INTRODUCTION TO WELL CHILD TAMARIKI ORA SERVICES

All New Zealand families and whānau are entitled to the Well Child/Tamariki Ora (WCTO) programme, a package of free health services for children from birth to the age of five years [231]. Most children receive WCTO services from Plunket, but some receive WCTO services from Māori and Pacific non-governmental agencies, DHB-funded providers, or primary health organisations [232].

The services all children are entitled to receive are set out in the Well Child/Tamariki Ora Schedule (on the Ministry of Health website), which describes the surveillance, education and support services that are delivered across a total of 12 core contacts [233]. As well as these 12 core contacts, the Schedule also includes a general practitioner check at six weeks of age, linked to the six-week immunisations, to ensure babies are connected to primary health services. High needs children and families may be allocated additional contacts on the basis of need [233].The WCTO Schedule divides services into three parallel streams, to be delivered as an integrated package of care. The streams are: health and development assessments, care and support for families and whānau, and health education.

The present WCTO framework is the result of an extensive review of the previous framework, involving consultation with key stakeholders and a literature review. The review led to WCTO services having a greater focus on social and emotional developmental stages (in addition to physical developmental stages), a greater emphasis on psychosocial factors that can affect children's wellbeing, more proactive approaches to promotion of attachment and prevention of behavioural problems, and an increased focus on identification of, and response to, individual family and whānau needs [234]. In addition, the present framework: includes evidence-based assessment tools to support care planning; encourages better coordination between WCTO practitioners/providers, lead maternity carers, general practice, specialist health services, and education and social services; promotes better use of information collected antenatally to improve postnatal care; and has an increased focus on monitoring and quality improvement.

The following sections review the immunisation coverage of children, the number of visits received by new babies enrolled with Plunket, and children participating in the B4 School Check.

IMMUNISATION COVERAGE

Introduction

Immunisation is the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine [235]. Vaccines mimic disease-causing micro-organisms and stimulate the body's immune system to produce T-lymphocytes and antibodies which provide protection against future encounters with these viruses or bacteria and thus prevent disease [236]. When a high proportion of a population is protected against a particular disease-causing virus or bacterium it is difficult for the associated disease to spread through the population because there are so few susceptible people left to infect. In such a population even non-vaccinated individuals receive a measure of protection. This phenomenon is known as "herd immunity" [237].

The 20th Century saw dramatic declines in vaccine-preventable diseases worldwide and vaccination has been identified as a cost-efficient means of reducing inequities in health [238,239]. Since 2005, the National Immunisation Register has provided data for monitoring immunisation coverage in New Zealand [240]. Immunisation rates have improved in recent years [241]. In the second quarter of the 2013/14 primary health care targets, 92% of eight month olds enrolled in a PHO were fully immunised [242] compared to 2005–2007 when 85% of all eligible children were fully immunised at 12 months [243]. Further increases in immunisation rates are likely to be beneficial; for instance, measles is considered to be eradicable if immunisation rates exceed 95% [244].

Immunisation uptake has been lower in populations living in more deprived areas in New Zealand, as is the case in other countries [243]. The "deprivation gradient" in immunisation rates has also been more pronounced for Māori and Pacific children [243]. Increasing immunisation coverage and timeliness continues to be a Ministry of Health target. The current target is that by December 2014, 95 percent of eight-months-olds will have had their primary course of immunisation (six weeks, three months and five months immunisation events) [245].

The following section provides a brief overview of New Zealand's current immunisation schedule, along with a summary of recent changes.

New Zealand's Current Immunisation Schedule

The New Zealand Immunisation Schedule offers publicly funded vaccination for eleven vaccine preventable diseases: diphtheria, tetanus, pertussis, poliomyelitis, hepatitis B, *Haemophilus influenzae* type b, measles, mumps, rubella, pneumococcal disease and rotavirus, to children aged between six weeks and 11 years (**Table 1**) [246]. Human papillomavirus (HPV) vaccination is offered to girls aged 12 years. Additional publicly funded vaccinations for hepatitis A, influenza, meningococcal A, C, W135 and Y, varicella (chickenpox), and tuberculosis (BCG vaccination) are offered to those at risk.

The Ministry of Health has recently published a new Immunisation Schedule that details the changes made to timing or type of immunisation [246,247]. All children transfer to the new Schedule from 1 July 2014. The rotavirus vaccine and the 13-valent pneumococcal vaccine are new additions. The text box below provides a brief overview of these two additions.

Table 1. The National Immunisation Schedule for babies, children, and adolescents

Age	Antigen	Vaccine Brand Name
6 weeks	Diphtheria/tetanus/acellular pertussis/inactivated polio vaccine/hepatitis B/*Haemophilus influenzae* type b	1 injection (INFANRIX-hexa®)
	13-valent pneumococcal conjugate	1 injection (Prevenar 13®)
	Pentavalent rotavirus vaccine (an oral vaccine)	1 dose RotaTeq®
3 months	Diphtheria/tetanus/acellular pertussis/inactivated polio vaccine/hepatitis B/*Haemophilus influenzae* type b	1 injection (INFANRIX-hexa®)
	13-valent pneumococcal conjugate	1 injection (Prevenar 13®)
	Pentavalent rotavirus vaccine (an oral vaccine)	1 dose RotaTeq®
5 months	Diphtheria/tetanus/acellular pertussis/inactivated polio vaccine/hepatitis B/*Haemophilus influenzae* type b	1 injection (INFANRIX-hexa®)
	13-valent pneumococcal conjugate	1 injection (Prevenar 13®)
	Pentavalent rotavirus vaccine (oral vaccine)	1 dose RotaTeq®
15 months	*Haemophilus influenzae* type b	1 injection (Act-HIB®)
	measles/mumps/rubella	1 injection (M-M-R ll®)
	13-valent pneumococcal conjugate	1 injection (Prevenar 13®)
4 years	Diphtheria/tetanus/acellular pertussis/inactivated polio vaccine	1 injection (INFANRIX-IPV®)
	Measles/mumps/rubella	1 injection (M-M-R ll ®)
11 years	Diphtheria/tetanus/acellular pertussis	1 injection (BOOSTRIX®)
12 years girls only	Human papillomavirus	3 injections given over 6 months (GARDASIL®)

Source: Ministry of Health, New Zealand Immunisation Schedule [246]

Recent changes to the New Zealand Immunisation Schedule

Rotavirus vaccination has been added to the schedule from 1 July 2014. Rotavirus is ubiquitous in the community and all children are likely to be infected before the age of five years. Rotavirus infection causes gastroenteritis (diarrhoea and vomiting). The resulting dehydration can lead to infants being admitted to hospital. The peak incidence of rotavirus gastroenteritis is between 6 and 24 months of age [248]. The rotavirus vaccine used in New Zealand, RotaTeq®, is a live oral vaccine containing five human-bovine rotavirus reassortants: G1, G2, G3, G4 and P1A [242,248].

The 2012 Cochrane review assessing vaccines for preventing rotavirus diarrhoea reported on 12 RCTs of RotaTeq® [249]. It found that in children aged less than one year living in countries with low mortality rates, RotaTeq® probably prevented 87% of severe rotavirus diarrhoea cases (relative risk 0.13, 95% CI 0.04–0.45). This finding was based on moderate quality evidence from three trials with a total of 2344 participants. One trial from Finland, with 1029 participants, provided low quality evidence that the vaccine may prevent 72% of severe all-cause diarrhoea cases: (RR 0.28, 95% CI 0.16–0.48). Three other trials conducted in low-mortality countries, with a total of 3190 participants, reported on severe rotavirus diarrhoea in the two years after vaccination. These trials provided moderate quality evidence that RotaTeq® probably prevented 82% of severe rotavirus diarrhoea cases (RR 0.18, 95% CI 0.07–0.50). In addition, the trial from Finland provided low quality evidence that, in the two years after vaccination, the vaccine may prevent 96% of all-cause severe diarrhoea: (RR 0.04, 95% CI 0.00–0.70).There was no evidence that the vaccine affected mortality rates, but since death from rotavirus infection is very rare in developed countries, the trials were underpowered to detect an effect on this end point. Following vaccination with RotaTeq® there were adverse events reported in 1884 out of 78,226 children. Thirty-four cases of intussusception were reported in 81,459 children. (Intussusception is a serious adverse event which involves part of the intestine being pulled in on itself. This can result in blockage of the intestine and loss of blood supply to part of the intestine causing it to die.) There was no significant difference in intussusception rates between children receiving RotaTeq®, Rotarix (the other vaccine brand) and placebo.

Since 2006, many countries have included rotavirus vaccination in their vaccination schedules. Studies in high income countries have found that, following the instruction of the pentavalent vaccine, there was a 89–100% reduction in rotavirus emergency department visits or hospitalisations in children under five years of age [250]. A study which investigated rates of intussusception following the introduction of rotavirus vaccination in Australia, where both brands of the vaccine are use in different states, found a statistically significantly increased risk of intussusception in the seven days after the first, and to a lesser extent, the second, vaccine doses.

The magnitude increased risk was similar for both vaccines. The study authors estimated that the introduction of the vaccine had resulted in 14 extra cases of intussusception and more than 6,500 fewer gastroenteritis hospitalisations in young children in Australia each year [251].

The 13-valent pneumococcal vaccine (Prevenar 13®, PCV13) replaced the 10-valent vaccine for all children in July 2014 [246]. The first pneumococcal vaccine in the immunisation schedule was Prevnar-7® (PCV7), introduced in June 2008. It was replaced by the 10-valent vaccine Synflorix® in July 2011. Invasive pneumococcal disease (IPD) has been notifiable since 2008 and notification data is reported on by the ESR [252].

The latest ESR report indicates that the rate of IPD in infants under two years of age has decreased by 64% since the introduction of PCV7 from an average incidence of 100.3 cases per 100,000 population per year in 2006/07 to 35.9 per 100,000 per year in 2012. Cases of IPD caused by PCV7 serotypes in 0–2 year olds decreased by 98%, from an average of 83.1 per 100,000 in 2006/2007 to 1.6 per 100,000 in 2012. There were also significant reduction in both all IPD and PCV7 IPD cases in the 2–4 years age group. Rates of PCV7 IPD, but not all-cause IPD, decreased in the 5–64 years and the 65+ years age-groups indicating a herd immunity effect. Rates of IPD for Māori have been about 3 times, and for Pacific peoples about 4 times the European rate. Since 2009, in the <2 years age group, IPD rates have decreased significantly for Māori, decreased, but not significantly, for Europeans and increased, but not significantly, for Pacific peoples. Reductions in incidence of both all IPD and IPD due to the pneumococcal serotypes that are additional in the PCV13 vaccine have been reported in the U.S., the U.K, Denmark, Germany, Greece and Spain [253]. A study of admission rates for all lower respiratory infections in Counties Manukau following the introduction of PCV7 in June 2008 found that pneumonia admissions in children <2 years decreased significantly after the introduction of the vaccine (incidence risk ratio (IRR) 1.51; 95% CI 1.08–1.77), additional to the gradual decline that had been occurring since 2001. There was significant decline for Pacific children (IRR 1.70; 95% CI 1.39–2.07) but not for Māori children (IRR 1.05; 95% CI 0.78–1.40) [254].

Immunisation Coverage Rates

The following section uses the National Immunisation Register to review immunisation coverage rates for children at 6, 8, 12, 18, and 24 months, and 5 years of age.

Data Source and Methods

Indicator

Proportion of children fully immunised at 6, 8, 12, 18, and 24 months, and 5 years of age

Numerator: National Immunisation Register (NIR): The number of children who turned the milestone age during the reporting period and who had completed their age appropriate immunisations by the time they turned that milestone age.

Denominator: NIR: The number of children who turned the milestone age during the reporting period.

Notes on Interpretation

During pregnancy and after birth, parents are informed about the NIR, with Lead Maternity Carers playing a key role in information provision. Following delivery, all of the relevant information about each child is added to the NIR, with parents being able to 'opt off' having their child's immunisation information stored in the NIR. In this case the child's National Health Index number, date of birth, District Health Board and any immunisations already recorded in the NIR are retained, so that immunisation coverage can be accurately calculated. Parents may also choose not to immunise their children and this is recorded on the NIR as a declined immunisation event to prevent recalls.

The NIR was implemented by the Ministry of Health and District Health Boards in 2005. The rollout occurred in a staged fashion commencing with the Greater Auckland region in April 2005 and finishing in Nelson Marlborough in December 2005. Thus only children born from 2005 onwards have their details recorded in the NIR. However, all children immunised with the MeNZB vaccine as part Meningococcal B Immunisation Programme had their details recorded in the NIR, along with any other immunisations given at the same time (although no further vaccinations are recorded on the NIR for these older children). For further details on the NIR see http://www.health.govt.nz/our-work/preventative-health-wellness/immunisation/national-immunisation-register/questions-and-answers-national-immunisation-register.

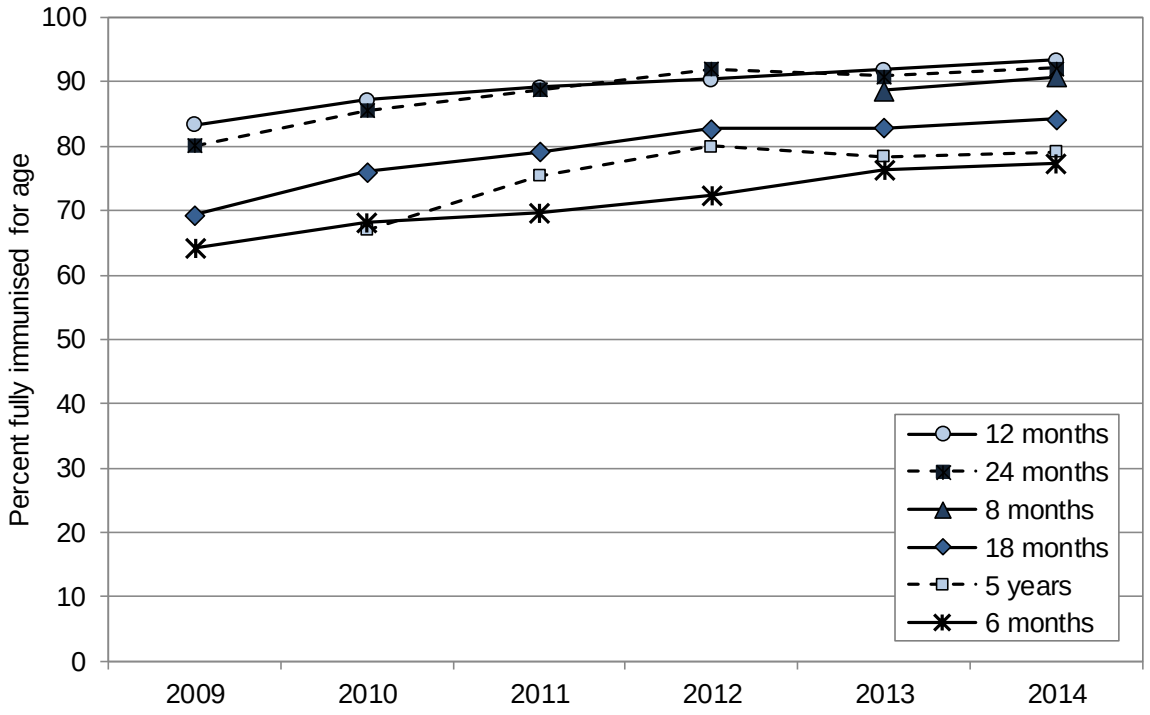
New Zealand Distribution and Trends

Distribution by Milestone Age

In New Zealand during 2009 to 2014 (years ending 30 June), the immunisation coverage rates were highest for children aged 12 and 24 months. The coverage rates were lowest for children aged 6 months. Immunisation coverage rates, however, increased for all age groups during this period. The immunisation health targets were expanded in 2012/13 to include completion of primary course of immunisation by 8 months. For the year ended

June 2013, the immunisation coverage rates for children aged 8 months was 88.7% and increased to 90.8% for the year ended June 2014. (**Figure 1**).

Figure 1. Immunisation coverage by milestone age New Zealand, years ended 30 June 2009–2014



Source: National Immunisation Register; Note: the 8-month target was introduced in 2012/13; From 1 July 2012, coverage figures include pneumococcal vaccine

Distribution by Ethnicity

In New Zealand during the year ending June 2014, the immunisation coverage rates increased for all ethnic groups. The immunisation coverage rates during this period were highest for Asian and Pacific children aged 12 and 24 months, followed by European children, with rates being the lowest for Māori children (**Figure 2**).

The immunisation coverage rates were highest for Asian children aged 8 months, followed by Pacific and European children. The lowest rates at 8 months were for Māori children (**Figure 4**).

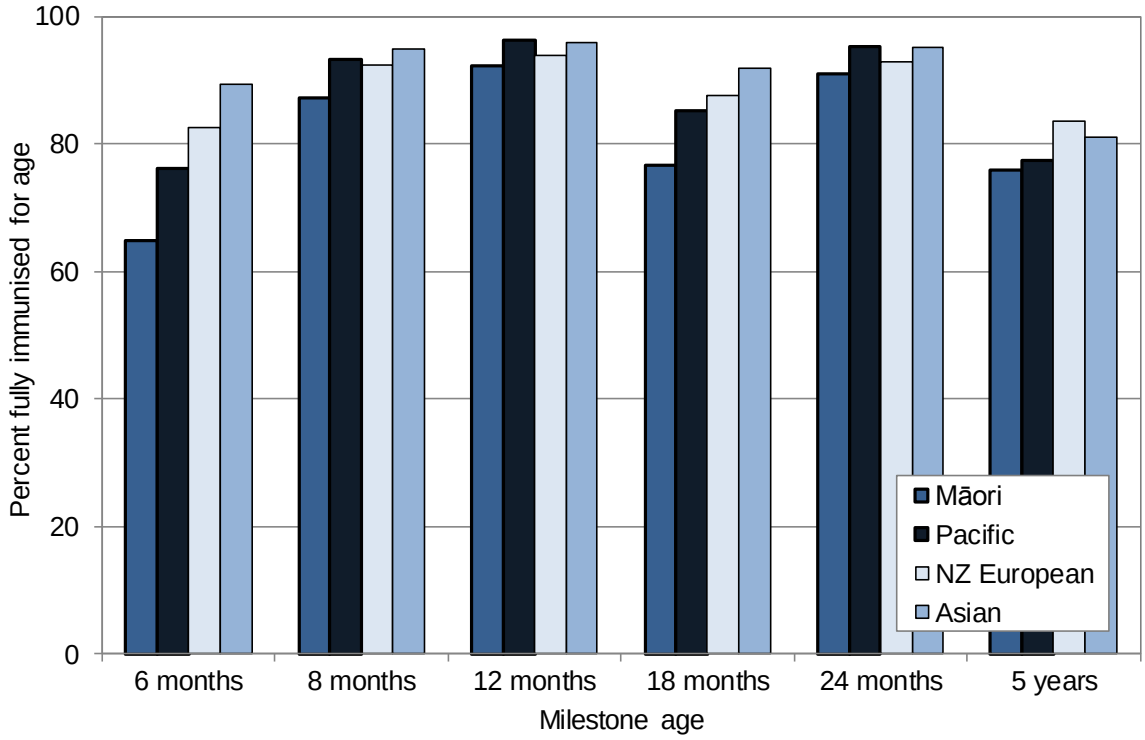
Distribution by NZ Deprivation Index Decile

In New Zealand for the years ending June 2009 to 2014, the immunisation coverage rates among children across the deprivation quintiles increased (**Figure 3**).

The coverage rates at 24 months were higher for children from the least deprived (NZDep deciles 1–2) that those in average deciles (NZDep deciles 5–6) and all were higher than the most deprived aeas (NZDep deciles 9–10) until the year ended June 2011. The socioeconomic gradients lessened after this so that by June 2014, coverage rates were very similar for children from the most and the least deprived areas (**Figure 4**).

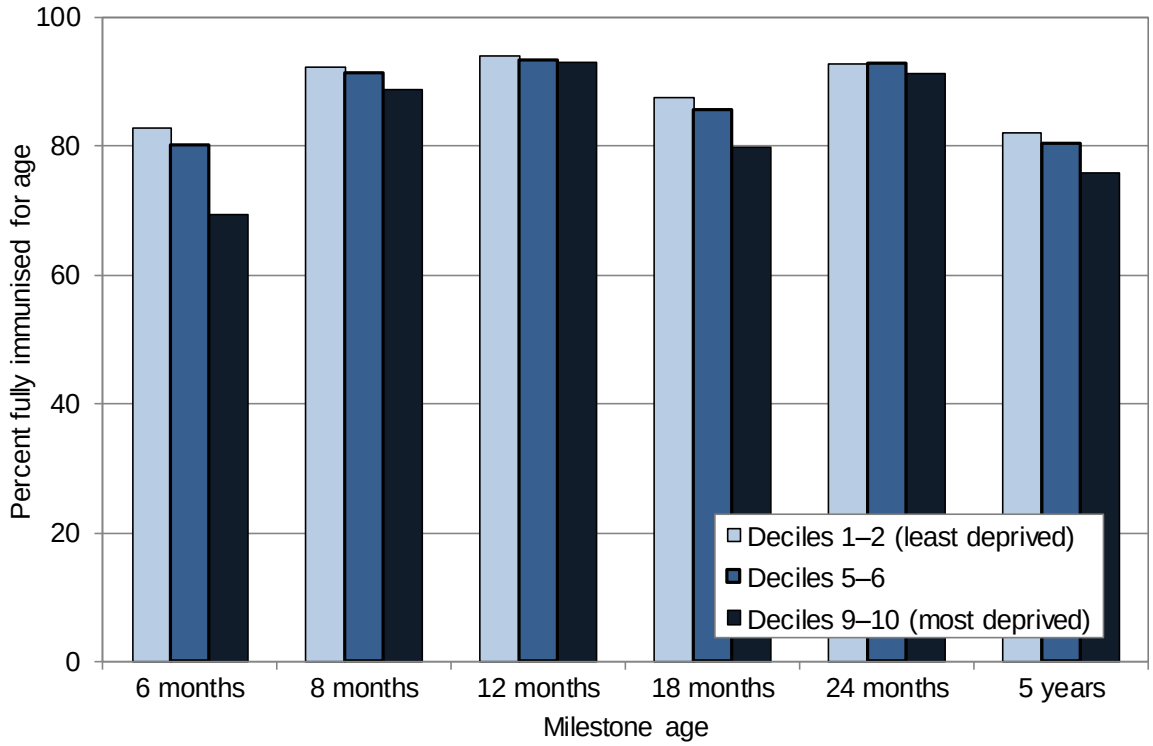
During the quarters ending March 2013 to June 2014 the immunisation coverage rate at 8 months remained highest for children from the least deprived areas (NZDep deciles 1–2) compared to the average (NZDep deciles 5–6) and rates were higher than those for the most deprived areas (NZDep deciles 9–10) (**Figure 4**). By the year ended 30 June 2014, immunisation coverage at 8 months was 92.3% for children from the least deprived areas (NZDep deciles 1–2), 91.5% for children from average areas (NZDep deciles 5–6), and 88.7% for children from the most deprived areas (NZDep deciles 9–10) (**Figure 3**).

Figure 2. Immunisation coverage by milestone age and ethnicity New Zealand, year ended 30 June 2014



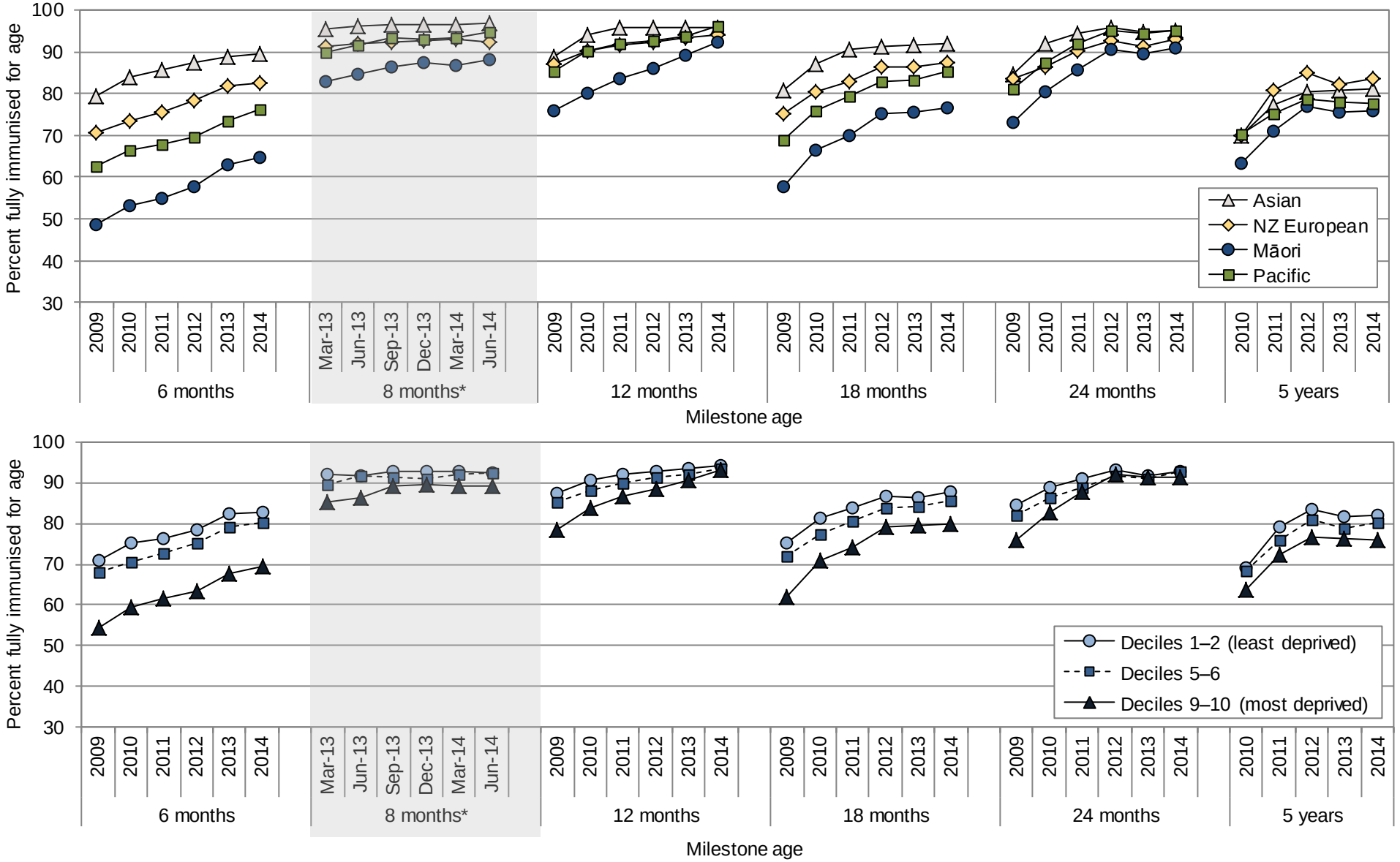
Source: National Immunisation Register

Figure 3. Immunisation coverage by milestone age and NZ Deprivation Index decile, New Zealand year ended 30 June 2014



Source: National Immunisation Register; Note: NZ Deprivation Index is Dep 06

Figure 4. Immunisation coverage by milestone age, ethnicity and NZ Deprivation Index decile, New Zealand years ended June 2009–2014



Source: National Immunisation Register; Note: Ethnicity is level 1 prioritised; NZ Deprivation Index is Dep 06; * Immunisation coverage at milestone age of 8 months was first reported for the quarter ended March 2013

South Island DHBs Distribution and Trends

Distribution by Milestone Age

During 2009 to 2014 (years ending 30 June), while immunisation coverage in Nelson Marlborough and in South Canterbury increased at all ages, rates at each milestone age were generally higher than the New Zealand rate. Similar patterns were seen in Canterbury and Southern DHB (although rates at 8 months did not increase in the shorter time period reviewed) (**Figure 5**, **Figure 6**).

In the West Coast, the immunisation coverage rates were lower than the New Zealand rate. The immunisation coverage rates increased were only seen for the 12 month and 18 month milestone ages (**Figure 5**, **Figure 6**).

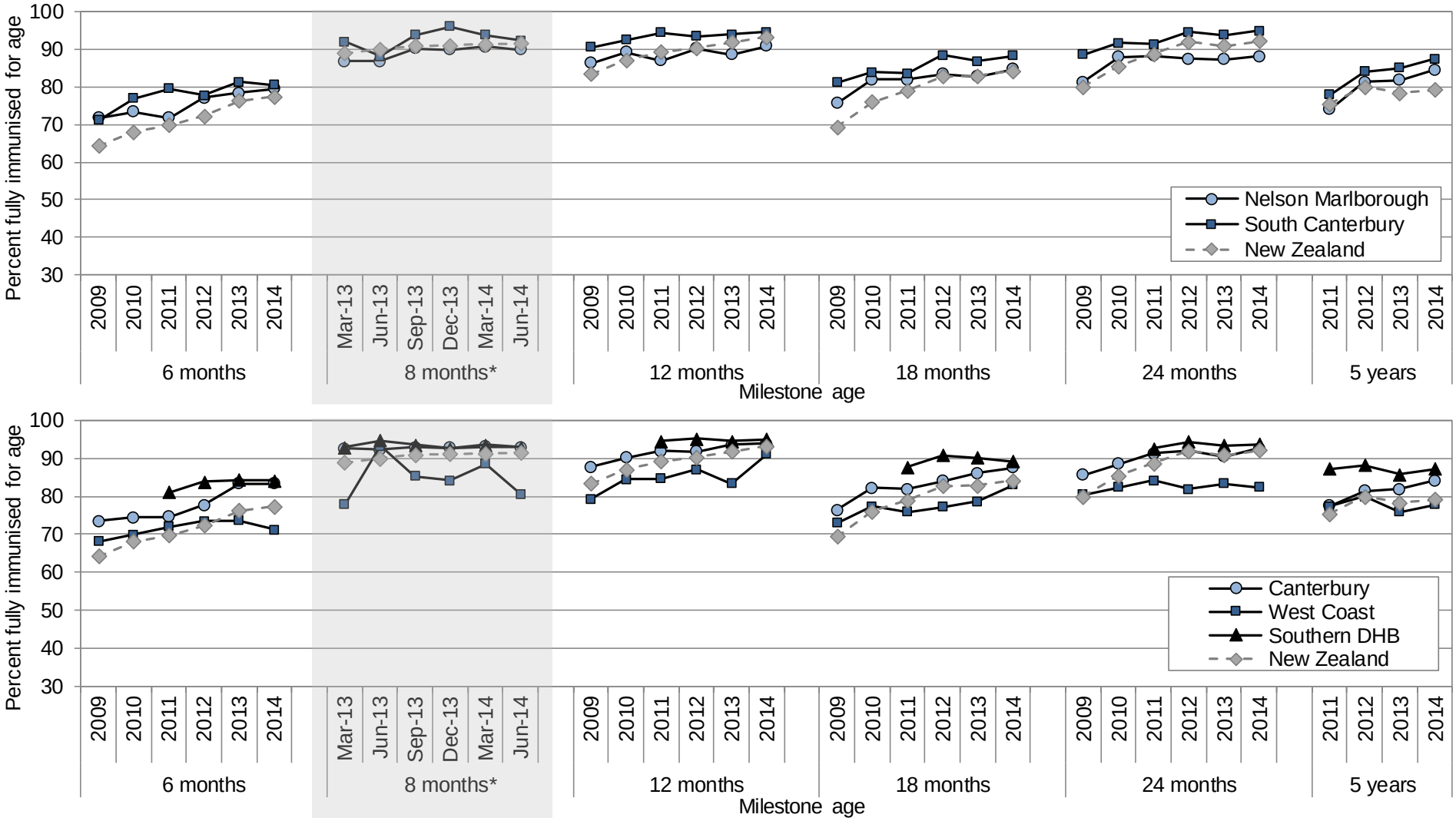
Distribution by Ethnicity

In the Canterbury during the quarters ending March 2013 to June 2014, immunisation coverage rates at 8 months were generally higher for Asian > European > Pacific and Māori infants. In the remaining South Island DHBs, coverage rates at 8 months were generally higher for European than for Māori infants (**Figure 7**).

Distribution by NZ Deprivation Index Decile

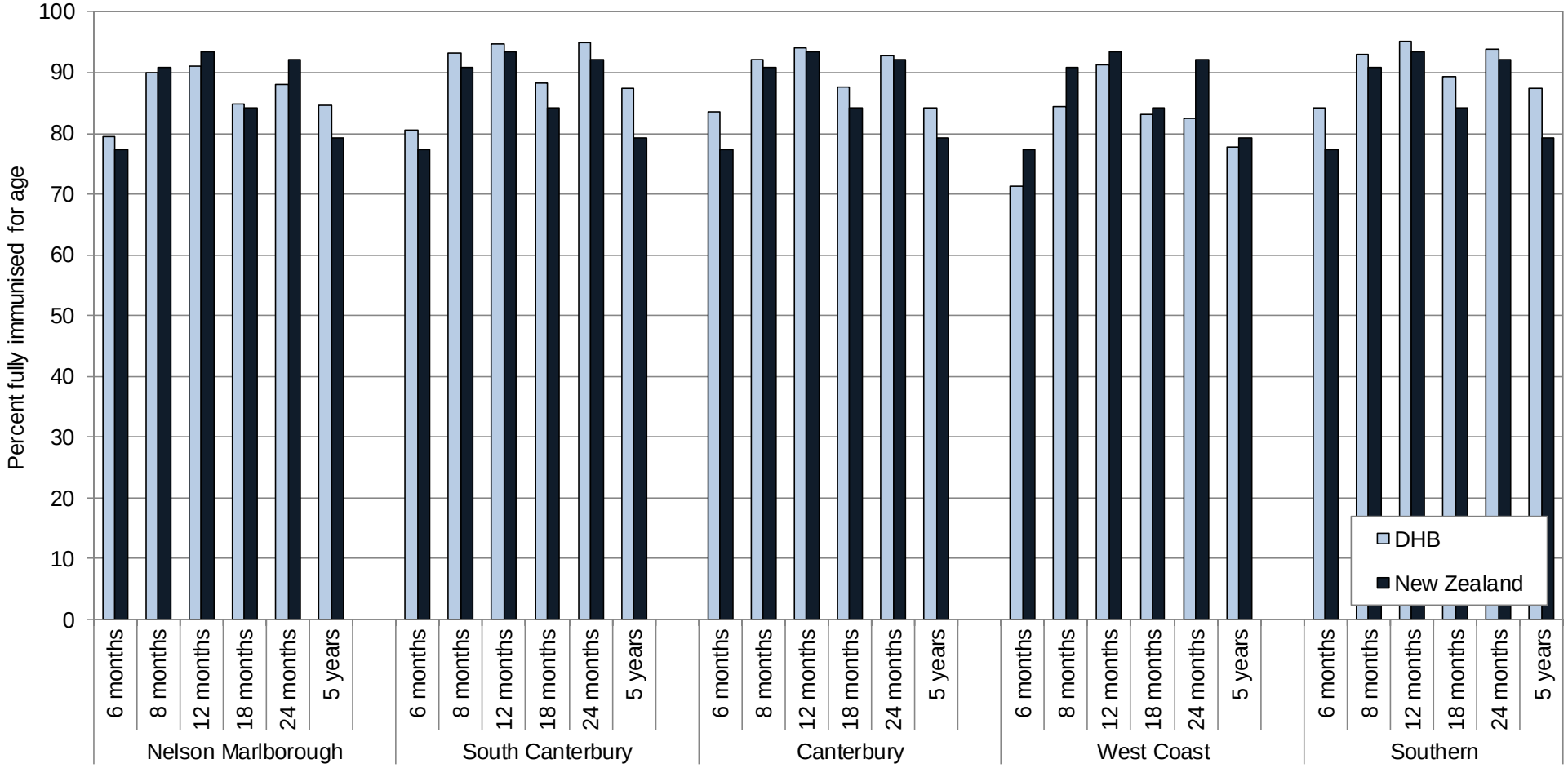
In Nelson Marlborough and Canterbury during the quarters ending March 2013 to June 2014, immunisation coverage rates at 8 months were higher for infants from the least deprived areas (NZDep deciles 1–2) than for infants from the most deprived areas (NZDep deciles 9–10). In the remaining South Island DHBs there were no consistent socioeconomic differences (as measured by NZDep Index decile) in immunisation coverage at 8 months, although rates for South Canterbury infants living in the most deprived areas were higher than for infants from the least deprived areas for parts of this period (**Figure 8**).

Figure 5. Immunisation coverage by milestone age, South Island DHBs vs. New Zealand years ended June 2009–2014



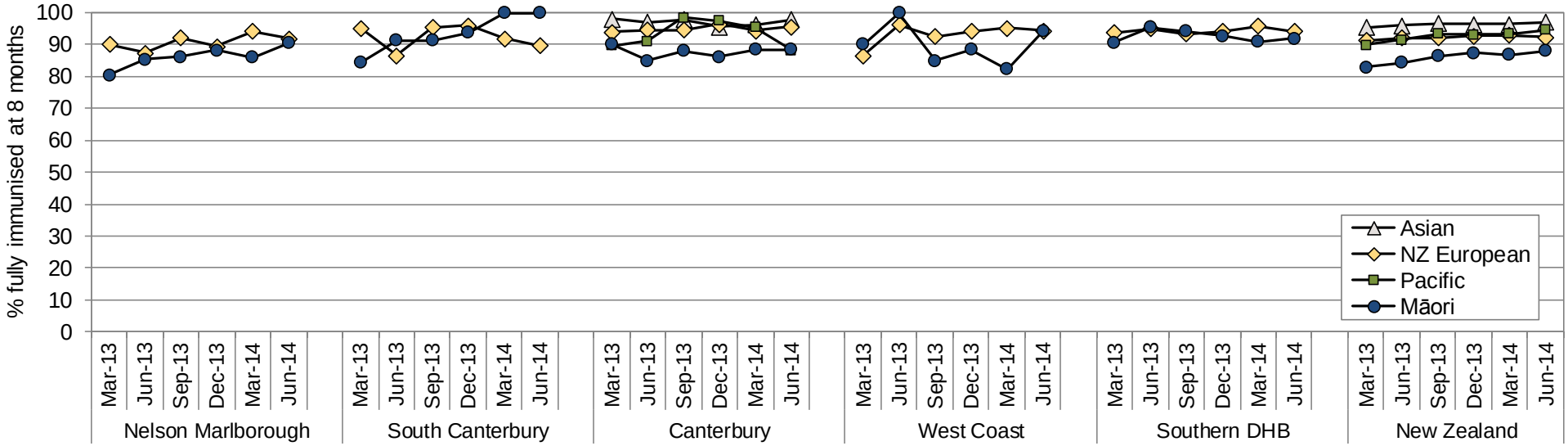
Source: National Immunisation Register; Note: *Immunisation coverage at milestone age of 8 months was first reported for the quarter ended March 2013

Figure 6. Immunisation coverage by milestone age, South Island DHBs vs. New Zealand, year ended 30 June 2014



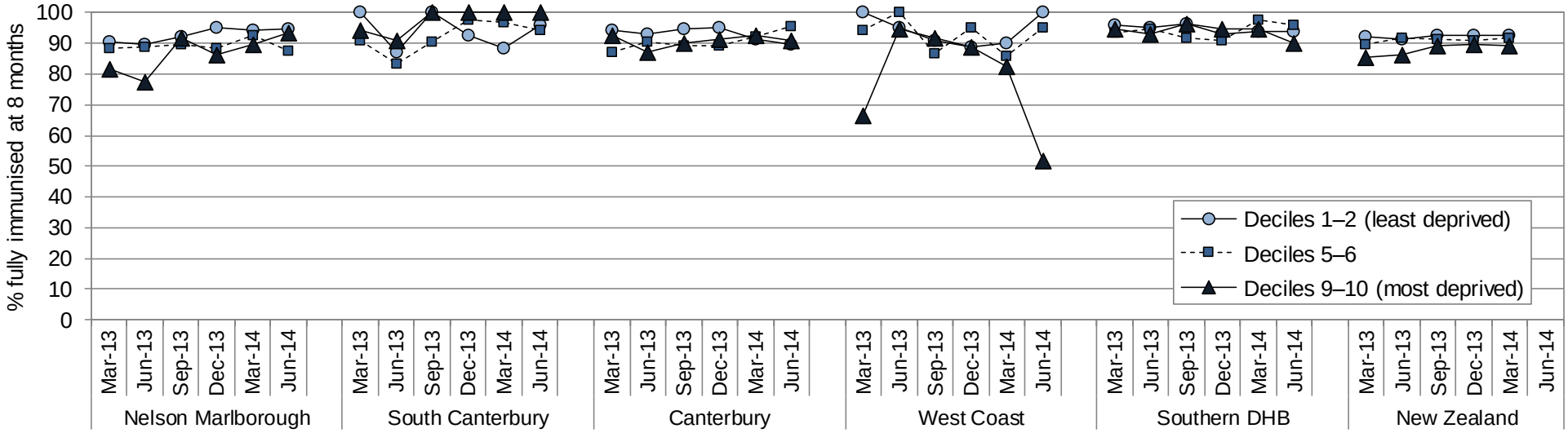
Source: National Immunisation Register

Figure 7. Immunisation coverage at eight months by ethnicity, South Island DHBs vs. New Zealand for quarters ended March 2013–June 2014



Source: National Immunisation Register; Note: Ethnicity is level 1 prioritised; Immunisation coverage at milestone age of 8 months was first reported for the quarter ended March 2013

Figure 8. Immunisation coverage at eight months by NZ Deprivation Index decile, South Island DHBs vs New Zealand for quarters ended March 2013–June 2014



Source: National Immunisation Register; Note: NZ Deprivation Index is NZDep06

Local Policy Documents and Evidence-based Reviews Relevant to Immunisation and Increasing Immunisation Coverage

Table 2 (below) provides a brief overview of local policy documents and evidence based reviews which consider immunisation and interventions aimed at increasing immunisation coverage.

Table 2. Local policy documents and evidence-based reviews relevant to immunisation and increasing immunisation coverage

Ministry of Health publications
Ministry of Health. 2012. **National Guidelines for Vaccine Storage and Distribution**. Wellington: Ministry of Health. http://www.health.govt.nz/publication/national-guidelines-vaccine-storage-and-distribution-2012 From the place of manufacture to the point of administration, vaccines must be kept within the temperature range +2°C to +8°C. The system for achieving this is known as the "cold chain". These guidelines are intended to ensure that everyone who handles vaccines is aware of their responsibilities for maintaining the cold chain to maximise the effectiveness of the immunisation programme.
Ministry of Health. 2012. **Annual Cold Chain Management Guide and Record**. Wellington: Ministry of Health. http://www.health.govt.nz/publication/annual-cold-chain-management-guide-and-record This guide is a quality tool to support immunisation providers in achieving cold chain accreditation. It enables immunisation providers to • record vaccine refrigerature temperatures • use the trouble shooting tips for cold chain problems • self-audit vaccine handling and storage.
Ministry of Health. 2011. **Immunisation Handbook 2011**. Wellington: Ministry of Health. http://www.health.govt.nz/publication/immunisation-handbook-2011 The Immunisation Handbook provides clinical guidance for health professionals on the effective and safe use of vaccines. The Handbook contains information on eligibility for vaccines and the diseases covered by the National Immunisation Schedule, as well as on other vaccine preventable diseases.
Ministry of Health. 2011. **Targeting Immunisation: increased immunisation**. Wellington: Ministry of Health. http://www.health.govt.nz/system/files/documents/publications/targeting-immunisation-health-target.pdf Increased immunisation has been a national health target since 2007. The 2014 immunisation target (available at: http://www.health.govt.nz/new-zealand-health-system/health-targets/about-health-targets/health-targets-increased-immunisation) is that 90% of eight-month-olds will have had their primary course of immunisation at six weeks, three months and five months on time by July 2014, increasing to 95% by December 2014. This report provides a summary of the reasons behind this target, including improvements in child health and reductions in ethnic inequalities in health, and a series of case studies illustrating best practice in increasing immunisation uptake. Three recommendations are identified: • All children should be enrolled with a general practice as soon as possible after birth. • Parents should be contacted before each immunisation is due • Immunisation appointments should be made at a time that suits the parents.
Ministry of Health. **Review of Neonatal BCG Immunisation Services in New Zealand**. 2007, Ministry of Health: Wellington. http://www.health.govt.nz/publication/review-neonatal-bcg-immunisation-services-new-zealand This review evaluated the neonatal BCG immunisation programme. Its objectives were: to describe the neonatal BCG immunisation services; review tuberculosis (TB) surveillance data and service monitoring; identify any imbalance between current policy and services; and make recommendations on the future monitoring of the service. The incidence of TB over the previous 20 years was found to be stable although increasing rates had been identified in immigrants and refugees from high-risk Asian and African countries, and recent arrivals from Pacific countries and their contacts. A survey of all 21 DHBs indicated a wide variability in how the service was offered in New Zealand. Monitoring was patchy and only a few DHBs collected data on the number of TB risk assessments performed on babies, meaning that coverage rates could not be calculated because the total number of eligible babies was unknown. Three priorities for improving the effectiveness of service were identified: to institute a systematic approach to delivering the BCG immunisation service in all DHBs; to improve the quality of the monitoring of the BCG immunisation service; and to improve the completeness of notification data. The review made a number of recommendations in the areas of contracts, monitoring, new resources and surveillance.

International guidelines

Taddio A, Appleton M, Bortolussi R, et al. 2010. **Reducing the pain of childhood vaccination: an evidence-based clinical practice guideline**. CMAJ, 182(18), E843–55. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3001531/

This Canadian guideline offers practical recommendations backed up by an evidence base derived from systematic reviews of the literature. It relates to the immediate pain and distress occurring at the time of vaccination, not any delayed-onset pain occurring in the hours or days after vaccination. The guideline addresses 18 clinical questions related to vaccination and it provides evidence-based answers for fourteen of them. The questions that had an evidence base to provide definitive recommendations relate to breastfeeding during the procedure, the use of sweet tasting solutions, brand of vaccine, position of child, injection techniques, order of injections, tactile stimulation, parent led distraction and coaching, topical anaesthetics, clinician-led distraction, child-led distraction, breathing techniques, combined psychological interventions, and telling the child "it won't hurt". The questions for which there was insufficient evidence related to skin cooling techniques, using two providers to give two injections simultaneously at different sites, intramuscular vs, subcutaneous administration of a vaccine when either is acceptable, and oral ibuprofen or acetaminophen (paracetamol) given before injections. The guideline authors note that the practice of giving acetaminophen before vaccination has been questioned as there is some data indicating that it may interfere with the immunogenicity of some childhood vaccines.

Evidence-based medicine reviews

Fu LY, Bonhomme L-A, Cooper SC, et al. 2014. **Educational interventions to increase HPV vaccination acceptance: A systematic review**. Vaccine, 32(17), 1901–20.

The authors of this review identified 33 English language studies of HPV vaccination educational interventions for both young women and their parents. The studies were of various designs: RCTs (25 studies), non-randomised trials and quasi-experimental (comparing pre and post intervention outcomes). Eight studies tested the effectiveness of interventions with adolescents or young adults and seven with parents. Eighteen compared the effectiveness of different message frames in interventions (e.g. comparing "advantages of getting the vaccine" with "disadvantages of not getting it" or "preventing cervical cancer" with "preventing genital warts" or "message delivery by peers" with "message delivery by medical experts") with either adolescents, young adults or their parents. The authors judged that seven studies were at low risk of bias, 15 at medium risk and 11 at high risk. Most of the studies had methodological deficiencies and most did not have receipt of HPV vaccination as the primary outcome measure but rather intention to receive HPV vaccination or attitude towards HPV vaccination. The review authors concluded that there was not strong evidence to recommend any one specific educational intervention. They noted that most studies had used written informational hand-outs aimed at educated populations and they stated that further research should include interventions for less literate or culturally diverse populations since HPV infection disproportionately affects minority and socioeconomically disadvantaged women.

Sadaf A, Richards JL, Glanz J, et al. 2013. **A systematic review of interventions for reducing parental vaccine refusal and vaccine hesitancy**. Vaccine, 31(40), 4293–304.

Parents may choose not to immunise their children for various reasons: they may believe that vaccines are dangerous, or that they can control their child's susceptibility to disease, they may distrust modern medicine, or cite religious grounds for vaccine refusal. Research on cognitive decision making has indicated that parents prefer to make "errors of omission" (such as letting their child their child get sick because of not being vaccinated) to "errors of commission" (e.g. being responsible for their child having an adverse reaction to vaccination). This review aimed to assess the effectiveness of interventions to address parental vaccine refusal. This review included 33 studies, 25 of which were from the U.S. where vaccination is mandatory for entry to school and childcare. (There are variations between states in which vaccines are mandatory. Exemptions are allowed for medical reasons in all states and for religious reasons in most states. Some states allow personal beliefs/philosophical exemptions.)

There were 13 before and after intervention studies, 3 RCTs, 7 non-RCTs, and 6 evaluation studies. Four studies evaluated the results of introducing state-level philosophical or personal belief exemptions for school immunization requirements and three studies evaluated the results of varying the complexity of state-level procedures for obtaining exemptions on nonmedical exemption rates. The most commonly studied intervention was parent-centred education or information. Seventeen studies (including 2 RCTs) tested written educational information. Other interventions included: outreach by immunisation coordinator, parent meeting, 'Radionovela', Powerpoint presentations and a web-based decision aid for parents. Fifteen studies of educational interventions measured parents' attitudes to vaccination as the outcome and eight of them reported a statistically significant improvement. Of the ten studies evaluating educational interventions and using parents' intention to vaccinate their children as the outcome measure, five reported a statistically significant positive effect on intention. The review authors considered that the overall quality of the studies investigating education/information interventions was poor. They assigned the 2 RCTs a final GRADE evidence score of 2 (out of a possible 8). They concluded that their review had not revealed any convincing evidence regarding effective interventions to address parental vaccine hesitancy and refusal. They stated that "there is a need for randomized trials on cost-effective interventions with outcomes that are measured in terms of the impact on vaccination rates among refusing parents".

Kaufman J, Synnot A, Ryan R, et al. 2013. **Face to face interventions for informing or educating parents about early childhood vaccination**. Cochrane Database of Systematic Reviews, 5. http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD010038.pub2/abstract

This review aimed to assess the effects of face to face interventions for educating or informing parents about early childhood vaccination on immunisation uptake and parental knowledge. It included six RCTs and one cluster RCT, involving 2978 participants in total. The cluster RCT did not contribute usable data to the review. The interventions were delivered in the clinic or hospital, in the mother's home or at antenatal classes. The six RCTs compared face to face intervention with individuals vs. control and the cluster RCT compared face to face intervention with groups of parents vs. control. Six studies measured immunisation status as an outcome but in two of them it was not possible to isolate the effect of the face to face intervention from the effects of other components of the intervention. Three studies measured parental knowledge or understanding of vaccination. The quality of the evidence for each outcome was considered to be low or very low, with moderate risk of bias overall, and the study results were inconsistent. The review authors concluded that the limited available evidence was of low quality and suggested that face to face interventions have little or no effect on immunisation status, or knowledge or understanding of immunisation. They also found no evidence to allow them to comment on the cost of such interventions, parent intention to vaccinate, parent experience of vaccination or adverse effects of vaccination.

Hendry M, Lewis R, Clements A, et al. 2013. **"HPV? Never heard of it!": A systematic review of girls' and parents' information needs, views and preferences about human papillomavirus vaccination**. Vaccine, 31(45), 5152–67.

This review included 28 qualitative studies and 44 surveys exploring girls and parents' information needs, views and preferences regarding HPV vaccination. The authors considered that all but one of the qualitative studies were of good to moderately good standard but that only about one third of the surveys had been well conducted. Only five surveys had a sample size > 600 participants and a response rate of >70%. The main findings of the review were as follows. Overall the acceptability of HPV vaccination was high but people had insufficient knowledge and understanding of HPV. The link between HPV, cancer and sexually transmitted infection was not well understood by the girls or their parents. This lack of knowledge hampered their ability to weigh up the risks and benefits of vaccination and make an informed choice. Some people erroneously thought that HPV vaccination replaced cervical screening. Parents were afraid that vaccination might encourage their daughters into early and/or promiscuous sexual activity. Mothers were worried about vaccine safety and girls were worried about the size of the needle. These factors are likely to affect uptake of HPV vaccination and could affect future uptake of cervical screening.

Uman LS, Birnie KA, Noel M, et al. 2013. **Psychological interventions for needle-related procedural pain and distress in children and adolescents**. Cochrane Database of Systematic Reviews (10). http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD005179.pub3/abstract

This updated review included 39 RCTs involving 3394 children between the ages of two and 19 years. The most common needle-related procedures in the studies included venepuncture, intravenous line insertion and immunisation. The psychological interventions to reduce pain included distraction, hypnosis and cognitive behavioural theory (CBT). Nineteen studies examined distraction only (e.g. music, toys, books, watching cartoons or playing games). Six studies investigated hypnosis. There was strong evidence supporting the efficacy of both distraction and hypnosis. The review authors found no evidence to support the efficacy of preparation and/or information, combined CBT, parent coaching plus distraction, suggestion or virtual reality. They reported that more research is needed on the following interventions which had been the subject of only one RCT each: memory alteration, parent positioning plus distraction, blowing out air, and distraction plus suggestion. They stated that: "There are continuing issues with the quality of trials examining psychological interventions for needle-related pain and distress".

Kassab M, Foster JP, Foureur M, et al. 2013. **Sweet-tasting solutions for needle-related procedural pain in infants one month to one year of age**. Cochrane Database of Systematic Reviews (2). http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD008411.pub2/abstract

This review included 14 RCTs involving 1551 participants. Compared to infants who received water, infants who received a sweet-tasting solution had a significantly reduced duration of cry: mean difference (in seconds) −13.47 (95% CI −16.80 to −10.51, p<0.00001). There was considerable heterogeneity between studies and the review authors stated that they were unable to explain it. Duration of cry was the only outcome for which meta-analysis could be done, due to differences in study design, but most of the individual studies that assessed pain in other ways found that sucrose significantly reduced pain compared to controls. One study compared sucrose with Lidocaine-prilocaine cream and found no significant difference for the outcomes cry duration and pain. The review authors stated that, due to differences between the studies they could not determine the optimal concentration, volume or method of administration of sweet tasting solutions in this age group and that additional large RCTs are needed. They concluded that there was insufficient evidence to allow confident judgment of the effectiveness of sweet-tasting solutions in reducing needle-related pain in infants aged one to 12 months but the treatment appeared promising and further RCTs were warranted to determine the optimal concentration, volume and method of administration and to assess possible adverse effects.

Harrison D, Yamada J, Adams-Webber T, et al. 2011. **Sweet tasting solutions for reduction of needle-related procedural pain in children aged one to 16 years**. Cochrane Database of Systematic Reviews (10). http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD008408.pub2/abstract

This review included four RCTs with 330 participants in total. Two studies involved toddlers and pre-schoolers receiving either sucrose or water/no treatment for immunisation pain and two studies involved school-aged children who received either sweetened or unsweetened chewing gum before, or before and during, immunisation and blood collection. The results for the pre-schooler studies were conflicting. In one study the sucrose group had significantly lower cry duration

and behavioural pain scores and in the other there was no difference in cry duration. In the school-age children sweetened chewing gum did not significantly reduce pain scores. The review authors concluded that: "Based on these four studies, two of which were subgroups of small numbers of eligible toddlers from larger studies, there is insufficient evidence of the analgesic effects of sweet tasting solutions or substances during acute painful procedures in children over one year of age. Further well-conducted RCTs are warranted in this population".

Williams N, Woodward H, Majeed A, et al. 2011. **Primary care strategies to improve childhood immunisation uptake in developed countries: systematic review**. JRSM Short Rep, 2(10), 81. http://researchonline.lshtm.ac.uk/1126650/1/SHORTS-11-112.pdf

This review included 46 studies assessing strategies to optimise immunisation uptake for preschool children in developed countries, published between 1980 and 2009. It included 26 RCTs, 11 before and after studies, and 9 controlled intervention trials. Twenty two papers reported on 41 interventions involving parental reminders and recalls (by various methods including postcards, letters and telephone calls, both personal and automated). Using Black's quality scoring framework the review authors determined that the average quality score for these studies was 24.8 (out of a possible 29.5). Fourteen out of the 41 intervention arms (39%) found a statistically significant increase in immunisation rates (median 11%, range −11% to +19%). No one type of reminder/recall appeared to be better than any other. Two papers reported on two intervention arms assessing the effect of simple parental education programmes on immunisation uptake. Neither of them found a significant effect on immunisation rates. Five studies reported on six intervention arms looking at provider recall/reminder strategies (such as automatic computer notifications or the person dealing with patient records manually searching patients' records and notifying practitioners that immunisations are due). These studies had an average quality score of 23.7 (out of a possible 31). The median change in immunisation rate was +7% (range −2% to +33%). Four studies reported on four intervention arms studying the effect of provider education on immunisation rates. These studies had an average quality score of 22.4 and found a median change in immunisation rates of +8% (range 1% to 25%). Four studies reported on six intervention arms involving provider feedback as part of strategies to improve immunisation rates. The average quality score for these papers was 24.1 and the overall median change in immunisation rates was 19% (range 12% to 19%). Eight studies reported on eight intervention arms which featured a combination of interventions. These had an average quality score of 20.5 (out of a possible 31) and an overall median change in immunisation rates of 15% (range −4% to 47%). Three of these intervention arms reported that the change in immunisation rates was statistically significant and four did not report the significance level for their results. The review authors concluded that reminding parents and providers of upcoming and overdue immunisations as well as educating and giving feedback to immunisation providers can help improve immunisation rates. They stated that further research is needed to determine the cost-effectiveness of these interventions and their impact in groups with poor immunisation rates and in those at high risk of complications from vaccine-preventable diseases.

In their commentary on this review the CRD stated: "Concerns about study quality, reporting of the review and the synthesis mean that the conclusions may not be sufficiently cautious and reliable". The CRD commentary can be found here: http://www.crd.york.ac.uk/NIHR_CRDWEB/ShowRecord.asp?LinkFrom=OAI&ID=12012051405#.U4aPzPmSx8E

Glenton C, et al. 2011. **Can lay health workers increase the uptake of childhood immunisation? Systematic review and typology**. Tropical Medicine & International Health, 16(9), 1044–53. http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3156.2011.02813.x/pdf

This review assessed the effects of lay health workers (LHWs) on childhood immunisation uptake. Twelve studies, (including 10 RCTs) were included in the review, mostly comparing LHWs with no intervention or standard care. Seven of the studies were conducted among economically disadvantaged populations in high-income countries (LHWs made home visits to parents to promote routine childhood immunisations and encourage clinic visits for vaccination), and the remaining five studies were conducted in low and middle income countries (in some of which LHWs gave vaccinations). Most of the studies showed that LHWs increased immunisation coverage. The diversity of settings meant the meta-analysis was possible for only four of the studies, all in high income settings (3568 participants). These LHW programmes were associated with a statistically significant increased the number of children whose immunisations were up to date (RR 1.19, 95% CI 1.09 to1.30). The authors conclude that while LHWs show promise in improving vaccination coverage, further high quality studies are needed in low and middle income countries.

National Collaborating Centre for Women's and Children's Health. 2009. **Reducing differences in the uptake of immunisations (including targeted vaccines) in children and young people aged under 19 years: systematic review of effectiveness and cost effectiveness evidence**. London: National Collaborating Centre for Women's and Children's Health. http://www.nice.org.uk/nicemedia/live/12247/45534/45534.pdf

This review provides the evidence base for the NICE guidance on reducing differences in uptake of immunisations. (The guidance can be found here: http://guidance.nice.org.uk/PH21/Guidance/pdf/English). The review is focused on what interventions are effective and cost effective in reducing differences in immunisation uptake in children and young people aged less than 19 years. The effectiveness review included 142 studies and the cost-effectiveness review included 10 studies. Three key themes were identified: issues relevant to all childhood vaccines; issues relevant to MMR as an exemplar of a universal vaccine; issues relevant to neonatal Hep B as an exemplar of a targeted vaccine. Interventions assessed included: recipient reminder/recall systems; home visits; client or family incentives/disincentives; interventions in school or day care settings; provider based interventions (including education, reminders and incentives); national immunisation programmes; and multi-component interventions. A review of studies examining barriers to immunisation and the views and experiences of children, young people, parents/carers, and health professionals is included. Only one study included evaluated differential uptake of immunisations across population subgroups, although numerous studies assessed targeted interventions. The executive summary provides 66 effectiveness evidence statements and three cost-effectiveness evidence statements. The quality of included studies

was variable and while there were some RCTs included, only 16 intervention studies had the highest quality rating. Evidence-based recommendations include:

- improve access to immunisation services, for example, by extending clinic times and making sure clinics are 'child-friendly'
- provide parents and young people with tailored information and support and an opportunity to discuss any concerns
- check children and young people's immunisation status during health appointments and when they join nurseries, playgroups, schools and further education colleges, and offer them vaccinations
- ensure babies born to hepatitis B-positive mothers are given all recommended doses of the vaccine on time, a blood test to check for infection and, where appropriate, hepatitis B immunoglobulin.

Other relevant publications

Litmus. 2013. **Audience Research: Delayers of Infant Immunisation**. Wellington: Ministry of Health. http://www.health.govt.nz/publication/audience-research-delayers-infant-immunisation

This is the report of qualitative research commissioned by the Ministry of Health to learn more about the parents who have delayed one or more of their baby's immunisations. Understanding the reasons why some parents delay their child's immunisation is an important step in achieving the immunisation target. The research involved focus groups and interviews with 68 parents of infants aged eight to 12 months for whom one or more immunisations had not been administered on time. It found that parents had a strong desire to protect their babies' health. They generally believed babies are protected at home but vulnerable to disease once they start socialising outside the family. Starting early childhood education was often the "tipping point" for catching up with delayed immunisations. Parents had little understanding of the importance of timely immunisation and were reluctant to immunise an infant who was unwell. Mothers found support from their partner or other family member very valuable when their baby was being immunised. Most parents feared the immunisation experience even though they had confidence in vaccine safety. Low income families could find it difficult to get their babies' immunisations on time due to environmental factors such as not having transport. While most parents were comfortable having their child immunised in a clinical setting they did not like having to comfort a distressed infant in a public waiting room.

Litmus. 2012. **HPV Immunisation Programme Implementation Evaluation Volume 1: Final Report**. Wellington: Litmus. http://www.health.govt.nz/publication/hpv-immunisation-programme-implementation-evaluation

Litmus was commissioned by the Ministry of Health to evaluate the implementation of the HPV Immunisation Programme and assess whether the programme was equitable for Māori and Pacific girls (as the Ministry has a long term goal of reducing inequalities in cervical cancer).The evaluation focused on Māori, Pacific and Other (non-Māori, non-Pacific) young women in two groups: those born between 1990 and 1991 who could access the free vaccine up till 31 December 2011, and those born in 1997. The evaluation found that in the 1997 cohort, vaccine uptake targets for dose 1 were achieved for Māori and Pacific girls, but not for Other girls. Some Pākehā parents were not opposed to the vaccine but wished to delay it until their daughters were more mature while others perceived that it was only necessary for Māori and Pacific girls (an unintended consequence of targeting these groups). In the 1990–91 cohort, equity of uptake was achieved for Pacific young women, who achieved the target for doses 1 and 2 but not 3, but not for Māori who were around 10% under the target for doses 1, 2 and 3. Other young women were close to achieving the target for all three doses. Twice as many Māori and Pacific young women (as compared to Other young women) failed to access dose 3 after having received dose 1. Vaccine uptake appeared to be greater where there was integration and information sharing between the various components involved in programme implementation: DHB Planning and Funding; the HPV Team/Coordinator; school-based delivery; primary care delivery; and whānau engagement. Key ways to improve HPV vaccine coverage were stated to be: development of evidence-based strategies to counter misinformation about the HPV vaccine; increased integration of school-based and primary care delivery; and identifying possible health equity mechanisms that could be used in primary care delivery, including the role of and levers available to primary health organisations.

Health Committee. 2011. **Inquiry into how to improve completion rates of childhood immunisation, and Briefings from the Chief Coroner on the coronial process, from Dr Michael Tatley on the adverse reaction process, and from Professor Sir Peter Gluckman on how to improve completion rates of childhood immunisation**. 49th Parliament: March. http://www.parliament.nz/en-NZ/PB/SC/Documents/Reports/8/c/a/49DBSCH_SCR5060_1-Inquiry-into-how-to-improve-completion-rates-of.htm

This Parliamentary Health Committee inquiry into improving rates of childhood immunisation examined: statistics on timeliness and completion of vaccination in New Zealand, and international comparisons; the National Immunisation Register; relevant literature on optimising timeliness and completion rates; information on community concerns, informed consent and conscientious objection; and an assessment of the benefits of immunisation. A large number of recommendations are made regarding what methods could be applied at minimal cost to improve immunisation coverage in New Zealand. Recommendations include an expansion of targets to older age groups, improvements in the National Immunisation Register, exploration of provider and parent incentives, and improved information resources targeted at parents. Dr Nikki Turner's "six star" plan to improve rates of childhood immunisation, covering enhanced business as usual, contractual/legislative aspects, responsibilities and support for primary care and parents, communication and safety surveillance, is included in the appendices.

On 22 June 2011, the Government, led by the Ministry of Health, issued its response to the Health Select Committee's Report, noting that the Ministry had met, or that work was underway to meet, the majority (24) of the Report's 30 recommendations (http://www.parliament.nz/en-NZ/PB/Presented/Papers/6/d/4/49DBHOH_PAP21651_1-Government-Response-to-Report-of-the-Health-Committee.htm). A briefing paper, released by the Ministry of Health in August 2012 outlines the Ministry's progress on implementation of the six remaining recommendations, including ongoing exploration

of incentives for parents and providers and improved immunisation information for pregnant women (http://www.health.govt.nz/our-work/preventative-health-wellness/immunisation/immunisation-programme-decisions/progress-report-inquiry-how-improve-completion-rates-childhood-immunisation).
Websites
Ministry of Health. 2014. **New Zealand Immunisation Schedule**. http://www.health.govt.nz/our-work/preventative-health-wellness/immunisation/new-zealand-immunisation-schedule accessed May 2014. This web page contains the current immunisation schedule and links to other pages relevant to immunisation.
Ministry of Health. 2014. **2014 Immunisation Schedule Change**. http://www.health.govt.nz/our-work/preventative-health-wellness/immunisation/new-zealand-immunisation-schedule/2014-immunisation-schedule-change accessed June 2014. This web page contains information on the changes to the immunisation schedule, and the following links to relevant publications: • Schedule from 1 July 2014 (pdf, 139 KB) • Rotavirus and the RotaTeq vaccine: Factsheet for vaccinators and health professionals (pdf, 162 KB) • Rotavirus and the RotaTeq vaccine: Factsheet for vaccinators and health professionals (docx, 293 KB) • Additional Funded vaccines for special groups (pdf, 110 KB)

Note: The publications listed were identified using the search methodology outlined in Appendix 1.