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World AIDS Day — December 1, 2018

World AIDS Day, observed each year on December 1, draws attention to the status of the human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) epidemic worldwide. Today, approximately 36.9 million persons worldwide are living with HIV infection, including 1.8 million persons newly infected during 2017 (*1*). An estimated 940,000 persons worldwide died from AIDS-related illnesses in 2017 (*1*).

In 2015, an estimated 1.1 million persons in the United States were living with HIV infection, and 86% were aware of their infection (*2*).

Through global efforts, including the U.S. President's Emergency Plan for AIDS Relief, for which CDC is an implementing agency, 21.7 million persons worldwide received antiretroviral therapy for HIV infection in 2017, an increase of 2.3 million persons since the end of 2016 (*1*). A report in this issue of *MMWR* (*3*) describes activities to implement the Treat All policy in India, which involves offering antiretroviral therapy to all persons with HIV infection.

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Implementation of the Treat All Policy Among Persons with HIV Infection Enrolled in Care But Not on Antiretroviral Therapy — India, May 2017–June 2018

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Since September 2015, the World Health Organization has recommended antiretroviral therapy (ART) for all persons with human immunodeficiency virus (HIV) infection, regardless of clinical stage or CD4 count (*1*). This Treat All policy was based on evidence that ART initiation early in HIV infection as opposed to waiting for the CD4 count to decline to certain levels (e.g., <500 cells/mm^3, per previous guidelines), was associated with reduced morbidity, mortality, and HIV

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transmission (*2–4*). Further, approximately half of persons enrolled in non-ART care that included monitoring for HIV disease progression (i.e., in pre-ART care) were lost to follow-up before becoming ART-eligible (*5*). India, the country with the third largest number of persons with HIV infection in the world (2.1 million), adopted the Treat All policy on April 28, 2017. This report describes implementation of Treat All during May 2017–June 2018, by India's National AIDS Control Organization (NACO) and partners, by facilitating ART initiation among persons previously in pre-ART care at 46 ART centers supported by the U.S. President's Emergency Plan for AIDS Relief (PEPFAR)* in six districts in the states of Maharashtra and Andhra Pradesh. Partners supported these 46 ART centers in identifying and attempting to contact persons who were enrolled in pre-ART care during January 2014–April 2017, and educating those reached about Treat All. ART center–based records were used to monitor implementation indicators, including ART initiation. A total of 9,898 (39.6%) of 25,007 persons previously enrolled in pre-ART care initiated ART; among these 9,898 persons, 6,315 (63.8%) initiated ART after being reached during May 2017–June 2018, including 1,635 (16.5%) who had been lost to follow-up before ART initiation. NACO scaled up efforts nationwide to build ART centers' capacity to implement Treat All. Active tracking and tracing of persons with HIV infection enrolled in care but not on ART, combined with education about the benefits of early HIV treatment, can facilitate ART initiation.

Among the estimated 2.1 million persons with HIV infection in India in 2017,† 1.7 million (81%) had received a diagnosis, and 1.2 million receive free ART. Through PEPFAR, CDC and its implementing partners§ provide technical support to improve HIV care and treatment in three districts each in Maharashtra (32 ART centers) and Andhra Pradesh (14), the two states with the highest prevalence of HIV infection. In 2015, these six districts accounted for 36% and 39% of persons with HIV infection in Maharashtra (301,453) and Andhra Pradesh (including Telangana, which has since separated from Andhra Pradesh) (394,661), respectively (*6*).

On May 1, 2017, state and district health authorities, in collaboration with CDC and implementing partners, began activities to implement Treat All by projecting antiretroviral needs through estimates of persons who were alive and on ART and the assumption that 50% of enrolled persons not on ART would initiate ART within 6 months. CD4 laboratory registers and electronic databases at ART centers were used to identify persons with HIV infection enrolled at one of the 46 PEPFAR-supported ART sites in Maharashtra or Andhra Pradesh who had a CD4 count or clinic visit during January 2014–April 2017, but who were not on ART (i.e., in pre-ART care before Treat

* https://www.pepfar.gov/about/270968.htm.

† https://nhp.gov.in/nhpfiles/hivaidsact.pdf.

§ CDC's implementing partners for HIV Care and Treatment are UW International Training and Education Center for Health and SHARE INDIA.

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All). Persons who had died, transferred out, opted out, or started ART were excluded. Paper records were reviewed to deduplicate entries with matching names and addresses and to verify ART status and contact information. Persons in pre-ART care before Treat All implementation were categorized as 1) in active care (having had a CD4 count or clinical assessment every 6 months) or 2) lost to follow-up (not having been seen at the center for ≥12 months) (*7*).

CDC and implementing partners supported ART centers to scale up and systematize NACO-recommended activities for tracking and tracing persons with HIV infection in pre-ART care. ART center counselors made three attempts to contact each person previously in pre-ART care by telephone and used standardized materials describing the benefits of early ART to educate those who were reached. Home visits were scheduled for those persons who were not reached by telephone, who declined to go to the ART center, or who agreed to go but did not. Persons who missed appointments before or after ART initiation were contacted by telephone within approximately 7 and 2 days, respectively. Partners adapted existing tracking tools to monitor missed appointments, ART initiation, and retention on ART, defined as documented receipt of ART at specific time points (e.g., 6 or 12 months); implementation indicator data, including ART initiation and retention, were entered and maintained in electronic spreadsheets.

Among 25,007 persons in pre-ART care, counselors reached 12,691 (50.7%); among those reached, 1,950 (15.4%) reported already having initiated ART since May 1, 2017 (Table). Among the remaining 10,741 persons reportedly not on ART, 10,243 (95.4%) agreed to visit the ART center, 6,524 (63.7%) of whom did visit the center before June 30 or within 2 weeks of the appointment (whichever period was longer). Among these 6,524 persons, 6,315 (96.8%) initiated ART. Among 6,564 persons previously in pre-ART active care who agreed to visit the center, 4,836 (73.7%) visited the ART center, compared with 1,688 (45.9%) of 3,679 persons who had been lost to follow-up. Nearly all (97.0%) persons in both groups who visited centers initiated ART.

The median interval from the agreement to visit the center to the actual visit was 18 days (interquartile range [IQR] = 4–61 days) and from visiting the center until ART initiation was 3 days (IQR = 1–9 days). Among 21,631 (86%) persons previously in pre-ART care with available CD4 data, the median CD4 count was 571 cells/mm^3 (IQR = 412–759); among the 6,524 persons who visited the ART center, the median CD4 count was 645 cells/mm^3 (IQR, 522–826).

In addition to the 6,315 persons who initiated ART after being reached, 3,583 persons were found to have already initiated ART after the May 1 implementation of Treat All; 1,950 were identified through outreach, and 1,633 were identified while monitoring center records for visits. Thus, among all 25,007 persons with HIV infection previously in pre-ART care, 9,898 (39.6%) persons initiated ART during May 2017–June 2018. Among 6,315 persons who began ART after being reached, 4,463 of 5,247 (85.1%) were retained in care at 6 months and 682 of 809 (84.3%) at 12 months.

TABLE. Follow-up of persons with human immunodeficiency virus (HIV) infection enrolled in care but not on antiretroviral therapy (pre-ART) who were contacted during implementation of the Treat All policy at 46 ART centers,* by pre-ART care status — Maharashtra and Andhra Pradesh states, India, May 2017–June 2018

	Pre-ART HIV care status no. (%)		
Contact efforts/Outcome	**Total**	**Active care†**	**Lost to follow-up§**
Contact attempted	**25,007 (100.0)**	13,308 (100.0)	11,699 (100.0)
Reached	**12,691 (50.7)**	8,139 (61.2)	4,552 (38.9)
By telephone	**9,441 (74.4)**	6,508 (80.0)	2,933 (64.4)
By home visit	**3,250 (25.6)**	1,631 (20.0)	1,619 (35.6)
Already on ART (% of persons reached)¶	**1,950 (15.4)**	1,368 (16.8)	582 (12.8)
Not on ART (% of persons reached)	**10,741 (84.6)****	6,771 (83.2)	3,970 (87.2)
Agreed to visit ART center (% of persons not on ART)	**10,243 (95.4)**	6,564 (96.9)	3,679 (92.7)
Visited ART center (% of persons who agreed to visit)	**6,524 (63.7)**	4,836 (73.7)	1,688 (45.9)
Initiated ART (% of persons who visited ART center)	**6,315 (96.8)**	4,680 (96.8)	1,635 (96.9)

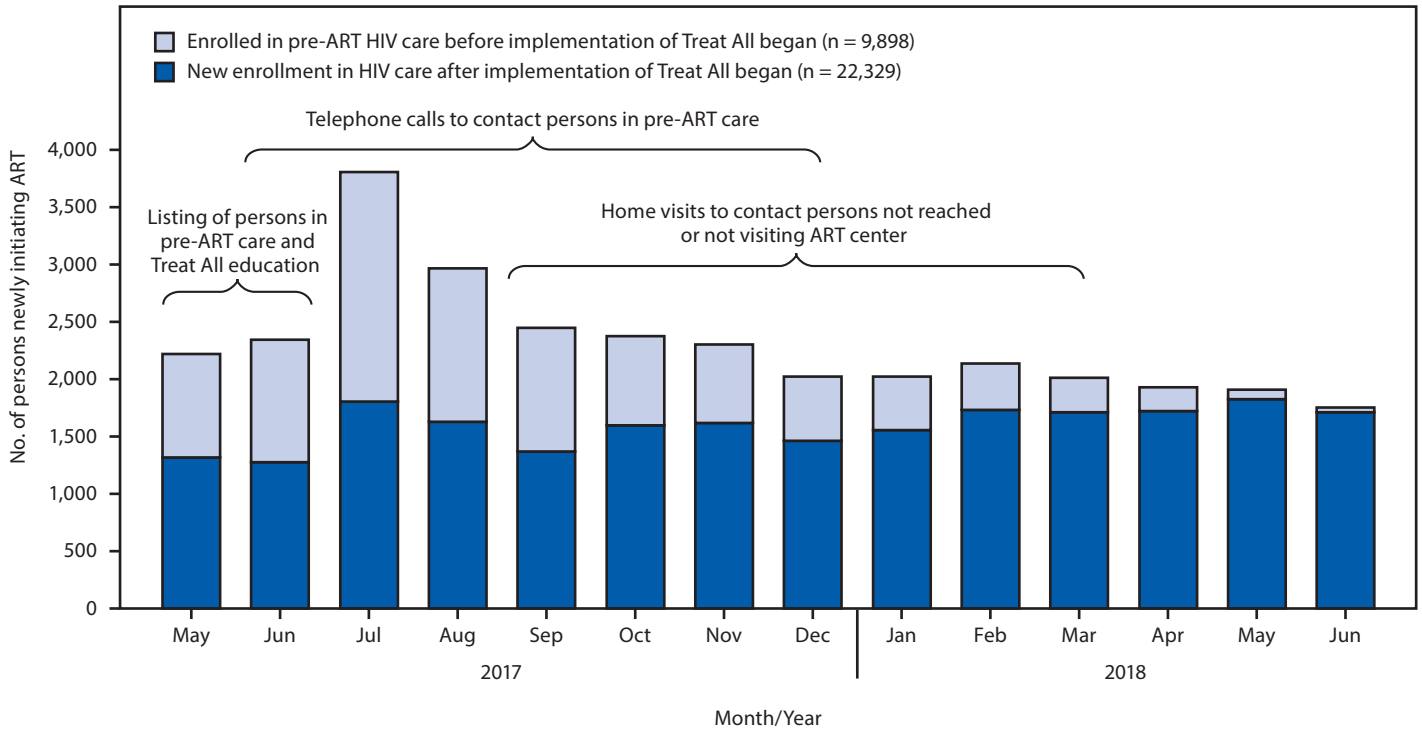
Abbreviation: AIDS = acquired immunodeficiency syndrome.
* Supported by U.S. President's Emergency Plan for AIDS Relief.
† Defined as having had a CD4 count or clinical visit during May 2016–April 2017.
§ Defined as having had a CD4 count or clinical visit during January 2014–April 2016 , and subsequently did not visit the ART center for ≥12 months.
¶ Among 12,691 persons reached, 1,950 (15.4%) reported having already visited the ART center and initiating ART since May 1, 2017.
** Three of 10,741 persons who reported not being on ART were eventually identified through medical records to be on ART.

Before implementation of Treat All, a median of 1,847 (IQR = 1,615–2,007) persons with HIV infection initiated ART each month at the 46 ART centers. After May 1, 2017, this number increased, peaking at 3,797 in July, at which time persons previously in pre-ART care accounted for approximately half (52%) of all ART initiations (Figure); thereafter, this proportion declined to approximately 2%. During the course of the 14-month implementation of Treat All, ART center staff members required a decreasing level of support from implementing partners in responding to questions about Treat All, tracking and tracing activities, and data management.

Discussion

This is the first report describing a national ART program's effort to facilitate ART initiation among persons with HIV infection enrolled in pre-ART care immediately after adoption of the Treat All policy. During the third and fourth months of implementation at the 46 PEPFAR-supported ART centers in India, the number of persons previously in pre-ART care

FIGURE. Number of persons with human immunodeficiency virus (HIV) infection newly initiating antiretroviral therapy (ART) (N = 32,227) among those who enrolled in care before* or after implementation of the Treat All policy† at 46 centers supported by the President's Emergency Plan for AIDS Relief (PEPFAR), by month and year — Maharashtra and Andhra Pradesh states, India, May 1, 2017–June 30, 2018



Abbreviation: AIDS = acquired immunodeficiency syndrome.

* Pre-ART; persons enrolled in non-ART HIV care.

† The Treat All policy, based on evidence that ART initiation early in HIV infection is associated with reduced morbidity, mortality, and HIV transmission, was adopted by India on April 28, 2017, and policy implementation began on May 1, 2017.

returning to ART centers resulted in a doubling of the median number of persons initiating ART each month. Approximately two thirds of those who initiated ART within 14 months of implementation of Treat All did so after active follow-up. This effort to facilitate ART initiation improved ART centers' capacity in counseling, tracking and tracing, and managing data, prompting NACO to scale up activities to implement Treat All nationwide. Ensuring linkage to ART is an important factor in realizing population-level benefits of the Treat All policy through reducing HIV transmission (*8*).

Approximately half of all persons previously in pre-ART care were reached by telephone and home visits, highlighting the importance of regularly updating contact information. Although most persons who were reached and not on ART did agree to visit an ART center, fewer than two thirds actually did so. The high median CD4 count among persons previously in pre-ART care who were reached suggests that many were likely asymptomatic. Thus, education about the Treat All policy is needed to address the misperception, based on earlier guidance, that this population is not eligible for ART. Most persons previously in pre-ART care (97%) who visited ART centers initiated ART within a median of 3 days; early data determined a 12-month ART retention of 84%, which is 13 percentage points higher than the national average of 71% (*9*).

The findings in this report are subject to at least four limitations. First, ART center–based records might be subject to data entry errors. Second, persons who initiated ART at other centers might have been missed. Third, because verified, deduplicated data on ART status were unavailable for persons previously enrolled in pre-ART care at the national level, the trend in new ART initiations could not be assessed in districts not supported by PEPFAR. Finally, direct causality cannot be inferred from the activities described in this report and the observed trend in ART initiations.

With half of persons in pre-ART care not yet reached, the eventual decline of new ART initiations to levels similar to those before adoption of Treat All suggests the need for ongoing education about the policy. Continued efforts also are needed to reach persons with HIV infection who are not on ART to understand and address barriers to ART initiation. Further, the full individual and public health benefits of Treat All can only be realized by overcoming program challenges for early

Summary

What is already known about this topic?

The World Health Organization's Treat All policy recommends antiretroviral therapy (ART) for all persons with human immunodeficiency virus (HIV) infection immediately after HIV diagnosis.

What is added by this report?

To implement Treat All in India, 46 ART centers in two states supported by the President's Emergency Plan for AIDS relief attempted to contact 25,007 persons enrolled in HIV care but not receiving ART; 9,898 (40%) subsequently initiated ART over a 14-month period. Among those initiating ART, 6,315 (64%) began ART after being reached, including 1,635 (17%) who had been lost to follow-up.

What are the implications for public health practice?

Tracking and tracing and education about benefits of early HIV treatment among persons with HIV infection who are not on ART can facilitate implementation of Treat All in India.

HIV diagnosis and linkage to ART, rapid ART initiation, and support of ART adherence and retention among all persons with HIV infection (*10*). India is actively working to improve each of these areas through efforts that include implementation of patient-centered service delivery models to maximize the number of persons with HIV infection receiving ART and to improve quality of care.

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Multistate Infestation with the Exotic Disease–Vector Tick *Haemaphysalis longicornis* — United States, August 2017–September 2018

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Haemaphysalis longicornis is a tick indigenous to eastern Asia and an important vector of human and animal disease agents, resulting in such outcomes as human hemorrhagic fever and reduction of production in dairy cattle by 25%. *H. longicornis* was discovered on a sheep in New Jersey in August 2017 (*1*). This was the first detection in the United States outside of quarantine. In the spring of 2018, the tick was again detected at the index site, and later, in other counties in New Jersey, in seven other states in the eastern United States, and in Arkansas. The hosts included six species of domestic animals, six species of wildlife, and humans. To forestall adverse consequences in humans, pets, livestock, and wildlife, several critical actions are indicated, including expanded surveillance to determine the evolving distribution of *H. longicornis*, detection of pathogens that *H. longicornis* currently harbors, determination of the capacity of *H. longicornis* to serve as a vector for a range of potential pathogens, and evaluation of effective agents and methods for the control of *H. longicornis*.

H. longicornis is native to eastern China, Japan, the Russian Far East, and Korea. It is an introduced, and now established, exotic species in Australia, New Zealand, and several island nations in the western Pacific Region. Where this tick exists, it is an important vector of human and animal disease agents. In China and Japan, it transmits the severe fever with thrombocytopenia syndrome virus (SFTSV), which causes a human hemorrhagic fever (*2*), and *Rickettsia japonica,* which causes Japanese spotted fever (*3*). Studies in Asia identified ticks infected with various species of *Anaplasma*, *Babesia*, *Borrelia*, *Ehrlichia*, and *Rickettsia*, and all of these pathogen groups circulate zoonotically in the United States (*4*,*5*). In addition, parthenogenetic reproduction, a biologic characteristic of this species, allows a single introduced female tick to generate progeny without mating, thus resulting in massive host infestations. In some regions of New Zealand and Australia, this tick can reduce production in dairy cattle by 25% (*6*). Before 2017, *H. longicornis* ticks were intercepted at U.S. ports of entry at least 15 times on imported animals and materials (James W. Mertins, U.S. Department of Agriculture [USDA], personal communication).

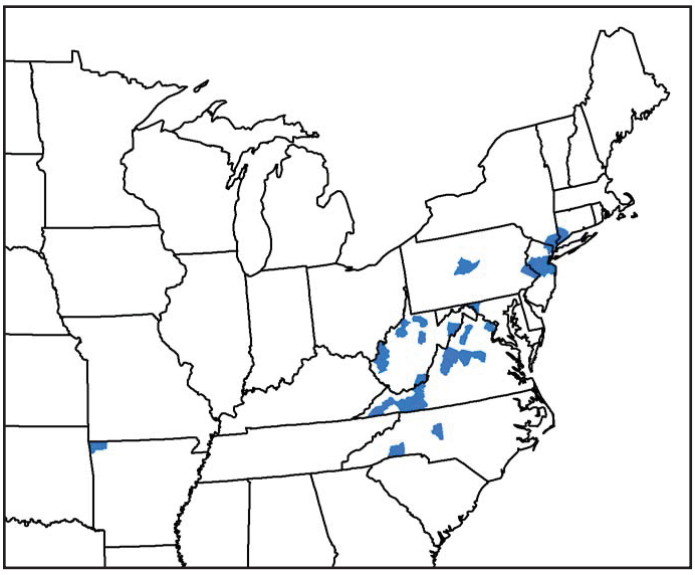
The USDA Animal and Plant Inspection Service coordinated cooperative efforts through telephone conference calls with various local, state, and federal agricultural and public health agencies. Through these efforts, enhanced vector and animal surveillance were implemented to detect additional tick infestations. Suspect archival specimens that were available among previously collected ticks were also examined. Ticks were identified definitively by morphology at the USDA National Veterinary Services Laboratories or by DNA sequence analysis (molecular barcoding) at Rutgers University Center for Vector Biology, Monmouth County (New Jersey) Mosquito Control Division; College of Veterinary Medicine, University of Georgia; and Center for Veterinary Health Sciences, Oklahoma State University. By definition, a "report" is any new morphologic or molecular identification of *H. longicornis* ticks with a new county or host species from that county, identified from August 2017 through September 2018. Subsequent repeat collections are not reported here.

From August 2017 through September 2018, vector and animal surveillance efforts resulted in 53 reports of *H. longicornis* in the United States, including 38 (72%) from animal species (23 [61%] from domestic animals, 13 [34%] from wildlife, and two [5%] from humans), and 15 (28%) from environmental sampling of grass or other vegetation using cloth drags or flags* or carbon dioxide–baited tick traps.† With the exception of one report from Arkansas, the remaining reports of positively identified ticks are from eight eastern states: New Jersey (16; 30%), Virginia (15; 28%), West Virginia (11; 21%), New York (three; 6%), North Carolina (three; 6%), Pennsylvania (two; 4%), Connecticut (one; 2%), and Maryland (one; 2%) (Figure). Among the 546 counties or county equivalents in the nine states, ticks were reported from 45 (8%) counties (1.4% of all 3,109 U.S. counties and county equivalents) (Table 1).

* Drags consist of white cloth (usually 1 m^2) that have a wooden leading frame and are dragged by a cord through grass or a leafy forest floor. Flags are similar but are used to brush uneven surfaces such as small bushes in wooded areas. Drags and flags are used to sample the environment for ticks trying to locate a host.

† Carbon dioxide traps consist of dry ice–filled small boxes with holes that allow the CO_2 to escape which are placed on a white cloth or mat in a grassy area or forest floor. Ticks, attracted by the CO_2, crawl on to the cloth or mat surface, which is inspected for ticks after a period of time.

FIGURE. Counties and county equivalents* where *Haemaphysalis longicornis* has been reported (N = 45) — United States, August 2017–September 2018



* Benton County, Arkansas; Fairfield County, Connecticut; Washington County, Maryland; Bergen, Hunterdon, Mercer, Middlesex, Monmouth, Somerset, and Union Counties, New Jersey; Davidson, Polk, and Rutherford Counties, North Carolina; Richmond, Rockland, and Westchester Counties, New York; Bucks and Centre Counties, Pennsylvania; Albemarle, Augusta, Carroll, Fairfax, Giles, Grayson, Louisa, Page, Pulaski, Rockbridge, Russell, Scott, Smyth, Staunton City, Warren, and Wythe Counties, Virginia; Cabell, Hardy, Lincoln, Mason, Marion, Monroe, Putnam, Ritchie, Taylor, Tyler, Upshur Counties, West Virginia.

Excluding 15 reports of positive environmental sampling using flagging, dragging, or carbon dioxide traps, the remaining 38 reports reflect collection of ticks from infested host species (Table 2). Surveillance efforts did not include testing the ticks or hosts for pathogens. No cases of illness in humans or other species were reported. Concurrent reexamination of archived historical samples showed that invasion occurred years earlier. Most importantly, ticks collected from a deer in West Virginia in 2010 and a dog in New Jersey in 2013 were retrospectively identified as *H. longicornis*.

Discussion

Cooperative efforts among federal, state, and local experts from agricultural, public health, and academic institutions during the last year have documented that a tick indigenous to Asia is currently resident in several U.S. states. The public health and agricultural impacts of the multistate introduction and subsequent domestic establishment of *H. longicornis* are not known. At present, there is no evidence that *H. longicornis* has transmitted pathogens to humans, domestic animals, or wildlife in the United States. This species, however, is a potential vector of a number of important agents of human and animal diseases in the United States, including *Rickettsia*, *Borrelia*, *Ehrlichia*, *Anaplasma*, *Theileria*, and several important viral agents such as Heartland and Powassan viruses. Consequently, increased tick surveillance is warranted, using standardized animal and environmental sampling methods.

The findings in this report are subject to at least two limitations. First, the findings are limited by the variable surveillance methods used to identify the geographic and host distribution of *H. longicornis*. These methods included both passive and active surveillance. Conclusions about the geographic and host distribution might reflect the biases in the collection and submission of samples to states and USDA and the paucity of available information. Second, the data in this report reflect the collection of specimens that were positively identified by morphology or molecular barcoding. These represent sentinels that *H. longicornis* is present in different U.S. states and regions, and not a comprehensive assessment of the distribution of *H. longicornis*

TABLE 1. Percentage of *Haemaphysalis longicornis*–infested counties or county equivalents in infested states — nine states, August 2017–September 2018

State	No. of counties* per state	No. (%) of counties* with *H. longicornis* on host or in environment
Arkansas	75	1 (1)
Connecticut	8	1 (13)
Maryland	24	1 (4)
New Jersey	21	7 (33)
New York	62	3 (5)
North Carolina	100	3 (3)
Pennsylvania	67	2 (3)
Virginia	134	16 (12)
West Virginia	55	11 (20)
Total	**546**	**45 (8)**

* Counties or county equivalents.

TABLE 2. Distribution of *Haemaphysalis longicornis*, by host and species — nine states, August 2017–September 2018

Host category, no. (% of total)/Species	No. (% of host category)
Domestic animal, 23 (61)	
Cat	1 (4)
Cow	4 (17)
Dog	12 (52)
Goat	2 (9)
Horse	2 (9)
Sheep	2 (9)
Total	**23 (100)**
Wildlife, 13 (34)	
Coyote	1 (8)
White-tailed deer	7 (54)
Gray fox	1 (8)
Groundhog	1 (8)
Virginia opossum	2 (15)
Raccoon	1 (8)
Total	**13 (100)**
Human, 2 (5)	2 (100)
Total	**38 (100)**

Summary

What is already known about this topic?

Haemaphysalis longicornis is a tick indigenous to Asia, where it is an important vector of human and animal disease agents, which can result in human hemorrhagic fever and substantive reduction in dairy production.

What is added by this report?

During 2017–2018, *H. longicornis* has been detected in Arkansas, Connecticut, Maryland, New Jersey, New York, North Carolina, Pennsylvania, Virginia, and West Virginia on various species of domestic animals and wildlife, and from two humans.

What are the implications for public health practice?

The presence of *H. longicornis* in the United States represents a new and emerging disease threat. Characterization of the tick's biology and ecology are needed, and surveillance efforts should include testing for potential indigenous and exotic pathogens.

in the United States. The absence of positive samples from many states and counties might reflect the absence of infestation, absence of sampling, or failure to recover the tick. Even in states where *H. longicornis* has been found, the available data do not describe the actual extent or intensity of infestation.

The biology and ecology of *H. longicornis* as an exotic species in the United States should be characterized in terms of its vector competence (ability to transmit a pathogen) and vectorial capacity (feeding habits, host preference, climatic sensitivity, population density, and other factors that can affect the risk for pathogen transmission to humans) for tickborne pathogens known to be present in the United States (*5*). Surveillance for *H. longicornis* should include adequate sampling of companion animals, commercial animals, wildlife, and the environment. Where *H. longicornis* is detected, there should be testing for a range of indigenous and exotic viral, bacterial, and protozoan tickborne pathogens potentially transmitted by *H. longicornis*. Given the similarity between SFTSV and Heartland virus, a tickborne phlebovirus (https://www.cdc.gov/heartland-virus/index.html), further evaluation of the potential role of *H. longicornis* in transmission of this disease agent among animal reservoirs and possibly to humans is warranted. A broad range of interventions should be evaluated, including insecticide and acaricide sensitivity testing. Many state and federal agencies are developing and disseminating information for stakeholders, including development of hotlines, and some states are identifying ticks submitted by the public. The recently documented occurrence of *H. longicornis* in the United States presents an opportunity for collaboration among governmental, agricultural, public health agencies and partners in academic public health, veterinary sciences, and agricultural sciences to prevent diseases of potential national importance before onset in humans and other animal species.

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Health Disparities Among American Indians/Alaska Natives — Arizona, 2017

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Compared with other racial/ethnic groups, American Indians/Alaska Natives (AI/AN) have a lower life expectancy, lower quality of life, and are disproportionately affected by many chronic conditions (*1*,*2*). Arizona has the third largest population of AI/AN in the United States (approximately 266,000 in 2017), and is home to 22 federally recognized American Indian tribal nations.* The small AI/AN sample size in previous Behavioral Risk Factor Surveillance System (BRFSS) surveys has presented analytic challenges in making statistical inferences about this population. To identify health disparities among AI/AN living in Arizona, the Arizona Department of Health Services (ADHS) and CDC analyzed data from the 2017 BRFSS survey, for which AI/AN were oversampled. Compared with whites, AI/AN had significantly higher prevalences of sugar-sweetened beverage consumption (33.0% versus 26.8%), being overweight or having obesity (76.7% versus 63.2%), diabetes (21.4% versus 8.0%), high blood pressure (32.9% versus 27.6%), report of fair or poor health status (28.7% versus 16.3%), and leisure-time physical inactivity during the past month (31.1% versus 23.0%). AI/AN also reported a lower prevalence of having a personal doctor or health care provider (63.1%) than did whites (72.8%). This report highlights the need to enhance surveillance measures at the local, state, and national levels and can inform interventions centered on confronting social inequities, developing culturally competent prevention strategies, and facilitating access to care to improve population health and work toward health equity.

BRFSS† is a telephone (landline and cellular) survey conducted annually in all 50 states, the District of Columbia, and U.S. territories to collect information on health-related behavioral risk factors, health care access, and chronic conditions among noninstitutionalized U.S. adults aged ≥18 years. To increase sample size and representation of AI/AN, the U.S. Department of Health and Human Services Office of Minority Health collaborated with CDC to oversample AI/AN in 11 states to improve understanding of their health status.§ Data from the 2017 Arizona BRFSS (15,004) were used to examine the prevalence of selected sociodemographic characteristics, lifestyle health-related behaviors, and chronic conditions among AI/AN, compared with prevalences among whites and other races. In 2017, Arizona BRFSS landline and cellular response rates were 52.3% and 79.6%, respectively. Race was categorized as white or AI/AN according to the BRFSS variable denoting preferred race category¶ based on the response to the following question: "Which one or more of the following would you say is your race?" The preferred race category was selected to avoid missing or excluding persons self-identifying as AI/AN, regardless of Hispanic ethnicity. Other races** (others) were defined as any race category apart from white or AI/AN. Age-adjusted prevalences standardized to the projected 2000 U.S. population†† with 95% confidence intervals (CIs) were calculated for sociodemographic characteristics (sex, marital status, education level, income, and employment status), access to care§§ (health care coverage and having a personal doctor or health care provider), lifestyle indicators¶¶ (current smoking, current smokeless tobacco use,

* https://pub.azdhs.gov/health-stats/report/hspam/2016/index.php.
† https://www.cdc.gov/brfss/index.html.
§ https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=2&lvlid=89.

¶ Respondents were identified as AI/AN, whites, or others according to the BRFSS variable denoting preferred race category, a calculated race variable. Response options available to respondents included White, Black or African American, American Indian or Alaska Native, Asian, Pacific Islander. Respondents who did not select a single race were defined as "Don't know/Not sure" or "Refused" and were coded as missing and not included in the analysis.

** Others were defined as respondents selecting any race category other than white or AI/AN, including black or African American, Asian, Native Hawaiian or other Pacific Islander, Other race, or No preferred race, regardless of Hispanic ethnicity.

†† https://www.cdc.gov/nchs/data/statnt/statnt20.pdf.

§§ Health care coverage was defined among respondents aged 18–64 years who answered "yes" to the following question: "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?" Having access to a health care provider was defined by responses of "yes," "only one" or "more than one" to the following question: "Do you have one person you think of as your personal doctor or health care provider?"

¶¶ Current smoking was defined as reporting smoking ≥100 cigarettes during one's lifetime and currently smoking every day or some days. Current smokeless tobacco use was defined as a response of "Every day" or "Some days" to the following question: "Do you currently use chewing tobacco, snuff, or snus every day, or not at all?" Binge drinking was defined as having ≥5 drinks on one occasion (men) or ≥4 drinks on one occasion (women). In 2017, the BRFSS included an optional module with two sugar-sweetened beverage intake questions: 1) "During the past 30 days, how often did you drink regular soda or pop that contains sugar? Do not include diet soda or diet pop." and 2) "During the past 30 days, how often did you drink sugar-sweetened fruit drinks (such as Kool-Aid and lemonade), sweet tea, and sports or energy drinks (such as Gatorade and Red Bull)? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks." Respondents answered number of times per month, week, or day, and responses were converted to daily intake. To calculate daily intake frequency, both questions were summed and categorized as none, >0 to <1, and ≥1 time per day. Consumption of sugar-sweetened beverage was defined as consumption ≥1 time per day (https://www.cdc.gov/brfss/data_documentation/pdf/brfss_ssb-userguide.pdf). Physical inactivity was defined according to a non-confirmatory response to the following question: "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"

binge drinking, consumption of sugar-sweetened beverages, and physical inactivity), and health status and chronic conditions*** (frequent mental distress, being overweight or having obesity, and doctor-diagnosed coronary heart disease, asthma, chronic obstructive pulmonary disease, diabetes, arthritis, high blood pressure, high blood cholesterol, and depression). Group differences were assessed with pairwise tests (AI/AN versus whites and AI/AN versus others) with statistical significance defined as $p<0.05$. Only statistically significant results are presented. Statistical software was used to account for survey weights and complex survey design.

Among all 15,004 respondents, 766 (5.1%) identified their race as AI/AN, 12,472 (76.3%) as white, and 1,766 (18.6%) as other. Among AI/AN, the prevalences of having less than a high school diploma (23.2%), reporting <$15,000 annual income (22.8%), and reporting unemployment (11.6%) were higher than those among whites (11.8%, 6.7%, and 5.9%, respectively) (Table 1). The prevalence of having health care coverage was higher among AI/AN (74.1%) than that among whites (71.7%) and others (65.3%), but the prevalence among AI/AN of having a personal doctor or health care provider (63.1%) was lower than that among whites (72.8%) and others (67.6%) (Table 1). The prevalences among AI/AN reporting fair or poor health status (28.7%), being overweight or having obesity (76.7%), and having diabetes (21.4%) were higher than those among whites (16.3%, 63.2%, and 8.0%, respectively) and others (23.6%, 65.9%, and 13.1%, respectively) (Table 2). In addition, among AI/AN, the prevalences of leisure-time physical inactivity (31.1%), daily sugar-sweetened beverage consumption (33.0%) and high blood pressure (32.9%) were higher than those among whites (23.0%, 26.8%, and 27.6%, respectively) (Table 2).

*** Respondents rated their general health as being excellent, very good, good, fair, or poor. The responses were then categorized into two groups: 1) those who reported that their health was excellent, very good, or good and 2) those who reported that their health was fair or poor. Fair or poor health status was defined as a report of fair or poor health status. All respondents were asked to determine how many days during the past 30 days their mental health status (e.g., stress, depression, and problems with emotions) was not good. The respondents were divided into two groups: those who reported frequent mental distress (≥14 mentally unhealthy days during the past 30 days) and those who reported no frequent mental distress (<14 mentally unhealthy days during the past 30 days). Frequent mental distress was defined as a report of ≥14 mentally unhealthy days during the past 30 days. Overweight or having obesity was defined as a body mass index ≥25 kg/m^2, or ≥30 kg/m^2, respectively, calculated from self-reported weight and height. Coronary heart disease was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had a heart attack (myocardial infarction) or angina. Asthma was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had asthma and still had it at the time of survey participation. Chronic obstructive pulmonary disease was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had chronic obstructive pulmonary disease, emphysema, or chronic bronchitis. Diabetes was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had diabetes, excluding gestational diabetes, prediabetes, or borderline diabetes. Arthritis was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia. High blood pressure was defined as having ever been told by a doctor, nurse, or other health care professional the respondent had high blood pressure. High blood cholesterol was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent's blood cholesterol was high. Depression was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had a depressive disorder, which includes depression, major depression, dysthymia, or minor depression.

Discussion

BRFSS estimates in this report were based on an oversampling of AI/AN in Arizona, to obtain data to inform strategies for mitigating health disparities among AI/AN (*3*,*4*). Consistent with other findings (*5*), these data indicate lower levels of educational attainment and income, and higher levels of unemployment among AI/AN, compared with those among whites and others, indicative of the disadvantages faced by AI/AN. Addressing these issues is important to decreasing the high prevalence and incidence of chronic conditions among AI/AN (*6*).

In 2017, the prevalence of self-reported health care coverage was higher among AI/AN than among whites and others. An example of health care coverage listed in the BRFSS question is Indian Health Service (IHS), which is a health care system that provides clinical, behavioral, and limited specialty health care services to enrolled members of federally recognized AI/AN tribes.††† With IHS, access to health care services is only available at federal hospitals and clinics operated or funded by IHS and might not ensure that AI/AN have ready access to health interventions or coverage to see non-IHS providers. Thus, although respondents reported having health care coverage, many might not be able to access care beyond IHS facilities. Review of the BRFSS question on health care coverage might be necessary to distinguish between respondents reporting Medicare, Medicaid, IHS, Veterans Administration, private health insurance, or being uninsured.

Prevalence of having a personal doctor or health care provider was lower among AI/AN than among whites and others. Historically, IHS facilities are located in geographically isolated areas on reservations (*6*). As the AI/AN population has become younger and more racially diverse, larger numbers of AI/AN are residing in cities, limiting continuity of care through IHS (*5*,*7*) and possibly the ability of AI/AN to obtain and retain a personal doctor or health care provider. Studies have highlighted additional barriers preventing AI/AN from accessing providers, including long wait times; travel time to an IHS facility; and lack of or limited access to transportation, culturally and linguistically appropriate providers, a full range of services, preventive care, screening, and early treatment for health conditions (*3*,*8*,*9*).

††† https://www.ihs.gov/forpatients/.

TABLE 1. Age-adjusted* weighted prevalence of sociodemographic characteristics and health care access among American Indians/Alaska Natives, whites, and adults aged ≥18 years with other race (total estimated population = 5,192,000) — Behavioral Risk Factor Surveillance System, Arizona, 2017

Characteristic	American Indians/Alaska Natives† n = 766; weighted % = 5.1			Whites† n = 12,472; weighted % = 76.3			Others† n = 1,766; weighted % = 18.6		
	Unweighted sample size, no.	Estimated population, no.	Weighted % (95% CI)	Unweighted sample size, no.	Estimated population, no.	Weighted % (95% CI)	Unweighted sample size, no.	Estimated population, no.	Weighted % (95% CI)
Age group (yrs)									
18–24	64	39,600	14.9 (11.1–18.6)	559	446,600	11.3 (10.3–12.2)	192	188,000	19.5 (16.8–22.1)
25–44	252	111,000	41.7 (37.0–46.5)	2,233	1,211,100	30.6 (29.4–31.7)	581	401,000	41.5 (38.6–44.4)
45–64	315	84,400	31.7 (27.5–35.9)	4,224	1,254,000	31.7 (30.7–32.6)	632	277,000	28.7 (26.3–31.1)
≥65	135	31,000	11.7 (9.1–14.3)	5,456	1,049,000	26.5 (25.7–27.3)	361	100,000	10.3 (9.0–11.6)
Sex									
Male	328	141,000	52.9 (48.2–57.5)	5,547	1,904,000	48.6 (47.3–49.9)	871	500,000	52.1 (49.3–54.9)
Female	435	125,000	47.2 (42.5–51.8)	6,910	2,052,000	51.4 (50.1–52.7)	892	465,000	47.9 (45.2–50.7)
Marital status									
Married††,§§	255	82,500	31.9 (27.8–36.1)	6,768	2,079,000	51.4 (50.2–52.6)	804	421,000	46.8 (44.1–49.4)
Divorced/Widowed/ Separated††,§§	209	57,300	23.5 (20.1–27.0)	3,697	879,800	19.6 (18.7–20.4)	439	161,000	19.2 (17.3–21.1)
Never married/Member of an unmarried couple††,§§	302	126,400	44.5 (40.6–48.4)	2,007	1,002,000	29.0 (28.0–30.1)	523	384,000	34.1 (31.8–36.4)
Education									
Less than high school††	101	59,100	23.2 (18.6–27.7)	588	450,400	11.8 (10.7–12.9)	226	202,100	22.4 (19.7–25.0)
High school/GED††,§§	257	83,300	30.8 (26.8–34.8)	2,739	951,700	24.1 (23.1–25.2)	475	265,000	26.1 (23.8–28.4)
College/Technical school or higher††,§§	403	121,600	45.2 (40.6–49.7)	9,111	2,549,000	63.9 (62.6–65.2)	1,054	490,800	50.7 (47.9–53.5)
Annual income									
<$15,000††,§§	178	60,000	22.8 (18.7–26.9)	755	261,800	6.7 (6.0–7.4)	173	93,600	10.2 (8.5–11.8)
$15,000–$34,999	222	68,200	26.4 (22.5–30.3)	2,618	882,400	21.9 (20.8–23.0)	457	263,200	27.1 (24.6–29.6)
$35,000–$74,999††	154	51,200	19.3 (15.7–22.9)	3,347	1,042,200	26.5 (25.3–27.6)	388	204,400	20.8 (18.6–22.9)
≥$75,000††,§§	76	27,900	10.3 (7.4–13.2)	3,526	1,078,600	28.3 (27.2–29.4)	333	174,200	18.1 (16.0–20.2)
Unknown/Refused	127	55,000	19.8 (15.9–23.7)	2,169	671,700	16.1 (15.1–17.1)	400	221,000	22.9 (20.5–25.2)
Employment status§									
Employed/Self-employed††,§§	350	128,600	45.8 (41.5–50.2)	5,435	2,093,800	58.5 (57.3–59.7)	947	576,700	57.3 (54.9–59.7)
Unemployed††,§§	82	32,400	11.6 (8.5–14.7)	475	209,600	5.9 (5.2–6.6)	101	59,300	5.6 (4.4–6.8)
Unable to work	219	66,300	28.1 (24.5–31.7)	5,750	1,371,500	28.5 (27.5–29.5)	547	249,300	28.2 (26.0–30.3)
Other††,§§	105	36,500	13.5 (10.1–17.0)	731	251,000	6.2 (5.6–6.7)	147	63,000	7.2 (5.9–8.5)
Have health care coverage¶,††,§§	553	206,600	74.1 (71.3–76.9)	6,153	2,483,800	71.7 (70.7–72.6)	1,099	658,600	65.3 (63.0–67.5)
Have a personal doctor or health care provider**,††,§§	504	163,800	63.1 (58.7–67.4)	10,399	3,001,800	72.8 (71.5–74.0)	1,269	617,000	67.6 (65.1–70.2)
Total estimated population		**266,000**			**3,960,000**			**966,000**	

Abbreviations: CI = confidence interval; GED = general educational development certificate.

* https://www.cdc.gov/nchs/data/statnt/statnt20.pdf.

† Respondents were identified as American Indians/Alaska Natives, whites or others according to the BRFSS variable denoting preferred race category, a calculated race variable. It does not specify Hispanic ethnicity. Response options available to respondents included White, Black or African American, American Indian or Alaska Native, Asian, Pacific Islander. Others were defined as respondents selecting any of the other race categories including Black or African American, Asian, Native Hawaiian or other Pacific Islander, Other race, No preferred race. Respondents who did not select a single race were defined as "Don't know/Not sure" or "Refused" and were coded as missing and not included in the analysis.

§ Employment status was defined by respondents who answered "Are you currently..? Employed for wages, self-employed, out of work for 1 year or more, out of work for less than 1 year, a homemaker, a student, retired, or unable to work." "Employed" was defined according to an affirmative response to employed or self-employed. "Unemployed" was defined according to an affirmative response to out of work for 1 year or more or out of work for less than 1 year. Other was defined according to an affirmative response to any of the following categories: a homemaker, a student, and retired.

¶ Health care coverage was defined by affirmative responses by respondents aged 18–64 years to the following question: "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?"

** Have access to a health care provider was defined by a response of "yes," "only one," or "more than one" to the following question: "Do you have one person you think of as your personal doctor or health care provider?"

†† Characteristic differed significantly between American Indians/Alaska Natives and whites (p<0.05).

§§ Characteristic differed significantly between American Indians/Alaska Natives and others (p<0.05).

In 2015, the top five leading causes of death for AI/AN in Arizona were unintentional injury, cancer, coronary heart disease, chronic liver disease and cirrhosis, and diabetes (*10*). When compared with the entire U.S. population, diabetes and chronic liver disease and cirrhosis are more common causes of death among the AI/AN population. Population-level behavioral and policy interventions are needed to reduce disparities in diabetes and chronic liver disease and cirrhosis mortality in the AI/AN population. These current analyses indicated a higher prevalence of sugar-sweetened beverage intake, leisure-time physical inactivity, being overweight or having obesity, and having diabetes or high blood pressure among AI/AN compared with whites in Arizona. Population-specific data on these indicators is crucial to formulating data-informed strategic plans and priority setting at ADHS. The Arizona Health Improvement Plan§§§ provides a structure to link networks of partners to align resources and programs to improve the health of persons and communities across Arizona using evidence-based preventive health strategies.

§§§ https://azdhs.gov/documents/operations/managing-excellence/azhip.pdf.

TABLE 2. Age-adjusted* weighted prevalence of lifestyle health-related behaviors and chronic conditions among American Indians/Alaska Natives, whites, and adults aged ≥18 years with other race (total estimated population = 5,192,000) — Behavioral Risk Factor Surveillance System, Arizona, 2017

Characteristic	American Indians/Alaska Natives† n = 766; weighted % = 5.1			Whites† n = 12,472; weighted % = 76.3			Others† n = 1,766; weighted % = 18.6		
	Unweighted sample size, no.	Estimated population, no.	Weighted % (95% CI)	Unweighted sample size, no.	Estimated population, no.	Weighted % (95% CI)	Unweighted sample size, no.	Estimated population, no.	Weighted % (95% CI)
Health-related behaviors§									
Current smoker	89	38,900	15.7 (11.9–19.5)	1,596	601,700	16.7 (15.6–17.7)	240	128,500	14.8 (12.7–16.9)
Current smokeless tobacco user**	47	12,400	4.8 (2.9–6.7)	275	109,600	3.2 (2.7–3.7)	36	18,900	2.2 (1.3–3.0)
Binge drinking**	81	41,700	17.6 (13.6–21.6)	1,310	553,000	16.9 (15.8–18.0)	207	126,400	14.0 (12.0–16.1)
Sugar-sweetened beverage ≥1 time per day††	178	65,100	33.0 (27.9–38.1)	2,031	793,500	26.8 (25.4–28.2)	390	224,700	31.4 (28.4–34.4)
Leisure-time physical inactivity††	186	66,900	31.1 (26.4–35.8)	2,804	873,900	23.0 (21.9–24.1)	398	212,700	27.6 (24.8–30.3)
Health status and chronic conditions¶									
Fair/Poor health status**,††	219	75,000	28.7 (24.4–33.0)	2,195	686,000	16.3 (15.4–17.2)	398	214,400	23.6 (21.2–26.0)
Frequent mental distress	103	40,700	15.1 (11.5–18.8)	1,291	474,700	12.8 (11.9–13.7)	212	115,900	12.1 (10.3–13.9)
Asthma	88	30,000	11.8 (8.5–15.1)	1,271	408,100	10.5 (9.7–11.3)	158	75,800	7.9 (6.5–9.3)
Overweight or having obesity**,††	519	183,800	76.7 (72.6–80.7)	7,394	2,323,900	63.2 (61.9–64.4)	1,062	546,200	65.9 (63.0–68.7)
Coronary heart disease	50	13,700	5.8 (3.9–7.8)	1,143	263,100	5.2 (4.8–5.7)	103	34,900	4.7 (3.6–5.8)
Chronic obstructive pulmonary disease	41	12,700	5.3 (3.3–7.3)	1,119	289,800	6.4 (5.8–6.9)	93	31,000	3.9 (3.0–4.7)
Diabetes**,††	179	52,800	21.4 (18.0–24.7)	1,507	381,800	8.0 (7.5–8.6)	256	103,300	13.1 (11.5–14.8)
Arthritis	169	52,200	21.5 (17.8–25.2)	4,347	1,076,700	23.4 (22.5–24.3)	379	140,700	17.4 (15.6–19.2)
High blood pressure††	262	81,000	32.9 (29.1–36.8)	4,970	1,264,200	27.6 (26.6–28.5)	595	246,800	29.6 (27.4–31.9)
High cholesterol	464	164,200	74.1 (69.6–78.5)	6,626	2,179,800	69.6 (68.4–70.8)	1,038	588,100	72.0 (69.6–74.5)
Depression**	121	45,700	17.2 (13.6–20.8)	2,387	797,600	20.7 (19.6–21.7)	280	132,100	13.7 (11.9–15.5)
Total estimated population		**266,000**			**3,960,000**			**966,000**	

Abbreviation: CI = confidence interval.

* https://www.cdc.gov/nchs/data/statnt/statnt20.pdf.

† Respondents were identified as American Indians/Alaska Native (AI/AN), white, or others according to the BRFSS variable denoting preferred race category, a calculated race variable. It does not specify Hispanic ethnicity. Response options available to respondents included White, Black or African American, American Indian or Alaska Native, Asian, Pacific Islander. Others were defined as respondents selecting any of the other race categories including Black or African American, Asian, Native Hawaiian or other Pacific Islander, Other race, No preferred race. Respondents who did not select a single race were defined as "Don't know/Not sure" or "Refused" and were coded as missing and not included in the analysis.

§ Current smoking was defined as reporting smoking ≥100 cigarettes during one's lifetime and currently smoking every day or some days. Current smokeless tobacco use was defined as a response of "Every day" or "Some days" to the following question: "Do you currently use chewing tobacco, snuff, or snus every day, or not at all?" Binge drinking was defined as having ≥5 drinks on one occasion (men) or ≥4 drinks on one occasion (women). In 2017, the BRFSS included an optional module with two sugar-sweetened beverage intake questions: 1) "During the past 30 days, how often did you drink regular soda or pop that contains sugar? Do not include diet soda or diet pop." and 2) "During the past 30 days, how often did you drink sugar-sweetened fruit drinks (such as Kool-Aid and lemonade), sweet tea, and sports or energy drinks (such as Gatorade and Red Bull)? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks." Respondents answered number of times per month, week, or day, and responses were converted to daily intake. To calculate daily intake frequency, both questions were summed and categorized as none, >0 to <1, and ≥1 time per day. Consumption of sugar-sweetened beverage was defined as consumption ≥1 time per day (https://www.cdc.gov/brfss/data_documentation/pdf/brfss_ssb-userguide.pdf). Physical inactivity was defined according to a non-confirmatory response to the following question: "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"

¶ Respondents rated their general health as being excellent, very good, good, fair, or poor. The responses were then categorized into two groups: 1) those who reported that their health was excellent, very good, or good and 2) those who reported that their health was fair or poor. Fair or poor health status was defined as a report of fair or poor health. All respondents were asked to determine how many days during the past 30 days their mental health status (e.g., stress, depression, and problems with emotions) was not good. The respondents were divided into two groups: those who reported frequent mental distress (≥14 mentally unhealthy days during the past 30 days) and those who reported no frequent mental distress (<14 mentally unhealthy days during the past 30 days). Frequent mental distress was defined as a report of ≥14 mentally unhealthy days during the past 30 days. Overweight or having obesity was defined as a body mass index ≥25 kg/m^2, or ≥30 kg/m^2, respectively, calculated from self-reported weight and height. Coronary heart disease was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had a heart attack (myocardial infarction) or angina. Asthma was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had asthma and still had it at the time of survey participation. Chronic obstructive pulmonary disease was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had chronic obstructive pulmonary disease, emphysema, or chronic bronchitis. Diabetes was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had diabetes, excluding gestational diabetes, prediabetes, or borderline diabetes. Arthritis was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia. High blood pressure was defined as having ever been told by a doctor, nurse, or other health care professional the respondent had high blood pressure. High blood cholesterol was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent's blood cholesterol was high. Depression was defined as having ever been told by a doctor, nurse, or other health care professional that the respondent had a depressive disorder, which includes depression, major depression, dysthymia, or minor depression.

** Significant association between American Indians/Alaska Natives and others ($p<0.05$).

†† Significant association between American Indians/Alaska Natives and whites ($p<0.05$).

These findings identified a number of health disparities among AI/AN in Arizona, which will require a concerted effort and culturally tailored public health approaches to address. ADHS's Native American liaison serves as a link between ADHS and tribal communities, tribal health offices, urban Indian health programs, IHS area offices, and other local, state, and federal organizations. Moreover, CDC funding mechanisms (e.g., "Tribal Practices for Wellness in Indian Country"¶¶¶ and "Good Health and Wellness in Indian Country"****) help to identify culturally tailored public health approaches to reduce risk factors for chronic diseases. Support

¶¶¶ https://www.cdc.gov/chronicdisease/tribal/tribalpractices.htm.

**** https://www.cdc.gov/chronicdisease/tribal/factsheet.htm.

Summary

What is already known about this topic?

American Indians/Alaska Natives (AI/AN) have a lower life expectancy, a lower quality of life, and a higher prevalence of many chronic conditions.

What is added by this report?

Analysis of 2017 Behavioral Risk Factor Surveillance System data from Arizona found significantly higher prevalences of sugar-sweetened beverage consumption, being overweight or having obesity, diabetes, hypertension, fair or poor health status, and leisure-time physical inactivity and a lower prevalence of having a personal doctor among AI/AN compared to whites.

What are the implications for public health practice?

Culturally tailored public health approaches to reducing risk factors and chronic diseases among AI/AN are needed. Improved surveillance can better equip health professionals to identify priorities and implement interventions to improve health and reduce disparities among AI/AN.

for culturally competent public health approaches over time could potentially facilitate the elimination of health disparities.

The findings in this report are subject to at least seven limitations. First, BRFSS information collected is self-reported; therefore, study findings might be subject to recall and social desirability biases. Second, the prevalence of conditions represents only diagnosed disease, not underdiagnosed disease, which is an important factor and might be different among groups. Third, although weighting methods are used to account for nonresponse bias and differential probability of selection in BRFSS data, bias might still exist. Fourth, results presented for AI/AN are intended to be representative of all tribes in Arizona; even so, results do not record variation among different tribal groups in Arizona or other tribes across the United States. Fifth, place of residence (urban, suburban, rural, or reservation) was not elucidated in BRFSS data but might influence the degree to which health disparities or risk behaviors affect certain groups. Sixth, publicly available state-based survey weights from the Arizona BRFSS data set were used, and reported results might slightly differ for the AI/AN population if more precise population-specific survey weights are used. Finally, because this is a cross-sectional study, causality cannot be inferred.

Characterizing health disparities adds to the understanding of AI/AN population health. Enhanced surveillance measures at the local, state, and national level can increase awareness about health challenges faced by this population, which will be instrumental to improving health and working toward health equity. Nonetheless, challenges associated with confronting social inequities, effectively working through cultural differences, increasing health literacy within the AI/AN population, and eliminating roadblocks that limit access to care will need to be overcome (*6*–*9*). In addition, tribal, state, and federal entities need to work together to address disparities. Documenting characteristics contributing to the health of AI/AN can better equip health professionals to identify priorities and culturally and linguistically appropriate interventions to improve health and decrease health disparities.

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Outbreak of Dengue Virus Type 2 — American Samoa, November 2016–October 2018

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The U.S. territory of American Samoa has experienced recent outbreaks of illnesses caused by viruses transmitted by *Aedes* species mosquitoes, including dengue, chikungunya, and Zika virus. In November 2016, a traveler from the Solomon Islands tested positive for infection with dengue virus type 2 (DENV-2). Additional dengue cases were identified in the subsequent weeks through passive and active surveillance. Suspected dengue cases were tested locally with a dengue rapid diagnostic test (RDT) for DENV nonstructural protein 1 (NS1). Specimens from RDT-positive cases and patients meeting the dengue case definition were tested by real-time reverse transcription–polymerase chain reaction (real-time RT-PCR) at Hawaii State Laboratories. During November 2016–October 2018, a total of 3,240 patients were tested for evidence of DENV infection (118 by RDT-NS1 alone, 1,089 by real-time RT-PCR alone, and 2,033 by both methods), 1,081 (33.4%) of whom tested positive for dengue (19.5 per 1,000 population). All 941 real-time RT-PCR-positive specimens were positive for DENV-2. The monthly number of laboratory-confirmed cases peaked at 120 during December 2017. Among laboratory-confirmed dengue cases, 380 (35.2%) patients were hospitalized; one patient, who was transferred to American Samoa for care late in his illness, died. The public health response to this outbreak included disposal of solid waste to remove mosquito breeding sites, indoor residual spraying of pesticides in schools, reinforcement of dengue patient management education, and public education on mosquito avoidance and seeking medical care for symptoms of dengue.

Epidemiologic and Laboratory Surveillance

American Samoa consists of five Pacific Ocean islands. Among the 55,519 persons who resided in American Samoa in 2010, nearly all (95%) lived on the largest island, Tutuila, which has a land area of 76.8 square miles.* Electronic surveillance for dengue, chikungunya, and Zika virus disease has been in place since 2016. Electronic health records at Lyndon B. Johnson Tropical Medical Center and three of the five regional health centers were reviewed weekly by automated query to identify patients with febrile illnesses. The surveillance definition for suspected dengue included 1) the presence of two or more of the following: fever, rash, arthralgia, vomiting, nausea, myalgia, malaise, or headache; 2) the words "dengue," "viral syndrome," or "thrombocytopenia" in the electronic health record; or 3) an *International Classification of Disease, 10th Revision* (ICD-10) code for "unspecified viral illness," "mosquitoborne illness," or "arboviral fever." Dengue with warning signs and severe dengue were defined according to World Health Organization 2009 case definitions (*1*).

Local diagnostic testing for patients with suspected dengue was performed using an RDT for DENV NS1 and anti-DENV immunoglobulin M (IgM), the sensitivity and specificity of which varies by DENV type and geographic location (*2*). Specimens from RDT-positive patients and from patients meeting the suspected dengue case definition were tested at Hawaii State Laboratories by real-time RT-PCR.† Specimens testing positive for detection of DENV nucleic acid were further tested at Hawaii State Laboratories by multiplex DENV real-time RT-PCR (*3*). Laboratory-confirmed specimens included those positive by real-time RT-PCR or positive for NS1 by RDT. Because of the possibility of extended duration of antiflavivirus IgM antibody, potential crossreactivity of anti-Zika virus IgM antibody with DENV antigen, and lack of evaluation of test performance in American Samoa, 434 patients who tested positive only by RDT-IgM were excluded from further analysis. Estimated incidence was calculated using laboratory-confirmed dengue cases and population denominators from publically available sources.

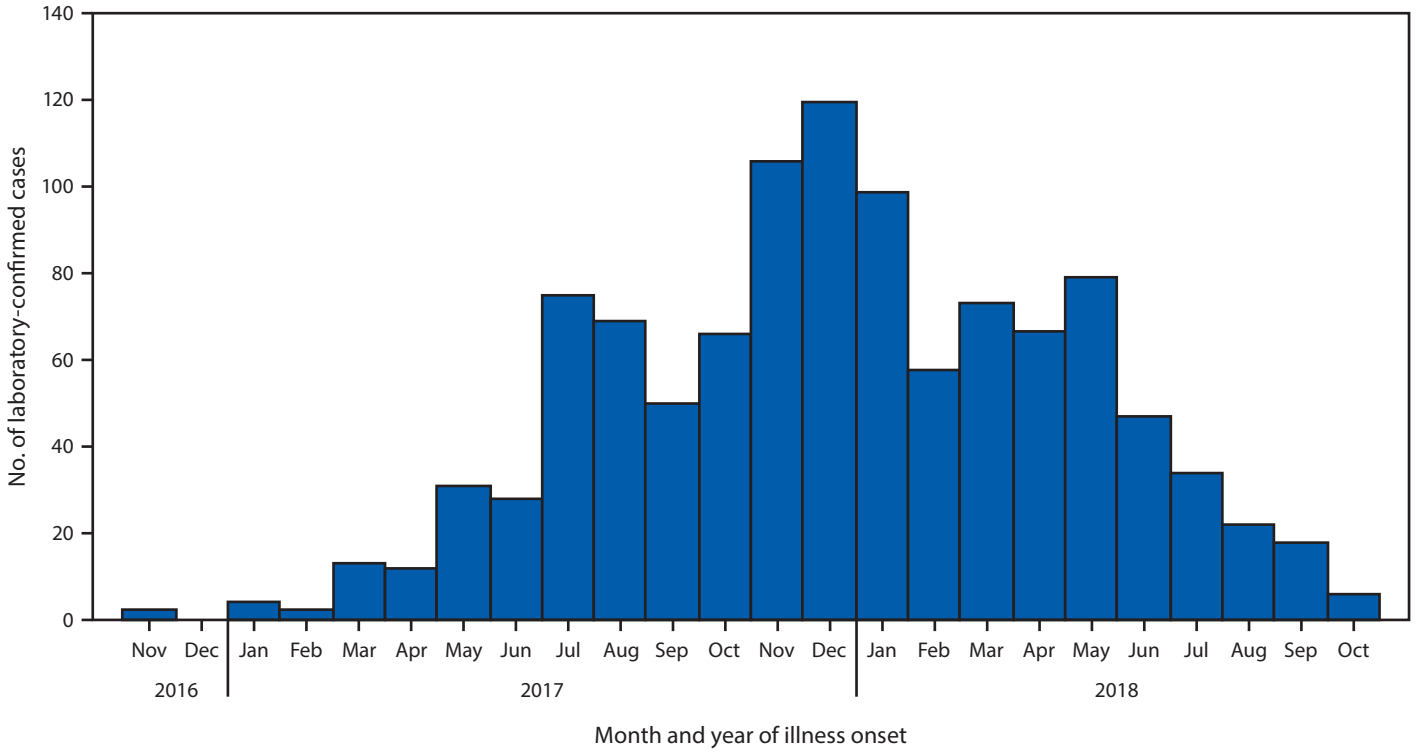
On November 2, 2016, a fisherman from the Solomon Islands was evaluated in Sua County, American Samoa, with fever, arthralgia, rash, and shortness of breath. The real-time RT-PCR assay was negative for Zika virus and chikungunya virus, but positive for DENV. Additional testing identified DENV-2. Two days after being evaluated, the patient departed American Samoa. Soon after, additional suspected cases from neighboring counties were reported.

After detection of the presumed index patient in November 2016, up to four laboratory-confirmed dengue cases were detected per month until March 2017, when case counts began to increase (Figure 1). The number of laboratory-confirmed cases detected per month reached 75 in July 2017, declined for 2 months, and increased again, peaking

* http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

† https://www.nature.com/articles/s41467-018-03772-1.

FIGURE 1. Laboratory-confirmed dengue cases (N = 1,079), by month of reported illness onset — American Samoa, November 2016–October 2018



in December 2017 at 120 cases. The monthly number of laboratory-confirmed dengue cases gradually decreased from 96 in May 2018, and further decreased through October 2018, when six laboratory-confirmed cases were detected. The last identified laboratory-positive case reported illness onset on October 25, 2018.

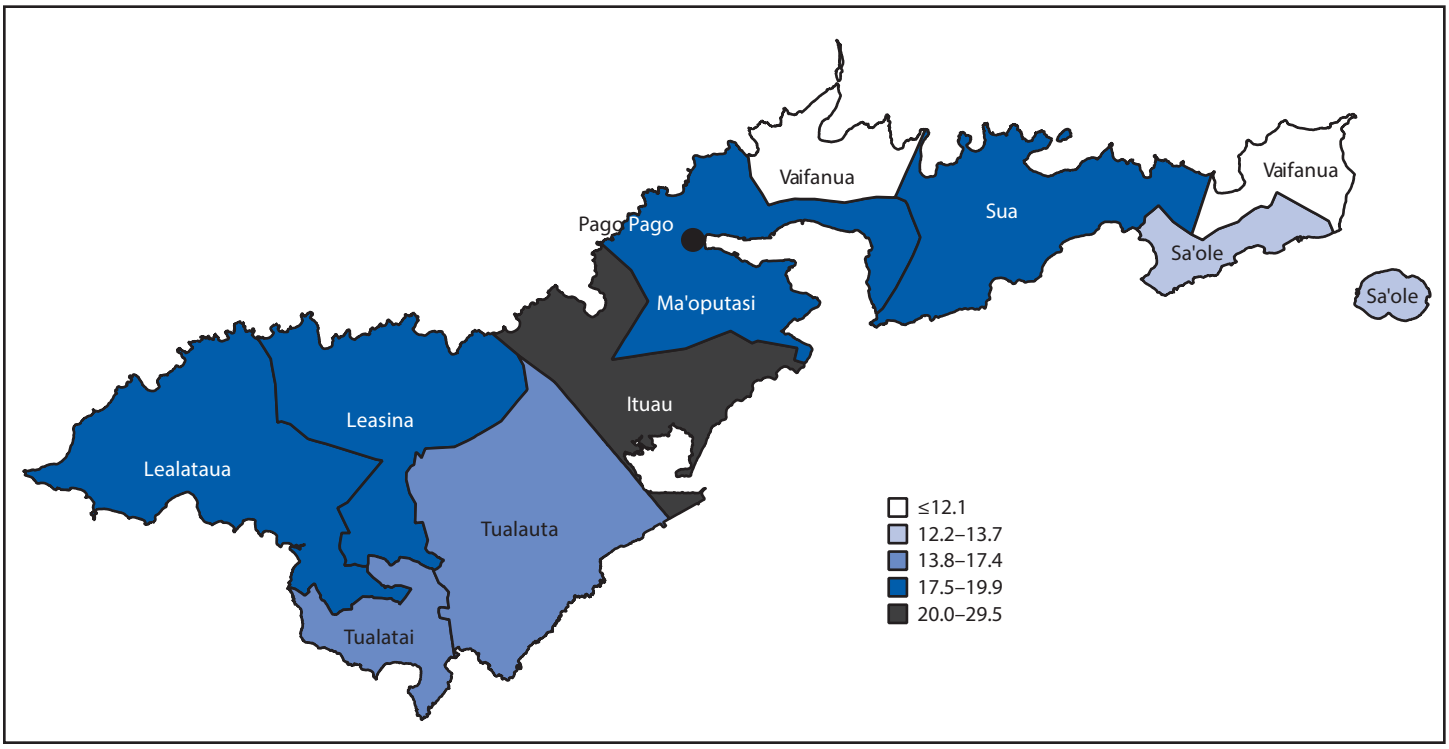
Among 3,122 serum specimens tested by real-time RT-PCR, 941 (30.1%) were positive for DENV-2. No cases tested positive by real-time RT-PCR for Zika virus, chikungunya virus, or another DENV type. Among 2,151 specimens tested by RDT, 421 (19.6%) were positive for detection of NS1. A total of 281 cases tested positive by both real-time RT-PCR and RDT-NS1. Overall, 1,081 (33.4%) laboratory-confirmed dengue cases (19.5 per 1,000 population) were identified.

As of October 31, 2018, the incidence of laboratory-confirmed dengue cases by county was highest in Ituau County (29.5 per 1,000 population), which neighbors the county containing the capital city of Pago Pago (Figure 2). The incidence of laboratory-confirmed dengue cases among other counties ranged from 12.1 to 19.9 per 1,000 population. Among laboratory-confirmed cases, 50.6% of patients were female, and median age was 16 years (Table). Incidence of laboratory-confirmed dengue was highest among persons aged 10–19 years (38.1 per 1,000 population) and lowest among persons aged 40–49 years (10.6). Overall, 380 (35.2%) patients with laboratory-confirmed dengue were hospitalized. A man aged 68 years who had been transferred for care from neighboring Samoa died within 24 hours of arrival in American Samoa. Among 89 hospitalized laboratory-confirmed dengue patients for whom medical records were reviewed, 30 (33.7%) had dengue with warning signs, and 23 (25.8%) had severe dengue.

Public Health Response

When American Samoa declared the DENV-2 outbreak in March 2017, the Zika public health response was ongoing, and those response efforts remained in effect and were applied to combat dengue. The Environmental Health Division of the American Samoa Department of Public Health (ASDOH) conducted detailed outdoor environmental assessments of private properties and business locations, issuing citations to those in violation of mosquito breeding site removal laws. During August–September 2017, an estimated 108 tons of solid waste and scrap metal were removed from yards and public spaces. The Environmental Health Division conducted indoor residual spraying in all public and private schools, focusing environmental inspections on private properties and businesses in the villages with the highest incidence of laboratory-confirmed cases. The American Samoa territorial epidemiologist spoke on broadcast radio and television programs to spread public

FIGURE 2. Number of laboratory-confirmed dengue cases per 1,000 persons, by county of residence — American Samoa, November 2016–October 2018



messaging regarding seeking care for acute febrile illness and ways to prevent mosquito bites; educational messages were posted on billboards in high-traffic locations. Mosquito repellent sprays were distributed at community health clinics across the island.

Discussion

Dengue is the world's most common mosquitoborne viral disease (*1*), resulting in an estimated 58 million symptomatic infections and 13,000 deaths in 2013 (*4*). Approximately 75% of dengue virus infections do not result in illness (*5*); however, 5% of patients progress to severe dengue. The case-fatality rate among hospitalized dengue patients ranges from 0.5% to 5.0% (*1*), and the rate can be reduced by improving the timing and quality of clinical care (*6*).

During an outbreak of DENV-3 in American Samoa in 2015, approximately 900 suspected dengue cases were reported, including four laboratory-confirmed fatal cases (unpublished data, ASDOH). Clinical dengue management trainings were conducted by American Samoa and CDC in response to these fatalities, and no further DENV-3 associated deaths among persons infected in Samoa were reported. Through continued adherence to proper dengue management techniques, no fatal cases resulting from the current DENV-2 outbreak in American Samoa have been reported. Similar training can be considered for dengue outbreak responses in other locations.[§]

[§] https://www.cdc.gov/dengue/educationtraining/index.html.

American Samoa has had numerous outbreaks of arboviral disease, starting with DENV-2 in 1972 (*7*). A serosurvey conducted in 2010 demonstrated 96% seroprevalence against DENV, suggesting widespread exposure among all age groups (*8*). Chikungunya virus was detected in American Samoa in 2014, followed by the outbreak of DENV-3 in 2015. Zika virus was first detected in American Samoa in January 2016 (*9*), and transmission was waning but still ongoing when the DENV-2 outbreak was detected in November 2016 (*10*).

Since the DENV-3 outbreak in 2015, ASDOH has used electronic arboviral disease surveillance on the island of Tutuila, which helped identify the apparent index patient in the most recent outbreak and stimulated a public health response. Because of limitations in patient care-seeking behavior, physician awareness, diagnostic sensitivity, and interpretation of RDT-IgM, the 1,081 laboratory-confirmed dengue cases likely underestimate the actual magnitude of this outbreak.

Transmission of DENV-2 continued in American Samoa for at least 24 months, demonstrating the need for sustainable and effective vector control interventions. Further efforts to develop and implement sustainable and effective vector control interventions are needed. Appropriate medical management appears to be effective at decreasing the number of dengue-related deaths. Persons living or traveling in areas with endemic dengue who develop an acute febrile illness should immediately seek medical care, and clinicians should be aware of appropriate

TABLE. Number and percentage of dengue patients (N = 1,081*), by selected characteristics and rate of cases per 1,000 population by age group — American Samoa, November 2016–October 2018

Characteristic	No. (%)
Female	547 (50.6)
Age, median (range)	16 yrs (0–87 yrs)
Travel outside of American Samoa within 14 days of illness onset	8 (0.7)
Signs/Symptoms	
Fever	994 (92.0)
Myalgia	687 (63.6)
Headache	525 (48.6)
Nausea	314 (31.5)
Vomiting	308 (28.5)
Severity of disease among 89 hospitalized patients	
Dengue with warning signs†	30 (33.7)
Severe dengue§	23 (25.8)
Fatal	0 (0.0)
Age group (yrs)	**Cases per 1,000 population¶**
0–9	16.7
10–19	38.1
20–29	17.7
30–39	11.1
40–49	10.6
50–59	10.8
60–69	12.7
≥70	13.0

* Demographic data were missing for three cases.
† Abdominal pain or tenderness, persistent vomiting, clinical fluid accumulation, mucosal bleed, lethargy, restlessness, liver enlargement >2 cm, increase in hematocrit concurrent with rapid decrease in platelet count.
§ One or more of the following: 1) plasma leakage leading to shock or fluid accumulation, with or without respiratory distress, 2) severe bleeding, or 3) severe organ impairment.
¶ Incidences calculated using laboratory-confirmed dengue cases and population denominators from the U.S. Census Bureau, 2011 American FactFinder. https://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

testing and management for patients suspected of dengue (*1*) and other arboviral diseases. Persons residing or traveling in regions with endemic dengue should use insect repellent, wear long sleeves and pants, and stay in residences with screens on doors and windows where possible.¶

¶ https://www.cdc.gov/dengue/prevention/index.html.

Summary

What is already known about this topic?

American Samoa has experienced multiple outbreaks of mosquitoborne viral disease in recent years, including chikungunya in 2014, dengue in 2015, and Zika in 2016.

What is added by this report?

During November 2016–October 2018, 1,081 laboratory-confirmed dengue cases were identified, with only dengue virus type 2 detected. The epidemic peaked in December 2017, after which, case counts slowly decreased.

What are the implications for public health practice?

Sustainable, effective interventions are still needed to control dengue, as is continued emphasis on clinical management to reduce mortality. Persons residing in or traveling to areas with risk for dengue should use insect repellent, wear long sleeves and pants, and stay in residences with screens on doors and windows.

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Progress Toward Regional Measles Elimination — Worldwide, 2000–2017

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In 2010, the World Health Assembly set three milestones for measles prevention to be achieved by 2015: 1) increase routine coverage with the first dose of measles-containing vaccine (MCV1) among children aged 1 year to ≥90% at the national level and to ≥80% in every district; 2) reduce global annual measles incidence to less than five cases per million population; and 3) reduce global measles mortality by 95% from the 2000 estimate (*1*).* In 2012, the World Health Assembly endorsed the Global Vaccine Action Plan (GVAP),† with the objective of eliminating measles§ in four of the six World Health Organization (WHO) regions by 2015 and in five regions by 2020. Countries in all six WHO regions have adopted goals for measles elimination by 2020. This report describes progress toward global measles control milestones and regional measles elimination goals during 2000–2017 and updates a previous report (*2*). During 2000–2017, estimated MCV1 coverage increased globally from 72% to 85%; annual reported measles incidence decreased 83%, from 145 to 25 cases per million population; and annual estimated measles deaths decreased 80%, from 545,174 to 109,638. During this period, measles vaccination prevented an estimated 21.1 million deaths. However, measles elimination milestones have not been met, and three regions are experiencing a large measles resurgence. To make further progress, case-based surveillance needs to be strengthened, and coverage with MCV1 and the second dose of measles-containing vaccine (MCV2) needs to increase; in addition, it will be important to maintain political commitment and ensure substantial, sustained investments to achieve global and regional measles elimination goals.

Immunization Activities

WHO and the United Nations Children's Fund (UNICEF) use data from administrative records and vaccination coverage surveys reported annually by 194 countries to estimate coverage with MCV1 and MCV2 delivered through routine immunization services.¶ During 2000–2017, estimated MCV1 coverage increased globally from 72% to 85% (Table 1), although coverage has remained 84%–85% since 2010, and considerable variation in regional coverage exists. Since 2013, MCV1 coverage has remained relatively constant in the African Region (AFR) (69%–70%), the Region of the Americas (AMR) (92%), the European Region (EUR) (93%–95%), and the Western Pacific Region (WPR) (96%–97%). During 2013–2017, MCV1 coverage increased from 78% to 81% in the Eastern Mediterranean Region (EMR) and from 84% to 87% in the South-East Asia Region (SEAR). WPR is the only region to achieve and sustain >95% MCV1 coverage since 2006. Among the 73 countries that receive funding through Gavi, the Vaccine Alliance (Gavi-eligible countries),** MCV1 coverage increased during 2000–2017, from 59% to 79% (Table 1). Globally, 118 (61%) countries achieved ≥90% MCV1 coverage in 2017, an increase from 85 (44%) countries in 2000, and a slight decrease from 120 (62%) countries in 2016. During 2000–2017, the largest increases in the percentage of countries with ≥90% MCV1 coverage were in AFR (from 9% to 34%) and SEAR (from 27% to 64%); among Gavi-eligible countries, the percentage

* The coverage milestone is to be met by every country, whereas the incidence and mortality reduction milestones are to be met globally.

† The Global Vaccine Action Plan is the implementation plan of the Decade of Vaccines, a collaboration between WHO; UNICEF; the Bill and Melinda Gates Foundation; the National Institute of Allergy and Infectious Diseases; the African Leaders Malaria Alliance; Gavi, the Vaccine Alliance; and others to extend the full benefit of immunization to all persons by 2020 and beyond. In addition to 2015 targets, it also set a target for measles and rubella elimination in five of the six WHO regions by 2020. http://www.who.int/immunization/global_vaccine_action_plan/en; http://apps.who.int/gb/ebwha/pdf_files/wha65/a65_22-en.pdf.

§ Measles elimination is defined as the absence of endemic measles virus transmission in a region or other defined geographic area for ≥12 months, in the presence of a high quality surveillance system that meets targets of key performance indicators.

¶ For MCV1, among children aged 1 year or, if MCV1 is given at age ≥1 year, among children aged 24 months. For MCV2, among children at the recommended age for administration of MCV2, per the national immunization schedule. WHO/UNICEF estimates of national immunization coverage are available at http://www.who.int/immunization/monitoring_surveillance/data/en.

** Gavi, the Vaccine Alliance (Gavi), previously known as the Global Alliance for Vaccines and Immunization (GAVI), is a public-private global health partnership committed to increasing access to immunization in poor countries. Gavi-eligible countries are those that received funding support from Gavi. Countries are eligible to apply for Gavi support when their Gross National Income (GNI) per capita is ≤US$1,580 on average over the past 3 years (according to World Bank data published every year on July 1). In Gavi phase I (2000 to 2006), the GNI per capita eligibility threshold was US$1,000 (based on 1998 World Bank data). In Gavi phase II (2007 to 2010), country eligibility was based on the World Bank GNI per capita data for 2003. The eligibility threshold was maintained at the initial level of US$1,000. Since January 1, 2011, Gavi phase III, the threshold is adjusted for inflation annually. All 73 Gavi-eligible countries are included here, even if they graduated from Gavi support during 2000–2017. Timor Leste and South Sudan data were not available for the year 2000.

TABLE 1. Estimates of coverage with the first and second doses of measles-containing vaccine administered through routine immunization services, reported measles cases and incidence, estimated measles deaths,* and estimated measles deaths averted by vaccination by World Health Organization (WHO) region — worldwide, 2000 and 2017

WHO region or Gavi-eligible countries (no. of countries in category)/Year	MCV1† coverage, %	Countries with ≥90% MCV1 coverage, %	MCV2† coverage, %	Reporting countries with <5 measles cases/million, %	Reported measles cases,§ no.	Measles incidence§,¶	Estimated no. of measles deaths (95% CI)	Estimated mortality reduction, 2000–2017, %	Cumulative measles deaths averted by vaccination, 2000–2017, no.
African (47)									
2000	53	9	5	8	520,102	835	348,207 (239,261–565,071)	86	10,402,672
2017	70	34	25	53	72,603	69	48,017 (22,167–166,341)		
Americas (35)									
2000	93	63	43	89	1,754	2.1	NA	—	92,777
2017	92	63	74	97	775	1.7	NA		
Eastern Mediterranean (21)									
2000	72	57	29	17	38,592	90	42,977 (23,351–77,054)	43	2,535,740
2017	81	62	67	55	36,427	57	24,321 (2,418–70,806)		
European (53)									
2000	91	60	48	45	37,421	50	346 (109–1,801)	71	90,134
2017	95	83	90	57	24,356	27	100 (1–1,356)		
South-East Asia (11)									
2000	63	27	3	0	78,558	51	143,333 (100,362–203,472)	75	6,699,720
2017	87	64	77	45	28,474	14	35,925 (21,401–83,156)		
Western Pacific (27)									
2000	85	48	2	30	177,052	105	10,311 (5,153–65,828)	88	1,230,932
2017	97	59	94	80	10,695	6	1,275 (136–54,960)		
Total (194)									
2000	72	44	15	38	853,479	145	545,174 (368,236–913,226)	80	21,051,974
2017	85	61	67	65	173,330	25	109,638 (46,123–376,619)		
Gavi-eligible countries (73)**									
2000	59	15	2	14	645,880	258	536,122 (364,323–839,659)	80	19,320,191
2017	79	44	51	58	138,334	40	107,232 (45,839–314,724)		

Abbreviations: CI = confidence interval; Gavi = Gavi, the Vaccine Alliance; MCV1 = first dose of measles-containing vaccine; MCV2 = second dose of measles-containing vaccine; NA = not applicable; UNICEF = United Nations Children's Fund.

* Mortality estimates for 2000 might be different from previous reports. When the model used to generate estimated measles deaths is rerun each year using the new WHO/UNICEF Estimates of National Immunization Coverage data, as well as updated surveillance data, adjusted results for each year, including the baseline year, are also produced and updated.

† Coverage data: WHO/UNICEF Estimates of National Immunization Coverage, July 15, 2018 update. http://www.who.int/immunization/monitoring_surveillance/data/en.

§ Reported case data: measles cases (2017) from World Health Organization, as of July 15, 2018 (http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tsincidencemeasles.html). Reported cases are a sizeable underestimate of the actual number of cases, accounting for the inconsistency between reported cases and estimated deaths.

¶ Cases per 1 million population; population data from United Nations, Department of Economic and Social Affairs, Population Division, 2017. Any country not reporting data on measles cases for that year was removed from both the numerator and denominator.

** Gavi, the Vaccine Alliance (Gavi), previously known as the Global Alliance for Vaccines and Immunization (GAVI), is a public-private global health partnership committed to increasing access to immunization in poor countries. Gavi-eligible countries are those that received funding support from Gavi, the Vaccine Alliance. Countries are eligible to apply for Gavi support when their Gross National Income (GNI) per capita is ≤US$1,580 on average over the past three years (according to World Bank data published every year on July 1). In Gavi phase I (2000 to 2006), the GNI per capita eligibility threshold was US$1,000 (based on 1998 World Bank data). In Gavi phase II (2007 to 2010), country eligibility was based on the World Bank GNI per capita data for 2003. The eligibility threshold was maintained at the initial level of US$1,000. Since January 1, 2011, Gavi phase III, the threshold is adjusted for inflation annually. All 73 Gavi-eligible countries are included here, even if they graduated from Gavi support during 2000–2017. Timor Leste and South Sudan data were not available for the year 2000.

of countries with ≥90% MCV1 coverage increased from 15% to 44% (Table 1). In 2017, 78 (40%) countries reached ≥95% MCV1 coverage nationally, and 45 (23%) countries achieved ≥80% MCV1 coverage in all districts. Globally, an estimated 20.8 million infants did not receive MCV1 through routine immunization services in 2017. The six countries with the most unvaccinated infants were Nigeria (3.9 million), India (2.9 million), Pakistan (1.2 million), Indonesia (1.2 million), Ethiopia (1.1 million), and Angola (0.7 million).

Estimated MCV2 coverage increased globally from 15% in 2000 to 67% in 2017, largely because of an increase in the number of countries providing MCV2 nationally from 98 (51%) in 2000 to 167 (86%) in 2017 (Table 1). Three countries introduced MCV2 in 2017 (Laos, Namibia, and Nicaragua). During 2000–2017, the largest increases in regional MCV2 coverage were from 3% to 77% in SEAR, and from 2% to 94% in WPR. Among Gavi-eligible countries, MCV2 coverage increased from 2% to 51% during 2000–2017.

During 2017, approximately 205 million persons received supplementary doses of measles-containing vaccine (MCV) during 53 supplementary immunization activities (SIAs)[††] implemented in 39 countries (Table 2). Based on doses administered, SIA coverage was ≥95% in 26 (49%) SIAs. During 2010–2017, a total of 1,476,826,523 persons were vaccinated globally through 443 measles SIAs (an average of 55 SIAs per year); 172 (39%) SIAs included at least one other health intervention.

Reported Measles Incidence

In 2017, 189 (97%) countries conducted measles case-based surveillance in at least part of the country, and 191 (98%) had access to standardized quality-controlled testing through the WHO Global Measles and Rubella Laboratory Network. However, surveillance was weak in many countries, and fewer than half of the countries reporting surveillance indicators (73 of 152; 48%) achieved the sensitivity indicator target of two or more discarded measles and rubella[§§] cases per 100,000 population.

Countries report the aggregate number of incident measles cases[¶¶,***] to WHO and UNICEF annually through the Joint Reporting Form.[†††] During 2000–2017, the number of measles cases reported worldwide decreased 80%, from 853,479 in 2000 to 173,330 in 2017, and measles incidence decreased 83%, from 145 to 25 cases per million population (Table 1). Compared with the reported number of cases (132,328) and incidence (19 cases per million) in 2016, both cases and incidence increased in 2017, in part because eight more countries reported case data in 2017 (184 of 194; 95%) than did in 2016 (176 of 194; 91%).[§§§] The percentage of reporting countries with annual measles incidence of <5 cases per million population increased from 38% (64 of 169) in 2000 to 69% (122 of 176) in 2016, and then decreased to 65% (119 of 184) in 2017. During 2016–2017, reported measles cases increased 31% globally, 100% in AFR, 6,358% in AMR, 481% in EMR, 458% in EUR, and 3% in SEAR, but decreased 82% in WPR. In Gavi-eligible countries, reported cases increased 45% from 2016.

Genotypes of viruses isolated from measles cases were reported by 76 (59%) of the 129 countries that reported at least one measles case in 2017. Among the 24 recognized measles virus genotypes, 11 were detected during 2005–2008, eight during 2009–2014, six in 2015, and five in 2016 and 2017, excluding those from vaccine reactions and cases of subacute sclerosing panencephalitis, a fatal progressive neurologic disease caused by persistent measles virus infection (*3*).[¶¶¶] In 2017, among

[††] Supplemental immunization activities (SIAs) generally are carried out using two target age ranges. An initial, nationwide catch-up SIA focuses on all children aged 9 months–14 years, with the goal of eliminating susceptibility to measles in the general population. Periodic follow-up SIAs then focus on all children born since the last SIA. Follow-up SIAs generally are conducted nationwide every 2–4 years and focus on 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 MCV1.

[§§] A discarded case is defined as a suspected case that has been investigated and discarded as nonmeasles and as nonrubella using 1) laboratory testing in a proficient laboratory or 2) epidemiological linkage to a laboratory-confirmed outbreak of a communicable disease that is not measles or rubella. The discarded case rate is used to measure the sensitivity of measles surveillance.

[¶¶] http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tsincidencemeasles.html.

[***] Measles cases are defined differently in different countries. Some countries define measles cases as those that are laboratory-confirmed or epidemiologically linked; others define measles cases as those that are laboratory-confirmed, epidemiologically linked, or clinically compatible. Laboratory-confirmed cases are suspected measles cases with specimens that have detectable measles virus–specific immunoglobulin class M antibodies, or specimens from which measles virus can be isolated or measles virus genome can be detected in appropriate clinical specimens by a proficient laboratory. Epidemiologically linked confirmed measles cases are suspected measles cases that have not been confirmed by a laboratory but are geographically and temporally related to a laboratory-confirmed case or, in the event of a chain of transmission, to another epidemiologically confirmed measles case, with dates of rash onset between cases occurring 7–21 days apart. Clinically compatible measles cases are suspected measles cases with fever and maculopapular rash and cough, coryza, or conjunctivitis, for which no adequate clinical specimen was collected and which have not been linked epidemiologically to a laboratory-confirmed case of measles or to a laboratory-confirmed case of another communicable disease.

[†††] http://www.who.int/immunization/monitoring_surveillance/routine/reporting/en/.

[§§§] Ten countries did not report measles case data in 2017: Brazil, Cook Islands, Fiji, Marshall Islands, Morocco, Nauru, Niue, Tuvalu, United States of America, and Vanuatu. Eighteen countries did not report case data in 2016: Belgium, Cabo Verde, Cook Islands, Haiti, Ireland, Italy, Kiribati, Marshall Islands, Monaco, Morocco, Mozambique, Niue, Samoa, Singapore, Suriname, Tuvalu, United States of America, and Vanuatu.

[¶¶¶] http://dx.doi.org/10.1016/B978-0-444-53488-0.00027-4.

TABLE 2. Measles supplementary immunization activities (SIAs)* and the delivery of other child health interventions, by World Health Organization (WHO) region and country — African, Eastern Mediterranean, European, South-East Asian, and Western Pacific Regions, 2017

WHO region/country	Age group targeted	Extent of SIA	No. of children (%) reached in targeted age group†	% coverage based on survey results	Other interventions delivered
African					
Algeria	6–14 yrs	N	3,154,279 (45)	—	Rubella vaccine
Burundi	9 mos–14 yrs	N	4,126,421 (99)	98	Rubella vaccine
Central African Republic	6 mos–14 yrs	SN	28,155 (98)	—	—
Central African Republic	6 mos–14 yrs	SN	63,823 (131)	—	Vitamin A, deworming
Chad	9–59 mos	SN	707,103 (102)	—	—
Democratic Republic of the Congo	6–59 mos	SN	5,466,923 (103)	89	—
Ethiopia	9 mos–14 yrs	SN	21,225,199 (96)	93	—
Ethiopia	6–179 mos	SN	2,524,841 (98)	—	—
Gabon	9–59 mos	N	200,648 (75)	—	Vitamin A, bOPV
Guinea	6–10 yrs	SN	148,344 (104)	—	—
Guinea	6–10 yrs	SN	662,733 (96)	—	—
Guinea	6–59 mos	SN	1,315,918 (104)	—	—
Lesotho	9 mos–14 yrs	N	540,017 (89)	92	Rubella vaccine, vitamin A, bOPV, deworming
Malawi	9 mos–14 yrs	N	8,132,788 (102)	93	Rubella vaccine, vitamin A, deworming
Nigeria	9–59 mos	N	40,044,875 (107)	88	—
Rwanda	9–15 yrs	SN	93,893 (98)	—	Rubella vaccine
Rwanda	9–59 mos	N	1,508,834 (102)	97	Rubella vaccine, vitamin A, deworming
Senegal	9–59 mos	N	2,226,482 (107)	91	Rubella vaccine
South Africa	6–59 mos	N	4,255,588 (80)	—	—
South Africa	5–14 yrs	SN	846,642 (82)	—	—
South Sudan	6–59 mos	N	1,950,955 (84)	—	Vitamin A, OPV, deworming
Eastern Mediterranean					
Afghanistan	9–59 mos	SN	1,053,452 (97)	—	—
Djibouti	4–8 yrs	N	11,628 (92)	—	Vitamin A, deworming
Iraq	6–13 yrs	SN	319,314 (82)	—	Rubella vaccine, mumps vaccine
Kuwait	1–19 yrs	N	165,296 (16)	—	Rubella vaccine, mumps vaccine
Lebanon	1–15 yrs	SN	1,938 (83)	—	Rubella vaccine, mumps vaccine, OPV, IPV, PCV
Libya	3–6 yrs	N	721,488 (101)	—	Rubella vaccine, mumps vaccine
Oman	20–35 yrs	N	1,658,642 (92)	—	Rubella vaccine, mumps vaccine
Yemen	6 mos–15 yrs	SN	205,731 (41)	—	Rubella vaccine
Yemen	6 mos–15 yrs	SN	166,654 (100)	—	Rubella vaccine
Europe					
Cyprus	14 yrs	N	6,176 (86)	—	Rubella vaccine, mumps vaccine
Cyprus	6–12 yrs	N	7,446 (92)	—	Rubella vaccine, mumps vaccine
Cyprus	6–12 yrs	N	7,957 (91)	—	Rubella vaccine, mumps vaccine
Georgia	6–30 yrs	N	7,501 (15)	—	Rubella vaccine, mumps vaccine
Romania	9–11 mos	N	97,958 (30)	—	Rubella vaccine, mumps vaccine
Tajikistan	1–9 yrs	N	1,938,190 (100)	—	Rubella vaccine
Turkey	refugees	N	85,670 (21)	—	Rubella vaccine, mumps vaccine, Hepatitis B vaccine, DTaP vaccine, IPV, Hib vaccine
Turkey	refugees	N	28,908 (7)	—	Rubella vaccine, mumps vaccine
Turkey	refugees	N	28,732 (7)	—	Rubella vaccine, mumps vaccine
Ukraine	1–9 yrs	N	163,782 (57)	—	Rubella vaccine, mumps vaccine
Ukraine	6–9 yrs	N	154,430 (67)	—	Rubella vaccine, mumps vaccine
South-East Asia					
Bangladesh	9 mos–<5 yrs	SN	1,552,374 (100)	—	Rubella vaccine
Bangladesh	6 mos–<15 yrs	SN	490,501 (107)	—	Rubella vaccine, OPV
Bhutan	9 mos– 40 yrs	N	263,337 (98)	—	Rubella vaccine
India§	9 mos–15 yrs	N	59,156,720 (98)	—	Rubella vaccine
Indonesia	9 mos–15 yrs	SN	35,307,148 (101)	—	Rubella vaccine
Maldives	15–25 yrs	N	46,835 (76)	—	Rubella vaccine
Maldives	8–14 yrs	N	1,645 (77)	—	Rubella vaccine
Western Pacific					
Cambodia	6–59 mos	N	1,452,821 (90)	75	Rubella vaccine
Fiji	12 mos–11 yrs	N	178,069 (95)	—	Rubella vaccine
Laos	9 mos–<5 yrs	N	703,924 (100)	—	Rubella vaccine, bOPV
Federated States of Micronesia	12–60 mos	SN	1,491(79)	—	Rubella vaccine, mumps vaccine
Samoa	1–12 yrs	N	57,229 (95)	—	Rubella vaccine

See table footnotes on next page.

TABLE 2. (*Continued*) Measles supplementary immunization activities (SIAs)* and the delivery of other child health interventions, by World Health Organization (WHO) region and country — African, Eastern Mediterranean, European, South-East Asian, and Western Pacific Regions, 2017

Abbreviations: bOPV = bivalent oral poliovirus vaccine; DPT = diphtheria and pertussis toxoids and tetanus vaccine; DT = diphtheria and tetanus toxoids; DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine; Hib = *Haemophilus influenzae* type b vaccine; IPV = inactivated polio vaccine; N = national; OPV = oral poliovirus vaccine; PCV = pneumococcal conjugate vaccine; Penta = pentavalent (DTP, hepatitis B, Hib) vaccine; SIA = supplementary immunization activity; SN = subnational.

* SIAs generally are carried out using two approaches: 1) An initial, nationwide catch-up SIA targets all children aged 9 months to 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. 2) Follow-up SIAs are generally conducted nationwide every 2–4 years and 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 1 dose of measles-containing vaccine, and the time since the last SIA.

† Values >100% indicate that the number of doses administered exceeded the estimated target population.

§ Rollover national campaigns started the previous year or will continue into the next year.

5,789 reported measles virus sequences,**** 2,641 (45.6%) were genotype B3 (53 countries); 15 (0.26%) were D4 (two countries); 2,542 (43.9%) were D8 (49 countries); 46 (0.80%) were D9 (six countries); and 545 (9.4%) were H1 (11 countries).

Measles Mortality Estimates

A previously described model for estimating measles disease and mortality was updated with new measles vaccination coverage data, case data, and United Nations population estimates for all countries during 2000–2017, enabling derivation of a new series of disease and mortality estimates. For countries with previously anomalous estimates, the model was modified slightly to generate mortality estimates consistent with the observed case data (*4*). Based on the updated data, the estimated number of measles cases declined from 28,493,539 (95% confidence interval [CI] = 19,808,871–64,780,514) in 2000 to 6,732,904 (CI = 2,950,042–36,842,865) in 2017. During this period, estimated measles deaths decreased 80%, from 545,174 (CI = 368,236–913,226) in 2000 to 109,638 (CI = 46,123–376,619) in 2017 (Table 1). During 2000–2017, compared with no measles vaccination, measles vaccination prevented an estimated 21.1 million deaths globally and 19.3 million deaths among Gavi-eligible countries (Figure) (Table 1).

Regional Verification of Measles Elimination

In 2017, AFR and EMR established regional verification commissions (RVCs); thus, all six regions now have RVCs. In September 2016, the AMR RVC declared the region free of endemic measles (*5*). In 2017, the EUR RVC verified measles elimination in 37 (70%) countries and the reestablishment of endemic measles virus transmission in the Russian Federation and in Germany (*6*). In SEAR, Maldives and Bhutan were verified as having eliminated measles in 2017 (*7*). In WPR, six (22%) countries (Australia, Brunei, Cambodia, Japan, New Zealand, and South Korea) and two areas, Hong Kong Special Autonomous Region (China) and Macao Special Autonomous Region (China), had verified measles elimination in 2017 (*8*). No EMR or AFR countries had verified elimination in 2017.

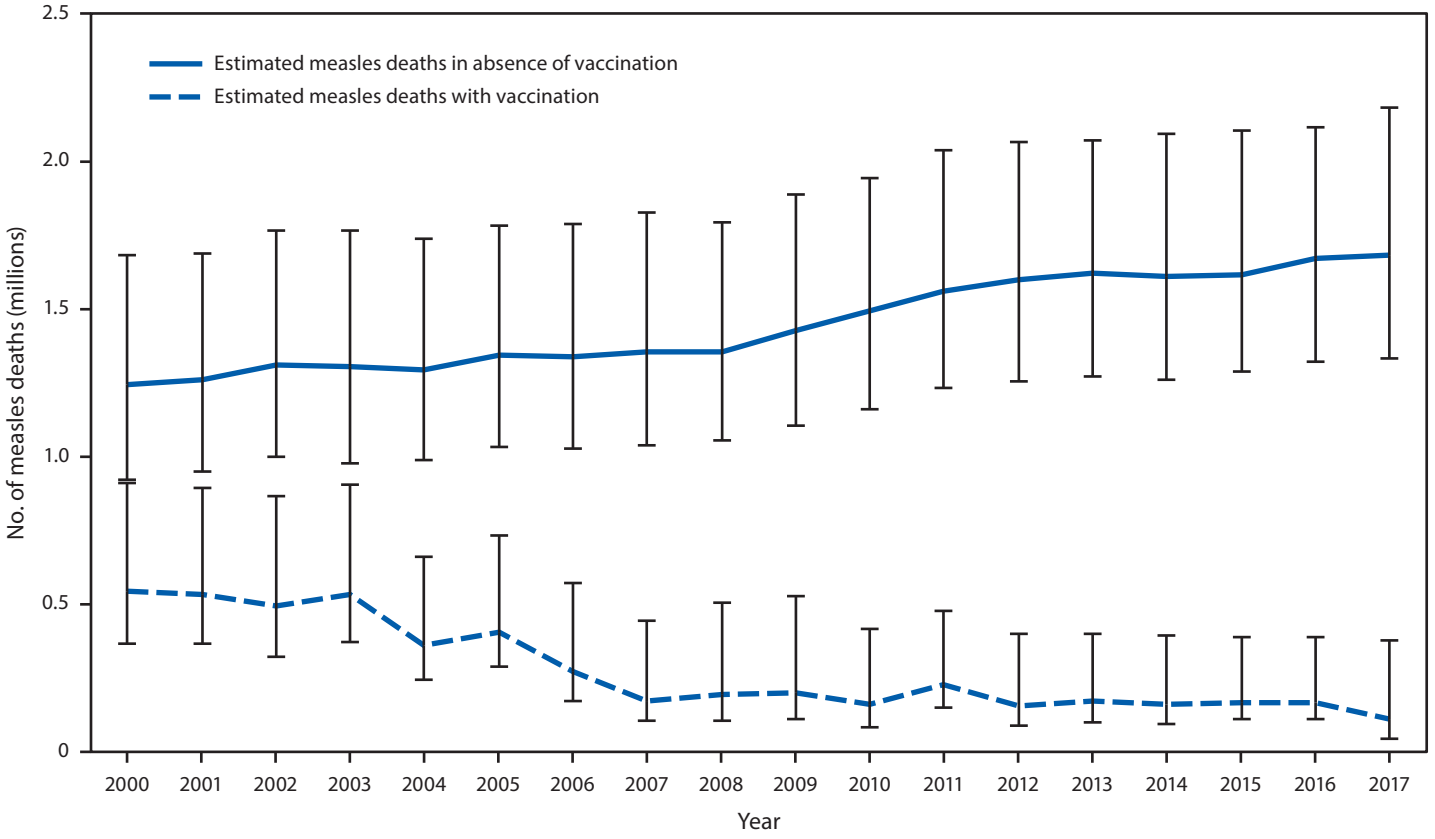
**** Sequences were for the 450 nucleotides coding for the carboxy-terminal 150 amino acids of the nucleoprotein of measles virus. Data (as of October 4, 2018) were available from the Measles Nucleotide Surveillance database. http://www.who-measles.org/Public/Web_Front/main.php.

Discussion

During 2000–2017, increased coverage with MCV administered through routine immunization programs and SIAs, and other global measles elimination efforts contributed to an 83% decrease in reported measles incidence and an 80% reduction in estimated measles mortality. Measles vaccination prevented an estimated 21.1 million deaths during this period; the large majority of deaths averted were in AFR and among Gavi-eligible countries. Global MCV2 coverage has steadily increased since 2000; in 2017, 167 (86%) countries provided MCV2. In 2017, MCV1 and MCV2 coverage in WPR was ≥94%, and measles incidence in this region was at an all-time low. The increasing number of countries verified as having achieved measles elimination indicates progress toward global interruption of measles virus transmission.

Despite this progress, however, the 2015 global milestones have not been achieved; global MCV1 coverage has stagnated for nearly a decade; global MCV2 coverage is only at 67% despite steady increases; and SIA quality was inadequate to achieve ≥95% coverage in several countries. Since 2016, measles incidence has increased globally and in five of the six WHO regions. Furthermore, as of July 2018, endemic measles has been reestablished in Venezuela because of the sustained transmission of measles virus for >12 months; the remaining 34 AMR countries continue to maintain their measles elimination status, but the ongoing outbreak in Venezuela has led to measles virus importations and outbreaks in bordering AMR countries. In addition, the measles resurgence in Europe has likely led to reestablished endemic measles in some EUR countries. These outbreaks highlight the fragility of gains made toward global and regional measles elimination goals. Continuing to increase MCV1 and MCV2 coverage is critical to both the achievement and sustainability of the global and regional measles elimination goals. Meanwhile, conducting high quality SIAs that reach unvaccinated and undervaccinated

FIGURE. Estimated annual number of measles deaths with and without vaccination programs — worldwide, 2000–2017*



* Deaths prevented by vaccination are indicated by the area between estimated deaths with vaccination and those without vaccination (cumulative total of 21.1 million deaths prevented during 2000–2017). Error bars represent upper and lower 95% confidence limits around the point estimate.

children will prevent future outbreaks that are costly in terms of morbidity and mortality and are disruptive to immunizations service delivery. It is important to have high-performing surveillance for early detection of outbreaks; and when outbreaks do occur, thorough outbreak investigations are needed to better understand and address the underlying causes of the outbreak and why children are being missed by immunization delivery systems.

The findings in this report are subject to at least three limitations. First, SIA administrative coverage data might be biased by inaccurate reports of the number of doses delivered, doses administered to children outside the target age group, and inaccurate estimates of the target population size. Second, large differences between the estimated and reported incidence indicate variable surveillance sensitivity, making comparisons between countries and regions difficult to interpret. Finally, the accuracy of estimates from the measles mortality model is affected by biases in all model inputs, including country-specific measles vaccination coverage and measles case-based surveillance data.

Monitoring progress toward measles elimination goals could be improved by establishing updated indicators. For example, the WHO Strategic Advisory Group of Experts on Immunization recently approved country classifications, and updates to the framework for the verification of measles elimination will standardize monitoring of countries' progress toward verified elimination (*9*). Moreover, synergizing future global health efforts and capitalizing on immunization partners' investments could be enhanced by dovetailing measles and rubella elimination strategies with post-GVAP immunization targets and strategies.

Strengthening routine immunization and continuing to conduct high-quality SIAs will help achieve global and regional measles elimination goals, improve overall vaccination coverage and equity, and assist in attaining universal health coverage. It is important that countries continue to strengthen case-based surveillance and increase MCV1 and MCV2 coverage and that immunization partners continue to raise the visibility of measles elimination goals and secure political commitment to these goals and sustained investments in health systems.

Summary

What is already known about this topic?

In 2012, the World Health Assembly endorsed the Global Vaccine Action Plan; as a result, countries in all six World Health Organization regions have adopted goals for elimination of measles by 2020.

What is added by this report?

During 2000–2017, annual reported measles incidence decreased 83%, and annual estimated measles deaths decreased 80%. Since 2000, global measles elimination efforts have prevented an estimated 21.1 million deaths. However, measles elimination milestones have not been met, and three regions are experiencing a large measles resurgence.

What are the implications for public health practice?

To make further progress, case-based surveillance needs to be strengthened, and coverage with the first and second dose of measles-containing vaccine needs to increase; moreover, it is important to maintain political commitment, and secure substantial, sustained investments.

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All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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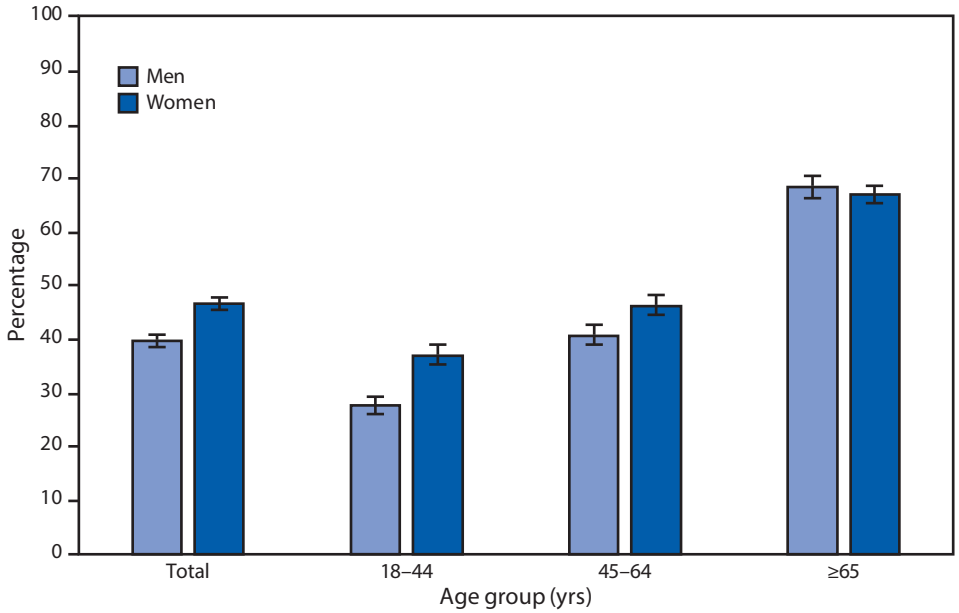
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of U.S. Adults Aged ≥18 Years Who Have Had a Flu Vaccination in the Past 12 Months,† by Sex and Age Group — National Health Interview Survey,§ 2017



* With 95% confidence intervals indicated with error bars.
† Based on a response to the question "During the past 12 months, have you had a flu vaccination?" Annual calendar-year estimates of vaccinations differ from seasonal flu vaccination totals, which reflect vaccinations obtained during the flu season.
§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the National Health Interview Survey Sample Adult component.

Overall, 46.7% of women and 39.9% of men aged ≥18 years have had a flu vaccination in the past 12 months. For both sexes, as age increased, a higher percentage of adults had a flu vaccination. Among men, 27.8% of those aged 18–44 years, 40.8% of those aged 45–64 years, and 68.7% of those aged ≥65 years have had a flu vaccination. Among women, 37.2% of those aged 18–44 years, 46.4% of those aged 45–64 years, and 67.1% of those aged ≥65 years have had a flu vaccination. Women aged 18–44 years and 45–64 years were significantly more likely to have had a flu vaccination compared with men of the same age groups.

Source: National Health Interview Survey, 2017. https://www.cdc.gov/nchs/nhis/index.htm.

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