

Histoplasmosis Associated with a Bamboo Bonfire — Arkansas, October 2011

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On October 27, 2011, the Arkansas Department of Health (ADH) was notified by a northeast Arkansas primary care provider of a cluster of three histoplasmosis cases. On November 4, ADH was notified by a pediatric infectious diseases specialist regarding seven potential cases of pulmonary histoplasmosis associated with a family gathering that included a bonfire that burned bamboo from a grove that had been a red-winged blackbird roost. These reports prompted an outbreak investigation to ensure that the persons involved received appropriate medical care, to identify whether any novel exposures were associated with illness, and to determine whether any factors were associated with hospitalization. The investigation found that, among the 19 attendees at the family gathering, seven were confirmed with histoplasmosis, 11 were probable, and one did not have histoplasmosis.

Index Cases

Investigators found that two siblings, a boy aged 8 years and a girl aged 5 years had become ill on October 16, reporting vague abdominal pain and a dry cough. One day later, both children developed fever and nonbloody emesis, prompting their parents to seek care for them. The children were determined to be rapid streptococcal antigen–positive and were prescribed amoxicillin for 10 days. During the next 6 days, their coughs worsened and became productive of white sputum. Both continued to be febrile with temperatures $\geq 104^{\circ}\text{F}$ ($\geq 40.0^{\circ}\text{C}$).

On October 22, the children returned to their primary care provider. Each had a chest radiograph (CXR) demonstrating bilateral diffuse infiltrative disease. Both were diagnosed with pneumonia, admitted to a local hospital, and placed on intravenous azithromycin and ceftriaxone. On October 24, both children were transferred to Arkansas Children's Hospital for further care.

At the hospital, the two children had increasing oxygen requirements and sustained high fevers. Repeat CXRs

demonstrated micronodular density patterns bilaterally and mediastinal lymphadenopathy. Additional history revealed that the children had attended a family gathering 8 days before symptom onset. Participants cut bamboo, made a fort, and burned wood in a small grove that had served as a red-winged blackbird roost. Other attendees were reported to be ill with similar symptoms.

Serum specimens for *Histoplasma capsulatum* yeast and mycelial antibody tests were obtained, and the children were empirically started on itraconazole 5 mg/kg/dose twice daily. Both children improved dramatically with antifungal therapy and defervesced within 48 hours. Both had positive *Histoplasma* yeast and mycelial antibodies and positive serum antigen results. The siblings completed a 3-month course of itraconazole for acute diffuse pulmonary histoplasmosis. Repeat CXRs demonstrated resolution of acute lung findings.

Epidemiologic Investigation

A retrospective cohort study was performed to determine the extent of the outbreak and risk factors for illness. Cases

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were sought by asking attendees at the gathering to recall the names of all other attendees. All attendees were interviewed with a standard questionnaire and were offered free serologic testing for *Histoplasma*.

The local county health officer contacted all local primary care providers to assist in case finding. Because histoplasmosis is reportable in Arkansas, case identification also was attempted by reviewing all *Histoplasma*-related laboratory results reported to the ADH communicable disease surveillance system. All persons with suspected histoplasmosis identified in this manner in October and November were contacted to determine whether their illness was related to this outbreak. Clinical records were obtained for all persons who sought care.

The Council of State and Territorial Epidemiologists has not published standard case definitions for sporadic or outbreak-related acute respiratory histoplasmosis. In Arkansas, cases are considered to be confirmed if the patient has a measured fever $\geq 101^\circ\text{F}$ ($\geq 38.3^\circ\text{C}$), and either cough, chest pain, shortness of breath, or abnormal CXR, and at least one positive culture, antigen, or serologic test for *Histoplasma*. Cases are considered probable if the patient has symptoms consistent with histoplasmosis (self-reported fever and either cough, chest pain, or shortness of breath) and at least one positive culture, antigen, or serologic test for *Histoplasma*.

Because subclinical illness and illness for which no histoplasmosis tests were performed were observed in this outbreak, when a confirmed case was identified, the definition of a probable case was broadened to include any person exposed to the

site or event who also had clinical features of fever $\geq 101^\circ\text{F}$ ($\geq 38.3^\circ\text{C}$) and at least one of cough, chest pain, shortness of breath, or abnormal CXR within 3 weeks of exposure, even in the absence of laboratory testing for *Histoplasma*.

All attendees were asked to provide blood for analysis. If provided, serum was sent to ARUP Laboratories, a national reference laboratory in Salt Lake City, Utah, for assessment of quantitative titers for *Histoplasma* yeast and *Histoplasma* mycelial immunoglobulin G.

Investigators learned that 19 persons, aged 4–62 years, had attended the family gathering during October 7–8, 2011. Of those persons, 12 were male. The majority of attendees were children; eight were aged <10 years, and five were aged 10–19 years.

The setting was the backyard of a home in a residential area of a small town in northeastern Arkansas, with no construction or excavation projects nearby. The site was approximately one quarter acre in area, of which roughly 25% was wooded and 75% was covered by well-groomed zoysia grass. The wooded area included a tall canopy of white pine and sparse, bamboo grove understory contained within an area measuring approximately 15 feet by 15 feet (4.6 meters by 4.6 meters). The bamboo grove was described as a prominent red-winged blackbird (*Agelaius phoeniceus*) roost. Bat and bird droppings are a common source of histoplasmosis contamination (1). Local residents stated that during annual migrations there were so many birds as to “darken the sky.” No bats were reported.

The *MMWR* series of publications is published by the Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30333.

Suggested citation: [Author names; first three, then et al, if more than six.] [Report title]. *MMWR* 2014;63:[inclusive page numbers].

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Activities during the gathering on October 7 included clearing a small patch of bamboo and building a bamboo fort. On October 8, the family built a bamboo bonfire and used it to roast hot dogs. Leaf litter or ash was then raked and children were noted to be playing in the dirt.

The host family had moved to this location 1 month before the gathering. The family had not previously spent extended time in the backyard. Family members had never before cut or burned bamboo. No other attendees had direct exposure to this site previously. One adult was visiting Arkansas for the weekend from an area where histoplasmosis is not endemic.

Attendees were healthy; none reported an underlying pulmonary or immune-related disorder. Four attendees cited one underlying medical condition each: allergic rhinitis (two), attention deficit hyperactivity disorder, and insomnia.

Among attendees, all 19 participated in the bamboo bonfire and cookout, three cut bamboo, three built a small bamboo fort, one raked leaf litter, and eight raked or disturbed bamboo ash. All 19 attendees reported illness after the gathering; however, one attendee was excluded from the case definition because this person reported only a headache and cough. Among the 18 attendees who met the case definition, 16 could recall the date of their illness onset (Figure). Among the 18, the most common signs and symptoms included fever (83%), cough (67%), and shortness of breath (61%) (Table).

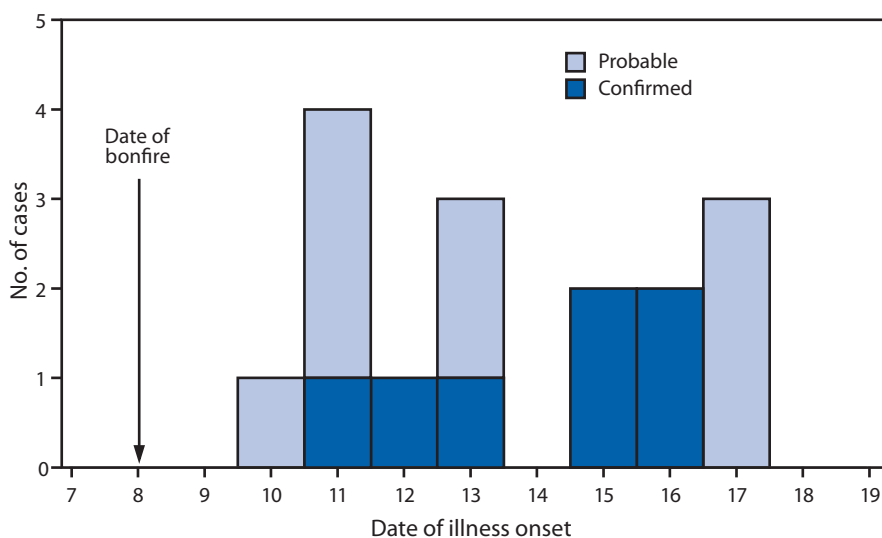
Test Results

CXR results were abnormal for 11 (79%) of the 14 attendees who had CXR performed. Among those 11 persons, *Histoplasma* yeast antibody results were positive for 10, and mycelial antibody results were positive for eight. For three of six attendees tested, serum antigen test results were positive, and urine antigen test results were positive for two of three attendees who had that test performed. No attendees had bone marrow biopsies, tissue biopsies, or tissue cultures performed.

Overall, results for seven persons met the definition of a confirmed case, 11 met the definition for probable cases, and one, having only cough and headache, did not meet either definition. Among the 18 attendees with probable or confirmed histoplasmosis, 16 sought care, including seven who were hospitalized and seven who were treated with itraconazole. The other two had self-limited disease. All recovered.

No statistically significant associations were found between hospitalization and either demographic characteristics or activities at the site. Younger attendees were more likely to be

FIGURE. Illness onset among 16 persons* with probable or confirmed histoplasmosis associated with a bamboo bonfire — Arkansas, October 2011



* Among 18 cases; two symptomatic attendees could not recall when their symptoms started.

TABLE. Characteristics of 18 persons who attended a bamboo bonfire and had signs and symptoms of suspected histoplasmosis — Arkansas, October 2011

Characteristic	No.	(%)
Sex		
Male	11	(61)
Female	7	(39)
Age group (yrs)		
<5	2	(11)
5–9	5	(28)
10–19	5	(28)
≥20	6	(33)
Signs and symptoms		
Fever (≥101°F [≥38.3°C])	15	(83)
Cough	12	(67)
Shortness of breath	11	(61)
Chest pain	9	(50)
Body aches	8	(44)
Vomiting	5	(28)

hospitalized, but this association was not statistically significant (chi-square test, $p=0.084$). Quantitative anti-*Histoplasma* antibody titers were not associated with either activities at the site or demographic characteristics.

Actions Taken

All attendees were provided information on histoplasmosis and were encouraged to contact their physician if ill. Primary care providers statewide and Arkansas county health officers were notified of the outbreak and were reminded to consider histoplasmosis in the differential diagnosis of patients presenting with compatible symptoms. All children were evaluated

What is already known on this topic?

The association of *Histoplasma capsulatum* with bird feces, bat guano, or disturbed ground has long been established.

What is added by this report?

This report describes efficient transmission of *H. capsulatum* in the setting of a bonfire of bamboo that was previously used as a blackbird roost. This bonfire was the only common exposure reported by all ill attendees.

What are the implications for public health practice?

Clinicians should be aware that exposure to a bonfire of bamboo in which birds have previously roosted might be a risk factor to consider when questioning patients with signs and symptoms of histoplasmosis.

by a pediatric infectious diseases specialist, either in person or via telephone.

In an effort to prevent recurrence of histoplasmosis, the owner had the home's heating and air mechanical systems professionally cleaned and also planned to cut down the bamboo grove to lessen roosting. On request, he was provided current CDC recommendations for the use of formaldehyde in environmental decontamination with histoplasmosis (1). However, decontamination was not recommended by ADH because it was judged in this instance to be impractical and marginally effective.

Editorial Note

Histoplasmosis is endemic in Arkansas and many states along the Ohio, Mississippi, and Missouri river valleys (2). This is the first outbreak of histoplasmosis associated with a bamboo bonfire reported in Arkansas. A previous report from Louisiana in 1980 linked histoplasmosis to the clearing of a field of bamboo measuring 40 feet by 70 feet that was heavily laden with blackbird feces (3). In that case, the trees were bulldozed

to the middle of the field and burned, and all six workers became ill. Because all attendees in both outbreaks reported illness, this raises the possibility that heating of *Histoplasma* spores in conjunction with fire-related air currents might create an ideal mode of transmission. Additional research on heating and desiccation on mold particle size and infectivity might be warranted.

The findings in this report are subject to at least two limitations. First, persons who were ill with histoplasmosis-compatible symptoms but did not have definitive testing were included as meeting the definition for probable cases in the context of this outbreak, which might overestimate the case count. Second, because of the small number of cases and lack of variability in exposures reported, data from the investigation were insufficient to determine statistically significant findings relating an exposure at the site to acute histoplasmosis. The only exposure that was clearly associated with illness was attending the bonfire. However, because all attendees participated in the bonfire, the magnitude of association could not be estimated.

Acknowledgments

Donnette Donnell, Linda Gladden, Carla Grayson, Terry Paul, Shirley Louie, Arkansas Department of Health.

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Multiple-Serotype *Salmonella* Outbreaks in Two State Prisons — Arkansas, August 2012

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In August 2012, the Arkansas Department of Health (ADH) was notified of gastrointestinal illness outbreaks in two Arkansas state prisons. ADH investigated the outbreaks and conducted case-control studies to identify the source of the illnesses. This report describes the results of these investigations, which identified 528 persons with onset of diarrhea during August 2–18, 2012. Results from the prison A investigation identified chicken salad as the most likely vehicle. At prison B, person-to-person transmission and contamination of multiple foods likely contributed to illness. Analysis of stool specimens from inmates identified eight serotypes and 15 pulsed-field gel electrophoresis (PFGE) patterns of *Salmonella*. Isolates of *Salmonella* from eggs produced at prison B matched two outbreak patterns. An additional 69 inmates were positive by culture but were not interviewed or did not report diarrhea, making the total case count 597. Sanitarians identified problems with food preparation, hand washing, and food safety training. ADH tested inmate kitchen workers, excluded infected inmates from work, and provided food safety training. Prison kitchen staff should follow guidelines consistent with state regulations for safe food preparation (1) and pass sanitarian inspection.

Notification of the Outbreaks

On August 6, 2012, ADH learned of an outbreak of diarrhea in approximately 260 inmates at prison A via a local newspaper. ADH began an investigation on August 7. The ADH Public

Health Laboratory (ADPHL) isolated *Salmonella* from stool specimens of seven inmates experiencing diarrhea and identified three serotypes: Anatum, Cerro, and Heidelberg.

On August 14, stool specimens from 16 inmates with diarrheal illness from prison B were sent to a reference laboratory for enteric pathogen testing. On August 21, prison B notified ADH that *Salmonella* was isolated from stool specimens of eight of the 16 inmates. Serotyping completed by ADPHL on the eight stool isolates identified *Salmonella* Anatum. PFGE patterns were indistinguishable from Anatum isolates from stool specimens of prison A inmates. ADH began a concurrent investigation at prison B on August 22, 8 days after prison B initiated testing.

Case Finding

Investigators interviewed a convenience sample of 505 (59%) inmates from prison A, 440 (27%) inmates from prison B, and all available staff from both prisons (Table 1). Inmates and prison staff completed questionnaires characterizing food history, symptoms, and symptom onset times. A probable case was defined as self-reported diarrhea with onset during August 2–18, 2012, among prison A or B inmates or staff. A confirmed case was defined as *Salmonella* isolated from a stool specimen during the period of stool specimen testing (August 7–September 25), regardless of the presence or absence of diarrhea. Investigators identified 309 probable and 51 confirmed cases at prison A and 133 probable and 85 confirmed

TABLE 1. Interviews and laboratory testing among prison A and B inmates and staff — Arkansas, August 2012

Prison	Prison subgroup	No. interviewed	Reported diarrhea		No. tested*	Laboratory confirmed [†]	
			No.	(%)		No.	(%)
A [§]	Staff	57	15	(26.3)	0	0	—
	Inmate kitchen workers	68	48	(70.6)	89	52	(58.4)
	Inmates not assigned to kitchen	437	288	(65.9)	7	4	(57.1)
	Total	562	351	(62.5)	96	56	(58.3)
B [¶]	Staff	45	3	(6.7)	0	0	—
	Inmate kitchen workers	190	58	(30.5)	194	85	(43.8)
	Inmates not assigned to kitchen	250	116	(46.4)	24	14	(58.3)
	Total	485	177	(36.5)	218	99	(45.4)

* Stool specimens were tested for *Salmonella* using standard microbiologic techniques. Serotyping and pulsed-field gel electrophoresis were completed for at least one sample per person.

[†] 19 confirmed cases were excluded from the case-control analyses because the case-patient was not interviewed.

[§] Prison A housed 849 inmates during August 2012.

[¶] Prison B housed 1,616 inmates during August 2012.

cases at prison B. Of the 360 interviewed persons whose illness met the probable or confirmed case definition at prison A, seven required intravenous rehydration; one experienced acute appendicitis requiring appendectomy, possibly related to the outbreak. No cases from prison B involved complications or receipt of intravenous therapy.

All inmates assigned to kitchen work submitted stool specimens for *Salmonella* testing. Inmates from whom *Salmonella* was isolated were required to submit weekly stool specimens to monitor *Salmonella* clearance. ADHPHL completed serotyping and PFGE on at least one specimen per person by picking a single colony per stool culture plate. Subsequent samples were assessed only for the presence of *Salmonella*. Nineteen additional confirmed cases were identified by stool culture among inmate kitchen workers who were not interviewed.

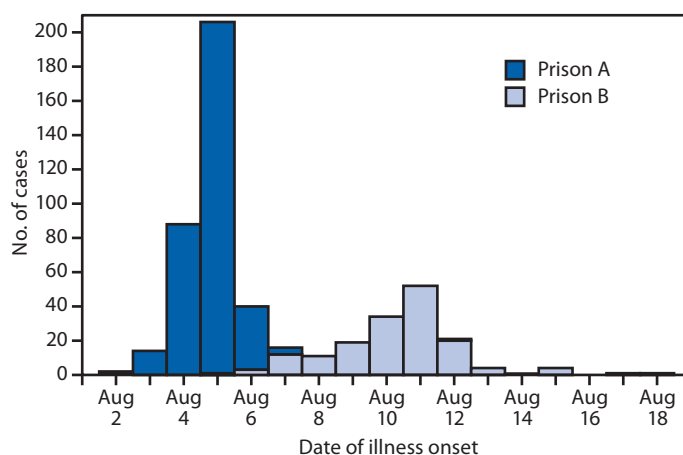
Case-Control Studies

Cases were matched to controls by prison housing unit using variable-ratio matching (i.e., the number of controls per case differed for each housing unit). All food items served in the prison cafeterias and commissaries during August 2–5 at prison A and August 7–11 at prison B were included as exposures in conditional logistic regression models. Persons with probable or confirmed illness were excluded from matched odds ratio (mOR) calculations examining food items served after their reported onset date of diarrhea.

At prison A, the 75.1% of persons interviewed who reported consuming chicken salad during lunch on August 4 were much more likely to have probable or confirmed illness than persons who did not report consuming chicken salad (mOR = 7.5; 95% confidence interval [CI] = 4.6–12.7). Given the timing of the chicken salad meal and the peak in cases on August 5 (Figure), a substantial proportion of cases at prison A were likely attributable to consuming the chicken salad. Probable and confirmed cases among persons reporting diarrhea onset before the chicken salad was served also were examined. Fifty cases were identified, two of which were in kitchen workers. One kitchen worker had *Salmonella* Heidelberg (PFGE pattern JF6X01.0022) infection, and the other did not have *Salmonella* isolated from a stool specimen at the time of testing. These persons might have contributed to the early spread of salmonellosis or to contamination of the chicken salad.

At prison B, the 57% of persons interviewed who reported consuming chicken salad for dinner on August 10 were more likely to have probable or confirmed illness than persons who did not report consuming chicken salad (mOR = 4.0; CI = 2.4–6.7). Twenty-three additional food items also were statistically associated with probable or confirmed illness. Inmate interviews did not implicate a single vehicle. One inmate reporting symptom onset on August 2 (Figure) was infected

FIGURE. Number of confirmed and probable salmonellosis cases at prisons A and B* — Arkansas, August 2012



* N = 514 cases (350 at prison A and 164 at prison B) with a reported symptom onset date.

with *Salmonella* Anatum (PFGE pattern JAGX01.0473) and prepared vegetables in the prison B kitchen. Two additional kitchen workers reported symptom onset on August 6. These three persons were not excluded from kitchen work until the ADH investigation began on August 22, 20 days after the earliest reported symptom onset. The prison B outbreak likely was propagated by contamination of multiple foods, although person-to-person transmission also might have perpetuated the outbreak.

Laboratory Results

ADHPHL cultured stool specimens from 314 inmates; 155 inmates had positive stool cultures for *Salmonella* and were classified as meeting the confirmed case definition. Among the 314 inmates whose stool specimens were cultured, 122 inmates reported diarrhea, and 140 inmates did not report diarrhea. Of the 122 inmates reporting diarrhea, 70.5% tested positive for *Salmonella*. Of the 140 inmates who did not report diarrhea, 35.7% tested positive for *Salmonella*. The remaining 52 inmates tested by stool culture were kitchen workers who were not available for interviews; therefore, symptom information was not obtained. Among the 52 inmate kitchen workers tested and not interviewed, 36.5% tested positive for *Salmonella*.

ADHPHL identified 15 PFGE patterns from *Salmonella* isolated from the 155 positive stool cultures (Table 2). Seven PFGE patterns common to both prisons represented 78% of all stool specimens yielding *Salmonella*; six of these seven patterns had not been isolated previously in Arkansas. The seventh pattern, *Salmonella* Adelaide (PFGE pattern TDAX01.003AR), was isolated only once previously, in 2008, from a child whose father worked at prison B. Weekly stool specimens were submitted by 137 inmate kitchen workers to ensure *Salmonella*

TABLE 2. Serotypes and pulsed-field gel electrophoresis (PFGE) patterns of *Salmonella* isolates from positive stool cultures at two prisons, and from prison B eggs — Arkansas, August 2012

Serotype	PFGE pattern	No. of isolates at prison A	No. of isolates at prison B	No. of isolates in prison B eggs
Adelaide	TDAX01.003AR	1	5	9
Anatum	JAGX01.0474	5	7	0
Anatum	JAGX01.0473	5	73	0
Anatum	NA*	0	2	0
Braenderup	JBPX01.0007	12	5	0
Cerro	JCGX01.0060	6	5	0
Cerro	JCGX01.003AR	1	2	8
Cerro	JCGX01.004AR	0	1	0
Cerro	JCGX01.005AR	0	3	0
Cerro	JCGX01.006AR	0	1	0
Heidelberg	JF6X01.0022	20	0	0
Heidelberg	JF6X01.0052	2	0	0
Litchfield	JGXX01.0010	0	1	0
Mbandaka	TDRX01.0373	2	1	0
Newport	JJPX01.0056	5	0	0
Newport	JJPX01.4010	1	0	0
Total	15	60[†]	106[§]	17

* Not available (PFGE analysis not completed).

[†] A total of 60 *Salmonella* isolates were cultured from 56 patients; three patients had multiple-serotype infections. Two patients were infected with two serotypes of *Salmonella*. One was infected with Cerro and Newport, and the second was infected with Anatum and Heidelberg. One patient was infected with three serotypes of *Salmonella* (Anatum, Cerro, and Heidelberg).

[§] A total of 106 *Salmonella* isolates were cultured from 99 patients; seven patients had multiple-serotype infections. Six patients were infected with serotypes Anatum and Cerro. One patient was infected with serotypes Anatum and Braenderup.

clearance. Among 31 persons who had multiple specimens serotyped, 10 had two or more serotypes identified (Table 2).

Environmental Investigations

ADH sanitarians inspected each prison's kitchen and dining facilities after receiving reports of illness. Sanitarians documented multiple violations of the Arkansas State Board of Health's *Rules and Regulations Pertaining to Food Establishments* (1). During four inspections conducted by ADH sanitarians at prison A on August 6–15, violations included neglect of hand washing among inmates; inadequate freezing, cooling, and reheating procedures; moldy ceilings; unclean equipment and surfaces; and cracked, noncleanable food storage containers, food preparation surfaces, walls, and floors. Hand washing sinks required hand contact to operate and were below standard height.*

Interviews with prison A kitchen workers were conducted to characterize the preparation of the chicken salad served for lunch on August 4. Along with video surveillance footage, interviews revealed that the cooked chicken was not refrigerated and was held at an ambient temperature of approximately 75°F–99°F (23.9°C–37.2°C) for 15 hours before incorporation into the chicken salad. Inmates were unsupervised during much of the meal preparation.

*The height of hand washing sinks at prison A was approximately 24 inches (62 cm). ADH recommended installing sinks at a height of approximately 36 inches (91 cm).

Violations documented during an August 28 inspection of the prison B kitchen included absent temperature monitoring during cooking and noncleanable, cracked floors and food storage containers. Rodents and cockroaches infested both facilities. Neither facility provided food safety training to kitchen workers. Additionally, neither facility required ill workers to report symptoms to management, nor did they ensure ill workers were restricted or excluded from working with food. Both facilities passed ADH sanitarian inspection <6 months before the outbreaks; however, review of the inspection records revealed that the inspections did not fully adhere to ADH inspection guidelines for commercial food establishments. In Arkansas, prisons are required to follow the same regulations as commercial food establishments and are subject to periodic inspection by ADH sanitarians.

Because prison B supplied itself and other state prisons, including prison A, with eggs from its three hen houses during August 2012, ADH sanitarians inspected the prison B hen houses and egg processing procedures and equipment. Prison B officials revealed that their outdoor egg washer required frequent maintenance and was replaced with an indoor washer in August 2012. Both prisons incorporated eggs produced at prison B into the chicken salad dishes served on August 4 and 10 at prisons A and B, respectively.

Food Item Testing

On January 24, 2013, 12 raw, nonsanitized eggs were collected from one of the prison B hen houses. The two other

hen houses that were operational during August 2012 were demolished during September–December 2012. ADHPHL cultured each egg sample using four types of selective media and selected two colonies with suspected *Salmonella* morphologies from each culture plate for biochemical testing. Of the 96 candidate colonies subject to biochemical testing, 17 were identified as *Salmonella*. PFGE patterns of the 17 egg isolates were indistinguishable from *Salmonella* Adelaide and *Salmonella* Cerro patterns from nine stool specimens from inmates at both prisons (Table 2).

Several other food items were collected for *Salmonella* testing during August 7–September 13, 2012. Samples of several meals were collected on August 7 from prison A and on August 22 from prison B, including the chicken salad served on August 4 at prison A, frozen samples of the chicken salad served on August 10 at prison B, and frozen samples of the meatloaf and baked chicken served for lunch and dinner, respectively, on August 11 at prison B. Additionally, several food items not consumed by inmates or prison staff during the outbreak period but representative of ingredients used in meals served during August 2012 were collected. These included raw, frozen chicken collected from prison A on August 24, raw, frozen chicken collected from prison B on August 22, and salad dressing used in the chicken salad recipes at both prisons from the Arkansas correctional system's food supplier warehouse on September 13. All items tested negative for *Salmonella*, with the exception of raw, frozen chicken from prison B, which tested positive for *Salmonella* Enteritidis, a *Salmonella* serotype not identified in stool specimens from inmates at either prison.

Public Health Response

All inmate kitchen workers were required to submit stool specimens for testing. Inmates testing positive for *Salmonella* submitted weekly stool specimens for testing and were excluded from kitchen work until two successive stool specimens were negative for *Salmonella*, *Shigella*, *Escherichia coli*, and *Campylobacter* and diarrheal symptoms resolved. Exclusion of inmate kitchen workers at prison B was delayed because of a 20-day lapse from the earliest reported symptom onset date to the beginning of the ADH investigation. ADH sanitarians provided recommendations and food safety training, emphasizing compliance with published guidelines (1). Inmate transfers and releases were suspended until the outbreaks were controlled. Ciprofloxacin treatment was recommended for patients at risk for systemic disease, in accordance with published guidelines (2).

Editorial Note

This report describes two large, multiple-serotype *Salmonella* outbreaks associated with food preparation deficiencies.

What is already known on this topic?

Salmonella is the most common cause of bacterial foodborne illness in the United States; however, multiple-serotype *Salmonella* infections and outbreaks are identified infrequently.

What is added by this report?

Two linked *Salmonella* outbreaks occurred in Arkansas prisons during August 2012, revealing 15 pulsed-field gel electrophoresis patterns of *Salmonella* and 10 inmates with multiple-serotype infections. Deficiencies in safe food preparation practices, a lack of inmate kitchen worker training, neglect of hand washing, a delay in recognition and reporting of one of the outbreaks, and inadequately sanitized eggs produced by and distributed to the prisons might have influenced the occurrence, size, and transmission modes associated with the outbreaks.

What are the implications for public health practice?

Correctional facility and inmate food service personnel should receive food safety training. Prisons should be inspected by sanitarians in accordance with state or local guidelines and should maintain equivalent standards to commercial food service establishments.

Inadequately sanitized eggs provided to both prisons were a potential source for at least two of the *Salmonella* PFGE patterns involved. Among the sample of 1,047 inmates and prison staff interviewed, 64.1% and 44.9% at prisons A and B, respectively, had illness that met the probable case definition (i.e., reported diarrhea) or met the confirmed case definition after having *Salmonella* isolated by stool culture, with or without reporting symptoms of diarrhea. Additional cases likely existed among noninterviewed and untested inmates beyond the 597 total cases identified in the investigation.

Multiple-serotype outbreaks of *Salmonella* have been reported in prisons previously (3); however, the number of serotypes in these outbreaks surpasses all previous reports. These outbreaks demonstrated different epidemiologic characteristics, one primarily involving point-source contamination of chicken salad, and the other potentially involving multiple transmission modes and vehicles. These outbreaks show that environmental and food preparation practices can affect the course and extent of an outbreak caused by the same pathogen.

Ten cases of infection with multiple serotypes of *Salmonella* were identified. Multiple-serotype infection in individuals is reported infrequently (4). Additional multiple-serotype infections in these outbreaks likely were missed because laboratory testing of follow-up samples was limited to ascertaining whether *Salmonella* was present. Further, only one stool culture medium was used, although detection of specific serotypes is influenced by enrichment medium choice (5). The detection of multiple serotypes in different stool specimens over time might indicate coinfection. Persons infected with multiple serotypes also could clear one serotype before another, manifesting

differential serotype survival. Furthermore, the persistence in the gut or infectious periods of *Salmonella* serotypes might differ. These limited data indicated that among persons with multiple-serotype infections, serotype Anatum was present in 90% of cases; however, no clear progression was observed from infection with one serotype to infection with a second. The effect of multiple-serotype infection on *Salmonella* shedding and pathogenesis is unknown.

Asymptomatic carriage was identified in 50 confirmed cases; 56% were infected with *Salmonella* Anatum pattern JAGX01.0473. The combination of 15 serotypes, 10 multiple-serotype infections, and asymptomatic infection among 32.3% of confirmed cases might illustrate the persistence of certain *Salmonella* serotypes among the prison population. Because *Salmonella* colonization among poultry has been demonstrated (6) and two of the 15 outbreak serotypes were isolated from non-sanitized eggs collected from a prison B hen house, the outbreak strains might colonize laying hens from prison B. Laboratory testing of nonfood items, including laying hens, was outside of the scope of this investigation. Although it was not possible to describe the *Salmonella* serotypes colonizing poultry from prison B beyond their identification in eggs, the propensity of *Salmonella* to colonize poultry further highlights the need for safe cooking and food storage practices to kill *Salmonella* and prevent its growth in contaminated food before consumption.

Prisons should follow safe food preparation guidelines (1). Inmates should receive food safety training before assignment to kitchen work. Sanitarians should regularly inspect prison kitchens, cafeterias, and agricultural facilities, and require them to maintain standards equivalent to those of commercial establishments in accordance with state or local guidelines. Health departments might consider enhancing collaborative surveillance with prison staff to improve control of foodborne outbreaks in prisons.

Acknowledgments

Glen Baker, MD, Arthur Banks, Rick Barnhardt, James Bishop, MS, Amy Blubaugh, Candace Campbell, MPH, Martin Chambers, Eugenia Davis, Cameron Dixon, Amelia Foust, Brenda Garrard, Timothy Hereford, MA, Dana Hill, David Holcomb, MPH, Rachel Hulitt, MPH, Marcus Jones, Carl Long, Shirley Louie, MS, Adrienne Macias, DeLois Manor, James Matthews, Stephanie McGaha, Ashley Nale, Jerome Ngundue, MHSA, J. Terry Paul, Dena Poteat, Rebecca Rush, MS, Evan San Juan, Kim Sutphin, Rossina Stefanova, PhD, Janis Thompson, MPH, Teresa Vela, Megan D. Wallace, MPH, Mary Whisnant, MS, Elizabeth Wilson, Sherri Woodus, Arkansas Department of Health. Alice Green, DVM, Food Safety and Inspection Service, US Department of Agriculture. CDC/Council of State and Territorial Epidemiologists Applied Epidemiology Fellowship. Cheryl Bopp, Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC.

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Two-Dose Varicella Vaccination Coverage Among Children Aged 7 years — Six Sentinel Sites, United States, 2006–2012

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In 2007, the Advisory Committee on Immunization Practices (ACIP) recommended a routine second dose of varicella vaccine for children at age 4–6 years, in addition to the first dose given at age 12–15 months (1). One strategy recommended for increasing varicella vaccination coverage is a school entry requirement of proof of varicella immunity (1,2). To determine the extent of implementation of the routine 2-dose varicella vaccination program, the number of states with a 2-dose varicella vaccination elementary school entry requirement in 2012 was compared with the number in 2007, and 2-dose varicella vaccination coverage during 2006 was compared with coverage in 2012 among children aged 7 years, using data from six Immunization Information System (IIS) sentinel sites. The number of states (including the District of Columbia) with a 2-dose varicella vaccination elementary school entry requirement increased from four in 2007 to 36 in 2012. Two-dose varicella vaccination coverage levels among children aged 7 years in the six IIS sentinel sites increased from a range of 3.6%–8.9% in 2006 to a range of 79.9%–92.0% in 2012 and were approaching the levels of 2-dose measles, mumps, and rubella (MMR) coverage, which had a range of 81.9%–94.0% in 2012. These increases suggest substantial progress in implementing the routine 2-dose varicella vaccination program in the first 6 years since its recommendation by ACIP. Wider adoption of 2-dose varicella vaccination school entry requirements might help progress toward the *Healthy People 2020* target of 95% of kindergarten students having received 2 doses of varicella vaccine.

Data on the number of states with 1-dose and 2-dose varicella vaccine elementary school entry requirements at the start of the school year were obtained from state immunization websites for 2007 and 2012. Data on varicella vaccination coverage were obtained from six sentinel IIS sites. IIS, also known as immunization registries, are computerized, population-based systems that consolidate data from participating vaccine providers and provide tools for supporting effective immunization strategies at the vaccination provider and program levels (3). The IIS sentinel site project is a collaboration between CDC and state- and city-based IIS. To be eligible to compete for CDC sentinel site funding, ≥85% of vaccination providers must participate in the IIS, ≥85% of children aged <19 years must have at least two vaccinations recorded in the IIS, and

≥70% of doses administered must be reported to the IIS within 30 days of administration. The six IIS sentinel sites funded for the 2013–2017 project period are Michigan, Minnesota, North Dakota, New York City, and Wisconsin, which include data from the entire jurisdiction, and Oregon, which includes data from six counties (56% of the state population).

De-identified individual record-level data were received from IIS sentinel sites and processed in accordance with IIS best practices (4). Children who were designated in the IIS as permanently inactive (i.e., deceased) or “moved or gone elsewhere” were excluded from analysis.

Varicella and MMR vaccination coverage were assessed at age 7 years to allow time for the 2-dose series to be completed. Two-dose varicella vaccination coverage estimates were calculated for each year of the study period (i.e., January 1, 2006–December 31, 2012) among children aged 7 years (born during January 1, 1999–December 31, 2005). Intercensal population estimates for 2006–2009 and postcensal estimates for 2010–2012 were used for the denominators (5). Valid doses of varicella vaccine were defined as dose 1 administered no earlier than 4 days before age 12 months, dose 2 administered at least 28 days after dose 1, and either dose administered on the same day as or ≥4 weeks after any other live vaccine.* Coverage was calculated by dividing the number of children aged 7 years with 2 valid doses of varicella vaccine by the U.S. Census estimate of the total number of same-aged children in the sentinel site population. To have a single measure of coverage at the six sites that could be compared from year to year, the unweighted average of the estimates for each of the six sites was calculated for each year.

Two-dose varicella vaccination coverage estimates derived from IIS data for children aged 6 years were compared with data from the kindergarten vaccination assessment for the four sentinel sites (Michigan, Minnesota, North Dakota, and Wisconsin) that had 2-dose varicella vaccination school entry requirements for the 2012–13 school year (6). Kindergarten assessments, conducted annually by federal immunization grantees through a vaccination coverage survey or census of enrolled students to determine compliance with school vaccination requirements (6), are the only available source of national data on 2-dose varicella vaccination coverage. Differences

* Additional information available at <http://www.cdc.gov/vaccines/programs/iis/interop-proj/cds.html>.

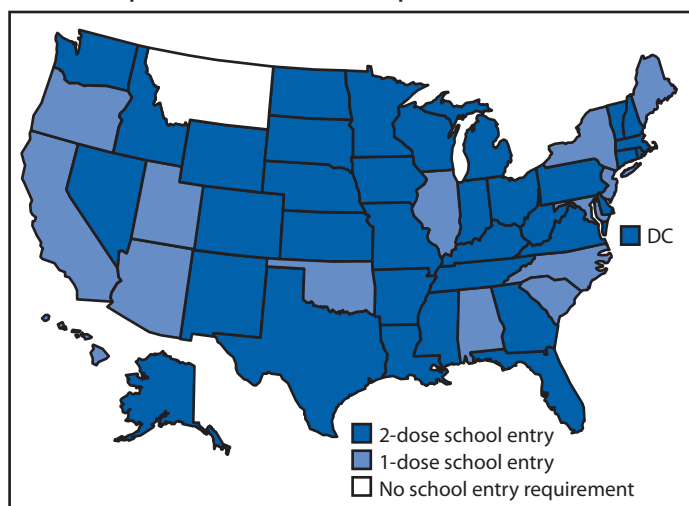
between 2-dose varicella vaccination coverage in 2012 at sites with and without 2-dose school entry requirements for children aged 6 years were examined and analyzed for statistical significance using the Wilcoxon-Mann-Whitney test.

The number of states requiring 2 doses of varicella vaccine for school entry increased rapidly, from four in 2007 to 36 by 2012, and all but one state required 1 or more doses of varicella vaccine for elementary school entry by the 2012–13 school year (Figure 1).

Varicella vaccination coverage levels with 2 doses among children aged 7 years increased greatly at the six IIS sentinel sites, from a range of 3.6%–8.9% in 2006 to a range of 79.9%–92.0% in 2012, approaching that of 2-dose MMR vaccination coverage, which ranged from 81.9% to 94.0% in 2012 (Figure 2). Implementation of the 2-dose varicella vaccination recommendation was rapid, with the average of coverage percentages increasing to 72.4% by 2009.

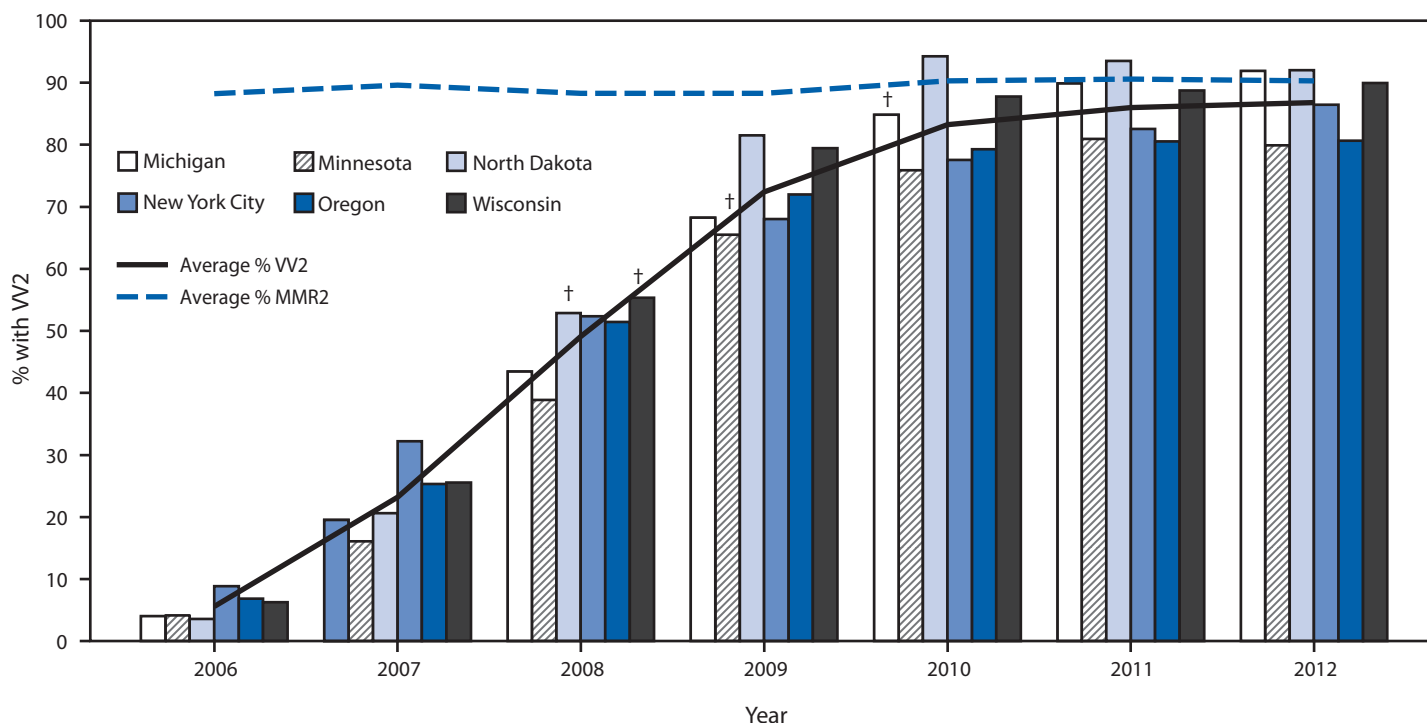
Coverage estimates for 2 doses of varicella vaccine among children aged 6 years at four IIS sites based on IIS data were similar to those reported in the kindergarten assessment. The IIS estimate was lower than the kindergarten assessment at two of the sites (percentage-point differences of 0.5 and 15.6) and higher at two sites (percentage-point differences of

FIGURE 1. Varicella vaccine school entry requirements, by number of doses required — United States, September 2012



2.0 and 4.4) (Table). Two-dose varicella vaccination coverage in 2012 for children aged 6 years was slightly higher in the four states with 2-dose school entry requirements (Michigan, Minnesota, North Dakota, and Wisconsin), compared with sites with only a 1-dose school entry requirement (New York

FIGURE 2. Among children aged 7 years, average percentage of 2-dose varicella vaccination coverage (VV2), compared with average percentage of 2-dose measles, mumps, and rubella (MMR2) vaccination coverage, and VV2 by Immunization Information System (IIS) sentinel site* — six IIS sites, United States, 2006–2012



* Data for 3,633,391 children aged 7 years for the period 2006–2012 were analyzed to estimate VV2. The average number of children available for analysis per sentinel site during that period ranged from 10,343 in North Dakota to 159,167 in New York City.

† VV2 became required for elementary school entry in 2008 in North Dakota and Wisconsin, in 2009 in Minnesota, and in 2010 in Michigan.

City and Oregon), although this difference was not statistically significant ($p=0.5$) (Table).

Editorial Note

During the first 6 years of the 2-dose varicella vaccination program, the number of states with 2-dose varicella vaccination elementary school entry requirements increased from four to 36, and 2-dose coverage among children aged 7 years in IIS sentinel sites increased from 4%–9% to 80%–92%, approaching the level for 2-dose MMR coverage. The rapid increase in 2-dose coverage after the ACIP recommendation and before 2-dose school entry requirements were widely adopted suggests extensive implementation of the recommendation by health-care providers. School entry requirements have been useful for increasing 1-dose varicella vaccination coverage among children (2). Adoption of 2-dose varicella vaccination school entry requirements by additional states and for higher grades might help reach the *Healthy People 2020* targets of 95% and 90% 2-dose coverage among kindergarten and adolescent students, respectively.

IIS sentinel sites provide an important source of population-based, provider-verified vaccination data and can be useful for assessing coverage for vaccines, such as varicella, for which other mechanisms to estimate coverage nationally are inadequate. Two-dose varicella vaccination coverage data are available from surveys of kindergarten-aged children; however, data collection and validation methodologies vary by state, and data are limited to doses required for school entry. Two-dose varicella vaccination coverage estimates for the 2012–13 school year based on IIS data were similar to those obtained from the kindergarten assessment, except for one site (6). Improvements in kindergarten survey methodology and ongoing adoption of 2-dose varicella school entry requirements will make it increasingly feasible to estimate 2-dose coverage for varicella vaccination nationally using data from kindergarten students, as is already done for MMR coverage.

The findings in this report are subject to at least two limitations. First, census-based denominators were used, which might have resulted in underestimation of varicella protection because children with a history of varicella disease are included in the denominator even though varicella vaccination would not be indicated for them. Second, the IIS sentinel sites are highly selected and might not be representative of other cities and states.

The 1-dose varicella vaccination program, implemented in 1996, resulted in 70%–90% declines in varicella disease incidence, hospitalizations, and mortality (7–9). The routine 2-dose varicella vaccination program was implemented to

TABLE. Two-dose varicella vaccination coverage among children aged 6 years, based on 2012 Immunization Information System (IIS) data, compared with 2-dose varicella vaccination coverage based on a 2012–13 kindergarten school year survey — IIS sentinel sites, United States

Sentinel site	2-dose varicella vaccination coverage, 2012 IIS data %	2-dose varicella vaccination coverage, 2012–13 kindergarten school year survey %
Sites requiring 2 doses of varicella vaccine for school entry*		
Michigan	92.2	92.9
Minnesota	80.3	95.9
North Dakota	92.9	88.5
Wisconsin	93.1	91.1
Sites requiring 1 dose of varicella vaccine for school entry*		
New York City	89.1	—
Oregon	80.9	—
Average % for all six sites	88.1	—

* The differences in 2-dose varicella vaccination coverage among sites requiring 2 doses and sites requiring 1 dose were not statistically significant ($p=0.5$).

What is already known on this topic?

A second dose of varicella vaccine was recommended for children by the Advisory Committee on Immunization Practices in 2007, and the recommendation has been followed by decreases in varicella incidence nationwide. However, estimates of 2-dose varicella vaccination coverage have not been available previously.

What is added by this report?

The number of states with a 2-dose varicella vaccine elementary school entry requirement increased from four in 2007 to 36 in 2012. Two-dose varicella vaccination coverage levels among children aged 7 years in six selected sentinel sites increased from a range of 3.6%–8.9% in 2006 to a range of 79.9%–92.0% in 2012, approaching the coverage level for 2 doses of measles, mumps, and rubella vaccine.

What are the implications for public health practice?

Health-care providers have been important to the increase in coverage levels for 2 doses of varicella vaccine. Wider adoption of 2-dose varicella vaccine school entry requirements in more states and higher grades might help reach the *Healthy People 2020* targets of 95% and 90% 2-dose varicella vaccination coverage among kindergarten and adolescent students, respectively.

further decrease varicella disease and control outbreaks. Since its implementation in 2007, declines in varicella incidence and outbreaks ranging from 67% to 76% have been reported (10). Further declines in varicella incidence and outbreaks might occur as higher 2-dose varicella vaccination coverage is achieved.

Acknowledgments

Rachel Potter, DVM, Bea Salada, Michigan Department of Community Health; Karen White, MPH, Emily Emerson, Minnesota Department of Health; Molly Howell, MPH, Mary Woinarowicz, MA, North Dakota Department of Health; Vikki Papadouka, PhD, Alexandra Ternier, MPH, New York City Department of Health and Mental Hygiene; Andrew Osborn, MBA, Mary Beth Kurilo, MPH, Oregon Immunization Program, Oregon Health Authority; Thomas Maerz, Stephanie Schauer, PhD, Wisconsin Immunization Program; Cindi Knighton, Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC.

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Notes from the Field

Wildlife Rabies on an Island Free from Canine Rabies for 52 Years — Taiwan, 2013

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Dog-to-dog transmission of rabies in Taiwan was eliminated in 1961; the island was considered canine rabies-free for 52 years. On July 16, 2013, three ferret-badgers (*Melogale moschata*) (Figure) tested positive for rabies by fluorescent antibody testing at the Animal Health Research Institute, Council of Agriculture of Taiwan. This was the first time wild animals other than bats were tested. During 1999–2012, a total of 6,841 clinically healthy dogs and five apparently normal cats from shelters were tested and found negative for rabies. During 2009–2012, a total of 322 bats were tested and found negative for rabies.

On July 23, Taiwan agriculture authorities asked forestry workers, wildlife rescue and rehabilitation stations, and local animal health agencies to submit for testing all dead wild mammals and ill wild mammals with neurologic signs, in addition to any mammals that bit or scratched humans or licked humans on broken skin or mucous membranes. Wildlife rescue and rehabilitation stations were instructed not to rehabilitate ill wild mammals exhibiting neurologic signs. Rabies vaccination campaigns for dogs and cats also were initiated.

During January 1–October 3, among samples tested at the Animal Health Research Institute, 159 of 512 (31.1%) ferret-badgers, one of 138 (0.7%) shrews, and one of 908 (0.1%) dogs tested positive for rabies. During that period, 62 cats, 44 bats, 138 wild carnivores other than ferret-badgers, and 289 other mammals also were tested and found negative for rabies. The one dog had contact with a rabid ferret-badger and developed signs of rabies while quarantined. To date, cases of rabies have been confirmed in central, southern, and eastern Taiwan; no cases have been identified in northern Taiwan.

Rural farmers and hunters who trap and slaughter ferret-badgers might be at increased risk for rabies exposure. Educational efforts are being developed for this high-risk group. To evaluate the feasibility of oral vaccination of ferret-badgers against rabies, the Council of Agriculture and CDC conducted a small-scale palatability field trial using three placebo bait types. These trials have not yet identified a bait that is universally palatable to ferret-badgers, suggesting that oral rabies vaccination of wild ferret-badgers might be difficult.

FIGURE. The Chinese ferret-badger, also known as the small-toothed ferret-badger (*Melogale moschata*), is widely distributed in Southeast Asia



Photo/Hsi-Chi Cheng, Taiwan Endemic Species Research Institute

Since July 24, 2013, the Taiwan Centers for Disease Control has provided rabies vaccine and immune globulin for persons with exposure to potentially rabid animals after risk assessment using guidelines issued by Taiwan's Advisory Committee on Immunization Practices (1,2). During July 21–October 7, a total of 4,207 persons received postexposure prophylaxis. The Taiwan Centers for Disease Control urges clinicians to maintain a high index of suspicion for rabies when evaluating patients with encephalitis in Taiwan. Surveillance for animal and human cases will need to be continued to appropriately describe the epidemiology of rabies in Taiwan.

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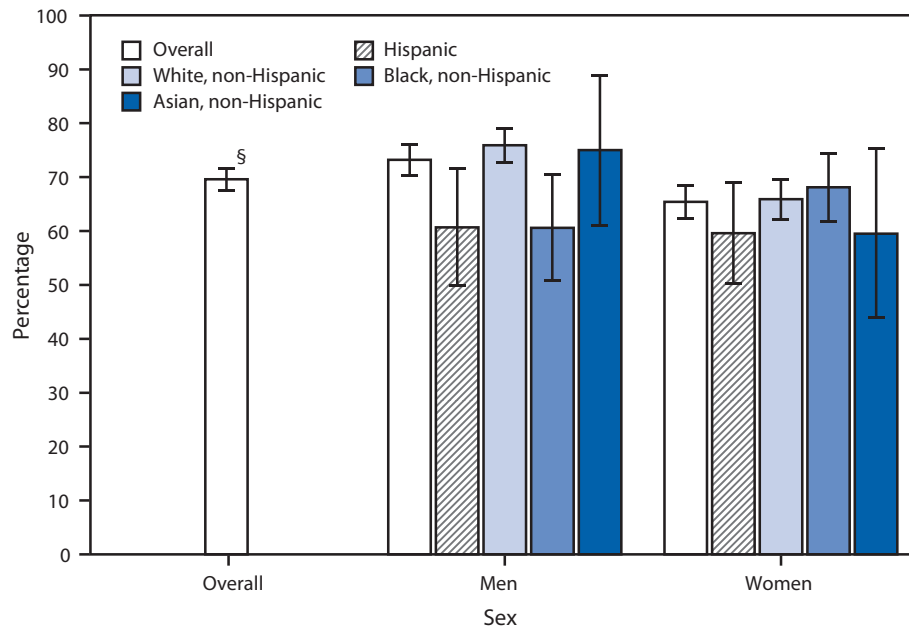
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QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Adults Aged ≥ 40 Years Who Ever Had a Cardiovascular Event* and Are Now Taking Low-Dose Aspirin to Prevent or Control Heart Disease, by Sex and Race/Ethnicity — National Health Interview Survey, 2012[†]



* Includes heart attack (myocardial infarction), angina pectoris, coronary heart disease, or stroke.

[†] Estimates are based on household interviews of a sample of the noninstitutionalized U.S. civilian population and are derived from the National Health Interview Survey sample adult component.

[§] 95% confidence interval.

In 2012, 69.6% of adults aged ≥ 40 years who ever had a cardiovascular event (73.2% of men and 65.4% of women) were taking low-dose aspirin to prevent or control heart disease. Non-Hispanic white men (75.9%) were more likely to be taking low-dose aspirin compared with Hispanic (60.7%) and non-Hispanic black men (60.6%). No statistically significant differences were observed among women by race/ethnicity.

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

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Morbidity and Mortality Weekly Report

The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format. To receive an electronic copy each week, visit *MMWR*'s free subscription page at <http://www.cdc.gov/mmwr/mmwrsubscribe.html>. Paper copy subscriptions are available through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; telephone 202-512-1800.

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U.S. Government Printing Office: 2014-723-032/01046 Region IV ISSN: 0149-2195