FOOD STANDARDS Australia New Zealand
Te Mana Kounga Kai – Ahitereiria me Aotearoa

Supporting document 1

Risk assessment – Proposal P1018

Companion Dogs in Outdoor Dining Areas

Background

Clause 24 of Standard 3.2.2 of *Australia New Zealand Food Standards Code* (the Code), shown in the box below, specifies food safety requirements in relation to the control and management of live animals and pests in areas in which food is handled[1]. It is the food business's responsibility to manage live animals and pests in the food preparation and service area to ensure food and drink handled in the premises are safe for consumers. This includes not permitting live animals in areas in which food is handled.

24. Animals and pests

(1) A food business must –
- (a) subject to paragraph (b), not permit live animals in areas in which food is handled, other than seafood or other fish or shellfish;
- (b) permit an assistance animal only in dining and drinking areas and other areas used by customers;
- (c) take all practicable measures to prevent pests entering the food premises; and
- (d) take all practicable measures to eradicate and prevent the harbourage of pests on the food premises and those parts of vehicles that are used to transport food.

(2) In subclause (1), 'assistance animal' means an animal referred to in section 9 of the *Disability Discrimination Act 1992* of the Commonwealth.

Editorial note:
Section 9 of the *Disability Discrimination Act 1992* refers to a guide dog, a dog trained to assist a person in activities where hearing is required and any other animal trained to assist a person to alleviate the effect of a disability.

Different approaches have been taken to manage the implementation of the presence of companion dogs in outdoor dining areas which form part of the food business premises. The presence of companion dogs in the outdoor dining areas of the premises operated by a food business, in addition to guide dogs, is permitted in New South Wales, South Australia, and Victoria, subject to the permission of the food businesses operating the outdoor dining areas. In Western Australia, local government authorities will actively enforced the compliance by a food business with the above standard only when there is evidence of a present risk of unsafe or unsuitable food being sold by a particular food business.

This risk assessment is prepared to describe food safety implications arising from the presence of companion dogs in outdoor dining areas attached to a food business.

[1] In Standard 1.1.1 of the Code, **handling** of food includes the making, manufacturing, producing, collecting, extracting, processing, storing, transporting, delivering, preparing, treating, preserving, packing, cooking, thawing, serving or displaying of food. Clause 24 of Standard 3.2.2 therefore prohibits pet animals from being present in outdoor dining areas where food for sale is being served to customers. This prohibition does not apply if the food consumed has already been purchased.

Scope of the assessment

The following risk assessment presents an outline of the common zoonotic pathogens[2] potentially associated with companion dogs in Australia; their common modes of transmission; the likelihood that these pathogens are transmitted to humans through a foodborne route; and the food safety risk posed to consumers in outdoor dining areas if companion dogs were permitted to be present.

Human pathogens potentially carried by companion dogs and routes of transmission

1. Pathogens carried by dogs

Zoonotic pathogens potentially carried by dogs include bacteria, fungi, parasites, protozoa and viruses. Pathogens shown to be transmittable to humans from domestic dogs in Australia are summarised in Table 1.

Table 1: Zoonotic pathogens potentially carried by dogs

Pathogens	Microbiological and epidemiological characteristics	Comments and likely mode of transmission
Bacteria		
Campylobacter spp.	*Campylobacter* species are commonly found in the intestines of food animals, birds, dogs and cats.	Known to be foodborne; young animals are more likely to excrete the pathogen.
Shiga toxin-producing *Escherichia coli* (STEC)	STEC bacteria have been isolated from animals such as cattle, pigs, sheep, dogs, cats, horses, and birds including seagulls and geese.	Known to be foodborne; children and immune-compromised individuals are at higher risk of STEC caused illnesses.
Leptospira interrogans	*Leptospira* species, notably *L. interrogans* are pathogenic, causing leptospirosis in humans and animals.	Leptospirosis is a rare disease of dogs in Australia; can be foodborne but mostly an occupational disease associated with cattle or through exposure to contaminated (by animal urine) waterways.
Salmonella spp.	*Salmonella* spp. are found in a wide range of animals including ruminants, poultry and dogs, and in various environmental sources, such as water, soil and animal faeces.	Known to be foodborne; children and immune-compromised individuals are at higher risk of *salmonella* cause illnesses.
Yersinia enterocolitica and *Y. pseudotuberculosis*	*Y. enterocolitica* and *Y. pseudotuberculosis* infects humans and a wide range of animals including dogs. *Y. enterocolitica* is usually transmitted to humans through ingestion of insufficiently cooked pork or contaminated water.	Known to be foodborne; transmission to humans is achieved through ingestion of contaminated food.
Protozoa		
Cryptosporidium spp.	Humans and animals such as horses, pigs, sheep, goats, cattle, dogs and cats can be infected by *Cryptosporidium* spp.	Can be foodborne but person to person transmission is more common; children and immune-compromised individuals are at higher risk of disease.
Giardia spp.	*Giardia* spp. can infect humans and many animals. *Giardia* is transmitted from host to host by ingesting cysts through contaminated feed or water.	Can be foodborne but person to person and contact with waterways are more common forms of transmission.
Parasites		
Dipylidium (dog tapeworm)	*Dipylidium* and *Echinococcus* are tapeworms of cats and dogs. People become infected	Hydatids are rare in domestic dogs in Australia and infection of dogs requires

[2] Zoonotic pathogens refer to pathogens that can be transmitted (sometimes via a vector) to humans through non-human animals, both domestic and wild.

Echinococcus (hydatids)	when they accidentally swallow tapeworm (Dipylidium) larvae excreted by flea or eggs in (*Echinochochus*) infected faeces. Infection with *Echinococcus* results in hydatid disease.	an intermediate (sheep) host. Not known to be foodborne.
Ancylostoma caninum (dog hookworm)	*Ancylostoma caninum* is a parasite nematode. It lives in the small intestine of its host, such as dogs. *A. canium* can infect humans.	Not known to be foodborne; contact with environment and skin penetration is the most common form of transmission to humans.
Toxocara canis (dog roundworm)	Adult worms of the *Toxocara canis* live in the small intestine of dogs and puppies. Almost all puppies are infected at or soon after birth. *Toxocara* eggs can survive for years in the environment, and humans typically ingest the eggs via oral contact with contaminated hands.	Not known to be foodborne; direct contact with animals is the most common form of transmission to humans.

Although uncommon, companion dogs fed with raw meat can also be infected by *Bacillus anthracis*, *Clostridium botulinum*, *C. perfringens*, *Listeria monocytogenes*, *Mycobacterium bovis*, *M. tuberculosis*, and *Yersinia enterocolitica* (Lejeune and Hancock 2001).

While it is out of the scope of this assessment, it is also relevant to note that dog bites can transmit multiple microorganisms. Some of them are pathogenic to humans, most commonly *Pasteurella* species. Infections acquired through dog bites are the most common form of disease transmitted to humans from dogs.

Symptoms of human diseases caused by pathogens listed in Table 2 are described in Appendix 1.

2. Prevalence of pathogens in dogs

Although there are published data indicating the prevalence of zoonotic pathogens in dogs, most of the data relate to investigations after dogs have been exposed to zoonotic pathogens through raw food diets. The following data demonstrates the variability in positive stool samples detected for several common pathogenic agents in dogs:

- pathogenic *Campylobacter* spp. in dogs has been reported to be in the range of 2.4% to 47% (Lenz et al. 2009, McKill et al. 2009, Workman et al. 2005);
- STEC O157 has been reported at 3% prevalence (Hancock et al. 1998); and
- pathogenic *Salmonella* spp. has been reported in the range of 14% to 44% (Joffe and Schlesinger 2002; Finley et al. 2007; Lenz et al. 2009).

In general only a small number of samples were collected in the above studies. This would also contribute to the variability in the observed prevalence. Despite this, and the different methodologies used, it is apparent that dogs may at times harbour and excrete pathogens of public health concern to a varying extent.

3. Routes of transmission of zoonotic pathogens from dogs to humans

The pathogens listed in Table 2 can be transmitted to humans through one or more of the following routes:

- consumption of food and/or water contaminated by faeces of infected dogs
- direct contact with parts of the infected companion dog that may have been contaminated with faeces of infected dogs, such as the skin, fur, or mouth
- an intermediate vector, for example ticks or fleas carried by dogs (Stehr-Green and Schantz 1987).

Situations where human illness has been caused by consumption of food contaminated by pathogens originating from an infected dog are most likely rare and no reports have been identified in a literature scan. Therefore the studies described below focus on illness caused by direct contact with pathogens carried by dogs and provide a basis for identifying the pathogens which theoretically are transmissible via a foodborne route.

The most common route of transmission of zoonotic pathogens from dogs to humans is through direct contact with faecally contaminated material. Dogs, particularly puppies, are more likely to carry and therefore readily excrete pathogens. They present a significant risk of transmitting zoonotic pathogens to young children who come into contact with them in a family environment (Salfield and Pugh 1987; Hald and Madsen 1997). Transmission of STEC O157 to young children from infected dogs through direct contact has been demonstrated (Trevena et al. 1996).

Published Australian data demonstrating an epidemiological link between human illness and contact with pet animals are scarce. In a case-control study of risk factors associated with *Campylobacter* infection in Australia, Stafford et al. (2008) reported that contact with domestic dogs aged less than 6 months was an independent risk factor for acquiring campylobacteriosis. The study however, did not reveal any association that dogs were a significant risk factor for acquiring campylobacteriosis through foodborne exposure.

One Australian publication reported an investigation of 27 human cases of *Cryptosporidium* infection that occurred in association with an animal nursery at an agricultural show. Although several species of animals were present including dogs, puppies, calves, chickens, goats, pet rats, rabbits, sheep, and some native animals, the investigation (Ashbolt et al. 2003) concluded that *Cryptosporidium* was most likely acquired through human contact with infected faeces present in hay used by ruminants. An Australian PhD study[3] that examined gastrointestinal parasites in dogs and cats in Australia concluded that *Cryptosporidium* arising from companion animals is of limited significance in terms of transmitting disease to healthy people.

Parasites such as hookworm, roundworm and tapeworm in dogs are commonly under control in Australia as a result of preventative worming programs for domestic dogs and present a low risk to consumers if the health of companion dogs is appropriately maintained. Again direct transmission through close contact with dogs, particularly in children, is the most common route of transmission for these agents.

Human leptospirosis caused by *Leptospira interrogans* is commonly associated with outdoor water activities where transmission is a result of exposure to contaminated water, most often through rodents. Published data of Australia's National Notifiable Disease Surveillance System indicate that approximately 100 to 150 cases of human leptospirosis are reported each year in Australia. Human leptospirosis in Australia is largely occupational and associated with those working in the intensive animal farming sector and livestock industries. Eating contaminated food or drinking contaminated water however can be responsible occasionally for the transmission of *Leptospira interrogans* to humans according to a factsheet on leptospirosis prepared by the NSW Department of Health (NSW Health, 2007). However, clinical leptospirosis in dogs is rare in Australia (Biosecurity Australia, 2000).

The available literature indicates that *Campylobacter* spp., STEC and pathogenic *Salmonella* spp. are the most likely pathogenic organisms that could be transmitted, via food, to humans from infected dogs. This could potentially arise through consumption of food contaminated

[3] http://researchrepository.murdoch.edu.au/703/1/01Front.pdf

with dog faecal material or through food handlers who have been in contact with faeces of infected dogs.

4. Factors influencing shedding of pathogenic microorganisms in dogs

Faecal shedding of zoonotic pathogens in dogs is influenced by a range of factors. It is known that inclusion of ingredients such as raw pork, chicken and eggs in the diet of dogs can increase the faecal shedding of pathogens such as *Campylobacter* spp., STEC and *Salmonella* spp. Intake of raw meat has been assumed to be the main vehicle through which dogs acquire these pathogens (Fox 1998; Green 1998; Lenz et al. 2009).

Shedding of zoonotic pathogens such as STEC and *Salmonella* by animals is frequently higher in summer and autumn (NASPHV, 2007). During this period, outdoor dining activities are more common and therefore higher exposure to people from potential pathogens may occur.

5. Studies on interactions between humans and dogs

The nature and extent of interaction between humans and their companion dogs has been examined in some communities in the United Kingdom with a view to assessing the risk of disease transmission from pets (Westgarth et al. 2007 and 2008). In general, the greatest and most intimate contact (e.g. playing, cuddling, feeding, allowing pets to lick the owner and sleeping in close proximity) was seen between the owner and his or her dog, suggesting that the highest risk of zoonotic disease transmission would occur in the home and with family members. When dogs were outside the home, there was minimal contact (mainly patting) with other people and this mainly occurred when walking the dog. Other dog-owners tended to have most of this contact as opposed to people that did not own dogs (Westgarth et al. 2007).

Heller et al. (2011) also studied the interactions between humans and companion dogs in a Scottish community to explore the differences between dog-owners and non-dog-owners with respect to hygiene and knowledge of zoonotic disease. This study confirmed that closer contact occurred between dog-owners and their own dogs compared with dogs of other owners. However, it also showed that dog owners were no more likely to have intimate interactions (play, cuddle, feed treats) with non-owned dogs compared to those not owning a dog. The study implied that the potential routes for pathogen transmission from non-owned dogs are similar and minimal for both dog owners and non-dog-owning humans. This was in contrast to the comparatively greater number of routes and risk factors that are likely to be present between dog-owners and their own dogs.

6. Potential modes of transmission of pathogens from companion dogs to food

Food served in outdoor dining settings may potentially be contaminated with zoonotic pathogens carried by companion dogs via the following routes (Figure 1).

Food hygiene and safety regulations in most jurisdictions include basic measures to restrict the movement of companion dogs in outdoor dining areas such that food prepared and/or served by food businesses would not come into direct contact with companion dogs or dog faeces. It is therefore considered that transmission of pathogens by companion dogs in outdoor dining areas to consumers through the direct contact scenario in Figure 1 is unlikely.

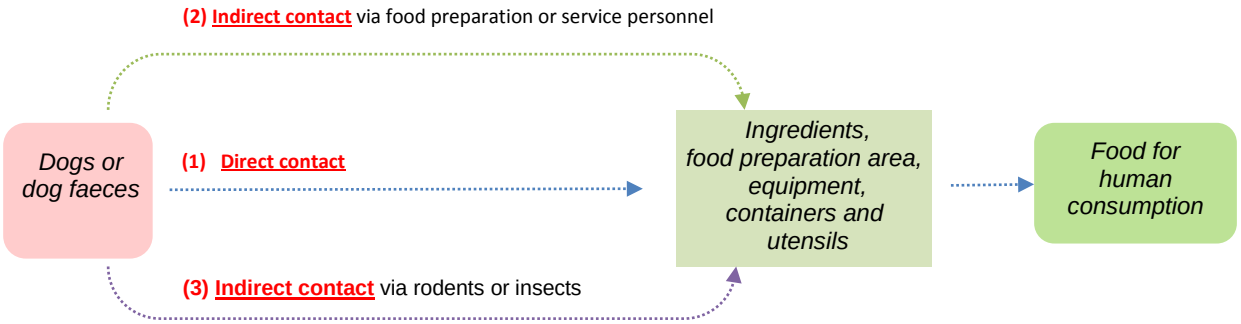

Figure 1: Mode of transmission of pathogens from infected dogs to food

A second possibility by which food could become contaminated with infectious faecal material of companion dogs is through the restaurant staff that prepares and/or serves food (scenario 2 shown in Figure 1). This route involves personnel handling or touching an infectious companion dog and then handling food or food preparation equipment or utensils without washing hands thoroughly. Therefore, in these circumstances food contamination would be due to unhygienic practices of food preparation or service personnel and not due to direct contact of dogs with food preparation areas. Clause 13 of Standard 3.2.2 requires a food handler not handle food or surfaces likely to come into contact with food in a way that is likely to compromise the safety and suitability of food. Clause 15 of Standard 3.2.2 requires a food handler must wash his or her hands whenever his or her hands are likely to be a source of contamination of food. Provided that the food preparation and service personnel and the food businesses comply with these requirements, transmission of pathogens from companion dogs through food via scenario 2 above is also unlikely.

A third route of food contamination could arise through rodents or insects acting as carriers of human pathogens (scenario 3 in Figure 1). However, the likelihood of this occurring is again dependent on the general hygiene, as well as pest management control measures, maintained by the food business. A food business is required to ensure its premises are kept clean (clause 19 of Standard 3.2.2 of the Code), to take all practicable measures to prevent pests entering the food premises, and to eradicate and prevent the harbourage of pests on the food premise (clause 24 of Standard 3.2.2 of the Code). Provided that food businesses comply with these requirements, transmission of pathogens to food via indirect contact with rodents or insects is also unlikely.

7. Assistance animals

Clause 24 of Standard 3.2.2 of the Code permits assistance animals to be present in dining, drinking or other areas of food establishments used by customers. This is to ensure compliance with the Commonwealth *Disability Discrimination Act (1992)*. Although assistance animals, such as guide dogs, present the same potential to carry zoonotic pathogens, these animals are generally thoroughly trained to follow a set of standard behaviour in public areas. Companion dogs which are not trained to this level of standard behaviour may present a slightly higher risk of transmitting zoonotic diseases to consumers through food if they were allowed in alfresco dining areas.

Conclusion

The potential risk of foodborne transmission of zoonotic agents from companion dogs in outdoor dining settings to humans is considered to be very low to negligible. This is supported by the following factors:

- The likelihood of direct contact of food or food preparation areas with infected companion dogs or dog faeces is negligible as dogs would not ordinarily be allowed into food preparation areas.

- Acquiring diseases through indirect foodborne transmission routes requires the involvement of an intermediate vector. As illustrated in Figure 1, such vectors may include food preparation personnel, food service personnel or rodents/insects. A successful foodborne disease transmission through an intermediate vector is dependent on (1) a successful transmission of pathogens carried by companion dogs to an intermediate vector, and (2) a successful transmission of such pathogens to humans through food contaminated by the intermediate vector. Therefore the likelihood of acquiring diseases carried by companion dogs in outdoor dining areas involving an intermediate vector is predicted to be very low, because the probability of the occurrence of one event that is dependent on the occurrence of two consecutive events[4] is very low when the probabilities of the occurrence of the two consecutive events are themselves both low.

- Potential contamination of food directly from companion dogs, or indirectly through contaminated intermediate vectors, in outdoor dining settings is managed through compliance with general food safety standards and food safety management or control programs for restaurant food hygiene.

- Studies on human-dog interactions indicate that, in general, contact between people and dogs that are not their own pet/s is limited. This minimises the potential for contact and consequently the transmission of pathogens from dogs in outdoor dining settings to humans.

Zoonotic pathogens originating from companion dogs present in outdoor dining areas represent a theoretical foodborne disease risk to consumers dining in these settings in Australia. This risk may be slightly higher for young children and immune-compromised individuals. However, the overall level of food safety risk arising from the presence of companion dogs in such settings is expected to be very low to negligible. Adherence to good hygienic practices in food preparation and service, maintenance of cleanliness, and proper pest control by food businesses should contribute to the minimisation of any potential risk of foodborne transmission of pathogens potentially carried by companion dogs in outdoor dining areas.

References

Ashbolt R, Coleman DJ, Misrachi A, Conti JM, Kirk MD (2003) An outbreak of cryptosporidiosis associated with an animal nursery at a regional fair. Communicable Diseases Intelligence 27:244-249

Biosecurity Australia (2000) A scientific review of Leptospirosis and implications for quarantine policy. http://www.daff.gov.au/__data/assets/pdf_file/0006/43089/leptoreviewfinal.pdf, accessed 8 Nov 2010.

Brower A, Okwumabua O, Massengill C, Muenks Q, Vanderloo P, Duster M, Homb K, Kurth K (2007) Investigation of the spread of *Brucella canis* via the U.S. interstate dog trade. International Journal of Infectious Diseases 11:454-458

Finley R, Ribble C, Aramini J, Vandermeer M, Popa M, Litman M, Reid-Smith R (2007) The risk of Salmonellae shedding by dogs fed *Salmonella* contaminated commercial raw food diets. The Canadian Veterinary Journal 48:69-75

[4] The probability of the occurrence of one event (P_A for the probability of occurrence of event A) that is dependent on the occurrence of two consecutive events (event B and C) is the product of the probabilities of occurrence of the two consecutive events (P_B for the probability of occurrence of event B and P_C for the probability of occurrence of event C), i.e. $P_A = P_B \times P_C$.

Fox J (1998) *Campylobacter* infections. In: Greene C (ed) Infectious Diseases of the Dog and Cat. WB Saunders, Philadelphia, pp226-229.

Greene C (1998),Salmonellosis. In: Greene C (ed) Infectious Diseases of Dog and Cat. WB Saunders, Philadelphia, pp235-240

Hald B, Madsen M (1997) Healthy puppies and kittens as carriers of *Campylobacter* spp., with special reference to *Campylobacter upsaliensis*. Journal of Clinical Microbiology 35:3351-3352

Hancock DD, Besser TE, Rice DH, Ebel ED, Herriott DE, Carpenter LV (1998) Multiple sources of *Escherichia coli* O157 in feedlots and dairy farms in the northwestern USA. Preventative Veterinary Medicine 35:11-19

Heller J, Bierbaum S, Hyden B, Reid S, Mellor D (2011) Defining interactions between humans and pet dogs. Proceedings of 1st International One Health Congress, 2010, Ecohealth 7(S1): 155.

Joffe DJ, Schlesinger DP (2002) Preliminary assessment of the risk of *Salmonella* infection in dogs fed raw chicken diets. The Canadian Veterinary Journal 43:441-442

LeJeune JT, Hancock DD (2001) Public health concerns associated with feeding raw meat diets to dogs. Journal of the American Veterinary Medical Association 219:1222-1225

Lenz J, Joffe D, Kauffman M, Zhang Y, LeJeune J (2009) Perception, practices, and consequences associated with foodborne pathogens and the feeding of raw meat to dogs. The Canadian Veterinary Journal 50:637-643

McGill K, Golden O, Jones BR, Fanning S, Whyte P (2009) Prevalence of thermophilic *Campylobacter* species in household cats and dogs in Ireland. The Veterinary Record, 164(2):44-47

NASPHV (2007) Compendium of measures to prevent disease associated with animals in public settings, 2007. http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5605a1.htm, accessed 8 Nov 2010

NSW Health (2007) Infectious Disease Factsheet - Leptospirosis. http://www.health.nsw.gov.au/factsheets/infectious/leptospirosis.html, accessed 8 Nov 2010.

Pointon A, Sexton M, Dowsett P, Saputra T, Kiermeier A, Lorimer M, Holds G, Arnold G, Davos D, Combs B, Fabiansson S, Raven G, McKenzie H, Chapman A, Sumner J (2008) a baseline survey of the microbiological quality of chicken portions and carcases at retail in two Australian states (2005 to 2006) Journal of Food Protection 71(6):1123-1134

Salfield NJ, Pugh EJ (1987) *Campylobacter* enteritis in young children living in households with puppies. British Medical Journal 294:21-22

Stafford RJ, Schluter P, Wilson A, Martyn DK, Hall G, Unicomb L, the OzFooNet Working Group (2008) Population-attributable risk estimates for risk factors associated with *Campylobacter* infection, Australia. Emerging Infectious Diseases 14(6):895-901

Stehr-Green JK, Schantz PM (1987) The impact of zoonotic diseases transmitted by pets on human health and the economy. Veterinary Clinics of North America: Small Animal Practice 17:1-15

Steinmuller N, Demma L, Bender JB, Eidson M, Angulo FJ (2006) Outbreaks of enteric disease associated with animal contact: not just a foodborne problem anymore. Clinical Infectious Diseases 43:1596-1602

Trevena WB, Hooper RS, Wray C, Willshaw GA, Cheasty T, Domingue G (1996) Vero cytotoxin-producing *Escherichia coli* O157 associated with companion animals (letter) Veterinary Records 138:400

Westgarth C, Pinchbeck GL, Bradshaw JWS, Dawson, S, Gaskell RM, Christley RM (2007) Factors associated with dog ownership and contact with dogs in a UK community. BMC Veterinary Research 3:5-9.

Westgarth C, Pinchbeck GL, Bradshaw JWS, Dawson, S, Gaskell RM, Christley RM (2008) Dog-human and dog-dog interactions of 260 dog-owning households in a community in Cheshire. Veterinary Record 162: 436-442.

Workman SN, Mathison GE, Lavoie MC (2005) Pet dogs and chicken meat as reservoirs of *Campylobacter* spp. in Barbados. Journal of Clinical Microbiology 43(6):2642-2650

APPENDIX 1: Symptoms of human diseases caused by zoonotic pathogens potentially carried by dogs[5]

Pathogen	Symptoms of human infection
Bacteria	
Campylobacter spp.	Both *Campylobacter jejuni* and *C. coli* cause diarrhoea, fever, abdominal pain, nausea, and headache and muscle pain in humans. Most symptoms caused by *Campylobacter* are self-limiting. Campylobacters are responsible for the highest number of gastroenteritis cases in humans in Australia. *Campylobacter* transmission to humans occurs primarily through food consumption, for example, consumption of unpasteurised milk, non-chlorinated water and undercooked poultry meat.
Shiga toxin-producing *Escherichia coli (STEC)*	Human illness caused by STEC is characterised by severe abdominal pain and diarrhoea, initially watery but becoming grossly bloody. Occasionally vomiting occurs. Fever is either low-grade or absent. The illness is usually self-limiting and lasts for an average of 8 days. More severe disease may be seen in children and immune-compromised persons, including haemolytic uraemic syndrome in children. STEC have been identified as the cause of some of the major foodborne outbreaks in Australia and overseas.
Leptospira interrogans	Various serovars of *L. interrogans* can cause leptospirosis in humans. Leptospirosis is most common in the tropics, and has recently been recognized as a re-emerging infectious disease among animals and humans. Leptospirosis begins with fever, chills, muscle aches, intense headache, and vomiting, followed by meningitis, liver damage and renal failure if not treated. The symptoms in humans appear after a 4–14 day incubation period.
Salmonella spp.	*Salmonella* infection causes acute enteritis and individuals can display nausea, vomiting, abdominal cramps, diarrhoea, fever, and headache. Infected individuals may develop arthritic symptoms 3-4 weeks after onset of acute symptoms. The onset time is 6-48 hours after infection. *Salmonella* spp. is a major cause of foodborne illnesses in Australia.
Yersinia enterocolitica and *Y. pseudotuberculosis*	Yersiniosis mainly occurs in these children younger than 5 years old and is frequently characterized as gastroenteritis, with diarrhoea and/or vomiting accompanied by fever and abdominal pain. A small proportion of children (less than 10%) produce bloody stools. *Yersinia* infections mimic appendicitis and mesenteric lymphadenitis, but the bacteria may also cause infection in other sites, such as wounds, joints, and the urinary tract. The illness might last from a few days to 3 weeks.
Protozoa	
Cryptosporidium spp.	The pathogen causes cryptosporidiosis in humans. Infected individuals may show symptoms 2 to 10 days after infection of watery diarrhoea, stomach cramps, dehydration, nausea, vomiting, and fever and weight loss. The symptoms usually last about 1 to 2 weeks, and may progress in cycles.
Giardia spp.	The pathogen causes giardiasis in humans. Infected individuals may show symptoms, mainly diarrhoea, 1 to 2 weeks after infection. Other symptoms include flatulence, greasy stools and stomach cramps and nausea. The symptoms usually last 2 to 6 weeks but can be persistent.
Parasites	
Dipylidium (dog tapeworm) *Echinococcus* (dog tapeworm)	Human infection caused by *Dipylidium* (dog tapeworm) or *Echinococcus* (dog tapeworm) has not been shown to be foodborne. Dipylidiosis in humans is often asymptomatic but can result in anal itching and abdominal pain. In humans, Echinococcus infection may result in tissue cysts that can persist and grow for years. They are regularly found in the liver and are asymptomatic until their growing size produces symptoms or are accidentally discovered. Disruption of the cysts (spontaneous or iatrogenic) can be life threatening due to anaphylactic shock.
Ancylostoma canium (dog hookworm)	Larvae of *A caninum* typically enter a human host by skin penetration, although infection by oral ingestion is possible. These larvae probably remain dormant in skeletal muscles and create no symptoms. In some individuals, larvae may reach the gut and mature into adult worms. Adult worms secrete various potential allergens into the intestinal mucosa. Some patients have been reported to have increasingly severe recurrent abdominal pain, which may be analogous to a response to repeated insect stings.
Toxocara canis (dog roundworm)	Most infections mild and self-limiting. A proportion may result in larvae migrating to the eyes causing ocular larva migrans, which occurs most commonly in children 6-14 years old. In children younger than 5 years, roundworm larvae tend to migrate to the organs such as the lungs and liver.

[5] Information in the table was collected from various food safety risk assessments prepared by FSANZ and supplemented with data sourced from the website of U.S. Food and Drug Administration.