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The role of the pre-symptomatic food handler in a common source outbreak of food-borne SRSV gastroenteritis in a group of hospitals

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SUMMARY

A common source outbreak of small round structure virus (SRSV) gastroenteritis affected 81 patients and 114 staff in four hospitals served by one central hospital kitchen. Eating salad items was found to be significantly associated with illness. In a cohort study of a staff buffet function eating turkey salad sandwiches was associated with illness (relative risk = 2·4; 95% CI = 1·4–4·1; $P = 0·003$), and a case control study of patients in one hospital showed an odds ratio of 6·6 (95% CI = 1·0–71·6; $P = 0·04$) for eating tuna salad and becoming ill. One of two food handlers who prepared the salads became ill the day following food preparation; she also had a young child at home who had been ill with a gastrointestinal illness during the previous two days. Contamination of food by mechanical transmission of the virus from the child via clothes and hands of the mother, or pre-symptomatic faecal excretion in the mother are possible explanations of contamination of food.

INTRODUCTION

Small round structured viruses (SRSV) of the Norwalk group are an important cause of food-borne infection [1]. Despite the usually mild nature of the illness, they are of major public health importance because they may cause lengthy outbreaks [2], infect large numbers of people [3] and affect institutions such as hospitals, schools, colleges, cruise ships and hotels, with serious disruption to services [2, 4–10].

Food may be contaminated by an infected food handler during illness or even within 48 h of recovery [10–13]. Less certain, however, is the possibility of food contamination from a pre-symptomatic infected food handler. We describe a common source outbreak of SRSV gastroenteritis in a group of hospitals in which a pre-symptomatic food handler was the possible source of primary infection.

THE OUTBREAK

The outbreak occurred in one acute district general hospital (DGH) and three smaller peripheral hospitals (PH) with long-stay and rehabilitation patients. The outbreak was first noted on Saturday 9 March when a total of 65 cases of gastroenteritis affecting patients and staff were reported. Illnesses were of short duration (< 72 h) and symptoms were of vomiting and diarrhoea, suggesting viral infection. An outbreak control team was set up according to the District Outbreak Control Plan. Preliminary enquiries suggested that the outbreak was probably food-borne since all four hospitals were supplied with meals prepared at the DGH central kitchen which supplied food prepared by the cook–chill methods as well as other foods such as salads and sandwiches. Provisional control measures included closure of the central kitchen, disposal of all remaining food, discontinuing all hospital admissions and ward transfers, daily ward cleaning with 2% hypochlorite and emphasis on hand washing.

INVESTIGATION

A suspected case was defined as a patient or staff member who had an episode of vomiting and/or diarrhoea (three or more loose motions in 24 h) since 6 March. Suspected cases were ascertained through the Occupational Health Department, daily discussion with ward staff and review of laboratory samples. All suspected cases were reviewed by the outbreak control team and those with no other medical explanations were considered to be cases.

Microbiology

Faecal samples collected within 48 h of onset of illness were sent for bacteriological examination, routine electron microscopy and immunoelectron microscopy. Food and water samples were also subjected to standard bacteriological investigation.

Buffet lunch study

A cohort study of staff who attended a retirement buffet lunch of 7 March was undertaken using a standard questionnaire distributed by the function organizer 10 days after the event.

Patient case-control study

A case-control study of early onset patient cases (cases occurring from 8 to 11 March inclusive) based at the DGH was conducted on 13 March, testing the hypothesis that the gastrointestinal illness was associated with the consumption of food prepared at the central kitchen between 7 and 9 March. Patients from the peripheral hospitals were not included because many had impaired memory. The controls were those who had been in-patients since 6 March on the same ward as cases and did not have gastrointestinal illness. We attempted to obtain a ratio of two controls per case by taking the next two eligible patients on the ward list of patients. On one ward, however, there were insufficient numbers of uninfected patients to give this ratio. The cases and controls were not matched for age or sex.

Interviews were conducted using a standard questionnaire to establish the details of their illness and the items of food and drink consumed.

Nursing staff case-control study

A nursing staff case-control study in the DGH was undertaken on 14 March to test the hypothesis that consumption of food purchased from the staff canteen from 7 to 9 March was associated with illness. Nursing staff cases were those nurses rostered for ward duty during the week starting 4 March and who reported illness between 7 and 13 March. Two controls per case were selected from the duty roster of the same ward as the cases by taking the next two eligible staff from the duty roster. Self-administered questionnaires were distributed via the Occupational Health Department.

Statistical analysis

The risk of illness in the cohort (buffet lunch) and case-control studies was measured by relative risks (RR) and odds ratios (OR) respectively. Tests of significance were based on two-tailed χ^2 and Fisher's exact tests, as appropriate.

Environmental investigations

Inspections of the kitchen and modes of food preparation were carried out on 11 March by members of the outbreak control team, who also interviewed the catering staff for details of their illnesses and work practices.

RESULTS

Eighty-one patients and 114 staff in four hospitals were identified as cases of viral gastroenteritis between 6 and 17 March. Detailed symptoms were recorded in 184 cases; 19% (35/184) had diarrhoea only, 31% (57/184) vomiting only, and 50% (92/184) diarrhoea and vomiting. The ward attack rates in patients in the four hospitals varied between 4 and 50% (median 15%), and in staff between 5 and 40% (median 11%).

The onset of illness in patients and staff are shown in Figs 1 and 2. The onset of illness in both patients and staff from the peripheral hospitals occurred earlier than onset in those from the DGH. Onset was also earlier amongst patients than amongst staff, with peak dates of onset on 9 and 10 March respectively.

Microbiology

SRSV virus was identified by electron microscopy in 5 of the first 21 faecal samples submitted from cases. The first positive result was obtained within 36 h of the first reported cases and confirmed by immunoelectron microscopy by Bristol Public Health Laboratory. No other enteric pathogens were detected in faeces, food or water samples.

Buffet lunch study

No guest list was kept of this function held on 7 March, but it was estimated that approximately 40–50 people attended. A total of 41 replies was received giving an estimated minimum response rate of 82% (41/50). The food-specific attack rates (Table 1) showed that eating turkey salad sandwiches was significantly associated with illness (RR = 2·4; 95% CI = 1·4–4·1; $P = 0{\cdot}003$).

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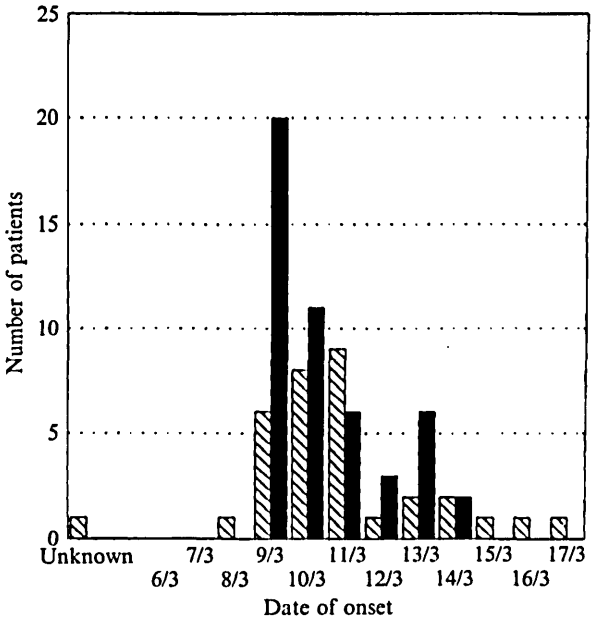

Fig. 1. Date of onset of illness in patients, district general hospital and peripheral hospitals. □, DGH ($n = 33$); ■, PHs ($n = 48$).

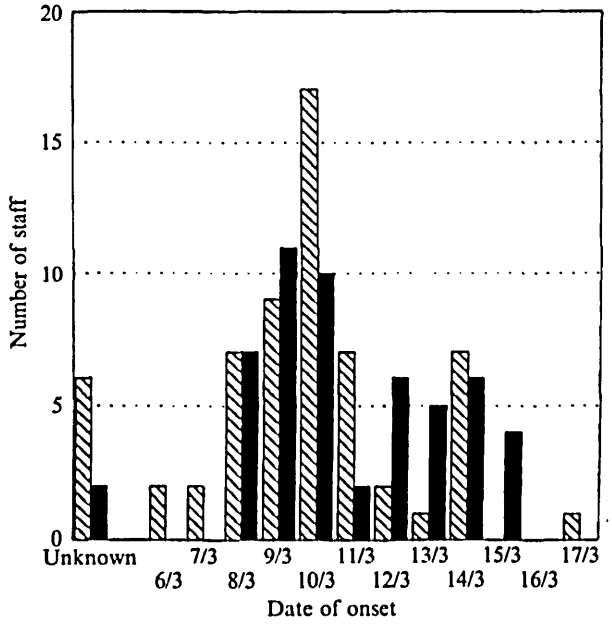

Fig. 2. Date of onset of illness in staff, district general hospital and peripheral hospitals. □, DGH (61); ■, PHs (53).

Patient case-control study

Ninety-six percent (23/24) of cases and 97% (35/36) of controls completed questionnaires. There was a significant association between illness and one meal, tuna salad, eaten on 7 March (6/21 cases *v.* 2/35 controls; OR 6·6; 95% CI

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Table 1. *Buffet lunch study – relative risk (RR) and 95% Confidence Intervals (CI)*

Food	Persons eating: No. ill	Persons eating: Total (%)	Persons not eating: No. ill	Persons not eating: Total (%)	RR	95% CI
Ham & tomato	13	22 (59%)	11	19 (58%)	1·0	0·6–1·7
Cheese & pickle	3	6 (50%)	21	35 (60%)	0·8	0·4–1·9
Turkey salad	15	17 (88%)	9	24 (38%)	2·4*	1·4–4·1
Tuna	15	24 (63%)	9	17 (53%)	1·2	0·7–2·0
Sausage roll	15	25 (60%)	9	16 (56%)	1·1	0·6–1·8
Cheese & pineapple	16	27 (59%)	8	14 (57%)	1·0	0·6–1·8
Sausage mushroom	17	25 (68%)	7	16 (44%)	1·6	0·8–2·9
Fresh fruit	2	4 (50%)	22	37 (59%)	0·8	0·3–2·3
Meringue	12	22 (55%)	12	19 (63%)	0·9	0·5–1·4
Orange juice	4	7 (57%)	20	34 (59%)	1·0	0·48–2·0
Wine	20	34 (59%)	4	7 (57%)	1·0	0·51–2·1

* $P = 0{\cdot}003$.

1·0–71·6; $P = 0{\cdot}04$). Further high ORs were found for salads served on 8 March (3·2 for beef salad and 2·5 for chicken salad), but these did not reach statistical significance (Table 2) except when grouped together (OR of 4·7; 95% CI 0·9–30; $P < 0{\cdot}05$). The ORs for cooked foods were all lower than those for salads and stayed below or close to 1.

Staff case-control study

Eighty-one percent (22/27) of cases and 91% (49/54) of controls responded. There were only 10 cases and 23 controls who reported eating food in the staff canteen. No statistically significant associations were found.

Catering staff and kitchen inspection

Fifteen percent (13/86) of the catering staff at the district general hospital reported having a gastrointestinal illness during the course of the outbreak. The first case was a cook who had last worked in the kitchen on 5 March and vomited at home on 6 March. She did not return to work until after the outbreak had commenced. A further five staff became ill on 8 March, one of whom was responsible for preparing salads. She vomited in the wash-up area at 07.30 h and then resumed work. She vomited again at 08.00 h in the kitchen lavatory before being sent home. It was noted that her baby son had also been ill with gastrointestinal illness which commenced on the evening of 6 March. The only other food handler to prepare salads did not become ill throughout the course of the outbreak (Table 3).

Salad preparation involved the washing of lettuce, tomatoes and cucumber in tap water in a separate salad preparation area. Routinely salad items were washed each afternoon and stored in boxes overnight in a refrigerator to be used the following day in plated salads and sandwiches. If necessary additional salad was washed on the day. One wholesaler supplied salad items to the kitchens of all the

Table 2. *Table case-control study*

Food	Cases		Controls		OR	95% CI
	Ate	Did not eat	Ate	Did not eat		
7 March						
Beef cobble	0	23	5	30	0	0–1·7
Beef crumble	3	20	3	32	1·6	0–11·5
Mince	3	20	6	29	0·7	0·1–3·9
Sausage & onion	3	20	12	23	0·3	0·1–1·3
Cheese pie	1	22	7	28	0·2	0–1·6
Lamb salad	2	21	7	28	0·4	0·05–2·4
Tuna salad	6	15	2	33	6·6*	1·0–71·6
Any salad	8	15	8	27	1·8	0·5–6·8
Corn beef sandwich	2	21	2	33	1·6	0·1–23
Any sandwich	5	18	2	33	4·6	0·6–39
8 March						
Cod	8	15	12	23	1	0·3–3·5
Chicken curry	6	17	11	24	0·8	0·2–2·8
Flaked fish	1	22	2	33	0·7	0·01–15
Lamb casserole	5	18	8	27	0·9	0·2–3·9
Mushroom pizza	1	22	4	31	0·3	0·01–3·9
Savoury lamb	2	21	3	32	1	0·1–9·7
Beef salad	2	21	1	34	3·2	0·2–97
Chicken salad	3	20	2	33	2·5	0·3–31
Any salad	7	16	3	32	4·7*	0·9–30
Salmon sandwich	1	22	7	38	0·2	0–2·2
Any sandwich	2	21	7	28	0·4	0·04–2·3
9 March						
Pork casserole	7	16	8	27	1·5	0·4–5·7
Chicken pie	3	20	11	24	0·3	0·1–1·5
Minced chicken	1	22	7	28	0·2	0–1·6
Cawl	3	20	3	32	1·6	0·2–13
Fishcake	3	20	8	27	0·5	0·1–2·5
Egg salad	1	22	4	31	0·3	0–3·9
Cheese salad	5	18	4	31	2·2	0·2–4·8
Any salad	5	18	7	28	1·1	0·2–4·8
Ham sandwich	1	21	3	31	0·5	0·01–6·7
Any sandwich	2	21	3	32	1	0·1–9·7

*$P < 0·05$.

Table 3. *Time and place of onset and symptoms of illness in catering staff on 6–8 March*

Date	Staff designation	Time of onset	Place of onset	Symptoms
6 March	Cook	06.00 h	Home	Vomiting
8 March	Salad preparer	07.30 h	Hospital kitchen	Vomiting and diarrhoea
8 March	Cook	12.00 h	Casualty	Vomiting
8 March	Catering assistant	15.00 h	Home	Vomiting and diarrhoea
8 March	Catering assistant	20.20 h	Home	Vomiting
8 March	Dish-wash supervisor	22.00 h	Home	Abdominal pain and vomiting

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hospitals of the Health Authority as well as to other retail outlets, but there was no evidence of an outbreak in other hospitals or in the community.

DISCUSSION

The outbreak we report was one of the largest reported hospital outbreaks of SRSV gastroenteritis in the United Kingdom. Control measures necessitated the closure of the four hospitals to admissions for 10 days, causing major disruption to hospital services within and beyond the Health Authority. The epidemic curves indicate that a common source outbreak occurred with primary infection occurring over a 2–3 day period, followed by secondary person-to-person spread.

Contaminated salad items were implicated as vehicles for the virus in the start of this outbreak. Illness in staff was significantly associated with eating turkey salad sandwiches served at the buffet function on 7 March and, in patients, with eating tuna salad served to patients on the same day. We considered the possibility that the salad items could have been contaminated before purchase, but there was no evidence of an outbreak in other hospitals or retail outlets supplied by the same wholesaler.

Those salad items served on 7 March were washed either on the afternoon of 6 March or the morning of 7 March, and handled again that day. The available evidence indicates that the probable source of contamination of the salad on 7 March in the hospital was a salad food handler who contaminated food pre-symptomatically. She had nursed her baby who was ill with vomiting and diarrhoea on 6 and 7 March and developed symptoms of gastrointestinal illness herself on 8 March, when she vomited in the kitchen.

A number of previous authors have suggested the possibility of pre-symptomatic excretion of the virus. Pether and Caul [4] reported an outbreak of food-borne SRSV gastroenteritis related to chicken sandwiches prepared by a food handler who was incubating the disease. The food handler became unwell on the day after the food was prepared. Pre-symptomatic excretion was considered to be the cause although the authors could not confirm definitely that the food handler was symptom free at the time of food preparation. Griffin and colleagues [14] suggest the possibility of this mode of food contamination in an outbreak in a restaurant, but also demonstrated that there were multiple other sources of cross-contamination of salad from fish, shellfish and raw meat in the kitchen. Guest and colleagues and Gross and colleagues [6, 7] described outbreaks of SRSV related to food from school cafeterias. As no other source of contamination was found they suggested the possibility of pre-symptomatic excretion of the virus from food handlers, 24 h and 36 h before onset of illness respectively. In the outbreak we report pre-symptomatic excretion would have had to occur at least 24 h before onset of symptoms. We know of no microbiological evidence which supports pre-symptomatic shedding of SRSV. In a viral challenge study, in which faecal filtrates from infected persons were used, detectable virus excretion commenced at the onset of symptoms of illness [15]. The unavailability of faeces from pre-symptomatic people makes this a difficult subject to study and so would require further microbiological experiments on volunteers.

An alternative explanation is that mechanical transmission of the virus took place. The food handler preparing the salads on 7 March had handled her ill baby before coming to work. Her baby had commenced vomiting the evening before. The food handler may have brought the virus shed by her child into the kitchen where she handled raw food which did not have any further cooking. Her handwashing before handling the salad is unknown but contaminated hands could have been at fault as has occurred when a community outbreak was due to mechanical transmission of *Giardia lamblia* from a baby's diaper [16]. She did not change from her outdoor clothing before commencing work. Her clothes could have been contaminated with vomitus from her baby. Other studies have shown that environmental contamination by a victim who has vomited is important in the spread of infection [2, 9, 10]. Although decontamination with 2% hypochlorite is effective on hard surfaces, some experiments with artificial contamination of carpet with the related calicivirus have shown that virus inactivation in these circumstances requires prolonged contact with high doses of disinfectants [1]. The airborne spread of SRSV from contaminated linen was proposed as a cause of an outbreak of SRSV in an emergency room in a hospital in the US [17]. Contaminated clothing could explain the contamination of food in this outbreak.

The differences between peak onset of cases in the peripheral hospitals and the district general hospital may be explained by the most heavily contaminated salads being distributed to the peripheral hospitals. We attempted to discover whether these were the salads which were prepared on 7 March by the food handler who became ill, but we were unable to confirm this. Contamination of salad by the food handler on 7 March which was served on 7 and 8 March would not explain all the cases in this outbreak. Other foods were probably contaminated on 8 March when the food handler vomited in the kitchen. Vomitus contains large numbers of SRSV [18] and has been shown to be responsible for continuing contamination of environment in an outbreak on a cruise ship [2] and for contamination of food in a hostel outbreak [10].

The staff case-control study did not show any significant association with eating food from the canteen and less than half of the nursing cases had eaten there. There were no questions asked about the food eaten on the ward. Nursing staff are not allowed to eat left-over patient food, but it is a common practice in many hospitals for food remaining from patients to be stored on the ward and eaten later by staff. This is a possible explanation of the nursing staff cases.

Education of food handlers should include awareness that they could contaminate food before illness, following infection or contamination by an ill child at home. They should be advised to take especial care to follow good kitchen hygiene practices, particularly hand washing, under these circumstances. Mechanical transmission via clothes would be minimized by kitchen staff being required to change into kitchen over-clothing in a separate room before commencing work, and this over-clothing should not be taken home. Following a bout of vomiting and/or diarrhoea while at work, catering staff should not be allowed to resume work or to enter the kitchen area again. If they have vomited within the kitchen area all food they have handled should be destroyed, as well as any other food which could have been exposed to aerosolized virus from the vomitus, and the kitchen decontaminated.

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