TUBERCULOSIS

Introduction

Tuberculosis is caused by *Mycobacterium tuberculosis,* with infection usually occurring as the result of inhaling infected droplets produced by someone who has pulmonary TB. Primary infections in children are often asymptomatic, self-healing and can remain completely unnoticed unless discovered by Mantoux testing. In a minority of cases, latent infection progresses to active TB, with the risk of progression being greater in the very young, or those who are immunocompromised (e.g. persons with HIV). Symptoms of active pulmonary TB include a chronic cough, fever and weight loss, or failure to thrive. Tuberculosis can also spread from the lungs to other sites including the lymph nodes, the meninges, the pleura, the peritoneum, the joints, and the pericardium [156].

In New Zealand, as in other developed countries, annual notifications for TB declined steadily after World War Two [157]. Between 1980 and 2010 annual notifications fell further, from 15.1 per 100,000 to 7.0 per 100,000, although there was little change from 2005 to 2010 [158]. A 2006 review of TB in New Zealand children however reported a resurgence in TB cases between 1992 and 2001, with childhood TB rates being highest in those under five years of age. The report also noted significant ethnic disparities, with disease rates per 100,000 being 575.2 for African, 15.2 for Pacific, 6.4 for Māori, 5.6 for Asian and 0.6 for European children. Most cases were identified through contact tracing or immigrant screening and almost half were part of outbreaks [159].

From a public health perspective, the mainstays of controlling TB infection remain the BCG vaccination of high risk neonates, case finding with treatment of active and latent infections, contact tracing and the selective screening of high risk groups [148,160]. In this context, the most common risk factors for TB are having been born outside of New Zealand (80% of cases) and current or recent residence with a person born outside of New Zealand (76.2% of cases), with the highest rates occurring in people born in Asia, followed by those born in Sub-Saharan Africa and in the Pacific Islands [158]. Further, two relatively recently reported outbreaks in Palmerston North and in Auckland, were each able to be traced back to a single source case [161,162].

The following section explores TB rates in children and young people using information from the National Minimum Dataset and Mortality Collection. The section concludes with a brief overview of local policy documents and evidence-based reviews which consider interventions to address TB at the population level.

Data Sources and Methods

Indicator

1. *Acute and Semi Acute Hospital Admissions for Tuberculosis in Children and Young People 0–24 Years*

Numerator: National Minimum Dataset: Acute and semi-acute hospital admissions for children and young people aged 0–24 years with an ICD-10-AM primary diagnosis of Tuberculosis (A15–A19).

Denominator: Statistics NZ Estimated Resident Population (with linear extrapolation being used to calculate denominators between Census years).

2. Mortality from Tuberculosis in Children and Young People 0–24 Years

Numerator: National Mortality Collection; Deaths in children and young people aged 0–24 years where the main underlying cause of death was Tuberculosis (A15–A19).

Denominator: Statistics NZ Estimated Resident Population (with linear extrapolation being used to calculate denominators between Census years).

Notes on Interpretation

Note 1: An acute admission is an unplanned admission occurring on the day of presentation, while a semi-acute admission (referred to in the NMDS as an arranged admission) is a non-acute admission with an admission date <7 days after the date the decision was made that the admission was necessary.

Note 2: **Appendix 3** outlines the limitations of the hospital admission data used. The reader is urged to review this Appendix before interpreting any trends based on hospital admission data.

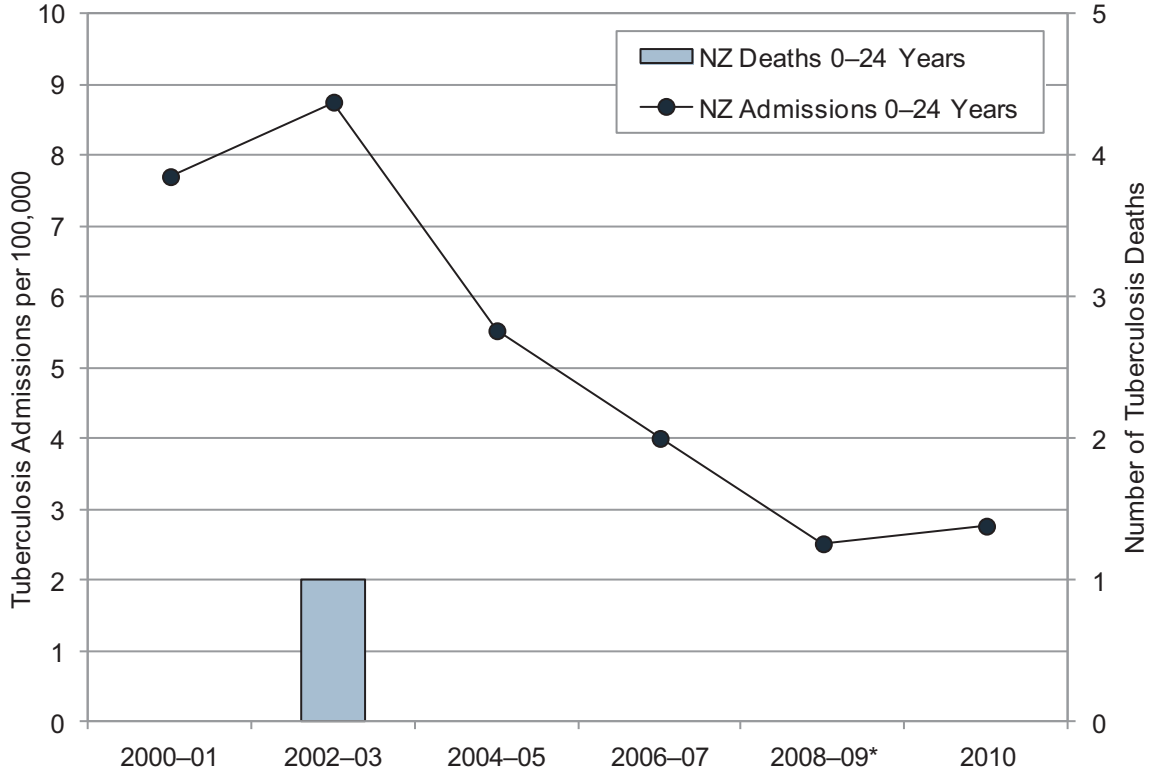
Note 3: 95% confidence intervals have been provided for the rate ratios in this section and where appropriate, the terms *significant* or not *significant* have been used to communicate the significance of the observed associations. Tests of statistical significance have not been applied to other data in this section, and thus (unless the terms *significant* or non-*significant* are specifically used) the associations described do not imply statistical significance or non-significance (see **Appendix 2** for further discussion of this issue).

New Zealand Distribution and Trends

New Zealand Trends

In New Zealand, hospital admissions for tuberculosis in children and young people declined after 2002–03, although a small upswing in rates was evident in 2010. During 2000–2008, one child or young person died as the result of tuberculosis (**Figure 83**).

Figure 83. Acute and Semi-Acute Hospital Admissions (2000−2010) and Deaths (2000−2008) from Tuberculosis in New Zealand Children and Young People Aged 0−24 Years



Source: Numerators: National Minimum Dataset (Acute and semi-acute admissions only) and National Mortality Collection; Denominator: Statistics NZ Estimated Resident Population.*Note: Number of Deaths is per 2 year period, with the exception of 2008–09, which is for a single year (2008) only.

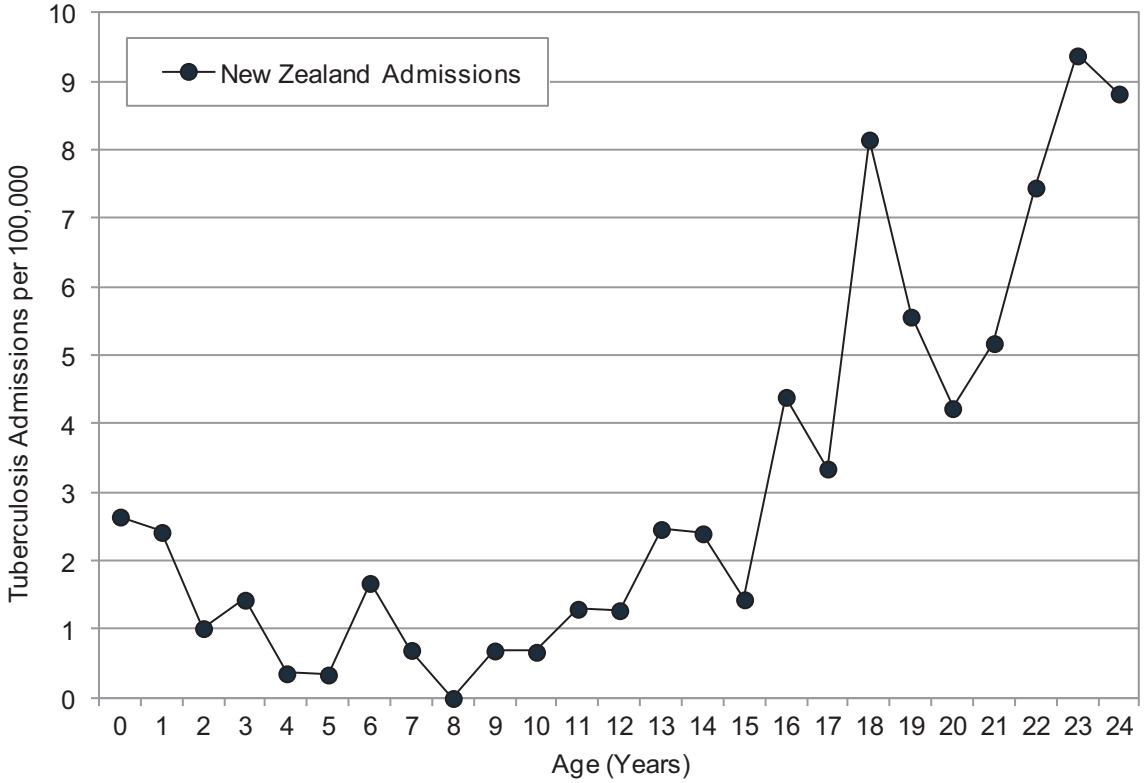
New Zealand Distribution by Age

In New Zealand during 2006–2010, hospital admissions for tuberculosis were highest amongst those in their late teens and early twenties. During 2004–2008, no children or young people died as a result of tuberculosis (**Figure 84**).

New Zealand Distribution by Ethnicity, NZDep Index Decile and Gender

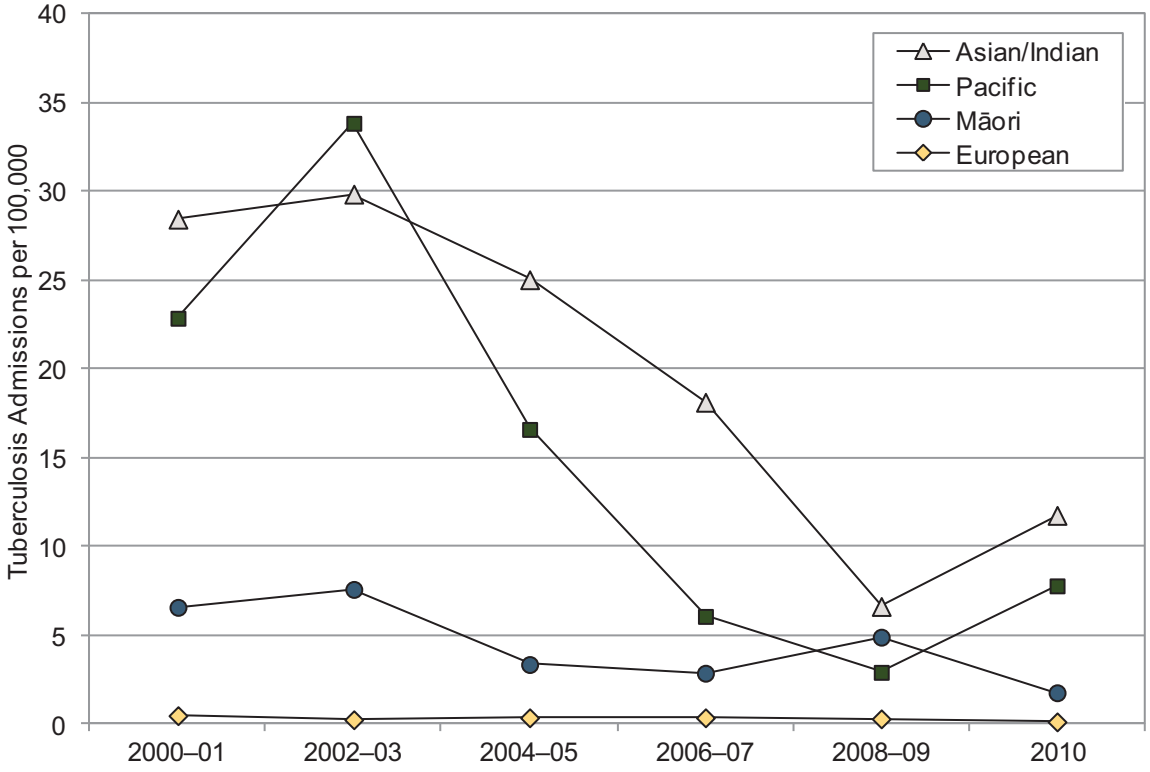
In New Zealand during 2006–2010, hospital admissions for tuberculosis were *significantly* higher for Asian/Indian, Pacific and Māori children and young people than for European children and young people. Admission rates were also *significantly* higher for those from more deprived (NZDep decile 5–10) areas (**Table 86**). Similar ethnic differences were seen during 2000–2010, although admission rates for Pacific and Asian/Indian children and young people declined during this period (**Figure 85**).

Figure 84. Acute and Semi-Acute Hospital Admissions for Tuberculosis in Children and Young People by Age, New Zealand 2006−2010



Source: Numerator: National Minimum Dataset (Acute and semi-acute admissions only); Denominator: Statistics NZ Estimated Resident Population

Figure 85. Acute and Semi-Acute Hospital Admissions for Tuberculosis in Children and Young People Aged 0−24 Years by Ethnicity, New Zealand 2000−2010



Source: Numerator: National Minimum Dataset (Acute and semi-acute admissions only); Denominator: Statistics NZ Estimated Resident Population. Note: Ethnicity is Level 1 Prioritised.

Table 86. Acute and Semi-Acute Hospital Admissions for Tuberculosis in Children and Young People Aged 0−24 Years by Ethnicity, NZ Deprivation Index Decile and Gender, New Zealand 2006−2010

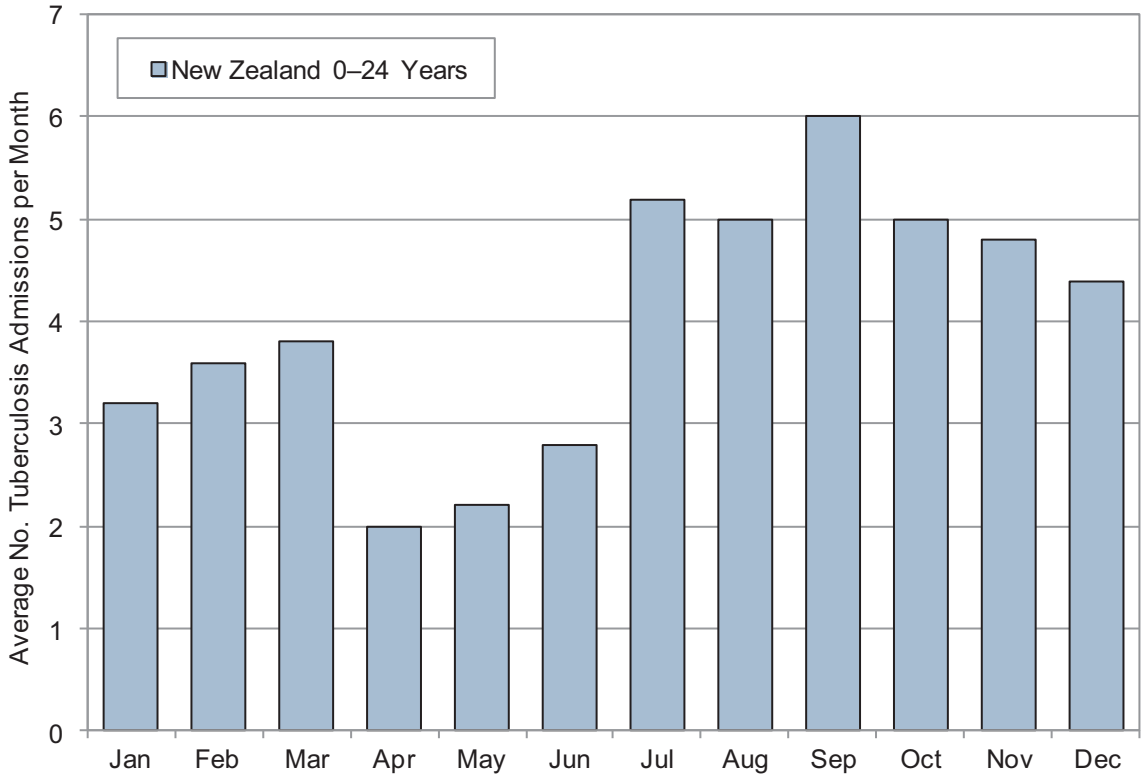
Variable	Rate	Rate Ratio	95% CI	Variable	Rate	Rate Ratio	95% CI
Tuberculosis 0–24 Years							
NZ Deprivation Index Quintile				Prioritised Ethnicity			
Decile 1–2	1.14	1.00		European	0.28	1.00	
Decile 3–4	1.65	1.45	0.77–2.74	Māori	3.45	12.3	6.58–22.8
Decile 5–6	2.79	2.45	1.37–4.39	Pacific	5.15	18.3	9.48–35.2
Decile 7–8	2.21	1.94	1.08–3.51	Asian/Indian	12.0	42.5	23.4–77.1
Decile 9–10	6.75	5.93	3.52–9.98				
Gender							
Female	2.96	1.00		Male	3.3	1.12	0.87–1.45

Source: Numerator: National Minimum Dataset (Acute and semi-acute admissions only); Denominator: Statistics NZ Estimated Resident Population. Note: Rate is per 100,000; Ethnicity is Level 1 Prioritised; Decile is NZDep2001.

New Zealand Distribution by Season

In New Zealand during 2006–2010, there were no consistent seasonal variations in hospital admissions for tuberculosis in children and young people, although admissions were lowest in April–June (**Figure 86**).

Figure 86. Average Number of Acute and Semi-Acute Hospital Admissions for Tuberculosis in Children and Young People Aged 0−24 Years by Month, New Zealand 2006−2010



Source: National Minimum Dataset (Acute and semi-acute admissions only)

South Island Distribution and Trends

South Island DHBs vs. New Zealand

In Nelson Marlborough and Canterbury during 2006–2010, while hospital admissions for tuberculosis in children and young people were lower than the New Zealand rate, in

neither case did these differences reach statistical significance. Small numbers precluded a valid analysis in South Canterbury and Otago, while there were no admissions for tuberculosis in West Coast or Southland children and young people during this period (**Table 87**).

Table 87. Acute and Semi-Acute Hospital Admissions for Tuberculosis in Children and Young People Aged 0−24 Years, South Island DHBs vs. New Zealand 2006−2010

DHB	Number: Total 2006–2010	Number: Annual Average	Rate per 100,000	Rate Ratio	95% CI
Tuberculosis 0–24 Years					
Nelson Marlborough	3	0.6	1.44	0.46	0.15–1.43
West Coast	0	0.0	–	–	–
Canterbury	17	3.4	2.01	0.64	0.39–1.05
South Canterbury	<3	s	s	s	s
Otago	<3	s	s	s	s
Southland	0	0.0	–	–	–
New Zealand	240	48.0	3.15	1.00	

Source: Numerator: National Minimum Dataset (Acute and semi-acute admissions only); Denominator: Statistics NZ Estimated Resident Population. Note: s: suppressed due to small numbers.

South Island Trends

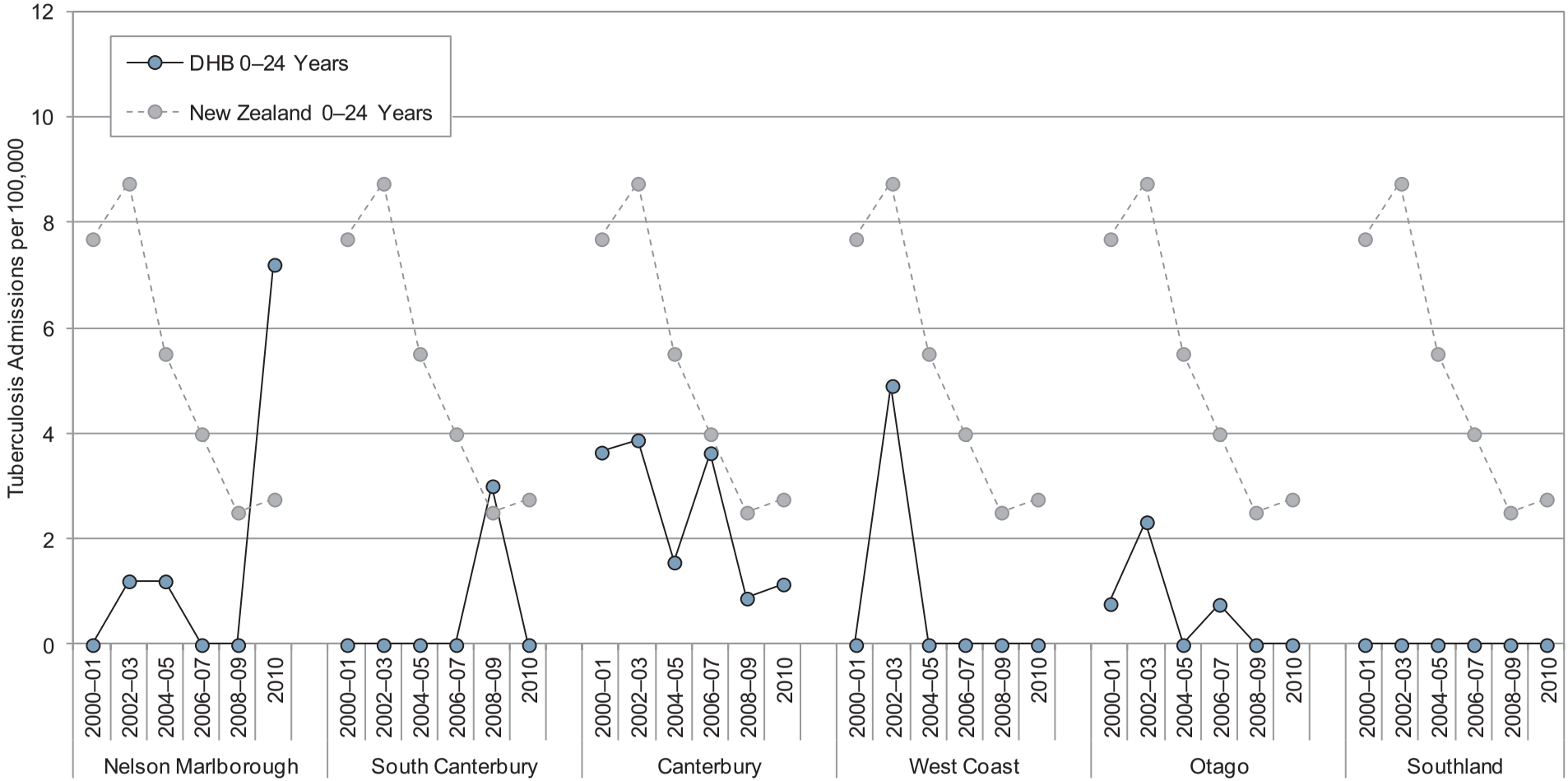
In the South Island during 2000–2010, small numbers made trends in hospital admissions for tuberculosis difficult to interpret (**Figure 87**).

Summary

In New Zealand, hospital admissions for tuberculosis in children and young people declined after 2002–03, although a small upswing in rates was evident in 2010. During 2006–2010, admissions were highest amongst those in their late teens and early twenties. Rates were also *significantly* higher for Asian/Indian, Pacific and Māori children and young people than for European children and young people and for those from more deprived (NZDep decile 5–10) areas.

In the South Island during 2000–2010, small numbers made trends in hospital admissions for tuberculosis in children and young people difficult to interpret. During 2006–2010, while admissions were lower than the New Zealand rate in Nelson Marlborough and Canterbury, in neither case did these differences reach statistical significance. Small numbers precluded a valid analysis in South Canterbury and Otago, while there were no admissions for tuberculosis in West Coast or Southland children and young people during this period.

Figure 87. Acute and Semi-Acute Hospital Admissions for Tuberculosis in Children and Young People Aged 0−24 Years, South Island DHBs vs. New Zealand 2000−2010



Source: Numerator: National Minimum Dataset (Acute and semi-acute admissions only); Denominator: Statistics NZ Estimated Resident Population

Local Policy Documents and Evidence-Based Reviews Relevant to the Control of Tuberculosis

In New Zealand a number of policy documents consider the control of TB, and these are considered in **Table 88**, along with a range of international reviews and guidelines which also consider these issues. In addition, a number of publications consider approaches to infectious diseases more generally, and these are reviewed in other sections of this report:

1. **Generic Approaches to Infectious and Respiratory Disease:** Table 46 on Page 166
2. **The Prevention of Second Hand Smoke Exposure:** Table 47 on Page 168
3. **Interventions Aimed at Housing and Household Crowding:** Table 48 on Page 170

Interventions to Improve Breastfeeding: Table 27 on Page 107

Table 88. Local Policy Documents and Evidence-Based Reviews Relevant to the Control of Tuberculosis

Ministry of Health Policy Documents
Ministry of Health. 2011. **Immunisation Handbook 2011**. Wellington: Ministry of Health. http://www.moh.govt.nz/moh.nsf/Files/immunisation2011/$file/14-Tuberculosis-v2.pdf Chapter 14 of this publication details who should be offered neonatal Bacillus Calmette-Guérin (BCG) vaccine: infants living in a house or family/whanau with a person with a past or current history of TB, household members or carers who have lived for a period of six months or more in a high risk country during the past five years, and infants who during their first five years will be living for three months or more in a high risk country and are likely to be exposed to people with TB. Information on neonatal immunisation should be collected for the NIR unless the parent/guardian has opted off. Older at-risk children who missed vaccination as neonates should be vaccinated at any time up to 5 years, with children older than six months having a pre-vaccination Mantoux to see if they have already been infected.
Ministry of Health. 2010. **Guidelines for Tuberculosis Control in New Zealand 2010**. Wellington: Ministry of Health. http://www.moh.govt.nz/moh.nsf/indexmh/tuberculosis-control-nz-guidelines-2010 These comprehensive guidelines cover the epidemiology of tuberculosis in New Zealand, diagnosis, treatment and management of people with tuberculosis, special population groups, laboratory matters, and infection control and occupational health. Chapter five deals specifically with TB in children.
Ministry of Health. 2007. **Review of Neonatal BCG Immunisation in New Zealand**. Wellington: Ministry of Health. http://www.moh.govt.nz/moh.nsf/pagesmh/7247/$File/review-of-neonatal-bcg-immunisation-services-2006.pdf In New Zealand selective neonatal immunisation with BCG vaccination is used to prevent severe disseminated disease in high risk young children including children of migrants or refugees from high risk Asian and African countries and recent arrivals from Pacific countries. There have been concerns that not all high risk infants are being identified. This review aimed to describe the neonatal BCG immunisation services offered, review TB notification and hospitalisation data, identify any imbalance between current policy and services, and review monitoring and make recommendations on future monitoring. The review found considerable variation between DHBs in neonatal BCG vaccination and a lack of monitoring data. The review concludes with recommendations for contracts, monitoring, resources and surveillance.
International Guidelines
National Institute for Health and Clinical Excellence. 2011**. Tuberculosis: Clinical diagnosis and management of tuberculosis, and measures for its prevention and control**. London: National Institute for Health and Clinical Excellence. http://www.nice.org.uk/nicemedia/live/13422/53642/53642.pdf This U.K. evidence-based guideline provides advice on the care of people with, or at risk of contracting, TB and, where the scientific evidence supports this, on service organisation. It covers diagnosis, management and infection control, TB of non-respiratory sites, disseminated TB, improving adherence to therapy, risk assessment and infection control, drug-resistant TB, latent TB, groups who should be offered BCG vaccination, TB in HIV-infected individuals, case finding and contact tracing, and prevention of infection in healthcare environments and prisons. It does not explain the treatments for TB in detail, nor does it discuss the evidence on which the recommendations are based however details on the methodology used to create the guideline and the studies and models used can be found in the appendices which can be obtained from: http://www.nice.org.uk/nicemedia/live/13422/53639/53639.pdf. The key priorities for implementation are identified as: Management of patients with active TB, Improving adherence to therapy, screening of people who have recently arrived or returned from high incidence countries, and BCG vaccination for babies and others at increased risk of contracting TB.

World Health Organization. 2006. **Guidance for national tuberculosis programmes on the management of tuberculosis in children**. Geneva: World Health Organization. http://whqlibdoc.who.int/hq/2006/WHO_HTM_TB_2006.371_eng.pdf

These WHO guidelines aim to fill gaps in existing materials and provide current recommendations based on the best available evidence. Key recommendations are that children who are close contacts of smear-positive TB cases should have contact investigations and BCG vaccination should be given to all neonates in countries with high TB prevalence.

Systematic and Other Reviews from the International Literature

Ridge A, Whyte P, Grzemska M, et al. 2010. **Beyond Randomized Trials—TB treatment in Children**. Evidence-Based Child Health: A Cochrane Review Journal 5(4) 1566-77.

This review by WHO staff provides a summary of the reviews and key issues encountered when using available data to develop treatment recommendations for inclusion in the WHO guidelines for the treatment of tuberculosis in children, in particular the lack of high quality randomised controlled trials and the difficulty of retrieving observational studies through systematic search strategies. It includes evidence reviews for key clinical questions in the management of TB in children.

Ritz N, Connell TG, Curtis N. 2008. **To BCG or not to BCG? Preventing travel-associated tuberculosis in children**. *Vaccine* 26(47) 5905-10.

The Australian authors of this review note that global tourism is increasing rapidly and that recommendations for pre-travel BCG vaccination are inconsistent reflecting a paucity of data on the effectiveness of BCG vaccination and other preventive strategies in this situation. They review relevant studies and guidelines and conclude that the safest strategy, particularly in those under five years old, is to maintain a low threshold for recommending BCG immunisation.

Teo SSS, Shingadia DV. 2006. **Does BCG have a role in tuberculosis control and prevention in the United Kingdom?** Archives of Disease in Childhood 91(6) 529-31.

This brief article discusses changes to the BCG vaccination policy in the U.K. The schools' BCG vaccination programme has been discontinued in favour of targeting infants and children at increased risk including those living in high risk areas, and those who were born (or whose parents or grandparents were born) in high risk areas. The authors note that there are difficulties in identifying at risk infants including language barriers and the difficulty of obtaining reliable information on ethnicity and on the prevalence of TB in particular areas and that the new policy does not address who is to identify high risk children and how. They also state that better documentation is needed for effective monitoring of the programme and that other aspects of TB control need to be in place particularly the early diagnosis and treatment of infectious individuals and also better surveillance, contact tracing and new entrant screening.

Binkin NJ, Vernon AA, Simone PM, et al. 1999. **Tuberculosis prevention and control activities in the United States: an overview of the organization of tuberculosis services**. The International Journal of Tuberculosis and Lung Disease 3(8) 663-74.

This paper reviews the epidemiology of TB in the U.S. and presents a brief history of its TB control efforts. It describes the organisational structure of TB services in the U.S., the role of the private sector in TB control and how TB control is funded. The U.S. combines a centralised role of the national government in policy development, funding and the maintenance of national surveillance with a decentralised role of state and local jurisdictions in the adaptation/implementation of national guidelines and day to day programme activities. The authors note "Given the relative success of this combined approach, other countries facing the challenge of maintaining an effective TB control program in the face of increased decentralization of health services may find this description useful."

Colditz GA, Brewer TF, Berkey CS, et al. 1994. **Efficacy of BCG vaccine in the prevention of tuberculosis: Meta-analysis of the published literature**. Journal of the American Medical Association 271(9) 698-702.

This paper reports on a meta-analysis of 14 prospective trials (7 of which were RCTs) and 12 case-control studies. From the trials it was estimated (using a random effects model) that the relative risk of TB in the vaccine recipients compared with the non-recipients was 0.49 (95% CI 0.34-0.74). From the case-control studies the odds ratio was estimated to be 0.50 (95% CI 0.39-0.64). The authors concluded "On average, BCG vaccine significantly reduces the risk of TB by 50%. Protection is observed across many populations, study designs and forms of TB. Age at vaccination did not enhance predictiveness of BCG efficacy. Protection against TB death, meningitis, and disseminated disease is higher than for total TB cases, although this result may reflect reduced error in disease classification rather than greater BCG efficacy."

Other Relevant Publications

Bissielo A, Lim E, Heffernan H. 2011. **Tuberculosis in New Zealand: Annual Report 2010**. Wellington: Institute of Environmental Science and Research Ltd (ESR). http://www.surv.esr.cri.nz/PDF_surveillance/AnnTBReports/TBAnnualReport2010.pdf

This report summarises the epidemiology of TB notifications in New Zealand in 2010 and the trends from 2006 to 2010. In total during 2010 there were 661 notified cases, 29 of which were under the age of 20.

The Asthma and Respiratory Foundation of New Zealand, Innes Asher and Cass Byrnes, editors. 2006. **Trying to Catch our Breath: The burden of preventable breathing disorders in children and young people**. Wellington: The Asthma and Respiratory Foundation of New Zealand. http://www.asthmanz.co.nz/files/PDF-files/Burden_FullDocument.pdf

Chapter 10 deals with TB. It notes that most children with TB acquire the disease from an infectious adult as TB in young children is rarely infectious. Thus BCG vaccination is recommended for young children who live with people who have a past or present history of TB or who have come from a high risk country. It recommends continuing commitment to TB treatment and surveillance programs, cooperation with other agencies (e.g. immigration, housing) to improve screening and to help reduce the spread of disease, and the development of community y education programmes in at risk groups.