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## A Medical Mystery Unfolds in Minnesota

By [DENISE GRADY](#)

AUSTIN, Minn. — If you have to come down with a strange disease, this town of 23,000 on the wide-open prairie in southeastern Minnesota is a pretty good place to be. The [Mayo Clinic](#), famous for diagnosing exotic ailments, owns the local medical center and shares some staff with it. Mayo itself is just 40 miles east in Rochester. And when it comes to investigating mysterious outbreaks, Minnesota has one of the strongest health departments and best-equipped laboratories in the country.

And the disease that confronted doctors at the Austin Medical Center here last fall was strange indeed. Three patients had the same highly unusual set of symptoms: fatigue, pain, weakness, [numbness and tingling](#) in the legs and feet.

The patients had something else in common, too: all worked at Quality Pork Processors, a local meatpacking plant.

The disorder seemed to involve nerve damage, but doctors had no idea what was causing it.

At the plant, nurses in the medical department had also begun to notice the same ominous pattern. The three workers had complained to them of “heavy legs,” and the nurses had urged them to see doctors. The nurses knew of a fourth case, too, and they feared that more workers would get sick, that a serious disease might be spreading through the plant.

“We put our heads together and said, ‘Something is out of sorts,’ ” said Carole Bower, the department head.

Austin’s biggest employer is Hormel Foods, maker of Spam, bacon and other processed meats (Austin even has a Spam museum). Quality Pork Processors, which backs onto the Hormel property, kills and butchers 19,000 hogs a day and sends most of them to Hormel. The complex, emitting clouds of steam and a distinctive scent, is easy to find from just about anywhere in town.

Quality Pork is the second biggest employer, with 1,300 employees. Most work eight-hour shifts along a conveyor belt — a disassembly line, basically — carving up a specific part of each carcass. Pay for these line jobs starts at about \$11 to \$12 an hour. The work is grueling, but the plant is exceptionally clean and the benefits are good, said Richard Morgan, president of the union local. Many of the workers are Hispanic immigrants. Quality Pork’s owner does not allow reporters to enter the plant.

A man whom doctors call the “index case” — the first patient they knew about — got sick in December 2006 and was hospitalized at the Mayo Clinic for about two weeks. His job at Quality Pork was to extract the brains from swine heads.

“He was quite ill and severely affected neurologically, with significant weakness in his legs and loss of function

in the lower part of his body,” said Dr. Daniel H. Lachance, a neurologist at Mayo.

Tests showed that the man’s spinal cord was markedly inflamed. The cause seemed to be an autoimmune reaction: his immune system was mistakenly attacking his own nerves as if they were a foreign body or a germ. Doctors could not figure out why it had happened, but the standard treatment for inflammation — a steroid drug — seemed to help. (The patient was not available for interviews.)

Neurological illnesses sometimes defy understanding, Dr. Lachance said, and this seemed to be one of them. At the time, it did not occur to anyone that the problem might be related to the patient’s occupation.

By spring, he went back to his job. But within weeks, he became ill again. Once more, he recovered after a few months and returned to work — only to get sick all over again.

By then, November 2007, other cases had begun to turn up. Ultimately, there were 12 — 6 men and 6 women, ranging in age from 21 to 51. Doctors and the plant owner, realizing they had an outbreak on their hands, had already called in the Minnesota Department of Health, which, in turn, sought help from the federal [Centers for Disease Control and Prevention](#).

Though the outbreak seemed small, the investigation took on urgency because the disease was serious, and health officials worried that it might indicate a new risk to other workers in meatpacking.

“It is important to characterize this because it appears to be a new syndrome, and we don’t truly know how many people may be affected throughout the U.S. or even the world,” said Dr. Jennifer McQuiston, a veterinarian from the disease centers.

In early November, Dr. Aaron DeVries, a health department epidemiologist, visited the plant and combed through medical records. The disease bore no resemblance to [mad cow disease](#) or to [trichinosis](#), the notorious parasite infection that comes from eating raw or undercooked pork. Nor did it spread person to person — the workers’ relatives were unaffected — or pose any threat to people who ate pork.

A survey of the workers confirmed what the plant’s nurses had suspected: those who got sick were employed at or near the “head table,” where workers cut the meat off severed hog heads.

On Nov. 28, Dr. DeVries’s boss, Dr. Ruth Lynfield, the state epidemiologist, toured the plant. She and the owner, Kelly Wadding, paid special attention to the head table. Dr. Lynfield became transfixed by one procedure in particular, called “blowing brains.”

As each head reached the end of the table, a worker would insert a metal hose into the foramen magnum, the opening that the spinal cord passes through. High-pressure blasts of compressed air then turned the brain into a slurry that squirted out through the same hole in the skull, often spraying brain tissue around and splattering the hose operator in the process.

The brains were pooled, poured into 10-pound containers and shipped to be sold as food — mostly in China and Korea, where cooks stir-fry them, but also in some parts of the American South, where people like them scrambled up with eggs.

The person blowing brains was separated from the other workers by a plexiglass shield that had enough space under it to allow the heads to ride through on a conveyor belt. There was also enough space for brain tissue to

splatter nearby employees.

“You could see aerosolization of brain tissue,” Dr. Lynfield said.

The workers wore hard hats, gloves, lab coats and safety glasses, but many had bare arms, and none had masks or face shields to prevent swallowing or inhaling the mist of brain tissue.

Dr. Lynfield asked Mr. Wadding, “Kelly, what do you think is going on?”

The plant owner watched for a while and said, “Let’s stop harvesting brains.”

Quality Pork halted the procedure that day and ordered face shields for workers at the head table.

Epidemiologists contacted 25 swine slaughterhouses in the United States, and found that only two others used compressed air to extract brains. One, a plant in Nebraska owned by Hormel, has reported no cases. But the other, Indiana Packers in Delphi, Ind., has several possible cases that are being investigated. Both of the other plants, like Quality Pork, have stopped using compressed air.

But why should exposure to hog brains cause illness? And why now, when the compressed air system had been in use in Minnesota since 1998?

At first, health officials thought perhaps the pigs had some new infection that was being transmitted to people by the brain tissue. Sometimes, infections can ignite an [immune response](#) in humans that flares out of control, like the condition in the workers. But so far, scores of tests for viruses, bacteria and parasites have found no signs of infection.

As a result, Dr. Lynfield said the investigators had begun leaning toward a seemingly bizarre theory: that exposure to the hog brain itself might have touched off an intense reaction by the immune system, something akin to a giant, out-of-control allergic reaction. Some people might be more susceptible than others, perhaps because of their genetic makeup or their past exposures to animal tissue. The aerosolized brain matter might have been inhaled or swallowed, or might have entered through the eyes, the mucous membranes of the nose or mouth, or breaks in the skin.

“It’s something no one would have anticipated or thought about,” said Dr. Michael Osterholm, an epidemiologist who is working as a consultant for Hormel and Quality Pork. Dr. Osterholm, a professor of public health at the [University of Minnesota](#) and the former state epidemiologist, said that no standard for this kind of workplace exposure had ever been set by the government.

But that would still not explain why the condition should suddenly develop now. Investigators are trying to find out whether something changed recently — the air pressure level, for instance — and also whether there actually were cases in the past that just went undetected.

“Clearly, all the answers aren’t in yet,” Dr. Osterholm said. “But it makes biologic sense that what you have here is an inhalation of brain material from these pigs that is eliciting an immunologic reaction.” What may be happening, he said, is “immune mimicry,” meaning that the immune system makes [antibodies](#) to fight a foreign substance — something in the hog brains — but the antibodies also attack the person’s nerve tissue because it is so similar to some molecule in hog brains.

“That’s the beauty and the beast of the immune system,” Dr. Osterholm said. “It’s so efficient at keeping

foreign objects away, but anytime there's a close match it turns against us, too."

Anatomically, pigs are a lot like people. But it is not clear how close a biochemical match there is between pig brain and human nerve tissue.

To find out, the Minnesota health department has asked for help from Dr. Ian Lipkin, an expert at [Columbia University](#) on the role of the immune system in neurological diseases. Dr. Lipkin has begun testing blood serum from the Minnesota patients to look for signs of an immune reaction to components of pig brain. And he expects also to study the pig gene for myelin, to see how similar it is to the human one.

"It's an interesting problem," Dr. Lipkin said. "I think we can solve it."

Susan Kruse, who lives in Austin, was stunned by news reports about the outbreak in early December. Ms. Kruse, 37, worked at Quality Pork for 15 years. But for the past year, she has been too sick to work. She had no idea that anyone else from the plant was ill. Nor did she know that her illness might be related to her job.

Her most recent job was "backing heads," scraping meat from between the vertebrae. Three people per shift did that task, and together would process 9,500 heads in eight or nine hours. Ms. Kruse (pronounced KROO-zee) stood next to the person who used compressed air to blow out the brains. She was often splattered, especially when trainees were learning to operate the air hose.

"I always had brains on my arms," she said.

She never had trouble with her health until November 2006, when she began having pains in her legs. By February 2007, she could not stand up long enough to do her job. She needed a walker to get around and was being treated at the Mayo Clinic.

"I had no strength to do anything I used to do," she said. "I just felt like I was being drained out."

Her immune system had gone haywire and attacked her nerves, primarily in two places: at the points where the nerves emerge from the spinal cord, and in the extremities. The same thing, to varying degrees, was happening to the other patients. Ms. Kruse and the index case — the man who extracted brains — probably had the most severe symptoms, Dr. Lachance said.

Steroids did nothing for Ms. Kruse, so doctors began to treat her every two weeks with IVIG, intravenous immunoglobulin, a blood product that contains antibodies. "It's kind of like hitting the condition over the head with a sledgehammer," Dr. Lachance said. "It overwhelms the immune system and neutralizes whatever it is that's causing the injury."

The treatments seem to help, Ms. Kruse said. She feels stronger after each one, but the effects wear off. Her doctors expect she will need the therapy at least until September.

Most of the other workers are recovering and some have returned to their jobs, but others, including the index case, are still unable to work. So far, there have been no new cases.

"I cannot say that anyone is completely back to normal," Dr. Lachance said. "I expect it will take several more months to get a true sense of the course of this illness."

Dr. Lynfield hopes to find the cause. But she said: "I don't know that we will have the definitive answer. I

suspect we will be able to rule some things out, and will have a sense of whether it seems like it may be due to an autoimmune response. I think we'll learn a lot, but it may take us a while. It's a great detective story.”

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