THE EPIDEMIOLOGY AND CONTROL
OF HEPATITIS B
IN NEW ZEALAND

Report to the Ministry of Health
and Public Health Commission

Nicholas Wilson
Public Health Medicine Specialist

Michael Baker
Public Health Medicine Specialist

Judith Miller
Virologist

Epidemiology and Virology Groups
New Zealand Communicable Disease Centre

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ABSTRACT

Hepatitis B infection and its long term sequelae, represent a major international challenge to public health. This disease also has particular relevance to New Zealand which has characteristics of both intermediate and high endemicity regions of the world. This report aimed to explore aspects of both the epidemiology of hepatitis B in New Zealand and its control.

The Epidemiology of Hepatitis B in New Zealand

A large number of sero-epidemiological studies have helped clarify the extent of hepatitis B virus (HBV) infection in New Zealand. These studies are reviewed and the findings summarised in the first chapter. One of the most striking findings has been the large geographical variation in disease rates, with pockets of particularly high endemicity, eg, in Kawerau in the Bay of Plenty. To some extent, regional variation in hepatitis B marker prevalence reflects the marked ethnic differential in New Zealand. Both Maori and Pacific Island Polynesian populations show markedly higher rates of all hepatitis B markers, higher notification rates, higher rates of hospitalisations for acute disease, and higher incidence of chronic sequelae, notably primary hepatocellular carcinoma. A gender differential is also apparent with higher overall rates in males of hospitalisations for acute hepatitis B and also chronic sequelae. The cause of this difference is unknown but higher rates of injecting drug use in young adult males may be a factor. Sexual transmission is likely to be important for both genders in young adult years when hospitalisation and notification rates peak.
The precise mechanisms for horizontal transmission of hepatitis B in childhood remain unclear in the New Zealand setting. There is some suggestion however, of various factors being relevant including children sharing beds, amateur tattooing and sharing toothbrushes. In terms of the chronic sequelae of hepatitis B, New Zealand work has suggested a very low risk for developing chronic HBV carriage if infected outside childhood.

A large number of New Zealand-based sero-epidemiological studies have also been conducted into "at-risk" adult groups and occupational groups. These have been compatible with overseas studies in suggesting elevated risk for certain groups such as health care workers and the developmentally disabled. Despite the epidemiology of hepatitis B being better described than for any other communicable disease in New Zealand, there are still significant gaps in our understanding, such as the key transmission mechanisms in adults.

In Chapter Two, the value of epidemiological information provided by hospitalisation and notification data concerning acute hepatitis B in New Zealand are examined. Acute hepatitis B was found to have had a significant impact on health status in New Zealand in recent years, with an average annual hospitalisation rate of 1.4 per 100,000 and an average annual notification rate of 10.1 per 100,000 (for 1985-91). Fortunately, there has been a significant downward trend in both hospitalisations and notifications in all age groups and in the major ethnic groups (eg, the correlation coefficient (r) for all notified cases was r =-0.95, 95% confidence interval (CI) -0.99, -0.76). There was some evidence to suggest that this trend was related to mass childhood immunisation programmes and to vaccination programmes in particular groups such as health care workers. Results from both data sources reiterated the importance of the ethnic differential associated with hepatitis B (eg, relative risk (RR) for hospitalisation of Maori: RR =2.24, 95% CI 1.98-2.52)). Sexual
transmission, and possibly transmission relating to injecting drug use, are likely to be important in the young adult population. Hospitalised cases with acute hepatitis B during the 1980-91 time period imposed direct costs on the hospital sector of at least $2.6 million. Despite these data sources providing useful trend and other information, there is a particular need to improve the quality of notification data on acute hepatitis B, especially with regard to possible transmission mechanisms. This clarification will help prioritise the various public health control measures that are relevant to hepatitis B.

The issue of hepatitis B in "at-risk" adult groups is developed further in Appendix One. Here the relevant New Zealand sero-epidemiological data are reviewed and adult groups that are most likely to benefit from vaccination are described. These groups include individuals with recently acquired sexually transmitted diseases, individuals who have had unprotected sexual activity with multiple partners in the previous six months, sexually active homosexual males, intravenous drug users, prison inmates, and residents of institutions for the developmentally disabled. International evidence suggests that the vaccination of these populations is a relatively cost-effective use of health care resources.

The epidemiology and control of hepatitis B in occupational groups is examined further in Appendix Two. The key finding was the compatibility of New Zealand-based sero-epidemiological studies with the international literature, particularly with regard to health care workers. A survey of health sector organisations suggested that a majority of workers in the most "at-risk" occupational groups had been vaccinated. Many areas for improving coverage and vaccination policies were identified however. Similarly a survey of general practitioners in the Wellington region identified sub-optimal vaccination coverage in this population.
The Control of Hepatitis B in New Zealand

Chapter Three examines a range of control activities that relate largely to immunoprophylactic control measures (vaccination and immunoglobulin). To begin with, this chapter reviews the impressive range of control measures undertaken to date. Indeed, New Zealand led the world with the introduction of hepatitis B vaccine into a national childhood immunisation schedule. There has been a rational incremental progression in improving vaccination coverage, from neonates of carrier mothers through to all children under 16 years of age. Much of the credit for this progress rests with effective health professional advocacy, advocacy by Maori and the mobilisation of community support.

Although some aspects of these control measures have been well evaluated to date, major deficiencies remain, particularly with the lack of evaluation of the programme providing immunoprophylaxis to the infants of HBV carrier mothers. A range of problems with the control of hepatitis B also exist. Outstanding among these is the fact that large proportions of the childhood population, particularly Maori, have received suboptimal vaccination coverage. This has been the case for both the pre-school "catch-up" vaccination programme and routine administration in the general practice setting. Despite growing understanding of the need for culturally sensitive strategies to improve vaccination uptake in Maori and other ethnic groups, there remains inadequate action at the operational level to address this.

Possibly the next major problem with current control mechanisms is that at least 8% of hepatitis B vaccine is of compromised potency at the point of administration. Major inadequacies have been identified in the operation of the national vaccine cold chain, particularly with regard to freeze sensitive vaccines such as hepatitis B. Other challenges remaining for hepatitis B control include the need to establish clearer national guidelines
on hepatitis B vaccination, the need for a systematic programme of monitoring current control activities, and the need for a review of the appropriateness of screening carriers for primary liver cancer. Chapter Three contains a range of recommendations for improving hepatitis B control in New Zealand. Key recommendations are reiterated at the end of this abstract.

Appendix Three examines a particular facet of mass immunisation programmes, that is whether or not to screen for the hepatitis B virus (HBV) carrier state prior to vaccination. The major advantage of such screening is that it opens up the possibility of immunising sexual partners and close family contacts. Other advantages of screening require further clarification, such as allowing treatment with interferon and further screening for primary liver cancer. Indeed, screening can have a range of adverse effects on mass immunisation programmes including the requirement for further visits to a health professional for vaccination, increased costs for the health sector, and adverse effects potentially associated with disease labelling and stigmatisation. For these reasons this review suggested that the current Ministry of Health policy not to advocate routine pre-vaccination screening be continued.

Another New Zealand-based hepatitis B control programme that is very likely to be cost-effective, concerns the delivery of immunoprophylaxis to the infants of HBV carrier mothers. This issue is examined in Appendix Four, which reviews a range of strategies that could be applied to the current programme in New Zealand. Indeed the lack of monitoring and evaluation of this programme is probably the major deficit in hepatitis B programme evaluation activities to date.

The process of delivering hepatitis B vaccinations in a selection of computerised general practices was examined in Appendix Five. This study found that the delivery of hepatitis
B vaccine outside the desirable time periods was common at 44%, suggesting a fairly disrupted immunisation schedule for most children. The relatively infrequent delivery of hepatitis B vaccine at the same time as other immunisations was of note and this may reflect provider concern about administering multiple injections at the same visit. Further improvements in the collection of data by computerised practices is necessary before the full value of this data source can be realised.

Finally, the benefits and costs of immunising a 20 year old New Zealander against hepatitis B were examined in Appendix Six. The perspective of the individual was taken and the major benefit was summarised as the immunisation reducing the risk of being too sick to work from hepatitis B for three to four months by fivefold. That is a five-fold reduction in risk from 1/200 down to 1/1000 over a 15 year period. Despite the complexities involved in the assessment of the benefits and costs of immunisation, it appears possible to summarise these in ways that at least a proportion of potential vaccinees and employers may be able to understand.
RECOMMENDATIONS

Specific recommendations for improving our understanding of the epidemiology of hepatitis B, and the successful implementation of control measures, are detailed in the relevant chapters of this document and in Chapter Four. Key recommendations are also highlighted below:

Improving understanding of the epidemiology of hepatitis B in New Zealand

That the Ministry of Health / Public Health Commission:

- Consider commissioning a study into hepatitis B marker prevalence of children in Form One. Such a study would help determine the value of further immunisation of this group.

- Contract with the necessary agencies to improve the provision of data on the transmission mechanisms of hepatitis B in the adult population. Suitable methods would include both improvements in the quality of notification data and a case control study using hospitalised cases. Such information is critical to prioritising control strategies.
Improving the control of hepatitis B in New Zealand

That the Ministry of Health / Public Health Commission:

- Act on the recommendations in the report of the National Immunisation Coverage Survey to improve immunisation coverage in general and in particular to implement measures that will specifically improve hepatitis B vaccination coverage in Maori and Pacific Island Polynesians.

- Act on the recommendations in the report on the review of the national vaccine cold chain to improve the quality of hepatitis B vaccine at the point of delivery.

- Adopt one of the possible strategies available for systematically evaluating the current programme to provide immunoprophylaxis to the infants of HBV carrier mothers.

- Develop a national strategy for the control and eventual eradication of hepatitis B in New Zealand. There would be some advantages in integrating such a strategy with a national strategy for the control of blood-borne viral diseases in general (ie hepatitis C, hepatitis D and HIV).

- Act on previous recommendations to provided state-purchased hepatitis B vaccine for the protection of "at-risk" occupational and other adult groups.
INTRODUCTION

Viral hepatitis B is a major public health problem for most developed countries. This problem is manifest in acute disease and in the chronic sequelae of hepatitis B virus (HBV) infection - including chronic active hepatitis, cirrhosis, and primary hepatocellular carcinoma. As with certain other developed countries, New Zealand has characteristics of an "intermediate" level of endemicity but also with features of "high endemicity" in certain parts of the country. The aspects of this disease which make it a particularly appropriate topic for further study by public health professionals are listed below:

- Hepatitis B is one of the most important communicable diseases in New Zealand in terms of impact on health status. Fortunately, however, the means to control the disease through immunoprophylactic and other measures are relatively inexpensive and readily available. Indeed, hepatitis B transmission can theoretically be eliminated in New Zealand given a sustained inter-generational approach.

- The New Zealand health sector has probably spent more on the control of hepatitis B in the last decade than the control of any other communicable disease except possibly HIV. However, not all this expenditure has been adequately evaluated.

- There has been a notably greater impact of hepatitis B on the health status of Maori and Pacific Island Polynesians than New Zealanders of European descent. Also, health sector attempts to control hepatitis B have been largely unable to address this ethnic differential. Therefore, hepatitis B represents a key issue in terms of social equity within this country.
The issue of hepatitis B highlights the role of epidemiology in providing a rational approach to the application of disease control measures. Despite this, however, a large amount of work has been performed in New Zealand on the epidemiology and control of this disease without an integrated review of these two areas having been performed.

There are a range of important lessons that can be learnt from New Zealand's control of hepatitis B to date. Applying these lessons will allow more efficient control of hepatitis B and other communicable diseases in the future. Other countries may also benefit from New Zealand experience in this area.

This report reviews key aspects of the epidemiology and control of hepatitis B in New Zealand to date. It also presents a range of original work that relates to both epidemiology and control of hepatitis B. Finally it draws out some of the key conclusions and makes recommendations for further research and control activities.
Chapter One

REVIEW OF THE EPIDEMIOLOGY OF HEPATITIS B IN NEW ZEALAND

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ABSTRACT

A large number of sero-epidemiological studies have helped clarify aspects of the epidemiology of hepatitis B in New Zealand. One of the most striking findings has been the large geographical variation in disease, with pockets of particularly high endemicity (e.g., in Kawerau in the Bay of Plenty). To some extent, regional variation in hepatitis B marker prevalence reflects the marked ethnic differential in New Zealand. Both Maori and Pacific Island Polynesian populations show markedly higher rates of all hepatitis B markers, higher notification rates, higher rates of hospitalisations for acute disease, and higher incidence of chronic sequelae such as primary hepatocellular carcinoma. A gender differential is also apparent with higher overall rates, in males, of hospitalisations for acute hepatitis B. The cause of this differential is unknown, but higher rates of injecting drug use in young adult males may be a factor. Sexual transmission is likely to be important for both genders in the young adult years when hospitalisation and notification rates peak.

The precise mechanisms for horizontal transmission of hepatitis B in childhood remain unclear in the New Zealand setting. Various factors may be relevant, including children sharing beds and sharing toothbrushes. In terms of the chronic sequelae of hepatitis B, New Zealand work has suggested a very low risk for individuals developing chronic HBV carriage if infected outside childhood.

A large number of New Zealand-based sero-epidemiological studies have also been conducted into "at-risk" adult groups and occupational groups. Findings have been compatible with overseas studies in suggesting elevated risk for certain groups such as health care workers and the developmentally disabled. Despite the epidemiology of hepatitis B being better described than for any other communicable disease in New Zealand, there are still significant gaps in our understanding. Recommendations are made
to address further developments with priorities being the clearer identification of current levels of immunity in school children and improved understanding of HBV transmission mechanisms in New Zealand.

INTRODUCTION

Hepatitis B is perhaps the most thoroughly studied communicable disease in New Zealand's history. This is no doubt a reflection on the relatively high endemicity of hepatitis B virus (HBV) infection in this country compared to most other developed nations. The particularly high endemicity in Maori has also made the disease a special focus of concern. Community and health professional pressure, along with the reduction in hepatitis B vaccination costs during the last decade, has led to an increase in the size and scope of mass vaccination programmes. Detailed epidemiological studies have both preceded and been driven by the potential use of vaccination as a control strategy. Nevertheless, the epidemiology of hepatitis B in New Zealand has not been systematically and comprehensively reviewed in one document to date. This paper attempts to review this disease and its impact on health status in New Zealand. Recommendations for future areas of worthwhile research and disease surveillance are also made.

The development of hepatitis B epidemiology in New Zealand

The availability of a commercially available antigen test in 1971 paved the way for the more detailed understanding of hepatitis B in New Zealand [1]. Indeed, as a result of this test, hepatitis B became a notifiable condition that year. During the 1970s the first studies began to highlight the importance of this disease as a cause of viral hepatitis [2,3,4].
Concern was also developing over the magnitude of hepatitis B as a problem in specific parts of the country [5,6].

In 1982 a workshop on hepatitis B in New Zealand was held in Whakatane [7]. It included international experts in hepatitis B and focused attention on the need for immunisation programmes in this country. Following this in 1983, Scobie published a review of hepatitis B in New Zealand. This article was already able to refer to 14 New Zealand-based studies [8].

It was not until commercial tests for other serological markers became available in 1982, that studies could begin to provide sero-prevalence data on a large scale. The first of these of note was carried out on sera that had been collected in 1978 for a polio survey [9]. This was a non-representative sample but provided the first nation-wide picture of HBV sero-prevalence.

A far more specific study on the population in Kawerau, Bay of Plenty, was undertaken in 1984/85 [10,11]. This study provided valuable data on the ethnic and age distribution of infection for virtually the whole population of the town.

The next study to provide national data was part of a national sero-survey for markers of vaccine preventable diseases [12]. It was able to provide the most accurate national picture that has yet been obtained on HBV infection in New Zealand children. Another conference on hepatitis B was held in Whakatane in 1987 [13], which helped to further mobilise interest in vaccination programmes, potentially using low-dose vaccine.
Some of the studies during the 1980s were able to speculate on transmission mechanisms relevant to this country. Of more value however, was one small case control study that suggested a role for certain factors in the home environment [14].

Acute hepatitis B infection has received little attention to date other than the study in Chapter Two. The chronic sequelae of HBV infection have, however, been investigated especially in relationship to primary liver cancer [15,16]. One review has clarified the importance of the age of infection in terms of chronic carriage and risk of future liver disease [17].

**National trends in HBV infection rates**

Data on national trends in hepatitis B are limited by the absence of any cohort studies or a repeat of the 1985 national immunisation sero-survey. Also, no other sero-surveys have been repeated on similar population groups over time. Data on acute hospitalisations and notifications do, however, provide strong evidence for a decline in hepatitis B, at least in the last decade (see Chapter Two). This trend is likely to be real despite the limitations of notifications in under-reporting hepatitis B in New Zealand [18,19].

Declining trends in HBV infection have been noticed in other developed countries [20,21], including the United States since a peak in 1985 [22], and the United Kingdom since a peak in 1984 [23]. The US decrease has been attributed to a decrease in reported risk factors associated with homosexual activity, health care employment and blood transfusion [24]. The decline in Italy has been explained as being due to a range of medical and non-medical factors [25].
Incidence of HBV infection in New Zealand

Sero-prevalence data for major studies conducted in New Zealand are included in Table 1. Of these studies, the one that provides the best national picture for children is the national immunisation survey. For adults, the national study of police and customs officers and the national study of pregnant women are probably the most valuable. Overall these studies suggest that in the mid 1980s, approximately 13% of New Zealand children had become infected by the age of 15 years and that this rate increased by up to two times once they had reached their late twenties. In some parts of the country, however, such as the Eastern Bay of Plenty, the risk of infection at age 15 years was three times the national average. These data tend to place New Zealand in an "intermediate endemicity" pattern with characteristics of "high endemicity" in certain areas such as parts of the Bay of Plenty (Table 2).
Table 1  Summary of Key Hepatitis B Marker Sero-Prevalence Data for Populations in New Zealand

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Study size</th>
<th>Marker Prevalence</th>
<th>Study</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>total - HBsAg</td>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>markers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NATIONAL STUDIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polio Sero-survey (aged 0-21) (standardised by age and region)</td>
<td>2001</td>
<td>13 2.3 [29] 1978</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Immunisation Survey (at age 15y)</td>
<td>1000</td>
<td>13 1.8 [31] 1985</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Police &amp; Customs Study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Police officers</td>
<td>5193</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customs officers</td>
<td>1026</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REGIONAL STUDIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood donors (Auckland)</td>
<td>1002</td>
<td>12 2.4 [33] 1982</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population of Kawerau</td>
<td>7901</td>
<td>42 6.6 [34] 1984</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bay of Plenty Children (aged 14-15 years)</td>
<td>1006</td>
<td>45 9.2 [35] 1985</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant Women (Taranaki)</td>
<td>1094</td>
<td>13 1.3 [36] 1988</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endemicity:</td>
<td>Low</td>
<td>Intermediate</td>
<td>High</td>
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<td></td>
</tr>
<tr>
<td>HBsAg prevalence</td>
<td>0.1-0.5%</td>
<td>2-7%</td>
<td>8-15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anti-HBs prevalence</td>
<td>4-6%</td>
<td>20-55%</td>
<td>70-95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neonatal infection</td>
<td>Rare</td>
<td>Uncommon</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childhood infection</td>
<td>Rare</td>
<td>Uncommon</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution</td>
<td>N. America</td>
<td>Mediterranean</td>
<td>SE Asia</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>W. Europe</td>
<td>CIS</td>
<td>China</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Australia</td>
<td>Middle East</td>
<td>Pacific Is.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>?New Zealand</td>
<td>Africa</td>
<td></td>
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</tr>
</tbody>
</table>

Notes: * Adapted from Maynard [38].

Geographical distribution of HBV infection in New Zealand

The results from the national immunisation survey supported the notion of a north-south gradient and even a west to east gradient in the North Island. Independent of age and ethnicity, the relative risk of infection in the eastern region was 1.5 times that of the northern and central regions of the North Island. The South Island had a relative risk that was 0.6 times that of the northern and central regions. One explanation for this difference is that with the high infection rates among Maori in these regions, some cross-infection to non-Maori children was occurring. More recent data on hospitalisations and notifications continues to demonstrate large regional variations but with a less notable north-south gradient (see Chapter Two).
The geographical distribution suggested by notification data are generally consistent with the findings of the immunisation survey [39]. For the 1983-86 period the highest notification rates were in the former health districts of Whangarei, Auckland, South Auckland, Rotorua, Gisborne, and Hutt.

Pockets of particularly high HBV endemicity have also been identified in New Zealand. For example, the prevalence of markers for HBV infection in a Kawerau school were 1.5 times greater than those in other Bay of Plenty schools [40]. Also, the national immunisation survey found particularly high marker prevalence levels at individual schools in the health districts of Invercargill, Takapuna and Hamilton [41]. In contrast, some other areas have had relatively low sero-prevalence rates, for example Marlborough at 1.7% for non-Maori and 2.5% for Maori [42]. Hawke’s Bay school children also had relatively lower rates of positive markers compared to other parts of the eastern North Island [43].

**Age and gender distribution of HBV infection**

The change in hepatitis B marker status by age has been described in three New Zealand studies (see Figure 1 [44,45,46]). In the Kawerau population, peak marker prevalence occurred in the 15 to 19 year age group and declined after this (Figure 1). The extent of this decline for both Maori and non-Maori is suggestive of a dramatic increase in incidence rates having occurred at some time in the previous 30 years, possibly involving some factor relating to the creation of the town [47]. While the polio sero-survey study found little gender difference [48], males appeared to be at significantly higher risk for marker positivity and for HBsAg positivity (1.5 times) from the Kawerau sero-survey [49]. This
Figure 1 Changes in hepatitis B marker prevalence with age, - three New Zealand studies
pattern was also apparent in the Bay of Plenty School study of 14-15 year olds [50]. These results are generally consistent with other studies in the Pacific [51,52]. More recent New Zealand data highlight the presence of a peak in incidence rates for adults in the 15 to 29 year age group and the predominance of males in acute hospitalisations and notifications of hepatitis B (see Chapter Two). Greater use of injecting drugs by males is one explanation for the gender difference in overseas data. There are insufficient local data to confirm this in New Zealand.

The importance of ethnicity in the distribution of HBV infection

One of the most notable epidemiological features of hepatitis B in New Zealand is the ethnic differential. The results of the key studies that reflect this aspect are presented in Figure 2 and described in more detail in Table 3.
Figure 2 Hepatitis B marker prevalence and ethnicity, five New Zealand studies

Study

National Sero-survey

Polio Sero-survey

Bay of Plenty *

Kawerau

Civilians #

* 14-15 year olds
# Civilians in police & customs
Table 3  Summary of Sero-Prevalence Data Reflecting the Ethnic Differential for Hepatitis B

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Study size</th>
<th>Marker prevalence</th>
<th>Study</th>
<th>Marker prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>- total</td>
<td>- HBsAg</td>
<td></td>
</tr>
<tr>
<td>Polio Sero-survey</td>
<td>2001</td>
<td>- European</td>
<td>10</td>
<td>1.7</td>
</tr>
<tr>
<td>(standardised by age and region)</td>
<td></td>
<td>- Maori</td>
<td>25</td>
<td>6.3</td>
</tr>
<tr>
<td>National Imm Survey</td>
<td>3000</td>
<td>- European</td>
<td>8</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Maori</td>
<td>25</td>
<td>7.5</td>
</tr>
<tr>
<td>Civilians (Police &amp; Customs Depts)</td>
<td>691</td>
<td>- Maori</td>
<td>55</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- European</td>
<td>55</td>
<td>7</td>
</tr>
<tr>
<td>Kawerau (age standardised)</td>
<td>3106</td>
<td>Europeans</td>
<td>33</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-European</td>
<td>1863</td>
<td>54</td>
</tr>
<tr>
<td>Bay of Plenty 14-15 year olds</td>
<td>525</td>
<td>European</td>
<td>55</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-European</td>
<td>481</td>
<td>61</td>
</tr>
<tr>
<td>Pacific Islanders</td>
<td>95</td>
<td>(Wellington)</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Samoans (Auckland)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Samoans (Christchurch)</td>
<td>96</td>
<td>70</td>
</tr>
</tbody>
</table>

Of the studies in Table 3, the results from the national immunisation survey in 1985 probably provide the best national picture of the importance of ethnicity [61]. These results suggest a relative risk for Maori, independent of age or region, of 5.0 for total markers and 12.7 for the carrier state. National notification data are consistent with the sero-survey data described above [62]. Notification and hospitalisation data also highlight
the importance of acute hepatitis B in Pacific Island Polynesians and other non-Europeans (Chapter Two).

The pattern for HBV infection in Maori is not atypical when compared to other indigenous populations throughout the world. This pattern of infection is similar to that found in Native Americans in North America and Aborigines in Australia [63,64]. The marker prevalence in Pacific Island Polynesians in New Zealand is less, however, than rates reported for the residents of Fiji, Samoa, the Cooks, and Niue [65].

**Occupational risk and high-risk adult groups**

The available New Zealand data provide some evidence of an increased occupational risk for HBV infection, similar to that described in other developed countries. More detailed reviews of the New Zealand sero-prevalence data for various occupational groups have recently been performed [66], and are detailed in Appendix Two. A summary of the relevant New Zealand-based studies is included in Table 4.

New Zealand-based studies for high-risk adult groups, such as homosexual men and the developmentally disabled are reviewed separately in Appendix One. Results of the New Zealand-based work do not differ, in any major way, from overseas findings.
Table 4  Studies on Hepatitis B in Relation to Occupational Groups in New Zealand

<table>
<thead>
<tr>
<th>Occupational group</th>
<th>Overall evidence of risk</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff working with the developmentally disabled</td>
<td>Fairly suggestive</td>
<td>[67] (1977), [68] (1979), [69] (1991)</td>
</tr>
<tr>
<td>Dental workers</td>
<td>Fairly suggestive</td>
<td>[70] (1987), [71] (1986)</td>
</tr>
<tr>
<td>Police and customs officers</td>
<td>Not suggestive</td>
<td>[76] (1991)</td>
</tr>
<tr>
<td>Prison officers</td>
<td>Not suggestive</td>
<td>[77] (1988)</td>
</tr>
</tbody>
</table>

HBV transmission mechanisms in New Zealand

Vertical transmission

Vertical transmission was calculated to directly contribute 20-30% of the carrier pool according to one early mathematical model of the New Zealand situation [78]. In specific areas, however, it would seem that vertical transmission explains very little of the overall prevalence of markers. A study in the Eastern Bay of Plenty found only 15% of mothers of child carriers to be HBsAg positive [79]. Another study in this region found that vertical transmission accounted for under 20% of HBV infections [80]. Also, the age distribution of markers in the studies to date would suggest that horizontal transmission accounts for over 90% of marker prevalence (see Figure 1).
Horizontal transmission in children

That horizontal transmission between children is important in the New Zealand is highly probable in view of the age distribution of markers (see the section above). Overseas studies also provide evidence for cross-infection between children in other parts of the South Pacific, Africa and Alaska [81,82,83]. There has been much speculation about the actual transmission mechanism of HBV in New Zealand children. Early work suggested that the size of households, amateur tattoos, and the number of years spent in Kawerau were important [84]. Another study, however, suggested that the role of amateur tattooing in school children was likely to be insignificant [85]. More specific explanations for the relatively high prevalence of HBV infection in the town of Kawerau still remain unconfirmed, but observations that suggest potential for the spread of infection between children have included the following: (i) common occurrence of abrasions, (ii) barefoot play being common, (iii) impetigo being common, and (iv) the access of Kawerau to a heated swimming pool (at which barefoot play on concrete would occur) [86,87]. That skin lesions may be relevant in HBV transmission is suggested by some international studies [88,89].

Only one study has systematically explored risk factors for horizontal transmission to date in the New Zealand situation [90]. This small case control study, involving school children, found a range of significant risk factors. These included having amateur tattoos (odds ratio (OR)=3.5 95% confidence interval (CI) 1.3-10.0), a history of bed sharing (OR = 3.1, 95% CI 1.2-8.2), sharing a toothbrush regularly (OR =5.2, 95% CI 1.4-18.9), and sharing bath towels regularly (OR =2.15, 95% CI 1.1-4.1). Other variables which showed no increase in risk included sharing food, leaving cuts uncovered, having eczema or sores, and sharing bottles as a baby. Inadequate data were available to explore the role
of becoming "blood brothers" where a child mixes a prick of their blood with another child. Toothbrush sharing has been described as a risk factor in overseas studies [91].

Other evidence for the role of bed sharing in New Zealand has since been published from a small North Island study of school children [92]. Although the data were not thoroughly analysed in the published article, a high relative risk for bed sharing can be calculated from the data presented (RR = 3.2, 95% CI 2.0-5.3). Further general support for transmission in the home environment comes from the Kawerau study where larger households had a significantly higher proportion of infected members than smaller households [93]. This risk factor group has been identified elsewhere [94,95].

Insect vectors have been raised as a possible source of infection, especially in Kawerau where they were prevalent. The seasonal distribution of acute HBV cases in this area did not, however, support the involvement of insect vectors [96]. Despite the presence of HBsAg in some insects [97,98], and their unconfirmed involvement in HBV spread in African children [99], there remains no direct demonstration of transmission to humans from this source [100].

**HBV transmission in adults**

Little data are available to determine the importance of sexual transmission of hepatitis B in the New Zealand situation. Data on 1,000 STD clinic attenders in Christchurch in 1981 are suggestive of some increased risk, at least for this population [101]. This study found that 18.2% of attenders had HBV markers which is over double that found for pregnant women in the South Island [102]. Also suggestive of the importance of sexual transmission is that the rate of hepatitis B notifications for those aged 15-25 years is
slightly higher in females than that for males [103], and that hospitalisation and notification rates for adults peak in the 15 to 29 age group (see Chapter Two). These results raise the possibility that sexual transmission is reasonably important in the young adult population which would be consistent with the pattern seen in other developed countries [104,105,106]. However, injecting drug use could also be important for HBV transmission in this age group (see Chapters Two and Appendix One). Indeed a small outbreak of hepatitis B in New Zealand has been described in injecting drug users [107] (see also Appendix Two). It is conceivable that contact sports in which bleeding can occur, such as rugby, play some role in HBV transmission, but this has not been evaluated in New Zealand or overseas.

A community study into viral hepatitis was able to identify some possible risk factors in those who were infected with HBV. These included known contact with a person with hepatitis, 12%; hospital admission involving transfusion or surgery, 6%; intravenous drug use 6%; and overseas travel to Asian/Pacific areas in 5% [108]. Notification data also suggest the presence of risk factors such as contact with a known case, travel and tattooing (Chapter Two). This data source is notable, however, for its current lack of information on the source of HBV infection.

That tattooing may be a significant transmission mechanism for HBV in New Zealand adults is of note considering this has been described as being implicated in 2.3% of reported cases in the United Kingdom [109], and elsewhere [110,111]. Tattooing also appears to be important for other blood-borne viral disease such as hepatitis C transmission in Australia [112]. Although acupuncture has been involved in HBV transmission overseas [113], this has not been described in New Zealand.
Impact of HBV infection on health status

Acute sequelae

Clinically evident acute hepatitis B occurs in fewer than 10% of preschool children infected with HBV and up to 30-40% of adult infections [114,115]. Although there has been a decline in recent years, acute HBV infection still has a significant impact in terms of symptomatic illness in the community and hospitalisations (estimated annual incidence rates of 30.2 per 100,000 and 1.4 per 100,000 population respectively, see Chapter Two). The data presented in this Chapter and a community survey of acute HBV infection in the Auckland area [116], continue to highlight the higher rates of HBV in Maori. A total of 36 deaths in those hospitalised with hepatitis B occurred in the time period 1980 to 1991 (Chapter Two).

Other serious sequelae of hepatitis B infection affecting other organ systems include aplastic anaemia, necrotising vasculitis, and glomerulonephritis [117]. It is possible that a proportion of the deaths from these diseases are due to hepatitis B (eg, some fraction of the total of 56 deaths for these three diseases in 1988-89 [118,119]).

Hepatitis B carriage and chronic liver disease

Quantification of the numbers of HBV carriers in New Zealand has been previously attempted with an estimate of between 60,000 and 90,000 carriers in 1985 [120]. For the current 1991 New Zealand population, another estimate is from 51,000 to 101,000, assuming a 1-2% carriage rate in non-Maori and 5-10% carriage rate in Maori (see Table 3).
HBV and primary liver cancer

Although chronic sequelae of infection in adults is relatively rare [132,133], it is estimated that more than 25% of HBV carrier infants will die from primary liver cancer (PLC) or cirrhosis [134]. It has been known for some time that carriers of HBsAg have a risk of developing PLC that is over 300 times greater than that of noncarriers [135]. There is also evidence for this association in the New Zealand context [136, 137]. One of these New Zealand studies found relatively high rates for Maori (approximately three times those of non-Maori) for the period 1974-78. A north-south gradient was apparent and the incidence of PLC was also found to be nearly three times higher in males than in females. General interpretation of these data are difficult however, in view of the potential for misclassification of chronic liver disease as being alcohol-related. This is because alcohol consumption differs between ethnic groups [138]. Nevertheless hepatitis B is probably a more important determinant of liver cancer than alcohol in New Zealand [139].

The incidence of PLC in Maori for the 1974-83 period was approximately four times that of non-Maori [140]. There was also a slight upward trend for Maori over this period. Although a number of overseas studies have highlighted the relevance of birth order and risk of hepatitis B related PLC [141,142], no such work has been undertaken in New Zealand.

Analysis of more recent mortality data for PLC confirms the persistence of higher rates in Maori males and females (see Table 5). Indeed the true relative risk for PLC in Maori is likely to be higher, due to the under-reporting of Maori ethnicity in the collection of mortality data [143].
For the period 1971 to 1989 there has been a significant increase in deaths from PLC for males (correlation coefficient (r) of $r = 0.34$, 95% confidence intervals 0.17-0.82). For females there was only a slight increase as shown in Figure 3, but this was not at a statistically significant level (National Health Statistics Centre Mortality data from 1971 to 1989).

If 50-90% of PLC is attributable to hepatitis B, this would suggest approximately 40 to 72 deaths per year for New Zealand. Similarly if one half of chronic liver disease is attributable to viral hepatitis and two thirds of this group is attributable to hepatitis B as opposed to hepatitis C, as has been assumed for Australia [144], the New Zealand mortality data would suggest an additional 38 deaths per year are attributable to chronic hepatitis B infection. This is based on 1986-89 mortality data with the ICD9 code for viral hepatitis being 571.

Table 5
Deaths Attributed to Primary Liver Cancer in New Zealand that may Reflect the Chronic Sequelae of Hepatitis B and C Infection (1986-89, ICD9 code 155) [145,146,147,148].

<table>
<thead>
<tr>
<th>Ethnic and gender group</th>
<th>Number</th>
<th>Annual Rate per 100,000</th>
<th>Relative Risk (Maori vs non-Maori)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maori males</td>
<td>35</td>
<td>5.7</td>
<td>1.69 (1.25-2.29)</td>
</tr>
<tr>
<td>Non-Maori males</td>
<td>189</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Maori females</td>
<td>7</td>
<td>1.2</td>
<td>2.23 (1.15-4.33)</td>
</tr>
<tr>
<td>Non-Maori females</td>
<td>28</td>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>
Figure 3 Trends in deaths from primary liver cancer for 1991-89 (ICD9 codes 155.0 & 155.1)

Annual rate per 100,000 population

Year (1971-1989)

Males

Females
Of particular note with regard to HBV morbidity and mortality is the younger age at which Maori appear to be affected. For example, mortality data for recent years suggests a median age of death in Maori to be two decades less than for non-Maori (Figure 4).

Another feature of PLC has been the relatively high toll that has been sustained by single extended families. One study recorded four siblings in a large New Zealand Chinese family developing PLC in their mid forties [149]. Another noted four deaths from PLC in an extended Maori family of 173 members [150]. This impact of multiple deaths within extended families may be particularly important for ethnic groups with a health concept that includes the integrity of the extended family (eg, whanau for Maori [151]).

Improving our understanding of the epidemiology of hepatitis B in New Zealand

The major focus of research into hepatitis B in New Zealand should relate to the appropriate implementation and evaluation of vaccination and other relevant hepatitis B control programmes. Consequently, this paper argues that the following areas should be high priorities for further research on HBV in New Zealand.

1 HBV marker prevalence in high school students

In view of the suboptimal hepatitis B vaccination coverage and quality of the national vaccine cold chain, documented in Chapter Three, consideration needs to be given to investigating the extent that school children have protective antibody levels to hepatitis B. Such research, when combined with a cost-effectiveness analysis, could guide further
immunisation programmes for children in this age group. Children in form one could be chosen as this is the age at which the measles/mumps/rubella vaccination is given in the school setting. It should be noted that the major benefit of vaccination at this age is the prevention of acute hepatitis B over the next decade of life since the benefit of preventing chronic carriage of HBV at this age is relatively small (as under 1% will probably become carriers).

2 HBV transmission studies

The case for further exploring hepatitis B transmission in children has been made in recent times [152]. Although increasing vaccination coverage in the child population may complicate studies in this area, there remain some important reasons to conduct this type of research:

- To identify ways to further minimise hepatitis B transmission to those who have not been fully protected by immunisation. For example, if bed- or toothbrush-sharing and amateur tattooing are confirmed as important risk factors, then this information should be publicised in health promotional messages.

- To improve understanding of the transmission of other blood-borne diseases for which vaccines are not yet available (eg, hepatitis C and HIV).

- To provide data on modes of transmission of hepatitis B that may assist developing nations who can not yet afford mass vaccination programmes.
Ideally this research should involve a case-control study of children who are notified or hospitalised with hepatitis B. Data items in the questionnaire would cover behaviour at home and in the school environment. A case for studies to explore the mechanisms of HBV transmission in the adult population is made in Chapter Two.

3 Improving hepatitis B surveillance

Despite their limitations, notification data have proven to be useful in broad descriptive terms ([153] and Chapter Two). Continuous incremental improvement in this area is certainly a worthwhile way to maintain a national perspective on the disease. A development that should assist this is a framework for vaccine-preventable disease surveillance in New Zealand that has recently been completed [154]. Developments in terms of laboratory surveillance of hepatitis B could also be modelled on the US Centers for Disease Control's "Viral Hepatitis Surveillance Program" [155]. Better surveillance of hepatitis infection in general is also important given the current uncertainty over the modes of hepatitis C transmission and the changing epidemiology of hepatitis A in New Zealand [156].

4 Systematic Analysis of Hospital Discharge and Mortality Data that Relate to the Chronic Sequelae of Hepatitis B

There has been no detailed review of New Zealand data on PLC and chronic hepatic disease for nearly a decade. This is despite the importance of this exercise in terms of ranking hepatitis B alongside other diseases as a cause of preventable morbidity and mortality in New Zealand.
5 Modelling studies of HBV

Communicable disease modelling may provide opportunities for new insights into the control of communicable diseases [157]. Deterministic models for HBV transmission have been developed for developed countries with relatively high HBV endemicity such as Singapore [158] and Italy [159]. These could be reviewed with regard their adaptation for use in the New Zealand setting.

6 Systematic collection and review of sero-prevalence data

Fairly comprehensive data on HBV markers are collected from a range of groups, including blood donors and pregnant women. Less comprehensive data are also collected on new police officers, new prison officers, some prisoners, sewerage system workers, and personnel beginning careers in certain health sector occupations. Of these groups, the data on pregnant women are likely to provide the most representative picture of marker prevalence at a national level. These data are not, however, systematically collated at either the regional or the national level. There is a real need to collate and analyse these data on a national and annual basis. This review should also include periodic assessment of the state of delta agent coinfection in the New Zealand population and be combined with data collection on hepatitis C. It could also provide an opportunity for a periodic review of the New Zealand situation with regards to antigenic variants (escape mutants) of HBV that are known to exist in New Zealand and overseas [160]. A significant presence of such variants would require modification of the current vaccine.
RECOMMENDATIONS

That the Ministry of Health / Public Health Commission:

1. Consider commissioning a study into the hepatitis B marker prevalence in school children in a range of schools throughout New Zealand. Such a study would help determine the value of the provision of further immunisations to this age-group.

2. Consider inviting tenders for case control studies to identify the transmission of hepatitis B in the childhood and adult populations of New Zealand.

3. Ensure that in the contract with the NZ Communicable Disease Centre (NZCDC), continuous improvement is made in the surveillance system of hepatitis B (especially with regard to the identification of the source of infection).

4. Consider commissioning a systematic review of morbidity and mortality data on the chronic sequelae of HBV infection.

5. Consider commissioning the systematic surveillance of data obtained through antenatal screening programmes. This could include further surveillance for delta virus infection.

6. Encourage further research activity into the relationship between hepatitis B and hepatitis C infection in New Zealand.
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45 Herman YE, Muschawar IK, Tobias MI. loc cit.

46 Tobias MI, Miller JA, Clements CJ, Patel AC. loc cit.

47 Milne A, Allwood, GK, Moyes CD, Pearce NE. loc cit.

48 Herman YE, Muschawar IK, Tobias MI. loc cit.

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4.3


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Chapter Two

THE EPIDEMIOLOGY OF ACUTE HEPATITIS B

IN NEW ZEALAND:

AN ANALYSIS OF HOSPITALISATION

AND NOTIFICATION DATA

ABSTRACT

Study Objectives: To assess recent trends in acute hepatitis B in New Zealand. To also determine some of the key morbidity, mortality and economic impacts of acute hepatitis B in New Zealand. Finally to determine the value of epidemiological information provided by hospitalisation and notification data concerning acute hepatitis B.

Method: Hospitalisation data (ICD9 codes 070.2-3) for the years 1980-91 and notification data for the years 1985-92 were analysed.

Results: Acute hepatitis B has had a significant impact on health status in New Zealand in recent years with an average annual hospitalisation rate of 1.4 per 100,000 and an average annual notification rate of 10.1 per 100,000 (for 1985-91). Fortunately, there has been a significant downward trend in both hospitalisations and notifications in all age groups and in the major ethnic groups (eg, the correlation coefficient \( r \) for all notified cases against time was \( r = -0.95 \), 95% confidence interval
There was some evidence to suggest that this trend was related to mass childhood immunisation programmes and to vaccination programmes in particular groups (eg, health care workers). Results from both data sources reiterated the greater risk of morbidity in Maori and Pacific Island Polynesians (eg, relative risk (RR) for hospitalisation of Maori: RR =2.24 (5% CI 1.98-2.52). Sexual transmission, and possibly transmission relating to injecting drug use, are likely to be important in the young adult population. Hospitalised cases with acute hepatitis B during the 1980-91 time period imposed direct costs on the hospital sector of at least $2.6 million.

**Conclusions:** Notification and hospitalisation data suggest a significant downward trend in acute hepatitis B in recent years and there is some evidence to support mass childhood vaccination as an important factor in this decline. While these data sources provide useful trend and other information, there is a particular need to improve notification data on acute hepatitis B, especially with regard to possible transmission mechanisms. This clarification will help prioritise the various public health control measures that are relevant to hepatitis B.

**INTRODUCTION**

The epidemiology of hepatitis B has been better described than that of any other communicable disease in New Zealand. Nevertheless, there has been little information on recent changes in the distribution of disease since the introduction of a various nationwide immunisation strategies from 1985 to 1990. Hepatitis B has been a notifiable disease since 1971, and although notification data have been examined previously [1,2], there has been no review of the data beyond 1988.
Hospitalisation data on hepatitis B, which has been specifically coded since 1980, have never been reviewed. Similarly, there has been no attempt to use these or other data to make any estimates of the cost of acute hepatitis B to the health sector. This paper describes information derived from these two data sources and make recommendations for improving these forms of surveillance.

**METHOD**

All hospital discharge data relating to viral hepatitis for the years 1970 to 1991 were obtained from the Health Statistical Services of the Ministry of Health (International Classification of Diseases, ninth revision (ICD9) codes: 070.1 to 070.9). Notifications of acute hepatitis B to the Department of Health between 1985 and 1992 were entered onto a computer database. The majority of the data since 1990 were directly available from area health boards (AHBs) in a computerised form. These data were checked and notifications that were not acute cases (ie had evidence of chronic hepatitis B carriage) were excluded from the analysis (2.7% of notifications). All the data were analysed with the software package Epi Info [3]. Odds ratios and relative risks were used to evaluate relationships between key variables (along with their Mantel-Haenszel 95% confidence intervals (95% CI)) and multivariate linear regression was also performed. Nonparametric one-way analysis of variance (Kruskal-Wallis) was used for comparing mean values between groups. Census data from the 1991 census were used for the calculation of rates.

No data on the costs of a hospital stay associated specifically with acute hepatitis B were available. Therefore data for the more general category "disorders of liver, (except malignancy, cirrhosis and alcoholic hepatitis) and aged under 70 years" were used (ie $378 per day) [4]. This average cost was based on data from four area health boards and does not include capital costs (ie $378).
RESULTS

Trends in acute hepatitis B

Analysis of hospital discharge data, by year, produced results that highlighted the overall decline in all types of viral hepatitis since the early 1970s (Figure 1). A downward trend of acute hepatitis B related discharges from 1980 to 1991 was also apparent, and this was at a statistically significant level ($r = -0.72$, 95% CI -0.24 to -0.91). This downward trend was apparent in all age-groups (Figures 2 and 3) and all ethnic groups (Figure 4) except for Pacific Island Polynesians, though the numbers for this group were small. For the 1980-91 period hepatitis B made up 49.3% of discharges for viral hepatitis and 62.0% of hepatitis that was specified as being due to a particular type of hepatitis (ie ICD9 codes 070.0, 070.1, 070.2, 070.3, 070.4 and 070.5).

The trend in the number of notifications was also downward for the 1985 to 1992 period in all age and ethnic groups (Table 1). The downward trend was greatest in children and in Maori.
Figure 1 Trends in Viral Hepatitis Hospitalised & Notified Cases from 1970 to 1992

Number of cases

Year

Hepatitis B*  Notified hepatitis B  All viral hepatitis*

* Hospitalised (type of hepatitis not specified prior to 1980).
Figure 2 Trends in Hepatitis B Hospitalisations by Age Group in New Zealand (1980-91)

Annual number of cases

Year

All ages < 15 years > 14 years
Figure 3  Trends in Hepatitis B Hospitalisations by Age Group in New Zealand (1980-91)

Annual number of cases

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt;5 years</th>
<th>5-14 years</th>
<th>15-19 years</th>
<th>20-29 years</th>
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</tr>
<tr>
<td>91</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Figure 4  Trends in Hepatitis B Hospitalisations by Ethnicity in New Zealand (1980–91)

Annual number of cases

Year

- All cases
- Maori
- Polynesian
- Other

* European & other ethnic groups
Table 1  Trends in Notified Hepatitis B by Demographic Group (1985-1992)

<table>
<thead>
<tr>
<th>Demographic Group</th>
<th>Number**</th>
<th>r*</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cases</td>
<td>2579</td>
<td>-0.95</td>
<td>(-0.99, -0.76)</td>
</tr>
<tr>
<td>Children (&lt;5 years)</td>
<td>41</td>
<td>-0.88</td>
<td>(-0.98, -0.46)</td>
</tr>
<tr>
<td>Children (5-9 years)</td>
<td>115</td>
<td>-0.90</td>
<td>(-0.98, -0.55)</td>
</tr>
<tr>
<td>Children (10-14 years)</td>
<td>241</td>
<td>-0.99</td>
<td>(-1.00, -0.93)</td>
</tr>
<tr>
<td>Children (5-14 years)</td>
<td>347</td>
<td>-0.99</td>
<td>(-1.00, -0.92)</td>
</tr>
<tr>
<td>All children (&lt;15 years)</td>
<td>400</td>
<td>-0.99</td>
<td>(-1.00, -0.93)</td>
</tr>
<tr>
<td>Adults (&gt;14 years)</td>
<td>2109</td>
<td>-0.92</td>
<td>(-0.99, -0.60)</td>
</tr>
<tr>
<td>Males</td>
<td>1418</td>
<td>-0.95</td>
<td>(-0.99, -0.74)</td>
</tr>
<tr>
<td>Females</td>
<td>1159</td>
<td>-0.95</td>
<td>(-0.99, -0.76)</td>
</tr>
<tr>
<td>European</td>
<td>1560</td>
<td>-0.93</td>
<td>(-0.99, -0.64)</td>
</tr>
<tr>
<td>Maori</td>
<td>705</td>
<td>-0.96</td>
<td>(-0.99, -0.81)</td>
</tr>
<tr>
<td>Pacific Is. Polynesian</td>
<td>171</td>
<td>-0.84</td>
<td>(-0.97, -0.34)</td>
</tr>
<tr>
<td>Other ethnicity</td>
<td>91</td>
<td>-0.33</td>
<td>(-0.84, 0.49)</td>
</tr>
</tbody>
</table>

Notes:

*  r = correlation coefficient (notified cases against time).
NS  Not statistically significant.
** Some subgroups do not add up exactly to the total due to missing age and ethnicity data.

In the hospitalised cases there were a total of 742 cases for which acute hepatitis B was the primary diagnosis and an additional 69 for whom it was a secondary or lower level diagnosis. All of the following results for hospitalised cases refer only to the former group and only for the first discharge with that diagnosis (ie a total of 668 since 10.0% had repeat discharges).
Annual incidence of hepatitis B

For the period of 1985 to 1991, there was a national annual hospitalisation rate of 1.4 per 100,000 population (Table 2). In comparison the annual notification rate was 10.1 per 100,000 population. Given that one New Zealand study has suggested a hospitalisation rate of 4.6% for symptomatic cases of hepatitis B in the community [5], an annual incidence rate of symptomatic infection can be estimated for this time period ie, of approximately 30.2 per 100,000. This estimate would suggest that only 33.5% of acute hepatitis B was being notified over this time period.

Seasonal distribution of hepatitis B

There was no significant seasonal variation in acute hepatitis B hospitalisations though most hospitalisations occurred in autumn (ie March to May, OR =1.30, 95% CI 0.99-1.69). Date of notification was significantly more common in autumn and winter (OR =1.26, 95% CI 1.11-1.42 for autumn and OR =1.16, 95% CI 1.02-1.31 for winter).

Regional distribution of hepatitis B

Hospitalisation rates and notification rates for different area health boards (AHBs) and regional health authorities (RHAs) are shown in Table 2. The highest rates for hospitalisation were observed in the Northland AHB and the Central-North RHA. The lowest rates for hospitalisation and notification were in the South Island. For the hospitalisation rates there was some suggestion of decreasing rates in a north to south gradient but this was not statistically significant (for Maori: r = -0.37, (95% CI -0.75, 0.20); and for non-Maori, non-Polynesian, r = -0.16, (95% CI -0.64, 0.40)). For the North Island there was no significant west to east gradient.
### Regional and Ethnic Distribution of Acute Hepatitis B Notifications and Hospitalisations (1985 to 1991)

<table>
<thead>
<tr>
<th>AHB/RHA</th>
<th>Hospitalisations (H)</th>
<th>Notifications (N)</th>
<th>H/N %</th>
<th>Hospitalisations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N  Rate*</td>
<td>N  Rate</td>
<td></td>
<td>Maori</td>
</tr>
<tr>
<td>Northland</td>
<td>19  2.16</td>
<td>202 22.96</td>
<td>9.4</td>
<td>4.46</td>
</tr>
<tr>
<td>Auckland</td>
<td>99  1.48</td>
<td>712 10.67</td>
<td>13.9</td>
<td>1.55</td>
</tr>
<tr>
<td>Waikato</td>
<td>44  1.93</td>
<td>264 11.59</td>
<td>16.6</td>
<td>3.76</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td>17  1.17</td>
<td>85  5.87</td>
<td>20.0</td>
<td>3.20</td>
</tr>
<tr>
<td>Tairawhiti</td>
<td>4   1.29</td>
<td>57  18.44</td>
<td>7.0</td>
<td>3.21</td>
</tr>
<tr>
<td>Hawke's Bay</td>
<td>17  1.76</td>
<td>39  4.04</td>
<td>43.6</td>
<td>3.56</td>
</tr>
<tr>
<td>Taranaki</td>
<td>12  1.60</td>
<td>93  12.40</td>
<td>12.9</td>
<td>4.48</td>
</tr>
<tr>
<td>Manawatu/Wanganui</td>
<td>26  1.69</td>
<td>162 10.51</td>
<td>16.0</td>
<td>4.88</td>
</tr>
<tr>
<td>Wellington</td>
<td>28  1.02</td>
<td>380 13.84</td>
<td>7.4</td>
<td>1.41</td>
</tr>
<tr>
<td>Nelson/Marlborough</td>
<td>3   0.41</td>
<td>61  8.27</td>
<td>4.9</td>
<td>0.00</td>
</tr>
<tr>
<td>West Coast</td>
<td>2   0.91</td>
<td>8   3.63</td>
<td>25.0</td>
<td>0.00</td>
</tr>
<tr>
<td>Canterbury</td>
<td>42  1.38</td>
<td>183 6.00</td>
<td>23.0</td>
<td>4.51</td>
</tr>
<tr>
<td>Otago</td>
<td>7   0.58</td>
<td>68  5.65</td>
<td>10.3</td>
<td>0.00</td>
</tr>
<tr>
<td>Southland</td>
<td>9   1.20</td>
<td>75  10.02</td>
<td>12.0</td>
<td>3.06</td>
</tr>
<tr>
<td><strong>National</strong></td>
<td>329 1.39</td>
<td>2389 10.12</td>
<td>13.8</td>
<td>2.92</td>
</tr>
<tr>
<td>Northern RHA</td>
<td>118 1.56</td>
<td>914 12.10</td>
<td>12.9</td>
<td>2.30</td>
</tr>
<tr>
<td>Central-North RHA</td>
<td>77  1.61</td>
<td>499 10.43</td>
<td>15.4</td>
<td>3.55</td>
</tr>
<tr>
<td>Central-South RHA</td>
<td>74  1.24</td>
<td>642 10.72</td>
<td>11.5</td>
<td>2.94</td>
</tr>
<tr>
<td>Southern RHA</td>
<td>60  1.15</td>
<td>334 6.40</td>
<td>18.0</td>
<td>3.16</td>
</tr>
</tbody>
</table>

**Notes:**
* Rate per 100,000 population (1991 census data)
** Other = non-Maori, non-Pacific Island Polynesian population.
A downward trend in notifications and hospitalisations was apparent in all RHAs (Table 3). This trend was statistically significant for notifications in all areas except the South Island.

Table 3  Trends in Acute Hepatitis B by Region

<table>
<thead>
<tr>
<th>RHA</th>
<th>Hospitalisations (1980-91) r** (95% CI)</th>
<th>Notifications (1985-92) r (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>-0.38 (-0.78, 0.25)</td>
<td>-0.96 (-0.99, -0.78) *</td>
</tr>
<tr>
<td>Central-north</td>
<td>-0.42 (-0.80, 0.21)</td>
<td>-0.80 (-0.96, -0.23) *</td>
</tr>
<tr>
<td>Central-south</td>
<td>-0.87 (-0.96, -0.60) *</td>
<td>-0.81 (-0.96, -0.24) *</td>
</tr>
<tr>
<td>Southern</td>
<td>-0.50 (-0.83, 0.11)</td>
<td>-0.31 (-0.83, 0.51)</td>
</tr>
</tbody>
</table>

Notes:
* Statistically significant trend (p<0.05)
**r = correlation coefficient (notified cases against time).

**Age and gender distribution of hepatitis B**

Males made up 57.8% of all hospitalised cases for acute hepatitis B and were significantly more likely to be admitted with this diagnosis (RR = 1.17, 95% CI 1.10-1.25). For the notification data, the corresponding figure was 55.0% and a relative risk of 1.12 (95% CI 1.08-1.16). The median age for hospitalised females was 25 years compared to 31 years for males (29 years overall). This difference was smaller for the notification data for which the median age for females was 22 compared to 24 years in males.

The age and gender distribution for both hospitalised and notified cases is shown in Table 4 and for hospitalised cases alone in Figure 5. Of note is the observation that the
highest hospitalisation rates for females were in the 15 to 19 year age group. Notification rates for both genders also peaked in this age group. Hospitalisation data showed a significant increase in the median age between the years 1980 and 1991 \( (r = 0.63, 95\% \text{ CI } 0.08-0.88) \). Notification data also demonstrated an increase in median age \( (r = 0.67) \), though this was not at a statistically significant level. There was however, a significant north to south trend in increasing median age \( (r = 0.70, 95\% \text{ CI } 0.24-0.90) \). The median age also varied by ethnic group as follows: European, 23; Maori, 21; Pacific Island Polynesian, 27 and other ethnic groups 30 years. Similarly the hospitalisation data showed a lower median age for Maori compared to those of non-Maori/non-Pacific Island Polynesian ethnicity (24 compared to 30 years). Pacific Island Polynesians had an older median age at 37 years.
Figure 5 Age Distribution of Hospitalised Cases of Acute Hepatitis B (1985-91)

Age groups (years)

< 5
5-9
10-14
15-19
20-29
30-39
40-49
50-59
60+
All ages

Annual rate per 100,000 population

- Females
- Males
### Table 4  Age and Gender Distribution of Acute Hepatitis B

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.11 0.40</td>
<td>0.34 0.46</td>
<td>1.3 2.0</td>
<td>5.5 7.0</td>
</tr>
<tr>
<td>0-4</td>
<td>0.8 0.9</td>
<td>2.9 1.7</td>
<td>10.1 16.4</td>
<td>29.3 22.4</td>
</tr>
<tr>
<td>5-9</td>
<td>2.0 2.3</td>
<td>30-39</td>
<td>19.0 22.0</td>
<td>7.8 11.4</td>
</tr>
<tr>
<td>10-14</td>
<td>1.2 2.2</td>
<td>40-49</td>
<td>7.8 11.4</td>
<td>4.4 9.6</td>
</tr>
<tr>
<td>15-19</td>
<td>0.5 2.0</td>
<td>50-59</td>
<td>4.3 6.4</td>
<td>4.4 9.6</td>
</tr>
<tr>
<td>20-29</td>
<td>1.0 1.2</td>
<td>60+</td>
<td>1.7 1.4</td>
<td></td>
</tr>
<tr>
<td>All ages</td>
<td>1.1 1.7</td>
<td></td>
<td>9.1 11.5</td>
<td></td>
</tr>
</tbody>
</table>

**Distribution by hepatitis B by ethnicity**

There was a statistically significant increased risk for Maori and Pacific Island Polynesians being hospitalised and notified with acute hepatitis B (Table 5).
Table 5  Ethnicity and Risk of Acute Hepatitis B

<table>
<thead>
<tr>
<th>Hospitalisations</th>
<th></th>
<th>Notifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>RR*</td>
</tr>
<tr>
<td>Maori</td>
<td>184</td>
<td>27.5%</td>
</tr>
<tr>
<td>PIP#</td>
<td>62</td>
<td>9.3%</td>
</tr>
</tbody>
</table>

Notes:  
* Calculated relative to all non-Maori, non-Pacific Island Polynesian discharges.  
# PIP - Pacific Island Polynesian.

Diagnostic categories for hospitalisation with hepatitis B

Specific diagnostic categories and median and maximum hospital stay are shown in Table 6. Acute hepatitis B causing coma made up only 2.8% of the acute hepatitis B related discharges and this percentage was relatively stable over the 12 year time period.

Table 6  Acute hepatitis B hospitalisations from New Zealand public hospitals (1980-1991), numbers and length of stay.

<table>
<thead>
<tr>
<th>Diagnosis &amp; ICD9 Code</th>
<th>No.</th>
<th>%</th>
<th>Days Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Median</td>
</tr>
<tr>
<td>Acute hepatitis B with hepatic coma (070.2)</td>
<td>19</td>
<td>2.9%</td>
<td>5</td>
</tr>
<tr>
<td>Acute hepatitis B without mention of coma (070.3)</td>
<td>649</td>
<td>97.1%</td>
<td>6</td>
</tr>
</tbody>
</table>
Although there were no statistically significant differences in diagnostic groups by ethnicity, Pacific Island Polynesians were over twice as likely to have hepatitis with coma as those in the non-Maori non-Polynesian group. There were no significant differences in length of hospital stay by ethnic group.

The median length of hospital stay was six days (mean 9.5 days). The longest recorded stay was for 14.6 weeks with the next longest being 10.4 weeks. Readmission into hospital for the same diagnosis was documented in 10.0% of cases. The risk of readmission was not associated with gender or ethnicity.

**Deaths from acute hepatitis B**

There were 36 deaths in those hospitalised over the 12 year time period (5.4% of the discharges). There was a slight decline in the number of deaths over this period and deaths were nearly twice as common in females. Neither of these results were however, statistically significant. In terms of ethnicity, Pacific Island Polynesians had over a fourfold risk of death out of all those admitted (OR = 4.57, 95% CI 1.91-10.83). The median age of the deceased was 46, with an age range from four to 78 years. All deaths occurred at some time after the first day of admission.

There were 20 deaths recorded in the notification data. The median age of death was 39.5 years with a distribution of 19 to 78 years. Deaths were slightly more common in males but this was not statistically significant.
Risk factors for hepatitis B

The confirmed or speculative source of infection for a particular case was occasionally documented in the notification data (Table 7). Contact with a known carrier or acute case was the most commonly described source of infection. Although males notified with hepatitis B were over twice as likely to have engaged in injecting drug use, this was not statistically significant.

Table 7  Confirmed or Suspected Source of Infection Associated with Acute Hepatitis B Notifications in Adults (1985-1992).

<table>
<thead>
<tr>
<th>Source of Infection</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None identified</td>
<td>2191</td>
<td>93.8</td>
</tr>
<tr>
<td>Contact with a known case or carrier (including sex contact)</td>
<td>44</td>
<td>2.0</td>
</tr>
<tr>
<td>Tattooing</td>
<td>29</td>
<td>1.3</td>
</tr>
<tr>
<td>Injecting drug use</td>
<td>21</td>
<td>1.0</td>
</tr>
<tr>
<td>Sex with a known/suspected case</td>
<td>20</td>
<td>0.9</td>
</tr>
<tr>
<td>Travel overseas*</td>
<td>9</td>
<td>0.4</td>
</tr>
<tr>
<td>Other possible**</td>
<td>14</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>2191</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: * Includes a transfusion when overseas.
** Included sharing razors (4), ear piercing (3), acupuncture (2), needlestick injuries (2), significant contact with blood (3).
Occupational factors

The occupational status was collected on 93.7% of individuals who were notified and aged 15 years and over. The trends in disease incidence for particular occupational groups are shown in Table 8. The decline in notifications for adults in the workforce is slightly greater than for adults not in the workforce. There were also significant declines for health care workers and in groups who have some association with children i.e., teachers and home makers. The trend for particular groups of health care workers is shown in Figure 6.

Table 8 Trends in Notified Hepatitis B in Adults by Occupational Group (1985 to 1992)

<table>
<thead>
<tr>
<th>Demographic/Occupation group</th>
<th>N</th>
<th>r**</th>
<th>% 95 CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>All notifications</td>
<td>2579</td>
<td>-0.95</td>
<td>(-0.99, -0.76) *</td>
</tr>
<tr>
<td>Adults (&gt;14 years)</td>
<td>2109</td>
<td>-0.92</td>
<td>(-0.99, -0.60) *</td>
</tr>
<tr>
<td>Adults in the workforce</td>
<td>1161</td>
<td>-0.96</td>
<td>(-0.99, -0.80) *</td>
</tr>
<tr>
<td>Adults not in workforce#</td>
<td>892</td>
<td>-0.82</td>
<td>(-0.97, -0.26) *</td>
</tr>
<tr>
<td>Home makers</td>
<td>220</td>
<td>-0.92</td>
<td>(-0.99, -0.62) *</td>
</tr>
<tr>
<td>Teachers</td>
<td>72</td>
<td>-0.79</td>
<td>(-0.96, -0.18) *</td>
</tr>
<tr>
<td>Health care workers</td>
<td>65</td>
<td>-0.96</td>
<td>(-0.99, -0.77) *</td>
</tr>
<tr>
<td>Clerical workers</td>
<td>68</td>
<td>-0.49</td>
<td>(-0.89, 0.32)</td>
</tr>
<tr>
<td>Labourers</td>
<td>53</td>
<td>-0.51</td>
<td>(-0.89, 0.30)</td>
</tr>
<tr>
<td>Students (&gt;14 years)</td>
<td>218</td>
<td>-0.58</td>
<td>(-0.91, 0.20)</td>
</tr>
<tr>
<td>Military (all forces)</td>
<td>20</td>
<td>0.28</td>
<td>(-0.53, 0.82)</td>
</tr>
</tbody>
</table>

Notes:
* Statistically significant (p<0.05)
**r = correlation coefficient (notified cases against time).
# This group is composed of home makers, beneficiaries, the retired, and the unemployed.
Cost of hospitalisations

A total of 6,980 days in hospital, including readmissions, were directly related to acute hepatitis B discharges over this time period. This is equivalent to 19.1 person years. Using the cost of $378 per day, suggests a total cost estimate for acute hepatitis B hospital admissions of $2.6 million dollars for the 1980-1991 time period or $220,000 per year (in 1992 dollars).

DISCUSSION

New Zealand hospital discharge data have been recognised as providing valuable information on disease trends, assessing aspects of disease morbidity and mortality and generating hypotheses concerning disease epidemiology [6]. This data source is, however, known to suffer from relatively high rates of miscoding of diagnostic groups [7]. Similarly, notification data on viral hepatitis B have been recognised as being limited due to under-notification and misclassification of cases [8]. It is of note however, that recent improvements in the notification system such as computerisation and improved feedback systems (the Communicable Disease New Zealand) may have significantly improved the notification system. Despite this, these factors highlight the need for cautious interpretation of the results obtained in this paper, and a need to put these in context with the information obtained from other data sources.

Trends in acute hepatitis B: The data obtained from both sources suggest a significant decline in the incidence of acute hepatitis B in recent years. Indeed, this decline is apparent in all RHAs, for all age groups and for the three major ethnic groups. It is conceivable that changing patterns in admission to hospital may be a
factor in this trend for hospitalisations. However, the fact that this decline is accompanied by a rise in the median age of hospitalised case is consistent with a true decline in total disease incidence (since vaccination of children results in a rise in the median age of cases).

As viral hepatitis hospitalisations and hepatitis B notifications have been decreasing for some time (see Chapter One), it is difficult to estimate the importance of increasing vaccination coverage in the last seven years. Nevertheless, some role for vaccination is suggested by the decline being particularly steep in the populations with the highest vaccination coverage in recent years (i.e., children under 16 years). Further support for the role of vaccination in this trend comes from the sharp decline in rates from those demographic and occupational groups with an association with children (e.g., home makers and teachers) relative to other groups. The larger decline in North Island notifications, relative to the South Island, may also reflect the greater emphasis on vaccination in the north (at least on the part of particular State-funded programmes and some private immunisation programmes). The decline of acute hepatitis B in health care workers may be partly due to the relatively high levels of vaccination coverage that has been achieved in this population over recent years in New Zealand [9]. However, the experience in some other countries suggests the decline of hepatitis B in this population occurred largely before the use of HBV vaccine [10].

Despite this declining trend, acute hepatitis B is an important proportion of all acute viral hepatitis that requires hospitalisation in NZ (at 62.0% of specified types of viral hepatitis). It is less important however, as a relative cause of symptomatic viral hepatitis in the community according to two New Zealand studies (29% in Auckland [11], and 13% in Christchurch [12]).

The significant autumnal increase in notifications (and to a lesser extent hospitalisations), has not previously been described for hepatitis B. Due to the long
incubation period of this disease (averaging 60 to 90 days [13]), this observation may suggest the occurrence of particular risk factors in summer. Possibilities may include an increase in the population going without footwear and more frequent injecting drug use (eg, associated with the "poppy season" [14]) and unprotected sexual intercourse during the holiday season. Nevertheless, the possibility that this finding is an artefact of when patients with mild hepatitis symptoms see doctors can not be excluded. For example patients may be less likely to consult their doctor over summer and more likely to in autumn when there is a seasonal increase in respiratory infections.

*Morbidity and mortality due to acute hepatitis B:* Although there was a significant increase in the median age of hospitalised cases over the 1980-91 time period, there was no evidence of increasing severity of disease as judged by length of stay in hospital and the proportion of hospitalised cases having coma or dying. While both data sources demonstrate the significant mortality associated with acute hepatitis B (5.4% of hospitalised cases and 0.8% of notifications) it is important to note that these sources ignore other serious sequelae of this disease, notably the risk of developing chronic carriage and chronic liver disease (see Chapter One).

*Gender and ethnic distribution:* The increased risks for males of being notified and hospitalised with acute hepatitis B has been well documented in this country and overseas (see Chapter One). Similarly the greater risk for Maori and Pacific Island Polynesians is not a new finding (see Chapter One). However, the four fold increase in the death rate of hospitalised Polynesians has not previously been described. This increased risk could possibly be attributable to more severe disease in this population due to co-infection with hepatitis delta virus, which is known to be relatively common in Polynesian HBV carriers [15,16]. Despite the relative importance of acute hepatitis B to Maori and the other non-European ethnic groups in New Zealand, immunisation coverage of these populations remains suboptimal [17]. There is a critical need to
improve the appropriate delivery of hepatitis B immunisation to remove this ethnic
differential in health status (see Chapter Three).

**Economic impact of acute hepatitis B:** Based on the calculations in this analysis,
acute hepatitis B has a significant economic impact on the health sector. Indeed, the
annual cost of admissions is greater than the cost of a complete course of hepatitis B
vaccine for over 55,000 children per year (NZCDC data). Even so, this simplistic
analysis underestimated the true cost of acute hepatitis B to the health sector as it
excluded the cost of general practitioner consultations, associated laboratory expenses
and outpatient costs. In addition, there are large societal costs associated with the care
of cases outside hospital and from premature death due to acute hepatitis B (see
Chapter One). A more complete analysis of the total cost of this disease to New
Zealand would have to include costs associated with the several acute deaths a year
and the larger number of deaths associated with the chronic sequelae of developing
chronic hepatitis B carriage.

**Transmission of hepatitis B:** The relatively high rates of hepatitis B among young
adults is suggestive of the relative importance of either sexual transmission or
transmission associated with injecting drug use. Other possibilities that have not been
thoroughly evaluated could include a role for contact sports or transmission within
households (eg, shaving). Indeed the relatively smaller decline in acute hepatitis B for
the student population (over 14 years) compared to other demographic groups, may
suggest that health promotion campaigns (regarding safer sex and drug use) need to be
targeted on this group. Such campaigns should considering addressing tattooing in
view of the New Zealand-based evidence for its role in hepatitis B transmission
[18,19]. The lack of risk factor information associated with the notification data are a
cause of concern as this removes much of the public health value of collecting such
data.
**Improving information on acute hepatitis B in New Zealand:** Both hospitalisation and notification data help contribute to the understanding of acute hepatitis B. Hospitalisation data probably provides a more accurate measure of disease trends and can provide one measure of the cost of a particular aspect of this disease.

In contrast, notification data can begin to provide more specific information on trends within particular demographic and occupational groups. Notification data can also begin to clarify the nature of the transmission mechanisms involved, though substantial improvements in data collection are necessary if this is to be done more completely. Another major improvement in notification data would be the inclusion of information concerning hospitalisations. This modification is now included in the latest version of national surveillance software (EpiSurv 2.0).

Regular review of both data sources is desirable to monitor the on-going gains made by routine childhood immunisation and improve our understanding of hepatitis B epidemiology in general.

**Improving control of hepatitis B:** While these data suggest routine childhood immunisation is likely to be contributing to the decline of hepatitis B in New Zealand, further clarification of the predominant transmission mechanisms in adults is necessary to help prioritise other control programmes. For example, although sexual transmission is likely to be the major cause of transmission in young adults, this is by no means certain (ie injecting drug use could be equally as important). Until such issues are clarified it would seem prudent to improve control of hepatitis B in young adults through a range of mechanisms. As well as providing vaccination to sexually active young adults (see Appendix One), other public health measures could include promoting the use of barrier contraceptives and promoting safer behaviours associated with injecting drug use. The latter two actions are desirable regardless of hepatitis B
as they control other blood-borne viral diseases and barrier contraception prevents unwanted pregnancy.

Conclusions

Acute hepatitis B has had a significant impact on health status in New Zealand during the time period 1980-92. Fortunately there has been a significant downward trend in both hospitalisations and notifications in all age groups and in the major ethnic groups. There is some evidence to suggest that this trend is related to mass childhood immunisation programmes and to vaccination programmes in particular groups (eg, health care workers). These data reiterate the importance of ethnicity that has been previously described for the morbidity and mortality of acute hepatitis B. Sexual transmission, and possibly transmission relating to injecting drug use, are likely to be important factors for young adults. There is a need to improve information on acute hepatitis B particularly with regard to possible transmission mechanisms. This clarification will help prioritise the various public health control measures that are relevant to this disease.

Acknowledgments

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Chapter Three

THE CONTROL OF HEPATITIS B

IN NEW ZEALAND: A REVIEW

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ABSTRACT

The hepatitis B control measures introduced in New Zealand are described and reviewed. There has been a fairly rational and incremental progression in improving vaccination coverage from neonates of carrier mothers through to all children under 16 years of age. Much of the credit for this progress rests with effective health professional advocacy, advocacy by Maori, and the mobilisation of community support.

Although some aspects of these control measures have been well evaluated to date, there remain major deficiencies particularly with the lack of evaluation of the programme providing immunoprophylaxis to the infants of HBV carrier mothers. A range of problems with the control of hepatitis B also exist. Outstanding among these is the fact that large proportions of the childhood population, particularly Maori, have received suboptimal vaccination coverage. This has been the case for both the pre-school "catch-up" vaccination programme and routine administration in the general practice setting. Despite growing understanding of the need for culturally sensitive strategies to improve vaccination uptake in Maori and other ethnic groups, there remains inadequate action at the operational level to address this.

Possibly the next major problem with current control mechanisms is that at least 8% of hepatitis B vaccine is of compromised potency at the point of administration. Major inadequacies have been identified in the operation of the national vaccine cold chain, particularly with regard to freeze-sensitive vaccines such as hepatitis B. Other challenges remaining for hepatitis B control include the need to establish clearer national guidelines on hepatitis B vaccination, the need for a systematic programme of monitoring current control measures, and the need for a review of the appropriateness of screening carriers for primary liver cancer.
A range of recommendations for improving hepatitis B control in New Zealand are made. The most important of these relate to improving immunisation coverage (especially for Maori and Polynesian populations) and improving the national vaccine cold chain. The development of a strategic plan for the elimination of HBV transmission in New Zealand is necessary for successful long term control of this disease.

INTRODUCTION

Over the last decade New Zealand has developed an impressive state-funded hepatitis B vaccination programme. The principal focus of this programme has been to protect children against hepatitis B infection because of their high-risk of becoming carriers [1]. Prevention of acute hepatitis B has been a secondary consideration. Since 1988, the programme has included routine vaccination of all children under age five. Fully subsidised vaccination has also become available to children up to age 16 years and to household contacts of identified HBV carriers and their sexual partners. These developments have all followed increasing awareness of hepatitis B as an important problem in New Zealand and a steady fall in vaccine costs.

Although mass vaccination programmes against hepatitis B have been attempted elsewhere [2], New Zealand has been the first country in the World to have integrated hepatitis B vaccine into its routine childhood immunisation programme. This approach of offering universal immunisation to newborns has recently been considered to be the best long term strategy for hepatitis B control [3]. There remain however, a number of areas in which the national control strategy for this disease in New Zealand can be improved. Any
such developments will help both national control of the disease and provide models from which other countries can learn. Indeed, reduction in HBV is a World Health Organization objective [4].

**Hepatitis B control measures to date**

A wide range of hepatitis B control strategies have been introduced in the last decade. These are summarised in Tables 1 and 2. The rationale behind the various steps in the programme is complex and has already been reviewed by the Ministry of Health (DOH), albeit briefly [5]. The approach taken has been to protect infants of carrier mothers first and then to progressively vaccinate children in increasingly older age groups. This approach is consistent with hepatitis B control strategies advocated overseas for countries of intermediate HBV endemicity [6,7,8] and low endemicity [9,10,11,12]. The key aspects of the control measures to date have been:

*Advocacy by health professionals and Maori:* Advocacy from health professionals from within and from outside the DOH have been a predominant aspect of developing and implementing control measures. Milne, Moyes and co-workers from Whakatane have been extraordinarily dedicated in their efforts to control hepatitis B at a local and national level [13,14]. Indeed one political scientist has detailed the effectiveness of this advocacy and characterised its key features, including the value of the "health zealot" effect [15]. Milne and co-workers have made major contributions through direct advocacy to the Communicable Disease Control Advisory Committee (CDCAC), the Department of Health and relevant politicians. This advocacy has been backed with an impressive array of local studies and support from visiting experts in hepatitis control at workshops and forums in 1982, 1987 and 1993 [16,17].
Advocacy from Maori and those concerned with Maori health has also become increasingly important in the last eight years [18,19]. This has included valuable contributions by Maori health professionals [20,21], and advocacy from the Maori Women's Welfare League. Such advocacy has been combined with strong community support for vaccination programmes by both Maori and non-Maori, especially in the Bay of Plenty [22].

Technical developments: There has been increasing evidence for the effectiveness of a reduced dose of paediatric vaccine along with a reduction in the number of doses of vaccine required (ie from four low-dose to three low-dose injections) over the last five years. Hepatitis B vaccine prices have also fallen by a factor of 25 since the vaccine was first marketed in this country in 1982.

The prominence of blood-borne viral diseases: Other blood-borne viruses (such as HIV and hepatitis C) have attracted much professional and public attention in recent years. Hepatitis D has also been described in the New Zealand context for the first time in the last six years [23]. Nearly all the control measures for these diseases are of value in controlling hepatitis B as well.
Table 1  
**Chronological Summary of Key Hepatitis B Control Measures Involving Immunoprophylaxis (immune globulin and or vaccine).**

<table>
<thead>
<tr>
<th>Date</th>
<th>Control Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>Hepatitis B vaccine becomes commercially available (at approximately $150 per adult course and $75 per paediatric course). Immunoprophylaxis of infants of carrier mothers was recommended by a workshop in Whakatane [24].</td>
</tr>
<tr>
<td>1985 (Sept)</td>
<td>The DOH made funding available for providing immunoprophylaxis to the infants of &quot;e&quot; antigen positive carrier mothers (approximately 480 infants per year [25]).</td>
</tr>
<tr>
<td>1986</td>
<td>The DOH funded the provision of immunoprophylaxis to the infants of all surface antigen positive carrier mothers (approximately 1650 infants per year [26]).</td>
</tr>
<tr>
<td>1987 (March)</td>
<td>The DOH funded vaccination to all neonates in seven out of 18 health districts (Northland, Takapuna, Auckland, South Auckland, Rotorua, Gisborne and Napier).</td>
</tr>
<tr>
<td>1988 (Feb)</td>
<td>The DOH provided fully subsidised vaccination to all neonates and children under five years through a clinic based &quot;catch-up&quot; vaccination programme. A low-dose plasma-derived vaccine was used. Hepatitis B vaccination became integrated into the national childhood immunisation programme. Fully subsidised vaccination was made available to the close contacts of women identified as carriers through antenatal screening.</td>
</tr>
<tr>
<td>1989</td>
<td>Private vaccination initiatives to vaccinate school children occurred throughout much of the country. The groups involved included general practitioners, the Hepatitis Research Unit (Whakatane), vaccine manufacturers, and community organisations (eg, Lions and Rotary).</td>
</tr>
<tr>
<td>1989 (Nov)</td>
<td>DOH funding was made available to AHBs to develop strategies to target the vaccination of school children (ie $320,000).</td>
</tr>
<tr>
<td>1980s (mid &amp; late)</td>
<td>Vaccination coverage for health workers improves, especially for doctors, nurses and dentists.</td>
</tr>
<tr>
<td>1989 (Dec)</td>
<td>Recombinant hepatitis B vaccine was made available for use in national vaccination programmes.</td>
</tr>
</tbody>
</table>
Nonimmunologic strategies appear to have been important in the reduction of hepatitis B in other developed countries [28]. Indeed the implementation of such strategies represents a guarantee against failures in vaccine effectiveness and immunisation coverage. For example, given a field effectiveness of hepatitis B vaccine of as high as 85% (considering the performance of the vaccine cold chain in New Zealand) and a vaccination coverage in the child population of 80%, this will mean that approximately 32% of children reaching teenage years will remain unprotected from hepatitis B. A summary of the nonimmunologic control strategies undertaken in New Zealand to date are listed below in Table 2.
Table 2  **Chronological Summary of Hepatitis B Related Control Measures**
(other than immunoprophylaxis)

<table>
<thead>
<tr>
<th>Date</th>
<th>Control Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>Universal screening of blood transfusions begins.</td>
</tr>
<tr>
<td>1977</td>
<td>Antenatal screening begins.</td>
</tr>
<tr>
<td>1970s (late)</td>
<td>Infection control measures were introduced to high-risk environments such as dialysis units.</td>
</tr>
<tr>
<td>1980s</td>
<td>Strategies to reduce HIV transmission are promoted. Virtually all of these strategies are likely to have assisted in hepatitis B control.</td>
</tr>
<tr>
<td></td>
<td>Examples included:</td>
</tr>
<tr>
<td></td>
<td>- Improvements in self deferral by donors for blood transfusions.</td>
</tr>
<tr>
<td></td>
<td>- The introduction of the Needle and Syringe Exchange Programme to protect injecting drug users from HIV infection.</td>
</tr>
<tr>
<td></td>
<td>- Promotion of safer sex and barrier contraception.</td>
</tr>
<tr>
<td>1990/91</td>
<td>The Hepatitis B Research Unit (Whakatane) initiated a working party to improve the management of the HBV carrier state in New Zealand [29,30].</td>
</tr>
<tr>
<td>1993</td>
<td>&quot;The Hepatitis Foundation&quot;, (Whakatane) organised the &quot;1993 South Pacific Hepatitis Forum&quot; focusing on the management of hepatitis B carriers and other hepatitis B control issues.</td>
</tr>
</tbody>
</table>

**Evaluation of control measures to date**

The wide range of hepatitis B control measures attempted in New Zealand and their status as regards evaluation are listed below. It is of note that evaluation of many of these control efforts is far from complete. Indeed, in the area of the cost-effectiveness of hepatitis B vaccination programmes, only one New Zealand study has been completed
A further concern is that the evaluation efforts have only occasionally been an integral part of the particular programmes from their inception. Particular strategies and any associated evaluation are summarised below:

**Routine childhood immunisation with hepatitis B vaccine**

This aspect of hepatitis B control has been the most thoroughly evaluated to date. Key aspects of the immunisation programme include:

- **Vaccine Efficacy:** A large number of studies have been undertaken by Milne, Moyes and co-workers into the benefits of low-dose vaccination [32,33,34] and use of booster doses [35]. These studies continued on to demonstrate the value of various yeast-derived hepatitis B vaccines [36,37,38]. Further work, in a study partially funded by the DOH, showed that effective immunity could occur after only three doses of low-dose vaccine [39]. This study also suggested that the additional benefit of a fourth dose was of questionable value.

- **Process Evaluation:** A process evaluation of the preschool "catch-up" programme was performed by Health Services Research in July 1990 [40]. It highlighted the suboptimal coverage of Maori.

- **"High-risk" Strategies:** A process evaluation of "high-risk" strategies used by AHBs was performed by Health Services Research in September 1990 [41].
• "Prevention Programme Delivery": Procedures for the delivery of prevention programmes were reviewed by Health Services Research in June 1990 [42]. Much of this was relevant to the delivery of hepatitis B vaccination.

• "Neonatal Cohort Study": A cohort study of neonates in Northland has provided preliminary data on vaccination coverage [43].

• Coverage Survey: An immunisation coverage survey was conducted by the New Zealand Communicable Disease Centre (NZCDC) in 1992. This provided nationwide data on coverage of hepatitis B vaccination [44].

• Cold Chain Study: A cold chain study that includes hepatitis B vaccine was undertaken by NZCDC in 1992/3. This suggested that at least 8% of hepatitis B vaccine is damaged to some extent by freezing prior to its delivery in the general practice setting [45].

• Study of Computerised General Practices: This study suggested suboptimal delivery of hepatitis B vaccine with regard to the timing of vaccinations and the use of hepatitis B vaccination with other vaccines at the same visit to a general practice (see Appendix Five).

• Analysis of Benefit Claim Data: A review of this data source has suggested that benefit claims are of limited value in measuring the coverage of hepatitis B vaccination [46].
Provision of immunoprophylaxis to the infants of HBV carrier mothers

A very superficial evaluation of this programme was conducted by the DOH in July 1989 (Patel A, personal communication, 1992).

Routine programmes for the immunisation of adults in particular high-risk or occupational groups

There has been no published evaluation of provision of hepatitis B to high-risk adult or occupational groups in New Zealand. One survey to assess the extent of vaccination policies for particular occupational groups in the health sector has been completed [47].

Provision of vaccination to sexual partners and household contacts of known carriers

There is no published evaluation of this strategy. A report by Health Research Services noted however, that no AHB had a programme in place for ensuring vaccination for the contacts of identified carrier mothers. One unpublished study has suggested that the follow-up by general practitioners of carriers identified in hospital occurs less than half the time [48].

Screening of donated blood (followed by counselling and offer of vaccination)

There has been no published evaluation of this strategy. Anecdotal evidence suggests that follow-up and counselling of HBV carriers identified by screening is poorly performed at the general practitioner level (Woodfield G, personal communication, 1991).
The Needle and Syringe Exchange Programme for injecting drug users

This programme has been well evaluated to date [49,50,51]. The results suggest a substantial reduction in sharing of drug injecting equipment is probably attributable to the programme.

Sex education and access to barrier contraception

Some evaluation of this control strategy has occurred in the context of evaluations relating to HIV/AIDS [52,53].

Current problems with the hepatitis B control programme

The key problems with hepatitis B control in New Zealand today are summarised below. These problems are reviewed in more detail in the subsequent text.

- Large proportions of the childhood population, particularly Maori, have received suboptimal vaccination coverage.

- A significant proportion of hepatitis B vaccine being used throughout New Zealand may be ineffective due to inadvertent freezing of vaccine (at least 8%).

- The programme for the provision of immunoprophylaxis to the infants of HBV carrier mothers requires clear guidelines and systematic monitoring.

- There is a shortage of clear guidelines, standards and national strategies for improving the vaccination of high-risk adult and occupational groups. Also, there
has been "little control, accountability or coordination of providers" in the hepatitis B immunisation programmes that has been directly and indirectly funded by the state (eg, through benefits and grants) [54].

- There has been a lack of emphasis on non-vaccination control strategies to date.

- Screening to detect HBV carriers and also screening to detect primary liver cancer pose problems associated with all screening programmes. The value of such programmes in the New Zealand setting requires clarification.

- There is a lack of information on the cost of various hepatitis B control measures.

**Suboptimal vaccination of the childhood population, especially Maori**

Evaluation of the preschool immunisation programme showed a significant decline in vaccine uptake over the four dose course (Table 3). Although four doses provides an optimal level of immunity, it is likely that the majority of those children who received three vaccines will have a satisfactory level of protection [55]. Nevertheless even when considering three doses as adequate, this campaign left up to 29% of non-Maori and up to 57% of Maori children with incomplete vaccination coverage. Indeed the coverage in this programme compares poorly with immunisation programmes encompassing ethnic minority populations elsewhere (eg, Aboriginal children in Australia [56]).

Also of note was that vaccination coverage across all four regional health authorities was similarly poor for the third dose of vaccine in the coverage survey (see Figure 1 based on
Figure 1 Hepatitis B immunisation coverage & hospitalisation rates for acute hepatitis B (Maori & non-Maori)

* Three doses of hepatitis B vaccine by age 15 months (National Coverage Survey)
data from Chapter Two and [57, 58]). The Midland RHA had the lowest coverage level and it also had a marginally higher hospitalisation rate for acute hepatitis B.

A range of explanations have been put forward for the lack of success of the preschool "catch-up" campaign. These have included the poor design of the programme to attract socially disadvantaged populations [59], and the use of clinics as opposed to traditional vaccinators (general practitioners and practice nurses). Indeed the CDCAC did not actually recommend the preschool catch-up campaign to the Minister, preferring instead a catch-up programme at school entry where higher coverage rates would be expected [Reid S, personal communication].

Table 3  Hepatitis B vaccination coverage by ethnicity for the routine childhood immunisation schedule and the pre-school "catch-up" programme (1988)

<table>
<thead>
<tr>
<th>Vaccinations</th>
<th>Preschool Programme</th>
<th>Routine*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maori</td>
<td>non-Maori</td>
</tr>
<tr>
<td>1st injection</td>
<td>54%</td>
<td>80%</td>
</tr>
<tr>
<td>2nd injection</td>
<td>49%</td>
<td>75%</td>
</tr>
<tr>
<td>3rd injection</td>
<td>43%</td>
<td>71%</td>
</tr>
<tr>
<td>4th injection</td>
<td>35%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Notes: * Hepatitis B coverage at two years of age. Range for the four Regional Health Authority (RHA) areas as determined in the 1992 coverage survey [60]. The first injection was given at birth and the low figure may represent the poor recording of this information in children's Health and Development Record Books and in general practitioner records. Also, for the time period that this survey covered, the recommended vaccination schedule was revised with the neonatal dose being eliminated for most children. This change may have created some potential for confusion among parents and vaccination providers.
Evaluation of the strategies used by AHBs to target school children in high-risk groups has also highlighted difficulties in achieving success in this area [61]. In some AHBs the activities of private initiatives since 1988 may have improved coverage in high-risk groups. This may be so for campaigns organised by Milne and co-workers in certain parts of the North Island. It may not apply however, for school based campaigns organised by entrepreneurs (eg, Central Medical) or vaccine manufacturers (eg, Smith Kline Biologicals). Indeed the DOH noted in 1990 that some of the private programmes had been leaving children incompletely immunised [62]. Unfortunately, no data has been systematically collected on the coverage achieved by these various campaigns.

The recent national coverage survey reinforces the findings of the preschool "catch-up" evaluation. These were that a large proportion of the general population, and in particular Maori, are continuing to receive inadequate coverage of hepatitis B vaccine (Table 3). Children whose principal caregiver had identified themselves as being Maori or part-Maori, were only about 70% as likely to have received the full series of childhood immunisations (including hepatitis B). This was compared to children whose caregiver came from a European or Pacific Island Polynesian ethnic background. In contrast to actual coverage levels achieved, there was a widespread feeling by caregivers that hepatitis B immunisation was important (range 80.7% to 91.4% for the four RHAs).

The coverage survey results are consistent with other studies that suggest that there is a significant fall-off in the uptake of the third dose of hepatitis B vaccine. One study of a sample of general practices found that 44% of doses were administered outside the broadly defined acceptable ranges (under 18 weeks of age or between 12 and 15 months) (see Appendix Five).
A range of solutions is available to improve immunisation coverage in the childhood population and especially Maori. Many of these have already been described [63,64] and indeed the Department of Health has attempted to address these with catch-up vaccination programmes aimed at high-risk schools in the North Island (through contracts with the Hepatitis B Research Unit). Such programmes need evaluation however, so that revised estimates of hepatitis B coverage can be made.

**Use of ineffective hepatitis B vaccine**

While hepatitis B vaccine is known to be relatively robust with regard to warming, it is highly sensitive to freezing with up to a 50% loss of potency in a single freezing cycle [65]. This raises concerns in view of the results of a review of the national vaccine cold chain by NZCDC which found that at least 8% (95% confidence interval, 3.9-12.3%) of hepatitis B vaccine vials may be of impaired effectiveness at the time of administration to children [66]. Indeed, for various methodological reasons, this study is likely to have underestimated damage to hepatitis B vaccine in the cold chain. Other studies support this finding in suggesting that the vaccine cold chain in New Zealand is performing suboptimally [67,68,69].

**Lack of evaluation of the provision of immunoprophylaxis to the infants of HBV carrier mothers**

This area has only been very superficially evaluated to date with a survey that highlighted the lack of mechanisms at AHB level for following up these infants (Patel A, personal communication, 1992). Indeed, in the Department's own review of hepatitis B control, this area was highlighted as a priority for further evaluation efforts [70]. A paper
addressing evaluation options for this programme has already been prepared (see Appendix Four). This paper highlights this area as an extremely cost-effective aspect of hepatitis B control and reviews a range of options for improving and monitoring this programme.

Inadequate guidelines, standards and national strategies to improve vaccination of "high-risk" adult and occupational groups

Despite the evidence suggestive of the value in providing vaccine to various high-risk adult and occupational groups, the Department of Health has only issued limited guidelines to practitioners on this matter (eg, for dentists [71]). The results of a survey of organisations involved with "at-risk" occupational groups in the health sector suggested areas of suboptimal vaccination coverage and a diverse range of local policies [72] (see also Appendix Two). Room for improvement in the hepatitis B vaccination of general practitioners has also been identified in a recent survey [73]. A group for which vaccination coverage may be especially low are health care workers in institutions caring for the developmentally disabled [74].

The case for considering improving vaccination efforts for high-risk adults is made in Appendix One.

Lack of emphasis on non-vaccination control strategies

The relative importance of non-vaccination strategies in hepatitis B control has been discussed in Chapter Three. In addition, there is growing evidence that the incidence of
HBV in some overseas populations (homosexual men) has declined with behaviour changes involving greater condom use and limitation of partner numbers [75,76].

It is of note that Professor Pomare made recommendations on this issue [77], and yet these do not appear to have been acted upon. The "New Zealand Strategy on HIV/AIDS" document also contained some recommendations in this area, for example concerning the need to improve hygiene in prisons [78]. There is no evidence that these have been followed up in the two years since this report was produced.

Screening for carriers and of carriers for disease markers poses unresolved ethical and health sector cost problems

The issue of screening prior to mass hepatitis B immunisation programmes has been subject to significant debate (see Appendix Three). More recently however, the screening issue has moved from a focus on screening to detect carriers to routine screening of identified carriers. In particular the Hepatitis Research Unit in Whakatane published a guide for health professionals on the management of hepatitis B carriers in 1991 [79]. This document provided some useful information on the management of HBV carriers. It also included recommendations that carriers at certain levels of risk have annual testing for alpha feta protein and in some cases an annual liver ultrasound. These protocols amount to a defacto screening programme for many of the 50,000 or more HBV carriers in the country. Of concern is that this type of screening programme has not been systematically evaluated in the New Zealand setting. Indeed at an international level there is still a need for "larger prospective studies" to evaluate screening HBV carriers [80]. In particular, alpha feta protein and ultrasonography screening have not been demonstrated to meet all the criteria for a successful screening programme (eg, cost-effectiveness; high sensitivity,
specificity and predictive value of the screening tests; availability, acceptability, and access to screening and treatment services). This lack of systematic evaluation contrasts with the approach taken with other screening programmes in New Zealand such as the introduction of pilot programmes for mammographic screening.

Lack of information on the cost of hepatitis B control measures

As with most other public health sector interventions, there is a marked lack of data on the costs of controlling hepatitis B in New Zealand. Some information is available on the cost of vaccine and the cost of immunisation benefits paid to doctors for childhood vaccinations (assuming hepatitis B accounts for 19% of the total immunisation benefit). This totals to approximately $1.1 million dollars annually. There are no data however, on the costs of distributing vaccines via the national vaccine distribution system and the costs to the State in practice nurse time to administer vaccinations. There is also no data on the cost of vaccinating the contacts of carriers and the cost of vaccination programmes in the workplace setting. In terms of non-vaccination control measures, there is no data on the cost of the needle and syringe exchange programme or of State-funded sex education in schools.
RECOMMENDATIONS FOR IMPROVING THE CONTROL OF HEPATITIS B IN NEW ZEALAND

The recommendations for how hepatitis B might be further controlled in New Zealand are prioritised in each of the following sections. Such recommendations should ideally be in a context of relative cost-effectiveness and the control of other blood-borne viral diseases (hepatitis C, hepatitis D and HIV). Nevertheless, since adequate costing data are not available, these recommendations are made on grounds of what seems reasonable given the current state of knowledge. Improvements in control of hepatitis B could serve as a model for the delivery of other vaccines and other desirable health interventions. Successful hepatitis B control programmes in New Zealand can also provide a valuable model for other countries.

1 Immunisation programmes

That the Ministry of Health / Public Health Commission:

- Act promptly on the recommendations of the recently completed immunisation cold chain survey [81].

- Commence with a strategy to continuously monitor and improve the programme for providing immunoprophylaxis to the infants of HBV carrier mothers. Action in this area could include making the HBV carrier state in mothers a notifiable condition (eg, by expanding the current case definition for notifiable hepatitis B). These recommendations are detailed in Appendix Three.
• Continue to strengthen the current national childhood immunisation programme. In particular, there is an urgent need to follow through with the recommendations arising from the immunisation coverage survey [82]. Particular consideration should be given to strategies to improve vaccination coverage in high-risk populations such as Maori, Pacific Island Polynesians, and lower socioeconomic groups.

• Continue to facilitate the delivery of vaccination through a wide range of providers. This includes building on the recent legislative changes allowing for the legitimate use of the nursing workforce to deliver vaccines without medical supervision. The provision of guidelines and user-friendly information for nurses and non-medical vaccinators is a potential example of how these changes can be brought into practice.

• Further develop a multicultural response to the delivery of immunisation programmes. Immunisation programmes should be designed and implemented with the active involvement of cultural minority community organisations. The Department/Commission should consider funding and support for ethnic and community organisations involved in hepatitis B immunisation programmes. Similarly it would be desirable to have a Maori health professional on the Communicable Disease Control Advisory Committee.

• Systematically review the data available from the screening and vaccination programme that was managed by the Hepatitis B Research Unit on contract with the DOH.

• Distribute the immunisation handbook for providers (currently being prepared).
Provide comprehensive guidelines on the vaccination of high-risk adult and occupational groups and consider the provision of vaccine by the state (subsidised or at cost, see Appendices One and Two).

Continue to monitor the results of the neonatal cohort study in Northland organised by Bandaranayake and co-workers.

Commission a review on the feasibility and cost-effectiveness of offering a booster of hepatitis B vaccine to children receiving the second dose of MMR vaccine in school (at form one level). Adolescent immunisation was considered at worthwhile strategy for countries with a HBsAg carriage rate of less than 2% at a recent international conference on hepatitis [83].

Commission a review of the cost-effectiveness of providing state-funded vaccine to adults in the 17 to 30 year age group.

2 Information systems and feedback to health professionals

That the Ministry of Health / Public Health Commission:

Contract with the NZ Communicable Disease Centre to improve the surveillance of hepatitis B through the continuous improvement of the notification system (see also Chapter One).
• That specific additional funding be considered to develop a laboratory surveillance system for viral hepatitis (based on the principles of the hepatitis surveillance system operated by the US Centers for Disease Control).

• Consider producing an annual report summarising the efforts to control hepatitis B in New Zealand (e.g., in the *Communicable Disease New Zealand*).

3 Management issues

That the Ministry of Health / Public Health Commission:

• Develop a strategic plan for the control of hepatitis B in New Zealand. Ideally this document would be one facet of a more comprehensive strategic plan to control blood-borne viral diseases (including HIV and hepatitis C and D). A strategic plan would also address the issue of potentially eliminating hepatitis B from New Zealand and the need to assist neighbouring Pacific nations with their control efforts. Such plans have been developed for hepatitis B eradication in Asia [84] and for other communicable diseases [85].

• Appoint a national coordinator for the control of vaccine preventable diseases in New Zealand in addition to coordinators at the local (RHA) level. The appointment of local immunisation coordinators was the key recommendation of the 1993 Expert Working Group on Immunisation [86].
Non-vaccination control strategies

That the Ministry of Health / Public Health Commission:

- Strengthen efforts to promote personal hygiene. While personal hygiene may be of only limited value in the control of hepatitis B [87], these messages are valuable in preventing a wide range of other diseases.

- Work with the Department of Justice to improve the supply of bleach to prison inmates (to allow more effective cleaning of drug using equipment).

- Develop a systematic plan to improving access to barrier contraceptives. This plan would require integration with other public health sector goals (the control of STDs and the prevention of unwanted pregnancy). The New Zealand Strategy on HIV/AIDS includes recommendations on improving access to condoms. In terms of the control of hepatitis B, as an STD, there may be significant cost-effectiveness gains from geographical targeting of certain interventions (eg, provision of state supported condom vending machines).

- Make better use of notification data to highlight important public health aspects of hepatitis B in the media. For example, the occasional deaths of young adults from sexually transmitted hepatitis B can be used to highlight the importance of both vaccination and use of barrier contraception, if presented in a sensitive and confidential way.
Management of hepatitis B carriers

That the Ministry of Health / Public Health Commission:

- Commission a study to review the place of alpha fetoprotein and liver ultrasonography screening of HBV carriers in New Zealand pending the outcome of controlled trials overseas.

- Commission a study to review the place of interferon treatment of chronic viral hepatitis in the New Zealand setting (see Appendix Three).

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Chapter Four

CONCLUSIONS AND RECOMMENDATIONS

This document covers a broad range of issues relating to the epidemiology and control of hepatitis B in New Zealand. Since so many conclusions can be drawn, only the most important are detailed below. Following these the key recommendations of this whole review are itemised.

The epidemiology of hepatitis B in New Zealand

- Hepatitis B has a significant impact on health status in New Zealand, both in terms of acute disease and the associated chronic sequelae of HBV infection (the carrier state and chronic liver disease).

- The impact of hepatitis B falls disproportionately on Maori and Pacific Island Polynesians. There is also significant geographical variation independent of ethnicity.

- There is a range of particularly "at-risk" adult populations in New Zealand, including specific occupational groups.

- There is a lack of information on horizontal transmission mechanisms in the childhood and adult populations.
All the available data suggest that there has been a significant decline in the incidence of hepatitis B in recent years. This decline is present in all age groups, in all the major regions and in the three major ethnic groups. There is some evidence that mass childhood HBV immunisation has contributed to this trend.

The control of hepatitis B in New Zealand

The New Zealand health sector has instituted in an incremental way, what is regarded as a desirable framework for hepatitis B control through infant immunisation.

Advocacy by motivated health professionals, by Maori, and by the community have been key factors in the development and implementation of mass immunisation programmes.

Important gaps in the evaluation of hepatitis B control programmes remain. The most important of these is the absence of evaluation of the provision of immunoprophylaxis to the infants of HBV carrier mothers.

The major problem with control efforts to date has been inadequate immunisation coverage of the childhood population. Inadequate immunisation applies particularly to Maori and Pacific Island Polynesian though recent attempts are being made by the Ministry of Health to address this.
Suboptimal quality of hepatitis B vaccine due to deficiencies with the national vaccine cold chain needs to be urgently addressed.

Improvements in the national control, coordination, and evaluation of hepatitis B control activities are necessary and could be facilitated by a national strategy to control hepatitis B in New Zealand.

Hepatitis B immunisation appears to be delivered in a suboptimal manner in the general practice setting. A large proportion of hepatitis B immunisations are not given at the appropriate time. This finding highlights the need for reminder/recall systems in the general practice setting.

There is significant potential to improve the control of hepatitis B in various institutional and occupational settings, such as facilities for the developmentally disabled.

The benefits and costs of hepatitis B immunisation can be summarised in ways that at least a proportion of potential vaccinees and employers may be able to understand.

The history of hepatitis B control in New Zealand highlights the value of epidemiological studies in defining the optimal control strategies for a communicable disease. Advances in critical aspects of the epidemiology of hepatitis B will continue to assist in defining the optimal form of control programmes. Similarly, rigorous evaluation of control programmes should improve their performance and help address the large ethnic differential that exists for hepatitis B. To guide these developments there is a critical need
for a clearly defined national control strategy. Only with such a strategy, and with a sustained inter-generational effort, is the transmission of hepatitis B likely to be eliminated from New Zealand.

RECOMMENDATIONS

1 Recommendations concerning the epidemiology of hepatitis B

That the Ministry of Health / Public Health Commission:

1.1 Consider commissioning a study into the hepatitis B marker prevalence in school children in a range of schools throughout New Zealand. Such a study would help determine the value of the provision of further immunisations to this age group.

1.2 Consider inviting tenders for case control studies to identify the transmission of hepatitis B in the childhood and adult populations of New Zealand.

1.3 Consider commissioning a systematic review of morbidity and mortality data on the chronic sequelae of HBV infection.

1.4 Consider commissioning the systematic surveillance of data obtained through antenatal screening programmes. This could include further surveillance for delta virus infection.
Encourage further research activity into the relationship between hepatitis B and hepatitis C infection in New Zealand.

2 Recommendations for improving the control of hepatitis B in New Zealand

The recommendations for how hepatitis B might be further controlled in New Zealand are prioritised in each of the following sections. Such recommendations should ideally be in a context of relative cost-effectiveness and the control of other blood-borne viral diseases (hepatitis C, hepatitis D and HIV). Nevertheless, since adequate costing data are not available, these recommendations are made on grounds of what seems reasonable given the current state of knowledge. Improvements in control of hepatitis B could serve as a model for the delivery of other vaccines and other desirable health interventions. Successful hepatitis B control programmes in New Zealand can also provide a valuable model for other countries.

2.1 Childhood immunisation programmes

That the Ministry of Health / Public Health Commission:

2.1.1 Act promptly on the recommendations of the recently completed immunisation cold chain survey [1].

2.1.2 Commence with a strategy to continuously monitor and improve the programme for providing immunoprophylaxis to the infants of HBV carrier mothers. Action in
this area could include making the HBV carrier state in mothers a notifiable condition (eg, by expanding the current case definition for notifiable hepatitis B). These recommendations are detailed further in Appendix Four.

2.1.3 Continue to strengthen the current national childhood immunisation programme. In particular, there is an urgent need to follow through with the recommendations arising from the immunisation coverage survey [2]. Particular consideration should be given to strategies to improve vaccination coverage in high-risk populations such as Maori, Pacific Island Polynesians, and lower socioeconomic groups.

2.1.4 Continue to facilitate the delivery of vaccination through a wide range of providers. This includes building on the recent legislative changes allowing for the legitimate use of the nursing workforce to deliver vaccines without medical supervision. The provision of guidelines and user-friendly information for nurses and non-medical vaccinators is a potential example of how these changes can be brought into practice.

2.1.5 Further develop a multicultural response to the delivery of immunisation programmes. Immunisation programmes should be designed and implemented with the active involvement of cultural minority community organisations. The Department/Commission should consider funding and support for ethnic and community organisations involved in hepatitis B immunisation programmes. Similarly it would be desirable to have a Maori health professional on the Communicable Disease Control Advisory Committee (CDCAC).

2.1.6 Distribute the immunisation handbook for providers (currently being prepared).
2.1.7 Systematically review the data available from the screening and vaccination programme that was managed by the Hepatitis B Research Unit on contract with the MOH. Also continue to monitor the results of the neonatal cohort study in Northland organised by Bandaranayake and co-workers.

2.1.8 Commission a review on the feasibility and cost-effectiveness of offering a booster of hepatitis B vaccine to children receiving the second dose of MMR vaccine in school (at form one level).

2.1.9 Commission a review of the cost-effectiveness of providing state-funded vaccine to adults in the 17 to 30 year age group.

2.1.10 That the current position of the CDCAC not to recommend routine screening prior to immunisation be retained until further discussion and consultation suggests that this position is no longer appropriate.

2.1.11 That the Ministry of Health not support routine pre-vaccination screening as part of mass hepatitis B immunisation programmes until the benefits of screening are better established. The process of more clearly identifying these benefits and adverse effects still requires consultation with the Maori community and those running community-based screening and vaccination programmes.
2.2 Adult immunisation programmes

That the Ministry of Health / Public Health Commission:

2.2.1 Act on the 1992 recommendation of the CDCAC to consider making state-purchased vaccine (for childhood immunisation) available to appropriate organisations at cost price to improve the coverage of "at-risk" occupational groups.

2.2.2 That the key organisations (Ministry of Health (MOH), the Public Health Commission (PHC), Department of Labour (Occupational Safety and Health, (OSH)) and Regional Health Authorities (RHAs)), recognise and support the key role that medical practitioners, practice nurses and occupational health staff play in controlling hepatitis B in occupational groups. This role involves alerting patients in various occupational groups to the potential risk of infection and in delivering vaccinations in both the general practice and workplace settings.

2.2.3 That the key organisations (MOH, PHC and OSH) work together to improve the provision of occupational group specific information and guidelines to AHBs/RHAs and other health sector organisations.

2.2.4 That organisations with "at-risk" employees support the effective control of hepatitis B in their workforce by:

- Employing an adequate occupational health workforce.
- Emphasising the importance of good documentation of vaccinations given and supporting the use of computerised systems to facilitate recall and for surveillance of vaccination coverage and needlestick injuries.

- Controlling needlestick injuries and by using the occurrence of such injuries in staff to highlight the importance of hepatitis B vaccination to the injured person and of similarly "at-risk" co-workers.

- Considering adopting a policy of mandatory choice regarding hepatitis B vaccination upon recruitment of new staff.

2.2.5 That the key organisations involved with primary health care workers (MOH, PHC, OSH and the Royal New Zealand College of General Practitioners) act further to encourage uptake of hepatitis B vaccination among general practitioners. In addition the issue of an occupational health service that attends to the needs of primary health care workers needs to be considered.

2.2.6 That in view of the relative cost-effectiveness of vaccinating the close family members and sexual contacts of carriers (when carriers have already been identified), incentives to providers to improve hepatitis B immunisation in this group should be considered. For example, consideration could be given to a more substantial payment than the current immunisation benefit (of $7.65) to GPs or other providers who could vaccinate this group.
2.3 Information systems and feedback to health professionals

That the Ministry of Health / Public Health Commission:

2.3.1 Ensure, that in the contract with the NZ Communicable Disease Centre (NZCDC),
continuous improvement is made in the surveillance system of hepatitis B
(especially with regard to the identification of the source of infection).

2.3.2 That specific additional funding be considered to allow NZCDC develop a
laboratory surveillance system for viral hepatitis (based on the principles of the
hepatitis surveillance system operated by the Centers for Disease Control in
Atlanta).

2.3.3 Consider producing an annual report summarising the efforts to control hepatitis B
in New Zealand (eg, in the Communicable Disease New Zealand).

2.4 Management issues

That the Ministry of Health / Public Health Commission:

2.4.1 Develop a strategic plan for the control of hepatitis B in New Zealand. Ideally this
document would be one facet of a more comprehensive strategic plan to control
blood-borne viral diseases (including HIV and hepatitis C and D). A strategic plan
would also address the issue of potentially eliminating hepatitis B from New
Zealand and the need to assist neighbouring Pacific nations with their control
efforts. Such plans have been developed for hepatitis B eradication in Asia [3] and
for other communicable diseases [4].
2.4.2 Appoint a national coordinator for the control of vaccine-preventable diseases in New Zealand in addition to coordinators at the local (RHA) level. The appointment of local immunisation coordinators was the key recommendation of the 1993 Expert Working Group on Immunisation [5].

2.5 Non-vaccination control strategies

That the Ministry of Health / Public Health Commission:

2.5.1 Strengthen efforts to promote personal hygiene. While personal hygiene may be of only limited value in the control of hepatitis B [6], these messages are valuable in preventing a wide range of other diseases.

2.5.2 Work with the Department of Justice to improve the supply of bleach to prison inmates (to allow more effective cleaning of drug-using equipment).

2.5.3 Develop a systematic plan to improving access to barrier contraceptives. This plan would require integration with other public health sector goals (the control of STDs and the prevention of unwanted pregnancy). The New Zealand Strategy on HIV/AIDS includes recommendations on improving access to condoms. In terms of the control of hepatitis B, as an STD, there may be significant cost-effectiveness gains from geographical targeting of certain interventions (eg, provision of state-supported condom vending machines).
2.5.4 Make better use of notification data to highlight important public health aspects of hepatitis B in the media. For example, the occasional deaths of young adults from sexually transmitted hepatitis B can be used to highlight the importance of both vaccination and use of barrier contraception, if presented in a sensitive and confidential way.

2.6 Management of hepatitis B carriers

That the Ministry of Health / Public Health Commission:

2.6.1 Commission a study review the place of interferon treatment of chronic viral hepatitis in the New Zealand setting. This could address the role of this agent in treating disease associated with hepatitis B and C. The Gastroenterology Society of New Zealand could also be asked to assist in formulating recommended protocols and standards of good practice with regard to the management and treatment of the hepatitis B carrier state.

2.6.2 Commission a study to review the place of AFP and US screening of HBV carriers in New Zealand pending the outcome of controlled trials overseas.

2.6.3 Note that to reduce the risk of adverse effects from disease labelling in those individuals who have already been identified as HBV carriers, the following actions be considered:

- That more detailed printed information on the HBV carrier state be distributed to health care workers and the carriers themselves.
• That a special benefit be paid to GPs and health care workers with counselling skills who have a role in regular support for carriers. This benefit should be considerably more than the current paediatric and adult general medical services benefit.

2.6.4 That Regional Health Authorities be required in their contracts with primary care providers, to specify minimum standards for the provision of counselling to HBV carriers.

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Appendix One

EPIDEMIOLOGY AND CONTROL OF HEPATITIS B

IN HIGH-RISK ADULT GROUPS, A REVIEW

ABSTRACT

The epidemiological studies that relate to high-risk adult populations (other than occupational groups) for hepatitis B in New Zealand are reviewed. The groups for which some New Zealand data consistent with increased risk include sexually active heterosexuals, men who have sex with men, prison inmates and injecting drug users. This is also the case for groups with specific medical problems including haemophiliac patients and blood product recipients, the developmentally disabled, and haemodialysis patients. There is some anecdotal evidence to suggest that New Zealand travellers to high-risk areas may be also at increased risk. Examination of cost-effectiveness analyses performed overseas strongly suggest that the provision of vaccination to these particular populations is a very cost-effective intervention. Medical practitioners and the state both have important roles in improving vaccination coverage in adult groups at increased risk from hepatitis B.

INTRODUCTION

New Zealand has developed an impressive state-funded hepatitis B vaccination programme. Since 1988 this has included routine vaccination of all children under age five. Fully subsidised
vaccination is also available to children up to age 16 years, household contacts of identified HBV carriers and their sexual partners. These developments have all followed increasing awareness of hepatitis B as an important problem in New Zealand and a steady fall in vaccine costs. Further improvements could be made in vaccine delivery to children as demonstrated by the results of the recent immunisation coverage survey [1]. Also there has yet to be a comprehensive evaluation of vaccine delivery to the infants of HBV carrier mothers. Another area that has received little investigation is that of extending hepatitis B vaccination for high-risk adults. This appendix will review hepatitis B vaccination for this population.

Recommendations to extend the provision of the hepatitis B vaccination programme to high-risk adult groups were first made by the Hepatitis Subcommittee for the Communicable Disease Control Advisory Committee in 1985 [2]. It was acknowledged by the subcommittee that while these recommendations remain long term goals they were not immediately feasible due to the high cost of vaccination. Since this time the costs of vaccination have dropped dramatically and indeed a Department of Health review of hepatitis B vaccination in 1990 recommended a review of the issue of adult vaccination [3]. Since this time other public health professionals have even raised the question of mass hepatitis B vaccination for the general New Zealand population [4].

**Epidemiology of hepatitis B in adult New Zealanders**

No specific study has investigated the epidemiology of hepatitis B in adult New Zealanders. However, a study of pregnant women throughout the country gives perhaps the best approximation [5]. The results presented in Table 1 highlight the regional differences in marker prevalence and a north-south gradient. Other studies highlight the major differences in marker prevalence by ethnicity [6]. Data for other adult populations are detailed below and the key studies are summarised in Table 1.
**Sexually Active Heterosexual Adults:** The only sero-survey data available on this group are from a study of 1000 STD clinic attenders in Christchurch in 1981 [7]. This found that 18.2% of attenders had HBV markers which is over double that found for pregnant women in the South Island [8]. Current surveillance data from STD clinics reveals that hepatitis B carriers are regularly diagnosed at STD clinics. The national average is 16 new cases each month [9]. Regional differences in the data are apparent with a disproportionate number of cases occurring in the eastern North Island (see Figure 1). Trends in some sexually transmissible diseases and teenage pregnancy suggest that unprotected sexual intercourse in young people is fairly common [10].

**Men Who Have Sex With Men:** One study on sera from 200 homosexual males in the Auckland region found a total hepatitis B marker prevalence of 35% with 5.5% being HBV carriers [11]. A similar result was found for 137 Caucasian homosexuals in Christchurch with a total marker prevalence of 32% and 4% being HBV carriers [12]. The only other New Zealand study found that 45% of a group of 100 homosexual males from Wellington and Auckland had hepatitis B markers and 12% were HBV carriers [13].

**Prison Inmates:** Inmates of a North Island "borstal institution" were first tested for hepatitis B markers in 1972 with results suggesting a HBV carriage rate of 19% [14]. This result may be inaccurate however, as this was obtained in the early years of hepatitis B testing. The only other published data found a total marker prevalence of 58% in 100 Auckland prisoners [15]. The HBV carriage rate in this group was 6%. Preliminary results from an investigation into an outbreak of hepatitis C in a South Island prison also indicate a hepatitis B marker prevalence rate of 33% of 273 inmates and a 3.7% rate of carriage (Brunton C, personal communication 1992).

Anecdotal reports suggest that a wide range of risk behaviours occur in the inmate population, including sharing intravenous drug using equipment, tattooing with unsterilised equipment, and unprotected anal and oral intercourse. Evidence of these behaviours has been documented in a joint Department of Justice and Department of Health study [16]. The provision of supplies of
Figure 1 Hepatitis B Carriage in STD / Sexual Health Clinic Attenders in 1991 *

Area Health Board

- Northland
- Auckland
- Waikato
- Bay of Plenty
- Tairawhiti
- Taranaki
- Hawkes Bay
- Manawatu-Wanganui
- Wellington
- Nelson-Marlborough
- Canterbury
- West Coast
- Otago
- Southland
- New Zealand

Cases / 100,000 Population

* For cases first detected in a New Zealand STD/Sexual Health Clinic.
bleach to allow the cleaning of tattooing and injecting equipment appears to be relatively common in New Zealand prisons at present.

**Injecting Drug Users:** The only serological investigation into this group in New Zealand found that 76% of 64 injecting drug users in Wellington had hepatitis B markers and 8% were HBV carriers [17]. A small outbreak of acute hepatitis B among injecting drug users has also been described [18]. Of particular note is the prevalence of delta hepatitis virus in this population [19], and its association with mortality [20]. This association is consistent with overseas studies [21].

A high frequency of risk behaviours (sharing drug using equipment and unprotected sexual intercourse) in this population has also been documented in New Zealand [22]. Although needle sharing behaviour may decline further with the Ministry of Health's Needle and Syringe Exchange Scheme, this behaviour is unlikely to completely disappear (Baker M, personal communication, 1993).

**Haemophiliac Patients and Blood Product Recipients:** The only published serological investigation into this group in New Zealand found that 57% of 75 haemophiliacs had hepatitis B markers and 20% were HBV carriers [23].

**Developmentally Disabled:** The first study in a psychopaedic hospital in New Zealand was conducted in 1977 in Canterbury [24]. This found that 83/138 (60%) of patients aged from 10 to 62 years had hepatitis B markers. This figure was very much higher than the marker prevalence found in the Canterbury blood donor pool (less than 2%) at this time.

Also in 1977, a total of 1283 patients in an Otago psychiatric hospital were screened for hepatitis B carriage [25]. This revealed that only 0.8% of this population were HBV carriers. One explanation for this low prevalence was the isolated villa type of accommodation that reduced the extent of interpersonal contact. More recently, a study in a Nelson psychopaedic hospital found
that 61% of the residents had markers and that 37% of residents were HBV carriers [26]. The average age of this group was 30.0 years.

**Haemodialysis Patients:** The only published data on this group in New Zealand is from an outbreak of "serum hepatitis" in the Auckland dialysis unit between 1970 and 1971 [27]. During this time 15 cases of hepatitis occurred in patients (41% of the patients in the unit) and an additional four patients had serological evidence of past hepatitis B infection. Subsequent improvements in hospital infection control may have reduced this risk in the New Zealand setting but the extent of this is unknown.

**Travellers to High Prevalence Areas:** There are no New Zealand data on the risks to travellers to countries with a high prevalence of HBV carriage in the population. There have however been anecdotal reports of New Zealanders acquiring other sexually transmissible diseases in Asia. These reports also suggest that some New Zealand travellers support the sex industry of South East Asia. This is a matter of concern in view of studies from other countries that suggest that sexual transmission of hepatitis B is relatively common in travellers to areas of high hepatitis B endemicity [28].

**Specific Occupational Groups:** A number of sero-prevalence studies have also been undertaken on various occupational groups in New Zealand. These have recently been reviewed elsewhere [29].
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<th>Adult Subpopulations</th>
<th>Hepatitis B Marker Prevalence</th>
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<td>other patients</td>
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<td>Psychopaedic patients (Nelson)</td>
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Notes:
* For the population 15 years and over [44].
Is the vaccination of these high-risk adult groups cost-effective?

The key criterion for introducing or extending a health sector intervention should be its cost-effectiveness in preventing morbidity and mortality. The studies described in this section suggest that vaccination is likely to be cost-effective for all the high-risk adult groups discussed in this review.

The classic work on the cost-effectiveness of hepatitis B vaccination programmes comes from Mulley et al in 1982 [45]. Even at this time, when vaccine costs were $US 100 per course, direct savings to the health care sector were calculated to occur for vaccination programmes for specific groups including homosexual men and surgical residents. When indirect benefits (mainly lost wages) were included, it was calculated that vaccination of populations with hepatitis B incidence rates as low as 1 to 2% would produce savings for the economy. Examination of the models used by Mulley et al suggests that direct cost-savings to the health care sector could occur if vaccination occurs in population groups with annual incidence rates of only 1%. This is provided vaccine purchase and administration costs are under $US 25.

The most thorough recent study took a more comprehensive view of the direct and indirect benefits of vaccination [46]. Even with vaccine costs of $US 108 per vaccine course, it was found that the vaccine programme would only have to avoid one or more cases per year per 6517 low-risk individuals to be beneficial overall (ie an annual incidence rate of only 0.00015 for all cases including subclinical cases). This calculation involves valuation of pain and suffering giving a weighted average value of avoiding a case of hepatitis B at $US 117,000.

It is highly likely that the cost estimates and assumptions made in this study are inappropriate for the New Zealand situation. Nevertheless they would have to be dramatically inappropriate to rule out overall benefits for a vaccination programme for populations with an annual incidence rate of even 0.5% (ie to overestimate the benefits by a factor of 33). Annual incidence rates of greater
than 0.5% are likely for all the groups discussed in this review (Table 1) and hence vaccination for these groups is likely to be cost-effective. Indeed vaccination for nearly all these groups is currently recommended in the United States [47]. A study specifically relating to homosexual men in the United Kingdom also suggested that hepatitis B vaccination was cost-effective, despite high vaccine costs at this time [48].

These data also suggest that the incidence rates for Maori, Polynesian, and pregnant women are high in particular areas (Table 1). The benefit of vaccinating adults in these populations may be less pronounced however, as infection could have occurred largely in childhood. Nevertheless a case can be made for increasing hepatitis B immunisation to young adults in general (see Appendix Six).

**Strategies to improve the provision of hepatitis B vaccination**

The data presented in this review suggest that medical practitioners should consider offering vaccination to the following high-risk adults:

- Those with recently acquired sexually transmitted diseases, sex workers, individuals who have had unprotected sexual activity with multiple partners in the previous six months (and especially those with syphilis and other STDs that cause genital ulceration [49]).
- Sexually active homosexual males.
- Intravenous drug users (and especially those at increased risk of delta agent infection such as Pacific Island Polynesians and migrants from Europe).
- Prison inmates (especially those who use drugs or tattoo themselves or each other).
• Haemophiliacs and other recipients of certain blood products.

• Residents of institutions for the developmentally disabled.

• Haemodialysis patients.

• International travellers who will live for more than six months in areas of high HBV endemicity and who otherwise will be at risk (eg, by being a health care worker, or being likely to have sexual contact with local people).

Practitioners should also remember to provide vaccine for those adults for whom free vaccine is currently available ie, sexual partners of HBV carriers and household contacts of HBV carriers.

This review also highlights the need for health authorities to explore ways of making vaccination less expensive and more accessible to high-risk adult groups. Measures to assist in this include extending immunisation benefits to cover vaccination of particular adult populations and allowing vaccine that is bulk purchased for routine childhood vaccine to be used for adult vaccination.

Acknowledgments

The authors would like to acknowledge the helpful comments made by Dr Don Bandaranayake on the manuscript.
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Appendix Two

THE EPIDEMIOLOGY AND CONTROL OF HEPATITIS B IN OCCUPATIONAL GROUPS

Nicholas Wilson
Public Health Medicine Specialist
Epidemiology Group
April 1993

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Executive summary

Hepatitis B is an important occupational communicable disease and is probably the most important disease in this category for health care workers (HCWs) in New Zealand. Indeed, it is likely that given the high prevalence of carriers in the general New Zealand population (see Part One), the risks for HCWs here may be higher than for other developed countries. In addition, hepatitis B is a readily controllable disease, due largely to a highly effective and safe vaccine. As the cost of this vaccine has declined, its use has increased in occupationally at risk HCWs throughout the world. Given this background, this review aimed to explore the issue of the epidemiology and control of occupationally acquired hepatitis B in the New Zealand context. It particularly focused on reviewing what was known about the New Zealand-specific epidemiology, surveying a range of organisations with "at-risk" occupational groups, and surveying a private sector group (general practitioners) with regard to hepatitis B control measures.

In Part One the impressive array of sero-prevalence studies undertaken in New Zealand on occupational groups and hepatitis B were reviewed. These studies have supported overseas data in suggesting an increase risk for health care workers, particularly those working in dentistry, laboratories and in institutions for the developmentally disabled. Groups for which overseas data are suggestive of increased risk but for which no New Zealand data of note are available include: (i) the staff of non-residential child care and school programmes for the developmentally disabled individuals, (ii) commercial sex workers, and (iii) New Zealand workers who spend significant time periods in developing countries with high levels of HBV endemicity.

New Zealand-based studies have also examined prison officers, customs officers and police officers and found no evidence for increased risk of hepatitis B. Other groups for
which an increased risk is plausible but for which minimal New Zealand or overseas data exists, include sewerage system workers, firefighters, and professional tattooists.

A range of cost-effectiveness studies into hepatitis B vaccination have been conducted internationally. These studies suggested that vaccination is a very cost-effective intervention, particularly when both the direct and indirect (non-pecuniary) benefits of vaccination are considered. The recent reduction in vaccine costs should make vaccination programmes even more attractive to employers and employees.

National guidelines for the vaccination of occupational groups in New Zealand apply only to a few groups (eg, for dental workers) and indeed the responsibility for developing such guidelines has been largely delegated to the professional organisations and area health boards (AHBs).

The survey of AHBs and six other relevant organisations in Part Two examined the effectiveness of local responsibility and control of the vaccination of "at-risk" occupational groups. It found that 10 out of 12 boards and three out of six of the other organisations had fully subsidised vaccination programmes for their high-risk staff. There was however considerable policy variation for certain other group's that could be regarded as being "at-risk" occupations.

None of the organisations surveyed had accurate figures for vaccination coverage of staff, except in certain small districts for particular occupational groups. Nevertheless the estimates for vaccination coverage obtained suggested that coverage was relatively high for groups with well defined elevated risk (laboratory staff, doctors and nurses). The range of coverage between different boards and organisations was large however, with estimates for vaccination coverage for doctors and nurses in some boards being as low as
40%. The range of vaccination was even wider for groups with less well defined levels of risk (eg, laundry and clerical staff). Overall however, coverage of "at-risk" occupational groups remains suboptimal in many AHBs and organisations for groups that are well established as being "at-risk" for hepatitis B infection.

Only around half of the AHBs and other organisations had written vaccination policies. These had on average less than a third of 12 basic criteria necessary for a comprehensive policy. Even so, many of the details relating to these criteria were very scanty. Such inadequacies make it harder for occupational staff to successfully run vaccination programmes and manage some of the difficult issues that can arise.

The relatively poor documentation of hepatitis B coverage in the workforce of each organisation was also apparent from this survey. This factor, combined with the lack of computerised record keeping, makes it harder to target programmes to sectors of the workforce with the lowest coverage rates.

The comments obtained from the occupational health staff suggested frustration at being unable to achieve high vaccination rates in "at-risk" groups, especially medical and nursing staff. This was often despite a large amount of educational work being performed by the occupational health staff involved.

The issue of hepatitis B vaccination in a specific occupational group in the private sector, ie, general practitioners (GPs), was explored in Part Three. As GPs are considered likely to be at increased risk of hepatitis B infection compared to the general population, a survey was undertaken in the Wellington region to explore the extent of this groups vaccination coverage. The survey found that 73% of the responding GPs reported having had hepatitis B vaccination (though the 95% confidence interval for this result being
representative of the Wellington region was large at 60% to 86%). Since some GPs reported immunity through natural infection, a total of 89% of practitioners were therefore immune or vaccinated to hepatitis B. It was of note that GPs practising obstetrics were approximately half as likely to have been vaccinated as those not conducting deliveries, though this difference was not at a statistically significant level. While this survey suggested a reasonable level of protective immunity to hepatitis B among GPs, a significant proportion remain non-immune to hepatitis B and hence susceptible at times when exposure to body fluids may be hard to avoid (eg, when performing emergency procedures). As for a similar survey in Britain, it would seem that the perception of not being at risk and of "just not getting around to it" are the most important reasons for GPs not to get vaccinated.

**Recommendations for Improving the Control of Hepatitis B in Occupational Groups**

The continuing fall of hepatitis B vaccine prices will make vaccination even more cost-effective in the future for "at-risk" occupational groups in New Zealand. Nevertheless, the following recommendations may go some way to accelerating the vaccination coverage in these populations.

1. That the Ministry of Health act on the 1992 recommendation of the Communicable Disease Control Advisory Committee to consider making state purchased vaccine (for childhood immunisation) available to appropriate organisations at cost price to improve the coverage of "at-risk" occupational groups.
2 That the key organisations (Ministry of Health (MOH), the Public Health Commission (PHC), Department of Labour (Occupational Safety and Health, (OSH)) and Regional Health Authorities (RHAs)), recognise and support the key role that medical practitioners, practice nurses and occupational health staff play in controlling hepatitis B in occupational groups. This role involves alerting patients in various occupational groups to the potential risk of infection and in delivering vaccinations in both the general practice and workplace settings.

3 That the key organisations (MOH, PHC and OSH) work together to improve the provision of occupational group specific information and guidelines to AHBs/RHAs and other health sector organisations.

4 That organisations with "at-risk" employees support the effective control of hepatitis B in their workforce by:

- Employing an adequate occupational health workforce.

- Emphasising the importance of good documentation of vaccinations given and supporting the use of computerised systems to facilitate recall and for surveillance of vaccination coverage and needlestick injuries.

- Controlling needlestick injuries and by using the occurrence of such injuries in staff to highlight the importance of hepatitis B vaccination to the injured person and of similarly "at-risk" co-workers.

- Considering adopting a policy of mandatory choice regarding hepatitis B vaccination upon recruitment of new staff.
That the key organisations involved with primary health care workers (MOH, PHC, OSH and the Royal New Zealand College of General Practitioners) act further to encourage uptake of hepatitis B vaccination among general practitioners. In addition the issue of an occupational health service that attends to the needs of primary health care workers needs to be considered.

Some of these recommendations may be inappropriate or not cost-effective for particular organisations. Nevertheless it is important that a range of national and organisational issues be considered to allow further progress in the control of this important occupational communicable disease.
INTRODUCTION

The major reason for reviewing this topic was that hepatitis B is an important occupational communicable disease, especially for health care workers (HCWs) in New Zealand. This is partly a result of the nature of this disease and the relatively high prevalence of carriers in the general New Zealand population compared to other developed countries. In addition, hepatitis B is a readily controllable disease due largely to a highly effective and safe vaccine. As the cost of this vaccine has declined, its use has increased in occupationally "at-risk" HCWs. Despite this, coverage of many groups of HCWs is still suboptimal and this is explored in the New Zealand context in Parts Two and Three of this review.

Focusing on how to improve hepatitis B vaccination programmes may benefit both the unvaccinated and the vaccinated. The latter may be relevant because the need for booster doses (eg, at 15 years after the initial course) may become apparent in the future. Similarly if vaccines against hepatitis C and HIV become available, then vaccination programmes similar in structure to those for hepatitis B may need to be organised.
PART ONE

WHAT OCCUPATIONAL GROUPS IN NEW ZEALAND SHOULD BE VACCINATED AGAINST HEPATITIS B?

Introduction

Although New Zealand has developed an impressive state-funded hepatitis B vaccination programme, this has largely focused on the childhood population to date. There is no doubt that this policy has been appropriate in view of the high hepatitis B virus (HBV) carriage rates resulting from infection in early life [1]. Nevertheless adult HBV infection is also of concern due to the greater importance of acute clinical illness in this population (at 30-40% of infections [2]). For this reason the issue of hepatitis B vaccination for various high-risk adults was recently reviewed in the New Zealand context [3]. This review paper develops this theme further by focusing on occupational groups.

Epidemiology of Hepatitis B in Various Occupational Groups in New Zealand

The epidemiology of hepatitis B in New Zealand is characterised by major differences in marker prevalence by ethnicity [4]. Regional differences including a north-south gradient, independent of ethnicity, are also apparent. These aspects are highlighted by the national and regional studies summarised in Table 1. Such studies provide some basis upon which to interpret the more specific data collected on occupational groups. New Zealand-specific data on these occupational groups are detailed below.
Staff Working With the Developmentally Disabled

The studies on these workers provide some limited evidence for an elevated risk. Marker prevalence rates for Christchurch psychopaedic nurses (13%)[5], and Nelson psychopaedic workers (16%)[6], have been examined. Although not strictly comparable, these results were marginally higher than the nearest comparable population of pregnant women in the southern region who had a marker prevalence rate of 8% [7]. Psychiatric workers in Otago were noted to have fairly low HBV carriage levels of 0.8% but this was not compared to the rate in other local populations [8].

There is little doubt that hepatitis B chronic carriage is relatively common in the developmentally disabled population in New Zealand [9,10,11,12]. This is particularly the case for children compared to adults. For example, hepatitis B markers were found in 50% of sera from 133 intellectually handicapped children in the Wellington region in 1986 [13]. Of the total group of children, 25% were also HBV carriers.

Dental Workers

The incidence of viral hepatitis in New Zealand dentists has been an area of occupational health concern for some time [14]. One seroepidemiological survey in Christchurch found hepatitis B markers at the following levels: dentists 14%, dental assistants 7.4% and school dental nurses 6.9% [15]. These rates were compared to the marker level in the general Canterbury blood donor population of less than 2%. Another study in school dental nurses found that 23% were hepatitis B marker positive though results varied
widely throughout the country [16]. The results provided some evidence that many of the nurses were infected during adult life but the role of occupation was unclear.

**Hospital and Laboratory Staff**

The first sero-survey in this area examined hepatitis B in hospital staff in Canterbury [17]. The marker prevalence in decreasing order was dental staff (36%), medical staff (22%), general hospital staff (13%), laboratory staff (11%), and nursing staff (10%). Another study in Auckland found that 20% of technical (i.e., laboratory) staff had HBV markers [18]. There was a statistically significant difference between this group and marker prevalence in random new blood donors in Auckland (14.1%) and "non blood" laboratory staff (5.6%).

A hospital outbreak of hepatitis B has also been documented in the early 1980s where a HBV infected patient infected three staff [19]. One of these staff further infected two other patients. This situation highlights the potential of nosocomial hepatitis B infection that has also been well documented overseas [20]. Indeed there are several New Zealand studies that highlight the high rates of HBV infection in groups having contact with health professionals. Examples include injecting drug users in treatment programmes [21], patients with haemophilia [22], and haemodialysis patients [23].

**Commercial Sex Workers**

New Zealand data on the sexually active population is limited to sero-prevalence rates in STD clinic attenders [24] and homosexual men [25,26,27]. While these groups appear to be at increased risk of STDs (including hepatitis B), it is unclear if this is also currently the
case for commercial sex workers. Although overseas data suggests some risk [28],
anecdotal reports in New Zealand suggest that this occupational group have high rates of
barrier contraceptive use. Indeed this behaviour is supported and condoms are supplied
by organisations such as the Prostitutes Collective. Nevertheless, sex workers who are
part time and have less of a professional focus (eg, street sex workers) may have lower
rates of condom use and be at increased risk of STDs. Such a group were involved in an
outbreak of penicillinase-producing gonorrhoea in Auckland recently [29].

Workers Travelling to High Prevalence Areas

There are no New Zealand data on the risks to travellers to countries with a high
prevalence of HBV carriage in the population. Studies from other countries do suggest
however that unprotected sex is relatively common in overseas aid workers and business
travellers working in areas of high hepatitis B endemicity [30].

Military Personnel

Military personnel do not appear to be at increased risk of HBV infection [31]. However
increased risk can occur for soldiers who provide emergency care to combat casualties
[32], and when military personnel are assigned to high-risk areas [33]. The latter may be
particularly relevant for New Zealand troops in view of the high hepatitis B endemicity of
most Pacific Islands and parts of South East Asia [34].
Groups at Minimal or No Increased Risk

**Police and Customs Officers:** An extensive national cross-sectional study has found that the marker prevalence rates for police officers and customs officers were no greater than the rates for civilians employed in both organisations [35]. Despite the lack of evidence for any increased risk, many police have been supplied with hepatitis B vaccination by their employers.

**Prison Officers:** The only New Zealand study on prison officers found that 23% of this group had HBV markers [36]. There was no statistical association between marker status and years of time spent in prison service. Indeed the ethnic mix of this group suggested that marker levels were likely to reflect the normal population. Nevertheless, some theoretical risk may exist if prison officers received injuries from inmates as this population is known to have relatively high HBV carriage rates [37,38]. Prisoners are also known to engage in relatively high-risk behaviours for HBV infection [39]. Due to these and other concerns, prison officers are generally provided with hepatitis B vaccination by their employers (Brunton C. personal communication, 1992).

**Sewerage System Workers:** Although some New Zealand sewerage workers are offered vaccination by their employers, the international evidence does not support evidence of increased risk [40]. There is no published New Zealand data on this occupational group. Despite these findings, there are a range of theoretical reasons why sewerage system workers may be at increased risk of hepatitis B. These include the following: (i) performing work with a significant risk of minor injuries that puncture the skin; (ii) performing work in confined spaces (where contact could be made with blood from minor injuries); (iii) contact with sewage that may contain hepatitis B virus from blood products or semen and (iv) contact with discarded drug injecting equipment in the sewerage system.
**Firefighters:** Even though firefighters are involved in emergency and rescue work no increased risk for hepatitis B has yet been documented. Nevertheless a review of the available data by the Occupational Safety and Health Administration in the United States suggested that this group (along with police and prison officers) were at increased risk [41].

**Other Groups:** This author is aware of anecdotal reports of workers who suffer occasional needlestick injuries from discarded syringes. This group includes cleaners of public facilities (Dr D Matheson, personal communication), cleaners of international aircraft (Dr D Black, personal communication), and garbage disposal workers. If these discarded syringes have frequently been used by injecting drug users (a group with a high-risk of hepatitis B carriage) as opposed to insulin dependent diabetics, then such workers may well be at some increased risk of hepatitis B. An increased risk may also exist for tattooists and beauticians who may be involved in practices that penetrate the skin of clients (eg, during "electrolysis" procedures).
Table 1  Summary of Key Sero-Prevalence Data for the National Population and Occupational Groups in New Zealand

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Study size</th>
<th>Marker Prevalence</th>
<th>Year of study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>total - HBsAg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>markers %</td>
<td></td>
</tr>
<tr>
<td>National Studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant Women (all NZ)</td>
<td>1198</td>
<td>26 3.3</td>
<td>[43] 1984</td>
</tr>
<tr>
<td>Northern region</td>
<td>91</td>
<td>39 2.8</td>
<td></td>
</tr>
<tr>
<td>Central region</td>
<td>829</td>
<td>24 3.9</td>
<td></td>
</tr>
<tr>
<td>Southern region</td>
<td>78</td>
<td>8 0</td>
<td></td>
</tr>
<tr>
<td>Civilians (Police &amp; Customs Depts)</td>
<td>691</td>
<td>55 1.8</td>
<td>[44] 1991</td>
</tr>
<tr>
<td>Maori</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European</td>
<td>55</td>
<td>7 1.8</td>
<td></td>
</tr>
<tr>
<td>National Immunisation Survey</td>
<td>1000</td>
<td>13 1.8</td>
<td>[45] 1985</td>
</tr>
<tr>
<td>(at age 15)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional Studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood donors (Auckland)</td>
<td>1002</td>
<td>12 2.4</td>
<td>[46] 1982</td>
</tr>
<tr>
<td>Population of Kawerau (all)</td>
<td>7901</td>
<td>42 6.6</td>
<td>[47] 1984</td>
</tr>
<tr>
<td>Europeans (adults)</td>
<td>3106</td>
<td>31 1.8</td>
<td></td>
</tr>
<tr>
<td>Non-European (adults)</td>
<td>1863</td>
<td>62 12.0</td>
<td></td>
</tr>
<tr>
<td>Pregnant Women (Taranaki)</td>
<td>1094</td>
<td>13 1.3</td>
<td>[49] 1988</td>
</tr>
<tr>
<td>Occupational Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff Working With the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developmentally Disabled:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychopaedic nurses (Canterbury)</td>
<td>127</td>
<td>13 0.8</td>
<td>[50] 1977</td>
</tr>
<tr>
<td>Psychiatric workers (Otago)</td>
<td>73</td>
<td>0 0</td>
<td>[51] 1979</td>
</tr>
<tr>
<td>Psychopaedic workers (Nelson)</td>
<td>129</td>
<td>16 0</td>
<td>[52] 1991</td>
</tr>
</tbody>
</table>
### Table 1 Contd  
Summary of Key Sero-Prevalence Data for the National Population and Occupational Groups in New Zealand

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Study size</th>
<th>Marker Prevalence</th>
<th>Year of study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(total - HBsAg)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>markers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Dental Workers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School dental nurses:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European</td>
<td>954</td>
<td>27</td>
<td>&lt;1</td>
</tr>
<tr>
<td>non-European</td>
<td>40</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Canterbury Dental Workers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dentists</td>
<td>60</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>dental assistants</td>
<td>81</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>school dental nurses</td>
<td>88</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Hospital and Laboratory Staff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital laboratory personnel (Auckland)</td>
<td>519</td>
<td>20</td>
<td>1.7</td>
</tr>
<tr>
<td>Hospital Staff Christchurch:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>medical</td>
<td>67</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>nursing</td>
<td>93</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>laboratory staff</td>
<td>140</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>dental staff</td>
<td>11</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td>general hospital staff</td>
<td>338</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td><strong>Groups at Minimal or No Increased Risk</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Police officers</td>
<td>5193</td>
<td>12</td>
<td>[57] 1991</td>
</tr>
<tr>
<td>Customs officers</td>
<td>1026</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Prison officers</td>
<td>132</td>
<td>23</td>
<td>[58] 1988</td>
</tr>
</tbody>
</table>
The Cost-effectiveness of Vaccinating Occupational Groups

The cost-effectiveness of delivering hepatitis B vaccine to particular occupational groups has been examined in detail for the following groups: laboratory personnel [59], dental staff [60], surgical residents [61], and high-risk medical centre personnel [62]. These studies suggested that vaccination is a cost-effective intervention, even when vaccine costs exceed $US 100 per course. A more recent study took a comprehensive view of both the direct and indirect (non-pecuniary) benefits of vaccination [63]. It found that a vaccination programme in the occupational setting would only have to avoid one or more cases per year per 6517 low-risk individuals to be beneficial overall (i.e., an annual incidence rate of only 0.00015 for all cases including subclinical cases).

Improving Vaccination Policies in New Zealand

The data presented in this review are consistent with the international literature that suggests an increased risk of infection for certain occupational groups. These groups are listed in Table 2.
<table>
<thead>
<tr>
<th>Benefit</th>
<th>Occupational group</th>
</tr>
</thead>
<tbody>
<tr>
<td>•••</td>
<td>health care workers including dental and laboratory workers (particularly if their tasks involve contact with blood or blood-contaminated body fluids);</td>
</tr>
<tr>
<td>••×</td>
<td>staff of institutions for the developmentally disabled;</td>
</tr>
<tr>
<td>××</td>
<td>staff of non-residential child care and school programmes for developmentally disabled individuals attended by one or more known HBV carriers;</td>
</tr>
<tr>
<td>××</td>
<td>commercial sex workers;</td>
</tr>
<tr>
<td>××</td>
<td>those planning to work for significant time periods in developing countries with high levels of HBV endemicity.</td>
</tr>
<tr>
<td>××</td>
<td>prison officers;</td>
</tr>
<tr>
<td>××</td>
<td>police;</td>
</tr>
<tr>
<td>××</td>
<td>sewerage system workers;</td>
</tr>
<tr>
<td>××</td>
<td>firefighters;</td>
</tr>
<tr>
<td>××</td>
<td>professional tattooists.</td>
</tr>
</tbody>
</table>

**Notes:**

- ••• Groups for which the New Zealand and international data suggest increased risk.
- •× Groups for which some international data suggest increased risk [64], but for which no New Zealand data exist.
- × Groups in which the benefit from vaccination (relative to the general population) is plausible but remains unclear.

Guidelines covering vaccination for dentists have been available for some time in the New Zealand setting [65]. The responsibility for development of guidelines for other occupational groups has been largely delegated to the appropriate organisations and area
health boards [66]. In some situations particular organisations have achieved high vaccination rates, especially for laboratory and medical personnel. In other groups vaccination rates may be low. One recent survey found that only 4% of psychopaedic staff had been vaccinated despite work in a relatively high-risk environment [67]. Indeed some of the organisations caring for the developmentally disabled do not have any hepatitis B vaccination policy (see Part Two).

With the continuing fall of vaccine prices there remain few reasons not to continue to improve vaccination for occupational groups. In addition, steps by the Ministry of Health to make state-purchased vaccine (for childhood immunisation) available to appropriate organisations at cost price would facilitate attempts to increase coverage. This action alone could reduce the cost of the vaccine by up to four times. The Department is reviewing this option at present [68].

Medical practitioners, practice nurses and occupational health staff continue to have a key role in alerting those in particular occupations to the possibility of increased risk from HBV. They are also the means by which hepatitis B vaccination can be delivered, in both the general practice and workplace settings.

**Acknowledgments**

The author would like to thank Dr Don Bandaranayake and Dr Michael Baker for their helpful comments on the manuscript.
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46 Anderson RA, Woodfield DG. loc. cit.

47 Milne A, Allwood, GK, Moyes CD, Pearce NE. loc. cit.


50 Faoagali JL, Young SA. loc. cit.

51 Maguire T, McInnes EJ. loc. cit.


53 de Liefe B, Miller JA, Salmond CE. loc. cit.


55 Anderson RA, Woodfield DG. loc. cit.


57 Bandaranayake DR, Salmond CE, Tobias MI, loc. cit.

58 Cullen R, loc. cit.


Introduction

Infection from hepatitis B has long been recognised as a threat to health care workers [69]. Following the advent of specific serological tests in the 1970s this risk has become better defined. Various seroepidemiological studies have indicated that dentists, doctors and laboratory workers have a three- to fivefold elevated risk [70,71]. In addition, a range of studies has demonstrated that hepatitis B virus (HBV) has become the most important infectious disease of health care workers (HCW) in developed countries [72]. This is likely to also be the case in New Zealand though confirmatory data on this point are lacking.

Fortunately, a range of strategies is available to prevent HBV in the workplace including: (i) better HCW understanding of the pathways of HBV transmission, (ii) implementation of universal precautions to prevent exposure to blood and body fluids; and (iii) hepatitis B vaccination. Use of these strategies appears to have contributed to declining HBV infection rates among HCWs in some countries such as Sweden [73], and parts of the United States [74]. Limited data also suggest this trend is present in New Zealand (see Chapter Three).
Of the strategies available, vaccination is possibly the most effective. Yet its use over the
decade since its introduction, in 1982, is still not particularly high among HCWs. Price
was a significant barrier in the past, but vaccine costs have declined dramatically in recent
years. It appears that organisational issues such as the availability of a vaccination
programme through a well organised occupational health service may now be the major
determinant of HCW vaccine uptake. To assess the importance of this issue in the New
Zealand health sector, the following study was undertaken.

**Methods**

A survey form was developed and posted to the managers of the occupational health
service of area health boards (AHBs) in July 1992. The form was also sent to six other
organisations which employed staff that were known to be or could conceivably be
considered at increased risk of hepatitis B. These organisations included the Armed
Forces, the Police Force, the Justice Service, the Family Planning Association, the
Crippled Children Society (CCS) and the IHC. A reminder letter was sent to the relevant
person if no response was received within four weeks of the initial mailout.

To establish criteria necessary for a comprehensive vaccination policy a range of key
documents was also reviewed [75,76].
Results

Results for Area Health Boards

Completed survey forms were obtained from 12 of the 14 area health boards (86%). One of the boards declining involvement cited excessive work commitments as the reason for their nonresponse. Responses were obtained from all six of the non-AHB organisations.

Of the 12 AHBs who responded, 10 had fully subsidised vaccination programmes for their high-risk staff (Table 1). There was considerable policy variation for clerical staff and those in the "other AHB staff" category. Written policies for staff hepatitis B vaccination were present in 11 of the 12 boards. However, several respondents noted that these policies were either very limited or out of date. Seven out of the 12 provided a copy of the policy as requested. One board reported an informal policy of "not encouraging the vaccination of clerical staff".
Table 1 AHB Policies for Hepatitis B Vaccination of Specified Occupational Groups

<table>
<thead>
<tr>
<th>Vaccination Policy</th>
<th>Laboratory</th>
<th>Doctors</th>
<th>Nurses</th>
<th>Laundry</th>
<th>Clerical</th>
<th>Other#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccination is fully subsidised</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Vaccination is partly subsidised*</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Vaccination is encouraged (via GP)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>There is no policy on vaccination</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes:
# This group included the following: ambulance drivers, mortuary staff, administration staff who handle/transport serum specimens, plumbers, electricians, community health workers other than district nurses, food service workers, drivers, gardeners, social workers, ward domestic staff, orderlies, central sterilising supply department staff, cleaning services staff, orthotic department staff, dental staff.

In three of the AHBs the hepatitis B vaccination records were decentralised (ie managed at a district level). Two of these boards supplied the information requested in this survey. In the remaining board, restructuring and personnel changes prevented this information being collected.

No AHB had accurate figures for vaccination coverage of its staff except in certain districts for particular occupational groups. Nevertheless estimates for vaccination coverage within relatively broad ranges were obtained (Table 2). These results suggest that vaccination rates are relatively high for groups with well defined elevated risk (laboratory staff, doctors and nurses). The range of coverage between boards was large.
however, with estimates for vaccination coverage for doctors and nurses in some boards being as low as 40%. The range of vaccination was even wider for groups with less well defined levels of risk (eg, laundry and clerical staff).

Table 2  Vaccination Coverage by Occupational Group as Estimated by the Occupational Health Staff of the Organisation

<table>
<thead>
<tr>
<th>Occupational Group</th>
<th>No. of AHBs Vaccinating</th>
<th>Mean Coverage</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory staff</td>
<td>10</td>
<td>90%</td>
<td>60% - 100%</td>
</tr>
<tr>
<td>Doctors</td>
<td>10</td>
<td>85%</td>
<td>40% - 100%</td>
</tr>
<tr>
<td>Nurses</td>
<td>10</td>
<td>80%</td>
<td>40% - 100%</td>
</tr>
<tr>
<td>Laundry staff#</td>
<td>10</td>
<td>75%</td>
<td>50% - 100%</td>
</tr>
<tr>
<td>Clerical staff#</td>
<td>9</td>
<td>30%</td>
<td>0% - 100%</td>
</tr>
<tr>
<td>Other*#</td>
<td>9</td>
<td>60%</td>
<td>0% - 100%</td>
</tr>
</tbody>
</table>

Notes:

# Vaccination coverage applied to "at-risk" selected staff only in some boards (ie certain laundry staff in three boards, certain clerical staff in four boards, and certain "other staff" in six boards).

* This group included the following: ambulance drivers, mortuary staff, administration staff who handle/transport serum specimens, plumbers, electricians, community health workers other than district nurses, food service workers, drivers, gardeners, social workers, ward domestic staff, orderlies, central sterilising supply department staff, cleaning services staff, orthotic department staff, dental staff.

All of the respondents from AHBs stated that only written records of the hepatitis B vaccination status of staff were kept. One board was exploring the computerisation of this
information. All except one board stated that they would like more information on the issue of the provision of hepatitis B vaccination to occupation groups.

**Results for Other Organisations**

An even wider range of both policies and vaccination coverage existed for the other organisations surveyed (Table 3). Indeed, three of these organisations lacked any written policy and one organisation seemed to have no involvement with hepatitis B vaccination activities at all. All three of these organisations were involved in the health care sector. In addition two of the organisations were not able to provide estimates of vaccination coverage in their "at-risk" groups. Estimates obtained also varied widely as shown in Table 3.

Only two of the organisations kept written records on hepatitis B vaccination. All but one was interested in obtaining further information on hepatitis B vaccination for occupational groups.
Table 3 Vaccination Policies and Coverage in a Range of Other Organisations

Other Organisations
(Coded to preserve anonymity)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Fully</td>
<td>No policy</td>
<td>Fully</td>
<td>Partly</td>
<td>Partly</td>
</tr>
<tr>
<td></td>
<td>90%</td>
<td>?%</td>
<td>?%</td>
<td>90%</td>
<td>50%</td>
</tr>
<tr>
<td>Group 2</td>
<td>Fully</td>
<td>No policy</td>
<td>No policy</td>
<td>No policy</td>
<td>No policy</td>
</tr>
<tr>
<td></td>
<td>&lt;20%</td>
<td>?%</td>
<td>?%</td>
<td>&lt;20%</td>
<td>70%</td>
</tr>
</tbody>
</table>

Notes:
Group 1 = "Increased risk staff" ie, staff at definitely increased risk of occupationally acquired hepatitis B.
Group 2 = "Possible risk staff" ie, staff at possibly increased risk of occupationally acquired hepatitis B.
"Fully" - Vaccination fully subsidised.
"Partly" - Vaccination partly subsidised.
"-" Not applicable.

Review of Policy Documents

Hepatitis B vaccination policy documents were reviewed according to a set of criteria. These criteria are detailed in Table 4. Of note was the finding that at most only one out of seven AHBs had more than eight of the 12 criteria. Indeed the average number of criteria met was only 3.2 out of 12. Even so, many of the details in the documents relating to these criteria were very scanty.
Table 4  Criteria for a Comprehensive Hepatitis B Vaccination Policy

<table>
<thead>
<tr>
<th>Areas Documented in the Policy</th>
<th>AHBs (N=7)</th>
<th>Other Organisations (N=3)</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility</td>
<td>5</td>
<td>2</td>
<td>70</td>
</tr>
<tr>
<td>Consent for vaccination</td>
<td>1</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Pre-vaccination blood screening</td>
<td>3</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Vaccine administration</td>
<td>4</td>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>Vaccine documentation</td>
<td>3</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>Follow-up procedures for subsequent doses</td>
<td>4</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>The post vaccination blood screen</td>
<td>4</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Vaccination strategies for non-seroconverters</td>
<td>4</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Booster requirements</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Procedures and equipment necessary for managing anaphylaxis</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Policy is integrated or cross referenced with the protocol for needlestick injury management</td>
<td>2</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

AHB policy varied considerably. Key examples of these variations were: (i) the post vaccination evaluation blood test occurred at three different times (at one month, three months and six months); (ii) long term post vaccination checks on antibody status varied from one year to five years after vaccination; (iii) boosting of vaccinees with inadequate antibody response varied from one dose to three doses.
In addition to these variations, most policies implied that pre-vaccination screening was an essential requirement before getting vaccinated. This policy contrasts with the position of the US Occupational Safety and Health Administration which states that such screening be offered as an option in its Workplace and Safety Manual.

One unusual practice conducted in the policy of one board was to give an initial 1/10th dose of vaccine that would be followed by a 9/10ths dose one to two weeks later if no adverse reaction occurred. This approach is not supported in any of the literature on hepatitis B vaccination.

Comments by Occupational Health Staff

The comments obtained from some of the respondents suggested frustration at being unable to achieve high vaccination rates in medical and nursing staff. This was often despite a large amount of educational work being performed by the occupational health staff involved. One respondent noted that even with extensive education and fully subsidised vaccine, an estimated 30-40% of the staff in this particular board did not want vaccination. It was noted however that the occurrence of an incident where body fluid exposure occurred would often prompt interest in hepatitis B vaccination by the worker involved.

A respondent representing one of the non-AHB organisations also noted that concern over HIV transmission from hepatitis B vaccination had been an important concern in the recent past. However, this concern had subsided after a vigorous education campaign within the organisation aimed at alleviating it.
Respondent's Suggestions for Improving Vaccination Cover

Suggestions for improving hepatitis B vaccination coverage included the need for more education of the health workforce, organised at a national level. Respondents also felt that there was a need to focus education on vaccination in the medical and nursing training programmes. The issue of making hepatitis B vaccination a condition of employment for non-immune staff was mentioned. The need to improve staffing in the occupational area was also raised along with a general need for greater support from management for health and safety. Access to cheaper vaccination (possibly through greater subsidisation by the employer) was also mentioned as being an important aspect to improving vaccination coverage.

Discussion

The response rate to this survey was relatively high in view of the organisational changes affecting occupational health staff during 1992. Indeed the restructuring and industrial action in much of the health sector in 1992 is likely to have generated a lot of work for occupational health staff (eg, in responding to new management structures and high staff turnover). This workload is likely to have reduced the time available for answering surveys as well as maintaining activity in on-going programmes (such as hepatitis B vaccination).

The most important finding from this survey is that coverage of "at-risk" occupational groups remains suboptimal in many AHBs and organisations with "at-risk" occupational groups. Even though vaccination rates have steadily increased over the last decade, current rates of coverage would appear to be to low in view of the relatively low cost of
vaccination. Indeed, inadequate vaccination may even increase overall costs for health care organisations given current estimates of the high cost-effectiveness of vaccinating occupationally exposed workers [77].

Another important finding was the inadequate content of vaccination policies held by these organisations. In general there were also significant gaps in the comprehensiveness of these policies. Such inadequacies make it harder for occupational staff to successfully run vaccination programmes and to manage any difficulties that arise.

The relatively poor documentation of hepatitis B coverage in the workforce of each organisation was also apparent from this survey. This factor, combined with the lack of computerised record keeping, makes it harder to target programmes to sectors of the workforce with the lowest coverage rates. Computerised record keeping would also allow a range of functions that would reduce administrative burdens on occupational staff (eg, automatic vaccination reminder letters and letters with results could be generated).

Suggestions from the respondents to this survey and other occupational health professionals have highlighted a range of strategies to improve the delivery of hepatitis B vaccine to health care workers. At a national level some of the following options would appear to be worth exploring:

- Improved information provision to AHBs and other health sector organisations concerning vaccination of their workforce.

- Permission for state purchased vaccine to be used by boards and selected organisations for vaccinating staff. This option is already being considered by the Ministry of Health [78].
While a national approach encourages consistency and is often the most efficient, effective action at the organisation level is always critical. Some of the necessary options that were raised in this survey are as follows:

- Employment of an adequate occupational health workforce by the organisation.

- An emphasis on good documentation and use of computerised systems to facilitate recall and for surveillance purposes.

- Improving control of needlestick injuries and use of these injuries to highlight the importance of vaccination to the injured person and to co-workers. There are approximately 120 such injuries reported per month in the Auckland AHB alone (Dr V Hope, personal communication 1992).

- Giving consideration to adopting a policy of mandatory choice upon recruitment of new staff. This could include the obligation to sign a form that stated that the employee had refused to have free vaccination.

Some of these possibilities may be inappropriate or not cost-effective for particular organisations. Nevertheless it is important that a range of national and organisational issues be considered to allow further progress in the control of this important occupational communicable disease.
Acknowledgments

The authors gratefully acknowledges the time and effort put into this survey by the occupational health staff in the area health boards and other organisations involved.
APPENDIX TWO A

DETAILED RESULTS FOR INDIVIDUAL AHBS AND
HEALTH SECTOR ORGANISATIONS

The results for each organisation and AHB are listed in Table 5. These results are coded to maintain anonymity.

Table 5  Vaccination Provision to Particular Occupational Group by Organisation

<table>
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<tr>
<th>Organisation</th>
<th>Lab</th>
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<th>Nurse</th>
<th>Laundry</th>
<th>Clerical</th>
<th>Other#</th>
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</tbody>
</table>

Notes: HD - Health district; F - Vaccination fully subsidised; P - Vaccination partly subsidised; E - Encouraged to be vaccinated (by their GP); N - No policy; (%) - Coverage; # - Varies with district (includes F, P and N); U - Policy unknown.
This group included the following: ambulance drivers, mortuary staff, administration staff who handle/transport serum specimens, plumbers, electricians, community health workers other than district nurses, food service workers, drivers, gardeners, social workers, ward domestic staff, orderlies, central sterilising supply department staff, cleaning services staff, orthotic department staff, dental staff.

Table 6  Vaccination Coverage by Occupational Group as Estimated by the Occupational Health Staff of Each Organisation

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Lab</th>
<th>Doctor</th>
<th>Nurse</th>
<th>Laundry</th>
<th>Clerical</th>
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<tr>
<td>D</td>
<td>90*</td>
<td>?</td>
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</tr>
<tr>
<td>F</td>
<td>80*</td>
<td>80*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

* Estimate (ie plus or minus 10%).
This group included the following: ambulance drivers, mortuary staff, administration staff who handle/transport serum specimens, plumbers, electricians, community health workers other than district nurses, food service workers, drivers, gardeners, social workers, ward domestic staff, orderlies, central sterilising supply department staff, cleaning services staff, orthotic department staff, dental staff.
These draft guidelines are included to assist organisations that are considering revising their hepatitis B vaccination policies. Such guidelines build on the policy document produced by the Auckland AHB and other key documents [79].

Eligibility for Vaccination

Options available include a policy for all staff (including part time staff in the organisation) or staff considered to be at certain levels of increased risk. The "all staff vaccination" option has significant advantages in being simple and likely to minimise inter-occupational group demarcation concerns.

However, due to the cost of vaccination, a case can be made for targeted programmes for selected staff. Indeed the risk of acquiring hepatitis B infection from occupational exposures is entirely dependent on the frequency of percutaneous and permucosal exposures to blood or blood products. If occupational tasks involve contact with blood or blood-contaminated body fluids, these workers are the most likely to benefit from vaccination. As it is recognised that the risks of hepatitis B are often highest in the training phase of employees' careers, it is desirable that vaccination be completed during training and before potential contact with blood.
The following grading of risk for all AHB staff could be used to maximise the targeting of the vaccination programme (Table 7). In certain situations these gradings may require modification to suit local risks present in particular work situations.

Table 7  A Model for the Prioritisation of HCW Groups for Hepatitis B Vaccination

<table>
<thead>
<tr>
<th>Highest Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory staff</td>
</tr>
<tr>
<td>Medical officers</td>
</tr>
<tr>
<td>Nursing staff in the following areas:</td>
</tr>
<tr>
<td>Emergency Departments</td>
</tr>
<tr>
<td>Operating Theatres &amp; Anaesthetic Departments</td>
</tr>
<tr>
<td>Intensive care</td>
</tr>
<tr>
<td>Surgical wards</td>
</tr>
<tr>
<td>Dialysis/Renal Departments</td>
</tr>
<tr>
<td>Blood Bank &amp; Blood Donor Centres</td>
</tr>
<tr>
<td>Central Sterile Supply Department (CSSD) staff</td>
</tr>
<tr>
<td>Laundry staff who have contact with unwashed materials</td>
</tr>
<tr>
<td>Ambulance staff (full-time and volunteer)</td>
</tr>
<tr>
<td>General practitioners practising obstetrics and minor surgery</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurses on other wards</td>
</tr>
<tr>
<td>Rubbish collectors</td>
</tr>
<tr>
<td>Orderlies</td>
</tr>
<tr>
<td>General practitioners not practising obstetrics and minor surgery</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lowest Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumbers</td>
</tr>
<tr>
<td>Electricians</td>
</tr>
<tr>
<td>Engineers</td>
</tr>
<tr>
<td>Orthotics Department staff</td>
</tr>
<tr>
<td>X-ray Department staff</td>
</tr>
<tr>
<td>Physiotherapists</td>
</tr>
<tr>
<td>Occupational therapists</td>
</tr>
<tr>
<td>Gardeners</td>
</tr>
<tr>
<td>Drivers</td>
</tr>
<tr>
<td>Other laundry staff</td>
</tr>
<tr>
<td>Clerical &amp; managerial staff</td>
</tr>
<tr>
<td>Other AHB staff not described above</td>
</tr>
</tbody>
</table>
Consent For Vaccination

There should be a standard consent procedure with the following information being provided to the prospective vaccinee:

- Costs involved to the person (if any).
- Benefits of vaccination.
- Possible short term side effects of vaccination (e.g., some discomfort at the injection site) and an extremely small risk of hypersensitivity reactions.
- Absence of any proven adverse long term effects of vaccination.
- That while prevaccination screening is generally desirable, it may identify them as a hepatitis B carrier (with implications for their potential involvement in continuing to perform invasive procedures, if this was part of their employment).

Pre-vaccination Blood Screening

Consideration should be given to offering a pre-vaccination blood screen as this can be cost-saving for the organisation or to employee (if the latter is paying). The provision of the first dose of vaccine at the time the blood test is taken is a legitimate option. Employers should not make prescreening a condition of receiving vaccination.

If screening is undertaken, subsequent vaccination should only be given if the person is negative to hepatitis B antibodies. If it is over three months since the negative antibody status was reported negative, consideration should be given to having a repeat test.
Administration of Vaccine

Prior to vaccination the person should be asked about known allergies, hypersensitivities and past reactions to vaccination. If these are significant, then vaccination should be reconsidered and possibly discussed with an infectious disease consultant. The person should also be asked about having any current severe illness or being on oral steroids. Vaccination should not be performed if these contraindications are present. Pregnant women should also not be vaccinated. Minor colds or minor respiratory illness is not a valid contraindication to hepatitis B vaccination.

Dosage: The dose of recombinant DNA hepatitis B vaccine (eg, Engerix B) is 20 mcg for all adults.

The vaccine should be injected into the deltoid muscle of the non-dominant arm. The skin over this area should be cleaned with an alcohol swab. A two millilitre syringe with a 23-25 gauge needle should be used. The needle should not be recapped and should be placed in an appropriate puncture-proof container. Intradermal injection should not be performed [80].

Ideally the vaccinee should stay in the clinic for at least 10 minutes after vaccination to facilitate prompt treatment if any adverse reactions occur.

Prior to leaving the site of vaccine delivery, all vaccinees should be provided with a written note or card detailing the time and date for the next vaccination. When the third vaccination is provided, a time should be given for testing blood for evidence of seroconversion.
Documentation of the Vaccination

The following information should be recorded by the person giving the vaccine: The person's name, date of birth, location in the organisation, the date of vaccination, dosage, the batch number of the vaccine, and the occurrence of any adverse reactions (other than mild soreness at the injection site). This information should be stored in a secure place (eg, a locked filing cabinet) to ensure confidentiality. If this information is on a computerised data storage system it should have password protection with protected copies of the database stored in one other part of the organisation. This information should not be removed from the institution unless the individual has transferred to another workplace, resigned, or retired, in which case the information should be provided to the person to take with them.

Follow-up Procedures For Subsequent Doses

The ideal vaccination course is to have the second vaccination four to five weeks after the first and the third vaccination six months after the first dose. The third dose may be given a minimum of three months after the second dose if necessary (eg, if the person is about to go on extended leave). If the person does not turn up for the next dose, a standardised reminder note should be sent to them with a proposed alternative time and date.

If the second dose is not given within six months after the first dose, the whole course should be recommenced. If a staff member leaves employment with the organisation before receiving the third dose they should still be provided with this vaccination on the terms that apply if they were still employed.
The Post Vaccination Blood Screen and Response to the Results

This blood screen should be performed 12 months after the first dose of vaccine, provided the course of three doses has been completed. The person should be informed of this result by a standardised letter. They should also be given a letter to forward to their general practitioner. The responses to various antibody levels are outlined below:

- \( \geq 10 \text{ mIU/ml} \): A positive result. The employee should be reminded that strict adherence to universal precautions remains essential if they are to protect themselves from other blood-borne viral infections (eg, HIV and hepatitis C).

- 5-10 mIU/ml: Health care workers with this result should receive a booster dose of hepatitis B vaccine within one year.

- 1-5 mIU/ml: A further booster dose should be given immediately.

**Note:** An adequate antibody response is \( \geq 10 \text{ milliInternational units (mIU)/ml, measured one to six months after completion of the vaccine series.} \)

If the person's antibody status remains negative after a booster dose they should be advised that nothing further can be done. They should be told that they may have developed some immunity to hepatitis B but this should not be relied upon. Indeed they need to strictly observe universal precautions to protect themselves from HBV and other blood-borne viral infections (eg, HIV and hepatitis C).
Routine Booster Doses & Further Checks of Hepatitis B Marker Status

The question of the timing of booster doses remains to be defined. Between 30% and 50% of individuals who develop adequate antibody after three doses of vaccine will lose detectable antibodies within seven years. However, protection against viraemic infection and clinical disease appears to persist [81]. Until the issue of booster doses has been determined, there would not appear to be any grounds for routine serological testing for HBV immunity. Indeed testing for immunity several years after vaccination is probably only justified in the following groups:

- dialysis patients,
- exposed health care personnel,
- individuals in whom a suboptimal response to vaccine may have been expected due to HIV infection or administration of vaccine into the buttock.

This approach differs from that advocated for surgeons in Britain where booster doses three to five years after the initial vaccination course are recommended [82].

Vaccine Storage

Hepatitis B vaccines should be stored at 2 to 8 degrees C. Freezing destroys the effectiveness of the vaccine. Dial thermometers should be used in all refrigerators where vaccines are stored.
Emergency Equipment

Although anaphylactic reactions to hepatitis B vaccine are extremely rare, it is important that personnel with appropriate skills and appropriate equipment are available at or within close proximity to the facility where vaccination is given.

Equipment to have on hand:

- Adrenaline (1:1000). This should be within the expiry date on the packet.
- Oxygen cylinder (this should be checked weekly).
- Laerdal ambu bag with masks and airways (3, 2, 1 and 6.0 cm).

Response if anaphylaxis occurs:

- Medical assistance should be summoned.
- Adrenaline 1:1000, 0.5 ml should be given at a rate of up to 0.1 ml per minute if the reaction is severe.
- CPR measures should be instituted if necessary.
- The patient should be put in the recovery position with the head elevated.

References


81 American Academy of Pediatrics. loc cit.

Part Three

UPTAKE OF HEPATITIS B VACCINE BY GENERAL PRACTITIONERS IN THE WELLINGTON REGION

Introduction

General practitioners are considered likely to be at increased risk of hepatitis B infection compared to the general population. Although specific studies have not yet been able to detail the extent of this risk, GPs do come into contact with body fluids when doing obstetrics, taking blood specimens, obtaining microbiological specimens and cervical smears, and when performing minor surgery [83]. The US Centers for Disease Control has documented increased hepatitis B marker prevalence in "health care workers having no or infrequent blood contact", a group into which GPs are likely to fit [84].

For these reasons organisations such as the British Medical Association have specifically recommended that general practitioners be vaccinated against hepatitis B. New Zealand recommendations are less specific and recommend vaccination to "any health care worker who is likely to come into contact with blood should be offered hepatitis B immunisation according to individual board policies" [85].

The uptake of this vaccine by New Zealand general practitioners has not been examined to date. To begin to address this issue, a survey was conducted in one particular region in New Zealand.
Methods

A random sample of 38 general practitioners was selected out of the 225 in the Wellington telephone calling area. Each practitioner was posted a standard questionnaire in November 1992. The questions asked were consistent with those asked in a recent British study with the same objectives [1]. The survey also included questions relating to a separate issue (Haemophilus influenzae vaccination) that is detailed elsewhere [86]. Follow-up contact by telephone was made with practitioners who had not responded within a three week period.

Results

Of the doctors sent questionnaires, two were no longer in general practice. Of the remainder, a total of 33 responded giving an overall response rate of 92%.

Of the respondees, 24 general practitioners (73%) reported having had hepatitis B vaccination. The 95% confidence interval for this result being representative of the Wellington region was large at 60% to 86%. Two reported they were immune through natural infection. A total of 89% of practitioners were therefore immune or vaccinated to hepatitis B.

The reasons given by the nine GPs for not having the vaccination are summarised in Table 1.
Table 1  Reasons Given by Wellington GPs for Not Having Hepatitis B Vaccination

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regard themselves at low risk:</td>
<td>3</td>
<td>(33)</td>
</tr>
<tr>
<td>Have just not got around to it:</td>
<td>3</td>
<td>(33)</td>
</tr>
<tr>
<td>Immune through natural infection:</td>
<td>2</td>
<td>(22)</td>
</tr>
<tr>
<td>Do not trust the vaccine:</td>
<td>0</td>
<td>(0 )</td>
</tr>
<tr>
<td>Vaccination is of no proven benefit:</td>
<td>0</td>
<td>(0 )</td>
</tr>
<tr>
<td>Reason not stated:</td>
<td>1</td>
<td>(11)</td>
</tr>
</tbody>
</table>

Of the GPs responding, 14 (42%) described themselves as practising obstetrics (ie conducting deliveries). Five of this group had not been vaccinated (36%). Indeed this group were approximately half as likely to have been vaccinated as those not conducting deliveries though this difference was not at a statistically significant level (odds ratio = 0.48, 95% confidence intervals; 0.08-2.92).

There was no statistically significant relationship between uptake of hepatitis B vaccination by this group of GPs and their attitudes towards the use of the other vaccination (for Haemophilus influenzae) that was asked about in the other part of this survey.

Discussion

Despite the relatively high response rate to this survey its small size remains an important limitation. Nevertheless it does provide some evidence that protective immunity to hepatitis B
among GPs is relatively high, at least in the Wellington region. Even so, a significant proportion remain non-immune to hepatitis B and hence susceptible at times when exposure to body fluids may be hard to avoid (eg, when performing emergency procedures).

Due to the absence of high quality data on vaccination rates among other occupational groups in the New Zealand health sector, comparisons are difficult. However estimates of coverage of health care workers in hospital by occupational staff tend to be slightly higher than those found in this survey (ie in the 80% to 90% range, see Part Two). If such differences are real, they may reflect greater concern about risk by hospital staff and also the presence of an occupational health service that encourages vaccination. Indeed there is no formal service that is focused on occupational health issues for GPs or other primary health care workers. This deficit has been a focus for concern overseas [87].

Given the small number of GPs who had not been vaccinated, it is impossible to make any definitive comments on the reasons for this. However, it would seem that the perception of not being at risk and of "just not getting around to it" are likely to be the most important ones. Indeed these reasons were the ones that predominated in the British survey of the same design as this one [1]. Also the reason of "not getting around to it" is a major reason given by New Zealand parents who miss vaccinations for their children [88].

As the level of hepatitis B risk for the general population varies significantly throughout the country, this may affect GP attitudes towards vaccination on a regional basis. The Wellington region appears to have a level of risk similar to that of the nation as a whole, with the risk in certain parts of the country (especially in the north and east of the North Island) being several times higher [89,90]. In view of this any specific attempts to improve vaccination coverage in the GP population should begin in these higher risk regions. Such attempts should ideally be in the
context of a concerted approach to address the occupational health concerns of primary health care workers in Regional Health Authorities.

Acknowledgments

The author would like to thank the general practitioners who took part in this survey and Dr Don Matheson for his assistance in organising it.

References


Appendix Three

SCREENING IN THE CONTEXT OF A NATIONAL IMMUNISATION PROGRAMME FOR HEPATITIS B

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ABSTRACT

The extension of the Department of Health's hepatitis B immunisation programme to all individuals under the age of 16 years sharpened debate over the issue of pre-vaccination screening. A major advantage of screening is that the identification of carriers opens the possibility of intervening in the spread of hepatitis B virus (HBV) infection by immunising sexual partners and close family contacts. Such interventions appear to be well worth while as only an estimated 36 parents would have to be immunised to prevent one case of clinical hepatitis. Identifying carriers may also allow reduction in disease transmission through education to modify risk behaviours. The benefits of immunising contacts and providing counselling need to be qualified however, in that these services are currently poorly provided and barriers to access are likely for Maori and individuals from lower socio-economic groups. Screening for hepatitis B markers to identify carriers may also facilitate treatment of chronic viral hepatitis with interferon and the early treatment of hepatocellular carcinoma. While interferon treatment is continuing to show promise, it remains very expensive and access to this treatment may be poor. The value of screening for primary liver cancer based on detection of alpha fetoprotein and ultrasonography remains to be demonstrated in controlled trials.

Potential adverse effects of screening include the effect of screening on immunisation coverage of the target population. Data from the pre-school hepatitis B immunisation programme suggests that the two extra visits required for screening may reduce the uptake of the third dose of vaccine by 10% to 15%. This effect could be ameliorated if vaccine delivery occurred in schools and possibly in community based programmes.

Another concern is the cost to individuals of disease labelling. This has been found to be the case with less serious, non infectious and treatable diseases (eg, hypertension)
and may be considerably greater for hepatitis B. Discrimination in terms of employment opportunities is another potential hazard of identifying HBV carriers.

Pre-vaccination screening in the general practice setting was found to be cost-saving to the public health sector only where the total marker prevalence exceeds 75% in 5 to 10 year olds and 55% in 11 to 15 year olds. The former groups are likely to be very uncommon in New Zealand though the latter group may occur in parts of the eastern region of the North Island, particularly in Maori. Community funded immunisation programmes may however, be more cost-effective in providing both screening and immunisation.

The potential total costs to the public health sector of pre-vaccination screening of 20% to 50% of the childhood population aged over 5 and under 16 years is in the order of $3.11 to $7.78 million (from laboratory benefits and GMS payments). Total costs to parents in terms of additional transport to the doctors and laboratories are also likely to be considerable. The opportunity cost associated with this extra resource consumption may also be considered a potential disadvantage.

For pre-vaccination screening to be considered as a worth while health sector intervention, the benefits should be demonstrably greater than the risk of adverse effects. From a public health perspective the benefits do not clearly outweigh the risks. Therefore it is recommended to the Communicable Disease Control Advisory Committee that routine pre-vaccination screening as part of a mass immunisation programme should not be endorsed at this stage. Further consultation is needed however, to obtain a greater community and Maori perspective. Recommendations are also made concerning improving the immunisation of contacts of HBV carriers, the provision of appropriate information and counselling to carriers and the need for a review of the place of interferon use in the New Zealand setting.
INTRODUCTION

In 1990 the New Zealand Department of Health's programme of free hepatitis B immunisation was extended to all individuals under the age of 16 years and the sexual partners and household family contacts of all carriers. Both before and since this decision, there has been some controversy over the question of screening prior to immunisation, particularly for Maori and Pacific Island children. The Communicable Disease Control Advisory Committee (CDCAC) has discussed the issue previously and routine screening was considered not to be a necessary prerequisite to immunisation [1]. The press release at this time from the committee's chairperson stated that justification for screening was a "matter of opinion" but that it should always be subject to informed consent.

This discussion paper examines the issue of pre-vaccination screening in the context of a national immunisation programme. Most attention is paid to the major delivery system used at present, that is via GPs. Some comments are also made on immunisation programmes based in schools and those organised and funded by the community.

The importance of the chronic sequelae of hepatitis B infection in New Zealand

The hepatitis B carrier state in itself is not a major cause of physical morbidity [2]. It is reasonable to assume however that it can have some impact on mental health as detailed in the subsequent section on the issue of disease labelling. Of particular concern however are the chronic disease outcomes associated with the carrier state.
These include chronic active hepatitis, cirrhosis of the liver and primary liver cancer (PLC). The impact of these conditions in the New Zealand context are detailed elsewhere (Chapter One). It is worth noting however that the morbidity and mortality impact of the chronic sequelae of HBV may be similar to that of cervical cancer. This particular cancer is a disease for which screening has been endorsed by the public health community in most developed countries, including New Zealand.

Another major consideration is that of health status equity since hepatitis B is one of the diseases which affect Maori and Pacific Island Polynesians at disproportionately greater rates than Pakeha New Zealanders [3,4] (see also, Chapter One). In particular, the age standardised rates for PLC in Maori are significantly higher than non-Maori [5]. The need to address such inequalities in health status outcome for Maori puts particular emphasis on the prevention of hepatitis B associated disease.

The extent of the advantages of screening and the effectiveness of early treatment

*Immunising sexual partners and close family contacts:* Identifying carriers opens the possibility of intervening in the spread of hepatitis B infection by immunising sexual partners and close family contacts. This is a benefit for individuals other than those being screened and so differs from other screening programmes. Nevertheless, this intervention is likely to be well worth while in view of the estimate that only 36 parents would have to be immunised to prevent one case of clinical hepatitis (see Appendix 3b). This form of follow-up of identified carriers is also considered to be a fairly cost-effective activity, at least once a carrier has already been identified. The benefits of protecting other family members from hepatitis B may be felt more strongly by certain cultural groups. For example, the sense of family identity and care for other family
members may be stronger among Maori and Pacific Island communities than in Pakeha culture [6].

*Lifestyle changes to modify risk of disease transmission and chronic liver disease:* Identifying carriers may allow a reduction in disease transmission through education to modify risk behaviours. For example, regular counselling could be given to encourage the avoidance of excess alcohol, the use of barrier contraceptives, and higher standards of hygiene (e.g., bandaging cuts and not sharing toothbrushes). Although there is some evidence that alcohol is either a co-carcinogen or tumour promoter with hepatitis B [7] and can induce hepatic damage [8,9], the benefits of actual counselling programmes aimed at avoiding excess alcohol by individual carriers still require clarification. Indeed the relative importance of alcohol relative to other factors that may have some role in the aetiology of PLC in the HBV carrier state is also not well defined. These other factors include contaminated water, low selenium levels in the diet, tobacco smoking, certain occupations, and androgen therapy [10].

It could be argued that interventions to promote behaviours that maintain the health of HBV carriers are more appropriately conducted through population-based health promotion strategies. This approach would maximise the benefit obtained in the prevention of other blood-borne viral diseases (hepatitis C, hepatitis D and HIV) and minimise harm from alcohol over the whole population. Indeed, such campaigns have already been undertaken in New Zealand, particularly with regard to preventing sexually transmissible diseases and HIV.

Also an exclusive focus on individually targeted lifestyle modification, as opposed to a population approach, has tended to be rejected in recent developments in health promotion and disease prevention [11,12,13]. This change has arisen from a recognised lack of success in persuading individuals to change deeply ingrained and emotionally laden behaviours especially concerning sexual and drug-using behaviour.
It also relates to a realisation of the danger of victim-blaming which is inherent in an exclusively individual focus [14].

**Screening to allow treatment with antiviral agents:** There is growing consensus regarding both the value of appropriately used interferon to treat chronic viral hepatitis caused by HBV [15]. Formal cost benefit analyses also produce results that favour this treatment, especially when liver transplantation is considered [16]. Nevertheless, appropriate patients need to be selected with care, and the morbidity and small risk of death need to be considered with this treatment [17]. The cost of interferon is also a major factor [18].

**Further screening to allow early treatment of liver cancer:** Another intervention that hepatitis B marker screening can facilitate is the potential early surgical resection of hepatocellular carcinoma. A further screening process is required, which involves a blood test for alpha fetoprotein (AFP) and regular liver ultrasonography (US). There is some evidence that surgical intervention (tumour resection or transplantation) improves prognosis compared with treatment at a later stage when the patient presents with symptoms [19,20,21,22]. However, the average gain in quantity and quality of life from early liver tumour resection remains to be clarified and there is a need for "larger prospective studies" [23,24]. Indeed, there has never been a controlled clinical trial to evaluate AFP and US screening to date, although one is currently under way in China [25]. Such screening programmes must therefore be considered research procedures at the present time [26].

Preliminary results from work in Alaska do suggest however that a 50% reduction in the one-year case fatality rate can occur [27]. Yet these results need to be considered alongside the finding that 676 people had to be screened for one year to allow beneficial early surgery for only one case (calculated from data in reference [28]). Also, of those in whom surgery was instigated at an early stage, 25% still died within a
Further experience with this programme has found a positive predictive value of AFP screening of only 4.9% overall, and 28.3% in males [29].

The long term results of liver transplantation as a treatment of HBV-related liver disease, have not been particularly encouraging to date. That is even when the liver is replaced by a transplant, primary carcinoma recurs in 35-74% of cases with 43-80% of these cancer recurrences leading to death [30]. Indeed liver transplantation for liver cancer has a five year survival rate of only 29% [31].

To get some idea of the numbers of individuals that could possibly benefit from early surgical intervention in the New Zealand setting, the following (unsubstantiated) assumptions are made: (i) that 80% of the carrier population accepts regular screening and (ii) that the preliminary results of the work in Alaska would apply here ie, 50% of patients are likely to be suitable for and accept surgery and 75% of surgical cases would live for longer than a year. Given that between 40 and 72 New Zealanders are likely to die each year as a result of HBV-induced PLC (see Chapter One), it is therefore conceivable that 12 to 22 could get at least an additional year of life from screening and surgical intervention. The cost-effectiveness of such screening could be dramatically increased by focusing on male HBV carriers over 40 years and relatives of known PLC cases (Moyes C, personal communication, 1990).

For those with other chronic sequelae of HBV infection, such as chronic active hepatitis and cirrhosis, there is unlikely to be any advantage from surgical intervention.

**Screening to avoid unnecessary harm:** Screening to avoid immunising already immune children could prevent vaccine-associated morbidity. This is only of minimal benefit however, as even minor side effects such as injection site symptoms and mild pyrexia occur in only a small percentage of vaccinated children. After 448,000 doses of hepatitis B vaccine were used in New Zealand children, adverse events were
reported at a rate of only 0.56%. No other more serious or long term effects of vaccination were detected [32]. This has also been the experience overseas [33,34,35]. Similarly there is no evidence of harm to carriers from receiving unnecessary vaccination.

It has been suggested that immunising carriers without identifying their carrier status first, may provide them with a false feeling of security with regard to the risk of transmitting hepatitis B (Milne S, personal communication, 1990). This may be true though there is, as yet, no evidence that individuals who know their carrier status actually alter their behaviour in terms of personal hygiene and safer sexual behaviour. Also when an available and cost-effective treatment for the carrier state emerges, an appropriate publicity campaign could be used to alert all individuals to seek testing whatever their vaccination history.

**The availability and acceptability of early interventions and treatment**

The potential advantages of screening described above are considered below in terms of their availability and acceptability.

**Immunising sexual partners and close family contacts:** Current activity in this area is considered to vary widely among different GPs. It is the impression of some practitioners however that there is a lot of potential for improvement in the level of GP follow-up of sexual partners and close family contacts (Reid S, personal communication, 1990). One unpublished study has suggested that the follow-up by general practitioners of carriers identified in hospital occurs less than half the time [36].

There is also no guarantee, with the current system, that individual GPs will all provide hepatitis B immunisations for contacts for free. This financial barrier is likely to
discriminate against access to immunisation by individuals in lower socio-economic
groups and amongst Maori. The importance of these financial barriers for Maori have
been described for other medical interventions [37,38].

**Lifestyle changes to modify risk of disease transmission and chronic liver disease:**
As for immunisation provision for contacts, there is a great deal of variation in
counselling of hepatitis B carriers by GPs. One GP considered that little counselling
was currently given and that what is provided focuses largely on sexual behaviour and
rarely deals with avoiding excess alcohol (Matheson D, personal communication,
1990). There is also general concern about the level of support from GPs for carriers
referred to them by the blood transfusion services (Woodfield DG, personal
communication, 1990).

In view of the probability that most GPs charge individuals given counselling, the issue
of financial barriers discriminating against individuals in lower socio-economic groups
and amongst Maori needs to be considered. Any attempt to deal with this potential
problem would have to examine more culturally appropriate mechanisms of service
delivery. Programmes for health promotion for HBV carriers are being developed by
the Hepatitis Foundation in Whakatane and evaluation of these may highlight the
optimal strategies for the delivery of this service [39]

**Further screening to allow early treatment of liver cancer:** The accessibility to, and
availability of, routine screening of adult carriers using AFP and US is largely unknown
in this country. Anecdotal evidence suggests that this form of screening is uncommon
and that there although there is some professional agreement on its value [40], there is
no consensus or policy on this subject at a national level via the Ministry of Health or
from the gastroenterology community (Scobie B, personal communication, 1992).
Early surgical intervention is only applicable to those who are vigorously screened with AFP and US every six to twelve months and are relatively healthy at the time of surgery [41]. This high level of contact with health services and possible expense to the individuals concerned may also lead to problems in terms of access.

Another factor to consider concerns ethnic issues and access to surgical intervention. It is possible for example, that Maori may be less likely to benefit from liver surgery as is the case with coronary artery surgery. This may be the result of culturally insensitive mechanisms of service delivery and possibly cultural resistance to surgery [42].

**Treatment with antiviral agents:** As described above, access to interferon is limited by its suitability for particular individuals and its very high cost. It has been argued that the promise of cheaper alternatives to interferon and other treatment options (eg, treatment with the plant *Phyllanthus amarus* [43]) may help to justify screening at the present time [44]. Yet even if a current New Zealand-based trial suggests some benefit from this agent [45], it is unlikely to be available in a form for routine medical treatment for several years at the very least. Indeed to screen for HBV carriers on the presumption of the availability of a more successful treatment in the near future may give the individuals involved false hope. They may assume that treatment would be made available to them as soon as it is developed. Yet this is not necessarily the case as for example, there was a time delay of over two years between the development of a reasonably reliable test for hepatitis C and the eventual implementation of this to screen donated blood in New Zealand.
Adverse effects of screening

Screening programmes to detect disease at the pre-symptomatic stage may generate adverse effects especially due to false positive diagnoses [46]. This would be a problem for hepatitis B screening if initially reactive HBsAg tests were not confirmed by a further test. A screening campaign that included only one HBsAg test without confirmation of reactives could produce a false positive rate up to 27% in some populations and result in large numbers of individuals being wrongly labelled as hepatitis B carriers [47]. No New Zealand evidence exists, however, to suggest that laboratories are not performing the appropriate confirmatory tests.

Another potential adverse effect of pre-vaccination screening is that it may decrease overall levels of immunisation coverage. Also, identifying hepatitis B carriers may have adverse effects relating to disease labelling and discrimination. These issues are discussed further below.

The effect of screening on immunisation coverage of the target population: Taking of blood tests from children to assess their hepatitis B marker status may adversely affect the overall uptake of the vaccine in the population. This blood test, if requested by a GP, will usually be taken by laboratory staff and therefore involve an additional visit by the parent and child. Indeed, children who are found to be non-immune will have a total of two extra visits compared to immunisation without screening. As a result of this and the small possibility of being upset with the venepuncture for the blood sample, many parents may not take their child to receive all three doses of the vaccine. The fall-off in the vaccination coverage of under five year olds with each dose in the previous component of the hepatitis B immunisation programme, provides some warning regarding this [48]. Indeed, these results suggest that the required extra two visits may reduce the coverage of the third dose to 10 - 15% less than if screening was not performed. This reduction could be somewhat limited by vigorous use of recall
systems. Many general practices, however, do not have immunisation registers with this capacity. In contrast, GP based or community organised programmes that immunise children in schools are able to maintain high levels of coverage for each dose of vaccine (Milne S, personal communication, 1990).

*Risks of labelling:* Studies have shown that being labelled "hypertensive" has significant adverse effects in terms of much greater absenteeism and greater psychological distress. These effects were present regardless of treatment and strongly support the concept that labelling is harmful in itself [49,50]. Indeed, results of five out of six studies which have looked at this issue [51], suggest that the consequences of labelling may outweigh the benefits of treating mild hypertension. With hepatitis B, however, it could be expected that the labelling effects of being a carrier would be greater than that of hypertension. This is because the carrier state is infectious and usually incurable. Also, the labelling of children and young people who have less ability to understand these issues, may pose greater risks in terms of the chronic adoption of sick role behaviour. Children are also much less able to cope with discrimination.

It should be noted however, that the risks of labelling can be minimised if individuals have regular contact, access to support, and empathy from health professionals. Other factors such as socioeconomic status have also been shown to influence "sick role behaviour" and it is likely that cultural factors play a role [52]. In this sense it is possible that the greater role of the extended family in the Maori community helps to buffer against the effects of labelling and sick role behaviour.

*Risks of discrimination:* There has been no systematic review of discrimination against hepatitis B carriers in New Zealand or other countries. Anecdotal reports do suggest however that hepatitis B carriers in New Zealand may on occasions be unjustifiably put off work as food handlers and be denied careers in polytechnics, the
military and as health professionals (eg, HBV carriers are not admitted for dental training) [53]. There are also reports of dentists charging patients more when they identified themselves as carriers [54]. In addition there is certainly some potential risk of discrimination if an individual's carrier status has to legally be disclosed (eg, to an insurance company or employer).

Discrimination is a very complex psychological and social issue that can occur in many subtle ways. One cause is fear of infection, and this has been evident in New Zealand. For example, in 1988 the teachers of several primary and secondary schools in Invercargill demanded to know the carrier status of their pupils (Jarman J, personal communication, 1990). Although this situation was resolved, while such ignorance and irrational concerns by non-immunised adults continue there is always a risk of discriminatory behaviour.

In other developed countries, discrimination has been quite overtly demonstrated as with a group of dentists in England in the early 1980s refusing to treat hepatitis B carriers (Bandaranayake D, personal communication, 1990). The most compelling warning of discrimination against those with incurable and infectious diseases comes in recent times with the negative social reaction to HIV-positive individuals.

**Morbidity associated with tests for screening:** The process of screening prior to immunisation requires that all children have a test requiring approximately 3 ml of blood, prior to possible immunisation. This is, however, likely to cause only very minimal and transient discomfort with skilled phlebotomists. The experience of one practitioner suggests that less than one percent of children given a venepuncture will cry (Milne S, personal communication, 1990).
The resource implications for screening as part of an immunisation programme and the opportunity costs

Is pre-vaccination screening cost-saving to the public health sector? The economic issues relating to pre-vaccination screening need to be considered in the New Zealand context. The purchase cost of the vaccines used by the Ministry of Health's programmes is unknown as this is commercially sensitive. For the purposes of this exercise, it has been assumed that the price of the vaccine used is in the range of $3 to $9 per paediatric course, averaged at $6 in the analysis. Indeed it could be even less in view of the significant decline in vaccine prices that has occurred in the last few years. The other considerations are the cost of the paediatric General Medical Services benefit (GMS) of $16 by the government to subsidise medical consultations, the immunisation benefit of $7.65 and the cost of laboratory screening tests. The latter are based on the laboratory benefits for HBsAg ($3.62) and anti-HBs ($10.90) with the former test being repeated when a carrier is identified. Testing for anti-HBc is not considered as no benefit is paid for this test. The results of a range of simulations for the cost to the public health sector of screening and immunising in the general practice setting are shown in Table 1.
Table 1  Range of Immunisation and Screening Costs (SNZ) in Different Situations of Total Marker (T) and Carrier Prevalence (C) *

<table>
<thead>
<tr>
<th>Age-group</th>
<th>5 - 10 years (paediatric dose)</th>
<th>11 - 15 years (adult dose)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunisation only 1</td>
<td>$41</td>
<td>$59</td>
</tr>
<tr>
<td>Immunisation &amp; Screening 2</td>
<td>$51</td>
<td>$59</td>
</tr>
<tr>
<td>T=55%, C=12%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunisation &amp; Screening 2,3</td>
<td>$44</td>
<td>$48</td>
</tr>
<tr>
<td>T=75%, C=16%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunisation &amp; Screening 2</td>
<td>$36</td>
<td>$37</td>
</tr>
<tr>
<td>T=95%, C=35%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

1  Immunisation only includes the costs of the vaccine and three immunisation benefits.

2  Screening prior to immunisation includes the costs of one paediatric GMS benefit. It is assumed that non-immune children are vaccinated at a cost equivalent to three immunisation benefits and all carriers return for one further counselling session which will involve an additional paediatric GMS benefit. It is assumed that other immune children who are not carriers are notified by telephone (not costed).

3  This scenario is comparable with the high rate of hepatitis B carrier and marker prevalence identified in a Non-European 10 to 14 year old population in Kawerau. In this population 15% were identified as carriers and the prevalence of total markers was 71% [55].

It can be seen from this analysis that screening is cost-saving (ie costs less than immunisation alone) to the public health sector where the total marker prevalence exceeds 75% in 5 to 10 year olds and 55% in 11 to 15 year olds. The former groups are likely to be very uncommon in New Zealand though the latter group may occur in parts of the eastern region of the North Island, particularly in non-Europeans. It should be noted however that the cost of vaccine may be lower than used here and the real costs of screening may be higher as the cost of testing is probably greater than the benefit currently paid to laboratories. Alternatively the screening and immunisation
programmes administered by the Hepatitis B Research Trust may be less than the benefit paid, depending on the infrastructure costs of such organisations.

**Screening and community funded immunisation programmes:** With certain community based programmes that do not include GMS or immunisation benefit payments, the cost calculations will be different from those described above. However, in these situations if vaccine delivery costs and in particular labour are appropriately accounted for, screening is unlikely to be cost-saving. This is because the cost of testing is generally likely to exceed the cost of vaccine purchase and delivery in all but extremely high prevalence areas. It should be noted however, that these community based programmes are possibly a very economical way to deliver vaccine to children (estimated at around $1 to $2 per dose, Milne S, personal communication, 1990).

**The cost-effectiveness of screening in treatment for carriers and the opportunity costs:** As resources of all types are finite it is necessary to examine the potential total costs of pre-vaccination screening. From laboratory benefits alone, the cost to the public health sector of pre-vaccination screening of 20% to 50% of the childhood population aged over 5 and under 16 years is in the order of $1.48 to $3.70 million. Added to this, however, are the costs of GMS payments for the associated consultation at $1.63 to $4.08 million (again assuming 20% to 50% are screened). Total costs to parents in terms of additional transport to the doctors and laboratories are also likely to be considerable.

Other costs would arise from screening in terms of carriers receiving follow-up counselling and also further investigations. Follow-up screening with AFP and US would be potential flow on costs. These costs would be particularly great if screening was ever commenced on children aged between 5 to 15 years who may require follow-up for many decades. When these costs are balanced against the small numbers who
might benefit from early liver surgery, such an intervention is probably very cost ineffective. Even in selected screening programmes (eg, for Maori children in high-risk areas) the cost for the benefits gained are likely to be high. Indeed, it is likely that even selective screening strategies are a poor choice compared to other interventions to improve the life expectancy and quality of life of carriers. For example, although carriers do have a reduced life expectancy from their HBV infection, if they are smokers then the effects of smoking on their life expectancy is generally much greater. Targeted efforts by GPs to assist all their patients that smoke in smoking cessation are likely to be more cost-effective than most other medical treatments [56]. Similarly, focusing on pregnant smokers is very cost-effective [57]. More attention to these interventions would also particularly benefit Maori for whom smoking causes particularly high levels of morbidity and mortality [58,59].

Any present day programme to screen for carriers to allow future treatment when this becomes available, is also likely to be fairly cost ineffective. This is because of the high cost of keeping track of carriers for the years until the new treatment became available. If large centralised or regionally based databases were used, there would be major costs in keeping these updated in view of the frequent changes of address occurring among this young population [60]. Indeed it would be extremely difficult to keep track of the whereabouts of many young people once they had left school. If the responsibility of keeping contact was devolved to GPs, these problems would still be significant. Also GPs are not obliged to transfer their medical records to other doctors and so this could result in the loss of contact with carriers in some cases. It is possible however, that long term follow-up may be very feasible in the hands of highly motivated individuals in small communities (Milne S, personal communication, 1990).
Do the benefits of pre-vaccination screening as part of an immunisation programme clearly outweigh the adverse effects?

For pre-vaccination screening as part of an immunisation programme to be considered a worthwhile health sector intervention, the benefits should be demonstrably greater than the risk of adverse effects. The currently available benefits of screening to identify hepatitis B carriers have been identified as follows:

- The option of offering immunisation to sexual partners and family contacts and hence reducing HBV associated disease.

- The prospect of targeting lifestyle education to help prevent chronic liver disease.

- The prospect of treatment with antiviral agents.

- The prospect of further screening for PLC and early treatment with surgery in a small proportion of cases.

The extent of these benefits is still poorly defined in some areas especially individual lifestyle counselling and AFP and US screening. They are also currently limited by their relatively poor availability and by financial barriers. Although programmes such as those run by the Hepatitis Foundation (Whakatane) are beginning to address these issues, large improvements in health care access to low income groups would be necessary to fully realise the benefits of these interventions.

In contrast to the benefits of screening are the adverse effects:
- Potential reductions in immunisation coverage of the target population due to extra travel and time involved for additional consultations.

- Potential risks associated with disease labelling.

- Potential risks associated with discrimination.

The opportunity cost associated with the extra resource consumption required for pre-vaccination screening may also be considered a potential disadvantage. This, however, relies on the very uncertain assumption that resources that would have been spent on screening could be used on more cost-effective interventions such as reducing smoking. Nevertheless, it is likely that interventions to reduce smoking will do more to save lives and redress the imbalance between Pakeha and Maori health status than improvements in access to interferon treatment and in access to early surgery for liver cancer.

Balancing the benefits of pre-vaccination screening against only potential adverse effects is difficult and depends largely on value judgements. From a public health perspective that attempts to consider physical, psychological and social effects it is not at all clear which at the present time is the best option. If, however, the decision to screen prior to immunisation is to be made only if it is clearly beneficial overall, then the default option is probably one of not supporting routine pre-vaccination screening. It is possible that future developments will clarify this situation. That is, improvements in access to interferon treatment for carriers may be made available and issues regarding labelling and discrimination might also be clarified. Similarly a strong community demand for screening in a relatively high-risk area may swing the balance towards this option.
RECOMMENDATIONS

Recommendations for the Communicable Disease Control Advisory Committee

1. That the current position of the CDCAC not to recommend routine screening prior to immunisation be retained until further discussion and consultation suggests that this position is no longer appropriate.

2. That any recommendation to the Ministry of Health to support screening (eg, benefits for laboratory tests) in specific communities, be only made when the benefits of screening are better established. The process of more clearly identifying these benefits and adverse effects still requires consultation with the Maori community and those running community based screening and vaccination programmes.

Recommendations to the Ministry of Health and Public Health Commission

1. That in view of the relative cost-effectiveness of vaccinating the close family members and sexual contacts of carriers (when carriers have already been identified), incentives to providers to improve hepatitis B immunisation in this group should be considered. For example, consideration could be given to a more substantial payment than the current immunisation benefit (of $7.65) to GPs or other providers who could vaccinate this group.
2 That a study be commissioned to review the place of interferon treatment of chronic viral hepatitis in the New Zealand setting. This could address the role of this agent in treating disease associated with hepatitis B and C. The Gastroenterology Society of New Zealand could also be asked to assist in formulating recommended protocols and standards of good practice with regard to the management and treatment of the hepatitis B carrier state.

3 That a study be commissioned to review the place of AFP and US screening of HBV carriers in New Zealand pending the outcome of controlled trials overseas.

4 That to reduce the risk of adverse effects from disease labelling in those individuals who have already been identified as HBV carriers, the following actions be considered:

- That more detailed printed information on the HBV carrier state be distributed to health care workers and the carrier's themselves.

- That a special benefit be paid to GPs and health care workers with counselling skills who have a role in regular support for carriers. This benefit should be considerably more than the current paediatric and adult general medical services benefit.

- That Regional Health Authorities be required in their contracts with primary care providers, to specify minimum standards for the provision of counselling to HBV carriers.
Appendix 3b

Is vaccinating the parents of children identified as carriers worth while?

The best data available on the risk of infection from carrier children is from a study on Asian children adopted in the United States [61]. The results of this study suggested that 7% more parents seroconverted compared to controls over an average time period of 3.4 years. This suggests an average annual incidence rate of approximately 2%. Interestingly, there was no evidence of increased infection in the new siblings of the adopted children. Since the adopted children in this study were young and therefore more likely to spread infection, the analysis below uses a lower incidence rate of 1%. This, however, could still be a significant overestimate of the true rate. Other assumptions made are that the average time period before the child leaves home is seven years and that there is already a 20% level of marker prevalence in the adult population.

For the purposes of this analysis, the cost to the public health sector is again considered. It is assumed that the immunisation benefit is paid for each case and that the vaccine supplied by the Ministry of Health is used (estimated at $12 a course). It is also assumed that the practice nurse will perform the task of organising the parents to come to the practice and administer the vaccine. As the state funds 70% of the practice nurse's salary, the time cost for this activity is taken as $20 per adult course. This gives a total cost of approximately $40 per adult vaccinated.

The results of the number of vaccinations required to prevent cases of hepatitis and the cost of vaccine delivery are summarised in Table 2.
Table 2  The Costs and Benefits of Vaccinating the Parents of Children Identified as HBV Carriers

<table>
<thead>
<tr>
<th>Acute &amp; Chronic Sequelae of HBV</th>
<th>Risk per infected adult*</th>
<th>Number to vaccinate**</th>
<th>Cost***</th>
</tr>
</thead>
<tbody>
<tr>
<td>subclinical hepatitis</td>
<td>50%</td>
<td>36</td>
<td>$1,428</td>
</tr>
<tr>
<td>clinical hepatitis (all forms)</td>
<td>50%</td>
<td>36</td>
<td>$1,428</td>
</tr>
<tr>
<td>anicteric hepatitis (non hospitalised)</td>
<td>30%</td>
<td>174</td>
<td>$2,380</td>
</tr>
<tr>
<td>icteric hepatitis (non hospitalised)</td>
<td>19.9%</td>
<td>200</td>
<td>$8,003</td>
</tr>
<tr>
<td>icteric hepatitis (hospitalised)</td>
<td>19.9%</td>
<td>600</td>
<td>$24,009</td>
</tr>
<tr>
<td>fulminant hepatitis (nonfatal)</td>
<td>0.03%</td>
<td>59,524</td>
<td>$2,380,952</td>
</tr>
<tr>
<td>fulminant hepatitis (fatal)</td>
<td>0.07%</td>
<td>25,510</td>
<td>$1,020,408</td>
</tr>
<tr>
<td>chronic carrier</td>
<td>0.5%</td>
<td>3,571</td>
<td>$476,190</td>
</tr>
<tr>
<td>chronic liver disease/cancer</td>
<td>0.3%</td>
<td>5,952</td>
<td>$238,095</td>
</tr>
</tbody>
</table>

Notes:

* Risk of various outcomes for a nonimmune adult infected with hepatitis B [62].
** Number of parents that would need to be vaccinated to prevent one case.
*** Cost to the public health sector.

From this analysis it would seem that approximately 36 adults would have to be immunised to prevent one case of clinical hepatitis (assuming the 1% annual incidence rate). This could be achieved at a cost of $1,400 which would seem reasonably worth while in view of the amount of suffering and time off work usually associated with clinical hepatitis. It is unlikely however, that this strategy would actually be cost-saving for the public health sector in view of the large cost ($24,000) to prevent a
hospitalised case. It may also not be particularly cost-effective compared to other interventions eg, GP counselling to reduce tobacco consumption. To answer such questions a more detailed cost-effectiveness analysis would be required.

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Appendix Four

OPTIONS FOR EVALUATING THE PROGRAMME FOR HEPATITIS B PREVENTION IN INFANTS BORN TO HBV CARRIER MOTHERS

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ABSTRACT

Preventing hepatitis B virus (HBV) transmission during early childhood is particularly important due to the high likelihood of chronic HBV infection and chronic liver disease resulting from infection at this age. The key control strategy is the provision of immunoprophylaxis to infants of hepatitis B carrier mothers. These women are identified by routine testing during pregnancy for hepatitis B surface antigen (HBsAg). This strategy is known to be over 70% effective in preventing HBV-related disease. Indeed data from overseas suggests that this is a very cost-effective public health intervention.

Since 1986, New Zealand has had a national policy of antenatal screening followed by immunoprophylaxis of infants of carrier mothers. The process and outcome of this public health activity has not yet been thoroughly evaluated. This is despite the birth of approximately 1650 infants per year who are at risk of maternally transmitted HBV.

This paper lists a range of process and outcome criteria for a comprehensive antenatal screening and immunoprophylaxis programme. These criteria cover the process of antenatal screening, the management of infants of HBsAg-positive mothers, the management of other contacts of the HBsAg-positive mothers, and programme cost-effectiveness.

Also identified is a range of evaluation strategies to assess performance by some or all of these criteria. These include: (i) continuous ongoing monitoring (subsequent to the dissemination of guidelines and performance criteria), (ii) initial outcome evaluation, and (iii) comprehensive evaluation (process and outcome).

This paper recommends that the Ministry of Health:

Choose the continuous monitoring strategy.
2 Make maternal hepatitis B carriage a notifiable condition

3 Consider including the monitoring of other antenatal tests in the evaluation strategy (rubella, syphilis, and the cervical swab).

INTRODUCTION

This paper examines possible evaluation strategies for the current New Zealand-based programme for the prevention of hepatitis B virus (HBV) infection in infants born to HBV carrier mothers.

The acute and especially the chronic sequelae of HBV infection are important health problems in New Zealand. These problems can be substantially avoided with the use of appropriate immunoprophylaxis [1]. Preventing HBV transmission during early childhood is particularly important because of the high likelihood of chronic HBV infection and chronic liver disease that occurs in children infected at under five years of age [2].

The risk of perinatal HBV infection among infants born to HBV-infected mothers is in the range 10% to 85% [3,4,5]. This is largely dependent on the mother's hepatitis B e antigen (HBeAg) status. Those infants who do become infected by perinatal transmission have up to a 90% risk of chronic infection. In the long term up to 25% will die of chronic liver disease as adults [6]. Even if HBV infection does not occur in the neonatal period, the children of HBV infected mothers will remain at risk of horizontal transmission from their mother during the early years of life.
The strategy of routine testing to identify pregnant women who are hepatitis B surface antigen positive (HBsAg positive) followed by providing their infants with immunoprophylaxis is known to be important in preventing HBV-related disease [3,7]. Hepatitis B vaccination and one dose of hepatitis B immunoglobulin (HBIG) are 85%-95% effective in preventing both HBV infection and the chronic carrier state (if administered within 24 hours after birth) [3,7,5]. Even if hepatitis B vaccine is administered alone in either a three or four dose schedule (beginning 24 hours after birth), this is 70% to 95% effective in preventing HBV infections [5,8]. It is generally thought that the few infections that are not prevented by vaccination or HBIG are most likely acquired in utero or may be due to very high levels of maternal HBV-DNA [9].

At least in the United States, the universal HBsAg screening of pregnant women to prevent perinatal HBV infection has been shown to save costs [10]. An even more cost-effective result might be obtained for the New Zealand situation where current vaccine costs are very much less than have been used in past cost-effectiveness studies.

For the infants of HBV infected mothers who are given vaccination and HBIG, testing for anti-HBs at 9 to 15 months of age can be valuable to determine the success of immunoprophylaxis. In the case of immunoprophylaxis failing, this repeat testing will identify infants who may require revaccination. Testing for HBsAg at the same time will also identify any infants who have become HBV carriers. Being a carrier has a range of personal and public health implications such as the need to vaccinate all household contacts of the child. Testing for anti-HBc could be performed on a subsample of anti-HBs positive children to determine the proportion who developed antibodies as a result of infection as opposed to immunisation.
METHODS

A literature search was performed to identify the relevant New Zealand and international literature relating to the epidemiology and control of HBV infection in infants of HBV carrier mothers. This review facilitated the development of comprehensive evaluation criteria for which the current immunoprophylaxis programme could be evaluated by. General information on evaluating health sector inventions was also consulted to provide ideas on the scope of evaluation options [11].

History of immunoprophylaxis in New Zealand

In 1985 the Communicable Disease Control Advisory Committee (CDCAC) recommended that combined immunoglobulin and vaccine be given to the infants of carrier mothers [12]. This programme was implemented in 1986 and targeted only the infants of e antigen positive mothers. Later in 1986 the programme was extended to include infants of all carrier mothers. The programme has continued without major change since this time. The recommended regime for the plasma-derived vaccine was 10 mcg at birth, six weeks and three months, and 2 mcg at 15 months [13].

At present the vast majority of antenatal screening tests are ordered in the general practice setting at approximately three to four months into most women's pregnancies. At the same time antenatal screening tests for rubella and syphilis are performed along with a cervical swab and smear.
**Relevant New Zealand epidemiology**

The most relevant study in this area was conducted by Miller in 1984 [14]. It involved the testing of 1198 samples of maternal sera from throughout New Zealand. Of these 3.3% were HBsAg-positive. As the annual birth rate at this time was approximately 50,000 live births, these results suggested that 1650 infants were at risk of maternally transmitted HBV per year. This study also found that HBeAg was present in 29% of the HBsAg carriers. Since this time the birth rate has risen to 60,000 per year and it is probable that the prevalence of HBV infection has declined. The only data to support such a decline is the reduction in hepatitis B notification rates in the last five years. If the prevalence of maternal carriage has fallen to a national average of 2.5%, a large hospital experiencing 2% of the nations live births would expect to screen 30 HBsAg-positive women per year.

Other New Zealand studies have been smaller and have just focused on the effectiveness of vaccination and HBIG in inducing immunity in the infants of carrier mothers [15,16].

**Evaluation criteria for the immunoprophylaxis programme**

A set of criteria for an optimum immunoprophylaxis programme is listed below. These criteria include recommendations made by the US Centers for Disease Control [1], and are probably more comprehensive than what is generally considered standard practice in New Zealand at present.

1. **Criteria for an effective antenatal screening process**

   - All pregnant women seen by general practitioners are offered screening.
Antenatal screening for HBsAg is performed at the same time as other routine antenatal laboratory testing (to ensure maximum cost-effectiveness).

Tests for HBV markers other than HBsAg are not performed unless indicated for a purpose other than that of maternal screening.

HBsAg testing is repeated late in the last month of pregnancy for women who were initially tested as HBsAg negative but who are at high-risk of HBV infection. This group includes injecting drug users, those with intercurrent sexually transmitted disease, commercial sex workers and those who have had clinically apparent hepatitis.

All HBsAg-positive women identified during screening are referred for further investigation of possible HBV-related liver disease [17].

All women who have not had antenatal HBsAg testing and who are admitted for delivery have blood taken for testing. While results are pending the infants of these mothers are given hepatitis B vaccine within 12 hours of birth. This is at a dose appropriate for infants born to HBsAg-positive mothers. For mothers that are found to be HBsAg positive, HBIG is given as soon as possible and within seven days of birth.

Criteria for effective management of infants of HBsAg positive mothers

Infants born to mothers who are HBsAg positive receive the appropriate doses of hepatitis B vaccine (2.5 micrograms of recombinant vaccine) by intramuscular injection (IM) occurring at the following times [1]: dose one within 12 hours of
birth; dose two at four to six weeks of age; and dose three at five to six months of age.

- Infants born to HBsAg positive mothers are given HBIG by IM injection within 12 hours of birth.

- Both injections are given concurrently.

- The injections are given at different body sites.

- For infants of HBsAg positive mothers, repeat testing at between 9 and 15 months is performed [18]. (This is not currently standard practice in the New Zealand setting.)

3 Criteria for effective management of other contacts of the HBsAg positive mothers

- All the household contacts and sexual partners of the HBsAg-positive women identified through antenatal screening are offered free vaccination.

- The decision to perform prevaccination screening for these contacts is one that is always made by the clinician involved after discussion with the individual being offered vaccination.

4 Criteria for achieving protective antibody levels

- The data from repeat testing indicate that over 70% of infants of HBsAg-positive mothers have no evidence of past or current HBV infection.
Criteria for achieving other quality measures associated with the programme

- Laboratory facilities involved in the testing have TELARC registration.

- There is a systematic mechanism to ensure that general practitioners have received all the relevant information from the hospital within one month of the mother or infant being discharged from hospital.

- The hepatitis B vaccine and immunoglobulin are stored in the hospital in ways recommended to minimising potential disruptions to the cold chain.

- HBsAg-positive mothers receive appropriate counselling. The education materials supplied to mothers cover the following:
  - the need for her sexual partner/s to be tested and offered vaccination if appropriate,
  - the importance of the use of barrier contraceptives with sexual contacts,
  - the need for all her household contacts to be offered testing and vaccination (if appropriate),
  - the need for her to avoid donating blood,
  - the benefit of her having follow-up blood tests on an annual basis,
  - the importance of her informing other health care workers and dental workers of her HBsAg-positive status,
  - the need for her to regard all her body fluids as potentially infectious,
  - the need for her to be aware of the issues relating to her disclosure of her HBsAg-positive status and risks of discrimination.
6 Cost-effectiveness of the programme

A comprehensive evaluation of the immunoprophylaxis programme should include collecting data to calculate the cost per case prevented. Cases would be defined as children of HBsAg-positive mothers (who were offered antenatal screening) who develop chronic HBV carriage. While there is no doubt that this screening programme is currently a cost-effective intervention, its cost-effectiveness will steadily decline with decreasing numbers of HBsAg-positive mothers (due to mass vaccination programmes). Indeed the programme may become relatively cost ineffective when the prevalence of HBsAg-positive women in the maternal population dropped to below 0.06% [19] (it is now approximately 2.5%). A full cost evaluation would also require the following data:

- the cost of the tests,
- the sensitivity and specificity of the tests,
- the cost of the vaccine and HBIG,
- the cost of health professional time relating to specimen collection, blood testing, immunoprophylaxis provision and counselling the mother,
- the cost of testing, vaccination and immunisation benefits incurred with the vaccination of contacts.

Evaluation strategies for the immunoprophylaxis programme

Three different approaches to evaluating the immunoprophylaxis programme are described below. Only very crude cost estimates are included though these could be developed further when a clearer idea of the preferred options is available.
Continuous monitoring

The Ministry of Health could develop definitive guidelines for the immunoprophylaxis programme and a standardised mechanism for documenting its ongoing performance. These guidelines would be based on the criteria described in the previous section. Once these guidelines had been promoted, the Department could require that AHBs provide regular data that documented performance in relation to selected criteria. These results could be reviewed on a regular basis or at a specified time, eg, 12 to 18 months after the guidelines had been distributed. Some funding to get this system working in AHBs would probably be necessary.

The continuous monitoring approach and indeed other evaluation strategies would be assisted if maternal hepatitis B carriage was declared a notifiable condition to the Medical Officer of Health (MOH). It may be that this would not require any legal changes and could simply be regarded as a minor expansion of the current case definition of notifiable hepatitis B (which currently relates to acute cases only). Alternatively a system of voluntary reporting to the MOH could be encouraged.

The advantages of the continuous monitoring approach are that:

- It would involve a process of making explicit to service providers what the criteria for a successful immunoprophylaxis programme are.
- It supports the development of built-in and on-going evaluation at the local level as part of a quality assurance programme.
- It would put into place well recognised performance criteria on which to base subsequent evaluations.
- It recognises possible complicating factors such as inadequate vaccine quality (hepatitis B vaccine is very sensitive to freezing). The problems associated with hepatitis B and the national vaccine cold chain are significant (see Chapter Three).
- It may be more appropriate than other strategies considering the current state of organisational flux in the health sector which may reduce the willingness of hospital and general practice personnel to assist in a detailed one-off evaluation.

2 Initial Outcome Evaluation

Performing an outcome evaluation first would help determine the need for a process evaluation. That is, if the result obtained suggested that fewer than 70% of infants of known carrier mothers had vaccine induced protective antibodies, this would confirm the need for a process evaluation.

The outcome evaluation could be either retrospective or prospective. A retrospective study would use hospital records to identify a cohort of carrier mothers who delivered infants in the previous two to three years. Those children older than six months would then be tested for HBV markers. A retrospective study would be faster than a prospective one although the follow-up of the mothers and children would be more difficult. This study would require ethics committee approval by the AHBs involved.

3 Comprehensive evaluation

A comprehensive evaluation could measure the performance of the immunoprophylaxis programme by all of the criteria identified in this document. It could also be either
retrospective or prospective. Obtaining good process information may be more difficult with the retrospective approach but the study would be quicker to conduct. A prospective study may collect better quality data but it would have the disadvantage of possibly stimulating improvements in the programme and distorting the results of the evaluation.

For a prospective study to obtain enough data it would be desirable to run the evaluation in two large hospitals with antenatal services in the northern or eastern regions of the North Island (these regions of increased risk were described in the 1985 National Immunisation Survey). A minimum study size would be 25 HBsAg-positive women from each hospital. To obtain these numbers the study would have a running time of at least nine months.

The results of either the retrospective or prospective studies would be more able to be generalised to the rest of the population if a stratified sample of hospitals and regions were used. For example, the hospitals with antenatal services within the northern and eastern regions could be stratified into small, medium and large hospitals. From each category, two or more hospitals could be randomly selected.
RECOMMENDATIONS

It is recommended that the Ministry of Health:

1  Choose the continuous monitoring strategy

   This would involve the development and dissemination of guidelines, performance criteria and data collection, reporting and review mechanisms.

   

2  Make maternal hepatitis B carriage a notifiable condition

   This would be achieved by expanding the case definition currently in use for hepatitis B. To make this addition to the surveillance system successful there would need to be appropriate publicity targeting key personnel.

   

3  Consider including monitoring of other antenatal tests in the evaluation strategy (rubella, syphilis and cervical swabs).

   That in addition to continuous monitoring of the hepatitis B immunoprophylaxis programme, evaluation of other antenatal screening tests be considered.
References


Appendix Five

DELIVERY OF HEPATITIS B IMMUNISATIONS IN A
SELECTION OF COMPUTERISED GENERAL PRACTICES

Nicholas Wilson, Susan Dovey¹, Don Bandaranayake², Murray Tilyard¹

¹ Royal New Zealand College of General Practitioners
² Wellington School of Medicine

ABSTRACT

A study was undertaken to assess the value of computerised general practices in providing information concerning the delivery of hepatitis B immunisation. Hepatitis B immunisation data from August 1990 to June 1991 were collected from 27 general practices. The study identified significant limitations in the use of data from computerised general practices for estimating hepatitis B immunisation coverage. While an accurate coverage figure could not be estimated, the results did suggest that hepatitis B coverage for three doses was at least 59.5% and that its use was very similar to the triple vaccine and measles/MMR for the third dose. Hepatitis B immunisation delivery outside the desirable time periods was common at 44%, suggesting a fairly disrupted immunisation schedule for many children. The relatively infrequent delivery of hepatitis B vaccine at the same time as other vaccinations may reflect provider concern about administering multiple injections at the same visit. Further improvement in the collection of data by computerised practices is necessary before the full value of this data source can be realised. Improvements in reminder/recall systems would improve the efficiency with which hepatitis B immunisation is delivered.
INTRODUCTION

Hepatitis B vaccination has, since 1988, become a routine part of the childhood immunisation schedule. Since this time there has been some focus on how reminder/recall systems work in the general practice setting for immunisation in general [1,2,3]. Also in 1992, a national coverage survey provided the most accurate national hepatitis B vaccination coverage to date [4]. This study gave an estimate of hepatitis B vaccination coverage of between 86 and 95% for the first two doses and 61 to 69% for the third dose, across the four regional health authorities. In contrast, the use of immunisation benefit claims data has yet to provide a valuable source of immunisation coverage data for hepatitis B [5]. Therefore, to provide further information on the delivery of hepatitis B immunisation in the general practice setting, the following study was performed.

METHOD

The study employed a standard methodology for data collection developed by the Royal New Zealand College of General Practice (NZCGP) Computer Research Group. This involved supplying the 27 contributing general practitioners with a search program that downloaded relevant information on childhood immunisations (including hepatitis B) from their practice computer systems onto a diskette. The search program collected data for the time period August 1990 to June 1991. Data items included a patient code number, date of birth, and the date and type of immunisations given. The data were analysed with the software package Epi Info [6].

Although the general practices involved were located throughout New Zealand, it was recognised that this group was not likely to be geographically representative. This group of practices is also likely to differ from non-computerised practices. A separate study has been undertaken to address this issue, but the results of this are not yet available.
Up to date denominator data on each practice were not available due to patients having left the practice not informing the doctor of this change. Itinerant practice attenders were also on the practice's computer systems. Therefore, the denominator population for each of the practices was estimated from the number of children registered in the practice who were born in the one year period preceding June 1991. This figure was multiplied by the number of months over which immunisation data were collected to give a specific denominator population for each practice.

The study as a whole was reviewed and approved by the Ethics Committee of the Otago Area Health Board.

RESULTS

The codes used to identify the delivery of hepatitis B immunisations varied greatly between participating general practitioners and even within practices. This suggested both a lack of standardisation in the software and in the coding system used by the different staff. As a result, extensive recoding was required before systematic analysis of the data could commence.

When the denominator populations were calculated and summed, a total of 4,596 children was obtained for all 27 practices combined. This total was used in the calculations below.

Vaccination coverage

Overall, 8,206 doses of hepatitis B vaccine were given to these children during the study period. It was determined however, that this was less than the true total due to incomplete data being obtained from some practitioners. This omission was caused by
some doctors recording immunisation data in more than one part of their practice computer (all of which was not examined by the search program). Despite this, the coverage for three doses of hepatitis B vaccination was estimated at 59.5% of the denominator population (Table 1). For the three doses overall, hepatitis B was administered slightly more frequently than the triple vaccine, but this was not at a statistically significant level (odds ratio = 1.06, 95% confidence interval 0.97-1.15). There were also no significant differences in the frequency of administration of the first two doses of hepatitis B compared to the triple vaccine and for the third dose of hepatitis B compared to the first dose of measles/MMR vaccine (both of which are meant to be given in the 12 to 15 month age range).
Table 1  Immunisation Coverage of Hepatitis B Compared to Other Immunisations, by Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Immunisation Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(as a percentage of the denominator population in each age group for each dose)</td>
</tr>
<tr>
<td></td>
<td>Hepatitis B (3 doses)</td>
</tr>
<tr>
<td>&lt;11 weeks</td>
<td>50.3</td>
</tr>
<tr>
<td>11 - 18 weeks</td>
<td>46.7</td>
</tr>
<tr>
<td>19 - 28 weeks</td>
<td>11.2</td>
</tr>
<tr>
<td>7 - 12 months</td>
<td>7.0</td>
</tr>
<tr>
<td>&lt; 1 year</td>
<td></td>
</tr>
<tr>
<td>12 - 15 months</td>
<td>3.6</td>
</tr>
<tr>
<td>7 - 16 months</td>
<td></td>
</tr>
<tr>
<td>15 - 20 months</td>
<td>31.4</td>
</tr>
<tr>
<td>16 - 20 months</td>
<td></td>
</tr>
<tr>
<td>15 m - 3 yrs</td>
<td></td>
</tr>
<tr>
<td>20 m - 4 yrs</td>
<td></td>
</tr>
<tr>
<td>20 m - 5 yrs</td>
<td>28.3</td>
</tr>
<tr>
<td>3 - 5 yrs</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>59.5</td>
</tr>
</tbody>
</table>

Notes:

**Codes for Immunisations:**  DTP - Triple vaccine (diphtheria, tetanus and pertussis); DT - (diphtheria & tetanus); MMR - Measles, mumps & rubella vaccine.

**Bolding** signifies the correct immunisation time (within broad limits) for hepatitis B.
Timing of vaccination delivery

The timing of hepatitis B immunisation delivery at particular ages and with other vaccinations is shown in Table 2. A total of 43.6% of hepatitis B immunisations occurred outside the broadly defined "correct" time periods. The majority of these (77% of the total) occurred after 15 months of age.

Administration with other vaccinations

These data also suggest that hepatitis B vaccine is given on its own on 65% of occasions. This is despite the fact that its administration is always meant to coincide with other immunisations on the immunisation schedule. Indeed hepatitis B was only given with the vaccine it is meant to be associated with on the schedule on 34.1% of all occasions. The frequency of being given with the appropriate other vaccines at the appropriate time by dose was: 33.6% for the first dose (ie with DTP), 37.9% for the second dose with DTP and polio (including DTP alone) and only 0.2% for the third dose with measles or MMR (ie 46 doses out of an expected one third of 8,206 doses).
Table 2  The Timing of Hepatitis B Immunisation Delivery in 27 General Practices

<table>
<thead>
<tr>
<th>Vaccinations</th>
<th>&lt;11w</th>
<th>11-18w</th>
<th>19-28w</th>
<th>7-12m</th>
<th>12-15</th>
<th>15-20</th>
<th>20-5y</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>1365</td>
<td>1184</td>
<td>364</td>
<td>265</td>
<td>120</td>
<td>817</td>
<td>1199</td>
<td>5314</td>
<td>64.8%</td>
</tr>
<tr>
<td>HB,p,DTP</td>
<td>324</td>
<td>848</td>
<td>119</td>
<td>36</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>1334</td>
<td>16.3%</td>
</tr>
<tr>
<td>HB,DTP</td>
<td>596</td>
<td>85</td>
<td>19</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>711</td>
<td>8.7%</td>
</tr>
<tr>
<td>HB,m</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>10</td>
<td>289</td>
<td>33</td>
<td>342</td>
<td>4.2%</td>
</tr>
<tr>
<td>HB,MMR</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>36</td>
<td>321</td>
<td>45</td>
<td>407</td>
<td>5.0%</td>
</tr>
<tr>
<td>HB,DT</td>
<td>26</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>46</td>
<td>0.6%</td>
</tr>
<tr>
<td>HB,p,DT</td>
<td>0</td>
<td>17</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>8</td>
<td>7</td>
<td>35</td>
<td>0.4%</td>
</tr>
<tr>
<td>HB,p</td>
<td>0</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>15</td>
<td>0.2%</td>
</tr>
<tr>
<td>HB,MMR,p</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.0%</td>
</tr>
<tr>
<td>HB,t</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

2312 2148 512 323 169 1442 1300 8206 100

28.2%  26.2%  6.2%  3.9%  2.1%  17.6%  15.8%  100%

Notes:

Bolding signifies the correct immunisation time (within broad limits) and the particular vaccines that are meant to be administered at the same time as hepatitis B.

Age group: First interval: under 11 weeks; Second interval: 11 weeks to 18 weeks; Third interval: 19 weeks to 28 weeks; Fourth interval: 7 months - 12 months (29 weeks to 51 weeks); Fifth interval: 12 to 15 months (52 weeks to 60); Sixth interval: 15 - 20 months (61 to 80 weeks); Seventh interval: 20 months - five years (81 to 259 weeks).

Codes for Immunisations: HB - hepatitis B vaccine; DTP - Triple vaccine (diphtheria, tetanus and pertussis); DT - Double vaccine (diphtheria & tetanus); m - measles vaccine; MMR - Measles, mumps & rubella vaccine; p - polio vaccine; t - tetanus vaccine
DISCUSSION

Obtaining immunisation data from computerised general practices has certain attractions in that information on the exact immunisation is available along with the precise timing. This system can also define characteristics of those who miss out on immunisations, allowing improvements in targeting. Also, as all these computerised practices used their computers for claiming immunisation benefits, there is a good reason for this data to be recorded, ie, likely to be valid. In addition only minimal effort on behalf of the practitioner is required to supply the data.

Despite these advantages, this study highlighted problems with both numerator and denominator data. Numerator data were incomplete due to non-standardised recording of behaviour by practice staff using the computer. Denominator data was not accurate because patients frequently change practices and old records are not purged. Nevertheless, the method of calculating a denominator population used in this study is likely to provide a reasonable estimate for the true figure. It does assume however, an even age structure in the children under six years of age in the practice.

In view of the incomplete collection of numerator data, it is not surprising that this study found that the overall coverage rate for hepatitis B immunisation was in the lower end of the range reported in the recent national coverage survey [7]. Nevertheless, it does provide a lower bound for immunisation coverage. Also, this data capture problem is very unlikely to have differentiated between hepatitis B and other immunisations so that the relative similarities in coverage found between different immunisations is likely to reflect the true situation in these practices [5].

That the administration of immunisations outside the optimal time periods was common (44%), is of concern. Given the large proportion who were vaccinated after 15 months, this may be due to some of these immunisations being catch-up immunisations for children
who have missed out on this vaccine at younger ages. Nevertheless, the administration of
a large proportion of this immunisation outside the optimal time periods has implications
for confusing parents and leading to dislocation of the whole immunisation schedule. This
in turn can reduce immunisation coverage and lead to increased time and travel costs for
parents attending for catch-up vaccinations. Delays in immunisation also leave children
with longer periods of susceptibility. In the long term, if adequate catch-up is not
achieved, then there is also the risk of hepatitis B in incompletely immunised children. The
cost-effectiveness of hepatitis B immunisation delivery is also decreased as extra visits
result in more immunisation benefits paid by the state. Use of immunisation recall and
reminder systems, at the provider and/or regional level, may help to address this problem.

The low use of combinations of vaccines may relate to some extent to the dislocation in
timing as described above. This is not likely however to explain the different use of
vaccinations at the first visit for an immunisation where hepatitis B was only given with
the triple vaccine 39.7% of the time. This may reflect some level of unwillingness among
general practice staff to provide multiple immunisations at the same visit. A recent survey
has certainly highlighted concern about the possibility of giving three injections at one
immunisation event [8]. Although there are no medical reasons for avoiding giving
hepatitis B vaccine with DTP and MMR, it is recognised that parental acceptance of two
injections at once may not be particularly high (especially if the child cries after the first
vaccination). For this reason it may be good practice to defer one of the injections if
either the parent is particularly concerned or if the child is extremely upset. A more
desirable option may be to wait a few minutes to allow the child and/or parent to relax
before the second injection is given.

In summary, this study identified some important limitations in the use of data from
computerised general practices for estimating hepatitis B immunisation coverage. It did
however, suggest that hepatitis B coverage for three doses was at least 59.5% and that its
use was very similar to the triple vaccine and measles/MMR for the third dose. Hepatitis
B immunisation delivery outside the desirable time periods was common at 44%, and suggests a fairly disrupted immunisation schedule for many children. The relatively infrequent delivery of hepatitis B vaccine at the same time as other vaccinations may reflect provider concern about administering multiple injections at the same visit. Further improvement in the collection of data by computerised practices is necessary before the full value of this data source can be realised. Improvements in reminder/recall systems would improve the efficiency with which hepatitis B immunisation is delivered. These recommendations are developed in more detail below.

**RECOMMENDATIONS**

1 **For the General Practice Research Unit, Otago University**

1.1 Practitioners in the network should be encouraged to record immunisation data in only one standard part of their computer system.

1.2 Future search programmes should be designed to exclude children who have not attended the practice in the last two years so that a more accurate denominator population can be determined.

1.3 Practitioners in the network should be encouraged to use a more unified coding system (eg, HB1, HB2, HB3 for hepatitis vaccination codes). (see Appendix Two).

1.4 Investigators should arrange a further study to assess the representativeness of the current network of computerised practices.
For the New Zealand Communicable Disease Centre

2.1 Further financial support for a repeat search should be considered once a standardised set of codes for vaccinations has been put into use.

For the Ministry of Health/Public Health Commission

3.1 That greater use of reminder/recall systems at the provider or regional level be encouraged (eg, by specifying these be in contracts that regional health authorities have with primary care providers).

3.2 That consideration be given to a survey of providers to obtain further information on knowledge, attitudes and behaviour with regard to immunisation delivery (and in particular the delivery of multiple immunisations at the same immunisation event).

Acknowledgments

The authors gratefully acknowledge the input of all the general practitioners and their practice staff who supplied the data for this study.
References


6 Dean AD, Dean JA, Burton JH, Dicker RC. Epi Info, Version 5.01: a word processing, database, and statistics program for epidemiology on microcomputers. Atlanta: Centers for Disease Control, 1990.


Appendix Six

BENEFITS AND COSTS OF HEPATITIS B IMMUNISATION
FROM THE INDIVIDUAL'S PERSPECTIVE

ABSTRACT

Objective: To determine the benefits and costs of immunising a 20 year old New Zealander against hepatitis B from the perspective of the individual. In addition, to describe these in terms a potential vaccinee can understand.

Method: A spreadsheet model was developed using data on New Zealand age-specific rates of hospitalisation and death from hepatitis B.

Results and Discussion: The benefits of vaccination can be summarised as reducing the risk of being too sick to work from hepatitis B for three to four months fivefold, from 1/200 to 1/1000 (over the next 15 years). The risk of death is reduced from one in a million to one in six million. On average, the vaccinee would have to spend approximately seven hours time earning money to pay for vaccine and to get vaccinated to prevent 11 hours of being too ill from hepatitis B to work.

Conclusion: Despite the complexities involved in the assessment of the benefits and costs of immunisation, it appears possible to summarise these in ways that at least a proportion of potential vaccinees may be able to understand.
INTRODUCTION

During the 1988 "catch-up" pre-school immunisation programme for hepatitis B in New Zealand, there were a number of critics of the immunisation policy. These critics considered that there was a need for more information on the costs and benefits of hepatitis B vaccination in the New Zealand situation [1,2]. In addition, some health professionals lacked the necessary information to counter information from the "fairly intense antivaccination lobby" that existed in parts of the country [3].

Medical practitioners and members of the public are not alone in feeling that more information should be available for individuals on making such decisions relating to medical interventions. Professor Geoffrey Rose, a leading British expert in preventive medicine, has argued that experts should make their advice known, and that the reasoning behind recommendations should be explained [4]. He has also urged that care must be taken to avoid confusion between the technical and value judgements of experts. The choice whether to accept the recommendations of experts should rest freely with the recipients, who should be spared coercion and unreasonable pressure [5].

The provision of information regarding a threat to health existing, along with an understanding of how the individual can reduce that risk, is part of the health beliefs model used in health promotion activities [6]. This principle has also been used in health promotion activities concerned with HIV prevention [7].
Along with the increase in consumer awareness of the right to know more about medical interventions, the introduction of new gambling outlets may have led to a greater public awareness of probabilities in recent years. For example, activities such as "Lotto" convey some crude impression about probabilities.

This analysis attempts to calculate the benefits of hepatitis B vaccination from the perspective of an individual adult and to express these in understandable terms. An adult aged 20 years is chosen since this age is currently outside the age-group for which immunisation is freely available. This is also the age when many people enter the workforce and costs of illness can be assessed in terms of lost productivity.

**METHOD**

The following information on risk of infection, impact of infection on health status, and vaccine efficacy were incorporated into a spreadsheet model of acute hepatitis B.

**The risk of illness:** The probability of developing acute hepatitis B requiring hospitalisation is based on New Zealand hospitalisation data for the age groups 20-29 years and 30-39 years for the time period 1987 to 1991 inclusive (ie annual incidence rates of 1.63 and 1.29 per 100,000 population respectively). The death rate of hospitalised cases for this time period was 1.8%. To determine the risk of symptomatic illness not requiring hospitalisation, data from an Auckland study that suggested a 4.6% hospitalisation rate for acute hepatitis B were used [8]. The risk of developing a chronic carrier state has been estimated at being extremely low, ie, under 0.5% [9,10], so was ignored in this analysis. Data on the risk for travellers were also reviewed [11].
Impact of infection of health status: There are no detailed data on the length of clinically significant illness associated with acute hepatitis B for New Zealand. Therefore, an estimate from a British study of 117 lost working days is used [12]. An estimate of 20 lost work days before death is used for the fatal fulminant form of hepatitis B as was used in a recent Israeli study [13]. Based on current life expectancy for New Zealanders, death is assumed to result in an average of 55 years of lost life for individuals dying at a mean age of 25 years [14].

Costs of vaccination: It is assumed that the cost of three doses of adult vaccine and the cost of the first consultation will amount to $75 on average (equivalent to approximately 5.3 hours of work on the average weekly wage of $563 [15]). In addition, vaccinees are assumed to spend, on average, two hours of time travelling to the doctor's practice and waiting around to get vaccinated. Although approximately 10% of vaccinees are assumed to develop temporary soreness or erythema at the injection site, it was considered that there would be no adverse reactions that caused permanent disability or fatalities [16,17]. This assumption has also been used in a recent cost-benefit study [18]. The possibility of hepatitis B vaccination causing chronic fatigue syndrome was also excluded as suggested by the available evidence [19].

Vaccine efficacy: Due to recent evidence of suboptimal performance of vaccine cold chain maintenance in the New Zealand setting [20,21], the vaccine is assumed to have an efficacy of only 80% for a 15 year time period and for this age group. However, this level of efficacy may be pessimistic given the current interest in improving the quality of the vaccine cold chain.
RESULTS

The overall benefits of immunisation are summarised in Table 1. Of note is the fact that the risk of death in this age-group is already extremely low. Vaccination therefore has a negligible impact on improving life expectancy (ie by only 20 minutes). The mean numbers of hours of illness prevented through vaccination is only slightly greater than the time spent on earning sufficient money to pay for the vaccine and obtaining the vaccinations (ie eleven versus seven hours). This is only true, however, if the individual values time in the future as being equivalent to time in the present, ie, is operating at a 0% discount rate. If the individual discounts time at the rate of 10% or more per year, then the process of getting vaccinated would involve more time than the amount of illness prevented.
Table 1   Expected Benefits Attributable to Hepatitis B Immunisation in a New Zealand Adult (aged 20 years) over a 15 year Period.

<table>
<thead>
<tr>
<th>Disease state</th>
<th>Reduction in the probability of the illness or death</th>
<th>Mean hours of illness prevented* [mean hours of life saved]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>discount rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0%              10%         20%</td>
</tr>
<tr>
<td>Acute hepatitis B (symptomatic)</td>
<td>1/202 to 1/1010</td>
<td>11.1              5.3        2.3</td>
</tr>
<tr>
<td>Acute hepatitis B (hospitalisation then death)</td>
<td>1 in 1.2 million to 1 in 6.0 million</td>
<td>[0.3] [0.2] [0.1]</td>
</tr>
</tbody>
</table>

Note: * Illness severe enough to prevent attendance at work.

The information collected on costs and benefits could be presented to potential vaccinees in a range of ways. One approach is as follows:

**The benefit of vaccination:** "Having this vaccine will lower your chance of developing hepatitis B and being too sick to work for three to four months, by five times. That is, it will reduce your risk from one chance in two hundreded down to one in a thousand, over the next 15 years. It will also lower your risk of dying from hepatitis B from one in a million to one in six million."

"Another benefit of being immune to hepatitis B is a reduced level of risk if you ever happen to be in situation where the chance of infection is increased (such as travel in a developing country where the risk can be up to one in four hundred per month). Also, by being immune, you help to protect other people from infection and help to eradicate hepatitis B from New Zealand."
**The cost of vaccination:** "Vaccination will cost you the equivalent of five hours of time spent earning income (if you are on the average wage). In addition, you will have to spend approximately two hours of time on the process of getting vaccinated."

"The injection will cause a very minor degree of discomfort that lasts for only a few seconds. There is, however, a 10% chance that you will develop temporary soreness at the injection site. There is no evidence of any harmful short term or long term effects of this vaccine and it has now been used on tens of millions of people world-wide."

**DISCUSSION**

This study has highlighted the complexity of decision-making concerning hepatitis B vaccination for adults in this age-group. Indeed, the decision becomes even more complex if the individual is likely to participate in "at-risk" activities in the future. Such activities would include spending some time in developing countries where the risk of hepatitis B is significantly higher, participating in unprotected sexual activity, or participating in injecting drug use. To some extent the region of New Zealand the person lives in, and particularly their ethnicity, can increase their risk of infection significantly (see Chapter One).

Another important factor may include the individuals' concerns about risk, since some people are highly risk averse [22]. The results also suggest the importance of time preferences, since the benefit of vaccination, in terms of illness prevented, is dramatically eroded if individuals operate with little concern for their health in the future, ie, at a high discount rate. Indeed, behaviour consistent with a mean annual discount rate of 30% has
been described previously for health related behaviour in adults [23]. It is of note, however, that not all workers in the field of health intervention decision making agree with the use of discounting [24].

A further complexity is that the incidence of hepatitis B in New Zealand is likely to continue to decline at a significant rate, hence reducing the benefits of vaccination described above (see Chapter Two).

The use of probabilities to explain the benefits of immunisation may be the most desirable way to present information to potential vaccinees as opposed to presenting the number of hours of illness prevented or life saved in the average vaccinee. This is because the full impact of long term illness and death is dramatically reduced when it is conceptualised as just so many hours of illness or life lost. It is also desirable that the benefit of vaccination is also conveyed in terms of the reduction in risk, that is "fivefold" in this case. This gives some idea of how effective the intervention is.

It is likely that a relatively large proportion of the population will have difficulty conceptualising any benefit explained through the use of probabilities or "average amount of illness prevented". Even so this type of analysis may be of value by providing medical practitioners with a better impression of the costs and benefits. The doctor can then look for other ways of conveying these benefits and costs that are appropriate to the specific individual and their cultural background. For example, the benefits of being immune so as to not spread infection to family members may have special significance to ethnic groups with a strong concept of family or whanau (eg, Maori and Pacific Island Polynesians) [25]. This analysis may also help employers decide on the benefit of workplace based vaccination programmes.
If information detailed here was to be produced in a written format, as part of a campaign to encourage hepatitis B immunisation, it would be necessary for it to be pre-tested on the appropriate target populations. Such pre-testing is a critical aspect of modern health promotion programmes [26]. Video presentations of people who have had hepatitis B talking about their illness and its impact on their lives, may also assist in conveying useful information. Similarly, such videos may convey the relatively painless nature of being vaccinated.

In summary, this analysis has provided an estimate of the benefits and costs of hepatitis B to the average 20 year old New Zealander. While the benefits and costs involved in obtaining this immunisation are complex, it would appear possible to summarise the key information in a way that is likely to be relatively understandable, at least to educated consumers and employers. Actual testing of such information on potential vaccinees would be required to determine how understandable such concepts really are in practice.

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Science Centres located at:

Head Office
Level 6, Clear Centre,
15-17 Murphy Street, Thorndon.
PO Box 12-444, Wellington, New Zealand.

Mt. Eden Science Centre
17 Kelly Street, Mt. Eden,
Auckland, New Zealand.
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New Zealand Communicable Disease Centre
Kenepuru Drive,
PO Box 50-348, Porirua, New Zealand.
Telephone 0-4-237 0149, Facsimile 0-4-237 8983

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Hampstead Road, Private Bag 92-021,
Auckland, New Zealand.
Telephone 0-9-815 3670, Facsimile 0-9-849 6046

Wellington Science Centre
Gracefield Road,
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Telephone 0-4-570 1555, Facsimile 0-4-569 4500

Christchurch Science Centre
27 Creyke Road,
PO Box 29-181, Christchurch, New Zealand.
Telephone 0-3-351 6019, Facsimile 0-3-351 9923

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