Peer-reviewed articles

Norovirus in residential care facilities: Does prompt notification of outbreaks help?

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Abstract

Outbreaks of viral gastroenteritis occur regularly in residential care facilities (RCFs), with norovirus being the most common agent. Notification of outbreaks to public health authorities is encouraged in Australia, although there is limited evidence that this results in public health benefit. The aim of this study was to investigate if prompt notification of suspected norovirus outbreaks to public health authorities is associated with a reduction in either the duration or attack rate of outbreaks. Viral gastroenteritis outbreaks notified from Queensland RCFs between 2004 and 2007 were analysed. Foodborne outbreaks were excluded, along with 6 outbreaks where viruses other than norovirus were identified as the causative agent. Of the 264 remaining outbreaks, 70.8% were laboratory-confirmed as being due to norovirus. The average time to notification was 4 days and the average duration of outbreaks was 12 days. Outbreaks notified promptly (within 1 day) were of significantly shorter duration compared with outbreaks notified within 2–3 days ($P < 0.02$) or 4 or more days ($P < 0.001$). Early notification of outbreaks was not significantly associated with a reduced attack rate, however there was a significantly higher attack rate in facilities with less than 150 individuals at risk compared with facilities with 150 or more individuals at risk (30% versus 18%, respectively; $P < 0.001$). The shorter duration of promptly notified outbreaks provides some evidence to support recommendations from best practice guidelines for prompt notification of outbreaks by RCFs. However, further research is needed to unravel the interplay of factors that may influence the severity of viral gastroenteritis outbreaks in RCFs. *Commun Dis Intell* 2011;35(2):162–167.

Keywords: norovirus, viral gastroenteritis, residential care facilities, outbreak management, and notification of outbreaks

Introduction

Viral gastroenteritis affects all age groups, with particularly severe disease occurring in the elderly and people with chronic diseases.[1] Outbreaks of viral gastroenteritis are commonly reported from residential care facilities (RCFs)[2–4] where they may be long-lasting and may result in deaths.[1,5] A number of viruses may cause these outbreaks, including norovirus, rotaviruses, and adenoviruses,[6] although norovirus is by far the most common.[1,4,5]

Norovirus is most commonly associated with outbreaks because it requires only a small infective dose,[5,7–9] may be transmitted via multiple routes (i.e. person-to-person, food, water and environmental sources),[1,9,10] may become established well before the outbreak is identified,[8] immunity is usually short-lived,[9,11,12] is highly stable in the environment,[13,14] and is resistant to disinfectants.[9] Outbreaks in RCFs are also facilitated by factors such as decreased personal hygiene related to immobility, incontinence and dementia.[2,15] Host susceptibility is considered general although variable,[9] and transmission, particularly within outbreak settings, may be enhanced by extended periods of symptoms and viral shedding[1,9,14,16] as well as asymptomatic infection.[14,17] Aerosolisation of viral particles may occur during vomiting[18] and environmental surface contamination is a significant factor contributing to transmission in the enclosed living conditions of institutional facilities.[9,15,19]

Outbreaks cause considerable additional workload and logistical and economic burden for institutional facilities and public health authorities.[20–24] In residential care facilities ill residents require isolation and additional care, and in more serious cases may require hospitalisation. Common areas may be closed to residents and sometimes entire wings or facilities may be closed to visitors. Additional cleaning and infection control measures are required and there are staff productivity costs. For public health authorities, outbreaks trigger a range of investigations (laboratory, environmental and epidemiological), as well as additional surveillance and reporting requirements.[5,25]

A range of public health guidelines in Australia[26–28] advise on how to manage gastroenteritis outbreaks in RCFs, including the management of ill patients, staff and visitors, cleaning and disinfection, and monitoring and investigation. These guidelines encourage notification of outbreaks to public health, although there is little evidence that early identification and intervention are an effective use of public health resources.

There were two aims to this study. Firstly, to describe the epidemiology of notified viral gastroenteritis outbreaks in Queensland from 2004 to 2007 thought to be due to person-to-person transmission of norovirus; and secondly, to determine if prompt notification of outbreaks to public health authorities was associated with reduced severity of outbreaks.

Methods

Data source

The data used in this analysis were an extract of records from the Queensland OzFoodNet outbreak register, a state-wide register of reported foodborne and non-foodborne outbreaks. The data in the register were collected by public health units (PHUs) as part of routine surveillance of outbreaks notified by residential care facilities. Outbreak details were recorded by PHUs using a standard report template and forwarded to OzFoodNet Queensland for inclusion in their outbreak register, which forms part of the national OzFoodNet outbreak register. In this register, an outbreak includes 'two or more people with sudden onset of vomiting or diarrhoea (two or more episodes than is considered normal for the specific individual) within 24 hours'. Records were extracted from the register where transmission was recorded as person-to-person and where the onset date of the first case in the outbreak occurred between 1 January 2004 and 31 December 2007. Foodborne outbreaks were excluded, along with 6 outbreaks where viruses other than norovirus were identified as the causative agent (5 due to rotavirus and 1 due to adenovirus).

Data description

Fields extracted from the OzFoodNet outbreak register included the following: notification (report) date, date of onset of first case, date of onset of last case, total number ill (residents and staff combined), total number at risk of illness (residents and staff combined), number with faecal specimen collected, number laboratory confirmed, number hospitalised, number who died, type of epidemiological investigation, causative organism, and means of transmission. The identification of those who were ill, as well as those at risk of infection, was made by residential care facilities. The numbers reporting symptoms including diarrhoea, bloody diarrhoea, vomiting, nausea, abdominal pain, and fever was also collected. All specimens were tested for norovirus at the Public Health Virology Laboratory, Queensland Health Forensic and Scientific Services, Brisbane using reverse transcriptase polymerase chain reaction.[10]

Time to notification was calculated as the difference in the number of days between the notification date (report date) and the date of onset of symptoms of the first case and categorised as within 1 day, 2–3 days, and 4 or more days. These categories were chosen on the basis of clinical judgment and recommendations in guidelines for prompt notification within 24 hours.[26]

Facility size was calculated as the number of people (residents and staff combined) at risk of infection and was grouped as either less than 150 people or 150 people or more, given that median facility size was 153 people.

Outcome measures included attack rate and duration of outbreak. Both are continuous variables that were further categorised for analysis on the basis of clinical judgment and distribution of data. Attack rate was calculated as a percentage of the number of people who were ill, divided by those at risk of being ill, including both staff and residents of facilities. Attack rate was grouped for analysis as less than 15%, 15%–29% and 30% or more. Duration of outbreak was calculated as the number of days between the onset of the first case and the onset of the last case and categories used in the analysis were less than 9 days, 9–17 days, and 18 days or more.

Data analysis

The effect of the time taken to notify the outbreak and the size of the facility, on attack rates and duration of outbreaks were explored. As these variables were not normally distributed the Kruskal-Wallis test was used to test for statistical significance, with a two-sided *P*-value of less than 0.05 considered statistically significant. Median and inter-quartile ranges (IQR) are also presented. All analyses were carried out using Stata version 9.1.

Ethical approval

Ethical approval for this study was obtained from the Australian National University.

Results

Characteristics of notified outbreaks

A total of 264 outbreaks were notified between 2004 and 2007 (Table). The number of outbreaks in each calendar year ranged from 9 (in 2005) to 144 (in 2007). Peak months for notified outbreaks were June and July with the 6 months from April to September accounting for 74% (197) of all notified outbreaks (Figure).

Of 45,025 people at risk of infection, 9,020 (20%) ill cases were recorded. The median number of cases per outbreak was 28 (range 3–119) and the median number at risk of infection was 151 (range 17–1,026). Overall, there were 154 hospitalisations across

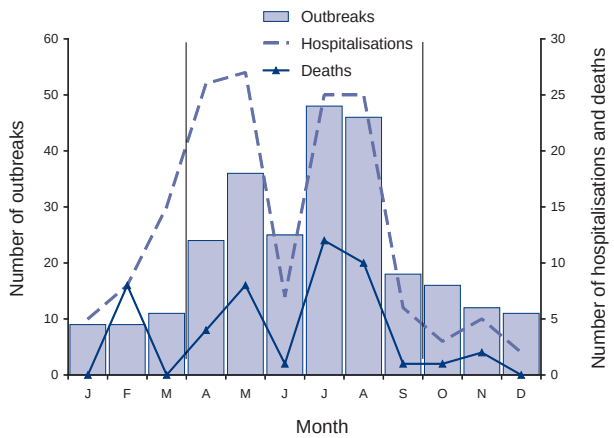
Table: Characteristics of notified viral gastroenteritis outbreaks in residential care facilities, Queensland, 2004 to 2007

Characteristics of notified outbreaks	2004	2005	2006	2007	2004–2007
Number of notified outbreaks	68	9	43	144	264
Total number who were ill	2,715	228	1,486	4,591	9,020
(range)	(3–104)	(7–78)	(5–102)	(3–119)	(3–119)
mean number per outbreak	40	25	35	32	34
median number per outbreak	35	16	29	25	28
Total number who were at-risk	11,528	1,517	6,615	24,680	44,340
(range)	(50–800)	(80–407)	(40–528)	(17–1,026)	(17–1,026)
mean number per outbreak	170	190	158	174	173
median number per outbreak	123	162	154	166	151
Attack rate	23.6%	15.0%	22.5%	18.6%	20.3%
Number of ill who were hospitalised	53	3	21	77	154
mean number per outbreak	0.9	0.4	0.6	0.6	0.6
% of ill who were hospitalised	2.0%	1.3%	1.4%	1.7%	1.7%
Number of cases who died	11	2	3	31	47
mean number per outbreak	0.2	0.3	0.1	0.2	0.2
% of ill who died	0.4%	0.9%	0.2%	0.7%	0.5%

85 (32%) outbreaks and 47 deaths across 33 (12%) outbreaks. The number of hospitalised cases and deaths peaked in June and July with approximately 75% of both occurring between April and September (Figure). Hospitalisation and death rates per 10,000 population were 34.4 and 10.2, respectively.

There were 1,335 faecal specimens collected for testing from 249 (94.3%) outbreaks. Half (50.5%, 674) of all faecal specimens collected tested positive to norovirus. Norovirus was confirmed (one or more stools testing positive) as the cause for 70.8% (187) of outbreaks.

Figure: Seasonality of notified viral gastroenteritis outbreaks in residential care facilities, by month of onset of first case, and associated hospitalisations and deaths, Queensland, 2004 to 2007



Outbreak duration and attack rate

The median number of days to notification of all outbreaks was 3.0 days (range 0–27 days). The median duration of all outbreaks was 11.0 days (range 0–36 days). The median duration of outbreaks notified within 1 day (7.5 days, IQR = 5–13 days) was significantly less ($P = 0.04$) than the median duration of outbreaks notified within 2–3 days (10 days, IQR = 6–14.5 days), and highly significantly less ($P < 0.001$) than the median duration of outbreaks notified after 4 or more days (14 days, IQR = 10–19 days). The median duration of outbreaks for facilities with less than 150 people at risk of infection was 11 days (IQR = 6–15 days) which was similar to that for facilities with 150 or more people at risk (11 days, IQR = 7–17.8 days).

The overall attack rate for all outbreaks included in this study was 20.8%. The median attack rate for outbreaks notified within 1 day (17.9%, IQR = 8.6%–26.5%) was not significantly different to that of outbreaks notified within 2–3 days (22.4%, IQR = 11.8%–36.8%) or notified after 4 or more days (20.7%, IQR = 10.2%–35.3%). The median attack rate for facilities with less than 150 people at risk of infection (24.9%, IQR = 16.8%–41.8%) was significantly higher ($P < 0.001$) than the attack rate for facilities with 150 or more people at risk (15.1%, IQR = 8.5%–26.1%).

Discussion

Our study shows that outbreaks of viral gastroenteritis, either due to or presumed due to norovirus, are

common in RCFs in Queensland and cause considerable burden to RCFs, PHUs and the community. From 2004 to 2007, there were 264 outbreaks notified involving more than 9,000 cases. One in 3 outbreaks involved at least 1 hospitalisation and one in 8 outbreaks involved at least 1 death. Such serious outcomes ensure that these outbreaks continue to attract media attention.

There is little published evidence that early identification of gastroenteritis outbreaks in RCFs and intervention are an effective use of public health resources. One recent study reported a significant reduction in attack rates in staff (but not residents) where the time to implementation of control measures was within 3 days of the onset of symptoms in the first case.[29] Infection control protocols were provided to facilities prior to study commencement, and there was no subsequent public health advice or support in managing the outbreaks. The study reported variable compliance with implementation of recommended control measures.

Our study found that prompt notification of outbreaks (within 1 day) was associated with significantly shorter outbreak duration (7.5 days) compared with outbreaks notified within 2–3 days and 4 or more days (10.0 days ($P < 0.02$) and 14.0 days ($P < 0.001$), respectively), suggesting that the advice provided by PHUs at notification of outbreaks may help to reduce the severity of outbreaks.

While there was also a lower attack rate in outbreaks notified promptly, this finding was not statistically significant. Our inability to demonstrate a significant association between these two parameters may have been due to a lack of study power due to the relatively small number of notified outbreaks over the study period, or confounding. Time to notification of outbreaks was assumed to be a proxy for time to implementation of control measures. However, control measures such as cohorting of ill residents, allocation of dedicated nursing staff, restricted access to common areas and infection control may be implemented prior to the notification of outbreaks.

While time to notification was not associated with attack rate, facility size was found to be inversely related to attack rate. There was a significantly higher attack rate in smaller facilities with less than 150 people at risk than in larger facilities. Smaller facilities may have fewer resources to identify and manage outbreaks, or reduced capacity to isolate the ill. However, facility size (the population at risk of infection) may be subject to measurement bias, particularly in large facilities and particularly in relation to staff numbers.

Two previous studies have reported an increased risk of disease outbreaks (number of outbreaks not severity) with increasing size of facility.[29,30] One of these studies included gastroenteritis outbreaks (mostly due to norovirus)[29] while the other included both respiratory and gastroenteritis outbreaks.[30] Neither of these studies examined the association between size of facility and severity of outbreak (attack rate and duration). Twenty-nine per cent of the outbreaks included in the study were presumed to be due to norovirus, in the absence of laboratory confirmation. As norovirus is by far the most common cause of viral gastroenteritis in RCFs,[1,4,5] it is likely that most outbreaks lacking laboratory confirmation were indeed due to norovirus. This assumption is supported by the finding that only 6 outbreaks required exclusion from the study due to laboratory confirmation of another viral pathogen, while 187 outbreaks were laboratory confirmed as norovirus.

Other factors that should be considered in interpreting our study findings include the potential for variation in PHU advice to RCFs and RCF skills at implementing control measures, and that some of the data reported by RCFs and PHUs may be subject to recall or measurement bias.

Despite these limitations, this study highlights that outbreaks of viral gastroenteritis are common in RCFs and place a considerable burden on residents, the facilities and on public health resources. The study was able to demonstrate an association between prompt notification to public health authorities and a shorter duration of outbreaks. This provides some evidence to support existing guidelines for management of outbreaks of viral gastroenteritis in RCFs which recommend prompt notification to public health authorities and early implementation of control measures.[4,27,28] With an ageing population in Australia and other western countries, it is increasingly important that we gain a better understanding of the risk of norovirus infection in RCF settings.[31] This study however only represents a preliminary exploration of what is a very complex issue. Further research is needed to unravel the interplay of factors including time to notification, timing and effectiveness of control measures, facility attributes including size, design, ease of movement within the facility, and staffing patterns, which may influence the severity of viral gastroenteritis outbreaks in RCFs.

Acknowledgements

Craig Davis was a Master of Applied Epidemiology (MAE) scholar at the time this study was conducted. The MAE Program and OzFoodNet Queensland are funded by the Department of Health and Ageing. Outbreak data were collected by public health nurses based in public health units, Queensland Health,

and provided to OzFoodNet Queensland. Russell Stafford and Robert Bell, OzFoodNet Queensland, compiled and extracted outbreak records from the OzFoodNet outbreak register.

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