2. Fiore MC, Bailey WC, Cohen SJ, et al. Treating tobacco use and dependence: clinical practice guideline. Rockville, MD: US Department of Health and Human Services, Public Health Service; 2000. Available at http://www.surgeongeneral.gov/tobacco/treating_tobacco_use.pdf.
3. Zaza S, Briss PA, Harris KW, eds. Tobacco. In: The guide to community preventive services: what works to promote health? New York, NY: Oxford University Press; 2005. Available at http://www.thecommunityguide.org/tobacco/default.htm.
4. Institute of Medicine. Ending the tobacco problem: a blueprint for the nation. Washington, DC: National Academies Press; 2007.
5. US Department of Health and Human Services. Healthy people 2010 (conference ed, in 2 vols). Washington, DC: US Department of Health and Human Services; 2000. Available at http://www.health.gov/healthypeople.
6. CDC. State Medicaid coverage for tobacco-dependence treatments—United States, 2005. MMWR 2006;55:1193–7.
7. CDC. Cigarette smoking-attributable morbidity—United States, 2000. MMWR 2003;52:842–4.
8. CDC. Best practices for comprehensive tobacco control programs—2007. Atlanta, GA: US Department of Health and Human Services, CDC; 2007. Available at http://www.cdc.gov/tobacco/tobacco_control_programs/stateandcommunity/best_practices/index.htm.
9. Miller LS, Zhang X, Novotny T, et al. State estimates of Medicaid expenditures attributable to cigarette smoking, fiscal year 1993. Public Health Rep 1998;113:140–51.
10. Maciosek MV, Coffield AB, Edwards NM, Flottemesch TJ, Goodman MJ, Solberg LI. Priorities among effective clinical preventive services: results of a systematic review and analysis. Am J Prev Med 2006;31:52–61.

Investigation of Progressive Inflammatory Neuropathy Among Swine Slaughterhouse Workers — Minnesota, 2007–2008

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On October 29, 2007, the Minnesota Department of Health (MDH) was notified by a tertiary-care provider of unexplained neurologic illnesses among workers in a swine slaughterhouse (plant A) in southeast Minnesota. As a result, MDH initiated a detailed investigation at plant A to characterize the outbreak. This report describes the ongoing investigation and outbreak-control measures undertaken by state public health officials and CDC.

Plant A, located in southeastern Minnesota, employs approximately 1,200 workers and processes 18,000 pigs per day. After being notified of the illnesses, MDH investigators initiated active case finding, interviewed workers at plant A, and reviewed the plant's occupational health and employment records. As of January 28, 2008, a total of 12 workers at plant A had been identified with confirmed (eight workers), probable (two), or possible (two) progressive inflammatory neuropathy (PIN) (Box). Illness onset ranged from November 2006 through November 2007. Median age of the 12 patients was 31 years (range: 21–51 years); six patients were female. All 12 patients reported being healthy before the onset of neurologic symptoms.

Symptoms ranged from acute paralysis to gradually progressive symmetric weakness over periods ranging from 8 to 213 days. Severity ranged from minor weakness and numbness to paralysis predominantly in the lower extremities affecting mobility. Eleven patients had evidence of axonal or demyelinating peripheral neuropathy by electrodiagnostic testing. Cerebrospinal fluid was obtained from seven patients. All seven had elevated protein levels (median: 125 mg/dL; range: 75–231 mg/dL [normal: 14–

BOX. Working case definition for progressive inflammatory neuropathy among swine slaughterhouse workers, 2007–2008

Epidemiologic criterion
- Participation in or close exposure to commercial or private swine-slaughtering operations.

Clinical criteria
- New onset of bilateral and relatively symmetric flaccid weakness/paralysis of the limbs, with or without involvement of cranial-nerve innervated muscles.
- New onset of decreased or absent deep-tendon reflexes at least in affected limbs.

Diagnostic criteria
- Electrodiagnostic studies consistent with axonal or demyelinating peripheral neuropathic features in affected limbs and not attributable to an underlying chronic disease process.
- Neuroimaging consistent with radiculitis, myelitis, or encephalitis.
- Cerebrospinal fluid protein level >45 mg/dL (with or without pleocytosis).

Exclusion criterion
- Identification of an alternative etiology for clinical or diagnostic findings.

Case classification
- Confirmed case: Meets epidemiologic criterion, meets both clinical criteria, and has electrodiagnostic studies consistent with axonal or demyelinating features.
- Probable case: Meets epidemiologic criterion, at least one clinical criterion, and at least one diagnostic criterion.
- Possible case: Meets epidemiologic criterion and at least one clinical criterion.

45 mg/dL]) with no or minimal pleocytosis (median: 1 cell/dL; range: 1–73 cells/dL in a nontraumatic tap); five patients had evidence of inflammation on spinal magnetic resonance imaging (four patients in peripheral nerves or roots and one patient in the anterior spinal cord).

All 12 patients reported either working at or having regular contact with an area where swine heads were processed (known as the head table), which was located within a larger processing area in plant A known as the warm room. A case-control study was conducted among plant A workers to identify specific risk factors associated with illness. The 10 patients with confirmed or probable cases were included in the study, along with two stratified control groups: 1) a random selection of 48 healthy warm-room workers and 2) all 65 healthy head-table workers. Statistically significant ($p<0.05$) differences were calculated by chi-square test. Blood samples and throat swabs were collected from all consenting case-patients and controls. As of January 30, laboratory investigations had not identified any infectious agent from the blood and throat-swab specimens that would explain the occurrence of PIN.

Results of the case-control study indicated that case-patients (seven of 10, 70%) were significantly more likely to have worked at the head table than the warm-room controls (12 of 48, 25%) (odds ratio [OR]: 7.0; 95% confidence interval [CI] = 1.3–42.2; p = 0.009). Case-patients also were more likely to have removed brains or remaining skeletal muscle from the pig head (a process known as backing heads) (four of 10, 40%) than controls (two of 46, 4%) (OR: 15.3; CI = 1.8–163.4; p = 0.006). Among head-table workers, case-patients were significantly more likely to have removed brains or skeletal muscle from the head (four of seven, 57%) than head-table controls (eight of 65, 12%) (OR: 9.50; CI = 1.40–70.2; p = 0.01). Illness was not determined to be associated with previous travel outside or within the United States; exposure to chemicals, fertilizers, or insecticides; use of medications; or receipt of previous vaccinations.

An environmental assessment of the plant was conducted on November 28, 2007. Standard personal protective equipment (PPE) used by workers at plant A included hard hats, laboratory coats (including some that were short-sleeved), boots, hearing protection, eye protection, and specialized gloves that varied with the particular task of the worker. A compressed air device was used in the plant to harvest brain tissue from pig heads at the head table. The device was placed into the skull of the pig through the foramen magnum, and the force of the air disrupted the brain material into a liquefied form that made it easier to remove (a technique known as "blowing brains"). This technique caused generation of small droplets and splatter, possibly including aerosolized brain material, to which workers operating the device and others nearby might have been exposed. In response to the investigation, plant A voluntarily suspended harvesting of brains and instituted additional mandatory PPE on November 28, 2007, including face shields and long sleeves, for workers stationed at the head table and other workers who chose to use additional PPE.

Results of Case-Finding Survey

A survey of the 25 federally inspected swine slaughterhouses with ≥500 employees in the United States indicated that only three plants (plant A in Minnesota and plants in Nebraska and Indiana) reported recent use of compressed air to extract pig brains. To date, no cases of PIN have been identified in association with workers at the Nebraska plant. However, several workers at the Indiana plant have been preliminarily identified with neurologic illnesses and similar histories of exposure to head-processing activities at that slaughterhouse. Further assessments of these patients, and additional measures to identify other workers with illness, are being conducted in Indiana. As a result of this investigation, all three plants have stopped using compressed air to extract brain material.

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Editorial Note: This report summarizes an ongoing investigation of PIN, a syndrome that appears to be associated with swine slaughterhouse workers who process pig heads. Several clinical and laboratory features of this illness and the distinctive epidemiology associated with patients appear unique. Pigs slaughtered at plant A have passed inspection by the U.S. Department of Agriculture Food Safety and Inspection Service, and the investigation has not identified any foodborne risk to the general population.

The investigation in Minnesota indicates that PIN appears associated with having worked at the head table, where a compressed-air device was used to extract pig brains. In the process of blowing compressed air into the pig skull, brain material might have been splattered or even aerosolized, and workers might have been exposed through inhalation or contact with mucous membranes. One hypothesis for development of PIN is that worker exposure to

aerosolized pig neural protein might have induced an autoimmune-mediated peripheral neuropathy (*1,2*). Additional investigation of the characteristics and causes of PIN is under way.

Whether compressed-air devices are being used for pig-brain extraction in other slaughterhouses or processing facilities, in the United States or internationally, is unknown. Clinicians should provide CDC with information regarding swine slaughterhouse workers who might have illnesses similar to PIN, including patients with peripheral neuropathy, myelopathy, or features of both. Clinicians who identify such patients should report the cases to their state health department and contact CDC at 770-488-7100.

References

1. Quattrini A. Inflammatory neuropathies. Neurol Sci 2005;26:S6.
2. Tatsumoto M, Koga M, Gilbert M, et al. Spectrum of neurological diseases associated with antibodies to minor gangliosides GM1b and GalNAc-GD1a. J Neuroimmunol 2006;177:201–8.

Acute Allergic-Type Reactions Among Patients Undergoing Hemodialysis — Multiple States, 2007–2008

On February 1, this report was posted as an MMWR Early Release *on the* MMWR *website* (http://www.cdc.gov/mmwr).

CDC is investigating an outbreak of acute allergic-type reactions among patients who have undergone hemodialysis since November 19, 2007. The majority of reactions have occurred among adult hemodialysis patients, with onset within minutes of initiating a hemodialysis session. Although the cause of the outbreak is unknown and remains under investigation, the majority of reactions occurred in patients who received intravenous heparin produced by Baxter Healthcare Corporation (Deerfield, Illinois). Baxter voluntarily recalled nine lots of heparin multidose vials after learning of these adverse events among patients who received heparin during dialysis. This report describes the ongoing investigation.

CDC was first notified on January 7, 2008, by the Missouri Department of Health and Senior Services (MDHSS) of allergic-type reactions among pediatric hemodialysis patients that occurred beginning November 19, 2007, at a pediatric hospital. The reactions had been reported to MDHSS by a health-care provider at the hospital. The symptoms occurred within minutes of dialysis initiation and included facial swelling, tachycardia, hypotension, urticaria, and nausea. A total of eight episodes of acute allergic-type reactions have been identified as occurring among four patients at the pediatric hospital during November 19, 2007–January 15, 2008. These reactions were reviewed by a clinical allergist and were determined to be consistent with anaphylactic or anaphylactoid reaction.

Upon learning of the initial cluster, CDC solicited reports of similar allergic-type reactions among hemodialysis patients nationally through nephrology e-mail lists and public health notifications. In response to these case-finding measures, CDC was contacted on January 9, 2008, by a dialysis supply company that had received reports during the previous 2-week period of approximately 50 similar reactions among adult hemodialysis patients at dialysis facilities in six states. A second supply company reported learning of similar reactions from dialysis facilities as early as December 10, 2007. CDC alerted the Food and Drug Administration (FDA) to these nationwide reports of allergic-type reactions on January 9, 2008, and has been collaborating with FDA on the investigation.

As part of the investigation, CDC has created a working case definition for these reactions. A confirmed case of acute allergic-type reaction has been defined as an episode of anaphylactic or anaphylactoid reaction characterized by angioedema (particularly swelling of lips/mouth, tongue, throat, or eyelids) or urticaria. A probable case has been defined as an episode that includes at least two of the following signs and symptoms: 1) generalized or localized sensations of warmth; 2) numbness or tingling of the extremities; 3) difficulty swallowing; 4) shortness of breath, audible wheezing, or chest tightness; 5) low blood pressure/tachycardia; or 6) nausea or vomiting.

Of the episodes reported as of January 30, CDC has identified 65 confirmed or probable cases among 53 hemodialysis patients that occurred during November 19, 2007–January 21, 2008, at 19 dialysis facilities in 12 states. CDC currently is investigating an additional 36 possible cases. Most reactions resolved after interruption of the dialysis session or treatment with diphenhydramine or steroids at the facility. Other than the eight episodes reported by MDHSS, all cases have occurred among adults.

One common factor among the cases being investigated was receipt of heparin (1,000 units/mL) from 30-mL or 10-mL vials manufactured by Baxter. Intravenous heparin is administered during most hemodialysis sessions to prevent clotting of the access and dialysis circuit. In 61 (94%) of the 65 cases, the affected patient received Baxter heparin during hemodialysis. Dialyzers from four different companies were being used when the reactions occurred. The most commonly used dialyzers, manufactured by Fresenius Medi-