Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 71 / No. 8
February 25, 2022

Interim Guidance: 4-Month Rifapentine-Moxifloxacin Regimen for the Treatment of Drug-Susceptible Pulmonary Tuberculosis — United States, 2022

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Summary

On May 5, 2021, CDC's Tuberculosis Trials Consortium and the National Institutes of Health (NIH)–sponsored AIDS Clinical Trials Group (ACTG) published results from a randomized controlled trial indicating that a 4-month regimen containing rifapentine (RPT), moxifloxacin (MOX), isoniazid (INH), and pyrazinamide (PZA) was as effective as the standard 6-month regimen for tuberculosis (TB) treatment (*1*). On the basis of these findings, CDC recommends the 4-month regimen as a treatment option for U.S. patients aged ≥12 years with drug-susceptible pulmonary TB and provides implementation considerations for this treatment regimen.

Background

Standard treatment for culture-positive TB requires ≥6 months of antibiotics (*2*). Shorter, effective TB treatments could enable more rapid cure and improve patient quality of life. Sponsored by CDC and conducted in collaboration with the NIH-sponsored ACTG, Study 31/A5349 (https://clinicaltrials.gov/ct2/show/NCT02410772) was an international, open label, phase 3 noninferiority clinical trial that randomized 2,516 participants at 34 clinical sites in 13 countries. The trial confirmed that a 4-month daily treatment regimen containing high-dose RPT and MOX, as well as INH and PZA, is as effective as (noninferior to) the standard daily 6-month regimen in curing drug-susceptible TB (*1*).

Methods

CDC developed this interim guidance, based on evidence from Study 31/A5349, preclinical and animal evidence, previous clinical trial findings, pharmacokinetic and pharmacodynamic modeling (*1*,*3*–*6*), and CDC expert opinion regarding considerations for implementation of the new 4-month daily treatment regimen in the United States. A systematic review framework was not applicable because this regimen has not been compared in other studies. A CDC writing group reviewed the evidence and drafted guidance for comments from external TB subject matter experts and for presentation for public comment. Comments were addressed by developing content to be published at https://www.cdc.gov/tb/topic/treatment/tbdisease.htm.

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Rationale and Evidence

Clinical practice guidelines for treatment of drug-susceptible TB in the United States were published in 2016 (*2*). This interim guidance updates 2016 guidelines by recommending and providing implementation considerations for a novel 4-month daily treatment regimen, based on high-dose daily RPT with MOX, INH, and PZA (*1*) as a treatment option for U.S. patients aged ≥12 years with drug-susceptible pulmonary TB. The regimen is intended for administration in settings where mycobacterial cultures, molecular and phenotypic drug susceptibility testing (DST), radiographic studies and other diagnostic tools, infrastructure for adverse event monitoring, patient-centered clinical care, and coordination with public health for case management are available.

Recommendation for Use of the 4-month Rifapentine-Moxifloxacin Regimen

CDC recommends the 4-month RPT-MOX regimen for treating patients aged ≥12 years with body weight ≥40 kg with pulmonary TB caused by organisms that are not known or suspected to be drug-resistant and who have no contraindications to this regimen. The 4-month daily treatment regimen consists of an intensive phase composed of 8 weeks of daily treatment with RPT, MOX, INH, and PZA, followed by a continuation phase of 9 weeks of daily treatment with RPT, MOX, and INH (Table 1). Anti-TB drugs should be administered once daily with food, 7 days per week, for a total of 119 treatment doses; similar to the standard 6-month regimen, at least 5 of 7 weekly doses should be administered under direct observation (*2*). The 4-month regimen can be used in persons with an HIV infection who have CD4 counts ≥100 cells/μL and are receiving or planning to initiate efavirenz as part of their antiretroviral therapy (ART) regimen in the absence of any other known drug-drug interactions between antituberculosis and antiretroviral medications.

Considerations. The 4-month daily treatment regimen was not studied in, and CDC does not recommend this regimen for, the following patient groups: body weight <40 kg; age <12 years; pregnant or breastfeeding; most types of suspected or documented extrapulmonary TB infection (see exceptions below); history of prolonged QT syndrome or concurrent use of one or more QT-prolonging medications (in addition to MOX); patients receiving medications with known clinically relevant drug-drug interactions with RPT, MOX, INH, or PZA; or patients infected with a baseline *Mycobacterium tuberculosis* isolate known or suspected to be resistant to INH, PZA, rifampin (RIF), or fluoroquinolones.

The 4-month daily treatment regimen was not studied in, and CDC recommends that clinical consultation be obtained to determine if this regimen is an acceptable treatment option for, patient groups with increased risk for *M. tuberculosis* resistance to any drug in the regimen, including persons who received >5 doses of treatment directed against TB in the preceding 6 months, who received >5 doses of latent tuberculosis

The *MMWR* series of publications is published by the Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30329-4027.

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2022;71:[inclusive page numbers].

TABLE 1. Dosing recommendation for a 4-month rifapentine-moxifloxacin regimen for patients aged ≥12 years with pulmonary tuberculosis caused by drug-susceptible organisms — United States, 2022

Medication*	Body weight, kg	Dose	Intensive phase	Continuation phase	Total doses
Rifapentine	≥40	1,200 mg	7 days/wk for 56 doses (8 wks)	7 days/wk for 63 doses (9 wks)	119
Moxifloxacin	≥40	400 mg			
Isoniazid†	≥40	300 mg			
Pyrazinamide	40–<55	1,000 mg		NA	
	≥55–75	1,500 mg			
	>75 kg	2,000 mg			

Abbreviation: NA = not applicable.
* Medications should be administered with food.
† Pyridoxine (vitamin B6), 25–50 mg/day, should be given with isoniazid to all patients.

infection treatment in the preceding 6 months, or who received >5 doses of treatment with any one or more of the following drugs for any reason (e.g., urinary tract infection or pneumonia) in the preceding 30 days: INH, RIF, rifabutin, RPT, PZA, or any fluoroquinolone. Other patient groups for whom clinical consultation is recommended include those with serum or plasma alanine aminotransferase or aspartate aminotransferase >3 times the upper limit of normal or total bilirubin >2.5 times the upper limit of normal, or with preexisting advanced liver disease; renal insufficiency or end-stage renal disease, or with serum or plasma creatinine level >2 times the upper limit of normal; plasma potassium level <3.5 mEq/L; who have types of extrapulmonary TB that are likely to be paucibacillary, not pose a substantial risk for death or disability, and not require prolonged treatment (i.e., pleural or lymph node TB); or for whom a specimen was unable to be submitted for any *M. tuberculosis* resistance testing before initiating treatment.

The 4-month daily treatment regimen was not studied in patients with a negative sputum culture, but who in the judgment of the clinician likely represent paucibacillary or low mycobacterial burden pulmonary TB disease. A 4-month regimen for smear-negative, culture-negative, noncavitary TB exists in the 2016 CDC guidelines (*2*), and CDC recommends that the 4-month RPT-MOX regimen may also be used unless patients are in one of the nonrecommended patient groups listed above.

Baseline and follow-up evaluations. Microbiology, laboratory, and clinical assessments are recommended before starting and during treatment with the 4-month daily regimen (Table 2). A respiratory specimen for acid-fast bacilli smear microscopy and culture should be obtained at baseline and at monthly intervals during treatment until two consecutive specimens are negative on culture. Baseline molecular drug-susceptibility testing for rapid identification of mutations associated with resistance to at least INH, PZA, RIF, and fluoroquinolones is advisable. Phenotypic DST should follow with a panel to include at least RIF (as surrogate for RPT), INH, PZA, and MOX as the preferred fluoroquinolone. CDC's Tuberculosis Elimination Laboratory (TBLab@cdc.gov) can assist identifying laboratories to perform this testing for TB programs that intend to implement the 4-month daily treatment regimen.

Summary

What is already known about this topic?

A recent clinical trial identified a daily 4-month regimen that is as effective as the standard daily 6-month regimen in curing drug-susceptible tuberculosis.

What is added by this report?

This report provides a recommendation for using a 4-month regimen consisting of 8 weeks of daily treatment with rifapentine (RPT), isoniazid (INH), pyrazinamide, and moxifloxacin (MOX), followed by 9-weeks of daily treatment with RPT, INH, and MOX in patients with drug-susceptible tuberculosis.

What are the implications for public health practice?

The 4-month RPT-MOX regimen is a treatment option for patients aged ≥12 years with drug-susceptible pulmonary tuberculosis.

Duration and definition of completion of therapy. The 4-month daily treatment regimen is considered complete based on the total number of doses taken (119). Recommended treatment duration is independent of any cavitation on baseline chest radiograph. Intensive phase doses (56) should be administered within 70 days from treatment initiation, and continuation phase doses (63) should be administered within 84 days from intensive phase completion, so that the regimen is completed within 5 months. If these targets are not met, the patient should be considered to have interrupted therapy and be managed as described in TB treatment guidelines (*2*). Confirmation of continued susceptibility to all drugs in the 4-month daily treatment regimen is required before restarting this regimen.

Poor treatment response and treatment failure or discontinuation. Patients with any positive culture at completion of 2 months of therapy, with or without ongoing symptoms, should be carefully evaluated to identify the cause of delayed

TABLE 2. Baseline and follow-up evaluations for patients treated with a 4-month rifapentine-moxifloxacin regimen — United States, 2022*

Evaluation	Baseline	Week 4	Week 8 (end of intensive phase)	Week 12	Week 17 (end of treatment)
Microbiology					
Sputum for rapid molecular test†	Y	NA	NA	NA	NA
Sputum for AFB smear and culture§	Y	Y	Y	Y¶	Y¶
Drug susceptibility testing**	Y	NA	Y¶	NA	NA
Imaging					
Chest radiograph††	Y	NA	Y¶	NA	Y¶
Clinical assessment					
Weight§§	Y	Y	Y	Y	Y
Symptoms, adverse events, and adherence¶¶	Y	Y	Y	Y	Y
Laboratory testing					
ALT, AST, bilirubin, and alkaline phosphate***	Y	Y¶	Y¶	Y¶	Y¶
Platelet count	Y	Y¶	Y¶	Y¶	Y¶
Creatinine	Y	Y¶	Y¶	Y¶	Y¶
Potassium, calcium, and magnesium†††	Y	Y¶	Y¶	Y¶	Y¶
HIV	Y	NA	NA	NA	NA
CD4 count and HIV RNA load (if HIV infection)§§§	Y¶	NA	NA	NA	NA
Hepatitis B and C screen¶¶¶	Y¶	NA	NA	NA	NA
Diabetes screen****	Y¶	NA	NA	NA	NA
Pregnancy testing for persons who might become pregnant††††	Y	NA	NA	NA	NA

Abbreviations: AFB = acid-fast bacilli; ALT = alanine aminotransferase; AST = aspartate aminotransferase; DST = drug susceptibility testing; INH = isoniazid; MOX = moxifloxacin; NA = not applicable; PZA = pyrazinamide; RIF = rifampin; RPT = rifapentine; Y = yes.

* Regimen consists of RPT, MOX, INH, and PZA.

† At least one baseline specimen is advised to be tested using a rapid molecular test for susceptibility to INH, PZA, RIF, and fluoroquinolones.

§ Sputa for AFB smear and culture should be obtained at baseline, then monthly until two consecutive specimens are AFB smear- and culture-negative.

¶ These activities are optional or contingent on other information.

** Drug susceptibility at least for INH, RIF, PZA, and fluoroquinolones (preferred fluoroquinolone is MOX) should be obtained. Drug susceptibility testing (rapid molecular preferred) should be repeated if patient's culture remains positive after completing 2 months (8 weeks) of treatment.

†† Chest radiograph should be obtained at baseline for all patients and at month 2 if baseline cultures are negative. End-of-treatment chest radiograph is optional. Electrocardiogram is not routinely recommended for all patients; electrocardiogram should be done if clinically indicated.

§§ Weight should be monitored monthly to assess response to treatment; adjust PZA dose if needed.

¶¶ Adherence should be assessed, improvement in tuberculosis symptoms (e.g., cough, fever, fatigue, or night sweats) monitored, and development of medication adverse effects (e.g., jaundice, dark urine, nausea, vomiting, abdominal pain, diarrhea, anorexia, dizziness, seizures, fever, rash, malaise, neuropathy, arthralgias, tendinopathy, heart palpitations, irregular heartbeat, weakness, or syncope) evaluated.

*** Liver function tests only at baseline unless abnormalities at baseline, symptoms consistent with hepatotoxicity develop, or for patients who chronically consume alcohol, take other potentially hepatotoxic medications, or have viral hepatitis or history of liver disease, HIV infection, or previous drug-induced liver injury.

††† Further monitoring if baseline abnormalities or clinically indicated.

§§§ HIV testing in all patients; CD4 lymphocyte count and HIV RNA load testing if HIV infection.

¶¶¶ Hepatitis screening for all patients in accordance with CDC guidelines. Patients with hepatitis B or C risk factors or elevated baseline liver function tests should be tested for these viruses. https://www.cdc.gov/mmwr/volumes/69/rr/rr6902a1.htm

**** Fasting glucose or hemoglobin A1c for patients with risk factors for diabetes according to the American Diabetes Association, including age >45 years; body mass index >25 kg/m^2; first-degree relative with diabetes; and race/ethnicity of African American, Asian, Hispanic, American Indian or Alaska Native, or Native Hawaiian or other Pacific Islander. For patients with diabetes, glucose monitoring is indicated. https://professional.diabetes.org/content-page/practice-guidelines-resources

†††† Persons who can become pregnant should be advised to use a barrier contraceptive method, nonhormonal intrauterine device, or abstain from heterosexual intercourse during treatment.

response (*2*). Mycobacterial isolates obtained after 2 months should be sent to a reference laboratory for DST. If drug resistance to INH, RIF, PZA, or any fluoroquinolone is detected by any testing method (i.e., phenotypic or molecular) in baseline or follow-up specimens, the 4-month regimen should be stopped, and patients should be started on an appropriate treatment regimen that accounts for the identified drug-resistance pattern (*7*). Patients who become pregnant while on treatment should receive clinical consultation regarding whether to stop the 4-month daily treatment regimen and be treated with an alternative regimen that is considered safer for pregnant persons (*2*).

Discussion

The 4-month RPT-MOX regimen is a treatment option for patients aged ≥12 years with drug-susceptible pulmonary TB. Additional studies are needed to understand the pharmacokinetics and efficacy of the 4-month daily treatment regimen in patients for whom this regimen is not currently recommended, including young children, persons who are pregnant, patients with extrapulmonary TB, and patients with an HIV infection who are taking non-efavirenz–based antiretroviral therapy. Clinicians should carefully review a patient's clinical history, concurrent medications, social determinants of health, and risk

factors for adverse drug reactions when making the decision to use this regimen.

Although neither RPT nor MOX has a labeling indication for a 4-month treatment of TB disease in the United States, RPT is recommended in U.S. guidelines as part of a preferred treatment regimen to prevent TB in persons with latent tuberculosis infection (*8*), and MOX is recommended as a drug for TB treatment (*2*). Available formulations of RPT, a key drug in the 4-month regimen, and of RIF, a key drug in standard 6-month TB treatment, have recently been found to contain low levels of nitrosamines.* More information about nitrosamines in these and other pharmaceuticals is available from the Food and Drug Administration (https://www.fda.gov/drugs/drug-safety-and-availability/information-about-nitrosamine-impurities-medications).

Health care providers seeking clinical consultation should contact their state, tribal, local, and territorial health department TB programs (https://www.tbcontrollers.org/community/statecityterritory/) or the CDC-funded TB Centers of Excellence for Training, Education, and Medical Consultation (https://www.cdc.gov/tb/education/tb_coe/). CDC has information for health care providers and patients at https://www.cdc.gov/tb/topic/treatment/tbdisease.htm. CDC and other organizations will monitor the implementation of this interim guidance and update TB clinical guidelines as necessary.

* https://www.fda.gov/drugs/drug-safety-and-availability/fda-updates-and-press-announcements-nitrosamines-rifampin-and-rifapentine

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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Use of Ebola Vaccine: Expansion of Recommendations of the Advisory Committee on Immunization Practices To Include Two Additional Populations — United States, 2021

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Introduction

On December 19, 2019, the Food and Drug Administration (FDA) approved rVSVΔG-ZEBOV-GP Ebola vaccine (ERVEBO, Merck) for the prevention of Ebola virus disease (EVD) caused by infection with Ebola virus, species *Zaire ebolavirus,* in adults aged ≥18 years. In February 2020, the Advisory Committee on Immunization Practices (ACIP) recommended preexposure vaccination with ERVEBO for adults aged ≥18 years in the United States who are at highest risk for potential occupational exposure to Ebola virus because they are responding to an outbreak of EVD, work as health care personnel at federally designated Ebola treatment centers in the United States, or work as laboratorians or other staff members at biosafety level 4 facilities in the United States (*1*).

This policy note reviews the expansion of these recommendations to include two additional populations: 1) health care personnel* involved in the care and transport of patients with suspected or confirmed EVD at special pathogens treatment centers (SPTCs) and 2) laboratorians and support staff members at Laboratory Response Network (LRN) facilities that handle specimens that might contain replication-competent Ebola virus (species *Zaire ebolavirus*) in the United States.

Background

Ebola virus, species *Zaire ebolavirus,* is the most lethal of the four viruses that cause EVD in humans, with case fatality rates of 70%–90% when untreated (*2*). The virus is highly transmissible and can be found in all body fluids of an infected person (*3*–*5*). If untreated, death from EVD can be rapid, usually occurring 7–10 days after the onset of symptoms (*6*–*9*).

Methods

During March 2020–November 2021, the Ebola Vaccine Work Group met at least monthly via conference call to review and discuss relevant evidence regarding expansion of recommendations to the two populations of interest using the Evidence to Recommendations framework.†

SPTCs. SPTCs (formerly known as state-designated Ebola treatment centers) are health care facilities, designated by states, that intend to receive and can provide care for a patient with suspected or confirmed EVD for the duration of their illness (*10*). Currently, there are approximately 55 U.S. SPTCs, with 100–150 health care personnel at each facility. Upon the recommendation of the Council for State and Territorial Epidemiologists, the name "special pathogens treatment centers" replaced "state-designated Ebola treatment centers" because many of these centers have the capability to treat patients with other diseases in addition to EVD.

LRN facilities. LRN is a large network of laboratories throughout the United States; these facilities aim to rapidly respond to biologic and chemical threats and other public health emergencies. Within the LRN, there are currently 58 laboratories that have the capacity to test for Ebola virus, with up to 15 persons at each facility trained to perform the testing (*11*).

Knowledge, Attitude and Practices survey. A Knowledge, Attitude and Practices survey was distributed to personnel at both SPTCs and LRN facilities. The purpose of the survey was to measure EVD vaccine acceptability and sentiments in these populations. Survey questions assessed perceived severity of EVD and risk for infection, interest in receiving the vaccine, and concerns about the vaccine. SPTCs and LRN facilities were provided anonymous survey website links to a point of contact at each site. The survey was distributed to the SPTCs on October 14, 2020 and to LRN facilities on

* Health care personnel refers to all paid and unpaid persons serving in health care settings who have the potential for direct or indirect exposure to patients or infectious materials, including body substances (e.g., blood, tissue, and specific body fluids); contaminated medical supplies, devices, and equipment; contaminated environmental surfaces; or contaminated air. These health care personnel include, but are not limited to, emergency medical service personnel, nurses, nursing assistants, physicians, technicians, clinical laboratory personnel, autopsy personnel, therapists, phlebotomists, pharmacists, students and trainees, contractual staff members not employed by the health care facility, and persons not directly involved in patient care, but who could be exposed to infectious agents that can be transmitted in the health care setting (e.g., clerical, dietary, environmental services, laundry, security, engineering and facilities management, administrative, billing, and volunteer personnel).

† https://www.cdc.gov/vaccines/acip/recs/grade/ebola-vaccine-etr.html

December 29, 2020 and remained open for both populations until January 22, 2021.[§]

Vaccine efficacy and safety. The Ebola Vaccine Work Group relied upon Grading of Recommendations, Assessment, Development and Evaluation (GRADE) evidence profiles, which provide detailed methods and results used to assess Ebola vaccine efficacy and safety.[¶] These profiles were presented at the February 26, 2020, ACIP meeting.

Summary of Major Findings

Knowledge, Attitude and Practices survey to SPTCs and LRN facilities. Fifty-one SPTCs in 24 states were identified at the time of the survey. Among those, the survey was distributed to 49 centers; contact information was missing for two of the centers. In total, 364 survey responses were received from the SPTC population; 66 were excluded because of incompleteness, leaving 298 responses for analyses. Among SPTC respondents, 69% were women and 52% were aged ≥40 years. Thirty-nine percent of SPTC respondents self-identified as nurses and 22% as physicians. Additional health care professional groups included respiratory therapists, emergency medical technicians, advanced practice providers, laboratory technicians, and others. Sixty-two LRN facilities (the number of facilities capable of testing for Ebola virus at the time of the survey) were identified. Ninety-six survey responses were received from this population; 26 were excluded because of incompleteness, leaving 70 responses included for analyses. Among LRN respondents, 64% were women and 76% were aged ≥40 years. Most LRN respondents (64%) self-identified as "laboratory scientist."

Fifty-four percent of SPTC survey respondents reported willingness to be vaccinated if they were eligible and offered the vaccine at the time of survey administration.[**] When given the choice to get vaccinated at different time points (i.e., when an EVD case is imported to the United States or when an EVD case is imported to their state), willingness to receive vaccine increased to 81%. When asked whether they believed that ACIP should recommend the vaccine for their population, 53% responded yes, 9% responded no, and 38% were unsure.

Fifty-nine percent of LRN survey respondents reported willingness to be vaccinated if they were eligible and offered the vaccine at the time of survey administration.[††] When given the choice to get vaccinated at different time points (i.e., when an EVD case is imported to the United States, or when an EVD case is imported to their state), willingness to receive vaccine increased to 86%. When asked whether they believed that ACIP should recommend the vaccine for their population, 59% responded yes, 9% responded no, and 33% were unsure.

Summary

What is already known about this topic?

Preexposure vaccination against Ebola virus disease is currently recommended for adults aged ≥18 years in the United States who are at highest risk for occupational exposure to Ebola virus.

What is added by this report?

The Advisory Committee on Immunization Practices has expanded recommendations to include two additional populations at high risk for potential occupational exposure to Ebola virus: health care personnel at special pathogens treatment centers and laboratorians and support staff members at Laboratory Response Network facilities.

What are the implications for public health practice?

Ebola virus remains an international and domestic public health threat. Preexposure vaccination can protect those at occupational risk for exposure to Ebola virus.

Rationale

Similar to the initial groups for whom the vaccine was recommended in February 2020, the decision to recommend preexposure vaccination in these groups was based on the following conditions: 1) documented protective efficacy of the vaccine against the development of symptomatic EVD, 2) high mortality and severity of illness in persons infected with Ebola virus, 3) high transmissibility of Ebola virus, 4) EVD-related sequelae in survivors, 5) the potential for continued disease transmission and disease recrudescence, and 6) an acceptable safety profile relative to the severity of Ebola virus infection.

Recommendations

Preexposure vaccination with ERVEBO is now also recommended for adults aged ≥18 years in the U.S. population who are at high risk for potential occupational exposure to Ebola virus:

- Health care personnel involved in the care and transport of patients with suspected or confirmed EVD at SPTCs, or
- Laboratorians and support staff members at LRN facilities that handle specimens that might contain replication-competent Ebola virus (species *Zaire ebolavirus*) in the United States.

[§] During this time, there was an Ebola outbreak in Equateur Province in the Democratic Republic of the Congo; the end of the outbreak was declared on November 18, 2020.

[¶] https://www.cdc.gov/vaccines/acip/recs/grade/ebola-vaccine.html

[**] These respondents took the survey during October 14, 2020–January 22, 2021. During this time, there was an Ebola outbreak in Equateur Province in the Democratic Republic of the Congo; the end of the outbreak was declared on November 18, 2020.

[††] These respondents took the survey during December 29, 2020–January 21, 2021. During this time, there were no active Ebola virus outbreaks in the world.

Future Research and Monitoring Priorities

Research regarding ERVEBO is ongoing, including safety of ERVEBO in immunocompromised persons, pregnant women, and children. The same considerations and recommendations for these special populations apply as in the initial recommendations (*1*). In addition, long-term studies are continuing to assess immunogenicity and duration of protection. ACIP will consider these data as they become available and revise recommendations accordingly.

Acknowledgments

Members of the Advisory Committee on Immunization Practices; member roster as of November 2021 is available (https://www.cdc.gov/vaccines/acip/members/index.html).

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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Antigen Test Positivity After COVID-19 Isolation — Yukon-Kuskokwim Delta Region, Alaska, January–February 2022

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Isolation is recommended during acute infection with SARS-CoV-2, the virus that causes COVID-19, but the duration of infectiousness varies among individual persons. Rapid antigen test results have been correlated with detection of viable virus (*1*–*3*) and might inform isolation guidance, but data are limited for the recently emerged SARS-CoV-2 B.1.1.529 (Omicron) variant. On January 5, 2022, the Yukon-Kuskokwim Health Corporation (YKHC) recommended that persons with SARS-CoV-2 infection isolate for 10 days after symptom onset (or, for asymptomatic persons, 10 days after a positive nucleic acid amplification or antigen test result). However, isolation could end after 5–9 days if symptoms were resolving or absent, fever was absent for ≥24 hours without fever-reducing medications, and an Abbott BinaxNOW COVID-19 Ag (BinaxNOW) rapid antigen test result was negative. Antigen test results and associated individual characteristics were analyzed among 3,502 infections reported to YKHC during January 1–February 9, 2022. After 5–9 days, 396 of 729 persons evaluated (54.3%) had a positive antigen test result, with a declining percentage positive over time. In a multivariable model, a positive antigen test result was more likely after 5 days compared with 9 days (adjusted odds ratio [aOR] = 6.39) or after symptomatic infection (aOR = 9.63), and less likely after previous infection (aOR = 0.30), receipt of a primary COVID-19 vaccination series (aOR = 0.60), or after both previous infection and receipt of a primary COVID-19 vaccination series (aOR = 0.17). Antigen tests might be a useful tool to guide recommendations for isolation after SARS-CoV-2 infection. During the 10 days after infection, persons might be infectious to others and are recommended to wear a well-fitting mask when around others, even if ending isolation after 5 days.

YKHC provides health care and public health services to approximately 27,000 persons in an area of southwest Alaska that includes 50 remote communities; high rates of COVID-19 have been reported in this region.* On January 5, 2022, after rapidly increasing incidence of SARS-CoV-2 infections associated with introduction of the Omicron variant,† YKHC recommended an isolation policy incorporating the use of SARS-CoV-2 antigen tests.§ All persons with a positive SARS-CoV-2 antigen or nucleic acid amplification test (NAAT) result were eligible to receive a follow-up BinaxNOW SARS-CoV-2 antigen test 5–9 days after symptom onset (or, in asymptomatic persons, after the first positive test result) if the person reported no symptoms or resolving symptoms, and no fever for ≥24 hours without fever-reducing medications. Persons were recommended to isolate for 10 days but could end isolation after 5–9 days if the follow-up antigen test was negative; all persons were advised to wear a well-fitting mask around others and to avoid close contact with persons at elevated risk for severe COVID-19, until the end of the 10-day period.

Persons with a positive SARS-CoV-2 NAAT or antigen test result were interviewed by a public health or clinic staff member after notification to YKHC, and at the time of a follow-up antigen test, if performed after the initial interview. Information collected included age, sex, whether the person was of the American Indian or Alaska Native race, and whether any symptoms were reported during follow-up. Persons were considered vaccinated if ≥14 days had elapsed since completion of a primary COVID-19 vaccination series and were considered to have received a booster dose if ≥7 days had elapsed after receipt of their booster dose. Previous infection was defined as a previous positive NAAT or antigen test result >90 days before the current infection episode; vaccination and previous infection status were assessed from electronic health records. Follow-up antigen testing was performed by YKHC staff members at a local health facility using the BinaxNOW antigen test¶; results of the first follow-up antigen test were recorded in the electronic health record.

Positive results of the first follow-up antigen test were evaluated by demographic characteristics, symptom status, previous infection, vaccination status, and number of days since symptom onset or a positive test result. Multivariable logistic regression models were used to identify factors independently associated with a positive follow-up antigen test result, adjusted for age group, previous infection, vaccination status, presence of symptoms, and number of days since symptom onset or the initial positive test result. Statistical analyses were conducted

* https://www.ykhc.org/covid-19/situation-reports (Accessed February 12, 2022).
† https://akvariants.github.io (Accessed February 7, 2022).
§ https://www.ykhc.org/wp-content/uploads/2022/01/010522-YKHC-Guidance-for-Vaccinated-and-Unvaccinated-Individuals-1.pdf
¶ https://www.fda.gov/media/141570/download

using SAS (version 9.4; SAS Institute), using a two-sided significance threshold of p<0.05; univariate comparisons were made using the chi-square test. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.**

During January 1–February 9, 2022, a total of 3,502 persons with SARS-CoV-2 infection were reported to YKHC, including 3,266 (93.3%) in whom symptom onset or the initial positive test result had occurred 5–9 days earlier. Among these persons, 729 (22.3%) received a follow-up BinaxNOW antigen test 5–9 days after symptom onset or, among asymptomatic persons, after the first positive test result (Supplementary Table, https://stacks.cdc.gov/view/cdc/114423). The median age was 30 years (IQR = 17–45 years), 380 (52.1%) were female, and 666 (91.4%) were of the American Indian or Alaska Native race. By the day of the initial positive test, 541 (74.2%) had completed a primary COVID-19 vaccination series ≥14 days earlier, including 215 (39.7%) who had also received a booster dose; 21 (2.9%) persons were partially vaccinated, and 167 (22.9%) were unvaccinated. Previous infection was documented in 145 (19.9%) persons, including 108 who had also completed a primary COVID-19 vaccination series; among persons with a previous infection, a median of 418 days (IQR = 343–439 days) had elapsed between the earlier infection and the current episode. Symptoms were reported by 564 (77.4%) persons. Compared with persons with SARS-CoV-2 infection without follow-up antigen testing, those with follow-up antigen testing were more likely to be older (median age = 30 years versus 22 years, p<0.001) and to have received a primary COVID-19 vaccine series (74.2% versus 59.9%; p<0.001), although other characteristics were similar.

Overall, 396 (54.3%) tested persons had a positive BinaxNOW antigen test 5–9 days after symptom onset or after an initial positive test (Table 1). A positive antigen test was more likely after a symptomatic infection (361 of 564, 64.0%) than after an asymptomatic infection (35 of 165, 21.2%) (p<0.001). The proportion of positive antigen test results declined with the number of days since an initial positive test (p<0.001), and, among persons with symptomatic infections, since symptom onset (p<0.001) (Figure). A positive test result was more likely if there was no history of previous infection (346 of 584, 59.2%) than if there was a documented previous infection (50 of 145, 34.5%) (p<0.001). Among 541 persons who received a primary vaccination series, 285 (52.7%) had a positive antigen test result, including 127 of 215 (59.1%) persons who had received a booster dose and 158 of 326 (48.5%) who had not received a booster dose. Among 167 unvaccinated persons, 98 (58.7%) had a positive antigen test result. In multivariable models, a positive antigen test result was more likely after 5 days than after 9 days (aOR = 6.39; 95% CI = 3.39–12.03), symptomatic infection (aOR = 9.63; 95% CI = 6.03–15.37), and less likely after previous infection (aOR = 0.30; 95% CI = 0.19–0.46), receipt of a primary COVID-19 vaccination series (aOR = 0.60; 95% CI = 0.39–0.93) or after both previous infection and receipt of a primary COVID-19 vaccination series (aOR = 0.17; 95% CI = 0.09–0.33) (Table 2).

Discussion

In this study conducted after SARS-CoV-2 infection during emergence of the Omicron variant, the majority of persons with follow-up testing had a positive antigen test result 5–9 days after symptom onset, or, among asymptomatic persons, after the initial positive diagnostic test. The proportion of positive test results declined with time since infection and was lower after asymptomatic than symptomatic infections. The proportion of positive follow-up antigen test results was also lower after previous SARS-CoV-2 infection or vaccination and was lowest among vaccinated persons with a previous infection. However, the percentage of positive test results after SARS-CoV-2 infection among those who had received a booster dose was similar to that among unvaccinated persons; the reasons for this finding are unclear and might reflect differences in testing practices or other individual characteristics. Overall, these findings are consistent with other analyses of positive test results by time since infection, including a recent study in which 43% percent of health care workers with SARS-CoV-2 infection were found to have received a positive antigen test result after 5–10 days.††

Persons are estimated to be most infectious approximately 4 days after SARS-CoV-2 infection (*4*), and SARS-CoV-2 virus generally can be cultured up to 10 days after symptom onset (*3*). Rapid antigen test results have previously been shown to correlate with real-time reverse transcription–polymerase chain reaction cycle threshold values (*5*), and with detection of viable virus, for several days after infection (*1*,*3*,*6*). Among persons in this study with symptomatic infection, 64% received a positive antigen test result during the 5–9 days after symptom onset. However, a positive antigen test result does not necessarily mean that a person is infectious; similarly, a negative test result does not necessarily mean that a person is not infectious. Nonetheless, a positive or negative antigen test might be a useful proxy for the risk for being infectious. Therefore, lower prevalence of positive test results over time and after asymptomatic infections might reflect lower infectiousness. However,

** 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.

†† https://www.medrxiv.org/content/10.1101/2022.02.01.22269931v1.full.pdf

TABLE 1. Characteristics associated with a positive SARS-CoV-2 antigen test result 5–9 days after symptom onset or after a positive initial test result for SARS-CoV-2 — Yukon-Kuskokwim Delta region, Alaska, January–February 2022

Characteristic	Antigen test result* positive, no./total no. (%)		
	All infections† (N = 729)	Symptomatic infections† (n = 564)	Asymptomatic infections† (n = 165)
Symptomatic†			
No	**35/165 (21.2)**	—	35/165 (21.2)
Yes	**361/564 (64.0)**	361/564 (64.0)	—
Age group, yrs			
0–17	**93/186 (50.0)**	83/131 (63.4)	10/55 (18.2)
18–49	**216/400 (54.0)**	196/315 (62.2)	20/85 (23.5)
≥50	**87/143 (60.8)**	82/118 (69.5)	5/25 (20.0)
Sex			
Male	**180/349 (51.6)**	159/253 (62.8)	21/96 (21.9)
Female	**216/380 (56.8)**	202/311 (65.0)	14/69 (20.3)
Race and ethnicity			
American Indian or Alaska Native	**361/666 (54.2)**	329/513 (64.1)	32/153 (20.9)
Other	**35/63 (55.6)**	32/51 (62.7)	3/12 (25.0)
Previous infection§			
No	**346/584 (59.2)**	315/459 (68.6)	31/125 (24.8)
Yes	**50/145 (34.5)**	46/105 (43.8)	4/40 (10.0)
Primary COVID-19 vaccination¶			
No	**98/167 (58.7)**	88/123 (71.5)	10/44 (22.7)
Yes	**285/541 (52.7)**	264/427 (61.8)	21/114 (18.4)
Primary COVID-19 vaccination or previous infection¶,§			
Unvaccinated, no previous infection	**82/131 (62.6)**	72/96 (75.0)	10/35 (28.6)
Unvaccinated, previous infection	**16/36 (44.4)**	16/27 (59.3)	0/9 (—)
Vaccinated, no previous infection	**251/433 (58.0)**	234/349 (67.0)	17/84 (20.2)
Vaccinated, previous infection	**34/108 (31.5)**	30/78 (38.5)	4/30 (13.3)
Days since onset or test**			
5	**160/237 (67.5)**	142/179 (79.3)	18/58 (31.0)
6	**91/166 (54.8)**	80/121 (66.1)	11/45 (24.4)
7	**75/144 (52.1)**	74/111 (66.7)	1/33 (3.0)
8	**43/112 (38.4)**	39/93 (41.9)	4/19 (21.1)
9	**27/70 (38.6)**	26/60 (43.3)	1/10 (10.0)
5–9	**396/729 (54.3)**	361/564 (64.0)	35/165 (21.2)

Abbreviation: NAAT = nucleic acid amplification test.

* Abbott BinaxNOW COVID-19 Ag (BinaxNOW) rapid antigen test.

† SARS-CoV-2 infection diagnosed by NAAT or antigen test. persons were classified as symptomatic if symptoms were reported during routine case interview or isolation follow-up call.

§ Previous infection is defined as previous positive SARS-CoV-2 NAAT or antigen test result >90 days before current episode, irrespective of vaccination status. Among those who were vaccinated and with previous infection, 96 had an infection before completion of the vaccination series.

¶ Vaccinated was defined as being ≥14 days after 2 doses of an mRNA COVID-19 vaccine (Pfizer-BioNTech or Moderna) or 1 dose of the Janssen (Johnson & Johnson) COVID-19 vaccine. Compared with no vaccination; 21 persons with partial vaccination were excluded. Among vaccinated persons, 518 had completed a 2-dose COVID-19 mRNA vaccination series, and 23 had received 1 dose of the Janssen vaccine. Two hundred fifteen persons were ≥7 days after a booster dose, among whom 127 of 215 (59.1%) had a positive antigen test result (126 of 212 [59.4%] among those aged ≥18 years); 158 of 326 (48.5%) other vaccinated persons had a positive test result (119 of 232 [51.3%] among those aged ≥18 years).

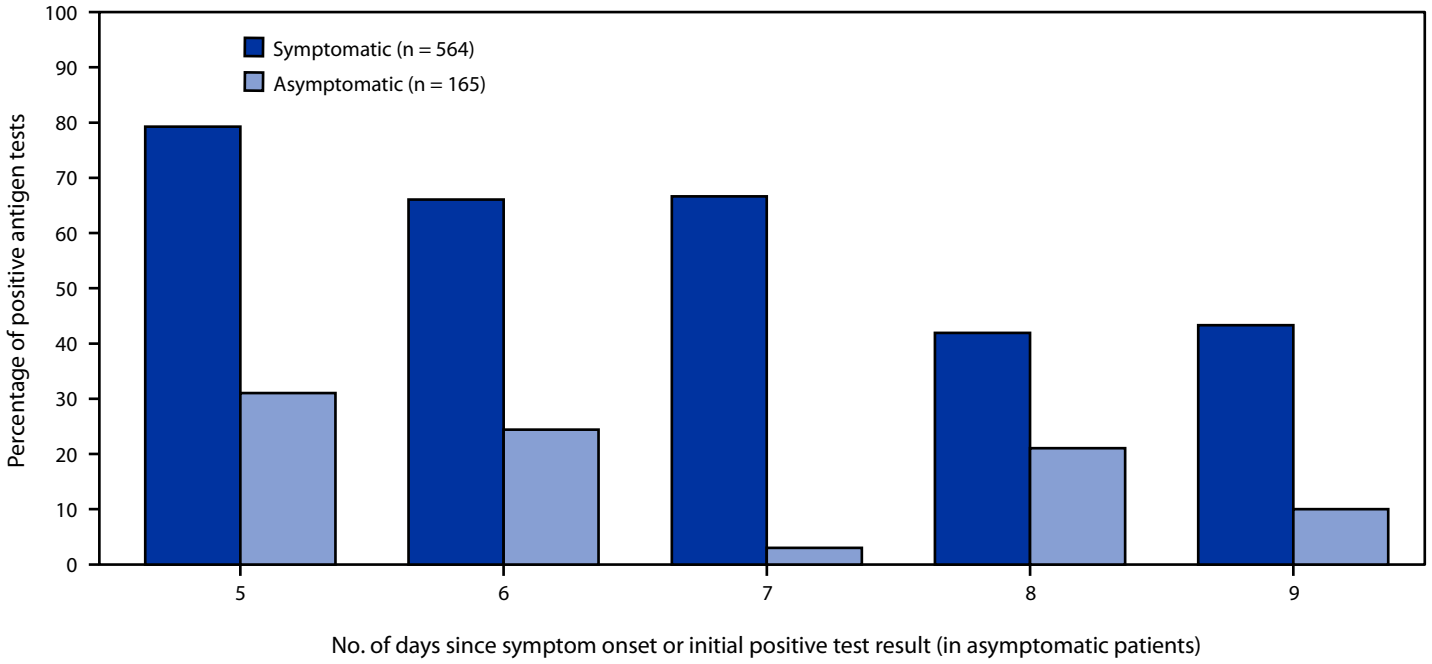
** Defined as days since symptom onset if symptomatic, or days since the initial NAAT or antigen test if asymptomatic.

even if a person is infectious after an initial diagnosis, the risk for transmission to others depends on other important factors, including the duration and proximity of contact with others, and proper use of a well-fitting mask (*7,8*). Following CDC recommendations,§§ YKHC advised continued mask use for 10 days after symptom onset even if a person met the criteria for ending isolation after 5 days. The high percentage of positive antigen test results during the 5–9 days after symptom onset reinforces the importance of correct and consistent mask use during this period.

The findings in this report are subject to at least six limitations. First, only one follow-up antigen test was included in the analysis for each person; data were cross-sectional rather than longitudinal. However, the multivariable model accounted for changes in reported characteristics over time. Second, the timing of acquisition of asymptomatic infections was unknown, limiting interpretation of changes in positivity over time in this group. Third, information is still accruing on the correlation between antigen tests and virus culture over time. Correlation

§§ https://www.cdc.gov/coronavirus/2019-ncov/your-health/quarantine-isolation.html (Accessed February 12, 2022).

FIGURE. Proportion of Abbott BinaxNOW COVID-19 Ag rapid antigen test results positive 5–9 days after symptom onset or after a positive initial test result* for SARS-CoV-2, by symptom status† (N = 729) — Yukon-Kuskokwim Delta region, Alaska, January–February 2022



* The initial test was a nucleic acid amplification test or antigen test for SARS-CoV-2. The chart summarizes the first follow-up antigen test result for each person during the 5–9 days after illness onset, or after the initial positive test result if asymptomatic.
† Persons are classified as symptomatic if symptoms were reported during routine interview or isolation follow-up call.

might vary between some tests or after introduction of the Omicron variant, although initial viral titers appear to be similar between Omicron and B.1.617.2 (Delta) variants.¶¶ Fourth, approximately 22% of persons who were 5–9 days after illness onset or an initial positive test result opted to have a follow-up antigen test, introducing potential selection bias. The sample was limited to persons whose symptoms were already resolving and might not be representative of all reported cases in other ways. Fifth, behavioral bias associated with the threshold for testing initially or during follow-up could possibly affect comparisons between individual characteristics. Finally, the results might be confounded by unmeasured factors.

Approximately 50% of antigen tests were positive 5–9 days after infection, but the percentage of positive results declined during this period and was lower after asymptomatic infection, after previous infection, and in persons who have completed a primary COVID-19 vaccine series. During the 10 days after infection, persons might be infectious to others and are recommended to wear a well-fitting mask when around others, and to avoid contact with those at elevated risk for severe disease, even if ending isolation after 5 days. Antigen tests might be a useful tool to guide recommendations for isolation after SARS-CoV-2 infection.

Summary

What is already known about this topic?

Positive rapid antigen test results after SARS-CoV-2 infection have been associated with the presence of viable virus, but the role of antigen tests in isolation guidance for persons with SARS-CoV-2 infection is unclear.

What is added by this report?

Between 5 and 9 days after symptom onset or after initial diagnosis with SARS-CoV-2 infection, 54% of persons had positive SARS-CoV-2 antigen test results. The proportion of positive results declined over time. Negative follow-up antigen test results were associated with asymptomatic infection, previous infection, and being vaccinated.

What are the implications for public health practice?

Antigen tests might be a useful tool to guide recommendations for isolation after SARS-CoV-2 infection.

¶¶ https://www.medrxiv.org/content/10.1101/2022.01.10.22269010v2

TABLE 2. Associations between individual characteristics and a positive SARS-CoV-2 antigen test result 5–9 days after symptom onset or after a positive initial SARS-CoV-2 test result — Yukon-Kuskokwim Delta region, Alaska, January–February 2022

	Odds ratio (95% CI)					
	All infections* (N = 729)		Symptomatic infections* (n = 564)		Asymptomatic infections* (n = 165)	
Characteristic	Unadjusted	Adjusted†	Unadjusted	Adjusted†	Unadjusted	Adjusted†
Symptomatic infection§	**6.61 (4.38–9.96)**	**9.63 (6.03–15.37)**	—	—	—	—
Age group, yrs						
<18 (Ref)	**Ref**	**Ref**	Ref	Ref	Ref	Ref
18–49¶	**1.17 (0.83–1.66)**	**1.2 (0.78–1.85)**	0.95 (0.63–1.45)	1.05 (0.65–1.71)	1.39 (0.59–3.24)	1.93 (0.69–5.45)
≥50¶	**1.55 (1.00–2.42)**	**1.62 (0.95–2.76)**	1.32 (0.78–2.24)	1.58 (0.87–2.86)	1.13 (0.34–3.72)	1.36 (0.33–5.61)
Vaccination and previous infection status						
Previous infection**	**0.36 (0.25–0.53)**	**0.30 (0.19–0.46)**	0.36 (0.23–0.55)	0.29 (0.18–0.46)	0.34 (0.11–1.0)	0.37 (0.11–1.19)
Primary COVID-19 vaccination††	**0.78 (0.55–1.11)**	**0.60 (0.39–0.93)**	0.64 (0.42–1)	0.6 (0.36–0.99)	0.77 (0.33–1.8)	0.67 (0.26–1.76)
Unvaccinated, no previous infection (Ref)	**Ref**	**Ref**	Ref	Ref	Ref	Ref
Primary COVID-19 vaccination, no previous infection§§	**0.82 (0.55–1.23)**	**0.60 (0.37–0.99)**	0.68 (0.41–1.13)	0.68 (0.39–1.19)	0.63 (0.26–1.57)	0.5 (0.18–1.42)
Primary COVID-19 vaccination, previous infection§§	**0.28 (0.16–0.47)**	**0.17 (0.09–0.33)**	0.21 (0.11–0.4)	0.16 (0.08–0.34)	0.39 (0.11–1.39)	0.30 (0.07–1.29)
No. of days after symptom onset until positive SARS-CoV-2 antigen test result						
5¶¶	**3.31 (1.9–5.75)**	**6.39 (3.39–12.03)**	5.02 (2.68–9.38)	6.84 (3.49–13.43)	4.05 (0.48–34.41)	4.11 (0.45–37.37)
6¶¶	**1.93 (1.09–3.42)**	**3.39 (1.78–6.46)**	2.55 (1.35–4.81)	3.16 (1.61–6.23)	2.91 (0.33–25.63)	3.18 (0.34–29.67)
7¶¶	**1.73 (0.97–3.1)**	**2.85 (1.48–5.47)**	2.62 (1.37–4.99)	3.47 (1.74–6.93)	0.28 (0.02–4.95)	0.34 (0.02–6.29)
8¶¶	**0.99 (0.54–1.83)**	**1.24 (0.63–2.42)**	0.94 (0.49–1.82)	1.18 (0.59–2.35)	2.4 (0.23–24.96)	2.25 (0.19–26.76)
9 (Ref)	**Ref**	**Ref**	Ref	Ref	Ref	Ref

Abbreviations: NAAT = nucleic acid amplification test; Ref = referent group.

* SARS-CoV-2 infection diagnosed by NAAT or antigen test. Persons were classified as symptomatic if symptoms were reported during routine case interview or isolation follow-up call.

† Adjusted for age group, days since symptom onset or positive test result, previous infection status, previous vaccination status, and whether symptoms were reported.

§ Compared with asymptomatic infection. Adjusted analyses excluded 21 persons (14 symptomatic and seven asymptomatic).

¶ Compared with children and adolescents (aged <18 years). Adjusted analyses excluded 21 persons (14 symptomatic and seven asymptomatic).

** Defined as previous positive SARS-CoV-2 NAAT or antigen test result >90 days before current episode, irrespective of vaccination status.

†† Vaccinated was defined as being ≥14 days after 2 doses of an mRNA COVID-19 vaccine (Pfizer-BioNTech or Moderna) or 1 dose of the Janssen (Johnson & Johnson) COVID-19 vaccine. Compared with no COVID-19 vaccination. Excluded 21 persons with partial vaccination (14 symptomatic infections and seven asymptomatic infections). Among 541 vaccinated persons, the adjusted odds ratio for a positive test result after being ≥7 days after a booster dose compared with no booster was 1.69 (95% CI = 1.13–2.52), after adjusting for age group, days since symptom onset or positive test result, previous infection status, and whether symptoms were reported.

§§ Compared with unvaccinated without previous infection. Excluded 21 persons with partial vaccination, and 36 unvaccinated persons with previous infection (overall 57 excluded, 41 symptomatic infections and 16 asymptomatic infections).

¶¶ Compared with day 9, where the day is defined as symptom onset (if symptomatic) or initial positive NAAT or antigen test result (if asymptomatic). Adjusted analyses excluded 21 persons (14 symptomatic and seven asymptomatic).

Acknowledgments

Jennifer Amigliore, Chelsey Beans-Polk, Faith Brink, Katherine Crow, Fisnike Dalipi, Martha Flores, Jackson Grimes, Joseph Klejka, Russell Lamont, Alyssa Leary, Helen Leinberger, Genevieve Maczynski, Kelly O'Brien, Jennifer Pak, Christine Richman, Franceska Robinson, Emily Tracy, Moses Tulim, Jeri Zapotosky, Yukon-Kuskokwim Health Corporation; Prabasaj Paul, Division of Healthcare Quality Promotion, National Centers for Emerging and Zoonotic Diseases, CDC; Eric Mooring, CDC COVID-19 Emergency Response Team; Joseph McLaughlin, Alaska Department of Health and Social Services.

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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Results from a Test-to-Release from Isolation Strategy Among Fully Vaccinated National Football League Players and Staff Members with COVID-19 — United States, December 14–19, 2021

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During December 2021, the United States experienced a surge in COVID-19 cases, coinciding with predominance of the SARS-CoV-2 B.1.1.529 (Omicron) variant (*1*). During this surge, the National Football League (NFL) and NFL Players Association (NFLPA) adjusted their protocols for test-to-release from COVID-19 isolation on December 16, 2021, based on analytic assessments of their 2021 test-to-release data. Fully vaccinated* persons with COVID-19 were permitted to return to work once they were asymptomatic or fever-free and experiencing improving symptoms for ≥24 hours, and after two negative or high cycle-threshold (Ct) results (Ct≥35) from either of two reverse transcription–polymerase chain reaction (RT-PCR) tests† (*2*). This report describes data from NFL's SARS-CoV-2 testing program (*3*) and time to first negative or Ct≥35 result based on serial COVID-19 patient testing during isolation. Among this occupational cohort of 173 fully vaccinated adults with confirmed COVID-19 during December 14–19, 2021, a period of Omicron variant predominance, 46% received negative test results or had a subsequent RT-PCR test result with a Ct≥35 by day 6 postdiagnosis (i.e., concluding 5 days of isolation) and 84% before day 10. The proportion of persons with positive test results decreased with time, with approximately one half receiving positive RT-PCR test results after postdiagnosis day 5. Although this test result does not necessarily mean these persons are infectious (RT-PCR tests might continue to return positive results long after an initial positive result) (*4*), these findings indicate that persons with COVID-19 should continue taking precautions, including correct and consistent mask use, for a full 10 days after symptom onset or initial positive test result if they are asymptomatic.

The NFL consists of 32 member clubs based in 24 states. NFL required COVID-19 vaccination (as of June 7, 2021) and boosters (as of December 27) for staff members who directly interact with players and incentivized but did not require vaccination among players. By October 13, 2021, the NFL population vaccination rate was >96% (staff members >99%; players >94%) (*5*). For most of the 2021 season, fully vaccinated persons were tested weekly and unvaccinated persons were tested daily by RT-PCR; antigen testing was not used. On December 18, 2021, testing protocols transitioned to symptom- or exposure-based testing, determined through enhanced symptom screening and contact tracing for fully vaccinated persons, resulting in approximately two thirds the number of tests, but retaining a high level of case detection (*6*). Around the same time, NFL also updated test-to-release protocols (Box). Daily testing was requested for all fully vaccinated persons with COVID-19, who could be released from isolation if they were asymptomatic or fever-free with symptoms improved for 24 hours with medical staff clearance, and receipt of two negative or Ct≥35 RT-PCR test results (point of care [POC] or laboratory-based) within 24 hours (*2*). Although Ct values have not been validated as a measure of infectiousness (*7*), a conservative Ct cutoff was chosen by NFL based on higher Ct values correlating with limited culturable virus in other studies (*8*).

COVID-19 cases§ identified during December 12, 2021–January 1, 2022, were stratified by whether persons were fully vaccinated, partially vaccinated, or unvaccinated. SARS-CoV-2 tests included either laboratory-based real-time RT-PCR (BioReference Laboratories RT-PCR assay [Roche Cobas assay], Roche) or POC RT-PCR (Mesa Biotech Accula SARS-CoV-2 Test, Mesa Biotech Inc.); both tests demonstrated

*Fully vaccinated was defined as ≥14 days after primary vaccination series completion, with or without a booster. Partially vaccinated was defined by NFL as receipt of 1 dose of a 2-dose series or <14 days after primary vaccine series completion. Under NFL-NFLPA protocols, persons with 1 dose of a 2-dose mRNA vaccination series and a documented history of COVID-19 were subject to the same requirements as were fully vaccinated persons in the NFL-NFLPA protocols; however, these persons were excluded from analyses summarizing the test-to-release from isolation strategy.

†SARS-CoV-2 tests included either laboratory-based real-time RT-PCR (BioReference Laboratories RT-PCR assay [Roche Cobas assay, Roche]) or point of care (POC) RT-PCR (Mesa Biotech Accula SARS-CoV-2 test, Mesa Biotech Inc.). The Roche Cobas RT-PCR test used received Food and Drug Administration (FDA) Emergency Use Authorization as a qualitative diagnostic assay with a Ct cutoff of >40. Use of this assay with alternative Ct cutoffs is not authorized by FDA. The Mesa Biotech Accula test produces a qualitative result (positive/negative) without Ct values.

§A COVID-19 case was defined as detection of SARS-CoV-2 RNA using a diagnostic nucleic acid amplification test performed by a Clinical Laboratory Improvement Amendments–certified provider and confirmed by additional RT-PCR tests alongside clinical adjudication. For COVID-19 cases, day of diagnosis ("day zero") was defined as the day of first positive test result, which in this setting of high access to testing was often the day of symptom onset.

BOX. Test-to-release from isolation procedures — National Football League, United States, June 16, 2021–January 1, 2022

June 16, 2021 (NFL season start)

- Requested daily laboratory-based and POC RT-PCR testing* for all fully vaccinated† persons with COVID-19
- Permitted fully vaccinated persons with COVID-19 to voluntarily return to work early (before 10 days since first positive test) upon meeting the following testing and clinical criteria:
- Testing criteria
  - Two negative laboratory-based RT-PCR tests separated by ≥24 hours
  - One negative POC RT-PCR test before entry on the date of entry
- Clinical criteria
  - Asymptomatic for 48 hours
  - Medical clearance by the team physician
  - Review of test results by the NFL Chief Medical Officer and clinical consultants
- Upon return, all persons followed existing NFL-NFLPA masking and behavioral protocols

November 9, 2021

- Requested daily laboratory-based RT-PCR testing for all fully vaccinated persons with COVID-19
- Permitted fully vaccinated persons with COVID-19 to voluntarily return to work early (before 10 days since first positive test) upon meeting the following testing and clinical criteria
- Testing criteria
  - Days 1–6 after a confirmed positive test result: two negative laboratory-based RT-PCR test results separated by ≥24 hours
  - Days 7–10 after a confirmed positive test result: 1) one negative laboratory-based RT-PCR test result; and 2) one negative POC RT-PCR test result before entry on the day following specimen collection of initial laboratory-based RT-PCR test (taken ≥24 hours later)
- Clinical criteria: Days 1–6 or Days 7–10
  - Asymptomatic for 48 hours (other than loss of taste or smell)
  - Medical clearance by the team physician
  - Confirmation of test results by the NFL Chief Medical Officer and clinical consultants
- Upon return, all persons followed existing NFL-NFLPA masking and behavioral protocols

See box footnotes on the next page.

previous high performance in this setting (*3*) (NFL, unpublished data). Sequence analysis was performed using Illumina COVIDSeq (*9*) for a portion of cases. Symptoms throughout illness were clinically monitored but not centrally recorded; NFL clubs requesting early return permission were required to provide documentation of asymptomatic or improving symptom status. Clubs were requested to closely monitor persons returning and report any new symptoms; persons returning were required to adhere to applicable NFL-NFLPA masking policies.

This report describes results from the NFL test-to-release from isolation strategy for fully vaccinated persons with confirmed COVID-19 during December 14–19, 2021. These dates reflect a period during which the Omicron variant accounted for 97% of sequenced viruses, and protocols requested COVID-19 patients test daily for 10 days after diagnosis (isolation ended on day 5 beginning December 28, 2021). Fully vaccinated persons were included if they were tested ≥6 times during infection, with a final test on day 8 or 9 postdiagnosis or achieved two negative or Ct≥35 RT-PCR test results (after which testing ceased). Subsequent transmission from persons returning from isolation early could not be ascertained because of high community COVID-19 incidence and limited Omicron genomic sequencing diversity. The analysis in this report was conducted by IQVIA on behalf of NFL with CDC's support. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

During December 12, 2021–January 1, 2022, a surge in COVID-19 cases occurred among NFL players and staff, with an average of 336 cases per week, compared with 30 cases per week during the preceding 3 months. Sixty-six (53%) cases occurred among 125 unvaccinated persons, three (23%)

¶ 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.

BOX. (*Continued*) Test -to-release from isolation procedures — National Football League, United States, June 16, 2021–January 1, 2022

December 16, 2021[§]

- Strongly requested daily testing using laboratory-based and POC RT-PCR after a confirmed positive test result for all fully vaccinated persons with COVID-19
- Permitted fully vaccinated persons with COVID-19 to voluntarily return to work early (before 10 days since first positive test result) upon meeting the following testing and clinical criteria
- Testing criteria: two samples collected ≤24 hours of each other on Day 1 or thereafter (may be collected on the same day; must be separate swabs)
  - Two negative or Ct≥35 laboratory-based RT-PCR test results; or
  - One negative or Ct≥35 laboratory-based RT-PCR test result and one negative POC RT-PCR test result; or
  - Two negative POC RT-PCR test results
- Clinical criteria
  - Asymptomatic or fever-free and improving symptoms for ≥24 hours
  - Medical clearance by the team physician
  - Confirmation of test results by the NFL Chief Medical Officer and clinical consultants
- Although Ct values are not a measure of infectiousness[¶] a Ct cutoff of 35 was chosen based on higher Ct values correlating with limited culturable virus using alternative RT-PCR tests[**]
- Upon return, all persons followed existing NFL-NFLPA masking and behavioral protocols

December 28, 2021

- Allowed for day 5 return if fever-free for ≥24 hours, asymptomatic or improving symptoms, and cleared by team physician, regardless of vaccination status[††]
- Once cleared from isolation (between Days 5 and 10), all persons were required to wear a KN95 or N95 mask at all times other than when actively engaged in physical activity at practice or in a game until 10 days following positive test result, at which time they returned to existing NFL-NFLPA masking protocols
- Fully vaccinated persons with COVID-19 could return before Day 5 by meeting the December 16 protocol criteria. Upon return, persons were required to follow existing NFL-NFLPA masking and behavioral protocols.

Abbreviations: FDA = Food and Drug Administration; NFL = National Football League; NFLPA = National Football League Players Association; POC = point-of-care; RT-PCR = reverse transcription–polymerase chain reaction.

* SARS-CoV-2 tests included either laboratory-based real-time RT-PCR (BioReference Laboratories RT-PCR assay [Roche Cobas assay], Roche) or POC RT-PCR (Mesa Biotech Accula SARS-CoV-2 test, Mesa Biotech Inc.); the Roche Cobas RT-PCR test used received FDA Emergency Use Authorization as a qualitative diagnostic assay with a Ct cutoff of >40. Use of this assay with alternative Ct cutoffs is not authorized by FDA. The Mesa Biotech Accula test produces only a qualitative result (positive/negative) and no Ct values.

† Fully vaccinated was defined as ≥14 days after primary vaccine series completion, with or without a booster. Under NFL-NFLPA protocols, persons with 1 dose of a 2-dose mRNA vaccination series and a documented history of COVID-19 were subject to the same requirements as fully vaccinated persons in the NFL-NFLPA protocols; however, these persons were excluded from analyses summarizing the test-to-release from isolation strategy.

§ https://www.nfl.com/news/nfl-updates-covid-19-protocols-to-allow-for-quicker-return-from-quarantine-for-v

¶ https://www.cdc.gov/coronavirus/2019-ncov/lab/faqs.html

** https://academic.oup.com/cid/article/73/11/e3884/6018217

†† https://www.cdc.gov/media/releases/2021/s1227-isolation-quarantine-guidance.html

among 13 partially vaccinated persons, and 924 (14%) among 6,443 fully vaccinated persons.** Among 117 (12%) cases with a sequenced virus isolate during this period, 111 (95%) were classified as Omicron and six (5%) as the SARS-CoV-2 B.1.617.2 (Delta) variant.

** The remaining 15 cases occurred among 75 persons with 1 dose of a 2-dose mRNA vaccination series and a documented history of COVID-19, who were subject to the same requirements as fully vaccinated persons in the NFL-NFLPA protocols. These persons were not included in analyses summarizing the test-to-release from isolation strategy.

Using data from December 14–19, 2021, a total of 218 (5%) cases were identified in NFL players and staff members among 4,134 persons tested; 87 (97%) of 90 sequenced isolates were Omicron. Among 201 COVID-19 cases in fully vaccinated persons that were either confirmed as Omicron or unsequenced (presumed Omicron), 173 (86%) tested for isolation release; the remaining 28 (14%) did not test frequently enough for inclusion. Among these 173 persons, 53 (31%) obtained at least one negative or Ct≥35 RT-PCR test result on or before day 5 postdiagnosis, 79 (46%) on or before day 6 (concluding 5 full days of isolation), and 146 (84%) within 10 days after

diagnosis. Among the 146 persons with at least one negative or Ct≥35 RT-PCR test result in the 10 days after diagnosis, the median interval from diagnosis to first negative result was 6 days (IQR = 5–8 days); among all 173 persons, the median interval was 7 days (IQR = 5–9 days) (Figure 1).

Overall, 130 (75%) of 173 persons tested for return from isolation met NFL-NFLPA protocol testing criteria before 10 days, with median interval to second negative or Ct≥35 test result of 7 days (IQR = 5–8 days); 122 (71%) met both testing and clinical criteria and were eligible to return to work before 10 days after diagnosis (Figure 2). Among the 130 persons who tested for early return from isolation, 116 applied for early return; the remaining 14 did not because either their job function did not require early return (six), or they were still symptomatic (six); two did not apply for early return for unknown reasons. Among 173 persons who tested for release from isolation, the median time to return to work was 8 days (IQR = 6–10 days). None of the persons who returned to work reported onset of new symptoms after early return during the 10 days after diagnosis.

Summary

What is already known about this topic?

On December 16, 2021, the National Football League (NFL) updated its test-to-release from COVID-19 isolation protocols in response to increasing COVID-19 cases and predominance of the SARS-CoV-2 Omicron variant.

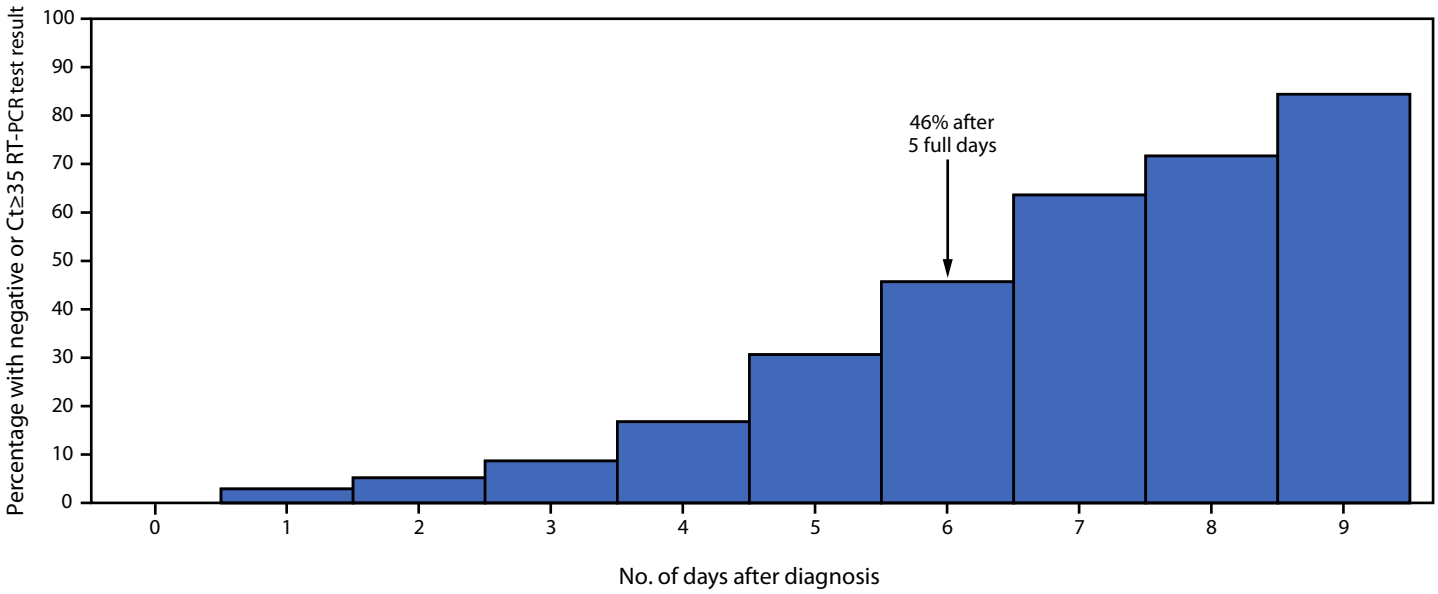
What is added by this report?

Among 173 vaccinated adults with COVID-19 undergoing serial reverse transcription–polymerase chain reaction (RT-PCR) testing during Omicron predominance, 46% received a negative or high cycle threshold RT-PCR test result on or before day 6 postdiagnosis.

What are the implications for public health practice?

Although a positive RT-PCR test result does not necessarily indicate infectiousness, these data indicate that persons with COVID-19 should continue to take precautions, including correct and consistent mask use, for a full 10 days after symptom onset or after initial positive test result if they are asymptomatic.

FIGURE 1. Percentage of 173 fully vaccinated* COVID-19 patients (SARS-CoV-2 B.1.1.529 [Omicron] and unsequenced†) with a negative or cycle-threshold ≥35§ reverse transcription–polymerase chain reaction test result, by number of days after diagnosis — National Football League, United States, December 14–19, 2021



Abbreviations: Ct = cycle threshold; NFL = National Football League; NFLPA = National Football League Players Association; RT-PCR = reverse transcription–polymerase chain reaction.

* Fully vaccinated was defined as ≥14 days after primary vaccine series completion. Under NFL-NFLPA protocols, persons with 1 dose of a 2-dose mRNA vaccination series and a documented history of COVID-19 were subject to the same requirements as fully vaccinated persons in the NFL-NFLPA protocols; however, these persons were excluded from analyses summarizing the test-to-release from isolation strategy.

† Among 173 cases, 77 (45%) were sequenced as Omicron, and 96 (55%) were not sequenced (unsequenced). During December 14–19, 2021, 87 (97%) of 90 sequenced isolates from 218 total cases were Omicron, therefore unsequenced cases were presumed Omicron.

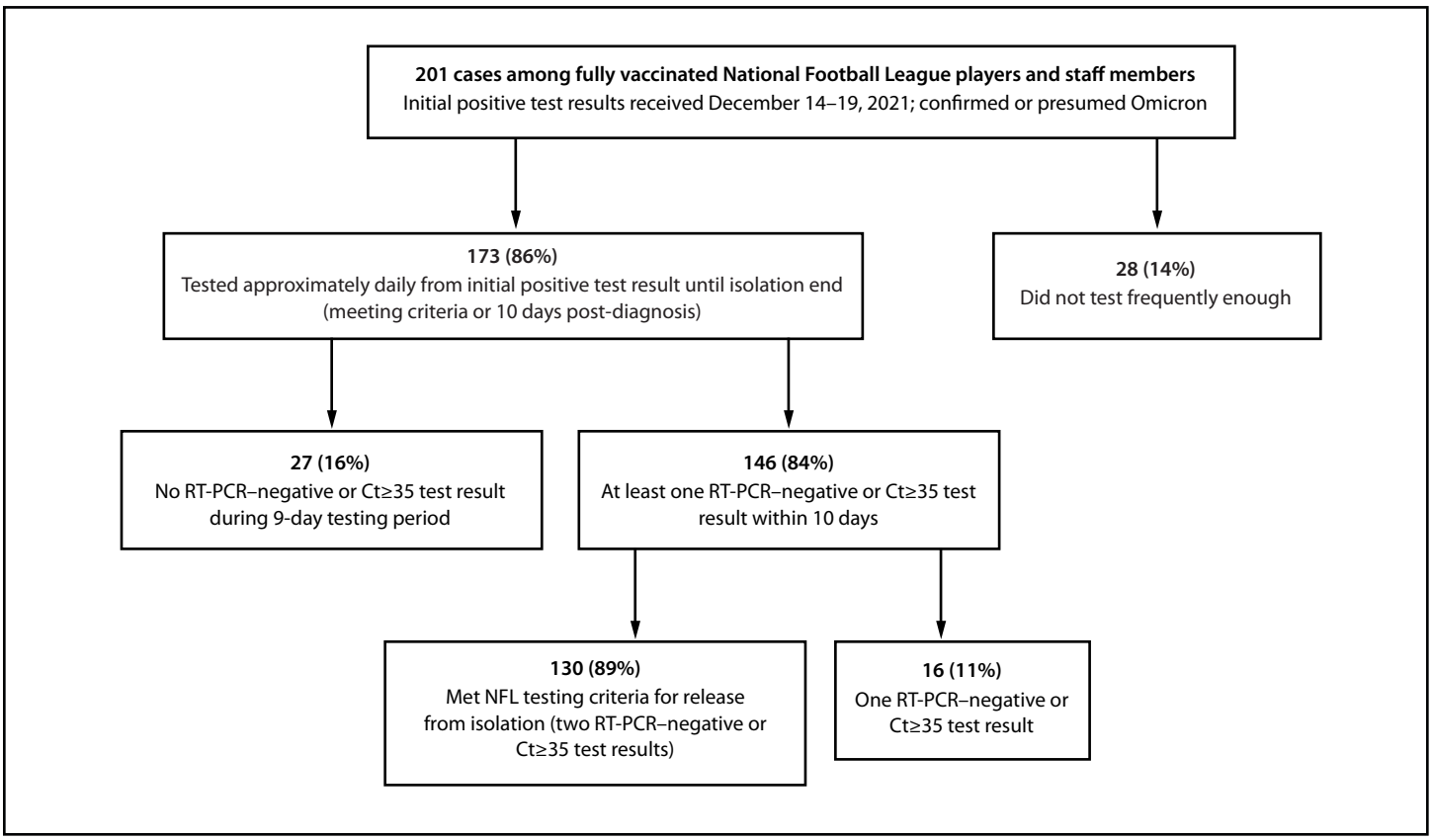
§ Although Ct values are not a measure of infectiousness (https://www.cdc.gov/coronavirus/2019-ncov/lab/faqs.html) a Ct cutoff of 35 was chosen by NFL based on higher Ct values correlating with limited culturable virus using alternative RT-PCR tests (https://academic.oup.com/cid/article/73/11/e3884/6018217).

Discussion

This report describes results from the NFL test-to-release from isolation strategy for fully vaccinated NFL players and staff members with COVID-19 during December 14–19, 2021, after emergence of the Omicron variant. Before day 10 postdiagnosis, ≥71% of infected persons were asymptomatic or significantly improved for 24 hours and had received two negative or Ct≥35 test results and were therefore eligible to return to work under NFL-NFPLA protocols. Although persons were not systematically tested after return from isolation, and transmission after early return from isolation could not be documented, none of the persons who returned to work experienced new symptoms detected by in-facility symptom monitoring.

CDC recommends an additional 5 days of mask use when around others following an isolation period of 5 days, which can end when a person has been fever-free for 24 hours and other symptoms have improved (*10*). The results from this analysis support this masking recommendation, although infectiousness or transmission could not be assessed. Under

FIGURE 2. Test-to-release from isolation results among 201 fully vaccinated* COVID-19 patients (SARS-CoV-2 B.1.1.529 [Omicron] and unsequenced†) undergoing serial reverse transcription–polymerase chain reaction testing§ to allow release from isolation — National Football League, December 14–19, 2021¶,,††**



Abbreviations: Ct = cycle threshold; NFL = National Football League; NFLPA = National Football League Players Association; POC = point of care; RT-PCR = reverse transcription–polymerase chain reaction.

* Fully vaccinated was defined as ≥14 days after primary vaccine series completion, with or without a booster. Under NFL-NFLPA protocols, persons with 1 dose of a 2-dose mRNA vaccination series and a documented history of COVID-19 were subject to the same requirements as fully vaccinated persons in the NFL-NFLPA protocols; however, these persons were excluded from analyses summarizing the test-to-release from isolation strategy.

† Among 201 cases, 79 (39%) were sequenced as Omicron, and 122 (61%) were not sequenced (unsequenced). During December 14–19, 2021, 87 (97%) of 90 sequenced isolates from 218 total cases were Omicron, therefore unsequenced cases were presumed Omicron.

§ RT-PCR tests included either laboratory-based real-time RT-PCR (Bioreference Labs RT-PCR assay [Roche Cobas assay], Roche) or POC RT-PCR (Mesa Biotech Accula SARS-CoV-2 Test, Mesa Biotech Inc.).

¶ Among those who did not test frequently enough, 26 (93%) had a job function that did not require regular attendance in facility or immediate return or were travel-related.

** Among 130 persons who met testing criteria, 122 (94%) met testing and clinical criteria for release from isolation, six had continuing symptoms, and two did not apply for early return for unknown reasons.

†† Although Ct values are not a measure of infectiousness (https://www.cdc.gov/coronavirus/2019-ncov/lab/faqs.html) a Ct cutoff of 35 was chosen by NFL based on higher Ct values correlating with limited culturable virus using alternative RT-PCR tests (https://academic.oup.com/cid/article/73/11/e3884/6018217).

NFL's test-to-release from isolation strategy, approximately one half of fully vaccinated persons with COVID-19 had negative or Ct≥35 RT-PCR test results after 5 full days of isolation (i.e., on day 6), and 84% by day 10. CDC advises that persons with access to tests might use an antigen test toward the end of the 5-day isolation period (*10*), because RT-PCR tests can continue to return positive results with high Ct values intermittently after an initial positive result (*4*). Ct values are not a validated measure of infectiousness; however, the data from this study indicate that persons can receive a positive test result after a 5-day isolation period. It is therefore important for persons with COVID-19 to continue to wear masks correctly and consistently for a full 10 days after symptom onset or after an initial positive test result if they are asymptomatic (*10*).

The findings in this report are subject to at least six limitations. First, these data are based on results from highly sensitive RT-PCR tests, whereas CDC advises that persons with access to rapid antigen tests might use these toward the end of the 5-day isolation period (*10*). Second, because of high community incidence of COVID-19 during this period and limited Omicron genomic sequencing diversity, subsequent transmission postisolation release cannot be ascertained. Third, this investigation is limited to a population of predominantly adult men in an occupational setting, who are likely healthier than the general population, and the NFL testing program differed from U.S. community-based testing; thus, these findings might not be generalizable to other populations. Fourth, Ct values from RT-PCR tests do not necessarily indicate viral load or infectiousness in an individual person, and other factors, including specimen collection and handling, can affect Ct values (*7*). The use of a Ct≥35 cutoff-point for these RT-PCR tests did not have Emergency Use Authorization and was not systematically evaluated nor had either assay been evaluated against the Omicron variant. Fifth, because of rapid administration of booster vaccine doses during the investigation period, cases could not be reported by booster dose receipt status. Finally, symptom data were not available throughout illness; reporting of asymptomatic status on negative test receipt was based on NFL clubs' submission for early return permission.

In this report describing test-to-release from isolation strategies in an occupational sport setting and RT-PCR test results among fully vaccinated persons with Omicron variant COVID-19, approximately one half had a negative result or a Ct value ≥35 on or before day 6, concluding 5 days of isolation. Although a positive RT-PCR test result does not necessarily indicate infectiousness, these data indicate that persons with COVID-19 should continue taking precautions, including correct and consistent mask use, for a full 10 days after symptom onset or after initial positive test result if they are asymptomatic.

Acknowledgments

Monita Patel, CDC; National Football League (NFL) club infection control officers; NFL team athletic trainers, physicians, and orthopedists; NFL Players Association; NFL COVID-19 Advisory and Operational Team including Dawn Aponte, NFL; Michele Best, University of Maryland Capital Region Health; Meghan C. Carroll, NFL; M. Anthony Casolaro, Washington Football Team; Molly Delaney, NFL; Daniel Eichner, Sports Medicine Research and Testing Laboratory; Jacob Frank, NFL; John Lynch, Department of Medicine, University of Washington; Jimmie Mancell, Department of Medicine, University of Tennessee Health Science Center; Damion Martins, Atlantic Sports Health, Morristown Medical Center; John Mellody, NFL; Eric Sugarman, Minnesota Vikings; IQVIA and NFL contact tracing and technical team including Megan Miraval, Ally Thrasher, Sabrina Trujillo Smith, Madeline Lassiter, Emily Watson, Kristin Archibald, Emma Bergqvist, Paul Blalock, Justin Reid, Julie Griffith, Kristina Zeidler; Sequencing partners at Tempus and Yale School of Public Health.

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Christina D. Mack, Erin B. Wasserman, and Saamir Pasha report full-time employment by IQVIA. Deverick J. Anderson reports receipt of royalties for authorship from UpToDate Online, LLC and co-ownership of Infection Control Education for Major Sports, LLC. Patti Walton reports consulting fees from NFL, honoraria for presentation from Ortho Clinical Diagnostics, payment as an expert witness regarding laboratory practices, support for travel to meetings from the American Society for Clinical Pathology (ASCP), serving on the Board of Directors of the Clinical Laboratory Management Association (2019–2021), membership on the ASCP Board of Governors (2019–current), and Chairmanship of the Tennessee Medical Laboratory Licensing Board (2019–2021). Catherine O'Neal reports consulting fees from NFL. Christopher J. Hostler reports co-ownership of Infection Control Education for Major Sports, LLC. Allen Sills and Emily Myers report employment by NFL. Navdeep Singh reports receipt of consulting fees from NFL and the Las Vegas Raiders. No other potential conflicts of interest were disclosed.

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Changes in Suicide Rates — United States, 2019 and 2020

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Suicide was among the 10 leading causes of death in the United States in 2020 among persons aged 10–64 years, and the second leading cause of death among children and adolescents aged 10–14 and adults aged 25–34 years (*1*). During 1999–2020, nearly 840,000 lives were lost to suicide in the United States. During that period, the overall suicide rate peaked in 2018 and declined in 2019 and 2020 (*1*). Despite the recent decline in the suicide rate, factors such as social isolation, economic decline, family stressors, new or worsening mental health symptoms, and disruptions to work and school associated with the COVID-19 pandemic have raised concerns about suicide risk in the United States. During 2020, a total of 12.2 million U.S. adults reported serious thoughts of suicide and 1.2 million attempted suicide (*2*). To understand how changes in suicide death rates might have varied among subpopulations, CDC analyzed counts and age-adjusted suicide rates during 2019 and 2020 by demographic characteristics, mechanism of injury, county urbanization level, and state. From 2019 to 2020, the suicide rate declined by 3% overall, including 8% among females and 2% among males. Significant declines occurred in seven states but remained stable in the other states and the District of Columbia. Despite two consecutive years of declines, the overall suicide rate remains 30% higher compared with that in 2000 (*1*). A comprehensive approach to suicide prevention that uses data driven decision-making and implements prevention strategies with the best available evidence, especially among disproportionately affected populations (*3*), is critical to realizing further declines in suicide and reaching the national goal of reducing the suicide rate by 20% by 2025 (*4*).

Death certificate data from the 2019–2020 National Vital Statistics System multiple cause-of-death mortality files were analyzed. Suicide deaths were identified by using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes U03, X60–X84, and Y87.0. Age-adjusted death rates (per 100,000 population) and CIs were calculated by using the direct method and the 2000 U.S. standard population. Rates were suppressed for case counts <20 because they are unstable as a result of the small number of deaths (*1*); data were not presented for persons aged <10 years in age group analyses because determining suicidal intent in younger children is difficult (*5*). Urbanization level of the decedent's county of residence was categorized by using the 2013 National Center for Health Statistics Urban–Rural Classification Scheme for Counties.*

Changes in suicide rates from 2019 to 2020 were examined overall and by race/ethnicity, age, mechanism of injury, county urbanization level, sex, and state. Single-race estimates are presented and might not be comparable to estimates produced by bridging multiple races to a single race choice.† Hispanic and unknown ethnicity include persons of any race. Racial groups exclude persons of Hispanic or unknown ethnicity. Differences in rates between 2019 and 2020 were assessed using z-tests when the number of deaths was ≥100 and using nonoverlapping CIs based on a gamma distribution when the number was <100; p-values <0.05 were considered statistically significant.§ Absolute and relative changes in rates were calculated and are shown in the tables; however, only relative changes are presented in the text. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

During 2020, a total of 45,979 deaths were attributable to suicide, a decrease of 1,532 from 47,511 suicide deaths in 2019 (Table). From 2019 to 2020, the overall suicide rate declined significantly by 3.0% (from 13.9 to 13.5 per 100,000 population). Among racial/ethnic groups, overall, suicide rates in 2020 were highest among persons who were non-Hispanic American Indian or Alaska Native (23.9 per 100,000), non-Hispanic White (16.9 per 100,000), and non-Hispanic Native Hawaiian or other Pacific Islander (12.5 per 100,000). Non-Hispanic White persons experienced a 4.5% decline in suicide rate; no other changes among racial/ethnic groups were significant. Rates in 2020 were highest among persons aged ≥85 years (20.9 per 100,000), followed by those aged 75–84 and 25–34 years (both 18.4 per 100,000).

* The classification levels for counties are as follows: 1) large central metropolitan: part of a metropolitan statistical area with ≥1 million population and covers a principal city; 2) large fringe metropolitan: part of a metropolitan statistical area with ≥1 million population but does not cover a principal city; 3) medium metropolitan: part of a metropolitan statistical area with ≥250,000 but <1 million population; 4) small metropolitan: part of a metropolitan statistical area with <250,000 population; 5) micropolitan (nonmetropolitan): part of a micropolitan statistical area (has an urban cluster of ≥10,000 but <50,000 population); and 6) noncore (nonmetropolitan): not part of a metropolitan or micropolitan statistical area. https://www.cdc.gov/nchs/data_access/urban_rural.htm

† https://www.cdc.gov/nchs/data/nvsr/nvsr70/nvsr70-03-508.pdf

§ https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_09-508.pdf

¶ 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. Annual number of suicides and age-adjusted* rates of suicide† per 100,000 population, by selected characteristics — National Vital Statistics System, United States, 2019 and 2020

Characteristic	2019		2020		Absolute change§	Relative change¶
	No.	Rate (95% CI)	No.	Rate (95% CI)		
Overall						
Total	**47,511**	**13.9 (13.8–14.1)**	**45,979**	**13.5 (13.4–13.6)**	**−0.4****	**−3.0****
Race/Ethnicity††						
American Indian or Alaska Native	546	22.5 (20.5–24.4)	588	23.9 (21.9–25.9)	1.4	6.5
Asian	1,342	6.7 (6.3–7.1)	1,302	6.4 (6.1–6.8)	−0.3	−4.3
Black or African American	3,115	7.5 (7.2–7.7)	3,286	7.8 (7.5–8.1)	0.3	4.1
Hispanic	4,331	7.3 (7.0–7.5)	4,571	7.5 (7.3–7.8)	0.2	4.0
Multiracial	527	8.8 (8.0–9.6)	599	9.6 (8.7–10.4)	0.8	8.3
Native Hawaiian or other Pacific Islander	90	14.4 (11.5–17.7)	79	12.5 (9.9–15.6)	−1.9	−13.2
White	37,428	17.7 (17.5–17.9)	35,442	16.9 (16.7–17.0)	−0.8**	−4.5**
Unknown	132	(—)§§	112	(—)§§	NA	NA
Age group, yrs¶¶						
10–14	534	2.6 (2.4–2.8)	581	2.8 (2.6–3.0)	0.2	9.0
15–24	5,954	13.9 (13.6–14.3)	6,062	14.2 (13.9–14.6)	0.3	2.1
25–34	8,059	17.5 (17.2–17.9)	8,454	18.4 (18.0–18.7)	0.9**	4.6**
35–44	7,525	18.1 (17.7–18.5)	7,314	17.4 (17.0–17.8)	−0.7**	−3.9**
45–54	8,012	19.6 (19.2–20.0)	7,249	18.0 (17.5–18.4)	−1.6**	−8.4**
55–64	8,238	19.4 (19.0–19.8)	7,160	16.9 (16.5–17.3)	−2.5**	−13.0**
65–74	4,867	15.5 (15.0–15.9)	4,716	14.5 (14.1–14.9)	−1.0**	−6.3**
75–84	2,977	18.6 (18.0–19.3)	3,032	18.4 (17.8–19.1)	−0.2	−1.1
≥85	1,329	20.1 (19.0–21.2)	1,389	20.9 (19.8–22.0)	0.8	3.7
Urbanization***						
Large central metro	11,762	11.2 (11.0–11.4)	11,058	10.5 (10.3–10.7)	−0.7**	−6.1**
Large fringe metro	10,840	12.6 (12.3–12.8)	10,347	12.0 (11.8–12.2)	−0.6**	−4.6**
Medium metro	10,789	15.2 (14.9–15.5)	10,574	14.9 (14.6–15.2)	−0.3	−2.2
Small metro	5,327	17.4 (16.9–17.9)	5,160	16.9 (16.4–17.4)	−0.5	−2.9
Micropolitan (nonmetro)	5,009	18.1 (17.6–18.6)	5,004	18.2 (17.7–18.7)	0.1	0.4
Noncore (nonmetro)	3,784	20.1 (19.5–20.8)	3,836	20.6 (19.9–21.3)	0.5	2.2
Mechanism of injury						
Cut or pierce	921	0.3 (0.2–0.3)	907	0.2 (0.2–0.3)	−0.1	−3.1
Drowning	506	0.2 (0.1–0.2)	498	0.2 (0.1–0.2)	0.0	0.0
Fall	1,183	0.4 (0.3–0.4)	1,074	0.3 (0.3–0.3)	−0.1	−9.8**
Fire or flame	187	0.1 (0.0–0.1)	175	0.1 (0.0–0.1)	0.0	0.0
Firearm	23,941	6.8 (6.8–6.9)	24,292	7.0 (6.9–7.0)	0.2	1.7
Poisoning	6,125	1.8 (1.7–1.8)	5,528	1.6 (1.5–1.6)	−0.2**	−10.7**
Suffocation	13,563	4.2 (4.1–4.3)	12,495	3.9 (3.8–3.9)	−0.3**	−7.4**
Other†††	1,085	0.3 (0.3–0.4)	1,010	0.3 (0.3–0.3)	0.0	0.0

See table footnotes on page 309.

Suicide rates were inversely related to county urbanization level, with the most rural (noncore) counties experiencing the highest rate (20.6 per 100,000). Rates decreased by 6.1% and 4.6% in large central metro and large fringe metro areas, respectively in 2020 and remained stable in all other county urbanization levels.

Firearms accounted for approximately one half (24,292; 53%) of suicides in 2020; the rate of suicide by firearm did not change significantly between 2019 and 2020. Rates of suicide by fall, poisoning, and suffocation declined significantly, with more than 100, nearly 600, and more than 1,000 fewer deaths by these means, respectively.

Males accounted for approximately three quarters (36,551; 79%) of all suicides in 2020. From 2019 to 2020, the suicide rate among males declined by 1.9% (from 22.4 to 22.0 per 100,000). Significant rate changes included a 3.1% decrease among non-Hispanic White males and a 5.7% increase among Hispanic males. The highest rate overall was among males aged ≥85 years (52.0 per 100,000). From 2019 to 2020, rates increased by 5.0% in males aged 25–34 years and declined by 5%–12% among those aged 45–54, 55–64, and 65–74 years.

Among females, the suicide rate declined by 8.0% (from 6.0 to 5.5 per 100,000) from 2019 to 2020. The suicide rate among non-Hispanic White females decreased 9.9% but increased 29.2% among non-Hispanic multiracial females. The highest rate of suicide in females was among those aged 45–54 years (8.5 per 100,000). From 2019 to 2020, declines in suicide rates of 8%–19% occurred among females aged 35–44, 45–54, and 55–64 years.

Across all racial/ethnic and age group strata, males experienced higher suicide rates than did females during 2019–2020 (Figure 1). Among both male and female non-Hispanic

TABLE. (*Continued*) Annual number of suicides and age-adjusted* rates of suicide† per 100,000 population, by selected characteristics — National Vital Statistics System, United States, 2019 and 2020

Characteristic	2019		2020		Absolute change§	Relative change¶
	No.	Rate (95% CI)	No.	Rate (95% CI)		
Female						
Total	**10,255**	**6.0 (5.9–6.1)**	**9,428**	**5.5 (5.4–5.6)**	**−0.5****	**−8.0****
Race/Ethnicity††						
American Indian or Alaska Native	145	12.1 (10.1–14.1)	144	11.7 (9.8–13.6)	−0.4	−3.3
Asian	392	3.7 (3.3–4.0)	390	3.7 (3.3–4.0)	0.0	0.0
Black or African American	624	2.9 (2.7–3.2)	620	2.9 (2.6–3.1)	0.0	0.0
Hispanic	886	3.0 (2.8–3.1)	870	2.8 (2.6–3.0)	−0.2	−4.1
Multiracial	122	3.9 (3.2–4.7)	166	5.0 (4.2–5.9)	1.1**	29.2**
Native Hawaiian or other Pacific Islander	18	(—)§§	14	(—)§§	NA	NA
White	8,046	7.7 (7.5–7.9)	7,200	6.9 (6.8–7.1)	−0.8**	−9.9**
Unknown	22	(—)§§	24	(—)§§	NA	NA
Age group, yrs¶¶						
10–14	203	2.0 (1.7–2.3)	204	2.0 (1.7–2.3)	0.0	0.0
15–24	1,154	5.5 (5.2–5.8)	1,203	5.8 (5.4–6.1)	0.3	4.5
25–34	1,526	6.8 (6.4–7.1)	1,572	6.9 (6.6–7.3)	0.1	2.8
35–44	1,710	8.2 (7.8–8.6)	1,591	7.5 (7.2–7.9)	−0.7**	−7.9**
45–54	2,156	10.4 (10.0–10.9)	1,735	8.5 (8.1–8.9)	−1.9**	−18.5**
55–64	1,948	8.9 (8.5–9.3)	1,621	7.4 (7.0–7.8)	−1.5**	−16.7**
65–74	985	5.9 (5.5–6.2)	973	5.6 (5.3–6.0)	−0.3	−4.5
75–84	410	4.6 (4.1–5.0)	387	4.2 (3.8–4.6)	−0.4	−8.2
≥85	158	3.7 (3.2–4.3)	134	3.2 (2.6–3.7)	−0.5	−15.5
Urbanization***						
Large central metro	2,682	5.0 (4.8–5.2)	2,433	4.6 (4.4–4.7)	−0.4**	−8.8**
Large fringe metro	2,457	5.6 (5.4–5.8)	2,205	5.1 (4.9–5.3)	−0.5**	−9.8**
Medium metro	2,400	6.7 (6.4–7.0)	2,211	6.1 (5.9–6.4)	−0.6**	−8.7**
Small metro	1,106	7.3 (6.9–7.8)	1,060	7.1 (6.6–7.5)	−0.2	−4.0
Micropolitan (nonmetro)	918	6.9 (6.4–7.3)	888	6.7 (6.3–7.2)	−0.2	−2.1
Noncore (nonmetro)	692	7.9 (7.3–8.5)	631	7.1 (6.5–7.7)	−0.8	−9.6
Mechanism of injury						
Cut or pierce	152	0.1 (0.1–0.1)	156	0.1 (0.1–0.1)	0.0	0.0
Drowning	187	0.1 (0.1–0.1)	170	0.1 (0.1–0.1)	0.0	0.0
Fall	333	0.2 (0.2–0.2)	254	0.1 (0.1–0.2)	−0.1**	−27.3**
Fire or flame	59	0.0 (0.0–0.1)	50	0.0 (0.0–0.0)	0.0	0.0
Firearm	3,216	1.8 (1.8–1.9)	3,112	1.8 (1.7–1.9)	0.0	0.0
Poisoning	3,079	1.7 (1.7–1.8)	2,694	1.5 (1.4–1.6)	−0.2**	−14.0**
Suffocation	2,971	1.8 (1.8–1.9)	2,742	1.7 (1.6–1.8)	−0.1**	−6.6**
Other†††	258	0.1 (0.1–0.1)	250	0.1 (0.1–0.2)	0.0	0.0

See table footnotes on page 309.

American Indian or Alaska Native, non-Hispanic Asian, non-Hispanic Black or African American, non-Hispanic multiracial, and Hispanic persons, rates were highest in persons aged 15–24 or 25–34 years. Among non-Hispanic White females, rates peaked in those aged 45–54 years. Non-Hispanic White males experienced consistently high rates (35.1–37.4 per 100,000) in all age groups from 25–34 to ≥65 years. Subgroups with the highest suicide rates were non-Hispanic American Indian or Alaska Native males aged 25–34 years (71.1) and 15–24 years (59.7), and non-Hispanic Native Hawaiian or other Pacific Islander males aged 25–34 years (49.1).

The overall suicide rate declined significantly from 2019 to 2020 in seven states (California, Connecticut, Florida, New Jersey, Ohio, Oregon, and Pennsylvania) (Figure 2) and remained stable in all other states and the District of Columbia. In 2020, six states and the District of Columbia had rates <10 per 100,000; however, nine states had rates >20 per 100,000, with the highest rate of 30.5 per 100,000 in Wyoming (Figure 2).

Discussion

The second consecutive year of declining suicide rates in the United States is encouraging and is consistent with other high-income and upper-middle-income countries that experienced either unchanged or declining suicide rates during the early months of the COVID-19 pandemic (*6*). From 2019 to 2020, the U.S. suicide rate decreased by 3%, with significant declines among both females and males. Overall suicide rates declined in large metropolitan areas and in seven states and remained stable in other county urbanization levels and states. Rates of suicide by fall, poisoning, and suffocation declined significantly. Although, rates among non-Hispanic White

TABLE. (*Continued*) Annual number of suicides and age-adjusted* rates of suicide† per 100,000 population, by selected characteristics — National Vital Statistics System, United States, 2019 and 2020

Characteristic	2019		2020		Absolute change§	Relative change¶
	No.	Rate (95% CI)	No.	Rate (95% CI)		
Male						
Total	**37,256**	**22.4 (22.1–22.6)**	**36,551**	**22.0 (21.7–22.2)**	**−0.4****	**−1.9****
Race/Ethnicity††						
American Indian or Alaska Native	401	33.0 (29.7–36.3)	444	36.4 (32.9–39.8)	3.4	10.3
Asian	950	10.1 (9.4–10.7)	912	9.5 (8.9–10.2)	−0.6	−5.1
Black or African American	2,491	12.5 (12.0–13.0)	2,666	13.1 (12.6–13.6)	0.6	5.1
Hispanic	3,445	11.6 (11.2–12.0)	3,701	12.3 (11.9–12.7)	0.7**	5.7**
Multiracial	405	14.2 (12.7–15.7)	433	14.5 (13.0–16.0)	0.3	2.4
Native Hawaiian or other Pacific Islander	72	22.1 (17.3–28.0)	65	20.0 (15.4–25.6)	−2.1	−9.7
White	29,382	28.0 (27.7–28.4)	28,242	27.2 (26.8–27.5)	−0.8**	−3.1**
Unknown	110	(—)§§	88	(—)§§	NA	NA
Age group, yrs¶¶						
10–14	331	3.1 (2.8–3.5)	377	3.6 (3.2–3.9)	0.5	14.1
15–24	4,800	22.0 (21.4–22.6)	4,859	22.4 (21.7–23.0)	0.4	1.6
25–34	6,533	28.0 (27.3–28.6)	6,882	29.4 (28.7–30.0)	1.4**	5.0**
35–44	5,815	28.0 (27.2–28.7)	5,723	27.2 (26.5–27.9)	−0.8	−2.8
45–54	5,856	29.0 (28.3–29.8)	5,514	27.7 (26.9–28.4)	−1.3**	−4.7**
55–64	6,290	30.7 (29.9–31.4)	5,539	27.0 (26.3–27.7)	−3.7**	−11.9**
65–74	3,882	26.4 (25.6–27.2)	3,743	24.7 (23.9–25.4)	−1.7**	−6.7**
75–84	2,567	36.7 (35.3–38.1)	2,645	36.6 (35.2–38.0)	−0.1	−0.2
≥85	1,171	49.3 (46.5–52.1)	1,255	52.0 (49.1–54.8)	2.7	5.5
Urbanization***						
Large central metro	9,080	17.8 (17.5–18.2)	8,625	16.9 (16.6–17.3)	−0.9**	−5.0**
Large fringe metro	8,383	20.0 (19.6–20.5)	8,142	19.4 (19.0–19.9)	−0.6	−3.0
Medium metro	8,389	24.3 (23.7–24.8)	8,363	24.1 (23.6–24.6)	−0.2	−0.7
Small metro	4,221	27.9 (27.0–28.7)	4,100	27.2 (26.3–28.0)	−0.7	−2.5
Micropolitan (nonmetro)	4,091	29.5 (28.6–30.4)	4,116	29.8 (28.8–30.7)	0.3	0.9
Noncore (nonmetro)	3,092	32.1 (31.0–33.3)	3,205	33.7 (32.5–34.9)	1.6	4.9
Mechanism of injury						
Cut or pierce	769	0.4 (0.4–0.5)	751	0.5 (0.4–0.5)	0.1	1.6
Drowning	319	0.2 (0.2–0.2)	328	0.2 (0.2–0.2)	0.0	0.0
Fall	850	0.5 (0.5–0.5)	820	0.5 (0.5–0.5)	0.0	0.0
Fire or flame	128	0.1 (0.1–0.1)	125	0.1 (0.1–0.1)	0.0	0.0
Firearm	20,725	12.3 (12.1–12.4)	21,180	12.5 (12.3–12.7)	0.2	1.8
Poisoning	3,046	1.8 (1.7–1.9)	2,834	1.7 (1.6–1.7)	−0.1**	−6.4**
Suffocation	10,592	6.6 (6.5–6.7)	9,753	6.1 (6.0–6.2)	−0.5**	−7.5**
Other†††	827	0.5 (0.4–0.5)	760	0.5 (0.4–0.6)	0.0	0.0

Abbreviation: NA = not applicable.

* Age-adjusted rates (suicides per 100,000 population) were calculated using the direct method and the 2000 U.S. standard population. Rates and 95% CIs are rounded to one digit after the decimal, and, as a result, might not exactly match similar rates published elsewhere. Suicides for persons aged <10 years were included in the total numbers and age-adjusted rates but are suppressed for the analysis by age groups because determining suicidal intent in younger children can be difficult.

† Suicide deaths were identified by using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes U03, X60–X84, and Y87.0.

§ Absolute change was the rate in 2020 minus the rate in 2019.

¶ Relative change was calculated using the equation: (2020 rate−2019 rate)/2019 rate x 100. To improve precision, relative change was calculated using rates rounded to three digits after the decimal. However, if the absolute change was 0, the relative change was also listed as 0.

** P<0.05 for difference between 2019 and 2020. Z-tests were used if the number of deaths was ≥100 in both 2019 and 2020; nonoverlapping CIs based on the gamma method were used if the number of deaths was <100 in 2019 or 2020.

†† Data for Hispanic origin should be interpreted with caution; studies comparing Hispanic origin on death certificates and on U.S. Census surveys have shown inconsistent reporting on Hispanic ethnicity. Potential racial misclassification might lead to underestimates for certain categories, primarily American Indian, Alaska Native, Asian, and other Pacific Islander decedents. Single-race estimates are presented and might not be comparable to earlier years produced by bridging multiple races to a single race choice. Hispanic and unknown ethnicity include persons of any race. Racial groups exclude persons of Hispanic or unknown ethnicity. https://www.cdc.gov/nchs/data/nvsr/nvsr70/nvsr70-03-508.pdf https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf

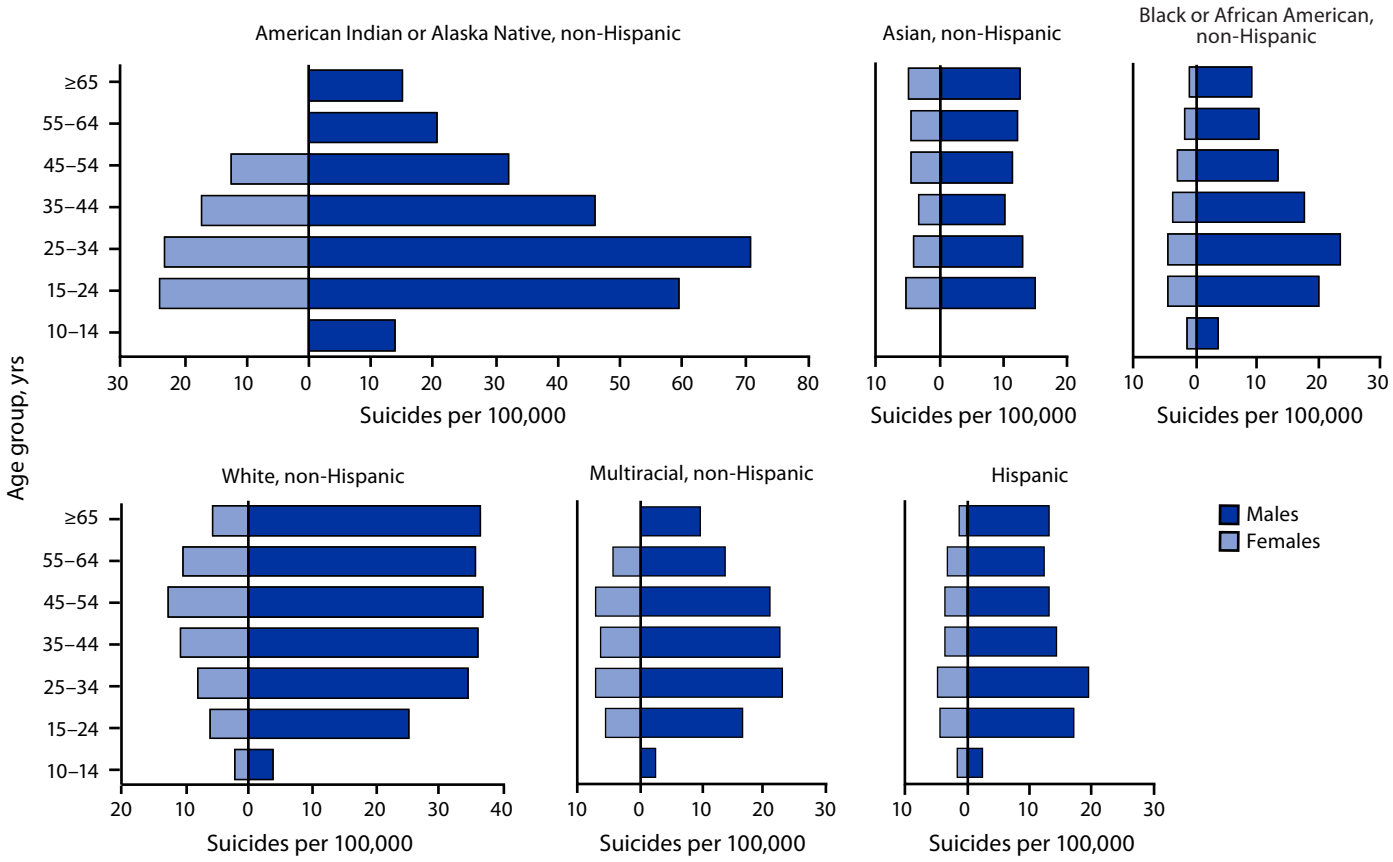
§§ Age-adjusted rates were suppressed for Native Hawaiian or other Pacific Islander females because of unstable rates due to small numbers of deaths (<20). Age-adjusted rates could not be calculated for persons of unknown race/ethnicity.

¶¶ Crude rates (deaths per 100,000) are presented for age groups.

*** Urbanization level of the decedent's county of residence was categorized using the 2013 National Center for Health Statistics Urban–Rural Classification Scheme for Counties (https://www.cdc.gov/nchs/data_access/urban_rural.htm). The classification levels for counties are as follows: 1) large central metropolitan (large central metro): part of a metropolitan statistical area with ≥1 million population and covers a principal city; 2) large fringe metropolitan (large fringe metro): part of a metropolitan statistical area with ≥1 million population but does not cover a principal city; 3) medium metropolitan (medium metro): part of a metropolitan statistical area with ≥250,000 but <1 million population; 4) small metropolitan (small metro): part of a metropolitan statistical area with <250,000 population; 5) micropolitan (nonmetro): part of a micropolitan statistical area (has an urban cluster of ≥10,000 but <50,000 population); and 6) noncore (nonmetro): not part of a metropolitan or micropolitan statistical area.

††† "Other" mechanisms of injury include other land transport, struck by or against, other specified, and unspecified.

FIGURE 1. Crude rate* of suicide,† stratified by race/ethnicity,§ sex, and age group¶ — National Vital Statistics System, United States, 2019–2020



* Death rates per 100,000 population.
† Suicide deaths were identified by using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes U03, X60–X84, and Y87.0.
§ Hispanic and unknown ethnicity included persons of any race. Racial groups excluded persons of Hispanic or unknown ethnicity.
¶ Rates are not provided for non-Hispanic Native Hawaiian or other Pacific Islander persons because of unstable rates in most strata resulting from small numbers of deaths. In addition, rates are not provided for the following strata because of unstable estimates resulting from small numbers of deaths: non-Hispanic American Indian or Alaska Native females aged 0–14 years, 55–64 years, and ≥65 years; non-Hispanic Asian females and males aged 10–14 years; and non-Hispanic multiracial females aged 10–14 years and ≥65 years.

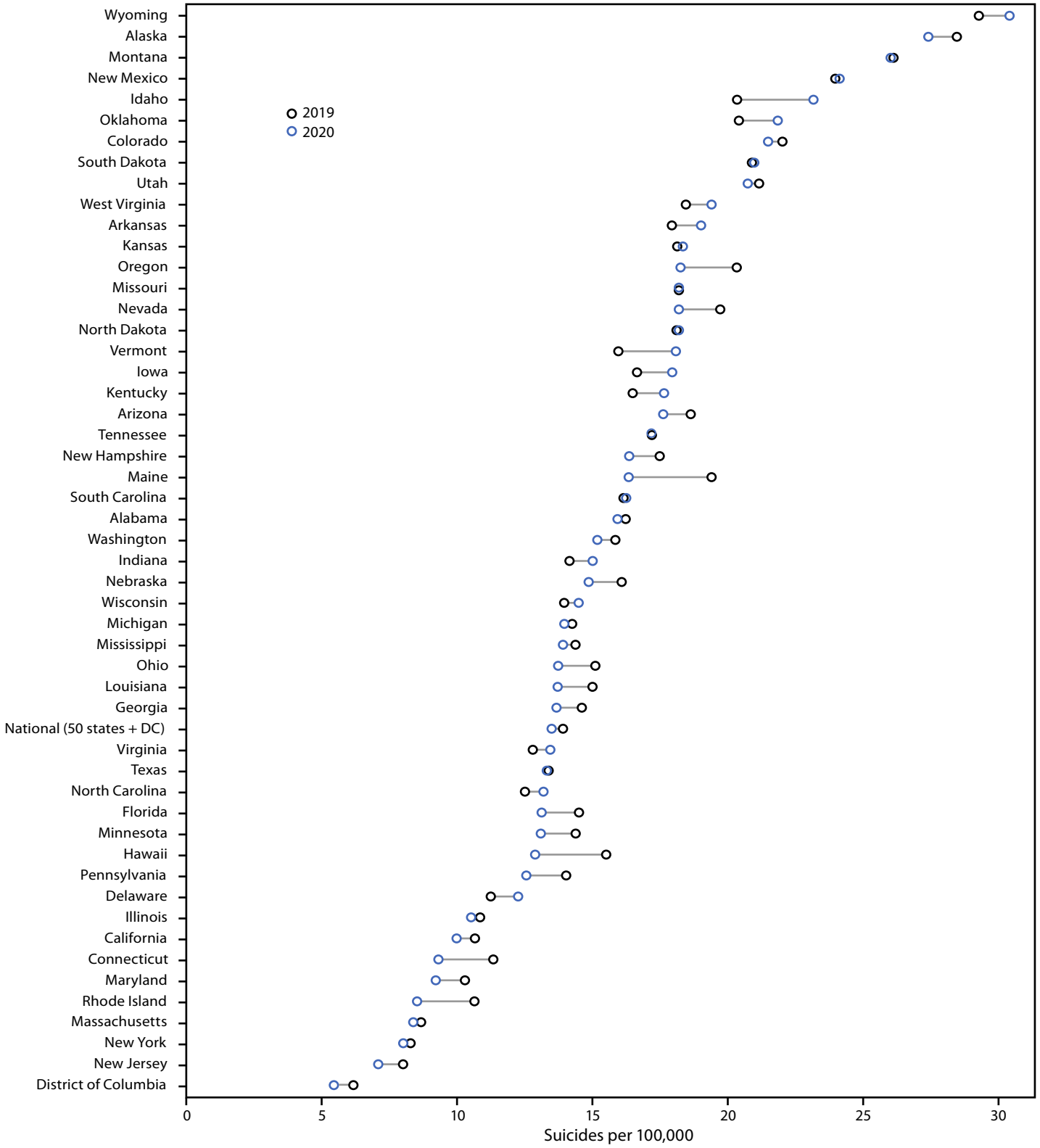
females and males declined from 2019 to 2020, the suicide rate among Hispanic males and non-Hispanic multiracial females increased. Although many age groups experienced a decline in rates, rates increased among persons aged 25–34 years; rates were highest among persons aged ≥85 years, followed by those aged 75–84 and 25–34 years. Moreover, whereas rates were stable among most racial/ethnic groups, and in most states and county urbanization levels, some subgroups experienced increases, underscoring that persistent health disparities remain. Provisional data indicate similar case counts in the first half of 2021 compared with the first half of 2020 (*1*).

As the nation continues to respond to the COVID-19 pandemic and its long-term effects on isolation, stress, economic insecurity, and worsening substance use, mental health, and well-being, prevention is critical. Existing data suggest that suicide rates might be stable or decline during a disaster, only to rise afterwards as the longer-term sequelae unfold in persons, families, and communities, as was the case in New Orleans 2 years after Hurricane Katrina (*7*).

Suicide is preventable. A comprehensive approach to suicide prevention is urgently needed in all states to continue to build on the progress that began in 2019. A comprehensive approach relies on the use of data to drive decision-making and robust implementation and evaluation of prevention strategies (*3*) that address the range of factors associated with suicide, especially among disproportionately affected populations.** Such strategies, as laid out in CDC's Suicide Prevention Technical Package (*3*) are especially relevant during the COVID-19 pandemic and should include community partners, such as public health, education, health care, and employers, coming together to enhance resilience and improve well-being by strengthening

** https://www.cdc.gov/suicide/facts/disparities-in-suicide.html

FIGURE 2. Age-adjusted rate*,† of suicide,§ by state — National Vital Statistics System, United States, 2019 and 2020



Abbreviation: DC = District of Columbia.

* Age-adjusted death rates per 100,000 population were calculated by using the direct method and the 2000 U.S. standard population.

† States with statistically significant changes ($p<0.05$); z-tests were used if the number of deaths was ≥100 in both 2019 and 2020; nonoverlapping CIs based on the gamma method were used if the number of deaths was <100 in 2019 or 2020. States with statistically significant declines were California, Connecticut, Florida, New Jersey, Ohio, Oregon, and Pennsylvania.

§ Suicide deaths were identified by using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes U03, X60–X84, and Y87.0.

Summary

What is already known about this topic?

After peaking in 2018, suicide rates declined in 2019 and 2020; however, nearly 46,000 lives were lost in 2020.

What is added by this report?

From 2019 to 2020, the suicide rate declined overall by 3%, including 8% among females and 2% among males. Rates declined in large metropolitan areas and seven states; rates by fall, poisoning, and suffocation also declined. Demographic disparities in suicide persist, as evidenced by increasing rates among persons aged 25–34 years, Hispanic males, and non-Hispanic multiracial females.

What are the implications for public health practice?

A comprehensive approach to suicide prevention is critical to realizing further declines in suicide and to reaching the national goal of reducing the suicide rate by 20% by 2025.

economic supports (e.g., unemployment benefits), expanding access to and delivery of care (e.g., telehealth), promoting social connectedness, creating protective environments (e.g., safely securing medications and firearms), teaching coping and problem-solving skills, identifying and supporting persons at risk, and lessening harms and preventing future risk (e.g., safe media reporting on suicide) (*3*).

The findings in this report are subject to at least two limitations. First, caution should be used when interpreting rate decreases from one year to the next because rates might be unstable, especially in smaller segments of the population. Second, suicides might be undercounted on death certificates for a variety of reasons, including the higher burden of proof to classify a death as a suicide (versus that needed to classify other manners of death), stigma, misclassification, and lack of autopsies or thorough investigations (*8*).

CDC's Suicide Prevention Technical Package and its Comprehensive Suicide Prevention Program,[††] which currently funds 10 states and one university, are helping states and communities prioritize prevention strategies with the best available evidence to save lives. Expansion and adoption of these resources are critical to realizing further declines in suicide and reaching the national goal of reducing the suicide rate by 20% by 2025 set by the American Foundation for Suicide Prevention and the National Action Alliance for Suicide Prevention (*4*).

[††] https://www.cdc.gov/suicide/programs/csp/index.html

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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Pediatric Emergency Department Visits Before and During the COVID-19 Pandemic — United States, January 2019–January 2022

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On February 18, 2022, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Emergency departments (EDs) in the United States remain a frontline resource for pediatric health care emergencies during the COVID-19 pandemic; however, patterns of health-seeking behavior have changed during the pandemic (*1*,*2*). CDC examined changes in U.S. ED visit trends to assess the continued impact of the pandemic on visits among children and adolescents aged 0–17 years (pediatric ED visits). Compared with 2019, pediatric ED visits declined by 51% during 2020, 22% during 2021, and 23% during January 2022. Although visits for non–COVID-19 respiratory illnesses mostly declined, the proportion of visits for some respiratory conditions increased during January 2022 compared with 2019. Weekly number and proportion of ED visits increased for certain types of injuries (e.g., drug poisonings, self-harm, and firearm injuries) and some chronic diseases, with variation by pandemic year and age group. Visits related to behavioral concerns increased across pandemic years, particularly among older children and adolescents. Health care providers and families should remain vigilant for potential indirect impacts of the COVID-19 pandemic, including health conditions resulting from delayed care, and increasing emotional distress and behavioral health concerns among children and adolescents.

CDC assessed data from the National Syndromic Surveillance Program (NSSP)* for three surveillance periods: March 15, 2020–January 2, 2021 (2020), January 3, 2021–January 1, 2022 (2021), and January 2, 2022–January 29, 2022 (January 2022), and compared them with corresponding weeks in 2019 from health care facilities consistently† reporting data during 2019– January 2022. Data were evaluated by total visits among children and adolescents aged 0–17 years, and by three age groups (0–4, 5–11, and 12–17 years), and visit diagnoses. The Healthcare Cost and Utilization Project (HCUP) Clinical Classifications Software Refined (CCSR) (version 2022; CCSR) tool§ was used to group *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) codes into clinically meaningful diagnostic categories. All ICD-10-CM codes associated with an ED visit were mapped to CCSR categories using a one-to-many approach: a visit with multiple codes could be counted across more than one category; however, if multiple codes in a single visit mapped to the same category, the visit was counted only once. CDC selected 15 categories with the largest increases and decreases in number of mean weekly visits and identified 20 categories with the largest relative change measured by visit ratios (VRs)¶ and 95% CIs; CIs that excluded 1 were considered statistically significant. Categories with both largest change in mean weekly visits and in VRs were included only once. To retain practical relevance, categories were restricted to those with a total difference of ≥100 visits between surveillance and comparison periods. All analyses were conducted using R software (version 4.1.2; R Foundation). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.**

Pediatric ED visits declined by 51% during 2020, 22% during 2021, and 23% during January 2022, compared with 2019 (Figure 1), with some differences by age (Figure 2) but negligible differences between sexes. Overall, the largest decreases in mean weekly visits and proportion of visits were for non–COVID-19 respiratory illnesses when compared with

* NSSP is a collaboration among CDC, local, and state health departments, and federal, academic, and private sector partners. https://www.cdc.gov/nssp/index.html

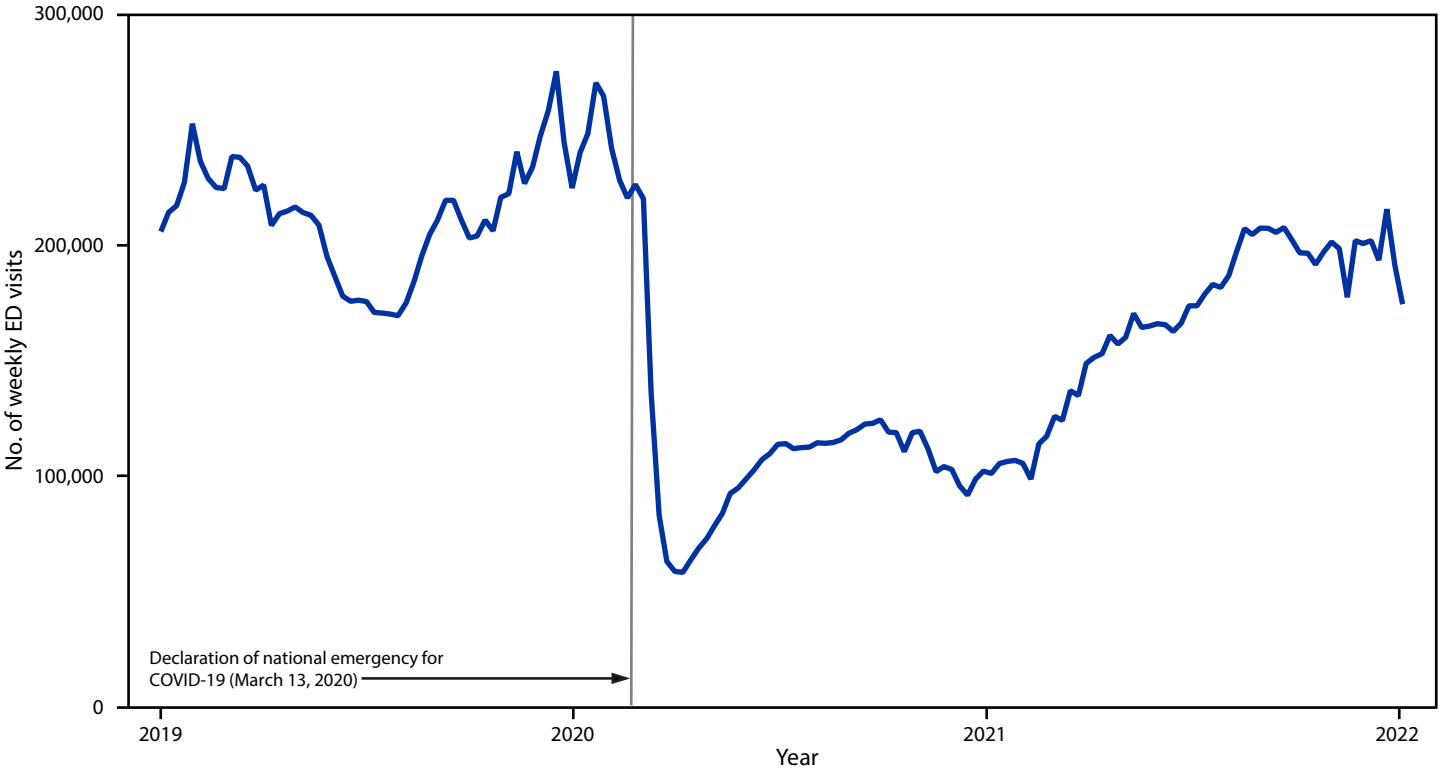
† To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation ≤40 and average weekly informative discharge diagnosis ≥75% complete with consistent discharge diagnosis code formatting throughout 2019–2022. Visits from 1,674 facilities from 41 states were eligible to be included in the study. All facilities from three counties in California (El Dorado, Plumas, and Yosemite), the District of Columbia, Florida, Guam, Hawaii, Maryland, Nebraska, Ohio, Oklahoma, South Dakota, Virginia, Wyoming, and one facility from Washington were excluded because they do not meet one of the inclusion criteria.

§ A full list of categories and corresponding codes is available at the HCUP website: https://www.hcup-us.ahrq.gov/toolssoftware/ccsr/dxccsr.jsp (Accessed January 14, 2022).

¶ To assess greatest increases and decreases in mean weekly visits, no filtering on visit count or relative standard error was applied. VRs were calculated as the proportion of all ED visits in each diagnostic category during the pandemic surveillance period, divided by the proportion of all ED visits in that category during the comparison period. Ninety-five percent CIs that excluded 1 were considered statistically significant. To maintain practical relevance of results, VRs were suppressed if there were <100 visits, the difference in visit counts between periods was <100, or the relative standard error was >30%. Ratios of not applicable (N/A) do not meet at least one of those criteria.

** 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. Weekly number of emergency department visits* among children and adolescents aged 0–17 years — National Syndromic Surveillance Program, United States, 2019–2022



Abbreviations: ED = emergency department; NSSP = National Syndromic Surveillance Program.

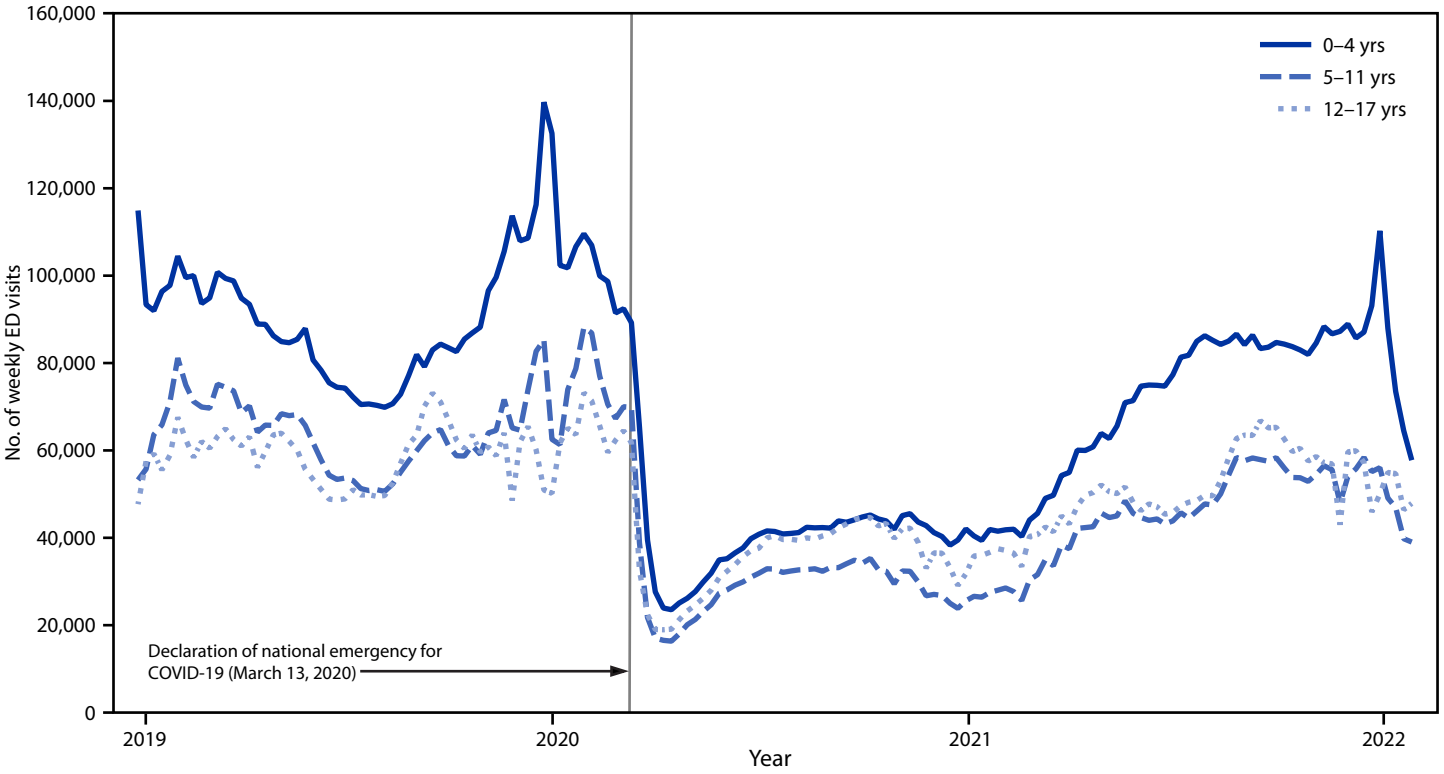
* NSSP is a collaboration among CDC, local, and state health departments, and federal, academic, and private sector partners. To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation ≤40 and average weekly informative discharge diagnosis ≥75% complete with consistent discharge diagnosis code formatting throughout 2019–2022. Visits from 1,674 facilities from 41 states were eligible to be included in the study. All facilities from three counties in California (El Dorado, Plumas, and Yosemite), the District of Columbia, Florida, Guam, Hawaii, Maryland, Nebraska, Ohio, Oklahoma, South Dakota, Virginia, Wyoming, and one facility from Washington were excluded because they do not meet one of the inclusion criteria. https://www.cdc.gov/nssp/index.html

2019; however, proportion of visits for fever increased during January 2022 (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/114478). The largest increases in mean weekly visits during 2020–2022 occurred in diagnostic categories for infectious disease exposure and screening, and COVID-19. Proportion of visits also increased for infectious disease exposure and screening. Number and proportion of visits related to pedal cycle injuries and visits for some chronic conditions and their treatment (e.g., specific cancers, cancer therapy, and connective tissue disorders) also increased, with pandemic year and pediatric age variations.

Compared with 2019, the number and proportion of cannabis-involved visits among children aged 0–4 years increased during 2020 and 2021, with an increase of eight visits per week in 2020 (VR = 3.94) and an increase of 15 visits per week during 2021 (VR = 3.14). The number and proportion of firearm injury visits among children in this age group also increased during 2020 and 2021, with an increase of three visits per week during 2020 (VR = 4.20) and two visits per week during 2021 (VR = 2.33). Similarly, the number and proportion of visits for psychosocial factors among children aged 0–4 years increased during 2021 and January 2022, with an increase of 38 visits per week during 2021 (VR = 1.53) and 55 visits per week during January 2022 (VR = 1.91) compared with 2019. The number and proportion of visits for neurodevelopmental disorders among children in this age group also increased during 2021 and January 2022, with an increase of 18 visits per week during 2021 (VR = 1.35) and 45 visits per week during January 2022 (VR = 1.71) (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/114478). During January 2022, although visits for epilepsy decreased by 35 visits per week and visits for respiratory symptoms (e.g., cough) decreased by 2,063 visits per week in this age group, the proportion of visits increased both for epilepsy (VR = 1.37) and respiratory symptoms (VR = 1.12).

Among children aged 5–11 years, the number and proportion of cannabis-involved visits increased during 2020 and 2021 compared with 2019, with an increase of four visits per week during 2020 (VR = 3.72) and an increase of nine visits

FIGURE 2. Weekly number of emergency department visits* among children and adolescents aged 0–17 years, by age group — National Syndromic Surveillance Program, United States, 2019–2022



Abbreviations: ED = emergency department; NSSP = National Syndromic Surveillance Program.

* NSSP is a collaboration among CDC, local, and state health departments, and federal, academic, and private sector partners. To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation ≤40 and average weekly informative discharge diagnosis ≥75% complete with consistent discharge diagnosis code formatting throughout 2019–2022. Visits from 1,674 facilities from 41 states were eligible to be included in the study. All facilities from three counties in California (El Dorado, Plumas, and Yosemite), the District of Columbia, Florida, Guam, Hawaii, Maryland, Nebraska, Ohio, Oklahoma, South Dakota, Virginia, Wyoming, and one facility from Washington were excluded because they do not meet one of the inclusion criteria. https://www.cdc.gov/nssp/index.html

per week during 2021 (VR = 3.54) (Supplementary Table 3, https://stacks.cdc.gov/view/cdc/114478). The number and proportion of visits for psychosocial concerns also increased during 2021 and January 2022 compared with 2019, with an increase of 20 visits per week during 2021 (VR = 1.74) and 35 visits per week during January 2022 (VR = 2.18). During 2021, the number and proportion of visits for firearm injuries, self-harm, and drug-poisoning were higher compared with 2019, with an increase of two visits per week for firearm injuries (VR = 2.01), six visits per week for self-harm (VR = 1.69), and seven visits per week for drug poisoning (VR = 1.55). During January 2022, although the number of visits for viral infection, fever, and epilepsy decreased compared with 2019, the proportion of visits increased, with a decrease of 286 visits per week for viral infection (VR = 1.26), a decrease of 814 visits per week for fever (VR = 1.11), and a decrease of 38 visits per week for epilepsy (VR = 1.29).

Among adolescents aged 12–17 years, during 2020, 2021, and January 2022, the number and proportion of visits for injuries from physical activities (e.g., walking, swimming, and running) decreased compared with 2019, with decreases of 1,669 visits per week during 2020 (VR = 0.80), 966 visits per week during 2021 (VR = 0.80), and 757 visits per week during January 2022 (VR = 0.72). Conversely, the number and proportion of visits for self-harm increased in all 3 years, with increases of 30 visits per week during 2020 (VR = 1.77), 210 visits per week during 2021 (VR = 1.59), and 207 visits per week during January 2022 (VR = 1.48). Similarly, the number and proportion of visits for drug poisonings and eating disorders increased during all 3 years compared with 2019, with increases of 12 visits per week for drug poisonings during 2020 (VR = 1.72), 171 visits per week during 2021 (VR = 1.53), and 178 visits per week during January 2022 (VR = 1.43); and increases of nine visits per week for eating disorders during 2020 (VR = 2.00), 41 visits per week during

2021 (VR = 2.14), and 38 visits per week during January 2022 (VR = 1.92) (Supplementary Table 4, https://stacks.cdc.gov/view/cdc/114478). The number and proportion of visits for firearm injuries increased by 22 visits per week (VR = 2.43) during 2020 and by 20 visits per week during January 2022 (VR = 1.69) compared with 2019. The number and proportion of visits for psychosocial concerns and for symptoms of mental health conditions and substance use increased during 2021 and January 2022, with increases of 78 visits per week during 2021 (VR = 1.66) and 62 visits per week during January 2022 (VR = 1.48) for psychosocial concerns and increases of 113 visits per week during 2021 (VR = 1.35) and 197 visits per week during January 2022 (VR = 1.43) for symptoms of mental conditions and substance use. In January 2022, the number and proportion of visits for respiratory symptoms (e.g., cough) increased by 905 visits per week (VR = 1.55).

Discussion

Pediatric ED visits sharply declined in the United States during 2020 compared with 2019 (*1*), and although the weekly numbers of visits have varied, ED visits remained lower during 2021 and January 2022 compared with those before the pandemic (*2*). These declines might be associated with parents' and caregivers' risk perception and avoidance of EDs or health care, among other reasons. Despite overall declines, weekly ED visits did increase for children aged 0–4 years at the end of 2021, aligning with the increased circulation of the B.1.1.529 (Omicron) variant of SARS-CoV-2, the virus that causes COVID-19, in the United States. These increases were not observed in children aged 5–11 and adolescents aged 12–17 years; both age groups were eligible for vaccination at the end of 2021. COVID-19–associated visits, and those for exposure and screening for infectious disease, were the top two visit diagnoses for children of all age groups during January 2022. Being up to date with vaccinations is critical for adults and eligible children and adolescents[††] to prevent infection, severe illness, or death from COVID-19 (*3*,*4*), and might reduce strain on health care resources. Supplementary testing[§§] strategies for COVID-19 can further alleviate the impact of the pandemic on EDs (*3*,*5*).

The proportion of visits for non–COVID-19 respiratory illnesses mostly declined across all periods examined, suggesting that COVID-19 prevention measures might have reduced transmission of other respiratory viruses as well (*6*). However, during January 2022, the proportion of visits for fever, viral infection, and respiratory symptoms such as cough increased, with variations by age group. Clinicians should remain vigilant for potentially changing clinical COVID-19 presentations associated with the Omicron variant (*7*), as well as any newly emergent variants of concern.

Elevated proportions of visits for some other diseases, including some chronic conditions and treatments (e.g., cancer therapies), might indicate delay of care and routine well child visits; reduced screening; or postponed procedures to reallocate medical resources during the pandemic (*1*,*2*). Health care systems should encourage caregivers of children and adolescents to seek necessary and scheduled care.

Higher numbers and proportions of cannabis-involved visits among children aged 0–11 years during 2020 and 2021 might be associated with increases in unintentional ingestion. Although there was some variation by pandemic year, increases in visits with certain injuries across all age groups (e.g., firearm injuries), as well as among children and adolescents aged 5–17 years (e.g., drug poisoning and self-harm), are consistent with reports of increased overdose and violence outcomes during the pandemic (*8*). Factors affecting caregivers, including unavailable or unpredictable child care, illness, financial hardship, and mental health concerns, might increase children and adolescents' vulnerabilities. Children and adolescents' loss of parents or other caregivers (*9*), increases in other adversities, and disruptions in daily routine because of the COVID-19 pandemic[¶¶] might also increase children and adolescents' behavioral health concerns and unhealthy coping behaviors. Comprehensive prevention strategies,[***,†††,§§§] including strengthening supports to reduce family stress; enhancing access to services and resources; safe storage of firearms and other lethal means; and limiting accessibility to drugs such as cannabis, to reduce use among children and adolescents, can help address these factors. Further, increases in visits for other behavioral concerns and eating disorders align with previous findings, suggesting that the COVID-19 pandemic has exacerbated already high rates of mental health concerns

[††] https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/children-teens.html (Accessed January 15, 2022). Persons aged 12–17 years became eligible for vaccination on May 10, 2021. https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-authorizes-pfizer-biontech-covid-19-vaccine-emergency-use. Children aged 5–11 years became eligible for vaccination on October 29, 2021. Age 5 years is the current youngest age eligible for COVID-19 vaccination. https://www.fda.gov/news-events/press-announcements/fda-authorizes-pfizer-biontech-covid-19-vaccine-emergency-use-children-5-through-11-years-age

[§§] https://www.cdc.gov/coronavirus/2019-ncov/testing/self-testing.html (Accessed January 14, 2022).

[¶¶] https://www.aap.org/en/patient-care/family-snapshot-during-the-covid-19-pandemic/ (Accessed February 15, 2022).

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

[†††] https://www.cdc.gov/suicide/pdf/suicideTechnicalPackage.pdf. (Accessed January 18, 2022).

[§§§] https://www.cdc.gov/violenceprevention/pdf/yv-technicalpackage.pdf (Accessed January 18, 2022).

Summary

What is already known about this topic?

Health seeking behavior has changed during the COVID-19 pandemic.

What is added by this report?

Compared with 2019, overall pediatric emergency department visits decreased by 51%, 22%, and 23% during 2020, 2021, and January 2022, respectively. COVID-19 visits predominated across all pediatric ages; visits for other respiratory illnesses mostly declined. Number and proportion of visits increased for certain injuries (e.g., firearm injuries, self-harm, and drug poisonings), some chronic diseases, and behavioral health concerns, with variations by age group.

What are the implications for public health practice?

Health care providers and families should remain vigilant for potential indirect impacts of the COVID-19 pandemic, including health conditions resulting from delayed care, and increasing emotional distress and behavioral health concerns among children and adolescents.

among children and adolescents[¶¶¶,****] (*10*). In addition to those who routinely treat children and adolescents' mental and behavioral health, educators and others who work with children and adolescents can also help identify symptoms of distress and unhealthy coping behaviors that might warrant further intervention.

The findings in this report are subject to at least five limitations. First, NSSP ED visit data are a convenience sample and should not be considered nationally representative. Second, fluctuations in underlying data quality, coding practices, and variations in lengths of surveillance periods, particularly during January 2022, might not be reflective of trends from a longer period, potentially over- or underrepresenting visit trends. To help account for this, visit data were analyzed only from facilities with consistent reporting during the study period. Third, many factors, including patterns of care-seeking, changed during the COVID-19 pandemic, and this study was not able to draw conclusions about the underlying prevalence of these conditions outside EDs. Fourth, this report assessed trends in ED visits with one or many diagnosis codes; multiple visits by the same patient are possible, and each would be counted separately. Finally, this analysis could not ascertain which diagnosis was the primary reason for the visit; any visit with a relevant diagnosis was included in that clinical category.

Health care systems should be aware of indirect effects of delayed medical care and maintain vigilance for signs of exacerbated emotional distress and behavioral health concerns, especially among older children and adolescents. Prevention programs that improve children and adolescents' physical and mental health are critical during and after emergencies. Reducing COVID-19 infection through vaccination and other nonpharmaceutical prevention strategies can further protect pediatric health.

[¶¶¶] 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/ (Accessed January 14, 2022).

[****] https://www.hhs.gov/about/news/2021/12/07/us-surgeon-general-issues-advisory-on-youth-mental-health-crisis-further-exposed-by-covid-19-pandemic.html (Accessed January 14, 2022).

Acknowledgments

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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Pediatric Emergency Department Visits Associated with Mental Health Conditions Before and During the COVID-19 Pandemic — United States, January 2019–January 2022

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On February 18, 2022, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

In 2021, a national emergency* for children's mental health was declared by several pediatric health organizations, and the U.S. Surgeon General released an advisory† on mental health among youths. These actions resulted from ongoing concerns about children's mental health in the United States, which was exacerbated by the COVID-19 pandemic (*1*,*2*). During March–October 2020, among all emergency department (ED) visits, the proportion of mental health-related visits increased by 24% among U.S. children aged 5–11 years and 31% among adolescents aged 12–17 years, compared with 2019 (*2*). CDC examined changes in U.S. pediatric ED visits for overall mental health conditions (MHCs) and ED visits associated with specific MHCs (depression; anxiety; disruptive behavioral and impulse-control disorders; attention-deficit/hyperactivity disorder; trauma and stressor-related disorders; bipolar disorders; eating disorders; tic disorders; and obsessive-compulsive disorders [OCD]) during 2019 through January 2022 among children and adolescents aged 0–17 years, overall and by sex and age. After declines in weekly visits associated with MHCs among those aged 0–17 years during 2020, weekly numbers of ED visits for MHCs overall and for specific MHCs varied by age and sex during 2021 and January 2022, when compared with corresponding weeks in 2019. Among adolescent females aged 12–17 years, weekly visits increased for two of nine MHCs during 2020 (eating disorders and tic disorders), for four of nine MHCs during 2021 (depression, eating disorders, tic disorders, and OCD), and for five of nine MHCs during January 2022 (anxiety, trauma and stressor-related disorders, eating disorders, tic disorders, and OCD), and overall MHC visits during January 2022, compared with 2019. Early identification and expanded evidence-based prevention and intervention strategies are critical to improving children's and adolescents' mental health (*1*–*3*), especially among adolescent females, who might have increased need.

CDC examined data from the National Syndromic Surveillance Program (NSSP)§ using three pandemic surveillance periods following the declaration of a national COVID-19 emergency on March 13, 2020: March 15, 2020–January 2, 2021 (2020); January 3, 2021–January 1, 2022 (2021); and January 2, 2022–January 29, 2022 (January 2022). These periods were compared with corresponding weeks in 2019, from facilities consistently reporting data during 2019–2022.¶ Keyword syndromes** using reported reason for visit (chief complaint) and administrative diagnosis codes were developed and validated by CDC in partnership with state, tribal, local, and territorial health departments (Supplementary Box, https://stacks.cdc.gov/view/cdc/114477). To quantify change over time, CDC calculated the percent change in mean number of weekly ED visits†† for children and adolescents aged 0–17 years, as well as by age group (0–4, 5–11, and 12–17 years) and sex. To describe changes in visit volume reported to NSSP, CDC classified the

* 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/

† https://www.hhs.gov/sites/default/files/surgeon-general-youth-mental-health-advisory.pdf

§ NSSP is a collaboration among CDC, local, and state health departments, and federal, academic, and private sector partners. https://www.cdc.gov/nssp/index.html

¶ To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation ≤40 and average weekly informative discharge diagnosis ≥75% complete during 2019–2022.

** NSSP collects free-text reason for visit (chief complaint), discharge diagnosis, and patient demographic details. Diagnosis information is collected using codes from the *International Classification of Diseases, Ninth Revision, Clinical Modification*, *International Classification of Diseases, Tenth Revision, Clinical Modification*, and Systematized Nomenclature of Medicine. Free-text keywords and diagnostic codes combined using Boolean searches were used to create distinct keyword syndromes to identify visits associated with overall MHCs and nine distinct disorders (anxiety; depression; attention-deficit/hyperactivity; bipolar; disruptive behavioral and impulse-control; eating; obsessive-compulsive; tic; trauma and stressor-related). The overall MHC keyword syndrome captures any mental health-related visits, nine individual mental disorders, schizophrenia spectrum disorders, some additional low prevalence mental health conditions (e.g., reactive attachment disorder, delusional disorders, and somatoform disorders), and general mental health terms and codes.

†† Percent change in visits per week during each surveillance period was calculated as ([mean weekly ED visits with health outcome during surveillance period – mean weekly ED visits with health outcome during comparison period] / mean weekly ED visits with health outcome during comparison period) × 100.

percent change in visits as decreasing (less than a –10% change), stable (–10% to 10% change), or increasing >10% change). Visit ratios (VRs)[§§] with 95% CIs were calculated; CIs that excluded 1 were considered statistically significant. Analyses were conducted using R software (version 4.1.2; R Foundation). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[¶¶]

Average weekly visits for overall MHCs[***] among all children and adolescents (aged 0–17 years) decreased during 2020 (–27%) and were stable during 2021 (–8%) and January 2022 (–5%) compared with 2019, with differences by sex (Figure 1) (Supplementary Table, https://stacks.cdc.gov/view/cdc/114477). However, visits for overall MHCs among all children and adolescents accounted for a larger proportion of all pediatric visits during 2020, 2021, and January 2022 than during 2019, with variation by age group and MHC. By age group and sex, female adolescents aged 12–17 years accounted for the largest increases in the number and proportion of visits for overall MHCs and specific MHCs during all periods compared with 2019 (Supplementary Figure 1, https://stacks.cdc.gov/view/cdc/114477). The number of weekly visits for overall MHCs and specific MHCs mostly decreased for males aged 0–17 years and for children aged 0–4 and 5–11 years across surveillance periods; the proportion of ED visits for males and younger children varied by MHCs and surveillance period (Supplementary Table; https://stacks.cdc.gov/view/cdc/114477) (Supplementary Figure 2, https://stacks.cdc.gov/view/cdc/114477). The volume of visits was low for overall MHCs and for specific MHCs among children aged 0–4 years.

With regard to specific MHCs, weekly visits for tic disorders among girls aged 5–11 years increased during 2020, 2021, and in January 2022, compared with 2019, as did the proportion of visits for tic disorders (VR = 3.04, 2.03, and 2.16, respectively); this pattern was not found among children aged 5–11 years overall or among boys within this age group (Supplementary Table, https://stacks.cdc.gov/view/cdc/114477) (Supplementary Figure 2, https://stacks.cdc.gov/view/cdc/114477).

Among adolescents aged 12–17 years, weekly visits increased among females for two of nine MHCs in 2020 (eating and tic disorders); four of nine MHCs during 2021 (depression, eating andtic disorders, and OCD); and five of nine MHCs during January 2022 (anxiety, trauma and stressor-related, eating and tic disorders, and OCD) and overall MHC visits during January 2022, compared with 2019 (Figure 1) (Figure 2) (Supplementary Table, https://stacks.cdc.gov/view/cdc/114477) (Supplementary Figure 1, https://stacks.cdc.gov/view/cdc/114477). Whereas the proportion of visits varied by MHC and surveillance period compared with 2019, the proportion of visits for eating disorders among adolescent females increased during 2020, 2021, and January 2022 (VR = 1.95, 2.29, and 1.99, respectively) as did those for tic disorders (VR = 3.65, 3.94, and 2.96 respectively).

Discussion

Following declines in weekly visits associated with MHCs among children and adolescents aged 0–17 years, during 2020 compared with 2019, weekly ED visits for MHCs overall and for specific MHCs varied by age and sex during 2021 and in January 2022. The current trends in the number and proportion of MHC-related ED visits, along with previous research (*1*,*2*,*4*–*8*), indicate that the mental health effects of the pandemic might be particularly high among adolescent girls.

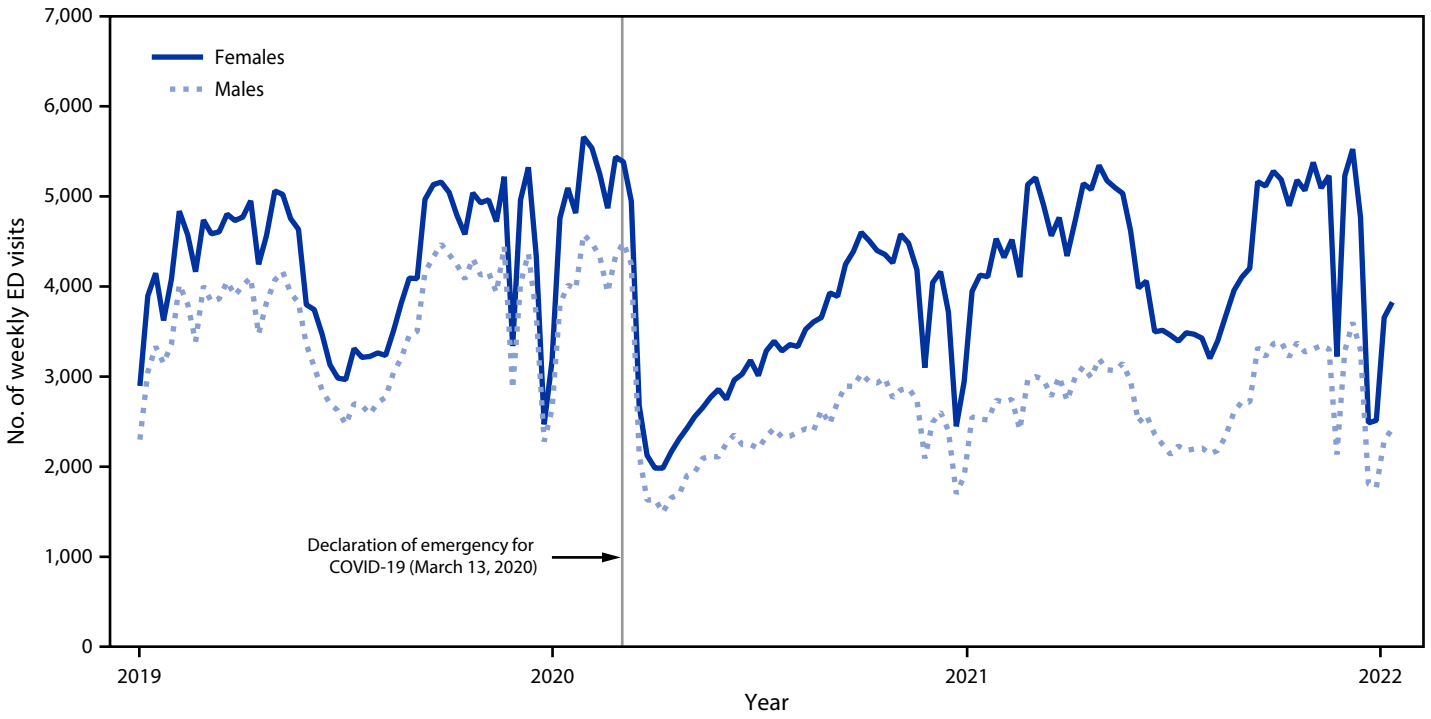
Increases in weekly visits for eating and tic disorders for females, and particularly among adolescent females aged 12–17 years during 2020, 2021, and in January 2022, could represent an overall increase in distress among females during the pandemic. Both eating and tic disorders can co-occur with anxiety, depression, and OCD (*1*,*4*–*7*). Eating disorders can be triggered by pandemic-related risk factors (e.g., lack of structure in daily routine, emotional distress, and changes in food availability) or exacerbated by reduced access to mental health care during the pandemic (*4*,*5*). Increases in visits for tic disorders among adolescent females are atypical; tic disorders usually begin earlier in childhood and are more prevalent among males (*6*,*7*). Stress of the pandemic or exposure to severe tics, highlighted on social media platforms, might be associated with increases in visits with tics and tic-like behavior among adolescent females (*6*). In general, the number of MHC-related visits decreased for adolescent males aged 12–17 years during 2020, 2021, and in January 2022, but there was variation in the proportion of MHCs of all ED visits by pandemic year and specific MHC. These sex differences might represent differences in need, recognition, and health care–seeking behavior.

[§§] VRs = (ED visits with health outcome [surveillance period] / all ED visits [surveillance period]) / (ED visits with health outcome [comparison period] / all ED visits [comparison period]). Ratios >1 indicate a higher proportion of ED visits with the health outcome during the surveillance period than the comparison period; ratios <1 indicate a lower proportion during the comparison period than during the surveillance period; 95% CIs that exclude 1 were considered statistically significant. Female to male visit ratios = (proportion of ED visits with health outcome during surveillance period for females / proportion of ED visits with health outcome during surveillance period for males). These ratios do not include a temporal comparison. Ratios >1 indicate a higher proportion of ED visits with health outcome during the surveillance period for females compared with males.

[¶¶] 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

[***] Overall MHCs keyword syndrome captures any mental health–related visit, nine individual mental disorders, schizophrenia spectrum disorders, some additional low prevalence mental health conditions (e.g., reactive attachment disorder, delusional disorders, and somatoform disorders), and general mental health terms and codes.

FIGURE 1. Weekly number of emergency department visits* for overall mental health conditions† among children and adolescents aged 0–17 years, by sex — National Syndromic Surveillance Program, United States, 2019–2022



Abbreviations: ED = emergency department; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; ICD-10-CM = *International Classification of Diseases, Tenth Revision, Clinical Modification*; MHC = mental health condition; NSSP = National Syndromic Surveillance Program; SNOMED = Systematized Nomenclature of Medicine.

* NSSP receives anonymized medical record information from approximately 71% of nonfederal EDs nationwide. To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with more consistent reporting of more complete data (coefficient of variation ≤40 and average weekly informative discharge diagnosis ≥75% complete during 2019–2022).

† NSSP collects free-text reason for visit (chief complaint), discharge diagnosis, and patient demographic details. Diagnosis information is collected using ICD-9-CM, ICD-10-CM, and SNOMED codes. Free-text keywords and diagnostic codes combined using Boolean searches were used to create a keyword syndrome to identify visits associated with overall MHCs. This keyword syndrome includes visits related to nine distinct disorders (anxiety; depression; attention-deficit/hyperactivity; bipolar; disruptive behavioral and impulse-control; eating; obsessive-compulsive; tic; and trauma and stressor-related), schizophrenia spectrum disorders, some additional low prevalence MHCs (e.g., reactive attachment disorder, delusional disorders, or somatoform disorders), and general mental health terms and codes.

Systemic changes, such as increasing access to available tools[†††] and mental health services can improve emotional well-being during and after crises among children and adolescents (*3*).

EDs are often the access point of care for pediatric mental health emergencies. Declines in MHC-related visits during 2020 align with previous research (*2*), and with reported declines in overall volume of pediatric ED visits during the pandemic (*8*). During 2021 and January 2022, visits for overall MHCs were stable among children and adolescents aged 0–17 years but accounted for a larger proportion of all ED visits compared with 2019. Concerns about ED capacity and potential spread of COVID-19 might have contributed to a delay in seeking health care; thus, ED visits related to MHCs during the pandemic might underestimate the actual need and represent more severe presentations of MHCs than if earlier intervention and treatment were available (*5*).

The highly complex nature of individual experiences makes it difficult to identify a single reason for changes in MHCs during the pandemic. Although prolonged time at home could have increased familial support and identification of mental health care needs for some youths, it might have amplified adversities and stressors among others.[§§§] Exposure to adverse childhood experiences,[¶¶¶] such as loss of parents and caregivers, increases in parental mental health challenges and substance use (*9*), and financial vulnerabilities[****] might have been exacerbated by the pandemic and are associated with poor mental health outcomes among children and adolescents. As of June 2021, approximately 140,000 U.S. children and adolescents had lost parents and caregivers to COVID-19 (*10*). In addition,

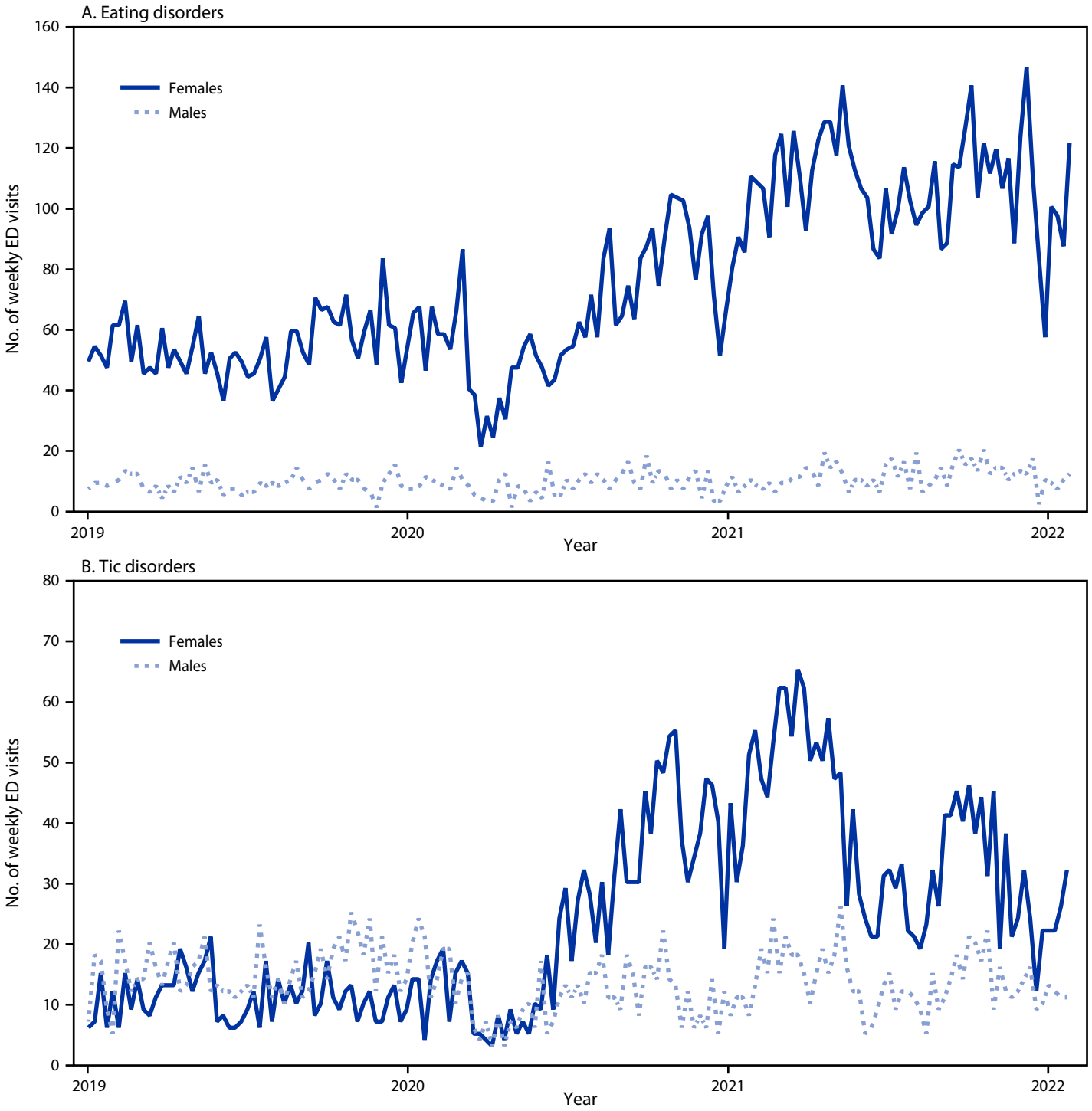
[†††] https://www.nap.edu/resource/other/dbasse/wellbeing-tools/interactive/

[§§§] https://www.aap.org/en/patient-care/family-snapshot-during-the-covid-19-pandemic/

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

[****] https://www.aap.org/en/patient-care/family-snapshot-during-the-covid-19-pandemic/the-financial-impact-of-the-pandemic-on-families-with-children/

FIGURE 2. Weekly number of emergency department visits* associated with eating disorders† (A) and tic disorders† (B) among adolescents aged 12–17 years, by sex — National Syndromic Surveillance Program, United States, 2019–2022



Abbreviations: ED = emergency department; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; ICD-10-CM = *International Classification of Diseases, Tenth Revision, Clinical Modification*; NSSP = National Syndromic Surveillance Program; SNOMED = Systematized Nomenclature of Medicine.

* NSSP receives anonymized medical record information from approximately 71% of nonfederal EDs nationwide. To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with more consistent reporting of more complete data (coefficient of variation ≤40 and average weekly informative discharge diagnosis ≥75% complete during 2019–2022).

† NSSP collects free-text reason for visit (chief complaint), discharge diagnosis, and patient demographic details. Diagnosis information is collected using ICD-9-CM, ICD-10-CM, and SNOMED codes. Free-text keywords and diagnostic codes combined using Boolean searches were used to create a keyword syndrome to identify visits associated with eating and tic disorders.

the pandemic disrupted social and physical activities: many adolescents have experienced substantial disruption to daily and academic routines, faced uncertainty and loneliness, and increased social media use (*3*–*7*,*9*). These factors could have created or exacerbated risk for MHCs among children and adolescents. Promoting policies to improve access to mental health services, including telemental health, and community-based primary prevention strategies to reduce exposure to adverse childhood experiences can help mitigate risk for MHCs before they begin (*3*,*9*).

The findings of this study are subject to at least five limitations. First, findings might differ from other studies based on the method of assessing ED visits for health effects. Second, these cross-sectional data cannot be used to make causal inferences for changes in visit trends, draw conclusions about the acute versus chronic presentation of MHC visits within EDs, or distinguish between visits where MHCs are primary reason for visit versus those where MHCs are present but might not be the sole reason for the visit. Third, estimates for the youngest age group (0–4 years) should be interpreted with caution because of small numbers of weekly visits. Fourth, fluctuations in underlying data quality, coding practices, and variations in lengths of surveillance periods, particularly during 2022, might not be reflective of trends from a longer period, potentially over- or underrepresenting visit trends. To account for this, only facilities with more complete data during the period of study were included. Finally, NSSP ED visit data are a convenience sample and should not be considered nationally representative. However, surveillance periods were compared with corresponding weeks in 2019 from facilities consistently reporting data during 2019–January 2022, and numbers of EDs remained relatively constant over time.

Implementing evidence-based primary prevention, early identification, and intervention, and treatment strategies that promote physical and mental health among children and adolescents and that can be rapidly adapted during public health emergencies, can help prevent MHCs and improve pediatric health (*1*–*3*). CDC supports efforts to promote the emotional well-being of children and adolescents and provides resources for clinicians,†††† families,§§§§ schools,¶¶¶¶ and communities.*****

†††† https://www.cdc.gov/childrensmentalhealth/documents/access-infographic.html

§§§§ https://www.cdc.gov/mentalhealth/stress-coping/help-children-cope/index.html

¶¶¶¶ https://www.cdc.gov/healthyyouth/whatworks/what-works-safe-and-supportive-environments.htm

***** https://www.cdc.gov/violenceprevention/childabuseandneglect/essentials/

Summary

What is already known about this topic?

The proportion of pediatric emergency department (ED) visits for mental health conditions (MHCs) increased during 2020.

What is added by this report?

Weekly ED visits among adolescent females (aged 12–17 years) increased for two MHCs (eating and tic disorders) during 2020, four (depression, eating, tic, and obsessive-compulsive disorders) during 2021, and five (anxiety; trauma and stressor-related; eating; tic; and obsessive-compulsive disorders) and overall MHC visits during January 2022, compared with 2019. The proportion of ED visits with eating disorders doubled among adolescent females; those for tic disorders approximately tripled during the pandemic.

What are the implications for public health practice?

Early identification and expanded evidence-based prevention and intervention strategies are critical to improving pediatric mental health, especially among adolescent females, who might have increased need.

Acknowledgments

National Syndromic Surveillance Program Community of Practice (NSSP CoP); NSSP CoP Syndrome Definition Committee and Council of State and Territorial Epidemiologists; Dylan Johns, Zachary Stein, Barbara Lopes-Cardozo, Matthew D. Ritchey, Umed A. Ajani, Paula Yoon.

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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Erratum

Vol. 71, No. 3

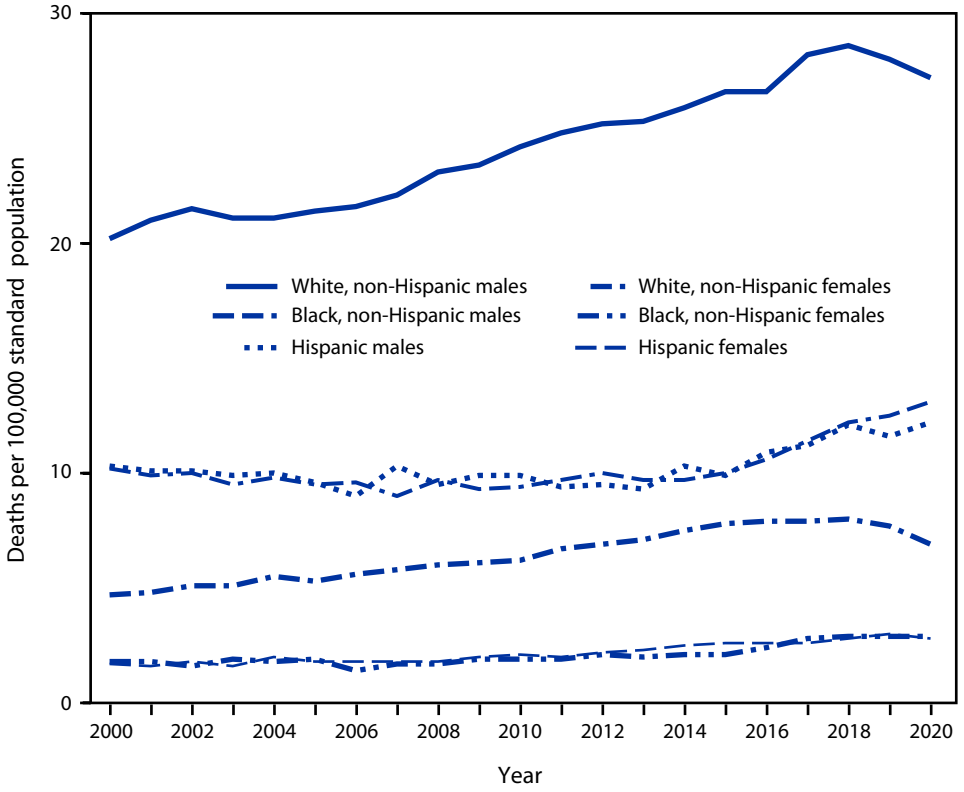
In the report "Racial and Ethnic Disparities in Receipt of Medications for Treatment of COVID-19 — United States, March 2020–August 2021," on p. 98, in Table 1, under the "Inpatients with positive SARS-CoV-2 test result" column, the numbers and percentages for the following rows listed under "Medical conditions associated with high risk" should have read Anemia "**28,645 (23.8)**," Arrythmia "**33,443 (27.8)**," Asthma "**14,542 (12.1)**," COPD "**13,447 (11.2)**," Cancer "**11,642 (9.7)**," Chronic kidney disease "**26,221 (21.8)**," Chronic pulmonary disorders "**28,994 (24.1)**," Coagulopathy "**18,908 (15.7)**," Congestive heart failure "**21,246 (17.7)**," Coronary artery disease "**25,308 (21.1)**," Diabetes type 2 "**41,888 (34.8)**," Hypertension "**69,671 (58.0)**," Mental health disorders "**23,857 (19.8)**," Peripheral vascular disorders "**14,484 (12.0)**," and Severe obesity (BMI ≥40 kg/m^2) "**17,716 (14.7)**."

On p. 99, in Table 2, under the column heading, "Total no. eligible for treatment," the numbers for the row headings "Monoclonal antibodies (November 2020–August 2021): Ethnicity," should have read Non-Hispanic "**387,403**," and Hispanic "**80,176**," and the percentages in the same rows under the column "Total no. (%) treated" should have read Non-Hispanic "**(2.9)**," and Hispanic "**(1.3)**." These corrections do not affect findings of this report.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Suicide Rates* for Males and Females, by Race† and Ethnicity — National Vital Statistics System, United States, 2000–2020



* Age-adjusted suicide rates are per 100,000 standard population. Suicides were identified using *International Classification of Diseases, Tenth Revision* codes U03, X60–X84, and Y87.0.

† Rates for 2000–2017 are based on multiple-race mortality data that were bridged to single-race categories based on the 1977 Office of Management and Budget standard for the classification of race and ethnicity. Rates for 2018–2020 were based on the 1997 Office of Management and Budget standards and might differ slightly compared with the 1977 standards. https://dx.doi.org/10.15620/cdc:103476

After increasing from 2000 to 2018, age-adjusted suicide rates for non-Hispanic White males and females declined from 2018 to 2020, from 28.6 per 100,000 to 27.2 for males and from 8.0 to 6.9 for females. Rates for non-Hispanic Black males and Hispanic males were lower than that for non-Hispanic White males over the entire period and increased more recently to 13.1 and 12.3, respectively, in 2020. Rates for non-Hispanic Black females and Hispanic females, also lower than rates for non-Hispanic White females over the entire period, generally increased throughout most of the period and then leveled off to 2.9 and 2.8, respectively, in 2020. Rates for all races and ethnic groups were higher for males than for females throughout the period.

Source: National Vital Statistics System, Mortality Data. http://www.cdc.gov/nchs/nvss/deaths.htm

Reported by: Sally C. Curtin, MA, sac2@cdc.gov, 301-458-4142.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/suicide/index.html

The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format. To receive an electronic copy each week, visit *MMWR* at *https://www.cdc.gov/mmwr/index.html*.

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ISSN: 0149-2195 (Print)