附件 1

Notes from the Field

Outbreak of Acute Lead Poisoning Among Children Aged <5 Years — Zamfara, Nigeria, 2010

On May 8, 2010, the Nigerian Federal Ministry of Health assembled federal, state, and international organizations to investigate reports of death from lead poisoning in at least six villages in Zamfara, Nigeria. Participating organizations included CDC, the Nigerian Field Epidemiology and Laboratory Training Program, World Health Organization (WHO), and Medecins Sans Frontieres (MSF). Eight days later, on May 16, 2010, a multidisciplinary team began an investigation in two affected villages, including administering a house-to-house questionnaire, collecting blood from selected children aged <5 years, and analyzing blood and environmental samples for lead.

From May 23 to June 4, 2010, the team surveyed 119 family compounds. In the 12 months beginning May 2009, 118 of 463 (26%) children aged <5 years in the surveyed compounds died; 82% of deaths had occurred within the preceding 6 months. Parents reported that 82% of children who died had convulsions before death, a sign of severe lead poisoning (*1*). Blood samples collected from 205 living children aged <5 years all revealed lead poisoning (≥10 μg/dL), and 97% of children had levels above the threshold (≥45 μg/dL) for initiating chelation therapy (*2*). Blood lead concentrations ranged from 33.3 to 445 μg/dL. Two thirds of households reported processing gold ore rich in lead (breaking, grinding, and drying ore) inside family compounds; 76% of households had begun within the preceding 12 months. Lead concentrations in soil and dust ranged from 45 parts per million (ppm) to >100,000 ppm; 85% of family compounds exceeded the U.S. Environmental Protection Agency standard (400 ppm) for areas where children are present (*3*).

Control measures have included initiating chelation therapy when appropriate, identifying and remediating contaminated areas, developing public health messages, and controlling mining activities. As of July 13, MSF had provided oral chelation therapy to 166 children in a local hospital. Most children have responded well, with convulsions resolving within 1 day of initiating treatment. On June 8, environmental remediation (e.g., removal of contaminated soil) began in two villages. Active case identification in other villages, an assessment of animal health, and discussions about long-term monitoring and support of lead-poisoned children are ongoing.

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附件3

Centers for Disease Control and Prevention

MMWR Morbidity and Mortality Weekly Report

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Human Paragonimiasis After Eating Raw or Undercooked Crayfish — Missouri, July 2006–September 2010

Paragonimiasis is a parasitic disease caused by *Paragonimus* trematodes, commonly known as lung flukes. Humans become infected by eating raw or undercooked crayfish (also known as crawfish and crawdads) or freshwater crabs that harbor the parasites. Paragonimiasis most frequently involves the lungs, but can affect other organs, including the brain and skin. In North America, *Paragonimus kellicotti* causes infections among dogs, cats, and wild carnivores, but rarely infects humans (*1*). Paragonimiasis is not a nationally notifiable condition. In September 2009, physicians from the Washington University School of Medicine (WUSM) in St. Louis published details of three paragonimiasis cases diagnosed since July 2006 in persons who had eaten raw crayfish from rivers in Missouri (*2*), prompting the Missouri Department of Health and Senior Services (MDHSS), CDC, and WUSM to collaborate in paragonimiasis surveillance and prevention. During September 2009–September 2010, six additional cases were diagnosed in Missouri. These nine patients, aged 10–32 years, had fever, cough, pleural effusion, and eosinophilia. All had eaten raw or undercooked crayfish from rivers in Missouri while on canoeing or camping trips within 4 months of illness onset. Health-care providers should consider paragonimiasis when examining patients with unexplained fever, cough, eosinophilia, and pleural effusion or other chest radiographic abnormalities and should ask those patients whether they have eaten raw or undercooked crayfish.

The WUSM article (*2*) and reports of two paragonimiasis cases in October 2009 prompted MDHSS, the Missouri Department of Natural Resources, and the Missouri Division of Tourism to distribute posters warning against eating raw or undercooked crayfish to campers and canoe outfitters in November 2009. After the sixth case was reported in April 2010, MDHSS issued a health advisory on April 30 to enhance health-care provider awareness about paragonimiasis and to request voluntary reporting of cases. MDHSS developed an investigation form and revised the Missouri Health Surveillance Information System for reporting of paragonimiasis. In May, WUSM issued a press release to publicize the series of six cases, resulting in an additional patient (patient 7) seeking evaluation in June, 10 months after illness onset and after having undergone multiple diagnostic tests and failed treatments. In September, a medical center in northwest Missouri reported the other two cases.

Clinical information and exposure histories were collected through medical record review and interviews of patients and the parents of a patient by attending physicians. Sputum, stool, pleural effusion, and lung biopsies, if available, were examined microscopically for *Paragonimus* parasites or eggs. Serum samples were tested for *Paragonimus* antibodies by enzyme-linked immunosorbent assay (ELISA) at a commercial laboratory or by immunoblot assay at CDC. Seven patients lived in Missouri and two in Illinois (Table). All nine patients had eaten raw or undercooked crayfish directly taken from rivers in Missouri (i.e., Current, Jacks Fork, Huzzah, Little Niangua, and Meramec) while canoeing or camping within the months of May–August during 2006–2010. Among the eight adults, seven had eaten raw crayfish during group canoe trips, and the other had eaten undercooked crayfish while camping. Seven adults had eaten raw or undercooked crayfish after alcohol consumption; two had eaten raw crayfish on dares. The child had eaten a small raw crayfish while camping to demonstrate outdoor survival skills to other children.

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TABLE. Characteristics of nine patients with paragonimiasis — Missouri, July 2006–September 2010

Patient	Age (yrs)	Sex	Crayfish ingestion		Incubation period (wks)	Onset to diagnosis (wks)	Basis of diagnosis
			Date	Source river			
1	31	Male	Jun 2006	Jacks Fork and Current	2	3	Clinical history and findings, and response to therapy; IB negative
2	26	Female	Jul 2007	Meramec	2	12	ELISA positive
3	32	Male	Aug 2007	Current	3	12	ELISA positive
4	28	Male	Jun 2009	Huzzah	8	12	ELISA positive; IB negative
5	10	Male	May 2009	Current	16	3	Clinical history and findings, and response to therapy; IB negative
6	20	Male	Jun 2009	Jacks Fork	12	36	IB positive
7	22	Male	Aug 2009	Jacks Fork	6	40	Sputum cytology, IB positive
8	18	Male	Jun 2010	Jacks Fork	3	10	IB positive
9	27	Male	Aug 2009	Little Niangua	12	45	Bronchoalveolar lavage fluid cytology, IB positive

Abbreviations: ELISA = enzyme-linked immunosorbent assay; IB = immunoblot assay.

Illness onset ranged from 2–16 weeks after crayfish ingestion. Common signs and symptoms were fever (100%), cough (100%), weight loss (56%), malaise (56%), chest pain (44%), dyspnea (44%), myalgia (44%), and night sweats (44%). Cough was not among the earliest indicators for patients 1, 4, and 7. Patient 1 experienced fever and headache 3 weeks before the onset of mild nonproductive cough. Two patients (patients 4 and 7) experienced upper-abdominal pain 6–8 weeks after crayfish ingestion. Patient 4 underwent emergency cholecystectomy for suspected acute cholecystitis, but his resected gall bladder was normal. Patient 7 experienced acute chest pain 2 weeks after experiencing abdominal pain. In addition, patient 8 experienced bilateral spontaneous pneumothoraces 3 weeks after the onset of fever, dyspnea, and nonproductive cough. These clinical manifestations likely were caused by *P. kellicotti* migration through the diaphragm into the pleural space and lungs.

During routine clinical care, all patients received a presumptive diagnosis of paragonimiasis 3–45 weeks after illness onset. All had eosinophilia (range: 850–3,900 eosinophils/mm^3; eosinophil percentage:

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7%–40%) and pleural effusion. Pleural effusions were analyzed for six patients. Five patients had eosinophilic pleural effusion, defined as a pleural effusion with ≥10% eosinophils (eosinophil percentage: 44%–90%; normal: ≤3%). Other chest radiologic abnormalities included pulmonary nodules (four patients), pericardial effusion (three patients), pulmonary infiltrates (three patients), and pneumothorax (one patient). Extrapulmonary complications included migratory skin nodules (four patients), cardiac tamponade (one patient), and cerebral lesions (one patient) associated with blurred vision.

P. kellicotti eggs were identified in sputum or bronchoalveolar lavage fluid from two patients 40–45 weeks after illness onset. *Paragonimus* antibodies were positive by ELISA or immunoblot for seven patients (Table). Among seven patients (patients 1 and 4–9) whose serum samples were tested for *Paragonimus* antibodies by immunoblot, three (patients 1, 4, and 5) tested negative in two consecutive serum samples collected ≥1 month apart. An acute serum from patient 4 was tested by ELISA; the result was positive. Patients 1 and 5 were diagnosed on the basis of their clinical histories and findings and response to therapy.

All patients were treated with 75 mg praziquantel per kilogram of body weight in 3 divided doses for 2–3 days. Their symptoms promptly improved. All symptoms, eosinophilia, and radiographic abnormalities resolved within 1–3 months of treatment.

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Editorial Note

During 1965–2007, only six other cases of nonimported paragonimiasis were reported in the United States, occurring in Colorado, Iowa, Michigan, Missouri, and Oklahoma. Among those six patients, five had eaten crayfish (*3–8*). This report of nine cases recently identified in Missouri highlights the need for increased awareness of this underrecognized disease and public education to prevent it.

What is already known on this topic?

Paragonimiasis, a rare parasitic disease in the United States, is caused by *Paragonimus* trematodes (lung flukes) that infect humans who eat raw or undercooked crayfish or freshwater crabs that harbor the parasites.

What is added by this report?

During July 2006–September 2010, nine cases of paragonimiasis were identified by physicians within 4 months of illness onset in patients who had eaten raw or undercooked crayfish from rivers in Missouri while canoeing or camping.

What are the implications for public health practice?

Efforts are needed to educate the public, especially persons involved in recreation along streams and rivers, to avoid eating uncooked crayfish. Healthcare providers should consider paragonimiasis in patients who have eaten raw or undercooked crayfish and have unexplained fever, cough, eosinophilia, and pleural effusion or other chest radiographic abnormalities.

The life cycle of *P. kellicotti* requires two intermediate hosts. The first intermediate host is a snail (e.g., *Pomatiopsis lapidaria*), and the second is crayfish, principally *Cambarus* spp. (*1*). After humans eat raw or undercooked crayfish that harbor *P. kellicotti*, the parasite penetrates through the intestinal wall into the peritoneal cavity, then through the diaphragm into the pleural space and lungs, and can migrate to other organs, including the brain and skin. Eggs laid in lungs are excreted in sputum, or swallowed and passed with stool. *Paragonimus* species are endemic in Africa, the Americas, and Asia, but the distribution of *P. kellicotti* is still being determined (*1*).

Behavioral factors that led patients in this report to eat raw or undercooked crayfish included alcohol consumption, dares, and demonstration of survival skills. Eight of the nine patients were males. Although crayfish commonly is regarded as food in survival situations, persons who learn or practice survival skills should be cautioned that eating raw or undercooked crayfish carries a risk for paragonimiasis and other diseases (*9*). Owners and customers of campgrounds and canoe rental businesses should be alerted to thoroughly cook crayfish before eating. The Food and

Drug Administration advises cooking shellfish to an internal temperature of 145°F (63°C).*

Early symptoms of paragonimiasis include diarrhea, abdominal pain, and fever, which can occur 2–15 days after eating infected crayfish. Later manifestations include fever, cough, hemoptysis, and chest radiographic abnormalities, which occur when the parasite migrates to lungs. Migration of the parasite to the brain can cause severe complications, including vision loss. Eosinophilia in blood or pleural effusion is a supportive laboratory finding.

Definitive paragonimiasis diagnosis classically is based on viewing *Paragonimus* eggs or parasites in tissues or bodily fluids by microscope, although the eggs typically are not present until 2–3 months after infection. *P. kellicotti* eggs were evident in sputum, bronchoalveolar lavage fluid, pleural effusion or biopsies, or lung biopsies in previous reports and in two cases described in this report; the intervals from illness onset to parasitologic diagnosis ranged from 1 month to 5 years (*4–9*). Serologic testing is an important tool for diagnosing infections with *Paragonimus westermani*, a related fluke, but experience with its use in *P. kellicotti* infection is limited. ELISA is easier to perform, but might not provide positive results until the *P. kellicotti* infection has progressed 4–24 months (*1*). CDC's immunoblot assay targets antibodies directed against *P. westermani* antigens and is highly sensitive (96%) and specific (99%) for *P. westermani* infection (*10*). Although existing serologic methods using *P. westermani* antigens might be less sensitive for early detection of *P. kellicotti* infection, a positive result is useful in confirming the diagnosis. Immunoblot assay was positive as early as 10 weeks after illness onset in one case described in this report.

Health-care providers should consider paragonimiasis and inquire about ingestion of raw or undercooked crayfish among patients with unexplained fever, cough, eosinophilia, and pleural effusion or other chest radiographic abnormalities. Empiric treatment with praziquantel is warranted for patients with signs and symptoms consistent with paragonimiasis and a history of eating raw or undercooked crayfish, regardless of serology results, particularly with an illness of <3 months duration.†

*Additional guidelines for selecting and serving fresh and frozen seafood safely are available at http://www.fda.gov/food/resourcesforyou/consumers/ucm077331.htm.

† Additional information about paragonimiasis is available from CDC at http://www.dpd.cdc.gov/dpdx/html/paragonimiasis.htm.

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This report is based, in part, on contributions by R Tolen, St. Joseph–Buchanan County Health Dept; and A Turner, C Butler, C Hinkle, J Bauer, and L Buchanan, Missouri Dept of Health and Senior Svcs.

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附件2

La Crosse Virus Neuroinvasive Disease — Missouri, 2009

La Crosse virus (LACV), a California serogroup bunyavirus, is a leading cause of pediatric arboviral encephalitis in the United States and is transmitted primarily by the eastern treehole mosquito (*Aedes triseriatus*) (*1*). On August 7, 2009, the Missouri Department of Health and Senior Services (MDHSS) was notified of suspected LACV neuroinvasive disease in a boy aged 8 years from northwest Missouri. Laboratory testing at CDC confirmed LACV infection. An environmental inspection identified multiple vector habitats, including tree holes and discarded tires within a 300-foot radius of the patient's home. Although a median of 67 (range: 29–167) California serogroup virus neuroinvasive disease cases have been reported annually in the United States since 1964, mostly from upper Midwestern and mid-Atlantic states (*2*), this is the first reported case of LACV neuroinvasive disease in Missouri since 2002. *Ae. triseriatus* is found throughout Missouri and as far west as central Kansas and eastern Nebraska. Healthcare providers serving this region should maintain a high clinical suspicion for LACV among patients with unexplained meningoencephalitis occurring during summer and fall.

Case Report

On July 29, 2009, a previously healthy boy aged 8 years, who lived in Kansas City, Missouri, arrived at a local emergency department with headache, fatigue, nausea, vomiting, and abdominal pain. He was prescribed amoxicillin for presumed streptococcal pharyngitis. During the next 48 hours, he continued to have vomiting and developed fever and worsening headache, prompting a second emergency department visit on July 31. Physical examination revealed no focal neurologic signs, and a noncontrasted computed tomography of the head was unremarkable. Because of the child's fever, severe headache, and intractable vomiting, the physician transferred the patient to a pediatric hospital for admission on August 1 because of concerns about possible acute meningitis.

On examination at the pediatric hospital, the child's temperature was 104°F (40°C), with photophobia noted and neck pain with flexion. Neurologic examination, including mental status testing, was normal. Blood counts were remarkable for leukocytosis of 22,000/mm^3 with neutrophil predominance (89%). Cerebrospinal fluid (CSF) obtained through lumbar puncture revealed an elevated white blood cell count (182 cells/mm^3 [43% neutrophils, 40% lymphocytes, and 17% monocytes]), normal protein (31 mg/dL), and normal glucose (61 mg/dL). Polymerase chain reaction for enterovirus on CSF was negative. Vancomycin and ceftriaxone were initiated after lumbar puncture for possible bacterial meningitis.

Blood and CSF bacterial cultures remained negative. On August 3, the patient's serum and CSF were submitted to a referral laboratory for immunofluorescence assay (IFA) for antibodies against West Nile, eastern equine encephalitis, western equine encephalitis, St. Louis encephalitis, and California serogroup viruses. On August 7, results showed positive immunoglobulin M (IgM) and immunoglobulin G (IgG) against California serogroup viruses in serum and CSF. Because LACV is the most prevalent member of California serogroup viruses,* a presumptive diagnosis of LACV neuroinvasive disease was made. Antibiotics were discontinued. The patient's headache, neck pain, and abdominal pain improved during the course of admission, and he was discharged home on August 7. The patient remained healthy, and no neurologic abnormalities were detected through medical follow-up.

Public Health and Laboratory Investigations

MDHSS was notified of the case on August 7. The patient's parents were interviewed on August 13. The patient was the only child in this family, which lived in a house that had an air conditioner but no window screens. The mother reported that the patient had received multiple mosquito bites while playing in the woods near his home the week before symptom onset. He had no recent travel out of northwest Missouri. None of his family members were ill.

The patient's acute serum samples were not available from the hospital, and the parents did not consent to another blood draw. A sample of CSF collected during hospitalization was sent to CDC on September 3 and was reported positive by CDC

*The national surveillance case definition of California serogroup virus neuroinvasive disease is available from CDC at http://www.cdc.gov/ncphi/disss/nndss/casedef/arboviral_current.htm.

on September 23 for LACV neutralizing antibodies. A titer of 1:128 was reported based on results of a plaque-reduction neutralization test (PRNT) with a 90% cutoff value ($PRNT_{90}$). Convalescent serum collected on October 2 was reported positive by CDC on November 2 for LACV-specific IgM and IgG by capture enzyme-linked immunosorbent assay and for LACV neutralizing antibodies by PRNT. CDC tested the same serum sample for neutralizing antibodies against the closely related Jamestown Canyon virus by $PRNT_{90}$ to rule out potential cross-reactivity; the titers for LACV were 1:10,240, whereas the titers for Jamestown Canyon virus were 1:40. LACV infection was confirmed.

On November 11, an examination was conducted in a 300-foot radius around the patient's home to locate and count containers that might serve as habitats for mosquito larvae; 14 tree holes and eight discarded tires, one of which contained water and mosquito larvae, were identified.

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Editorial Note

Before the case reported here, LACV neuroinvasive disease was last reported in Missouri in 2002 (in a girl aged 10 years from northeastern Missouri) and 13 cases were reported in the state during 1973–2001. LACV neuroinvasive disease has never been reported in Kansas or Nebraska. However, identification of this LACV case in northwest Missouri, near the border with Kansas, increases concern that LACV disease might have been underrecognized and underreported in this region. Because *Ae. triseriatus* is found throughout Missouri and as far west as central Kansas and eastern Nebraska, health-care providers serving this region should maintain a high clinical suspicion for LACV among patients with unexplained meningoencephalitis during summer and fall, when mosquitoes are active.

This investigation identified two characteristic *Ae. triseriatus* habitats, tree holes and discarded tires, near the patient's home. Holes in trees near areas in which persons live are a risk factor for LACV neuroinvasive disease (*3,4*). The holes can collect water and become breeding sites for mosquitoes. Similarly, manufactured containers (e.g., tires and buckets) might increase the risk for LACV transmission by increasing local mosquito density around the residence (*3*).

LACV neuroinvasive disease was first described from La Crosse County, Wisconsin, after isolation of the virus in 1964 from brain tissue of a girl aged 4 years who had died of encephalitis in 1960 (*5,6*). The incubation period in humans ranges from 5 to 15 days. Common reservoirs of LACV are small mammals such as chipmunks and squirrels. LACV passes from the female *Ae. triseriatus* mosquito to the eggs she lays, survives in dormant eggs through the winter, and results in infectious adult mosquitoes in the spring. LACV causes an illness that often includes fever, headache, nausea, vomiting, seizures, and disorientation (*7*). Severe neuroinvasive disease occurs most frequently among children. Neurologic sequelae, including epilepsy, hemiparesis, and cognitive and neurobehavioral abnormalities, have been reported in 6%–15% of all diagnosed cases (*1*).

California serogroup virus neuroinvasive disease has been nationally notifiable since 1995; however, CDC has been collecting data on the etiologic agents of arboviral neuroinvasive disease, including California serogroup viruses, since 1964. The highest number of California serogroup virus cases was reported in 2002; during 2003–2007, a total of 412 cases were reported (range: 50–113 cases per year). During 2003–2007, 407 (99%) of the 412 California serogroup virus neuroinvasive disease cases reported to CDC were LACV; of the 398 LACV cases for which outcome was known, seven (2%) were fatal (*8*). The disease is likely underdiagnosed because it mimics other viral encephalitides (e.g., enteroviral and herpes virus encephalitides) (*1,9*).

During the 1960s and 1970s, most cases of LACV neuroinvasive disease were reported from states in the upper Midwest (Illinois, Indiana, Iowa, Minnesota, Ohio, and Wisconsin). Since the mid-1980s, more cases have been reported from mid-Atlantic states (North Carolina, Tennessee, Virginia, and West Virginia). The reason for the increase in cases reported outside the upper Midwest is unclear but might be related to changes in diagnosis, reporting, or the ecology of the vectors (*10*).

This report indicates that LACV neuroinvasive disease still can occur in Missouri. CDC

What is already known on this topic?

La Crosse virus (LACV) neuroinvasive disease is a mosquitoborne disease that occurs mostly in the upper midwestern and mid-Atlantic states.

What is added by this report?

A case of LACV neuroinvasive disease was confirmed in a boy aged 8 years in late 2009, the first case reported in Missouri since 2002.

What are the implications for public health practice?

This case indicates that LACV neuroinvasive disease still occurs in Missouri. Because the primary vector of LACV is found throughout Missouri and as far west as central Kansas and eastern Nebraska, LACV neuroinvasive disease should be considered among patients with unexplained meningoencephalitis in this region. The risk for LACV infection can be reduced by using mosquito repellents; wearing long sleeves, long pants, and socks; installing and repairing screens; filling tree holes; and removing standing water from containers.

recommendations to reduce the risk for LACV infection include using mosquito repellents; wearing long sleeves, long pants, and socks; installing and repairing screens; filling tree holes; and removing standing water from containers. When LACV disease is suspected or confirmed, health-care providers should promptly report the case to the state and local public health departments. A Food and Drug Administration (FDA)-cleared and commercially available kit providing indirect IFA to detect IgM and IgG antibodies against California serogroup viruses can be useful in making a presumptive diagnosis. The FDA-cleared, commercially available test was validated for use with serum samples only. Currently, no FDA-cleared immunoassays are available for detection of LACV-specific IgM or IgG antibodies in serum or CSF. Confirmatory serologic testing by PRNT performed in a public health reference laboratory is recommended to differentiate LACV from other California serogroup viruses (*1*). Testing for LACV and other arboviruses can be performed at certain state public health laboratories and at CDC's Arboviral Diseases Branch (telephone: 970-221-6400). More information is available from CDC at http://www.cdc.gov/lac/index.html.

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附件4

Severe Leptospirosis Similar to Pandemic (H1N1) 2009, Florida and Missouri, USA

To the Editor: Leptospirosis is caused by pathogenic spirochetes of the genus *Leptospira* and transmitted through direct contact of skin or mucous membranes with urine or tissues of *Leptospira*-infected animals or through indirect contact with contaminated freshwater or soil. Leptospirosis shares common clinical signs with influenza, including fever, headache, myalgia, and sometimes cough and gastrointestinal symptoms. During 2009, acute complicated influenza-like illness (ILI) and rapid progressive pneumonia were often attributed to pandemic (H1N1) 2009; however, alternative final diagnoses were reported to be common (*1*). We report 3 cases of severe leptospirosis in Florida and Missouri with clinical signs similar to those of pandemic (H1N1) 2009.

Patient 1 was a 40-year-old Florida man who sought treatment at an emergency department after a 4-day history of fever, myalgia, calf pain, malaise, and headache in July 2009. ILI was diagnosed. Laboratory testing was not performed, and the patient was instructed to take ibuprofen. Three days later, jaundice developed. He was admitted to an intensive-care unit with a diagnosis of hepatitis and acute renal failure. The man raised horses, goats, and chickens on his farm and was frequently employed to control rat infestations at an auto parts store and warehouse. Leptospirosis was suspected. Doxycycline was administered, and the man recovered and was discharged on the eighth day of hospitalization. *Leptospira*-specific immunoglobulin M antibodies were detected by dot blot (ARUP Laboratories, Salt Lake City, Utah, USA) on the second of paired consecutive blood specimens.

Patient 2 was a 17-year-old Missouri woman with a history of obesity. She was hospitalized in August 2009 with a 5-day history of fever, myalgia, calf pain, malaise, headache, nausea, vomiting, dyspnea, and cough, complicated by acute renal failure. The diagnosis on admission was viral infection. On the third day of hospitalization, severe pneumonia and respiratory failure developed, and she was administered vancomycin, piperacillin/tazobactam, levofloxacin, and doxycycline. She died the same day. Ten days before illness onset, she had swum in a creek near her residence.

Patient 3 was a 59-year-old Florida man with a history of obesity and diabetes mellitus. He sought treatment at a clinic in September 2009 and reported a 5-day history of fever, myalgia, malaise, nausea, abdominal pain, and dyspnea. He was treated for gastritis. Two days later, he came to an emergency department and was admitted to the hospital with severe pneumonia and multiorgan failure; he died the next day. The man had frequently engaged in activities to control rat infestations on the farm where he raised chickens, pigs, and goats.

Although patients 2 and 3 were neither tested nor treated for influenza before they died, their clinical signs and rapidity of death prompted postmortem suspicion of pandemic (H1N1) 2009. Autopsies were performed and formalin-fixed tissues were submitted to the Centers for Disease Control and Prevention (Atlanta, GA, USA). Histopathologic evaluation of both patients demonstrated extensive pulmonary hemorrhage and interstitial nephritis (Figure, panels A and B), features consistent with leptospirosis. Immunohistochemical tests for leptospirosis, spotted fever group rickettsiae, and influenza A were performed on multiple tissues obtained from patients 2 and 3. Immunohistochemical evidence of leptospiral infection was identified in lung, liver, kidney, heart, and spleen tissue in both patients (Figure, panels C and D).

These cases of severe leptospirosis were reported during the 2009 influenza pandemic. Although pulmonary hemorrhage (experienced by patients 2 and 3) is increasingly recognized as a severe manifestation of leptospirosis (*2*), it is also a known complication of influenza (*3*). ILI was initially diagnosed in patient 1, but symptom progression and

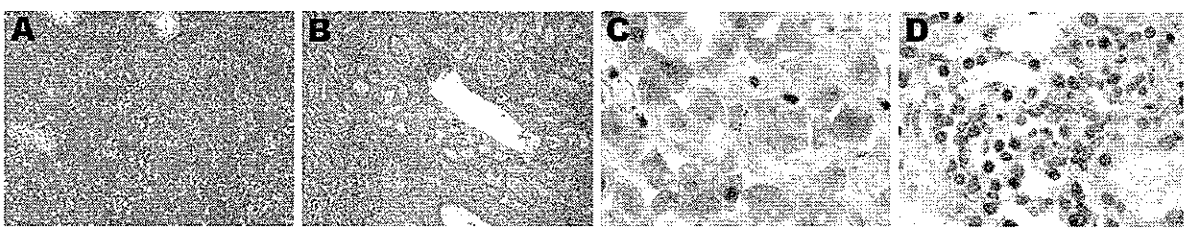

Figure. Photomicrographs of lung, liver, and kidney sections from patient 2 during study, Missouri and Florida, USA, 2009. Hematoxylin and eosin stain showed pulmonary hemorrhage (A) (original magnification ×10) and interstitial nephritis (B) (original magnification ×5), 2 characteristic pathologic findings of leptospirosis. Immunohistochemical testing showed scattered granular leptospiral antigens in liver (C) and kidney (D) (original magnification ×63). A color version of this figure is available online (www.cdc.gov/EID/content/17/6/1145-F.htm).

clinical complications, combined with a history of animal exposure, prompted the physician to consider leptospirosis and to initiate appropriate antimicrobial drug therapy.

Autopsies are critical in determining the reasons for death after undiagnosed illness. Pulmonary involvement in cases of leptospirosis is characterized by congestion and hemorrhage, usually without prominent inflammatory infiltrates (*4*); pulmonary involvement in cases of severe pandemic (H1N1) 2009 typically manifests as diffuse alveolar damage (*5*). Postmortem diagnosis of leptospirosis was supported by characteristic histopathologic findings, including pulmonary hemorrhage and interstitial nephritis, and was confirmed by immunohistochemical tests. Our report illustrates the need for autopsies in unexpected deaths, even if the cause appears obvious in a specific clinical and epidemic setting.

Leptospirosis ceased being nationally notifiable in the United States in 1994 and is likely underdiagnosed because it is not routinely considered in differential diagnoses. However, outbreaks with exposures similar to the case-patients we studied have been periodically reported in the United States (*6–8*). Because leptospirosis commonly manifests as acute febrile illness, cases can be underrecognized during infectious-disease epidemics (e.g., dengue) (*9*). Leptospirosis should be included in the differential diagnosis of acute febrile illness in the United States and other industrialized countries. Epidemiologic clues include recreational or occupational water exposure; animal exposure (including rodents) in the home or the workplace, travel to tropical areas, and water exposure during travel. These risk factors for leptospirosis are increasing in industrialized countries (*10*). Thorough patient-history reviews and consideration of alternative diagnoses are needed for cases of respiratory illness during an influenza pandemic.

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Notes from the Field

Fatal Fungal Soft-Tissue Infections After a Tornado — Joplin, Missouri, 2011

On May 22, 2011, at 5:34 p.m. a tornado with winds >200 mph struck Joplin, Missouri, injuring approximately 1,000 persons and causing 159 deaths. On June 3, a local physician notified the Springfield-Greene County Health Department and the Missouri Department of Health and Senior Services (MODHSS) of two patients hospitalized with tornado injuries who had suspected necrotizing fungal soft-tissue infections. MODHSS initiated active surveillance for such infections at hospitals and laboratories serving patients injured in the tornado, and CDC began assisting MODHSS with identification of fungal isolates. By June 10, eight patients with necrotizing fungal soft-tissue wound infections caused by Mucormycetes (formerly Zygomycetes) were identified. On June 14, a CDC field team arrived in Missouri to assist with the onsite investigation.

As of July 19, a total of 18 suspected cases of cutaneous mucormycosis had been identified, of which 13 were confirmed. A confirmed case was defined as 1) necrotizing soft-tissue infection requiring antifungal treatment or surgical debridement in a person injured in the tornado, 2) with illness onset on or after May 22, and 3) positive fungal culture or histopathology and genetic sequencing consistent with a Mucormycete. No additional cases have been reported since June 17.

The field team reviewed medical charts to describe the 13 confirmed cases. The median age of the patients was 48 years (range: 13–76 years); seven were female, and all were white. Injuries sustained during the tornado included lacerations (12 patients), fractures (11), and blunt trauma (nine). The 13 patients had an average of four wounds documented in the medical chart when they were examined at the emergency department. Post-trauma wound management included surgical debridement for all 13 patients and removal of a foreign body from six. Wooden splinters were the most common foreign body, found in the wounds of four patients. Two patients had diabetes, and none were immunocompromised. Ten patients required admission to an intensive-care unit, and five died.

CDC received 48 clinical specimens, including 32 fungal isolates and 16 tissue blocks collected from wounds for microscopic evaluation, immunohistochemical staining, and DNA sequencing; specimens from all 13 patients yielded the Mucormycete *Apophysomyces trapeziformis*. Further laboratory and epidemiologic studies are ongoing, including case-control studies to evaluate risk factors for infection.

Cutaneous mucormycosis is a rare infection caused by fungi of the order Mucorales, which typically are found in soil and decaying wood and other organic matter. Although cutaneous mucormycosis often is opportunistic, affecting patients with diabetes, hematologic malignancy or solid organ transplant (*1*), *A. trapeziformis* often is associated with immunocompetent hosts after traumatic implantation of fungal spores (*2*). The case-fatality rate for cutaneous mucormycosis has ranged from 29% to 83%, depending on severity of disease and underlying medical condition of the patient (*1*). Early diagnosis, aggressive surgical debridement, and administration of systemic antifungals have been associated with improved outcomes (*1*).

Cutaneous mucormycosis has been reported after previous natural disasters (*3,4*); however, this is the first known cluster occurring after a tornado. None of the infections were found in persons cleaning up debris. Health-care providers should consider environmental fungi as potential causes of necrotizing soft-tissue infections in patients injured during tornados and initiate early treatment for suspected infections. Additional information is available at http://www.cdc.gov/mucormycosis.

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