AN OUTBREAK OF HEMORRAGIC ESCHERICHIOSIOSIS TRACED TO SPINACH

There is no just ground, therefore, for the charge brought against me by certain ignoramuses—that I have never written a moral tale, or, in more precise words, a tale with a moral.1

It was a Friday evening: 6:08 pm. We were working the swing shift in Acute & Communicable Disease Prevention. The phone rang. It was J—, a microbiologist at the Oregon Public Health Lab. The conversation was brief, but her terse message would set in motion a chain of events that would dominate domestic news for weeks, bring a large segment of the agro-industrial complex to its knees, and strike fear into salad eaters everywhere.

The spinach investigation was underway.

What was that message? What was its real meaning? How did the investigation proceed? Where did it lead? Why did this outbreak occur? Was it a fluke, or does it really speak to the safety of produce in general and spinach in particular? In today’s installment of the CD Summary, we’ll explore some of these issues, separating the myth from the hype.

In this country, the Four Horsemen of bacterial gastroenteritis are Campylobacter, Salmonella, Shigella, and Shiga-toxigenic Escherichia coli (STEC2). Although now eclipsed as causes of morbidity and mortality by diabetes, cancer, and even heart disease, these infections continue to capture the attention of patients and clinicians, not to mention public health and regulatory agencies, the media, and the food industry (sensu lato). All are spread by the fecal-oral route: what John Waters might call Divine retribution. Some of that is really speak to the safety of produce in general and spinach in particular?

By far the most commonly identified STEC pathogen identified in the United States is E. coli O157:H7 (“O157”), not least because it is pretty much the only one ever tested for, and its epidemiology is more or less3 typical of the lot. Since 1990, when they became reportable in Oregon, 1,992 O157 infections have been reported. Most of them (62%) were what we call “sporadic”—not known to be epidemiologically linked to any other cases (see figure). About 27% were part of recognized multi-household outbreaks, and the balance were part of intra-household clusters (two siblings, parent and child, etc.). But while explaining only around one-quarter of reported cases, outbreaks are of disproportionate importance in terms of public health significance.

Epi Links of Reported O157 Cases, Oregon, 1990-2006

But we digress. It was [still] Friday evening—September 8th, to be specific. The report was that we had 3 “PFGE-matching” O157 cases, one from Linn County, one from Marion, and one from Cowlitz (Washington).4 PFGE is the acronym for pulsed-field gel electrophoresis, a restriction fragment length polymorphism-based subtyping method. While often referred to as a “molecular fingerprinting” method, it is important to realize that “molecular blood typing” might be a more apt metaphor. These kinds of matches are reported frequently, and it is relatively uncommon for common sources to be identified. Indeed, some PFGE patterns are common, appearing year-in, year-out in a context not suggestive of any ongoing common source. That said, suspicious matches always deserve a second look, particularly when they match, not only in the lab but cluster in space and time, as these did.

This investigation unfolded rapidly. Routine interviews had already been conducted with these 3 cases by local health department nurses in Oregon and Washington. While sometimes a hot prospect jumps out from even those basic interviews (e.g., everyone visiting the same county fair, swimming hole, or restaurant; or everyone reporting consumption of a high-risk food such as alfalfa sprouts or unpasteurized cider), more often the clues are harder to read. That was the story this time, unfortunately—but for the tantalizing fact that one of the Oregon cases had been in Idaho for the 2 weeks before onset. With an incubation period of 1–10 days (and usually in the 2–7 day range), that almost certainly meant an exposure in Idaho. So right off the bat we knew that these cases had been exposed in Idaho, Washington, and Oregon, respectively. But did they really have a common source?

By Monday we were able to confirm that there were no other matching cases in the Northwest, California, or British Columbia.5 Tuesday was quiet until again around 6 pm, when our lab reported 3 more matching isolates: these from Multnomah and Benton Counties. Other than the observation that 5 of 6 were adult women we still had little to go on. At this point we began to reinterview these cases with our “shotgun” questionnaire—a brute tour-de-force to find something (anything) that people may have eaten in common. We asked about over 300 specific food items, as well as questions to jog people’s memories about places they may have eaten in the week or so before they became ill. In addition to the obvious, people are reminded to think about food they may have eaten at bars, airports, at sporting events or concerts; foods from street vendors or handed out as free samples, at

1 from an essay by E. A. Poe (1841). Never bet the Devil your head: a tale with a moral.
2 Two syllables; rhymes with the capital of Kyrgyzstan.
3 Unfortunately, we don’t know which.
4 Isolates from residents of other states frequently turn up at the OSPHL. All formal reporting and almost all investigations are based on state of residence, however.
5 Unfortunately, a computer glitch kept us from learning that there were matching cases in Wisconsin.
ice cream shoppes, gas stations, and on
and on.

Interviews continued until almost 10
pm Tuesday night, and resumed Wednes-
day morning. By mid-morning, the word
was spinach: 4 of 5 recalled eating pre-
washed, ready-to-eat bagged spinach.
Given background rates of (any) spinach
consumption in a given week of 15–
25%\textsuperscript{7}, finding this 80% proportion
was highly suspicious.\textsuperscript{8} Moreover, spinach
and similar produce (e.g., bagged lettuce
and other salad mixes) were certainly
plausible vehicles, having been previously
implicated in outbreaks of O157 infec-
tions and salmonellosis. The Oregon
interviews did not suggest a common
brand, however, but discussions with
California health officials confirmed
suspicions that multiple brands were often
packaged by a single processor.

There was still no word of similar
cases in neighboring states. When we
notified CDC that afternoon (September
13) about the cluster and our evidence
pointing at spinach, however, we learned
for the first time that Wisconsin epidemi-
ologists were investigating a large cluster
of cases (~18 at that moment) that they
thought were due to some kind of pro-
duce item, and that there were matching
cases in New Mexico and Utah at least. A
hastily arranged conference call con-
firmed that indeed we were all working
on the same outbreak, and that the cause
was bagged spinach. New Mexico offi-
cials were already collecting leftover
samples for lab testing—testing that days
later would corroborate the epidemiological findings.

The rest, as they say, is history. The
FDA announced a public recall, initially of
all spinach products. Additional cases were
quickly identified in state after state—
eventually 194 lab-confirmed cases in at
least 25 states\textsuperscript{9} (see figure), with at least 98
hospitalized and 3 deaths. Evidence collect-
ed over the next several weeks would nar-
row the spotlight of suspicion to product
packaged at only one California facility on
August 15, 2006—product that for the most
part would have long since been consumed or slimed by the time of the
September 14 recall. A vast investigation
conducted by public health agencies in
California has identified similar O157
isolates in cattle-grazed areas and wild pigs
in close proximity to implicated spinach
fields, suggesting that wind- or waterborne
runoff from livestock or direct contamina-
tion by wild animals could have been the
proximate source of contamination. At this
writing, lab comparison of those isolates
with the outbreak isolates is incomplete.

Microbial contamination of produce is a
vexing problem. While a higher proportion
of raw meat and poultry packages at the
grocery store may be contaminated with
Salmonella, Campylobacter, or other
pathogens, the kill steps including in com-
nercial processing methods and just plain
thorough cooking offer pre-prandial
opportunities to ameliorate those risks.
With uncooked fruits and vegetables,
however, there may be little the con-
sumer can do of great effect. Refrigerat-
ing produce to minimize bacterial
growth and hand washing to reduce
cross-contamination are worthwhile
practices—and we recommend them—
but don’t kid yourself; probability theo-
ry is the consumer’s main line of
defense for uncooked produce. Washing
loose spinach is an effective way to
reduce the amount of rocks and dirt, but
has limited effect on bacterial loads.
Re-washing commercially washed produce
is probably a waste of time and water.
Effective control will have to occur
further “upstream”—in the fields and
packing houses.

Although a meal of chicken nuggets
and freedom fries does pose little risk of
an enteric infection, these risks must be
kept in perspective—especially during
an obesity epidemic. Fruits and vegeta-
bles, including spinach, are well-recog-
nized pillars of a healthy diet. Grease
and salt are not.\textsuperscript{10} Regulatory agencies,
produce buyers, packers, growers, and
litigators are now working to identify
practical ways to minimize the future risk
of infection. We close with the hack-
neyed observation that this outbreak
again demonstrates the utility of disease
surveillance. Without appropriate diag-
nostic testing and disease reporting by
clinicians and laboratories, this outbreak
would have gone unnoticed. And while
that might be a Good Thing for some in
the short term, in the long run it would be
a Bad Thing for the public’s health.

\textsuperscript{7} This from ongoing FoodNet-sponsored population surveys.
\textsuperscript{8} With a binomial model and a background consumption rate
of 15–25%, the probability of getting 4 or more consumers
out of a random sample of 5 would be 0.2–1.6%.
\textsuperscript{9} and 1 in Canada.
\textsuperscript{10} Indeed, pillars of salt have distinctly unhealthy
connotations that have been long recognized.