Surveillance Report 2018

Auckland Regional Public Health Service
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Auckland Regional Public Health Service
Ratonga Hauora-ā-Iwi ō Tāmaki Makaurau
Working with the people of Auckland, Waitemata and Counties Manukau

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About Auckland Regional Public Health Service

Auckland Regional Public Health Service (ARPHS) provides public health services for the three district health boards (DHBs) in the Auckland region (Counties Manukau Health, Auckland and Waitemata District Health Boards).

ARPHS has a statutory obligation under the New Zealand Public Health and Disability Act 2000 to improve, promote and protect the health of people and communities in the Auckland region. The Medical Officer of Health has an enforcement and regulatory role under the Health Act 1956 and other legislative designations to protect the health of the community.

ARPHS' primary role is to improve population health. It actively seeks to influence any initiatives or proposals that may affect population health in the Auckland region to maximise their positive impact and minimise possible negative effects.

For more information on ARPHS see www.arphs.health.nz

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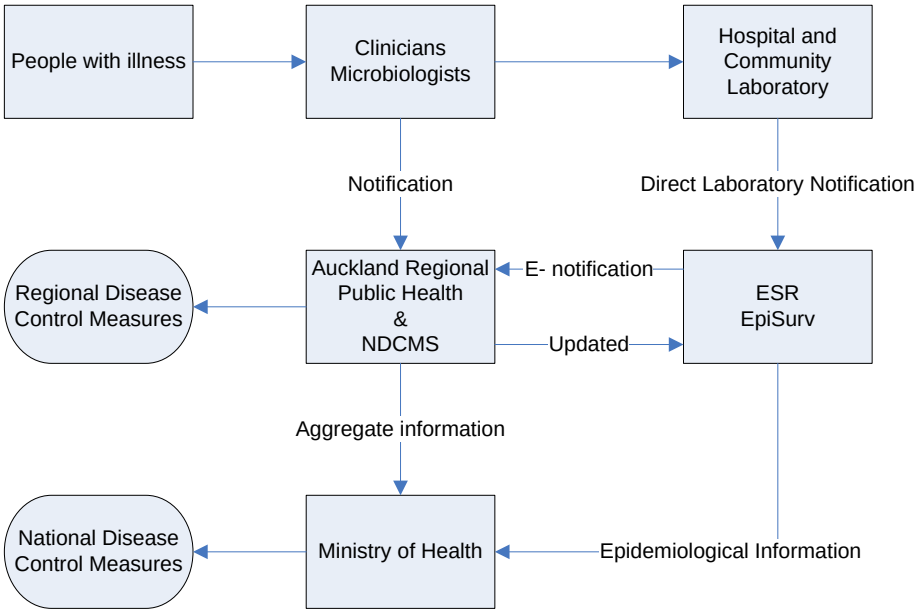
Section 1: Summary

Throughout 2018, the infectious disease burden in the Auckland region was assessed through the implementation of the Auckland Regional Public Health Service (ARPHS) Surveillance Strategy. This is a surveillance system utilising the national surveillance system EpiSurv, and ARPHS independent Notifiable Diseases and Case Management System (NDCMS).

Any disease outbreaks notified to ARPHS are promptly identified and investigated. Notifiable disease data obtained throughout the year are collated, analysed, and discussed at a weekly surveillance triggers meeting to ensure a coordinated whole-of-organisation response, and again at a Friday handover meeting to weekend staff. Weekly information regarding key surveillance triggers is also routinely disseminated to selected external stakeholders in the NDCMS Surveillance Report.

The process of disease notification is shown in Figure 1. The diseases that are notifiable to the Medical Officer of Health are listed in Appendix 1. Not all notifiable diseases and conditions come to ARPHS attention so the operational reality is a subset of these.

Figure 1: Notifiable disease notification process for ARPHS



1.1 Basic terms and definitions in this report

Notifications received are assessed against nationally determined surveillance case definitions published in the Ministry of Health Communicable Disease Control Manual[1]. These notifications are classified into “cases under investigation”, “probable cases” and “confirmed cases”. Those cases that don’t meet the surveillance case definitions for a confirmed or probable case after all the information has been analysed and assessed, are classified as “not a case”. The term “cases” in this report therefore refers to probable and confirmed cases.

Age groups comply with agreed national reporting age group categories. Incidence is expressed as crude rates which are defined as the number of cases for a defined population based on 2018-estimated mid-year population statistics. Population statistics are sourced from Statistics New Zealand.

[1]Communicable Disease Control Manual https://www.health.govt.nz/publication/communicable-disease-control-manual

Ethnicity data are prioritised ethnicity. The prioritisation is Maori, Pacific, Asian, Other (MPAO). Ethnicity rates are based on 2018 projected prioritised ethnic populations from the 2013 base. Age group data by ethnicity are sourced through the Ministry of Health. This standard MPAO was commissioned by the Ministry of Health and the version used in this report was last updated by Statistics New Zealand in 2015 (but still using the 2013 Census base).

1.2 Morbidity, mortality and case fatality of Notifiable Diseases in the Auckland Region 2018

The incidence, mortality, morbidity and case-fatality rates of notifiable diseases reported in 2018 are shown in Table 1.

Table 1: Morbidity, mortality and case fatality rates of notifiable diseases in the Auckland region 2018

	Cases	Morbidity rate*		Hospitalisation		Mortality		
Disease	Auckland region cases	Auckland region per 100,000	Rest of NZ per 100,000	Auckland region cases	(%)	Died.	Mortality rate per 100,000	Case fatality rate %
Brucellosis	2	0.1	<0.1	2	100%			
Campylobacteriosis	2066	120.4	153.3	84	4%			
Chikungunya fever	5	0.3	0.2	1	20%			
Cholera	1	0.1	0.0	1	100%			
Cryptosporidiosis	573	33.5	32.5	13	2%			
Dengue fever	187	10.9	3.4	124	66%			
Giardiasis	560	32.6	32.1	4	1%			
Haemophilus influenzae type b	0	0.0	0.1	-	-			
Hepatitis A	35	2.0	1.0	19	54%			
Hepatitis B	17	1.0	0.6	9	53%			
Hepatitis C	6	0.3	0.9	4	67%			
Hepatitis NOS	5	0.3	0.1	3	60%			
Invasive pneumococcal disease	180	10.5	11.9	161	89%	8	0.5	4.4%
Latent tuberculosis infection*	106	6.2	5.5	0	0%			
Legionellosis	61	3.6	3.9	56	92%	3	0.2	4.9%
Leprosy	3	0.2	0.0	1	33%			
Leptospirosis	13	0.8	3.1	11	85%			
Listeriosis	8	0.5	0.5	8	100%	1	<0.1	12.5%
Listeriosis - perinatal	3	0.2	0.1	3	100%			
Malaria	16	0.9	0.6	12	75%			
Measles	5	0.3	0.8	2	40%			
Meningococcal disease	38	2.2	2.6	37	97%	3	0.2	7.9%
Mumps	270	15.7	5.4	14	5%			
Murine Typhus	0	0.0	0.0	-	-			
Paratyphoid fever	10	0.6	0.3	8	80%			
Pertussis	709	41.3	70.9	126	18%			
Rheumatic fever - initial attack	110	6.4	1.8	109	99%			

Rheumatic fever - recurrent attack	15	0.9	0.1	15	100%			
Rickettsial disease	1	0.1	0.0	1	100%			
Ross River virus infection	1	0.1	0.0	-	-			
Rubella	0	0.0	0.0	-	-			
Salmonellosis	286	16.7	25.5	79	28%			
Shigellosis	122	7.1	3.0	32	26%			
Taeniasis	3	0.2	0.0	-	-			
Toxic Shellfish Poisoning	0	0.0	0.1	-	-			
Tuberculosis disease - new case	155	9.0	4.8	93	60%	2	0.1	1.3%
Tuberculosis disease - relapse	7	0.4	0.3	3	43%			
Tuberculosis infection - preventative tx.	6	0.3	0.1	-	-			
Typhoid fever	29	1.7	0.8	25	86%			
VTEC/STEC infection	218	12.7	22.1	59	27%			
Yersiniosis	370	21.6	26.1	8	2%			
Zika virus	0	0.0	0.1	-	-			

*Only a minority of LTBI cases are diagnosed so this does not represent a true incidence rate
Source : EpiSurv

1.3 Vectorborne diseases

A total of 187 cases of dengue fever were reported in the Auckland region, an increase on the 85 and 95 cases in 2016 and 2017 respectively. Dengue has increased gradually over the past seven years. There was an increase in 2014 coinciding with an outbreak of serotype 3 in the Pacific. However, in 2017, serotype 3 was replaced by serotype DEN2 as the predominant serotype. The number of severe dengue fever cases was noticeably higher in 2017 and 2018 compared with other years due to this change in circulating serotype, which is particularly associated with travel to Samoa. More severe illness with concurrent dengue of differing serotypes is a well described feature of dengue fever, and this was a feature in 2018 with two cases of dengue haemorrhagic fever and a higher than normal hospitalisation rate (66%) (compared with 41% of cases in 2016). In 2018 there were no deaths in New Zealand from dengue fever in 2018 but there were two highly publicised deaths of New Zealanders on an extended stay with family in Samoa.

There were four cases of chikungunya notified in the Auckland region and a further case where the diagnosis was uncertain. The source countries for these cases were India, Brazil and Thailand. In 2018 there was only one case of Ross River Virus notified for a traveller to Australia despite a considerable increase of Ross River Virus in most Australian states. No cases of Zika were notified.

The number of malaria notifications was low with just 16 cases. All cases were overseas acquired, with the majority from India and Africa. Five cases had P. falciparum, nine had P. vivax, 12 of the cases were hospitalised, and there were no deaths.

There were 13 cases of leptospirosis notified compared to eight in 2017 and nine in 2016. Notifications have been increasing since 2014, but this may be due to increased volume or sensitivity of laboratory testing. All cases were adults - nine male and four female. Eleven of the 13 cases required hospitalisation but there were no deaths.

ARPHS responded to 36 mosquito interceptions at the border and at transitional facilities in 2018. There were two Aedes aegypti interventions compared with 14 in 2017.

1.4 Foodborne diseases

There were 29 typhoid notifications, down from 46 cases reported during the Auckland typhoid outbreak in 2017. Cases occurred throughout the year with a small unexpected peak in mid-winter (Figure 7). The majority of cases required hospitalisation (86%) but there were no deaths. There were three locally acquired cases who acquired their illness from visiting friends and relatives from the Pacific during the exposure period. The remainder of cases (26) were overseas acquired with the source of infection being Middle East, South East Asia and the Pacific region.

Paratyphoid notifications (10) were well down from 2017(24) due to the change of classification for Paratyphi B var Java (12 cases), which was previously classified as a paratyphoid fever notification but is now classified as salmonellosis. Cases were notified throughout the year, with the highest number of cases reported in February and May, with three each. All but one case was overseas acquired. Countries of origin for those cases were Indian subcontinent, South East Asia India and the Pacific region.

There was one confirmed case of cholera. This case presented to hospital whilst in Pakistan with watery diarrhoea. On return to New Zealand symptoms continued requiring admission to hospital. The cholera toxin screen was positive and the organism was later identified as Vibrio cholerae O1 biotype El Tor, subtype Inaba. There were no secondary cases. There were also 13 other possible cases notified during the year but ESR confirmatory testing was negative.

A total of 122 cases of shigellosis were notified, down from the 150 cases in 2017 but up from 107 in 2016 and 62 in 2015. The peak month was January, driven by the local population visiting friends and relatives overseas (Figure 9). Hospitalisation was reported in 26% of cases and there were no deaths. Two thirds (66%) of cases were overseas acquired, with most coming from Tonga (20), India (20), and Samoa (15). Shigella flexneri Type 1b Shigella sonnei biotype g, and Shigella sonnei biotype a, were the most common serotypes in 2018. Shigella flexneri Type 1 cases tended to be acquired in Tonga or associated with the consumption of raw fish. Shigella sonnei biotype g cases were mostly overseas acquired, predominantly India and Indonesia. Of the remaining cases four had recent MSM contact. Shigella sonnei biotype a, was the next most common serotype and again the majority were overseas acquired from Samoa, Fiji and the Philippines. Of the locally acquired cases, the risk factors were consumption of raw fish and recreational swimming.

Salmonellosis has remained stable for the past three years with approximately 300 cases per year. An increasing trend was observed for Salmonella enterica subsp. enterica (I) ser. 4, 5,12: i: - in late spring but no epilink could be found between the cases. Most of the other salmonella serotypes were spread sporadically throughout the year with lower numbers generally reported in the winter months.

Campylobacteriosis was markedly up during the last quarter of 2018, and this trend continued well into 2019 with 1,210 notifications for the five month period from October 2018 to February 2019, compared with 928 notifications during the same period in 2017/18. Initial review of the risk factor data from the national campylobacteriosis study did not reveal any particular risk factor. Theories were many, but one of the more compelling was the pre-Christmas purchase of poultry and turkey. The traditionally perceived risk factor of undercooked chicken at the “Christmas do” BBQ was not supported by the evidence. It will be interesting to see the results of the campylobacteriosis attribution by serotype data as there were anomalies in Beachlands, Waiheke and Whangaparoa, all areas with differing water sources and waste water management.

Cryptosporidiosis notifications for 2018 were nearly double that of 2017. Routine interviews of cryptosporidiosis cases ceased in October 2017 as ARPHS moved to a risk based approach for cryptosporidiosis. Therefore routine risk factor data was only collected up until the end of the third quarter of 2017, following which, the reaching of a surveillance trigger was required to prompt further investigation. Surveillance triggers occurred multiple times between February 20 and April 11 2018. Of these cases investigated, 31% reported travel within NZ (of which a third of this number drank untreated water, went swimming in a pool, rivers or at the beach, or had contact with pets). Contact with an unwell person, suggesting person to person spread, was a potential cause in 15% of cases, and 58% of cases also had direct contact with pets, which is approximately the pet ownership proportion for New Zealanders. Cryptosporidiosis is frequently associated with recreational swimming in public pools. This was a risk factor for half of the cases, though no one pool was able to be singled out for more than one or two cases. In 2018 a higher proportion of cases than normal had contact with animal or human faeces and contact with manure or compost was a risk factor for 20% of cases. Consumption of untreated water was a risk factor for 15% of cases.

Giardiasis has remained stable for the past six years with around 580 notifications. Giardiasis typically has the highest number of notifications in the summer holiday period and autumn and then tails off over the second half of the year. In 2018, there was an additional peak in August, which coincided with lambing and calving season.

There were 370 notifications of yersiniosis in the Auckland region, well up from 289 notifications in 2017, and is a continuation of the upward trend seen since 2015. At least some of this increase has been due to a change in laboratory testing methodology. Microbiological typing of the 370 yersiniosis cases by ESR for the Auckland region indicates some seasonality of Yersinia enterocolitica biotype 1A. This increase occurs in the last quarter and the cause is not known. Otherwise the predominant strains were Yersinia enterocolitica biotype 2/3 serotype O:9 (52%), and Yersinia enterocolitica biotype 4 serotype O:3 (21%). Yersinia also demonstrated an unusual yo-yo like effect where notifications were up one week and down the next and the reason for this is not known.

A total of 218 confirmed cases of Verotoxin E. coli (VTEC) were reported, up from 177 in 2017 and the previous peak of 197 in 2016. Cases occurred throughout the year, with a large number of notifications during the first quarter of 2018 characterised by an increased number of O157 strains. Hospitalisation occurred in 58 cases (27%). There were three reported cases of Haemolytic Uraemic Syndrome (HUS) (all associated with the O157 strain), which, causes anaemia and kidney failure. Fortunately there were no deaths. Although there has been a big increase in VTEC since the change to PCR testing in mid-2015, there has not been a substantial increase in the O157 strain.

Hepatitis A cases were stable over the period. Just over two thirds of cases (24/35) were acquired overseas in 2018. The main source countries were Tonga, India, Pakistan, Fiji and Samoa. Early in the year there were a small number of cases associated with an outbreak in Northland.

Listeriosis notifications were low in number. There were three perinatal cases all with good outcomes and no link found to connect the cases.

1.5 Vaccine preventable diseases

There were five cases of measles in 2018 compared with three cases in 2017, and 10 cases in 2016. There were three measles cases in the last quarter of 2018 requiring extensive contact tracing. Fortunately there were no secondary cases. Of the Auckland cases, two were aged less than one year of age and too young to be vaccinated, two were in the 20 to 29 year age group, and one in the 30 to 39 year age group. Countries of origin were India, Malaysia and the Philippines. One case on an international flight required a large contact trace. During this period there were large measles epidemics reported overseas so importation was always likely.

The large mumps outbreak of 2017 tailed off sharply in the first half of 2018. The incidence rate was highest in Pacific peoples due to immunisation programmes in the Pacific not including mumps in the measles and rubella vaccination.

There were no confirmed or probable rubella notifications in 2018. The last case was notified in 2016.

The pertussis epidemic starting in 2017 gradually tailed off over the 2018 winter. However, this was followed by a second wave of pertussis in spring 2018. A biphasic peak of pertussis is not unusual, and this resulted in 447 cases notified for the first peak between October 2017 and February 2018, compared with 353 cases during the second peak between October 2018 and February 2019. The proportion of pertussis cases aged less than one year of age has decreased from 17% in 2009 to 8% in 2018. This would suggest the focused strategy of protecting infants less than one year old is working, despite nearly 1200 notifications over the past two years.

Invasive pneumococcal disease (IPD) is a seasonal disease, with the timing of notifications in 2018 reflecting a similar period in 2017. The most spectacular increase in specific serotype for 2018 was type 12F, which normally averages about two cases per year, but this increased to seven cases in 2017, and then to 25 cases in 2018. Another serotype worth monitoring is serotype 10A, which has averaged two cases annually over the past ten years but for 2018, five cases were recorded.

Meningococcal disease notifications were slightly down on 2017 with 38 cases. The Auckland region is also experiencing a change in circulating meningococcal serogroups, with a decrease in serogroup B in 2018 compared with 2017, but increases in serogroups W and Y. Of the 11 serogroup W cases notified in 2018, three were aged under nine years, with one under 12 months. Three cases were aged over 60 years, with one case each in the 20-29, 30-39 and 50-59 age groups. There were three deaths in the Auckland region for cases with meningococcal disease. Two deaths were in cases with serogroups W meningococcal disease and one with serogroup B.

1.6 Airborne and Environmental diseases

Tuberculosis notifications are stable. Of the 155 new cases notified in 2018, 129 (83%) were born outside of New Zealand. The likely source countries were India (43%), China (13%), the Philippines (8%), Tonga (5%), South Africa, Samoa (4%), and Fiji (3%). The average duration of time between arrival in New Zealand and onset date was 12 years. Nineteen cases were diagnosed within the first two years of their arrival, and five within one year, raising some concerns about the quality of offshore pre-border screening.

Acute rheumatic fever notifications are up substantially on 2017 with 110 cases notified for the Auckland region. The largest burden of disease in 2018 was in the Counties Manukau region with high rates in Pacific children under the age of 19. Of all acute rheumatic fever cases, 84% occurred in Auckland's most deprived areas (NZDEP 8, 9, 10).

Legionellosis notifications were up from 49 in 2017 to 61 in 2018, but were still lower than the 82 cases notified in 2016. The predominant serotype for 2018 was L. pneumophila 1 (54%), which is typically associated with aerosolized water, followed by L. longbeachae (29%), which is typically associated with soil and soil products. In 2016, Auckland Council issued a bylaw requiring all industrial cooling towers to be registered and undergo monthly testing. The 2017 data would suggest this was effective but cases were up again for 2018, prompting a coordinated cooling tower shock treatment in mid-February 2019.

1.7 Bloodborne disease

There were 17 hepatitis B notifications, up from the two cases in 2017. The incidence rate for the Auckland region was nearly double that for the rest of New Zealand with the highest age specific incidence rate observed in the 20 to 29 year age group, representing a shift from the older age group predominance of previous years.

There were six hepatitis C cases notified. Two cases had previous body piercing and four cases were associated with past IV drug use. No cases were knowingly exposed to blood or blood products, household contacts, or casual sexual partners.

1.8 Other viral diseases

In the Auckland region, the 2018 flu season saw higher levels of Respiratory Syncytial Virus (RSV) preceding the increase in influenza viruses. This was followed by an early increase in influenza A (H1N1), then by an increase in Influenza A (H3N2) - as with the rest of New Zealand. As the season progressed, flu isolates followed a fairly typical flu season pattern, with influenza B occurring at low levels. Influenza A (H1N1), A (H3N2) and RSV all peaked at the same time during week 33. As the influenza virus and RSV levels dropped over subsequent weeks, para-influenza 3 increased, peaking in week 41.

Adenovirus and enterovirus isolation occurred throughout the year, with higher levels of adenovirus observed in the second half of the year. Enterovirus EV68 was detected in three isolates. EV68 has outbreak potential and has been associated with acute flaccid paralysis cases in North America. There were no isolates of enterovirus EV71 in 2018. Otherwise, the most common viruses isolated were Coxsackievirus Group A virus, predominantly Types 6, 8, and 21. Coxsackieviruses cause a wide spectrum of diseases from conjunctivitis and vesicular stomatitis or pharyngitis to meningitis and carditis. During June 2018 there were nine isolates of Echovirus type 5 over five weeks. Echoviruses can also cause encephalitis.

1.9 Outbreaks

ARPHS managed 126 outbreaks, down from 146 in 2017 and 166 in 2016. Normally there are more outbreaks reported in summer and early spring, but in 2018 the outbreaks were reported throughout the year.

Major outbreaks included the on-going pertussis outbreak, a school norovirus outbreak of 198 cases, and a retirement village norovirus outbreak of 97 cases. There was an observed decrease in the number of cryptosporidiosis and giardiasis outbreaks.

Of the 126 outbreaks, 122 were foodborne outbreaks - for which a cause was found in 88 (72%), compared with 74% for 2017.

Norovirus, salmonellosis and VTEC were responsible for the greatest number of outbreaks in 2018, as opposed to giardia, cryptosporidium and salmonella in 2017. There were 34 outbreaks of gastroenteritis in which a cause could not be found.

Norovirus outbreaks caused illness in 1339 cases, up from 912 cases in 2017 and 792 in 2016 and very close to the 1,328 cases in 2015. Norovirus was responsible for the majority of outbreak-associated illness, and probably a good number of the gastroenteritis where the cause was not identified.

Long-term care facilities had the greatest number of reported foodborne outbreaks (34) and cases (635). Outbreaks in the home (28) were numerous, but involved a smaller number of cases (73). Childcare centres had 25 outbreaks, involving 389 children, compared with schools, where there were nine larger outbreaks involving 519 children and staff.

Section 2: Vector-borne diseases

This chapter includes information about the most common arboviral diseases seen in New Zealand, and malaria, another vector-borne disease. Mosquito interceptions are also covered.

2.1 Arboviral Diseases

Arbovirus is a term used to refer to a group of viruses that are transmitted by arthropod vectors. The word arbovirus is an acronym (ARthropod-BOrne virus). Symptoms of arbovirus infection generally occur three to 15 days after exposure to the virus and last three or four days. The most common clinical features of infection are fever, rash, headache, and malaise, but for dengue fever and chikungunya, haemorrhagic fever and encephalitis, respectively, may also occur. Zika virus is also able to be transmitted sexually, and can cause neurological impairment in the developing foetus.

For arboviruses, the vectors are commonly mosquitoes, ticks, sand-flies and other arthropods that consume the blood of vertebrates for nutritious or developmental purposes. New Zealand does not currently have a suitable environment for sustaining populations of a competent vector for arboviral disease transmission, but as global warming progresses, mosquitoes capable of transmitting the viruses are moving further from the equator into areas which previously did not harbour the mosquito.

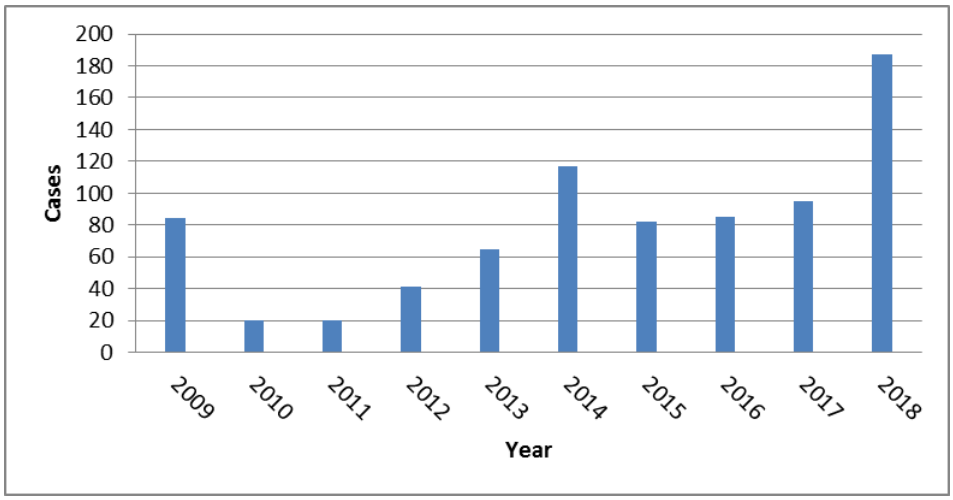
2.1.1 Dengue fever

Dengue fever, also known as “break-bone fever”, is a mosquito-borne tropical disease caused by the dengue virus. Symptoms include fever, headache, muscle and joint pains, and a characteristic skin rash that is similar to measles. In a small proportion of cases the disease develops into the potentially life-threatening severe dengue, (with haemorrhagic features, (previously referred to as haemorrhagic fever) characterised by bleeding, low levels of blood platelets and blood plasma leakage), or into dengue shock syndrome. More severe illness and dengue with haemorrhage features, is more likely in people previously infected with one of the four known serotypes of dengue virus (DEN1, DEN2, DEN3, DEN4), who are subsequently infected with a different serotype.

A total of 187 cases of dengue fever were reported for the Auckland region, up from 95 cases in 2017 and 85 cases in 2016. Dengue has increased gradually over the past seven years. There was an increase in 2014 coinciding with an outbreak of DEN3 in the Pacific, but in 2017, DEN3 was replaced by DEN2 as the predominant serotype. The number of severe dengue fever cases was noticeably higher in 2017 and 2018 compared with other years due to this change in circulating serotype from DEN3 to DEN2 in the Pacific, particularly in Samoa. More severe illness with concurrent dengue of differing serotypes is a well-documented feature of dengue fever.

In 2018 the incidence rate for the Auckland region was 11.0 cases per 100,000, compared with 3 cases per 100,000 for the rest of New Zealand.

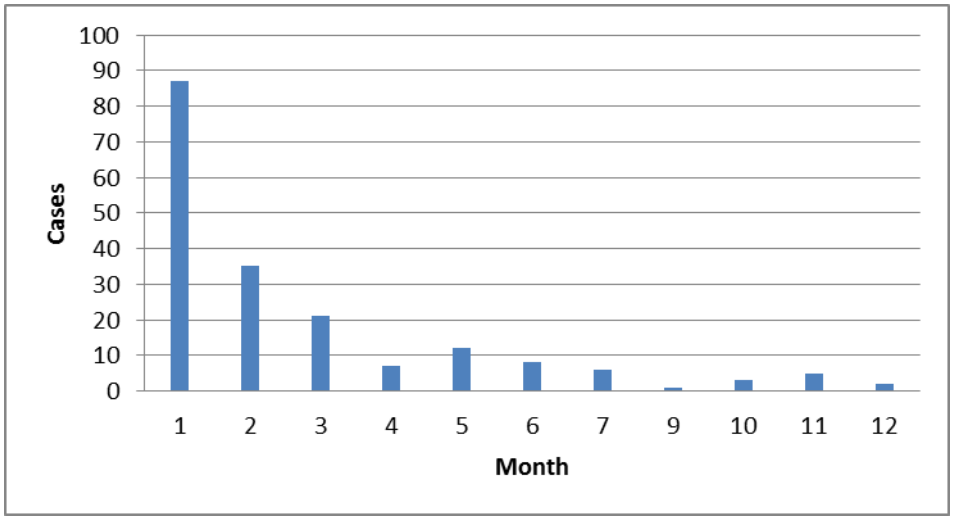
Figure 2: Dengue fever cases in the Auckland region 2009 - 2018



Hospitalisation occurred in 66% of cases - similar to the 64% in 2017. This compares with 41% of cases in 2016 and 51% of cases in 2015, and represents an increase in the occurrence of more severe disease. There were no deaths.

Dengue cases are characteristically higher in the first quarter of the year when many local residents take holidays or visit friends and relatives in the Pacific. In 2017 this changed, and there was a steady increase in cases through the third and fourth quarters reflecting the new emergence of outbreaks of predominantly DEN2 in the Pacific region, which then continued into the first quarter of 2018 (Figure 3).

Figure 3: Dengue fever cases by month in the Auckland region 2018



All notified cases were confirmed by one or more laboratory tests: NS1 antigen, dengue PCR and in a reducing number of cases, anti-dengue IgM.

Age-specific incidence rates were highest in the 40-49 age group (18.3/100,000) followed by the 15-19 year age group (15.4/100 000) (Table 3).

Table 3: Age-gender distribution and age-specific incidence rates of dengue fever in the Auckland region 2018

Age group	Female	Male	Total	Rate per 1000,000*
1 to 4	0	1	1	0.9
5 to 9	4	0	4	3.5
10 to 14	6	6	12	11.4
15 to 19	6	11	17	15.4
20 to 29	22	11	33	10.8
30 to 39	14	19	33	12.8
40 to 49	20	20	40	18.3
50 to 59	8	14	22	10.8
60 to 69	10	9	19	12.6
70+	4	2	6	4.3
Total	94	93	187	11.0

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand)

People of Pacific ethnicity accounted for 136 (72%) of all cases, and had the highest incidence rate of 63 per 100,000. This rate is more than double the rate in 2017 (19.4/100,000) (Table 4). More detailed ethnicity is shown in (Table 5).

Table 4: Ethnic and gender distribution and ethnic specific incidence rates of dengue fever in the Auckland region 2018

Ethnic group	Female	Male	Grand Total	Rate per 1000,000*
Asian	10	14	24	5.4
Maori	2	0	2	1.0
Pacific Peoples	70	66	136	63.0
European Other	12	13	25	3.0
Total	94	93	187	11.0

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base) (Source: Statistics New Zealand)

Table 5: Detailed ethnicity distribution of dengue fever in the Auckland region 2018

Ethnicity	Total
Samoan	85
Tongan	43
European	22
Indian	13
Fiji, Indo-Fijian	7
Unknown/Not stated	6
South East Asian	4
Pacific Other	2
Chinese	1
German	1
Maori	1
Middle Eastern	1
Tokelauan	1
Total	187

The majority of cases (164, or 88%) acquired their illness whilst travelling or visiting friends and relatives in the Pacific Islands east of the Solomon Islands (Table 6).

Table 6: Source countries of dengue fever notification in the Auckland region 2018

Source Country	Total
Samoa	88
Tonga	47
Fiji	22
Thailand	8
India	4
French Polynesia	3
Indonesia	2
Vietnam	2
Australia	1
Cambodia	1
Cook Islands	1
Malaysia	1
New Caledonia	1
Papua New Guinea	1
Philippines	1
Saudi Arabia	1
Solomon Islands	1
USA	1
Vanuatu	1
Total	187

The predominant circulating strain of dengue for 2018 was DEN2. There were small numbers of DEN1 (5), DEN3 (3), and DEN4 (3). The source countries for these serotypes are shown in Table 7.

Table 7: Dengue fever serotypes by source country in the Auckland region 2018

Serotype	Source Country	Total
DEN1	Cook Islands	1
	French Polynesia	2
	Indonesia	1
	Philippines	1
DEN1 Total		5
DEN2	Australia	1
	Cambodia	1
	Fiji	14
	Malaysia	1
	Samoa	66
	Thailand	4
	Tonga	42
	Vanuatu	1
DEN2 Total		130
DEN3	Indonesia	1
	Papua New Guinea	1
	Vietnam	1
DEN3 Total		3
DEN 4	India	1
	Saudi Arabia	1
	Thailand	1
DEN4 Total		3

2.1.2 Chikungunya

Chikungunya is an infection caused by the Chikungunya virus. It features the sudden onset of fever, usually lasting two to seven days, and joint pains, typically lasting weeks or months. The mortality rate is a little less than 1 in 1000.

The virus is mainly passed to humans by two species of mosquito of the genus *Aedes*: *A. albopictus* and *A. aegypti*. These mosquitoes are not endemic to New Zealand, but they are widely distributed across the Pacific Islands. Animal reservoirs of the virus include monkeys, birds, cattle, and rodents. This is in contrast to dengue, for which only humans and primates are hosts.

Five cases of Chikungunya were reported. There was one case with uncertain status because of the clinical presentation, indeterminate serology, and the source country given was Australia. The remaining four confirmed cases represent an increase of two from 2017. The incidence rate of Chikungunya for the Auckland region was 0.3 cases per 100,000 compared with 0.2 cases per 100,000 for the rest of New Zealand. All cases were teens or adults.

Source countries for the confirmed cases were India (2), Brazil (1), and Thailand (1).

2.1.3 Ross River Virus

Ross River virus (RRV) is a small encapsulated single-strand RNA alphavirus endemic to Australia, Papua New Guinea, and other islands in the South Pacific. It is responsible for a type of mosquito-borne non-lethal but debilitating tropical disease known as Ross River fever, previously termed "epidemic polyarthritis". The virus is suspected to be enzootic in populations of various native Australian mammals, and has been found on occasion in horses.

There was only one case notified for the year down from five in 2017. Typically there are only one or two cases notified in the Auckland region each year. This single case had a recent travel history to Australia and did not require hospitalisation.

2.1.4 Zika Virus

Zika virus is a member of the *Flaviviridae* virus family, along with dengue, yellow fever, West Nile and Japanese encephalitis viruses. In humans, it causes a disease known as Zika fever.

The first outbreak of the disease outside of Africa and Asia was in April 2007, on the island of Yap in the Federated States of Micronesia. As such, it could be considered an emerging pathogen. This illness is characterised by rash, conjunctivitis, and arthralgia, and was initially mistaken for dengue.

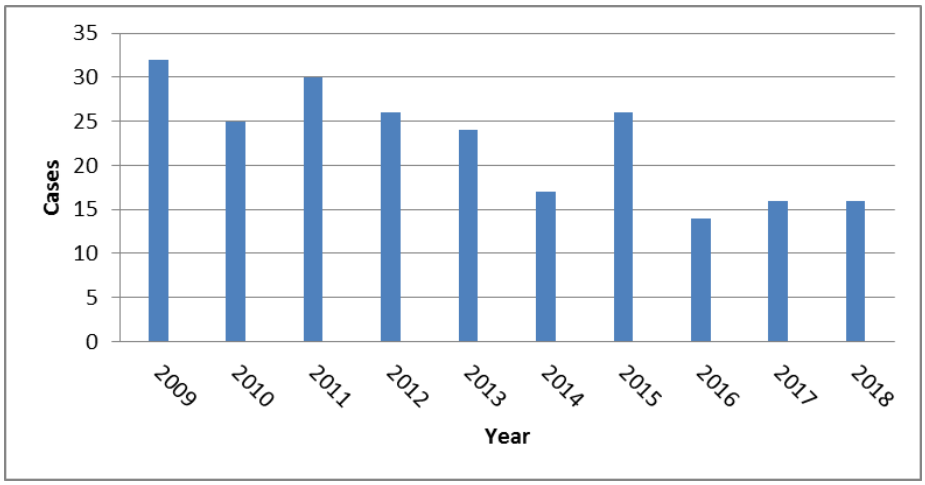
There were no notifications of Zika notified to ARPHS in 2018.

2.1.5 Malaria

Malaria is a mosquito-borne infectious disease of humans and other animals caused by parasitic protozoa (a group of single-celled microorganism) belonging to the genus *Plasmodium*. The disease is transmitted by an infected female *Anopheles* mosquito. Five species of *Plasmodium* can infect and be spread by the mosquito to human route. Most deaths are caused by *P. falciparum* because *P. vivax, P. ovale*, *P. knowlesi* and *P. malariae* generally cause a milder form of malaria.

There were 16 cases notified, the same as for 2017 (Figure 4*)*. The incidence rate of malaria for the Auckland region was 0.9 cases per 100,000, compared with 0.6 cases per 100,000 for the rest of New Zealand.

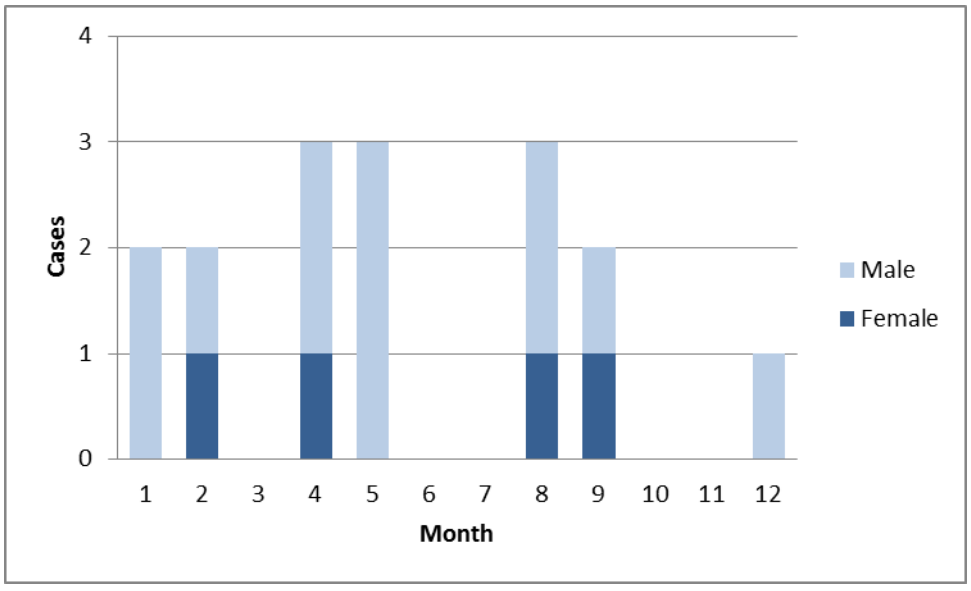
Figure 4: Malaria cases by year in the Auckland region 2009 - 2018



All cases were overseas acquired. Five cases had P. *falciparum*, nine *had P. vivax*, 12 of the cases were hospitalised, and there were no deaths.

Cases were reported throughout the year.

Figure 5: Malaria cases by month and sex in the Auckland region 2018



The age-specific incidence rate was highest in the 20-29 year age group, and the male to female ratio was 3:1 (Table 8).

Table 8: Age-gender distribution and age-specific incidence rates of reported malaria cases in the Auckland region 2018

Age-group	Female	Male	Total	Incidence per 100,000*
1 to 4	1		1	0.9
15 to 19	1	1	2	1.8
20 to 29		6	6	2.1
30 to 39	1		1	0.4
40 to 49		3	3	1.3
50 to 59	1	1	2	1.0
60 to 69		1	1	0.7
Total	4	12	16	0.9

*Rates are based on 2018 estimated mid-year population (Source: Statistics New Zealand).

Asian, Middle Eastern, Latin and African ethnicity represented 69% of cases (Table 9). Five of the 16 cases acquired their illness in India (Table 10).

Table 9: Ethnic-gender distribution and ethnic-specific incidence rates of malaria in the Auckland region 2018

Ethnic group	Female	Male	Total	Incidence per 100,000*
Asian	1	6	7	1.6
European or Other	1	2	3	0.4
Pacific Peoples	-	-	-	-
Middle Eastern/Latin American/ Africa	1	3	4	-
Unknown	-	-	2	-
Total	5	11	16	0.9

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

Table 10: Overseas acquired malaria cases by country of origin in the Auckland region 2018

Source Country	Total
India	5
Ethiopia	2
Dem. Rep. of Congo	1
Fiji	1
Indonesia	1
Papua New Guinea	1
Rwanda	1
Sri Lanka	1
Zambia	1
Reactivation ex Afghanistan	1
Reactivation ex India	1
Total	16

2.1.6 Mosquito Interceptions

ARPHS responded to 36 mosquito interceptions at the border and at transitional facilities in 2018. There were two Aedes aegypti interceptions, compared with 14 in 2017 and two in 2016. Details of specimens identified and their source country are shown in Table 11.

Table 11: Specimen identification of ARPHS mosquito interceptions/incursions in the Auckland region 2018

Species	Female	Male	Country of origin
Chironomidae	1		Mexico
Aedes notoscriptus	1		NZ
Aedes taeniorhynchus	1		USA
Culex pervigilans	9		NZ
Culex quinquefasciatus	6	15	Australia, Columbia, Malaysia, Brisbane, Singapore, USA
Culex sp.	3	2	NZ
Aedes aegypti*		2	Unknown, Tonga**
Aedes vexans		2	Fiji
Aedes vexans	89	68	Tonga**
Two non-mosquitoes		2	Singapore
Total	110	91	

*Denotes an exotic species
** Single incursion on board a ship
Source: ARPHS Mosquito Interception Response Database 2018

Both Aedes albopictus and Aedes aegypti are mosquito vectors for dengue, and are also important vectors for Chikungunya and Zika virus. These mosquitoes have not been able to establish populations in New Zealand to date, so fortunately New Zealand does not have a competent vector for autochthonous spread of these arboviruses. As global warming continues, the distribution of these mosquito species has drifted further south (and north) bringing the disease vector to formerly temperate climates.

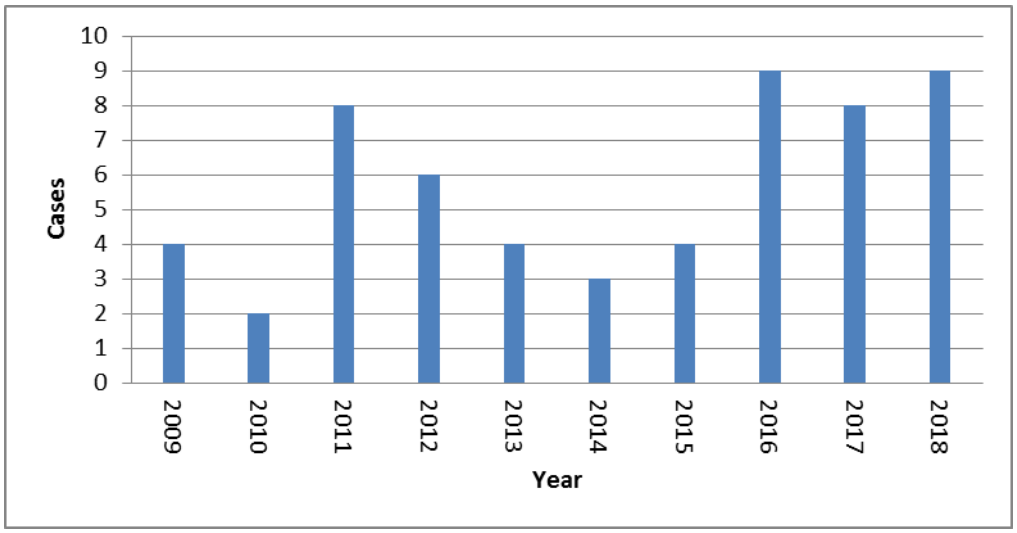
2.1.7 Leptospirosis

Leptospirosis is an infection caused by corkscrew-shaped bacteria called *Leptospira*. Symptoms can range from none, to mild (such as headaches, muscle pains, and fevers) to severe, with bleeding from the lungs, or meningitis. If the infection causes jaundice, kidney failure and bleeding it is known as Weil's disease.

Up to 13 different genetic types of *Leptospira* may cause disease in humans. It is transmitted by both wild and domestic animals. The most common animals that spread the disease are rodents. It is often transmitted by animal urine or by water or soil containing animal urine coming into contact with breaks in the skin, eyes, mouth, or nose. Outbreaks often occur after major flooding.

There were 13 cases of leptospirosis notified compared with eight in 2017, nine in 2016, and four in 2015 (Figure 6). Notifications have been increasing since 2014, but this may be due to increased volume or sensitivity of laboratory testing. All cases were adults; nine were male and four female. Eleven of the 13 required hospitalisation, but there were no deaths. Cases occurred throughout the year, with three cases occurring in June.

Figure 6: Leptospirosis cases by year in the Auckland region 2009-2018



Section 3: Foodborne diseases

3.1 Enteric Fevers

Enteric fever (typhoid and paratyphoid fever) is caused by faecal oral transmission of *Salmonella enterica* serotypes Typhi or Paratyphi. About 27 million people suffer from enteric fever each year, with about 200,000 deaths, almost exclusively in the developing world. The incidence of these neglected illnesses in some parts of South Asia is as high as 1,600 cases per 100,000. Due to the ready availability of over-the-counter antibiotics there is increasing antibiotic resistance and enteric fever is becoming harder to treat.

A total of 39 cases of enteric fevers were reported, well down from the 70 cases in 2017, and more in line with the 10-year average. Of the 39 cases, 29 (75%) were typhoid fever and 10 (25%) were paratyphoid fever (Table 12).

Table 12: Classification of enteric fever cases in the Auckland region 2009-2018

Year	Paratyphoid fever	Typhoid fever	Total
2009	12	26	38
2010	8	20	28
2011	7	36	43
2012	11	30	41
2013	16	39	55
2014	9	28	37
2015	14	32	46
2016	15	28	43
2017	24	46	70
2018	10	29	39

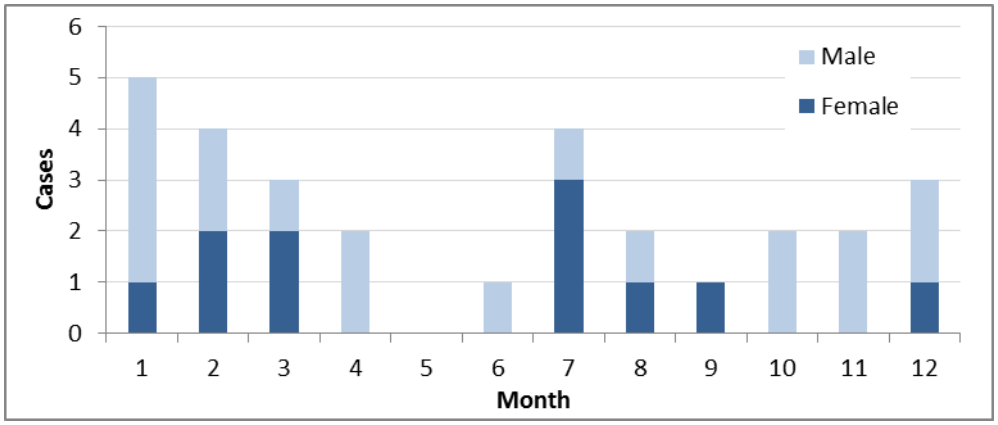
3.1.1 Typhoid fever

Typhoid fever — also known simply as typhoid — is a common worldwide bacterial disease transmitted by the ingestion of food or water contaminated with the faeces of an infected person that contain the bacterium *Salmonella typhi*. In New Zealand, most cases acquire the infection while travelling overseas or through contact with visitors from abroad.

The incidence rate for the Auckland region was 1.7 cases per 100,000; approximately twice the rate for the rest of New Zealand (0.8/100,000).

Typhoid cases (29) were reported throughout the year, with a small unexpected peak in mid-winter (Figure 7). The majority of cases required hospitalisation (86%). There were no deaths.

Figure 7: Monthly distribution of typhoid cases by gender in the Auckland region 2018



Age-specific incidence rates were highest in younger adults and the 10 to 14 year old age group (Table 13). The overall male to female ratio was 1.6:1. Nearly all cases were of Asian and Pacific peoples' ethnic groups (Table 14*).* The three locally acquired cases were from the Samoan community. The majority of overseas acquired cases were of Samoan or Indian ethnicity.

Table 13: Age-gender distribution and age-specific incidence rates of typhoid in the Auckland region 2018

Age-group	Female	Male	Total	Incidence-rate per 100,000*
1 to 4	1		1	0.9
5 to 9	1		1	0.9
10 to 14		3	3	2.8
15 to 19		1	1	0.9
20 to 29	2	6	8	2.8
30 to 39	3	5	8	3.3
40 to 49	2	1	3	1.3
50 to 59		1	1	0.5
60 to 69	1	1	2	1.3
70+	1		1	0.7
Total	11	18	29	1.7

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

Table 14: Ethnic group distribution and ethnic-specific incidence rates of typhoid cases in the Auckland region 2018

Ethnic group	Female	Male	Total	Incidence-rate per 100,000*
Asian	7	7	14	3.1
Māori	0	0	0	0.0
European or Other	1	0	1	0.1
Pacific Peoples	3	10	13	6.0
Unknown	0	1	1	-
Total	11	18	29	1.7

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

There were three locally acquired cases, all amongst the Pacific community who had visiting friends and relatives during the exposure period. The remainder of cases (26) were overseas acquired. The majority of the typhoid cases were overseas acquired from India (11), Samoa (11), Pakistan (2) and the Philippines (2) (Table 15).

Table 15: Country of origin for overseas acquired typhoid fever cases in the Auckland region 2018

Source country	Cases
India	11
Samoa	11
Pakistan	2
Philippines	2
Total	26

3.1.2 Paratyphoid fever

Paratyphoid fever is an enteric illness caused by one of the following three serotypes of *Salmonella (S) enterica* subspecies enterica: *S. Paratyphi* A*, S. Paratyphi* B and *S. Paratyphi* C. Like *S. Typhi,* they are transmitted by means of contaminated water or food. Paratyphoid fever bears similarities with typhoid fever and the two are referred to by the common name enteric fever, but the clinical course of paratyphoid fever is more benign. *S. Paratyphi B var Java* cases (12) were previously classified as a paratyphoid fever notification, but these have now been reclassified and are managed as salmonellosis.

The incidence rate of paratyphoid fever for the Auckland region was 0.6 cases per 100,000 and was similar to the incidence rate for the rest of New Zealand (0.7/100,000). A total of 10 cases of paratyphoid fever were notified in 2018; well down from the 24 cases in 2017 due to the reclassification of S. *Paratyphi B var Java.* Cases were reported throughout the year, with the highest number of cases in February and May, with three each. Cases by gender were evenly split, and the predominant age groups were 20 to 29 years (6), and 40 to 49 years (2). 8 of the 10 cases were hospitalised. There were no deaths.

The predominant ethnic groups were Asian (7) and NZ European (2).

All but one case was overseas acquired. Countries of origin included India Indonesia Malaysia, Bangladesh, Pakistan and Australia.

Paratyphi A accounted for all 10 cases. There were no cases of *Paratyphi B* in 2018.

3.1.3 Shigellosis

Shigellosis is also known as bacillary dysentery. It is a foodborne illness caused by infection by bacteria of the genus *Shigella*. Shigellosis rarely occurs in animals other than humans. The causative organism is frequently found in water polluted with human faeces, and is transmitted via the faecal-oral route. The usual mode of transmission is person-to-person or faecal hand-to-mouth spread.

In 2018, the incidence rate for the Auckland region was 7.2 cases per 100,000, more than double the incidence rate for the rest of New Zealand (3.0/100,000).

A total of 122 cases of shigellosis were notified, down from the 150 cases notified in 2017, but still up from 107 cases in 2016, and 62 cases in 2015 (Figure 8). The 2016 and 2017 increase is a true increase as PCR testing was not extended to shigellosis. Lab testing methodology was the same as for previous year's i.e. bacterial culture. Cases were reported throughout the year, though typically notifications are less in the winter months. The peak month was January, driven by the local population visiting friends and relatives overseas (Figure 9). Hospitalisation was reported in 26% of cases; there were no deaths.

Figure 8: Shigellosis cases in the Auckland region 2009 to 2018

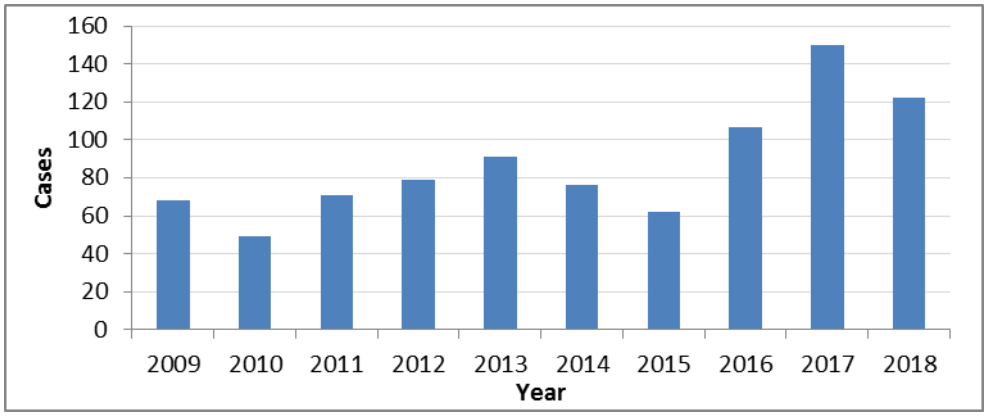
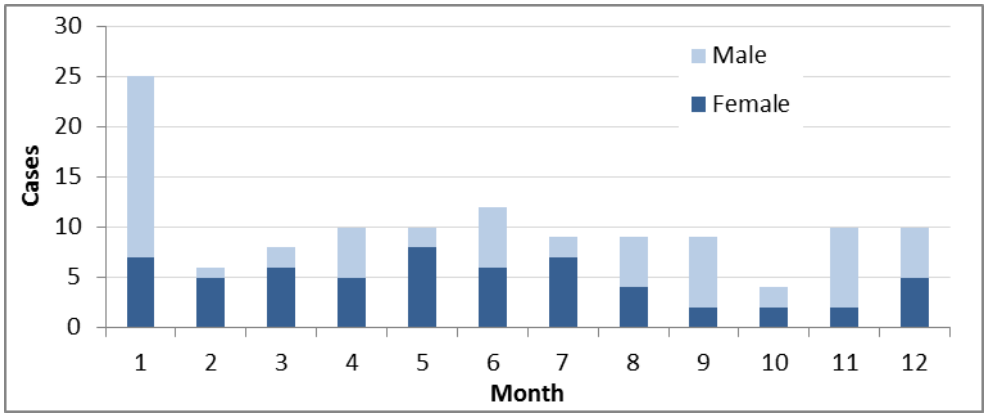


Figure 9: Monthly distribution by gender of shigellosis cases in the Auckland region 2018



The age-gender distribution and age-specific incidence rates shows a wide distribution, with the highest incidence in children aged less than five years old. The male to female ratio is equal (Table 16).

Table 16: Age-gender distribution and age-specific incidence rates of shigellosis in the Auckland region 2018

Age-group	Female	Male	2018 Total	Rate per 100,000*
1 to 4	8	9	17	15.2
5 to 9	5	3	8	7.1
10 to 14	3	4	7	6.5
15 to 19	2	4	6	5.4
20 to 29	12	4	16	5.7
30 to 39	6	10	16	6.6
40 to 49	8	5	13	5.8
50 to 59	6	10	16	7.7
60 to 69	5	7	12	7.8
70+	4	7	11	7.7
Total	59	63	122	7.2

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

The highest incidence was seen in Pacific peoples, with 22.2cases per 100,000 (Table 17). This is four times the rate of any other ethnic group. Tongan and Samoan ethnic groups (44) made up 3% of all cases (Table 18).

Table 17: Ethnic-group distribution and gender-specific incidence rates of shigellosis in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	10	9	19	4.3
European or Other	21	18	39	4.6
Maori	3	6	9	4.7
Pacific Peoples	23	25	48	22.2
Unknown	2	5	7	-
Total	59	63	122	7.2

* Ethnicity rates are based on 2018 projected prioritised ethnic populations (2016 base).

Table 18: Ethnicity distribution of shigellosis cases in the Auckland region 2018

Ethnicities	Female	Male	Total
NZ European	17	12	29
Tongan	12	13	25
Samoan	9	10	19
Indian	7	5	12
Maori	1	4	5
Other Asian	2	4	6
Other European	3	9	12
Latin American	2		2
Chinese	1		1
Fijian	1		1
Middle Eastern	1		1
Niuean		1	1
Other Pacific Peoples	1		1
Unknown	2	5	7
Total	59	63	122

Two thirds (66%) of cases were overseas acquired. Tonga (20), India (20) and Samoa (15) predominated as source countries (Table 19).

Table 19: Country of origin for shigellosis cases in the Auckland region 2018

Source Country	Total	%
Tonga	20	25%
India	20	25%
Samoa	15	19%
Indonesia	7	9%
Fiji	3	4%
Singapore	2	3%
Pakistan	2	3%
Bangladesh	2	3%
Cambodia	1	1%
Philippines	1	1%
Botswana	1	1%
United States of America	1	1%
Thailand	1	1%
Australia	1	1%
Vietnam	1	1%
Jordan	1	1%
Kenya	1	1%
Total	80	100%

Various serotypes were identified throughout the year; *Shigella flexneri* (50%), *Shigella sonnei* (43%), *Shigella boydii* (2%), and others (5%). All *Shigella* isolates were from stool specimens. See Table 20

Table 20: Shigella Isolates in the Auckland region 2018

Serotype	Total
Shigella boydii 1	1
Shigella boydii 10	1
Shigella boydii 2	1
Shigella dysenteriae 3	1
Shigella flexneri	2
Shigella flexneri 1a	2
Shigella flexneri 1b	31
Shigella flexneri 1c	5
Shigella flexneri 2a	7
Shigella flexneri 2b	1
Shigella flexneri 3a	2
Shigella flexneri 3b	1
Shigella flexneri 4a	1
Shigella flexneri 6 Biotype Boyd 88	6
Shigella flexneri Y	2
Shigella flexneri Yv	1
Shigella sonnei Biotype a	19
Shigella sonnei Biotype f	1
Shigella sonnei Biotype g	31
Shigella sonnei ISOLATED	1
EHEC	3
Untyped	2
Total	122

Shigella flexneri Type 1b and *Shigella sonnei* type g were the most common serotypes.

Of the 31 *Shigella flexneri* Type 1b cases identified, 14 were acquired in Tonga, three in India, and two in other countries. Twelve cases were locally acquired. Various risk factors were established in this group, but nothing stood out - contact with another case (1), consumption of raw fish (2) and recreational swimming (1), were identified.

Shigella sonnei Biotype g was isolated for 31 cases. Twenty one of these cases were overseas acquired; predominantly India and Indonesia. Of the remaining cases, four were in men who have sex with men (MSM).

Different public health messaging is utilised for MSM cases, and ARPHS circulates advice from the CDC "*Shigella* infections among Gay and Bisexual Men" factsheet (www.cdc.gov/shigella/pdf/msm-factsheet-508.pdf).

Shigella sonnei type a, was the next most common serotype, with 19 cases. Thirteen of these cases were overseas acquired from Samoa (9), Fiji (3), and the Philippines (1). Of the locally acquired cases, risk factors included consumption of raw fish (1), recreational swimming at a beach outside Auckland (1), and recreational swimming in a public swimming pool (2).

3.1.4 Vero-toxigenic *E. coli* / Shiga toxin-producing *E. coli* (VTEC/STEC)

Escherichia coli (E. coli) bacteria normally live in the intestines of people and animals. Most *E. coli* are harmless, and are an important part of a healthy human intestinal tract. However, some *E. coli* are pathogenic, meaning they can cause illness, either diarrhoea, or illness outside of the intestinal tract. One group of pathogenic *E. coli* produces a toxin called shiga toxin. This toxin is capable of damaging the gut lining, blood cells and kidneys, to the extent that around 5–10% of those who are diagnosed with VTEC/STEC infections develop a potentially life-threatening complication known as haemolytic uraemic syndrome (HUS). HUS is a disease characterised by haemolytic anaemia (anaemia caused by destruction of red blood cells), acute kidney failure (uraemia), and a low platelet count (thrombocytopenia). It predominantly, but not exclusively, affects children.

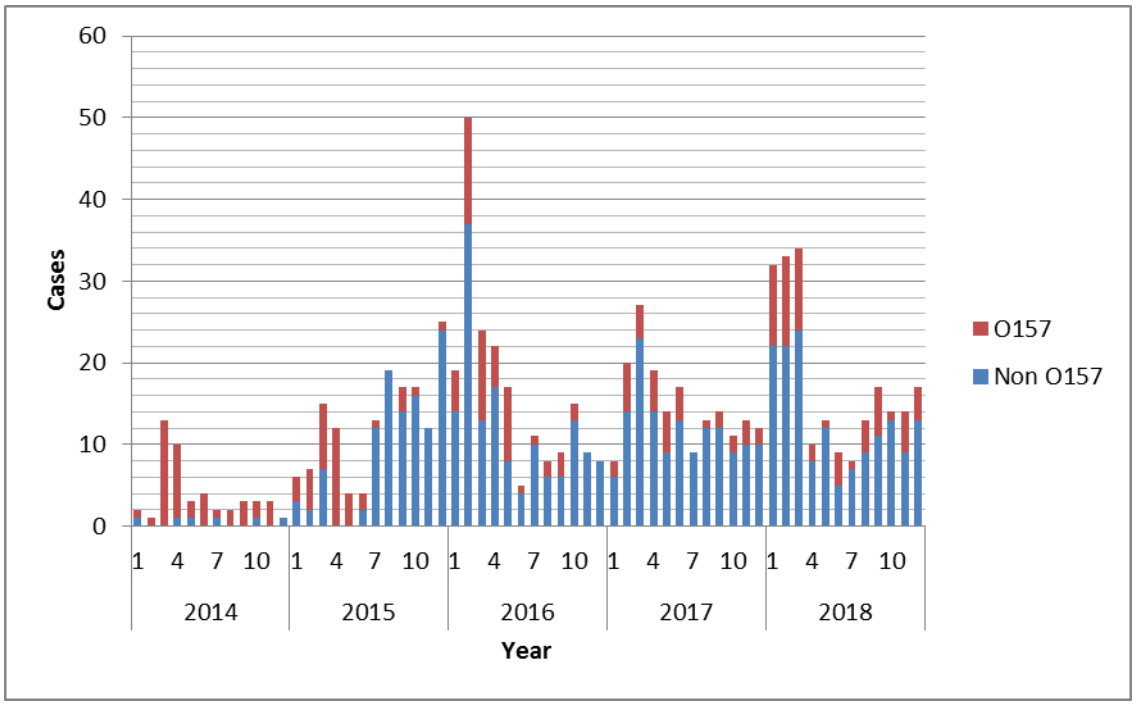
In mid-2015, Labtests Auckland introduced testing using Entericbio® Gastro Panel. This PCR-based platform has the advantage of automated testing of multiple pathogens including viruses, bacteria, and parasites in one assay. This results in a faster turn-around time and therefore improves the timeliness of diagnosis, patient management and the public health response. Labtests held a short trial in March 2015, which demonstrated good sensitivity and specificity and in June 2015, PCR based testing in the Auckland region went live.

Verotoxin PCR positive samples processed by Labtests were sent to the Enteric Reference Laboratory at ESR (Institute for Environmental and Scientific Research), a Crown Research Institute for further typing and analysis.

Prior to the introduction of PCR based testing, the VTEC incidence rate for the Auckland region was 3.5 cases per 100,000 (30 to 50 cases). By the end of 2016 the incidence rate had increased to 12 cases per 100,000 due to a larger number of cases being detected by the more sensitive testing method.

The incidence rate for 2018 in the Auckland region was 12.9 cases per 100,000, with a total of 218 probable and confirmed cases of VTEC for the year, up from 177 cases in 2017. During the year most of New Zealand moved to PCR based testing, and the incidence rate for the rest of New Zealand increased from 11.8 cases per 100,000 in 2017 to 22.1 cases per 100,000 in 2018.

Figure 10: VTEC serotypes O157 and non-O157 by year and month for the Auckland region 2014 – 2018



Since the change in laboratory testing in 2015 the proportion of *E. Coli* O157 to non-O157 cases has decreased from 87% in 2014 to 26% in 2015 and 2016 (Figure 10 and Table 21). This proportion of *E. Coli* O157 cases has remained largely unchanged since apart from an observed 8% increase in 2018 over 2017 (however this increase is not statistically significant). This suggests the new testing methodology is detecting more non-O157 cases.

Table 21: Proportion of O157 to non-O157 cases prior to PCR testing (June 2015) and after in the Auckland region 2014 – 2018

Year	Non O157	O157
2014	13%	87%
2015	74%	26%
2016	74%	26%
2017	80%	20%
2018	72%	28%

ARPHS' risk-based approach is based on two key aspects:

1. Severity of the illness and
2. Public health risk.

The case definition for VTEC is: "A clinically-compatible illness plus laboratory isolation of specific organisms or toxin". The Ministry of Health's Communicable Disease Guideline is in the process of clarifying what constitutes 'a clinically compatible illness'. It was apparent from our investigations that there is a wide spectrum of presenting symptoms. We also know that there are specific high-risk groups for HUS and public health risk, so from 2016, symptoms from all notifications received by ARPHS were graded into three levels. During 2018 it was felt this

could be simplified further into just two categories (Table 22). This was implemented for the final quarter.

Table 22: Grading of symptoms of VTEC illness

Clinical Illness	Status	Assignment
Acute onset (<2 weeks) diarrhoeal illness (with or without blood or mucus in stool) OR Any case with documented HUS or TTP	Under Investigation	Assign to Disease Investigation
Chronic diarrhoea (>2 weeks) or no diarrhoea*	Not a case	Assign to Medical officer

*If marginal e.g. acute diarrhoea 3 weeks ago in a young child, farm worker or travel then assign for interview

Clinical exclusion criteria (despite having definitive laboratory evidence):
Asymptomatic cases
Cases with only mild bowel symptoms (e.g. occasional loose stools) or presentation with abdominal pain alone

All cases were assigned to the Senior Medical Officer (SMO) for initial assessment, which included symptom grading, and an attempt to establish whether the case was high risk i.e. worked as a food handler, ECEC teacher, attended ECEC, or worked in healthcare.

After initial assessment, the following actions were taken:

- All acute onset diarrhoeal illness (< 2 weeks) or any case with HUS or TTP was referred to disease investigators (DI) for interview
- The remaining cases with chronic diarrhoea (> 2 weeks) or no diarrhoea were classified as 'not a case', and were assigned to a MO pending typing
- Culture positive cases with symptoms > 2 weeks were reviewed in light of the serotyping results, especially for O157, O26, O128 cases, to consider a possible link to other cases (even though they are classified as "not a case" for surveillance purposes as they do not meet the national clinical case definition).

A total of 218 cases of VTEC were reported, up from 177 in 2017 and the previous peak of 197 in 2016 (*Figure 11*).

Cases occurred throughout the year, with a large number of notifications during the first quarter (Figure 12). Hospitalisation occurred in 58 cases (27%). There were three reported cases of HUS; all three cases were associated with the O157 strain. There were fortunately no deaths.

Figure 11: VTEC cases in the Auckland region 2009-2018

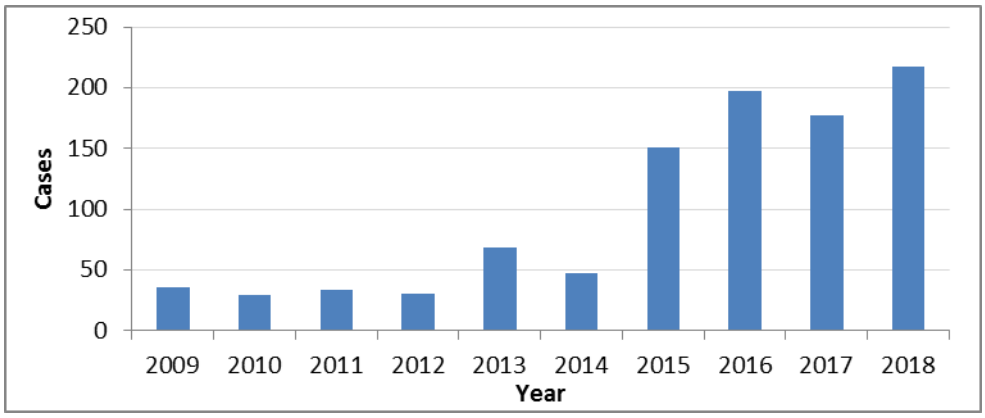
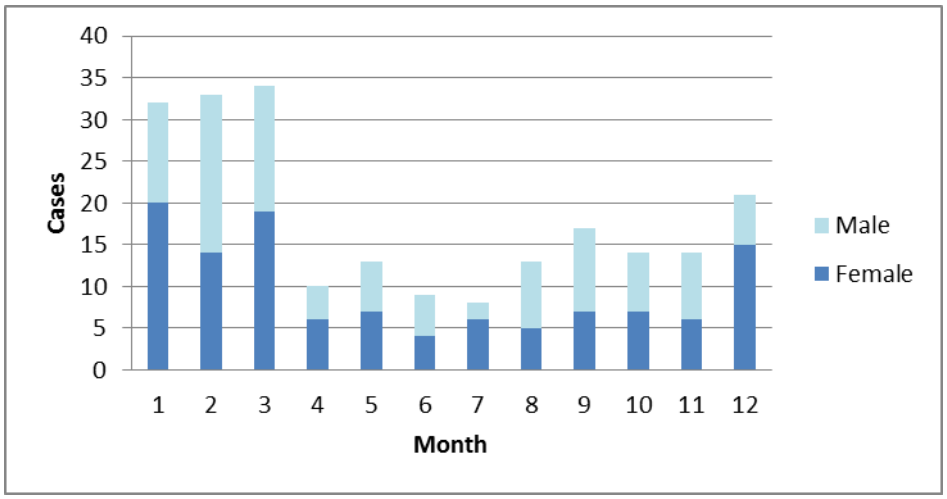


Figure 12: Monthly distribution of VTEC cases in the Auckland region 2018



The highest incidence rates were seen in the less than five year age group. The female to male ratio was fairly equal in most age groups, however, a 2:1 male to female ratio was present in the 1-4 year age group, and this ratio then reverses in favour of females aged 20 to 39 (Table 23*)*. The highest incidence rate was seen in the 'Other' ethnic group (this grouping includes European, Middle Eastern, and Latin American ethnicities) and represented two thirds of all cases notified (Table 24).

Table 23: Age-gender distribution and age-specific incidence rates of VTEC in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
<1	8	6	14	62.6
1 to 4	10	24	34	38.0
5 to 9	8	6	14	12.3
10 to 14	7	6	13	12.4
15 to 19	5	3	8	7.3
20 to 29	21	12	33	10.8
30 to 39	12	5	17	6.6
40 to 49	7	8	15	6.9
50 to 59	15	8	23	11.3
60 to 69	10	7	17	11.3
70+	13	17	30	21.7
Total	116	102	218	12.7

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand)

Table 24: Ethnic distribution and gender-specific incidence rates of VTEC in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	14	19	33	7.4
Māori	12	8	20	10.4
Other	74	65	139	16.5
Pacific Peoples	11	5	16	7.4
Unknown	5	5	10	-
Total	116	102	218	12.7

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

Risk factors for VTEC are listed below. In some situations more than one risk factor was present, especially for those on farms where there was contact with farm animals and untreated tank water (Table 25). These risk factors have not changed substantially since 2016, although more than twice the numbers of cases were acquired overseas in 2018 compared with 2016.

Table 25: Risk factors associate with VTEC in the Auckland region 2016 – 2018

Risk factors	Cases	% Present 2016	% Present 2017	% Present 2018
Overseas acquired	53	9%	18%	24%
Untreated water supply	26	17%	11%	17%
Contact with farm animals	25	14%	17%	16%
Contact with domestic pets	74	43%	42%	47%
Contact with faeces or manure	34	24%	20%	22%
Contact with confirmed case or person with similar illness	22	13%	11%	14%
Recreational water contact	1	1%	1%	0.6%
Consumption of home kill meat	7	5%	4%	4%

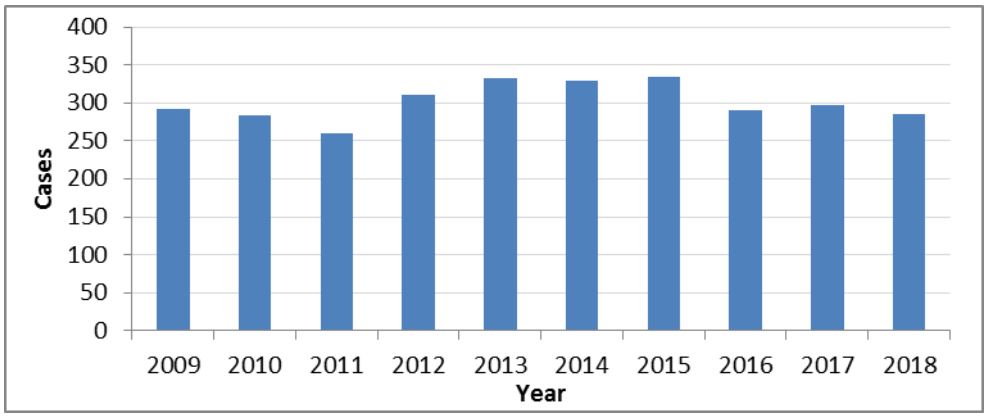
Source: NDCMS (overseas acquired cases are excluded from the denominator for locally acquired cases).

3.1.5 Salmonellosis

Salmonellosis is an infection caused by *Salmonella* bacteria. Most people infected with *Salmonella* develop diarrhoea, fever, vomiting, and abdominal cramps 12 to 72 hours after infection. In most cases the illness lasts four to seven days, and most people recover without treatment. In some cases, the diarrhoea may be so severe that the patient becomes dangerously dehydrated and is hospitalised.

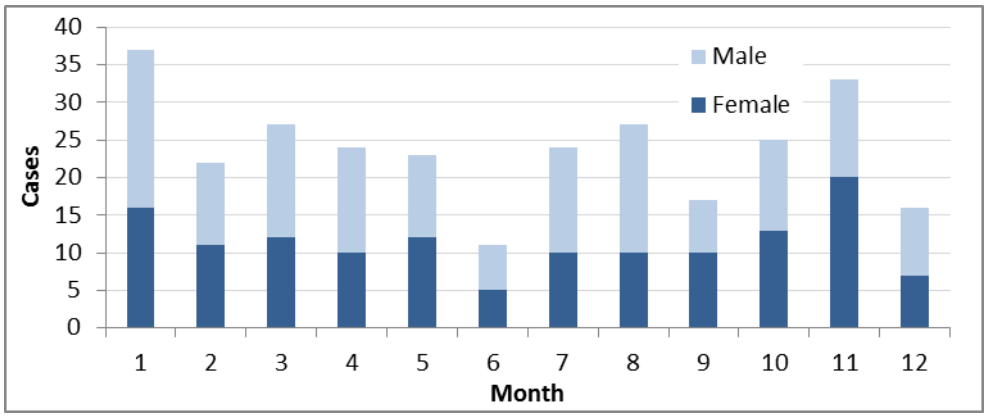
The incidence rate for the Auckland region was 16.9 cases per 100,000, lower than the incidence rate for the rest of New Zealand (25.5/100,000). A total of 286 cases of salmonellosis were reported compared with 297 cases in 2017 and 291 cases in 2016 (Figure 13).

Figure 13: Salmonellosis cases in the Auckland region 2009 - 2018



January and November were the peak months, with the fewest notifications over the winter months (Figure 14).

Figure 14: Monthly distribution by gender of salmonellosis cases in the Auckland region 2018



The incidence rate was highest in children less than five years of age (Table 26). Among the major ethnic groups, the incidence rates were highest among Pacific peoples followed by 'Other' (which includes European ethnic group) and the Asian ethnic groups (Table 27). Just over a quarter (28%) of salmonellosis cases were hospitalised in 2018. There were no deaths.

Table 26: Age-gender distribution and age-specific incidence rates of salmonellosis in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
<1	2	9	11	49.2
1 to 4	25	14	39	43.6
5 to 9	9	13	22	19.3
10 to 14	2	4	6	5.7
15 to 19	6	9	15	13.6
20 to 29	21	27	48	15.7
30 to 39	14	18	32	12.4
40 to 49	17	12	29	13.3
50 to 59	18	21	39	19.1
60 to 69	12	18	30	19.9
70+	10	5	15	10.9
Total	136	150	286	16.9

*Rates are based on estimated mid-year population, 2018 (Source: NZ Stats, New Zealand).

Table 27: Ethnic distribution and gender-specific incidence rates of salmonellosis in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	24	38	62	13.9
Māori	14	8	22	11.4
Other	76	70	146	17.3
Pacific Peoples	15	32	47	21.8
Unknown	7	2	9	-
Total	136	150	286	16.9

* Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

Salmonella serotype analysis of the 276 out of 286 samples that were able to be typed showed the highest incidence of salmonellosis was caused by *Salmonella Typhimurium* phage type 56 variant. This occurred throughout the year. An increasing trend was observed for *Salmonella enterica* subsp*. enterica (I) ser.* 4,5,12:i in late spring, but no epilink could be found between cases. Most of the other serotypes were spread sporadically throughout the year, with lower numbers reported in the winter months (Table 28).

Table 28: Selected serotypes identified for salmonellosis in the Auckland region 2018

Serotype	Number
Salmonella Typhimurium phage type 56 variant	18
Salmonella enterica subsp. enterica (I) ser. 4,5,12 : i : -	14
Salmonella Paratyphi B var Java	12
Salmonella Bovismorbificans	12
Salmonella Stanley	10
Salmonella Weltevreden	10
Salmonella Typhimurium phage type 23	9
Salmonella Typhimurium phage type RDNC	9
Salmonella Typhimurium phage type 135	7
Salmonella Typhimurium phage type 101	7
Salmonella Brandenburg	6
Salmonella Enteritidis phage type 11	6

Salmonella Pensacola	6
Salmonella Javiana	5
Salmonella Typhimurium phage type 9	5
Salmonella enterica subsp. enterica (I) ser. 4,5,12 : b : -	5
Salmonella Enteritidis phage type 1b	5
Salmonella Typhimurium	4
Salmonella Agona	4
Salmonella Enteritidis phage type 8	4
Salmonella Typhimurium phage type 10	4
Salmonella Typhimurium phage type Untypable	4
Salmonella Infantis	4
Salmonella Enteritidis phage type RDNC	4
Salmonella Enteritidis phage type 6a	3
Salmonella Bareilly	3
Salmonella Anatum	3
Salmonella enterica subsp. enterica (I) ser. 6,7 : k : -	3
Salmonella Typhimurium phage type 12a	3
Salmonella Enteritidis phage type 1	3
Salmonella Corvallis	3
Salmonella Saintpaul	3
Salmonella Braenderup	3
Salmonella Enteritidis phage type 21	3
Salmonella Aberdeen	2
Salmonella Mississippi	2
Salmonella Panama	2
Salmonella Enteritidis phage type 21 variant	2
Salmonella Albany	2
Salmonella Montevideo	2
Salmonella enterica subsp. enterica (I) ser. 4,12 : i : -	2
Salmonella Enteritidis phage type 3	2
Salmonella Virchow	2
Salmonella Typhimurium phage type 156	2
Salmonella Oslo	2
Salmonella Hvittingfoss	2

Overseas travel accounted for 35% of cases (101). The top source countries were Indonesia (14), Thailand (14), Vietnam (10), Fiji (11), Malaysia (6), Tonga (4) and Samoa (4). Other risk factors are shown in (Table 29). Nearly a quarter of cases reported direct contact with pets. One case in six implicated a restaurant or food premises. Chicken and other meat products were the most frequently consumed food for cases with salmonellosis, but in no food samples were the presence of *salmonella* bacteria confirmed.

Table 29: Risk factors for salmonellosis in the Auckland region 2016 and 2017*

Risk factor	2016	2017	2018
Case overseas during the incubation period	41%	41%	35%
Case travelled within NZ during the incubation period*	12%	7%	6%
Contact with a confirmed case/another unwell person *	18%	17%	3%
Environmental risk factors *			
Direct contact with pets	41%	29%	20%
Implicated restaurant or premises	23%	16%	17%
Contact with manure or compost	18%	5%	1%
Recreational swimming pool and other	13%	14%	8%
Untreated water from tank, bore or stream	10%	7%	5%
Visit farm	5%	10%	4%
Consumed food at large gathering	12%	5%	9%
Contact with animal faeces	7%	7%	3%
Contact with sick animals	2%	1%	0%
Foods *			
Chicken	52%	37%	33%
Other meats and poultry products	41%	29%	21%
Takeaway foods	16%	17%	17%
Tofu / soy products	5%	5%	2%
Cold sliced meat	-	5%	15%
Raw eggs	3%	2%	2%
Sesame seed products	3%	2%	2%
Untreated raw milk	2%	-	0.3%

*Excludes those cases who acquired their illness overseas

3.1.6 Campylobacteriosis

Campylobacter enteritis is a zoonotic disease with clinical and epidemiological features similar to that of salmonellosis. Transmission may occur when food is cross-contaminated by raw poultry or other meat.

The incidence rate for the Auckland region was 120.4 cases per 100,000, significantly less than the incidence rate for the rest of New Zealand (151.3/100,000, p=<0. 001).

A total of 2,065 cases were reported well up on the low of 1,763 cases in 2017 (Figure 15). Campylobacter shows a typical seasonal distribution, with lower levels seen during winter, increasing during spring, and peaking in early summer (Figure 16).

Figure 15: Campylobacteriosis cases in the Auckland region 2009-2018

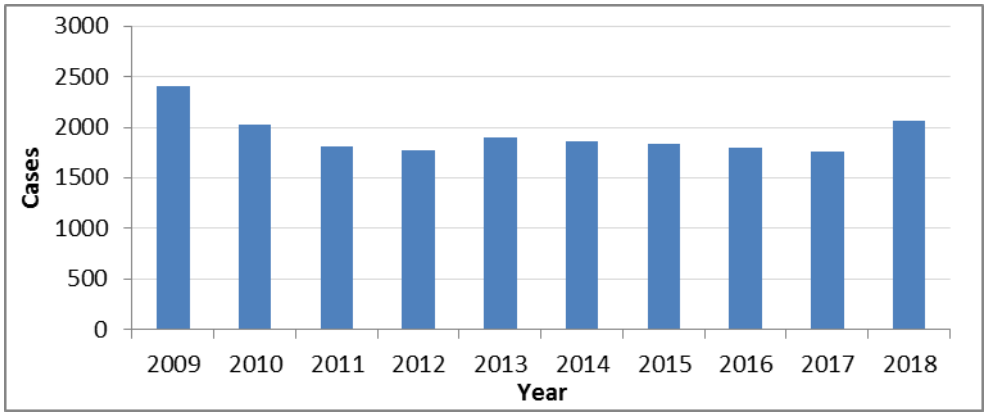
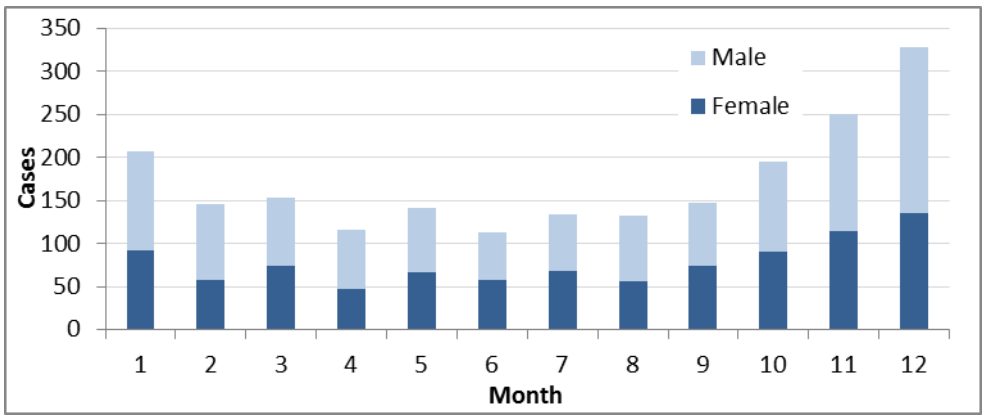


Figure 16: Monthly distribution of campylobacteriosis by sex in the Auckland region 2018



The incidence rate was highest in the less than five year age group, followed by the over 70s age group (Table 30). Males are slightly more likely to be affected, with a male to female ratio of 1.2:1.

Table 30: Age-gender distribution and age-specific incidence rates of campylobacteriosis in the Auckland region 2018

Age group	Female	Male	Total	Rate per 100,000*
<1	8	18	26	116.3
1 to 4	78	115	193	215.8
5 to 9	25	56	81	71.2
10 to 14	30	50	80	76.0
15 to 19	46	75	121	109.9
20 to 29	180	171	351	115.1
30 to 39	124	129	253	98.2
40 to 49	109	119	228	104.3
50 to 59	122	148	270	132.2
60 to 69	87	119	206	136.7
70+	126	130	256	185.3
Total	935	1130	2065	120.4

* Rates are based on estimated mid-year population, 2018 (Source: Statistics New Zealand).

Waitemata DHB had the largest number of reported campylobacteriosis cases (903), and Counties Manukau the least (576). This may represent health-seeking behaviour rather than true geographical predisposition. The highest incidence rate was seen in the Other (includes European) ethnic group (119.8/100,000), which is double the rate for Māori, and four times that of Pacific peoples. The Asian rate, though still well below the European/Other rate, is approximately the same as Māori, and higher than that of Pacific peoples at 47.7 cases per 100,000 (Table 31).

Table 31: Ethnic distribution and gender-specific incidence rates of campylobacteriosis in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000
Asian	92	120	212	47.7
Māori	44	50	94	48.7
Other	458	551	1009	119.8
Pacific Peoples	27	44	71	32.9
Unknown	314	365	679	-
Total	935	1130	2065	120.4

3.1.7 Cholera

Cholera is an infection of the small intestine caused by the bacterium *Vibrio cholerae*. The main symptoms are watery diarrhoea and vomiting. This may result in dehydration and, in severe cases, greyish-bluish skin. Transmission occurs primarily by drinking water or eating food that has been contaminated by the faeces (waste product) of an infected person, including asymptomatic cases.

There was one confirmed case of cholera in 2018. This was in a case who presented to hospital whilst in Pakistan with watery diarrhoea. On return to New Zealand the case was admitted to hospital with on-going symptoms. The cholera toxin screen was positive, and the organism was later identified as *Vibrio cholerae* O1 biotype El Tor, subtype Inaba. There were no secondary cases. There were also 13 other possible cases notified during the year due to testing PCR positive for *Vibrio cholera* but confirmatory toxin testing at ESR was negative.

The last previous confirmed case of cholera was notified in 2010.

3.1.8 Cryptosporidiosis

Cryptosporidiosis, also known as “crypto”, is a parasitic disease caused by *Cryptosporidium*, a protozoan parasite. It affects the intestines and typically causes an acute short-term infection. It is spread through the faecal-oral route, often through contaminated water. The main symptom is self-limiting diarrhoea in people with intact immune systems. In immunocompromised individuals, such as people with AIDS, the symptoms may be particularly severe. It is often associated with animal contact, contaminated drinking water, and recreational water contact, and is a useful environmental health indicator in this regard.

The incidence rate for the Auckland region was 33.4 cases per 100,000; much the same as the incidence rate for the rest of New Zealand (32.5/100,000).

A total of 573 cases of cryptosporidiosis were reported, a large increase from the 333 cases notified in 2017, representing a 72% increase. The introduction of PCR laboratory testing in 2015 doubled the detection rate of cryptosporidiosis, but this does not explain the increase for 2018.

Cryptosporidiosis shows a typical seasonal distribution, with peak levels in late summer and early autumn, then lower levels during winter. Typically, there is an increase in spring during the lambing and calving seasons - which start in August - when there is closer contact with farm animals, but this was not obvious in 2018. Thirteen cases (2%) required hospitalisation. There were no deaths.

Figure 17: Cryptosporidiosis cases in the Auckland region 2009 – 2018

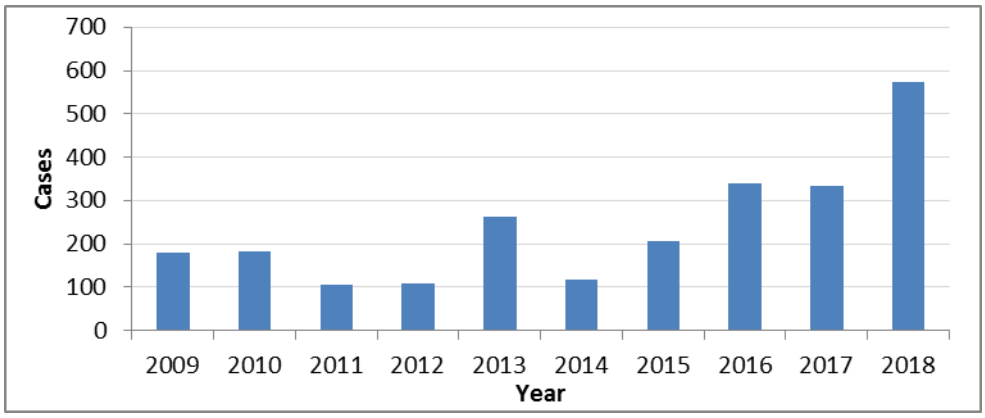
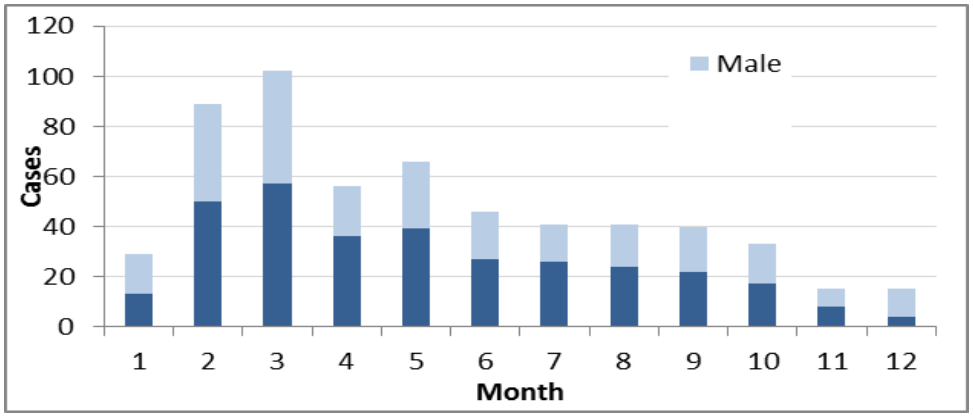


Figure 18: Monthly distribution of cryptosporidiosis cases by sex in the Auckland region 2018



The age-specific incidence rate was highest in children aged 1-4 years, followed by those in the 5 to 9 year age group (Table 32). Overall, the female to male ratio was 1.3:1. The ratio of females to male was 0.8:1 under the age of 15 years, and then there is a reversal to a higher female to male ratio, increasing to 3:1 in the 20 to 29 year age group, before it returns to 0.5:1 over the age of 70.

Table 32: Age-gender distribution and age-specific incidence rates of cryptosporidiosis in the Auckland region 2018

Age-group	Female	Male	2018	Rate per 100,000*
<1	5	6	11	49.2
1 to 4	53	66	119	133.1
5 to 9	34	44	78	68.6
10 to 14	17	18	35	33.3
15 to 19	10	5	15	13.6
20 to 29	63	21	84	27.6
30 to 39	71	38	109	42.3
40 to 49	38	23	61	27.9
50 to 59	13	7	20	9.8
60 to 69	13	11	24	15.9
70+	6	11	17	12.3
Total	323	250	573	33.4

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

The incidence rate was highest for the European/Other ethnic group, with 34.8 cases per 100,000 (Table 33).

Table 33: Ethnic distribution and gender-specific incidence rates of cryptosporidiosis in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	34	22	56	12.6
Māori	26	21	47	24.3
Other	173	120	293	34.8
Pacific Peoples	23	25	48	22.2
Unknown	67	62	129	-
Total	323	250	573	33.4

* Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

Routine interviews of cryptosporidiosis cases ceased in October 2017, so the data reported below only applies up until the end of the third quarter of 2017, and where a surveillance trigger has prompted further investigation during 2018. This occurred for the surveillance triggers between 20 February and 11 April (110 cases). Of these, 31% of cases reported travel within New Zealand (of which a third of this number drank untreated water, went swimming in pools, rivers or at beaches, or had contact with pets). There was contact with an unwell person in 15% of cases. Of the environmental risk factors, 58% of cases had direct contact with pets. Recreational swimming in public pools was a risk factor for half of the cases. A higher proportion than normal had contact with animal or human faeces, and contact with manure or compost was a risk factor for 20% of cases. Consumption of untreated water was a risk factor for 15% of cases (Table 34).

Table 34: Risk factors for cryptosporidiosis in the Auckland region 2016 to 2018

Risk factor	2016	2017	2018
Case overseas during the incubation period	11%	11%	3%
Case travelled within NZ during the incubation period	13%	10%	31%
Contact with an unwell person	11%	19%	15%
Environmental risk factors *			
Direct contact with pets	48%	38%	58%
Recreational swimming pool and other	20%	18%	53%
Visit farm petting zoo etc.	16%	13%	5%
Contact with animal faeces	14%	7%	21%
Contact with manure or compost	13%	16%	20%
Untreated water	11%	9%	15%
Contact with human faeces	10%	4%	20%
Contact with sick animals	5%	4%	3%

2017 data is from 1/1/2017 to September 30 2017
2018 data from 20/2/2018 to 11/4/2018 (n=110)
*Excludes those cases who acquired their illness overseas

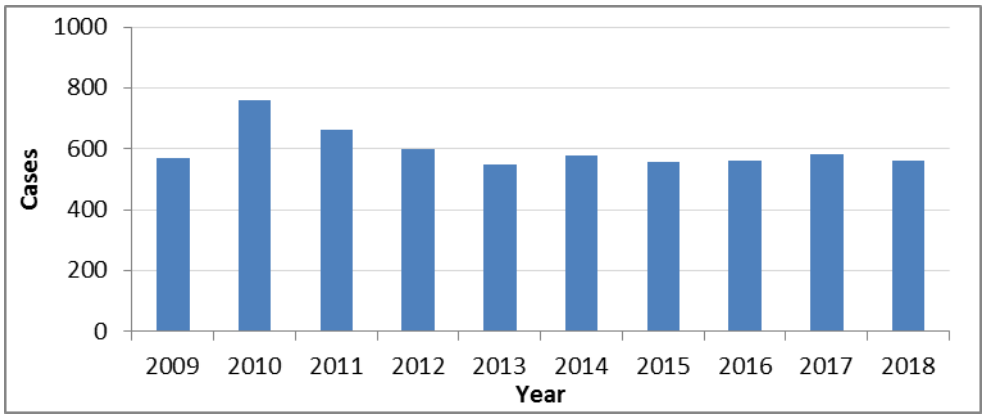
3.1.9 Giardiasis

Giardiasis (usually known in New Zealand as "giardia") is a zoonotic parasitic disease caused by the flagellate protozoan *Giardia lamblia*. The giardia organism inhabits the digestive tract of a wide variety of domestic and wild animal species, as well as humans. It is the most common pathogenic parasitic infection in humans. In 2014, there were an estimated 280 million people worldwide with symptomatic giardiasis.

The incidence rate for the Auckland region was 32.6 cases per 100,000, virtually the same as for the rest of New Zealand (32.1/100,000).

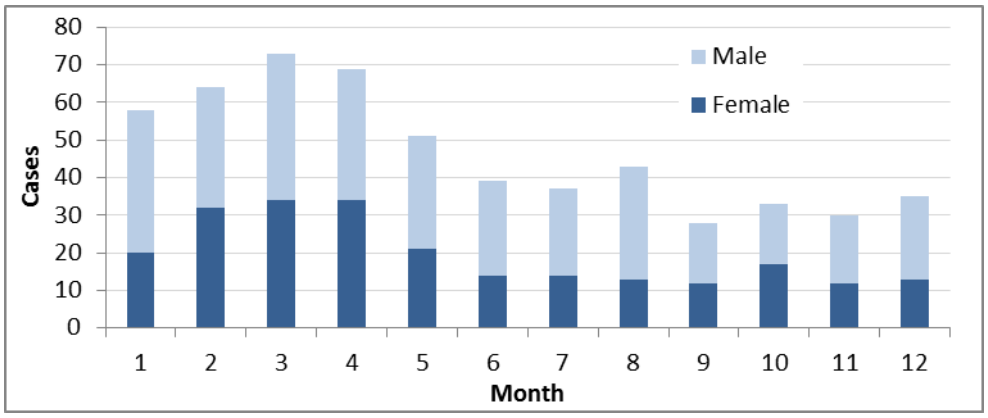
A total of 560 cases of giardiasis were reported similar to the 582 in 2017 and 560 in 2016 (Figure 19). Hospitalisation data are incomplete, and only four hospitalisations were recorded. There were no deaths.

Figure 19: Giardiasis cases in the Auckland region 2009 – 2018



Giardiasis typically has the highest number of cases in the summer holiday period and autumn, and then tails off over the second half of the year. In 2018 there was an additional peak in August, which coincided with the lambing and calving season (Figure 20).

Figure 20: Monthly distribution by gender of giardiasis in the Auckland region 2018



The age-specific incidence rate was highest in the 1-4 year age group. This was followed by the 30-39 year age group, and older adults. More males were reported than females, with a male to female ratio of 1.4:1 (Table 35).

Table 35: Age-gender distribution and age-specific incidence rates of giardiasis in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
<1	2	4	6	26.8
1 to 4	39	55	94	105.1
5 to 9	14	22	36	31.7
10 to 14	5	14	19	18.1
15 to 19	8	9	17	15.4
20 to 29	34	59	93	30.5
30 to 39	42	50	92	35.7
40 to 49	35	41	76	34.8
50 to 59	30	40	70	34.3
60 to 69	22	21	43	28.5
70+	5	9	14	10.1
Total	236	324	560	32.6

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

Ethnicity data is incomplete, with 26% of cases having no ethnicity data. The estimated incidence rate is highest in the Other group (include European ethnicity) followed by Maori (Table 36).

Table 36: Ethnic group distribution of giardiasis in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	17	43	60	13.5
Māori	18	14	32	16.6
Other	126	187	313	37.2
Pacific Peoples	5	5	10	4.6
Unknown	70	75	145	-
Total	236	324	560	32.6

*Rates are based on 2018 projected mid-year population, ethnicity is prioritised (Source: Statistics New Zealand).

3.1.10 Listeriosis

Listeriosis is a bacterial infection most commonly caused by *Listeria monocytogenes*. Listeriosis primarily causes infections of the central nervous system (meningitis, meningoencephalitis, brain abscess) and bacteraemia in those who are immunocompromised, pregnant women, and those at the extremes of age (newborns and the elderly). It may also cause gastroenteritis in healthy persons who have ingested a large inoculum of the organism. *Listeria* is ubiquitous in the environment and is primarily transmitted via the oral route after ingestion of a contaminated food product. Listeria has been isolated from raw meat, dairy products, vegetables, fruit and seafood. Soft cheeses, unpasteurised milk and unpasteurised pâté are higher risk food items.

Eight listeria cases were notified in the Auckland region, up one from 2017, and down from 12 in 2016, and just above the 10 year average of 7.2 cases per year. The 2018 incidence rate for the Auckland region was 0.5 cases per 100,000, with the same rate occurring for the rest of New Zealand. The age-specific incidence rate was highest in the over 70 age group, and the female to male ratio was 1.7:1. Two cases were of Asian ethnicity, five cases were from the Other ethnic group, and one case was Pacific peoples. There was one death.

There were three additional cases of listeriosis in the perinatal period. The mothers of two cases were in the 30 to 39 year age group, and one mother was aged 40. One case was of Asian ethnicity and the other two were Pacific peoples. One baby remained well throughout the perinatal period, one was a premature labour at 37 weeks, and the other an emergency LSCS at 33 weeks, but both premature babies had good outcomes. Consumption of high risk foods including sushi, raw fruit and raw vegetables were thought to be the sources. Two cases were O4 serotype, and one case O1/2.

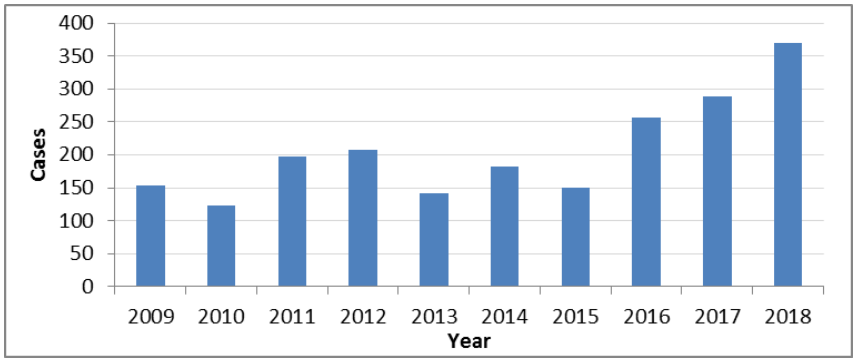
3.1.11 Yersiniosis

Yersiniosis is an infectious disease caused by a bacterium of the genus *Yersinia*. Most yersiniosis infections among humans are caused by *Y. enterocolitica,* of which there are several pathogenic subtypes. Infection with *Y. enterocolitica* occurs most often in young children. The infection is thought to be contracted through the consumption of undercooked meat products, especially pork, unpasteurised milk, or water contaminated by the bacteria.

There were 370 cases of yersiniosis for the Auckland region. This is an incidence rate of 21.6 cases per 100,000 (compared with 26.1 cases per 100,000 for the rest of New Zealand), and is well up from the 289 notifications in 2017, continuing an upward trend seen since 2015 (Figure 21). A factor in the increase was a change in laboratory methods. At the beginning of 2016, Labtests Auckland doubled the incubation period for stool culture from 24 to 48 hours based

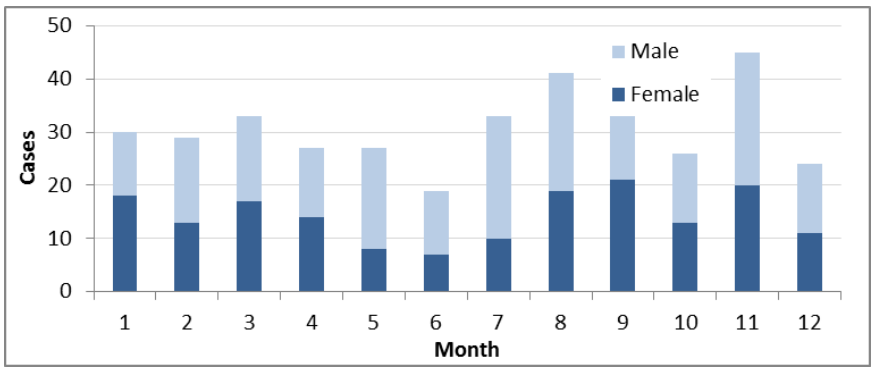
on evidence that this increased the yield of *Yersinia enterocolitica* and *Yersinia pseudotuberculosis*. Then in mid-2017 Labtests introduced PCR testing.

Figure 21: Yersiniosis cases in the Auckland region 2009-2018



Yersiniosis occurs throughout the year, typically with spring peaks. Note in Figure 22 the peak in August and then again in November. In 2018, *Yersinia* also demonstrated an unusual yo-yo like effect where notifications were up one week and down the next. In October, ARPHS utilised a self- completed online questionnaire that had been successful in investigating the increase in cryptosporidiosis earlier in the year, and had a response rate in the 90% range. For yersiniosis, the response rate was 23%, despite follow up calls and encouragement. Of 39 consecutive cases in October cases, there were 9 responses. Risk factors elicited were consumption of salad mix (7/9), chicken (7/9), and beef (7/9). There were few environmental risk factors identified.

Figure 22: Monthly distribution of yersiniosis cases by sex in the Auckland region 2018



Children less than five years of age lead the age-specific incidence rates (Table 37). Males were slightly more likely to be affected, with a male to female ratio of 1.2:1.

Table 37: Age-gender distribution and age-specific incidence rates of yersiniosis in the Auckland region 2018

Age-group	Female	Male	2018	Rate per 100,000
<1	5	13	18	80.5
1 to 4	34	42	76	85.0
5 to 9	7	6	13	11.4
10 to 14	8	15	23	21.9
15 to 19	4	7	11	10.0
20 to 29	20	29	49	16.1
30 to 39	19	23	42	16.3
40 to 49	16	18	34	15.6
50 to 59	32	14	46	22.5
60 to 69	16	12	28	18.6
70+	10	20	30	21.7
Total	171	199	370	21.6

The Asian ethnic group had the highest incidence rate, and in cases where ethnicity is defined further, Chinese ethnicity had 67 cases (18 %) (Table 38). Of these, 42% were aged less than five years old. In all other ethnic groups, children less than five years of age were responsible for 20% of cases. This finding is reproduced year after year, so the less than five year age group would be a good group to target with food diary analysis.

Table 38: Ethnic distribution and gender-specific incidence rates of yersiniosis in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	41	71	112	25.2
Māori	10	8	18	9.3
Other	66	59	125	14.8
Pacific Peoples	8	12	20	8.8
Unknown	46	49	95	-
Total	171	199	370	21.6

* Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

ESR microbiological typing of the 370 yersiniosis cases for the Auckland region by month is shown below (Figure 23) with yearly totals (Table 39). Of note is the seasonality of *Yersinia enterocolitica* biotype 1A. This increase occurs every year at the same time between September and November; the cause is not known. Otherwise, the predominant strains were *Yersinia enterocolitica* biotype 2/3 serotype O:9 (52%), and *Yersinia enterocolitica* biotype 4 serotype O:3 (21%) (Table 39).

Figure 23: Microbiological typing of yersiniosis by month in the Auckland region 2018

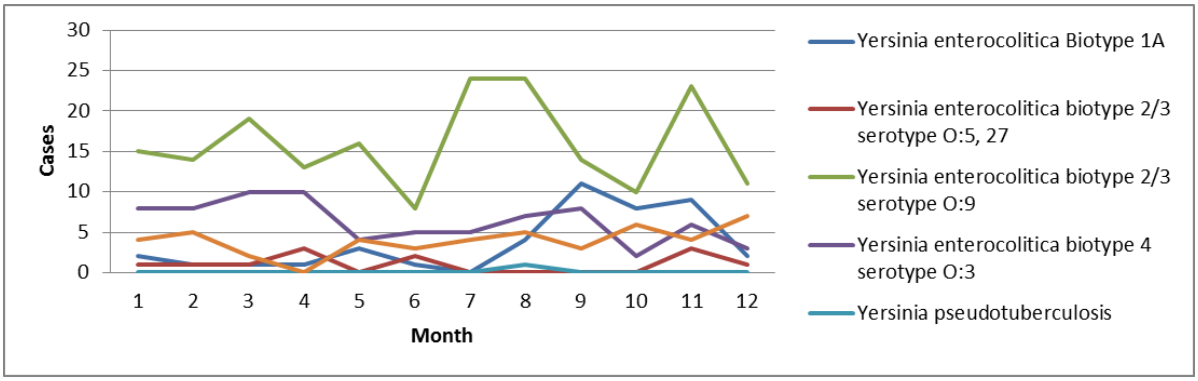


Table 39: Microbiological typing of yersiniosis in the Auckland region 2018

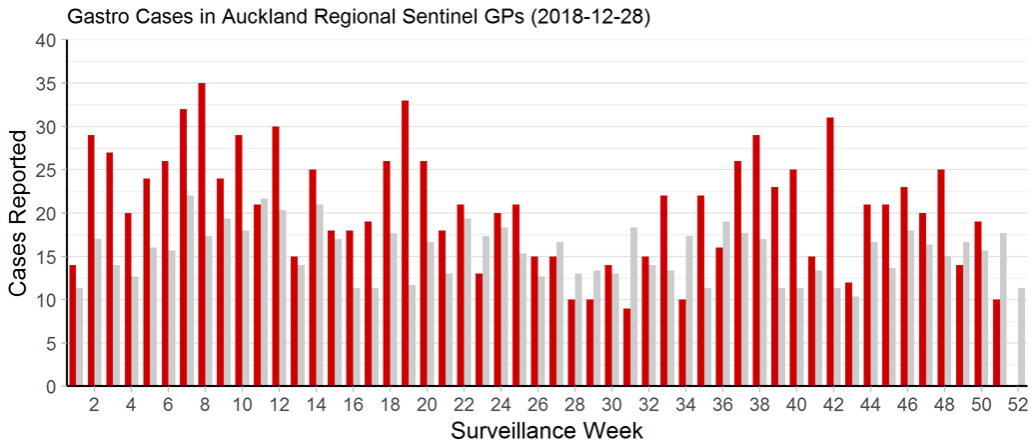
Serotype	Total	%
Yersinia enterocolitica Biotype 1A	43	12%
Yersinia enterocolitica biotype 2/3 serotype O:5, 27	12	3%
Yersinia enterocolitica biotype 2/3 serotype O:9	191	52%
Yersinia enterocolitica biotype 4 serotype O:3	76	21%
Yersinia pseudotuberculosis	1	0.3%
Not isolated	47	13%
Total	370	100%

3.1.12 Gastroenteritis

ARPHS received weekly data from privately contracted sentinel GPs in the Auckland region (representing approximately 10% of Auckland's GP population). These practices code gastroenteritis based on a case definition of 'three or more episodes of diarrhoea in a 24 hour period with or without nausea, vomiting and/or abdominal pain'. On a weekly basis HealthStat extracts these events from practices via the Medtech 32 practice management software. This data is collected and plotted against a three year moving average as cases (Figure 24) and rates by DHB (Figure 25).

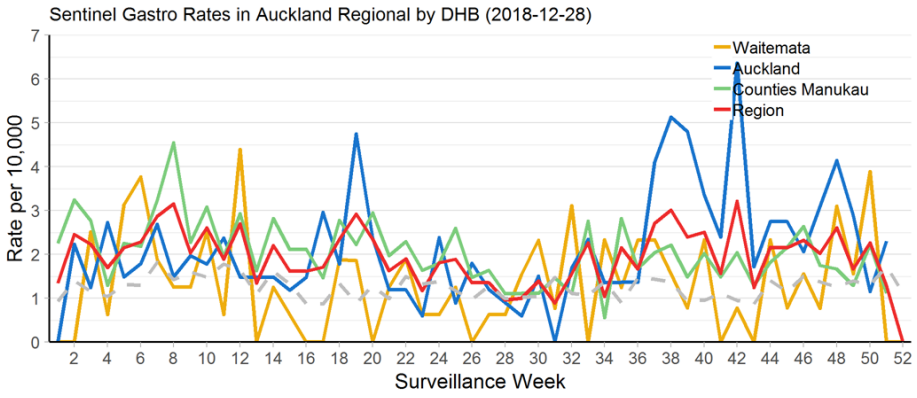
Outbreaks of gastroenteritis occur frequently in the Auckland region. Please see Chapter 10 for further information.

Figure 24: Gastroenteritis cases from sentinel GPs in the Auckland region 2018



Note Week 52 cases reported = 0

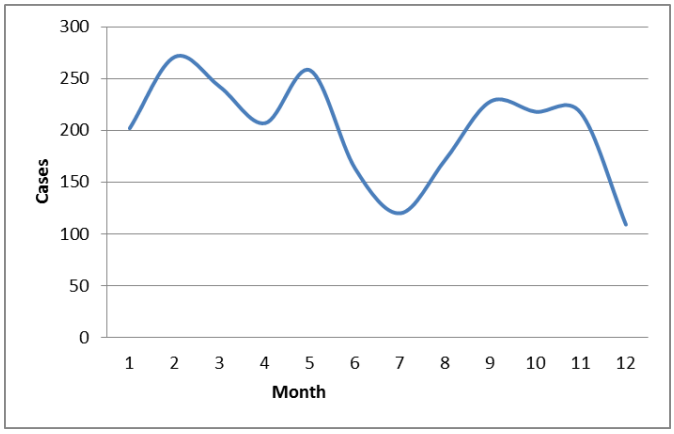
Figure 25: Gastroenteritis rates from sentinel GPs by DHB in the Auckland region 2018



Source: HealthStat

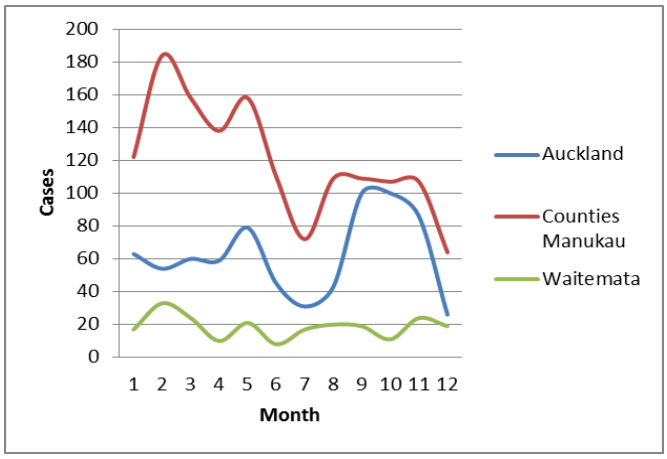
The weekly data is rather “noisy” but monthly plotting identifies four waves of gastroenteritis over the year - presumably relating to new strains moving through the community. Total cases by month are shown below (Figure 26) and cases by DHB and month for 2018 (Figure 27).

Figure 26: Gastroenteritis cases from sentinel GPs by month in the Auckland region 2018



Source: HealthStat

Figure 27: Gastroenteritis cases by DHB from sentinel GPs in the Auckland region 2018



Source: HealthStat

Nearly a third of the gastroenteritis cases reported were aged less than 5 years. The 15 to 44 year age group also represented a third of cases. These proportions are very similar to 2017 (Table 40).

Table 40: Age group and proportion of cases reported by sentinel GP in the Auckland region 2018

Age group	Cases	%
0 to 4	863	29%
5 to 14	351	12%
15 to 44	1067	36%
45 to 64	493	17%
65+	187	6%
Total	995	100%

Source: HealthStat

3.1.13 Viral Hepatitis

Viral hepatitis is liver inflammation due to a viral infection. It may present in acute or chronic forms. The most common causes of viral hepatitis are the five unrelated hepatotropic viruses: hepatitis A, hepatitis B, hepatitis C, hepatitis D, and hepatitis E.

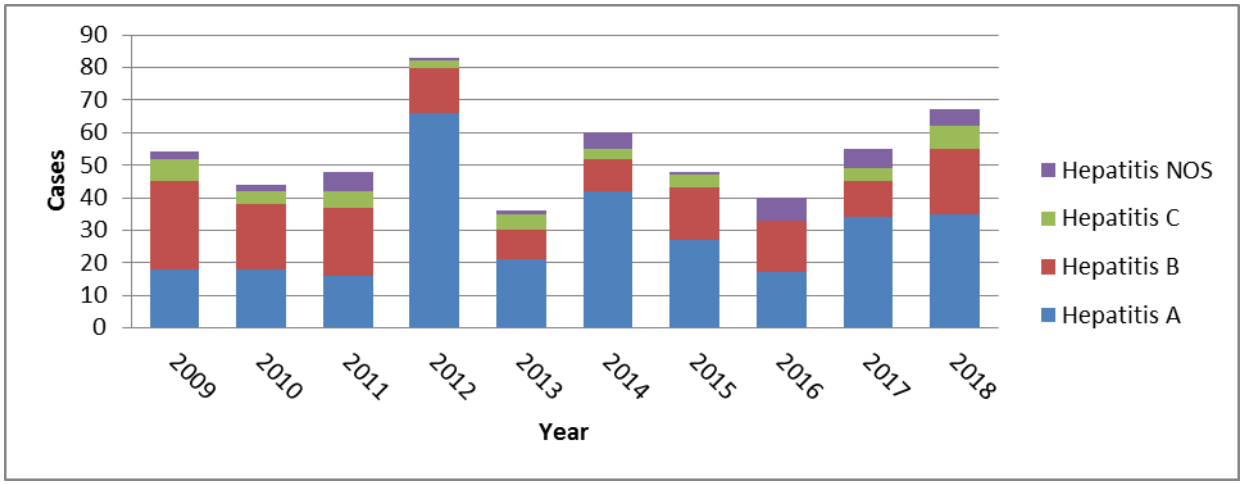
A total of 63 cases of probable and confirmed viral hepatitis were reported compared with 52 cases in 2017. This increase was primarily the result of an increase in hepatitis B cases (7) (Table 41). All cases were serologically confirmed: 35 as hepatitis A, 17 as hepatitis B, six as hepatitis C and five as hepatitis 'Not Otherwise Specified' (NOS). The distribution of acute viral hepatitis serotypes by year is shown in Figure 28. Hospitalisation was required for 54% of cases. No deaths were reported from acute viral hepatitis.

Table 41: Classification of acute viral hepatitis cases in the Auckland region 2018

Hepatitis Type	No. of Cases Total	%
Hepatitis A	35	52.2%
Hepatitis B	17	27.0%
Hepatitis C	6	9.5%
Hepatitis NOS	5	7.9%
Hepatitis D (2)		
Hepatitis E (1)		
Total	63	100.0%

Hepatitis A = anti-HAV IgM positive,
Hepatitis B = anti-HBc IgM positive,
Hepatitis C = anti-HCV IgM positive /HEPCRNA positive

Figure 28: Viral hepatitis cases by type in the Auckland region 2018



3.1.14 Hepatitis A

Hepatitis A or "infectious jaundice" is caused by the hepatitis A virus (HAV), a picornavirus transmitted by the faecal-oral route and is often associated with ingestion of contaminated food. It causes an acute form of hepatitis and does not have a chronic stage. The patient's immune system makes antibodies against HAV that confer immunity against future infection. People with hepatitis A are advised to rest, stay hydrated and avoid alcohol. A vaccine is available that will prevent HAV infection for up to 10 years. Hepatitis A can be spread through personal contact, consumption of raw berries or seafood, or drinking contaminated water.

Of the 35 hepatitis A cases notified, 19 cases were hospitalised. The incidence rate for the Auckland region was 2.1 cases per 100,000, more than twice the rate for the rest of New Zealand (1.0/ 100,000). The highest incidence rate was observed in the 5 to 9 year age group, followed by the 20 to 29 and 30 to 39 year age groups (Table 42). The overall male to female ratio was equal. The ethnic-specific incidence rate of hepatitis A was highest in Pacific peoples followed by Maori and Asian ethnic groups (Table 43).

Table 42: Age-gender distribution and age-specific incidence rates of acute hepatitis A in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
1 to 4	1		1	0.9
5 to 9	4	5	9	8.0
10 to 14	1	1	2	1.9
15 to 19	2	2	4	3.6
20 to 29	5	6	11	3.9
30 to 39	2	1	3	1.2
40 to 49	1	2	3	1.3
60 to 69	1	1	2	1.0
Total	17	18	35	2.1

*Rates are based on 2018 estimated mid-year population (Source: Statistics New Zealand).

Table 43: Ethnic group specific incidence rates of acute hepatitis A in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	6	4	10	2.2
European or Other	4	2	3	0.4
Maori	3	1	4	2.1
Pacific Peoples	3	10	13	6.0
Unknown	1	1	2	-
Total	17	18	35	2.1

*Rates are based on 2018 projected mid-year population, ethnicity is MPAO prioritised (Source: Statistics New Zealand).

A range of ethnicities were identified, with the highest number of cases reported in Samoan and Tongan ethnicities, followed by Indian (Table 44).

Table 44: Ethnicity of acute hepatitis A in the Auckland region 2018

Ethnicities	Female	Male	Total
Samoan	1	5	6
Tongan	1	5	6
Indian	1	3	4
NZ European	3	1	4
Other Asian	4	1	5
Maori	2	1	3
Middle Eastern	2		2
Unknown	1	1	2
Afghani	1		1
Fijian	1		1
Latin American / Hispanic		1	1
Total	17	18	35

Just over two thirds of cases (69%) were acquired overseas. The source countries for these 24 cases are shown in Table 45.

Table 45: Source country for overseas acquired acute hepatitis A in the Auckland region 2018

Source Country	Total
Tonga	6
India	4
Pakistan	3
Fiji	3
Samoa	2
Philippines	1
Chile	1
Australia	1
Argentina	1
Afghanistan	1
Mexico	1
Total	24

Of the 35 cases, six were reported as being household contacts of a confirmed case i.e. they were secondary cases.

3.1.15 Hepatitis B

Hepatitis B is an infectious disease caused by the hepatitis B virus (HBV), which affects the liver. It can cause both acute and chronic infections. Almost 20% of adult infections have no symptoms during the initial infection. Some develop a rapid onset of sickness with vomiting, yellow skin, feeling tired, dark urine and abdominal pain. It may take 30 to 180 days before symptoms begin. Often these symptoms last a few weeks, and rarely does the initial infection result in death. In those who get infected around the time of birth, 90% develop chronic hepatitis B, while 30 to 50% of children infected between one and five years, and 5% of infected adults, will develop chronic infection. Most of those with chronic disease have no symptoms. However, cirrhosis and liver cancer may eventually develop. These complications result in the death of 15 to 25% of those with chronic disease.

Of the 17 acute hepatitis B cases notified in 2018, 10 cases were hospitalised. The incidence rate for the Auckland region was 1.0 case per 100,000, which is nearly double that for the rest of New Zealand (0.6/100,000) (Table 46). The highest age specific incidence rate was observed in the 20 to 29 year age group, and this represents a shift from the older age group predominance of previous years. The overall male to female ratio was 4.6:1. Ethnicity of the 17 cases is shown in Table 47.

Table 46: Age-gender distribution and age-specific incidence rates of acute hepatitis B in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
15 to 19	1	1	2	1.8
20 to 29	1	7	8	2.8
30 to 39	0	2	2	0.8
40 to 49	1	2	3	1.3
50 to 59	0	1	1	0.5
60 to 69	0	1	1	0.7
Total	3	14	17	1.0

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

Table 47: Ethnic group specific incidence rates of acute hepatitis B in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian		3	3	0.7
European or Other		3	3	0.4
Maori		1	1	0.5
Pacific Peoples	1	6	7	3.2
Unknown	2	1	3	-
Total	3	14	17	1.0

*Rates are based on 2018 projected mid-year population, ethnicity is MPAO prioritised (Source: Statistics New Zealand)
.

Overseas travel was a risk factor in four cases. Casual sexual contact was a risk factor in three cases, and three others had hepatitis B-positive household contacts. No cases appeared to be associated with body piercing, tattooing or intravenous drug use.

3.1.16 Hepatitis C

There were six hepatitis C cases notified in 2018, of which four were female, and four were of European ethnicity. Two cases had previous body piercing, and four cases were associated with past IV drug use. No cases were knowingly exposed to blood or blood products, household contacts or casual sexual partners.

3.1.17 Hepatitis NOS

Five cases of hepatitis NOS were notified to ARPHS in 2018. All cases were aged between 20 and 49 years. Four of the five were positive for hepatitis E, and acquired their illness whilst in India. The remaining case was positive for hepatitis D.

Section 4: Airborne Diseases

4.1 Measles

Measles, also known as morbilli, is a highly contagious infection caused by the measles virus. Initial symptoms typically include fever, (often greater than 40°C), cough, runny nose, and conjunctivitis. Two or three days after the start of symptoms, small white spots may form inside the mouth, known as Koplik's spots. A red, flat rash, which usually starts on the face and then spreads to the rest of the body, typically begins three to five days after the start of symptoms. Symptoms usually develop 10–12 days after exposure to an infected person, and last 7–10 days. Complications occur in about 30% of cases, and may include, diarrhoea, encephalitis, and pneumonia. Worldwide, measles affects about 20 million people a year, primarily in the developing areas of Africa and Asia. It resulted in approximately 96,000 deaths in 2013. During 2018 there was an increase in measles notification across Europe, Asia, North America and the Philippines.

Cases of measles in the Auckland region from 2009 to 2018 are shown in Figure 29. There were five cases in 2018 compared with three cases in 2017, and 10 cases in 2016. The incidence rate for the Auckland region was 0.3 cases per 100,000, which is lower than the rest of New Zealand (0.8/100,000). This was due to small outbreaks that occurred in Dunedin and the Waikato region.

Of the Auckland cases, one was aged less than one year of age and too young to be vaccinated. Two were in the 20 to 29 year age group, and two in the 30 to 39 year age group. Countries of origin were India, Malaysia, the Philippines and there was one case from an international flight. All cases were laboratory confirmed by measles RNA detection by PCR, or measles-specific IgM antibody. Two cases were hospitalised and there were no deaths.

Figure 29: Measles cases in the Auckland region 2009 – 2018

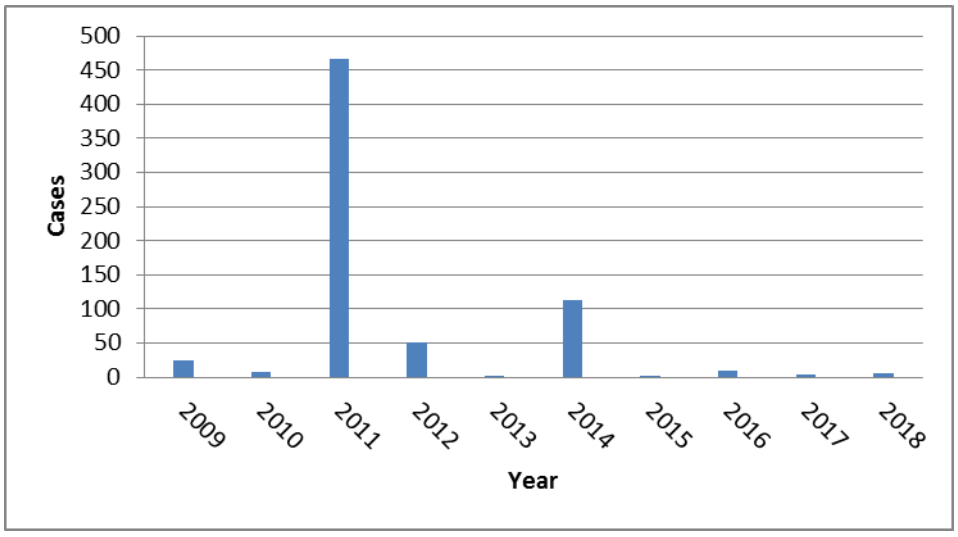
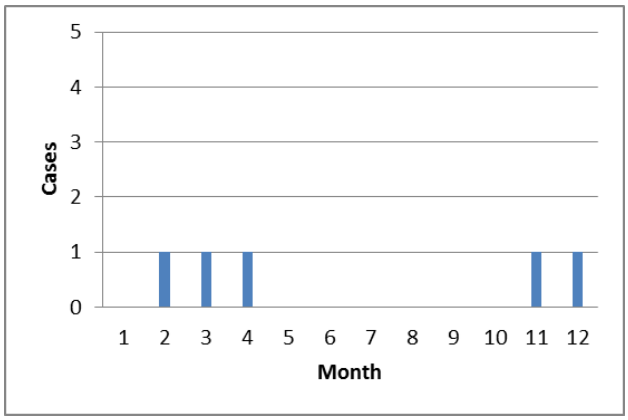


Figure 30: Monthly distribution of measles cases in the Auckland region 2018



4.2 Mumps

Mumps (epidemic parotitis) is a highly infectious, self-limiting viral disease caused by the mumps virus. Fever, painful swelling of the parotid glands, muscle pain, headache and feeling tired are common initial symptoms. Up to 48 hours later, painful swelling of the salivary glands – classically the parotid gland – usually occurs and is the most typical presentation found in up to 95% of cases. Complications include painful testicular swelling, which can lead to reduced fertility. Symptoms in adults are often more severe than in children. Mumps is highly contagious and is able to spread rapidly among people living in close quarters. The virus is transmitted by respiratory droplets, direct contact, or contaminated objects. Symptoms typically occur 14 to 18 days after exposure, and patients are infectious a few days before the onset of symptoms.

There were 269 cases of mumps, compared with 1,080 cases in 2017, which was the highest incidence for decades (Figure 31). The “Stamp it out phase” by ARPHS continued from January through to March 2018, after which there was a change to “Manage it”, so cases occurred primarily in the first half of the year (Figure 32).

Figure 31: Mumps cases in the Auckland region 2009 – 2018

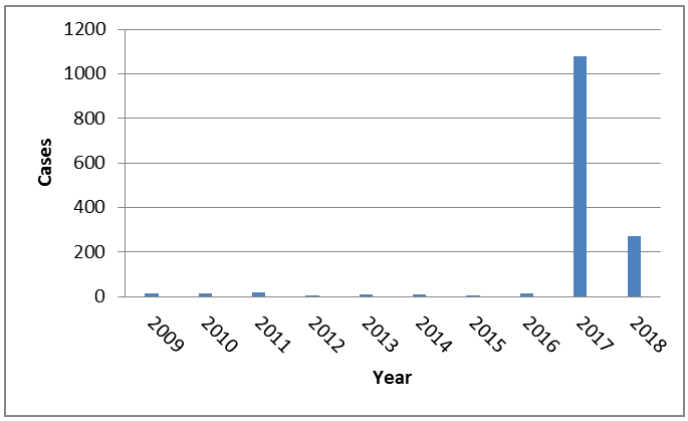
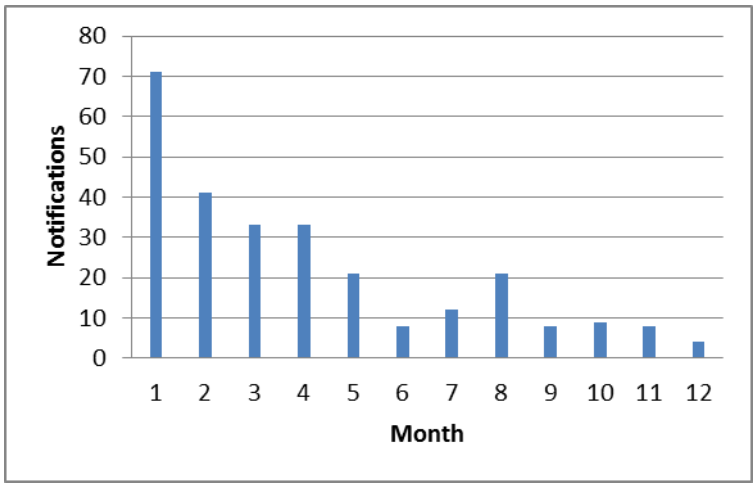


Figure 32: Monthly distribution of mumps cases in the Auckland region 2018



As with 2017, the highest age specific incidence rate was in the 15 to 19 year old age group (Table 48). The highest ethnic group specific incidence rate was seen in Pacific peoples (40.8 /100,000) (Table 49), representing 33% of cases. Mumps cases were higher in residents from countries where mumps is not included in the childhood vaccination schedule (Table 50). Fourteen cases were hospitalised (5%), and there were no deaths.

Table 48: Age-gender distribution and age-specific incidence rates of mumps in the Auckland region 2018

Age-group	Female	Male	2018	Rate per 100,000*
1 to 4	14	22	36	32.1
5 to 9	9	19	28	25.0
10 to 14	9	20	29	27.1
15 to 19	17	20	37	33.5
20 to 29	34	42	76	26.9
30 to 39	16	8	24	9.9
40 to 49	8	12	20	9.0
50 to 59	6	6	12	5.8
60 to 69	4	1	5	3.3
70+	1	1	2	1.4
Total	118	151	269	15.9

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

Table 49: Ethnic group distribution and ethnic specific incidence rates of mumps in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	24	35	59	13.3
European/ Other	39	39	78	9.3
Maori	13	17	30	15.5
Pacific Peoples	35	53	88	40.8
Unknown	7	7	14	-
Total	118	151	269	15.9

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

Table 50: Ethnicity of mumps cases in the Auckland region 2018

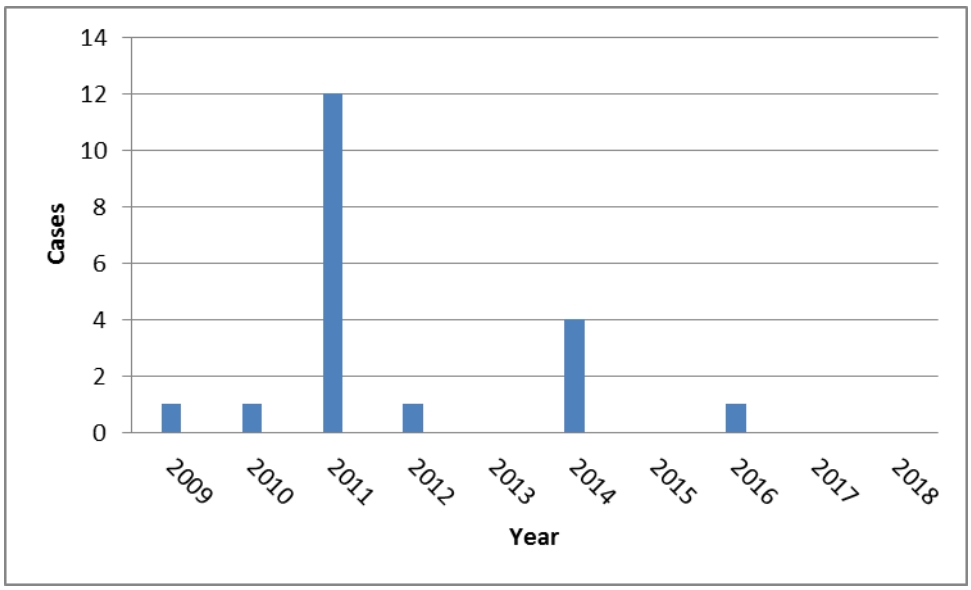
Ethnicity	Total
European	78
Samoan	49
Indian	23
Maori	24
Tongan	20
Chinese	14
Southeast Asian	12
Cook Islands	8
Asian	7
Fijian/Fiji Indian	5
Niuean	2
African	3
Other Pacific Peoples	2
Korean	1
Chilean	1
Pakistani	1
Middle Eastern	2
South African	1
Latin American	1
Japanese	1
Unknown	14
Total	269

4.3 Rubella

Rubella is a common childhood infection that is seldom fatal and usually presents with minimal systemic upset, although transient arthropathy may occur in adults. Rubella is transmitted via airborne droplet emission from the upper respiratory tract of active human cases. Serious complications are very rare. Apart from the effects of transplacental infection on the developing foetus i.e. congenital rubella syndrome (CRS), rubella is a minor infection.

There were no rubella cases for 2018. The last case was notified in 2016 (Figure 33).

Figure 33: Rubella cases in the Auckland region 2008 – 2018

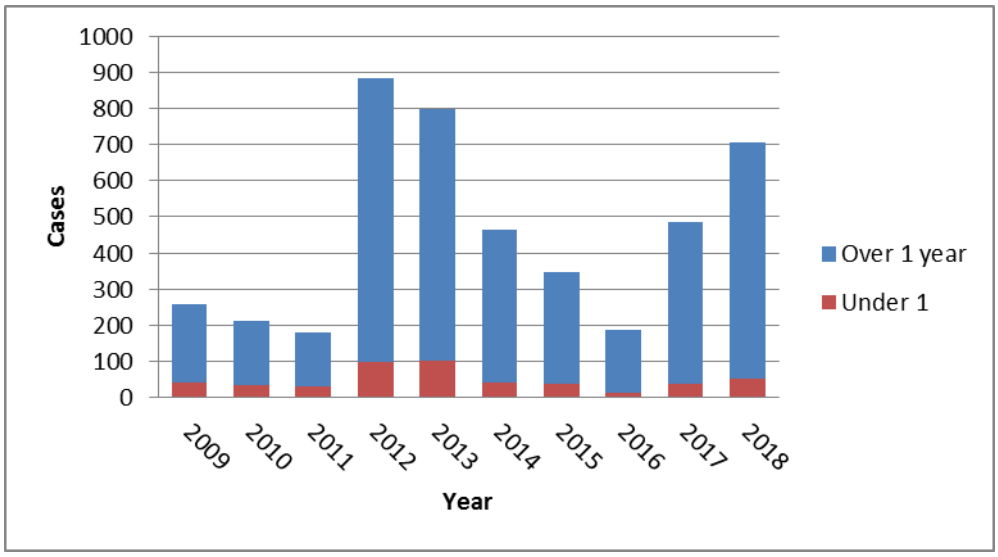


4.4 Pertussis

Pertussis is caused by the bacteria *Bordetella pertussis*. It is an airborne disease which spreads easily through the coughs and sneezes of an infected person. People are infectious to others from the start of symptoms until about three weeks into the coughing fits. It is estimated that pertussis affects 16 million people worldwide each year. Most cases occur in the developing world, and people of all ages may be affected. In 2013 it resulted in 61,000 deaths, down from 138,000 deaths in 1990. Nearly 2% of infected children less than a year of age with pertussis will die.

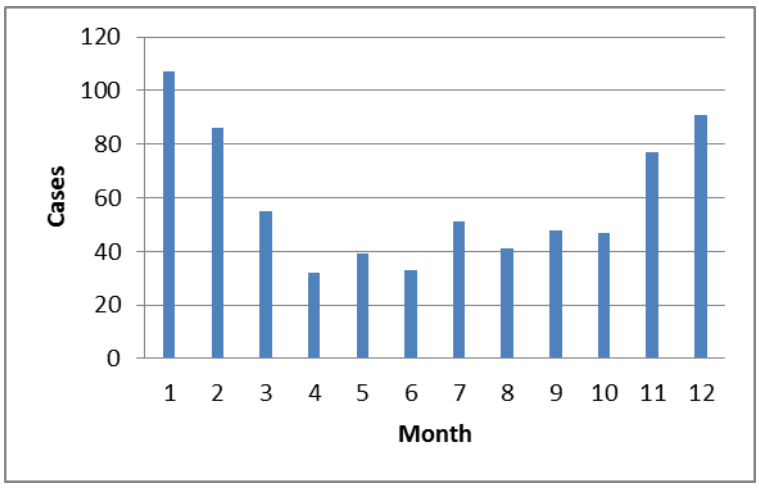
The 707 cases reported for the Auckland region represented a second wave of the pertussis outbreak which started in 2017 (Figure 34). This is an incidence rate of 41.7 cases per 100,000 for the Auckland region, but this was nearly half the rate for the rest of New Zealand (70.9/ 100,000). The ARPHS strategy focused on protecting infants less than one year of age, and involved extra case containment efforts at early childcare centres and schools. This appears to have been somewhat successful at preventing spread to those most vulnerable. Hospitalisation was required for 126 cases (18%) but this increased to 69% for those infants under one year of age. There were no deaths.

Figure 34: Pertussis cases in the Auckland region 2009 to 2018



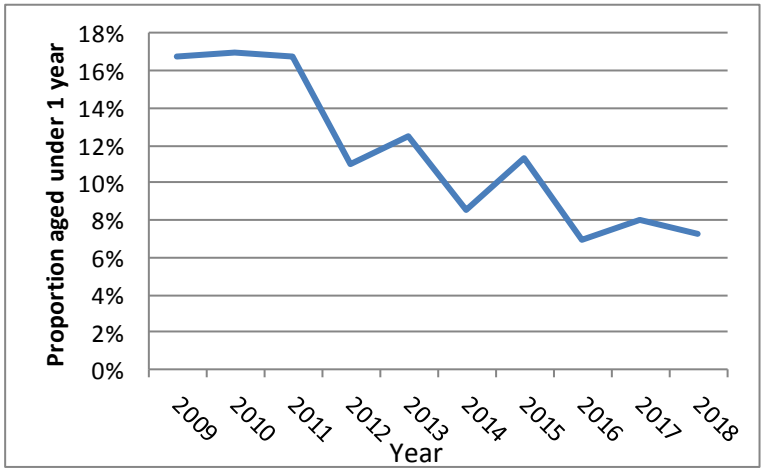
Cases decreased over the second and third quarters of 2018, then increased again in the last quarter for a second wave of infections (Figure 35).

Figure 35: Monthly distribution of pertussis cases in the Auckland region 2018



The highest age-specific incidence rate was seen in children less than five years old (119.6/100,000), followed by the 5 to 19 year age group. The yearly proportion of pertussis cases aged less than one year for the last decade is shown in Figure 36. This downward trend would suggest the focused strategy of protecting the under one year old infants is working, despite nearly 1,200 cases over the past two years.

Figure 36: Proportion of pertussis cases in infants under one year of age in the Auckland region 2009 to 2018



The overall female to male ratio was 1.2:1, but it is notable that this ratio increases to 1.7:1 for the 30 to 39 year age group (Table 51). Ethnic-specific rates were marginally higher in European than other ethnic groups (Table 52). Of note is the low incidence rate of pertussis in the Asian ethnic group. The reason for this is not known, but the Asian ethnic group does have the highest childhood vaccination rates in excess of 90% at six months and five years (refer to Chapter 10).

Table 51: Age-gender distribution and age-specific incidence rates of pertussis cases in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
0 to 4	61	73	134	119.6
5 to 9	46	37	83	74.1
10 to 14	35	29	64	59.7
15 to 19	26	30	56	50.7
20 to 29	29	19	48	17.0
30 to 39	50	29	79	32.5
40 to 49	55	34	89	39.9
50 to 59	29	36	65	31.2
60 to 69	27	24	51	33.2
70+	20	18	38	26.6
Total	378	329	707	41.7

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

Table 52: Ethnic distribution and ethnic specific incidence rate of pertussis cases in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	24	13	37	8.3
European/ Other	236	200	436	51.8
Maori	47	48	95	49.2
Pacific Peoples	47	47	94	43.6
Unknown	19	18	37	-
Total	378	329	707	41.7

* Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

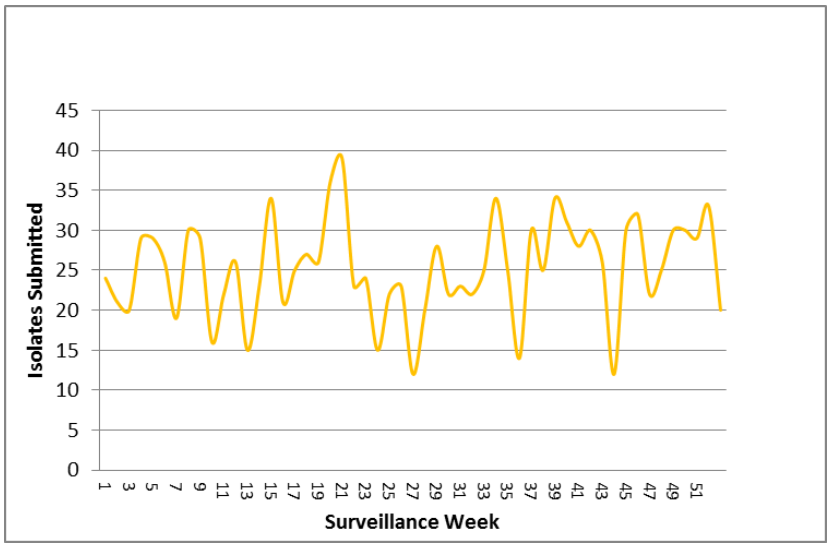
4.5 Chickenpox

Chickenpox, also known as varicella, is a highly contagious disease caused by the initial infection with varicella zoster virus (VZV). The disease results in a characteristic skin rash that forms small blisters, is itchy, and eventually scabs over. It usually starts on the face, chest, and back, and then spreads to the rest of the body. The disease is often more severe in adults than children. Symptoms begin 10 to 21 days after exposure to the virus. Chickenpox is an airborne disease which spreads easily through the coughs and sneezes of an infected person. It may be spread from one to two days before the rash appears, until all lesions have crusted over.

Chickenpox is not a notifiable disease in New Zealand.

Chickenpox activity was stable in 2018, with perhaps a slight increase over the year based on the number of isolates submitted to ESR (Figure 37).

Figure 37: Number of chickenpox isolates submitted to ESR from Auckland laboratories in the Auckland region 2018



Source: ESR Influenza weekly, Virology Weekly report

4.6 Influenza (Seasonal flu)

Seasonal flu is the type of flu that typically causes illness for just a few months out of the year. The flu season is different depending on where you are in the world. In New Zealand, it usually falls between April and September. There are three types of flu viruses that cause seasonal influenza: A, B, and C.

4.6.1 Influenza A ("Flu A")

Type A influenza (or Flu A) is usually responsible for the majority of seasonal flu cases. It is found in humans and in animals. Influenza A is spread from person to person by people who are already infected. Touching objects the infected person has touched (doorknobs, faucets, phones) or even being in the same room as the person, especially if they are coughing or sneezing, is enough to become infected. There are many different varieties of influenza A that are classified into subtypes - H and N - and even further into different strains.

H and N subtypes of influenza A are based on the particular proteins that are attached to the virus. There are 16 different types of hemagglutinin (H) proteins and nine different types of neuraminidase (N) proteins. This is how names such as "H1N1" or "H3N2" are acquired. However, the pandemic H1N1 influenza is different because it was created from a combination of human, swine, and bird flu viruses.

4.6.2 Influenza B ("Flu B")

Influenza B is another type of flu that causes seasonal illness. It is found only in humans and is typically less severe than influenza A, but it can still be dangerous. It does not cause pandemics. There are also different strains of influenza B.

4.6.3 Influenza C

Influenza C, which affects only humans, is much milder than types A and B. It typically causes mild respiratory illnesses, and it is not known to have caused any seasonal flu epidemics. The symptoms of influenza C are similar to those of a cold.

4.6.4 Flu Pandemic

Any influenza A virus has the potential to become a flu pandemic, during which there are mass outbreaks of illness in humans around the world in a relatively short amount of time. In the past, some flu pandemics have caused very severe illness and killed millions of people, such as the 1918 flu pandemic. Others are less serious.

4.6.5 Influenza in the Auckland region

During the year, the incidence of influenza in the Auckland region was monitored through weekly attendances for acute respiratory infections (ARI) at HealthStat sentinel GPs situated across the Auckland region, representing approximately 10% of the population. Influenza visit surveillance showed that visits remained low until week 20, when there were lower numbers reported than normal, and even once the season got underway, it did not meet the three year curve until week 36, after which it dropped off rapidly (Figure 38) and (Figure 39).

Figure 38: Influenza visits to HealthStat sentinel GPs in the Auckland region compared with three year average (grey bars) 2018

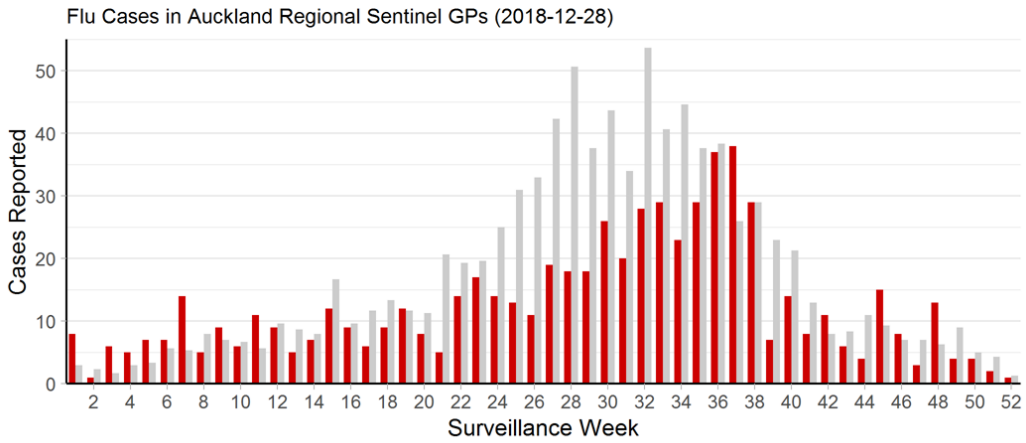
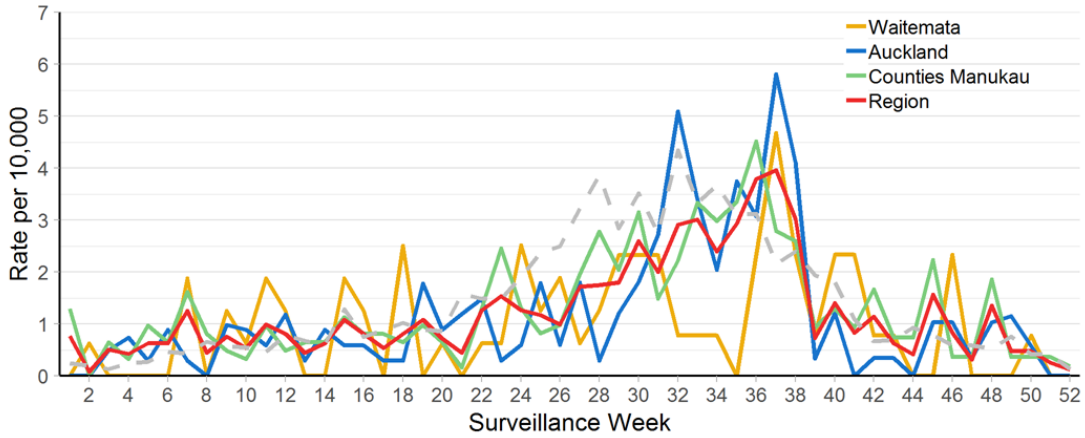


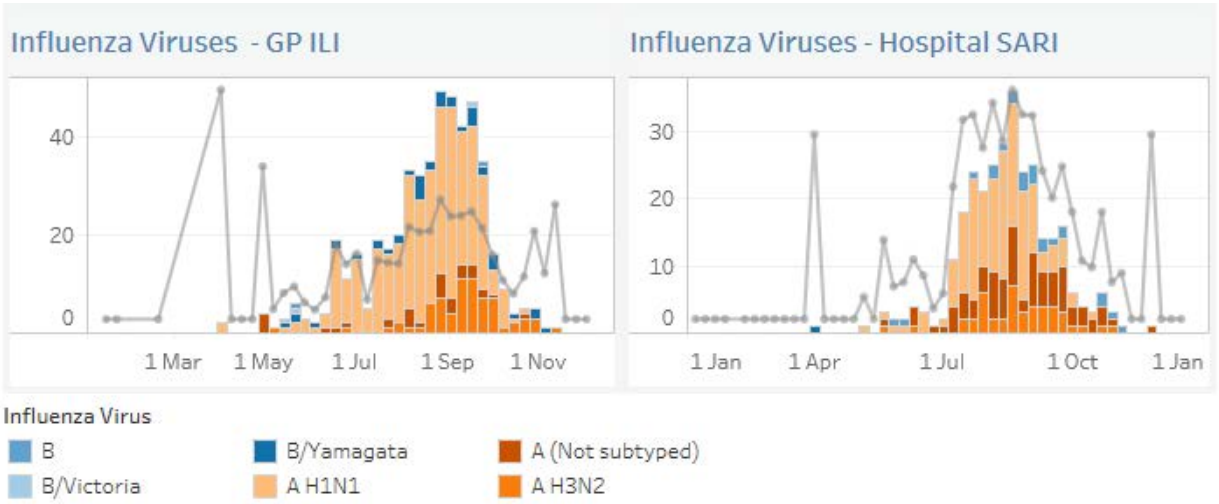
Figure 39: Influenza visit rates to HealthStat sentinel GPs in the Auckland region compared with three year average (grey dotted line) by DHB 2018



Virology isolation reports were received from ESR throughout the flu season (Figure 40). Influenza A (H1N1) predominated in the early part of the influenza season, with Influenza A (H3N2) emerging about halfway through. They co-circulated, and then peaked at approximately the same time in early September. Influenza B cases occurred sporadically throughout the season.

There was little difference between isolates from GPs participating in the GP Influenza-like Illness viruses (GP-ILI) surveillance and Hospital Severe Acute Respiratory Illness (Hospital SARI) surveillance. Para-influenza 3 was reported throughout, with more isolates also identified in the latter half of the season.

Figure 40: Influenza virus typing by week for all New Zealand 2018



Source (New Zealand Influenza Intelligence Report – ESR).

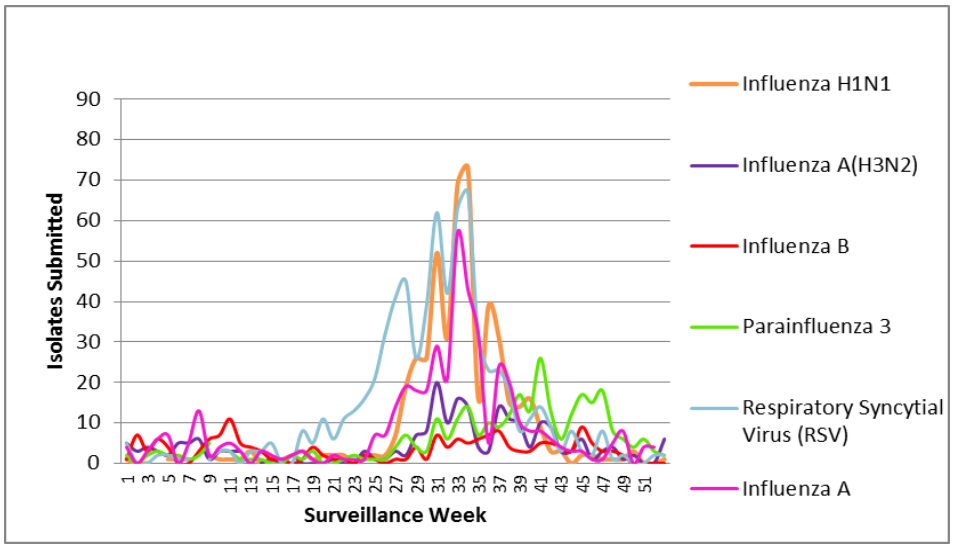
4.7 Other airborne viruses

ESR undertakes other virological analysis of clinical samples taken from primary and secondary care patients. This surveillance is purely an observed volumes analysis, but it does provide a useful picture of what viruses have been circulating at any one time, despite a reporting lag of two to three weeks.

In the Auckland region, the 2018 flu season saw higher levels of Respiratory Syncytial Virus (RSV) preceding the increase in influenza viruses. This was followed by an early increase in influenza A (H1N1), then by an increase in Influenza A (H3N2). As the season progressed influenza A (H1N1), A (H3N2) and RSV all peaked at the same time during week 33. Meanwhile, influenza B occurred at low levels throughout. As the influenza virus and RSV levels dropped over subsequent weeks, para-influenza 3 increased, peaking in week 41 (Figure 41).

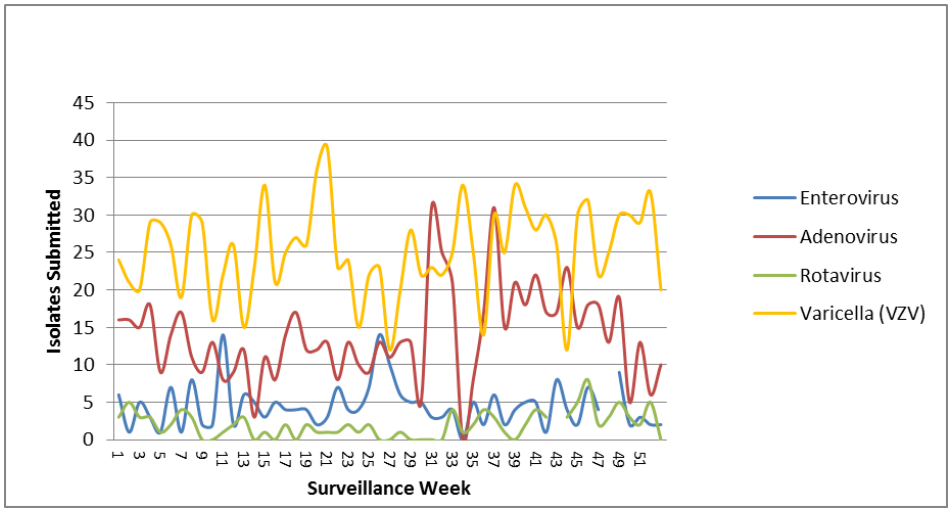
Adenovirus and enterovirus isolation occurred throughout the year, with higher levels of adenovirus observed in the second half of the year (Figure 42). Enterovirus EV68 was detected in three isolates. EV68 has outbreak potential, and has been associated with acute flaccid paralysis cases in North America. There were no isolates of enterovirus EV71 in 2018. EV71 has occurred as large outbreaks in South East Asia, presenting as Hand Foot and Mouth Disease - it can also cause encephalitis in a small number of cases. Otherwise, the most common viruses isolated were Coxsackievirus Group A virus, predominantly types 6, 8, and 21. Coxsackieviruses cause a wide spectrum of diseases from conjunctivitis and vesicular stomatitis or pharyngitis to meningitis and carditis. During June 2018 there were nine isolates of Echovirus type 5 over five weeks. Echoviruses can also result in viral encephalitis, and it is noted that these samples were cerebrospinal fluid samples.

Figure 41: Respiratory virus isolates submitted to ESR for the Auckland region by week, 2018



Source: ESR Weekly Virology Report.

Figure 42: Other virus isolates submitted to ESR for the Auckland region by week, 2018



Source: ESR Weekly Virology Report.

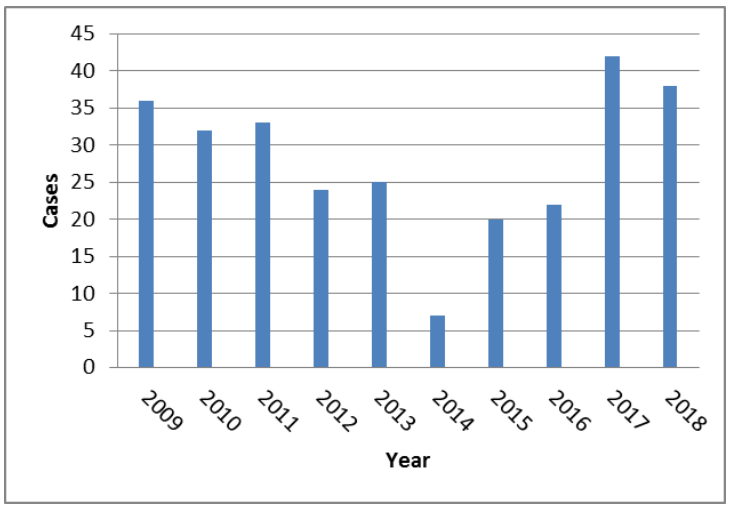
4.8 Meningococcal disease

Invasive meningococcal disease is an acute, potentially life-threatening illness caused by the bacterium *Neisseria meningitidis*, a gram-negative diplococcus. There are multiple different serogroups of *N. meningitidis*: the most clinically-relevant serogroups are A, B, C, Y and W-135. Meningococci are transmitted in large respiratory droplets or secretions from the nasopharynx of colonised persons. Most transmission occurs from persons who do not themselves have meningococcal disease.

There were 38 reported cases of meningococcal disease, compared to 42 in 2017, and 22 in 2016 (Figure 43). Since the end of the meningococcal epidemic in 2005 the number of cases per year has ranged from 7 to 47.

All cases but one were hospitalised. The remaining case was a post-mortem notification. There were three deaths, two in the less than one year age group, and one in the 5 to 9 year age group. Two of the deaths were attributed to serogroup W (2/11 serogroup W cases, case fatality rate (CFR) 18%), and one to serogroup B (1/17 serogroup B cases, CFR 6%).

Figure 43: Meningococcal disease cases in the Auckland region 2006 – 2018



The highest age specific incidence rate was in the under- five year age group. Seven of the 10 cases in this age group were under the age of 12 months. The female to male ratio was equal (Table 53).

Table 53: Age-gender distribution and age-specific incidence rates of probable & confirmed meningococcal disease in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
0 to 4	5	5	10	8.9
5 to 9	1	3	4	3.6
10 to 14	1	1	2	1.9
15 to 19	1	5	6	5.4
20 to 29	1	2	3	1.1
30 to 39	1	1	2	0.8
40 to 49	1		1	0.4
50 to 59	3		3	1.4
60 to 69	1	2	3	2.0
70+	4		4	2.8
Total	19	19	38	2.2

*Rates are based on estimated mid-year population, 2018 (Source: NZ Stats New Zealand).

The highest ethnic group incidence rate was among Pacific peoples and Maori; three times the rate of the European/Other ethnic group (Table 54).

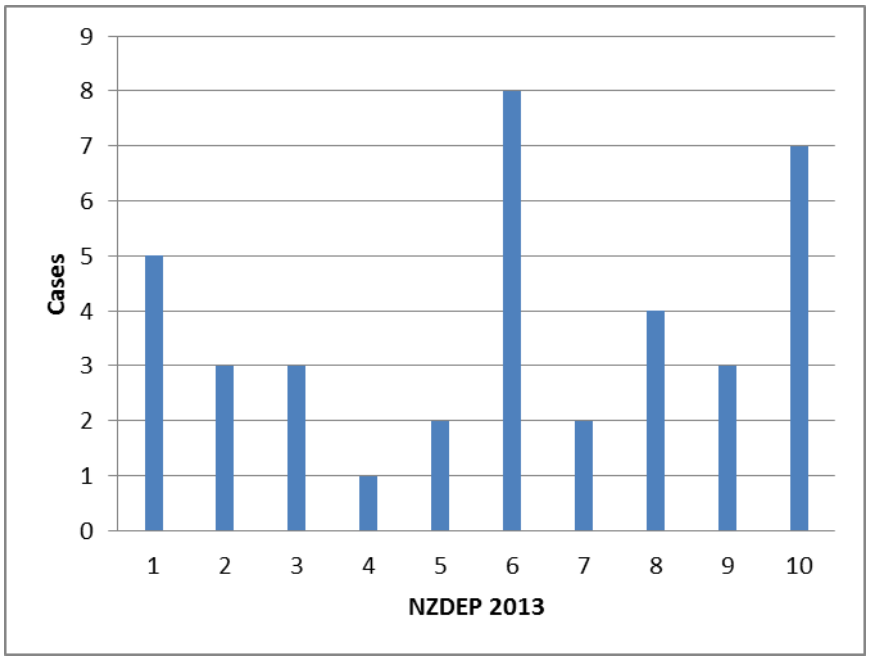
Table 54: Ethnic group specific incidence rates of meningococcal disease in the Auckland region 2018.

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	4	5	9	2.0
European or Other	6	5	11	1.3
Maori	4	4	8	4.1
Pacific Peoples	5	5	10	4.6
Total	19	19	38	2.2

*Rates are based on estimated mid-year population, 2018 (Source: NZ Stats New Zealand).

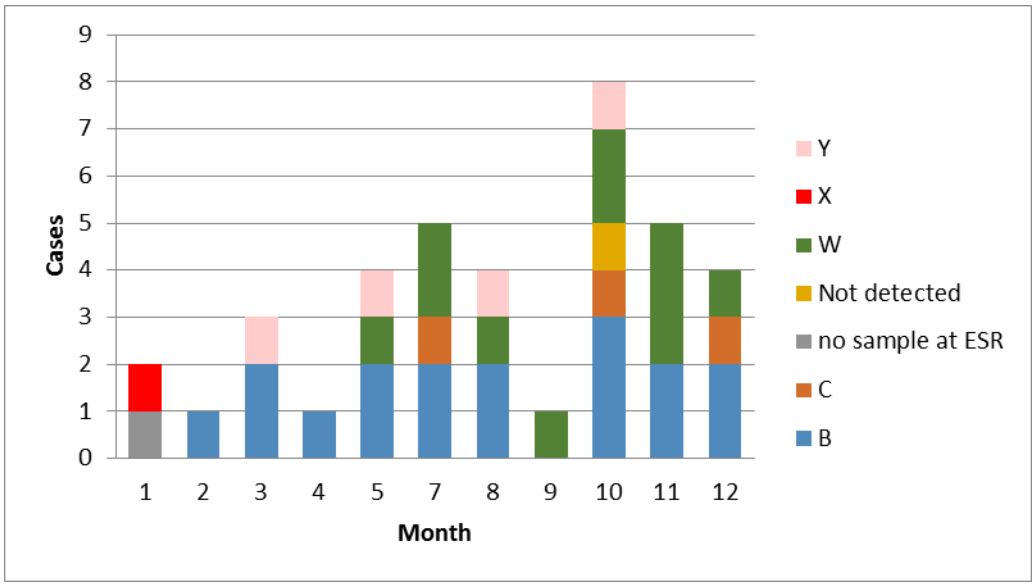
Nearly two thirds of the cases (63%) occurred in deciles 6 to 10 communities with the highest deprivation (Figure 44).

Figure 44: Meningococcal disease cases and NZ deprivation index in the Auckland region 2018



The most common serogroup was *N. meningitidis* serogroup B, with 17 cases (45%) (Figure 45). Groups C and Y had three and four cases respectively, but the major issue for 2018 was the emergence of serotype W, with 11 cases (29%) in 2018, compared with three cases in 2017. This increase was seen across New Zealand, with higher rates occurring in Northland resulting in a mass vaccination campaign.

Figure 45: *N. meningitidis* serogroups isolated from meningococcal disease cases by month in the Auckland region 2018



Of the 11 serogroup W cases, four were aged under nine years, with one under 12 months. Three were aged over 60 years, with one case each in the 15-19, 20-29, 30-39 and 50-59 age groups.

Specific typing of serogroup B cases showed the predominant PorA typing was P1.7-2,4, with six cases (35%). All 11 serogroup W cases were of Por. Type P1.5,2 (Table 55).

Table 55: Specific typing of *N. meningitidis* serogroup B meningococcal disease in the Auckland region 2018

Por. Typing	B	C	W	X	Y	Total
P1.17,13-4	1					1
P1.17,16-3	1					1
P1.17-1,23	1					1
P1.18-1,34	2					2
P1.20,9	1			1		2
P1.5,2			11			11
P1.5-1,10-1					2	2
P1.5-1,10-4					2	2
P1.5-1,10-8		2				2
P1.7,16	1					1
P1.7,16-26	1					1
P1.7-12,14	2					2
P1.7-2,16-167		1				1
P1.7-2,4	6					6
Not detected	1					2
No sample at ESR						1
Total	17	3	11	1	4	36

4.9 Invasive pneumococcal disease

Invasive pneumococcal disease (IPD) is caused by *Streptococcus pneumoniae*, or pneumococcus, a gram-positive *cocci* bacterium. *S. pneumoniae* resides asymptomatically in the nasopharynx of healthy carriers. The respiratory tract, sinuses, and nasal cavity are the parts of the host body that are usually infected. However, in susceptible individuals, such as elderly and immunocompromised people and children, the bacterium may become pathogenic, spread to other locations, and cause disease. *S. pneumoniae* is the main cause of community acquired pneumonia and meningitis in children and the elderly, and of septicaemia in HIV-infected persons. The methods of transmission include sneezing, coughing, and direct contact with an infected person. Invasive pneumococcal diseases include: bronchitis, rhinitis, acute sinusitis, otitis media, conjunctivitis, meningitis, bacteraemia, sepsis, osteomyelitis, septic arthritis, endocarditis, peritonitis, pericarditis, cellulitis, and brain abscess.

IPD is defined as an infection of *S. pneumoniae* in a normally sterile site. There were a total of 180 cases of IPD reported to ARPHS during 2018, up from 165 in 2017. This represents an incidence rate for the Auckland region of 10.6 notifications per 100,000, similar to the rate for the rest of New Zealand (11.9/ 100,000). The yearly number of notifications is shown in Figure 46, and the distribution by month for 2018 in Figure 47, which shows an increasing trend over the winter months. Of the 180 IPD cases, 162 (90%) were hospitalised. There were eight deaths, representing 4.4% of all IPD cases.

Figure 46: Invasive pneumococcal disease cases in the Auckland region 2009 – 2018

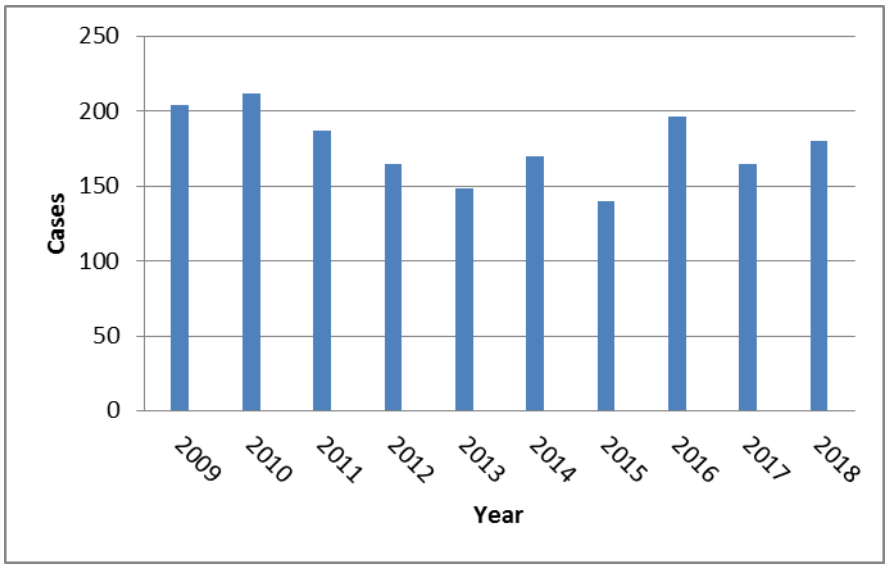


Figure 47: Monthly distribution of invasive pneumococcal disease cases in the Auckland region 2018

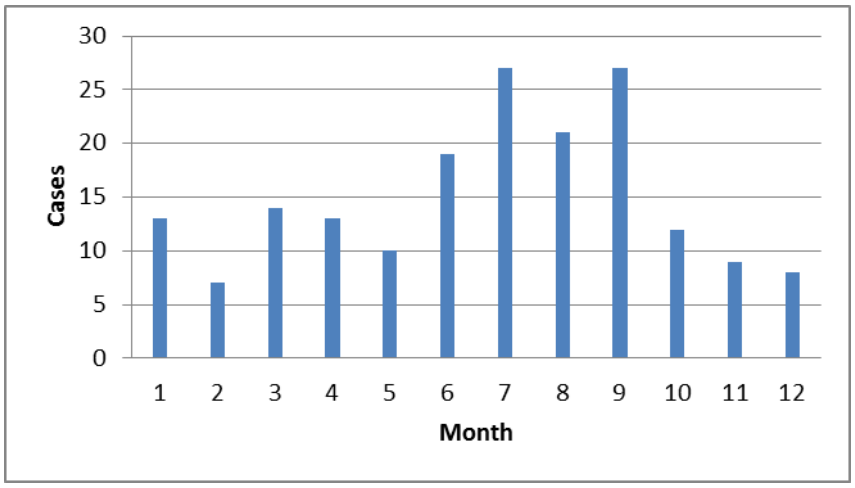


Table 56: Age-gender distribution and age-specific incidence rates of pneumococcal disease cases in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
0 to 4	13	9	22	19.6
5 to 9	2	4	6	5.4
10 to 14	0	1	1	0.9
15 to 19	2	6	8	7.2
20 to 29	4	4	8	2.8
30 to 39	10	6	16	6.6
40 to 49	6	12	18	8.1
50 to 59	17	10	27	13.0
60 to 69	19	19	38	24.7
70+	14	22	36	25.2
Total	87	93	180	10.6

*Rates are based on estimated mid-year population 2018 (Source: NZ Stats New Zealand).

Ethnic specific incidence rates were highest in Pacific peoples and Maori, with rates of 30.6 and 14.5 cases per 100,000 respectively (Table 57).

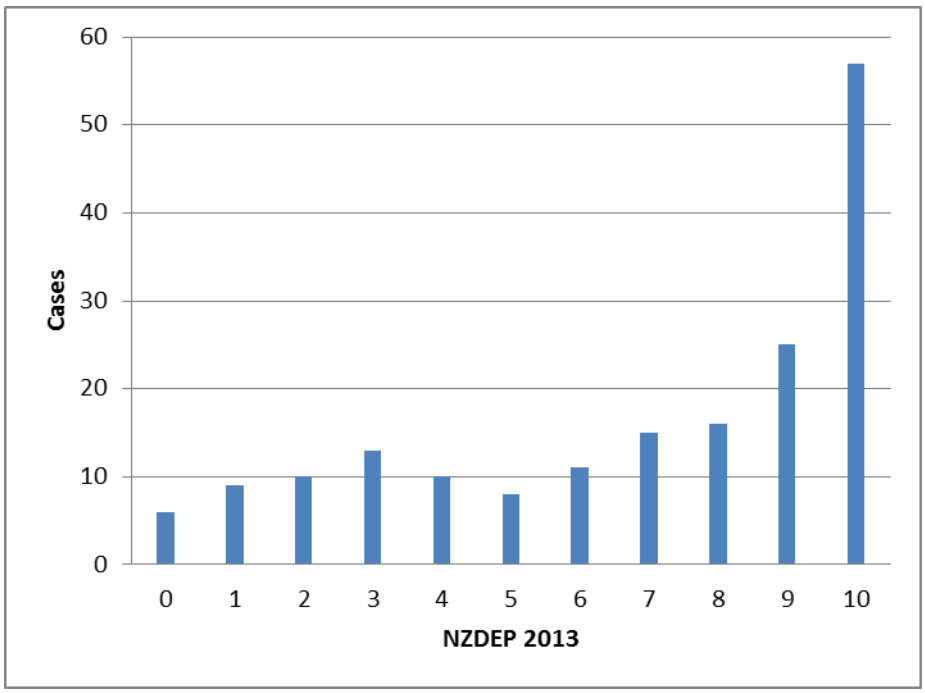
Table 57: Ethnic-specific proportion and incidence rates of pneumococcal disease cases in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	7	6	13	2.9
European/ Other	20	29	49	5.8
Maori	12	16	28	14.5
Pacific Peoples	38	28	66	30.6
Unknown	10	14	24	-
Total	87	93	180	10.6

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

Over 50% of IPD cases occurred in those living in the most deprived areas (deciles 8, 9 and 10 as defined by NZDep13) (Figure 48).

Figure 48: Invasive pneumococcal disease cases by NZ deprivation index in the Auckland region 2018



Immunisation with PCV7 was introduced in June 2008. This was replaced by PCV10 in July 2011, and then PCV13 in July 2014. From July 2017, PCV10 was again used on the routine schedule. It will be interesting to see the changes with serotypes 19A and 3, as these serotypes are not covered by the PCV10 immunisation (Table 58).

The most spectacular increase in specific serotype was type 12F, which normally averages about two cases per year. There were two cases in 2016, but this increased to seven in 2017 and to 25 in 2018. The other highlighted serotypes - 22F - normally averages about 12 cases per year, and serotype 23B – normally averages about two cases per year but there were7 cases in 2018. Another serotype worth watching is 10A, which had an average of just over two cases per year, but recorded five for 2018.

Table 58: Serotypes of IPD isolated, alongside the serotypes covered by the PCV10 and PCV13 vaccines in the Auckland region 2009 - 2018

Serotype	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	PCV10	PCV13
1	62	37	15	2	-	-	-	-	-	1		
3	5	9	10	9	5	17	7	10	9	7		
4	14	15	17	13	7	6	2	8	6	2		
5	-	-	-	-	-	-	-	1	-	-		
6A	3	4	-	2	1	-	1	-	1	1		
6B	8	6	7	1	2	-	1	1	-	2		
6C	-	6	5	3	3	14	12	8	4	5		
6D	-	-	-	-	-	-	-	1	-	-		
7A	1	-	6	-	2	-	-	-	-	-		
7C	-	-	-	-	-	1	2	2	2	1		
7F	5	3	7	8	20	22	13	14	13	11		
8	5	2	3	8	3	4	3	11	14	12		
9 Non-typable	-	1	-	1	1	-	-	-	-	-		
9N	4	6	2	4	3	3	3	7	4	5		
9V	8	12	7	7	3	5	2	1	2	1		
10 Non-typable	-	-	-	2	-	-	-	-	-	-		
10A	2	3	6	2	1	1	-	2	1	5		
11A	1	7	7	3	3	4	1	4	6	3		
12F	2	1	2	-	3	1	1	2	7	25		
13	1	-	-	2	-	1	1	1	-	-		
14	24	17	6	5	5		-	2	2	-		
15 Non-typable	-	-	-	2	2	1	-	-	-	-		
15A	-	-	-	-	-	1	1	4	4	3		
15B	-	-	4	4	1	5	6	4	4	2		
15C	-	-	-	-	-	1	1	1	2	1		
16 Non-typable	-	-	-	-	2	4	-	-	-	-		
16F	-	-	-	-	-	-	-	6	3	3		
17 Non-typable	-	1	-	-	-	-	-	-	-	-		
17F	1	1	1	1	2	-	1	2	2	2		
18A	-	-	1	-	-	-	-	-	1	-		
18C	7	3	6	2	4	4	1	1	-	-		
18F	-	-	-	-	-	-	-	-	-	1		
19A	4	14	18	28	27	31	33	40	24	21		
19F	13	11	10	13	5	6	9	4	2	4		
20	2	3	2	2	2	-	1	-	1	-		
21	-	-	1	-	-	-	-	2	-	1		
22 Non-typable	-	1	-	1	-	-	-	-	-	-		
22A	-	-	1	-	-	-	-	-	-	-		
22F	7	9	15	10	15	16	6	15	7	12		
23A	1	3	2	2	2	4	10	4	8	9		
23B	-	1	-	3	2	2	2	5	3	7		
23F	9	14	8	3	2	1	2	2	-	1		
24 Non-typable	-	-	-	1	-	-	-	1	-	-		

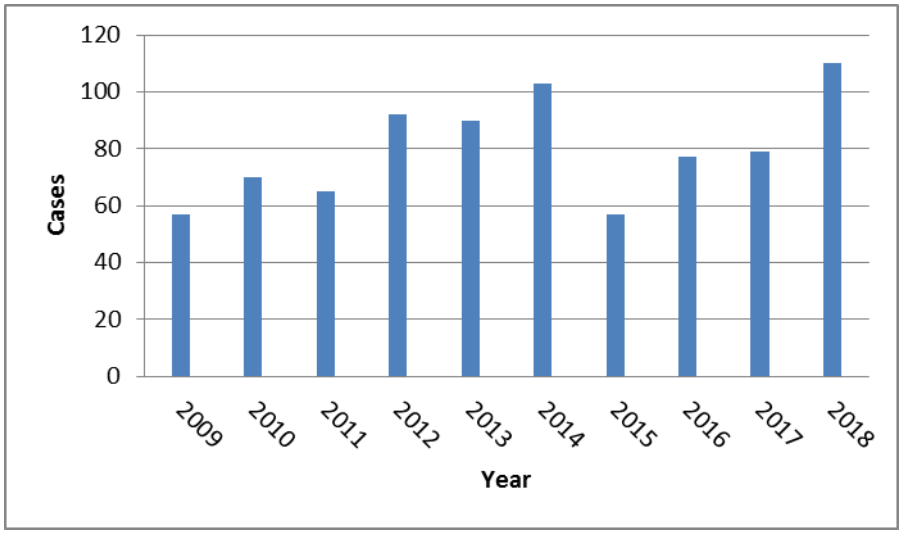
31	-	-	1	1	-	-	1	1	2	3
33 Non-typable	-	-	-	-	1	-	2	3	1	3
33F	-	1	-	1	2	2	2	7	4	2
34	-	-	2	-	1	2	1	4	1	4
35 No factor sera	1	2	2	-	-	-	-	-	-	-
35 Non-typable	-	-	5	2	2	5	-	-	-	-
35B	-	-	-	-	-	-	4	1	1	1
35F	-	-	-	-	-	-	-	-	2	1
37	-	-	1	-	-	-	-	-	-	1
38	1	2	1	1	-	1	1	-	5	2
42	-	-	-	-	-	-	-	-	1	-
Non-typable	1	2	-	-	-	1	1	2	2	3

4.10 Acute rheumatic fever

Rheumatic fever is an inflammatory disease that can involve the heart, joints, skin, and brain. The disease typically develops two to four weeks after a streptococcal throat infection. Signs and symptoms include fever, multiple painful joints, involuntary muscle movements, and occasionally a characteristic non-itchy rash known as erythema marginatum. The heart is involved in about half of cases. Damage to the heart valves, known as rheumatic heart disease, usually occurs after repeated attacks, but can sometimes occur after one. Worldwide, rheumatic fever occurs in about 325,000 children each year, and about 33.4 million people currently have rheumatic heart disease. Those who develop rheumatic fever are most often between the ages of 5 and 14, with only 20% of first-time attacks occurring in adults. The disease is most common in the developing world, and among indigenous peoples in the developed world.

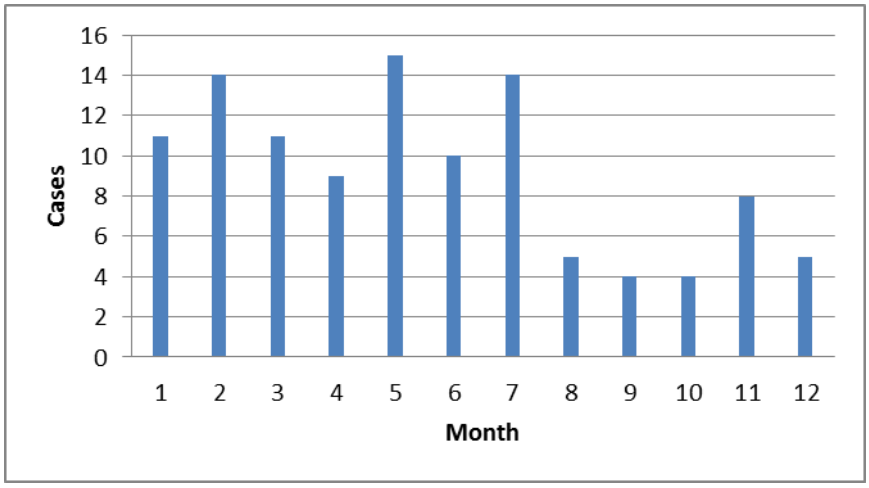
There were 110 probable and confirmed acute rheumatic fever (ARF) cases, up 31 from 2017, and up 33 from 2016 (Figure 49). Of the 110 cases, 76 cases (69%) resided in South Auckland. The incidence rate for ARF in the Auckland region was 6.5 cases per 100,000, compared with 1.8 cases per 100,000 for the rest of New Zealand.

Figure 49: Acute rheumatic fever cases in the Auckland region 2009 – 2018



Cases occurred throughout the year, peaking in February, May and July (Figure 50).

Figure 50: Acute rheumatic fever cases by month in the Auckland region 2018



The onset of ARF typically occurs during childhood or adolescence, with the majority of cases occurring in 5 to14 year old children. The highest age-specific incidence was again in the 5 to 14 year old age group, with 57% of all new acute rheumatic fever cases (Table 59). A new finding for 2018 was the increased incidence rate in the 15 to19 year age group, and the 20 to 29 year age group.

Table 59: Age-gender distribution and age-specific incidence rates of ARF in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
1 to 4	1	0	1	0.9
5 to 9	13	21	34	30.3
10 to 14	10	19	29	27.1
15 to 19	9	10	19	17.2
20 to 29	12	10	22	7.8
30 to 39	1	3	4	1.6
40 to 49	1	0	1	0.4
Total	47	63	110	6.5

*Rates are based on estimated mid-year population, 2018 (Source: NZ Stats New Zealand).

For the Auckland region 16% of cases were Maori, and 82% were from the Pacific people's ethnic group (Table 60).

Table 60: Ethnic group distribution and age-specific incidence rates of ARF in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
European	2	0	2	0.2
Maori	5	13	18	9.3
Pacific Peoples	40	50	90	41.7
Asian	0	0	0	0.0
Total	47	63	110	6.5

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base)

A further breakdown of ethnic groups is shown in Table 61.

Table 61: Ethnicity distribution and sex of ARF cases in the Auckland region 2018

Ethnicity	Female	Male	Total
Samoan	22	27	49
Tongan	10	13	23
Maori	5	12	17
Cook Islands Maori	4	6	10
Niuean	2	1	3
NZ European	2	2	4
Fiji Indian		1	1
Fijian		1	1
Other Pacific People	2		2
Total	47	63	110

ARF is rare in non-Māori and non-Pacific children. In 2018, Pacific children aged 5-19 years had the highest rate of ARF in the Auckland region, followed by Māori children aged 5-19 years (Table 62).

Table 62: Acute rheumatic fever cases by selected age and ethnic groups, 2009 to 2018

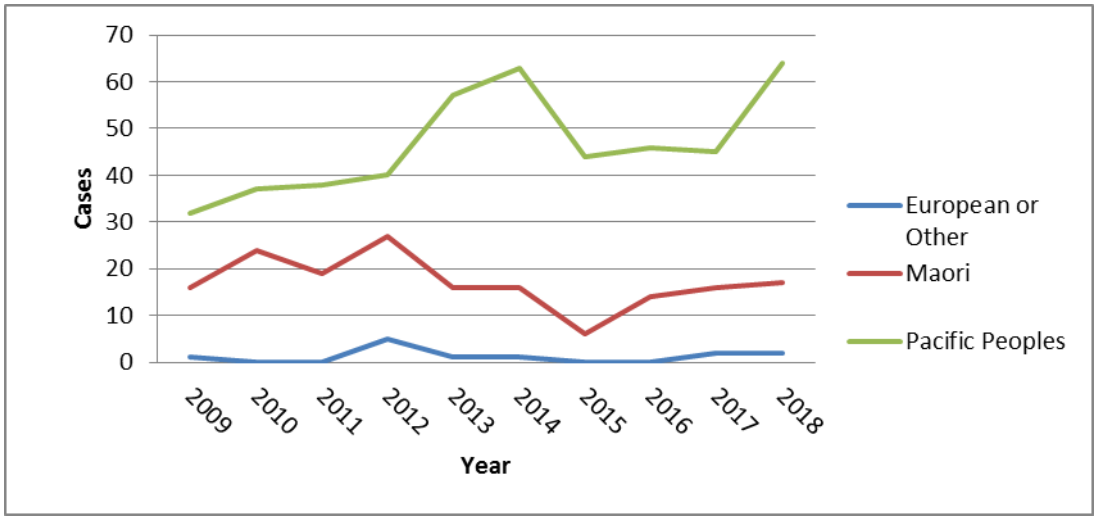
Ethnic group	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5 to 14 year										
Asian	0	1	0	2	2	0	0	0	0	0
European or Other	1	0	0	2	1	1	0	0	1	1
Maori	13	18	17	25	14	11	6	12	14	15
Pacific Peoples	29	33	37	33	48	49	39	35	34	47
Total (5 to 19 years)	43	52	54	62	65	61	45	47	49	63
15 to 19 years										
European or Other				3					1	1
Maori	2	6	2	2	2	5		2	2	1
Pacific Peoples	3	4	1	7	9	13	3	11	10	17
Total (15 to 19yrs)	5	10	3	12	11	18	3	13	13	19
20 to 29 years										
Asian					1		1			
European or Other						1				

Maori	4	3	1	4	4	2	3	2	3	1
Pacific Peoples	3	4	4	12	8	17	3	9	8	21
Total (20 to 29 years)	7	7	5	16	13	20	7	11	11	22

In 2011 the Rheumatic Fever Prevention Programme was established to prevent and treat strep throat infections, which can lead to rheumatic fever. The programme was expanded significantly from 2012 following the introduction of the five-year rheumatic fever 'Better Public Services' target to reduce rheumatic fever by two-thirds, to 1.4 cases per 100,000 people.

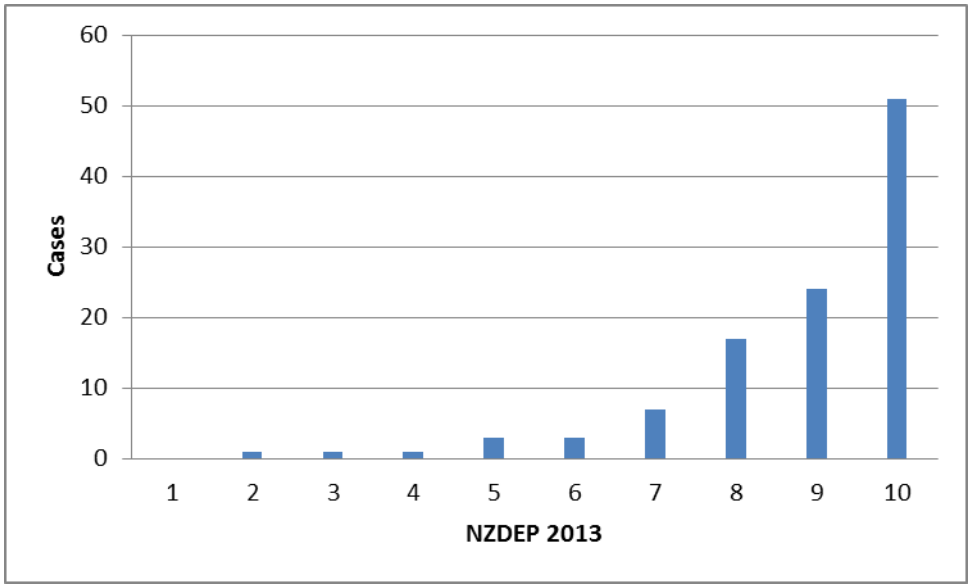
Between 2013 and 2015 there was a 62% reduction in cases for Māori (16 cases to 6) and a 23% reduction (57 to 44) for Pacific children aged 0 to 19 years living in the Auckland region. ARF is a disease of poverty, but the reason for the increase since 2016 is not known (Figure 51).

Figure 51: Acute rheumatic fever cases in the 0 to 19 year age-group in the Auckland region 2009 - 2018



During 2018, 84% of all ARF occurred in Auckland's most deprived areas (NZDEP 8, 9, 10) (Figure 52). This proportion is the same for the 5 to 14 year age group, and this has remained virtually unchanged since 2013, when it was 85%.

Figure 52: ARF cases by NZ DEP in the Auckland region 2018



New Zealand has yet to see the removal of recurrent rheumatic fever as a public health burden, and consistently experiences higher recurrence rates in Maori and Pacific ethnic groups compared to the European group. This has been attributed to poor socioeconomic conditions, in particular, household overcrowding[2] and difficulties with access to health care.

To prevent a recurrence of ARF, secondary prophylaxis is instigated. In New Zealand, this involves an intramuscular injection of antibiotic every 28 days, for a minimum of 10 years, depending on the extent of carditis.

These recurrences represent a failure of this follow up. The 2018 incidence rate for recurrent rheumatic fever in the Auckland region was 0.9 cases per 100,000 compared to 0.1 cases per 100,000 for the rest of New Zealand.

This was at its worst in 2014, with 17 recurrent RF cases in the Auckland region, but this dropped away in 2015, but since that time it has gradually increased back to 15 cases for 2018 (Figure 53).

[2] Oliver, J. R., Pierse, N., Stefanogiannis, N., Jackson, C., & Baker, M. G. (2017). Acute rheumatic fever and exposure to poor housing conditions in New Zealand: A descriptive study. Journal of Paediatrics & Child Health, 53(4), 358-364.

Figure 53: Numbers of recurrent rheumatic fever cases in the Auckland region 2009 - 2018

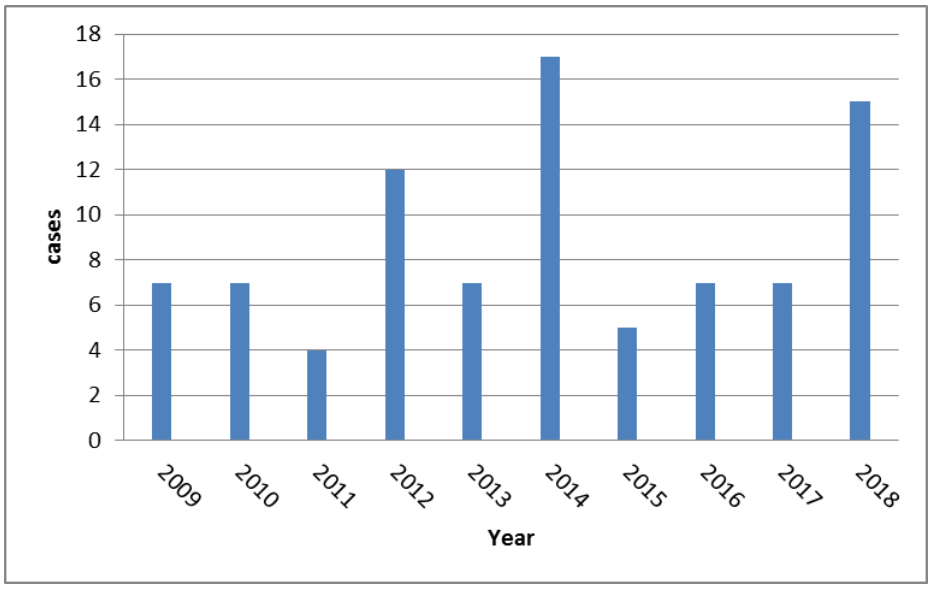


Table 63: Age-gender distribution of recurrent rheumatic fever cases in the Auckland region 2018

Age-group	Female	Male	Total
10 to 14		2	2
15 to 19	2	1	3
20 to 29	3	2	5
30 to 39	2	3	5
Total	7	8	15

Table 64: Ethnic group distribution of recurrent rheumatic fever cases in the Auckland region 2018

Ethnic group	Female	Male	Total
Asian		1	1
Maori	1	2	3
Pacific Peoples	6	5	11
Total	7	8	15

All but one of the recurrent rheumatic fever cases was from Counties Manukau DHB, and 11 of the 15 cases lived in areas of NZDEP (2013)9 and 10.

4.11 Tuberculosis, Latent Tuberculosis and Leprosy

4.11.1 Tuberculosis

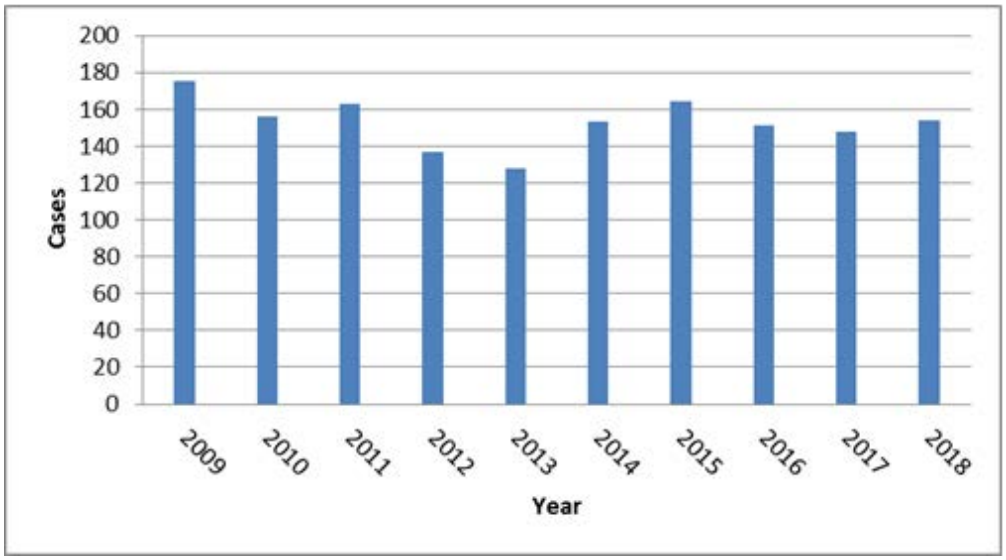
Tuberculosis (TB) is a bacterial infection, usually caused by *Mycobacterium tuberculosis,* but occasionally caused by *Mycobacterium bovis*. TB disease usually affects the lungs (pulmonary TB), but can also affect many other parts of the body, such as the lymph nodes, brain, kidneys, bowel, or bones (extrapulmonary TB). People with TB disease can have pulmonary or extrapulmonary TB, or both. TB disease is usually curable, but requires 6 to 12 months of multi-drug therapy to achieve cure. Multi-drug resistant TB (MDR-TB) has lower cure rates than drug sensitive TB, and requires treatment for up to two years or more, with drugs that may have more side effects.

Following infection with the TB bacterium, 90 to 95% of people contain and control the infection as Latent TB Infection (LTBI), with only 5 to 10% of people developing primary TB. However, this applies only to healthy HIV-negative adults – the risk of progression to active TB disease is much higher for young children, for adults with certain medical risk factors, and especially for people who are HIV positive. People with LTBI are not infectious to others, and do not have any symptoms of TB disease. However, due to their small risk of developing TB disease in the future, LTBI is often treated. The risk of developing active TB disease is higher within the first two years of becoming infected, and for people who are immunosuppressed (for example, people with HIV/AIDS, cancer, kidney disease, diabetes, or who are taking chemotherapy or long term oral steroid treatment), or young children.

TB is the ninth leading cause of death worldwide, and the leading cause from a single infectious agent, ranking above HIV/AIDS. In 2016, there were an estimated 1.3 million TB deaths among HIV-negative people (down from 1.7 million in 2000), and an additional 374,000 deaths among HIV-positive people. An estimated 10.4 million people fell ill with TB in 2016: 90% were adults, 65% were male, 10% were people living with HIV (74% in Africa) and 56% were in five countries: India, Indonesia, China, the Philippines and Pakistan (WHO Global Tuberculosis report 2017).

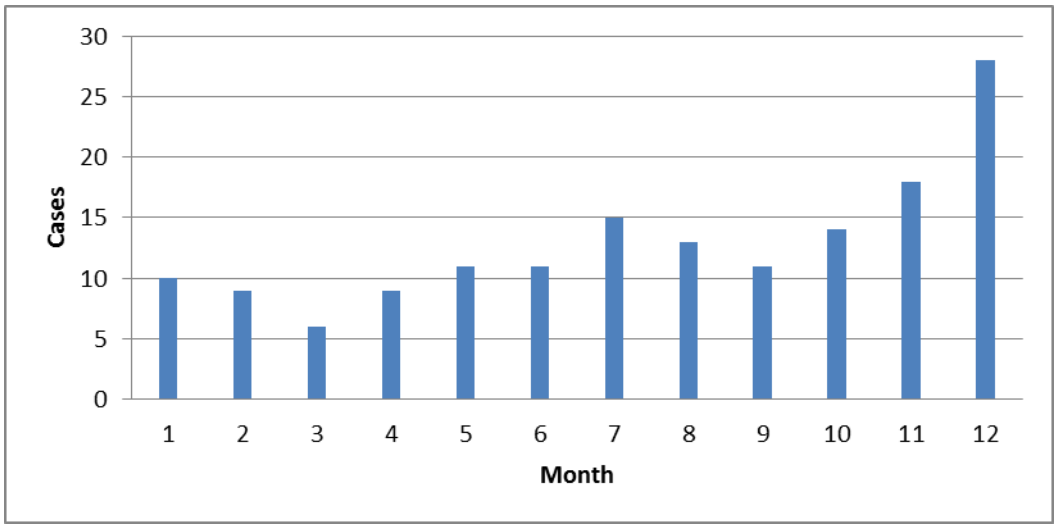
There were 155 new TB diagnoses made and notified in the Auckland region, very similar to 2017 (148) and 2016 (151), but down from 164 in 2015 (Figure 54). The 2018 incidence rate for the Auckland region was 9.1 cases per 100,000, which is approximately double that of the rest of New Zealand, with a rate of 4.8 cases per 100,000. Of the 155 cases, 60% received inpatient hospital care. Five TB-associated deaths were reported in 2018 in cases with multiple comorbidities, a case-fatality rate of 3.2%.

Figure 54: New tuberculosis cases in the Auckland region 2009 - 2018



Due to the variable, and potentially very long time between a person being exposed to TB and actually developing TB disease, it is hard to take any meaning from fluctuations of TB notifications between months or years, and the data is best looked at for trends over several or many years. Despite this, cases occurred throughout the year, and the peak months were November and December 2018, with 46 new cases in total over those two months (Figure 55).

Figure 55: Monthly distribution of new tuberculosis cases in the Auckland region 2018



Of the 155 new TB diagnoses, 91 (59%) were pulmonary TB. Of these, 47% (43) were smear-positive, compared with 25% smear-positive cases in 2017.

The highest age-specific incidence rate of new tuberculosis was in the 70 and over age group (16.1 /100,000), followed by the 60 to 69 year age group (14.3/100,000). This represents a shift in highest age-group incidence rate from the 20 to 29 and 30 to 39 year age groups in 2017 (Table 65). The male to female ratio is equal.

Table 65: Age-specific incidence and age-specific incidence rates of new tuberculosis cases in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
1 to 4	1		1	0.9
5 to 9	1		1	0.9
10 to 14	3	2	5	4.7
15 to 19	6	3	9	8.1
20 to 29	15	18	33	11.7
30 to 39	14	18	32	13.2
40 to 49	5	9	14	6.3
50 to 59	9	6	15	7.2
60 to 69	8	14	22	14.3
70+	11	12	23	16.1
Total	135	139	274	9.1

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand)

Among the four major ethnic groups, Asian people had the highest incidence rate with 23.2 cases per 100,000. A key feature of 2018 was the increase in Pacific people cases, which increased from 10.8 cases per 100,000 to 15.3 cases per 100,000 (Table 66).

Table 66: Ethnic group specific new tuberculosis cases and incidence rates in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000*
Asian	46	57	103	23.2
European or Other	2	7	9	1.1
Maori	5	1	6	3.1
Pacific Peoples	18	15	33	15.3
Unknown	2	3	4	-
Total	73	83	155	9.1

* Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base)

Of the 155 cases, 129 (83%) of new TB cases were born outside of New Zealand. The probable source countries were India (43%), China (13%), the Philippines (8%), Tonga (5%), South Africa (4%), Samoa (4%), and Fiji (3%) (Table 67). The average duration of time between arrival in New Zealand and onset date was 12 years. Nineteen cases were diagnosed within the first two years of their arrival, and five within one year.

Table 67: Source contries for new tuberculosis cases born outside New Zealand in the Auckland region 2018

Probable Source Country	Proportion of cases born outside NZ
India	43%
China	13%
Philippines	8%
Tonga	5%
South Africa	4%
Samoa	4%
Fiji	3%
Indonesia	2%
Pakistan	2%
Afghanistan	2%
Cambodia	2%
Others*	14%
Total	100%

There was known contact with a case for 22% of new cases, and no known contact in 60% of cases. The remainder of cases (18%) were reported as “Unknown”.

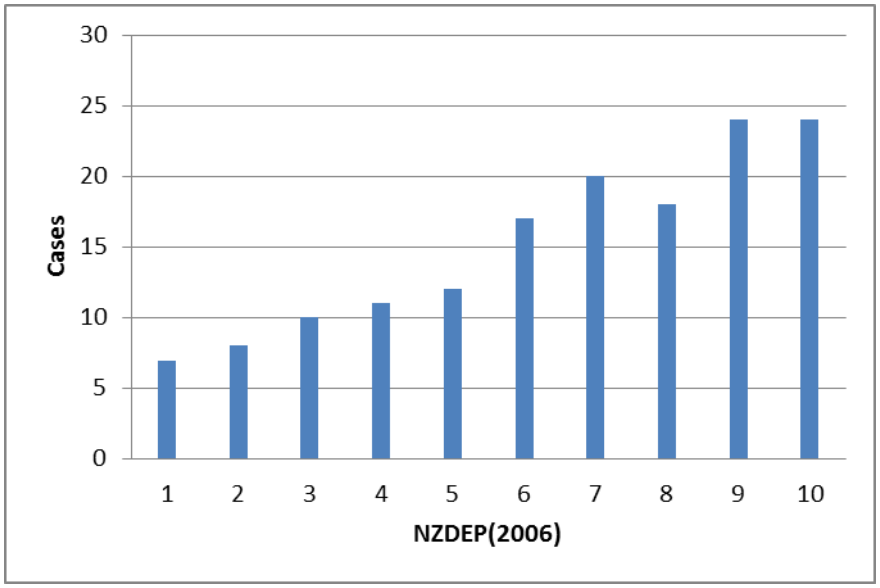
Occupational groups are shown in Table 68. Retired persons increased to make up 18.7% of cases. Students make up 14.2% of cases in 2018, somewhat down on previous years, while service industry and technicians remain stable at 14.2% and 3.9% respectively. Healthcare workers account for two cases, down from four in 2017 and 11 in 2016.

Table 68: Occupational-group for new tuberculosis cases in the Auckland region 2015 - 2018

Occupational-group	2015	2016	2017	2018	Percentage for 2018
Unemployed or beneficiary	24	13	26	16	10.3%
Student	26	31	23	22	14.2%
Service industry	23	25	19	22	14.2%
Retired persons	31	21	20	29	18.7%
Administration roles	16	15	13	6	3.9%
Food handler	12	4	13	8	5.2%
Unknown	6	15	6	15	7.7%
Tradesperson/factory worker	8	8	9	12	7.7%
Visitor to NZ	5	3	7	2	1.3%
Healthcare worker	5	11	4	2	1.3%
Technician	0	0	4	6	3.9%
Children 0 to 15 years	1	2	1	2	1.3%
Self employed	0	0	2	7	4.5%
Teacher	0	1	0	3	1.9%
Music, art & sports	2	0	0	0	0%
Prison inmate	1	0	0	0	0%
Total	164	151	148	155	100%

NZ Deprivation Index distribution of new TB cases is shown below. There is a clear clustering of cases in the higher deprivation zones, with half of the cases occurring in NZDep zones 7, 8, 9, and 10 (Figure 56.).

Figure 56: Distribution of new TB cases by NZDep in the Auckland region 2018



Drug resistance to isoniazid was found in eight new TB cases, and two of these cases were also resistant to Ethambutol. These two multidrug resistant cases had source countries of Saudi Arabia, and China.

4.11.2 Latent tuberculosis

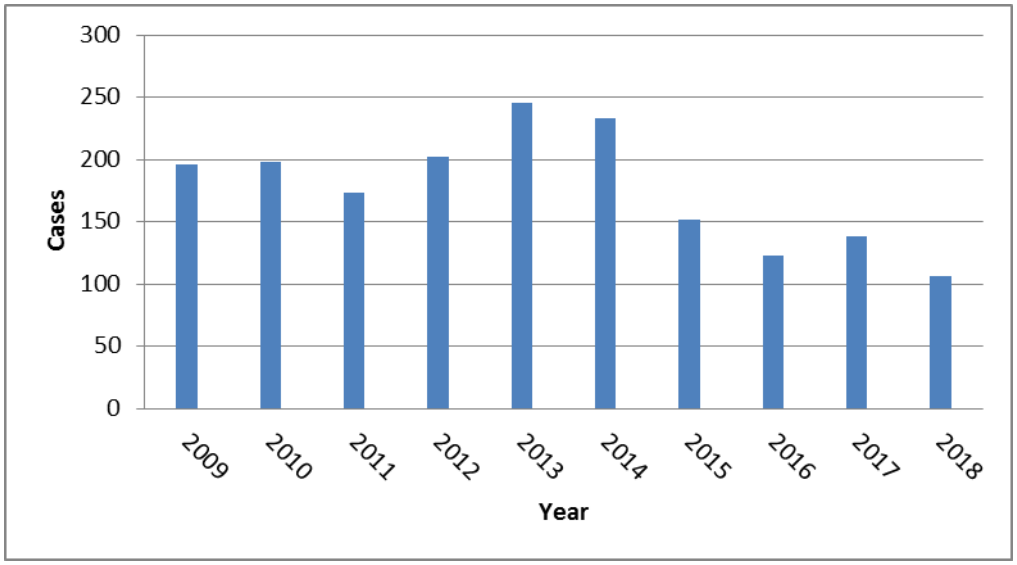
A diagnosis of latent tuberculosis (LTB), also called latent tuberculosis infection (LTBI), means a person is infected with *Mycobacterium tuberculosis*, but does not have active tuberculosis disease. Active tuberculosis can be contagious, while LTBI is not. The main risk is that approximately 10% of cases (5% in the first two years after infection, and 0.1% per year thereafter) will go on to develop active tuberculosis. This is more likely where the immune system is suppressed by medications, disease, or advancing age, or in very young children.

The identification and treatment of people with LTBI is an important part of controlling this disease, especially if the exposure has been recent. Various treatment regimens are in use to treat LTBI, which generally need to be taken for several months.

It is not mandatory for all cases of LTBI to be notified to the Medical Officer of Health. Cases are only notified with consent from the individual. Data presented here is thus not representative of the true burden of LTBI in the community, or of the number of TB contacts followed up by ARPHS.

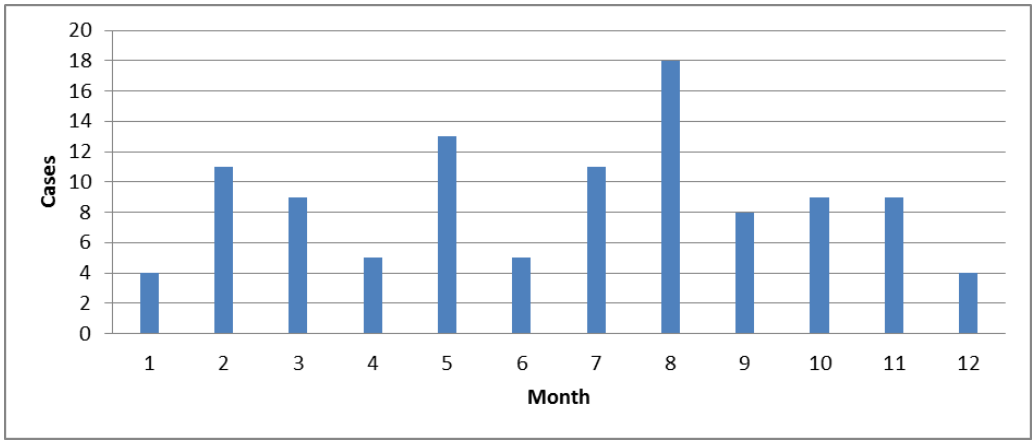
A total of 106 LTBI cases were reported, compared with 136 cases in 2017, and 120 cases in 2016 (Figure 57). Only a minority of LTBI cases are diagnosed so this does not represent a true incidence rate

Figure 57: LTBI cases in the Auckland region, 2009 to 2018



Cases occurred throughout the year, with peaks in May and August 2018 (Figure 58).

Figure 58: Monthly distribution of LTBI notifications in the Auckland region 2018



The incidence rate was 6.3 cases per 100,000, with the highest age-specific incidence rate in the less than 5 year age-group (15.2/100,000), followed by the next two youngest age groups up to age 14 (Table 69). The male to female ratio is similar at 1.1:1.

Table 69: Age-specific incidence and age-specific incidence rates of LTBI in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000*
0 to 4	10	7	17	15.2
5 to 9	6	6	12	10.7
10 to 14	8	8	16	14.9
15 to 19	0	1	1	0.9
20 to 29	8	6	14	5.0
30 to 39	9	4	13	5.3
40 to 49	4	5	9	4.0
50 to 59	7	5	12	5.8
60 to 69	3	6	9	5.9
70+	1	2	3	2.1
Total	56	50	106	6.3

*Rates are based on 2018-estimated mid-year population (Source: Statistics New Zealand).

The Asian ethnic group had the highest incidence rate (16.2/100,000), followed by Pacific peoples (9.3/100,000) (Table 70).

Table 70: Ethnic group specific latent tuberculosis cases and incidence rates in the Auckland region 2018

Ethnic group	Female	Male	Grand Total	Rate per 100,000*
Asian	35	37	72	16.2
European or Other	6	5	11	1.3
Maori	1	0	1	0.5
Pacific Peoples	13	7	20	9.3
Unknown	1	1	2	-
Grand Total	56	50	106	6.3

* Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

There were six TB preventative treatment cases during 2018. These cases were aged between 23 and 67 years (median age = 28). All were of Asian ethnicity.

The last remaining subgroup of tuberculosis that is monitored by ARPHS is the relapse or reactivations of tuberculosis disease. In 2018 there were seven cases in this group, and this number is relatively stable over the years. The age range was 20 to 87 years, and all were of Asian ethnicity. Two cases were smear positive.

4.11.3 Leprosy

Hansen's Disease (HD), also known as leprosy, is a rare but important notifiable infectious disease in New Zealand. In almost all cases of HD notified in New Zealand, the disease has been acquired in overseas countries where HD is still endemic, such as the Pacific Islands or India. HD is caused by *Mycobacterium leprae*, an acid-fast bacillus. The disease is curable with appropriate multidrug therapy (MDT). HD is not particularly infectious to others, but timely diagnosis and treatment of HD is important to prevent the complications associated with untreated disease and to prevent transmission of the disease in New Zealand. HD has a long incubation period where the person has the bacteria in the body but no symptoms. This is why HD can sometimes occur years after the person arrives in New Zealand.

There were 211 009 new leprosy cases registered globally in 2017, according to official figures from 159 countries from the 6 WHO Regions.

In Auckland there are usually only one or two cases diagnosed and notified per year. In 2018, there were two new cases and an additional case identified living overseas, but who had been resident in New Zealand while infectious. All cases presented with skin manifestations, were aged between 20 and 40, and had acquired their illness in the Pacific.

Section 5: Environmental related diseases

5.1 Hand foot and mouth disease

Hand foot and mouth disease (HFMD) is not a notifiable disease. ARPHS does, however, receive calls regarding HFMD throughout the year. There were four enquiries logged in 2018 relating to HFMD.

HFMD is caused by viruses that belong to the enterovirus genus (group). This group includes polioviruses, coxsackieviruses, echoviruses, and enterovirus, so tracking the number of these isolates gives us a broad idea of activity in the community. The virus most classically associated with HFMD is coxsackievirus A16 (CA16), but no isolates of this virus were received from the Auckland region during 2018. There was, however, an increase in coxsackievirus A type 2 (3) throughout the year, and coxsackievirus B type 1 (4) during the last quarter of 2018. Picornaviruses include enteroviruses that may present as HFMD. Over 1,500 isolates were examined by ESR in 2018 and classified as picornaviruses. The peak detections were in the second and third quarters.

5.2 Legionellosis

Legionnaires' disease (also known as legionellosis) is a form of atypical pneumonia caused by any species of gram-negative aerobic bacteria belonging to the genus *Legionella*. There is a less severe form of the infection known as Pontiac fever, which resembles acute influenza. The main causative species are *L pneumophila* and *L. longbeachae*. *L longbeachae* is typically present in soil, whereas *L. pneumophila* is generally found in water. It thrives in temperatures between 25 and 45°C, with an optimum temperature of 35°C.

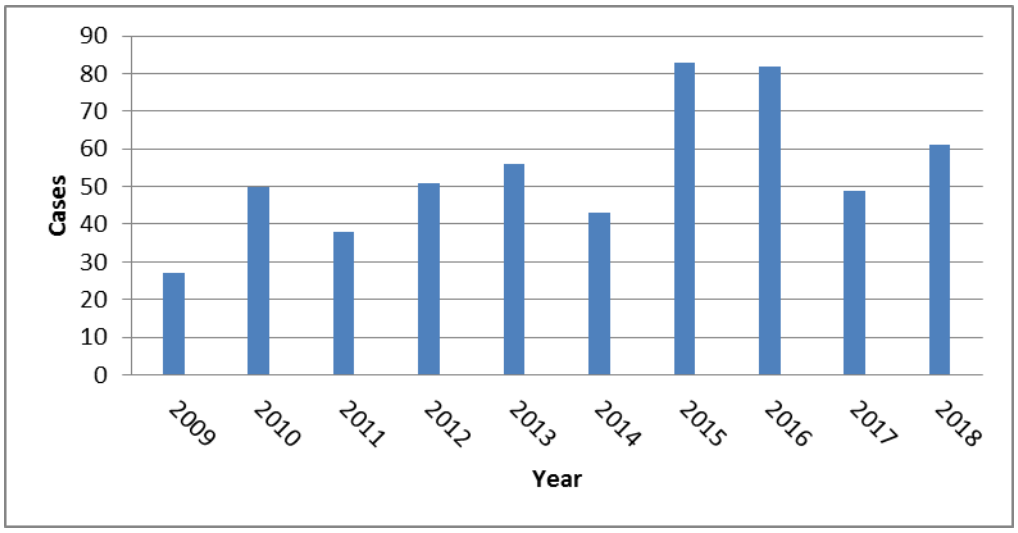
Legionnaires' disease is transmitted by inhalation of aerosolized water and/or soil contaminated with the bacteria. It is not transmitted from person-to-person. Sources where temperatures allow the bacteria to thrive include hot-water tanks, cooling towers, and evaporative condensers of large air-conditioning systems, such as those commonly found in hotels and large office buildings.

A total of 61 legionellosis cases were reported, up from 49 in 2017, but still down from 82 in 2016 (Figure 59). The diagnosis of legionellosis was based on either a pan- *legionella* PCR, *legionella*-species specific PCR, *legionella* urinary antigen test (LUA), or a fourfold rise in ESR-confirmed indirect fluorescent antibody titre or specific ESR confirmed antibody titres in the presence of a clinically compatible illness.

The incidence rate of legionellosis in the Auckland region was 3.6 cases per 100,000, compared to the rest of New Zealand at 3.9 cases per 100,000.

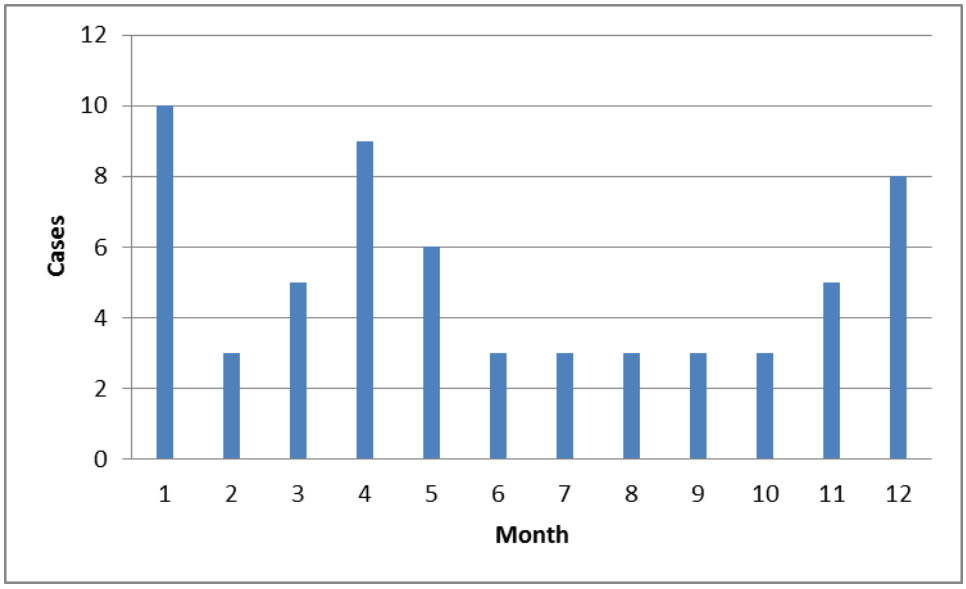
Of the 61 cases notified, 56 (92%) received hospital treatment. Three deaths were reported in 2018, giving a case-fatality rate of 4.9%. The three deaths were associated *with L. pneumophila serotype 1*, *L. Longbeachae* and one was unable to be serotyped. There were no legionellosis outbreaks in 2018.

Figure 59: Legionellosis cases in the Auckland region 2009 - 2018



There were seven overseas acquired cases involving patients who contracted the disease while staying overseas. The rest of the cases occurred singly and sporadically throughout the Auckland region throughout the year, with a sustained increase through the first two quarters, then another peak in the last quarter as exposures to gardening soil and potting mix resulted in an increase in disease (Figure 60).

Figure 60: Monthly distribution of legionellosis cases in the Auckland region 2018



The male to female ratio was 2.4:1 with the ages of the reported cases ranging from 29 to 87 years. The highest age-specific incidence rate was among persons aged 70 years and over (Table 71).

Table 71: Age-specific incidence and age-specific incidence rates of legionellosis in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000 population
20 to 29		1	1	0.4
30 to 39	1		1	0.4
40 to 49	2	6	8	3.6
50 to 59	7	12	19	9.1
60 to 69	3	8	11	7.2
70+	5	16	21	14.7
Total	18	43	61	3.6

Among the four major ethnic groups, European or Other had the highest incidence rate (5.0/100,000), followed by Maori (4.1/100,000), Pacific peoples (2.3/100,000) and Asian (0.9/100,000). The reason for the low incidence rate amongst Asian populations is not known (Table 72).

Table 72: Ethnic group specific legionellosis cases and incidence rates in the Auckland region 2018

Ethnic-group	Female	Male	Total	Rate per 100,000*
Asian	1	3	4	0.9
European or Other	12	30	42	5.0
Maori	3	5	8	4.1
Pacific Peoples	2	3	5	2.3
Unknown		2	2	-
Total	18	43	61	3.6

*Ethnicity rates are based on 2018 projected prioritised ethnic populations (2013 base).

Of the 61 reported cases where immunosuppressive illness status was recorded, 67% had evidence of concurrent immunosuppressive illness.

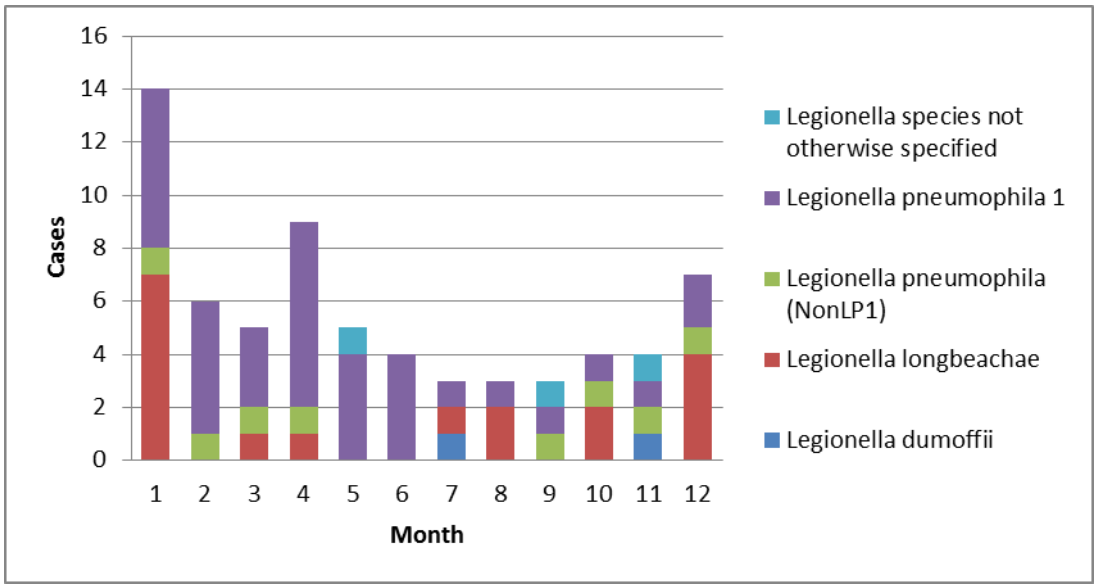
The predominant serotype for 2018 was *L. pneumophila serogroup 1* (54%), which is typically associated with aerosolized water, followed by *L. longbeachae (29%),* which is typically associated with soil and compost products (Table 73).

Table 73: *Legionella* serotypes in the Auckland region 2018

***Legionella* serotype**	**Total**
Legionella longbeachae	18
Legionella bozemanii	0
Legionella pneumophila 1	36
Legionella pneumophila other	8
Legionella dumoffii	2
Legionella species	3
Total	61

The monthly distribution of *Legionella* serotypes is shown in Figure 61. There is an observed increase in *L. longbeachae* in spring and summer as people have greater exposure to soil, gardens, composts and potting mixes. *L pneumophila 1* peak notifications were predominant during the first and second quarter of 2018.

Figure 61: Monthly distribution of *legionella* serotypes in the Auckland region 2018

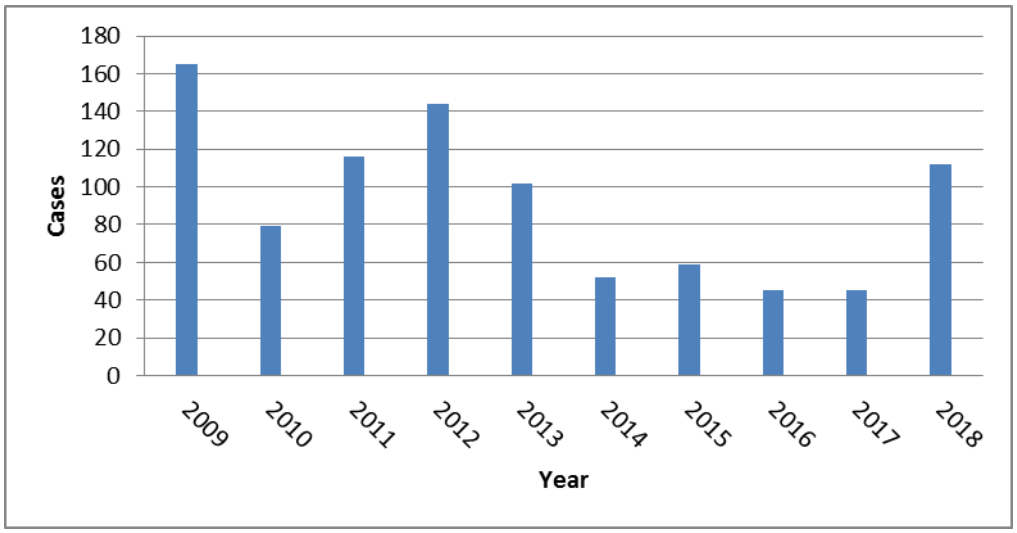


5.3 Lead absorption

Lead is one of the heavy metals which can cause illness in humans and other vertebrates. It interferes with the development of the nervous system, so it is particularly dangerous for children, causing learning and behaviour disorders, which may be permanent. Mechanisms of exposure to lead include contaminated air, water, soil, food, and consumer products. Occupational exposures such as painting and lead smelting are common causes of lead poisoning in adults. Certain hobbies, DIY projects involving house renovations, indoor shooting, and consumption of Ayurvedic medications are recurrent sources of lead absorption in New Zealand.

There were 116 lead cases, well up from the 2017 total of 45 (Figure 62). Notifications were received throughout the year, with various spikes due to an increase in occupational testing. The increase was driven by large numbers of Housing Corporation contractors undergoing occupational testing.

Figure 62: Lead absorption cases in the Auckland region 2009 - 2018



The overall incidence rate was 6.8 cases per 100,000. The highest age-specific rate was among persons aged 50 to 59, followed by the 60 to 69 age group (Table 74). The male to female ratio was 8: 1. Among the four major ethnic groups, Pacific peoples had the highest incidence rate (18.1/100,000), followed by European and Other (5.2/1000,000) (Table 75).

Table 74: Age-specific incidence rates of lead absorption in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000
0-4	1		1	0.9
5 to 9	1		1	0.9
10 to 14	-	-	-	-
15 to 19	-	3	3	2.7
20 to 29	-	14	14	5.0
30 to 39	3	23	26	10.7
40 to 49	3	16	19	8.5
50 to 59	4	28	32	15.4
60 to 69	1	17	18	11.7
70+		2	2	1.4
Total	13	103	116	6.8

Table 75: Ethnic group specific lead absorption cases and incidence rates in the Auckland region 2018

Ethnic group	Female	Male	Total	Rate per 100,000
Asian	2	7	9	2.0
European or Other	4	26	30	3.6
Maori	3	7	10	5.2
Pacific Peoples	3	36	39	18.1
Unknown	1	27	28	-
Total	13	103	116	6.8

There were 89 cases for occupational exposures. This included 64 cases identified as part of a nationwide study which included foundry workers. If these cases are excluded, then there were 25 other occupation-based notifications of lead absorption, up from 15 in 2017. The average blood lead level overall was 0.94µmol/l. The individual highest level was seen in nationwide study (2.8µmol/l). Of the non-study cases the highest levels were seen in those involved with painting and paint stripping (2.0 and 2.2µmol/l) (Table 76).

Table 76: Sources of exposure in occupational lead absorption cases in the Auckland region 2018

Occupation	Total
Cable soldering	1
Foundry	12
Glass worker	1
Housing NZ Study	58
Metal worker	1
Painter/paint removal	14
Roofer	1
Shooter	1
Total	89

Six cases, who were no longer working in a lead exposing environment but were still on a monitoring programme, were notified. These cases had previously worked in either battery manufacturing (2), in a radiator factory, as a builder, as a lead based mortar factory worker, or in a lead sinker factory. The average blood lead was 1.1µmol/l.

Of the 21 non-occupational exposures, eight were associated with the stripping and painting of houses previously painted with lead based paints, four were in shooters, and six were linked to past or current consumption of Ayurvedic medications. The individual highest blood lead level was seen in a person using Ayurvedic medicine (4.7µmol/l), and the next highest levels were seen in people renovating homes and stripping old paint (1.4, 0.98µmol/l) (Table 77).

Table 77: Sources for non-occupational lead absorption cases and average blood lead levels in the Auckland region 2018

Occupation	Total	Ave. Blood Lead
Ayurvedic medications	6	1.3
Glass polisher (hobby)	1	0.6
Paint removal / renovation	8	0.73
Person with embedded lead shrapnel	1	0.76
Shooter	4	0.6
Spincasting (hobby)	1	0.48
Total	21	1.2

5.4 Toxic shellfish poisoning

There are four main kinds of toxic shellfish poisoning. The chemicals that cause toxic shellfish poisoning are produced by certain species of toxic algae, and released into the shellfish when they ingest the algae.

Paralytic shellfish poisoning (PSP) is caused by a group of chemicals called the saxitoxins and gonyautoxins. These chemicals all differ in their toxicity to humans, and the toxin load may vary, depending on the species of shellfish and the species of algae producing the toxin. Toxic algae of the species *Gymnodinium catenatum, Alexandrium minutum* and *Alexandrium catenella* commonly cause PSP toxicity in New Zealand shellfish.

Amnesic shellfish poisoning (ASP) is caused by domoic acid in shellfish. Symptoms are mainly gastrointestinal, especially at low levels. However, about a quarter of cases experience neurological problems, including memory loss that may be significant and permanent.

Symptoms first appear within 24 hours, and neurological difficulties within 48 hours. Toxic algae of the *Pseudonitzchia* genus produce domoic acid.

Neurotoxic shellfish poisoning (NSP) also attacks the nervous system. Symptoms include difficulty in swallowing, double vision, unsteadiness and tremor, nausea, diarrhoea, vomiting, numbness, tingling of the mouth, lips and extremities. Difficulty in distinguishing between hot and cold is characteristic. Onset of symptoms is likely to be within 24 hours. NSP is sometimes produced by an algal species known as *Karenia mikimotoi*[3].

Diarrhetic shellfish poisoning (DSP) is caused by okadaic acid and related compounds. Symptoms are diarrhoea, nausea, vomiting and abdominal pain. Acute symptoms usually occur within 12 hours and are of short duration. DSP group toxins are produced by a variety of phytoplankton species, mainly of the *Dinophysis* genus.

There were no cases of toxic shellfish poisoning notified. The last case notified was in 2014.

5.5 Hazardous Substances injuries

As defined in the Hazardous Substances and New Organisms Act 1996, a hazardous substance is officially defined as any substance with one or more of the following intrinsic properties: explosiveness, flammability (catch fire), a capacity to oxidise, corrosiveness, or be toxic to humans. The same act requires hospitals and medical practitioners to notify hazardous substances injuries to the Medical Officer of Health.

Hazardous substances injury cases are derived from the large number of hazardous substances or chemical injuries that are treated at the region's hospital emergency departments. Prior to 2018 this data was only available for ADHB but during 2018 all the regions hospitals were able to contribute. This data is assessed and managed by ARPHS as required and the resultant clinical and epidemiological data is entered into the national HSDIRT database where it is collated and analysed by Massey's Centre for Public Health Research.

Hazardous substances injury cases encompass a vast group of diagnoses, from children swallowing cleaning products or cosmetics, intentional overdoses with agrichemicals, carbon monoxide poisoning, illness caused by exposure to chemicals such as solvents or chlorine, contact dermatitis from chemicals, fireworks burns or eye injuries, and huffing of substances.

[3] MPI: www.mpi.govt.nz/travel-and-recreation/fishing/shellfish-biotoxin-alerts/

There were 40 hazardous substances cases during, well up from 2017, as a result of the wider process described above for 2018. The incidence rate was highest in the 1 to 4 age group, followed by the 20 to 29 year age group (Table 78).

Table 78: Hazardous substances injury cases by age-group in the Auckland region 2018

Age-group	Female	Male	Total	Rate per 100,000
1 to 4	2	2	4	4.5
15 to 19	2	1	3	2.7
20 to 29	8	3	11	3.6
30 to 39	4	3	7	2.7
40 to 49	5	1	6	2.7
50 to 59	4		4	2.0
60 to 69	2	1	3	2.0
70+	1	1	2	1.4
Total	28	12	40	2.3

Although numbers were small, Pacific peoples and Maori were over-represented compared with the European or Other ethnic group (Table 79).

Table 79: Hazardous substances injury cases by age-group in the Auckland region 2018

Ethnicity	Female	Male	Total	Rate per 100,000
Asian	9	2	11	2.5
European or Other	8	3	11	1.3
Maori	3	4	7	3.6
Pacific Peoples	8	3	11	5.1
Total	28	12	40	2.3

Of the 40 cases, 16 were office workers who were exposed to unknown fumes in a single event. Otherwise, other occupations all had a small number of cases. All but two were reported as being assessed at hospital, and there were no deaths.

The majority of cases were for poisoning by ingestions or by inhaled fumes, and the majority of events took place at work (Tables 80 and 81).

Table 80: Hazardous substances injury cases by type of injury in the Auckland region 2018

Type of injury	Cases
Injury corrosive burns	2
Injury poisoning	14
Inhaled fumes	12
Injury other	8
Not stated	4
Total	40

Table 81: Hazardous substances cases by setting in the Auckland region 2018

Place of exposure	Total
Home	11
Work	21
Other/unknown	8
Total	40

The hazardous agent involved is shown in Table 82. The unknown chemical that affected 16 office workers was not identified. Other than this event, six hazardous substances were from gaseous products, five were from liquid cleaning products, three were other toxic liquids, and two were petroleum-based products.

Table 82: Hazardous substances injuries by agent in the Auckland region 2018

Hazardous agent	Total
Ammonia	1
Carbon dioxide gas	1
Carbon monoxide	2
Carpet cleaner	1
Chlorine	1
Cleaning product	2
Ethylene Glycol	1
Flea Bomb	1
Formaldehyde	1
Glyphosate	1
Hypochlorite	1
Medications	1
Not contactable	1
Not known	5
Petrol	1
Turpentine	1
Unknown chemical	17
Unknown coloured powder	1
Total	40

Section 6: Rare diseases

The information for rare diseases has been deliberately generalised so as to avoid any individual case being able to be identified.

6.1 Brucellosis

Brucellosis is a highly contagious zoonosis caused by ingestion of unpasteurized milk or undercooked meat from infected animals, or from close contact with their secretions.

Brucella species are small, gram-negative, non-motile, non-spore-forming, rod-shaped (coccobacilli) bacteria. They function as facultative intracellular parasites, causing chronic disease, which usually persists for life. Acute symptoms include profuse sweating and joint and muscle pain.

There were two cases of Brucellosis notified.

One case was in a case who recently returned from living in the Pacific for two years. *Brucella suis* biovar l was isolated on a blood culture. The second case was from the Middle East who consumed raw milk from camels and cows. *Brucella melitensis* was identified.

6.2 Haemophilus influenzae B (HiB)

Invasive HiB disease is an acute, potentially life-threatening illness caused by the bacterium *Haemophilus influenzae*, a gram-negative coccobacillus. Non-encapsulated *H. influenzae* strains cause non-invasive disease, such as bronchitis and otitis media. However, six encapsulated strains of the bacteria (types a - f) cause invasive disease. Prior to the introduction of vaccination, type b (HiB) was the prevalent strain.

There were no cases of HiB confirmed out of 33 *Haemophilus influenzae* notifications for the year. The last notified case was a single HiB notification in 2017.

6.3 Hydatid disease

Hydatid disease, also called echinococcosis, is a parasitic disease of tapeworms of the *Echinococcus* type. People get two main types of disease, cystic echinococcosis, and alveolar echinococcosis. The disease often starts without symptoms, and this may last for a year. The symptoms and signs that occur depend on the cyst's location and size. The disease is spread when food or water that contains the eggs of the parasite is consumed, or by close contact with an infected animal. The eggs are released in the stool of meat-eating animals that are infected by the parasite. Commonly infected animals include dogs - which become infected by eating the organs of an animal that contains the cysts such as sheep or rodents.

There were no cases of hydatid disease notified. The last notified cases were in 2016 (3).

6.4 Q fever

Q fever is a disease caused by infection with *Coxiella burnetii*, a bacterium that affects humans and other animals. This organism is uncommon, but may be found in cattle, sheep, goats and other domestic mammals, including cats and dogs. The infection results from inhalation of a spore-like small cell variant, and from contact with the milk, urine, faeces, vaginal mucus, or semen of infected animals. Other modes of transmission to humans, including tick bites, ingestion of unpasteurized milk or dairy products, and human to human transmission, are rare. Humans are often very susceptible to the disease, and very few organisms may be required to cause infection.

In 2018 there were three lab notifications of possible Q fever but all were found to be "Not a case".

6.5 Rickettsial disease

Rickettsial disease in humans (spotted fevers, typhus or scrub typhus) is caused by a number of related species of intracellular bacteria of the genus *Rickettsia*, which have blood-feeding arthropod vectors. Each species is associated with a different spectrum of clinical features, geographical distribution, insect vector (tick, louse, flea, mite or chigger), seasonal incidence and other epidemiological factors.

There was one confirmed case of overseas acquired Rickettsial disease in a case following a visit to a game park.

6.6 Murine typhus

Murine typhus is caused by *Rickettsia typhi* and *R. felis*, which are transmitted to humans by fleas. It is clinically similar to, but milder than, epidemic typhus, causing chills, headache, fever, and rash. Murine typhus is a rickettsial disease. Animal reservoirs include wild rats, mice, and other rodents, and there are reservoirs of infection in the Southern Kaipara.

There were no cases of Murine typhus notified. The last case was in 2017.

6.7 Diphtheria

There were no cases of *Corynebacterium diphtheria* notified. The last case was in 2017.

6.8 Taeniasis

Taeniasis is a parasitic disease due to infection with tapeworms belonging to the genus *Taenia*. The two most important human pathogens in the genus are *Taenia solium* (the pork tapeworm) and *Taenia saginata* (the beef tapeworm). The third species - *Taenia asiatica* is found only in East Asia. Taeniasis is generally asymptomatic, but heavy infection causes weight loss, dizziness, abdominal pain, diarrhoea, headaches, nausea, constipation, chronic indigestion, and loss of appetite. A type of taeniasis called cysticercosis is caused by accidental infection with the eggs of *T. solium* from contaminated food and water. A specific form of cysticercosis called neurocysticercosis is said to be the most common infection of the central nervous system.

There were three notifications of taeniasis, compared with four in 2017, and one in 2016. All cases were acquired overseas in Africa.

Section 7: Environmental health indicators

Environmental health indicators (EHIs) are measures that summarise the relationship between the environment and health. Their main functions are to:

- monitor changes in the environment and health
- enable surveillance of the status or trends of public health events associated with environmental exposures
- provide information to decision-makers in order to identify needs and actions both in the environment and in health
- provide objective baseline information for developing targets
- demonstrate spatial and temporal variations
- monitoring effectiveness of policy actions
- promote specific policy issues.

7.1 Environmental Health Indicators in New Zealand

Environmental Health Indicators (EHIs) provide information about the possible relationship between the environment and health. EHIs can be used as a tool to assess, quantify and monitor the health and vulnerability of our region, inform adaptations and policy development, and measure the effectiveness of climate change adaptation and mitigation activities. In addition, they provide baseline information for assessing and monitoring temporal and spatial variability of risks with respect to climate change, enabling projection scenarios (e.g. epidemics, cost/benefits of interventions) of how the current situation may evolve. Monitoring of human disease surveillance data has the potential to act as a warning system for ecosystem disruption, and may be used to identify interventions for the preservation of ecologic and human health. Such an approach means that interventions can be applied higher up the causal chain than would have been possible based on environmental monitoring or health surveillance alone. Implementation of such interventions can improve ecological well-being, which in turn will reduce the resultant burden of disease in humans. EHIs give us information and statistics on how the environment affects the health of New Zealanders.

7.2 ARPHS environmental health indicators project and data collection

There were five EHIs that were selected by ARPHS' in 2016 as foundations for an environmental health surveillance tool.

Data collection for these EHIs will continue as progress is made towards establishing a long-term monitoring program at ARPHS.

The five indicators are:

- rainfall
- mean monthly temperature (maximum)
- land use
- population growth
- air quality (PM2.5 and PM10).

In the future, the impact of these five indicators on human health will be further measured by:

- mortality data
- morbidity data - though this analysis has not yet started and would require some statistical analysis and reference to consistency with the international literature.

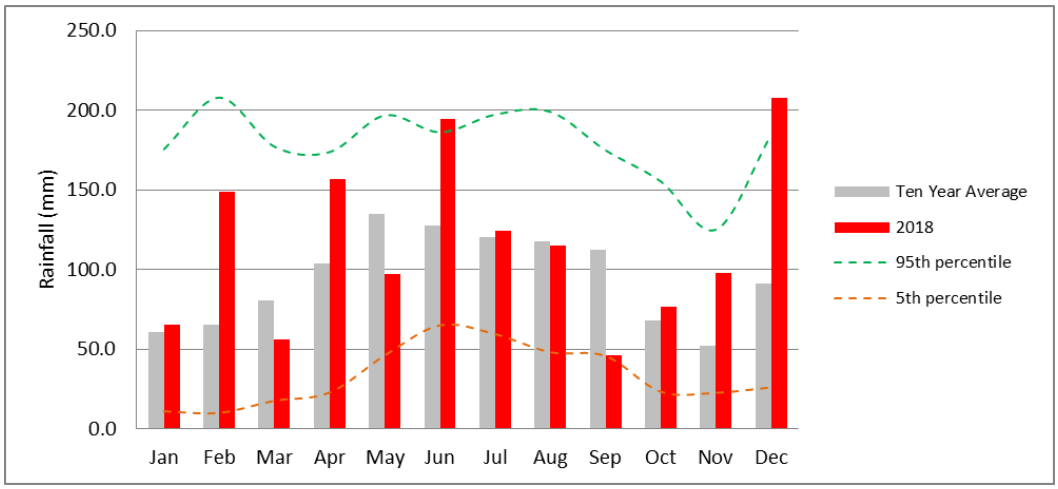
Data collection trials were completed and the project team was successful in confirming five EHIs, and also securing data sources for these indicators. The overall data collection for the

2018 calendar year is summarised in the figures below. ARPHS' will continue collecting data and reporting on climate sensitive EHIs.

7.2.1 Rainfall

It was another year of extremes for rainfall in the Auckland region. The Auckland Airport station reported high levels of rainfall exceeding the 95 percentile for June and December 2018. Rainfall was lower than the 10-year average in March 2018, and very dry in September - well below the 10-year average, and below the 5th percentile (Figure 63). Further study is required to understand what (if any) impact this has on human health.

Figure 63: Auckland Airport rainfall 2018

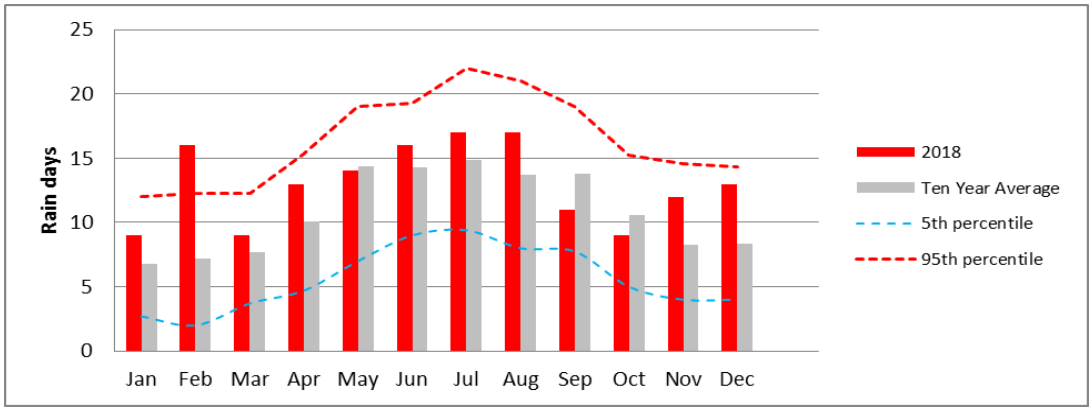


Source: NIWA

7.2.2 Rain days

February exceeded the 95th percentile for rain days in 2018 - almost reaching the wet day totals of the winter months of June, July and August. The observed number of rain days dropped below the 10-year average in September and October, before November and December bounced back with 12 and 13 rainy days respectively - well over the eight day 10-year average (Figure 64).

Figure 64: Auckland Airport rain days 2018

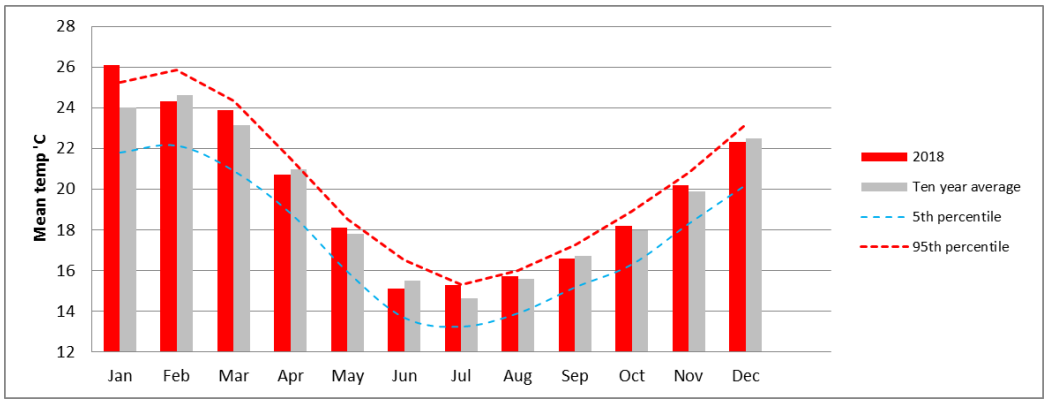


Source: NIWA

7.2.3 Temperature

One of the key climate measures is the daily maximum temperature averaged over a whole month (mean monthly temperature max). This reached the 95% percentile for January, and exceeded the 10-year average in seven of the 12 months (Figure 65).

Figure 65: Auckland mean monthly temperature maximum 2018



Source: NIWA

7.2.4 Mean monthly temperature and rainfall

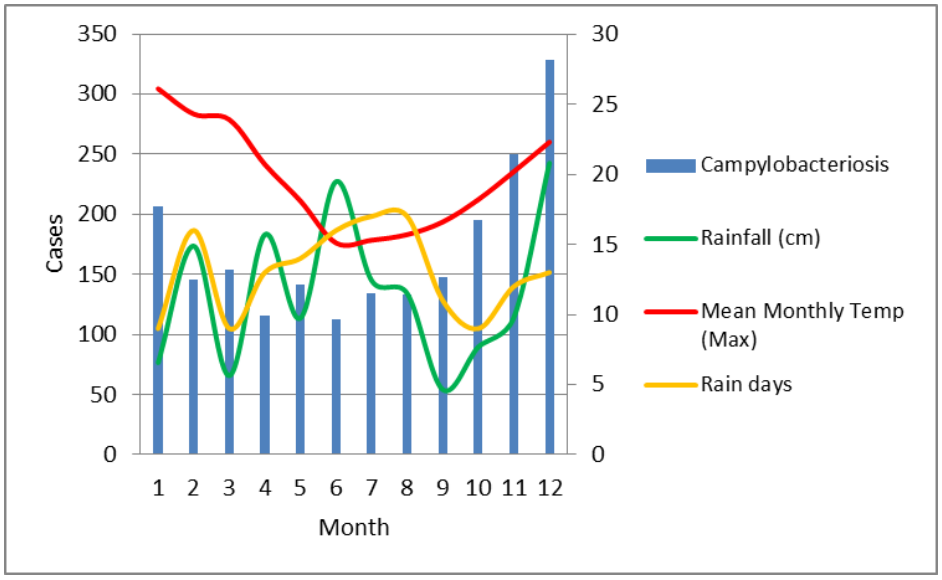
Evaluating the influence of climate variability on enteric disease incidence may improve our ability to predict how climate change affects these diseases.

Associations between monthly rainfall, mean monthly temperature, and enteric diseases (cryptosporidiosis, salmonellosis, campylobacteriosis, yersiniosis and VTEC) were investigated using data models available to the project team.

7.2.5 Campylobacteriosis

There is an observed association of campylobacteriosis cases with the mean monthly temperature max. This has not necessarily been a consistent finding across previous years, and appears more compelling in 2018 (Figure 66). Further work is required to ascertain whether this is statistically significant.

Figure 66: Campylobacteriosis, rainfall and temperature 2018

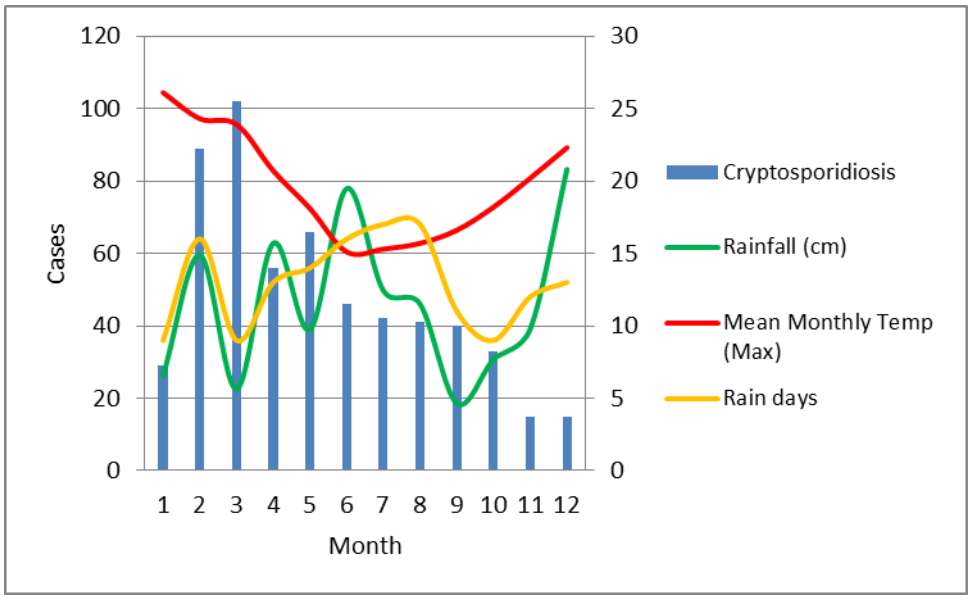


Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days are read of the Y2 axis

7.2.6 Cryptosporidiosis

No climatic factors were significantly associated with cryptosporidiosis (Figure 67).

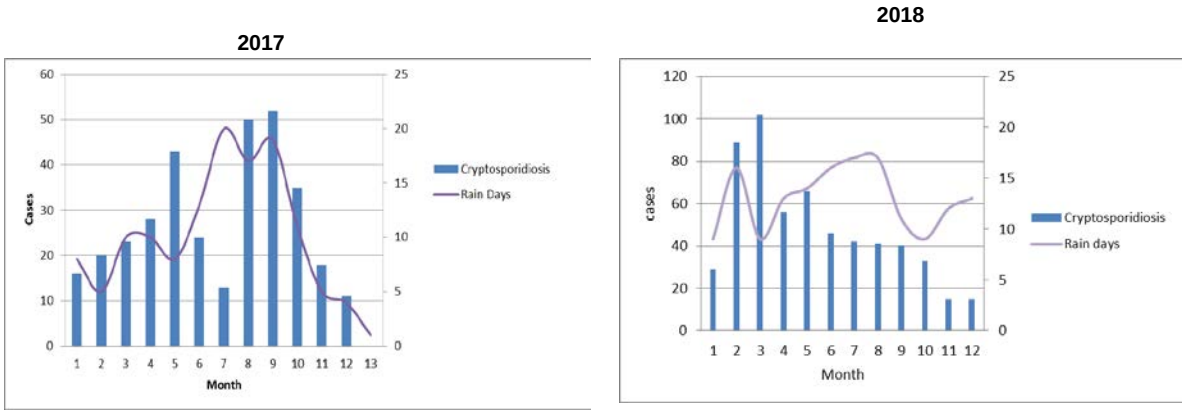
Figure 67: Cryptosporidiosis, rainfall and temperature 2018



Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days are read of the Y2 axis

There *may* be an increase associated with rainfall or rain days. During 2017, it appeared there was an association between rain days, but not rainfall, but this was not observed for 2018 (Figure 68).

Figure 68: Cryptosporidiosis and rain days 2017 & 2018

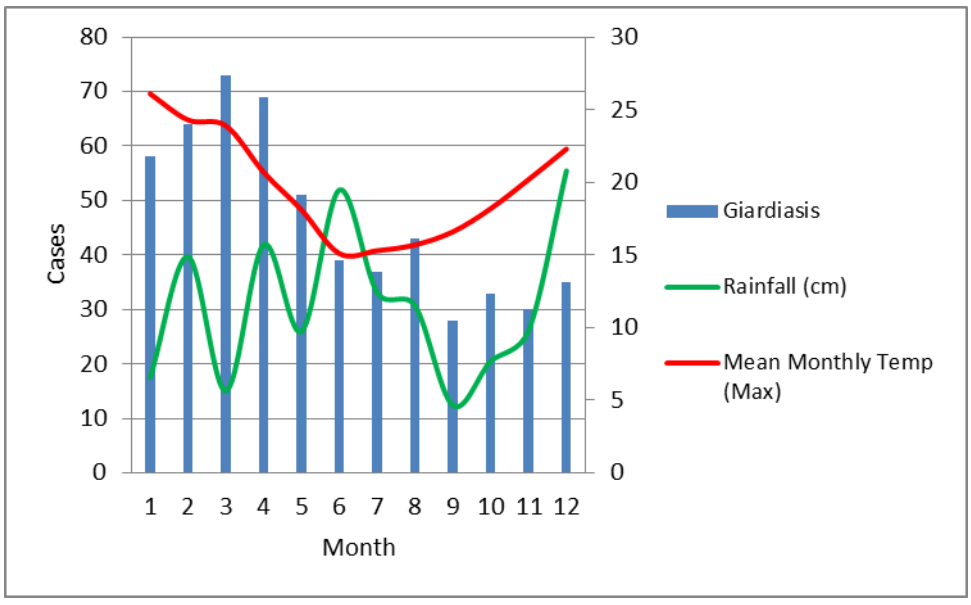


Note: Rainfall (mm), Rain days (No.) are read of the Y2 axis

7.2.7 Giardiasis

There was no consistent observed association between climatic factors and giardiasis. There does appear to be a rough association with rainfall, but in reality, giardiasis usually has stable levels following an increase in cases during January, February and March (Figure 69).

Figure 69: Giardiasis, rainfall and temperature 2018

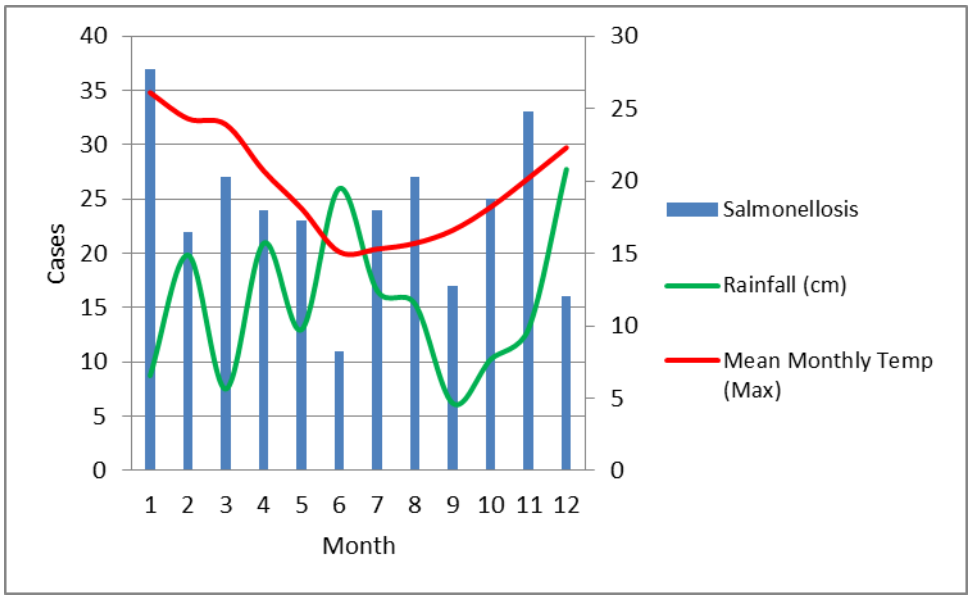


Note: Rainfall (mm), Mean Monthly Temp (Max ‘C) are read off the Y2 axis

7.2.8 Salmonellosis

Despite an observed relationship between Mean Monthly Temperature (Max) and salmonellosis notifications in 2015 and 2016, no climatic factors were significantly associated with salmonellosis in 2017. However, in 2018, the loose association returned. Auckland region notifications are probably impacted by animal health drivers during spring. If we remove the impact of lambing and calving in August, September and October it might well be that this association is more compelling (Figure 70).

Figure 70: Salmonellosis, rainfall and temperature 2018

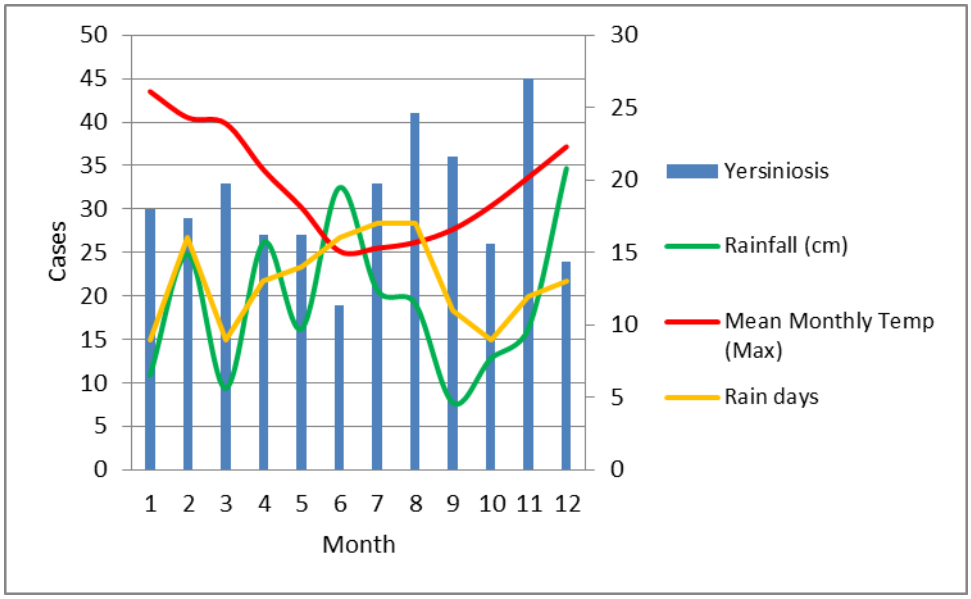


Note: Rainfall (mm), Mean Monthly Temp (Max 'C) are read off the Y2 axis

7.2.9 Yersiniosis

There was no clear association between climatic factors and yersiniosis in 2018. There may be a relationship with mean monthly temperature max. The spring increase in yersiniosis is complex, as there is an increase in rainfall and lambing/calving, but it is also the seasonal vegetable growing season after fields have been lying fallow for the winter (Figure 71).

Figure 71: Yersiniosis, rainfall and temperature in 2018

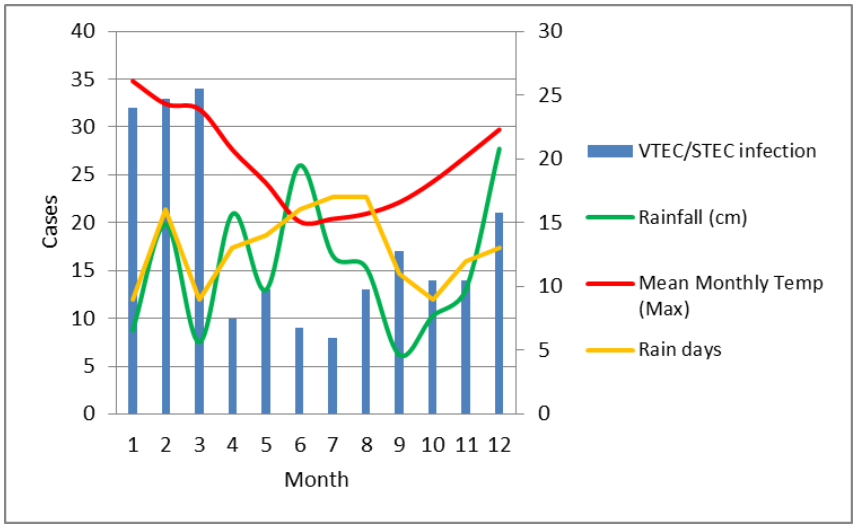


Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days (No.) are read off the Y2 axis.

7.2.10 VTEC

There was no clear association between climatic factors and VTEC. In previous years there has been a spike in VTEC cases after a dry spell, but this was not observed in 2018. There may be a relationship with mean monthly temperature max, but this will require further study (Figure 72).

Figure 72: VTEC, rainfall and temperature 2018

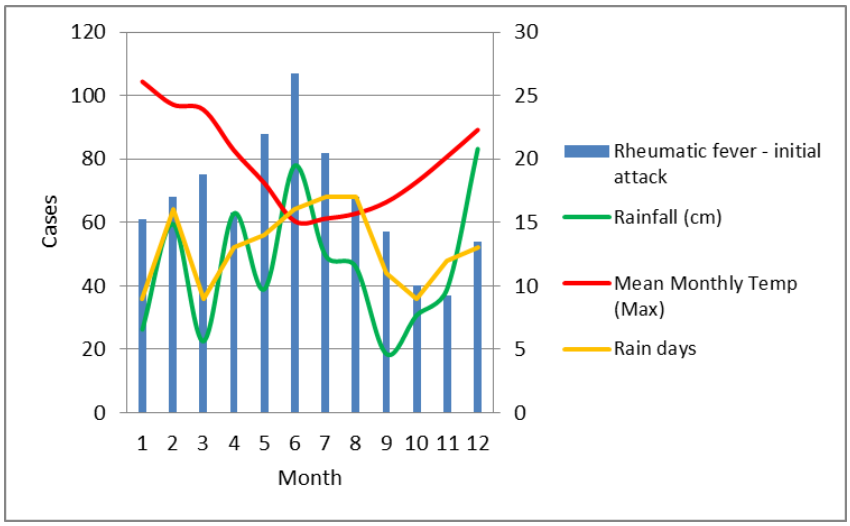


Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days (No.) are read off the Y2 axis.

7.2.11 Acute Rheumatic Fever

In 2018, acute rheumatic fever demonstrated a direct relationship between rainfall and rain days, and an inverse relationship with temperature, supporting hypotheses regarding "cold" and "damp" as risk factors for this illness[2] (J Oliver, N Pierce, N Stefanogiannis, C Jackson and M Baker, 2016) (Figure 73).

Figure 73: Acute rheumatic fever, rainfall and temperature 2018

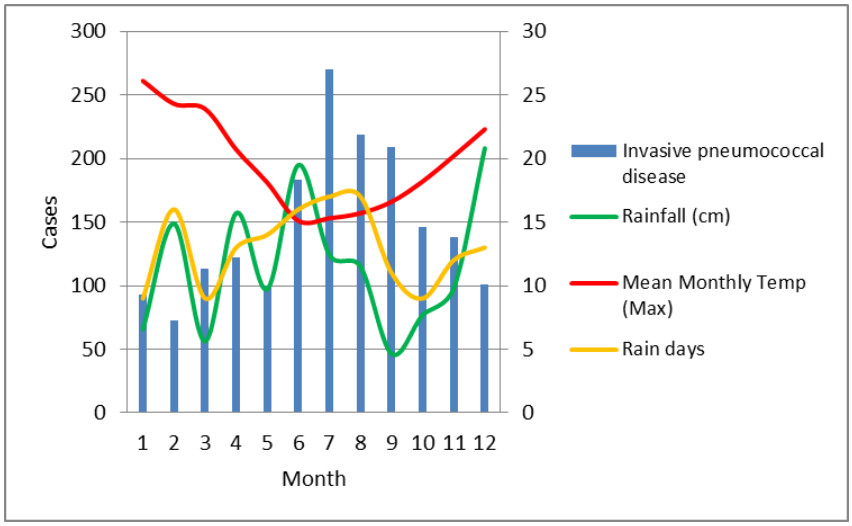


Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days (No.) are read off the Y2 axis.

7.2.12 Invasive pneumococcal disease

Invasive pneumococcal disease has a similar association with climatic factors as acute rheumatic fever. However, whereas the peak month for acute rheumatic fever is June, for pneumococcal disease it is July. The "cold" and "damp" association appears to fall down in November and December, apart from the inverse relationship with mean monthly temperature, which demonstrated as the temperature increases, the notifications of pneumococcal disease decrease (Figure 74).

Figure 74: Invasive pneumococcal disease, rainfall and temperature 2018

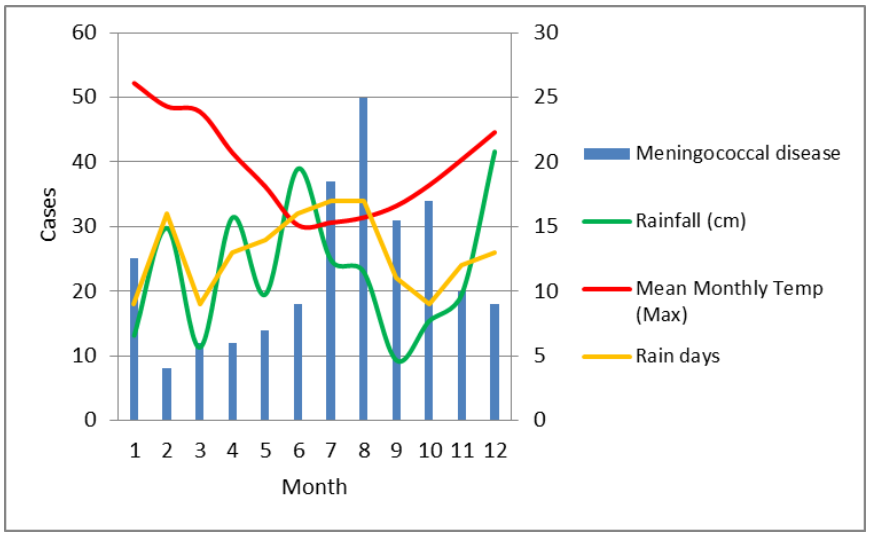


Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days (No.) are read off the Y2 axis.

7.2.13 Meningococcal disease

Meningococcal disease is the third airborne disease of poverty. In 2018 the pattern was similar to acute rheumatic fever and invasive pneumococcal disease, except that the peak month for meningococcal disease is later in August. This is one month prior to the peak of influenza in September (Figure 75).

Figure 75: Meningococcal disease, rainfall and temperature 2018

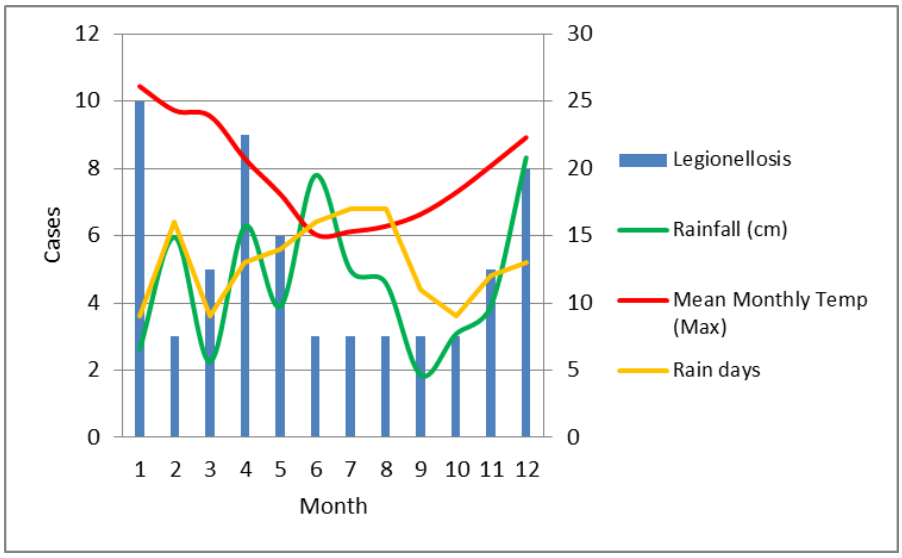


Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days (No.) are read off the Y2 axis.

7.2.14 Legionellosis

In 2018 legionellosis appeared to have an association with mean monthly temperature, with the peak number of notifications occurring in January. This association is not so clear cut when plotting *L. pneumophila* and *L. longbeachae* serotypes individually. It is generally accepted that legionellosis occurs predominantly during warmer months, and the acute occurrence of disease is best predicted by wet and humid weather[4]. (J Infect Dis. 2005 Dec 15;192(12):2066-73. Epub 2005 Nov 11). For 2018 this might hold for December, but it is not very convincing for other months.

Figure 76: Legionellosis, rainfall and temperature 2018



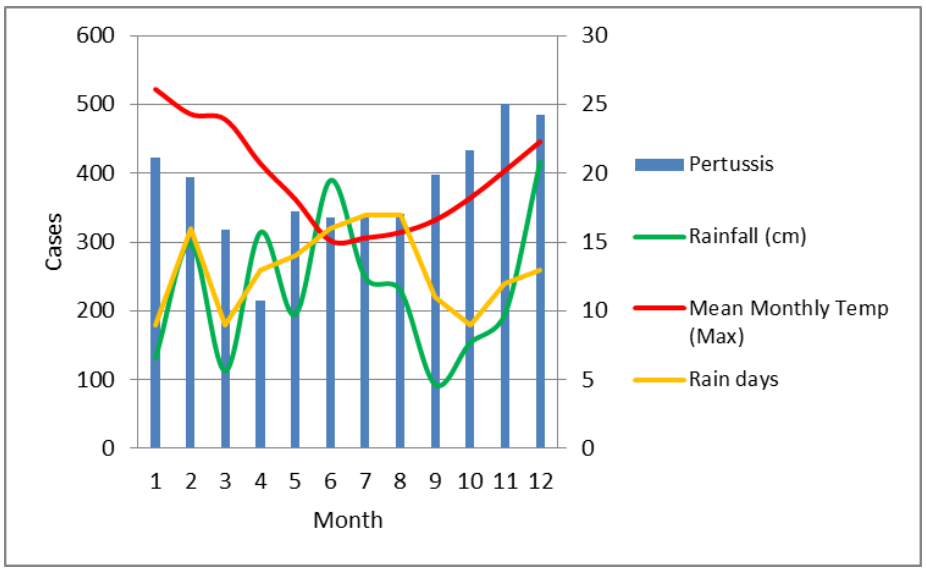
Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days (No.) are read off the Y2 axis.

[4] It's not the heat, it's the humidity: wet weather increases legionellosis risk in the greater Philadelphia metropolitan area.. Fisman DN1, Lim S, Wellenius GA, Johnson C, Britz P, Gaskins M, Maher J, Mittleman MA, Spain CV, Haas CN, Newbern C. (J Infect Dis. 2005 Dec 15;192(12):2066-73. Epub 2005 Nov 11)

7.2.15 Pertussis

A bimodal peak for pertussis is not uncommon. The Auckland region experienced a bimodal pertussis outbreak during late 2017 and throughout 2018, with a summer peak in 2017, a drop off over the 2018 winter months, followed by resurgence in spring 2018. It is thought climatic factors such as temperature and humidity may play an important role in transmission. Figure 77 would at least suggest a link with temperature.

Figure 77: Pertussis, rainfall and temperature 2018

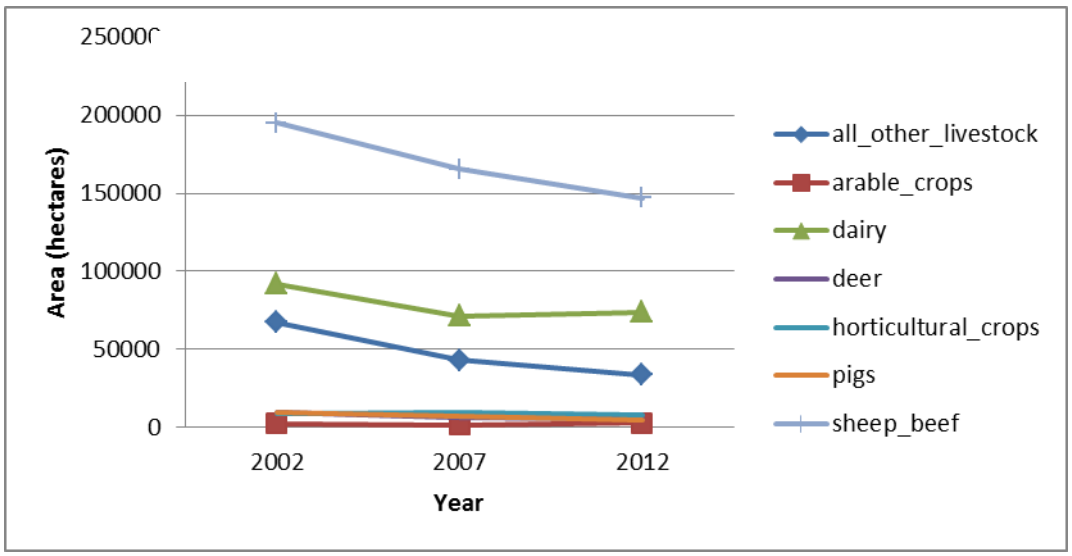


Note: Rainfall (mm), Mean Monthly Temp (Max 'C), Rain days (No.) are read off the Y2 axis.

7.2.16 Land use

Human-induced land use changes are thought to be a contributor to climate change with subsequent impact on human health. We would also surmise that a change in land use with altering animal types and numbers could have an impact on the incidence of zoonotic illnesses. Data used in this project were received from Statistics New Zealand, ESR, Agresearch, and Land Information New Zealand (Figure 78).

Figure 78: Land use by area 2002 - 2012



The decline in numbers of beef and sheep could have a positive effect on land compaction. However soils under dairy farming are affected by compaction, which reduces the productivity of land, although the increase in dairy cattle for the Auckland region between 2006 and 2016 does not look very convincing. An updated land usage survey is underway, but data from Statistics New Zealand would indicate that the number of dairy herds have increased sharply since 2012, while sheep numbers have continued to decline (Figure 79, Figure 80 and Figure 81). New data is expected during 2019

Figure 79: Changes in dairy cow numbers per hectare of farmland from 2006 - 2016

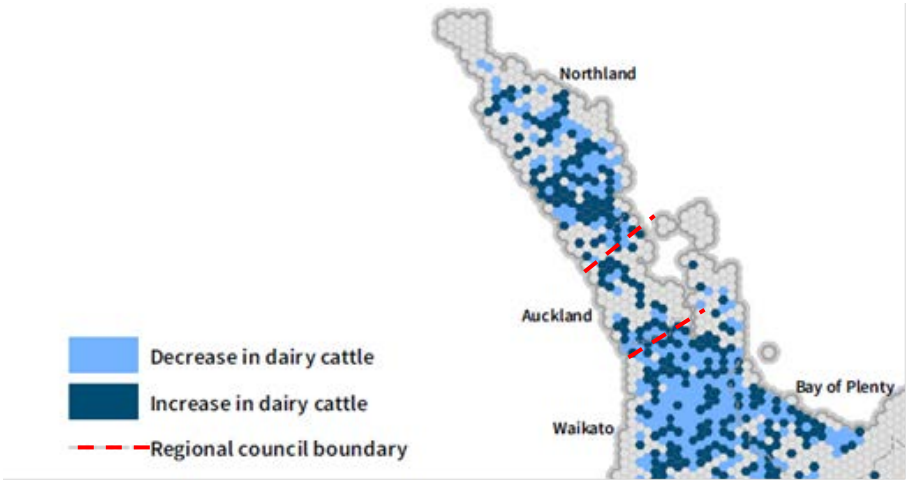
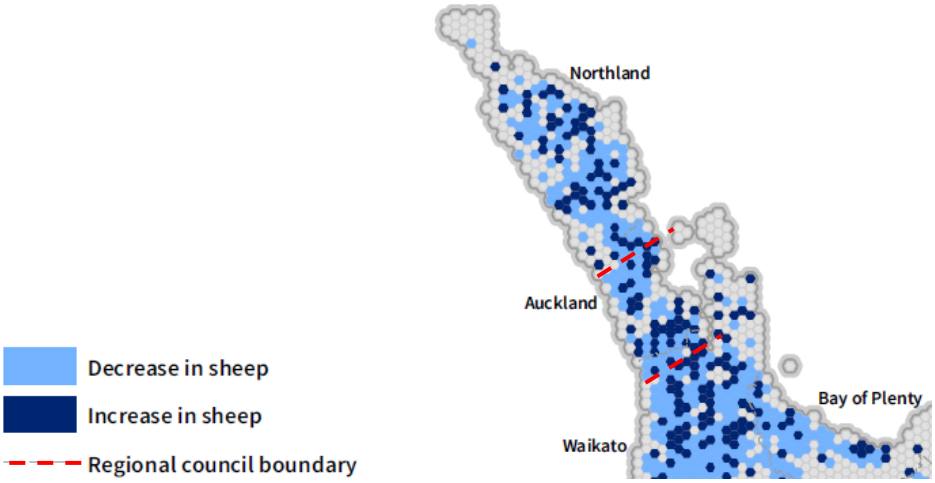
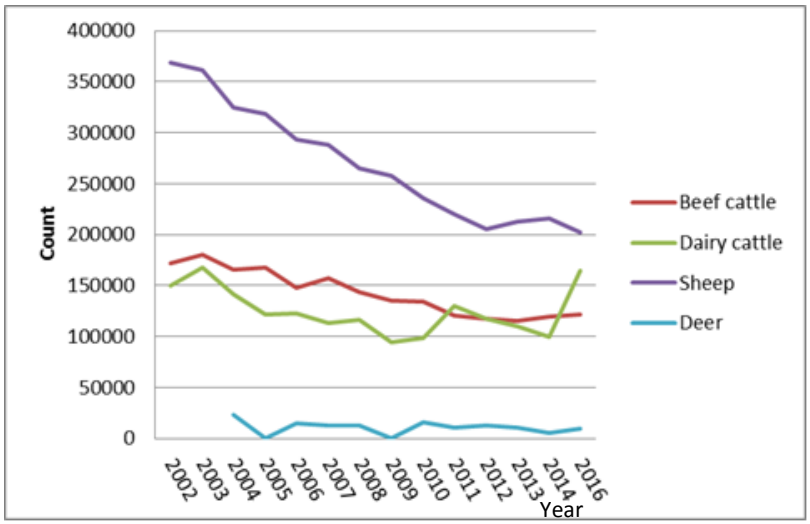


Figure 80: Changes in sheep numbers per hectare of farmland from 2006 - 2016



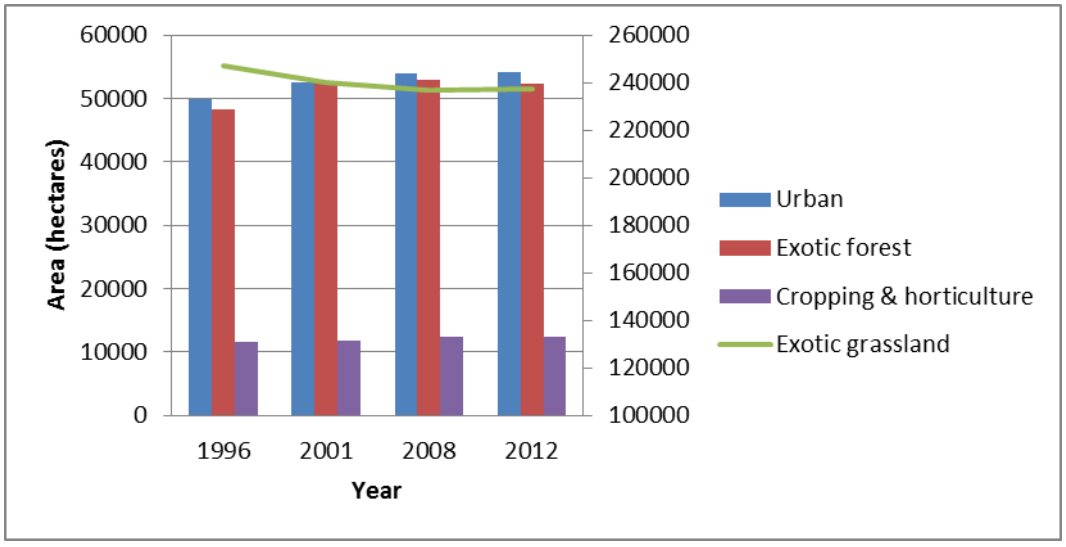
https://www.stats.govt.nz/information-releases/agricultural-production-statistics-june-2017-provisional

Figure 81: Livestock numbers in the Auckland region 2002 – 2016



The estimated area making up agricultural land has not changed substantially since 1996, but pressure on land for housing is likely to have resulted in the increase in urban land area (Figure 82).

Figure 82: Land use cover in the Auckland region 1996 – 2012



Source: https://data.mfe.govt.nz/table/52469-land-use-land-cover-classes-1996-2001-2008-and-2012/

7.2.17 Population growth

This indicator has been utilised by many international studies as an underlying driving force indicator for both positive and negative effects on human health. Population growth represents one of the major driving forces acting on environmental health. Rapid population growth may be seen as evidence of growing pressures on the environment and health-related services, and potential increased risks to health. ARPHS plans to integrate data in relation to population growth and health effects to assist in future planning and decision making (Figures 83, 84, 85).

Figure 83: Population of the Auckland region projected to 2026

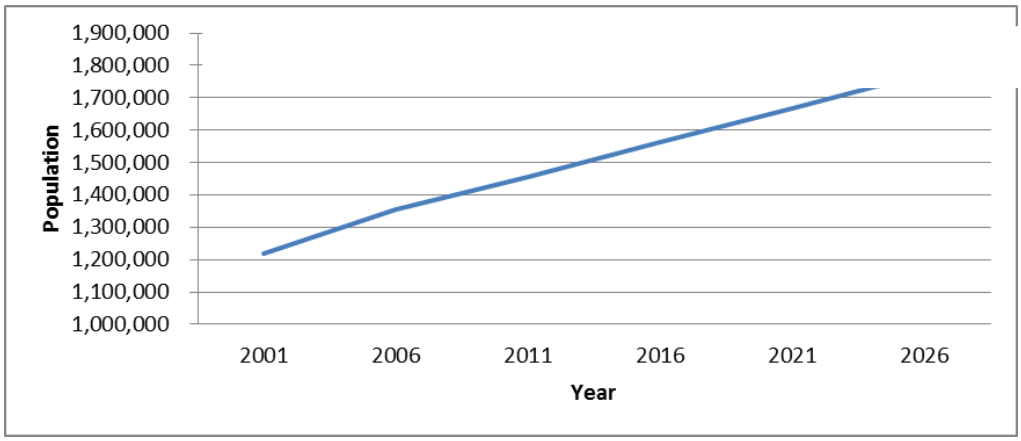


Figure 84: Population of the Auckland region projected to 2026 by age group

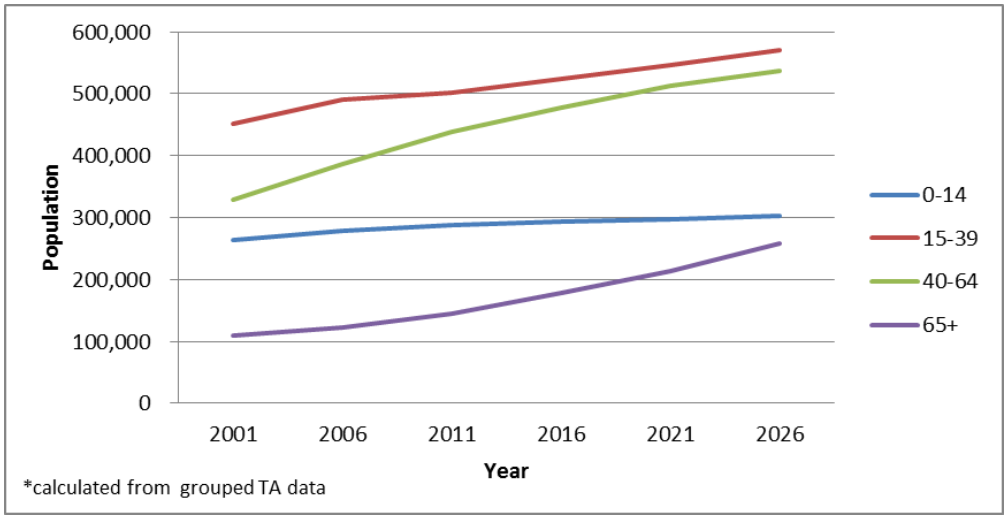
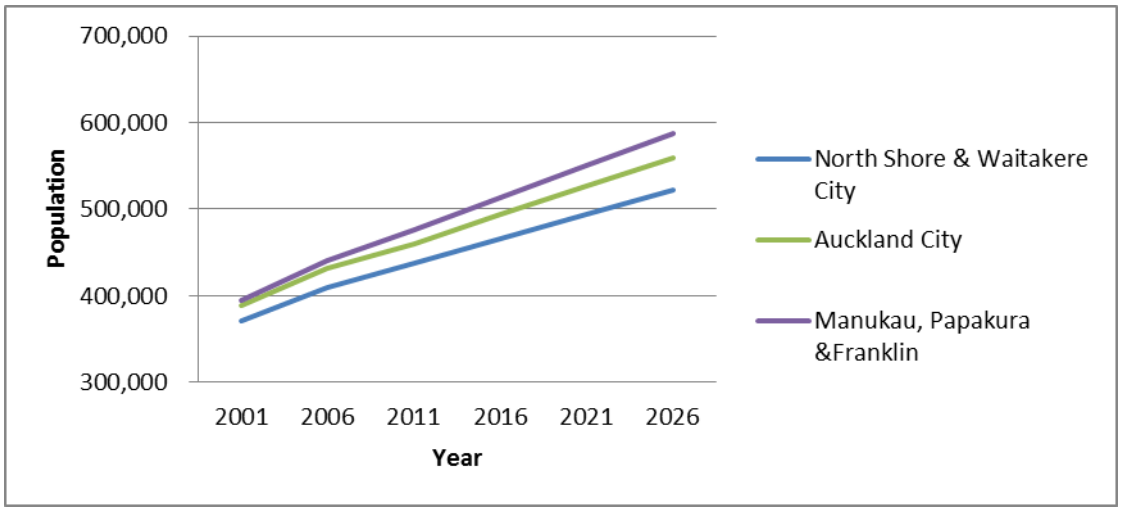


Figure 85: Population of the Auckland region projected to 2026 by territorial authority groups



This information provides an early warning of developing pressures on the environment or service facilities, and can identify areas of high population growth as a basis for informing resource allocations.

7.2.18 Air quality (PM2.5 and PM10)

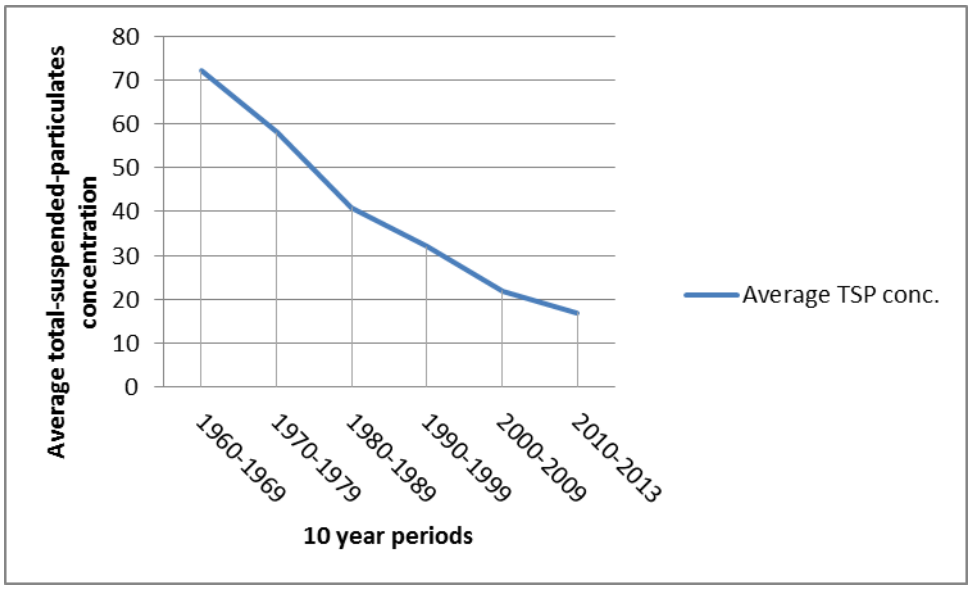
The air pollutant of most concern from a health perspective is particulate matter – the tiny airborne particles that affect respiratory and cardiovascular health. Damage to respiratory and cardiovascular systems can lead to hospital admissions, days of work lost, and shorter lives for some New Zealanders.

In Auckland, PM10 and PM2.5 concentrations sometimes exceed air quality thresholds. Over the years, the average concentrations of PM10 have decreased, but PM2.5 concentrations have remained relatively stable. This reduction is the result of advances in industrial and vehicle technology, and better fuel standards (Figure 86).

Air quality data collection is carried out by Auckland Council. ARPHS is looking into ways to work with Auckland Council to continue work from this project by collecting data and reporting on climate sensitive EHIs.

Frequency of outputs for on-going monitoring and automated reporting would be the next stage to follow on from this surveillance.

Figure 86: Average Total Suspended Particles, Queen Street monitoring site 1965 – 2013

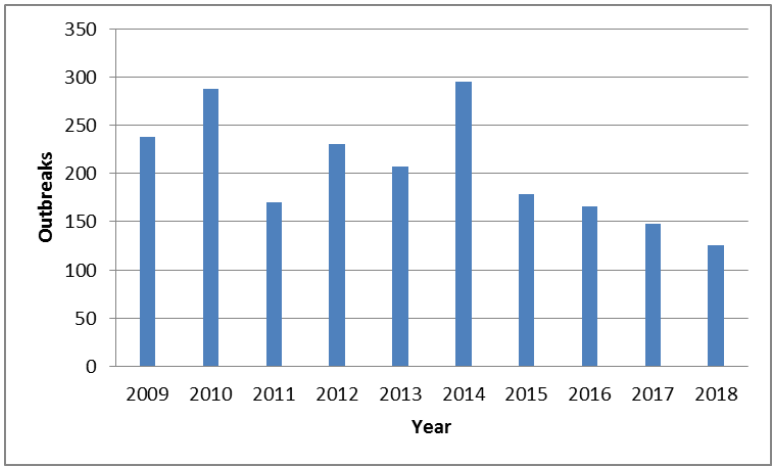


Source: https://data.mfe.govt.nz/document/11124-air-domain-report-2014-about-the-indicators/

Section 8: Outbreaks

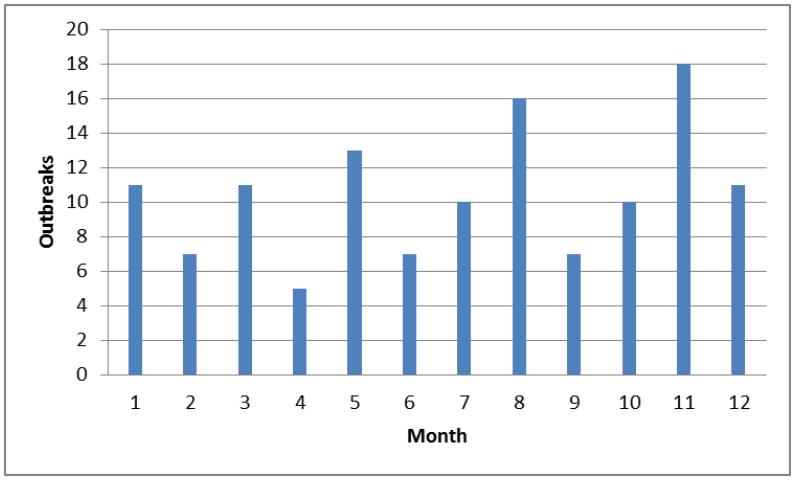
ARPHS identified or received notifications of 126 outbreaks in 2018, down from 146 in 2017 and 166 in 2016 (Figure 87). In addition the 2017 pertussis outbreak required on-going management throughout 2018. It's important to note that these are reported outbreaks and there will have been outbreaks that ARPHS does not hear about

Figure 87: Outbreaks by year in the Auckland region 2009 - 2018



In previous years there were more outbreaks reported in summer and early spring. However in 2018, outbreaks were reported throughout the year (Figure 88).

Figure 88: Outbreaks identified by ARPHS in the Auckland region 2018



Major outbreaks included the on-going pertussis outbreak and two separate large norovirus outbreaks, a school norovirus outbreak of 198 cases, and a retirement village norovirus outbreak of 97 cases. There was an observed decrease in the number of cryptosporidiosis and giardiasis outbreaks (Table 83).

Table 83: Number of outbreaks identified or reported to ARPHS in 2015 - 2018

Pathogen	2015	2016	2017	2018
Adenovirus	-	-	1	-
Astrovirus	1	-	-	-
Bacillus	-	-	-	1
Campylobacter	1	-	1	1
Ciguatera fish poisoning	-	-	1	-
Clostridium	3	-	-	1
Cryptosporidium	12	19	17	1*
Diphtheria	1	-	-	-
Giardia	27	18	11	2
Hepatitis B	-	-	-	-
Hepatitis A	1	-	3	1
Hazardous Substances	-	-	-	1
Histamine (scombroid) fish poisoning	-	1	1	-
Lead poisoning	2	4	2	1
Legionella	2	-	-	
Measles virus	-	1	1	1
Mumps virus	-	1	1	-
Mycobacterium tuberculosis	2	2	1	-
Neisseria meningitidis	-	1	-	-
Norovirus	50	35	49	51
Pertussis	-	-	1	1
Rotavirus				1
Rheumatic fever	-	-	-	1
Salmonella	16	12	8	9*
Sapovirus	1	7	-	-
Shigella	7	1	6	6
Staphylococcus	1	-	-	-
Typhoid	-	-	1	2
VTEC/EHEC	11	9	7	12
Yersinia	-	1	-	-
Unknown	40	54	36	34
Total	179	166	146	126 + (1)

Of these 126 outbreaks, 122 were foodborne outbreaks - for which a cause was found in 88 (72%), compared with 74% for 2017. The remaining four outbreaks were non-foodborne. In addition there was a continuation of the pertussis outbreak from 2017 which increased the total number of outbreaks managed in 2018 to 127. The number of cases for each outbreak is shown in Table 84.

Table 84: Number of cases in non-foodborne outbreaks in the Auckland region 2018

Pathogen	Cases
Hazardous Substances	19
Pertussis	707
Lead absorption	64
Measles	2
Rheumatic Fever	2
Total	794

8.1 Non foodborne outbreaks

8.1.1 Hazardous substances

The hazardous substances injury was an exposure of 19 people to unknown gas/fumes at a house in central Auckland. Symptoms were predominantly upper respiratory, and all made a full recovery without any long term sequelae.

8.1.2 Pertussis

Please see Chapter 3 for a summary of the pertussis outbreak (707 cases for 2018).

8.1.3 Lead absorption

The 64 cases of lead absorption were designated an outbreak. They are part of a national study which includes foundry workers. Many of the cases were previously known to ARPHS and have been working with Worksafe and third parties to reduce exposure risk.

8.1.4 Measles

The measles outbreak was a two-person outbreak, the index case had that had recently returned from India), followed by a secondary case in a quarantined exposed international flight contact. There were no further cases.

8.1.5 Rheumatic fever

This household outbreak affected siblings from the same household. The onset dates were only a week apart with the second case becoming unwell a week later while contact tracing and management was underway.

8.2 Foodborne outbreaks

Norovirus, salmonellosis and VTEC were responsible for the greatest number of outbreaks in 2018, compared to giardia, cryptosporidium and norovirus in 2017 (Table 83). In 2018 there were 34 outbreaks of gastroenteritis in which a cause could not be found. We would expect the majority of these unknown cause outbreaks to also be norovirus outbreaks. Potential reasons for this 'unknown' status include negative testing, or single household food complainants choosing not to follow up with the requested stool sample.

Four small outbreaks had an overseas origin. These were VTEC (2 cases) from a cruise ship, VTEC (3 cases) from the Pacific, typhoid (2 cases) from Middle East , and *Shigella flexneri* Y variant (3 cases) in a group of 18 who had travelled to the Pacific

All foodborne outbreaks by size of outbreak, disease, and the total number of cases associated are shown in Tables 85 and 86.

Table 85: Foodborne outbreaks in the Auckland region by size and number of cases 2018

Pathogen	Size of Outbreak												Grand Total
	2	3	4	5	6	7	8	9	10-19	20-49	50-100	>100	
Campylobacter	1												1
Cryptosporidiosis		1											1
Cryptosporidium/Salmonella					1								1
Enterotoxin										1			1
Gastroenteritis - unknown cause	10	2	3	3	2	1	1	2	7	3			34
Giardia	1		1										2
Hepatitis A			1										1
Norovirus	2	2	2	1	2	1		1	19	14	6	1	51
Norovirus/enterotoxin									1				1
Rotavirus										1			1
Salmonella	4	1	1	1			1		1				9
Shigella	2	3	1										6
Typhoid	2												2
VTEC/STEC infection	6	2	1						2				11
Grand Total	**28**	**11**	**10**	**5**	**5**	**2**	**2**	**3**	**30**	**19**	**6**	**1**	**122**

There were 34 outbreaks where no pathogen could be found for the gastroenteritis, compared to 31 in 2017.

STEC/VTEC bacteria were found to be the source for 54 outbreak associated cases and salmonella for 44 cases. Enterotoxin food contaminations resulted in 35 outbreak associated cases (Table 86).

Table 86: Foodborne outbreaks in the Auckland region by pathogen and number of cases 2018

Pathogen	Total
Campylobacter	2
Cryptosporidiosis	3
Cryptosporidium/Salmonella	6
Enterotoxin	35
Gastroenteritis - unknown cause	257
Giardia	6
Hepatitis A	4
Norovirus	1339
Norovirus/enterotoxin	15
Rotavirus	22
Salmonella	44
Shigella	17
Typhoid	4
VTEC/STEC infection	54
Total	1808

Norovirus outbreaks caused illness in 1,339 cases, up from 912 cases in 2017 and 792 in 2016 and very close to the 1,328 cases in 2015. Norovirus was responsible for the majority of outbreak-associated illness, and probably a good number of the gastroenteritis where the cause was not identified.

Long-term care facilities had the greatest number of outbreaks (34) and cases (635). Outbreaks in the home (28) were numerous, but involved a smaller number of cases (73). Childcare centres had 25 outbreaks, involving 389 children, compared with schools, where there were nine larger outbreaks involving 519 children and staff (Table 87 and Table 88).

Table 87: Foodborne outbreaks in the Auckland region by setting and number of cases 2018

Setting	Total
Camp/ School camp	28
Catered function	15
Childcare centre	389
Cruise ship, airline, tour bus, train	2
Distributed food source	8
Farm	16
Home	73
Hospital (acute care)	42
Long term care facility	635
Other institution	31
Overseas	6
Restaurant/cafe/bakery	34
School	519
Swimming Pool	3
Takeaway/Fast food	7
Total	1808

There were 25 outbreaks involving only two persons in either a household and/or food premise setting, and six outbreaks in the same settings where three persons were affected.

Table 88: No of foodborne outbreaks by settings in the Auckland region 2018

	Size of Outbreak												Grand
Setting	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10-19**	**20-49**	**50-100**	**>100**	**Total**
Camp/ School camp						1				1			2
Catered function									1				1
Childcare centre			2		2	1		2	12	5	1		25
Cruise ship, airline, tour bus, train	1												1
Distributed food source							1						1
Farm									1				1
Home	18	4	5	1									28
Hospital (acute care)								1	1	1			3
Long term care facility	2	2	1	4	2		1		13	7	2		34
Other institution			1		1				2				4
Overseas		2											2
Restaurant/cafe/bakery	5	1								1			7
School			1							4	3	1	9
Swimming Pool		1											1
Takeaway/Fast food	2	1											3
Grand Total	**28**	**11**	**10**	**5**	**5**	**2**	**2**	**3**	**30**	**19**	**6**	**1**	**122**

In the household setting, the largest outbreak involved five cases. In the restaurant setting, the largest outbreak affected 21 people. In Auckland hospitals there were four outbreaks involving nine to 20 cases.

There were six outbreaks involving 50 or more cases, and these were seen in the following settings:

- one large outbreak in a childcare centre (56 cases)
- two outbreaks in long term care facilities, involving 82 cases and 97 cases
- three outbreaks in schools, with 52, 58 and 76 cases.

Table 89 shows the spectrum of pathogens in various settings, with the widest spectrum in the home, childcare, and food outlet settings. A pathogen was able to be determined in 72% of outbreaks.

Table 89: Exposure setting by identified foodborne pathogen in the Auckland region 2018

Setting	Campylobacter	Cryptosporidiosis	Cryptosporidium Salmonella	Enterotoxin	Gastroenteritis - unknown cause	Giardia	Hepatitis A	Norovirus	Norovirus/enterotoxin	Rotavirus	Salmonella	Shigella	Typhoid	VTEC/STEC infection	Grand Total
Camp/ School camp					2										2
Catered function									1						1
Childcare centre			1		8			13		1	1			1	25
Cruise ship, airline, tour bus, train														1	1
Distributed food source											1				1
Farm														1	1
Home					4	2	1	2			6	4	2	7	28
Hospital (acute care)								3							3
Long term care facility	1				12			21							34
Other institution					1			3							4
Overseas												1		1	2
Restaurant/cafe/bakery					5			1			1				7
School				1				7				1			9
Swimming Pool		1													1
Takeaway/Fast food					2			1							3
Grand Total	1	1	1	1	34	2	1	51	1	1	9	6	2	11	122

Section 9: Determinants and drivers of infectious diseases threat events

Around the globe infectious disease threat events (IDTEs) are increasing in frequency. In 2016 the European Centre of Disease Prevention and Control (ECDC) undertook a study[5] of "Determinants and Drivers of Infectious Disease Threat Events in Europe" for the period 2008 to 2013. That study is reproduced here with minor modifications for 95 IDTEs detected in the Auckland region during 2016 and 2017.

Our objective was to identify the determinants and drivers for IDTEs in the Auckland region for purposes of identifying which drivers which would need to be modified to achieve better public health outcomes. The ECDC study[i] identified 17 IDTE drivers, which were categorised into three groups (Table 90).

Table 90: Grouping of identified IDTE drivers

Driver Group	Drivers
Globalisation and environment	Climate, Natural environment, Human-made environment, Travel and tourism, Migration, Global trade
Sociodemographic	Demographic, Social inequality, Vulnerable groups, Prevention, Lifestyle, Occupational, Terrorism
Public health systems.	Healthcare system, Animal health, Food and water quality, Surveillance and reporting failure

For the purposes of this exercise, ARPHS defined Auckland region IDTEs as exceeding the epidemic surveillance triggers for a specific notifiable disease in a given week. This trigger is defined as the three year mean plus two standard deviations. For each observed IDTE a single assessor selected one or more of the 17 drivers as defined by the ECDC study Semenza et al (2016) by analysing the risk factor data collected in ARPHS' Notifiable Disease and Case Management System (NDCMS). This was undertaken retrospectively over a two year period from 1 January 2016 to 31 December 2017.

The IDTEs were then sorted into five threat event categories (Table 91) and plotted into network charts where the middle axis black dots are individual IDTEs, which are connected to as many drivers as deemed relevant to the event [A,B,C,D] (Figure 89).

The ECDC study included five other threat event categories not included here; institutional outbreaks, other zoonoses, injection drug use associated diseases, sexually transmitted diseases, and influenza. These could be included in the future. For ARPHS purposes we introduced a new category, environmental IDTEs, which better captures certain important diseases that are more prevalent in the Auckland region.

[5] Semenza JC, Lindgren E, Balkanyi L, Espinosa L, Almqvist MS, Penttinen P, Rocklöv J. (2016). *Determinants and Drivers of Infectious Disease Threat Events in Europe*, Emerg Infect Dis. 22 (4): 581-9. doi: 10.3201/eid2204.

Table 91: Threat event categories of IDTEs detected in the Auckland region 2016 – 17

Threat event category	Definition and examples*
Foodborne and waterborne	All notifiable diseases caused by the transmission of organisms through food or water i.e. (drinking water, recreational water) campylobacteriosis, cryptosporidiosis, giardiasis, hepatitis A, listeriosis, salmonellosis ,shigellosis, yersiniosis, typhoid, VTEC
Vectorborne and rodentborne	All vector-borne and rodent-borne diseases . Chikungunya, dengue, leptospirosis, zika, murine typhus, rickettsial disease
Vaccine preventable	Main vaccine preventable diseases that are normally part of the health systems vaccination programme; hepatitis B, invasive pneumococcal disease, measles, mumps, pertussis
Airborne	Respiratory disease acquired through transmission of pathogens through air (e.g. particles, droplets) Includes respiratory infections transmitted through aerosols, fomites or direct contact . e g TB
Environmental	Diseases associated through community carriage of organisms or through amplification or exposure to environmental factors e. g. acute rheumatic fever, meningococcal disease, legionellosis, lead absorption

- Examples are not all inclusive

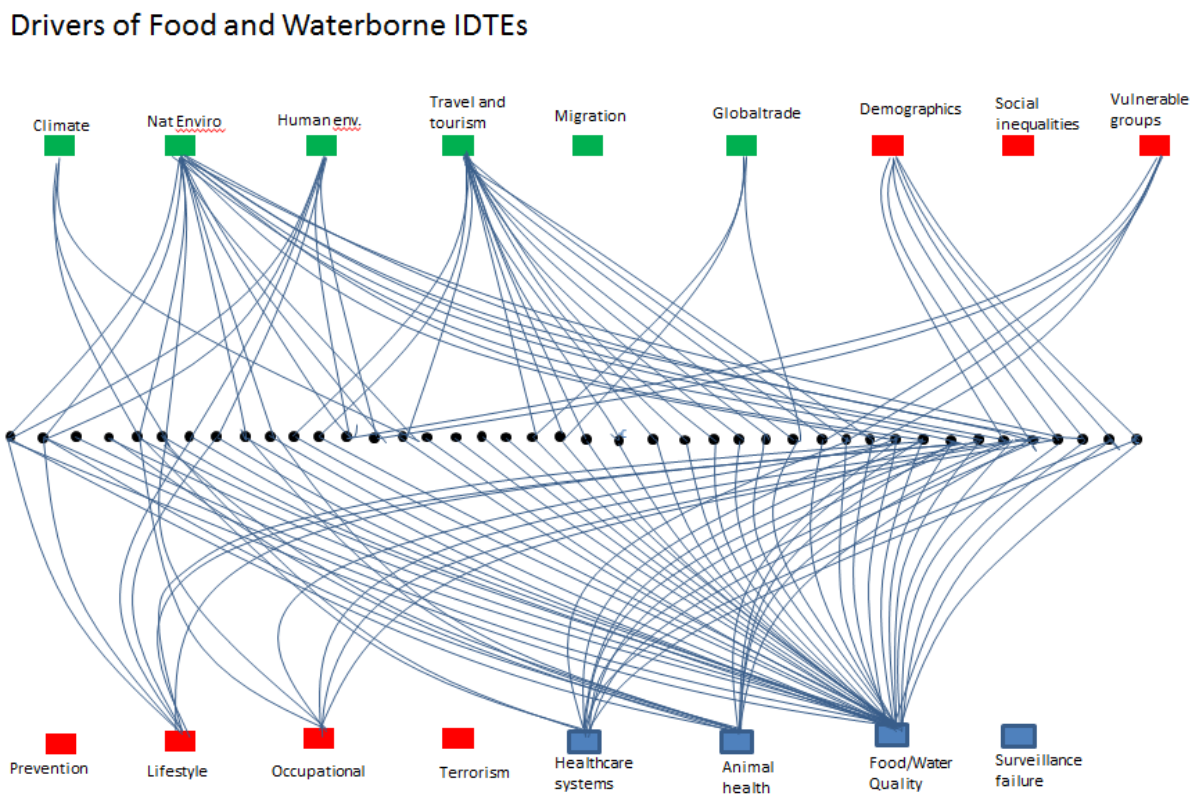
There were 96IDTE events identified during the study period for which there were 276 drivers attributed. Food borne and waterborne IDTEs were the most frequent occurring events (n=42) followed by environmental (n=20), vaccine preventable (n=16), airborne (n=11), and vectorborne and rodentborne (n=7).

The driver group that was most frequently involved in IDTEs was sociodemographic at 37%, globalisation and environment at 35%, followed by public health systems failures at 28%.

The individual driver travel and tourism was linked to three of the five types of threat event categories (food and waterborne, vaccine preventable, and vectorborne and rodentborne diseases), while migration was also linked to vaccine preventable diseases and the other two threat event categories i.e. airborne and environmental. The individual drivers' vulnerable groups and demographics were linked to four IDTE threat event categories, while the occupational driver was linked to three of the five threat event categories.

The most frequent notifiable foodborne disease IDTE was shigellosis with nine events, followed by yersiniosis with six, salmonellosis with five, and campylobacteriosis, cryptosporidiosis, typhoid and VTEC with four each. The strongest driver in this group was food and water quality (implicating the food and water treatment infrastructure) often in combination with the travel and tourism, natural environment, animal health and lifestyle drivers. The healthcare systems driver should be temporary as our triggers adjust to the increased detection resulting from the change in laboratory testing methodology.

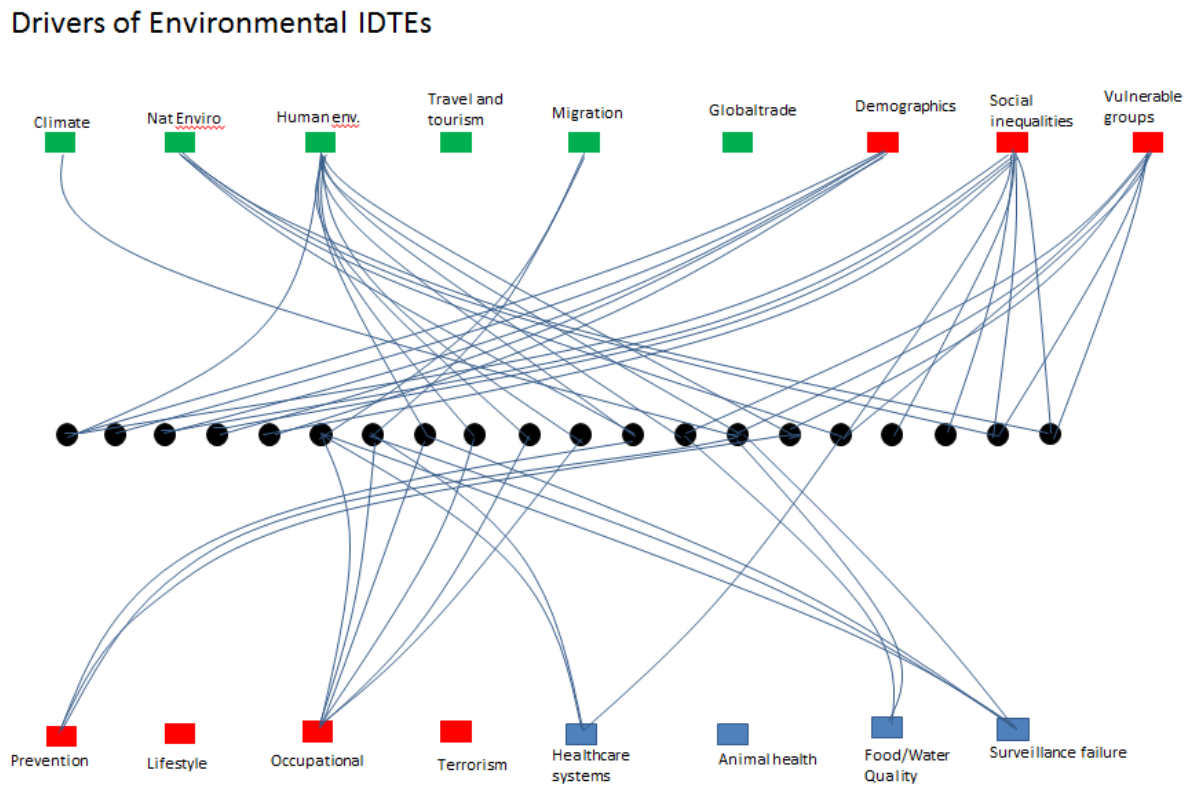
Figure 89: Food and waterborne IDTEs by contributing drivers observed in the Auckland region 2016 - 2017



Source: NDCMS Surveillance data

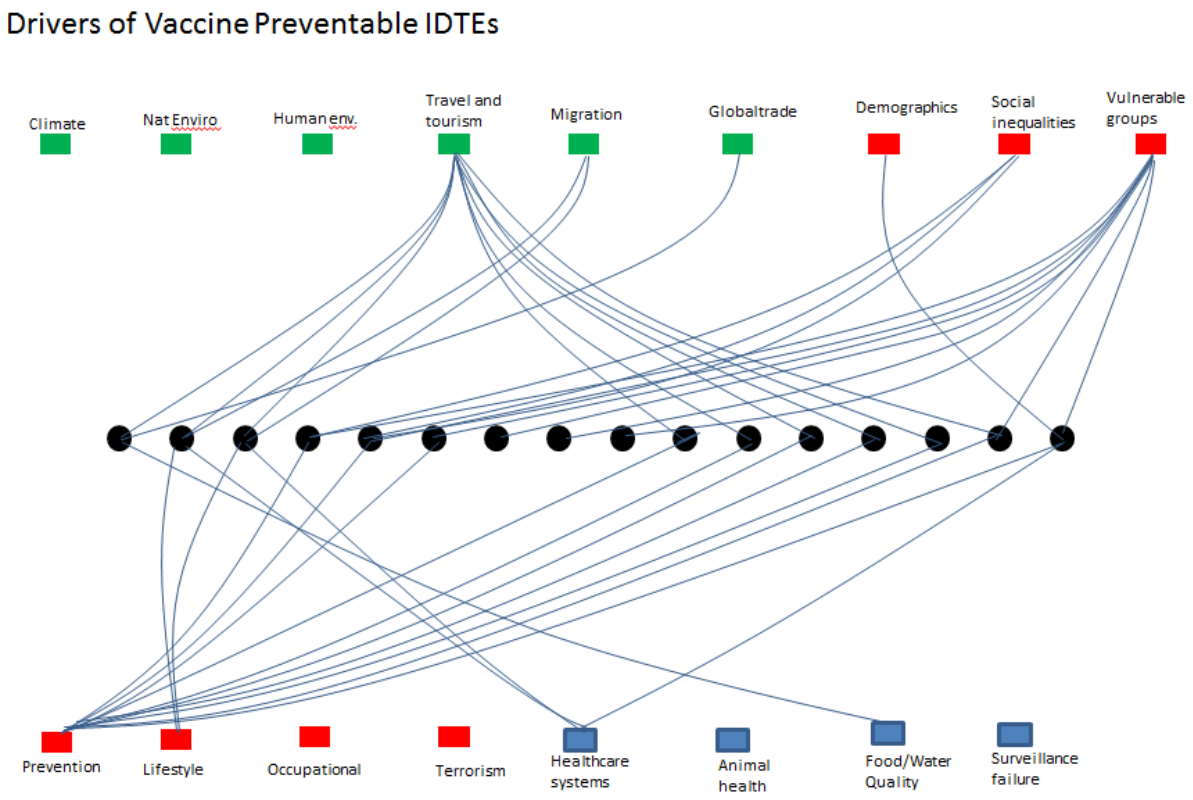
Environmental disease IDTEs over 2016 - 2017 included acute rheumatic fever (ARF), lead absorption, legionellosis and meningococcal disease. ARF and meningococcal disease are diseases of poverty and there is a clear demographic driver associated with these two diseases. There is an observed vulnerable grouping amongst ARF, meningococcal disease, and the vaccine preventable invasive pneumococcal disease. It is postulated that their living conditions and human-made environments are contributory drivers. Climate drivers may play a part in these three IDTE events but this is more marked with IPD than for ARF and meningococcal disease.

Figure 90: Environmental IDTEs by contributing drivers observed in the Auckland region 2016-2017



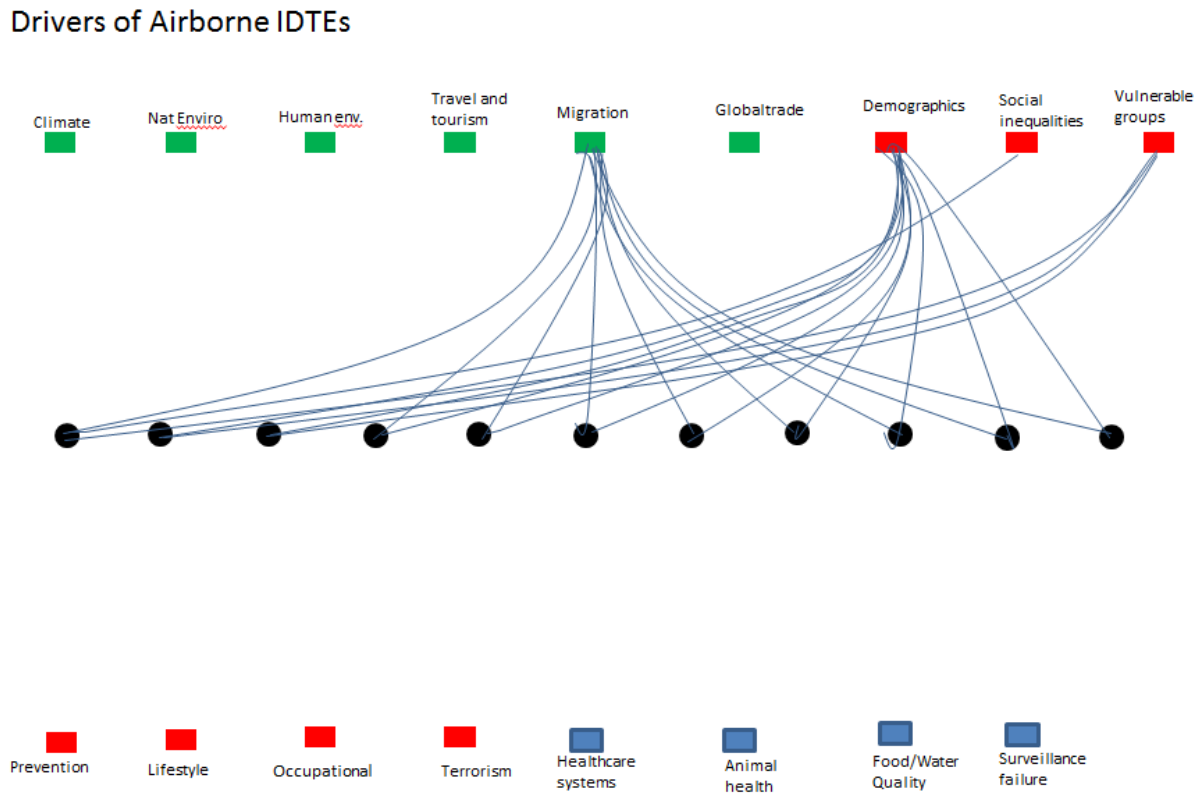
Sixteen IDTEs including measles, mumps, pertussis and hepatitis B were reported for the vaccine preventable threat event category. The drivers responsible for this category were a combination of prevention, vulnerable groups and social inequities. Travel and tourism are important drivers for these outbreaks as many were directly related to importation from overseas affected countries. The pertussis outbreak starting in week 38 of 2017 has progressed into the first half of 2018. Specific vaccination strategies for pregnant women have had relatively poor uptake, while waning immunity from the acellular pertussis vaccine has facilitated the spread of pertussis through schools.

Figure 91: Vaccine preventable IDTEs by contributing drivers observed in the Auckland region 2016 – 2017



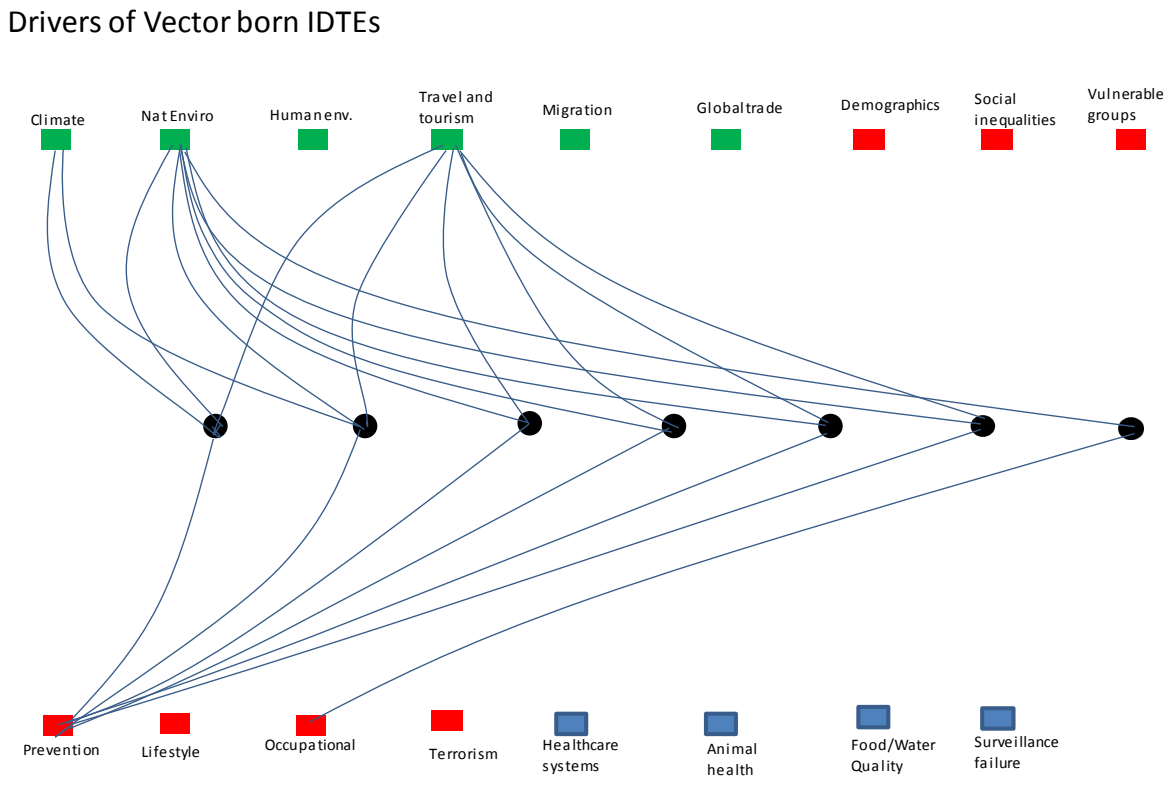
The 11 airborne disease IDTEs recorded here are all TB related diseases driven by migration, demographics and vulnerable groups who develop TB disease sometimes long after migrating to New Zealand from affected areas in the Asia-Pacific region.

Figure 92: Airborne IDTEs by contributing drivers observed in the Auckland region 2016-2017



There were only seven vector borne and rodent borne IDTEs during 2016-2017. Two IDTEs were for chikungunya, three were for dengue, and one each for Zika and leptospirosis. These related to travel and tourism to the Pacific Islands, the lack of personal mosquito prevention, and under-resourced mosquito control activities to eradicate breeding sites in the natural and human-made environment.

Figure 93: Vectorborne and rodentborne IDTEs by contributing drivers observed in the Auckland region, 2016-2017



Monitoring IDTEs can help anticipate future IDTEs and identify the prevention and control measures that require strengthening. Sociodemographic and public health system drivers make up 65% of drivers in this analysis, and these may be more directly responsive to interventions to reduce the impact of these drivers and improve public health outcomes. Some interventions are likely to be more cost-effective than others, and it would be useful to identify which of these is most likely to help us anticipate, respond and recover from future events.

Section 10: Immunisation Programme 2018

The childhood immunisation programme (Table 92) in New Zealand offers vaccination against tuberculosis (for high risk groups when vaccine is available), rotavirus, hepatitis B, diphtheria, pertussis, tetanus, poliomyelitis, haemophilus influenzae B, measles, mumps, rubella, varicella, pneumococcal disease, human papillomavirus, influenza (high risk groups) and zoster for the over 65 age group.

Parents have the right to opt-off the National Immunisation Register (NIR). This means that any future immunisations their child receives will not be recorded on the NIR, although their child is still included in the number eligible for immunisation. Parents are also able to decline immunisation, and this is recorded on the child's individual record on the register. Again, the child is still included in the number eligible for immunisation. In 2018, the national opt-off percentage remains low at 0.6% by two years of age. In 2018, the decline rate ranged from 4.5% to 5.3%, and was lowest at age 12 months at 4.5%, increasing to 5.3% by 18 months, and 5.0% by five years of age. The decline rate is up slightly on the previous 2017 data. High immunisation coverage of 95% or higher is required for control of most vaccine preventable diseases; national targets are set at this level.

The data utilised in this chapter was provided by Ministry of Health immunisation data.

Table 92: New Zealand Immunisation Schedule from July 2017

Age	Diseases covered and vaccines
Pregnancy	Tetanus/Diphtheria/Pertussis (BOOSTRIX™)
	Influenza - 1 Injection
6 weeks	Rotavirus oral (Rotarix®)
	Diphtheria/Tetanus/Pertussis/Polio/Hepatitis B/Haemophilus influenzae type b (INFANRIX® -hexa)
	Pneumococcal PCV10 (SYNFLORIX ®)
3 months	Rotavirus oral (Rotarix®)
	Diphtheria/Tetanus/Pertussis/Polio/Hepatitis B/Haemophilus influenzae type b (INFANRIX® -hexa)
	Pneumococcal PCV10 (SYNFLORIX ®)
5 months	Diphtheria/Tetanus/Pertussis/Polio/Hepatitis B/Haemophilus influenzae type b (INFANRIX® -hexa)
	Pneumococcal PCV10 (SYNFLORIX ®)
15 months	Haemophilus influenza type b (HIBERIX ®)
	Measles/Mumps/Rubella (M-M-R PRIORIX ®)
	Varicella (Varilrix ®)
	Pneumococcal PCV10 (SYNFLORIX ®)
4 years	Diphtheria/Tetanus/Pertussis/Polio (INFANRIX™-IPV)
	Measles/Mumps/Rubella (M-M-R PRIORIX ®)
11 years	Tetanus/Diphtheria/Pertussis (BOOSTRIX™)
12 years	Human papillomavirus - 2 doses given over 6 months (GARDASIL 9®)
45 years	Diphtheria/Tetanus (ADT™ Booster)
65 years	Diphtheria/Tetanus (ADT™ Booster)
	Shingles vaccine (Zostavax ®)
	Influenza - 1 Injection (annually)

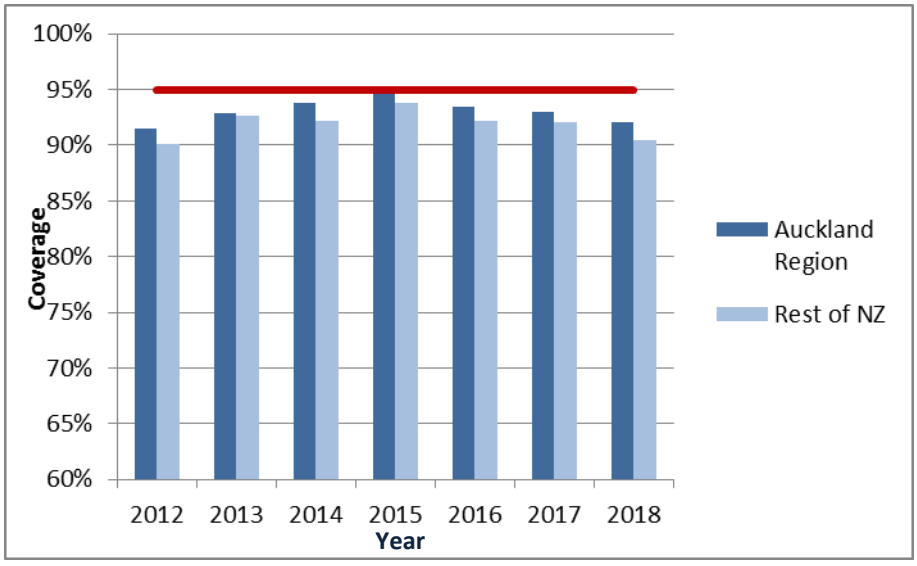
10.1 Immunisation coverage

Immunisation coverage is measured at 'milestone ages' using National Immunisation Register (NIR) data. The milestone ages are six months, eight months, 12 months (one year), 18 months, 24 months (two years), and five years of age.

Figure 94 shows the immunisation coverage for children who have completed their age-appropriate immunisations at the 24 month (two years) milestone age during the calendar year over the last six years for the Auckland region and the rest of New Zealand. Compared to 2017, there has been a continued small decline in percentages consistent with the rest of the country in 2018.

Immunisation rates at the 24 month milestone age peaked in 2015 for the Auckland region and the rest of the country.

Figure 94: Percentage of two year old children fully vaccinated by year in the Auckland region compared with the rest of New Zealand 2012 - 2018



Immunisation coverage for all milestone ages is shown in Figure 95 for the Auckland region compared with the rest of New Zealand, and for the Auckland metro DHBs in Figure 96. Since 2012 there has been sustained improvement in 12 month and five year old coverage rates.

Figure 95: Percentage immunisation coverage for children at various age milestones in Auckland region compared with the rest of New Zealand 2018

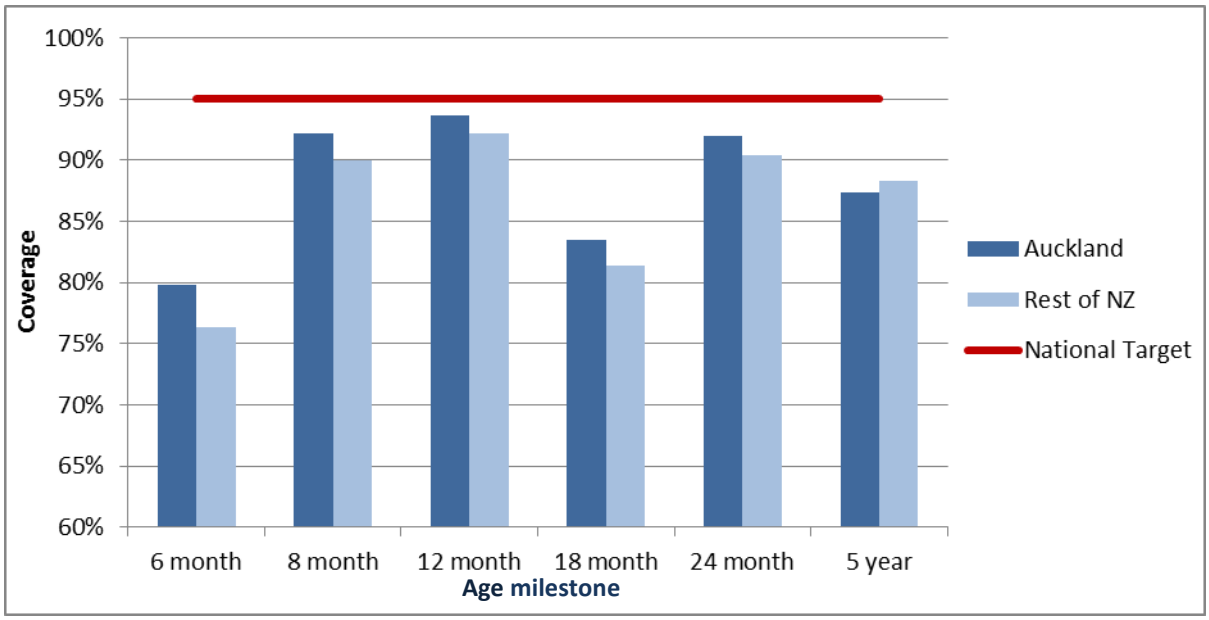
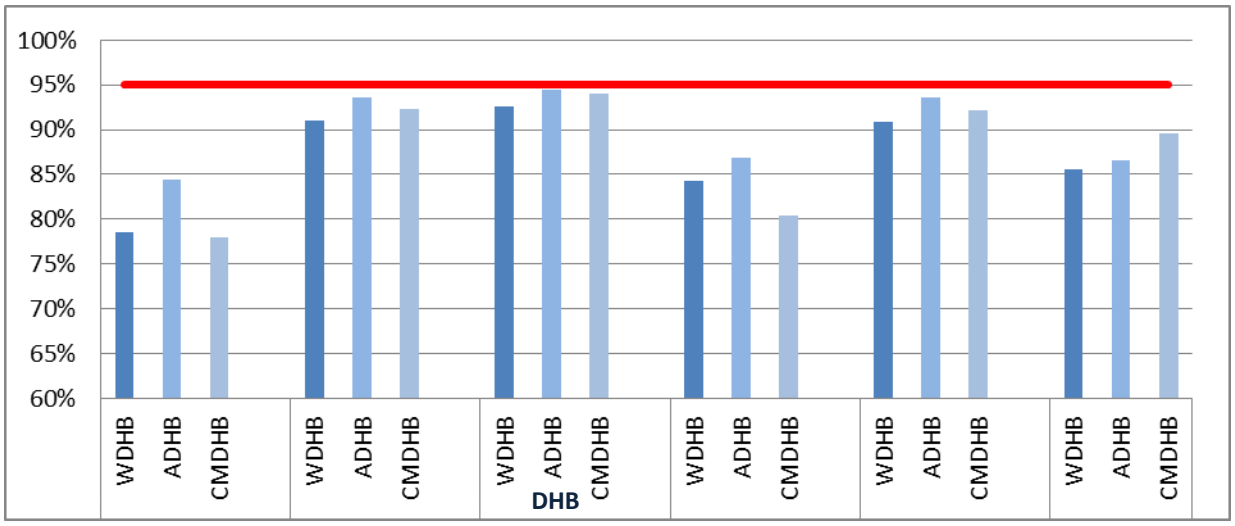
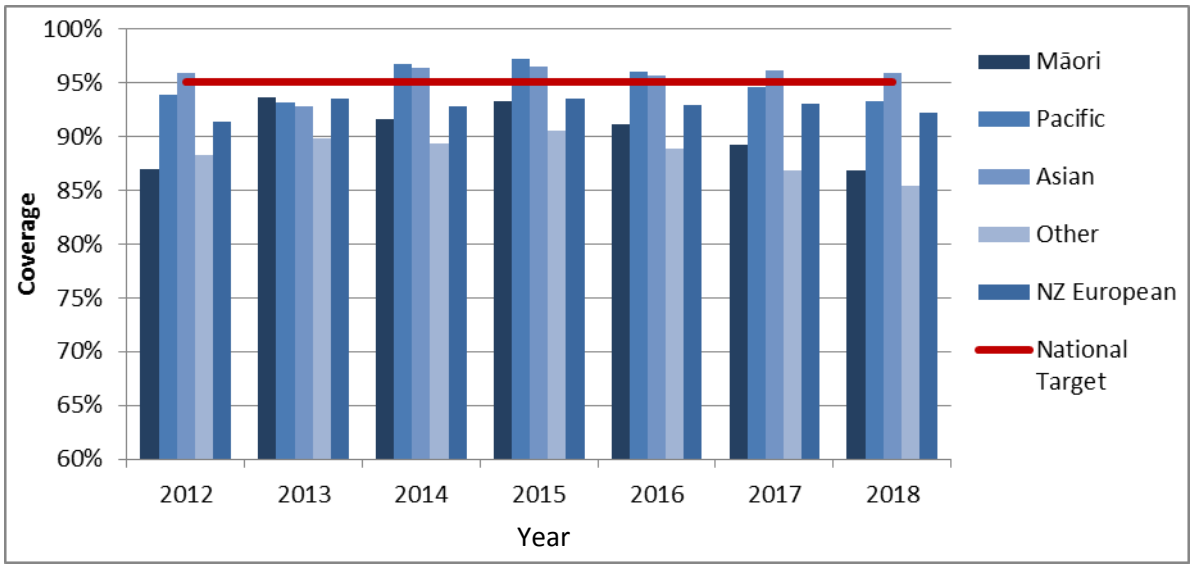


Figure 96: Percentage immunisation coverage for children at various age milestones in the Auckland region by DHB 2018



Immunisation coverage by ethnic group shows a gradual improvement in coverage at two years of age between 2012 and 2015 but this is followed by a reduction in coverage in the Auckland region (Figure 97) with Asian ethnicity the only group above the government target of 95%.

Figure 97: Percentage immunisation coverage at two years by ethnic group in the Auckland region 2012 – 2018



Receiving childhood immunisations on time is important to prevent vaccine preventable diseases in infancy and during the school years. In particular, pertussis control relies on mothers being vaccinated in pregnancy (this data is not yet captured in this analysis), babies being vaccinated on time at six weeks, three months, and five months, and on older siblings being up-to-date with their immunisations during the school years. Infants with delayed immunisation at six weeks, three months, or five months are at much greater risk of hospital admission for pertussis in their first year of life.

Immunisation timeliness at six months has been improving since 2012 (Figure 98) though slightly declined in 2017 and 2018. Asian ethnicity is most associated with timeliness and Maori ethnicity is least associated with timeliness (Figure 99). Compared to 2016, timeliness worsened over 2017 and 2018 in Maori and Pacific ethnic groups, with reduced timeliness also occurring during this time period in ethnicities grouped as “Other”.

Figure 98: Percentage immunisation coverage at six months in the Auckland region and the rest of New Zealand 2012 – 2018

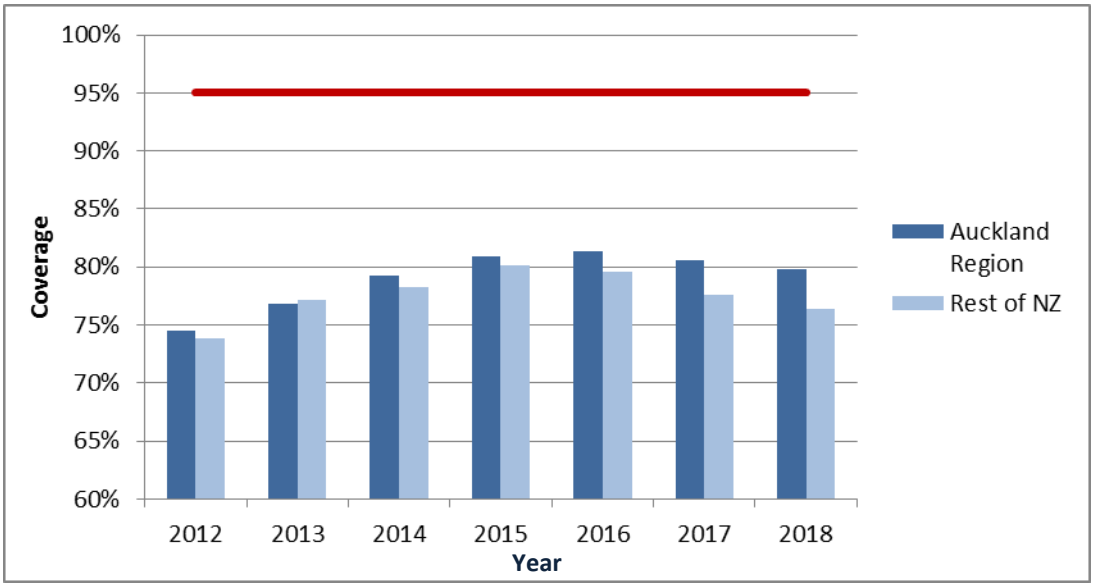
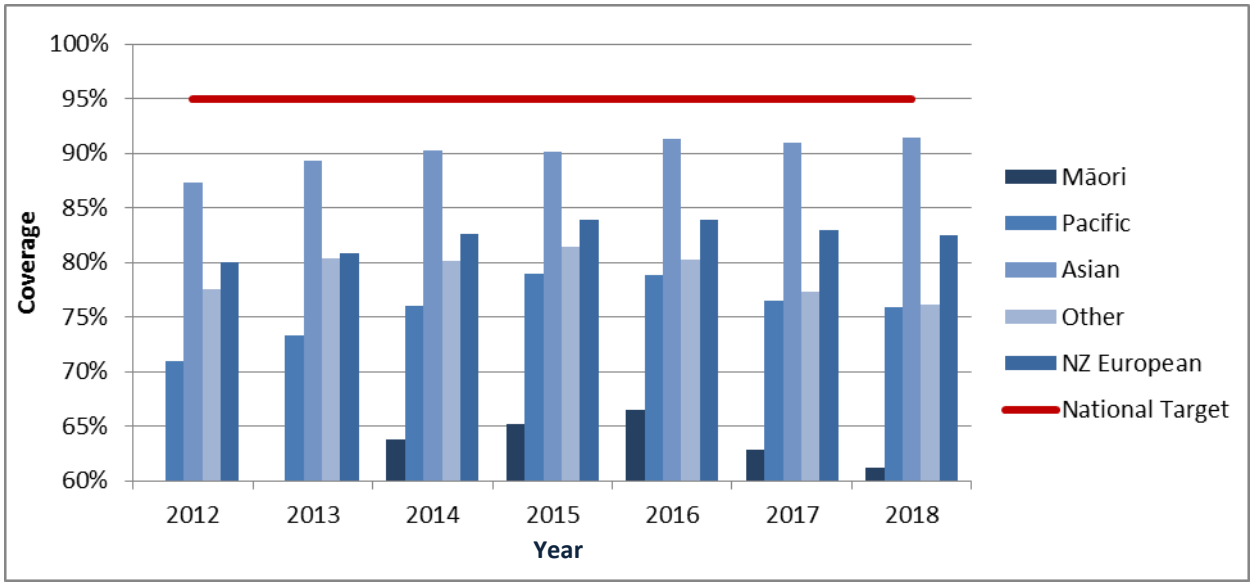


Figure 99: Percentage immunisation coverage at six months by ethnic group in the Auckland region 2012 – 2018



Immunisation before starting school is important to ensure immunity against vaccine preventable diseases that are easily transmitted in school settings. Immunisation at four years of age includes a pertussis booster and a second measles vaccine. Pertussis continues to circulate in the Auckland region with regular large outbreaks, and there continue to be regular measles importations from overseas (see Chapter 4). Throughout 2017 and 2018 a mumps epidemic circulated through the Auckland region.

Immunisation timeliness at age five years has continued to show marked improvement over time in Auckland and the rest of New Zealand. In 2018, there was a levelling out of timeliness in the five year old cohort in all ethnicities, including Maori.

Figure 100: Percentage immunisation coverage at five years in the Auckland region and the rest of New Zealand 2012 – 2018

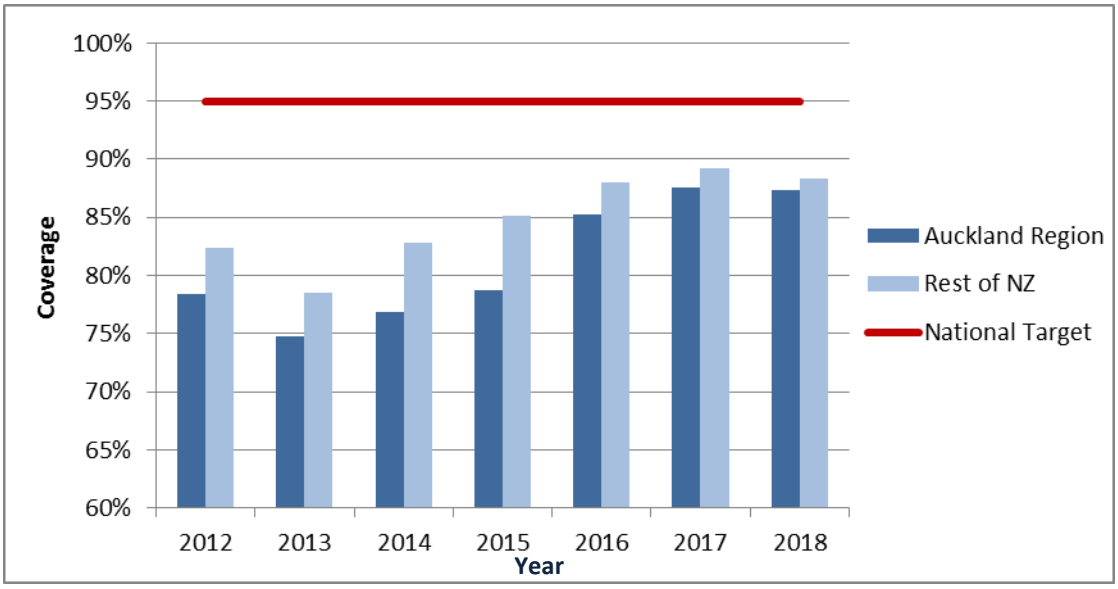
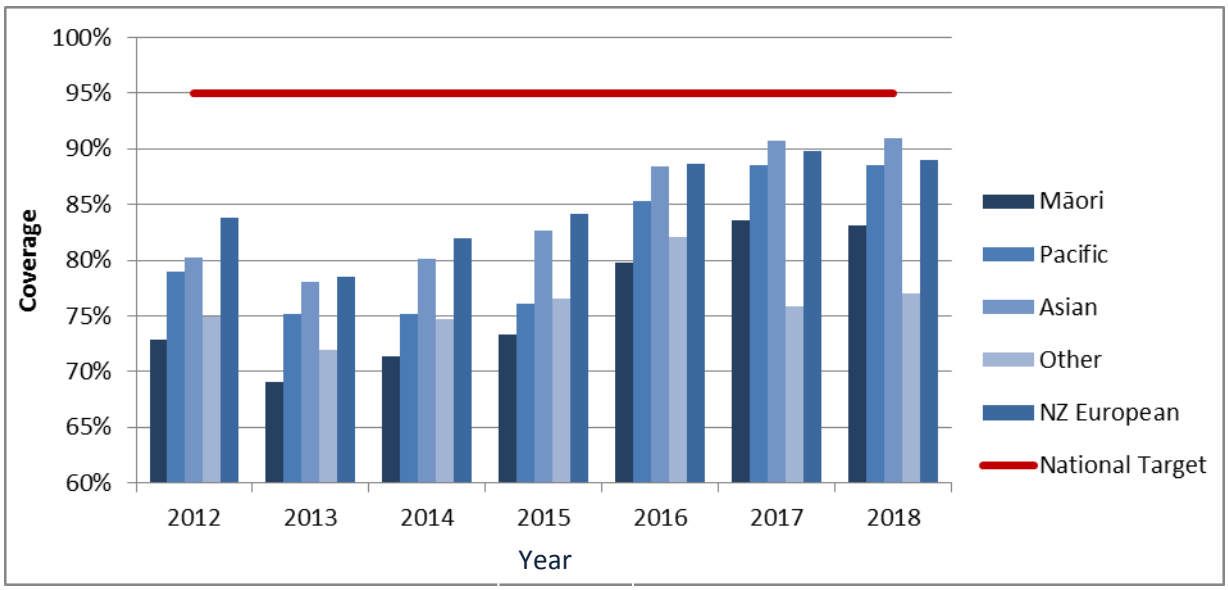


Figure 101: Percentage immunisation coverage at five years by ethnic group in the Auckland region 2012 – 2018



Section 11: What we die of

For the first time ARPHS has included a chapter on "what we die of" for the Auckland region. The information comes from death certificates and records the primary cause of death - which is why the diabetes numbers are lower than might be expected. If you have diabetes, and as a result of your diabetes you die of a heart attack, then acute myocardial infarction (acute MI) would be the main cause of death recorded. Note this data is currently not matched for age and sex, so the rates quoted are crude rates. This data will be updated for the period of 2011 to 2015.

Death happens to all of us eventually, but we are more likely to die of some diseases than others depending on who we are and what illnesses we develop during our lifetimes. We can never know precisely how long we will live but statistics show that:

- New Zealanders are living progressively longer
- Women live longer than men
- Death rates continue to decline at all ages
- Life expectancy increases further for each year we live.

The 2008 to 2013 mortality data from the Ministry of Health shows that there were 37,268 deaths registered in the Auckland region over the five year period.

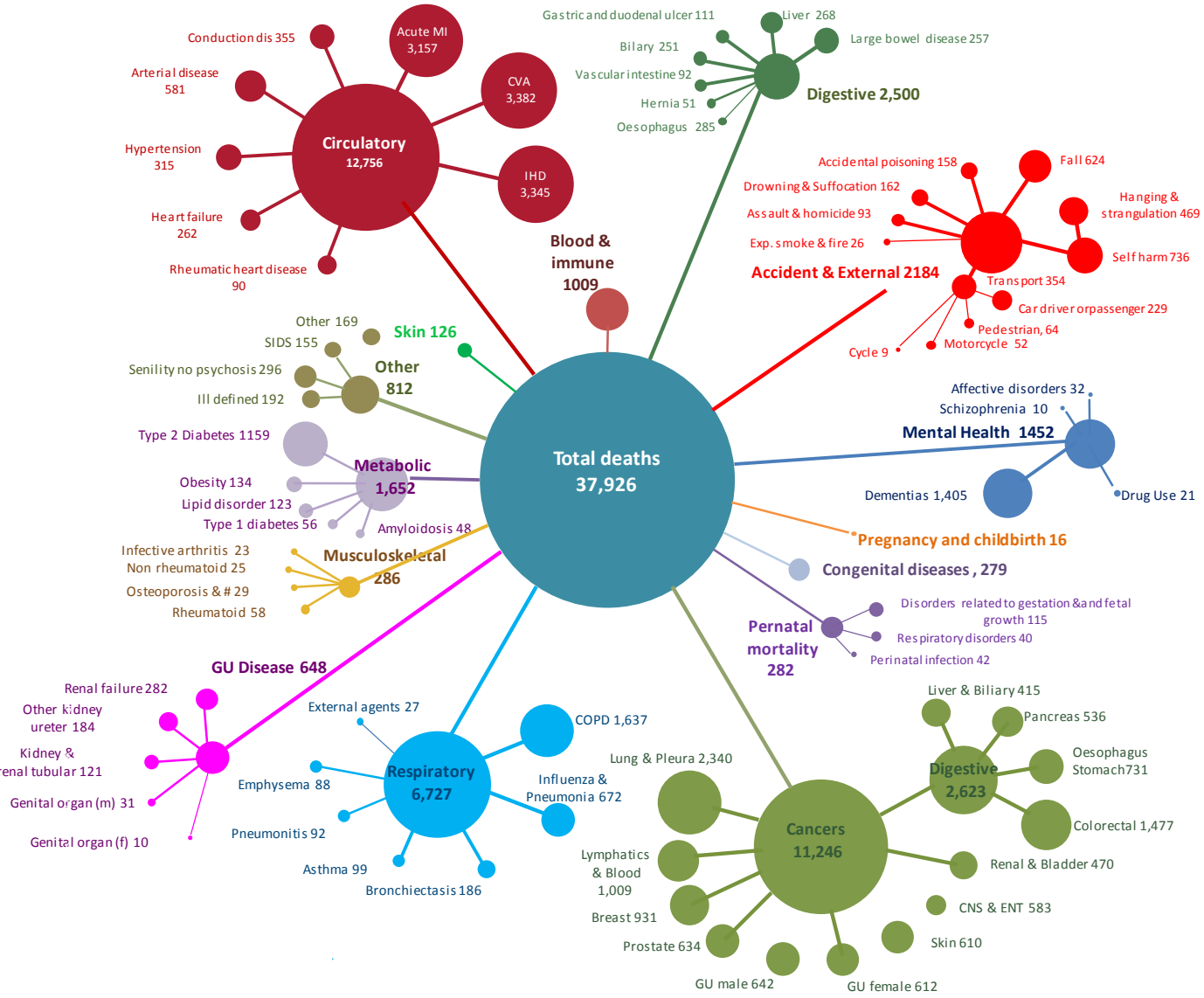
The leading cause of death in Auckland is still circulatory disease deaths, which make up 42% of deaths, and include the biggest individual killers of ischaemic heart disease and strokes.

Cancers follow with 11,246 deaths (30%), with digestive cancers leading this category. Colorectal cancer is the leading digestive system cancer with 1,477 deaths, but lung cancer still leads the cancer death statistics in Auckland with 2,340 deaths.

Respiratory conditions are responsible for 18% of deaths, and a quarter of these deaths are due to chronic obstructive pulmonary disease (COPD) (Figure 102).

Accidental and external causes are an interesting category. Car driver and passenger deaths in the Auckland region over the five year period were 229, but reported deaths from self-harm (736), falls (624), and hanging or strangulation (469) were much higher, suggesting there is some inequity in where resources are currently being allocated. As the "boomer bulge" ages, the number of recorded deaths in this cohort 65 years plus age group is increasing, and it is of note that the number of dementia deaths is a leading cause of death in the mental health category with 1,405 deaths, and ranks seventh in the top 20 causes of death for the region (Table 93).

Figure 102: Bubble chart of 'what we die of' in the Auckland region 2008 - 2013



Data source: Ministry of Health Mortality data

11.1 Top 20 causes of death

The impact of inequalities on mortality is a major public health concern. The top 20 causes of death in the Auckland region are shown in Table 93. Additional tables for the top 20 causes of death follow for the four major ethnic groups for the Auckland region.

Table 93: Top 20 causes of death in all ethnicities recorded as crude five year mortality rates in the Auckland region 2008 – 2013

Auckland region	Five Year Mortality rate
Ischaemic Heart Disease	230.7
CVA	226.5
Acute MI	211.4
Lung and Pleural cancer	146.5
COPD	109.6
Colorectal cancer	98.9
Dementias	93.9
Type 2 Diabetes	77.6
Blood Diseases & Immune	70.6
Breast cancer	62.3
Alzheimer's	54.2
Oesophagus Stomach cancer	49.0
Influenza, bronchitis & pneumonia	45.0
Prostate cancer	42.5
Falls	41.8
GU female cancer	41.0
Malignant Conditions of the Skin	40.9
Arterial disease	37.0
Pancreatic cancer	35.9
Non rheumatic valvular disease	35.9

11.1.1 Top 20 causes of death in Maori

Lung and pleural cancer deaths are the leading cause of death in Maori. Type 2 diabetes is the fourth leading cause of death, with 35 % higher death rates than the region as a whole. Self-harm, hanging and strangulation also feature well up the list with 67.7 deaths per 100,000, double that of the Auckland region as a whole. Car driver and passenger death rates are also double that of the regional rate.

Table 94: Top 20 causes of death in Maori recorded as five year mortality rates in the Auckland region 2008 – 2012

Disease	Crude 5 Year Mortality rate
Lung and Pleural cancer	190.2
Ischaemic Heart Disease	151.9
Acute MI	120.1
Type 2 Diabetes	104.8
COPD	92.5
CVA	87.2
Self-harm Hanging and strangulations	67.7
Breast cancer	49.5
Blood Diseases & Immune	44.8
Oesophagus Stomach cancer	42.4
Colorectal cancer	39.5
Myocarditis and cardiomyopathy	37.7
Liver & Biliary Tract cancer	35.3
Car Driver or passenger	33.6
Congenital disease	30.6
GU female cancer	29.4
Arterial disease	26.5
ARF	24.7
Pancreatic cancer	23.0
Prostate cancer	21.8

11.1.2 Top 20 causes of death in Asian ethnic groups

Apart from the big five causes of death (CVA, acute MI, lung and pleural cancer, ischaemic heart disease, and type 2 diabetes), liver and biliary cancer is the sixth leading cause of death, in the Asian ethnic- group, and only in this ethnic-group, do cancers of the mouth, ear, nose and throat, and renal and bladder cancers, feature in the top 20.

Table 95: Top 20 causes of death in Asian ethnic group recorded as five year mortality rates in the Auckland region 2008 – 2013

Asian	Crude Year Mortality rate
CVA	69.1
Acute MI	55.0
Lung and Pleural cancer	47.6
Ischaemic Heart Disease	45.3
Type 2 Diabetes	34.7
Liver & Biliary Tract cancer	20.3
Blood Diseases & Immune	19.5
Oesophagus Stomach cancer	18.9
Colorectal cancer	18.3
Self-harm Hanging and strangulations	18.1
Breast cancer	16.6
Dementias	12.0
GU female cancer	11.8
Pancreas cancer	11.2
Arterial disease	10.3
Cancers of mouth, ear nose and throat	10.0
Falls	9.2
COPD	8.6
Congenital disease	7.7
Renal & Bladder cancer	7.5

11.1.3 Top 20 causes of death in Pacific peoples

For the Pacific ethnic group the mortality rate from type 2 diabetes is three times the Auckland region rate. GU female cancer rates rank highest in this ethnic-group and self-harm death rates also feature in the middle of the ranking. Recorded deaths from obesity are three time the rate of the Auckland region rate. It is difficult to understand how obesity can be a primary cause of death, so as with much of this data, interpret with caution.

Table 96: Top 20 causes of death in Pacific ethnic group as five year mortality rates in the Auckland region 2008 – 2013

Pacific	Crude 5 Year Mortality rate
Type 2 Diabetes	171.4
CVA	150.7
Ischaemic Heart Disease	141.0
Acute MI	112.8
Lung and Pleural cancer	100.5
Blood Diseases & Immune	58.6
Breast cancer	56.4
COPD	52.0
GU female cancer	50.2
Colorectal cancer	44.5
Oesophagus Stomach cancer	41.9
Liver & Biliary Tract cancer	38.8
Self-harm Hanging and strangulations	33.0
Congenital disease	30.0
Dementias	28.2
Hypertension	28.2
Influenza, bronchitis & pneumonia	26.4
ARF	26.0
Prostate cancer	25.6
Obesity	25.6

11.1.4 Top 20 causes of death in European/Other ethnic groups

The big five feature strongly in the European/other ethnic group for the top 20 causes of death in the Auckland region. It is interesting to see Alzheimer's and dementia up there as number six in the top 20, and deaths from influenza, bronchitis, and pneumonia at 12.

Table 97: Top 20 causes of death in European/other ethnic group recorded as five year mortality rates, Auckland region 2008 – 2013

European	Crude 5 Year Mortality rate
Ischaemic Heart Disease	304.4
CVA	296.2
Acute MI	281.0
Lung and Pleural cancer	165.2
COPD	149.6
Dementias	142.3
Colorectal cancer	139.1
Blood Diseases & Immune	87.1
Alzheimer's	83.0
Breast cancer	73.3
Malignant Conditions of the Skin	65.9
Influenza, bronchitis & pneumonia	62.2
Falls	60.1
Prostate cancer	58.8
Oesophagus Stomach cancer	55.4
Type 2 Diabetes	52.7
Non rheumatic valvular disease	52.6
Arterial disease	48.3
Pancreatic cancer	46.5
GU female cancer	44.9

Section 12: Antimicrobial resistance

The World Health Organisation's Antibiotic Awareness Week began on 12 November 2018 and highlighted increasing concerns about the emergence of bacterial strains showing resistance to all classes of antibiotics commonly used in human medicine.

12.1 Carbapenamase–Producing Enterobacterales

Enterobacterales is a family of bacteria that are commonly found in soil, water, plants and animals, and can cause common infections such as urinary tract infections. It includes bacteria like E.coli. Some of these bacteria have become resistant to certain antibiotics, and this resistance is mediated by a group of enzymes called carbapenemases. These bacteria are referred to as carbapenamase-producing Enterobacterales (CPE).

Enzyme-mediated resistance to carbapenems (a class of antibiotic agents) is due to the production of beta-lactamases that are able to inactivate carbapenems together with other beta-lactam antibiotics and therefore called carbapenemases [Walsh, 2010[6]; Poirel et al. 2007[7]]. This type of resistance is the most important clinically because these enzymes hydrolyse all or almost all beta-lactams, confer high levels of carbapenem minimum inhibitory concentrations (MICs), are encoded by genes that are horizontally transferable by plasmids or transposons, and are commonly associated with genes encoding for other resistance determinants.

The most effective carbapenemases, in terms of carbapenem hydrolysis and geographical spread, are KPC, VIM, IMP, NDM and OXA-48 types [Poirel et al. 2012][8][9]. KPCs inactivate all beta-lactam antibiotics and are only partially inhibited by beta-lactamase inhibitors like clavulanic acid, tazobactam and boronic acid. Metallo-beta lactamases (MBLs) are able to hydrolyse all beta-lactams except aztreonam, and are not inhibited by the aforementioned inhibitors.

CPE is considered to be a significant health concern. The case fatality rate for serious infections with CPE may be as high as 50%. Treatment of infections with CPE may be difficult because CPE are resistant to many antibiotics that are considered the last line of defence.

Antimicrobial resistant carbapenemases found in Enterobacterales belong to three of four major classes of B lactamases enzymes A, B, C and D (Table 98).

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[6] Emerging carbapenamases a global perspective WalshT.R, International Journal of Antimicrobial Agents
Volume 36, Supplement 3, November 2010

[7] Carbapenemases: molecular diversity and clinical consequences; Poire L, Pitout JD, Nordmann P. Future Microbiol. 2007 Oct;2(5):501-122007 Carbapenem resistance: overview of the problem and future perspectives

[8] Identification and screening of carbapenemase-producing Enterobacteriaceae.Nordmann P, Gniadkowski M, Giske CG, Poirel L, Woodford N, Miriagou V; European Network on Carbapenemases.Clin Microbiol Infect. 2012 May; 18(5):432-8.

[9] OXA-48-like carbapenemases: the phantom menace. Poirel L, Potron A, Nordmann P. J Antimicrob Chemother. 2012 Jul;67(7):1597-606.

Table 98: The four classes of antimicrobial resistant carbapenemases

Class A (KPC)	Class B (MBL)	Class C	Class D (OXA)
Includes Klebsiella pneumoniae carbapenamases (KPCs): -KPCs -GES -IMIs -SFCs	Includes metalo B lactamases: -NDMs -IMPs -VIMs (first seen 2015) -SPM -GIM -SIM -AIM -DIM -FIM -POM	Class C enzymes are not considered carbapenemases. It has been shown however that they possess a low potential of carbapenem hydrolysis and their overproduction may contribute to carbapenem resistance	These belong to the OXA-48 group of B lactamases OXAs

The most common MBL is New Delhi Metallo B Lactamase group (NDM). These were first detected in New Zealand in 2009. Now a further 20 subtypes, NDM-2 to NDM 21, have been detected. The following information comes from the ESR AMR Reference Laboratory annual reports at and the current year line listing which are publically available on ESR website www.esr.cri.nz

Table 99: Number of carbapenemases-producing Enterobacterales (CPE) isolates identified in New Zealand by carbapenemases class and Enterobacterales species 2018

Class	Carbapenamase and Subtype	Citrobacter freundii	Citrobacter youngae	Escherichia cloacae	Escherichia cloacae complex	Escherichia coli	Klebsiella oxytoca	Klebsiella pneumoniae	Klebsiella quasipneumoniae	Proteus mirabilis	Proteus vulgaris complex	Providentia stuartii	Pseudomonas aeruginosa	All Species
A	**KPC Total**			**1**				**2**						**3**
	KPC-3							2						**2**
	IMI-2			1										**1**
B	**NDM Total**	**3**	**1**	**1**	**15**	**22**	**1**	**15**	**0**	**1**	**1**	**2**	**3**	**65**
	NDM-1	1			3	3	1	10		1	1	2	3	**25**
	NDM-4	1												**1**
	NDM-5				9	16		1						**26**
	NDM-7	1				1								**2**
	NDM-9					1		1						**2**
	NDM-25		1			1		1						**3**
	NDM-5 & OXA-181				2									**2**
	NDM-5 & OXA-232							2						**2**
	DIM-1				1									**1**
	IMP-4			1										**1**
D	**OXA Total**	**0**	**0**	**0**	**10**	**15**	**0**	**3**	**1**	**0**	**0**	**0**	**0**	**29**
	OXA-181				8	5		2						**15**
	OXA-23								1					**1**
	OXA-48				2	10		1						**13**
	Grand Total	**3**	**1**	**2**	**25**	**37**	**1**	**20**	**1**	**1**	**1**	**2**	**3**	**97**

In 2018, 61 of the 97 cases (63%) resided in Auckland. In 2017 this number was 32/55 (58%).

Class A (KPCs) accounted for 3.1% (3/97) of the carbapenemases identified in 2018, compared with 4.3% of CPE identified in New Zealand to date. Up until now in New Zealand, all KPCs have been identified exclusively in K. pneumoniae. In 2018 this was seen with KPC-3, but there was one case of IMI-2 identified in E Cloacae, which are widely encountered in nature, but they can act as pathogens (Table 99).

As has been observed in earlier years, the most frequently identified carbapenemases among CPE identified in New Zealand in 2018 were various subtypes of NDM (Table 99). NDM carbapenemases accounted for 64.9 % (63/97) of the carbapenemases identified in 2018, and have accounted for approximately 60.5% (170/281) of carbapenemases identified in CPE in New Zealand to date. In 2018 two additional types of Class B MBL were identified, DIM-1 and IMP-4.

The second most common carbapenemases identified were OXA-48-like carbapenemases, which accounted for 29.9% (29/281) of the carbapenemases identified in 2018 (Table 99), and have accounted for 31.3% (99/281) of all carbapenemases identified in CPE in New Zealand.

In 2018 the first plasmid-associated IMI carbapenemase gene was identified in New Zealand. The IMI-1 gene was first identified in the USA in 1984. Initially reports of the IMI carbapenemase from clinical isolates were rare, although recently a number of IMI subtypes have been reported on plasmids, both in Enterobacter sp. and in other species.

2018 was also the first year that an OXA-23 carbapenemase was identified in a CPE in New Zealand. The OXA-23 carbapenemases have been reported worldwide in Acinetobacter baumannii, however their presence in Enterobacterales is rare.

Over half (60/97) of the CPE were detected through hospital screening programmes and the other half were from clinical samples (Table 100). In previous years half of the isolates were from patients over the age of 65, but this is still to be analysed for 2018 (Table 101).

Table 100: Source of isolates identified in New Zealand 2018

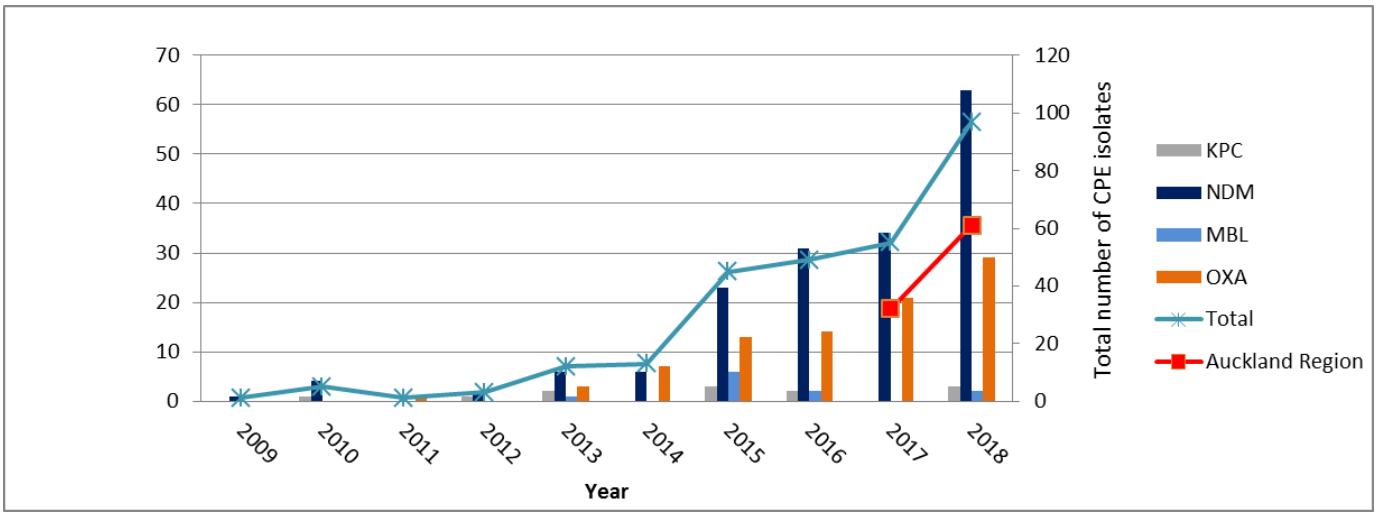
Sources	Cases
Screening	60
Blood	2
Skin and Soft Tissue	13
Urinary	22
Total	97

Table 101: Age group distribution of CPE identified in New Zealand 2017 (awaiting 2018 analysis)

Age group	Cases
0 to 15	2.10%
15 to 45	25.00%
45 to 64	20.80%
Over 65	52.10%
Total	100%

The number of CPE has been increasing sharply in New Zealand since 2014 (Figure 103). The bacterial species identified for each carbapenamase subtype is shown in Table 99.

Figure 103: Number of carbapenemases-producing Enterobacterales (CPE) isolates identified in New Zealand by carbapenemases class 2009 – 2018



Overseas travel history was reported in 70% (68/97) of the CPE cases that were isolated in 2018. Overseas travel to the Indian subcontinent was by far the most common probable place of acquisition (Table 102).

Table 102: AMR isolates probable country of acquisition all New Zealand 2018

Probable place of acquisition	Cases
India	41
China	4
Tahiti	3
Vietnam	3
Cambodia	2
Italy	2
Philippines	2
Samoa	2
Tonga	2
Afghanistan	1
Cook Islands	1
Iraq	1
Pakistan	1
Portugal	1
Russia	1
Sri Lanka	1
Locally acquired	29
Grand Total	97

Of the locally acquired cases, 14 were thought to be acquired at a single Auckland hospital, 10 from Wellington, two from Waikato, and one from another Auckland Hospital. Two cases from one hospital had several different carbapenamase producing species, and horizontal transfer of the NDM-1 gene was suspected in these patients.

12.2 Vancomycin-resistant enterococci (VRE)

Vancomycin-resistant enterococci (VRE) are a type of bacteria called enterococci that have developed resistance to many antibiotics, especially vancomycin. Enterococci bacteria live in our intestines and on our skin, usually without causing problems. However, if they become resistant to antibiotics, they can cause serious infections, especially in people who are ill or weak. These infections can occur anywhere in the body. Some common sites include the intestines, the urinary tract, and wounds.

Hospital and community diagnostic laboratories are requested to refer all vancomycin-resistant E. faecium and E. faecalis (VRE) isolates to ESR for the national surveillance of these resistant organisms. At ESR, the isolates are confirmed as vancomycin resistant, the van gene is identified by PCR, the isolates' susceptibility to a range of antibiotics is determined, and the isolates are typed by pulsed-field gel electrophoresis (PFGE). In addition, the index isolate of each new PFGE profile identified among vancomycin resistant E. faecium is typed by multilocus sequence typing (MLST).

The data for 2018 is yet to be published (as of Sep 1, 2018). However the 2017 ESR report indicated there were 70 VRE cases confirmed in 2017. The predominant E. faecium van types are van A and van B (Table 103).

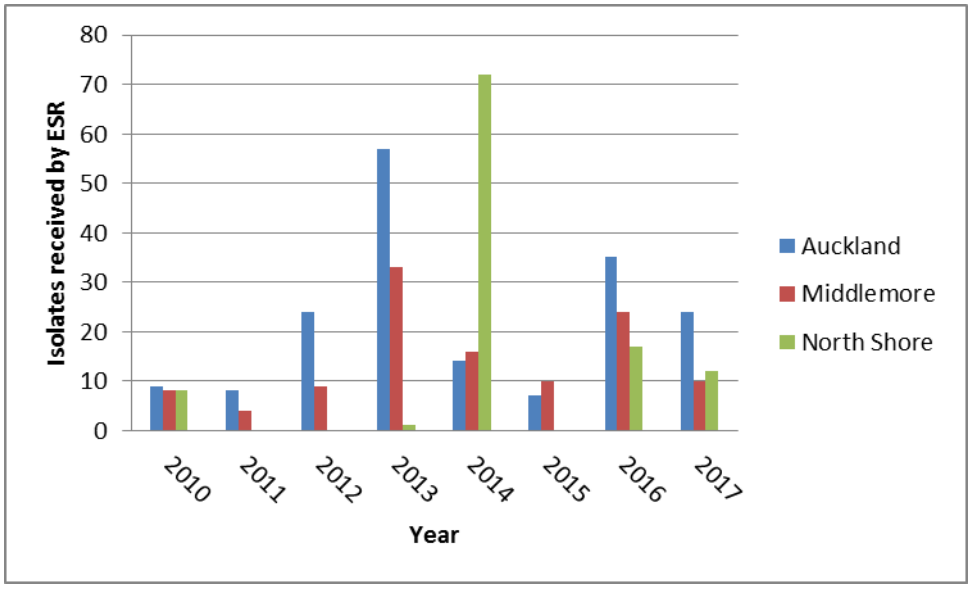
Table 103: VRE by species and van type for VRE identified in New Zealand 2017

Species	Van Type	Cases
Enterococcus faecium	A	34
Enterococcus faecium	B	29
Enterococcus faecium	D	2
Enterococcus faecalis	B	1
Enterococcus faecalis	A	4
Total		70

Note: 2018 data not yet publically available

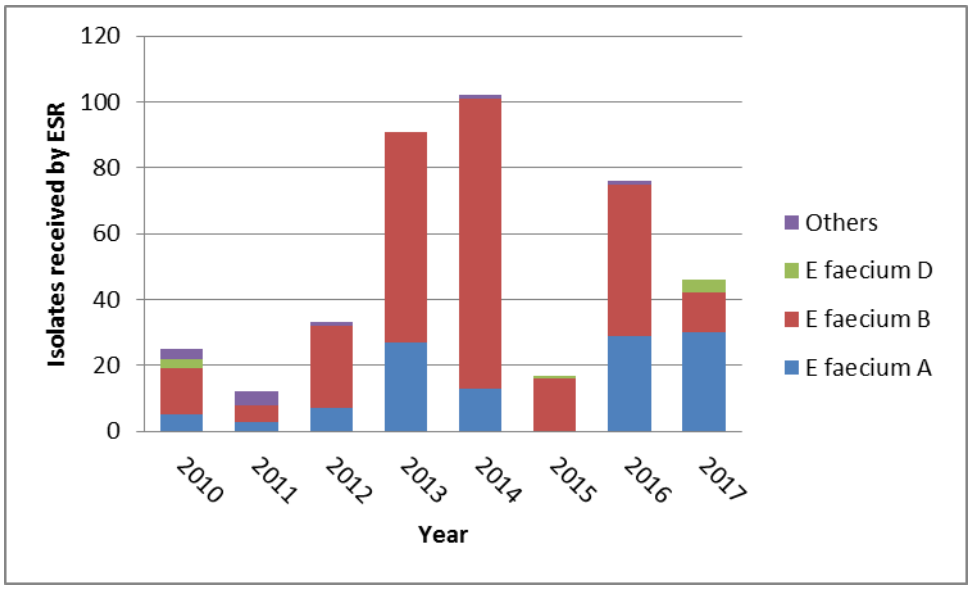
In 2017, the majority of the VRE were isolated from patients (45, 60.8%) in Auckland hospitals: Auckland City Hospital (23, 31.1%), Middlemore Hospital (11, 14.9%) and North Shore Hospital (11, 14.9%) (Figure 104).

Figure 104: Distribution of patients with VRE by DHB, Auckland region 2010 – 2017



The number of patients with VRE confirmed each year over the last 10 years in the Auckland region is shown in Figure 105. There was a marked decrease in the number of patients from whom VRE were isolated in 2017 compared with 2013, 2014 and 2016 Also, between 2010 and 2016 van B E. faecium was the dominant VRE genotype and species. In contrast, van A E. faecium was prevalent in 2017.

Figure 105: Distribution of patients with VRE by species and van gene Auckland region 2010 – 2017



Among the large van B E. faecium isolates, two PFGE strains predominated: EfAP and EfBB. Strain EfAP is common in parts of Australia and was first identified in New Zealand in 2012. In 2017, strain EfAP was identified in small numbers from patients in Auckland hospitals and several hospitals in the South Island. Strain EfBB was newly identified in 2017, and isolated solely from patients in Dunedin Hospital.

References and resources

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   https://www.health.govt.nz/publication/communicable-disease-control-manual

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Resources

Books

Control of Communicable Diseases Manual: David Heymann et al, 2015

Communicable Disease Control Handbook Hawker Begg et al, 2004

Immunisation Handbook 2017 Ministry of Health.

Principles and Practice of Infectious Disease Mandell, Douglas and Bennetts (Eighth edition)

Census data

Statistics New Zealand (SNZ): http://archive.stats.govt.nz/ for 2018 estimated resident population numbers

Ministry of Health: Commissioned population projection figures for prioritised ethnicity

ESR Public Health Surveillance https://surv.esr.cri.nz

ARPHS Fact Sheets www.arphs.govt.nz

ARPHS Normal and After hours protocols – Internal access only

ARPHS Surveillance Strategy 2016-2018, 2018 to 2022(Draft) – Internal access only

EpiSurv Reports

Episurv reports supply the basic epidemiological data though for all intents and purposes this is now also extracted directly out of NDCMS

File names from EpiSurv Custom Reports

ARPHS Cases by year

ARPHS All EpiWeek Report

Enteric Disease with Addlab ESR Typing

ARPHS Arbovirus

ARPHS Hep B_C_NOS

ARPHS HiB

ARPHS Leprosy

ARPHS Listeriosis

ARPHS Malaria

ARPH Measles Mumps Rubella

ARPHS Outbreak Surveillance Report

ARPHS TB

Hepatitis A

Lead Absorption cases

Lead Notification Risk factors

Legionellosis

LTBI

Meningococcal Line Listing

Pertussis

Rheumatic fever

Rheumatic fever NZDep

VTEC AddLab

Yersiniosis Auckland

NDCMS Reports

Vector-borne diseases, Food-borne Diseases, Hepatitis and Air-borne diseases data are extracted from NDCMS and processed in “R” with outputs to Excel (Ron King)

Risk factor data is extracted through Risk factor reports designed and created by Anne Morrison

Salmonellosis, Shigellosis, Cryptosporidiosis, Giardiasis, VTEC yersiniosis

Hepatitis A, B, C

Lead Absorption

Environmental Health Reports

NIWA

Cliflo database: https://cliflo.niwa.co.nz/

NZ Stats

https://www.stats.govt.nz/information-releases/agricultural-production-statistics-june-2017-provisional

MfE

https://data.mfe.govt.nz/table/52469-land-use-land-cover-classes-1996-2001-2008-and-2012/

https://data.mfe.govt.nz/document/11124-air-domain-report-2014-about-the-indicators/

Determinants and Driver of Outbreaks

ARPHS Annual Surveillance Report 2016 (Internal Publication)

ARPHS Annual Surveillance Report 2017 (Internal Publication

Immunisation coverage

Ministry of Health Immunisation data: https://www.health.govt.nz/our-work/preventative-health-wellness/immunisation/immunisation-coverage/national-and-dhb-immunisation-data

What we die of

Ministry of Health Mortality Data (courtesy of Ministry of Health)

Antimicrobial Resistance

ESR Antimicrobial Resistance Laboratory (Helen Heffernan)

- Enterobacterales with acquired carbapenemases, 2018
- Vancomycin-resistant enterococci, 2017

Appendix 1: Notifiable Diseases in New Zealand

Diseases that are notifiable to the Medical Officer of Health are:

- Acute gastroenteritis (when part of a suspected outbreak)
- AIDS
- Anthrax
- Arboviral diseases e.g. Dengue fever
- Brucellosis
- Campylobacteriosis
- Cholera
- Creutzfeldt-Jakob disease
- Cryptosporidiosis
- Cysticercosis
- Decompression Sickness
- Diphtheria
- Enterobacter sakazakii invasive disease
- Giardiasis
- Haemophilus influenza B
- Hepatitis (acute A,B,C or viral NOS)
- Hydatid Disease
- Influenza (High pathogenic Avian)
- Invasive Pneumococcal Disease
- Lead Poisoning
- Legionellosis
- Leprosy
- Leptospirosis
- Listeriosis
- Malaria
- Measles
- Meningoencephalitis (primary amoebic)
- Mumps
- Neisseria meningitidis (invasive disease)
- Pertussis
- Plague
- Poisoning arising from chemical contamination of the environment
- Poliomyelitis
- Rabies
- Rheumatic fever
- Rickettsial diseases
- Rubella
- Salmonellosis
- SARS
- Shigellosis
- Taeniasis
- Tetanus
- Trichinosis
- Tuberculosis (all forms)
- Typhoid and paratyphoid fever
- Viral haemorrhagic fevers
- Yellow fever
- Yersiniosis