Outbreak of Gastroenteritis in Adults Due to Rotavirus Genotype G12P[8]

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Background. Rotavirus infection in adults is poorly understood and few rotavirus outbreaks among US adults have been reported in the literature. We describe an outbreak due to genotype G12P[8] rotavirus among medical students, faculty, and guests who attended a formal dinner event in April 2013.

Methods. A web-based questionnaire was distributed to event attendees to collect symptom and exposure data. A clinical case was defined as a person who developed diarrhea after attending the formal event. A laboratory-confirmed case was defined as a clinical case who attended the formal event, with rotavirus detected in stool by enzyme immunoassay or reverse transcription-polymerase chain reaction (RT-PCR) assay.

Results. Among 334 dinner attendees, 136 (41%) completed the web-based questionnaire; 58 (43%) respondents reported illness. Symptom onset ranged from 1 to 8 days, with peak onset 3 days after the event. In addition to diarrhea, predominant symptoms included fever (91%), abdominal pain (84%), and vomiting (49%). The median duration of illness was 2.5 days. Thirteen (22%) of 58 cases sought medical attention; none were hospitalized. Analysis of food exposures among questionnaire respondents did not identify significant associations between any specific food or drink item and illness. Stool specimens were negative for bacterial pathogens by culture and negative for norovirus by RT-PCR assay; 4 specimens were positive for rotavirus by enzyme immunoassay or PCR. G12P[8]-R1-C1-M1-A1-N1-T1-E1-H1 was identified as the causative full-genome genotype.

Conclusions. Rotavirus outbreaks can occur among adults, including young adults. Health professionals should consider rotavirus as a cause of acute gastroenteritis in adults.

Keywords. outbreak; rotavirus; adults; genotype; G12P[8].

During the prevaccine era, rotavirus was the most common cause of acute gastroenteritis in children; outbreaks have occurred in childcare and hospital settings [1, 2]. With the introduction of routine rotavirus vaccination in the United States in 2006, the burden of rotavirus among young children has decreased [3, 4]. Data suggest that older children and adults benefit from the indirect protective effect of vaccinating infants, which reduces the amount of rotavirus circulating in the community [5–8].

Symptomatic rotavirus infections, particularly those that require medical care, are much less common in older children and adults because of protection acquired from previous exposures [9, 10]. Additionally, diagnostic testing is not commonly performed in adults who present with diarrhea. As a result, rotavirus infections in adults often go undetected. However, rotavirus infections in adults may cause severe disease [11]. In the United States, outbreaks of gastroenteritis caused by rotavirus have been reported among retirement and nursing home residents and university students [12–14].

Group A rotaviruses, which cause most human infections, are classified based on G and P structural viral proteins. Rotavirus infections are commonly associated with a small subset of the more than 70 human G and P antigen combinations [15, 16]. To date, in the United States, G2P[4] is the rotavirus strain most often associated with adult outbreaks [12, 17]. After first being
reported in 1987, rotavirus genotype G12 has reemerged worldwide only recently [18, 19]. G12P[8] was 1 of the 4 most prevalent genotypes circulating among children in the United States during 2013 (Centers for Disease Control and Prevention [CDC], personal communication). Here, we describe an outbreak due to genotype G12P[8] rotavirus among medical students, faculty, and guests who attended a dinner at a Chicago hotel (Hotel A).

METHODS

On 11 April 2013, the Chicago Department of Public Health (CDPH) received reports of illness among medical school students and faculty who attended a dinner at Hotel A on 5 April.

Epidemiologic Investigation

CDPH conducted initial interviews with the event organizer and 4 attendees to gather details regarding program activities, food and drink items served, and symptoms of illness. Responses were used to develop a standardized web-based questionnaire, which was made available to event attendees through Chicago’s Heath Alert Network web application. University administrators distributed the questionnaire link via e-mail to event attendees on 12 April; attendees were asked to share the link with their event guests. Responses were provided to CDPH from 12 April through 17 April. A clinical case was defined as a person who attended the formal dinner and developed diarrhea between 5 April and 13 April. Descriptive statistics and bivariate analyses were performed using SAS software, version 9.3 (SAS Institute, Cary, North Carolina).

Some medical student attendees, but no faculty, attended the event who had been caring for patients around the time of the event. In order to determine if there was any disease transmission from attendees to hospital or ambulatory patients, infection control staff from the medical center associated with the event reviewed 87 medical charts of adult and pediatric patients who were cared for between 2 April and 15 April by event attendees for evidence of gastroenteritis (nausea, vomiting, diarrhea, fever, increased number of stools per day). Additionally, the medical center reviewed medical charts for all adult and pediatric patients who had specimens sent for fecal pathogen testing during that time to determine whether medical students who attended the event had cared for the patients.

Communicable disease investigators conducted on-site interviews of hotel managers and food handlers who worked during the medical school dinner to assess reported illness and to educate staff regarding hand hygiene and infection control measures. Food sanitarians inspected the kitchen facilities, interviewed food workers concerning food-handling practices, and educated managers and staff about safe food-handling practices.

Laboratory Analysis

All persons who responded as being ill were asked to submit stool specimens for testing. Specimens were collected from 5 symptomatic medical students and 1 food worker who reported being ill with nausea the day prior to the event.

Stool specimens were tested for bacterial pathogens by culture, for norovirus by reverse transcription-polymerase chain reaction assay (RT-PCR, using GI and GII primers), and for rotavirus by enzyme immunoassay (EIA; Premier Rotacclone) or RT-PCR; not all tests were performed on each sample. A laboratory-confirmed case was defined as a clinical case who attended the formal event, with rotavirus detected in stool. Rotavirus testing performed by the CDC Rotavirus Surveillance and Molecular Epidemiology Laboratory included antigen detection by Premier Rotacclone EIA, RNA detection by RT-PCR of the VP6 gene, as well as full genome sequencing as described previously [16].

RESULTS

Epidemiologic Investigation

A total of 334 medical students, faculty, and guests attended the dinner at Hotel A. Among 136 attendees who completed the web-based questionnaire, 113 were students, 7 were faculty, and 16 were guests. A total of 58 of 136 (43%) reported illness. The median age of ill respondents was 24 years (range, 22–64 years; interquartile range, 23–26); 35 (60%) were female; 49 (84%) were medical students, and 11 (22%) of the 49 reported being on a clinical rotation at the time of the event. Attack rates among student respondents by the medical school year were 51%, first year; 32%, second year; 50%, third year; and 43%, fourth year. There were no statistically significant differences in attack rates among respondents by medical school year cohort (Table 1); only respondents who were either third- or fourth-year medical students reported being on clinical rotation at the time of the event. Two of 7 (28%) nonclinical faculty and 7 of 16 (43%) guests reported being ill after attending the event.

Dates of symptom onset were 6 April to 13 April, 1–8 days after the event (Figure 1). In addition to diarrhea, predominant symptoms among the 58 cases included fever (91%), abdominal pain (84%), and vomiting (49%). The median duration of illness was 2.5 days (range, 1–5 days). Thirteen (22%) of 58 cases sought medical attention at urgent care or student health clinics; none were hospitalized. Analysis of food exposures among respondents did not identify any statistically significant association between illness and specific food or drink items served at the event. The event was open seating.

In order to prevent secondary transmission at the medical center, all medical students (whether they attended the event or not) were restricted from working at the medical center from 12 April to 15 April until a complete list of medical student attendees was compiled. Subsequently, medical students who had been
symptomatic were placed on medical leave and required to be cleared by student health before returning to work. Clearance was given if the student presented to student health and was deemed to no longer be ill or if the student presented a note from his or her physician documenting symptom resolution; 44 students were officially cleared by student health. Chart review conducted by infection control staff at the medical center identified 1 adult patient who might have contracted infection secondary to nosocomial exposure. This patient was cared for by one of the symptomatic medical students who attended the event before rotation restrictions were implemented and subsequently developed gastroenteritis, with vomiting and diarrhea, within 2 days of being discharged home. The patient sought medical attention in the emergency department and required intravenous fluids. At the time, the emergency department was unaware of the gastroenteritis outbreak among students, and no consideration was made for a possible earlier nosocomial exposure. No stool studies were sent.

Food Inspection
Staff from the CDPH Food Protection Program inspected the hotel kitchen facility on 12 April 2013. Several critical breaches related to hand hygiene were identified, including missed opportunities for hand washing, bare-hand contact with ready-to-eat food, and contact of food with potentially contaminated utensils. Thirty-eight food handlers worked during the event on 5 April (13 culinary team; 25 banquet service). Of the 38, 24 (63%) were interviewed (11 culinary team; 13 banquet service); among these, 1 food handler reported onset of nausea the day before the event but did not report developing diarrhea after the event. The hotel kitchen facility was re-inspected on 22 April 2013 and found to be in compliance with Chicago’s health code. Ten other events were held at the hotel between 29 March and 15 April. Eight of the 10 event organizers denied receiving reports of illness, and 2 event organizers did not respond to CDPH inquiry. In addition, the CDPH Food Protection Program received no complaints of illness from 6 other food venues on the hotel premises.

Laboratory Analysis
Laboratory results for the stool samples obtained from the 5 medical student cases and the food handler who reported nausea are presented in Table 2. Rotavirus was detected in 4 of the 5 specimens tested using EIA and in 3 of the 4 tested using RT-PCR. No pathogens were detected in the sample collected on 12 April from the food worker who reported nausea on 4 April. Tested specimens were negative for norovirus and bacterial pathogens. Three specimens tested by the CDC and that were positive for rotavirus were further characterized by full genome sequencing as genotype G12P[8]-R1-C1-M1-A1-N1-T1-E1-H1. The gene sequences for the 3 rotavirus strains analyzed were almost identical, with only 5 nucleotide changes and a single amino acid change in 1 gene out of 17 430 coding base-pairs/5799 amino acid residues per genome when compared with the nucleotide and amino acid consensus sequences derived from the 3 strains (see Supplementary Table 3).

DISCUSSION
We identified an outbreak of gastroenteritis caused by rotavirus genotype G12P[8] among medical student and faculty attendees
of a dinner event. Among 136 attendees who completed an online questionnaire, 58 (43%) reported illness and 13 (22%) sought outpatient medical care. One possible nosocomial case was identified in a retrospective chart review of patients cared for by ill attendees between the time of the event and the time rotation exclusions were initiated.

Tight clustering of symptom onset after the event and the large number of cases suggests a common point-source exposure to contaminated food or drink or to fomites at Hotel A, although an association with a specific food or drink was not identified by statistical analysis. Given the occupation of the attendees, it is also conceivable that an attendee who was ill with, or at least shedding, rotavirus at the time of the event (possibly contracting it from a patient) was the source of the contamination. However, no respondent reported gastrointestinal illness just prior to or on the day of the event. Additionally, respondents who were not in clinical settings as well as those who were on clinical rotations developed illness within days of the event, supporting a point-source exposure at the event rather than separate, coincidental exposures during routine patient care. The very high degree of sequence identity among the 3 G12P[8] strains sequenced also suggests a point-source exposure.

The dynamics of immunity to rotavirus among adults is not well understood; however, repeated exposures throughout life and resultant heterotypic antibody response are expected to provide protection from severe disease caused by common strains [20, 21]. The CDC’s New Vaccine Surveillance Network, which conducts surveillance for acute gastroenteritis among children aged <5 years, detected the emergence of genotype G12P[8] in 2006. G12P[8] is commonly identified now throughout the world [22–25]. Based on CDC data, genotype G12P[8] was 1 of the 4 most prevalent genotypes that circulated among children in the United States during 2013 (CDC, personal communication), although data are not available specifically from the Chicago area and surveillance data about adult disease are not systematically collected.

This is the first reported outbreak caused by rotavirus G12P[8] among adults; as with adult disease in general, adult outbreaks are likely underidentified. Given the healthcare worker population affected, outbreak identification was necessary in order to mitigate spread of the disease to patient populations. The investigators had previous experience in the Chicago area with rotavirus outbreak among adults, and this heightened awareness led to testing for rotavirus during outbreak investigation [12]. There are no data available on rotavirus disease in adults to ascertain whether the recently emerged G12P[8] strains are more likely to cause adult disease (or an outbreak among adults) compared with exposure to other rotavirus genotypes. However, rotavirus genotype G2P[4], which is from a genogroup different from most other circulating strains including G12P[8], appears to be overrepresented in adult outbreaks [12, 17].

Use of a web-based questionnaire allowed for rapid data collection about illness and exposures. Web-based methods may be particularly suitable for students who extensively use electronic methods of communication. Skip patterns were used to allow follow-up questions conditional to the response of a prior question; this conditional branching allows respondents to skip questions that do not apply. Use of forced-choice fields and skip patterns improved data quality by avoiding implausible or incomplete answers [26, 27]. Additionally, since the data collected can be readily transformed for analysis, errors in data entry were avoided. Our use of an online questionnaire also presented several limitations. Due to an incorrect skip pattern, data regarding frequency of stool were not collected; therefore, our

### Table 2. Stool Specimen Testing Summary

<table>
<thead>
<tr>
<th>Subject</th>
<th>Days From Event to Symptom Onset</th>
<th>Days From Onset to Sample Collection</th>
<th>Bacterial Culture</th>
<th>Norovirus Polymerase Chain Reaction</th>
<th>Rotavirus Enzyme Immunoassay</th>
<th>Rotavirus Reverse Transcription-Polymerase Chain Reaction Assay</th>
<th>Rotavirus Genotyping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>1</td>
<td>5</td>
<td>Negative&lt;sup&gt;a&lt;/sup&gt;</td>
<td>NP</td>
<td>Positive&lt;sup&gt;a&lt;/sup&gt;</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>Student 2</td>
<td>1</td>
<td>4</td>
<td>Negative&lt;sup&gt;a&lt;/sup&gt;</td>
<td>NP</td>
<td>Negative&lt;sup&gt;b&lt;/sup&gt;</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>Student 3</td>
<td>1</td>
<td>5</td>
<td>Negative&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Negative&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Positive&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Positive&lt;sup&gt;c&lt;/sup&gt;</td>
<td>G12P[8]&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Student 4</td>
<td>2</td>
<td>4</td>
<td>NP</td>
<td>Negative&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Positive&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Positive&lt;sup&gt;c&lt;/sup&gt;</td>
<td>G12P[8]&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Student 5</td>
<td>2</td>
<td>3</td>
<td>NP</td>
<td>Negative&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Positive&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Positive&lt;sup&gt;c&lt;/sup&gt;</td>
<td>G12P[8]&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Food worker</td>
<td>d</td>
<td>8</td>
<td>Negative&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Negative&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Negative&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Negative&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Negative&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Abbreviation: NP, not performed.

<sup>a</sup> Performed by the medical center associated with the event.

<sup>b</sup> Performed by the Illinois Department of Public Health Laboratory.

<sup>c</sup> Performed by Centers for Disease Control and Prevention (CDC) Rotavirus Surveillance and Molecular Epidemiology Laboratory.

<sup>d</sup> Onset of nausea 1 day prior to event; food worker did not report developing diarrhea after the event.

<sup>e</sup> Performed by CDC National Calicivirus Laboratory.
case definition was based on patient reporting diarrhea but not further quantified.

Our study has additional limitations. No true response rate could be calculated since CDPH sent the questionnaire link to event organizers who forwarded it to attendees. This might have introduced some response bias that could not be accounted for given that a complete list of attendees was not provided. Additionally, only a small number of stool specimens were available for rotavirus testing; although testing these samples for other pathogens strengthens the association between rotavirus and illness. One student who met the clinical case definition had stool specimen negative for bacterial pathogens; however, this specimen was not tested for viral pathogens. Also, only 24 of the 38 food handlers were interviewed; the remainder did not respond or could not be located. Although none were recorded by the employer as absent from work due to illness, interview data were missing for 14 food handlers who worked during the event. Lastly, no data regarding secondary transmission was collected through the questionnaire.

CONCLUSION

Symptomatic rotavirus infections and rotavirus outbreaks may occur in adult populations, including young adults. This is the first outbreak described due to G12P[8] among adults in the United States and highlights the importance of this recently emergent rotavirus genotype as a pathogen. Health professionals should consider rotavirus as a cause of acute gastroenteritis in adults. Recognition of this outbreak was important to initiate infection control precautions to prevent transmission to vulnerable patient populations cared for by potentially ill healthcare workers and to limit transmission to other healthcare workers.

Supplementary Data

Supplementary materials are available at Clinical Infectious Diseases online (http://cid.oxfordjournals.org). Supplementary materials consist of data provided by the author that are published to benefit the reader. The posted materials are not copyedited. The contents of all supplementary data are the sole responsibility of the authors. Questions or messages regarding errors should be addressed to the author.

Notes

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Disclaimer. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Potential conflicts of interest. All authors: No potential conflicts of interest.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

References