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Short report

Kebabs with a side of *Salmonella*: Two outbreaks of *Salmonella* linked to kebab shops in Canberra, ACT

Jill Padrotta, Jenny Post, Alexandra Marmor, Nevada Pingault, Davoud Pourmarzi

Abstract

We report two outbreaks of *Salmonella* associated with kebab shops in Canberra, Australian Capital Territory, detected through routine surveillance. The first consisted of 12 cases of *Salmonella* Agona, nine of whom reported eating chicken from the same kebab shop. The second consisted of two cases of *Salmonella* Virchow who both reported eating chicken from another (unrelated) kebab shop. Environmental investigations identified similar food safety issues at both businesses, including improper cleaning of kebab shaving equipment and serving cut rotisserie meat without further cooking. Environmental samples detected *Salmonella* genomically linked to the respective outbreak cases. These outbreaks highlight the importance of appropriate cleaning and sanitising of kebab shaving equipment and the use of a second cook step after kebab meat is shaved from the rotisserie.

Key words: *Salmonella*; Agona; Virchow; kebab; foodborne disease; outbreak

Background and methods

In Australia, *Salmonella* infection is associated with significant morbidity and mortality. In 2015, *Salmonella* gastroenteritis was responsible for more than 90,000 cases, around 4,300 hospitalisations, and 19 deaths, with an estimated total cost of AUD \$124.4 million.¹ Targeted interventions aimed at preventing *Salmonella* infections remain a public health priority.

Between February and April 2022, eight cases of *Salmonella enterica* serovar Agona (*S. Agona*) were detected by the Australian Capital Territory (ACT) Health Protection Service (HPS) through routine surveillance. This serovar typically accounts for one to two *Salmonella* notifications per year in the ACT.¹ Interviews were conducted by ACT HPS using the standard ACT *Salmonella* Questionnaire. In the ACT, all salmonellosis case are routinely interviewed following notification, before serotyping results

are available. Interviews found six of the eight cases had eaten at the same kebab shop. New South Wales Health interviewed one case who lived across the border. One case was unable to be interviewed. No active case finding was undertaken as customer contact details were not collected due to the predominantly takeaway nature of the business. It was not possible to access customer details from third-party delivery services, as the ACT *Food Act 2001*ⁱⁱ does not have provision for collecting this information. Retrospective review of salmonellosis notifications during the previous 12 months was undertaken.

In June 2022, routine interviews for two cases notified to ACT HPS with *Salmonella enterica* serovar Virchow (*S. Virchow*) revealed both cases had eaten at the same kebab shop (a different business to the earlier outbreak). The recency of the first outbreak led to rapid identification of the second.

i ACT Health Protection Service, unpublished data.

ii <https://www.legislation.act.gov.au/a/2001-66/>.

Inspections of the implicated businesses were carried out by the HPS Environmental Health Unit. Environmental swabs, cleaning cloths, and food samples were collected for microbiological analysis. Initial polymerase chain reaction (PCR) and culture were undertaken by the Microbiology Unit of the ACT Government Analytical Laboratory. *In silico* serotyping and phylogenetic analysis of isolates was undertaken at the Microbiological Diagnostic Unit, Melbourne and the Institute of Clinical Pathology and Medical Research, Sydney.

Descriptive analyses were undertaken with Microsoft Excel 2017. The outbreaks and their associated public health investigation and response were described.

These investigations were conducted as part of the standard response under the ACT *Public Health Act 1997*,ⁱⁱⁱ covered by ethics approval from the Australian National University Human Research Ethics Committee (Protocol 2017/909).

Description of outbreaks

Following the initial eight cases in the first outbreak, two additional *S. Agona* cases were notified during the remainder of April 2022. A retrospective review of notifications identified two further cases, notified in September and December 2021, resulting in a total of 12 cases. A confirmed outbreak case was defined as laboratory-confirmed *S. Agona* reported to ACT HPS between September 2021 and April 2022, where the case reported eating from the kebab shop in the seven days before symptom onset. A probable outbreak case was defined as laboratory-confirmed *S. Agona* reported during this period, where the case's food exposures were unconfirmed.

Case interviews revealed nine cases (75%) ate chicken from the kebab shop. Two cases had limited recall of their food intake during the week before their illness. Retrospective review

of interview data for the 2021 cases revealed both ate chicken at the kebab shop. In total, nine confirmed and three probable outbreak cases were identified (Figure 1).

Cases ranged in age from 6 to 62 years with a median age of 28 years. Males and females were equally affected (50% each). All cases reported diarrhoea and three cases (25%) reported blood in their stool. Five cases (42%) presented to the emergency department (ED). One case was hospitalised.

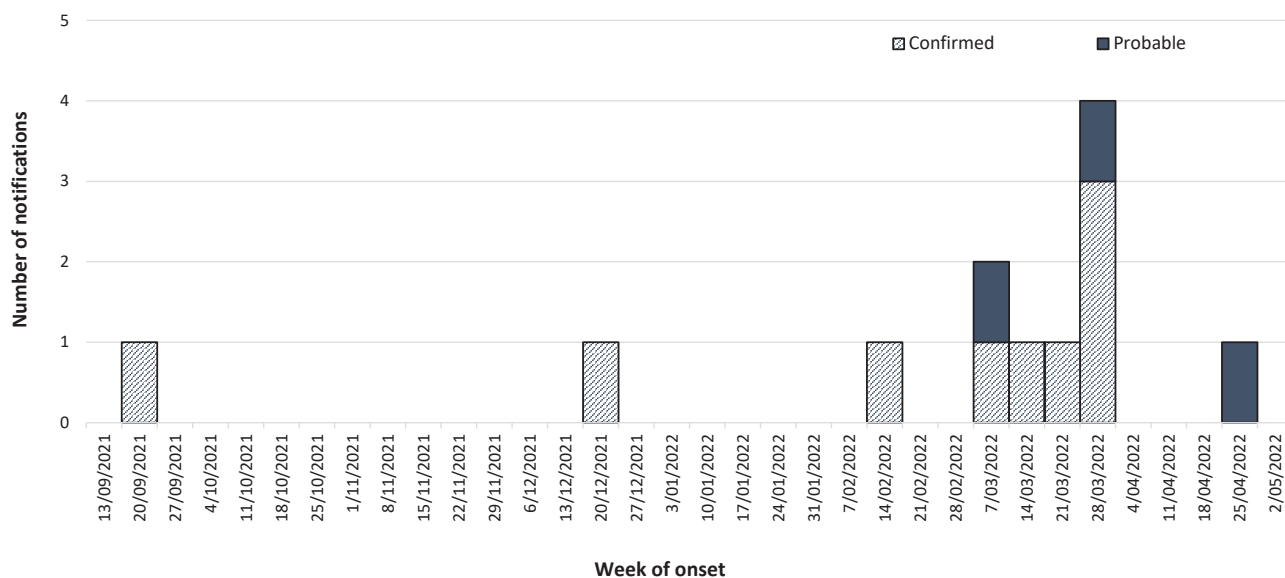
In the second outbreak, two cases of *S. Virchow* were notified on 8 and 15 June 2022, with onset dates on 5 and 12 June 2022, respectively. Both were interviewed and reported eating a chicken kebab at the same kebab shop. A confirmed outbreak case was defined as a laboratory-confirmed *S. Virchow* infection where the case reported eating from the kebab shop between 3 and 16 June 2022. Cases had a median age of 33.5 years, and neither was hospitalised.

Laboratory and environmental investigation

Environmental investigations into the first outbreak identified food safety concerns including inadequate cleaning and sanitising processes. Staff were unable to detach the blade from the electric kebab shaving equipment used to cut rotisserie meat, which limited proper cleaning. It was noted kebab meat was either cut from the rotisserie and served directly to customers (particularly when the business was busy) or placed in a holding unit and further cooked on a hot plate before serving. The temperature of meat in the holding unit was measured at 56–74 °C. Microbiological analyses detected *Salmonella* spp. via PCR from swabs taken from the chicken and lamb shaving blades, from a chicken scoop pan, and from samples of lamb and chicken. Culture confirmed *S. Agona*. A cleaning cloth was also subsequently detected to be culture positive for *S. Agona*. The kebab shaving blades were seized and dismantled for further swabbing. Swabs from the inner and outer aspects of each blade were PCR positive for *Salmonella* spp.

iii <https://www.legislation.act.gov.au/a/1997-69>.

Figure 1: Number of *S. Agona* confirmed and probable outbreak cases in the ACT from September 2021 to April 2022, by week of onset



Isolates from human and environmental samples were identified as *S. Agona*, sequence type 13, core genome multi locus sequence type (cgMLST) 2045 (formerly known as cgMLST 1760).

In the second outbreak, environmental investigations of the business identified similar food safety issues as the first outbreak. Staff were observed to have significant difficulty dismantling the kebab shaver for cleaning. Shaved meat was placed in a bain-marie (set to 80 °C) and served without a second cooking step. When the business was busy, additional meat was placed on top. Meat in the bain-marie was sampled at 56 °C. Microbiological analyses of food samples, environmental swabs and cleaning cloths seized from the business were PCR negative for *Salmonella* spp. However, a cleaning cloth was culture positive for *Salmonella* spp. Isolates from the cloth and human samples were identified as *S. Virchow*, sequence type 26, cgMLST 1936.

Public health response

Both businesses were issued an Improvement Notice requiring food safety issues to be addressed. Food preparation areas were cleaned and sanitised, and staff provided with food safety education and training. Follow up

indicated the businesses had addressed the food safety issues. Meat shavers were disassembled daily for cleaning and cut rotisserie meat was subjected to a second cook step before serving. Repeat swabs were negative for *Salmonella*. No further cases were identified for either outbreak.

The results of this investigation have contributed to the initiation of proactive public health activities in the ACT, including a targeted food sampling program for kebab businesses, targeted education on cleaning and sanitising of electric meat shavers, and review of the need for a second kill step for shaved meats.

Discussion

Doner kebabs have been linked to previous *Salmonella* outbreaks in Australia and overseas.^{2,3,4} These outbreaks highlight the risk of salmonellosis associated with kebab meat, particularly in the context of inadequate food safety practices.

In the first outbreak, the protracted nature of the outbreak suggests intermittent contamination of food products. Environmental and laboratory investigations demonstrated widespread *Salmonella* contamination. *Salmonella* was detected on four swabs taken from the

inner and outer aspects of two shaving blades, suggesting the outbreak mechanism was repeated contamination of rotisserie meat from inadequately cleaned shavers. In the second outbreak, the outbreak mechanism was less clear as *Salmonella* was only isolated from a cleaning cloth.

In both outbreaks, staff were observed to have difficulty disassembling the kebab shaving equipment for cleaning. Previous studies have found inadequately cleaned cutting utensils can lead to cross-contamination by *Salmonella* of other foods and surfaces.^{5,6} One study found *S. Typhimurium* could survive on deli slicers for six days, with the physical complexity of mechanical slicers, intermittent nature of use, and large area of food contact surfaces contributing factors.⁷ Another study confirmed the potential for bacteria to attach to the micro-ridges and grooves of mechanical deli slicer blades, allowing for sporadic transfer to previously uncontaminated products.⁸ Over time, continuous use and cleaning of blades can result in roughening of the blade surface, providing further opportunity for attachment of bacteria.⁸ Effective cleaning and sanitising of disassembled blades reduces the risk of cross-contamination.⁶

In Australia, food businesses are required to ensure equipment and utensils are in a clean and sanitary condition.⁹ However, specific guidance emphasising the importance of routine disassembly, cleaning, and sanitising of kebab shaving blades is lacking. Guidance for food businesses should emphasise the risk associated with contaminated kebab shaving equipment.

In both outbreaks, inadequate temperature control of meat may have been a contributing factor. Australian food businesses are required to store heated chicken at a temperature of 60 °C and above.⁹ In the first outbreak, cut rotisserie meat was either cooked on a hot plate prior to serving, or shaved directly into flatbread and served to customers. This may explain the intermittent detection of cases over a protracted period. In the second outbreak, cut meat was stored in a bain-marie before serving with cut meat added

on top when the business was busy. For both businesses, the temperature of shaved meat was measured at 56 °C. The implementation of a second cook step, employed consistently before serving meat to customers, may reduce the risk of transmission of foodborne pathogens.

A limitation of these investigations is that case identification relied on passive surveillance of *Salmonella* notifications without active case finding, as customer contact details could not be collected. With increasing uptake of third-party food delivery services, the role of these businesses in foodborne illness outbreak investigations should be explored.

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