# *Salmonella* Typhimurium phage type 170 in a tertiary paediatric hospital with person-to-person transmission implicated

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## Abstract

**Nosocomially-acquired salmonellosis is uncommonly reported in Australia. We report a cluster of gastroenteritis caused by *Salmonella* Typhimurium phage type 170 (STm 170) centred on a tertiary paediatric hospital in Sydney, New South Wales from 8 to 19 May 2004. A total of 12 children had STm 170 isolated from faecal specimens. Of the 12 cases, seven were acquired in hospital and five in the community. The mean age of the cases was 4.1 years (range: 2 months to 11.2 years). We conducted a case series investigation to generate hypotheses regarding the cause of this outbreak. Standardised interviews with cases' parents were conducted to identify potential exposures including in recently consumed food. An environmental investigation mapped the food preparation and storage areas, movements of staff caring for cases, relative case-bed locations, and duration of stay in these locations. Five of the seven hospital-acquired cases were immunocompromised with a history of prolonged and/or multiple hospital admissions. We found that STm 170 was probably brought into the hospital by a community-acquired case and spread to other in-patients through person-to-person transmission by hospital staff and/or patients. This study emphasises the importance of stringent compliance with hospital infection control practices at all times. *Commun Dis Intell* 2005;29:374–378.**

*Keywords:* Salmonella *Typhimurium phage-type 170, salmonellosis, outbreak, nosocomial infection, paediatric hospital*

## *Introduction*

*Salmonella* species are a common cause of gastrointestinal illness in humans. *Salmonella enterica* serotype Typhimurium (STm) is the most frequently notified serotype in Australia. The most commonly reported phage type (PT) among *S.* Typhimurium is PT170. Notifications of STm 170 have increased in eastern Australia since 2002 and comprised 16 per cent of all salmonellosis notifications in New South Wales in 2004.[1]

Reported outbreaks of nosocomially-acquired salmonellosis are rare in Australia but can be serious and difficult to eradicate.[2] Nosocomially-acquired salmonellosis outbreaks are most commonly linked to contaminated food.[2–6] Person-to-person spread can readily occur in the hospital environment.[6,7] A 10-year (1978–1987) study of 248 outbreaks of nosocomially-acquired salmonellosis in the United Kingdom found 30 per cent of infections were linked to person-to-person spread.[4] Salmonellosis outbreaks in paediatric hospitals are of particular concern due to the increased susceptibility and associated high morbidity in this group.[8] Person-to-person transmission can prolong the duration of an outbreak, particularly when immunocompromised patients are involved.[5]

On 24 May 2004, a cluster of 12 cases of gastroenteritis caused by *Salmonella* species in in-patients of a tertiary referral paediatric hospital was reported to the Western Sydney Centre for Public Health, and an investigation was commenced. This outbreak is notable for two reasons: this is an uncommon nosocomial salmonellosis cluster linked to person-to-person transmission in Australia and, the *Salmonella* infections were acquired by mostly immunocompromised

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hospital in-patients. This report documents the outbreak investigation, suggests possible means of transmission and describes the importance of hospital infection control measures.

## *Methods*

### Epidemiological investigation

We defined a probable case as any in-patient, staff member or visitor with laboratory-confirmed STm 170 isolated from a clinical specimen collected on or after 10 May 2004. A confirmed case was defined as either community-acquired or nosocomially-acquired depending on whether the case resided or worked in the hospital in the three days prior to the onset of symptoms. We checked with the Western Sydney Public Health Unit to ascertain whether or not this was part of a community-wide *Salmonella* outbreak. We also checked the Notifiable Diseases Database of NSW Health through the Health Outcomes Information Statistical Toolkit to compare the current pattern of notifications of STm 170. We collected and reviewed the inventory of hospital supplied food items. Parents confirmed which foods, if any, their children had eaten. The parents of all nosocomially-acquired cases and four of five community-acquired cases were interviewed using a standardised questionnaire. This questionnaire explored possible sources of infection during the 3-days prior to onset of symptoms. Sources investigated included food and water consumption, travel history, and environmental contacts such as animals and other ill people. We mapped both cases and staff movements within the hospital. To ascertain whether staff may have been vehicles for transmission, we examined hospital staff absenteeism data in May 2004 and traced staff contact with cases from clinical notes. Temporal and spatial relationships between the cases during likely incubation periods were examined by reviewing case-records.

### Laboratory investigation

All initial *Salmonella* isolates were performed in the Department of Microbiology at The Children's Hospital at Westmead, New South Wales. These isolates were serotyped at the Institute of Clinical Pathology and Medical Research, Westmead. Phage typing of all isolates was carried out at the Microbiological Diagnostic Unit, Melbourne University, Melbourne, Victoria.

### Environmental investigation

We inspected preparation, storage and handling of food in the hospital, including the preparation of infants formula and observed general food handling and cleanliness in the food preparation areas. Environmental sampling was not done as we considered it impractical nine days after the last reported case.

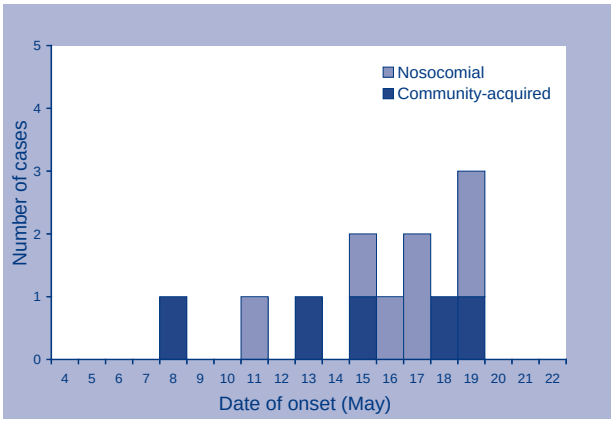
## *Results*

### Epidemiological investigation

Of the 12 STm 170 cases fitting the case definition, seven (58%) were hospital-acquired and five (42%) were community-acquired. Of the seven nosocomially-acquired cases, six were male and the mean age was 4.1 years. Nosocomially-acquired cases occurred between 11 and 19 May 2004, and community-acquired cases between 8 and 19 May 2004. Our local public health unit was not aware of any localised community-wide *Salmonella* outbreaks. The HOIST database however showed an upswing of notifications of STm 170 especially in metropolitan areas of New South Wales in the preceding months, which is consistent with the seasonal variations.[1] No links were found between the five community-acquired cases. Five of the seven nosocomially-acquired cases were immunocompromised. The background data on each of the cases are listed in the Table.

An epidemic curve for both community-acquired and nosocomially-acquired cases is shown in Figure 1.

**Figure 1. *Salmonella* Typhimurium PT170 cases at a paediatric hospital, Sydney, May 2004, by date of onset and source of exposure**




The characteristics of the epidemic curve do not suggest a point-source outbreak. Reviews of hospital supplied food items did not implicate food being the vehicle of transmission of STm 170. No food handlers were reported to have been sick during the period of investigation. Interviews with parents did not implicate particular food types as the source of the infection in either the nosocomially-acquired or community-acquired cases. No food samples were

**Table. Distribution of age, dates of onset and admission, place of illness and underlying medical conditions of patients of STm 170 cases**

| Case number | Age (month) | Date of onset | Date of admission | Community-acquired (C) or nosocomially-acquired (N) | Underlying medical condition | Reason for admission |
|---|---|---|---|---|---|---|
| Case 1 | 36 | 8 May | 10 May | C | Viral gastroenteritis | Diarrhoea, blood in stool |
| Case 2 | 6 | 11 May | 4 May | N | Immune deficiency | Failure to thrive |
| Case 3 | 36 | 13 May | 15 May | C | Viral gastroenteritis | Diarrhoea, vomiting |
| Case 4 | 42 | 15 May | 12 May | N | Cardiac/juvenile arthritis | Pain in lower limb and abdomen, high fever |
| Case 5 | 2 | 15 May | 16 May | C | Vomiting and nausea | Vomiting, nausea |
| Case 6 | 12 | 16 May | 9 March | N | Liver disease | Liver transplant |
| Case 7 | 36 | 17 May | 15 May | N | Acute laryngotracheitis | 'Barking' cough, difficulty in breathing |
| Case 8 | 36 | 17 May | 6 April | N | Leukaemia | Bone marrow transplant |
| Case 9 | 48 | 18 May | 19 May | C | Congenital heart disease/ lower respiratory tract infection | Diarrhoea, vomiting, fever, cough |
| Case 10 | 132 | 19 May | 20 May | C | Chronic headache | Fever, headache, vomiting, diarrhoea |
| Case 11 | 108 | 19 May | 18 May | N | Rheumatic heart disease | Heart murmur, arthritis, rash, fever, haematuria |
| Case 12 | 96 | 19 May | 13 May | N | Leukaemia | Bone marrow transplant |

available for laboratory investigation. Three sub-clusters of two to four cases had possible common links; either the same staff member attended two or more cases within the infectious period and/or cases shared the same ward within their infectious period (Figure 2).

In each of the sub clusters we found circumstantial evidence—proximity in terms of time (infectious period) and place (ward)—of contact between community-acquired (n=5) and nosocomially-acquired cases (n=7), indicating likely person-to-person transmission. The index case (Case 1) was admitted to the hospital on 10 May with gastrointestinal illness later confirmed as STm 170. Case 4 was admitted on 12 May and shared a common ward with Case 1. Staff member 1 attended both patients within the infectious period. This may suggest a possible person-to-person spread either by the cases themselves or by the attending staff. Similarly, Staff member 2 attended Cases 2 and 4 within a 72-hour period. Case 4 also shared Staff member 1 with Case 1 within a 48-hour period. Case 5 and Case 7 shared the same ward (Ward 1) while Case 5 was probably infectious. Case 7 and Case 11 are both nosocomially-acquired Cases. Both stayed in the same ward on 18 May and shared Staff member 3 for 24 hours. Cases 8 and 12 also shared the same ward, and Staff member 4 attended both within 48 hours when Case 8 could still have been infectious. However, we do not have an objective explanation as to the source of acquisition of STm 170 for three in-patients; Cases 2, 6 and 8, all of whom had been hospital in-patients for a prolonged period (2 to 6 months). Our review of the hospital staff absenteeism data found no staff reported illness during the period of our investigation.

### Environmental investigation

The hospital has a Hazard Analysis Critical Control Point (HACCP) system in operation which is responsible for monitoring potential points as a source of food contamination and taking early action to control food safety concerns from microbiological, chemical and physical hazards. The hospital had two food preparation areas for its in-patients; an infants formula preparation area, which was a protected sterile area and a separate kitchen where food was prepared for other in-patients. Our investigation of the food handling, preparation and storage did not reveal any obvious potential causes of *Salmonella* contamination.

## *Discussion*

Nosocomial infections are a continual challenge to any healthcare system.[9] Foodborne salmonellosis outbreaks in a hospital environment have been previously reported.[3,6,8,10] However, *Salmonella* infections due to person-to-person transmission in paediatric healthcare facilities are only rarely reported.[7,11] In Australia, of the three reported *Salmonella* outbreaks linked to person-to-person spread in 2004,

(Martyn Kirk, personal communication, 2005) this is the only outbreak reported in the hospital environment. The notification of this STm 170 cluster, warranted prompt public health intervention because of the potentially serious consequences of this infection in already ill children, especially those who are immunocompromised.

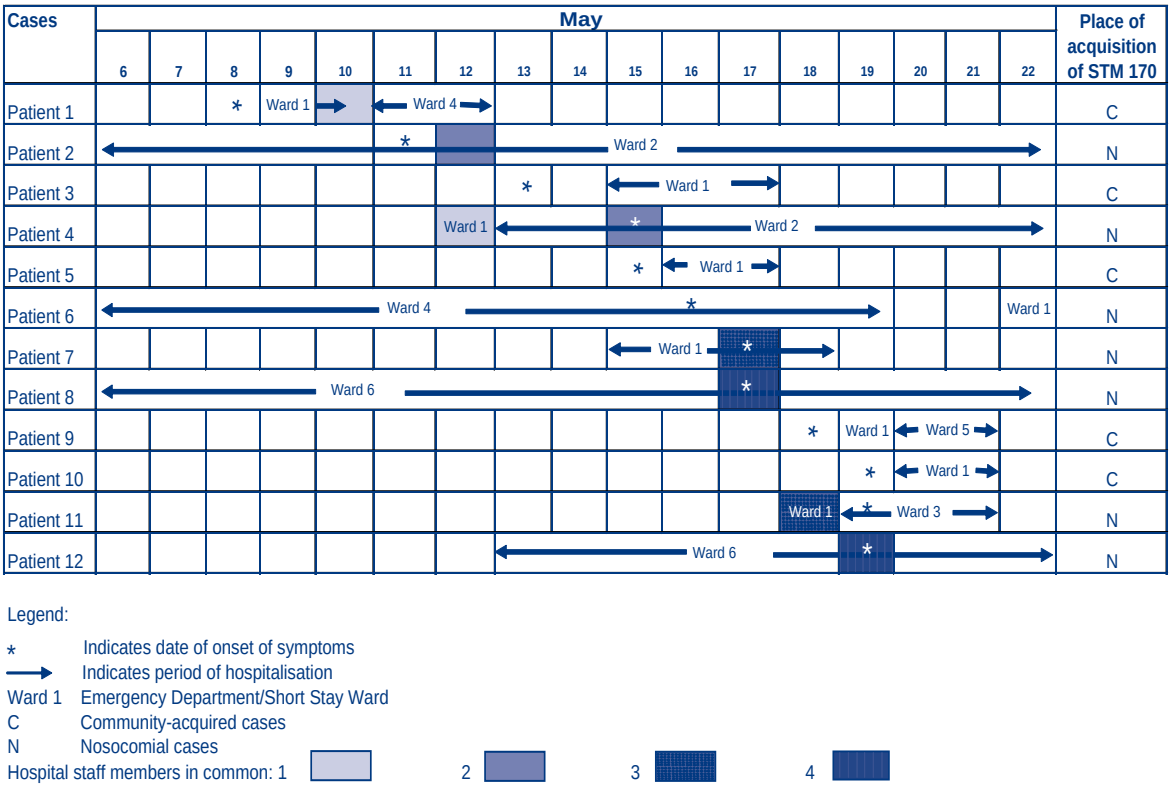
We hypothesise that this outbreak was the result of person-to-person transmission of infection from community-acquired cases to hospital in-patients. This is evidenced by both the temporal and spatial relationships between cases within the hospital and lack of evidence implicating food or any other common exposures. Analysis of the sub-clustering of cases by ward and hospital staff members who attended the cases strengthens the hypothesis that staff members contributed to person-to-person transmission (Figure 2).

The transmission of infection within the hospital is likely to have occurred as a result of direct contact between a case and a susceptible in-patient, or else facilitated by staff members attending both. Person-to-person transmission was most likely to occur at the time of children being in the Emergency Department (ED) or Short Stay Ward or SSW (Ward 1 shown in Figure 2) where patients staying longer than four hours in ED are transferred to SSW.

Although we did not investigate the hospital's infection control procedures for the management of diarrhoeal disease, stringent compliance with appropriate infection control policies are widely regarded as effective measures for prevention of nosocomial outbreaks of infectious diseases. As there is always *Salmonella* activity in the community, there is an ongoing risk of hospital outbreaks through introduction by community-acquired cases. During nosocomial outbreaks, instituting measures to enable the early detection of cases and to prevent ongoing spread are vital.[7] Methods to enhance surveillance are based around improving ward and laboratory staff's awareness, testing and reporting of in-patients with symptoms of gastroenteritis. Measures to prevent further spread include strict enforcement of hand-washing practices, cohorting or isolating infected patients, and enhanced cleaning and disinfection. We found that such measures were undertaken during the early stages of this outbreak and it is likely that this limited the duration of the outbreak.

The preliminary results of this investigation were communicated to the hospital infection control unit. The final report of this investigation was presented at a meeting of the hospital's infection control physicians on 22 June 2004. The hospital accepted the recommendations in terms of enhancement of infection control measures in all areas of the hospital and particularly in the ED and SSW areas at all times.

**Figure 2. Epidemiological links between date of onset, ward and attending staff for STM 170 nosocomial and community-acquired cases**



In summary, this report documents an outbreak of salmonellosis amongst paediatric hospital in-patients. The source of the outbreak was one or more community-acquired cases admitted to the hospital, with subsequent direct spread to in-patients or facilitated by staff members. Although the exact nature of the breakdown in infection control measures that lead to nosocomial transmission could not be ascertained, prompt action to enhance infection control measures terminated the outbreak. It reinforces the importance of maintaining strict infection control measures at all times in order to prevent outbreaks in vulnerable hospitalised populations.

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