Screening Policies for Daycare Attendees

Lessons Learned from an Outbreak of *E.coli* O157:H7 in a Daycare in Waterloo, Ontario

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ABSTRACT

Objectives: Control measures for enteric outbreaks in child care settings frequently include screening by stool cultures from symptomatic children only. We present evidence from an investigation of *Escherichia coli* (*E. coli*) O157:H7 in a daycare in Waterloo, Ontario to support implementation of a mandatory screening policy for all children during an outbreak.

Methods: In addition to routine outbreak control measures employed by the health unit, stool samples from all children and staff were collected, with positive *E. coli* cultures typed by pulsed field gel electrophoresis (PFGE). We conducted a cohort study, using data from the environmental investigation and questionnaires administered to parents and staff, to look for risk factors for infection and to survey parent/staff knowledge regarding appropriate management of diarrhea.

Results: Overall 11 *E. coli* O157:H7 cases were identified (7 lab-confirmed); 9 were children. No common source of infection was identified. Factors identified as possibly contributing to person-to-person transmission within the daycare included: i) the under-reporting and possible attendance of symptomatic children despite alerting parents to the outbreak and requirements to keep symptomatic children at home, ii) possible transmission from an asymptomatic infected child, and iii) inconsistent understanding among parents and staff regarding diarrhea and appropriate management of a child with diarrhea.

Discussion/Conclusion: This investigation reveals that in child care settings, *E. coli* O157:H7 outbreak screening policies based on reported symptoms only may be insufficient. We recommend that such policies be amended to include the collection of at least one stool culture from all children in attendance, regardless of symptom history.

Key words: Child day care centers; child, preschool; disease outbreaks; *Escherichia coli* O157; health knowledge, attitudes, practice; mass screening

La traduction du résumé se trouve à la fin de l'article.

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Child-to-child transmission is typically attributed to outbreaks of *E. coli* O157:H7 in child care facilities.¹⁻¹¹ Younger age^{2,3} and duration of attendance¹ have been associated with increased risk for infection. Factors contributing to transmission include unobserved child toileting,⁴ poor handwashing,^{4,10} overcrowding or low staff-to-child ratios,^{1,7} food preparation practices,^{7,8} and inadequate disinfection of diapering areas.^{7,10} The contribution of symptomatic children who continue to attend daycares is highlighted.^{1-4,9,11}

Recommended control measures include closing facilities^{3,4,7,11} or cohorting symptomatic or shedding children.^{5,10} Exclusion criteria typically include excluding symptomatic cases until two negative consecutive stool samples are obtained;^{1,3-5,7,10} this criteria can be applied to all children, including asymptomatic children.^{1,3}

On June 21, 2005, Region of Waterloo Public Health (ROWPH) was notified of two preliminary *E. coli* O157:H7 positive stools from unrelated children who attended the same daycare facility, and declared an outbreak. This paper describes our investigation results and supports the implementation of a mandatory screening policy for all children during an outbreak of *E. coli* O157:H7 in child care settings.

METHODS

Environmental and laboratory testing

The investigation identified a probable case with an onset of June 14, 2005, suggesting transmission as early as Saturday, June 4 (using a 10-day incubation period).^{*} All staff and children attending the daycare from the following Monday, June 6, to June 24, 2005 were requested to submit stool samples. Stools were cultured for *E. coli* O157:H7, and positive cultures were sent for further subtyping and PFGE testing. Foods served during the relevant exposure period that were present at the time of the site investigation were also submitted for testing.

Site investigation

A modified Hazard Analysis and Critical Control Point (HACCP) inspection was performed and hygiene practices were

* A child meeting the probable case definition had an earlier date of onset (June 9), however due to the atypical clinical presentation (persistent diarrhea symptoms >3 weeks) and lack of laboratory confirmation, another etiology was thought possible.

reviewed. Information collected during the inspection included: attendance records; diapering, toileting and diarrheal illness practices; general sanitation; facility layout; daycare activities; food preparation; menu items; and staff schedules.

Epidemiological and statistical investigation

Case Definition and Case Finding

Confirmed cases were individuals with an epidemiologic link to the daycare since June 4, 2005 and a positive stool culture for *E. coli* O157:H7; probable cases were individuals having ≥ 3 loose stools in 24 hours, any episode of bloody stool since June 4, 2005 or asymptomatic individuals confirmed laboratory positive for *E. coli* O157:H7. All identified cases either attended or worked in the daycare facility, or had direct contact with such persons. Case finding occurred through stool cultures, contacting parents, active daily surveillance at the facility, and questionnaires.

Cohort Study

Questionnaires were administered to staff and parents of daycare attendees between June 6-24, 2005. Information collected included: symptoms, medical treatment, food and activity exposures. Parents and staff were asked how they defined diarrhea and what actions they would take when their child or student had diarrhea. Additional data were collected from attendance records, sign-in sheets, menu records, and child dietary preferences.

Analysis

All questionnaire data were entered into a database using EpiData v. 3.0¹² and analyzed in SPSS v. 13.0.¹³ Daycare attendees and staff not meeting the case definition were considered controls. Relative risks and 95% confidence intervals were calculated using the Statcalc function of EpiINFO v. 6.04.¹⁴ Statistical significance of results were tested using Fisher's exact, chi-square and two-sample t-tests (level of significance $p < 0.05$).

RESULTS

Environmental and laboratory testing

All 9 staff and 95% (52/55) of children submitted at least one stool sample.

TABLE I

Control Measures Instituted During the *E. coli* O157:H7 Outbreak Associated with a Daycare Facility, Waterloo Region, Ontario, June-July 2005

Control Measure	Action
Environment	<ul style="list-style-type: none"> Inspected facility, including kitchen, using a modified HACCP Prohibited use of water and sand tables Instituted regular environmental cleaning using 1:10 bleach solution Collected food samples and submitted for bacteriological testing.
Exclusion	<ul style="list-style-type: none"> Set exclusion criteria for confirmed and probable cases Prohibited enrolment of new children to daycare Cohorted toddlers and staff who work with toddlers Requested stool samples from every child and staff in the facility.
Communication with Parents	<ul style="list-style-type: none"> Posted outbreak alert on daycare door Provided <i>E. coli</i> O157:H7 fact sheets to parents/guardians Educated parents of excluded cases regarding importance of not sending their children to other daycares or other group child care Sent letters regarding stool submission, and the continued need to notify public health of any symptoms developing in daycare attendees.
Communication with Staff Surveillance	<ul style="list-style-type: none"> Educated staff regarding importance of hand washing and sanitizing diaper change areas. Requested all attendance records, illness logs and sign-in sheets Performed active daily surveillance in cooperation with daycare centre for diarrheal symptoms Contacted parents directly to obtain information about symptoms and daycare attendance Compared daycare records to parents' reports.

* two asymptomatic confirmed cases not included

Figure 1. Epidemic curve of *E. coli* O157:H7 outbreak associated with a daycare facility, Waterloo Region, Ontario, June 2005

Specimens from 7 people were positive for *E. coli* O157:H7: 6 children (6/52, 12%) and 1 staff (1/9, 11%). Six of these specimens had an identical PFGE pattern (ECXAI.1221). The remaining specimen had a different but related PFGE pattern (ECXAI.1226).¹⁵

At the time of the inspection, there were only two food items present from the week of June 14-21 (frozen fully cooked meat balls and ground beef). Test results on both items were negative for *E. coli*.

Site investigation

Between June 6 and 24, 55 children were enrolled at the daycare, including 20 tod-

dlers (14 months-2 years) and 35 preschoolers (2-4 years). The toddlers were separate from the preschoolers, except for mixing of the two groups early in the morning and at the end of the day, use of bathroom facilities during playground time, and 4 children transitioning between groups. Nine staff worked in the facility (8 involved in child care, of whom 4 primarily worked with toddlers and 3 with preschoolers). Staff had a separate bathroom.

The modified HACCP inspection identified no problems with food handling in the daycare. All meals were prepared in the kitchen, children and staff consumed the

No.	Class	Case*	PFGE [†]	Symptoms	M 6	T 7	W 8	Th 9	F 10	Sa 11	Su 12	M 13	T 14	W 15	Th 16	F 17	Sa 18	Su 18	M 20	T 21	W 22	Th 23	F 24	Sa 25	Su 26	M 27	T 28	W 29	Th 30	Sa 1
1	Pre-school	P		Yes				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	Pre-school	P		Yes									X	X																
3	Toddler	P		Yes										X	X	X	X	X	X	X										
4	Toddler	C	A	Yes												X	X	X	X	X	X	X	X	X	X	X				
5	Toddler	C	A	Yes												X	X	X	X	X	X	X								
6	Teacher	P		Yes														X												
7	Toddler	C	A	Yes																X	X	X	X							
8	Teacher	C	B	Yes																			X	X	X					
9	Toddler	C	A	No																										
10	Pre-school	C	A	No																										
11 [§]	Toddler	C	A	Yes																									X	X

* P = Probable case, C = Confirmed case

† PFGE = pulsed field gel electrophoresis

‡ A = pattern XCAI 1221, B = pattern XCAI 1226

§ Case 11: Negative stool sample collected on June 26; positive stool sample collected on July 3

Figure 2. Attendance record, symptom duration, and date of specimen collection for cases, *E. coli* O157:H7 outbreak associated with a daycare facility, Waterloo Region, Ontario, June 6-July 1, 2005

same food, and no other food was brought into the daycare and shared among students. Appropriate hygiene practices were observed (i.e., cleaning and sanitizing of surfaces, floors and toys; hand hygiene). Absenteeism due to illness was appropriately recorded. The control measures implemented during this outbreak investigation are summarized in Table I. Confirmed cases and probable cases with a history of bloody stool were required to have two consecutive negative stool specimens a minimum of 24 hours apart prior to return to the daycare. Only one negative specimen was required for probable cases reporting no bloody stool.

Epidemiological and statistical investigation

Descriptive Epidemiology

Questionnaires were completed for 50/55 (91%) children including 20/20 (100%) toddlers and 30/35 (86%) preschoolers; all staff completed questionnaires. A total of 11 cases were identified (11/59, attack rate 19%); 7 (12%) confirmed and 4 (7%) probable cases. Symptom onset ranged from June 9 to June 30 (Figure 1). Nine

cases were children (9/50, attack rate 18%, average age 2.3 years), and most were toddlers (6/9, 66%, attack rate 30%). Overall, 9/11 (82%) cases had symptoms including diarrhea (100%), bloody diarrhea (4/11, 36%), vomiting, fever, abdominal cramps, and nausea. One child was hospitalized overnight; there were no complications or deaths.

The duration of symptoms, date of stool specimen collection, and attendance for each case is shown in Figure 2. Assuming an incubation period for *E. coli* O157:H7 of 2-10 days (median 3-4 days),¹⁶ with the exception of the first probable case, all cases were present at the daycare at the same time as another case. Three children attended the daycare while symptomatic: Case 1 and Case 3 before, and Case 7 after the outbreak was declared. Two asymptomatic children (Cases 9, 10) had positive stool cultures.

Of particular interest is the likely source of infection for Case 11, who may have become infected on one of two occasions: 1) 9 days prior to symptom onset when a symptomatic case (Case 7) was present; or 2) 2-3 days prior to symptom onset when an asymptomatic infected child (Case 9)

was in attendance. Given the higher probability of infection 2-3 days before symptom onset, it is possible that Case 11 acquired *E. coli* O157:H7 from an asymptomatic infected child.

Cohort Study

Toddlers and their staff were more likely to be confirmed cases than preschoolers and their staff (RR 8.9, 95% CI 1.1-68.9, $p=0.014$). Toddlers were still more likely to be confirmed cases when analysis was restricted to children (RR 7.5, 95% CI 0.95-60.0, $p=0.032$). The average daily attendance for confirmed and probable cases during this period was 7.0 days (range 4-8 days) compared to 3.3 days (range 0-7 days) for other toddlers ($p=0.007$). No other significant exposures were identified.

All staff defined diarrhea as a liquid or watery bowel movement. When asked what actions they would take regarding diarrhea, half (4/8, 50%) reported they would act after ≥ 3 loose stools in one day, while the ROWPH and daycare guidelines specify action after ≥ 2 loose stools. While most parents stated that they would keep their child home with 1-2 episodes of diar-

rhea, 10 parents (10/37, 27%) had different criteria, including: ≥ 3 episodes; presence of other symptoms such as fever, bloody stools, or mucus; severe illness; or based on physician recommendation. One parent did not see a need to exclude a child with diarrhea from the daycare.

DISCUSSION

The original source of *E. coli* O157:H7 was not identified. It is likely that this pathogen was introduced into the daycare by an index case and spread through person-to-person transmission. The epidemic curve and the finding that cases were more likely to have a greater duration of attendance (also reported elsewhere) suggest this.¹ Cases were more likely to be toddlers, possibly explained by increased transmission among diapered children.^{2,3}

In this outbreak, the daycare was not closed. Our initial investigation suggested no point source of infection, and the daycare's compliance with environmental cleaning and control measures was timely and satisfactory. An influential factor was the fact that the parents would place potentially infected or shedding children in other daycares or group childcare settings if the daycare were closed. Previously reported measures to prevent the movement of infected children have included: routine questioning of parents about child care arrangements, distribution of names of children to other facilities, and issuing parents with legal orders.¹⁰

If a daycare remains open during an outbreak, screening policies followed by exclusion of cases assume additional importance. Screening and case identification are usually based on reported symptoms, followed by stool cultures of symptomatic children and exclusion until there are two negative stool cultures. In this outbreak, the following findings support screening, including mandatory stool cultures of *all* children during an *E. coli* O157:H7 outbreak in a daycare.

To our knowledge, this study is the first to demonstrate that some parents or staff may not recognize the significance of diarrhea, or understand the appropriate actions to take. Parents and staff described a variety of actions, at times contrary to public health recommendations. During this outbreak, three cases continued to attend the

daycare with diarrheal symptoms and likely contributed to disease transmission. Education and increased awareness of parents and staff regarding the significance of diarrhea and keeping children home or immediately excluding them from the daycare are essential during an outbreak. However, despite direct contact with all parents/caregivers to ask about symptoms and to reinforce the necessity of excluding symptomatic children, we still identified one case who attended the daycare *after* parental contact had occurred. Notification and education of parents may not be sufficient due to other competing pressures (i.e., need for child care for employed parents). Screening that includes mandatory stool cultures of *all* children during an *E. coli* O157:H7 outbreak in a daycare may be helpful in identifying such cases. The development of clear definitions, policies, and educational interventions are also important for outbreak control in these settings.

A final finding supporting mandatory screening of all children during *E. coli* O157:H7 outbreaks is that asymptomatic infected children may attend. While not conclusive, the results of this investigation suggest that secondary transmission of infection from an asymptomatic child may have occurred. The presence of asymptomatic infected children has been documented in other daycare outbreaks of *E. coli* O157:H7^{1-3,6,7} although transmission from asymptomatic children has not been identified.¹⁶

A reliance on case identification through reporting of symptoms alone may not be sufficient to effectively control an outbreak. A screening policy for *all* children (both symptomatic and asymptomatic) that includes submission of stool samples would allow for a more objective identification of cases of *E. coli* O157:H7. As a result of this outbreak, the ROWPH outbreak protocol has been changed to include this control measure, with a single negative stool culture required from asymptomatic children prior to return to the facility. If asymptomatic children remain in attendance prior to stool culture results, increased diligence and reinforcement of infection control precautions such as handwashing and cleaning are required.

In Canada, this and previous investigations of *E. coli* O157:H7 outbreaks have

identified the need to develop clear national guidelines or recommendations for management of enteric illness in child care settings.^{4,11} No such guidelines currently exist. Based on this outbreak investigation, we recommend that screening policies including stool cultures for all children, and improved education of parents and staff, be considered for inclusion in future guidelines or in existing outbreak management protocols in other jurisdictions.

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RÉSUMÉ

Objectifs : Les mesures de contrôle des éclosons d'infections entériques dans les milieux de garde d'enfants comprennent souvent le prélèvement de cultures de selles auprès des enfants symptomatiques seulement. Nous présentons les résultats d'une enquête sur le colibacille (*Escherichia coli*) O157:H7 menée dans une garderie de Waterloo, en Ontario, à l'appui de la mise en œuvre d'une politique de dépistage obligatoire de tous les enfants lors d'une écloson.

Méthode : En plus des mesures habituelles de contrôle des éclosons préconisées par le bureau de santé, nous avons prélevé des échantillons de selles de tous les enfants et du personnel; les cultures positives pour le colibacille ont ensuite été typées par électrophorèse sur gel en champs pulsé (EGCP). Nous avons mené une étude par cohortes à l'aide des données de l'enquête environnementale et des questionnaires administrés aux parents et au personnel, afin de déceler des facteurs de risque d'infection et de sonder les connaissances des répondants sur la prise en charge de la diarrhée.

Résultats : Globalement, 11 cas d'infection par le colibacille O157:H7 ont été rapportés (dont 7 confirmés en laboratoire); 9 étaient des enfants. Aucune source commune d'infection n'a été décelée. Les facteurs suivants ont pu contribuer à la transmission interpersonnelle à la garderie même : i) la sous-déclaration et la présence possible d'enfants symptomatiques (bien que les parents aient été alertés de l'écloson et qu'on leur ait demandé de garder les enfants symptomatiques à la maison), ii) la transmission possible par un enfant infecté asymptomatique, et iii) les lacunes dans les connaissances des parents et du personnel sur la diarrhée et la prise en charge appropriée d'un enfant ayant la diarrhée.

Discussion/Conclusion : L'enquête révèle que dans les milieux de garde d'enfants, les politiques de détection des éclosons du colibacille O157:H7 uniquement d'après les symptômes déclarés pourraient être insuffisantes. Nous recommandons que l'on modifie ces politiques pour y inclure le prélèvement d'au moins une culture de selle de chaque enfant présent, qu'il ait ou non présenté des symptômes.

Mots clés : garderies; enfants d'âge préscolaire; éclosons de maladies; *Escherichia coli* O157; connaissances, attitudes et pratiques liées à la santé; dépistage collectif

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