

# Three nursing home outbreaks of Norwalk-like virus in Brisbane in 1999

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## Abstract

**We report on three nursing home outbreaks of gastroenteritis in Brisbane in 1999. The presence of Norwalk-like virus (NLV) genogroup 2 was demonstrated by reverse transcription polymerase chain reaction (RT-PCR) in all three outbreaks. Common findings of these investigations were rapid spread of the illness within the institutions and difficulties in identifying a common source. Nursing home populations are vulnerable and it is important for each institution to have infection control policies in place so outbreaks can be managed promptly. This includes the exclusion of ill staff for 48 to 72 hours after recovery from illness. Genogrouping of NLV by RT-PCR can take several days so control measures will generally have to be instituted before results become available. *Commun Dis Intell* 2000;24:229-233.**

*Keywords: disease outbreaks, Norwalk-like virus, small round structured virus, gastroenteritis, nursing homes, polymerase chain reaction, infection control*

## Introduction

The Norwalk-like viruses (NLVs) - also known as small round structured viruses (SRSVs) - are a genetically diverse group of RNA viruses within the family *Caliciviridae*.<sup>1</sup> Two main groups of NLVs have been identified: genogroup 1 (Norwalk virus group) and genogroup 2 (Snow Mountain virus group).<sup>2</sup> Symptoms of infection with NLVs commonly include sudden onset of nausea and vomiting and/or diarrhoea, accompanied by abdominal cramps, headache and low grade fever.<sup>3</sup> The vomiting and diarrhoea are frequently explosive in nature.<sup>4</sup> Documented modes of transmission of NLVs are water, food (especially shellfish and salads), fomites and person to person spread.<sup>5</sup> Aerosol transmission has also been postulated.<sup>6,7,8</sup>

Outbreaks due to NLVs have been associated with various settings including hospitals, nursing homes, restaurants, catered events, schools, prisons and cruise ships; nursing homes are the setting most commonly identified.<sup>1</sup> An analysis of faecal samples from south-eastern Australia collected between 1980 and 1996 showed that the majority of incidents occurred in elderly people in nursing homes or hospitals.<sup>2</sup> This, together with increasing reports of NLV incidents in Australia and overseas,<sup>1,2,9,10</sup> demonstrates that NLVs represent a significant and previously under-recognised public health problem, particularly amongst the elderly and institutionalised. We describe here three outbreaks of gastroenteritis in long-stay nursing homes. The outbreaks were subsequently shown to be due to Norwalk-like virus.

## Methods

### Epidemiological investigation

A team from the public health unit conducted an investigation of each outbreak of gastroenteritis using a standard questionnaire to collect data on case characteristics, symptomatology and duration of illness. A case was defined as a person who developed nausea and/or vomiting and/or diarrhoea during the outbreak period. An illness and food-history questionnaire was administered and, where indicated, a kitchen hygiene audit conducted (including food and water sampling). Staff were requested to collect faecal or vomitus specimens from cases and to provide such specimens if they themselves were affected. Food, water and stool samples were delivered to Queensland Health Scientific Services for analysis.

### Microbiological investigation

Food specimens were cultured for *Escherichia coli*, coagulase-positive staphylococci, *Clostridium perfringens*, *Vibrio parahaemolyticus*, *Bacillus cereus*, *Salmonella* spp, *Yersinia enterocolitica*, *Campylobacter* spp and *Listeria* spp. A standard plate count, coliform counts and *E. coli* counts were performed on water samples. Stools were examined for ova, cysts and parasites, and cultured for bacteria. Two faecal and one vomitus specimen from outbreak A were tested for staphylococcal and *Bacillus cereus* toxins. Reverse transcription polymerase chain reaction (RT-PCR) was used to test stools and vomitus for enteric viruses (rotavirus, astrovirus, Norwalk-like virus and adenovirus).

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## Results

### Outbreak A

On 26 February 1999 the Brisbane North Public Health Unit was notified of an outbreak of gastroenteritis in nursing home A. From the date the outbreak started (18 February) both staff and residents were affected. The home had a hostel section where the more ambulant residents lived and a nursing home section for those requiring more care. Outbreak control measures already instituted at the time of notification included barrier nursing, hand-washing and restrictions on the movements of ill residents. In addition, the public health unit advised that affected staff should not return to work until 48 hours after cessation of symptoms.

The main outbreak features are summarised in the Table. Affected staff included domestic, administrative, catering and nursing personnel. An incubation period could be recognised for only one resident: he was absent from the nursing home when the outbreak started but developed symptoms within 48 hours of return.

Figure 1 shows the epidemic curve for Outbreak A. Most early cases occurred in the hostel section with subsequent spread to the nursing home. Analysis of food histories did not suggest any common food source and there were no reports of illness amongst food handlers just prior to the outbreak. Inspection of kitchen facilities did not reveal any major breaches of hygiene. No pathogens were identified in the food samples, and coliforms were not detected in the water samples. Stool cultures for bacterial pathogens and tests for staphylococcal toxin were negative. Sixteen specimens were submitted and Norwalk-like virus genogroup 2 was detected by PCR from two specimens from two different cases.

### Outbreak B

On 14 April 1999, the Brisbane Southside Public Health Unit was notified of an outbreak of gastroenteritis in nursing home B that had started on 13 April and involved both staff and residents. Staff brought their own meals. Residents were provided with meals from a central kitchen at another nursing home. No other institutions serviced by the central kitchen had become affected and this kitchen had recently been audited and found to meet food hygiene standards. The outbreak lasted 3 days, with five cases (one staff, four residents) on the first day, five cases (two staff, three residents) on the second and eight cases (six staff, two residents) on the third day.

Both staff and residents became ill from the same date and one member of the nursing staff reported a gastrointestinal illness 4 days prior to the outbreak. Analysis of food histories did not suggest any common food source. Four faecal and two vomitus specimens were submitted from five cases. *Staphylococcus aureus* was isolated from one faecal specimen but Norwalk-like virus genogroup 2 was detected by PCR in all six specimens.

### Outbreak C

On 25 May 1999, the West Moreton Public Health Unit was notified of an outbreak of gastroenteritis in nursing home C. The outbreak had started on 7 May and also involved both staff and residents. Due to dementia and debility in a high proportion of residents, it was decided that only staff would be asked to complete a standardised questionnaire.

Residents ate food prepared in the nursing home. Staff brought their own food.

Ill staff came from domestic, catering, managerial and nursing categories. Eleven cases (28%) were still symptomatic when they returned to work. Figure 2 shows the epidemic curve for staff cases. Norwalk-like virus genogroup 2 was detected by PCR in three of three faecal specimens submitted.

## Discussion

The epidemic curve of outbreak A clearly demonstrates the spread of the outbreak within the nursing home. Although ill residents were restricted to their rooms, staff may have transmitted the virus while moving within the facility. In both outbreaks A and B, the rapid initial peak might suggest a point source but it may also reflect rapid person to person spread.

Interpretation of the epidemic curve in outbreak C is limited by the lack of known onset dates for resident cases and by the absence of confirmation of NLV in the first two cases. It was most probably a propagated source outbreak. The gap between the initial two and subsequent cases may be due to poor case ascertainment. Alternatively, these two cases may not have been part of the outbreak. The negative results of epidemiological and microbiological investigations and the fact that staff and residents shared no food in any of these nursing homes suggest that food was an unlikely source of transmission.

It is particularly difficult to identify a source of infection in nursing home settings as many factors limit the quality of information available.<sup>1</sup> These may include inability of residents to provide accurate histories, uncooperative management fearing criticism from families of residents, lack of appropriate documentation, staff covering for sick colleagues being too busy to assist, and a lack of coordination between the various medical practitioners involved. In addition, late notification in two of the outbreaks described meant that secondary person to person transmission would have masked any common source.

The clinical and epidemiological features of all three outbreaks fit the criteria developed by Kaplan<sup>11</sup> for identifying NLV outbreaks, namely stool cultures negative for bacterial pathogens, mean or median duration of illness 12 to 60 hours, vomiting in 50% of cases, and a mean or median incubation period of 24 to 48 hours. Although *S. aureus* was isolated in one specimen, the significance of this is uncertain and the first three of the listed criteria were met in all three outbreaks. The incubation period could not be calculated due to lack of an obvious initial exposure.

In the outbreaks described here, the clinical and epidemiological features do not fit with other viral gastroenteritis agents of public health importance (rotaviruses, astroviruses, and certain serotypes of adenoviruses).<sup>3,5</sup> Rotaviruses can cause an illness lasting around 4 to 6 days in which vomiting, watery diarrhoea, fever and abdominal pain are prominent<sup>3,5</sup> but they usually affect young children. Astrovirus outbreaks are common in closed communities but the incubation period is 3 to 4 days, diarrhoea is more typical than vomiting and symptoms usually last 3 to 4 days.<sup>3</sup> Adenoviruses have a relatively long incubation period (3 to 10 days) and the illness lasts for a week or more.<sup>5</sup>

**Table. Main outbreak features**

Outbreak		A		B		C	
Duration (days)		21		3		23	
Population (n)	Staff	278		105		67	
	Residents	517		70		112	
Affected (attack rate %)	Staff	30	11%	9	9%	36	58%
	Residents	136	26%	9	13%	29	26%
Median duration of illness (hours)	Staff	24		48		48	
	Residents	48		N/I*		N/I	
Median age (years)	Staff	45		45		43	
	Residents	87		90		N/I	
Symptoms (%)	Vomiting	57%		83%		67%	
	Diarrhoea	79%		61%		78%	
Outcomes (number of persons)	Hospitalised	1		0		3	
	Died	1		0		0	

\* N/I = not interviewed

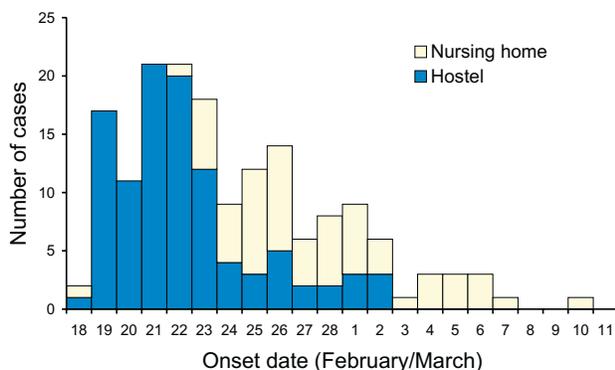
Substantial proportions of staff and residents were affected in these outbreaks. Attack rates in nursing homes can be as high as 50 to 70%.<sup>7</sup> Airborne transmission by aerosolised vomitus is suggested as a contributing factor to the rapid spread of NLVs.<sup>4</sup> In addition, spread of NLVs in nursing homes is facilitated by the enclosed environment, and by decreased personal hygiene related to patient factors such as immobility, incontinence and dementia. The risk of spread is augmented if staff return to work while still infectious or if staff members are rostered to work in unfamiliar areas of the nursing home. The early return of staff to work in nursing homes A and C may have prolonged these outbreaks.

NLVs cannot be grown in cell culture but can be identified by electron microscopy where sufficient amounts are present (1 million viruses/mL of stool). These levels of excretion usually only occur during the first 48 hours of diarrhoea.<sup>5</sup> Even when acute samples are obtained, only about 25% of samples will be positive.<sup>12</sup> PCR is the most sensitive diagnostic test available and can theoretically detect one

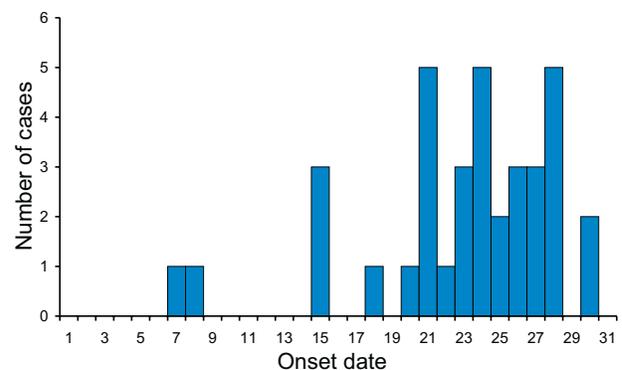
virus particle. Although PCR has increased sensitivity to detect NLVs when specimens are collected late (more than 3 days) after onset of illness,<sup>4</sup> the success rate for detection is highest if the specimens (faeces and/or vomitus) are collected within 48 to 72 hours of illness onset. Specimens should be transported at 4°C if other enteric viruses are being considered (adenoviruses, astroviruses or rotaviruses), otherwise they can be frozen.

Genogroup 2 viruses were detected in all three outbreaks. Surveillance of outbreaks in Australia, the UK, the Netherlands and the US using PCR methodology has repeatedly found genotype 2 to be the predominant circulating strain.<sup>1,2,4,9,10</sup> Different primers are needed to detect the two genogroups and currently Queensland laboratories only report to this level. NLVs are genetically very varied and may sometimes fail to be detected because genetic mutations prevent the PCR primers used from binding.

**Figure 1. Norwalk-like virus outbreak A, February/March 1999. Number of cases by onset date and location**



**Figure 2. Norwalk-like virus outbreak C, May 1999. Number of cases by onset date**



The PCR results were not available for a minimum of 5 days in this series. Given adequate warning, the turnaround time for a confirmed result would be a minimum of 4 days from the receipt of specimens although provisional results could be available within 48 hours. Infection control measures clearly need to be instituted prior to obtaining results. In nursing home settings this is particularly important because poor mobility, chronic disease and diuretic therapy can both increase the initial susceptibility of residents to infection and also the risk of an adverse outcome.

Enteric disease control measures should be incorporated into the facility's infection control policies and outbreak management plans to ensure rapid and effective implementation. One particularly important measure when NLVs are suspected or confirmed is the exclusion of ill staff for 48 to 72 hours after recovery because excretion of the virus is minimal after this time.<sup>3,5</sup>

Recent studies suggest that viral shedding may persist for up to 10 to 14 days after recovery and can also occur in asymptomatic individuals, though the infectivity of the latter is uncertain.<sup>13,14</sup> Low levels of shedding may be important with NLV given the very small infectious dose (10 to 100 virions).<sup>13</sup> Exclusion of staff for prolonged periods is difficult to implement and of unproven benefit so it would appear reasonable to continue to recommend a 48 to 72 hour period of exclusion. However, staff returning to work should be scrupulous about hygiene.

## Conclusion

Due to better diagnostic techniques, NLVs are now recognised as a major cause of epidemic non-bacterial gastroenteritis.<sup>1,4,10</sup> The highly susceptible population in nursing homes makes it imperative to have sound infection control policies in place for prompt management of NLV outbreaks.

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## References

1. Fankhauser RL, Noel JS, Monroe SS, Ando T, Glass RI. Molecular epidemiology of 'Norwalk-like viruses' in outbreaks of gastroenteritis in the United States. *J Infect Dis* 1998; 178:1571-1578.
2. Wright PJ, Gunsekere IC, Doultree JC, Marshall JA. Small round-structured (Norwalk-like) viruses and classical human caliciviruses in south-eastern Australia, 1980-1996. *J Med Virol* 1998;55:312-320.
3. Hocking A, Arnold G, Jensen I, Newton K, Sutherland P, eds. Viruses, food and environment. In: Food Microbiology Group. Foodborne Microorganisms of Public Health Significance, 5th ed. Sydney: Australian Institute of Food Science and Technology NSW Branch, 1997:605-618.
4. Caul EO. Viral gastroenteritis: small round structured viruses, caliciviruses and astroviruses. Part I. The clinical and diagnostic perspective. *J Clin Pathol* 1996;49:874-880.
5. LeBaron CW, Furutan NP, Lew JF et al. Viral agents of gastroenteritis: public health importance and outbreak management. *MMWR Morb Mortal Wkly Rep* 1990;39(No. RR-5):1-24.
6. Benenson A, ed. Control of Communicable Diseases Manual, 16th ed. Washington: American Public Health Association, 1995:200-201.
7. Caul EO. Viral gastroenteritis: small round structured viruses, caliciviruses and astroviruses. Part II. The epidemiological perspective. *J Clin Pathol* 1996;49:959-964.
8. Sawyer LA, Murphy JJ, Kaplan JE et al. 25- to 30-nanometer virus particle associated with a hospital outbreak of acute gastroenteritis with evidence for airborne transmission. *Am J Epidemiol* 1988;127:1261-1271.
9. Maguire AJ, Green J, Brown DW, Desselberger U, Gray JJ. Molecular epidemiology of outbreaks of gastroenteritis associated with small round-structured viruses in East Anglia, United Kingdom, during the 1996-1997 season. *J Clin Microbiol* 1999;37:81-89.
10. Vinje J, Koopmans MP. Molecular detection and epidemiology of small round-structured viruses in outbreaks of gastroenteritis in the Netherlands. *J Infect Dis* 1996;174:610-615.
11. Kaplan JE, Felman R, Campbell DS, Lookabaugh C, Gary GW. The frequency of a Norwalk-like pattern of illness in outbreaks of acute gastroenteritis. *Am J Public Health* 1982;72:1329-1332.
12. Caul EO, Curry A, Chadwick PR. Viral diarrhoea in hospitals (letter). *J Hosp Infect* 1995;31:320-321.
13. Parashar UD, Dow L, Fankhauser RL et al. An outbreak of viral gastroenteritis associated with consumption of sandwiches: implications for the control of transmission by food handlers. *Epidemiol Infect* 1998;121:615-621.
14. Green J, Wright PA, Gallimore CI, Mitchell O, Morgan-Capner P, Brown DW. The role of environmental contamination with small round structured viruses in a hospital outbreak investigated by reverse-transcriptase polymerase chain reaction assay. *J Hosp Infect* 1998;39:39-45.