

Name of Outbreak: Multi-County Outbreak of *Escherichia coli* O157:H7 – Subtype MOE014, MBE104, Among Persons who Consumed Unpasteurized Goat's Milk – Spring 2008

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Introduction

On May 12, 2008, the Lawrence County Health Department (LCHD) was notified of a case of hemolytic uremic syndrome (HUS) in a child with a history of bloody diarrhea. The health care provider reported the child had consumed unpasteurized goat's milk obtained from a local store (Store A) in Barry County, Missouri, on April 29, 2008. The LCHD contacted the Missouri Department of Health and Senior Services (DHSS) per established protocols and initiated an investigation into the reported illness. As part of the initial investigation, an evaluation of surveillance data revealed a young child from Barry County was confirmed to have a recent *Escherichia coli* (*E. coli*) O157:H7 associated illness. The child had consumed unpasteurized goat's milk on April 21, 2008, which had also been obtained from Store A. An outbreak investigation was initiated by DHSS on May 12, 2008, to confirm the infectious agent, determine the source of the infections, and institute control measures to prevent additional cases. This report summarizes the findings from the investigation.

Background

Enterohemorrhagic *E. coli* (EHEC) are a group of bacteria that cause diarrheal illnesses ranging from mild and nonbloody diarrhea to stools that are virtually all blood.¹ The primary reservoirs for the bacteria are cattle, though a variety of other animals may also carry EHEC bacteria.¹⁻³ *E. coli* O157:H7, the predominant type of EHEC in North America, produce cell-destroying toxins called Shiga toxins.^{1,2} Approximately 8% of persons with diarrhea due to Shiga toxin producing EHEC will develop a severe condition called HUS.^{1,2} HUS typically develops within two weeks after onset of diarrhea. Fifty percent of persons with diarrhea-associated HUS will require dialysis, and 3% to 5% of these cases will be fatal.² EHEC infection is the primary cause of HUS and the leading cause of renal insufficiency in children.² Young children and the elderly are at greater risk of developing HUS.³ Serious outbreaks of *E. coli* O157:H7 have been associated with the consumption of beef, produce (alfalfa sprouts, lettuce, etc.), and unpasteurized dairy milk.¹

Testing for EHEC typically includes a Shiga toxin test and culture for the pathogenic bacteria from stool specimens.^{1,2} Illnesses caused by Shiga toxin-producing *E. coli* and persons diagnosed with HUS, are reportable diseases and conditions in Missouri (19 CSR 20-20.020). In addition, all *E. coli* O157:H7 isolates identified by laboratories in the state should be submitted to the State Public Health Laboratory (SPHL). The testing of these bacterial isolates at the SPHL includes identification of the bacteria and testing for the presence of Shiga toxin. In addition, the *E. coli* O157:H7 isolates submitted to the SPHL, are subtyped by a process called Pulsed Field Gel Electrophoresis (PFGE).

PFGE developed in 1984, utilizes deoxyribonucleic acid (DNA) cut up by enzymes that result in a small number of large DNA fragments. The PFGE process facilitates migration of the DNA fragments through agarose gels by constantly changing the direction of the electrical field during electrophoresis. The DNA fragments separate on the gels forming patterns, which can be compared with the patterns produced from other similar bacteria. The bacteria can then be classified into subtypes based on their specific DNA patterns. PFGE subtyping has been successfully applied to the subtyping of many pathogenic bacteria including *E. coli* O157:H7. PFGE has been repeatedly shown to be more discriminating than other methods and the PFGE patterns generated are stable and reproducible. PFGE is the method of choice for epidemiologic subtyping of pathogenic bacteria including *E. coli* O157:H7.⁴

Methods

Following the initial report on May 12, 2008, the DHSS analyzed surveillance data to identify additional cases. Cases of *E. coli* O157:H7 and HUS were investigated per DHSS guidelines. Information regarding the cases was collected through phone interviews conducted by public health nurses and epidemiologist from their respective local public health agencies. The questionnaire used to collect the data on confirmed cases was the Record of Investigation of Enteric Illness, DHSS Form MO 580-0802 (6-02). Information collected included demographics, onset dates and symptoms, possible risk factors, and the presence of ill contacts. In addition, health care providers and laboratories were contacted to obtain information

regarding clinical and laboratory findings. The SPHL conducted routine testing on each *E. coli* O157:H7 isolates to confirm the production of Shiga toxin, the identification of the bacteria, and determine the PFGE subtype. The SPHL findings are reported to the DHSS and forwarded to the appropriate local public health agency.

For the purpose of this investigation, a confirmed case is defined as any person residing in Southwest Missouri, with an acute onset of symptoms that include diarrhea, an illness onset of April 5, 2008 through May 25, 2008, and whose specimens tested positive for *E. coli* O157:H7, PFGE type MOE014, MBE104. A probable case is defined as any person residing in Southwest Missouri, with an acute onset of symptoms that include diarrhea and a diagnosis of diarrhea-associated HUS, in the absence of laboratory confirmation of the causative agent, and an illness onset of April 5, 2008 through May 25, 2008.

On May 13, 2008, a DHSS representative made an unannounced onsite visit to Store A to determine the availability of unpasteurized dairy in the store. On May 14, 2008, a DHSS epidemiologist and representative from the Barry County Health Department made an onsite visit and met with the owner/operator of Store A. The purpose of the meeting was to identify additional cases, identify the source of the milk, and provide educational information regarding the risks associated with the consumption of unpasteurized dairy products. A list of others who had obtained the unpasteurized goat's milk from Store A was requested. Upon determining the source of the unpasteurized goat's milk, the Springfield-Greene County Health Department (SGCHD) was contacted and informed the milk originated from a rural Greene County Farm (Farm A).

On May 15, 2008, SGCHD and DHSS representatives made an unannounced onsite visit to Farm A, to meet with the owner. No one was present at that time; therefore, the SGCHD contacted the owner by phone. The purpose of the call was to inform the owner of the illnesses, the concerns regarding the unpasteurized goat's milk produced on the farm, and to identify others who had consumed the product. A list of customers who regularly purchase the unpasteurized goat's milk was provided to the SGCHD. SGCHD staff called persons on the list to express concerns associated with the consumption of the unpasteurized goat's milk and to identify additional cases. Multiple attempts were made to contact persons when there was no answer and messages requesting a return call were left when answering machines were available. In addition, the SGCHD requested information from the owner of Farm A, regarding the production of the goat's milk and requested samples of the goat's milk for the purpose of laboratory testing. The requested milk specimens were to be tested at the SPHL for the presence of bacteria including *E. coli* O157:H7.

Results

A total of 4 cases (3 confirmed, 1 probable) of *E. coli* O157:H7 and/or HUS were identified. The median age of cases was 4.5 years with a range of 1- 57 years. Fifty percent of the cases were female. Each of the cases resided in different counties in Southwest Missouri, and were not known to be related or have other direct contact to the other known cases. The symptoms reported included diarrhea 100% (n = 4), bloody diarrhea 100% (n = 4), nausea 75% (n = 3), vomiting 75% (n = 3), abdominal cramps 75% (n = 3), and fever 50% (n = 2). The reported

onset dates of illnesses ranged from April 25 through May 4, 2008 (Figure 1). Each of the cases sought medical care from a health care provider and two of the cases were hospitalized. No deaths associated with this outbreak were reported.

The hospitalized cases were diagnosed with HUS. In addition to the symptoms noted, these two cases presented with thrombocytopenia, elevated creatinine levels, and acute renal failure. These findings were noted less than one week following the onset of bloody diarrhea in each of the two cases. Both were placed on dialysis with a duration of 15 days and 20 days respectively and the average length of their hospital stay was 23 days.

Laboratory testing was performed on stool specimens from each of the cases. The three confirmed cases tested positive for *E. coli* Shiga toxin at a hospital laboratory (Hospital A). The Shiga toxin positive specimens submitted to the SPHL were culture positive for *E. coli* O157:H7. PFGE subtyping of the *E. coli* O157:H7 isolates from each of the confirmed cases were identified as indistinguishable subtypes, MOE014, MBE104. Specimens collected from the probable case on May 8, 2008 and May 12, 2008 were negative for several enteric bacterial pathogens including *E. coli* O157:H7, at hospital laboratories (Hospital B and Hospital C) respectively. Shiga toxin testing on specimens from the probable case, were not performed and specimens from this case were not submitted or tested at the SPHL.

No unpasteurized goat's milk was observed to be available for sale from Store A during the onsite visits conducted on May 13, 2008 and May 14, 2008. The owner of Store A was informed of the ongoing investigation and provided information regarding the risks associated with the consumption of unpasteurized milk. The owner acknowledged providing the unpasteurized goat's milk she obtained from Farm A, to an undefined number of persons. In addition, the owner reported having received a call from a relative of a child who had reportedly become ill after consuming the unpasteurized goat's milk. The owner of Store A declined to provide the names of persons for whom she provided the milk or the relative that had called regarding the ill child.

Farm A is located in Greene County. The owner raises and sells a variety of animal products including beef, chicken, eggs, pork, turkey, and unpasteurized goat's milk. In 2008, Farm A's seasonal production and sale of goat's milk was reported to have begun in late March to early April 2008. The milk is sold in 1 gallon and ½ gallon amounts in glass jugs, which narrow at the neck to the opening at the top. The jugs are provided by Farm A and once emptied are returned to Farm A, washed, and reused. The owner declined to provide further details regarding milk production and also declined to provide samples of the goat's milk to the SGCHD for testing at the SPHL. The owner of Farm A stated unpasteurized goat's milk samples from the farm were submitted to a private laboratory and tested negative for *E. coli*. The owner declined a verbal request for the identity of the laboratory that conducted the tests.

The owner of Farm A provided a list of 13 persons who purchased the unpasteurized goat's milk on a regular basis to the SGCHD. A total of 11 (85%) of persons from the list were contacted and informed of the risks associated with the consumption of unpasteurized milk and the concerns regarding the unpasteurized goat's milk product. The remaining two persons on the list were unable to be contacted or did not respond to the messages left on answering machines. A

complete list of Farm A customers who purchase the milk was not maintained by the owner of Farm A.

Discussion

E. coli O157:H7 associated illnesses are endemic in Missouri, with a total of 80 cases reported statewide in 2007. During the past five years, a median of 5 cases of *E. coli* O157:H7 associated illnesses were reported in Southwest Missouri residents through July 1. The outbreak-associated cases all reported an illness onset within a 10-day period from April 25 through May 4. Four reported cases of *E. coli* O157:H7 during this short period of time exceed the expected incidence of the disease among residents of Southwest Missouri.

The *E. coli* O157:H7 isolates associated with the outbreak are considered to be genetically indistinguishable and identified as PFGE subtype MOE014, MBE104. Since mid-year 2004, a total of 261 *E. coli* isolates have been PFGE subtyped using similar methods, of which only three (1.1%) were subtype MOE014, MBE104. The only three *E. coli* O157:H7, subtype MOE014, MBE104 on record in Missouri, were isolated from cases associated with this outbreak. *E. coli* O157:H7, subtype MOE014, MBE104 is a unique subtype, which had not been previously identified in Missouri. In addition, no illnesses or outbreaks associated with *E. coli* O157:H7, subtype MOE014, MBE104 were reported nationally (unpublished PulseNet data - CDC).

The temporal and geographic clustering of these illnesses caused by a bacterium, with matching and unique PFGE subtypes, is strongly suggestive of a common source of exposure. The only common risk factor identified for all of the cases was the consumption of unpasteurized goat's milk originating from Farm A. Each of the four cases had consumed the milk within 3-4 days prior to becoming ill. One of the cases reported direct contact with the goats at Farm A in addition to consuming the milk. Information regarding other potential risk factors was reviewed, however, no other plausible sources of exposure common to all four cases were identified. The median incubation period for *E. coli* O157:H7 infections is 3-4 days following exposure to the bacteria.¹

Several limitations were identified during this investigation. A limited sample size of 4 cases restricted our ability to use a more powerful epidemiologic study design to identify statistical associations between risk factors and disease. No unpasteurized goat's milk consumed prior to the onset of illness or after identification of the outbreak was available for testing for the presence of *E. coli* O157:H7. In addition, no environmental sampling and testing of feces from the goat's or from the milk production area was performed. Finally, details regarding the specific procedures used by Farm A to milk the goats were not provided.

Consuming unpasteurized dairy products is a known risk factor for developing gastrointestinal illnesses caused by a variety of pathogens including *E. coli* O157:H7.¹⁻³ Outbreaks of *E. coli* O157:H7 associated with the consumption of unpasteurized dairy products and contact with farm animals have been well documented in the literature.⁵⁻¹² From 1998 to May 2005, unpasteurized milk or unpasteurized milk products were implicated in 45 foodborne illness outbreaks in the United States, accounting for more than 1,000 cases of illness.⁵ The majority of these illnesses were associated with the consumption of unpasteurized cows milk. However, goats can also

shed *E. coli* O157:H7 and outbreaks of illness have been associated with direct contact with goats or consumption of unpasteurized goat's milk.⁹⁻¹² Despite the numerous claims regarding the health benefits of unpasteurized dairy products, the product, no matter how carefully produced, may be unsafe.¹³

Conclusions

The findings from this investigation confirm three of the illnesses described in this report were the result of *E. coli* O157:H7 subtype MOE014, MBE104. The one probable case was not laboratory confirmed. However, it is plausible the same etiologic agent was present, given the cases clinical syndrome and exposure history. The temporal and geographic clustering of these illnesses caused by a previously unidentified subtype of *E. coli* O157:H7 strongly suggests a common source of exposure. The only common risk factor identified for all of the cases, whom reside in four diverse areas of Southwest Missouri, was the consumption of unpasteurized goat's milk originating from Farm A. Each of the four cases had consumed the milk within 3-4 days prior to becoming ill, which is consistent with the known incubation period for *E. coli* O157:H7. Due to the limitations of this investigation, the source of the infections could not be confirmed. However, the epidemiological findings strongly suggest the unpasteurized goat's milk from Farm A was the likely source of infection for each of the cases associated with this outbreak.

Public Health Intervention

During the course of this investigation several measures were implemented to prevent additional cases of *E. coli* O157:H7. The many public health agencies, laboratories, and the broader medical community collaborated to recognize the outbreak and rapidly identified the potential risk factors. The SGCHD attempted to quickly contact and alert each of the persons identified as consumers of the unpasteurized goat's milk from Farm A of the potential risks associated with the product. In addition, DHSS collaborated with the Missouri State Milk Board in issuing a statewide news release on May 16, 2008, to warn Missourians of the risks associated with consuming unpasteurized milk and milk products.¹⁴ The DHSS also collaborated with the Missouri State Milk Board and other regulatory agencies during inquiries pertaining to the sale and distribution of the unpasteurized goat's milk. The local public health agencies and the DHSS will continue to rapidly investigate reported *E. coli* O157:H7 associated illness and work to promote food safety.

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Figure 1.

Number of *E. coli* O157:H7-MOE014, MBE104, by Date of Onset, Multi-County Outbreak Among Persons who Consumed Unpasteurized Goat's Milk - Spring 2008

