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Estimated Number of Cases of High-Grade Cervical Lesions Diagnosed Among Women — United States, 2008 and 2016

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Human papillomavirus (HPV) causes approximately 30,000 cancers in the United States annually (*1*). HPV vaccination was introduced in 2006 to prevent HPV-associated cancers and diseases (*1*). Cervical cancer is the most common HPV-associated cancer in women (*1*). Whereas HPV-associated cancers typically take decades to develop, screen-detected high-grade cervical lesions (cervical intraepithelial neoplasia grades 2 [CIN2], 3 [CIN3], and adenocarcinoma in situ, collectively CIN2+) develop within a few years after infection and have been used to monitor HPV vaccine impact (*1*–*3*). CDC analyzed data from the Human Papillomavirus Vaccine Impact Monitoring Project (HPV-IMPACT), a population-based CIN2+ surveillance system, to describe rates of CIN2+ among women aged ≥18 years during 2008–2016. Age-specific rates were applied to U.S. population data to estimate the total number of CIN2+ cases diagnosed in the United States in 2008* and in 2016. From 2008 to 2016, the rate of CIN2+ per 100,000 women declined significantly in women aged 18–19 years and 20–24 years and increased significantly in women aged 40–64 years. In the United States in 2008, an estimated 216,000 (95% confidence interval [CI] = 194,000–241,000) CIN2+ cases were diagnosed, 55% of which were in women aged 18–29 years; in 2016, an estimated 196,000 (95% CI = 176,000–221,000) CIN2+ cases were diagnosed, 36% of which were in women aged 18–29 years. During 2008 and 2016, an estimated 76% of CIN2+ cases were attributable to HPV types targeted by the vaccine currently used in the United States. These estimates of CIN2+ cases likely reflect changes in CIN2+ detection resulting from updated cervical cancer screening and management recommendations, as well as primary prevention through HPV vaccination. Increasing coverage of HPV vaccination in females at the routine age of 11 or 12 years and catch-up vaccination through age 26 years will contribute to further reduction in cervical precancers.

In 2006, HPV vaccine was licensed and recommended for routine vaccination in females aged 11 or 12 years and for catch-up vaccination through age 26 years (*1*). Two vaccines primarily have been used in the United States: until 2015, the quadrivalent vaccine, which in addition to HPV 6 and 11, targets high-risk, or oncogenic, HPV 16 and 18, and since 2016, 9-valent vaccine, which also targets high-risk HPV types 31, 33, 45, 52, and 58. HPV vaccination coverage among females

* Surveillance through HPV-IMPACT began in 2008. Although the vaccination program began in 2006, because of the time it takes for cervical precancers to develop and be detected through screening, rates in 2008 should not be affected by vaccination and should therefore represent prevaccine era rates.

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aged 13–17 years has increased since 2007. In 2016, coverage of ≥1 dose was 65.1% and 3 doses was 43.0% (*1*).

The HPV-IMPACT sites are located in five surveillance network locations. The specific catchment areas, defined by county or zip code, were selected to provide a diverse population of women and a feasible population size and geographic area for complete case ascertainment; in total, approximately 1.5 million women reside in the catchment areas.† HPV-IMPACT uses active surveillance of diagnostic pathology laboratories to collect all CIN2+ cases (*3*). Site staff members routinely audit all laboratories and gynecology practices serving catchment areas to ensure complete case ascertainment. Archived diagnostic specimens for type-specific HPV DNA detection of 37 types are obtained for cases in women aged 18–39 years (*2*). Age-stratified CIN2+ incidence rates per 100,000 women were calculated for each year (2008–2016)§; trends were evaluated using joinpoint models in Joinpoint software (version 4.6.0.0; National Cancer Institute) and reported as average annual percentage change (AAPC) with 95% CIs.¶

To estimate the number of CIN2+ cases in 2008 and 2016 by age group, the observed age-specific CIN2+ rates were applied to age-specific, annual U.S. population estimates.** HPV types were categorized as HPV16/18, HPV31/33/45/52/58, and other type/HPV-negative. To estimate the number of HPV type–specific cases, the age-specific HPV type distribution observed from typing data was applied to age-specific total CIN2+ estimates.†† Case estimates were rounded to the nearest

† The HPV-IMPACT sites are located in five of the 10 Emerging Infections Programs (EIP) surveillance network locations (https://www.cdc.gov/ncezid/dpei/eip/eip-sites.html); the specific catchment areas within the EIP sites are New Haven County, Connecticut; Monroe County, New York; Davidson County, Tennessee; portions of Alameda County, California; and portions of Washington and Multnomah Counties, Oregon. (https://www.cdc.gov/ncird/surveillance/hpvimpact/index.html).

§ Population denominators were based on county-level data from CDC's National Center for Health Statistics (https://www.cdc.gov/nchs/nvss/bridged_race/data_documentation.htm); for California and Oregon sites, county estimates were adjusted for the specific catchment area using American Community Survey data.

¶ Trends were measured with AAPC in age-stratified rates and were considered to increase (AAPC>0) or decrease (AAPC<0) if the 95% CI did not include 0; otherwise trends were considered stable.

** The total number of U.S. CIN2+ cases in each age group and 95% CIs were estimated by multiplying the age-specific CIN2+ rates and upper and lower CIs by the age-specific U.S. population estimates. For example, in women aged 20–24 years, the observed HPV-IMPACT CIN2+ rate in 2008 was 559 (95% CI = 521–600) per 100,000 women, and there were 10,339,566 women aged 20–24 years in the United States; therefore, the estimated number of U.S. CIN2+ cases in this age group was 559 x 10,339,566/100,000 = 58,000 CIN2+ cases (rounded to the nearest 1,000). The total cases were estimated by summing the age-specific estimates.

†† HPV typing data were available for approximately 70% of cases in women aged 18–39 years, and the proportion positive for each HPV type group varied by lesion grade. Therefore, to estimate the number of cases in each age group attributable to each HPV type group, the proportion positive for each HPV type group within each lesion grade was multiplied by the number of cases having each lesion grade within each age group. For age groups <40 years, the observed HPV type proportion within each lesion grade for each age group was applied. For age groups ≥40 years, the observed HPV type proportion within each lesion grade for cases among women aged 30–39 years was applied.

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1,000 cases.[§§] An analysis using higher and lower CIN2+ rates observed in specific HPV-IMPACT sites was performed to describe potential uncertainty in estimates.[¶¶]

During 2008–2016, a total of 23,489 CIN2+ cases were reported to HPV-IMPACT, and HPV DNA typing was performed for 11,581 of 16,590 (69.8%) cases in women aged 18–39 years. In 2008, HPV-IMPACT CIN2+ rates were highest in women aged 20–24 years (559 per 100,000 women [95% CI = 521–600]) and were lower in successively older age groups (Table). In 2016, CIN2+ rates were highest in women aged 25–29 years (480 [95% CI = 448–515]) and lower in each successively older age group. From 2008 to 2016, the rate of CIN2+ per 100,000 women declined significantly in women aged 18–19 years and 20–24 years and increased significantly in women aged 40–64 years.

[§§] Components might not sum to totals because of rounding.

[¶¶] A range of lower and higher national estimates were developed based on data from two sites with historically lower CIN2+ rates (California and Tennessee) and from two sites with historically higher CIN2+ rates (Connecticut and New York). The low and high estimates of the number of prevaccine era CIN2+ cases were 159,000 (95% CI = 131,000–197,000) and 283,000 (95% CI = 246,000–328,000); the low and high estimates of the number of 2016 CIN2+ cases were 179,000 (95% CI = 150,000–217,000) and 210,000 (95% CI = 177,000–253,000).

Extrapolating age-specific HPV-IMPACT rates to the U.S. population, an estimated 216,000 (95% CI = 194,000–241,000) CIN2+ cases were diagnosed in the United States in 2008 (Figure 1), including 119,000 (55%) in women aged 18–29 years, 57,000 (26%) in women aged 30–39 years, and 40,000 (18%) in women aged ≥40 years. Among the estimated 216,000 cases, 165,000 (76%) were attributable to 9-valent vaccine types (111,000 [52%] to HPV16/18 and 54,000 [25%] to HPV31/33/45/52/58) (Figure 2). Among women aged 18–24 years, 52% of CIN2+ cases were HPV16/18-attributable. Of the 165,000 CIN2+ cases attributable to 9-valent vaccine types, 91,000 (55%), 43,000 (26%), and 31,000 (19%) occurred in women aged 18–29, 30–39, and ≥40 years, respectively.

In 2016, an estimated 196,000 (95% CI = 176,000–221,000) CIN2+ cases were diagnosed in the United States, including 71,000 (36%) in women aged 18–29 years, 74,000 (38%) in women aged 30–39 years and 51,000 (26%) in women aged ≥40 years (Figure 1). Among the 196,000 total cases, 150,000 (76%) were attributable to 9-valent vaccine types, including 84,000 (43%) to HPV16/18 and 66,000 (34%) to HPV31/33/45/52/58 (Figure 2). Among women aged 18–24 years, 30% of CIN2+ cases were HPV

TABLE. Age group–specific annual CIN2+ cases per 100,000 women, and average annual percentage change (AAPC)* — Human Papillomavirus Vaccine Impact Monitoring Project, United States, 2008–2016

Age group (yrs)†	CIN2+ rate (95% CI) Year of diagnosis 2008	2009	2010	2011	2012	2013	2014	2015	2016	AAPC* (95% CI)
18–19	206 (172 to 248)	118 (93 to 151)	83 (62 to 110)	27 (16 to 45)	20 (11 to 36)	15 (7 to 29)	9 (4 to 23)	8 (3 to 20)	12 (5 to 26)	–38.5 (–44.6 to –31.8)
20–24	559 (521 to 600)	499 (463 to 537)	412 (380 to 447)	381 (350 to 415)	351 (322 to 383)	271 (246 to 300)	191 (169 to 215)	185 (163 to 209)	151 (132 to 173)	–14.9 (–17.1 to –12.6)
25–29	504 (469 to 542)	506 (471 to 544)	499 (464 to 536)	466 (433 to 502)	461 (428 to 497)	495 (461 to 531)	442 (411 to 476)	427 (397 to 460)	480 (448 to 515)	–1.4 (–2.8 to 0.1)
30–34	371 (339 to 406)	363 (332 to 397)	334 (304 to 366)	363 (333 to 396)	337 (308 to 368)	366 (336 to 398)	398 (367 to 431)	420 (389 to 454)	419 (388 to 453)	2.1§ (–0.4 to 4.8)
35–39	202 (179 to 228)	235 (210 to 263)	238 (213 to 267)	226 (202 to 254)	213 (189 to 240)	229 (205 to 257)	210 (187 to 236)	276 (250 to 306)	276 (250 to 306)	2.7 (–0.1 to 5.6)
40–44	143 (124 to 165)	147 (127 to 169)	166 (145 to 190)	154 (134 to 177)	149 (129 to 171)	172 (150 to 196)	172 (151 to 196)	171 (149 to 195)	175 (153 to 200)	2.4 (0.9 to 3.9)
45–49	87 (72 to 104)	88 (74 to 105)	73 (60 to 89)	95 (80 to 113)	101 (86 to 120)	92 (77 to 110)	112 (95 to 132)	92 (77 to 110)	112 (95 to 132)	3.4 (0.3 to 6.6)
50–54	54 (42 to 68)	51 (40 to 64)	51 (40 to 64)	53 (42 to 66)	48 (38 to 62)	67 (54 to 82)	77 (63 to 93)	76 (63 to 92)	65 (53 to 80)	5.5 (1.6 to 9.6)
55–59	30 (22 to 41)	36 (27 to 49)	45 (34 to 58)	41 (31 to 53)	38 (29 to 50)	43 (33 to 56)	44 (34 to 57)	41 (32 to 54)	58 (46 to 72)	5.3 (1.4 to 9.2)
60–64	30 (20 to 43)	24 (16 to 36)	26 (18 to 38)	41 (31 to 55)	41 (31 to 55)	33 (24 to 45)	32 (23 to 44)	42 (32 to 55)	48 (37 to 62)	6.1 (0.7 to 11.9)
≥65	14 (10 to 19)	13 (10 to 18)	14 (10 to 19)	11 (8 to 16)	13 (9 to 18)	12 (9 to 17)	10 (7 to 14)	13 (10 to 18)	12 (9 to 17)	–1.6 (–4.7 to 1.6)

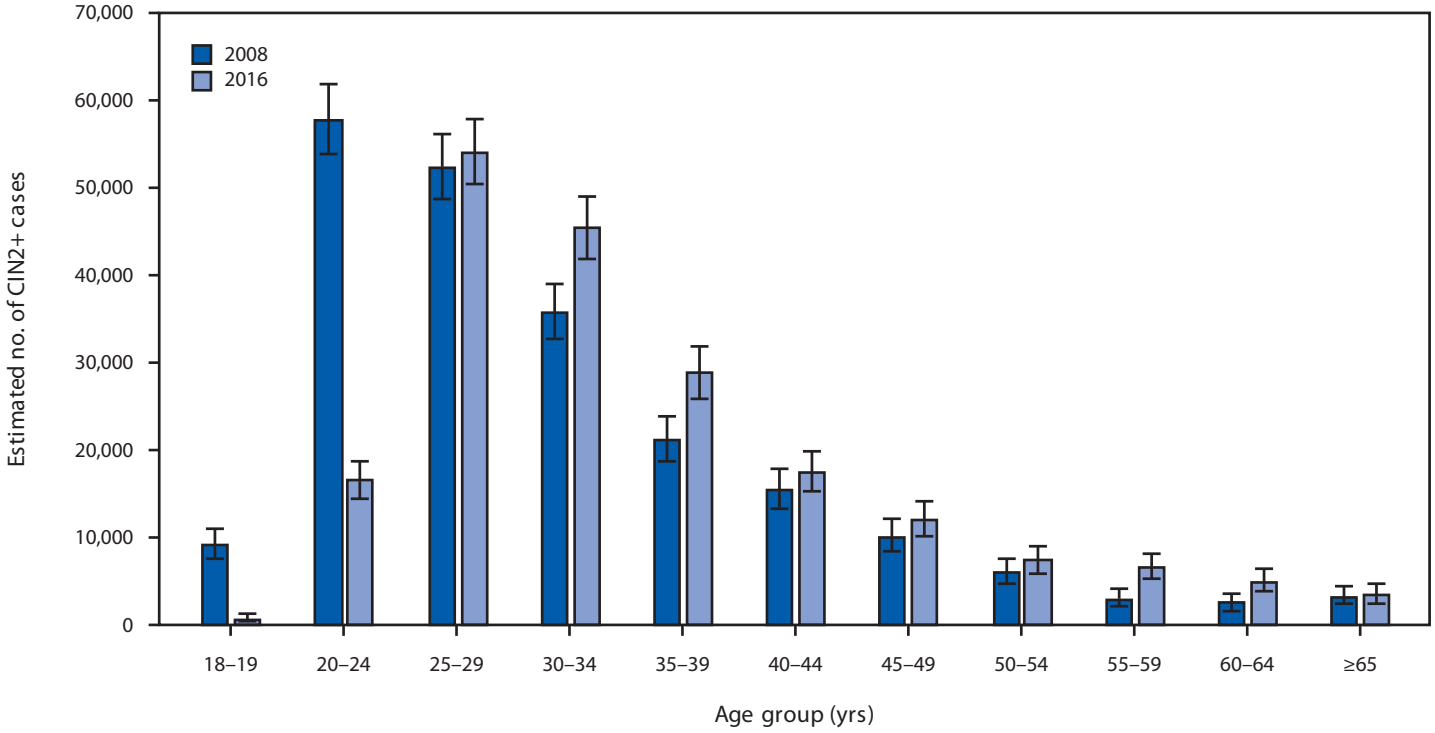
Abbreviations: CI = confidence interval; CIN2+ = cervical intraepithelial neoplasia grades 2, 3, and adenocarcinoma in situ.

* Trends were measured with AAPC in age-stratified rates, and were considered to increase (AAPC>0) or decrease (AAPC<0) if the 95% confidence interval did not include 0; otherwise, trends were considered stable.

† The median age at CIN2+ diagnosis was 28 years (interquartile range [IQR] = 24–35 years) in 2008 and 32 years (IQR 27–39 years) in 2016.

§ In women aged 30–34 years, a joinpoint was detected. From 2008 to 2012, the annual percentage change (APC) indicated that rates were stable (-1.4 [95% CI = –6.5 to 4.1]), but from 2012 to 2016, the APC indicated that rates were increasing (5.8 [95% CI = 0.7 to 11.1]).

FIGURE 1. Estimated number of diagnosed CIN2+ cases,* by age group — United States, 2008 and 2016



Abbreviation: CIN2+ = cervical intraepithelial neoplasia grades 2, 3, and adenocarcinoma in situ.
* Error bars indicate 95% confidence intervals, which were calculated by applying the upper and lower limits of CIN2+ rates to the age-specific U.S. population.

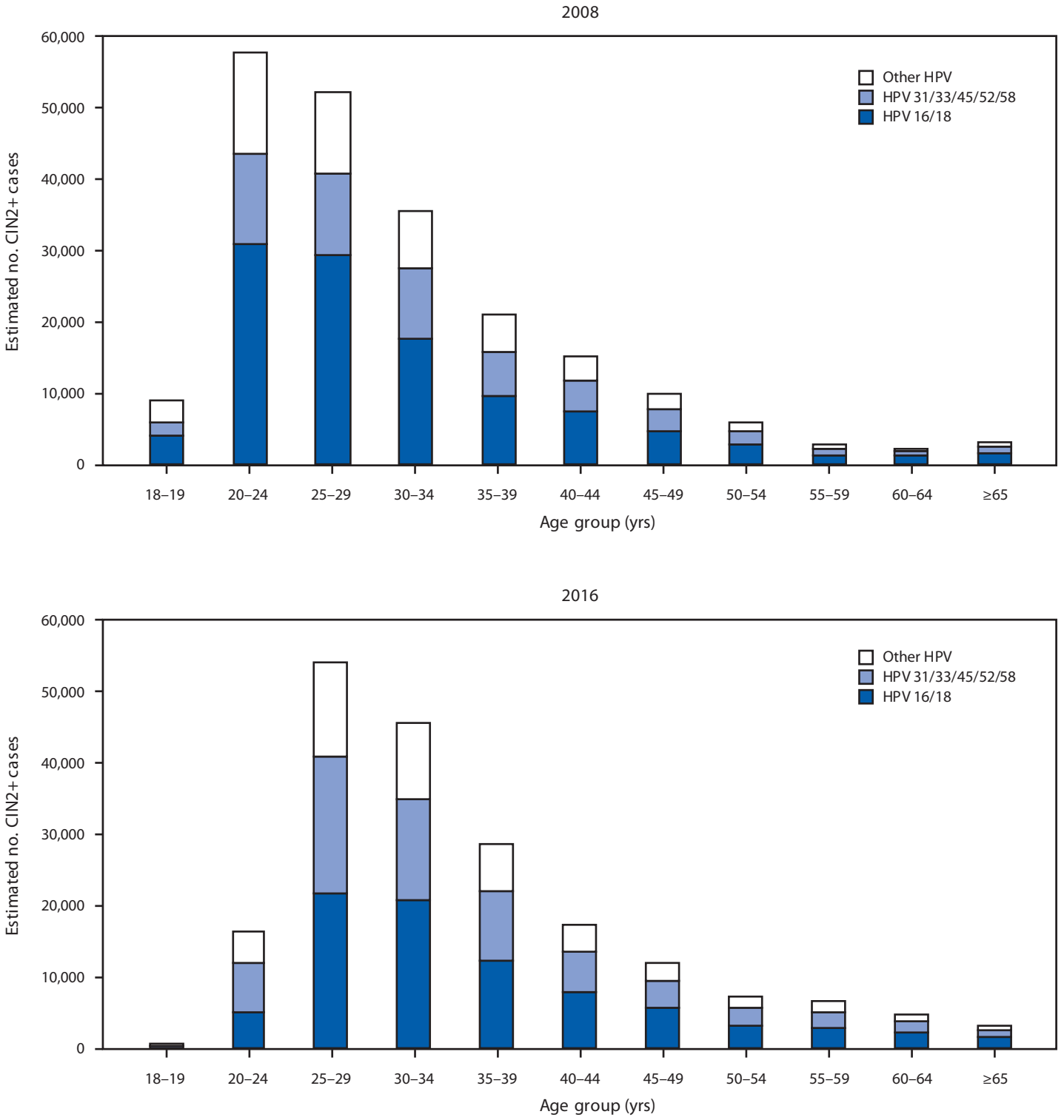
16/18-attributable. Of the 150,000 CIN2+ cases attributable to 9-valent vaccine types, 53,000 (35%), 57,000 (38%), and 40,000 (27%) occurred in women aged 18–29, 30–39, and ≥40 years, respectively.

Discussion

This report describes the first estimates of the number of U.S. CIN2+ cases developed from population-based data. In 2008 and 2016, an estimated 216,000 and 196,000 CIN2+ cases were diagnosed, respectively; in both years, 76% were attributable to 9-valent HPV vaccine types. A previous U.S. estimate of 177,469 CIN2+ cases in 2000 was limited by extrapolation from health claims data among privately insured women (*4*). To estimate U.S. CIN2+ cases, this report also extends previously reported HPV-IMPACT CIN2+ rates, by including rates in women aged ≥40 years (*3*). Two additional population-based surveillance systems have published CIN2 or CIN3 rates, but have not used them to estimate numbers of U.S. CIN2+ cases (*5*,*6*). Rates from those systems were not incorporated into estimates presented in this report because those rates were calculated using a denominator of screened women, did not include HPV typing data, or did not include data on all age groups and years.

Both the estimated number and rates of U.S. CIN2+ cases in this report must be interpreted in the context of cervical cancer prevention strategies, including HPV vaccination and cervical cancer screening. CIN2+ is detected through cervical cancer screening and referral for diagnostic biopsy; thus, changes in screening and management recommendations that occurred during the surveillance period in this report affect CIN2+ detection (*7*,*8*). In 2008, the recommended age for initiation of screening was within 3 years of initiation of sexual activity or by age 21 years, with annual screening thereafter recommended by many professional organizations. By 2016, the recommended age for screening initiation was 21 years, and screening intervals had increased to every 3 years with cytology alone, or every 5 years with cytology plus HPV testing in women aged ≥30 years. Older age at screening initiation, longer screening intervals, and more conservative management in young women might be expected to reduce the number of CIN2+ cases detected in younger age groups in whom lesions are most likely to regress and shift detection of some CIN2+ to older age groups, resulting in a transient increase in rates (*3*,*5*). In younger age groups, the decline in HPV 16/18-attributable CIN2+, targeted by the quadrivalent vaccine from 2006 to 2015, also reflects the impact of the U.S. HPV vaccination program. Some of the increases in older age groups could be

FIGURE 2. Estimated number of diagnosed CIN2+ cases, by human papillomavirus (HPV) type* and age group — United States, 2008 and 2016



Abbreviation: CIN2+ = cervical intraepithelial neoplasia grades 2, 3 and adenocarcinoma in situ.

* Type-specificity for 2008 was based on typing data from 2008, and for 2016, was based on typing data from 2015 (most recently available) applied to 2016 case counts by diagnosis grade. HPV type group "other HPV" includes HPV-negative cases.

attributable to use of HPV testing, which is more sensitive than cytology, as part of cervical cancer screening, as has been predicted by modeling studies (*9*).

The findings in this report are subject to at least three limitations. First, U.S. CIN2+ cases were extrapolated from population-based surveillance in five communities, which was not designed to be nationally representative. Compared with the U.S. population, HPV-IMPACT catchment areas have a similar proportion of white women, a slightly higher proportion of black and Asian women, and a lower proportion of Hispanic women. Age-stratified rates were used to project to the U.S. population; however, this analysis did not adjust for race or other population characteristics, such as screening practices, that could affect the estimates. If actual U.S. CIN2+ rates are higher or lower than HPV-IMPACT CIN2+ rates, U.S. case numbers could be incorrectly estimated. Second, HPV type distribution in age groups ≥40 years was based on the distribution in women aged 30–39 years; prior HPV typing data in older age groups suggest that these calculations might overestimate contributions of 9-valent vaccine types in women aged ≥40 years (*10*). Finally, this analysis could not fully differentiate the factors influencing changes in CIN2+ development and detection, including screening and management recommendations and vaccination. However, previous studies have demonstrated that declining CIN2+ rates are not fully explained by changes in screening (*3*), and the proportion of CIN2+ attributable to vaccine types is declining (*2*).

This first estimate of the number of U.S. CIN2+ cases derived from population-based data, including the percentage that could be prevented by vaccination, is important for understanding CIN2+ trends across all age groups and will help to better identify the impact of both vaccination and changes to cervical screening and management guidelines. Increasing coverage of HPV vaccination in females at the routine age of 11 or 12 years and catch-up vaccination through age 26 years for those not adequately vaccinated previously will contribute to further reduction in cervical precancers.

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Summary

What is already known about this topic?

Cervical cancer is the most common human papillomavirus (HPV)-associated cancer in women, and high-grade cervical lesions (CIN2+) have been used to monitor HPV vaccine impact.

What is added by this report?

During 2008–2016, CIN2+ rates in a population-based surveillance system declined in women aged 18–24 years. The estimated numbers of U.S. CIN2+ cases were 216,000 (2008) and 196,000 (2016), with an estimated 76% attributable to 9-valent HPV vaccine types.

What are the implications for public health practice?

Cervical cancer prevention strategies include both HPV vaccination and screening. The reduction in CIN2+ attributable to vaccine types in young women demonstrates impact of the HPV vaccination program. Continued efforts to increase coverage and encourage vaccination at the routine ages (11–12 years) can increase vaccine impact on cervical disease in the United States.

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Outbreak of Human Immunodeficiency Virus Infection Among Heterosexual Persons Who Are Living Homeless and Inject Drugs — Seattle, Washington, 2018

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Although diagnoses of human immunodeficiency virus (HIV) infection among persons who inject drugs in the United States are declining, an HIV outbreak among such persons in rural Indiana demonstrated that population's vulnerability to HIV infection (*1*). In August 2018, Public Health–Seattle and King County (PHSKC) identified a cluster of cases of HIV infection among persons living homeless, most of whom injected drugs. Investigation identified 14 related cases diagnosed from February to mid-November 2018 among women who inject drugs and men who have sex with women (MSW) who inject drugs and their sex partners. All 14 persons were living homeless in an approximately 3–square-mile area and were part of a cluster of 23 cases diagnosed since 2008. Twenty-seven cases of HIV infection were diagnosed among women and MSW who inject drugs in King County during January 1–November 15, 2018, a 286% increase over the seven cases diagnosed in 2017. PHSKC has alerted medical and social service providers and the public about the outbreak, expanded HIV testing among persons who inject drugs or who are living homeless, and is working to increase the availability of clinical and prevention services in the geographic area of the outbreak. This outbreak highlights the vulnerability of persons who inject drugs, particularly those who also are living homeless, to outbreaks of HIV infection, even in areas with high levels of viral suppression and large syringe services programs (SSPs).

Investigation and Findings

Cluster cases met one or more of the following criteria: 1) HIV infection diagnosis in a woman or MSW in 2018, with partner services data indicating sex or sharing injection-drug equipment with a person in a previously identified cluster case; 2) HIV infection diagnosis in 2018 in a woman or MSW living homeless in the outbreak area; 3) molecular analysis indicating HIV infection with a strain related to those identified among persons meeting either of the first two criteria (HIV-TRACE genetic distance ≤1.5%) (*2*). Cases were excluded if molecular analysis indicated infection with an HIV strain unrelated to the cluster.

In July 2018, an MSW living homeless in north Seattle tested positive for acute HIV infection (HIV Ag/Ab positive, Geenius HIV negative, HIV RNA positive) at an emergency department (ED) after being evaluated with fever (patient 6) (Table 1). He did not report injecting drugs, but had paid a woman for sex. That woman was living homeless in the area, injected heroin, and had tested HIV-positive in June (patient 5). A social media search performed by a public health disease intervention specialist linked her to a man who injected drugs and was living homeless who had tested HIV-positive in July (patient 7). PHSKC was aware of three other recently diagnosed cases of HIV infection among women who inject drugs and were living homeless in north Seattle (patients 1, 2, and 3); none of these women had known epidemiologic links to other recently diagnosed cases. Subsequent molecular analyses conducted with HIV TRACE (*2*), a program that uses HIV genotypes to identify cases with related HIV strains based on HIV genetic sequence data, confirmed that four of the recently diagnosed cases in women and MSW who inject drugs, including the three without known epidemiologic links to other 2018 diagnoses, were infected with related HIV strains (patients 1–4). Molecular analysis also linked the seven recently diagnosed cases to eight cases diagnosed during 2008–2017 (patients 15–21 and 23) and two cases identified in September 2018 (patients 11 and 12). As of November 20, 2018, the cluster included 23 cases (Figure) (Table 2), 14 of which were diagnosed in 2018, demonstrating that transmission was at least intermittently ongoing since 2008, with evidence suggesting an acceleration in transmission during 2017–2018.

All 14 cases diagnosed in 2018 occurred in persons living homeless in an area of approximately 3 square-miles; 11 were in women who identified as cisgender, nine of whom reported exchanging sex for money or nonmonetary items, and 12 were in persons who inject drugs, 10 of whom used both heroin and methamphetamine.

Analysis of all newly reported HIV infections during January 1–November 30, 2018, identified 27 cases of HIV infection among women and MSW who inject drugs in King County. This represents a 286% increase over the seven cases diagnosed in 2017.

TABLE 1. Clinical and epidemiologic characteristics of a cluster of human immunodeficiency virus (HIV) cases among 23 persons living homeless who inject drugs and their sex partners and molecularly linked cases — Seattle, Washington, 2008–2018

Patient no.	Diagnosis quarter/yr	Gender	HIV risk factor and substance use	Reported exchange of sex	Reason for HIV testing	Date last HIV test*	Links to other cases identified through investigation	Related HIV strain	Cluster criteria†	Care status§
HIV infection diagnosed 2018										
1	Q1, 2018	F	Heroin/meth (IDU)	No	Regular testing	Q4, 2013	None	Yes	2,3	Suppressed
2	Q1, 2018	F	Heroin/meth (IDU uncertain)	No	STD symptoms	Unknown	Sex	Yes	1,2,3	In care, not suppressed
3	Q1, 2018	F	Heroin/meth (IDU)	No	Acute HIV symptoms	Never tested	None	Yes	2,3	Suppressed
4	Q2, 2018	M	Heroin (IDU); meth (smoke)	No	Hospitalized	Q1, 2017	IDU	Yes	1,2,3	In care, not suppressed
5	Q2, 2018	F	Heroin (IDU); meth (smoke)	Yes	Court-ordered testing	Unknown	Sex; IDU	ND	1,2	Out of care
6¶	Q3, 2018	M	NIR: presumed heterosexual; heroin, meth (non-IDU)	Yes	Acute HIV symptoms	Unknown	Sex	ND	1,2	In care, not suppressed
7	Q3, 2018	M	Heroin/meth (IDU)	No	Surveillance outreach testing	Unknown	Social media; IDU	ND	1,2	Out of care
8	Q3, 2018	F	Heroin (IDU); meth (smoke)	Yes	Outreach	Q4, 2017	None	ND	2	Out of care
9	Q3, 2018	F	Heroin (IDU); meth (smoke)	Yes	Outreach	Q4, 2016	None	ND	2	Suppressed
10	Q3, 2018	F	Unknown drugs (IDU)	Yes	Acute HIV symptoms	Unknown	No interview	ND	2	Out of care
11	Q3, 2018	F	Meth (IDU)	Yes	ED screening	Q1, 2018	No interview	Yes	2,3	In care, not suppressed
12	Q3, 2018	F	Heterosexual	Yes	Outreach	Q3, 2018	Sex	Yes	2,3	Suppressed
13	Q4, 2018	F	Heroin (IDU); meth (unknown route)	Yes	Mobile clinic	Q4, 2013	No interview	ND	2	In care, not suppressed
14	Q4, 2018	F	Meth (IDU)	Yes	Outreach	Q1, 2018	No interview	ND	2	Out of care
HIV infection diagnosed 2008–2017										
15	Q1, 2008	F	Heterosexual	Unknown	Unknown	Q1, 2006	No interview	Yes	3	Deceased
16	Q2, 2008	M	Unknown drugs (IDU)	Unknown	Unknown	Unknown	None	Yes	3	Deceased
17	Q3, 2011	M	NIR; Unknown drug use	Unknown	Unknown	2009	Sex	Yes	1,3	Out of care
18	Q3, 2014	F	NIR; history of IDU (none recently)	No	Acute HIV symptoms	2000	None	Yes	3	In care, not suppressed
19	Q4, 2016	F	Heroin (IDU); crack cocaine	Yes	HIV-unrelated infection	Q4, 2008	None	Yes	3	Suppressed
20	Q4, 2016	M	Heroin/meth (IDU)	Unknown	Unknown	2014	No interview	Yes	3	Suppressed
21	Q4, 2016	F	Unknown drugs (IDU)	Unknown	Unknown	Unknown	Sex	Yes	1,3	Suppressed
22	Q2, 2017	M	Heterosexual; unknown drug use	Unknown	Unknown	Unknown	Sex	ND	1	Out of care
23	Q4, 2017	F	Heroin (IDU); meth (unknown route)	No	Regular testing	Unknown	None	Yes	3	Suppressed

Abbreviations: ED = emergency department; F = female; IDU = injection drug use; M = male; Meth = methamphetamine; MSW = men who have sex with women; ND = no data available; NIR = no identified risk; Q = quarter.

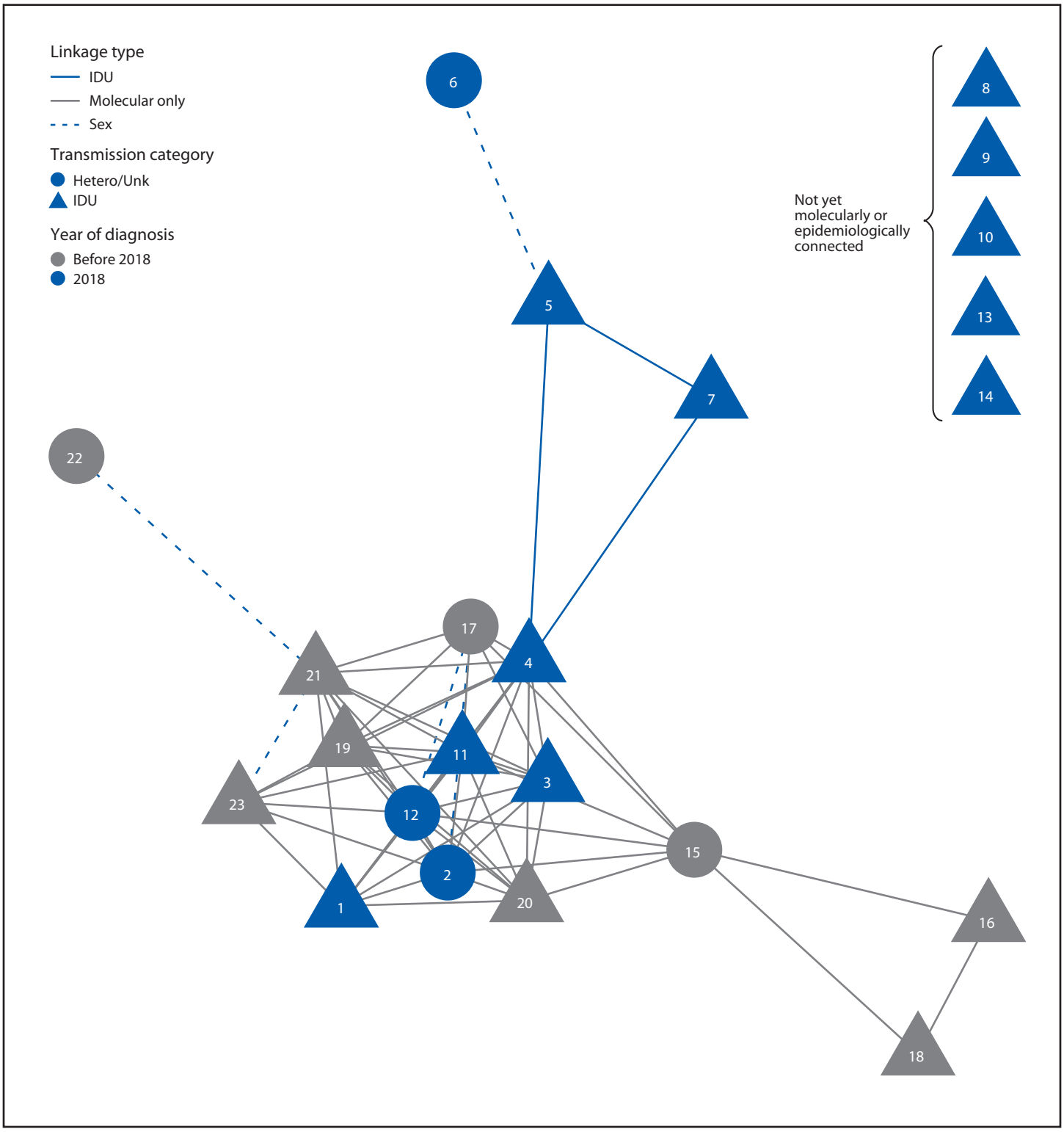
* Most recent test based on patient self-report or verified result from medical record. Quarter not specified when unknown.

† Cluster criteria: 1 = HIV infection diagnosis in a woman or MSW in 2018, with partner services data indicating sex or sharing injection-drug equipment with a previously identified cluster case; 2 = HIV infection diagnosis in 2018 in a woman or MSW living homeless in the outbreak area; 3 = molecular analysis indicating HIV infection with a strain related to those identified among persons meeting either of the first two criteria (HIV-TRACE genetic distance ≤1.5%). Cases were excluded if molecular analysis indicated infection with an HIV strain unrelated to the cluster.

§ Suppression (<200 copies of HIV RNA/mL of blood) based on most recent HIV RNA test result performed during September 1, 2017–September 17, 2018.

¶ Index case for cluster.

FIGURE. Human immunodeficiency virus (HIV) transmission network among heterosexual men and women who inject drugs,* by linkage type,† transmission category, and year of diagnosis — Seattle, Washington, 2008–2018



Abbreviations: Hetero/Unk = heterosexual/unknown; IDU = injection drug use.
* N = 23; includes sex partners of persons who inject drugs and those with a molecularly linked HIV strain.
† Molecular linkages do not necessarily indicate a direct epidemiologic connection between two cases, and line lengths are not reflective of the degree of relatedness of each molecular linkage.

TABLE 2. Demographic and behavioral characteristics of 23 persons living homeless who inject drugs and their sex partners and molecularly linked cases in a cluster of human immunodeficiency virus (HIV) transmission — Seattle, Washington, 2008–2018

Characteristic	No. (%)	
	2018 cases (n = 14)	All cases (n = 23)
Median age (range) (yrs)	**39 (22–61)**	**39 (21–65)**
Race/Ethnicity		
White, non-Hispanic	11 (78)	17 (74)
Black, non-Hispanic	2 (14)	2 (9)
Latino	0 (—)	2 (9)
Multiracial	1 (7)	2 (9)
Gender		
Female	11 (79)	16 (70)
Male	3 (21)	7 (30)
HIV risk factor		
Injection drug use	12 (86)	16 (70)
Heterosexual	1 (7)	3 (13)
No identified risk	1 (7)	3 (13)
Drug use		
Heroin and methamphetamine	10 (71)	12 (52)
Heroin without methamphetamine	0 (—)	1 (4)
Methamphetamine without heroin	2 (14)	2 (8)
None	1 (7)	3 (13)
Injection drug use of unknown drug	1 (7)	3 (13)
Unknown	0 (—)	2 (9)
Women who exchange sex*	**9 (82)**	**10 (73)**

* Includes data from all 11 women with diagnoses in 2018 and 14 of 16 women in the entire cluster.

Public Health Response

On August 3, 2018, a PHSKC disease intervention specialist identified epidemiologic links among patients 5, 6, and 7. Four days later, the health department issued an alert to medical and social service providers concerning the cluster and the increase in HIV diagnoses among persons who inject drugs and who are living homeless. The HIV/Sexually Transmitted Diseases program also contacted several local EDs and the hospital closest to where the patients lived. These EDs have asked providers to increase screening of persons who inject drugs and persons who are living homeless, and at least three are developing more systematic, risk-based opt-out HIV screening programs. To date, ED screening has identified one case of HIV infection (patient 11). On August 20, the King County Jail expanded HIV testing, including opt-out testing at health assessments at 10–14 days and, when resources permit, at time of jail booking. This effort has identified one new case of HIV infection, which has not been linked to the cluster. PHSKC also initiated an expanded program of outreach testing, condom distribution, and syringe services among persons living homeless in north Seattle. As of November 15, 2018, that initiative had tested 534 persons and identified four related cases of HIV infection (patients 8, 9, 12, and 14).

Summary

What is already known about this topic?

Although diagnoses of human immunodeficiency virus (HIV) infection among persons who inject drugs in the United States are declining, an HIV outbreak among such persons in rural Indiana demonstrated that population's vulnerability to HIV infection.

What is added by this report?

In 2018, disease investigation and molecular HIV surveillance in Seattle, Washington, identified 14 related HIV diagnoses among heterosexuals who were living homeless, most of whom injected drugs. From 2017 to mid-November 2018, the number of HIV diagnoses among heterosexuals in King County, Washington, who inject drugs increased 286%.

What are the implications for public health practice?

Persons who inject drugs, particularly those living homeless, remain vulnerable to outbreaks of HIV infection, even in cities with large HIV prevention programs and shrinking HIV epidemics.

PHSKC is increasing access to HIV testing and preexposure prophylaxis (PrEP) among persons who inject drugs through its sexually transmitted disease clinic and SSPs and via a collaboration with a mobile clinic serving north Seattle women who exchange sex or are living homeless. PHSKC is also conducting a rapid assessment to define the medical and social service needs and preferences of persons who inject drugs or who are living homeless in north Seattle with the goal of expanding services, including medication-assisted treatment. Investigations of this cluster and efforts to link infected persons to care are ongoing.

Discussion

This report describes an outbreak of HIV infection in a population of women and MSW who inject drugs and the sex partners of these persons. The outbreak was part of a cluster of 23 persons, nine of whom received a diagnosis of HIV during 2008–2017. The data suggest that HIV transmission from persons with these earlier diagnoses, some of whom were not virally suppressed, or from their sex partners without a diagnosis, led to a rapid expansion of transmission during 2017–2018, with 14 related infections diagnosed in 2018 in a small geographic area.

The occurrence of a large HIV outbreak in Indiana in 2014–2015 (*1*) highlighted the vulnerability of rural communities with few HIV prevention and medical services to HIV outbreaks among persons who inject drugs. Subsequent CDC analyses sought to identify the 5% of U.S. counties with the highest risk for HIV and hepatitis C virus outbreaks among persons who inject drugs (*3*). King County, Washington, was not among those highest-risk counties. PHSKC estimates that 93% of county residents with HIV infection know their HIV

status and that 85% of persons with diagnosed infection were virally suppressed in 2017 (<200 copies of HIV RNA/mL of blood) (*4*). The rate of new diagnoses of HIV infection in King County declined 51% from 2008 to 2017 (PHSKC, unpublished data, 2019). PHSKC SSPs provided >7 million syringes to persons who inject drugs in 2017; 79% of persons who inject drugs report using SSPs, and syringe sharing among persons who inject drugs has declined over time (*5*). Only 1%–3% of the approximately 21,000 women and MSW who inject drugs in the county have HIV infection, and 80% of those with a diagnosis are virally suppressed (*4*). Despite these successes, the current outbreak, similar to a recent outbreak in Massachusetts, demonstrates that vulnerability to outbreaks of HIV infection among persons who inject drugs is widespread in the United States (*6*).

The outbreak described here is part of a larger increase in HIV infection among heterosexual persons who inject drugs that is ongoing in King County. During 2018, the county experienced a nearly threefold increase in new HIV infections among women and MSW who inject drugs. Several factors might contribute to King County's vulnerability. First, although access to HIV care and prevention in the county is generally good, this outbreak was concentrated in an area where syringe and clinical services for persons who inject drugs are limited, highlighting the need to expand access. Second, like much of the United States, King County faces growing epidemics of opioid overdose and homelessness. From 2007 to 2018, the number of heroin overdose deaths in the county increased 264% (*7*), and from 2007 to 2017, the number of country residents living homeless increased 47% (*8*). Among SSP users surveyed in 2017, 43% were living homeless, and an additional 26% were unstably housed, a 19% increase from 2015 (*4*). Thus, the area has a rapidly growing population who inject drugs and are living homeless, a group for whom accessing services is particularly difficult. These factors have resulted in a new population-level susceptibility to HIV transmission.

The King County outbreak also illustrates both the value and limitations of disease intervention specialist investigations and molecular HIV analyses. Disease intervention specialists initially identified the outbreak, and PHSKC and the Washington State Department of Health used molecular analyses to recognize related cases not identified through disease investigation and to confirm relationships suggested by epidemiologic linkages. Retrospective review of the molecular data demonstrated that 10 related cases (eight with genetic sequence data available) were diagnosed from December 2016 to August 2018, when the cluster was first identified. Had the molecular data been available and analyzed more quickly, it might have been possible to respond earlier, possibly averting some cases. CDC recently initiated a national effort to expand the use of molecular HIV analyses to identify growing clusters of cases (*9*). The experience described here suggests how such analyses might be useful if they were available and analyzed in real time with appropriate thresholds for action.

Finally, the King County outbreak demonstrates how difficult it is to engage the most socially marginalized persons with medical care. As of mid-November 2018, seven of the 21 living persons in the cluster were not receiving HIV care. Disease intervention specialists are actively seeking these persons to link them to a clinic that provides walk-in HIV medical care (*10*).

Persons who inject drugs remain vulnerable to outbreaks of HIV infection, even in cities with large HIV prevention programs and shrinking HIV epidemics. A new U.S. Department of Health and Human Services initiative, Ending the HIV Epidemic: A Plan for America,* defines molecular HIV surveillance and associated responses as one of four central pillars for ending the epidemic. The outbreak described in this report illustrates the benefits of integrating disease investigations and molecular HIV analyses to more rapidly and efficiently identify and respond to localized outbreaks of HIV infection and should prompt health departments in other jurisdictions to investigate whether similar outbreaks are ongoing in their areas.

* https://www.hhs.gov/blog/2019/02/05/ending-the-hiv-epidemic-a-plan-for-america.html.

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Prevalence of Violence Victimization and Perpetration Among Persons Aged 13–24 Years — Four Sub-Saharan African Countries, 2013–2015

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Violence is a major public health and human rights concern, claiming over 1.3 million lives globally each year (*1*). Despite the scope of this problem, population-based data on physical and sexual violence perpetration are scarce, particularly in low-income and middle-income countries (*2*,*3*). To better understand factors driving both children becoming victims of physical or sexual violence and subsequently (as adults) becoming perpetrators, CDC collaborated with four countries in sub-Saharan Africa (Malawi, Nigeria, Uganda, and Zambia) to conduct national household surveys of persons aged 13–24 years to measure experiences of violence victimization in childhood and subsequent perpetration of physical or sexual violence. Perpetration of physical or sexual violence was prevalent among both males and females, ranging among males from 29.5% in Nigeria to 51.5% in Malawi and among females from 15.3% in Zambia to 28.4% in Uganda. Experiencing physical, sexual, or emotional violence in childhood was the strongest predictor for perpetrating violence; a graded dose-response relationship emerged between the number of types of childhood violence experienced (i.e., physical, sexual, and emotional) and perpetration of violence. Efforts to prevent violence victimization need to begin early, requiring investment in the prevention of childhood violence and interventions to mitigate the negative effects of violence experienced by children.

From 2013 to 2015, CDC collaborated with Together for Girls* and the governments of Malawi, Nigeria, Uganda, and Zambia to plan and implement Violence Against Children Surveys, which are nationally representative, multistage cluster surveys of adolescents and young adults aged 13–24 years. Surveys were administered via household, face-to-face interviews by host country interviewers trained by CDC and host country partners. Informed consent or assent was obtained for all participants. Multiple safeguards were incorporated into study protocols to protect the confidentiality and safety of participants, including provision of a list of available services for all participants and direct referral to social services for any victims requesting aid.† Study protocols were approved by host country and CDC institutional review boards.

This analysis examines lifetime perpetration of physical or sexual violence among persons of both sexes aged 13–24 years. Physical violence perpetration included ever punching, kicking, whipping, beating, choking, smothering, threatening with a weapon, attempting to drown, or intentionally burning another person. Sexual violence perpetration included forcing nonconsensual sexual intercourse or any other sex acts on another person. In Nigeria, Uganda, and Zambia, sex was defined as vaginal/anal penetration by the penis, hands, fingers, mouth, or objects, or oral penetration by the penis. In Malawi, sex was defined as vaginal, oral, or anal sex or the insertion of an object into an anus or vagina. Prevalence of physical and sexual violence was stratified by perpetration against an intimate partner versus a nonpartner.

Childhood experiences of violence victimization were also examined. Physical violence victimization was defined as ever being punched, kicked, whipped, beaten, choked, smothered, threatened with a weapon, held under water (attempted drowning), or intentionally burned by any person before age 18 years. Emotional violence victimization was defined as ever being told by one's parents or caregivers that he or she was not loved, that they wished he or she had never been born, or he or she was ridiculed or belittled before age 18 years. Sexual violence victimization was defined as unwanted sexual touching, unwanted attempted sex, physically forced sex, or pressured sex by any person.

Questionnaires for all countries included identical questions regarding perpetration of violence, demographics, and potential risk factors, such as experiences of violence in childhood and educational status. Questionnaires were administered in local languages appropriate to each of the four countries (Malawi: Chichewa and Tumbuka; Nigeria: English, Hausa, Igbo, and Yoruba; Uganda: English, Ateso-Karamajong, Luganda, Lugbara, Luo, Swahili, Runyankole-Rukiga, and Runyoro-Rutoro; and Zambia: English, Bemba, Kaonde, Lozi, Lunda, Luvale, Nyanja, and Tonga). The English survey instrument was translated into local languages, back-translated into English, and cross-validated by a language translation team prior to administration. In addition, the questionnaire was piloted in each country to ensure that the intent of questions was consistent after translation. Weighted percentages of participants reporting lifetime perpetration of physical or

* Together for Girls is a public-private partnership comprising host country governments, the United Nations Children's Fund, the President's Emergency Plan for AIDS Relief, and other organizations. https://www.togetherforgirls.org.
† https://www.cdc.gov/violenceprevention/pdf/vacs/VACS-trainingwhitepaper.pdf.

sexual violence were calculated for each independent variable. Logistic regression models were used to identify predictors of violence perpetration, adjusting for age at time of survey, marital status, sex, educational status, and experiencing any violence in childhood. To identify independent predictors of perpetration, adjusted models included all significant ($p<0.05$) factors in unadjusted analyses. Each type of childhood violence was entered in the model separately because of significant collinearity among types of violence. Analyses and data visualizations were conducted using SAS (version 9.4; SAS Institute).

Prevalence of violence perpetration varied by type of violence and country (Table 1). Perpetration of physical violence was more common than sexual violence in all four countries and occurred among both males and females. Perpetration of physical violence was more prevalent among youths in Uganda; 46.2% of males and 26.8% of females in Uganda reported ever perpetrating physical violence against another person. Physical violence against a nonpartner was more common than against an intimate partner in all countries. In contrast, sexual violence was more commonly perpetrated against an intimate partner. Perpetration of sexual violence was most prevalent among males in Malawi; more than one in four (26.6%) males in Malawi reported perpetrating forced sex.

Among respondents in all four countries, males and victims of childhood violence had consistently higher odds of perpetrating physical or sexual violence (Table 2). In all countries, being a victim of childhood violence was the strongest independent predictor of being a perpetrator of violence. In all countries, the adjusted odds ratio (aOR) for perpetrating violence was more than five times higher (aOR range = 5.4–7.0) for victims of childhood violence, compared with those who had not experienced violence in childhood. Experiencing physical violence in childhood was associated with the highest odds of perpetrating any form of violence in all countries (aOR range = 2.8–6.4). Experiencing childhood sexual or physical violence was consistently associated with similar types of violence perpetration across all countries when stratified by sex.

A dose-response relationship between the number of types of violence experienced in childhood and adjusted odds of perpetrating violence was observed for all countries (Figure). For example, in Zambia, persons who experienced physical, emotional, and sexual violence before age 18 years were approximately 20 times more likely to perpetrate violence than were persons who did not experience any form of violence (aOR = 19.8, 95% confidence interval = 9.0–43.6).

TABLE 1. Prevalence of physical and sexual violence perpetration among persons aged 13–24 years, by sex and type of violence — Malawi, Nigeria, Uganda, and Zambia, 2013–2015

	Weighted % (95% CI)	
Country (survey year)/Violence type	**Males**	**Females**
Malawi (2013) N = 1,553		
Any physical violence	38.6 (33.3–43.8)	23.1 (16.0–30.2)
Physical violence against an intimate partner	8.0 (5.7–10.3)	7.6 (3.2–12.0)
Physical violence against other	34.1 (29.0–39.1)	17.7 (13.3–22.1)
Any forced sex	26.6 (21.9–31.3)	5.9 (1.8–10.1)
Forced sex against an intimate partner	24.5 (19.9–29.2)	4.6 (2.1–7.1)
Forced sex against other	7.5 (5.4–9.7)	2.8 (0.0–7.0)
Any physical or sexual violence	51.5 (46.1–57.0)	25.6 (18.7–32.6)
Nigeria (2014) N = 2,464		
Any physical violence	24.8 (21.3–28.4)	19.0 (15.1–22.8)
Physical violence against an intimate partner	13.5 (10.8–16.0)	6.3 (4.5–8.2)
Physical violence against other	18.1 (15.0–21.2)	13.8 (10.5–17.0)
Any forced sex	8.5 (6.1–10.9)	1.5 (0.8–2.3)
Forced sex against an intimate partner	6.4 (4.4–8.5)	1.2 (0.5–1.9)
Forced sex against other	3.3 (1.8–4.8)	0.7 (0.2–1.2)
Any physical or sexual violence	29.5 (25.5–33.5)	19.9 (16.1–23.7)
Uganda (2015) N = 3,875		
Any physical violence	46.2 (43.3–49.1)	26.8 (22.5–31.0)
Physical violence against an intimate partner	18.7 (16.3–21.1)	7.6 (5.1–10.0)
Physical violence against other	37.7 (35.0–40.5)	22.9 (19.0–26.9)
Any forced sex	11.7 (9.8–13.6)	2.1 (1.1–3.1)
Forced sex against an intimate partner	9.5 (7.6–11.3)	2.1 (1.1–3.1)
Forced sex against other	4.7 (3.6–5.8)	0.1 (0.0–0.3)
Any physical or sexual violence	50.6 (47.8–53.5)	28.4 (24.1–32.6)
Zambia (2014) N = 1,170		
Any physical violence	23.7 (19.5–28.0)	12.5 (9.3–15.7)
Physical violence against an intimate partner	13.9 (10.4–17.4)	7.4 (5.0–9.9)
Physical violence against other	17.9 (14.1–21.7)	7.5 (5.0–10.0)
Any forced sex	14.6 (10.5–18.7)	3.5 (1.6–5.5)
Forced sex against an intimate partner	12.0 (8.3–15.8)	3.1 (1.2–5.0)
Forced sex against other	6.7 (4.2–9.2)	1.7 (0.1–3.2)
Any physical or sexual violence	32.8 (28.1–37.6)	15.3 (12.1–18.6)

Abbreviation: CI = confidence interval.

Discussion

Perpetration of violence is common among both males and females in Malawi, Nigeria, Uganda, and Zambia. Strong associations between youths' experiences of violence and subsequent perpetration of physical or sexual violence were observed in all four studied countries. The dose-response relationship observed between the number of types of violence experienced in childhood and the odds of perpetrating violence highlights the importance of interrupting the cycle of violence early in life.

Previous population-based studies of men in Brazil, Chile, Croatia, India, Mexico, Rwanda, and South Africa estimated lifetime prevalence of physical intimate partner violence perpetration at 24%–42% (*4*,*5*). Accurately quantifying and addressing perpetration of violence is a critical first step to reducing such violence, along with its associated consequences, such as transmission of human immunodeficiency virus (*6*,*7*).

Associations between experiences of physical, sexual, and emotional violence during childhood and subsequent perpetration of violence are consistent with a growing body of research

TABLE 2. Prevalence and adjusted odds ratios for physical and sexual violence perpetration among persons aged 13–24 years, by risk factors for perpetrating violence — Malawi, Nigeria, Uganda, and Zambia, 2013–2015

Country (survey year)/Risk factor	Ever perpetrated physical or sexual violence, weighted % (95% CI)	Chi-square p-value	OR (95% CI)	Adjusted OR (95% CI)
Malawi* (2013) N = 1,553				
Age at time of survey (yrs)				
13–17	51.4 (43.5–59.4)	<0.001	2.3 (1.6–3.3)	1.4 (0.9–2.3)
18–24	31.3 (25.8–36.9)		1.0 (Ref)	1.0 (Ref)
Marital status				
Ever married or living as married	25.8 (20.4–31.1)	<0.001	0.4 (0.3–0.5)	0.8 (0.5–1.2)
Never married	47.6 (41.9–53.3)		1.0 (Ref)	1.0 (Ref)
Education				
Primary education or less	36.6 (30.5–42.7)	0.38	0.8 (0.6–1.2)	—
Secondary or more	40.6 (33.4–47.8)		1.0 (Ref)	
Sex				
Male	51.5 (46.1–57.0)	<0.001	3.1 (2.0–4.7)	2.6 (1.6–4.3)
Female	25.6 (18.7–32.6)		1.0 (Ref)	1.0 (Ref)
Victim of any violence in childhood†				
Yes	45.5 (39.9–51.1)	<0.001	8.4 (5.1–13.8)	7.0 (4.1–12.0)
No	9.1 (5.1–13.0)		1.0 (Ref)	1.0 (Ref)
Victim of sexual violence in childhood				
Yes	47.8 (37.2–58.4)	0.01	1.9 (1.2–3.1)	2.6 (1.5–4.4)§
No	32.6 (27.2–38.0)		1.0 (Ref)	1.0 (Ref)
Victim of physical violence in childhood				
Yes	46.0 (41.0–51.0)	<0.001	3.8 (2.4–6.1)	2.8 (1.7–4.5)
No	18.2 (11.0–25.5)		1.0 (Ref)	1.0 (Ref)
Victim of emotional violence in childhood				
Yes	55.7 (50.0–61.4)	<0.001	2.9 (2.1–4.0)	2.5 (1.8–3.4)
No	30.0 (24.6–35.4)		1.0 (Ref)	1.0 (Ref)
Nigeria¶ (2014) N = 2,464				
Age at time of survey (yrs)				
13–17	32.8 (27.8–37.9)	<0.001	1.9 (1.4–2.4)	1.7 (1.2–2.2)
18–24	20.8 (17.8–23.7)		1.0 (Ref)	1.0 (Ref)
Marital status				
Ever married or living as married	15.5 (12.3–18.7)	<0.001	0.4 (0.3–0.6)	0.6 (0.5–0.9)
Never married	29.5 (26.0–33.1)		1.0 (Ref)	1.0 (Ref)
Education				
Primary education or less	19.2 (14.6–23.7)	0.01	0.7 (0.5–0.9)	1.0 (0.7–1.4)
Secondary or more	26.6 (23.2–30.0)		1.0 (Ref)	1.0 (Ref)
Sex				
Male	29.5 (25.5–33.5)	<0.001	1.7 (1.2–2.3)	1.5 (1.1–2.1)
Female	19.9 (16.1–23.7)		1.0 (Ref)	1.0 (Ref)
Victim of any violence in childhood				
Yes	31.4 (27.8–35.0)	<0.001	7.3 (4.9–10.8)	6.6 (4.4–9.8)
No	5.9 (3.9–7.9)		1.0 (Ref)	1.0 (Ref)
Victim of sexual violence in childhood				
Yes	31.2 (26.2–36.2)	<0.001	1.6 (1.3–2.2)	1.7 (1.3–2.2)
No	21.6 (18.5–24.6)		1.0 (Ref)	1.0 (Ref)
Victim of physical violence in childhood				
Yes	34.7 (30.7–38.7)	<0.001	5.7 (4.2–7.8)	5.2 (3.8–7.1)
No	8.5 (6.4–10.6)		1.0 (Ref)	1.0 (Ref)
Victim of emotional violence in childhood				
Yes	35.7 (30.6–40.7)	<0.001	2.1 (1.7–2.8)	1.9 (1.4–2.5)
No	20.6 (17.5–23.6)		1.0 (Ref)	1.0 (Ref)

See table footnotes on next page.

TABLE 2. (*Continued*) Prevalence and adjusted odds ratios for physical and sexual violence perpetration among persons aged 13–24 years, by risk factors for perpetrating violence — Malawi, Nigeria, Uganda, and Zambia, 2013–2015

Country (survey year)/Risk factor	Ever perpetrated physical or sexual violence, weighted % (95% CI)	Chi-square p-value	OR (95% CI)	Adjusted OR (95% CI)
Uganda (2015) N = 3,875**				
Age at time of survey (yrs)				
13–17	57.6 (53.3–62.0)	<0.001	3.1 (2.5–3.8)	2.2 (1.7–2.8)
18–24	30.8 (27.5–34.1)		1.0 (Ref)	1.0 (Ref)
Marital status				
Ever married or living as married	28.9 (25.3–32.4)	<0.001	0.4 (0.4–0.6)	0.9 (0.7–1.2)
Never married	47.7 (43.7–51.7)		1.0 (Ref)	1.0 (Ref)
Education				
Primary education or less	36.7 (31.5–41.8)	0.35	1.1 (0.9–1.4)	—
Secondary or more	39.4 (36.1–42.6)		1.0 (Ref)	
Sex				
Male	50.6 (47.8–53.5)	<0.001	2.6 (2.0–3.3)	2.5 (1.9–3.2)
Female	28.4 (24.1–32.6)		1.0 (Ref)	1.0 (Ref)
Victim of any violence in childhood				
Yes	43.8 (40.6–47.1)	<0.001	7.1 (5.1–9.9)	6.5 (4.7–8.9)
No	10.3 (7.2–13.5)		1.0 (Ref)	1.0 (Ref)
Victim of sexual violence in childhood				
Yes	40.6 (35.0–46.1)	0.31	1.1 (0.9–1.5)	1.3 (1.0–1.7)
No	37.3 (33.9–40.7)		1.0 (Ref)	1.0 (Ref)
Victim of physical violence in childhood				
Yes	48.7 (45.2–52.2)	<0.001	7.6 (5.7–10.2)	6.4 (4.8–8.5)
No	11.1 (8.4–13.9)		1.0 (Ref)	1.0 (Ref)
Victim of emotional violence in childhood				
Yes	47.7 (43.2–52.3)	<0.001	2.0 (1.6–2.4)	1.9 (1.5–2.3)
No	31.7 (28.4–35.0)		1.0 (Ref)	1.0 (Ref)
Zambia†† (2014) N = 1,170				
Age at time of survey (yrs)				
13–17	27.2 (21.1–33.2)	0.07	1.4 (1.0–2.0)	1.1 (0.7–1.8)
18–24	21.1 (17.8–24.4)		1.0 (Ref)	1.0 (Ref)
Marital status				
Ever married or living as married	17.3 (13.4–21.1)	0.001	0.6 (0.4–0.8)	0.9 (0.6–1.4)
Never married	26.8 (22.5–31.0)		1.0 (Ref)	1.0 (Ref)
Education				
Primary education or less	19.5 (15.3–23.7)	0.05	0.7 (0.5–1.0)	0.8 (0.5–1.1)
Secondary or more	25.6 (21.3–29.9)		1.0 (Ref)	1.0 (Ref)
Sex				
Male	32.8 (28.1–37.6)	<0.001	2.7 (1.9–3.8)	2.5 (1.8–3.6)
Female	15.3 (12.1–18.6)		1.0 (Ref)	1.0 (Ref)
Victim of any violence in childhood				
Yes	31.6 (27.5–35.7)	<0.001	5.4 (3.4–8.6)	5.4 (3.4–8.6)
No	7.9 (4.9–10.9)		1.0 (Ref)	1.0 (Ref)
Victim of sexual violence in childhood				
Yes	32.5 (26.0–39.0)	<0.001	1.9 (1.3–2.8)	2.6 (1.8–3.9)§§
No	19.8 (16.4–23.3)		1.0 (Ref)	1.0 (Ref)
Victim of physical violence in childhood				
Yes	37.0 (31.8–42.3)	<0.001	5.1 (3.5–7.5)	4.9 (3.3–7.2)
No	10.3 (7.5–13.2)		1.0 (Ref)	1.0 (Ref)
Victim of emotional violence in childhood				
Yes	42.4 (34.5–50.2)	<0.001	3.6 (2.4–5.4)	3.4 (2.3–5.1)
No	16.8 (13.8–19.7)		1.0 (Ref)	1.0 (Ref)

Abbreviations: CI = confidence interval; OR = odds ratio; Ref = referent.

* Malawi model included age at time of survey, marital status, and sex. Effect measure modification between sex, age, and sexual violence was observed for Malawi; pooled results are provided.

† For all four countries, violence victimization was defined as ever experiencing any physical, sexual, or emotional violence at age <18 years.

§ Stratified adjusted ORs: females: 2.3 (0.9–5.9), males: 3.1 (1.8–5.2); age 13–17 years: 1.4 (0.8–2.5), age 18–24 years: 3.9 (2.0–7.6).

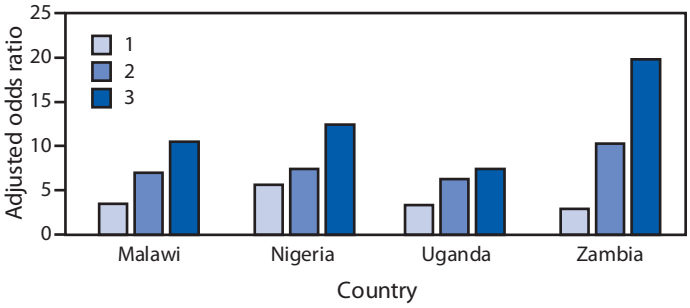
¶ Nigeria model included age at time of survey, marital status, educational status, and sex.

** Uganda model included age at time of survey, marital status, and sex.

†† Zambia model included age at time of survey, marital status, educational status, and sex. Effect measure modification between sex and sexual violence was observed for Zambia; pooled results are provided.

§§ Stratified adjusted ORs: females, 2.2 (1.3–3.8); males, 3.1 (1.8–5.5).

FIGURE. Adjusted odds ratios for perpetrating violence based on the number of types of violence* experienced in childhood,† among persons aged 13–24 years — four sub-Saharan African countries,§ 2013–2015



* The three types of violence analyzed were physical, sexual, and emotional violence. The referent was experiencing zero types of violence.
† Experienced at age <18 years.
§ The Malawi model included age at time of survey, marital status, sex, and victim of violence in childhood status; the Nigeria model included age at time of survey, marital status, educational status, sex, and victim of violence in childhood status; the Uganda model included age at time of survey, marital status, sex, and victim of violence in childhood status; the Zambia model included age at time of survey, marital status, educational status, sex, and victim of violence in childhood status.

Summary

What is already known about this topic?

Violence against children is a public health issue with important consequences, including the subsequent potential perpetration of violence by victims.

What is added by this report?

Analysis of data from Violence Against Children Surveys in four sub-Saharan African countries found that the prevalence of violence perpetration ranged among males from 29.5% in Nigeria to 51.5% in Malawi and among females from 15.3% in Zambia to 28.4% in Uganda. In all countries, a strong dose-response relationship was observed between the number of types of childhood violence experienced and odds of perpetrating violence.

What are the implications for public health practice?

The strong association between experiencing violence in childhood and later perpetration of violence highlights the importance of long-term, comprehensive interventions for both victims and perpetrators.

linking adverse childhood experiences with later perpetration of criminal violence, child abuse, and intimate partner violence (*8*,*9*). Understanding the risk factors for perpetration is integral to combating violence, particularly in stopping the transmission cycle of violence. Efforts to prevent future violence must include both strategies to prevent perpetration and interventions to counteract the negative effects of physical, sexual, and emotional violence among victims. Improved data and information on what factors buffer victims of violence from potential adverse consequences can inform the development and evaluation of programs and policies to interrupt the intergenerational cycle of violence.

The findings in this report are subject to at least five limitations. First, this was a cross-sectional study, and causality between violence victimization and perpetration cannot be established. Second, data were self-reported, and recall bias might be present, particularly for remote episodes of abuse. Third, limited disclosure might have occurred because of the sensitive nature of the survey, particularly questions asking about perpetration. Fourth, surveys did not assess the frequency of violent acts committed by perpetrators or the interval between victimization and perpetration; future studies of the links between victimization and perpetration could benefit from inclusion of this information. Finally, persons not living in households (e.g., street children, children living in institutions, or students living in dormitories) were not included in this analysis; therefore, these findings might not be generalizable.

The strong association between experiencing physical, sexual, or emotional violence in childhood and later perpetration of violence highlights the importance of long-term, comprehensive interventions for both victims and perpetrators. Potential strategies include improved access to therapeutic services and counseling, support and education of parents, reduction of community violence, and improving gender equity (*10*). In addition, the unique results observed for different countries emphasize the need for country-specific data to respond directly to countries' distinct patterns and drivers of violence. Although violence perpetration is common among both males and females, it is preventable. INSPIRE is a technical package that aids countries in identifying evidence-based programs and policies to prevent and respond to violence against children (*10*). Early intervention is critical to preventing the adverse effects of violence victimization.

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Notes from the Field

Six Cases of Acute Flaccid Myelitis in Children — Minnesota, 2018

Heidi Moline, MD[1]; Anupama Kalaskar, MD[2]; William F. Pomputius III, MD[2]; Adriana Lopez, MHS[3]; Janell Routh, MD[3]; Cynthia Kenyon, MPH[4]; Jayne Griffith, MA, MPH[4]

During September 14–October 1, 2018, the Minnesota Department of Health (MDH) was notified of six children hospitalized in the Minneapolis-St. Paul region with symptoms consistent with acute flaccid myelitis (AFM). A confirmed case of AFM is defined as acute onset of flaccid limb weakness with magnetic resonance image indicating spinal cord lesions largely restricted to gray matter and spanning one or more vertebral segments (*1*). All six cases were confirmed by CDC. After a cluster of three cases occurred in 2014, an average of fewer than one AFM case per year had been reported to MDH.

Among the six patients, the median patient age was 6.0 years (range = 1.3–9.2 years). All children resided in different Minnesota counties, and all experienced fever and upper respiratory signs and symptoms (e.g., rhinorrhea and cough) beginning a median of 8 days (range = 5–11 days) before weakness onset; none had a history of being immunocompromised. In addition, four patients experienced neck pain or headache, and two experienced diarrhea before weakness onset. Four patients had marked weakness of proximal muscle groups in one arm, although distal motor function was largely preserved. The other two patients initially had weakness in one leg, which became bilateral and rapidly ascended during hospitalization; both of these patients required endotracheal intubation and mechanical ventilation. In all six patients, limb weakness was first noted after waking in the morning. No epidemiologic links among patients were identified.

All six patients were hospitalized. Three patients were discharged home, and two were discharged to inpatient rehabilitation facilities. One patient remains hospitalized with complete paralysis of all voluntary muscles, including the diaphragm, at the time of this report. All discharged patients had residual weakness at time of discharge; among these patients, the median duration of hospitalization was 8 days (range = 1–14 days).

Magnetic resonance imaging (MRI) indicated spinal cord gray matter involvement in all six patients, largely in the anterior horns. The extent of gray matter involvement did not always correlate with deficits seen on physical exam; in three patients with only single limb weakness, multisegment gray matter involvement was apparent. Among all patients, three had anterior nerve root and facial nerve enhancement, and two had basilar and brainstem involvement. Three patients had normal MRI findings early in the illness course, but demonstrated extensive gray matter involvement on a subsequent MRI.

Cerebrospinal fluid (CSF) was collected in five patients, with pleocytosis (white blood cell count >5 cells/mm^3) present in two patients (Table). One CSF specimen (patient B) was positive for enterovirus (not typed) by reverse transcription–polymerase chain reaction (RT-PCR) at a commercial reference laboratory. Serum, CSF, stool, and nasopharyngeal specimens from five patients were tested at CDC. One nasopharyngeal swab (patient D) was positive for enterovirus-D68 (EV-D68) by real-time RT-PCR. One nasal wash specimen from patient B was positive for EV-D68 and a second specimen for EV-D68 and parechovirus A6 by real-time RT-PCR; CSF from this patient also was positive for EV-D68. The remaining specimens were negative, including those from three patients who had no positive specimens. All stool specimens were negative for poliovirus.

Five of six patients received some form of immunomodulatory treatment (Table). One patient was treated with steroids and plasmapheresis followed by intravenous immune globulin (IVIG), one with steroids followed by IVIG, three with only IVIG, and one with supportive care only.

This AFM cluster, the largest identified in Minnesota, occurred during a period of increased reporting of AFM nationally and is consistent with the epidemiologic and clinical characteristics of previously described AFM clusters (*2*–*6*). Despite report of upper respiratory tract signs and symptoms in all patients, testing for viruses that commonly cause upper respiratory tract infections was positive from nonsterile specimens in only two cases. EV-D68 in the CSF of patient B is considered the cause of AFM in this patient. Detection of a pathogen in the CSF might be related to the severity and prolonged nature of illness in this patient; however, host or other factors contributing to illness severity are unknown.

AFM is a rare but serious cause of sudden onset limb weakness, especially in children, and should be considered in the differential diagnosis. Diagnosis and care of patients with AFM includes early collection of specimens, including CSF, for laboratory testing, MRI scans, and consultation with neurology and infectious disease experts. Potential cases should be reported to public health departments in a timely manner. Public health classification of AFM cases involves expert review of clinical and imaging findings; however, it is important that clinical care not be delayed pending case classification.

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TABLE. Demographic characteristics, clinical findings and evaluation, hospital course, and outcome among six patients with acute flaccid myelitis — Minnesota, September–October 2018

Characteristic	Patient A	Patient B	Patient C	Patient D	Patient E	Patient F
Age	7 yrs	7 yrs	16 mos	3 yrs	9 yrs	5 yrs
Sex	Male	Female	Female	Female	Female	Female
Previous/Underlying medical conditions	None	None	Cerebral palsy, seizure disorder	Congenital cataract	None	None
Viral prodrome period	Sep 9–11	Sep 9–13	Sep 17–19	Sep 16–18	Sep 17–21	Sep 21–26
Other symptoms preceding weakness onset	Headache, vomiting, body aches	Headache	Diarrhea	Headache, neck ache, vomiting, diarrhea	None	Neck ache
Weakness onset date	Sep 14	Sep 19	Sep 22	Sep 23	Sep 24	Sep 29
Weakness site	Left arm	Left leg	Left leg	Left arm	Right arm	Right arm
Hospital admission date	Sep 20	Sep 19	Sep 22	Sep 25	Sep 28	Oct 1
Magnetic resonance Imaging findings	HD 1: Normal	HD 1: Enhancement of meninges; gray matter in thoracic cord	HD 1: Normal	HD 1: Normal	HD 1: Enhancement of gray matter in cervical and thoracic cord	HD 2: Enhancement of cervical and brainstem gray matter
	HD 7: Enhancement of cervical and brainstem anterior horn, cauda equina	HD 8: Improved thoracic cord enhancement; new cervical, cauda equina, and frontal lobe enhancement	HD 3: Enhancement of gray matter from cervical cord to cauda equine	HD 3: Extensive enhancement of cervical and thoracic anterior horn		
Cerebrospinal fluid test results	HD 1: No pleocytosis; no viral detection	HD 1: Pleocytosis; no virus detected	HD 1: Pleocytosis; no virus detected	HD 1: No pleocytosis; no virus detected	Not collected	HD 1: No pleocytosis; no virus detected
		HD 3: Pleocytosis; EV-D68 positive				
		HD 9: Pleocytosis; no virus detected				
Nasopharyngeal swab test results	HD 7: No virus detected	HD 3: EV-D68 positive	HD 1: No virus detected	HD 1: EV-D68 positive	Not collected	HD 1: No virus detected
		HD 10: EV-D68 positive; PEV-A6 positive				
Treatment	Steroids, IVIG	Plasmapheresis, steroids, IVIG	IVIG	IVIG	None	IVIG
Hospital course	Left arm and left facial weakness noted at admission; facial weakness improved; arm weakness with minimal improvement at discharge	Rapidly ascending paralysis; respiratory failure; loss of all voluntary motor function; pupillary response intact; cognitively intact; no clinical improvement	Ascending paralysis; respiratory failure; gradual improvement of weakness; persistent left leg weakness and dysphagia at discharge	Left arm and left facial weakness at admission; resolution of facial weakness; improved arm weakness at discharge	Right arm weakness at admission; mild improvement of weakness at discharge	Right arm and neck weakness at admission; improvement in neck weakness; minimal improvement of arm weakness at discharge
Discharge date	Oct 3	Not applicable	Oct 4	Oct 3	Sep 29	Oct 10
No. of days hospitalized	14	>90 (ongoing)	12	9	1	9
Discharge location	Home	Not applicable	Inpatient rehabilitation	Home	Home	Inpatient rehabilitation

Abbreviations: EV = enterovirus; HD = hospital day; IVIG = intravenous immunoglobulin; PEV = parechovirus.

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Notes from the Field

Identification of a *Triatoma sanguisuga* "Kissing Bug" — Delaware, 2018

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In July 2018, a family from Kent County, Delaware contacted the Delaware Division of Public Health (DPH) and the Delaware Department of Agriculture (DDA) to request assistance identifying an insect that had bitten their child's face while she was watching television in her bedroom during the late evening hours. The parents were concerned about possible disease transmission from the insect. Upon investigation, DPH learned that the family resided in an older single-family home near a heavily wooded area. A window air conditioning unit was located in the bedroom where the bite occurred. The family reported no recent travel outside the local area.

The insect was preliminarily identified as *Triatoma sanguisuga* (a "kissing bug") by staff members from DDA. Triatomines are blood-sucking insects that feed on animals and humans, and they have a predilection for biting the faces of humans (*1*). DPH and DDA jointly contacted Texas A&M University's Kissing Bug Citizen Science Program, a multidisciplinary research program aimed at documenting and collecting kissing bugs from across the United States.* The insect was identified based on a photograph as *Triatoma sanguisuga,* a vector that can transmit the protozoan parasite *Trypanosoma cruzi* which causes Chagas disease (*1*,*2*). Subsequently, the insect was sent to CDC, where species-level identification was morphologically confirmed. Conventional polymerase chain reaction testing of the triatomine hindgut was negative for *T. cruzi*. Bloodmeal analysis detected a human bloodmeal; the girl who was bitten had no ill effects.

This finding represents the first confirmed identification of *T. sanguisuga* in Delaware. Texas A&M had received a previous report of a suspected kissing bug in July 2017 from Kent County, Delaware. That insect was found dead with no reported human exposure. Photographic identification by Texas A&M indicated *T. sanguisuga;* however, physical inspection by a local institution in Delaware had initially identified it as a milkweed bug and destroyed it before the client contacted Texas A&M, precluding definitive identification.

Chagas disease can cause serious cardiac and gastrointestinal complications. CDC estimates that approximately 300,000 persons with Chagas disease live in the United States, and most were infected with *T. cruzi* in the parts of Latin America where Chagas disease is found. Triatomine bugs also are found in the United States, but only a few cases of Chagas disease from contact with the bugs have been documented in this country (*2*). Although presence of the vector has been confirmed in Delaware, there is no current evidence of *T. cruzi* in the state (*2*). *T. cruzi* is a zoonotic parasite that infects many mammal species and is found throughout the southern half of the United States (*2*). Even where *T. cruzi* is circulating, not all triatomine bugs are infected with the parasite. The likelihood of human *T. cruzi* infection from contact with a triatomine bug in the United States is low, even when the bug is infected (*2*).

Precautions to prevent house triatomine bug infestation include locating outdoor lights away from dwellings such as homes, dog kennels, and chicken coops and turning off lights that are not in use. Home owners should also remove trash, wood, and rock piles from around the home and clear out any bird and animal nests from around the home. Cracks and gaps around windows, air conditioners, walls, roofs, doors, and crawl spaces into the house should be inspected and sealed. Chimney flues should be tightly closed when not in use and screens should be used on all doors and windows. Ideally, pets should sleep indoors, especially at night, and outdoor pet resting areas kept clean. Finally, homeowners might consider using a licensed pest control professional for insect control (*1*,*2*).

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* https://kissingbug.tamu.edu/.

Erratum

Vol. 68, No. 12

In the report "Enterovirus D68–Associated Acute Respiratory Illness — New Vaccine Surveillance Network, United States, July–October, 2017 and 2018," a percentage was misreported in multiple places. On page 277, the sixth sentence of the first paragraph should have read "Among patients with ARI who were tested, EV-D68 was detected in two patients (**0.08%**) in 2017 and 358 (13.9%) in 2018."

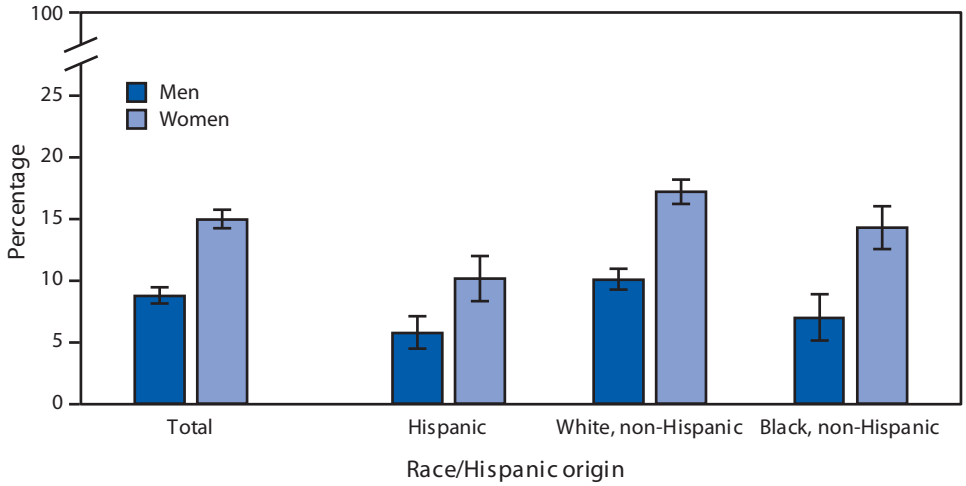
On page 278, in the second section of the summary box, the first sentence should have read "Based on active, prospective surveillance of ARI through the New Vaccine Surveillance Network, EV-D68 was detected in two (**0.08%**) patients in 2017 and 358 (13.9%) in 2018."

On page 280, the first sentence of the last paragraph should have read "Through recently established active, prospective, ARI surveillance in NVSN, EV-D68 was detected in **0.08%** of patients tested in 2017 and 13.9% in 2018."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentages* of Adults Aged ≥18 Years Who Were Told in the Past 12 Months by a Doctor or Health Professional That They Had Sinusitis,† by Sex, Race, and Hispanic Origin§ — National Health Interview Survey, 2017¶



* With 95% confidence intervals shown with error bars.
† Based on a positive response to the question "During the past 12 months, have you been told by a doctor or other health professional that you had sinusitis?"
§ Categories shown are for non-Hispanic respondents who selected one racial group; respondents had the option to select more than one racial group. Hispanic origin refers to persons who are of Hispanic ethnicity and might be of any race or combination of races. Total bar based on all adults aged ≥18 years.
¶ Estimates based on household interviews of a sample of the civilian, noninstitutionalized U.S. population are shown for sample adults aged ≥18 years and are age-adjusted using the projected 2000 U.S. population as the standard population for four age groups: 18–44, 45–64, 65–74, and ≥75 years.

Among adults aged ≥18 years, women (15.0%) were more likely than men (8.8%) to have been told by a doctor or health professional in the past 12 months that they had sinusitis. Among men, non-Hispanic white men (10.1%) were more likely than both non-Hispanic black (7.0%) and Hispanic (5.8%) men to have received a diagnosis of sinusitis. Among women, non-Hispanic white women (17.2%) were most likely to have received a diagnosis of sinusitis, followed by non-Hispanic black (14.3%) and Hispanic (10.2%) women.

Source: Tables of Summary Health Statistics, 2017. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/NHIS/SHS/2017_SHS_Table_A-2.pdf.

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