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Measles Outbreak in an Unvaccinated Family and a Possibly Associated International Traveler — Orange County, Florida, December 2012–January 2013

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The Florida Department of Health in Orange County (DOH-Orange) was notified by a child care facility on January 11, 2013, that a parent had reported that an attendee and three siblings were ill with measles. All four siblings were unvaccinated for measles and had no travel history outside of Orange County during the periods when they likely had been exposed. A fifth, possibly associated case was later reported in a Brazilian citizen who had become ill while vacationing in Florida. The outbreak investigation that was conducted at multiple community settings in Orange County, including at an Orlando-area theme park, identified no additional cases. The genotype sequence was identical for cases 2–5, and visits to the same theme park suggested an unknown, common exposure and link between the cases. Sources of measles exposure can be difficult to identify for every measles case. Measles should be considered in the differential diagnosis of febrile rash illness, especially in unvaccinated persons. Reporting a confirmed or suspected case immediately to public health authorities is critical to limit the spread of measles.

Measles cases in the United States are evaluated by state and local health departments using standard case definitions and classifications (*1*). For this investigation, the CDC definition of exposure period as 7–21 days before rash onset and the American Academy of Pediatrics 2009 Red Book definition for infectious period as 2 days before symptom onset through 4 days after rash onset were used (*1,2*).

Case 1

An Orange County unvaccinated resident aged 10 years developed a fever (maximum temperature 104.5°F [40.3°C]) on December 25, 2012. Rash onset was on December 28. Additional symptoms included cough, coryza, and conjunctivitis. The patient was evaluated at a local pediatric urgent care clinic on December 29 and given a presumptive diagnosis of viral rash of unknown etiology. Activities during the exposure period of patient 1 included a family trip to an Orlando-area theme park on December 15 and school attendance through December 21. No travel history or ill contacts were reported. During the patient's infectious period, attendance at a church on December 24 and 25, a visit to a health care facility on December 27 (unrelated to illness), and the visit to the pediatric urgent care clinic on December 29 occurred. Patient 1 did not attend school during her infectious period because of winter break. No clinical specimens were collected from patient 1.

Cases 2, 3, and 4

Patient 2 (aged 7 years), patient 3 (aged 13 years), and patient 4 (aged 4 years) are all siblings of patient 1, and their illnesses were secondary cases in this outbreak. All four children

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in the family were unvaccinated; the parents had claimed a religious exemption to vaccination. Prodromal fever (≥101°F [≥38.3°C]) onset occurred on January 6, 2013, for patients 2 and 3, with patient 4 having onset of prodromal fever the next day. Rash onset in patients 2, 3, and 4 occurred on January 10, 11, and 12, respectively. Additional symptoms reported in all three cases included diarrhea, cough, coryza, and conjunctivitis. After onset of illness in all four of their children, the parents independently suspected measles infection and reported this to the children's child care facility and school. Patients 2 and 3 did not attend school during their infectious periods. Activities during the infectious period included participation on a sports team by patient 2 during January 4 and 5 and attendance at child care by patient 4 on January 7, the date of fever onset.

Public Health Laboratory Analysis

Nasopharyngeal specimens were collected from patients 2, 3, and 4, a urine specimen from patient 3, and a blood specimen from patient 2 on January 11 by staff from DOH-Orange and tested at the Florida Department of Health (DOH), Bureau of Public Health Laboratories. On Monday, January 14, the laboratory reported that the blood specimen was positive for measles-specific immunoglobulin M and all nasopharyngeal and urine specimens were positive for measles virus RNA by reverse transcription polymerase chain reaction. Testing at CDC confirmed identical sequences of measles genotype D8 for all three cases.

Possibly Associated Case 5

On January 25, 2013, the Florida Department of Health in Miami-Dade County (DOH-Miami-Dade) was notified by CDC of a report from Brazil of a confirmed measles case in a Brazilian citizen who had visited Florida during his exposure and infectious periods. Patient 5, aged 20 years, sought medical care for same-day onset of rash and a 4-day history of fever, oral lesions, and conjunctival hyperemia at a Miami urgent care facility on December 30, 2012. With a discharge diagnosis of acute pharyngitis, patient 5 returned to Brazil on December 31, where he tested serum-positive for measles immunoglobulin M and positive for measles virus RNA from nasopharyngeal and urine specimens; genotype D8 was detected. Public health officials in Brazil reported to CDC that this patient had no documented history of measles vaccination and had also visited Orlando-area theme parks in Orange County during the December 14–21 timeframe; the theme parks were not identified. The genomic sequence from the patient in Brazil was identical to the sequences obtained from patients 2–4 in the United States, suggesting an epidemiologic linkage between these cases (Figure). A total of four secondary cases linked to patient 5 were identified in Brazil, and all had genotype D8 detected.

Public Health Response

On January 11, 2013, for patients 2–4, guidance was provided to the parents to isolate the children at home during

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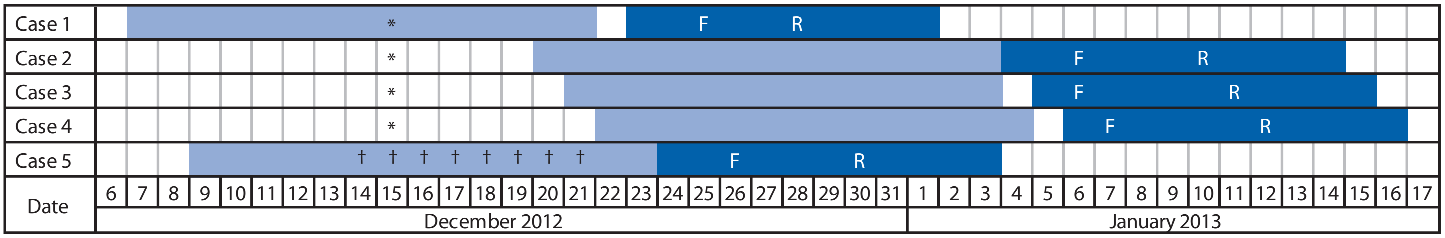
FIGURE. Exposure and infectious periods of five measles cases — Orange County, Florida, December 2012–January 2013



Exposure period: 7–21 days before rash onset§

Infectious period: 2 days before symptom onset to 4 days after rash onset¶

Abbreviations: F = fever onset; R = rash onset.

* Known travel to a theme park in Orange County, Florida.

† Known travel to Orange County, Florida, including visits to unknown theme parks.

§ Per CDC's *Manual for the Surveillance of Vaccine-Preventable Diseases*. Atlanta, GA: US Department of Health and Human Services, CDC; 2013. Information available at http://www.cdc.gov/vaccines/pubs/surv-manual/chpt07-measles.html.

¶ Per American Academy of Pediatrics' *Red Book* (Pickering LK, ed. Red book: 2009 report of the committee of infectious diseases. 28th edition. Elk Grove Village, IL: American Academy of Pediatrics; 2009:444–55). Information available at http://redbookarchive.aappublications.org/cgi/content/full/2009/1/3.77.

the remainder of their infectious periods. Before laboratory confirmation was received, actions were taken to ensure a rapid response to the outbreak, including briefing public information officers, querying the DOH electronic syndromic surveillance system for additional cases, and updating the health care provider alert letter, media press release, and measles exposure notification letters to contacts of the patients.

On January 14, after laboratory confirmation, a health alert was distributed to health care providers, including hospital and urgent care facilities in Orange County, Florida. In addition, contact investigations were initiated at identified community settings where there was a potential for disease transmission. Measles exposure notification letters were distributed to contacts in the identified settings, recommending isolation of persons with onset of symptoms clinically compatible with measles (with immediate notification of DOH-Orange), review of personnel vaccination status, and full vaccination. Additionally, the pediatric urgent care clinic and the urgent care clinic in Miami were encouraged to review its diagnostic and infection control policies for patients with rash and febrile illness. Because the exposure source for patient 1 was unknown, contact investigation was also initiated at the public school attended during the patient's exposure period. School health logs were reviewed for all school days in December 2012 for compatible infection; however, none was identified. No exclusions were applied at any public school because patients 1–3 did not attend while infectious and no clinically compatible cases were identified during the investigation. Three unvaccinated child care contacts of patient 4 were excluded from child care attendance and voluntarily isolated through January 28, 2013. In total, measles exposure notification letters were sent to 528 students, 50 school faculty and staff, 24 sports team contacts, 15 pediatric urgent care contacts, six health care facility contacts, and 67 child care contacts. The notification letters were also distributed to an unknown number of church parishioners during the January 19 weekend services. No additional cases were identified.

Upon notification of a potential theme park link, contact was initiated with the Orlando-area theme park where the suspected exposure of patient 1, and possibly patient 5, occurred to ascertain if there were any theme park guest complaints or reports of rash illness from the beginning of December 2012 through January 2013. No rash illness had been reported among theme park guests or staff.

DOH-Miami-Dade followed up on potential disease transmission from patient 5 at the urgent care facility in Miami. The facility identified 14 patients and three staff members who were potentially exposed to the measles virus. All identified persons reported evidence of immunity to measles and had no compatible illnesses.

Discussion

Measles is an acute, highly infectious, viral disease spread via large respiratory droplets and aerosolized droplet nuclei. In the United States, interruption of year-round endemic transmission of measles was documented in 2000 (*3*). This occurred as a result of high population immunity, attained through vaccination, and rapid public health response to cases. However, infants aged <12 months and unvaccinated children and adults remain at risk for acquiring and transmitting measles. Despite a high number of potential exposures in school, child care, and health care settings, no transmission occurred, highlighting that high population immunity can limit measles transmission and maintain measles elimination in the United States.

Measles is currently endemic in much of the world, including Europe, where genotype D8 is circulating, which provides an ongoing source of imported cases to the United States (*4*–*8*). Despite a detailed investigation, no source of

What is already known on this topic?

High population immunity to measles, which has been achieved through vaccination, combined with rapid public health responses to cases, have resulted in the elimination of endemic measles in the United States since 2000. Failure to vaccinate is one of the most frequent preventable causes of measles outbreaks among U.S. children. Unvaccinated persons continue to be at risk for measles infection.

What is added by this report?

Four children in a Florida family were diagnosed with measles in January 2013. None of the four were vaccinated against measles, and none had traveled outside of Orange County, Florida, during the periods when they likely had been exposed. A fifth case of measles was later reported in a Brazilian citizen who had become ill while vacationing in Florida at the same time as the first Florida patient. The genotype was determined for three of the siblings and the Brazilian case; all were identical. The investigation detected no additional cases and suggested that visits to the same theme park might have resulted in an unknown, common exposure.

What are the implications for public health practice?

Sources of measles exposure can be difficult to identify for measles cases. Destinations popular among domestic and international visitors might serve as important sources of exposure. Children should be vaccinated against measles routinely. Clinicians should be educated on the recognition and diagnosis of measles and should consider measles diagnoses in persons with no or unknown vaccination history and compatible symptoms. Rapid identification is critical to effective public health response.

exposure was found for patients 1 and 5, who became febrile on December 25 and 26, respectively, and their presence at a theme park with domestic and international attendees was suggestive of a common exposure at this location. Large congregate settings might be an important potential source of measles exposure in the United States. This outbreak also highlights the importance of molecular epidemiology. The identical D8 sequences from patients 2–5 was suggestive of an epidemiologic linkage or common source of exposure, although two separate importations from areas where this lineage is circulating cannot be excluded as an explanation.

The misdiagnosis of patients 1 and 5 is a reminder that many health care providers are no longer familiar with the clinical presentation of measles and they need to maintain a high index of suspicion when a clinically compatible febrile rash illness occurs in an unvaccinated person. High vaccination coverage in the entire population and rapid, robust public health response to cases, which includes physicians immediately reporting suspected cases to public health agencies, appropriate isolation and specimen collection for both viral detection and genotyping as well as serologic testing, and thorough contact investigations, are necessary elements in the effort to maintain measles elimination in the United States.

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Assessment of Varicella Surveillance and Outbreak Control Practices — United States, 2012

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Case-based varicella (chickenpox) surveillance is important for monitoring the impact of the varicella vaccination program. In 2002, the Council of State and Territorial Epidemiologists (CSTE) recommended that all states move toward case-based varicella surveillance by 2005; in 2003, varicella was made nationally notifiable (Table 1) (*1*). To ease the transition to case-based reporting, CSTE and CDC recommended starting with sentinel site or outbreak surveillance and then moving to statewide case-based surveillance when feasible. To gauge progress in varicella surveillance, in 2012 CDC and CSTE developed a survey for assessing varicella surveillance practices, which CSTE administered to all states and the District of Columbia (DC). As of 2012, varicella was reportable in 44 (86.3%) of the 51 jurisdictions surveyed, of which 37 (84.1%) conduct statewide case-based surveillance. Of the 38 jurisdictions conducting statewide or sentinel site varicella case-based surveillance, more than 84% reported collecting information on age, sex, and race/ethnicity (all 97.4%), vaccination status (94.7%), outbreak association (86.8%), and disease severity (84.2%). Nineteen (43.2%) of the 44 jurisdictions where reporting was mandated transmitted varicella-specific data to CDC using Health Level 7 (HL7) messaging. Currently, HL7 messaging is the only mechanism available for states to send varicella-specific data to CDC. Although public health agencies have made much progress to strengthen varicella surveillance throughout the United States (*2*), strategies are needed to facilitate transmission of varicella-specific data to CDC from all jurisdictions, using HL7 messaging, and to increase the number of jurisdictions collecting the varicella-specific data necessary to monitor varicella epidemiology and the impact of the vaccination program nationally.

The CDC and CSTE assessment addressed several important aspects of varicella surveillance, including 1) whether varicella is a reportable condition in the state; 2) type and breadth of surveillance conducted (e.g., statewide case-based, outbreak only, case-based in sentinel sites, or aggregate); 3) varicella-specific variables collected (e.g., vaccination status, disease severity [number of lesions, hospitalizations, complications, and deaths], laboratory testing and results, and clinical and epidemiologic data); 4) types of reporting sites; 5) whether varicella surveillance data are sent to CDC via HL7 messaging; 6) whether laboratory testing for varicella is performed in the state; 7) varicella vaccination requirements for school entry; and 8) outbreak control policies. The assessment was pilot-tested in five states and the final version distributed via e-mail in September 2012 to all state epidemiologists.

All 51 jurisdictions (50 states and DC) completed the assessment. Forty-four (86.3%) indicated that varicella is reportable in their jurisdiction. Among these 44 jurisdictions, varicella cases are reported by schools (42 jurisdictions, 95.4%), hospitals (40, 90.9%), and health care providers (37, 84.1%). A total of 38 jurisdictions (86.4%) conducted case-based surveillance,

TABLE 1. History of national varicella surveillance and related events — United States, 1972–2007*

Year	Surveillance milestone
1972	Varicella becomes a nationally notifiable disease.
1981	Varicella is removed from the nationally notifiable diseases list.†
1991	The Council of State and Territorial Epidemiologists (CSTE) recommends that states develop or maintain sources of varicella surveillance data (e.g., active surveillance in health maintenance organizations or cities/counties/schools, sentinel reporting systems, notifiable disease reporting where feasible, death certificate data, or surveys) to monitor trends in disease incidence.
1995	Varicella vaccine is licensed for use in the United States.
1996	1-dose varicella vaccine is recommended for routine childhood vaccination in the United States.
1997	CSTE recommends that states and territories investigate all varicella-related deaths to monitor changes in varicella-related mortality and to understand why deaths occurred.
1998	CSTE recommends that states establish some form of ongoing systematic morbidity surveillance that might include aggregate case reporting, hospital discharge data review, sentinel systems, or surveys.
1999	Varicella deaths become nationally notifiable, effective January 1, 1999.
2002	CSTE recommends including varicella in the National Notifiable Diseases Surveillance System by 2003 and establishing case-based surveillance in all states by 2005.
2006	Varicella vaccination recommendation is updated to include a routine 2-dose childhood vaccination schedule in the United States.

* **Source:** adapted from CDC. Varicella surveillance practices—United States, 2004. MMWR 2006;55:1126–9.
† During 1972–1997, a total of 14 states maintained continuous varicella reporting to CDC.

either statewide or at regional sentinel sites, and 20 (45.4%) conducted surveillance only for varicella outbreaks or cases associated with outbreaks (Table 2).

Among reporting variables, more than 84% of the 38 jurisdictions conducting statewide or sentinel site varicella case-based surveillance reported collecting information on age, sex, and race/ethnicity (all 97.4%), vaccination status (94.7%), outbreak association (86.8%), and disease severity (84.2%) (Table 3). Outcome data, including hospitalizations and deaths, were collected by 35 (92.1%) and 34 (89.5%) jurisdictions, respectively (Table 3). Collection of clinical information ranged from 28 jurisdictions (57.9%) for treatment (i.e., medication or type) to 36 jurisdictions for rash onset date and laboratory testing (both 94.7%) (Table 3).

Varicella-specific data were transmitted to CDC via HL7 messaging by 19 (43.2%) of the 44 jurisdictions. Of the 22 (50%) jurisdictions that did not send data via HL7 messaging in 2012, 14 (63.6%) had not transitioned to HL7 standards. Seven (31.8%) either had other methods for sending data, were planning to transition to HL7 messaging, or were not collecting case-based data, and one (4.5%) had no plans to transition to HL7. Barriers hindering transition to HL7 messaging included competing priorities and lack of staff and funds. Three jurisdictions reported not knowing whether they were sending HL7 messages to CDC.

Of the 51 jurisdictions, 49 (96.1%) reported providing public notification of varicella outbreaks and recommending vaccination as an outbreak control strategy. Other reported control strategies included exclusion from the outbreak setting of 1) patients (34 jurisdictions, 66.7%), 2) persons without evidence of immunity who refuse vaccination (33, 64.7%), 3) persons not up-to-date on vaccinations who refused vaccination (18, 35.5%), and 4) immunocompromised persons or pregnant women without evidence of immunity (27, 52.9%). Overall, 31 (60.8%) of the 51 jurisdictions reported having state guidelines for varicella outbreak control.

A total of 41 (80.4%) of the 51 jurisdictions reported having laboratory capability for varicella testing, and 17 (33.3%) routinely provided such testing. In 36 (70.6%) jurisdictions, most testing was conducted as part of outbreak investigation and control. Testing by polymerase chain reaction (PCR) and culture, the most commonly reported types of varicella tests, were available in 26 jurisdictions (51.8%), and the varicella-zoster virus immunoglobulin G test was available in 24 jurisdictions (47.1%).

In 2012, 13 (25.5%) of the 51 jurisdictions reported requiring only 1 dose of varicella vaccine for school entry, 20 (39.2%) reported having a 2-dose school entry requirement, and 17 (33.3%) reported having both 1-dose and 2-dose school entry requirements depending on the grade level. One (2%) jurisdiction reported having no varicella vaccination requirement for school entry.

TABLE 2. Varicella surveillance practices as reported by the 44 jurisdictions where varicella was a reportable condition — United States, 2012

Type of surveillance*	Jurisdictions reporting No.	(%)
Statewide case-based	37	(84.1)
Regional sentinel site case-based	3	(6.8)
Outbreak	20	(45.4)
Aggregate	3	(6.8)
Other†	4	(9.1)

* Responses could include multiple types of varicella surveillance.
† Includes passive surveillance and surveillance limited to varicella deaths, hospitalizations, and outbreaks.

TABLE 3. Information collected by 38 jurisdictions conducting statewide or sentinel site varicella case-based surveillance — United States, 2012

Variables collected by jurisdictions conducting varicella case-based surveillance*	Jurisdictions reporting No.	(%)
Demographic information		
Age	37	(97.4)
Sex	37	(97.4)
Race/Ethnicity	37	(97.4)
Country of birth	25	(65.8)
Clinical information		
Rash onset date	36	(94.7)
Disease severity	32	(84.2)
Location of rash (generalized, localized)	24	(63.2)
Types of lesions (macules, papules, vesicles)	24	(63.2)
Fever	28	(73.7)
Complications	27	(71.0)
Immunocompromised	24	(63.2)
Treatment (medication, type)	22	(57.9)
Pregnancy status	28	(73.7)
Past history of varicella disease	30	(79.0)
Laboratory testing for varicella performed	36	(94.7)
Varicella vaccination history		
Received varicella vaccine	36	(94.7)
No. of doses received and dates	35	(92.1)
Epidemiologic data		
Epidemiologic link	30	(79.0)
Transmission setting	27	(71.0)
Outbreak association	33	(86.8)
Outcome		
Hospitalized	35	(92.1)
Died	34	(89.5)

* Respondents were able to select more than one variable.

Discussion

Because a large number of varicella cases occurred in the United States at the beginning of the varicella vaccination program (estimated at 4 million cases each year, which approximated the size of the U.S. birth cohort) and varicella was not included as a nationally notifiable condition, nationwide reporting of every varicella case was not feasible at that time (*3*). In

What is already known on this topic?

National varicella surveillance data are important for monitoring trends in varicella epidemiology. In 2002, the Council of State and Territorial Epidemiologists recommended that varicella be added to the list of nationally notifiable conditions by 2003 and that all states move to case-based reporting for varicella by 2005.

What is added by this report?

As of 2012, varicella has been a reportable condition in 44 of 51 jurisdictions; 38 jurisdictions were conducting statewide or sentinel site case-based surveillance for varicella. However, only 19 jurisdictions had the capability to send varicella-specific data to CDC through Health Level 7 electronic messaging. Among the 51 jurisdictions, 80.4% had the laboratory capacity to test specimens for varicella, and 60.8% of jurisdictions had guidelines for outbreak control. Additionally, all jurisdictions except one had either a 1-dose or 2-dose varicella vaccine school entry requirement.

What are the implications for public health practice?

Continued work by jurisdictions to collect and improve completeness of reporting of all relevant clinical and epidemiologic data, disease severity and outcomes, and vaccination status, along with full implementation of Health Level 7 systems to allow jurisdictions to send their varicella-specific data to CDC will be useful for continued monitoring of the varicella vaccination program and guiding future varicella vaccination policy.

the absence of robust national varicella surveillance, beginning in 1995, data from active surveillance sites were used to monitor impact of the 1-dose varicella vaccination program, and later, the 2-dose program that was recommended in 2006 and implemented in 2007 (*2,4*). As varicella vaccination coverage increased nationwide (*5*), and the number of varicella cases decreased, CSTE recommended that states move to case-based varicella reporting by 2005 (*6*). The findings in this report update an assessment conducted in 2004 and document a 63.0% increase in the number of jurisdictions that mandated varicella reporting, from 27 jurisdictions in 2004 to 44 in 2012 (*1,3*). Since 2004, varicella surveillance has been greatly strengthened, with 38 (86.4%) of the jurisdictions that mandate varicella reporting now conducting statewide or sentinel site case-based reporting. In nearly all jurisdictions (95.4%) varicella cases are reported by schools. However, hospitals and health care providers also are important sources of reporting, particularly for cases in adults and infants. As varicella incidence continues to decline and vaccination coverage increases, monitoring disease severity, outcomes, and epidemiology among all age groups, including those not targeted for vaccination, remains important.

As the varicella vaccination program matures and more cases occur among vaccinated persons, laboratory confirmation is increasingly necessary. Diagnosis of breakthrough disease (i.e., varicella in vaccinated persons) is challenging because disease is often mild and might resemble other rash illnesses or insect bites. PCR testing of lesion specimens has been shown to be the most sensitive and specific for diagnosing varicella (*7,8*). With the majority of jurisdictions now able to perform laboratory testing for varicella, laboratory confirmation of varicella cases is increasingly feasible and will improve the accuracy of surveillance data. A real-time PCR method was deployed to all state laboratories in 2002 for ruling out smallpox in suspected cases of bioterrorism. The permissible uses for this assay have now been expanded to include confirmation of varicella outbreaks and verification of suspected cases of severe varicella. Vaccine-preventable disease reference centers also are available in the state public health laboratories of Wisconsin, New York, Minnesota, and California for varicella-zoster virus PCR testing, discriminating between vaccine and wild-type strains, and varicella-zoster virus genotyping.

Because varicella disease in vaccinated persons is usually mild, with fewer lesions than in unvaccinated persons, confirming and investigating varicella outbreaks in the 2-dose vaccine era can be challenging and resource intensive (*9*). Approximately 60% of jurisdictions have developed guidelines for varicella outbreak control.* Although 96.1% of jurisdictions reported recommending vaccination as part of their outbreak control strategies, only 64.7% reported excluding persons without evidence of immunity who refuse vaccination. Such exclusion is an important strategy for controlling outbreaks and for protecting those at risk for severe disease who have not been vaccinated.

Currently, most jurisdictions conducting case-based surveillance collect varicella-specific information; however, fewer than half are able to send those data via HL7 messaging to CDC. HL7 messaging is the only mechanism available to states for sending the varicella-specific data they collect to CDC.† Jurisdictions report that resource limitations remain an important barrier to implementing HL7 messaging.

Considerable progress has been made in national varicella surveillance, and national data are now used to monitor trends in varicella incidence. More complete reporting of all relevant clinical and epidemiologic data, disease severity and outcomes, and vaccination status, along with full implementation of HL7 messaging is needed so that CDC can receive the varicella data collected by jurisdictions and use those data to fully monitor the impact of the varicella vaccination program and guide future varicella vaccination policy.

* CDC has developed a document to provide guidance for investigating and managing varicella outbreaks, available at http://www.cdc.gov/chickenpox/outbreaks/downloads/manual.pdf.

† A varicella HL7 message mapping guide is available at http://www.cdc.gov/phin/library/guides/varicella_message_mapping_guide_v2_01.pdf.

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Vital Signs: Sodium Intake Among U.S. School-Aged Children — 2009–2010

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Abstract

Background: A national health objective is to reduce average U.S. sodium intake to 2,300 mg daily to help prevent high blood pressure, a major cause of heart disease and stroke. Identifying common contributors to sodium intake among children can help reduction efforts.

Methods: Average sodium intake, sodium consumed per calorie, and proportions of sodium from food categories, place obtained, and eating occasion were estimated among 2,266 school-aged (6–18 years) participants in *What We Eat in America*, the dietary intake component of the National Health and Nutrition Examination Survey, 2009–2010.

Results: U.S. school-aged children consumed an estimated 3,279 mg of sodium daily with the highest total intake (3,672 mg/d) and intake per 1,000 kcal (1,681 mg) among high school–aged children. Forty-three percent of sodium came from 10 food categories: pizza, bread and rolls, cold cuts/cured meats, savory snacks, sandwiches, cheese, chicken patties/nuggets/tenders, pasta mixed dishes, Mexican mixed dishes, and soups. Sixty-five percent of sodium intake came from store foods, 13% from fast food/pizza restaurants, 5% from other restaurants, and 9% from school cafeteria foods. Among children aged 14–18 years, 16% of total sodium intake came from fast food/pizza restaurants versus 11% among those aged 6–10 years or 11–13 years ($p<0.05$). Among children who consumed a school meal on the day assessed, 26% of sodium intake came from school cafeteria foods. Thirty-nine percent of sodium was consumed at dinner, followed by lunch (29%), snacks (16%), and breakfast (15%).

Implications for Public Health Practice: Sodium intake among school-aged children is much higher than recommended. Multiple food categories, venues, meals, and snacks contribute to sodium intake among school-aged children supporting the importance of populationwide strategies to reduce sodium intake. New national nutrition standards are projected to reduce the sodium content of school meals by approximately 25%–50% by 2022. Based on this analysis, if there is no replacement from other sources, sodium intake among U.S. school-aged children will be reduced by an average of about 75–150 mg per day and about 220–440 mg on days children consume school meals.

Introduction

A *Healthy People 2020* (HP2020) objective is to reduce average sodium intake in the U.S. population aged ≥2 years to decrease the risk of high blood pressure (hypertension), a major cause of heart disease and stroke (1). The target is 2,300 mg daily, a decrease of approximately 40% from current intake.* A 40% reduction in U.S. sodium intake is projected to save 280,000 to 500,000 lives over 10 years (2). Although hypertension, heart disease, and stroke are more common among adults, their origins can be in childhood: an estimated one in six U.S. children aged 8–17 years have pre–high blood pressure or high blood pressure (3). Children with higher blood pressure are more likely to develop hypertension as adults, making early prevention imperative (4–8).†

Average sodium consumption among U.S. children does not meet HP2020 targets. Over 90% of U.S. school-aged children and adolescents consume too much sodium (*9*) relative to the *Dietary Guidelines for Americans* and the Institute

* Additional information available for Nutrition and Weight Status Objective 19 at http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=29.

† Additional information available at http://www.nel.gov/conclusion.cfm?conclusion_statement_id=250164&highlight=sodium&home=1.

of Medicine (IOM) upper intake levels.[§] Average daily sodium consumption declined slightly over the past decade among younger (aged ≤13 years) school-aged children, but not among adolescents, and not in terms of sodium consumed per calorie (*9*). It is estimated that more than three fourths of sodium intake comes from commercially processed packaged and restaurant foods (*10*). To reduce U.S. sodium intake, the primary strategy recommended by IOM is reductions in the sodium content of commercially processed and restaurant foods (*10*). Additionally, new national nutrition standards for school meals and other foods sold in schools might help reduce sodium intake among children who consume these foods.[¶]

Identifying the major food sources among U.S. school-aged children can aid in developing strategies for reducing sodium consumption in this population. This report describes mean sodium intake, sodium density (defined as mg of sodium per 1,000 kcal), and the food categories, places obtained (e.g., restaurant), and eating occasions contributing to sodium intake among U.S. children aged 6–18 years during 2009–2010.

Methods

The National Health and Nutrition Examination Survey is an ongoing, nationally representative, multistage, stratified survey of the U.S. noninstitutionalized population.[**] During 2009–2010, 2,375 children aged 6–18 years were interviewed and examined (about 85%–87% of those screened). Of these, 2,266 completed an initial, in-person, 24-hour dietary recall as part of *What We Eat in America* (WWEIA), the dietary intake component of the National Health and Nutrition Examination Survey. Details on the 24-hour dietary recall and food and nutrient analysis have been published.[††,§§,¶¶] Estimates excluded sodium from salt added at the table (estimated to be about 5% of intake) (*10*).

To identify foods contributing to sodium consumption, foods similar in use and nutrient content were grouped together using WWEIA food categories for 2009–2010.[***] Food categories were ranked based on their percentage contribution to total sodium intake among U.S. children aged 6–18 years, calculated as the sum of the sodium from foods consumed from a specific category, divided by the sum of sodium consumed from all foods for all persons, and multiplied by 100. Food categories contributing to sodium intake were examined by age, sex, race/ethnicity, family income, and weight status. Age groups correspond to enrollment in elementary (6–10 years), middle (11–13 years), and high school (14–18 years). Family income corresponds with eligibility to receive free (≤130% of poverty) or reduced-price (>130%–185%) school meals. Weight status was determined by body mass index (weight [kg]/[height {m}]^2) for age and sex percentile in reference to the 2000 CDC growth charts.[†††]

To determine how foods obtained from a specific setting (i.e., school cafeteria) contributed to total sodium intake among children who consumed a school meal, responses of 568 children (with a weekday dietary recall) who met the following criteria were analyzed separately: "now attending school" and "usually get a complete school lunch" or a "school breakfast" five times a week.

Wald F tests were used to examine whether means differed among subgroups, and t-tests were used to examine differences between age groups (e.g., ages 6–10 years compared with 14–18 years) in proportions of sodium consumed and mean sodium density from different places (e.g., stores and restaurants). Statistical software accounting for the complex survey design was used for all analyses. Each participant was assigned a numerical sample weight equivalent to the number of children in the population represented by that person. Sample weights for NHANES participants incorporate adjustments for unequal selection probabilities by specific age, sex, or race/ethnicities and certain types of nonparticipation or nonresponse. The

§ According to the 2010 *Dietary Guidelines for Americans*, children aged ≥2 years should reduce their daily sodium intake to <2,300 mg and those who are African-American or have hypertension, diabetes, or chronic kidney disease should further reduce intake to 1,500 mg. Additional information is available at http://www.health.gov/dietaryguidelines/2010.asp. Using NHANES 2009–2010 data, 21.5% of U.S. children aged 6–18 years are African-American or have hypertension, diabetes or chronic kidney disease, and 99.2% of these children consume >1,500 mg sodium daily based on usual intakes. Of the remaining children, 87.9% consume ≥2,300 mg daily. Thus, 90.3% of U.S. children (0.215 x 99.2% + 0.785 x 87.9%) consume more sodium then recommended by the *Dietary Guidelines for Americans*. Tolerable upper intake levels are levels above which "usual intake may place an individual at risk of adverse effects from excessive nutrient intake." The tolerable upper intake level for sodium intake for children aged 4–8 years is 1,900 mg/day, for children aged 9–13 years is 2,200 mg/day, and for children aged 14–18 years is 2,300 mg/day. Additional information available at http://www.iom.edu/reports/2004/dietary-reference-intakes-water-potassium-sodium-chloride-and-sulfate.aspx.

¶ Additional information regarding the sodium reduction targets is available at http://www.gpo.gov/fdsys/pkg/FR-2013-06-28/pdf/2013-15249.pdf and http://www.gpo.gov/fdsys/pkg/FR-2012-01-26/pdf/2012-1010.pdf. Note the baseline data for the sodium reduction targets were from the School Nutrition and Dietary Assessment Study III, the most current data available at the time of the study period. These data are available at http://www.fns.usda.gov/school-nutrition-dietary-assessment-study-iii.

** Additional information available at http://www.cdc.gov/nchs/nhanes.htm.

†† Additional information about the USDA Automated Multiple-Pass Method available at http://www.ars.usda.gov/services/docs.htm?docid=7710.

§§ Additional information available in the USDA Food and Nutrient Database for Dietary Studies, 5.0 at http://www.ars.usda.gov/services/docs.htm?docid=22370.

¶¶ Additional information available in the USDA National Nutrient Database for Standard Reference, Release 24 at http://www.ars.usda.gov/services/docs.htm?docid=22808.

*** Additional information available at http://www.ars.usda.gov/services/docs.htm?docid=23429.

††† Additional information available at http://www.cdc.gov/nccdphp/dnpa/growthcharts/resources/growthchart.pdf.

numerical sample weights for the (day 1) 24-hour dietary recall were used for all analyses.

Results

Mean daily sodium consumption was 3,279 mg, and mean sodium density was 1,638 mg sodium per 1,000 kcal. Total sodium intake was highest among high school–aged children and among males (Table 1), lowest among children (with family income ≤185% of the federal poverty level) who qualified for reduced-price school meals (Table 2), and did not vary by race/ethnicity (Table 1) or weight status (Table 2). Sodium density was highest among high school–aged children and varied by age group (p=0.01), but not by other examined variables (p≥0.05).

Approximately 43% of sodium among U.S. children aged 6–18 years was consumed from foods in the following 10 categories: 1) pizza; 2) yeast bread and rolls; 3) cold cuts/cured meats; 4) savory snacks (e.g., chips, pretzels, and popcorn); 5) sandwiches[§§§]; 6) cheese; 7) chicken patties, nuggets, and tenders; 8) pasta mixed dishes (including spaghetti with meat sauce but excluding macaroni and cheese); 9) Mexican-mixed dishes[¶¶¶]; and 10) soups (Tables 1 and 2). The five leading food categories consistently appeared among the top 10 ranked categories among the subgroups examined.

Among participants, 65.1% of sodium consumed came from foods (or ingredients) obtained from a store (e.g., supermarket, warehouse store); 13.0% from fast food/pizza restaurants, 4.9% from other restaurants, 9.1% from the school cafeteria, and 7.4% from other sources (Table 3). Among high school–aged (14–18 years) participants, a higher proportion of total sodium intake came from fast food/pizza restaurants (15.5%) compared with children aged 6–10 years (10.9%) and 11–13 years (10.8%), p<0.05). Among elementary school–aged versus middle and high school–aged children, a higher proportion came from school cafeteria foods (11.7% versus 8.9% and 7.4%, respectively, p<0.05). Among participants who consumed a school meal on the day of recall, 26.0% of sodium came from school cafeteria foods; this proportion did not vary by age group.

Overall, the mean sodium density (1,843 mg/1,000 kcal) was highest in fast food/pizza restaurants foods. Among high school–aged, compared with elementary and middle school–aged children, the mean sodium density from school cafeteria foods was greater (1,828 versus 1,528 and 1,617, respectively, p<0.05) and did not appear to differ from mean sodium density from fast food/pizza restaurant foods among high school–aged children (1,817).

Key Points

- A national health objective for 2020 is to reduce average daily sodium intake by about 40% to 2,300 mg, projected to save 280,000 to 500,000 lives over 10 years.
- Total sodium intake was 3,279 mg, higher among high school–aged children than other children. The amount of sodium consumed per calorie also was higher among high school–aged versus younger children, but otherwise did not vary by group.
- Although foods from grocery stores contribute the majority of sodium intake, foods from fast-food/pizza restaurants continue to contribute higher amounts of sodium per calorie, and contribute higher proportions of total sodium intake among high school–aged versus younger children.
- Among children aged 6–18 years, 9% of total sodium intake came from school cafeterias; among 568 children who consumed a school meal on their 24-hour dietary recall day, 26% of total sodium intake came from school cafeterias.
- Approximately 43% of sodium was consumed from foods in the following 10 categories: pizza; yeast bread and rolls; cold cuts/cured meats; savory snacks (e.g., chips and pretzels); sandwiches like cheeseburgers; cheese; chicken patties, nuggets, and tenders; pasta mixed dishes (including spaghetti with meat sauce but excluding macaroni and cheese); Mexican-mixed dishes (e.g., burritos and tacos); and soups.
- Additional information is available at http://www.cdc.gov/vitalsigns.

When examined by eating occasion, 39.2% of sodium intake occurred at dinner; 29.5% lunch; 16.4% snacks; and 14.9% breakfast (Table 4). Among high school–aged compared with younger children, a lower proportion of total sodium intake came from breakfast (p<0.05). In addition to foods obtained from a store, which contributed 11.3% to 26.0% of total sodium intake across eating occasions on a typical day, foods from school cafeterias at lunch contributed 7.2% to sodium intake and from fast/food pizza restaurants at dinner, 6.6%. This pattern differed little by age, except among high school–aged children, for whom foods from fast/food pizza restaurants consumed at lunch contributed the same as foods from school cafeterias.

§§§ Sandwiches, like cheeseburgers, as identified by a single code in WWEIA.
¶¶¶ Mexican-mixed dishes, like burritos and tacos, as identified by a single code in WWEIA.

TABLE 1. Ranked proportions of sodium consumed by children aged 6–18 years,* by selected food categories, age groups, sex, and race/ethnicity — National Health and Nutrition Examination Survey, United States, 2009–2010

		Age group (yrs)				Sex		Race/Ethnicity		
		6–18 overall	6–10	11–13	14–18	Male	Female	Hispanic	Black, non-Hispanic	White, non-Hispanic
Rank[†]	Food category[§]	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)
1	Pizza	8.4 (0.9)	7.4 (1.0)	8.5 (1.0)	9.0 (1.9)	9.3 (1.3)	7.2 (0.8)	8.2 (0.6)	9.2 (1.5)	8.4 (1.5)
2	Yeast breads/rolls/buns[¶]	5.8 (0.3)	6.3 (0.3)	6.2 (0.8)	5.2 (0.4)	6.2 (0.4)	5.4 (0.4)	5.3 (0.4)	5.1 (0.4)	6.4 (0.5)
3	Cold cuts/cured meats	4.7 (0.5)	3.4 (0.4)	5.9 (1.0)	5.2 (0.7)	5.3 (0.7)	4.1 (0.7)	3.5 (0.6)	3.4 (1.0)	5.7 (0.9)
4	Savory snacks**	4.3 (0.3)	4.2 (0.3)	4.8 (1.0)	4.2 (0.3)	4.6 (0.4)	4.0 (0.2)	4.3 (0.4)	4.4 (0.5)	4.4 (0.4)
5	Sandwiches (single code)[††]	4.0 (0.4)	3.7 (0.5)	4.0 (0.7)	4.4 (0.5)	4.3 (0.4)	3.7 (0.5)	4.3 (0.9)	3.9 (0.9)	4.0 (0.3)
6	Cheese	3.6 (0.2)	3.2 (0.2)	3.7 (0.4)	3.9 (0.3)	3.1 (0.3)	4.2 (0.3)	3.6 (0.3)	3.4 (0.4)	3.8 (0.3)
7	Chicken patties/nuggets/etc.[§§]	3.3 (0.6)	4.0 (0.6)	3.2 (0.8)	3.0 (0.9)	2.9 (0.5)	3.9 (0.9)	2.6 (0.3)	4.4 (0.6)	3.6 (1.0)
8	Pasta mixed dishes[¶¶]	3.1 (0.4)	3.1 (0.4)	3.5 (1.3)	2.9 (0.5)	2.5 (0.4)	3.9 (0.7)	2.6 (0.4)	3.6 (0.9)	2.8 (0.3)
9	Mexican mixed dishes***	3.0 (0.4)	2.1 (0.5)	2.5 (0.6)	3.8 (0.9)	3.2 (0.6)	2.7 (0.5)	4.8 (0.7)	2.4 (0.8)	2.6 (0.6)
10	Soups	2.9 (0.2)	4.1 (0.5)	2.2 (0.6)	2.4 (0.4)	3.0 (0.4)	2.9 (0.3)	5.0 (0.5)	2.9 (0.4)	1.9 (0.3)
Mean daily sodium consumed										
As measured in mg		**3,279**	**2,903**	**3,194**	**3,672[†††]**	**3,626**	**2,943[†††]**	**3,125**	**3,202**	**3,278**
(SE)		**(84)**	**(46)**	**(103)**	**(157)**	**(112)**	**(74)**	**(61)**	**(115)**	**(111)**
Mean daily energy consumed										
As measured in kcal		**2,017**	**1,845**	**1,983**	**2,195[†††]**	**2,220**	**1,821[†††]**	**1,963**	**2,027**	**2,023**
(SE)		**(36)**	**(20)**	**(51)**	**(64)**	**(55)**	**(30)**	**(24)**	**(71)**	**(47)**
Mean daily sodium density										
As measured in mg/1,000 kcal		**1,638**	**1,586**	**1,646**	**1,681[§§§]**	**1,637**	**1,639**	**1,611**	**1,586**	**1,636**
(SE)		**(15)**	**(11)**	**(25)**	**(29)**	**(14)**	**(21)**	**(20)**	**(24)**	**(21)**
Unweighted no. of participants in sample		**2,266[¶¶¶]**	**943**	**509**	**814**	**1,170**	**1,096**	**901**	**461**	**748**

Abbreviation: SE = standard error.

* The proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food category for all participants divided by the sum of sodium consumed from all food categories for all participants multiplied by 100. All estimates use 24-hour dietary recall, take into account the complex sampling design, and use dietary day 1 sample weights to account for nonresponse and weekend/weekday recalls.

† Rank based on population proportions of sodium consumed for the overall U.S. population aged 6–18 years. Columns for other groups are ordered by this ranking.

§ Additional information regarding food categorization is available at the *What We Eat in America* website, http://www.ars.usda.gov/services/docs.htm?docid=18349. Food categories contributing ≥3% to overall sodium consumption within specific sociodemographic groups but not listed among the top 10 contributors were as follows: Children aged 6–10 years, milk (unflavored), whole, reduced, low, and no-fat (3.4%) and frankfurters and sausages (3.3%); children aged 11–13 years, pancakes, waffles, and French toast (3.1%), chicken, whole pieces, and other poultry (3.0%); children aged 14–18 years, chicken whole pieces and other poultry (3.0%); Hispanic children, chicken whole pieces and other poultry (3.6%), tortillas (3.4%); non-Hispanic black children (chicken whole pieces and other poultry (5.2%), frankfurters and sausages (3.4%), tomato-based condiments (3.3 %); non-Hispanic white children, milk (unflavored), whole, reduced, low, and no-fat (3.2%).

¶ Excludes bagels and English muffins.

** Tortilla, corn, and other chips/pretzels/snack mix/potato chips/popcorn.

†† Sandwiches as identified by a single *What We Eat in America* food code, chicken or turkey sandwiches/burgers/egg/breakfast sandwiches/other sandwiches (e.g., corn dog).

§§ Includes chicken tenders. Excludes chicken whole pieces and turkey, duck, and other poultry.

¶¶ e.g., spaghetti with meat sauce or meat balls (excludes macaroni and cheese).

*** Burritos and tacos/nachos/other Mexican mixed dishes.

††† Statistically significant differences in mean sodium intake across subgroups, determined by the Wald F test (p<0.001).

§§§ Statistically significant differences in mean sodium intake per 1,000 kcal across subgroups, determined by the Wald F test (p=0.01).

¶¶¶ Includes other race/ethnicities not shown separately.

TABLE 2. Ranked proportions of sodium consumed by children aged 6–18 years,* by selected food categories, household income status, and weight status — National Health and Nutrition Examination Survey, United States, 2009–2010

		Household income relative to federal poverty level			Weight status†	
		≤130%	>130%–185%	>185%	Normal	Overweight/ Obese
Rank§	Food category¶	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)
1	Pizza	8.5 (1.3)	9.4 (2.3)	8.5 (1.4)	8.5 (1.2)	8.1 (1.0)
2	Yeast breads/rolls/buns**	5.6 (0.5)	5.5 (0.4)	6.0 (0.5)	6.0 (0.4)	5.4 (0.3)
3	Cold cuts/cured meats	4.6 (0.6)	2.4 (0.7)	5.5 (0.7)	5.3 (0.7)	3.9 (0.4)
4	Savory snacks††	3.9 (0.3)	5.7 (0.6)	3.8 (0.3)	4.2 (0.4)	4.5 (0.3)
5	Sandwiches (single code)§§	4.6 (0.7)	5.1 (1.1)	3.8 (0.4)	3.3 (0.4)	5.4 (0.8)
6	Cheese	3.9 (0.4)	3.2 (0.5)	3.6 (0.3)	3.7 (0.3)	3.4 (0.3)
7	Chicken patties/nuggets/tenders¶¶	3.5 (0.6)	3.7 (0.8)	3.5 (0.8)	3.3 (0.9)	3.8 (0.5)
8	Pasta mixed dishes***	3.2 (0.7)	2.7 (0.6)	3.2 (0.6)	3.3 (0.7)	2.9 (0.4)
9	Mexican mixed dishes†††	2.9 (0.8)	3.7 (1.1)	2.9 (0.7)	3.3 (0.5)	2.2 (0.3)
10	Soups	3.2 (0.3)	3.9 (1.0)	2.4 (0.3)	2.6 (0.4)	3.4 (0.6)
Mean daily sodium consumed						
	As measured in mg	**3,316§§§**	**2,879**	**3,320**	**3,280**	**3,270**
	(SE)	**(75)**	**(117)**	**(136)**	**(100)**	**(107)**
Mean daily energy consumed						
	As measured in kcal	**2,007**	**1,881**	**2030**	**2,030**	**1,992**
	(SE)	**(38)**	**(82)**	**(57)**	**(45)**	**(49)**
Mean daily sodium density						
	As measured in mg/1,000 kcal	**1,667**	**1,562**	**1,645**	**1,629**	**1,654**
	(SE)	**(17)**	**(41)**	**(21)**	**(17)**	**(27)**
Unweighted no. of participants in sample		**931**	**285**	**859**	**1352**	**834**

Abbreviation: SE = standard error.

* The proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food category for all participants divided by the sum of sodium consumed from all food categories for all participants multiplied by 100. All estimates use 24-hour dietary recall, take into account the complex sampling design, and use dietary day 1 sample weights to account for nonresponse and weekend/weekday recalls.

† Normal was defined as a body mass index (BMI) for age and sex between the 5th and 85th percentiles. Overweight/obese was defined as a BMI for age and sex ≥85th percentile, based on specific reference values from the 2000 CDC growth charts.

§ Rank based on proportions of sodium consumed for the overall U.S. population aged 6–18 years. Columns for other groups are ordered by this ranking.

¶ Additional information regarding food categorization is available at the *What We Eat in America* website, http://www.ars.usda.gov/services/docs.htm?docid=18349. Food categories contributing ≥3% to overall sodium consumption within specific sociodemographic and weight status groups but not listed among the top 10 contributors overall were as follows: children with family income ≤130% of the federal poverty level, tomato-based condiments (3.5%), chicken whole pieces and other poultry (3.5%); family income >130%-185% of the poverty level, frankfurters and sausages (3.0%), dips, gravies, and other sauces (3.0%); overweight/obese children, tomato-based condiments (3.5%), chicken whole pieces and other poultry (3.1%).

** Yeast breads/rolls and buns, excludes bagels and English muffins.

†† Tortilla, corn, and other chips/pretzels/snack mix/potato chips/popcorn.

§§ Sandwiches as identified by a single *What We Eat in America* code, chicken or turkey sandwiches/burgers/egg/breakfast sandwiches/other sandwiches (e.g., corn dog).

¶¶ Excludes chicken whole pieces and turkey, duck, and other poultry.

*** e.g., spaghetti with meat sauce or meat balls (excludes macaroni and cheese).

††† Burritos and tacos/nachos/other Mexican mixed dishes.

§§§ Statistically significant differences in mean sodium intake across subgroups, determined by the Wald F test, p=0.01.

TABLE 3. Ranked proportions of sodium consumed by children aged 6–18 years* and mean sodium, energy, and sodium density intake,† by place obtained§ and age group among all participants and among those who consumed a school lunch or breakfast on any given day¶ — National Health and Nutrition Examination Survey, United States, 2009–2010

	Place obtained									
	Store		Restaurant with fast food/Pizza		Restaurant with waitstaff		Cafeteria at school		Other	
Participants/Age groups (yrs)	Value	(SE)	Value	(SE)	Value	(SE)	Value	(SE)	Value	(SE)
All participants										
6–18 (Overall, N = 2,266)										
Proportion of sodium %	65.1	(1.4)	13.0	(0.7)	4.9	(0.6)	9.1	(1.3)	7.8	(0.6)
Mean sodium in mg	2,135	(52)	426	(26)	162	(22)	299	(47)	257	(17)
Mean energy in kcal	1,346	(24)	231	(12)	92	(12)	179	(24)	169	(11)
Mean sodium density, mg/1,000 kcal	1,558	(18)	1,843	(52)	1,818	(45)	1,636	(50)	1,364	(56)
6–10 (n = 943)										
Proportion of sodium %	64.3	(2.1)	10.9	(1.1)	5.4	(1.1)	11.7	(1.4)**	7.6	(1.1)
Mean sodium in mg	1,868	(68)	318	(35)	157	(32)	340	(39)	221	(31)
Mean energy in kcal	1,206	(37)	171	(18)	86	(17)	217	(23)	165	(20)
Mean sodium density, mg/1,000 kcal	1,531	(21)	1,863	(67)	1,915	(81)	1,528	(42)	1,134	(43)***
11–13 (n = 509)										
Proportion of sodium %	67.6	(1.8)	10.8	(1.0)	3.8	(0.9)	8.9	(1.6)	9.0	(1.0)
Mean sodium in mg	2,160	(72)	345	(36)	120	(32)	283	(53)	286	(29)
Mean energy in kcal	1,354	(36)	197	(19)	76	(24)	172	(28)	185	(19)
Mean sodium density, mg/1,000 kcal	1,592	(16)††	1,873	(147)	1,618	(157)	1,617	(95)	1,691	(218)
14–18 (n = 814)										
Proportion of sodium %	64.5	(2.1)	15.5	(1.4)§§	5.2	(0.6)	7.4	(1.8)	7.5	(1.2)
Mean sodium in mg	2,367	(110)	569	(58)	190	(24)	271	(72)	274	(42)
Mean energy in kcal	1,471	(44)	305	(25)	107	(14)	147	(36)	165	(20)
Mean sodium density, mg/1,000 kcal	1,564	(46)	1,817	(76)	1,802	(78)	1,828	(63)¶¶	1,396	(98)
Participants who consumed a school meal on their 24-hour dietary recall day										
6–18 (n = 568)										
Proportion of sodium %	56.8	(2.2)	8.9	(1.1)	3.0	(0.7)	26.0	(2.2)	5.3	(1.4)
Mean sodium in mg	1,902	(109)	297	(39)	102	(26)	871	(89)	177	(48)
Mean energy in kcal	1,223	(48)	164	(20)	56	(12)	507	(47)	102	(22)
Mean sodium density, mg/1,000 kcal	1,589	(57)	1,800	(94)	1,945	(162)	1,705	(38)	1,619	(241)
6–10 (n = 228)										
Proportion of sodium %	55.3	(3.7)	6.4	(1.0)	—†††	—	29.0	(2.0)	4.4	(0.8)
Mean sodium in mg	1,702	(115)	196	(31)	—	—	892	(62)	136	(23)
Mean energy in kcal	1,059	(64)	111	(19)	—	—	542	(40)	87	(18)
Mean sodium density, mg/1,000 kcal	1,588	(69)	1,883	(110)	—	—	1,636	(51)	1,472	(156)
11–13 (n = 157)										
Proportion of sodium %	57.6	(2.2)	8.4	(2.1)	—	—	26.9	(2.4)	—	—
Mean sodium in mg	1,790	(113)	260	(70)	—	—	838	(70)	—	—
Mean energy in kcal	1,195	(66)	137	(34)	—	—	514	(38)	—	—
Mean sodium density, mg/1,000 kcal	1,516	(59)	1,901	(107)	—	—	1,632	(73)	—	—
14–18 (n = 183)										
Proportion of sodium %	57.6	(4.4)	11.1	(2.1)	2.2	(0.5)	23.2	(4.1)	—	—
Mean sodium in mg	2,161	(234)	416	(87)	84	(21)	870	(195)	—	—
Mean energy in kcal	1,396	(118)	231	(44)	41	(12)	470	(97)	—	—
Mean sodium density, mg/1,000 kcal	1,635	(131)	1,688	(155)	2,161	(156)§§§	1,854	(53)¶¶	—	—

Abbreviation: SE = standard error.

* The proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food category for all participants divided by the sum of sodium consumed from all food categories for all participants multiplied by 100. All estimates use 24-hour dietary recall, take into account the complex sampling design, and use dietary day 1 sample weights to account for nonresponse and weekend/weekday recalls.

† A measure that accounts for differences in the amount of calories consumed from foods obtained from each source, defined as mg of sodium/1,000 kcal.

§ Place obtained was analyzed from responses to the question, "Where did you get this (most of the ingredients for this) [food name]?" Sources other than those shown were combined under "other" and included "from someone else/gift" (4.9% population proportion), and 19 other sources (e.g., vending machine), including "missing," "do not know," and "other/specify" (<1%).

¶ Analyzed separately were the responses of 568 children (with a weekday dietary recall) who met the following criteria: "now attending school" and "usually get a complete school lunch" or a "school breakfast" five times a week.

** Differences in population proportions compared with children aged 11–13 years and 14–18 years, T-tests, p<0.05.

†† Statistically significant difference in sodium density compared with children aged 6-10 years, by t-tests, p=0.02.

§§ Statistically significant difference in population proportions compared with children aged 6–10 years and 11–13 years, by t-tests, p<0.05.

¶¶ Statistically significant difference in mean sodium consumed per 1,000 kcal compared with children aged 6–10 years and 11–13 years, by t-tests, p<0.05.

*** Statistically significant difference in mean sodium consumed per 1,000 kcal compared with children aged 11–13 years and 14–18 years, by t-tests, p<0.05.

††† Estimates not reported, data are statistically unreliable, relative standard error ≥30%.

§§§ Statistically significant difference in mean sodium consumed per 1,000 kcal compared with children aged 11–13 years, by t-tests, p<0.05.

TABLE 4. Proportion* of sodium consumed from each eating occasion† and place obtained§ among children aged 6–18 years and by age group — National Health and Nutrition Examination Survey, United States, 2009–2010

		Eating occasion							
		Breakfast		Lunch		Dinner		Snack	
Age group (yrs)	Place obtained	%	(SE)	%	(SE)	%	(SE)	%	(SE)
6–18 (N = 2,266)									
	All	14.9	(0.6)	29.5	(1.0)	39.2	(1.1)	16.4	(0.6)
	Store	11.3	(0.4)	14.9	(1.0)	26.0	(1.1)	12.9	(0.5)
	Restaurants with fast food/Pizza	—¶		4.2	(0.5)	6.6	(0.5)	1.2	(0.2)
	Restaurant with waitstaff	—		1.3	(0.3)	3.0	(0.3)	—	
	School cafeteria	1.4	(0.3)	7.2	(1.3)	—		—	
	Other	—		1.9	(0.2)	3.4	(0.3)	1.9	(0.2)
6–10 (n = 943)									
	All	17.1	(0.6)	28.8	(0.8)	38.2	(1.4)	15.9	(0.6)
	Store	12.9	(0.6)	13.4	(1.2)	26.0	(1.4)	12.0	(0.6)
	Restaurants with fast food/Pizza	—		3.1	(0.5)	6.0	(0.5)	1.0	(0.3)
	Restaurant with waitstaff	—		2.0	(0.6)	3.0	(0.6)	—	
	School cafeteria	2.1	(0.3)	9.0	(1.2)	—		—	
	Other	—		1.3	(0.3)	3.0	(0.8)	2.4	(0.4)
11–13 (n = 509)									
	All food	15.8	(0.6)	26.4	(2.0)	40.3	(2.0)	17.5	(1.6)
	Store	12.4	(0.8)	13.8	(1.4)	27.1	(2.4)	14.3	(1.4)
	Restaurants with fast food/Pizza	—		2.3	(0.5)	6.9	(1.0)	—	
	Restaurant with waitstaff	—		—		2.0	(0.5)	—	
	School cafeteria	1.1	(0.4)	7.0	(1.5)	—		—	
	Other	—		2.3	(0.4)	4.2	(0.7)	1.8	(0.4)
14–18 (n = 814)									
	All	12.8	(1.1)**	31.5	(1.2)††	39.5	(1.5)	16.2	(1.1)
	Store	9.5	(1.0)	16.6	(1.2)	25.4	(1.5)	12.9	(0.9)
	Restaurants with fast food/Pizza	1.0	(0.3)	5.9	(0.8)	6.9	(0.9)	1.6	(0.3)
	Restaurant with waitstaff	—		1.0	(0.3)	3.5	(0.4)	—	
	School cafeteria	1.0	(0.3)	5.9	(1.8)	—		—	
	Other	—		2.1	(0.5)	3.3	(0.9)	1.5	(0.2)

* The proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food category for all participants divided by the sum of sodium consumed from all food categories for all participants multiplied by 100. All estimates use 24-hour dietary recall, take into account the complex sampling design, and use dietary day 1 sample weights to account for nonresponse and weekend/weekday recalls.
† Eating occasions were defined by the participant. Responses were categorized as follows: breakfast was defined as "breakfast," "desayuno," or "almuerzo"; lunch was defined as "brunch," "lunch," or "comida"; dinner was defined as "dinner," "supper," or "cena"; and snack as "snack," "drink," "extended consumption (items that were consumed over a long period of time)," "merienda," "entre comidas," "botana," "bocadillo," "tentempie," or "bebida."
§ Place obtained was analyzed from responses to the question, "Where did you get this (most of the ingredients for this) [food name]?" Sources other than those shown were combined under "other." The most common "Other" source listed was "from someone else/gift" (4.9%). Other sources each contributed <2% of sodium intake, including "missing," "do not know," and "other/specify" (<1%).
¶ Estimate not reported, either <1% or statistically unreliable, relative standard error ≥30%.
** Statistically significant difference in population proportion compared with children aged 6–10 years and children aged 11–13 years, by t-tests, p<0.05.
†† Statistically significant difference in population proportion compared with children aged 11–13 years, by t-tests, p<0.001.

Conclusions and Comments

U.S. school-aged children, on average, consume sodium in excess of recommended levels regardless of age, sex, race-ethnicity, income or weight status. The top 10 food categories contributed >40% of total sodium intake and, in general, varied little among population subgroups. Although foods from grocery stores contribute the majority of sodium intake, fast-food/pizza restaurant foods have the highest sodium density (*11*). Among high school–aged compared with younger children, school cafeteria foods also contribute high sodium density. Results support the need for sodium reduction across multiple foods, venues, and eating occasions.

These are the most current analyses regarding contributors to population sodium consumption among U.S. school-aged children. As in 2007–2008 analyses (*11*), results indicate mean sodium intake is higher among older age groups and reaching adult levels among adolescents aged 14–18 years. Although this difference appears related to greater energy requirements and intake, high school–aged children also consumed more sodium per calorie versus younger age groups, suggesting the greater sodium intake among this age group was related to both higher sodium content and the amount of foods consumed. The higher the sodium density, the less effective caloric reduction could be as a single strategy to reduce sodium intake. As several commonly consumed foods (e.g., pizza and yeast breads/rolls/buns) are leading contributors to children's intake of both sodium and energy, strategies to reduce consumption of sodium-dense foods and/or replace them with lower sodium versions of these foods or potassium rich foods (e.g., fruits and vegetables) might advance efforts to prevent higher blood pressure and leverage ongoing efforts to prevent and reduce childhood obesity.

Children who qualified for reduced price school meals had the lowest average sodium intake, but sodium density and types of food contributing to sodium intake did not differ significantly. Given that sodium and energy intake are highly correlated, this finding is likely related to energy intake.

Among children who consume school meals, mean energy intakes from foods obtained from the cafeteria (470–542 kcal) were consistent with 2004–2005 School Nutrition and Dietary Assessment data (517–546 kcal) (*12*). Among high school–aged children, the high sodium density from foods from school cafeterias might be related to greater availability of competitive foods (e.g., a la carte options) sold in schools separately from the National School Lunch Program or School Breakfast Programs. Among younger children, the slightly greater contribution (higher proportion) of school cafeteria foods to overall sodium intake might be related to higher participation rates among elementary school versus older children in school meal programs.****

The findings in this report are subject to at least seven limitations. First, institutionalized populations were excluded, and results might be influenced by nonresponse bias unaccounted for by the sample weights. Second, the food code used in WWEIA to estimate the nutrient content of a specific food (e.g., pizza) was the same across venues (e.g., schools and stores), but the foods served in these settings might vary in sodium content. Third, ranking is greatly influenced by categorization method (e.g. sandwiches do not include those coded as separate components, such as bread).†††† Fourth, dietary recall data are subject to reporting error. Fifth, comparisons do not control for differences in other characteristics across groups. Sixth, the 568 children who consumed school meals might not represent all children participating in the National School Lunch Program or School Breakfast Program. Children who skipped meals and/or did not consume a complete school lunch or breakfast are included in the analyses (*13*). Questions about foods obtained from school cafeterias do not specify whether the food was obtained from the National School Lunch Program or School Breakfast Program or other foods sold in the cafeteria. Finally, statistical power was limited in the ability to examine results from smaller subgroups.

Commonly consumed foods, such as pizza, bread, cold cuts, savory snacks, and sandwiches contributed to excess sodium intake among school-aged children. These findings are consistent across population subgroups, reinforcing the IOM recommendations to set phased targets to reduce the sodium content of U.S. commercially processed foods (*10*) to achieve national health objectives. In the United Kingdom, use of this strategy for commercially processed packaged foods was associated with a 15% decrease in mean sodium intake over 7 years (*14*). IOM recommends also setting targets for commercially processed restaurant foods to further reduce sodium intake (*10*). Complementing this strategy, national nutrition standards for school breakfasts and lunches and almost all foods sold in U.S. schools set phased targets for sodium content starting with the 2014–2015 school year, and evidence suggests that reducing the sodium content of these foods is achievable (*15*). These phased targets are estimated to result in a 25%–50% sodium reduction in school meals by 2022. Considering sodium from school cafeteria foods contributes about 300 mg daily to overall sodium intake among U.S. school aged children, and about 870 mg daily on days children consume school meals, this measure could reduce sodium intake by 75–150 mg per day overall, and about 220–440 mg on days school meals are consumed, if there is no replacement from other sources.

Meta-analyses of studies of diverse groups of children have found that lowering sodium intake reduces average blood pressure; a 42% sodium reduction in children reduces average blood pressure by 0.6–1.8 (systolic)/0.7–1.9 (diastolic) mm Hg (*7,8*). A 2 mm Hg reduction, if maintained into adulthood, could translate into a large reduction in heart attacks and strokes and subsequent mortality (*2,16*). Given the relationship between sodium reduction and high blood pressure, sodium reduction is an important part of the strategy to help prevent 1 million heart attacks and strokes by 2017.§§§§

**** Additional information available at http://www.fns.usda.gov/sites/default/files/snda-iv_findings_0.pdf.

†††† Additional information available at http://www.cdc.gov/nchs/nhanes/nhanes2009-2010/dr1iff_f.htm.

§§§§ Additional information available at http://millionhearts.hhs.gov/index.html.

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Severe Respiratory Illness Associated with Enterovirus D68 — Missouri and Illinois, 2014

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On September 8, 2014, this report was posted as an MMWR *Early Release on the* MMWR *website (http://www.cdc.gov/mmwr).*

On August 19, 2014, CDC was notified by Children's Mercy Hospital in Kansas City, Missouri, of an increase (relative to the same period in previous years) in patients examined and hospitalized with severe respiratory illness, including some admitted to the pediatric intensive care unit. An increase also was noted in detections of rhinovirus/enterovirus by a multiplex polymerase chain reaction assay in nasopharyngeal specimens obtained during August 5–19. On August 23, CDC was notified by the University of Chicago Medicine Comer Children's Hospital in Illinois of an increase in patients similar to those seen in Kansas City. To further characterize these two geographically distinct observations, nasopharyngeal specimens from most of the patients with recent onset of severe symptoms from both facilities were sequenced by the CDC Picornavirus Laboratory. Enterovirus D68* (EV-D68) was identified in 19 of 22 specimens from Kansas City and in 11 of 14 specimens from Chicago. Since these initial reports, admissions for severe respiratory illness have continued at both facilities at rates higher than expected for this time of year. Investigations into suspected clusters in other jurisdictions are ongoing.

Of the 19 patients from Kansas City in whom EV-D68 was confirmed, 10 (53%) were male, and ages ranged from 6 weeks to 16 years (median = 4 years). Thirteen patients (68%) had a previous history of asthma or wheezing, and six patients (32%) had no underlying respiratory illness. All patients had difficulty breathing and hypoxemia, and four (21%) also had wheezing. Notably, only five patients (26%) were febrile. All patients were admitted to the pediatric intensive care unit, and four required bilevel positive airway pressure ventilation. Chest radiographs showed perihilar infiltrates, often with atelectasis. Neither chest radiographs nor blood cultures were consistent with bacterial coinfection.

Of the 11 patients from Chicago in whom EV-D68 was confirmed, nine patients were female, and ages ranged from 20 months to 15 years (median = 5 years). Eight patients (73%) had a previous history of asthma or wheezing. Notably, only two patients (18%) were febrile. Ten patients were admitted to the pediatric intensive care unit for respiratory distress; two required mechanical ventilation (one of whom also received extracorporeal membrane oxygenation), and two required bilevel positive airway pressure ventilation.

Enteroviruses are associated with various clinical symptoms, including mild respiratory illness, febrile rash illness, and neurologic illness, such as aseptic meningitis and encephalitis. EV-D68, however, primarily causes respiratory illness (*1*), although the full spectrum of disease remains unclear. EV-D68 is identified using molecular techniques at a limited number of laboratories in the United States. Enterovirus infections, including EV-D68, are not reportable, but laboratory detections of enterovirus and parechovirus types are reported voluntarily to the National Enterovirus Surveillance System, which is managed by CDC. Participating laboratories are encouraged to report monthly summaries of virus type, specimen type, and collection date.

Since the original isolation of EV-D68 in California in 1962 (*2*), EV-D68 has been reported rarely in the United States; the National Enterovirus Surveillance System received 79 EV-D68 reports during 2009–2013. Small clusters of EV-D68 associated with respiratory illness were reported in the United States during 2009–2010 (*3*).

There are no available vaccines or specific treatments for EV-D68, and clinical care is supportive. Health care providers should consider EV-D68 as a possible cause of acute, unexplained severe respiratory illness; suspected clusters or outbreaks should be reported to local or state health departments. CDC's Picornavirus Laboratory (e-mail: wnix@cdc.gov) is available for assistance with diagnostic testing.

* Enterovirus and rhinovirus species names recently were revised to remove host names and to append the type number to the species designation; hence, human enterovirus 68 (HEV-68, also previously called EV68) is now EV-D68.

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Notes from the Field

Measles in a Micronesian Community — King County, Washington, 2014

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Measles is a highly contagious viral disease that can lead to complications and death. The United States achieved measles elimination (interruption of continuous transmission lasting ≥12 months) in 2000. Despite elimination, 592 measles cases were reported in the United States during January 1−August 22, 2014, the highest number since 1994 (*1*), primarily among unvaccinated travelers and their unvaccinated contacts. Measles remains endemic outside the Western Hemisphere, with outbreaks affecting communities in the Philippines, Vietnam, and China (*1,2*). An ongoing measles outbreak with approximately 350 measles cases and one death in the Federated States of Micronesia during January–July 2014 also has been reported (*3*).

On May 30, 2014, a child in King County, Washington, aged 4 years and unvaccinated against measles, developed a measles rash 4 days after returning home from 2 weeks in the Federated States of Micronesia. During the following 5 weeks, 14 additional measles cases (nine laboratory-confirmed B3 wild-type and five epidemiologically linked) were reported in King and Pierce counties. Patients were aged 5 months−48 years (median = 3 years). Two patients were too young to have been vaccinated against measles according to U.S. recommendations, nine were aged >12 months and unvaccinated against measles, three had received 1 dose of measles-containing vaccine, and one had received 2 doses. Twelve cases occurred in the local Micronesian community, in which many children and adults have no documentation of measles vaccination; during two community vaccination clinics early in the outbreak, 71% of the 267 community members who came to the clinic had no electronic or written vaccination record nor knowledge of previous measles vaccination. Large, loosely defined family structures pose challenges for case and contact investigations. Additional exposures occurred in medical facilities and workplaces; six patients visited more than one acute care facility for treatment while they were infectious.

Local public health officials conducted extensive community outreach (in collaboration with a Micronesian community liaison), contact tracing, and community-based vaccination clinics. Measles outbreaks are ongoing in the Federated States of Micronesia. The risk for acquiring measles during travel to the area is elevated, especially among unvaccinated persons.

This outbreak demonstrates the ease with which measles can be imported from a country with an ongoing outbreak and spread among a local population. These events also highlight the need for directed community outreach regarding the importance of routine vaccinations, including vaccination before travel. Health care providers should be vigilant for measles among persons with febrile rash illness returning from countries with ongoing measles transmission.

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Announcement

National Child Passenger Safety Week — September 14–20, 2014

In the United States, motor vehicle crashes are a leading cause of death among children (*1*). In 2012, a total of 1,168 passenger vehicle occupants aged 0–14 years died as a result of a motor vehicle traffic crash (*2*). During 1975–2012, child restraints saved an estimated 10,157 lives of children aged 0–4 years (*2*). Seating position also contributes to child passenger safety. To keep child passengers as safe as possible, drivers should properly restrain children aged <13 years in a back seat and follow the American Academy of Pediatrics' child passenger safety recommendations, which include properly restraining children in age- and size-appropriate restraints as follows: rear-facing child safety seats up to age 2 years; forward-facing child safety seats up to at least age 5 years; booster seats through at least age 8 years and until seat belts fit properly; and adult seat belts, still in the back seat, until age 13 years. Passengers aged ≥13 years should use adult seat belts on every trip (*3*). Additional information on child passenger safety is available at http://www.cdc.gov/vitalsigns/childpassengersafety/index.html.

For 2014, National Child Passenger Safety Week is September 14–20. As part of the campaign, September 20 is designated as National Seat Check Saturday, when drivers with child passengers are encouraged to visit a child safety seat inspection station to have a certified technician inspect their car seat and give hands-on advice free of charge. Additional information and an inspection station locator are available from the National Highway Traffic Safety Administration at http://www.safercar.gov/cpsApp/cps/index.htm. Promotional materials (in English and Spanish) are available at http://www.trafficsafetymarketing.gov/cps.

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Erratum

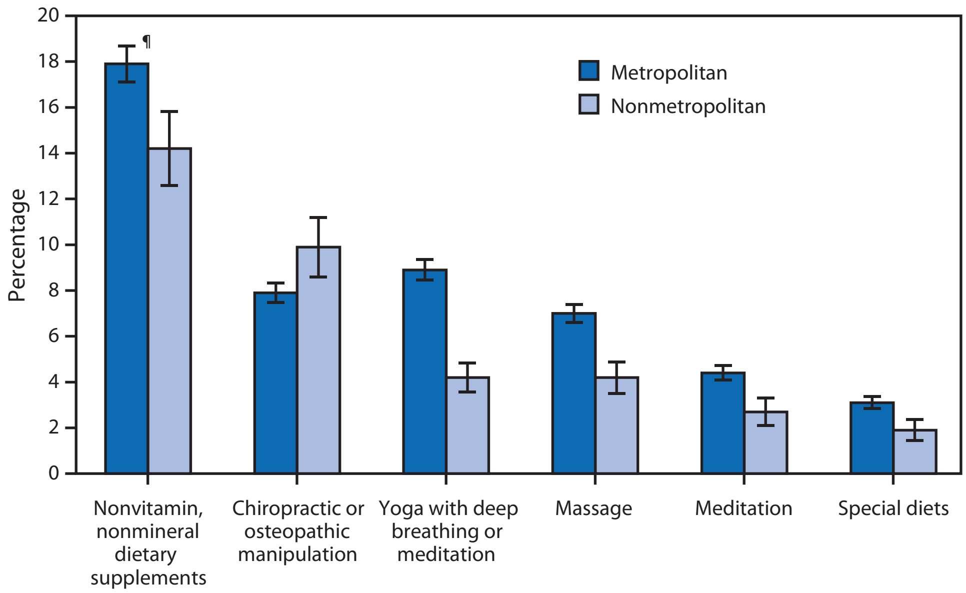
Vol. 63, No. 35

In the report, "Notes from the Field: Reports of Expired Live Attenuated Influenza Vaccine Being Administered—United States, 2007–2014," the third sentence of the first paragraph should read, "Influenza vaccine **typically** becomes widely available beginning in late summer or early fall."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Adults Who Used Selected Complementary Health Approaches* in the Preceding 12 Months, by Metropolitan Status of Residence† — National Health Interview Survey,§ United States, 2012



* Based on the six most commonly used complementary health approaches among U.S. adults in 2012.

† Based on the household residence location. Metropolitan is located within a metropolitan statistical area, defined as a county or group of contiguous counties that contains at least one urbanized area of ≥50,000 population. Surrounding counties with strong economic ties to the urbanized area also are included. Nonmetropolitan areas do not include a large urbanized area and are generally thought of as more rural.

§ Estimates are based on household interviews of a sample of the civilian noninstitutionalized U.S. population.

¶ 95% confidence interval.

During 2012, the percentages of U.S. adults aged ≥18 years who used nonvitamin, nonmineral dietary supplements, yoga, massage, meditation, and special diets were higher in metropolitan areas than in nonmetropolitan areas. A greater proportion of adults in nonmetropolitan areas used chiropractic or osteopathic manipulation (9.9%) compared with those in metropolitan areas (7.9%). In both metropolitan and nonmetropolitan areas, dietary supplements had the highest percentage of use (17.9% in metropolitan; 14.2% in nonmetropolitan), and special diets had the lowest percentage of use (3.1% in metropolitan; 1.9% in nonmetropolitan).

Source: National Health Interview Survey, 2012. Available at http://www.cdc.gov/nchs/nhis.htm.

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