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Review

Listeria: An Australian Perspective (2001–2010)

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Abstract

Despite having a low occurrence rate, *Listeria monocytogenes* is one of the most prominent foodborne pathogens in Australia. The organism is responsible for severe outbreaks with high case fatality and substantial economic losses due to food recalls. In this study, we analyze the incidence trends of listeriosis in Australia during 2001–2010, discuss the relevance of food recalls, and investigate the pathogen's role in foodborne outbreaks. A significant epidemiological finding was a consistently high national age-specific rate recorded for individuals aged 60 years and over. Analysis of Australian *Listeria* outbreak and food recall data suggests deficiencies in food safety programs of food manufacturing businesses implicated in *Listeria* outbreaks and revealed that ready-to-eat foods are high-risk vehicles for transmitting listeriosis. Highlighted is Australia's highly efficient *Listeria* management and surveillance systems bolstered by the introduction of *Listeria* molecular subtyping in 2010 coupled with a nationally standardized questionnaire by the ''Australian foodborne disease surveillance network (OzFoodNet).'' The detection of clusters and therefore outbreaks was now possible, allowing cases to be linked across multiple jurisdictions and enabling timely public health action. Considering current changes in food production and consumption patterns, continuous monitoring and improvement of surveillance systems will provide ongoing public health benefits and be crucial to future development of food safety policy for Australia.

Introduction

Foodborne disease continues to be a persistent challenge to public health and an economic burden to society and health care systems (Sumner *et al.,* 2000; Tauxe *et al.,* 2002; Thomas *et al.,* 2006). With an estimated 5.4 million food-related cases reported annually in Australia and an estimated cost of $1.2 billion, it is evident that foodborne microbial pathogens can have far-reaching consequences (Abelson *et al.,* 2006; Swaminathan *et al.,* 2007). Among bacteria usually implicated in foodborne illnesses in Australia, *Listeria monocytogenes* is of particular concern (Allos *et al*., 2004). As a key member of the Gram-positive, nonspore-forming *Listeria* genus, *L. monocytogenes* is the most commonly associated with human listeriosis (Hill *et al.,* 1995; Doumith *et al.,* 2004). Currently, a total of 13 serotypes of *L. monocytogenes* are known, with serotypes 1/2a, 1/2b, 1/2c, and 4b accounting for more than 90% of environmental, food sourced, and human isolates (Swaminathan *et al.,* 2007).

L. monocytogenes can be transmitted from person to person or through utero/parental transmission. However, the majority of cases of listeriosis in humans are foodborne (Bille *et al.,* 2006; Cartwright *et al.,* 2013). Listeriosis is predominantly caused by the consumption of food products contaminated with *L. monocytogenes.* The required infective dose depends on the strain as well as the susceptibility of the individual (Cotter and Hill, 2003). While *L. monocytogenes* is usually responsible for asymptomatic infection or mild flu-like illness in the general population, the invasive form of listeriosis, although rare, represents a severe disease with a high hospitalization and fatality rate (20–30%) (Crerar *et al.,* 1996; De Valk *et al.,* 2005). Persons affected by listeriosis are generally immunocompromised individuals with underlying medical conditions, elderly people, and pregnant women (De Valk *et al.,* 2005; Gillespie *et al.,* 2006). In elderly people, this vulnerability is the result of changes to both the innate and adaptive immune system where functional alterations weaken the host defense mechanism to food pathogens like *L. monocytogenes* (Ramaswamy *et al.,* 2007). This phenomenon is reflected in *Listeria* notifications rates, which are considerably higher for these established high-risk groups (Ammon and Tauxe, 2007).

The ubiquitous presence of *L. monocytogenes* in the environment may result in the contamination of food-processing settings and ultimately food products (Cartwright *et al.,* 2013).

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L. monocytogenes possesses unique growth characteristics that increase its prevalence in food (Cotter and Hill, 2003). *Listeria* species can survive in relatively low pH and high salt conditions and are perhaps best known for their ability to proliferate even at low temperatures, thereby challenging important food-preservation techniques such as refrigeration (Flint *et al.,* 2005). *L. monocytogenes* readily produces biofilms, allowing the organism to attach and survive on contact surfaces while resisting sanitization techniques employed in food-processing environments (Koch and Stark, 2006). The general severity of listeriosis and difficulty in eradicating this foodborne pathogen emphasize the importance of food-safety measures against *Listeria* (Cotter and Hill, 2003).

The management of *L. monocytogenes* in food is a major challenge due to the organism's ability to infiltrate a variety of food-processing environments (Olsen *et al.*, 2005; Cartwright *et al.,* 2013). Epidemiological findings demonstrate that ready-to-eat products such as processed delicatessen meats, soft cheeses, meat spreads, smoked seafood, cooked cold chicken, and pre-prepared salads are frequently implicated in outbreaks of listeriosis (Olsen *et al.*, 2005; Ammon and Tauxe, 2007). *Listeria* contamination is commonly attributed to processing and production failures (Bille *et al.,* 2006). In Australia, licensed food businesses are required to develop a food safety program based on the internationally recognized Hazard Analysis at Critical Control Points system or standard 3.2.1 of the Australian & New Zealand Food Standards Code (Australia New Zealand Food Authority, 2012). Despite extensive control measures regulating Australia's food industry, *L. monocytogenes* continues to be reported in sporadic and epidemic forms across the country (Hall *et al.,* 2005). Food recalls due to bacterial contamination by *L. monocytogenes* are widespread with significant costs incurred by food businesses (Food Standards Australia New Zealand, 2001, 2002). Given the importance of in-depth analyses of the various factors that determine the occurrence of foodborne disease in the development of improved control and prevention strategies (Majowicz *et al.,* 2005; Lyytikainen *et al.,* 2006), this study presents an overview of key epidemiological trends relating to foodborne *Listeria* infections in Australia with particular emphasis on *Listeria* notification rates, key outbreaks, and food recalls that have been documented in the 2001–2010 period.

Materials and Methods

In 2000, the Australian Government and Department of Health and Ageing established OzFoodNet as a surveillance initiative with Australia's State and Territory health authorities (The OzFoodNet Working Group, 2001). The OzFoodNet network comprises epidemiologists and food microbiologists who work in collaboration on foodborne disease research in Australia (The OzFoodNet Working Group, 2002). The OzFoodNet working group utilizes food pathogen notification data obtained from state health departments to perform epidemiological studies (The OzFoodNet Working Group, 2001). Their findings are published in both quarterly and yearly reports. For the purposes of this study, annual surveillance data from OzFoodNet are collated to provide an overview of *Listeria* incidence and to identify key epidemiological trends relating to *L. monocytogenes* in Australia. The first annual OzFoodNet report was released in 2001 and the most recent in 2010. In addition, Australian food recall data will be acquired from Food Standards Australia New Zealand (FSANZ). A summary of Australian food recall statistics helps determine common recall trends among foods affected by microbial and, more specifically, *Listeria* contamination.

Definitions

In Australia, listeriosis is determined by isolation of *Listeria* species from a sterile site (blood, spinal fluid, fetal gastrointestinal contents) (The Department of Health, 2010). Cases of listeriosis involving a pregnant woman, miscarriage, stillbirth, or an infant less than 1 month of age are defined as maternal or neonatal (Crerar *et al.,* 1996). If a pregnant woman and her newborn are infected by *L. monocytogenes*, this is described as a single case of listeriosis (The OzFoodNet Working Group, 2001). Single cases of *Listeria* gastroenteritis and infections of nonsterile sites are non-notifiable to health departments in Australia (The OzFoodNet Working Group, 2001). An outbreak is identified when two or more listeriosis cases are caused by the same serotype of *Listeria* and are also found to be associated with a common food source (The Department of Health, 2010). Outbreaks are considered to be multijurisdictional if cases relating to the same serotype of *L. monocytogenes* occur in more than one state (OzFoodNet Working Group, 2002). Sporadic cases of listeriosis, on the other hand, are defined as cases that appear at irregular intervals in an isolated manner and without any clear epidemiological pattern (Murray *et al.,* 2007; The OzFoodNet Working Group, 2003). Food recalls involve foods that may pose a safety risk to consumers and that are therefore removed from sale and distribution (Food Standards Australia New Zealand, 2001, The OzFoodNet Working Group, 2005).

Results

Between 2001 and 2010, OzFoodNet sites reported a total of 667 cases of *L. monocytogenes* infections in the Australian population, representing an annual incidence of 2.5–3.6 cases per 1,000,0000 population per year. Most cases of listeriosis were of a sporadic nature (91% of cases) rather than outbreak related (Table 1). Predominantly, a total of 60–70 notified cases of listeriosis were documented annually in Australia, with a case fatality rate of 20–30%. There were no major changes in listeriosis notifications in the study period, with a notification rate of 0.3 cases per 100,000 population being recorded for most years except for 2003 and 2009. In 2003, no common source outbreaks of listeriosis were confirmed despite the spike in cases. However, the increase in the number of cases in 2009 was the direct result of a multijurisdictional outbreak. Among all states and territories, New South Wales reported an increase in notifications after 2002, with a rise in the crude rate from 0.2 to 0.3–0.4 cases per 100,000 population. This rate (0.3–0.4 per 100,000 population) remained fairly constant throughout the remainder of the study period. In contrast, Queensland has seen the opposite, with a decrease in the number of cases being recorded after 2002.

Between 2001 and 2010, most infections were reported in elderly people, immunocompromised individuals, as well as pregnant women. The highest age-specific rate was seen among males over 80 years of age (1.6 per 100,000 population) (Fig. 1). The average age of infected individuals ranged

TABLE 1. *LISTERIA* INFECTIONS NOTIFIED TO OZFOODNET DUE TO FOOD, 2001–2010

	ACT	*NSW*	*QLD*	*SA*	*TAS*	*VIC*	*WA*	*NT*	*Total*	*Rate*
2001	1	14	19	6	2	10	11	0	63	0.3
2002	0	12	20	2	2	15	11	0	62	0.3
2003	1	31	11	1	2	21	8	0	75	0.4
2004	1	31	8	3	1	13	9	1	67	0.3
2005	3	25	7	6	0	11	4	0	56	0.3
2006	1	24	3	5	0	13	13	0	59	0.29
2007	0	22	7	7	2	10	10	0	58	0.2
2008	1	34	12	1	1	11	8	0	68	0.3
2009	2	26	13	4	3	27	13	0	88	0.4
2010	2	26	9	1	3	27	3	0	71	0.3

Australia is a federation of six states: New South Wales (NSW), Queensland (QLD), South Australia (SA), Tasmania (TAS), Victoria (VIC) and Western Australia (WA) and two territories the Australian Capital Territory (ACT) and the Northern Territory (NT); rate, rate per 100,000 population.

from 60 to 68 years. A decline in the number of maternofetal infections was recorded during 2002 and 2003. This trend continued to be observed for the remainder of the study period. On the contrary, an increase in the age-specific rate for individuals aged 60 years and over was noted between 2002 and 2004. The notification rate, however, decreased the following year but remained relatively high compared to that of other age groups.

Overall, there were five outbreaks due to *L. monocytogenes* infections in the 2001–2010 study period (Table 2). A total of 57 cases and 14 deaths were recorded. Hospitals and the community proved to be a common outbreak site, with hospitals reported as a setting for three of the five outbreaks and the community for two outbreaks. On two occasions, the food implicated was unknown, while meat (chicken) and processed ready-to-eat meat served as food vehicles for outbreaks in 2005 and 2009. In 2009, the annual incidence of *Listeria* was the highest recorded since the OzFoodNet network was established in 2000. The dramatic rise in *L. monocytogenes* notifications at this time was attributed to a multijurisdictional outbreak linked to chicken wraps sold on domestic airline flights across Australia. A total of 36 people were affected, with four deaths recorded.

Of the 188 recalls due to the presence of microbial spoilage, 96 (51%) were due to *Listeria monocytogenes* (Fig. 2). A significant rise in the number of recalls due to *L. monocytogenes* was not observed between 2001 and 2010. Overall, of the 96 reports of food recalls as a result of contamination by *L. monocytogenes*, 61 involved processed ready-to-eat delicatessen meats, 21 involved dairy products, and 11 involved seafood (Fig. 3).

Discussion

The results obtained from this analysis indicate that the epidemiology of listeriosis in Australia has not changed considerably between 2001 and 2010. The incidence has not increased or decreased significantly as demonstrated by a consistent annual rate of 0.3 cases per 100,000 population. It should be noted that in comparison with other developed countries displaying similar demographic characteristics, *Listeria* notification rates are lower in Australia (Ammon and

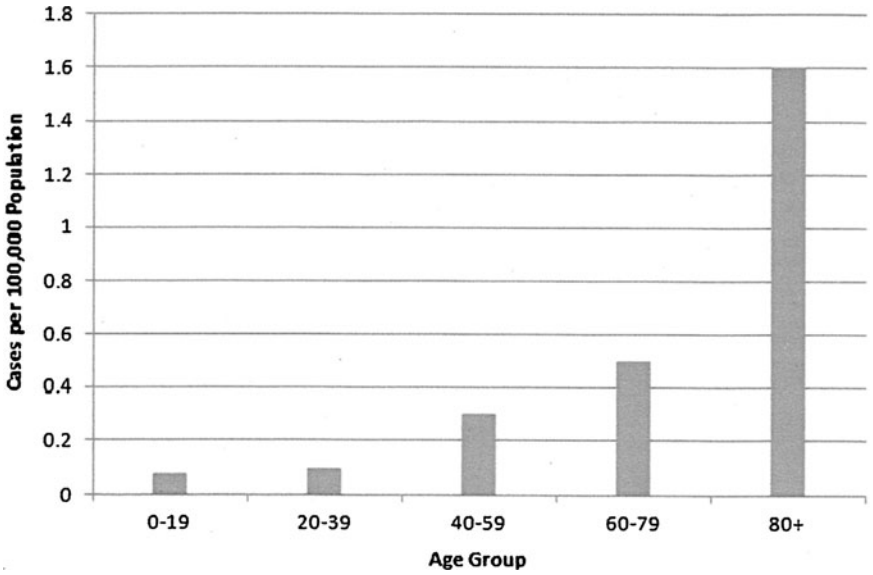

FIG. 1. Cases of listeriosis per 100,000 population, Australia (2001–2010) by age group.

Table 2. Listeriosis Outbreaks in Australia (2001–2010)

Year	*Jurisdiction*	*Setting*	*Cases*	*Deaths*	*Foods implicated*
2004	South Australia	Community	2	2	Unknown
2005	South Australia	Hospital	4	2	Ready-to-eat processed meats
2009	QLD/NSW/ VIC/TAS/SA/WA	Airline catering company	36	4	Chicken wraps
2010	Victoria / Queensland / New South Wales	Hospital & community	9	2	Rockmelons
2010	Victoria	Hospital	6	4	Unknown

QLD, Queensland; NSW, New South Wales; VIC, Victoria; TAS, Tasmania; SA, South Australia; WA, Western Australia.

Tauxe, 2007). Surveillance data across Europe have revealed an increase in human listeriosis cases in the last decade (De Valk *et al.,* 2005; Doorduyn *et al.,* 2006; Bouwknegt *et al*., 2013). The average incidence is 0.47 cases per 100,000 population, with increases recently observed for a list of nations including Germany, Switzerland, and Belgium (Koch and Stark, 2006; Goulet *et al.,* 2008). Numerous reasons have been identified for this, but upon considering that Australia was ranked second overall in the ''Food Safety Performance World Rankings of 2010'' (Charlebois, 2010), it can be theorized that this clear difference in *Listeria* notification rates may be due to the high level of food safety protection enjoyed by Australians (Charlebois, 2010). The majority of listeriosis cases in Australia are representative of sporadic events for which there are no discernible epidemiological links (Hall *et al.,* 2005; The OzFoodNet Working Group, 2006). This may suggest that the Australian population may be exposed to food products that have low-level *L. monocytogenes* contamination (Ramaswamy *et al.,* 2007). Based on the findings of this study, it is also apparent that listeriosis primarily affects elderly people. A key epidemiological feature of listeriosis in Australia is the constantly high age-specific rate recorded for individuals aged 60 years and over. This observation also corresponds with epidemiological conclusions made in other developed countries that share demographic characteristics similar to those of the Australian population (Roy *et al.,* 2006; Bouwknegt *et al*., 2013).

Although the majority of listeriosis cases in Australia are of a sporadic nature (91%), several outbreaks resulting from *Listeria* contamination were noted in the study period (Sumner *et al.,* 2000). In 2009 in particular, *L. monocytogenes* further demonstrated its potential to cause outbreaks affecting large numbers of people with a high case fatality rate. A multi-jurisdictional outbreak of *L. monocytogenes* occurred with 36 cases and a total of 4 deaths (The OzFoodNet Working Group, 2009). An epidemiological analysis of the outbreak indicated that prepackaged chicken wraps sold on flights of a domestic airline were the implicated food vehicle (The OzFoodNet Working Group, 2009). Further examination of the contaminated food product revealed that the chicken used in the wraps was supplied by a New South Wales producer to a food manufacturer in Queensland. A public health investigation established that the supplier's food safety program had numerous deficiencies. The food business was ultimately fined and the prosecution noted due to a breach of food standards set by the New South Wales Food Authority (New South Wales Food Authority, 2011). Apart from contributing to the highest recorded *L. monocytogenes* annual notification rate since the OzFoodNet network was established in 2000, the severity of the outbreak also prompted the implementation of an enhanced national system of *Listeria* surveillance in Australia (The OzFoodNet Working Group, 2010). As part of the arrangement, state and territory public health reference laboratories have agreed to perform molecular typing of all human listeriosis isolates (The OzFoodNet Working Group, 2010).

Until the 2009 domestic airline outbreak, there was no nationally coordinated systematic surveillance for invasive listeriosis in Australia (Allos *et al*., 2004). Previously, cases

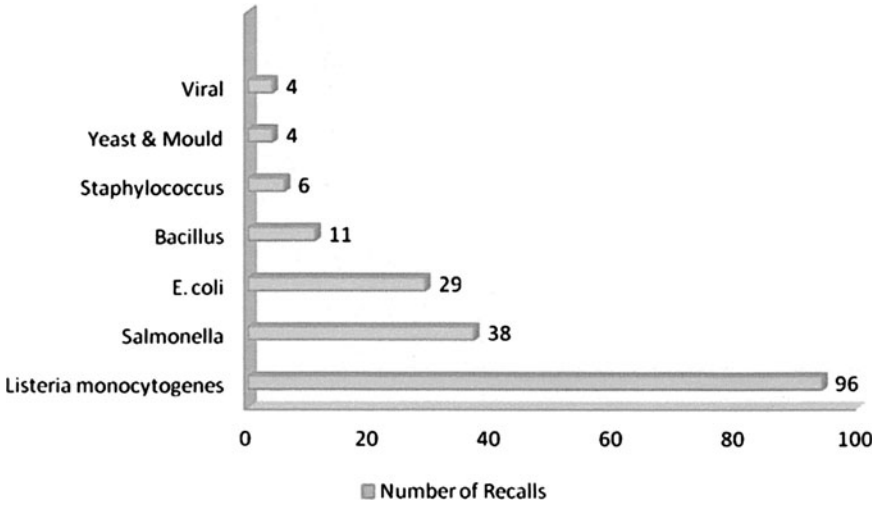

FIG. 2. Organisms associated with food recalls in Australia (2001–2010).

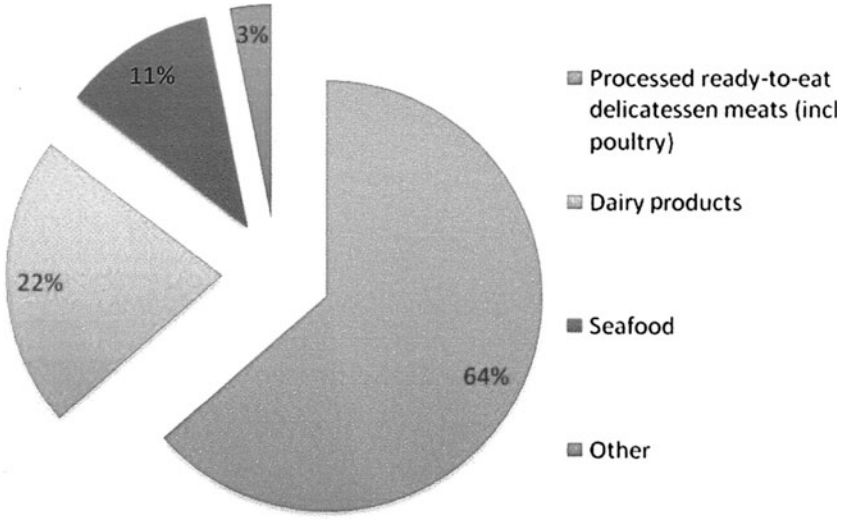

FIG. 3. Food recalls by food group due to *Listeria monocytogenes* spoilage, Australia (2001–2010).

were notified and investigated at the state and territory level only, with limited or no molecular typing of *Listeria* isolates (The OzFoodNet Working Group, 2010). The outbreak associated with the airline food was a stimulus for the development of a national molecular surveillance plan for listeriosis (The OzFoodNet Working Group, 2009). OzFoodNet's proposal for enhanced surveillance of Listeria received full support by Australia's Public Health Laboratory Network and was implemented in 2010. As part of the program it is a requirement for each state and territory to conduct interviews when listeriosis cases are notified to public health departments. A nationally standardized questionnaire is administered that addresses questions about food consumption in the month before the onset of symptoms (The OzFoodNet Working Group, 2010). The corresponding *Listeria* isolates are forwarded to public health references laboratories for molecular typing (The OzFoodNet Working Group, 2010). Results are entered onto a web-based database (Net-Epi) (The OzFoodNet Working Group, 2009). OzFoodNet epidemiologists then conduct a case-by-case analysis, which allows food exposure data to be compared between cases in the cluster of interest and noncluster cases (The OzFoodNet Working Group, 2010). If a statistical association is identified between a case of listeriosis and a particular food, an outbreak investigation is initiated (The OzFoodNet Working Group, 2010). With this national approach, the surveillance of *Listeria* in Australia has been significantly boosted (The OzFoodNet Working Group, 2010). The initiative will assist with the timely detection and investigation of clusters of human *Listeria* infections, linking cases of listeriosis across multiple jurisdictions and identifying outbreaks, thus enabling timely public health action (The OzFoodNet Working Group, 2010).

The implementation of the enhanced *Listeria* surveillance scheme helped identify one multijurisdictional outbreak during 2010 (The OzFoodNet Working Group, 2010). Although it was of small scale, with nine cases and two deaths, the outbreak highlighted the importance of nationally coordinated surveillance for *Listeria.* The OzFoodNet network initially recorded a rise in a common strain of *L. monocytogenes*, which resulted in an immediate public health investigation (The OzFoodNet Working Group, 2010). The early detection of the outbreak can be attributed to the sharing of national molecular typing data, which was enabled by the introduction of the enhanced surveillance initiative for *Listeria.* The OzFoodNet working group confirmed that consumption of rockmelons grown in a specific region of New South Wales was associated with the outbreak (The OzFoodNet Working Group, 2010). As part of a separate investigation, the same strain of *L. monocytogenes* was also found in rockmelons used to make fruit salads by two food premises (The OzFoodNet Working Group, 2010). In response, the New South Wales Food Authority in corporation with the New South Wales Department of Primary Industries designed and distributed an information booklet targeting melon producers. The aim of the package was to raise awareness of the 2010 outbreak, highlight risks associated with food spoilage by *L. monocytogenes*, and to provide information on manufacturing strategies that may help prevent future contamination incidents (The OzFoodNet Working Group, 2010). Data gathered from outbreak investigations such as the ones discussed in this study highlight the constant challenges posed by this food pathogen (Food Standards Australia New Zealand, 2001). What is also clear is the reliance on epidemiological data (Allos *et al.,* 2004). The rapid detection and successful investigation of outbreaks also emphasizes the contributions of OzFoodNet and particularly the recently implemented *Listeria* surveillance initiative (Food Standards Australia New Zealand, 2001; The OzFoodNet Working Group, 2010).

Food recall statistics revealed in this study depict the extent of food spoilage due to *L. monocytogenes* in Australia (Food Standards Australia New Zealand, 2010). The food recall and outbreak investigation data gathered have revealed that ready-to-eat foods in particular are high-risk vehicles for transmitting listeriosis (Food Standards Australia New Zealand, 2010; The OzFoodNet Working Group, 2010). Foods in this category include unpasteurized milk and products prepared from unpasteurized milk, soft unfermented cheeses, unreheated frankfurters, delicatessen meats, poultry products, and certain seafood (Mead *et al.,* 2006;

Swaminathan and Gerner-Smidt, 2007; Food Standards Australia New Zealand, 2010). As ready-to-eat products such as delicatessen meats are usually preserved by refrigeration, they offer an appropriate environment for the survival and proliferation of *L. monocytogenes* (Doumith *et al.,* 2004; Koch and Stark, 2005; Doorduyn *et al.,* 2006). As a result, one may question whether ready-to-eat products are less safe considering the high number of food recalls. This is difficult to ascertain, as food safety is the product of complex interactions between numerous factors (Gottlieb *et al.,* 2006; Mead *et al.,* 2006). Although the number of food recalls due to *L. monocytogenes* is high, it should be noted that the vast majority of recalls due to *Listeria* are the direct result of food businesses conducting internal testing (Food Standards Australia New Zealand, 2010). Rigorous recall criteria in Australia highlight the commitment of the government and food authorities in preventing microbial contamination of products sold in the Australian food market (Food Standards Australian New Zealand, 2010).

Australia is internationally renowned for stringent food standards (The OzFoodNet Working Group, 2004). According to the Australian Food Standards Code, a zero-tolerance approach has been adopted, especially for ready-to-eat foods, which are at higher risk of *Listeria* contamination (Food Standards Australia New Zealand, 2001). However, as *L. monocytogenes* is difficult to eradicate, additional prevention strategies may need to be considered. The newly implemented enhanced *Listeria* surveillance initiative may assist in minimizing the prevalence of *Listeria* contamination (The OzFoodNet Working Group, 2010). Commencing in 2009, the OzFoodNet network has been requesting molecular typing results for all reported *Listeria* infections (at least PCR serogroup and binary type); however, the typing method employed is at the discretion of the laboratory processing the sample. As part of this new program, specific *L. monocytogenes* genotypes identified with human cases of listeriosis are screened against food isolates through investigations associated with food recalls (The OzFoodNet Working Group, 2010). Genotyping food and environmental isolates may also assist in targeting the source of contamination, thus helping food businesses identify errors in their manufacturing practices and food safety protocols (The OzFoodNet Working Group, 2010). Such enhanced surveillance practices may help identify potential *Listeria* outbreaks and save food businesses from financial losses associated with food recalls (Ammon and Tauxe, 2007).

The findings presented in this study are a snapshot of listeriosis in Australia. The data are useful for determining potential areas of future public health research. It is imperative to note the limitations of the data used to conduct this investigation. There are several obstacles to reporting to the Australian National Notifiable Diseases Surveillance System (Flint *et al.,* 2005; The OzFoodNet Working Group, 2007). Surveillance data collected by health departments are actually an underestimate of the true burden of foodborne disease and listeriosis (The OzFoodNet Working Group, 2002; Lynch *et al.,* 2006). Most foodborne illnesses under surveillance by state health departments are not reported, as only a limited number of people infected with food pathogens like *Listeria* seek medical treatment and subsequently submit specimens for testing (Flint *et al.,* 2005; Hall *et al.,* 2005; Hoffman *et al.,* 2005). Although there are limitations due to the failure of cases being reported, this study is important as it provides a credible collation of data on listeriosis from Australia's most comprehensive foodborne disease surveillance system. The ability of the OzFoodNet network to conduct foodborne disease research successfully has been demonstrated on numerous occasions since its conception in 2000 (Scallan, 2007; The OzFoodNet Working Group, 2008).

Conclusion

Conclusively, Australia has a well-deserved reputation for a safe and clean food supply (Hall *et al.,* 2005). Recent changes in food consumption habits will undoubtedly create new food safety and public health concerns (Sobel *et al.,* 2002; Van Pelt *et al.,* 2003; Allos *et al.,* 2004; Hall *et al.,* 2012). An increased market demand for convenience food is clearly evident in Australia even though products with an extended shelf life, such as ready-to-eat foods, carry inherent risks of increased contamination by *L. monocytogenes* (Hall *et al.,* 2005; Lyytikainen *et al.,* 2006). The occurrence of *Listeria* outbreaks and food recalls in Australia will continue to be affected by processing and production failures (Cartwright *et al.,* 2013). On the basis of Australian food recall and outbreak data, it is apparent that food safety in this country represents a major challenge requiring continued vigilance and high levels of foodborne disease surveillance (The OzFoodNet Working Group, 2002; Food Standards Australia New Zealand, 2010). The newly implemented enhanced national mechanism of *Listeria* surveillance will prove to be crucial in source tracking contamination from food-processing plants and in revealing food safety deficiencies (The OzFoodNet Working Group, 2010). Molecular typing of *Listeria* isolates complements traditional methods (Doumith *et al.,* 2004). Collation of such data on a national level has already proven to assist in the timely detection of food outbreaks involving *L. monocytogenes* (The OzFoodNet Working Group, 2010). Whether an aging population will contribute to an increase in *Listeria* notification rates in Australia as it has in other developed countries with similar demographic characteristics is yet to be determined (De Valk *et al.,* 2005; Doorduyn *et al.,* 2006; Bouwknegt *et al*., 2013).

Disclosure Statement

No competing financial interests exist.

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