A protracted outbreak of **Salmonella Hessarek** infection associated with one brand of eggs—South Australia, March 2017 – July 2018

Bernadette Kenny, Megge J Miller, Vanessa McEvoy, Alessia Centofanti, Cherylyn P Stevens and Tambri Housen

# Abstract

Salmonella Hessarek is an uncommon serotype in Australia. We report on the investigation of a protracted outbreak of 25 cases of S. Hessarek gastroenteritis in which cases were defined as any laboratory confirmed case of Salmonella Hessarek notified to the South Australian Communicable Disease Control Branch from 1st March 2017 to 3 July 2018. We conducted a descriptive case series investigation interviewing all cases and 17 (68%) reported consuming brand X free-range eggs. Four samples of one-dozen brand X eggs were cultured for the presence of Salmonella spp. One out of the four samples returned positive for S. Hessarek in the contents of the eggs; Salmonella was not present in any of the whole egg rinses of the four samples. The high proportion of cases reporting the consumption of brand X free-range eggs and the isolation of S. Hessarek from sampling four dozen brand X eggs is an unusually strong signal implicating brand X eggs as the source of this outbreak. From a public health perspective, it is important to understand the behaviour of S. Hessarek including its ability to be present in the content of eggs and further research is recommended. The findings in this investigation into a rare Salmonella serotype highlight the need for continuous monitoring of the epidemiology of Salmonella in Australia including the epidemiology of egg-associated Salmonella outbreaks of human disease.

Keywords: Salmonella, Hessarek, gastroenteritis, foodborne disease, eggs

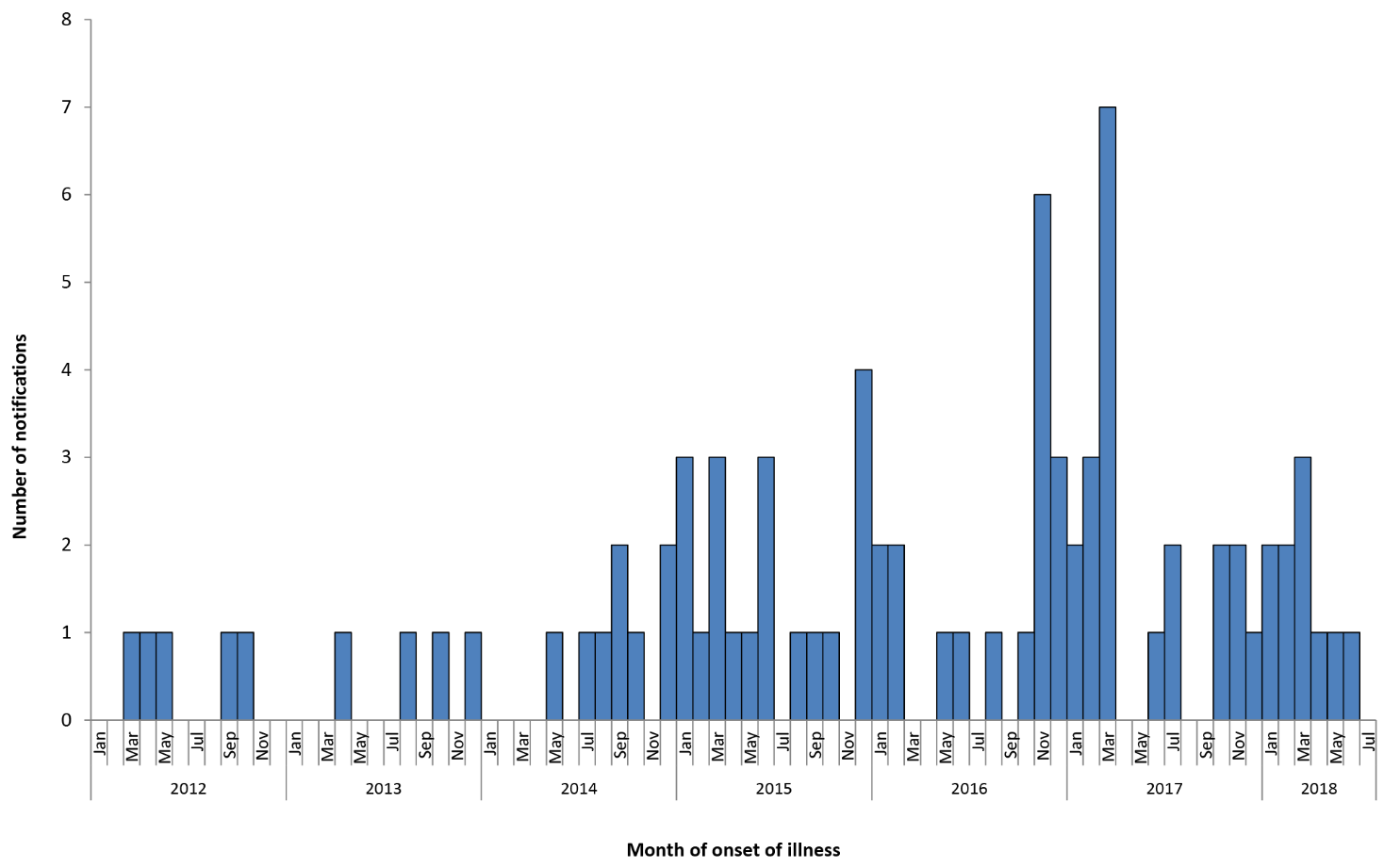
# Introduction

Salmonella enterica subspecies enterica serotype Hessarek (*S*. Hessarek) is an uncommon serotype in Australia. From 1 January 2012 to 31 December 2016, there were 96 notifications of S. Hessarek nationally (the National Notifiable Diseases Surveillance System Salmonella public dataset does not include Salmonella notified in the Australian Capital Territory), representing 0.1% of Australian Salmonella notifications for the five-year period.1 Of the 96 notifications, 52 (54%) were for residents of South Australia, a state in which 7% of the Australian population resides. For the five year period, the rate of S. Hessarek notifications in South Australians was more than seven times higher than the rate for Australians overall; 3.1 compared to 0.4 notifications per 100,000 persons.2 Globally, there is one published report of a S. Hessarek outbreak in humans; in 2005, five cases notified within the Australian Capital Territory were sourced to free range eggs served at a restaurant.3

S. Hessarek was originally isolated from a Common Raven (Corvus corax) in Iran in 19534 and has subsequently been detected in outbreaks of septicaemic salmonellosis in wild birds (song thrushes and European starlings)5,6,7 and, in European mammals (lynx,8 red foxes9 and free-range pigs10), possibly transmitted through ingestion of infected birds.5

The South Australian (SA) Communicable Disease Control Branch (CDCB) observed an increase in S. Hessarek notifications beginning around mid-2014. Between November 2016 and February 2017, two to six S. Hessarek cases per month (Figure 1) amongst a total of 136 Salmonella notifications per month had been noted.

Figure 1: Notifications of Salmonella Hessarek infection by month of illness onset, South Australia, 1 Jan 2012 to 3 July 2018



On 21 March 2017, the CDCB became aware of five cases of S. Hessarek notified in the three weeks since 1 March 2017. This was more than the expected 0.8 S. Hessarek notifications in March, based on data for the years 2012 to 2016. An investigation commenced to identify any common cause of illness for which appropriate public health action could be implemented to prevent further cases.

# Methods

## Epidemiological investigation

A retrospective review of previous S. Hessarek cluster investigations in SA was undertaken. We extracted outbreak records from 1 January 2001 to 21 March 2017 from the SA OzFoodNet Outbreak Register and the SA Notifiable Infectious Disease Surveillance System, identified investigations of S. Hessarek and, reviewed the investigation summaries to look for potential sources of the pathogen.

A case-series investigation was conducted to generate hypotheses about the source of S. Hessarek infection in cases notified in SA since 1 March 2017. We interviewed all persons notified with S. Hessarek infection between 1 March 2017 and 3 July 2018 using the national OzFoodNet Salmonella Hypothesis Generating Questionnaire. The data collected via the questionnaire include demographic details, clinical information including date of illness onset and symptoms experienced, information regarding any contact with persons with gastroenteritis in the seven days prior to onset of illness, travel history, environmental exposures such as animal contact and consumption of untreated water, food items eaten outside of the home, a seven day open-ended food history and specific questions regarding poultry and egg consumption.

Questionnaire responses relating to egg consumption, including brands of eggs consumed, were compared with data from 20 other SA community Salmonella clusters which were investigated using the same Salmonella Hypothesis Generating Questionnaire between 1 March 2017 and 3 July 2018. This comparison was intended to identify whether the pattern of consumption of particular egg brands reported during the S. Hessarek investigation was similar to the pattern of consumption of particular egg brands reported in SA in general. A case-control study was not conducted as we initially anticipated that there would be insufficient cases to generate a meaningful result and, later in the investigation, there was deemed to be sufficient epidemiological and laboratory evidence to identify the source of the outbreak without case-control study evidence.

An outbreak case was defined as any laboratory confirmed case of Salmonella Hessarek notified to the South Australian Communicable Disease Control Branch from 1st March 2017 to 3 July 2018. All S. Hessarek notifications were confirmed by the Australian Salmonella Reference Centre.

Data were analysed using Microsoft Excel 2010 (Microsoft United States of America (USA)).

The investigation was conducted under the auspices of the South Australian Public Health Act 2011 and covered under the Australian National University Human Research Ethics Committee approval (2017/909). The SA Department for Health and Ageing Human Research Ethics Committee granted approval for publication of the findings (HREC/17/SAH/113).

## Environmental investigation

Based on the responses of seven cases interviewed between 22 March and 7 April 2017, on 10 April 2017 the SA Health Food and Controlled Drugs Branch (FCDB) conducted retail sampling of brand X free-range eggs; four samples of one-dozen eggs with best before dates between 21 April and 12 May 2017 were collected from two retail stores and cultured for the presence of Salmonella spp. by the SA Pathology Food and Environmental Laboratory.

# Results

## Epidemiological investigation

CDCB had investigated previous clusters of S. Hessarek infection in SA; in 2006 a cluster of nine cases of S. Hessarek was associated with raw or semi-cooked eggs, in 2014, an investigation of eight cases found that seven cases consumed chicken and six consumed eggs with three cases consuming brand X free-range eggs and, in January 2016, an investigation of six cases found that four consumed eggs, with one case reporting consumption of brand X eggs and another case reporting purchase of eggs of an unknown brand in the isolated SA region where brand X eggs are produced.

Between 1 March 2017 and 3 July 2018, 25 cases met the case definition (Figure 1). The median age of cases was 49 years (age range 1-91 years) with nine cases (36%) aged 71 years or older. Fifteen cases were male and ten were female. Twenty-one cases lived in metropolitan Adelaide and four were non-metropolitan residents. Ten cases (40%) were hospitalised and two other cases occurred in pregnant women.

Twenty-four of the 25 cases (96%) reported eating eggs; 23 cases (92%) consumed eggs at home including five cases (20%) who consumed eggs both at home and away from home and one case (4%) consumed eggs away from home only. Seventeen cases (68%) are known to have consumed brand X free-range eggs, another brand of eggs was named by three cases (12%). Twenty-four cases responded to questions about food items other than eggs and one case declined these questions. Ten cases (42% of 24 respondents) consumed poultry cooked at home and eight cases (33% of 24 respondents) consumed chicken which was purchased cooked; however, there were no chicken items with common brands or from common retail outlets. Eleven other food items were reported by more than 25% of cases but, with the exception of bottled water, no common brands or common retail outlets were identified. Three brands of bottled water were each named by two to four cases (8-17%). Contact with dogs, cats and/or dried pet food was reported by seven to ten cases (29-42%) but further detail did not indicate any of these exposures as a possible common source (Table 1).

Table 1: Food items consumed by cases of S. Hessarek infection, South Australia, 1 March 2017 to 3 July 2018

| Food Item | Number of cases reporting consumption / Number of cases interviewed \* | Proportion of interviewed cases reporting consumption |
| --- | --- | --- |
| Eggs | 24/25 | 96% |
| Eggs eaten at home | 23/25 | 92% |
| Eggs eaten away from home | 6/25 | 24% |
| Foods containing raw egg | 7/25 | 28% |
| Brand X eggs | 17/25 | 68% |
| Poultry - cooked at home | 10/24 | 42% |
| Chicken pieces | 8/24 | 33% |
| Chicken whole | 2/24 | 8% |
| Chicken on a skewer | 1/24 | 4% |
| Chicken mince | 1/24 | 4% |
| Chicken sausages | 1/24 | 4% |
| Chicken-other | 1/24 | 4% |
| Turkey | 1/24 | 4% |
| Duck | 0/24 | 0% |
| Poultry - purchased cooked | 8/24 | 33% |
| Roast/barbecue chicken | 2/24 | 8% |
| Chicken burger | 1/24 | 4% |
| Shredded chicken | 0/24 | 0% |
| Other cooked chicken | 6/24 | 25% |
| Food Items reported by more than 25% of cases |  |  |
| Bread | 18/24 | 75% |
| Potatoes | 11/24 | 46% |
| Bottled water | 11/24 | 46% |
| Beef (non-minced) | 10/24 | 42% |
| Coffee | 9/24 | 38% |
| Bananas | 9/24 | 38% |
| Pasteurised milk | 9/24 | 38% |
| Carrots | 8/24 | 33% |
| Fish | 8/24 | 33% |
| Lettuce | 7/24 | 29% |
| Cucumbers | 7/24 | 29% |
| Environmental Exposures |  |  |
| Dogs | 10/24 | 42% |
| Cats | 7/24 | 29% |
| Dried pet food | 10/24 | 42% |

\* The number of cases interviewed varies as one case declined interview for all food items except eggs.

The eggs consumed were cooked in a variety of ways including fried, boiled, scrambled, poached, as omelette and in Béchamel sauce. Seven cases consumed raw egg: in smoothies (three cases), in raw cake batter (three cases) and one case sucked raw eggs (Table 1).

## Environmental investigation

One out of four samples returned positive for S. Hessarek in the contents of the eggs. Salmonella was not present in any of the whole egg rinses of the four egg samples. Additionally, FCDB identified that S. Hessarek had been isolated from the content of brand X brand eggs but not the whole egg rinse during a retail food survey in 2014.11

# Discussion

The high proportion of cases reporting the consumption of brand X free-range eggs and the isolation of S. Hessarek from sampling four dozen brand X eggs is an unusually strong signal implicating brand X eggs as the source of this protracted S. Hessarek outbreak in South Australia. There is also absence of another possible source based on the hypothesis generating interviews.

Brand X eggs are produced in SA and are predominantly sold in SA. A limitation of the epidemiological investigation is that we did not have information on the proportion of the SA population who usually consume brand X eggs. For reasons stated previously, a case-control study was not conducted and, SA lacks a food frequency consumption database to compare cluster investigation results with the foods that are consumed by healthy people in the community. Egg consumption data, obtained from case interviews in 20 other SA Salmonella clusters during the same time period, 1 March 2017 to 3 July 2018, found that only 5/189 (3%) of interviewed persons and 5/125 (4%) of respondents reporting egg consumption, consumed brand X eggs. This suggests that the proportion of cases reporting consumption of brand X eggs in the S. Hessarek investigation is not simply a reflection of market share for brand X eggs within SA, however, it is possible egg consumption patterns for persons who have not experienced Salmonella infection may differ from those who have and who were interviewed.

The ongoing nature of this outbreak reflects the difficulty in controlling Salmonella infection in free range laying flocks. Brand X eggs are produced on a free-range farm and birds raised in free range production systems are potentially exposed to different environmental stressors than caged birds, including social stress and aggression, predation, or thermal challenges with stress known to be a determinant of shedding of Salmonella .12 Additionally, the control of rodents and other potentially infected animals and environments is challenging on free-range farms. Salmonella contamination of eggs is a complex issue affected by variables at each stage of the food production process. Currently, the literature regarding the benefits of free range, barn and caged production processes with respect to Salmonella contamination is conflicting. However, the current literature does indicate it is not yet achievable to produce eggs guaranteed to be Salmonella free.13

Because Salmonella can be highly persistent in both infected birds and diverse environmental reservoirs, global egg safety programs include interventions at multiple stages of egg production and supply to the public.14 However, the specific interventions, such as requirements for vaccination of laying flocks against specific Salmonella serotypes, requirements for monitoring for Salmonella on egg farms, requirements for egg pasteurisation or other actions when Salmonella is detected in a laying flock, requirements for washing of eggs, and requirements for mandatory refrigeration of eggs vary vastly between countries and vary with respect to which specific Salmonella serotypes the interventions apply to (often, interventions are applicable to Salmonella serotypes S. Enteritidis and S. Typhimurium only).14 To illustrate, egg washing with sanitizers is one of the most common methods of reducing eggshell contamination in Australia, Japan, and the USA but the technique is banned in the European Union;15 the major advantage of egg washing is the removal of faecal debris thereby reducing the overall bacterial load on the eggshell surface. However, the process requires strict control, especially of rinse water temperature and quality, to avoid adverse results including cracking of the shell, damage to the egg cuticle layer and egg penetration by Salmonella bacteria.16

The variation in egg safety programs internationally results from variation in the perceived risk of contaminated eggs between countries; each country’s risk management/tolerance/perception being influenced by local industry, environmental, cultural and epidemiological factors, for example, the types of Salmonella contaminating eggs. Stringent egg safety programs in the USA and Europe have resulted from the prevalence of Salmonella Enteritidis in those countries. S. Enteritidis has the ability to colonize the ovary/oviduct of laying hens for long periods and therefore to internally contaminate eggs, and has been the most frequent serotype associated with egg-related foodborne outbreaks in Europe since the mid-1980s.17 S. Enteritidis is, however, not endemic to Australian commercial layer flocks, a factor which was taken into account during the Food Standards Australia New Zealand (FSANZ) risk assessment of egg production and processing in Australia, a component of the development of the Primary Production and Processing (PPP) Standard for Eggs and Egg Products (Standard 4.2.5), gazetted in May 2011.18

In Australia, egg producers must comply with Standard 4.2.5 and under clause 11(1) an egg producer must not sell or supply eggs or egg pulp for human consumption if it knows, ought to reasonably know or to reasonably suspect, that the eggs are ‘unacceptable’. ‘Unacceptable egg’ is defined as: a cracked egg or; a dirty egg; ‘egg product’ (defined as the contents of an egg in any form) which has not been pasteurised or subjected to heating or other processes that provide a lethal effect on any pathogenic micro-organisms in the egg product; or egg product which contains a pathogenic micro-organism whether or not the egg product has been processed as previously described.19 The definition of ‘unacceptable egg’ and clauses restricting the sale of such product do not automatically restrict the sale of whole eggs which are not known to be contaminated but are from a producer or farm where Salmonella has been isolated within whole eggs or when a farm or producer has been associated with an outbreak of human disease.

An important consideration in the risk assessment on which the Primary Production and Processing (PPP) Standard for Eggs and Egg Products (Standard 4.2.5) of the Australian Food Standards Code is based is the premise that, in Australia, Salmonella contamination in eggs occurs via dirty or cracked eggs. Our finding of S. Hessarek in the content of eggs but not in the egg-shell rinse on two occasions, and our association of S. Hessarek contaminated eggs with cases of human salmonellosis raise questions regarding whether the risk of contamination of eggs with Salmonella in Australia has changed since Standard 4.2.5 was introduced in 2011.

There are two pathways for eggs to become internally contaminated with Salmonella : direct contamination occurs during the formation of an egg in the reproductive track of hens (including ovary and oviduct), whereas indirect contamination occurs after an egg has been laid and Salmonella contaminating the outside of the egg penetrates through the shell membrane.20 From a public health perspective, it is important to understand the behaviour of S. Hessarek including its ability to be present in the content of eggs and further research is recommended. A high proportion of cases in this investigation were elderly or pregnant and/or consumed raw egg which suggests that S. Hessarek might be an opportunistic rather than highly virulent cause of Salmonella infection in humans.

To determine whether cases of S. Hessarek notified prior to March 2017 were associated with the source identified in this investigation, we explored the possibility of conducting whole genome sequencing (WGS) of human and egg S. Hessarek isolates in SA since 2014. However, as S. Hessarek is a rare Salmonella, no S. Hessarek reference genome, required for the WGS analysis, is available globally. Further research incorporating WGS of S. Hessarek would require generation of a complete reference genome for S. Hessarek based on consideration of the public health benefit of WGS in understanding the epidemiology of this rare Salmonella serotype.

The findings in this investigation highlight the need for continuous monitoring of the epidemiology of Salmonella in Australia including the epidemiology of egg-associated Salmonella outbreaks of human disease. Any substantial changes in the epidemiology of egg-associated Salmonella need to be considered in future risk assessments related to Salmonella in eggs and future reviews of the Primary Production and Processing Standard for Eggs and Egg Products (Standard 4.2.5) of the Australian Food Standards Code. Joint efforts from Australian national and state/territory communicable disease control, food safety and primary industry organisations are essential to the control of Salmonella in the Australian egg supply chain.

# Acknowledgements

The authors acknowledge the staff at the following organisations for their assistance with the investigation: the Communicable Disease Control Branch and the Food and Controlled Drugs Branch (SA Department for Health and Wellbeing), the Australian Salmonella Reference Centre and Food and Environmental Laboratory (SA Pathology), OzFoodNet, Primary Industries and Regions SA Biosecurity SA division, and the South Australian Health and Medical Research Institute.

# Authors

* Ms Bernadette Kenny, Master of Applied Epidemiology (MAE) Scholar / Public Health Nurse, Communicable Disease Control Branch, Department for Health and Wellbeing, SA Health, Government of South Australia.
* Dr Megge J Miller, OzFoodNet Senior Epidemiologist, Communicable Disease Control Branch, Department for Health and Wellbeing, SA Health, Government of South Australia.
* Ms Vanessa McEvoy, Senior Policy Officer, Food and Controlled Drugs Branch, Department for Health and Wellbeing, SA Health, Government of South Australia.
* Ms Alessia Centofanti, Manager, Food Standards Surveillance Section, Food and Controlled Drugs Branch, Department for Health and Wellbeing, SA Health, Government of South Australia.
* Ms Cherylyn P Stevens, Policy Officer, Food and Controlled Drugs Branch, Department for Health and Wellbeing, SA Health, Government of South Australia.
* Ms Tambri Housen, Research Fellow, National Centre for Epidemiology and Population Health, Research School of Population Health, Australian National University.

## Corresponding Author

Bernadette Kenny

Communicable Disease Control Branch

South Australian Department for Health and Wellbeing

PO Box 6, Rundle Mall, Adelaide, SA 5000

Mobile: +61476841951

Email: Bernadette.Kenny@sa.gov.au

# References

1. Australian Government Department of Health. National Notifiable Disease Surveillance System; Salmonella Public Dataset [Internet]. Canberra. 2018 [Revised 4 July 2018, Cited 4 July 2018]. Available at: http://www9.health.gov.au/cda/source/pub\_salmo.cfm
2. Australian Bureau of Statistics. 3101.0 - Australian Demographic Statistics, Dec 2013 [Internet] Canberra. 2014 [Revised 24 September 2014, Cited 8 August 2018]. Available at: http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/FA627CA7C5708380CA257D5D0015EB95?opendocument
3. OzFoodNet Working Group. OzFoodNet: Enhancing foodborne disease surveillance across Australia: quarterly report, January to March 2005. Commun Dis Intell Q Rep. 2003;27(4):504-7
4. Neel R, Le Minor L, Kawah M. Une nouvelle espe`ce de salmonella isole´e chez un corbeau ( Corvus corax ): Salmonella Hessarek. Ann Inst Pasteur (Paris). 1953;85(2):271-4.
5. Velarde R, Porrero MC, Serrano E, Marco I, García M, Téllez S et al. Septicemic salmonellosis caused by Salmonella Hessarek in wintering and migrating Song Thrushes ( Turdus philomelos ) in Spain. J Wildl Dis. 2012;48(1):113-21
6. Singer N, Weissman Y, Yom-Tov Y,Marder U. Isolation of Salmonella Hessarek from starlings ( Sturnus vulgaris ). *Avian Dis*. 1977;21(1):117-9.
7. Magistrali CM, Latini E, Manuali C, Neri C, Panzieri V, Bazzucchi A et al. Cases of salmonellosis from S. Hessarek in European Starling ( Sturnus vulgaris ) in the center of Italy. Sanitá Pubblica Veterinaria. 2008; 49, http://indice.spvet.it/arretrati/numero-49/005.html. Accessed September 2011. [In Italian]
8. OIE (World Organization for animal health). Report of the meeting of the OIE working group on wildlife diseases: 73rd Annual General Session of the International Committee. [Internet] Paris. 2005. [Cited 1 Jul 2018]. Available at http://www.oie.int/doc/ged/D3888.PDF.
9. Handeland K, Nesse LL, Lillehaug A, Vikøren T, Djønne B, Bergsjø B. Natural and experimental Salmonella Typhimurium infections in foxes ( Vulpes vulpes ). *Vet Microbiol*. 2008;132:129-34
10. Gomez-Laguna J, Hernandez M, Creus E, Echeita A, Otal J, Herrera-Leon S et al. Prevalence and antimicrobial susceptibility of Salmonella infections in free range pigs. Vet J. 2011;190(1):176-8.
11. South Australian Department of Health and Ageing. SA Health Food Act Report: year ending 30 June 2014. [Internet] Adelaide. Government of South Australia. 2014 [cited 2 Jun 2018]. Available from http://www.sahealth.sa.gov.au/wps/wcm/connect/1bd053004659eb248ff1bf795015c38d/14155%2BFood%2BAct%2BReport%2B2013-14\_WEB.PDF?MOD=AJPERES&CACHE=NONE&CONTENTCACHE=NONE
12. Chousalkar KK, McWhorter A. Egg Production Systems and Salmonella in Australia. In: Ricke SC, Gast RK, eds. Producing safe eggs: microbial ecology of Salmonella. London, United Kingdom, San Diego, CA, United States, Academic Press. Elsevier Science & Technology. 2016;71-85 [cited 2 Jun 2018]. Available at https://ebookcentral-proquest-com.virtual.anu.edu.au/lib/anu/detail.action?docID=4690602
13. Whiley H, Ross K. Salmonella and eggs: from production to plate. *Int J Environ Res Public Health*. 2015;12(3):2543-56.
14. Gast RK. Microbiology of shell egg production in the United States. In:Ricke SC, Gast RK, eds. Producing safe eggs: microbial ecology of Salmonella. London, United Kingdom, San Diego, CA, United States, Academic Press. Elsevier Science & Technology. 2016;25-44.
15. Messens W. Egg Decontamination by Washing. In: Van Immerseel F, Nys Y, Bain M, eds. Improving the Safety and Quality of Eggs and Egg Products. Cambridge. Woodhead Publishing Limited. 2013;163–177.
16. Galiş AM, Marcq C, Marlier D, Portetelle D, Van I, Beckers Y et al. Control of Salmonella contamination of shell eggs—preharvest and postharvest methods: a review. *Compr Rev Food Sci Food Saf*. 2013;12:155-82.
17. Thorns CJ. Bacterial food-borne zoonoses. *Rev Sci Tech*. 2000;19(1)226-39.
18. Food Standards Australia New Zealand. Primary Production and Processing Standard for Eggs and Egg Products: Final assessment Report. (Proposal P301). 7 Apr 2011. Available from http://www.foodstandards.gov.au/code/proposals/documents/P301%20Eggs%20\_%20Egg%20Products%20PPPS%20FAR%20FINAL%20AMENDED%2024061.pdf
19. Food Standards Australia New Zealand. Primary Production and Processing (PPP) Standard for Eggs and Egg Products (Standard 4.2.5) of the Australian Food Standards Code. 20 May 2011. Available at https://www.legislation.gov.au/Details/F2011L00860
20. Howard ZR, O’Bryan CA, Crandall PG, Ricke SC. Salmonella Enteritidis in shell eggs: Current issues and prospects for control. *Food Res Int*. 2012;45(2):755-64.

**Communicable Diseases Intelligence**

ISSN: 2209-6051 Online

**Communicable Diseases Intelligence (CDI) is a peer-reviewed scientific journal published by the Office of Health Protection, Department of Health. The journal aims to disseminate information on the epidemiology, surveillance, prevention and control of communicable diseases of relevance to Australia.**

**Editor:** Cindy Toms

**Deputy Editor:** Simon Petrie

**Design and Production:** Kasra Yousefi

**Editorial Advisory Board:** David Durrheim, Mark Ferson, John Kaldor, Martyn Kirk and Linda Selvey

**Website**: <http://www.health.gov.au/cdi>

**Contacts**Communicable Diseases Intelligence is produced by:   
Health Protection Policy Branch, Office of Health Protection, Australian Government Department of Health  
GPO Box 9848, (MDP 6) CANBERRA ACT 2601

**Email:** [cdi.editor@health.gov.au](mailto:cdi.editor@health.gov.au)

**Submit an Article**You are invited to submit your next communicable disease related article to the Communicable Diseases Intelligence (CDI) for consideration. More information regarding CDI can be found at: <http://health.gov.au/cdi>.

Further enquiries should be directed to: [cdi.editor@health.gov.au](mailto:cdi.editor@health.gov.au).

This journal is indexed by Index Medicus and Medline.

Creative Commons Licence - Attribution-NonCommercial-NoDerivatives CC BY-NC-ND

© 2019 Commonwealth of Australia as represented by the Department of Health

This publication is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International Licence from <https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode> (Licence). You must read and understand the Licence before using any material from this publication.

**Restrictions**The Licence does not cover, and there is no permission given for, use of any of the following material found in this publication (if any):

* the Commonwealth Coat of Arms (by way of information, the terms under which the Coat of Arms may be used can be found at [www.itsanhonour.gov.au](http://www.itsanhonour.gov.au/));
* any logos (including the Department of Health’s logo) and trademarks;
* any photographs and images;
* any signatures; and
* any material belonging to third parties.

**Disclaimer**Opinions expressed in Communicable Diseases Intelligence are those of the authors and not necessarily those of the Australian Government Department of Health or the Communicable Diseases Network Australia. Data may be subject to revision.

**Enquiries**Enquiries regarding any other use of this publication should be addressed to the Communication Branch, Department of Health, GPO Box 9848, Canberra ACT 2601, or via e-mail to: [copyright@health.gov.au](mailto:copyright@health.gov.au)

**Communicable Diseases Network Australia**Communicable Diseases Intelligence contributes to the work of the Communicable Diseases Network Australia.  
<http://www.health.gov.au/cdna>