TUBERCULOSIS IN NEW ZEALAND
ANNUAL REPORT 2008

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ANNUAL REPORT 2008

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SUMMARY

In 2008, there were 763 notifications of tuberculosis (TB), comprising 297 cases of TB disease (new and relapse/reactivation cases) and 466 cases of TB infection (treatment of latent infection and old disease on preventive treatment).

Annual TB disease notification rates have more than halved since 1980 and continue to trend downwards with the 2008 notification rate (7.0 per 100 000 population).

Disease notification rates in 2008 were highest in those aged over 70 years (11.6 per 100 000 population, 43 cases) but the highest number of cases were reported in the 20 to 29 and 30 to 39 years age groups (59 cases each).

The highest rate of TB disease occurred in the Asian ethnic group (42.8 per 100 000 population), followed by "Other" ethnicity (32.5 per 100 000 population). Case numbers were greatest in the Asian ethnic group (146 cases), followed by Pacific Peoples (52 cases).

More than half of the disease notifications (161 cases, 54.2%) were reported by the three District Health Boards (DHBs) in the Auckland region. After Auckland DHB at 12.3 per 100 000 population, Counties Manukau and Hutt Valley DHBs had the next highest TB disease notification rates (12.0 per 100 000 population each).

TB disease notifications were skewed towards those living in more socio-economic deprived areas with over 60% (179/297) of cases assigned to the four most deprived New Zealand Social Deprivation Index (NZDep06) deciles.

Being born overseas (213/295, 72.2%) and current or recent residence with a person born outside of New Zealand (181/256, 70.7%) were the most commonly reported risk factors amongst the cases. Sixty nine cases (30.5%) had prior contact with a confirmed TB case.

Based on country of birth, the highest rate occurred in those born in Asia (56.5 per 100 000 population, 142 cases) followed by Sub-Saharan Africa (28.8 per 100 000 population, 17 cases) and the Pacific Islands (28.7 per 100 000 population, 39 cases).

For 51% of the overseas-born cases (85/167) TB disease was reported less than five years after arriving in New Zealand.

Over three quarters (241/297, 81.1%) of the TB disease notifications in 2008 were culture positive, of which 233 (96.7%) were due to *Mycobacterium tuberculosis* and eight (3.3%) were due to *M. bovis*.

More than two thirds of the cases had pulmonary disease (200/287, 69.7%). Among those with extra-pulmonary disease this was most commonly in a lymph node (excluding abdominal) (55 cases, 42.0%), followed by "other" sites (includes TB of skin) (27 cases, 20.6%).

Almost 60% of cases were hospitalised (172/288), and the mortality rate was 4.9% (14/285). Eight cases (2.7%) were co-infected with TB and HIV.

Four TB outbreaks were reported during 2008 the largest of which involved five confirmed cases within an extended family.

The median interval between symptom onset in cases and starting treatment was five months, with 40.7% of cases (72/177) commencing treatment within one month of symptom onset.

Based on 2007 TB disease notification data, 86.4% (242/283) completed their treatment course, 24 cases (8.6%) went overseas, 13 cases (4.6%) died before completion of treatment, two cases (0.7%) stopped treatment because of adverse effects, two (0.7%) refused to complete treatment and two (0.7%) were lost to follow up. Thirty-seven percent of the 2007 cases (100/274) received directly observed therapy throughout the course of their treatment.

Over the five year period 2004 to 2008, there were 1148 *M. tuberculosis* cases that had a TB molecular typing result of which 414 (36.1%) were non-unique. These 414 cases were associated with 147 molecular types. Cases with non-unique molecular types were significantly ($p \leq 0.05$) more likely to be aged less than one year, 1 to 4 years, 10 to 14 years, or 15 to 19 years; to be of Maori or Pacific ethnicity; and to reside in Northland, Counties Manukau or Hawke's Bay DHBs. Such cases were also significantly more likely to have the following risk factors or clinical features: contact with a confirmed case of TB; born in New Zealand or a Pacific Island country; and pulmonary TB disease.

During the ten year period 1999 to 2008, there has been no significant change in resistance to the five routinely tested antimicrobials used to treat TB. In 2008, rates of resistance were relatively low and there were no cases of multidrug-resistant TB (MDR-TB). A total of 18 MDR-TB cases have been identified since 1999, and all but two are assumed to have acquired their MDR-TB overseas. No cases of extensively drug resistant TB (XDR-TB) have ever been identified in New Zealand.

1. INTRODUCTION

Worldwide, tuberculosis (TB) is one of the most common causes of death from communicable disease. Infection is usually curable with a combination of specific antibiotics but relies upon full compliance. The annual incidence rate of TB disease in New Zealand was approximately seven cases per 100 000 population in 2007. Based on the 2007 statistics reported by the World Health Organization, this incidence rate is higher than the United States (4 per 100 000 population), Canada (5 per 100 000 population) and Australia (6 per 100 000 population), but lower than the United Kingdom (15 per 100 000 population) (1).

1.1. Purpose

The purpose of this report is to summarise the descriptive epidemiology of TB notifications (disease and latent infections) in New Zealand for 2008 and examine trends from 2004 to 2008. This report includes TB drug susceptibility data, TB molecular typing data and may be used to monitor TB policy. The primary audience of this report is New Zealand TB practitioners including Medical Officers of Health, and Respiratory and Infectious Disease Physicians.

2. METHODS

2.1. Data sources

This report is based on an analysis of TB notification data reported in EpiSurv, the national notifiable diseases database; TB drug susceptibility and mycobacterial species identification data reported to the Institute of Environmental Science and Research (ESR) by the Mycobacteriology Reference Laboratories at LabPlus, Wellington Hospital and Waikato Hospital; and TB molecular typing data reported to ESR by LabPlus.

2.1.1. TB notification data

EpiSurv is the national notifiable diseases database managed by ESR on behalf of the Ministry of Health. Clinicians are required to notify all cases of TB disease and infection to their local Medical Officer of Health under the Tuberculosis Act 1948.

Once a Public Health Service (PHS) receives a notification, a staff member enters details of the case into EpiSurv using the TB Case Report Form. This case report form includes information such as the type of TB, demographic details, clinical details, laboratory results, risk factors and case management.

TB cases are reported in one of the following categories:

- Tuberculosis disease – new case
  Active TB in a person who has never been treated for TB before.

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

- Tuberculosis – treatment of latent infection
  A person with all of the following: positive Mantoux test or Mantoux conversion; no evidence of active disease; and placed on chemoprophylaxis with one or more drugs.

- Tuberculosis infection – old disease on preventive treatment
  A person on anti-tuberculosis treatment with multiple drugs in whom active disease is suspected but remains unproven or reactivation is likely to occur.

For TB disease cases (new cases or relapse/reactivations) the following status definitions apply:

- Confirmed – (with laboratory confirmation)
  A case that is laboratory confirmed by one of the following: positive culture for M. tuberculosis or M. bovis; positive microscopic examination for acid-fast bacilli when a culture has not been or cannot be obtained; demonstration of M. tuberculosis nucleic acid in specimens; or histology strongly suggestive of TB.

- Probable – presumptive (without laboratory confirmation)
  There is no laboratory confirmation but (a) there are symptoms or signs compatible with active TB, such as compatible radiology or clinical evidence of current disease, AND (b) full anti-tuberculous treatment had been started by a clinician.

- Under investigation
  A case which had been notified, but information is not yet available to classify it as confirmed.

2.1.2. TB species and drug susceptibility data

Antimicrobial susceptibility testing of *Mycobacterium tuberculosis* and *M. bovis* isolates is undertaken in the three Mycobacteriology Reference Laboratories at LabPlus (Auckland City Hospital), Wellington Hospital, and Waikato Hospital. These laboratories use the BACTEC® 460 radiometric method or the BACTEC® MGIT 960 method of susceptibility testing. Susceptibility to isoniazid (at concentrations of 0.1 and 0.4 mg/L), rifampicin, ethambutol, pyrazinamide and streptomycin is routinely tested. Susceptibility to second-line antimicrobials is determined for all multidrug-resistant isolates (MDR-TB). The susceptibility results and species identification are sent to ESR and integrated with tuberculosis disease case notifications recorded in EpiSurv.

2.1.3. TB molecular typing data

The national TB molecular typing database is maintained by LabPlus who undertakes all of the human TB molecular typing work in New Zealand. Isolates are primarily typed by restriction fragment length polymorphism (RFLP). For those isolates with less than or equal to six bands on RFLP, secondary typing is undertaken using mycobacterial interspersed repetitive units (MIRU) analysis. Tuberculosis molecular typing data from LabPlus is routinely reported to ESR and is periodically integrated with TB disease case notifications recorded within EpiSurv.

2.1.4. TB/HIV co-infection data

This information is sourced from the AIDS Epidemiology Group at Otago University.

2.2. Analytical methods

This report includes all notifications of TB reported in New Zealand from 1 January 2008 to 31 December 2008. This dataset includes all notifications and status categories of 'TB disease - new cases', 'TB disease - relapse or reactivation', 'TB - treatment of latent infection' and 'TB infection - old disease on preventive treatment'. In this report notifications of 'TB disease – new cases' and 'TB disease – relapse or reactivations' are referred to as TB disease and 'TB - treatment of latent infection' and 'TB infection - old disease on preventive treatment' are referred to as TB infections.

Due to the length of time taken for treatment of TB disease to be completed, 2007 notification data is used for the sections on use of directly observed treatment and treatment outcomes. The notification data was extracted from EpiSurv on 29 July 2009 therefore any changes to EpiSurv data by PHS staff after this date will not be reflected in this report.

All disease rates have been calculated using 2008 mid-year population estimates from Statistics New Zealand except where otherwise noted in the text. In particular, disease rates for ethnic groups are based on 2006 Census data from Statistics New Zealand. Rates are not calculated where there are fewer than five notified cases in any category. Calculating rates from fewer than five cases produces unstable rates for comparisons.

Birth country regions are based on the country of birth and grouped into regions according to the Statistics New Zealand standard.

Socio-economic deprivation is based on the 2006 New Zealand Deprivation Index (NZDep2006). NZDep2006 combines nine variables from the 2006 Census which reflect eight dimensions of deprivation. NZDep2006 provides a deprivation score for each meshblock in New Zealand. Meshblocks are geographical units defined by Statistics New Zealand, containing a median of approximately 87 people in 2006. The NZDep2006 index of deprivation ordinal scale ranges from one to ten, where one represents the areas with the least deprived scores and ten the areas with the most deprived scores (2).

For the TB molecular typing section the dataset is limited to cases of TB disease due to *M. tuberculosis*.

3. RESULTS

3.1. Overall TB notifications

During 2008, there were a total of 763 notified cases of TB recorded in EpiSurv. Of these, 297 cases were TB disease (286 new cases and 11 relapse or reactivations of TB disease) and 466 cases were TB infection (453 treatment of latent infection and 13 on preventive treatment) (Table 1).

Table 1: TB notifications by status, 2008

Disease name	Status				
	Confirmed	Probable	Under investigation	Not applicable	**Total**
TB disease – new case	240	39	7	-	**286**
TB disease – relapse or reactivation	10	1	0	-	**11**
TB – treatment of latent infection	-	-	-	453	**453**
TB infection – on preventive treatment	-	-	-	13	**13**
Total	**250**	**40**	**7**	**466**	**763**

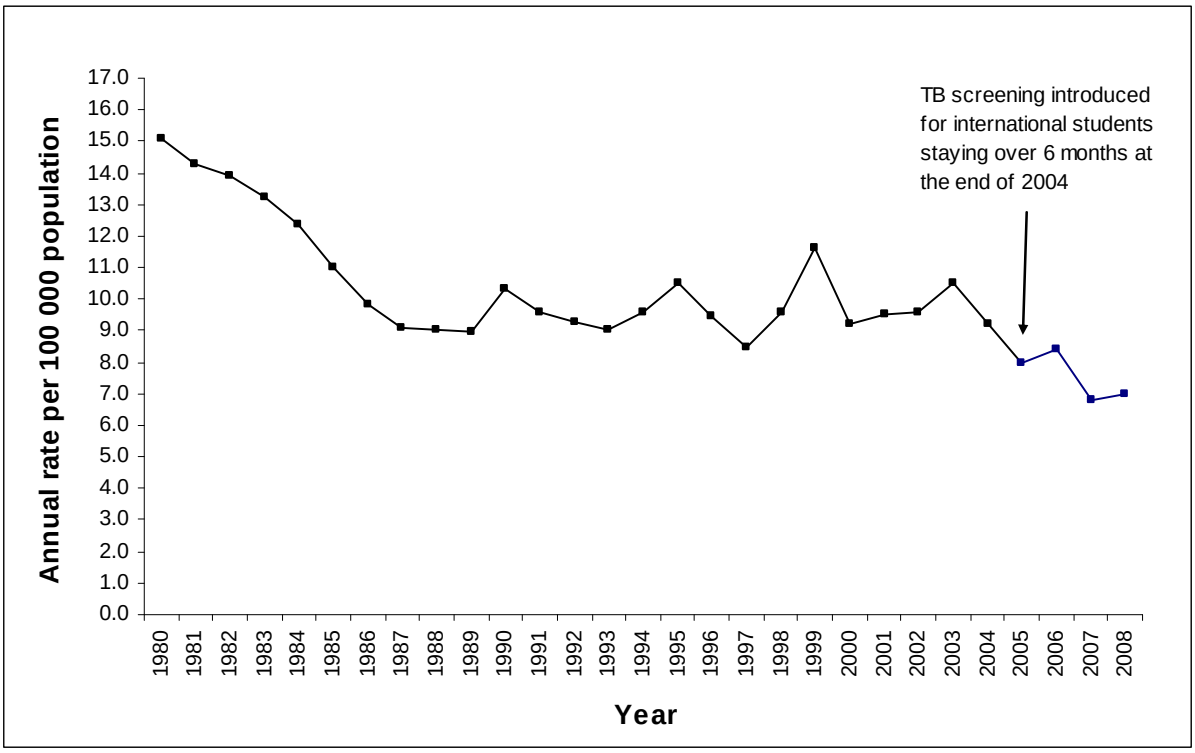
3.2. TB disease notifications

3.2.1. Trends

Long term trends (1980-2008)

The annual rate for TB disease notifications in New Zealand from 1980 to 2008 is shown in Figure 1. From 1980 to 2008 the annual notification rate per 100 000 population has decreased by 53.6% (15.1 in 1980 compared to 7.0 in 2008).

Figure 1: TB disease rate[1] by year, 1980 to 2008



[1] Rate per 100 000 population based on Census population data for (1980 to1990) and mid-year population estimate for each year (1991 to 2008)

Recent trends (2004-2008)

From 2004 to 2008, the annual number of notifications of TB disease decreased by 20.8% (375 in 2004 compared to 297 in 2008). The annual rate per 100 000 population decreased by 23.9% (9.2 in 2004 compared to 7.0 in 2008) with a five year average rate of 7.8 per 100 000 population (Table 2).

More detailed trend data, including rates by age group, sex, ethnicity and geographic area are presented in the Appendix.

Table 2: TB disease notifications by status and year, 2004 to 2008

Year	Status				Total	Rate[1]
	Confirmed	Probable	Under investigation	Unknown		
2004	283	72	11	9	375	9.2
2005	267	59	2	2	330	8.0
2006	274	75	2	-	351	8.4
2007	230	48	5	-	283	6.7
2008	250	40	7	-	297	7.0
Total	**1304**	**294**	**27**	**11**	**1636**	**7.8**

[1] Rate per 100 000 population based on the mid-year population estimate for each year

3.2.2. Demographic information

In 2008, the annual notification rate of TB disease differed by age group, and sex (Table 3). The TB disease rate for males was higher than for females (7.6 per 100 000 population compared to 6.3 per 100 000 population, respectively).

The highest age specific rate was reported in the over 70 years age group (11.6 per 100 000 population, 43 cases), followed by the 60 to 69 years (10.6 per 100 000 population, 40 cases), the 20 to 29 years (10.4 per 100 000 population, 59 cases) and the 30 to 39 years age groups (10.1 per 100 000 population, 59 cases). Overall for individuals aged less than 15 years the TB disease notification rate was 1.8 per 100 000.

The highest age specific rate for males was reported in the over 70 years age group (17.3 per 100 000 population, 28 cases), whereas for females it was the 20 to 29 years age group (12.2 per 100 000 population, 35 cases).

Table 3: TB disease notifications by age group and sex, 2008

Age group (years)	Male		Female		Total	
	No.	Rate[1]	No.	Rate[1]	No.	Rate[1]
<1	0	-	1	-	1	-
1 to 4	1	-	2	-	3	-
5 to 9	4	-	2	-	6	2.1
10 to 14	3	-	3	-	6	2.0
15 to 19	7	4.2	8	5.1	15	4.7
20 to 29	24	8.5	35	12.2	59	10.4
30 to 39	31	11.1	28	9.2	59	10.1
40 to 49	15	4.9	14	4.3	29	4.6
50 to 59	23	9.0	13	4.9	36	6.9
60 to 69	24	13.0	16	8.3	40	10.6
70+	28	17.3	15	7.1	43	11.6
Total	**160**	**7.6**	**137**	**6.3**	**297**	**7.0**

[1] Rate per 100 000 population

The highest rate of TB disease occurred in the Asian ethnic group (42.8 per 100 000 population, 146 cases) followed by "Other" (32.5 per 100 000 population, 11 cases), Pacific Peoples (23.0 per 100 000 population, 52 cases), Maori (8.3 per 100 000 population, 47 cases) and European (1.2 per 100 000 population, 32 cases). Table 4 shows the age group and ethnicity distribution of TB cases in 2008.

Table 4: TB disease notifications by age group and ethnicity[1], 2008

Age group	Maori		Pacific Peoples		Asian		Other		European		Unknown		Total	
(years)	No.	Rate[2]	No.	Rate[2]	No.	Rate[2]	No.	Rate[2]	No.	Rate[2]	No.	Rate[2]	No.	Rate[2]
<1	0	-	0	-	0	-	0	-	0	-	1	-	1	-
1 to 4	1	-	2	-	0	-	0	-	0	-	0	-	3	-
5 to 9	1	-	3	-	2	-	0	-	0	-	0	-	6	2.1
10 to 14	2	-	2	-	1	-	1	-	0	-	0	-	6	2.0
15 to 19	5	8.5	3	-	3	-	2	-	1	-	1	-	15	5.0
20 to 29	5	6.2	3	-	42	55.4	3	-	5	1.7	1	-	59	11.5
30 to 39	9	11.5	9	26.7	33	59.6	3	-	1	-	4	-	59	10.2
40 to 49	3	-	2	-	20	36.6	1	-	3	-	0	-	29	4.8
50 to 59	4	-	11	64.5	16	53.5	1	-	4	-	0	-	36	7.4
60 to 69	8	34.8	10	103.1	18	119.6	0	-	4	-	0	-	40	12.2
70+	9	69.4	7	122.9	11	123.0	0	-	14	4.6	2	-	43	12.4
Total	**47**	**8.3**	**52**	**23.0**	**146**	**42.8**	**11**	**32.5**	**32**	**1.2**	**9**	**-**	**297**	**7.4**

[1] Ethnic groups were prioritised in the following order: Maori; Pacific Peoples; Asian; Other; European; Unknown
[2] Rate per 100 000 population based on the 2006 Census

3.2.3. Geographic information

Auckland District Health Board (DHB) had the highest TB disease rate (12.3 per 100 000 population, 54 cases) followed by Counties Manukau (12.0 per 100 000 population, 57 cases) and Hutt Valley DHBs (12.0 per 100 000 population, 17 cases) (Table 5).

Table 5: TB disease notifications and rates by DHB, 2008

District health board	Number of cases	Rate[1]
Northland	7	4.5
Waitemata	50	9.6
Auckland	54	12.3
Counties Manukau	57	12.0
Waikato	20	5.6
Lakes	4	-
Bay of Plenty	8	3.9
Tairawhiti	1	-
Taranaki	3	-
Hawke's Bay	5	3.3
Whanganui	3	-
Mid Central	7	4.2
Hutt Valley	17	12.0
Capital and Coast	25	8.8
Wairarapa	0	-
Nelson Marlborough	5	3.7
West Coast	0	-
Canterbury	28	5.6
South Canterbury	1	-
Otago	1	-
Southland	1	-
Total	**297**	**7.0**

[1] Rate per 100 000 population

3.2.4. Risk factor information

For the 297 TB disease notifications in 2008, data completion varied for each risk/protective factor. Table 6 shows TB disease notification for 2008 by risk/protective factors.

For those cases where information was recorded, 70.7% (181 cases) currently or recently resided with a person born overseas, 30.5% (68 cases) had contact with a confirmed case, 19.3% (53 cases) had an immunosuppressive illness, 7.7% (17 cases) were exposed in a healthcare setting, 4.5% (11 cases) currently or recently resided in an institution, and 4.4% (12 cases) were on immunosuppressive medication. Sixty six percent (109 cases) had been vaccinated with BCG.

Table 6: TB disease notifications risk and protective factors, 2008

Category	Yes		No	
	No.	%	No.	%
Contact with a confirmed case (n=223)	68	30.5%	155	69.5%
Exposure in a healthcare setting (n=220)	17	7.7%	203	92.3%
Current/recent residence in an institution (n=245)	11	4.5%	234	95.5%
Current/recent residence with person born outside NZ (n=256)	181	70.7%	75	29.3%
Has immunosuppressive illness (n=274)	53	19.3%	221	80.7%
On immunosuppressive medication (n=274)	12	4.4%	262	95.6%
Vaccinated with BCG (n=166)	109	65.7%	57	34.3%

Birth country

Of the 295 cases that had birth country information recorded, 72.2% (213 cases) were born outside of New Zealand. The highest rate was for those born in Asia (56.5 per 100 000 population, 142 cases) followed by Sub-Saharan Africa (28.8 per 100 000 population, 17 cases) and the Pacific Islands (28.7 per 100 000 population, 39 cases) (Table 7).

Table 7: TB disease notifications by birth country, 2008

Birth country region (n=293)	**Number of cases**	**Rate**[1]
Asia	142	56.5
Australia	3	-
New Zealand	82	2.8
North Africa & the Middle East	2	-
North America	2	-
North West Europe	5	1.7
Pacific Islands	39	28.7
South & Central America	1	-
Southern & Eastern Europe	0	-
Sub-Saharan Africa	17	28.8

[1] Rate per 100 000 based on Census 2006 birthplace for the usually resident population counts

Table 8 shows the number and percentage of TB disease cases born in New Zealand or overseas by ethnicity. Of the 297 TB disease notifications in 2008, information on country of birth was recorded for 99.3% (295 cases). Of these, 27.8% (82 cases) were born in New Zealand and 72.2% (213 cases) were born overseas. For cases born in New Zealand the largest proportion occurred among Maori (54.9%) followed by those of European (24.4%) ethnicity, and Pacific Peoples (18.3%). For cases born overseas the largest proportion occurred among those of Asian ethnicity (68.1%) followed by Pacific Peoples (17.4%).

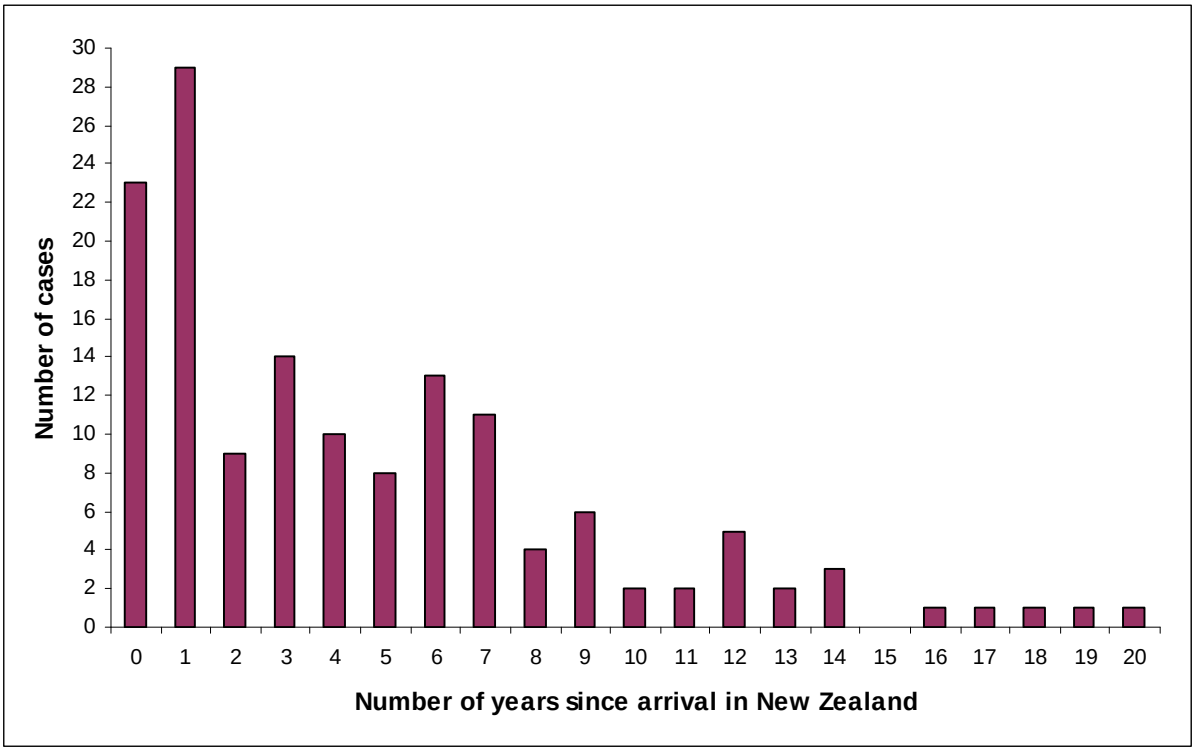
Table 8: New Zealand-born and overseas-born TB disease notifications by ethnicity, 2008

Ethnicity[1]	Born in New Zealand		Born overseas	
	No.	%	No.	%
Maori	45	54.9	1	0.5
Pacific Peoples	15	18.3	37	17.4
Asian	1	1.2	145	68.1
Other	0	-	11	5.2
European	20	24.4	12	5.6
Unknown	1	1.2	7	3.3
Total	**82**	**100**	**213**	**100.0**

[1] Ethnic groups were prioritised in the following order: Maori; Pacific Peoples; Asian; Other; European; Unknown

The date of arrival in New Zealand was recorded for 78.4% (167/213) of the overseas-born TB disease notifications in 2008. Of these, the interval between date of arrival in New Zealand and TB disease notification date ranged from 3 days to 56 years, with a median of four years. For 51 percent of overseas-born cases TB disease notification occurred less than five years after arriving in New Zealand. Figure 2 shows the distribution of the time intervals between the dates that overseas-born TB disease cases arrived in New Zealand and the date of their disease notification.

Figure 2: Overseas-born TB disease notifications by number of years since arrival in New Zealand[1], 2008



[1] Excludes 21 cases with TB disease notification >20 years after arrival in New Zealand and 46 cases where no information on arrival date was recorded

Over the five year period 2004 to 2008, the median interval between arrival in NZ and TB disease notification fluctuated between three and four years (Table 9). Over the same time period, the mean interval to notification initially declined from 8.4 years in 2004 to 6.1 years in 2005, but has since increased to a high of 8.5 years in 2008.

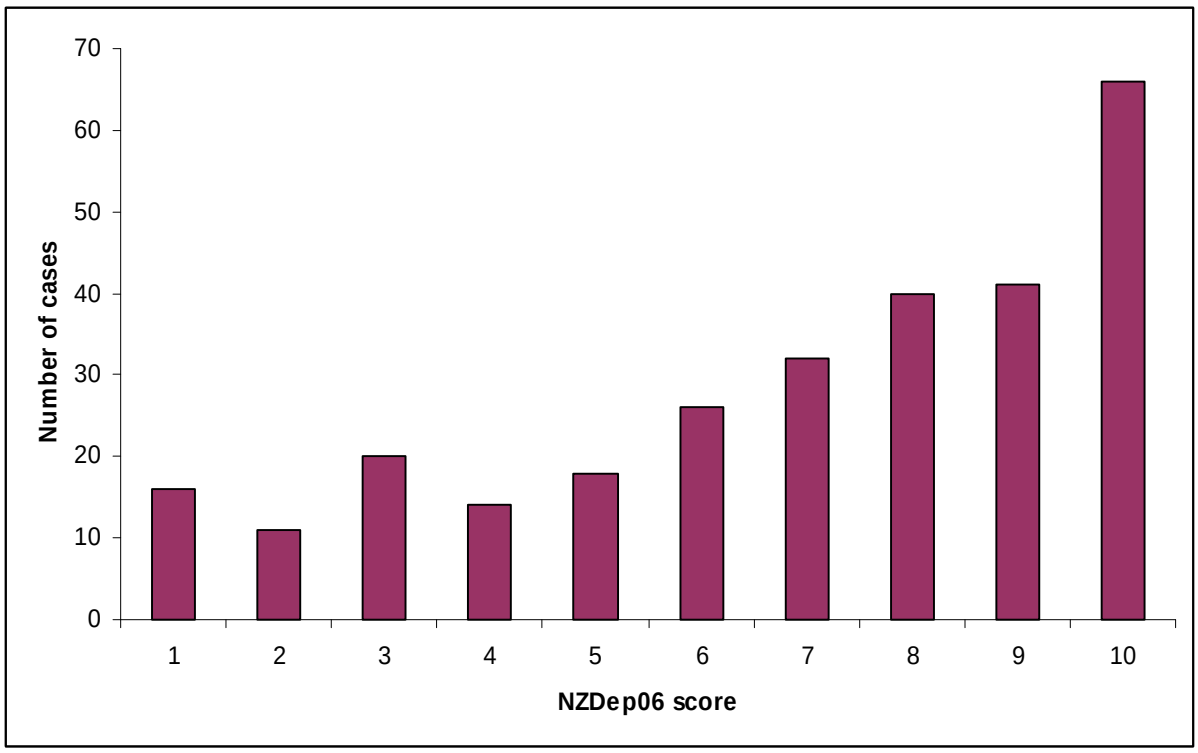
Table 9: Overseas-born TB disease notifications, mean and median time interval between arrival in NZ and TB disease notification, 2004 to 2008

Report Year	Mean interval (years)	Median interval (years)
2004	8.4	3
2005	6.1	4
2006	6.9	3
2007	6.9	4
2008	8.5	3
Total	**7.4**	**4**

3.2.5. Socio-economic deprivation

In 2008, 95.6% (284/297) of TB disease notifications had a residential address recorded that could be linked to NZDep06. Of these, the highest proportion 23.2% (66 cases) resided in NZDep06 decile 10 areas (most deprived areas), while the lowest proportion 3.9% (11 cases) resided in a NZDep06 2 areas (second least deprived areas). Over 60% of cases resided in an NZDep06 decile 7 or higher area. Figure 3 shows the distribution of TB disease notifications in 2008 by NZDep06 decile scale.

Figure 3: TB disease notifications by NZDep06 decile scale, 2008



3.2.6. Basis of discovery

Information on how the case was discovered was available for 98.3% (292/297) of TB disease notifications in 2008 (Table 10). Most commonly TB disease was discovered when the case attended a practitioner with symptoms (70.7% of cases). Immigrant or refugee screening was the basis of discovery for 12.5% of cases, and only 5.7% of cases were identified through contact follow-up.

Table 10: TB disease notifications by basis of discovery, 2008

Basis of discovery	No.	%
Contact follow-up	17	5.7
Immigrant/refugee screening	37	12.5
Attended practitioner with symptoms	210	70.7
Other	28	9.4
Unknown	5	1.7

3.2.7. Basis of diagnosis

Table 11 shows the basis of diagnosis for the 297 TB disease notifications recorded in 2008. Isolation of *M. tuberculosis or M. bovis* from a clinical specimen was recorded as the basis of diagnosis for 76.8% of the cases. Note that a case may have more than one basis of diagnosis recorded.

Table 11: TB disease notifications by basis of diagnosis, 2008

Basis of diagnosis[1]	No.	%
Demonstration of acid-fast bacilli in a clinical specimen	132	44.4
Isolation of *M. tuberculosis or M. bovis* from a clinical specimen	228	76.8
Demonstration of *M. tuberculosis* nucleic acid (PCR of LCR only)	38	12.8
Histology strongly suggestive of tuberculosis	62	20.9

[1] A case may have more than one basis of diagnosis recorded

3.2.8. Mycobacterium species

Based on the antimicrobial susceptibility data received from the three mycobacteriology reference laboratories and molecular typing data from LabPlus, 241 (81.1%) of the 297 TB disease notifications in 2008 were culture positive. Note: this figure of 241 differs from the 228 cases that were reported, at the time of notification, to be diagnosed on the basis of isolation of *M. tuberculosis or M. bovis* (Table 11). Among the 241 culture-positive cases, 233 (96.7%) were due to *M. tuberculosis*, and eight cases (3.3%) were due to *M. bovis.*

3.2.9. Site of infection

Site of infection was recorded for 99.0% (294/297) of TB disease notifications in 2008. Of these, 163 (55.4%) cases were pulmonary only, 37 (12.6%) cases were both pulmonary and extra-pulmonary and 94 (32.0%) cases were extra-pulmonary only. Table 12 shows the distribution of disease sites among the 131 cases with extra-pulmonary TB. Of the four cases with either tuberculous meningitis or miliary tuberculosis, none were aged less than 15 years.

Table 12: Extra-pulmonary TB disease notifications by site of infection, 2008

Site[1] of extra-pulmonary TB	No.	%
Node (excluding abdominal)	55	42.0
Intra-abdominal (excluding renal)	10	7.6
Pleural	24	18.3
Bone/joint	13	9.9
Renal/urinary tract	8	6.1
Tuberculous meningitis	2	1.5
Miliary tuberculosis	2	1.5
Other[2]	27	20.6
Not stated	0	-

[1] A case may have more than one site recorded
[2] Other includes TB of skin

3.2.10. Pulmonary cases

In 2008, 200 (69.7%) cases had pulmonary disease. Of these, 91.0% (182/200) of pulmonary TB disease notifications had information recorded regarding the demonstration of acid-fast bacilli in a clinical specimen. A total of 107 (58.8%) were smear positive i.e. demonstrated acid-fast bacilli in a clinical specimen. Of these, 88 (82.2%) were from sputum specimens.

3.2.11. Hospitalisations

Hospitalisation status was known for 97.0% (288/297) of TB disease notifications in 2008. Of these, 172 (59.7%) cases were hospitalised.

3.2.12. Mortality

Mortality status was known for 96.0% (285/297) of TB disease notifications in 2008. Of these, 14 deaths were reported giving a mortality rate of 4.9%.

3.2.13. Outbreaks

Of the 297 TB disease notifications in 2008, 15 (5.1.%) were linked to outbreaks of TB disease recorded in EpiSurv. There were four TB outbreaks reported in 2008 involving a total of 13 cases, all were outbreaks of *M. tuberculosis.* The largest outbreak occurred in Porirua and included five confirmed cases. The mode of transmission was person-to-person spread within an extended family. One case in the outbreak died; however, *M. tuberculosis* was not the primary cause of death.

3.2.14. Delay to treatment

The interval between onset of symptoms and commencement of treatment could be calculated for 177 (59.6%) of the 297 TB disease notifications in 2008. Of these, 72 (40.7%) cases started treatment within one month of the onset of symptoms. An additional 54 (30.5%) cases started treatment between one and three months. The median interval to start of treatment was five months.

3.2.15. Use of directly observed therapy

Of the 283 TB disease notifications in 2007, information on the use of directly observed therapy (DOT) was known for 274 (96.8%) cases. Of these, 100 (36.5%) received DOT throughout the course of treatment.

3.2.16. Treatment outcomes

Of the 283 TB disease notifications in 2007, treatment outcome information was recorded for 280 (98.9%) cases. Of these, 242 (86.4%) completed treatment to the satisfaction of the prescribing doctor, 24 (8.6%) went overseas, 13 (4.6%) died before completion of treatment, two (0.7%) refused to complete treatment, two (0.7%) stopped treatment because of adverse effects and two (0.7%) were lost for follow-up.

3.3. TB molecular typing

Of the 297 TB disease notifications in 2008, 240 (80.8%) had TB molecular typing results. Of the 97.1% (233/240) of cases due to *M. tuberculosis*, 42.1% (98/233) had a non-unique molecular type. These cases were associated with 54 separate molecular types. The remaining 57.9% (135/233) of cases had a unique molecular type.

Table 13 and Table 14 compare the demographic, risk and protective factors, and clinical presentation between cases with non-unique and unique molecular types for the period 2004 to 2008. This analysis is based on the proportions. Therefore, it is important to also refer to the actual number of cases reported in the tables when interpreting these results. Over the five year period, there were 1148 *M. tuberculosis* cases that had a TB molecular typing result of which 414 (36.1%) were non-unique. These 414 cases were associated with 147 molecular types.

Cases with non-unique molecular types were significantly ($p \leq 0.05$) more likely to be aged less than one year, 1 to 4 years, 10 to 14 years or 15 to 19 years; to be of Maori or Pacific ethnicity; and to reside in Northland, Counties Manukau or Hawke's Bay DHBs. Such cases were also significantly more likely to have the following risk factors and clinical features: contact with a confirmed case of TB; born in New Zealand or a Pacific Island country; and pulmonary TB disease.

In contrast, cases with unique molecular types were significantly ($p \leq 0.05$) more likely to be aged 70 years and over, to be of Asian ethnicity, and to reside in Auckland DHB. These cases were also significantly more likely to have the following risk factors: born outside New Zealand; born in Asia, or Southern and Central America; and current or recent residence with a person born outside New Zealand.

Table 13: Comparison of demographic factors of TB disease cases with unique and non-unique molecular types, 2004 to 2008

Category	Sub-category	Molecular type				χ^2	*p*-value
		Non-unique (n=474)		Unique (n=735)			
		No.	%	No.	%		
Age (years)	<1	4	1.0	0	0.0	7.1	0.008
	1 to 4	3	0.7	0	0.0	5.3	0.021
	5 to 9	2	0.5	4	0.5	0.0	0.890
	10 to 14	19	4.6	3	0.4	24.7	0.000
	15 to 19	35	8.5	29	3.9	10.2	0.001
	20 to 29	101	24.4	182	24.8	0.0	0.890
	30 to 39	75	18.1	165	22.4	3.0	0.083
	40 to 49	49	11.8	85	11.6	0.0	0.891
	50 to 59	47	11.4	78	10.6	0.1	0.699
	60 to 69	41	9.9	82	11.2	0.4	0.510
	70+	38	9.2	107	14.6	6.9	0.008
Sex	Male	209	50.5	357	48.6	0.4	0.534
	Female	204	49.3	373	50.7	0.2	0.632
	Unknown	1	0.2	5	0.7	1.0	0.322
Ethnicity (prioritised)[1]	Maori	115	27.8	50	6.8	94.7	0.000
	Pacific Peoples	97	23.4	72	9.8	39.2	0.000
	Asian	123	29.7	456	62.0	110.7	0.000
	Other	20	4.8	55	7.5	3.1	0.081
	European	42	10.1	72	9.8	0.0	0.849
	Unknown	17	4.1	30	4.1	0.0	0.984
District Health Board	Northland	14	3.4	9	1.2	6.3	0.012
	Waitemata	55	13.3	121	16.5	2.1	0.151
	Auckland	61	14.7	187	25.4	17.9	0.000
	Counties Manukau	103	24.9	142	19.3	4.9	0.027
	Waikato	18	4.3	30	4.1	0.0	0.829
	Lakes	3	0.7	7	1.0	0.2	0.690
	Bay of Plenty	7	1.7	17	2.3	0.5	0.479
	Tairawhiti	1	0.2	2	0.3	0.0	0.922
	Taranaki	7	1.7	6	0.8	1.8	0.178
	Hawke's Bay	24	5.8	13	1.8	13.8	0.000
	Whanganui	6	1.4	3	0.4	3.7	0.055
	MidCentral	17	4.1	21	2.9	1.3	0.256
	Hutt	16	3.9	22	3.0	0.6	0.428
	Capital and Coast	34	8.2	64	8.7	0.1	0.773
	Wairarapa	1	0.2	5	0.7	1.0	0.322
	Nelson Marlborough	1	0.2	2	0.3	0.0	0.922
	West Coast	3	0.7	7	1.0	0.2	0.690
	Canterbury	41	9.9	64	8.7	0.5	0.499
	South Canterbury	0	0.0	3	0.4	1.7	0.193
	Otago	2	0.5	8	1.1	1.1	0.289
	Southland	0	0.0	2	0.3	1.1	0.288

[1] Ethnic groups were prioritised in the following order: Maori; Pacific Peoples; Asian; Other; European; Unknown.

Table 14: Comparison of risk and protective factors, and clinical presentation of TB disease cases with unique and non-unique molecular types, 2004 to 2008

Category	Sub-category	Molecular type				χ^2	*p*-value
		Non-unique (n=414)		Unique (n=731)			
		No.	%	No.	%		
Contact with a confirmed case	Yes	131	31.6	102	13.9	51.7	0.000
	No	181	43.7	472	64.2	45.4	0.000
	Unknown	102	24.6	161	21.9	1.1	0.290
Exposure in a healthcare setting	Yes	20	4.8	53	7.2	2.5	0.112
	No	313	75.6	520	70.7	3.1	0.077
	Unknown	81	19.6	162	22.0	1.0	0.324
Born outside NZ	Yes	232	56.0	629	85.6	123.0	0.000
	No	167	40.3	98	13.3	108.8	0.000
	Unknown	15	3.6	8	1.1	8.7	0.003
Current or recent residence with person born outside NZ	Yes	218	52.7	507	69.0	30.3	0.000
	No	141	34.1	143	19.5	30.3	0.000
	Unknown	55	13.3	85	11.6	0.7	0.392
Birth country region	New Zealand	182	44.0	106	14.4	123.0	0.000
	Australia	3	0.7	3	0.4	0.5	0.475
	Pacific Island	77	18.6	64	8.7	24.1	0.000
	North Western Europe	3	0.7	16	2.2	3.4	0.064
	Southern & Eastern Europe	1	0.2	6	0.8	1.4	0.229
	North Africa & the Middle East	1	0.2	5	0.7	1.0	0.322
	South-East Asia	34	8.2	118	16.1	14.2	0.000
	North-East Asia	40	9.7	127	17.3	12.4	0.000
	Southern & Central Asia	45	10.9	212	28.8	49.3	0.000
	North America	0	0.0	1	0.1	0.6	0.453
	Southern & Central America	0	0.0	9	1.2	5.1	0.024
	Sub-Saharan Africa	27	6.5	66	9.0	2.2	0.143
	Unknown	1	0.2	2	0.3	0.0	0.922
Current or recent residence in an institution	Yes	18	4.3	18	2.4	3.1	0.076
	No	328	79.2	601	81.8	1.1	0.293
	Unknown	68	16.4	116	15.8	0.1	0.775
Has immunosuppressive illness	Yes	70	16.9	140	19.0	0.8	0.368
	No	313	75.6	560	76.2	0.0	0.823
	Unknown	31	7.5	35	4.8	3.6	0.057
On immunosuppressive medication	Yes	20	4.8	44	6.0	0.7	0.412
	No	359	86.7	646	87.9	0.3	0.563
	Unknown	35	8.5	45	6.1	2.2	0.136
Vaccinated with BCG	Yes	154	37.2	311	42.3	2.9	0.090
	No	72	17.4	97	13.2	3.7	0.054
	Unknown	188	45.4	327	44.5	0.1	0.763
Pulmonary disease	Yes	315	76.1	464	63.1	20.4	0.000
	No	91	22.0	244	33.2	16.1	0.000
	Unknown	8	1.9	27	3.7	2.7	0.099

3.4. TB and HIV/AIDS co-infection

Of the 297 TB disease notifications in 2008, HIV and TB co-infection was noted in eight (2.7%) cases.

3.5. TB drug susceptibility

Antimicrobial susceptibility data for the isolates from 241 culture-positive TB disease cases in 2008 was available. The proportion of isolates resistant to the five antimicrobials routinely tested is shown in Table 15. Overall, during the last 10 years, 1999 to 2008, there has been no significant change ($p \leq 0.05$) in resistance to any of these five antimicrobials.

Table 15: Resistance to each antimicrobial, by mycobacterial species, 2008

Antimicrobial	Resistant[1]					
	M. tuberculosis (n=233)		***M. bovis*** (n=8)		**All isolates** (n=241)	
	No.	**%**	**No.**	**%**	**No.**	**%**
Isoniazid (0.1mg/L)	10	4.3	0	-	10	4.2
Isoniazid (0.4mg/L)[2]	5	2.1	0	-	5	2.1
Rifampicin	1	0.4	0	-	1	0.4
Ethambutol	0	-	0	-	0	-
Pyrazinamide	1	0.4	8	100[3]	9	3.7
Streptomycin	9	3.9	0	-	9	3.7

[1] Includes resistance alone or in combination with other antimicrobials
[2] 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
[3] *M. bovis* is intrinsically resistant to pyrazinamide

In 2008, the majority (88.0%) of the isolates were susceptible to all five antimicrobials tested. There were no cases of multidrug-resistant TB (MDR-TB, resistance to at least isoniazid and rifampicin), and all resistant isolates were resistant to only one antimicrobial. MDR-TB remains relatively rare in New Zealand, with an average annual incidence among culture-positive TB disease cases of 0.7% and a total of 18 cases recorded during the last 10 years. All but two of these 18 MDR-TB cases were born overseas and assumed to have acquired their MDR-TB overseas.

Any MDR-TB isolates are now tested for susceptibility to an extended range of antibiotics. No cases of extensively drug-resistant TB (XDR-TB) have been identified in New Zealand. XDR-TB is MDR-TB with additional resistance to any fluoroquinolone and at least one of the following second-line drugs: capreomycin, kanamycin or amikacin.

A comparison of resistance among isolates from cases born in New Zealand and cases born overseas is presented in Table 16. While, except for pyrazinamide, resistance was higher among isolates from cases born overseas, none of the differences were significant ($p \leq 0.05$).

Table 16: Resistance by case's place of birth, 2008

Susceptibility	Born overseas (n=176)		Born in New Zealand (n=65)		*p*-value[1]
	No.	%	No.	%	
Fully susceptible	154	87.5	58	89.2	0.7140
Resistant to:[2]					
Isoniazid[3]	9	5.1	1	1.5	0.2952
Rifampicin	1	0.6	0	-	1.0000
Ethambutol	0	-	0	-	-
Pyrazinamide[4]	4	2.3	5	7.7	0.0623
Streptomycin	8	4.6	1	1.5	0.4509

[1] Rates compared by the Chi-square test or Fishers Exact test, as appropriate
[2] Includes resistance alone or in combination with other antimicrobials
[3] Isoniazid resistance at the standard concentration of 0.1 mg/L
[4] All 4 of the pyrazinamide-resistant isolates from overseas-born cases were *M. bovis* and 4 of the 5 pyrazinamide-resistant isolates from NZ-born cases were *M. bovis*

Resistance by ethnicity is shown in Table 17. Isoniazid and streptomycin resistance was highest among cases of Asian ethnicity. Ninety percent (9/10) of all isoniazid-resistant isolates, and 77.8% (7/9) of all streptomycin-resistant isolates, were from cases of Asian ethnicity.

Table 17: Resistance by case's ethnicity, 2008

Susceptibility	Maori (n=41)		Pacific Peoples (n=40)		Asian (n=119)		Other (n=9)		European (n=23)		Unknown (n=9)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Fully susceptible	39	95.1	37	92.5	103	86.6	8	88.9	17	73.9	8	88.9
Resistant to:[1]												
Isoniazid[2]	0	-	0	-	9	7.6	0	-	1	4.4	0	-
Rifampicin	0	-	0	-	0	-	0	-	0	-	1	11.1
Ethambutol	0	-	0	-	0	-	0	-	0	-	0	-
Pyrazinamide	1	2.4	3	7.5	0	-	0	-	5	21.7	0	-
Streptomycin	1	2.4	0	-	7	5.9	1	11.1	0	-	0	-

[1] Includes resistance alone or in combination with other antimicrobials
[2] Isoniazid resistance at the standard concentration of 0.1 mg/L

Eleven (4.6%) of the 241 culture-positive cases in 2008 were reported to be tuberculosis disease relapses or reactivations. This category of disease could also include cases of re-infection. As the number of cases notified as tuberculosis disease relapses/reactivations in any one year is small, the following analysis of relapses/reactivations covers the last five years, 2004 to 2008. During this period, 68 (5.3%) of the 1285 culture-positive tuberculosis cases were reported to be relapses/reactivations. Information on previous treatment was recorded for 55 of the 68 relapses/reactivations and of these, 46 (83.6%) were recorded as having received previous antituberculosis drug treatment.

Resistance among new cases of tuberculosis, cases reported to be relapses/reactivations, and cases that were reported to have been previously treated, is shown in Table 18. Compared with new cases, previously treated cases were significantly more resistant to isoniazid, rifampicin and ethambutol; more likely to be MDR-TB; and less likely to be fully susceptible to all five antimicrobials.

Table 18: Resistance among new cases, relapses/reactivations and previously treated[1] cases, 2004-2008

Susceptibility	New cases (n=1217)	Relapse/reactivation cases			
		All (n=68)		Previously treated (n=46)	
	%	%	*p*-value[2]	%	*p*-value[2]
Fully susceptible	86.0	75.0	0.0129	65.2	0.0001
Resistant to:[3]					
Isoniazid[4]	6.8	20.6	<0.0001	28.3	<0.0001
Rifampicin	0.3	11.8	<0.0001	17.4	<0.0001
Ethambutol	0.5	7.4	<0.0001	10.9	<0.0001
Pyrazinamide	3.2	7.4	0.0783	10.9	0.0193
Streptomycin	7.1	7.4	0.8103	10.9	0.3741
MDR-TB[5]	0.3	10.3	<0.0001	15.2	<0.0001

[1] Information on previous treatment reported for only 55 of the 68 relapse/reactivation cases
[2] Rate compared with that among new cases by the Chi-square test or Fishers Exact test, as appropriate
[3] Includes resistance alone or in combination with other antimicrobials
[4] Isoniazid resistance at the standard concentration of 0.1 mg/L
[5] Multidrug-resistant tuberculosis (i.e. resistant to at least isoniazid and rifampicin)

3.6. TB infection notifications

During 2008, there were a total of 466 cases of TB infection (453 treatment of latent infection and 13 on preventive treatment). The TB infection rate was highest in Hutt Valley DHB (24.7 per 100 000 population, 35 cases) followed by Auckland DHB (21.2 per 100 000 population, 93 cases) and Waitemata DHB (20.0 per 100 000 population, 104 cases) (Table 19).

Table 19: TB infections - cases and rates by DHB, 2008

District health board	Number of cases	Rate[1]
Northland	13	8.4
Waitemata	104	20.0
Auckland	93	21.2
Counties Manukau	76	16.1
Waikato	36	10.1
Lakes	1	-
Bay of Plenty	3	-
Tairawhiti	1	-
Taranaki	1	-
Hawke's Bay	9	5.9
Whanganui	0	-
Mid Central	9	5.5
Hutt Valley	35	24.7
Capital and Coast	47	16.5
Wairarapa	0	-
Nelson Marlborough	4	-
West Coast	0	-
Canterbury	34	6.9
South Canterbury	0	-
Otago	0	-
Southland	0	-
Total	**466**	**10.9**

[1] Rate per 100 000 population

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APPENDIX

TB disease notifications demographic and geographic factors, 2004-2008

Category	Sub-category	2004		2005		2006		2007		2008	
		No.	Rate[1]	No.	Rate[1]	No.	Rate[1]	No.	Rate[1]	No.	Rate[1]
Age group (years)	<1	1	-	2	-	3	-	3	-	1	-
	1 to 4	8	3.5	8	3.5	9	4.0	9	3.9	3	-
	5 to 9	9	3.1	6	2.1	4	-	7	2.4	6	2.1
	10 to 14	9	2.9	9	2.9	19	6.1	4	-	6	2.0
	15 to 19	17	5.7	17	5.6	20	6.4	20	6.3	15	4.7
	20 to 29	93	17.3	85	15.6	88	16.0	53	9.5	59	10.4
	30 to 39	76	12.6	61	10.1	58	9.7	51	8.6	59	10.1
	40 to 49	36	5.9	50	8.1	47	7.5	33	5.2	29	4.6
	50 to 59	42	8.8	30	6.1	33	6.5	29	5.7	36	6.9
	60 to 69	33	10.4	28	8.5	26	7.6	34	9.4	40	10.6
	70+	51	14.8	34	9.7	44	12.4	40	11.0	43	11.6
	Unknown	0	-	0	-	0	-	0	-	0	-
Sex	Male	187	9.3	170	8.4	177	8.6	134	6.5	160	7.6
	Female	185	8.9	160	7.6	170	8.0	149	6.9	137	6.3
	Unknown	3	-	0	-	4	-	0	-	0	-
Ethnicity (prioritised)[2,3]	Maori	74	13.1	46	8.1	62	11.0	48	8.5	47	8.3
	Pacific Peoples	63	27.8	48	21.2	48	21.2	27	11.9	52	23.0
	Asian	149	43.7	161	47.2	152	44.6	140	41.1	146	42.8
	Other	20	59.0	15	44.3	27	79.7	20	59.0	11	32.5
	European	40	1.5	39	1.4	50	1.9	38	1.4	32	1.2
	Unknown	29	-	21	-	12	-	10	-	9	-
District Health Board	Northland	5	3.3	18	11.9	30	19.7	15	9.7	7	4.5
	Waitemata	47	9.6	55	11.1	31	6.1	40	7.8	50	9.6
	Auckland	68	16.2	72	17.0	56	13.1	52	12.0	54	12.3
	Counties Manukau	71	16.4	53	11.9	67	14.7	39	8.4	57	12.0
	Waikato	27	7.9	24	6.9	33	9.4	21	5.9	20	5.6
	Lakes	4	-	5	4.9	3	-	1	-	4	-
	Bay of Plenty	8	4.1	4	-	7	3.5	8	3.9	8	3.9
	Tairawhiti	2	-	0	-	0	-	0	-	1	-
	Taranaki	4	-	4	-	3	-	3	-	3	-
	Hawke's Bay	26	17.2	6	4.0	8	5.2	17	11.1	5	3.3
	Whanganui	2	-	5	7.8	2	-	3	-	3	-
	MidCentral	16	9.8	8	4.9	31	18.9	10	6.1	7	4.2
	Hutt Valley	10	7.2	8	5.7	8	5.7	11	7.8	17	12.0
	Capital and Coast	43	15.9	30	11.0	32	11.5	17	6.0	25	8.8
	Wairarapa	4	-	2	-	2	-	1	-	0	-
	Nelson Marlborough	9	6.8	2	-	4	-	3	-	5	3.7
	West Coast	2	-	1	-	2	-	1	-	0	-
	Canterbury	19	4.1	23	4.8	21	4.3	36	7.3	28	5.6
	South Canterbury	1	-	2	-	2	-	2	-	1	-
	Otago	5	2.7	5	2.7	7	3.8	2	-	1	-
	Southland	2	-	3	-	2	-	1	-	1	-

[1] Rate per 100 000 population based on the mid-year population estimate for each year
[2] Rate per 100 000 population based on 2001 & 2006 Census data
[3] Ethnic groups were prioritised in the following order: Maori; Pacific Peoples; Asian; Other; European; Unknown