

COMMON COMMUNICABLE DISEASES



PERTUSSIS

Introduction

Pertussis (whooping cough) is a highly contagious acute respiratory tract infection caused by the bacterium *Bordetella pertussis*. It is spread by aerosol droplets. “Classic” pertussis follows an incubation period of a few days to a few weeks and is recognised as having three stages: a catarrhal stage with a runny nose and sneezing (1–2 weeks), a paroxysmal stage (2–6 weeks) in which prolonged bursts of uninterrupted coughing are followed by a characteristic inspiratory whoop, and a convalescent stage (≥ 2 weeks). Young infants in their first few months of life, who make up more than 90% of the fatalities from pertussis, do not display the classic stages and initially apnoea and cyanosis may be the only signs of the disease. Young infants suspected of having pertussis need hospitalisation and the most severely affected can require intubation, drug-induced paralysis and ventilation.⁷²

Routine pertussis vaccination began in New Zealand in 1960 and the current schedule recommends vaccination at six weeks, three months, and five months of age with booster doses at four years and 11 years, and during pregnancy at 28 to 38 weeks’ gestation.⁵⁸ Neither vaccination nor natural disease provides complete or lifelong immunity.⁷² Immunity wanes over time, and *Bordetella pertussis* is endemic in the older child and adult population so there is always the potential for an incompletely vaccinated infant to be infected by an older person who may not have any symptoms other than a persistent cough and may not be especially unwell.⁵⁸ The fact that neither natural infection nor vaccination provides long term immunity is the reason why pertussis epidemics continue to recur in two to five-yearly epidemic cycles, just as they did before routine immunisation. Now, despite these recurrences, there are much lower rates of disease. New Zealand had a pertussis epidemic from 2011 to 2014 with several hundred infant hospitalisations and three deaths.⁷³

Besides improving coverage and timeliness of infant vaccination, which is the most important strategy, the Global Pertussis Initiative recommends universal preschool booster doses, universal adolescent immunisation, universal adult immunisation, selective immunisation of new mothers, family, and close contacts of newborns (the “cocoon strategy”), selective immunisation of healthcare workers, and selective immunisation of childcare workers.^{74,75}

The following section reviews pertussis rates in infants aged less than one year using information from the National Minimum Dataset and Mortality Collection. The section concludes with a brief overview of policy and evidence-based review documents which consider interventions to reduce pertussis at the population level.

Data sources and methods

Indicators

Deaths from pertussis in infants

Hospitalisations for pertussis in infants

Data sources

Numerator: Deaths: National Mortality Collection

Hospitalisations: National Minimum Dataset

Denominator: Birth Registration Dataset

Definition

Pertussis or whooping cough was used to identify hospitalisations and deaths. This includes:

Whooping cough due to *Bordetella pertussis*

Whooping cough due to *Bordetella parapertussis*

Whooping cough due to other *Bordetella* species

Whooping cough, unspecified

Deaths: Deaths of infants (up to one year old) where the main underlying cause of death was pertussis (per 100,000 age-specific population)

Hospitalisations: Acute and arranged admissions of infants (up to one year old) with a primary diagnosis of pertussis (per 1,000 age-specific population). Refer to **Appendix 6** for the codes included.

Notes on interpretation

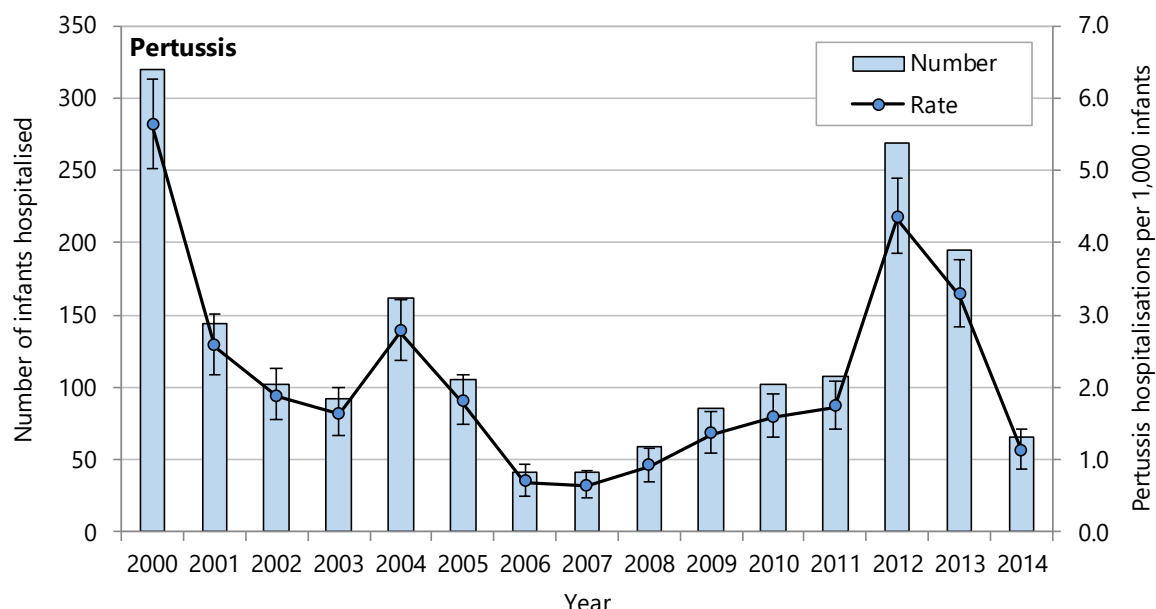
Note 1: An acute hospitalisation is an unplanned hospitalisation occurring on the day of presentation, while an arranged hospitalisation (also referred to as a semi-acute hospitalisation) is a non-acute hospitalisation with an admission date less than seven days after the date the decision was made that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

Note 2: **Appendix 3** describes the National Minimum Dataset and outlines the limitations of the data utilised from this collection. The reader is advised to review this appendix before interpreting any trends.

National trends and distribution

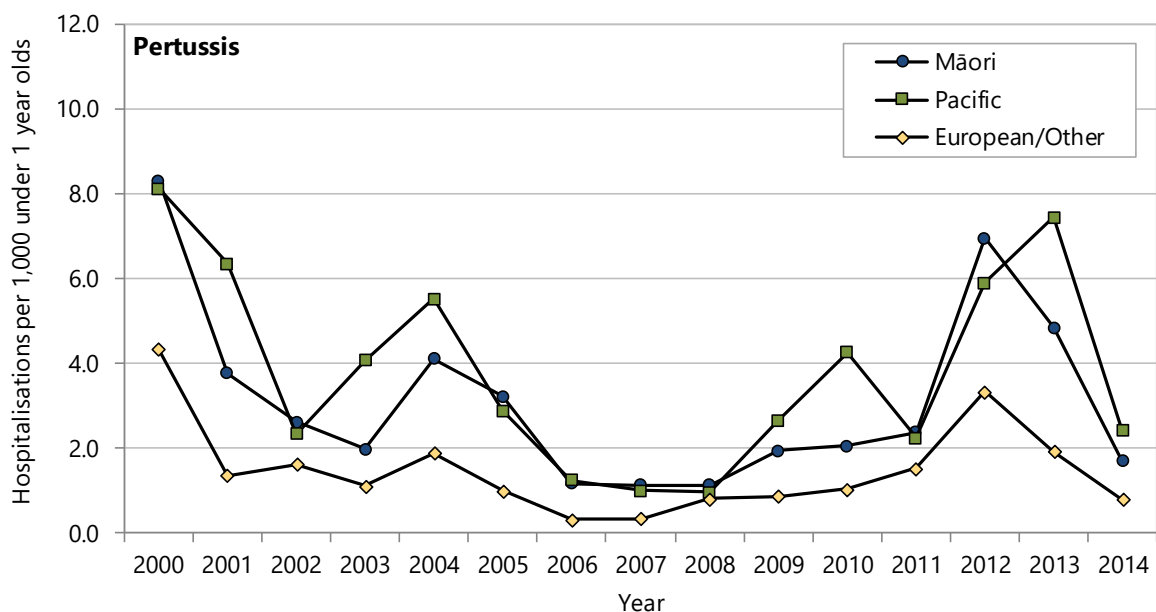
Between 2000 and 2014, hospitalisations for pertussis in infants fluctuated, with peaks occurring in 2000, 2004 and 2012. Rates reached their lowest point in 2007, after which rates rose gradually until 2011, increased sharply in 2012 and then fell sharply in each of the following two years (**Figure 1**). During this period hospitalisations for pertussis were consistently higher for Pacific and Māori than European/Other (**Figure 2**).

Figure 1. Hospitalisations for pertussis in under 1 year olds, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Birth Registration Dataset

Figure 2. Hospitalisations for pertussis in under 1 year olds, by ethnicity, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Birth Registration Dataset; Rates are per 1,000 infants; Asian/Indian rates suppressed due to small numbers

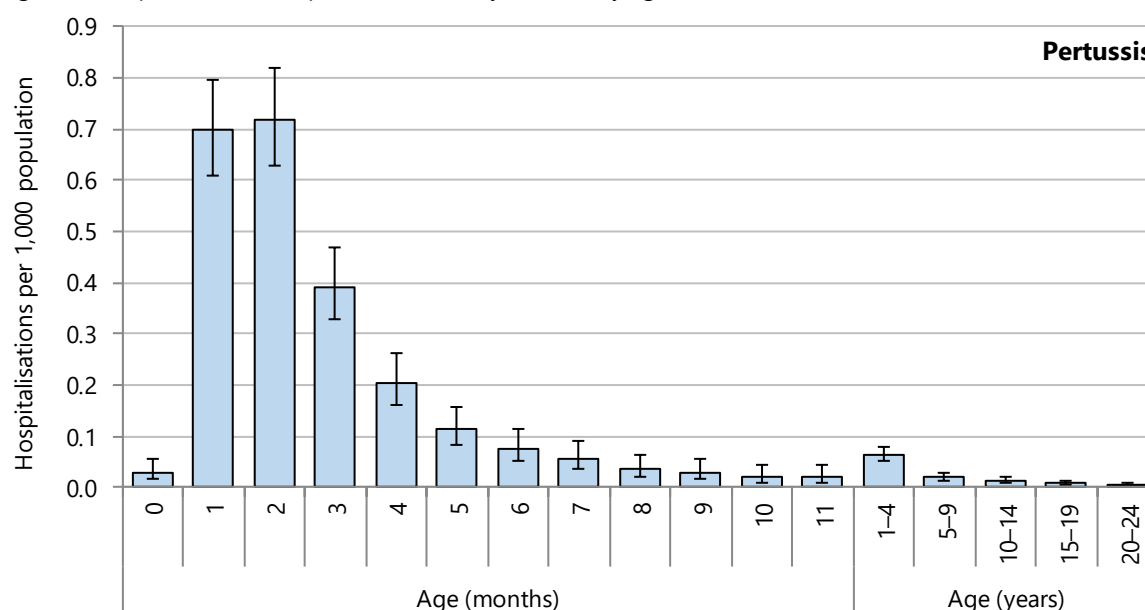
Distribution by demographic factors

Between 2010 and 2014 hospitalisation rates for pertussis were highest in infants aged one and two months. Rates then declined rapidly with increasing age (**Figure 3**).

During the same period, hospitalisation rates for pertussis were *significantly lower* for infants in areas with the lowest NZDep2013 scores (NZDep2013 deciles 1–2) compared with areas with higher scores (deciles 3–10).

Rates were *significantly higher* for Pacific and Māori and *significantly lower* for Asian/Indian compared with European/Other, whereas rates for MELAA were *not significantly different*. There was *no significant difference* by gender (**Table 1**).

Figure 3. Hospitalisations for pertussis in 0–24 year olds, by age, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominators: under 1 year: Birth registration Dataset; 1–24 years: Statistics NZ Estimated Resident Population

Table 1. Hospitalisations of under 1 year olds for pertussis, by demographic factors, New Zealand 2010–2014

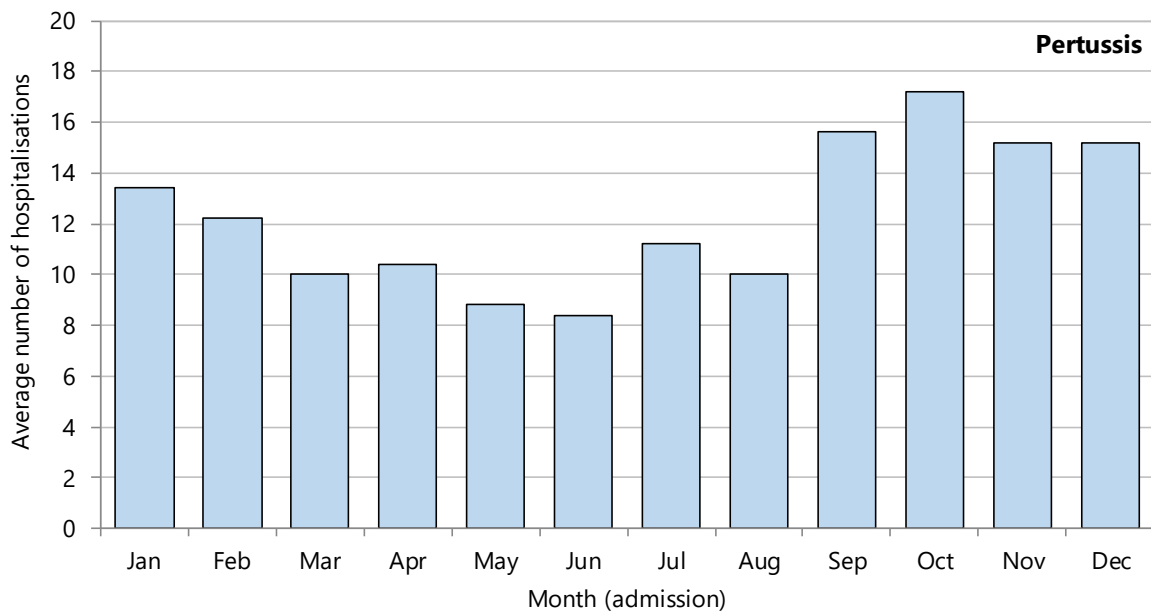
Variable	Number: 2010–2014	Rate per 1,000 under one year olds	Rate ratio	95% CI
Pertussis in under 1 year olds				
New Zealand				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	37	0.82	1.00	
Deciles 3–4	72	1.45	1.77	1.19–2.63
Deciles 5–6	107	1.90	2.31	1.59–3.36
Deciles 7–8	169	2.51	3.05	2.14–4.36
Deciles 9–10	352	4.03	4.91	3.50–6.88
Prioritised ethnicity				
Māori	318	3.59	2.09	1.77–2.47
Pacific	151	4.44	2.58	2.11–3.17
Asian/Indian	23	0.55	0.32	0.21–0.49
MELAA	10	1.84	1.07	0.57–2.02
European/Other	236	1.72	1.00	
Gender				
Female	379	2.54	1.00	
Male	359	2.28	0.90	0.78–1.04

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Birth Registration Dataset; Rate ratios are unadjusted; Ethnicity is level 1 prioritised; Decile is NZDep2013

Distribution by season

Between 2010 and 2014 there were slightly more hospitalisations for pertussis in infants aged under one year during the last four months of the year (**Figure 4**).

Figure 4. Average number of hospitalisations for pertussis in under 1 year olds, by month, New Zealand 2010–2014

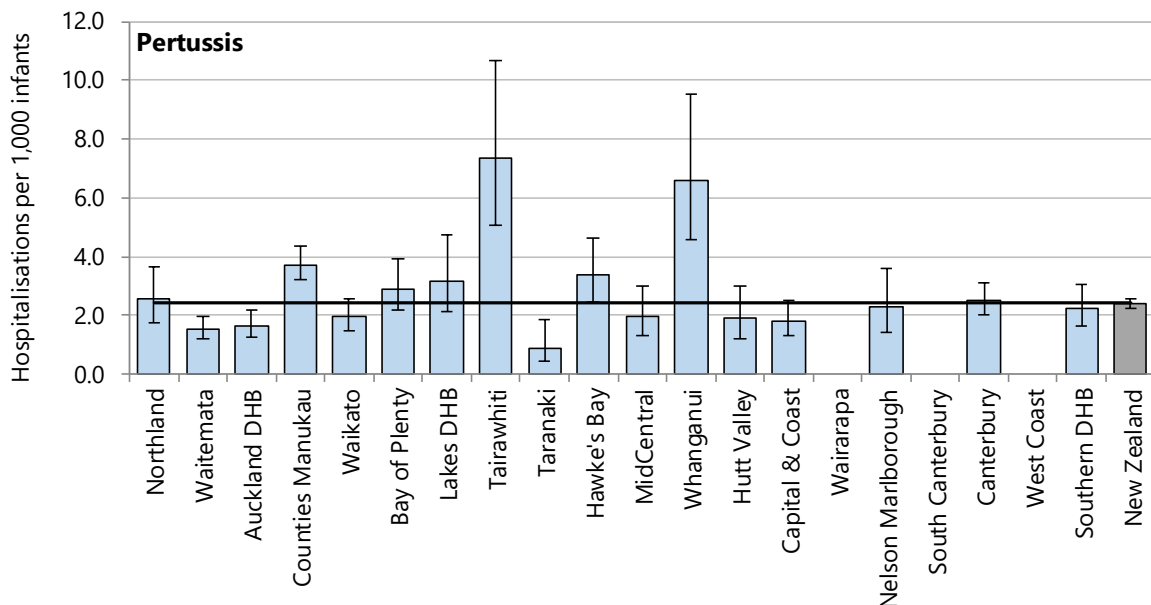


National Minimum Dataset (acute and arranged admissions); Number is annual average

Distribution by region

In Counties Manukau, Tairāwhiti, Hawke's Bay, and Whanganui during 2010–2014, hospitalisations for pertussis in infants were *significantly higher* than the national rate, while in Waitemata, Auckland, and Taranaki, rates were *significantly lower*. While rates in a number of other DHBs also differed from the national rate, in no other cases did these differences reach statistical significance (**Figure 5, Table 2**).

Figure 5. Under one year olds hospitalised for pertussis, by district health board, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Birth Registration Dataset; Rates suppressed for Wairarapa, South Canterbury and West Coast due to small numbers

Table 2. Under one year olds hospitalised for pertussis, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 under one year olds	Rate ratio	95% CI
Pertussis in under one year olds					
Northland	29	6	2.54	1.06	0.73–1.53
Waitemata	60	12	1.52	0.63	0.49–0.82
Auckland	53	11	1.65	0.69	0.52–0.91
Counties Manukau	159	32	3.73	1.55	1.31–1.84
Waikato	53	11	1.96	0.81	0.62–1.07
Bay of Plenty	42	8	2.91	1.21	0.89–1.65
Lakes	24	5	3.18	1.32	0.88–1.99
Tairāwhiti	27	5	7.36	3.06	2.09–4.49
Taranaki	7	1	0.90	0.37	0.18–0.79
Hawke's Bay	38	8	3.39	1.41	1.02–1.95
MidCentral	22	4	1.97	0.82	0.54–1.25
Whanganui	28	6	6.59	2.74	1.88–3.99
Hutt Valley	19	4	1.91	0.79	0.50–1.25
Capital & Coast	34	7	1.80	0.75	0.53–1.05
Wairarapa	<5	s	s	s	s
Nelson Marlborough	18	4	2.27	0.95	0.59–1.51
South Canterbury	<5	s	s	s	s
Canterbury	77	15	2.50	1.04	0.82–1.32
West Coast	<5	s	s	s	s
Southern	40	8	2.24	0.93	0.68–1.28
New Zealand	738	148	2.40	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Birth Registration Dataset; s: suppressed due to small numbers

South Island region distribution and trends

Comparison with New Zealand

Between 2010 and 2014 hospitalisation rates for pertussis in infants less than one year old were *too small to report* in South Canterbury and West Coast DHBs, and *not significantly different* from the national rate in Nelson Marlborough, Canterbury, and Southern DHBs (**Table 3**).

Table 3. Hospitalisations for pertussis in under one year olds, South Island DHBs vs New Zealand 2010–2014

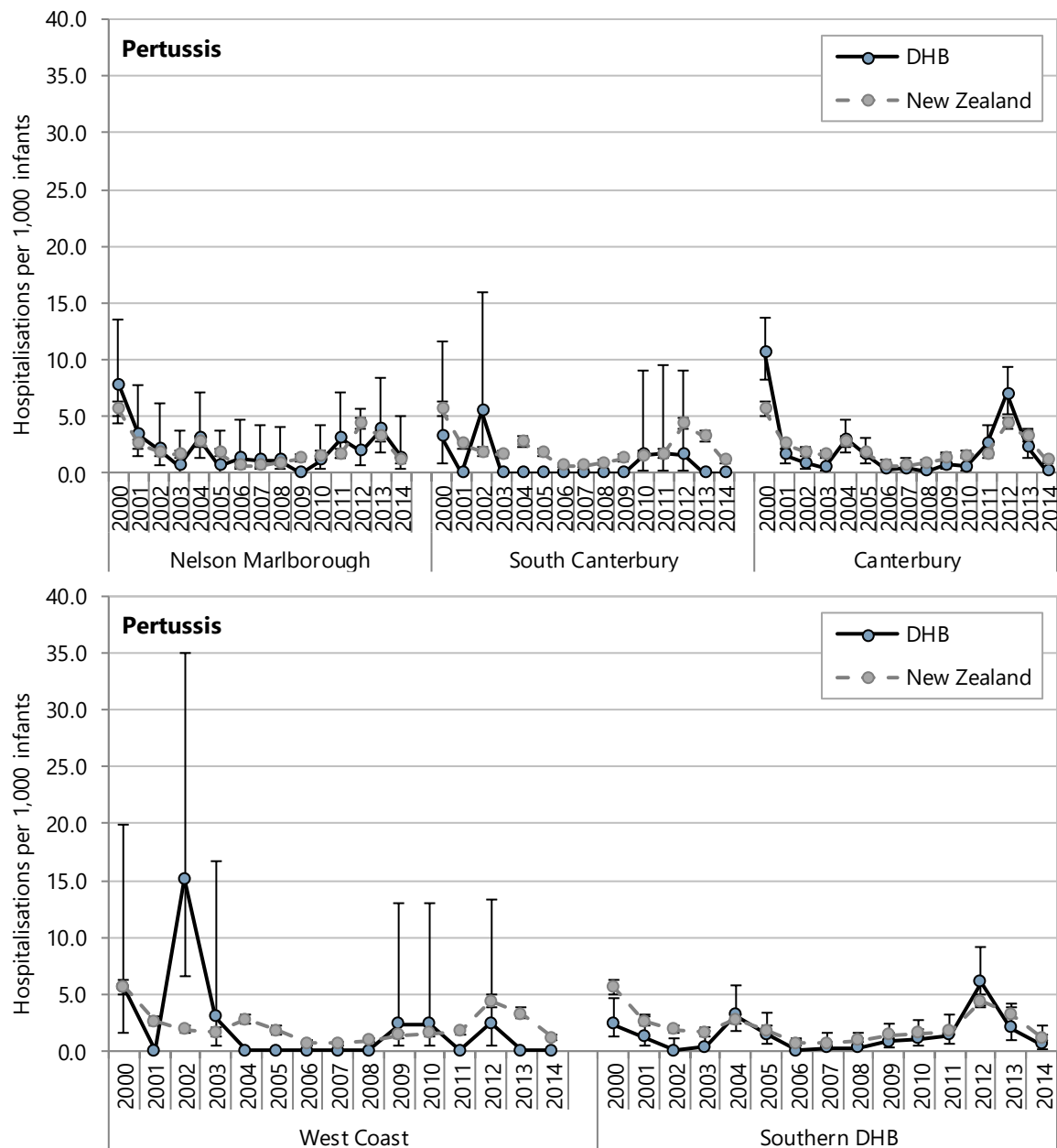
DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 under 1 year olds	Rate ratio	95% CI
Pertussis in under 1 year olds					
Nelson Marlborough	18	4	2.27	0.95	0.59–1.51
South Canterbury	<5	s	s	s	s
Canterbury	77	15	2.50	1.04	0.82–1.32
West Coast	<5	s	s	s	s
Southern	40	8	2.24	0.93	0.68–1.28
New Zealand	738	148	2.40	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Birth Registration Dataset

Regional trends

In the South Island DHBs, from 2000 to 2014 patterns in hospitalisations for pertussis in infants aged less than one year were similar to the national pattern, with peaks in 2000, 2003–2004 and 2012–2013. There was considerable year to year variation in hospitalisation rates (**Figure 6**).

Figure 6. Hospitalisations for pertussis in under one year olds, South Island DHBs vs New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Birth Registration Dataset

Evidence for good practice for the prevention and management of pertussis

Ministry of Health documents

Ministry of Health. 2014. **Immunisation Handbook 2014**. Wellington: Ministry of Health.

<http://www.health.govt.nz/publication/immunisation-handbook-2014>

Chapter 14 of this handbook provides key information on pertussis, its clinical features and epidemiology, the available vaccines, the immunisation schedule, contraindications and precautions, expected responses and adverse events, and public health measures. The immunisation schedule specifies a primary course of pertussis vaccine given as DTaP-IPV-HepB/Hib (Infanrix-hexa) at ages 6 weeks, 3 months and 5 months, followed by a dose of DTaP-IPV (Infanrix-IPV) at age 4 years. A further booster is given at age 11 years (school year 7) as Tdap (Boostrix). Pregnant women should receive a dose of Tdap (funded) from 28 to 38 weeks' gestation. This should be given during each pregnancy. Combined tetanus, diphtheria and pertussis immunisation is recommended, but not funded for lead maternity carers and other health care workers who work in neonatal units or are exposed to infants, household contacts of newborns including older siblings (for whom update vaccines are funded) and mothers shortly after delivery, and early childhood workers. A ten yearly booster dose is recommended for those with on-going contact with infants.

Ministry of Health. 2012. **Communicable Disease Control Manual**. Wellington: Ministry of Health.

<http://www.health.govt.nz/publication/communicable-disease-control-manual-2012>

Pertussis is a notifiable disease. This manual sets out the standard practice that public health services would normally follow in regard to the prevention and control of notifiable diseases. The chapter on pertussis covers epidemiology, case definition, laboratory testing, notification, management of cases and contacts, other control measures, and reporting. The references include guidelines from other countries, including the US, the UK and Australia.

Ministry of Health. 2007. **Direct Laboratory Notification of Communicable Diseases National Guidelines**. Wellington:

Ministry of Health. <http://www.health.govt.nz/publication/direct-laboratory-notification-communicable-diseases-national-guidelines>

The purpose of these guidelines is to inform those working in the health sector, so that they can fulfil their legislative requirements under Section 74AA of the Health Act 1956 with respect to notifying a Medical Officer of Health (and a territorial authority for some conditions) when a notifiable disease case is suspected and when it is confirmed by laboratory testing. Many of the infectious diseases covered in this report are notifiable diseases including acute gastroenteritis (in some situations only), meningitis, vaccine preventable diseases (including pertussis), tuberculosis and rheumatic fever.

Evidence-based medicine reviews

Zhang L, Prietsch Silvio OM, Axelsson I, et al. 2014. **Acellular vaccines for preventing whooping cough in children**.

Cochrane Database of Systematic Reviews (9) <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD001478.pub6/abstract>

The first pertussis vaccines were made from killed whole pertussis bacteria. Concerns about the possible association of these vaccines with neurological disorders led to the development of acellular vaccines which contain up to five *Bordetella* pertussis antigens. These vaccines were developed in the 1970s and widely used and tested in Japan in the 1980s. This updated review included six efficacy trials (46,283 participants) and 52 safety trials (136,541 participants) of acellular pertussis vaccines. Multi-component vaccines (≥ 3 antigens) had efficacy ranging from 84% to 85% in preventing typical whooping cough and 71% to 78% in preventing mild pertussis disease. One and two-component vaccines had efficacy ranging from 59% to 75% against typical whooping cough and 41% to 58% against mild pertussis disease. The review authors concluded that multi-component acellular vaccines are more effective than low-efficacy whole cell vaccines but may be less effective than high efficacy whole cell vaccines. However acellular vaccines were followed by significantly fewer local and systemic adverse events than whole cell vaccines both for the primary series and the booster doses.

Wang K, Bettiol S, Thompson Matthew J, et al. 2014. **Symptomatic treatment of the cough in whooping cough**. Cochrane

Database of Systematic Reviews (9) <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003257.pub5/abstract>

A characteristic feature of whooping cough is coughing paroxysms that may last for over a minute and be followed by gasping for air that produces the classic inspiratory whoop. Much of the morbidity associated with pertussis is due to the effects of the paroxysmal cough. This review aimed to assess the efficacy and safety of interventions to reduce the severity of paroxysmal cough in whooping cough in children and adults. Studies were eligible for inclusion if they were RCTs or quasi-RCTs of any intervention (excluding antibiotics and vaccines) for cough suppression. Twelve trials were included, with a total of 578 participants. Trial sample sizes ranged from nine to 135. Ten trials (448 participants) involved children and two (130 participants) adolescents and adults. Only three trials were considered to be of high methodological quality (one trial each of diphenhydramine, pertussis immunoglobulin and montelukast). The trials in the review did not show a statistically significant benefit for any of the interventions. The review authors concluded that there was insufficient evidence to draw any conclusions about the effectiveness of interventions for the cough in whooping cough. They stated that more high quality trials are needed.

Bar-On Edna S, Goldberg E, Hellmann S, et al. 2012. **Combined DTP-HBV-HIB vaccine versus separately administered DTP-HBV and HIB vaccines for primary prevention of diphtheria, tetanus, pertussis, hepatitis B and Haemophilus influenzae B (HIB)**. Cochrane Database of Systematic Reviews (4)

<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD005530.pub3/abstract>

Combining childhood vaccines reduces the number of visits and injections, and patient discomfort, thus increasing compliance and optimising disease prevention. This review compared the effectiveness of combined DTP-HBV-HIV vaccines with separate DTP-HBV and HIB vaccinations. The reviewers did not identify any studies providing data on the prevention of disease i.e. the incidence of diphtheria, tetanus, pertussis and *H. influenzae* type B after vaccination. The 20 included RCTs or quasi-randomised clinical trials compared vaccination with combined DTP-HBV-HIB vaccine (with or without polio vaccine) with separate DTP-HBV and HIB vaccinations and assessed the outcomes immunogenicity (5874 participants) and reactogenicity (adverse events, 5232 participants). There were no significant differences found in immunogenicity for pertussis, diphtheria, polio and tetanus but two studies found less immunologic response for HBV and HIB after the combined vaccines. Serious adverse events were comparable (mainly hospitalisation and acute bronchiolitis). Minor adverse events were more common after the combined vaccine. The authors stated that the studies' results were inconclusive due to uncertain risk of bias and studies not using intention-to-treat analysis and

therefore they were unable to conclude that the responses elicited by the combined vaccines were either different from, or equivalent to, those elicited by the separate vaccines. They stated that studies addressing clinical end points whenever possible, using correct methodology and a large enough sample size, should be conducted.

Altunajji Sultan M, Kukuruzovic Renata H, Curtis Nigel C, et al. 2007. **Antibiotics for whooping cough (pertussis)**. Cochrane Database of Systematic Reviews (3) <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004404.pub3/abstract>

It is commonly recommended that people with whooping cough and their contacts take erythromycin for 14 days but this regimen is often unpopular with patients due to gastrointestinal side effects. This review aimed to assess the risks and benefits of antibiotic treatment of whooping cough, and contact prophylaxis against whooping cough, in children and adults. Thirteen trials (RCTs and quasi-RCTs) of variable quality were included, with 2197 participants in total. Eleven trials investigated treatment regimens and two investigated prophylaxis regimens. Ten of the treatment studies compared one antibiotic with another and one compared antibiotics vs. no treatment. The two prophylaxis studies compared antibiotics with placebo. Results from the treatment studies indicated that, for eradicating *Bordetella pertussis* (*B. pertussis*) from the nasopharynx, short-term antibiotics (azithromycin for three to five days, or clarithromycin or erythromycin for seven days) were as effective as long-term (erythromycin for 10 to 14 days) (risk ratio (RR) 1.01; 95% CI 0.98 to 1.04), but had fewer side effects (RR 0.66; 95% CI 0.52 to 0.83). Trimethoprim/sulphamethoxazole for seven days was also effective. There were no differences between short and long term antibiotics in clinical outcomes or microbiological relapse. When used to prevent infection in contacts older than six months of age, antibiotics did not significantly improve clinical symptoms, nor reduce the number of people developing culture-positive *B. pertussis*. Antibiotics had side effects. These varied between antibiotics. In their conclusions, the review authors stated that, although antibiotics were effective in eliminating *B. pertussis*, they did not make any difference to the subsequent clinical course of the illness. They reported that there was insufficient evidence to determine the benefits of prophylactic antibiotics for pertussis contacts. They cautioned that the review's conclusions were based on a limited number of trials, some of which had small numbers of participants.

Other relevant publications

Kiedrzyński T, Bissielo A, Suryaprakash M, et al. 2015. **Whooping cough-where are we now? A review**. N Z Med J 128(1416) 21-7 <https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vol-128-no-1416/6559>

This paper describes the recent trends in pertussis and vaccine uptake in New Zealand, based on analysis of notifications and immunisation registration data since 2011. It notes that, despite having >90% immunisation coverage at 12 months, New Zealand experienced a large pertussis epidemic from 2011 to 2014 with several hundred infant hospitalisations and three deaths. It highlights the current risk for infants in the first months after birth and the crucial role a pertussis booster in pregnancy could play. It also aims to show that protection of infants by the current vaccine can be improved by timely immunisation even in a situation of improving overall uptake rates that are nearing the national target of 95%. It states that pertussis vaccination should be offered to all mothers between 28 and 38 weeks of pregnancy and that further improvements are still possible in coverage at 6 months, particularly in Māori and but also in Pacific populations, and in more deprived populations.

Lugnér AK, van der Maas N, van Boven M, et al. 2013. **Cost-effectiveness of targeted vaccination to protect new-borns against pertussis: Comparing neonatal, maternal, and cocooning vaccination strategies**. Vaccine 31(46) 5392-97

Pertussis disease is a severe disease in infants aged less than six months, who are too young to have received any or all of their vaccinations. Strategies to protect neonates include vaccinating neonates, vaccinating their mothers directly after birth (cocooning), or vaccinating the mother during pregnancy (maternal vaccination). This paper reports on a study which investigated the cost-effectiveness of these three strategies in the Netherlands. Costs for health care utilisation and productivity losses, as well as impact on quality of life were calculated for a 10-year vaccination programme, assuming that vaccine-induced immunity lasts 5 years. Cocooning was the most cost-effective strategy, costing €89,000 per QALY, followed by maternal vaccination (€126,000 per QALY) then neonatal vaccination (€318,000 per QALY); however none of these strategies would be cost-effective when judged by (unofficial) thresholds for cost-effectiveness of preventive health interventions in the Netherlands (€20,000–€50,000/QALY).

Philpston K, Goodyear-Smith F, Grant CC, et al. 2013. **When is acute persistent cough in school-age children and adults whooping cough? A prospective case series study**. Br J Gen Pract 63(613) e573-9.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3722834/>

Most patients with pertussis infection presenting in primary care have been vaccinated, therefore their signs and symptoms are subtle and it is difficult for clinicians to distinguish pertussis from other causes of acute persistent cough. This paper reports on a study conducted in Auckland which aimed to estimate the proportion of school-aged children and adults <50 years of age identified in general practice with acute persistent cough who had recent infection with *B. pertussis* and to determine whether there are symptoms that predict *B. pertussis* infection. The study used an oral fluid-based assay (measurement of IgG antibodies to pertussis toxin) as the diagnostic test for *B. pertussis* infection, and so a secondary aim of the study was to demonstrate the applicability of this test to the primary care setting. In total 226 participants were enrolled: 70 children aged 5–16 years (31%) and 156 adults (69%). Oral fluid samples were obtained from 225 participants. Ten per cent (23/225) had recent *B. pertussis* infection: a greater proportion of children than adults (17% versus 7%, $P = 0.003$). Neither cough duration nor any individual symptom discriminated between those with and without recent *B. pertussis* infection. The study authors concluded that pertussis is a common cause of acute persistent cough in primary care and that distinguishing pertussis from other causes of acute persistent cough is clinically difficult. They stated that an oral fluid based diagnostic test, which is less invasive than other diagnostic approaches (e.g. blood sampling), has high acceptability in primary care.

Websites

The Institute of Environmental Science and Research Ltd (ESR). 2015. **Pertussis report**.

<https://surv.esr.cri.nz/surveillance/PertussisRpt.phps>

These reports include information on the descriptive epidemiology of pertussis cases reported in New Zealand. Pertussis is a notifiable disease in New Zealand and these reports use data available from EpiSurv, the national notifiable disease database.

Auckland Regional Public Health Service. **Pertussis (Whooping cough)** <http://www.arphs.govt.nz/health-information/communicable-disease/pertussis-whooping-cough#.VdVbcPmqpBc>

This website has a variety of useful information and resources relating to pertussis, including advice for health professionals, information for cases and contacts, information for schools and early childhood centres, posters, and video and audio recordings.

MENINGOCOCCAL DISEASE

Introduction

Neisseria meningitidis bacteria can cause a serious invasive disease that begins suddenly as a flu-like illness and rapidly progresses to potentially fatal septicaemia and in severe cases to shock and multi-organ failure. Children with meningococcal disease typically experience acute fever, malaise, nausea, myalgia, arthralgia and prostration with a rash in about two-thirds of cases. Infants present with less-specific features.⁷⁶ There are several serogroups of meningococci; groups B and C are the important types seen in children and young adults in New Zealand.⁵⁸

Highest age-specific rates of meningococcal disease are seen in infants aged under one year and children aged one to four years with a secondary peak in notification rates at age 15–19 years. Infection rates are consistently higher for Māori and for Pacific people, with the highest rates of all observed in Māori infants aged under one year.⁵⁸ About 15% of the New Zealand population carry *N. meningitidis* in the nasopharynx without any outward symptoms. The events that cause invasive meningococcal disease are poorly understood but include a combination of factors related to the organism, the susceptible child and the external environment. There tends to be a seasonal pattern with more cases in winter and spring.⁷⁶ Early detection and prompt follow-up of contacts with antibiotics to reduce nasopharyngeal carriage of *N. meningitidis* are key components of control of meningococcal disease. Living in crowded dwellings and exposure to environmental tobacco smoke are also risk factors and can be addressed through social planning and effective health promotion.⁷⁷

The following section reports on deaths and hospitalisations for meningococcal disease in children and young people using information from the National Mortality Collection and the National Minimum Dataset. It concludes with a brief overview of evidence-based reviews and guidelines which consider the most effective interventions for preventing or managing this condition in children and young people.

Data sources and methods

Indicators

Deaths from meningococcal disease in 0–24 year olds

Hospitalisations for meningococcal disease in 0–24 year olds

Data sources

Numerator:

Deaths: National Mortality Collection

Hospitalisations: National Minimum Dataset

Denominator:

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

Definition

Meningococcal disease includes: meningococcal meningitis; Waterhouse-Friderichsen syndrome; acute meningococcaemia; chronic meningococcaemia; meningococcaemia unspecified; meningococcal heart disease; other meningococcal infections; and meningococcal infection unspecified

Deaths: Deaths of 0–24 year olds with where the main underlying cause of death was meningococcal disease (deaths per 100,000 age-specific population)

Hospitalisations: Acute and arranged hospitalisations of 0–24 year olds with a primary diagnosis of meningococcal disease (hospitalisations per 100,000 age-specific population). Refer to **Appendix 6** for the codes included.

Notes on interpretation

Note 1: While in the datasets used it was not possible to break down the cases identified by strain, it was likely that a mix of group B and C strains predominated. The ESR review of meningococcal disease notifications during 2011 found that of the 100 notified cases where the strain type was identified (92.6% of all notifications), 37.0% were group B:P1.7-2,4 and 27.0% were group C:P1.5-1,10-8.⁷⁸

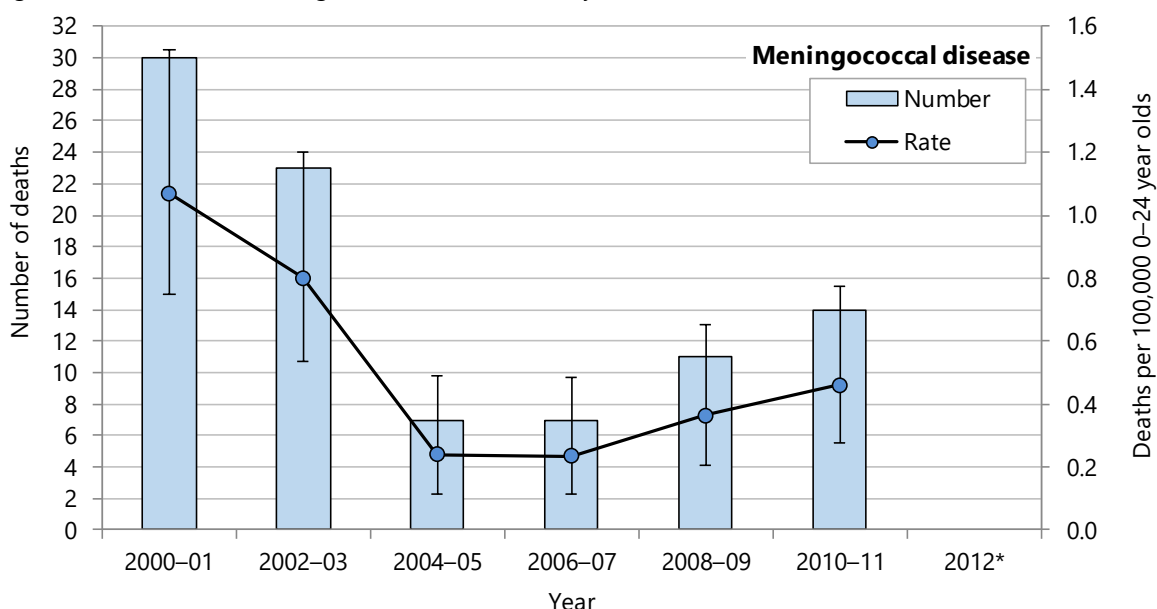
Note 2: An acute admission is an unplanned hospitalisation occurring on the day of presentation, while an arranged admission (also referred to as a semi-acute admission) is a non-acute hospitalisation with an admission date less than seven days after the date the decision was made that the hospitalisation was necessary.

Note 3: **Appendix 3** outlines the limitations of the data utilised from the National Minimum Dataset. The reader is advised to review this appendix before interpreting any trends.

National trends and distribution

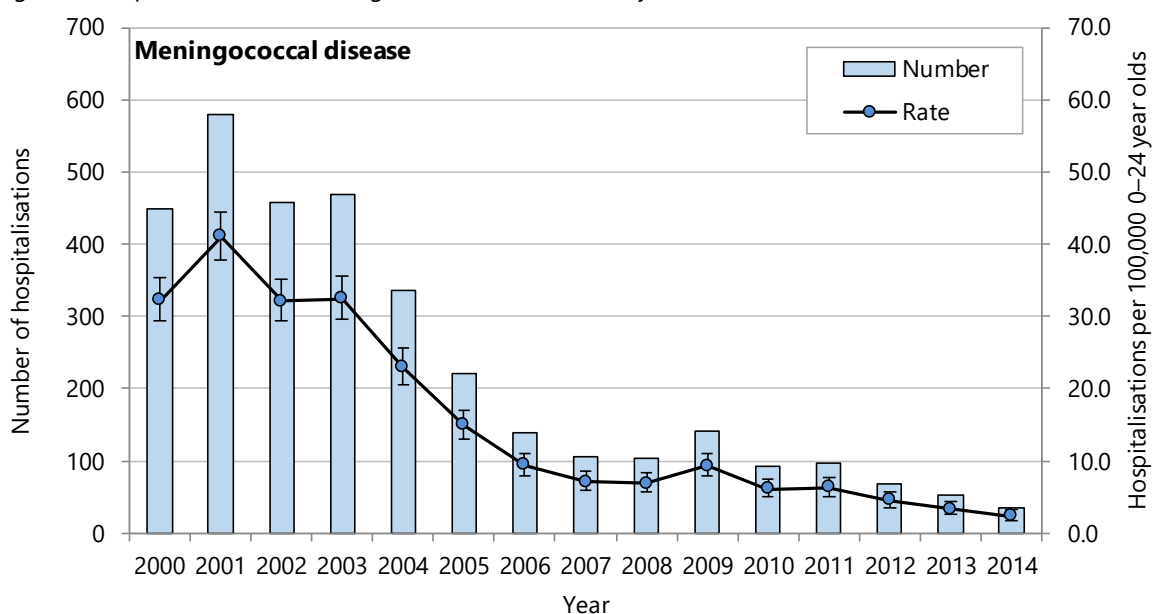
From 2008 to 2012 there were 28 deaths of 0–24 year olds with meningococcal disease as the underlying cause. The death rate varied from year to year (**Figure 7**). From 2000 to 2014 the hospitalisation rate for meningococcal disease in 0–24 year olds declined rapidly during the early-mid 2000s, and continued to decline at a much slower rate over subsequent years (**Figure 8**). Rates for all ethnic groups fell over the period and ethnic disparities reduced considerably as Pacific and Māori rates fell to a greater degree than European rates (**Figure 9**).

Figure 7. Deaths due to meningococcal disease in 0–24 year olds, New Zealand 2000–2012



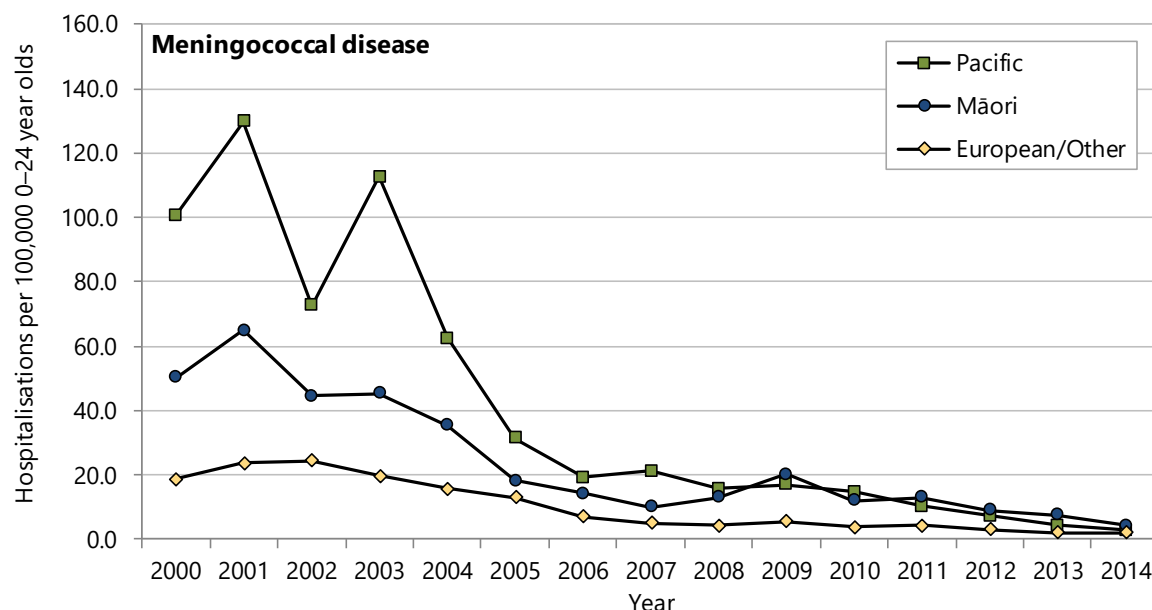
Numerator: National Mortality Collection; Denominator: Statistics NZ Estimated Resident Population; Numbers of deaths are per two year period, with the exception of 2012; * 2012 is a single year

Figure 8. Hospitalisations for meningococcal disease in 0–24 year olds, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Figure 9. Hospitalisations for meningococcal disease in 0–24 year olds, by ethnicity, New Zealand 2000–2014

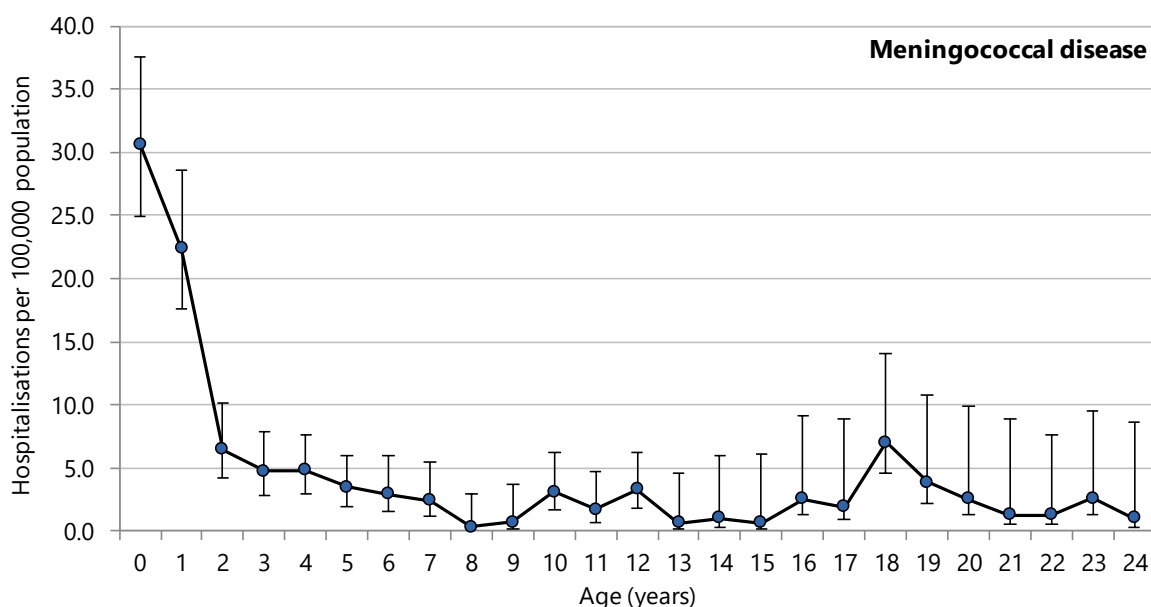


Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Asian/Indian rates suppressed due to small numbers

Distribution by demographic factors

Between 2010 and 2014 hospitalisation rates for meningococcal disease were highest in infants aged under one year, and next highest in one year olds. Rates in other age groups were much lower (**Figure 10**). Rates for meningococcal disease were *significantly higher* for 0–4 year olds compared with 15–24 year olds, for Pacific and Māori compared with European/Other, and for those living in areas with higher deprivation scores (NZDep2013 deciles 3–10) compared with those in deciles 1–2 (**Table 4**).

Figure 10. Hospitalisations for meningococcal disease in 0–24 year olds, by age at discharge, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Table 4. Hospitalisations for meningococcal disease in 0–24 year olds, by demographic factor, New Zealand 2010–2014

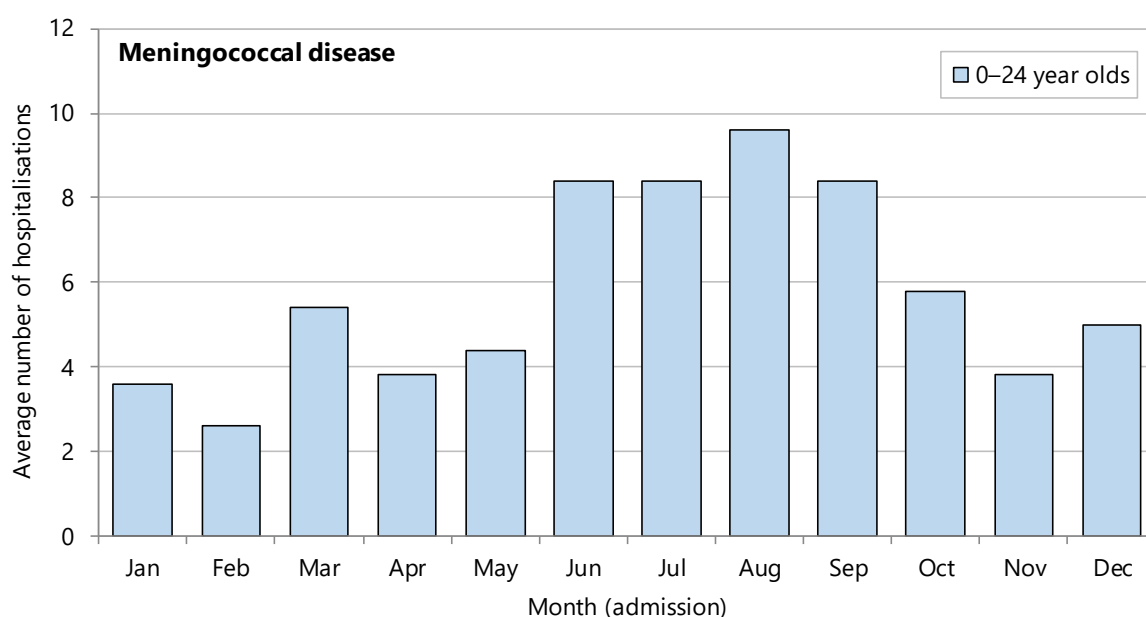
Variable	Number: 2010–2014	Rate per 100,000 0–24 year olds	Rate ratio	95% CI
Meningococcal disease in 0–24 year olds				
New Zealand				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	23	1.64	1.00	
Deciles 3–4	41	3.08	1.88	1.13–3.13
Deciles 5–6	55	3.83	2.33	1.43–3.80
Deciles 7–8	66	4.07	2.48	1.55–3.99
Deciles 9–10	159	8.55	5.21	3.37–8.07
Prioritised ethnicity				
Māori	160	8.97	3.04	2.40–3.85
Pacific	54	7.71	2.61	1.89–3.59
Asian/Indian	7	0.75	0.25	0.12–0.54
MELAA	<5	s	s	s
European/Other	122	2.95	1.00	
Gender				
Female	164	4.38	1.00	
Male	182	4.66	1.06	0.86–1.31
Age group (years)				
0–4	210	13.63	5.52	4.25–7.17
5–14	59	1.97	0.80	0.57–1.12
15–24	77	2.47	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rates are per 100,000 0–24 year olds; Rate ratios are unadjusted; Ethnicity is level 1 prioritised; Decile is NZDep2013

Distribution by season

There was seasonal variation in meningococcal hospitalisation rates, particularly for 0–14 year olds. The highest rates were observed in June–September and the lowest rates in January–February (**Figure 11**).

Figure 11. Average number of hospitalisations for meningococcal disease in 0–24 year olds, by admission month, New Zealand 2010–2014

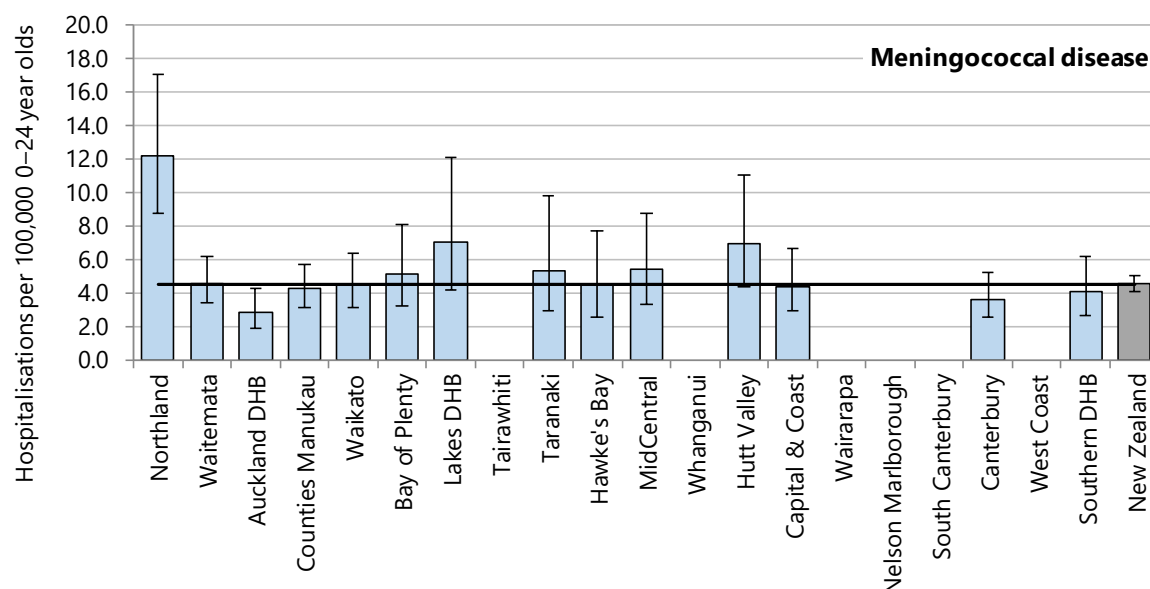


National Minimum Dataset (acute and arranged admissions); Number is annual average

Distribution by region

Between 2010 and 2014 hospitalisation rates for meningococcal disease were *significantly higher* than the national rate in Northland DHB, while rates in the Auckland and Nelson Marlborough DHBs were *significantly lower*. In remaining district health boards there was *no significant difference* from the national rate (**Figure 12, Table 5**).

Figure 12. Hospitalisations for meningococcal disease in 0–24 year olds, by district health board, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rates are per 100,000 0–24 year olds; Rates suppressed due to small numbers for Tairāwhiti, Whanganui, Wairarapa, Nelson Marlborough, South Canterbury and West Coast DHBs

Table 5. Hospitalisations for meningococcal disease in 0–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 100,000 0–24 year olds	Rate ratio	95% CI
Meningococcal disease in 0–24 year olds					
Northland	34	7	12.24	2.71	1.90–3.85
Waitemata	43	9	4.55	1.01	0.73–1.38
Auckland	22	4	2.81	0.62	0.40–0.96
Counties Manukau	41	8	4.22	0.93	0.68–1.29
Waikato	30	6	4.43	0.98	0.67–1.42
Bay of Plenty	18	4	5.11	1.13	0.70–1.81
Lakes	13	3	7.06	1.56	0.90–2.71
Tairāwhiti	<5	s	s	s	s
Taranaki	10	2	5.31	1.17	0.63–2.20
Hawke's Bay	12	2	4.43	0.98	0.55–1.74
MidCentral	16	3	5.37	1.19	0.72–1.96
Whanganui	4	1	3.82	0.84	0.32–2.26
Hutt Valley	17	3	6.92	1.53	0.94–2.49
Capital & Coast	22	4	4.36	0.96	0.63–1.48
Wairarapa	<5	s	s	s	s
Nelson Marlborough	<5	s	s	s	s
South Canterbury	<5	s	s	s	s
Canterbury	30	6	3.62	0.80	0.55–1.16
West Coast	<5	s	s	s	s
Southern	21	4	4.07	0.90	0.58–1.40
New Zealand	346	69	4.52	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

South Island region distribution and trends

Comparison with New Zealand

Between 2010 and 2014, meningococcal hospitalisation rates for 0–24 year olds were *not significantly different* from the national rate in Canterbury and Southern DHBs, while rates were suppressed due to small numbers in Nelson Marlborough, South Canterbury and West Coast (**Table 6**).

Table 6. Hospitalisations for meningococcal disease in 0–24 year olds, South Island DHBs vs New Zealand 2010–2014

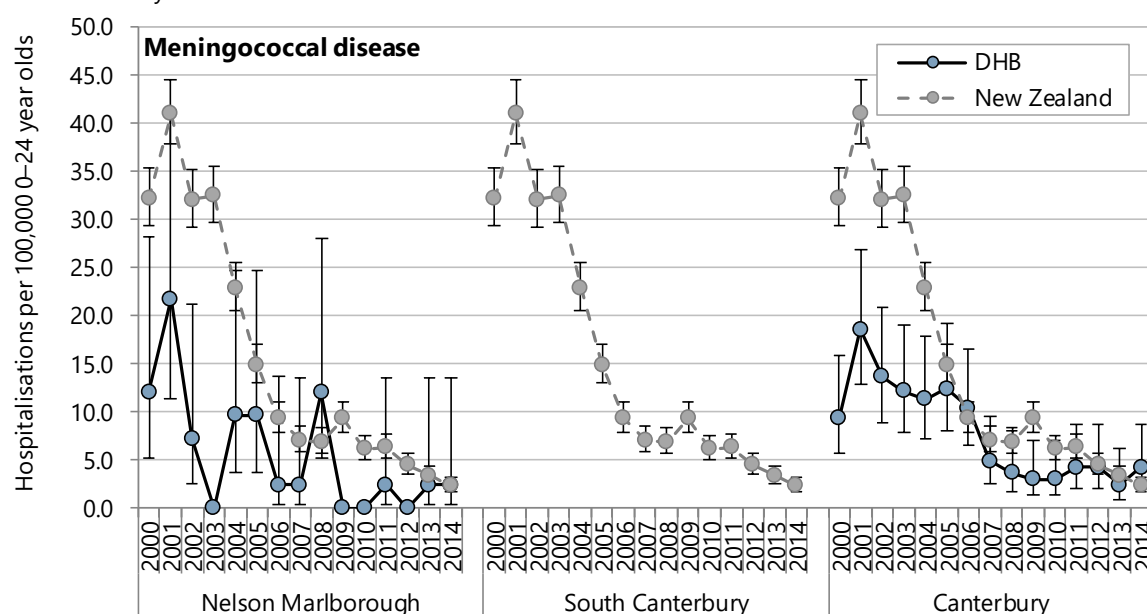
DHB	Number: 2010–2014	Number: annual average	Rate per 100,000 0–24 year olds	Rate ratio	95% CI
Meningococcal disease in 0–24 year olds					
Nelson Marlborough	<5	s	s	s	s
South Canterbury	<5	s	s	s	s
Canterbury	30	6	3.62	0.80	0.55–1.16
West Coast	<5	s	s	s	s
Southern	21	4	4.07	0.90	0.58–1.40
New Zealand	346	69	4.52	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Regional trends

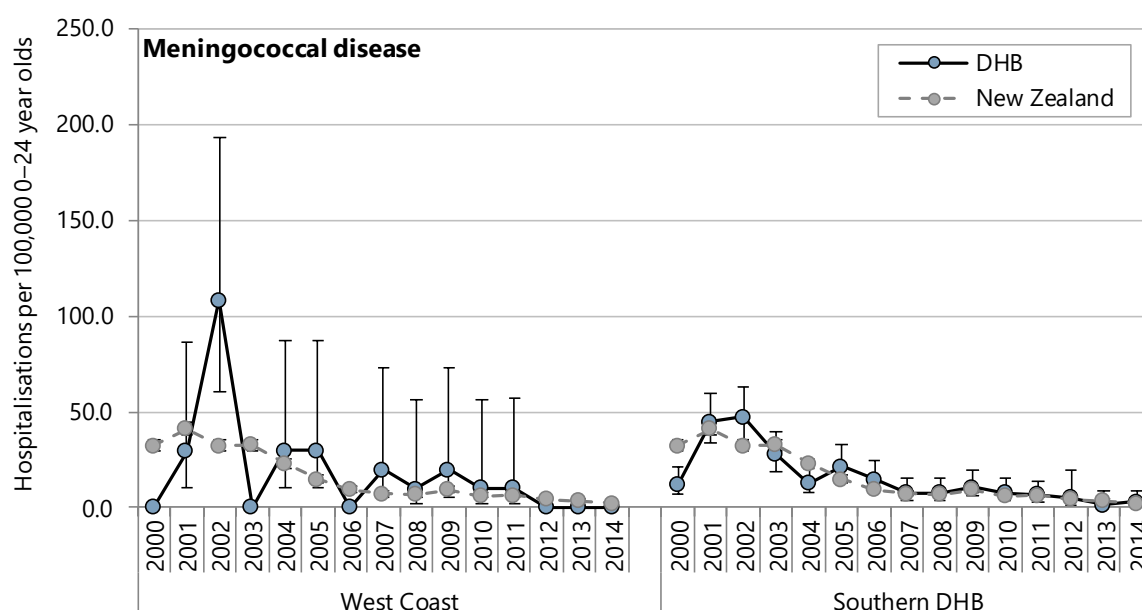
From 2000 to 2014 the hospitalisation rates for meningococcal disease in 0–24 year olds fell in all South Island DHBs, as they did in New Zealand as a whole (**Figure 13**, **Figure 14**).

Figure 13. Hospitalisations for meningococcal disease in 0–24 year olds, Nelson Marlborough, South Canterbury, and Canterbury DHBs vs New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rates in Nelson Marlborough are based on small numbers in later years, while suppressed for South Canterbury due to annual numbers less than five

Figure 14. Hospitalisations for meningococcal disease in 0–24 year olds, West Coast and Southern DHBs vs New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rates on the West Coast are based upon small numbers

Evidence for good practice for the prevention and management of meningococcal disease

Ministry of Health publications

Ministry of Health. 2012. **Communicable Disease Control Manual 2012**. Wellington: Ministry of Health.
<http://www.health.govt.nz/publication/communicable-disease-control-manual-2012>

The Communicable Disease Control Manual seeks to describe the standard practice that public health services would normally follow in regard to the prevention and control of notifiable diseases. It is intended to be used alongside other best practice guidelines including the *Immunisation Handbook*. Invasive meningococcal disease is a notifiable condition and attending medical practitioners or laboratories must immediately notify the local medical officer of health of suspected cases even before confirmation has been obtained. Key steps in management include administering parenteral antibiotics as soon as the diagnosis is suspected, and public health follow-up of all household and other close contacts who have had unprotected contact with respiratory droplets from the affected child. Cases should be kept isolated (droplet precautions) until 24 hours after the start of antibiotic treatment. Antibiotic prophylaxis should be provided to contacts as soon as possible and ideally within 24 hours.

Ministry of Health. 2014. **Immunisation Handbook 2014**. Wellington: Ministry of Health.

Details about meningococcal disease are provided on pages 313–340. There is currently no meningococcal vaccine funded in the routine New Zealand immunisation schedule. Polysaccharide and conjugate meningococcal vaccines (that protect against serogroups A, C, Y, and W135) are funded in special circumstances including children with functional asplenia or who require splenectomy, with immunodeficiency including HIV, complement deficiency or following solid organ transplant, and close contacts of meningococcal cases. Children who are travelling to high risk countries including travel to the Hajj are recommended to have a meningococcal vaccine, as are young adults living in communal accommodation like school or university hostels. There is no group B vaccine available in New Zealand. Management of organisational or community outbreaks is the responsibility of the medical officer of health and the Ministry of Health, and may include a funded vaccination programme for a defined population.

Ministry of Health. 2014. **Meningococcal B immunisation programme and MenZB vaccine**.

<http://www.health.govt.nz/our-work/preventative-health-wellness/immunisation/immunisation-programme-decisions/meningococcal-b-immunisation-programme-and-menzbtm-vaccine> accessed 28 October 2015.

This webpage provides a succinct summary of the meningococcal vaccination programme offered in New Zealand between 2004 and 2011. More than 1.1 million young New Zealanders received the MenZB vaccine and the number of people developing meningococcal disease due to the then epidemic strain of serogroup B reduced from over 300 cases in 2001 to less than 30 cases in 2010, meaning that vaccination is no longer needed to control the epidemic. The epidemic waned faster than expected and as the MenZB™ vaccine was developed specifically to curb the epidemic of this particular strain of meningococcal disease it is no longer available in New Zealand.

International guidelines
<p>National Institute for Health and Care Excellence. 2015. Bacterial meningitis and meningococcal septicaemia overview. http://pathways.nice.org.uk/pathways/bacterial-meningitis-and-meningococcal-septicaemia accessed 28 October 2015.</p> <p>This NICE pathway covers diagnosis and management of bacterial meningitis and meningococcal septicaemia in children and young people (under 16 years) in primary and secondary care. Control of meningococcal disease is both a clinical and public health priority in the UK where serogroup B meningococcus is now the most common cause of bacterial meningitis and septicaemia in children and young people aged 3 months and older. Introduction of <i>Haemophilus influenza</i> type b, pneumococcal, and serogroup C meningococcal vaccines have dramatically affected the epidemiology of these conditions in the UK over the past two decades. The paths in the pathway include symptoms and signs, pre-hospital management and management of meningococcal disease. There is a particularly helpful path on long-term management and immune testing after an episode of meningococcal disease which emphasises the importance of audiological assessment within four to six weeks after discharge from hospital. Immune testing is not generally required except in a few specific circumstances.</p>
Evidence-based medicine reviews
<p>Zalmanovici Trestioreanu A, et al. 2013. Antibiotics for preventing meningococcal infections. Cochrane Database of Systematic Reviews doi:10.1002/14651858.CD004785.pub5 http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004785.pub5/abstract</p> <p>This systematic review studied the effectiveness of different antibiotics to prevent infection and eradicate asymptomatic <i>Neisseria meningitidis</i> carriage among household contacts of people with invasive meningococcal infection. The review included 19 studies with a total of 2531 randomised participants, and five studies with a total of 4354 cluster-randomised participants. Most studies were of high quality. As there were no cases of meningococcal disease during the follow-up of all these individuals, the end point of eradication of <i>N. meningitidis</i> was used. Compared with placebo, ciprofloxacin, rifampicin and penicillin were effective at eradicating <i>N. meningitidis</i> at one to two weeks following treatment. Although ceftriaxone was not compared with placebo, it was more effective than rifampicin at one to two weeks following treatment. Side effects were reported for 18 of the studies, and these were all mild in nature including nausea, diarrhoea, headaches, dizziness and pain at the injection site. Drug-resistant isolates were seen in some contacts treated with rifampicin, which may mean that this antibiotic is inappropriate to use in an outbreak. All of the antibiotics recommended for prophylactic use in New Zealand were found to be effective in this systematic review.</p>
Other relevant publications
<p>Sarfatti A & Nadel S. 2015. Management of meningococcal disease. Paediatrics and Child Health (United Kingdom), 25(5), 203-09.</p> <p>This article provides an overview of the management of meningococcal disease with an international perspective. Early recognition and treatment is vital to improve outcome of invasive meningococcal disease which remains an important cause of childhood sickness and death. Introduction of serogroup C vaccine into the routine vaccination schedule in the UK and other countries has been associated with a dramatic reduction in the incidence of disease. The impact of a recently developed serogroup B meningococcal vaccine is yet to be determined.</p>
Websites
<p>Ministry of Health. 2015. Meningococcal disease. http://www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/meningococcal-disease accessed 28 October 2015.</p> <p>This webpage provides information about meningococcal disease for New Zealand families. It includes a 3 minute video interview with the parents of an 18-year-old woman who died from meningococcal disease.</p>
<p>Ministry of Health. 2014. Meningococcal http://www.health.govt.nz/our-work/diseases-and-conditions/meningococcal accessed 28 October 2015.</p> <p>This webpage provides information about meningococcal disease for health professionals and includes a link to a helpful page of frequently asked questions about the condition.</p>
<p>HealthEd. 2013. Meningococcal disease: Information for health professionals. https://www.healthed.govt.nz/resource/meningococcal-disease-information-health-professionals accessed 28 October 2015.</p> <p>This webpage provides information for health professionals about the symptoms and signs of meningococcal disease plus detailed information about recommended antibiotics, together with links to a patient information leaflet. Free copies of the A3 poster and the patient information leaflet can be ordered through the website.</p>

TUBERCULOSIS

Introduction

The overall rate of active tuberculosis (TB) in New Zealand is low compared with many countries, although TB remains one of the most common notifiable infectious diseases.⁵⁸ TB is a chronic bacterial infection caused by *Mycobacterium complex*, including *M. tuberculosis* or *M. bovis*. The lung is the most common site of infection, but any organ can be affected. Young children with active TB may present with symptoms of fever, lassitude and cough, while older children and adults may present with loss of appetite, fatigue, weight loss, chills, night sweats, cough, blood in sputum or chest pain. The disease may be active or latent; the risk of progression from latent to active TB disease is much higher for children than for healthy adults.⁷⁹

Most children with TB are infected as a result of contact with an infectious adult in their family although there have been outbreaks of TB among New Zealand children in the past.^{80,81} Children aged under 15 years account for 7–14% of all notified cases; this proportion varies significantly by ethnicity such that children account for 25% of TB cases in Pacific peoples, 14% of cases in Māori, 5% in Europeans and 4% in ‘Others’. The very youngest children appear to be most susceptible, with just over half the cases of childhood TB occurring in children aged under 5 years.⁷⁹ In all countries TB mostly affects the poorest and most vulnerable communities and in Auckland the notification rates in the least affluent parts of the region are 60 times higher than notification rates in the most affluent.⁷⁹ The most common risk factor for TB infection is contact with a known case of TB.⁷⁹ Vaccination can protect neonates and infants at high risk from severe forms of TB disease.⁵⁸ The mainstay of tuberculosis control in New Zealand is early identification of people with the disease and public health follow-up of cases and contacts.⁷⁹

As there have only been two deaths during the period 2000 to 2014, the following section reports on hospitalisations for TB in children and young people using information from the National Minimum Dataset. It concludes with a brief overview of evidence-based reviews and guidelines which consider the most effective interventions for preventing or managing TB in children and young people.

Data sources and methods

Indicator

Hospitalisations for tuberculosis in 0–24 year olds

Data sources

Numerator: National Minimum Dataset

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

Definition

Acute and arranged hospitalisations of 0–24 year olds with a primary diagnosis of tuberculosis (hospitalisations per 100,000 0–24 year olds). Refer to **Appendix 6** for the codes included.

Notes on interpretation

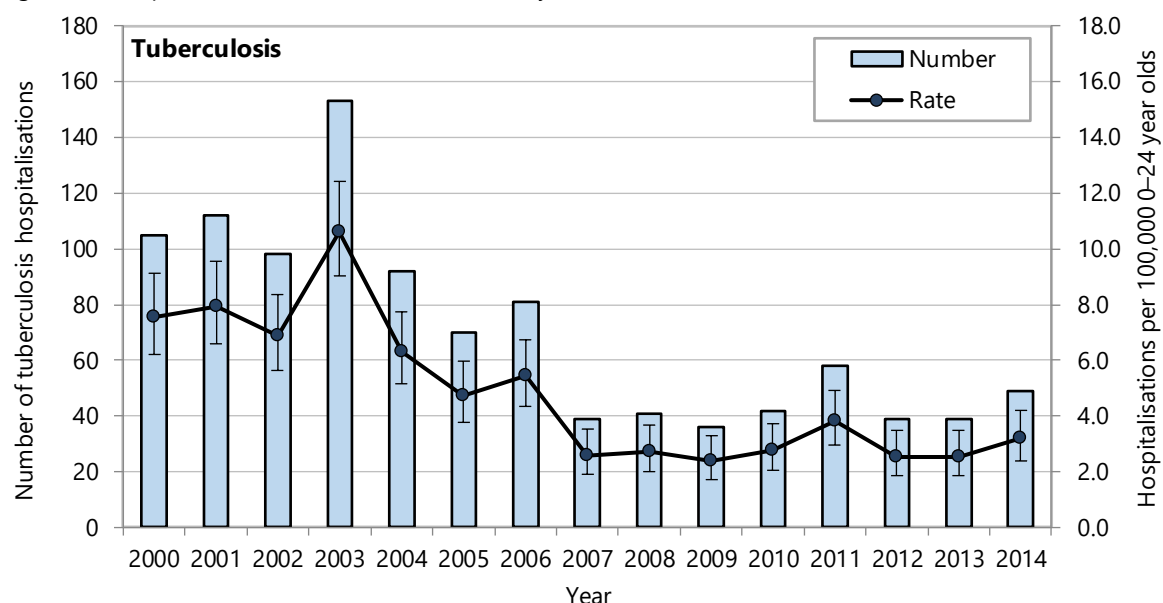
Note 1: An acute admission is an unplanned hospitalisation occurring on the day of presentation, while an arranged admission (also referred to as a semi-acute admission) is a non-acute hospitalisation with an admission date less than seven days after the date the decision was made that the hospitalisation was necessary

Note 2: **Appendix 3** outlines the limitations of the data utilised from the National Minimum Dataset. The reader is advised to review this appendix before interpreting any trends.

National trends and distribution

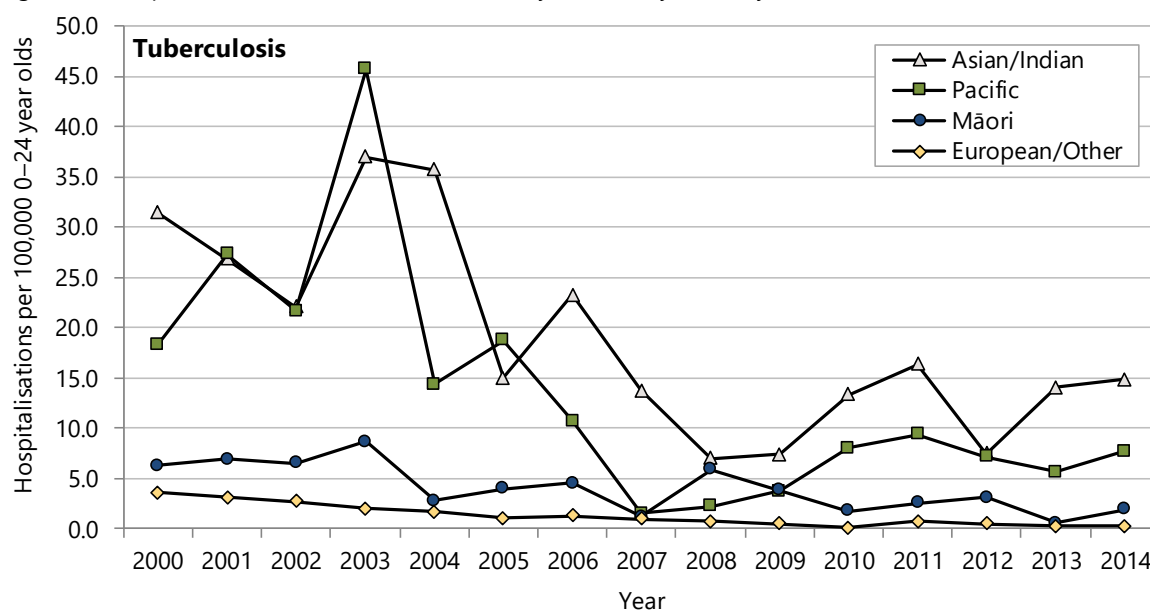
The hospitalisation rate for tuberculosis in 0–24 year olds declined from 2003 to 2007 and remained steady from 2007 onwards (**Figure 15**). While there was year to year variation, rates generally declined for all ethnic groups from 2003 to 2007. From 2007–2008 onwards rates rose somewhat for Pacific and Asian/Indian children and young people while Māori and European rates were variable (**Figure 16**).

Figure 15. Hospitalisations for tuberculosis in 0–24 year olds, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Figure 16. Hospitalisations for tuberculosis in 0–24 year olds, by ethnicity, New Zealand 2000–2014

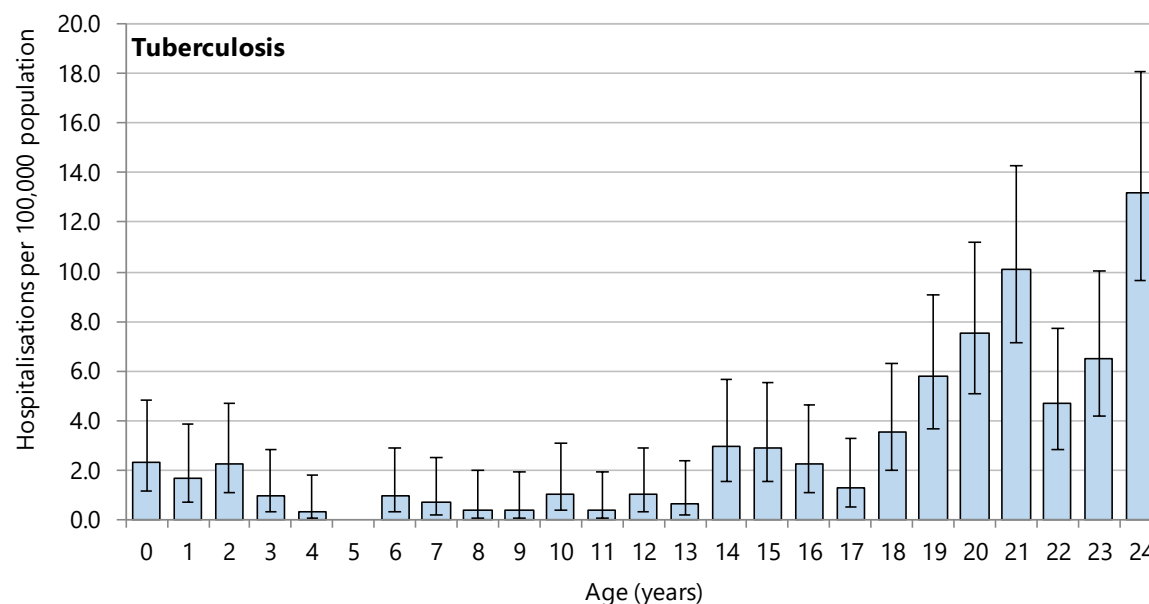


Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Caution: rates are subject to small number effect, particularly European/Other from 2009

Distribution by demographic factors

Between 2010 and 2014 tuberculosis hospitalisation rates for 0–24 year olds were highest amongst those in their late teens and early twenties (**Figure 17**). There were disparities in tuberculosis hospitalisation rates by NZDep2013 index of deprivation score, ethnicity and age. Rates were *significantly lower* in areas with the lowest deprivation scores (NZDep2013 deciles 1–2) compared with higher deprivation scores (deciles 5–10). Compared with European/Other, rates were *significantly higher* for Māori, Pacific, Asian/Indian, and MELAA. Rates were *significantly higher* for young people aged 15–24 than for younger children (**Table 7**).

Figure 17. Hospitalisations for tuberculosis in 0–24 year olds, by age New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Table 7. Hospitalisations for tuberculosis in 0–24 year olds, by demographic factor, New Zealand 2010–2014

Variable	Number: 2010–2014	Rate per 100,000 0–24 year olds	Rate ratio	95% CI
Tuberculosis in 0–24 year olds				
New Zealand				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	13	0.93	1.00	
Deciles 3–4	21	1.58	1.70	0.85–3.40
Deciles 5–6	42	2.92	3.15	1.69–5.87
Deciles 7–8	51	3.15	3.40	1.85–6.24
Deciles 9–10	99	5.32	5.74	3.22–10.24
Prioritised ethnicity				
Māori	35	1.96	16.22	6.35–41.39
Pacific	53	7.56	62.47	25.0–156.27
Asian/Indian	124	13.22	109.16	44.65–266.89
MELAA	10	10.20	84.21	28.78–246.37
European/Other	5	0.12	1.00	
Gender				
Female	109	2.91	1.00	
Male	118	3.02	1.04	0.80–1.34
Age group (years)				
0–4	23	1.49	0.26	0.17–0.40
5–14	25	0.84	0.15	0.10–0.22
15–24	179	5.74	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rates are per 100,000 0–24 year olds; Rate ratios are unadjusted; Ethnicity is level 1 prioritised; Decile is NZDep2013

Distribution by season

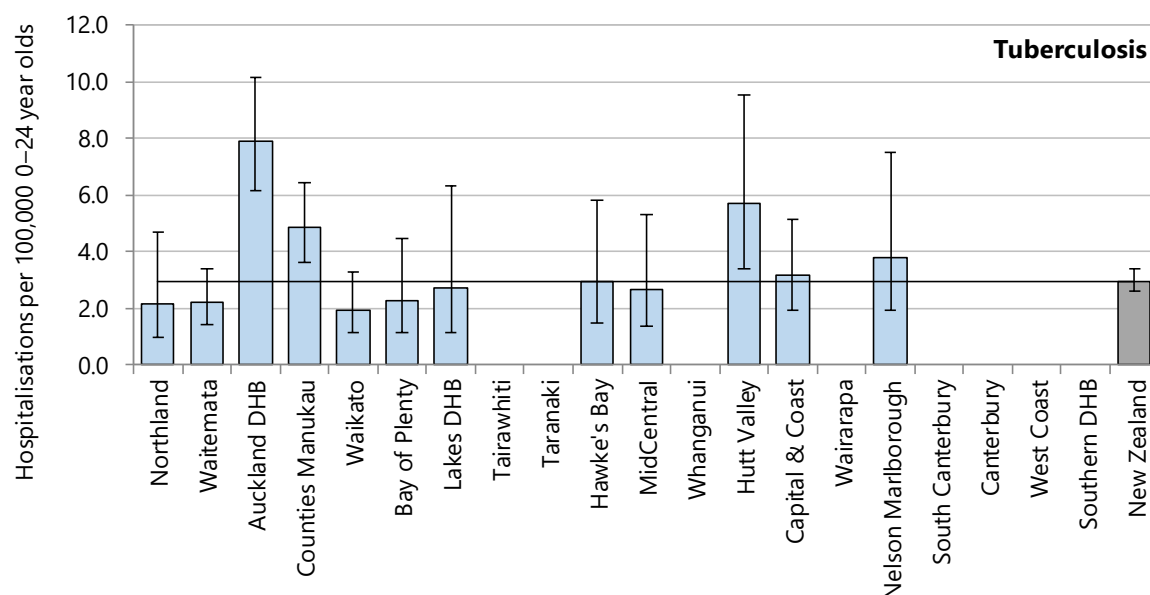
There were no consistent seasonal variations in hospitalisations for tuberculosis in 0–24 year olds.

Distribution by region

Between 2010 and 2014 hospitalisation rates for tuberculosis in 0–24 year olds were *significantly higher* than the national rate in the Auckland, Counties Manukau and Hutt Valley DHBs. While rates in a number of other

DHBs also differed from the national rate, in no other cases did these differences reach statistical significance (**Figure 18**). In addition it should be noted that most DHBs had very small numbers of hospitalisations per year. Only Auckland and Counties Manukau had an average number of hospitalisations per year of more than five (**Table 8**).

Figure 18. Hospitalisations for tuberculosis in 0–24 year olds, by district health board, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; rates suppressed for Taranaki, Whanganui, Wairarapa, Canterbury, and Southern DHBs due to numbers less than 5

Table 8. Hospitalisations for tuberculosis in 0–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 100,000 0– 24 year olds	Rate ratio	95% CI
Tuberculosis in 0–24 year olds					
Northland	6	1	2.16	0.73	0.32–1.64
Waitemata	21	4	2.22	0.75	0.48–1.17
Auckland	62	12	7.92	2.67	2.01–3.53
Counties Manukau	47	9	4.84	1.63	1.19–2.23
Waikato	13	3	1.92	0.65	0.37–1.13
Bay of Plenty	8	2	2.27	0.77	0.38–1.55
Lakes	5	1	2.71	0.91	0.38–2.22
Tairāwhiti	0	..	..	..	..
Taranaki	<5	s	s	s	s
Hawke's Bay	8	2	2.95	1.00	0.49–2.01
MidCentral	8	2	2.69	0.91	0.45–1.83
Whanganui	<5	s	s	s	s
Hutt Valley	14	3	5.70	1.92	1.12–3.30
Capital & Coast	16	3	3.17	1.07	0.64–1.77
Wairarapa	<5	s	s	s	s
Nelson Marlborough	8	2	3.82	1.29	0.64–2.60
South Canterbury	0	..	..	..	..
Canterbury	<5	s	s	s	s
West Coast	0	..	..	..	..
Southern	<5	s	s	s	s
New Zealand	227	45	2.97	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

South Island region distribution and trends

Comparison with New Zealand

Between 2010 and 2014 tuberculosis hospitalisation rates for 0–24 year olds Nelson Marlborough DHB were *not significantly different* than the national rate. Rates were suppressed for the Canterbury and Southern DHBs due to small numbers, and there were no hospitalisations for tuberculosis in the South Canterbury and West Coast DHBs (**Table 9**). The annual hospitalisation rates between 2000 and 2014 have not been presented for South Island DHBs due to small numbers.

Table 9. Hospitalisations for tuberculosis in 0–24 year olds, South Island DHBs vs New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 100,000 0–24 year olds	Rate ratio	95% CI
Tuberculosis in 0–24 year olds					
Nelson Marlborough	8	2	3.82	1.29	0.64–2.60
South Canterbury	0	..	..	..	..
Canterbury	<5	s	s	s	s
West Coast	0	..	..	..	..
Southern	<5	s	s	s	s
New Zealand	227	45	2.97	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Evidence for good practice for the control of tuberculosis

Ministry of Health Publications
<p>Ministry of Health. 2014. Immunisation Handbook 2014. Wellington: Ministry of Health. http://www.health.govt.nz/publication/immunisation-handbook-2014 accessed 22 October 2015</p> <p>Details about TB and Bacillus Calmette–Guérin (BCG) vaccination for TB are provided on pages 471–488. Neonatal BCG vaccine should be offered to infants at increased risk of TB, for example those who will be living in a house or family/whānau with a person with either current TB or a history of TB, who will be living for 3 months or longer in a country with a TB rate ≥ 40 per 100,000 before they reach age five years, or whose parents or caregivers have lived in such countries for six months or more in the past 5 years. Funded BCG vaccination may be offered to at-risk people if they are tuberculin skin test- or interferon gamma release assay (IGRA)-negative, including contacts of active TB cases aged under 5 years, immigrants aged under 5 years from countries with a rate ≥ 40 per 100,000, health care workers and laboratory staff depending on their risk of exposure, and people exposed to animals that are likely to be infected. BCG immunisation in New Zealand may legally be performed only by gazetted BCG vaccinators.</p>
<p>Ministry of Health. 2012. Communicable Disease Control Manual 2012. Wellington: Ministry of Health. http://www.health.govt.nz/publication/communicable-disease-control-manual-2012 accessed 23 October 2015</p> <p>The Communicable Disease Control Manual seeks to describe the standard practice that public health services would normally follow in regard to the prevention and control of notifiable diseases. It is intended to be used alongside other best practice guidelines including the <i>Immunisation Handbook</i> and <i>Guidelines for tuberculosis control in New Zealand</i>. The lifetime risk of developing active TB following infection is 5–10% in adults although higher in children, or in those with a predisposing medical condition and immunosuppression (e.g. HIV). The main means of transmission of infection is by inhalation of airborne droplets; infection after drinking contaminated unpasteurised milk or milk products is infrequent. Index cases should be considered infectious from onset of cough or three months before diagnosis, and the risk of transmission usually reduces to negligible levels 2–4 weeks after commencing effective treatment. The manual outlines reporting responsibilities, notification procedure, and key aspects of case management including isolation precautions, management of contacts and counselling for all affected people.</p>
New Zealand guidelines
<p>Ministry of Health. 2010. Guidelines for tuberculosis control in New Zealand 2010. http://www.health.govt.nz/publication/guidelines-tuberculosis-control-new-zealand-2010 accessed 13 October 2015</p> <p>These guidelines were published in 2010 and the Ministry of Health notes that recent evidence suggests that the guidance given for treatment of tuberculosis, particularly in Chapter 3 needs to be revised. Any treatment concerns should be discussed with an appropriate clinician (respiratory / infectious diseases / paediatric) rather than relying on the guidelines. However the document still provides useful information about the epidemiology and surveillance of tuberculosis (TB) in New Zealand, detailed information about the clinical features, investigation (including laboratory methods and standards) and assessment of TB. Specific circumstances, settings and population groups are also considered including HIV associated TB, contact investigation, TB in correctional facilities, infection control including in hospital settings, and people from countries with a high incidence of TB. Chapter 5 addresses TB in children. Although optimal treatment regimens and dosages are not known for children, most children have good outcomes on current regimens. Most child cases of TB are the result of transmission of infection from a close family member, and the treatment regimen is based on drug sensitivity testing from the adult case. Most TB in children occurs within a year of infection, and children have a higher risk than adults of developing severe disease especially if the child is aged under two years or has HIV infection or other immunocompromising condition.</p>

International Guidelines
<p>National Institute for Health and Care Excellence. 2015. Tuberculosis overview. http://pathways.nice.org.uk/pathways/tuberculosis accessed 23 October 2015</p> <p>This NICE pathway, designed to be interactive and used on-line, brings together guidance, quality standards and materials to support commissioning of TB services, preventing spread of TB, and diagnosing and managing active TB. There is also a link to the NICE pathway on antimicrobial stewardship. The downloadable PDF includes a helpful glossary. Hard-to-reach groups include children from any ethnic background whose social circumstances, language, culture or lifestyle, or those of their parents or carers, make it difficult to recognise the clinical onset of TB, access diagnostic and treatment services, have treatment administered by a parent or carer or attend regular clinic appointments. This group includes unaccompanied minors, children whose parents are hard-to-reach, children whose parents are in prison, and looked-after children. Within the interactive pathway there are links to guidance about screening for latent TB in children who have been in close contact with people with sputum-smear-positive TB several by age group from neonates through to 5 years and older and by BCG vaccination status. There is also guidance about immigrant screening children from high-incidence countries. This is a good place to quickly find guidance, particularly about prevention of spread to TB, for very specific population groups of children.</p>
<p>World Health Organization. 2014. Guidance for national tuberculosis programmes on the management of tuberculosis in children. Geneva: World Health Organization. http://www.who.int/tb/publications/childtb_guidelines/en/ accessed 23 October 2015</p> <p>While designed for countries where TB is endemic at a high level, the principles of TB treatment in children (page 33) remain relevant in all countries: Cure the child of TB, prevent death, relapse and transmission of TB, prevent development and transmission of drug-resistant TB, and achieve all this with minimal toxicity. Medication dosages for children need to take into account the risk of drug-induced hepatotoxicity with isoniazid or pyrazinamide and optic neuritis due to ethambutol. The WHO revised dosage recommendations have an excellent safety profile based on systematic review of available evidence and underpin the recommendations for children in <i>Guidelines for tuberculosis control in New Zealand</i>.</p>
Evidence-Based Medicine Reviews
<p>Bose A, et al. 2014. Intermittent versus daily therapy for treating tuberculosis in children. Cochrane Database of Systematic Reviews doi:10.1002/14651858.CD007953.pub2 http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD007953.pub2/abstract</p> <p>Treatment for TB includes a combination of drugs given daily for six at least months. Although the World Health Organization currently recommends treatments, some national governments recommend twice- or thrice-weekly doses for children with TB as this is more convenient. The authors undertook a systematic literature review to compare the effectiveness and safety of intermittent compared with daily TB treatment. They found only four randomised trials that compared twice-weekly treatment with daily doses of anti-TB drugs including a total of 563 children aged five months to 15 years. The trials were small, and did not detect a difference between twice-weekly or daily treatment in the number of children who were cured, died, relapsed, reported taking most or all of the drugs, or had adverse effects. They concluded that trials conducted to date are insufficient to support or refute the use of intermittent twice- or thrice-weekly, short-course treatment regimens over daily short-course treatment in children with TB.</p>
<p>M'Imunya James M, et al. 2012. Patient education and counselling for promoting adherence to treatment for tuberculosis. Cochrane Database of Systematic Reviews doi:10.1002/14651858.CD006591.pub2 http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD006591.pub2/abstract</p> <p>Because non-adherence to treatment can lead to prolonged infectivity and increase morbidity and mortality from TB, the authors undertook a systematic review to evaluate the effects of patient education or counselling on treatment completion in people requiring treatment for active or latent TB. They identified three randomised controlled trials with a total of 1437 participants and found that educational or counselling interventions may improve completion of treatment. In a trial in children from Spain telephone counselling or home visits by nurses increased completion of treatment from 65% to 94% or 95%. Both interventions were superior to counselling by physicians at the TB clinic.</p>
Other Relevant Publications
<p>World Health Organization. 2014. Global tuberculosis report 2014. World Health Organization. http://apps.who.int/iris/bitstream/10665/137094/1/9789241564809_eng.pdf accessed 23 October 2015</p> <p>This comprehensive report provides an international perspective on TB, which remains one of the world's deadliest communicable diseases responsible for a total of 1.5 million deaths in 2013. Estimating global TB incidence in children is technically difficult. The report has a supplement highlighting progress in surveillance of and responses to multidrug-resistant TB. The WHO post-2015 global TB strategy was approved by all Member States in May 2014 and includes targets of 95% reduction in TB deaths and 90% reduction in TB incidence by 2035 together with a target of zero catastrophic costs for TB-affected families by 2020.</p>
Websites
<p>Institute of Environmental Science and Research. 2015. Public Health Surveillance: Information for New Zealand public health action. https://surv.esr.cri.nz/index.php accessed 23 October 2015</p> <p>This website provides detailed surveillance data for all notifiable diseases in New Zealand, including TB.</p>
<p>Ministry of Health. 2015. Tuberculosis. http://www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/tuberculosis accessed 23 October 2015</p> <p>This website provides consumer information about TB with links to brochures about TB and BCG vaccination in English and other languages.</p>

RHEUMATIC FEVER AND HEART DISEASE

Introduction

Acute rheumatic fever (RF) is an autoimmune reaction that occurs two to three weeks after a throat infection with the bacterium *Streptococcus pyogenes* also known as group A *Streptococcus* (GAS).^{76,82} It causes an illness that mainly affects the heart, joints, brain and skin. If a person experiences several attacks of RF they may develop rheumatic heart disease (RHD). Damage to the heart valves can cause serious health problems and may require cardiac surgery. The primary episode usually occurs in children aged 5–15 years and consequently interventions are usually targeted on this group.⁸³ A child with RF will usually present with sore or swollen joints and may also have a skin rash, fever, stomach pains and jerky movements.⁸⁴

Although acute RF appears to have been virtually eradicated from most ‘developed’ countries, rates in New Zealand remain some of the highest reported in a developed country. Observed inequality between ethnic groups has increased over time with much higher rates for Pacific and for Māori compared with non-Māori non-Pacific children aged 5–14 years.⁸³ Reducing the incidence of RF by two-thirds is one of the results set by the Government as part of the priority to support vulnerable children through delivery of better public services.⁸⁵ Effective strategies to address the multiple determinants of RF include prevention of transmission of GAS infections, for example, by addressing household crowding and socioeconomic factors that predispose to it, and early detection and treatment of GAS infections through improved community awareness and capacity, for example, by improving health literacy, health service access and early diagnosis and treatment. All patients presenting with sore throat should be assessed for the presence or absence of significant risk factors for rheumatic fever. Patients are considered to be at high risk if they have a personal, family or household history of rheumatic fever, or meet two or more of the following criteria: Māori or Pacific ethnicity, age 3–35 years or living in crowded circumstances or in lower socioeconomic areas of the North Island. High risk patients presenting in primary care or emergency departments should have a throat swab if follow-up is possible and be started on 10 days of empiric penicillin or amoxicillin or given a single dose of IM benzathine penicillin, while high risk patients identified in school sore throat clinics should have a throat swab and, only if this is positive for group A streptococcus (GAS), be given 10 days of antibiotics.⁸⁶ Patients not considered to be at high risk may not require either throat swabbing or antibiotics unless they have severe symptoms or are at increased risk of spreading GAS.⁸⁶ Early diagnosis of acute RF can reduce the risk of severe rheumatic heart disease especially if there is good follow-up for antibiotic prophylaxis (secondary prevention) for those with a diagnosis of acute RF.⁷⁶ Monthly injections of long-acting benzathine penicillin G can prevent RF recurrences and must be continued for 10 years after diagnosis or until age 21 (whichever is the longer) or until age 30 or even life-long in the presence of carditis or established RHD.⁸⁷ Annual influenza vaccination is recommended and funded for children aged over 6 months who have RHD.⁵⁸ Because RF is a notifiable disease the attending medical practitioner is expected to notify the local medical officer of health of suspected initial or recurrent cases of acute RF within seven days, and not wait for a confirmed diagnosis.⁷⁶

The following section reports on deaths and hospitalisations for rheumatic fever and rheumatic heart disease in children and young people using information from the National Mortality Collection and the National Minimum Dataset. It concludes with a brief overview of evidence-based reviews and guidelines which consider the most effective interventions for preventing or managing these conditions in children and young people.

Data sources and methods

Indicators

Deaths of 0–24 year olds due to acute rheumatic fever or rheumatic heart disease
Hospitalisations of 0–24 year olds for acute rheumatic fever or rheumatic heart disease

Data sources

Numerator:

Deaths National Mortality Collection
Hospitalisations National Minimum Dataset

Denominator:

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

Definition

Deaths: Deaths of 0–24 year olds where the main underlying cause of death was acute rheumatic fever or rheumatic heart disease

Hospitalisations: Acute and arranged hospitalisations of 0–24 year olds with a diagnosis of acute rheumatic fever or chronic rheumatic heart disease (hospitalisations per 100,000 population). Refer to **Appendix 6** for the codes included

Notes on interpretation

Note 1: Unless otherwise specified, this analysis focuses on hospitalisations of 0–24 year olds with either acute rheumatic fever (as primary diagnosis) or chronic rheumatic heart disease listed in any of the first 15 diagnoses. The rationale for this wider focus for chronic rheumatic heart disease was that many 0–24 year olds with chronic rheumatic heart disease will not be hospitalised for their heart disease per se, but rather for one of its resulting complications. For example, during 2005–2009 only 39.0% of hospitalisations for 0–24 year olds with rheumatic heart disease had this listed as the primary diagnosis, with 11.8% being admitted for pregnancy and childbirth, and 11.0% for other cardiovascular diagnoses.

Note 2: An acute admission is an unplanned hospitalisation occurring on the day of presentation, while an arranged admission (also referred to as a semi-acute admission) is a non-acute hospitalisation with an admission date less than seven days after the date the decision was made that the hospitalisation was necessary.

Note 3: **Appendix 3** describes the National Minimum Dataset and outlines the limitations of the data utilised from this collection. The reader is advised to review this appendix before interpreting any trends.

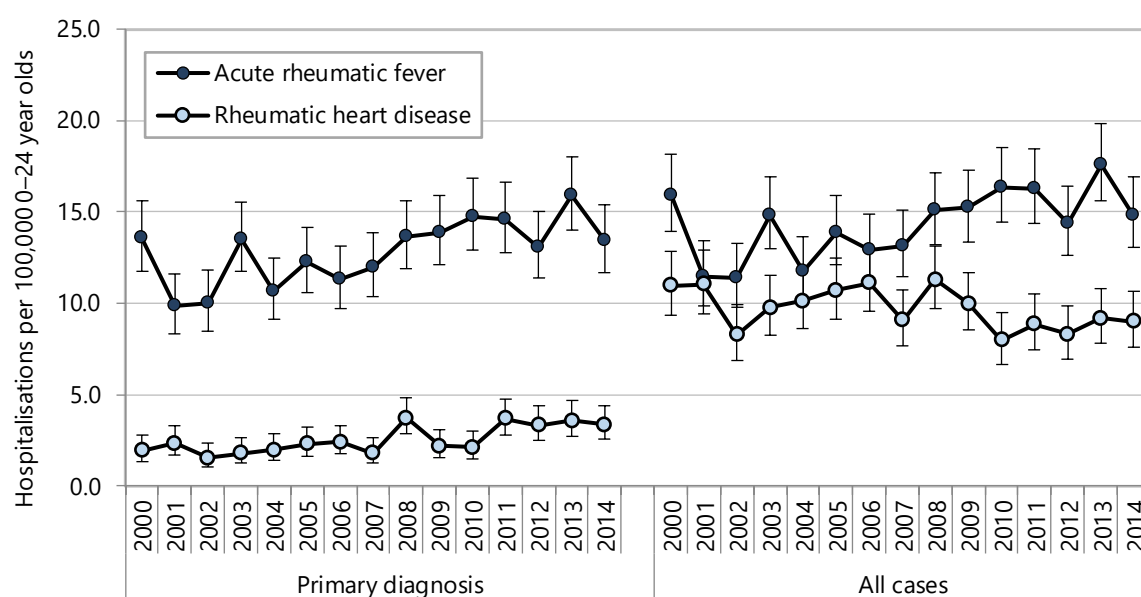
Note 4: All data presented are based on counts of hospitalisations (not individuals) and some individuals may have had multiple hospitalisations.

National trends and distribution

From 2008 to 2012 there were nine deaths of 0–24 year olds with acute rheumatic fever or rheumatic heart disease as the underlying cause.

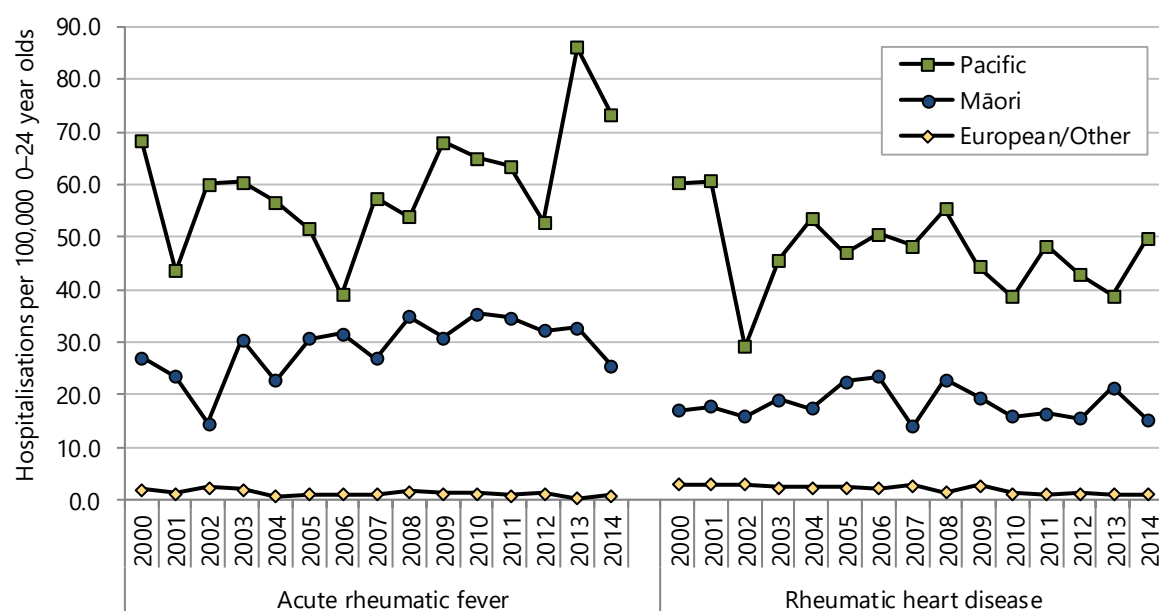
From 2000 to 2014 the hospitalisation rates for 0–24 year olds with a primary or any diagnosis of acute rheumatic fever and a primary or any diagnosis of rheumatic heart disease were stable with year-to-year fluctuations (**Figure 19**). Similar patterns over time were observed for all ethnic groups but rates were consistently highest in Pacific children and young people, and next highest in Māori (**Figure 20**).

Figure 19. Hospitalisations for acute rheumatic fever and rheumatic heart disease in 0–24 year olds, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; 'All cases' corresponds to hospitalisations with the condition listed in any of the first 15 diagnoses

Figure 20. Hospitalisations for acute rheumatic fever and rheumatic heart disease in 0–24 year olds, by ethnicity, New Zealand 2000–2014



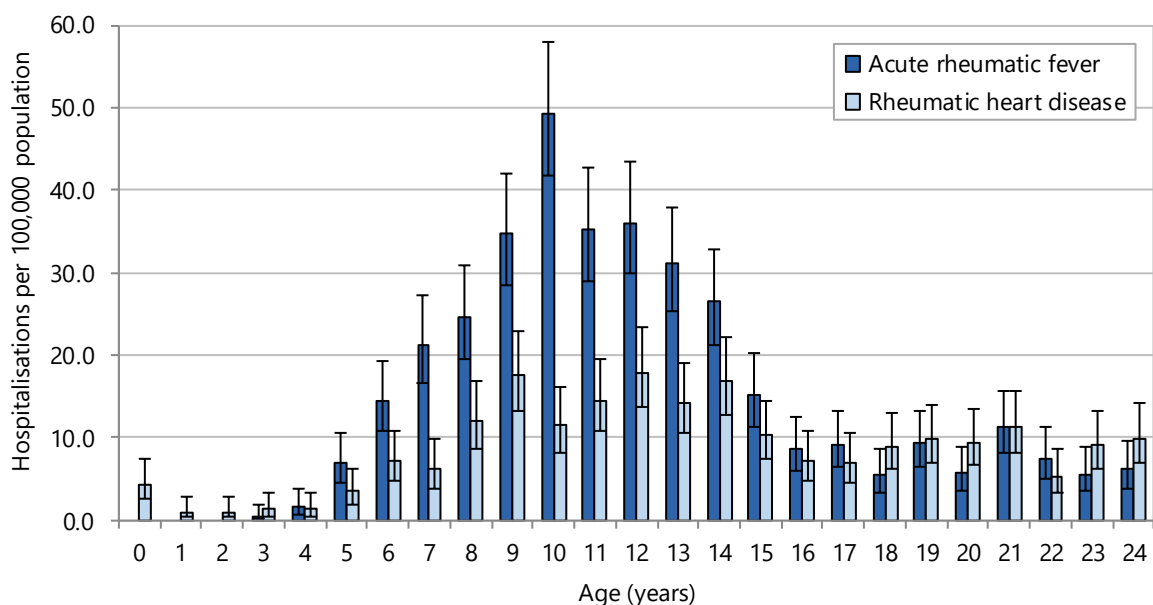
Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Acute rheumatic fever is primary diagnosis; Chronic rheumatic heart disease is listed in any of the first 15 diagnoses; Asian/Indian rates suppressed due to small numbers

Distribution by demographic factors

Between 2010 and 2014 acute rheumatic fever hospitalisation rates for 0–24 year olds were low in preschool children, rose rapidly with increasing age from 5 years to peak at 10 years, then fell until 16 years, after which they did not vary much with age (**Figure 21**). Hospitalisation rates for rheumatic heart disease followed a similar pattern but with a broader, less pronounced, peak over the age range 8–14 years (**Figure 21**).

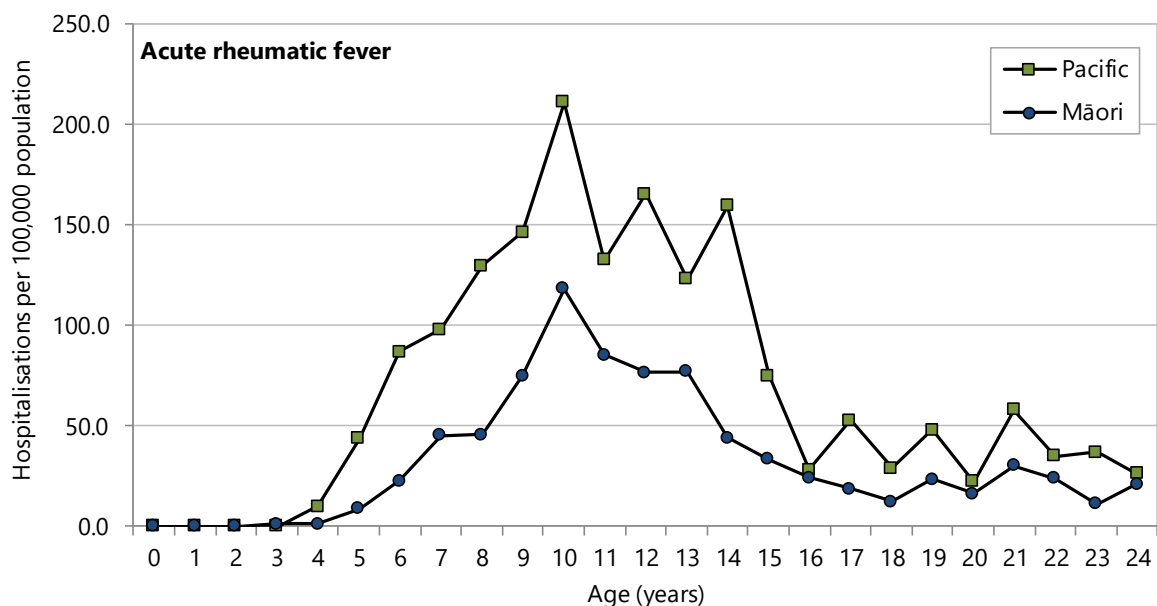
Pacific and Māori hospitalisation rates for acute rheumatic fever followed a similar pattern by age to the overall rate. Pacific rates were higher than Māori rates at all ages. Rates for European and Asian/Indian children and young people were so low that no clear pattern by age was apparent (**Figure 22**). Pacific hospitalisations for rheumatic heart disease peaked over the age range 8–14 years, but no clear pattern with age could be seen in Māori (except that hospitalisations were low in under 6 year olds). Rates for European and Asian/Indian children and young people were so low that no clear pattern by age was apparent (**Figure 23**).

Figure 21. Hospitalisations for acute rheumatic fever and rheumatic heart disease in 0–24 year olds, by age, New Zealand 2010–2014



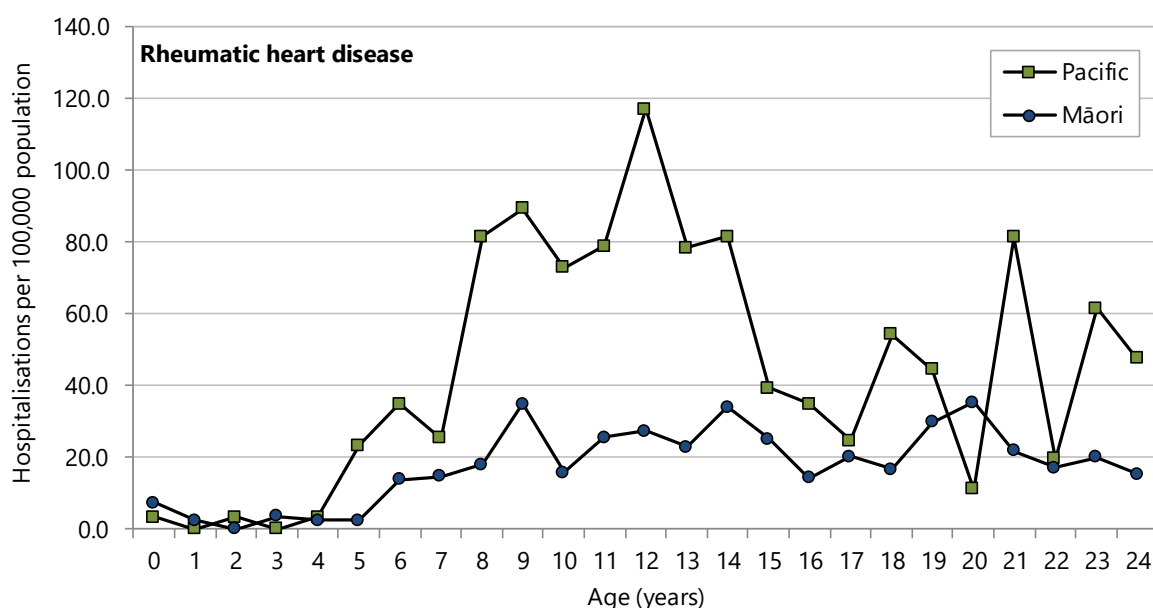
Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Acute rheumatic fever is primary diagnosis; Chronic rheumatic heart disease is listed in any of the first 15 diagnoses; Rates are per 100,000 age-specific population

Figure 22. Hospitalisations for acute rheumatic fever in 0–24 year olds, by age and ethnicity, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rates are per 100,000 population; Asian/Indian and European/Other rates are suppressed due to small numbers

Figure 23. Hospitalisations for rheumatic heart disease in 0–24 year olds, by age and ethnicity, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Chronic rheumatic heart disease in any of the first 15 diagnoses; Rates are per 100,000 population; Asian/Indian and European/Other rates suppressed due to small numbers

Between 2010 and 2014 there were disparities in acute rheumatic fever hospitalisation rates by NZDep2013 index of deprivation score, ethnicity, gender and age. Rates were *significantly higher* in areas with the highest deprivation score (deciles 9–10) compared to all other areas. Rates were *significantly lower* in areas with the lowest deprivation scores (NZDep2013 deciles 1–2) compared with areas with higher deprivation scores (deciles 3–10). Compared with European/Other, rates were *significantly higher* for Pacific and Māori. Male rates were *significantly higher* than female rates. Compared to rates for 15–24 year olds, rates were *significantly lower* in 0–4 year olds and *significantly higher* in 5–14 year olds (**Table 10**).

There were also disparities in rheumatic heart disease by NZDep2013 index of deprivation score, ethnicity, and age. Rates were *significantly higher* in areas with the highest deprivation score (deciles 9–10) compared to all other areas and in deciles 7–8 compared to deciles 1–4 and *significantly lower* in areas with the lowest deprivation scores (NZDep2013 deciles 1–2) compared with areas with higher deprivation scores (deciles 5–10). Compared with European/Other, rates were *significantly higher* for Pacific and Māori. Compared to rates for 15–24 year olds, rates were *significantly lower* in 0–4 year olds and *significantly higher* in 5–14 year olds (**Table 10**).

Table 10. Hospitalisations for acute rheumatic fever and rheumatic heart disease in 0–24 year olds, by demographic factor, New Zealand 2010–2014

Variable	Number: 2010–2014	Rate per 100,000 population	Rate ratio	95% CI
0–24 year olds				
Acute rheumatic fever				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	18	1.28	1.00	
Deciles 3–4	46	3.46	2.70	1.56–4.65
Deciles 5–6	87	6.05	4.72	2.84–7.84
Deciles 7–8	207	12.78	9.96	6.15–16.12
Deciles 9–10	854	45.91	35.78	22.43–57.06
Prioritised ethnicity				
Māori	636	35.68	30.78	23.02–41.16
Pacific	521	74.35	64.15	47.86–85.98
Asian/Indian	8	0.85	0.74	0.35–1.55
MELAA	0	..	..	..
European/Other	49	1.16	1.00	
Gender				
Female	516	13.89	1.00	
Male	699	18.05	1.30	1.16–1.46
Age				
0–4 years	6	0.40	0.04	0.02–0.09
5–14 years	904	30.17	3.06	2.68–3.48
15–24 years	305	9.88	1.00	
Rheumatic heart disease				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	13	0.93	1.00	
Deciles 3–4	19	1.43	1.54	0.76–3.12
Deciles 5–6	47	3.27	3.53	1.91–6.52
Deciles 7–8	118	7.28	7.86	4.43–13.93
Deciles 9–10	443	23.82	25.70	14.80–44.61
Prioritised ethnicity				
Māori	301	16.88	14.57	10.77–19.70
Pacific	306	43.67	37.68	27.87–50.94
Asian/Indian	5	0.53	0.46	0.18–1.15
MELAA	0	..	..	..
European/Other	49	1.16	1.00	
Gender				
Female	345	9.28	1.00	
Male	318	8.21	0.88	0.76–1.03
Age				
0–4 years	27	1.80	0.20	0.14–0.30
5–14 years	361	12.05	1.35	1.16–1.58
15–24 years	275	8.90	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Acute rheumatic fever is primary diagnosis; Chronic rheumatic heart disease is listed in any of the first 15 diagnoses; Rate ratios are unadjusted; Ethnicity is level 1 prioritised; Decile is NZDep2013

Distribution by season

There was no clear seasonal pattern in hospitalisations for either acute rheumatic fever or rheumatic heart disease.

Distribution by region

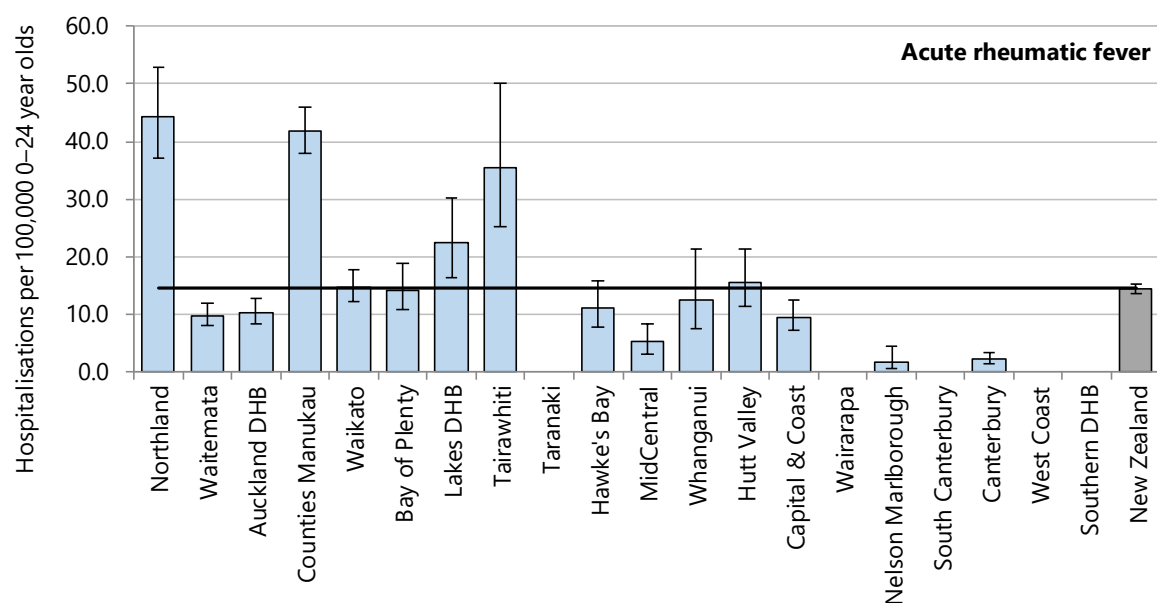
Acute rheumatic fever

Between 2010 and 2014 hospitalisations for acute rheumatic fever were *significantly higher* than the national rate in the Northland, Counties Manukau, Lakes and Tairāwhiti DHBs, and *significantly lower* in the Waitemata, Auckland, Taranaki, MidCentral, Capital & Coast, Wairarapa, Nelson Marlborough, Canterbury, South Canterbury, West Coast and Southern DHBs. While rates in a number of other DHBs also differed from the New Zealand rate, in no other cases did these differences reach statistical significance (**Figure 24, Table 11**).

Rheumatic heart disease

Between 2010 and 2014 hospitalisations for rheumatic heart disease were *significantly higher* than the national rate in the Counties Manukau and Tairāwhiti DHBs, while rates were *significantly lower* in the Waitemata, MidCentral, Canterbury, and Southern DHBs. While rates in a number of other DHBs also differed from the national rate, in no other DHB did these differences reach statistical significance and some DHBs had very small numbers (**Figure 25, Table 12**).

Figure 24. Hospitalisations for acute rheumatic fever in 0–24 year olds, by district health board, New Zealand 2010–2014



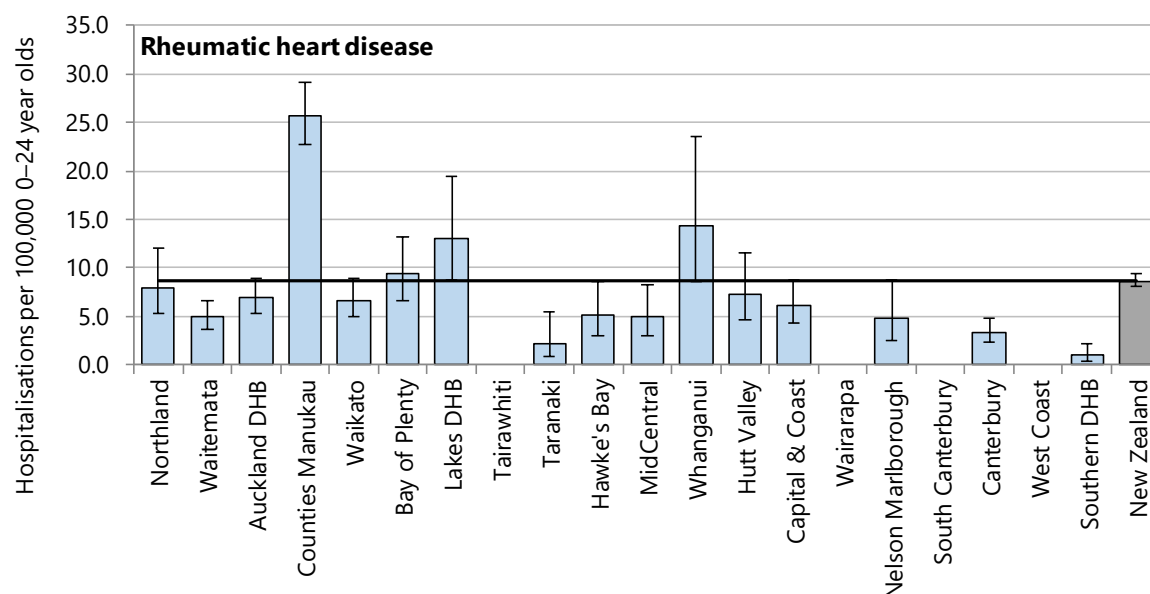
Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Table 11. Hospitalisations for acute rheumatic fever in 0–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 100,000 population	Rate ratio	95% CI
Rheumatic fever					
0–24 year olds					
Northland	123	25	44.27	3.09	2.56–3.72
Waitemata	91	18	9.63	0.67	0.54–0.83
Auckland	80	16	10.21	0.71	0.57–0.89
Counties Manukau	406	81	41.80	2.91	2.60–3.27
Waikato	99	20	14.61	1.02	0.83–1.25
Bay of Plenty	50	10	14.19	0.99	0.75–1.31
Lakes	41	8	22.26	1.55	1.14–2.12
Tairāwhiti	32	6	35.46	2.47	1.74–3.51
Taranaki	<5	s	s	s	s
Hawke's Bay	30	6	11.08	0.77	0.54–1.11
MidCentral	15	3	5.04	0.35	0.21–0.58
Whanganui	13	3	12.41	0.87	0.50–1.50
Hutt Valley	38	8	15.47	1.08	0.78–1.49
Capital & Coast	47	9	9.32	0.65	0.49–0.87
Wairarapa	<5	s	s	s	s
Nelson Marlborough	<5	s	s	s	s
South Canterbury	0	..	..	..	..
Canterbury	17	3	2.05	0.14	0.09–0.23
West Coast	<5	s	s	s	s
Southern	<5	s	s	s	s
New Zealand	1,097	219	14.34	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rate ratios are unadjusted; s: suppressed due to small numbers

Figure 25. Hospitalisations for rheumatic heart disease in 0–24 year olds, by district health board, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Chronic rheumatic heart disease is listed in any of the first 15 diagnoses; Rates suppressed if numbers less than five

Table 12. Hospitalisations for rheumatic heart disease in 0–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 100,000 population	Rate ratio	95% CI
Rheumatic heart disease					
0–24 year olds					
Northland	22	4	7.92	0.91	0.60–1.40
Waitemata	47	9	4.97	0.57	0.43–0.77
Auckland	54	11	6.89	0.80	0.60–1.05
Counties Manukau	250	50	25.74	2.97	2.57–3.43
Waikato	45	9	6.64	0.77	0.57–1.04
Bay of Plenty	33	7	9.36	1.08	0.76–1.53
Lakes	24	5	13.03	1.50	1.00–2.26
Tairāwhiti	24	5	26.59	3.07	2.04–4.61
Taranaki	<5	s	s	s	s
Hawke's Bay	14	3	5.17	0.60	0.35–1.01
MidCentral	15	3	5.04	0.58	0.35–0.97
Whanganui	15	3	14.32	1.65	0.99–2.76
Hutt Valley	18	4	7.33	0.85	0.53–1.35
Capital & Coast	31	6	6.14	0.71	0.49–1.02
Wairarapa	<5	s	s	s	s
Nelson Marlborough	10	2	4.77	0.55	0.29–1.03
South Canterbury	<5	s	s	s	s
Canterbury	28	6	3.38	0.39	0.27–0.57
West Coast	0	..	..	..	..
Southern	5	1	0.97	0.11	0.05–0.27
New Zealand	663	133	8.67	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rate ratios are unadjusted; Chronic rheumatic heart disease is listed in any of the first 15 diagnoses

South Island region distribution and trends

Comparison with New Zealand

Between 2010 and 2014 hospitalisation rates for acute rheumatic fever were *significantly lower* than the national rate in the Canterbury DHB, and too small to report in the other South Island DHBs. While similar levels were evident for rheumatic heart disease, rates in Canterbury and Southern DHBs were *significantly lower* than the national rate (**Table 13**). The annual hospitalisation rates between 2000 and 2014 have not been presented for South Island DHBs due to small numbers.

Table 13. Hospitalisations for Rheumatic fever and heart disease in 0–24 year olds, South Island DHBs vs New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 100,000 population	Rate ratio	95% CI
0–24 year olds					
Rheumatic fever					
Nelson Marlborough	<5	s	s	s	s
South Canterbury	0	..	..	..	..
Canterbury	17	3	2.05	0.14	0.09–0.23
West Coast	<5	s	s	s	s
Southern	<5	s	s	s	s
New Zealand	1,097	219	14.34	1.00	
Rheumatic heart disease					
Nelson Marlborough	10	2	4.77	0.55	0.29–1.03
South Canterbury	<5	s	s	s	s
Canterbury	28	6	3.38	0.39	0.27–0.57
West Coast	0	..	..	..	..
Southern	5	1	0.97	0.11	0.05–0.27
New Zealand	663	133	8.67	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Acute rheumatic fever is primary diagnosis; Chronic rheumatic heart disease is listed in any of the first 15 diagnoses

Evidence for good practice for the prevention and management of rheumatic fever

Ministry of Health publications

Ministry of Health. 2015. **Rheumatic fever**. <http://www.health.govt.nz/our-work/diseases-and-conditions/rheumatic-fever> accessed 30 October 2015.

This section provides information about what is being done by the Ministry of Health through the Rheumatic Fever Prevention Programme (RFPP) and also by the health sector to address RF. It includes the latest media updates and provides links to information for health professionals. It includes links to RF resources developed in partnership with the Health Promotion Agency <http://www.health.govt.nz/our-work/diseases-and-conditions/rheumatic-fever/rheumatic-fever-resources> accessed 30 October 2015. From 1 July 2017, the government will invest ongoing funding of \$5 million each year to continue with proven RF prevention initiatives. This webpage provides links to RF plans for each of the 11 DHBs in high incidence areas <http://www.health.govt.nz/our-work/diseases-and-conditions/rheumatic-fever/district-health-board-rheumatic-fever-prevention-plans>

New Zealand Guidelines Group. 2011. **Rheumatic fever: a systematic review of the literature on health literacy, overcrowding and rheumatic fever**. Wellington: Ministry of Health. <http://www.health.govt.nz/publication/rheumatic-fever-systematic-review-literature-health-literacy-overcrowding-and-rheumatic-fever>

The NZ Guidelines Group (NZGG) undertook systematic reviews of the literature to establish if health literacy/health education and interventions to reduce overcrowding and improve housing quality were effective in reducing GAS infections and rheumatic fever. The authors included relevant systematic reviews, meta-analyses, randomised controlled trials, cohort, case-control and cross-sectional studies involving children aged 5–15 years. Four NZ case studies are also included. Studies were of varying quality and not all could be fully appraised. Key factors in effective education and literacy programmes include multimodal approaches, collaboration between health and education sectors, addressing barriers to accessing health practitioners, and culturally appropriate information in local languages ideally coming from the local community, church and educational leaders and lay health workers. Within NZ endorsement by Māori and Pacific leadership is important for ensuring acceptance of RF prevention education, and Māori and Pacific networks are key partners in resource development and dissemination. NZGG recommend establishment of processes and structures that “allow programme providers and stakeholders to consolidate and share resources, innovations and key learnings” (p.44). Decreasing overcrowding is likely to improve health in general and as a consequence to lead to a decrease in rheumatic fever incidence. NZGG note that improvements in health literacy and primordial prevention in the form of decreased overcrowding and improved housing quality will only be effective within a wider prevention programme that includes case detection and registration and effective primary and secondary prophylaxis.

New Zealand Guidelines Group. 2011. **Management of Group A Streptococcal Sore Throat**. Wellington: New Zealand Guidelines Group. <http://www.health.govt.nz/system/files/documents/publications/12041320sore20throat20final20to20the20ministry.pdf>

The purpose of this evidence review is to provide an evidence-based summary of current New Zealand and overseas evidence to inform best practice in the management of people with GAS throat infection (pharyngitis) especially with the aim of preventing more acute RF. There are several key messages from the report: Antibiotics should be initiated as soon as possible as there is no evidence to support current practice of delaying treatment by up to nine days and there is no evidence to support any other recommendation about the

timing of treatment. Children at high risk of developing rheumatic fever should continue to receive empiric (immediate) antibiotic treatment and the presence of GAS should continue to be confirmed by laboratory culture. Where an intervention is planned in a school population, all consented children should be swabbed before and after the intervention, regardless of symptoms, to allow evaluation of programme effectiveness. There is reliable evidence about the efficacy of rapid antigen diagnostic tests, which give a result much faster than swabbing and testing, however there are also concerns about the heterogeneity between studies and the potential false positives if this is used as a front-line test. Once daily amoxicillin is the first choice for antibiotic treatment for a GAS throat infection. Amoxicillin is likely to achieve better compliance than Penicillin V because of once daily dosing and ability to be taken with food compared with more frequent dosing and the requirement to take it on an empty stomach.

Ministry of Health. 2015. **Using practitioner supply orders and standing orders in the rheumatic fever prevention programme: Guidance for sore throat management services.** Wellington: Ministry of Health.
<http://www.health.govt.nz/system/files/documents/publications/using-practitioner-supply-orders-and-standing-orders-rheumatic-fever-prevention-programme-feb15-v5.pdf>

A practitioner supply order is a written order for the supply of community pharmaceuticals. This document provides guidance for the dispensing and supply of antibiotics in RFPP sore throat management services including school-based programmes, rapid response clinics and other clinics that are part of the RFPP and will help health practitioners to meet the requirements of the Medicines Act 1981 and Medicines Regulations 1984. In the context of the RFPP a practitioner supply order enables a practitioner to order quantities of certain antibiotics in excess of the usual limits set by the PHARMAC Pharmaceutical Schedule, to ensure medical supplies are available for patients with suspected or confirmed GAS throat infections. The document includes advice for medical practitioners, pharmacists, and people working under a standing order. Appendices detail the recommended antibiotics with dosages, and provide a template for RFPP standing orders.

Litmus Ltd. 2013. **Implementation and Formative Evaluation of the Rheumatic Fever Prevention Programme: Final Report.** Wellington: Litmus LTD. <http://www.health.govt.nz/publication/implementation-and-formative-evaluation-rheumatic-fever-prevention-programme>

This report was prepared for the Ministry of Health and evaluates the first 18 months of the rheumatic fever prevention programme (RFPP) from 1 July 2011 to 31 December 2012. The evaluation used a mixed-methods approach including: literature and documentation review; interviews and focus groups with RFPP providers interviews and parents/caregivers as well as a survey of parents/caregivers; review of monitoring data; and case studies of four RFPP sites. The report found that there had been a positive response to the RFPP roll-out, with enthusiastic local providers rising to the challenge of implementing school throat swabbing services and community awareness raising in short timeframes. The report also identified a number of aspects to be considered to maximise the effectiveness, consistency and sustainability of activities across the RFPP sites, including better linkage to existing DHB and local child health strategies and better integration with primary care and with other health and social service providers. Key informants often cautioned that the mix of RFPP activities would not adequately address the primordial causes of RF (poverty, crowded housing, lack of access to culturally competent primary care) and there were also questions raised about cost-effectiveness of the RFPP.

Ministry of Social Development documents

Ministry of Social Development. 2011. **Delivering better public services: Supporting vulnerable children result action plan.** Wellington: Ministry of Social Development <http://www.msd.govt.nz/documents/about-msd-and-our-work/work-programmes/better-public-services/supporting-vulnerable-children/supporting-vulnerable-children-result-action-plan.pdf>

This results action plan provides the context for the Government target to reduce the incidence of rheumatic fever to 1.4 cases per 100,000 people by June 2017. This target is part of supporting vulnerable children, which is a component of the Government priority to deliver better public services within tight financial constraints. The key actions are to provide throat swabbing and treatment to children at high risk; raise community and health sector awareness of the disease; improve knowledge of rheumatic fever through surveillance and research; and work across Government agencies to address risk factors like housing conditions and hygiene in schools. The result action plan outlines the expected pattern of disease if the five-year goal is met, as well as ways the results will be measured and reported.

New Zealand guidelines

Heart Foundation of New Zealand. 2014. **Group A Streptococcal Sore Throat Management Guideline. 2014 Update.** Auckland: Heart Foundation of New Zealand.
http://www.heartfoundation.org.nz/uploads/sore_throat_guideline_14_10_06_FINAL-revised.pdf

This guideline aims to maximise diagnosis and management of pharyngitis in those who are at greatest risk of developing rheumatic fever, while minimising investigations and antibiotic use in those who are at the lowest risk, with the overall goal of RF prevention. Both the sore throat management and household sore throat management algorithm have been updated. The population at high risk for RF is defined as those individuals who have a personal, family or household history of RF, or who have two or more of the following criteria; Māori or Pacific ethnicity, age 3-35 years, living in crowded circumstances or in lower socioeconomic areas of the North Island. Correct treatment of GAS pharyngitis will substantially reduce the occurrence of ARF in populations at high risk. Throat swabbing remains the gold standard for diagnosing GAS pharyngitis and rapid antigen diagnostic tests are not currently recommended. Confirmed or suspected GAS pharyngitis in high risk populations should be treated as soon as possible; it is not safe to wait up to nine days as previously recommended. Courses of oral antibiotics for GAS pharyngitis should be of 10 days duration as there is no evidence that shorter courses prevent the subsequent development of RF. Throat swabbing is also recommended for symptomatic contacts of a patient with GAS pharyngitis, particularly if they are school-aged. Some symptomatic GAS positive patients may require isolation for 24 hours after starting antibiotics if there is a high risk of spread of infection. There are specific recommendations for outbreaks of GAS pharyngitis within a household or in another group setting. Given the lack of clarity in the literature on certain aspects of (GAS) pharyngitis the report recommends research on 14 specific research questions. An algorithms for sore throat management is available as a standalone document from <http://www.heartfoundation.org.nz/programmes-resources/health-professionals/guidelines-and-position-statements>

Heart Foundation of New Zealand. 2015. **New Zealand Guidelines for Rheumatic Fever: Diagnosis, Management and Secondary Prevention of Acute Rheumatic Fever and Rheumatic Heart Disease: 2014 Update.** Auckland: Heart Foundation of New Zealand.

http://www.heartfoundation.org.nz/uploads/HF2227A_Rheumatic_Fever_Guideline_v3.pdf

This guideline has been developed by the Heart Foundation of New Zealand and the Cardiac Society of Australia and New Zealand to identify and present the evidence for best practice in acute rheumatic fever (ARF) diagnosis, identify the standard of care that should be available to all people in New Zealand and areas where current management strategies may not be in line with available evidence, and ensure that high-risk populations receive the same standard of care as that available to other New Zealanders. It is recommended that the NZ criteria are used for the diagnosis of RF (a table on page 15 shows how these differ from the revised Jones criteria 1992 and Australian high risk criteria). The guideline details initial and ongoing management of acute RF, secondary prevention including prophylaxis in general and in specific circumstances such as in pregnancy, on oral contraceptives and in patients on anticoagulant medication. The comprehensive section on rheumatic heart disease considers oral health care, pregnancy and childbirth, anticoagulation, prevention of infective endocarditis and indications for cardiac surgery. There is no formal screening programme for RHD in NZ, however the WHF guidelines (see below) can be used to diagnose RHD by echocardiogram following clinical scenarios such as investigation of a heart murmur, history suggestive of past acute RF, or chance finding on echocardiography for other indications. Algorithms for use of echocardiography in acute RF and duration of secondary prophylaxis are available as standalone documents from <http://www.heartfoundation.org.nz/programmes-resources/health-professionals/guidelines-and-position-statements>

International guidelines

Remenyi B, et al. 2012. **World Heart Federation criteria for echocardiographic diagnosis of rheumatic heart disease--an evidence-based guideline.** *Nature Reviews Cardiology*, 9, 297-309.

Since 2004 the WHO has recommended echocardiographic screening for RHD in high-risk populations; a global consequence has been the observation that prevalence of RHD is much higher than previously thought. An international advisory group of 21 experts in rheumatic heart disease from six continents worked together to define the minimum echocardiographic criteria for a diagnosis of RHD in individuals without a clear history of acute RF. The guidelines are important to overcome systematic differences in the approaches to diagnosis and reporting of RHD that had developed over time, based on the differing experiences and disease patterns between localities. The guidelines address the full spectrum of RHD from normal, to borderline to definite RHD with subcategories of the latter two groups, and were developed on the basis of the best available evidence. A formal consensus process was used to reach agreement where evidence was insufficient in itself. Criteria are provided for individuals aged 20 years or younger, and for those aged over 20 years. Criteria are based on the type of portable echocardiographic machines that are available in relatively resource-poor and remote settings (2D, continuous-wave, and colour-Doppler echocardiography). The current value of applying the guidelines is to establish the epidemiology of RHD; further research is needed to determine whether a screening programme can reduce the burden of RHD. In particular there is uncertainty about the natural history of subclinical disease detected by echocardiography where there is no clinical heart murmur.

Evidence-based medicine reviews

Webb RH, et al. 2015. **Acute rheumatic fever.** *BMJ*, 351, h3443.

The authors searched Medline and the Cochrane Database of Systematic Reviews to collate and summarise what is currently known about RF. The journal article summarises the diagnostic criteria, management of the various symptoms of acute RF, long term complications, antibiotic prophylaxis and public health implications. References are provided to educational resources for patients, families and health professionals. Questions for future research include improving knowledge about the pathogenesis of RF, better estimation of the global burden of the disease, assessing the possible role of screening high-risk populations for RHD, cost-effectiveness of throat swabbing programmes, and questions about potential efficacy of a GAS vaccine to prevent acute RF and RHD or for immune modulatory therapies to improve cardiac outcomes and prevent the need for surgery.

Cilliers A, et al. 2015. **Anti-inflammatory treatment for carditis in acute rheumatic fever.** *Cochrane Database of Systematic Reviews* doi:10.1002/14651858.CD003176.pub3

<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003176.pub3/pdf>

Although it is clear that antibiotic treatment can prevent the development of RF and antibiotic prophylaxis can prevent recurrence, the role of anti-inflammatory treatment for established active carditis is less certain. Carditis is the most serious major manifestation of RF which may culminate in chronic valvular disease and can lead to heart failure and, ultimately, death. This systematic review included eight randomised controlled trials involving 996 people; six of the trials included children. Researchers compared several steroidal agents versus aspirin, placebo or no treatment. There was little evidence of any benefit when corticosteroids or intravenous immunoglobulins were used to reduce the risk of heart valve lesions in patients with acute RF. Most of the trials were completed over 40 years ago and there was substantial risk of bias, so results should be viewed with caution. New randomised controlled trials are needed in patients with acute RF to assess the effects of corticosteroids such as oral prednisone and intravenous methylprednisolone and the effects of other new anti-inflammatory agents, using contemporary echocardiography techniques to provide more objective and precise assessments of cardiac outcomes.

Spinks A, et al. 2013. **Antibiotics for sore throat.** *Cochrane Database of Systematic Reviews*

doi:10.1002/14651858.CD000023.pub4 <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD000023.pub4/pdf>

A systematic review of 27 randomised placebo-controlled trials with a total of 12,835 cases of sore throat found that antibiotics shortened the duration of pain symptoms by about one day and reduced the chance of developing RF by more than two-thirds in communities where that complication was common. Very few of these studies included children. The studies were of moderate to high quality; however most were conducted more than 30 years ago when patterns of disease and of antibiotic resistance were different from the present time. Based on the results of this review the use of antibiotics to treat sore throats may be justified to reduce the incidence of RF in high-prevalence settings, but in other settings there is a balance to be made between modest symptom reduction and the hazards of antimicrobial resistance. More trials are needed that involve children, and in high-income countries we need better prognostic studies to further define which patients are most likely to develop complications of sore throat and therefore benefit from antibiotic treatment.

<p>Esposito S, et al. 2015. Geoepidemiological hints about Streptococcus pyogenes strains in relationship with acute rheumatic fever. Autoimmunity Reviews, 14(7), 616-21.</p> <p>Group A Streptococcus causes a wide array of syndromes, including acute RF and GAS isolates can be serotyped using serotype specific antisera against the M protein. Although the epidemiological relationship between peculiar GAS strains and acute RF epidemics is complex, types M5 and M18 are particularly associated with acute RF. Newer genotyping methods (<i>emm</i>-typing) allows scientists to distinguish between GAS strains that were identical based on M-typing. Over 200 <i>emm</i> genotypes have been documented so far, and many studies have shown variability of <i>emm</i> genotypes in different countries of the world. The association with RF for each strain is variable depending on the design of studies, year of observation, seasonal variations, country involved, patients' age and gender. This area of laboratory research is important because surveillance of disease-causing <i>emm</i> genotypes in communities with high rates of acute rheumatic fever could contribute to design of a potential vaccine against GAS infections.</p>
<p>Other relevant publications</p>
<p>Saxena A. 2014. Increasing detection of rheumatic heart disease with echocardiography. Expert Review of Medical Devices, 11(5), 491-97.</p> <p>This article reviewed data on echocardiographic screening from several countries including India and summarised the current understanding of unresolved issues relevant to the significance and management of subclinical RHD detected by echocardiography in asymptomatic patients. The author notes that RHD is estimated to affect over 20 million people worldwide with the vast majority of these people living in developing countries. Screening for RHD has been recommended by the WHO since 2004. Conventionally, auscultation of the chest with a stethoscope has been used for diagnosing RHD, but this method has limitations and may not detect mild cases. A large number of studies have reported echocardiographic screening for RHD over the last several years. Most of these studies report an almost 10-fold higher prevalence of RHD by echocardiography as compared to conventional method of auscultation. Early diagnosis of such mild cases may be important as instituting secondary prophylaxis in such cases may reduce the burden of the disease. However, several concerns remain about the significance and natural history of these minor valvular changes detected by echocardiography. Whether secondary prophylaxis will reverse these abnormalities is also unclear. Long term follow up studies are required to answer some of these concerns.</p>
<p>Websites</p>
<p>Ministry of Health. 2015. Rheumatic fever. http://www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/rheumatic-fever accessed 29 October 2015.</p> <p>Information for families and communities about the symptoms of RF, ways to prevent it, and important actions for children who have had RF (e.g. monthly penicillin injections, and precautions before dental procedures. Includes links to videos and transcripts of interviews of children with RF and their parents as well as to the Ministry of Health RF website http://rheumaticfever.health.govt.nz/ All of the RF videos are available at http://www.health.govt.nz/our-work/diseases-and-conditions/rheumatic-fever/rheumatic-fever-resources/rheumatic-fever-campaign-online-videos</p>
<p>Ministry of Health. 2015. Sore throat clinics. https://www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/sore-throat/sore-throat-clinics accessed 29 October 2015.</p> <p>This patient information page provides details of the free clinics where Māori or Pacific children aged 4–19 years in the Northland, Auckland, Lakes, Waikato, Bay of Plenty, Gisborne/East Coast, Hawke's Bay, Porirua or Hutt Valley areas can have a sore throat checked at no charge.</p>
<p>Kidshealth. 2015. Rheumatic fever. http://www.kidshealth.org.nz/rheumatic-fever accessed 30 October 2015</p> <p>This webpage provides information for parents and caregivers of children with RF and rheumatic heart disease. It describes conditions, explains that a child will usually need to stay in hospital for one to two weeks, or longer if their heart is affected, and provides advice about caring for the child when they return home, ensuring monthly penicillin injections continue until advised to stop by a doctor (usually at age 21 or 30), and key points to prevent further episodes of RF.</p>
<p>National Heart Foundation. Rheumatic fever. http://www.heartfoundation.org.nz/know-the-facts/conditions/rheumatic-fever accessed 30 October 2015</p> <p>This is a further webpage with information for the public about RF and rheumatic heart disease. It includes a link to a booklet about RF, published in 2012 and currently under revision, which is available in English, Tongan and Samoan.</p>

SERIOUS SKIN INFECTIONS

Introduction

Serious skin infections are bacterial infections of the skin or subcutaneous tissue which require hospitalisation and often require invasive treatment like surgery. Such infections may be associated with a primary disease of the skin (e.g. eczema) and may follow trauma to the skin (e.g. insect bites).⁸⁸

New Zealand has one of the highest rates of childhood skin infections in the western world.⁸⁹ Between 1990 and 2007 skin infection hospitalisation rates almost doubled with disproportionate increases in infection rates in Māori and Pacific children and children from areas with high socioeconomic deprivation scores.⁹⁰ An initial study suggests that there may be 14 cases treated in the community (primary care/GP) for every serious skin infection hospitalisation.⁹¹ A number of socioeconomic factors are linked to the increasing frequency of skin infections including affordability of hot water, washing machines and dryers, access to medical care, household crowding, and inadequate nutrition.⁹² Other reasons for the development of skin infection include lack of awareness or knowledge about skin infections, and community attitudes which normalise such infection or stigmatise it so that people keep the condition hidden.⁸⁹

The following section reports on hospitalisations for serious skin infections in children and young people using information from the National Minimum Dataset. It concludes with a brief overview of evidence-based reviews and guidelines which consider the most effective interventions for preventing or managing serious skin infections.

Data sources and methods

Indicator

Hospitalisations involving serious skin infections in 0–24 year olds

Data sources

Numerator: National Minimum Dataset

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

Definition

Hospitalisations of 0–24 year olds with a diagnosis of a serious skin infection in any of the first 15 diagnoses (hospitalisations per 1,000 age-specific population)

The following select conditions were identified as the primary diagnosis among the hospitalisations involving serious skin infections: impetigo, cutaneous abscess, furuncle, or carbuncle, cellulitis, acute lymphadenitis, pilonidal cyst with abscess, other infections of skin and subcutaneous tissue, infections of other anatomical sites, infected, unspecified, or other dermatitis, insect or spider bites, post traumatic or open wound infection, scabies, and varicella with other complications.

Notes on interpretation

Note 1: This section utilises hospitalisations with relevant codes (see **Appendix 6**) in ANY of the first 15 diagnoses, rather than the primary diagnosis.

Note 2: This section utilises a broader set of the diagnostic codes compared to those utilised in the sections covering ambulatory sensitive hospitalisations (ASH) or hospitalisations with a social gradient. Select codes external to the skin infection codes have been incorporated, such as insect and spider bites, infected and unspecified eczema, infected open wounds, and infections at specific anatomical sites (e.g. the genitalia), based on review by O'Sullivan and Baker of skin infections in children.⁹⁰

Note 3: The rates presented here differ from those presented in the ambulatory sensitive hospitalisations (ASH) or hospitalisations with a social gradient sections. As these indicators utilise primary diagnoses and full assessment and sector consultation has not yet occurred regarding these sections adopting of the revised coding convention, as utilised in this section.

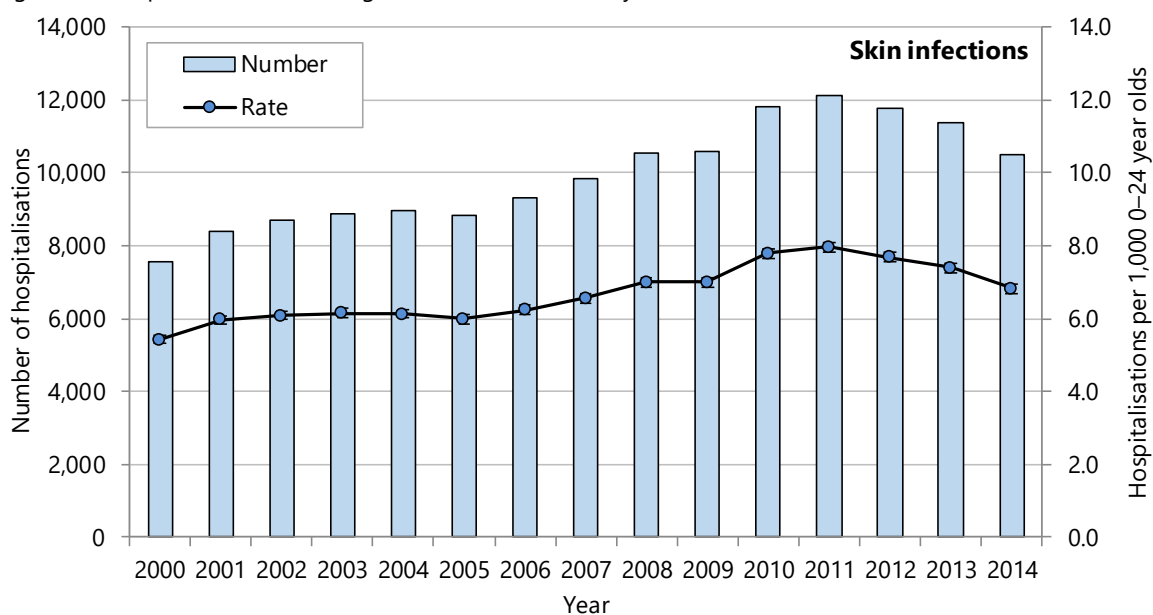
Note 4: **Appendix 3** outlines the limitations of the data utilised from the National Minimum Dataset. The reader is advised to review this appendix before interpreting any trends.

National trends and distribution

The hospitalisation rate for skin infections in 0–24 year olds was stable from 2000 to 2005, rose from 2005 to 2011 and has since been steadily falling (**Figure 26**). A similar pattern was seen in 0–14 year olds and 15–24 year olds although in every year the rate was higher in the younger age group (**Figure 27**).

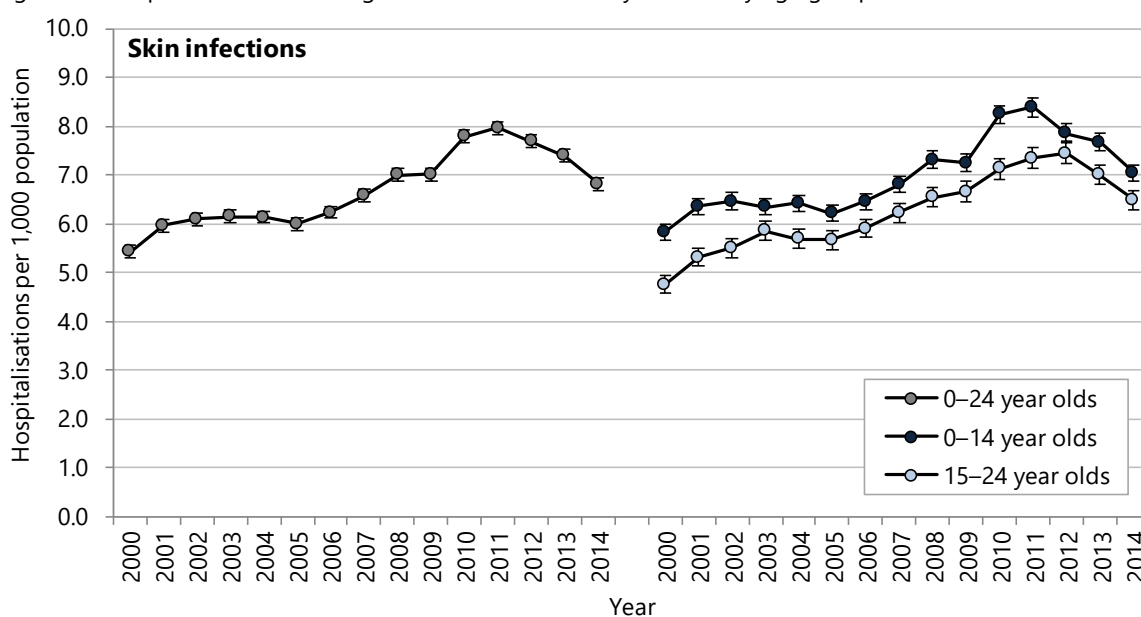
During the same period, rates were consistently highest in Pacific 0–24 year olds, followed by Māori then European then Asian/Indian. Pacific rates peaked in 2011 and Māori rates in 2010. Asian/Indian rates, although low, rose from 2000 to 2014, while European rates rose from 2000 to 2011 and then fell. Rates for MELAA were variable and slightly higher than European rates in 2009–2014 (**Figure 28**).

Figure 26. Hospitalisations involving skin infections in 0–24 year olds, New Zealand 2000–2014



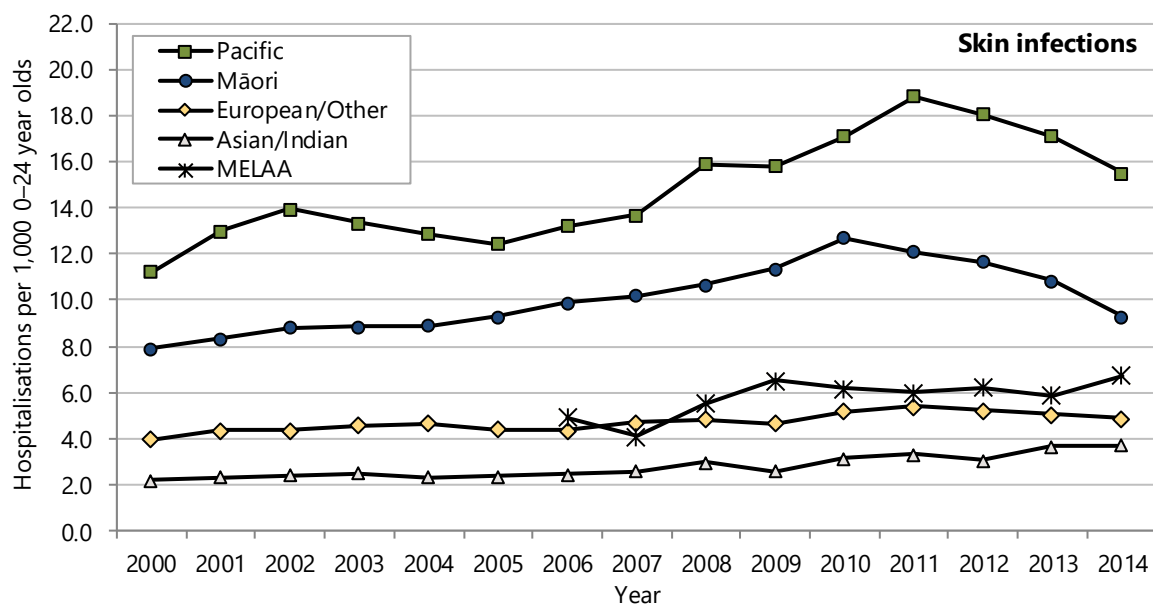
Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; skin infections in any of the first 15 diagnoses

Figure 27. Hospitalisations involving skin infections in 0–24 year olds, by age group, New Zealand 2000–2014



Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Rate is per 1,000 age-specific population; skin infections in any of the first 15 diagnoses

Figure 28. Hospitalisations involving skin infections in 0–24 year olds, by ethnicity, New Zealand 2000–2014



Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Rate is per 1,000 age-specific population; skin infections in any of the first 15 diagnoses

Distribution by cause

Between 2010 and 2014 cellulitis and cutaneous abscesses/furuncles/ carbuncles were the most frequent primary diagnoses in 0–14 year olds and 15–24 year olds hospitalised with serious skin infections (**Table 14**). Pilonidal cyst with abscess was also a relatively common diagnosis in 15–24 year olds.

Table 14. Hospitalisations for skin infections in 0–24 year olds, by age group and primary diagnosis, New Zealand 2010–2014

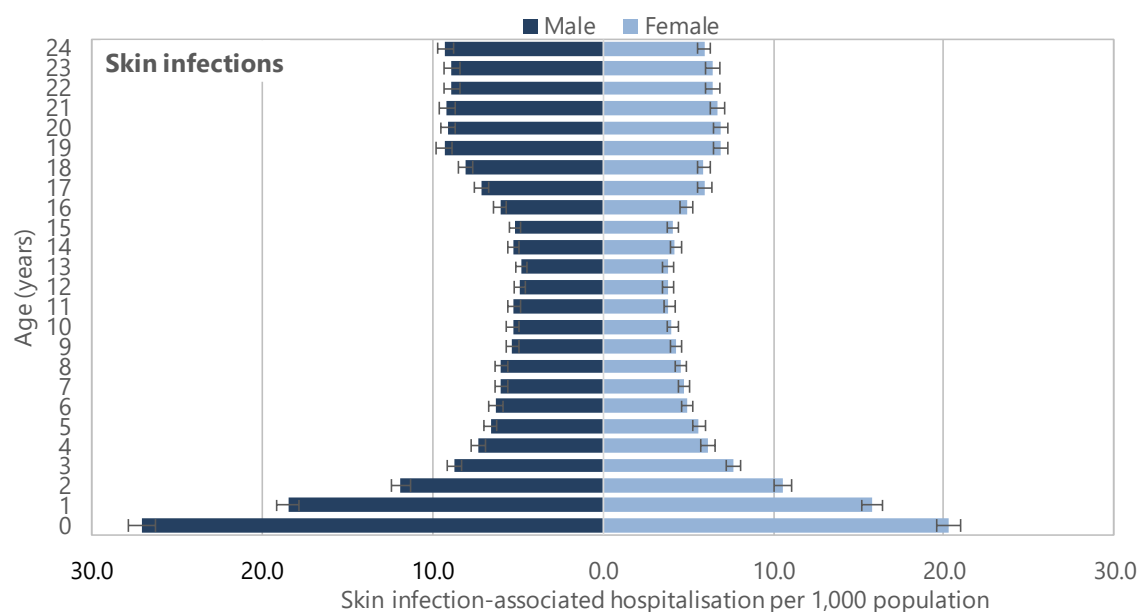
Primary skin infection diagnosis	Number: 2010–2014	Number: annual average	Rate	95% CI	Per cent
New Zealand					
0–14 year olds					
Cellulitis	6,674	1,335	1.47	1.44–1.51	18.8
Cutaneous abscess, furuncle, or carbuncle	6,392	1,278	1.41	1.38–1.45	18.0
Infected, unspecified, or other dermatitis	2,823	565	0.62	0.60–0.65	8.0
Infections of other anatomical sites	1,977	395	0.44	0.42–0.46	5.6
Acute lymphadenitis	1,151	230	0.25	0.24–0.27	3.2
Impetigo	825	165	0.18	0.17–0.20	2.3
Other infections of skin and subcutaneous tissue	623	125	0.14	0.13–0.15	1.8
Insect or spider bites	566	113	0.12	0.12–0.14	1.6
Scabies	518	104	0.11	0.10–0.12	1.5
Varicella with other complications	465	93	0.10	0.09–0.11	1.3
Post traumatic or open wound infection	144	29	0.03	0.03–0.04	0.4
Pilonidal cyst with abscess	113	23	0.02	0.02–0.03	0.3
Other diagnoses	13,209	2,642	2.92	2.87–2.97	37.2
Total	35,480	7,096	7.83	7.75–7.92	100.0
15–24 year olds					
Cutaneous abscess, furuncle, or carbuncle	4,703	941	1.51	1.46–1.55	21.3
Cellulitis	3,507	701	1.12	1.09–1.16	15.9
Pilonidal cyst with abscess	2,750	550	0.88	0.85–0.91	12.5
Infections of other anatomical sites	1,803	361	0.58	0.55–0.61	8.2
Infected, unspecified, or other dermatitis	399	80	0.13	0.12–0.14	1.8
Insect or spider bites	321	64	0.10	0.09–0.11	1.5
Other infections of skin and subcutaneous tissue	168	34	0.05	0.05–0.06	0.8
Post traumatic or open wound infection	121	24	0.04	0.03–0.05	0.5
Acute lymphadenitis	119	24	0.04	0.03–0.05	0.5
Impetigo	117	23	0.04	0.03–0.04	0.5
Scabies	71	14	0.02	0.02–0.03	0.3
Varicella with other complications	8	2	<0.01	s	<0.1
Other diagnoses	7,993	1,599	2.56	2.51–2.62	36.2
Total	22,080	4,416	7.07	6.98–7.17	100.0

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; skin infections in any of the first 15 diagnoses

Distribution by demographic factors

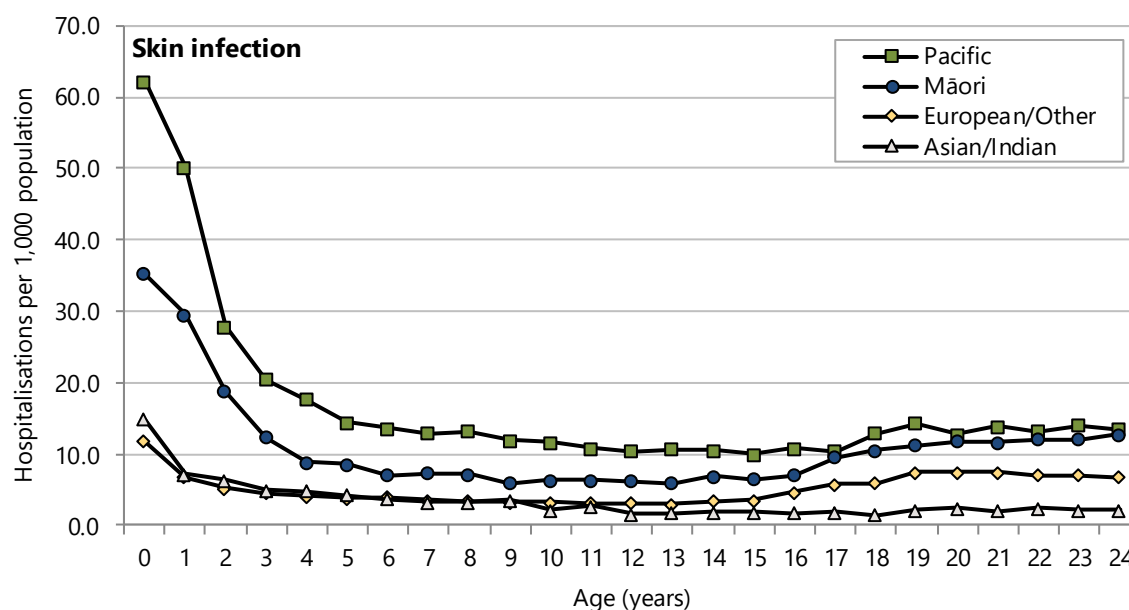
Between 2010 and 2014 skin infection hospitalisation rates for 0–24 year olds were highest for one year olds and decreased sharply with increasing age from one to four years. From age 15 years, rates rose somewhat with increasing age before levelling off from 19 years. At every age, male rates were a little higher than female rates (**Figure 29**). Similar patterns according to age were observed for all ethnic groups. Hospitalisation rates were consistently highest in Pacific, followed by Māori then European/Other and then Asian/Indian (**Figure 30**).

Figure 29. Hospitalisations involving skin infections in 0–24 year olds, by age and gender, New Zealand 2010–2014



Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Rates are per 1,000 age-specific population; skin infections in any of the first 15 diagnoses

Figure 30. Hospitalisations involving skin infections in 0–24 year olds, by age and ethnicity, New Zealand 2010–2014



Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Rates are per 1,000 age-specific population; skin infections in any of the first 15 diagnoses

Between 2010 and 2014 in 0–14 year olds there were disparities in skin infection hospitalisation rates by NZDep2013 index of deprivation score, ethnicity and gender. At each level of deprivation (other than deciles 1–2), rates were *significantly higher* than those of the level below. There were *significant* differences in rates between all ethnic groups. Rates were highest in Pacific, followed by (in decreasing order) Māori, MELAA, Asian/Indian and European. Male rates were *significantly higher* than female rates (**Table 15**).

In 15–24 year olds there were also disparities in skin infection hospitalisation rates by NZDep2013 index of deprivation score, ethnicity and gender. At each level of deprivation (other than deciles 1–2), rates were *significantly higher* than those of the level below. There were *significant* differences in rates between most ethnic groups. Only the difference between MELAA and European was *non-significant*. Rates were highest in

Pacific, followed by (in decreasing order) Māori, European and MELAA. Male rates were *significantly higher* than female rates (**Table 15**).

Table 15. Hospitalisations involving skin infections in 0–24 year olds, by age group and demographic factor, New Zealand 2010–2014

Variable	Number: 2010–2014	Rate per 1,000 population	Rate ratio	95% CI
Skin infections				
0–14 year olds				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	3,078	3.53	1.00	
Deciles 3–4	3,549	4.40	1.24	1.19–1.31
Deciles 5–6	4,868	5.69	1.61	1.54–1.69
Deciles 7–8	7,245	7.71	2.18	2.09–2.28
Deciles 9–10	16,578	15.71	4.45	4.28–4.62
Prioritised ethnicity				
Māori	13,629	11.83	2.74	2.67–2.81
Pacific	8,806	20.24	4.68	4.55–4.81
Asian/Indian	2,235	4.69	1.09	1.04–1.14
MELAA	336	6.04	1.40	1.25–1.56
European/Other	10,418	4.32	1.00	
Gender				
Female	15,385	6.97	1.00	
Male	20,095	8.65	1.24	1.22–1.27
15–24 year olds				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	2,288	4.31	1.00	
Deciles 3–4	2,709	5.19	1.20	1.14–1.27
Deciles 5–6	3,539	6.08	1.41	1.34–1.49
Deciles 7–8	5,027	7.39	1.72	1.63–1.80
Deciles 9–10	8,302	10.31	2.39	2.29–2.51
Prioritised ethnicity				
Māori	6,523	10.35	1.64	1.59–1.69
Pacific	3,326	12.52	1.99	1.91–2.06
Asian/Indian	947	2.05	0.33	0.30–0.35
MELAA	272	6.41	1.02	0.90–1.15
European/Other	10,847	6.30	1.00	
Gender				
Female	9,219	6.01	1.00	
Male	12,861	8.11	1.35	1.31–1.39

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Rates are per 1,000 age-specific population; skin infections in any of the first 15 diagnoses; Rate ratios are unadjusted; Ethnicity is level 1 prioritised; Decile is NZDep2013

Distribution by season

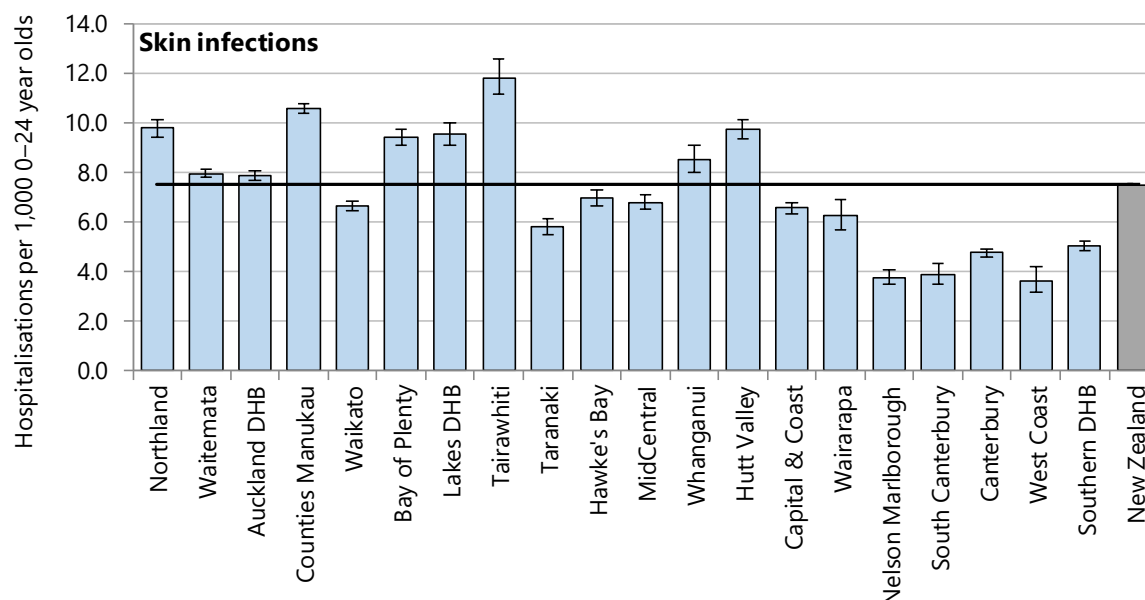
There was no great variation in hospitalisation for serious skin infections by month in 0–14 year olds or 15–24 year olds in 2010–2014 but rates tended to be somewhat higher during January–March.

Distribution by region

Between 2010 and 2014 hospitalisation rates for serious skin infections in 0–24 year olds were *significantly higher* than the national rate in the Northland, Waitemata, Auckland, Counties Manukau, Bay of Plenty, Lakes, Tairāwhiti, Whanganui, and Hutt Valley DHBs, and *significantly* lower in Waikato, Taranaki's Bay, MidCentral, Capital & Coast, Wairarapa and all of the South Island DHBs (**Figure 31, Table 16**).

The significance for DHB hospitalisation rates for serious skin infections in 0–14 year olds was the same as for 0–24 year olds (**Table 17**) while for **15–24 year olds** rates were *significantly higher* than the national rate in the Northland, Counties Manukau, Bay of Plenty, Lakes, Tairāwhiti, Whanganui and Hutt Valley DHBs, and *significantly lower* in Auckland, Waikato, Capital & Coast, and all of the South Island DHBs (**Table 18**).

Figure 31. Hospitalisations involving skin infections in 0–24 year olds, by district health board, New Zealand 2010–2014



Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; skin infections in any of the first 15 diagnoses; Rates are per 1,000 0–24 year olds

Table 16. Hospitalisations involving skin infections in 0–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 0–24 year olds	Rate ratio	95% CI
Any skin infections					
0–24 year olds					
Northland	2,721	544	9.79	1.30	1.25–1.35
Waitemata	7,525	1,505	7.96	1.06	1.03–1.08
Auckland	6,161	1,232	7.87	1.05	1.02–1.07
Counties Manukau	10,295	2,059	10.60	1.41	1.38–1.44
Waikato	4,493	899	6.63	0.88	0.85–0.91
Bay of Plenty	3,316	663	9.41	1.25	1.21–1.29
Lakes	1,761	352	9.56	1.27	1.21–1.33
Tairāwhiti	1,068	214	11.83	1.57	1.48–1.67
Taranaki	1,096	219	5.82	0.77	0.73–0.82
Hawke's Bay	1,889	378	6.97	0.93	0.89–0.97
MidCentral	2,023	405	6.79	0.90	0.86–0.94
Whanganui	893	179	8.53	1.13	1.06–1.21
Hutt Valley	2,394	479	9.75	1.30	1.24–1.35
Capital & Coast	3,309	662	6.56	0.87	0.84–0.90
Wairarapa	413	83	6.28	0.83	0.76–0.92
Nelson Marlborough	792	158	3.78	0.50	0.47–0.54
South Canterbury	330	66	3.87	0.51	0.46–0.57
Canterbury	3,939	788	4.76	0.63	0.61–0.65
West Coast	182	36	3.65	0.49	0.42–0.56
Southern	2,611	522	5.05	0.67	0.65–0.70
New Zealand	57,560	11,512	7.52	1.00	

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; skin infections in any of the first 15 diagnoses; Rates are per 1,000 0–24 year olds

Table 17. Hospitalisations for serious skin infections in 0–14 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 0–14 year olds	Rate ratio	95% CI
Any skin infections					
0–14 year olds					
Northland	1,853	371	10.22	1.30	1.24–1.37
Waitemata	4,805	961	8.56	1.09	1.06–1.13
Auckland	3,949	790	9.57	1.22	1.18–1.26
Counties Manukau	6,749	1,350	11.37	1.45	1.41–1.49
Waikato	2,720	544	6.67	0.85	0.82–0.88
Bay of Plenty	2,143	429	9.44	1.21	1.15–1.26
Lakes	1,100	220	9.36	1.19	1.13–1.27
Tairāwhiti	738	148	12.60	1.61	1.50–1.73
Taranaki	596	119	4.98	0.64	0.59–0.69
Hawke's Bay	1,240	248	7.16	0.91	0.86–0.97
MidCentral	1,098	220	6.40	0.82	0.77–0.87
Whanganui	567	113	8.66	1.11	1.02–1.20
Hutt Valley	1,574	315	10.42	1.33	1.27–1.40
Capital & Coast	1,905	381	6.96	0.89	0.85–0.93
Wairarapa	244	49	5.81	0.74	0.65–0.84
Nelson Marlborough	473	95	3.52	0.45	0.41–0.49
South Canterbury	197	39	3.72	0.48	0.41–0.55
Canterbury	2,048	410	4.33	0.55	0.53–0.58
West Coast	75	15	2.38	0.30	0.24–0.38
Southern	1,255	251	4.48	0.57	0.54–0.60
New Zealand	35,480	7,096	7.83	1.00	

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; skin infections in any of the first 15 diagnoses; Rate ratios are unadjusted

Table 18. Hospitalisations for serious skin infections in 15–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 15–24 year olds	Rate ratio	95% CI
Any skin infections					
15–24 year olds					
Northland	868	174	9.00	1.27	1.19–1.36
Waitemata	2,720	544	7.09	1.00	0.96–1.04
Auckland	2,212	442	5.97	0.84	0.81–0.88
Counties Manukau	3,546	709	9.39	1.33	1.28–1.37
Waikato	1,773	355	6.57	0.93	0.89–0.97
Bay of Plenty	1,173	235	9.35	1.32	1.25–1.40
Lakes	661	132	9.92	1.40	1.30–1.51
Tairāwhiti	330	66	10.42	1.47	1.32–1.64
Taranaki	500	100	7.27	1.03	0.94–1.12
Hawke's Bay	649	130	6.65	0.94	0.87–1.02
MidCentral	925	185	7.33	1.04	0.97–1.11
Whanganui	326	65	8.31	1.17	1.05–1.31
Hutt Valley	820	164	8.67	1.23	1.14–1.31
Capital & Coast	1,404	281	6.08	0.86	0.81–0.91
Wairarapa	169	34	7.11	1.01	0.86–1.17
Nelson Marlborough	319	64	4.23	0.60	0.54–0.67
South Canterbury	133	27	4.12	0.58	0.49–0.69
Canterbury	1,891	378	5.33	0.75	0.72–0.79
West Coast	107	21	5.84	0.83	0.68–1.00
Southern	1,356	271	5.74	0.81	0.77–0.86
New Zealand	22,080	4,416	7.07	1.00	

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; skin infections in any of the first 15 diagnoses; Rate ratios are unadjusted

South Island region distribution and trends

Comparison with New Zealand

Between 2010 and 2014 hospitalisation rates for serious skin infections in 0–24 year olds and 0–14 year olds were *significantly lower* than the national rate in all five South Island DHBs. In 15–24 year olds, rates were *significantly lower* in all South Island DHBs except West Coast DHB, where it was *not significantly different* from the national rate (**Table 19**).

Table 19. Hospitalisations involving skin infections in 0–24 year olds, by age group, South Island DHBs vs New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 population	Rate ratio	95% CI
Any skin infections					
0–24 year olds					
Nelson Marlborough	792	158	3.78	0.50	0.47–0.54
South Canterbury	330	66	3.87	0.51	0.46–0.57
Canterbury	3,939	788	4.76	0.63	0.61–0.65
West Coast	182	36	3.65	0.49	0.42–0.56
Southern	2,611	522	5.05	0.67	0.65–0.70
New Zealand	57,560	11,512	7.52	1.00	
0–14 year olds					
Nelson Marlborough	473	95	3.52	0.45	0.41–0.49
South Canterbury	197	39	3.72	0.48	0.41–0.55
Canterbury	2,048	410	4.33	0.55	0.53–0.58
West Coast	75	15	2.38	0.30	0.24–0.38
Southern	1,255	251	4.48	0.57	0.54–0.60
New Zealand	35,480	7,096	7.83	1.00	
15–24 year olds					
Nelson Marlborough	319	64	4.23	0.60	0.54–0.67
South Canterbury	133	27	4.12	0.58	0.49–0.69
Canterbury	1,891	378	5.33	0.75	0.72–0.79
West Coast	107	21	5.84	0.83	0.68–1.00
Southern	1,356	271	5.74	0.81	0.77–0.86
New Zealand	22,080	4,416	7.07	1.00	

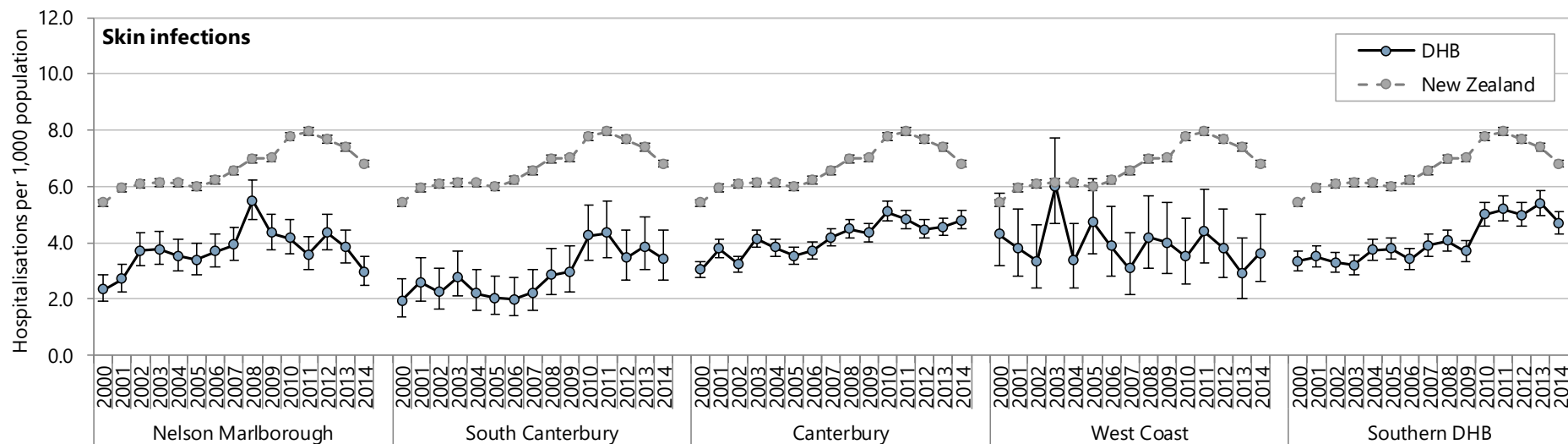
Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses; Rate ratios are unadjusted

Regional trends

Hospitalisations for serious skin infections in 0–24 year olds generally increased in all South Island DHBs except West Coast DHB between 2000 and 2014 (**Figure 32**). On the West Coast decreasing hospitalisation rates were observed for both the 0–14 and 15–24 years age groups, while increases for the two age groups were seen in the other South Island DHBs (**Figure 33**).

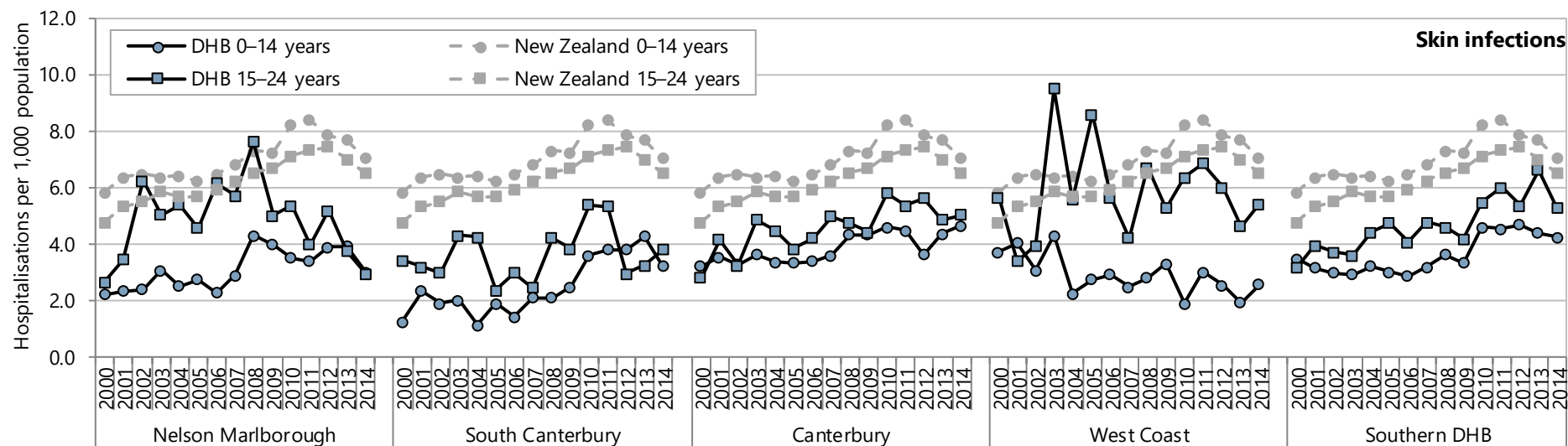
From 2000 to 2014, rates for 0–24 year olds hospitalised with skin infections were highest for Pacific than for the other ethnic groups in Nelson Marlborough, Canterbury and Southern DHBs. Hospitalisation rates for Māori increased in all South Island DHBs except on the West Coast. European/Other rates remained steady in Nelson Marlborough and West Coast DHBs, and rose for the other DHBs (**Figure 34**, **Figure 35**).

Figure 32. Hospitalisations involving skin infections in 0–24 year olds, South Island DHBs vs New Zealand 2000–2014



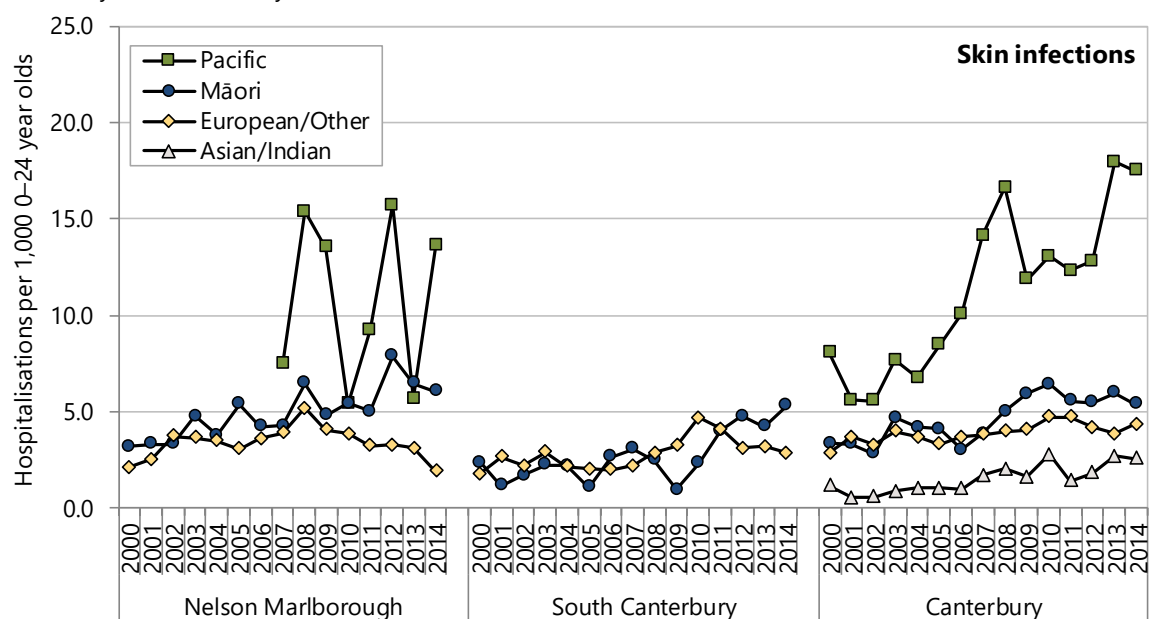
Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses

Figure 33. Hospitalisations involving skin infections in 0–24 year olds, by age group, South Island DHBs vs New Zealand 2000–2014



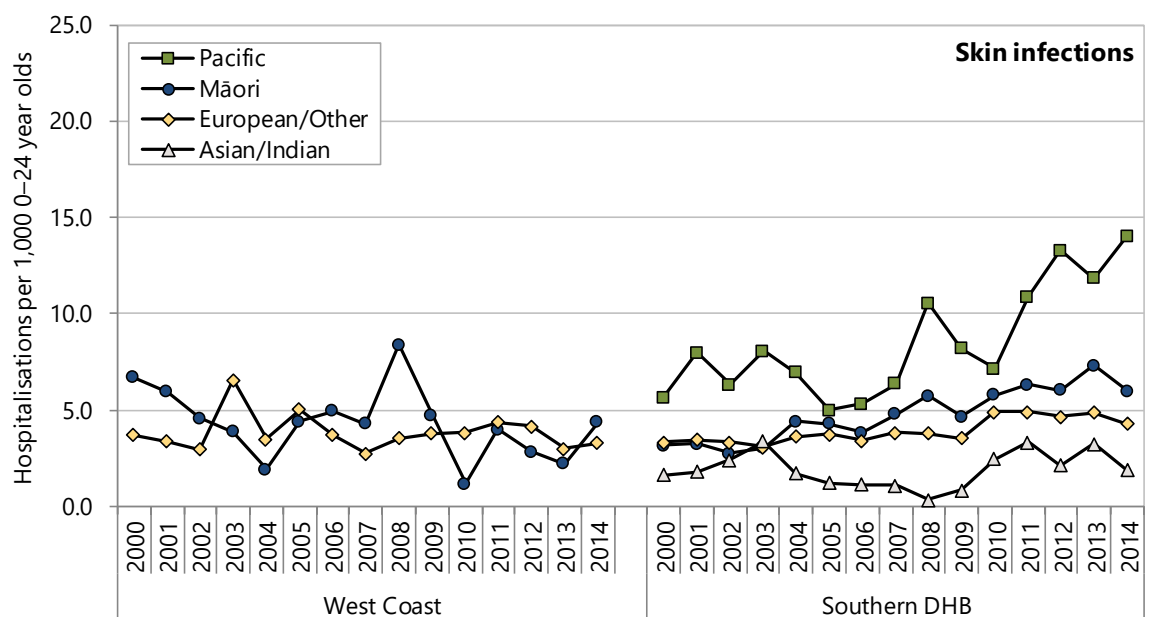
Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses

Figure 34. Hospitalisations involving skin infections in 0–24 year olds, by ethnicity, Nelson Marlborough, South Canterbury, and Canterbury DHBs 2000–2014



Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses; Pacific rates for Nelson Marlborough are suppressed in the earlier years due to small numbers

Figure 35. Hospitalisations involving skin infections in 0–24 year olds, by ethnicity, West Coast and Southern DHBs 2000–2014



Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses

Regional distribution by cause

In all the South Island DHBs during 2010–2014, cellulitis and cutaneous abscesses, furuncles or carbuncles were the most frequent primary diagnoses in 0–24 year olds admitted to hospital with serious skin infections (**Table 20–Table 24**).

Table 20. Hospitalisations for serious skin infections in 0–24 year olds, by age group and primary diagnosis, Nelson Marlborough DHB 2010–2014

Primary diagnosis	Number: 2010–2014	Number: annual average	Rate per 1,000 population	95% CI	Per cent
Nelson Marlborough					
0–14 year olds					
Cellulitis	56	11	0.42	0.32–0.54	11.8
Cutaneous abscess, furuncle, or carbuncle	55	11	0.41	0.31–0.53	11.6
Infected, unspecified, or other dermatitis	52	10	0.39	0.30–0.51	11.0
Infections of other anatomical sites	23	5	0.17	0.11–0.26	4.9
Insect or spider bites	22	4	0.16	0.11–0.25	4.7
Impetigo	17	3	0.13	0.08–0.20	3.6
Acute lymphadenitis	14	3	0.10	0.06–0.18	3.0
Other infections of skin and subcutaneous tissue	10	2	0.07	0.04–0.14	2.1
Post traumatic or open wound infection	7	1	0.05	0.03–0.11	1.5
Varicella with other complications	5	1	0.04	0.02–0.09	1.1
Scabies	<5	s	s	s	s
Other diagnoses	209	42	1.56	1.36–1.78	44.2
Total	473	95	3.52	3.22–3.85	100.0
15–24 year olds					
Pilonidal cyst with abscess	68	14	0.90	0.71–1.14	21.3
Cutaneous abscess, furuncle, or carbuncle	33	7	0.44	0.31–0.61	10.3
Cellulitis	31	6	0.41	0.29–0.58	9.7
Infections of other anatomical sites	25	5	0.33	0.22–0.49	7.8
Insect or spider bites	6	1	0.08	0.04–0.17	1.9
Infected, unspecified, or other dermatitis	<5	s	s	s	s
Post traumatic or open wound infection	<5	s	s	s	s
Other infections of skin and subcutaneous tissue	<5	s	s	s	s
Other diagnoses	148	30	1.96	1.67–2.31	46.4
Total	319	64	4.23	3.79–4.72	100.0

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses

Table 21. Hospitalisations for serious skin infections in 0–24 year olds, by age group and primary diagnosis, South Canterbury DHB 2010–2014

Primary diagnosis	Number: 2010–2014	Number: annual average	Rate per 1,000 population	95% CI	Per cent
South Canterbury					
0–14 year olds					
Infected, unspecified, or other dermatitis	33	7	0.62	0.44–0.88	16.8
Cellulitis	29	6	0.55	0.38–0.79	14.7
Cutaneous abscess, furuncle, or carbuncle	18	4	0.34	0.22–0.54	9.1
Impetigo	9	2	0.17	0.09–0.32	4.6
Infections of other anatomical sites	8	2	0.15	0.08–0.30	4.1
Acute lymphadenitis	<5	s	s	s	s
Varicella with other complications	<5	s	s	s	s
Other infections of skin and subcutaneous tissue	<5	s	s	s	s
Scabies	<5	s	s	s	s
Post traumatic or open wound infection	<5	s	s	s	s
Other diagnoses	91	18	1.72	1.40–2.11	46.2
Total	197	39	3.72	3.24–4.28	100.0
15–24 year olds					
Cellulitis	27	5	0.84	0.57–1.22	20.3
Cutaneous abscess, furuncle, or carbuncle	20	4	0.62	0.40–0.96	15.0
Infections of other anatomical sites	19	4	0.59	0.38–0.92	14.3
Pilonidal cyst with abscess	8	2	0.25	0.13–0.49	6.0
Insect or spider bites	<5	s	s	s	s
Infected, unspecified, or other dermatitis	<5	s	s	s	s
Acute lymphadenitis	<5	s	s	s	s
Other infections of skin and subcutaneous tissue	<5	s	s	s	s
Post traumatic or open wound infection	<5	s	s	s	s
Other diagnoses	49	10	1.52	1.15–2.01	36.8
Total	133	27	4.12	3.48–4.88	100.0

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses

Table 22. Hospitalisations for serious skin infections in 0–24 year olds, by age group and primary diagnosis, Canterbury DHB 2010–2014

Primary diagnosis	Number: 2010–2014	Number: annual average	Rate per 1,000 population	95% CI	Per cent
Canterbury					
0–14 year olds					
Cellulitis	350	70	0.74	0.67–0.82	17.1
Cutaneous abscess, furuncle, or carbuncle	251	50	0.53	0.47–0.60	12.3
Infected, unspecified, or other dermatitis	186	37	0.39	0.34–0.45	9.1
Infections of other anatomical sites	148	30	0.31	0.27–0.37	7.2
Acute lymphadenitis	137	27	0.29	0.24–0.34	6.7
Impetigo	51	10	0.11	0.08–0.14	2.5
Other infections of skin and subcutaneous tissue	47	9	0.10	0.07–0.13	2.3
Insect or spider bites	45	9	0.10	0.07–0.13	2.2
Varicella with other complications	33	7	0.07	0.05–0.10	1.6
Scabies	16	3	0.03	0.02–0.05	0.8
Post traumatic or open wound infection	6	1	0.01	0.01–0.03	0.3
Pilonidal cyst with abscess	5	1	0.01	<0.01–0.02	0.2
Other diagnoses	773	155	1.63	1.52–1.75	37.7
Total	2,048	410	4.33	4.14–4.52	100.0
15–24 year olds					
Pilonidal cyst with abscess	408	82	1.15	1.04–1.27	21.6
Cutaneous abscess, furuncle, or carbuncle	272	54	0.77	0.68–0.86	14.4
Infections of other anatomical sites	173	35	0.49	0.42–0.57	9.1
Cellulitis	168	34	0.47	0.41–0.55	8.9
Infected, unspecified, or other dermatitis	22	4	0.06	0.04–0.09	1.2
Insect or spider bites	21	4	0.06	0.04–0.09	1.1
Acute lymphadenitis	19	4	0.05	0.03–0.08	1.0
Other infections of skin and subcutaneous tissue	18	4	0.05	0.03–0.08	1.0
Impetigo	15	3	0.04	0.03–0.07	0.8
Post traumatic or open wound infection	8	2	0.02	0.01–0.04	0.4
Scabies	6	1	0.02	0.01–0.04	0.3
Varicella with other complications	<5	s	s	s	s
Other diagnoses	760	152	2.14	1.99–2.3	40.2
Total	1,891	378	5.33	5.09–5.57	100.0

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses; Rates are per 1,000 age-specific population

Table 23. Hospitalisations for serious skin infections in 0–24 year olds, by age group and primary diagnosis, West Coast DHB 2010–2014

Primary diagnosis	Number: 2010–2014	Number: annual average	Rate per 1,000 population	95% CI	Per cent
West Coast					
0–14 year olds					
Cellulitis	13	3	0.41	0.24–0.70	17.3
Infections of other anatomical sites	7	1	0.22	0.11–0.46	9.3
Cutaneous abscess, furuncle, or carbuncle	5	1	0.16	0.07–0.37	6.7
Insect or spider bites	<5	s	s	s	s
Infected, unspecified, or other dermatitis	<5	s	s	s	s
Other infections of skin and subcutaneous tissue	<5	s	s	s	s
Scabies	<5	s	s	s	s
Varicella with other complications	<5	s	s	s	s
Other diagnoses	39	8	1.24	0.90–1.69	52.0
Total	75	15	2.38	1.90–2.98	100.0
15–24 year olds					
Cellulitis	21	4	1.15	0.75–1.75	19.6
Infections of other anatomical sites	9	2	0.49	0.26–0.93	8.4
Insect or spider bites	7	1	0.38	0.19–0.79	6.5
Cutaneous abscess, furuncle, or carbuncle	<5	s	s	s	s
Pilonidal cyst with abscess	<5	s	s	s	s
Post traumatic or open wound infection	<5	s	s	s	s
Infected, unspecified, or other dermatitis	<5	s	s	s	s
Other diagnoses	59	12	3.22	2.50–4.15	55.1
Total	107	21	5.84	4.84–7.06	100.0

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses

Table 24. Hospitalisations for serious skin infections in 0–24 year olds, by age group and primary diagnosis, Southern DHB 2010–2014

Primary diagnosis	Number: 2010–2014	Number: annual average	Rate per 1,000 population	95% CI	Per cent
Southern DHB					
0–14 year olds					
Cellulitis	217	43	0.77	0.68–0.88	17.3
Infected, unspecified, or other dermatitis	132	26	0.47	0.40–0.56	10.5
Cutaneous abscess, furuncle, or carbuncle	125	25	0.45	0.37–0.53	10.0
Infections of other anatomical sites	68	14	0.24	0.19–0.31	5.4
Acute lymphadenitis	52	10	0.19	0.14–0.24	4.1
Impetigo	41	8	0.15	0.11–0.20	3.3
Other infections of skin and subcutaneous tissue	26	5	0.09	0.06–0.14	2.1
Insect or spider bites	21	4	0.07	0.05–0.11	1.7
Scabies	12	2	0.04	0.02–0.07	1.0
Post traumatic or open wound infection	12	2	0.04	0.02–0.07	1.0
Varicella with other complications	11	2	0.04	0.02–0.07	0.9
Pilonidal cyst with abscess	<5	s	s	s	s
Other diagnoses	535	107	1.91	1.75–2.08	42.6
Total	1,255	251	4.48	4.24–4.73	100.0
15–24 year olds					
Cellulitis	228	46	0.96	0.85–1.10	16.8
Pilonidal cyst with abscess	220	44	0.93	0.82–1.06	16.2
Cutaneous abscess, furuncle, or carbuncle	176	35	0.74	0.64–0.86	13.0
Infections of other anatomical sites	111	22	0.47	0.39–0.57	8.2
Insect or spider bites	16	3	0.07	0.04–0.11	1.2
Infected, unspecified, or other dermatitis	11	2	0.05	0.03–0.08	0.8
Other infections of skin and subcutaneous tissue	9	2	0.04	0.02–0.07	0.7
Acute lymphadenitis	8	2	0.03	0.02–0.07	0.6
Post traumatic or open wound infection	7	1	0.03	0.01–0.06	0.5
Impetigo	<5	s	s	s	s
Scabies	<5	s	s	s	s
Varicella with other complications	0	..	..	..	..
Other diagnoses	564	113	2.39	2.20–2.59	41.6
Total	1,356	271	5.74	5.44–6.05	100.0

Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population; Skin infections in any of the first 15 diagnoses; Rates are per 1,000 age-specific population

Regional distribution by season

In the South Island DHBs during 2010–2014, there were no consistent seasonal variations in hospitalisation rates for serious skin infections 0–24 year olds.

Evidence for good practice relevant to serious skin infections

Ministry of Health publications
<p>White C, et al. 2013. Health literacy and the prevention and management of skin infections. Workplace Education Trust. http://www.healthliteracy.org.nz/wp-content/uploads/2013/11/Report-skin-infections.pdf</p> <p>This report was prepared for the Ministry of Health to investigate the role of health literacy interventions in the prevention and management of skin infections in Māori children aged under 15 years. Identification of barriers to and facilitators of health literacy as well as interventions to improve health literacy led to the development and trialling of resources for parents and caregivers. These could be used by health practitioners and teachers to discuss the prevention and management of skin infections. The booklet and poster were well received and lesson plans developed for schools also received positive feedback from teachers. Appendices include the full skin infection literature review and copies of the booklet and poster. The latter resources can also be accessed from the Workplace Education webpage (scroll down to find skin resources) http://www.healthliteracy.org.nz/research-and-projects/#3726.</p>
New Zealand guidelines
<p>DermNet New Zealand Trust. 2015. DermNet NZ: The dermatology resource. http://www.dermnetnz.org/contents.html accessed 16 November 2015.</p> <p>This interactive website provides detailed information about skin conditions including boils, abscesses, impetigo and cellulitis. For each type of skin infection there are links to clinical information including photographs, reasons for occurrence, prevention and treatment methods. Within the website there is also a link to an online continuing education resource for health professionals on bacterial skin infections http://www.dermnetnz.org/doctors/bacterial-infections/</p>
Evidence-based medicine reviews
<p>Bowen AC, et al. 2015. The global epidemiology of impetigo: A systematic review of the population prevalence of impetigo and pyoderma. PLoS ONE, 10(8).</p> <p>A systematic review of the global childhood population prevalence of impetigo (also known as skin sores or school sores) and bacterial skin infections associated with the production of pus (collectively known as pyoderma; a term that is inclusive of impetigo) using journal articles published between 1970 and 2014. Impetigo prevalence was highest in Oceania, in both resource-poor countries and underprivileged populations within high-income countries. The authors comment that as antibiotics are a mainstay of treatment for impetigo, the high disease burden may contribute to antibiotic resistance in the absence of evidence-based treatment algorithms.</p>
<p>Koning S, et al. 2012. Interventions for impetigo. Cochrane Database of Systematic Reviews. http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003261.pub3/full</p> <p>Authors included 68 trials with 5578 participants, reporting on 50 different treatments, including placebo. Topical antibiotic treatment showed better cure rates than placebo (pooled risk ratio (RR) 2.24, 95% confidence interval (CI) 1.61 to 3.13) in 6 studies with 575 participants. In 4 studies with 440 participants the two most commonly studied topical antibiotics (mupirocin and fusidic acid) were equally effective. There was good evidence that topical mupirocin and topical fusidic acid are equally, or more, effective than oral treatment. There was a lack of evidence for the benefit of using disinfectant solutions. In 2 pooled studies with 292 participants, topical antibiotics were significantly better than disinfecting treatments (RR 1.15, 95% CI 1.01 to 1.32).</p>
Other relevant publications
<p>O'Sullivan CE, et al. 2011. Increasing hospitalizations for serious skin infections in New Zealand children, 1990 - 2007. Epidemiology and Infection, 139(11), 1794-804.</p> <p>Descriptive epidemiology of serious skin infections in New Zealand 0–14 year olds showed an increase in incidence from 1990 to 2007 in which time rates almost doubled. Between 1990 and 2007 there were 64,568 hospitalisations of NZ children for serious skin infections with a mean stay of 3.3 days. Cost of hospitalisations in 2007 alone was estimated at NZ\$15 million. Hospitalisation rates were significantly higher in summer and autumn, and there was a rough North-South gradient with higher rates in North Island DHBs compared with South Island. Urban areas had higher hospitalisation rates than rural areas for skin infections. There was worsening disparity by NZ Index of Deprivation score over time.</p>
<p>O'Sullivan C & Baker MG. 2012. Skin infections in children in a New Zealand primary care setting: Exploring beneath the tip of the iceberg. New Zealand Medical Journal, 125(1351), 70-79. https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2012/vol-125-no-1351/article-osullivan2</p> <p>O'Sullivan et al undertook subsequent research to estimate the incidence of childhood skin infections in primary care through prospective observational analysis of cases seen by a cohort of general practitioners (GPs) in the Tairāwhiti region. They found that the epidemiology of skin infections in primary care reflected that of hospitalised serious skin infections, except there was a relatively higher proportion of 5–9 year olds presenting to GPs whereas hospitalisations were mainly of preschool-aged children. If the observed ratio of 14 primary care cases for every one hospitalised case applied uniformly across NZ there may be 62,347 GP cases per year nationally, although further studies in other primary care populations are needed before relying on such extrapolations.</p>
Websites
<p>Kidshealth. 2014. Looking after your child's skin and treating skin infections. http://kidshealth.org.nz/looking-after-your-childs-skin-and-treating-skin-infections accessed 18 November 2015. Kidshealth. 2014. Boils. accessed 16 November 2015.</p> <p>This webpage provides a link to a 24 page booklet that will assist parents and caregivers to keep skin healthy and recognise a number of skin conditions including boils, cellulitis and impetigo. From this page parents can follow links to information about a number of skin conditions including patient-centred information about identification and management of boils http://kidshealth.org.nz/boils_and_impetigo and a poster about skin problems in children http://kidshealth.org.nz/skin-problems-children.</p>

GASTROENTERITIS

Introduction

Acute gastroenteritis is the sudden onset of diarrhoea with three or more loose stools per day and may be accompanied by vomiting. It is most commonly caused by micro-organisms spread by the faecal-oral route and is only rarely due to chemical contamination of water or food.⁷⁶ Gastroenteritis caused by rotavirus is extremely common, estimated to affect almost all children, and has an illness spectrum more severe than diarrhoea from other causes. Clinical presentation of rotavirus can vary from asymptomatic infection to severe dehydrating gastroenteritis; the latter occurs predominantly between the ages of three months and two years.⁵⁸

Certain categories of acute gastroenteritis are notifiable conditions including cases of infectious gastroenteritis where there is a suspected common source (e.g. norovirus or rotavirus outbreak); single cases in a high-risk category (e.g. early childhood education worker), single cases of chemical, bacterial or toxic food poisoning (e.g. botulism), and disease caused by toxin-producing *Escherichia coli* or other organisms of public health importance. These must all be reported to the local medical officer of health without delay.⁷⁶ The most important factors in preventing the spread of gastroenteritis are washing hands with soap in warm running water and careful drying (especially after going to the toilet or changing nappies and before preparing, serving or eating food), and keeping children away from school until at least 48 hours after the last episode of diarrhoea or vomiting and from swimming in pools until two weeks after the last episode of diarrhoea.^{76,93} However because rates of rotavirus illness are similar in developed and developing countries it is likely that good hygiene and clean water supplies do not have a significant impact on primary prevention of rotaviral disease and immunisation is the primary public health measure for the reduction of rotavirus disease burden. Since July 2014 rotavirus vaccine has been funded at ages 6 weeks, 3 and 5 months as part of the National Immunisation Schedule.⁵⁸

The following section reports on hospitalisations for gastroenteritis in children and young people using information from the National Minimum Dataset. It concludes with a brief overview of evidence-based reviews and guidelines which consider the most effective interventions for preventing or managing gastroenteritis in children and young people.

Data sources and methods

Indicator

Hospitalisations for gastroenteritis in 0–24 year olds

Data sources

Numerator: National Minimum Dataset

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

Definition

Hospitalisations: Acute and arranged hospitalisations for 0–24 year olds with a primary diagnosis of gastroenteritis. Refer to **Appendix 6** for the codes included.

Notes on interpretation

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

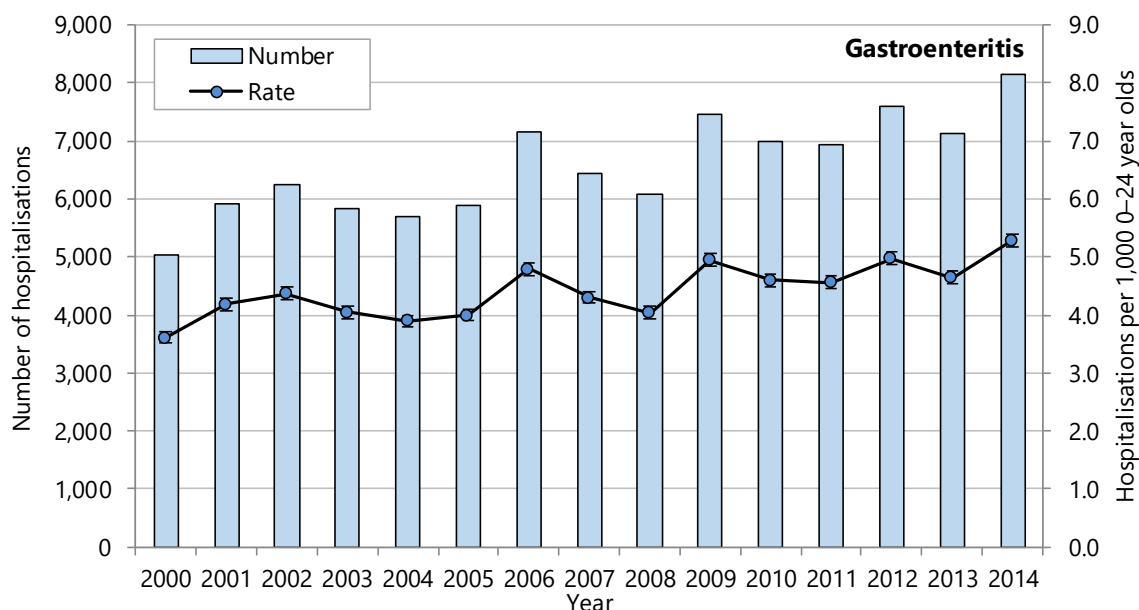
Note 2: **Appendix 3** outlines the limitations of the data utilised from the National Minimum Dataset. The reader is advised to review this appendix before interpreting any trends.

National trends and distribution

From 2000 to 2014 the gastroenteritis hospitalisation rate for 0–24 year olds rose slightly overall although there were year to year fluctuations (**Figure 36**).

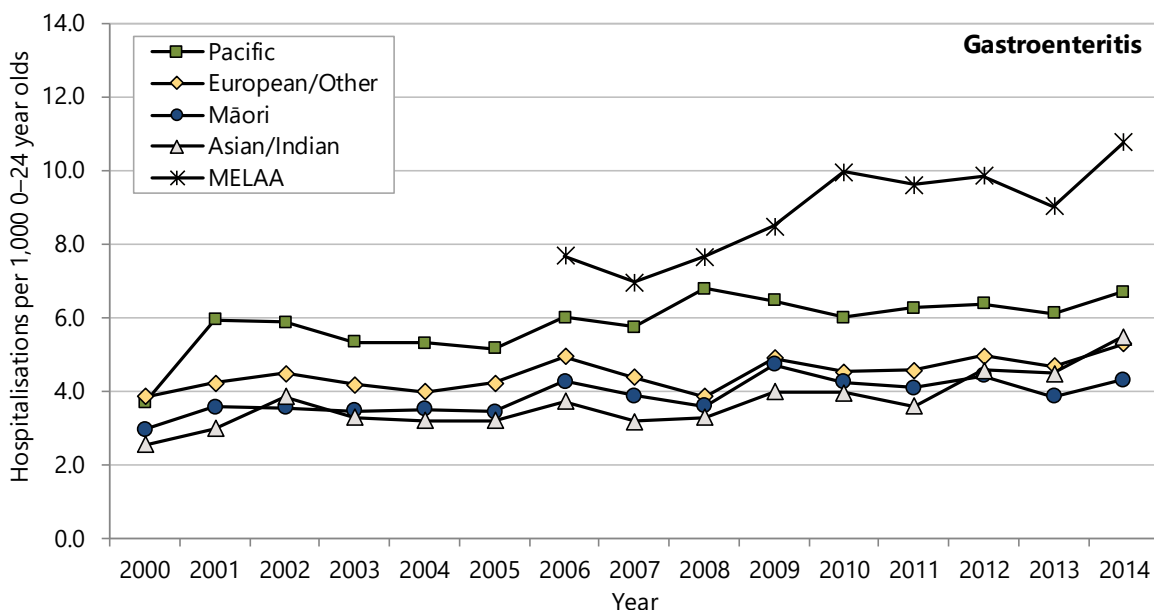
Similar patterns over time were observed for the four largest ethnic groups. Pacific rates were consistently higher than all other groups except MELAA. Māori, European/Other and Asian/Indian rates were similar over the period (with European rates generally being slightly higher), but MELAA rates were consistently higher than any other ethnic group and increased to a greater degree from 2007 onwards so that the gap between rates for MELAA and for other ethnic groups increased noticeably over time (**Figure 37**). The upward trend in gastroenteritis admission rates was evident in all age groups (**Figure 38**).

Figure 36. Hospitalisations for gastroenteritis in 0–24 year olds, New Zealand 2000–2014



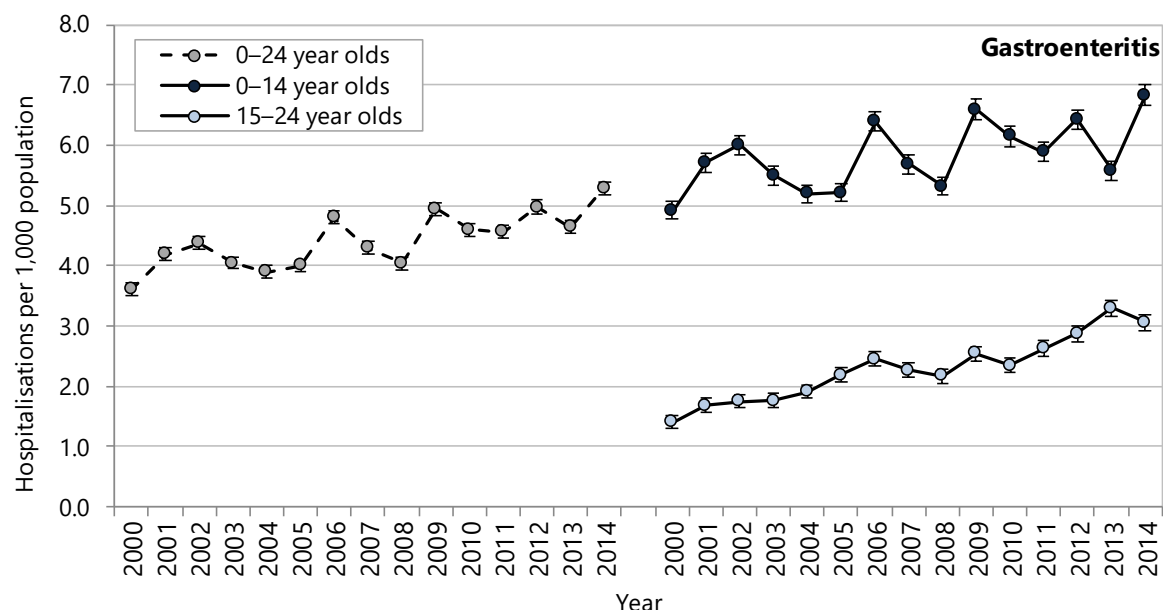
Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Figure 37. Hospitalisations for gastroenteritis in 0–24 year olds, by ethnicity, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Figure 38. Hospitalisations for gastroenteritis in 0–24 year olds, by age group, New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Distribution by cause

Between 2010 and 2014 most gastroenteritis hospitalisations were presumed infectious although the specific agent was not identified, and where identified, viral infections were most common. During this period, then the most frequent primary diagnoses among 0–24 year olds admitted to hospital with gastroenteritis were ‘other gastroenteritis and colitis of infectious origin and viral enteritis’ (**Table 25**).

Table 25. Hospitalisations for gastroenteritis in 0–24 year olds, by primary diagnosis, New Zealand 2010–2014

Primary diagnosis	Number: 2010–2014	Number: annual average	Rate per 1,000 0–24 year olds	95% CI	Per cent
Gastroenteritis in 0–24 year olds					
New Zealand					
Bacterial					
Typhoid and paratyphoid fevers	116	23	0.02	0.01–0.02	0.3
Other salmonella infections	202	40	0.03	0.02–0.03	0.5
Shigellosis	42	8	0.01	0.004–0.01	0.1
Other bacterial intestinal infections	1,150	230	0.15	0.14–0.16	3.1
Other bacterial foodborne intoxications	106	21	0.01	0.01–0.02	0.3
Total bacterial	1,616	323	0.21	0.20–0.22	4.4
Parasitic					
Amoebiasis	11	2	0.00	0.001–0.003	0.0
Other protozoal intestinal diseases	138	28	0.02	0.02–0.02	0.4
Total parasitic	149	30	0.02	0.02–0.02	0.4
Viral					
Rotavirus	3,557	711	0.46	0.45–0.48	9.7
Norovirus	81	16	0.01	0.01–0.01	0.2
Other viral	8,461	1,692	1.11	1.08–1.13	23.0
Total viral	12,099	2,420	1.58	1.55–1.61	32.9
Other infectious					
Other gastroenteritis and colitis of infectious origin	16,848	3,370	2.20	2.17–2.24	45.7
Other (presumed non-infectious)					
Nausea and vomiting	5,719	1,144	0.75	0.73–0.77	15.5
Non-infective gastroenteritis and colitis, unspecified	397	79	0.05	0.05–0.06	1.1
Total	36,828	7,366	4.81	4.77–4.86	100.0

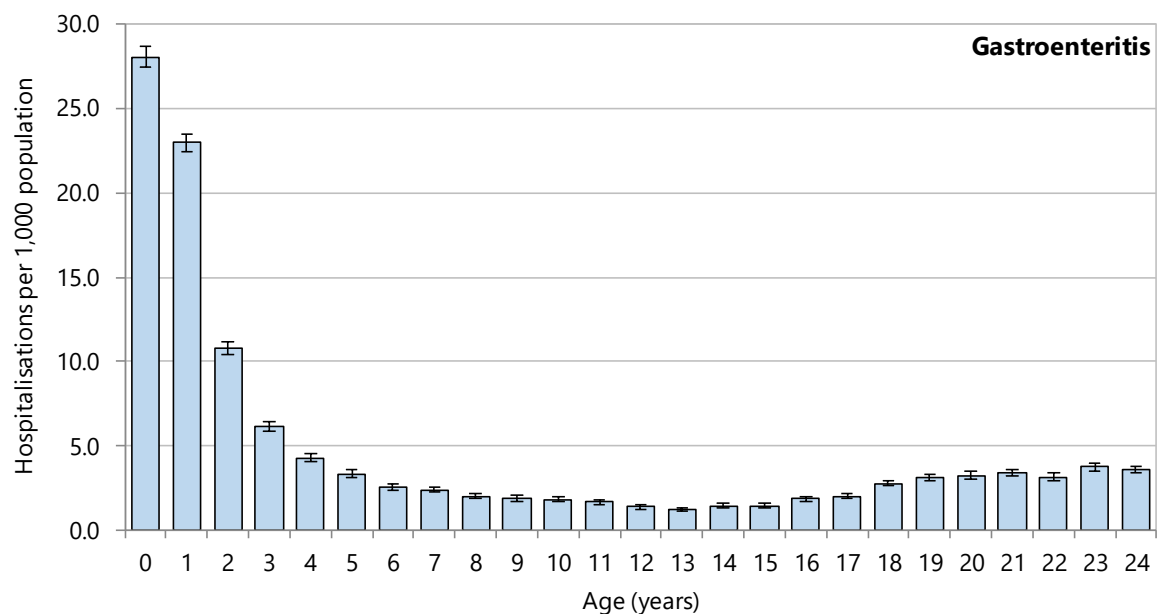
Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Distribution by demographic factors

Between 2010 and 2014 gastroenteritis hospitalisation rates for 0–24 year olds were highest for babies under one year old and decreased steeply with increasing age from zero to five years, and then changed little with increasing age from age six years, although there was a small increase from age 15 to 21 years (**Figure 39**).

Between 2010 and 2014 there was disparity in gastroenteritis hospitalisation rates by NZDep2013 index of deprivation score, ethnicity and age. Rates were *significantly lower* in areas with lower deprivation scores compared with areas with higher deprivation scores. There was a *significant increase* in gastroenteritis hospitalisation rates between each quintile of NZDep2013 scores compared with the quintile below. Compared with European/Other, rates were *significantly lower* for Māori and Asian/Indian and *significantly higher* for Pacific and MELAA. The rate for the 0–4 year olds was *significantly higher* than those of older age groups (**Table 26**).

Figure 39. Hospitalisations for gastroenteritis in 0–24 year olds, by age New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Table 26. Hospitalisations for gastroenteritis in 0–24 year olds, by demographic factor, New Zealand 2010–2014

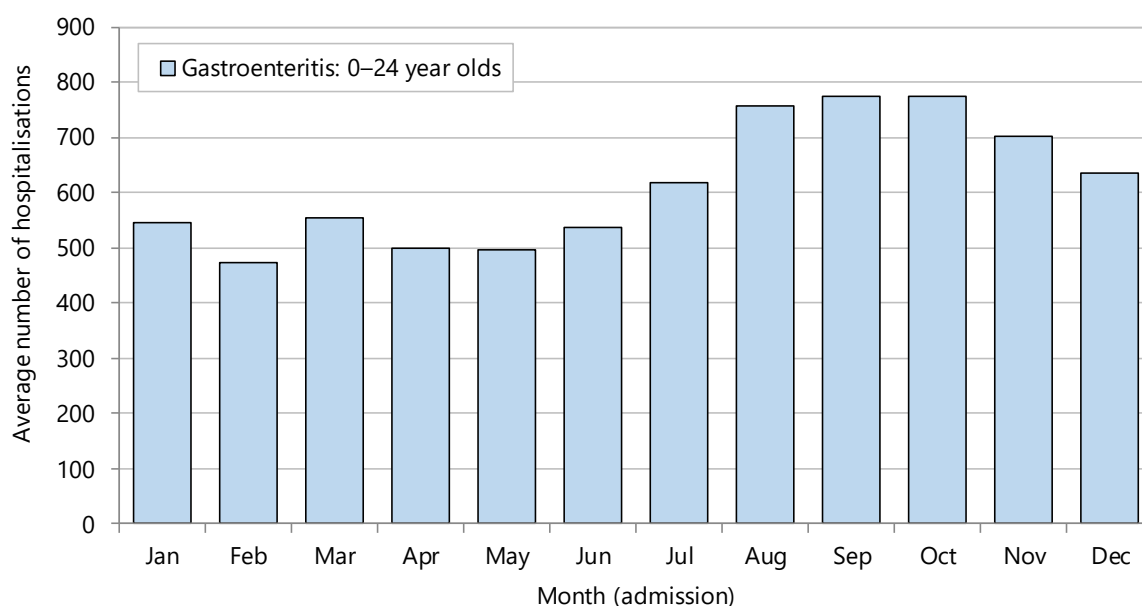
Variable	Number: 2010–2014	Rate per 1,000 0–24 year olds	Rate ratio	95% CI
Gastroenteritis in 0–24 year olds				
New Zealand				
NZDep2013 Index of deprivation quintile				
Deciles 1–2	4,807	3.43	1.00	
Deciles 3–4	5,364	4.04	1.18	1.13–1.22
Deciles 5–6	6,463	4.50	1.31	1.26–1.36
Deciles 7–8	8,379	5.17	1.51	1.46–1.56
Deciles 9–10	11,501	6.18	1.80	1.74–1.87
Prioritised ethnicity				
Māori	7,430	4.17	0.87	0.85–0.89
Pacific	4,400	6.28	1.31	1.27–1.35
Asian/Indian	4,148	4.42	0.92	0.89–0.95
MELAA	965	9.84	2.06	1.93–2.19
European/Other	19,771	4.79	1.00	
Gender				
Female	18,179	4.86	1.00	
Male	18,649	4.77	0.98	0.96–1.00
Age group (years)				
0–4	22,037	14.30	5.03	4.91–5.15
5–14	5,918	1.98	0.70	0.67–0.72
15–24	8,873	2.84	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population; Rate ratios are unadjusted; Ethnicity is level 1 prioritised; Decile is NZDep2013

Distribution by season

There was seasonal variation in gastroenteritis hospitalisation rates. Between 2010 and 2014, rates were higher in late winter, spring and early summer (**Figure 40**).

Figure 40. Average number of hospitalisations for gastroenteritis in 0–24 year olds, by month, New Zealand 2010–2014



National Minimum Dataset (acute and arranged admissions); Number is annual average

Distribution by region

Between 2010 and 2014 hospitalisation rates for gastroenteritis in 0–24 year olds were *significantly higher* than the national rate in the Waitemata, Auckland, Counties Manukau, Bay of Plenty, Whanganui and Hutt Valley DHBs and *significantly lower* in the Taranaki, Hawke's Bay, MidCentral, and Capital & Coast DHBs and all the South Island DHBs except for Southern DHB. In the remaining district health boards there was *no significant difference* from the national rate (**Table 27, Figure 41**).

In 2010–2014 hospitalisation rates for gastroenteritis in 0–14 year olds were *significantly higher* than the national rate in the Waitemata, Auckland, Counties Manukau, Bay of Plenty and Hutt Valley DHBs and *significantly lower* in the Northland, Lakes, Taranaki, Hawke's Bay, MidCentral, and Capital & Coast DHBs and all the South Island DHBs except for Southern DHB. In the remaining district health boards there was *no significant difference* from the national rate (**Table 28**).

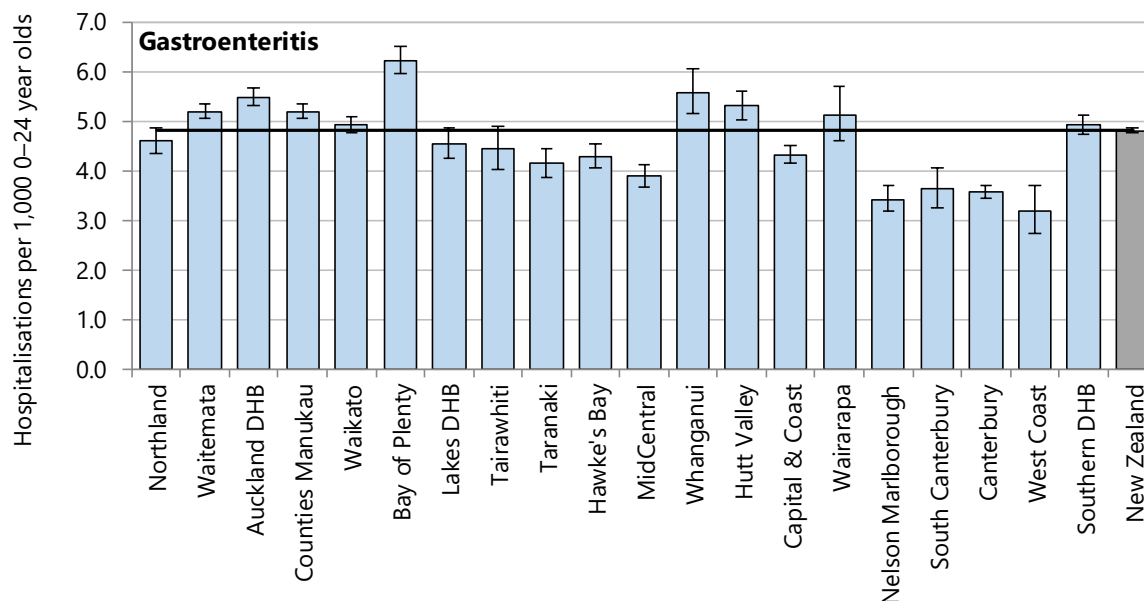
In 2010–2014 hospitalisation rates for gastroenteritis in 15–24 year olds were *significantly higher* than the national rate in the Northland, Waitemata, Bay of Plenty, Taranaki, Whanganui, Wairarapa and Southern DHBs and *significantly lower* in the Counties Manukau, Tairāwhiti, Hutt Valley, Capital & Coast, Canterbury and West Coast DHBs. In the remaining district health boards there was *no significant difference* from the national rate (**Table 29**).

Table 27. Hospitalisations for gastroenteritis in 0–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 0–24 year olds	Rate ratio	95% CI
Gastroenteritis					
0–24 year olds					
Northland	1,278	256	4.60	0.96	0.90–1.01
Waitemata	4,916	983	5.20	1.08	1.05–1.11
Auckland	4,303	861	5.49	1.14	1.11–1.18
Counties Manukau	5,046	1,009	5.19	1.08	1.05–1.11
Waikato	3,343	669	4.93	1.02	0.99–1.06
Bay of Plenty	2,196	439	6.23	1.29	1.24–1.35
Lakes	838	168	4.55	0.94	0.88–1.01
Tairāwhiti	402	80	4.45	0.93	0.84–1.02
Taranaki	782	156	4.15	0.86	0.80–0.93
Hawke's Bay	1,163	233	4.29	0.89	0.84–0.95
MidCentral	1,164	233	3.91	0.81	0.77–0.86
Whanganui	584	117	5.58	1.16	1.07–1.26
Hutt Valley	1,304	261	5.31	1.10	1.04–1.17
Capital & Coast	2,181	436	4.32	0.90	0.86–0.94
Wairarapa	338	68	5.14	1.07	0.96–1.19
Nelson Marlborough	720	144	3.43	0.71	0.66–0.77
South Canterbury	310	62	3.64	0.76	0.68–0.85
Canterbury	2,961	592	3.57	0.74	0.72–0.77
West Coast	159	32	3.19	0.66	0.57–0.77
Southern	2,544	509	4.93	1.02	0.98–1.06
New Zealand	36,828	7,366	4.81	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Figure 41. Hospitalisations for gastroenteritis in 0–24 year olds, by district health board, New Zealand 2010–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Table 28. Hospitalisations for gastroenteritis in 0–14 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 0–14 year olds	Rate ratio	95% CI
Gastroenteritis					
0–14 year olds					
Northland	941	188	5.19	0.84	0.79–0.90
Waitemata	3,705	741	6.60	1.07	1.03–1.11
Auckland	3,275	655	7.94	1.29	1.24–1.33
Counties Manukau	4,064	813	6.84	1.11	1.07–1.15
Waikato	2,524	505	6.19	1.00	0.96–1.04
Bay of Plenty	1,728	346	7.61	1.23	1.18–1.29
Lakes	631	126	5.37	0.87	0.80–0.94
Tairāwhiti	334	67	5.70	0.92	0.83–1.03
Taranaki	516	103	4.31	0.70	0.64–0.76
Hawke's Bay	905	181	5.22	0.85	0.79–0.90
MidCentral	813	163	4.74	0.77	0.72–0.82
Whanganui	440	88	6.72	1.09	0.99–1.20
Hutt Valley	1,119	224	7.41	1.20	1.13–1.27
Capital & Coast	1,583	317	5.78	0.94	0.89–0.99
Wairarapa	253	51	6.02	0.98	0.86–1.10
Nelson Marlborough	507	101	3.78	0.61	0.56–0.67
South Canterbury	222	44	4.20	0.68	0.60–0.78
Canterbury	2,343	469	4.95	0.80	0.77–0.84
West Coast	138	28	4.37	0.71	0.60–0.84
Southern	1,730	346	6.17	1.00	0.95–1.05
New Zealand	27,955	5,591	6.17	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Table 29. Hospitalisations for gastroenteritis in 15–24 year olds, by district health board, New Zealand 2010–2014

DHB	Number: 2010–2014	Number: annual average	Rate per 1,000 15–24 year olds	Rate ratio	95% CI
Gastroenteritis					
15–24 year olds					
Northland	337	67	3.49	1.23	1.10–1.37
Waitemata	1,211	242	3.16	1.11	1.05–1.18
Auckland	1,028	206	2.77	0.98	0.91–1.04
Counties Manukau	982	196	2.60	0.91	0.86–0.98
Waikato	819	164	3.04	1.07	0.99–1.15
Bay of Plenty	468	94	3.73	1.31	1.20–1.44
Lakes	207	41	3.11	1.09	0.95–1.25
Tairāwhiti	68	14	2.15	0.76	0.60–0.96
Taranaki	266	53	3.87	1.36	1.20–1.54
Hawke's Bay	258	52	2.64	0.93	0.82–1.05
MidCentral	351	70	2.78	0.98	0.88–1.09
Whanganui	144	29	3.67	1.29	1.10–1.52
Hutt Valley	185	37	1.96	0.69	0.59–0.80
Capital & Coast	598	120	2.59	0.91	0.84–0.99
Wairarapa	85	17	3.58	1.26	1.02–1.56
Nelson Marlborough	213	43	2.83	0.99	0.87–1.14
South Canterbury	88	18	2.73	0.96	0.78–1.18
Canterbury	618	124	1.74	0.61	0.56–0.66
West Coast	21	4	1.15	0.40	0.26–0.62
Southern	814	163	3.44	1.21	1.13–1.30
New Zealand	8,873	1,775	2.84	1.00	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

South Island region distribution and trends

In the South Island DHBs between 2010 and 2014, hospitalisations for gastroenteritis were *significantly lower* than the national rate in Nelson Marlborough, South Canterbury, Canterbury, and West Coast DHBs and *not significantly different* from the national rate in Southern DHB (**Table 30**).

Table 30. Hospitalisations for gastroenteritis in 0–24 year olds, South Island DHBs vs New Zealand 2010–2014

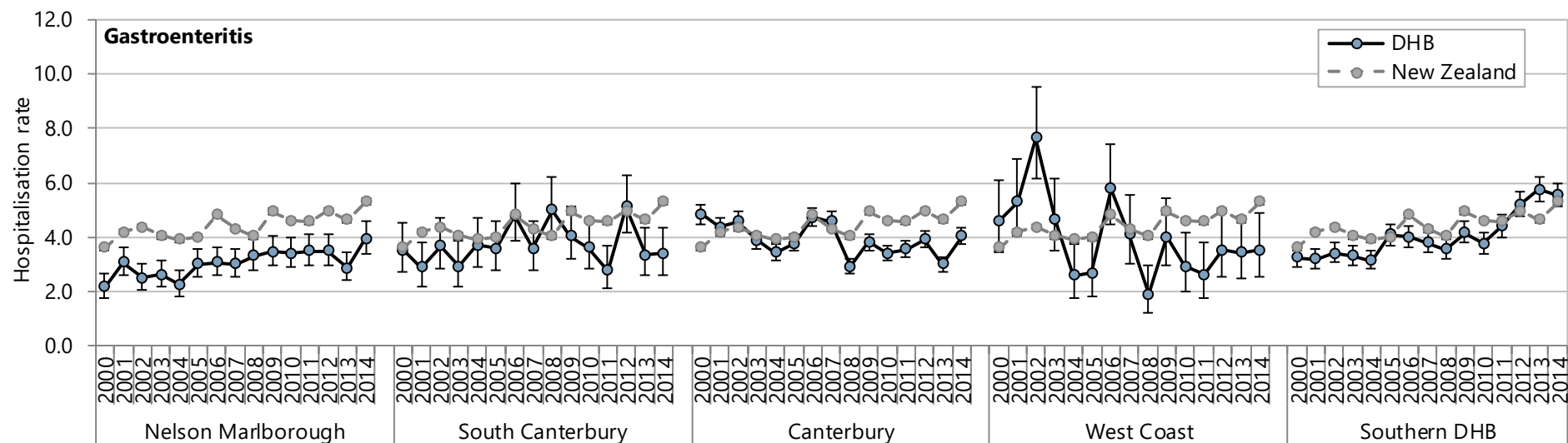
DHB	Number: 2010–2014	Number: annual average	Rate per 1,000	Rate ratio	95% CI
Gastroenteritis					
0–24 year olds					
Nelson Marlborough	720	144	3.43	0.71	0.66–0.77
South Canterbury	310	62	3.64	0.76	0.68–0.85
Canterbury	2961	592.2	3.57	0.74	0.72–0.77
West Coast	159	31.8	3.19	0.66	0.57–0.77
Southern	2544	508.8	4.93	1.02	0.98–1.06
New Zealand	36828	7365.6	4.81	1	

Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Regional trends

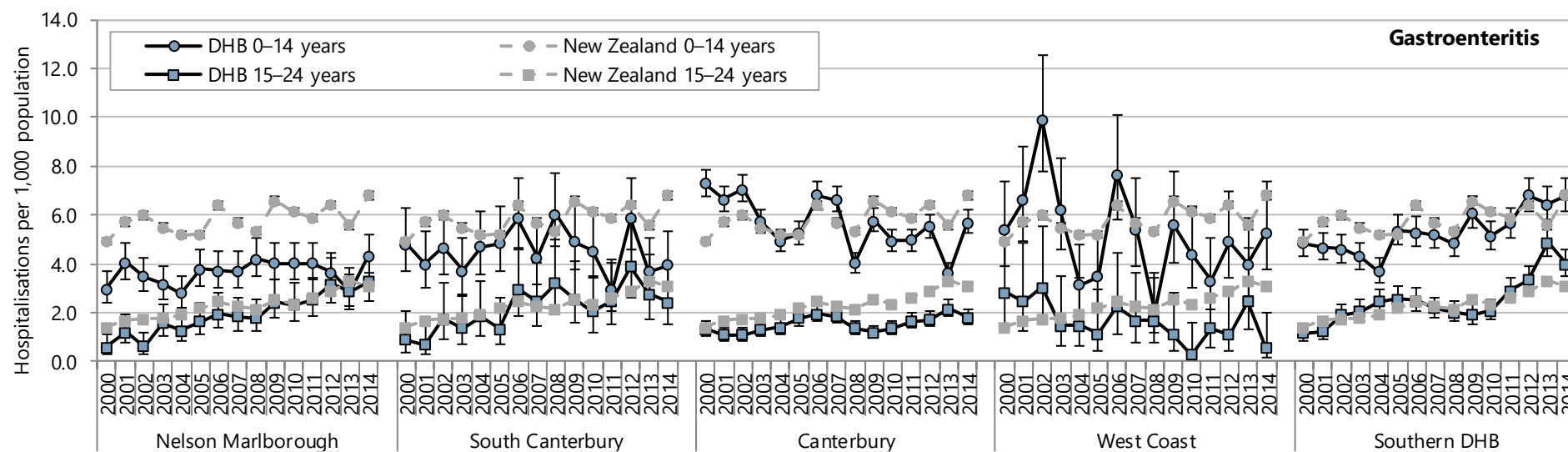
Hospitalisations for gastroenteritis in 0–24 year olds increased over the period 2000 to 2014 in all the South Island DHBs, in a similar manner to the national trend (**Figure 42**). As in New Zealand as a whole, rates were higher in 0–14 year olds than in 15–24 year olds in all the South Island DHBs (**Figure 43**).

Figure 42. Hospitalisations for gastroenteritis in 0–24 year olds South Island DHBs vs New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Figure 43. Hospitalisations for gastroenteritis in 0–24 year olds, by age group, South Island DHBs vs New Zealand 2000–2014



Numerator: National Minimum Dataset (acute and arranged admissions); Denominator: Statistics NZ Estimated Resident Population

Evidence for good practice for the prevention and management of gastroenteritis

Ministry of Health publications

Ministry of Health. 2012. **Communicable Disease Control Manual 2012**. Wellington: Ministry of Health.
<http://www.health.govt.nz/publication/communicable-disease-control-manual-2012>

This manual outlines the epidemiology and clinical features of gastroenteritis, with management advice for individual cases and for managing contacts. In early childhood services or other institutional situations it is important to ensure satisfactory facilities and practices regarding hand cleaning; nappy changing; toilet use and toilet training; preparation and handling of food; and cleaning of sleeping areas, toys and other surfaces. Complete case information must be entered into EpiSurv and the Ministry of Health Communicable Diseases Team notified if an outbreak occurs. If a food premise or commercial food source is thought to be involved then liaison with a local authority environmental health officer or with the Ministry for Primary Industries is required.

Ministry of Health. 2014. **Immunisation Handbook 2014**. Wellington: Ministry of Health.

Since July 2014 rotavirus vaccine has been funded at ages 6 weeks, 3 and 5 months as part of the National Immunisation Schedule. The first dose must be given before age 15 weeks and the third dose must be given before age 8 months. The Immunisation Handbook provides information about the microbiology, clinical features and epidemiology of rotavirus infection in NZ as well as details of public health measures..

Ministry for Primary Industries publications

Ministry for Primary Industries. 2012. **Food safety at home**. Wellington: Ministry for Primary Industries.
<http://www.foodsmart.govt.nz/elibrary/consumer/food-safety-in-the-home.pdf>

A consumer-focused booklet detailing ways to avoid foodborne illness. Covers general measures and also specific advice regarding outdoor cooking (barbecue) and packed lunches. The Ministry for Primary Industries also has detailed information about food regulation and legislation safety and food handling advice for households on interactive websites <http://www.foodsafety.govt.nz/> and <http://www.foodsmart.govt.nz/>

New Zealand guidelines

Ministry of Health. 2015. **Guidelines for Drinking Water Quality Management for New Zealand 2015**. Wellington: Ministry of Health. <http://www.health.govt.nz/system/files/documents/publications/guidelines-drinking-water-quality-management-for-new-zealand-2015-oct15.pdf>

The guidelines provide information about tools the Ministry of Health uses to promote provision of drinking water that is safe to drink and protects the public from pathogenic micro-organisms and toxic chemicals. There have been a number of waterborne gastroenteritis outbreaks in New Zealand including several involving school children. Contaminated drinking water also contributes to the endemic and sporadic enteric disease burden. The Guidelines bring together legislative and regulatory requirements, guidance and good management principles for community drinking-water supplies and technical data to assist drinking-water providers, especially in small communities, to comply with the standards.

International Guidelines

National Institute for Health and Care Excellence. 2015. **Diarrhoea and vomiting in children overview**.
<http://pathways.nice.org.uk/pathways/diarrhoea-and-vomiting-in-children#> accessed 12 November 2015.

This overview brings together information about the 'red flag' symptoms and signs of clinical dehydration and shock as well as key steps in the diagnosis and management of gastroenteritis and advise for parents and carers. It is presented as an interactive webpage and also available as a downloaded pdf file. There is a link to a detailed flow chart with guidance on fluid and nutritional management in children with diarrhoea and vomiting.

<http://pathways.nice.org.uk/pathways/diarrhoea-and-vomiting-in-children#path=view%3A/pathways/diarrhoea-and-vomiting-in-children/fluid-and-nutritional-management-in-children-with-diarrhoea-and-vomiting.xml&content=view-index>

Evidence-Based Medicine Reviews

Fedorowicz Z, et al. 2011. **Antiemetics for reducing vomiting related to acute gastroenteritis in children and adolescents**. Cochrane Database of Systematic Reviews doi:10.1002/14651858.CD005506.pub5

<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD005506.pub5/abstract> accessed 12 November 2015

This is a systematic review of seven trials involving 1,020 children and adolescent aged five months to 12 years who presented with vomiting and had a confirmed clinical diagnosis of gastroenteritis. All seven trials were randomized, double blind, and placebo-controlled. Six of the trials were conducted in emergency departments of children's hospitals and one enrolled children from six paediatric practices. Although all seven studies were classified as either 'unclear' or 'high' risk of bias, the authors consider that the body of evidence is sufficient to allow certain conclusions to be drawn about the effectiveness of the interventions used in the treatment of vomiting related to acute gastroenteritis in children and adolescents. Ondansetron given as a single dose (0.1 mg/kg orally, or intravenously) to children with mild to moderate dehydration in the emergency department appears to decrease the number of children who have persistent vomiting as a barrier to oral rehydration therapy (ORT) and decreases the number of children requiring intravenous

rehydration and hospital admission. It may not reduce the chance of a revisit or admission after departure from the emergency department. Oral ondansetron may be useful alongside ORT in the outpatient or home-care setting.

Soares-Weiser K, et al. 2012. **Vaccines for preventing rotavirus diarrhoea: vaccines in use.** Cochrane Database of Systematic Reviews doi:10.1002/14651858.CD008521.pub3

<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD008521.pub3/abstract> accessed 12 November 2015

A systematic review of 41 randomised controlled trials (RCTs) in children comparing rotavirus vaccines approved for use with placebo, no intervention, or another vaccine. Twenty-nine trials (101,671 participants) assessed RV1, and 12 trials (84,592 participants) evaluated RV5 which is the vaccine funded in NZ. In countries with low-mortality rates, RV5 probably prevents 87% of severe rotavirus diarrhoea cases in children aged up to one year (RR 0.13, 95% CI 0.04 to 0.45; 2344 participants, three trials; moderate-quality evidence), and may prevent 72% of severe all-cause diarrhoea cases (RR 0.28, 95% CI 0.16 to 0.48; 1029 participants, one trial; low-quality evidence). Three trials reported on severe rotavirus diarrhoea cases in children aged up to two years and found that RV5 probably prevents 82% (RR 0.18, 95% CI 0.07 to 0.50; 3190 participants, three trials; moderate-quality evidence), and may prevent 96% of severe all-cause diarrhoea cases (RR 0.04, 95% CI 0.00 to 0.70; 1029 participants, one trial; low-quality evidence). The trials were not powered to detect death as an end point. Serious adverse events were reported in 1884 out of 78,226 children (2.4%) vaccinated with RV5 with 34 cases of intussusception reported in 81,459 children after RV5 vaccination. No significant difference was found between children receiving RV1 or RV5 and placebo in the number of serious adverse events, and intussusception in particular.

Pammi M & Haque Khalid N. 2011. **Oral immunoglobulin for the prevention of rotavirus infection in low birth weight infants.** Cochrane Database of Systematic Reviews doi:10.1002/14651858.CD003740.pub2

<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003740.pub2/abstract> accessed 12 November 2015

Rotavirus infection can occur and spread in a neonatal unit and oral administration of anti-rotaviral immunoglobulin preparations is a possible way to prevent rotaviral infections especially in low birth weight babies. A search of the literature found only one published study addressing the effectiveness and safety of oral immunoglobulin preparations for the prevention of rotavirus infection in hospitalized low birthweight infants (birthweight < 2500 g), and found no significant difference in the rates of rotavirus infection after oral gammaglobulin versus placebo in hospitalized low birthweight babies [RR 1.27 (95% CI 0.65 to 2.37)]. In the subset of infants in the study who became infected with rotavirus there was no significant difference in the duration of rotavirus excretion between the group who had gammaglobulin (mean 2 days, range 1 to 4 days) and the group who had placebo (mean 3 days, range 1 to 6 days). Therefore current evidence does not support the use of oral immunoglobulin preparations to prevent rotavirus infection in low birthweight infants and more research is needed.

Websites

Kidshealth. 2015. **Viral gastroenteritis.** <http://kidshealth.org.nz/viral-gastroenteritis-gastro> accessed 4 November 2015.

Kidshealth provides accurate and reliable information about children's health for NZ parents, caregivers, family and whānau. Key points in relation to gastroenteritis include the importance of maintaining fluid intake by offering small amounts of fluid often, and taking children to the doctor if they become dehydrated or if aged less than six months. The page provides specific information about care at home and preventing spread of illness. There are links to the Ministry of Health information about rotavirus vaccination which is free for babies aged up to 15 weeks <https://www.healthed.govt.nz/resource/immunise-against-rotavirus-protect-your-child> and also to Ministry of Health leaflets about specific bacterial causes of gastroenteritis: <https://www.healthed.govt.nz/resource/campylobacter> <https://www.healthed.govt.nz/resource/giardia> and <https://www.healthed.govt.nz/resource/cryptosporidium>

Ministry of Health. 2015. **Rotavirus.** <http://www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/rotavirus> accessed 4 November 2015.

This webpage provides consumer information about the symptoms, treatment and prevention of rotavirus and includes a link to the Ministry of Health information about rotavirus vaccination <https://www.healthed.govt.nz/resource/immunise-against-rotavirus-protect-your-child>

Ministry of Health. 2012. **Drinking-water DVD series.** <http://www.health.govt.nz/publication/drinking-water-dvd-series> accessed 12 November 2015.

A series of five DVDs owned by the Ministry of Health and licensed for reuse under a Creative Commons Licence which are intended for users of small drinking-water supplies (and also suitable for Pacific Island countries) to support drinking-water quality improvement.