TUBERCULOSIS IN NEW ZEALAND
ANNUAL REPORT 2013

Prepared as part of a Ministry of Health contract for scientific services by
the Health Intelligence Team, Institute of Environmental Science and Research Limited

February 2015

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

First published: 24 February 2015

Suggested citation:

Institute of Environmental Science and Research Ltd (ESR).
Tuberculosis in New Zealand: Annual Report 2013. Porirua: ESR; 2015.

Client Report: FW14034

Acknowledgements

This report was prepared by Ange Bissielo, Helen Heffernan and Jill Sherwood.

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

- The Mycobacteriology Section of the Department of Microbiology, Auckland City Hospital; the Mycobacteriology Laboratory, Waikato Hospital; and the Mycobacteriology Laboratory, Wellington Hospital, 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.
- Bible Lee (AIDS Epidemiology Group) for providing the HIV/TB co-infection data.
- Tim Wood (ESR) for peer checking and Sarah Wilcox (Descipher) for proofreading this report
- Deborah Williamson, Graham Mackereth (ESR), Cathy Pikholz and Sally Roberts (Auckland District Health Board) for peer reviewing this report.
- Grant Storey and Andrea McNeil (Ministry of Health) for their helpful comments and feedback.

Disclaimer

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

SUMMARY

In this report we describe the epidemiology of tuberculosis in New Zealand for 2013 as well as trends during the past 5–10 years.

Tuberculosis disease (TB) is a notifiable condition in New Zealand and the TB notification rate has been stable over the last 5 years. The 2013 TB notification rate was 6.6 per 100 000 population. The majority of TB notifications were for new disease, with relapse/reactivation cases contributing sparingly to the notifications. A high proportion of TB cases (78.3%) were laboratory confirmed by positive culture for *Mycobacterium tuberculosis* complex (predominantly *M. tuberculosis)*.

As in previous years, there were demographic differences among new TB case rates. Rates were higher in males than females, especially in the older age groups. The Asian and Middle Eastern/Latin American/African (MELAA) ethnic groups have consistently experienced the highest notification rates, although the absolute number of MELAA cases remains relatively low. As in previous years, higher rates of TB occurred in socioeconomically deprived areas.

Being born outside of New Zealand and current or recent residence with a person born outside New Zealand have consistently been dominant risk factors, whereas exposure in a healthcare setting and current or recent residence in an institution were reported for comparatively few new TB cases.

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 nine percent 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 cases of miliary TB in children aged <5 years were reported in 2013 and only one case has been reported in this age group in the last 5 years. There were no cases of tuberculous meningitis in this age group over the last 5 years.

Most (96%) new TB cases in 2013 were reported to have received treatment. For cases where the time between the onset of symptoms and start of treatment could be calculated, approximately 37% of cases started treatment within 1 month of the onset of illness and 42% started treatment between 1 and 3 months.

None of the new TB cases in 2013 were reported to have HIV co-infection, compared with the three co-infections reported in 2012.

Two outbreaks of *Mycobacterium tuberculosis* with six associated cases were reported in 2013.

Ministry of Health hospitalisation data showed a decreasing trend in hospital admissions for TB over the last decade. This was true for all the age groups analysed.

Three (1.4%) of the 216 culture-positive TB cases reported in 2013 were multidrug-resistant TB (MDR-TB, defined as resistance to at least isoniazid and rifampicin). Resistance to all antimicrobials except pyrazinamide was higher among isolates from cases born overseas than among isolates from New Zealand-born cases, although none of the differences were significant. All isoniazid-resistant, rifampicin-resistant, ethambutol-resistant and MDR-TB isolates were from cases of Asian ethnicity.

Between 2004 and 2013, there has been a significant trend of decreasing pyrazinamide resistance, but no significant changes in resistance to isoniazid, rifampicin, ethambutol or streptomycin. Over the same 10 years, an average of 1.3% of TB cases were MDR-TB.

Approximately one third of the *M. tuberculosis* isolates that underwent molecular typing between 2009 and 2013 had results that matched other typed isolates, ie, were non-unique and could be assigned to a cluster. Most clusters contained less than five cases. Four new clusters were identified in 2013 with two cases in each.

INTRODUCTION

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. The World Health Organization's most recent estimated global TB incidence rate was 122 per 100 000 population for 2012, with widely variable regional rates [1]. TB is more prevalent in, but not confined to, low-income countries. The target for TB elimination is to reduce the global annual incidence to less than one case per million population by 2050. This requires a 1000-fold reduction in a relatively short time [1].

In New Zealand, TB is notifiable under the Tuberculosis Act 1948. The 2012 notification rate was 6.6 per 100 000 population, the lowest observed in the past 30 years. Notification rates had decreased during the 1980s, ranging between 8.5 and 11.6 per 100 000 from 1990 to 2003, then decreasing between 2003 and 2007 to 6.7 per 100 000 [2]. 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 [3].

In this report we describe the epidemiology of TB in New Zealand for 2013 as well as 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

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 and Wellington Hospital 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

Clinicians are required to notify all cases of 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 [4], 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.

Hospitalisations

Hospital discharge data for TB (*ICD-10* AM codes A15−A19 and P37.0) was extracted from the Ministry of Health's National Minimum Dataset (NMDS) (see www.health.govt.nz for more information). Hospitalisation numbers from the NMDS may differ from EpiSurv, since the NMDS data includes repeated hospital discharges for the same individual and discharges that relate to cases notified in previous years. In addition, the criteria for TB notification differ from that required for diagnostic coding.

Deaths

Mortality data for TB was extracted from the Ministry of Health's Mortality Collection, which records a classification for the underlying cause of each death registered in New Zealand. Mortality data is available only up to 2011 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 Wellington Hospital. Susceptibility to isoniazid (at concentrations of 0.1 and 0.4 mg/L), rifampicin, ethambutol, pyrazinamide and streptomycin is routinely tested. In addition, first-line DST at Wellington Hospital 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 ethionamide, moxifloxacin, amikacin, capreomycin, *p*-aminosalicylic acid and linezolid.

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

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

- Isolates with high-level isoniazid resistance are screened for rifampicin resistance using the Cepheid GeneXpert® system. Rifampicin resistance detected in the GeneXpert system or in phenotypic susceptibility tests is further investigated by 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, fluoroquinolone and aminoglycosides, respectively. As these assays only target the common mutations associated with resistance, results need to be reported in conjunction with the phenotypic DST results.
- In addition to these commercial assays, in-house PCR (polymerase chain reaction) assays are used to detect mutations in the *rpoB* gene, within and outside the 81 bp mutation hotspot, and in the

katG gene. These assays are useful tools to confirm phenotypic rifampicin and high-level isoniazid resistance where no mutations in the *rpoB* gene or *katG* gene are detected by the GeneXpert® or Hain Lifescience GenoType® line probe assays.

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

Molecular typing

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

A TB isolate is defined as having a unique molecular type if either the MIRU 12 alone or the MIRU 12 + MIRU 24 combination does not match that of any other isolate in the national database. At least one isolate from all 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. The analyses were done using the statistical software SAS 9.3.

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 2013 and trends since 2004 or 2009, 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 2012 rather than 2013.

Notification data presented in this report is based on information recorded in EpiSurv as at 14 July 2014. 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. Notification data from 2004 to 2012 has been updated to reflect the cases in EpiSurv as at 14 July 2014.

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 birthplace, has been derived from the 2013 mid-year population estimates published by Statistics New Zealand.

The denominator data used to determine ethnic-specific disease rates for 2010–2013 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. For the 2009 ethnic-specific rates, the denominator was based on the proportion of people in each ethnic group from the usually resident 2006 census population applied to the 2009 mid-year population estimates.

Population data used to determine disease rates for each birthplace is derived from the 2006 Census usually resident population count by birthplace, because 2013 Census data by birthplace was not available at the time of analysis.

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 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 [5]. 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 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 2009 to 2013 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 from 86% in 2011 to 99% in 2012 and 2013 following changes to this section of the case report form during 2012. Among children aged <5 years, the completeness of the BCG vaccination status improved from 58% in 2009 to 100% in 2013.

Variables with consistently high levels of data completeness (≥94%) 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 (≥95%) across the 4 years analysed (2009–2012).

The date of onset of illness variable had the lowest levels of completeness, ranging from 58% to 69%. This is to be expected due to the nature of the disease.

Table 1. Percentage of data completeness for tuberculosis notifications (new cases) by variable and year, 2009–2013

Variable	2009	2010	2011	2012	2013
Basis of diagnosis					
Basis of discovery	97	96	97	100	92
Laboratory confirmation	91	88	88	97	97
Demographic details					
Age	100	100	100	100	100
Sex	100	100	100	100	100
Ethnicity	99	98	97	99	98
Geocoding accuracy*	93	95	96	96	96
Clinical course and outcomes					
Onset date	62	66	60	58	69
Hospitalisation status	99	99	99	99	98
Survival status	98	98	100	96	98
Protective and risk factors					
BCG vaccination[a]	58	100	100	100	100
Has immunosuppressive illness	93	95	94	95	89
On immunosuppressive medication	92	95	94	95	90
Contact with confirmed case of tuberculosis	76	80	79	82	79
Case born outside New Zealand	100	100	100	100	100
Date of arrival[b]	69	76	73	89	71
Current/recent residence with person born outside New Zealand	82	87	91	91	86
Exposure in a healthcare setting	74	73	80	84	83
Current/recent residence in an institution	80	79	82	87	85
Clinical characteristics					
Pulmonary disease	97	97	97	100	99
Extra-pulmonary involvement	85	89	86	99	99
Treatment[c]					
Date treatment started	95	98	97	99	-
Treatment outcome	99	99	100	96	-
Use of directly observed therapy (DOT)	98	100	100	97	-

[a] Cases in the <5 years age group only.

[b] Cases born outside New Zealand only.

[c] Cases reported as having received treatment only. Data is only reported for 2009−2012 due to length of time taken for TB treatment to be completed.

*Geocoding accuracy is based on exact and nearest match to LINZ addresses.

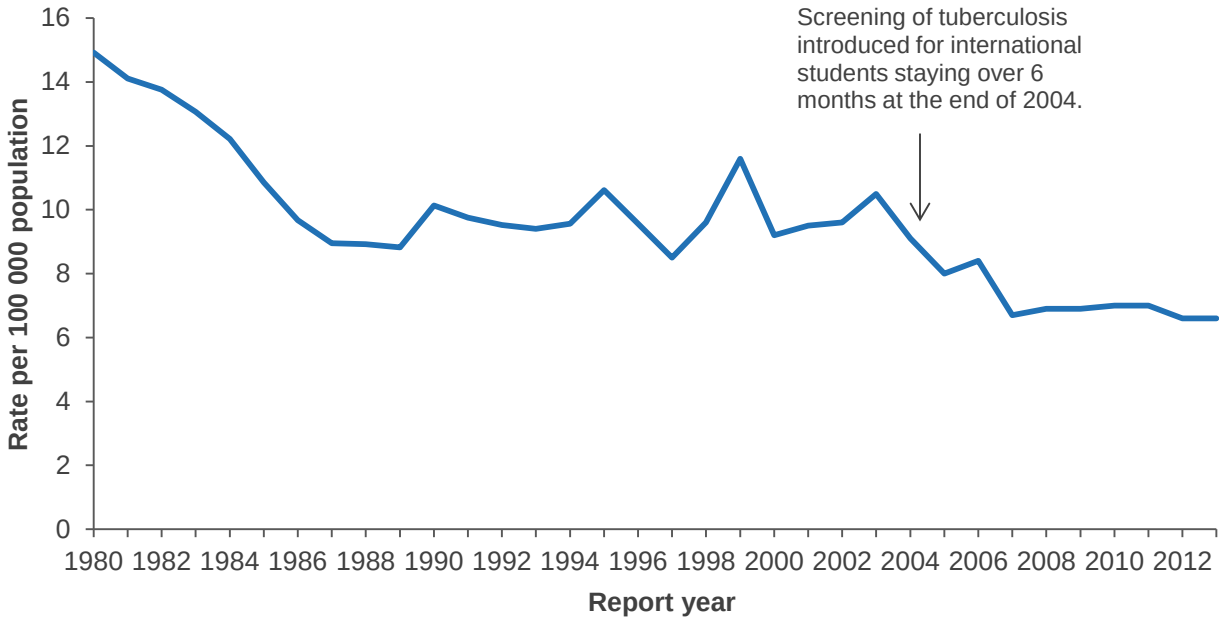
NOTIFICATIONS

NOTIFICATIONS

There were 276 cases of TB notified in 2013, including 264 (95.7%) new cases. The 2013 notification rate was 6.6 per 100 000 population, which is the same rate as that recorded for 2012.

The notification rate in 2013 was the lowest observed in the 30 years prior to 2012. Trends in rates since 1980 are shown in Figure 1. 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 comparatively stable rates over the next 6 years. On average, the TB incidence rate has declined by 2% per year between 1980 and 2013.

Figure 1. Notification rate of tuberculosis disease by year, 1980−2013



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 264 new TB cases notified in 2013, giving a notification rate of 5.9 per 100 000 population. This is a decrease from 2012 (6.3 per 100 000). Between 2009 and 2013, the notification rate showed a slight decrease from 6.7 to 5.9 per 100 000 (Table 12).

Basis of discovery

Information on the means by which TB was discovered was recorded for 244 (92.4%) of the new TB cases. More than 84% (206 cases) of cases were diagnosed when the symptomatic case presented to a health practitioner. Other recorded means of discovery included immigrant or refugee screening (4.1%, 10 cases) and contact follow-up (4.1%, 10 cases) (Table 2).

Between 2009 and 2013, the proportion of cases for each method of discovery was: symptomatic case presented to health practitioner (71−84%), immigrant/refugee screening (4−12%), contact follow-up (4−9%), and other means of discovery (7−13%).

Table 2. Tuberculosis notifications (new cases) by basis of discovery, 2013

Basis of discovery	Cases	%[a]
Symptomatic case presented to health practitioner	206	84.4
Immigrant/refugee screening	10	4.1
Contact follow-up	10	4.1
Other	18	7.4
Unknown	20	-
Total	**264**	

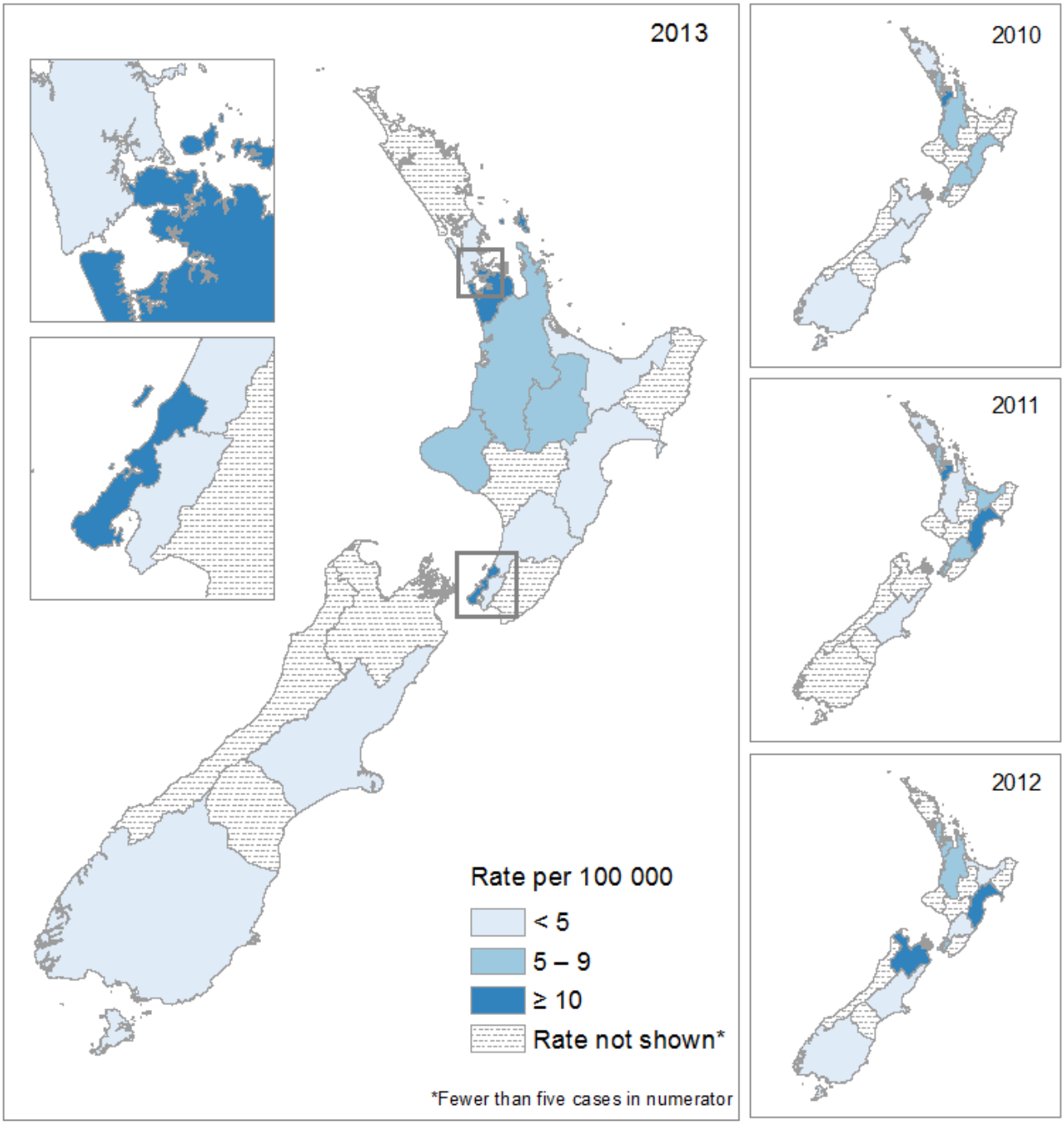
[a] The denominator used to calculate this percentage was the total number of cases for which the information was available.

In 2013, 227 (86.0%) of the new TB cases were laboratory-confirmed. Among the 223 (98.2%) cases for which the method of laboratory confirmation was recorded, 205 (91.9%) were confirmed by isolation of *M. tuberculosis* (200), *M. bovis* (3) or *M. tuberculosis* complex (2) from a clinical specimen. A further 3 cases (1.3%) were confirmed by demonstration of acid-fast bacilli in a clinical specimen, 8 cases (3.6%) by demonstration of *M. tuberculosis* nucleic acid directly from specimens and 7 cases (3.1%) by histology strongly suggestive of TB.

Notifications by District Health Board

The spatial distribution of notification rates by District Health Board (DHB) for the last 4 years is shown in Figure 2. The DHBs with the highest notification rates for new TB cases in 2013 were Auckland (11.3 per 100 000, 53 cases), Capital & Coast (11.3 per 100 000, 34 cases), followed by Counties Manukau (10.5 per 100 000, 54 cases), Waikato (6.2 per 100 000, 23 cases) and Lakes (5.8 per 100 000, 6 cases) DHBs. More details can be found in Table 12 in the appendix.

Figure 2. Notification rate of tuberculosis (new cases) by District Health Board and year, 2010–2013



Notifications by age and sex

In 2013, TB rates were higher among adults (≥15 years) than children (<15 years). The age group with the highest notification rate for new TB cases in 2013 was the 15–39 years age group (8.6 per 100 000, 130 cases), followed by the ≥60 years (6.5 per 100 000, 57 cases) and the 40–59 years (5.6 per 100 000, 67 cases) age groups. The lowest rates were in the <5 years age group (1.6 per 100 000, 5 cases) and the 5–14 years age group (0.9 per 100 000, 5 cases). The five cases in the <5 years age group were all male.

The notification rate for males (6.4 per 100 000, 140 cases) was 1.2 times higher than the rate for females (5.5 per 100 000, 124 cases) (Table 3). This finding is consistent with rates from previous years.

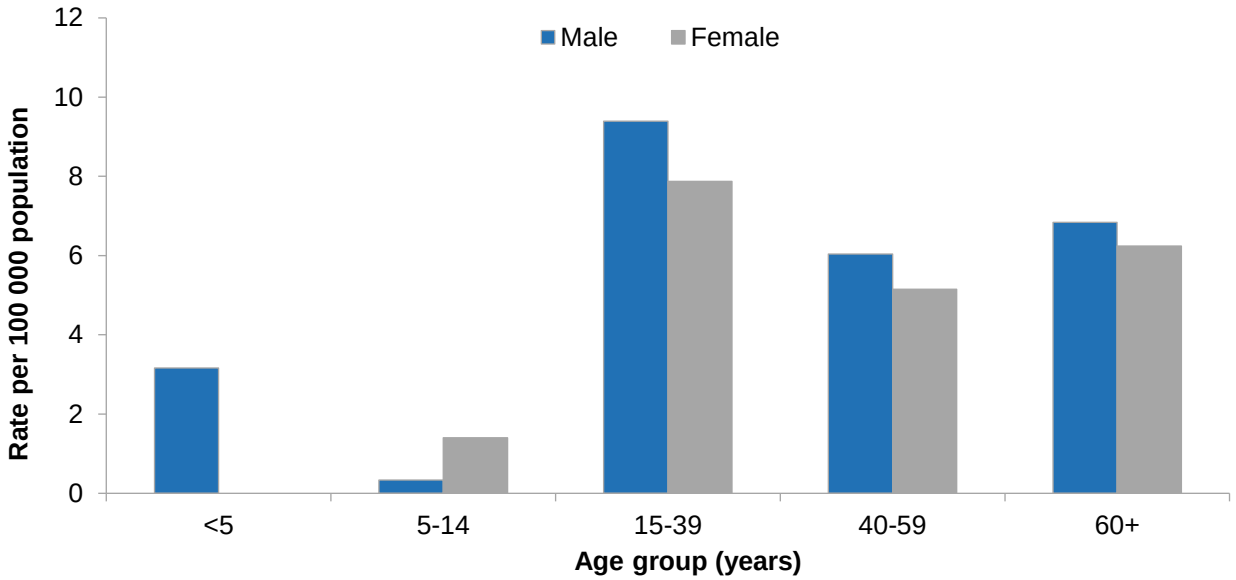
Table 3. Number and rate of tuberculosis notifications (new cases) by age group and sex, 2013

Age group (years)	Male		Female		Total	
	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]
<5	5	3.2	0	-	5	1.6
5 to 14	1	-	4	-	5	0.9
15 to 39	71	9.4	59	7.9	130	8.6
40 to 59	35	6.0	32	5.1	67	5.6
60+	28	6.8	29	6.2	57	6.5
Total	**140**	**6.4**	**124**	**5.5**	**264**	**5.9**

[1] Rate per 100 000 based on 2013 mid-year population estimates; not shown for counts less than 5 cases

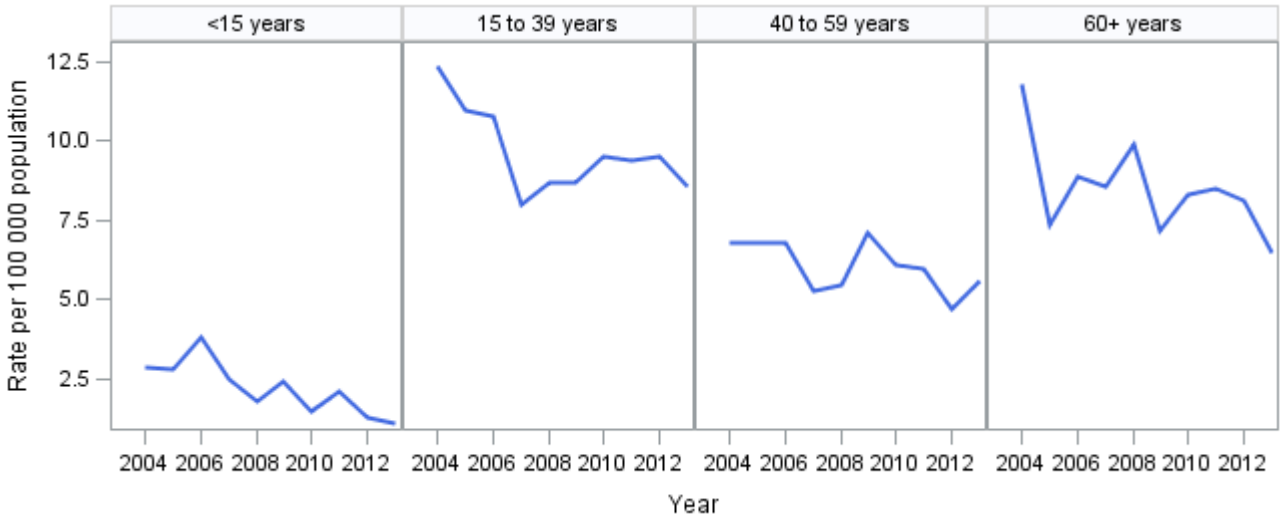
The age distribution of TB notification rates was similar in males and females. The 15–39 years age group had the highest rate for both males and females with 9.4 per 100 000 population (71 cases) and 7.9 per 100 000 (59 cases) respectively (Figure 3, Table 3).

Figure 3. Notification rate of tuberculosis (new cases) by age group and sex, 2013



Between 2004 and 2013, there was a decreasing trend in the notification rate for all age groups (Figure 4). The decrease was mainly observed in those aged <15 years (down 62.1% from 2.9 to 1.1 per 100 000 population), ≥60 years (down 44.9% from 11.8 to 6.5 per 100 000) and 15–39 years (down 30.6% from 12.4 to 8.6 per 100 000). On average, the annual notification rate has been highest in the 15–39 years age group (9.7 per 100 000) over the past 10 years, followed by the ≥60 years (8.5 per 100 000), 40–59 years (6.1 per 100 000) and the <15 years (2.2 per 100 000) age groups.

Figure 4. Notification rate of tuberculosis (new cases) by age group and year, 2004–2013



The rate in New Zealand-born children in the <5 years age group was 1.6 per 100 000. This was a decline from 3.6 in 2009, with an average of 2.2 per 100 000 over the past 5 years. In 2013, the New Zealand child-to-adult ratio (<15 years to ≥15 years) for notification rates was 0.16, a decline from 0.30 in 2009.

Notifications by ethnicity

Ethnicity was recorded for 260 (98.5%) of the new TB cases notified in 2013. The Asian ethnic group had the highest notification rate (30.3 per 100 000, 156 cases), followed by the Middle Eastern/Latin American/African (MELAA) (28.0 per 100 000, 14 cases), Pacific Peoples (14.5 per 100 000, 40 cases), Māori (3.9 per 100 000, 26 cases) and European or Other (European (0.8 per 100 000, 24 cases) ethnic groups. For the new TB cases born in New Zealand, 46.3% (25/54) were in the Māori ethnic group. A further 35.2% (19/54) were in the European or Other ethnic group.

Between 2009 and 2013 the Asian and the MELAA ethnic groups have consistently had the highest notification rates (Figure 5), although it should be noted that the number of cases in the MELAA ethnic group in any one year was low (11–15 cases annually).

Figure 5. Notification rate of tuberculosis (new cases) by ethnic group and year, 2009–2013

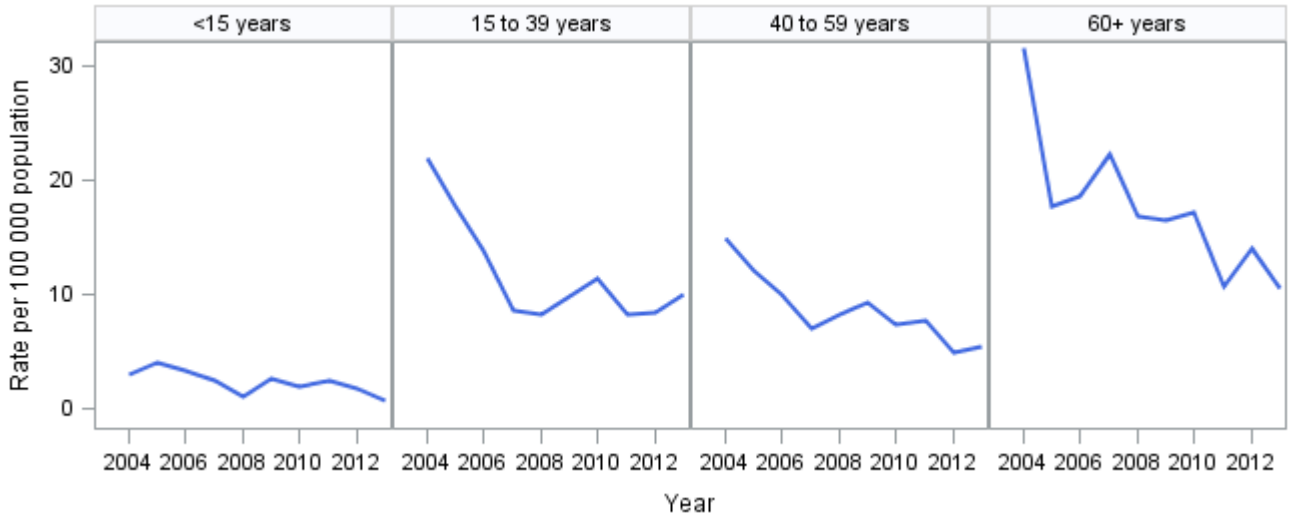
MELAA: Middle Eastern/Latin American/African.

Hospitalisations

Hospitalisation status was complete for 260 (98.5%) of the new TB cases notified to EpiSurv in 2013, of which 158 (60.8%) were hospitalised. The 158 hospitalised cases were distributed in the following age groups: 5−14 years (3), 15–39 years (80), 40–59 years (34), and ≥60 years (41). None of the five cases in the <5 years age group was reported to have been hospitalised.

Figure 6 shows hospitalisation rates by age group and year based on the NMDS data. Data from the Ministry of Health's NMDS shows a decreasing trend in the TB hospitalisation rate for all age groups over the past 10 years (Figure 6), which is similar to the trend observed in TB notification rates (Figure 4). All age groups showed a sharp drop between 2004 and 2008 followed by a plateau or small decline.

Figure 6. Hospitalisation rate for tuberculosis by age group and year, 2004–2013



Source: National Minimum Dataset, Ministry of Health.

Deaths

Of the 264 new TB cases notified in 2013, the disease was recorded as fatal for three cases. The three deaths were in the 40–49 years (1 case) and ≥60 years (2 cases) age groups. In the last 10 years (2004−2013), 43 cases were reported to have died from the disease. Reported fatalities varied from 3–8 cases annually, all of whom were aged ≥20 years.

Between 2004 and 2011 (the latest year available from the Mortality Collections), TB was recorded as the underlying cause of death in 48 cases; 1–13 deaths were recorded each year, with approximately 92% (44 cases) aged ≥40 years. No TB deaths were recorded in children aged <5 years during this period.

Protective factors

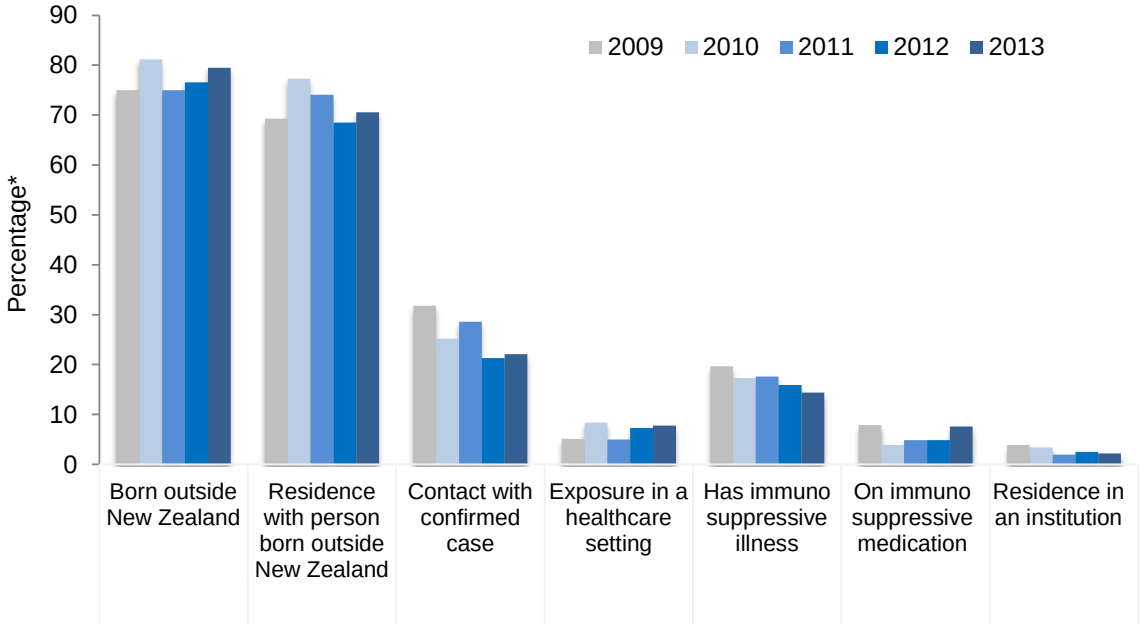
Immunisation of neonates with the Bacillus Calmette-Guérin (BCG) vaccine was introduced in New Zealand in 1976. It is currently available to neonates at increased risk of exposure to TB and is primarily given to protect young children from developing severe disease, particularly miliary TB and tuberculous meningitis [6].

There were five cases of TB in the <5 years age group in 2013, including four cases born in New Zealand. Two of the four cases born in New Zealand were reported to have received BCG vaccine. There was insufficient information to know if the unvaccinated children born in New Zealand were eligible for the high risk BCG vaccination programme. The case born overseas was unvaccinated but was eligible for the programme as they were born in a high endemicity country. It is not recorded whether this child had been offered vaccination after arrival in New Zealand.

Risk factors

The percentage of cases with available information for the various risk factors ranged from 78.8 to 100%. In 2013, the most common risk factor reported by new TB cases was being born outside New Zealand (79.5%), followed by current/recent residence with person(s) born outside New Zealand (70.6%), contact with a confirmed case of TB (22.1%), or having an immunosuppressive illness (14.4%). Less than 10% of cases reported exposure in a healthcare setting, being on immunosuppressive medication or having current/recent residence in an institution (Table 4, Figure 7).

Figure 7. Annual percentage of tuberculosis notifications (new cases) reporting exposure to risk factors, 2009–2013



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

Table 4. Risk factors reported for tuberculosis notifications (new cases), 2013

Risk factor	Cases[a]	Total[b]	%
Born outside New Zealand	210	264	79.5
Current/recent residence with person born outside New Zealand	161	228	70.6
Contact with confirmed case	46	208	22.1
Has immunosuppressive illness	34	236	14.4
Exposure in a healthcare setting	17	219	7.8
On immunosuppressive medication	18	238	7.6
Current/recent residence in an institution	5	224	2.2

[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 born in the Southern and Central Asia region had the highest notification rate in 2013 (168.1 per 100 000 population, 97 cases), followed by the South-East Asia region (58.4 per 100 000, 34 cases) (Table 5). More than 90% (88/97) 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 (50.0%, 17/34).

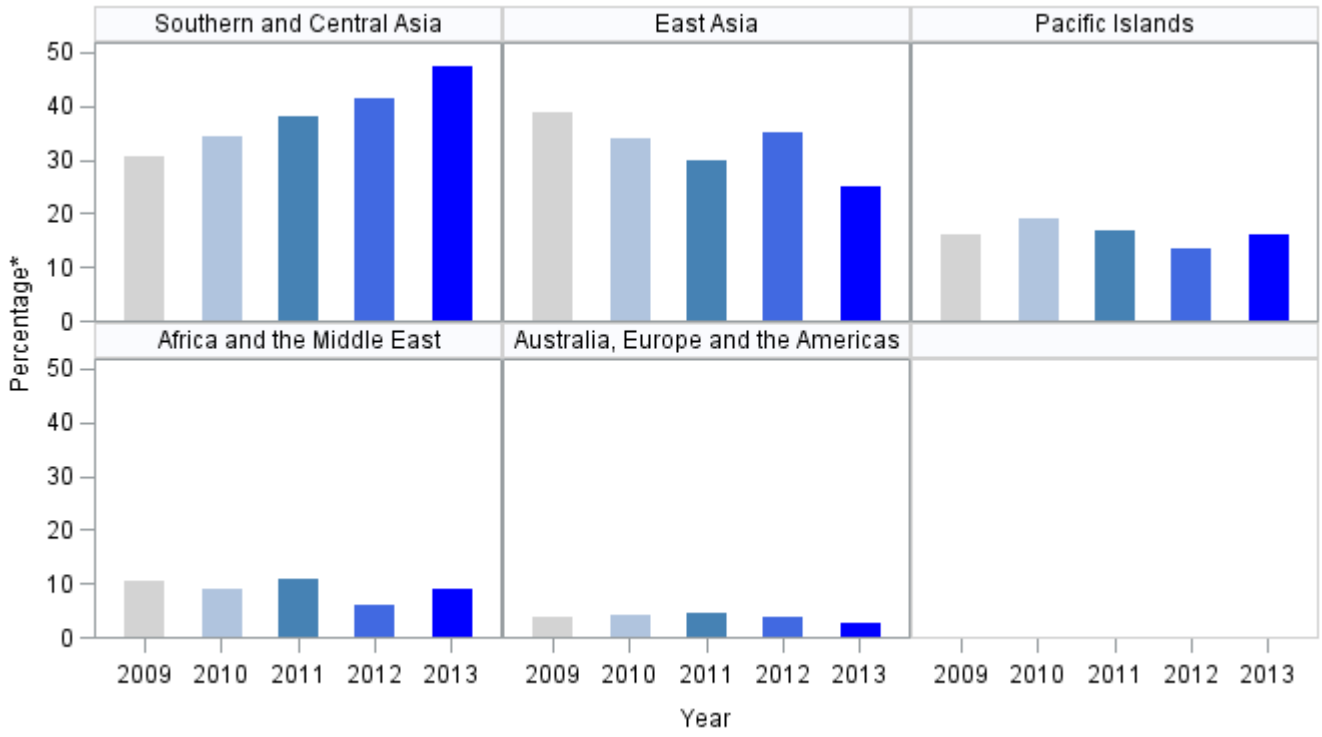
Table 5. Tuberculosis notifications (new cases) by region of birth, 2013

Region of birth	Cases	Rate[a]
Born in New Zealand	**54**	**1.8**
Born outside New Zealand	**210**	**23.9**
Australia	2	-
Pacific Islands	33	24.3
North Africa and the Middle East	2	-
Sub-Saharan Africa	16	27.1
North-East Asia	17	12.6
South-East Asia	34	58.4
Southern and Central Asia	97	168.1
Europe	2	-
Southern and Central America	1	-
Unknown	6	-
Total	**264**	**-**

[a] Rate per 100 000 population. Population data used for the denominator was derived from the 2006 census usually resident population count by birthplace, published by Statistics New Zealand.

Among new TB cases born outside New Zealand, the proportion of cases born in the Southern and Central Asia region increased steadily between 2009 and 2013 from 30.6% to 47.5% (Figure 8). Conversely, the percentage of cases born in East Asia (North-East and South-East Asia) shows a decreasing trend while the trend is relatively stable for those born in other regions.

Figure 8. Percentage of tuberculosis notifications (new cases) born outside New Zealand by birth region and year, 2009−2013



* 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.

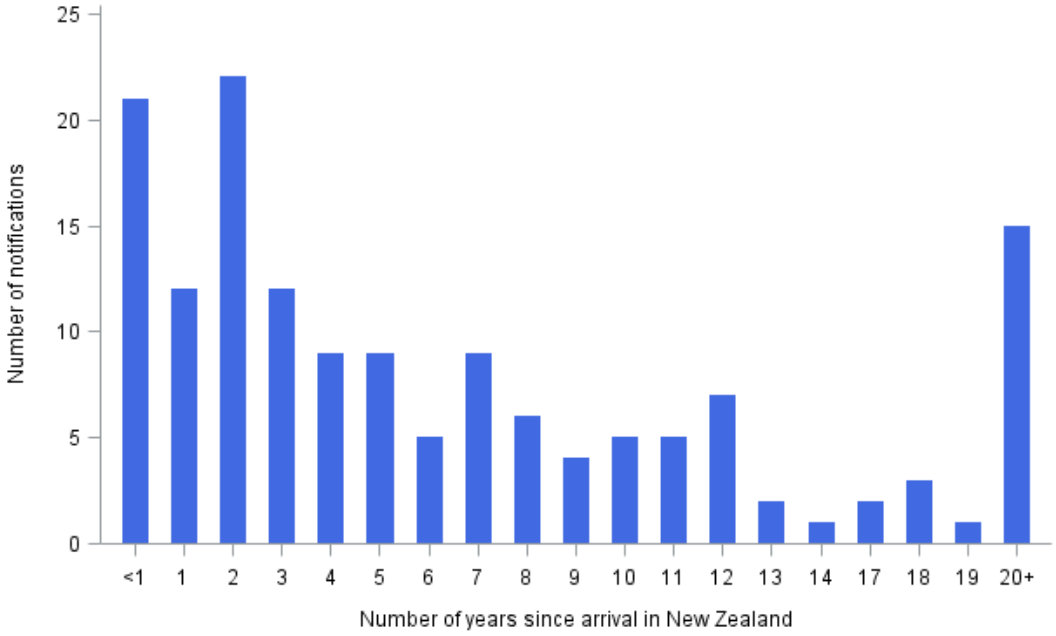
East Asia includes North-East and South-East Asia.

Years since arrival in New Zealand

The date of arrival in New Zealand was recorded for 150 (71.4%) of the 210 new TB cases born outside New Zealand. Of these, the interval between the date of arrival in New Zealand and the TB notification date ranged from 0 to 54 years, with a mean interval of 7.6 years and median interval of 4 years. TB notification occurred in the first year of arrival in New Zealand for 14.0% (21/150) of cases born outside New Zealand (Figure 9). Around 51% of notifications occurred in the first 5-year period after arrival in New Zealand.

Between 2009 and 2013, the annual median interval between arrival in New Zealand and the date of TB notification remained stable at 4 years. The annual mean interval ranged between 7.1 and 8.4 years.

Figure 9. Tuberculosis notifications (new cases) born outside New Zealand by the number of years since arrival in New Zealand, 2013



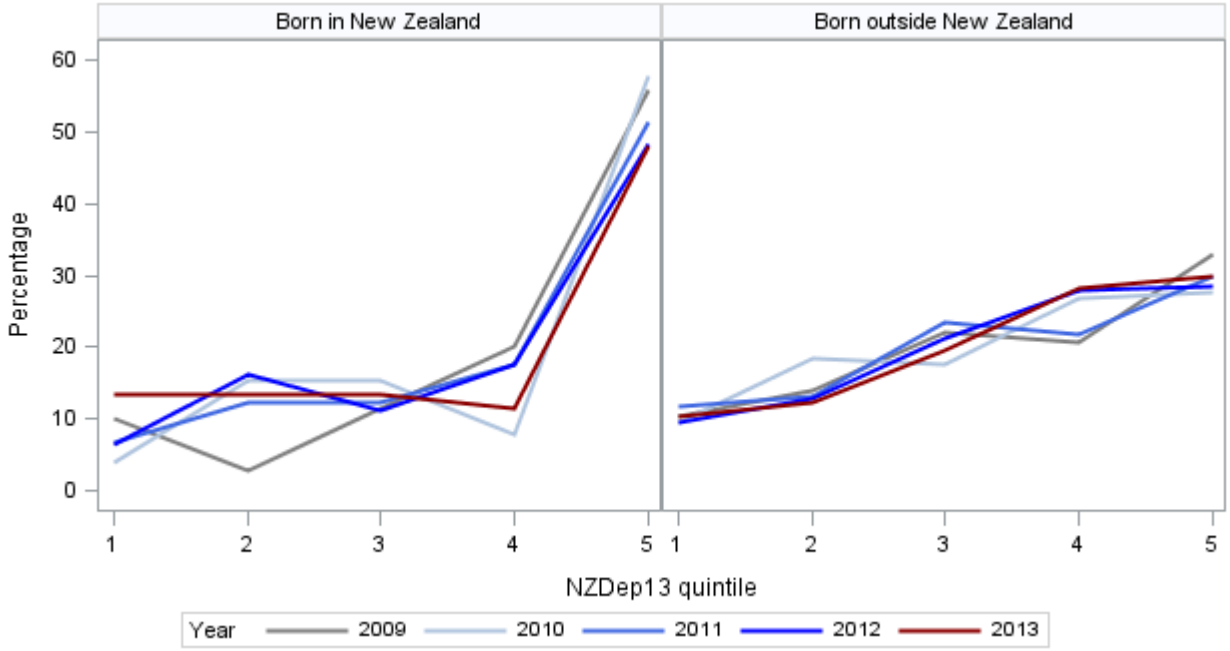
Note: the date of arrival was not recorded for 60 cases.

Socioeconomic deprivation

In 2013, 257 (97.3%) of new TB cases could be assigned a 2013 New Zealand Socioeconomic Deprivation Index (NZDep13) score. Of the 257 cases, 58.4% (150) resided in the most deprived areas (NZDep13 quintile 4 or 5).

Figure 10 shows the relationship between deprivation quintile and percentage of new TB cases in the last 5 years. Of the 1392 cases with available information, 310 (22.3%) cases were born in New Zealand. A disproportionate number of new TB cases lived in the most deprived areas. This result is observed each year and is more marked for cases born in New Zealand.

Figure 10. Tuberculosis notifications (new cases) for cases born in New Zealand and born outside New Zealand by quintiles of the 2013 New Zealand Deprivation Index (NZDep13) and year, 2009−2013

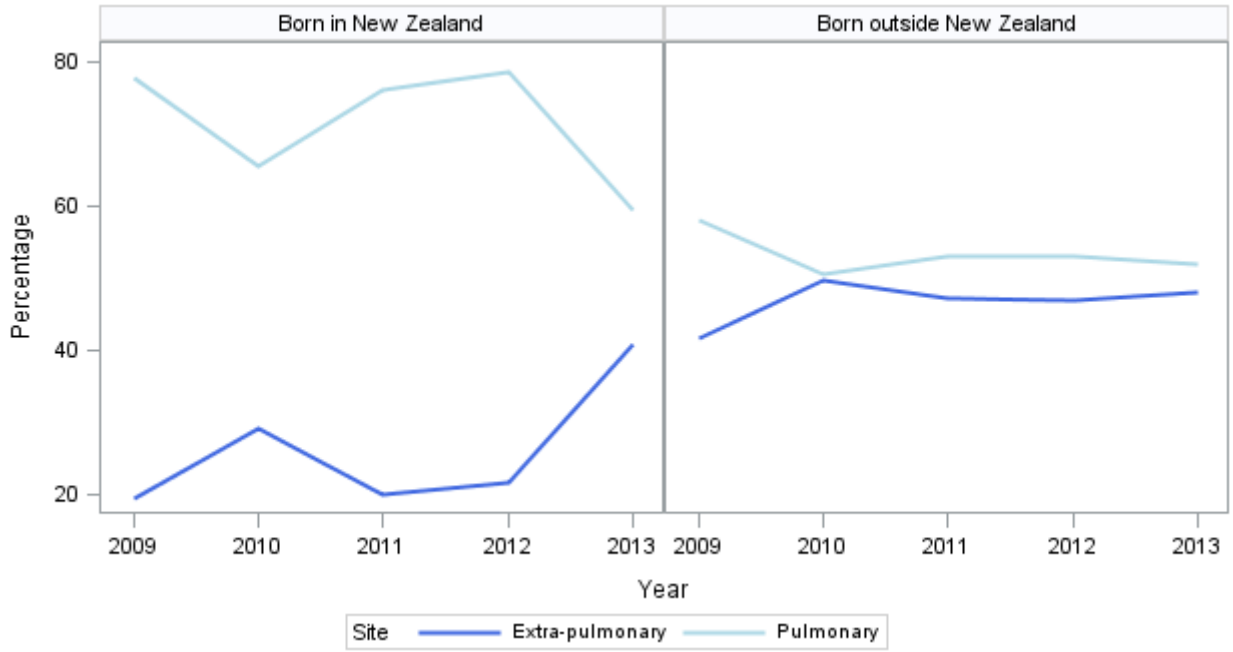


Site of infection

There were 141 (53.4%) new TB cases in 2013 with pulmonary disease, including 45 cases who also had extra-pulmonary involvement. A further 123 cases (46.6%) reported having extra-pulmonary involvement solely.

Whereas in previous years marked differences were seen in the clinical characteristics of cases born in New Zealand compared with cases born outside New Zealand, this was less apparent in 2013. Among cases born in New Zealand, approximately 74% were reported with pulmonary disease between 2009 and 2012, decreasing to 59% in 2013. Compared with cases born in New Zealand, new TB cases born outside New Zealand had less pulmonary disease between 2009 and 2013, the percentage being fairly stable at approximately 53% (Figure 11).

Figure 11. Comparison of the percentage of pulmonary versus solely extra-pulmonary involvement for tuberculosis (new cases) born in New Zealand and born outside New Zealand by year, 2009−2013



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

Of the 141 new TB cases in 2013 with pulmonary disease, 133 had available information on whether acid-fast bacilli were demonstrated in a direct smear of a clinical specimen. Of these, 50.4% (67/133) were smear positive, with sputum reported as the specimen site for 76.1% (51/67) of these cases.

For cases with extra-pulmonary involvement in 2013, 41.1% (69/168) had lymph node (excluding abdomen) recorded as a site of infection. Five cases of tuberculous meningitis were reported in 2013: two cases in the 15–39 years and three cases in the ≥60 years age groups. Seven cases of miliary TB were reported, all of which were aged ≥15 years.

Between 2009 and 2013, the most common site of infection recorded for cases with extra-pulmonary involvement was lymph node (excluding abdominal), followed by pleural and intra-abdominal (excluding renal). During this period, there were 23 cases of tuberculous meningitis and 23 cases of miliary TB. One of the miliary new TB cases was an infant aged <1 year who had not received BCG vaccine. There were no cases of tuberculous meningitis in the <5 years age group. A breakdown of the new TB cases with extra-pulmonary involvement by site of infection and year is shown in Table 13 in the summary tables section of this report.

HIV status

None of the new TB cases notified in 2013 was co-infected with HIV compared with three new TB cases reported to be co-infected with HIV in 2012.

Of the 264 new TB cases in 2013, information on whether an HIV test was done was recorded for 90.9% (240). Of these 240 cases, 78.8% (189) were reported to have been tested for HIV.

Receipt of treatment

In 2013, 96.2% (227/236) of new TB cases were reported to have received treatment. The interval between the onset of symptoms and start of treatment could be calculated for 150 (66.1%) cases. Of these, 18 (12.0%) started treatment within 1 month of the onset of symptoms and 89 (59.3%) started treatment between 1 and 3 months. The median interval to the start of treatment was 2 months from the onset of symptoms.

A treatment delay for patients with pulmonary TB represents a risk to public health from disease transmission. The interval between the onset of symptoms and the start of treatment could be calculated for 58.7% (71/121) of the new TB cases with pulmonary disease. Among these, 14 (19.7%) started treatment within 1 month of the onset of symptoms and 45 (63.4%) started treatment between 1 and 3 months. The median interval to the start of treatment was 2 months from the onset of symptoms.

Treatment outcomes for cases notified in 2012

Due to the length of time taken for the treatment of TB to be completed, the data presented in this section is for the 279 TB cases notified in 2012. Of these, 96.7% (260/269) reported receiving treatment for TB.

Treatment outcome information was recorded for 249 (95.8%) of the cases who received treatment. The majority of these cases (87.6%, 218 cases) completed treatment to the satisfaction of the prescribing doctor. TB treatment for the remaining 31 cases ended earlier than planned for the following reasons: case went overseas (5.6%, 14 cases), case died (2.4%, 6 cases), treatment was stopped because of adverse effects (2.4%, 6 cases), case transferred to overseas medical care (1.6%, 4 cases) and case refused to complete treatment (0.4%, 1 case).

Of the 218 new TB cases who completed treatment to the satisfaction of the prescribing doctor, approximately 43% (91/211) received directly observed therapy (DOT) throughout the course of their treatment. The proportion of cases who received DOT throughout their course of treatment was higher in those born outside New Zealand (44.7%) than those born in New Zealand (38.8%). Similarly, for cases with pulmonary disease, the proportion who received DOT throughout the course of treatment was higher in cases born outside New Zealand (61.4%) than those born in New Zealand (47.5%).

Tuberculosis disease – relapses or reactivations

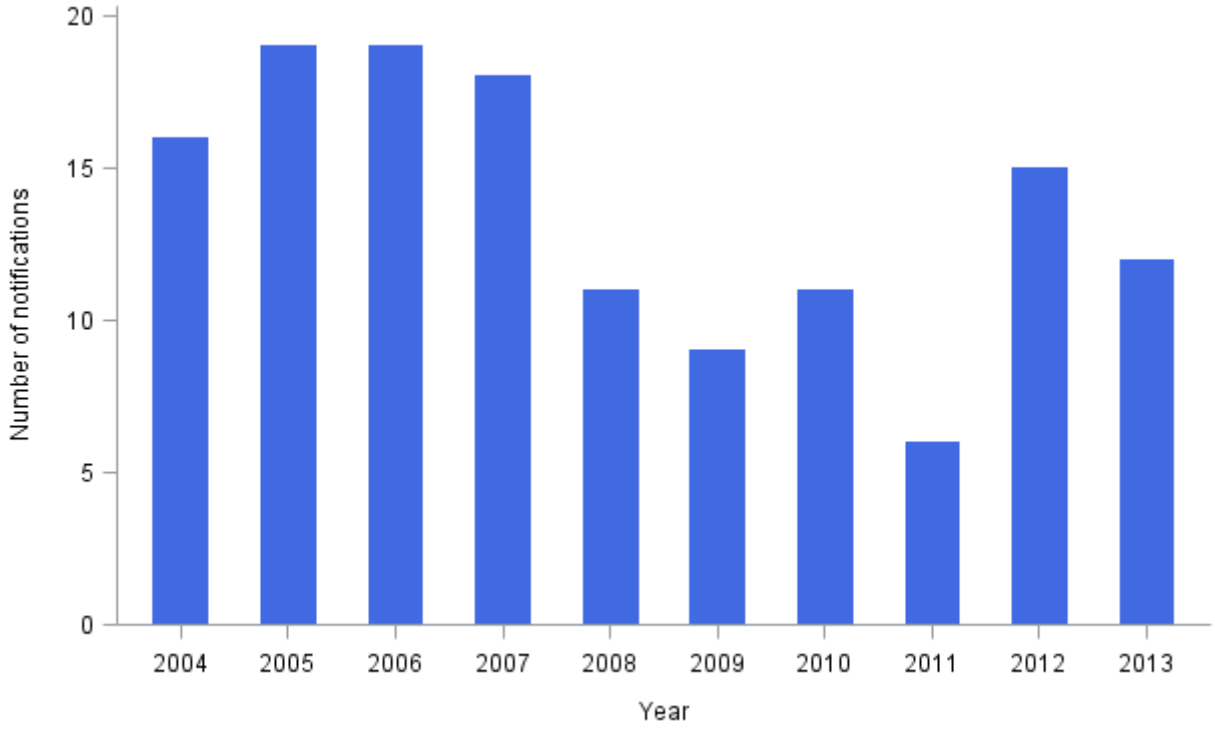
In 2013, 12 TB relapse/reactivation cases were notified from seven DHBs: Auckland and Capital & Coast (3 cases each), Counties Manukau (2 cases), Waitemata, Waikato, Canterbury and Southern (1 case each) DHBs. The cases were distributed in the 15–39 years (4 cases), 40–59 years (3 cases) and ≥60 years age groups (5 cases). Relapse/reactivation cases included those in the Asian (8 cases), Māori, Pacific Peoples and European or Other (1 case each) ethnic groups. Ethnicity was unknown for one case.

Information about the place of birth, place of original diagnosis and whether the case had been previously treated for TB was recorded for all of the relapse/reactivation cases. One case was both born and diagnosed with TB in New Zealand, while 11 were born and diagnosed overseas. All 12 cases had been previously treated for TB. The case that had been diagnosed in New Zealand had previously received treatment for 12 months, two cases had received treatment for 9 months, seven cases had received treatment for 6 months and the duration of treatment was unknown for the remaining two cases.

Hospitalisation status was recorded for all 12 relapse/reactivation cases and five (41.7%) were hospitalised. No deaths from disease were reported among reactivation cases.

The number of TB relapse/reactivation cases has remained low over the last 10 years ranging from 6 to 19 cases annually (Figure 12).

Figure 12. Tuberculosis notifications (reactivation cases) by year, 2004−2013



Outbreaks

In 2013, two TB outbreaks were reported in Hawke's Bay and Capital & Coast DHBs, respectively.

The outbreak in Hawke's Bay DHB comprised three cases and a further 12 cases with latent TB infection were identified. The exposures occurred in a private home and a healthcare setting.

The outbreak in Capital & Coast DHB comprised three cases. The exposure occurred in a private home.

CULTURE CONFIRMATION, SPECIATION AND DRUG SUSCEPTIBILITY

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 2013, 205 new TB cases were culture-positive. The mycobacterial species identified were *M. tuberculosis* (200 cases), *M. bovis* (3 cases) and *M. tuberculosis* complex (2 cases). Almost 88% (124/141) of the new TB cases with pulmonary disease were culture-positive, comprising 120 cases identified as *M. tuberculosis*, three cases as *M. bovis* and one case as *M. tuberculosis* complex.

Of the 12 TB relapse/reactivation cases notified in 2013, 11 were culture-positive and the isolates were identified as *M. tuberculosis*.

Fewer than 10 cases of culture-positive TB due to *M. bovis* were reported each year between 2009 and 2013.

Drug susceptibility

Antimicrobial susceptibility data for the isolates from 216 (205 new cases and 11 relapses/reactivations) culture-positive TB cases in 2013 was available. The proportion of isolates resistant to the five antimicrobials routinely tested is shown in Table 6.

In addition to the five antimicrobials routinely tested, 59 isolates were tested for susceptibility to fluoroquinolones, either moxifloxacin or ofloxacin, and all were found to be susceptible.

Table 6. Resistance to each antimicrobial, by mycobacterial species, 2013

Antimicrobial	Resistant[a]					
	M. tuberculosis *n* = 211		*M. bovis* *n* = 3		All isolates *n* = 216[b]	
	No.	%	No.	%	No.	%
Isoniazid (0.1 mg/L)	14	6.6	0	-	14	6.5
Isoniazid (0.4 mg/L)[c]	10	4.7	0	-	10	4.6
Rifampicin	3	1.4	0	-	3	1.4
Ethambutol	2	1.0	0	-	2	0.9
Pyrazinamide	1	0.5	3[d]	100	5	2.3
Streptomycin	13	6.2	0	-	13	6.0

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

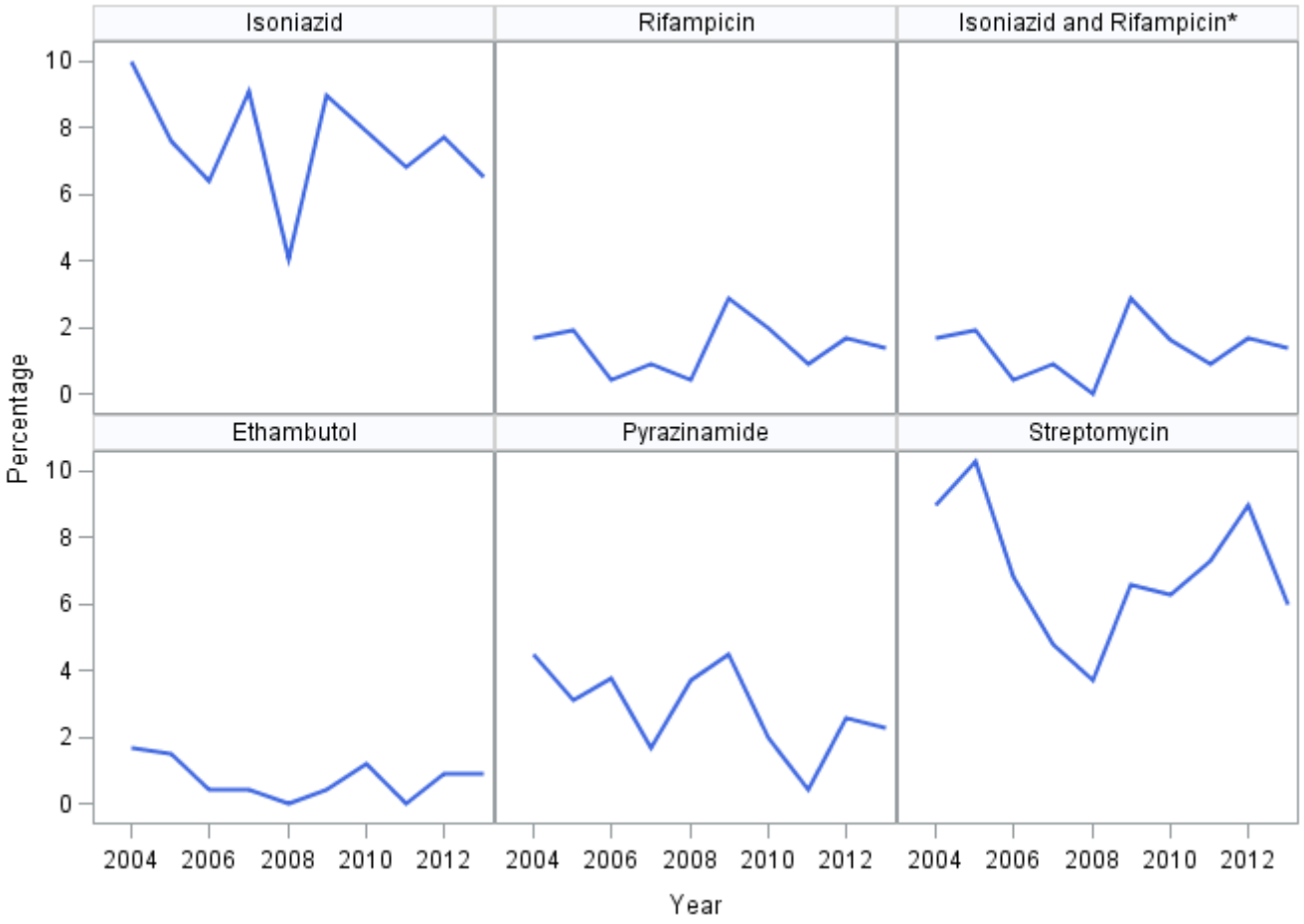
[b] Includes two isolates only identified as *M. tuberculosis* complex.

[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 2004 to 2013, there has been a significant trend ($p \leq 0.05$) of decreasing pyrazinamide resistance, but no significant changes in resistance to isoniazid, rifampicin, ethambutol or streptomycin have been observed (Figure 13).

Figure 13. Resistance among tuberculosis isolates by antimicrobial and year, 2004−2013



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

In 2013, 88.0% (190/216) of the isolates were fully susceptible to all five routinely tested antimicrobials. There were three (1.4%) cases of multidrug-resistant tuberculosis (MDR-TB, defined as resistance to at least isoniazid and rifampicin) (Table 7). During the last 10 years there have been a total of 33 cases of MDR-TB – an average annual rate of 1.3% among culture-positive TB cases. All but two of these 33 cases were born overseas and are assumed to have acquired MDR-TB overseas. The majority (29, 93.5%) of the 31 MDR-TB cases assumed to have acquired MDR-TB overseas were born in an Asian country.

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 7. Distribution of antimicrobial resistance patterns among tuberculosis isolates, 2013

	Resistance pattern[a]	% (No.) of isolates with each pattern
Fully susceptible		**88.0 (190)**
Resistant to 1 agent		**9.3 (20)**
	H	3.7 (8)
	S	3.7 (8)
	Z	1.9 (4)
Resistant to 2 agents		**1.4 (3)**
	HS	1.4 (3)
Resistant to 3 agents		**0.9 (2)**
	HRE[b]	0.5 (1)
	HRS[b]	0.5 (1)
Resistant to 5 agents		**0.5 (1)**
	HREZS[b]	0.5 (1)

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

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

Table 8 compares antimicrobial resistance among isolates from cases born in New Zealand and cases born overseas. Resistance to all antimicrobials, except pyrazinamide, was higher among isolates from cases born overseas than among isolates from New Zealand-born cases, although none of the differences were significant. All three MDR-TB cases in 2013 were born overseas.

Table 8. Antimicrobial resistance by place of birth, 2013

	Born in New Zealand (*n* = 41)		Born overseas (*n* = 175)		*p*-value[a]
	No.	%	No.	%	
Fully susceptible					
	37	90.2	153	87.4	0.792
Resistant to:[b]					
Isoniazid[c]	1	2.4	13	7.4	0.478
Rifampicin	0	-	3	1.7	1.000
Ethambutol	0	-	2	1.1	1.000
Pyrazinamide	2	4.9	3	1.7	0.241
Streptomycin	1	2.4	12	6.9	0.470
MDR-TB[d]					
	0	-	3	1.7	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.

Isoniazid, rifampicin, ethambutol, pyrazinamide and streptomycin resistance was most frequent among isolates from cases of Asian ethnicity. All isoniazid-resistant, rifampicin-resistant, ethambutol-resistant and MDR-TB isolates were from cases of Asian ethnicity (Table 9).

Table 9. Antimicrobial resistance by ethnicity, 2013

	Māori[a] (*n* = 20)		Pacific Peoples (*n* = 34)		Asian (*n* = 128)		MELAA (*n* = 9)		European or Other (*n* =21)		Unknown (*n* = 4)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Fully susceptible												
	18	90.0	30	88.2	112	87.5	6	66.7	20	95.2	4	100
Resistant to:[b]												
Isoniazid[c]	0	-	0	-	14	10.9	0	-	0	-	0	-
Rifampicin	0	-	0	-	3	2.3	0	-	0	-	0	-
Ethambutol	0	-	0	-	2	1.6	0	-	0	-	0	-
Pyrazinamide	1	5.0	1	2.9	1	0.8	1	11.1	1	4.8	0	-
Streptomycin	1	5.0	3	8.8	7	5.5	2	22.2	0	-	0	-
MDR-TB[d]												
	0	-	0	-	3	2.3	0	-	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 2013, 5.1% (11/216) 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 2009 to 2013. During this period, 3.8% (45/1180) of the culture-positive cases were reported to be relapses/reactivations. Information about previous treatment was recorded for 33 of the 45 relapses/reactivations and all 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 10. Compared with isolates from new cases, isolates from previously treated cases were significantly more resistant to isoniazid and rifampicin, and consequently also more likely to be MDR-TB.

Table 10. Antimicrobial resistance among new cases, relapses/reactivations and previously treated cases, 2009–2013

	New cases (*n* = 1135)	Relapse/reactivation cases			
		All (*n* = 45)		Previously treated[a] (*n* = 33)	
	%	%	*p*-value[b]	%	*p*-value[b]
Fully susceptible					
	87.4	75.6	0.021	75.8	0.062
Resistant to:[c]					
Isoniazid[d]	7.3	15.6	0.076	18.2	0.034
Rifampicin	1.4	11.1	<0.001	12.1	0.002
Ethambutol	0.7	0.0	1.000	0.0	1.000
Pyrazinamide	2.2	6.7	0.087	6.1	0.176
Streptomycin	6.8	13.3	0.125	15.2	0.076
MDR-TB[e]					
	1.3	11.1	<0.001	12.1	0.002

[a] Information on previous treatment was reported for only 33 of the 45 relapse/reactivation cases, all 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

MOLECULAR TYPING

TB molecular typing results were available for 205 culture-positive new TB cases in 2013. The mycobacterial species identified were *M. tuberculosis* (200 cases), *M. bovis* (3 cases) and *M. tuberculosis* complex (2 cases). For the 200 *M. tuberculosis* cases, 63 (31.5%) had non-unique molecular types and were in 46 separate molecular clusters. Four new clusters were identified in 2013 with two cases in each. The remaining 137 cases (68.5%) had a unique strain type.

In the last 5 years (2009–2013), 1,114 *M. tuberculosis* cases had TB molecular typing results, of which 388 (34.8%) had non-unique molecular types and were in 134 separate molecular clusters.

The median cluster size was two cases (range 2−46) and 89.6% (120/134) of clusters had fewer than five cases. The remaining 14 clusters were distributed into the following cluster sizes: 5−9 cases (8), 10−19 cases (4) and 20 or more cases (2).

Between 2009 and 2013, there was a higher proportion of cases with non-unique molecular types, compared with those with unique strain types, in cases aged <15 years (5.4% vs. 1.1%). Similarly there was a higher proportion of cases with non-unique molecular types in the Māori (25.7% vs. 4.2%) and Pacific Peoples (28.9% vs. 7.0%) ethnic groups. This pattern was also seen in cases from Hawke's Bay DHB (6.2% vs. 2.3%) and cases born in New Zealand (36.1% vs. 11.4%).

Conversely, there was a lower proportion of cases with non-unique molecular types, compared with those with unique strain types, in the Asian and MELAA ethnic groups (37.3% vs. 77.9%). Similarly there was a lower proportion of cases with non-unique molecular types in cases from Auckland DHB (19.9% vs. 24.8%), as well as in cases born in Southern and Central Asia (17.9% vs. 36.5%) and East Asia (15.6% vs. 32.6%).

Table 11 shows a breakdown of cases by age group, sex, ethnic group, DHB, region of birth, quintiles of NZDep13 and clinical manifestation, separated by whether cases had unique or non-unique strain types.

Table 11. Number and percentage of non-unique and unique strain tuberculosis notifications (new cases) for selected variables, 2009−2013

Variable[a]	Non-unique		Unique	
	Cases	%[b]	Cases	%[b]
Age group (years)	**387**	-	**730**	-
<15	21	5.4	8	1.1
15−39	193	49.9	364	49.9
40−59	95	24.5	168	23.0
60+	78	20.2	190	26.0
Sex	**387**	-	**730**	-
Male	210	54.3	354	48.5
Female	177	45.7	376	51.5
Ethnic group	**381**	-	**719**	-
Māori	98	25.7	30	4.2
Pacific Peoples	110	28.9	50	7.0
Asian	136	35.7	521	72.5
Middle Eastern/Latin American/African	6	1.6	39	5.4
European or Other	31	8.1	79	11.0
District Health Board	**387**	-	**730**	-
Northland	10	2.6	6	0.8
Waitemata	47	12.1	98	13.4
Auckland	77	19.9	181	24.8
Counties Manukau	77	19.9	151	20.7
Waikato	22	5.7	47	6.4
Lakes	4	1.0	9	1.2
Bay of Plenty	14	3.6	26	3.6
Tairawhiti	1	0.3	2	0.3
Taranaki	3	0.8	7	1.0
Hawke's Bay	24	6.2	17	2.3
Whanganui	1	0.3	2	0.3
MidCentral	15	3.9	14	1.9
Hutt Valley	17	4.4	22	3.0
Capital & Coast	40	10.3	53	7.3
Wairarapa	1	0.3	1	0.1
Nelson Marlborough	9	2.3	10	1.4
West Coast	0	-	3	0.4
Canterbury	20	5.2	59	8.1
South Canterbury	1	0.3	1	0.1
Southern	4	1.0	21	2.9
Region of birth	**385**	-	**726**	-
New Zealand	139	36.1	83	11.4
Southern and Central Asia	69	17.9	265	36.5
East Asia	60	15.6	237	32.6
Pacific Islands	92	23.9	56	7.7
Africa and the Middle East	17	4.4	59	8.1
Australia, Europe and the Americas	8	2.1	26	3.6
2013 NZ Deprivation Index (NZDep13) quintile	**377**	-	**722**	-
1	26	6.9	86	11.9
2	40	10.6	102	14.1
3	61	16.2	150	20.8
4	89	23.6	175	24.2
5	161	42.7	209	28.9
Clinical manifestation	**387**	-	**729**	-
Pulmonary disease	273	70.5	428	58.7
Extra-pulmonary involvement only	114	29.5	301	41.3

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

[b] The denominator value used to calculate this percentage is the total number of cases for which information was recorded for the variable.

DISCUSSION

DISCUSSION

The incidence of TB in New Zealand (6.6 per 100 000 in 2013) has remained fairly stable over the past 5 years. This rate is higher than the 2012 incidences reported in Australia (5.8 per 100 000), Canada (4.8 per 100 000) and the United States (3.2 per 100 000) [7-9], but lower than recent rates recorded in the United Kingdom (13.9 per 100 000 in 2012 and 12.3 per 100 000 in 2013 [10, 11].

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, Capital & Coast, and Counties Manukau DHBs all had incidence rates above the national rate. These three DHBs have large urban populations and the higher incidence may reflect the ethnic makeup of these communities, settlement patterns of migrants from high endemicity countries and housing issues such as overcrowding. This is similar to the distribution of cases noted in the United Kingdom where TB is concentrated in large urban areas [11]. In 2013, 58.4% 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 40% most deprived areas in the UK [11].

Amongst cases born in New Zealand the highest proportion of cases were in the Māori ethnic group (46.3%), although the incidence in the Māori ethnic group was lower than for Pacific Peoples and for people born overseas. This is different from Australia where, among cases born in Australia, there was a lower proportion of cases in indigenous people compared to non-indigenous Australians [12]. The pattern for incidence rates for indigenous people compared with other groups varies between countries. In Canada the incidence rate is highest among Canadian born aboriginal people when compared with non-aboriginal Canadians and also with those born overseas [8]; in Australia the incidence rate is 11 times higher in indigenous Australians compared with non-indigenous Australians, but is still much lower than the rate in overseas born people [12]; and in the United States the incidence rate is higher in indigenous people compared with those of European ethnicity but lower than in people born overseas [13, 14].

Country of birth

During the past 5 years, 75–80% of TB cases notified were born outside of New Zealand, an increase from earlier periods (61.3% for 1995–1999 and 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 steadily increased over 10 years, reaching 90% in 2010 [12]. The proportion of cases born outside New Zealand in 2013 (79.5%) is similar to that reported in the United Kingdom (almost 75% in 2013), but higher than in Canada (64% in 2012) and the United States (65% in 2013) [8, 11, 14].

Although the proportion of cases born overseas has been increasing in New Zealand, the incidence rate in people born overseas in 2013 was 23.9 per 100 000 which is lower than the rates reported for 1995 – 1999 (31.7 per 100 000) and 2000 – 2004 (32.3 per 100 000). This decrease may be due to changes in immigration screening practices, 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. Although this rate is higher than the 15.6 per 100 000 reported for foreign born people in the United States in 2013, the US foreign born rate excludes cases born in American territories such as the Federated States of Micronesia, Guam, the Northern Marianas and Palau, all of which are high endemicity countries [14].

Of the cases born outside New Zealand, the majority were born in South and Central Asia, followed by South East Asia, all high TB burden areas. The most frequently reported country of birth, India, followed by the Philippines, is similar to the countries of birth for TB cases reported from Australia (India, Vietnam, Philippines) but differs from the countries of birth most commonly reported for UK cases (India, Pakistan, Somalia) [11, 12]. This difference reflects differing immigration patterns but all the countries listed underscore the high risk of being born in country with high endemicity.

The time since arrival in New Zealand and notification date, while only recorded for 71.4% of cases born overseas, showed a similar pattern to that seen in Australia and the United Kingdom. 14% of cases born overseas were notified with TB in the first year after arrival and 57% within 5 years of arrival. Australia recorded this information for 82% of those born overseas and reported that 29% of these cases were notified in the first 2 years and 50% within 3 years after arrival [12]. Time from arrival until diagnosis was known for 89% of non-UK born cases with 30% diagnosed within 2 years and 48% within 5 years of arrival [11].

Clinical presentation and treatment

Pulmonary disease was reported in 53.4% of new TB cases in 2013, a lower proportion than in Canada (67% in 2012), Australia (61% in 2010), but similar to the United Kingdom (52% in 2013) [8, 11, 12].

None of the five children aged <5 years diagnosed with TB in 2013 were reported as having had miliary or meningeal TB. Only two of these five children were reported to have had BCG vaccination. There was insufficient information to know if the unvaccinated children born in New Zealand were eligible for the high risk BCG vaccination programme. The case born overseas was unvaccinated but was eligible for the programme as they were born in a high endemicity country. It is not recorded whether this child had been offered vaccination after their arrival in New Zealand. 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 were "new disease" (95.7%), meaning there was no history of prior treatment. This is a similar proportion to that reported from Australia in 2010 (96%) and the United Kingdom (93% in 2013) [11, 12] . All of the 12 relapse/reactivation cases were reported to have been previously treated for TB, but the majority (11/12) were diagnosed and treated overseas. From the data available it is unclear whether these cases are genuine relapse or reinfection. However it is of concern that isolates from these previously treated cases 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 diagnosed in 2012, 87.6% were reported to have completed treatment, a similar proportion to Canada (86% of cases diagnosed in 2011) and the United Kingdom (86.8% of cases diagnosed in 2012), but lower than the 96% reported by Australia for cases diagnosed in 2009 [8, 11, 12]. The proportion of cases diagnosed in 2012 reported to have died in New Zealand (2.4%) is lower than the 4.5% recorded in the United Kingdom for cases diagnosed in 2012 but higher than the 1.3% reported by Australia for cases diagnosed in 2009 [11, 12]. However all three countries report problems with the quality of the follow up data with about 5% of cases lost to follow up for a similar variety of reasons [8, 11, 12].

Drug susceptibilities and MDR-TB

Over the last 10 years (2004-2013), there has been a significant trend of decreasing pyrazinamide resistance, but no significant changes in resistance to isoniazid, rifampicin, ethambutol or streptomycin. However, the apparent decrease in pyrazinamide resistance may be 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*).

The proportion of cases (both new disease and relapses/reactivations) with MDR-TB in 2013 (1.4%) 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 2013) and the United Kingdom (1.6% for 2011–2013), but lower than the 3.5% reported in Australia in 2010 [11-13].

Over the past 10 years, 94% of MDR-TB cases were born overseas, the majority in Asian countries, and the cases are assumed to have acquired their resistant organisms overseas. In the United Kingdom a high proportion (87.3%) of MDR-TB cases were also reported to be born overseas, but the most common

countries of birth for these cases were Somalia as well as Asian countries [11]. For the United States, the proportion of MDR-TB cases that occurred in foreign-born persons has increased from 30.8% (149 of 484) in 1993 to 89.5% (85 of 95) in 2013 [13]. There was a different pattern reported from Australia in 2010 with half of the MDR-TB cases reported as being born in the Papua New Guinea-Torres Strait region and the remainder in Asian countries [12].

From 2009–2013, 12.1% of New Zealand relapse/reactivation cases that had previously been treated for TB had MDR-TB, a much higher proportion than for cases with "new disease". This is also higher than the 4.0% of MDR-TB in previously treated cases reported from the United Kingdom in 2013 [11].

Transmission and control

Several indicators are used by Public Health England to assess transmission in low endemicity countries such as the UK and New Zealand. For recent transmission the indicator used is the rate of TB in children born within the country and, for ongoing transmission within a community, the indicator used is the child (<15 years) to adult (>15 years) ratio [10]. The 2013 rate in New Zealand-born children <5 years of age was 1.6 per 100 000, a decline from 3.6 in 2009, with an average of 2.2 per 100 000 over the past five years. The 2013 New Zealand child-to-adult ratio (<15 years to 15+ years) for notification rates was 0.16 in 2013 and this ratio has shown a sustained decline over the last five years.

The decreased proportion of new TB cases reporting contact with a confirmed case between 2009 (30.9%) and 2013 (22.1%) may be due to lower rates of transmission of disease within New Zealand but is also likely to be affected by the increased proportion of cases born overseas who acquired their infection in a high endemicity country prior to arrival in New Zealand.

Both of these indicators suggest decreasing 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. As the majority of these cases occur in settled migrants from high endemicity countries, rather than on entry of new migrants, repeat screening sometime after entry could be considered for this group, along with a reminder for increased vigilance by clinicians.

REFERENCES

REFERENCES

1. WHO. 2013. *Global tuberculosis report 2013.* Geneva: World Health Organization.
2. Lim E, Heffernan H. 2013. *Tuberculosis in New Zealand: Annual Report 2012.* Porirua: Insitute of Environmental Science and Research Ltd (ESR).
3. Baker MG, Barnard LT, Kvalsvig A, et al. 2012. Increasing incidence of serious infectious diseases and inequalities in New Zealand: a national epidemiological study. *The Lancet* 379(9821): 1112-1119.
4. Ministry of Health. 2012. *Communicable Disease Control Manual 2012.* Wellington: Ministry of Health.
5. Salmond C, Crampton P, Atkinson J. 2007. *NZDep2006 Index of Deprivation.* Wellington: University of Otago.
6. Ministry of Health. 2014. *Immunisation Handbook 2014.* Wellington: Ministry of Health.
7. NNDSS. 2012. *Notification Rates of Tuberculosis 2012.* Department of Health.
8. Public Health Agency of Canada. 2013. *Tuberculosis in Canada 2012 - Pre-Release.* Ottawa: Public Health Agency of Canada.
9. CDC. 2013. *TB incidence in United States 1995-2012.* Atlanta: Centers for Disease Control.
10. Public Health England. 2013. *Tuberculosis in the UK: 2013 report.* London: Public Health England.
11. Public Health England. 2014. *Tuberculosis in the UK 2014 report.* London: Public Health England.
12. Bareja C, Waring J, Stapledon R. 2014. Tuberculosis Notifications in Australia, 2010. *CDI* 38(1): E36-E48.
13. CDC. 2013. *Trends in Tuberculosis, 2013.* Atlanta: Centers for Disease Control.
14. CDC. 2013. *Reported Tuberculosis in the United States, 2013.* Atlanta.
15. Das D, Baker M, Calder L. 2006. Tuberculosis epidemiology in New Zealand: 1995-2004. *New Zealand Medical Journal* 119(1243).

APPENDIX

APPENDIX

Table 12. Number and rate of tuberculosis notifications (new cases) by age group, sex, ethnic group, District Health Board and year, 2009–2013

Category	2009		2010		2011		2012		2013	
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]
Age group (years)										
<5	12	3.9	3	-	8	2.5	4	-	5	1.6
5–14	9	1.5	10	1.7	11	1.9	8	1.4	5	0.9
15–39	129	8.7	142	9.5	141	9.4	142	9.5	130	8.6
40–59	83	7.1	72	6.1	71	6	56	4.7	67	5.6
60+	56	7.2	66	8.3	70	8.5	69	8.1	57	6.5
Sex										
Male	145	6.8	147	6.9	153	7.1	147	6.7	140	6.4
Female	144	6.6	146	6.6	148	6.6	132	5.9	124	5.5
Ethnic group[b]										
Māori	49	7.5	31	4.7	39	5.9	36	5.4	26	3.9
Pacific Peoples	32	11.8	45	16.5	47	17.1	33	12	40	14.5
Asian	154	30.8	174	34.4	162	31.9	168	32.9	156	30.3
MELAA	11	22.4	11	22.2	15	30.2	12	24.1	14	28
European or Other	39	1.4	27	0.9	30	1	26	0.9	24	0.8
Unknown	4	-	5	-	8	-	4	-	4	-
District Health Board										
Northland	7	4.5	6	3.8	6	3.8	3	-	1	-
Waitemata	46	8.7	33	6.1	33	6	40	7.2	21	3.7
Auckland	63	14.2	62	13.8	79	17.3	53	11.5	53	11.3
Counties Manukau	66	13.7	61	12.4	51	10.2	45	8.9	54	10.5
Waikato	12	3.3	20	5.5	18	4.9	22	5.9	23	6.2
Lakes	6	5.9	3	-	2	-	2	-	6	5.8
Bay of Plenty	12	5.8	4	-	14	6.6	9	4.2	10	4.7
Tairawhiti	6	13.0	3	-	3	-	2	-	2	-
Taranaki	0	-	1	-	1	-	4	-	6	5.4
Hawke's Bay	9	5.8	10	6.4	17	10.9	19	12.2	6	3.9
Whanganui	0	-	2	-	1	-	1	-	1	-
MidCentral	5	3.0	9	5.4	11	6.5	6	3.5	6	3.5
Hutt Valley	10	7.0	12	8.3	9	6.2	10	6.9	7	4.9
Capital & Coast	16	5.6	28	9.6	36	12.2	22	7.4	34	11.3
Wairarapa	0	-	1	-	0	-	0	-	2	-
Nelson Marlborough	3	-	5	3.6	4	-	14	10.0	4	-
West Coast	2	-	1	-	0	-	1	-	1	-
Canterbury	21	4.2	23	4.5	12	2.4	17	3.4	22	4.3
South Canterbury	2	-	0	-	0	-	1	-	0	-
Southern	3	-	9	3.0	4	-	8	2.6	5	1.6
Total	**289**	**6.7**	**293**	**6.7**	**301**	**6.8**	**279**	**6.3**	**264**	**5.9**

[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 2006 census population applied to the 2012 mid-year population estimates published by Statistics New Zealand. 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 notifications (new cases) with extra-pulmonary involvement by year, 2009–2013

Site of infection	2009		2010		2011		2012		2013	
	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
Lymph node (excl. abdominal)	48	34.3	75	46.9	65	44.2	54	35.3	69	41.1
Pleural	19	13.6	25	15.6	18	12.2	30	19.6	23	13.7
Intra-abdominal (excl. renal)	22	15.7	21	13.1	26	17.7	18	11.8	7	4.2
Bone/joint	19	13.6	16	10.0	16	10.9	14	9.2	12	7.1
Renal/genitourinary tract	10	7.1	5	3.1	5	3.4	15	9.8	5	3.0
Soft tissue/skin	9	6.4	6	3.8	7	4.8	8	5.2	7	4.2
Miliary tuberculosis	6	4.3	3	1.9	2	1.4	5	3.3	7	4.2
Tuberculous meningitis	3	2.1	8	5.0	6	4.1	1	0.7	5	3.0
Other	14	10.0	11	6.9	14	9.5	17	11.1	55	32.7
Total	**140**	100	**160**	100	**147**	100	**153**	100	**168**	100

Note: Total number of new tuberculosis cases reported with extra-pulmonary involvement, including cases with pulmonary disease. Some cases had more than one site of infection recorded.