Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 69 / No. 47
November 27, 2020

# Sexual Violence in the Media: An Exploration of Traditional Print Media Reporting in the United States, 2014–2017

Olivia Egen, MPH[1,2]; Laura M. Mercer Kollar, PhD[2]; Jenny Dills, MPH[2]; Kathleen C. Basile, PhD[2]; Bethlehem Besrat, MPH[3]; Laura Palumbo, MA[4]; Kellie E. Carlyle, PhD[5]

Sexual violence is prevalent and, for many victims, begins early in life (*1*). In the United States, one in five women and one in 38 men report completed or attempted rape victimization during their lifetime, with 43.2% of female and 51.3% of male victims reporting that their first rape victimization occurred before age 18 years (*1*). Media have been shown to act as a socializing agent for a range of health and social behaviors (*2*). Media portrayals might influence, reinforce, or modify how the public responds to incidents of sexual violence and their support for prevention efforts and media might construct a lens through which the public can understand who is affected by sexual violence, what forms it takes, why it happens, and who is responsible for addressing it (*3*). Media portrayals of sexual violence were assessed using a systematic random sample of newspaper articles from 48 of the top 50 distributed traditional print media outlets that were examined for sexual violence content and potential differences by geographic region and year of publication. Differences by year and region in type of sexual violence covered, media language used, and outcomes reported were identified, highlighting an opportunity for public health officials, practitioners, and journalists to frame sexual violence as a preventable public health issue and to incorporate best practices from CDC and the National Sexual Violence Resource Center's Sexual Violence Media Guide (*4*).

Whereas numerous studies describe media portrayals of sexual violence and other forms of violence (*5*–*7*), none examined regional or temporal differences in coverage. This study used 27 sexual violence-related terms* to identify a systematic random sample of 2,600 articles from 48 of the top 50 traditional print media outlets distributed in the United States (*8*) available via electronic newspaper databases.† Outlets were

* Boolean search for each publication: ((“sexual violence”) OR (“sexual assault”) OR (“sexual abuse”) OR (“child sexual abuse”) OR rape OR incest OR (“intimate partner violence”) OR (“sexual exploitation”) OR (“human trafficking”) OR (“sex trafficking”) OR prostitution OR (“sexual harassment”) OR exposure OR (“unwanted penetration”) OR (“unwanted sexual contact”) OR (“forced oral contact”) OR (“forced genital contact”) OR grope OR voyeurism OR (“alleged victim”) OR (“alleged perpetrator”) OR perpetrator OR (“sex scandal”) OR intercourse OR (“perform oral sex”) OR fondle OR accuser).

† Newspaper databases: News Bank Inc. (https://www.newsbank.com/); Gale OneFile (https://www.gale.com/databases/gale-onefile); US Newsstream (https://about.proquest.com/products-services/nationalsnews_shtml.html).

## INSIDE



**Continuing Education** examination available at https://www.cdc.gov/mmwr/mmwr_continuingEducation.html

**U.S. Department of Health and Human Services**
Centers for Disease Control and Prevention

stratified by regional or nationwide reach, and equal systematic samples of 130 articles were selected from each stratum for each publication year, 2014–2017. Articles were coded for strata represented and year published, type of sexual violence mentioned (sexual assault, rape, child sexual abuse, sexual exploitation, sex trafficking, prostitution, sexual harassment, or child pornography), what Sexual Violence Media Guide language was used (sex scandal/scandal, sex/intercourse, accuser, or accused) (*4*), and outcomes. Outcomes included perpetrator consequences (criminal justice system, civil justice system, social, or business consequences) and prevention messaging (primary, secondary, and tertiary prevention). The codebook development relied on the Sexual Violence Media Guide, which provides relevant information for effective communication about sexual violence (*4*). The guide is grounded in media language recommendations from the Maine Coalition Against Sexual Assault (*4*), CDC's Stop SV: A Technical Package to Prevent Sexual Violence (*9*), and past similar research (*5*,*6*). Media language considerations include suggested language (e.g., "alleged perpetrator" or "perpetrator" if convicted) and language to avoid (e.g., "accused"). Two coders were trained, and intercoder reliability was assessed on 20% of the sample, resulting in an average Kappa = 0.81, and the remaining sample was randomly split between the coders and coded. Analysis of variance (ANOVA) and post-hoc Tukey comparisons were made by article characteristic (region or year) for the type of sexual violence mentioned, media language used/language to avoid, and outcomes. Codes were not mutually exclusive.

The types of sexual violence mentioned in newspaper articles (Table 1) differed significantly by region (Table 2). The percentage of articles within each region covering child sexual abuse was lower nationwide (28.5%) than in the Midwest (38.3%) and Northeast (42.9%) regions. National outlets published a significantly higher percentage of articles on sexual harassment (27.7%) than did media in all other regions (11.5% to 19.2%). National outlets used the term "sex scandal" or "scandal" more frequently than did media in all four regions (11.0% versus 3.5%–6.0%). The percentage of articles using the term "sex" or "intercourse" was higher in national outlets (17.1%) than in media in the Midwest (10.8%), Northeast (8.5%), and West (9.6%) regions. Inclusion of consequences for perpetrators was similar in all regions; however, calls for primary prevention of sexual violence were more frequent in national media articles (12.5%) than in those published in the Northeast (6.0%), South (6.0%), and West (7.3%).

Coverage for the types of sexual violence was similar by year, except for significant differences in reporting during 2017 for rape, sexual exploitation, sex trafficking, and sexual harassment (Table 3). In 2017, reporting on rape and sex trafficking was significantly lower (34.9%, and 5.7%, respectively) than during 2014–2016 (46.8%–48.5% and 9.8%–10.9%, respectively; Table 3). Sexual harassment articles were more frequent in 2017 (35.7%) than in previous years (a low of 9.7% in 2014).

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 2020;69:[inclusive page numbers].

**TABLE 1. Sexual violence in traditional print media, newspapers, by geographic region — United States, 2014–2017**

| Region/States* | Newspapers in region* |
|---|---|
| **Nationwide** | |
| National distribution | The Los Angeles Times<br>The New York Times<br>USA Today<br>The Wall Street Journal<br>The Washington Post |
| **Midwest** | |
| Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin | Chicago Sun Times<br>Chicago Tribune<br>Detroit Free Press<br>Milwaukee Journal Sentinel<br>St. Louis Post-Dispatch<br>Star Tribune<br>The Cincinnati Enquirer<br>The Columbus Dispatch<br>The Indianapolis Star<br>The Kansas City Star<br>The Plain Dealer |
| **Northeast** | |
| Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont | New York Daily News<br>New York Post<br>Newsday<br>Pittsburg Post-Gazette<br>The Boston Globe<br>The Buffalo News<br>The Hartford Courant<br>The Philadelphia Inquirer<br>The Star-Ledger |
| **South** | |
| Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia | Atlanta Journal-Constitution<br>Orlando Sentinel<br>San Antonio Express News<br>Star-Telegram<br>Sun Sentinel<br>Tampa Bay Times<br>The Arkansas Democrat-Gazette<br>The Baltimore Sun<br>The Courier-Journal<br>The Dallas Morning News<br>The Houston Chronicle<br>The Oklahoman<br>The Virginian Pilot |
| **West** | |
| Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming | Arizona Republic<br>Honolulu Star Advertiser<br>San Diego Union Tribune<br>San Francisco Chronicle<br>The Denver News<br>The Orange County Register<br>The Oregonian<br>The Sacramento Bee<br>The San Jose Mercury News<br>The Seattle Times |

* States and newspapers are listed in alphabetical order within their region; newspapers are not listed in association with the states.

Newspaper coverage in 2017 differed considerably from that in other years in media language used, with significantly more coverage than all other years for use of the term "sex scandal" or "scandal" (10.9%), "accuser" (15.4%), and "accused" (37.4%). In 2017, coverage of consequences for perpetrators (38.9%) was significantly higher than coverage in 2014 (31.5%). No significant differences by year regarding calls for primary, secondary, or tertiary prevention were found.

## Discussion

Major differences in the type of sexual violence mentioned, media language used, and outcomes were identified by region, year, or both. Overall, a higher percentage of articles in national outlets than in regional outlets used sex scandal, sex/intercourse and included calls for prevention. In general, the type of sexual violence mentioned and the language used in 2017 differed from that during other years (e.g., decreased mention of rape and sex trafficking and increased mention of sexual harassment). These changes might reflect wider coverage of sexual harassment and exploitation allegations involving prominent figures in the film industry, media, state and national congresses, and technology companies, including the "#metoo" movement, which experienced a resurgence in the fall of 2017 that could have influenced article content during the last quarter of 2017.[§]

The findings in this report are subject to at least three limitations. First, research was limited by access to electronic databases that carried traditional print media newspapers; therefore, only 48 of the top 50 distributed newspapers in the United States were accessible. Second, although outlets were identified by reach and stratified by region, how much each publication outlet encompasses rural readership is unclear, and generalizations to these populations should be made with caution. However, many print outlets are also widely available online, likely increasing their reach beyond their physical distributions. Finally, this study did not examine how audiences interact with print and electronic news media through social media. For example, social media allows users to comment on and challenge how traditional news frames sexual violence (*10*). Such social media interactions present an opportunity for further research and consideration in understanding the complex impact of media on public perceptions of sexual violence.

Media reporting included both suggested language (e.g., "sexual assault") and language to avoid (e.g., "sex scandal" or "scandal"), as referenced in the Sexual Violence Media Guide (*4*). Traditional media might have more of an impact on increasing awareness and prevention of sexual violence if their portrayals do not place blame on the victim and if they use suggested terms to describe violent acts throughout their articles. Focused dissemination of the Sexual Violence Media Guide (*4*) might benefit all media outlets.

[§] https://journals.sagepub.com/doi/10.1177/1940161220968081; https://metoomvmt.org.

**TABLE 2. Characteristics of sexual violence articles in national and regional traditional media outlets, by region — United States, 2014–2017***

| Characteristic | No. (%) of articles | | | | |
|---|---|---|---|---|---|
| | Nationwide (n = 520) | Midwest (n = 520) | Northeast (n = 520) | South (n = 520) | West (n = 520) |
| **Type of sexual violence** | | | | | |
| Sexual assault | 302 (58.1)† | 322 (61.9) | 341 (65.6) | 345 (66.3) | 320 (61.5) |
| Rape | 242 (46.5)§ | 245 (47.1)¶ | 224 (43.1) | 246 (47.3)** | 194 (37.3) |
| Child sexual abuse | 148 (28.5)††,§§ | 199 (38.3) | 223 (42.9)¶¶ | 184 (35.4) | 176 (33.8) |
| Sexual exploitation | 233 (44.8) | 243 (46.7) | 223 (42.9) | 239 (46.0) | 263 (50.6) |
| Sex trafficking | 41 (7.9) | 52 (10.0)*** | 26 (5.0)¶¶,††† | 59 (11.3) | 63 (12.1) |
| Prostitution | 33 (6.3)§ | 43 (8.3) | 28 (5.4)¶¶,††† | 55 (10.6) | 61 (11.7) |
| Sexual harassment | 144 (27.7)§§§ | 80 (15.4) | 73 (14.0) | 60 (11.5)** | 100 (19.2) |
| Child pornography | 19 (3.7)†† | 40 (7.7) | 26 (5.0) | 37 (7.1) | 27 (5.2) |
| **Media language used** | | | | | |
| Sex scandal/Scandal | 57 (11.0)§§§ | 25 (4.8) | 28 (5.4) | 31 (6.0) | 18 (3.5) |
| Sex/Intercourse | 89 (17.1)§,††,§§ | 56 (10.8) | 44 (8.5)††† | 83 (16.0)** | 50 (9.6) |
| Accuser | 69 (13.3)§,†† | 40 (7.7) | 55 (10.6) | 50 (9.6) | 41 (7.9) |
| Accused | 170 (32.7)§ | 134 (25.8)¶¶¶ | 144 (27.7)††† | 186 (35.8)** | 129 (24.8) |
| **Outcome/Prevention messaging** | | | | | |
| Consequences for perpetrator | 180 (34.6) | 208 (40.0)*** | 154 (29.6) | 174 (33.5) | 184 (35.4) |
| Call for secondary/tertiary prevention | 117 (22.5)§§ | 118 (22.7)*** | 76 (14.6) | 103 (19.8) | 93 (17.9) |
| Call for primary prevention | 65 (12.5)†,§,§§ | 50 (9.6) | 31 (6.0) | 31 (6.0) | 38 (7.3) |

* Comparisons are made between regions by type of sexual violence, media language used, and outcome/prevention messaging (p<0.05).
† Nationwide significantly different from South.
§ Nationwide significantly different from West.
¶ Midwest significantly different from West.
** South significantly different from West.
†† Nationwide significantly different from Midwest.
§§ Nationwide significantly different from Northeast.
¶¶ Northeast significantly different from West.
*** Midwest significantly different from Northeast.
††† Northeast significantly different from South.
§§§ Significantly different from all other regions.
¶¶¶ Midwest significantly different from South.

Outcomes including perpetrator consequences or prevention messaging generally were reported infrequently. Although outcomes might not be known at the time of reporting, traditional media might be missing an opportunity to integrate prevention messages within current or breaking news. The media can play an important role by partnering with public health organizations to ensure that their portrayals of sexual violence are factual, nonbiased, do not inadvertently blame victims, and include prevention messages in stories about sexual violence. One of the prevention strategies identified in the STOP SV technical package, which includes the best available evidence to prevent sexual violence, is promoting social norms that protect against violence (*9*). As an institution that can influence social norms, the media might contribute to efforts to prevent sexual violence through accurate descriptions of prevalence and impact of sexual violence, establishment of sexual violence as a public health issue, and, when possible, inclusion of messages and resources for prevention. In this way, awareness of the problem and prevention messaging might reach broader audiences.

Understanding how media outlets have historically framed sexual violence might help public health officials and practitioners work productively with journalists to identify potential unintended effects of specific language use. The Sexual Violence Media Guide (*4*) can be used to inform and evaluate the impact of public health and media collaborations. The media, public health practitioners, and communities can work together to incorporate language from the Sexual Violence Media Guide (*4*) to change public perceptions about circumstances surrounding sexual violence and encourage public health approaches to prevention.

Corresponding author: Laura M. Mercer Kollar, lkollar@cdc.gov, 770-488-1737.

[1]Association of Schools and Programs of Public Health, Washington, D.C.; [2]Division of Violence Prevention, National Center for Injury Prevention and Control, CDC; [3]Department of Behavioral Sciences and Health Education, Rollins School of Public Health, Emory University, Atlanta, Georgia; [4]National Sexual Violence Resource Center, Harrisburg, Pennsylvania; [5]Department of Health Behavior and Policy, School of Medicine, Virginia Commonwealth University, Richmond, Virginia.

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.

**TABLE 3. Characteristics of sexual violence traditional media articles — United States, 2014–2017***

| Characteristic | No. (%) of articles | | | |
|---|---|---|---|---|
| | 2014 (n = 650) | 2015 (n = 650) | 2016 (n = 650) | 2017 (n = 650) |
| **Type of sexual violence** | | | | |
| Sexual assault | 392 (60.3) | 389 (59.8) | 423 (65.1) | 426 (65.5) |
| Rape | 315 (48.5) | 305 (46.9) | 304 (46.8) | 227 (34.9)† |
| Child sexual abuse | 233 (35.8) | 230 (35.4) | 246 (37.8) | 221 (34.0) |
| Sexual exploitation | 251 (38.6)§ | 263 (40.5) | 308 (47.4) | 379 (58.3)† |
| Sex trafficking | 71 (10.9) | 69 (10.6) | 64 (9.8) | 37 (5.7)† |
| Prostitution | 67 (10.3)¶ | 69 (10.6)** | 53 (8.2) | 31 (4.8) |
| Sexual harassment | 63 (9.7) | 78 (12.0) | 84 (12.9) | 232 (35.7)† |
| Child pornography | 39 (6.0) | 42 (6.5) | 31 (4.8) | 37 (5.7) |
| **Media language** | | | | |
| Sex scandal/Scandal | 25 (3.8) | 24 (3.7) | 39 (6.0) | 71 (10.9)† |
| Sex/Intercourse | 89 (13.7) | 97 (14.9)** | 75 (11.5) | 61 (9.4) |
| Accuser | 40 (6.2)§ | 47 (7.2) | 68 (10.5) | 100 (15.4)† |
| Accused | 173 (26.6) | 170 (26.2) | 177 (27.2) | 243 (37.4)† |
| **Outcome/Prevention messaging** | | | | |
| Consequences for perpetrator | 205 (31.5)¶ | 219 (33.7) | 223 (34.3) | 253 (38.9) |
| Call for secondary/tertiary prevention | 134 (20.6) | 143 (22.0) | 107 (16.5) | 123 (18.9) |
| Call for primary prevention | 60 (9.2) | 46 (7.1) | 44 (6.8) | 65 (10.0) |

* Comparisons are made between years by type of sexual violence, media language used, and outcome/prevention messaging (p<0.05).
† Significantly different from all other years.
§ 2014 significantly different from 2016.
¶ 2014 significantly different from 2017.
** 2015 significantly different from 2017.


**Summary**

What is already known about this topic?

Sexual violence media portrayals can influence public perceptions, which can affect social norms and behavior.

What is added by this report?

Examination of articles from traditional print media outlets found regional and temporal differences in types of sexual violence covered, media language used, and outcomes reported in news story coverage in 2017, compared with that from 2014 to 2016.

What are the implications for public health practice?

Through cross-sectoral collaboration and use of the Sexual Violence Media Guide language suggestions, media, public health practitioners, and communities can work together to effectively use best practices to report on sexual violence, emphasize sexual violence as preventable, and frame sexual violence as a public health issue.


## References


1. Smith SG, Zhang X, Basile KC, et al. National Intimate Partner and Sexual Violence Survey (NISVS): 2015 data brief–updated release. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/violenceprevention/pdf/2015data-brief508.pdf
2. Tynan MA, Polansky JR, Titus K, Atayeva R, Glantz SA. Tobacco use in top-grossing movies—United States, 2010–2016. MMWR Morb Mortal Wkly Rep 2017;66:681–6. PMID:28683057 https://doi.org/10.15585/mmwr.mm6626a1
3. Eveland WP Jr. The impact of news and entertainment media on perceptions of social reality. In: Dillard JP, Pfau M, eds. The persuasion handbook: development of theory and practice. Thousand Oaks, CA: Sage Publications; 2002.
4. CDC. Reporting on sexual violence. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://vetoviolence.cdc.gov/sites/all/themes/veto_bootstrap/assets/sv-landing/SV_Media_Guide_508c.pdf
5. Carlyle KE, Slater MD, Chakroff JL. Newspaper coverage of intimate partner violence: skewing representations of risk. J Commun 2008;58:168–86. PMID:21297889 https://doi.org/10.1111/j.1460-2466.2007.00379.x
6. Mejia P, Somji A, Nixon L, Dorfman L, Quintero F. Issue 22: what's missing from the news on sexual violence? An analysis of coverage, 2011–2013. Berkeley, CA: Berkeley Media Studies Group; 2015. http://www.bmsg.org/resources/publications/issue-22-whats-missing-from-the-news-on-sexual-violence-an-analysis-of-coverage-2011-2013/
7. Weatherred JL. Framing child sexual abuse: a longitudinal content analysis of newspaper and television coverage, 2002–2012. J Child Sex Abuse 2017;26:3–22. PMID:27997291 https://doi.org/10.1080/10538712.2016.1257528
8. Barthel M. State of the news media methodology. Washington, DC: Pew Research Center; 2018. https://www.journalism.org/2019/06/25/state-of-the-news-media-methodology/
9. Basile KC, DeGue S, Jones K, et al. STOP SV: a technical package to prevent sexual violence. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/violenceprevention/pdf/SV-Prevention-Technical-Package.pdf
10. Carlyle KE. The role of social media in promoting understanding of violence as a public health issue. J Commun Healthc 2017;10:162–4. https://doi.org/10.1080/17538068.2017.1373907

# Decline in SARS-CoV-2 Antibodies After Mild Infection Among Frontline Health Care Personnel in a Multistate Hospital Network — 12 States, April–August 2020

Wesley H. Self, MD[1,*]; Mark W. Tenforde, MD, PhD[2,*]; William B. Stubblefield, MD[1]; Leora R. Feldstein, PhD[2]; Jay S. Steingrub, MD[3]; Nathan I. Shapiro, MD[4]; Adit A. Ginde, MD[5]; Matthew E. Prekker, MD[6]; Samuel M. Brown, MD[7]; Ithan D. Peltan, MD[7]; Michelle N. Gong, MD[8]; Michael S. Aboodi, MD[8]; Akram Khan, MD[9]; Matthew C. Exline, MD[10]; D. Clark Files, MD[11]; Kevin W. Gibbs, MD[11]; Christopher J. Lindsell, PhD[1]; Todd W. Rice, MD[1]; Ian D. Jones, MD[1]; Natasha Halasa, MD[1]; H. Keipp Talbot, MD[1]; Carlos G. Grijalva, MD[1]; Jonathan D. Casey, MD[1]; David N. Hager, MD, PhD[12]; Nida Qadir, MD[13]; Daniel J. Henning, MD[14]; Melissa M. Coughlin, PhD[2]; Jarad Schiffer, MS[2]; Vera Semenova, PhD[2]; Han Li, PhD[2]; Natalie J. Thornburg, PhD[2,*]; Manish M. Patel, MD[2,*]; CDC COVID-19 Response Team; IVY Network

Most persons infected with SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), develop virus-specific antibodies within several weeks, but antibody titers might decline over time. Understanding the timeline of antibody decline is important for interpreting SARS-CoV-2 serology results. Serum specimens were collected from a convenience sample of frontline health care personnel at 13 hospitals and tested for antibodies to SARS-CoV-2 during April 3–June 19, 2020, and again approximately 60 days later to assess this timeline. The percentage of participants who experienced seroreversion, defined as an antibody signal-to-threshold ratio >1.0 at baseline and <1.0 at the follow-up visit, was assessed. Overall, 194 (6.0%) of 3,248 participants had detectable antibodies to SARS-CoV-2 at baseline (*1*). Upon repeat testing approximately 60 days later (range = 50–91 days), 146 (93.6%) of 156 participants experienced a decline in antibody response indicated by a lower signal-to-threshold ratio at the follow-up visit, compared with the baseline visit, and 44 (28.2%) experienced seroreversion. Participants with higher initial antibody responses were more likely to have antibodies detected at the follow-up test than were those who had a lower initial antibody response. Whether decay in these antibodies increases risk for reinfection and disease remains unanswered. However, these results suggest that serology testing at a single time point is likely to underestimate the number of persons with previous SARS-CoV-2 infection, and a negative serologic test result might not reliably exclude prior infection.

Once infected with SARS-CoV-2, most persons develop virus-specific antibodies within 2–3 weeks (*2*,*3*). Serology tests are now being used widely in seroprevalence studies to understand patterns of viral spread, cumulative incidence of SARS-CoV-2 infection, and pandemic trajectory (*4*–*6*). Further, serologic testing has been proposed as a way to identify persons who might have developed immunity through a previous infection. Understanding how rapidly SARS-CoV-2 antibody levels decline after seroconversion is critical for interpreting serology results. A limited number of studies have found declines in SARS-CoV-2 antibody levels over time (*7*–*9*), but the frequency and timing of seroreversion (the decline in antibody levels below the positivity threshold after initial seroconversion) remains largely unknown.

The Influenza Vaccine Effectiveness in the Critically Ill (IVY) Network, a collaboration of academic medical centers in the United States that studies influenza and COVID-19 (*1*), enrolled a convenience sample of frontline health care personnel at 13 centers in 12 states,[†] with a target of 250 participants per center. Health care personnel were eligible if they reported regular direct contact with COVID-19 patients and worked in the emergency department, intensive care unit, or other hospital-based unit that cared for patients with COVID-19. Participants underwent two study visits: a baseline visit (conducted April 3–June 19, 2020) and a follow-up visit approximately 60 days after the baseline visit. At both visits, blood was collected for SARS-CoV-2 antibody testing, and participants were questioned about demographic characteristics, underlying medical conditions, signs or symptoms of an acute viral infection from February 1, 2020, until the visit date,[§] and any previous SARS-CoV-2 testing (e.g., reverse transcription–polymerase chain reaction [RT-PCR]) for acute infection. Blood specimens collected at the baseline and follow-up visits were tested for SARS-CoV-2 antibodies at CDC using an enzyme-linked immunosorbent assay (ELISA) against the extracellular domain of the SARS-CoV-2 spike protein (*4*). The assay detects all SARS-CoV-2 immunoglobulin (Ig) types (IgA, IgM, or IgG). Specimens were considered reactive with a signal-to-threshold ratio >1.0 at a background corrected

[*] Wesley H. Self and Mark W. Tenforde contributed equally to this report; Manish M. Patel and Natalie J. Thornburg contributed equally to this report.

[†] Participating academic medical centers and their locations were Harborview Medical Center (Washington), Oregon Health & Science University (Oregon), University of California Los Angeles (California), Hennepin County Medical Center (Minnesota), Vanderbilt University Medical Center (Tennessee), Ohio State University (Ohio), Wake Forest University (North Carolina), Montefiore Medical Center (New York), Beth Israel Deaconess Medical Center (Massachusetts), Baystate Medical Center (Massachusetts), Intermountain Medical Center (Utah), UCHealth University of Colorado Hospital (Colorado), and Johns Hopkins Hospital (Maryland).

[§] Previous signs and symptoms included one or more of the following: fever (temperature >99.5°F [37.5°C]), cough, shortness of breath, myalgias, sore throat, vomiting, diarrhea, change in or loss of taste, change in or loss of smell, chest tightness.

serum dilution of 1:100, with higher ratios indicating higher antibody titers. The assay has a sensitivity estimated at 96% and specificity at 99% (*4*).

The change in signal-to-threshold ratio between the baseline visit and follow-up visit was quantified, and the percentage of participants who experienced seroreversion was reported. Logistic regression was used to evaluate the association between baseline signal-to-threshold value and seroreversion, adjusting for age, sex, race/ethnicity, number of days between the baseline and follow-up visit, and presence of one or more chronic medical condition. Analyses were conducted using Stata (version 16; StataCorp). The project was determined to be nonresearch public health surveillance by participating institutions and CDC and was conducted consistent with applicable federal law and CDC policy.¶

Among 3,248 health care personnel, 194 (6.0%) had antibodies to SARS-CoV-2 at the baseline visit (*1*). Among these, 156 (80.4%) returned for the follow-up visit around 60 days later (range = 50–91 days). Among these 156 participants with a positive baseline serology and follow-up antibody testing performed, median age was 38 years (interquartile range [IQR] = 30–48 years), 94 (60.3%) were female, and 108 (69.2%) reported one or more symptoms of an acute infection consistent with COVID-19 between February 1, 2020 and the baseline visit. Among the 108 participants who reported symptoms, the median interval between symptom onset and baseline serology testing was 30 days (IQR = 19–40 days). Participants who reported symptoms of an acute viral illness since February had higher baseline signal-to-threshold ratios (median = 3.6; IQR = 3.1–3.9) than did those who did not report symptoms (median = 2.5; IQR = 1.5 to 3.6) (p<0.001). Among these 156 participants, 72 (46.2%) reported past RT-PCR testing for SARS-CoV-2, 46 (63.9%) of whom had positive test results; no hospitalizations were reported.

Among the 156 participants who returned for follow-up, the signal-to-threshold value for 146 (93.6%) had declined since the baseline visit, including 44 (28.2%) participants who experienced seroreversion (Table 1) (Supplementary Figure, https://stacks.cdc.gov/view/cdc/97358), with antibody levels falling below the threshold for positivity. Among 108 participants who reported previous COVID-19–compatible signs or symptoms, 21 (19.4%) seroreverted, compared with 23 (47.9%) of 48 of participants who did not report symptoms (p<0.001). Among 72 participants with previous RT-PCR testing, one (2.2%) of 46 with a positive test result versus seven (26.9%) of 26 with a negative test result seroreverted. Seroreversion occurred in 64.9% (37 of 57) of participants with a low antibody response

¶ 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. 501 et seq.

**TABLE 1. Antibody signal-to-threshold ratio of panimmunoglobulin reactivity to SARS-CoV-2 full length S protein enzyme-linked immunosorbent assay among frontline health care personnel from a baseline visit (April–June 2020) to a follow-up visit approximately 60 days later,* overall and by baseline antibody level (N = 156) — 13 academic medical centers,† United States, April–August, 2020**

| Baseline signal-to-threshold ratio | No. | Baseline signal-to-threshold ratio, median (IQR) | Follow-up signal-to-threshold ratio, median (IQR) | No. (%) who seroreverted |
|---|---|---|---|---|
| **All** | **156** | **3.4 (2.3–3.8)** | **2.6 (0.9–3.2)** | **44 (28.2)** |
| Low positive (1.0–2.9) | 57 | 1.6 (1.3–2.4) | 0.8 (0.5–1.2) | 37 (64.9) |
| High positive (≥3) | 99 | 3.7 (3.5–5.3) | 3.1 (2.6–3.3) | 7 (7.1) |

**Abbreviation:** IQR = interquartile range.

* Range = 50–91 days. The population included 156 frontline health care personnel in the United States from 13 academic medical centers in 12 states who tested positive for SARS-CoV-2 antibodies (signal-to-threshold >1.0) at the baseline visit and underwent repeat testing at the follow-up visit.

† Harborview Medical Center (Washington), Oregon Health & Science University (Oregon), University of California Los Angeles (California), Hennepin County Medical Center (Minnesota), Vanderbilt University Medical Center (Tennessee), Ohio State University (Ohio), Wake Forest University (North Carolina), Montefiore Medical Center (New York), Beth Israel Deaconess Medical Center (Massachusetts), Baystate Medical Center (Massachusetts), Intermountain Medical Center (Utah), UCHealth University of Colorado Hospital (Colorado), and Johns Hopkins Hospital (Maryland).

(baseline signal-to-threshold value = 1.0–2.9) and 7.1% (seven of 99) of participants with a high antibody response (baseline signal-to-threshold value ≥3.0) (p<0.001) (Figure). A higher baseline signal-to-threshold ratio was associated with lower odds of seroreversion at the follow-up visit (adjusted odds ratio [aOR] for a 1-unit increase in signal-to-threshold ratio = 0.29; 95% CI = 0.18–0.46) (Table 2). In this model, a 10-year increase in participant age was associated with higher odds of seroreversion (aOR = 1.74; 95% CI = 1.06–2.85). Compared with non-Hispanic White participants, odds of seroreversion were lower among non-Hispanic Black participants (aOR = 0.11; 95% CI = 0.15–0.76) and Hispanic participants (aOR = 0.10; 95% CI = 0.01–0.88).

## Discussion

In this study of 156 frontline U.S. health care personnel who received positive SARS-CoV-2 antibody test results in spring 2020 and returned for follow-up testing approximately 60 days later, 146 (93.6%) had a decline in antibody levels between baseline and follow-up, and 44 (28.2%) had complete seroreversion, i.e., a decline of antibody to levels below the threshold for positivity. A higher percentage of those with low baseline antibody levels seroreverted (64.9%) than did those with high baseline titers (7.1%). These results suggest that a substantial proportion of persons infected with SARS-CoV-2 might have negative serologic test results in the months following infection. This has several important implications. Cross-sectional seroprevalence studies that estimate the number of

**TABLE 2. Baseline characteristics associated with SARS-CoV-2 seroreversion (multivariable logistic regression model)* among frontline health care personnel† (N = 156) — 13 academic medical centers, United States, 2020§**

| Characteristic | Odds ratio (95% CI) | |
|---|---|---|
| | Unadjusted | Adjusted¶ |
| **Signal-to-threshold ratio at baseline visit, 1-unit change**** | 0.34 (0.23–0.51) | 0.29 (0.18–0.46) |
| **Age, 10-yr change††** | 1.13 (0.83–1.55) | 1.74 (1.06–2.85) |
| **Time from baseline visit to follow-up visit antibody testing, 1-wk change§§** | 1.66 (1.24–2.21) | 2.23 (1.46–3.40) |
| **Female sex** | 0.93 (0.46–1.90) | 1.49 (0.49–4.50) |
| **Race/Ethnicity** | | |
| White, non-Hispanic | Referent | Referent |
| Black, non-Hispanic | 0.24 (0.07–0.88) | 0.11 (0.15–0.76) |
| Hispanic or Latino | 0.21 (0.05–0.98) | 0.10 (0.01–0.88) |
| Other | 0.42 (0.13–1.38) | 0.37 (0.08–1.59) |
| **≥1 baseline medical condition¶¶** | 1.44 (0.61–3.40) | 2.70 (0.74–9.94) |

**Abbreviation:** CI = confidence interval.

* A seropositive result (signal-to-threshold >1.0) at the baseline visit in the spring of 2020 and a seronegative result (signal-to-threshold <1.0) at the follow-up visit approximately 60 days later.

† Persons who tested positive for SARS-CoV-2 antibodies (signal-to-threshold >1.0) at the baseline visit and underwent repeat testing at the follow-up visit.

§ Harborview Medical Center (Washington), Oregon Health & Science University (Oregon), University of California Los Angeles (California), Hennepin County Medical Center (Minnesota), Vanderbilt University Medical Center (Tennessee), Ohio State University (Ohio), Wake Forest University (North Carolina), Montefiore Medical Center (New York), Beth Israel Deaconess Medical Center (Massachusetts), Baystate Medical Center (Massachusetts), Intermountain Medical Center (Utah), UCHealth University of Colorado Hospital (Colorado), and Johns Hopkins Hospital (Maryland).

¶ All variates in table were included in multivariable logistic regression model.

** This measured the odds ratio for seroreversion associated with a 1-unit difference in signal-to-threshold ratio value (e.g., 5 versus 4), comparing the higher ratio to the lower ratio.

†† This measured the odds ratio for seroreversion associated with a 10-year difference in age (e.g., 60 years versus 50 years), comparing the higher age to the lower range.

§§ This measured the odds ratio for seroreversion associated with a 1-week difference in time to follow-up (e.g., 9 weeks versus 8 weeks), comparing the later follow-up time to the earlier follow-up time.

¶¶ Medical conditions included one or more of the following: asthma, chronic obstructive pulmonary disease, other chronic lung condition, chronic heart failure, coronary artery disease, diabetes mellitus, hypertension, chronic renal disease (dialysis), autoimmune disease, active cancer (not in remission), immunosuppression (undergoing active chemotherapy or taking a medication to suppress the immune system).

persons who have been infected with SARS-CoV-2 will likely underestimate incidence because a proportion of previously infected persons will likely seroревert and thus not be counted as having been previously infected. In addition, these results challenge the notion of using serologic testing results at an individual level to designate previous SARS-CoV-2 infection. COVID-19 convalescent plasma is widely being used as a treatment for COVID-19, including through a Food and Drug Administration Emergency Use Authorization in the United States (*10*); these results demonstrate that the optimal window for collecting convalescent plasma with high levels of SARS-CoV-2 antibodies from donors who have recovered from COVID-19 might be short because of substantial decline in antibody levels within 60 days. Whether decline in SARS-CoV-2 antibodies increases risk for reinfection and disease in humans remains unknown. Humoral immunity to primary infections from a novel virus might not be as durable or strong as that to secondary infections, but memory B-cell and T-cell responses might reduce the severity of illness with repeat exposure or infection.

The findings in this report are subject to at least four limitations. First, the timing of the baseline serologic test relative to symptom onset was not standardized, which might affect baseline signal-to-threshold ratios, particularly for recently acquired infection in which antibody levels might still have been increasing. Second, the study population was derived from a convenience sample, which might result in nonrepresentativeness. Third, 38 (20%) participants were lost to follow-up, limiting size of the study population. Finally, misclassification of antibody status was possible; however, this was considered to be unlikely because of the high sensitivity and specificity of the ELISA.

In this study of frontline health care personnel at 13 medical centers who received positive SARS-CoV-2 antibody test results in spring 2020, more than one quarter were seronegative approximately 60 days after testing. Because SARS-CoV-2 antibody levels might decline in a proportion of persons following primary infection, a negative serology test does not reliably exclude previous infection. These antibody declines might not equate to loss of protective immunity or increased risk for reinfection; this was not assessed in this study. Cross-sectional seroprevalence studies to evaluate population immunity are likely to underestimate rates of previous infection because antibodies appear to only be detectable for a discrete period of time following infection.

**Summary**

What is already known about this topic?

Most persons develop virus-specific antibodies to SARS-CoV-2 after infection; however, the timeline of antibody decline over time is uncertain.

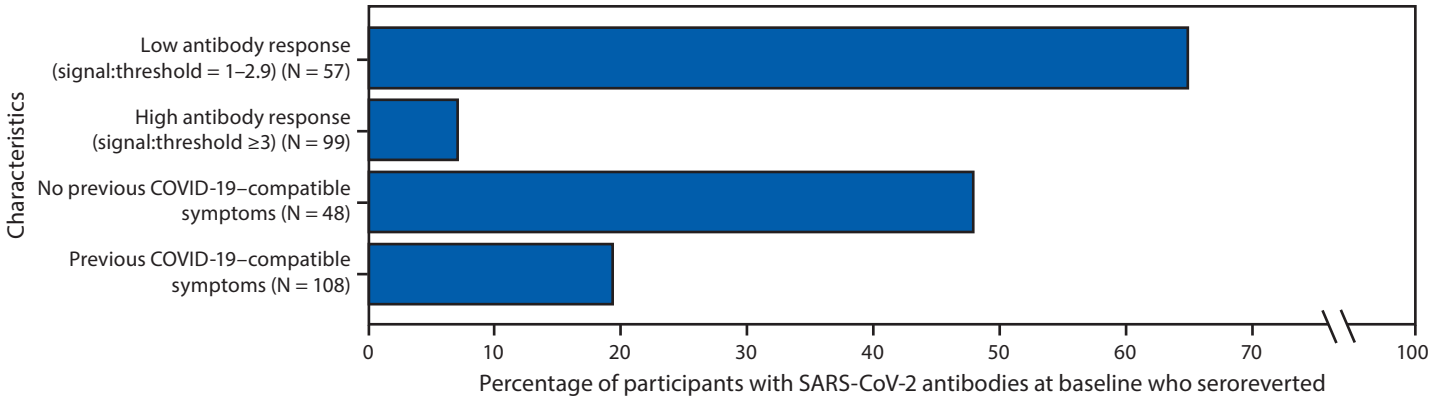
What is added by this report?

Among 156 frontline health care personnel who had positive SARS-CoV-2 antibody test results in spring 2020, 94% experienced a decline at repeat testing approximately 60 days later, and 28% seroreverted to below the threshold of positivity. Participants with higher initial antibody responses were more likely to have antibodies detected at the follow-up test than were those who had a lower initial antibody response.

What are the implications for public health practice?

SARS-CoV-2 antibodies decline over weeks following acute infection. Negative SARS-CoV-2 serologic results do not exclude previous infection, which has significant impacts on how serologic studies are interpreted.

**FIGURE. Percentage of 156 participants with SARS-COV-2 antibodies at baseline who seroreverted approximately 60 days later, by baseline antibody response* and history of COVID-19–compatible symptoms before baseline testing† — 13 academic medical centers, United States, 2020**




**Abbreviations:** COVID-19 = coronavirus disease 2019; ELISA = enzyme-linked immunosorbent assay.

* Antibody response was categorized as high or low based on signal-to-threshold ratio of panimmunoglobulin reactivity to SARS-CoV-2 full length S protein ELISA at baseline visit.

† Signs and symptoms included one or more of the following reported between February 1, 2020, and the date of baseline study visit: fever (temperature >99.5°F [37.5°C]), cough, shortness of breath, myalgias, sore throat, vomiting, diarrhea, change in or loss of taste or smell, and chest tightness.

## CDC COVID-19 Response Team

Mohammed Ata Ur Rasheed, CDC COVID-19 Response Team; Lisa Mills, CDC COVID-19 Response Team; Sandra N. Lester, CDC COVID-19 Response Team; Brandi Freeman, CDC COVID-19 Response Team; Bailey Alston, CDC COVID-19 Response Team; Muyiwa Ategbole, CDC COVID-19 Response Team; Peter Browning, CDC COVID-19 Response Team; Shanna Bolcen, CDC COVID-19 Response Team; Darbi Boulay, CDC COVID-19 Response Team; Li Cronin, CDC COVID-19 Response Team; Ebenezer David, CDC COVID-19 Response Team; Rita Desai, CDC COVID-19 Response Team; Monica Epperson, CDC COVID-19 Response Team; Yamini Gorantla, CDC COVID-19 Response Team; Tao Jia, CDC COVID-19 Response Team; Pete Maniatis, CDC COVID-19 Response Team; Kristina Ortiz, CDC COVID-19 Response Team; So Hee Park, CDC COVID-19 Response Team; Palak Patel, CDC COVID-19 Response Team; Yunlong Qin, CDC COVID-19 Response Team; Heather Tatum, CDC COVID-19 Response Team; Briana Zellner, CDC COVID-19 Response Team.

## IVY Network

Adrienne Baughman, IVY Network; Kimberly W. Hart, IVY Network; Robert McClellan, IVY Network; Rendie McHenry, IVY Network; Jakea Johnson, IVY Network; Andrea Fletcher, IVY Network; Kemberlyne Cordero, IVY Network; Lori Kozikowski, IVY Network; Lesley De Souza, IVY Network; Sarah Romain, IVY Network; Scott Ouellette, IVY Network; Andres Santana, IVY Network; Sherell Thornton-Thompson, IVY Network; Michelle Howell, IVY Network; Jennifer Peers, IVY Network; Shelby Shelton, IVY Network; Lani Finck, IVY Network; Kirsten Soules, IVY Network; Michael Klausner, IVY Network; Ximena Calderon-Morales, IVY Network; Heidi L. Erickson, IVY Network; Audrey Hendrickson, IVY Network; Jamie Stang, IVY Network; Ellen Maruggi, IVY Network; Alex Dunn, IVY Network; Eddie Stenehjem, IVY Network; Valerie Aston, IVY Network; Mikaele Bown, IVY Network; Michelle Matheu, IVY Network; Rilee Smith, IVY Network; Olivia Krol, IVY Network; Andrew Salar, IVY Network; Makrina Kamel, IVY Network; Kelly Nguyen, IVY Network; Peter Huynh, IVY Network; Sarah Karow, IVY Network; Michelle Bright, IVY Network; Holly Bookless, IVY Network; Sandy Mullins, IVY Network; Kelly Neidert, IVY Network; Dina McGowan, IVY Network; Elizabeth Cassandra, IVY Network; Emily Brown, IVY Network; Claire Carlin, IVY Network; Trina Wemlinger, IVY Network; Breona Edwards, IVY Network; Lori Flores, IVY Network; Mary LaRose, IVY Network; Kathie J. Ferbas, IVY Network; Rachel Martin-Blais, IVY Network; Grace M. Aldrovandi, IVY Network; Olivia Thompson, IVY Network; Sakshi Sehgal, IVY Network.

Corresponding author: Wesley H. Self, wesley.self@vumc.org.

[1]Vanderbilt University Medical Center, Nashville, Tennessee; [2]CDC COVID-19 Response Team; [3]Baystate Medical Center, Springfield, Massachusetts; [4]Beth Israel Deaconess Medical Center, Boston, Massachusetts; [5]University of Colorado School of Medicine, Aurora, Colorado; [6]Hennepin County Medical Center, Minneapolis, Minnesota; [7]Intermountain Medical Center and University of Utah School of Medicine, Salt Lake City, Utah; [8]Montefiore Medical Center, Bronx, New York; [9]Oregon Health & Science University Hospital, Portland, Oregon; [10]Ohio State University Wexner Medical Center, Columbus, Ohio; [11]Wake Forest University Baptist Medical Center, Winston-Salem, North Carolina; [12]Johns Hopkins Hospital, Baltimore, Maryland; [13]UCLA Medical Center, Los Angeles, California; [14]Harborview Medical Center, Seattle, Washington.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Christopher J. Lindsell reports grants from National Institutes of Health, grants from Department of Defense, Marcus Foundation, Endpoint Health, Entegrion, bioMerieux, and Bioscape Digital, outside the submitted work. Daniel J. Henning reports personal fees from CytoVale and grants from Baxter, outside the submitted work. Akram Khan reports grants

from United Therapeutics, Actelion Pharmaceuticals, Regeneron, and Reata Pharmaceuticals, outside the submitted work. Samuel M. Brown reports grants from National Institutes of Health, Department of Defense, Intermountain Research and Medical Foundation, and Janssen; consulting fees paid to his employer from Faron and Sedana, all outside the submitted work. Ithan D. Peltan reports grants from the National Institutes of Health and, outside the submitted work, grants from Asahi Kasei Pharma, Immunexpress Inc., Janssen Pharmaceuticals, and Regeneron. Carlos Grijalva reports other from Pfizer, other from Merck, other from Sanofi-Pasteur, grants from Campbell Alliance, the National Institutes of Health, the Food and Drug Administration, the Agency for Health Care Research and Quality, outside the submitted work. Todd W. Rice reports consulting work for Cumberland Pharmaceuticals, Inc, outside the submitted work. H. Keipp Talbot has served on a data safety and monitoring board for Seqirus. Natasha Halasa receives grant support from Quidel and Sanofi, donation of vaccines and hemagglutination inhibition/microneutralization titers performed by Sanofi, and speaker fees by an educational grant supported by Genentech, outside the submitted work. No other potential conflicts of interest were disclosed.

## References


1. Self WH, Tenforde MW, Stubblefield WB, et al.; CDC COVID-19 Response Team; IVY Network. Seroprevalence of SARS-CoV-2 among frontline health care personnel in a multistate hospital network—13 academic medical centers, April–June 2020. MMWR Morb Mortal Wkly Rep 2020;69:1221–6. PMID:32881855 https://doi.org/10.15585/mmwr.mm6935e2
2. Zhao J, Yuan Q, Wang H, et al. Antibody responses to SARS-CoV-2 in patients of novel coronavirus disease 2019. Clin Infect Dis 2020;ciaa344. PMID:32221519 https://doi.org/10.1093/cid/ciaa344
3. Long QX, Liu BZ, Deng HJ, et al. Antibody responses to SARS-CoV-2 in patients with COVID-19. Nat Med 2020;26:845–8. PMID:32350462 https://doi.org/10.1038/s41591-020-0897-1
4. Havers FP, Reed C, Lim T, et al. Seroprevalence of antibodies to SARS-CoV-2 in 10 sites in the United States, March 23–May 12, 2020. JAMA Intern Med 2020. Epub July 21, 2020. https://doi.org/10.1001/jamainternmed.2020.4130
5. Stringhini S, Wisniak A, Piumatti G, et al. Seroprevalence of anti-SARS-CoV-2 IgG antibodies in Geneva, Switzerland (SEROCoV-POP): a population-based study. Lancet 2020;396:313–9. PMID:32534626 https://doi.org/10.1016/S0140-6736(20)31304-0
6. Anand S, Montez-Rath M, Han J, et al. Prevalence of SARS-CoV-2 antibodies in a large nationwide sample of patients on dialysis in the USA: a cross-sectional study. Lancet 2020;396:1335–44. PMID:32987007 https://doi.org/10.1016/S0140-6736(20)32009-2
7. Crawford KHD, Dingens AS, Eguia R, et al. Dynamics of neutralizing antibody titers in the months after SARS-CoV-2 infection. J Infect Dis 2020;jiaa618. PMID:33000143 https://doi.org/10.1093/infdis/jiaa618
8. Patel MM, Thornburg NJ, Stubblefield WB, et al. Change in antibodies to SARS-CoV-2 over 60 days among health care personnel in Nashville, Tennessee. JAMA 2020;324:1781–2. PMID:32940635 https://doi.org/10.1001/jama.2020.18796
9. Ibarrondo FJ, Fulcher JA, Goodman-Meza D, et al. Rapid decay of anti-SARS-CoV-2 antibodies in persons with mild Covid-19. N Engl J Med 2020;383:1085–7. PMID:32706954 https://doi.org/10.1056/NEJMc2025179
10. Food and Drug Administration. Emergency use authorization declaration. Washington, DC: US Department of Health and Human Services, Food and Drug Administration; 2020. https://www.fda.gov/media/141477/download

# Implementation of Hospital Practices Supportive of Breastfeeding in the Context of COVID-19 — United States, July 15–August 20, 2020

Cria G. Perrine, PhD[1]; Katelyn V. Chiang, MPH[1,2]; Erica H. Anstey, PhD[1]; Daurice A. Grossniklaus, PhD[1]; Ellen O. Boundy, ScD[1]; Erin K. Sauber-Schatz, PhD[3]; Jennifer M. Nelson, MD[1]

Breastfeeding has health benefits for both infants and mothers and is recommended by numerous health and medical organizations*,† (*1*). The birth hospitalization is a critical period for establishing breastfeeding; however, some hospital practices, particularly related to mother-newborn contact, have given rise to concern about the potential for mother-to-newborn transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) (*2*). CDC conducted a COVID-19 survey (July 15–August 20, 2020) among 1,344 hospitals that completed the 2018 Maternity Practices in Infant Nutrition and Care (mPINC) survey to assess current practices and breastfeeding support while in the hospital. Among mothers with suspected or confirmed COVID-19, 14.0% of hospitals discouraged and 6.5% prohibited skin-to-skin care; 37.8% discouraged and 5.3% prohibited rooming-in; 20.1% discouraged direct breastfeeding but allowed it if the mother chose; and 12.7% did not support direct breastfeeding, but encouraged feeding of expressed breast milk. In response to the pandemic, 17.9% of hospitals reported reduced in-person lactation support, and 72.9% reported discharging mothers and their newborns <48 hours after birth. Some of the infection prevention and control (IPC) practices that hospitals were implementing conflicted with evidence-based care to support breastfeeding. Mothers who are separated from their newborn or not feeding directly at the breast might need additional postdischarge breastfeeding support. In addition, the American Academy of Pediatrics (AAP) recommends that newborns discharged before 48 hours receive prompt follow-up with a pediatric health care provider.

Peripartum practices, including immediate maternal-newborn skin-to-skin contact, enabling mothers and newborns to room-in together, and teaching mothers to breastfeed (e.g., demonstrating good positioning and attachment and supporting mothers to express breast milk if they are temporarily separated from their newborns), are recommended worldwide for implementation in birth hospitals (*3*,*4*). These practices have a positive impact on both short- and long-term breastfeeding outcomes, which in turn benefit maternal and child health (*5*,*6*). Guidance on care during the birth hospitalization has evolved with the pandemic and at times has varied across public health and professional medical organizations.

CDC's mPINC survey is a census of all birth hospitals in the United States and its territories.§ The 2,039 hospitals that completed the 2018 mPINC survey (70% response) were sent an e-mail link to a 13-item COVID-19 survey, conducted using Research Electronic Data Capture (REDCap) (version 10.0.08; Vanderbilt University). The survey was open during July 15–August 20, 2020 and asked about current hospital practices. Maternity services had been closed at 22 hospitals, and 130 e-mailed surveys were undeliverable (i.e., e-mails bounced back). Overall, 1,344 hospitals completed the survey (66.6% overall response rate; 71.2% among delivered surveys). Hospitals were asked about their actual or planned approach to managing maternity patients with suspected or confirmed COVID-19 (as defined by the hospital), and the approximate number of these patients they had cared for. Descriptive analyses were conducted using SAS software (version 9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶ Data on annual births and hospital type were obtained from the 2018 mPINC survey.

Among 1,343 hospitals with available information, 724 (53.9%) had cared for one to 19 newborns whose mothers had confirmed COVID-19; 152 (11.4%) had cared for 20 or more, and 457 (34.0%) had not cared for any (Table 1). Approximately one half of the hospitals reported fewer than 1,000 annual births, 42.0% reported 1,000–4,999, and 2.8% reported 5,000 or more. The majority (78.8%) of hospitals were nonprofit.

Among 1,344 birth hospitals, 1,211 (90.2%) reported having enough COVID-19 tests, and 864 (64.3%) were performing universal COVID-19 testing of women admitted to labor and delivery (Table 2). Few hospitals (4.8%) reported separating all mothers and newborns until the mother received a negative test result, and 28.6% separated newborns and mothers if the mother was symptomatic or had a known exposure until test results were obtained; 24.2% separated mothers and newborns only if the mother received a positive test result.

Overall, 178 (13.3%) hospitals encouraged skin-to-skin contact between mothers with suspected or confirmed COVID-19 and their newborns immediately after birth, and 883 (66.1%) decided this on a case-by-case basis; 187 (14.0%) hospitals discouraged,

* https://www.cdc.gov/breastfeeding/about-breastfeeding/why-it-matters.html.
† https://apps.who.int/nutrition/topics/exclusive_breastfeeding/en/index.html.

§ https://www.cdc.gov/breastfeeding/data/mpinc.
¶ 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.

**TABLE 1. Characteristics of hospitals participating in CDC's Maternity Practices in Infant Nutrition and Care (mPINC) COVID-19 survey — U.S. states and territories, July 15–August 20, 2020**

| Characteristic | No. (%) |
|---|---|
| **Total responding hospitals** | **1,344 (100.0)** |
| **No. of infants born to mothers with confirmed COVID-19 since the start of the pandemic*** | |
| 0 | 457 (34.0) |
| 1–19 | 724 (53.9) |
| 20–59 | 111 (8.3) |
| 60–99 | 24 (1.8) |
| ≥100 | 17 (1.3) |
| Do not know | 10 (0.7) |
| **Hospital type†** | |
| Nonprofit | 1,059 (78.8) |
| Private | 221 (16.4) |
| Government/Military | 64 (4.8) |
| **Hospital annual births†** | |
| <500 | 438 (32.6) |
| 500–999 | 305 (22.7) |
| 1,000–1,999 | 285 (21.2) |
| 2,000–4,999 | 279 (20.8) |
| ≥5,000 | 37 (2.8) |

**Abbreviation:** COVID-19 = coronavirus disease 2019.
* Because of a missing response, the sample size for this question is 1,343. Hospitals were asked to estimate the approximate number of infants born to mothers with confirmed COVID-19; no definition of confirmed COVID-19 was provided.
† Hospital type and annual births were reported by hospitals in the 2018 mPINC survey.

and 87 (6.5%) prohibited skin-to-skin contact between mothers with suspected or confirmed COVID-19 and their newborns. Approximately one half of hospitals (726; 54.4%) encouraged rooming-in for mothers with suspected or confirmed COVID-19, with precautions to maintain distance, whereas 504 (37.8%) discouraged and 70 (5.3%) prohibited rooming-in. Approximately two thirds of hospitals supported direct breastfeeding with precautions (e.g., mask use and handwashing) for mothers with suspected or confirmed COVID-19 (893; 66.9%), whereas 268 (20.1%) discouraged direct breastfeeding but would allow it according to mother's choice, and 170 (12.7%) did not support direct breastfeeding but encouraged expressed breast milk feeding by a healthy caregiver. When mothers with suspected or confirmed COVID-19 were not breastfeeding directly, 438 (33.3%) hospitals reported supporting expression of breast milk within 1 hour of birth, and 645 (49.0%) within 1–3 hours.

Because of the COVID-19 pandemic, 239 (17.9%) hospitals reported decreased access to in-person lactation support and 72.9% discharged mothers and newborns <48 hours after birth. After discharge, 802 (59.7%) and 655 (48.7%) hospitals offered in-person and virtual breastfeeding consultations, respectively. Since the start of the pandemic, 924 hospitals (68.9%) reported that their exclusive breastfeeding rates during hospitalization had stayed about the same, and similar percentages reported increases (11.3%), compared with decreases (12.2%).

## Discussion

During a 5-week period (July 15–August 20) when many areas of the country were experiencing substantial community transmission of SARS-CoV-2, hospitals were implementing a variety of practices intended to balance evidence-based maternity care with COVID-19-related IPC. Hospital practices are likely evolving along with the pandemic (*7*), potentially driven by multiple factors, including level of community transmission, guidance from public health and medical professional organizations, and a hospital's own experience in preparation for or caring for pregnant women and newborns with COVID-19.

Various organizations have promulgated COVID-19 guidance on care for pregnant women and newborns, which at times has been conflicting. The World Health Organization recommends that mothers with COVID-19 be able to practice skin-to-skin care, rooming-in, and direct breastfeeding while wearing a mask, unless they are too ill to do so**; similar guidance is supported by the American Academy of Family Physicians,†† and the American College of Obstetricians and Gynecologists§§ promotes shared decision-making with the mother and the health care team. On the other hand, when this survey was launched, CDC and AAP recommended temporary separation of newborns from mothers with suspected or confirmed COVID-19 (*8*). During data collection for this survey, CDC (August 3¶¶) and AAP (July 22***) updated their guidance, supporting maternal autonomy in decision-making. Changes in guidance reflect evolving knowledge about the virus and its potential impact on newborns. To date, there has been no definitive evidence of transmission of SARS-CoV-2 through breast milk. In addition, there have been reports of secretory immunoglobulin A against SARS-CoV-2 in breast milk samples of women with COVID-19, suggesting that breastfeeding might be particularly important for newborns of mothers with COVID-19 (*9*).

One third of hospitals in this study reported not having cared for any neonates born to mothers with COVID-19; however, others had extensive experience, including 17 hospitals reporting caring for at least 100 of these newborns. Follow-up of mothers with COVID-19 delivering at three large New York birth hospitals found reduced breastfeeding rates both in the hospital and after returning home among mothers who had been separated from their newborns (*7*). After identification of this finding, and the observed stress among mothers and

** https://www.who.int/news-room/commentaries/detail/breastfeeding-and-covid-19.
†† https://www.aafp.org/about/policies/all/breastfeeding-covid19.html.
§§ https://www.acog.org/en/Clinical/Clinical%20Guidance/Practice%20Advisory/Articles/2020/03/Novel%20Coronavirus%202019.
¶¶ https://www.cdc.gov/coronavirus/2019-ncov/hcp/caring-for-newborns.html.
*** https://services.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/clinical-guidance/faqs-management-of-infants-born-to-covid-19-mothers/.

**TABLE 2. Hospital maternity care practices and breastfeeding support in the context of the COVID-19 pandemic — U.S. states and territories, July 15–August 20, 2020**

| Hospital maternity care practices (no. with available information) | No. (%) |
|---|---|
| **Universal COVID-19 testing among women admitted to labor and delivery (1,344)** | **864 (64.3)** |
| **Adequate COVID-19 tests available for women admitted to labor and delivery (1,343)** | **1,211 (90.2)** |
| **Is hospital separating mothers and newborns until the mother receives a negative COVID-19 test? (1,322)** | |
| Yes, all newborns are separated until mother receives a negative result | 64 (4.8) |
| No, newborns are only separated from mothers with symptoms or known exposure while awaiting results | 378 (28.6) |
| No, all mothers and newborns remain together until the mother receives a positive result | 320 (24.2) |
| No, all mothers and newborns are kept together regardless of symptoms, known exposure, or test results | 560 (42.4) |
| **Skin-to-skin care in the first hour after birth of a healthy newborn whose mother has suspected/confirmed COVID-19 (1,335)** | |
| Encouraged | 178 (13.3) |
| Determined case-by-case as shared decision with the mother | 883 (66.1) |
| Discouraged | 187 (14.0) |
| Prohibited | 87 (6.5) |
| **Rooming-in for newborns of mothers with suspected/confirmed COVID-19 (1,334)** | |
| Encouraged; no precautions required | 34 (2.6) |
| Encouraged with precautions to maintain distance | 726 (54.4) |
| Discouraged, but allowed if mother's preference | 504 (37.8) |
| Prohibited; newborn was cared for in a room separate from mother | 70 (5.3) |
| **Breastfeeding for mothers with suspected/confirmed COVID-19 (1,334)** | |
| Direct breastfeeding encouraged with precautions (e.g., mask, handwashing) | 893 (66.9) |
| Direct breastfeeding discouraged but allowed with precautions if mother chooses | 268 (20.1) |
| Direct breastfeeding not supported, but mothers encouraged to express breast milk for feeding by a healthy caregiver | 170 (12.7) |
| Formula feeding recommended | 3 (0.2) |
| **Mothers with suspected/confirmed COVID-19 who are not breastfeeding are supported to start expressing breast milk (1,316)** | |
| Within 1 hr of birth | 438 (33.3) |
| 1–3 hrs after birth | 645 (49.0) |
| 4–6 hrs after birth | 195 (14.8) |
| Timing is not a consideration | 34 (2.6) |
| Mothers are discouraged from expressing breast milk | 4 (0.3) |
| **Because of the COVID-19 pandemic, direct lactation support has decreased (1,339)** | 239 (17.9) |
| **Because of the COVID-19 pandemic, hospital is discharging mothers and newborns <48 hrs after birth (1,337)** | 975 (72.9) |
| **Postdischarge breastfeeding support currently offered by the hospital* (1,344)** | |
| In-person breastfeeding support consultations | 802 (59.7) |
| Virtual breastfeeding consultations | 655 (48.7) |
| Information on how to access a breast pump | 1,047 (77.9) |
| Renting or lending hospital-grade breast pumps | 469 (34.9) |
| **Hospital exclusive breastfeeding rate since start of the pandemic (1,341)** | |
| Increased | 152 (11.3) |
| Decreased | 164 (12.2) |
| Stayed about the same | 924 (68.9) |
| Don't know | 101 (7.5) |

**Abbreviation:** COVID-19 = coronavirus disease 2019.
* Hospital could indicate all types of discharge support that applied.

newborns as a result of separation, the hospital system revised its policy and began to allow asymptomatic mothers with laboratory-confirmed COVID-19 to room-in and breastfeed.

Nearly one in five hospitals in this study reported that in-person lactation support had decreased during the pandemic. Approximately 60% of hospitals in this study reported offering in-person breastfeeding consultations postdischarge, compared with 69% of hospitals reporting offering this in the 2018 mPINC survey (CDC, unpublished data, 2020). Lactation specialists working in health care settings should follow recommended IPC measures for those settings.††† Nearly one half of hospitals reported offering virtual breastfeeding consultations; however, no data are available on this practice before the pandemic. Notably, these changes in lactation support affect newborns broadly, not just those born to mothers with COVID-19.

Approximately equal numbers of hospitals reported that their exclusive breastfeeding rates had increased and decreased; the majority reported the rate had stayed approximately the same. The reasons for these changes are unknown. However, the pandemic could contribute to reduced breastfeeding as a result of maternal/newborn separation and reductions in lactation support. On the other hand, the visitor restriction policies implemented by many hospitals could potentially provide more opportunities for breastfeeding and for a mother

††† https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html.

**Summary**

What is already known about this topic?

Evidence-based hospital practices supporting breastfeeding have sometimes conflicted with COVID-19 infection prevention and control measures.

What is added by this report?

During summer 2020, hospitals implemented a variety of practices intended to balance evidence-based maternity care with infection prevention and control. Because of the pandemic, 17.9% of hospitals reported that in-person lactation support had decreased, and 72.9% reported discharging mothers and their babies <48 hours after birth.

What are the implications for public health practice?

Additional postdischarge breastfeeding support and newborn follow-up might be needed during the COVID-19 pandemic. Longer-term monitoring of exclusive breastfeeding rates at hospital discharge will be important for assessing this aspect of the pandemic on infant health.

to learn her newborn's feeding cues.[§§§] Longer-term monitoring of exclusive breastfeeding rates at hospital discharge will be important to assess as one measure of the impact of the pandemic on infant health.

Approximately three fourths of hospitals reported discharging mothers and their newborns <48 hours after birth because of the pandemic. No standard length of stay for the birth hospitalization exists, but the Newborn Mothers' Health and Protection Act of 1996 prohibits the restriction of benefits to <48 hours for a vaginal delivery or <96 hours for a cesarean section.[¶¶¶] AAP describes discharge <48 hours after delivery as a "shortened hospital stay" and notes that although it can be accommodated for healthy term newborns, it is not appropriate for all mothers and infants (*10*). AAP also recommends that all newborns discharged <48 hours after birth be evaluated by a pediatric health care provider within 48 hours of discharge (*10*). This visit, in part, assesses effective feeding, which might be more critical during the pandemic when breastfeeding mothers might be receiving reduced hospital lactation support.

The findings in this report are subject to at least three limitations. First, although mPINC is a census of all birth hospitals, this survey was only sent to the hospitals that completed the 2018 mPINC survey. Second, hospitals used their own definitions for suspected and confirmed COVID-19, and those definitions might have been different. Finally, data captured in this survey represent a single point in time. Policies and practices likely will continue to change as the pandemic evolves.

Women with suspected or confirmed COVID-19 who are separated from their newborns and whose newborns are not feeding directly at the breast might need timely, professional, breastfeeding support.[****] In addition, AAP advises that infants discharged <48 hours after delivery receive prompt follow-up with a pediatric health care provider to ensure optimal feeding.

[§§§] https://www.medscape.com/viewarticle/933964.

[¶¶¶] https://www.cms.gov/CCIIO/Programs-and-Initiatives/Other-Insurance-Protections/nmhpa_factsheet.

[****] https://www.cdc.gov/coronavirus/2019-ncov/hcp/care-for-breastfeeding-women.html.

Corresponding author: Cria G. Perrine, cperrine@cdc.gov.

[1]Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee [3]CDC COVID-19 Response Team.

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.

## References

1. American Academy of Pediatrics. Section on breastfeeding. Breastfeeding and the use of human milk. Pediatrics 2012;129:e827–41. https://doi.org/10.1542/peds.2011-3552
2. Davanzo R, Merewood A, Manzoni P. Skin-to-skin contact at birth in the COVID-19 era: in need of help! Am J Perinatol 2020;37(Suppl 02):S1–4. PMID:32772355 https://doi.org/10.1055/s-0040-1714255
3. World Health Organization. Implementation guidance: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services—the revised Baby Friendly Hospital Initiative. Geneva, Switzerland: World Health Organization; 2018. https://www.who.int/nutrition/publications/infantfeeding/bfhi-implementation-2018.pdf
4. US Department of Health and Human Services. The Surgeon General's call to action to support breastfeeding. Washington, DC: US Department of Health and Human Services, Office of the Surgeon General; 2011. https://www.ncbi.nlm.nih.gov/books/NBK52682/
5. Pérez-Escamilla R, Martinez JL, Segura-Pérez S. Impact of the Baby-friendly Hospital Initiative on breastfeeding and child health outcomes: a systematic review. Matern Child Nutr 2016;12:402–17. https://doi.org/10.1111/mcn.12294
6. Feltner C, Weber RP, Stuebe AM, Grodensky CA, Orr C, Viswanathan M. Breastfeeding programs and policies, breastfeeding uptake, and maternal health outcomes in developed countries. Rockville, MD: Agency for Healthcare Research and Quality; 2018. https://effectivehealthcare.ahrq.gov/products/breastfeeding/research
7. Popofsky S, Noor A, Leavens-Maurer J, et al. Impact of maternal severe acute respiratory syndrome coronavirus 2 detection on breastfeeding due to infant separation at birth. J Pediatr 2020;226:64–70. PMID:32791077 https://doi.org/10.1016/j.jpeds.2020.08.004
8. Puopolo KM, Hudak ML, Kimberlin DW, Cummings J; Committee on Fetus and Newborn, Section on Neonatal Perinatal Medicine and Committee on Infectious Disease. Initial guidance: management of infants born to mothers with COVID-19. Itasca, IL: American Academy of Pediatrics; 2020. https://www.tn.gov/content/dam/tn/health/documents/cedep/novel-coronavirus/AAP_COVID-19-Initial-Newborn-Guidance.pdf
9. Fox A, Marino J, Amanat F, et al. Robust and specific secretory IgA against SARS-CoV-2 detected in human milk. iScience 2020;23:101735. PMID:33134887 https://doi.org/10.1016/j.isci.2020.101735
10. Benitz WE; Committee on Fetus and Newborn, American Academy of Pediatrics. Hospital stay for healthy term newborn infants. Pediatrics 2015;135:948–53. https://doi.org/10.1542/peds.2015-0699

# COVID-19 Outbreak Associated with a 10-Day Motorcycle Rally in a Neighboring State — Minnesota, August–September 2020

Melanie J. Firestone, PhD[1,2]; Haley Wienkes, MPH[1]; Jacob Garfin[1]; Xiong Wang, DVM, PhD[1]; Kelley Vilen, MPH[1]; Kirk E. Smith, DVM, PhD[1]; Stacy Holzbauer, DVM[1,3]; Matthew Plumb, MS[1]; Kelly Pung[1]; Carlota Medus, PhD[1]; Joseph D. Yao, MD[4]; Matthew J. Binnicker, PhD[4]; Andrew C. Nelson, MD, PhD[5]; Sophia Yohe, MD[5]; Kathryn Como-Sabetti, MPH[1]; Kris Ehresmann, MPH[1]; Ruth Lynfield, MD[1]; Richard Danila, PhD[1]

*On November 20, 2020, this report was posted as an* MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

During August 7–16, 2020, a motorcycle rally was held in western South Dakota that attracted approximately 460,000 persons from across the United States to numerous indoor and outdoor events over a 10-day period. During August–September 2020, the Minnesota Department of Health (MDH) investigated a coronavirus disease 2019 (COVID-19) outbreak associated with the rally in Minnesota residents. Fifty-one primary event-associated cases were identified, and 35 secondary or tertiary cases occurred among household, social, and workplace contacts, for a total of 86 cases; four patients were hospitalized, and one died. Approximately one third (34%) of 87 counties in Minnesota had at least one primary, secondary, or tertiary case associated with this rally. Genomic sequencing supported the associations with the motorcycle rally. These findings support current recommendations for mask use, physical distancing, reducing the number of attendees at gatherings, isolation for patients with COVID-19, and quarantine for close contacts to slow the spread of SARS-CoV-2 (*1*). Furthermore, although these findings did not capture the impact of the motorcycle rally on residents of other states, they demonstrate the rationale for consistent mitigation measures across states.

## Investigation and Findings

On August 21, 2020, MDH identified confirmed COVID-19 cases in persons who reported attending the motorcycle rally in the neighboring state of South Dakota. A primary, event-associated case was defined as an illness in a person who reported attending the rally or who traveled to western South Dakota by motorcycle during August 7–16 and who had symptom onset or specimen collection before August 30 (within 14 days after the end of the rally). Reverse transcription–polymerase chain reaction testing for SARS-CoV-2, the virus that causes COVID-19, was used to confirm cases. All confirmed cases among Minnesota residents were reported to MDH. MDH or local public health department staff members interviewed patients with confirmed SARS-CoV-2 infection to identify exposures and persons who might have been in contact with patients during their infectious period (2 days before through 10 days after symptom onset).* To assess exposures, interviews included questions about travel and being in specific settings, such as bars or restaurants, schools, health care facilities, or events or social gatherings in the 14 days before symptom onset. During August–September 2020, MDH and local health department staff members interviewed >80% of patients with a confirmed SARS-CoV-2 infection.

Secondary and tertiary cases were identified from case interview data. Confirmed secondary cases were defined as laboratory-confirmed infections in persons who did not attend the rally but who received SARS-CoV-2–positive test results after having contact with a person who had a primary case during their infectious period. Tertiary cases were laboratory-confirmed cases in persons who had contact with a person who had a secondary case during their infectious period. Likely event-associated secondary cases were confirmed infections in patients who had contact with a person who had symptoms of COVID-19 and had attended the motorcycle rally but who were not tested. Likely event-associated tertiary cases were confirmed infections in patients who had contact with persons who had a likely event-associated secondary case during their infectious period.

To investigate genomic similarity among COVID-19 cases, available SARS-CoV-2 RNA-positive clinical specimens were obtained from clinical laboratories, and whole genome sequencing was conducted at the MDH Public Health Laboratory on 38 specimens using previously described methods (*2*). Phylogenetic relationships, including distinct clustering of viral whole genome sequences, were inferred based on nucleotide differences via IQ-TREE† using general time reversible substitution models (*3*) as a part of the Nextstrain§ workflow (*4*). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

* The infectious period was estimated to begin 2 days before symptom onset and end 10 days after symptom onset, according to CDC guidance. https://www.cdc.gov/coronavirus/2019-ncov/php/contact-tracing/contact-tracing-plan/investigating-covid-19-case.html.

† http://www.iqtree.org/.

§ https://nextstrain.org/.

¶ 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.

**Summary**

What is already known about this topic?

Gatherings present an opportunity for rapid spread of COVID-19.

What is added by this report?

Following a 10-day motorcycle rally in South Dakota attended by approximately 460,000 persons, 51 confirmed primary event-associated cases, 21 secondary cases, and five tertiary cases were identified in Minnesota residents. An additional nine likely rally-associated secondary or tertiary cases occurred. Four patients were hospitalized, and one died. Genomic sequencing supported the associations with the motorcycle rally.

What are the implications for public health practice?

The impact of gatherings as a source of virus transmission underscores the importance of reducing the number of attendees at gatherings, using face masks, and encouraging physical distancing to prevent ongoing transmission of SARS-CoV-2. Furthermore, these findings demonstrate the rationale for consistent mitigation measures across states.

This investigation identified 86 cases, including 51 (59%) primary event-associated cases,** 26 (30%) confirmed secondary and tertiary cases, and nine (10%) likely event-associated secondary or tertiary cases. Four patients were hospitalized, and one died (Table). The median interval between specimen collection and interview was 3 days (range = 1–13 days). Overall, 64 (74%) patients were symptomatic, including 39 (76%) of 51 patients with a primary case and 25 (71%) of 35 patients with secondary and tertiary cases. Among patients with primary cases and symptom onset after the start of the rally, onset dates ranged from August 8 to August 26 (Figure 1). Two patients reported symptom onset before the event and attended the rally during their infectious period. Among primary patients, the median age was 44 years (range = 26–76 years), and 31 (61%) were male. Sixteen (33%) of 48 interviewed patients reported working while infectious, including five who worked at the rally and four who worked in health care after returning from the rally.

Forty-one (80%) interviewed patients with primary event-associated COVID-19 reported having close contact†† with others during their infectious period, with an average of 2.5 close contacts per patient (range = 1–8). Overall, 36 (75%) of 48 interviewed patients with primary event-associated cases reported having close contact with persons in their household while infectious, and 17 (35%) reported having other (social/workplace) close contacts while infectious. Patients reported a total of 59 household contacts (range = 0–4 per patient) and 43 social/workplace contacts (range = 0–6 per patient).

Among the 35 patients with confirmed or likely event-associated secondary/tertiary COVID-19, 25 (71%) were symptomatic, with symptom onset dates during August 12–29 (Table). The median age was 32 years (range = 1–83 years), and 13 (37%) were male. Fifteen (43%) persons with secondary or tertiary COVID-19 were household contacts of a person with a primary or secondary infection, 12 (34%) were social contacts, and eight (23%) were workplace contacts. Secondary transmission from this rally occurred via two workplace outbreaks, one wedding outbreak, and one funeral outbreak. Approximately one third (34%) of Minnesota's 87 counties had at least one primary, secondary, or tertiary case associated with this rally.

## Whole Genome Sequencing

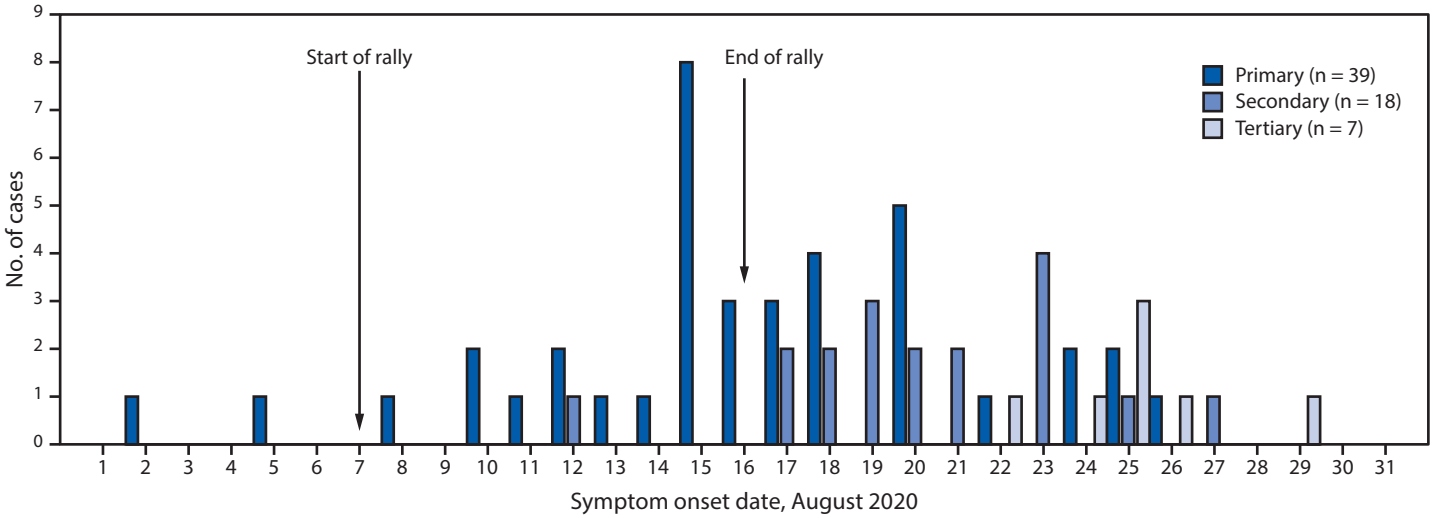
Specimens were obtained from 52 (60%) patients. Among these, 38 (73%) specimens (23 [61%] from primary and 15 [39%] from secondary and tertiary cases) were successfully sequenced, covering at least 98% of the SARS-CoV-2 genome. Six genetically similar clusters with known epidemiologic links were identified (i.e., cases in patients who were close contacts or who had common exposures at the rally), five of which demonstrated secondary or secondary and tertiary transmission. Cluster A (Figure 2) included genetically similar specimens for seven primary cases and one secondary case (specimen MN-MDH-1710). Among primary cases, specimens were collected from two patients who reported working at the rally, including one who worked at a restaurant. Two other patients in this cluster reported visiting that restaurant. Another patient who attended the rally also reported visiting the same restaurant; this patient was a household contact of the patient with specimen MN-MDH-1710. Cluster B represented a chain of transmission in a workplace setting that included five cases. The secondary case in this cluster (with specimen MN-MDH-STU0004) occurred in a workplace contact of a motorcycle rally attendee (specimen MN-MDH-STU0001) and a social contact of one of the persons with a tertiary case (specimen MN-MDH-STU0008). Another secondary case§§ in this cluster was in a workplace contact of the rally attendee and was a household contact of two of the three patients with tertiary cases in this cluster (specimens MN-MDH-1708 and MN-MDH-1709). Cluster C represented secondary transmission from a rally attendee (specimen MN-MDH-1651) to a household contact (specimen MN-MD-1705). Cluster D

** One patient reported attending the rally but refused interview. Two additional patients who refused to be interviewed were identified as having attended the rally through secondary case interviews in which other patients reported them as primary event-associated contacts.

†† Close contact was defined as being within 6 feet of a patient with laboratory-confirmed COVID-19 infection for ≥15 minutes. https://www.cdc.gov/coronavirus/2019-ncov/php/contact-tracing/contact-tracing-plan/contact-tracing.html.

§§ Although the specimen from this patient was obtained, sequencing was incomplete.

**FIGURE 1. Date of symptom onset among symptomatic patients with primary,* secondary,† and tertiary§ COVID-19 (N = 64) associated with a motorcycle rally in a neighboring state — Minnesota, August 2020**




**Abbreviation:** COVID-19 = coronavirus disease 2019.

* Laboratory-confirmed SARS-CoV-2 infection in a person who attended the motorcycle rally or traveled to western South Dakota by motorcycle during August 7–16 and had symptom onset or specimen collection within 14 days of the end of the rally.

† Laboratory-confirmed infection in a person who had contact with a laboratory-confirmed primary case during the infectious period or with a symptomatic rally attendee who was not tested.

§ Laboratory-confirmed infection in a person who had contact with a secondary case or likely event-associated secondary case.

represented likely event-associated cases of secondary transmission (specimens MN-MDH-STU0002, MN-MDH-1706, and MD-MDH-1712) and tertiary transmission (specimens MN-MDH-STU-0005 and MN-MDH-1711) related to a wedding. The index patient at this wedding reportedly had COVID-19–like symptoms at the wedding after attending the rally but did not receive testing. Cluster E comprised two cases (specimens MN-MDH-1567 and MN-MH-1714) in persons who were household contacts, both of whom attended the rally. Cluster F represents workplace and household contacts (specimens MN-MDH-1715, MN-MDH-1716, MN-MDH-1713, and MN-MDH-STU0007) of the primary patient with specimen MN-MDH-1569. Specimen MN-MDH-1569 was from a musician who performed at the rally and later at another concert with a different band whose members did not attend the rally. Primary event-associated cases with specimens MN-MDH-1571 and MN-MDH-1572 had no known connection to each other or identified common exposure at the rally; however, the reported symptom onset dates and travel dates for these cases were identical. Similarly, primary event-associated cases with specimens MN-MDH-1568 and MN-MDH-1707 had no known epidemiologic link but had identical symptom onset dates. This might indicate a common exposure that was not identified through epidemiologic evidence.

## Public Health Response

On August 5, MDH recommended through media events that motorcycle rally attendees quarantine for 14 days upon return and be tested 5–7 days later even if they were asymptomatic. Attendees and their close contacts with confirmed COVID-19 were instructed to self-isolate. Contacts of patients with confirmed COVID-19 were instructed to quarantine.

### Discussion

Eighty-six Minnesota COVID-19 cases were associated with the South Dakota motorcycle rally; approximately one third of counties in Minnesota reported at least one case epidemiologically linked to this event. These findings highlight the far-reaching effects that gatherings in one area might have on another area. The motorcycle rally was held in a neighboring state that did not have policies regarding event size and mask use, underscoring the implications of policies within and across jurisdictions. The findings suggest that this rally not only had a direct impact on the health of attendees, but also led to subsequent SARS-CoV-2 transmission among household, social, and workplace contacts of rally attendees upon their return to Minnesota. Whole genome sequencing results supported the finding of secondary and tertiary transmission associated with this rally.

**TABLE. Demographic and clinical characteristics of confirmed* and likely event-associated COVID-19 cases (N = 86) associated with a 10-day motorcycle rally in a neighboring state — Minnesota, August–September 2020**

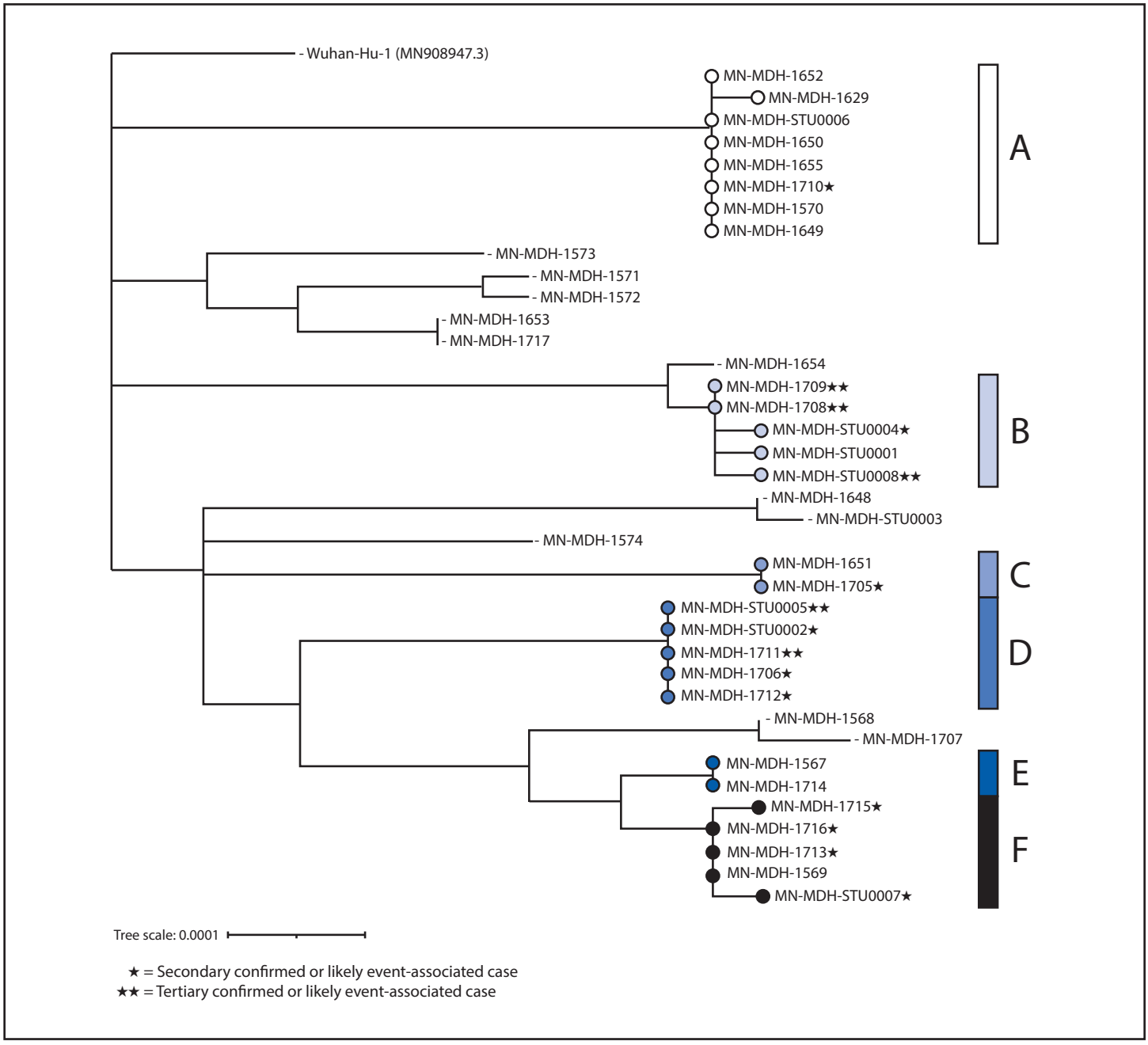
| Characteristic | No. of cases (%) | | |
|---|---|---|---|
| | Primary event–associated† (n = 51) | Confirmed secondary§/tertiary¶ (n = 26) | Likely event-associated secondary**/tertiary†† (n = 9) |
| **Demographic** | | | |
| **Sex** | | | |
| Female | 20 (39.2) | 16 (61.5) | 6 (66.7) |
| Male | 31 (60.8) | 10 (38.5) | 3 (33.3) |
| **Age, yrs, median (range)** | 44 (26–76) | 43 (12–83) | 22 (1–51) |
| **Age group, yrs** | | | |
| <18 | 0 (—) | 3 (11.5) | 3 (33.3) |
| 18–24 | 0 (—) | 2 (7.7) | 2 (22.2) |
| 25–44 | 26 (51.0) | 8 (30.8) | 3 (33.3) |
| 45–64 | 21 (41.2) | 10 (38.5) | 1 (11.1) |
| ≥65 | 4 (7.8) | 3 (11.5) | 0 (—) |
| **Race/Ethnicity** | | | |
| White, NH | 43 (84.3) | 22 (84.6) | 8 (88.9) |
| More than one race/Other, NH | 1 (2.0) | 0 (—) | 1 (11.1) |
| Unknown | 7 (13.7) | 4 (15.4) | 0 (—) |
| **Clinical** | | | |
| Symptomatic§§ | 39 (76.5) | 19 (73.1) | 6 (66.7) |
| Hospitalized | 3 (5.9) | 1 (3.8) | 0 (—) |
| ICU admission | 1 (2.0) | 0 (—) | 0 (—) |
| Died | 1 (2.0) | 0 (—) | 0 (—) |
| **Close contacts** | | | |
| Household | NA | 12 | 3 |
| Social | NA | 6 | 6 |
| Workplace | NA | 8 | 0 |

**Abbreviations:** COVID-19 = coronavirus disease 2019; ICU = intensive care unit; NA = not applicable; NH = non-Hispanic.
* Receipt of a positive SARS-CoV-2 reverse transcription–polymerase chain reaction test result.
† Laboratory-confirmed SARS-CoV-2 infection in a person who attended the motorcycle rally or traveled to western South Dakota by motorcycle during August 7–16 and had symptom onset or specimen collection within 14 days of the end of the rally.
§ Laboratory-confirmed infection in a person who had contact with a primary case during that person's infectious period.
¶ Laboratory-confirmed infection in a person who had contact with a secondary case during that person's infectious period.
** Laboratory-confirmed infection in a person who had contact with a symptomatic person who attended the rally but was not tested.
†† Laboratory-confirmed infection in a person who had contact with a likely secondary case.
§§ Symptom status was unknown for three patients with a primary case, three with a secondary/tertiary case, and one with a likely event-associated secondary/tertiary case.

The findings in this report are subject to at least three limitations. First, despite in-depth epidemiologic investigation, the findings represent an underestimate of the motorcycle rally's impact in Minnesota and did not capture the impact within South Dakota or other states. Case interviews were voluntary, and patients could choose not to respond to certain questions. Ten patients reported having close contacts but refused to disclose additional details regarding these contacts. Therefore, it was not possible to identify all contacts of patients who attended the rally. Second, attendees and their contacts might not have been tested for SARS-CoV-2. Two rally attendees indicated that their contacts had COVID-19–like symptoms but did not plan to be tested. As such, the findings underrepresent the number of cases, close contacts, and secondary and tertiary cases. Finally, only 52 specimens were received at the MDH Public Health Laboratory because many testing laboratories do not retain or store specimens long-term. Among these specimens, only 38 were successfully sequenced. The lack of whole genome sequencing data from all cases hindered establishment of complete genetic relatedness for epidemiologic investigation.

A large event in a neighboring state triggered chains of SARS-CoV-2 transmission within Minnesota. Other studies have shown that chains of transmission associated with gatherings are not uncommon within the United States (*5*,*6*). Despite underascertainment of the rally's full impact in Minnesota and other states, these findings highlight the importance of reducing the number of attendees at gatherings and emphasizing mask use, physical distancing, isolation for patients with COVID-19, and quarantine for close contacts as strategies for reducing the spread of COVID-19. Furthermore, these findings demonstrate the rationale for consistent mitigation measures across states.

**FIGURE 2. Phylogenetic tree* showing genetic distance between available† SARS-CoV-2 virus specimens collected from South Dakota motorcycle rally attendees and their contacts (N = 38) — Minnesota, August 2020**




* This figure was created using Interactive Tree of Life (version 5.7; European Molecular Biology Laboratory). https://itol.embl.de/.
† Genetic divergence based on nucleotide difference is indicated by length of branches in substitutions per site. Available specimens include specimens from clinical labs where specimens could be retrieved and RNA could be extracted.

## Acknowledgments

Patients described in this report; Brooke Wiedinmyer, Maureen Sullivan, Nicholas Lehnertz, Minnesota Department of Health; Kris Bisgard, CDC; local public health partners; Mayo Clinic, Rochester, Minnesota; University of Minnesota Genomics Center; M Health Fairview Molecular Diagnostics Laboratory, Minneapolis, Minnesota; M Health Fairview Infectious Disease Diagnostic Laboratory, Minneapolis, Minnesota.

Corresponding author: Melanie J. Firestone, mfirestone@cdc.gov.

[1]Minnesota Department of Health; [2]Epidemic Intelligence Service, CDC; [3]Division of State and Local Readiness, Center for Preparedness and Response, CDC [4]Mayo Clinic, Rochester, Minnesota; [5]Department of Laboratory Medicine and Pathology, University of Minnesota.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Matthew J. Binnicker reports personal fees from DiaSorin Molecular for an educational webinar on COVID-19 diagnostics and as a member of the advisory board. No other potential conflicts of interest were disclosed.

## References

1. CDC. Coronavirus disease 2019 (COVID-19): considerations for events and gatherings. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/community/large-events/considerations-for-events-gatherings.html
2. Artic Network. SARS-CoV-2 sequencing protocols. London, United Kingdom: Wellcome Trust; 2020. https://artic.network/ncov-2019
3. Nguyen LT, Schmidt HA, von Haeseler A, Minh BQ. IQ-TREE: a fast and effective stochastic algorithm for estimating maximum-likelihood phylogenies. Mol Biol Evol 2015;32:268–74. PMID:25371430 https://doi.org/10.1093/molbev/msu300
4. Hadfield J, Megill C, Bell SM, et al. Nextstrain: real-time tracking of pathogen evolution. Bioinformatics 2018;34:4121–3. PMID:29790939 https://doi.org/10.1093/bioinformatics/bty407
5. Ghinai I, Woods S, Ritger KA, et al. Community transmission of SARS-CoV-2 at two family gatherings—Chicago, Illinois, February–March 2020. MMWR Morb Mortal Wkly Rep 2020;69:446–50. PMID:32298246 https://doi.org/10.15585/mmwr.mm6915e1
6. Hamner L, Dubbel P, Capron I, et al. High SARS-CoV-2 attack rate following exposure at a choir practice—Skagit County, Washington, March 2020. MMWR Morb Mortal Wkly Rep 2020;69:606–10. PMID:32407303 https://doi.org/10.15585/mmwr.mm6919e6

# Trends in County-Level COVID-19 Incidence in Counties With and Without a Mask Mandate — Kansas, June 1–August 23, 2020

Miriam E. Van Dyke, PhD[1]; Tia M. Rogers, PhD[1]; Eric Pevzner, PhD[2]; Catherine L. Satterwhite, PhD[3]; Hina B. Shah, MPH[4]; Wyatt J. Beckman, MPH[4]; Farah Ahmed, PhD[5]; D. Charles Hunt, MPH[4]; John Rule[6]

*On November 20, 2020, this report was posted as an* MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Wearing masks is a CDC-recommended* approach to reduce the spread of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), by reducing the spread of respiratory droplets into the air when a person coughs, sneezes, or talks and by reducing the inhalation of these droplets by the wearer. On July 2, 2020, the governor of Kansas issued an executive order† (state mandate), effective July 3, requiring masks or other face coverings in public spaces. CDC and the Kansas Department of Health and Environment analyzed trends in county-level COVID-19 incidence before (June 1–July 2) and after (July 3–August 23) the governor's executive order among counties that ultimately had a mask mandate in place and those that did not. As of August 11, 24 of Kansas's 105 counties did not opt out of the state mandate§ or adopted their own mask mandate shortly before or after the state mandate was issued; 81 counties opted out of the state mandate, as permitted by state law, and did not adopt their own mask mandate. After the governor's executive order, COVID-19 incidence (calculated as the 7-day rolling average number of new daily cases per 100,000 population) decreased (mean decrease of 0.08 cases per 100,000 per day; net decrease of 6%) among counties with a mask mandate (mandated counties) but continued to increase (mean increase of 0.11 cases per 100,000 per day; net increase of 100%) among counties without a mask mandate (nonmandated counties). The decrease in cases among mandated counties and the continued increase in cases in nonmandated counties adds to the evidence supporting the importance of wearing masks and implementing policies requiring their use to mitigate the spread of SARS-CoV-2 (*1*–*6*). Community-level mitigation strategies emphasizing wearing masks, maintaining physical distance, staying at home when ill, and enhancing hygiene practices can help reduce transmission of SARS-CoV-2.

The Kansas mandate requiring the wearing of face coverings in public spaces became effective July 3, 2020. Data on county mask mandates were obtained from the Kansas Health Institute.¶ A Kansas state law** enacted on June 9, 2020, authorizes counties to issue public health orders that are less stringent than the provisions of statewide executive orders issued by the governor, which allowed counties to opt out of the state mask mandate. For this study, counties in Kansas that, as of August 11, 2020, did not opt out of the state mandate or adopted their own mask mandate were considered to have a mask mandate in place; those that opted out of the state mandate and did not adopt their own mask mandate were considered to not have a mask mandate in place.

Daily county-level COVID-19 incidence (cases per 100,000 population) was calculated using case and population counts accessed from USAFacts†† for Kansas counties during June 1–August 23.§§ Rates were calculated as 7-day rolling averages. Segmented regression¶¶ was used to examine changes in COVID-19 incidence before and after July 3, 2020, among mandated and nonmandated counties. Mandated and nonmandated counties were compared to themselves over time,

* https://www.cdc.gov/coronavirus/2019-ncov/more/masking-science-sars-cov2.html?fbclid=IwAR28PppCa6x2uxwO8Z2baHM0KHS4JXx0inzzMQs3zRHV1qql_0a8mxZfpCw. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover-guidance.html.

† https://governor.kansas.gov/wp-content/uploads/2020/07/20200702093130003.pdf.

§ Allen, Atchison, Bourbon, Crawford, Dickinson, Douglas, Franklin, Geary, Gove, Harvey, Jewell, Johnson, Mitchell, Montgomery, Morris, Pratt, Reno, Republic, Saline, Scott, Sedgwick, Shawnee, Stanton, and Wyandotte counties. Data on county orders were collected through point-in-time surveys of local health department and other county officials and were supplemented with online searches for published orders and announcements on social media and local news sites. Text in the county orders was analyzed to determine whether mask mandates were in place as of August 11, 2020. Counties that took no official action to opt out of the state mask mandate or adopted their own mask mandate shortly before or after the state mandate were considered to have a mask mandate in place. Counties were considered to not have a mask mandate in place if they took official action to opt out of the state mask mandate and did not adopt their own mask mandate or if their official action used only the language of guidance (e.g., "should" or "recommend").

¶ https://www.khi.org/policy/article/20-25. https://www.khi.org/assets/uploads/news/15015/august_11_update1105.pdf.

** https://ag.ks.gov/docs/default-source/documents/addendum-3-to-march-24-law-enforcement-duties-and-authorities-memo.pdf?sfvrsn = d088af1a_3.

†† https://usafacts.org/visualizations/coronavirus-covid-19-spread-map.

§§ August 23, 2020, was selected as the study end date because most Kansas counties had already started or were about to begin school the week of August 24, 2020. The implementation of in-person schooling would have signified an important change in events influencing COVID-19 incidence rates after the executive order.

¶¶ Generalized estimating equation regression modeling with an autoregressive correlation variance structure was used to estimate trends over time within counties. Trends in 7-day rolling average of daily COVID-19 incidence among mask mandated counties and among non–mask-mandated counties were analyzed separately before (June 1–July 2, 2020) and after (July 3–August 23, 2020) the governor's executive order requiring masks, effective July 3.

allowing for the control of constant county-related characteristics (e.g., urbanicity or rurality) that might otherwise confound a comparison between mandated and nonmandated counties. Sensitivity analyses were also conducted by 1) examining incidence trends after July 3 separately among mandated counties with and without other public health mitigation strategies and 2) recategorizing nonmandated counties that included cities mandating masks (n=6) as mandated counties. Analyses were conducted using SAS software (version 9.4; SAS Institute).

As of August 11, 24 (23%) Kansas counties had a mask mandate in place, and 81 did not. Mandated counties accounted for two thirds of the Kansas population (1,960,703 persons; 67.3%)*** and were spread throughout the state, although they tended to cluster together. Six (25%) mandated and 13 (16%) nonmandated counties were metropolitan areas.††† Thirteen (54%) mandated counties and seven (9%) nonmandated counties had implemented at least one other public health mitigation strategy not related to the use of masks (e.g., limits on size of gatherings and occupancy for restaurants). During June 1–7, 2020, the 7-day rolling average of daily COVID-19 incidence among counties that ultimately had a mask mandate was three cases per 100,000, and among counties that did not, was four per 100,000 (Table). By the week of the governor's executive order requiring masks (July 3–9), COVID-19 incidence had increased 467% to 17 per 100,000 in mandated counties and 50% to six per 100,000 among nonmandated counties. By August 17–23, 2020, the 7-day rolling average COVID-19 incidence had decreased by 6% to 16 cases per 100,000 among mandated counties and increased by 100% to 12 per 100,000 among nonmandated counties.

Trend analyses using segmented regression (Figure) indicated that during June 1–July 2, 2020, the COVID-19 7-day rolling average incidence increased each day in both counties that ultimately had mask mandates in place (mean increase = 0.25 cases per 100,000 per day; 95% confidence interval [CI] = 0.17–0.33) and counties that did not (mean increase = 0.08 cases per 100,000 per day; 95% CI = 0.01–0.14). After the governor's executive order, COVID-19 incidence decreased each day in mandated counties (mean decrease = 0.08 cases per 100,000 per day; 95% CI = –0.14 to –0.03); in nonmandated counties, incidence continued to increase each day (mean increase = 0.11 cases per 100,000 per day; 95% CI = 0.01–0.21).

*** Total population in mask-mandated counties = 1,960,703; total population in non–mask-mandated counties = 952,611; based on 2019 U.S. Census data.

††† As designated by the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for Counties. https://www.cdc.gov/nchs/data_access/urban_rural.htm#Data_Files_and_Documentation.

## Discussion

After implementation of mask mandates in 24 Kansas counties, the increasing trend in COVID-19 incidence reversed. Although rates were considerably higher in mandated counties than in nonmandated counties by the executive order, rates in mandated counties declined markedly after July 3, compared with those in nonmandated counties. Kansas counties that had mask mandates in place appear to have mitigated the transmission of COVID-19, whereas counties that did not have mask mandates continued to experience increases in cases.

The findings in this report are consistent with declines in COVID-19 cases observed in 15 states and the District of Columbia, which mandated masks, compared with states that did not have mask mandates (*7*). Mask requirements were also implemented as part of a multicomponent approach in Arizona, where COVID-19 incidence stabilized and then decreased after implementation of a combination of voluntary and enforceable community-level mitigation strategies, including mask requirements, limitations on public events, enhanced sanitation practices, and closures of certain services and businesses (*8*). The combining of community-level mitigation strategies including physical distancing and enhanced hygiene practices, in addition to consistent and correct use of masks, is a CDC-recommended approach.§§§ The decreased COVID-19 incidence among mask-mandated counties in Kansas occurred during a time when the only other state mandates issued were focused on mitigation strategies for schools as they reopened in mid-August. In at least 13 (54%) of the 24 mandated counties, the mask mandates occurred alongside other county-level recommended or mandated mitigation strategies (e.g., limits on size of gatherings and occupancy for restaurants), facilitating a potential synergistic effect resulting from combining community mitigation strategies. However, in sensitivity analyses, similar decreases in COVID-19 incidence after July 3 were observed among mandated counties with and without other mitigation strategies. Therefore, although implementing multiple mitigation strategies is the recommended approach, strategies related to mask use mandates appear to be important. Additional information on the utility and acceptability of mask mandates in public settings could help further inform health education campaigns aimed at increasing proper use of masks and strengthening mandate adherence.

The findings in this report are subject to at least four limitations. First, the ecologic design of this study and limited information on community mask-wearing behaviors and county implementation and enforcement provisions of mask mandates limit the ability to determine the extent to which

§§§ https://www.cdc.gov/coronavirus/2019-ncov/community/community-mitigation.html.

**TABLE. Confirmed COVID-19 infection 7-day rolling average case counts, rates, and percentage changes, by mask mandate status[*,†] and period — Kansas, June 1–August 23, 2020**

| Characteristic | Before executive order June 1–June 7 | Executive order effective[§] July 3–9 | After executive order August 17–23 | % Change in incidence[¶] June 1–7 versus July 3–9 | % Change in incidence[¶] July 3–9 versus August 17–23 |
|---|---|---|---|---|---|
| **Mandated counties (N = 24)[*,**]** | | | | | |
| No. of daily cases[††] | 60 | 333 | 310 | N/A | N/A |
| Incidence[§§] | 3 | 17 | 16 | 467 | –6 |
| **Nonmandated counties (N = 81)[†,**]** | | | | | |
| No. of daily cases[††] | 40 | 59 | 118 | N/A | N/A |
| Incidence[§§] | 4 | 6 | 12 | 50 | 100 |

**Abbreviations:** COVID-19 = coronavirus disease 2019; mandated = counties with a mask mandate; N/A = not applicable; nonmandated = counties without a mask mandate.

* Counties that as of August 11 did not opt out of the state mandate or adopted their own mask mandate shortly before or after the state mandate include Allen, Atchison, Bourbon, Crawford, Dickinson, Douglas, Franklin, Geary, Gove, Harvey, Jewell, Johnson, Mitchell, Montgomery, Morris, Pratt, Reno, Republic, Saline, Scott, Sedgwick, Shawnee, Stanton and Wyandotte. Total population in mask-mandated counties = 1,960,703 based on 2019 U.S. Census Bureau data.

† Counties that took no official action to opt out of the state mask mandate or adopted their own mask mandate shortly before or after the state mandate were considered to have a mask mandate in place. Counties were considered to not have a mask mandate in place if they took official action to opt out of the state mask mandate and did not adopt their own mask mandate or if their official action used only the language of guidance (e.g., "should" or "recommend"). Total population in non–mask-mandated counties = 952,611 based on 2019 U.S. Census Bureau data.

§ Week of governor's executive order (effective July 3, 2020).

¶ Change in incidence = [(incidence in period – incidence in previous period)/incidence in previous period] X 100.

** Data on county orders were collected through point-in-time surveys of local health department and other county officials and were supplemented with online searches for published orders and announcements on social media and local news sites. Text in the county orders was analyzed to determine whether mask mandates were in place as of August 11, 2020.

†† Seven-day rolling average number of new daily cases.

§§ Seven-day rolling average number of new daily cases per 100,000 population.

the countywide mask mandates accounted for the observed declines in COVID-19 incidence in mandated counties. Second, this analysis did not account for mask ordinances in six cities in non–mask-mandated counties. However, in sensitivity analyses recategorizing nonmandated counties that included cities mandating masks as mandated counties, results were consistent with those in primary analyses, although they were attenuated. In those analyses, after the governor's executive order, COVID-19 incidence among mandated counties stabilized rather than decreased, and incidence continued to increase among nonmandated counties. Third, although the design of this study limits potential confounding from constant county-related characteristics, the findings in this report are conditional on the absence of any time-varying factors (e.g., mobility patterns, changes in other community-level mitigation strategies, and access to testing) within counties before and after July 3. Nonetheless, in additional analyses examining testing data among Kansas counties during the study period, testing rates were observed to increase overall over time. Therefore, despite increases in testing during this period, decreases in COVID-19 incidence were observed in mandated counties after July 3. Finally, counties in Kansas with a mask mandate might not be representative of other U.S. counties. However, the findings are consistent with observations from other states that mask mandates are associated with declines in COVID-19 cases (*7*).

**Summary**

What is already known about this this topic?

Wearing face masks in public spaces reduces the spread of SARS-CoV-2.

What is added by this report?

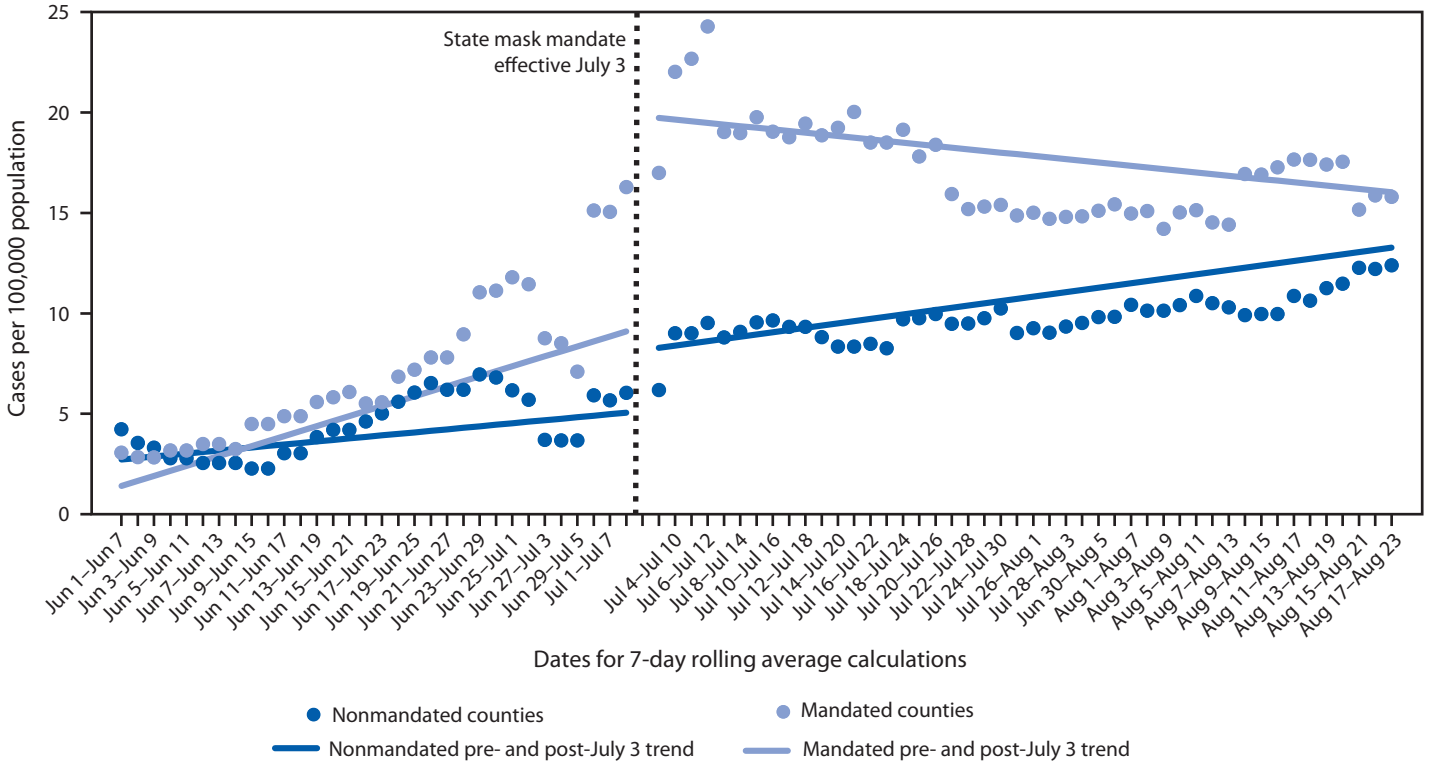
The governor of Kansas issued an executive order requiring wearing masks in public spaces, effective July 3, 2020, which was subject to county authority to opt out. After July 3, COVID-19 incidence decreased in 24 counties with mask mandates but continued to increase in 81 counties without mask mandates.

What are the implications for public health practice?

Countywide mask mandates appear to have contributed to the mitigation of COVID-19 transmission in mandated counties. Community-level mitigation strategies emphasizing use of masks, physical distancing, staying at home when ill, and enhanced hygiene practices can help reduce the transmission of SARS-CoV-2.

Masks are an important intervention for mitigating the transmission of SARS-CoV-2 (*1*–*6*), and countywide mask mandates appear to have contributed to the mitigation of COVID-19 spread in Kansas counties that had them in place. Community-level mitigation strategies emphasizing use of masks, physical distancing, staying at home when ill, and enhanced hygiene practices can help reduce the transmission of SARS-CoV-2.

**FIGURE. Trends* in 7-day rolling average of new daily COVID-19 cases per 100,000 population among mask-mandated† and non–mask-mandated counties before (June 1–July 2)§ and after (July 3–August 23)¶ the governor's executive order requiring masks — Kansas, June 1–August 23, 2020**




**Abbreviation:** COVID-19 = coronavirus disease 2019.

* Generalized estimating equation regression modeling with an autoregressive correlation variance structure was used to estimate trends over time within counties. Trends in 7-day rolling average of daily COVID-19 incidence among mask-mandated counties and non–mask-mandated counties were analyzed separately before (June 1–July 2, 2020) and after (July 3–August 23, 2020) the governor's executive order requiring masks, effective July 3.

† Kansas counties (n = 24) that as of August 11 did not opt out of the state mandate effective July 3, 2020, or adopted their own mask mandate shortly before or after the state mandate include Allen, Atchison, Bourbon, Crawford, Dickinson, Douglas, Franklin, Geary, Gove, Harvey, Jewell, Johnson, Mitchell, Montgomery, Morris, Pratt, Reno, Republic, Saline, Scott, Sedgwick, Shawnee, Stanton and Wyandotte. Data on county orders were collected through point-in-time surveys of local health department and other county officials and were supplemented with online searches for published orders and announcements on social media and local news sites. Text in the county orders was analyzed to determine whether mask mandates were in place as of August 11, 2020. Counties that took no official action to opt out of the state mask mandate or adopted their own mask mandate shortly before or after the state mandate were considered to have a mask mandate in place. Counties were considered to not have a mask mandate in place if they took official action to opt out of the state mask mandate and did not adopt their own mask mandate or if their official action used only the language of guidance (e.g., "should" or "recommend").

§ Before the mask mandate (June 1–July 2), 7-day rolling average COVID-19 incidence increased each day (mean increase = 0.25 cases per 100,000 persons per day; 95% confidence interval [CI] = 0.17–0.33) in mask-mandated counties and increased each day (mean increase = 0.08 cases per 100,000 per day; 95% CI = 0.01–0.14) in nonmandated counties.

¶ After the mask mandate (July 3–August 23), 7-day rolling average COVID-19 incidence decreased each day (mean decrease = 0.08 cases per 100,000 persons per day; 95% CI = –0.14 to –0.03) in mask-mandated counties and increased each day (mean increase = 0.11 cases per 100,000 per day; 95% CI = 0.01–0.21) in nonmandated counties.

## Acknowledgments

Melanie Firestone, Epidemic Intelligence Service, CDC; Laura Gieraltowski, Jamie Perniciaro, CDC COVID-19 Response Team.

Corresponding author: Miriam Van Dyke, mpy4@cdc.gov.

[1]Epidemic Intelligence Service, CDC; [2]CDC COVID-19 Response Team; [3]Office of the Assistant Secretary for Health, U.S. Department of Health and Human Services; [4]Kansas Health Institute, Topeka, Kansas; [5]Kansas Department of Health and Environment; [6]Kansas Army National Guard.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. D. Charles Hunt, Wyatt J. Beckham, and Hina B. Shah report a grant from the Kansas Health Foundation to the Kansas Health Institute. No other potential conflicts of interest were disclosed.

## References


1. Brooks JT, Butler JC, Redfield RR. Universal masking to prevent SARS-CoV-2 transmission–the time is now. JAMA 2020;324:635–7. PMID:32663243 https://doi.org/10.1001/jama.2020.13107
2. Hendrix MJ, Walde C, Findley K, Trotman R. Absence of apparent transmission of SARS-CoV-2 from two stylists after exposure at a hair salon with a universal face covering policy—Springfield, Missouri, May 2020. MMWR Morb Mortal Wkly Rep 2020;69:930–2. PMID:32673300 https://doi.org/10.15585/mmwr.mm6928e2
3. Wang X, Ferro EG, Zhou G, Hashimoto D, Bhatt DL. Association between universal masking in a health care system and SARS-CoV-2 positivity among health care workers. JAMA 2020;324:703–4. PMID:32663246 https://doi.org/10.1001/jama.2020.12897
4. Chu DK, Akl EA, Duda S, et al.; COVID-19 Systematic Urgent Review Group Effort (SURGE) study authors. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet 2020;395:1973–87. PMID:32497510 https://doi.org/10.1016/S0140-6736(20)31142-9
5. Lerner AM, Folkers GK, Fauci AS. Preventing the spread of SARS-CoV-2 with masks and other "low-tech" interventions. JAMA 2020;324:1935–6. PMID:33104157 https://doi.org/10.1001/jama.2020.21946
6. Kanu FA, Smith EE, Offutt-Powell T, Hong R, Dinh TH, Pevzner E; Delaware Case Investigation and Contact Tracing Teams. Declines in SARS-CoV-2 transmission, hospitalizations, and mortality after implementation of mitigation measures—Delaware, March–June 2020. MMWR Morb Mortal Wkly Rep 2020;69:1691–4. PMID:33180757 https://doi.org/10.15585/mmwr.mm6945e1
7. Lyu W, Wehby GL. Community use of face masks and COVID-19: evidence from a natural experiment of state mandates in the US. Health Aff (Millwood) 2020;39:1419–25. PMID:32543923 https://doi.org/10.1377/hlthaff.2020.00818
8. Gallaway MS, Rigler J, Robinson S, et al. Trends in COVID-19 incidence after implementation of mitigation measures—Arizona, January 22–August 7, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1460–3. PMID:33031366 https://doi.org/10.15585/mmwr.mm6940e3

# The Advisory Committee on Immunization Practices' Ethical Principles for Allocating Initial Supplies of COVID-19 Vaccine — United States, 2020

Nancy McClung, PhD[1]; Mary Chamberland, MD[1,2]; Kathy Kinlaw, MDiv[3]; Dayna Bowen Matthew, JD, PhD[4]; Megan Wallace, DrPH[1,5]; Beth P. Bell, MD[6]; Grace M. Lee, MD[7]; H. Keipp Talbot, MD[8]; José R. Romero, MD[9]; Sara E. Oliver, MD[1]; Kathleen Dooling, MD[1]

*On November 23, 2020, this report was posted as an* MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

To reduce the spread of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) and its associated impacts on health and society, COVID-19 vaccines are essential. The U.S. government is working to produce and deliver safe and effective COVID-19 vaccines for the entire U.S. population. The Advisory Committee on Immunization Practices (ACIP)* has broadly outlined its approach for developing recommendations for the use of each COVID-19 vaccine authorized or approved by the Food and Drug Administration (FDA) for Emergency Use Authorization or licensure (*1*). ACIP's recommendation process includes an explicit and transparent evidence-based method for assessing a vaccine's safety and efficacy as well as consideration of other factors, including implementation (*2*). Because the initial supply of vaccine will likely be limited, ACIP will also recommend which groups should receive the earliest allocations of vaccine. The ACIP COVID-19 Vaccines Work Group and consultants with expertise in ethics and health equity considered external expert committee reports and published literature and deliberated the ethical issues associated with COVID-19 vaccine allocation decisions. The purpose of this report is to describe the four ethical principles that will assist ACIP in formulating recommendations for the allocation of COVID-19 vaccine while supply is limited, in addition to scientific data and implementation feasibility: 1) maximize benefits and minimize harms; 2) promote justice; 3) mitigate health inequities; and 4) promote transparency. These principles can also aid state, tribal, local, and territorial public health authorities as they develop vaccine implementation strategies within their own communities based on ACIP recommendations.

The ACIP COVID-19 Vaccines Work Group has met several times per month (approximately 25 meetings) since its establishment in April 2020. Work Group discussions included review of the epidemiology of COVID-19 and consultation with experts in ethics and health equity to inform the development of an ethically principled decision-making process. The Work Group reviewed the relevant literature, including frameworks for pandemic influenza planning and COVID-19 vaccine allocation (*3*–*8*); summarized this information; and presented it to ACIP. ACIP supported four fundamental ethical principles to guide COVID-19 vaccine allocation decisions in the setting of a constrained supply. Essential questions that derive from these principles can assist in vaccine allocation planning (Table 1).

**Maximize benefits and minimize harms.** Allocation of COVID-19 vaccine should maximize the benefits of vaccination to both individual recipients and the population overall. These benefits include the reduction of SARS-CoV-2 infections and COVID-19–associated morbidity and mortality, which in turn reduces the burden on strained health care capacity and facilities; preservation of services essential to the COVID-19 response; and maintenance of overall societal functioning. Identification of groups whose receipt of the vaccine would lead to the greatest benefit should be based on scientific evidence, accounting for those at highest risk for SARS-CoV-2 infection or severe COVID-19–related disease or death, and the essential role of certain workers. The ability of essential workers, including health care workers and non–health care workers, to remain healthy has a multiplier effect (i.e., their ability to remain healthy helps to protect the health of others or to minimize societal and economic disruption). Some of these workers are at increased risk for SARS-CoV-2 infection because of their limited ability to maintain physical distance in the workplace or because they do not have consistent access to recommended personal protective equipment.

**Promote justice.** Inherent in the principle of justice is an obligation to protect and advance equal opportunity for all persons to enjoy the maximal health and well-being possible. Justice rests on the belief in the fundamental value and dignity of all persons. Allocation of COVID-19 vaccine should promote justice by intentionally ensuring that all persons have equal opportunity to be vaccinated, both within the groups recommended for initial vaccination, and as vaccine becomes more widely available. This includes a commitment to removing unfair, unjust, and avoidable barriers to vaccination that disproportionately affect groups that have been economically or

*The ACIP includes 15 voting members responsible for making vaccine recommendations. Fourteen of the members have expertise in vaccinology, immunology, pediatrics, internal medicine, nursing, family medicine, virology, public health, infectious diseases, and/or preventive medicine; one member is a consumer representative who provides perspectives on the social and community aspects of vaccination. In addition to the 15 voting members, ACIP includes eight ex officio members who represent other federal agencies with responsibility for immunization programs in the United States, and 30 nonvoting representatives of liaison organizations that bring related immunization expertise. https://www.cdc.gov/vaccines/acip/members/index.html.

**TABLE 1. Essential questions for COVID-19 vaccine allocation planning related to ethical principles — United States, 2020**

| Ethical principle | Essential question |
|---|---|
| **Maximize benefits and minimize harms** | What groups are at highest risk for SARS-CoV-2 infection, COVID-19 disease, hospitalization, and death? |
| | What groups are essential to the COVID-19 response? |
| | What groups are essential to maintaining critical functions of society? |
| | What are the important characteristics of these groups (e.g., size or geographic distribution) that might inform the magnitude of benefit based on the amount of vaccine available or its characteristics? |
| **Promote justice** | Does the allocation plan result in fair and equitable access of the vaccine for all groups? |
| | How do characteristics of the vaccine and logistical considerations affect fair access for all persons? |
| | Does allocation planning include input from groups who are disproportionately affected by COVID-19 or face health inequities resulting from social determinants of health, such as income and health care access? |
| **Mitigate health inequities** | Does the plan identify and address barriers to vaccination among any groups who are disproportionately affected by COVID-19 or who face health inequities resulting from social determinants of health, such as income and health care access? |
| | Does the allocation plan contribute to a reduction in health disparities in COVID-19 disease and death? |
| | What health inequities might inadvertently result from the allocation plan, and what interventions could remove or reduce them? |
| | Is there a mechanism for timely assessment of vaccination coverage among groups experiencing disadvantage and the possibility for course correction if inequities are identified? |
| **Promote transparency** | How does development of the allocation plan include diverse input, and if possible, public engagement? |
| | Are the allocation plan and evidence-based methods publicly available? |
| | Is the allocation plan clear about what is known and unknown and about the quality of available evidence? |
| | What is the process for revision of allocation plans based on new information? |
| | Is there a mechanism to report demographic data elements for vaccine recipients (e.g., age, race/ethnicity, and occupation) to support equitable vaccination coverage? |

**Abbreviation:** COVID-19 = coronavirus disease 2019.

socially marginalized, as well as a fair and consistent implementation process. Input from a range of external entities, partners, and community representatives is particularly important in developing and assessing allocation plans.

**Mitigate health inequities.** Health equity is achieved when every person has the opportunity to attain his or her full health potential and no one is disadvantaged from achieving this potential because of social position or other socially determined circumstances.[†] Disparities in the severity of COVID-19 and COVID-19–related death, as well as inequities in social determinants of health that are linked to COVID-19 risk, such as income or health care access and utilization, are well documented among certain racial and ethnic minority groups (*9*). Vaccine allocation strategies should aim to both reduce existing disparities and to not create new disparities. Efforts should be made to identify and remove obstacles and barriers to receiving COVID-19 vaccine, including limited access to health care or residence in rural, hard-to-reach areas.

**Promote transparency.** Transparency relates to the decision-making process and is essential to building and maintaining public trust during vaccine program planning and implementation. The underlying principles, decision-making processes, and plans for COVID-19 vaccine allocation must be evidence-based, clear, understandable, and publicly available. To the extent possible, considering the urgency of the COVID-19 response, public participation in the creation and review of the decision-making process should be facilitated. In addition, when feasible, tracking administration of vaccine to the groups recommended for initial vaccine allocation can contribute to transparency and trust in the process. In an ongoing public health response, the situation continually evolves as new information becomes available. Transparency includes being clear about the level of certainty in the available evidence and communicating new information that might change recommendations in a timely fashion.

For the period when the supply of COVID-19 vaccine will be limited, ACIP has considered four groups for initial vaccine allocation. These include health care personnel, other essential workers, adults with high-risk medical conditions, and adults aged ≥65 years (including residents of long-term care facilities) (Table 2). These groups were selected based on available scientific data, vaccine implementation considerations, and ethical principles. The principle of transparency is applied across the entirety of the vaccine allocation decision-making process.

[†] https://www.cdc.gov/chronicdisease/healthequity/index.htm.

**TABLE 2. Application of ethical principles to four candidate groups for initial COVID-19 vaccine allocation — United States, 2020**

| Principles (with transparency across the decision-making process) | Candidate groups* (approximate no.) | | | |
|---|---|---|---|---|
| | Health care personnel† (21 million) | Other essential workers† (87 million) | Adults with high-risk medical conditions§ (>100 million) | Adults aged ≥65 years (53 million) |
| **Maximize benefits and minimize harms** | Preserves health care services essential to the COVID-19 response and the overall health care system | Preserves services essential to the COVID-19 response and overall functioning of society | Reduces morbidity and mortality in persons with high incidence of COVID-19 disease and death** | Reduces morbidity and mortality in persons with high incidence of COVID-19 disease and death†† |
| | Multiplier effect¶ | Multiplier effect¶ | | |
| **Promote justice** | Addresses elevated occupational risk for SARS-CoV-2 exposure for those unable to work from home | Addresses elevated occupational risk for SARS-CoV-2 exposure for those unable to work from home | Will require focused outreach to vaccinate persons in this group who have no or limited access to health care or experience inequities in social determinants of health | Will require focused outreach to vaccinate persons in this group who have no or limited access to health care or experience inequities in social determinants of health |
| | Promotes access to vaccine across a spectrum of HCP job types and settings | Promotes access to vaccine and reduces barriers to vaccination in occupations with low vaccine uptake§§ | | |
| **Mitigate health inequities** | Racial and ethnic minority groups are disproportionately represented in low-wage HCP¶¶ | Racial and ethnic minority groups are disproportionately represented in many essential industries*** | Increased prevalence of obesity and diabetes (most prevalent conditions in this group) among some racial and ethnic minority groups; increased prevalence of some medical conditions for persons in rural areas§§§ | Although racial and ethnic minority groups are underrepresented among adults aged ≥65 years, certain groups have disproportionate COVID-19–related hospitalization and death rates¶¶¶ |
| | | Approximately one quarter of essential workers live in low-income families††† | Could increase health inequities because diagnosis of high-risk medical conditions requires access to health care | Strict age-based criterion could increase disparities due to racial and social inequities, such as occupation, income, access to health care |

**Abbreviations:** COVID-19 = coronavirus disease 2019; HCP = health care personnel.

* Health care personnel: paid and unpaid persons serving in health care settings who have the potential for direct or indirect exposure to patients or infectious materials; other essential workers: person who conduct operations vital for continuing critical infrastructure, such as food, agriculture, transportation, education, and law enforcement; adults with high risk medical conditions: adults who have one or more high-risk medical conditions, such as obesity, diabetes, and cardiovascular disease; adults aged ≥65 years: includes adults living at home and approximately 3 million living in long-term care facilities. There is considerable overlap between groups, for example, many adults aged ≥65 years also have high-risk medical conditions.

† Essential workers during the COVID-19 response have been defined by the U.S. Department of Homeland Security Cybersecurity and Infrastructure Security Agency. https://www.cisa.gov/sites/default/files/publications/Version_4.0_CISA_Guidance_on_Essential_Critical_Infrastructure_Workers_FINAL%20AUG%2018v2_0.pdf.

§ Medical conditions considered high-risk are updated routinely based on the best available scientific data: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html.

¶ The ability of one or more groups to remain healthy helps protect the health of others and/or minimize disruption to society and the economy.

** As of October 31, 2020, nearly 90% of persons with COVID-19–associated hospitalizations have at least one high-risk condition. Data are routinely updated through COVID-19–Associated Hospitalization Surveillance Network (COVID-NET) (https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html); in-hospital deaths reported to COVID-NET during March–May, 2020 were associated with certain underlying medical conditions (https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa1012/5872581).

†† As of November 12, 2020, 80% of COVID-19 deaths were among adults aged ≥65 years. Data are routinely updated through CDC case-based surveillance (https://covid.cdc.gov/covid-data-tracker/#demographics); long-term care residents account for a large proportion of deaths among adults aged ≥65 years (https://data.cms.gov/stories/s/COVID-19-Nursing-Home-Data/bkwz-xpvg/).

§§ Influenza vaccination coverage is low among many non–health care essential workers; such coverage is lowest among construction workers (10.7%) (https://www.cdc.gov/niosh/docs/2012-161/pdfs/2012-161.pdf?id = 10.26616/NIOSHPUB2012161).

¶¶ Health Resources and Services Administration estimates from American Community Survey 2011–2015 (https://bhw.hrsa.gov/sites/default/files/bhw/nchwa/diversityushealthoccupationstechnical.pdf).

*** Among 742 food and agriculture workplaces in 30 states, 73% of workers were Hispanic or Latino and 83% of COVID-19 cases occurred in racial or ethnic minority workers (https://wwwnc.cdc.gov/eid/article/27/1/20-3821_article).

††† Center for Economic and Policy Research estimates from American Community Survey, 2014–2018 (https://cepr.net/a-basic-demographic-profile-of-workers-in-frontline-industries).

§§§ National Center for Health Statistics. National Health Interview Survey, 2018. Estimates not available for Hawaiian/other Pacific Islander persons or for chronic kidney disease among American Indian/Alaska Native persons (https://www.cdc.gov/nchs/nhis/ADULTS/www/index.htm; https://www.cdc.gov/mmwr/volumes/69/wr/mm6929a1.htm).

¶¶¶ As of October 31, 2020, compared with COVID-19 hospitalization rates for adults aged ≥65 years who are non-Hispanic White, such rates were higher among adults aged ≥65 years who were non-Hispanic Black (rate ratio [RR] = 3.3), Hispanic or Latino (RR = 2.6), and non-Hispanic American Indian or Alaska Native (RR = 2.4). Data are routinely updated through COVID-NET (https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html); adults aged ≥65 years who are Hispanic or non-Hispanic Black experience disproportionate COVID-19–associated death rates (https://www.cdc.gov/nchs/nvss/vsrr/covid19/health_disparities.htm).

**Summary**

What is already known about this topic?

During the period when the U.S. supply of COVID-19 vaccines is limited, the Advisory Committee on Immunization Practices (ACIP) will make vaccine allocation recommendations.

What is added by this report?

In addition to scientific data and implementation feasibility, four ethical principles will assist ACIP in formulating recommendations for the initial allocation of COVID-19 vaccine: 1) maximizing benefits and minimizing harms; 2) promoting justice; 3) mitigating health inequities; and 4) promoting transparency.

What are the implications for public health practice?

Ethical principles will aid ACIP in making vaccine allocation recommendations and state, tribal, local, and territorial public health authorities in developing vaccine implementation strategies based on ACIP's recommendations.

ACIP's meetings are open to the public, meeting minutes and archived webcasts are available online, and data (including data from vaccine clinical trials) and analytic methods used in developing ACIP recommendations are publicly available.[§] Members of the public are invited to submit written comments to the Federal Register or provide oral comment during ACIP meetings. ACIP's 30 nonvoting representatives from liaison organizations facilitate engagement with professional medical and public health organizations and other stakeholders and partners.

All four groups proposed for initial allocation of COVID-19 vaccine merit strong consideration from an ethical perspective. Current planning scenarios estimate, however, that the expected number of doses during the first weeks of vaccine distribution might only be sufficient to vaccinate approximately 20 million persons.[¶] Although there is considerable overlap between groups[**] (*10*), the initial supply will not be adequate to vaccinate the entirety of all four groups; for example, there are approximately 100 million health care personnel and essential workers (Table 2). Published frameworks for COVID-19 allocation and ACIP discussions indicate a clear consensus that the first allocation of COVID-19 vaccine supplies should be directed to health care personnel (*1*,*5*–*8*); discussion of allocation to the other three groups is ongoing. As additional vaccine supplies become available, other groups may be vaccinated concurrent with health care personnel.

[§] https://www.cdc.gov/vaccines/acip/index.html.

[¶] https://www.cdc.gov/vaccines/imz-managers/downloads/COVID-19-Vaccination-Program-Interim_Playbook.pdf.

[**] There is overlap among these four groups. For example, in one analysis, among the 3.8% of U.S. adults who work directly with patients as health care workers, 38.6% have high-risk medical conditions or are aged >65 years.

## Discussion

During a pandemic, ethical guidelines can help steer and support decisions around prioritization of limited resources (*3*,*4*). Consideration of ethical values and principles has featured prominently in discussions about allocation of COVID-19 vaccines. This consideration is particularly relevant because the COVID-19 pandemic has highlighted long-standing, systemic health and social inequities. Although various frameworks for COVID-19 vaccine allocation demonstrate differences in their structure (e.g., based on varying combinations of different goals, objectives, criteria, and other structural elements) and emphasis (e.g., inclusion of global and national considerations), nearly all reference values and principles similar to those which ACIP considers fundamental (*5*–*8*). ACIP viewed the following characteristics as critical for its ethical approach to COVID-19 vaccine allocation when supply is limited: simplicity in structure and definitions; acceptability to stakeholders; and ease of application, both at the national and state, tribal, local, and territorial levels.

Allocation of limited vaccine supplies is complicated by efforts to address the multiple goals of a vaccine program, most notably those related to the reduction of morbidity and mortality and the minimization of disruption to society and the economy. If the goals of a pandemic vaccination program are not clearly articulated and prioritized, drawing distinctions between groups that merit consideration for allocation of vaccine when supply is constrained can become difficult. The unanimity in opinion for early vaccination of health care personnel indicates that maintenance of health care capacity has emerged as a high priority in the context of a severe pandemic. This perspective aligns with ethical considerations for pandemic influenza planning (*3*,*4*). If vaccine supply remains constrained, it might be necessary to identify subsets of other groups for subsequent early allocation of COVID-19 vaccine. At the national, state, tribal, local, and territorial levels, such decisions should be guided, in part, by ethical principles and consideration of essential questions, with particular consideration of mitigation of health inequities in persons experiencing disproportionate COVID-19 morbidity and mortality. In the setting of a constrained supply, the benefits of vaccination will be delayed for some persons; however, as supply increases, there will eventually be enough vaccine for everyone.

In addition to ethical considerations, ACIP's recommendations regarding receipt of the initial allocations of COVID-19 vaccine during the period of constrained supply will be based on science (e.g., available information about the vaccine's characteristics such as safety and efficacy in older adults and epidemiologic risk) and feasibility of implementation (e.g., storage and handling

requirements). Thus, ACIP's allocation recommendations will be made in conjunction with specific recommendations for the use of each FDA-authorized or licensed COVID-19 vaccine. Although the ethical principles in this report are fundamental for stewardship of limited vaccine supply, they can also be applied when COVID-19 vaccines are widely available, to ensure equitable and just access for all persons.

## Acknowledgments

Members of the Advisory Committee on Immunization Practices COVID-19 Vaccines Work Group.

Corresponding author: Nancy McClung, nmcclung@cdc.gov.

[1]CDC COVID-19 Response Team; [2]General Dynamics Information Technology, Falls Church, Virginia; [3]Emory University, Atlanta, Georgia; [4]George Washington University Law School, Washington, D.C.; [5]Epidemic Intelligence Service, CDC; [6]University of Washington, Seattle, Washington; [7]Stanford University School of Medicine, Stanford, California; [8]Vanderbilt University School of Medicine, Nashville, Tennessee; [9]Arkansas Department of Health.

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.

## References

1. Bell BP, Romero JR, Lee GM. Scientific and ethical principles underlying recommendations from the Advisory Committee on Immunization Practices for COVID-19 vaccination implementation. JAMA 2020. PMID:33090194 https://doi.org/10.1001/jama.2020.20847
2. Lee G, Carr W, Reingold A, et al.; ACIP Evidence-Based Recommendations Work Group. Updated framework for development of evidence-based recommendations by the Advisory Committee on Immunization Practices. MMWR Morb Mortal Wkly Rep 2018;67:1271–2. PMID:30439877 https://doi.org/10.15585/mmwr.mm6745a4
3. Kinlaw K, Barrett DH, Levine RJ. Ethical guidelines in pandemic influenza: recommendations of the Ethics Subcommittee of the Advisory Committee of the Director, Centers for Disease Control and Prevention. Disaster Med Public Health Prep 2009;3(Suppl 2):S185–92. PMID:19675459 https://doi.org/10.1097/DMP.0b013e3181ac194f
4. Williams JH, Dawson A. Prioritising access to pandemic influenza vaccine: a review of the ethics literature. BMC Med Ethics 2020;21:40. PMID:32408869 https://doi.org/10.1186/s12910-020-00477-3
5. National Academies of Sciences, Engineering, and Medicine. Framework for equitable allocation of COVID-19 vaccine. Washington, DC: The National Academies Press; 2020. https://www.nap.edu/catalog/25917/framework-for-equitable-allocation-of-covid-19-vaccine
6. World Health Organization. WHO SAGE values framework for the allocation and prioritization of COVID-19 vaccination. 14 September 2020. Geneva, Switzerland: World Health Organization; 2020. https://apps.who.int/iris/bitstream/handle/10665/334299/WHO-2019-nCoV-SAGE_Framework-Allocation_and_prioritization-2020.1-eng.pdf?ua=1
7. Toner E, Barnill A, Krubiner C, et al. Interim framework for COVID-19 vaccine allocation and distribution in the United States. Baltimore, MD: Johns Hopkins Center for Health Security; 2020. https://www.centerforhealthsecurity.org/our-work/publications/interim-framework-for-covid-19-vaccine-allocation-and-distribution-in-the-us
8. Persad G, Peek ME, Emanuel EJ. Fairly prioritizing groups for access to COVID-19 vaccines. JAMA 2020;324:1601–2. PMID:32910182 https://doi.org/10.1001/jama.2020.18513
9. Williams DR, Cooper LA. COVID-19 and health equity—a new kind of "herd immunity." JAMA 2020;323:2478–80. PMID:32391852 https://doi.org/10.1001/jama.2020.8051
10. Gibson DM, Greene J. Risk for severe COVID-19 illness among health care workers who work directly with patients. J Gen Intern Med 2020;35:2804–6. PMID:32583348 https://doi.org/10.1007/s11606-020-05992-y

# Timing of Introduction of Complementary Foods — United States, 2016–2018

Katelyn V. Chiang, MPH[1,2]; Heather C. Hamner, PhD[1]; Ruowei Li, MD[1]; Cria G. Perrine, PhD[1]

The American Academy of Pediatrics (AAP) recommends introducing complementary foods (i.e., any solid or liquid other than breast milk or infant formula) to infants at approximately age 6 months (*1*). Although a consensus on ideal timing is lacking, most experts agree that introduction of complementary foods before age 4 months is too early because of infant gastrointestinal and motor immaturity (*1*,*2*). In addition, early introduction prevents exclusively breastfed infants from reaching the recommended 6 months of exclusive breastfeeding (*1*) and might be associated with increased risk for overweight and obesity (*3*). Nationally representative data on complementary feeding are limited; state-level estimates have been previously unavailable. CDC analyzed 2016–2018 data from the National Survey of Children's Health (NSCH) (N = 23,927) to describe timing of complementary feeding introduction and prevalence of early introduction of complementary foods before age 4 months (early introduction) among children aged 1–5 years. Prevalence of early introduction was 31.9% nationally and varied geographically and across sociodemographic and infant feeding characteristics. These estimates suggest that many infants are introduced to complementary foods before they are developmentally ready. Efforts by health care providers and others who might influence infant feeding practices could help decrease the number of infants who are introduced to complementary foods too early.

NSCH is funded and directed by the Maternal and Child Health Bureau of the Health Resources and Services Administration. It is an annual web- and paper-based survey that collects information from parents and caregivers on their children's physical and emotional health, including infant nutrition, and is representative of noninstitutionalized U.S. children aged 0–17 years. During 2016–2018, the overall weighted response rate ranged from 37.4% to 43.1%. Missing data for race/ethnicity (1.3%) and household income relative to the federal poverty level (FPL) (16.3%) were imputed using hot-deck and sequential regression imputation methods, respectively (*4*).

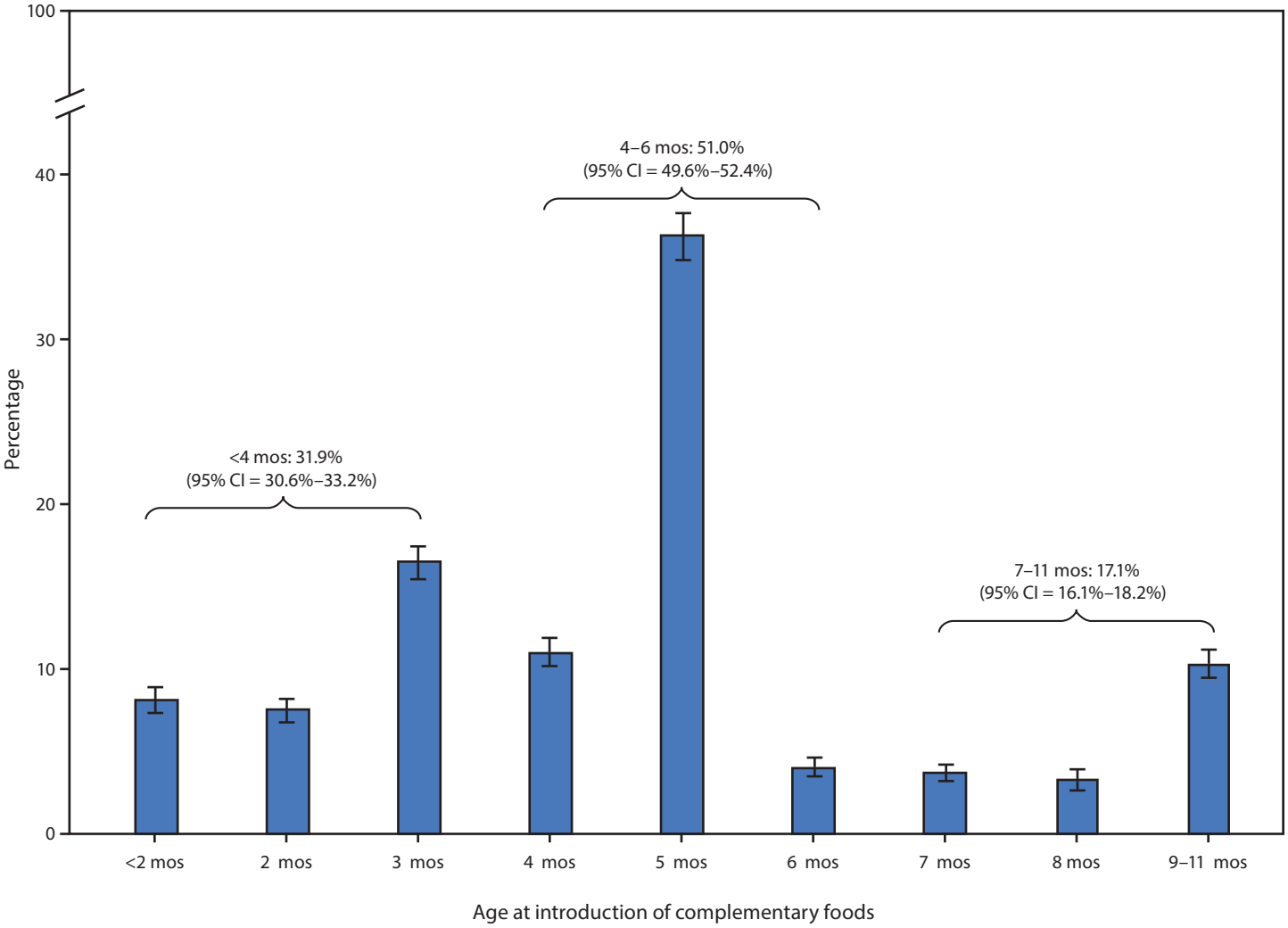
Timing of introduction of complementary foods was assessed by asking respondents with children aged 0–5 years "How old was this child when he or she was first fed anything other than breast milk or formula" (*4*). To ensure that children had sufficient time to have been introduced to complementary foods, analysis was restricted to children aged 1–5 years. Participants with reported introduction to complementary foods at age ≥12 months (887) and those with other implausible feeding patterns (recalled breastfeeding duration, infant formula introduction, and complementary feeding introduction indicated ≥2 months with no source of nutrition; 101) were excluded from analyses. The percentage of children who were introduced to complementary foods before age 4 months (early introduction) was calculated overall, at the state and regional levels, and by sociodemographic and infant feeding characteristics using SAS-callable SUDAAN (version 11.0; RTI International). Two-sample t-tests were used to identify statistically significant ($p<0.05$) differences across subgroups.

Among 23,927 children aged 1–5 years, the mean age at introduction of complementary foods was 4.7 months, with 31.9% of children introduced at <4 months, 51.0% at 4–6 months, and 17.1% at 7–11 months (Figure 1). Prevalence of early introduction varied across sociodemographic groups. Prevalence of early introduction was significantly higher among non-Hispanic Black (Black) children (40.5%), compared with all other racial/ethnic groups and significantly lower among non-Hispanic Asian children (23.8%), compared with all other groups except Hispanic children (29.9%). Prevalence of early introduction was significantly lower among children living in households at ≥400% of the FPL (28.5%) and whose mothers had a bachelor's degree or higher (27.7%), compared with all other household FPL and maternal education groups. Early introduction also differed significantly by infant milk feeding status at age 4 months: prevalence of early introduction was 18.5% among children receiving only breast milk for milk feeds, 32.1% among those receiving breast milk and infant formula, and 41.6% among those receiving only infant formula for milk feeds (Table). At the state level, prevalence of early introduction ranged from 18.0% in New Mexico to 49.0% in Mississippi. In 34 states, ≥30% of children were introduced to complementary foods before age 4 months, including 14 states in which prevalence of early introduction was at least 35% (Supplementary Table, https://stacks.cdc.gov/view/cdc/95035) (Figure 2).

## Discussion

Nearly one in three (31.9%) U.S. infants is introduced to complementary foods before age 4 months, with a higher prevalence of early introduction among Black infants and infants of mothers and households at lower socioeconomic status. Reasons for early introduction to complementary foods are not fully understood; however, many early introducing mothers have reported believing that their infant was old enough to begin consuming solids (*5*). This suggests a perception of

**FIGURE 1. Age at introduction of complementary foods among children aged 1–5 years* — National Survey of Children's Health, United States, 2016–2018**




**Abbreviation:** CI = confidence interval.
* 95% CIs are indicated by error bars.

infant readiness for complementary feeding before the infant is actually ready and a potential lack of awareness of feeding recommendations, health effects associated with early introduction, and signs of developmental readiness. In general, infants show outward signs of readiness for complementary feeding when they can sit up on their own with good head control, show interest in mealtimes, are hungry in between feedings, and no longer have "tongue-thrust" or extrusion reflex, usually at approximately age 4–6 months (*2*).

Not only do younger infants lack the physiologic development to safely consume complementary foods, infants who are introduced to complementary foods too early have increased risk for multiple associated health conditions (*1*). Early introduction to complementary foods prevents infants from meeting the recommended 6 months of exclusive breastfeeding, decreasing the benefits both mothers and infants derive from exclusive breastfeeding. Compared with exclusive breastfeeding for 6 months, exclusive breastfeeding for 3–4 months followed by mixed breastfeeding and complementary feeding is associated with increased risk for gastrointestinal infection and slower maternal weight loss after birth (*6*). Further, limited evidence also suggests introduction to complementary foods before age 4 months might increase later overweight and obesity risk (*3*).

Health care providers can help increase awareness of recommended timing of introduction of complementary foods by employing consistent messaging in accordance with AAP recommendations and stressing the importance of developmental readiness when discussing complementary feeding with families (*1*). Resources are available to help health care providers engage with and educate families to better navigate the

**TABLE. Percentage of infants introduced to complementary foods before age 4 months, by sociodemographic characteristics, infant milk feeding status at age 4 months, and region among children aged 1–5 years — National Survey of Children's Health, United States, 2016–2018**

| Characteristic | Total no.* | % Introduced early† | 95% CI† |
|---|---|---|---|
| **Total** | **23,927** | **31.9** | **(30.6–33.2)** |
| **Race/Ethnicity§** | | | |
| Hispanic | **2,626** | 29.9 | (26.3–33.7) |
| White, non-Hispanic | **16,853** | 31.5 | (30.2–32.9) |
| Black, non-Hispanic | **1,211** | 40.5 | (35.7–45.4) |
| Asian, non-Hispanic | **1,125** | 23.8 | (19.1–29.1) |
| Other/Multiracial, non-Hispanic | **2,112** | 33.2 | (29.5–37.1) |
| **Maternal age group (yrs)¶,**** | | | |
| 18–29 | **4,634** | 34.0 | (31.1–37.1) |
| 30–39 | **14,201** | 28.8 | (27.3–30.5) |
| ≥40 | **3,412** | 33.3 | (30.0–36.8) |
| **Maternal highest education level¶,††** | | | |
| High school diploma or less | **2,544** | 34.3 | (30.6–38.1) |
| Some college | **5,962** | 33.4 | (30.8–36.1) |
| Bachelor's degree or more | **13,664** | 27.7 | (26.3–29.1) |
| **Household income§§** | | | |
| <100% FPL | **2,429** | 35.2 | (31.0–39.6) |
| 100%–199% FPL | **3,745** | 34.3 | (30.9–37.8) |
| 200%–399% FPL | **7,662** | 31.7 | (29.4–34.0) |
| ≥400% FPL | **10,091** | 28.5 | (26.7–30.4) |
| **Infant milk feeding status at age 4 mos¶¶** | | | |
| Breast milk feeding only | **9,085** | 18.5 | (16.9–20.2) |
| Infant formula feeding only | **9,567** | 41.6 | (39.5–43.8) |
| Mixed breast milk and infant formula feeding | **4,863** | 32.1 | (29.1–35.2) |
| **Region***,††† | | | |
| Northeast | **4,093** | 33.8 | (30.8–36.8) |
| Midwest | **6,063** | 32.3 | (30.2–34.4) |
| South | **7,675** | 34.8 | (32.6–37.0) |
| West | **6,096** | 25.7 | (23.0–28.7) |

**Abbreviations:** CI = confidence interval, FPL = federal poverty level.

* Denominators might not sum to total because of missing maternal sociodemographic or infant milk feeding status data.

† Percentages are weighted to account for complex survey design.

§ The percentage of infants introduced to complementary foods before age 4 months among Hispanic children is significantly different from that of non-Hispanic Black children. The percentage introduced early among non-Hispanic White children is significantly different from that of non-Hispanic Black and non-Hispanic Asian children. The percentage introduced early among non-Hispanic Black children is significantly different from that of all other racial/ethnic groups. The percent introduced early among non-Hispanic Asian children is significantly different from that of non-Hispanic White, non-Hispanic Black, and non-Hispanic other/multiracial children. The percentage introduced early among non-Hispanic other/multiracial children is significantly different from that of non-Hispanic Black and non-Hispanic Asian children.

¶ Maternal sociodemographic data might be missing because no mother was reported in the child's household or because information was not reported by respondent.

** The percentage of infants introduced to complementary foods before age 4 months among children of mothers aged 30–39 years is significantly different from that of children of mothers aged 18–29 and ≥40 years.

†† The percentage of infants introduced to complementary foods before 4 months among children of mothers with bachelor's degrees or higher is significantly different from that of children of mothers of all other highest education levels.

§§ The percentage of infants introduced to complementary foods before 4 months among children living at ≥400% FPL is significantly different from that of children living at all other household income levels.

¶¶ The percentage of infants introduced to complementary foods before age 4 months among children receiving only breast milk for milk feeds at age 4 months is significantly different from that of children receiving all other types of nutrition for milk feeds at age 4 months. The percentage introduced early among children receiving only infant formula for milk feeds at age 4 months is significantly different from that of children receiving all other types of nutrition for milk feeds at age 4 months. The percentage introduced early among children receiving both breast milk and infant formula for milk feeds at age 4 months is significantly different from that of children receiving all other types of nutrition for milk feeds at age 4 months.

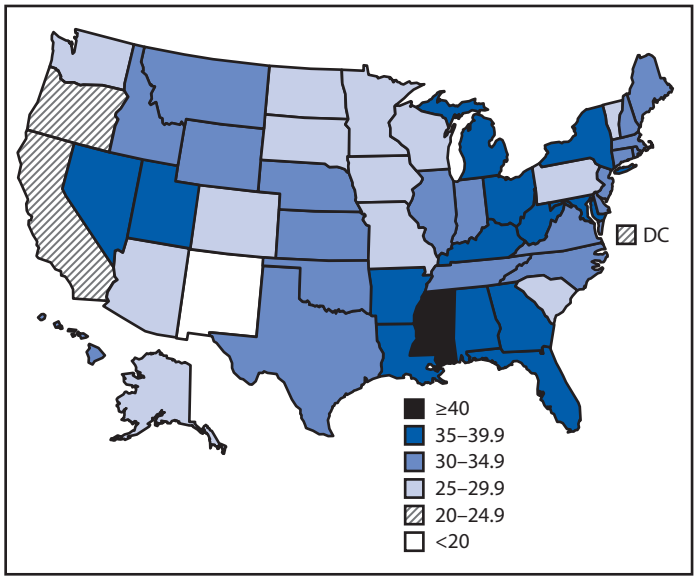
*** U.S. Census Bureau classifications for regions.

††† The percentage of children introduced to complementary foods before age 4 months among children living in the West is significantly different from that of children living in all other regions.

transition from milk feeds to family foods (*7*). Further, given the high prevalence of early introduction of complementary foods among infants receiving formula, targeted education to parents and caregivers of those receiving infant formula might be particularly helpful. Similar efforts by others who could influence infant feeding practices such as peer educators, early care and education staff members, and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) staff members might also help reduce early introduction.

Another nationally representative study of U.S. children, the 2009–2014 National Health and Nutrition Examination Surveys (NHANES), found a lower prevalence of early

**FIGURE 2. Percentage of children introduced to complementary foods before age 4 months among children aged 1–5 years — National Survey of Children's Health, United States, 2016–2018**




**Abbreviation:** DC = District of Columbia.

**Summary**

What is already known about this topic?

The American Academy of Pediatrics recommends introducing complementary foods at approximately age 6 months. Introduction before age 4 months is too early because infants are not developmentally ready for complementary foods. Early introduction prevents infants from reaching the recommended 6 months of exclusive breastfeeding.

What is added by this report?

Nearly one in three infants is introduced to complementary foods before age 4 months; prevalence of early introduction varies geographically and across sociodemographic and infant feeding characteristics.

What are the implications for public health practice?

Increasing awareness of and adherence to feeding recommendations could help reduce early introduction. Health care providers and others who might influence infant feeding practices should educate families on recommended timing of introduction of complementary foods.

introduction (16.3%) than the estimate from NSCH participants (31.9%); however, similar patterns in early introduction by sociodemographic and infant feeding status characteristics were seen across both studies (*8*). The questions used to identify timing of complementary feeding introduction were the same for both studies. Some of the discrepancy might be explained by inherent differences in the surveys including representativeness of participants and response rates or by the different age ranges of studied children (6–36 months in NHANES compared with 1–5 years in NSCH). Differences might also reflect changes over time in parental attitudes toward complementary feeding or health care provider advice because participants included in the NHANES and NSCH analyses were born during 2006–2014 and 2010–2018, respectively. Over the past decade, there has been growing awareness of the benefits of not delaying introduction of allergenic foods among children at high risk for food allergies to prevent the development of food allergies (*9*). It is possible that research might have been misinterpreted by parents, caregivers, and health care providers, leading to increases in early introduction to complementary foods in recent years. Further education on correct timing of introduction of allergenic foods and identification of children at high risk for food allergies might be needed to improve adherence to feeding recommendations.

The findings in this report are subject to at least four limitations. First, data might be affected by information bias. Though maternal recall of breastfeeding has been shown to have high validity and reliability, recall of solid and other liquid feeding might not be as reliable (*10*). However, participants with implausible feeding patterns were removed from the sample to account for potential misreporting of infant feeding information. Second, although multiply imputed, household FPL data might be misclassified. Third, data do not allow for analysis of types, amounts, or frequency of complementary foods offered; these are important markers of early child nutrition. Finally, small sample sizes limited the ability to conduct further sociodemographic analyses at the state level.

Introduction of complementary foods at the recommended time could help improve infant health and might play a role in prevention of overweight and obesity; however, nearly one third of infants are introduced to complementary foods too early. Early introduction also varies geographically and across sociodemographic and infant feeding characteristics, placing some infants, such as Black infants and infants of mothers and households of lower socioeconomic status, at increased risk for potential poor health outcomes related to early introduction of complementary foods. Increased education on complementary feeding recommendations, including the possible effects of early introduction and signs of developmental readiness, might help decrease the number of infants who are introduced to complementary foods too early.

Corresponding author: Katelyn V. Chiang, kchiang@cdc.gov, 404-498-0612.

[1]Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee.

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.

## References


1. American Academy of Pediatrics Committee on Nutrition. Feeding the infant. In: Kleinman RE, Greer FR, eds. Pediatric nutrition. 8th ed. Itasca, IL: American Academy of Pediatrics; 2019.
2. Pérez-Escamilla R, Segura-Pérez S, Lott M. Feeding guidelines for infants and young toddlers: a responsive parenting approach. Durham, NC: Healthy Eating Research; 2017.
3. English LK, Obbagy JE, Wong YP, et al. Timing of introduction of complementary foods and beverages and growth, size, and body composition: a systematic review. AM J Clin Nutr, 2019; 109(Suppl_7):935S–55S.
4. Child and Adolescent Health Measurement Initiative. About the National Survey of Children's Health. Baltimore, MD: Data Resource Center for Child and Adolescent Health; 2019. https://www.childhealthdata.org/learn-about-the-nsch/NSCH
5. Clayton HB, Li R, Perrine CG, Scanlon KS. Prevalence and reasons for introducing infants early to solid foods: variations by milk feeding type. Pediatrics 2013;131:e1108–14. PMID:23530169 https://doi.org/10.1542/peds.2012-2265
6. Kramer MS, Kakuma R. Optimal duration of exclusive breastfeeding. Cochrane Database Syst Rev 2012;8:CD003517. PMID:22895934
7. American Academy of Pediatrics Institute for Healthy Childhood Weight. Educating and engaging parents and families. Building a Foundation for Healthy Active Living. Itasca, IL: American Academy of Pediatrics Institute for Healthy Childhood Weight; 2020. https://ihcw.aap.org/Pages/EFHALF_parents.aspx
8. Barrera CM, Hamner HC, Perrine CG, Scanlon KS. Timing of introduction of complementary foods to US infants, National Health and Nutrition Examination Survey 2009–2014. J Acad Nutr Diet 2018;118:464–70. PMID:29307590 https://doi.org/10.1016/j.jand.2017.10.020
9. Togias A, Cooper SF, Acebal ML, et al. Addendum guidelines for the prevention of peanut allergy in the United States: report of the National Institute of Allergy and Infectious Diseases–sponsored expert panel. Ann Allergy Asthma Immunol 2017;118:166–173.e7. PMID:28065802 https://doi.org/10.1016/j.anai.2016.10.004
10. Li R, Scanlon KS, Serdula MK. The validity and reliability of maternal recall of breastfeeding practice. Nutr Rev 2005;63:103–10. PMID:15869124 https://doi.org/10.1111/j.1753-4887.2005.tb00128

# Prevalence and Trends in Cigarette Smoking Among Adults with Epilepsy — United States, 2010–2017

Sanjeeb Sapkota MBBS[1]; Rosemarie Kobau, MPH[2]; Janet B. Croft, PhD[2]; Brian A. King, PhD[3]; Craig Thomas, PhD[2]; Matthew M. Zack, MD[2]

Cigarette smoking remains the leading cause of preventable disease and death in the United States (*1*). Although the percentage of all U.S. adults who smoke cigarettes has declined substantially since the mid-1960s (*1*,*2*), marked disparities persist, and declines have not been consistent across population groups (*1*,*2*). Studies have shown that cigarette smoking is as common, and sometimes more so, among adults with a history of epilepsy compared with those without a history of epilepsy, but reasons for this are unclear (*3*–*6*). Compared with adults without epilepsy, adults with epilepsy report lower household income, more unemployment and disability, worse psychological health, and reduced health-related quality of life (*3*,*4*,*6*,*7*). Trends in cigarette smoking among U.S. adults with epilepsy have not been previously assessed. CDC analyzed National Health Interview Survey (NHIS) data among 121,497 U.S. adults from 2010, 2013, 2015, and 2017 to assess current cigarette smoking by epilepsy status. From 2010 through 2017, the age-standardized percentages of current smoking were 24.9% among adults with active epilepsy, 25.9% among adults with inactive epilepsy, and 16.6% among adults with no history of epilepsy. After accounting for differences in data collection intervals and patterns in smoking status among subgroups, CDC found that current cigarette smoking declined significantly from 2010 to 2017 among adults with no history of epilepsy (19.3% to 14.0% [p<0.001]) and inactive epilepsy (29.2% to 16.2% [p = 0.03]), but declines among adults with active epilepsy were not statistically significant (26.4% to 21.8% [p = 0.2]). Epilepsy health and social service providers should promote smoking cessation resources to adults with active epilepsy who smoke cigarettes to help them quit smoking and to reduce their risk of smoking-related disease and death.*

NHIS is an annual, nationally representative, in-person survey of the noninstitutionalized U.S. civilian population. The NHIS Sample Adult core questionnaire is administered to a randomly selected adult aged ≥18 years in each family within the selected household. Sample sizes and final response rates for sample adults in each of the 4 years were as follows: 2010 (27,157; 72.1%), 2013 (34,557; 61.2%), 2015 (33,672; 55.2%) and 2017 (26,742; 53.0%).† Supplementary questions on epilepsy were added to the Sample Adult Core component of NHIS in 2010, 2013, 2015, and 2017.

Respondents were defined as having "any epilepsy" (either active or inactive epilepsy) or no history of epilepsy based on three questions.§ Those who reported doctor-diagnosed epilepsy and also reported taking antiseizure medication, having one or more seizures in the past year, or both were classified as having "active" epilepsy. Respondents were classified as having "inactive" epilepsy if they reported a history of epilepsy but were not taking medication for epilepsy and had not had a seizure in the past year. Current combustible cigarette smoking was defined as self-reported use of at least 100 cigarettes during the respondent's lifetime and smoking "every day" or "some days" at the time of interview. Current cigarette smoking,¶ by epilepsy status, was assessed overall and by survey year; data from 2010, 2013, 2015, and 2017 were aggregated to provide more stable estimates of current cigarette smoking by sex, age, race/ethnicity, education, family income,** health insurance coverage at the time of survey, employment status, disability status, U.S. Census region, and presence or absence of serious psychological distress.

SAS (version 9.4; SAS Institute) and SUDAAN (version 11.0; RTI International), which accounted for the respondent sampling weights and the NHIS complex sample design, were used for the analysis. The aggregated analytical sample for this report included 121,497 adults with complete data on epilepsy and current cigarette smoking status. All reported differences among three or more groups were assessed using a Wald F test; differences between two subgroups were assessed using two-tailed t-tests. The threshold for statistical significance for all tests was p<0.05. Orthogonal polynomials, a statistical analysis to examine trends, was used to estimate the decline in percentage of adults who smoked from 2010 to 2017, accounting for unequal data collection intervals and different patterns in smoking prevalence among the three subgroups.

* https://www.cdc.gov/tobacco/quit_smoking/cessation/index.htm.

† ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2017/srvydesc.pdf.

§ The questions were asked as follows: "Have you ever been told by a doctor or other health professional that you have a seizure disorder or epilepsy?" Responses included Yes, No, Refused, Not ascertained, and Don't know. If respondents answered "Yes" to having been told that they have seizure disorder or epilepsy, they were also asked "Are you currently taking any medicine to control your seizure disorder or epilepsy?" Responses included Yes, No, Refused, Not ascertained, and Don't know. Respondents who answered "Yes" were also asked "Think back to last year about the same time. About how many seizures of any type have you had in the past year?" Responses included: None, One, Two or three, Between four and 10, More than 10, Refused, Not ascertained, and Don't know.

¶ Cigarette smoking percentages were age-standardized to the 2000 U.S. projected population.

** Categorized based on the ratio of total family income to the federal poverty level calculated using the NHIS imputed income files.

Among all U.S. adults, 1.1% had active epilepsy and 0.7% had inactive epilepsy. Current cigarette smoking prevalence was 24.9% for adults with active epilepsy, 25.9% for adults with inactive epilepsy, and 16.6% for adults without epilepsy (Table). Current cigarette smoking prevalence was higher among adults with active epilepsy than among those with no history of epilepsy overall and for both men and women; adults aged 35–54 or 55–64 years; non-Hispanic Whites and Other, non-Hispanic adults; adults with <12 or >12 years of education; adults with family incomes <100% or >300% of the

**TABLE. Age-standardized* estimates of current smoking† prevalence among adults, by epilepsy status and selected characteristics — United States, 2010, 2013, 2015 and 2017**

| Characteristic | Active epilepsy | | Inactive epilepsy | | No history of epilepsy | |
|---|---|---|---|---|---|---|
| | No.§ | % (95% CI) | No.§ | % (95% CI) | No.§ | % (95% CI) |
| **Total (crude)** | **1,372** | **25.2 (22.4–28.2)** | **868** | **26.5 (23.1–30.3)** | **119,257** | **16.3 (15.9–16.7)** |
| **Total (age-standardized)** | **1,372** | **24.9 (22.1–28.0)** | **868** | **25.9 (22.6–29.6)** | **119,257** | **16.6 (16.2–16.9)** |
| **Sex** | | | | | | |
| Men | 607 | 24.1 (20.0–28.7) | 345 | 27.5 (22.3–33.4) | 53,346 | 18.5 (18.0–19.0) |
| Women | 765 | 25.5 (21.9–29.5) | 523 | 25.3 (21.2–29.8) | 65,911 | 14.7 (14.2–15.1) |
| **Age group (yrs)** | | | | | | |
| 18–34 | 287 | 22.4 (16.9–29.1) | 241 | 24.8 (18.7–32.1) | 31,891 | 17.9 (17.3–18.5) |
| 35–54 | 503 | 33.1 (28.2–38.5) | 315 | 31.7 (25.938.1) | 39,089 | 18.8 (18.2–19.4) |
| 55–64 | 296 | 28.4 (22.1–35.7) | 166 | 25.1 (18.6–23.9) | 20,006 | 17.1 (16.4–17.8) |
| ≥65 | 286 | 7.8 (5.1–11.7) | 146 | 15.0 (9.7–22.6) | 28,271 | 8.7 (8.2–9.1) |
| **Race/Ethnicity** | | | | | | |
| White, non-Hispanic | 919 | 27.2 (23.8–30.9) | 610 | 27.1 (23.1–31.4) | 73,561 | 18.8 (18.3–19.3) |
| Black, non-Hispanic | 218 | 16.6 (10.9–24.5) | 122 | 26.6 (18.0–37.3) | 16,397 | 17.2 (16.4–18.0) |
| Hispanic | 145 | 14.9 (9.6–22.4) | 89 | 14.1 (8.4–22.8) | 19,611 | 10.8 (10.2–11.4) |
| Other, non-Hispanic | 90 | 32.6 (21.7–45.7) | 47 | 35.7 (20.6–54.2) | 9,688 | 11.8 (10.9–12.8) |
| **Education level (yrs)** | | | | | | |
| <12 | 311 | 34.3 (27.5–41.9) | 141 | 39.7 (30.8–49.3) | 17,123 | 25.3 (24.2–26.4) |
| 12 | 415 | 25.3 (20.4–30.9) | 231 | 28.3 (22.1–35.6) | 30,044 | 23.9 (23.1–24.6) |
| >12 | 629 | 20.8 (17.2–24.9) | 488 | 21.3 (17.4–25.9) | 71,614 | 12.0 (11.7–12.4) |
| **Family income** | | | | | | |
| <100% of FPL | 362 | 35.2 (28.8–42.2) | 173 | 40.7 (32.3–49.7) | 15,019 | 25.9 (24.8–26.9) |
| 100%–200% of FPL | 305 | 26.4 (20.3–33.6) | 151 | 30.9 (21.8–41.9) | 18,570 | 21.3 (20.4–22.2) |
| 201%–300% of FPL | 145 | 28.7(18.9–41.0) | 101 | 25.2 (16.6–36.3) | 15,413 | 18.1 (17.2–18.9) |
| >300% of FPL | 559 | 18.9 (15.0–23.6) | 443 | 20.9 (16.9–25.6) | 70,254 | 14.2 (13.8–14.6) |
| **Insurance status** | | | | | | |
| Uninsured | 121 | 35.2 (24.5–46.4) | 126 | 40.1 (29.9–51.3) | 16,635 | 26.1 (24.8–27.4) |
| Insured | 1,246 | 24.1 (21.1–27.3) | 739 | 23.3 (19.9–27.0) | 102,206 | 14.7 (14.3–15.1) |
| **Current employment** | | | | | | |
| Employed | 375 | 17.6 (13.4–22.7) | 410 | 21.7 (16.8–27.5) | 70,478 | 15.1 (14.7–15.5) |
| Retired | 229 | —¶ | 122 | 67.8 (63.3–71.9) | 24,358 | 24.7 (15.6–36.8) |
| Disabled | 612 | 29.0 (24.3–34.2) | 216 | 32.9 (24.9–42.1) | 8,411 | 32.8 (30.9–34.6) |
| Unemployed | 66 | 41.8 (29.2–55.7) | 55 | 35.6 (21.5–52.8) | 5,565 | 27.2 (25.6–28.9) |
| Other (e.g., student or homemaker) | 88 | 21.1 (12.3–33.9) | 65 | 23.7 (15.0–35.3) | 10,394 | 12.8 (11.9–13.8) |
| **U.S. Census region** | | | | | | |
| Northeast | 210 | 25.4 (19.3–32.6) | 111 | 25.2 (18.2–33.8) | 19,510 | 14.8 (14.1–15.6) |
| Midwest | 301 | 30.9 (24.5–38.2) | 219 | 27.0 (20.6–34.4) | 25,860 | 19.6 (18.8–20.5) |
| South | 542 | 25.1(20.9–29.7) | 323 | 26.2 (21.0–32.1) | 43,189 | 17.8 (17.1–18.5) |
| West | 319 | 18.1 (13.1–24.5) | 215 | 22.4 (16.1–30.3) | 30,698 | 13.1 (12.5–13.7) |
| **Serious psychological distress**** | | | | | | |
| No | 1,091 | 22.4 (19.4–25.6) | 775 | 23.9 (20.5–27.7) | 111,432 | 15.7 (15.4–16.1) |
| Yes | 213 | 43.7 (34.9–52.9) | 76 | 44.5 (30.1–59.9) | 4,293 | 38.2 (36.3–40.1) |

**Abbreviations:** CI = confidence interval; FPL = federal poverty level.

* Age-standardized to the 2000 U.S. projected population, aged ≥18 years, using four age groups (18–34, 35–54, 55–64, and ≥65 years). All percentages are age-standardized except those for age groups and overall (crude).

† Current smoking was defined by self-report of smoking at least 100 cigarettes during one's lifetime and smoking every day or some days at the time of the interview.

§ Categories in subgroups might not sum to total because of missing responses for some variables.

¶ Suppressed because relative standard error was ≥0.30.

** Serious psychological distress was defined as a score ≥13 for responses to six questions based on the Kessler psychological distress scale about feelings of hopelessness, sadness, nervousness, restlessness, worthlessness, and feeling like everything is an effort in the past 30 days. Participants were asked to respond on a Likert scale ranging from "None of the time" (score = 0) to "All of the time" (score = 4). Responses were summed over the six questions; respondents with a score of ≥13 were coded as having serious psychological distress, and respondents with a score <13 were coded as not having serious psychological distress.

federal poverty level; adults with health insurance; unemployed adults; and adults residing in the Northeast, the Midwest, or the South (Table). Among those without serious psychological distress, current cigarette smoking among adults with active epilepsy was higher (22.4%) than it was among adults without epilepsy (15.7%).

Current cigarette smoking prevalence among adults with inactive epilepsy was higher than that among adults with no history of epilepsy in many of the same subgroups. Current cigarette smoking was also higher among adults with inactive epilepsy than it was among those without epilepsy for any age group; those with <12 or >12 years of education; those with family incomes <100% or >300% of the federal poverty level; among both the insured or the uninsured; the employed; the retired; those in other employment categories (e.g., students); and those residing in all U.S. regions. Among adults without serious psychological distress, cigarette smoking prevalence among those with inactive epilepsy was higher than that among those without epilepsy.

Current cigarette smoking declined significantly among adults without a history of epilepsy, from 19.3% in 2010 to 14.0% in 2017; a 9.3% decline (95% confidence interval [CI] = −10.6% to −7.9%) ($p<0.05$) and among adults with inactive epilepsy (from 29.2% to 16.2%; a 16.6% decline [95% CI = −31.9% to −1.7%]) ($p = 0.03$) (Figure). However, declines in current cigarette smoking among adults with active epilepsy were not statistically significant (from 26.4% to 21.8%; a 9.9% decline [95% CI = −23.7% to 3.9%]) ($p = 0.2$).

**Summary**

**What is already known on this topic?**

Studies have shown that cigarette smoking is as common, and sometimes more so, among adults with a history of epilepsy as it is among those without a history of epilepsy.

**What is added by this report?**

During 2010–2017, one in four adults with active or inactive epilepsy were current smokers, compared with one in six persons without epilepsy. Although fewer adults with active epilepsy smoked cigarettes in 2017 than in 2010, this difference was not statistically significant.

**What are the implications for public health practice?**

Epilepsy health and social service providers should promote smoking cessation resources to adults with active epilepsy who smoke cigarettes to help them quit smoking and reduce their risk for smoking-related disease and death.

## Discussion

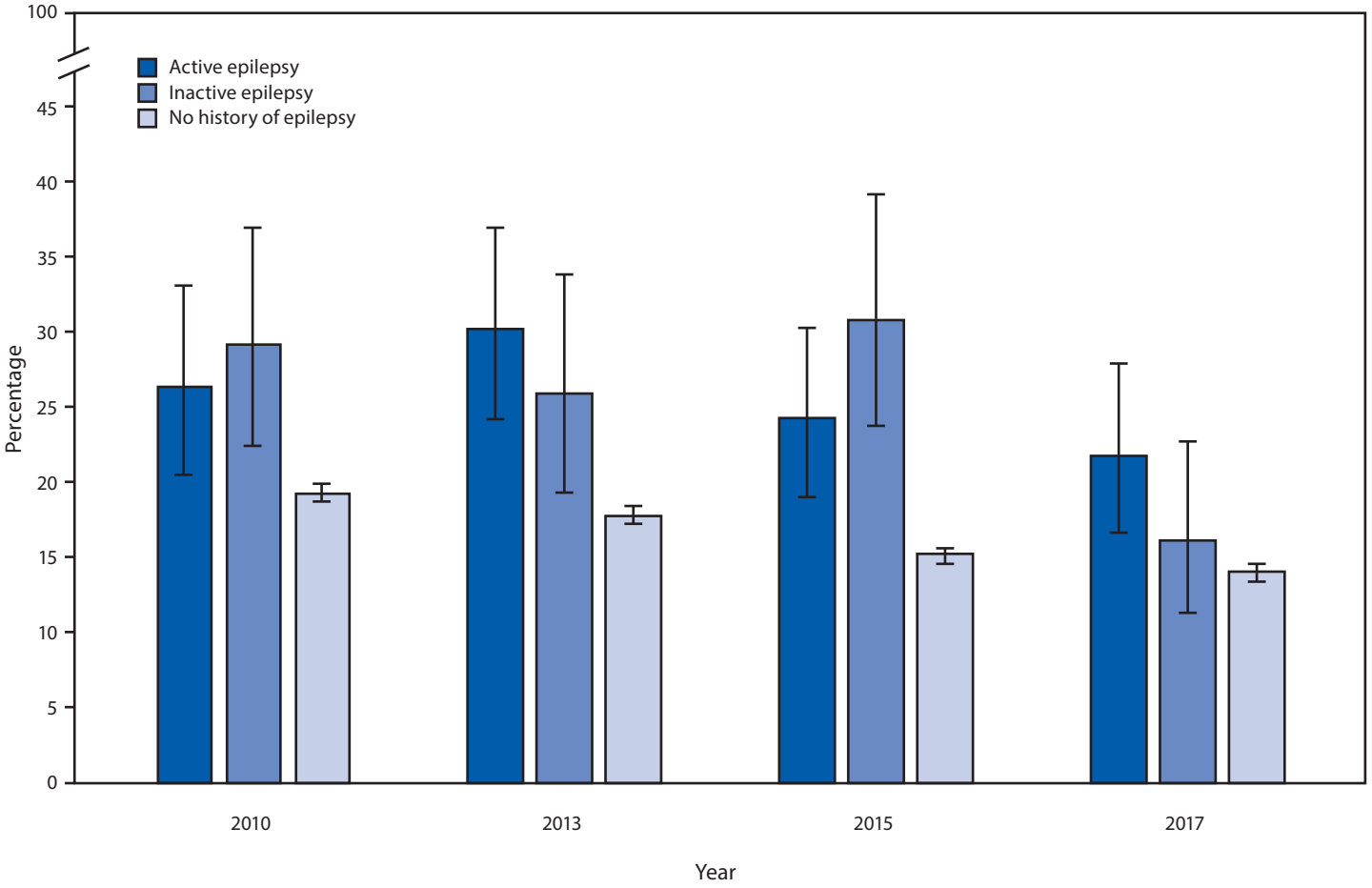
During the 4 survey years (2010, 2013, 2015 and 2017), approximately one in four U.S. adults with active or inactive epilepsy currently smoked cigarettes. This finding reinforces the importance of efforts to reduce cigarette smoking among all adults, especially those with any epilepsy.

Differences in current smoking among adults with epilepsy within subgroups generally paralleled those in the general U.S. adult population, with higher prevalences among some racial/ethnic minorities and those with lower income, a disability, or serious psychological distress (*2*). Like the general population, adults with epilepsy have reported challenges in maintaining healthful behaviors but might benefit from interventions that increase skills for adopting and maintaining healthy behaviors (*8*). Cigarette smoking is especially complex in epilepsy because nicotine and tobacco smoke have both proconvulsant effects (e.g., reducing the anticonvulsive effects of certain antiseizure drugs) and anticonvulsant effects, which has been demonstrated in various human studies and animal models (*5*,*9*). Although one study found that smokers with epilepsy were approximately four times more likely to have experienced a seizure in the past year than were nonsmokers with epilepsy, further research is needed to identify associations between seizure control, current smoking, and smoking cessation in representative samples of persons with active epilepsy (*5*,*9*).

Possible differences in smoking trends between adults with active and inactive epilepsy might be associated with differences in overall health status, work limitations, and quality of life between these two groups (*7*), but this will require further study. Encouraging smoking prevention and cessation among all adults, including those with epilepsy and other population groups with disproportionately higher prevalences of smoking, is critical to reducing their risk of smoking-related disease and death.

The findings in this report are subject to at least six limitations. First, because epilepsy and smoking status were self-reported and not validated by clinical chart review or biochemical testing, these classifications are subject to social desirability bias, interviewer effects, and misclassification of epilepsy. Second, because NHIS excludes institutionalized populations such as the military, detained or incarcerated persons, and nursing home residents, results are not generalizable to these groups. Third, assessment of subgroup differences within a relatively small sample of adults with epilepsy can obscure differences within these populations. Fourth, the NHIS survey response rate has declined from 72% in 2010 to 53% in 2017, resulting in increasing nonresponse bias, which might result in less representative samples of U.S. adults with epilepsy participating in NHIS over time. Fifth, assessment of trends in smoking prevalence among those with active epilepsy might have been underpowered because of sample size limitations. Finally, this study assessed cigarettes only, and not other forms of tobacco products; given that nicotine has been found to have both proconvulsant and anticonvulsant effects, further research on any relationship between epilepsy and the use of noncigarette tobacco products, including e-cigarettes, is warranted.

**FIGURE. Age-standardized percentage* of current smoking among adults with active epilepsy, inactive epilepsy, and no history of epilepsy, by survey year — United States, 2010, 2013, 2015, and 2017**




* With 95% confidence intervals indicated by error bars.

Health and social service providers who interact with persons with active epilepsy should ensure that smoking cessation information and resources are available to them and should encourage persons who smoke to use these resources to help them quit smoking and to reduce their risk of smoking-related disease and death. Funding state tobacco control programs, including state quit lines, at CDC-recommended levels, increasing tobacco prices, implementing comprehensive smoke-free policies, conducting antitobacco mass media campaigns, and enhancing access to quitting assistance could increase tobacco cessation and reduce tobacco-related disease and death among all adults, including those with epilepsy[††] (*1*,*10*). Insurers and employers could improve coverage and increase use of cessation treatment, and health systems can integrate cessation interventions into clinical care (*1*).

[††] https://www.cdc.gov/tobacco/data_statistics/sgr/2020-smoking-cessation/index.html.

## Acknowledgment

Michael Boring, Starr and Associates, Atlanta, Georgia.

Corresponding author: Sanjeeb Sapkota, ssapkota@cdc.gov, 770-488-5853.

[1]ASRT Inc., Atlanta, Georgia; [2]Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; [3]Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, CDC.

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.

## References

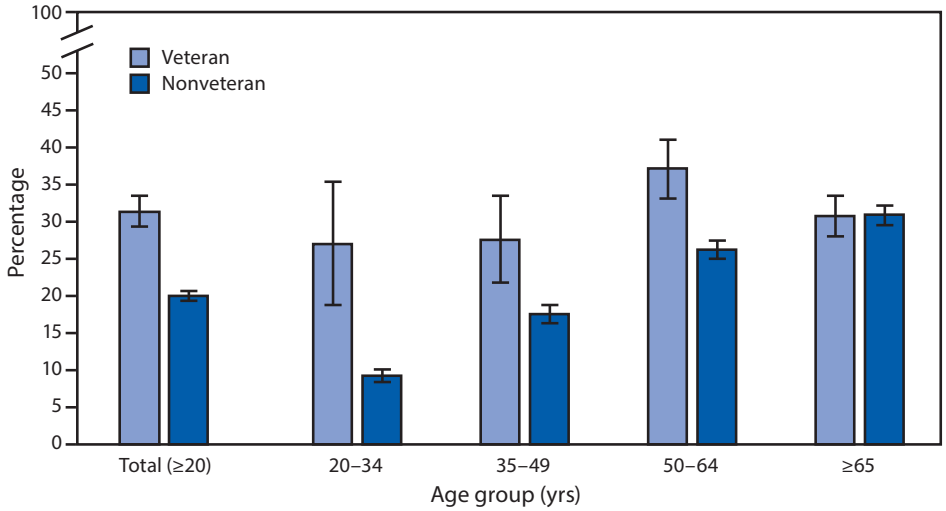
1. US Department of Health and Human Services. The health consequences of smoking—50 years of progress: a report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, CDC; 2014.
2. Wang TW, Asman K, Gentzke AS, et al. Tobacco product use among adults—United States, 2017. MMWR Morb Mortal Wkly Rep 2018;67:1225–32. PMID:30408019 https://doi.org/10.15585/mmwr.mm6744a2

3. Elliott JO, Moore JL, Lu B. Health status and behavioral risk factors among persons with epilepsy in Ohio based on the 2006 Behavioral Risk Factor Surveillance System. Epilepsy Behav 2008;12:434–44. PMID:18178133 https://doi.org/10.1016/j.yebeh.2007.12.001
4. Elliott JO, Lu B, Moore JL, McAuley JW, Long L. Exercise, diet, health behaviors, and risk factors among persons with epilepsy based on the California Health Interview Survey, 2005. Epilepsy Behav 2008;13:307–15. PMID:18490199 https://doi.org/10.1016/j.yebeh.2008.04.003
5. Johnson AL, McLeish AC, Shear PK, Sheth A, Privitera M. The role of cigarette smoking in epilepsy severity and epilepsy-related quality of life. Epilepsy Behav 2019;93:38–42. PMID:30831400 https://doi.org/10.1016/j.yebeh.2019.01.041
6. Cui W, Zack MM, Kobau R, Helmers SL. Health behaviors among people with epilepsy—results from the 2010 National Health Interview Survey. Epilepsy Behav 2015;44:121–6. PMID:25678033 https://doi.org/10.1016/j.yebeh.2015.01.011
7. Kobau R, Cui W, Kadima N, et al. Tracking psychosocial health in adults with epilepsy—estimates from the 2010 National Health Interview Survey. Epilepsy Behav 2014;41:66–73. PMID:25305435 https://doi.org/10.1016/j.yebeh.2014.08.002
8. Helmers SL, Kobau R, Sajatovic M, et al.; Centers for Disease Control and Prevention Managing Epilepsy Well Network. Self-management in epilepsy: why and how you should incorporate self-management in your practice. Epilepsy Behav 2017;68:220–4. PMID:28202408 https://doi.org/10.1016/j.yebeh.2016.11.015
9. Rong L, Frontera AT Jr, Benbadis SR. Tobacco smoking, epilepsy, and seizures. Epilepsy Behav 2014;31:210–8. PMID:24441294 https://doi.org/10.1016/j.yebeh.2013.11.022
10. CDC. Best practices for comprehensive tobacco control programs—2014. Atlanta, GA: US Department of Health and Human Services, CDC; 2014.

# QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

## Percentage* of Adults Aged ≥20 Years Who Had Chronic Pain,† by Veteran Status and Age Group — National Health Interview Survey, United States, 2019§




* With 95% confidence intervals shown with error bars.
† Based on the response to a survey question that asked "In the past 3 months, how often did you have pain? Would you say never, some days, most days, or every day?" Chronic pain was defined as pain on most days or every day in the past 3 months.
§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the National Health Interview Survey Sample Adult component.

During 2019, military veterans aged ≥20 years were more likely to have chronic pain than were nonveterans (31.5% versus 20.1%). By age group, the likelihood of having chronic pain was higher among veterans than nonveterans for those aged 20–34 years (27.1% versus 9.4%), 35–49 years (27.7% versus 17.7%), and 50–64 years (37.2% versus 26.3%). Among those aged ≥65 years, prevalence of chronic pain did not differ significantly by veteran status (30.8% among veterans versus 31.0% among nonveterans). Among nonveterans, the prevalence of chronic pain increased with age. Among veterans, those aged 50–64 years had the highest prevalence of chronic pain.

**Source:** National Health Interview Survey, 2019. https://www.cdc.gov/nchs/nhis.htm.

**Reported by:** Carla Zelaya, PhD, vdn3@cdc.gov, 301-458-4164; James M. Dahlhamer, PhD; Yu Sun, PhD.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/drugoverdose/prescribing/guideline.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*.

Readers who have difficulty accessing this PDF file may access the HTML file at *https://www.cdc.gov/mmwr/index2020.html*. Address all inquiries about the *MMWR* Series, including material to be considered for publication, to Executive Editor, *MMWR* Series, Mailstop E-90, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30329-4027 or to mmwrq@cdc.gov.



ISSN: 0149-2195 (Print)