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Hospitalizations for Endocarditis and Associated Health Care Costs Among Persons with Diagnosed Drug Dependence — North Carolina, 2010–2015

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Opioid dependence and overdose have increased to epidemic levels in the United States. The 2014 National Survey on Drug Use and Health estimated that 4.3 million persons were nonmedical users of prescription pain relievers (*1*). These users are 40 times more likely than the general population to use heroin or other injection drugs (*2*). Furthermore, CDC estimated a near quadrupling of heroin-related overdose deaths during 2002–2014 (*3*). Although overdose contributes most to drug-associated mortality, infectious complications of intravenous drug use constitute a major cause of morbidity leading to hospitalization (*4*). In addition to infections from hepatitis C virus (HCV) and human immunodeficiency virus (HIV), injecting drug users are at increased risk for acquiring invasive bacterial infections, including endocarditis (*5*,*6*). Evidence that hospitalizations for endocarditis are increasing in association with the current opioid epidemic exists (*7*–*9*). To examine trends in hospitalizations for endocarditis among persons in North Carolina with drug dependence during 2010–2015, data from the North Carolina Hospital Discharge database were analyzed. The incidence of hospital discharge diagnoses for drug dependence combined with endocarditis increased more than twelvefold from 0.2 to 2.7 per 100,000 persons per year over this 6-year period. Correspondingly, hospital costs for these patients increased eighteenfold, from $1.1 million in 2010 to $22.2 million in 2015. To reduce the risk for morbidity and mortality related to opioid-associated endocarditis, public health programs and health care systems should consider collaborating to implement syringe service programs, harm reduction strategies, and opioid treatment programs.

The North Carolina Hospital Discharge database (processed by Truven Health Analytics for the North Carolina State Center for Health Statistics) included discharge data from all 128 hospitals in North Carolina, accounting for approximately 1 million hospital admissions per year. Patients aged ≥18 years who were discharged with diagnosis codes (ninth and tenth revisions of *Classification of Diseases Clinical Modification and Related Health Problems* [ICD-9-CM or ICD-10-CM]) for both drug dependence and endocarditis (Supplemental Table; https://stacks.cdc.gov/view/cdc/45932) were included in this analysis. Drug dependence was defined as discharge diagnoses indicating drug withdrawal or overdose/poisoning from or dependence on any drug, including cocaine, opioids, amphetamines, or hallucinogens. Endocarditis outcomes were determined using diagnosis codes for acute or chronic endocarditis, and persons with diagnosis codes suggesting coinfections with HIV or HCV were identified.

Payer status was categorized as private insurance, Medicaid, Medicare, unidentified payer, and other. Patients with unidentified payers included those listed as self-pay (e.g., uninsured), unknown,

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or missing. Cost was reported as the total cost billed by the hospital. Open-source, state-specific data were used to categorize counties as rural (<250 persons per square mile [ppsm]), a regional city (250–750 ppsm), or urban (>750 ppsm). To calculate the incidence rates of hospital discharge diagnoses for drug dependence combined with endocarditis among the general North Carolina population, census estimates of persons aged ≥18 years for 2010–2015 were used for denominators. Wilcoxon rank sum tests were used to analyze the hospital charge (cost) data. Incidence rate ratios (IRRs) were used to compare incidence rates by age. Analyses were performed using spreadsheet and statistical software.

During 2010–2015, a total of 505 North Carolina residents aged ≥18 years were hospitalized with the two diagnoses of drug dependence and endocarditis (Table). Nearly two thirds of patients were aged ≤40 years, including approximately half who were aged 26–40 years. Patients were mostly white (87%) and non-Hispanic (92%), and the majority (60%) were from rural counties. Nineteen percent of patients hospitalized for endocarditis were uninsured and 23% were on Medicaid. HIV coinfections were uncommon (1.4%), but 36% of patients with endocarditis had past or current HCV infections.

The incidence of hospital discharge diagnoses for drug dependence combined with endocarditis among the general North Carolina population sharply increased during the study period, particularly beginning in 2013 (Figure 1). Rates of hospital admissions for drug dependence–associated endocarditis increased approximately twelvefold, from 0.2 cases per 100,000 persons per year in 2010 to

TABLE. Characteristics of patients hospitalized with drug dependence and endocarditis (N = 505) — North Carolina, 2010–2015

Characteristic	No. (%)
Age at hospital admission (yrs)	
18–25	82 (16)
26–40	245 (49)
41–60	131 (26)
>60	47 (9)
Gender	
Male	240 (48)
Female	265 (52)
Ethnicity	
Non-Hispanic	465 (92)
Hispanic	7 (1)
Unknown	33 (7)
Race	
African-American	41 (8)
White	440 (87)
Other	24 (5)
Geographic classification*	
Rural	302 (60)
Regional city	128 (25)
Urban	75 (15)
Insurance payer	
Private	215 (43)
Medicaid	116 (23)
Medicare	67 (13)
Other	10 (2)
Unidentified/Uninsured	97 (19)
Other infections	
Hepatitis C virus	181 (36)
Human immunodeficiency virus	7 (1.4)

*Rural defined as <250 persons per square mile (ppsm); regional city defined as 250–750 ppsm; urban defined as >750 ppsm.

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2.7 cases per 100,000 persons in 2015. The sharpest rate of increase occurred among persons aged 18–25 years (IRR 2.1; 95% confidence intervals [CI] = 1.4–3.1) and 26–40 years (IRR 3.8; 95% CI = 2.8–5.1) compared with rates in persons aged >40 years.

The median hospital charge for drug dependence–associated endocarditis hospitalization was $54,281; total costs of hospitalizations for drug dependence–associated endocarditis increased eighteenfold during 2010–2015, from $1.1 to $22.2 million (Figure 2). In 2015, 42% of patients with drug dependence–associated endocarditis were either uninsured or on Medicaid, accounting for a total $9.3 million in health care costs compared with only $481,000 in 2010 (p<0.01).

Discussion

The incidence of hospitalizations for drug-associated endocarditis is increasing rapidly, particularly among drug users who are younger, white, non-Hispanic, and from rural areas (*7*–*9*). Approximately one third of patients hospitalized with drug dependence–associated endocarditis in North Carolina during 2010–2015 were coinfected with HCV; this finding was not unexpected because injection drug use is a recognized risk factor for both endocarditis and HCV infection (*5*,*7*–*9*).

Among patients hospitalized for drug dependence–associated endocarditis, 42% were uninsured or had Medicaid coverage, suggesting that the health care system and public payers could share a larger proportion of the cost of the increasing

Summary

What is already known about this topic?

Injection drug use and opioid dependence have increased to epidemic levels in the United States, and evidence suggests that bacterial complications of injection drug use, such as endocarditis, are increasing.

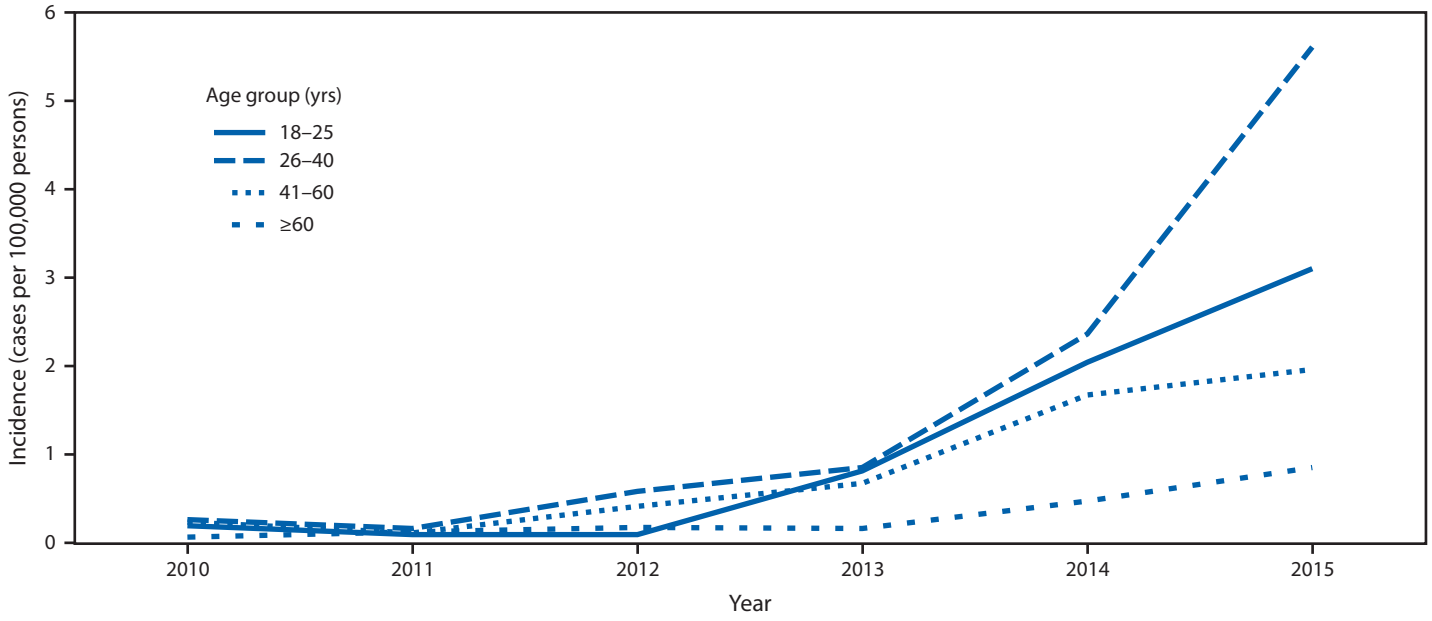
What is added by this report?

In North Carolina, analysis of hospital discharge data identified an approximately twelvefold increase in hospitalizations for endocarditis combined with drug dependence during 2010–2015. Consistent with overall trends in the U.S. opioid epidemic, the majority of patients were non-Hispanic, white, aged <40 years, and from rural areas; in addition, approximately one third were infected with hepatitis C virus. On average, the cost for each hospitalization for endocarditis exceeded $50,000, and 42% of hospitalizations were among persons on Medicaid or without insurance. The total hospital costs of hospitalizations for drug dependence–associated endocarditis increased eighteenfold during 2010–2015.

What are the implications for public health practice?

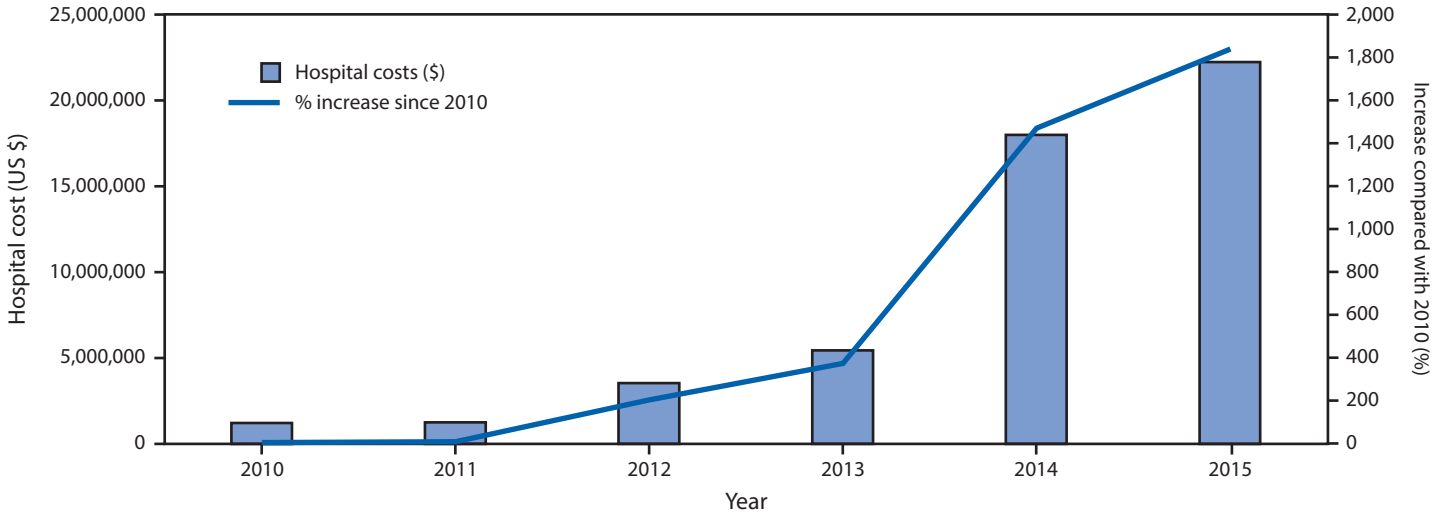
As the U.S. opioid epidemic continues to grow, hospitalizations for infectious complications associated with injection drug use are likely to increase. Effective and cost-saving public health interventions, such as syringe service programs and harm reduction strategies, are needed to reduce disease burden and save health care costs. Collaboration between public health, health care systems, and policy makers is important to reduce the risks associated with injection drug use.

FIGURE 1. Incidence* of hospital discharge diagnoses of drug dependence–associated endocarditis,† by age group — North Carolina, 2010–2015



* North Carolina Hospital Discharge database, which includes discharge data from all 128 hospitals in North Carolina.
† Ninth and tenth revisions of *International Classification of Diseases Clinical Modification and Related Health Problems* (ICD-9-CM or ICD-10-CM) codes for both drug dependence and endocarditis.

FIGURE 2. Hospital costs for persons with drug dependence–associated endocarditis and percentage increase since 2010 — North Carolina, 2010–2015



incidence of endocarditis, particularly if the costs of infectious complications of injection drug use, including endocarditis and HCV, continue to rise. These findings suggest a need to focus preventive interventions on harm reduction strategies such as syringe service programs, safe injection education, and treatment programs offering opioid agonist and antagonist therapies (*10*).

The findings in this report are subject to at least four limitations. First, ICD-9-CM and ICD-10-CM codes for drug use are subject to coding errors and misclassification (e.g., historic use versus current use). Only hospitalizations with drug dependence listed as a diagnosis were included in this analysis, but patients might not have disclosed drug use; thus, hospitalizations for drug dependence–associated endocarditis might have been under-ascertained. Second, administrative codes do not provide sufficient information to identify a causal association between current drug use and developing endocarditis. Third, administrative codes are nonspecific and do not identify the mode of drug dependency (e.g., injection, oral, or inhalation). Finally, the charge data do not reflect the actual cost to the health system or to the payer, but rather the initial charge billed by the hospital. Therefore, the cost data might be overestimated because of insurance-negotiated pricing.

In North Carolina, the incidence of hospitalizations for endocarditis among drug-dependent patients has increased twelvefold since 2010. Simple and cost-effective public health interventions such as syringe service programs and harm reduction strategies that include the use of fact-based drug education, drug-related illness and injury prevention, and drug treatment could lead to decreased morbidity as well as potential cost savings for the health care system in North Carolina. Coordination among public health providers, health care systems, and policy makers is essential to address the growing U.S. opioid epidemic and its consequences.

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References

1. Center for Behavioral Health Statistics and Quality. Behavioral health trends in the United States: results from the 2014 National Survey on Drug Use and Health. HHS publication No. SMA 15–4927. Rockville, MD: US Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality; 2015. https://www.samhsa.gov/data/sites/default/files/NSDUH-FRR1-2014/NSDUH-FRR1-2014.pdf
2. Jones CM. Heroin use and heroin use risk behaviors among nonmedical users of prescription opioid pain relievers—United States, 2002–2004 and 2008–2010. Drug Alcohol Depend 2013;132:95–100. https://doi.org/10.1016/j.drugalcdep.2013.01.007
3. Rudd RA, Aleshire N, Zibbell JE, Gladden RM. Increases in drug and opioid overdose deaths—United States, 2000–2014. MMWR Morb Mortal Wkly Rep 2016;64:1378–82. https://doi.org/10.15585/mmwr.mm6450a3
4. Scheidegger C, Zimmerli W. Incidence and spectrum of severe medical complications among hospitalized HIV-seronegative and HIV-seropositive narcotic drug users. AIDS 1996;10:1407–14. https://doi.org/10.1097/00002030-199610000-00014
5. Klevens RM, Hu DJ, Jiles R, Holmberg SD. Evolving epidemiology of hepatitis C virus in the United States. Clin Infect Dis 2012;55 (Suppl 1):S3–9. https://doi.org/10.1093/cid/cis393
6. Wilson LE, Thomas DL, Astemborski J, Freedman TL, Vlahov D. Prospective study of infective endocarditis among injection drug users. J Infect Dis 2002;185:1761–6. https://doi.org/10.1086/340827
7. Ronan MV, Herzig SJ. Hospitalizations related to opioid abuse/dependence and associated serious infections increased sharply, 2002–12. Health Aff (Millwood) 2016;35:832–7. https://doi.org/10.1377/hlthaff.2015.1424

8. Wurcel AG, Anderson JE, Chui KK, et al. Increasing infectious endocarditis admissions among young people who inject drugs. Open Forum Infect Dis 2016;3:ofw157. https://doi.org/10.1093/ofid/ofw157
9. Hartman L, Barnes E, Bachmann L, Schafer K, Lovato J, Files DC. Opiate injection-associated infective endocarditis in the southeastern United States. Am J Med Sci 2016;352:603–8. https://doi.org/10.1016/j.amjms.2016.08.010
10. Marshall BDL, Green TC, Yedinak JL, Hadland SE. Harm reduction for young people who use prescription opioids extra-medically: obstacles and opportunities. Int J Drug Policy 2016;31:25–31. https://doi.org/10.1016/j.drugpo.2016.01.022

Measures Taken to Prevent Zika Virus Infection During Pregnancy — Puerto Rico, 2016

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Zika virus infection during pregnancy remains a serious health threat in Puerto Rico. Infection during pregnancy can cause microcephaly, brain abnormalities, and other severe birth defects (*1*). From January 1, 2016 through March 29, 2017, Puerto Rico reported approximately 3,300 pregnant women with laboratory evidence of possible Zika virus infection (*2*). There is currently no vaccine or intervention to prevent the adverse effects of Zika virus infection during pregnancy; therefore, prevention has been the focus of public health activities, especially for pregnant women (*3*). CDC and the Puerto Rico Department of Health analyzed data from the Pregnancy Risk Assessment Monitoring System Zika Postpartum Emergency Response (PRAMS-ZPER) survey conducted from August through December 2016 among Puerto Rico residents with a live birth. Most women (98.1%) reported using at least one measure to avoid mosquitos in their home environment. However, only 45.8% of women reported wearing mosquito repellent daily, and 11.5% reported wearing pants and shirts with long sleeves daily. Approximately one third (38.5%) reported abstaining from sex or using condoms consistently throughout pregnancy. Overall, 76.9% of women reported having been tested for Zika virus by their health care provider during the first or second trimester of pregnancy. These results can be used to assess and refine Zika virus infection prevention messaging and interventions for pregnant women and to reinforce measures to promote prenatal testing for Zika.

The Puerto Rico Department of Health (PRDH), in collaboration with CDC, collected data using a methodology adapted from the Pregnancy Risk Assessment Monitoring System (PRAMS) (*4*) to obtain island-wide and regionally representative information regarding experiences related to prevention and detection of Zika virus infection during pregnancy among women who had a live birth from August 28, 2016 to December 3, 2016. Thirty-six hospitals in Puerto Rico reporting ≥100 births in 2015 (representing >98% of live births) were eligible, and all agreed to participate. Hospitals were assigned to one of eight regional strata corresponding to health districts (Arecibo, Aguadilla, Bayamon, Caguas, Fajardo, Mayaguez, Metro, and Ponce). Regions with fewer births were oversampled to ensure sufficient sample size for computing region-specific estimates. Mothers were selected for inclusion, with probability of selection proportional to the size of the total birth cohort within each region. Within each hospital, clusters (delivery dates) were selected using random sampling. Hospital birth logs were used to identify women (Puerto Rico residents) who gave birth on the selected dates to include in the sample. Sampled women were approached during their hospital stay, 24–36 hours after delivery, and invited to complete a self-administered survey using either a tablet computer (Dell Venue Pro 7139) or paper form. A small incentive (crib mosquito net, calendar of baby's first year, or mosquito repellent) was offered to participants. Women not contacted before hospital discharge were not followed up. Data were weighted to account for the stratified sampling design and to adjust for differential nonresponse. Percentages and 95% confidence intervals (CIs) were calculated for all indicators.

Among 2,933 selected women, 2,364 (80.6%) agreed to participate. Among respondents, 72.0% completed the survey via tablet, and 28.0% used the paper form. Most women (79.7%) were aged 20–34 years, 59.5% were married, 68.6% had more than a high school education, 68.6% had Medicaid coverage for prenatal care, 88.5% were recipients of the Special Supplemental Nutrition Program for Women, Infants, and Children, and 91.3% received prenatal care during the first trimester of pregnancy.

Most women reported feeling somewhat or very worried about contracting Zika during their pregnancy (93.4%), and about the possibility of microcephaly or other birth defects in their infants (92.3%) (Table 1). Most women (94.3%) also reported that their health care provider talked to them about Zika virus infection during pregnancy, including counseling them about the risk for transmitting Zika to their baby (91.1%), how to prevent mosquito bites (89.4%), and the use of condoms to prevent sexual transmission of Zika during pregnancy (86.8%). Altogether, 70.6% of women considered their health care provider to be the best source of information about Zika virus infection. Approximately three quarters of respondents reported that their health care provider offered a test (78.2%), and most reported that they were subsequently tested for Zika virus infection (76.9%) during the first or second trimester of pregnancy (Table 1).

TABLE 1. Concerns about Zika virus, health care provider counseling and testing, and use of measures to prevent Zika virus transmission during pregnancy among Puerto Rico residents with a recent live birth — Pregnancy Risk Assessment Monitoring System Zika Postpartum Emergency Response Survey, Puerto Rico, 2016

Survey responses	Overall total (n = 2,364)	
	Unweighted no.*	%† (95% CI)
Maternal Zika-related concern		
Somewhat/Very worried about getting Zika	2,205	93.4 (92.4–94.3)
Somewhat/Very worried about microcephaly/birth defects in baby	2,154	92.3 (91.2–93.2)
Information from health care provider		
Counseling on Zika virus (any discussion)	2,155	94.3 (93.4–95.0)
Counseling on risk for passing Zika virus to baby	2,053	91.1 (90.0–92.0)
Counseling on how to prevent mosquito bites	2,030	89.4 (88.2–90.5)
Counseling on using condoms to prevent sexual transmission of Zika	1,982	86.8 (85.4–88.1)
Considered health care provider best source of information on Zika	1,662	70.6 (68.7–72.3)
Testing for Zika		
Health care provider offered Zika test in first or second trimester of pregnancy	1,801	78.2 (76.6–79.7)
Health care provider provided Zika test in first or second trimester of pregnancy	1,758	76.9 (75.3–78.4)
Use of measures to prevent Zika virus infection		
Environmental measures to avoid mosquito bites		
Always used screens on open doors and open windows, or always kept unscreened doors and windows closed	2,032	88.4 (87.0–89.6)
Removed standing water from around the home weekly	2,068	88.7 (87.3–90.0)
Received professional indoor/outdoor spraying of home	1,274	55.0 (53.1–56.9)
Received professional larvicide application outside home	688	29.3 (27.5–31.1)
Slept under mosquito net	424	17.4 (16.0–18.9)
Personal measures to avoid mosquito bites		
Wore long sleeves and pants every day	262	11.5 (10.3–12.8)
Used mosquito repellent every day	1,055	45.8 (43.9–47.8)
Measures to prevent sexual transmission		
Abstained from sexual activity for entire pregnancy for any reason	467	19.9 (18.4–21.5)
Condom use during pregnancy among sexually active women (n = 1,864)		
Every time	414	22.7 (20.8–24.6)
Sometimes§	372	21.2 (19.4–23.1)
Never	1,017	56.2 (53.9–58.4)
Measures to prevent mosquito bites and sexual transmission		
Used at least one environmental protective measure around the home	2,309	98.1 (97.4–98.6)
Used at least one personal protective measure every day (long sleeves and pants or repellent)	1,128	48.8 (46.9–50.8)
Used at least one measure to avoid sexual transmission for entire pregnancy (sexual abstinence or condom use)	881	38.5 (36.6–40.4)
Used at least one personal protective measure against mosquitos and at least 1 personal protective measure against sexual transmission consistently throughout pregnancy	552	24.2 (22.6–26.0)

Abbreviation: CI = confidence interval.
* Unweighted sample size; sample size varies because of missing responses or skip pattern in survey.
† Weighted percent.
§ Excludes condom use every time.

Measures to prevent mosquito bites in the home environment were reported to be commonly practiced during pregnancy. These included always using screens on windows and doors or keeping unscreened windows and doors closed (88.4%); removing standing water from the house and yard weekly (88.7%); receiving professional indoor/outdoor spraying of the home (55.0%); and receiving professional larvicide application outside the home (29.3%). Fewer than two in 10 women (17.4%) reported sleeping under a mosquito net at some time during pregnancy. Overall, 98.1% of women adopted at least one measure to protect their home environment from mosquitos (Table 1).

Use of personal protective measures against mosquito bites was reported less frequently than implementation of home environment prevention measures. Personal protective measures included wearing long-sleeved shirts and pants daily during pregnancy (11.5% of participants), and using mosquito repellent on exposed skin every day when outside (45.8%) (Table 1). Being too hot (76.4%) was the most commonly reported reason for not wearing long-sleeved shirts and pants. Forgetting to apply/reapply repellent (51.4%), disliking the smell (18.8%), and being concerned that chemicals would harm the baby (15.3%) were the most commonly reported reasons for not using repellent daily (Table 2).

Measures to prevent sexual transmission of Zika virus during pregnancy through sexual abstinence or consistent condom use were not commonly practiced; overall, one in five (19.9%) women reported that they abstained from sex during the entire pregnancy, one quarter of whom did so specifically to avoid Zika virus infection. Among sexually active women, less than a

TABLE 2. Reasons for not using measures to prevent Zika virus transmission during pregnancy among Puerto Rico residents with a recent live birth — Pregnancy Risk Assessment and Monitoring System Zika Postpartum Emergency Response Survey, Puerto Rico, 2016

Survey response	Unweighted no.*	%† (95% CI)
Reason for not wearing long sleeves and pants every day (n = 2339)		
It was too hot to wear long sleeves or long pants	1,783	76.4 (74.7–78.0)
My clothes with long sleeves or long pants no longer fit because of pregnancy	457	19.7 (18.1–21.3)
I did not have clothes with long sleeves or long pants	111	4.7 (4.0–5.7)
I was indoors	44	2.1 (1.6–2.8)
Some other reason	131	5.3 (4.5–6.2)
Reasons for not using mosquito repellent every day on exposed skin when outside (n = 2241)		
I forgot to apply/reapply it	1,137	51.4 (49.4–53.4)
I did not like the way it smelled	408	18.8 (17.3–20.4)
I worried about the chemicals in the repellent harming my baby	329	15.3 (13.9–16.9)
I did not like the way it made my skin feel	265	11.8 (10.6–13.1)
I worried about the chemicals in the repellent harming me	128	5.8 (4.9–6.8)
I was indoors	56	2.7 (2.1–3.5)
Mosquito repellent was too expensive	54	2.5 (1.9–3.2)
I have an allergy	35	1.4 (1.0–1.8)
Some other reason	200	7.9 (6.9–9.0)
Reasons for not using condoms every time during sex§ (n = 1406)		
I didn't think my partner had Zika virus	505	37.4 (35.0–39.9)
I didn't think I needed to use condoms during pregnancy	432	31.8 (29.5–34.3)
I didn't want to use condoms	287	20.1 (18.2–22.2)
I forgot to use condoms	180	12.2 (10.6–13.9)
My partner didn't want to use condoms	153	11.0 (9.5–12.7)
I didn't know you could get Zika virus from having sex	94	7.3 (6.0–8.9)
I didn't think a condom would prevent Zika infection	58	4.7 (3.7–6.0)
I was not worried about getting the Zika virus	41	3.1 (2.3–4.2)
I could not get condoms when I needed them	33	2.3 (1.7–3.2)
Allergy	29	2.1 (1.5–3.0)
I could not afford condoms	20	1.6 (1.0–2.4)
Some other reason	105	7.1 (6.0–8.5)

Abbreviation: CI = confidence interval.
* Unweighted sample size; sample size varies because of missing response or skip pattern in survey.
† Weighted percent.
§ Among women who were sexually active during pregnancy.

quarter (22.7%) reported using condoms consistently throughout pregnancy. Altogether, approximately one third (38.5%) of respondents reported using at least one measure to prevent sexual transmission of Zika during pregnancy (abstinence or consistent condom use) (Table 1). Common reasons for not using condoms consistently were not thinking her partner had Zika (37.4%), not thinking that condom use was necessary during pregnancy (31.8%), and not wanting to use condoms (20.1%) (Table 2).

Overall, approximately one quarter (24.2%) of women reported using at least one personal protective measure against mosquito bites daily (repellent or protective clothing) and at least one protective measure against sexual transmission (abstinence or consistent condom use) throughout pregnancy.

Discussion

In 2016 and early 2017, approximately 3,300 pregnant women in Puerto Rico had laboratory evidence of possible Zika virus infection, the largest number in the United States (*2*,*5*). Because Zika virus infection during pregnancy can cause microcephaly and other severe brain defects in infants (*1*,*6*), public health measures have focused on raising awareness about the virus and ways to prevent infection among pregnant women.*,†,§ PRDH has widely disseminated information to the public regarding avoiding mosquito bites to prevent Zika virus infection. The messaging might be familiar to many women because similar guidance has been provided in earlier campaigns to prevent mosquito-borne illnesses such as dengue and chikungunya (*7*). Whereas almost all respondents to this survey (98.1%) used environmental measures to protect themselves from mosquito bites around the home, reported use of personal protective measures was less common (<50%), despite respondent awareness of and concern about the risks of contracting Zika virus infection during pregnancy. Public awareness campaigns and provider advice should focus on prevention messages related to the safety of repellent use during pregnancy, and include specific suggestions about remembering repellent use daily and the availability of scent-free repellent.

* https://www.cdc.gov/zika/prevention/index.html.
† http://www.salud.gov.pr/Sobre-tu-Salud/Pages/Condiciones/Zika.aspx.
§ https://www.hhs.gov/sites/default/files/hhs-assistance-to-puerto-rico-to-fight-zika.pdf.

The CDC Foundation, with technical assistance from CDC and in partnership with PRDH, has launched initiatives promoting the prevention of transmission of Zika virus infection during pregnancy, including sexual transmission, through engagement of social networks and communities surrounding pregnant women (*8*).¶ The findings from this study, however, suggest that measures to improve adherence to recommendations about prevention of sexual transmission need reinforcement. Although respondents reported high levels of concern about Zika virus infection and of receipt of counseling by health care providers about using condoms to prevent sexual transmission, only approximately one in five women reported consistently using condoms throughout pregnancy. The most common reasons for not using condoms were thinking that their partner did not have Zika virus and thinking that condoms were not needed during pregnancy. Given that CDC guidance recommends that pregnant women in areas with risk for Zika virus infection abstain from sexual intercourse or consistently use condoms during pregnancy,** the results from this study point to the need to further evaluate the content of health care provider counseling and communication campaigns, and to identify personal barriers to condom use to ensure that the ongoing risk for Zika virus infection through sexual transmission during pregnancy is clearly understood by women and their male partners.††

In February 2016, CDC issued recommendations that all symptomatic and asymptomatic pregnant women in regions with ongoing Zika virus transmission be tested for infection at the initiation of prenatal care, with follow-up testing in the second trimester (*9*). These recommendations were adopted immediately by the PRDH with the release of administrative orders prompting health care providers to offer testing to pregnant women. Nevertheless, >20% of survey respondents reported not receiving testing for Zika virus infection in their first or second trimester, indicating a need for enhanced measures to increase awareness and implementation of the testing guidelines for pregnant women. PRDH modified the testing guidance on October 19, 2016, and added a requirement for third trimester testing (*10*). Although prenatal testing could be improved, findings from this survey demonstrate that health care providers are adhering to recommendations to counsel pregnant women about Zika virus infection (>90% of respondents reported receipt of counseling).

The findings in this report are subject to at least three limitations. First, data do not represent all pregnant women in Puerto Rico in 2016; only live births from late August through early December were included. Given that the height of the Zika outbreak in Puerto Rico was in August, the group of surveyed women might differ in their behaviors from women who became pregnant later in the outbreak. Second, women whose pregnancy did not result in a live birth, who gave birth in hospitals with fewer than 100 births annually, or who gave birth outside the hospital setting were not included. Finally, this self-reported information is subject to social desirability bias on sensitive topics such as sexual activity and condom use, and recall bias for preventive behaviors practiced throughout pregnancy, which could have resulted in misreporting of these behaviors.

Understanding health behaviors of pregnant women during the Zika outbreak can inform programs and initiatives that seek to prevent Zika virus infection and promote testing of pregnant women in Puerto Rico. In particular, these data illuminate gaps in the use of preventive measures that could be reinforced during prenatal care visits and through public communication campaigns. Messages pertaining to the safety and frequency of use of mosquito repellent, the need for sexual abstinence or consistent condom use during pregnancy, and provider adherence to recommended testing guidelines for Zika virus infection can improve the prevention and detection of Zika virus infection during pregnancy.

Summary

What is known about this topic?

Zika virus infection during pregnancy can cause microcephaly, brain abnormalities, and other severe birth defects. Puerto Rico has recorded the largest number of laboratory-confirmed cases of Zika virus infections among pregnant women in the United States, and has implemented strategies to prevent infection during pregnancy and ensure health care provider counseling and testing for Zika virus.

What is added by this report?

Among women in Puerto Rico who had a recent live birth, 98.1% reported using at least one measure to avoid mosquitos in their home environment during their pregnancy. However, fewer than half of women reported wearing mosquito repellent daily (45.8%), and only one in 10 reported wearing pants and shirts with long sleeves daily. Among sexually active pregnant women, 38.5% reported abstaining from sex or using condoms consistently throughout pregnancy. Most women (94.3%) also reported that their health care provider talked to them about Zika virus infection during pregnancy, and approximately three quarters of respondents (76.9%) reported being tested for Zika virus by their health care provider during the first or second trimester of pregnancy.

What are the implications for public health practice?

Women in Puerto Rico have high levels of concern about acquiring Zika virus infection during pregnancy, and health care providers are counseling them about Zika virus prevention. However, additional measures are needed to encourage consistent use of preventive measures throughout pregnancy and increase testing for Zika virus during pregnancy.

¶ http://detenelzika.org/.
** https://www.cdc.gov/mmwr/volumes/65/wr/mm6539e1.htm?s_cid=mm6539e1_w.
†† https://www.cdc.gov/condomeffectiveness/.

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References

1. Rasmussen SA, Jamieson DJ, Honein MA, Petersen LR. Zika virus and birth defects—reviewing the evidence for causality. N Engl J Med 2016;374:1981–7. https://doi.org/10.1056/NEJMsr1604338
2. Departamento de Salud de Puerto Rico. Informe semanal de enfermedades Arbovirales (ArboV). San Juan, Puerto Rico: Departamento de Salud de Puerto Rico; 2017. http://www.salud.gov.pr/Estadisticas-Registros-y-Publicaciones/Informes%20Arbovirales/Reporte%20ArboV%20semana%207-2017.pdf
3. Adams L, Bello-Pagan M, Lozier M, et al. Update: ongoing Zika virus transmission—Puerto Rico, November 1, 2015–July 7, 2016. MMWR Morb Mortal Wkly Rep 2016;65:774–9. https://doi.org/10.15585/mmwr.mm6530e1
4. Shulman HB, Gilbert BC, Lansky A. The Pregnancy Risk Assessment Monitoring System (PRAMS): current methods and evaluation of 2001 response rates. Public Health Rep 2006;121:74–83. https://doi.org/10.1177/003335490612100114
5. Simeone RM, Shapiro-Mendoza CK, Meaney-Delman D, et al.; Zika and Pregnancy Working Group. Possible Zika virus infection among pregnant women—United States and Territories, May 2016. MMWR Morb Mortal Wkly Rep 2016;65:514–9. https://doi.org/10.15585/mmwr.mm6520e1
6. Russell K, Oliver SE, Lewis L, et al. Update: interim guidance for the evaluation and management of infants with possible congenital Zika virus infection—United States, August 2016. MMWR Morb Mortal Wkly Rep 2016;65:870–8. https://doi.org/10.15585/mmwr.mm6533e2
7. Noyd DH, Sharp TM. Recent advances in dengue: relevance to Puerto Rico. P R Health Sci J 2015;34:65–70.
8. CDC Foundation. Comprehensive Zika prevention campaign launches in Puerto Rico. Atlanta, GA: CDC Foundation; 2016. http://www.cdcfoundation.org/pr/2016/comprehensive-zika-prevention-campaign-launches-puerto-rico
9. Oduyebo T, Petersen EE, Rasmussen SA, et al. Update: interim guidelines for health care providers caring for pregnant women and women of reproductive age with possible Zika virus exposure—United States, 2016. MMWR Morb Mortal Wkly Rep 2016;65:122–7. https://doi.org/10.15585/mmwr.mm6505e2
10. Departamento de Salud de Puerto Rico. Orden Administrativa Num. 360. San Juan, Puerto Rico: Departamento de Salud de Puerto Rico; 2016. http://www.salud.gov.pr/Estadisticas-Registros-y-Publicaciones/rdenes%20Administrativas/360-PARA%20ENMENDAR%20LA%20OA%20348.pdf

Morbidity and Mortality Weekly Report

Japanese Encephalitis Surveillance and Immunization — Asia and Western Pacific Regions, 2016

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Japanese encephalitis (JE) virus is the most important vaccine-preventable cause of encephalitis in the Asia-Pacific region. The World Health Organization (WHO) recommends integration of JE vaccination into national immunization schedules in all areas where the disease is a public health priority (*1*). This report updates a previous summary of JE surveillance and immunization programs in Asia and the Western Pacific in 2012 (*2*). Since 2012, funding for JE immunization has become available through the GAVI Alliance, three JE vaccines have been WHO-prequalified,* and an updated WHO JE vaccine position paper providing guidance on JE vaccines and vaccination strategies has been published (*1*). Data for this report were obtained from a survey of JE surveillance and immunization practices administered to health officials in countries with JE virus transmission risk, the 2015 WHO/United Nations Children's Fund Joint Reporting Form on Immunization, notes and reports from JE meetings held during 2014–2016, published literature, and websites. In 2016, 22 (92%) of 24 countries with JE virus transmission risk conducted JE surveillance, an increase from 18 (75%) countries in 2012, and 12 (50%) countries had a JE immunization program, compared with 11 (46%) countries in 2012. Strengthened JE surveillance, continued commitment, and adequate resources for JE vaccination should help maintain progress toward prevention and control of JE.

JE is a mosquito-borne disease that is a leading cause of encephalitis in Asia (*1*). More than 3 billion persons live in 24 countries that have JE virus transmission risk areas (Figure) (*1*,*3*). The majority (75%) of JE cases occur in children aged <15 years (*3*). Although most JE cases are asymptomatic, the case fatality rate among patients with encephalitis approaches 30%, and approximately 30%–50% of survivors have long-term neurologic sequelae (*4*). Vaccination is the cornerstone of JE control and prevention measures (*1*). A 2011 systematic review of JE disease burden estimated that approximately 68,000 cases occur globally each year; only about 10% of these cases are reported to WHO (*3*).

Information on JE surveillance and immunization programs was obtained from several sources. Health officials from 18 WHO countries with endemic JE who attended the 7th Biregional Meeting on Prevention and Control of JE in 2016 were surveyed; abbreviated surveys† were sent to health officials from six additional countries with endemic JE. Unpublished 2016 meeting notes, 2015 Joint Reporting Form on Immunization§ reports (*5*), the 2014 report of the 6th Biregional Meeting on Prevention and Control of JE (*6*), unpublished meeting notes from the 2015 Biregional Workshop on Strengthening the Capacity of the JE Laboratory Network in the WHO South-East Asian and Western Pacific Regions, and published literature and Ministry of Health websites served as additional data sources. Information collected about surveillance programs included a description of the surveillance system; case definitions used; age groups under surveillance; availability of diagnostic testing; and 2015 case numbers. Information collected on immunization programs included whether the country had an established JE immunization program, age of the first dose in the immunization schedule, and types of vaccines used.

Surveillance Programs

Representatives from all 24 countries with JE virus transmission risk completed the surveys.¶ In 2016, 22 (92%) of the 24 countries conducted JE surveillance. Fourteen (58%) countries conducted national JE surveillance, two (8%) conducted subnational surveillance in all JE risk areas, and 11 (46%) conducted sentinel surveillance (including five countries that also conducted surveillance nationally or in all risk areas) (Table 1). Among 11 countries with sentinel surveillance, the median number of sentinel sites was eight (range = 1–223). JE case definitions were used in 22 (92%) countries. Twelve

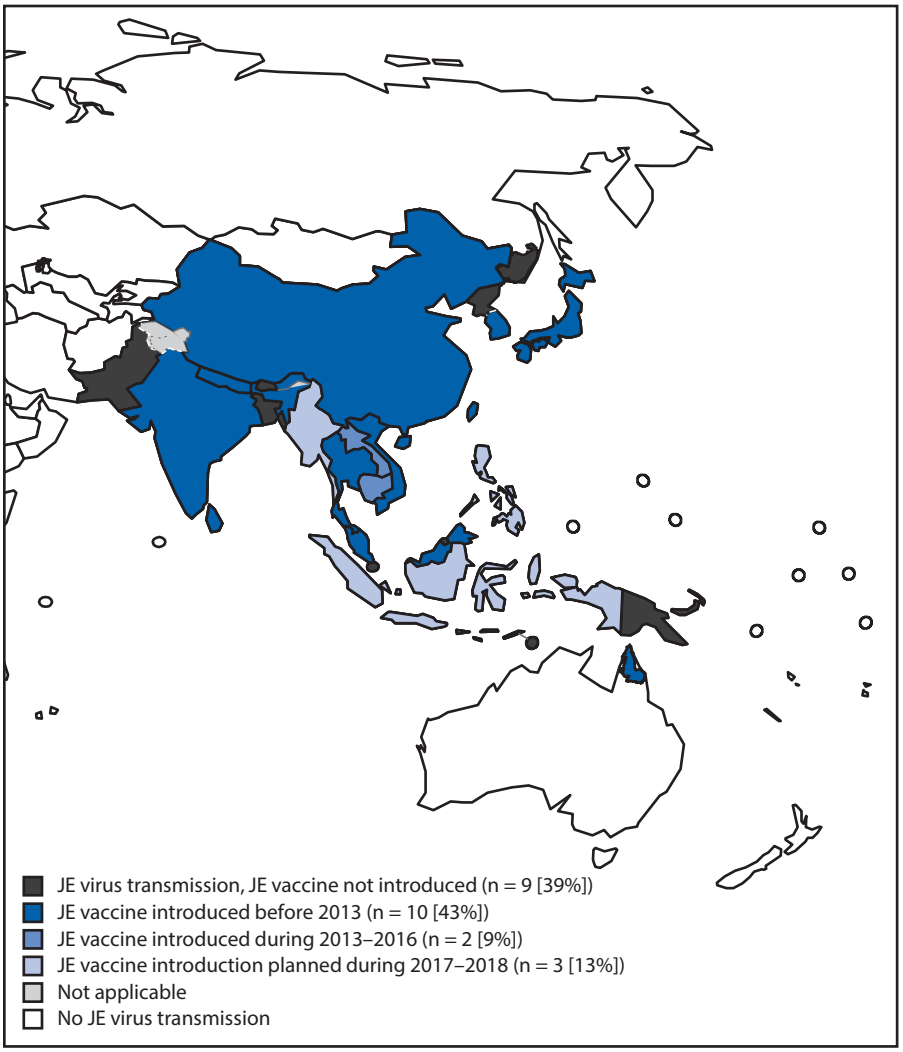
* Prequalification by WHO is a process through which the quality, safety, and efficacy of medicinal products is assessed. Prequalified products meet specified requirements, and the associated manufacturing site(s) and contract research organization(s) are determined to be compliant with WHO standards. http://www.who.int/mediacentre/factsheets/fs278/en/.

† Surveys requested information on existence of a JE surveillance program, whether a JE case definition is used, integration of encephalitis and meningitis surveillance, age groups under surveillance, availability of laboratory confirmation of JE, existence of a JE immunization program, strategy used for JE immunization, scheduled aged groups for routine JE immunization, and types of JE vaccines used in the national immunization program.

§ The Joint Reporting Form is a standard questionnaire sent annually to all WHO countries, through which WHO and the United Nations Children's Fund jointly collect immunization data.

¶ A survey was not administered to health officials from Taiwan. Data for Taiwan were obtained from published literature and the Taiwan CDC website.

FIGURE. Areas with risk for Japanese encephalitis (JE) virus transmission and JE vaccine introduction* — 24 countries in Asia and the Western Pacific Region,†,§ 2016



Source: World Health Organization (WHO)/Immunization Vaccines and Biologicals database; May 12, 2017.
* Singapore made a decision not to introduce JE vaccine because only rare, sporadic human cases are reported in the country.
† The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the WHO concerning the legal status of any country, territory, city, or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there might not yet be full agreement.
§ JE vaccine introduction in Indonesia will be limited to Bali.

(50%) countries used the WHO acute encephalitis syndrome (AES) case definition (*7*), four (17%) used an acute meningoencephalitis syndrome (AMES) case definition,** three (12%) used AES or AMES case definitions in different settings, and three (12%) used country-specified case definitions. All countries with JE surveillance reported that some or most suspected cases were confirmed using JE-specific diagnostic testing of serum or cerebrospinal fluid (CSF) or both.

** AMES (acute meningitis/encephalitis syndrome) is defined as an acute febrile illness that is clinically compatible with meningitis and/or encephalitis.

During 2015, WHO received reports of 4,087 JE cases from 20 (83%) of 24 countries; 3,549 (87%) of these cases were reported from four countries (China [624 cases], India [1,620], Nepal [937], and Vietnam [368]). No other country reported more than 115 cases.

Immunization Programs

Twelve (50%) of the 24 countries had a JE immunization program in 2016 (Table 2); 10 (42%) programs were implemented nationally or subnationally in all risk areas, and two (8%) were subnational and did not include all risk areas. Six countries used live attenuated vaccine, two used live recombinant vaccine, one used an inactivated Vero cell culture-derived vaccine, one used an inactivated mouse brain-derived vaccine,†† and two used multiple vaccine types.

Discussion

Since 2012, JE surveillance and immunization programs have expanded and improved. In 2016, 92% of countries with JE virus transmission risk conducted JE surveillance compared with 75% in 2012, and two countries that only conducted sentinel surveillance in 2012 were conducting surveillance nationally or subnationally in all risk areas in 2016 (*2*). The percentage of countries that had a JE immunization program increased slightly, from 46% in 2012 to 50% in 2016. Larger increases were reported in breadth of implementation: programs in 42% of countries were implemented nationally or in all risk areas compared with only 25% in 2012 (*2*). Several countries have transitioned from using mouse brain-derived vaccine to newer, less reactogenic vaccines with simpler dosing schedules, as recommended by WHO (*1*). Only two (8%) countries currently use mouse brain-derived vaccine (including one that uses multiple vaccine types), compared with five (21%) countries that used this vaccine in 2012.

The number of reported JE cases was approximately 60% lower in 2015 than in 2011, and there was a change in the proportions of reported cases by country. In 2011, China and India accounted for nearly 95% of JE cases reported to WHO

†† Mouse brain-derived JE vaccine is also used in Taiwan's JE immunization program.

TABLE 1. Characteristics of Japanese encephalitis (JE) surveillance in countries with JE virus transmission risk, 2016

Country	JE surveillance program (no. sentinel sites)	Case definition used	Integration of encephalitis and meningitis surveillance	Age groups under surveillance	Laboratory confirmation of suspected cases	CSF tested*	Serum tested*
Australia†	All risk areas§	Other¶	No	All	Yes	Most	Most
Bangladesh	Sentinel (4)	AMES	No	All	Yes	Most	Most
Bhutan	Sentinel (5)	WHO AES	No	<15 yrs	Yes	Some	Most
Brunei	National	WHO AES	Yes	All	Yes	No	Most
Burma	National	WHO AES	Yes	All	Yes	Some	Most
Cambodia	Sentinel (6)	AMES	No	<15 yrs	Yes	Most	Most
China	National and sentinel (27)	WHO AES (national); AMES (sentinel)	Yes**	All	Yes	Most	Most
Taiwan	All areas	Other††	NA	All	Yes	Yes§§	Yes§§
India	All risk areas and sentinel (223)	WHO AES	No	All	Yes	Most	Most
Indonesia	Sentinel (34)	WHO AES	No	All	Yes	No	Most
Japan	National	Other¶¶	No	All	Yes	Yes§§	Yes§§
Laos	National and sentinel (3)	AMES (national); WHO, AES, AMES (sentinel)	Yes***	All	Yes	Most	Most
Malaysia	National	Other†††	No	All	Yes	Most	Most
Nepal	National	WHO AES	No	All	Yes	Most	Some
North Korea	National	AMES	Yes	<15 yrs	Yes	Yes§§§	Yes§§§
Pakistan	None	—	—	—	—	—	—
Papua New Guinea	Sentinel (1)	WHO AES	No	<15 yrs	Yes	Most	Most
Philippines	Sentinel (9)	AMES	Yes	All	Yes	Most	Most
Russia†	None	—	—	—	—	—	—
Singapore	National	WHO AES	No	All	Yes	Most	Most
South Korea	National	WHO AES	No	All	Yes	Most	Most
Sri Lanka	National	WHO AES	No	All	Yes	Most	Some
Thailand	National and sentinel (40)	WHO AES	No	All	Yes	Most	Most
Timor Leste	National	WHO AES	No	All	Yes¶¶¶	Most	No
Vietnam	National and sentinel (8)	WHO AES, AMES****	Yes††††	All (AES); <15 yrs (AMES)	Yes	Most	Most

Abbreviations: AMES = Acute meningoencephalitis surveillance; AES = Acute encephalitis surveillance; CSF = cerebrospinal fluid; NA = not available.

* Most = country reported testing specimens from ≥50% suspected JE cases. Some = country reported testing.

† JE virus transmission risk in well-defined, limited areas.

§ Torres Strait Islands and northern Cape York.

¶ Clinical evidence of non-encephalitic disease (acute febrile illness with headache, myalgia and/or rash) or encephalitic disease (e.g., focal neurologic disease, impaired level of consciousness, abnormal brain imaging study, abnormal encephalogram, and/or presence of pleocytosis in cerebrospinal fluid) plus definitive laboratory evidence of JE infection.

** Encephalitis and meningitis surveillance integrated for sentinel but not national surveillance program.

†† A clinical case was defined as a person of any age with an acute onset of fever and a change in mental status and/or a new onset of seizures (excluding simple febrile seizures) at any time of the year. A confirmed case was defined as a clinical case with a positive laboratory test specific for JE in serum, plasma, blood, CSF or tissue or that met the clinical case definition and was epidemiologically linked to a confirmed case (Chang YK, Chang HL, Wu HS, Chen KT. Epidemiological features of Japanese encephalitis in Taiwan from 2000 to 2014. Am J Trop Med Hyg 2017;382–8).

§§ Reported "Yes" but did not quantify percentage.

¶¶ Patients with encephalitis syndrome with laboratory-confirmed JE.

*** Encephalitis and meningitis surveillance integrated for national (but not sentinel) surveillance program.

††† Febrile illness with neurologic symptoms (e.g., headache, meningeal signs, stupor, disorientation, coma, tremors, general paresis, hypertonia, loss of consciousness).

§§§ Reported "Yes" but did not quantify percentage. Also, reported that laboratory has not performed a JE diagnostic test on a human sample since 2014.

¶¶¶ Testing suspended because of reagent stockouts in 2016.

**** Five sentinel sites use AES and three use AMES case definition.

†††† At AMES sites.

(*2*), compared with only 55% in 2015. From 2011 to 2015, the number of cases reported by Nepal increased elevenfold from 75 to 937, and the number reported from Vietnam doubled from 183 to 368. However, because of substantial underreporting of cases, potential inconsistencies in reporting, or changes in surveillance practices, and the known year-to-year variability in intensity of JE virus transmission, the significance of changes based on surveillance data from these two time points is not known. However, JE vaccine impact assessments indicate immunization programs can result in substantial reductions in JE cases; if high coverage can be achieved and maintained in countries with endemic transmission, JE disease might be practically eliminated even while the virus remains in circulation (*8*).

JE surveillance has been established or strengthened during the last 4 years in several countries; since 2012, national surveillance programs were established in Brunei, North Korea, and Timor Leste, and expanded in India and Nepal. However, the need to enhance the quality of JE surveillance is recognized (*6*). More countries reported availability of laboratory diagnostic

TABLE 2. Characteristics of Japanese encephalitis (JE) immunization programs in countries with JE virus transmission risk, 2016

Country	JE immunization program	Strategy	Scheduled age to begin routine immunization	Vaccine used in national program
Australia*	All risk areas†	Routine	12 mos	JE-CV
Bangladesh	None	—	—	—
Bhutan	None	—	—	—
Brunei	None	—	—	—
Cambodia	National	Routine	9 mos	CD-JEV
Burma	None§	—	—	—
China	National¶	Routine	8 mos	CD-JEV
Taiwan	All areas	Routine	15 mos	MB
India	Subnational**	Routine	9–11 mos	CD-JEV
Indonesia	None††	—	—	—
Japan	National	Routine	6 mos	VC
Laos	National	Routine	9–11 mos	CD-JEV
Malaysia	Subnational§§	Routine	9 mos	JE-CV
Nepal	National	Routine	12 mos	CD-JEV
North Korea	None¶¶	—	—	—
Pakistan	None	—	—	—
Papua New Guinea	None	—	—	—
Philippines	None***	—	—	—
Russia*	None	—	—	—
Singapore	None†††	—	—	—
South Korea	National	Routine	12 mos	CD-JEV, MB, VC,
Sri Lanka	National	Routine	12 mos	CD-JEV
Thailand	National	Routine	12 mos	CD-JEV, JE-CV
Timor Leste	None	—	—	—
Vietnam	National	Routine	12 mos	MB

Abbreviations: CD-JEV = live attenuated JE vaccine; JE-CV = live recombinant JE vaccine; MB = inactivated, mouse brain-derived JE vaccine; VC = inactivated, Vero cell culture–derived JE vaccine.

* JE virus transmission risk in well-defined, limited areas.
† Vaccination recommended for residents of the outer Torres Strait Islands or nonresidents living or working there for ≥30 days during the wet season.
§ Burma is planning a national JE vaccination campaign for 2017, followed by routine introduction.
¶ Excluding the provinces of Qinghai, Tibet, and Xinjiang, which do not have endemic transmission.
** JE vaccine included in 216 districts with endemic JE.
†† Indonesia will initiate JE vaccine campaign in Bali in 2017.
§§ In Sarawak state; in peninsular Malaysia and Sabah, vaccination is provided to children aged <15 years in the vicinity of an outbreak.
¶¶ North Korea conducted a JE vaccination campaign in 2016.
*** Philippines is planning a subnational JE vaccination campaign in 2018, followed by routine introduction nationally.
††† Singapore made a decision not to introduce JE vaccine because only rare, sporadic human cases are reported in the country.

testing for suspected JE cases, and most report testing of both serum and CSF specimens, although the percentage of suspected JE cases for which testing is performed is unknown. Reported increases in diagnostic testing might in part be explained by support provided by the JE laboratory networks that were established in WHO's South-East Asia and Western Pacific regions during 2006–2008. WHO has developed a JE laboratory accreditation program, which includes proficiency testing, confirmatory testing, and other measures to ensure high quality laboratory testing.

Substantial progress has been made in establishing and strengthening JE immunization programs. During 2015–2016, Nepal's JE immunization program expanded from a subnational to a national program after conduct of a catch-up campaign, and both Cambodia and Laos established national JE vaccination programs following catch-up campaigns in children aged <15 years. Burma, Indonesia, and the Philippines plan to introduce JE vaccine in late 2017 or early 2018. Progress has been aided by the availability of three WHO-prequalified JE vaccines; enhanced awareness of the importance of JE prevention and control; and increased commitment by governments, international organizations and nongovernmental organizations such as PATH, the Bill and Melinda Gates Foundation, and the GAVI Alliance.

Despite this progress, gaps and challenges remain, including incomplete case reporting and misclassification of cases. For example, the limited scope of surveillance in some countries results in incomplete case ascertainment, and data needed to improve suspected case classification to guide program expansion and laboratory capacity enhancement are insufficient. Immunization program monitoring data, such as the vaccination histories of JE cases, are often not collected. In addition, monitoring of vaccination coverage following JE vaccine introduction, critical for ensuring achievement of coverage targets, is often inadequate. Finally, more complete and accurate JE disease data are needed to estimate global burden.

The findings in this report are subject to at least two limitations. First, data were collected from self-administered surveys

Summary

What is already known about this topic?

Japanese encephalitis (JE) virus is a leading cause of encephalitis in Asia. The World Health Organization recommends integration of JE vaccination into national immunization schedules in all areas where the disease is a public health priority.

What is added by this report?

A review of surveillance and immunization program data in the 24 countries with JE virus transmission risk found that in 2016, 22 countries conducted at least some surveillance for JE, and 12 had implemented a JE immunization program. This represents substantial progress in JE prevention and control measures, but challenges remain, including incomplete case reporting, misclassification of cases, lack of immunization program monitoring data, and inadequate monitoring of JE vaccination coverage following vaccine introduction.

What are the implications for public health practice?

Strengthened surveillance, continued commitment, and adequate resources for JE vaccination should help maintain progress toward prevention and control of JE.

and might be susceptible to social desirability, recall, or other biases. Second, reported data might be incomplete.

Vaccination is the most effective strategy to prevent and control JE, and immunization has been demonstrated to reduce the economic burden of JE disease (*1*,*8*). In 2014, the countries of the WHO Western Pacific Region endorsed a goal to accelerate the control of JE by extending vaccination to all JE risk areas where incidence exceeds very low levels (*9*). Furthermore, countries in the WHO South-East Asia Region are developing a plan for accelerated control of JE by extending vaccination to all areas with any risk of JE transmission. WHO updated its JE vaccine position paper in 2015 (*1*) and produced a guidance document for measuring the effectiveness and impact of JE vaccination (*7*). Strengthened surveillance, continued commitment, and adequate resources for JE vaccination should help maintain progress toward prevention and control of JE.

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References

1. World Health Organization. Japanese encephalitis vaccines: WHO position paper—February 2015. Wkly Epidemiol Rec 2015;90:69–87.
2. Baig S, Fox KK, Jee Y, et al. Japanese encephalitis surveillance and immunization—Asia and the Western Pacific, 2012. MMWR Morb Mortal Wkly Rep 2013;62:658–62.
3. Campbell GL, Hills SL, Fischer M, et al. Estimated global incidence of Japanese encephalitis: a systematic review. Bull World Health Organ 2011;89:766–74. https://doi.org/10.2471/BLT.10.085233
4. Fischer M, Hills S, Staples E, Johnson B, Yaich M, Solomon T. Japanese encephalitis prevention and control: advances, challenges, and new initiatives [Chapter 6]. In: Scheld WM, Hammer SM, Hughes JM, eds. Emerging infections 8. Washington, DC: American Society for Microbiology Press; 2008:93–124.
5. World Health Organization. WHO/UNICEF joint reporting process. Geneva, Switzerland: World Health Organization; 2016. http://www.who.int/immunization/monitoring_surveillance/routine/reporting/en/
6. World Health Organization. Meeting report. Sixth biregional meeting on prevention and control of Japanese encephalitis. Bangkok, Thailand: World Health Organization, Regional Office for South East Asia; 2014. http://www.searo.who.int/entity/immunization/documents/prevention_and_control_of_je.pdf?ua=1
7. World Health Organization. Measuring the effectiveness and impact of Japanese encephalitis vaccination. Geneva, Switzerland; World Health Organization; 2016. http://www.who.int/immunization/diseases/japanese_encephalitis/JE_effectiveness.pdf
8. World Health Organization SAGE Working Group on Japanese Encephalitis Vaccines. Background paper on Japanese encephalitis vaccines—SAGE working group. Geneva, Switzerland; World Health Organization; 2014. http://www.who.int/immunization/sage/meetings/2014/october/1_JE_Vaccine_Background_Paper.pdf?ua=1
9. World Health Organization. Regional framework for implementation of the global vaccine action plan in the Western Pacific. Geneva, Switzerland; World Health Organization; 2015. http://iris.wpro.who.int/bitstream/handle/10665.1/10921/9789290617099_eng.pdf

Vital Signs: Health Care–Associated Legionnaires' Disease Surveillance Data from 20 States and a Large Metropolitan Area — United States, 2015

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Abstract

Background: Legionnaires' disease, a severe pneumonia, is typically acquired through inhalation of aerosolized water containing *Legionella* bacteria. *Legionella* can grow in the complex water systems of buildings, including health care facilities. Effective water management programs could prevent the growth of *Legionella* in building water systems.

Methods: Using national surveillance data, Legionnaires' disease cases were characterized from the 21 jurisdictions (20 U.S. states and one large metropolitan area) that reported exposure information for ≥90% of 2015 *Legionella* infections. An assessment of whether cases were health care–associated was completed; definite health care association was defined as hospitalization or long-term care facility residence for the entire 10 days preceding symptom onset, and possible association was defined as any exposure to a health care facility for a portion of the 10 days preceding symptom onset. All other Legionnaires' disease cases were considered unrelated to health care.

Results: A total of 2,809 confirmed Legionnaires' disease cases were reported from the 21 jurisdictions, including 85 (3%) definite and 468 (17%) possible health care–associated cases. Among the 21 jurisdictions, 16 (76%) reported 1–21 definite health care–associated cases per jurisdiction. Among definite health care–associated cases, the majority (75, 88%) occurred in persons aged ≥60 years, and exposures occurred at 72 facilities (15 hospitals and 57 long-term care facilities). The case fatality rate was 25% for definite and 10% for possible health care–associated Legionnaires' disease.

Conclusions and Implications for Public Health Practice: Exposure to *Legionella* from health care facility water systems can result in Legionnaires' disease. The high case fatality rate of health care–associated Legionnaires' disease highlights the importance of case prevention and response activities, including implementation of effective water management programs and timely case identification.

Introduction

Legionella is a waterborne bacterium responsible for Legionnaires' disease, a severe pneumonia that occurs most frequently in susceptible persons, including those aged ≥50 years, former or current smokers, and those with chronic diseases or immunosuppression (*1*). Whereas approximately 9% of Legionnaires' disease cases are fatal (*1*), mortality associated with health care–associated Legionnaires' disease is higher, with reported case fatality rates (CFRs) historically as high as 46% (*2*). *Legionella* grows well in building water systems* that are not adequately managed, especially those where disinfectant levels are low, water is stagnant, or water temperatures are optimal for growth† (*3*). Illness with Legionnaires' disease most commonly occurs after inhalation of *Legionella*-containing aerosols from showerheads, certain medical equipment (e.g., respiratory equipment), cooling towers, hot tubs, hydrotherapy equipment, or decorative fountains (*4*). Less commonly, disease occurs from aspiration of *Legionella*-containing water (*5*). Only one case of probable person-to-person transmission has been reported (*6*).

The size and complexity of health care facility water systems and the vulnerability of the patient populations served by these facilities increase the risk for *Legionella* transmission and severe outcomes. A review of 27 Legionnaires' disease

* Large or complex water systems, where *Legionella* has more opportunity to grow and spread, are most often found in commercial, institutional, multiunit residential, health care, and industrial buildings, often with multiple stories. ASHRAE Standard 188 recommends water management for these types of buildings in addition to those in which vulnerable populations, such as immunocompromised or elderly persons, live or are treated.

† The temperature range most favorable for growth of *Legionella* is 77°F–108°F (25°C–42°C), although *Legionella* has been recovered from water with temperatures outside this range. For health care facilities, ASHRAE Guideline 12-2000 recommends storing and distributing cold water at temperatures <68°F (<20°C), whereas hot water should be stored at >140°F (>60°C) and circulated with a minimum return temperature of 124°F (51°C). In other settings, hot water should be stored at ≥120°F (≥49°C).

outbreaks investigated by CDC during 2000–2014 indicated that health care–associated Legionnaires' disease accounted for 33% of the outbreaks, 57% of outbreak-associated cases, and 85% of outbreak-associated deaths (*7*). In addition, 85% of all Legionnaires' disease outbreaks were attributed to water system exposures that could have been prevented by effective water management programs.

Implementation of water management programs that prevent conditions conducive to *Legionella* growth and transmission, combined with rapid case identification and investigation, could prevent health care–associated Legionnaires' disease cases and outbreaks (*8*–*10*). Health care facilities are ideally positioned to establish and maintain prevention and response activities because they can build upon existing infection control and patient safety activities.

Legionnaires' disease cases are reportable to CDC. Fifty states, two large U.S. metropolitan areas, and five territories report basic demographic information to the National Notifiable Diseases Surveillance System (NNDSS) for all cases of legionellosis, which comprises two distinct clinical presentations: Pontiac fever, a mild influenza-like illness, and Legionnaires' disease. NNDSS does not distinguish between the two presentations. In 2015, 6,079 cases of legionellosis were reported to NNDSS, although this number might be an underestimate because of underdiagnosis. The Supplemental Legionnaires' Disease Surveillance System (SLDSS) receives more epidemiologic information, such as exposure to health care facilities, and does distinguish Legionnaires' disease from Pontiac fever, but reporting to SLDSS is less complete.

The proportion of the U.S. Legionnaires' disease cases associated with health care facilities has not been established. The objective of this analysis was to describe reported U.S. cases of health care–associated Legionnaires' disease using surveillance data from 21 jurisdictions in 2015 to highlight the importance of Legionnaires' disease prevention and response in health care facilities.

Methods

The 20 states and one large metropolitan area[§] that reported ≥90% of confirmed NNDSS legionellosis cases to SLDSS in 2015 were included in this analysis. Only confirmed Legionnaires' disease cases from SLDSS, defined by the Council of State and Territorial Epidemiologists as laboratory confirmation of *Legionella* in a person with clinical illness compatible with Legionnaires' disease (*11*), were analyzed.

[§] The 21 jurisdictions are Alabama, Colorado, Connecticut, Georgia, Hawaii, Iowa, Kentucky, Maine, Michigan, Minnesota, Missouri, New Hampshire, New Mexico, New York, New York City, North Dakota, Ohio, Rhode Island, South Carolina, Texas, and Virginia.

Reported case exposures were categorized as health care–associated or not health care–associated. Cases were considered health care–associated if they occurred in a person who visited, worked, or stayed in a health care facility for any amount of time in the 10 days preceding symptom onset. Health care–associated Legionnaires' disease cases were further classified as definite (continuous exposure to a hospital or long-term care facility for the entire 10 days preceding symptom onset) or possible (any exposure to a health care facility for a portion of the 10 days preceding symptom onset). Health care–specific exposure settings included hospitals, long-term care facilities (facilities providing a skilled need such as intravenous medication administration), clinics, and others (e.g., outpatient laboratories). Descriptive statistics were generated, and results are reflective of cases reported to SLDSS as of April 14, 2017.

Results

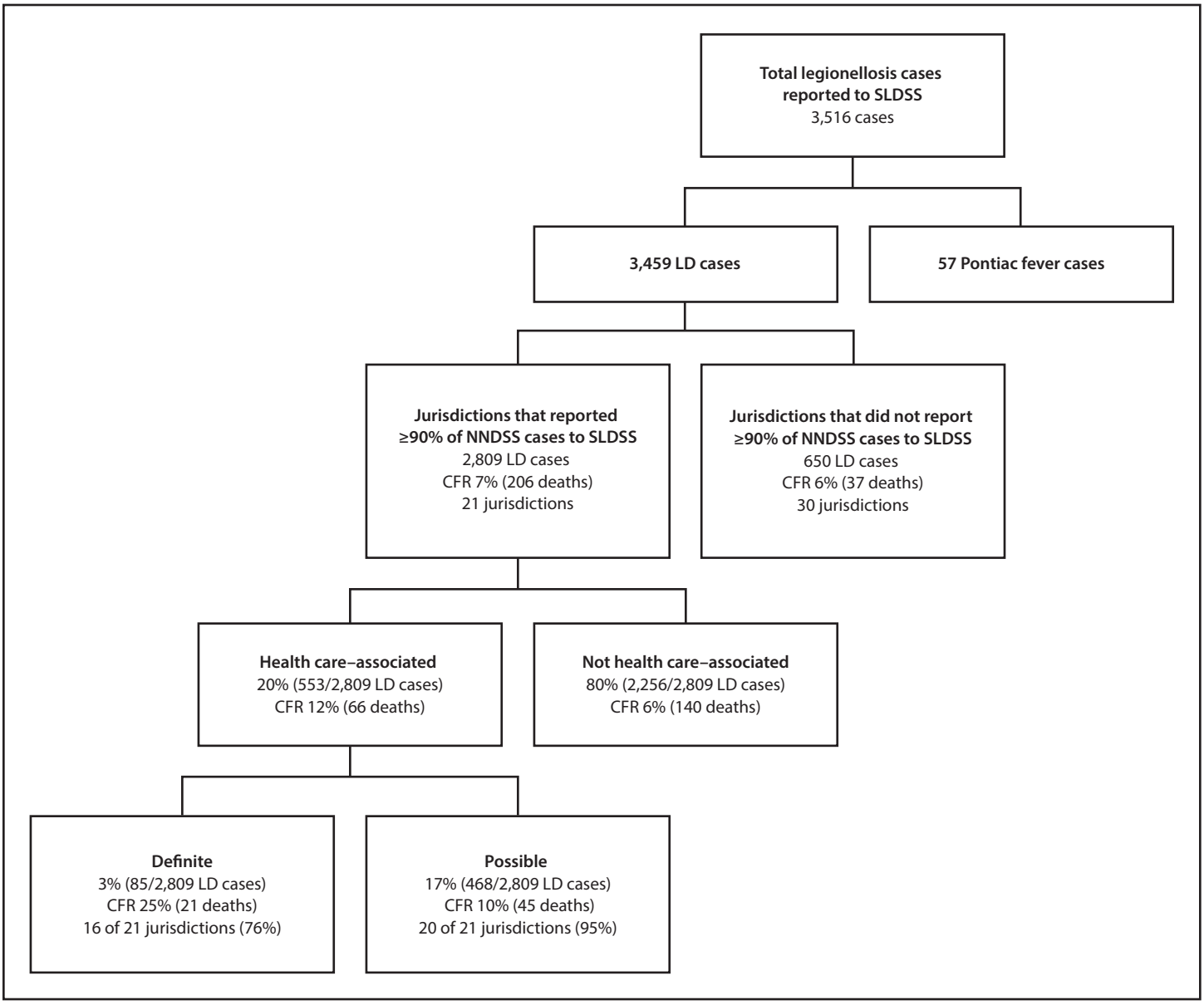
Among 6,079 confirmed legionellosis cases reported to NNDSS, SLDSS received reports of 3,516 (58%), including 3,459 Legionnaires' disease cases (Figure). Among the 3,459 Legionnaires' disease cases, 2,809 (81%) were reported by the 21 jurisdictions included in this analysis, including 553 (20%) that were health care–associated.

Among the 21 jurisdictions, 16 (76%) reported definite health care–associated cases (1–21 cases per jurisdiction); four of the remaining five reported possible health care–associated Legionnaires' disease cases. Definite and possible health care–associated cases accounted for 3% and 17%, respectively, of all cases reported by the 21 jurisdictions (Figure). CFR was 12% overall for health care–associated Legionnaires' disease cases (25% for definite and 10% for possible cases).

Among the 85 definite health care–associated Legionnaires' disease cases, 68 (80%) were associated with long-term care facilities, 15 (18%) with hospitals, and two (2%) with both (Table 1). Definite health care–associated Legionnaires' disease cases were reported in 72 facilities, including 15 hospitals and 57 long-term care facilities, and included one to six cases per facility. The majority of definite cases occurred in persons aged ≥60 years (75, 88%) (Table 2).

Among 468 possible health care–associated Legionnaires' disease cases, 61 (13%) were possibly associated with long-term care facilities, 227 (49%) with hospitals, 123 (26%) with clinics, 13 (3%) with other settings such as outpatient laboratories, and 44 (9%) with more than one setting. Possible health care–associated Legionnaires' disease cases occurred in approximately 415 health care facilities and included one to 31 cases per facility.

FIGURE. Categorization of confirmed cases of legionellosis*,† reported to the Supplemental Legionnaires' Disease Surveillance System, 2015



Abbreviations: CFR = case fatality rate; LD = Legionnaires' disease; NNDSS = National Notifiable Diseases Surveillance System; SLDSS = Supplemental Legionnaires' Disease Surveillance System.
* Legionellosis cases include Legionnaires' disease and Pontiac fever, a mild influenza-like illness.
† A total of 6,079 cases of legionellosis were reported to NNDSS in 2015.

Conclusions and Comments

Although health care–associated Legionnaires' disease is less common than some other health care–acquired infections, its impact on patients and affected health care facilities is considerable. For patients, health care–associated Legionnaires' disease can result in high morbidity, mortality, and financial cost (*1*,*12*). For health care facilities, Legionnaires' disease cases and outbreaks can involve substantial expense related to investigation, remediation, legal action, and reputational costs (*13*,*14*). Furthermore, compared with more common health care–acquired infections, general understanding of the necessary prevention and response measures for waterborne pathogens, such as *Legionella*, might be lacking.

In this analysis, definite health care–associated Legionnaires' disease cases were reported by the majority of the 21 jurisdictions and occurred in 72 institutions. Although only 3% of reported Legionnaires' disease cases from the 21 jurisdictions were definitely health care–associated, the CFR among these cases was high. Furthermore, the number of definite cases and facilities reported here is likely an underestimate of the actual

case number, because some possible cases likely acquired their infection from a health care facility, and some infections were likely undiagnosed because of a lack of *Legionella*-specific testing. A larger number of definite cases were associated with long-term care facilities than with hospitals. One explanation for this might be that hospital stays are typically shorter (*15*) than the 10-day period used in this analysis to define a definite health care–associated case. Pending further research, other conclusions cannot accurately be drawn, and thus these findings should not be used to establish the level of risk among facility types.

In health care facilities, prevention of the first case of Legionnaires' disease is the ultimate goal. This goal is likely best achieved by establishing and maintaining an effective water management program (*8*,*10*). In 2015, ASHRAE[¶] issued guidance on water management programs (*3*). CDC and partners adapted this standard into a simpler format (https://www.cdc.gov/legionella/WMPtoolkit) that guides users such as health care facility leaders[**] or other decision makers through the steps needed for such a program. Most recently, the Centers for Medicare & Medicaid Services released a survey and certification memo stating that health care facilities should develop and adhere to ASHRAE-compliant water management programs to reduce the risk for *Legionella* and other pathogens in their water systems *(16).*

In general, the principles of effective water management include maintaining water temperatures outside the ideal range for *Legionella* growth, preventing water stagnation, ensuring adequate disinfection, and maintaining equipment to prevent scale, corrosion, and biofilm growth, which provide a habitat and nutrients for *Legionella* (*3*). Once established, water management programs require regular monitoring of key areas in the system for potentially hazardous conditions, and the use of prespecified responses to remediate such conditions if they are detected. The additional benefit of water management programs include the control of other water-related health care–associated infections such as those caused by nontuberculous mycobacteria. Programs need to be monitored for their efficacy in reducing risk across microbial species (*17*). Such ongoing monitoring is especially relevant because specific mitigation strategies, or partially implemented mitigation strategies, might control one pathogen at the expense of selecting for another (*18*).

[¶] Formerly known as the American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

[**] Persons in leadership roles for prevention activities might include infection control practitioners, facility managers, hospital administrators, quality assurance staff members, or others who are ultimately responsible for implementing an effective water management program and for ensuring that ongoing communication regarding *Legionella* occurs between environmental health personnel, clinical staff members, and public health officials.

TABLE 1. Confirmed health care–associated Legionnaires' disease,[*] by setting and likelihood that exposure to *Legionella* was from a health care facility's water system — 21 public health jurisdictions,[†] 2015

	No. cases (%)		
Type of facility	**Definite[§]**	**Possible[¶]**	**Total**
Hospital	15 (18)	227 (49)	**242 (44)**
Long-term–care	68 (80)	61 (13)	**129 (23)**
Clinic	0 (0)	123 (26)	**123 (22)**
Multiple[**]	2 (2)	44 (9)	**46 (8)**
Other[††]	0 (0)	13 (3)	**13 (2)**
Total	**85 (100)**	**468 (100)**	**553 (100)**

[*] Health care–associated Legionnaires' disease includes both definite and possible cases in persons who worked, visited, or stayed in a health care setting for any amount of time in the 10 days preceding symptom onset.

[†] Twenty-one jurisdictions that reported at least 90% of confirmed National Notifiable Diseases Surveillance System legionellosis cases to the Supplemental Legionnaires' Disease Surveillance System in 2015: Alabama, Colorado, Connecticut, Georgia, Hawaii, Iowa, Kentucky, Maine, Michigan, Minnesota, Missouri, New Hampshire, New Mexico, New York, New York City, North Dakota, Ohio, Rhode Island, South Carolina, Texas, and Virginia.

[§] Definite case of health care–associated Legionnaires' disease was defined as laboratory-confirmed legionellosis in a patient with exposure to a hospital or long-term–care facility for the entire 10 days preceding symptom onset.

[¶] Possible case of health care–associated Legionnaires' disease was defined as laboratory-confirmed legionellosis in a patient with exposure to a health care facility for a portion of the 10 days preceding symptom onset.

[**] Multiple indicates two or more of the listed setting categories.

[††] Other setting includes locations such as outpatient laboratories.

Health care providers play a critical role in prevention and response by rapidly identifying and reporting cases. Legionnaires' disease is clinically indistinguishable from other causes of pneumonia; a failure to diagnose a health care–associated case could result in a missed opportunity to prevent subsequent cases. *Legionella* should be considered as a cause of health care–associated pneumonia, especially for groups at increased risk, when other facility-related cases have been identified, or when changes in water parameters might lead to increased risk for Legionnaires' disease. The preferred diagnostic procedure for Legionnaires' disease is to concurrently obtain a lower respiratory sputum sample for culture on selective media and a *Legionella* urinary antigen test. Sputum should ideally be obtained before antibiotic administration and should not be rejected on the basis of specimen quality (e.g., lack of polymorphonuclear leukocytes or contamination with other bacteria), as sputa produced by patients with Legionnaires' disease might not be purulent and contaminating bacteria will not negatively affect isolation of *Legionella* on selective media (*19*,*20*). The urinary antigen test only detects *Legionella pneumophila* serogroup 1, the most common cause of Legionnaires' disease (*21*). Particularly in health care settings, cases of Legionnaires' disease caused by other species and serogroups can occur. An isolate from culture is needed for the identification of these species and serogroups, as well as for molecular comparison of clinical to environmental isolates as part of investigations.

In addition to being critical partners in national Legionnaires' disease reporting, public health jurisdictions have an influential

TABLE 2. Demographic characteristics of patients with confirmed Legionnaires' disease*— 21 U.S. public health jurisdictions,† 2015

Characteristic	No. cases (%)		
	Definite health care–associated (n = 85)	Possible health care–associated (n = 468)	Not health care–associated (n = 2,256)
Age group (yrs)			
0–29	0 (0)	16 (3.4)	59 (2.6)
30–39	1 (1.2)	10 (2.1)	148 (6.6)
40–49	2 (2.4)	35 (7.5)	322 (14.3)
50–59	7 (8.2)	111 (23.7)	596 (26.4)
60–69	18 (21.2)	125 (26.7)	557 (24.7)
70–79	23 (27.1)	88 (18.8)	321 (14.2)
80–89	18 (21.2)	67 (14.3)	197 (8.7)
≥90	16 (18.8)	15 (3.2)	53 (2.4)
Unknown	0 (0)	1 (0.2)	3 (0.1)
Sex			
Male	40 (47.1)	263 (56.2)	1,419 (62.9)
Female	45 (52.9)	200 (42.7)	820 (36.4)
Unknown	0 (0)	5 (1.1)	17 (0.8)
Race			
Black or African American	16 (18.8)	91 (19.4)	598 (26.5)
White	53 (62.3)	315 (67.3)	1,373 (60.9)
Asian	0 (0)	5 (1.1)	20 (0.9)
American Indian/ Alaska Native	0 (0)	2 (0.4)	12 (0.5)
Native Hawaiian/ Pacific Islander	0 (0)	1 (0.2)	3 (0.1)
Multiple	1 (1.2)	0 (0)	0 (0)
Unknown	15 (17.7)	54 (11.5)	250 (11.1)
Ethnicity			
Hispanic	3 (3.5)	29 (6.2)	159 (7.1)
Non-Hispanic	65 (76.5)	338 (72.2)	1,673 (74.2)
Unknown	17 (20.0)	101 (21.6)	424 (18.8)

* Definite health care–associated Legionnaires' disease was defined as laboratory-confirmed legionellosis in a patient with exposure to a hospital or long-term care facility for the entire 10 days preceding symptom onset. Possible health care–associated Legionnaires' disease was defined as laboratory-confirmed legionellosis in a patient with exposure to a health care facility for a portion of the 10 days preceding symptom onset. All other cases were considered not health care–associated.

† Twenty-one jurisdictions that reported at least 90% of confirmed National Notifiable Diseases Surveillance System legionellosis cases to the Supplemental Legionnaires' Disease Surveillance System in 2015: Alabama, Colorado, Connecticut, Georgia, Hawaii, Iowa, Kentucky, Maine, Michigan, Minnesota, Missouri, New Hampshire, New Mexico, New York, New York City, North Dakota, Ohio, Rhode Island, South Carolina, Texas, and Virginia.

Key Points

- Legionnaires' disease is a severe lung infection caused by breathing in small droplets of water that contain *Legionella* bacteria. Persons aged ≥50 years, current or former smokers, and those with chronic diseases or a weakened immune system are at higher risk for Legionnaires' disease.
- *Legionella* grows well in building water systems that are not adequately managed such as those in which disinfectant levels are low or water temperatures are warm. Effective water management programs are recommended to prevent *Legionella* growth in buildings with large or complex water systems, including health care facilities.
- The size and complexity of health care facility water systems might increase the risk for *Legionella* growth. Such health care facilities also provide care to persons who might be more susceptible to Legionnaires' disease because of their underlying risk factors.
- Legionnaires' disease continues to occur in U.S. health care facilities. Sixteen of the 21 U.S. jurisdictions, including 72 health care facilities in this analysis, reported definite health care–associated cases of Legionnaires' disease.
- One fourth of persons with definite health care–associated Legionnaires' disease die.
- Prevention and response requires coordination among health care facility leaders, health care providers, and public health professionals. Instituting and maintaining effective water management programs are the principal prevention measures. Rapid patient identification with appropriate laboratory testing and prompt intervention might prevent additional cases from occurring.
- Additional information is available at https://www.cdc.gov/vitalsigns/.

role in prevention and response activities. Some public health departments or agencies might serve as a resource to facilities during the development, implementation, and evaluation of a water management program. Public health officials also play an important role in response, including outbreak identification, environmental assessment to determine *Legionella* exposure sources, and development of recommendations to prevent ongoing transmission. Hence, prompt reporting of Legionnaires' disease cases to public health can facilitate a timely and effective response.

The findings in this report are subject to at least three limitations. First, data from more jurisdictions and more years would improve the accuracy of U.S. health care–associated Legionnaires' disease case estimates. Second, the completeness of the health care exposure information in this data set was not assessed. For example, whether a substantial number of health care exposures were not reported or inaccurately reported is unknown. Finally, CFRs reported here might be biased by lack of information on Legionnaires' disease deaths that occurred after reporting to CDC (resulting in CFR underestimation) or deaths of Legionnaires' disease patients from other causes (resulting in CFR overestimation).

This report demonstrates that Legionnaires' disease continues to result from exposures to health care facility water systems. The high case fatality rate of health care–associated

Legionnaires' disease underscores the need for effective prevention and response programs. Implementation and maintenance of water management programs, combined with rapid case identification and investigation, could reduce the number of health care–associated Legionnaires' disease cases.

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References

1. Dooling KL, Toews KA, Hicks LA, et al. Active bacterial core surveillance for legionellosis—United States, 2011–2013. MMWR Morb Mortal Wkly Rep 2015;64:1190–3. https://doi.org/10.15585/mmwr.mm6442a2
2. Benin AL, Benson RF, Besser RE. Trends in Legionnaires disease, 1980–1998: declining mortality and new patterns of diagnosis. Clin Infect Dis 2002;35:1039–46. https://doi.org/10.1086/342903
3. ASHRAE. Legionellosis: risk management for building water systems. ASHRAE standard 188. Atlanta, GA: ASHRAE; 2015.
4. World Health Organization. *Legionella* and the prevention of legionellosis. Geneva, Switzerland: World Health Organization; 2007. http://www.who.int/water_sanitation_health/emerging/legionella.pdf
5. Marrie TJ, Haldane D, MacDonald S, et al. Control of endemic nosocomial Legionnaires' disease by using sterile potable water for high risk patients. Epidemiol Infect 1991;107:591–605. https://doi.org/10.1017/S0950268800049293
6. Correia AM, Ferreira JS, Borges V, et al. Probable person-to-person transmission of Legionnaires' disease. N Engl J Med 2016;374:497–8. https://doi.org/10.1056/NEJMc1505356
7. Garrison LE, Kunz JM, Cooley LA, et al. Vital signs: deficiencies in environmental control identified in outbreaks of Legionnaires' disease—North America, 2000–2014. MMWR Morb Mortal Wkly Rep 2016;65:576–84. https://doi.org/10.15585/mmwr.mm6522e1
8. Dyck A, Exner M, Kramer A. Experimental based experiences with the introduction of a water safety plan for a multi-located university clinic and its efficacy according to WHO recommendations. BMC Public Health 2007;7:34. https://doi.org/10.1186/1471-2458-7-34
9. Demirjian A, Lucas CE, Garrison LE, et al. The importance of clinical surveillance in detecting Legionnaires' disease outbreaks: a large outbreak in a hospital with a *Legionella* disinfection system—Pennsylvania, 2011–2012. Clin Infect Dis 2015;60:1596–602. https://doi.org/10.1093/cid/civ153
10. Cristino S, Legnani PP, Leoni E. Plan for the control of *Legionella* infections in long-term care facilities: role of environmental monitoring. Int J Hyg Environ Health 2012;215:279–85. https://doi.org/10.1016/j.ijheh.2011.08.007
11. Council of State and Territorial Epidemiologists. Public health reporting and national notification for legionellosis. Position statement no. 09-ID-45. Atlanta, GA: Council of State and Territorial Epidemiologists; 2010. http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/09-ID-45.pdf
12. Collier SA, Stockman LJ, Hicks LA, Garrison LE, Zhou FJ, Beach MJ. Direct healthcare costs of selected diseases primarily or partially transmitted by water. Epidemiol Infect 2012;140:2003–13. https://doi.org/10.1017/S0950268811002858
13. Raman DC. Evaluation of the effectiveness of a newly implemented, proactive approach to legionellosis investigations conducted by the Southern Nevada Health District [Dissertation]. Las Vegas, NV: University of Nevada Las Vegas; 2014. http://digitalscholarship.unlv.edu/cgi/viewcontent.cgi?article=3207&context=thesesdissertations
14. Smith SE, Bernier TP. Legionnaires' disease and premises liability: claims investigation and defense strategies for an emerging trend. Plantation, FL: CLM; 2013. http://clmmag.theclm.org/home/article/Legionnaires-Disease-and-Premises-Liability
15. Weiss AJ, Elixhauser A. Overview of hospital stays in the United States, 2012. Healthcare Cost and Utilization Project statistical brief no. 80. Rockville, MD: Agency for Healthcare Research and Quality, 2014. https://www.hcup-us.ahrq.gov/reports/statbriefs/sb180-Hospitalizations-United-States-2012.pdf
16. Centers for Medicaid & Medicare Services. Requirement to reduce *Legionella* risk in healthcare facility water systems to prevent cases and outbreaks of Legionnaires' disease (LD) [Memorandum dated June 2, 2017]. Baltimore, MD: US Department of Health and Human Services, Centers for Medicaid & Medicare Services, Center for Clinical Standards and Quality/Survey & Certification Group; 2017. https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Policy-and-Memos-to-States-and-Regions.html
17. Kanamori H, Weber DJ, Rutala WA. Healthcare outbreaks associated with a water reservoir and infection prevention strategies. Clin Infect Dis 2016;62:1423–35. https://doi.org/10.1093/cid/ciw122
18. Casini B, Buzzigoli A, Cristina ML, et al. Long-term effects of hospital water network disinfection on *Legionella* and other waterborne bacteria in an Italian university hospital. Infect Control Hosp Epidemiol 2014;35:293–9. https://doi.org/10.1086/675280
19. Murdoch DR. Diagnosis of *Legionella* infection. Clin Infect Dis 2003;36:64–9. https://doi.org/10.1086/345529
20. Mercante JW, Winchell JM. Current and emerging *Legionella* diagnostics for laboratory and outbreak investigations. Clin Microbiol Rev 2015;28:95–133. https://doi.org/10.1128/CMR.00029-14
21. Fields BS, Benson RF, Besser RE. *Legionella* and Legionnaires' disease: 25 years of investigation. Clin Microbiol Rev 2002;15:506–26. https://doi.org/10.1128/CMR.15.3.506-526.2002

Notes from the Field

Two Cases of Legionnaires' Disease in Newborns After Water Births — Arizona, 2016

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Legionnaires' disease is a severe, sometimes fatal disease characterized by fever, myalgia, cough, and clinical or radiographic pneumonia, caused by inhaling or aspirating small droplets of water containing *Legionella* bacteria.* In 2015, approximately 6,000 cases of Legionnaires' disease were reported in the United States (*1*). Nearly 10% of cases are fatal (*2*). The number of reported cases of Legionnaires' disease in Arizona has increased in recent years. Surveillance data from Arizona's Medical Electronic Disease Surveillance Intelligence System (MEDSIS) identified 46 reported cases in 2011 and 93 in 2015 (*3*), representing more than a 100% increase. During 2011–2015, only one case was reported in an infant aged <1 month; however, during the first 4 months of 2016, two cases were reported in infants, both of whom were delivered at home in a birthing tub (water births).

The first case was reported to the Maricopa County Department of Public Health (MCDPH) during January 2016. The infant was delivered at home by a midwife on January 6, 2016 in a tub filled with tap water. The 1- and 5-minute Apgar scores were 5/10 and 9/10, respectively. The following day the infant was taken to a local emergency department with severe respiratory distress, tachypnea, and hypoxemia, where a diagnosis of congenital heart disease was made; the infant was transferred to children's hospital A. An initial chest radiograph showed a confluent opacity in the lower left lobe, which was initially thought to represent atelectasis, although pneumonia could not be excluded. During the hospital stay, serial chest radiograph revealed persisting bilateral pulmonary infiltrates with possible cavitary lesions. The infant was later transferred to children's hospital B where a bronchoscopy was performed, and a bronchoalveolar lavage culture tested positive for *Legionella pneumophila*, later identified at CDC as serogroup 1. The patient was treated with a 10-day course of azithromycin, but remained hospitalized for more than 2 months, primarily because of the congenital heart disease.

MCDPH conducted an epidemiologic investigation to identify the etiology of Legionnaires' disease and provide recommendations based on potentially remediable transmission routes. The investigation revealed that a newly purchased birthing tub had been cleaned with vinegar and water before being filled with municipal tap water using a new drinking water hose immediately before the delivery. The mother delivered the child within an hour of entering the tub, and no aspiration by the infant was noted. No other risk factors for *Legionella* transmission were identified.

The second case was reported to MCDPH on April 18, 2016. The infant had been delivered by water birth at home on April 5 by a different, independently operating midwife, at home. Three days after delivery, the infant developed a fever reported to be as high as 101.0°F (38.3°C); the fever recurred the following day, at which time the baby was brought to the emergency department of hospital A for evaluation; the infant's temperature was 102.6°F (39.2°C) and a chest radiograph showed fluffy nodular opacities. The infant was admitted for treatment of neonatal sepsis and suspected pneumonia. On April 12, upper respiratory tract secretions and a urine specimen were collected. The urinary antigen test was positive for *Legionella pneumophila* antigen, and culture of the respiratory tract secretions was positive for *Legionella pneumophila*, later identified at CDC as serogroup 6.† The patient was started on a 10-day course of azithromycin and later discharged on April 16.

An infection preventionist at hospital A familiar with the first case reported the second case to MCDPH after inquiring about the delivery method and learning of the home water birth. Investigation of this case revealed that the water birth had taken place in a rented jetted Jacuzzi hot tub. The tub had been filled with municipal tap water using a newly purchased hose and maintained at 98.0°F (36.7°C) in the bedroom for a week before the delivery. During the birth, the mother labored outside the tub and entered the tub for delivery only. No aspiration by the infant was noted.

Investigation of these two cases identified numerous gaps in infection prevention for water births, including use of a jetted Jacuzzi rather than a disposable birthing tub, and allowing the water to remain for a week at 98.0°F (36.7°C), which is within the optimum range for *Legionella* growth 77.0°F–108.0°F (25.0°C–42.2°C). Although the tub for delivery in the first case was filled immediately before the birth, tap water is not sterile, and *Legionella* can grow and spread in man-made water systems, such as plumbing systems. Because both tubs were emptied immediately after the births, no environmental sampling was performed.

* https://www.cdc.gov/legionella/about/index.html.

† The urine antigen is only designed to detect serogroup 1; however, cross reactions with other serogroups have been documented.

During the follow-up investigation, a report of a Legionellosis death in an infant after a water birth in Texas in 2014 was identified (*4*). On the basis of subsequent guidelines developed by the Texas Department of State Health Services to assist licensed midwives conducting water births, the Arizona Department of Health Services (ADHS) and MCDPH, with support and guidance of the Arizona Healthcare-Associated Infection and Midwife Advisory Committees, developed educational resources and guidelines in November 2016.[§,¶] These resources aim to increase knowledge about the risk for *Legionella* infection and maximize the safety for women choosing water immersion for labor or birth by providing a review of information on labor and birth in water. For example, although the risk for *Legionella* infection cannot be eliminated because of the need for warm tap water to fill the tub, it can be reduced by running hot water through the hose for 3 minutes before filling the tub to clear the hose and pipes of stagnant water and sediment. These materials have been distributed to a listserv of >1,300 Healthcare-Associated Infection contacts, shared with the local Association for Professionals in Infection Control and Epidemiology Chapter, and disseminated to all licensed midwives in the state. The materials are public and posted on the ADHS website at http://www.azdhs.gov/licensing/special/midwives/index.php#training.

[§] http://www.azdhs.gov/documents/licensing/special/midwives/training/guidelines-for-water-immersion-water-birth.pdf.

[¶] http://www.azdhs.gov/documents/licensing/special/midwives/training/legionella-infographic.pdf.

Acknowledgments

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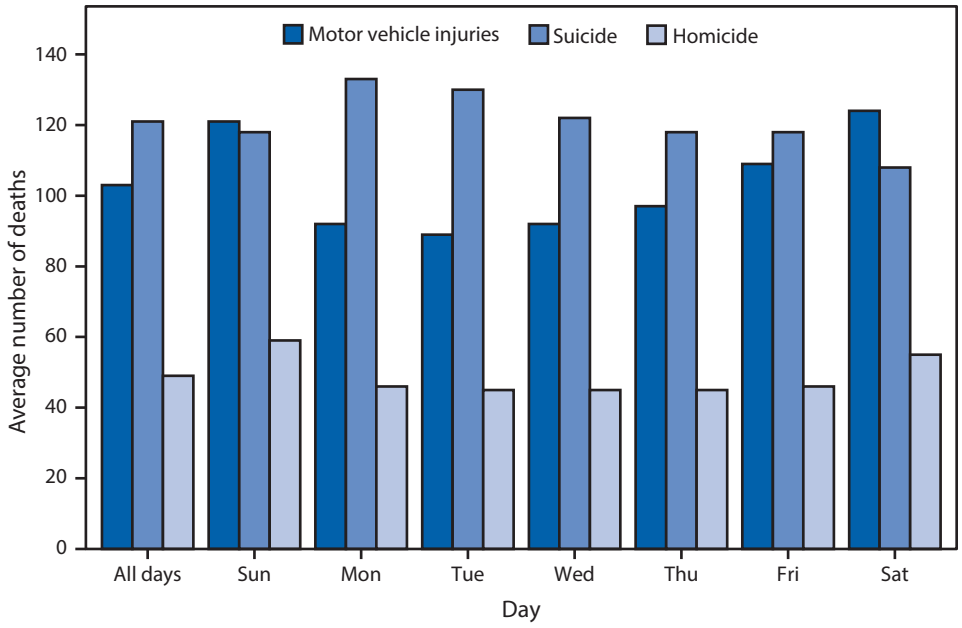
References

1. CDC. Notice to readers: final 2015 reports of nationally notifiable infectious diseases and conditions. MMWR Morb Mortal Wkly Rep 2016;65:1306–21. https://doi.org/10.15585/mmwr.mm6546a9
2. Dooling KL, Toews KA, Hicks LA, et al. Active bacterial core surveillance for Legionellosis—United States, 2011–2013. MMWR Morb Mortal Wkly Rep 2015;64:1190–3. https://doi.org/10.15585/mmwr.mm6442a2
3. Arizona Department of Health Services. Disease data, statistics, and reports—data and statistics tables. Phoenix, AZ: Arizona Department of Health Services; 2016. http://www.azdhs.gov/preparedness/epidemiology-disease-control/index.php#data-stats-archive
4. Fritschel E, Sanyal K, Threadgill H, Cervantes D. Fatal legionellosis after water birth, Texas, USA, 2014. Emerg Infect Dis 2015;21:130–2. https://doi.org/10.3201/eid2101.140846

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Average Number of Deaths from Motor Vehicle Injuries, Suicide, and Homicide,* by Day of the Week — National Vital Statistics System, United States, 2015



* *International Classification of Diseases, Tenth Revision* (ICD-10) codes V02-V04,V09.0,V09.2,V12-V14,V19.0-V19.2,V19.4-V19.6,V20-V79,V80.3-V80.5,V81.0-V81.1,V82.0-V82.1,V83-V86,V87.0-V87.8,V88.0-V88.8,V89.0,V89.2 were selected from underlying causes of death for motor vehicle injuries, U03,X60-X84,Y87.0 for suicide, and U01-U02,X85-Y09,Y87.1 for homicide.

In 2015, an average of 103 motor vehicle injury deaths, 121 suicides, and 49 homicides occurred each day. Motor vehicle injury deaths were more likely to occur on Saturdays and Sundays and least likely to occur on Tuesdays. The highest number of suicides occurred on Mondays and Tuesdays and the lowest on Saturdays. Homicides peaked on Sundays, followed by Saturdays; homicides were less likely to occur on weekdays.

Source: National Vital Statistics System. Mortality public use data file, 2015. https://www.cdc.gov/nchs/data_access/vitalstatsonline.htm.

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For more information on this topic, CDC recommends the following link: https://www.cdc.gov/injury

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