Salad and Pseudoappendicitis: *Yersinia pseudotuberculosis* as a Foodborne Pathogen

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(See the article by Nuorti et al., on pages 766–74.)

The next time you take a fork-full of meat or rice or peas, ponder for a moment the environment with which you are about to become intimate.

D. Waltner-Toews, 1992 [1]

Another foodborne pathogen appears on the scene. A report by Nuorti et al. at the Finnish National Public Health Institute, in this issue of *The Journal of Infectious Diseases*, provides solid documentation that *Yersinia pseudotuberculosis* can be transmitted through food [2]. Although this rare and enigmatic organism was first identified in 1883, its sources have remained obscure [3]. Clusters have been reported to occur without evidence of secondary spread among persons, indicating that an environmental source is likely. By virtue of its similarity to *Y. enterocolitica*, it has been presumed to be a possible foodborne pathogen, but the evidence for this assumption has been limited to a few suggestive clusters and to a large Canadian outbreak in 1998 that has been epidemiologically linked to pasteurized milk [4, 5]. In that outbreak, the origin of the presumed contamination was not clarified. The Finnish investigation is the first to link an outbreak of human illness to a likely environmental reservoir via contaminated food.

The outbreak was detected because routine surveillance was conducted for laboratory-diagnosed infections and because clinical isolates from a broad region were subtyped in a public health laboratory. Once the outbreak was recognized, the investigators used classic epidemiologic methods to link the large outbreak to locally grown lettuce. Although the harvest had been completed and lettuces were no longer available for culture, the investigators returned to the field the following year and succeeded in isolating several strains of *Y. pseudotuberculosis* from lettuce, soil, and irrigation water, indicating both the source and environmental persistence at the same time. An animal reservoir (hares or deer) was suspected, but this reservoir is, as yet, unconfirmed [6].

Such speculation is well justified. Though it is relatively rare in humans, infection with *Y. pseudotuberculosis* is a recurrent problem in animals. *Y. pseudotuberculosis* likely has several zoonotic reservoirs around the world. The organism causes a fatal plague-like illness in the guinea pig [7] and significant epidemic illness in the European brown hare [8]. It causes enteric illness in domesticated sheep [9] and has been problematic enough among farmed deer to lead to the development of a vaccine for those animals in New Zealand [10]. In addition, the organism has been isolated from the feces of healthy swine and from a variety of other mammals and birds in Eurasia [11, 12]. Thus, it would not be unexpected to find this organism in the deer or hares that inhabit the areas near the fields where the implicated lettuce was grown.

This natural history may provide a glimpse into the evolutionary origins of another major pathogen, *Y. pestis*, which is exceedingly close to *Y. pseudotuberculosis* genetically. The 2 pathogens are so closely related that Achtman et al. [13] recently proposed that *Y. pestis* diverged clonally from a progenitor *Y. pseudotuberculosis* strain within only the last 20,000 years, basing this hypothesis on multilocus sequence typing. Acquisition of 2 plasmids by *Y. pseudotuberculosis* may have permitted the new variant to circulate via the flea, as well as via the fecal-oral route [3].

This outbreak also illustrates the im-
The consumer can do little to prevent fresh produce–associated infections. Fresh produce is often eaten without having been cooked, so there is no final protective step to kill the pathogen in the kitchen. Washing dirt from the surface is prudent, but even washing with soap or using chlorine dips reduces the level of surface contamination by only 1–2 logs at best [27]. Prevention lies in reducing the likelihood of contamination from the field onward and in disinfection technologies, such as irradiation. In the case of the lettuce implicated in the Finnish study, it will be helpful to study the behavior of *Y. pseudotuberculosis* in the lettuce plant and to define whether deer, rabbits, or other animals are the specific reservoir. Prevention may ultimately involve fences and animal population control or vaccination, as well as the use of disinfected water in washing or processing. This outbreak reminds us how far the sources of illness extend beyond the clinic and hospital. The microbial world links the immediate illness in a patient to events over the horizon. To prevent such infections, we must first understand the pathogens’ transmission, as well as their natural history, well enough to prevent it.

References