International Journal of Infectious Diseases (2009) 13, 629—635

http://intl.elsevierhealth.com/journals/ijid

Food-related norovirus outbreak among people attending two barbeques: epidemiological, virological, and environmental investigation

Roberto Vivancos [a,b,*], Amir Shroufi [a], Margaret Sillis [c], Heather Aird [c], Chris I. Gallimore [d], Linda Myers [a], Hamid Mahgoub [a], Pat Nair [a]

[a] *Norfolk, Suffolk and Cambridgeshire Health Protection Unit, Health Protection Agency, St Andrews House, Norwich NR7 0HT, UK*
[b] *School of Medicine, Health Policy and Practice, University of East Anglia, Norwich, UK*
[c] *Microbiology Department, Norfolk and Norwich University Hospital, Norwich, UK*
[d] *Enteric Virus Unit, Virus Reference Department, Centre for Infections, Health Protection Agency, Colindale, London, UK*

Received 11 April 2008; received in revised form 2 September 2008; accepted 11 September 2008
Corresponding Editor: William Cameron, Ottawa, Canada

KEYWORDS
Norovirus;
Outbreak;
Food-borne;
Viral gastroenteritis;
Cohort study;
Case—control study

Summary
Background: Norovirus (NoV) is commonly associated with gastrointestinal infection. It is normally transmitted person-to-person or from contaminated surfaces, although food-borne transmission is possible.
Methods: We conducted environmental, epidemiological, and microbiological investigations to ascertain the route of transmission of two linked outbreaks of NoV associated with events where food was consumed. Multivariate logistic regression was used to determine food items independently associated with infection.
Results: In outbreak A, 19 of the 26 people who completed the food questionnaire fulfilled the case definition. The highest relative risks (RR) were for chicken kebab (RR 3, 95% confidence interval (CI) 0.9—10.4), pork sausages (RR 2.1, 95% CI 0.5—9.1), pasta salad (RR 1.94, 95% CI 0.9—4.1), cheese (RR 1.6, 95% CI 0.9—2.8), and green leaf salad (RR 1.5, 95% CI 0.9—2.4). In outbreak B, 60 of the 106 people surveyed fulfilled the case definition. Green leaf salad (adjusted odds ratio (aOR) 3.2, 95% CI 1.4—9.9) and coleslaw (aOR 8.2, 95% CI 3—22.2) were independently associated with illness in the multivariate logistic regression model. NoV genogroup II genotype 6 (GII-6) was identified in cases of both outbreaks and a food handler who had prepared salads for both events.
Conclusion: Because outbreak investigations of small cohorts may not yield epidemiological association to food, most of these outbreaks may be attributed to the person-to-person transmission route. Therefore ascertainment of food-borne NoV infection may be low, underestimating the true prevalence of this route of transmission.

* Corresponding author. Tel.: +44 (0)1603591399.
E-mail address: r.vivancos@uea.ac.uk (R. Vivancos).

1201-9712/$36.00
doi:10.1016/j.ijid.2008.09.023

Introduction

Norovirus (NoV) is a small round structured virus of the *Caliciviridae* family. It causes gastrointestinal symptoms in humans. It transmits person-to-person by the fecal–oral route and via environmental contamination.[1] Food-borne outbreaks have also been described in the literature, mainly associated with shellfish, frozen berries, and salads.[2–7] Because of the lack of long-lasting immunity in those affected and the small infective dose required, NoV outbreaks tend to affect large numbers of people.[8,9]

In England and Wales, most recorded outbreaks of NoV have occurred in healthcare settings (i.e., hospitals and care homes).[8] In this setting the greatest peak occurs in the winter, although infection occurs all year round.[10] There is probably under-reporting of outbreaks in other settings.

NoV outbreaks in Norfolk are reported to the Health Protection Unit (HPU) throughout the year with a peak in the winter months. The majority of cases occur in residential and nursing homes, and hospitals. More rarely outbreaks have been reported in schools and food outlets.

There is no formal surveillance system for NoV infections in Norfolk (East of England). In England suspected outbreaks of gastrointestinal infections are reported by institutions or members of the public to local authorities as well as the HPU. As part of the investigations into gastrointestinal infection outbreaks, fecal samples are tested for NoV. Positive samples are sent to the Health Protection Agency Reference Laboratory for further characterization. National surveillance of NoV strains associated with outbreaks of gastroenteritis involves characterization of strains collected at the beginning, middle, and end of each NoV season throughout the regions of the UK, including the East of England.[11]

In August 2007 the Norfolk team of the Norfolk, Suffolk and Cambridgeshire HPU was notified by South Norfolk District Council (SNDC) Environmental Health Department (EHD) of a number of cases of gastroenteritis in people who had attended a barbeque 2 days earlier, reported by the organizer of the event. An outbreak control team (OCT) was arranged at short notice and investigations and control measures instituted. The following day, the HPU was notified by North Norfolk District Council (NNDC) EHD of a second outbreak of gastroenteritis following a barbeque that occurred on the same day as the other outbreak, also reported by the organizer of the event. It later became evident that food served at both events was provided and prepared by the same catering company. The OCT investigated and instituted control measures for both outbreaks.

Investigations were aimed at ascertaining the causal organism of the outbreak and the source of the infections. The control measures were intended to minimize further spread and the risk to other members of the public. Here we present and discuss the investigations and control measures.

Methods

Environmental investigation

The Environmental Health Officers (EHOs) from two local authorities visited the venues where the two events took place to assess facilities, collect guest lists, ascertain seating arrangements, and to enquire about episodes of vomiting or suspected diarrhea during the events. Subsequently, the caterer's premises were inspected and food preparation procedures were discussed. Storage and preparation of food were investigated during the visit. Samples of food items left over from the two events or at the caterer's premises were also collected.

Epidemiological investigation

A case was defined as any person who had attended either of the barbeques and who had developed symptoms of nausea, vomiting, diarrhea, or malaise. Two epidemiological studies were conducted. Standard food questionnaires were sent by mail within a week of the initial report to the HPU, to those people identified as having attended either of the barbeques. The questionnaire asked about age, sex, symptoms and date/time of onset, and consumption of food items at the events. These enabled estimation of the attack rate, incubation period, and nature and duration of symptoms.

All of those who attended barbeque A could be identified. Hence, outbreak A was studied as a retrospective cohort, calculating attack rates and relative risks (RR) for individual food items. In the case of outbreak B, it is estimated that over 200 people attended but only a proportion could be identified; for this reason outbreak B was analyzed as an unmatched case–control study, where cases were those who completed the questionnaire and reported symptoms as per the case definition. In this case we calculated odds ratios (OR) for individual food items, and adjusted these by introducing those variables that were statistically significant ($p < 0.05$) into a multivariate logistic regression model to determine those food items independently associated with illness. All data were analyzed using SPSS v. 14.0. We did not ask for secondary cases outside those who attended the events.

Microbiological investigation

Fecal specimens obtained within 48 hours of onset of symptoms were cultured in the local microbiology laboratory for 48 hours in a range of media to allow detection of bacterial and viral enteric pathogens, in accordance with the National Standard Methods for investigating outbreaks of gastroenteritis (VSOP3, http://www.hpa-standardmethods.org.uk/pdf_sops.asp). In addition, samples were also tested in the IDEIA™ Norovirus EIA kit, which utilizes a combination of both genogroup 1- and genogroup 2-specific monoclonal and polyclonal antibodies in a solid-phase immunoassay for rapid detection of NoV genotypes.[12] Reactive specimens and specimens of exceptional importance in the outbreak collected later than 2 days after onset of symptoms were sent to the HPA Centre for Infections for NoV PCR to enable specific genotyping.[11] Genotyping was performed using GIIFBN/GIISKR primers, as previously described.[11] Genotyping was performed on five samples from the outbreaks A and B (A-1 and B-1, B-2, B-3, and B-4) and one sample from the food handler (FH).

Samples from leftover food were stored frozen while the epidemiological and environmental investigations were conducted, and later sent out for processing. PCR specific for