

Salmonella Typhimurium DT160 in house sparrows in Australia

Fact sheet

Introductory statement

Salmonella enterica subsp. *enterica* serotype Typhimurium definitive type (DT) 160 (*S. Typhimurium* DT160) is an enteric bacterial infection that can cause clinical disease and death in infected birds, humans and other animals. Mass mortalities have been seen in house sparrows (*Passer domesticus*) and other wild birds. Within Australia, *S. Typhimurium* DT160 was first detected in house sparrows in Tasmania in 2009, and in 2016 from sparrows and spotted turtle doves (*Streptopelia chinensis*) in Victoria. Infected birds may be a source of infection for humans, domestic animals and native species. *S. Typhimurium* DT160 has significant zoonotic potential, with a small number of human cases diagnosed in Australia to date.

Aetiology

Salmonella spp. are Gram negative facultative anaerobic bacteria, which primarily infect the gastrointestinal tract of the host. There are many strains of *Salmonella*, which are commonly found in a wide range of vertebrate hosts globally. *Salmonella* strains may vary in their ability to cause disease in the host, and in the range of host species which are affected.

Natural hosts

S. Typhimurium DT160 and is known to cause clinical disease in humans and wide range of mammals and birds (Alley et al. 2002).

Birds: fatal infections in house sparrows and other passerines including greenfinches (*Carduelis chloris*), goldfinches (*C. carduelis*), blackbirds (*Turdus merula*), sulphur-crested cockatoo (*Cacatua galerita*), kaka (*Nestor meridionalis*), and Moluccan cockatoo (*Cacatua moluccensis*); disease in ducks and quail (Tizard et al. 1979, Ministry for Primary Industries 2000, 2003, Callaghan and Simmons 2001, Alley et al. 2002, Lawson et al. 2010, Piccirillo et al. 2010).

Livestock: isolated from sheep, cattle, horses, pigs, deer and alpaca in New Zealand (NZ), although associated disease was not confirmed (Alley et al. 2002, Ministry for Primary Industries 2003).

Pets and other animals: isolated from dogs, cats and rabbits in NZ (Ministry for Primary Industries 2000, 2003, Alley et al. 2002); from monkeys, otters and shellfish in other countries (Ministry for Primary Industries 2003).

Humans: considered susceptible to infection and clinical disease; transmission from infected sparrows to humans has been suggested (Penfold et al. 1979, Villar et al. 1999, Alley et al. 2002, Ministry for Primary Industries 2003, Connolly et al. 2006).

World distribution

Salmonella Typhimurium DT160 has been associated with outbreaks of mortality in wild birds in many countries overseas including Canada, the United Kingdom, the United States, NZ, Italy and Australia (Penfold et al. 1979, Tizard et al. 1979, Villar et al. 1999, Alley et al. 2002, Thornley et al. 2003, Lawson et al. 2010, Piccirillo et al. 2010). Globally, it is an uncommon cause of sporadic mortality in wild birds during winter (Alley et al. 2002, Connolly et al. 2006).

In NZ, *S. Typhimurium* DT160 has caused mass mortalities of house sparrows and is now a major cause of human salmonellosis (Alley et al. 2002; Ministry for Primary Industries 2003; The Institute of Environmental Science and Research 2004, 2008, 2013; Price-Carter et al. 2011). From June 2000, mortalities were reported across NZ in house sparrows and other birds including blackbirds, silvereyes and ducks (Callaghan and Simmons 2001). Investigation of the dead sparrows during the outbreak suggested septicaemia caused by *S. Typhimurium* DT160, but infection was not confirmed in the silvereyes or the ducks (Alley et al. 2002).

Occurrences in Australia

The first locally acquired case of *S. Typhimurium* DT160 was reported from a child in Hobart in August 2008. In winter and spring 2009, mass mortalities were observed in house sparrows in the greater Hobart area (Animal Health Australia 2009). *S. Typhimurium* DT160 was cultured from dead house sparrows (21 isolates) and a silvereye (*Zosterops lateralis* race *lateralis*), from a domestic cat, a wombat in the wild and a captive sulphur-crested cockatoo (Animal Health Australia 2009, 2010; NEPSS 2009). There were 15 human cases in 2009, all from Hobart. Since then there have been ongoing human cases of infection with *S. Typhimurium* PT160 in Tasmania. Cases were initially restricted to the south of the state; since 2011 there have been cases reported from the north. In 2013 there was a mass mortality of sparrows in the Launceston area associated with the bacterium. There have been subsequent reports of infection in cockatoos, a chicken, a sheep and another domestic cat. One of the cockatoos and the cat were from the north of Tas.

Human cases have also been reported in 2010 from Orange in central west NSW.

In spring 2016, *S. Typhimurium* DT160 was diagnosed for the first time in wild birds in Victoria (this was the first report in wild birds from mainland Australia). Infection was associated with mass mortality of house sparrows, and deaths of spotted turtle doves in Melbourne (Grillo et al. 2017).

Epidemiology

Infection is via the faecal-oral route. Infected birds (and other vertebrate hosts) shed the bacteria in faeces, allowing for environmental contamination and potential infection of additional hosts. Infection and disease in

house sparrows is dependent on infective dose of bacterium. Birds can shed the bacteria asymptotically at least for 10 days, which is likely to contribute to the spread of infection to humans and other hosts (Connolly et al. 2006). Asymptomatic carriage by birds is considered likely.

Outbreaks of *S. Typhimurium* PT160 associated with mass mortalities in wild birds in the Northern Hemisphere have been associated with high densities of birds at both natural and man-made feeding sources. Gregarious birds such as sparrows, finches, pigeons, ducks and gulls have often been identified as carriers of the organism (Alley et al. 2002). Garden bird feeders have been associated with *Salmonella* outbreaks in birds and humans; feeders may become contaminated with bird faeces resulting in bacterial contamination levels in food. House sparrows generally live in close proximity to people and commonly visit bird feeders. Stressors such as bad weather and food shortages may contribute to shedding and spread of *Salmonella* in birds (Tizard 2004). Native bird species may be at risk if exposed to sparrows infected with *S. Typhimurium* DT160 or their droppings through predation or artificial feeding.

The organism has migrated from the Northern hemisphere, and has become established in NZ, Tasmania, and has now been reported on mainland Australia. The method of introduction of *S. Typhimurium* DT160 into NZ and Australia is unknown, however introduction by a human or animal carrier is suspected (Alley et al. 2002). Studies from NZ suggest that once *S. Typhimurium* DT160 was introduced to the country, it was transmitted between multiple hosts, including humans and house sparrows, and that one strain is responsible for all infections seen (Bloomfield et al. 2017). In Australia, ongoing spread is likely as house sparrows and blackbirds are common across much of the country. Some silvereyes may be migratory, including race *lateralis* which migrates between Tasmania and the southern and eastern Australian mainland states each year (Simpson and Day 2004).

Clinical signs

Affected house sparrows may show a dazed appearance with reluctance to move, then collapse and die rapidly. Most house sparrows with systemic disease are found dead (Alley et al. 2002, Connelly et al. 2006). Sparrows may be infected without showing clinical signs.

Diagnosis

The bacteria may be cultured from multiple tissues, including spleen, liver, intestine and crop from freshly dead birds, and can also be cultured from faeces of infected animals.

Pathology

Affected sparrows are generally in good body condition. Significant gross lesions are found in liver and spleen. Livers are often pale and swollen and spleens are enlarged and reddened. Affected birds may have cream-coloured plaques on the mucosa of the crop. Histologically, there are signs of septicaemia; liver and spleen show multifocal necrosis with infiltration by lymphocytes, plasma cells and occasional heterophils. Coagulative necrosis of the brain stem is common. Lesions in the crop are characterized as caseous granulomas often with mucosal ulceration. Colonies of bacteria may be seen in all of these lesions (Alley et al. 2002).

Differential diagnoses

Differential diagnoses include other diseases that can rapidly kill birds, such as avian influenza, avian paramyxovirus, other systemic bacterial infections, and toxins such as organophosphates (Balcomb et al. 1984).

Laboratory diagnostic specimens

Macerated intestinal contents or swabs, and fresh liver are collected for bacterial culture. The samples should be chilled and transported to the laboratory within eight hours of collection without exposure to soap or disinfectant. If delivery to the laboratory within eight hours is impossible, the samples should be refrigerated at 4°C or, for long term storage, at less than -70°C or on dry ice. Consult the relevant laboratory prior to sample collection.

Laboratory procedures

The organism is readily isolated by traditional methods used to isolate other *Salmonella* (Grimont and Weil 2007). Until recently, phage typing was standardly used to determine the definitive type (DT), which was conducted at reference laboratories by means of a bacteriophage-typing system (Anderson et al. 1977). Although phage typing is still conducted in some laboratories, phage typing reagents are no longer manufactured, and *S. Typhimurium* Multilocus Variable Tandem Repeat Analysis (MLVA) profiles are now used to detect these strains. MLVA is a molecular typing method that is used to differentiate *S. Typhimurium* isolates, and is the predominant typing system used in the surveillance of *S. Typhimurium* now that phage typing of human isolates in Australia has largely ceased. The most common MLVA type of *S. Typhimurium* DT160 is 03-09-05-13-370 (NEPSS 2018).

Genetic characterization: Pulsed-field Gel Electrophoresis (PFGE) has been used to study the relatedness of isolates from different individuals and different species (Tenover et al. 1995, Torpdahl et al. 2005). Increasingly, newer molecular methods such as Whole Genome Sequencing (WGS) are used to analyse the relatedness of isolates as these technologies become more affordable and accessible (Quainoo et al. 2017).

Treatment

Salmonella Typhimurium DT160 is sensitive to a wide range of antibiotics (Thornley et al. 2003). Treatment of house sparrows is neither indicated nor applicable. Treatment may be indicated in native birds, in humans and domestic animals. Refer to your local animal or human healthcare professional.

Prevention and control

To prevent the spread of salmonellosis in house sparrows, bacterial load on bird feeders should be reduced by regular cleaning, disinfection and drying. Human or domestic animal contact with sparrow droppings and live or dead birds should be avoided. Hands should be washed after contact with live or dead birds and bird feeders, and after contact with pet cats, their food and bowls if they have killed or played with a bird. To avoid faecal contamination from birds, rainwater tanks should be covered, if water is to be used for drinking.

Salmonella spp. are susceptible to a wide range of disinfectants including 1% sodium hypochlorite, 70% ethanol, 2% glutaraldehyde, iodine-based disinfectants, phenolics and formaldehyde and can be killed by moist heat (121°C for a minimum of 15 min) or dry heat (160-170°C for at least 1 hour).

Surveillance and management

Since 1978, the National Enteric Pathogens Surveillance Scheme (NEPSS) has collected data on human and non-human isolations of enteric bacterial pathogens in Australia, including information on *Salmonella* serotypes identified in Australian animals and wildlife. Reports of isolates are voluntarily submitted by the five reference laboratories capable of serotyping *Salmonella* within Australia. Isolates are submitted to these laboratories by primary diagnostic laboratories throughout the country.

Wildlife disease surveillance in Australia is coordinated by the Wildlife Health Australia. The National Wildlife Health Information System (eWHIS) captures information from a variety of sources including Australian government agencies, zoo and wildlife parks, wildlife carers, universities and members of the public. Coordinators in each of Australia's States and Territories report monthly on significant wildlife cases identified in their jurisdictions. NOTE: access to information contained within the National Wildlife Health Information System dataset is by application. Please contact admin@wildlifehealthaustralia.com.au. Mass wild bird mortality events are reported as part of Australia's general wildlife health surveillance system.

The 2009 *S. Typhimurium* DT160 event in Tasmania was identified as a result of work by local private practitioners with an interest in wildlife health. They collated data and researched the occurrence of *S. Typhimurium* DT160 outbreaks internationally, which led to recognition and reporting of the outbreak to the then Australian Wildlife Health Network (now Wildlife Health Australia) and Tasmanian government. This is a good example of the importance of veterinary practitioners as part of national surveillance arrangements for wildlife in Australia.

Salmonella Typhimurium DT160 is now considered enzootic in Tasmania with screening for this organism considered on a case by case basis. Salmonellosis is included in the list of differential diagnoses in mass bird mortality events in Australia.

Research

Although *S. Typhimurium* DT160 does not appear to have spread widely into other avian species in Australia, ongoing monitoring of bird deaths, especially in areas where the organism has been detected, is indicated. Passerine deaths, particularly blackbirds and house sparrows, should be investigated, as they may be indicative of the spread of *S. Typhimurium* DT160 or the emergence of other pathogenic *Salmonella* serovars/phage types. *Salmonella* isolates from birds should be serotyped and phage-typed or MLVA typed when possible and the results reported to the National Wildlife Health Information System and the NEPSS. Research to determine the genetic relationship between *S. Typhimurium* DT160 found in wild birds and humans in Australia would assist in understanding epidemiology and risk to people presented by wild birds.

Human health implications

Salmonella Typhimurium DT160 is a significant zoonotic concern. Infected humans may exhibit typical signs of salmonellosis: diarrhoea, vomiting and fever. The risk of *Salmonella* exposure to humans is increased through direct contact with sparrows or their faeces, transmission via carnivorous pets such as cats having contact with sparrows, or transmission via the contaminated environment (Tizard 2004). *Salmonella* Typhimurium DT160 can be transmitted to humans and cases of human salmonellosis concurrent with mass mortalities of sparrows have been reported in Australia.

Conclusions

Salmonella Typhimurium DT160 in house sparrows, and to a lesser extent other birds, may cause asymptomatic infection or acute septicaemia resulting in death. Outbreaks and associated mass mortalities have occurred in house sparrows in Tasmania and Victoria. *Salmonella* Typhimurium DT160 can be transmitted to humans and cases of human salmonellosis concurrent with mass mortalities of sparrows have been reported in Australia. Due to its zoonotic risks, *S. Typhimurium* DT160 should be considered as a cause of mass mortality events in house sparrows and other passerine birds. Ongoing surveillance is recommended.

References and other information

- Alley MR, Connolly JH, Fenwick SG, Mackereth GF, Leyland MJ, Rogers LE, Haycock M, Nicol C, Reed CEM (2002) An epidemic of salmonellosis caused by *Salmonella* Typhimurium DT160 in wild birds and humans in New Zealand. *New Zealand Veterinary Journal* **50**, 170-176.
- Anderson ES, Ward LR, de Saxe MJ, de Sa JDH (1977) Bacteriophage-typing designations of *Salmonella typhimurium*. *Journal of Hygiene* **78**, 297-300.
- Animal Health Australia (2009) Animal Health Surveillance Quarterly Report 14, 3. Available at <http://www.animalhealthaustralia.com.au> [accessed June 2013].
- Animal Health Australia (2010) Animal Health Surveillance Quarterly Report 14, 4. Available at <http://www.animalhealthaustralia.com.au> [accessed June 2013].
- Animal Health Australia (2013) Animal Health in Australia
- Animal Health Australia (2013) Animal Health Surveillance Quarterly Report 18, 3. Available at <http://www.animalhealthaustralia.com.au>.
- Balcomb R, Stevens R, Brown C (1984) Toxicity of 16 granular insecticides to wild-caught songbirds. *Bulletin of Environmental Contamination and Toxicology* **33**, 302-307.
- Bloomfield S, Benschop J, Biggs P, Marshall J, Hayman D, Carter P, Midwinter A, Mather A, French N (2017) Genomic Analysis of *Salmonella enterica* Serovar Typhimurium DT160 Associated with a 14-Year Outbreak, New Zealand, 1998–2012. *Emerging Infectious Diseases* **23**, 906.
- Callaghan MS, Simmons G (2001) Outbreak of *Salmonella* Typhimurium Phage type 160 in Auckland linked to an umu function. *New Zealand Public Health Report* **8**, 44–45.
- Connolly JH, Alley MR, Dutton GJ, Rogers LE (2006) Infectivity and persistence of an outbreak strain of *Salmonella enterica* serotype Typhimurium DT160 for house sparrows (*Passer domesticus*) in New Zealand. *New Zealand Veterinary Journal* **54**, 329-332.
- Daoust P, Prescott JF (2007) *Salmonellosis* in: Infectious diseases of wild birds (NJ Thomas, DB Hunter & CT Atkinson eds.), Blackwell Publishing, Oxford, UK, pp. 270-288.
- Environmental Science and Research <https://surv.esr.cri.nz/ehi/ehi.php> [Accessed 11 November 2013].
- Grillo T, Cox-Witton K, Gilchrist S, Ban S, East I (2017) *Salmonella* isolated in two mass mortalities of house sparrows in Animal Health Surveillance Quarterly Report 21, 3. Available at <http://www.animalhealthaustralia.com.au> [Accessed 16 May 2017].
- Grimont PAD, Weill FX (2007) Antigenic formulae of the *Salmonella* serovars, 9th edition. World Health Organisation Collaborating Centre for Research on *Salmonella*, Pasteur Institute, Paris.
- Lawson B, Howard T, Kirkwood JK, Macgregor SK, Perkins M, Robinson RA, Ward LR, Cunningham AA (2010) Epidemiology of salmonellosis in garden birds in England and Wales, 1993 to 2003. *EcoHealth* **7**, 294-306.

Ministry for Primary Industries (2000) 79 sparrow death sightings received. available at <http://www.mpi.govt.nz/news-resources/news/79-sparrow-death-sightings-received.aspx> [Accessed June 2013].

Ministry for Primary Industries (2003) Research Results 2001/02 Research Final Report Summaries. Available at <http://maxa.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results/2001-2002/research-results-01-02.pdf> [Accessed June 2013].

Penfold JB, Amery HCC, Peet PJM (1979) Gastroenteritis associated with wild birds in a hospital kitchen. *British Medical Journal* **2**, 802.

Piccirillo A, Mazzariol S, Caliarì D, Menandro ML (2010) *Salmonella* Typhimurium phage type DT160 infection in two Moluccan cockatoos (*Cacatua moluccensis*): Clinical presentation and pathology. *Avian Diseases* **54**, 131-135.

Price-Carter M, Roy-Chowdhury P, Pope CE, Paine S, De Lisle GW, Collins DM, Nicol C, Carter PE (2011) The evolution and distribution of phage ST160 within *Salmonella enterica* serotype Typhimurium. *Epidemiology and Infection* **139**, 1262–1271.

Quainoo S, Coolen JPM, van Hijum SAFT, Huynen MA, Melchers WJG, van Schaik W, Wertheim HFL (2017) Whole-Genome Sequencing of Bacterial Pathogens: the Future of Nosocomial Outbreak Analysis. *Clinical Microbiology Reviews* **30**, 1015-1063.

Rabsch W (2007) *Salmonella* Typhimurium phage typing for pathogens. *Methods in Molecular Biology* **394**, 177–211.

Simpson K and N Day (2004) Field guide to the birds of Australia. 7th Edition. Penguin Group (Australia), Camberwell, Victoria. p. 278.

Tenover FC, Arbeit RD, Goering RV, Mickelsen PA, Murray BE, Persing DH, Swaminathan B (1995) Interpreting chromosomal DNA restriction patterns produced by Pulse-Field Gel Electrophoresis: Criteria for bacterial strain typing. *Journal of Clinical Microbiology* **33**, 2233-2239.

The Institute of Environmental Science and Research (2004) Notifiable and other diseases in New Zealand Annual Report 2003. Available at http://www.surv.esr.cri.nz/PDF_surveillance/AnnualRpt/AnnualSurv/2003AnnualSurvRpt.pdf [Accessed June 2013].

The Institute of Environmental Science and Research (2008) Notifiable and other diseases in New Zealand Annual Report 2007. Available at http://www.surv.esr.cri.nz/PDF_surveillance/AnnualRpt/AnnualSurv/2007AnnualSurvRpt.pdf [accessed June 2013].

The Institute of Environmental Science and Research (2013) Notifiable and other diseases in New Zealand Annual Report 2012. Available at http://www.surv.esr.cri.nz/PDF_surveillance/AnnualRpt/AnnualSurv/2012/2012AnnualSurvRpt.pdf [Accessed June 2013].

Thornley CN, Simmons GC, Callaghan ML, Nicol CM, Baker MG, Gilmore KS, Garrett NKG (2003) First incursion of *Salmonella enterica* serotype Typhimurium DT160 into New Zealand. *Emerging Infectious Diseases* **9**, 493-495.

Tizard I (2004) Salmonellosis in wild birds. *Seminars in Avian and Exotic Pet Medicine* **13**, 50–66.

Tizard IR, Fish NA, Harmenson J (1979) Free flying sparrows as carriers of salmonellosis. *Canadian Veterinary Journal* **20**, 143-144.

Torpdahl M, Skov MN, Sandvang D, Baggesen DL (2005) Genotypic characterization of *Salmonella* by multilocus sequence typing, pulsed-field gel electrophoresis and amplified fragment length polymorphism. *Journal of Microbiological Methods* **63**, 173-184.

Villar RG, Macek MD, Simons S, Hayes PS, Goldoft MJ, Lewis JH, Rowan LL, Hursh D, Patnode M, Mead PS (1999) Investigation of multidrug-resistant *Salmonella* serotype Typhimurium DT104 infections linked to raw-milk cheese in Washington state. *JAMA* **281**, 1811-1816.

Ward LR, de Sa JDH, Rowe B (1987) A phage-typing scheme for *Salmonella enteritidis*. *Epidemiology and Infection* **99**, 291-294.

WHO Global Foodborne Infections Network (2010) "A WHO network building capacity to detect, control and prevent foodborne and other enteric infections from farm to table" Laboratory protocol: "Isolation of *Salmonella* and *Shigella* from faecal specimens" Available at <http://www.antimicrobialresistance.dk/data/images/protocols/gfn%20stool%20culture-nov2010.pdf> [Accessed June 2013].

WHO Global Foodborne Infections Network (2010) "A WHO network building capacity to detect, control and prevent foodborne and other enteric infections from farm to table" Laboratory protocol "Isolation of *Salmonella* spp. from food and animal faeces" Available at http://www.antimicrobialresistance.dk/data/images/protocols/isolation_of_salm_220610.pdf [accessed June 2013].

WHO Global Foodborne Infections Network (2010) "A WHO network building capacity to detect, control and prevent foodborne and other enteric infections from farm to table" Laboratory protocol "Biochemical identification of *Salmonella* and *Shigella* using an abbreviated panel of tests" available at http://www.antimicrobialresistance.dk/data/images/protocols/gfn_biochem_final.pdf [accessed June 2013].

World Organization of Animal Health (2012) Salmonellosis. In "Manual of diagnostic tests and vaccines for terrestrial animals 2012". Available at http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.09.09_SALMONELLOSIS.pdf [accessed June 2013].

Acknowledgements

We are extremely grateful to the many people who had input into this fact sheet and to those individuals, agencies and organisations that provided comment and external review. Without their ongoing support production of these fact sheets would not be possible.

Updated: August 2018

To provide feedback on this fact sheet

We are interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

Wildlife Health Australia would be very grateful for any feedback on this fact sheet. Please provide detailed comments or suggestions to admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and would like to produce a fact sheet (or sheets) for the network (or update current sheets). A small amount of funding is available to facilitate this.

Disclaimer

This fact sheet is managed by Wildlife Health Australia for information purposes only. Information contained in it is drawn from a variety of sources external to Wildlife Health Australia. Although reasonable care was taken in its preparation, Wildlife Health Australia does not guarantee or warrant the accuracy, reliability,

completeness, or currency of the information or its usefulness in achieving any purpose. It should not be relied on in place of professional veterinary or medical consultation. To the fullest extent permitted by law, Wildlife Health Australia will not be liable for any loss, damage, cost or expense incurred in or arising by reason of any person relying on information in this fact sheet. Persons should accordingly make and rely on their own assessments and enquiries to verify the accuracy of the information provided.



Find out more at www.wildlifehealthaustralia.com.au
email admin@wildlifehealthaustralia.com.au
or call +61 2 9960 6333