A review of listeriosis notifications and co-existing conditions in New South Wales, 2010-2015

Kit Leung, Kirsty Hope and Vicky Sheppeard

# Abstract

## Aim

To describe the distribution of known risk factors for listeria infection, including co-existing conditions, among listeriosis notifications in NSW between 2010 and 2015.

## Methods

Data from all notifications of invasive listeriosis in NSW between 01 January 2010 and 31 December 2015 were extracted from the NSW Notifiable Conditions Information Management System (NCIMS). OzFoodNet Listeria Case Questionnaires for each notification were reviewed. Descriptive analyses of notification data were undertaken.

## Results

Between 2010 and 2015, there were 158 listeriosis notifications in NSW with an average of 26.3 notifications a year. Persons over 65 years represented 71.5% of all notifications. A total of 4.4% notifications were among pregnant women, while 79.1% and 64.6% were among persons with a condition and on treatment, respectively, known to supress the immune response or increase the risk of infection. Specifically, cancer patients and persons on cancer treatment (chemotherapy, radiotherapy) represented 31.0% and 13.9%, respectively, of all listeriosis notifications. Information on foods to avoid in preventing listeria from a healthcare worker prior to infection was received by 7.2% of notifications with a known risk condition and 5.9% of notifications on medication; 41.6% and 46.1% respectively had visited a hospital in the four weeks prior to notification.

## Conclusion

The prevalence of known risk factors for listeriosis among notified cases remains significant in NSW. Improved risk communication for this population, starting with information from healthcare professionals, may be beneficial in reducing the burden of listeriosis in known vulnerable groups who have regular contact with the health system.

Key words: Listeria monocytogenes, listeriosis, immunocompromised conditions, immunosuppressant medications, cancer, risk factors, patient information, Australia

# Introduction

Listeriosis is a rare food-borne illness associated with high hospitalisation and fatality rates among those infected, particularly in the elderly, pregnant women and persons with weakened immune systems. The average case fatality rate among hospitalisations is estimated to be between 20%–30% 1-3 , with studies showing patients with an underlying condition having higher case fatality rates of up to 40%.4-6 Listeriosis which is caused by the gram-positive bacterium Listeria monocytogenes can be transmitted from person to person, but is commonly transmitted through the consumption of contaminated food including meat, poultry and dairy products, and through utero/placental transmission in infected pregnant women.7 The incubation period can be up to 70 days and will vary depending on the form of listeriosis.8,9 Invasive listeriosis is determined by the presence of L. monocytogenes in the blood, in the fluid of the central nervous system or infection of the uterus in the case of pregnancy, with a clinical presentation of septicaemia, meningitis and miscarriage.3 Main risk factors for infection are age, a weakened immune system (due to underlying medical conditions or the use of immunosuppressant therapies), pregnancy and exposure to a high dose or a highly-virulent strain.10 In the general population, most infections of L. monocytogenes are without symptoms or manifest as a mild gastroenteritis illness, often remaining unsuspected or unreported.1,11

Increased risk of listeriosis has been associated with: immunocompromising conditions such as HIV, leukaemia, and autoimmune diseases; immunosuppressing treatments, such as those used to treat malignancies (chemotherapy, radiotherapy) or prepare patients for organ transplants (systemic steroids); certain chronic medical conditions such as heart disease, diabetes, liver disease, renal disease, cancer, and alcohol dependency; and persons on medication associated with gastrointestinal tract infection (gastric acid inhibitors).11-14 A number of studies estimate that immunocompromised persons are between 100 - 2,500 times more likely to develop listeriosis, when compared to ‘healthy’ adults.1,4

Since standardised reporting of listeriosis in 1991, rates of notification have stabilised over the last decade across Australia. With an average of 80.4 cases reported per year (2009-2014), Australia has a notification rate of 0.3 per 100,000 population. 15 New South Wales (NSW) state accounts for a significant proportion of notifications and has with a mean notification rate of 0.4 per 100,000 (2009-2014).15

In Australia, few studies have examined the distribution of persons with immunocompromising conditions or receiving immunosuppressing treatments among listeriosis notifications. Studies to date, including that done by Popovic and authors, have analysed general epidemiological trends such as age, sex, pregnancy status, links to outbreaks, exposures and distribution across jurisdictional boundaries.16 A case-control study by Dalton and authors identified prior hospitalisation, use of gastric acid inhibitors and consumption of camembert to have been associated with an increased risk of listeriosis among non-perinatal notifications.17 Australia is expected to have similar epidemiological trends as other high-income countries, where persons with co-existing conditions, in particular those that affect the immune system, present at higher rates than the general population. A study in the UK found that among listeriosis notifications for a 10 year period, patients with co-existing malignancies accounted for more than one third of notifications and cancer patients had a 5 fold-increased risk for developing listeriosis.18 In Israel, a retrospective study showed 74% of non-perinatal infections involved immunocompromised patients with malignancies, chronic liver disease, chronic renal failure, or diabetes mellitus.19

In Australia, education and communication campaigns on the risks of listeriosis and preventative measures for pregnant women and maternal healthcare providers are well established and notification rates among this population remain low.20 There is a need to better understand the incidence of other risk groups, namely immunocompromised persons, among cases of listeriosis to better target risk reduction efforts in the future.

The aim of this study is to describe the distribution of patients with co-existing conditions and other known risk factors among known cases of listeriosis by examining the demographic and clinical characteristics, and risk factors for infection of notified cases between 2010 and 2015 in NSW, Australia.

# ****Methods****

## ****Data sources****

Listeriosis notification data were extracted from the NSW Notifiable Conditions Information Management System (NCIMS). Under the authority of the NSW Public Health Act 2010, all listed conditions, including invasive listeriosis, must be reported to public health units from general practitioners (GPs), hospitals, and pathology laboratories. Data were included in the study when the year of diagnosis (defined as symptom onset or in lieu of this, the specimen collection date) was between 01 January 2010 and 31 December 2015, The Australian enhanced foodborne disease surveillance network (OzFoodNet) Listeria Case Questionnaires for each case were reviewed where key data of interest was missing in the NCIMS database including whether the patient had cancer or was receiving immunosuppressant medications or treatment at the time of listeriosis diagnosis. OzFoodNet standardised Listeria Case Questionnaires are administered to all invasive listeriosis cases in NSW by public health units, capturing information on case demographics, risk factors, food history and laboratory data.

Responses in the questionnaire of both the attending clinician and the patient/caregiver themselves were included for analysis. Where there was an affirmative response from either treating clinician or patient/caregiver, a record was counted as affirmative, where there was no response recorded by either respondent, it was assumed negative.

Descriptive analyses of notification data were undertaken. Results were compared across demographics (age, gender, and pregnancy status), known risk factors (co-existing conditions, treatments, medications and foods consumed) and previous exposure to healthcare resources (visits and admissions to hospital, information received from healthcare workers) for the study period.

## ****Definitions**** (Case definition)

For the purpose of this study, a case is defined as a NSW resident with invasive listeriosis; confirmed by isolation or detection of L. monocytogenes from a site that is normally sterile, including fetal gastrointestinal contents, and whose symptom onset or specimen collection date was between 01 January 2010 and 31 December 2015. Only data for NSW was included and linked notifications (where both mother and neonate were both infected) were removed and the data for the mother only included.

Grouped response categories were created for study variables, treatments and food exposures, in order to analyse trends in risk. Response categories for treatments administered at the time of illness were created using responses to the question in the Listeria Case Questionnaire: in the 4 weeks prior to illness, were you taking any of the following treatments? (Table 1). Response categories for food exposures with a known high risk of Listeria monocytogenes transmission in Australia were created using the responses to the question: in the 4 weeks prior to illness, did you consume any of the following? (Table 1). Where ‘other’ or ‘comments’ were recorded for treatment and co-existing conditions in the questionnaire, data were reviewed by a medical registrar for inclusion in available categories where relevant to reduce measurement bias. In total, 32 conditions and 11 treatment responses recorded as ‘other’ were redistributed to available categories after review. Remaining ‘other’ medications and treatments were not included for analysis as they were not related to impeding the immune system or having a known risk associated with listeriosis.1

**Table 1. Definition of study variables**

| Risk category | Study variable | Data included\* |
| --- | --- | --- |
| **Treatments administered at the time of illness** | systemic steroids | corticosteroids (eg. prednisone) |
| immunosuppressants | cyclosporine other drugs that affect the immune system |
| cancer treatments | chemotherapy radiation therapy |
| antibiotics, antidiarrhoeals, antacids or other medication which reduces stomach acid | antidiarrhoeal medication (eg. Llomotil, Imodium) antacids (eg. Mylanta, Mucaine) medications that reduce stomach acid (e.g. Zantac, Tagamet, Somac, Losec) antibiotics other |
| **Food exposure with a known high risk of Listeria monocytogenes transmission in Australia** | pre-prepared fruit | fruit salad self-service salad bar, fruit salad delicatessen |
| soft cheeses | brie, camembert, blue veined, fetta, ricotta, mozzarella, other soft cheese |
| unpasteurised cheese/milk | unpasteurised cheese, unpasteurised milk |
| cold cooked chicken | cold cooked chicken |
| deli bought meat | BBQ chicken, luncheon/sandwich meat, ham, salami, chicken/turkey slices, silverside, liverwurst, frankfurts |
| pate | pate |
| pre-prepared salad | pre-prepared potato salad, pre-prepared coleslaw, pre-prepared pasta salad |
| cold/uncooked seafood | mussels, crab, prawns purchased cooked, prawns purchased cold, oysters, smoked salmon, other smoked fish/salmon, sushi/sashimi, other seafood |
| sandwich fillings | sandwiches/burgers/rolls containing ham, beef, bacon/lettuce/tomato, chicken, turkey, other meat, salad, cheese |
| \* OzFoodNet Listeria Case Questionnaire response categories | | |

## ****Descriptive analysis****

Descriptive analyses of notification data were undertaken using SAS® Enterprise Guide® (version 4.3, SAS Institute, Cary, NC, USA) and EXCEL (Microsoft, version 2010).

# ****Results****

Between 2010 and 2015, there were 158 listeriosis notifications in NSW with an average of 26.3 notifications a year. Notifications were notably higher in 2012 and 2013, with 32 and 30 notifications, respectively (Figure). There was equal distribution between males and females (79 females, 79 males) with a high proportion of notifications over 65 years, representing 71.5% (n=113) of all notifications. A total of 4.4% (n=7) of notifications were among pregnant women, while 79.1% (n=125) and 64.6% (n=102) were among persons with a condition or on treatment, respectively, known to suppress the immune response or increase the risk of infection (Table 2).

****Table 2. Characteristics of listeriosis notifications in NSW between 1 January 2010 to 31 December 2015****

| Year of notification | No. (%) notifications |
| --- | --- |
| 2010 | 26 (16.5%) |
| 2011 | 20 (12.7%) |
| 2012 | 32 (20.3%) |
| 2013 | 30 (19.0%) |
| 2014 | 23 (14.6%) |
| 2015 | 27 (17.1%) |
| Total | 158 (100.0%) |
| **Sex** |  |
| Female | 79 (50.0%) |
| Male | 79 (50.0%) |
| **Age group** |  |
| 0-4 | 1 (0.6%) |
| 25-29 | 2 (1.3%) |
| 30-34 | 5 (3.2%) |
| 35-39 | 2 (1.3%) |
| 40-44 | 4 (2.5%) |
| 45-49 | 4 (2.5%) |
| 50-54 | 6 (3.8%) |
| 55-59 | 5 (3.2%) |
| 60-64 | 6 (10.1%) |
| ≥ 65 years | 45 (28.5%) |
| **Pregnancy status** |  |
| Pregnant | 7 (4.4%) |
| Not pregnant | 150 (94.9%) |
| Unknown | 1 (0.6%) |
| **Co-existing conditions\*** |  |
| ≥ 1 co-existing condition | 131 (82.9%) |
| ≥ 1 co-existing condition known to supress the immune response or increase the risk of infection | 125 (79.1%) |
| Cancer | 49 (31.0%) |
| Heart disease | 48 (30.4%) |
| Rheumatological condition | 30 (19.0%) |
| Blood disorder | 29 (18.4%) |
| Liver disease | 28 (17.7%) |
| Diabetes (insulin) | 25 (15.8%) |
| Chronic lung disease (excluding asthma) | 18 (11.4%) |
| Renal or kidney disease requiring dialysis | 17 (10.8%) |
| Other renal disease | 14 (8.9%) |
| Diabetes (non-insulin) | 9 (5.7%) |
| Organ transplant | 9 (5.7%) |
| Other condition | 56 (35.4%) |
| **Medications or treatments\*** |  |
| ≥1 medication or treatment known to suppress the immune response or increase the risk of infection | 102 (64.6%) |
| ≥1 immunosuppressant medication | 62 (39.2%) |
| Systematic steroids | 50 (31.6%) |
| Cyclosporine or other drugs affecting the immune system | 21 (13.3%) |
| Cancer drugs (radiotherapy or chemotherapy) | 22 (13.9%) |
| Antibiotics, antidiarrhoeals, antacids or other medication which reduces stomach acid | 79 (50.0%) |
| Antidiarrhoeal medication | 9 (5.7%) |
| Antacids | 27 (17.1%) |
| Medications that reduce stomach acid | 45 (28.5%) |
| Antibiotics | 42 (41.2%) |
| \* percentage of all notifications | |

Underlying conditions known to suppress the immune response or increase the risk of infection included cancer (31.0% of all notifications), heart disease (30.4%), rheumatological conditions (19.0%), blood disorders (18.4%), and liver disease (17.7%) (Table 2). Treatments or medication known to suppress the immune response or increase the risk of listeriosis in the 4 weeks prior to notification included antidiarrhoeal, antacids and antibiotics (taken by 50.0% of all notifications) and systemic steroids (31.7%). At lower rates, cancer drugs and immunosuppressants were taken by 13.9% and 13.3% of notifications, respectively (Table 2).

****Figure. Number of listeriosis notifications in NSW between 1 January 2010 to 31 December 2015, by quarter and year of illness onset****

Figure is a bar graph showing the number of listeria notifications by year (2010-2015) and quarter in NSW.
• Listeriosis notifications range between 3 and 16 for each quarter 
• Quarter 1 in 2010 and 2013 show the highest number of listeriosis notifications with 16 and 13 notifications, respectively. 
• All quarters between 2010 and 2015 report listeriosis notifications expect for quarter 3 in 2010. 
• There is no apparent trend in notifications over time. 


Consumption of high risk foods was frequently reported in the 4 weeks prior to infection; consumption of deli meats, cold seafood, and soft cheeses were reported by 69.6%, 60.8% and 47.5% of respondents, respectively (Table 3). Similar levels of exposure were reported when controlling for having at least one co-existing condition (72.0%, 62.4% and 48.8% respectively), and being on at least one treatment (73.3%, 62.7% and 50.0% respectively).

****Table 3. Consumption of high risk foods among listeriosis notifications in NSW between 1 January 2010 to 31 December 2015****

| Consumption in the 4 weeks prior to illness | Notifications | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| All | | ≥ 1 co-existing condition\* | | ≥1 medication or treatment\* | |
|  | n | % | n | % | n | % |
| Deli meats | 110 | 69.6% | 90 | 72.0% | 75 | 73.5% |
| Cold or uncooked seafood | 96 | 60.8% | 78 | 62.4% | 64 | 62.7% |
| Soft cheeses | 75 | 47.5% | 61 | 48.8% | 51 | 50.0% |
| Sandwich filings | 65 | 41.1% | 53 | 42.4% | 42 | 41.2% |
| Cold cooked chicken | 35 | 22.2% | 25 | 20.0% | 18 | 17.6% |
| Pre-prepared salad | 35 | 22.2% | 29 | 23.2% | 24 | 23.5% |
| Pre-prepared fruit | 17 | 10.8% | 15 | 12.0% | 14 | 13.7% |
| Pate | 17 | 10.8% | 13 | 10.4% | 9 | 8.8% |
| Unpasteurised cheese or milk | 13 | 8.2% | 9 | 7.2% | 6 | 5.9% |
| Total respondents | 158 | 100.0% | 125 | 100.0% | 102 | 100.0% |
| \* known to suppress the immune response or increase risk of infection | | | | | | |

Contact with a healthcare professional prior to notification was relatively high among all notifications; 38.6% of all notifications visited a hospital (day visit) in the 4 weeks prior to onset of symptoms, and 28.5% were admitted to hospital during the same period. This was observed at slightly higher rates for notifications with a co-existing condition known to suppress the immune response or increase the risk of infection; 41.6% and 31.2% of notifications had visited and were admitted to a hospital prior to illness, respectively. Persons on at least one treatment known to suppress the immune response or increase the risk of infection also showed similar results; 46.1% and 35.3% had visited and were admitted to a hospital prior to illness, respectively (Table 4).

Receiving information from a healthcare worker about foods to avoid prior to illness was relatively low among all notifications; only 7.0% (n=11) of all notifications reported receiving information on foods to avoid from a healthcare worker. Among notifications with at least one condition or on medications known to suppress the immune response or increase the risk of infection, 7.2% and 5.9%, respectively, had received such information (Table 4).

****Table 4. Contact with a healthcare professional prior to illness among listeriosis notifications in NSW between 1**** ****January 2010 to 31 December 2015****

|  | Notifications | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| All (158) | | ≥ 1 co-existing condition\* (125) | | ≥1 medication or treatment\* (102) | |
| n | % | n | % | n | % |
| Contact with a health care professional in the 4 weeks prior to illness | | | | | | |
| Day visit to hospital | 61 | 38.6% | 52 | 41.6% | 47 | 46.1% |
| Admitted to hospital | 45 | 28.5% | 39 | 31.2% | 36 | 35.3% |
| Information received from healthcare professional on foods to avoid to prevent listeria | 11 | 7.0% | 9 | 7.2% | 6 | 5.9% |
| \*known to suppress the immune response or increase risk of infection | | | | | | |

# Discussion

This paper provides recent data on the prevalence of conditions and treatments known to increase risk of listeria infection among residents of NSW, indicating potential areas for improved clinical management and risk reduction strategies. Between 2010 and 2015, persons with a co-existing condition or on treatment known to suppress the immune response or increase the risk of infection, represented a considerable proportion of listeriosis notifications; 79.1% (125) and 64.6% (102) of all notifications, respectively. Malignancies, heart disease, rheumatological conditions and blood diseases, and antidiarrhoeal, antacids and antibiotics drugs, systemic steroids and cancer drugs specifically, were all frequently reported in persons with Listeria infection. Cancer patients accounted for a third of all listeriosis notifications in the reporting period. This is compared to other known risk factors including aged over 65 years (71.5%) and pregnancy (4.3%). Information on foods to avoid to prevent listeriosis provided by a healthcare worker prior to illness was received by relatively few notifications with a known risk factor: 7.2% of notifications with a known risk condition and 5.9% of notifications on medication reported receiving information reporting receiving such information. This was found despite relatively high levels of contact with health professionals prior to infection: 56.8% and 63.7% respectively had visited or been admitted to a hospital in the four weeks prior to illness.

This study is one of few studies to look at the distribution of immunocompromised persons among listeriosis notifications in Australia17, and the first to look at distribution in NSW over a 5-year period. Data extracted from notification records and a standardised questionnaire (OzFoodNet Listeria Case Questionnaire) was utilised throughout the study period, making it an appropriate data source for presenting long term trends. The limitations of this study include the use of self-reported data provided in the questionnaire on exposures and treatment regimens from patients and their caregivers prior to illness, potentially leading to recall bias, and the use of pre-fixed categories for treatments and conditions in the standardised questionnaire, which may have led to measurement bias depending on the person collecting the data. Further the questionnaire does not include separate disease categories for autoimmune diseases and HIV, which are associated with increased risk of infection, leading to potential underreporting of trends in these specific vulnerable populations. Incomplete recording of data by surveillance officers due to time constraints or data entry errors may have also occurred, leading to underreporting of certain conditions or exposures. Where possible this study compared both patient and treating clinician responses to the standardised questionnaire and reviewed conditions and treatment responses to ensure they had not been incorrectly categorised during data collection, adjusting where possible for measurement bias. It is also likely that perinatal cases are underreported, due to under recognition and subsequent testing of early stage miscarriages due to listeriosis not being suspected in the event of an adverse maternal outcome. Fatality outcomes were not used in this study due to incomplete data collection, however might be a useful variable in future analysis. Outbreak data during the study period were not examined and variation between variables in sporadic versus outbreak cases may also be considered in future research in cases among this population group.

Our findings suggest that, similar to studies in other industrialised countries 5, 18-19 ; immunocompromised persons, either with a primary immunodeficiency (a chronic condition suppressing the immune response) or receiving treatment or therapy that temporarily suppresses the immune system (chemotherapy, radiotherapy, systematic steroids), represents a significant proportion of listeriosis notifications. Findings are also consistent with those in a national case-control study, where cancer and use of antibiotics, systematic steroids and antibiotics were associated with risk of infection and were also found in significant proportion of cases.17 These results identify specific patient groups in NSW who could benefit from targeted food safety messages to reduce further infections.

Reducing the risk and subsequent burden in susceptible populations has long been the focus of listeriosis control measures in Australia as well as a number of industrialised countries. With the decline of listeriosis notifications among pregnant women over the years, there is encouraging evidence to suggest that targeted strategies in food safety in the food industry, enhanced surveillance and the adoption of protective behaviours by consumers have worked to reduce the incidence of listeriosis in this specific group. Understanding trends of listeriosis among persons with identifiable risk factors can provide useful information to further reduce the disease burden in the population. The significant burden of cancer among Australians 21 and the associated risk of listeriosis with cancer and commonly used cancer treatments and therapies17, raises a concern regarding current risk reduction measures targeted at cancer patients. Currently in Australia, food safety information is generally incorporated into consultations by dieticians and nurses on admission to hospital. The extent to which such advice is routinely provided by general practitioners and other primary healthcare providers who may provide long term care for cancer patients and other immunocompromised persons, is not well understood. Currently there are limited standardised information and resources available on food-borne diseases, immunocompromised persons and relevant food safety advice in Australia, leaving clinicians and health facilities to compile their own resources. This study shows that few immunocompromised persons who developed listeriosis, could recall receiving any information, suggesting room for improvement.

Communication of the significant proportion of immunocompromised persons among listeriosis notifications and development of key risk reduction messages for use by clinicians would be one step towards reducing the burden of the disease. Healthcare professionals, including those working in primary healthcare and key facilities frequented by immunocompromised patients including departments of oncology, haematology, aged-care and in-patient wards should be prioritised for targeted information and resources based on their frequent contact with the group at risk. Risk communication materials for clinicians of immunocompromised patients, including cancer patients, have been developed in other countries including the US.

There are a number of challenges in delivering food safety information to immunocompromised groups that should not be overlooked, such as the personal choice to prioritise food safety among persons with a terminal illness and the positioning of such information at a time when persons undergoing treatment or have been newly diagnosed are provided with large volumes of information.

Further research into clinicians’ understanding of associated risk factors, current trends in risk, relevant communication channels and barriers to adopting preventative behaviours by patients and their caregivers should be explored to better understand which risk communication strategies would be best suited for immunocompromised persons.

# ****Conclusion****

The prevalence of known risk factors for listeriosis among notified cases remains significant in NSW. Improved risk communication for this population, starting with information from healthcare professionals, may be beneficial in reducing the burden of listeriosis in known vulnerable groups who have regular contact with the health system.

## ****Ethics considerations****

Data has been de-identified for the use of this report. Data was collected under the NSW Public Health Act 2010.

# ****Acknowledgements****

Dr Katherine Todd, Brett Archer

# ****Author details****

Ms Kit M. Leung1, Public Health Officer

Dr Kirsty G. Hope2, Manager, Enteric and Zoonotic Diseases

Dr Vicky Sheppeard2 Director, Communicable Diseases Branch

1 New South Wales Ministry of Health, Sydney, New South Wales, Australia

2 Health Protection New South Wales, Sydney, New South Wales, Australia

Corresponding author: Kit Leung. Current postal address: 1A Tusculum Street, NSW 2011, Australia. Telephone: +61 481371586. Email: [kitminghk@gmail.com](mailto:kitminghk@gmail.com)

# ****References****

1. World Health Organization (WHO). Risk assessment of Listeria monocytogenes in ready-to-eat foods: technical report. Food & Agriculture Org. 2004.
2. Swaminathan B, Gerner-Smidt P. The epidemiology of human listeriosis. Microbes and Infection. 2007 Aug 31;9(10):1236-43.
3. Vázquez-Boland JA, Kuhn M, Berche P, Chakraborty T, Domínguez-Bernal G, Goebel W, González-Zorn B, Wehland J, Kreft J. Listeria pathogenesis and molecular virulence determinants. Clinical microbiology reviews. 2001 Jul 1;14(3):584-640.
4. Goulet, Véronique, et al. “Incidence listeriosis and related mortality among groups at risk of acquiring listeriosis.” Clinical infectious diseases (2011): cir902.
5. Skogberg K, Syrjänen J, Jahkola M, Renkonen OV, Paavonen J, Ahonen J, Kontiainen S, Ruutu P, Valtonen V. Clinical presentation and outcome of listeriosis in patients with and without immunosuppressive therapy. Clinical Infectious Diseases. 1992 Apr 1;14(4):815-21.
6. De Valk, H., et al. “Surveillance of listeria infections in Europe.” Euro surveillance: bulletin Europeen sur les maladies transmissibles, European communicable disease bulletin 10.10 (2005): 251-255.
7. Farber JM, Peterkin PI. Listeria monocytogenes, a food-borne pathogen. Microbiological reviews. 1991 Sep 1;55(3):476-511.
8. Heymann DL, editor. Control of Communicable Diseases Manual. 20th ed. Washington: American Public Health Association; 2015
9. Goulet V, King LA, Vaillant V, de Valk H. What is the incubation period for listeriosis?. BMC Infectious Diseases. 2013 Jan 10;13(1):11.
10. US Food and Drug Administration (FDA). Bad bug book: Foodborne pathogenic microorganisms and natural toxins handbook, 2nd ed. p.100–104. [cited 2017 Nov 17]. Available from: http://www.fda.gov/Food/FoodborneIllnessContaminants/CausesOfIllnessBadBugBook/ucm2006773.htm. Accessed on 19 November 2017 .
11. Ramaswamy V, Cresence VM, Rejitha JS, Lekshmi MU, Dharsana KS, Prasad SP, Vijila HM. Listeria-review of epidemiology and pathogenesis. Journal of Microbiology Immunology and Infection. 2007 Feb;40(1):4.
12. Schuchat A, Swaminathan B, Broome CV. Epidemiology of human listeriosis. Clinical microbiology reviews. 1991 Apr 1;4(2):169-83.
13. Jurado RL, Farley MM, Pereira E, Harvey RC, Schuchat A, Wenger JD, Stephens DS. Increased risk of meningitis and bacteremia due to Listeria monocytogenes in patients with human immunodeficiency virus infection. Clinical Infectious Diseases. 1993 Aug 1;17(2):224-7.
14. Gillespie IA, McLauchlin J, Grant KA, Little CL, Mithani V, Penman C, Lane C, Regan M. Changing pattern of human listeriosis, England and Wales, 2001–2004. Emerging infectious diseases. 2006 Sep;12(9):1361.
15. NNDSS Annual Report Writing Group. Australia’s notifiable disease status, 2014: Annual report of the National Notifiable Diseases Surveillance System. Commun Dis Intell 2016;40(1):E48–E145.
16. Popovic, Igor, Brett Heron, and Catherine Covacin. “Listeria: an Australian perspective (2001–2010).” Foodborne pathogens and disease 11.6 (2014): 425-432.
17. Dalton, C. B., et al. “A national case-control study of risk factors for listeriosis in Australia.” Epidemiology and infection 139.03 (2011): 437-445.
18. Mook P, O’Brien SJ, Gillespie IA. Concurrent conditions and human listeriosis, England, 1999–2009. Emerging infectious diseases. 2011 Jan;17(1):38.
19. Siegman-Igra Y, et al. Listeria monocytogenes Infection in Israel and Review of Cases Worldwide-Volume 8, Number 3—March 2002-Emerging Infectious Disease journal-CDC.
20. Torvaldsen, Siranda, et al. “Listeria awareness among new mothers in Western Australia.” Australian and New Zealand journal of public health 23.4 (1999): 362-367.
21. Australian Institute of Health and Welfare. Cancer in Australia 2017. Cancer series no.101. Cat. no. CAN 100. Canberra: AIHW. 2017.



© Commonwealth of Australia 2018 - ISSN: 2209-6051 (Online)

This work is copyright. You may download, display, print and reproduce the whole or part of this work in unaltered form for your own personal use or, if you are part of an organisation, for internal use within your organisation, but only if you or your organisation do not use the reproduction for any commercial purpose and retain this copyright notice and all disclaimer notices as part of that reproduction. Apart from rights to use as permit­ted by the Copyright Act 1968 or allowed by this copyright notice, all other rights are reserved and you are not allowed to reproduce the whole or any part of this work in any way (electronic or otherwise) without first being given the specific written permission from the Commonwealth to do so. Requests and inquiries concerning reproduction and rights are to be sent to the Online, Services and External Relations Branch, Department of Health, GPO Box 9848, Canberra ACT 2601, or by email to copyright@health.gov.au

Communicable Diseases Intelligence aims to disseminate information on the epidemiology and control of communicable diseases in Australia. Communicable Diseases Intelligence invites contri­butions dealing with any aspect of communicable disease epidemiology, surveillance or prevention and control in Australia. Submissions can be in the form of original articles, short reports, surveil­lance summaries, reviews or correspondence. Instructions for authors can be found in Commun Dis Intell 2016;40(1):E189–E193.

Communicable Diseases Intelligence contributes to the work of the Communicable Diseases Network Australia.

http://www.health.gov.au/cdna

This journal is indexed by Index Medicus and Medline.

**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.

**Editor:** Cindy Toms  
**Deputy Editor:** Phil Wright  
**Editorial and Production Staff:** Leroy Trapani, Kasra Yousefi  
**Editorial Advisory Board:** Peter McIntyre (Chair), David Durrheim, Mark Ferson, John Kaldor, Martyn Kirk  
**Website:** http://www.health.gov.au/cdi

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