ORIGINAL ARTICLE

Outbreak of acute gastroenteritis among emergency department staff

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Objectives: We attempted to examine an outbreak of acute gastroenteritis among the staff of the emergency department of Glasgow Royal Infirmary. We specifically looked at the pattern of spread among staff, the estimated hours of sick time and the practicalities of applying standard hospital guidelines for infection control within the emergency department.

Methods: Anonymous questionnaires were filled in by all medical and nursing staff within the department.

Results: The outbreak, considered to be caused by norovirus infection, affected 45% of staff over a 51-day period. The most commonly affected grades were staff/enrolled nurses (56%) and SHOs (58%), arguably the groups with greatest patient contact. The outbreak appeared to occur in three waves with affected staff at the start of each wave being more likely to recall contact with an infected patient than those towards the end. A total of 449.5 working hours were lost to the department through staff illness with further hours lost as staff took time to care for ill family members.

Conclusion: We hypothesise that the infection was introduced from the community on several occasions and was subsequently passed among staff within the department. Infection control measures designed for the inpatient setting can be partially applied to the emergency department. We felt the most useful measures would be early identification and isolation of infectious patients, barrier nursing, escalation of cleaning of the department and early investment in replacement staff to allow ill staff members to remain isolated at home and to prevent understaffing.

We examined an outbreak of acute gastroenteritis among emergency department (ED) staff at Glasgow Royal Infirmary (GRI). We aimed to document the pattern of spread among staff and estimate the staff hours lost to the department.

Most guidelines for infection control are designed for the inpatient setting. We looked at the suitability of these guidelines to limit spread within the ED.

Location and origin of the study

Hospital outbreaks of gastroenteritis cause disruption to service provision and put staff and patients at risk. The ED differs from other hospital departments as it has a rapidly changing patient population. During April 2006 GRI ED saw on average 188 new patients a day or 68 500 per annum.¹ This working environment with a mobile patient population is relevant as a literature review demonstrates an absence of published reports of outbreaks affecting ED staff.

Our outbreak occurred between 6 March and 25 April 2006. This coincided with a 51% increase in reports of norovirus to Health Protection Scotland (HPS), probably resulting from the emergence of a new variant of norovirus.²

Outbreaks of acute gastroenteritis

Norovirus is the major cause of outbreaks of gastroenteritis in health care settings, with Scottish hospitals accounting for 691 of 1552 confirmed cases of norovirus reported to the HPS in 2005.³ It is estimated that 1500 cases occur in the community for each one that is reported.⁴ Semi-closed communities, such as hospitals, are particularly susceptible to large outbreaks.⁵ Institutional risk factors predisposing to an outbreak include: a greater number of beds in a unit; being a geriatric or general medical care unit; and a short duration of patient stay, the average length of stay being inversely associated with incidence of outbreaks.⁶ The ED at GRI, with a high patient turnover and

heavy case mix of medical and geriatric patients, must be vigilant against an outbreak.

Diagnosis

Diagnosis of norovirus from stool specimens is difficult and depends on the identification of viral RNA by reverse transcriptase-polymerase chain reaction (RT-PCR), evidence of a specific antibody response on enzyme-linked immunosorbent assay (ELISA), or by visualisation with electron microscopy.^{7–8} In response to these difficulties Kaplan *et al* performed a review of over 600 cases and concluded that an outbreak has the clinical and epidemiological characteristics of a norovirus if it fulfils certain clinical criteria. These criteria state that the percentage of cases with vomiting should be greater than 50%, the average duration of illness is 12–60 h, the average incubation period is 24–48 h, and stool samples are negative for bacterial and parasitic pathogens.⁹

Norovirus

Norovirus is highly infectious and is acquired via the faecal–oral route, either by consuming contaminated food or water, or by ingestion of fomites or aerosol often generated by vomiting.¹⁰ The predominant symptom is vomiting that may not be preceded by any prodromal symptoms, so cases cannot be isolated in anticipation of its occurrence. Diarrhoea tends to be short-lived and less severe than with other types of gastroenteritis. Other symptoms include nausea, myalgia, abdominal cramps, headache, chills and fever. Symptoms generally last 1–3 days and recovery is rapid.⁵

Norovirus has the following characteristics that facilitate outbreaks¹¹:

Abbreviations: ED, emergency department; ELISA, enzyme-linked immunosorbent assay; GRI, Glasgow Royal Infirmary; HPS, Health Protection Scotland; RT-PCR, reverse transcriptase-polymerase chain reaction; SHO, senior house officer

- Low infectious dose, being as low as 10–100 virions.¹² Viral shedding occurs in stool and emesis with a single episode of vomiting generating 300 000–3 000 000 infectious doses.¹³
- Prolonged period of asymptomatic shedding. Norovirus is excreted before the onset of symptoms and for 7–10 days thereafter.¹⁴ Asymptomatic infection occurs, with these individuals still being infectious to others.¹⁵
- Environmental stability. Norovirus may be widely spread by emesis-generated aerosol and by fomite transmission from contaminated hands causing widespread environmental contamination. Norovirus survives for days on work surfaces and is partially resistant to removal by hypochlorite detergent preparations.¹⁶
- Lack of lasting immunity. Once infected, a person has immunity to the infecting strain for a few weeks with immunity diminishing over time. This explains the high attack rates in all ages reported in outbreaks.¹⁷

Impact on hospital function

Nosocomial outbreaks of gastroenteritis cost the National Health Service in England £115 million (€170 million, \$230 million) in 2002–3.⁶ Financial costs of infection control and diagnostic measures have been shown to be less than those of bed closures due to staff illness.¹⁸ To limit negative financial consequences, education of staff is essential, as discussed below.¹⁹

Outbreak management

Outbreaks may be controlled by preventing the introduction of infection into hospital, by containing the outbreak within a ward or department, and by preventing spread to other wards and departments.

With infected patients in ED, norovirus has already entered the hospital so we must concentrate on containment and prevention of secondary spread. Chadwick *et al* attempted a detailed review of the evidence base of measures to contain a hospital norovirus outbreak. Recommendations for which they found category I or II evidence were²⁰:

- (1) Isolating patients, instituting barrier-nursing precautions and frequent hand washing. Healthcare workers' hands are the most common vehicle of transmission of nosocomial infections. Hand washing occurs on fewer than 50% of the occasions it is warranted, and may be impacted on by clinical workload, time constraints, and concern about skin breakdown.²¹

Table 1 Questionnaire given to staff members for the gastroenteritis audit

Q1. What is your job? Please circle most appropriate category
Sister or charge nurse/staff nurse/auxiliary
SHO/middle grade/consultant
Q2. How many hours a week do you work?
.....hours
Q3. Have you had gastroenteritis in the last 2 months?
No..... If no then questionnaire complete thank you.
Yes..... If yes please continue with questions below.
Q4. What symptoms of gastroenteritis did you have? Please circle all that apply
Vomiting 1–2 times/vomiting 3–4 times/vomiting over 4 times
Diarrhoea/abdominal pain/myalgia/fever/fainting
Other, please state

Q5. What date (exactly) did you first develop symptoms of gastroenteritis?
Q6. How many hours off sick did you need?hours
Q7. Were you aware of having dealt with a patient with gastroenteritis in the 72 hours before you became unwell? Yes/No
Many thanks for your time in filling in this form.

SHO, senior house officer.

- (2) Exclusion of staff at the first sign of illness and not allowing them to return until symptom free for 48 h. The duration of ward outbreaks is negatively correlated with the length of time taken by staff to return to work after illness.²² Exposure to nurse cases produces a higher incidence of secondary spread among both staff and patients than exposure to patient cases, suggesting that nursing staff are more scrupulous in infection control measures when dealing with an ill patient than between themselves.²³
- (3) Closing the ward and not reopening until 72 h after the last case, not transferring infected patients out except in an emergency, and not allowing staff from infected areas to work in uninfected areas.
- (4) Excluding non-essential staff and cautioning visitors regarding hand washing and barrier precautions.
- (5) Clean spillages of infected fluids promptly and increase the cleaning of bathrooms during an outbreak. All hard surfaces should be cleaned with hypochlorite (at a concentration of 1000 parts per million) and curtains should be changed before reopening.

These recommendations were developed for the inpatient ward and may be applied in a more limited fashion within the ED.

METHODS

Anonymous questionnaires were distributed to all doctors and nurses working in the ED throughout March and April 2006 (table 1). Questionnaires were placed in staff mailboxes with a communal box for collection. All shifts were reminded to fill their forms until every form had been returned.

Data analysis

Data was analysed using Microsoft Excel.

Case definition

All staff reporting gastroenteritis during March–April 2006 with any two signs of vomiting, diarrhoea, abdominal pain, fever, myalgia or fainting.

Staff replacement

Hours of locum doctor and bank nurses employed were obtained from medical and nursing staffing. Costs were obtained from the locum agency and nurse staffing.

RESULTS

All 82 eligible staff (24 doctors and 58 nurses) completed the questionnaire; 37 (45%) fulfilled the case definition for gastroenteritis. The outbreak spanned 51 days from 6 March 2006 to 25 April 2006.

Aetiology of the outbreak

We considered this outbreak to be norovirus as it fulfilled both Kaplan's clinical criteria for a norovirus outbreak and was identified in the single stool sample sent for analysis.

Figure 1 Grade of staff affected. SHO, senior house officer.

Figure 2 Epidemic curve, cases over time.

Staff affected by grade

Doctors: none of the five consultants (0%), 2/7 middle graders (29%) and 7/12 senior house officers (SHOs) (58%) had gastroenteritis. Nurses: 6/15 (40%) of sisters and charge nurses, 20/36 (56%) staff and enrolled nurses, and 2/7 (29%) of auxiliaries were affected (fig 1).

Symptoms

Vomiting was the most frequently reported symptom (86%), followed by diarrhoea (73%), abdominal pain (65%), fever (43%), myalgia (19%) and fainting (8%).

Timing of illness

The epidemic curve produced (fig 2) appears to show three waves of infection. Numbers are small; however this fitted with the impression of staff that infection passed through the department in several cycles.

Contact with a symptomatic patient in the preceding 48 h

Eighteen staff members (49% of those with gastroenteritis) recalled contact with a symptomatic patient in the preceding 48 h. Cases early in each wave of the epidemic curve tended to occur among staff who recalled an infective contact before their own illness (fig 3). Figure 4 shows the odds of such contact being most likely in SHOs and staff nurses. Although these figures appear to demonstrate a plausible pattern, numbers are too small for further statistical analysis.

Hours of work time lost

A total of 449.5 working hours were lost to the department: 142 doctor hours and 307.5 nursing hours. The median number of hours taken off sick from work was 12 h (range 0–48 h), although the actual period of illness would have been longer.

During the outbreak period, 88.5 h of locum cover were employed compared with none during the same period in 2005. SHO locums cost £49.60 per hour equating to £4389 (€6525, \$8900) to cover only 88.5 of 142 (62%) doctors hours lost to sickness.

During the outbreak period 2022.5 h of bank nurse cover were required compared with 609.5 h in 2005. The 307.5 h requiring cover as a direct result of the outbreak cost an average of £20 per hour totalling £6150 (€9140, \$12 480). There remains an extra 1105.5 h of sick time over that in 2005 unaccounted for. We did not gather data on reasons for absence but are aware a proportion was taken by staff caring for family with gastroenteritis.

DISCUSSION

The epidemic within the department

Of the departmental staff, those most likely to be infected in this outbreak were SHOs and staff/enrolled nurses, arguably

Figure 3 Epidemic curve detailing contact and non-contact cases.

those with greatest patient contact. Cases with recall of contact with an infective patient tended to occur before cases with no recall of contact.

We hypothesise that infection was introduced into the ED from the community on several separate occasions and was subsequently passed between staff in the department, emphasising the importance of infection control to block onward transmission.

No consultants were infected and auxiliaries were relatively spared. This may be partly because consultants tend to use different bathroom facilities nearer to their offices shared with administrative staff who also remained well. Auxiliaries may have been protected as they work a lower average number of hours a week than trained staff, and many have administrative as well as clinical duties.

Locum and bank staff, employment and costs

This epidemic did involve other departments, but not the whole hospital, so we were able to draw disproportionately upon the shared resource of hospital bank staff which would not be possible in case of a hospital wide outbreak. Bringing staff in from non-infected departments does, however, run the risk of spreading infection through the hospital. Understaffing must be avoided as it is also a risk factor for further propagation of an outbreak.

Our analysis underestimates the true cost of replacing staff. Many additional hours of sick time may be indirectly accountable to the outbreak as nurses take time off to care for infected family. We also ignored the expense of maintaining a nursing bank and assumed that more expensive agency staff were not employed. The total cost of the epidemic to the department would be far higher.

Figure 4 Odds ratio of likelihood of exposure to a patient symptomatic for gastroenteritis in the 48 h before staff member's illness. SHO, senior house officer.

Outbreak control measures

It is essential to block transmission and avoid dissemination of infection during an outbreak of acute gastroenteritis by applying infection control measures as soon as the outbreak is recognised. Although we slowly became aware that an outbreak was occurring, few infection control measures were undertaken. This is recognised to be a problem both in departments that are particularly busy and where the number of healthcare workers available is compromised. Both of these apply here. This can lead to neglect of accepted infection control practices and an increase in secondary cases.

Chadwick's principles of infection control²⁰ were discussed in the introduction. Taking each in turn we can consider how they applied to our ED outbreak.

- (1) Isolating patients, instituting barrier nursing precautions, and frequent hand washing: Good communication from triage enables infective patients to be identified on arrival, allowing early implementation of isolation procedures. A scarcity of side rooms and many demands on their use makes their use for isolation unreliable. However, formal barrier nursing and increased hand washing are simple measures which are easily instituted.
- (2) Excluding infected staff: This is difficult and may prove a two edged sword. During this outbreak many staff came to work despite being unwell as they were aware the department was short staffed. This reflects commendable loyalty but increases the risk of secondary infection of others. However, if staff stay off and cannot be replaced then the subsequent understaffing itself can lead to a breakdown in infection control measures and exacerbate transmission.
- (3) Closing the ED: This is impracticable as no substitute to this essential service is readily available. Likewise the flow of patients out of the department cannot be halted; however, it is possible to limit areas to which potentially infective patients are transferred.
- (4) Excluding non-essential staff and cautioning visitors: There are few non-essential staff within an ED. Visitors come at all times and to exclude them entirely increases the distress of patients and family. However, it is possible to limit the number at each bedside and instruct visitors on barrier precautions and hand washing, but this places further demands on nursing time.
- (5) Clean spillages of infected fluids promptly and increase the cleaning of bathrooms: Spillages of vomit or faeces should always be promptly cleaned, outbreak or no outbreak. In an outbreak additional cleaning staff are required to escalate departmental cleaning and particularly increase frequency of cleaning of staff bathroom facilities. However, this relatively inexpensive way of interrupting secondary spread may prove difficult to instigate unless budget and staffing are available.

CONCLUSION

This outbreak of acute gastroenteritis in the ED at GRI caused considerable staff morbidity, disrupted the running of the department and placed an additional fiscal burden on the hospital.

Infection was probably introduced into the ED on several occasions from a concomitant community outbreak, and spread by secondary transmission through the staff. Loss of staff to illness was considerable and costly to the hospital, and contributed to understaffing, itself a risk factor for onward spread of infection.

From our experience the most useful practical measures that could be taken to prevent secondary spread through the ED during an outbreak include the following:

- (1) Put in place a system to identify and isolate potentially infectious patients early

- (2) Strict barrier nursing and frequent hand washing
- (3) Frequent cleaning of the department, especially cubicles vacated by infectious patients by extra staff designated for this purpose day and night
- (4) Very frequent cleaning of staff and patient toilets
- (5) Liberal employment of additional staff early in the outbreak to both encourage ill staff to remain at home and to prevent understaffing.

These measures to prevent the secondary spread of infection would require an investment of funds early in the outbreak that would be more than repaid if widespread infection of staff can be prevented.

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