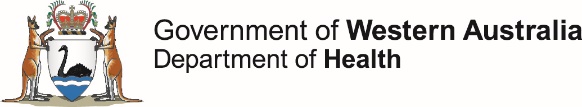
Enteric disease surveillance and outbreak investigations in Western Australia 2022 annual report



**Enhancing foodborne disease surveillance across Australia**



OzFoodNet, Communicable Disease Control Directorate

**Acknowledgments**

Acknowledgement is given to the following people for their assistance with the activities described in this report: the staff from PathWest Laboratory Medicine WA; scientific officers from Environmental Health Directorate of the Department of Health, Western Australia; Public Health Nurses from the metropolitan and regional Population Health Units; and Local Government Environmental Health Officers.

**Contributors/Editors**

Deirdre Collins, Barry Combs, Stacey Hong

Communicable Disease Control Directorate

Department of Health, Western Australia

PO Box 8172

Perth Business Centre

Western Australia 6849

Email: [OzfoodnetWA@health.wa.gov.au](mailto:OzfoodnetWA@health.wa.gov.au)

Telephone: (08) 6376 0514

Web:

OzFoodNet Department of Health, WA

<https://ww2.health.wa.gov.au/Articles/F_I/Infectious-disease-data/Enteric-infection-reports-and-publications-OzFoodNet>

OzFoodNet Department of Health and Ageing

<https://www1.health.gov.au/internet/main/publishing.nsf/Content/cdna-ozfoodnet.htm>

**Disclaimer**:

Every endeavour has been made to ensure that the information provided in this document was accurate at the time of writing. However, infectious disease notification data are continuously updated and subject to change.

PUBLISHED BY

This publication has been produced by the **Department of Health, Western Australia**.

# Executive summary

This report is a summary of enteric disease surveillance activities and outbreak investigations in Western Australia (WA) in 2022. Enteric disease causes a large burden of illness in the WA community. In WA, there are 15 enteric infections and one enteric disease-related condition that are notifiable to the Department of Health. The Department of Health through OzFoodNet (OFN) and other agencies conducts surveillance and investigates outbreaks so that targeted interventions can be used to help prevent further transmission.

In 2022, there were 6117 notifications of enteric disease in WA, which was a rate of 229 per 100 000 population. The 2022 rate was 6% lower than the mean rate for the previous five years. The age group with the highest enteric disease rate was 0-4 years with 561 cases per 100 000 population. The rate of enteric disease for Aboriginal people was 28% higher than for non-Aboriginal people. Of the notified enteric infections with a known place of acquisition, 87% reported acquiring their infection in WA, 12% reported overseas travel and 1% reported interstate travel.

As with previous years, campylobacteriosiswas the most commonly notified enteric disease in 2022 (n=4030/6117; 66%) followed by salmonellosis (n=950/6117; 16%); notification rates are 20% higher and 51% lower than the previous five-year average, respectively. Approximately half of the notifiable enteric diseases in 2022 had lower or comparable rates to the previous five-year average. Some of the decrease in 2022 may be due to overseas and interstate travel restrictions earlier in 2022 and social distancing measures as a result of the COVID-19 pandemic. Notable increases were observed for shiga-toxin producing *E. coli* (n=222, 2.1-fold increase), *Yersinia* (n=31, 1.5-fold increase) and Typhoid fever (n=17, 1.3-fold increase).

**Foodborne and probable foodborne outbreaks**

In 2022, there were seven outbreaks of foodborne or probable foodborne disease investigated in WA that caused at least 78 cases of illness. Of these seven outbreaks, four were caused by *Salmonella* Typhimurium (STM), one outbreak was due to *Salmonella* Oranienburg, one incident was an accidental food poisoning event with tetrahydrocannabinol (THC), and in one outbreak the aetiology was unknown (Table B).

Food vehicles responsible for causing the illness were identified in three outbreaks (43%, n=2). One was raw egg mayonnaise used as a key ingredient in banh mi rolls, one was due to contaminated baby cucumbers. Lastly, there was an incident with THC-in olive oil.

**Table A: Number of foodborne outbreaks investigated in WA by aetiology, 2017 to 2022**

 **Non-foodborne enteric disease outbreaks**

Non-foodborne enteric disease outbreaks and outbreaks with an unknown mode of transmission are a major cause of illness, especially in institutions such as residential care facilities (RCFs) and child care centres (CCCs). There were 155 non-foodborne outbreaks reported in 2022 which resulted in 1810 ill people, 32 hospitalisations and 2 associated deaths. Most of these outbreaks were in RCFs and CCCs and due to person-to-person transmission. The number of outbreaks peaked in the fourth quarter of 2022 with an average of 20 outbreaks per month compared to the second quarter of three outbreaks per month.

# Table of contents

[Executive summary 3](#_Toc133851724)

[Table of contents 5](#_Toc133851725)

[Introduction 8](#_Toc133851726)

[Data sources and methods 10](#_Toc133851727)

[Data sources 10](#_Toc133851728)

[Data collection by Aboriginality 11](#_Toc133851729)

[Regional boundaries 11](#_Toc133851730)

[Calculation of rates 11](#_Toc133851731)

[Definitions 12](#_Toc133851732)

[Site activities during the year 13](#_Toc133851733)

[Surveillance and investigation 13](#_Toc133851734)

[Activities on enhancing laboratory and epidemiological surveillance 14](#_Toc133851735)

[Activities to assist enteric disease policy development 14](#_Toc133851736)

[Strengthening skills and capacity for enteric disease surveillance and investigation 15](#_Toc133851737)

[Conference meetings and presentations 15](#_Toc133851738)

[Incidence of specific enteric diseases 15](#_Toc133851739)

[Botulism 16](#_Toc133851740)

[Campylobacteriosis 16](#_Toc133851741)

[Cholera 18](#_Toc133851742)

[Cryptosporidiosis 18](#_Toc133851743)

[Haemolytic Uraemic Syndrome (HUS) 20](#_Toc133851744)

[Hepatitis A infection 20](#_Toc133851745)

[Hepatitis E infection 21](#_Toc133851746)

[Listeriosis 21](#_Toc133851747)

[Rotavirus infection 22](#_Toc133851748)

[Salmonellosis 24](#_Toc133851749)

[Shiga toxin-producing *E. coli* (STEC) infection 28](#_Toc133851750)

[Shigellosis 30](#_Toc133851751)

[Typhoid and paratyphoid fever 32](#_Toc133851752)

[*Vibrio parahaemolyticus* infection 32](#_Toc133851753)

[*Yersinia* infection 32](#_Toc133851754)

[Gastrointestinal disease outbreaks and investigations 33](#_Toc133851755)

[Foodborne and probable foodborne outbreaks 33](#_Toc133851756)

[Outbreaks due to non-foodborne transmission or with an unknown mode of transmission 37](#_Toc133851757)

[Cluster investigations 39](#_Toc133851758)

[References 42](#_Toc133851759)

[Appendix 1: Number of notifications, notification rate2 and ratio of current to historical mean by pathogen/condition, 2017 to 2022, WA 43](#_Toc133851760)

List of tables

[Table 1 Number and proportion of the top 10 *Salmonella* serotypes notified in WA, 2022, with comparison to the five-year average 27](#_Toc133851761)

[Table 2 The 10 most common *S*. Typhimurium MLVA types reported in 2022 28](#_Toc133851762)

[Table 3 Foodborne and probable foodborne outbreaks, 2022 36](#_Toc133851763)

[Table 4 Outbreaks due to non-foodborne or unknown mode of transmission in WA by setting and agent, 2022 39](#_Toc133851764)

[Table 5 New cluster investigations in WA by month investigation started, setting and agent, 2022 40](#_Toc133851765)

List of figures

[Figure 1 Campylobacteriosis notifications by year and month, WA, 2017 to 2022 17](#_Toc133851766)

[Figure 2 Campylobacteriosis notification rate by age group and sex, WA, 2022 17](#_Toc133851767)

[Figure 3 Campylobacteriosis notification rates by region and Aboriginality, WA, 2022 18](#_Toc133851768)

[Figure 4 Cryptosporidiosis notifications by year and month, WA, 2017 to 2022 19](#_Toc133851769)

[Figure 5 Cryptosporidiosis notification rate by age group and sex, WA, 2022 19](#_Toc133851770)

[Figure 6 Cryptosporidiosis notification rates by region and Aboriginality, WA, 2022 20](#_Toc133851771)

[Figure 7 Place of acquisition for hepatitis A notifications, 2017 to 2022 21](#_Toc133851772)

[Figure 8 Notifications of listeriosis showing non-pregnancy related infections and deaths, and materno-foetal infections and deaths, WA, 2017 to 2022 22](#_Toc133851773)

[Figure 9 Rotavirus notifications by year and month, WA, 2017 to 2022 22](#_Toc133851774)

[Figure 10 Rotavirus notification rates by age group and sex, WA, 2022 23](#_Toc133851775)

[Figure 11 Rotavirus notification rates by region and Aboriginality, WA, 2022 24](#_Toc133851776)

[Figure 12 Salmonellosis notifications by year and month, WA, 2017 to 2022 24](#_Toc133851777)

[Figure 13 Salmonellosis notification rate by age group and sex, WA, 2022 25](#_Toc133851778)

[Figure 14 Salmonellosis notification rates by region and Aboriginality, WA, 2022 26](#_Toc133851779)

[Figure 15 Salmonellosis notifications by place of acquisition and year, 2017 to 2022 26](#_Toc133851780)

[Figure 16 STEC notifications by year and month, WA, 2017 to 2022 29](#_Toc133851781)

[Figure 17 STEC notification rates by age group and sex, WA, 2022 29](#_Toc133851782)

[Figure 18 Shigellosis notifications by year and month, WA, 2017 to 2022 30](#_Toc133851783)

[Figure 19 Shigellosis notification rates by age group and sex, WA, 2022 31](#_Toc133851784)

[Figure 20 Shigellosis notification rates by region and Aboriginality, WA, 2022 31](#_Toc133851785)

[Figure 21 Number of non-foodborne gastroenteritis outbreaks by mode of transmission and month, 2022 38](#_Toc133851786)

[Figure 22 Notifications of *S.* Typhimurium MLVA 03-17-09-12-523 in WA 41](#_Toc133851787)

# Introduction

It has been estimated that there are 5.4 million cases of foodborne illness in Australia each year and that the cost of this illness is $1.2 billion per year1. This is likely to be an underestimate of the true cost of enteric illness in Australia as not all enteric infections are caused by foodborne transmission. Other modes of transmission such as person-to-person, animal-to-person and waterborne transmission are also very important in enteric infection. Most enteric infections are preventable through interventions at the level of primary production, institution infection control, and food handling and hand hygiene at food businesses and in households.

This report describes Western Australian enteric disease surveillance and investigations carried out in 2022 by OzFoodNet (OFN) Western Australian (WA) branch and other Western Australian government agencies. Most of the data presented in this report is derived from enteric disease notifications from doctors and laboratories received by the WA Department of Health and are likely to underestimate the true incidence of disease. This data nevertheless remains the most important information on incidence of these infections for surveillance purposes in WA. In addition, norovirus, which is not notifiable, is the most common agent responsible for gastroenteritis illnesses in residential care facilities (RCF) and in the general community.

OFN is part of the Communicable Disease Control Directorate (CDCD) of the WA Department of Health. OFN in WA is also part of a National OFN network funded by the Commonwealth Department of Health2. The mission of OFN is to enhance surveillance of foodborne illness in Australia and to conduct applied research into associated risk factors. The OFN site based in Perth is responsible for the whole of WA. Collaboration between States and Territories is facilitated by circulation of fortnightly jurisdictional enteric surveillance reports, monthly teleconferences, bi-annual face-to-face meetings and through the OFN network. This network also includes communication and consultation with Food Standards Australia New Zealand, the Commonwealth Department of Health, the National Centre for Epidemiology and Population Health, the Communicable Diseases Network of Australia and the Public Health Laboratory Network.

The primary objectives of OzFoodNet nationally are to:

* estimate the incidence and cost of foodborne illness in Australia,
* investigate the epidemiology of foodborne diseases, by enhancing surveillance and conducting studies on foodborne pathogens,
* collaborate nationally to coordinate investigations into foodborne disease outbreaks, particularly those that cross State, Territory and country borders,
* identify foods and commodities that cause human disease, providing relevant information to stakeholders, advocacy for policy development and implementation, and contributing to risk assessments,
* develop and maintain skills and capacity for the epidemiological investigation of foodborne disease.

At a local level, OFN conducts surveillance of enteric infections to identify clusters and outbreaks of specific diseases and conducts epidemiological investigations to help determine the cause of outbreaks. OFN also conducts research into the risk factors for sporadic cases of enteric diseases and develops policies and guidelines related to enteric disease surveillance, investigation and control. OFN regularly liaises with staff from the Population Health Units (PHUs), the Environmental Health Directorate of Department of Health, WA (EHD); and the Microbiology Department (encompassing Environmental and Food, Enteric, Bacteriology, and Microbiology Surveillance laboratories) at PathWest Laboratory Medicine WA (PathWest).

CDCD maintains and coordinates the WA notifiable disease surveillance system and provides specialist clinical, public health and epidemiological training and advice to PHUs. The WA notifiable diseases surveillance system relies on the mandatory reporting by doctors and laboratories of notifiable diseases and disease-related conditions, 16 of which are enteric.

PHUs are responsible for public health activities, which includes communicable disease control, in their WA administrative health regions. There are eight PHUs in WA that are involved with communicable disease surveillance: Goldfields, Great Southern, Kimberley, Metropolitan, Midwest, Pilbara, South West and Wheatbelt. The PHUs monitor residential care facility (RCF) and child care centre (CCC) gastroenteritis outbreaks and provide infection control advice. The PHUs also conduct follow up of single cases of important enteric diseases including typhoid, paratyphoid, hepatitis A and E, cholera and *Shigella dysenteriae*. OFN will also assist with the investigation of these enteric diseases if there is a cluster and/or they are locally acquired. In addition, OFN will investigate gastroenteritis outbreaks due to probable foodborne transmission in RCF and CCC settings.

The EHD liaises with Local Government (LG) Environmental Health Officers (EHOs) during the investigation of food businesses, and coordinates food business investigations when multiple LGs are involved.

The Environmental and Food, Enteric, Bacteriology laboratories at PathWest provide routine diagnostic services. The Microbiology Surveillance laboratory provide genomic data to inform and enhance outbreak investigations carried out by OFN.

# Data sources and methods

### **Data sources**

Data on WA cases of notifiable enteric diseases were obtained from the WA Notifiable Infectious Disease Database (WANIDD). The notifications contained in WANIDD are received from medical practitioners and pathology laboratories under the provisions of the Public Health Act 2016 and subsequent amendments, and are retained in WANIDD if WA (for diseases not nationally notifiable)3 or national case definitions are met4.

Notifiable enteric diseases included in this report are botulism, campylobacteriosis, cholera, cryptosporidiosis, haemolytic uraemic syndrome (HUS), hepatitis A infection, hepatitis E infection, listeriosis, rotavirus infection, salmonellosis, shiga toxin-producing *Escherichia coli* (STEC) infection, shigellosis, typhoid and paratyphoid fever, *Vibrio parahaemolyticus* infection and yersiniosis. In March 2023, data for these diseases were extracted from WANIDD by optimal date of onset (ODOO) for the time period 01/01/2017 to 31/12/2022, and exported to Microsoft® Excel V2208. The ODOO is a composite of the ‘true’ date of onset provided by the notifying doctor or obtained during case follow-up, the date of specimen collection for laboratory notified cases, and when neither of these dates is available, the date of notification by the doctor or laboratory, or the date of receipt of notification, whichever is earliest.

Notification data extracted for this report may have been revised since the time of extraction. Subsequent minor changes to the data would not substantially affect the overall trends and patterns.

Information on *Salmonella* and STEC serotypes, *Shigella* species and biotypes, multi-locus variable number tandem repeat analysis (MLVA), multi-locus sequence typing (MLST) and whole genome sequencing (WGS) of certain pathogens was obtained from PathWest, the reference laboratory for WA. Other specialised diagnostic data were obtained from the Microbiological Diagnostic Unit, University of Melbourne and the Australian *Salmonella* Reference Laboratory, Institute of Medical and Veterinary Science (Adelaide).

Information on RCF and CCC outbreaks was collected by PHU staff who forward collated epidemiological and laboratory data to OFN.

### **Data collection by Aboriginality**

For the purposes of this report, the term ‘Aboriginal’ is used in preference to ‘Aboriginal and Torres Strait Islander’ to recognise that Aboriginal people are the original inhabitants of WA.

In WA, there is considerable mobility of Aboriginal people, both within WA and across the Northern Territory and South Australia borders, which means that some Aboriginal people will be patients of more than one health service. Due to the small size of the Aboriginal population in WA (4% of the total population in 2022) and the large number of cases reported in Aboriginal people, inaccuracies in the population estimates of Aboriginal people can have a disproportionate impact on calculated rates. In the preparation of this report, these factors are acknowledged as limitations. Information on Aboriginality is also missing for 4% of enteric notifications in 2022.

### **Regional boundaries**

Notification data is divided into ten WA Health administrative regions based on PHU boundaries. Three of the regions are in the Perth metropolitan area (East, North and South) and seven in the regional areas are Goldfields (GOLD), Great Southern (GSTH), Kimberley (KIMB), Midwest (MIDW), Pilbara (PILB), South West (STHW) and Wheatbelt (WHEAT). For the purposes of this report, the three metropolitan PHUs have been combined into one ‘metropolitan’ (METRO) region.

### **Calculation of rates**

Notification rates were calculated by dividing the number of notifications of infections within the relevant population by the total number of people within that population and were expressed per 100,000 population. WA’s estimated population denominators used for calculation of rates were obtained from Rates Calculator version 9.5.5.1 (Epidemiology Branch, WA Department of Health). The Rates Calculator provides population estimates by age, sex, Aboriginality, year and area of residence, and is based on population figures based upon 2016 Australian Bureau of Statistics Census data. Rates calculated for this report have not been adjusted for age. It should be noted that small numbers of notifications give unstable and imprecise notification rates.

### **Definitions**

**Foodborne outbreak** is an incident where two or more persons experience a similar illness after consuming a common food or meal and epidemiological analyses or microbiological evidence (including food and/or environmental) implicates the meal or food as the source of illness; or the aetiology of the outbreak can only result through foodborne transmission (e.g. *Listeria monocytogenes* infection, ciguatera fish poisoning).

**Probable foodborne outbreak** is an incident where two or more persons experience a similar illness after consuming a common food or meal and compelling descriptive epidemiological evidence implicates the meal or food as the suspected source of illness. This includes outbreaks where the mode of transmission is suspected to be from an ill food handler contaminating food being prepared.

**Probable person-to-person outbreak** is an incident where two or more persons develop gastrointestinal symptoms following exposure to a person or group of people, either known or suspected to be infectious, or an environment where an infected person has been known to have contaminated and onset dates of illness suggest ongoing transmission.

**Unknown outbreak transmission** is an incident where two or more persons experience a similar illness but the mode of transmission is unable to be determined.

***Salmonella* outbreak due to an egg dish** is nominated as the implicated food if

* *Salmonella* is isolated from eggs (from the implicated premises) or from the implicated dish containing eggs (microbiological evidence) OR
* There is analytical evidence that a dish containing eggs was associated with illness OR
* In the absence of microbiological or analytical evidence, an implicated dish is described as an egg dish if it contains raw or undercooked eggs and most cases report eating the dish in the absence of other high-risk foods eaten in common.

# Site activities during the year

During 2022 the following activities and prevention measures were conducted by OFN.

### **Surveillance and investigation**

* Ongoing surveillance of infectious enteric disease in WA
* Investigation of six local foodborne or probable foodborne outbreaks
* Investigation of eleven clusters.
* Investigation of nine listeriosis cases.
* Surveillance of 17 typhoid cases, which includes three probable person-to-person outbreaks.
* Surveillance of 14 hepatitis A cases, which includes two probable person-to-person outbreaks.
* Enhanced surveillance of one HUS case.
* Investigation of *S.* Enteritidis cases with unknown travel history and interviews of six locally acquired cases with a hypothesis generating questionnaire to identify risk factors for the cause of illness.
* Surveillance of 151 person-to-person gastroenteritis outbreaks, including 63 that occurred in RCFs, 74 in CCCs, five in schools, four in private residences, two in workplaces and two in hospitals.
* Investigation of three gastroenteritis outbreaks with unknown mode of transmission, two of which occurred at RCFs.
* Investigation of one probable waterborne outbreak due to STEC.
* Surveillance of 224 cases of STEC and interviewed select acute cases to identify risk factors for the cause of illness.
* Lead investigator in a multi-jurisdictional outbreak investigation of STM MLVA subtype 03-13-07-09-523.
* Participation in other multi-jurisdictional outbreak investigations.

### **Activities on enhancing laboratory and epidemiological surveillance**

* Participation in monthly meetings with EHD staff with a monthly *Salmonella* notifications and outbreak report.
* Initiated discussions with EHD staff regarding the project titled “Source Attribution of Campylobacteriosis Cases in Western Australia”.
* Provision of enteric disease data, interpretation and advice upon request to LG EHOs, laboratory and PHU staff.
* Participation in biannual combined Food unit (EHD), OFN WA and PathWest meetings.
* Participation in monthly national OzFoodNet teleconferences.
* Monitoring of culture-independent nucleic acid amplification diagnostic testing in private and public laboratories and impact on notification rates.
* Addition of illness and exposure data for WA *Listeria monocytogenes* and hepatitis A cases to national enhanced data sets.
* Participation in the WA *Salmonella* Outbreak Response Taskforce activities, which included a final report, oral presentation to the WA Chief Health Officer and a public-facing executive project summary.
* Participation in the AusPathoGen project, which included project planning and discussions, as well as *Salmonella* and *Shigella* national working groups.
* Developing a Research Electronic Data Capture (REDCap) notification tool for facilities to report gastroenteritis outbreaks.
* Provided reports on the emergent multidrug-resistant (MDR) *Shigella* to the WAMRO (Western Australia Multi-Resistant Organism) expert advisory committee.
* Participation in a working group with the aims to devise a national surveillance and public health response to emerging extensively-drug-resistant (XDR) *Shigella* *sonnei* strains.

### **Activities to assist enteric disease policy development**

* Progress of reviewing and transitioning operational directives related to sporadic enteric disease follow up, enteric disease exclusions and the management and reporting of gastroenteritis outbreaks in facilities.
* Documented governance structure on foodborne outbreaks and food poisoning events caused by non-infectious agents.

### **Strengthening skills and capacity for enteric disease surveillance and investigation**

* Delivered a lecture in August to post-graduate university students on foodborne pathogens and outbreak investigations.
* Collaborated with EHD staff to create workshop and lecture material for undergraduate university students on foodborne outbreak investigations and food safety.
* Attendance of REDCap workshop to strengthen general knowledge and utility of REDCap online surveys and databases for enteric disease public health follow up.
* Integration of R programming language to create automated reports.
* Mentoring of two Masters of Applied Epidemiology scholars.

### **Conference meetings and presentations**

* Presented the role of genomics in WA public health management of communicable disease at the AusPathoGen WA meeting in July.
* Presented on the outbreak of *Salmonella* Typhimurium in WA and control measures at the annual Public Health Unit meeting in November.
* Presented at the Australian Society for Microbiologists (ASM) seminar as a guest speaker on the WA *Salmonella* Outbreak Response Taskforce.
* Attended the national OFN face-to-face meeting in Canberra (December).

# Incidence of specific enteric diseases

In 2022, a total 6117 notifications of enteric disease were reported in WA, which was a rate of 229 per 100 000 population. This rate was 6% lower than the mean rate for the previous five years of 242.5 per 100 000 population. The overall rate was heavily influenced by notifications of campylobacteriosis and salmonellosis which comprised 66% and 16% of reports, respectively. The age group with the highest enteric disease rate was 0-4 years with 562 cases per 100 000 population, which is 2.5 times the overall rate for WA. In 2022, Aboriginal people had a rate of 278 cases per 100 000 population which was 29% higher than non-Aboriginal people (216 cases per 100 000 population). The age groups with the highest rates among Aboriginal people was 85 plus years and 0 to 4 years with a rate of 1167 cases and 1074 cases per 100 000 population respectively, compared to a 0-4 year and 85 plus years age group rates for non-Aboriginal people of 494 cases and 296 cases per 100 000 population respectively. The region with the highest rate was the Kimberley region with 625 cases per 100 000 population. Of the people notified with enteric infections with a known place of acquisition, 87% reported acquiring their infection in WA, 12% reported overseas travel and 1% reported interstate travel. Some of the decrease in enteric notifications in 2022 is likely a result of the COVID-19 public health measures including overseas travel restrictions (finished in March 2023). In the 2016-2020 period, of those enteric notifications with known place of acquisition, an average of 16% were acquired overseas.

### Botulism

Botulism is rare in WA, with the last case reported in 2015.

### Campylobacteriosis

Campylobacteriosis was the most commonly notified enteric infection in 2022 with 4030 notifications and a rate of 150.9 per 100 000 population. This notification rate was 20% higher than the previous five-year average (Appendix 1). Part of this increase is likely attributed to the introduction of polymerase chain reaction (PCR) tests in March 2023 for *Campylobacter* by one of the clinical pathology laboratories. PCR is considered more sensitive than culture in the detection of *Campylobacter*. Historically, notifications for campylobacteriosis were lowest in February and highest in the October to November months. This trend was also observed which in 2022 (Figure 1). In 2022, as with previous years, the campylobacteriosis notification rate for males was higher than for females (165.1 and 136.8 per 100 000 population, respectively). The highest rates were in older adults 75-79 years, 80-84 years and 85 plus years (235, 200 and 213 cases per 100 000 population, respectively) followed by young children 0-4 years (187 cases per 100 000 population) (Figure 2). The lowest rates were in the age groups 10-14 years (95 cases per 100 000 population) and 5-9 years (100 cases per 100 000 population).

Figure 1 Campylobacteriosis notifications by year and month, WA, 2017 to 2022



Figure 2 Campylobacteriosis notification rate by age group and sex, WA, 2022



For the previous five years the notification rate for non-Aboriginal people has been consistently higher than for Aboriginal people and for 2022, the rate for non-Aboriginal people was 1.6 times higher (147 and 91 per 100 000 population, respectively). The 2022 notification rate for campylobacteriosis was highest in the South West region (191 cases per 100 000 population). The region with the lowest rate was the Goldfields region (123 cases per 100 000 population) (Figure 3). Of those campylobacteriosis cases with known place of acquisition, most (89%) acquired their illness in WA with 10% acquiring their illness overseas. There were 30 (1%) cases who acquired their illness interstate.

Figure 3 Campylobacteriosis notification rates by region and Aboriginality, WA, 2022



### Cholera

Cholera is mainly seen in people who have travelled overseas and only toxigenic epidemic serotypes O1 and O139 are notified. There were no cases in 2022 and the last case in WA was in 2017.

### Cryptosporidiosis

There were 276 cryptosporidiosis cases notified in 2022, making it the fourth most common notifiable enteric disease. The notification rate for 2022 was 10.3 cases per 100 000 population, which is 1% less than the mean of the previous five years (10.4 cases per 100 000 population) (Appendix 1). In each of the years from 2017 to 2022, the number of cryptosporidiosis notifications tended to increase in the late summer through to autumn (Figure 4). In 2022, there was one probable person-to-person outbreak of cryptosporidiosis associated with a CCC with six confirmed cases.

Figure 4 Cryptosporidiosis notifications by year and month, WA, 2017 to 2022



The cryptosporidiosis notification rate in females was 17% higher than males in 2022 (11.3 and 9.3 per 100 000 population, respectively). The 0-4 years age group had the highest notification rate (47.8 per 100 000 population) and accounted for 30% of all cryptosporidiosis notifications (Figure 5).

Figure 5 Cryptosporidiosis notification rate by age group and sex, WA, 2022



The overall notification rate for the Aboriginal population was 1.93-fold higher than the rate for the non-Aboriginal population (18.3 and 9.5 cases per 100 000 population, respectively). The Kimberley region had the highest notification rate (69.8 cases per 100 000 population), followed by the Pilbara region (20.3 cases per 100 000 population) (Figure 6). Of those cryptosporidiosis cases with known place of acquisition, 93% acquired their illness in WA, 6% acquired their illness overseas and 1% acquired their illness interstate.

Figure 6 Cryptosporidiosis notification rates by region and Aboriginality, WA, 2022



### Haemolytic Uraemic Syndrome (HUS)

One case of HUS was notified in 2022, compared to the five-year historic mean of two cases. The case was a 10 year old male and the causative agent was *Salmonella* Typhi acquired whilst travelling in Pakistan.

### Hepatitis A infection

There were 14 cases of hepatitis A notified in 2022 with a rate of 0.5 cases per 100 000 population compared to the average rate of the previous five years of 0.4 cases per 100 000 population (Appendix 1). Of the 14 cases, 11 acquired their illness overseas and three in WA (Figure 7). Of the three locally acquired infections, the source of illness was unknown for two cases and the third case acquired their illness from their sibling.

Figure 7 Place of acquisition for hepatitis A notifications, 2017 to 2022



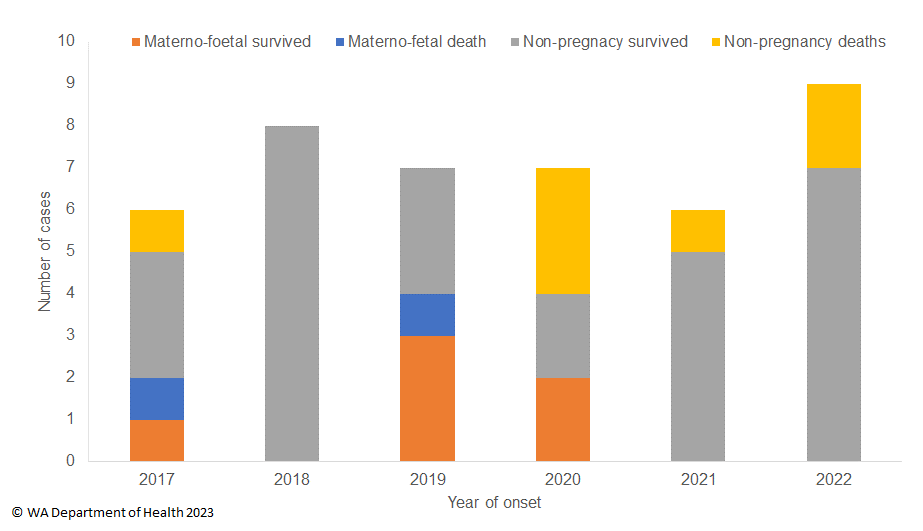
### Hepatitis E infection

There were no cases of hepatitis E notified in 2022 compared to the five-year average of three cases.

### Listeriosis

There were nine cases of listeriosisnotified in 2022 with a rate of 0.3 cases per 100 000 population, which was similar to the average rate of the previous five years (Appendix 1). There were no materno-foetal pairs in 2022 (Figure 8). The nine cases had immunocompromising and/or chronic illnesses, ages ranged from 57 to 84 years with four males and five female cases. Two deaths were temporally associated with the cases’ listeriosis diagnoses.

Figure 8 Notifications of listeriosis showing non-pregnancy related infections and deaths, and materno-foetal infections and deaths, WA, 2017 to 2022



### Rotavirus infection

There were 370 cases of rotavirus infection in WA in 2022 with a rate of 13.9 per 100 000 population, which was 21% lower than the previous five-year average of 17.6 cases per 100 000 population (Appendix 1). Historically, rotavirus notifications typically peak in the winter months, but in 2022, cases increased from September to December, similar to the period of increase in 2021 (Figure 9).

Figure 9 Rotavirus notifications by year and month, WA, 2017 to 2022



As in previous years, the age group with the highest rotavirus notification rate in 2022 was the 0-4 years group (148.1 cases per 100 000 population) (Figure 10). The overall notification rate was similar for females and males (13.1 and 14.4 per 100 000 population, respectively).

Figure 10 Rotavirus notification rates by age group and sex, WA, 2022



The regions with the highest rotavirus notification rates in 2022 were the Kimberley and Goldfields regions (49.4 and 23.8 cases per 100 000 population, respectively) (Figure 11). Overall, notification rates were 1.74 times higher for Aboriginal than for non-Aboriginal people (22.0 and 12.6 per 100 000 population, respectively). Of those rotavirus cases with known place of acquisition, 97% of cases acquired their illness in WA with 2.5% acquired overseas and the remaining 0.5% of cases acquiring their illness interstate. There were three person-to-person outbreaks due to rotavirus in 2022, which were all in RCFs. In WA, rotavirus vaccination is available to infants at six weeks of age and included in the childhood immunisation schedule.

Figure 11 Rotavirus notification rates by region and Aboriginality, WA, 2022



### Salmonellosis

Salmonellosis was the second most commonly notified enteric infection in WA in 2022 with 950 cases and rate of 35.6 cases per 100 000 population (Appendix 1), which was 51% lower than the previous five-year average (72.7 cases per 100 000 population). Historically, salmonellosis notifications are highest in the summer and autumn months, and a similar pattern of salmonellosis notifications occurred in 2022 (Figure 12).

Figure 12 Salmonellosis notifications by year and month, WA, 2017 to 2022



The notification rate for females was marginally higher than for males (35.6 and 34.6 per 100 000 population, respectively). As in previous years, the 0-4 year age group had the highest notification rate (135 per 100 000 population) (Figure 13). The age group 85 plus years had the next highest notification rate (44.3 per 100 000 population).

Figure 13 Salmonellosis notification rate by age group and sex, WA, 2022



The salmonellosis notification rate for Aboriginal people was 52.2 cases per 100 000 population, which was 1.55 times higher than the notification rate for non-Aboriginal people (33.7 cases per 100 000 population).

The Kimberley region had the highest notification rate in 2022 (180.3 per 100 000 population) which was 13 times the rate for the Goldfields region, with the lowest notification rate at 13.9 cases per 100 000 population (Figure 14). The notifications in the Kimberley region include 27 different serotypes and did not cluster in time or location.

Of those salmonellosis cases with known place of acquisition (70%), most (81%) cases acquired their illness in WA with 19% acquired overseas and <1% of cases acquiring their illness interstate (Figure 15).

Figure 14 Salmonellosis notification rates by region and Aboriginality, WA, 2022



Figure 15 Salmonellosis notifications by place of acquisition and year, 2017 to 2022

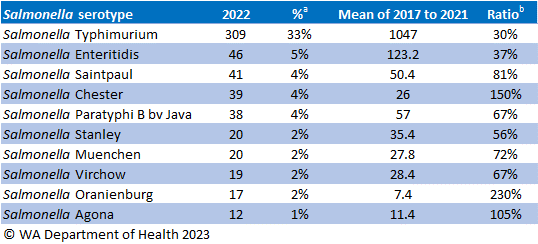


The most commonly notified *Salmonella* serotype in WA in 2022 was STM, with 309 notifications (Table 1), which was 33% of all *Salmonella* and 70% lower than the mean of the previous five years for STM. STM is further typed using MLVA and there were 119 MLVA types identified in 2022. Of these, the top 10 types contributed 50% (n=155) of the total STM notifications and the most common MLVA type 04-14-00-00-463 contributed 13% (n=39) of all STM notifications (Table 2). In 2022, a cluster of MLVA type 04-14-00-00-463 was investigated but the source of illness could not be identified. The next most common MLVA type was 03-13-07-09-523 (n=23) and was associated with an outbreak linked to the consumption of baby cucumbers (Table 3, page 35).

The second most commonly notified serotype was *S*. Enteritidis with 46 notifications, which was 63% below the mean of the previous five years for this serotype (Table 1). Most (85%) infections of this serotype were acquired overseas. In 2022, there were six cases of *S*. Enteritidis that were locally acquired, and interviews of cases did not identify a common source. WGS of *S*. Enteritidis strains identified one case was closely related to a case in 2021 but there were no known exposures in common for the two cases.

There were also 114 (12%) *Salmonella* cases in 2022 where a serotype was not identified.

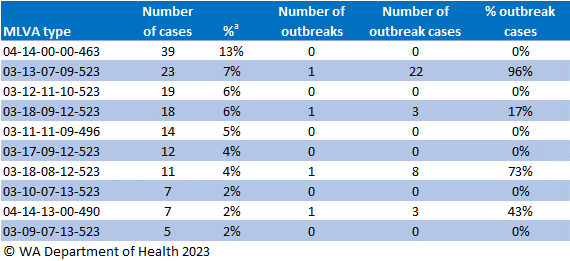
Table 1 Number and proportion of the top 10 *Salmonella* serotypes notified in WA, 2022, with comparison to the five-year average



aPercentage of total *Salmonella* cases notified in 2022.

bRatio of the number of reported cases in 2022 compared to the five-year average of 2017-2021.

Table 2 The 10 most common *S*. Typhimurium MLVA types reported in 2022



aPercentage of total *S*.Typhimurium cases notified in 2022.

### Shiga toxin-producing *E. coli* (STEC) infection

There were 222 cases of STEC reported in 2022 with a rate of 8.3 cases per 100 000 population, which was 3.9-fold higher than the five-year average (Appendix 1). Some of the increase in 2022 is likely to be due to one pathology laboratory introducing STEC PCR tests in March 2022 on all stool specimens requesting stool culture. This laboratory notified 61% of STEC cases in WA for 2022. Two other laboratories perform STEC PCR tests on stool specimens, but these tests were introduced in 2016. In 2022, STEC notifications peaked in March with 29 notifications and were generally lower in the middle of the year but peaked again in December with 30 notifications. (Figure 16).

Figure 16 STEC notifications by year and month, WA, 2017 to 2022



STEC notification rates in 2022 were generally higher in adults ≥64 years. The notification rate for females were 21% higher than males (8.2 and 6.8 per 100 000 population, respectively). The largest difference in notification rates between females and males was in the 85 plus years age group with the female rate 4.5-fold higher than the male rate. (Figure 17). The region with the highest notification rate was the Kimberley with 46.5 cases per 100 000 population. Notification rates for Aboriginal people was 17.4 cases per 100 000 population and was 2.3-fold higher than rates for non-Aboriginal people at 7.7 cases per 100 000 population.

Figure 17 STEC notification rates by age group and sex, WA, 2022



There were 99 cases that were culture positive and the main serotypes were O157 (n=19), O26 (n=8), O91 (n=8) and O76 (n=5). Of the cases with known place of acquisition (n=125), most (93%) had acquired their infection in WA and 7% were acquired overseas. Of locally acquired cases interviewed, there was one point source outbreak in children (two confirmed and 12 probable cases) who attended a recreational camp, and illness was thought to be associated with the consumption of contaminated drinking water.

### Shigellosis

There were 191 cases of shigellosis notified in 2022, with a notification rate of 7.2 per 100,000 population. The notification rate was 21% lower than the previous five-year average (Appendix 1). Like in previous years, in 2022 there was an increase in notifications during late spring into the summer months (Figure 18).

As of 1 July 2018 the national *Shigella* case definition changed to include notifications that are PCR positive as probable cases and culture positive notifications as confirmed cases. In 2022, there were 127 probable and 64 confirmed shigellosis cases. Most (61%) of the probable cases were in metropolitan Perth residents and most (63%) probable cases had acquired their illness in WA. In comparison, for the confirmed cases, only 25% were for Metropolitan residents and most (93%) confirmed cases had acquired their illness in WA.

Figure 18 Shigellosis notifications by year and month, WA, 2017 to 2022



The shigellosis notification rate was 23% higher in females compared to males in 2022 (7.9 and 6.4 per 100 000 population, respectively). The 0-4 years age group had the highest rate of notification with 29.6 cases per 100 000 population (Figure 19).

Figure 19 Shigellosis notification rates by age group and sex, WA, 2022



In 2022, the notification rate was 19 times higher for the Aboriginal population as compared to the non-Aboriginal population (75.0 and 4.0 per 100 000 population, respectively). The region with the highest shigellosis notification rate was Kimberley (142.5 cases per 100 000 population) followed by the Goldfields and Pilbara regions (33.7 and 23.6 cases per 100 000 population, respectively) (Figure 20).

Figure 20 Shigellosis notification rates by region and Aboriginality, WA, 2022



The predominant subtypes of *Shigella* notified in 2022 were *S. flexneri* 2B (n=18) and *S. flexneri* 2A (n=13). Of these 31 notifications with known travel history, all cases acquired their infection in WA.

There were five multi-drug resistant (MDR) *Shigella* notifications reported in 2022, compared to eight MDR in 2021. In 2022, 3/5 MDR *Shigella* were *S. flexneri* 2B in Aboriginal people. The remaining two cases were *S*. *flexneri* 1 and *S. sonnei* biotype F and acquired their illnesses in Mexico and India respectively.

### Typhoid and paratyphoid fever

In 2022, there were 17 cases of typhoid fever (caused by *Salmonella* Typhi) notified, which was 33% higher than the previous five-year average of 12 notifications (Appendix 1). Of the 17 cases, 13 acquired their illness in overseas countries including India (n=8), Pakistan (n=3) and one each in Bangladesh and Nepal, three were locally acquired and one had unknown place of acquisition.

Of the three locally acquired cases, one case acquired their illness from their daughter who was asymptomatic but had travelled to India in 2021. There was also one WA acquired case who acquired their infection from an asymptomatic household member who was positive after screening. The asymptomatic household member last travelled overseas in 2019 to Bangladesh, thus the place of acquisition was recorded as unknown. The source of infection of the third locally acquired case could not be identified.

Lastly, there was one case of paratyphoid fever notified in WA in 2022 and who had travelled to India.

### *Vibrio parahaemolyticus* infection

There were five cases of *Vibrio parahaemolyticus* infection notified in 2022 with a rate of 0.2 cases per 100 000 population, which was 74% lower than the mean rate of the previous five years (Appendix 1). Of the five cases, two had acquired their infection overseas and three were locally acquired wound infections.

### *Yersinia* infection

There were 31 cases of culture-positive *Yersinia* *enterocolitica* infection notified in 2022, with a rate of 1.2 cases per 100 000 population, which is 1.5-fold higher than the mean rate of the previous five years (Appendix 1). There were 13 female and 18 male cases with ages ranging between 3 years and 79 years. Of those cases with known travel history, 88% of cases had acquired their illness in WA and one case (12%) acquired their illness overseas. The majority (n=27) of cases were notified by one private pathology laboratory, which uses a faecal PCR test followed by reflex culture. There were no clusters or outbreaks of *Y.* *enterocolitica* investigated in 2022.

# Gastrointestinal disease outbreaks and investigations

### Foodborne and probable foodborne outbreaks

There were seven foodborne or probable foodborne gastroenteritis outbreaks investigated in WA in 2022 (Table 3). Of these, one was a multi-jurisdictional outbreak investigation (MJOI 2023-001) with cases from WA (n=23), as well as Queensland (n=8), New South Wales (n=6), Victoria (n=4), and South Australia (n=4). This outbreak was initially investigated in December 2022 and only WA case data will be included in this annual report. The number of foodborne and probable foodborne outbreaks was below the five-year average of 29, with a decrease reported each year since 2017 where the number of outbreaks investigated peaked at 42 (Table A). The seven foodborne outbreaks caused at least 78 cases of gastroenteritis and 13 hospitalisations. Short descriptions of these outbreaks are provided in [2022 quarterly reports](http://ww2.health.wa.gov.au/Articles/F_I/Infectious-disease-data/Enteric-infection-reports-and-publications-OzFoodNet).

**Aetiology**

Of the seven outbreaks, four were due to STM, with one outbreak each of MLVA types 03-13-07-09-523, 03-18-08-12-523 and 03-18-09-12-523, respectively. The last STM outbreak was caused by two genetically related MLVA types 04-14-13-00-490 and 04-14-14-00-490. This was an 84% decrease in STM outbreaks compared to the five-year average (n=24.8). A decrease in STM outbreaks has occurred since 2017. For the remaining three outbreaks in 2022, one was due to *Salmonella* Oranienburg, one accidental contamination of olive oil with tetrahydrocannabinol (THC) and the aetiology was unknown for one outbreak.

**Food vehicles**

The investigations of the seven outbreaks identified food vehicles for three outbreaks, which included egg mayonnaise, THC oil and baby cucumbers. Of these, there were laboratory evidence for two outbreaks.

In outbreak 06-2022-THC, left over dishes from a private dinner party were collected for toxicology analysis and THC was detected in food dishes and one vomitus (indicative of foodborne illness).

In the outbreak MJOI-2023-001, retail sampling of baby cucumbers across metropolitan WA identified one sample positive for STM 03-13-07-09-523. WGS and comparative genomic analysis showed that the STM 03-13-07-09-523 isolates from clinical specimens and the food sample were genomically highly related.

For outbreak 042-2022-003, descriptive evidence was used to identify the food vehicle as all cases reported consuming Vietnamese banh mi rolls prior to symptom onset. These rolls contained various types of meats, but all contained egg mayonnaise made in-house using eggs sourced from a local farm that had been previously implicated in another egg-related outbreak in 2020. This outbreak was the only egg-containing dish outbreak in 2022 compared to the five-year average of 9.4 outbreaks associated with STM and eggs. The decrease was due to an overall 70% decrease in STM notified cases in 2022 with 309 cases compared to the five-year average of 1047 cases. There were possibly multiple contributing factors for the outbreak 042-2022-003 including egg contaminated with *Salmonella*, inadequate acidification and storage of the egg mayonnaise.

In the remaining four outbreaks there were no food vehicle identified.

**Epidemiological investigation and evidence for food vehicle**

The evidence that supported the classification of seven enteric outbreaks as foodborne or probable foodborne transmission was obtained using laboratory evidence for two outbreaks and descriptive case studies (DCS) for other five outbreaks. Laboratory evidence refers to the implicated food being positive for the same pathogen/toxin as the cases. For the outbreaks investigated as a DCS, there was strong circumstantial evidence to support probable foodborne transmission, such as ill people independently visiting a common food business, or the venue being the only source of shared food for cases.

**Food preparation settings**

The setting where food was prepared for the seven foodborne and probable foodborne outbreaks in 2022 included three private caterers (caused by THC oil; STM MLVAs 04-14-13-00-490 and 04-14-14-00-490; and one unknown aetiological agent), one restaurant (caused by STM MLVA 03-18-09-12-523), one grocery store/delicatessen (caused by STM MLVA 03-18-08-12-523) and one at the primary production setting (caused by STM MLVA 03-18-09-12-523).

Table 3 Foodborne and probable foodborne outbreaks, 2022



**1**Month of outbreak is the month the outbreak was first reported or investigated, whichever is earliest

2MLVA=multi-locus variable number tandem repeat analysis

3Evidence relates to food vehicle.

### Outbreaks due to non-foodborne transmission or with an unknown mode of transmission

In 2022, there were 155 outbreaks of gastroenteritis investigated that were not classified as foodborne or probable foodborne outbreaks (Table 4). These outbreaks included 151 outbreaks associated with person-to-person transmission, three outbreaks where the mode of transmission was unclear or unknown and one outbreak due to probable waterborne transmission (Figure 21).

**Probable person-to-person outbreaks**

There were 151 probable person-to-person (PTP) transmission outbreaks in 2022. The number of PTP outbreaks in 2022 was 12% lower than the average of the previous five years (n=171). Of these PTP outbreaks the most common settings were CCC (n=74, 49%) and RCF (n=63, 42%). The majority of PTP outbreaks were reported in the first and fourth quarter of 2022 (Figure 21). In previous years, CCC had accounted for the majority of PTP outbreaks in 2020 (n=174/249, 70%) and 2021 (n=159/246, 65%). The remaining PTP outbreaks in 2022 occurred in schools (n=5, 3%), private residences (n=4, 3%), workplaces (n=2, 1%), hospitals (n=2, 1%) and the community (n=1, 1%) (Table 4).

The causative agent for 33 (22%) of the outbreaks was confirmed as norovirus, three outbreaks each were due to rotavirus and *Cryptosporidium*, and two outbreaks each were due to hepatitis A and *Salmonella* Typhi (typhoid fever), one outbreak each were due to adenovirus and *Campylobacter*. In the remaining 106 outbreaks, the causative agent was unknown, either because specimens were not collected, a pathogen was not identified during testing, viral testing was not requested, or it was not clear from the results what the causative pathogen was.

For the 151 PTP outbreaks, at least 1785 people were ill, with 28 hospitalisations and two associated deaths.

**Outbreaks with unknown mode of transmission**

In the three outbreaks where the likely mode of transmission was unclear or unknown. Two occurred in RCFs with an unknown causative agent and there was insufficient information to attribute a mode of transmission. In the third outbreak, while WGS linked one overseas acquired typhoid case with another typhoid case who had not travelled overseas (Table 4).

**Outbreaks with probable waterborne transmission**

There was one outbreak in 2022 due to probable waterborne transmission likely resulting from contaminated drinking water at a camp site. For this outbreak, two people reported gastroenteritis after attending two separate school camps at the same venue and both were diagnosed with STEC. In addition, there were at least 12 people that reported diarrhoeal illness during or following attending the camp facility.

Figure 21 Number of non-foodborne gastroenteritis outbreaks by mode of transmission and month, 2022



**Table 4 Outbreaks due to non-foodborne or unknown mode of transmission in WA by setting and agent, 2022**



1Deaths temporally associated with gastroenteritis, but contribution to death not specified

### Cluster investigations

In 2022, there were ten new clusters investigated which included nine *Salmonella* clusters and one cluster of yersiniosis (Table 5). Cases were interviewed with standard hypothesis generating questionnaires but no hypothesis for the cause of illness could be established.

**Table 5 New cluster investigations in WA by month investigation started, setting and agent, 2022**



\*MLVA=multi-locus variable number tandem repeat analysis; ST=sequence type.

**Ongoing investigation – *Salmonella* Typhimurium MLVA 03-17-09-12-523**

Up until September 2016, STM MLVA 03-17-09-12-523 had not been notified in WA since MLVA typing began in WA in January 2015. Since the emergence of this strain in September 2016 to the end of 2022, there have been a total 2020 cases, 516 hospitalisations and eight deaths temporally associated with this infection in WA (Figure 22).

In response to this ongoing investigation, the *Salmonella* Outbreak Response Taskforce was established in July 2019 which included representatives from WA Department of Health, PathWest laboratory, Department of Primary Industry and Regional Development, and select Local Governments. The primary outcomes of the taskforce were to collaborate with egg producers that would include on-farm investigations of epidemiologically linked farms. In addition, there were further investigations into the association between illness and egg consumption through microbiological sampling and WGS of isolates. Lastly, a chicken vaccination and biosecurity program commenced in October 2020 with the aims to reduce *Salmonella* prevalence on-farm and thereby potentially reducing contamination of chicken eggs.

The commencement of on-farm biosecurity measures and completion of the vaccination program in September 2021 correlated with a substantial reduction of salmonellosis notifications of STM MLVA 03-17-09-12-523. In 2022, a total of 12 cases of the outbreak MLVA type was notified. This was an 97% decrease compared to the five-year average (n=386), with no clusters or outbreaks identified among them.

Figure 22 Notifications of *S.* Typhimurium MLVA 03-17-09-12-523 in WA



# References

1. Hall, G., Kirk, MD., Becker, N., Gregory, JE., Unicomb, L., Millard, G., et al. Estimating foodborne gastroenteritis, Australia. Emerg Infect Dis 2005;11(8):1257-1264.
2. OzFoodNet Working Group. A health network to enhance the surveillance of foodborne diseases in Australia. Australian Government Department of Health 2020. <https://www1.health.gov.au/internet/main/publishing.nsf/Content/cdna-ozfoodnet.htm>
3. Western Australian Department of Health. A-Z list of case definitions. Western Australian Department of Health 2020. <http://ww2.health.wa.gov.au/Articles/N_R/Notification-of-infectious-diseases-and-related-conditions>.
4. Communicable Diseases Network Australia. Australian national notifiable diseases and case definitions. Australian Government Department of Health 2020

<http://www.health.gov.au/casedefinitions>

5 Ng, J., Eastwood, K., Walker, B., Durrheim, DN., Massey, PD and Porigneaux, P. Evidence of Cryptosporidium transmission between cattle and humans in northern New South Wales. Exp Parasitol 2012;130(4):437-441.

# Appendix 1: Number of notifications, notification rate2 and ratio of current to historical mean by pathogen/condition, 2017 to 2022, WA



1Abbreviations: STEC: Shiga toxin-producing *E. coli*; HUS: Haemolytic Uraemic Syndrome; NA: not applicable. 2Rate is cases per 100 000 population. 3*Shigella* includes probable and confirmed notifications as of 1st July 2018; the five-year mean should be interpreted with caution.

**This document can be made available in alternative formats on request for a person with a disability.**

© WA Department of Health 2023

Copyright to this material is vested in the State of Western Australia unless otherwise indicated. Apart from any fair dealing for the purposes of private study, research, criticism or review, as permitted under the provisions of the *Copyright Act 1968*, no part may be reproduced or re-used for any purposes whatsoever without written permission of the State of Western Australia.