents aged <18 years who died with influenza and influenza and SARS-CoV-2 coinfections (N = 44) — Influenza-Associated Pediatric Mortality Surveillance System, United States, October 3, 2021–October 1, 2022*

Characteristic	No. of patients (%) with influenza and SARS-CoV-2 coinfection (n = 7)	No. of patients (%) with only influenza (n = 37)	p-value†
Hemorrhagic pneumonia or pneumonitis	0 (—)	1 (3.1)	1.00
Reye syndrome	0 (—)	0 (—)	—
Shock	1 (14.3)	5 (15.6)	1.00
Sepsis	0 (—)	5 (15.6)	0.56
Other complications	3 (42.9)	13 (40.6)	1.00
Days from illness onset to death			
≤1	1 (20.0)	3 (9.7)	0.78
2–7	3 (60.0)	20 (64.5)	
>7	1 (20.0)	8 (25.8)	
Death location			
ED	1 (14.3)	7 (18.9)	1.00
ICU	4 (57.1)	19 (51.3)	
Inpatient ward	0 (—)	2 (5.4)	
Outside of hospital	2 (28.6)	9 (24.3)	

Abbreviations: ACIP = Advisory Committee on Immunization Practices; ED = emergency department; ICU = intensive care unit; RT-PCR = reverse transcription–polymerase chain reaction.

* Data on race and ethnicity were unknown for one patient with influenza and SARS-CoV-2 coinfection and one (2.7%) patient with only influenza; data on current season influenza vaccine were unknown for one patient with influenza and SARS-CoV-2 coinfection and four (10.8%) patients with only influenza; data on ACIP-defined high-risk conditions were unknown for two patients with influenza and SARS-CoV-2 coinfection and one (2.7%) patient with only influenza; data on invasive mechanical ventilation were unknown for one patient with influenza and SARS-CoV-2 coinfection and one (2.7%) patient with only influenza; data on any complications was unknown for five (13.5%) patients with only influenza; data on days from illness onset to death were unknown for two patients with influenza and SARS-CoV-2 coinfection and six (16.2%) patients with only influenza.

† Medians were compared using a Wilcoxon rank sum test. Proportions were compared using Fisher's exact tests.

§ Fully vaccinated is defined as immunization in a person aged ≥9 years who received ≥1 dose of current season's vaccine ≥14 days from illness onset; or for a person aged 6 months–8 years who 1) received ≥1 dose of current season's vaccine ≥14 days from illness onset, and 2) received ≥2 total doses in their lifetime (2 doses of current season's vaccine, both ≥14 days from illness onset, or 1 dose of current season's vaccine ≥14 days from illness onset plus 1 dose from a previous season). Not fully vaccinated: a person aged ≥6 months who did not receive any doses of the current season's vaccine; or a person aged ≥6 months who received ≥1 dose of the current season's vaccine, but the dose or final dose, if multiple doses, was ≤14 days from illness onset; or for a person aged 6 months–8 years who received only 1 dose of current season's vaccine ≥14 days from illness onset, but received no other doses from a previous season. A person was considered ineligible if aged <6 months.

¶ Proportions for test types are not mutually exclusive.

** One child with a SARS-CoV-2 infection also received a positive test result for adenovirus, rhinovirus/enterovirus, and respiratory syncytial virus. One child with only influenza also received a positive adenovirus test result.

†† Children who have chronic pulmonary (including asthma and cystic fibrosis), cardiovascular (excluding isolated hypertension), renal, hepatic, neurologic, hematologic, or metabolic disorders (including diabetes mellitus); are immunocompromised for any reason; are receiving aspirin- or salicylate-containing medications and might be at risk for Reye syndrome after influenza virus infection; or who have extreme obesity.

§§ p-values not calculated because of small numbers.

¶¶ Influenza antiviral treatments included oseltamivir or peramivir.

territories, FluSurv-NET and COVID-NET catchment areas include approximately 9%–10% of the U.S. population, limiting the generalizability of results. Fourth, circulation of influenza A and B viruses was lower during 2021–22 than during pre–COVID-19 seasons, thus reducing the number of patients included in the analysis and limiting the ability to examine the clinical effects of COVID-19 on the clinical course of influenza. Ongoing surveillance can help to assess the clinical progression and associated severity of pediatric influenza and SARS-CoV-2 coinfections. Fifth, because of the variability in testing practices found in passive surveillance systems such as the Influenza-Associated Pediatric Mortality Surveillance System (e.g., influenza testing not being performed or being performed late in the course of the illness when influenza could not be detected), pediatric deaths were likely underreported. Finally, SARS-CoV-2–only infections were not reported because these data were not available in the Influenza-Associated Pediatric Mortality Surveillance System.

To prevent and mitigate the incidence of severe respiratory virus–associated illness during periods of influenza virus and SARS-CoV-2 cocirculation, the public and parents should be aware of the risk for pediatric coinfection and adopt prevention strategies, including considering wearing well-fitted, high-quality masks when respiratory virus circulation is high and annual influenza vaccination and up-to-date COVID-19 vaccination (*9*,*10*). To identify coinfections with influenza virus and SARS-CoV-2, clinicians should follow recommended testing algorithms for patients with acute respiratory illness symptoms in outpatient, emergency department, and hospital settings. Clinical guidance on early initiation of antiviral treatment for influenza and SARS-CoV-2 should be followed for pediatric patients with suspected or confirmed influenza or SARS-CoV-2 infections (or both), who are hospitalized, have severe or progressive disease, or are at increased risk for complications (*9*,*10*).

Summary

What is already known about this topic?

Influenza and SARS-CoV-2 viruses individually contribute to pediatric morbidity. The prevalence and severity of coinfection with influenza and SARS-CoV-2 are less well understood.

What is added by this report?

During the 2021–22 influenza season, 6% of hospitalized pediatric influenza patients had SARS-CoV-2 coinfection; a higher percentage of patients with coinfection required invasive or noninvasive respiratory support compared with those with influenza only. Among influenza-associated pediatric deaths, 16% had SARS-CoV-2 coinfection; only one coinfected decedent received influenza antivirals, and none had been fully vaccinated against influenza.

What are the implications for public health practice?

The public should adopt prevention strategies, including influenza and COVID-19 vaccination, and consider mask use during high respiratory virus circulation.

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Notes from the Field:

Burkholderia pseudomallei Detected in a Raccoon Carcass Linked to a Multistate Aromatherapy-Associated Melioidosis Outbreak — Texas, 2022

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Burkholderia pseudomallei, the causative agent of melioidosis, is an environmental gram-negative bacterium endemic in tropical and subtropical regions worldwide. *B. pseudomallei* can infect humans and a wide range of animals through percutaneous inoculation, inhalation, or ingestion (*1*). Melioidosis symptoms are nonspecific and vary widely because *B. pseudomallei* can infect any organ of the body, including the brain. In October 2021, the source of a multistate outbreak of melioidosis that involved four human cases in Georgia, Kansas, Minnesota, and Texas was identified as an aromatherapy room spray imported from India* (*2*).

After the discovery of the aromatherapy spray as the outbreak source, the Texas Department of State Health Services (DSHS) learned that a previously healthy pet raccoon, owned by the family of the Texas patient, had broken a bottle of the implicated aromatherapy spray and walked through the liquid. On April 3, 2021, approximately 2 weeks after this exposure, the raccoon displayed acute neurologic symptoms consistent with neurologic melioidosis† and died from an undetermined cause 3 days later. The carcass was wrapped in a cloth robe and buried on the family's property. The strain found in the aromatherapy bottle (ATS2021) and linked to the outbreak contained a genetic variant, the $bimA_{Bm}$ allele, which is a virulence factor associated with neurologic melioidosis (*3*).

Environmental suitability modeling studies for *B. pseudomallei* suggest that the soil and climate in parts of Texas are suitable for *B. pseudomallei* (*1*). Because of concerns about establishment of *B. pseudomallei* in soil within a setting where the pathogen is not known to be endemic, and out of an abundance of caution, staff members from Texas DSHS Region 2/3, Environmental Protection Agency (EPA) Region 6, and CDC traveled to the Texas property on April 19, 2022, to determine whether there was evidence of *B. pseudomallei* contamination and to decontaminate the burial site. Thirty-two environmental samples§ were collected from the burial site and surrounding area, including soil, tree root fragments, and water from a stream downhill from the site. Soil samples were collected directly above, below, and adjacent to the carcass; 10 radial soil samples were collected at 2-, 4-, and 6-ft (0.6-, 1.2-, and 1.8-m) intervals around the carcass, oriented toward the natural drainage path, down to the stream (Figure). The raccoon carcass was found at a depth of approximately 1 ft (30 cm), and 12 tissue samples were collected during field necropsy.¶ After sampling, EPA staff members immediately decontaminated the carcass and excavated soil within a 2-ft (0.6-m) circumference of the carcass in germicidal bleach (8.25% sodium hypochlorite, diluted 1:3 with water) overnight for approximately 15 hours (*4*). All samples were tested for *B. pseudomallei* by polymerase chain reaction (PCR) and cultured by CDC. A portion of four of the 12 tissue samples were formalin-fixed by the Dallas County Health and Human Services Laboratory in Texas and tested for *B. pseudomallei* by immunohistochemistry (IHC) at CDC.

Two swabs collected from the raccoon's intraorbital tissue tested positive by PCR for the presence of *B. pseudomallei* DNA; however, viable *B. pseudomallei* was not cultured. All other tissue samples tested negative by PCR or IHC.** No environmental contamination was detected, with all environmental samples testing negative for *B. pseudomallei* by both PCR and culture.

The positive PCR result for *B. pseduomallei* from the raccoon tissue reaffirmed the suspicion that the racoon likely died of acute neurological melioidosis. This is the first reported presumed melioidosis case documented in a raccoon and the first animal case linked to this outbreak. Although the bacteria could not be cultured and sequenced, the raccoon was most likely infected by the outbreak strain given the animal's exposure history and that *B. pseudomallei* has never been isolated from Texas soil. Melioidosis is typically not transmitted from

* https://www.cpsc.gov/Recalls/2022/Walmart-Recalls-Better-Homes-and-Gardens-Essential-Oil-Infused-Aromatherapy-Room-Spray-with-Gemstones-Due-to-Rare-and-Dangerous-Bacteria-Bacteria-Identified-in-this-Outbreak-Linked-to-Two-Deaths

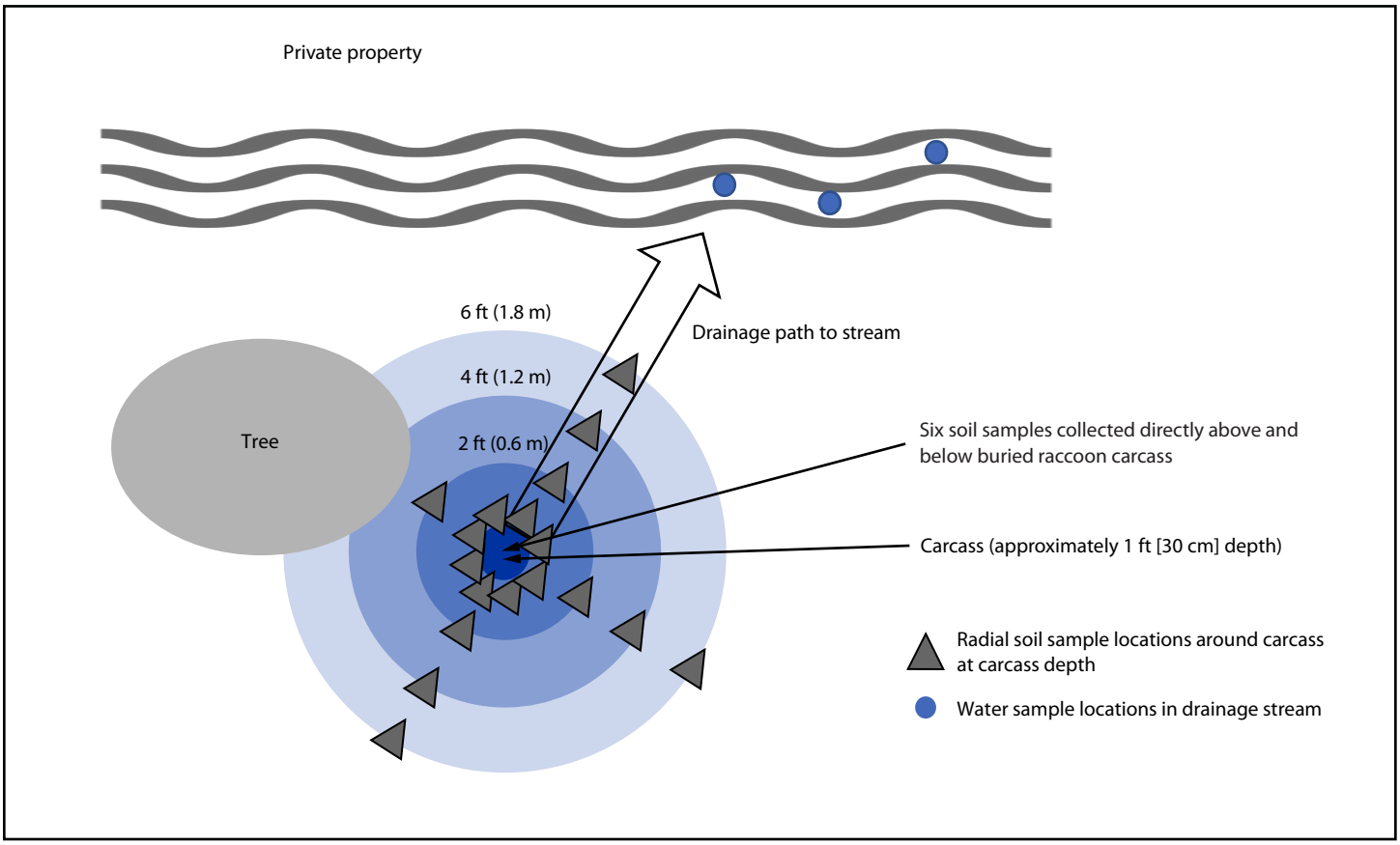
† Other considerations in the differential diagnosis included canine distemper and rabies.

§ In addition to the 32 environmental samples collected from the carcass burial site, three control soil samples were collected from public land across the street from the property, which ultimately tested negative; one sample was also collected from the robe in which the carcass was wrapped, which also tested negative.

¶ Tissue samples were taken from right and left orbits (likely brain tissue), intestinal contents, cardiac and pulmonary tissue, intestinal tissue, paw pads, spinal column tissue, adipose and epidermis, and other internal organs that were unidentifiable because of decomposition.

** Ten of the 12 tissue samples tested negative by PCR at the Zoonotic Select Agent Laboratory at CDC, and four tissue samples tested negative by IHC and PCR at the Infectious Diseases Pathology Branch laboratory, CDC.

FIGURE. Environmental sample locations around raccoon carcass burial site (aerial view), *Burkholderia pseudomallei* investigation — Texas, 2022



animals to humans; however, it does infect a diverse range of animals including mammals, reptiles, and fish (*1*,*5*). This investigation identified no evidence of environmental contamination by *B. pseudomallei* from the buried carcass; such investigations are important in preventing potential establishment of *B. pseudomallei* in soil within a setting where the pathogen is not known to be endemic.

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Errata

Vol. 71, No. 40

In the report, "Notes from the Field: Coagulopathy Associated with Brodifacoum Poisoning 2014 — Florida, December 2021," on page 1288, the second sentence of the third paragraph should have read, "Five patients provided the SCB products they had smoked **for analysis by the DEA TOX Toxicology Testing Program,** of which four tested positive for brodifacoum, a long-acting vitamin K oxidoreductase antagonist.[†]" On page 1289, the second sentence of the first paragraph should have read, "Close collaboration among the health care community, Florida Department of Health, Florida Poison Information Center Tampa, **DEA TOX, NMS Labs, and a private pharmaceutical company, in addition to** other stakeholders such as local law enforcement and the Drug Enforcement Agency, was critical to identifying and characterizing the cluster and providing the necessary treatment to prevent additional morbidity and mortality." In addition, on page 1289, the Acknowledgments should have included **"Roy Gerona, Jordan Trecki, DEA TOX Toxicology Testing Program."**

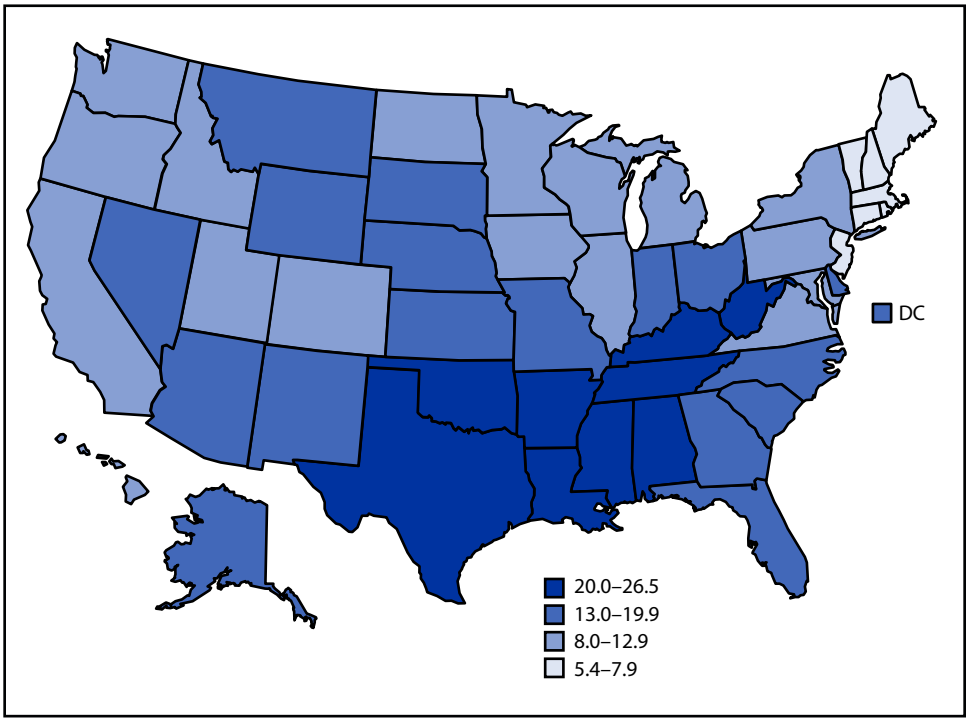
Vol. 71, No. 45

In the report "COVID-19–Associated Hospitalizations Among U.S. Infants Aged <6 Months — COVID-NET, 13 States, June 2021–August 2022," on page 1442, the fifth sentence of the first paragraph should have read, "During the Omicron BA.2/BA.5–predominant periods (**March 20**–August 31, 2022), weekly hospitalizations per 100,000 infants aged <6 months increased from a nadir of 2.2 (week ending April 9, 2022) to a peak of 26.0 (week ending July 23, 2022), and the average weekly hospitalization rate among these infants (13.7) was similar to that among adults aged 65–74 years (13.8)." In addition, on page 1443, the last sentence of the fourth paragraph should have read, "The mean weekly hospitalization rate among infants aged <6 months during the Omicron BA.2/BA.5 period (13.7) was less than that of adults aged ≥75 years (39.4), similar to that of adults aged 65–74 years (13.8) and higher than rates in all other pediatric age groups (2.3 and 0.8 for children aged **6 months–4 years and 5–17 years**, respectively) and in adults aged <65 years (**4.6**)."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Birth Rates* for Females Aged 15–19 Years, by State — National Vital Statistics System, United States, 2021



* Births per 1,000 females aged 15–19 years.

In 2021, the U.S. birth rate for females aged 15–19 years was 13.9 births per 1,000 persons, with rates generally lower in the Northeast and higher across the southern states. Birth rates among females aged 15–19 years ranged from 5.4 in New Hampshire, 5.7 in Massachusetts, and 6.4 in Vermont to 26.5 in Arkansas and 25.6 in Mississippi.

Source: National Center for Health Statistics, National Vital Statistics System, Natality Data, 2021. https://www.cdc.gov/nchs/nvss/births.htm

Reported by: Brady E. Hamilton, PhD, bhamilton@cdc.gov, 301-458-4653.

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