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National Arthritis Awareness Month — May 2018

May is National Arthritis Awareness Month. In the United States, 54 million adults have some form of doctor-diagnosed arthritis (*1*), a number projected to increase to 78 million by 2040.* Approximately two thirds of adults with arthritis have overweight or obesity (*1*), and only 36% meet the recommended aerobic physical activity guidelines.†

Engaging in physical activity and maintaining a healthy weight can help manage arthritis symptoms.§ Physical activity can reduce arthritis pain, improve function and mood, and delay the onset of disability. Even small amounts of weight loss have been shown to significantly reduce pressure on the joints. Adults who have overweight or obesity and receive weight-loss counseling from a health care provider are approximately four times more likely to attempt to lose weight than are those who do not receive counseling (*2*). Health care providers can play a valuable role by counseling their patients with arthritis to be physically active, lose weight if they have overweight or obesity, and get self-management education (*2*,*3*). A report in this issue found that the percentage of health care providers counseling arthritis patients about weight loss increased significantly from 2002 to 2014 (*3*).

* https://onlinelibrary.wiley.com/doi/epdf/10.1002/art.39692.
† https://www.sciencedirect.com/science/article/pii/S0749379717302076.
§ https://www.cdc.gov/arthritis/basics/management.htm.

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Health Care Provider Counseling for Weight Loss Among Adults with Arthritis and Overweight or Obesity — United States, 2002–2014

Dana Guglielmo, MPH[1,2]; Jennifer M. Hootman, PhD[1]; Louise B. Murphy, PhD[1]; Michael A. Boring, MS[1]; Kristina A. Theis, PhD[1]; Brook Belay, MD[3]; Kamil E. Barbour, PhD[1]; Miriam G. Cisternas, MA[1]; Charles G. Helmick, MD[1]

In the United States, 54.4 million adults report having doctor-diagnosed arthritis (*1*). Among adults with arthritis, 32.7% and 38.1% also have overweight and obesity, respectively (*1*), with obesity being more prevalent among persons with arthritis than among those who do not have arthritis (*2*). Furthermore, severe joint pain among adults with arthritis in 2014 was reported by 23.5% of adults with overweight and 31.7% of adults with obesity (*3*). The American College of Rheumatology recommends weight loss for adults with hip or knee osteoarthritis and overweight or obesity,* which can improve function and mobility while reducing pain and disability (*4*,*5*). The *Healthy People 2020*

* https://onlinelibrary.wiley.com/doi/epdf/10.1002/acr.21596.

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target for health care provider (hereafter provider) counseling for weight loss among persons with arthritis and overweight or obesity is 45.3%.[†] Adults with overweight or obesity who receive weight-loss counseling from a provider are approximately four times more likely to attempt to lose weight than are those who do not receive counseling (*6*). To estimate changes in the prevalence of provider counseling for weight loss reported by adults with arthritis and overweight or obesity, CDC analyzed National Health Interview Survey (NHIS) data.[§] Overall, age-standardized estimates of provider counseling for weight loss increased by 10.4 percentage points from 2002 (35.1%; 95% confidence interval [CI] = 33.0–37.3) to 2014 (45.5%; 95% CI = 42.9–48.1) (p<0.001). Providing comprehensive behavioral counseling (including nutrition, physical activity, and self-management education) and encouraging evidence-based weight-loss program participation can result in enhanced health benefits for this population.

NHIS is an ongoing, in-person, cross-sectional survey of the civilian, noninstitutionalized population. CDC analyzed data on adults aged ≥18 years with arthritis and overweight or obesity from the Sample Adult component for 2002, 2003, 2006, 2009, and 2014 (24,275–36,697; response rate = 58.9%–74.3%). Having arthritis was defined as an affirmative response to the question "Have you ever been told by a doctor or other health care professional that you have arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" Body mass index (BMI), defined as weight (kg) divided by height (m^2), was calculated from self-reported height and weight and categorized as: normal/underweight (<25); overweight (25 to <30); and obese (≥30).[¶] Obesity was further stratified into three BMI subgroups: class 1 (30 to <35); class 2 (35 to <40); and class 3 (≥40).[**] Provider counseling for weight loss, which was part of sponsored survey content featured in 2002, 2003, 2006, 2009, and 2014, was defined as an affirmative response to the question, "Has a doctor or other health professional ever suggested losing weight to help your arthritis or joint symptoms?"

All analyses accounted for the complex survey design; sampling weights were applied to make estimates representative of the U.S. civilian, noninstitutionalized population. Weighted numbers and age-standardized prevalences (using the projected 2000 U.S. population for ages 18–44, 45–64, and ≥65 years)[††] were calculated for adults with overweight or obesity overall and for selected sociodemographic and health-related characteristics for 2002 and 2014. Results were declared significant if t-tests yielded p-values <0.05 for differences in age-standardized prevalences between 2002 and 2014, and between categories of characteristics in 2014.

[†] https://www.healthypeople.gov/2020/topics-objectives/topic/Arthritis-Osteoporosis-and-Chronic-Back-Conditions/objectives.
[§] https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm.
[¶] https://www.cdc.gov/obesity/adult/defining.html.
[**] https://www.nhlbi.nih.gov/files/docs/guidelines/prctgd_c.pdf.
[††] https://www.cdc.gov/nchs/data/statnt/statnt20.pdf.

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Among the U.S. adult population, 28.3 million persons in 2002 and 38.9 million in 2014 had arthritis and overweight or obesity. From 2002 to 2014, the age-standardized prevalence of receiving provider counseling for weight loss among adults with arthritis and overweight or obesity increased by 10.4 percentage points from 35.1% (95% CI = 33.0–37.3) to 45.5% (95% CI = 42.9–48.1) (p<0.001) (Table), which met the *Healthy People 2020* target of 45.3%. The prevalence increased by 5.7 percentage points for adults with arthritis and overweight (from 18.1% to 23.8%; p = 0.006) and 12.4 percentage points for those with obesity (50.4% to 62.8%; p<0.001). By obesity subgroup, the prevalence increased 11.8 percentage points among persons with class 1 obesity (40.8% to 52.6%; p<0.001) and 15.5 percentage points among those with class 3 obesity (69.0% to 84.5%; p<0.001); the increase among persons with class 2 obesity was not significant (Figure). In 2014 among adults with arthritis and overweight or obesity, the prevalence of receiving provider weight-loss counseling was significantly higher for females (versus males), those with obesity (versus overweight), those who had ever received provider counseling to engage in physical activity to manage arthritis (versus those who had not), those who had ever taken a self-management class or course (versus those who had not), and those with a primary care provider (versus those without one) (Table).

Discussion

From 2002 to 2014, the percentage of adults with arthritis and overweight or obesity who reported receiving provider weight-loss counseling increased by 10.4 percentage points. These improvements are encouraging; however, approximately 75% of adults with overweight and 50% of those with class 1 obesity are not receiving provider weight-loss counseling.

A recent report indicated that 61.0% of adults with arthritis received provider counseling for physical activity in 2014 (*7*), more than the 45.5% reported here for weight loss. Providers might advise for physical activity more frequently than weight loss because the former might be easier to discuss with patients or they might be more aware of the arthritis-specific benefits of physical activity. Findings of the current report indicate that those who are not receiving counseling for weight loss might also not be receiving counseling for physical activity. Nevertheless, to address obesity, the U.S. Preventive Services Task Force recommends that providers either provide or refer patients to intensive, multicomponent behavioral interventions that include management strategies (e.g., goal setting), dietary and physical activity changes, addressing barriers to change, self-monitoring, and strategies to maintain healthy behaviors.[§§] The American College of Rheumatology also recommends that providers offer counseling for weight loss and physical activity to adults with hip or knee osteoarthritis. In randomized controlled trials, a combined exercise and diet intervention resulted in the greatest improvements in weight, pain, joint forces, inflammatory factors, and mobility compared with either intervention alone (*4*,*8*). In the current study, the percentage of adults with overweight or obesity who received weight-loss counseling was higher among those who had taken a self-management education course than among those who had not. Since the temporal sequencing of provider weight-loss counseling and taking a self-management education course (which includes weight-loss messages) cannot be delineated, this study could not determine whether provider counseling leads persons with arthritis and overweight or obesity to self-management education courses or vice versa. However, it is possible that persons with arthritis who receive recommendations for healthy behaviors, such as weight loss, from their provider are more amenable to engaging in other self-management behaviors, such as taking a self-management education course or engaging in physical activity.[¶¶] One benefit of self-management education program participation is substantial increases in self-confidence (*9*), which is an important characteristic that can help adults with arthritis act on counseling to lose weight and be physically active. Combined counseling for weight loss, physical activity, and self-management education might enhance arthritis and other health outcomes.

Strategies to increase provider counseling for weight loss include health system interventions (e.g., electronic medical record clinical decision supports) and provider training. Electronic medical record clinical decision supports are effective in increasing the delivery of nutrition and physical activity counseling and decreasing BMI in children with obesity (*10*), and similar strategies might translate into weight loss in adult populations. Standardized electronic medical record clinical decision supports could assist provider counseling and referrals to evidence-based, community-delivered weight-loss and physical activity programs, intensive multicomponent interventions, or bariatric specialists, as well as facilitate patient education and help providers follow up on patients' weight-loss goals and progress. Increased provider training regarding self-management support strategies can help providers to gain the skills and confidence to provide successful weight-loss counseling. Such training can include formal classroom instruction or use of publicly available online resources for counseling their patients.[***,†††] Many effective strategies, including motivational interviewing, the 5As approach (Assess, Advise, Agree, Assist, and Arrange), and emphasizing that small changes can have a big impact, are applicable to weight-loss counseling (*6*). For example, along with improving pain and mobility (*4*), a relatively small, but clinically significant, 5.1% reduction

[§§] https://www.uspreventiveservicestaskforce.org/Page/Name/tools-and-resources-for-better-preventive-care.

[¶¶] https://downloads.cms.gov/files/cmmi/community-basedwellnessrrevention-sixthmnthoutcomes-operationalcostrpt.pdf.

[***] http://stopobesityalliance.org/wp-content/themes/stopobesityalliance/pdfs/STOP-Provider-Discussion-Tool.pdf.

[†††] https://health.mo.gov/living/healthcondiseases/obesity/pdf/Toolkit_Adult.pdf.

TABLE. Age-standardized prevalence* of health care provider counseling for weight loss reported among adults aged ≥18 years with doctor-diagnosed arthritis and overweight or obesity, by selected characteristics — National Health Interview Survey, United States, 2002 and 2014

Characteristic	2002 Unweighted no.	2002 Weighted no. (x 1000) reporting counseling†	2002 Age-standardized % (95% CI)	2014 Unweighted no.	2014 Weighted no. (x 1000) reporting counseling†	2014 Age-standardized % (95% CI)	% change 2002 to 2014
Overall	**1,733**	**10,740**	**35.1 (33.0–37.3)**	**2,869**	**16,600**	**45.5 (42.9–48.1)**	29.6§
Sociodemographic characteristics							
Age group (yrs) (age-specific)							
18–44	246	1,599	30.9 (27.4–34.6)	399	2,570	47.1 (42.6–51.5)	52.4§
45–64	858	5,629	41.9 (39.4–44.4)	1,297	8,046	45.5 (42.8–48.2)	8.6
≥65	629	3,513	36.4 (34.0–38.9)	1,173	5,984	40.6 (38.2–43.1)	11.5§
Sex							
Male	592	4,444	31.3 (28.3–34.5)	1,028	6,670	41.1 (37.1–45.2)	31.3§
Female	1,141	6,297	38.6 (35.6–41.7)	1,841	9,930	49.2 (45.8–52.6)	27.5§
Race/Ethnicity							
Hispanic	1,168	8,061	32.9 (30.5–35.4)	1,887	12,033	44.0 (40.9–47.1)	33.7§
White, non-Hispanic	322	1,590	45.2 (39.2–51.3)	515	2,263	47.4 (41.8–53.1)	4.9
Black, non-Hispanic	209	825	38.5 (32.5–44.9)	364	1,865	54.0 (46.9–60.8)	40.3§
Other, non-Hispanic	34	265	44.0 (31.3–57.5)	103	439	42.0 (28.9–56.4)	-4.5
Education							
Less than HS graduate	423	2,183	31.3 (26.7–36.3)	527	2,567	41.7 (35.4–48.2)	33.2§
HS graduate or equivalent	535	3,461	34.3 (30.6–38.3)	776	4,728	45.9 (40.8–51.0)	33.8§
Technical school/Some college	458	2,905	35.2 (31.5–39.0)	913	5,417	47.1 (42.6–51.6)	33.8§
College degree or higher	306	2,128	37.9 (32.9–43.1)	645	3,818	44.1 (38.9–49.4)	16.4
Work status							
Employed	709	4,896	34.8 (32.0–37.8)	1,117	7,211	45.4 (42.1–48.7)	30.5§
Unemployed	33	191	25.5¶ (16.7–36.9)	111	697	45.8 (36.0–56.0)	79.6§
Unable to work/ Disabled	358	1,946	40.7 (35.5–46.1)	621	3,143	56.4 (50.2–62.4)	38.6§
Other	631	3,698	33.9 (27.2–41.3)	1019	5,546	39.6 (32.8–46.8)	16.8
Health-related characteristic							
BMI (kg/m^2)							
Overweight (25 to <30)	482	3,023	18.1 (15.8–20.7)	743	4,352	23.8 (20.8–27.0)	31.5§
Obesity (≥30)	1,733	10,740	50.4 (47.3–53.6)	2,869	16,600	62.8 (59.6–65.9)	24.6§
Class 1 (≥30 to <35)	600	3,756	40.8 (36.7–45.0)	959	5,708	52.6 (48.0–57.2)	28.9§
Class 2 (≥35 to <40)	362	2,232	60.2 (54.7–65.4)	585	3,229	63.0 (56.3–69.2)	4.7
Class 3 (≥40)	289	1,729	69.0 (60.6–76.3)	582	3,311	84.5 (80.2–88.0)	22.5§
Arthritis limitations							
No	852	5,519	30.6 (28.1–33.2)	1,411	8,567	43.1 (39.8–46.4)	40.8§
Yes	878	5,206	42.5 (38.9–46.3)	1,457	8,029	48.7 (44.7–52.7)	14.6§
Ever counseled by provider to engage in physical activity to manage arthritis							
No	351	2,219	15.7 (13.5–18.2)	400	2,294	17.5 (14.5–21.0)	11.5
Yes	1,373	8,481	51.7 (48.5–54.9)	2,467	14,304	60.5 (57.1–63.7)	17.0§
Ever taken a self-management class or course**							
No	1,470	9,099	33.2 (31.0–35.5)	2,430	13,907	43.3 (40.6–46.1)	30.4§
Yes	262	1,639	50.7 (43.9–57.5)	439	2,693	61.5 (54.5–68.2)	21.3§
Joint pain severity††							
None or mild (0–4)	328	2,207	32.8 (28.5–37.5)	607	3,655	45.8 (39.7–51.9)	39.6§
Moderate (5–6)	406	2,688	35.5 (31.1–40.2)	669	3,967	49.2 (43.8–54.6)	38.6§
Severe (≥7)	615	3,396	42.9 (39.0–46.8)	960	5,389	47.8 (42.7–53.0)	11.4
Self-rated health							
Excellent/Very good	460	3,017	28.1 (25.1–31.4)	799	5,258	37.8 (33.7–42.0)	34.5§
Good	581	3,703	35.8 (31.9–39.9)	1,032	5,918	48.2 (43.6–52.8)	34.6§
Fair/Poor	692	4,021	45.7 (41.2–50.2)	1,037	5,419	55.1 (50.2–59.9)	20.6§
Smoking status							
Current smoker	273	1,716	30.4 (26.7–34.4)	444	2,413	39.7 (34.7–44.9)	30.6§
Former smoker	635	4,137	36.2 (31.7–41.0)	961	5,705	48.4 (42.3–54.5)	33.7§
Never smoker	823	4,868	37.0 (33.9–40.3)	1,461	8,474	46.8 (43.3–50.4)	26.5§

See table footnotes on page 489.

TABLE. (*Continued*) Age-standardized prevalence* of health care provider counseling for weight loss reported among adults aged ≥18 years with doctor-diagnosed arthritis and overweight or obesity, by selected characteristics — National Health Interview Survey, United States, 2002 and 2014

Characteristic	2002			2014			% change 2002 to 2014
	Unweighted no.	Weighted no. (x 1000) reporting counseling†	Age-standardized % (95% CI)	Unweighted no.	Weighted no. (x 1000) reporting counseling†	Age-standardized % (95% CI)	
Aerobic physical activity level§§							
Active	509	3,490	33.9 (30.8–37.1)	941	5,715	42.2 (38.4–46.1)	24.5§
Insufficient	367	2,209	38.0 (32.9–43.4)	703	4,079	48.9 (43.1–54.9)	28.7§
Inactive	825	4,798	35.0 (31.7–38.5)	1,184	6,539	48.2 (43.5–52.8)	37.7§
Have a primary care provider							
No	133	709	30.8 (25.5–36.7)	190	947	32.1 (26.6–38.1)	4.2
Yes	1,600	10,032	36.0 (33.7–38.4)	2,678	15,649	47.6 (44.8–50.5)	32.2§
No. of co-occurring chronic conditions¶¶							
0	15	76	—***	49	311	51.4 (35.6–66.9)	—***
1–2	952	5,898	31.4 (29.1–33.8)	1,412	8,460	41.7 (38.7–44.7)	32.8§
≥3	766	4,767	49.4 (43.5–55.3)	1,408	7,829	52.8 (46.6–58.8)	6.9

Abbreviations: BMI = body mass index (kg/m^2); CI = confidence interval; HS = high school.

* Estimates age-standardized to the 2000 U.S. standard population aged ≥18 years using three groups (18–44, 45–64, and ≥65 years).

† Weighted number in thousands of adults with arthritis and overweight or obesity reporting counseling out of the total 28.3 million (2002) and 38.9 million (2014) adults with arthritis and overweight or obesity.

§ Difference is significant (p-value) at an α = 0.05 level.

¶ Estimate potentially unreliable: relative standard error between 20%–30%.

** Based on response to the question "Have you ever taken an educational course or class to teach you how to manage problems related to your arthritis or joint symptoms?"

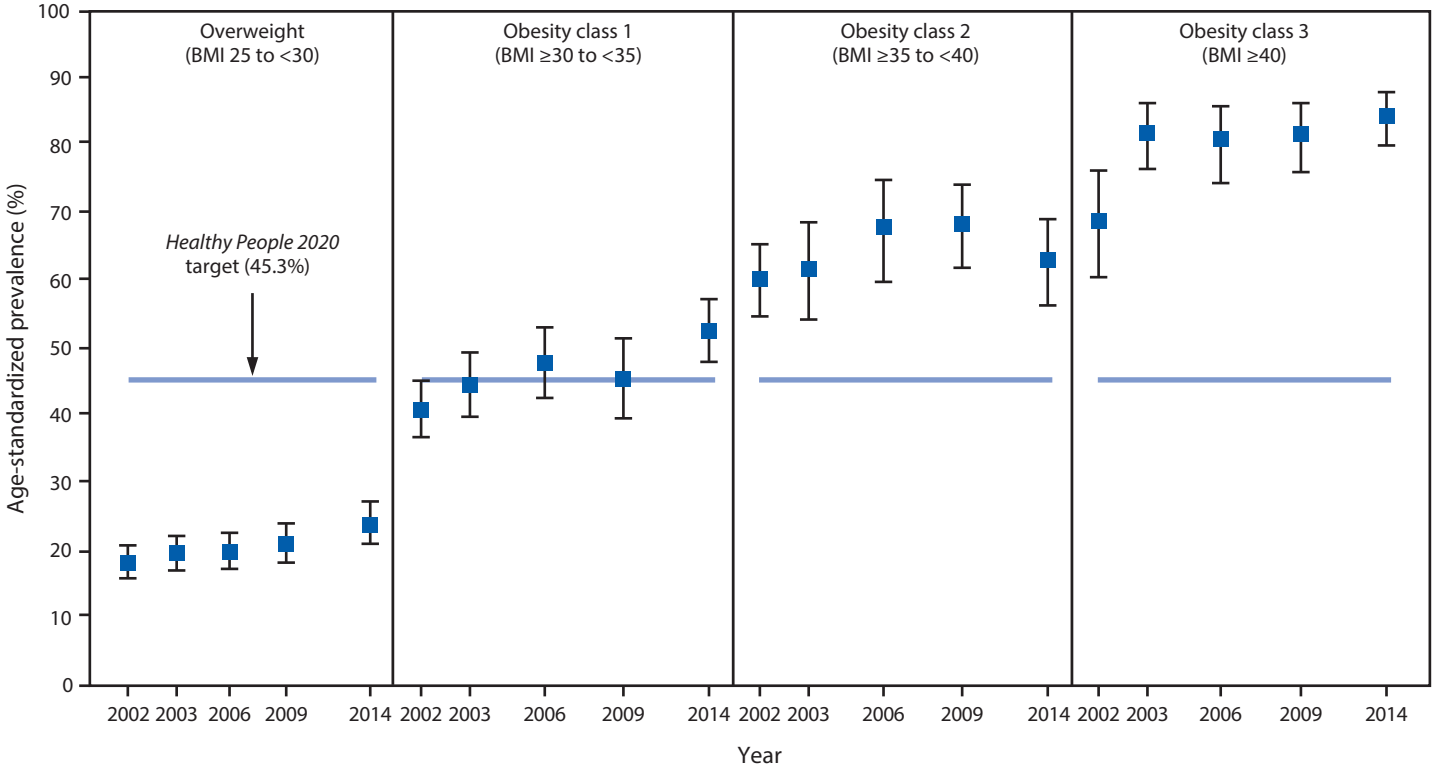
†† Joint pain severity was categorized on a scale of 0 to 10 where 0 is no pain or aching and 10 is pain or aching as bad as it can be.

§§ Respondents were classified as active if they reported ≥150 minutes of moderate intensity leisure time aerobic physical activity per week, insufficiently active if they reported 1–149 minutes, and inactive if they reported 0 minutes. Reported vigorous intensity physical activity minutes were counted double and added to moderate intensity physical activity minutes.

¶¶ Among these nine chronic conditions: asthma, cancer, diabetes, heart disease, hepatitis, hypertension, kidney disease, serious psychological distress, and stroke.

*** Estimate is suppressed because of unstable relative standard error >30.0%.

FIGURE. Age-standardized prevalence* of health care provider counseling for weight loss reported among adults aged ≥18 years with doctor-diagnosed arthritis and overweight or obesity, by year and body mass index (BMI) status — National Health Interview Survey, 2002, 2003, 2006, 2009, and 2014



* Estimates age-standardized to the 2000 U.S standard population aged ≥18 years using three age groups (18–44 , 45–64 ,and ≥65 years).

Summary

What is already known about this topic?

Weight loss among adults with arthritis and overweight or obesity can improve pain, function, mobility, and health-related quality of life, and reduce disability.

What is added by this report?

From 2002 to 2014, the prevalence of health care provider counseling for weight loss among adults with arthritis and overweight or obesity increased by 10.4 percentage points from 35.1% to 45.5%.

What are the implications for public health practice?

Provider counseling for weight loss in adults with arthritis and overweight or obesity, along with other health behavior counseling, including physical activity and self-management education, might increase attempts at weight loss and eventual success.

in weight over 20 weeks can significantly reduce functional disability in patients with knee osteoarthritis and obesity (*5*).

The findings in this report are subject to at least four limitations. First, NHIS data are self-reported and some characteristics might be susceptible to recall or social desirability bias. Specifically, the latter can lead to underestimation of BMI (*2*). Second, low response rates could also introduce response bias; however, sampling weights applied in the analysis include adjustment for nonresponse. Third, using BMI to classify overweight and obesity risks classifying some persons with a high muscle-to-fat ratio as having overweight or obesity, who might not require counseling. Finally, because 2014 data for provider counseling for weight loss were the most recent available, the prevalence might have changed since then.

Reported receipt of provider counseling for weight loss increased significantly among adults with arthritis and overweight or obesity from 2002 to 2014. Continuing this progress can ensure that the majority of adults in this population receive important messages that can increase their attempts to lose weight. Through combined counseling for weight loss, physical activity, and self-management education, and by making referrals to evidence-based programs, providers can help their patients with arthritis make meaningful improvements in quality-of-life and long-term health outcomes.

Conflict of Interest

No conflicts of interest were reported.

[1]Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]Oak Ridge Institute for Science and Education (ORISE); [3]Division of Nutrition, Physical Activity and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC.

Corresponding author: Dana Guglielmo, dguglielmo@cdc.gov, 404-498-5453.

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Progress Toward Measles Elimination — Western Pacific Region, 2013–2017

José E. Hagan, MD[1]; Jennifer L. Kriss, PhD[2]; Yoshihiro Takashima, MD, PhD[1]; Kayla Mae L. Mariano[1]; Roberta Pastore, MD[1]; Varja Grabovac, MSc[1]; Alya J. Dabbagh, PhD[3]; James L. Goodson, MPH[2]

In 2005, the Regional Committee for the World Health Organization (WHO) Western Pacific Region (WPR)* established a goal for measles elimination† by 2012 (*1*). To achieve this goal, the 37 WPR countries and areas implemented the recommended strategies in the WPR Plan of Action for Measles Elimination (*2*) and the Field Guidelines for Measles Elimination (*3*). The strategies include 1) achieving and maintaining ≥95% coverage with 2 doses of measles-containing vaccine (MCV) through routine immunization services and supplementary immunization activities (SIAs), when required; 2) conducting high-quality case-based measles surveillance, including timely and accurate testing of specimens to confirm or discard suspected cases and detect measles virus for genotyping and molecular analysis; and 3) establishing and maintaining measles outbreak preparedness to ensure rapid response and appropriate case management. This report updates the previous report (*4*) and describes progress toward measles elimination in WPR during 2013–2017. During 2013–2016, estimated regional coverage with the first MCV dose (MCV1) decreased from 97% to 96%, and coverage with the routine second MCV dose (MCV2) increased from 91% to 93%. Eighteen (50%) countries achieved ≥95% MCV1 coverage in 2016. Seven (39%) of 18 nationwide SIAs during 2013–2017 reported achieving ≥95% administrative coverage. After a record low of 5.9 cases per million population in 2012, measles incidence increased during 2013–2016 to a high of 68.9 in 2014, because of outbreaks in the Philippines and Vietnam, as well as increased incidence in China, and then declined to 5.2 in 2017. To achieve measles elimination in WPR, additional measures are needed to strengthen immunization programs to achieve high population immunity, maintain high-quality surveillance for rapid case detection and confirmation, and ensure outbreak preparedness and prompt response to contain outbreaks.

Immunization Activities

MCV1 and MCV2 coverage data are reported annually to WHO and the United Nations Children's Fund (UNICEF) from 36 of the 37 WPR countries and areas.§ WHO and UNICEF estimate vaccination coverage for 27 countries/areas in the region, using annual government-reported survey and administrative data; for the remaining areas and territories, reported coverage data from immunization program monitoring are used. Regional MCV1 and MCV2 coverage rates were maintained at ≥95% and >90%, respectively, during 2013–2016 (Table 1). In 2016, 18 (50%) of 36 countries achieved ≥95% MCV1 coverage, and 11 (31%) reported ≥95% coverage with both MCV1 and MCV2. As of 2017, only two (5%) WPR countries and areas (Solomon Islands and Vanuatu) had not yet introduced MCV2. During 2013–2017, 18 national SIAs¶ were conducted (Table 2); in addition, Japan conducted annual SIAs targeting schoolchildren aged 13 years and 17 years. Reported vaccination coverage was ≥95% in seven (39%) of the nationwide SIAs.

Surveillance Activities

Case-based measles and rubella surveillance data are reported monthly to WHO from all WPR countries and areas; 21 countries and areas of the Pacific Islands report data as one epidemiologic block.** The WHO Global Measles and Rubella Laboratory Network supports surveillance by providing laboratory confirmation and genotyping of reported cases. Suspected measles cases are confirmed based on laboratory findings, an epidemiologic link, or clinical criteria.†† Key indicators of surveillance performance include 1) the number of suspected measles cases discarded as nonmeasles (target: ≥2 per 100,000 population); 2) the proportion of second-level

* The Western Pacific Region, one of the six regions of the World Health Organization, consists of 37 countries and areas with a population of approximately 1.8 billion, including American Samoa (USA), Australia, Brunei, Cambodia, China, Commonwealth of the Northern Mariana Islands, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia (France), Guam (USA), Hong Kong (China), Japan, Kiribati, Laos, Macao (China), Malaysia, Marshall Islands, Mongolia, Nauru, New Caledonia (France), New Zealand, Niue, Palau, Papua New Guinea, Philippines, Pitcairn Islands (UK), Samoa, Singapore, Solomon Islands, South Korea, Tokelau (New Zealand), Tonga, Tuvalu, Vanuatu, Vietnam, and Wallis and Futuna (France).

† Measles elimination is defined as the absence of endemic measles virus transmission in a defined geographical area (e.g., region or country) for ≥12 months in the presence of a well-performing surveillance system.

§ The Pitcairn Islands, with a population of approximately 50 persons, does not report immunization coverage data to WHO/UNICEF.

¶ SIAs are generally carried out using two target age ranges. An initial, nationwide catch-up SIA targets children aged 9 months–14 years, with the goal of eliminating susceptibility to measles in the general population. Periodic follow-up SIAs then target children born since the last SIA. Follow-up SIAs are generally conducted nationwide every 2–4 years and generally target children aged 9–59 months; their goal is to eliminate any measles susceptibility that has developed in recent birth cohorts and to protect children who did not respond to the first measles vaccination.

** The epidemiologic block of countries and areas of the Pacific Islands includes American Samoa, Commonwealth of the Northern Mariana Islands, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, the Marshall Islands, Nauru, New Caledonia, Niue, Palau, Pitcairn Islands, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna.

†† Cases that meet the WHO clinical case definition for measles for which no adequate specimen was collected and cannot be epidemiologically linked to a laboratory-confirmed case of measles. Before 2013, in WPR these cases were classified as "clinically confirmed." Beginning in 2013, this classification was renamed "clinically compatible" and cases were only classified "confirmed" if they were laboratory-confirmed or epidemiologically linked. The change in terms reflects the recognition in WPR that clinically compatible cases represent a weakness in surveillance.

TABLE 1. Measles-containing vaccine (MCV) schedule, estimated coverage with the first and second dose of MCV,* number of confirmed measles cases,† and confirmed measles incidence, by country/area — World Health Organization Western Pacific Region, 2013, 2016, and 2017

			2013				2016				2017¶	
	MCV schedule§		Coverage (%)				Coverage (%)					
Country/Area	Age when 1st dose given	Age when 2nd dose given	MCV1	MCV2	No. of measles cases	Incidence per million population	MCV1	MCV2	No. of Measles cases	Incidence per million population	No. of measles cases	Incidence per million population
American Samoa**	12 mos	4 yrs	NR††	NR††	0	0	NR††	NR††	0	0.0	0	0.0
Australia	12 mos	18 mos	94	92	154	6.7	95	94	99	4.1	81	3.3
Brunei	12 mos	18 mos	96	92	0	0.0	98	97	1	2.4	0	0.0
Cambodia	9 mos	18 mos	76	49	0	0.0	81	58	56	3.6	10	0.6
China	8 mos	18 mos–24 mos	99	99	27,825	20.1	99	99	24,839	17.7	5,993	4.3
CNMI**	12 mos	4 yrs	68§§	65§§	0	0.0	62	72	0	0.0	0	0.0
Cook Islands	15 mos	4 yrs	97	95	0	0.0	90	90	0	0.0	0	0.0
Fiji	12 mos	6 yrs	94	94	0	0.0	94	94	5	5.6	1	1.1
French Polynesia**	12 mos	18 mos	99§§	98§§	0	0.0	99§§	98§§	0	0.0	0	0.0
Guam**	12 mos	4 yrs–6 yrs	51§§	44§§	0	0.0	92	NR††	0	0.0	0	0.0
Hong Kong (China)**	12 mos	6 yrs	95	95	38	5.3	95	95	9	1.2	4	0.5
Japan	12 mos	5 yrs	95	93	207	1.6	96	93	157	1.2	187	1.5
Kiribati	12 mos	6 yrs	91	84	0	0.0	80	79	0	0.0	0	0.0
Laos¶¶	9 mos	12 mos	82	NA***	68	10.5	76	NA***	8	1.2	3	0.4
Macao (China)**	12 mos	18 mos	99	96	3	5.2	94	92	0	0.0	2	3.2
Malaysia	12 mos	7 yrs	95	99	182	6.1	96	99	1,587	50.9	1,648	52.1
Marshall Islands	12 mos	13 mos	79	56	0	0.0	75	49	0	0.0	0	0.0
Micronesia	12 mos	13 mos	91	75	0	0.0	70	74	0	0.0	0	0.0
Mongolia	9 mos	2 yrs	97	97	0	0.0	98	90	28,813	9,517.4	9	2.9
Nauru	12 mos	15 mos	97	88	0	0.0	98	96	0	0.0	0	0.0
New Caledonia**	12 mos	16 mos	96	86	0	0.0	96	86	0	0.0	0	0.0
New Zealand	15 mos	4 yrs	92	86	25	5.5	92	89	104	22.3	15	3.2
Niue	15 mos	4 yrs	99	99	0	0.0	99	99	0	0.0	0	0.0
Palau	12 mos	15 mos	99	98	0	0.0	96	95	0	0.0	0	0.0
Papua New Guinea	9 mos†††	18 mos	89	NR††	9	1.2	70	NR††	0	0.0	7	0.8
Philippines	9 mos	12 mos–15 mos	87	54	5,798	58.9	80	66	641	6.2	1,224	11.7
Samoa	12 mos	15 mos	90	72	0	0.0	68	44	0	0.0	0	0.0
Singapore	12 mos	15 mos–18 mos	95	90	66	12.3	95	88	157	27.9	80	14.0
Solomon Islands	12 mos	NA***	93	NA***	0	0.0	99	NA***	1	1.7	0	0.0
South Korea	12 mos–15 mos	4 yrs–6 yrs	99	95	107	2.1	98	97	18	0.4	7	0.1
Tokelau**	12 mos	15 mos	100	100	0	0.0	100§§	100§§	0	0.0	0	0.0
Tonga	12 mos	18 mos	86	86	0	0.0	84	85	0	0.0	0	0.0
Tuvalu	12 mos	18 mos	96	84	0	0.0	96	92	0	0.0	0	0.0
Vanuatu	12 mos	NA***	53	NA***	0	0.0	53	NA***	0	0.0	0	0.0
Vietnam	9 mos	18 mos	98	86	1,232	13.5	99	95	368	3.9	667	7.0
Wallis and Futuna**	12 mos	18 mos	>100§§	>100§§	0	0.0	79§§	80§§	0	0.0	0	0.0
Western Pacific Region	—	—	97	91	35,700	19.2	96	93	56,836	30.1	9,938	5.2

Abbreviations: CNMI = Commonwealth of the Northern Mariana Islands; MCV1 = first dose of MCV; MCV2 = second dose of MCV; WHO = World Health Organization.

* WHO-United Nations Children's Fund (UNICEF) estimates.

† Includes confirmed cases by laboratory or epidemiologic linkage and clinically compatible cases meeting the WHO clinical case definition of measles for which no adequate specimen was collected and that cannot be epidemiologically linked to a laboratory-confirmed case of measles.

§ MCV schedule is the 2017 schedule.

¶ 2017 MCV1 and MCV2 coverage estimates not available.

** Country or area reported coverage for MCV1 and MCV2 based on administrative data.

†† NR = not reported (country did not report coverage in the year specified).

§§ No data available for assessment year; data from previous year is reported instead.

¶¶ Laos introduced MCV2 in 2017.

*** NA = not applicable (dose was not included in the vaccination schedule for that year).

††† Additional 6-month dose provided nationally.

administrative units with two or more nonmeasles discarded cases per 100,000 population (target: ≥80%); 3) the percentage of suspected measles cases with adequate investigation that includes all essential data elements§§ (target: ≥80%); 4) the percentage of suspected measles cases with adequate specimens collected within 28 days of rash onset (target: ≥80%, excludes epidemiologically linked cases); and 5) the percentage of specimens with laboratory results available within 7 days after receipt in the laboratory (target: ≥80%). During 2013–2017, the number of WPR countries and areas¶¶ that met the target for suspected cases discarded as nonmeasles per 100,000

§§ Essential data elements include name or identifier, date of birth or age, sex, place of residence, vaccination status or date of last vaccination, date of rash onset, date of notification, date of investigation, date of specimen collection, and place of infection or travel history.

¶¶ Percentages were calculated using a denominator of 17 (16 countries or areas, plus the epidemiologic block of the Pacific Islands countries and areas).

TABLE 2. Characteristics of measles supplementary immunization activities (SIAs),* by year and country/area — World Health Organization Western Pacific Region, 2013–2017

Year	Country/Area	Age group targeted	Vaccine used	Extent of SIA	No. (%) of population reached in targeted age group
2013	Cambodia	9 mos–14 yrs	MR	National	4,576,633 (>100)
	Federated States of Micronesia	12 mos–47 mos	MMR	Subnational	3,435 (95)
	Philippines	6 mos–59 mos	M	National	1,937,471 (ND)
	Singapore	6 yrs–7 yrs	MMR	National	38,436 (95)
	Vanuatu	12 mos–59 mos	MMR	National	33,604 (>100)
	Vietnam	1 yr–15 yrs	M	Subnational	163,870 (94)
2014	Federated States of Micronesia	6 mos–57 yrs†	MMR	National	71,388 (87)
	Laos	9 mos–9 yrs	MR	National	1,569,613 (100)
	Malaysia	6 mos–17 yrs	M	Subnational	54,656 (63)
	Philippines	9 mos–59 mos	MR	National	10,402,489 (91)
	Philippines	6 mos–36 mos	M	Subnational	1,695,930 (78)
	Vietnam	9 mos–24 mos	M	National	875,386 (94)
2015	Malaysia	9 mos–17 yrs	MMR	Subnational	21,518 (90)
	Mongolia	9 mos–17 yrs	M	National	347,685 (94)
	Papua New Guinea	9 mos–14 yrs	MR	National	801,436 (62)
	Vanuatu	6 mos–59 mos	M	Subnational	24,336 (98)
	Vanuatu	1 yr–15 yrs	MR	National	103,676 (>100)
	Vietnam	1 yr–14 yrs	MR	National	19,740,181 (98)
2016	Cambodia	9 mos–59 mos	MR	National	766,743 (91)
	Malaysia	1 yr–17 yrs	MR	Subnational	139,954 (85)
	Mongolia	18 yrs–30 yrs	MR	National	549,846 (88)
	Papua New Guinea	9 mos–15 yrs	MR	Subnational	436,854 (63)
	Vietnam	16 yrs–17 yrs	MR	National	1,787,588 (95)
2017	Cambodia	6 mos–59 mos	MR	National	1,452,821 (75)
	Fiji	12 mos–11yrs	MR	National	ND
	Laos	9 mos–4 yrs	MR	National	ND
	Papua New Guinea	6 mos–45 yrs	MR	Subnational	ND
2013–2017	**Western Pacific Region**				**47,595,549 (93§)**

Abbreviations: M = monovalent measles vaccine; MMR = measles, mumps, and rubella vaccine; MR = measles and rubella vaccine; ND = no data.

* SIAs generally are carried out using two approaches. An initial, nationwide catch-up SIA targets all children aged 9 months–14 years; it has the goal of eliminating susceptibility to measles in the general population. Periodic follow-up SIAs then target all children born since the last SIA. Follow-up SIAs generally are conducted nationwide every 2–4 years and generally target children aged 9–59 months; their goal is to eliminate any measles susceptibility that has developed in recent birth cohorts and to protect children who did not respond to the first measles vaccination. The exact age range for follow-up SIAs depends on the age-specific incidence of measles, coverage with measles-containing vaccine through routine services, and the time since the last SIA.

† Targeted age groups varied by province.

§ Average SIA coverage, weighted by size of target population.

population at the national level decreased from 11 (65%) to nine (53%), but increased from one (6%) to two (12%) at the subnational level. From 2013 to 2017, the percentage of suspected cases with adequate investigations decreased from 92% to 89%; the percentage of suspected cases with adequate specimens collected for laboratory testing decreased from 90% to 89%; and the proportion of blood specimens received by the laboratory with results available within 7 days increased from 84% to 98% (Supplementary Table, https://stacks.cdc.gov/view/cdc/53519).

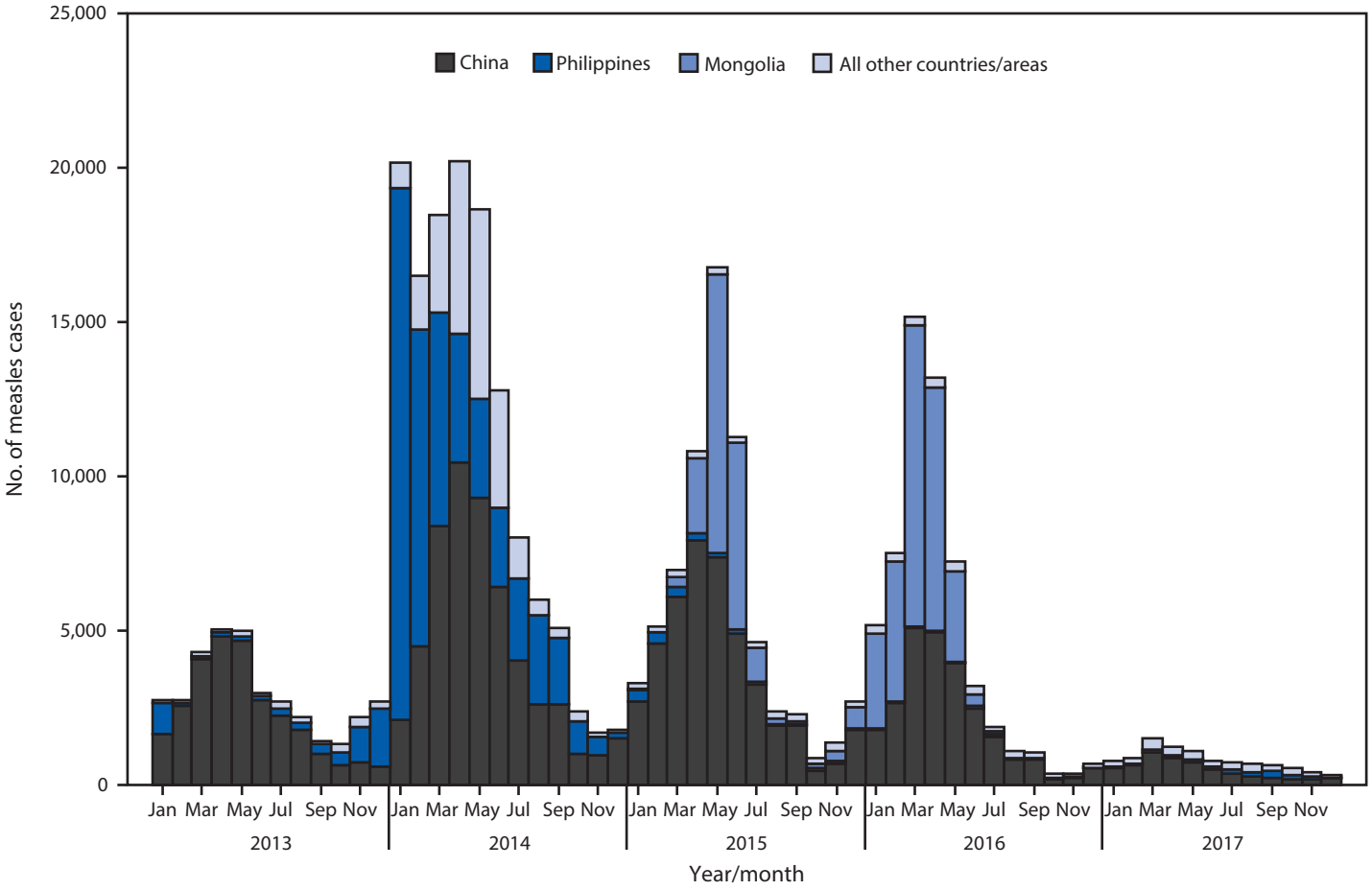
Measles Incidence and Genotypes

WPR experienced a resurgence of measles during 2013–2016 (Figure), after a record low incidence of 5.9 cases per million population in 2012. During the resurgence, incidence of seasonal endemic measles virus transmission in China increased, and large-scale nationwide outbreaks occurred in other countries with endemic measles (Malaysia and the Philippines). During 2013–2016, after importations from countries with endemic disease, measles outbreaks also occurred in countries that had been verified as having eliminated endemic measles virus transmission (Australia, Cambodia, Japan, and South Korea), including a large-scale outbreak in Mongolia. An increase in importations also led to outbreaks in several countries with endemic, low-incidence measles, including New Zealand, Papua New Guinea, Singapore, Solomon Islands, and Vietnam. Annual regional measles incidence per 1 million population increased from 19.2 in 2013 to 68.9 in 2014, and then decreased to 5.2 in 2017, a historic low (Table 1). The predominantly detected circulating measles virus genotypes were H1 in China, B3 in the Philippines, and both D8 and D9 in Malaysia and Vietnam.

Regional Verification of Measles Elimination

After the request of the Western Pacific Regional Committee (5) for WHO to establish a formal mechanism for verification of elimination through the Regional Verification Commission, verification guidelines were finalized in April 2013 and revised

FIGURE. Confirmed measles cases,* by month of rash onset — World Health Organization Western Pacific Region, 2013–2017



* Confirmed and clinically compatible measles cases reported by countries and areas to the World Health Organization (WHO). A case of measles was laboratory-confirmed when measles-specific immunoglobulin M antibody was detected in serum, measles-specific RNA was detected by polymerase chain reaction, or measles virus was isolated in cell culture from a person who was not vaccinated during the 30 days before rash onset. A case of measles was confirmed by epidemiologic linkage when linked in time and place to a laboratory-confirmed measles case without serologic confirmation. During 2013–2017, a case of measles meeting the WHO clinical case definition but without a specimen collected could be reported as clinically compatible.

in 2016 to include verification of rubella elimination. As of the September 2017 Regional Verification Commission meeting, a total of eight (47%) WPR countries and areas (Australia, Brunei, Cambodia, Hong Kong [China], Japan, Macao [China], New Zealand, and South Korea) have been verified as having achieved elimination of measles (*6*). After a nationwide outbreak in Mongolia during 2015–2016 that lasted longer than 12 months, the Regional Verification Commission determined that endemic measles virus transmission had been reestablished in Mongolia (*7*).

Discussion

The 2013–2016 measles resurgence in WPR was attributed to three factors. First, increased measles virus transmission occurred in countries with endemic disease (e.g., China, Malaysia, and the Philippines). Second, large-scale outbreaks occurred after importation of measles into countries with endemic, low-incidence measles. Third, multiple measles importations into countries or areas that had achieved elimination occurred, particularly in Mongolia, where a large outbreak persisted for >12 months and endemic measles virus transmission was reestablished.

Measles incidence in WPR declined to a historic low of 5.2 in 2017 because of achievement of control of the outbreaks in Vietnam (2013–2014) and Mongolia (2015–2016), burnout of the outbreak in the Philippines (2013–2014), and China's accelerated control of measles after the 2010–2011 outbreak. However, the resurgence during 2013–2016 revealed ongoing and emerging challenges that need to be addressed. These challenges include changing measles epidemiology, with increased measles incidence occurring among adolescents, young adults, and infants too young to be vaccinated as well as heterogeneity of measles epidemiology among subnational areas and specific groups at risk within countries with large populations. In addition, the resurgence revealed systems weaknesses: immunization

Summary

What is already known about this topic?

Most countries in the World Health Organization Western Pacific Region (WPR) have made substantial progress toward measles elimination.

What is added by this report?

During 2013–2016, a resurgence of measles occurred in WPR, with large-scale outbreaks in Mongolia, the Philippines, and Vietnam, and increased endemic transmission in China; in 2014, annual incidence increased to 68.9 cases per million. However, with control of the outbreaks, in 2017, incidence decreased to a new historic low (5.2 per million).

What are the implications for public health practice?

Achieving high reported vaccination coverage is not sufficient for achieving regional measles elimination. Efforts by WPR countries are needed to establish high population immunity, build strong immunization systems, maintain high-quality surveillance, and improve outbreak preparedness and response.

programs were unable to achieve and maintain high population immunity through routine immunization service delivery, and some national laboratories had insufficient capacity to conduct timely serologic testing during outbreaks. The challenges identified also included inadequately developed and implemented policies and processes for preventing measles resurgence and morbidity after virus introduction to the population, including delayed outbreak investigation, insufficient outbreak response, and nosocomial measles virus transmission. Finally, the resurgence revealed a need for greater involvement of local governments, private sectors, societies, and communities.

To address these challenges and to accelerate measles elimination efforts in WPR, the WHO Regional Office for the Western Pacific prepared a new strategy and plan of action for measles and rubella elimination in the Western Pacific that was endorsed by the 68th meeting of the WHO Regional Committee for the Western Pacific in October 2017 (*5*). The document details 31 strategies with accompanying activities in the following eight areas: 1) overall planning; 2) immunization services; 3) epidemiologic surveillance; 4) laboratory support; 5) program review and risk assessment; 6) outbreak preparedness and response; 7) partnerships, advocacy, information, education and communication, and social mobilization; and 8) progress monitoring and verification of elimination. The new regional strategy is designed to address specific challenges facing WPR countries and to serve as a resource for development of national plans of action (and subnational plans for countries with large populations), tailored to country-specific opportunities for achieving and maintaining measles elimination.

Collective efforts among WPR countries are important for achieving regional measles elimination. Working together to follow the recommended strategies and actions in the Regional Strategy and Plan of Action for Measles and Rubella Elimination could help WPR countries in their efforts to strengthen immunization programs to achieve and sustain high population immunity, maintain high-quality surveillance for rapid case detection and confirmation, and ensure outbreak preparedness and prompt response to contain outbreaks.

Conflict of Interest

No conflicts of interest were reported.

[1]Western Pacific Regional Office, Expanded Programme on Immunization, World Health Organization, Manila, Philippines; [2]Global Immunization Division, Center for Global Health, CDC; [3]Department of Immunization, Vaccines, and Biologicals, World Health Organization, Geneva, Switzerland.

Corresponding author: Jennifer L. Kriss, jkriss@cdc.gov, 404-718-5099.

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Vital Signs: Trends in Reported Vectorborne Disease Cases — United States and Territories, 2004–2016

Ronald Rosenberg, ScD[1]; Nicole P. Lindsey, MS[1]; Marc Fischer, MD[1]; Christopher J. Gregory, MD[1]; Alison F. Hinckley, PhD[1]; Paul S. Mead, MD[1]; Gabriela Paz-Bailey, MD[1]; Stephen H. Waterman, MD[1]; Naomi A. Drexler, MPH[1]; Gilbert J. Kersh, PhD[1]; Holley Hooks, MPH[1]; Susanna K. Partridge, MPH[1]; Susanna N. Visser, DrPH[1]; Charles B. Beard, PhD[1]; Lyle R. Petersen, MD[1]

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Abstract

Introduction: Vectorborne diseases are major causes of death and illness worldwide. In the United States, the most common vectorborne pathogens are transmitted by ticks or mosquitoes, including those causing Lyme disease; Rocky Mountain spotted fever; and West Nile, dengue, and Zika virus diseases. This report examines trends in occurrence of nationally reportable vectorborne diseases during 2004–2016.

Methods: Data reported to the National Notifiable Diseases Surveillance System for 16 notifiable vectorborne diseases during 2004–2016 were analyzed; findings were tabulated by disease, vector type, location, and year.

Results: A total 642,602 cases were reported. The number of annual reports of tickborne bacterial and protozoan diseases more than doubled during this period, from >22,000 in 2004 to >48,000 in 2016. Lyme disease accounted for 82% of all tickborne disease reports during 2004–2016. The occurrence of mosquitoborne diseases was marked by virus epidemics. Transmission in Puerto Rico, the U.S. Virgin Islands, and American Samoa accounted for most reports of dengue, chikungunya, and Zika virus diseases; West Nile virus was endemic, and periodically epidemic, in the continental United States.

Conclusions and Implications for Public Health Practice: Vectorborne diseases are a large and growing public health problem in the United States, characterized by geographic specificity and frequent pathogen emergence and introduction. Differences in distribution and transmission dynamics of tickborne and mosquitoborne diseases are often rooted in biologic differences of the vectors. To effectively reduce transmission and respond to outbreaks will require major national improvement of surveillance, diagnostics, reporting, and vector control, as well as new tools, including vaccines.

Introduction

Vectors are blood-feeding insects and ticks capable of transmitting pathogens between hosts. Wide varieties of pathogens have evolved to exploit vector transmission, including some viruses, bacteria, rickettsia, protozoa, and helminths. Dengue viruses are estimated to infect nearly 400 million persons worldwide each year (*1*), and malaria (*2*) is a major cause of pediatric mortality in equatorial Africa. Plague (*3*) and rickettsioses (*4*) cause deadly epidemics abroad. In the United States, 16 vectorborne diseases are reportable to state and territorial health departments, which are encouraged to report them to the National Notifiable Disease Surveillance System (NNDSS). Among the diseases on the list that are caused by indigenous pathogens are Lyme disease *(Borrelia burgdorferi*); West Nile, dengue and Zika virus diseases; plague (*Yersinia pestis*); and spotted fever rickettsioses (e.g., *Rickettsia rickettsii*). Malaria and yellow fever are no longer transmitted in the United States but have the potential to be reintroduced. As a group, vectorborne diseases in the United States are notable for their wide distribution and resistance to control. A Food and Drug Administration–approved vaccine is available to prevent only one of the notifiable diseases, yellow fever.

Despite the dissimilarities among vectorborne pathogens and the many vector species that can transmit them, commonalities exist. Vectorborne disease epidemiology is complex because of environmental influences on the biology and behavior of the vectors. The longevity, distribution, biting habits, and propagation of vectors, which ultimately affect the intensity of transmission, depend on environmental factors such as rainfall, temperature, and shelter. Most vectorborne pathogens are zoonoses, often with wild animal reservoirs, such as rodents or birds, making them difficult or impossible to eliminate. Arthropod vectors can bridge the gap between animals and

humans that would not ordinarily intersect, as happens in Lyme disease, plague, and West Nile virus (WNV), facilitating the introduction of emerging animal pathogens to humans.

The pace of emergence of new or obscure vectorborne pathogens through introduction or belated recognition appears to be increasing. Since 2004, these have included two previously unknown, life-threatening tickborne RNA viruses, Heartland (*5*) and Bourbon (*6*), both reported from the U.S. Midwest. A tickborne relapsing fever agent, *Borrelia miyamotoi*, first described in Japan, has been found widely distributed in the United States (*7*) and another bacterial spirochete, *Borrelia mayonii* (*8*) was discovered in the upper U.S. Midwest. Two tickborne spotted fever *Rickettsiae*, *R. parkeri* (*9*) and *Rickettsia* species 364D *(10)*, and a tickborne *Ehrlichia* (*E. muris eauclairensis*) (*11*) were discovered to be pathogenic to humans. The mosquitoborne viruses chikungunya and Zika were introduced to Puerto Rico in 2014 and 2015, respectively. Zika virus is emblematic of the dangers of emergence. Zika was one of a number of obscure, mosquitoborne viruses known to be pathogenic to humans that are rarely encountered or studied (*12*). In the 60 years following its discovery in a monkey in Uganda, it was seldom reported as a human pathogen. In 2016, there were >36,000 cases reported in Puerto Rico, limited autochthonous, or local, transmission in Florida and Texas, and nearly 5,000 cases among travelers to the United States (*13*). The teratogenic consequences of the 2015–2017 epidemic in the region of the Americas were unexpected.

CDC examined trends of reported vectorborne disease cases in the United States during 2004–2016; this report discusses the challenges of prevention and control and highlights opportunities for vectorborne disease preparedness at the state and local level.

Methods

Vectorborne disease data from NNDSS were retrieved from 2004, the first year that both neuroinvasive and nonneuroinvasive arthropodborne viral (arboviral) diseases were nationally notifiable, through 2016, the most recent year for which complete data are available (https://wwwn.cdc.gov/nndss/conditions/notifiable). Data were tabulated by disease, vector type (i.e., mosquito, tick, or flea), state or territory of residence, and year. State health departments report human disease cases using standard surveillance case definitions that include clinical and laboratory criteria. For some diseases, data reported according to Council of State and Territorial Epidemiologists definitions as confirmed or probable have been combined; autochthonous and travel-associated cases have been analyzed together by state or territory in which they were found.

Chikungunya virus, Zika virus, and *Babesia* cases became notifiable after 2004; only those data in NNDSS are presented. Although dengue became nationally notifiable only in 2010, earlier national data were available from CDC's Dengue Branch and are included in this analysis.

Results

Nearly 650,000 cases of vectorborne disease were reported during 2004–2016 (Table). Tickborne diseases, which accounted for >75% of reports, occur throughout the continental United States, but predominate in the eastern part of the country and in areas along the Pacific Coast (Figure 1). Reported cases of tickborne disease have doubled in the 13-year analysis period, with Lyme disease accounting for 82% of cumulative reported tickborne disease. The combined incidence of reported anaplasmosis and ehrlichiosis, which are tickborne bacterial diseases, rose almost every year, as did spotted fever; babesiosis, a tickborne parasitic infection that has been notifiable since 2011, also contributed to the rise. Endemic plague, a fleaborne disease that is transmitted mostly in the rural southwestern United States, did not exceed 17 cases in a year. Tularemia and ehrlichiosis are geographically widespread but more prevalent in the central United States.

By contrast, the occurrence of mosquitoborne viruses was dispersed (Figure 2) and punctuated by epidemics (Table) (Figure 3). WNV was the most commonly transmitted mosquitoborne disease in the continental United States. Its most notable epidemic during 2004–2016 occurred in 2012, especially in Texas. Epidemics of dengue, chikungunya, and Zika viruses were mostly confined to the U.S. territories. All four dengue viruses were endemic in Puerto Rico, which was subject to cyclical epidemics, notably in 2010 and during 2012–2013. Puerto Rico's first chikungunya virus epidemic peaked in 2014, followed by Zika virus in 2016. Travelers infected in the territories and Latin America accounted for >90% of the dengue, chikungunya, and Zika virus disease cases identified in the states and District of Columbia; limited autochthonous transmission of dengue occurred in Florida, Hawaii, and Texas, and of chikungunya and Zika viruses in Texas and Florida. Malaria is diagnosed in approximately 1,500 travelers yearly but no autochthonous transmission was documented during 2004–2016.

Conclusions and Comments

These data indicate persistent, locality-specific risks and a rising threat from emerging vectorborne diseases, which have increasingly encumbered local and state health departments tasked with preventing, detecting, reporting, and controlling them. The overall case number masks two distinct trends. Epidemics characterize the mosquitoborne viruses. WNV transmission is effectively limited to the continental United States, whereas most dengue, chikungunya, and Zika virus transmission occurred in the territories. By contrast, the increasing reports of tickborne disease, which occurs almost exclusively in the continental United States, has been gradual. The area at risk for Lyme disease has been expanding (*14*). Although Lyme disease accounts for 82% of all reported tickborne diseases, spotted fevers, babesiosis, and anaplasmosis/ehrlichiosis have become

TABLE. Vectorborne disease cases reported to National Notifiable Disease Surveillance System — U.S. states and territories, 2004–2016*

Disease	Year													
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Tickborne diseases														
Lyme disease†	19,804	23,305	19,931	27,444	35,198	38,468	30,158	33,097	30,831	36,307	33,461	38,069	36,429	**402,502**
Anaplasmosis/ Ehrlichiosis§	875	1,404	1,455	1,999	2,107	2,267	2,615	3,586	3,725	4,551	4,488	5,137	5,750	**39,959**
Spotted fever rickettsiosis¶	1,713	1,936	2,288	2,221	2,563	1,815	1,985	2,802	4,470	3,359	3,757	4,198	4,269	**37,376**
Babesiosis**	N	N	N	N	N	N	N	1,128	937	1,796	1,760	2,100	1,910	**9,631**
Tularemia	134	154	95	137	123	93	124	166	149	203	180	314	230	**2,102**
Powassan virus	1	1	1	7	2	6	8	16	7	15	8	7	22	**101**
Subtotal tickborne diseases	**22,527**	**26,800**	**23,770**	**31,808**	**39,993**	**42,649**	**34,890**	**40,795**	**40,119**	**46,231**	**43,654**	**49,825**	**48,610**	**491,671**
Mosquitoborne diseases														
Dengue viruses††	721	2,462	882	4,484	1,118	2,759	11,611	1,795	6,714	10,727	1,226	1,015	1,178	**46,692**
Zika virus	N	N	N	N	N	N	N	N	N	N	N	N	41,680	**41,680**
West Nile virus	2,539	3,000	4,269	3,630	1,356	720	1,021	712	5,674	2,469	2,205	2,175	2,149	**31,919**
Malaria**	1,458	1,498	1,476	1,411	1,257	1,456	1,778	1,726	1,504	1,594	1,654	1,397	1,958	**20,167**
Chikungunya virus	N	N	N	N	N	N	N	N	N	N	7,521	1,133	427	**9,081**
California serogroup viruses§§	118	80	69	55	62	55	75	137	81	112	96	70	53	**1,063**
St. Louis encephalitis virus	15	13	10	9	13	12	10	6	3	1	10	23	8	**133**
Eastern equine encephalitis virus	7	21	8	4	4	4	10	4	15	8	8	6	7	**106**
Yellow fever virus	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Subtotal mosquitoborne diseases	**4,858**	**7,074**	**6,714**	**9,593**	**3,810**	**5,006**	**14,505**	**4,380**	**13,991**	**14,911**	**12,720**	**5,819**	**47,461**	**150,842**
Fleaborne disease														
Plague	3	8	17	7	3	8	2	3	4	4	10	16	4	**89**
Total vectorborne diseases	**27,388**	**33,882**	**30,501**	**41,408**	**43,806**	**47,663**	**49,397**	**45,178**	**54,114**	**61,146**	**56,384**	**55,660**	**96,075**	**642,602**

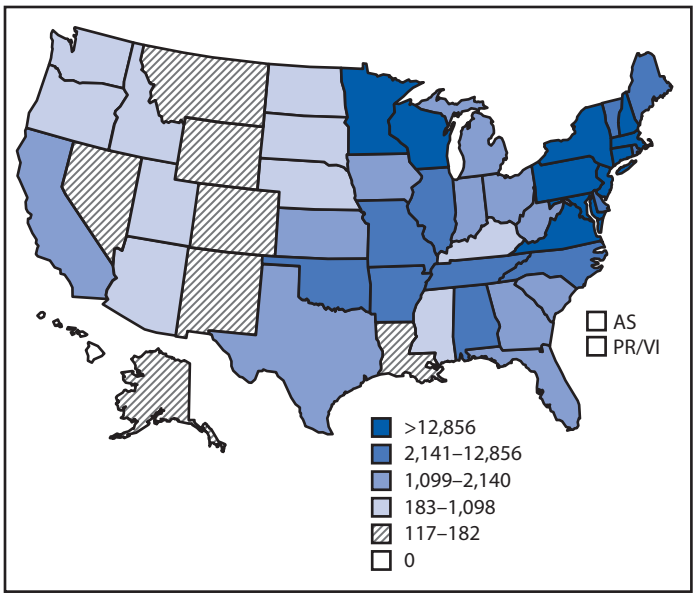
Abbreviation: N = not notifiable.
* U.S. territories included are Puerto Rico, U.S. Virgin Islands, and American Samoa.
† Lyme disease reporting changed in 2008 to include probable cases in addition to confirmed cases.
§ Anaplasmosis and ehrlichiosis were reported separately after 2008 but are combined here for the entire period.
¶ Includes *R. rickettsii, R. parkeri, R.* species 364D.
** Surveillance data for babesiosis and malaria may be reported independently to different CDC programs; these data might vary slightly from those presented elsewhere.
†† Dengue became reportable to the National Notifiable Diseases Surveillance System in 2010. 2004–2009 data from Dengue Branch, Division of Vector-Borne Diseases, CDC.
§§ Includes Jamestown Canyon, La Crosse, and unspecified California serogroup viruses.

increasingly prevalent. Diseases caused by pathogens that were relatively uncommon during the 13-year analysis period remain important because of their historical potential to cause epidemics (e.g., St. Louis encephalitis virus), their high case fatality rates (e.g., eastern equine encephalitis virus), or their potential as bioterror agents (e.g., plague and tularemia).

The reported data substantially underestimate disease occurrence. NNDSS relies on a person seeking care, a clinician requesting appropriate tests, and providers or laboratories reporting to public health authorities. Recent data from clinical and laboratory diagnoses estimate that Lyme disease infects approximately 300,000 Americans yearly, eight- to tenfold more than the number reported (*15*,*16*). Many arbovirus infections result in minimal symptoms. It has been estimated that 30–70 nonneuroinvasive arboviral disease cases occur for every WNV neuroinvasive disease case reported (*17*). Based on the number of neuroinvasive disease cases reported in 2016, between 39,300 and 91,700 nonneuroinvasive disease cases of WNV would have been expected to occur, but only 840 (1%–2%) were reported (*17*).

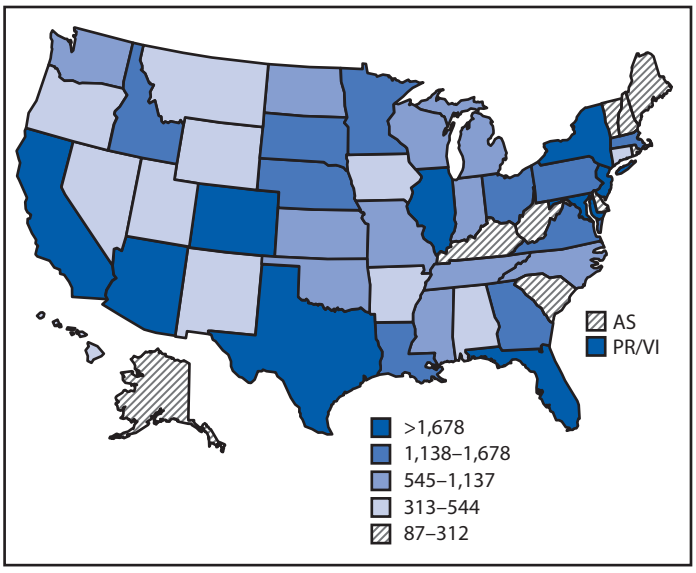
The dynamics of vectorborne pathogen transmission are significantly influenced by the characteristics of vector, reservoir, and host. Tickborne pathogens rarely cause sudden epidemics because humans are typically incidental hosts who do not transmit further, and tick mobility is mostly limited to that of its animal hosts. For ticks, the prolonged life cycle and widely separated blood feeds limit opportunities for pathogen transmission. *Ixodes scapularis*, for example, an important vector of *B. burgdorferi*, might feed on blood once in a year, but this is compensated for by their broad host preferences and the ability of single ticks to transmit multiple pathogen species. In contrast, the more mobile female mosquitoes feed on blood every 48–72 hours.

FIGURE 1. Reported cases* of tickborne disease — U.S. states and territories, 2004–2016



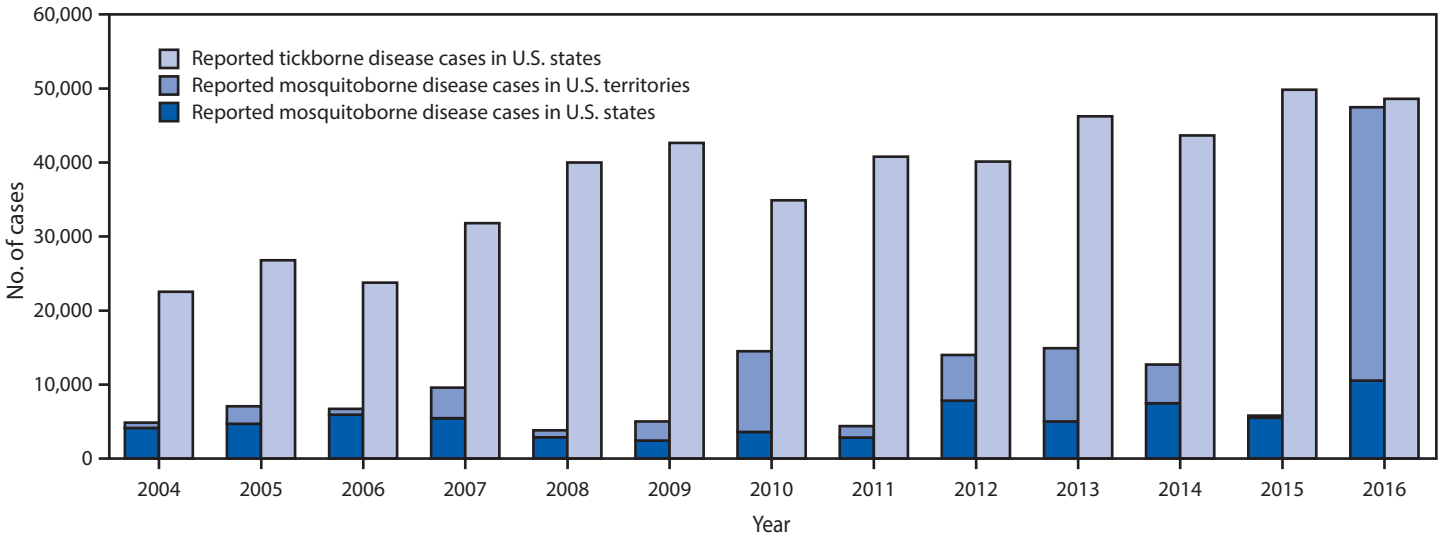
Sources: CDC, National Notifiable Diseases Surveillance System, 2016 Annual Tables of Infectious Disease Data. https://wwwn.cdc.gov/nndss/infectious-tables.html. CDC, Division of Health Informatics and Surveillance. CDC, ArboNET.
Abbreviations: AS = American Samoa; PR/VI = Puerto Rico/U.S. Virgin Islands.
* Data classified by quintile.

FIGURE 2. Reported cases* of mosquitoborne disease — U.S. states and territories, 2004–2016



Sources: CDC, National Notifiable Diseases Surveillance System, 2016 Annual Tables of Infectious Disease Data. https://wwwn.cdc.gov/nndss/infectious-tables.html. CDC, Division of Health Informatics and Surveillance. CDC, ArboNET.
Abbreviations: AS = American Samoa; PR/VI = Puerto Rico/U.S. Virgin Islands.
* Data classified by quintile.

FIGURE 3. Reported nationally notifiable mosquitoborne,* tickborne, and fleaborne† disease cases — U.S. states and territories, 2004–2016



* Mosquitoborne case counts include both locally transmitted and travel-associated cases. Only 305 arbovirus cases were reported from the territories in 2015.
† A total of 89 fleaborne disease cases (plague) were reported during 2004–2018, ranging from two cases in 2010 to 16 cases in 2015. The cases are not depicted on the figure.

Dengue, Zika, and chikungunya viruses are typically transmitted directly between humans by the mosquito, *Aedes aegypti*, after about a week's extrinsic incubation period, resulting in explosive epidemics. WNV is one of the few purely zoonotic vectorborne pathogens with epidemic potential; humans are only at risk from mosquitoes that have fed on viremic birds. There must be a coincidence of flocks with a high prevalence of infection near humans when vector mosquito species are abundant. Bird movement was responsible for WNV's rapid spread across the United States after its introduction to New York City in 1999.

The presence of competent vector species does not alone assure transmission. *Ae. aegypti*, whose range has been expanding,

might now be present in up to 38 states (*18*), but despite the frequent arrival of travelers infected with dengue, chikungunya, or Zika viruses, autochthonous transmission has been rare. No local transmission of malaria resulted from the importation of about 1,500 cases annually, even though *Anopheles* mosquitoes are present in much of the United States. Although the range of *Ixodes scapularis* extends over much of the eastern United States, transmission of Lyme disease, *B. microti* babesiosis, and Powassan virus are rare outside of the Northeast and upper Midwest regions. Whatever the biologic, economic, behavioral, or land use reasons for these differences, the presence of vectors with proven or possible capacity to transmit a wide range of pathogens leaves the United States susceptible to outbreaks of exotic vectorborne diseases, as demonstrated by the limited local transmission of dengue and Zika viruses in Florida and Texas.

The findings in this report are subject to at least three limitations. First, underreporting might have substantially limited the number of cases analyzed. As noted, the number of Lyme disease cases reported to NNDSS is estimated to represent a fraction of incident cases. In addition, because many patients with dengue, nonneuroinvasive West Nile, and Zika virus infections experience mild symptoms, they might not seek medical attention. Second, not all the diseases described in this report were reportable for the full 13-year analysis period or from all states and territories; babesiosis data are only available from 2011 from some states. Finally, although CDC collected national dengue data before 2011, the first year it was officially designated as notifiable, it is possible a higher proportion of cases were reported after reporting became mandatory. Overall, it is likely the actual number of vectorborne disease cases substantially exceeds those described in this report.

In the face of increasing incidence and threat from novel pathogens, the burden on local and state public health departments has increased. Critical to effectively preventing or responding to disease outbreaks is sensitive disease and vector surveillance, backed by well-organized, well-prepared, and sustained vector control operations. Good surveillance and reporting depend on rapid, accurate diagnostic confirmation; more sensitive and specific tests that can be used locally are needed. Vaccines against Lyme disease, dengue, chikungunya, and Zika, goals of intense research and development, could reduce risk from those major threats. The tools for vector control are limited but can be effective when implemented rapidly. Ticks have been especially difficult to control (*19*), increasing the responsibility for personal protective measures. Nearly all public vector control operations in the United States are locally funded and operated. Networks of vector control operatives are essential to support threat reduction and counter outbreaks, yet in a recent national survey 84% of 1,083 local mosquito control organizations reported lacking one or more of five core vector control competencies (*20*). Resources available to assist state and local health departments could be used to develop vector control program competencies.

Key Points

- A total of 642,602 cases of 16 diseases caused by bacteria, viruses, or parasites transmitted through the bites of mosquitoes, ticks, or fleas were reported to CDC during 2004–2016. Indications are that cases were substantially underreported.
- Tickborne disease cases more than doubled in 13 years and were 77% of all vectorborne disease reports. Lyme disease accounted for 82% of all tickborne cases, but spotted fever rickettsioses, babesiosis, and anaplasmosis/ehrlichiosis cases also increased.
- Tickborne diseases predominated in the eastern continental United States and areas along the Pacific coast. Mosquitoborne dengue, chikungunya, and Zika viruses were almost exclusively transmitted in Puerto Rico, American Samoa, and the U.S. Virgin Islands, where they were periodically epidemic. West Nile virus, also occasionally epidemic, was widely distributed in the continental United States, where it is the major mosquitoborne disease.
- During 2004–2016, nine vectorborne human diseases were reported for the first time from the United States and U.S. territories. The discovery or introduction of novel vectorborne agents will be a continuing threat.
- Vectorborne diseases have been difficult to prevent and control. A Food and Drug Administration–approved vaccine is available only for yellow fever virus. Many of the vectorborne diseases, including Lyme disease and West Nile virus, have animal reservoirs. Insecticide resistance is widespread and increasing.
- Preventing and responding to vectorborne disease outbreaks are high priorities for CDC and will require additional capacity at state and local levels for tracking, diagnosing, and reporting cases; controlling vectors; and preventing transmission.
- Additional information is available at https://www.cdc.gov/vitalsigns/.

Reducing vectorborne disease incidence and responding to outbreaks is a large and complex challenge. CDC is using two strategies to mitigate vectorborne threats: advancing innovation and discovery and rebuilding comprehensive vector control programs that have eroded over time (*20*). CDC works with states, territories, and tribal councils to compile surveillance data, develop strategies and guidance, and educate the public about specific threats and prevention measures for populations at risk. Expanding sustainable vectorborne disease prevention

programs is needed to respond to the ongoing and increasing threat of vectorborne disease.

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Conflict of Interest

No conflicts of interest were reported.

[1]Division of Vector-Borne Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC, Fort Collins, Colorado.

Corresponding author: Ron Rosenberg, rrosenberg@cdc.gov, 970-221-6407.

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Notes from the Field

Salmonella Oranienburg Infection Linked to Consumption of Rattlesnake Pills — Kansas and Texas, 2017

Lyndsay Bottichio, MPH[1]; Lindsey Martin Webb, MPH[2]; Greg Leos, MPH[3]; Beth Tolar, MS[1]; Natasha Dowell, MPH[1]; Colin Basler, DVM[1]

In November 2017, as part of a salmonellosis illness investigation, the Texas Department of State Health Services collected a bottle of rattlesnake pills from a patient's home. The Texas Department of State Health Services then contacted CDC to report that a sample of these rattlesnake pills yielded *Salmonella* Oranienburg. The *Salmonella* serotype isolated from the patient was not related by pulsed-field gel electrophoresis (PFGE) to that isolated from the rattlesnake pills. PulseNet, the national molecular subtyping network for foodborne disease surveillance, identified numerous isolates with a PFGE pattern indistinguishable from that of the rattlesnake pill isolate.* Whole genome sequencing (WGS) indicated that the *Salmonella* found in the sample of rattlesnake pills was closely related genetically to an isolate from a patient in Kansas.† This close genetic relationship makes it likely that the Kansas patient became ill from consumption of rattlesnake pills. Because the *Salmonella* serotype isolated from the patient was not related by PFGE to that isolated from the rattlesnake pills, the definitive cause of the Texas patient's illness was not ascertained; this patient was unable to be reinterviewed, and no additional samples were able to be collected.

Rattlesnake pills, which contain encapsulated dehydrated and pulverized rattlesnake meat, are marketed as remedies for various conditions, ranging from cancer to acne. Rattlesnake pills are not approved by the Food and Drug Administration and are sometimes labeled by the manufacturer as "natural." Rattlesnake pills can be found in alternative medicine and health food stores and roadside markets and can be purchased through Internet retailers.§

The Kansas patient was initially interviewed using a standard enteric illness questionnaire, which included a question about vitamins and supplements. This patient indicated taking other supplements but did not report taking rattlesnake pills. After learning the patient's isolate was closely related to the rattlesnake pill isolate by WGS, the Kansas Department of Health and Environment reinterviewed the patient on December 17, 2017, specifically asking about less common supplements including rattlesnake pills. During the second interview, the patient reported having traveled to the State of Chihuahua, Mexico, and purchasing "pastillas de víbora de cascabel" (rattlesnake pills). The patient believed the pills to be homemade and consumed five pills; the patient had no remaining pills, so it could not be determined whether the source was the same as for the Texas patient's pills. At the time of this report, no additional infections of *Salmonella* related to the Kansas patient or Texas pill sample have been identified; no other isolates were related to rattlesnake pills by WGS.

Reptiles and their meat can carry *Salmonella* species that cause illness. Previous outbreak investigations have identified rattlesnake pills as a source of human *Salmonella* infections; a majority of illnesses occurred in persons with cancer (*1–4*) who were taking the rattlesnake pills for medicinal purposes, and most of those infections were associated with *S. arizonae*. This is the first report of *S.* Oranienburg infection associated with consumption of rattlesnake pills. Persons with compromised immune systems, including those with human immunodeficiency virus infection or who are receiving chemotherapy, pregnant women, children aged <5 years, and adults aged >60 years are more likely to develop a severe *Salmonella* infection that can result in hospitalization or even death from consuming a contaminated food or supplement.¶ The Food and Drug Administration does not review rattlesnake pills for safety or effectiveness.** Persons choosing to take rattlesnake pills, especially persons at higher risk for severe *Salmonella* infections, should be aware of the risk for salmonellosis associated with their consumption. Consultation with a licensed health care provider to discuss potential risks and benefits is recommended before taking any supplements.

* https://www.cdc.gov/pulsenet.
† https://www.cdc.gov/pulsenet/pathogens/wgs.html.
§ https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm466588.htm.
¶ https://www.cdc.gov/salmonella/general/index.html#two.
** https://www.fda.gov/Food/DietarySupplements/UsingDietarySupplements/ucm109760.htm.

Conflict of Interest

No conflicts of interest were reported.

[1]Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Diseases, CDC; [2]Kansas Department of Health and Environment; [3]Texas Department of State Health Services.

Corresponding author: Lyndsay Bottichio, lbottichio@cdc.gov, 404-639-0570.

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Notes from the Field

Increase in Hepatitis A Virus Infections — Marshall Islands, 2016–2017

Megan G. Hofmeister, MD[1,2]; Jill A. McCready, MSPH[3]; Ruth Link-Gelles, PhD[1,2]; Blanche Greene Cramer, DrPH[2,4]; Leisha D. Nolen, MD, PhD[5]; Helentina Garstang, DCHMS[6]; Monique A. Foster, MD[1]

In mid-September 2016, a case of hepatitis A virus (HAV) infection was reported to the Marshall Islands Ministry of Health and Human Services (MOHHS). On November 4, MOHHS received laboratory confirmation of four additional cases, prompting activation of an outbreak investigation by the MOHHS Exposure Prevention Information Network (EPINet) team and solicitation of technical assistance from the Pacific Island Health Officers' Association, the World Health Organization, and CDC. CDC began participating in the investigation by providing technical assistance remotely at that time. CDC provided remote assistance throughout the course of the investigation. In April 2017, the CDC-affiliated coauthors traveled to the Marshall Islands to provide in-person technical assistance.

To characterize the outbreak, the MOHHS EPINet Team, with assistance from CDC, conducted an investigation through in-person interviews and medical chart abstractions. A probable HAV outbreak case was defined as an acute illness with onset of any signs or symptoms consistent with acute viral hepatitis (e.g., fever, anorexia, nausea, vomiting, diarrhea, fatigue, dark urine, clay-colored stool, or abdominal pain) on or after September 1, 2016, and either jaundice or elevated serum aminotransferase levels; a confirmed case met the probable case definition and also had either a positive immunoglobulin M (IgM) antibody to HAV on laboratory testing or an epidemiologic link to a confirmed case.*

From September 2016 (epidemiologic week 37) through July 2017 (epidemiologic week 28), 194 outbreak-associated hepatitis A cases (168 confirmed and 26 probable) were reported by MOHHS (Figure). Illness onset dates ranged from September 12, 2016, through July 11, 2017. The median age of infected persons was 8 years (range = 2–76 years), 57% of patients were male, 91% were Marshallese, and 11% were hospitalized. No deaths were reported. Persons aged <25 years accounted for 90% of cases, and 92% of patients were residents of the capital, Majuro. The most commonly reported signs and symptoms were jaundice (92%), nausea (76%), anorexia (75%), and dark urine (68%). Clay-colored stool (10%) was less commonly reported.

Complete contact information was available for 102 (53%) patients. A total of 1,143 contacts were identified, with a mean of 11 contacts identified per patient (range = 2–60). Among the identified contacts, 902 (79%) received postexposure prophylaxis (PEP) with hepatitis A vaccine. Some contacts were identified outside the recommended PEP window of 14 days after exposure, and 14 contacts were infants who were too young to be vaccinated (*1*). Seven contacts refused vaccination.

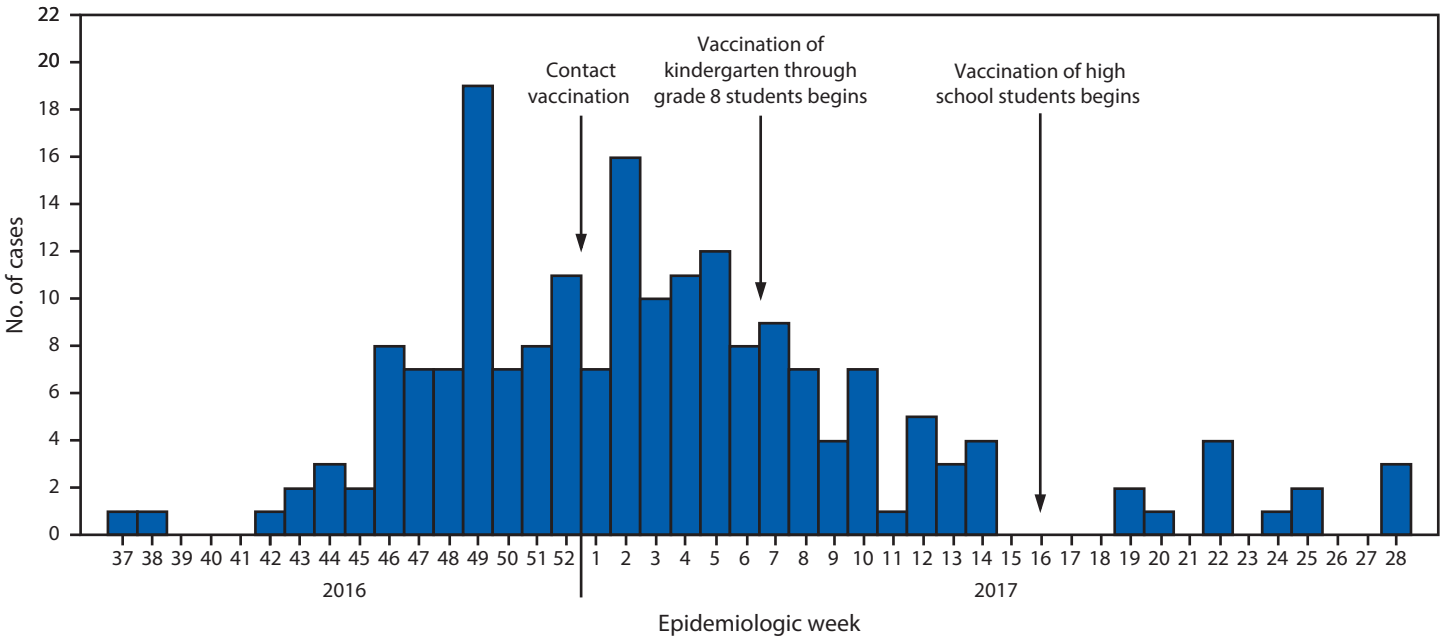
The EPINet team disseminated public information about the outbreak and recommendations on hygiene and vaccination through radio shows, mass text messages, posters, and school presentations; developed standardized case reporting and interview tools; and expanded case finding through investigation of contacts. Hepatitis A vaccine is not currently included in the Marshall Islands routine childhood immunization schedule. Marshall Islands began immunization of contacts of patients with hepatitis A in January 2017 and then launched a comprehensive immunization campaign targeting school-aged children on Majuro in February 2017, which ultimately covered approximately 70% of the total kindergarten through eighth grade student population. Once the vaccine supply was replenished in April 2017, a second immunization campaign was directed at high school students aged 14–19 years on Majuro. In total, approximately 12,500 doses of hepatitis A vaccine were administered to school-aged children and adult contacts of patients in response to the outbreak. No additional cases were reported as of August 30, 2017.

Before this outbreak, the last HAV outbreak in the Marshall Islands occurred approximately 25 years ago. Since then, approximately five hepatitis A cases per year have been reported (MOHHS, unpublished data, 2017). HAV infection is typically acquired through fecal-oral transmission, either from direct person-to-person contact or consumption of contaminated food or water. In this outbreak, transmission occurred primarily through direct person-to-person contact, and despite extensive measures, the initial source of HAV infection was not identified.

HAV infection occurs in three distinct epidemiologic patterns (high, intermediate, and low endemicity) associated with hygiene and sanitation, access to clean drinking water, household crowding, and socioeconomic conditions (*2*). As socioeconomic conditions and sanitation improve, areas transition from high to intermediate endemicity, which is associated with an increased incidence of symptomatic clinical disease and potential for outbreaks. Hepatitis A–related hospitalizations and mortality also increase as the age of infection shifts

* https://wwwn.cdc.gov/nndss/conditions/hepatitis-a-acute/case-definition/2012/.

FIGURE. Number of confirmed and probable hepatitis A cases (N = 194) — Marshall Islands, September 2016–July 2017



from early childhood, when disease is typically asymptomatic or mild, to adolescence and adulthood, when illness is more likely to be severe (*2*).

Before this outbreak, HAV was thought to be endemic in the Marshall Islands; however, this outbreak demonstrates that the country might be undergoing an epidemiologic transition toward intermediate endemicity (*3*). Health officials are evaluating the potential costs and benefits of incorporating routine hepatitis A vaccination in Marshall Islands as a means of reducing ongoing transmission and preventing outbreaks.

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Conflict of Interest

No conflicts of interest were reported.

[1]Division of Viral Hepatitis, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; [2]Epidemic Intelligence Service, CDC; [3]Pacific Island Health Officers' Association; [4]Division of Global Health Protection, Center for Global Health, CDC; [5]Division of Preparedness and Emerging Infections, National Center for Emerging and Zoonotic Infectious Diseases, CDC; [6]Department of Public Health, Ministry of Health and Human Services, Marshall Islands.

Corresponding author: Megan G. Hofmeister, mhofmeister@cdc.gov, 404-718-5458.

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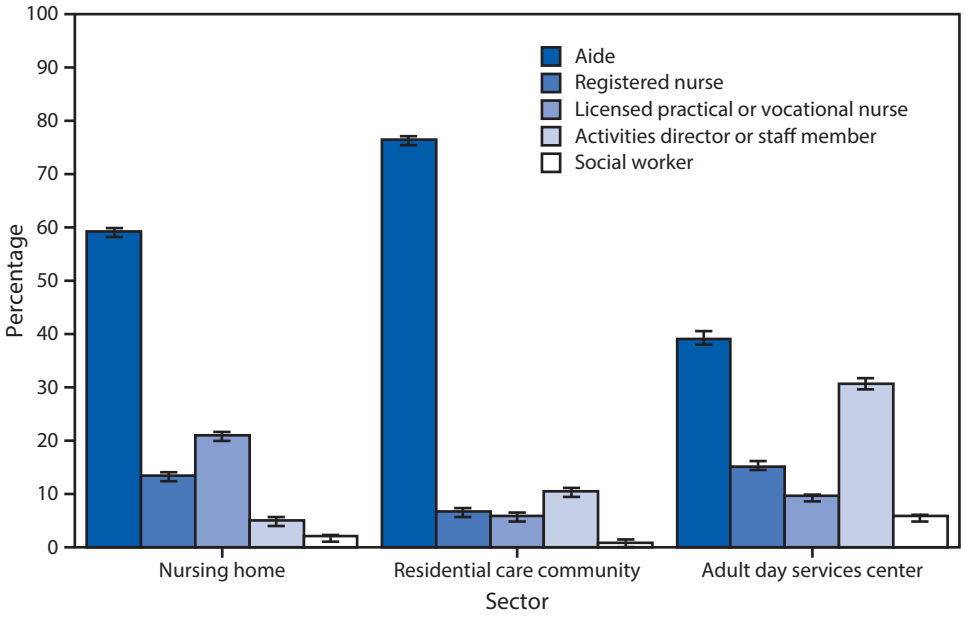
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage Distribution* of Long-Term Care Staffing† Hours,§ by Staff Member Type and Sector — United States, 2016



* With 95% confidence intervals indicated with error bars.
† Includes only employees; contract staff members are excluded.
§ Distribution of staffing hours within a sector is the percent of the total average hours per resident/participant per day worked by each staff member type. Estimates in each sector might not sum to 100% because of rounding.

In 2016, aides provided more hours of care in the major sectors of long-term care than the other staffing types shown. Aides accounted for 59% of all staffing hours in nursing homes, compared with licensed practical or vocational nurses (21%), registered nurses (13%), activities staff members (5%), and social workers (2%). Aides accounted for 76% of all staffing hours in residential care communities, in contrast to activities staff members (10%), registered nurses (7%), licensed practical or vocational nurses (6%), and social workers (1%). In adult day services centers, aides provided 39% of all staffing hours, followed by activities staff members (30%), registered nurses (15%), licensed practical or vocational nurses (9%), and social workers (6%).

Source: National Study of Long-Term Care Providers, 2016. https://www.cdc.gov/nchs/nsltcp/index.htm.

Reported by: Vincent Rome, MPH, vrome@cdc.gov, 301-458-4466; Manisha Sengupta, PhD; Lauren Harris-Kojetin, PhD.

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