Science for Communities

TUBERCULOSIS IN NEW ZEALAND ANNUAL REPORT 2017

PREPARED FOR:	**Ministry of Health**
CLIENT REPORT No:	**FW19026**
PREPARED BY:	**Health Intelligence Team, Health and Environment Group** **Institute of Environmental Science and Research Limited**
PUBLISHED:	**June 2021**

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

First published: June 2021

Suggested citation:
The Institute of Environmental Science and Research Ltd.
Tuberculosis in New Zealand: Annual Report 2017. Porirua: ESR; 2021
Porirua, New Zealand

Client Report: FW19026

ACKNOWLEDGEMENTS

This report was prepared by Liza Lopez, Helen Heffernan, Dr Jill Sherwood and Dr Shirley Crawshaw.

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

- The Mycobacteriology Section of the Department of Microbiology, Auckland City Hospital; the Mycobacteriology Laboratory, Waikato Hospital; the Mycobacteriology Laboratory, Wellington SCL; and the Mycobacteriology Laboratory, 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.
- Hedwig van Asten (AIDS Epidemiology Group) for providing the HIV/TB co-infection data.
- Charlotte Gilkinson (ESR) for peer checking and Tim Wood (ESR) for providing the trellis graphs.
- Dr Tom Kiedrzynski (Ministry of Health) for the helpful comments and feedback.

Disclaimer

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SUMMARY

Incidence

- In 2017, 308 cases of tuberculosis disease (TB) were notified in New Zealand, of which 295 were new cases.
- The incidence rate for TB in 2017 was 6.4 per 100,000 population, similar to the rates in the previous two years, and a small decline from the average of 6.7 per 100,000 for the preceding seven years.
- The incidence of TB in 2017 in New Zealand is higher than the 2017 rates in other developed countries such as USA (2.8 per 100.000), Canada (4.9 per 100,000) and Australia (5.8 per 100,000) but lower than that of UK (9.2 per 100,000) [1-4].

Demography

- Geographically the highest notification rates for new TB cases in 2017 were reported from Auckland, Counties Manukau and Hutt Valley DHBs, with the Auckland region accounting for just over 50% of new TB cases.
- Females had a slightly higher rate for new TB notifications in 2017 (6.2 per 100,000,152 cases) than males (6.1 per 100,0001 143 cases).
- By age group the highest notification rate for new TB cases in 2017 was in the 15–39 years age group (10.4 per 100,000, 170 cases).
- Ethnicity was recorded for 99.7% of new TB cases, with the highest rates reported in the Asian ethnic group (37.2 per 100,000, 205 cases) followed by Pacific peoples (12.2 per 100,000, 36 cases), MELAA (11.2 per 100,000, 6 cases), Māori (3.4 per 100,000, 24 cases) and European/Other (0.7 per 100,000, 23 cases) ethnic groups.

Place of birth and trends by country of birth

- People born outside New Zealand accounted for 83.4 % of notifications of new TB cases in 2017. The rate of TB among this population group was 12 times higher than the rate in those born in New Zealand.
- Being born in India or the Philippines were the most commonly reported risk factors for new TB cases in New Zealand in 2017.
- Of the new TB cases in people not born in New Zealand, nearly one fifth of notifications occurred in the first year after arrival in New Zealand and just over half occurred within 5 years.
- Between 2008 and 2017, among people not born in New Zealand, there was an 18.8% increase in the number (+39) and a 19% increase in rate of TB. In comparison, there was a 53% decrease in the number (-26) and a 36% decrease in the rate of TB among people born in New Zealand.
- Three quarters of direct observed therapy (DOT) utilisation during the intensive phase of treatment was for cases not born in New Zealand.
- For those new TB cases, between 2013-2017, who were born in New Zealand, the burden of disease was highest in the Auckland region, and in Waikato, Capital & Coast, Hawke's Bay, and Canterbury DHBs and rates were highest for those of Pacific peoples and Māori ethnicities.

Diagnosis

- Over three quarters of new TB cases present symptomatically to their health practitioner.
- The percentage of cases identified through immigrant / refugee screening has increased over three - fold (4% to 14%), within the last 4 years, whilst the percentage of cases identified through contact follow up has fallen to 4.4% from 8% over the same period.

Socioeconomic

- The rate of TB in the most deprived quintile of the population was five times higher than in the least deprived quintile (10.8/100,000 compared to 2.2/100,000).

Transmission within New Zealand

- In 2017, the 3-year moving average annual rate for new TB in New Zealand-born children aged <15 years (a proxy for recent transmission within the country), [5] was 1.2 per 100,000; a 60% reduction from the peak of 3.0 per 100,000 in 2008.

Treatment standards

- In 2017, 98.3% (290/295) of new TB cases received treatment.
- In just under two fifths (39.0%) of cases of new pulmonary TB (PTB), a date of symptom onset was not reported. For those where this information is documented, almost a third (32%) of the cases experienced an interval of greater than 3 months before the start of treatment.
- In 2016 the proportion of people with new TB who received appropriate treatment was 98.9% (280/283), of whom 86.1% (241/280) completed treatment; the majority of the remaining 13.9% most commonly did not complete treatment because they died (4.3%, 12/280), transferred/moved overseas (7.1%, 20/280), had adverse effects (1.8%, 5/280), or refused to complete treatment (0.7%, 2/280).

Outbreaks and molecular clusters

- There were three outbreaks of *M. tuberculosis* with 11 associated cases in 2017.
- Two new *M. tuberculosis* molecular clusters were identified in 2017.
- Over one-third of the isolates that underwent molecular typing between 2013 and 2017 were part of a cluster, of which 90.8% had fewer than five cases.

Drug susceptibilities

- There were five cases with confirmed multi-drug resistant tuberculosis (MDR-TB) in 2017; all five cases were born overseas. There were four MDR-TB cases in 2016. Three were transferred to overseas medical care and one completed treatment in New Zealand.
- Between 2008 and 2017 there has been increasing streptomycin resistance among isolates from cases born overseas and this is significantly higher in 2017 (*p* 0.019).

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.

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 [6, 7].

TB is a notifiable disease in New Zealand under the Health Act 1956 (see Methods section for detail). The 2016 notification rate was 6.3 per 100,000, similar to the average rates recorded since 2007 [8]. 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 [9].

The purpose of this report is to summarise the descriptive epidemiology of TB notifications in New Zealand for 2017 and to examine trends from 2008 to 2017. The report utilises data to the end of 2017 and adds to data included in previous TB reports published since 2008. It takes the same format as those 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 on EpiSurv, the national notifiable diseases database, is used in this report. Data provided by the mycobacteriology laboratories at Auckland City Hospital, Waikato Hospital, Wellington SCL 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). However, 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 such as 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 [10], 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 2015 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.

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 mg/L routinely and 0.4 mg/L if resistance found at 0.1 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 antituberculous agents, including amikacin, capreomycin, moxifloxacin, ethionamide, linezolid and *p*-aminosalicylic acid.

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 isoniazid resistance but phenotypic rifampicin susceptibility, 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 sequencing the *rpoB* gene.
- 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 identify Mycobacterium species in clinical specimens or cultures. 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* and MTBDRs*l,* 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, fluoroquinolones 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 2017 and trends since 2008 or 2013, depending on the availability of data. Due to the length of time taken to complete TB treatment, information regarding the use of directly observed treatment (DOT) and treatment outcomes is presented for cases reported in 2016 rather than 2017.

Notification data presented in this report is based on information recorded in EpiSurv as at 19 November 2018. Changes made to EpiSurv data by PHU staff after this date will not be reflected in this report. Consequently, future data analysis 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 2016 mid-year population estimates published by Statistics New Zealand.

The denominator data used to determine ethnic-specific disease rates for 2013–2017 is based on the proportion of people in each ethnic group from the usually resident 2013 census population applied to the corresponding mid-year population estimates.

The denominator used to determine rates in the New Zealand-born children between 2008–2017 is based on the proportion of people born in New Zealand from the usually resident 2006 (for 2005 to 2009) and 2013 (for 2013 to 2017) census population applied to the corresponding mid-year population estimates.

Population data used to determine disease rates for 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 [11]. 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, were 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 2013 to 2017 is shown in Table 1.

For most variables the level of completeness was more or less stable over the five year period, but there was one notable exception. The completeness of the extra-pulmonary involvement variable improved to 100% following changes to this section of the case report form during 2012.

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 4 years analysed (2013–2016).

The date of onset of illness variable had the lowest levels of completeness, ranging from 67% to 78%. However, this is partly explained by the nature of the disease as some cases are asymptomatic.

Table 1. Percentage of data completeness for tuberculosis notifications (new case) by variable and year, 2013–2017

Variable	2013	2014	2015	2016	2017
Basis of diagnosis					
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	99	98	100	99	100
Geocoding accuracy[a]	95	97	98	99	97
Clinical course and outcomes					
Onset date	71	73	78	73	67
Hospitalisation status	100	100	100	100	100
Survival status	98	100	100	99	99
Protective and risk factors					
BCG vaccination[b]	100	100	100	100	100
Has immunosuppressive illness	93	97	98	96	94
On immunosuppressive medication	94	97	98	98	95
Contact with confirmed case of tuberculosis	82	87	85	89	78
Case born outside New Zealand	100	100	100	100	100
Date of arrival[c]	79	82	87	89	85
Current/recent residence with person born outside New Zealand	90	93	91	92	93
Exposure in a healthcare setting	88	92	89	95	88
Current/recent residence in an institution	90	93	91	92	91
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	100
Treatment outcome[e]	99	99	99	100	-
Use of directly observed therapy (DOT)[d]	96	98	97	98	-

[a] Geocoding accuracy is based on exact and nearest match to LINZ 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.

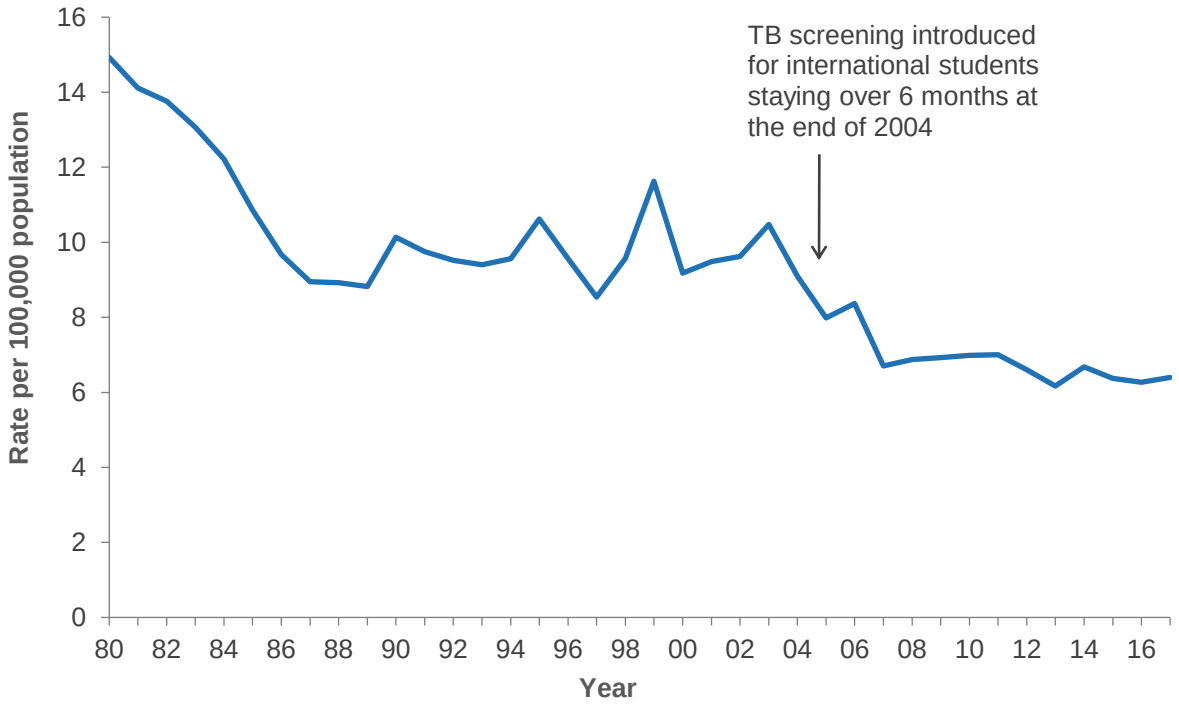
[e] Data is only reported for 2013−2016 due to length of time taken for TB treatment to be completed.

NOTIFICATIONS

There were 308 cases of TB disease notified in 2017, of which 295 (95.8%) were new cases. The 2017 TB disease notification rate was 6.4 per 100,000 population, similar to the rate recorded in 2016 (6.3 per 100,000). A high proportion of TB cases (89.6%, 276/308) were laboratory confirmed.

Trends in TB disease rates since 1980 are shown in Figure 1. Notification rates averaged 6.4 per 100,000 for the past 3 years (2015–2017), a decrease from an average rate of 6.7 per 100,000 for the years from 2007 to 2014. From 1980 to 1989 the rate had decreased from 14.9 to 8.8 per 100,000 but had then fluctuated between 8.5 and 11.6 per 100,000 for the next 15 years, followed by a gradual decrease to 6.7 per 100,000 in 2007. Although, on average, the TB notification rate declined by 1.5% each year from 1980 to 2017, the rate of decline has been slower in recent years since the annual notification rate remained under 10 per 100,000, with an average decline of 0.45% each year between 2007 and 2017.

Figure 1. Tuberculosis disease notification rates by year, 1980−2017



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 295 new TB cases notified in 2017, giving a notification rate of 6.2 per 100,000 population. This is similar to the 2016 rate of 6.0 per 100,000 (283 new TB cases). Between 2013 and 2017, the notification rate fluctuated between 5.9 and 6.4 per 100,000 but was relatively stable (Table 12 in the Appendix).

Basis of discovery and diagnosis

Information on the way TB was discovered was recorded for all 295 new TB cases. The majority (76%, 225/295) were diagnosed when the symptomatic case presented to a health practitioner (Table 2).

Between 2013 and 2017, the proportion of cases discovered by each method ranged from 76−87% for symptomatic case presented to health practitioner, 4−14% for immigrant/refugee screening, 4−8% for contact follow-up, and 2−5% for other means of discovery.

Table 2. Tuberculosis (new case) notification by basis of discovery, 2017

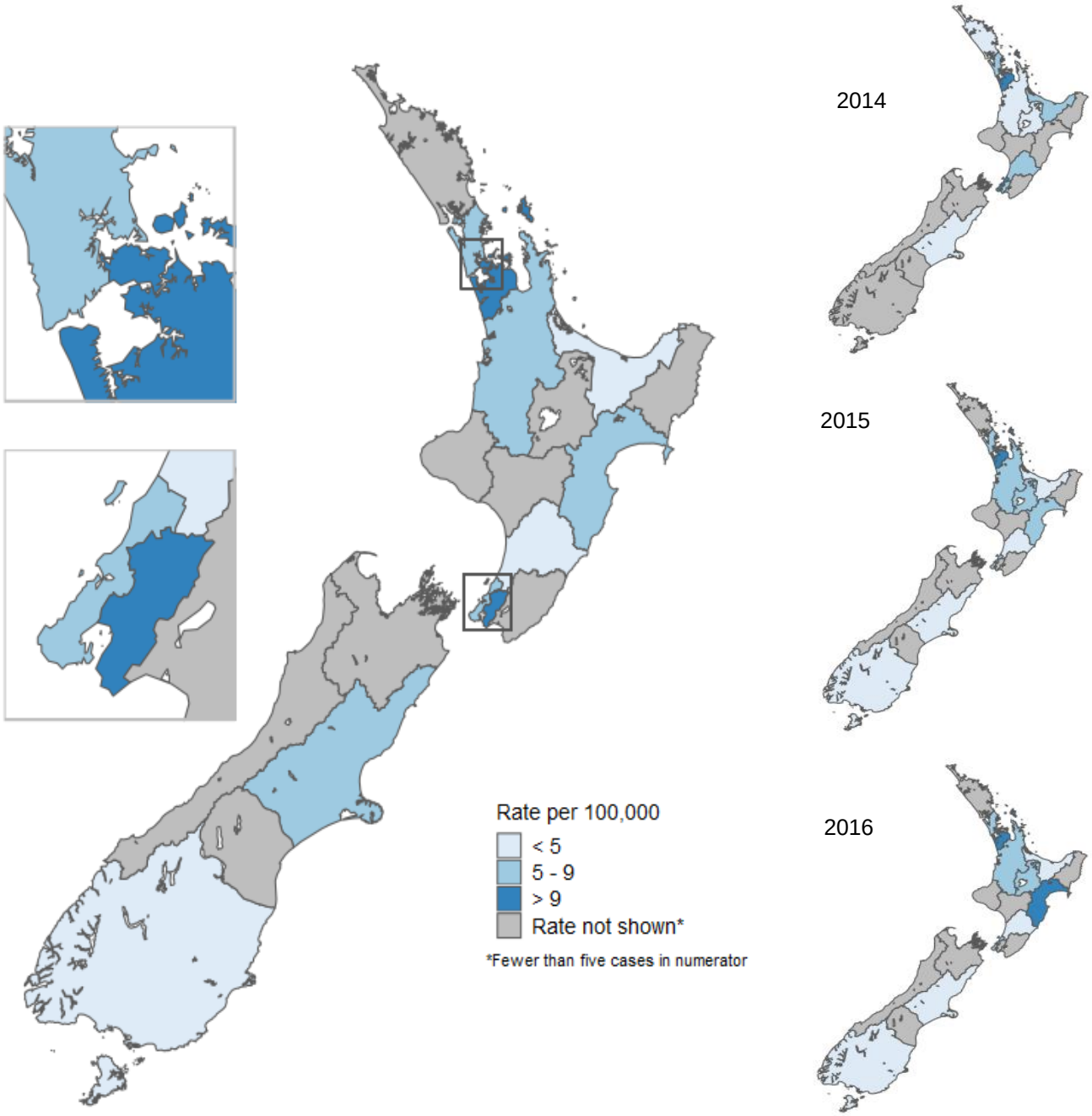
Basis of discovery	Cases	%
Symptomatic case presented to health practitioner	225	76.3
Immigrant/refugee screening	42	14.2
Contact follow-up	13	4.4
Other	15	5.1
Total	**295**	**100.0**

In 2017, 89.2% (263/295) new TB cases were laboratory confirmed. Among the 263 cases for which the method of laboratory confirmation was recorded, 95.8% (252 cases) were confirmed by isolation of *M. tuberculosis* (99.2%, 250 cases) or *M. bovis* (0.4%, 1 case) or *M. tuberculosis* complex (0.4%, 1 case). A further 11 cases were confirmed by the following methods; 1.5% (4 cases) by demonstration of acid-fast bacilli in a clinical specimen, 1.9% (5 cases) by demonstration of *M. tuberculosis* nucleic acid directly from specimens and 0.8% (2 cases) by histology strongly suggestive of TB. The remaining new TB cases (32) were classified as probable based on clinical grounds and treatment for presumptive TB, with five 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 2017 are shown in Figure 2. The highest notification rates in 2017 were recorded for Auckland (11.3 per 100,000, 59 cases), followed by Counties Manukau (10.1 per 100,000, 55 cases) and Hutt Valley (10.1 per 100,000, 15 cases) DHBs (Table 12 in the Appendix). Auckland and Counties Manukau DHBs have consistently had the highest rates in the past 5 years (Figure 2). The rate in the Hutt Valley increased between 2016 and 2017, of the 15 cases in the Hutt Valley, 13 were born outside of New Zealand and none of the cases were related to outbreaks.

Figure 2. Tuberculosis (new case) notification rates by district health board and year, 2014–2017



Age and sex

Table 3 shows that notification rates were higher among adults than in children (<15 years). This trend was consistent over the last five years (Table 12 in the Appendix). The highest notification rate for new TB cases in 2017 was in the 15–39 years age group (10.4 per 100,000, 170 cases), followed by the ≥60 years age group (6.8 per 100,000, 67 cases) (Table 3).

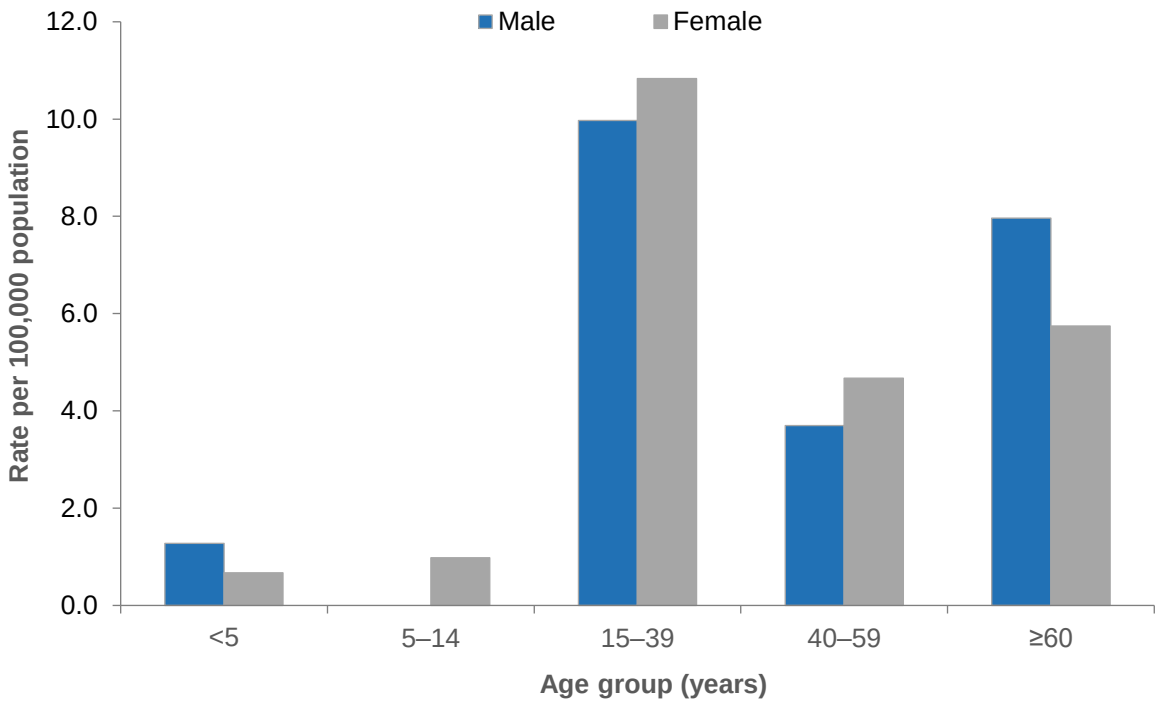
Table 3. Numbers and rates of tuberculosis notifications (new case) by age group and sex, 2017

Age group (years)	Male		Female		Total	
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]
<5	2	1.3	1	0.7	3	1.0
5–14	0	0.0	3	1.0	3	0.5
15–39	82	10.0	88	10.8	170	10.4
40–59	22	3.7	30	4.7	52	4.2
≥60	37	8.0	30	5.7	67	6.8
Total	143	6.1	152	6.2	295	6.2

[a] Rate per 100,000 based on 2016 mid-year population estimates; caution as rates shown for counts with less than five cases.

The notification rate for new TB cases in females (6.2 per 100,000, 152 cases) has now overtaken that for males (6.1 per 100,000, 143 cases) following the male rate being higher since 2013 (Table 12 in the Appendix). The 15–39 years age group had the highest rates for both males (10.0 per 100,000) and females (10.8 per 100,000) (Table 3, Figure 3).

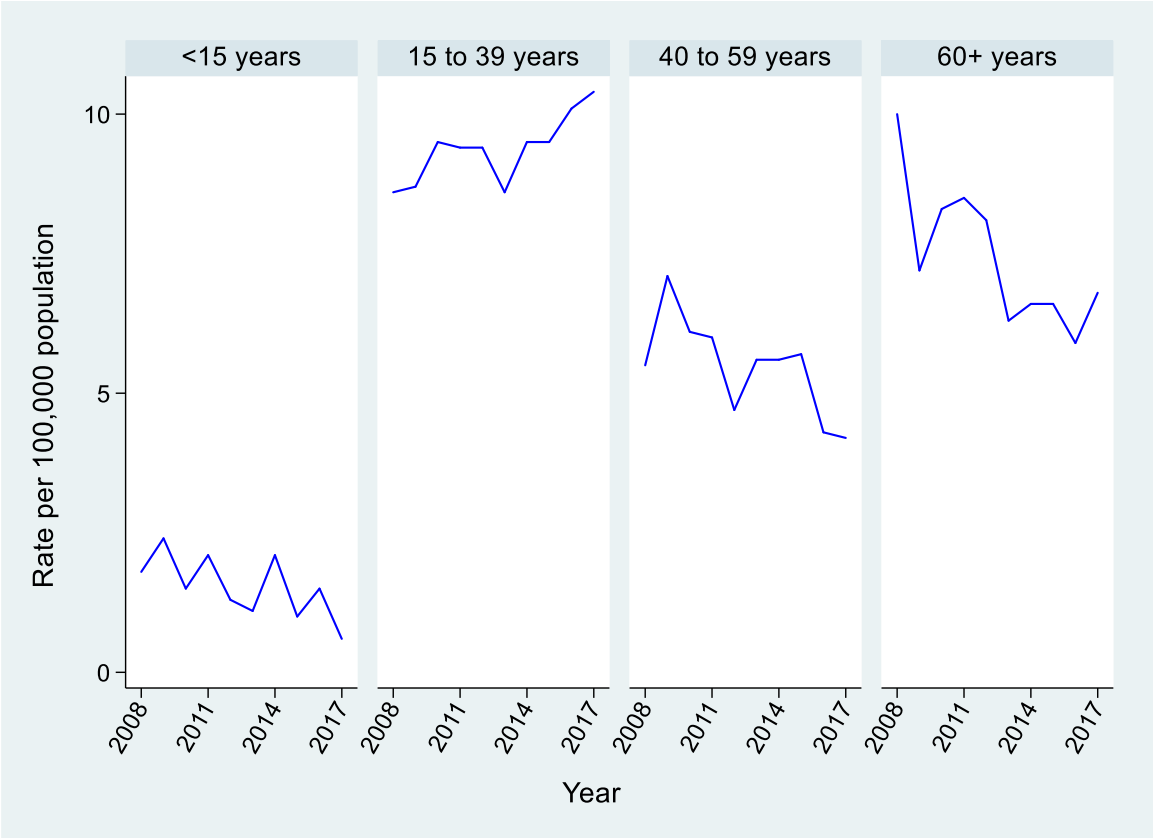
Figure 3. Notification rates of tuberculosis (new case) by age group and sex, 2017



Note: Caution as rates shown for counts with less than five cases for <5 and 5–14 years age groups.

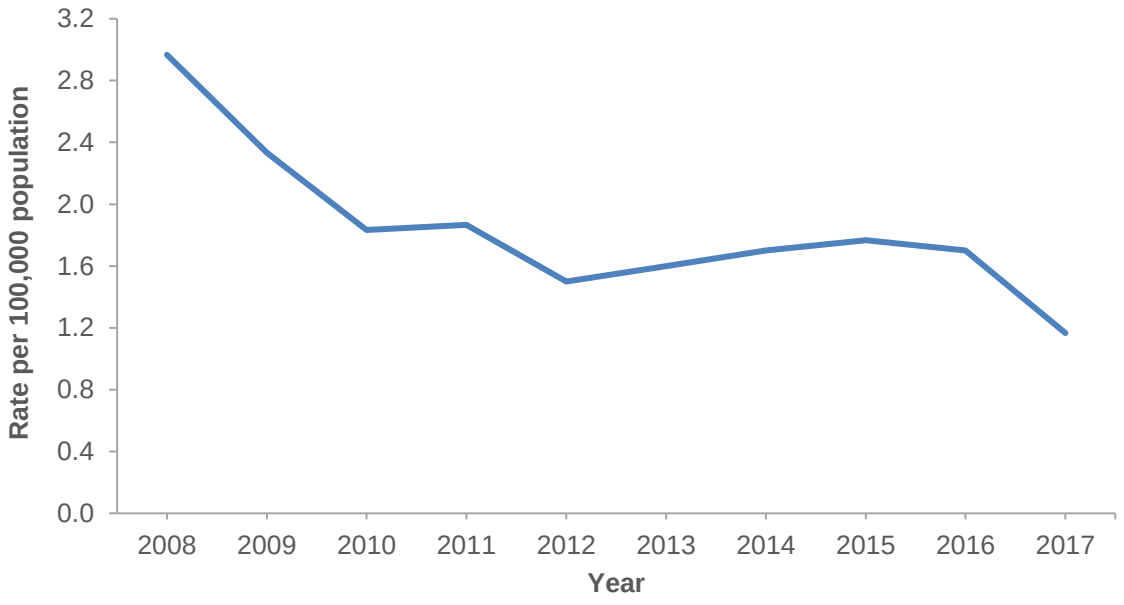
Over the past 10 years (2008–2017), the average annual notification rate was highest in the 15–39 years age group (9.4 per 100,000), followed by the ≥60 years (7.4 per 100,000), and 40–59 years (5.5 per 100,000) age groups. During this time (2008–2017), there was an increasing trend in the 15–39 years age group (up 20.8% from 8.6 to 10.4 per 100,000). In contrast, there was an overall decreasing trend observed in those aged <15 years (down 64.3% from 1.8 to 0.6 per 100,000), 40–59 years (down 24.2% from 5.5 to 4.2 per 100,000) and ≥60 years years (down 32.2% from 10.0 to 6.8 per 100,000) (Figure 4).

Figure 4. Tuberculosis (new case) notification rates by age group and year, 2008–2017



In 2017, 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 0.8 per 100,000 (5 cases). This was lower than the 2016 rate of 1.4 per 100,000 (9 cases). The low numbers (5–26 cases a year from 2006 to 2017) mean that the trend is better assessed by calculating a 3-year moving average annual rate. The 2008 3-year moving average annual rate was 3.0 per 100,000, decreasing to 1.5 per 100,000 in 2012, then remaining relatively stable from 2012–2016 with a further decrease to 1.2 per 100,000 in 2017 (Figure 5).

Figure 5. 3-year moving average annual rate of tuberculosis (new cases) in the New Zealand-born children (<15 years old), 2008–2017

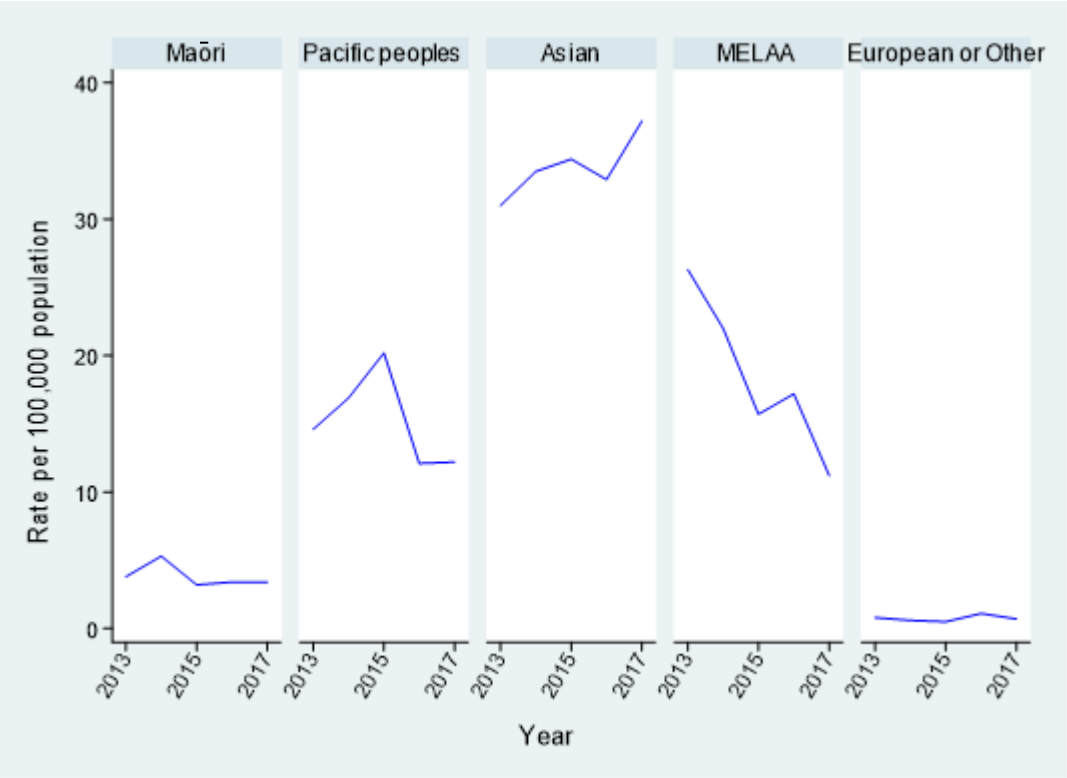


Ethnicity

Ethnicity was recorded for 99.7% (294/295) of the new TB cases notified in 2017. The Asian ethnic group had the highest notification rate (37.2 per 100,000, 205 cases), followed by Pacific peoples (12.2 per 100,000, 36 cases), MELAA (11.2 per 100,000, 6 cases), Māori (3.4 per 100,000, 24 cases) and European or Other (0.7 per 100,000, 23 cases) ethnic groups (Table 12 in the Appendix).

Between 2013 and 2017, the Asian and MELAA ethnic groups generally had the highest rates apart from in 2015 and 2017 where Pacific peoples had the second highest rate, ahead of the MELAA ethnic group (Figure 6). However, the trend data for the MELAA ethnic group should be interpreted with caution as the number of cases each year were low (6–13 cases annually).

Figure 6. Tuberculosis (new case) notification rates by ethnic group and year, 2013–2017



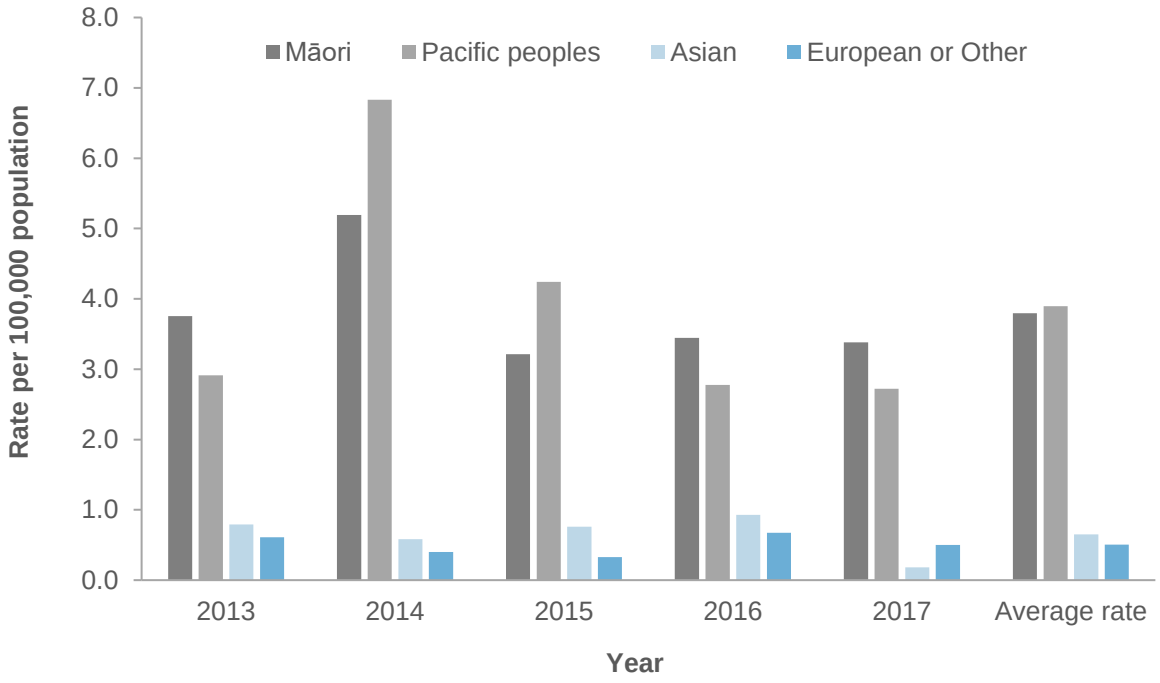
MELAA: Middle Eastern/Latin American/African.

Born in New Zealand

For new TB cases in 2017 who were born in New Zealand (49 cases), 49.0% (24/49) were in the Māori ethnic group, 32.7% (16/49) in the European or Other, 16.3% (8/49) in the Pacific peoples and 2.0% (1/49) in the Asian ethnic groups. Incidence rates in 2017 for New Zealand born new cases were highest for the Māori (3.4 per 100,000, 24 cases) and Pacific peoples (2.7 per 100,000, 8 cases) ethnic groups, and, in contrast, the rate for European or Other was only 0.5 per 100,000 (16 cases). When the average rates by ethnicity for New Zealand born cases are considered for 2013–2017, there was a similar pattern with the highest rates reported in Pacific peoples (3.9 per 100,000, 55 cases) and Māori (3.8 per 100,000, 130 cases). The lowest rates were in European or Other (0.5 per 100,000, 77 cases) and Asian (0.6 per 100,000, 17 cases) (Figure 7).

For those born in New Zealand (2013–2017), the burden of disease was highest in the Auckland region, and in Waikato, Capital & Coast, Hawke's Bay, and Canterbury DHB (Table 13 in the Appendix).

Figure 7. Rates of tuberculosis (new case) notifications for New Zealand born cases by ethnicity, 2013–2017



Hospitalisations

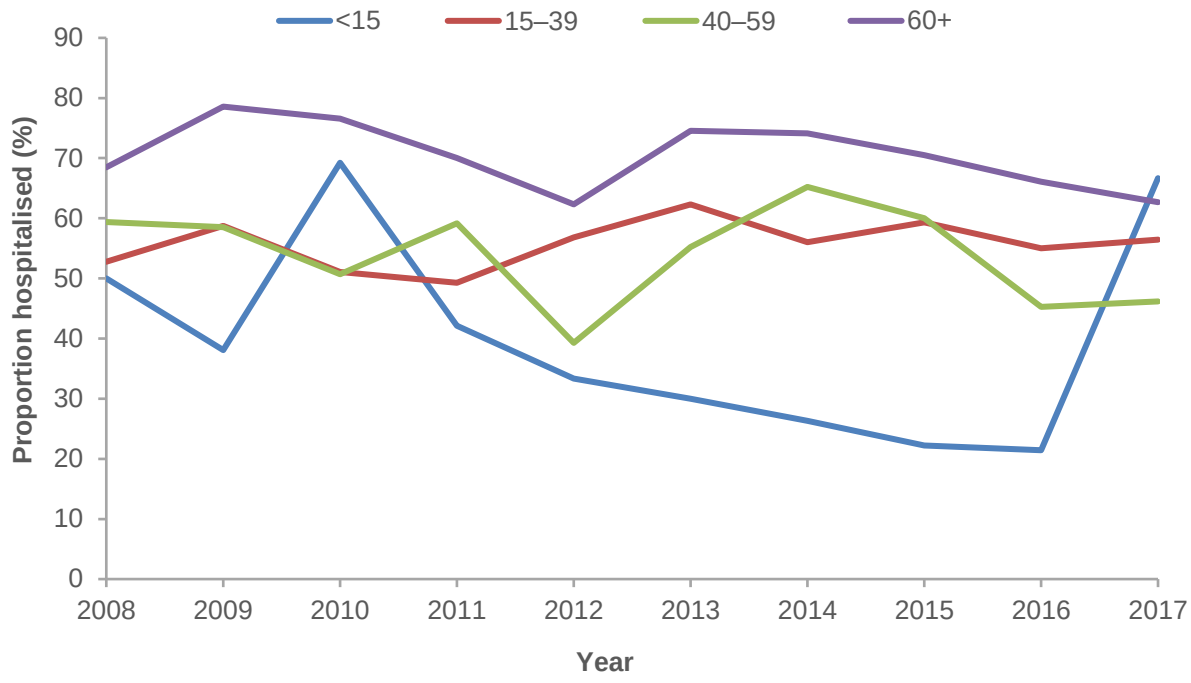
Hospitalisation status was complete for all new TB cases notified to EpiSurv in 2017, of which 56.3% (166/295) were hospitalised. All three cases in 5–14 years were hospitalised, 62.7% in ≥60 years and 56.5% in 15–39 years (Table 4).

Table 4. Hospitalisations by age group, 2017

Age group (years)	Hospitalised		
	Yes	No	%
<5	1	2	33.3
5–14	3	0	100.0
15–39	96	74	56.5
40–59	24	28	46.2
≥60	42	25	62.7

Over the past 10 years, up until 2016, the proportion of cases aged <15 years that were hospitalised had been decreasing. In 2017, the proportion increased, although numbers involved are small (4/6 cases) and therefore this change should be interpreted with caution (Figure 8).

Figure 8. Hospitalisation rates for tuberculosis by age group and year, 2008–2017



Deaths

There was one death (where TB was the primary cause of death) among the 295 new TB cases notified in 2017. The case was in the ≥60 age group. In the last 10 years (2008−2017), 41 deaths, where TB was the primary cause of death, were reported among the notified new TB cases, giving a case fatality rate of 1.4%. The majority (97.6%, 40/41) of deaths were in cases aged ≥20 years and one death (in a case notified in 2014, who died in 2016) was in a child aged <5 years.

Between 2008 and 2015 TB was recorded in the Ministry of Health's Mortality Collections dataset as the underlying cause of death in 56 cases. During this period 4–11 deaths were recorded each year, all of whom were aged ≥20 years. Most cases (92.9%, 52 cases) were aged ≥50 years.

Protective factors

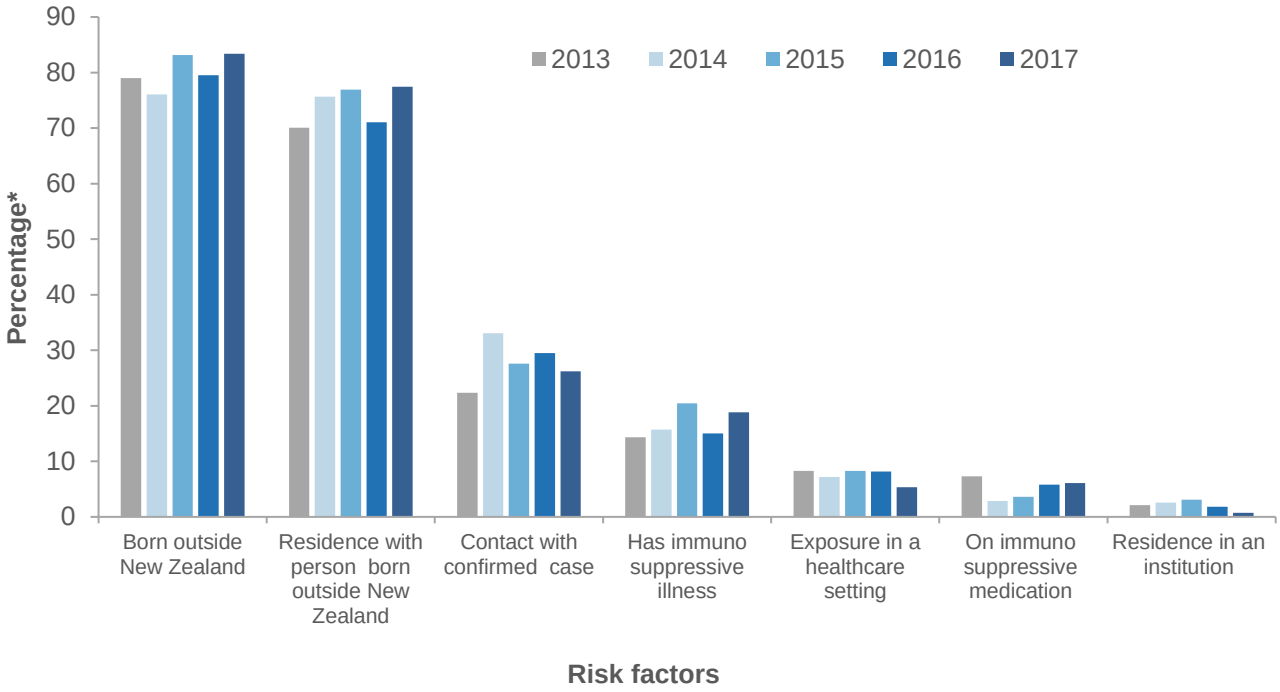
Immunisation of neonates with the Bacillus Calmette-Guérin (BCG) vaccine was introduced in New Zealand in 1976. As New Zealand is a low endemicity country, vaccination is recommended to neonates at increased risk of exposure to TB and is primarily given to protect young children from developing severe disease, particularly miliary TB and tuberculous meningitis. However, there has been an ongoing global shortage of BCG vaccine since 2015 which has led to postponement of vaccination clinics [12].

In 2017, three new TB cases were aged <5 years, all cases were born in New Zealand and had pulmonary disease. None of the cases had received the BCG vaccine. The three children were Māori aged one, three and four years old. Two were contacts of the index case in a local outbreak. There was insufficient information provided in the notification data to know if these children were eligible for the high-risk immunisation programme.

Risk factors

The percentage of cases with available information for the various risk factors ranged from 77.6% to 100% over the last five years. In 2017, the most common risk factors reported by new TB cases were being born outside New Zealand (83.4%) and current/recent residence with person(s) born outside New Zealand (77.5%) (Figure 9, Table 5).

Figure 9. Percentage of tuberculosis (new case) notifications reporting exposure to risk factors by year, 2013–2017



*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, 2017

Risk factor	Cases[a]	Total[b]	%
Born outside New Zealand	246	295	83.4
Current/recent residence with person born outside New Zealand	213	275	77.5
Contact with confirmed case	60	229	26.2
Has immunosuppressive illness	52	276	18.8
On immunosuppressive medication	17	279	6.1
Exposure in a healthcare setting	14	261	5.4
Current/recent residence in an institution	2	269	0.7

[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 246 new TB cases who were not born in New Zealand, cases born in the Southern and Central Asia region had the highest notification rate in 2017 (120.5 per 100,000, 104 cases), followed by the South-East Asia (76.3 per 100,000, 67 cases) regions (Table 6 and Table 16 in Appendix). Almost 90% (91/104) 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 (62.7%, 42/67).

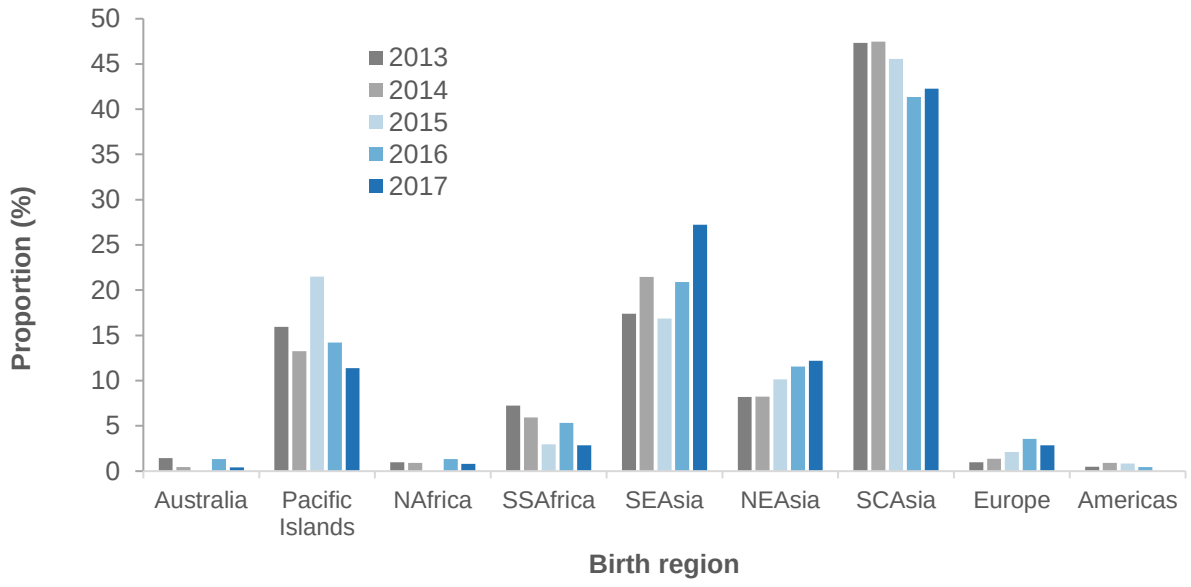
Table 6. Tuberculosis notifications (new case) by region of birth, 2017

Region of birth	Cases	Rate[a]
Born in New Zealand	**49**	**1.6**
Born outside New Zealand	**246**	**19.4**
Australia	1	1.6
Pacific Islands	28	18.5
North Africa and the Middle East	2	11.0
Sub-Saharan Africa	7	9.7
North-East Asia	30	21.1
South-East Asia	67	76.3
Southern and Central Asia	104	120.5
Europe	7	1.2
The Americas	0	0.0
Total	**295**	

[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.

Between 2013 and 2017, the proportion of cases born in North East Asia has shown significant increasing trend while the cases born in Southern and Central Asia has shown a significant decreasing trend (Figure 10).

Figure 10. Percentage of tuberculosis (new case) notifications born outside New Zealand by birth region and year, 2013−2017



NAfrica – North Africa and the Middle East
SSAfrica – Sub-Saharan Africa
SEAsia – South-East Asia
NEAsia – North-East Asia
SCAsia – Southern and Central Asia

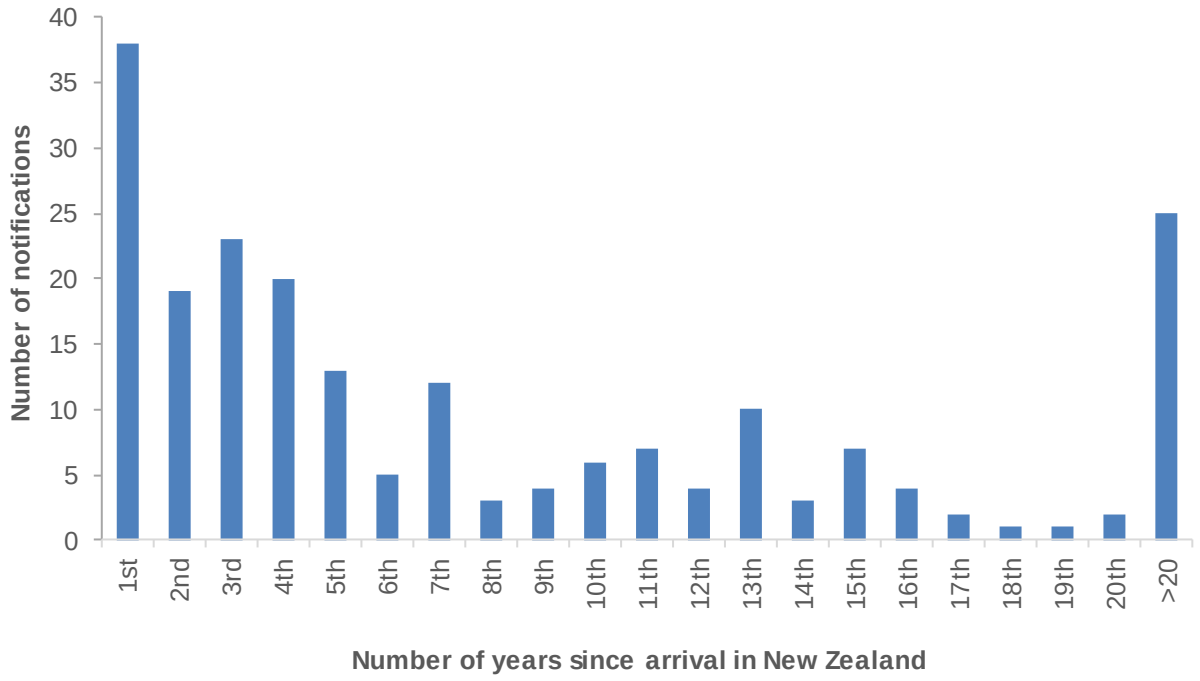
* Number of cases born in a region divided by the total number of cases born outside New Zealand, and for which the country of birth is known, for the year.

Years since arrival in New Zealand

The date of arrival in New Zealand was recorded for 85.0% (209/246) of the new TB cases in 2017 who were not born in New Zealand. Of these, the time between the date of arrival in New Zealand and the date of TB notification ranged from 0–59 years (mean 7.7 years and median 4 years). TB notification occurred in the first year after arrival in New Zealand for 18.2% (38/209) of cases not born in New Zealand (Figure 11) and for 54.1% within the first five years after arrival in New Zealand.

Between 2013 and 2017, the annual median time between arrival in New Zealand and the date of TB notification was between four and five years. The annual mean time ranged between 7.2 and 9.5 years.

Figure 11. Tuberculosis (new case) notifications born outside New Zealand by the number of years since arrival in New Zealand, 2017



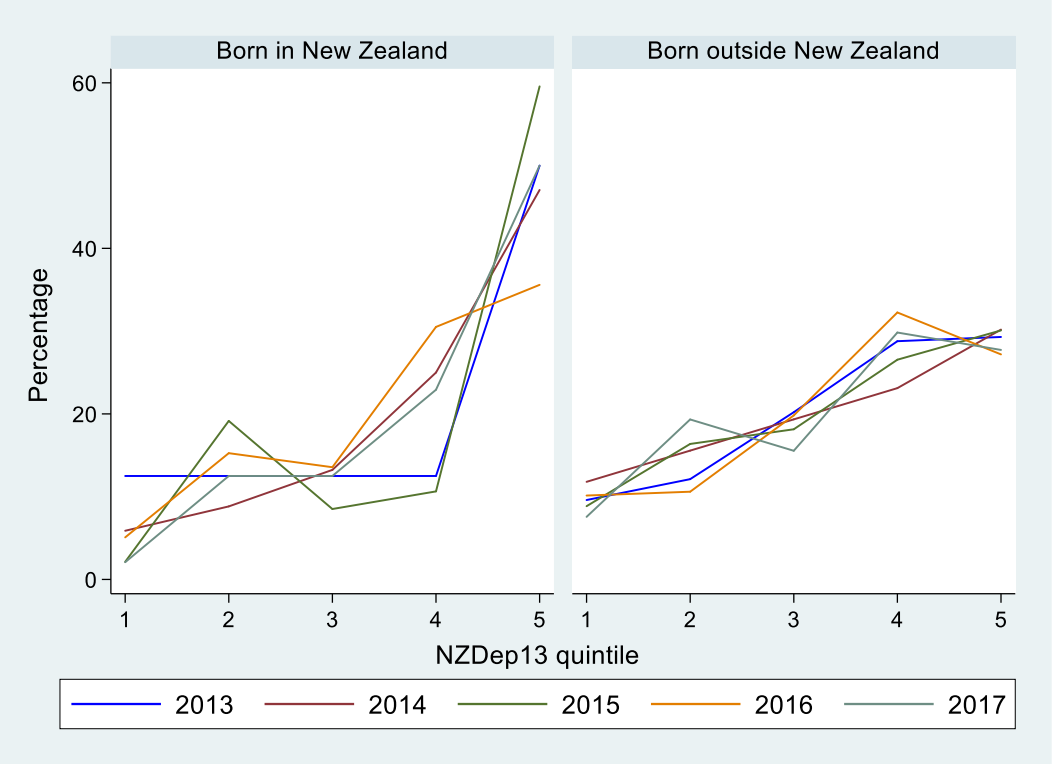
Note: The date of arrival was not recorded for 37 cases. Number of years: 1st means up to 1 year after arrival, 2nd means between 1–2 years after arrival, and 3rd means between 2–3 years since arrival etc.

Socioeconomic deprivation

In 2017, 96.9% (286/295) of new TB cases could be assigned a New Zealand Index of Deprivation 2013 (NZDep2013) score. Of the 286 cases, 172 (60.1%) resided in the most deprived areas (NZDep2013 quintile 4 or 5).

Figure 12 shows the relationship between deprivation and the percentage of new TB cases in the last five years (2013–2017). Of the 96.4% (1362/1413) cases with available information between 2013 and 2017, 269 (19.8%) cases were born in New Zealand. Higher numbers of new TB cases were observed among those from more socioeconomically deprived areas irrespective of their place of birth. A similar trend was observed each year and was most notable for cases born in New Zealand living in areas of highest deprivation (quintile 5).

Figure 12. Percentage of tuberculosis (new case) notifications by birth place (New Zealand/non-New Zealand), 2013 New Zealand Index of Deprivation and year, 2013−2017

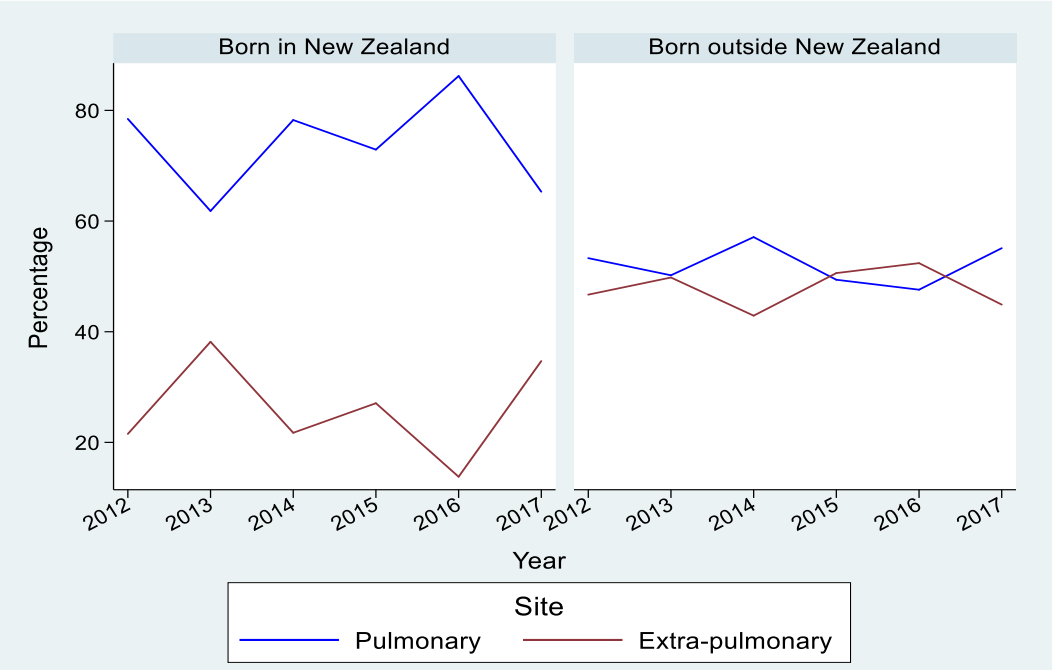


Site of infection

In 2017, 56.6% (167/295) of new TB cases had pulmonary (including laryngeal) disease. Of these, 127 had pulmonary disease only and 40 had both pulmonary and extra-pulmonary involvement. A further 43.4% (128 cases) had only extra-pulmonary involvement and were therefore unlikely to be infectious.

Between 2013 and 2017, there were 1413 new TB cases notified. There are some differences in the clinical characteristics of cases born in New Zealand (279 cases) compared with cases not born in New Zealand (1134 cases). Among cases born in New Zealand, 73.5% (205/279) were reported with pulmonary disease and 26.5% (74/279) were reported with extra-pulmonary disease only. In contrast, new TB cases not born in New Zealand (1134 cases) had less pulmonary disease (51.9%, 588/1134) and more extra-pulmonary disease (48.1%, 546/1134) (Figure 13).

Figure 13. Comparison of pulmonary versus solely extra-pulmonary involvement for tuberculosis (new case) notifications by birth place (New Zealand/non-New Zealand) and year, 2013–2017



Of the 167 new TB cases in 2017 with pulmonary disease, 161 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, 49.7% (80/161) were smear positive, with sputum reported as the specimen site for 87.5% (70/80) of these cases.

Of the 168 cases with extra-pulmonary involvement in 2017, 50.6% (85/168) had lymph node (excluding abdominal) recorded as a site of infection (Table 14 in the Appendix). Seventeen cases of central nervous system TB were reported in 2017 (16 aged ≥20 years and one case aged 15–19 years). Six cases of miliary TB were reported, all aged ≥20 years. Five of the six miliary TB cases had information on whether they had an underlying immunosuppressive illness and of these, two cases were reported as having an underlying immunosuppressive illness (arthritis and diabetes).

Between 2013 and 2017, the most common site of infection recorded for cases with extra-pulmonary involvement was lymph node (excluding abdominal) (48.7%), followed by pleural (16.6%) and intra-

abdominal (excluding renal) (10.3%). There were 52 cases of central nervous system TB (no cases of tuberculous meningitis aged <15 years) and 40 cases of miliary TB. Of the miliary TB cases two were aged <5 years (1 year and 3 years), neither had received the BCG vaccine. The 17 cases (10.1%) reported with CNS as a site of infection in 2017 was higher than the previous years (range 6−11). Table 14 in the Appendix gives a breakdown of the new TB cases with extra-pulmonary involvement by site of infection and year.

Immunosuppressive illness and HIV status

In 2017, 52 cases were reported to have an immunosuppressive illness, 11 of whom were on immunosuppressive medication. A further six cases were reported to be on immunosuppressive medication. Of the cases with an immunosuppressive illness, 50 cases provided information on the illness with 30 (60.0%) reported as having diabetes.

In 2017, 99.7% (294/295) of cases had information on whether an HIV test was done. Of these, 83.3% (245/294) were tested for HIV. In 2017, one case was co-infected with HIV, compared with zero cases being co-infected with HIV in 2016.

Receipt of treatment

In 2017, 98.3% (290 /295) of new TB cases received treatment. Onset dates were reported for 67.6% (196/290) of the cases who received treatment, thereby allowing calculation of the time between the onset of symptoms and start of treatment. Of these, 18.4% (36/196) started treatment within one month of the onset of symptoms and 42.3% (83/196) started treatment between 1 and 3 months. The median interval to the start of treatment was 69 days from the onset of symptoms.

A treatment delay for patients with pulmonary TB represents a risk to public health from disease transmission. In 2017, 98.2% (164/167) of the 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 61.0% (100/164) of these cases. Among these, 23.0% (23/100) started treatment within 1 month of the onset of symptoms (between 2013 and 2016 treatment within one month ranged from 21.2% in 2016 to 35.3% in 2014) and 45.0% (45/100) started treatment between one and three months (between 2013 and 2016 treatment between one and three months ranged from 36.9% in 2015 to 49.4% in 2013). The median interval to the start of treatment was 61.5 days from the onset of symptoms. Between 2013 and 2016 the median interval to the start of treatment ranged between 42.0 days (2015) to 76.0 days (2016).

Treatment outcomes for cases notified in 2016

Due to the length of time taken for TB treatment to be completed, the data presented in this section is for the 283 new TB cases notified in 2016. Of these, 98.9% (280/283) were reported to have received appropriate treatment for TB. Most of these cases (86.1%, 241/280) completed treatment to the satisfaction of the prescribing doctor. Of these 241 new TB cases, 51.5% (124/241) received directly observed therapy (DOT) during the intensive phase of their treatment. A lower proportion of cases not born in New Zealand were reported to have received DOT during the intensive phase of their treatment (49.0%) than those born in New Zealand (61.2%). However, those born overseas accounted for 75.8% of the overall usage of intensive phase DOT and, for pulmonary disease, 64.7% of cases born outside New Zealand received DOT during the intensive phase of their treatment compared to 65.1% for cases born in New Zealand.

Treatment for the remaining 13.9% (39/280) of cases ended earlier than planned for the following reasons: case died (4.3%, 12/280), case transferred to overseas medical care (3.9%, 11/280), case went overseas (medical care not transferred or unknown) (3.2%, 9/280), treatment was stopped

because of adverse effects (1.8%, 5/280), and case refused to complete treatment (0.7%, 2/280).

Three cases were reported as receiving no treatment (1.1%, 3/283 cases). Of these, one case was not treated because they died before treatment was initiated and/or the diagnosis was a post-mortem finding, for one case treatment was reported as inappropriate because they transferred to overseas medical care, and one case was reported to have gone overseas (medical care unknown).

TUBERCULOSIS DISEASE – RELAPSES OR REACTIVATIONS

In 2017, 13 TB relapse/reactivation cases were notified. This category of disease could also include cases of re-infection. The number of TB relapse/reactivation cases has remained low over the last 10 years (2008–2017) ranging from 6–13 cases a year (Figure 14).

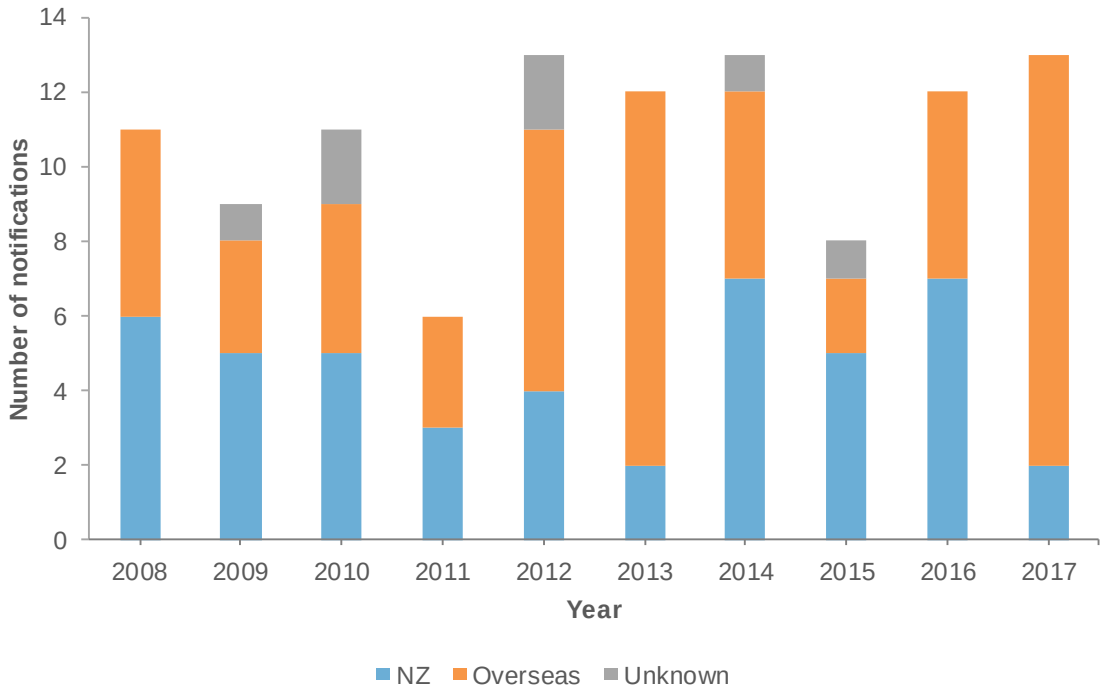
In 2017, the TB relapse/reactivation cases were reported from the following seven DHBs: Counties Manukau (4 cases), Auckland (3 cases), Waitemata (2 cases), Waikato, MidCentral, Canterbury and Southern (1 case each). The cases were aged in the 15–39 years (6 cases), 40–59 years (1 case) and ≥60 years (6 cases) age groups. Relapse/reactivation cases were reported in the following ethnic groups: Asian (12 cases) and Māori (1 case). Nine 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 53.8% (7/13) of the 2017 relapse/reactivation cases. Of these, one case was born and originally diagnosed with extra-pulmonary TB in New Zealand, had received treatment for 11 months and was reported to have received DOT throughout treatment. The remaining six cases were born overseas. Of these, one was previously diagnosed in New Zealand with extra-pulmonary disease, treated for 12 months and received DOT throughout treatment. The remaining five cases were previously diagnosed overseas and had received treatment for 6 months (4 cases) and five months (1 case).

In 2017, all 13 relapse/reactivation cases could be assigned a NZDep2013 score. Seven cases (53.8%) resided in the most deprived areas (NZDep2013 quintiles 4 and 5), a lower proportion than the 60.1% of new TB cases residing in the most deprived areas.

The information on whether the cases were previously treated was not recorded for six cases in 2017, but five of the cases had their previous diagnoses decades ago (4 cases now aged ≥60 years and 1 case aged 30−39 years). The remaining case aged 30−39 years was diagnosed four years ago.

Figure 14. Tuberculosis (relapse/reactivation) notifications by place of diagnosis by year, 2008−2017



OUTBREAKS

In 2017, three TB outbreaks were reported:

- Auckland DHB (1 outbreak, 2 cases), the exposures occurred in a workplace.
- Waikato DHB (1 outbreak, 6 cases), the exposure occurred in a private home and other setting.
- Wairarapa DHB (1 outbreak, 3 cases), the exposure occurred at a sports bar.

CULTURE CONFIRMATION, SPECIATION AND DRUG SUSCEPTIBILITY

Data presented in this section was collected from the three mycobacteriology laboratories in New Zealand.

CULTURE CONFIRMATION AND SPECIATION

In 2017, 85.4% (252/295) of new TB cases were culture positive. The mycobacterial species identified among these new cases were *M. tuberculosis* (250 cases), *M. bovis* (1 case) and one case only identified as *M. tuberculosis* complex. Of the new TB cases with pulmonary disease, 95.8% (160/167) were culture positive, comprising 158 cases due to *M. tuberculosis*, one case due to *M. bovis*, and one case only identified as *M. tuberculosis* complex.

Of the 13 TB relapse/reactivation cases notified in 2017, nine 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 2013 and 2017.

DRUG SUSCEPTIBILITY

Antimicrobial susceptibility data for the isolates from all 261 (252 new cases and nine relapses/reactivations) culture-positive TB cases in 2017 was available. The proportion of isolates resistant to the five antimicrobials routinely tested is shown in Table 7.

Table 7. Resistance to each antimicrobial, among tuberculosis isolates, by mycobacterial species, 2017

Antimicrobial	Resistant[a]					
	M. tuberculosis *n* = 259		*M. bovis* *n* = 1		All isolates *n* = 261[b]	
	No.	%	No.	%	No.	%
Isoniazid (0.1 mg/L)	20	7.7	0	-	20	7.7
Isoniazid (0.4 mg/L)[c]	14	5.4	0	-	14	5.4
Rifampicin	6	2.3	0	-	6	2.3
Ethambutol	4	1.5	0	-	4	1.5
Pyrazinamide	1	0.4	1[d]	100	3	1.1
Streptomycin	26	10.0	0	-	26	10.0

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

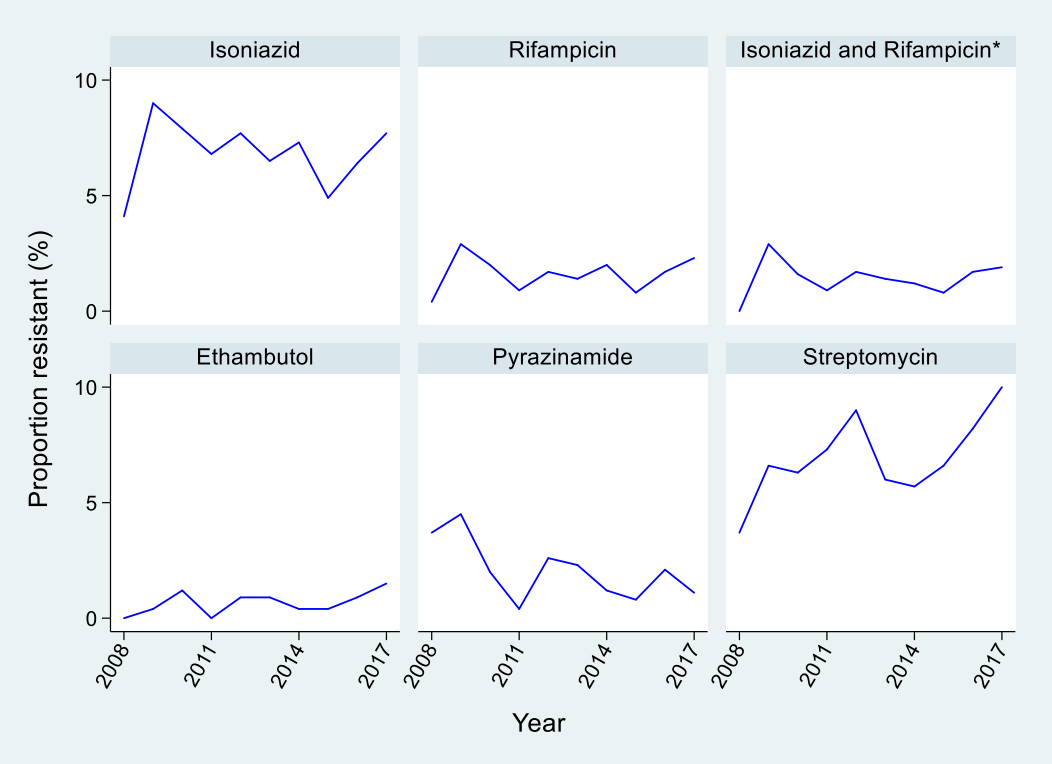
[b] This total of 261 isolates includes data for one isolate identified only as *M. tuberculosis* complex which was resistant to pyrazinamide.

[c] 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.

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

In the 10 years from 2008 to 2017, there were significant trends of decreasing pyrazinamide resistance and increasing streptomycin resistance (Figure 15). Further analysis by the patients' place of birth, showed both these trends were only evident among overseas-born cases. During the same 10 years, there has been no overall change in the prevalence of isoniazid, rifampicin or ethambutol resistance.

Figure 15. Antimicrobial resistance among tuberculosis isolates by antimicrobial and year, 2008−2017



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

In 2017, 84.7% (221/261) of the isolates were fully susceptible to all five routinely tested antimicrobials. There were five (1.9%) cases of multidrug-resistant tuberculosis (MDR-TB, defined as resistance to at least isoniazid and rifampicin) (Table 8). Four of the MDR-TB cases were reported to be cases of new disease and the fifth case was reported to be a relapse/reactivation. Notably, in addition to the five MDR-TB isolates, another isolate was resistant to rifampicin and streptomycin, but not isoniazid.

During the last 10 years there have been a total of 34 cases of MDR-TB – an average annual rate of 1.4% among culture-positive TB cases. MDR-TB isolates are tested for susceptibility to an extended range of antibiotics to detect extensively drug-resistant tuberculosis (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 - this case occurred in 2010.

Table 8. Distribution of antimicrobial resistance patterns among tuberculosis isolates, 2017

Antimicrobial resistance	Resistance pattern[a]	% (number) of isolates with each pattern	
Fully susceptible		**84.7**	**(221)**
Resistant to 1 agent		**11.5**	**(30)**
	S	6.5	(17)
	H	4.2	(11)
	Z[b]	0.8	(2)
Resistant to 2 agents		**1.9**	**(5)**
	HS	1.5	(4)
	RS	0.4	(1)
Resistant to 3 agents		**0.8**	**(2)**
	HRE[c]	0.4	(1)
	HRS[c]	0.4	(1)
Resistant to 4 agents		**0.8**	**(2)**
	HRES[c]	0.8	(2)
Resistant to 5 agents		**0.4**	**(1)**
	HREZS[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 two isolates with monoresistance to pyrazinamide, one was the *M. bovis* isolate and the other was the isolate identified only as *M. tuberculosis* complex.

[c] MDR-TB, multidrug-resistant tuberculosis, that is, resistant to at least isoniazid and rifampicin.

Table 9 compares antimicrobial resistance among isolates from cases born in New Zealand and cases born overseas. While resistance to all antimicrobials routinely tested, except pyrazinamide, was higher among cases born overseas, the difference was only significant for streptomycin (*p* 0.019).

All five MDR-TB cases identified in 2017 were born overseas. All but one of the 34 MDR-TB cases that have occurred in the last 10 years were born overseas and assumed to have acquired MDR-TB overseas. The majority (87.9%, 29/33) of MDR-TB cases assumed to have acquired MDR-TB overseas were born in an Asian country.

Table 9. Antimicrobial resistance among isolates from tuberculosis cases by place of birth, 2017

	Born in New Zealand (*n* = 39)		Born overseas (*n* = 222)		*p*-value[a]
	No.	%	No.	%	
Fully susceptible					
	37	94.9	184	82.9	0.055
Resistant to:[b]					
Isoniazid[c]	1	2.6	19	8.6	0.326
Rifampicin	0	-	6	2.7	0.596
Ethambutol	0	-	4	1.8	1.000
Pyrazinamide	1	2.6	2	0.9	0.386
Streptomycin	0	-	26	11.7	0.019
MDR-TB[d]					
	0	-	5	2.3	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, that is, resistant to at least isoniazid and rifampicin.

Resistance to isoniazid and streptomycin was most frequent among isolates from cases of Asian ethnicity (Table 10). All five MDR-TB cases were of Asian ethnicity.

Table 10. Antimicrobial resistance among isolates from tuberculosis cases by ethnic group, 2017

	Māori[a] (*n* = 18)		Pacific peoples (*n* = 31)		Asian (*n* = 187)		MELAA (*n* = 5)		European or Other (*n* = 20)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Fully susceptible										
	18	100	29	93.6	153	81.8	4	80.0	17	85.0
Resistant to:[b]										
Isoniazid[b]	0	-	1	3.2	17	9.1	1	20.0	1	5.0
Rifampicin	0	-	0	-	6	3.2	0	-	0	-
Ethambutol	0	-	0	-	4	2.1	0	-	0	-
Pyrazinamide	0	-	0	-	2	1.1	0	-	1	5.0
Streptomycin	0	-	2	6.5	23	12.3	0	-	1	5.0
MDR-TB[d]										
	0	-	0	-	5	2.7	0	-	0	-

[a] Ethnic groups were prioritised in the following order: Māori, Pacific peoples, Asian, Middle Eastern/Latin American/African (MELAA), European or Other ethnicity (including New Zealander).

[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, that is, resistant to at least isoniazid and rifampicin.

In 2017, 3.4% (9/261) of the culture-positive cases were reported to be TB relapses/reactivations. This category of disease could also include cases of re-infection. 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 5 years from 2013 to 2017. During this period, 3.6% (43/1199) of the culture-positive cases, for which susceptibility data was available, were reported to be relapses/reactivations. Information about previous treatment was recorded for 34 of the 43 relapse/reactivation cases and 33 were recorded as having received previous anti-tuberculosis drug treatment.

Antimicrobial resistance among new cases of TB, cases reported to be relapses/reactivations and cases who were reported to have been previously treated, is shown in Table 11. Compared with isolates from new cases, isolates from cases reported to be relapses/reactivations were more resistant to isoniazid and rifampicin, and consequently also more likely to be MDR-TB.

Table 11. Antimicrobial resistance among isolates from tuberculosis cases (new cases, relapses/reactivations and previously treated cases), 2013–2017

Antimicrobial resistance	Percentage of new cases (%) (*n* = 1156)	Relapse/reactivation cases			
		All (*n* = 43)		Previously treated[a] (*n* = 33)	
		%	*p*-value[b]	%	*p*-value[b]
Fully susceptible					
	87.5	83.7	0.481	84.8	0.597
Resistant to:[c]					
Isoniazid[d]	6.3	14.0	0.058	12.1	0.160
Rifampicin	1.5	7.0	0.032	6.1	0.095
Ethambutol	0.8	2.3	0.307	0.0	1.000
Pyrazinamide	1.5	2.3	0.484	0.0	1.000
Streptomycin	7.4	7.0	1.000	6.1	1.000
MDR-TB[e]					
	1.2	7.0	0.021	6.1	0.070

[a] Information on previous treatment was reported for only 34 of the 43 relapse/reactivation cases, 33 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, that is, resistant to at least isoniazid and rifampicin.

MOLECULAR TYPING

TB molecular typing results were available for all 252 culture-positive new TB cases in 2017. The mycobacterium species identified were *M. tuberculosis* (250 cases), *M. bovis* (1 case) and *M. tuberculosis* complex (1 case). Among the 252 new TB cases, 91 (36.1%) had non-unique molecular types and were in 65 separate molecular clusters. Two new clusters were identified in 2017, with two and three cases each respectively. The remaining 161 cases (63.9%) had a unique molecular type.

In the last 5 years (2013–2017), 1,156 new TB cases had TB molecular typing results, of which 452 (39.1%) had non-unique molecular types and were in 184 separate molecular clusters.

The median cluster size, based on cases in the last 5 years, was two cases (range 1–35)[ii] and 90.8% (167/184) of clusters had fewer than five cases. The remaining 17 clusters were distributed in the following cluster sizes: 5−9 cases (13), 10−19 cases (2) and 20 or more cases (2).

Figure 16 to Figure 21 show the percentage of new TB cases that had non-unique molecular types for subgroups within selected variables between 2013 and 2017 compared with the mean percentage for each variable. Table 15 in the Appendix 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 close to the mean (39.1%). Proportions were similar to the mean in both sexes (Figure 16).

Pacific peoples (77.3%) and Māori (76.9%) ethnic groups also had higher proportions of cases than the mean whereas the MELAA (12.8%), Asian (26.5%) and European or Other (34.8%) ethnic groups had a lower proportion than the mean (Figure 17).

Figure 16. Percentage of new TB cases that were non-unique molecular types by age group and sex, 2013–2017

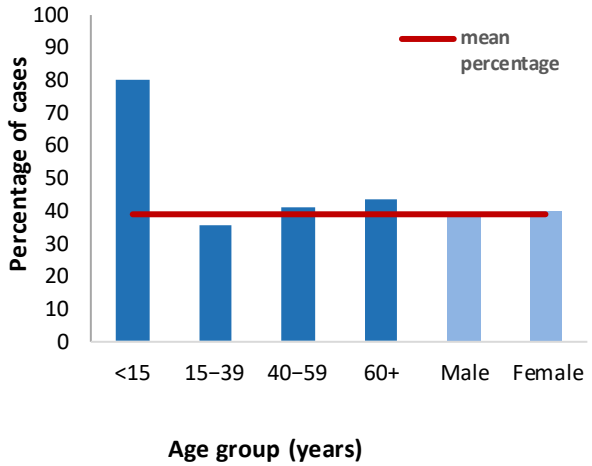
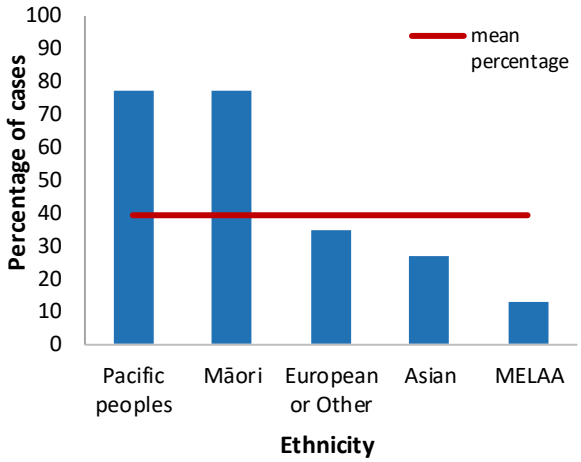


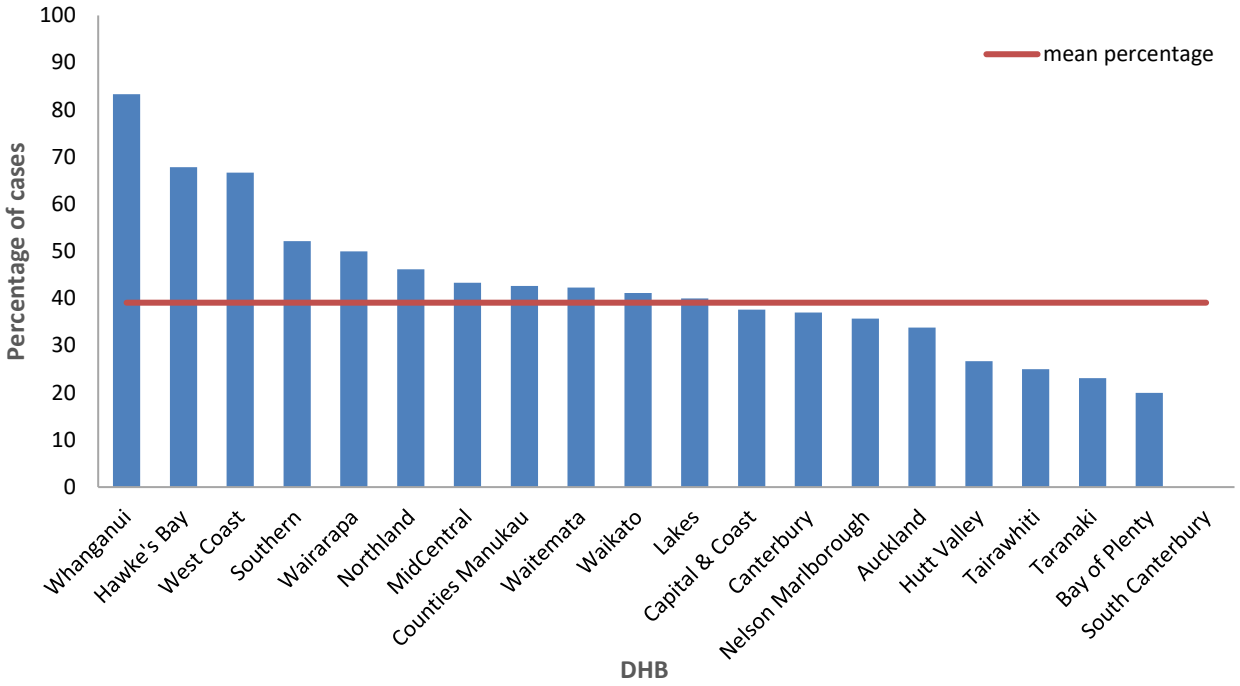
Figure 17. Percentage of new TB cases that were non-unique molecular types by ethnic group, 2013–2017



[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 5 years.

Whanganui (83.3%), Hawke's Bay (67.9%) and West Coast (66.7%) DHBs had the highest proportions of cases with non-unique molecular types. Whereas, Bay of Plenty (20.0%), Taranaki (23.1%), and Tairawhiti (25.0%) DHBs had the lowest proportions of cases with non-unique molecular types (Figure 18).

Figure 18. Percentage of new TB cases that were non-unique molecular types by DHB, 2013–2017



Cases born in the Pacific Islands (72.4%) and New Zealand (67.8%) had a higher proportion of non-unique molecular types than the mean, whereas for other foreign-born cases the proportion was well below the mean (Figure 19).

There was also a high proportion of cases with non-unique molecular types residing in NZDep2013 quintile 5 (more socioeconomically deprived) areas (47.9%) (Figure 20).

Figure 19. Percentage of new TB cases that were non-unique molecular types by region of birth, 2013–2017

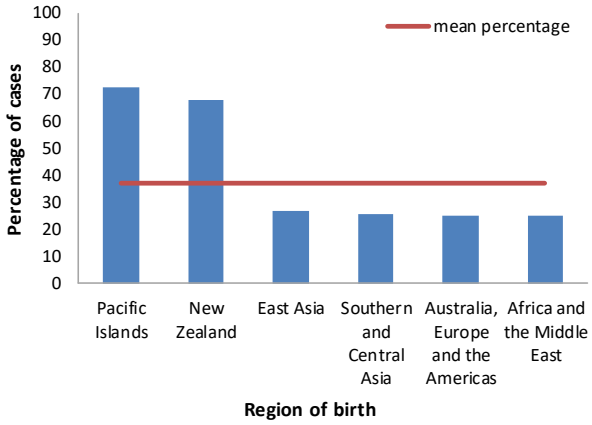
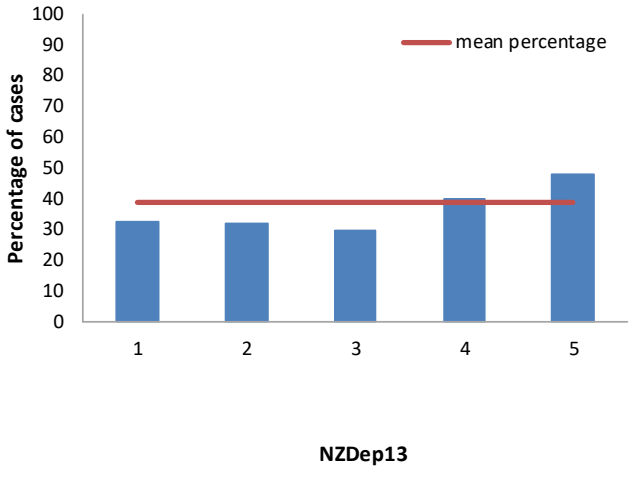
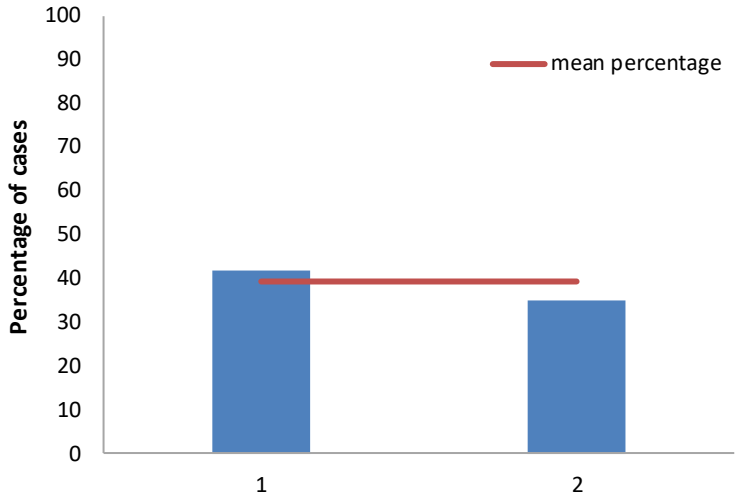


Figure 20. Percentage of new TB cases that were non-unique molecular types by NZDep13, 2013–2017



New TB cases with pulmonary disease (41.8%) had a higher proportion of non-unique molecular types compared with cases that had extra-pulmonary involvement only (34.8%) (Figure 21).

Figure 21. Percentage of new TB cases that were non-unique molecular types by clinical manifestation, 2013–2017



1=Pulmonary disease
2=Extra-pulmonary involvement only

DISCUSSION

During the decade preceding 2017 the incidence of new TB cases in New Zealand showed a small decline, from an average rate of 6.7 per 100,000 for the years from 2007 to 2014, to an average of 6.4 per 100,000 for the past three years (2015–2017). This contrasts with the more rapid decrease in rates seen during the 1980s when rates were above 10 per 100,000 but is a similar pattern to that seen in other low endemicity countries when the rate of decline slows once incidence falls below 10 per 100,000. However, the 2017 New Zealand rate remains higher than the 2017 incidences reported from Australia (5.8 per 100,000), Canada (4.9 per 100,000) and the United States (2.8 per 100,000) [1-3]. In 2017 the incidence rate in England declined to being under 10 per 100,000 for the first time at 9.2 per 100,000 [4].

PLACE OF RESIDENCE AND ETHNICITY

Geographically Auckland, Counties Manukau, Waikato, Hawke's Bay, Hutt Valley and Wairarapa DHBs all had incidence rates above the national rate. Apart from Hawke's Bay and Wairarapa DHBs, these DHBs have large urban populations. This is similar to the distribution of cases noted in the United Kingdom where TB is concentrated in large urban areas. 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 2017, 60.1% of TB cases resided in the most deprived areas of New Zealand (Quintiles 4 and 5), a slightly lower proportion than the 70% of cases residing in the two most deprived quintiles in England in 2014 [13] and, similar to New Zealand, analysis of the 2017 data in England shows a clear trend of an increasing rate of TB with increasing deprivation [4].

Among cases born in New Zealand the highest proportion of new TB cases were in the Māori ethnic group (49.0%), an increased proportion from the 41.4% reported in 2016. The incidence rate reported for the Māori ethnic group (3.4 per 100,000) was almost five times higher than the incidence in the New Zealand-born European or Other ethnic group (0.7 per 100,000). However, the rate for the Māori ethnic group was lower than the overall (born in New Zealand and overseas) rates reported for Asian (37.2 per 100,000), Pacific peoples (12.2 per 100,000) and the overall rate for all people born overseas (19.4 per 100,000). This is similar to the pattern reported in Australia in 2014, where the incidence rate for Australian-born indigenous people (5.8 per 100,000) was six times higher than the rate for Australian-born non-indigenous people (0.9 per 100,000), but still much lower than the rate in overseas-born people (19.1 per 100,000) [14]. The pattern was also similar in the United States where the 2017 incidence rate was eight times higher in indigenous people (3.9 per 100,000) compared with those of European ethnicity (0.5 per 100,000) but lower than the rate in people born overseas (14.7 per 100,000) [1]. In comparison, in Canada, the 2017 incidence rate for Canadian-born people was 43 times higher among indigenous people (21.5 per 100,000 population) compared with non-indigenous people (0.5 per 100,000) and the indigenous rate was higher than the rate in people born overseas (14.7 per 100,000) [2].

COUNTRY OF BIRTH

During the past five years, 76–83% of TB cases notified were born outside of New Zealand, an increase from earlier periods (61.3% for 1995–1999, 67.7% for 2000–2004) [15]. A similar pattern has been seen in Australia where the proportion of cases born outside the country was reported to have increased over 10 years, reaching a high of 90% in 2010 and was reported as 87% in 2015 [16]. The proportion of cases born outside New Zealand in 2017 (83.4%) is higher than that reported in England (71% in 2017), Canada (71.8% in 2017) and the United States (70.1% in 2017) [1, 2, 4].

Of the cases born outside New Zealand, the majority were born in Southern and Central Asia and South-East Asia, all high TB burden areas. The most frequently reported countries of birth, India, followed by the Philippines, are similar to the most common countries of birth for TB cases reported in 2014 by Australia (India, Vietnam, Philippines, China and Myanmar) [14] and in 2017 Canada (Philippines, India, China, Vietnam and Pakistan) [2]. However, this differs from the countries of birth most commonly reported for cases notified in England in 2017 (India, Pakistan, Romania, Somalia and Bangladesh) [4]. This difference reflects differing immigration patterns but all the countries listed underscore the high risk of being born in a country with high endemicity.

Although the proportion of cases born overseas has been increasing in New Zealand, the incidence rate in people born overseas in 2017 was 19.4 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, such as the introduction of screening for international students staying over six months at the end of 2004, 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, including drug resistant disease in New Zealand.

The time since arrival in New Zealand and notification date was recorded for 85.0% of new TB cases born overseas. This data showed a similar pattern to that seen in Australia, Canada and the United Kingdom, whereby the vast majority of new TB cases are occurring in people who were born in high endemicity countries and are diagnosed with TB disease within the first 4–5 years of entry. Just over 18% of New Zealand cases reported in 2017 who were born overseas, were notified within the first year after arrival, and 54.0% within five years of arrival. Australia recorded this information for 97% of those born overseas in 2014 and reported that 43% of these cases were notified in the first four years after arrival [14]. In 2017, time from arrival until diagnosis was known for 91.6% of non-UK-born cases notified in England with 16.2% diagnosed within two years and 36.9% within six years of arrival [4]. A similar proportion cases diagnosed within two years of arrival was reported from Canada for 2017 where the time from arrival until diagnosis was known for 91.0% of foreign-born cases, with 17.7% diagnosed within two years of arrival and 36.1% within the past five years [2].

CLINICAL PRESENTATION AND TREATMENT

Pulmonary disease was reported in 56.6% of new TB cases in 2017, a slight increase from 56.0% of new TB cases in 2016. This is similar to the proportion reported in England (54.4% in 2017) but a lower proportion than most recently reported in Canada (78.6% in 2017), and Australia (63% in 2014) [2, 4, 14].

Of the three cases of TB in the <5 years age group in 2017, all were born in New Zealand and none had miliary or meningeal TB. None of the cases were reported to have received BCG vaccine. There was insufficient information provided to know whether these children were eligible for the high risk vaccination programme. Collection of information about eligibility in future years would be useful to assess whether high-risk children aged <5 years diagnosed with TB had missed out on vaccination.

Nearly all the TB cases notified in 2017 were “new disease” (95.8%), meaning there was no history of prior treatment. This is similar to the proportion reported from Australia (95%, 2014) and England (94.1%, 2017) but higher than reported from Canada (92.2%, 2017) [2, 4, 14].

Information about previous diagnosis and treatment was recorded for 53.8% (7 cases) of the 13 relapse/reactivation cases. From the data available it is unclear whether these cases were genuine relapse or reinfection. For all seven cases with information available, treatment periods for their previous illness were recorded as being at least six months. One of these cases was born, diagnosed

and treated in New Zealand for their first TB illness and one of the six cases reported as born overseas were also diagnosed and treated in New Zealand for their first illness. Among these two cases previously treated in New Zealand, it was recorded that both had received 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. However, it is of concern that the percentage of cases previously treated in New Zealand has been relatively stable for the past 10 years and that isolates from previously treated cases over the past five years were significantly more resistant to isoniazid and rifampicin. This underscores the importance of ensuring adequate treatment is completed for all cases diagnosed in New Zealand, as well as early identification of relapse cases to prevent transmission of resistant organisms.

For all cases notified in 2016, 86.1% were reported to have completed treatment, a similar proportion to Canada (80.2% of cases reported in 2016) and the United Kingdom (84.4% of drug susceptible cases had completed treatment within 12 months in 2016) [2, 4]. These percentages are all lower than the 96% reported by Australia for cases diagnosed in 2013 [14]. However, the Australian percentage is not directly comparable as it is based only on cases considered “assessable”, meaning that cases that had transferred out of Australia, died of other causes or were still under treatment were excluded from the analysis.

The proportion of cases notified in New Zealand in 2015 reported to have not completed treatment because they died (4.3%) is lower than the 7.6% of cases reported in 2016 in Canada that died before or during treatment and also lower than the 5.5% recorded in England for cases notified in 2016. However, the English outcomes only refer to drug-sensitive cases and therefore may not be directly comparable. Similarly, although the New Zealand rate is higher than the 1% case-fatality rate reported by Australia for cases diagnosed in 2013, the Australian rate only refers to deaths due to TB in the cases considered to have assessable outcomes. There were another 3.3% of total cases in Australia that were reported to have died from other causes. All three countries have previously reported problems with the quality of the follow-up data with about 5% of cases lost to follow up for a similar variety of reasons [2, 4, 14].

DRUG SUSCEPTIBILITIES AND MDR-TB

Over the last 10 years from 2008 to 2017, 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. The apparent decrease in pyrazinamide resistance over several years, first reported in 2015, may have been due to changes in the laboratory methods used to detect pyrazinamide resistance rather than a real change in the prevalence of resistance (Roberts Sally, Personal communication, 2014) and this trend is no longer evident.

During the same 10 years, there has been no overall change in the prevalence of isoniazid, rifampicin or ethambutol resistance.

There were five MDR-TB cases in 2017, all from individuals born overseas. The proportion of culture positive cases (both new disease and relapses/reactivations) with MDR-TB in 2017 (1.9%) was similar to the average proportion for the past 10 years (1.4%) and this proportion of MDR-TB is similar to that reported in the United States (1.9% for 2017), England (1.8% for 2017), and Australia (1.7% for 2014) [1, 4, 14].

Over the past 10 years in New Zealand, 93.5% (29/31) of MDR-TB cases were born overseas, the majority in Asian countries, and were assumed to have acquired their resistant organisms overseas.

In England a high proportion (74.5%) of Multidrug/rifampicin-resistant TB (MDR/RR-TB) cases in 2017 were also reported to be born overseas, and the most common countries of birth for these cases were Lithuania and India [4]. For the United States, the proportion of MDR-TB cases that occurred in foreign-born persons has increased from 25% (103 of 407) in 1993 to 86% (105 of 121) in 2017 [1]. There was a similar pattern reported from Australia in 2015 with 78% of MDR-TB cases reported as being born overseas [16].

From 2013–2017, 6.1% of New Zealand relapse/reactivation cases previously treated for TB were reported with MDR-TB, a much higher proportion than the 1.2% of new TB cases with MDR-TB. However this is lower than the 6.6% of MDR/RR-TB in previously diagnosed cases reported from the United Kingdom in 2017[4].

As previously stated, and in common with Australia, England and Canada by far the vast majority of new TB cases in New Zealand are those occurring in people who were born in high endemicity countries and are diagnosed with TB disease within the first 4–5 years of arrival.

TRANSMISSION AND CONTROL

Recent transmission in low endemicity countries, such as New Zealand and England, can be assessed by using the rate of TB in children age <15 years born within the country as an indicator [5]. The 2017 rate of TB in New Zealand-born children aged <15 years was 0.8 per 100,000, lower than the 2017 rate of 1.4 per 100,000 reported in England for children aged <15 years born in the United Kingdom [4] and the comparable rates of TB in Australian-born children <15 years of age in 2014 which was 1.7 per 100,000 for indigenous and 0.8 per 100,000 for non-indigenous Australian born children [14]. However, as the case numbers in New Zealand are low, it is expected that the rates may be quite unstable and the 3-year moving annual average gives a better indication of trends in local transmission. The 2017 3-year moving annual average rate of TB in New Zealand-born children in the <15 years age group was 1.2 per 100,000, a decrease from 3.1 per 100,000 in 2007, but similar to the 2017 rate in children born in the United Kingdom [14].

For ongoing transmission within a community, the indicator now used by Public Health England is to identify clustered cases (with indistinguishable MIRU-VNTR strain types) as these may reflect cases that are part of the same chain of transmission. However, it is also recognised that these may also reflect common endemic strains circulating either within the country or in overseas countries where cases acquired their infection. The proportion of cases in clusters, the number of new clusters formed each year and the number of cases within each cluster are all considered useful when assessing the frequency of recent transmission [5].

Between 2013 and 2017, 39.1% of strain typed TB cases in New Zealand were part of a cluster and 90.8% of these clusters had fewer than five cases. This compares to the 58% of strain-typed TB cases in England that were part of a cluster during the same period, with 74% of these clusters having fewer than five cases [4]. However, in the future, whole genome sequencing will provide greater understanding of TB transmission and whether isolates in clusters are part of the same transmission chain [4].

These indicators suggest low and likely decreasing transmission of TB infection within New Zealand compared with England, at least partly 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 all other overseas regions.

These indicators suggest low transmission of TB infection within New Zealand, support the premise that most cases of TB diagnosed in New Zealand result from infection acquired overseas, but also

highlight that there is a higher risk of transmission within the country from cases born either in New Zealand or in the Pacific Island region. This suggests that as well as continuing with current strategies of early detection and treatment of TB disease and contact follow up to decrease the incidence of TB in New Zealand, consideration could be given to identifying high risk groups for LTBI screening and treatment, as suggested in the WHO framework to eliminate TB in low incidence countries[17].

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APPENDIX

Table 12. Numbers and rates of tuberculosis (new cases) notifications by age group, sex, ethnic group, district health board and year, 2013−2017

Category	2013		2014		2015		2016		2017	
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]
Age group (years)										
<5	5	1.6	12	3.9	3	1.0	6	2.0	3	1.0
5−14	5	0.8	7	1.2	6	1.0	8	1.3	3	0.5
15−39	130	9.0	141	9.5	145	9.5	160	10.1	170	10.4
40−59	67	5.5	69	5.6	70	5.7	53	4.3	52	4.2
≥60	55	6.3	59	6.6	61	6.6	56	5.9	67	6.8
Sex										
Male	139	6.4	169	7.6	155	6.9	149	6.5	143	6.1
Female	123	5.4	119	5.2	130	5.6	134	5.6	152	6.2
Ethnic group[b]										
Māori	25	3.8	36	5.3	22	3.2	24	3.4	24	3.4
Pacific peoples	40	14.6	47	16.9	57	20.2	35	12.1	36	12.2
Asian	157	31.0	172	33.5	181	34.4	177	32.9	205	37.2
MELAA	13	26.3	11	22.0	8	15.7	9	17.2	6	11.2
European or	24	0.8	17	0.6	16	0.5	34	1.1	23	0.7
Unknown	3	-	5	-	1	-	4	-	1	-
District health board										
Northland	1	0.6	7	4.2	2	1.2	2	1.2	3	1.7
Waitemata	21	3.8	36	6.4	38	6.6	34	5.8	35	5.8
Auckland	53	11.5	69	14.6	62	12.7	54	10.6	59	11.3
Counties	54	10.9	48	9.4	64	12.3	63	11.8	55	10.1
Waikato	23	6.1	17	4.4	23	5.9	21	5.3	28	6.8
Lakes	6	5.8	5	4.8	7	6.7	6	5.6	2	1.8
Bay of Plenty	10	4.7	11	5.1	6	2.7	10	4.4	9	3.9
Tairawhiti	2	4.3	1	2.1	1	2.1	1	2.1	1	2.1
Taranaki	6	5.3	3	2.6	2	1.7	3	2.6	4	3.4
Hawke's Bay	6	3.8	4	2.5	9	5.6	16	9.9	12	7.3
Whanganui	1	1.6	1	1.6	3	4.8	2	3.2	0	0.0
MidCentral	6	3.6	11	6.5	7	4.1	6	3.4	6	3.4
Hutt Valley	6	4.2	12	8.4	4	2.8	4	2.7	15	10.1
Capital & Coast	34	11.6	33	11.1	21	7.0	19	6.2	17	5.4
Wairarapa	2	4.7	1	2.3	0	0.0	2	4.6	4	9.0
Nelson	4	2.8	2	1.4	3	2.1	4	2.7	4	2.7
West Coast	1	3.0	1	3.0	1	3.1	1	3.1	0	0.0
Canterbury	21	4.2	23	4.5	26	4.9	26	4.8	33	6.0
South Canterbury	0	0.0	1	1.7	0	0.0	2	3.4	0	0.0
Southern	5	1.6	2	0.6	6	1.9	7	2.2	8	2.5
Total	**262**	**5.9**	**288**	**6.4**	**285**	**6.2**	**283**	**6.0**	**295**	**6.2**

[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 census population 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 13. Tuberculosis (new case) notifications for cases born in New Zealand by year by DHB, 2013–2017

District health board	2013	2014	2015	2016	2017	Total
Northland	0	4	2	0	1	7
Waitemata	2	11	2	2	3	20
Auckland	6	14	5	4	3	32
Counties Manukau	10	12	9	12	8	51
Waikato	6	4	7	7	9	33
Lakes	4	4	2	1	1	12
Bay of Plenty	6	1	0	1	3	11
Tairawhiti	0	0	1	1	1	3
Taranaki	0	0	1	2	1	4
Hawke's Bay	3	2	6	7	5	23
Whanganui	0	0	0	1	0	1
MidCentral	2	1	2	1	2	8
Hutt Valley	2	3	0	1	2	8
Capital & Coast	6	7	5	4	2	24
Wairarapa	1	0	0	2	1	4
Nelson Marlborough	2	0	1	1	0	4
West Coast	0	0	0	1	0	1
Canterbury	4	3	3	5	5	20
South Canterbury	0	1	0	0	0	1
Southern	1	2	2	5	2	12
Total	**55**	**69**	**48**	**58**	**49**	**279**

Table 14. Site of infection for tuberculosis (new case) notifications with extra-pulmonary involvement by year, 2013–2017

Site of infection	2013		2014		2015		2016		2017	
	Cases[b]	%	Cases[b]	%	Cases[b]	%	Cases[b]	%	Cases[b]	%
Lymph node (excl. abdominal)	76	45.2	81	48.8	87	47.5	87	51.2	85	50.6
Pleural	25	14.9	25	15.1	34	18.6	25	14.7	33	19.6
Intra-abdominal (excl. renal)	17	10.1	18	10.8	17	9.3	16	9.4	20	11.9
Bone/joint	16	9.5	24	14.5	12	6.6	8	4.7	12	7.1
Renal/genitourinary tract	10	6.0	5	3.0	14	7.7	4	2.4	7	4.2
Soft tissue/skin	8	4.8	5	3.0	16	8.7	14	8.2	11	6.5
Miliary tuberculosis	9	5.4	10	6.0	10	5.5	5	2.9	6	3.6
Central nervous system TB (CNS TB)[C]	6	3.6	8	4.8	10	5.5	11	6.5	17	10.1
Other	19	11.3	18	10.8	14	7.7	16	9.4	3	1.8
Total[a]	**168**	**100.0**	**166**	**100.0**	**183**	**100.0**	**170**	**100.0**	**168**	**100.0**

[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 15. Numbers and percentages of non-unique and unique strain of tuberculosis (new case) notifications for selected variables, 2013−2017

Variable[a]	Non-unique		Unique	
	Cases	%[b]	Cases	%[b]
Age group (years)	**452**	**39.1**	**704**	**60.9**
<15	12	80.0	3	20.0
15−39	228	35.6	413	64.4
40−59	101	41.2	144	58.8
≥60	111	43.5	144	56.5
Sex	**452**	**39.1**	**704**	**60.9**
Male	238	38.3	384	61.7
Female	214	40.1	320	59.9
Ethnic group	**445**	**38.9**	**699**	**61.1**
Māori	70	76.9	21	23.1
Pacific peoples	143	77.3	42	22.7
Asian	196	26.5	544	73.5
Middle Eastern/Latin American/African	5	12.8	34	87.2
European or Other	31	34.8	58	65.2
District health board	**452**	**39.1**	**704**	**60.9**
Northland	6	46.2	7	53.8
Waitemata	58	42.3	79	57.7
Auckland	88	33.8	172	66.2
Counties Manukau	102	42.7	137	57.3
Waikato	35	41.2	50	58.8
Lakes	8	40.0	12	60.0
Bay of Plenty	8	20.0	32	80.0
Tairawhiti	1	25.0	3	75.0
Taranaki	3	23.1	10	76.9
Hawke's Bay	19	67.9	9	32.1
Whanganui	5	83.3	1	16.7
MidCentral	13	43.3	17	56.7
Hutt Valley	8	26.7	22	73.3
Capital & Coast	35	37.6	58	62.4
Wairarapa	4	50.0	4	50.0
Nelson Marlborough	5	35.7	9	64.3
West Coast	2	66.7	1	33.3
Canterbury	40	37.0	68	63.0
South Canterbury	0	0.0	2	100.0
Southern	12	52.2	11	47.8
Region of birth	**452**	**39.1**	**704**	**60.9**
New Zealand	135	67.8	64	32.2
Southern and Central Asia	161	25.8	464	74.2
East Asia	26	26.8	71	73.2
Pacific Islands	110	72.4	42	27.6
Africa and the Middle East	12	23.5	39	76.5
Australia, Europe and the Americas	8	25.0	24	75.0
NZ Index of Deprivation 2013 quintile	**437**	**38.9**	**685**	**61.1**
1	32	32.7	66	67.3
2	50	31.8	107	68.2
3	58	29.7	137	70.3
4	123	39.8	186	60.2
5	174	47.9	189	52.1
Clinical manifestation	**452**	**39.1**	**704**	**60.9**
Pulmonary disease	296	41.8	412	58.2
Extra-pulmonary involvement only	156	34.8	292	65.2

[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 16. 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

Country Name	Region
El Salvador	The Americas
England	Europe
Eritrea	Sub-Saharan Africa
Estonia	Europe
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

Country Name	Region
Malawi	Sub-Saharan Africa
Malaysia	South-East Asia
Maldives	Southern and Central Asia
Mali	Sub-Saharan Africa
Marshall Islands	Pacific Islands
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

Country Name	Region
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
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

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