Science for Communities

TUBERCULOSIS IN NEW ZEALAND ANNUAL REPORT 2016

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Disclaimer

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

This report describes the epidemiology of tuberculosis in New Zealand for 2016 as well as trends during the past 5–10 years.

Tuberculosis disease (TB) is a notifiable condition in New Zealand. The TB notification rate has been relatively stable since 2007 apart from a small decrease recorded in 2013. The 2016 TB notification rate was 6.3 per 100,000 population (294 cases). The majority of TB notifications were for new disease, with relapse/reactivation cases making up a small number of notifications. A high proportion of TB cases (86.7%) were laboratory confirmed. The highest notification rates in 2016 were recorded for Counties Manukau, followed by Auckland and Hawke's Bay DHBs.

Between 2012 and 2016, there was a similar pattern in the demography among new TB cases. Rates were higher in males than females, especially those aged 15–39 years. Over the past 5 years, the Asian ethnic group has consistently experienced the highest notification rates. Although the absolute number of cases remains relatively low, the next highest rates were recorded in the Middle Eastern/Latin American/African (MELAA) ethnic group up until 2015 when the rate in this group was surpassed by the rate in the Pacific peoples ethnic group. As in previous years (2007–2016), higher rates of TB occurred in socioeconomically deprived areas.

Not being born in New Zealand and current or recent residence with a person not born in New Zealand have consistently been dominant risk factors.

For those born in New Zealand, the burden of disease is highest in the Auckland region, and in Waikato, Hawke's Bay, Capital & Coast and Canterbury DHBs and rates are highest for those of Māori ethnicity.

The pattern of disease detection for new TB cases has been consistent over the past 5 years, with more than two-thirds of TB cases diagnosed when they presented with symptoms to a health practitioner. Around 8% of cases were identified through immigrant/refugee screening.

Pulmonary disease was more common among new TB cases born in New Zealand than in cases born overseas. No miliary or meningeal TB in a child aged <5 years was reported in 2016. Only two cases of miliary TB and none of meningeal TB have been reported in this age group in the last 5 years.

Most (98.6%) new TB cases in 2016 were reported to have received treatment. For pulmonary cases where the time between the onset of symptoms and start of treatment could be calculated, 21.0% of cases started treatment within 1 month of the onset of illness and 42.0% started treatment between one and three months.

No TB cases notified in 2016 were co-infected with HIV. 40 cases were reported as immunosuppressed of whom 19/37 (51.4%) had diabetes.

Five outbreaks of *Mycobacterium tuberculosis* with 48 associated cases were reported in 2016.

Four (1.7%) of the culture-positive TB cases reported in 2016 were multidrug-resistant TB (MDR-TB, defined as resistance to at least isoniazid and rifampicin). All four of these MDR-TB cases were born overseas. Resistance to isoniazid, rifampicin, ethambutol and streptomycin was higher among isolates from cases born overseas than among isolates from New Zealand-born cases, but only streptomycin resistance was significantly higher (p = 0.028).

Between 2007 and 2016, there have been no significant changes in the overall resistance to any of the five antimicrobials routinely tested. Over the same 10 years, an average of 1.3% of culture-positive TB cases were MDR-TB.

Over one-third of the *M. tuberculosis* isolates that underwent molecular typing between 2012 and 2016 had results that matched other typed isolates, that is, were non-unique and could be assigned to a cluster. Most clusters contained fewer than five cases. Four new clusters were identified in 2016.

INTRODUCTION

Globally, tuberculosis disease (TB) is one of the most common causes of death from a communicable disease. TB had almost disappeared from the world's public health agenda in the 1960s, but returned in the early 1990s following the HIV/AIDS pandemic, and was sustained by a subsequent increase in drug resistance. Infection is usually curable with a combination of specific antibiotics, but this relies upon full compliance with treatment. TB is more prevalent in, but not confined to, low-income countries.

The World Health Organization's (WHO) estimated global TB incidence rate for 2016 was 140 per 100,000 population. WHO estimates also show a reduction in TB incidence of 2% per year between 2000 and 2013, and a reduction in mortality rates of 3.3% per year for the same period [1, 2]. This means that the 2015 Millennium Development Goal of halting and reversing TB incidence has been achieved globally [3]. However, WHO reports that "the TB epidemic is larger than previously estimated, reflecting new surveillance and survey data from India". It was estimated there were 10.4 million newly incident TB cases worldwide in 2016 and TB deaths remained one of the top 10 causes of death. People living with HIV accounted for 10% of new TB cases in 2016 and 56% of all new TB cases occurred in five countries: India, Indonesia, China, the Philippines and Pakistan [2]. WHO notes that global progress in TB control and elimination requires major advances in TB prevention and care in these countries. Another component of the "End TB Strategy" is preventive treatment (LTBI treatment) of infected persons at high risk of disease, such as those living with HIV newly enrolled in HIV care and children aged <5 years who are household contacts of a TB case [1, 3].

In New Zealand in 2016, TB was still notifiable under the Tuberculosis Act 1948. The 2015 notification rate was 6.4 per 100,000, similar to the average rates recorded since 2007. Notification rates decreased during the 1980s, then ranged between 8.5 and 11.6 per 100,000 from 1990 to 2003, followed by a further decrease between 2003 and 2007 to 6.7 per 100,000 [4]. 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 [5].

In this report we describe the epidemiology of TB in New Zealand for 2016 and provide detailed trends during the past 5–10 years. The report includes the distribution of TB disease notifications geographically, by age and sex, among specific ethnic groups and across protective and risk factors where information is available. We describe clinical outcomes based on hospitalisation and death data from the Ministry of Health's National Minimum Dataset and the National Mortality Collection. TB drug susceptibility and molecular typing data is also summarised.

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

In 2016, clinicians were required to notify all cases of active TB to their local Medical Officer of Health under the Tuberculosis Act 1948. However, cases diagnosed with latent tuberculosis infection (LTBI) or with old inactive tuberculosis disease are not notifiable under the Tuberculosis Act 1948[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 been treated for TB before, 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 [6], 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 2014 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, Wellington SCL 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. In addition, first-line DST at Wellington SCL includes fluoroquinolone (ofloxacin) susceptibility testing. 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 MTBDR*sl,* 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 2016 and trends since 2007 or 2012, 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 2015 rather than 2016.

Notification data presented in this report is based on information recorded in EpiSurv as at 25 September 2017. 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 2012–2016 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 2005–2016 is based on the proportion of people born in New Zealand from the usually resident 2006 (for 2005 to 2009) and 2013 (for 2011 to 2016) 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 ethnic groups. More information about ethnicity classification is available in the Ethnicity Data Protocols on the Ministry of Health website (link below):

http://www.health.govt.nz/publication/ethnicity-data-protocols-health-and-disability-sector.

Socioeconomic deprivation is based on the 2013 New Zealand Deprivation Index (NZDep13). 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 [7]. Quintiles of NZDep13, 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 2012 to 2016 is shown in Table 1.

For most variables the level of completeness was more or less stable over the 5 year period, but there were two notable exceptions. The completeness of the extra-pulmonary involvement variable improved to 99% or above following changes to this section of the case report form during 2012. Completion of risk factor information for the variables exposure in a healthcare setting and current or recent residence in an institution has gradually improved over the 5 years (84% to 94% and 88% to 97%, respectively).

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 not born in New Zealand. The completeness of data associated with the treatment variables was also high (≥96%) across the 4 years analysed (2012–2015).

The date of onset of illness variable had the lowest levels of completeness, ranging from 60% 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, 2012–2016

Variable	2012	2013	2014	2015	2016
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	99	98	100	99
Geocoding accuracy[a]	96	95	97	98	99
Clinical course and outcomes					
Onset date	60	71	73	78	72
Hospitalisation status	99	99	99	100	100
Survival status	100	98	100	100	99
Protective and risk factors					
BCG vaccination[b]	100	100	100	100	100
Has immunosuppressive illness	95	92	97	98	95
On immunosuppressive medication	95	93	97	98	97
Contact with confirmed case of tuberculosis	82	82	87	85	88
Case born outside New Zealand	100	100	100	100	100
Date of arrival[c]	89	78	80	87	89
Current/recent residence with person born outside New Zealand	91	90	93	91	90
Exposure in a healthcare setting	84	87	92	89	94
Current/recent residence in an institution	88	89	95	91	97
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	99	98
Treatment outcome[e]	98	100	99	98	-
Use of directly observed therapy (DOT)[d]	98	96	98	97	-

[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.

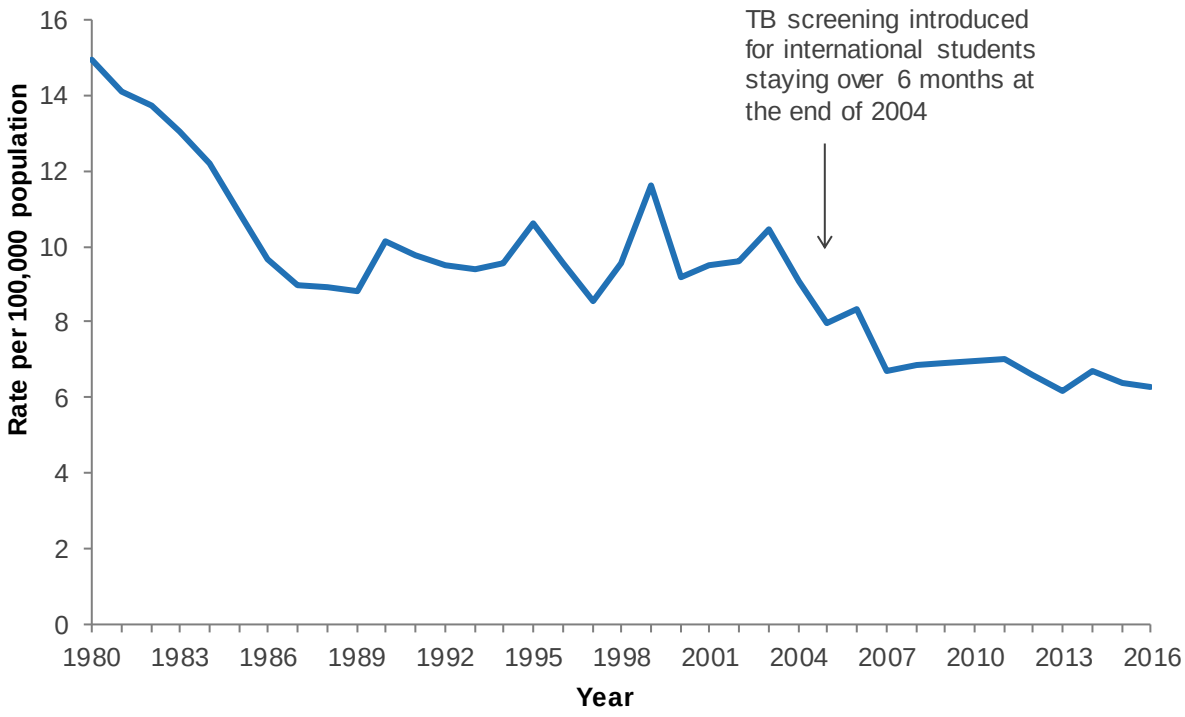
[e] Data is only reported for 2012−2015 due to length of time taken for TB treatment to be completed.

NOTIFICATIONS

There were 294 cases of TB disease notified in 2016, including 282 (95.9%) new cases. The 2016 TB disease notification rate was 6.3 per 100,000 population, similar to the rate recorded in 2015 (6.4 per 100,000). A high proportion of TB cases (86.7%, 255/294) were laboratory confirmed.

Trends in TB disease rates since 1980 are shown in Figure 1. The TB disease notification rate in 2016 was the second lowest since 1980. The lowest rate was in 2013 (6.2 per 100,000). From 1980 to 1989 the rate decreased from 14.9 to 8.8 per 100,000; between 1990 and 2003 the rate remained between 8.5 and 11.6 per 100,000; there was a decrease between 2003 and 2007 to 6.7 per 100,000; followed by relatively stable rates over the last 10 years. On average, the TB notification rate declined by 1.6% each year between 1980 and 2016.

Figure 1. Tuberculosis disease notification rates by year, 1980–2016



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 CASE

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

There were 282 new TB cases notified in 2016, giving a notification rate of 6.0 per 100,000 population. This is similar to the 2015 rate of 6.2 per 100,000 (285 new TB cases). Between 2012 and 2016, the notification rate fluctuated between 5.9 and 6.4 100,000 but was relatively stable (Table 12).

Basis of discovery and diagnosis

Information on the way TB was discovered was recorded for all 282 new TB cases. The majority (79.8%, 225/282) were diagnosed when the symptomatic case presented to a health practitioner (Table 2).

Between 2012 and 2016, the proportion of cases discovered by each method ranged from 78−87% for symptomatic case presented to health practitioner, 4−12% 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, 2016

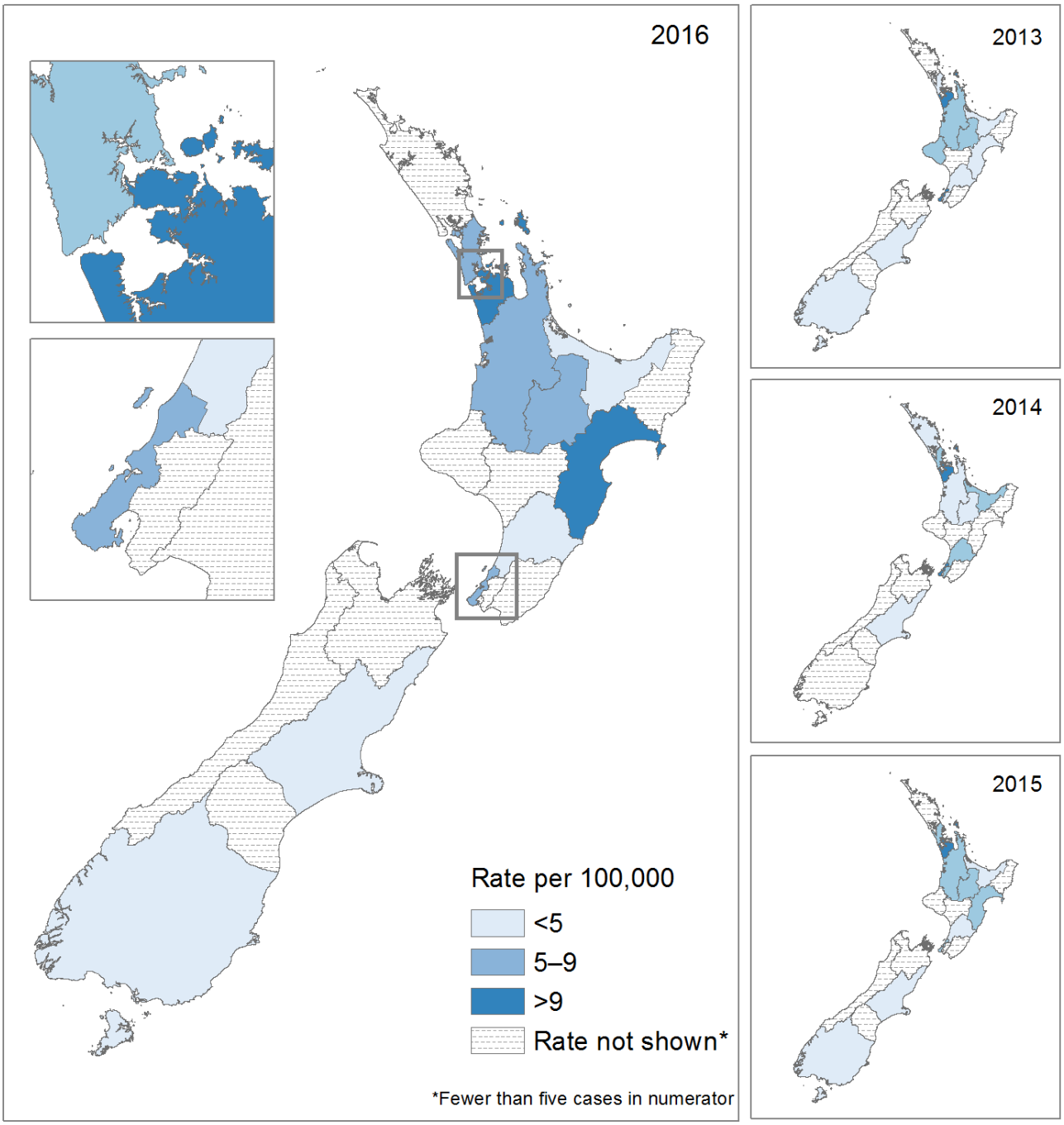
Basis of discovery	Cases	%
Symptomatic case presented to health practitioner	225	79.8
Immigrant/refugee screening	24	8.5
Contact follow-up	20	7.1
Other	13	4.6
Total	**282**	**100.0**

In 2016, 86.2% (243/282) new TB cases were laboratory confirmed. Among the 243 cases for which the method of laboratory confirmation was recorded, 92.6% (225 cases) were confirmed by isolation of *M. tuberculosis* (98.7%, 222 cases) or *M. bovis* (1.3%, 3 cases). A further 18 cases were confirmed by the following methods; 2.5% (6 cases) by demonstration of acid-fast bacilli in a clinical specimen, 1.6% (4 cases) by demonstration of *M. tuberculosis* nucleic acid directly from specimens and 3.3% (8 cases) by histology strongly suggestive of TB. The remaining new TB cases (39) were classified as probable based on clinical grounds and treatment for presumptive TB, with 18 of these cases recorded as having radiology suggestive of pulmonary TB.

Notifications by District Health Board

New TB case notification rates by district health board (DHB) for 2013 to 2016 are shown in Figure 2. The highest notification rates in 2016 were recorded for Counties Manukau (11.6 per 100,000, 62 cases), followed by Auckland (10.6 per 100,000, 54 cases) DHBs (Table 12). These two DHBs had consistently the highest rates in the last 5 years.

Figure 2. Tuberculosis (new case) notification rates by district health board and year, 2013–2016



Notifications by 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 5 years (Table 12). The highest notification rate for new TB cases in 2016 was in the 15–39 years age group (10.1 per 100,000, 160 cases), followed by the ≥60 years (5.8 per 100,000, 55 cases) (Table 3).

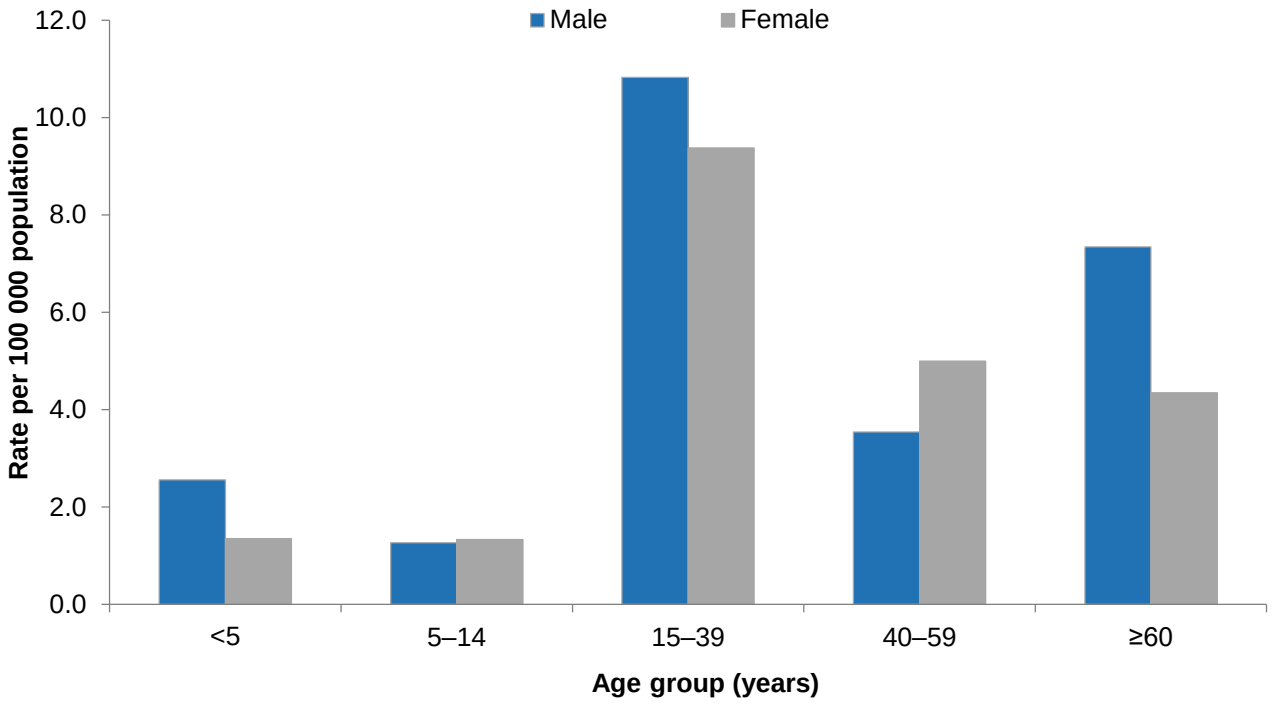
Table 3. Numbers and rates of tuberculosis notifications (new case) by age group and sex, 2016

Age group (years)	Male		Female		Total	
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]
<5	4	2.6	2	1.4	6	2.0
5–14	4	1.3	4	1.3	8	1.3
15–39	86	10.8	74	9.4	160	10.1
40–59	21	3.5	32	5.0	53	4.3
≥60	33	7.3	22	4.3	55	5.8
Total	**148**	**6.4**	**134**	**5.6**	**282**	**6.0**

[a] Rate per 100,000 based on 2016 mid-year population estimates; caution as rates shown for counts with less than 5 cases

The notification rate for males (6.4 per 100,000, 148 cases) was higher than the rate for females (5.6 per 100,000, 134 cases) (Figure 3). This has remained a consistent trend over the last 5 years (Table 12). The 15–39 years age group had the highest rates for both males (10.8 per 100,000) and females (9.4 per 100,000) (Figure 3,Table 3).

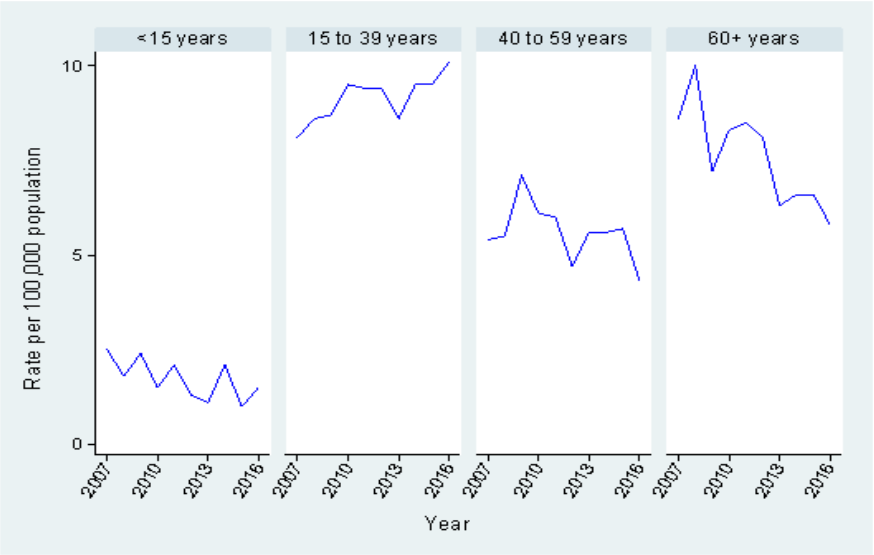
Figure 3. Notification rates of tuberculosis (new case) by age group and sex, 2016



Note: Rates not calculated for males and females <5 years and females aged 5–14 years as numbers are too small.

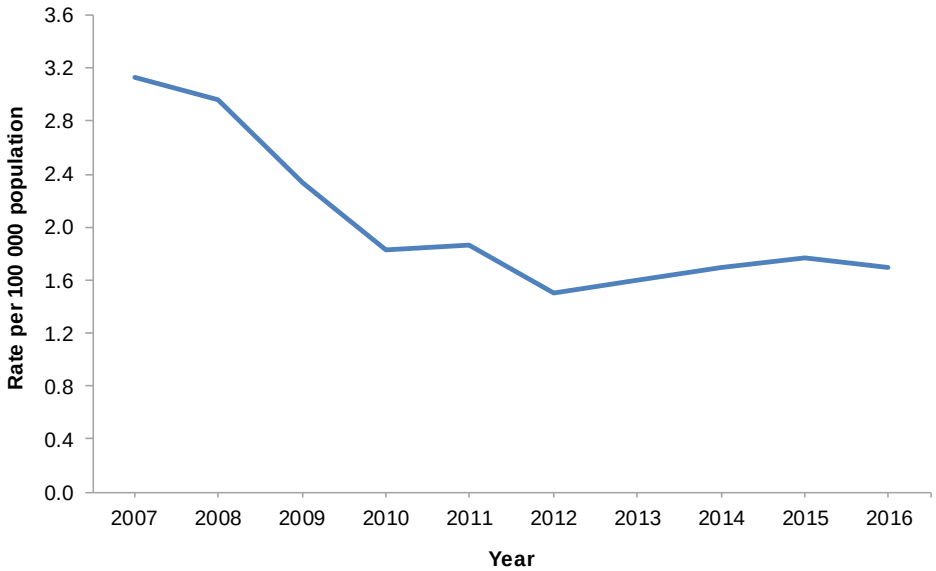
Over the past 10 years (2007–2016), the average annual notification rate was highest in the 15–39 years age group (9.1 per 100,000), followed by the ≥60 years (7.6 per 100,000), 40–59 years (5.6 per 100,000) and the <15 years (1.7 per 100,000) age groups. During this time (2007–2016), there was an overall decreasing trend in the notification rate for <15 years (down 38.6% from 2.5 to 1.5 per 100,000), ≥60 years (down 32.8% from 8.6 to 5.8 per 100,000) and 40–59 years (down 20.6% from 5.4 to 4.3 per 100,000) (Figure 4). In contrast, there was an increasing trend in the 15–39 years age group (up 24.9% from 8.1 to 10.1 per 100,000).

Figure 4. Tuberculosis (new case) notification rates by age group and year, 2007–2016



In 2016, 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 1.4 per 100,000 (9 cases). This was similar to the 2015 rate of 1.3 per 100,000 (8 cases). The low numbers (7–26 cases a year from 2005 to 2016) mean that the trend is better assessed by calculating a 3-year moving average annual rate. The 2007 3-year moving average annual rate was 3.1 per 100,000, decreasing to 1.5 per 100,000 in 2012, followed by a slight increase to 1.8 per 100,000 in 2015 and a slight decrease to 1.7 per 100,000 in 2016 (Figure 5).

Figure 5. Three-year moving average annual rate of tuberculosis (new cases) in New Zealand-born children (<15 years old), 2007–2016

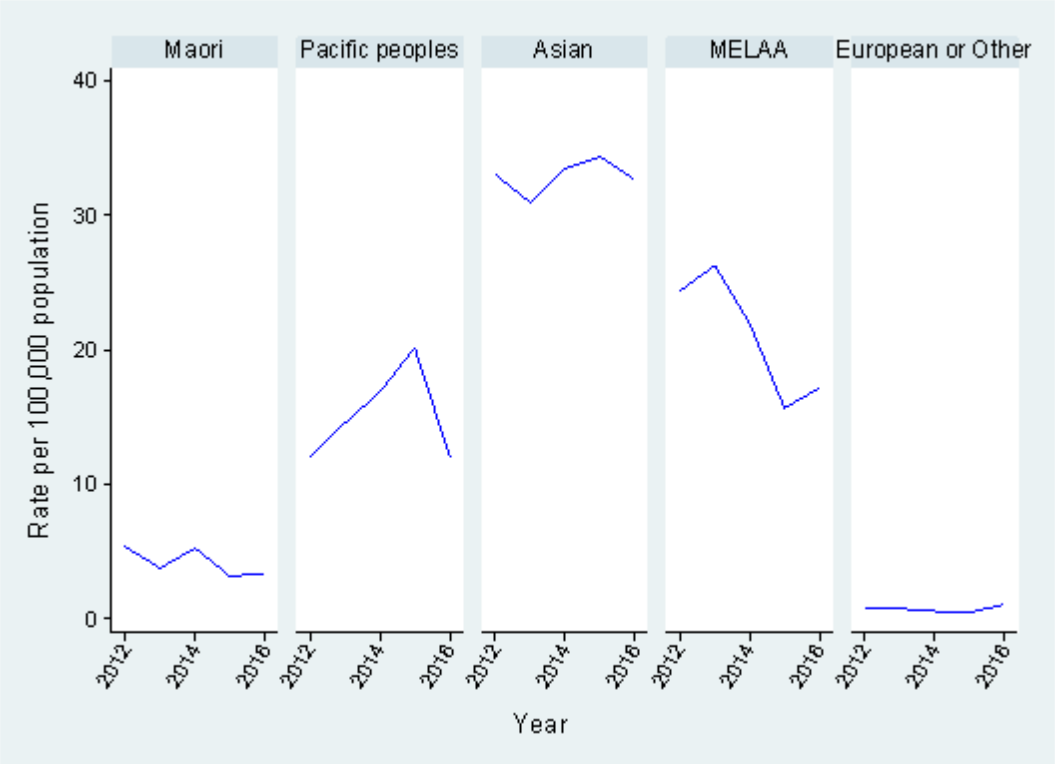


Ethnicity

Ethnicity was recorded for 98.6% (278/282) of the new TB cases notified in 2016. The Asian ethnic group had the highest notification rate (32.7 per 100,000, 176 cases), followed by MELAA (17.2 per 100,000, 9 cases), Pacific peoples (12.1 per 100,000, 35 cases), Māori (3.4 per 100,000, 24 cases) and European or Other (1.1 per 100,000, 34 cases) ethnic groups (Table 12).

Between 2012 and 2016, the Asian and MELAA ethnic groups generally had the highest rates apart from in 2015 where Pacific peoples had the second highest rate (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 (8–13 cases annually).

Figure 6. Tuberculosis (new case) notification rates by ethnic group and year, 2012–2016

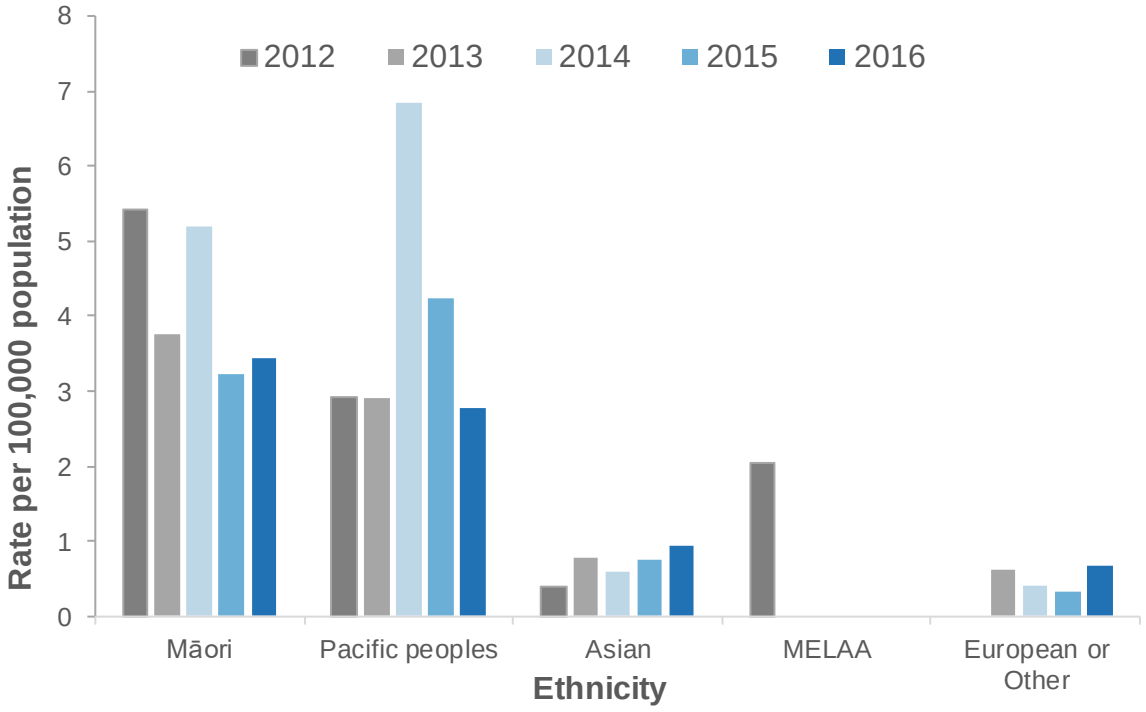


MELAA: Middle Eastern/Latin American/African.

Born in New Zealand

For new TB cases in 2016 who were born in New Zealand, 41.4% (24/58) were in the Māori ethnic group, 36.2% (21/58) in the European or Other, 13.8% (8/58) in the Pacific peoples and 8.6% (5/58) in the Asian ethnic groups. Although incidence rates in 2016 were highest for the Māori (3.4 per 100,000, 24 cases) and Pacific peoples (2.8 per 100,000, 8 cases) ethnic groups, the rate for European or Other was only 0.7 per 100,000 (21 cases). The average rates by ethnicity for New Zealand born cases in 2012–2016 showed a similar pattern with the highest rates reported in Māori (4.2 per 100,000, 142 cases) and Pacific peoples (3.9 per 100,000, 55 cases). The lowest rates were in Asian (0.7 per 100,000, 18 cases) and European or Other (0.5 per 100,000, 79 cases) (Figure 7).

Figure 7. Number of tuberculosis (new case) notifications for NZ born cases by ethnicity, 2012–2016



Hospitalisations

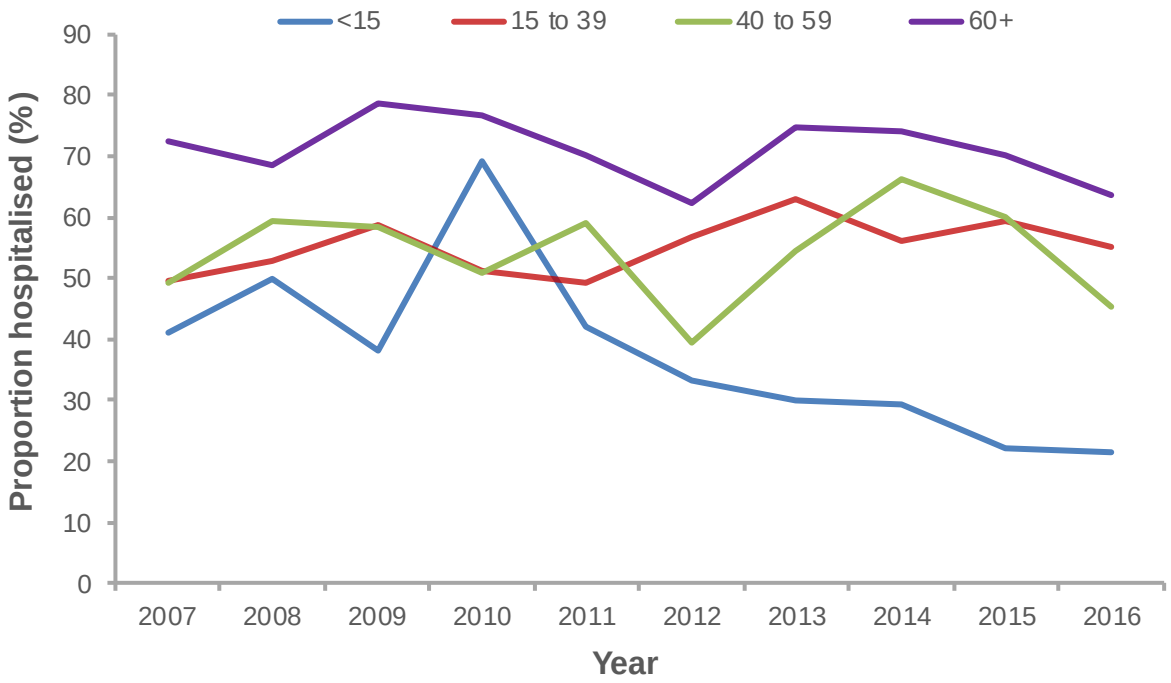
Hospitalisation status was complete for all new TB cases notified to EpiSurv in 2016, of which 53.2% (150/282) were hospitalised. Over half of the cases in ≥60 years (63.6%) and 15–39 years (55.0%) were hospitalised (Table 4).

Table 4. Hospitalisation by age group, 2016

Age group (years)	Hospitalised		
	Yes	No	%
<5	1	5	16.7
5–14	2	6	25.0
15–39	88	72	55.0
40–59	24	29	45.3
≥60	35	20	63.6

The proportion of cases hospitalised over the past 10 years shows a marked decrease for those aged <15 years, with a decreasing trend in the 40–59 years and ≥60 years age groups (Figure 8). This contrasts with an increasing trend in the 15–39 years age group.

Figure 8. Proportion hospitalised for tuberculosis by age group and year, 2007–2016



Deaths

There were five deaths (where TB was the primary cause of death) among the 282 new TB cases notified in 2016.The cases were aged in the 15–39 years (2 cases), 40–59 years (1 case) and ≥60 years (2 cases) age groups. In the last 10 years (2007−2016), 43 deaths among the notified new TB cases were reported, giving a case-fatality rate of 1.5%. The majority (97.7%, 42/43) of deaths were in cases aged ≥20 years with one death in a child aged <5 years who was notified in 2014 but died in 2016.

Between 2007 and 2014 TB was recorded in the Ministry of Health's Mortality Collections dataset as the underlying cause of death in 53 cases. During this period 4–11 deaths were recorded each year, all of whom were aged ≥20 years. The majority of cases (94.3%, 50 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 [8].

In 2016, six cases of TB were aged <5 years, five cases were born in New Zealand and one case was born overseas. Five of the cases had pulmonary disease and one had both pulmonary and extrapulmonary (not miliary or meningeal). Two cases were reported to have received BCG vaccine (one of whom was born in New Zealand). The remaining four cases were born in New Zealand and were not vaccinated. There was insufficient information to know whether these children were eligible for the high-risk vaccination programme.

Risk factors

The percentage of cases with available information for the various risk factors ranged from 82.0% to 100% over the last 5 years. In 2016, the most common risk factors reported for new TB cases were being born outside New Zealand (79.4%) and current/recent residence with person(s) born outside New Zealand (71.8%) (Table 5, Figure 9).

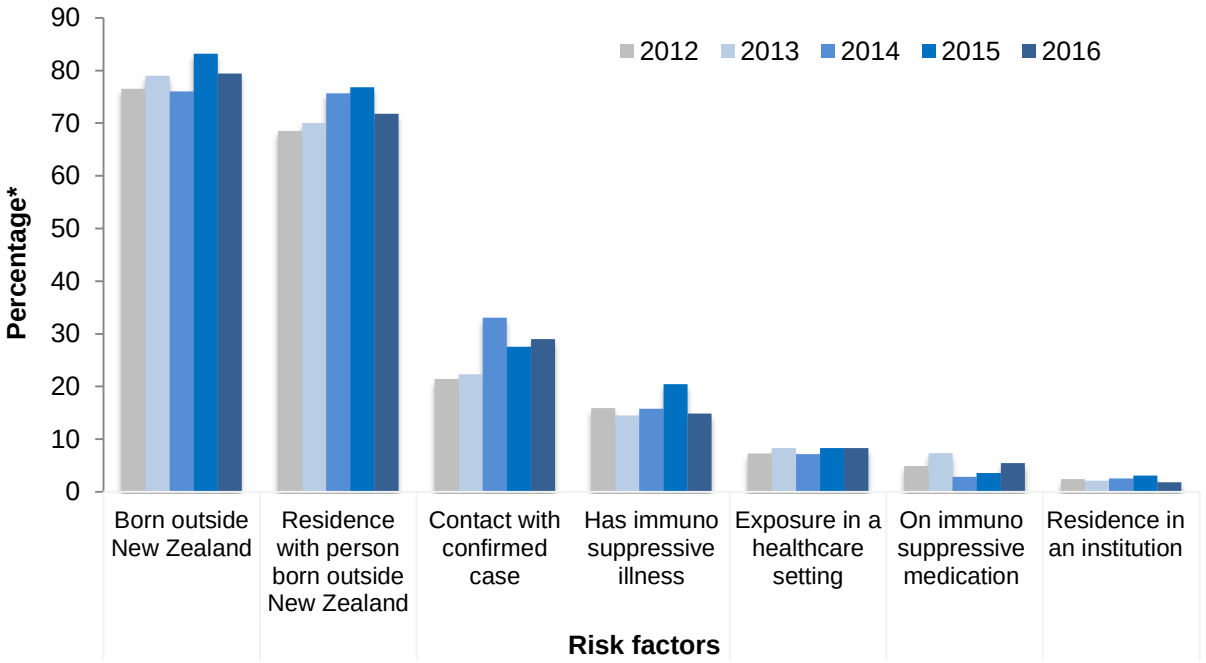
Table 5. Risk factors reported for tuberculosis (new case) notifications, 2016

Risk factor	Cases[a]	Total[b]	%
Born outside New Zealand	224	282	79.4
Current/recent residence with person born outside New Zealand	183	255	71.8
Contact with confirmed case	72	248	29.0
Has immunosuppressive illness	40	269	14.9
Exposure in a healthcare setting	22	264	8.3
On immunosuppressive medication	15	274	5.5
Current/recent residence in an institution	5	273	1.8

[a] Number of cases with 'yes' recorded for the risk factor.

[b] Number of cases for which information was recorded for the risk factor. Cases can have multiple risk factors.

Figure 9. Percentage of tuberculosis (new case) notifications reporting exposure to risk factors by year, 2012–2016



*Number of cases with the factor divided by the total number of cases for which the response is known, for the year.

Born outside New Zealand

Cases born in the Southern and Central Asia region had the highest notification rate in 2016 (106.6 per 100,000, 92 cases), followed by the South-East Asia (53.5 per 100,000, 47 cases) and Pacific Island (21.1 per 100,000, 32 cases) regions (Table 6). More than 90% (85/92) of the cases born in the Southern and Central Asia region were born in India. The most commonly reported country of birth for cases born in South-East Asia was the Philippines (57.4%, 27/47). SeeTable 15 for a list of countries in each region.

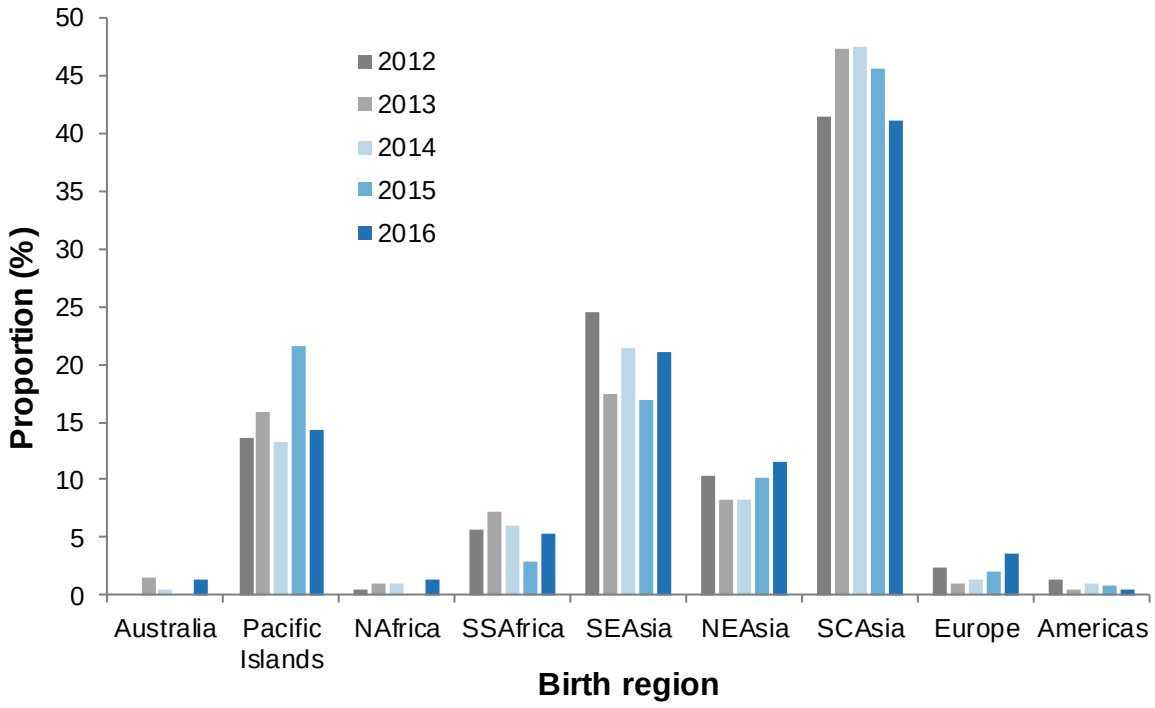
Table 6. Tuberculosis notifications (new case) by region of birth, 2016

Region of birth	Cases	Rate[a]
Born in New Zealand	**58**	**1.9**
Born outside New Zealand	**224**	**17.7**
Australia	3	4.8
Pacific Islands	32	21.1
North Africa and the Middle East	3	16.5
Sub-Saharan Africa	12	16.6
North-East Asia	26	18.3
South-East Asia	47	53.5
Southern and Central Asia	92	106.6
Europe	8	1.3
The Americas	1	2.3
Total	**282**	

[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.

Among new TB cases who were not born in New Zealand, the proportion of cases born in the Southern and Central Asia and Sub-Saharan Africa regions, the Pacific Islands, and Australia has remained relatively stable between 2012 and 2016 (Figure 10), apart from an increase in the Pacific Islands in 2015. In contrast, during the same period, North East Asia, Europe and North Africa showed an increasing trend and South East Asia and the Americas a decreasing trend.

Figure 10. Percentage of tuberculosis (new case) notifications born outside New Zealand by birth region and year, 2012−2016



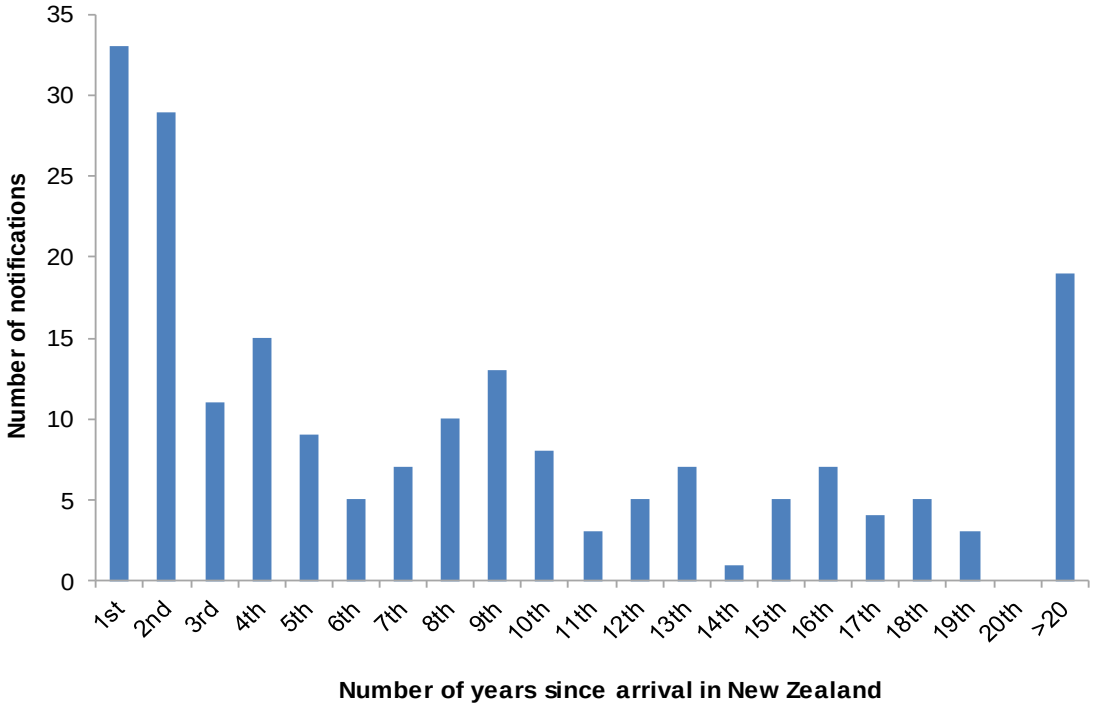
NAfrica – North Africa SSAfrica – Sub-Saharan Africa
SEAsia – South-East Asia NEAsia – North-East Asia SCAsia – Southern and Central Asia
*Number of cases born in a region divided by the total number of cases born outside New Zealand, and for which the country of birth is known, for the year.

Years since arrival in New Zealand

The date of arrival in New Zealand was recorded for 88.8% (199/224) new TB cases in 2016 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 to 64 years (mean 8.1 years and median 5 years). TB notification occurred in the first year after arrival in New Zealand for 16.6% (33/199) of cases not born in New Zealand, for 48.7% of cases within the first 5 years after arrival in New Zealand and for 51.3% within the first 6 years after arrival (Figure 11).

Between 2012 and 2016, the annual median time between arrival in New Zealand and the date of TB notification was between 4 and 5 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, 2016



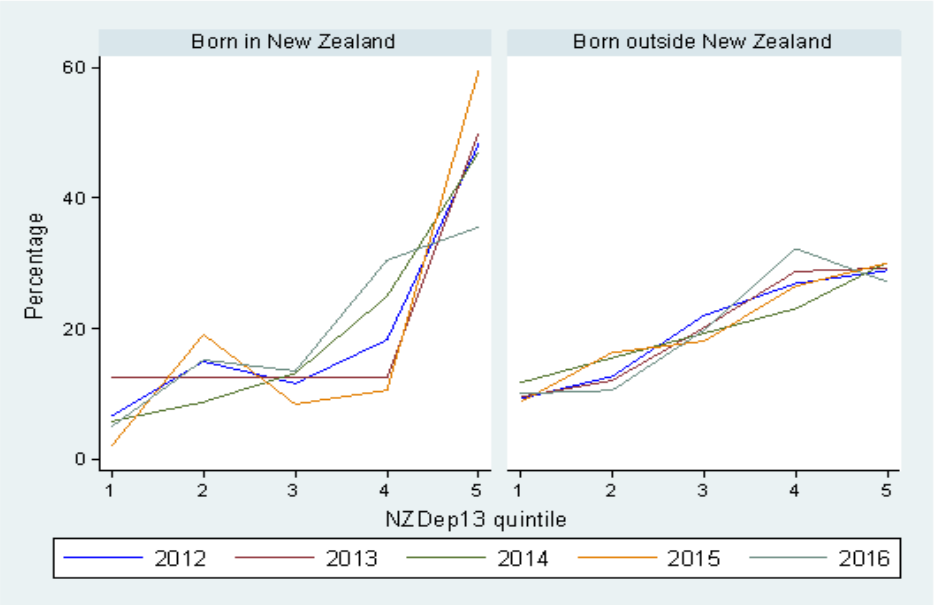
The date of arrival was not recorded for 29 cases.

Socioeconomic deprivation

In 2016, 97.9% (276/282) of new TB cases could be assigned a New Zealand Index of Deprivation 2013 (NZDep2013) score. Of the 276 cases, 168 (60.9%) 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 5 years (2012–2016) for TB new cases born in and outside NZ. Of the 1339 cases with available information between 2012 and 2016, 281 (21.0%) cases were born in New Zealand. Higher numbers of new TB cases were observed among those from more socioeconomically deprived areas for both cases in and outside of New Zealand. A similar trend was observed each year. This trend was most notable for 2012–2015 for cases born in New Zealand and living in areas of highest deprivation (quintile 5) but this was less apparent in 2016.

Figure 12. Percentage of tuberculosis (new case) notifications by birth place (New Zealand/non-New Zealand), 2013 New Zealand Index of Deprivation and year, 2012−2016



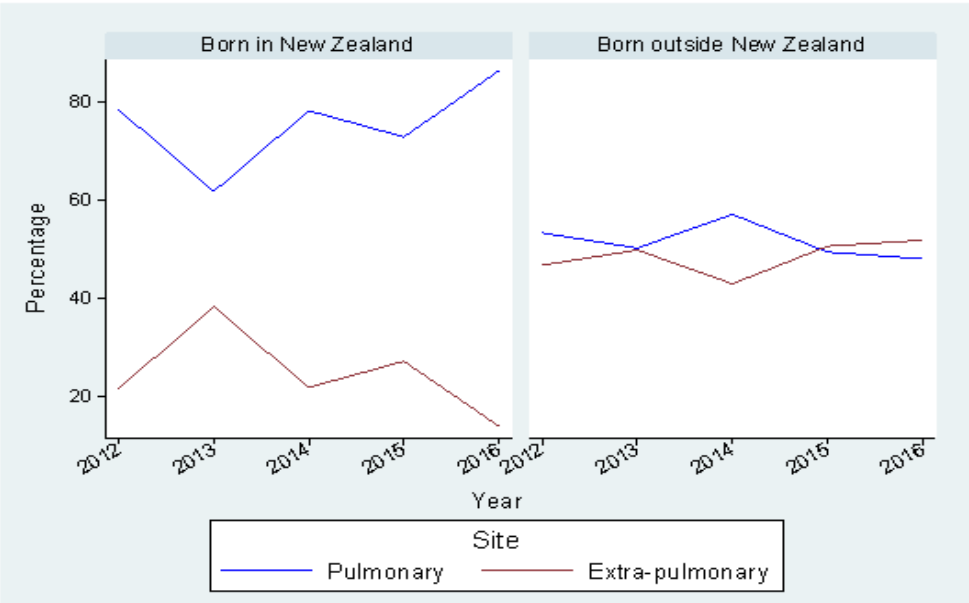
Site of infection

In 2016, 56.0% (158/282) of new TB cases had pulmonary disease, including 45 cases who also had extra-pulmonary involvement. A further 44.0% (124 cases) had only extra-pulmonary involvement.

Between 2012 and 2016, there were marked differences in the clinical characteristics of cases born in New Zealand compared with cases not born in New Zealand. Among cases born in New Zealand, 75.5% (224/295) were reported with pulmonary disease between 2012 and 2016, increasing from 61.8% in 2013 to 86.2% in 2016, while 41.7% (123/295) were reported with extra-pulmonary disease.

In contrast, new TB cases not born in New Zealand had less pulmonary disease and more extra-pulmonary disease , with the percentage being fairly stable at about 48–53% between 2012 and 2016 apart from a small peak of 57.1% in pulmonary disease in 2014 (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, 2012−2016



Note: Cases of pulmonary disease presented in this graph include cases with both pulmonary disease and extra-pulmonary involvement.

Of the 158 new TB cases in 2016 with pulmonary disease, 149 had information on whether acid-fast bacilli were demonstrated in a direct smear of a clinical specimen. Of these, 47.7% (71/149) were smear positive, with sputum reported as the specimen site for 83.1% (59/71) of these cases.

Of the 169 cases with extra-pulmonary involvement in 2016, 52.1% (88/169) had lymph node (excluding abdominal) recorded as a site of infection (Table 13). Ten cases of central nervous system TB were reported in 2016, all aged ≥20 years, six of whom had evidence of tuberculous meningitis. Five cases of miliary TB were reported, all aged ≥30 years. All five cases of miliary TB had information on whether they had an underlying immunosuppressive illness and, of these, two cases were reported as having an underlying immunosuppressive illness (neuroendocrine tumour and diabetes).

Between 2012 and 2016, the most common site of infection recorded for cases with extra-pulmonary involvement was lymph node (excluding abdominal) (46.1%), followed by pleural (16.5%) and intra-abdominal (excluding renal) (10.2%). There were 35 cases of central nervous system TB (no cases of tuberculous meningitis aged <15 years) and 39 cases of miliary TB. Of the miliary TB cases, two were aged <5 years (1 year and 3 years), and neither had received the BCG vaccine. Table 13 gives a breakdown of the new TB cases with extra-pulmonary involvement by site of infection and year.

Immunosuppressive illness and HIV status

In 2016, 40 cases were reported to have immunosuppressive illness, nine of whom were also reported to be on immunosuppressive medication. Of these, 37 cases provided the information on the illness with 19 (51.4%) cases reported as having diabetes.

In 2016, 98.2% (277/282) of cases had information on whether an HIV test was done. Of these, 78.3% (217/277) were tested for HIV. In 2016, no cases were co-infected with HIV, compared with one case being co-infected with HIV in 2015.

Receipt of treatment

In 2016, 98.6% (278 /282) of new TB cases were reported to have received appropriate treatment. The time between the onset of symptoms and start of treatment could be calculated for 72.3% (201/278) of cases. Of these, 16.9% (34/201) started treatment within 1 month of the onset of symptoms and 53.7% (108/201) started treatment between 1 and 3 months. The median interval to the start of treatment was 83 days from the onset of symptoms.

A treatment delay for patients with pulmonary TB represents a risk to public health from disease transmission. In 2016, 98.1% (155/158) of the new TB cases with pulmonary disease, were reported to have received appropriate treatment. The interval between the onset of symptoms and the start of treatment could be calculated for 64.5% (100/155) of these cases. Among these, 21.0% (21/100) started treatment within 1 month of the onset of symptoms and 42.0% (42/100) started treatment between 1 and 3 months. The median interval to the start of treatment was 76.5 days from the onset of symptoms.

Treatment outcomes for cases notified in 2015

Due to the length of time taken for the treatment of TB to be completed, the data presented in this section is for the 285 new TB cases notified in 2015. Of these, 96.8% (276/285) were reported to have received appropriate treatment for TB. The majority of these cases (85.1%, 235/276) completed treatment to the satisfaction of the prescribing doctor. Of the 235 new TB cases who completed treatment to the satisfaction of the prescribing doctor, 51.1% (120/235) received directly observed therapy (DOT) during the intensive phase of their treatment. The proportion of cases who received DOT during the intensive phase of their treatment was higher in those not born in New Zealand (76.7%) than those born in New Zealand (23.3%). For cases with pulmonary disease, the proportion who received DOT during the intensive phase of their treatment was similarly higher in cases not born in New Zealand (75.0%) than in those born in New Zealand (25.0%).

Treatment for the remaining 14.9% (41/276) of cases ended earlier than planned for the following reasons: case died (5.1%, 14/276), case transferred to overseas medical care (5.1%, 14/276), case went overseas and medical care not transferred or unknown (1.8%, 5/276), treatment was stopped because of adverse effects (0.7%, 2/276), case refused to complete treatment (0.7%, 2/276), and case was lost to follow-up (0.4%, 1/276). The remaining three cases (1.1%) were still on treatment at the time of data extraction.

No treatment was received by 3.2% (9/285) of cases. Of these, two cases were not treated because they died before treatment was initiated and/or the diagnosis was a post-mortem finding, three cases had treatment reported as inappropriate (two cases transferred to overseas medical care and one case was not yet treated as had low disease activity). The remaining four cases declined treatment (two were transferred to overseas medical care and two went overseas and medical care was not transferred or unknown). Three of these nine cases were recorded as having pulmonary disease of whom one case died within days of diagnosis and two cases transferred to overseas medical care.

TUBERCULOSIS DISEASE – RELAPSES OR REACTIVATIONS

In 2016, 12 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 (2007–2016) ranging from 6–18 cases a year (Figure 14).

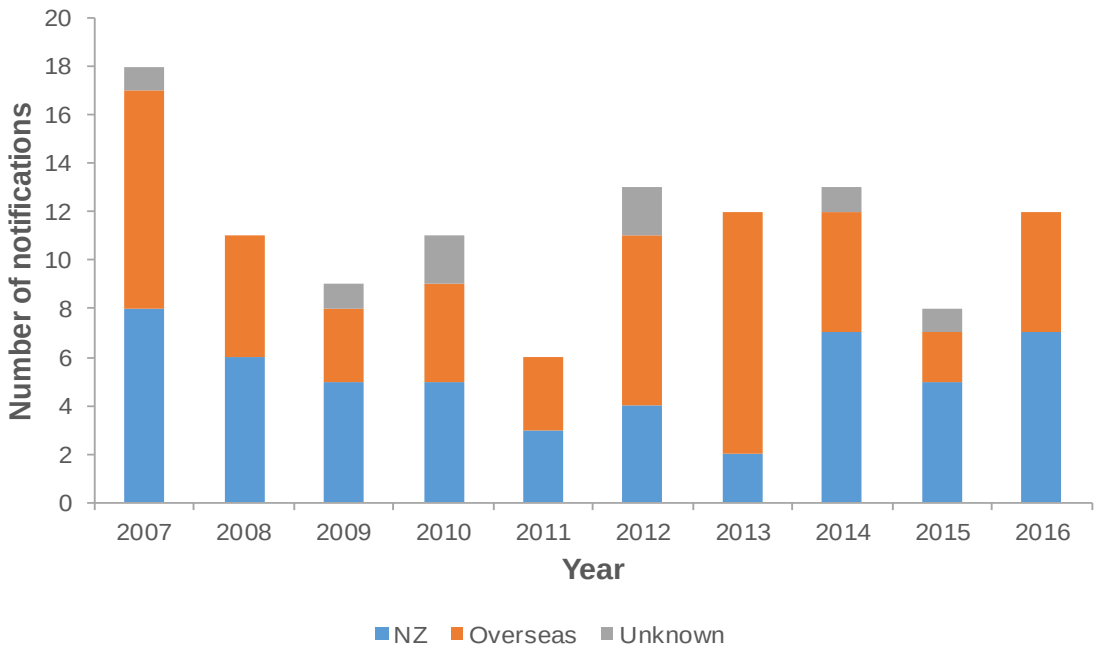
In 2016, TB relapse/reactivation cases were reported from the following six DHBs: Waikato (4 cases), Auckland (3 cases), Canterbury (2 cases), Bay of Plenty, MidCentral and Nelson Marlborough (1 case each). The cases were aged in the 15–39 years (5 cases), 40–59 years (2 cases) and ≥60 years (5 cases) age groups. Relapse/reactivation cases were reported in the following ethnic groups: Asian (5 cases), Māori (3 cases), Pacific peoples and European or Other (2 cases each). 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 75.0% (9/12) of the 2016 relapse/reactivation cases. Of these, three cases were born and originally diagnosed with TB in New Zealand and received treatment for 6 months, 9 months and 30 months respectively. Two of these cases were originally diagnosed with pulmonary disease; one of these cases received DOT throughout treatment and the other case did not receive DOT. There was no information about site of disease or DOT for the original diagnosis for the third case. Of the six cases born overseas, two were previously diagnosed in New Zealand and treated for 8 and 12 months respectively, and four cases were previously diagnosed overseas and had received treatment for 6 months (2 cases), 9 months (1 case) and 24 months (1 case). Of the two cases originally diagnosed in New Zealand, one had pulmonary disease and received DOT throughout treatment, and the other had extra-pulmonary disease and received DOT during the intensive phase of treatment.

In 2016, all 12 relapse/reactivation cases could be assigned a NZDep2013 score. Six cases (50.0%) resided in the most deprived areas (NZDep2013 quintiles 4 and 5), a lower proportion than the 60.9% of new TB cases residing in the most deprived areas.

The information on whether the cases were previously treated was not recorded for three cases in 2016, but the cases were now aged ≥60 years and their previous diagnoses had been at least six decades ago.

Figure 14. Tuberculosis (relapse/reactivation) notifications by year, 2007−2016



OUTBREAKS

In 2016, five TB outbreaks were reported:

- Hawke's Bay DHB (2 outbreaks, 14 cases), the exposures occurred in a private home (1 outbreak) and a private home and a tertiary educational institute (1 outbreak).
- Counties Manukau DHB (1 outbreak, 6 cases), the exposure occurred at a school and community gathering in Indonesia.
- Southern DHB (1 outbreak, 4 cases), the exposure occurred at a private home.
- Auckland DHB (1 outbreak, 2 cases), the exposure occurred at a hospital (acute care).

CULTURE CONFIRMATION, SPECIATION AND DRUG SUSCEPTIBILITY

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

CULTURE CONFIRMATION AND SPECIATION

In 2016, 79.8% (225/282) of new TB cases were culture positive. The mycobacterium species were identified as *M. tuberculosis* (222 cases) and *M. bovis* (3 cases). Of the new TB cases with pulmonary disease 85.4% (135/158) were culture positive, 133 cases were identified as *M. tuberculosis* and 2 cases were identified as *M. bovis.*

Of the 12 TB relapse/reactivation cases notified in 2016, 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 2012 and 2016.

DRUG SUSCEPTIBILITY

Antimicrobial susceptibility data was available for the isolates from 233 (224 new cases and 9 relapse/reactivations) of the total 234 culture-positive TB cases in 2016. The proportions of isolates resistant to the five antimicrobials routinely tested are shown in Table 7.

Table 7. Resistance to each antimicrobial among isolates from tuberculosis cases, by mycobacterial species, 2016

Antimicrobial	Resistant[a]					
	M. tuberculosis *n* = 230		*M. bovis*[c] *n* = 3		All isolates *n* = 233	
	No.	%	No.	%	No.	%
Isoniazid (0.1 mg/L)	15	6.5	0	-	15	6.4
Isoniazid (0.4 mg/L)[b]	14	6.1	0	-	14	6.0
Rifampicin	4	1.7	0	-	4	1.7
Ethambutol	2	0.9	0	-	2	0.9
Pyrazinamide	2	0.9	3[c]	100	5	2.1
Streptomycin	19	8.3	0	-	19	8.2

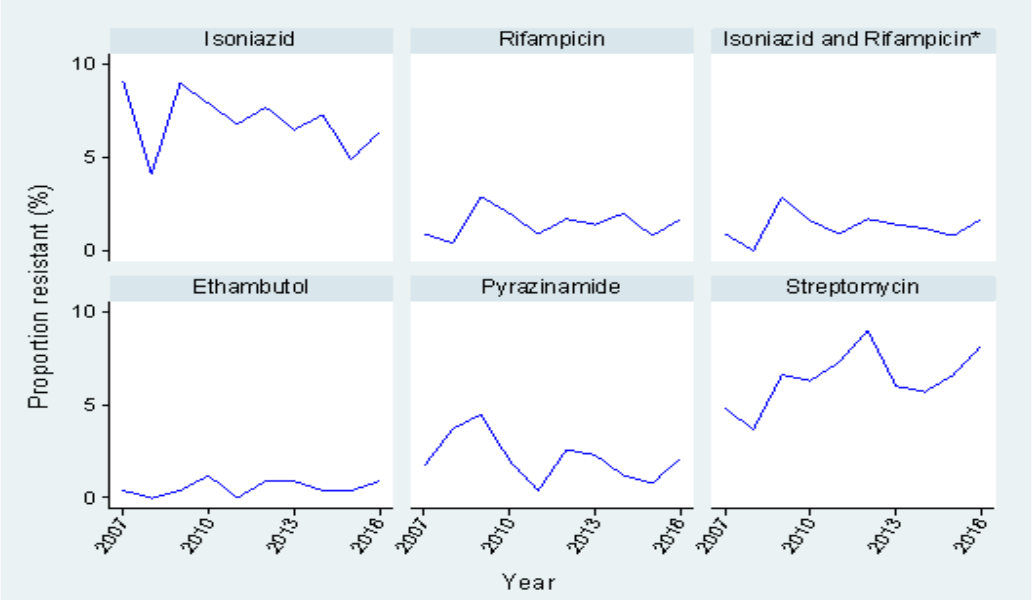
[a] Includes resistance alone or in combination with other antimicrobials.

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

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

In the 10 years from 2007 to 2016, there have been no significant trends in the prevalence of resistance to any of the five antimicrobials routinely tested (Figure 15).

Figure 15. Antimicrobial resistance among isolates from tuberculosis cases, by antimicrobial and year, 2007−2016



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

In 2016, 86.7% (202/233) of the isolates were fully susceptible to all five routinely tested antimicrobials. There were four (1.7%) cases of multidrug-resistant tuberculosis (MDR-TB, defined as resistance to at least isoniazid and rifampicin) (Table 8).

During the last 10 years (2007–2016) there were a total of 31 cases of MDR-TB - an average annual rate of 1.3% 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 (in 2010) of XDR-TB has been identified in New Zealand.

Table 8. Distribution of antimicrobial resistance patterns among isolates from tuberculosis cases, 2016

Antimicrobial resistance	Resistance pattern[a]	Number of isolates	Percentage of isolates (%)
Fully susceptible		**202**	**86.7**
Resistant to 1 agent		**24**	**10.3**
	S	13	5.6
	H	8	3.4
	Z[b]	3	1.3
Resistant to 2 agents		**3**	**1.3**
	HS	3	1.3
Resistant to 3 agents		**2**	**0.9**
	HRE[c]	1	0.4
	HRS[c]	1	0.4
Resistant to 4 agents		**1**	**0.4**
	HRZS[c]	1	0.4
Resistant to 5 agents		**1**	**0.4**
	HREZS[c]	1	0.4

[a] H, isoniazid resistance at the standard concentration of 0.1 mg/L; R, rifampicin; E, ethambutol; Z, pyrazinamide; S, streptomycin.

[b] The three isolates with this resistance pattern were the three *M. bovis* isolates.

[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. Resistance to pyrazinamide was significantly higher among isolates from New Zealand-born cases, due to all three *M. bovis* TB cases being New Zealand born. *M. bovis* is intrinsically resistant to pyrazinamide. Streptomycin resistance was significantly higher among cases born overseas.

All four MDR-TB cases identified in 2016 were born overseas. All but two of the 31 MDR-TB cases that have occurred in the last 10 years (2007–2016) were born overseas and are assumed to have acquired MDR-TB overseas. The majority (86.2%, 25/29) 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, 2016

	Born in New Zealand (*n* = 43)		Born overseas (*n* = 190)		*p*-value[a]
	No.	%	No.	%	
Fully susceptible					
	39	90.7	163	85.8	0.392
Resistant to:[b]					
Isoniazid[c]	1	2.3	14	7.4	0.316
Rifampicin	0	-	4	2.1	1.000
Ethambutol	0	-	2	1.1	1.000
Pyrazinamide	3	7.0	2	1.1	0.045
Streptomycin	0	-	19	10.0	0.028
MDR-TB[d]					
	0	-	4	2.1	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). Three of the four MDR-TB cases were of Asian ethnicity and the fourth case was from the European or Other ethnic group.

Table 10. Antimicrobial resistance among isolates from tuberculosis cases by ethnic group, 2016

	Māori[a] (*n* = 17)		Pacific peoples (*n* = 33)		Asian (*n* = 147)		MELAA (*n* = 7)		European or Other (*n* = 26)		Unknown (*n* = 3)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Fully susceptible												
	16	94.1	31	93.9	124	84.4	6	85.7	22	84.6	3	100
Resistant to:[b]												
Isoniazid[c]	0	-	2	6.1	11	7.5	0	-	2	7.7	0	-
Rifampicin	0	-	0	-	3	2.0	0	-	1	3.8	0	-
Ethambutol	0	-	0	-	1	0.7	0	-	1	3.8	0	-
Pyrazinamide	1	5.9	0	-	1	0.7	0	-	3	11.5	0	-
Streptomycin	0	-	2	6.1	15	10.2	1	14.3	1	3.8	0	-
MDR-TB[d]												
	0	-	0	-	3	2.0	0	-	1	3.8	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 2016, 3.8% (9/234) of the culture-positive cases were reported to be relapses or reactivations of TB disease. 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 2012 to 2016. During this period, 3.8% (45/1172) of the culture-positive cases, for which susceptibility data was available, were reported to be relapses/reactivations. Information about previous treatment was recorded for 36 of the 45 relapse/reactivation cases and 35 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 previously treated cases were significantly more resistant to rifampicin, and also more likely to be MDR-TB.

Table 11. Antimicrobial resistance among isolates from new cases, relapses/reactivations and previously treated cases of tuberculosis, 2012–2016

Antimicrobial resistance	New cases (*n* = 1127)	Relapse/reactivation cases			
		All (*n* = 45)		Previously treated[a] (*n* = 35)	
	%	%	*p*-value[b]	%	*p*-value[b]
Fully susceptible					
	87.5	84.4	0.547	85.7	0.794
Resistant to:[c]					
Isoniazid[d]	6.3	13.3	0.113	14.3	0.073
Rifampicin	1.2	8.9	0.004	8.6	0.013
Ethambutol	0.7	0.0	1.000	0.0	1.000
Pyrazinamide	1.8	2.2	0.564	2.9	0.477
Streptomycin	7.3	6.7	1.000	5.7	1.000
MDR-TB[e]					
	1.1	8.9	0.003	8.6	0.009

[a] Information on previous treatment was reported for only 36 of the 45 relapse/reactivation cases, 35 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 99.6% (224/225) of culture-positive new TB cases in 2016. Typing was not performed for the remaining case. The mycobacterium species identified were *M. tuberculosis* (222 cases) and *M. bovis* (3 cases). Among the 224 new TB cases, 85 (37.9%) had non-unique molecular types and were in 55 separate molecular clusters. Four new clusters were identified in 2016 with two cases each. The remaining 139 cases (62.1%) had a unique strain type.

In the last 5 years (2012–2016), 1,126 new TB cases had TB molecular typing results, of which 432 (38.4%) had non-unique molecular types and were in 173 separate molecular clusters.

The median cluster size, based on cases in the last 5 years, was two cases (range 1–39)[ii] and 90.8% (157/173) of clusters had fewer than five cases. The remaining 16 clusters were distributed in the following cluster sizes: 5−9 cases (11), 10−19 cases (3) 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 2012 and 2016 compared with the mean percentage for each variable. Higher percentages for any subgroup within a variable indicate that a higher proportion of cases for this subgroup are part of a cluster, suggesting possible transmission between cases. Table 14 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 (86.7%) while all other age groups were close to the mean (38.4%) (Figure 16). Proportions were similar to the mean in both sexes (Figure 16).

Pacific peoples (79.3%) and Māori (77.6%) ethnic groups also had a high proportion of cases with non-unique molecular types whereas the MELAA (11.1%), Asian (24.3%) and European or Other (36.7%) 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

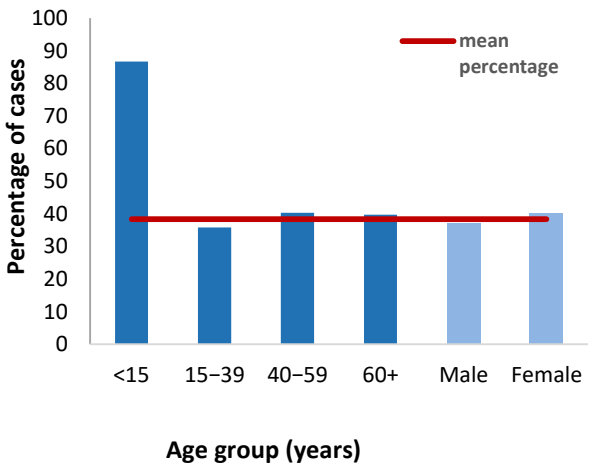
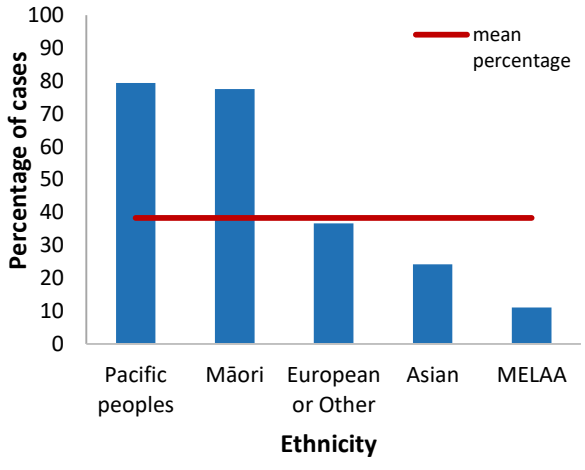


Figure 17. Percentage of new TB cases that were non-unique molecular types by ethnic group

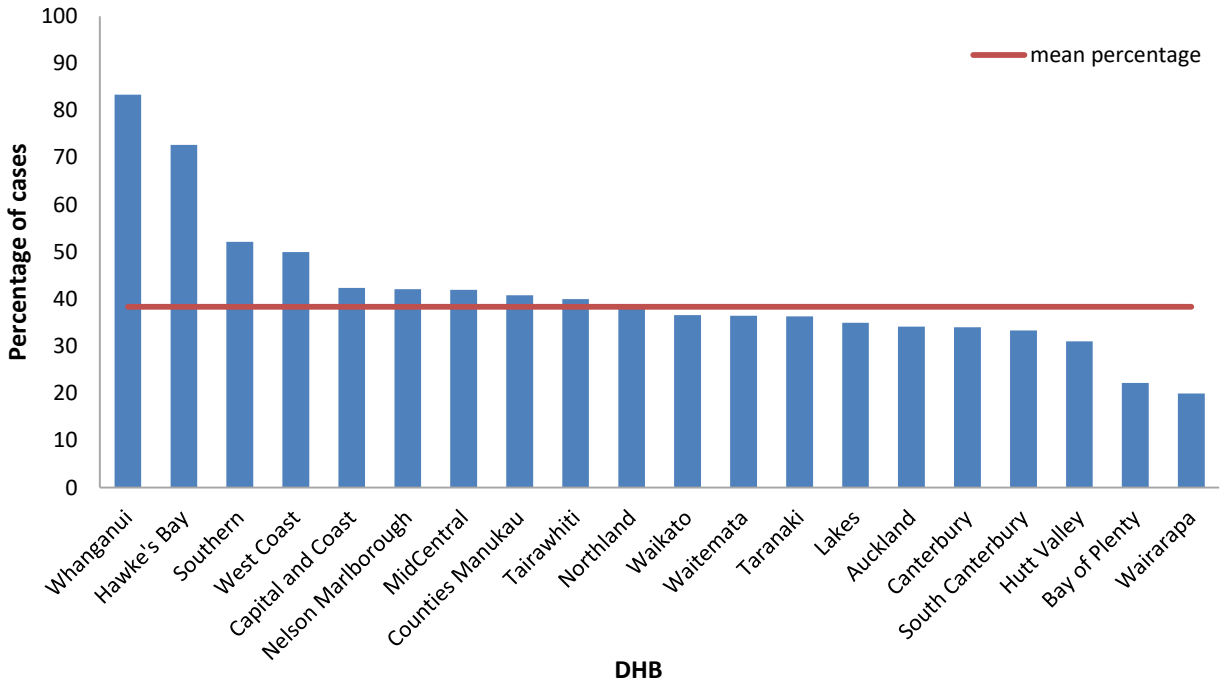


Whanganui (83.3%) and Hawke's Bay (72.7%) DHBs had the highest proportions of cases with non-

[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.

unique molecular types, whereas, Wairarapa (20.0% and Bay of Plenty (22.2%) DHBs had the lowest proportions (Figure 18).

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



Cases born in the Pacific Islands (73.0%) and New Zealand (67.8%) had a high 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 a higher 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

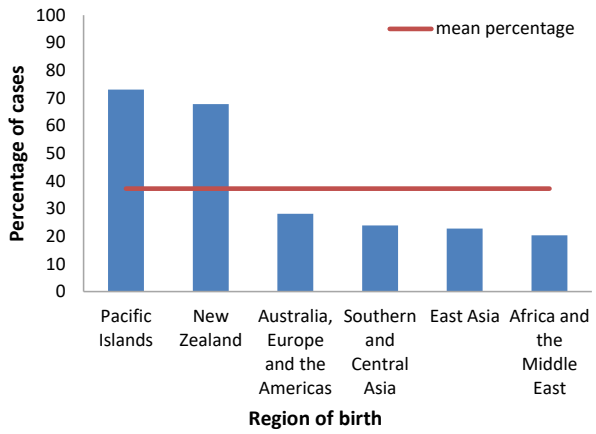
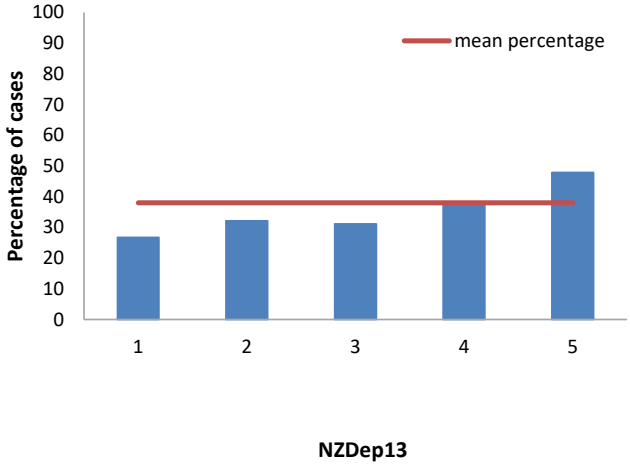
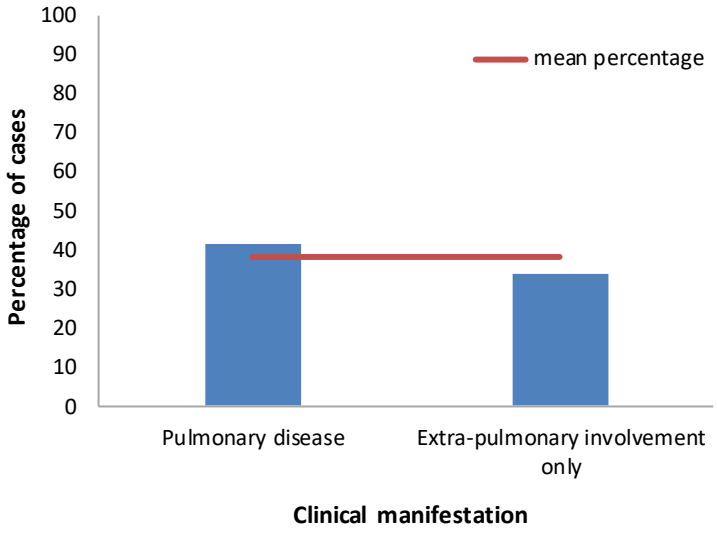


Figure 20. Percentage of new TB cases that were non-unique molecular types by NZDep13



New TB cases with pulmonary disease (41.3%) had a higher proportion of non-unique molecular types compared with cases that had extra-pulmonary involvement only (Figure 21).

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



DISCUSSION

The incidence of TB in New Zealand (6.3 per 100,000 population in 2016) has remained fairly stable over the past 7 years. This rate is higher than the 2016 incidences reported in Australia (5.7 per 100,000), the United States (2.9 per 100,000) and Canada (4.8 per 100,000) [9-11], but lower than the 2016 incidence recorded in the United Kingdom (10.2 per 100,000) [12].

PLACE OF RESIDENCE AND ETHNICITY

The overall incidence rate masks substantial differences in the rates of TB in different areas of the country and between population subgroups.

Geographically Auckland, Counties Manukau, Hawke's Bay and Capital & Coast DHBs all had incidence rates above the national rate. Apart from Hawke's Bay DHB, 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 2016, 60.9% 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].

Among cases born in New Zealand the highest proportion of new TB cases were in the Māori ethnic group (41.4%), a slight decrease from the proportion of 44.9% reported in 2015. 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 (32.7 per 100,000), Pacific peoples (12.1 per 100,000) and the overall rate for all people born overseas (17.7 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 2016 incidence rate was higher in indigenous people (4.7 per 100,000) compared with those of European ethnicity (0.6 per 100,000) but lower than the rate in people born overseas (14.7 per 100,000) [10]. In comparison, in Canada, the 2016 incidence rate for Canadian-born people was 41 times higher among indigenous people (23.8 per 100,000 population) compared with non-indigenous people (0.6 per 100,000) and the indigenous rate was also higher than the rate in people born overseas (15.2 per 100,000) [11].

COUNTRY OF BIRTH

During the past 5 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 86% in 2014 [14]. The proportion of cases born outside New Zealand in 2016 (79.4%) is higher than that reported in England (74% in 2016), Canada (70% in 2016) and the United States (68.5% in 2016) [10-12].

Although the proportion of cases born overseas has been increasing in New Zealand, the incidence rate in people born overseas in 2016 was 17.7 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 6 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.

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]. However, this differs from the countries of birth most commonly reported for cases notified in England in 2016 (India, Pakistan, Somalia, Bangladesh and Romania) [12]. This difference reflects differing immigration patterns but all the countries listed underscore the high risk of being born in a country with high endemicity.

The time since arrival in New Zealand and notification date was recorded for 88.8% of new TB cases born overseas and showed a similar pattern to that seen in Australia, Canada and the United Kingdom. Just over 16% of New Zealand cases reported in 2016, who were born overseas, were notified within the first year after arrival, 48.7% within 5 years of arrival, and 51.3% within 6 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 4 years after arrival [14]. In 2016, time from arrival until diagnosis was known for 93.2% of non-UK-born cases notified in England with 16.6% diagnosed within 2 years and 36.8% within 6 years of arrival [12]. A higher proportion cases diagnosed within two years of arrival was reported from Canada where the time from arrival until diagnosis was known for 97% of foreign-born cases, with 24% diagnosed within two years of arrival and 40% within the past five years [11].

CLINICAL PRESENTATION AND TREATMENT

Pulmonary disease was reported in 56.0% of new TB cases in 2016, a slight increase from 53.1% of new TB cases in 2015. This is similar to the proportion reported in England (53.9% in 2016) but a lower proportion than most recently reported in Canada (69% in 2016), and Australia (63% in 2014) [11, 12, 14].

Of the six cases of TB in the <5 years age group in 2015, five cases were born in New Zealand. None of these six cases had miliary or meningeal TB. Two of the cases were reported to have received BCG vaccine, including the one case born overseas. 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 2016 were “new disease” (95.9%), meaning there was no history of prior treatment. This is similar to the proportion reported from Australia (95%, 2014), but slightly higher than reported from England (93.5%, 2016) and Canada (93%, 2016) [11, 12, 14].

Information about previous diagnosis and treatment was recorded for 75% (9 cases) of the 12 relapse/reactivation cases. From the data available it is unclear whether these cases were genuine relapse or reinfection. For all nine cases with information available, treatment periods for their previous illness were recorded as being at least six months. Three of these cases were born, diagnosed and treated in New Zealand for their first TB illness and two of the six cases reported as born overseas were also diagnosed and treated in New Zealand for their first illness. Among these five cases previously treated in New Zealand, it was recorded that three received DOT throughout treatment for their original illness, one received DOT during their intensive phase of treatment and there was no information available for the other case. 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 5 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 cases notified in 2015, 85.1% were reported to have completed treatment, a similar proportion to Canada (84.9% of cases reported in 2015) and the United Kingdom (83.4% of drug sensitive cases had completed treatment within 12 months in 2015) [11, 12]. 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 (5.1%) is lower than the 8.7% of cases reported in 2015 in Canada that died before or during treatment and also lower than the 6.1% recorded in England for cases notified in 2015. 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 [11, 12, 14].

DRUG SUSCEPTIBILITIES AND MDR-TB

Over the last 10 years (2007-2016), there have been no significant changes in resistance to isoniazid, rifampicin, ethambutol, pyrazinamide or streptomycin. The apparent decrease in pyrazinamide resistance over several years 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.

The proportion of culture positive cases (both new disease and relapses/reactivations) with MDR-TB in 2016 (1.7%) was similar to the average proportion for the past 10 years (1.3%). This rate of MDR-TB is similar to that reported in the United States (1.4% for 2016), England (1.5% for 2016), and Australia (1.7% for 2014) [10, 12, 14].

Over the past 10 years, 93.5% (29/31) of MDR-TB cases were both born overseas, the majority in Asian countries, and assumed to have acquired their resistant organisms overseas. In England a high proportion (89.1%) of MDR-TB or rifampicin-resistant TB (MDR/RR-TB) cases in 2016 were also reported to be born overseas, but the most common countries of birth for these cases were Lithuania and India [12]. For the United States, the proportion of MDR-TB cases that occurred in foreign-born persons with no history of previous TB has increased from 25% (103 of 407) in 1993 to 89.7% (70 of 78) in 2016 [16]. There was a similar pattern reported from Australia in 2014 with the majority of the MDR-TB cases reported as being born overseas [14].

From 2012–2016, 8.6% of New Zealand relapse/reactivation cases previously treated for TB were reported with MDR-TB, a much higher proportion than the 1.1% of new TB cases with MDR-TB. This is higher than the 6.5% of MDR/RR-TB in previously treated cases reported from the United Kingdom in 2016 [12].

TRANSMISSION AND CONTROL

Several indicators are used by Public Health England (PHE) to assess transmission in low endemicity countries such as the United Kingdom and New Zealand. For recent transmission the indicator used is the rate of TB in children <15 years of age born within the country [12]. The 2016 rate of TB in New Zealand-born children in the <15 years age group was 1.4 per 100,000, lower than the 2016 rate reported in England of 1.8 per 100,000 in children born in the United Kingdom. These rates are higher than the rate in non-indigenous Australian-born children <15 years of age in 2014, 0.8 per 100,000, but, similar to the 2014 rate for indigenous Australian-born children (1.7 per 100,000) [12, 14]. However, as the rates recorded in New Zealand are based on low case numbers they tend to be quite unstable and the three year moving average annual rate gives a better indication of trends in local transmission. This has decreased from a rate of 3.1 per 100,000 calculated for 2007 and has been fairly stable since 2012 at about 1.7 per 100,000.

For ongoing transmission within a community, the indicator now used by PHE 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 [12].

Between 2012 and 2016, only 38.4% of strain typed TB cases in New Zealand were part of a cluster. This is lower than the 59.7% of strain-typed TB cases in England that were part of a cluster between 2010 and 2016. In New Zealand the majority of clusters (90.8%) had fewer than five cases and the median cluster size was two cases whereas in England there was a higher proportion of larger clusters with only 74.4% of the clusters having fewer than five cases, and the median cluster size was three cases [12]. This suggests there may be a lower rate of community transmission of TB within New Zealand compared with England. 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 and support the premise that most cases of TB diagnosed in New Zealand result from infection acquired overseas but, also, that there is a higher risk of transmission within the country from cases born either in New Zealand or in the Pacific 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, 2012−2016

Category	2012		2013		2014		2015		2016	
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]
Age group (years)										
<5	4	-	5	1.6	12	3.9	3	-	6	2.0
5−14	8	1.3	5	0.8	7	1.2	6	1.0	8	1.3
15−39	141	9.7	130	9.0	141	9.5	145	9.5	160	10.1
40−59	56	4.6	67	5.5	69	5.6	70	5.7	53	4.3
≥60	69	8.2	55	6.3	59	6.6	61	6.6	55	5.8
Sex										
Male	147	6.8	139	6.4	169	7.6	155	6.9	148	6.4
Female	131	5.8	123	5.4	119	5.2	130	5.6	134	5.6
Ethnic group[b]										
Māori	36	5.4	25	3.8	36	5.3	22	3.2	24	3.4
Pacific peoples	33	12.1	40	14.6	47	16.9	57	20.2	35	12.1
Asian	167	33.1	157	31.0	172	33.5	181	34.4	176	32.7
MELAA	12	24.4	13	26.3	11	22.0	8	15.7	9	17.2
European or Other	26	0.9	24	0.8	17	0.6	16	0.5	34	1.1
Unknown	4	-	3	-	5	-	1	-	4	-
District health board										
Northland	3	-	1	-	7	4.2	2	-	2	-
Waitemata	40	7.3	21	3.8	36	6.4	38	6.6	34	5.8
Auckland	52	11.4	53	11.5	69	14.6	62	12.7	54	10.6
Counties Manukau	45	9.2	54	10.9	48	9.4	64	12.3	62	11.6
Waikato	22	5.9	23	6.1	17	4.4	23	5.9	21	5.3
Lakes	2	-	6	5.8	5	4.8	7	6.7	6	5.6
Bay of Plenty	9	4.2	10	4.7	11	5.1	6	2.7	10	4.4
Tairawhiti	2	-	2	-	1	-	1	-	1	-
Taranaki	4	-	6	5.3	3	-	2	-	3	-
Hawke's Bay	19	12.0	6	3.8	4	-	9	5.6	16	9.9
Whanganui	1	-	1	-	1	-	3	-	2	-
MidCentral	6	3.6	6	3.6	11	6.5	7	4.1	5	2.9
Hutt Valley	10	7.0	6	4.2	12	8.4	4	-	4	-
Capital & Coast	22	7.5	34	11.6	33	11.1	21	7.0	19	6.2
Wairarapa	0	-	2	-	1	-	0	-	3	-
Nelson Marlborough	14	9.9	4	-	2	-	3	-	4	-
West Coast	1	-	1	-	1	-	1	-	1	-
Canterbury	17	3.4	21	4.2	23	4.5	26	4.9	26	4.8
South Canterbury	1	-	0	-	1	-	0	-	2	-
Southern	8	2.6	5	1.6	2	-	6	1.9	7	2.2
Total	**278**	**6.3**	**262**	**5.9**	**288**	**6.4**	**285**	**6.2**	**282**	**6.0**

[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. Site of infection for tuberculosis (new case) notifications with extra-pulmonary involvement by year, 2012–2016

Site of infection	2012		2013		2014		2015		2016	
	Cases[b]	%	Cases[b]	%	Cases[b]	%	Cases[b]	%	Cases[b]	%
Lymph node (excl. abdominal)	55	35.9	76	45.0	81	48.8	87	47.5	88	52.1
Pleural	30	19.6	25	14.8	25	15.1	34	18.6	25	14.8
Intra-abdominal (excl. renal)	18	11.8	17	10.1	18	10.8	17	9.3	16	9.5
Bone/joint	14	9.2	16	9.5	24	14.5	12	6.6	8	4.7
Renal/genitourinary tract	15	9.8	10	5.9	5	3.0	14	7.7	4	2.4
Soft tissue/skin	10	6.5	8	4.7	5	3.0	16	8.7	14	8.3
Miliary tuberculosis	5	3.3	9	5.3	10	6.0	10	5.5	5	3.0
Central nervous system TB (CNS TB)[C]	1	0.7	6	3.6	8	4.8	10	5.5	10	5.9
Other	15	9.8	19	11.2	18	10.8	14	7.7	15	8.9
Total[a]	**153**	**100.0**	**169**	**100.0**	**166**	**100.0**	**183**	**100.0**	**169**	**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 14. Numbers and percentages of non-unique and unique strain of tuberculosis (new case) notifications for selected variables, 2012–2016

Variable[a]	Non-unique		Unique	
	Cases	%[b]	Cases	%[b]
Age group (years)	**432**	**38.4**	**694**	**61.6**
<15	13	86.7	2	13.3
15–39	218	35.8	391	64.2
40–59	98	40.3	145	59.7
≥60	103	39.8	156	60.2
Sex	**432**	**38.4**	**694**	**61.6**
Male	232	37.0	395	63.0
Female	200	40.1	299	59.9
Ethnic group	**426**	**38.3**	**687**	**61.7**
Māori	76	77.6	22	22.4
Pacific peoples	142	79.3	37	20.7
Asian	170	24.3	531	75.7
Middle Eastern/Latin American/African	5	11.1	40	88.9
European or Other	33	36.7	57	63.3
District health board	**432**	**38.4**	**694**	**61.6**
Northland	5	38.5	8	61.5
Waitemata	50	36.5	87	63.5
Auckland	86	34.1	166	65.9
Counties Manukau	93	40.8	135	59.2
Waikato	30	36.6	52	63.4
Lakes	7	35.0	13	65.0
Bay of Plenty	8	22.2	28	77.8
Tairawhiti	2	40.0	3	60.0
Taranaki	4	36.4	7	63.6
Hawke's Bay	24	72.7	9	27.3
Whanganui	5	83.3	1	16.7
MidCentral	13	41.9	18	58.1
Hutt Valley	9	31.0	20	69.0
Capital & Coast	39	42.4	53	57.6
Wairarapa	1	20.0	4	80.0
Nelson Marlborough	8	42.1	11	57.9
West Coast	2	50.0	2	50.0
Canterbury	33	34.0	64	66.0
South Canterbury	1	33.3	2	66.7
Southern	12	52.2	11	47.8
Region of birth	**432**	**38.4**	**693**	**61.6**
New Zealand	139	67.8	66	32.2
Southern and Central Asia	141	23.9	449	76.1
East Asia	21	22.8	71	77.2
Pacific Islands	111	73.0	41	27.0
Africa and the Middle East	11	20.4	43	79.6
Australia, Europe and the Americas	9	28.1	23	71.9
NZ Index of Deprivation 2013 quintile	**413**	**38.0**	**675**	**62.0**
1	27	26.7	74	73.3
2	45	32.1	95	67.9
3	63	31.2	139	68.8
4	110	37.4	184	62.6
5	168	47.9	183	52.1
Clinical manifestation	**432**	**38.4**	**694**	**61.6**
Pulmonary disease	285	41.3	405	58.7
Extra-pulmonary involvement only	147	33.7	289	66.3

[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 15. Regional classification of countries

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

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

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

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

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