

CD SUMMARY

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BLUE LAKE REVISITED: SWIMMING-ASSOCIATED TRANSMISSION OF ESCHERICHIA COLI O157:H7

WITH SUMMER AT HAND, thoughts naturally turn to bacterial gastroenteritis. Warm temperatures and the pursuit of outdoor pleasures traditionally lead to peaking incidence rates for many enteric infections between June and September. A 1991 Portland-area outbreak of gastroenteritis caused by both *Escherichia coli* O157:H7 (O157) and *Shigella sonnei* illustrates one of the less-publicized hazards of summer fun.

This outbreak, traced to Multnomah County's Blue Lake Park, severely disrupted the lives of hundreds of people. Six children were hospitalized—four with hemolytic uremic syndrome. At the time, only 12 outbreaks of O157-caused illness had been reported in the United States.¹ Previous outbreaks had been linked to undercooked hamburger, contaminated drinking water, and person-to-person transmission in day-care centers and nursing homes. The Blue Lake outbreak was soon linked to exposure to lake water (*CD Summary*, August 13, 1991). While frequently reported for shigellosis, Norwalk-like viral gastroenteritis, and other enteric diseases, exposure to recreational water has not previously been described as a risk factor for O157 infection.

This cluster might have gone unnoticed but for the fact that Oregon is one of only a handful of states (including Washington, Minnesota, and Wisconsin) where O157 infections are reportable. Nothing in these initial case reports, scattered across four counties, suggested a common-source outbreak. These notifications, however, are followed up with more in-depth investigations with the goals of: identifying a source; finding additional cases; identifying persons at risk of infection; and recommending specific measures to reduce the likelihood of further transmission. In

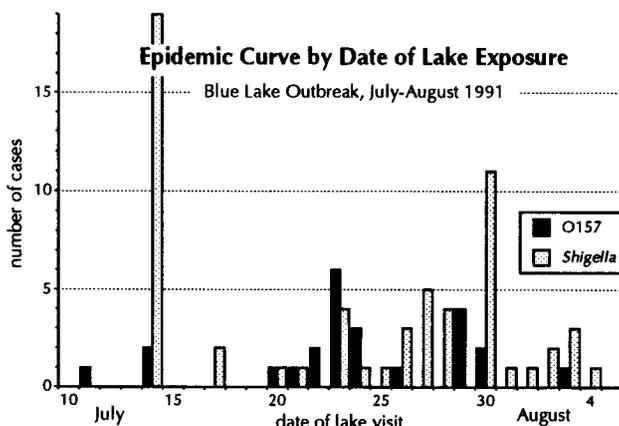
this instance, investigation revealed that at least two of the first five cases reported had attended a company picnic at Blue Lake Park on 14 July. Questioning of company employees showed that illness was not associated with any of the food or drink. The only persons to become ill were children who had gone swimming.

Meanwhile, other reports with of O157 infections continued to accumulate. Most had been to the park in the week before their illness, but on many different days. Area physicians were alerted to the outbreak, and hospital and other private labs

transmission. To identify a source, the Health Division conducted a case-control study. Ideally, cases would have been compared to an unbiased sample of others who had been at the park at the same time. Unfortunately, park visitors don't sign in and out, so we had no way to identify such a cohort. Instead, we used three kinds of controls, each with its own biases, and looked for exposures consistently associated with illness. The first group (the "exit poll," N=32) was obtained by stopping cars as they left the park and interviewing one child under the age of 17 in each vehicle, if present. The second group ("family controls," N=42) consisted of all persons, regardless of age, who had accompanied the cases to the park on their probable day of exposure—typically siblings, playmates, and a parent or two. The third group was children who had attended various organized picnics at the park over the weeks in question. Many groups had reserved sites with the parks department for company picnics, family reunions, and the like; we called the contact persons of record and asked them to provide us with names and phone numbers for persons who had attended these functions with children under the age of 17. A sample of these children ("park groups," N=246) was then interviewed.

RESULTS

No consistent associations were found between illness and any food or drink served by park concessionaires, nor with consumption of drinking water. What did emerge was a very strong association between illness and exposure to lake water—an odds ratio of 28.2 with park group controls, 7.1 with family controls, and 8.6 with exit pollees (all $p < .05$). Among those who had entered the lake, cases averaged more time in the water than controls (2.0 vs. 1.3 h; $p < .02$). In summary, everything but the lake water could be ruled out as a plausible common source, and lake water itself was strongly incriminated.



were canvassed about cultures from patients with bloody diarrhea. O157 is one of the most common causes of bacterial gastroenteritis in the Northwest, but recognition depends on physicians requesting the special culture. This should be routine for any patient with an unexplained history of bloody diarrhea, and is worth consideration in other cases. Eventually, a total of 24 cases of confirmed O157-caused illness associated with recent park visits was identified.

The O157 cases were between one and 16 years old (mean = 5 y). The average incubation time was five days (range 1-11 d). All but one developed bloody diarrhea, most within a day or two of onset. Four patients developed HUS, requiring transfusions and, in one case, dialysis.

STUDY DESIGN

While it was obvious that something had happened at the park, it was not a given that lake water itself was the vehicle of

¹ For an excellent recent review of O157 infections, see Griffin PM and Tauxe RV. The epidemiology of infections caused by *Escherichia coli* O157:H7, other enterohemorrhagic *E. coli*, and the associated hemolytic uremic syndrome. *Epi. Reviews*. 1991,13:60-98. A shorter review of O157 appeared in the *CD Summary*, September 27, 1988.

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SOURCE OF CONTAMINATION

O157 has been isolated from cattle, pigs, and chicken, but Blue Lake is not downstream from any stock herding or poultry-raising areas. Nearby residents and park visitors denied throwing raw hamburger into the lake, ruling out another possible source of introduction. By process of elimination, that left human fecal pollution as the likely source. A coincident [and with at least 67 primary cases, much larger] outbreak of lake-associated shigellosis confirmed this suspicion.² (A sample of these patients were compared with the same controls identified above, with identical results.) Lastly, because of a small outbreak of shigellosis the previous year, Multnomah County had been monitoring levels of bacterial contamination at the swimming area, and enterococcus levels³ had begun to exceed EPA-recommended limits by mid-July, roughly coincident with the beginning of the epidemic. High bacterial counts were limited to the immediate area of the swimming beach, suggesting indiscriminant defecation by bathers. (Blue Lake is fed by an underwater spring, and has no direct outlet other than evaporation; circulation was minimal.)

A striking and still unexplained finding was that transmission of both pathogens apparently continued over a three-week period. Except where ongoing sources of contamination have been identified, other outbreaks of swimming-associated gastroenteritis have usually been quite short-lived, attack rates often falling markedly within hours of putative pollut-

ing events. Both organisms may have been reintroduced repeatedly into Blue Lake, or relatively high levels of infectious organisms may have survived or even multiplied in lake water. There is no evidence to support or refute these hypotheses. Neither O157 nor *S. sonnei* could be cultured from lake water samples collected on 8 August, well after the apparent peak of transmission. *S. sonnei* was epidemic in Portland prior to the Blue Lake outbreak, so the prevalence among park visitors may have been higher than usual. The infectious dose for *Shigella* spp. is known to be quite low, and limited data suggest that the infectious dose for O157 may likewise be small.

OBJECT LESSONS

This outbreak underscores the fact that recreational waters, and particularly lakes, are inherently vulnerable to fecal contamination. Adequately maintained pools are relatively safe, but even chlorination is ineffective against some pathogens, notably *Cryptosporidium parvum* and *Giardia lamblia*. Incontinent bathers (*sensu lato*) can excrete a cloud of pathogens that gradually disperse over both space and time. The probability of infection is largely a function of having one's mouth open in the wrong place at the wrong time.

Parks officials have gone to great lengths to make improvements at Blue Lake, which reopened for swimming on 14 June. Some of these measures may be worth considering at other swimming areas where water circulation is poor:

Decrease pollution. Children who have not been toilet-trained should not be expected to master this skill at the local

swimming hole. At Blue Lake, a new water spray/play area for infants and toddlers has been constructed adjacent to the swimming beach to offer a fun and safe alternative. (It drains into sewer lines.) Adequate bathroom facilities should be conveniently located at any public bathing area. No one with a diarrheal illness, regardless of age, should endanger others by swimming in a public place. Finally, at some locations, it may be advisable to limit the number of bathers allowed in the water at any one time.

Increase dilution. In swift rivers, this is not a problem. An elaborate high-volume, low-pressure pumping system has been installed at Blue Lake to approximate the degree of water turnover seen in less stagnant bodies of water.

It is believed that these measures, in coordination with a public education campaign, will greatly reduce the likelihood of similar outbreaks at Blue Lake. There are thousands of Blue Lakes around the country, however, and few will be under such close and continuing scrutiny for evidence of disease transmission. Consequently, recreational water-associated illness will undoubtedly be with us for some time.

New AIDS Case Definition Postponed Indefinitely

THE PROPOSED REVISION of the AIDS surveillance case definition (to include HIV-infected persons with CD4 lymphocyte counts of <200/ μ l) has been shelved by federal health officials, apparently a victim of controversy more political than scientific. Any updates will be noted in the *CD Summary*.

²Shigellae infect only humans.

³ the best indicator of human fecal pollution.