United States Department of Agriculture

Animal and Plant Health Inspection Service

Veterinary Services

# A Public Health Concern: Escherichia coli 0157:H7

Serious human illnesses associated with verotoxic *E.coli* 0157:H7 (ECO157), including bloody diarrhea and renal disease, have been reported with increasing frequency since the first recorded case in 1982. Cattle have been implicated as the reservoir of this agent. In North America, reports of both sporadic cases and outbreaks have come mainly from the northern tier of U.S. states and Canada. A spring 1993 outbreak in several western states, the largest ever reported - involving hundreds of cases, prompted the following questions from veterinarians:

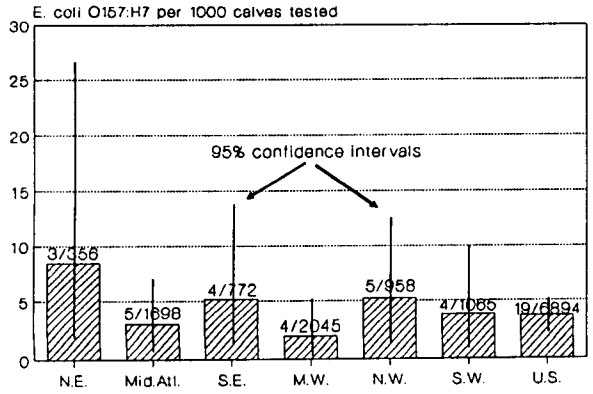
***1. Who is the most susceptible to disease due to ECO157 infections ?***

The group which is consistently reported to be at highest risk is children under 5 years of age. They are at increased risk for both ECO157-associated hemorrhagic colitis and hemolytic uremic syndrome (HUS) as a sequel to gastrointestinal disease. The increased risk to young children stems not only from foodborne exposures but from secondary exposure in day care centers, etc. The elderly and persons with previous gastrectomies have also been cited as being at increased risk.

***2. What are the signs in people? animals?***

The most common sign in ECO157 infections is bloody diarrhea commencing 2- to 9-days after exposure. Fever is not prominent. Ten to 20 percent of persons having diarrhea develop more serious symptoms, the most common of these is HUS. HUS may lead to death (~ 5%) or chronic renal insufficiency (~ 5%). Other complications include thrombotic thrombocytopenic purpura, strokes, and destruction of parts of the large bowel.

**Figure 1. Regional Prevalence of E. coli 0157:H7 in U.S. Dairy Calves**




USDA:APHIS:VS, National Dairy Heifer Evaluation Project

There is no evidence to suggest that ECO157 is an animal pathogen. Based on a lack of isolates among diagnostic lab *E. coli* cases, even if ECO157 were an animal pathogen, it is not a common one.

***3. Are there carrier states: man? animal? What is the duration of shedding?***

Infected humans have been shown to carry the organism for several days to weeks. Longer-term carriage has not been described; however, it has not been ruled out. The epidemiologic pattern is not consistent with long-term human carriage being a major source of human infection.

Published studies support a conclusion that ECO157 is present as part of the intestinal flora in 1 percent or less of dairy cattle. Several authors have speculated that the prevalence in beef cattle is lower, but available data do not support such a conclusion. As part of the National Dairy Heifer Evaluation Project conducted by Veterinary Services (USDA:APHIS), 6,894 heifer calves in 1,068 dairy herds were sampled in 28 states. The study found a prevalence of ECO157 of 3.6/1000 calves. Herd prevalence was roughly estimated at around 5 percent. Positive calves were found in all regions of the country (Figure 1). The issue of long-term carrier states in cattle has not yet been examined.

***4. How does it enter the food chain?***

Outbreaks of ECO157-associated disease have, on a number of well documented occasions, been traced to foods of bovine origin. Hamburger is the most commonly identified food vector of ECO157. Although the manner in which ECO157 comes to contaminate meat has not been specifically described, some bacterial contamination of carcasses is inevitable during skinning and processing, even in the absence of direct fecal contamination. Bacterial monitoring can be used within processing plants to identify and correct problems which result in high bacterial counts of meat, but this is not being done on an industry-wide basis in the U.S. Some recent discussion has focused on the possibility that ECO157 is deposited in deeper tissues

as a result of bacteremia in cattle; however, ECO157 does not appear to be invasive, and this is not required to explain the presence of bacteria in meat.

In addition to meat, raw milk can be a source of ECO157. Though human cases of ECO157-associated disease resulting from raw milk consumption have been described, pasteurization results in the destruction of ECO157 along with all other zoonotic pathogens.

Water has also been described as a source of infection in at least two outbreaks. And, as with all foodborne pathogens, it is possible for humans who are infected with ECO157 to pass the infection to other humans (through food contamination, hand-hand, etc.); transmission in day care centers is a particular concern.

***5. Are medicated animals (feed additives) related to carrier state?***

No published studies exist to support this hypothesis; however, it merits further investigation. Studies are currently underway to examine this issue with particular attention on products and practices which have emerged in the past 10 years.

***6. What is the risk to dairy practitioners of infection? to carrier status?***

Presently, there is no evidence that veterinarians, producers, or abattoir workers are at any different risk of disease associated with ECO157 than is the general public. Nevertheless, some excess risk might be expected, and careful hand washing and handling of soiled clothing is warranted. Also, as mentioned previously, raw milk drinking is a known risk factor for ECO157 infection.

The issue of carriage of ECO157 among humans who work with cattle in herds endemic for ECO157 is an interesting one that has not, to our knowledge, been investigated.

***7. How frequent are ECO157 outbreaks in the U.S. and Canada and the world?***

The Centers for Disease Control and Prevention (CDC) identified 17 outbreaks in the United States that warranted alert status[1] from 1982 through 1992, and an additional 17 occurred in 1993 alone. Reporting of outbreaks with animal sources has risen with increased monitoring and surveillance by U.S. state health departments. In 1987, only two states had mandatory reporting of ECO157. By the end of 1992, 11 states required reporting, and by the end of 1993, the number was 18. Canada has also experienced outbreaks.

Based on intense monitoring in limited areas, many unreported sporadic cases likely occur. In Washington state, where ECO157 is reportable, rates of ECO157-associated disease have been estimated at 8.0/100,000 people per year (roughly the same as the reported rate of Salmonellosis). During the past decade, reports of ECO157-associated disease have been made from a number of coutries around the world.

More than 75 percent of outbreaks for which a food source was identified were due to undercooked beef. One outbreak was traced to apple cider and another to raw milk. As mentioned above, waterborne outbreaks have also been reported.

***8. Is the disease preventable? What steps would be required? Are there any rapid tests for ECO157 or other E. coli?***

There are good prospects that the hazard of ECO157-associated disease can be reduced. Available evidence indicates that effective risk reduction will require measures at food production, processing, and preparation levels.

Adequate cooking of meat such that the center of any serving is heated to 155° F (i.e., not pink) will kill *E. coli*, and hand washing will prevent secondary spread. However, even though consumer education efforts have been helpful, the increasing rate of foodborne disease (particularly Salmonellosis, Campylobacteriosis, and disease associated with ECO157) indicates that consumer education alone will not be enough.

The recent outbreak focused attention on measures that could be taken at the processing level. A workable approach to food safety is based on the Hazard Analysis Critical Control Point (HACCP) system as proposed in the mid-1980's by two National Academy of Sciences reports (1985, 1987). Under such systems,the processes by which clean meat is produced are monitored. Agent specific, rapid microbial tests are not required for monitoring critical control points and thus reducing fecal-origin zoonotic agents in food.

Good reasons exist to think that farm-level food safety efforts (i.e., pre-harvest) might be successful for ECO157. Epidemiologic evidence suggests emergence of an ecologic niche for ECO157 in cattle populations during the 1980's. A particular management change introduced in the 1980's may have created the niche and could potentially be modified in control efforts. The 1993 outbreak with its human suffering and negative publicity to beef demonstrated the importance of intensive investigation of the natural history of ECO157 and development of effective intervention strategies.

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[1] Alert status is given to an outbreak in which the CDC determines to have national importance.