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Close-contact infectious diseases in New Zealand: Trends and ethnic inequalities in hospitalisations, 1989 to 2008

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June 2010

HE KAINGA ORANGA

Citation: Baker M, Telfar Barnard L, Zhang J, Verrall A, Howden-Chapman P. 2010. *Close-contact infectious diseases in New Zealand: Trends and ethnic inequalities in hospitalisations, 1989 to 2008*. Wellington: Housing and Health Research Programme, University of Otago.

Published in June 2010 by the Housing and Health Research Programme, University of Otago, PO Box 7343, Wellington South, New Zealand
ISBN 978-0-473-17160-5 (PDF)

This document is available on the Housing and Health Research Programme website:
http://www.healthyhousing.org.nz/publications

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Acknowledgements

He Kainga Oranga/Housing and Health Research Programme at the University of Otago, Wellington, would like to acknowledge support from Te Kete Hauora, Māori Health Directorate, Ministry of Health for this project.

1. Executive Summary

Introduction

Infectious diseases are the most common cause of acute hospitalisation in New Zealand. Their incidence is known to have increased during the 1990s. Infectious diseases are also a major cause of health inequalities, with Māori and Pacific peoples' hospitalisation rates consistently higher than those for Europeans and others.

A useful category for analysis is close-contact infectious diseases (CCIDs), i.e. respiratory, skin and enteric (faecal-oral) infections spread by person-to-person contact in the community. There are several reasons for focusing on CCIDs:

- they account for most cases of infectious disease;
- their incidence appears to have been rising over the past two decades;
- they include the infectious diseases with pandemic potential (e.g. influenza and SARS);
- they contribute to ethnic and socio-economic health inequalities;
- they provide a potential indicator of population vulnerability to infectious disease because they are likely to be driven by health determinants such as household crowding levels;
- they may provide a focus for improved disease prevention and control effort; and
- they are measurable using coded hospitalisation and mortality data that are routinely collected in New Zealand (as presented in this report).

This report describes the epidemiology of infectious diseases and CCIDs for the 20-year period from 1989 to 2008, with a specific focus on ethnic inequalities, particularly relating to Māori.

Methods

We analysed acute overnight hospitalisations, filtered to exclude non-relevant health events. All subsequent references to "hospitalisations" refer to this filtered subset. Hospitalisations were first categorised as infectious or non-infectious based on the ICD-9 or ICD-10 classification of their principal diagnosis. Infections were those that were predominantly caused by an infectious agent, the late effects of an infectious agent or from treatment for an infectious disease. They were further separated into CCIDs and non-close-contact infectious diseases (non-CCIDs). CCIDs were those where:

1. humans are the only or the most important source (i.e. excluding disease with zoonotic and environmental reservoirs);
2. transmission is by direct physical contact, respiratory transmission or faecal-oral spread (i.e. excluding diseases transmitted from contaminated food, water and environments; blood borne, sexually transmitted, congenital and perinatal infections; endogenous infections; and those with multiple and unknown transmission modes); and
3. infections are predominantly acquired in the community (i.e. excluding infections acquired overseas and in health-care settings).

Results have been reported for age bands, and by prioritised ethnicity. Rates were generally age-standardised to the distribution of population in the 2006 Census. In addition, these rates were often expressed as a percentage of total hospitalisations to adjust for the large rise in total hospitalisation rates over the past 20 years.

Results

Key findings:

- Infectious disease hospitalisations increased markedly over the 20-year period from 1989 to 2008, with a rise from 1071.6 per 100,000 in 1989 to 1993, to 1806.5 per 100,000 in 2004 to 2008. Over the same period, their contribution rose from 17.9 percent of hospitalisations to 25.8 percent in 2004 to 2008.
- There were marked ethnic differences in the distribution of infectious diseases. In the most recent 5-year period (2004 to 2008), infectious diseases accounted for 22.5 percent of hospitalisations for European/Other, 27.2 percent for Māori, and 31.8 percent for Pacific peoples.
- The largest contributor to the rise in infectious diseases over the last 20 years was CCID. By 2004 to 2008, CCIDs accounted for 16.5 percent of hospitalisations for European/Other, 20.4 percent of Māori hospitalisations and 24.3 percent of Pacific hospitalisations.
- There was evidence of generally widening ethnic inequalities in infectious diseases over the 20-year period 1989 to 2009. In the 1989 to 1993 period, the CCID age standardised rate ratio (SRR) for Māori was 2.04 and for Pacific peoples was 2.00 compared with European/Other. By 2004 to 2008, these SRRs had increased to 2.16 for Māori (8% increase) and to 2.60 for Pacific peoples (30% increase).
- CCID rates were highest in children less than 5 years with a rate of 4794.9 per 100,000 in the period from 2004 to 2008. Rates also increased markedly in this age group from 40.1 percent of hospitalisations in the 1989 to 1993 period, to 52.7 percent of hospitalisations in 2004 to 2008.
- The next most vulnerable group was adults aged 70+ with a CCID rate of 3295.2 per 100,000 in 2004 to 2008. CCIDs increased from 6.2 percent of hospitalisations in the 1989 to 1993 period to 13.7 percent in 2004 to 2008.
- Respiratory hospitalisations made up roughly half of all CCIDs. The largest single category was lower respiratory tract infections (LRTIs), which include pneumonia, bronchiolitis and influenza. This category increased from 6.6 percent of all-cause hospitalisations in 1989 to 1993 to 9.8 percent in 2004 to 2008. Because rates rose markedly for both Māori and European/Other, ethnic inequalities changed little over that period (the SRR of 2.5 for Māori vs. European/Other in the 1989 to 1993 period increased slightly to 2.6 in 2004 to 2008).
- The main increase in close-contact skin infections between 1989 and 2008 came from bacterial skin infections, which doubled from 2.3 percent of hospitalisations in the 1989 to 1993 period to 4.6 percent in the 2004-2008 period. Ethnic inequalities declined over the first five-year period, and subsequently increased again, leaving Māori close-contact skin infection rates 2.5 times higher than for European/Other.
- Within the enteric (faecal-oral) infection category, inequalities showed a significant increase in the late effects of enteric infections (e.g. peptic ulcers). An SRR of 1.3 was recorded for Māori vs. European/Other in the 1989 to 1993 period, increasing to 2.9 in the 2004 to 2008 period.
- The greatest increase in inequalities between the hospitalisations of Māori, and European/Other, was for post-streptococcal diseases, notably rheumatic fever. The SRR of 4.8 recorded for Māori vs. European/Other in the 1989 to 1993 period increased to 24.8 in the 2004 to 2008 period.

- Pertussis also showed an increase in inequalities between Māori and European/Other over this period. An SRR of 1.3 was recorded for Māori vs. European/Other in the 1989 to 1993 period, increasing to 3.2 in the 2004 to 2008 period.
- Inequalities in bacterial meningitis incidence increased over the 1989 to 2003 period, but then levelled out; an SRR of 2.5 was recorded for Māori vs. European/Other in the 2004 to 2008 period.
- CCID rates were associated with social deprivation. In the 2004 to 2008 period, they increased with each NZDep quintile, from 16.6 percent of all-cause hospitalisations in NZDep 1–2 to 21.0 percent in NZDep 9–10. By contrast, while non-CCID rates increased with increasing deprivation, they represented a lesser proportion of all-cause hospitalisations with increasing deprivation.

Discussion and conclusion

Infectious diseases, and particularly CCIDs, are making a large and increasing contribution to hospitalisations in New Zealand. They continue to be an important cause of health inequalities with markedly higher rates for Māori and Pacific people, compared with Europeans and others.

This large increase in infectious disease hospitalisations has important health and economic implications. The rise is equivalent to an additional 22,000 hospitalisations a year (compared with what would have been seen had the proportion of 17.9 percent of hospitalisations caused by infectious diseases in the 1989 to 1993 period continued to the present).

The findings of this report also support the validity of distinguishing CCIDs from infectious diseases more generally (i.e. non-CCIDs). The CCIDs were defined based on sharing common modes of transmission. As this report shows, they also appear to behave differently from non-CCIDs over time and across ethnic and deprivation groups.

Prevention and control measures for CCIDs include the following broad approaches.

1. Disease specific – these are measures focused on specific infectious diseases such as primary prevention of rheumatic fever, introduction and high coverage of vaccines for specific diseases (e.g. vaccinating against meningococcal disease and pneumococcal disease), and measures to improve access to specific treatment (e.g. improving treatment of *Helicobacter pylori* infection to reduce peptic ulcer disease and gastric cancer).
2. Mode of transmission focused – these are measures aimed at reducing specific modes of transmission that will usually be common to several diseases (e.g. reducing active and passive smoking and promoting cough etiquette to reduce rates of respiratory infection; providing adequate hand-washing facilities in schools and pre-schools to reduce enteric infections).
3. Underlying socio-economic determinants focused – these are measures aimed at more general socio-economic determinants of health (e.g. reducing household crowding to limit transmission of all CCIDs).

The next stages of this project will describe patterns of household crowding across ethnic groups and assess the potential for reductions in household crowding to lower the burden of infectious diseases in New Zealand, with a specific focus on Māori.

2. Introduction

Infectious diseases are the most common cause of hospitalisation in New Zealand (among the broad disease categories such as cardiovascular disease and cancer, and excluding admissions related to childbirth).[1] They also remain an important cause of premature mortality that is showing no evidence of declining.[1] Rates of several infectious diseases are unusually high in New Zealand, notably acute rheumatic fever,[2-3] childhood pneumonia[4] and cellulitis.[5]

New Zealand has experienced two meningococcal disease epidemics over the last 25 years: a serogroup A meningococcal disease epidemic from 1985 to 1988[6] and the recent serogroup B meningococcal disease epidemic from 1991 onwards.[7-8] These epidemics resulted in significant ethnic and socio-economic inequalities. The serogroup B meningococcal disease epidemic was only brought under control in 2005 by use of an effective, but expensive (greater than $200 million, excluding costs of workforce), vaccination programme.[9] This pattern of successive meningococcal disease epidemics is highly unusual for a developed country.

Infectious diseases are also a major cause of health inequalities, notably for tuberculosis,[10] acute rheumatic fever[2], meningococcal disease[11] and skin infections.[5] More recently we have seen marked health inequalities with the 2009 H1N1 influenza pandemic where hospitalisation rates were 3.0 times higher for Māori and 6.7 times higher for Pacific people than for European/Other.[12]

Aims of this project

- To produce a detailed description of CCID hospitalisations for the 20-year period from 1989 to 2008, with a specific focus on Māori rates and ethnic and socio-economic inequalities.
- To produce a detailed description of household crowding across the 1991 to 2006 census period, with a specific focus on Māori housing conditions and ethnic and socio-economic inequalities.
- To identify how improvement to housing conditions and reduced inequalities could contribute to a reduced burden of infectious diseases from housing conditions.

This report addresses the first of these aims.

3. Methods

3.1. Classification of CCIDs

Measuring the burden of infectious disease using hospitalisation and mortality data requires 'recoding' to identify those conditions (ICD codes) with an infectious aetiology. This approach was initially developed by the US Centers for Disease Control and Prevention[13] and applied to distinguish infectious disease deaths,[13] hospitalisations,[14] and hospitalisations of American Indians and Alaskan Natives.[15-17] This coding scheme has been used successfully in New Zealand to describe the burden of disease attributed to infections.[1]

To investigate the potential effects of disease transmission in households and the impact of health determinants, we have further refined this ICD list by identifying a subset of CCIDs (see

Table 6 in the appendix). These diseases include the traditional contagious diseases (from Latin *tangere*, meaning 'to touch'). These are diseases where:

(i) humans are the only or the most important source (i.e. excluding disease with zoonotic and environmental reservoirs);

(ii) transmission is by direct physical contact, respiratory transmission or faecal-oral spread (i.e. excluding diseases transmitted from contaminated food, water and environments; blood borne, sexually transmitted, congenital and perinatal infections; endogenous infections; and those with multiple and unknown transmission modes); and

(iii) infections are predominantly acquired in the community (i.e. excluding infections acquired overseas and from health-care settings).

The CCIDs include: pertussis; meningitis; invasive streptococcal and staphylococcal infections; eye infections; ear infections; rheumatic fever and acute glomerulonephritis; upper and lower respiratory tract infections; skin infections; infections of bone, joint and connective tissue; and the late effects of these infections.

There are several reasons for focusing on CCIDs:

- they account for most cases of infectious disease (explored further in this report);
- their incidence appears to have been rising over the past two decades (explored further in this report);
- they include the infectious diseases with pandemic potential (e.g. influenza and SARS);
- they contribute to ethnic and socio-economic health inequalities in New Zealand (explored further in this report);
- they provide a potential indicator of population vulnerability to infectious disease (as they are likely to be driven by socio-economic determinants of health such as household crowding levels);
- they may provide a focus for improved disease prevention and control effort; and
- they are measurable using coded hospitalisation and mortality data that are routinely collected in NZ (as presented in this report).

These diseases were distinguished using ICD.9 and ICD.10 codes. The conditions to be included in this list were refined at a workshop on 22 April 2009 attended by about 20 professional staff working in the infectious disease sector.

3.2. Obtaining hospitalisation records

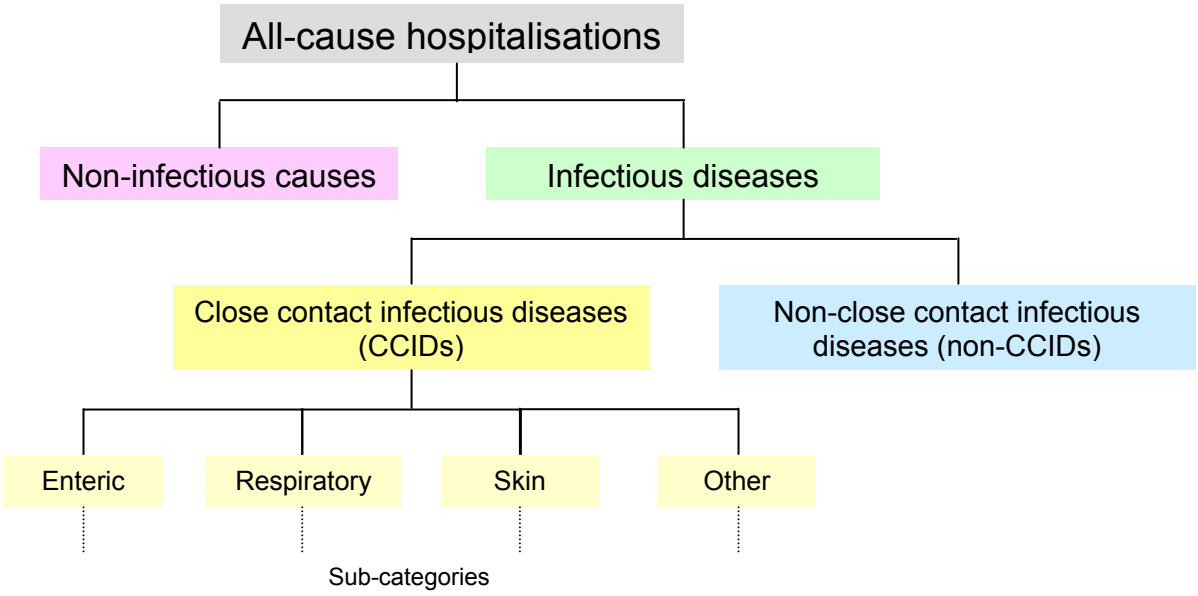
This research uses hospitalisation events recorded by the New Zealand Ministry of Health in the National Minimum Dataset (NMDS). The NMDS records coded data on all publicly funded hospital admissions in New Zealand. These data include a unique health sector identifier, the National Health Index (NHI) number, for all hospitalised individuals.

3.3. Analysis

Hospitalisation data were filtered to exclude health events that had little or no relationship to the research questions being investigated. The filtering steps and their rationale are shown in Table 1. This analysis used principal diagnoses (coded using ICD.9 or ICD.10) for conditions of interest. The standard filter excluded private hospital cases, overseas visitors, transfers, waiting list cases, day cases and readmissions within a month. A similar filtering approach has been used during the analysis of New Zealand injury hospitalisations.[18]

Hospitalisation categories included in this study are illustrated in Figure 1

Figure 1. Major categories of hospitalisations used in this study



The incidence of hospitalisations has been presented in four main ways:

- counts of hospitalised cases;
- age-standardised hospitalisation rates;
- age-standardised hospitalisations rates as a percentage of all-cause hospitalisation rates; and
- age-standardised hospitalisation rate ratios (SRR).

CCID and non-CCID rates are also each presented along with non-infectious disease hospitalisation rates. This comparison is particularly necessary with CCID rates, as some of the increase in all-cause hospitalisations is due to the CCID rate increase. It was also necessary to investigate whether changes in CCID hospitalisation rates over the study period had mirrored changes in non-infectious disease rates.

Age-standardised rates are needed because of changes in population size and age structure over time and across different ethnic groups. Most rates were age standardised to the age structure of the New Zealand population at the time of the 2006 Census. Age bands were 0–4, 5–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69 and 70+ years.

All-cause hospitalisation rates have risen markedly over the past 20 years, at least partly because of changes in medical and administrative practices. Consequently, there are advantages in expressing infectious disease hospitalisations as a percentage of all-cause hospitalisations (age-standardised rates expressed as a percentage of age-standardised all-cause hospitalisations). Such a measure is likely to give a better indication of shifts in disease burden than simply using absolute age-standardised hospitalisation rates.

For most of the analyses we split the 20-year period into four 5-year periods. Each was centred on a population census (i.e. the Census of 1991, 1996, 2001 or 2006), which provided the population denominator for rates calculation.

Ethnicity was divided into three groups and used prioritised ethnicity: Māori, Pacific peoples, and 'European/Other' (which consisted of European, Asian, Middle Eastern/Latin American/African, other, and not stated). This approach followed standard methods used for the health sector.[19]

The analysis used well documented methods for calculating adjusted rates, rate ratios and confidence intervals.[21]

Figure 2. Exclusions by 5-year period

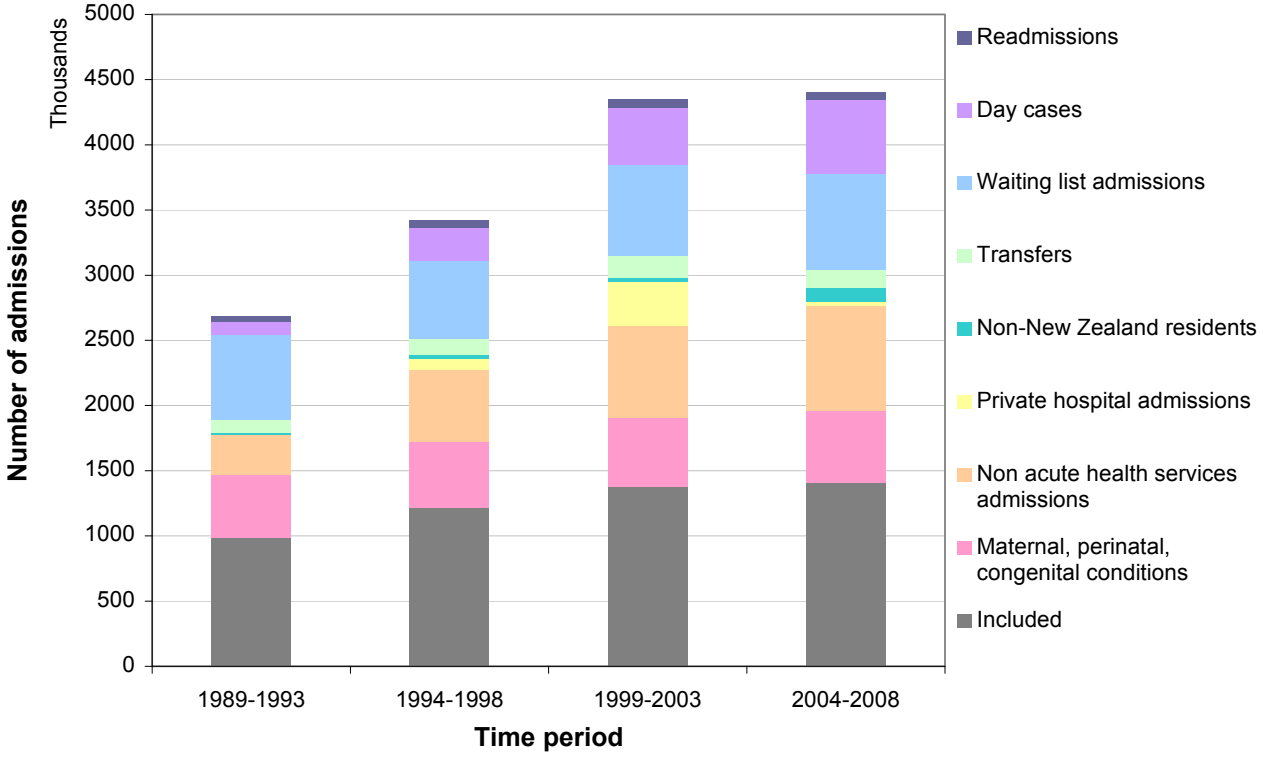


Table 1. Filters used in the analysis of hospitalisation data

Event removed	Rationale for removing event	Method for removing event
1. **Diagnoses that are not relevant –** Restrict to conditions of interest	All analyses begin by selecting the condition(s) of interest to the research question. Where the focus is on broad categories of events, such as all-cause hospitalisations, it is appropriate to remove events that may not represent illness or injury events, notably: • Maternal, perinatal, congenital conditions – strongly reflect demographic and reproductive patterns in the population. • Factors influencing health status and contact with health services – includes follow-up care, dialysis, rehabilitation, screening, immunizations, prosthetic fittings, normal deliveries, boarders and social factors which do not represent an acute health event.	Pregnancy, childbirth and the puerperium (O00-O99). Certain conditions originating in the perinatal period (P00-P96). Congenital malformations, deformations and chromosomal abnormalities (Q00-Q99). Factors influencing health status and contact with health services (Z00-Z99).
2. **Additional diagnoses** – Restrict to principal diagnosis	Principal diagnosis is defined as: 'The diagnosis established after study to be chiefly responsible for causing the patient's episode of care in hospital'. Other relevant diagnosis (or additional diagnosis) is defined as: 'A condition or complaint either co-existing with the principal diagnosis or arising during the episode of care or attendance at a healthcare facility'. Most analyses are based on principal diagnosis, though it may be appropriate to include other diagnoses, particularly for distinct and serious illnesses to detect all cases.	Diagnosis type. Principal diagnosis (diagnosis type A). Other relevant diagnosis (diagnosis type B), up to 98 can be recorded.
3. **Private hospital admissions** – Restrict to publicly funded hospital discharges	The collection of privately funded hospital discharges is considerably delayed and less complete than publicly funded hospital data. In New Zealand this category includes only about 10% of hospitalisations and most (about 90%) are for elective surgery so are not generally relevant for the research questions being investigated in this study.	Purchaser code = '06'
4. **Overseas visitors** – Restrict to New Zealand residents	Rate calculations use the census population of resident New Zealanders as the denominator, which does not include overseas visitors.	NZ Resident Status = N
5. Transfers – Restrict to new admissions	Transfers between DHBs (and sometimes hospitals and services) may be recorded as separate admissions, even when part of the same episode of care.	Combine transfers with new admissions into single admission episodes.
6. Waiting list cases – Restrict to acute and arranged admissions	Waiting list cases (those admitted 7+ days after being first assessed) are strongly influenced by the availability of health-care services.	Admission type = restrict to AC and AA, exclude WN.
7. **Day cases** – Restrict to overnight hospital events (i.e. inpatients)	Day patients include less serious hospital attendances as well as conditions that result in multiple-day case admissions, notably: renal dialysis, chemotherapy, radiotherapy and blood transfusions. Recording is also very inconsistent across different health authorities (DHB) and time periods.	Length of stay = 0 days
8. **Readmissions** – Restrict to incident cases	Readmissions are strongly influenced by the nature and severity of the initial illness or injury, social and health service factors. Removing them helps to identify incident events, and the factors that contribute to them. Note that this filter does not exclude recurrences of the same illness or injury at a later date (greater than 30 days later).	Same encrypted NHI, same diagnostic code, admission date within 30 days of previous admission, or, injury event date is the same as previous admission.

4. Results

4.1. Acute overnight hospitalisations

The effects of the filtering steps used with hospitalisation events are shown in Figure 2 with numbers in Table 5. The hospitalisation events of interest to this study are a subset of acute, overnight hospitalisations. These events increased from 984,515 in the 1989 to 1993 period, to 1,409,009 in the 2004 to 2008 period. As a proportion of total hospital discharges, they decreased from about 37 percent in the earlier period to 32 percent in the last 5 years. The largest drivers for this change in proportion were the marked increases in recorded day cases (from 98,165 to 565,547) and in 'factors influencing health status and contact with health services' (from 311,967 to 798,806). Many of these shifts reflect changes in the recording of hospitalisation events over time, and changes in how health care is administered in hospitals. They illustrate the importance of filtering out such admissions to leave a set of hospitalisation events sufficiently consistent to form the basis of analyses of changes in population health status over time, as used in this report.

As noted earlier, all references to "hospitalisations" in this report refer to the filtered subset of acute overnight hospitalisations, as distinct from hospitalisation events.

4.2. Incidence of hospitalisations and infectious diseases

Table 2 shows all-cause hospitalisations for 5-year periods from 1989 to 2008 along with the average annual rates for each period. These data show that hospitalisations increased from an average annual rate of 5992.9 per 100,000 (i.e. about 6.0 percent) to 6996.2 per 100,000 (i.e. about 7.0 percent) over this period.

Total infectious diseases increased more markedly, with a rise from 1071.6 per 100,000 in the 1989 to 1993 period, to 1806.5 per 100,000 in the 2004 to 2008 period. Their contribution rose from 17.9 percent of acute overnight hospitalisations in 1989 to 1993, to 25.8 percent in 2004 to 2008.

Table 2. All-cause hospitalisations, infectious diseases, non-CCIDs and CCIDs (and categories of CCIDs), for 5-year periods, 1989 to 2008

Time period	1989 to 1993			1994 to 1998			1999 to 2003			2004 to 2008		
	No.	Age-std rate†	% of total hosps	No.	Age-std rate†	% of total hosps	No.	Age-std rate†	% of total hosps	No.	Age-std Rate†	% of total hosps
All-cause hospitalisations	984515	5992.9	100.0	1211925	6868.0	100.0	1378174	7421.6	100.0	1409009	6996.2	100.0
Total infectious diseases	187388	1071.6	17.9	253734	1378.1	20.0	327099	1734.7	23.3	363823	1806.5	25.8
Non-CCIDs	53285	313.8	5.2	69353	386.2	5.6	76735	411.4	5.5	96377	478.5	6.8
Total CCIDs	134103	757.8	12.6	184381	992.0	14.4	250364	1323.3	17.8	267446	1328.0	19.0
▪ Respiratory	74687	413.9	6.9	97195	519.8	7.6	132189	698.2	9.4	140668	698.5	10.0
▪ Enteric	18070	108.8	1.8	26223	143.2	2.1	30154	158.8	2.1	31874	158.3	2.2
▪ Skin	26863	155.7	2.6	40679	222.9	3.2	63748	339.7	4.6	72266	358.8	5.1
▪ Other CCID	14483	79.5	1.3	20284	106.1	1.5	24273	126.6	1.7	22638	112.4	1.6

† Average annual rate per 100,000, age standardised to distribution of New Zealand population in 2006 Census

4.3. Incidence of CCIDs

Between the 1989 to 1993 and 2004 to 2008 time periods, the contribution of CCIDs rose from 12.6 percent of hospitalisations to 19.0 percent, a 50.8 percent increase. Non-CCIDs rose from 5.2 percent of hospitalisations to 6.8 percent, a 30.8 percent increase. Consequently, there was a moderate shift in the causes of infectious diseases, with CCIDs increasing their contribution from 70.7 percent to 73.5 percent.

Respiratory admissions made the largest contribution to CCID hospitalisations, accounting for more than half of CCIDs over the study period. For this reason, rate ratios for total CCIDs mirror rate ratios for respiratory illness. Respiratory admissions also outnumber non-CCIDs.

The greatest increase in CCIDs was for skin infections, with rates 2.1 times higher in both the 1999 to 2003 and 2004 to 2008 periods, than in the 1989 to 1993 period. Rates for respiratory infections were 1.8 times higher over the same periods, and for enteric infections 1.5 times higher. Only 'other' CCIDs have shown any sign of decrease; although rates in the 1999 to 2003 period were 1.7 times higher than those in the 1989 to 1993 period, the ratio slipped back to 1.4 in 2004 to 2008.

4.4. Trends in CCIDs by year

Age-standardised rates rose for both CCIDs and non-CCIDs over the study period, but the increase was greater for CCIDs (Figure 3).

Hospitalisations for CCIDs and non-CCIDs increased more than the overall increase in hospitalisations over the study period (Figure 4). As suggested by the age-standardised rates in Figure 3, CCIDs showed a greater increase than non-CCIDs as a percentage of all-cause hospitalisations.

However, Figure 4 shows the importance of looking at rates as a percentage of hospitalisations rather than at rates in isolation. It would be easy to assume from Figure 3 that the increase in infectious diseases had reached a plateau in the 2000s. Instead, Figure 4 shows that the increase in infectious disease incidence has been relatively steady over the study period.

Respiratory illness had the highest hospitalisation rate among CCIDs, followed by skin infections, then enteric infections, then other (Figure 5). All of these CCIDs increased as a percentage of all-cause hospitalisations (Figure 6), though the rate and steadiness of increase varied by category.

Figure 3. Annual rate of all-cause hospitalisations, and total infectious disease, CCID and non-CCID hospitalisations (age standardised to 2006 Census)

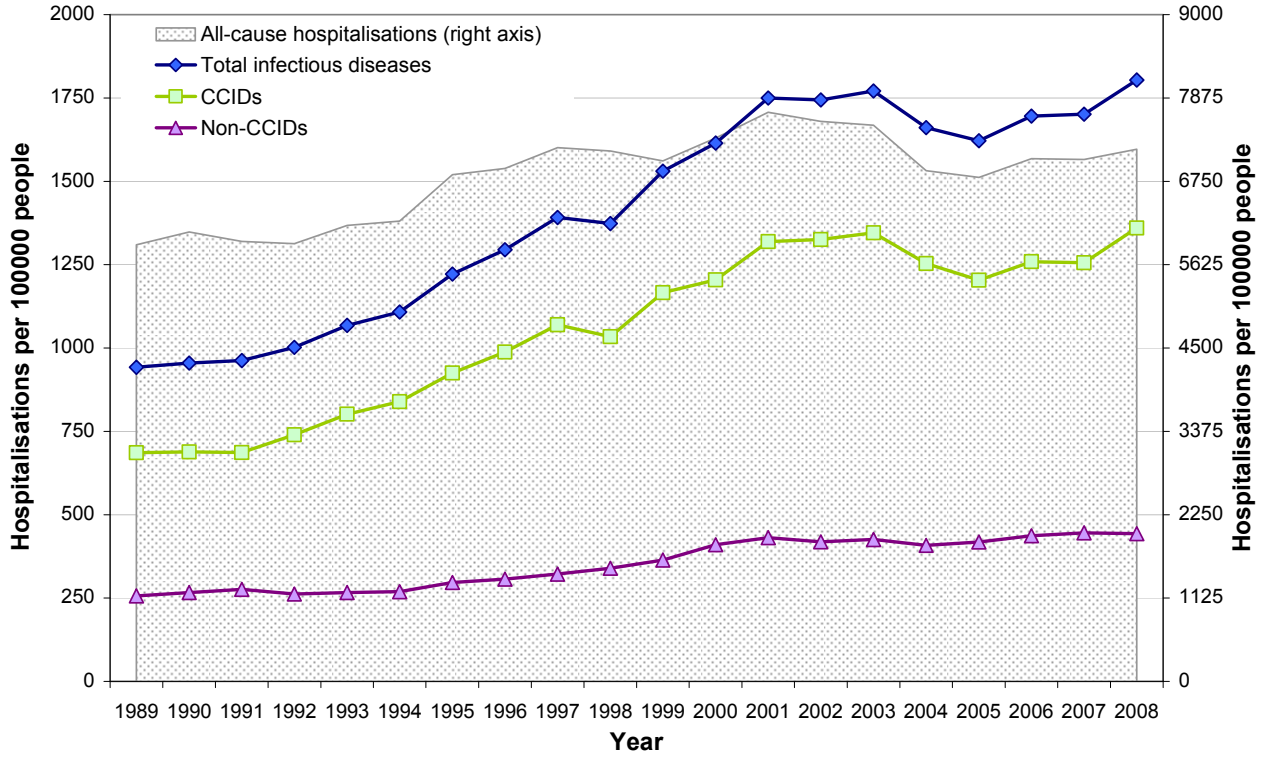


Figure 4. Total infectious disease, CCID and non-CCID hospitalisations as a percentage of all-cause hospitalisations, by year (age standardised to 2006 Census)

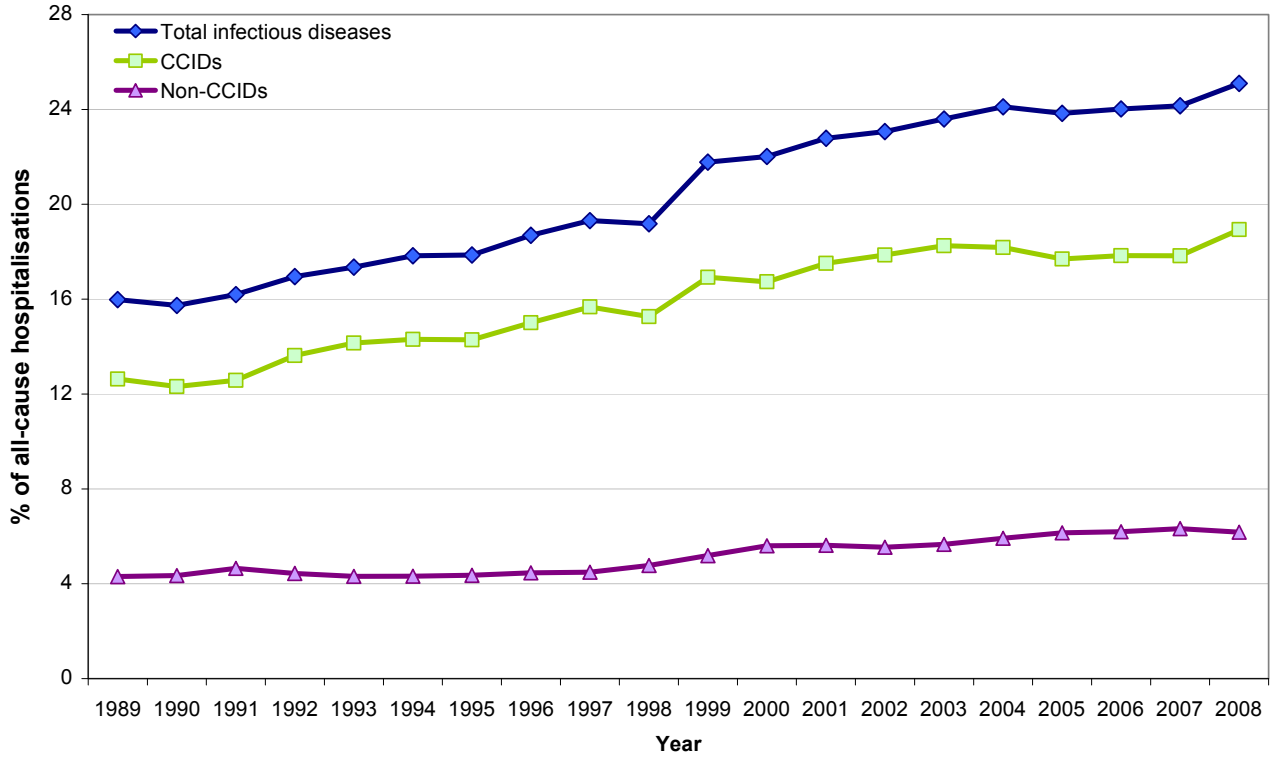


Figure 5. Annual hospitalisation rates for main categories of CCIDs (age standardised to 2006 Census)

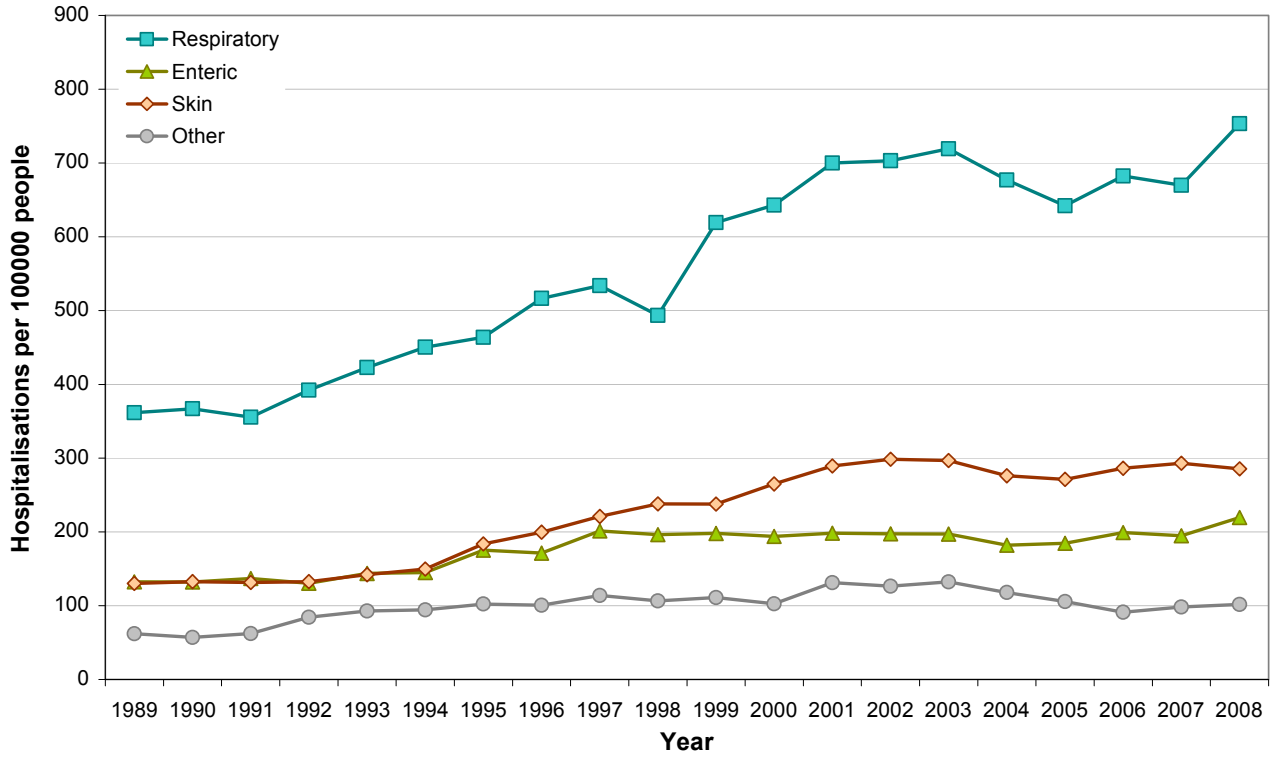
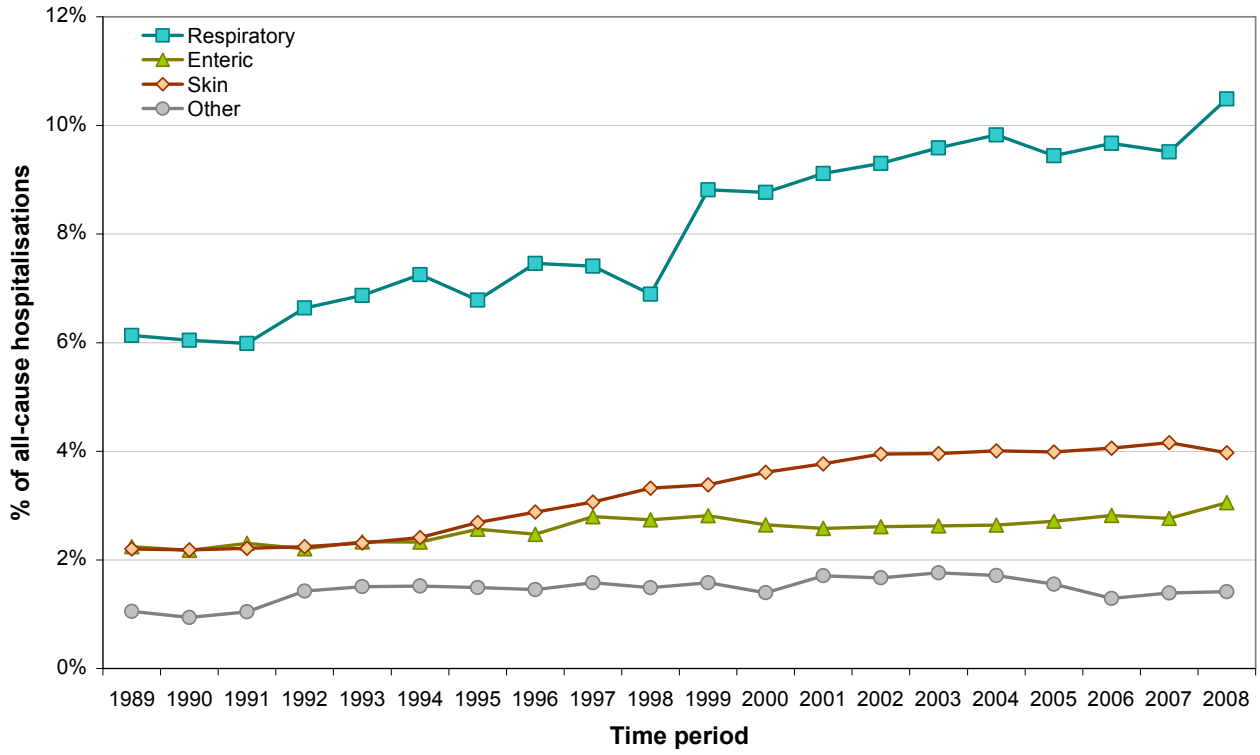


Figure 6. Hospitalisations for main categories of CCIDs, as a percentage of all-cause hospitalisations, by year (age standardised to 2006 Census)



4.5. Age and sex distribution of CCIDs

There were minimal differences in CCID distribution by sex over the study period. Males had a marginally higher incidence of CCID, with their SRR compared to females reducing from 1.31 to 1.21 over the study period.

CCID rates were highest in children under 5 years, then in adults aged 70+. Rates increased in all age groups, though particularly in adults 70+ years of age (Figure 7). However, the steep increase in CCID hospitalisation rates for adults 70+ reflects their increase in all-cause hospitalisation rates. As a proportion of all-cause hospitalisations (Figure 8), while CCIDs have increased for all age groups, the absolute increase was greatest in children under 5 years, for whom CCIDs went from 40.1 percent of hospitalisations in the 1989 to 1993 period, to 52.7 percent of hospitalisations in the 2004 to 2008 period. For adults 70+ they increased from 6.2 percent in the 1989 to 1993 period, to 13.7 percent in 2004 to 2008.

While CCID hospitalisations increased between each 5-year period for all age groups, the pattern of increase varied by age group; in the under-5 age group, the steepest increase occurred over the first three periods, and incidence reached plateaus between 1999 to 2003 and 2004 to 2008. The rate of increase became more linear with each increasing age group, with the 70+ age group increase almost straight.

Relative to the 15 to 29-year age group, the greatest increase in CCID rate ratios was for those aged 70+ (Figure 9). Rate ratios for children less than 5 years were still highest in comparison to the 15 to 29-year reference group, but gradually became closer to the reference group rate ratio.

Thus, the greatest concentration of CCID was found in the under-5 age group, but if current trends continue, their predominance will drop over coming decades, and may be overtaken by the 70+ age group.

Figure 7. Five-yearly CCID hospitalisation rates by age group

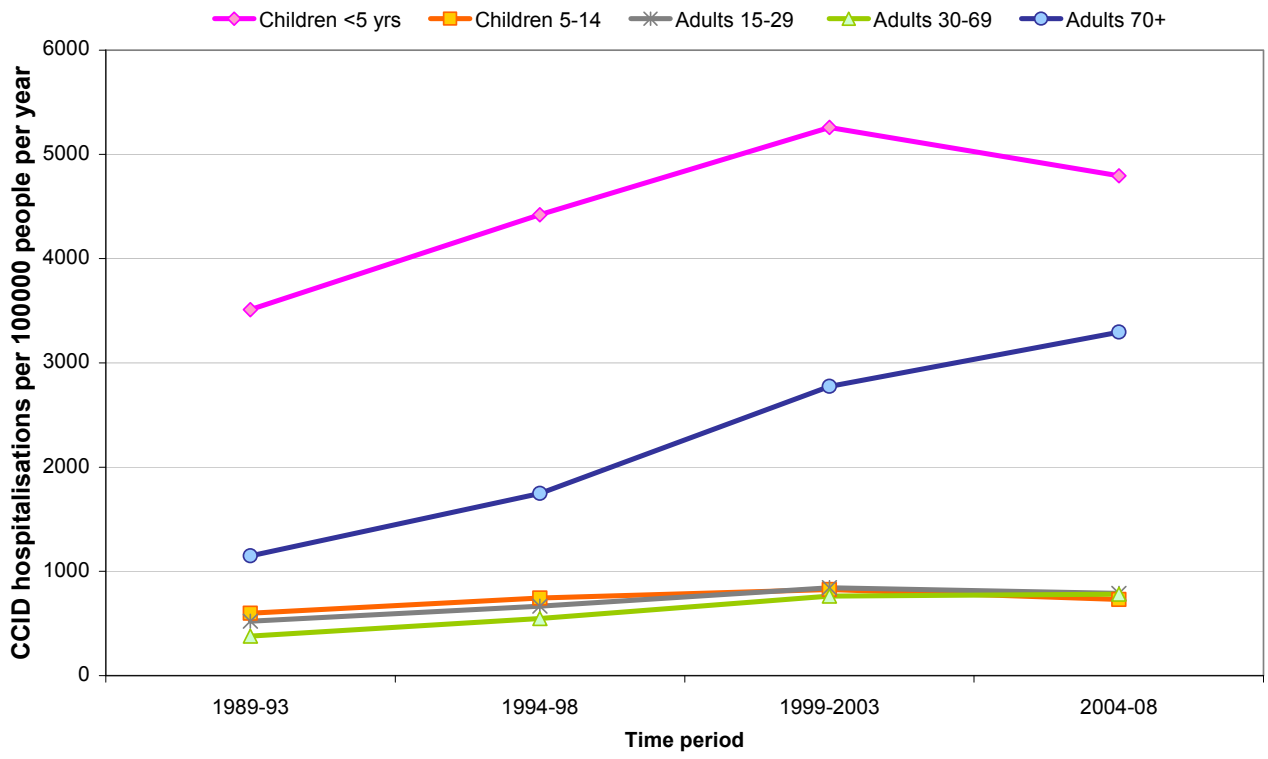


Figure 8. **CCIDs as a percentage of all-cause hospitalisations, by age group, for 5-year periods from 1989 to 2008**

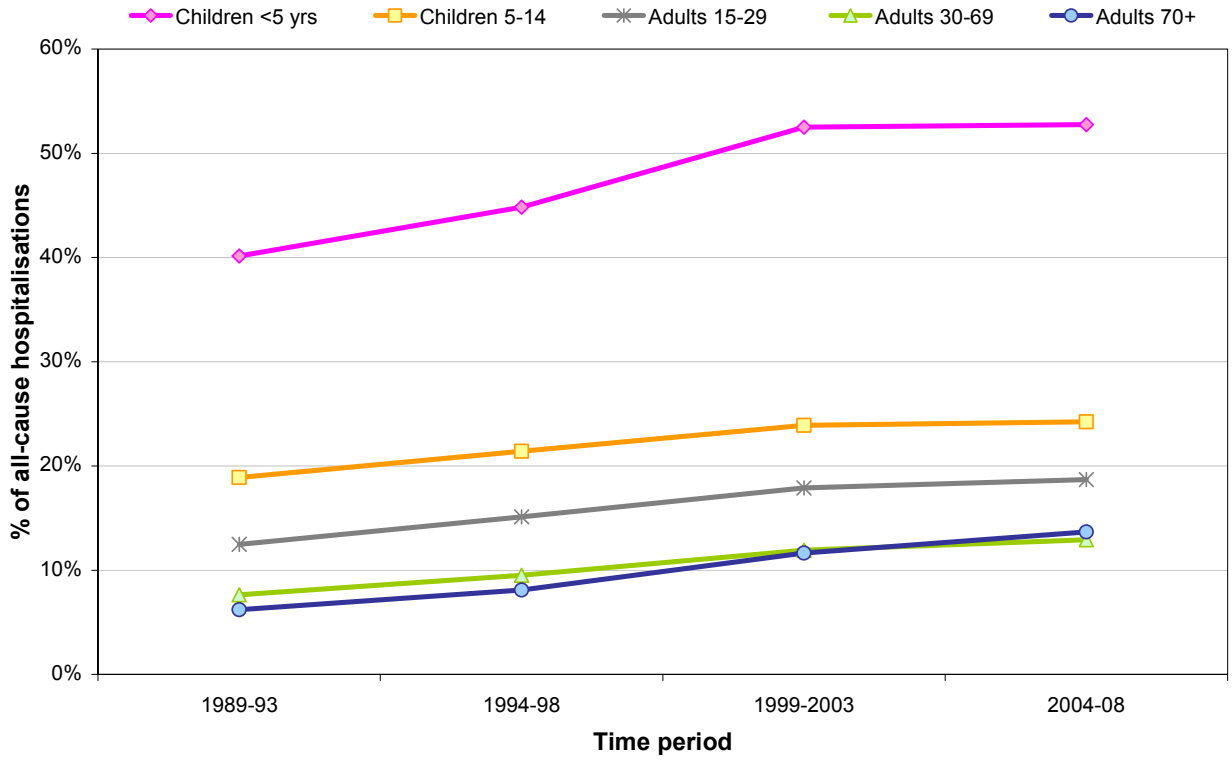
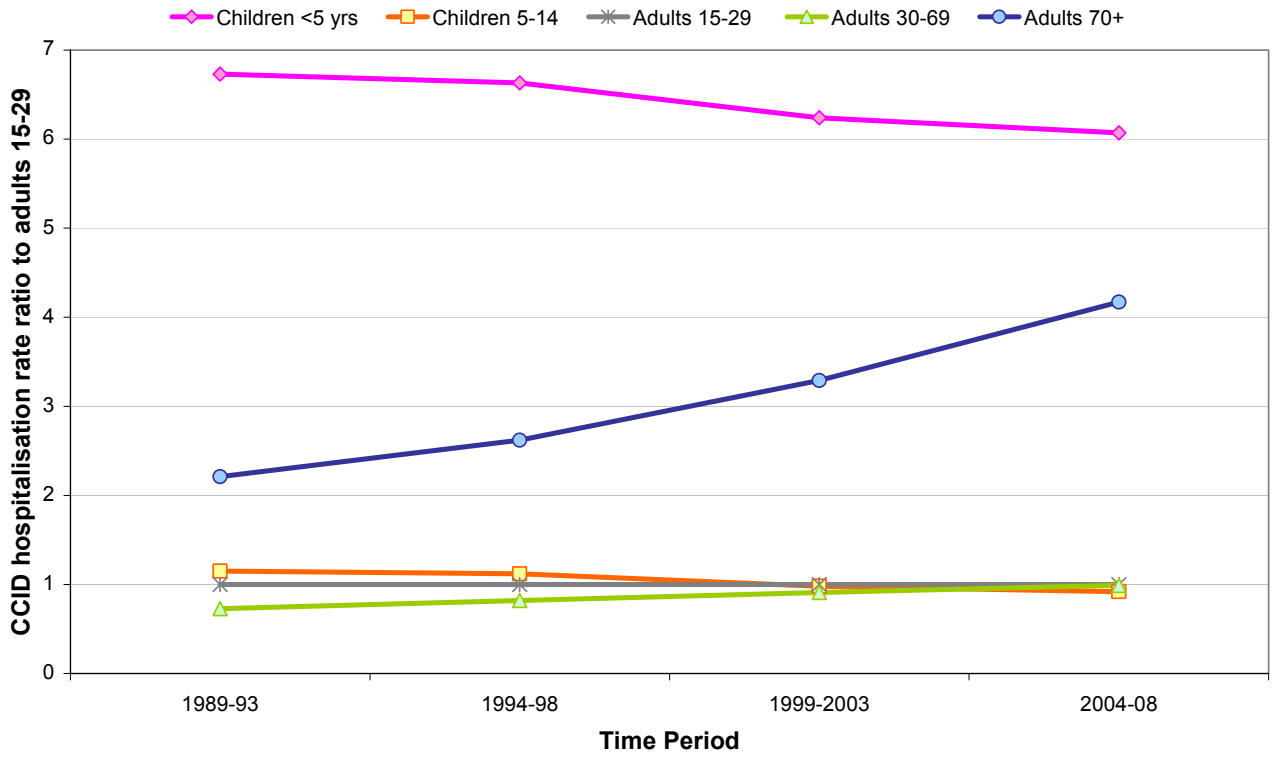


Figure 9. **Ratio of CCID hospitalisation rate by age group to CCID hospitalisation rates for adults 15-29, for 5-year periods from 1989 to 2008**



4.6. Ethnic distribution of CCIDs

These results compare the rates of CCIDs in different ethnic groups. They investigate how the ethnic distribution of CCIDs, and infectious diseases more generally, differ from non-infectious-disease hospitalisations. This analysis also assesses how this distribution has changed over time, to see if CCIDs have become relatively more concentrated in any particular ethnic group.

4.6.1. Contribution of infectious diseases

The overall contribution of infectious diseases to hospitalisations is shown in Table 3. Over the most recent 5-year period (2004 to 2008), infectious diseases accounted for 22.5 percent of hospitalisations for European/Other, 27.2 percent for Māori and 31.8 percent for Pacific peoples. This was an increase from the earlier 1989 to 1993 period for all ethnic groups (when infectious disease hospitalisations were 15.3 percent for European/Other, 19.6 percent for Māori, and 25.6 percent for Pacific peoples).

Table 3. Average annual rate of all-cause hospitalisations, total infectious diseases, and CCIDs, by ethnic group, for 5-year periods from 1989 to 2008 (age standardised to 2006 Census)

Time period	1989 to 1993		1994 to 1998		1999 to 2003		2004 to 2008	
	Age-std rate†	SRR*	Age-std rate†	SRR*	Age-std rate†	SRR*	Age-std rate†	SRR*
All-cause hospitalisations								
Euro/Other	5695.5	Ref	6589.3	Ref	6837.4	Ref	6283.7	Ref
Māori	8882.5	1.56	9143.1	1.39	11165.1	1.63	10983.3	1.75
Pacific	6781.8	1.19	8049.0	1.22	11053.3	1.62	11134.7	1.77
Total infectious diseases								
Euro/Other	872.1	Ref	1154.4	Ref	1433.8	Ref	1413.5	Ref
Māori	1738.7	1.99	1945.5	1.69	2881.4	2.01	2983.0	2.11
Pacific	1735.9	1.99	2286.8	1.98	3521.6	2.46	3537.2	2.50
CCIDs								
Euro/Other	628.7	Ref	873.8	Ref	1071.3	Ref	1037.4	Ref
Māori	1279.6	2.04	1468.9	1.68	2192.9	2.05	2237.9	2.16
Pacific	1254.5	2.00	1713.9	1.96	2702.0	2.52	2702.4	2.60
Non-CCIDs								
Euro/Other	243.5	Ref	280.7	Ref	362.4	Ref	376.1	Ref
Māori	459.1	1.89	476.6	1.70	688.5	1.90	745.1	1.98
Pacific	481.4	1.98	573.0	2.04	819.5	2.26	834.8	2.22

† Average annual rate per 100,000, age standardised to distribution of New Zealand population in 2006 Census
* Ref=reference group

4.6.2. CCID hospitalisation rates and relative risks

Hospitalisation rates for CCIDs have increased markedly for all ethnic groupings over the 20 years from 1989 to 2008 (Figure 10, Figure 11, Figure 12). Age-standardised European/Other CCID hospitalisation rates per 100,000 people were 86 percent higher in 2008 than in 1989; Māori rates were 106 percent higher; and Pacific rates were 154 percent higher. By the 2004 to 2008 period, CCID accounted for 16.5 percent of hospitalisations for European/Other, 20.4 percent of Māori hospitalisations, and 24.3 percent of Pacific hospitalisations.

Five-yearly SRRs (Figure 14) suggest widening ethnic inequalities over the 20-year period 1989 to 2009. Ethnic inequalities in CCID rates reduced between the 1989 to 1993 and 1994 to 1998 periods; markedly for Māori, from 2.00 to 1.68; and slightly for Pacific, from 2.00 to 1.96. However, those improvements were lost in subsequent periods, with the Pacific SRR at 2.6 (a 30% increase) for the 2004 to 2008 period, and Māori at 2.16 (an 8% increase).

Within the context of all-cause hospitalisations, the pattern is more complex. All-cause hospitalisations have also been increasing (see Figure 10, Figure 11, and Figure 12). Taking that rise into account, the increase in CCIDs, as a proportion of all-cause hospitalisations, has been broadly similar across ethnic groupings (Figure 13). For European/Other, CCIDs increased from 11.4 percent of all-cause hospitalisations in 1989 to 2003, to 16.5 percent in 2004 to 2008. For Māori, the corresponding increases were from 14.4 percent in 1989 to 2003, to 20.4 percent in 2004 to 2008, and for Pacific peoples, from 18.5 percent in 1989 to 2003, to 24.3 percent in 2004 to 2008. Here the differences in distribution of CCIDs across ethnic groups are influenced both by the rise in incidence of these diseases and by trends in the incidence of other causes of hospitalisation over that period. One striking ethnic difference is the much lower rise in other causes of hospitalisation for Europeans/Others over this period, relative to Māori and Pacific peoples. This change has also contributed to the increasing contribution of CCIDs to hospitalisations for Europeans/Others (when measured as a percentage of all-cause hospitalisations).

Figure 10. Māori annual CCID and non-infectious disease hospitalisation rates, 1989-2008 (age standardised to 2006 Census).

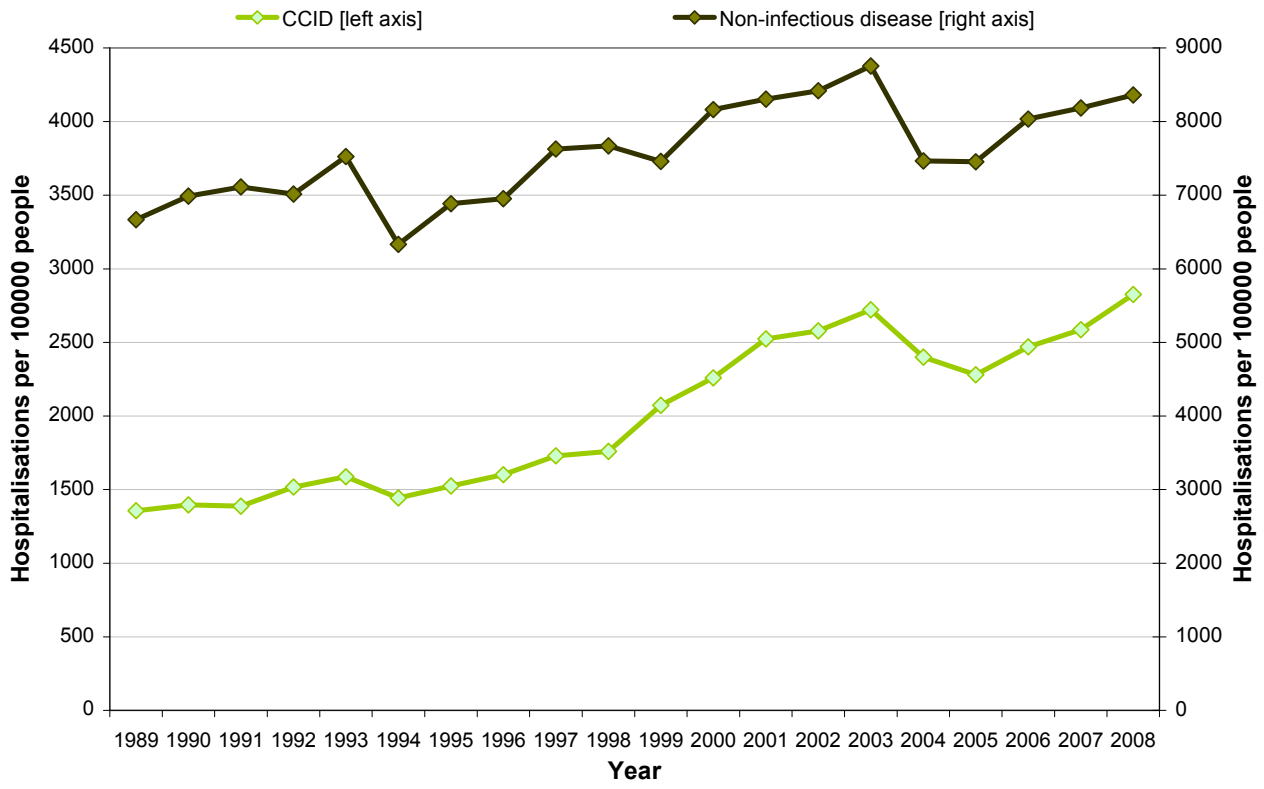


Figure 11. Pacific annual CCID and non-infectious disease hospitalisation rates, 1989-2008 (age standardised to 2006 Census).

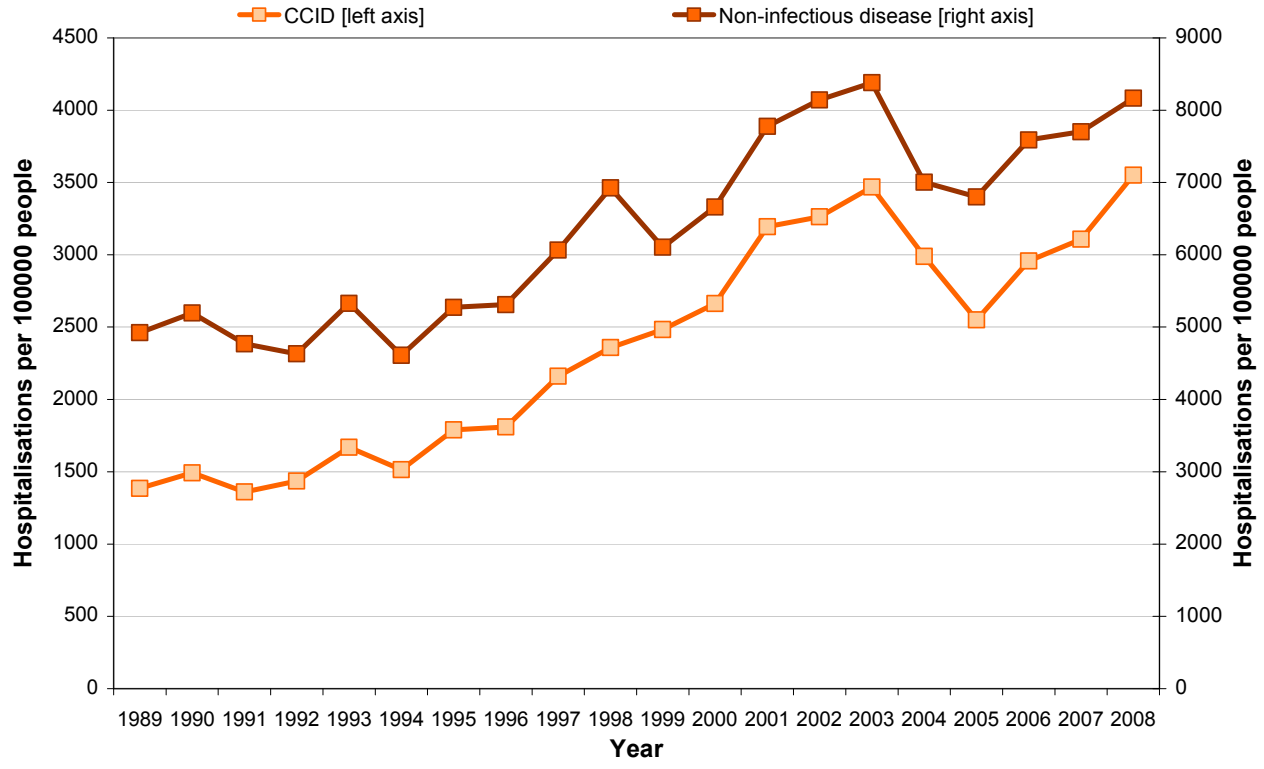


Figure 12. European/Other annual CCID and non-infectious disease hospitalisation rates, 1989-2008 (age standardised to 2006 Census).

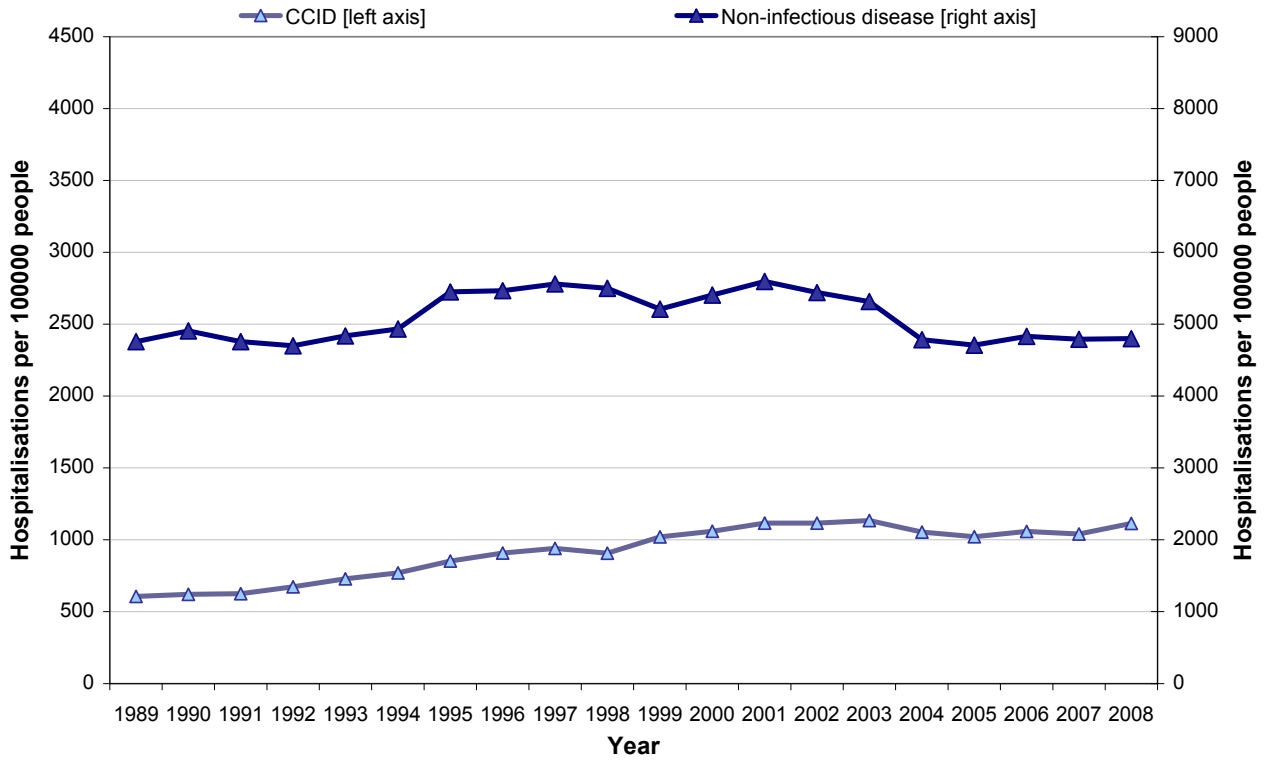


Figure 13. CCIDs as a percentage of all-cause hospitalisations, by ethnic grouping (age standardised to 2006 Census)

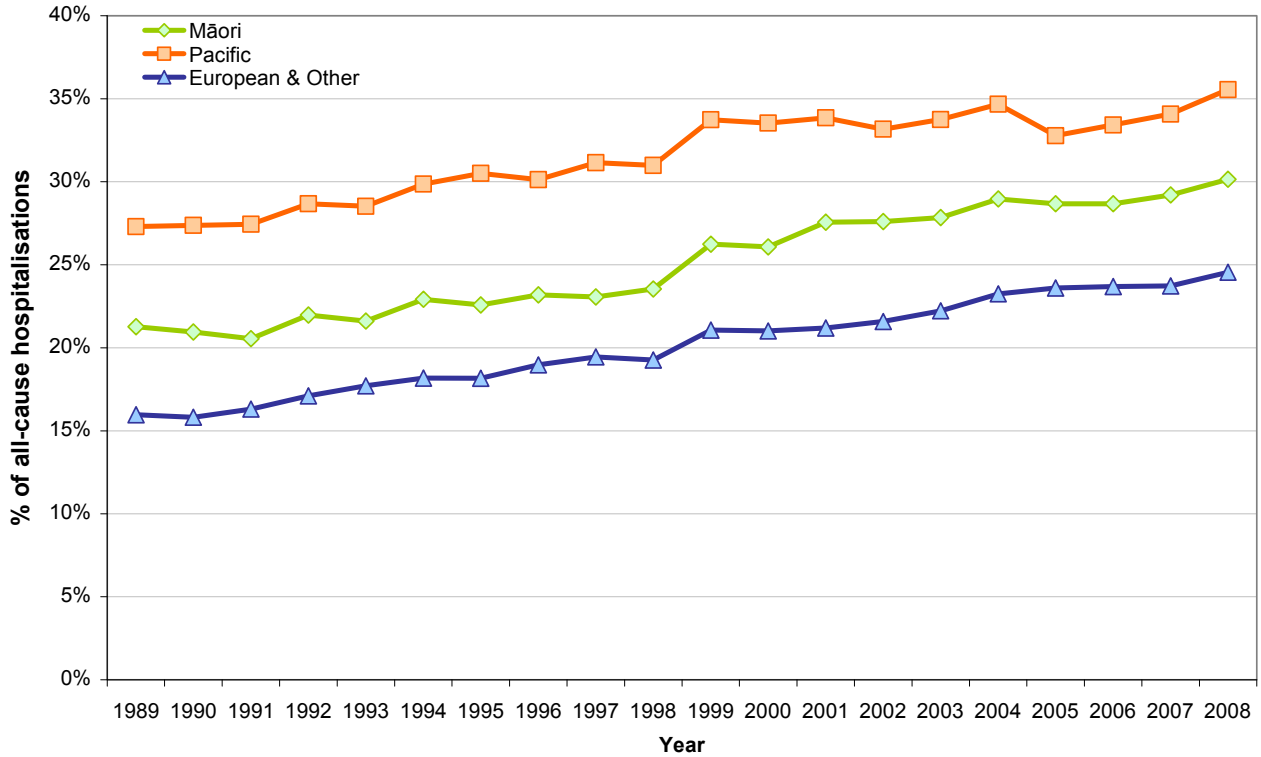
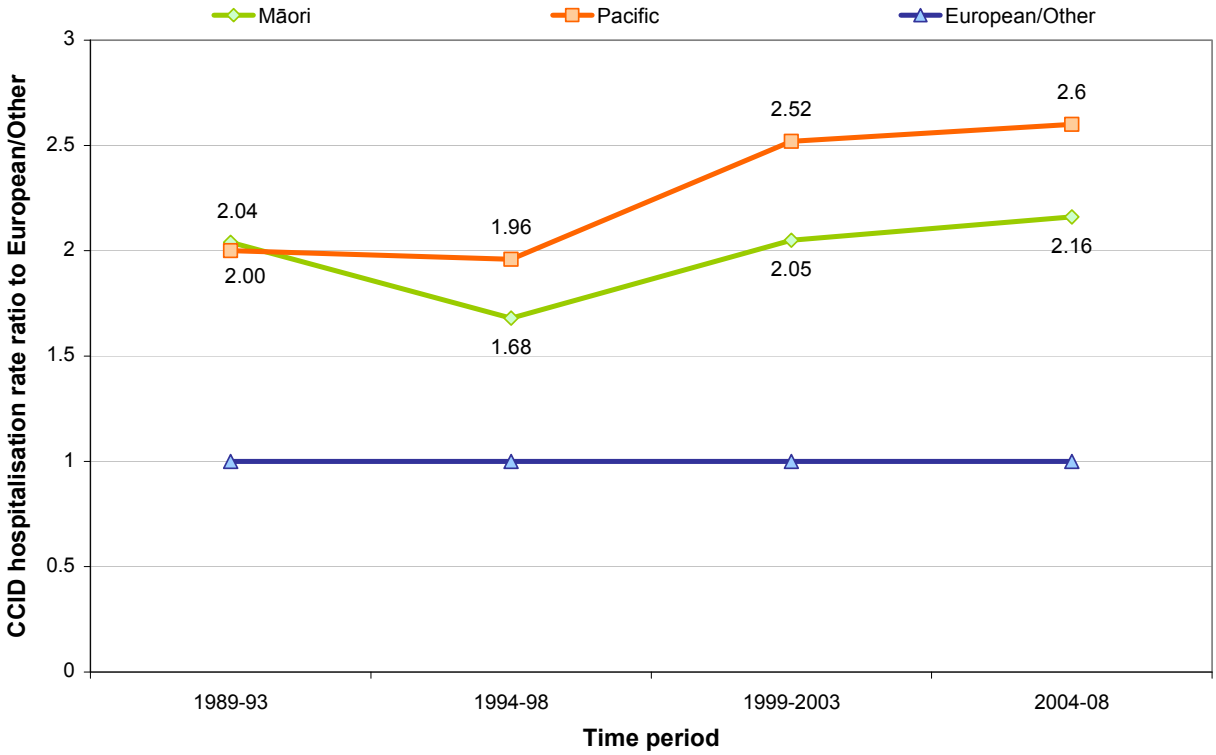


Figure 14. Ratio of Māori and Pacific CCID hospitalisation rates to European/Other CCID hospitalisation rates, for 5-year periods from 1989 to 2008 (age standardised to 2006 census).



4.7. Ethnic distribution of non-CCIDs

As with CCIDs, hospitalisation rates for non-CCIDs have increased between 1989 and 2008 for all ethnic groupings (Figure 15, Figure 16, Figure 17). However, the increase in non-CCIDs as a proportion of all-cause hospitalisations was not as similar across ethnic groupings as it was for CCIDs. Most notably, non-CCIDs as a proportion of all-cause hospitalisations (Figure 18) increased only a little for Pacific peoples, making up 6.8 percent of hospitalisations in 1989 and 7.5 percent in 2008. Māori and European/Other, both with proportions of 5.3 percent in 1989, have seen greater increases, taking them to 6.6 percent and 7.1 percent respectively in 2008, levels much closer to the Pacific rate.

SRRs for Māori and Pacific relative to European/Other non-CCID rates have followed different patterns (Figure 19). While SRRs were similar (1.98 and 1.89 respectively) in the 1989 to 1993 period, the Pacific SRR dropped to 1.7 in the 1994 to 1998 period and then rose to a level of 1.98 in 2004 to 2008. In contrast, the Māori SRR rose to a level of 2.26 in 1999 to 2003, but changed little in the subsequent period, finishing on 2.22.

Most importantly, however, although SRRs between European/Other and Māori and Pacific groupings have followed distinct paths over the study period, both were higher at the end of the study than at the beginning. Year by year trends also show a trend towards increasing inequalities continuing into the future.

Figure 15. Māori annual non-CCID and non-infectious disease hospitalisation rates, 1989-2008 (age standardised to 2006 Census).

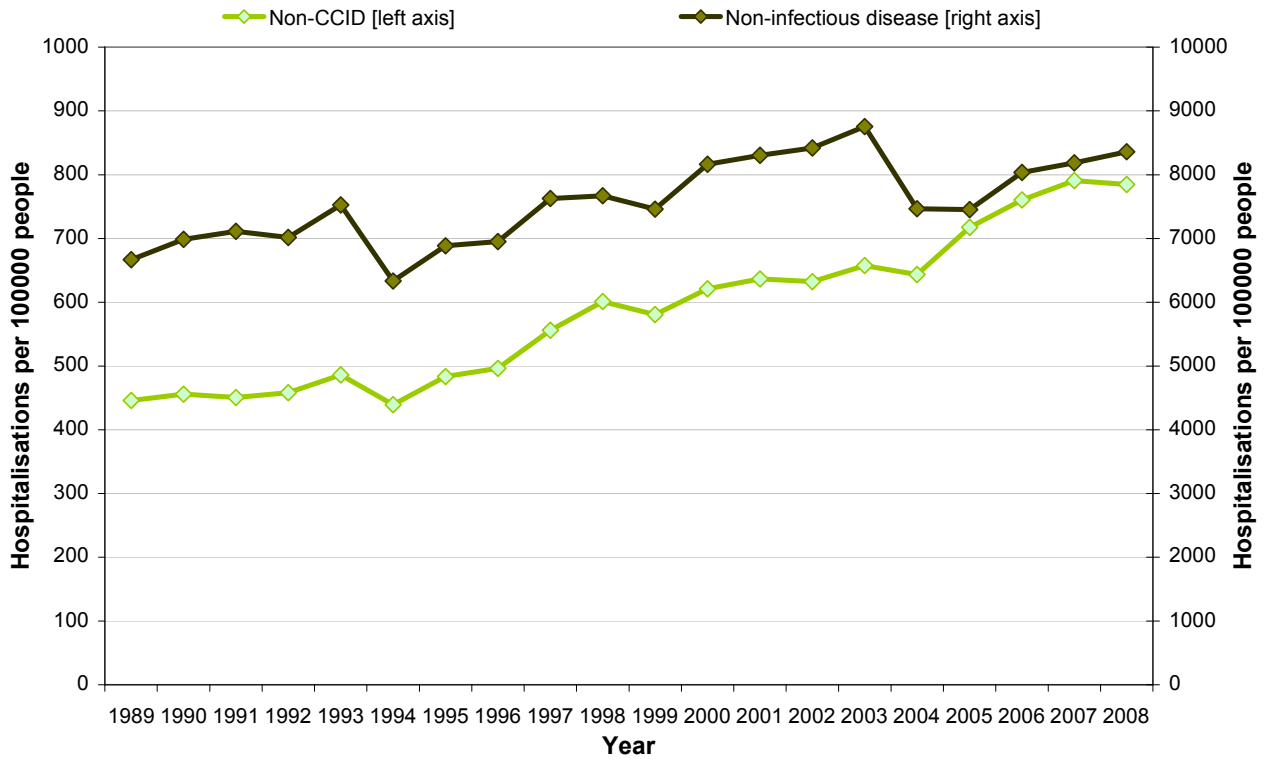


Figure 16. Pacific annual non-CCID and non-infectious disease hospitalisation rates, 1989-2008 (age standardised to 2006 Census).

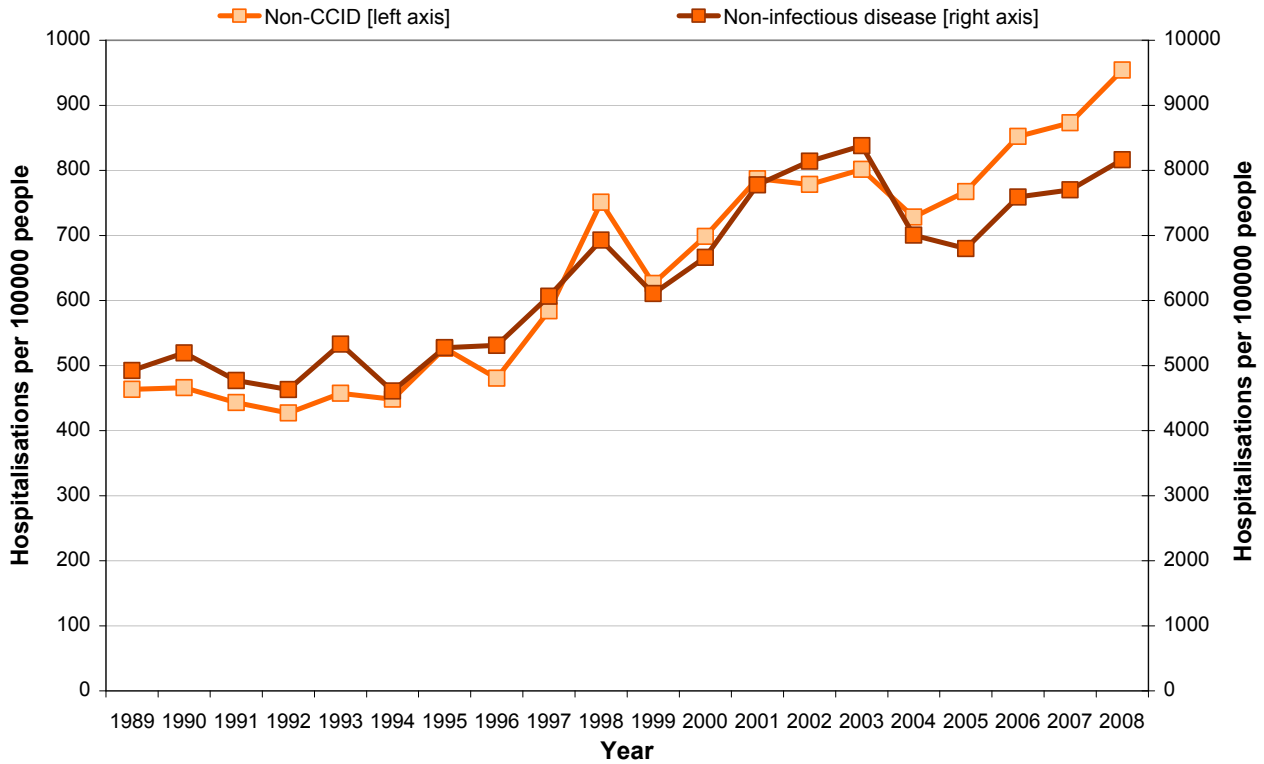


Figure 17. European/Other annual non-CCID and non-infectious disease hospitalisation rates, 1989-2008 (age standardised to 2006 Census).

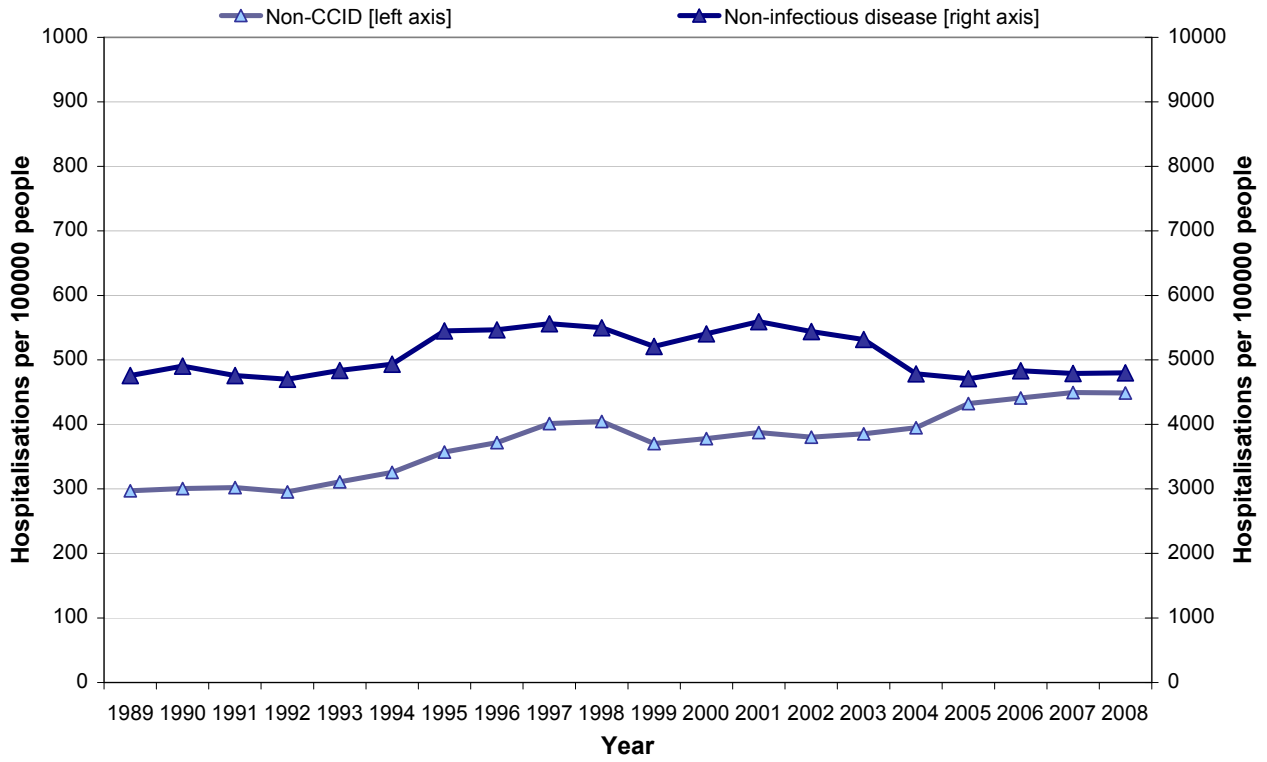


Figure 18. Non-CCIDs as a percentage of all-cause hospitalisations, by ethnic grouping (age standardised to 2006 Census)

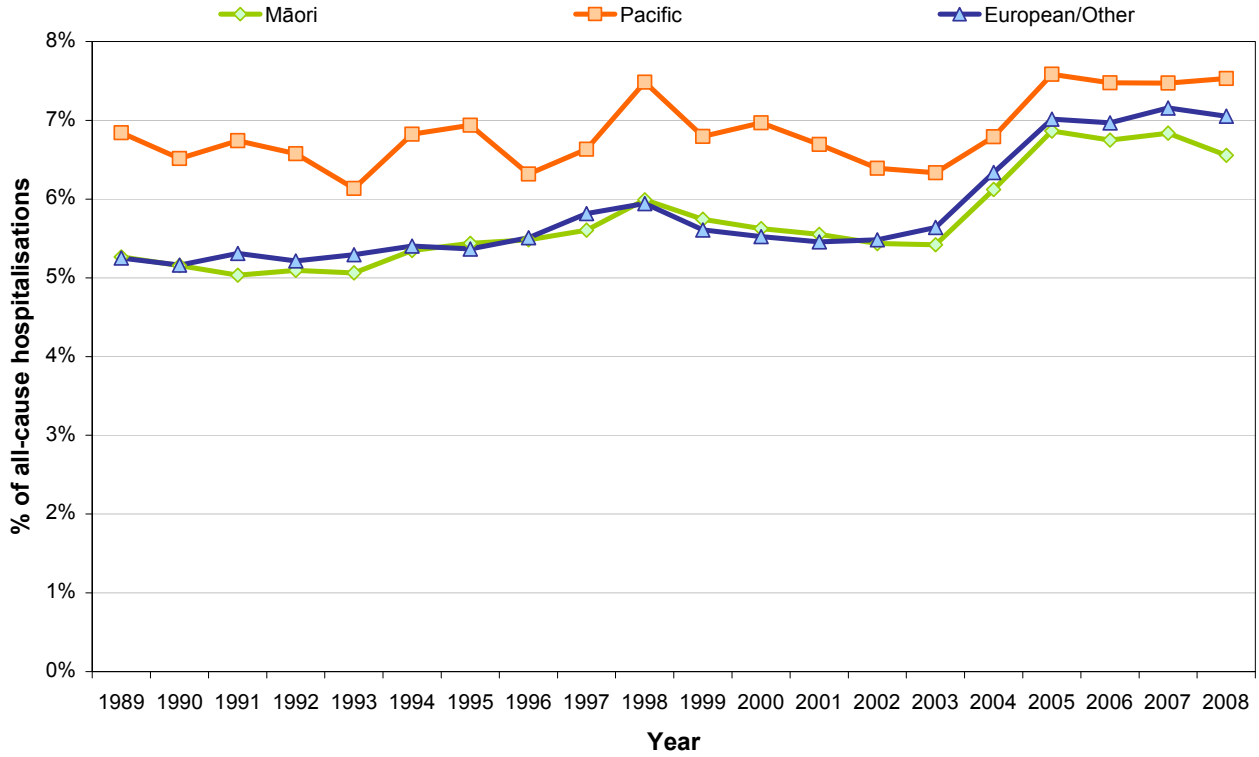
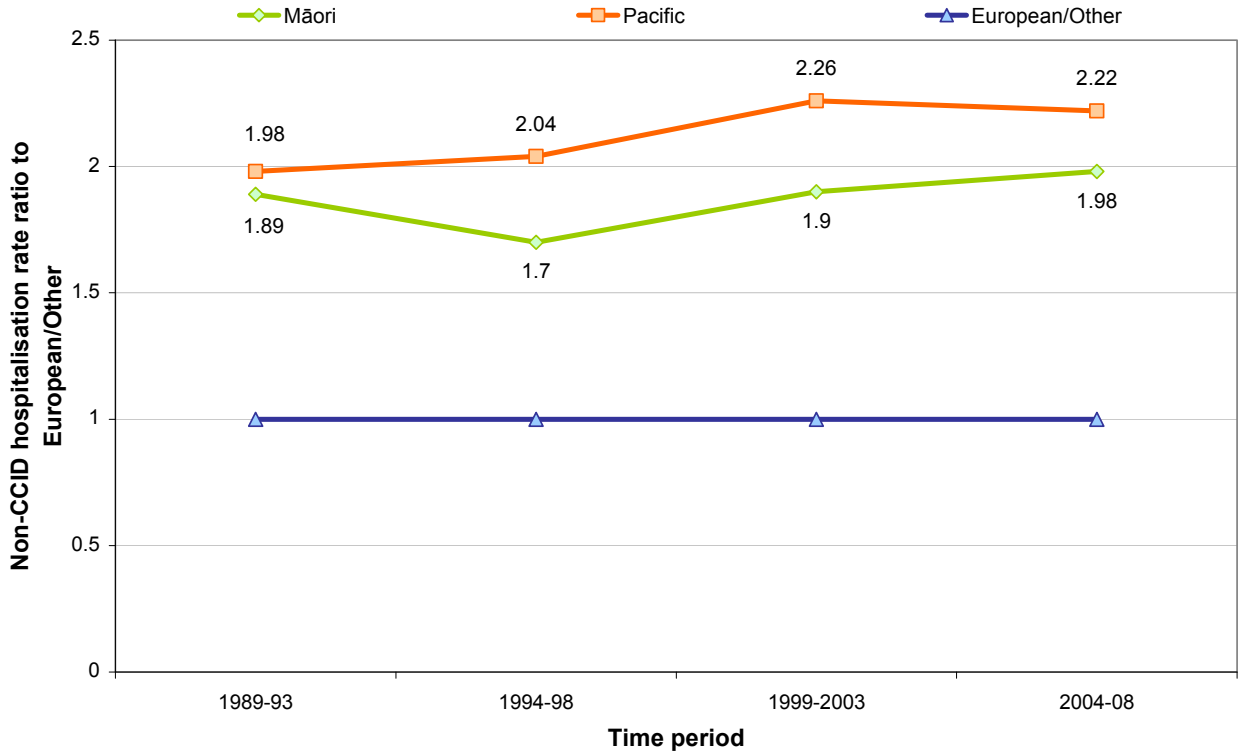


Figure 19. Ratio of Māori and Pacific non-CCID hospitalisation rates to European/Other CCID hospitalisation rates, for 5-year periods from 1989 to 2008 (age standardised to 2006 census).



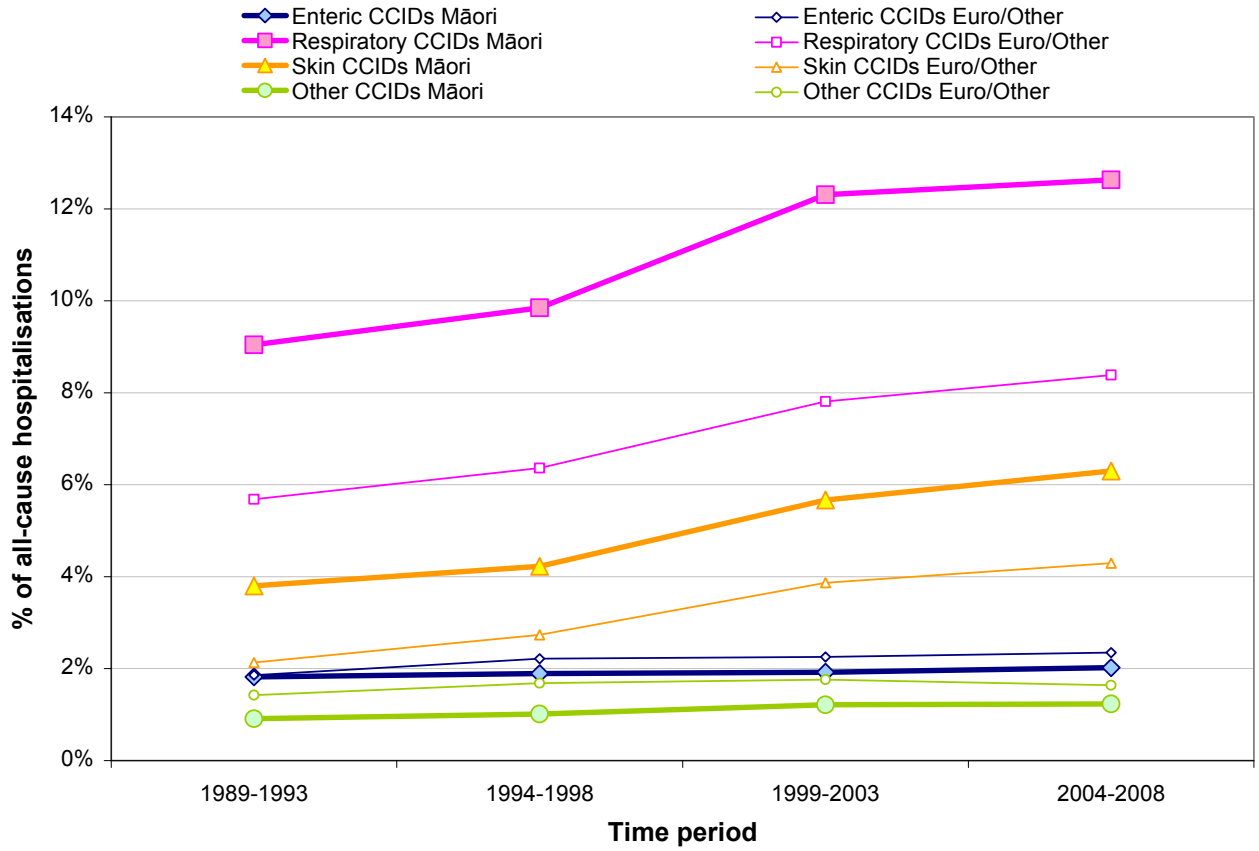
4.8. Distribution of specific disease groups

This section shows the distribution of specific disease groupings within the larger CCID category over time and across ethnic groups (specifically for Māori and European/Other).

Rates and all-cause hospitalisation-adjusted rates for the main categories of CCID are illustrated in Figure 5 and Figure 6.

CCIDs by category as a percentage of all-cause hospitalisations, for Māori and European/Other, are illustrated in Figure 20 below. Both ethnic groupings experienced increases across all categories of CCID over the study period.

Figure 20. CCIDs as a percentage of all-cause hospitalisations, by CCID category and ethnic grouping (age standardised to 2006 Census).



4.8.1. Enteric CCIDs

Figure 21 shows the changes in rates of different categories of enteric CCIDs as a proportion of all-cause hospitalisations. The increase in the total enteric category is primarily the result of an increase in gastroenteritis hospitalisations (for faecal-oral human pathogens such as norovirus and rotavirus). Other enteric infections from human sources (such as hepatitis A and enterovirus) are rare and have increased only slightly, and late effects of enteric infections (notably peptic ulcer and stomach cancer) have decreased.

Figure 21. Total close-contact enteric infections, and sub-categories, as percentage of all-cause hospitalisations (age standardised to 2006 Census)

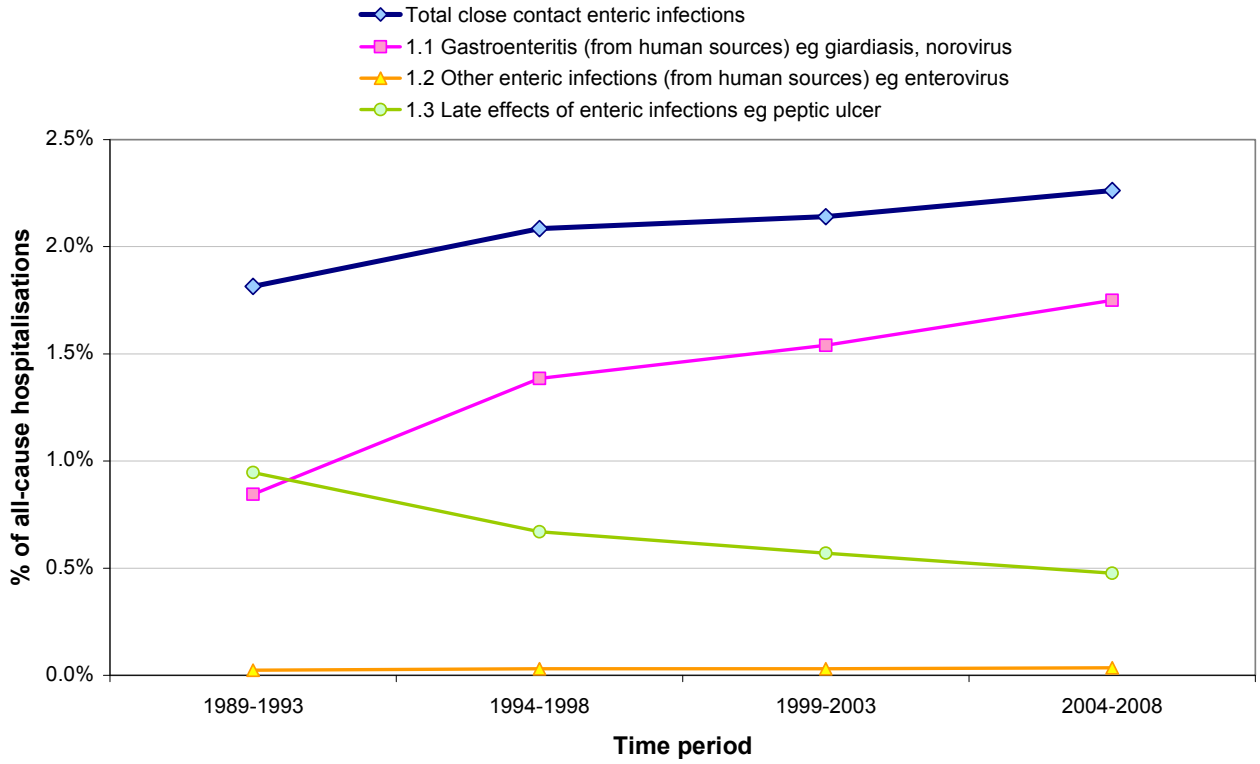


Figure 22. Māori enteric CCID hospitalisation rate ratio to European/Other rate, by enteric CCID subcategory (age standardised to 2006 Census)

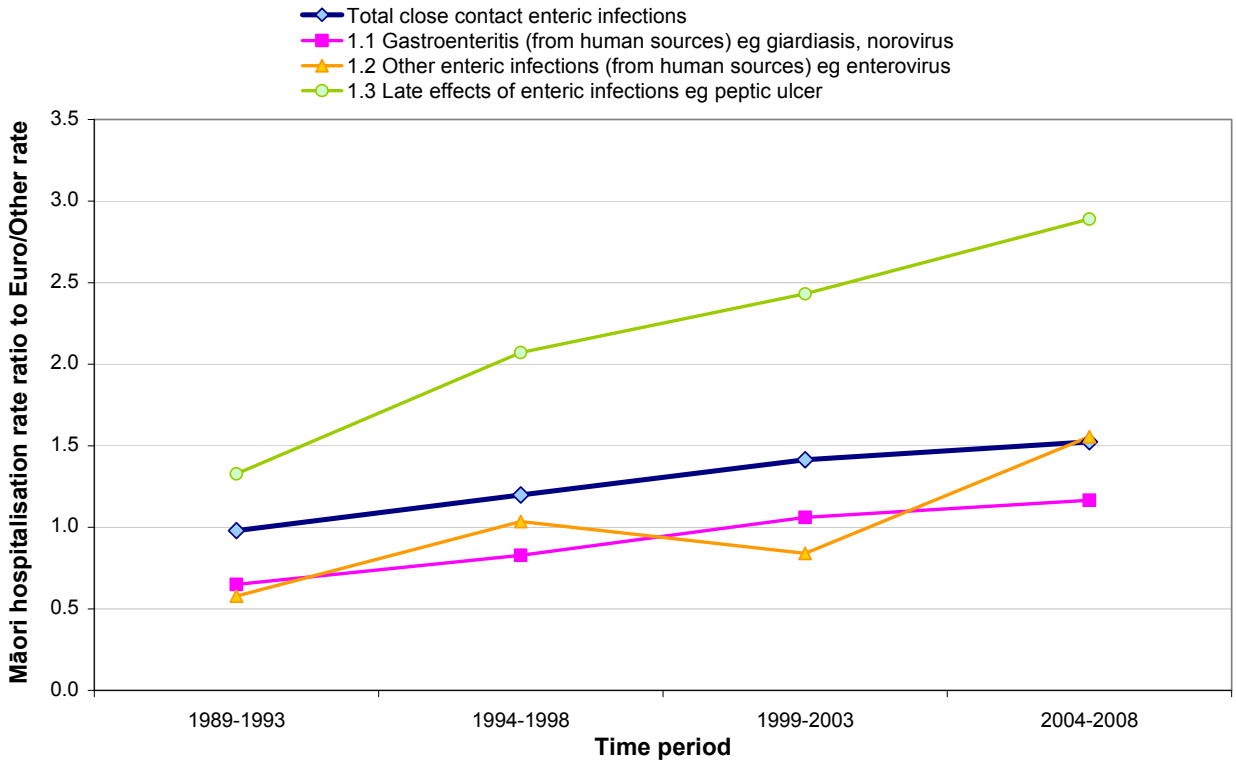


Figure 22 shows SRRs for Māori compared with European/Other hospitalisations for enteric infections. The study period has seen a shift for gastroenteritis CCID rates. Over the two periods between 1989 and 1998, gastroenteritis CCID rates were higher in European/Other than in Māori. Over the last two periods, however, gastroenteritis CCID rates in Māori overtook rates in European/Other. This reversal of inequality occurred as gastroenteritis rates increased overall, indicating that rates in Māori have increased faster than rates in European/Other. The Māori vs. European/Other SRR for other enteric infections from human sources also moved from less than 1 to more than 1 over the study period.

The largest increase in inequalities within the enteric category was in the late effects of enteric infections (the SRR was 1.33 for Māori vs. European/Other in the 1989 to 1993 period, increasing to 2.9 in the 2004 to 2008 period). However, this increase occurred because the rate of hospitalisation for this sub-category has not decreased as quickly for Māori as for European/Other, rather than because overall rates are increasing.

4.8.2. Respiratory CCIDs

Figure 23 shows changes in rates of different categories of respiratory CCIDs as a proportion of all-cause hospitalisations. Respiratory hospitalisations make up roughly half of all CCIDs. The largest single category of respiratory hospitalisations is LRTIs, which include pneumonia, bronchiolitis and influenza. This category has increased from 6.6 percent to 9.8 percent of all-cause hospitalisations.

While respiratory hospitalisations have been increasing overall as a percentage of hospitalisations, this is a reflection of the increase in LRTIs; rates have been dropping as a percentage of all-cause hospitalisations for all other respiratory CCID sub-categories except bacterial meningitis.

Figure 23. Total close-contact respiratory infections, and sub-categories, as a percentage of all-cause hospitalisations (age standardised to 2006 Census)

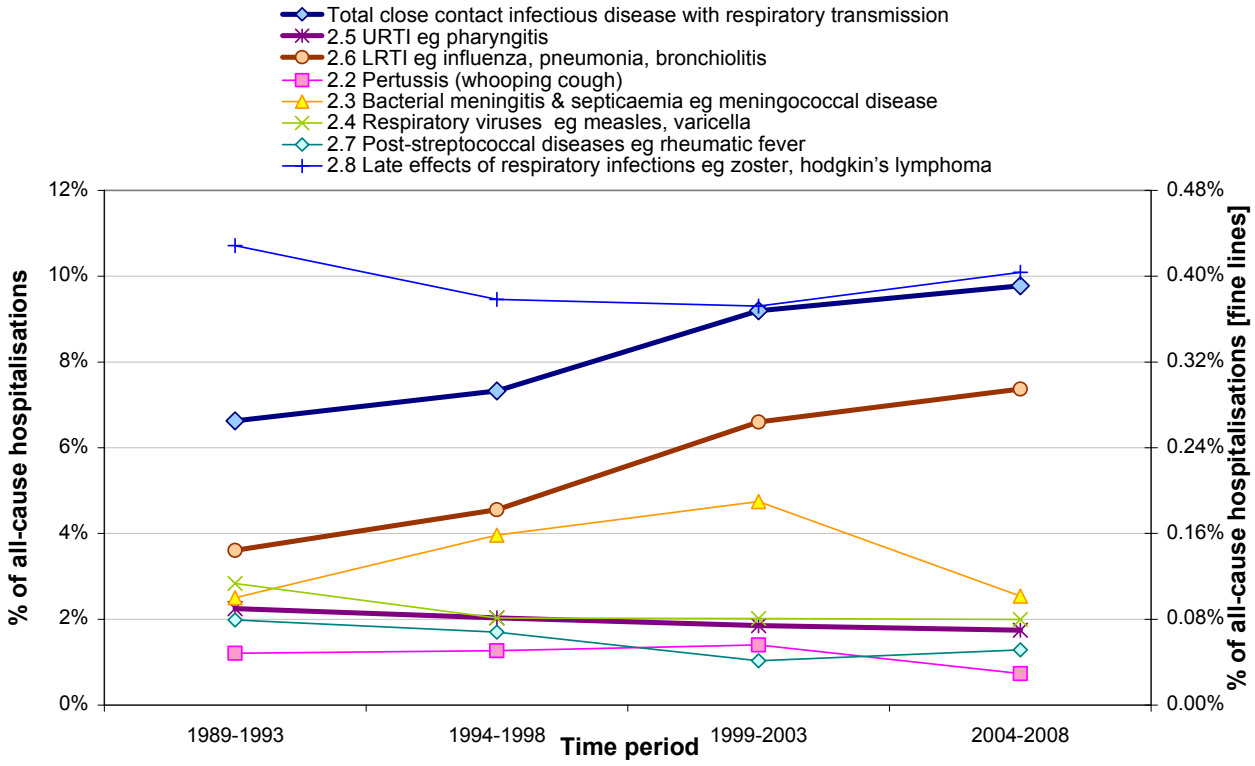
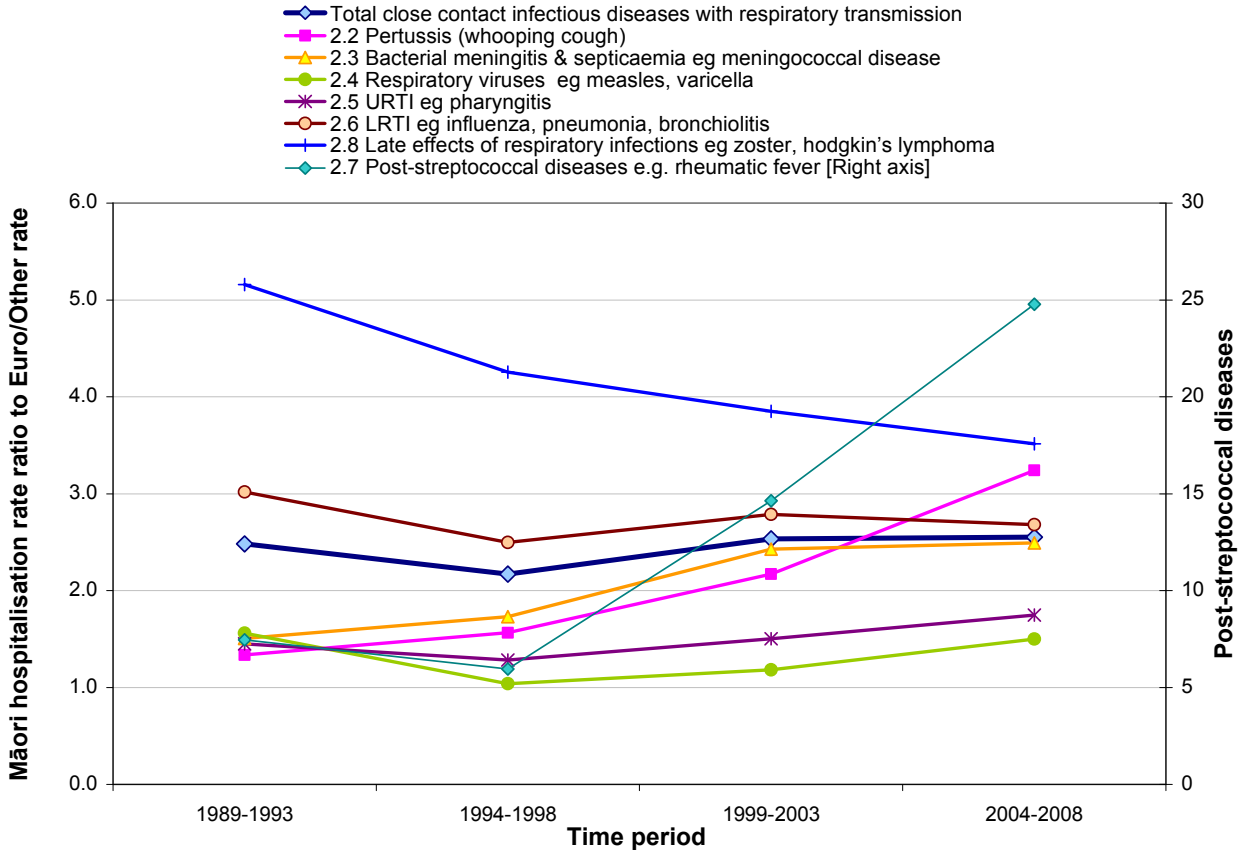


Figure 24 shows SRRs for Māori compared with European/Other hospitalisation rates for respiratory infections. The difference between Māori and European/Other respiratory hospitalisation rates has fluctuated only a little over the study period, with the SRR beginning at 2.5 1989 to 2003 period, and ending at 2.6 in the 2004 to 2008 period.

Figure 24. Māori respiratory CCID hospitalisation rate ratio to European/Other rate, by respiratory CCID subcategory (age standardised to 2006 Census)



Within the respiratory category, the greatest increase in inequalities between Māori and European/Other hospitalisations was for post-streptococcal diseases (notably acute rheumatic fever) (Figure 24). In 1989 to 1993, Māori had an age-standardised rate for post-streptococcal diseases of 13.2 hospitalisations per 1000 people per year, 4.8 times higher than the European/Other rate of 1.8. By the 2004 to 2008 period, the European/Other rate had dropped to 0.4, while the Māori rate was still at 10.0, giving an SRR of 24.8. The increase in acute rheumatic fever, and age and ethnic disparities in its occurrence, have been previously discussed by Jaine et al 2008.[2]

Pertussis also showed an increase in inequalities between Māori and European/Other (the SRR was 1.3 for Māori vs. European/Other in the 1989 to 1993 period, increasing to 3.2 in 2004 to 2008). Inequalities in bacterial meningitis incidence increased over the 1989 to 2003 period, but have since levelled out (the SRR was 2.5 for Māori vs. European/Other in the 2004 to 2008 period).

The incidence of both post-streptococcal diseases and pertussis is higher in younger age groups, therefore the increases in inequalities in these CCID sub-categories are not due to the increasing age of the Māori population.

Inequalities in respiratory CCID hospitalisation rates, as a percentage of all-cause hospitalisations between Māori, and European/Other, have decreased for late effects of respiratory infections, and

LRTIs. Respiratory virus inequalities initially reduced, but had returned to their 1989 to 1993 level by 2004 to 2008.

It is important to note that the late sequelae of respiratory infections (including rheumatic heart disease fever and lymphoma), reflects the results of infections several decades ago. This situation contrasts with other categories of infectious disease where the consequences of infection usually result in an acute disease.

4.8.3. Close-contact skin infections

Figure 25. Total close-contact skin infections, and sub-categories, as percentage of all-cause hospitalisations (age standardised to 2006 Census)

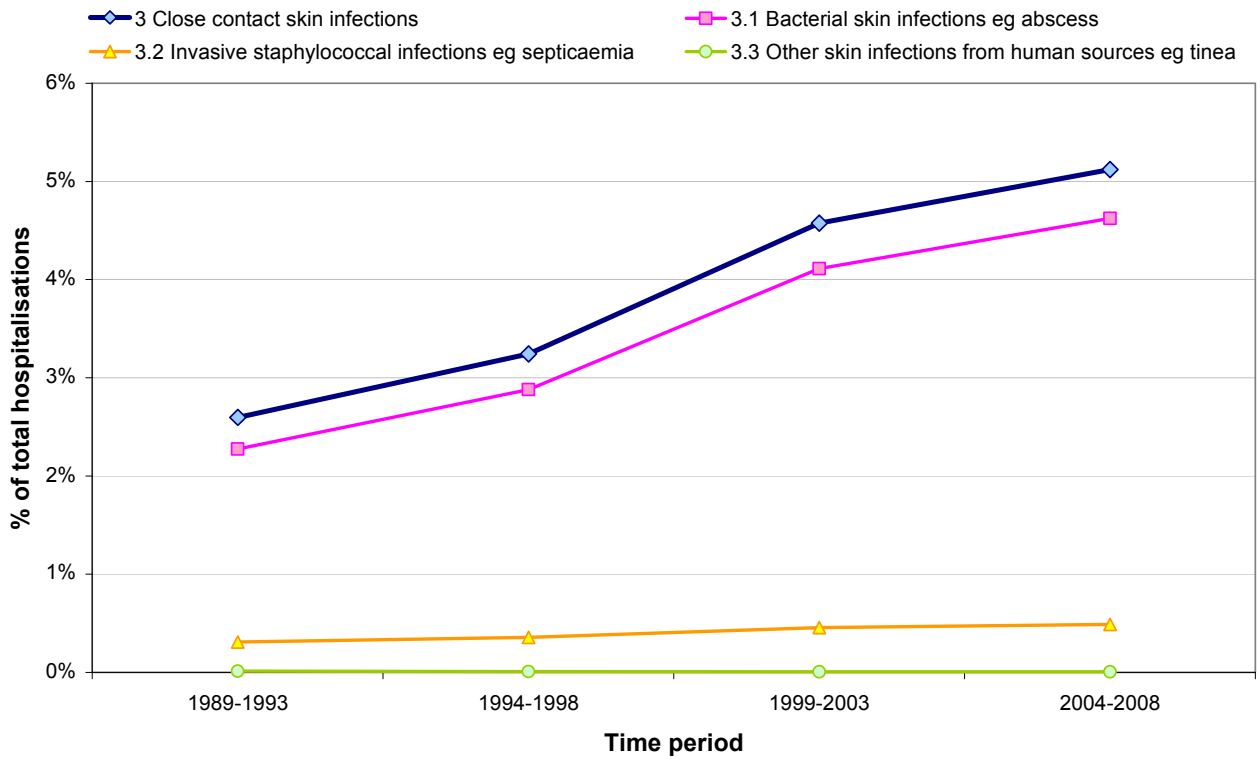
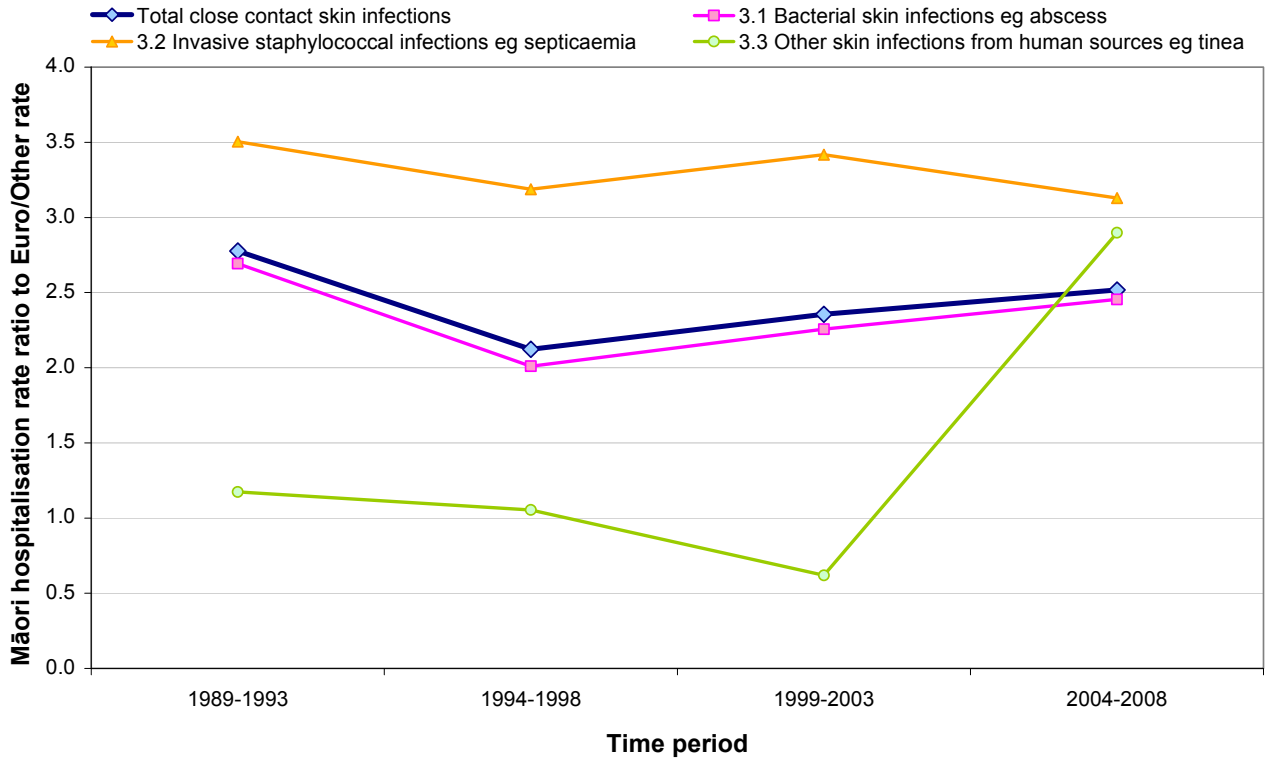


Figure 25 shows changes in rates of different categories of close-contact skin infections as a proportion of all-cause hospitalisations. The majority of the increase in close-contact skin infections between 1989 and 2008 came from bacterial skin infections, which doubled from 2.3 percent of hospitalisations in the 1989 to 1993 period, to 4.6 percent in the 2004 to 2008 period.

Figure 26 shows SRRs for Māori compared with European/Other hospitalisation rates for close-contact skin infections. Although inequalities between Māori and European/Other rates have declined over the 20-year study period, the decline occurred only between 1989 to 1993 and 1994 to 1998. SRRs increased over the last two periods, with Māori close-contact skin infection incidence 2.5 times higher than European/Other in 2004 to 2008.

Figure 26. Māori close-contact skin infection hospitalisation rate ratio to European/Other rate, by close-contact skin infection subcategory (age standardised to 2006 Census)



4.8.4. Other CCIDs

Figure 27 shows changes in rates of other CCIDs as a proportion of all-cause hospitalisations. Rates of other CCIDs increased over the 1989 to 2003 study periods, but dropped back a little by 2004 to 2008. The largest sub-category, which also showed the greatest increase, was other viral infections from human contact, which increased from 1.1 percent of hospitalisations in 1989 to 1993, to 1.4 percent in 2004 to 2008 (reaching 1.5 percent in the 1999 to 2003 period).

Figure 28 shows SRRs for Māori compared with European/Other hospitalisation rates for other CCIDs. Māori experienced a greater increase in CCIDs with multiple or unknown transmission than did European/Other (Figure 28). This effect was shared by the two largest sub-categories, other bacterial infections from human contact (e.g. streptococcal septicaemia) and other viral infections from human contact (e.g. viral encephalitis). Patterns for other and mixed infections from human contact (e.g. conjunctivitis) and late effects of other CCIDs (e.g. encephalitis) have less absolute effect, as these sub-categories make up less than 0.1 percent of all-cause hospitalisations.

Figure 27. Total other CCIDs, and sub-categories, as percentage of all-cause hospitalisations (age standardised to 2006 Census)

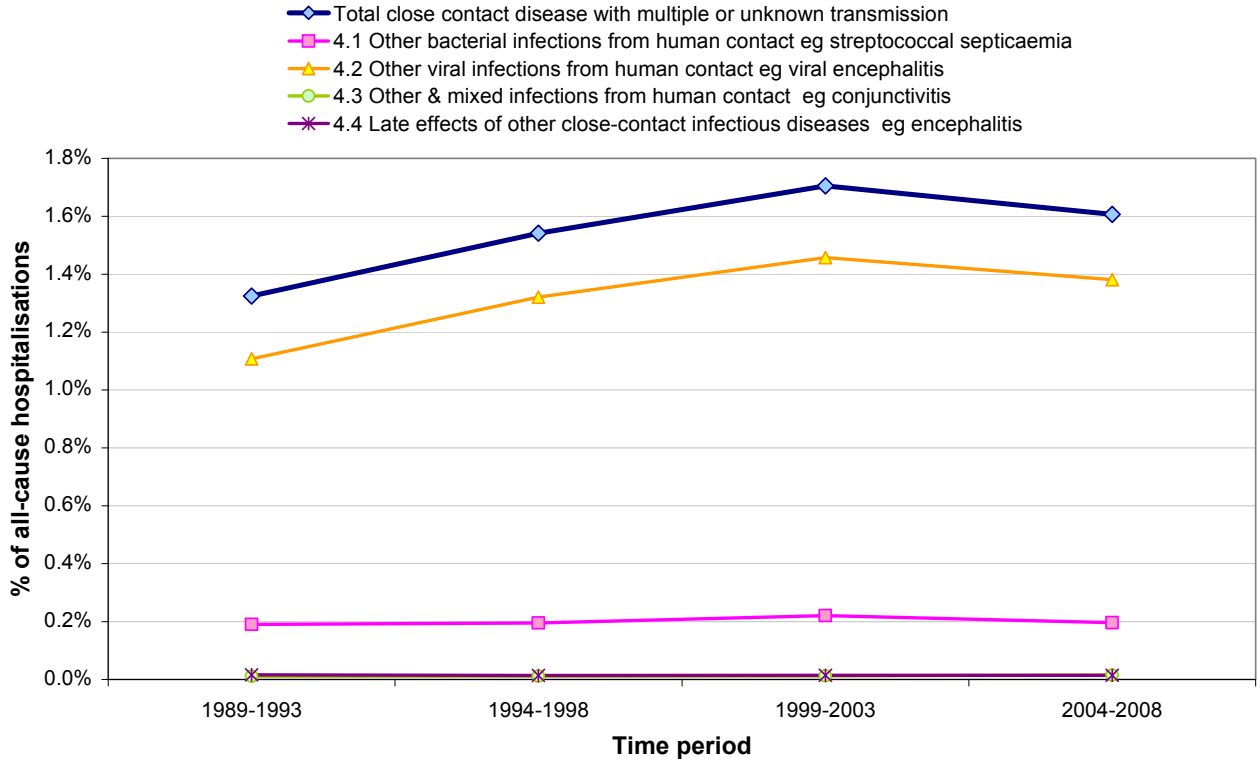
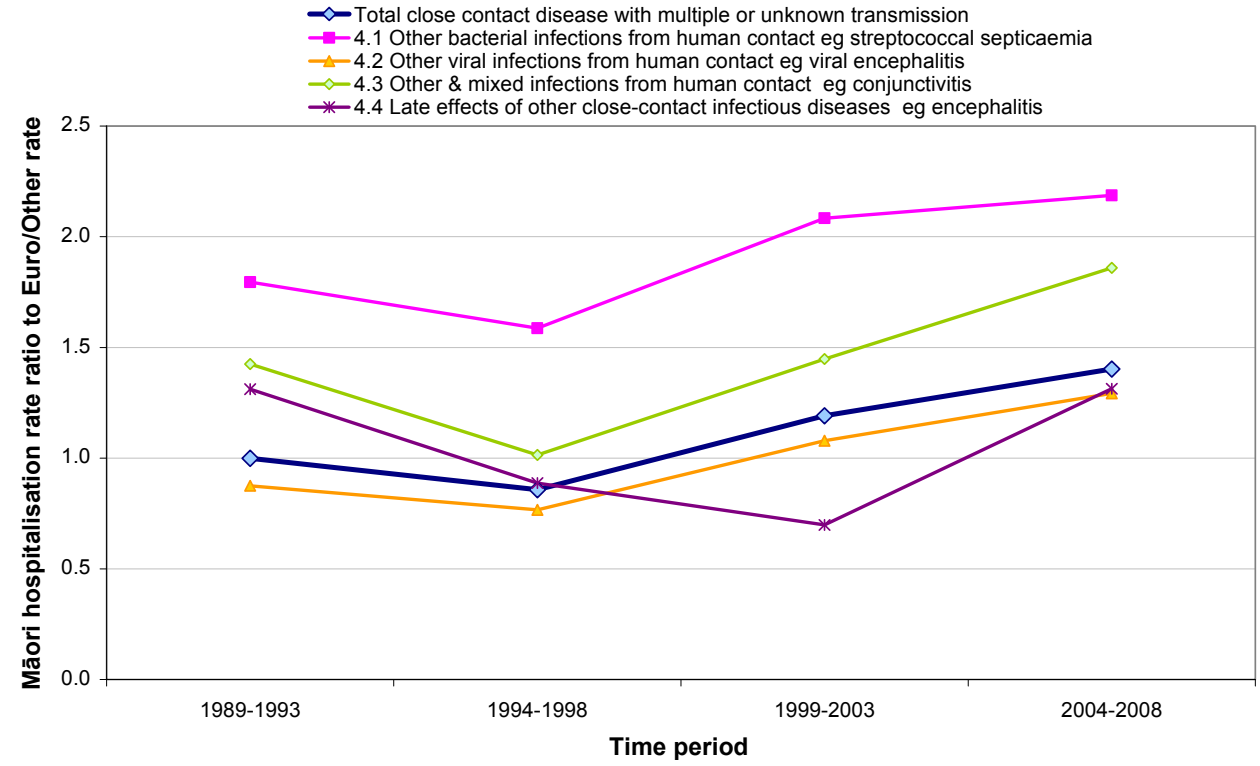


Figure 28. Māori hospitalisation rate ratio to European/Other, for CCIDs with multiple or unknown transmission (age standardised to 2006 Census)



4.9. Infectious disease and socio-economic status

Socio-economic status, as measured by NZDep, the census area unit-based measure of deprivation, could only be reliably assigned (via NMDS domicile code) to hospitalisations for the 1999 to 2003 and 2004 to 2008 periods.

For both time periods, the likelihood of hospitalisation for an infectious disease rose with increasing deprivation (Table 4). There was only a small trend across the first four NZDep quintiles; the largest inter-quintile increase was between NZDep deciles 7–8 and deciles 9–10.

Likelihood of hospitalisation for infectious disease remained the same in quintile 1 (NZDep 1-2, least deprivation) decreased for quintiles 2 and 3 (NZDep 3-6), and increased for quintiles 4 and 5 (NZDep 7-10, most deprivation) from the 1999 to 2003 period to the 2004 to 2008 period (Figure 29). These changes reflected changes in the larger CCID category. For non-CCIDs, hospitalisation rates increased for all quintiles. However, the gradient of increased hospitalisation with increased deprivation became steeper in the second time period, particularly for CCIDs.

Both CCIDs and non-CCIDs have also increased for all quintiles as a percentage of all-cause hospitalisations (Figure 30). However, the distribution across deciles has changed little between deciles for each sub-category.

Table 4. CCID and non-CCID hospitalisation rates, percentages and SRRs, by NZDep quintile and 5-year periods from 1999 to 2008

		1999 to 2003			2004 to 2008			Rate ratio 2004-2008 /1999-2003
	NZDep quintile	Age-std hosp rate†	% of total hosps	SRR	Age-std hosp rate†	% of total hosps	SRR	
CCIDs	1-2	785.1	15.9%	Ref	733.0	16.6%	Ref	0.93
	3-4	1001.2	16.4%	1.28	852.2	17.1%	1.16	0.85
	5-6	1214.4	16.7%	1.55	1126.5	17.7%	1.54	0.93
	7-8	1533.9	17.2%	1.95	1646.2	18.7%	2.25	1.07
	9-10	2226.1	19.8%	2.84	2298.3	21.0%	3.14	1.03
Non-CCIDs	1-2	289.8	5.9%	Ref	327.8	7.4%	Ref	1.13
	3-4	343.1	5.6%	1.18	356.4	7.2%	1.09	1.04
	5-6	404.4	5.6%	1.40	434.4	6.8%	1.33	1.07
	7-8	471.3	5.3%	1.63	579.9	6.6%	1.77	1.23
	9-10	620.9	5.5%	2.14	727.3	6.6%	2.22	1.17

† Average annual rate per 100,000, age standardised to distribution of New Zealand population in 2006 Census

Figure 29. **Infectious disease hospitalisation rates per 100000 people, by NZDep quintile and disease category, for the time periods 1999 to 2003 and 2004 to 2008 (age standardised to 2006 Census).**

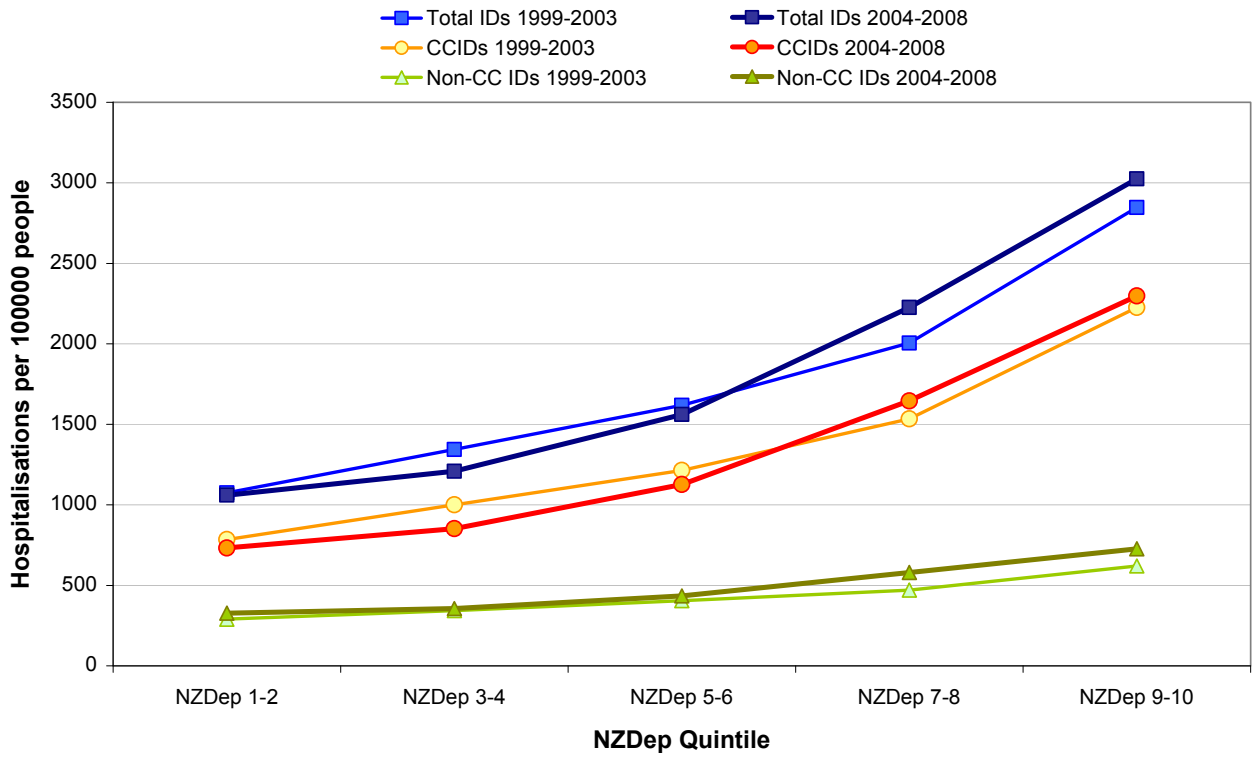
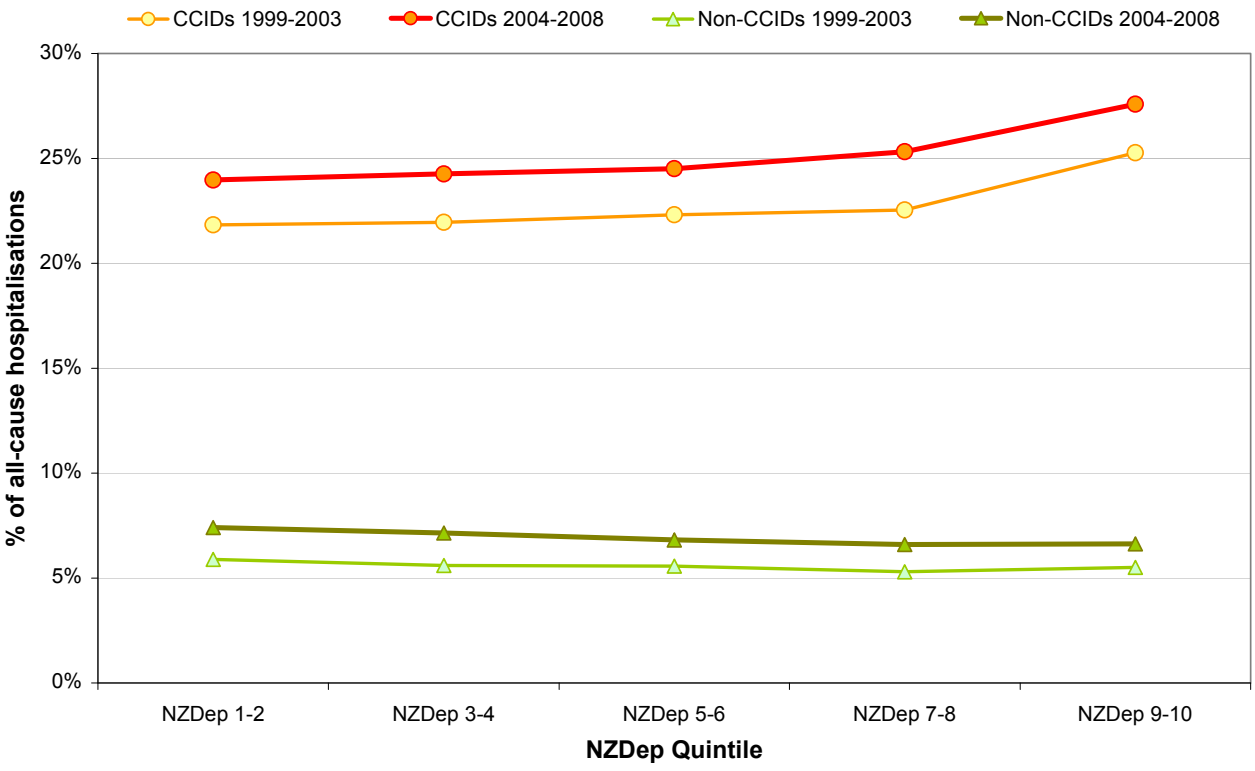


Figure 30. **Infectious disease hospitalisations as a percentage of all-cause hospitalisations, by NZDep quintile and disease category, for the time periods 1999 to 2003 and 2004 to 2008 (age standardised to 2006 Census).**



4.9.1. Infectious disease, socio-economic status and ethnicity

Overall, trends by NZDep for Māori and European/Other ethnicities were similar to trends for combined ethnicities. The only difference of note was for Māori, whose 1999 to 2003 NZDep quintile 2 hospitalisation rates for both CCIDs and non-CCIDs were not only higher than quintile 1 in the same period, but also higher than the more deprived quintiles 3 and 4. This unusual distribution disappeared in the 2004 to 2008 period.

Over the two time periods, NZDep gradients for both CCIDs and non-CCIDs became more similar across the Māori and European/Other ethnic groupings.

Figure 31. Māori infectious disease hospitalisation rates per 100000 people, by NZDep quintile and disease category, for the time periods 1999 to 2003 and 2004 to 2008 (age standardised to 2006 Census).

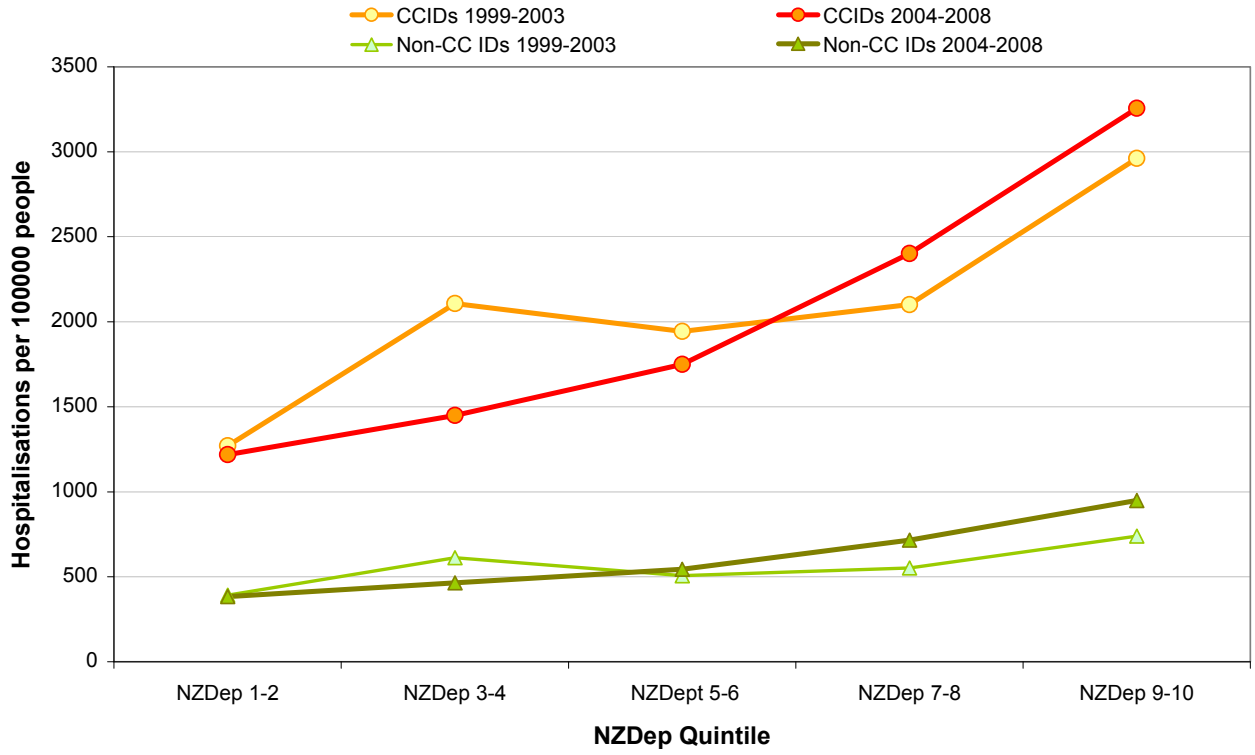
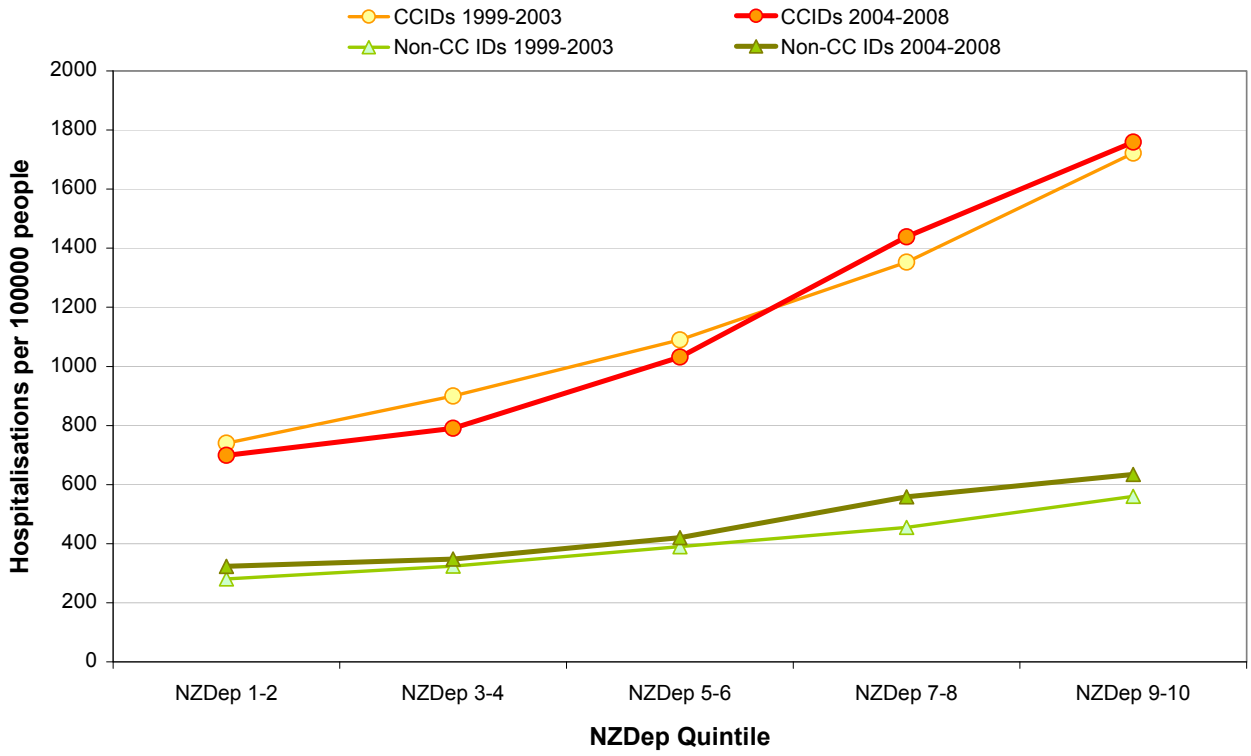


Figure 32. **European/Other infectious disease hospitalisation rates per 100000 people, by NZDep quintile and disease category, for the time periods 1999 to 2003 and 2004 to 2008 (age standardised to 2006 Census).**



5. Discussion and conclusions

5.1. Key findings

Infectious diseases make a large contribution to all-cause hospitalisations, accounting for 17.9 percent of hospitalisations in 1989 to 1993, increasing to 25.8 percent of hospitalisations in 2004 to 2008. This large increase in infectious disease hospitalisations has important health and economic implications. The increase is equivalent to an additional 22,000 hospitalisations a year (compared with what would have been seen had the proportion of 17.9 percent of hospitalisations caused by infectious diseases in 1989 to 1993 continued to the present).

CCID hospitalisations have also increased, both in total rates and as a proportion of all-cause hospitalisations. Their contribution to infectious diseases increased from 70.7 percent to 73.5 percent over this period. They now make up nearly a fifth of all hospitalisations.

Māori CCID rates were consistently higher than European/Other rates, as were Pacific CCID rates. In addition, there were widening ethnic inequalities in infectious disease over the 20-year observation period. In the 1989 to 1993 period the SRR for Māori was 2.04 and for Pacific peoples was 2.00 compared with European/Other. By 2004 to 2008, these SRRs had increased to 2.16 for Māori (8% increase) and to 2.60 for Pacific peoples (30% increase). The pattern was more varied for specific CCID sub-categories; in some instances increasing inequalities were the result of rates dropping less quickly among Māori than among European/Other, rather than increasing more quickly.

CCID incidence was higher among groups living in more socio-economically deprived areas, and increased more in these groups over the last 10 years of the study period. Otherwise, inequalities by NZDep were only slightly more pronounced in CCIDs than in other hospitalisations, and less pronounced in non-CCIDs.

Respiratory illness made the largest contribution to the increase in CCIDs over the study period. Inequalities between Māori and European/Other rates of respiratory CCID have reduced slightly in relation to all-cause hospitalisations.

The findings of this report also support the validity of distinguishing CCIDs from infectious diseases more generally (i.e. non-CCIDs) – not only are they different in mode of transmission, but they also behave differently over time and across ethnic groups and levels of small-area socio-economic deprivation. In particular, the distinct behaviour of CCIDs and non-CCIDs by NZDep over the 10 years from 1999 to 2008, in relation to all-cause hospitalisations, suggests the two categories should be approached differently.

5.2. Implications

As in many other areas of health, there are ethnic inequalities in rates of both CCIDs and non-CCIDs. There has also been a trend of increasing ethnic inequalities over the last 20 years. Given that rates of respiratory disease represent an area of significant inequality between Māori and non-Māori,[22] successful interventions in this area are likely to have multiple benefits for population health.

Because CCIDs make a large and increasing contribution to hospitalisations for Māori and Pacific peoples, they represent an important area for public health intervention. Prevention and control measures for CCIDs require further development, but can be classified into three broad groups:

1. Disease-specific – these are measures focused on specific infectious diseases such as primary prevention of rheumatic fever, introduction and high coverage of vaccines for specific diseases (e.g. meningococcal disease and pneumococcal disease), and measures to improve access to specific treatment (e.g. for *Helicobacter pylori* infection to reduce peptic ulcer disease and gastric cancer).
2. Focused on mode of transmission – these are measures aimed at reducing specific modes of transmission that will usually be common to several diseases (e.g. focus on reducing active and passive smoking and promoting cough etiquette to reduce rates of respiratory infection; focus on provision of adequate hand-washing facilities in schools and pre-schools to reduce enteric infections).
3. Focused on socio-economic determinants of health – these are measures aimed at more general determinants of inequalities in health (e.g. reducing household crowding to limit transmission of all CCIDs).

The disease sub-categories with the greatest potential for intervention are those which make a relatively large contribution to the disease burden, and which have been rising most rapidly. By these criteria, the prime candidates for intervention are lower respiratory tract infections and bacterial skin infections, which made up 7.4 percent and 4.6 percent respectively of all-cause hospitalisations in the 2004 to 2008 period, having increased from 3.6 percent and 2.3 percent respectively between 1989 and 1993.

The large, and increasing, health inequalities for acute rheumatic fever mean that prevention and control of this disease deserves particular attention. The need to halt or reverse increasing health inequalities would also support a particular focus on pertussis and improved access to *Helicobacter pylori* treatment.

5.3. Limitations

Findings from this study need to be interpreted with caution for a number of reasons.

- Limitations with the infectious disease classification system – the definition of diseases as predominantly infectious and predominantly CCID is based on expert judgement. This classification is built on previous international and New Zealand work. The system has been further refined by the project team and peer-reviewed by a highly qualified external reference group. However, there will inevitably be some errors remaining in this classification.
- Limitations with the numerator – hospitalisations will only capture a proportion of all diseases cases. For severe diseases, such as meningococcal disease, this proportion will be high, but for less severe diseases, such as mumps, this proportion will be low and possibly biased. There are a range of issues with using hospitalisation data, such as use of principal diagnosis, which inevitably under-counts some causal groups.
- Limitations with the denominator – rate calculations have used denominator populations from the New Zealand census. There are potential problems with matching to numerator, particularly for assigning ethnicity.
- Limitations of ethnicity coding – ethnicity data routinely collected in health data sets, such as hospitalisations, has been shown to undercount Māori.[23] It is possible that this degree of

undercount has decreased over time. If that is the case, then this effect would have tended to decrease the observed level of inequality in historic data compared with the 'true' effect and also compared with what is observed in more recent data.

- Study size and precision – by effectively using the entire population of New Zealand this analysis achieves a high level of statistical precision. However, some of the diseases reported here are still relatively uncommon so findings need to be interpreted with caution.
- Geographical variation – this study does not distinguish between different geographical areas of New Zealand. Infectious disease incidence may not be homogenous across the country.
- Limitations in methods for measuring inequalities – this report has used relatively simple methods for presenting ethnic inequalities in infectious disease rates. Additional methods could be used in future analyses.[20]

5.4. Further work

This is the first stage of a larger project. The next stage will produce a detailed description of household crowding across the 1991 to 2006 period (based on four censuses), with a specific focus on household crowding levels and ethnic inequalities. The goal is to identify how improvement to housing conditions and reduced inequalities in the determinants of health could contribute to lowering rates of infectious diseases.

This analysis by its very nature has looked at large disease groupings. All of the categories described here would benefit from more detailed analysis.

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6. Appendices

6.1. Filters

Table 5. Hospitalisations excluded and remaining by filter method

	1989 to 1993			1994 to 1998			1999 to 2003			2004 to 2008		
Method for removing event	**No. of hosps removed**	**No. of hosps remaining** 2687289	**% of total**	**No. of hosps removed**	**No. of hosps remaining** 3418927	**% of total**	**No. of hosps removed**	**No. of hosps remaining** 4347784	**% of total**	**No. of hosps removed**	**No. of hosps remaining** 4403379	**% of total**
Pregnancy, childbirth and the puerperium (O00-O99).	394078	2293211	85.34	397611	3021316	88.37	406012	3941772	90.66	430905	3972474	90.21
Certain conditions originating in the perinatal period (P00-P96).	56163	2237048	83.25	75920	2945396	86.15	86425	3855347	88.67	83730	3888744	88.31
Congenital malformations, deformations and chromosomal abnormalities (Q00-Q99).	33915	2203133	81.98	35481	2909915	85.11	38440	3816907	87.79	38578	3850166	87.44
Factors influencing health status and contact with health services (Z00-Z99).	311967	1891166	70.37	552287	2357628	68.96	700134	3116773	71.69	798806	3051360	69.30
Diagnosis type (no hospitalisations excluded).												
Purchaser code = '06'	69	1891097	70.37	86819	2270809	66.42	340455	2776318	63.86	35699	3015661	68.49
NZ Resident Status = N	8898	1882199	70.04	32192	2238617	65.48	32177	2744141	63.12	107666	2907995	66.04
Combine transfers with new admissions into single admission episodes.	99993	1782206	66.32	116184	2122433	62.08	163497	2580644	59.36	138857	2769138	62.89
Admission type = restrict to AC and AA, exclude WN	655116	1127090	41.94	605307	1517126	44.37	703491	1877153	43.17	734706	2034432	46.20
Length of stay = 0 days	98165	1028925	38.29	245286	1271840	37.20	436849	1440304	33.13	565547	1468885	33.36
Same encrypted NHI, same diagnostic code, admission date within 30 days of previous admission, or, injury event date is the same as previous admission.	44410	984515	36.64	59915	1211925	35.45	62130	1378174	31.70	59876	1409009	32.00

6.2. Close-contact infectious diseases (CCIDs)

Table 6. Conditions included as CCIDs

CCIDs	ICD10 code
1 Close-contact enteric infections	
1.1 Gastroenteritis (from human sources)	
Shigellosis	A03
Giardiasis	A071
Rotavirus enteritis	A080
Norovirus gastroenteritis	A081
Adenovirus enteritis	A082
Other viral enteritis	A083
Viral intestinal infection, unspecified	A084
Other specified intestinal infections	A085
Diarrhoea of presumed infectious origin	A09
Nausea and vomiting	R11
1.2 Other enteric infections (from human sources)	
Acute poliomyelitis	A80
Enteroviral encephalitis	A850
Enteroviral meningitis	A870
Acute hepatitis A	B15
Epidemic myalgia (Bornholm disease)	B330
Enterovirus infection, unspecified	B341
Enterobiasis (pinworm)	B80
1.3 Late effects of enteric infections	
Sequelae of Poliomyelitis	B91
Osteopathy after poliomyelitis	M896
Malignant neoplasm of stomach and carcinoma in situ of stomach	C16, D002
Peptic ulcer	K25-K28
2 Close-contact infectious disease with respiratory transmission	
2.1 Tuberculosis	
Tuberculosis (respiratory, CNS, other organs, miliary)	A15-A19
Tuberculosis of cervix, causing PID	N740, N741
Pneumoconiosis associated with TB	J65
Tuberculous oesophagitis	K230
Tuberculous arthritis	M011
Tuberculosis complicating pregnancy, childbirth and puerperium	O980
Observation for suspected tuberculosis	Z030
Tuberculosis disorders of intestines, peritoneum and mesenteric glands	K930
2.2 Pertussis	
Whooping cough	A37
2.3 Bacterial meningitis and septicaemia	
Meningococcal disease	A39
Meningococcal arthritis	M010
Septicaemia due to *Streptococcus pneumoniae*	A403
Pneumococcal meningitis	G001
Pneumococcal arthritis and polyarthritis	M001
Haemophilus influenzae septicaemia	A413
Haemophilus influenzae infection, unspecified	A492
Haemophilus meningitis	G000

2.4 Respiratory viruses	
Varicella	B010, B011, B012, B019
Measles	B05
Rubella	B06
Rubella arthritis	M014
Exanthema subitum (sixth disease)	B082
Erythema infectiosum (fifths disease)	B083
Hand, foot and mouth/enteroviral vesicular stomatitis with exanthem	B084
Enteroviral vesicular pharyngitis herpangina	B085
Other viral exanthemata with skin and mucous membrane lesions	B088, B09
Mumps	B26
Coronavirus infection, unspecified	B342
Parvovirus infection, unspecified	B343
2.5 URTI	
Suppurative otitis media	H660, H661, H662, H663, H664
Mastoiditis	H700, H701, H702, H708
Acute myringitis	H730
Acute nasopharyngitis	J00
Acute sinusitis	J01
Acute streptococcal pharyngitis	J020, J030
Acute pharyngitis	J028, J029
Acute tonsillitis	J038, J039,
Acute laryngitis and tracheitis	J04
Acute obstructive laryngitis (croup) and epiglottitis	J05
Acute upper respiratory infections of multiple and unspecified sites	J06
Chronic sinusitis	J32
Peritonsillar abscess	J36
Retro/pharyngeal abscesses	J390, J391
2.6 LRTI	
Influenza	J10, J11
Viral pneumonia not elsewhere classified	J12
Pneumonia due to *Streptococcus pneumoniae*	J13
Pneumonia due to *Haemophilus influenzae*	J14
Pneumonia due to other organisms not elsewhere classified	J16
Pneumonia organism, unspecified	J18
Acute bronchitis	J20
Acute bronchiolitis	J21
Unspecified acute lower respiratory infection	J22
Infective exacerbation of COPD	J440
Abscess of lung and mediastinum, pyothorax	J85, J86
2.7 Post-streptococcal diseases	
Rheumatic fever	I00, I01, I02
Acute nephritic syndrome	N003, N004
2.8 Late effects of respiratory infections	
Zoster	B02
Sequelae of Tuberculosis	B90
Malignant neoplasm of the nasopharynx	C11
Kaposi's sarcoma	C46
Hodgkin's lymphoma	C81
Burkitt's tumour	C837
Chronic rheumatic heart disease	I05, I06, I07, I08, I09
Bronchiectasis	J47
Nephrotic Syndrome – diffuse mesangial proliferative	N043
Nephrotic Syndrome – diffuse endocapillary proliferative	N044

3 Close-contact skin infections	
3.1 Bacterial skin infections	
Impetigo	L01
Cutaneous abscess, furuncle and carbuncle	L02
Cellulitis	L03
Acute lymphadenitis	L04
Pilonidal cyst with abscess	L050
Other local infections of skin	L08
Erysipelas	A46
Hordeolum (abscess, stye)	H000
Acute inflammation of orbit (including abscess, cellulitis)	H050
Abscess and cellulitis of external ear	H600, H601
Otitis externa	H602, H603, H608, H609
Abscess, furuncle and carbuncle of nose	J340
Other inflammatory disorders of penis	N482
Inflammatory disorder of scrotum	N492
Inflammatory disorder of unspecified male genital organ	N499
Anal abscess	K610
Abscess of vulva	N764
Varicella with other complications (infection)	B018
Scabies	B86
Other dermatitis (infective dermatitis)	L303, L308, L309
Insect/spider bite	S1013, S1083, S1093, S2013, S2033, S2043, S2083, S3083, S3093, S4083, S5083, S6083, S7083, S8083, S9083, T009, T0903, T1108, T1303, T1403, T633, T634
Post-traumatic wound infection NEC	T793
Open wound with foreign body (with or without infection)	T8901
Open wound with infection	T8902
3.2 Invasive staphylococcal infections	
Staphylococcus aureus septicaemia	A410
Staphylococcal septicaemia	A411, A412
Staphylococcal meningitis	G003
Staphylococcal arthritis and polyarthritis	M000
Osteomyelitis	M86
Inflammatory disorders of breast (abscess, carbuncle, mastitis)	N61
Staphylococcal infection, unspecified	A490
3.3 Other skin infections from human sources	
Viral warts	B07
Molluscum contagiosum	B081
Dermatophytosis (tinea)	B35
Other superficial mycosis	B36
4 Close-contact disease with multiple or unknown transmission	
4.1 Other bacterial infections from human contact	
Scarlet fever	A38
Septicaemia due to group A streptococcus	A400
Streptococcal infection, unspecified	A491
Streptococcal meningitis	G002
Other streptococcal arthritis and polyarthritis	M002
Pyogenic arthritis due to other bacteria and unspecified	M008, M009
Other bacterial meningitis	G008, G009,
Non pyogenic meningitis (non-bacterial)	G030
Chronic meningitis, benign recurrent meningitis (Mollaret)	G031, G032
Meningitis unspecified	G038, G039

Bacterial meningoencephalitis and meningomyelitis NEC	G042
4.2 Other viral infections from human contact	
Unspecified viral encephalitis	A86
Adenoviral meningitis	A871
Other and unspecified viral meningitis	A878, A879
Other and unspecific viral infections of CNS	A888, A89
Herpes simplex virus infection	B00
Cytomegalovirus	B25
Infectious mononucleosis (gammaherpesviral mononucleosis)	B270
Cytomegaloviral mononucleosis	B271
Infectious mononucleosis	B278, B279
Viral conjunctivitis	B30
Viral Carditis	B332
Adenoviral and other specified viral encephalitis	A851, A858
Adenovirus infection, unspec	B340
Papovavirus infection (including BKV and JCV), unspecified	B344
Other viral infections of unspecified site	B348
Viral infection, unspec (including viremia NOS)	B349
4.3 Other and mixed infections from human contact	
Conjunctivitis	H100, H102, H103, H104, H105, H108, H109
Pediculosis and phthiriasis	B85
4.4 Late effects of other close-contact infectious diseases	
Acute disseminated encephalitis	G040
Other encephalitis, myelitis and encephalomyelitis (post-infectious)	G048
Encephalitis, myelitis and encephalomyelitis, unspecified	G049

*CCID indicator excludes late effects of these diseases.

6.3. Hospitalisations by sex and age group

Table 7. Average annual rate of all-cause hospitalisations, infectious diseases and CCIDs, by sex and by age group, for 5-year periods from 1989 to 2008

Time period	1989 to 1993		1994 to 1998		1999 to 2003		2004 to 2008	
	Rate†	RR (95%CI)	Rate†	RR (95%CI)	Rate†	RR (95%CI)	Rate†	RR (95%CI)
All-cause hospitalisations								
• Males (age-std rate[1])	6676.5	1.24	7500.1	1.19	8062.6	1.18	7523.8	1.15
• Females (age-std rate[1])	5386.4	Ref	6311.6	Ref	6851.6	Ref	6518.3	Ref
• Children <5 yrs	8742.9	2.09	9861.1	2.24	10018.1	2.13	9091.2	2.15
• Children 5-14	3172.0	0.76	3484.5	0.79	3458.0	0.73	3014.2	0.71
• Adults 15-29	4177.9	Ref	4410.3	Ref	4713.4	Ref	4224.6	Ref
• Adults 30-69	4982.2	1.19	5764.7	1.31	6402.4	1.36	6047.8	1.43
• Adults 70+	18505.8	4.43	21604.9	4.90	23845.5	5.06	24095.5	5.70
Total infectious diseases								
• Males (age-std rate[1])	1083.7	1.21	1378.3	1.16	1812.9	1.16	1803.9	1.13
• Females (age-std rate[1])	896.3	Ref	1188.2	Ref	1565.8	Ref	1602.2	Ref
• Children <5 yrs	3862.5	5.46	4852.2	5.46	5792.7	5.05	5243.1	4.76
• Children 5-14	709.1	1.00	864.0	0.97	957.7	0.83	844.6	0.77
• Adults 15-29	707.5	Ref	889.5	Ref	1147.4	Ref	1101.3	Ref
• Adults 30-69	603.3	0.85	809.7	0.91	1131.8	0.99	1170.9	1.06
• Adults 70+	2036.0	2.88	2712.5	3.05	4032.8	3.51	4767.8	4.33
CCIDs								
• Males (age-std rate[1])	819.1	1.31	1084.8	1.25	1416.1	1.24	1392.4	1.21
• Females (age-std rate[1])	627.1	Ref	866.7	Ref	1141.2	Ref	1151.3	Ref
• Children <5 yrs	3509.5	6.73	4420.8	6.63	5259.2	6.24	4794.9	6.07
• Children 5-14	599.1	1.15	746.1	1.12	826.4	0.98	730.5	0.92
• Adults 15-29	521.6	Ref	666.7	Ref	843.3	Ref	790.0	Ref
• Adults 30-69	380.1	0.73	547.9	0.82	763.3	0.91	781.5	0.99
• Adults 70+	1150.2	2.21	1749.0	2.62	2774.3	3.29	3295.2	4.17

† Average annual rate per 100,000, age standardised to distribution of New Zealand population in 2006 Census

6.4. CCIDs by disease, time period and Māori vs. European/Other

Table 8. Distribution of CCIDs by disease group, time period and Māori vs. European/Other

Close-contact infectious diseases (CCIDs)	1989 to 1998												
	Māori rate					European/Other rate					RR of Māori vs. European/Other		
	No.	Crude rate	Age-std rate†	Low (CI)	Up (CI)	No.	Crude rate	Age-std rate†	Low (CI)	Up (CI)	RR	Low (CI)	Up (CI)
1. Close-contact enteric infections	**6228**	**130.0**	**167.7**	**161.6**	**173.9**	**35928**	**125.9**	**125.7**	**124.4**	**127.0**	**1.33**	**1.31**	**1.36**
1.1 Gastroenteritis (from human sources) e.g. giardiasis, norovirus	4373	91.3	69.7	66.6	72.9	22009	77.1	78.0	77.0	79.1	0.89	0.87	0.91
1.2 Other enteric infections (from human sources) e.g. enterovirus	96	2.0	1.8	1.4	2.3	511	1.8	1.8	1.6	1.9	1.00	0.88	1.13
1.3 Late effects of enteric infections e.g. peptic ulcer	1759	36.7	96.2	91.1	101.6	13408	47.0	45.9	45.1	46.7	2.09	2.04	2.15
	6228												
2. Close-contact infectious disease with respiratory transmission	**44099**	**920.4**	**859.3**	**847.0**	**871.8**	**106162**	**372.0**	**372.5**	**370.2**	**374.7**	**2.31**	**2.29**	**2.32**
2.1 Tuberculosis (not counted)													
2.2 Pertussis (whooping cough)	375	7.8	3.9	3.5	4.3	757	2.7	2.7	2.6	2.9	1.42	1.34	1.51
2.3 Bacterial meningitis and septicaemia e.g. meningococcal disease	808	16.9	11.1	10.1	12.2	1909	6.7	6.8	6.5	7.1	1.63	1.55	1.72
2.4 Respiratory viruses e.g. measles, varicella	612	12.8	7.0	6.5	7.6	1561	5.5	5.6	5.3	5.8	1.27	1.21	1.33
2.5 URTI e.g. pharyngitis	13733	286.6	175.4	171.8	179.1	36979	129.6	131.7	130.4	133.1	1.33	1.32	1.35
2.6 LRTI e.g. influenza, pneumonia, bronchiolitis	25643	535.2	565.1	554.3	576.1	59253	207.6	205.8	204.1	207.4	2.75	2.72	2.77
2.7 Post-streptococcal diseases e.g. rheumatic fever	779	16.3	11.4	10.6	12.4	488	1.7	1.8	1.6	1.9	6.43	6.07	6.81
2.8 Late effects of respiratory infections e.g. zoster, Hodgkin's lymphoma	2149	44.9	85.3	81.0	89.8	5215	18.3	18.1	17.6	18.6	4.72	4.59	4.86
3. Close-contact skin infections	**16694**	**348.4**	**364.7**	**357.4**	**372.1**	**43712**	**153.2**	**151.8**	**150.4**	**153.2**	**2.40**	**2.38**	**2.43**
3.1 Bacterial skin infections e.g. abscess	14270	297.8	310.7	303.9	317.6	38971	136.6	135.2	133.9	136.6	2.30	2.27	2.32
3.2 Invasive staphylococcal infections e.g. septicaemia	2385	49.8	53.3	50.7	56.0	4562	16.0	15.9	15.5	16.4	3.35	3.26	3.44
3.3 Other skin infections from human sources e.g. tinea	39	0.8	0.7	0.5	1.0	179	0.6	0.6	0.5	0.7	1.11	0.92	1.34
4. Close-contact disease with multiple or unknown transmission	**5635**	**117.6**	**87.2**	**84.3**	**90.2**	**27231**	**95.4**	**95.9**	**94.8**	**97.0**	**0.91**	**0.89**	**0.93**
4.1 Other bacterial infections from human contact e.g. streptococcal septicaemia	916	19.1	18.3	16.8	20.0	3115	10.9	11.0	10.6	11.3	1.67	1.60	1.75
4.2 Other viral infections from human contact e.g. viral encephalitis	4599	96.0	67.1	64.7	69.5	23650	82.9	83.3	82.2	84.4	0.81	0.79	0.82
4.3 Other and mixed infections from human contact e.g. conjunctivitis	65	1.4	0.8	0.6	1.1	197	0.7	0.7	0.6	0.8	1.15	0.99	1.34
4.4 Late effects of other close-contact infectious diseases e.g. encephalitis	55	1.1	1.0	0.7	1.4	269	0.9	0.9	0.8	1.1	1.07	0.90	1.29

Close-contact infectious diseases (CCIDs)	1999 to 2008												
	Māori rate					European/Other rate					RR of Māori vs. Euro/Other		
	No.	Crude rate	Age-std Rate	Low (CI)	Up (CI)	No.	Crude rate	Age-std Rate	Low (CI)	Up (CI)	RR	Low (CI)	Up (CI)
1. Close-contact enteric infections	**10651**	**195.1**	**218.1**	**212.7**	**223.7**	**46370**	**148.5**	**150.8**	**149.5**	**152.2**	**1.45**	**1.43**	**1.47**
1.1 Gastroenteritis (from human sources) e.g. giardiasis, norovirus	8177	149.8	125.1	121.6	**128.7**	34948	111.9	117.8	116.6	119.1	1.06	1.05	1.08
1.2 Other enteric infections (from human sources) e.g. enterovirus	180	3.3	2.5	2.1	2.9	653	2.1	2.3	2.1	2.4	1.10	1.00	1.20
1.3 Late effects of enteric infections e.g. peptic ulcer	2294	42.0	90.5	86.4	94.8	10769	34.5	30.7	30.2	31.3	2.94	2.87	3.02
2. Close-contact infectious disease with respiratory transmission	**65210**	**1194.7**	**1383.3**	**1369.0**	**1397.6**	**169637**	**543.1**	**530.8**	**528.2**	**533.3**	**2.61**	**2.59**	**2.62**
2.1 Tuberculosis (not counted)													
2.2 Pertussis (whooping cough)	458	8.4	4.7	4.3	5.2	585	1.9	2.2	2.0	2.3	2.19	2.07	2.33
2.3 Bacterial meningitis and septicaemia e.g. meningococcal disease	1245	22.8	16.9	15.8	18.1	2129	6.8	7.3	7.0	7.6	2.32	2.23	2.41
2.4 Respiratory viruses e.g. measles, varicella	557	10.2	6.3	5.8	6.8	1468	4.7	5.2	4.9	5.5	1.20	1.15	1.26
2.5 URTI e.g. pharyngitis	13197	241.8	173.8	170.4	177.2	33573	107.5	117.4	116.1	118.7	1.48	1.46	1.50
2.6 LRTI e.g. influenza, pneumonia, bronchiolitis	46474	851.5	1096.5	1083.2	1109.9	125254	401.0	379.2	377.1	381.3	2.89	2.87	2.91
2.7 Post-streptococcal diseases e.g. rheumatic fever	685	12.6	8.8	8.2	9.5	144	0.5	0.5	0.4	0.6	17.90	16.40	19.55
2.8 Late effects of respiratory infections e.g. zoster, Hodgkin's lymphoma	2594	47.5	76.2	72.8	79.8	6484	20.8	19.0	18.6	19.5	4.00	3.90	4.10
3. Close-contact skin infections	**34571**	**633.4**	**663.7**	**655.4**	**672.1**	**84939**	**271.9**	**267.2**	**265.4**	**269.1**	**2.48**	**2.47**	**2.50**
3.1 Bacterial skin infections e.g. abscess	30553	559.8	583.2	575.4	591.1	77199	247.2	242.7	241.0	244.5	2.40	2.39	2.42
3.2 Invasive staphylococcal infections e.g. septicaemia	3981	72.9	79.7	76.9	82.6	7610	24.4	24.1	23.6	24.6	3.31	3.24	3.38
3.3 Other skin infections from human sources e.g. tinea	37	0.7	0.8	0.5	1.1	130	0.4	0.4	0.4	0.5	1.80	1.48	2.21
4. Close-contact disease with multiple or unknown transmission	**9388**	**172.0**	**135.6**	**132.4**	**138.9**	**32704**	**104.7**	**111.6**	**110.4**	**112.8**	**1.21**	**1.20**	**1.23**
4.1 Other bacterial infections from human contact e.g. streptococcal septicaemia	1389	25.4	25.9	24.3	27.7	3769	12.1	12.2	11.8	12.6	2.13	2.06	2.21
4.2 Other viral infections from human contact e.g. viral encephalitis	7845	143.7	107.3	104.6	110.0	28357	90.8	97.5	96.4	98.7	1.10	1.09	1.12
4.3 Other and mixed infections from human contact e.g. conjunctivitis	103	1.9	1.4	1.1	1.8	261	0.8	0.9	0.8	1.0	1.50	1.31	1.72
4.4 Late effects of other close-contact infectious diseases e.g. encephalitis	51	0.9	1.0	0.7	1.4	317	1.0	1.0	0.9	1.2	0.96	0.80	1.16

† Average annual rate per 100,000, age standardised to distribution of New Zealand population in 2006 Census

Table 9. Distribution of CCIDs by disease group, time period and Māori vs. European/Other

Close-contact infectious diseases (CCIDs)	Māori			European/Other		
	1999 to 2008 vs. 1989 to 1998			1999 to 2008 vs. 1989 to 1998		
	RR	Low (CI)	Up (CI)	RR of Māori vs. Euro/Other	Low (CI)	Up (CI)
1. Close-contact enteric infections	**1.30**	**1.27**	**1.33**	**1.20**	**1.19**	**1.21**
1.1 Gastroenteritis (from human sources) e.g. giardiasis, norovirus	1.80	1.75	1.84	1.51	1.50	1.52
1.2 Other enteric infections (from human sources) e.g. enterovirus	1.40	1.21	1.62	1.27	1.20	1.34
1.3 Late effects of enteric infections e.g. peptic ulcer	0.94	0.91	0.97	0.67	0.66	0.68
2. Close-contact infectious disease with respiratory transmission	**1.61**	**1.60**	**1.62**	**1.43**	**1.42**	**1.43**
2.1 Tuberculosis (not counted)						
2.2 Pertussis (whooping cough)	1.22	1.14	1.30	0.79	0.75	0.83
2.3 Bacterial meningitis and septicaemia e.g. meningococcal disease	1.52	1.44	1.61	1.07	1.04	1.10
2.4 Respiratory viruses e.g. measles, varicella	0.89	0.84	0.94	0.94	0.90	0.97
2.5 URTI e.g. pharyngitis	0.99	0.98	1.00	0.89	0.88	0.90
2.6 LRTI e.g. influenza, pneumonia, bronchiolitis	1.94	1.92	1.96	1.84	1.83	1.85
2.7 Post-streptococcal diseases e.g. rheumatic fever	0.77	0.73	0.82	0.28	0.25	0.30
2.8 Late effects of respiratory infections e.g. zoster, Hodgkin's lymphoma	0.89	0.86	0.92	1.05	1.04	1.07
3. Close-contact skin infections	**1.82**	**1.80**	**1.84**	**1.76**	**1.75**	**1.77**
3.1 Bacterial skin infections e.g. abscess	1.88	1.85	1.90	1.79	1.78	1.81
3.2 Invasive staphylococcal infections e.g. septicaemia	1.50	1.45	1.54	1.51	1.49	1.54
3.3 Other skin infections from human sources e.g. tinea	1.09	0.85	1.40	0.67	0.60	0.75
4. Close-contact disease with multiple or unknown transmission	**1.56**	**1.52**	**1.59**	**1.16**	**1.15**	**1.17**
4.1 Other bacterial infections from human contact e.g. streptococcal septicaemia	1.42	1.34	1.49	1.11	1.08	1.14
4.2 Other viral infections from human contact e.g. viral encephalitis	1.60	1.57	1.63	1.17	1.16	1.18
4.3 Other and mixed infections from human contact e.g. conjunctivitis	1.68	1.40	2.02	1.29	1.18	1.41
4.4 Late effects of other close-contact infectious diseases e.g. encephalitis	1.00	0.78	1.27	1.11	1.03	1.20