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Community Needs Assessment After Microcystin Toxin Contamination of a Municipal Water Supply — Lucas County, Ohio, September 2014

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On August 1, 2014, routine testing at the Collins Park Water Treatment Plant in Lucas County, Ohio, revealed microcystin toxin levels in drinking water had reached 3.19 μg/L, surpassing the Ohio Environmental Protection Agency (EPA) drinking water advisory threshold of 1.0 μg/L. Microcystin is a hepatoxin released by cyanobacteria in certain harmful algal blooms. Exposure to microcystin has been associated with gastrointestinal and hepatic illness in both humans and animals (*1*–*3*). On August 2, a do-not-drink advisory was issued, warning community members not to drink, boil, or use the water for cooking or brushing teeth. Public health officials used traditional and social media outlets to disseminate public health messages to affected communities. On August 4, 2014, the advisory was lifted after multiple water samples confirmed microcystin toxin levels had dropped below the advisory threshold. To assess communication strategies, water exposure, and household needs, the Ohio Department of Health (ODH) and Toledo-Lucas County Health Department (TLCHD) conducted a Community Assessment for Public Health Emergency Response (CASPER) in Lucas County. Most households (88.1%) reported hearing about the advisory the morning it was issued, but 11% reported drinking and 21% reported brushing teeth with municipal water during the advisory. Household members reported physical (16%) and mental (10%) health concerns that they believed were related to the advisory and activity disruptions including temporarily staying outside of the home (6%) during the advisory and continued use of alternative water sources after the advisory was lifted (82%). During a do-not-drink advisory, governmental agencies and community partners need to engage in joint prevention and response efforts to decrease water exposure and prevent activity disruptions.

CASPER is a household-level survey methodology used to conduct a rapid community needs assessment after a public health emergency (*4*). Although the do-not-drink advisory was issued for all customers of the Collins Park Water Treatment Plant (440,552 residents in 108,301 households across four counties in 2010), the survey focused on Lucas County, where 84% of affected customers resided (*5*). A two-stage cluster sampling method (*4*) was used, with the goal of completing 210 household interviews. During the first stage, 30 Lucas County census tracts (clusters) were selected with probability of selection proportional to the number of housing units (size) (*4*).

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Interview teams then randomly selected seven housing units within each cluster and interviewed one adult per household.

A multiagency working group with representation from ODH, TLCHD, and CDC developed a questionnaire using questions modified from a previous CASPER (*6*). Regarding health issues, participants were asked to respond to the following initial question, "Since the do-not-drink advisory on August 2, 2014, did anyone in your household have any health issues they felt were related to the do-not-drink advisory?" CDC experts trained interview teams composed of TLCHD personnel, ODH personnel, and community volunteers to administer the survey. Interview teams conducted door-to-door surveys during September 11–15, 2014, approximately 6 weeks after the advisory was issued. Each questionnaire took approximately 15 minutes to administer. Frequencies were calculated using CDC Epi Info version 7.1.3. Weighted frequencies, based on probability of selection, are reported (*4*).

Among 314 households contacted, 171 (54.5%) completed the survey. Approximately 23% of these households included ≥1 member aged ≥65 years and 8.1% included ≥1 member aged ≤2 years (Table 1). Approximately 96% of households had heard about the advisory the same day it was issued, including 88.1% who learned of it in the morning. The most common information sources regarding the advisory were television (82.3%), word of mouth (54.5%), and social media (41.8%), with television reported as the most reliable source of information (73.4%).

TABLE 1. Number and percentage of households reporting selected characteristics — Lucas County, Ohio, 2014 (N = 171)*

Characteristic	No.	Estimated no. of households†	% of sampled households (95% CI)
Structure			
Single family	145	88,274	85.7 (74.4–96.9)
Mobile home	6	5,415	5.3 (-2.6–13.2)
Multiple unit	9	5,759	5.6 (-0.9–12.1)
Other	7	3,610	3.5 (-2.7–9.7)
No. of persons in household			
≤2	75	46,724	43.4 (33.9–52.8)
3–4	63	38,412	35.6 (27.1–44.1)
≥5	32	22,649	21.0 (11.9–30.2)
Home ownership			
Own	113	75,501	70.4 (59.4–81.3)
Rent	56	31,768	29.6 (18.7–40.6)
Age group (yrs) of persons in household§			
≤2	16	8,630	8.1 (4.3–11.9)
2–17	78	51,692	48.5 (39.2–57.8)
18–64	147	93,362	87.6 (81.7–93.6)
≥65	34	24,462	23.0 (13.9–32.0)
Race/Ethnicity of persons in household§			
Hispanic or Latino	18	12,652	11.7 (5.1–18.4)
White	119	74,152	68.5 (55.3–81.7)
Black	50	32,422	29.9 (17.2–42.7)
Other race	16	10,426	9.6 (4.4–14.9)
Highest education level in household			
High school, GED, or less	43	31,957	29.9 (19.3–40.6)
Some college	35	21,205	19.9 (13.6–26.1)
Two- or four-year degree	59	36,367	34.1 (26.6–41.6)
Graduate or professional degree	31	17,225	16.1 (8.4–23.9)

Abbreviations: CI = confidence interval; GED = general equivalency diploma.
* N values might differ because of item nonresponse.
† Based on 2010 U.S. Census estimates for Lucas County, Ohio.
§ Households could provide multiple responses.

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During the advisory, 67.5% of households used purchased water; however, 61.0% indicated continued use of municipal water in some capacity, primarily for bathing (43.7%), washing hands (32.0%), and brushing teeth (19.6%) (Table 2). Some households (10.7%) reported that members drank municipal water and 10.2% consumed food prepared with the water.

In 16.2% of households, at least one person reported physical health symptoms attributed to the advisory; gastrointestinal symptoms were most commonly reported (diarrhea 12.1%, nausea 9.1%, and vomiting 6.2%) (Table 3). Most (89.1%) households reporting symptoms indicated that the health issues were not serious enough to seek medical care. Approximately 10% of households reported mental health symptoms attributed to the advisory, most commonly anxiety or stress (7.0%). Among pet-owning households, 3.8% reported pet illness that the household member attributed to water exposure. Additional household activity disruptions included child care center or school closure (2.3%), work cancellation (5.7%), staying outside the home overnight to access alternative water sources (5.8%), and interruptions to routine medical services (7.9%).

After the advisory was lifted, 81.9% of households used an alternative water source during at least the first day, primarily for drinking (77.8%) or preparing food (47.2%). Approximately 6 weeks after the advisory was lifted, 58.5% of households reported using an alternative water source.

Discussion

The majority of households in the affected communities learned about the advisory quickly through traditional and social media outlets. However, many were still exposed to the water or otherwise affected by the emergency. Some households reported physical health symptoms that they attributed to the advisory, including gastrointestinal illness, skin irritation, eye and head pain, and respiratory illness. These physical symptoms are consistent with those reported in previous studies of recreational exposure to microcystin and harmful algal bloom-associated disease outbreaks (*1*,*2*). Some households reported mental health symptoms attributed to the advisory, primarily anxiety and stress and disruptions of daily activities. Many households relied on alternative water sources, often purchased water, during and after the advisory. These findings indicate the need for effective public health preparedness and response to meet various water and health needs of residents in the event of a do-not-drink advisory related to microcystin contamination.

TABLE 2. Number and percentage of households reporting water use and sources during and after the advisory — Lucas County, Ohio, 2014 (N = 171)*,†

Characteristic	No.	Estimated no. of households§	% of sampled households (95% CI)
Municipal water use during the advisory ¶			
Any use	107	66,089	61.0 (52.6–69.4)
Drank	18	11,552	10.7 (5.2–16.1)
Washed hands	57	34,669	32.0 (24.9–39.2)
Brushed teeth	36	21,179	19.6 (12.9–26.2)
Bathed	76	47,317	43.7 (36.5–50.9)
Ate or drank food prepared with water	17	11,036	10.2 (4.4–16.0)
Washed clothes	34	18,420	17.0 (11.1–22.9)
Washed dishes	28	15,721	14.5 (8.7–20.3)
Other	18	10,744	9.9 (5.4–14.4)
Alternative water sources used during the advisory			
Purchased water	120	73,138	67.5 (59.8–75.3)
Water from a friend or relative	37	22,227	20.5 (13.5–27.6)
Water from a water distribution site	37	25,683	23.7 (14.7–32.7)
Other	13	8,217	7.6 (2.7–12.5)
Alternative water use after the advisory was lifted			
Any use	136	88,050	81.9 (75.1–88.6)
Drank	129	84,440	78.0 (69.7–86.2)
Washed hands	25	17,638	16.3 (7.6–25.0)
Brushed teeth	57	34,562	31.9 (22.1–41.7)
Bathed	11	6,137	5.7 (2.1–9.2)
Ate or drank food prepared with water	79	51,125	47.2 (37.6–56.8)
Made baby formula	11	5,965	5.5 (2.1–8.9)
Washed clothes	8	4,418	4.1 (1.5–6.7)
Washed dishes	12	9,661	8.9 (1.8–16.1)
Other	49	33,324	30.8 (20.5–41.0)

Abbreviation: CI = confidence interval.
* N values might differ because of item nonresponse.
† Households could provide multiple responses.
§ Based on 2010 U.S. Census estimates for Lucas County, Ohio.
¶ No households reported using municipal water to make baby formula during the advisory.

TABLE 3. Number and percentage of households reporting household impacts — Lucas County, Ohio, 2014 (N = 171)*,†

Characteristic	No.	Estimated no. of households§	% of sampled households (95% CI)
Household physical health symptoms			
Any illness	25	17,431	16.2 (7.6–24.8)
Nausea	16	9,833	9.1 (4.2–14.0)
Vomiting	10	6,739	6.2 (1.9–10.5)
Abdominal pain	11	8,028	7.4 (2.5–12.4)
Diarrhea	19	13,134	12.1 (5.9–18.4)
Skin irritation or itching	6	5,879	5.4 (-1.6–12.4)
Headache	6	3,988	3.7 (0.3–7.0)
Eye irritation or pain	2	2,321	2.1 (-1.4–5.7)
Respiratory illness or cough	2	2,321	2.1 (-1.4–5.7)
Other	3	1,547	1.4 (-0.7–3.6)
Household mental health symptoms			
Any mental health concerns	14	10,443	9.9 (4.4–15.4)
Agitated behavior	3	2,235	2.1 (-0.5–4.7)
Anxiety or stress	10	7,607	7.0 (2.3–11.8)
Difficulty concentrating	3	2,235	2.1 (-0.5–4.7)
Loss of appetite	5	5,243	4.8 (0.2–9.5)
Trouble sleeping or nightmares	5	4,556	4.2 (0.0–8.4)
Alcohol or drug use	1	516	0.5 (-0.5–1.5)
Other	4	2,149	2.0 (0.1–3.9)
Pet illness¶ (n = 120)	6	3,988	3.8 (0.7–7.0)
Activity disruptions			
Interruptions of routine health services	15	8,509	7.9 (1.1–14.6)
Difficulty taking medications	4	2,355	2.2 (0.1–4.4)
Temporary displacement	12	6,275	5.8 (1.7–9.9)
Child care or school closure	4	2,355	2.3 (0.1–4.5)
Work cancellation	10	6,137	5.7 (2.4–9.0)

Abbreviation: CI = confidence interval.
* N values might differ because of item nonresponse.
† Households could provide multiple responses.
§ Based on 2010 U.S. Census estimates for Lucas County, Ohio.
¶ Among households reporting pet ownership.

Harmful algal blooms and the toxins they produce have become a recurring concern for Ohio's recreational and drinking water systems (*7*). This is likely related to increased nutrient runoff (e.g., phosphorus and nitrogen), warmer temperatures, and sunlight (*8*); however, it might also be at least partially explained by increased surveillance. Ohio's first do-not-drink advisory related to microcystin was issued in 2013 when levels in treated drinking water of Carroll Township exceeded the threshold of 1.0 μg/L (*9*); however, because of prompt connection to an alternative water source, community exposure to microcystin was unlikely. Therefore, the 2014 Lucas County incident was Ohio's first opportunity to investigate community needs and the public health response associated with elevated microcystin in publicly distributed municipal water.

Since the 2014 event, Ohio has continued to work on activities to help prevent future harmful algal bloom-related events and illnesses. Critical government and community partnerships, substantial resource investment, and guideline and legislation development have focused on addressing nutrient runoff, enhancing surveillance for toxin levels and harmful algal bloom-associated illness, and improving response efforts. In July 2015, after the release of the U.S. EPA's first guidelines* for safe levels of microcystin in drinking water, the Ohio EPA released modified microcystin thresholds for a do-not-drink advisory.† The new drinking water thresholds are 0.3 μg/L for special populations and children aged <6 years and 1.6 μg/L for adults and children aged ≥6 years; these thresholds are far below the levels reached during the 2014 event in Lucas County (which peaked at 3.19 μg/L), indicating a continued need for prevention efforts.

The findings in this report are subject to at least three limitations. First, sampling weights were created using information from the 2010 U.S. Census and did not account for potential population changes since 2010. Because of jurisdictional lines, the sampling frame was limited to the affected communities within Lucas County and did not include the other affected counties; these limitations might influence representativeness of the findings. Second, all responses were self-reported and questionnaires were administered approximately 6 weeks after the advisory, introducing the potential

* http://yosemite.epa.gov/opa/admpress.nsf/0/547DC50C15C82AAF85257E3D004D7F67.
† http://epa.ohio.gov/Portals/28/documents/HABs/PWS_HAB_Response_Strategy.pdf.

Summary

What is already known about this topic?

Cyanobacteria can cause harmful algal blooms when wind and water currents facilitate their development, or nutrient (e.g., phosphorus and nitrogen) runoff accumulates. Harmful algal blooms can produce toxic chemicals, including microcystin, which can potentially affect the health of humans and animals when contact with contaminated water occurs.

What is added by this report?

When microcystin contaminated a municipal water supply and a do-not-drink advisory was issued in Lucas County, Ohio, residents self-reported physical and mental health symptoms, primarily gastrointestinal symptoms, anxiety, and stress. Households also reported school and work closures, interrupted medical care, financial burdens, and use of alternative water sources after the advisory was lifted.

What are the implications for public health practice?

Governmental agencies and community partners need to engage in joint prevention and response efforts. When a community is exposed to microcystin and a do-not-drink advisory is issued, public health partnerships need to mobilize to provide timely communication, alternative water sources, and physical and mental health resources.

for recall bias. Finally, because of the wording of the survey question (asking whether household members experienced symptoms that they attributed to the advisory) and the absence of baseline data or a comparison group, the ability to draw conclusions about the association between microcystin exposure and health effects is limited, and no cause and effect conclusions can be drawn.

The findings of this assessment highlight the importance of using both traditional and nontraditional media outlets for public health communications during a do-not-drink advisory, and for continued consumer education to reduce exposure to municipal water during the advisory and promote use of the municipal water once the advisory is lifted. Therefore, focusing educational efforts on both improving consumer understanding of the advisory and improving understanding of the safety of the public water system once the advisory is lifted is warranted. Additionally, collaboration among government agencies, community organizations, local businesses, and health care is important to meet community water and health needs and minimize household burden related to a do-not-drink advisory. Finally, continued planning and investment in harmful algal bloom prevention and response efforts are critical for protecting the public's health.

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Raccoon Roundworm Infection Associated with Central Nervous System Disease and Ocular Disease — Six States, 2013–2015

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Baylisascaris procyonis, predominantly found in raccoons, is a ubiquitous roundworm found throughout North America. Although raccoons are typically asymptomatic when infected with the parasite, the larval form of *Baylisascaris procyonis* can result in fatal human disease or severe neurologic outcomes if not treated rapidly. In the United States, *Baylisascaris procyonis* is more commonly enzootic in raccoons in the midwestern and northeastern regions and along the West Coast (*1*). However, since 2002, infections have been documented in other states (Florida and Georgia) and regions (*2*). Baylisascariasis is not a nationally notifiable disease in the United States, and little is known about how commonly it occurs or the range of clinical disease in humans. Case reports of seven human baylisascariasis cases in the United States diagnosed by *Baylisascaris procyonis* immunoblot testing at CDC are described, including review of clinical history and laboratory data. Although all seven patients survived, approximately half were left with severe neurologic deficits. Prevention through close monitoring of children at play, frequent handwashing, and clearing of raccoon latrines (communal sites where raccoons defecate) are critical interventions in curbing *Baylisascaris* infections. Early treatment of suspected cases is critical to prevent permanent sequelae.

Despite expansion of the geographic distribution of *Baylisascaris procyonis* in the last 14 years (*2*) and probable increasing human exposure, baylisascariasis is likely an underreported disease: only 22 documented cases were reported in the United States during 1973–2010 (*3*,*4*). Laboratory and clinical diagnosis can be challenging: there is no commercially available serologic test in the United States, and although identification of larvae in tissue or specimens is confirmatory, this is not always possible or practical (*3*). If it is not considered in the differential diagnosis, baylisascariasis can be missed.

Baylisascaris procyonis eggs are passed in raccoon feces and become infectious after weeks to months in the environment. Infection occurs when soil or materials contaminated with feces containing infectious *Baylisascaris procyonis* eggs are ingested. Young children are at particular risk for infection if they place fecally contaminated objects or fingers into their mouths or have syndromes such as pica or geophagia. Once ingested, larvae migrate through the brain (neural larva migrans), eye (ocular larva migrans), and other organs (visceral larva migrans) (*1*).

Because there is no commercially available serologic test for baylisascariasis, a history of raccoon exposure and a high index of clinical suspicion are necessary to make the diagnosis. Serologic testing at CDC using a recombinant antigen rBpRAG1 immunoblot assay can aid in diagnosis by detecting *Baylisascaris procyonis* antibody in cerebrospinal fluid (CSF) and serum (*5*); however, because the assay detects immunoglobulin G antibodies, it is not possible to distinguish current from previous *Baylisascaris* infection, and detected antibody might represent an earlier exposure. Diagnosis of *Baylisascaris* ocular larva migrans is based on visualization of an appropriately sized larva in the eye, with or without serologic testing.

Neuroimaging studies can aid in the diagnosis of baylisascariasis. Although not diagnostic, the presence of diffuse deep white matter changes on magnetic resonance imaging (MRI) have been suggested as characteristic of baylisascariasis (*6*). A definitive diagnosis of neural larva migrans is based on compatible clinical findings and positive antibody test for *Baylisascaris*.

Baylisascaris serologic testing results were reviewed for serum, CSF samples, or both, and submitted to CDC during 2013–2015. Physicians of patients in whom antibody to *Baylisascaris procyonis* had been detected in either serum or CSF provided clinical summaries, imaging data, and laboratory data. Because of the overlap in geographic distribution, pathogenesis and clinical presentation of *Baylisascaris procyonis* and *Toxocara spp.*, a common roundworm of cats and dogs, all samples were also tested for *Toxocara spp.* antibodies.

During May 2013–December 2015, six cases of *Baylisascaris* neural larva migrans and one case of *Baylisascaris* ocular larva migrans were identified among patients from six states (California, Ohio, Oklahoma, [recurrent or persistent infection later diagnosed in Arkansas], Massachusetts, Minnesota, and Virginia), whose serum or CSF samples tested positive by the rBpRAG1 *Baylisascaris procyonis* immunoblot assay (Table). All patients tested negative for *Toxocara* and all survived, although some were left with severe neurologic deficits.

Case Summaries

Oklahoma and Arkansas. In May 2013, a female, aged 31 years with a history of Chiari malformation, and who

TABLE. Year and state of diagnosis, age and sex, clinical and laboratory* findings, and suspected exposure in seven cases of *Baylisascaris procyonis* infection — United States, 2013–2015

Year	State	Age	Sex	*Baylisascaris procyonis* rBpRAG1 Ab result (source)	Clinical finding	Suspected exposure	Outcome	Toxocara Ab result
2013	Oklahoma, Arkansas	31 yr	Female	05/2013: positive (serum); 05/2013: positive (CSF); 07/2014: positive (serum); 09/2014: positive (CSF)	Eosinophilic meningitis	Pet raccoon	Survived; neurologic deficits	Negative
2014	Ohio	15 mo	Male	05/2014: positive (serum); 08/2014: positive (serum); 08/2014: negative (CSF)	Eosinophilic meningitis	Patient's father hunted raccoons and sold pelts	Survived; full recovery	Negative
2014	Massachusetts	32 yr	Female	12/2014: positive (serum)	Eosinophilic meningitis	Hiking in raccoon-prevalent area	Survived; full recovery	Negative
2015	California	63 yr	Male	06/2015: positive (serum); 06/2015: positive (CSF)	Eosinophilic meningitis	Working in raccoon-prevalent areas	Survived; neurologic deficits	Negative
2015	California	3 yr	Male	08/2015: positive (Serum); 08/2015: positive (CSF)	Eosinophilic meningitis	Living in raccoon-prevalent area	Survived; neurologic deficits	Negative
2015	Virginia	10 mo	Female	08/2015: positive (serum); 08/2015: positive (CSF)	Eosinophilic meningitis	Geophagia in raccoon-prevalent area	Survived; neurologic deficits	Negative
2015	Minnesota	7 yr	Male	12/2015: positive (serum)	Ocular larva migrans	Living in raccoon-prevalent area	Survived; full recovery	Negative

Abbreviations: Ab = antibody; CSF = cerebral spinal fluid; rBpRAG1 = recombinant *Baylisascaris procyonis* RAG1 protein.
* *Baylisascaris procyonis* rBpRAG1 Ab testing and Toxocara Ab testing done at CDC.

owned a pet raccoon, was evaluated in Oklahoma for headaches and generalized pain. Analysis of CSF was consistent with eosinophilic meningitis (60% eosinophils), and *Baylisascaris procyonis* antibody was detected in both blood and CSF. The pet raccoon was removed from the home, and the patient was treated with albendazole and corticosteroids for 3 weeks and clinically improved; however, 16 months later, she was reevaluated in Arkansas for worsening headaches, nausea, photophobia, and sensory deficits. *Baylisascaris procyonis* antibody was again detected in CSF and serum, and the patient was retreated with albendazole and corticosteroids. It was unclear if this episode was caused by a recurrent or persistent infection. A ventriculoperitoneal shunt was placed to correct increased intracranial pressure. She survived with persistent neurologic deficits including intermittent headaches, sensory changes on her right side, diplopia, and gait disturbances.

Ohio. In May 2014, a male, aged 15 months from rural Ohio was brought to the hospital with lethargy and seizures and was found to have eosinophilic meningitis based on CSF testing. Despite the family's report that the child had no exposure to raccoons, clinical suspicion for baylisascariasis was high, based on the elevated CSF eosinophil count, and the fact that the family lived in an area where raccoons were prevalent. CSF samples were negative for *Baylisascaris procyonis* antibody; however, a serum sample was positive. The child was treated with albendazole and corticosteroids and survived without neurologic complications. It was later discovered that the patient's father hunted raccoons and stored raccoon pelts in a garage, where the child often played.

Massachusetts. In December 2014, a female, aged 32 years from rural Massachusetts was admitted to the hospital with a history of rapidly progressive right-sided sensory and motor deficits and decreased ability to concentrate. CSF contained 15% eosinophils but was negative for *Baylisascaris procyonis* antibody; however, serum was positive. All other microbiologic testing on CSF and serum was negative. The patient was hospitalized for several weeks. Large enhancing brain lesions found on MRI completely resolved with corticosteroid treatment alone (*4*). The patient showed a marked clinical improvement thereafter. Although no direct exposure to raccoons or raccoon feces was ever reported, the patient was known to hike in rural areas where raccoons are commonly found.

California. In June 2015, a male, aged 63 years from northern California was evaluated at a local hospital for a 2-week history of progressive memory impairment, loss of motor function, fatigue and confusion. He was found to have both peripheral blood and CSF eosinophilia (8% and 34%, respectively). He worked as a contractor, and his family reported that he rarely washed his hands before meals. Raccoons had been observed under his home and at his rural jobsite. *Baylisascaris procyonis* antibody was detected in both blood and CSF. The patient was treated with albendazole and corticosteroids for 6 weeks; 4 months after his diagnosis, he demonstrated partial recovery of cognitive and motor function (*7*).

In August 2015, a male, aged 3 years from California with a history of spastic paraplegia was admitted to the hospital with altered mental status and hypotonia and developed seizures while hospitalized. CSF analysis revealed 88% eosinophils and MRI findings were consistent with meningitis. Although no direct contact or evidence of feces ingestion was observed or reported, the child lived in a neighborhood where raccoons were common. Results of testing on both serum and

CSF detected *Baylisascaris procyonis* antibody. The patient was treated with albendazole and corticosteroids and was discharged to rehabilitation after a prolonged hospitalization. The patient suffered persistent neurologic deficits, including right-sided paralysis, incontinence, dysphagia, and apraxia.

Virginia. In August 2015, a female, aged 10 months from rural Virginia was found to have eosinophilic meningitis after being evaluated for altered mental status and seizures. The patient lived on a farm with her family and several dogs. There had been a witnessed episode of geophagia. *Baylisascaris procyonis* antibody was detected in both serum and CSF. She was treated with albendazole and corticosteroids and survived with substantial neurologic impairment. Although no specific raccoon exposure was reported, raccoons infected with *Baylisascaris procyonis* have been reported in Virginia (*1*).

Minnesota. In December 2015, a male, aged 7 years from rural Minnesota was evaluated at an ophthalmology clinic for a 1-week history of worsening vision in his right eye. Ocular examination and retinal imaging revealed a larva compatible in size with *Baylisascaris procyonis*. Routine blood tests showed no evidence of eosinophilia, and the patient had no neurologic abnormalities. He lived in an area where raccoons were common. Serum tests detected *Baylisascaris procyonis* antibody. CSF was not tested. The patient was treated with albendazole, and corticosteroids, and retinal photocoagulation laser therapy, and had near total recovery of his vision upon completion of therapy.

Summary

What is already known about this topic?

Baylisascaris procyonis, predominantly found in raccoons, is a ubiquitous roundworm found throughout North America. Infection can result in fatal human disease or severe neurologic outcomes if it is not treated rapidly. Only 22 documented cases were reported in the United States during 1973–2010; little is known about its actual prevalence or varied clinical presentation.

What is added by this report?

During May 2013–December 2015, seven cases of baylisascariasis not already described in the literature were identified among patients in the United States through testing at CDC, including six cases of central nervous system disease and one of ocular disease. Laboratory and clinical information for each patient was gathered and reviewed in a case series to contribute to knowledge about *Baylisascaris procyonis* infection. All seven patients survived, although approximately half had residual neurologic sequelae.

What are the implications for public health practice?

Prevention of baylisascariasis through close monitoring of children at play, frequent handwashing, especially after working or playing outdoors, and clearing of raccoon latrines, remain essential intervention strategies in curbing *Baylisascaris procyonis* infections. Prompt treatment after possible exposure to *Baylisascaris procyonis* is critical in preventing the devastating sequelae of infection. Communities should be aware of raccoons living in their area and take precautions to avoid accidental infection with *Baylisascaris procyonis.*

Discussion

The geographic distribution, clinical presentations, exposure history, and sequelae reported in this case series are similar to those previously reported (*3*,*8*); however, unlike most case reports of *Baylisascaris procyonis* infection, there were no deaths in this series. The patients in this series all lived in areas where raccoons are common. In all six patients with neural larva migrans, substantial eosinophilia was detected in the CSF, which is often found in *Baylisascaris procyonis* central nervous system disease (*8*). In the single case of ocular larva migrans, a larva compatible in size with *Baylisascaris procyonis* was visualized on retinal imaging. In all cases, antibody to *Baylisascaris procyonis* was detected by rBpRAG1 *Baylisascaris* immunoblot assay in a serum sample, a CSF sample, or both. All patients were treated with recommended regimens for baylisascariasis and all seven survived, although four were left with serious neurologic complications as a consequence of their infection.

The findings in this report are subject to at least two limitations. First, detection of *Baylisascaris procyonis* antibody is not a confirmation of current or active infection, but rather reflects a history of exposure to the parasite at some point. Other disease processes might have caused or contributed to the clinical presentation of the patients described here. However, in the absence of alternative, confirmed diagnoses, and given a history of raccoon exposure with compatible symptoms and response to baylisascariasis treatment, the patients presented were most likely infected with *Baylisascaris procyonis.* Second, all illnesses in this series were identified from specimens tested at CDC, and might represent an underestimate of the actual number of illnesses. Additional, undiagnosed illnesses, or illnesses diagnosed with testing conducted elsewhere were not collected in this series.

Because of the severity of most recognized illnesses associated with this disease, prevention and treatment of *Baylisascaris procyonis* infection are critical. Transmission can be prevented by avoiding contact with raccoons and their feces. Handwashing after contact with soil or outdoor play, and educating children not to put soil in their mouths are important prevention strategies. In addition to raccoons, other species of animals, such as kinkajous (*9*) and skunks that might be kept as pets can serve as *Baylisascaris* hosts and shed eggs in their feces. Wild animals should not be kept as pets, and susceptible exotic animal hosts should be tested and treated by a veterinarian if indicated. Although uncommon, infected dogs can also shed *Baylisascaris procyonis* eggs, therefore regular testing and

deworming of dogs by a veterinarian is important. Avoiding and safely clearing raccoon latrines can minimize the risk for accidental infection as well.

Treatment after a possible exposure to *Baylisascaris procyonis*, such as ingestion of raccoon feces, oral exposure to objects contaminated with raccoon feces or playing or working near raccoon latrines, is crucial to prevent the devastating sequelae of *Baylisascaris procyonis* infection (*3*). Physicians caring for patients with suspected or confirmed ingestion of raccoon feces should consider preemptive treatment to inhibit larval migration before development of clinical manifestations. Treatment should begin as soon as infection is considered, even if consideration is based on clinical suspicion or epidemiologic history alone. Patients with suspected exposure to *Baylisascaris procyonis* should immediately be started on a course of 20–50 mg/kg oral albendazole per day for 10–20 days, while further diagnostic investigations are being conducted (*6*). Additional information on *Baylisascaris procyonis* prevention, diagnosis and treatment, and sending samples to CDC for testing is available at http://www.cdc.gov/parasites/baylisascaris/.

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Cessation of Trivalent Oral Poliovirus Vaccine and Introduction of Inactivated Poliovirus Vaccine — Worldwide, 2016

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Since the 1988 World Health Assembly resolution to eradicate poliomyelitis, transmission of the three types of wild poliovirus (WPV) has been sharply reduced (*1*). WPV type 2 (WPV2) has not been detected since 1999 and was declared eradicated in September 2015. Because WPV type 3 has not been detected since November 2012, WPV type 1 (WPV1) is likely the only WPV that remains in circulation (*1*). This marked progress has been achieved through widespread use of oral poliovirus vaccines (OPVs), most commonly trivalent OPV (tOPV), which contains types 1, 2, and 3 live, attenuated polioviruses and has been a mainstay of efforts to prevent polio since the early 1960s. However, attenuated polioviruses in OPV can undergo genetic changes during replication, and in communities with low vaccination coverage, can result in vaccine-derived polioviruses (VDPVs) that can cause paralytic polio indistinguishable from the disease caused by WPVs (*2*). Among the 721 polio cases caused by circulating VDPVs (cVDPVs*) detected during January 2006–May 2016, type 2 cVDPVs (cVDPV2s) accounted for >94% (*2*). Eliminating the risk for polio caused by VDPVs will require stopping all OPV use. The first stage of OPV withdrawal involved a global, synchronized replacement of tOPV with bivalent OPV (bOPV) containing only types 1 and 3 attenuated polioviruses, planned for April 18–May 1, 2016, thereby withdrawing OPV type 2 from all immunization activities (*3*). Complementing the switch from tOPV to bOPV, introduction of at least 1 dose of injectable, trivalent inactivated poliovirus vaccine (IPV) into childhood immunization schedules reduces risks from and facilitates responses to cVDPV2 outbreaks. All 155 countries and territories that were still using OPV in immunization schedules in 2015 have reported that they had ceased use of tOPV by mid-May 2016.† As of August 31, 2016, 173 (89%) of 194 World Health Organization (WHO) countries included IPV in their immunization schedules.§ The cessation of tOPV use is a major milestone toward the global goal of eradicating polio; however, careful surveillance for polioviruses and prompt, aggressive responses to polio outbreaks are still needed to realize a polio-free world.

Global Cessation of Use of Trivalent Oral Poliovirus Vaccine

Although the global cessation of tOPV use is essential for eliminating cVDPV2s, cessation of tOPV use carries some risks for facilitating the spread of undetected or newly emergent cVDPV2s among persons without immunity to type 2 poliovirus infections after the switch to bOPV (*3–5*). To stop the spread of existing cVDPV2s before the switch and to reduce risks for post-switch outbreaks (*4*), population immunity to type 2 poliovirus at the time of the switch was boosted through implementation of 116 supplemental immunization activities (SIAs¶) with tOPV in 42 OPV-using countries during November 2015–April 2016. Afghanistan, Nigeria, and Pakistan also conducted SIAs with IPV in selected regions before stopping tOPV use. In addition, the synchronized timing of the switch aimed to prevent exportations of type 2 polioviruses from areas continuing to use tOPV to neighboring areas that have ceased tOPV use (*3,4*). All 155 countries and territories that used OPV in 2015 reported that they had terminated use of tOPV by May 12, 2016 (Figure 1). To facilitate global cessation of tOPV use, all manufacturers of OPV ended production of tOPV before the switch, after several years of communications and close coordination with the Global Polio Eradication Initiative (GPEI).**

* VDPVs are classified as cVDPVs if genetically linked examples of a VDPV strain are isolated from at least two persons who are not household contacts, from one person and at least one environmental surveillance (sewage) sample, or from two or more environmental surveillance samples collected from different environmental surveillance sites or collected from the same site more than 2 months apart.

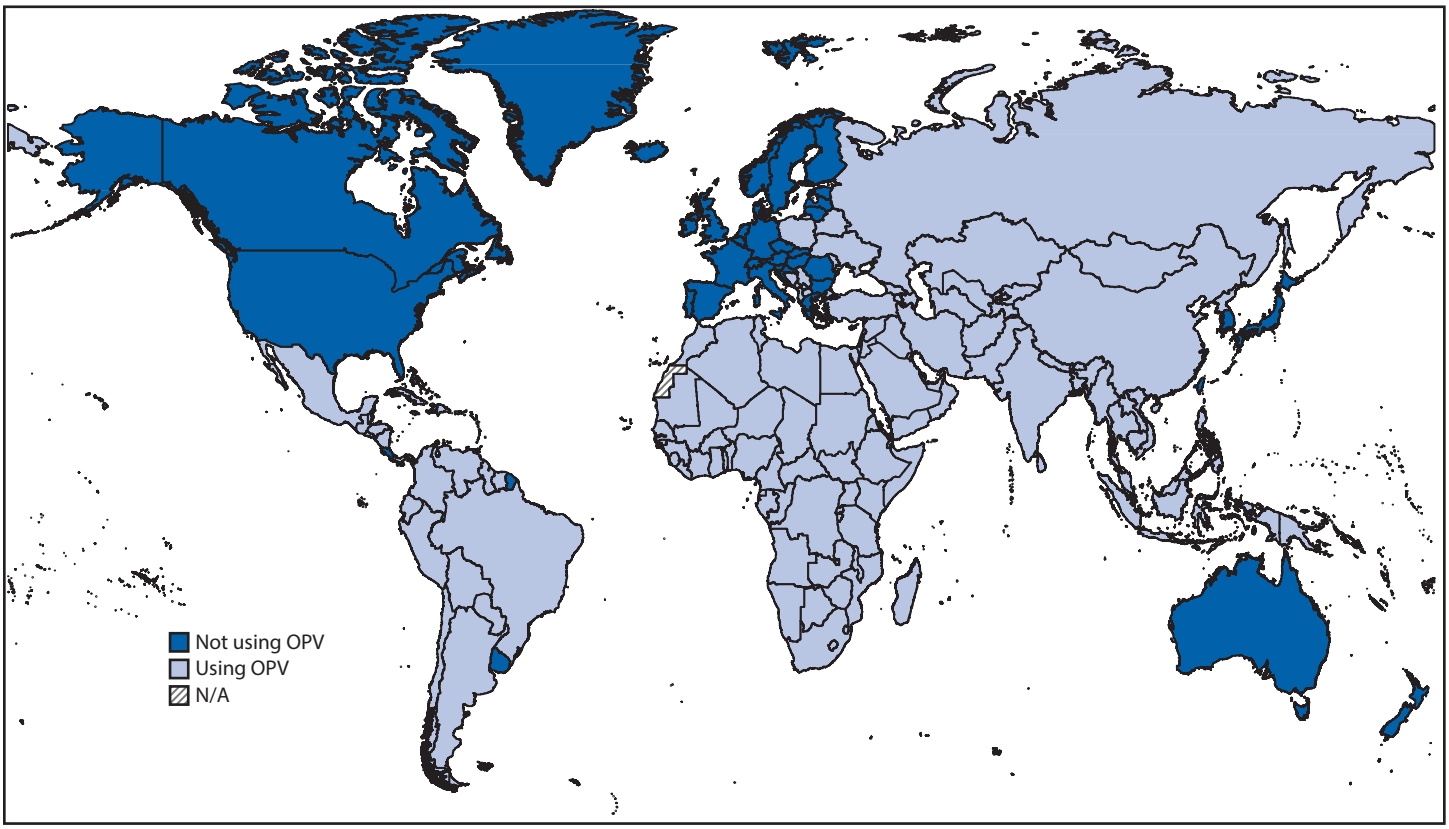
† Five countries reported ceasing all regular use of any OPV between early 2015 and March 2016. The other 150 countries and territories still using OPV in April 2016 all reported ceasing use of tOPV by May 12, 2016.

§ WHO tracks progress in the introduction of new vaccines by the number of WHO member states that have introduced a given vaccine. However, because of the need for even higher precision in tracking cessation of tOPV use, seven countries and territories using OPV in 2015 that are not full WHO member states were included in efforts to track tOPV use in addition to 148 countries using OPV in 2015 that are full WHO member states.

¶ Supplemental immunization activities are mass vaccination campaigns conducted over a short period (days to weeks), in this case, in which a dose of OPV is administered to all children aged <5 years, regardless of previous vaccination history. Campaigns can be conducted nationally or subnationally, in portions of a country.

** The Global Polio Eradication Initiative coordinates the global effort to eradicate polio; WHO, the United Nations Children's Fund, CDC, Rotary International, and the Bill and Melinda Gates Foundation are core partners.

FIGURE 1. Countries and territories using oral poliovirus vaccine (OPV) — worldwide, 2015



Abbreviation: N/A = not available.
Source: World Health Organization Immunization Repository.

To reduce the risk for inadvertent or intentional use of tOPV after the switch, which could lead to the emergence of new cVDPV2s (*5*), a combination of external and in-country monitors visited >160,000 vaccine stores and service delivery points in countries and territories participating in the switch. Monitors verified the absence of tOPV from each area's vaccine supply cold chain and helped ensure that any tOPV they found in the cold chain was removed. The monitors' findings in each country and territory were reviewed by a validation committee, whose assessment of whether or not tOPV had been removed from the cold chain was provided to the national government and later transmitted to WHO. By August 31, 2016, all but two countries and territories that used OPV in 2015 had submitted validation reports to WHO.

Type 2 poliovirus strains held in research or manufacturing facilities also might cause polio outbreaks if released into a population. To prevent such outbreaks, countries should ensure that all remaining type 2 polioviruses, including WPV2s, VDPV2s, and the type 2 Sabin polioviruses used in tOPV and monovalent OPV type 2 (mOPV2), are destroyed or appropriately contained in certified poliovirus-essential facilities in accordance with the third Global Action Plan to Minimize Poliovirus Facility-Associated Risk (GAPIII) (*3*,*6*).

If type 2 poliovirus outbreaks do occur, GPEI has developed a response protocol and assembled a global stockpile of mOPV2, managed by the United Nations Children's Fund and stored under containment conditions, to be released at the direction of the WHO Director-General. As of August 31, this stockpile contained approximately 36 million mOPV2 doses in finished vials. An additional 50 million mOPV2 doses will become available between September and December 2016, and another 50 million doses by March 2017. Hundreds of millions of doses stored in bulk form are also available for conversion into finished mOPV2 doses. GPEI has also created an IPV stockpile for use in outbreak responses. Surveillance for acute flaccid paralysis cases is supplemented by environmental surveillance for polioviruses in sewage in at least 36 countries to help identify and respond to the asymptomatic spread of type 2 polioviruses in those countries (*7*).

Global Introduction of Inactivated Poliovirus Vaccine

To further reduce the risk for type 2 poliovirus outbreaks after the cessation of tOPV use, the WHO Strategic Advisory Group of Experts (SAGE) on Immunization recommended in 2012 that all countries' immunization schedules include at least 1 IPV dose (*3*). IPV protects against paralytic polio from type 2 polioviruses, might facilitate interruption of transmission during cVDPV2 outbreaks by enhancing immunologic response to mOPV2 and reducing the duration and amount of viral shedding, and aids in eradicating WPV by boosting immunity to types 1 and 3 polioviruses in persons who have received bOPV or tOPV (*3*).

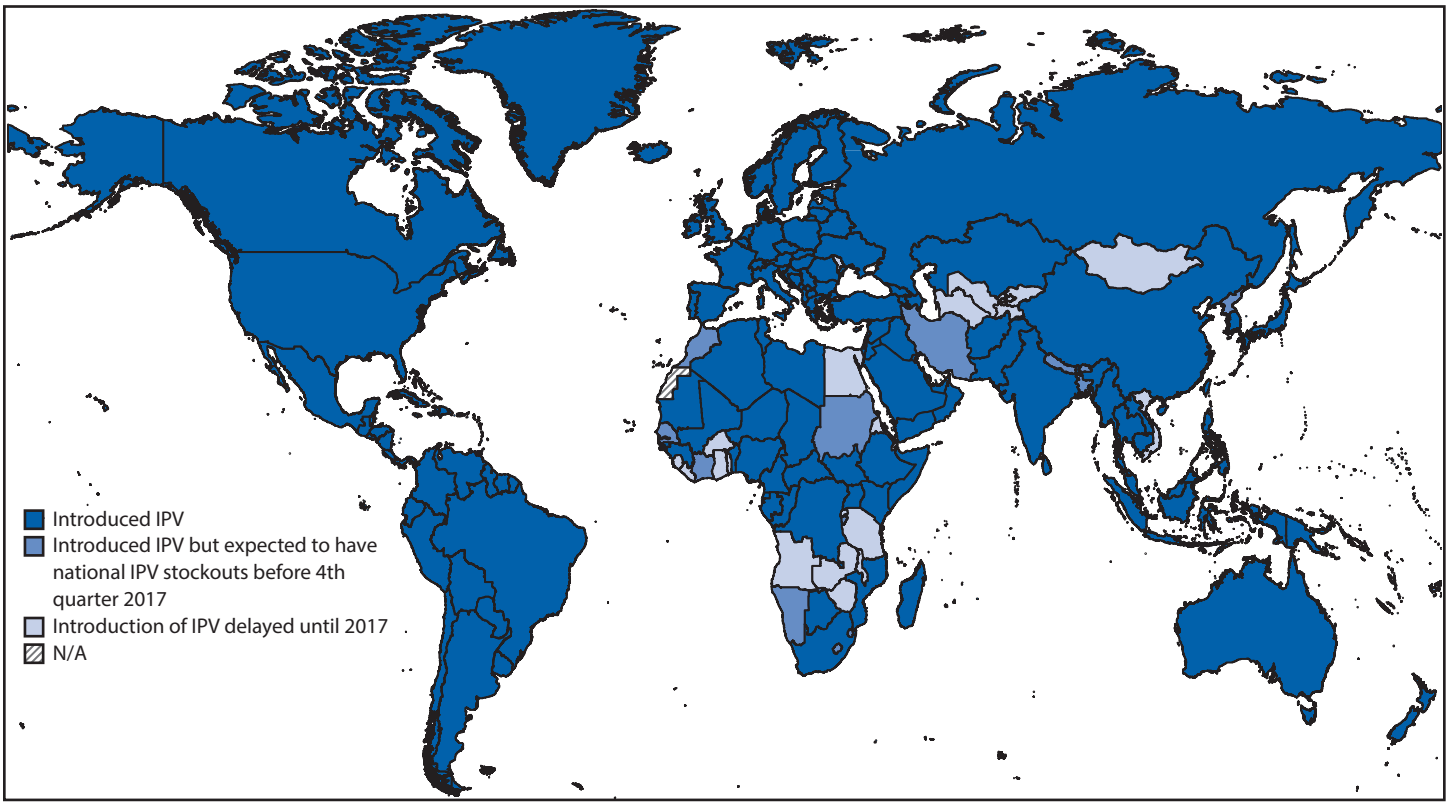
Efforts to introduce IPV in the 126 countries using only OPV at the beginning of 2013 have been hampered by challenges manufacturers have experienced in scaling up production to meet the increased demand for IPV, as well as increased need for IPV in SIAs targeting WPV1 in countries where polio is endemic and the need to stockpile IPV for outbreak response. As of August 31, 2016, among the 126 countries using only OPV at the beginning of 2013, a total of 105 (83%) had introduced IPV, resulting in 173 (89%) of 194 WHO member states using IPV. However, 20 countries have had to delay introduction of IPV until adequate supplies of IPV become available, which is not likely before the fourth quarter of 2017 (Figure 2). In addition, 29 countries that previously introduced IPV are expected to run out of IPV nationwide before they receive their next supply of IPV in late 2017, and Cabo Verde has opted to postpone its introduction until 2017 to avoid a similar stock-out.[††]

In response to the IPV shortage, GPEI has set priorities for allocating the limited IPV supply. The highest priority countries for receipt of IPV are Afghanistan, Nigeria, and Pakistan because of ongoing indigenous WPV transmission. The second priority is the other 33 countries considered to be at high risk for cVDPV2 outbreaks. The third priority for IPV allocation is SIAs conducted in response to polio outbreaks, and the final priority is countries considered to be at low risk for polio outbreaks.[§§] All countries considered to be at high risk for cVDPV2 outbreaks are providing IPV to infants through routine immunization service delivery. To use limited supplies

[††] Eight of these countries are Pacific island countries.

[§§] Countries are considered to be at high risk for a cVDPV2 outbreak if they have had a cVDPV outbreak since 2000, have endemic WPV transmission, or have estimated routine immunization coverage of <80% for the third dose of a vaccine containing diphtheria, tetanus, and pertussis antigens.

FIGURE 2. Status of introduction of inactivated poliovirus vaccine (IPV), by country — worldwide, August 31, 2016



Abbreviation: N/A = not available.
Source: World Health Organization Immunization Repository.

Summary

What is already known about this topic?

To address the risks posed by type 2 circulating vaccine-derived polioviruses, which have caused hundreds of paralytic poliomyelitis cases since 2006, the type 2 component of oral poliovirus vaccine was scheduled for global withdrawal through a synchronized switch from trivalent oral poliovirus vaccine (tOPV) to bivalent oral poliovirus vaccine (bOPV). All countries not already using inactivated polio vaccine (IPV) have committed to introducing it as part of their efforts to reduce risks associated with potential type 2 polio outbreaks after the switch.

What is added by this report?

All 155 countries and territories using OPV in their immunization programs in 2015 reported that they had completely ceased use of tOPV by mid-May 2016. As of August 31, 173 (89%) of 194 WHO countries had introduced inactivated polio vaccine (IPV) into their immunization programs despite a global shortage of IPV, although 29 of those countries are expected to deplete their supplies of IPV before being resupplied in 2017.

What are the implications for public health practice?

The cooperation of all OPV-using countries ending use of tOPV in a synchronized fashion is unprecedented. However, although the cessation of tOPV use is a major milestone toward the completion of the global effort to eradicate polio, vigilant surveillance for all polioviruses, including type 2 polioviruses, is still needed. Any tOPV found in a vaccine storage refrigerator or freezer in the future should be destroyed consistent with the Global Action Plan to Minimize Poliovirus Facility-Associated Risk. Any type 2 polioviruses detected in the future will require thorough investigation and an aggressive response.

of IPV efficiently, SAGE has recommended that countries consider administering 2 intradermal fractional doses of IPV to children eligible for IPV, instead of 1 full intramuscular dose (*8*). Two fractional doses of IPV, administered at separate visits, elicit a better immune response than a single full intramuscular dose of IPV, yet each fractional dose requires only one-fifth the volume of vaccine of a full intramuscular dose. Sri Lanka and India have begun administering 2 fractional doses of IPV to children through their routine immunization services.

Discussion

The synchronized global switch from tOPV to bOPV has gone smoothly based on the reported cessation of tOPV use in all countries and territories by mid-May 2016. The 721 cases of polio caused by cVDPV2s during 2006–2016 highlight both why the switch was necessary and why multiple precautions were taken to prevent cVDPV2s from emerging or spreading after the switch (*2*). Maintaining strong surveillance and response systems that can detect polioviruses, and responding promptly and aggressively when poliovirus is detected, will be essential for preserving and building upon the gains made against polio since 1988. The prompt detection and destruction of any tOPV vials found in the cold chain in the future, as well as of any mOPV2 vials found outside of the global mOPV2 stockpile after completion of an mOPV2 SIA, also will help to prevent new cVDPV2s from emerging in the future. Ultimately, the success of the withdrawal of tOPV and associated activities such as the tOPV and IPV SIAs held in the months before the switch and the global introduction of IPV will be measured by the number of polio cases caused by cVDPV2s that occur after tOPV withdrawal, with fewer cases indicating a greater success.

As of August 31, 2016, no new cVDPV outbreaks had been identified in 2016 (*2*). In April 2016, a cVDPV2 was identified in an environmental sample collected in March 2016 in northeastern Nigeria, before cessation of tOPV use, but genetic testing indicated that it is part of a known cVDPV2 lineage that was undetected after isolation from an environmental sample in early 2014 (*9*). Following the protocol for responding to detection of WPV2 after the switch and using the prepared mOPV2 stockpile, SIAs with mOPV2 were implemented in northeastern Nigeria after detection of the cVDPV2.¶¶ An SIA with fractional dose IPV is planned for the same area later in September, and SIAs with mOPV2 are planned for the high-risk neighboring countries of Cameroon, Chad, and Niger in October and November.*** The response to the identification in August of polio cases caused by WPV1 in northeastern Nigeria should lead to further strengthening of surveillance and, through vaccination, population immunity to polio infections in that area (*10*).

The introduction of IPV into the immunization schedules of 105 countries since 2013 is an important achievement, particularly given the challenges imposed by the global supply shortage. Continued external support for IPV introduction in countries that have not yet been able to introduce IPV but plan to do so once the supply shortages have been resolved and strengthening of routine immunization systems that distribute and administer IPV will help to maximize the benefit of IPV for all children.

The experience developed from tOPV cessation will contribute to the success of future efforts directed at the cessation

¶¶ New type 2 ambiguous vaccine-derived polioviruses (aVDPV2s), which are VDPV2s that cannot be classified as either circulating VDPV2s or immunodeficiency-related VDPV2s (iVDPV2s) after adequate investigation, had been identified in 2016 in the Democratic Republic of Congo, Egypt, India, Kenya, Nigeria, Pakistan, Senegal, and Syria, as of August 31. However, these aVDPV2s have generally had relatively few genetic changes compared with the attenuated Sabin polioviruses in OPV they are descended from, indicating they were detected relatively soon after they emerged. All of the affected countries conducted SIAs with tOPV in 2016 in preparation for the switch. Specifically in response to the detections of these aVDPV2s, a localized SIA with tOPV was held in early May in Egypt, a localized fIPV SIA was held in June in India, and a series of mOPV2 SIAs were conducted in Nigeria. In addition, a localized mOPV2 SIA and a localized fIPV SIA are planned in Pakistan.

*** As of August 31, 2016, additional VDPV2s had been identified in Ukraine and Yemen and had not yet been classified as cVDPV2s, aVDPV2s, or iVDPV2s because they were under investigation.

of all OPV use, primarily the withdrawal of bOPV. The cooperation of all OPV-using countries and territories in ending tOPV use in a synchronized manner is an unprecedented public health achievement. This synchronized withdrawal of tOPV followed over 2 years of preparation by and communications among GPEI, its partner organizations, OPV manufacturers, and country and territorial governments, and was achieved by essential work performed by immunization workers in the countries and territories that stopped use of tOPV. Active support from senior leaders of GPEI and national ministries of health was critical, as was the cooperation of all OPV manufacturers in ceasing production and distribution of tOPV and ensuring the availability and timely delivery of bOPV. Combined with the eradication of WPV, the ultimate withdrawal of all OPV from use will enable the creation of a polio-free world.

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Outbreak of Serogroup C Meningococcal Disease Primarily Affecting Men Who Have Sex with Men — Southern California, 2016

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During March 4–August 11, 2016, 25 outbreak-associated cases of meningococcal disease, including two deaths (8% case-fatality ratio), were reported in Southern California. Twenty-four of the cases were caused by serogroup C *Neisseria meningitidis* (NmC) and one by *N. meningitidis* with an undetermined serogroup (Figure). On June 24, 2016, in response to this increase in NmC cases, primarily among men who have sex with men (MSM) in Los Angeles County, the city of Long Beach, and Orange County, the California Department of Public Health (CDPH) issued a press release and health advisory, declaring an outbreak of NmC in Southern California (*1*).

During 2010–2016, clusters of NmC among MSM were reported in the United States in New York City (2010–2013), Los Angeles County (2012–2014), and Chicago (2015–2016), as well as in Europe, with clusters in Berlin (2012–2013) and Paris (2014) (*2–4*). In response to these clusters, the affected jurisdictions recommended vaccination with serogroup C–containing meningococcal vaccines. In the previous Los Angeles County cluster during 2012–2014, MenACWY vaccination recommendations were based on risk behaviors identified, and included MSM with human immunodeficiency virus (HIV) infection and MSM, regardless of HIV status, who regularly had close or intimate contact with multiple partners or sought partners through the use of digital applications ("apps"), particularly those who shared cigarettes or marijuana, or used illegal drugs. This vaccine recommendation had remained in place in Los Angeles County since that time.

The exact population size of MSM living in the currently affected communities is unknown. Denominators for calculating attack rates were estimated by using the US Census Bureau's American Community Survey for males aged ≥18 years (*5–7*).

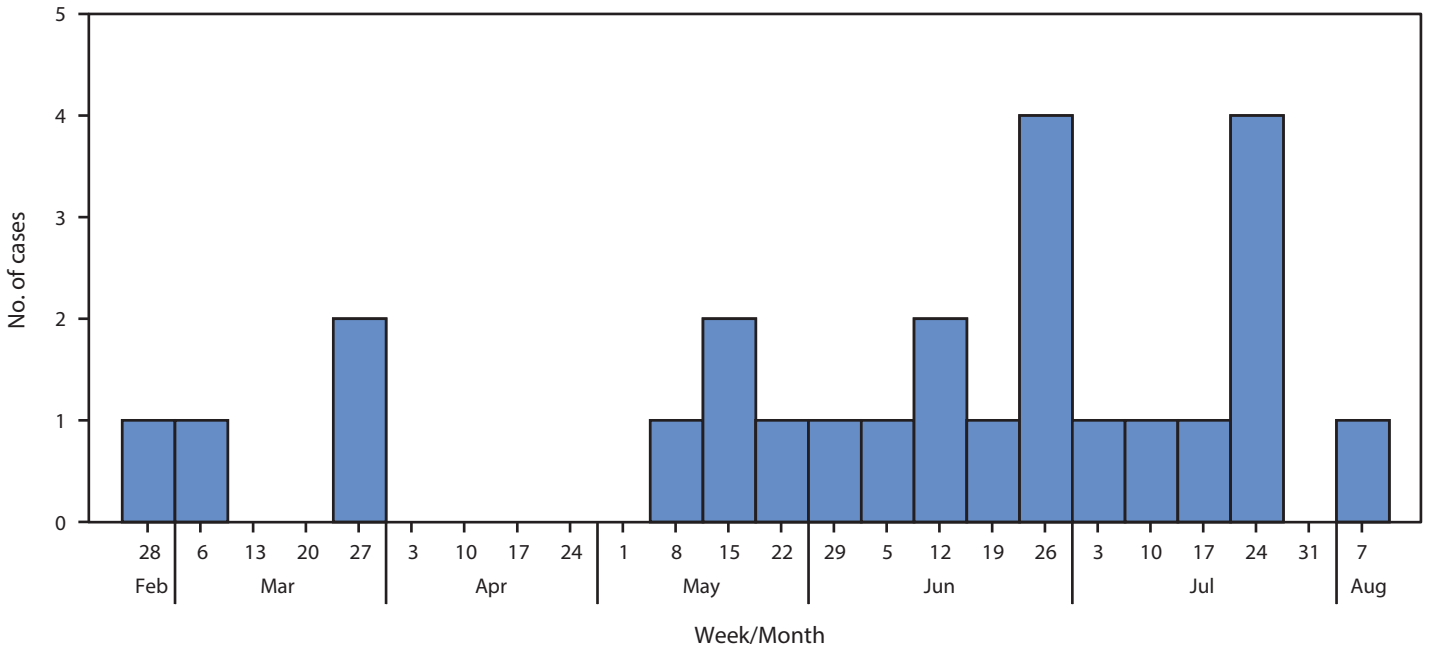
Of the 25 cases in the current outbreak, 23 (92.0%) patients were male, 20 (87.0%) of whom self-identified as MSM. Among MSM, eight (40.0%) reported Hispanic ethnicity, consistent with the proportion of Hispanic persons among the overall population of the three jurisdictions combined, and the median age was 32 years (range: 17–74 years). The estimated NmC attack rate among MSM in the three affected jurisdictions was 6.4 cases per 100,000 MSM which is more than 50 times the incidence of meningococcal disease among males aged ≥18 years in the United States in 2015 (0.12 cases per 100,000 population) (CDC, unpublished data, 2016).

Ten of the 25 cases occurred among residents from Los Angeles County, seven in residents from Long Beach, seven in residents from Orange County, and one in a resident of another state who traveled to Los Angeles in the week before illness onset. Two of the patients were known to have HIV infection. No direct epidemiologic linkages, geographic concentration, visits to common events or venues, or behaviors such as drug use or multiple sexual partners were consistently identified among the MSM patients. Through whole genome sequencing, isolates from 16 patients were identified as belonging to sequence type ST-11 and clonal complex CC11 with an identical molecular profile (PorA P1.5-1, 10-1; FetA F3-6; PorB 2-285). Whole genome sequencing results for the remaining isolates are pending.

On July 26, 2016, given the absence of identifiable risk groups among MSM, in contrast to the previous Los Angeles County cluster (2012–2014), local health departments in Los Angeles County, Long Beach, and Orange County, along with San Diego County, in consultation with CDPH, expanded their vaccination recommendations to include all MSM regardless of risk behaviors, residing in the respective jurisdictions (*8*). Outreach and vaccination activities are ongoing in collaboration with community-based organizations, pharmacies, and health care providers. The Advisory Committee on Immunization Practices recently discussed use of MenACWY vaccine among MSM and HIV-infected persons (http://www.cdc.gov/vaccines/acip/meetings/meetings-info.html) and in June 2016 recommended that all HIV-infected persons be routinely vaccinated with MenACWY (http://www.cdc.gov/vaccines/acip/index.html).

Increased awareness of the signs and symptoms of meningococcal disease (http://www.cdc.gov/meningococcal/about/symptoms.html) and prompt early case recognition among health care providers are critical. During investigations of meningococcal disease caused by any serogroup, health departments are encouraged to assess HIV status of all patients and sex of sex partners in cases occurring among males aged ≥16 years (*3*). If permitted by state law, state health departments are asked to complete a supplemental case report form (available at http://www.cdc.gov/meningococcal/

FIGURE. Outbreak-associated cases of meningococcal disease, by week — Southern California, 2016



surveillance/index.html) for all cases of meningococcal disease occurring among MSM, submit the forms to CDC via secure e-mail (meningnet@cdc.gov) or via secure fax (404-315-4681), and submit any available isolates to CDC for whole genome sequencing. In addition, health departments should assess NmC patients for epidemiologic linkages to the Southern California region to identify additional cases possibly related to this ongoing outbreak.

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Notes from the Field

Varicella Outbreak Associated with Riding on a School Bus — Muskegon County, Michigan, 2015

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On December 3, 2015, Public Health–Muskegon County (PHMC) in Michigan was notified by a local kindergarten–grade 2 school that a student aged 8 years (the index patient) had been sent home because of a rash suspected to be varicella (chickenpox); the rash had not been observed the previous day. Investigation by PHMC revealed that the student was one of five siblings in household A, none of whom had a history of having received any immunizations. During the preceding month the index patient's two older siblings (aged 12 years and 25 years) and two younger siblings (twins, aged 4 years) had been excluded from other schools in this rural district because of rashes that also were suspected to be varicella. Investigators also learned that a parent in household A had received a physician diagnosis of herpes zoster (shingles) nearly 7 weeks earlier, on October 20, after having been evaluated for a painful, unilateral trunk rash that had begun 3 days earlier, and for which acyclovir was prescribed. PHMC could not confirm whether any advice regarding prevention of possible transmission of varicella zoster virus to susceptible contacts was provided. The other children in household A had rash onsets on November 3, November 18 (two children), and November 22. The index patient rode a school bus and was the first student on and the last off each day; none of the index patient's four siblings attended the same school or rode on the same school bus as the index patient. Public health investigators subsequently linked three more cases in children to sharing the same school bus as the index patient.

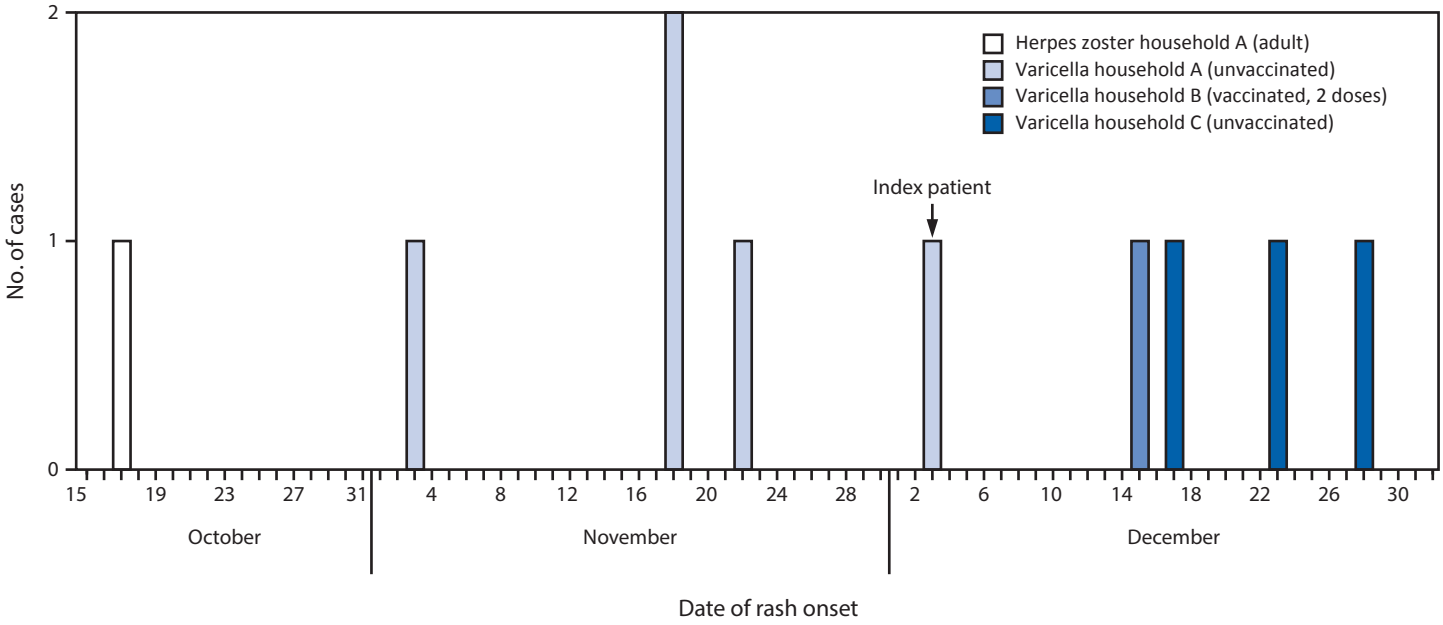
Three children from two additional households (household B and household C) who routinely rode the same school bus as the index patient also received diagnoses of varicella. The first case was diagnosed in a fully immunized student aged 7 years who resided in household B, and had rash onset on December 15 (Figure). That diagnosis was subsequently confirmed from a cutaneous lesion swab by polymerase chain reaction (PCR). This student rode on the same bus as the index patient for approximately 40 minutes in each direction each day. The next two cases occurred in siblings from household C, aged 7 years and 5 years, who had rash onset on December 17 and December 23, respectively. On December 28, a rash suspected to represent varicella was noted in a younger sibling (aged 17 months) of the two patients from household C. None of the three children in household C had been vaccinated against varicella. The diagnosis in the second sibling (aged 5 years) was also confirmed by PCR testing from a cutaneous lesion swab. None of the four children in households B and C were related to or interacted socially with members of household A; nor did the child in household B share any classes, lunchrooms, or recess with children in household C. It is not known whether the three students from households B and C sat next to or otherwise interacted with the index patient during the bus ride. No other cases of varicella had been reported in that school district during that school year. The reported coverage with at least 1 dose of varicella vaccine in the school was 96% and for coverage with 2 doses was 95%.* The overall coverage rate with all required immunizations for the school was 95%; 2% of children had waivers, and immunizations for 3% of children were incomplete.

This outbreak of varicella appears to have begun with an adult case of herpes zoster and resulted in nine cases of varicella in children residing in three households. The timeline of rash onsets is consistent with the 10–21 day incubation period for varicella (Figure). With continued 2-dose childhood varicella vaccination and declining incidence of varicella among children (*1*), transmission of varicella initiated by adults with herpes zoster might become increasingly more likely (*2*). This investigation also strongly suggests that transmission of varicella to children residing in households B and C occurred while riding the same school bus as the index patient. Varicella transmission on school buses is plausible and was implicated previously as a risk factor for transmission in a large varicella outbreak reported in China (*3*). Public health investigators who see similar findings might consider the close proximity of students in a relatively small, enclosed space, such as a school bus, as a risk factor for airborne transmission of diseases such as varicella.

This investigation underscores the importance of maintaining high 2-dose varicella immunization levels to reduce risk for disease transmission. The high immunization rates achieved in this school likely limited the scope of the varicella outbreak. Two doses of varicella vaccine are routinely recommended for children at age 12–15 months and age 4–6 years (*4*). In addition, contacts of patients with varicella or herpes zoster should immediately be evaluated for evidence of varicella immunity to determine need for postexposure varicella vaccination. Early vaccination of exposed susceptible persons can prevent disease and transmission.

*Michigan IP100 Report, February 2016 Reporting Period, 6124008057. Michigan schools and licensed childcare centers are required to report Immunization Program (IP) compliance on students aged ≤18 years to their local health department (https://www.mcir.org/school-childcare/reporting-immunization-program-status-to-the-health-department/).

FIGURE. Dates of varicella (chickenpox) rash onset among children in outbreak,* and date of diagnosis of herpes zoster (shingles) in the initiating parent in household A — Michigan, October–December, 2015



* The patient with rash onset December 28 was aged 17 months and did not attend school.

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Notes from the Field

Splenomegaly of Unknown Etiology in Congolese Refugees Applying for Resettlement to the United States — Uganda, 2015

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Approximately 70,000–90,000 refugees are resettled to the United States each year, and during the next 5 years, 50,000 Congolese refugees are expected to arrive in the United States. The International Organization for Migration (IOM) performs refugee medical examinations overseas for the U.S. Refugee Resettlement Program. In 2014, IOM reported that a large number of U.S.-bound Congolese refugees from Uganda had spleens that were enlarged on examination. During two evaluations of refugee populations in western Uganda in March and July 2015, refugees with splenomegaly on physical examination were offered additional assessment and treatment, including abdominal ultrasonography and laboratory testing. Among 987 persons screened, 145 (14.7%) had splenomegaly and received further testing. Among the 145 patients with splenomegaly, 63.4% were aged 5–17 years (median = 14.8 years). There was some evidence of family clustering, with 33 (22.7%) of the 145 cases occurring in families.

Overall, 144 of the 145 patients had abdominal ultrasonography, 122 (84.7%) of whom had massive splenomegaly (defined as >4 standard deviations above the local mean for splenic size, adjusted for height, based on the World Health Organization ultrasonography protocol) (*1*); 135 (93%) patients had normal liver architecture; and eight (5.5%) had hepatic nodules or masses. Specimens from 39 (26.9%) patients tested positive for malaria using rapid diagnostic testing; thin blood smear tests performed for all 145 cases were negative (thick films were not performed). Specimens from 134 (92.4%) patients were positive for *Plasmodium falciparum* merozoite surface protein 1 immunoglobulin G, indicating past exposure to *P. falciparum*. Specimens from three persons (2.1%) were positive for *Schistosoma mansoni* ova by stool wet preparation; no *Schistosoma* ova were detected in urine specimens. Enzyme-linked immunosorbent assay (rK39 ELISA) tests for infection by *Leishmania* were negative for all patients; however, one (0.7%) patient was positive by serology. Specimens from five (3.5%) patients were positive for hepatitis B surface antigen, and 10 (6.9%) had detectable hepatitis C virus antibodies.

Fewer than 33% of refugees had evidence of an active infection known to cause splenomegaly at the time of assessment (via positive malaria antigen, hepatitis B antigen, or *Schistosoma* ova). Low rates of serologic evidence of past or current leishmaniasis and hepatitis C eliminated these diseases as a common etiology. Although a definitive underlying etiology could not be determined, malaria-associated splenomegaly is one consideration: among potential infectious agents, malaria was the most prevalent, although active infection was found in less than one third of persons with splenomegaly. Malaria-associated splenomegaly is a diagnosis of exclusion and occurs following repeated malaria infections. The condition persists despite the absence of active parasitemia and usually resolves within 6 months after antimalarial treatment if subsequent malaria exposure can be prevented (*2*). Because no alternative diagnosis was identified, and because of the risk for severe sequelae of untreated malaria and the low risk for adverse effects of malaria medications, all refugees with splenomegaly were empirically treated for malaria with artemether-lumefantrine at the time of diagnosis, and were provided with bed nets for further prevention. In addition, all refugees received predeparture artemether-lumefantrine, as routinely administered during IOM predeparture examinations, per CDC recommendations; thus, persons with detectable splenomegaly received two treatment courses for blood-stage malaria infection before departure (*3*). CDC has recommended further laboratory and radiology testing for all refugees with splenomegaly after relocation to the United States, including repeat malaria testing in symptomatic patients (using one or more of the following: thick/thin blood smears, rapid diagnostic test, or malaria polymerase chain reaction testing) and empiric treatment with primaquine (after assuring normal glucose-6-dehydrogenase levels). Testing for additional etiologies of splenomegaly in this population and clinical support to receiving states and providers is ongoing. Because the interval between diagnosis of splenomegaly and departure to the United States was short, only a limited diagnostic and treatment protocol was developed. However, splenomegaly is a challenging clinical entity that appears to be an emerging, highly prevalent condition in Congolese refugees. Further investigation into its etiology and directed management is needed.

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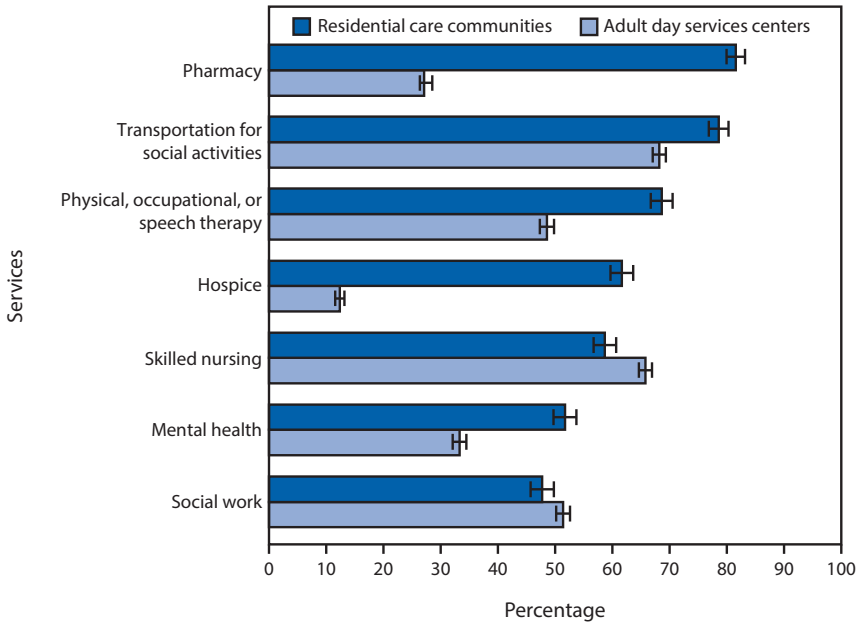
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentages* of Residential Care Communities and Adult Day Services Centers That Provided† Selected Services — United States, 2014



* Differences between residental care communities (e.g., assisted living) and adult day services centers are statistically significant at $p<0.05$; 95% confidence intervals are shown.

† Provided by paid employees, arranged for and paid by outside providers, or arranged for or referred to outside providers that are paid by others.

In 2014, a greater percentage of residential care communities than adult day service centers provided five of seven selected services. The majority of residential care communities provided pharmacy services (82%); followed by transportation for social activities (79%); physical, occupational, or speech therapy (69%); hospice (62%); skilled nursing (59%); and mental health services (52%). Fewer than half provided social work services (48%). The majority of adult day services centers provided transportation for social activities (69%); skilled nursing (66%); and social work (52%). Fewer than half provided physical, occupational, or speech therapy (49%). One third or less provided mental health (33%), pharmacy (27%), and hospice services (12%).

Source: Harris-Kojetin L, Sengupta M, Park-Lee E, et al. Long-term care providers and services users in the United States: data from the National Study of Long-Term Care Providers, 2013–2014. Vital Health Stat 3(38). 2016. http://www.cdc.gov/nchs/data/series/sr_03/sr03_038.pdf.

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