

Ebola Virus Disease in Health Care Workers — Guinea, 2014

Margaret Grinnell¹; Meredith G. Dixon, MD²; Monica Patton, MD³; David Fitter, MD⁴; Pépé Bilivogui, MD⁵; Candice Johnson, PhD⁶; Ellen Dotson, DSc⁷; Boubacar Diallo, MD⁸; Guenael Rodier, MD⁸; Pratima Raghunathan, PhD²

An outbreak of Ebola virus disease (Ebola) began in Guinea in December 2013 and has continued through September 2015 (1). Health care workers (HCWs) in West Africa are at high risk for Ebola infection owing to lack of appropriate triage procedures, insufficient equipment, and inadequate infection control practices (2,3). To characterize recent epidemiology of Ebola infections among HCWs in Guinea, national Viral Hemorrhagic Fever (VHF) surveillance data were analyzed for HCW cases reported during January 1–December 31, 2014. During 2014, a total of 162 (7.9%) of 2,210 laboratory-confirmed or probable Ebola cases among Guinean adults aged ≥15 years occurred among HCWs, resulting in an incidence of Ebola infection among HCWs 42.2 times higher than among non-HCWs. The disproportionate burden of Ebola infection among HCWs taxes an already stressed health infrastructure, underscoring the need for increased understanding of transmission among HCWs and improved infection prevention and control measures to prevent Ebola infection among HCWs.

Surveillance data from the national VHF database were analyzed for cases with a notification date in 2014. Using case definitions described previously (4), a standardized case investigation form was completed for every suspected, probable, or confirmed Ebola case that included age, sex, location of residence, occupation, symptom onset date, whether or not the patient was isolated in an Ebola treatment unit (ETU), and clinical outcome. Any person working in nonhousehold settings and who had contact with patients or patient waste was considered to be an HCW, including, but not limited to, doctors, nurses, midwives, hospital cleaners, ambulance drivers, laboratory workers, and ancillary health care staff. Traditional healers were not included. Only confirmed and probable Ebola cases in persons aged ≥15 years were included in the analysis. Incidence of Ebola infection was calculated using population denominators from the preliminary 2014 Guinea census and HCW denominators from the Guinea Ministry of Health (MOH) (5,6). Population denominators for persons aged ≥15 years were calculated assuming that 58% of the total population was aged ≥15 years (7). Outside of the capital Conakry, Guinea is divided into 33 administrative regions called prefectures. Geographic trends were analyzed by prefecture, with cases assigned to the location of the patient's permanent residence. Characteristics of HCW and non-HCW cases were compared using Chi-square tests; p-values <0.05 were considered statistically significant.

In 2014, a total of 162 (7.9%) of 2,210 laboratory-confirmed or probable Ebola cases reported from Guinea in persons aged ≥15 years occurred among HCWs. With an estimated 11,529 HCWs in Guinea and a national population of 6.15 million persons aged ≥15 years, the incidence of laboratory-confirmed or probable Ebola infections among HCWs in Guinea was 140.5 per 10,000 HCWs, compared with 3.3 per 10,000 non-HCWs aged ≥15 years (relative risk = 42.2; 95% confidence interval = 36.0–49.5).

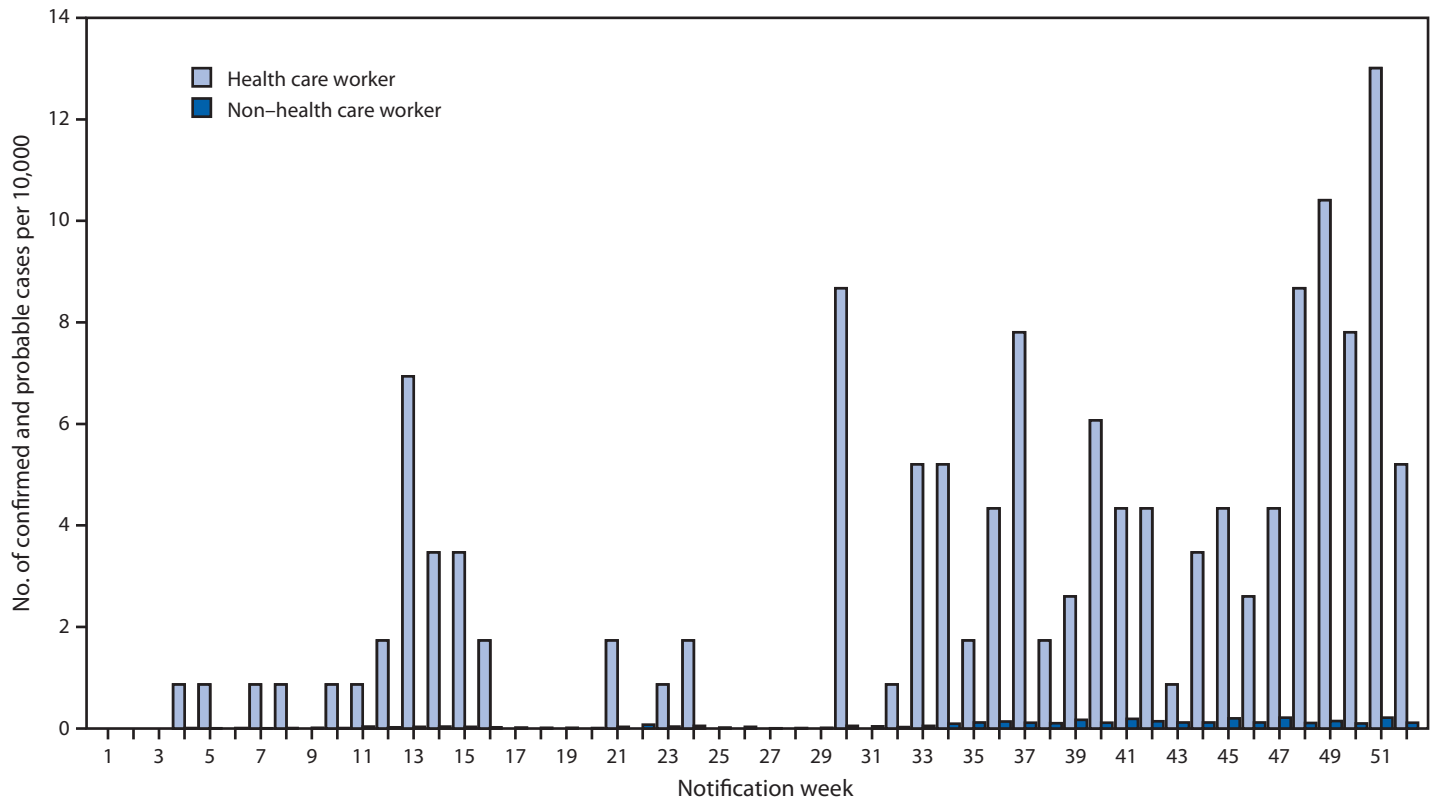
Cases of Ebola infections among HCWs during this outbreak were first reported in January 2014 (2014 notification week 4). The highest number of Ebola case notifications in HCWs in Guinea in a single week occurred during week 51 with 15 cases (Figure 1). This also corresponded to the week with the highest number of total Ebola cases (HCW and non-HCW) in Guinea during 2014.

During 2014, Ebola cases among HCWs were reported in Conakry and 17 (52%) of the 33 prefectures in Guinea (Figure 2). HCW case counts were highest in Conakry (64 cases) and N'Zérékoré (17 cases). HCW cases made up the largest percentage of total cases in Dabola (33.3%), Yomou (20.0%), and Conakry (19.6%).

Among persons with confirmed and probable Ebola, HCWs were more likely to be male than non-HCWs (Table). The majority of Ebola cases among both HCWs and non-HCWs occurred among persons aged 15–49 years. The fatality rate was higher among non-HCWs. Among Ebola patients, non-HCWs were also more likely to be identified in the community after their death. Although HCWs with Ebola were more likely than non-HCW Ebola patients to be isolated in an ETU, the time between symptom onset and isolation was similar for HCWs (4.9 days) and non-HCWs (5.2 days); however, time from symptom onset until isolation was missing for 38% of non-HCWs and 20% of HCWs. Data on Ebola exposures were not complete for all Ebola patients; among Ebola patients with complete information, HCWs were significantly less likely to report attendance at a funeral than were non-HCWs and were also less likely to report any contact with a person known to have Ebola than were non-HCWs.

The most common occupations of HCWs with Ebola were doctor, nurse, and health technician (Table); these accounted for almost two thirds of occupations of HCWs with Ebola. Among Guinean HCWs, incidence of Ebola infection was highest among laboratory technicians (34.7 per 1,000) and

FIGURE 1. Number of confirmed and probable cases of Ebola virus disease per 10,000 persons among health care workers and non-health care workers aged ≥ 15 years, by notification week — Guinea, 2014



doctors (26.6 per 1,000), followed by midwives (8.7 per 1,000) and nurses (5.5 per 1,000). Place of work was known for 114 (70%) HCWs with Ebola; among those, only one worked at an ETU.

Discussion

In 2014, Guinean HCWs had an incidence of Ebola infection 42.2 times higher than that of non-HCWs. Doctors and male HCWs were more affected than HCWs in other roles and female HCWs. Among Ebola cases, HCW patients were less likely than non-HCW patients to report risk factors such as funeral attendance or contact with a person known to have Ebola, although data completeness was poor for these measures.

Higher incidence of Ebola infection among HCWs than non-HCWs has also been reported in Sierra Leone and Liberia, two neighboring countries with intense Ebola transmission in 2014 (3). In Guinea, doctors represented the largest proportion of Ebola cases among HCWs, unlike Liberia, where nurses were the most affected group (8). In settings with an inadequate health infrastructure, high incidence of Ebola infection among HCWs not only limits the country's ability to respond to the Ebola outbreak, but also limits its baseline ability to address routine health care needs.

Summary

What is already known on this topic?

Health care workers (HCWs) are at high risk for infection in outbreaks of Ebola virus disease (Ebola). Ebola infections in HCW can be reduced through thorough appropriate triage and adherence to good infection prevention and control practices.

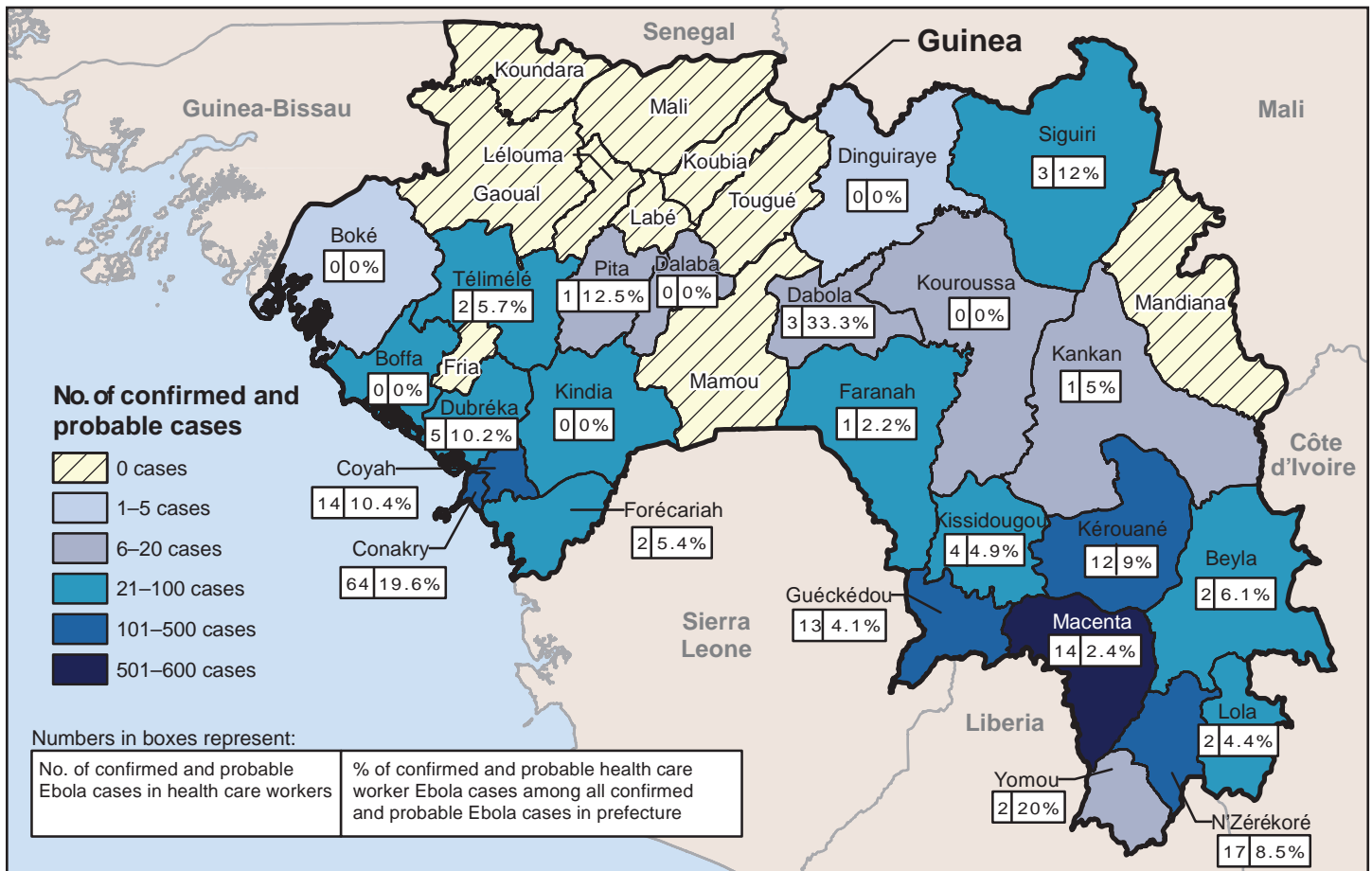
What is added by this report?

During 2014, a total of 162 (7.9%) of 2,210 laboratory-confirmed or probable Ebola cases among Guineans aged ≥ 15 years occurred among HCWs, resulting in a cumulative incidence of Ebola infection among HCWs 42.2 times higher than among non-HCWs. Doctors and male HCWs were disproportionately affected compared with HCWs in other roles and female HCWs.

What are the implications for public health practice?

Ebola infections among HCWs are an important focus area for Ebola outbreak response, and thorough investigation of cases in HCWs is important to better understand sources of exposure, reasons for delay in isolation once symptoms develop, particular job tasks that increase the risk for infection, and reasons that particular groups, such as males and doctors, are disproportionately affected. An increased understanding of HCW risks for infection along with continuous infection prevention and control efforts are necessary to prevent Ebola infection in this high-risk occupational group.

FIGURE 2. Geographic distribution of confirmed and probable Ebola virus disease (Ebola) cases among health care workers aged ≥15 years — Guinea, 2014



This evaluation found that 27% of Ebola infections among HCWs in Guinea occurred among doctors, who account for 14% of the health care workforce (5). Although no significant difference in infection rates among HCWs by sex has been reported from Sierra Leone or Liberia (3,8), male HCWs in Guinea appear to be at increased risk compared with female HCWs; in this evaluation, 75% of Ebola infections among HCWs occurred among males. Information on a subset of HCWs employed by the Guinea MOH indicates that males represent 46.4% of the overall health care workforce and 67.4% of doctors (Guinea MOH, unpublished data, September 2015). The male predominance in Ebola infections among HCWs is not completely explained by the predominance of doctors. When stratified by occupation, a majority of Ebola infections within each occupation except midwifery and nursing occurred among males. In this evaluation, 67% of Ebola infections among nondoctor HCWs occurred among males.

In response to Ebola infections among HCWs, the Guinea MOH is continuing to focus on HCW training and availability of personal protective equipment (PPE). Additionally,

the Guinea MOH is focusing additional resources on investigating cases of Ebola among HCWs as sentinel public health events. Guinea's Ebola case investigation form lacks detailed questions needed to determine routes of transmission among HCWs. An HCW-focused survey tool with questions about specific job tasks, infection control training, use of PPE, and known Ebola exposures in the community, among patients or among fellow HCWs, was implemented in December 2014 and continues to be used to investigate HCW infections in Guinea. Subsequent analysis of these data might help inform the response to HCW infections by identifying infection prevention and control failures, training gaps, or specific HCW groups at higher risk for infection. Additionally, analysis of these data might help determine if HCWs are being infected in the health care setting or in the community.

The findings in this report are subject to at least two limitations. First, surveillance data on potential Ebola exposures were not consistently available. For example, data on funeral attendance or contact with a person known to have Ebola were missing for more than half of HCWs with Ebola and almost

TABLE. Number and percentage of health care workers and non-health care workers with confirmed or probable Ebola virus disease (Ebola), by selected characteristics — Guinea, January 1–December 31, 2014

Characteristic	Health care workers (n = 162)			Non-health care workers (n = 2,048)		p-value
	No.	(%)	Cases per 1,000	No.	(%)	
Sex						
Male	122	(75.3)		952	(46.9)	<0.01
Female	40	(24.7)		1,080	(42.5)	
Unknown	0	(0)		16	(0.8)	
Age group (yrs)						
15–49	139	(85.8)		1,537	(75.0)	<0.01
≥50	23	(14.2)		511	(25.0)	
Risk factor						
Funeral attendance*	6	(10.0)		174	(40.2)	<0.01
Contact with a person known to have Ebola†	48	(66.7)		425	(77.8)	<0.01
Isolated at Ebola treatment unit	126	(77.8)		1,270	(62.0)	<0.01
Mean time to isolation (days)	4.9			5.2		
Final outcome						
Died	92	(56.8)		1,329	(64.9)	0.04
Dead at time of report	21	(13.0)		626	(30.9)	<0.01
Occupation[§]						
Doctor	43	(27.0)	26.6	—	—	
Nurse	40	(25.0)	5.5	—	—	
Health technician	22	(14.0)		—	—	
Laboratory technician	8	(5.0)	34.7	—	—	
Cleaner	8	(5.0)		—	—	
Medical student	6	(4.0)		—	—	
Midwife	6	(4.0)	8.7	—	—	
Ambulance driver	5	(3.0)		—	—	
Other	11	(14.0)		—	—	
Unknown	8	(5.0)		—	—	

* Data on funeral attendance were missing for 102 (63%) health care workers and 1,615 (79%) non-health care workers.

† Data on contact with a person known to have Ebola were missing for 90 (56%) health care workers and 1,502 (73%) non-health care workers.

§ Only occupations with five or more Ebola cases reported are shown.

three quarters of non-HCWs with Ebola. More complete data collection could increase understanding of potential Ebola exposures. Second, no standard definition of an HCW exists. For Ebola surveillance purposes, a broader definition of HCW was used than was used in the MOH estimate of the number of HCWs, which likely resulted in an overestimate of the actual incidence of Ebola infection among HCWs.

Ebola infections among HCWs are an important focus area for the outbreak response, and an increased understanding of potential Ebola exposures is needed to better tailor infection prevention and control trainings and practices. The finding that HCWs were less likely than non-HCWs to report contact with a person known to have Ebola suggests a failure to identify Ebola cases in patients who present to non-ETU settings. The finding that only one infected HCW worked at an ETU underscores the importance of infection prevention and control. HCWs working in ETUs might have had more comprehensive infection prevention and control training, more access to infection prevention and control resources such as PPE, more practice donning and doffing PPE, and heightened awareness of Ebola compared with HCWs in

non-ETU settings. Currently, substantial uncertainty exists about Ebola infections among HCWs, including source and place of exposure, reasons for delay in isolation after symptom onset, and particular job tasks that might increase the risk for infection. An enhanced understanding of HCW risks factors for infection, along with continuous infection prevention and control efforts, are necessary to prevent Ebola infection in this high-risk occupational group.

Acknowledgments

Ministry of Health, Guinea; World Health Organization; Médecins Sans Frontières; Guinea Ebola Response Team, CDC.

¹Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; ²Division of Global HIV/AIDS, Center for Global Health, CDC; ³Division of STD Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; ⁴Division of Global Health Protection, Center for Global Health, CDC; ⁵Guinea Ministry of Health and Public Hygiene; ⁶Division of Surveillance, Hazard Evaluations, and Field Studies, National Center for Occupational Safety and Health, CDC; ⁷Division of Parasitic Diseases and Malaria, Center for Global Health, CDC; ⁸World Health Organization, Conakry, Guinea.

Corresponding author: Margaret Grinnell, mhgrinnell@gmail.com.

References

1. Briand S, Bertherat E, Cox P, et al. The international Ebola emergency. *N Engl J Med* 2014;371:1180–3.
2. World Health Organization. Fact sheet no. 103: Ebola virus disease. Available at <http://www.who.int/mediacentre/factsheets/fs103/en>.
3. Kilmarx PH, Clarke KR, Dietz PM, et al. Ebola virus disease in health care workers—Sierra Leone, 2014. *MMWR Morb Mortal Wkly Rep* 2014;63:1168–71.
4. Dixon MG, Schafer IJ. Ebola viral disease outbreak—West Africa, 2014. *MMWR Morb Mortal Wkly Rep* 2014;63:548–51.
5. Guinea Ministry of Planning. Publication of preliminary results of the Third General Census of Population and Housing conducted March 1–April 2, 2014 [French]. Conakry, Guinea: Guinea Ministry of Planning; 2014. Available at <http://www.stat-guinee.org/index.php/result-prelim-rgph3?download=55:res-pre-rgph3>.
6. Guinea Division of Human Resources. Census of health workers 2009 [French]. Conakry, Guinea: Guinea Division of Human Resources; 2011.
7. US Central Intelligence Agency. The world factbook: Guinea. Available at <https://www.cia.gov/library/publications/the-world-factbook/geos/gv.html>.
8. Matanock A, Arwady MA, Ayscue P, et al. Ebola virus disease cases among health care workers not working in Ebola treatment units—Liberia, June–August, 2014. *MMWR Morb Mortal Wkly Rep* 2014;63:1077–81.

Frequency of Tobacco Use Among Middle and High School Students — United States, 2014

Linda J. Neff, PhD¹; René A. Arrazola, MPH¹; Ralph S. Caraballo, PhD¹; Catherine G. Corey, MSPH²; Shanna Cox, MSPH¹; Brian A. King, PhD¹; Conrad J. Choiniere, PhD²; Corinne G. Husten, MD²

The use of tobacco products during adolescence increases the risk for adverse health effects and lifelong nicotine addiction (1,2). In 2014, an estimated 4.6 million middle and high school students were current users of any tobacco product, of whom an estimated 2.2 million were current users of two or more types of tobacco products (3). Symptoms of nicotine dependence are increased for multiple tobacco product users compared with single-product users (4,5). CDC and the Food and Drug Administration (FDA) analyzed data from the 2014 National Youth Tobacco Survey (NYTS) to determine how frequently (the number of days in the preceding 30 days) U.S. middle school (grades 6–8) and high school (grades 9–12) students used cigarettes, e-cigarettes, cigars, and smokeless tobacco products. Among current users (≥ 1 day during the preceding 30 days) in high school, frequent use (≥ 20 days during the preceding 30 days) was most prevalent among smokeless tobacco users (42.0%), followed by cigarette smokers (31.6%), e-cigarette users (15.5%), and cigar smokers (13.1%); a similar pattern was observed for those who used during all 30 days. Among current users in middle school, frequent use was greatest among smokeless tobacco users (29.2%), followed by cigarette smokers (20.0%), cigar smokers (13.2%) and e-cigarette users (11.8%). Current use of two or more types of tobacco products was common, even among students who used tobacco products 1–5 days during the preceding 30 days: 77.3% for cigar smokers, 76.9% for cigarette smokers, 63.4% for smokeless tobacco users, and 54.8% for e-cigarettes users. Preventing youths from initiating the use of any tobacco product is important to tobacco use prevention and control strategies in the United States (1,2). Monitoring the frequency and patterns of tobacco use among youths, including the use of two or more tobacco products, is important to inform

evidence-based interventions to prevent and reduce all forms of tobacco use among youths (2).

NYTS is a cross-sectional, school-based, pencil-and-paper questionnaire administered to U.S. middle school and high school students. Information is collected to monitor the impact of comprehensive tobacco control policies and strategies and to inform FDA's regulatory actions (6). A three-stage cluster sampling procedure was used to generate a nationally representative sample of U.S. students in grades 6–12 who attend public and private schools. Of the 258 schools

INSIDE

- 1066 Flavored Tobacco Product Use Among Middle and High School Students — United States, 2014
- 1071 Q Fever Outbreak Among Travelers to Germany Who Received Live Cell Therapy — United States and Canada, 2014
- 1074 Estimated Lifetime Medical and Work-Loss Costs of Fatal Injuries — United States, 2013
- 1078 Estimated Lifetime Medical and Work-Loss Costs of Emergency Department–Treated Nonfatal Injuries — United States, 2013
- 1083 Ebola Virus Disease in Health Care Workers — Guinea, 2014
- 1088 Measles Outbreak Associated with Vaccine Failure in Adults — Federated States of Micronesia, February–August 2014
- 1094 QuickStats

Continuing Education examination available at http://www.cdc.gov/mmwr/cme/conted_info.html#weekly.



selected for the 2014 NYTS, 207 (80.2%) participated, with a sample of 22,007 (91.4%) among 24,084 eligible students; the overall response rate was 73.3%. Current use (use ≥ 1 day during the preceding 30 days) was assessed for nine products: cigarettes, cigars (defined as cigars, cigarillos, or little cigars), smokeless tobacco (defined as chewing tobacco, snuff, or dip), e-cigarettes, hookahs, tobacco pipes, snus, dissolvable tobacco (dissolvables), and bidis. Frequency of use (number of days during the preceding 30 days) was asked exclusively for four products: cigarettes, cigars, smokeless tobacco, and e-cigarettes; response options were 0 days, 1–2 days, 3–5 days, 6–9 days, 10–19 days, 20–29 days, and all 30 days. Estimates of multiple tobacco product use were determined by assessing preceding 30-day use of only one other tobacco product or the use of two or more other tobacco products among current cigarette, e-cigarette, cigar, and smokeless tobacco users. Data were weighted to account for the complex survey design and to adjust for nonresponse. National prevalence estimates were computed with 95% confidence intervals and population estimates rounded down to the nearest 10,000.

In 2014, among middle and high school students who used at least one of these four products, an estimated 480,000 middle school and high school students smoked cigarettes, 390,000 used smokeless tobacco, 340,000 used e-cigarettes, and 170,000 smoked cigars on ≥ 20 of the preceding 30 days (Table). Among high school students who were current users, 42.0% of smokeless tobacco users, 31.6% of cigarette smokers, 15.5% of e-cigarettes users, and 13.1% of cigar smokers

reported using the product during ≥ 20 of the preceding 30 days (Table); the proportion who used the product during 1–2 of the preceding 30 days was 52.0% for cigar smokers, 45.4% for e-cigarette users, 37.0% for cigarette smokers, and 26.6% for smokeless tobacco users. Among middle school students who were current users, 29.2% of smokeless tobacco users, 20.0% of cigarette smokers, 13.2% of cigar smokers, and 11.8% of e-cigarette users used the product on ≥ 20 of the preceding 30 days; the proportion who used the product during 1–2 of the preceding 30 days was 54.5% for e-cigarette users, 44.3% for cigar smokers, 43.2% for cigarette smokers, and 38.4% for smokeless tobacco users.

Among middle school and high school students who reported using cigarettes, e-cigarettes, cigars, or smokeless tobacco on 1–5 days during the preceding 30 days, the percentages using multiple tobacco products were 77.3% for cigar smokers, 76.9% for cigarette smokers, 63.4% for smokeless tobacco users, and 54.8% for e-cigarette users (Figure).

Discussion

In 2014, among middle and high school students who used at least one of these four products, an estimated 480,000 middle school and high school students smoked cigarettes, 390,000 used smokeless tobacco, 340,000 used e-cigarettes, and 170,000 smoked cigars on ≥ 20 of the preceding 30 days. The frequency of tobacco use among current users varied by school level and by type of tobacco product. High school students were more frequent users of tobacco products than

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* 2015;64:[inclusive page numbers].

Centers for Disease Control and Prevention

Thomas R. Frieden, MD, MPH, *Director*
 Harold W. Jaffe, MD, MA, *Associate Director for Science*
 Joanne Cono, MD, ScM, *Director, Office of Science Quality*
 Chesley L. Richards, MD, MPH, *Deputy Director for Public Health Scientific Services*
 Michael F. Iademarco, MD, MPH, *Director, Center for Surveillance, Epidemiology, and Laboratory Services*

MMWR Editorial and Production Staff (Weekly)

Sonja A. Rasmussen, MD, MS, *Editor-in-Chief*
 Charlotte K. Kent, PhD, MPH, *Executive Editor*
 Jacqueline Gindler, MD, *Editor*
 Teresa F. Rutledge, *Managing Editor*
 Douglas W. Weatherwax, *Lead Technical Writer-Editor*
 Teresa M. Hood, MS, Jude C. Rutledge, *Writer-Editors*

Martha F. Boyd, *Lead Visual Information Specialist*
 Maureen A. Leahy, Julia C. Martinroe,
 Stephen R. Spriggs, Brian E. Wood, Moua Yang
Visual Information Specialists
 Quang M. Doan, MBA, Phyllis H. King,
 Teresa C. Moreland, Terraye M. Starr
Information Technology Specialists

MMWR Editorial Board

Timothy F. Jones, MD, *Chairman*
 Matthew L. Boulton, MD, MPH
 Virginia A. Caine, MD
 Katherine Lyon Daniel, MPH
 Jonathan E. Fielding, MD, MPH, MBA
 David W. Fleming, MD

William E. Halperin, MD, DrPH, MPH
 King K. Holmes, MD, PhD
 Robin Ikeda, MD, MPH
 Rima F. Khabbaz, MD
 Phyllis Meadows, PhD, MSN, RN
 Jewel Mullen, MD, MPH, MPA

Jeff Niederdeppe, PhD
 Patricia Quinlisk, MD, MPH
 Patrick L. Remington, MD, MPH
 Carlos Roig, MS, MA
 William L. Roper, MD, MPH
 William Schaffner, MD

Morbidity and Mortality Weekly Report

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*'s free subscription page at <http://www.cdc.gov/mmwr/mmwrsubscribe.html>. Paper copy subscriptions are available through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; telephone 202-512-1800.

Readers who have difficulty accessing this PDF file may access the HTML file at <http://www.cdc.gov/mmwr/index2015.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.

All material in the *MMWR* Series is in the public domain and may be used and reprinted without permission; citation as to source, however, is appreciated.

Use of trade names and commercial sources is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services.

References to non-CDC sites on the Internet are provided as a service to *MMWR* readers and do not constitute or imply endorsement of these organizations or their programs by CDC or the U.S. Department of Health and Human Services. CDC is not responsible for the content of these sites. URL addresses listed in *MMWR* were current as of the date of publication.

ISSN: 0149-2195 (Print)