Etiology of Bloody Diarrhea among Patients Presenting to United States Emergency Departments: Prevalence of Escherichia coli O157:H7 and Other Enteropathogens

David A. Talan,1 Gregory J. Moran,1 Michael Newdow,1 Samuel Ong,1 William R. Mower,1 Janet Y. Nakase,1 Robert W. Pinner,2 and Laurence Slutsker,2 for the EMERGEncy ID NET Study Group

1Department of Emergency Medicine, Olive View–University of California Los Angeles Medical Center, University of California, Los Angeles; 2National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta

Escherichia coli O157:H7 and other Shiga toxin–producing E. coli (STEC) infections have been associated with bloody diarrhea. The prevalence of enteropathogens among patients with bloody diarrhea was determined by a prospective study at 11 US emergency departments. Eligible patients had bloody stools, ≥3 loose stool samples per 24-h period, and an illness lasting <7 days. Among 873 patients with 877 episodes of bloody diarrhea, stool samples for culture were obtained in 549 episodes (62.6%). Stool cultures were more frequently ordered for patients with fever, >10 stools/day, and visibly bloody stools than for patients without these findings. Enteropathogens were identified in 168 episodes (30.6%): Shigella (15.3%), Campylobacter (6.2%), Salmonella (5.8%), STEC (2.6%), and other (1.6%). Enteropathogens were isolated during 12.5% of episodes that physicians thought were due to a noninfectious cause. The prevalence of STEC infection varied by site from 0% to 6.2%. Hospital admissions resulted from 195 episodes (23.4%). These data support recommendations that stool samples be cultured for patients with acute bloody diarrhea.

Acute bloody diarrhea is a frightening symptom that has been associated with Escherichia coli O157:H7 and other Shiga toxin–producing E. coli (STEC) infections, illnesses occasionally complicated by the development of hemolytic-uremic syndrome (HUS) and death [1]. These infections cause ~100,000 illnesses, 3000 hospitalizations, and 90 deaths annually in the United States [2]. More than 70% of persons with E. coli O157:H7 (STEC) infection have a history of bloody diarrhea [1]. Despite the significant impact of bloody diarrhea, its causes and consequences in the United States and other developed countries are not well described.

Over the past 2 decades, many studies of sporadic cases and outbreaks of bloody diarrhea caused by E. coli O157:H7 have been reported [2–15]. One laboratory-based study conducted at 10 US hospitals isolated E. coli O157:H7 from 118 (0.39%) of 30,463 stool samples [16]. In this study, E. coli O157:H7 was found 20 times more frequently in visibly bloody stool specimens (8%) than in nonbloody specimens. Enteropathogens were isolated from ~20% of visibly bloody specimens, and E. coli O157:H7 was the most frequently isolated pathogen, accounting for 40% of identified entero-
PATIENTS AND METHODS

This study was a prospective case series of consecutive pediatric and adult patients with bloody diarrhea who were identified among all patients who presented to emergency departments at any time of day on every day, from 1 July 1996 through 30 September 1998. Investigative sites were part of a sentinel network of 11 urban, university-affiliated US emergency departments, EMERGEency ID NET, with an estimated total annual visit census of 900,000. EMERGEency ID NET methodology has been previously reported [24]. The study captured data from clinical information obtained and laboratory tests done in the course of routine care.

Inclusion criteria were as follows: a history of bloody stools or bloody stools evident on examination, including stools with occult blood (Hemoccult [SmithKline Diagnostics]; Seracult [Propper]; or ColoScreen [Helena Laboratories]); ≥3 loose stools per 24-h period; and an illness lasting <7 days. Patients could be enrolled if they had had >1 episode of illness, provided that episodes were separated by ≥1 month. Testing for occult blood was done at the discretion of the treating physician. Patients with presumptive noninfectious etiologies were not excluded.

Demographic and clinical data were collected by use of a written standardized questionnaire administered by a health care provider or research assistant during clinical care for all eligible patients, regardless of whether culture of stool was ordered. Fever on examination was defined as ≥38.0°C. Only data for which responses were recorded were analyzed (i.e., missing data were not included). Telephone follow-up to ascertain complications was attempted 2–4 weeks after presentation for all patients from whom an enteric pathogen was isolated.

Retrospective case-finding audits were conducted of all emergency department patients seen during 2 1-month periods, January 1997 and January 1998, to approximate the proportion of missed cases and to compare their characteristics with those of identified cases. Patient logs were reviewed to identify all cases with the discharge diagnosis of diarrhea, bloody diarrhea, or gastrointestinal bleeding. Patients’ charts were then reviewed to determine if inclusion criteria were met and if the case was entered into the study. Data collected for the audit included each patient’s age, sex, race; presence of fever; stool culture collection, and disposition (i.e., whether the patient was admitted or sent home). Missed cases identified through the audits were not included in the study data analysis.

The treating physician decided whether a stool specimen would be collected and a culture ordered. One specimen per patient was collected. Specimens were either transported to the laboratory immediately or placed into a transport medium (for whole stool, Para-Pak C&S [Meridian Diagnostics]; for rectal swabs, Culturette [Becton Dickinson], BBL Culturette II [Becton Dickinson], Liquid Amies Swabs [Copan Diagnostics], or Bacti-Swab II [Remel]). Specimens were usually plated for performance of routine bacterial cultures <2 h and not >24 h after the time of collection. Standard methods were used to isolate and identify Campylobacter, Salmonella, and Shigella species at all sites. Routine testing for Plesiomonas was done at 5 sites (Charlotte, Los Angeles, New Orleans, New York, and Orlando), for Yersinia species at 5 sites (Atlanta, Los Angeles, New Orleans, New York, and Orlando), and for Vibrio species at 3 sites (Los Angeles, New Orleans, and New York); at other sites cultures for these pathogens and others, such as Clostridium difficile, were not routinely done.

After broth enrichment, fecal specimens were tested for Shiga...
toxin by EIA with kits provided to participating laboratories (Meridian Premier EHEC ELISA; Meridian Diagnostics) [22]. All laboratories routinely plated specimens onto sorbitol-MacConkey agar to identify E. coli O157:H7. Sorbitol-negative colonies were tested for O157 antigen by agglutination with O157 latex reagents (Rim E. coli O157:H7 kit [Remel], Prolex E. coli O157 latex agglutination kit [Pro-Lab Diagnostics], or E. coli antiserum for O157 [Difco]). Some isolates were also tested for H7 antigen (Rim E. coli O157:H7 kit [Remel], Roach H7 antisera [Roach], E. coli antiserum for H7 [Difco], or CDC H7 antiserum). If specimens did not yield E. coli O157 and were positive for Shiga toxin in the Meridian EIA, then both sorbitol-positive and -negative colonies were tested for the presence of Shiga toxin. Presumed E. coli O157 and other Shiga toxin–producing strains were referred to the CDC for biochemical identification and serotyping.

An episode was classified as an “STEC” episode if a fecal specimen was collected that tested positive for Shiga toxin and a stool culture yielded STEC or E. coli O157:H7. Episodes with a Shiga toxin–positive fecal specimen and a stool culture that did not yield a pathogen were classified as “possible STEC.” Episodes with a fecal specimen that was not tested for Shiga toxin but with a stool culture that yielded an isolate that was O157 antigen–positive and for which flagellar antigen was not assayed were also classified as “possible STEC” episode. Results are reported on confirmed and possible STEC unless otherwise specified. Campylobacter, Salmonella, Shigella, Vibrio, Yersinia, Plesiomonas, and STEC species were considered enteric pathogens.

Data are presented as medians with interquartile ranges, RRs, and 95% CIs, as appropriate. Pathogen frequencies were calculated on the basis of a numerator of total number of episodes of illness in which a pathogen was identified and a denominator of total number of episodes for which stool cultures were performed. Age and stool frequency were made dichotomous at <5 or ≥5 years and ≥10 and <10 stools per day, respectively.

RESULTS

During the study period, 873 patients were enrolled with 877 episodes of bloody diarrhea (median number of patient episodes per site, 85; range, 32–150). Of the patients, 24.5% were aged <5 years (range, by site, 6%–38%). The racial or ethnic makeup of the study group was as follows: white, 34% (range, 7%–56%); African-American, 31% (range, 2%–85%); Hispanic, 30% (range, 0 to 71%). Twenty-five percent (range, 3%–49%) had Medicare benefits or private insurance, 33% (range, 9%–48%) had Medicaid, and 37% (range, 8%–72%) were uninsured. Of these 877 episodes, stool cultures were performed for 549 episodes (62.6%; range, by site, 28%–100%). Cultures were of whole stool for 347 episodes (63.2%), of rectal swabs for 93 (16.9%), of swabs of collected stool for 38 (6.9%), or of diapers for 51 (9.3%). For 20 episodes (3.6%), the specimen source was unspecified. Shiga toxin assays were done for 465 episodes (53.0%) and for 405 episodes (73.8%) for which stool cultures were performed. Fecal blood was noted in the patient’s history for 671 episodes (76.5%), as visible on examination in 340 (38.8%), and by means of occult blood testing only for 104 (11.9%). The most common presumptive clinical diagnoses were infectious diarrhea caused by viruses (125 episodes [20.2%]), bacteria (250 [40.6%]), or parasites (8 [1.3%]) and gastrointestinal bleeding not related to infection (69 [11.2%]). Other diagnoses included intussusception (2), inflammatory bowel disease (2), diverticulosis (2), and volvulus (1).

Compared with patients for whom treating physicians did not choose to order stool cultures, those for whom stool cultures were performed more frequently had a history of fever (RR, 1.1; 95% CI, 1.0–1.3) and more stools per day (≥10 vs. <10; RR, 1.2; 95% CI, 1.1–1.3). On examination, patients for whom stool cultures were performed more frequently had a temperature ≥38.0°C (RR, 1.2; 95% CI, 1.1–1.4) and visible blood in stool (RR, 1.3; 95% CI, 1.2–1.5).

Among the 549 episodes for which a stool specimen was submitted for culture and/or Shiga-toxin assay, enteric pathogens were identified for 168 (30.6%) (table 1). The following enteropathogens were identified: Shigella species, 84 episodes (15.3%; range, by site, 0 to 26.2%); Campylobacter species, 34 (6.2%; range, 0 to 18.2%); Salmonella species, 32 (5.8%; range, 2.5%–12.8%); STEC, 14 (2.6%; range 0 to 5.4%); and other pathogens, 9 (1.6%; Vibrio [4], Yersinia [4], and Plesiomonas species [1]). More patients presented with bloody diarrhea in the summer and fall than in the winter and spring (cases per season, 106 and 126 vs. 100 and 81, respectively). The proportion of stool cultures that yielded an enteropathogen was slightly lower in the spring than during other periods (23.6% vs. 32.0%). The proportion of stool cultures from patients aged

Table 1. Microbiological findings among US emergency department patients presenting with 549 episodes of bloody diarrhea at 11 EMERGENCY ID NET sites.

<table>
<thead>
<tr>
<th>Microbiological finding</th>
<th>No. (%)</th>
<th>95% CI, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stool pathogen isolated&lt;sup&gt;a&lt;/sup&gt;</td>
<td>168 (30.6)</td>
<td>27–35</td>
</tr>
<tr>
<td>Shigella species</td>
<td>84 (15.3)</td>
<td>12–19</td>
</tr>
<tr>
<td>Salmonella species</td>
<td>32 (5.8)</td>
<td>4–8</td>
</tr>
<tr>
<td>Campylobacter species</td>
<td>34 (6.2)</td>
<td>4–8</td>
</tr>
<tr>
<td>STEC</td>
<td>14 (2.6)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1–4</td>
</tr>
<tr>
<td>Other enteropathogens&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9 (1.6)</td>
<td>1–3</td>
</tr>
</tbody>
</table>

<sup>a</sup> Includes 6 confirmed and 8 possible STEC cases.

<sup>b</sup> Includes 1 each Plesiomonas or Salmonella species or E. coli O111.

<sup>c</sup> Includes 1 each Vibrio or Yersinia or Plesiomonas species.

NOTE. STEC, Shiga toxin–producing Escherichia coli.

<sup>a</sup> Includes 3 patients’ stool specimens yielded 2 enteropathogens; each Shigella plus 1 each Plesiomonas or Salmonella species or E. coli O111.
<5 years that yielded an enteropathogen was 35.4%. Prior antimicrobial use was not associated with culture yield. Stool cultures yielded enteropathogens for 33.1% of episodes in which patients reported bloody stools; in 23.8% of episodes in which bloody stool was reported by the patient but not detected on examination, in 38.3% of episodes blood was visible on examination, and in 19.4% of those in which only occult blood was detected (of these, none were STEC). Patients for whom physicians gave the presumptive diagnosis of bacterial diarrhea were more likely than patients with other diagnoses to have an enteropathogen isolated (RR, 2.1; 95% CI, 1.5–2.8). Eighty-eight (48.4%) of 182 episodes of bloody diarrhea that the physicians thought were due to a noninfectious cause had specimens obtained for stool cultures, and 11 (12.5%) had an enteropathogen isolated.

Demographic and clinical characteristics of study patients are summarized in table 2. Identification of an enteropathogen was associated with a history of fever (RR, 2.9; 95% CI, 2.1–4.0), cramps (RR, 1.5; 95% CI, 1.0–2.5), numerous stools (frequency, ≥10 stools per day; RR, 1.6; 95% CI, 1.2–2.1) and bloody stools (RR, 1.5; 95% CI, 1.0–2.2), and, on examination, temperature ≥38.0°C (RR, 1.9; 95% CI, 1.4–2.5) and visibly bloody stool (RR, 1.6; 95% CI, 1.2–2.0). An elevated peripheral WBC count was not associated with the presence or absence of enteric pathogens.

STEC was found in 14 (2.6%) of 405 case patients for whom both stool culture and Shiga toxin assay were performed, which corresponded to 8.3% of cases in which an enteric pathogen was identified (6 classified as STEC and 8 as possible STEC). Of 6 STEC isolates, 5 were identified as O157:H7; 1 was E. coli O111 strain (nonmotile; Shigella boydii, a non–Shiga toxin producer, was also recovered from the same specimen). Among 8 patients with possible STEC infection, 4 had fecal specimens that were Shiga toxin–positive but from which no STEC were recovered; culture of 2 of these specimens yielded Campylobacter species and culture of 2 others did not yield an enteropathogen. Three isolates were identified as E. coli O157 but had neither H7 nor Shiga toxin assays done. One fecal specimen was Shiga toxin–positive and yielded an O157–positive isolate that was not tested for H7 antigen. Compared with patients with infections due to other enteric pathogens, those infected with STEC were less likely to have a history or documented presence of fever and were more likely to have a history of blood in stools or visible stool blood on examination (table 2). Among patients with episodes for which an enteropathogen was isolated, STEC accounted for 10 (10.9%) of 92 with a history of visible blood in stool and 10 (10.3%) of 97 with visible blood on examination.

A total of 195 episodes of bloody diarrhea (23.4%) led to hospital admission (table 2). Hospital admission was associated with patient age ≥5 years (RR, 1.4; 95% CI, 1.0–2.0) and a presumptive diagnosis of noninfectious gastrointestinal bleeding (RR, 3.0; 95% CI, 2.3–3.8). The presence or absence of an identified enteric pathogen in general or of a specific enteropathogen, other than Campylobacter species and STEC, was not associated with the likelihood of hospital admission. Patients with episodes due to Campylobacter species or STEC were about half as likely to be admitted to the hospital as other patients. Follow-up data was available for 10 (71%) of patients with bloody diarrhea due to STEC; no cases of HUS occurred among these patients.

Case-finding audits revealed that ~75% of eligible case patients were identified; missed case patients were similar with respect to age, sex, race or ethnicity, and of likelihood of having a history of fever, of having stool cultures performed, and of hospital admission.

**DISCUSSION**

To our knowledge, this is the first prospective clinical study from a developed country of a wide cohort of patients who presented with acute bloody diarrhea. Our results help to define the etiology and confirm the importance of this syndrome. Approximately one-third of episodes were associated with the isolation of a bacterial enteric pathogen, and ~1 in 4 patients required hospital admission. Contrary to previous reports, E. coli O157:H7 and other STEC were not the most common identified infectious etiologic agents among patients with bloody diarrhea. Although STEC infection represented a small fraction (2.6%) of all acute bloody diarrhea cases in this study, the serious STEC infection–associated complications, such as HUS, and the significant yield of other enteropathogens with potential for disease prevention through outbreak detection appear to justify the performance of stool cultures for these patients.

There have been few etiologic studies of acute diarrhea from developed countries, and, until recently, the prevalence of STEC has not been investigated. Slutsker et al. [16] conducted the most recent large survey, reporting on the culture results of 30,463 fecal specimens submitted to 10 US hospital laboratories during 1990–1992. E. coli O157:H7 was screened for by use of culture; no Shiga toxin assay was performed. Our findings verify the relatively high yield of stool cultures among patients with bloody diarrhea; enteropathogens were found in about one-third of episodes. In contrast to the findings of Slutsker et al. [16], in which E. coli O157:H7 represented 40% of bacterial enteric pathogens isolated from visibly bloody specimens, as noted in the laboratory, in our study all STEC (as detected by culture and/or Shiga toxin assay) accounted for only 10.3% of pathogens isolated from visibly bloody stool, as noted by the patient’s physician.

Differences in the prevalence of infection with various en-
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All patient episodes</th>
<th>Culture performed</th>
<th>Pathogen isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Yes&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Age, median y (IR)</td>
<td>27.2 (5.8–41.8)</td>
<td>28.8 (7.6–44.4)</td>
<td>25.9 (4.3–40.2)</td>
</tr>
<tr>
<td>Duration of illness &lt;48 h</td>
<td>480 (55.3)</td>
<td>185 (57.5)</td>
<td>295 (54.0)</td>
</tr>
<tr>
<td>Fever</td>
<td>399 (48.1)</td>
<td>132 (42.7)</td>
<td>267 (51.2)</td>
</tr>
<tr>
<td>Cramps</td>
<td>628 (84.2)</td>
<td>234 (83.0)</td>
<td>394 (84.9)</td>
</tr>
<tr>
<td>Blood in stool&lt;sup&gt;c&lt;/sup&gt;</td>
<td>404 (48.2)</td>
<td>134 (43.6)</td>
<td>270 (50.8)</td>
</tr>
<tr>
<td>No. of stools per day, median (IR) [n]</td>
<td>8 (5–12) (794)</td>
<td>6 (4–10) [297]</td>
<td>8 (5–13) [497]</td>
</tr>
<tr>
<td>History of attending day care</td>
<td>90 (12.8)</td>
<td>39 (16.9)</td>
<td>51 (10.8)</td>
</tr>
<tr>
<td>History of foreign travel</td>
<td>57 (7.3)</td>
<td>19 (7.4)</td>
<td>38 (7.3)</td>
</tr>
<tr>
<td>Temperature &gt;38°C on examination</td>
<td>199 (23.6)</td>
<td>52 (16.8)</td>
<td>147 (27.6)</td>
</tr>
<tr>
<td>Visibly bloody stool on examination</td>
<td>340 (39.5)</td>
<td>87 (27.4)</td>
<td>253 (46.6)</td>
</tr>
<tr>
<td>WBC count, median cells/mm&lt;sup&gt;3&lt;/sup&gt; [n]</td>
<td>9.7 (7.2–13) [417]</td>
<td>9.7 (7.2–12.6) [134]</td>
<td>9.7 (7.1–13.3) [283]</td>
</tr>
<tr>
<td>Hospital admission because of bloody diarrhea</td>
<td>195 (23.4)</td>
<td>68 (21.9)</td>
<td>127 (24.2)</td>
</tr>
<tr>
<td>Total</td>
<td>877</td>
<td>328</td>
<td>549</td>
</tr>
</tbody>
</table>

**NOTE.** Data are no. (%) except as indicated. Proportions are calculated on basis of numerator of no. of patient episodes with specific finding and denominator of all patient episodes for which responses were recorded (e.g., the 70 patient episodes in which there was a history of fever and Shigella species was isolated accounted for 84.3% of all Shigella species cases in which fever history was recorded). IR, interquartile range.

<sup>a</sup> Stool culture and/or Shiga toxin assay.

<sup>b</sup> Shiga toxin-producing *Escherichia coli*; includes 6 confirmed and 8 possible STEC cases.

<sup>c</sup> Moderately or mostly bloody.
teropathogens found in these studies may have been because of differences in culture techniques and in the definition of bloody diarrhea (i.e., we included cases in which the only evidence of stool blood was the patient’s unsubstantiated report or the finding of occult blood). The lower prevalence of STEC infection in our study compared with that observed by Slutsker et al. [16] might be due to differences in the numbers of patients for whom culture was performed who were at risk for STEC infection. For example, the northern United States, where STEC is thought to be more prevalent, may have been relatively underrepresented among EMERGE ID NET sites; however, 9 of the 14 cases of bloody diarrhea due to STEC in our study came from southwestern sites (Albuquerque [4], Los Angeles [3], and Phoenix [2]). Similarly, enrollment of fewer young children and cultured stool for more patients with fever in our study, both factors associated with lower prevalence of STEC, could explain these results. However, the prevalence of all enteropathogens was greater than that seen in the previous study (33.1% vs. 20% among patients reporting bloody stools), and the presence of visible blood on examination, a factor associated with performance of a culture, favored the presence of STEC.

Our findings support previous recommendations of Slutsker et al. [16] and others [25] that, at a minimum, cultures for enteropathogens, including STEC, be performed for those patients with a history of acute bloody diarrhea. Our results also support American College of Gastroenterology guidelines for adults with acute infectious diarrhea which recommend that specimens that reveal occult blood be cultured [17]. In our study, 19.4% of patients for whom this was the only evidence of stool blood had enteropathogens isolated. We confirmed the observation that STEC infection is frequently unaccompanied by fever. The fact that 12.5% of specimens from patients with bloody diarrhea thought to be caused by a noninfectious condition yielded an enteropathogen on culture also suggests that specimens that reveal occult blood be cultured [17]. In our study, 19.4% of patients for whom this was the only evidence of stool blood had enteropathogens isolated. We confirmed the observation that STEC infection is frequently unaccompanied by fever. The fact that 12.5% of specimens from patients with bloody diarrhea thought to be caused by a noninfectious condition yielded an enteropathogen on culture also suggests that specimens that reveal occult blood be cultured [17].

Non-O157 STEC have been associated with outbreaks and sporadic disease-related bloody and nonbloody diarrhea and HUS [18–23]. New immunoassays for Shiga toxin, such as that used in the current study, appear to be sensitive and specific for STEC, including non-O157 strains, compared with sorbitol-MacConkey cultures [26]. Our findings are consistent with previous investigations suggesting that infections due to non-O157 strains may account for as many as 20%–30% of all STEC infections [21, 23].

Investigations of all forms of acute diarrhea (bloody and nonbloody) from developed countries reveal that *Campylobacter* and *Salmonella* species seem to be the predominant organisms, although *Shigella* infection appears to be seen with greater frequency among adults, particularly those with severe illness requiring hospitalization and with bloody stools [23, 27–36]. A laboratory-based investigation of 8097 stool specimens submitted to US National Nosocomial Infections Surveillance hospitals during 1980–1981 revealed *Campylobacter* to be the most frequently isolated bacterial pathogen overall, including among patients with stool blood or leukocytes in stool. Among adults, however, *Shigella* was the most common causative organism [27]. Goodman et al. [28] reported on 202 adults in Chicago with acute nonbloody diarrhea enrolled in a prospective outpatient treatment trial during 1985–1987. *Campylobacter, Shigella*, and *Salmonella* species were isolated from 35 (17%), 18 (9%), and 15 (7%) of the 202 patients, respectively [28]. Investigations among children have found *Campylobacter* and *Salmonella* to be the most commonly isolated pathogens in cases of acute bacterial gastroenteritis [29–33]. Most recently, preliminary 1998 data from population-based active laboratory surveillance through FoodNet revealed that *Campylobacter* was the most common (40.1% of isolates), followed by *Salmonella* (29.1%), *Shigella* (15.2%), and *E. coli* O157 (5.2%) [34].

Our study of pediatric and adult emergency department patients with bloody diarrhea revealed *Shigella* species to be the most common pathogen (84 [15.3%] of 549 episodes), followed by *Campylobacter* (34 [6.2%]) and *Salmonella* (32 [5.8%]) species. We are aware of only one other clinical study of patients with bloody diarrhea, conducted by Townes et al. [37], among 133 Bolivian children <5 years of age who presented for care during 1994–1995. *Shigella, Salmonella,* and *Campylobacter* species were isolated from 39 (29%), 12 (9%), and 6 (4%) of 133 children, respectively.

Our study methods had certain limitations. Not all patients with bloody diarrhea who met the inclusion criteria were enrolled, and not all enrolled patients had fecal specimens submitted for culture. However, our audits of all emergency department cases indicated that the proportion of eligible cases enrolled was ~75% and was not associated with identifiable bias. About two-thirds of enrolled patients had cultures performed, and data collected on cases in which cultures were not performed revealed that specimens tended to be submitted from patients who more often had fever, more frequent stools, and visible blood noted on examination. Therefore, it is likely that the prevalence of most enteropathogens (except perhaps STEC) would have been slightly lower had all eligible patients had stool cultures done. On the other hand, although participating sites reported, in general, times from specimen collection to plating of <2 h, delays could be responsible for the low culture yield.

Our sample of emergency departments at large urban university-affiliated hospitals was nonrandomly selected, and our conclusions may not be applicable to other populations in other settings. However, our results are likely to be representative of patients seen at US emergency departments, for several reasons.
Our group of emergency departments was geographically diverse and had a visit census of ~1% of all such visits in the United States. Because of the centralized food distribution patterns in the United States, exposure to foodborne pathogens in contaminated food may occur across a broad geographic range [38]. Further, at all investigative sites except one, the proportion of stool cultures that yielded an enteropathogen was substantial. On the other hand, compared with patients seen in office settings, patients seen in emergency departments may be more frequently acutely ill, of minority ethnicity, and uninsured [39]. Also, although we were not aware of any large outbreaks affecting our study populations, we cannot be certain that the reported prevalences reflect only sporadic disease.

In conclusion, bloody diarrhea led to hospitalization for ~20% of patients who presented for emergency care for bloody diarrhea. Extrapolating from these data, ~30% of episodes of bloody diarrhea among these patients are associated with infection with a bacterial enteropathogen, and depending on location, STEC infection accounts for 0% to 6% of these presumed sporadic cases. STEC infection frequency is unaccompanied by fever, and as many as 10%–15% of cases of bloody diarrhea presumed to be of noninfectious etiology are caused by this and other enteropathogens. *Shigella* species is the most frequently identified enteropathogen, followed by *Campylobacter* and *Salmonella*. Emergency physicians occupy the “front line” of clinical medicine and have a unique opportunity to assist in the early identification of outbreaks that can lead to effective preventive interventions. The significant prevalence of enteropathogens supports the recommendations that stool cultures be performed for patients with acute bloody diarrhea reported in their history or found on examination.

**Acknowledgments**

We acknowledge Meridian Diagnostics for donating Shiga toxin assays, Joy Wells (CDC) for assistance with laboratory methods, and the residents and staff at the participating emergency departments. We also acknowledge the assistance of the following study coordinators: Jane Dascalos, Emilio Larrier, Constance Parramore, Karen Pfaff, Marlow Price, Yvonne Sanchez, Christine Shields, Nancy Stratton, Jonah Tan, Amy E. Waldren, Mary Beth Wash, and Julie T. Wilke.

**APPENDIX**

The following investigators and centers collaborated in the EMERGEncy ID NET Study Group: Principal investigator: David Talan; Co-investigator: Gregory Moran; Director of Informatics and Biostatistics: William Mower; Assistant Director of Informatics and Biostatistics: Samuel Ong; Project coordinator: Michael Newdow and Janet Nakase; CDC collaborators: Robert Pinner, Laurence Slutsker, and Laura Conn; Executive Committee: David Talan, Gregory Moran, Charles Pollack, Jon Jui, Laurence Slutsker, Robert Pinner; Site investigators: Paul R. Cheney (University of New Mexico Health Sciences Center, Albuquerque); William K. Chiang (Bellevue Hospital Center, New York); Lala M. Dunbar (Louisiana State University Health Science Center, New Orleans); Katherine L. Heilpern (Emory University School of Medicine, Atlanta); Jon Jui (Oregon Health Sciences University, Portland); David J. Karras (Temple University School of Medicine, Philadelphia); Gregory J. Moran (Olive View–UCLA Medical Center, Sylmar, CA); Charles V. Pollack (Maricopa Medical Center, Phoenix); Steven G. Rothrock and John F. O’Brien (Orlando Regional Medical Center, Orlando, FL); Jeffrey W. Runge (Carolinias Medical Center, Charlotte, NC); Mark T. Steele (University of Missouri–Kansas City, Kansas City, MO); CDC investigator: Laura Conn (Atlanta).

**References**


