Science for Communities

TUBERCULOSIS IN NEW ZEALAND ANNUAL REPORT 2018

PREPARED FOR:	**Ministry of Health**
CLIENT REPORT No:	**FW21031**
PREPARED BY:	**Epidemiology Team, Health and Environment Group** **Institute of Environmental Science and Research Limited**
PUBLISHED:	**May 2022**

This report is available at www.surv.esr.cri.nz

First published: May 2022

Suggested citation:
The Institute of Environmental Science and Research Ltd.
Tuberculosis in New Zealand: Annual Report 2018. Porirua: ESR; 2022
Porirua, New Zealand

Client Report: FW21031

ACKNOWLEDGEMENTS

This report was prepared by Sherif Ammar, Liza Lopez, Kristin Dyet and Yvonne Galloway.

Thanks to the following people and organisations for their contributions to this report:

- The Mycobacteriology Laboratories at Auckland City Hospital; Waikato Hospital; Wellington Southern Community Laboratories; and Canterbury Health Laboratories, for provision of the species and antimicrobial susceptibility data.
- The Molecular Section of the Department of Microbiology, Auckland City Hospital, for the provision of molecular typing data.
- Sue McAllister (AIDS Epidemiology Group) for providing the HIV/TB co-infection data.

Disclaimer

TABLE OF CONTENTS

Table of contents ..... **ii**

List of figures ..... **iii**

List of tables ..... **iv**

Abbreviations ..... **v**

Summary **1**

Introduction **3**

Data sources 4

Analytical methods 6

Quality of surveillance data 8

Notifications **10**

Tuberculosis disease – new cases 11

Basis of discovery and diagnosis 11

Geographical distribution 11

Age and sex 13

Ethnicity 15

Born in New Zealand 16

Hospitalisations 16

Deaths 17

Protective factors 17

Risk factors 18

Site of infection 22

Immunosuppressive illness and HIV status 23

Receipt of treatment 23

Treatment outcomes for cases notified in 2017 23

Tuberculosis disease – relapses or reactivations 24

Outbreaks 25

Culture confirmation, speciation and drug susceptibility **26**

Culture confirmation and speciation 26

Drug susceptibility 26

Molecular typing **31**

Discussion **34**

References **36**

Appendix **37**

LIST OF FIGURES

Figure 1. Tuberculosis notification rates by year, 1980−2018 10
Figure 2. Tuberculosis (new case) notification rates by district health board and year, 2015–2018 ... 12
Figure 3. Tuberculosis (new case) notification rates by age group and sex, 2018 13
Figure 4. Tuberculosis (new case) notification rates by age group and year, 2009–2018 14
Figure 5. Three-year moving average annual rates of tuberculosis (new cases) in New Zealand-born children (<15 years old), 2009–2018..... 15
Figure 6. Tuberculosis (new case) notification rates by ethnic group and year, 2014–2018..... 15
Figure 7. Tuberculosis (new case) notification rates for New Zealand born cases by ethnicity, 2014–2018 16
Figure 8. Hospitalisation rates for tuberculosis (new case) by age group and year, 2009–2018 17
Figure 9. Percentage of tuberculosis (new case) notifications by risk factor and year, 2014–2018 18
Figure 10. Percentage of tuberculosis (new case) notifications born outside New Zealand by birth region and year, 2014–2018 19
Figure 11. Tuberculosis (new case) notifications born outside New Zealand by time since arrival in New Zealand, 2018..... 20
Figure 12. Percentage of tuberculosis (new case) notifications by birthplace category, NZDep2013 and year, 2014−2018..... 21
Figure 13. Tuberculosis (new case) notifications by site of infection, birthplace category and year, 2014−2018 22
Figure 14. Tuberculosis (relapse/reactivation) notifications by place of original diagnosis, 2009−2018 25
Figure 15. Antimicrobial resistance of tuberculosis isolates by antimicrobial and year, 2009−2018 ... 27
Figure 16. Percentage of new TB cases with non-unique molecular types by age group and sex, 2014–2018..... 31
Figure 17. Percentage of new TB cases with non-unique molecular types by ethnic group, 2014–2018 31
Figure 18. Percentage of new TB cases with non-unique molecular types by DHB, 2014–2018..... 32
Figure 19. Percentage of new TB cases with non-unique molecular types by region of birth, 2014–2018 32
Figure 20. Percentage of new TB cases with non-unique molecular types by NZDep2013, 2014–2018 32
Figure 21. Percentage of new TB cases with non-unique molecular types by clinical manifestation, 2014–2018..... 33

LIST OF TABLES

Table 1. Percentage of data completeness for tuberculosis (new case) notifications by variable and year, 2014–2018 9
Table 2. Tuberculosis (new case) notification by basis of discovery, 2018 11
Table 3. Numbers and rates for tuberculosis (new case) notifications by age group and sex, 2018 ... 13
Table 4. Hospitalisations for tuberculosis (new case) by age group, 2018 16
Table 5. Risk factors reported for tuberculosis (new case) notifications, 2018 18
Table 6. Tuberculosis (new case) notifications by region of birth, 2018 19
Table 7: Treatment outcomes for tuberculosis (new cases) notified in 2017 24
Table 8: Antimicrobial resistance of tuberculosis isolates by species, 2018 26
Table 9. Antimicrobial resistance patterns for tuberculosis isolates, 2018 27
Table 10. Antimicrobial resistance of tuberculosis isolates by birthplace category, 2018 28
Table 11. Antimicrobial resistance of tuberculosis isolates by ethnic group, 2018 29
Table 12. Antimicrobial resistance of tuberculosis (new cases, relapses/reactivations and previously treated cases) isolates 2014–2018 30
Table 13. Numbers and rates of tuberculosis (new cases) notifications by age group, sex, ethnic group, district health board and year, 2014−2018 37
Table 14. Tuberculosis (new case) notifications for cases born in New Zealand by DHB and year, 2014–2018 38
Table 15. Tuberculosis (new case) notifications with extra-pulmonary involvement by site of infection and year, 2014–2018 38
Table 16. Numbers and percentages of non-unique and unique strains for tuberculosis (new case) notifications for selected variables, 2014−2018 39
Table 17. Regional classification of countries 40

ABBREVIATIONS

Abbreviation	Description
BCG	Bacillus Calmette-Guérin (vaccine)
CNS	Central nervous system
DHB	District health board
DOT	Directly observed therapy
DST	Drug susceptibility testing
ESR	Institute of Environmental Science and Research
HIV	Human immunodeficiency virus
LTBI	Latent tuberculosis infection
MDR-TB	Multidrug-resistant tuberculosis
MELAA	Middle Eastern, Latin American or African ethnicity
MIRU	Mycobacterial interspersed repetitive units
NTM	Non-tuberculosis mycobacteria
NZDep	New Zealand index of deprivation
PCR	Polymerase chain reaction
PHU	Public Health Unit
RFLP	Restriction fragment length polymorphism
TB	Tuberculosis disease
WHO	World Health Organization
XDR-TB	Extensively drug-resistant tuberculosis

SUMMARY

Incidence

- In 2018, 307 cases of tuberculosis disease (TB) were notified in New Zealand, of which 297 (96.7%) were new cases.
- The incidence rate for TB in 2018 was 6.3 per 100,000 population, similar to the rate in the previous two years, and the average rate of 6.5 per 100,000 for the preceding seven years.
- The incidence of TB in 2018 in New Zealand was higher than the 2018 rates in other developed countries such as Iceland (2.3 per 100.000) [1], USA (2.8 per 100.000) [2], Netherlands (4.7 per 100.000) [1], and Australia (5.6 per 100,000) [3], but lower than that of Spain (8.6 per 100,000), Belgium (8.6 per 100,000), UK (7.7 per 100,000) and France (7.6 per 100,000) [1].

Demography

- Geographically the highest notification rates for new TB cases in 2018 were reported from Counties Manukau (11.8 per 100,000), Capital & Coast (10.1 per 100,000) and Waitemata (8.3 per 100,000) DHBs.
- Males had a slightly higher rate for new TB notifications in 2018 (6.3 per 100,000) than females (6.0 per 100,000).
- By age group, the highest notification rate for new TB cases in 2018 was in the 15–39 years age group (8.5 per 100,000).
- The highest ethnic-specific rates were reported in the Asian ethnic group (26.6 per 100,000), followed by MELAA (18.2 per 100,000) and Pacific peoples (11.8 per 100,000).

Place of birth and trends by country of birth

- People born outside New Zealand accounted for 80.5% (239/297 cases) of notifications of new TB cases in 2018. The rate of TB among this group (18.9 per 100,000) was 10 times higher than the rate for those born in New Zealand (1.9 per 100,000).
- Being born in the Southern and Central Asia region (particularly India) or South-East Asia (particularly Philippines) was the most common risk factor for new TB cases in 2018.
- Of the new TB cases in people born outside New Zealand, 15% of notifications occurred in the first year after arrival in New Zealand and nearly half occurred within five years.
- A lower proportion of cases born outside New Zealand were reported to have received directly observed therapy (DOT) during the intensive phase of their treatment (54.9%) than those born in New Zealand (70.2%).
- For New Zealand-born new TB cases, rates were highest for Pacific peoples (5.1 per 100,000) and Māori (2.9 per 100,000).

Diagnosis

- The majority (80.5%) of new TB cases present symptomatically to their health practitioner. A further 10.8% of cases were identified through immigrant/refugee screening and 4.7% through contact follow up.

Socioeconomic deprivation

- The rate for new TB cases in the most deprived quintile of the population was two and a half times the rate in the least deprived quintile (10.4 compared with 4.0 per 100,000).

Transmission within New Zealand

- In 2018, the three-year moving average annual rate for new TB cases in New Zealand-born children aged <15 years (a proxy for recent transmission within the country) [4], was 1.0 per 100,000; similar to 2017 (1.2 per 100,000).

Treatment standards

- In 2018, 96.0% (285/297) of new TB cases received treatment. For cases with an onset date recorded, 16.7% started treatment within one month of the onset of symptoms and 38.9% started treatment between one and three months.
- For new TB cases with pulmonary disease and a known onset date, 40.4% (42/104 cases) of cases started treatment between one and three months after symptom onset.
- In 2017, 98.3% (289/294) of new TB cases received appropriate treatment and 90.0% (260/289) completed treatment. Twenty-nine cases did not complete their treatment; the majority were transferred to overseas medical care (16 cases) or went overseas (6 cases). Three cases died before their treatment was completed.

Outbreaks and molecular clusters

- No TB outbreaks or new clusters were reported in New Zealand in 2018.

Drug susceptibilities

- Two (1.9%) culture-positive TB cases reported in 2018 were multidrug-resistant TB (MDR-TB). Both cases were born overseas.
- Resistance to pyrazinamide, isoniazid, rifampicin, ethambutol, and streptomycin was higher among isolates from cases born outside New Zealand than among isolates from New Zealand-born cases, but only isoniazid (p 0.029) and streptomycin (p 0.018) resistance were significantly higher.

INTRODUCTION

Globally, tuberculosis disease (TB) remains one of the top 10 causes of death and the leading cause from a single infectious agent. Infection is usually curable with a combination of specific antibiotics, but this relies on full compliance with treatment [5].

The WHO estimates that TB incidence has been falling since 2000 and 54 million lives have been saved between 2000 and 2017 through diagnosis and treatment. However, control of the worldwide epidemic remains a major public health challenge. The burden from TB disease has been sustained by the ongoing HIV/AIDS pandemic and by the continuing prevalence of multi-drug resistant TB. Although TB is more prevalent in low income countries, it is not confined to these countries and the WHO End TB Strategy recognises that low-incidence countries, such as New Zealand, should work towards eliminating TB within their settings, as well as supporting global control efforts [5, 6].

TB is a notifiable disease in New Zealand under the Health Act 1956 (see Methods section for detail). The 2018 notification rate was 6.3 per 100,000 population, similar to the average rate recorded since 2007 [7]. Although rates have been relatively stable since 2007, TB is one of a number of infectious diseases (including acute rheumatic fever, meningococcal disease and skin infections), that play a major role in ethnic and socioeconomic inequalities in New Zealand [8].

The purpose of this report is to summarise the descriptive epidemiology of TB notifications in New Zealand for 2018 and to examine trends from 2009 to 2018. The report uses data to the end of 2018 and adds to data included in previous TB reports published since 2009. It takes the same format as reports from recent years.

The report includes information on the distribution of TB disease notifications geographically, by age and sex, among specific ethnic groups, and includes protective and risk factor information where available. Clinical outcomes are based on hospitalisation and death data from the Ministry of Health's National Minimum Dataset and the National Mortality Collection. A summary of TB drug susceptibility and molecular typing data is included.

The primary audience of this report is the New Zealand Ministry of Health and TB practitioners, including medical officers of health, respiratory and infectious disease physicians, clinical microbiologists and medical laboratory scientists.

METHODS

DATA SOURCES

Tuberculosis disease (TB) notification data recorded in EpiSurv, the national notifiable diseases database, is used in this report. Data provided by the mycobacteriology laboratories at Auckland City Hospital, Waikato Hospital and Canterbury Health Laboratories on the species identification, antimicrobial susceptibility and molecular types of *Mycobacterium tuberculosis* complex isolates from cases of TB is also included. In addition, Ministry of Health data on hospitalisations and deaths due to tuberculosis is presented.

Notifications

From 2017, clinicians were required to notify all cases of TB to their local medical officer of health under the Health Act 1956 (previously the notification fell under the Tuberculosis Act 1948). Cases diagnosed with latent tuberculosis infection (LTBI) or with old inactive tuberculosis disease are not notifiable under the Health Act 1956[i]. Only cases of active tuberculosis disease (referred to as TB) are presented in this report.

TB notification data is entered into EpiSurv by staff at each public health unit (PHU) via a secure web-based portal. This near real-time data is collated and analysed by ESR on behalf of the Ministry of Health. Notification data includes information on the type of TB, case demography, clinical details, laboratory results, risk factors and case management details.

TB cases are recorded in EpiSurv as one of the following:

Tuberculosis disease – new case: active TB in a person who has never previously been treated for TB or has active disease from a new genotype.

Tuberculosis disease – relapse or reactivation: active TB in a person whose tuberculosis has been non-infectious or quiescent following full, partial or no treatment.

The case classification for TB, as defined by the Ministry of Health's Communicable Disease Control Manual in 2012 [9], is provided below:

Under investigation:	A suspected case that has been notified, but information is not yet available to classify it as probable, confirmed or not a case.
Probable:	Presumptive (without laboratory confirmation). There is no laboratory confirmation but: • there are symptoms or signs compatible with active tuberculosis, such as compatible radiology or clinical evidence of current disease; and • full anti-tuberculosis treatment has been started by a clinician.
Confirmed:	A clinically compatible illness that is laboratory confirmed. Laboratory confirmation requires at least one of the following: • positive culture for *Mycobacterium tuberculosis* complex • positive microscopic examination for acid-fast bacilli when a culture has not been or cannot be obtained • demonstration of *M. tuberculosis* complex nucleic acid directly from specimens • histology strongly suggestive of tuberculosis when there is a strong clinical probability.
Not a case:	A case that has been investigated and subsequently found not to meet the case definition.

[i] Cases of latent TB infection or with old inactive TB may be entered onto EpiSurv with patient consent for case management purposes.

Deaths

Mortality data for TB was extracted from the National Mortality Collection, which records a classification for the underlying cause of each death registered in New Zealand. Mortality data is available only up to 2017 due to the time taken to complete coronial inquiries. In the Mortality Collection, deaths due to TB are assigned to the year in which the person died, while in EpiSurv, deaths are assigned to the year of initial disease notification. For this reason, the number of deaths per year may differ between the two data sources.

Co-infections

Data for TB/HIV co-infection cases was provided by the AIDS Epidemiology Group at the University of Otago.

Speciation and drug susceptibility

First-line drug susceptibility testing (DST) is undertaken by the mycobacteriology laboratories at Auckland City Hospital (LabPlus), Waikato Hospital and Canterbury Health Laboratories. Susceptibility to isoniazid (at concentrations of 0.1 and 0.4 mg/L), rifampicin, ethambutol, pyrazinamide and streptomycin is routinely tested. Multidrug-resistant TB (MDR-TB) isolates (ie, isolates resistant to at least isoniazid and rifampicin) are tested at LabPlus for susceptibility to second-line anti-tuberculous agents, including amikacin, capreomycin, moxifloxacin, ethionamide and linezolid.

The BACTEC® MGIT 960 method is used to test phenotypic drug susceptibility. Pyrazinamide DST can be performed by either the BACTEC® MGIT 960 method or the Wayne's pyrazinamidase assay.

Molecular methods are used to aid the detection of drug resistance in certain cases. For example:

- Isolates with high-level isoniazid resistance are screened for rifampicin resistance using the Cepheid GeneXpert® system. Rifampicin resistance detected in the GeneXpert system or in phenotypic susceptibility tests is further investigated by (1) sequencing the *rpoB* gene and/or (2) by using the Hain Lifescience GenoType® MTBDR*plus* version 2.0 assay, that detects the presence of mutations *rpoB*.
- The pncA gene is sequenced in all MDR-TB isolates, regardless of their phenotypic susceptibility to pyrazinamide, and in all other isolates that are resistant to pyrazinamide in phenotypic susceptibility tests.
- For cases in which mixed cultures (eg, *M. tuberculosis* mixed with a rapid-growing *Mycobacterium* species) are suspected, the Hain Lifescience GenoType® line probe, Mycobacterium CM, may be used to differentiate *M tuberculosis* complex and non-tuberculosis mycobacteria (NTM). The presence of two or more *Mycobacterium* species will delay phenotypic DST, as pure cultures are needed before DST can be performed.
- For cases where there is a high index of clinical suspicion for MDR-TB, Hain Lifescience GenoType® line probes, MTBDR*plus* version 1.0 and MTBDR*sl* version 1.0, may be used directly on smear-positive clinical specimens and on cultures before DST results are available. These assays detect the presence of mutations in the *inhA*, *katG*, *rpoB*, *embB*, *gyrA* and *rrs* genes that are associated with resistance to low-level isoniazid, high-level isoniazid, rifampicin, ethambutol, fluoroquinolone and aminoglycosides, respectively. Alternatively the Hain Lifescience GenoType® MTBDR*plus* version 2.0 and MTBDR*sl* version 2.0 assays may be used, that detect the presence of mutations in the *inhA*, *katG*, *rpoB, gyrA/gyrB, eis* and *rrs* genes that are associated with resistance to low-level isoniazid, high-level isoniazid,

rifampicin, fluoroquinolone and aminoglycosides, respectively. As these assays only target the common mutations associated with resistance, results need to be reported in conjunction with the phenotypic DST results.

- In addition to these commercial assays, in-house PCR (polymerase chain reaction) assays are used to detect mutations in the *rpoB* gene, within and outside the 81 bp mutation hotspot, and in the *katG* gene. These assays are useful tools to confirm phenotypic rifampicin and high-level isoniazid resistance where no mutations in the *rpoB* gene or *katG* gene are detected by the GeneXpert® or Hain Lifescience GenoType® line probe assays.

Susceptibility testing and species identification results are sent to ESR and integrated with the TB notifications recorded on EpiSurv.

Molecular typing

The national TB molecular typing database is maintained by LabPlus, which carries out all human TB molecular typing in New Zealand. Since October 2011, typing of TB isolates has been undertaken by mycobacterial interspersed repetitive units (MIRU) analysis alone. Primary typing includes analysis at 12 loci (MIRU 12). Secondary typing at a further 12 loci (MIRU 24) is performed when an isolate has the same MIRU 12 as a previously typed isolate. Between October 2009 and October 2011, primary typing was by MIRU and secondary typing was by restriction fragment length polymorphism (RFLP). Prior to October 2009, RFLP was the primary typing method and MIRU was only performed where isolates had ≤5 bands on RFLP.

A TB isolate is defined as having a unique molecular type if either the MIRU 12 alone or the MIRU 12 + MIRU 24 combination does not match that of any other isolate in the national database. At least one isolate from each of the known MIRU/RFLP or RFLP-based clusters has been MIRU 12- and MIRU 24-typed so that new isolates can be matched to these existing clusters. The TB molecular typing data from LabPlus is routinely reported to ESR and periodically integrated with the TB notifications recorded in EpiSurv.

ANALYTICAL METHODS

The analytical methods used in this report are outlined below.

Dates

In this report, data is presented by the date the case was notified rather than by the date of onset of illness and focuses on cases of TB notified in 2018 and trends since 2009 or 2014, depending on the availability of data. Treatment outcomes are presented for cases reported in 2017.

Notification data presented in this report is based on information recorded in EpiSurv as at April 30, 2021. Changes made to EpiSurv data by PHU staff after this date will not be reflected in this report. Consequently, future data analyses may produce revised results.

Case status for notifications

All notifications of TB recorded in EpiSurv that meet the case classification criteria are included for analysis in this report, although their status may not be final. Any subsequent changes in the status of a case will be reflected in future surveillance reports.

Population rate calculations

Population data used to determine all disease rates, except that used to determine disease rates for ethnic groups and country of birth, has been derived from the 2018 mid-year population estimates published by Statistics New Zealand.

The denominator data used to determine ethnic-specific disease rates is based on the proportion of people in each ethnic group from the estimated resident populations for 2013 (for 2014-2017) and 2018 applied to the corresponding mid-year population estimates.

The denominator used to determine rates in the New Zealand-born children between 2009–2018 is based on the proportion of people born in New Zealand from the usually resident 2006 (for 2005 to 2010) and 2013 (for 2011 to 2018) census population applied to the corresponding mid-year population estimates.

Population data used to determine disease rates for New Zealand-born, overseas-born and each country of birth is derived from the 2013 Census usually resident population count by birthplace.

In this report, disease rates are written as cases per 100,000 population where they first appear in a section and subsequently as cases per 100,000.

Disease rates are not presented in the tables in this report if there were fewer than five notified cases in a category. Calculating population rates from fewer than five cases may produce unstable rates, especially in smaller populations.

Percentages

Percentages are calculated with the denominator as the total number of cases for which information was recorded, unless otherwise specified.

Categorisation

Countries of birth were grouped into regions according to the Statistics New Zealand standard.

Ethnic groups presented are based on a prioritised classification of ethnicity, with the Māori ethnic group at the top of the hierarchy, followed by Pacific peoples, Asian, Middle Eastern/Latin American/African (MELAA) and European or Other (including New Zealander) ethnic groups. More information about ethnicity classification is available on the Ministry of Health website:http://www.health.govt.nz/publication/ethnicity-data-protocols-health-and-disability-sector.

Socioeconomic deprivation is based on the 2013 New Zealand Index of Deprivation (NZDep2013). The index, which measures relative socioeconomic deprivation, is derived from a weighted combination of nine variables from the 2013 census, with each reflecting a different aspect of material and social deprivation. The deprivation score is calculated for each geographical meshblock in New Zealand [10]. Quintiles of NZDep2013, ranging from 1 (least deprived) to 5 (most deprived), are presented in this report. Approximately equal numbers of people reside in areas associated with each of the five deprivation levels.

Drug susceptibility

Drug susceptibility data is only available for cases of TB that were culture positive. An isolate is considered resistant if either the phenotypic susceptibility testing indicates such resistance, or the molecular testing detects a mutation associated with resistance.

The Chi-square test or Fisher's exact test, as appropriate, was used to determine the significance of any observed differences. The Cochran-Armitage trend test was used to calculate the significance of time trends. An associated *p*-value of ≤0.05 was used to assess whether a difference or trend was significant.

Molecular typing

Analysis of molecular typing data was only undertaken for culture-positive TB cases infected with *M*. *tuberculosis*. A case was categorised as having a non-unique molecular type if the combination of their MIRU 12 and MIRU 24 typing results matched at least one other case in the national database. If there was no matching strain type in the national database, the case was considered to have a unique strain.

QUALITY OF SURVEILLANCE DATA

The level of completeness of data recorded in EpiSurv for key TB surveillance variables from 2014 to 2018 is shown in Table 1.

For most variables the level of completeness was more or less stable over the five-year period. For 2017, completeness of several variables was lower than for other years. Variables with consistently high levels of data completeness (≥95%) were the demographic variables (age, sex, ethnicity and geocoding accuracy), basis of discovery, pulmonary disease and the risk factor relating to being born outside New Zealand. The completeness of data associated with the treatment variables was also high (≥96%) across the four years analysed (2014–2017).

The date of onset of illness variable had the lowest levels of completeness, ranging from 68% to 78% (Table 1). However, this is partly explained by the nature of the disease, as some cases are asymptomatic.

Table 1. Percentage of data completeness for tuberculosis (new case) notifications by variable and year, 2014–2018

Variable	2014	2015	2016	2017	2018
Basis of discovery	100	100	100	100	100
Laboratory confirmation	100	100	100	100	100
Demographic details					
Age	100	100	100	100	100
Sex	100	100	100	100	100
Ethnicity	98	100	99	100	98
Geocoding accuracy[a]	97	98	99	97	95
Clinical course and outcomes					
Onset date	73	78	73	68	70
Hospitalisation status	100	100	100	100	100
Survival status	100	100	99	99	99
Protective and risk factors					
BCG vaccination[b]	100	100	100	100	100
Has immunosuppressive illness	97	98	96	94	99
On immunosuppressive medication	97	98	98	96	97
Contact with confirmed case of tuberculosis	87	85	89	78	83
Case born outside New Zealand	100	100	100	100	100
Date of arrival[c]	82	87	89	85	84
Current/recent residence with person born outside New Zealand	93	91	92	94	95
Exposure in a healthcare setting	92	89	95	88	91
Current/recent residence in an institution	93	91	92	91	94
Clinical characteristics					
Pulmonary disease	100	100	100	100	100
Extra-pulmonary involvement	100	100	100	100	100
Treatment[d]					
Date treatment started	100	100	100	100	96
Treatment outcome[e]	99	100	100	100	-
Use of directly observed therapy (DOT)[d, e]	98	97	98	97	-

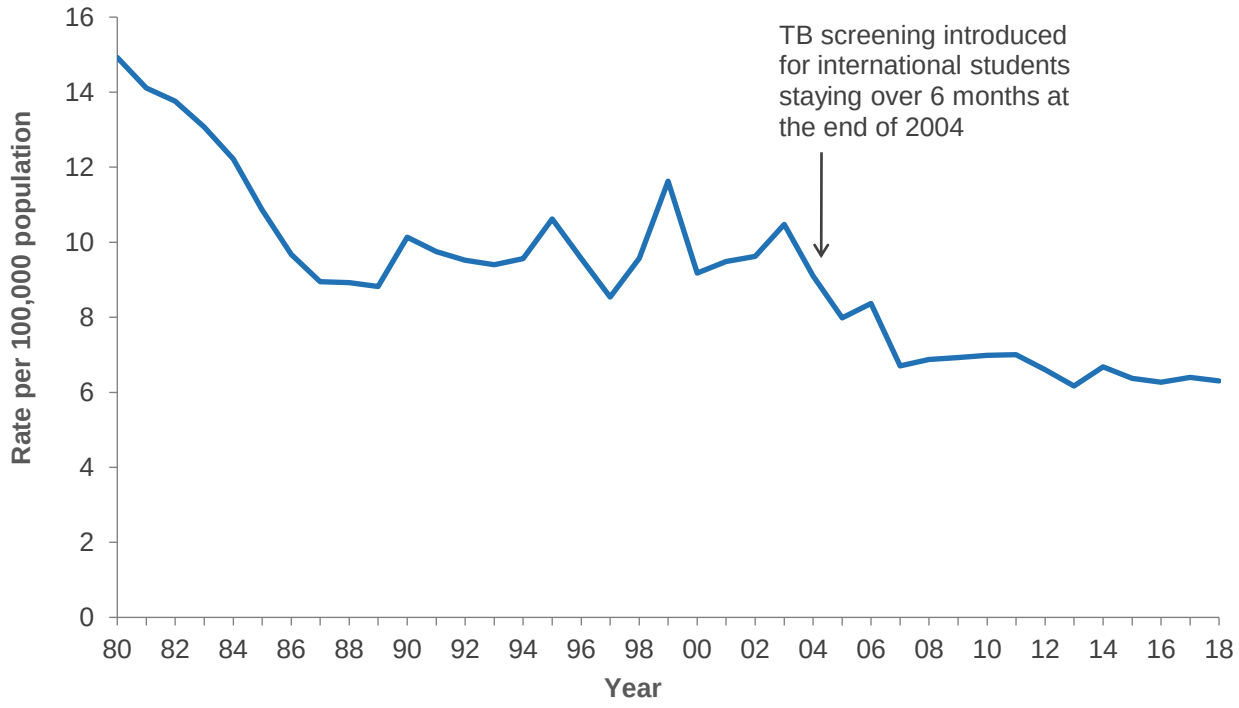
[a] Geocoding accuracy is based on exact and nearest match to Land Information New Zealand addresses.
[b] Cases in the <5 years age group only.
[c] Cases born outside New Zealand only.
[d] Cases reported as having received treatment only.
[e] Data is only reported for 2014−2017 due to length of time taken for TB treatment to be completed.

NOTIFICATIONS

There were 307 cases of TB disease notified in 2018, of which 297 (96.7%) were new cases. The 2018 TB disease notification rate was 6.3 per 100,000 population, similar to the rate recorded in 2017 (6.4 per 100,000). A high proportion of TB cases (88.9%, 273/307) were laboratory confirmed.

Trends in TB disease rates since 1980 are shown in Figure 1. The annual TB rate decreased from 14.9 per 100,000 in 1980 to 8.8 per 100,000 in 1989 and then fluctuated between 8.5 and 11.6 per 100,000 for the next 15 years before decreasing again to 6.7 per 100,000 in 2007. Since 2007, the rate has remained fairly steady, ranging from 6.2 to 7.0 per 100,000 each year.

Figure 1. Tuberculosis notification rates by year, 1980–2018



Note: Census population data was used as the denominator to calculate rates before 1991 and the Statistics New Zealand mid-year population estimates were used from 1991 onwards.

TUBERCULOSIS DISEASE – NEW CASES

This section presents data for notifications of “tuberculosis disease - new case” only. These notifications will be referred to as new TB cases.

There were 297 new TB cases notified in 2018, giving a notification rate of 6.1 per 100,000 population. The rate was the same as in 2017 (294 new TB cases). Between 2014 and 2018, the notification rate fluctuated between 6.0 and 6.4 per 100,000 but was relatively stable (Table 13).

Basis of discovery and diagnosis

Information on how TB was discovered was recorded for all 297 new TB cases. The majority (80.5%, 239/297) were diagnosed when the case presented to a health practitioner with symptoms (Table 2).

Between 2014 and 2018, the proportion of cases discovered by each method ranged from 76.2 to 84.9% for symptomatic cases presenting to a health practitioner, 6.6−13.9% for immigrant/refugee screening, 4.7−7.6% for contact follow-up, and 2.1−5.1% for other means of discovery.

Table 2. Tuberculosis (new case) notification by basis of discovery, 2018

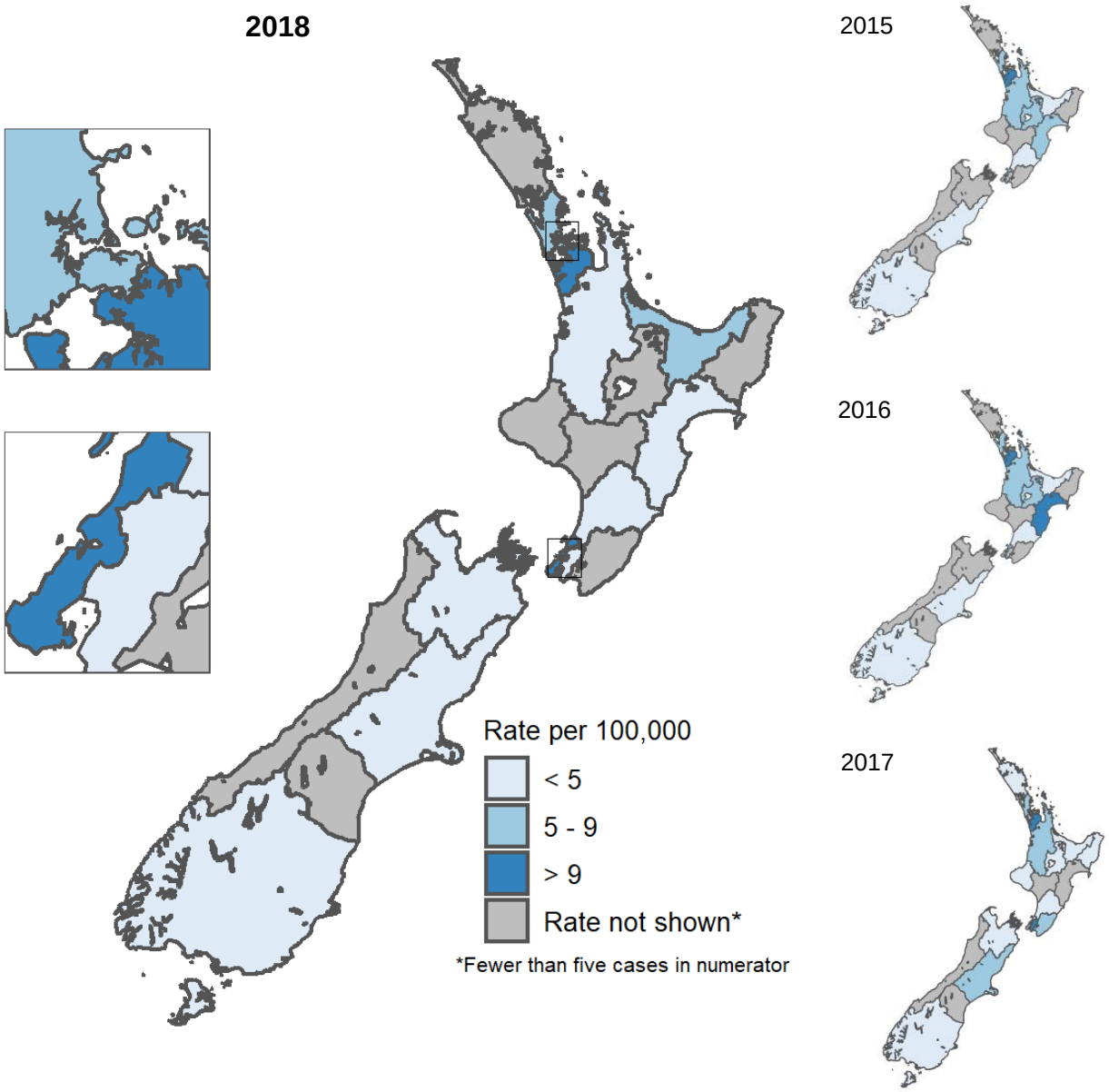
Basis of discovery	Cases	%
Symptomatic case presented to health practitioner	239	80.5
Immigrant/refugee screening	32	10.8
Contact follow-up	14	4.7
Other	12	4.0
Total	**297**	**100.0**

In 2018, 88.9% (264/297) new TB cases were laboratory confirmed. Among the 264 cases for which the method of laboratory confirmation was recorded, 90.2% (238 cases) were confirmed by isolation of *M. tuberculosis* (99.2%, 236 cases) or *M. bovis* (0.8%, 2 cases). A further 26 cases were confirmed by the following methods: 23.1% (6 cases) by demonstration of acid-fast bacilli in a clinical specimen, 19.2% (5 cases) by demonstration of *M. tuberculosis* nucleic acid directly from specimens and 57.7% (15 cases) by histology strongly suggestive of TB. The remaining 33 new TB cases were classified as probable based on clinical grounds and treatment for presumptive TB, with seven of these cases recorded as having radiology suggestive of pulmonary TB.

Geographical distribution

New TB case notification rates by district health board (DHB) for 2014 to 2018 are shown in Figure 2. The highest notification rates in 2018 were recorded for Counties Manukau (11.8 per 100,000, 67 cases), followed by Capital & Coast (10.1 per 100,000, 32 cases) and Waitemata (8.3 per 100,000, 51 cases) DHBs (Table 13). Auckland and Counties Manukau DHBs consistently had the highest rates in 2015−2017 (Figure 2). The rate in Capital & Coast DHB increased between 2017 and 2018 from 5.5 to 10.1 per 100,000, respectively.

Figure 2. Tuberculosis (new case) notification rates by district health board and year, 2015–2018



Age and sex

Table 3 and Figure 3 show that notification rates were higher among adults than in children (<15 years). This trend was consistent over the last five years (Table 13). Similar to 2017, the highest notification rate for new TB cases in 2018 was in the 15–39 years age group (8.5 per 100,000, 142 cases), followed by the ≥60 years age group (7.9 per 100,000, 79 cases) (Table 3).

Table 3. Numbers and rates for tuberculosis (new case) notifications by age group and sex, 2018

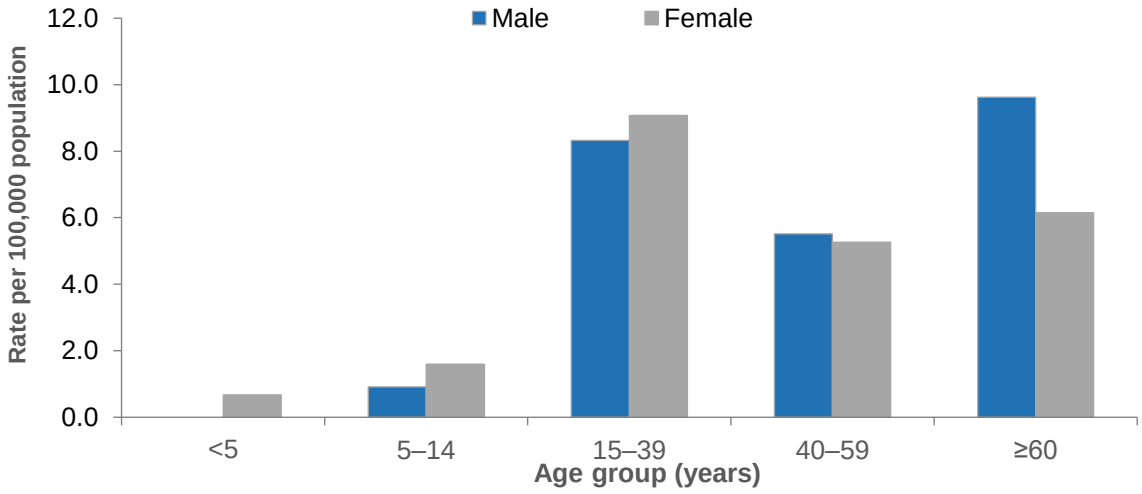
Age group (years)	Male		Female		Total	
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]
<5	0	0.0	1	-	1	-
5–14	3	-	5	1.6	8	1.2
15–39	68	8.3	74	9.1	142	8.5
40–59	33	5.5	34	5.3	67	5.3
≥60	46	9.6	33	6.1	79	7.9
Total	**150**	**6.3**	**147**	**6.0**	**297**	**6.1**

[a] Rate per 100,000 based on 2018 mid-year population estimates; caution as rates shown for counts with less than five cases.

Males have had a higher rate than females for the last five years with the exception of 2017 (Table 13). During this time the rate in males decreased from 7.6 per 100,000 in 2014 to 6.3 per 100,000 in 2018, while the rate for females increased from 5.2 per 100,000 in 2014 to 6.0 per 100,000 in 2018.

In 2018, the ≥60 years age group had the highest rates for males (9.6 per 100,000), while the 15–39 years age group had the highest rates for females (9.1 per 100,000) (Table 3, Figure 3).

Figure 3. Tuberculosis (new case) notification rates by age group and sex, 2018

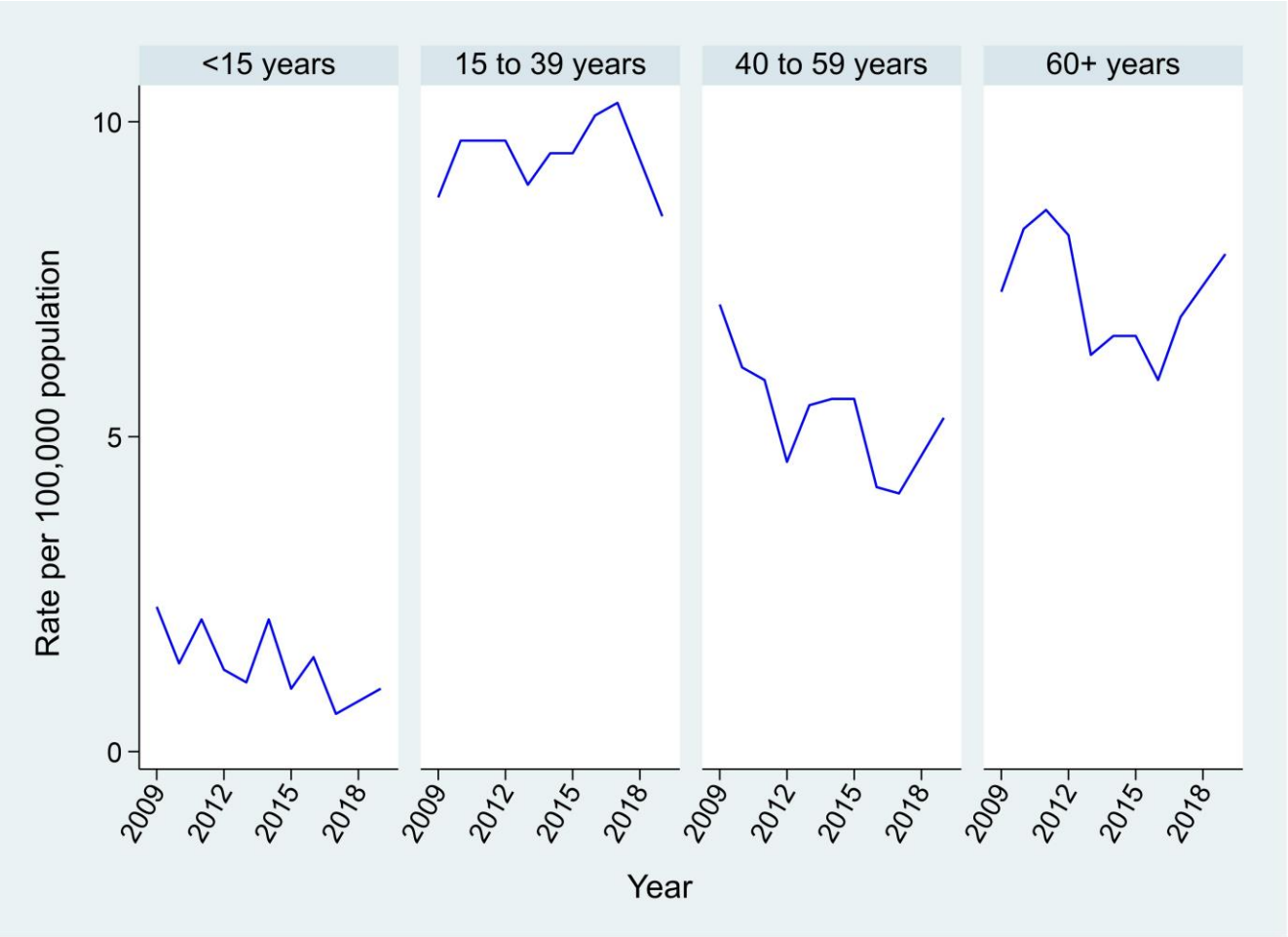


Over the past 10 years (2009–2018), the average annual notification rate was highest in the 15–39 years age group (9.5 per 100,000), followed by the ≥60 years (7.3 per 100,000), and 40–59 years (5.4 per 100,000) age groups.

In 2018, the rate for children aged less than 15 years was 1.0 per 100,000, while 15–39 and 40–59 years age groups had rates of 8.5 and 5.3 per 100,000, respectively. These rates were less than the average rates for 2009–2017 (1.5, 9.6 and 5.4 per 100,000 population, respectively). In contrast, in 2018 the rate for people aged ≥60 years (7.9 per 100,000) was higher than the average rate of 7.2

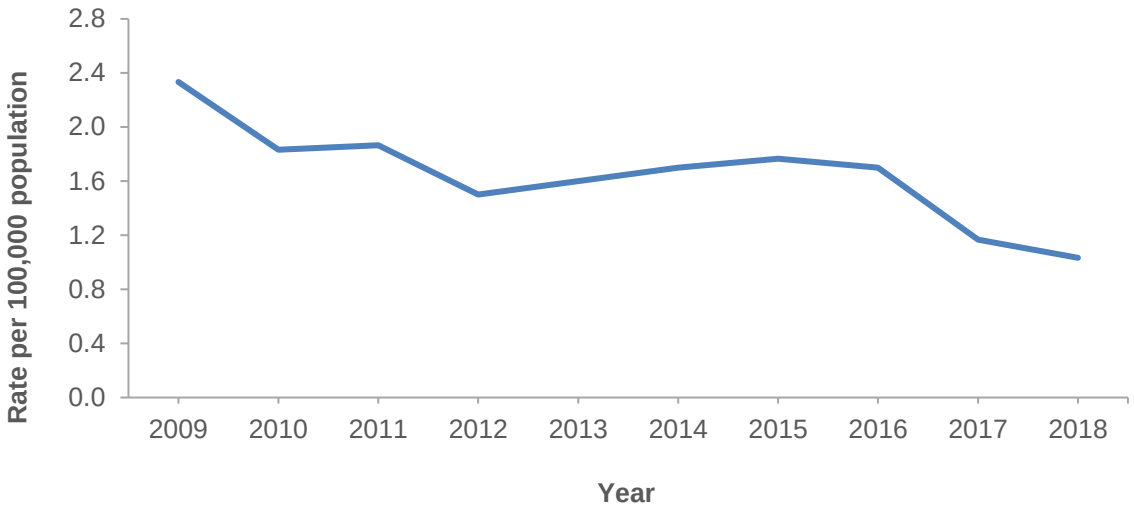
per 100,000 for 2009–2017 (Figure 4). However, despite overall decreasing trends for those aged ≥60 years during 2009- 2017, there has been an increase since 2016.

Figure 4. Tuberculosis (new case) notification rates by age group and year, 2009–2018



In 2018, the rate of new TB cases in New Zealand-born children aged less than 15 years, an indirect indicator of recent transmission within the country, was 0.9 per 100,000 (6 cases). This was similar to the 2017 rate of 0.8 per 100,000 (5 cases). The low numbers (5–18 cases a year from 2007 to 2018) mean that the trend is better assessed by calculating a three-year moving average annual rate. The three-year moving average annual rate has gradually decreased from 2.3 per 100,000 in 2009 to 1.0 per 100,000 in 2018 (Figure 5).

Figure 5. Three-year moving average annual rates of tuberculosis (new cases) in New Zealand-born children (<15 years old), 2009–2018

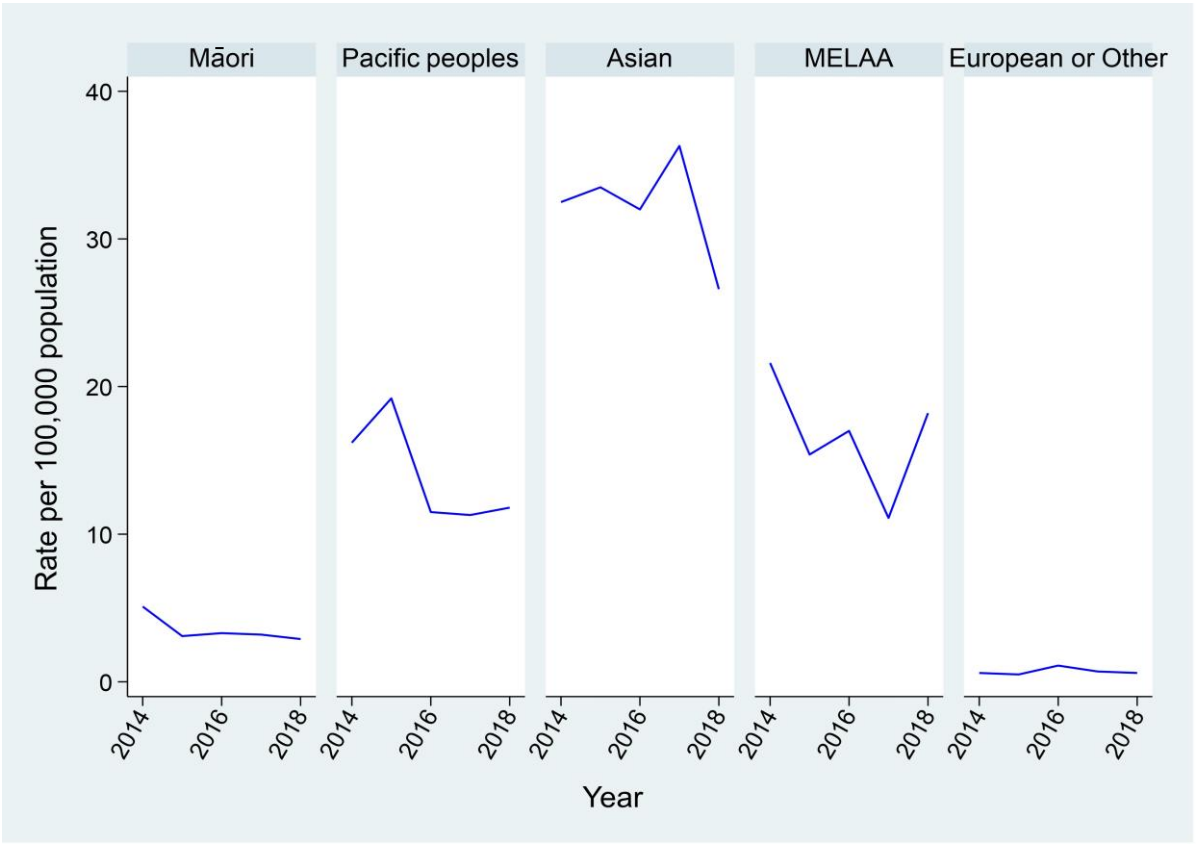


Ethnicity

Ethnicity was recorded for 98.3% (292/297) of the new TB cases notified in 2018. The Asian ethnic group had the highest notification rate (26.6 per 100,000), followed by MELAA (18.2 per 100,000), Pacific peoples (11.8 per 100,000), Māori (2.9 per 100,000) and European or Other (0.6 per 100,000) ethnic groups (Table 13).

Between 2014 and 2018, the Asian and MELAA ethnic groups had the highest rates, apart from in 2015 when Pacific peoples had the second highest rate ahead of MELAA (Figure 6, Table 13). The trend data for the MELAA ethnic group should be interpreted with caution as the number of cases each year are low (7–13 cases annually) and therefore prone to fluctuations in the rate.

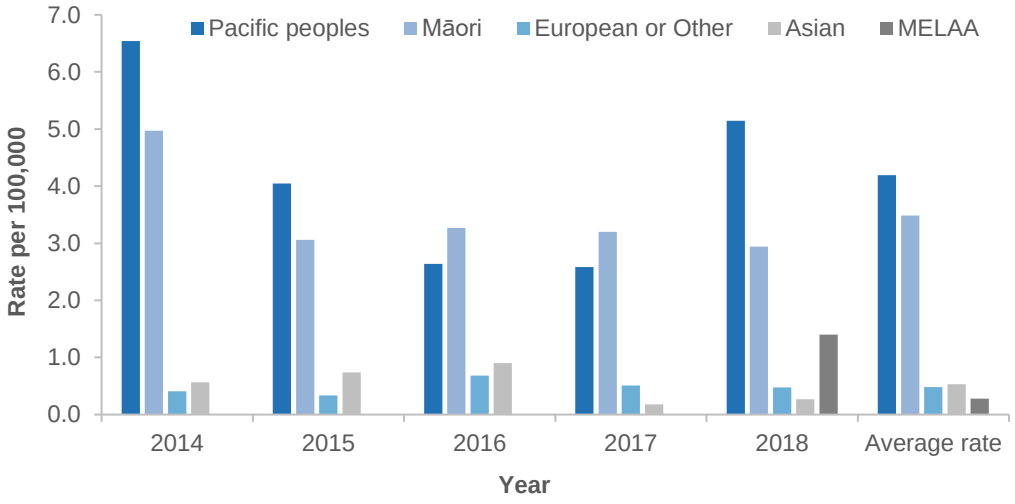
Figure 6. Tuberculosis (new case) notification rates by ethnic group and year, 2014–2018



Born in New Zealand

There were 58 new TB cases in 2018 who were born in New Zealand, a rate of 1.6 per 100,000. Of these, 24 (41.3%) were in the Māori ethnic group, 17 (29.3%) Pacific peoples, 14 (24.1%) European or Other, two (3.4%) Asian and one (1.7%) MELAA. Incidence rates in 2018 for New Zealand-born new TB cases were highest for Pacific peoples (5.1 per 100,000) and Māori (2.9 per 100,000). In contrast, the rate for European or Other was only 0.5 per 100,000. Similarly, for 2014–2018, the average rates by ethnicity for New Zealand-born cases were highest in Pacific peoples (4.2 per 100,000) and Māori (3.5 per 100,000) while the lowest rates were in European or Other and Asian with 0.5 per 100,000 each (Figure 7). For those 2014–2018 cases born in New Zealand, the burden of disease was highest in Counties Manukau (59 cases) DHB followed by Waikato (30 cases), Auckland (29 cases) and Waitemata, Hawke's Bay and Capital & Coast (23 cases each) DHBs (Table 14).

Figure 7. Tuberculosis (new case) notification rates for New Zealand born cases by ethnicity, 2014–2018



Hospitalisations

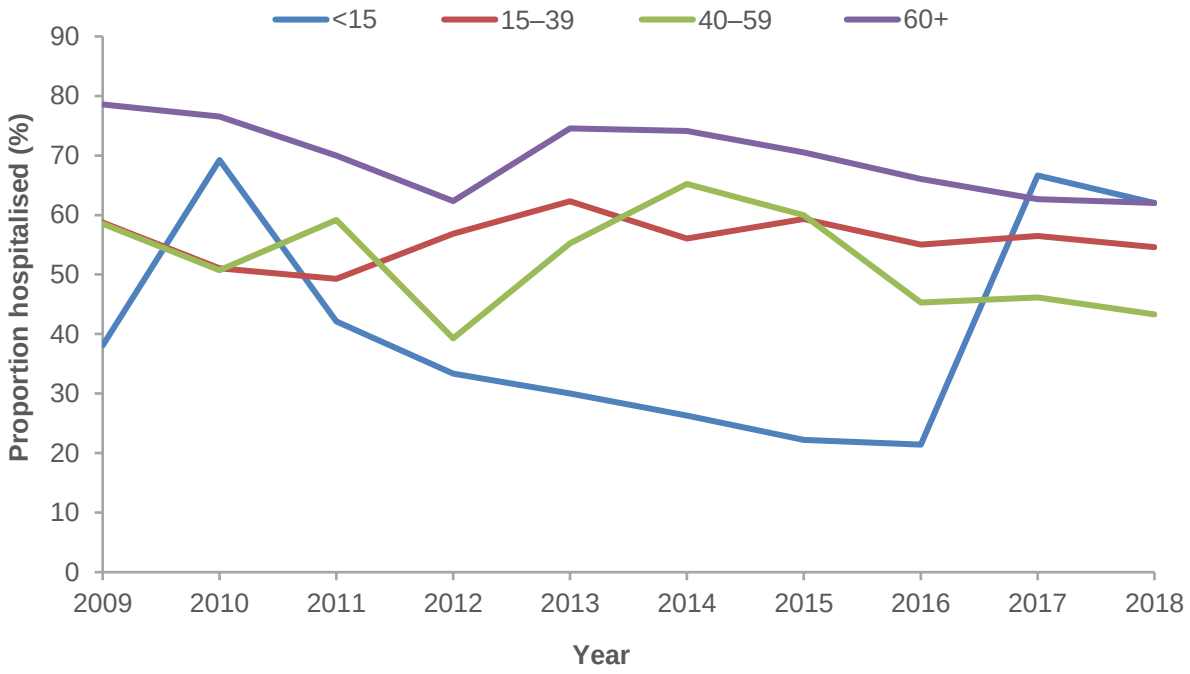
Hospitalisation status was provided for 99.7% (296/297) of the new TB cases notified in 2018, of which 54.1% (160/296) were hospitalised. More than half of the cases were hospitalised in each of the following age groups: 5–14 years (62.5%), >60 years (62.0%) and 15–39 years (54.6%) (Table 4).

Table 4. Hospitalisations for tuberculosis (new case) by age group, 2018

Age group (years)	Hospitalised		
	Yes	No	% (yes)
<5	0	1	0.0
5–14	5	3	62.5
15–39	77	64	54.6
40–59	29	38	43.3
≥60	49	30	62.0

The proportion of cases aged <15 years that were hospitalised decreased from 2010 to 2016 but increased in 2017 and remained high in 2018 (Figure 8). The trend data for the <15 years age group should be interpreted with caution as the number of hospitalisations each year are low (2–9 hospitalisations annually) and therefore prone to fluctuations in the proportion.

Figure 8. Hospitalisation rates for tuberculosis (new case) by age group and year, 2009–2018



Deaths

There were four deaths where TB was the primary cause of death among the 297 new TB cases notified in 2018. Three deaths were in the ≥60 years age group, and one was aged 40–59 years. In the last 10 years (2009−2018), 41 deaths were reported among new TB cases, giving a case fatality rate of 1.4% (41/2870). The majority (97.6%, 40/41) of deaths were in cases aged ≥20 years and one death was in a child aged <5 years.

Between 2009 and 2017, the most recent year for which data is available, TB was recorded in the Ministry of Health's mortality dataset as the underlying cause of death for 56 deaths. During this period, 4–11 TB deaths were recorded each year, all in adults. The majority of deaths (89.3%, 50 deaths) were in people aged ≥50 years.

Protective factors

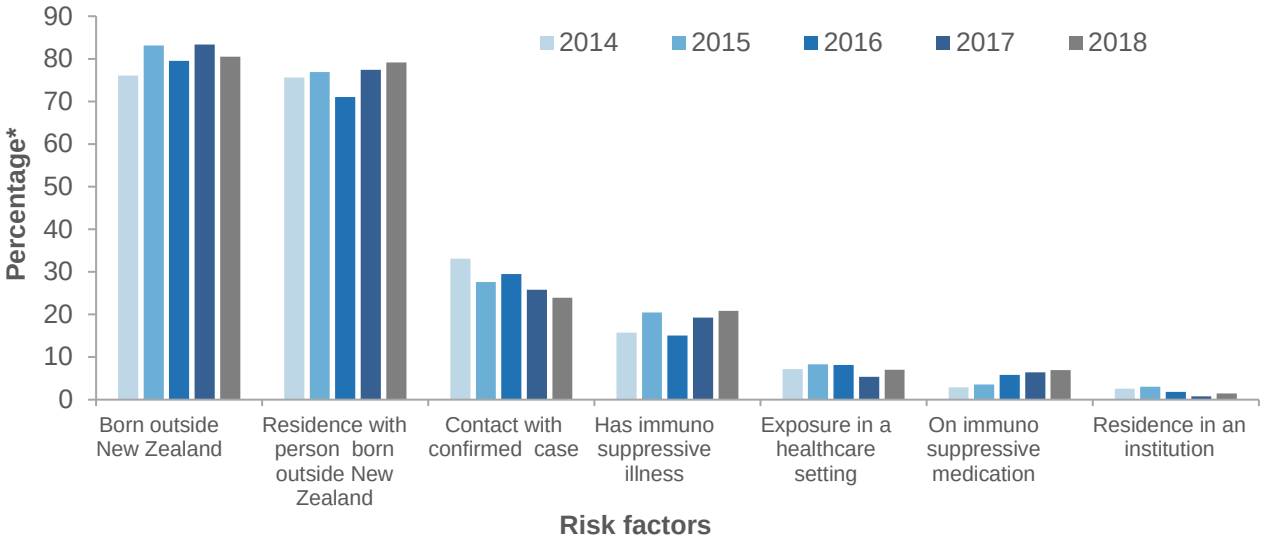
Immunisation of neonates with the Bacillus Calmette-Guérin (BCG) vaccine was introduced in New Zealand in 1976. As New Zealand is a low endemicity country, vaccination is only recommended for neonates at increased risk of exposure to TB and is primarily given to protect young children from developing severe disease, particularly miliary TB and tuberculous meningitis. An ongoing global shortage of BCG vaccine since 2015 has led to postponement of vaccination clinics.

In 2018, there was one new TB case aged <5 years. The case was born in New Zealand and had pulmonary disease. They had not received the BCG vaccine. The child was of Pacific ethnicity, aged 3 years and had a sibling who was a confirmed case. Insufficient information was available in EpiSurv to ascertain whether the child was eligible for the high-risk immunisation programme [11].

Risk factors

In 2018, the most common risk factors reported for new TB cases were being born outside New Zealand (80.5%, 239/297) and current/recent residence with person(s) born outside New Zealand (79.2%, 224/283) (Figure 9, Table 5).

Figure 9. Percentage of tuberculosis (new case) notifications by risk factor and year, 2014–2018



*Percentage refers to the number of cases that answered "yes" out of the total number of cases for which the information was known, for the year.

Table 5. Risk factors reported for tuberculosis (new case) notifications, 2018

Risk factor	Cases[a]	Total[b]	%
Born outside New Zealand	239	297	80.5
Current/recent residence with person born outside New Zealand	224	283	79.2
Contact with confirmed case	59	247	23.9
Has immunosuppressive illness	61	293	20.8
Exposure in a healthcare setting	19	270	7.0
On immunosuppressive medication	20	289	6.9
Current/recent residence in an institution	4	279	1.4

[a] Number of cases with 'yes' recorded for the risk factor.
[b] Number of cases for which information was recorded for the risk factor.

Born outside New Zealand

Among the 239 new TB cases who were born outside New Zealand (18.9 per 100,000), cases born in the Southern and Central Asia region had the highest notification rate in 2018 (128.6 per 100,000), followed by South-East Asia (59.2 per 100,000) (Table 6). The vast majority (89.2%, 99/111) of the cases born in the Southern and Central Asia region were born in India. The most commonly reported country of birth for cases born in South-East Asia was the Philippines (57.7%, 30/52) and for cases born in North-East Asia it was China (84.4%, 27/32).

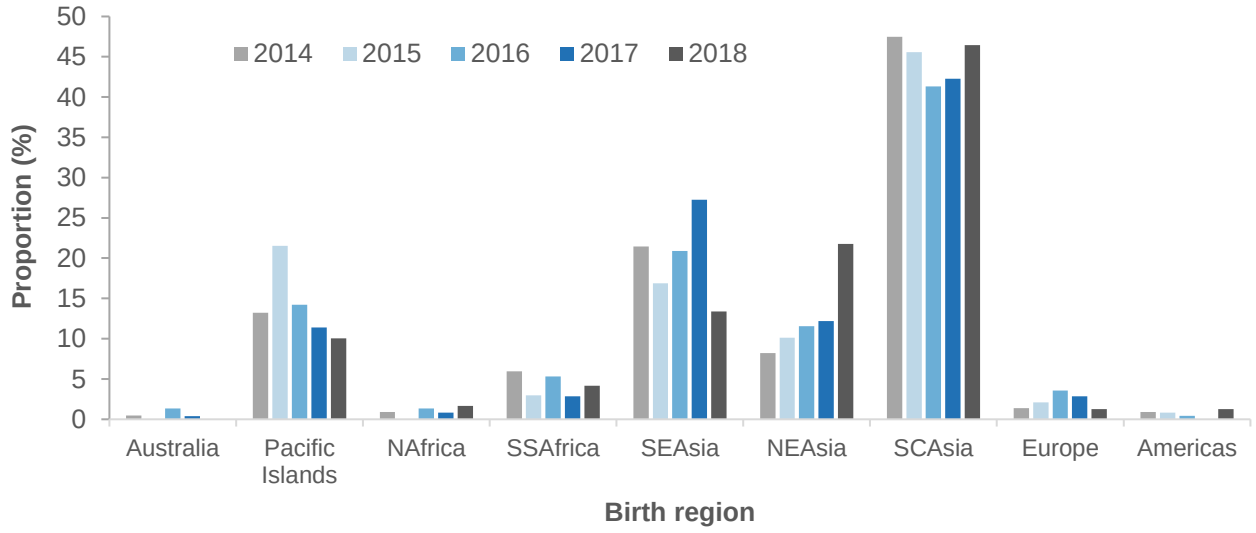
Table 6. Tuberculosis (new case) notifications by region of birth, 2018

Region of birth	Cases	Rate[a]
Born in New Zealand	**58**	**1.9**
Born outside New Zealand	**239**	**18.9**
Southern and Central Asia	111	128.6
South-East Asia	52	59.2
North-East Asia	32	22.5
Pacific Islands	24	15.8
Sub-Saharan Africa	10	13.9
North Africa and the Middle East	4	22.0
Europe	3	-
The Americas	3	-
Australia	0	-
Total	**297**	6.1

[a] Rate per 100,000 population. Population data used for the denominator was derived from the 2013 census usually resident population count by birthplace, published by Statistics New Zealand.

The proportion of new TB cases born overseas varied by region between 2014 and 2018 (Figure 10). An increasing trend occurred for cases born in North East Asia while a largely decreasing trend occurred for cases born in the Pacific Islands.

Figure 10. Percentage of tuberculosis (new case) notifications born outside New Zealand by birth region and year, 2014–2018



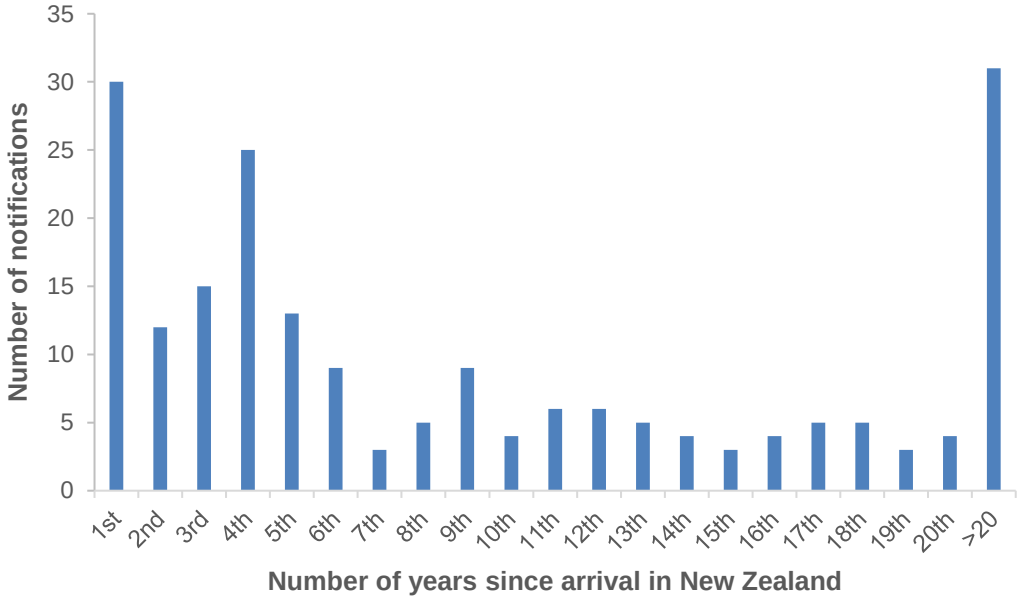
NAfrica – North Africa and the Middle East SSAfrica – Sub-Saharan Africa SEAsia – South-East Asia
NEAsia – North-East Asia SCAsia – Southern and Central Asia
* Number of cases born in a region divided by the total number of cases born outside New Zealand, and for which the country of birth is known, for the year.

Time since arrival in New Zealand

The date of arrival in New Zealand was recorded for 84.1% (201/239) of the new TB cases in 2018 who were born outside New Zealand. The time between the date of arrival in New Zealand and the date of TB notification ranged from 0 to 67 years (mean 10.5 years and median 5 years). TB notification occurred in the first year after arrival for 14.9% (30/201) of cases born outside New Zealand (Figure 11) and for 47.3% (95/201) within the first five years after arrival.

Between 2014 and 2018, the annual median time between arrival in New Zealand and the date of TB notification was between four and five years. The annual mean ranged between 7.2 and 10.5 years.

Figure 11. Tuberculosis (new case) notifications born outside New Zealand by time since arrival in New Zealand, 2018



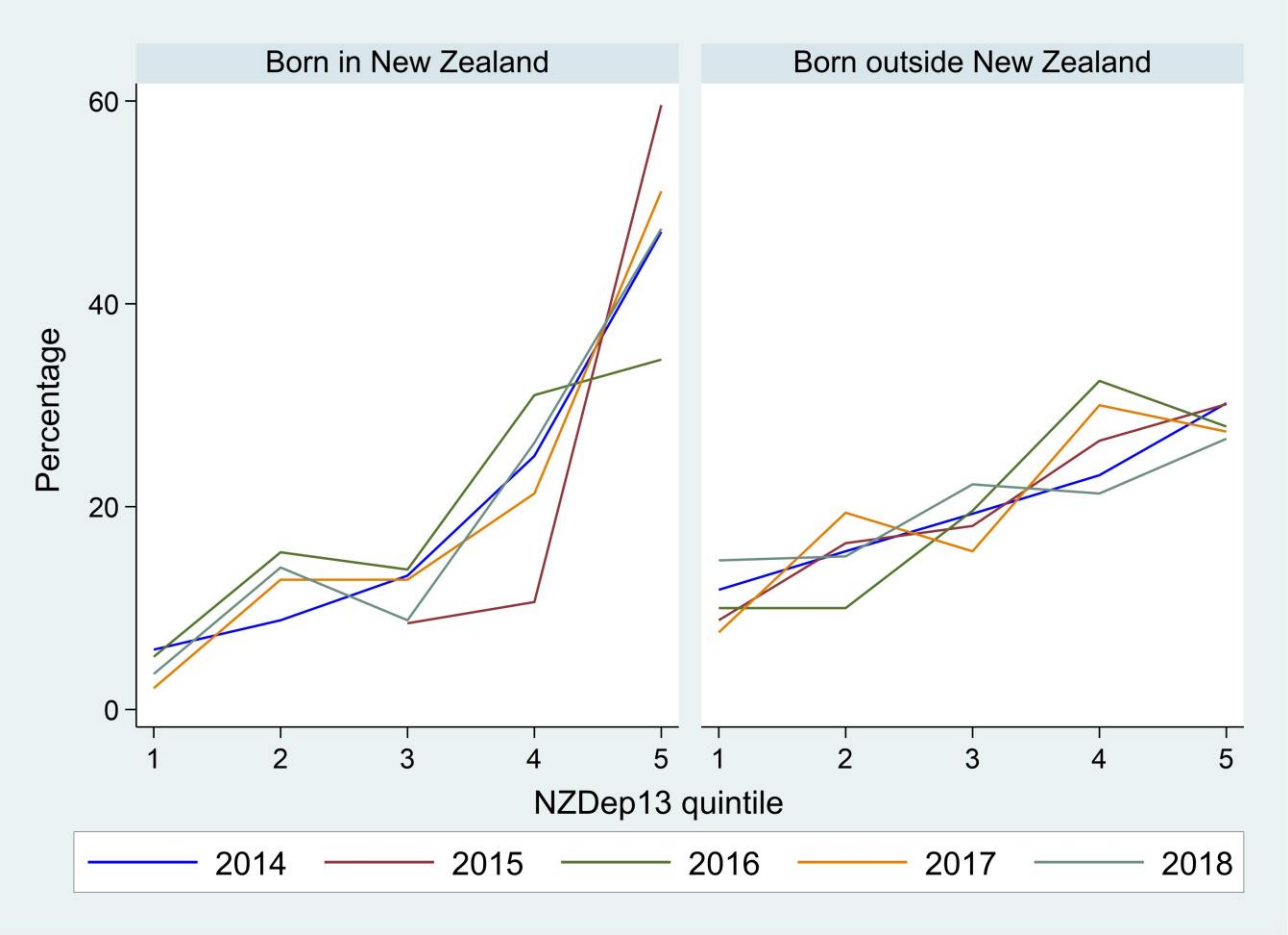
Note: The date of arrival was not recorded for 37 cases. Number of years: 1st: < 1 year after arrival, 2nd: 1–< 2 years after arrival, 3rd: 2–< 3 years after arrival etc.

Socioeconomic deprivation

In 2018, 94.9% (282/297) of new TB cases were assigned a New Zealand Index of Deprivation 2013 (NZDep2013) score. Of the 282 cases, 150 (53.2%) lived in the most deprived areas (NZDep2013 quintile 4 or 5). The rate for new TB cases in the most deprived quintile of the population was two and a half times the rate in the least deprived quintile (10.4 compared with 4.0 per 100,000).

Figure 12 shows the relationship between deprivation and the percentage of new TB cases in the last five years. Of the 1396 (96.5%) cases with available information, 277 (19.8%) cases were born in New Zealand and 1119 (80.2%) were born outside New Zealand. A higher proportion of new TB cases was reported from more deprived areas irrespective of their place of birth. This trend was more pronounced for cases born in New Zealand.

Figure 12. Percentage of tuberculosis (new case) notifications by birthplace category, NZDep2013 and year, 2014−2018

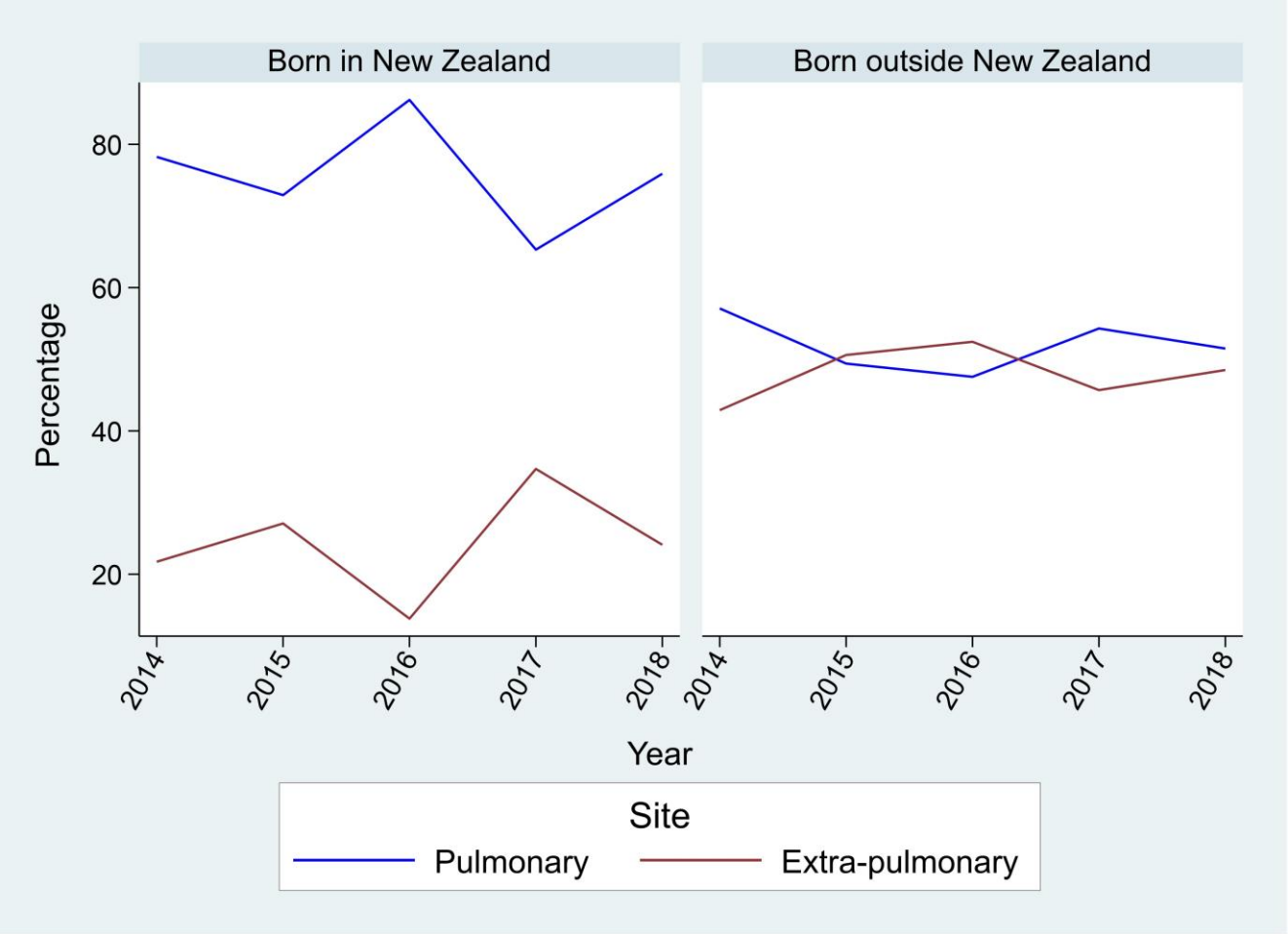


Site of infection

In 2018, 167 (56.2%) new TB cases had pulmonary (including laryngeal) disease. Of these, 124 had pulmonary disease only and 43 had both pulmonary and extra-pulmonary involvement. A further 130 cases (43.8%) had only extra-pulmonary involvement and were therefore unlikely to be infectious.

Between 2014 and 2018, there were 1447 new TB cases notified, of which 282 were born in New Zealand and 1165 were born outside New Zealand. Cases born in New Zealand were more likely to be reported with reported with pulmonary disease (76.2%, 215 cases) than extra-pulmonary disease only (23.8%, 67 cases), while new TB cases born outside New Zealand had similar proportions of pulmonary disease (51.9%, 605 cases) and extra-pulmonary disease (48.1%, 560 cases) (Figure 13).

Figure 13. Tuberculosis (new case) notifications by site of infection, birthplace category and year, 2014–2018



Of the 167 new TB cases in 2018 with pulmonary disease, 162 had information on whether acid-fast bacilli were demonstrated in a direct smear of a clinical specimen from a pulmonary or laryngeal site. Of these, 78 (48.1%) were smear positive, with sputum reported as the specimen site for 76.9% (60/78) of these cases.

Of the 173 cases with extra-pulmonary involvement in 2018, 87 (50.3%) had lymph node (excluding abdominal) recorded as a site of infection (Table 15). Twenty-two cases of central nervous system TB were reported in 2018 (20 aged ≥20 years, one aged 10–14 and one aged 15–19 years). Eight cases of miliary TB were reported, all aged ≥20 years. Five miliary TB cases had an underlying immunosuppressive illness (arthritis, ankylosing spondylitis, diabetes, HIV and renal failure).

Between 2014 and 2018, the most common site of infection for cases with extra-pulmonary involvement was lymph node (excluding abdominal) (49.6%), followed by pleural (16.2%) and intra-abdominal (excluding renal) (10.7%) (Table 15). There were 68 cases of central nervous system (CNS) TB (one case of tuberculous meningitis aged 10–14 years). The number of cases of reported with CNS as a site of infection increased from 8 cases in 2014 to 22 in 2018. A total of 39 cases of miliary TB were recorded between 2014 and 2018. Of these, two were aged <5 years and neither had received the BCG vaccine.

Immunosuppressive illness and HIV status

In 2018, 61 new TB cases were reported to have an immunosuppressive illness. Of these, 15 cases were on immunosuppressive medication. Information on the illness was provided for 60 cases, with 34 (56.7%) reported as having diabetes.

Information on whether an HIV test was done was available for all 297 new TB cases. Of these, 85.2% (253 cases) were tested for HIV. One case was co-infected with HIV in 2018.

Receipt of treatment

In 2018, 96.0% (285/297) of new TB cases received treatment. Onset dates were reported for 203 (71.2%) of the cases who received treatment, thereby allowing calculation of the time between the onset of symptoms and start of treatment. Of these, 16.7% (34/203) started treatment within one month of the onset of symptoms and a further 38.9% (79/203) started treatment between one and three months. The median interval to the start of treatment was 77 days from the onset of symptoms.

A treatment delay for patients with pulmonary TB represents a risk to public health from disease transmission. In 2018, 97.0% (162/167) of new TB cases with pulmonary disease were reported to have received treatment. The interval between the onset of symptoms and the start of treatment could be calculated for 104 (64.2%) of these cases. Among these, 22.1% (23/104) started treatment within one month of the onset of symptoms and 40.4% (42/104) started treatment between one and three months. Between 2014 and 2017, treatment within one month ranged from 21.2% in 2016 to 35.0% in 2014, and treatment between one and three months ranged from 36.9% in 2015 to 45.5% in 2016. The median interval to the start of treatment was 66 days from the onset of symptoms. Between 2014 and 2017 the median interval to the start of treatment ranged from 42 days in 2015 to 76 days in 2016.

Treatment outcomes for cases notified in 2017

Due to the length of time taken for TB treatment to be completed, data presented in this section is for the 294 new TB cases notified in 2017. Of these, 98.3% (289/294) were reported to have received appropriate treatment for TB (Table 7). Most of these cases (90.0%, 260/289) completed treatment to the satisfaction of the prescribing doctor. Of these 260 new TB cases, 49.6% (129/260) received directly observed therapy (DOT) during the intensive phase of their treatment. A lower proportion of cases born outside New Zealand were reported to have received DOT during the intensive phase of their treatment (49.1%) than those born in New Zealand (53.2%). However, those born overseas accounted for 80.6% of the overall usage of intensive phase DOT and for pulmonary disease, 68.2% of cases born outside New Zealand received DOT during the intensive phase of their treatment, compared to 54.8% for cases born in New Zealand.

Table 7: Treatment outcomes for tuberculosis (new cases) notified in 2017

Treatment outcomes for new TB cases	Cases	%
Received treatment	**289**	98.3
Treatment completed to satisfaction of doctor	260	90.0
Treatment ended earlier than planned	**29**	10.0
Case transferred to overseas medical care	16	5.5
Case went overseas (medical care not transferred or unknown)	6	2.1
Treatment was stopped because of adverse effects	3	1.0
Case died	3	1.0
Case refused to complete treatment	1	0.3

Treatment for the remaining 10.0% (29/289) cases was ended earlier than planned for the following reasons: case transferred to overseas medical care (5.5%, 16/289), case went overseas (medical care not transferred or unknown) (2.1%, 6/289), case died (1.0%, 3/289), treatment was stopped because of adverse effects (1.0%, 3/289), and case refused to complete treatment (0.3%, 1/289).

Five cases were reported as receiving no treatment: three cases went overseas, and two cases died before treatment was initiated and/or the diagnosis was post-mortem.

TUBERCULOSIS DISEASE – RELAPSES OR REACTIVATIONS

Ten TB relapse/reactivation cases were notified in 2018. This category of disease can also include cases of re-infection. The number of TB relapse/reactivation cases has remained low over the last 10 years (2009–2018) ranging from 8 to 14 cases a year (Figure 14).

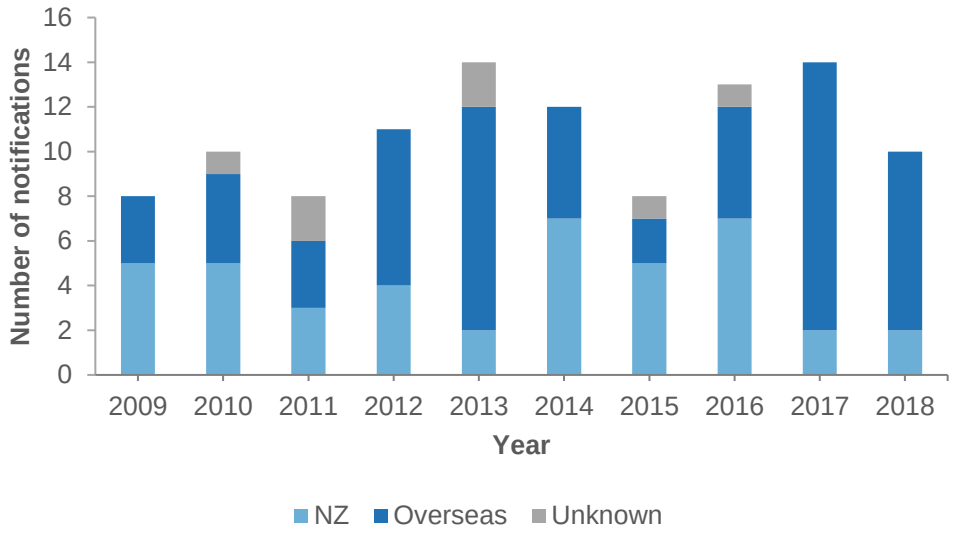
In 2018, TB relapse/reactivation cases were reported from the following six DHBs: Auckland (3 cases), Counties Manukau and Capital & Coast (2 cases each), Waikato, Lakes, and Taranaki (1 case each). The cases were aged 30–39 years (4 cases), 20–29 years (2 cases), 70+ years (2 cases), 50–59 and 60–69 years (1 case each). Eight relapse/reactivation cases were of Asian ethnicity, one was European or Other and one was MELAA. Eight of the relapse/reactivation cases were hospitalised and no deaths were reported.

Information about the place of birth, place of original diagnosis and whether the case had been previously treated for TB was recorded for nine (90%) cases. Of these, one case was born and originally diagnosed with extra-pulmonary TB in New Zealand. Of the eight cases born overseas, one was previously diagnosed in New Zealand with extra-pulmonary disease, treated for six months and did not receive DOT, and seven cases were previously diagnosed overseas and had received treatment for a period of six months (3 cases), 9 months (1 case), 12 months (2 cases) and 14 months (1 case).

Nine relapse/reactivation cases could be assigned a NZDep2013 score. Four cases (44.4%) lived in the most deprived areas (NZDep2013 quintiles 4 and 5).

Information on previously treatment was not recorded for one case in 2018, however, the case had a previous diagnosis in 1962.

Figure 14. Tuberculosis (relapse/reactivation) notifications by place of original diagnosis, 2009−2018



OUTBREAKS

No TB outbreaks were reported in New Zealand in 2018.

CULTURE CONFIRMATION, SPECIATION AND DRUG SUSCEPTIBILITY

Data presented in this section was collected from the mycobacteriology laboratories at Auckland City Hospital (LabPlus), Waikato Hospital and Canterbury Health Laboratories.

CULTURE CONFIRMATION AND SPECIATION

In 2018, 238 new TB cases were culture positive. The mycobacterial species identified among these new cases was either *M. tuberculosis* (236 cases) or *M. bovis* (2 cases). Of the new TB cases with pulmonary disease 90.4% (150/166) were culture positive, with 149 cases due *to M. tuberculosis* and one case due to *M. bovis*.

Of the 10 TB relapse/reactivation cases notified in 2018, eight were culture positive, all of which were due to *M. tuberculosis*.

Fewer than five cases of culture-positive TB due to *M. bovis* were reported each year between 2014 and 2018.

DRUG SUSCEPTIBILITY

Antimicrobial susceptibility data was available for the isolates from 244 (236 new cases and 8 relapses/reactivations) culture-positive TB cases in 2018. The proportion of isolates resistant to the five antimicrobials routinely tested is shown in Table 8.

Table 8: Antimicrobial resistance of tuberculosis isolates by species, 2018

Antimicrobial	Resistant[a]					
	***M. tuberculosis* complex** *n* = 242		***M. bovis*** *n* = 2		**All isolates** *n* = 244	
	No.	**%**	**No.**	**%**	**No.**	**%**
Isoniazid (0.1 mg/L)	20	8.3	0	-	20	8.2
Isoniazid (0.4 mg/L)[b]	18	7.4	0	-	18	7.4
Rifampicin	2	0.8	0	-	2	0.8
Ethambutol	2	0.8	0	-	2	0.8
Pyrazinamide	8	3.3	1[c]	100	9	3.7
Streptomycin	23	9.5	0	-	23	9.4

[a] Includes resistance alone or in combination with other antimicrobials.

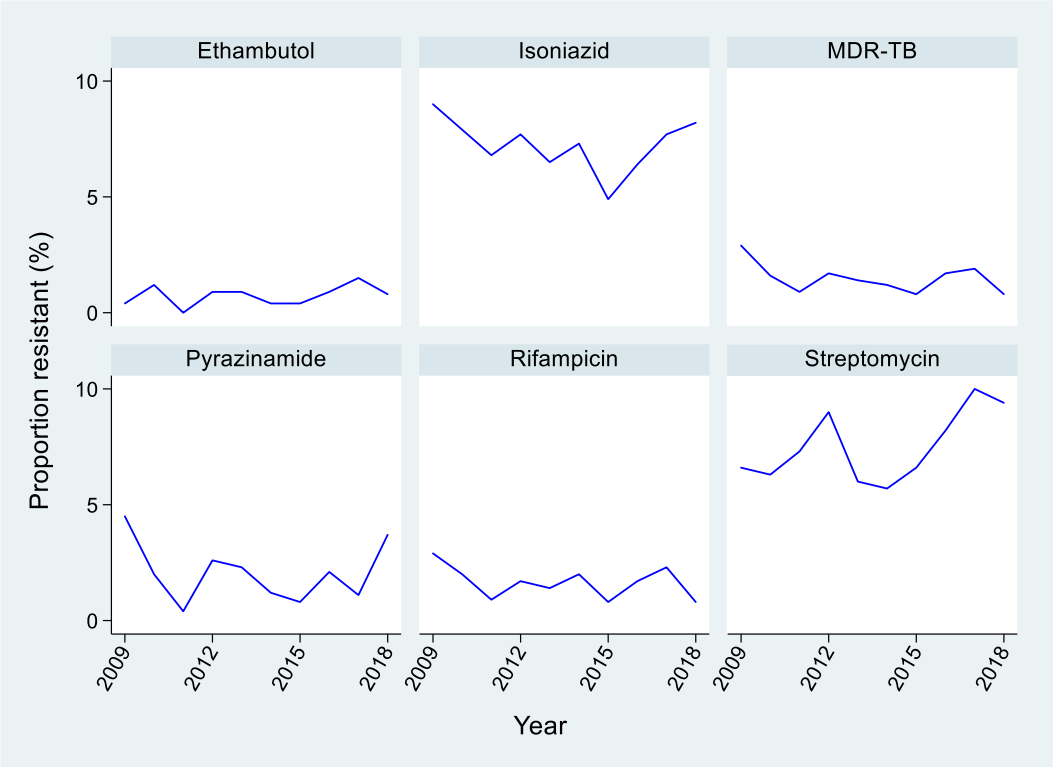
[b] All isolates resistant to isoniazid at the standard breakpoint concentration of 0.1 mg/L were also tested at the higher concentration of 0.4 mg/L.

[c] *M. bovis* is intrinsically resistant to pyrazinamide.

.

From 2009 to 2018, there were no significant trends in pyrazinamide, isoniazid, rifampicin, ethambutol or streptomycin resistance (Figure 15).

Figure 15. Antimicrobial resistance of tuberculosis isolates by antimicrobial and year, 2009−2018



*Isoniazid and rifampicin resistant isolates are defined as multidrug-resistant tuberculosis (MDR-TB).

In 2018, 83.2% (203/244) of isolates were fully susceptible to all five routinely tested antimicrobials. There were two (0.8%) cases of multidrug-resistant tuberculosis (MDR-TB, defined as resistance to at least isoniazid and rifampicin) (Table 9). Both of the MDR-TB were new TB cases. In addition to the two MDR-TB isolates, nine isolates were resistant to isoniazid and streptomycin, but not rifampicin.

Table 9. Antimicrobial resistance patterns for tuberculosis isolates, 2018

	Resistance pattern[a]	% (number) of isolates with each pattern	
Fully susceptible		**83.2**	**(203)**
Resistant to 1 agent		**12.3**	**(30)**
	S	5.3	(13)
	H	3.7	(9)
	Z[b]	3.3	(8)
Resistant to 2 agents		**3.7**	**(9)**
	HS	3.7	(9)
Resistant to 3 agents		**-**	**(0)**
Resistant to 4 agents		**0.8**	**(2)**
	HRES[c]	0.4	(1)
	HREZ[c]	0.4	(1)

[a] H, isoniazid resistance at the standard concentration of 0.1 mg/L; R, rifampicin; E, ethambutol; Z, pyrazinamide; S, streptomycin.
[b] Of the eight isolates with monoresistance to pyrazinamide: two were *M. bovis* and six were *M. tuberculosis*.
[c] MDR-TB, multidrug-resistant tuberculosis defined as resistant to at least isoniazid and rifampicin.

During the last 10 years there have been a total of 36 cases of MDR-TB, giving an average annual rate of 1.5% among culture-positive TB cases. MDR-TB isolates are tested for susceptibility to an extended range of antibiotics to detect extensively drug-resistant TB (XDR-TB, defined as MDR-TB with additional resistance to any fluoroquinolone and at least one of the following second-line injectable drugs: amikacin, capreomycin or kanamycin). Only one case of XDR-TB has been identified in New Zealand (in 2010).

Table 10 compares antimicrobial resistance among isolates from cases born in New Zealand and cases born overseas. While resistance to all routinely tested antimicrobials was higher among overseas-born cases, due to small numbers the difference was only significant for isoniazid ($p = 0.029$) and streptomycin ($p = 0.018$).

Table 10. Antimicrobial resistance of tuberculosis isolates by birthplace category, 2018

Antimicrobial resistance	Born in New Zealand (*n* = 44)		Born overseas (*n* = 200)		*p*-value[a]
	No.	%	No.	%	
Fully susceptible					
	43	97.7	160	80.0	0.003
Resistant to:[b]					
Isoniazid[c]	0	-	20	10.0	0.029
Rifampicin	0	-	2	1.0	1.000
Ethambutol	0	-	2	1.0	1.000
Pyrazinamide	1	2.3	8	4.0	1.000
Streptomycin	0	-	23	11.5	0.018
MDR-TB[d]					
	0	-	2	1.0	1.000

[a] Rates compared by the Chi-square test or Fisher's Exact test, as appropriate.
[b] Includes resistance alone or in combination with other antimicrobials.
[c] Isoniazid resistance at the standard concentration of 0.1 mg/L.
[d] Multidrug-resistant tuberculosis, defined as resistant to at least isoniazid and rifampicin.

Both MDR-TB cases identified in 2018 were born overseas. All 36 MDR-TB cases that have occurred in the last 10 years were born overseas and were assumed to have acquired MDR-TB overseas. The majority (30/36, 83.3%) were born in Asia.

Isoniazid and streptomycin resistance were most frequent among isolates from cases of Asian ethnicity (Table 11). One MDR-TB case was of Asian ethnicity and one was MELAA.

Table 11. Antimicrobial resistance of tuberculosis isolates by ethnic group, 2018

Antimicrobial resistance	Māori (*n* = 19)		Pacific peoples (*n* = 33)		Asian (*n* = 165)		MELAA[a] (*n* = 12)		European or Other (*n* = 11)		Unknown (*n* = 4)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Fully susceptible												
	18	94.7	32	97.0	130	78.8	8	66.7	11	100.0	4	100.0
Resistant to:[b]												
Isoniazid[c]	0	-	0	-	18	11.0	2	16.7	0	-	0	-
Rifampicin	0	-	0	-	1	0.6	1	8.3	0	-	0	-
Ethambutol	0	-	0	-	1	0.6	1	8.3	0	-	0	-
Pyrazinamide	1	5.3	1	3.0	5	3.0	2	16.7	0	-	0	-
Streptomycin	0	-	0	-	21	12.7	2	16.7	0	-	0	-
MDR-TB[d]												
	0	-	0	-	1	0.6	1	8.3	0	-	0	-

[a] Middle Eastern/Latin American/African (MELAA).
[b] Includes resistance alone or in combination with other antimicrobials.
[c] Isoniazid resistance at the standard concentration of 0.1 mg/L.
[d] Multidrug-resistant tuberculosis, defined as resistant to at least isoniazid and rifampicin.

In 2018, 3.3% (8/245) of culture-positive cases were TB relapses/reactivations. Because the number of cases notified as TB relapses/reactivations in any one year is small, the following analysis of drug resistance among relapses/reactivations is for the five years from 2014 to 2018. During this period, 3.4% (42/1231) of the culture-positive cases for which susceptibility data was available, were reported to be relapses/reactivations. Information about previous treatment was recorded for 30 of the 42 relapses/reactivations cases, and 30 were recorded as having previously received anti-tuberculosis drug treatment.

Antimicrobial resistance among new TB cases, cases reported to be relapses/reactivations, is shown in Table 12. Compared with isolates from new cases, isolates from cases reported to be relapses/reactivations were likely to be resistant to isoniazid, although this difference was not significant.

Table 12. Antimicrobial resistance of tuberculosis (new cases, relapses/reactivations and previously treated cases) isolates 2014–2018

Antimicrobial resistance	New cases (*n* = 1186)	Relapse/reactivation cases			
		All (*n* = 41)		Previously treated[a] (*n* = 30)	
	%	%	*p*-value[b]	%	*p*-value[b]
Fully susceptible					
	86.5	82.9	0.488	83.3	0.589
Resistant to:[c]					
Isoniazid[d]	6.7	14.6	0.059	13.3	0.143
Rifampicin	1.4	4.9	0.130	3.3	0.364
Ethambutol	0.8	2.4	0.289	0.0	1.000
Pyrazinamide	1.8	2.4	0.530	0.0	1.000
Streptomycin	8.0	7.3	1.000	6.7	1.000
MDR-TB[e]					
	1.2	4.9	0.097	3.3	0.314

[a] Information on previous treatment was reported for only 30 of the 41 relapse/reactivation cases, 30 of whom were recorded as being treated.

[b] Rate compared with that among new cases by the Chi-square test or Fisher's Exact test, as appropriate.

[c] Includes resistance alone or in combination with other antimicrobials.

[d] Isoniazid resistance at the standard concentration of 0.1 mg/L.

[e] Multidrug-resistant tuberculosis, defined as resistant to at least isoniazid and rifampicin.

MOLECULAR TYPING

TB molecular typing results were available for 99.6% (237/238) of culture-positive new TB cases in 2018. Typing was not performed for the remaining case. Two cases were identified as *M. bovis* and 236 were *M. tuberculosis*. A total of 88 (37.1%) new TB cases had non-unique molecular types and were in 58 separate molecular clusters. No new clusters were identified in 2018.

In the last five years (2014–2018), 1,187 new TB cases had TB molecular typing results, of which 481 (40.5%) had non-unique molecular types and were in 199 separate molecular clusters.

The median cluster size, based on cases in the last five years, was one case (range 1–37)[ii] and 89.9% (179/199) of clusters had fewer than five cases. The remaining 20 clusters were distributed in the following cluster sizes: 5−9 cases (12), 10−19 cases (6) and 20 or more cases (2).

Figure 16 to 21 show the percentage of new TB cases that had non-unique molecular types for subgroups within selected variables between 2014 and 2018 compared with the mean percentage for each variable. Table 16 shows a detailed breakdown of non-unique and unique molecular types for new TB cases by age group, sex, ethnic group, DHB, region of birth, NZDep2013 quintiles and clinical manifestation.

There was a high proportion of cases with non-unique molecular types aged <15 years (80.0%) while all other age groups were around the mean (40.5%). Proportions were similar to the mean in both sexes (Figure 16).

Pacific peoples (78.3%) and Māori (76.3%) ethnic groups also had higher proportions of cases than the mean, whereas the European or Other (37.5%), Asian (28.5%) and MELAA (17.1%) ethnic groups had a lower proportion than the mean (Figure 17).

Figure 16. Percentage of new TB cases with non-unique molecular types by age group and sex, 2014–2018

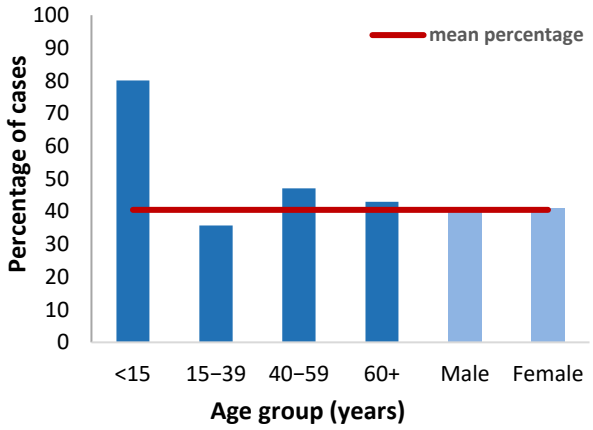
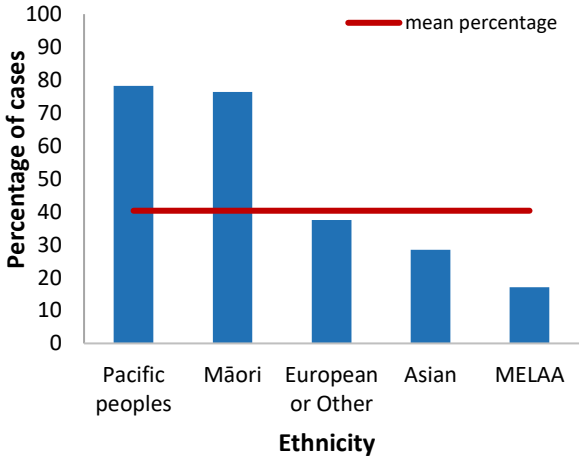


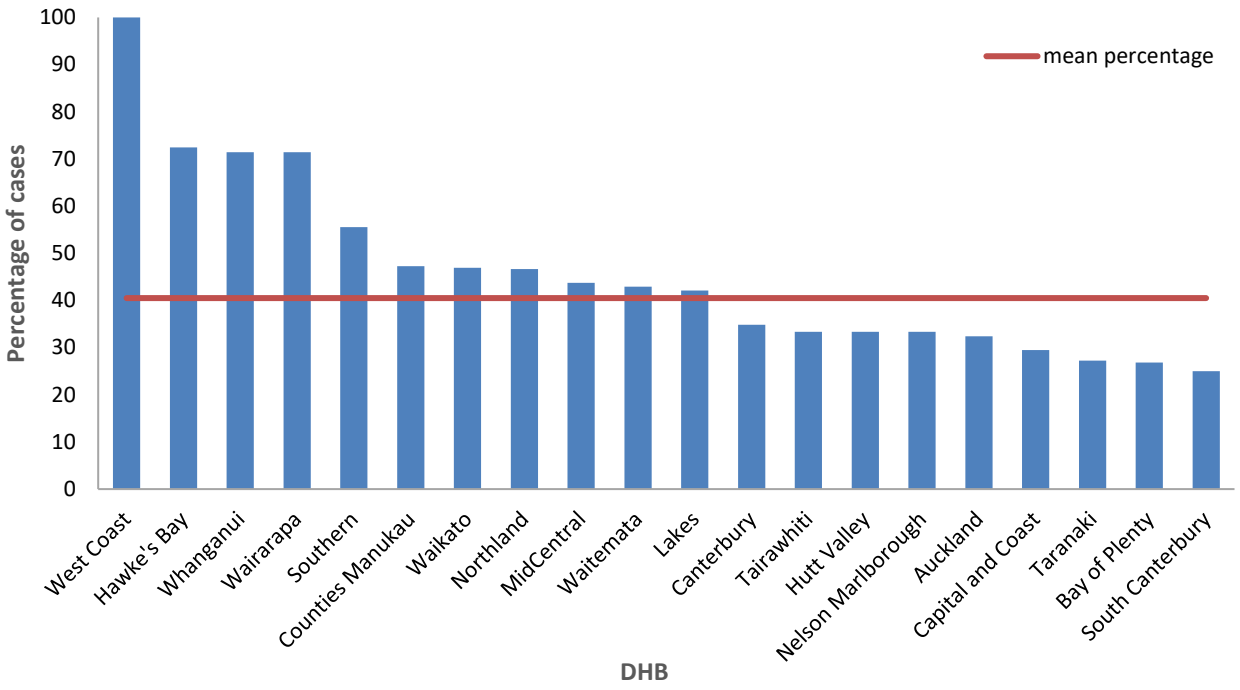
Figure 17. Percentage of new TB cases with non-unique molecular types by ethnic group, 2014–2018



[ii] A cluster can contain just one case when the other cases within that cluster were either not notified on EpiSurv or were notified prior to the last five years.

West Coast (100%), Hawke's Bay (72.4%), Whanganui (71.4%) and Wairarapa (71.4%) DHBs had the highest proportions of cases with non-unique molecular types. Whereas, South Canterbury (25.0%), Bay of Plenty (26.8%) and Taranaki (27.3%) DHBs had the lowest proportions of cases with non-unique molecular types (Figure 18).

Figure 18. Percentage of new TB cases with non-unique molecular types by DHB, 2014–2018



Cases born in the Pacific Islands (73.6%) and New Zealand (70.7%) had a higher proportion of non-unique molecular types than the mean, whereas for other overseas-born cases the proportion was well below the mean (Figure 19).

A high proportion of cases with non-unique molecular types lived in NZDep2013 quintile 5 (more socioeconomically deprived) areas (49.7%) (Figure 20).

Figure 19. Percentage of new TB cases with non-unique molecular types by region of birth, 2014–2018

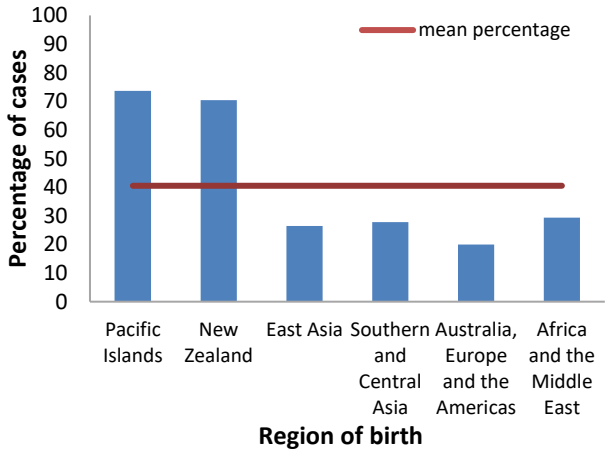
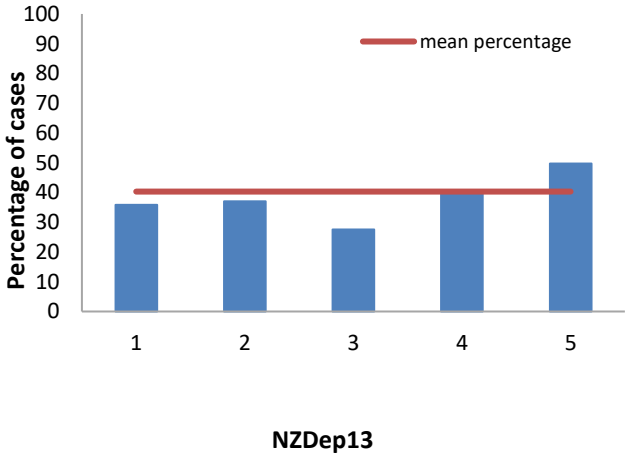
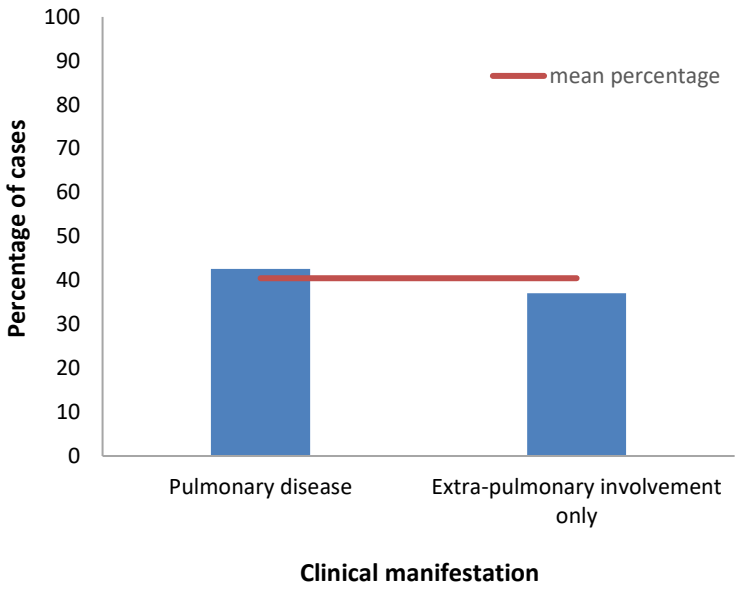


Figure 20. Percentage of new TB cases with non-unique molecular types by NZDep2013, 2014–2018



New TB cases with pulmonary disease (42.6 %) had a higher proportion of non-unique molecular types than cases with extra-pulmonary involvement only (37.1%) (Figure 21).

Figure 21. Percentage of new TB cases with non-unique molecular types by clinical manifestation, 2014–2018



DISCUSSION

The 2018 TB disease notification rate was 6.3 per 100,000 population, similar to the rate recorded in 2017 (6.4 per 100,000). Over the past 10 years, TB notification rates in New Zealand ranged from 6.2 (in 2013) to 7.0 (in 2011) per 100,000. New Zealand meets the World Health Organization (WHO) definition of a low TB incidence country (defined as a TB notification rate of ≤10 cases per 100,000 population a year). The WHO's global TB strategy emphasises the need for low-incidence countries, like New Zealand, to progress towards elimination. A common pattern seen in low endemicity countries, however, is that the rate of decline slows once incidence falls below 10 per 100,000 [1].

PLACE OF RESIDENCE AND ETHNICITY

Counties Manukau, Waitemata, Auckland and Capital & Coast, DHBs had incidence rates above the national rate. These DHBs have large urban populations. The higher incidence in these DHBs may reflect the ethnic makeup of these communities, settlement patterns of migrants from high endemicity countries and housing issues such as overcrowding. In 2018, 53% of TB cases lived in the most deprived areas of New Zealand (NZDep2013 quintile 4 or 5). As with previous years, a clear trend of increasing TB with increasing deprivation was noted.

The incidence rate reported for the Māori ethnic group (2.9 per 100,000) was almost six times higher than the incidence in the New Zealand-born European or Other ethnic group (0.5 per 100,000), but lower than the rate in people born overseas (18.9 per 100,000).

COUNTRY OF BIRTH

In 2018, people born outside New Zealand accounted for 80.5% of notifications of new TB cases. The rate of TB among this population group was about 10 times higher than the rate in those born in New Zealand. During the past 5 years, an average of 80.5% (range: 76–83%) of TB cases notified were born outside of New Zealand, an increase from earlier periods (61% for 1995–1999 and 68% for 2000–2004). The most frequently reported countries of birth were India and the Philippines. This can be explained by the fact that both of these countries have high endemicity and there is a high proportion of people from these ethnic groups in New Zealand.

Although the proportion of cases born overseas has been increasing in New Zealand, the incidence rate in people born overseas in 2018 was 18.9 per 100,000, which is lower than the rates reported for 1995–1999 (31.7 per 100,000) and 2000–2004 (32.3 per 100,000). This decrease may be due to changes in immigration screening practices, as well as the impact of interventions to improve the control of TB transmission both within New Zealand and overseas. However, migration from countries with high TB burden means that there is an ongoing potential source of new TB cases in New Zealand.

CLINICAL PRESENTATION AND TREATMENT

Pulmonary disease was reported in 56% of new TB cases in 2018, the same as in 2017. One new TB case aged <5 years was reported in 2018. The case was born in New Zealand and had pulmonary disease. There was insufficient information to know if the child was eligible for the high-risk immunisation programme.

Nearly all the TB cases notified in 2018 were "new disease" (97%), meaning there was no history of prior treatment. Information about previous diagnosis and treatment was recorded for 9/10 relapse/reactivation cases. For all nine cases with information available, treatment periods for their

previous illness were recorded as being between 6 and 14 months. One of these cases was born, diagnosed and treated in New Zealand for their first TB illness and had received DOT throughout treatment for their original illness. One of the eight overseas-born cases was also diagnosed and treated in New Zealand for their first illness and did not receive DOT throughout treatment for their original illness. The low percentage of relapse/reactivation cases, particularly where the original illness was diagnosed and treated in New Zealand, reflects the low incidence of TB in New Zealand and suggests effective treatment and high treatment compliance.

For all cases notified in 2017, 90% were reported to have completed treatment. There were 29 cases who did not complete treatment, the majority of which (22 cases) went overseas. Three cases died before they were able to finish their treatment.

DRUG SUSCEPTIBILITIES AND MDR-TB

Over the last 10 years from 2009 to 2018, there were significant trends of decreasing pyrazinamide resistance and increasing streptomycin resistance, however further analysis showed both these trends were only evident among isolates from cases born overseas. During the same 10 years, there has been no overall change in the prevalence of pyrazinamide, isoniazid, rifampicin, ethambutol or streptomycin resistance.

There were two MDR-TB cases in 2018, both from individuals born overseas. All the 36 MDR-TB cases reported in New Zealand in the past 10 years were born overseas, the majority in Asian countries, and assumed to have acquired their resistant organisms overseas.

TRANSMISSION AND CONTROL

Recent transmission in low endemicity countries, such as New Zealand, can be assessed by using the rate of TB in children age <15 years born within the country as an indicator [4]. The 2018 rate of TB in New Zealand-born children aged <15 years was 0.9 per 100,000. As case numbers in New Zealand are low, the three-year moving annual average gives a better indication of trends in local transmission. The 2018 three-year moving annual average rate of TB in New Zealand-born children in the <15 years age group was 1.0 per 100,000, a decrease from 2.8 per 100,000 in 2007.

Between 2014 and 2018, 41% of strain typed TB cases in New Zealand were part of a cluster and 89.9% of these clusters had fewer than five cases. During the same period, Public Health England reported higher proportions of strain-typed TB cases that were part of a cluster and lower proportions of these clusters having fewer than five cases [12].

These indicators suggest relatively low and likely decreasing transmission of TB infection within New Zealand, at least partly as a consequence of high-quality contact tracing and rigorous management of cases and contacts. However, it is also noteworthy that cases born in New Zealand and in the Pacific Islands are more likely to be part of a cluster compared with cases born in other overseas regions.

REFERENCES

1. World Health Organization, Tuberculosis surveillance and monitoring in Europe 2020: 2018 data. 2020.
2. Talwar, A., et al., Tuberculosis—United States, 2018. Morbidity and Mortality Weekly Report, 2019. **68**(11): p. 257.
3. Australian Government-Department of Health. National Notifiable Diseases Surveillance System. 2021 [cited 2021 20 July]; Available from: http://www9.health.gov.au/cda/source/rpt_2.cfm.
4. Public Health England, Tuberculosis in England, 2017 report (presenting data to end of 2016). 2017, Public Health England: London.
5. WHO, Global Tuberculosis Report 2018. 2018, World Health Organization: Geneva.
6. WHO, The End TB Strategy. 2015, World Health Organization: Geneva.
7. ESR, Tuberculosis in New Zealand: Annual Report 2017. 2021, Institute for Environmental Science and Research, Ltd: Porirua.
8. Baker, M.G., et al., Increasing incidence of serious infectious diseases and inequalities in New Zealand: a national epidemiological study. The Lancet, 2012. **379**(9821): p. 1112-1119.
9. Ministry of Health, Communicable Disease Control Manual 2012. 2012, Wellington: Ministry of Health.
10. Atkinson J, Salmond C, and Crampton P, NZDep2013 Index of Deprivation. 2014, University of Otago: Wellington.
11. Ministry of Health, Immunisation Handbook 2020. 2020, New Zealand-Wellington.
12. Public Health England, Tuberculosis in England: 2018 report, presenting data to end of 2017. 2018, Public Health England: London.

APPENDIX

Table 13. Numbers and rates of tuberculosis (new cases) notifications by age group, sex, ethnic group, district health board and year, 2014−2018

Category	2014		2015		2016		2017		2018	
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]
Age group (years)										
<5	12	3.9	3	-	6	2.0	3	1.0	1	-
5−14	7	1.2	6	1.0	8	1.3	3	0.5	8	1.2
15−39	141	9.5	145	9.5	160	10.1	169	10.3	142	8.5
40−59	69	5.6	70	5.7	53	4.3	52	4.2	67	5.3
≥60	59	6.6	61	6.6	56	5.9	67	6.8	79	7.9
Sex										
Male	169	7.6	155	6.9	149	6.5	143	6.1	150	6.3
Female	119	5.2	130	5.6	134	5.6	151	6.2	147	6.0
Ethnic group										
Māori	36	5.3	22	3.2	24	3.4	24	3.4	24	2.9
Pacific peoples	47	16.9	57	20.2	35	12.1	35	119	39	11.8
Asian	172	33.5	181	34.4	177	32.9	205	372	198	26.6
MELAA	11	22.0	8	15.7	9	17.2	6	112	13	18.2
European or Other	17	0.6	16	0.5	34	1.1	23	0.7	18	0.6
Unknown	5	-	1	-	4	-	1	-	5	-
District health board										
Northland	7	4.2	2	-	2	-	3	-	3	-
Waitemata	36	6.4	38	6.6	34	5.8	35	5.8	51	8.3
Auckland	69	14.8	62	13.1	54	11.2	58	11.9	35	7.1
Counties Manukau	48	9.4	64	12.2	63	11.7	55	9.9	67	11.8
Waikato	17	4.4	23	5.9	21	5.2	28	6.8	18	4.3
Lakes	5	4.8	7	6.6	6	5.5	2	-	4	-
Bay of Plenty	11	5.0	6	2.7	10	4.3	9	3.7	14	5.6
Tairawhiti	1	-	1	-	1	-	1	-	0	-
Taranaki	3	-	2	-	3	-	4	-	3	-
Hawke's Bay	4	-	9	5.5	16	9.6	12	7.1	6	3.5
Whanganui	1	-	3	-	2	-	0	-	2	-
MidCentral	11	6.4	7	4.0	6	3.4	6	3.4	9	5.0
Hutt Valley	12	8.3	4	-	4	-	15	9.9	7	4.5
Capital & Coast	33	11.1	21	6.9	19	6.2	17	5.5	32	10.1
Wairarapa	1	-	0	-	2	-	4	-	2	-
Nelson	2	-	3	-	4	-	4	-	5	3.2
West Coast	1	-	1	-	1	-	0	-	0	-
Canterbury	23	4.5	26	4.9	26	4.8	33	6.0	27	4.8
South Canterbury	1	-	0	-	2	-	0	-	3	-
Southern	2	-	6	1.9	7	2.2	8	2.4	9	2.7
Total	**288**	**6.4**	**285**	**6.2**	**283**	**6.0**	**294**	**6.1**	**297**	**6.1**

[a] Rate is expressed as cases per 100,000 population. Rates are not presented if there are fewer than five cases.
[b] Population data used to determine the rates for ethnic groups is based on the proportion of people in each ethnic group from the estimated resident 2013 and 2018 census populations applied to the mid-year population estimates. Ethnicity is prioritised and grouped in the following order: Māori, Pacific peoples, Asian, Middle Eastern/Latin American/African (MELAA) and European or Other (including New Zealander).

Table 14. Tuberculosis (new case) notifications for cases born in New Zealand by DHB and year, 2014–2018

District health board	2014	2015	2016	2017	2018	Total
Northland	4	2	0	1	1	**8**
Waitemata	11	2	2	3	5	**23**
Auckland	14	5	4	3	3	**29**
Counties	12	9	12	8	18	**59**
Waikato	4	7	7	9	3	**30**
Lakes	4	2	1	1	2	**10**
Bay of Plenty	1	0	1	3	4	**9**
Tairawhiti	0	1	1	1	0	**3**
Taranaki	0	1	2	1	0	**4**
Hawke's Bay	2	6	7	5	3	**23**
Whanganui	0	0	1	0	2	**3**
MidCentral	1	2	1	2	3	**9**
Hutt Valley	3	0	1	2	3	**9**
Capital & Coast	7	5	4	2	5	**23**
Wairarapa	0	0	2	1	1	**4**
Nelson	0	1	1	0	0	**2**
West Coast	0	0	1	0	0	**1**
Canterbury	3	3	5	5	3	**19**
South	1	0	0	0	0	**1**
Southern	2	2	5	2	2	**13**
Total	**69**	**48**	**58**	**49**	**58**	**282**

Table 15. Tuberculosis (new case) notifications with extra-pulmonary involvement by site of infection and year, 2014–2018

Site of infection	2014		2015		2016		2017		2018		Total (2014–2018)	
	Cases[b]	%	Cases[b]	%	Cases[b]	%	Cases[b]	%	Cases[b]	%	Cases[b]	%
Lymph node (excl. abdominal)	81	48.8	87	47.5	87	51.2	84	50.3	87	50.3	426	49.6
Pleural	25	15.1	34	18.6	25	14.7	33	19.8	22	12.7	139	16.2
Intra-abdominal (excl. renal)	18	10.8	17	9.3	16	9.4	20	12.0	21	12.1	92	10.7
Bone/joint	24	14.5	12	6.6	8	4.7	12	7.2	19	11.0	75	8.7
Renal/genitourinary tract	5	3.0	14	7.7	4	2.4	7	4.2	4	2.3	34	4.0
Soft tissue/skin	5	3.0	16	8.7	14	8.2	11	6.6	7	4.0	53	6.2
Miliary tuberculosis	10	6.0	10	5.5	5	2.9	6	3.6	8	4.6	39	4.5
Central nervous system TB (CNS TB)[C]	8	4.8	10	5.5	11	6.5	17	10.2	22	12.7	68	7.9
Other	18	10.8	14	7.7	16	9.4	3	1.8	4	2.3	55	6.4
Total[a]	**166**	**100**	**183**	**100**	**170**	**100**	**167**	**100**	**173**	**100**	**859**	**100**

[a] Note: Total number of new tuberculosis cases reported with extra-pulmonary involvement, including cases with pulmonary disease.
[b] Some cases had more than one site of infection recorded.
[C] Includes meningitis.

Table 16. Numbers and percentages of non-unique and unique strains for tuberculosis (new case) notifications for selected variables, 2014−2018

Variable[a]	Non-unique		Unique	
	Cases	%[b]	Cases	%[b]
Age group (years)	**481**	**40.5**	**706**	**59.5**
<15	16	80.0	4	20.0
15−39	232	35.8	416	64.2
40−59	114	47.1	128	52.9
≥60	119	43.0	158	57.0
Sex	**481**	**40.5**	**706**	**59.5**
Male	253	40.0	379	60.0
Female	228	41.1	327	58.9
Ethnic group	473	40.3	701	59.7
Maori	71	76.3	22	23.7
Pacific Peoples	144	78.3	40	21.7
Asian	221	28.5	555	71.5
MELAA	7	17.1	34	82.9
European or Other	30	37.5	50	62.5
District Health Board	**481**	**40.5**	**706**	**59.5**
Northland	7	46.7	8	53.3
Waitemata	70	42.9	93	57.1
Auckland	79	32.4	165	67.6
Counties Manukau	120	47.4	133	52.6
Waikato	38	46.9	43	53.1
Lakes	8	42.1	11	57.9
Bay of Plenty	11	26.8	30	73.2
Tairawhiti	1	33.3	2	66.7
Taranaki	3	27.3	8	72.7
Hawke's Bay	21	72.4	8	27.6
Whanganui	5	71.4	2	28.6
MidCentral	14	43.8	18	56.3
Hutt Valley	10	33.3	20	66.7
Capital & Coast	28	29.5	67	70.5
Wairarapa	5	71.4	2	28.6
Nelson Marlborough	4	33.3	8	66.7
West Coast	2	100.0	0	0.0
Canterbury	39	34.8	73	65.2
South Canterbury	1	25.0	3	75.0
Southern	15	55.6	12	44.4
Region of birth	**481**	**40.5**	**706**	**59.5**
New Zealand	145	70.7	60	29.3
Southern and Central Asia	181	27.8	470	72.2
East Asia	28	26.4	78	73.6
Pacific Islands	106	73.6	38	26.4
Africa and the Middle East	15	29.4	36	70.6
Australia, Europe and the Americas	6	20.0	24	80.0
NZ Deprivation Index (2013) quintile	**463**	**40.3**	**685**	**59.7**
1	38	35.8	68	64.2
2	64	37.0	109	63.0
3	54	27.7	141	72.3
4	125	40.6	183	59.4
5	182	49.7	184	50.3
Clinical manifestation	**481**	**40.5**	**706**	**59.5**
Pulmonary disease	312	42.6	420	57.4
Extra-pulmonary only	169	37.1	286	62.9

[a] The total provided for each variable is the number of cases for which the information was recorded.

[b] Percentage of the total number of cases in each sub-category.

Table 17. Regional classification of countries

Country Name	Region
Afghanistan	Southern and Central Asia
Albania	Europe
Algeria	North Africa & Middle East
Angola	Sub-Saharan Africa
Argentina	The Americas
Armenia	Southern and Central Asia
Australia	Australia
Bahrain	North Africa & Middle East
Bangladesh	Southern and Central Asia
Belgium	Europe
Bhutan	Southern and Central Asia
Bolivia	The Americas
Bosnia and Herzegovina	Europe
Botswana	Sub-Saharan Africa
Brazil	The Americas
Brunei Darussalam	South-East Asia
Bulgaria	Europe
Burundi	Sub-Saharan Africa
Cambodia	South-East Asia
Cameroon	Sub-Saharan Africa
Canada	The Americas
Central African Republic	Sub-Saharan Africa
Central and West Africa nfd	Sub-Saharan Africa
Central Asia nfd	Southern and Central Asia
Chad	Sub-Saharan Africa
Chile	The Americas
China, People's Republic of	North-East Asia
Colombia	The Americas
Congo	Sub-Saharan Africa
Congo, the Democratic Republic of the	Sub-Saharan Africa
Cook Islands	Pacific Islands
Costa Rica	The Americas
Croatia	Europe
Cuba	The Americas
Cyprus	Europe
Czech Republic	Europe
Denmark	Europe
Djibouti	Sub-Saharan Africa
East Timor	South-East Asia
Ecuador	The Americas
Egypt	North Africa & Middle East
El Salvador	The Americas
England	Europe
Eritrea	Sub-Saharan Africa
Estonia	Europe

Country Name	Region
Ethiopia	Sub-Saharan Africa
Falkland Islands	The Americas
Fiji	Pacific Islands
Former Yugoslav Republic of Macedonia (FYROM)	Europe
France	Europe
French Polynesia	Pacific Islands
Gambia	Sub-Saharan Africa
Gaza Strip/Palestine/West Bank	North Africa & Middle East
Georgia	Southern and Central Asia
Germany	Europe
Ghana	Sub-Saharan Africa
Greece	Europe
Guyana	The Americas
Hong Kong (Special Administrative Region)	North-East Asia
Hungary	Europe
India	Southern and Central Asia
Indonesia	South-East Asia
Iran	North Africa & Middle East
Iraq	North Africa & Middle East
Ireland	Europe
Isle of Man	Europe
Israel	North Africa & Middle East
Italy	Europe
Japan	North-East Asia
Jordan	North Africa & Middle East
Kazakhstan	Southern and Central Asia
Kenya	Sub-Saharan Africa
Kiribati	Pacific Islands
Korea, Democratic People's Republic of	North-East Asia
Kuwait	North Africa & Middle East
Kyrgyzstan	Southern and Central Asia
Laos	South-East Asia
Lebanon	North Africa & Middle East
Lesotho	Sub-Saharan Africa
Liberia	Sub-Saharan Africa
Libya	North Africa & Middle East
Macau (Special Administrative Region)	North-East Asia
Madagascar	Sub-Saharan Africa
Mainland South-East Asia nfd	South-East Asia
Malawi	Sub-Saharan Africa
Malaysia	South-East Asia
Maldives	Southern and Central Asia
Mali	Sub-Saharan Africa
Marshall Islands	Pacific Islands

Country Name	Region
Mauritius	Sub-Saharan Africa
Mexico	The Americas
Middle East nfd	North Africa & Middle East
Mongolia	North-East Asia
Morocco	North Africa & Middle East
Mozambique	Sub-Saharan Africa
Myanmar	South-East Asia
Namibia	Sub-Saharan Africa
Nauru	Pacific Islands
Nepal	Southern and Central Asia
Netherlands	Europe
New Zealand	New Zealand
Nigeria	Sub-Saharan Africa
Niue	Pacific Islands
North Africa nfd	North Africa & Middle East
Northern America nfd	The Americas
Northern Ireland	Europe
Norway	Europe
Oman	North Africa & Middle East
Pakistan	Southern and Central Asia
Papua New Guinea	Pacific Islands
Peru	The Americas
Philippines	South-East Asia
Poland	Europe
Polynesia (excludes Hawaii) nec	Pacific Islands
Rarotonga	Pacific Islands
Romania	Europe
Russia	Europe
Rwanda	Sub-Saharan Africa
Samoa	Pacific Islands
Samoa, American	Pacific Islands
Saudi Arabia	North Africa & Middle East
Scotland	Europe
Senegal	Sub-Saharan Africa
Serbia and Montenegro	Europe
Sierra Leone	Sub-Saharan Africa
Singapore	South-East Asia
Solomon Islands	Pacific Islands
Somalia	Sub-Saharan Africa
South Africa	Sub-Saharan Africa
South Eastern Europe nfd	Europe
South-East Asia nfd	South-East Asia
Southern and East Africa nec	Sub-Saharan Africa
Southern and East Africa nfd	Sub-Saharan Africa
Spain	Europe
Sri Lanka	Southern and Central Asia

Country Name	Region
Sudan	North Africa & Middle East
Sweden	Europe
Switzerland	Europe
Syria	North Africa & Middle East
Taiwan	North-East Asia
Tanzania	Sub-Saharan Africa
Thailand	South-East Asia
Timor-Leste	South-East Asia
Togo	Sub-Saharan Africa
Tokelau	Pacific Islands
Tonga	Pacific Islands
Tunisia	North Africa & Middle East
Turkey	North Africa & Middle East
Tuvalu	Pacific Islands
Uganda	Sub-Saharan Africa
Ukraine	Europe
United Arab Emirates	North Africa & Middle East
United Kingdom nfd	Europe
United States of America	The Americas
Uzbekistan	Southern and Central Asia
Vanuatu	Pacific Islands
Viet Nam	South-East Asia
Wales	Europe
Yemen	North Africa & Middle East
Zambia	Sub-Saharan Africa
Zimbabwe	Sub-Saharan Africa

INSTITUTE OF ENVIRONMENTAL SCIENCE AND RESEARCH LIMITED

Kenepuru Science Centre
34 Kenepuru Drive, Kenepuru, Porirua 5022
PO Box 50348, Porirua 5240
New Zealand
T: +64 4 914 0700 **F:** +64 4 914 0770

Mt Albert Science Centre
120 Mt Albert Road, Sandringham, Auckland 1025
Private Bag 92021, Auckland 1142
New Zealand
T: +64 9 815 3670 **F:** +64 9 849 6046

NCBID – Wallaceville
66 Ward Street, Wallaceville, Upper Hutt 5018
PO Box 40158, Upper Hutt 5140
New Zealand
T: +64 4 529 0600 **F:** +64 4 529 0601

Christchurch Science Centre
27 Creyke Road, Ilam, Christchurch 8041
PO Box 29181, Christchurch 8540
New Zealand
T: +64 3 351 6019 **F:** +64 3 351 0010

www.esr.cri.nz