Perinatal and Maternal Mortality Review Committee

He matenga ohorere, he wairua uiui, wairua mutungakore

Health Quality & Safety Commission New Zealand

Kupu Taurangi Hauora o Aotearoa

Sixth Annual Report of the Perinatal and Maternal Mortality Review Committee

Reporting mortality 2010

SECOND REPORT TO THE HEALTH QUALITY & SAFETY COMMISSION NEW ZEALAND

June 2012

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Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) members in 2012 are:

- Professor Cynthia Farquhar (Chair), obstetrician and gynaecologist and clinical epidemiologist, The University of Auckland
- Ms Sue Bree, midwife, Bay of Islands
- Dr Vicki Culling, Sands New Zealand, Wellington
- Dr Alec Ekeroma, obstetrician, Counties Manukau DHB
- Ms Anja Hale, neonatal nurse specialist, Waikato DHB
- Dr Beverley Lawton, GP, researcher and director of Women's Health Research Centre, Wellington
- Professor Lesley McCowan, obstetrician and maternal fetal medicine specialist, The University of Auckland
- Dr Maggie Meeks, neonatologist, Canterbury DHB
- Dr Stephanie Palmer, Māori health researcher
- Dr Graham Sharpe, anaesthetist, Capital & Coast DHB.

Maternal Mortality Review Working Group

The Maternal Mortality Review Working Group (MMRWG) members in 2012 are:

- Dr Alastair Haslam (Chair), obstetrician and gynaecologist, Waikato DHB
- Dr Claire McLintock, obstetric physician and haematologist, Auckland DHB
- Ms Jacqui Anderson, midwife, Christchurch
- Ms Alison Eddy, midwife, Christchurch
- Professor Cynthia Farquhar, Chair PMMRC
- Dr Cathy Hapgood, perinatal psychiatrist, Waitemata DHB
- Dr Jeanette McFarlane, pathologist, Auckland DHB
- Dr John Walker, anaesthetist, Auckland DHB
- Dr Graham Sharpe, PMMRC member
- Dr Alec Ekeroma, PMMRC member.

Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group (NEWG) members in 2012 are:

- Dr Malcolm Battin (Chair), neonatal paediatrician, Auckland DHB
- Professor Cynthia Farquhar, Chair PMMRC
- Ms Anja Hale, neonatal nurse specialist, Waikato DHB
- Ms Deborah Harris, neonatal nurse practitioner, Waikato DHB
- Dr Astrid Budden, obstetrician and gynaecologist, Auckland DHB
- Dr Thorsten Stanley, paediatrician, Capital & Coast DHB
- Ms Rachel Taylor, team manager, Accident Compensation Corporation
- Dr Alex Wallace, paediatrician, The University of Auckland.

Australasian Maternity Outcomes Surveillance System Working Group

The Australasian Maternity Outcomes Surveillance System Working Group (AMOSSWG) members in 2012 are:

- Dr Claire McLintock (Chair), obstetric physician and haematologist, Auckland DHB
- Dr Sarah Wadsworth, obstetrician and gynaecologist, Counties Manukau DHB
- Ms Alison Eddy, midwife, Christchurch
- Professor Cynthia Farquhar, Chair PMMRC
- Dr Ted Hughes, anaesthetist and ICU consultant, Waitemata DHB
- Dr Bev Lawton, PMMRC member
- Ms Jo McMullan, midwife and local coordinator, Hutt Valley DHB
- Ms Estelle Mulligan, midwife, Counties Manukau DHB
- Ms Kathleen Williamson, midwife, Hawke's Bay DHB.

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FOREWORD

The Health Quality & Safety Commission (the Commission) welcomes the Perinatal and Maternal Mortality Review Committee's (the Committee's) report. This is the second report to the Commission and the sixth report of the Committee. It details perinatal and maternal deaths from 1 January to 31 December 2010. It contains the second year of data on potentially avoidable perinatal deaths and five years of data on potentially avoidable maternal deaths. There is also new information on babies born very unwell and diagnosed with neonatal encephalopathy in the first week of life.

This report gives us an important indication of how our maternity services are performing. New Zealand perinatal mortality rates are comparable with those in the United Kingdom (2009 rates). The New Zealand maternal mortality ratio is significantly higher than the ratio reported by the United Kingdom for the triennium 2006–2008. There were 13 maternal deaths from suicide during the period 2006–2010 (almost a quarter of the total recorded maternal deaths), making suicide the leading cause of maternal mortality in New Zealand for this time period. The PMMRC has recommended the establishment of a mother and baby unit in the North Island for some years and it is well acknowledged that coordination between existing services in the primary and specialist sectors and better information sharing processes between providers could deliver better care for these mothers, and all New Zealand mothers.

The New Zealand specific data presented in this report on neonatal encephalopathy should help our understanding of this condition, including its substantial human and economic cost. Recommendations have been made regarding neonatal cooling and the collection of cord blood gases. We look forward to seeing this work completed in next year's report.

Much careful analysis has gone into this report and many months of data collection across the country by the Committee's established network of dedicated local coordinators. Professor Cindy Farquhar and the many people involved with the production of this report are to be congratulated.

The recommendations in this report have been presented to the Board of the Health Quality & Safety Commission. We will be working with the Committee to facilitate their implementation.

Professor Alan Merry, ONZM
Chair of Health Quality & Safety Commission

CHAIR'S INTRODUCTION

I am pleased to present the sixth annual report of the Perinatal and Maternal Mortality Review Committee (PMMRC). The aim of this committee is to identify areas in maternity and newborn care where improvements could be made. The purpose of this report is to provide an accurate estimate of the numbers and rates of perinatal and maternal deaths in New Zealand, to describe the risk factors for perinatal and maternal deaths, and to attempt to identify where the attention of maternity and neonatal services might be focused to prevent perinatal and maternal deaths.

This report presents both perinatal and maternal data for 2010. The data are the result of the collaborative efforts of the PMMRC, lead maternity carers, local coordinators and clinicians of the District Health Boards, supported by a national coordination service and the Mortality Review Data Group of the University of Otago. These data are one measure of the quality and safety of the New Zealand maternity services.

In 2010, the maternal mortality ratio was 17.8 per 100,000 maternities, and the perinatal mortality rate was 10.1 per 1000 total births. The rate for perinatal mortality is higher than Australia in 2009 (although this did not include the state of Victoria). Maternal deaths in Australia have not been reported since 2005, so no comparison can be made.

In this year's report, we are presenting new information on neonatal encephalopathy, where a term baby is born in poor condition generally requiring neonatal resuscitation and ongoing neonatal care. In 2010, there were 82 babies diagnosed with neonatal encephalopathy, of whom 59 survived. Based on initial analyses, we have made recommendations about neonatal cooling and the collection of cord blood gases. The data collection will be ongoing, and more comprehensive analysis of two years of data is awaited.

We are presenting a second year of data on potentially avoidable perinatal deaths and five years of data on potentially avoidable maternal deaths. Almost one in five perinatal deaths and one in three maternal deaths were found to be potentially avoidable. The most common contributory factors identified were barriers to accessing and engaging with care, the skills and knowledge of the health care professional and organisational factors such as a lack of protocols. Maternity providers need to consider the recommendations from this report and seek to implement them in their own settings.

We continue to collect data for the Australasian Maternity Outcomes Surveillance System (AMOSS) and numbers for the first two years are reported but again further analysis is awaited.

We welcome the release of the Healthy Beginnings report by the Ministry of Health. This report has made a number of recommendations about improving the provision of perinatal and infant mental health services. We particularly note the recommendation for mother and baby units in the North Island and will be working to see this implemented. It is also timely to receive the analysis of the maternal mental health survey from clinicians who work in the maternity sector, and we note the support for further educational workshops in the coming year.

This year, we will hold our fifth annual workshop, 'Beyond the numbers – maternal deaths and neonatal mortality in 2010', on 14 June 2012 in Wellington. These workshops are well attended, and once again, we have obstetric, midwifery and neonatal experts to critique our report.

Finally, I wish to thank everyone who has supported the work of the PMMRC and particularly those who have prepared the 2010 report. It has grown larger every year, and we are grateful to the almost universal collaboration we get from the maternity sector.

Professor Cynthia Farquhar

Chair of the Perinatal and Maternal Mortality Review Committee

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Terms of Reference and Mortality Definitions

- The Perinatal and Maternal Mortality Review Committee (PMMRC) is responsible for reviewing maternal deaths and all deaths of infants born from 20 weeks gestation to 28 completed days after birth, or weighing at least 400g if gestation is unknown.
- A maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management. It does not include accidental or incidental causes of death of a pregnant woman.
- Maternities are all live births and all fetal deaths at 20 weeks or beyond or weighing at least 400g if gestation was unknown. The maternal mortality ratio is calculated per 100,000 maternities.
- Perinatal mortality is fetal and early neonatal deaths from 20 weeks gestation until less than seven days of age or weighing at least 400g if gestation was unknown.
- The perinatal related mortality rate is fetal deaths (including terminations of pregnancy and stillbirths) and neonatal deaths (up to 28 days) per 1000 total babies born at 20 weeks or beyond, or weighing at least 400g if gestation is unknown.
- Neonatal mortality is all infant deaths from live birth to 27 days of age inclusive.

Key Points: Perinatal related mortality

Perinatal related mortality rates

1. In 2010, the perinatal mortality rate was 10.1/1000 births, and the perinatal related mortality rate was 10.8/1000 births, which represents a small non-significant decrease compared to the previous year. This rate is higher than the rate in Australia in 2009 and similar to the United Kingdom in 2009.

Perinatal related mortality and ethnicity

2. Māori and Pacific mothers are more likely to have stillbirths and neonatal deaths than New Zealand European and non-Indian Asian mothers.

a. There is an excess of perinatal related death from spontaneous preterm birth among Māori and Pacific mothers.

b. Neonatal deaths with no obstetric antecedent are more frequent in babies of Māori mothers. The majority of these are Sudden Unexpected Deaths in Infancy (SUDI).

c. Antepartum haemorrhage is a more common antecedent to death in Māori, while hypertension and diabetes are more common antecedents among Pacific mothers.

Perinatal related mortality and socioeconomic deprivation (New Zealand Dep2006)

3. There is a significantly increased rate of stillbirth and neonatal death among mothers in the most deprived socioeconomic quintile compared to all less deprived quintiles.

Perinatal related mortality and age

4. Teenage mothers (<20 years old) are at higher risk of perinatal related mortality, specifically stillbirth and neonatal death, compared to mothers aged 20–39 years (14.0/1000 compared to 10.4/1000) for the years 2007–2010. Mothers of 40 years and older are also at increased risk of perinatal related mortality (13.6/1000) compared to mothers aged 20–39 years.

a. The issues facing mothers at opposite ends of the age spectrum are different.

b. Spontaneous preterm birth is significantly more often the cause of perinatal related death in teenage mothers compared to women in the 20–39 year age bracket.

c. Maternal conditions and congenital abnormalities are significantly more common antecedent causes of perinatal related death in older mothers compared to women in the 20–39 year age bracket.

Drug and alcohol use in pregnancy

5. Nine percent of mothers reported using alcohol, and 3.4 percent reported using marijuana in pregnancy. Alcohol and marijuana use were associated with perinatal related death due to spontaneous preterm birth and SUDI. These findings may be confounded by smoking, socioeconomic deprivation and young age.

Contributory factors and potential avoidability of perinatal related deaths

6. Eighteen percent of all perinatal related deaths were thought to be potentially avoidable deaths – 2 percent of late terminations, 15 percent of stillbirths and 19 percent of neonatal deaths.

7. Contributory factors were identified in 27.3 percent of all perinatal related deaths – 2.6 percent of late terminations, 20.5 percent of stillbirths and 23.8 percent of neonatal deaths.

a. The most common contributory factors were barriers to accessing or engaging with maternity and health services (19%), personnel (7%) and organisational and management factors (4%).

Key Points: Neonatal encephalopathy

8. Eighty-two cases of moderate and severe neonatal encephalopathy were identified in 2010. This is a rate of 1.26/1000 total births.

Key Points: Maternal mortality

Maternal mortality ratio

9. The maternal mortality ratio for the five-year interval 2006–2010 was 17.8/100,000 maternities (95% confidence interval 13.5–23.0/100,000).

a. The New Zealand maternal mortality ratio is significantly higher than the ratio reported by the United Kingdom for the triennium 2006–2008 of 11.4/100,000 maternities.

b. There were eight maternal deaths in 2010.

c. The most frequent causes of maternal death in New Zealand in the years 2006–2010 were suicide (13 cases), maternal pre-existing medical conditions (11 cases) and amniotic fluid embolism (9 cases).

d. Thirty-six percent of maternal deaths in New Zealand from 2006–2010 were considered to be potentially avoidable.

e. Māori and Pacific mothers are more likely than New Zealand European mothers to die during pregnancy or in the six weeks postpartum.

6th Report Recommendations 2010

The recommendations listed below are those pertaining to the 2010 data presented in this report. These do not include recommendations made in previous years though they may still apply. A list of previous recommendations with progress to date in implementing these is included on page 6.

Recommendations (2010 data): Perinatal related mortality and morbidity

1. **Small for gestational age (SGA)**
   a. If SGA is confirmed by ultrasound at term, timely delivery is recommended.

2. **Maternal gestational weight gain**
   a. Pregnant women should be given an indication of ideal weight gain in pregnancy according to their body mass index (see page 52).

3. **Smoking cessation**
   a. All health professionals who provide care to pregnant women should offer smoking cessation advice.

4. **Neonatal encephalopathy**
   a. Cord gases should be performed on all babies born with an Apgar <7 at one minute.
   b. If neonatal encephalopathy is clinically suspected in the immediate hours after birth, early consultation with a neonatal paediatrician is recommended in order to avoid a delay in commencing cooling.
   c. All babies with moderate or severe neonatal encephalopathy should undergo a formal neurological examination and have the findings clearly documented prior to discharge.

Recommendations (2010 data): Maternal mortality and morbidity

1. **Pre-existing medical disease**
   a. Pregnant women who are identified with pre-existing medical disease during pregnancy should be referred appropriately.

2. **Maternal mental health**
   a. The committee notes the publication of the Healthy Beginnings report in January 2012 (MOH 2012b) and supports the recommendations with particular regard to the establishment of mother and baby units in the North Island and the importance of screening mothers for a history of mental health disorders.
   b. A comprehensive perinatal and infant mental health service includes:
      - screening and assessment
      - timely interventions including case management, transition planning and referrals
      - access to respite care and specialist inpatient care for mothers and babies
      - consultation and liaison services within the health system and with other agencies, for example, primary care and termination of pregnancy services.
   c. Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral.

SUMMARY OF KEY PMMRC RECOMMENDATIONS AND PROGRESS (2006–2009)

Below is a summary of progress against recommendations from the PMMRC.

Recommendation	Progress
Perinatal Mortality	
1. Early booking	
All women should commence maternity care before 10 weeks. This enables: • opportunity to offer screening for congenital abnormalities, sexually transmitted infections, family violence and maternal mental health, with referral as appropriate • education around nutrition, smoking, alcohol and drug use and other at-risk behaviour • recognition of underlying medical conditions, with referral to secondary care as appropriate • identification of at-risk women (maternal age, obesity, maternal mental health problems, multiple pregnancy, socioeconomic deprivation, maternal medical conditions).	The Ministry of Health is conducting qualitative research of at-risk (hard-to-reach) mothers to understand barriers to accessing care.
2. Teenage mothers (<20 years old)	
Lead maternity carers (LMCs) should be aware that teenage mothers are at increased risk of stillbirth and neonatal death due to preterm birth, fetal growth restriction and perinatal infection. Maternity services need to address this risk, paying attention to: • maternity care before 10 weeks • smoking cessation, prevention of preterm birth, screening for fetal growth restriction • antenatal education • undertaking research on the best model of care • engagement with the Ministry of Education regarding education in the school setting.	The PMMRC is not aware of any specific action in this area in terms of the development of a Ministry of Health plan to translate these findings into clinical practice. The PMMRC intends to meet with key officials at the Ministry of Education to discuss the progression of aspects of this recommendation.
3. Contributory factors and potentially avoidable perinatal deaths	
Key stakeholders providing health and social services to women at risk should work together and identify: • reasons for barriers to accessing maternity care • interventions to address barriers. Clinical services and clinicians have the following responsibilities: • continuing education • local review linked to quality improvement • up-to-date policies and guidelines that are implemented and audited • culture of teamwork • culture of practice reflection on patient outcomes linked to quality improvement • staff arrangements ensuring timely access to specialist services. Ministry of Health to develop a plan to translate these recommendations into clinical practice.	There is no specific progress on this recommendation to date.

4. Birth information	
Accurate, robust and timely clinical data on all pregnancies is important. A national perinatal database needs to be established so that perinatal mortality rates can be calculated and comparisons can be made between babies who die and those who survive the perinatal period.	The Ministry of Health supports national perinatal reporting and is considering a national perinatal epidemiology unit. Further work is needed to identify the funding required, potential sources of funding and potential 'hosts' for a unit. The Ministry of Health has funded a rebuild of the current maternity 'data mart' to more accurately report maternity outcomes.
The current birth registration dataset should be required to henceforth include maternity data critical to research (eg, parity, major complications, mode of birth, history of smoking and previous obstetric history).	The Ministry of Health's position is that the Births, Deaths and Marriages birth registration process is not an appropriate system for collecting additional obstetric/maternal information, especially as it relies on the parents completing the birth registration form. The Ministry of Health already collects this information from hospitals and LMCs. The Ministry notes that this collected information is not currently available for analysis due to technical difficulties with information systems.
All babies, whether stillborn or live born should be assigned a National Health Index (NHI) at the time of birth.	Stillborn babies are given an NHI in 15 of 20 DHBs.
Continued support and funding is required for DHBs and LMCs for collection of complete perinatal mortality statistics.	The Ministry of Health brought this recommendation to the attention of the DHB Women's Health Managers Network. The Ministry continues to support and fund DHBs and LMCs in their reporting of mortality data and collection of complete perinatal mortality statistics.
Possible causes for the increase in perinatal related death of babies born to Pacific women, Māori women, women under the age of 20 or over the age of 40 and women who live in areas of high socioeconomic deprivation should be researched. This information is necessary in order to develop appropriate strategies to reduce these possibly preventable deaths.	Further research is necessary to progress this recommendation.
5. DHB disparities	
Further research is warranted to understand the higher rate of perinatal related mortality in the Counties Manukau region.	The Ministry of Health, as well as representation from the PMMRC, met with Counties Manukau DHB to discuss this rate and develop strategies to improve perinatal related mortality in this region. Counties Manukau DHB have initiated a process for review of perinatal mortality and maternity services in the region.
6. Ethnicity	
New legislation should enable Births, Deaths and Marriages to accept NHI data and update the routine NHI dataset with regard to ethnicity.	A meeting will be organised between the National Health Board and members of the PMMRC to progress this item.
Clinicians and LMCs should be encouraged to collect accurate ethnicity details at the time of booking.	

7. Access to care	
The Ministry of Health, DHBs and professional colleges should collaboratively explore barriers to early booking with a view to increase the number of women who book with an LMC before 10 weeks gestation. A national media campaign should be considered.	Proceeding with a national media campaign and exploring barriers to early booking have been a low priority for the Ministry of Health. A recommendation for the Ministry's maternity work programme in 2011/12 will be improving information given to consumers about pregnancy, childbirth and the maternity system. The Ministry is investigating ways to purchase primary health and maternity services to ensure multidisciplinary collaboration in the community setting.
Strategies to improve awareness of antenatal care services and increase access among women who are isolated for social, cultural or language reasons should be developed.	Strategies to improve awareness of antenatal care services would be part of the Ministry of Health's proposed 2011/12 work programme on maternity consumer information. The Maternity Quality and Safety Programme will require DHBs to involve consumers.
Clinicians and LMCs should be aware that Pacific women, Māori women, women under 20 or over 40 years of age and those women who live in areas of high socioeconomic deprivation are at higher risk of a perinatal death.	
8. Screening for gestational diabetes, smoking and family violence	
LMCs should follow the Ministry of Health pregnancy guidelines for: • diabetes screening • smoking cessation • family violence screening. Screening for family violence should be a routine part of maternity care and documented.	Promotion of smoking cessation is a national health priority. The PMMRC will be collaborating with the Family Violence Death Review Committee to further identify strategies to improve screening for family violence in the maternity setting.
9. Multiple pregnancies	
All women with a multiple pregnancy should be offered an early specialist consultation, including ultrasound diagnosis of chorionicity prior to 14 weeks gestation. Women with high-risk monochorionic multiple pregnancies require fortnightly scans and specialist care.	Advice is available through the New Zealand Fetal Medicine Network.
10. Detection of fetal growth restriction	
Height and weight should be measured at the first antenatal visit and a customised growth chart, GROW (www.gestation.net), should be used to record fundal height to improve the recognition of small for gestational age infants.	Some obstetric databases have included the GROW program for use by clinicians.
11. Antepartum haemorrhage	
All women with bleeding during pregnancy, regardless of the apparent cause, should be monitored more closely for fetal growth and preterm birth.	No specific action has been taken to date.
12. Sudden unexpected death in infancy (SUDI)	
National guidelines should be developed for safe sleeping arrangements in postnatal wards to improve ward safety and to model safe sleeping practices that parents can follow after discharge.	The Ministry of Health is considering amendments to the service specifications for DHB-funded maternity services around safe sleeping in hospitals and maternity units.

The Ministry of Health should prioritise the preparation and dissemination of a comprehensive statement for parents and caregivers on risk factors and methods of prevention of SUDI to be provided to pregnant women.	The Child and Youth Mortality Review Committee (CYMRC) has made a similar recommendation. The Ministry is considering the development of a national SUDI prevention toolkit for DHBs and health practitioners, with a particular focus on supporting vulnerable families at higher risk of SUDI. This has been contracted to Whakawhetu. The Health Quality & Safety Commission is interested in working with other parts of the Ministry to address high SUDI rates.

13. Access to perinatal investigation and supporting parents

The Ministry of Health should require DHBs to ensure all providers of maternity services provide support to parents, families and whānau who have experienced perinatal and maternal loss, including providing access to information, counselling and clinical follow-up.	Funding is secured for the ongoing production of Stillbirth and neonatal death support (Sands) material. The secondary maternity services specification requires funding of 'social work' services, but these are not specified. These specifications are in the final stages of implementation.
The low uptake of post-mortems amongst families who experience perinatal loss should be investigated.	This issue was investigated during the Ministry of Health's Review of the Regulation of Human Tissue and Tissue-based Therapies in 2004. Public opinions of human tissue were explored as part of submissions received on this review. Reasons for low uptake of human tissue investigation among some populations included the need to involve both immediate and wider family in the consent process and the desire to have the body intact for burial.
The reasons for the difference in rates of optimally investigated perinatal deaths between DHBs needs investigation.	Part of the reason for differences in rates of optimally investigated perinatal deaths between DHBs is regional shortages of perinatal pathologists. Paediatric pathology is one of the services currently being considered by the National Health Board for national planning and funding. Rates of investigated deaths will be considered once planning and funding arrangements for paediatric pathology have been determined.

Maternal Mortality

14. Maternal information

Support is required for national reporting of maternal deaths.	A tick box has been added to the death certificate indicating that the deceased was pregnant or had been pregnant within the last 42 days. All maternal deaths must be reported to the coroner.
Improved communication between primary and secondary services is required. A variety of means should be used such as women-held maternity notes, integrated notes systems and electronic transfer of information.	The Quality in Maternity initiative has resulted in a drive towards a national standardised maternity record.

15. Seatbelts during pregnancy

There is a need for greater public awareness of the importance of wearing a seat belt during pregnancy. All pregnant women should know that three-point seat belts should be worn throughout pregnancy, with the lap strap placed as low as possible beneath the 'bump', lying across the thighs, and the diagonal shoulder strap placed above the 'bump', lying between the breasts.	A poster has been developed.

16. Maternal mental health	
Maternal mental health services should be integrated into maternity services.	The Ministry supports the recommendation that maternal mental health services be integrated into maternity services. This is in line with best practice. The Ministry has developed a draft Perinatal and Infant Mental Health guidance document that is consistent with this recommendation. It proposes collaboration across maternal health, child health and mental health. The draft document will be the subject of consultation with the National Health Board, DHBs and the Minister.
Access should be provided to a mother and baby unit in the North Island. Women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if well. Clinicians are reminded that the most common cause of maternal death in New Zealand is suicide.	The recommendation that there be a mother and baby unit in the North Island requires consideration of availability of capital and service funding, workforce and location. This recommendation is supported by the Ministry of Health publication Healthy Beginnings: Developing perinatal and infant mental health services in New Zealand. The PMMRC is planning to conduct a series of maternal mental health workshops.
Clinicians and LMCs should be encouraged to conduct antenatal screening and document any mental health history to identify women who are at increased risk of mental illness.	The Ministry of Health intends to forward this recommendation to the professional colleges and the National Screening Advisory Committee for additional advice.
17. Team approach to care	
Women with complex medical conditions require a multidisciplinary approach to care, often across more than one DHB. Each woman requiring such care should be assigned a key clinician to facilitate her care. Pregnant women who are admitted to hospital for medical conditions not related to pregnancy need to have specific pathways for perinatal care.	This recommendation will be considered as part of the development of the revised service specifications for DHB-funded maternity services.
18. Hypertension in pregnancy	
Obstetric units should adopt the evidence-based management of hypertension in pregnancy recommended by the Society of Obstetric Medicine of Australia and New Zealand.	
19. Postpartum haemorrhage	
Acute obstetric units should develop a massive transfusion protocol to respond to major obstetric haemorrhage.	
20. Emergency obstetric training	
All staff involved in care of pregnant women should undertake regular training in management of obstetric emergencies.	The Midwifery Council of New Zealand requires that midwives attend training in resuscitation annually and training in management of obstetric emergencies every three years.
21. Pandemic influenza (A) H1N1	
Pregnant women should be immunised against influenza. Pregnant women should consult their LMC as soon as symptoms of an influenza-like illness develop or if other family members are unwell, to allow referral and prescription of antiviral medication.	

1. PERINATAL MORTALITY 2010

1.1 Introduction

In New Zealand, maternity care is funded by the Ministry of Health (the Ministry). It was provided nationally by 20 District Health Boards (DHBs) in 2010 and by lead maternity carers (LMCs), who receive funding from the Ministry. LMCs may be self-employed midwives, general practitioners (GPs), private obstetricians or hospital-based midwives and obstetricians. Their services are free, except in the case of private obstetricians, who have the right to charge for their services.

LMCs are required to sign access agreements with any maternity facility where they intend to provide care.

Women have the right to choose who they engage as their LMC. However, professional colleges and the Ministry provide guidelines about appropriate care for mothers with risk factors. These referral guidelines were updated in 2011.

1.2 Methodology

Data sources

The perinatal deaths presented in this report occurred between 1 January and 31 December 2010. For fetal deaths, the date of birth is used as the date of death. For neonatal deaths, the actual date of death is used.

An expanded description of data collection methods for this report is available in the first Perinatal and Maternal Mortality Review Committee (PMMRC) report (PMMRC 2007).

After the PMMRC was established in 2005 and following consultation with stakeholders, it was agreed that a review of all perinatal deaths would require the assistance of the LMC and the DHBs to collect detailed clinical information on each perinatal death.

The PMMRC approached all the DHBs, requesting their help to establish a network of local PMMRC coordinators. Individual coordinators within each DHB identify perinatal deaths and oversee the collection of the required data. These data are submitted to the Mortality Review Data Group at the University of Otago. The coordinators are also responsible for initiating local clinical reviews of each case, including assigning classification codes, contributory factors and potential avoidability, and ensuring appropriate, timely follow-up with parents.

The dataset of perinatal deaths is a compilation of data submitted by the local coordinators, death notifications and some additional data from Births, Deaths and Marriages (BDM). A website commissioned by the PMMRC and run by the University of Otago enables web-based data entry. LMCs are required to complete rapid reporting forms within 48 hours of a perinatal death. One form contains information on the mother (for example, her past medical and obstetric history and details of the birth), and the other form contains information on the baby. The questions are assessed and adjusted annually to ensure the data collected remain current and robust.

After local review, the local coordinator completes the PMMRC classification form. The classification system that has been adopted is the Perinatal Society of Australia and New Zealand (PSANZ) system of classification of cause of perinatal death (PSANZ 2009). This system includes both perinatal and neonatal classifications (listed in Appendix C below). The local coordinator also includes post-mortem and histology reports with the classification form (Ministry of Health 2012a).

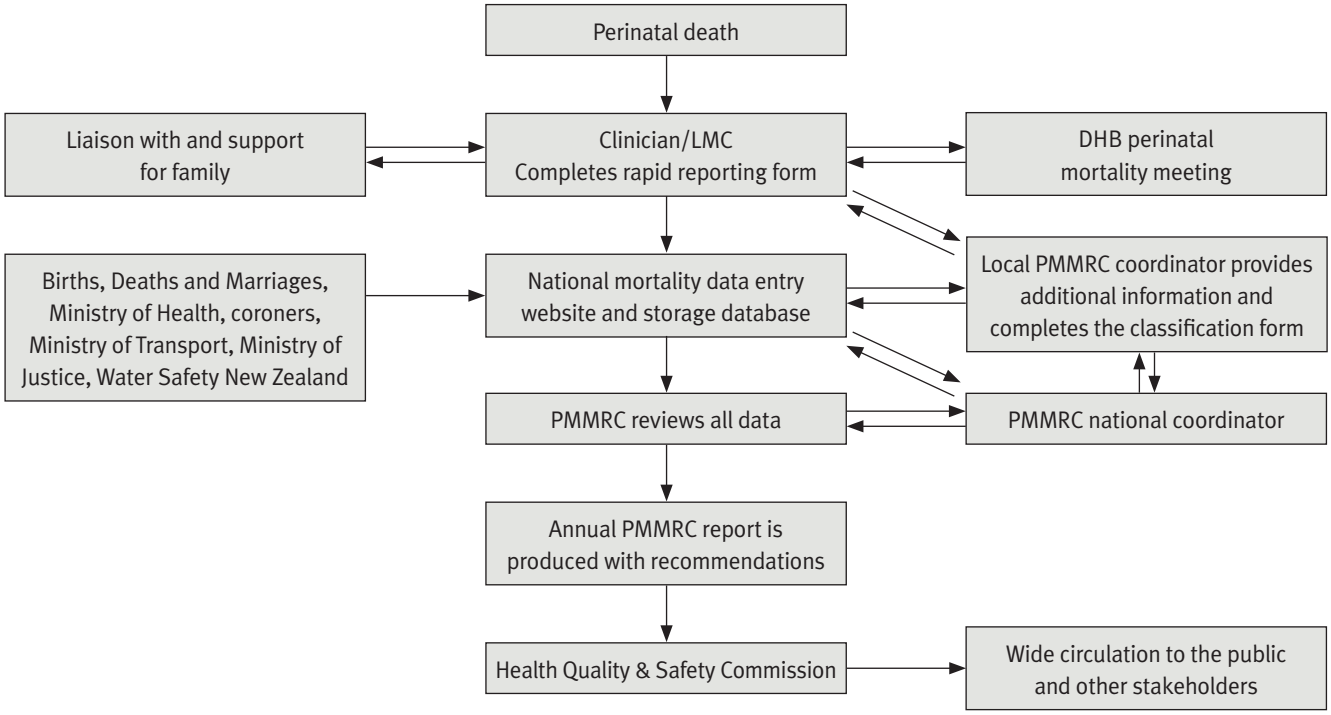
Contributory factors and potential avoidability

The assessment of contributory factors and potential avoidability is completed by the PMMRC local coordinators following local review and submitted along with the PSANZ classification of perinatal death. The PMMRC contributory factors and potential avoidability form was adapted to include questions that identify contributory factors related to organisation and management, personnel, technology and equipment, environment and barriers to accessing/engaging with care. A death is considered potentially avoidable if the absence of the contributory factors may have prevented the death. A copy of this form can be found in Appendix D.

The Maternal Mortality Review Working Group (MMRWG) have identified potentially avoidable maternal deaths since 2006. From 2009, the MMRWG started to use the same tool identifying contributory factors and potential avoidability as that used for perinatal deaths.

Figure 1 outlines the PMMRC process. A user guide describing the definitions and data elements used by the PMMRC (PMMRC 2009) is available online at www.hqsc.govt.nz/pmmrc

Figure 1: Flow of information in the PMMRC's perinatal data collection process



PMMRC data validation

Data are regularly validated, using a standard set of queries, to eliminate duplicate records, complete missing mother or baby information, clarify DHB of residence (where this is inconsistent with the given residential address) and rectify other inconsistencies.

The national coordinator reviews all perinatal death classifications and checks complicated cases with a PMMRC member with expertise in stillbirth classifications. Each year, an audit of 10 percent of perinatal deaths is undertaken by the national coordinator by comparing these data with clinical records from the relevant DHBs. The audit in 2010 is not yet completed and includes perinatal deaths due to congenital anomalies associated with cardiac, neural tube or chromosomal abnormalities. This audit will include assessing the accuracy, completeness and PSANZ classification in the PMMRC data and the quality of maternity care provided. It has been funded by the Health Quality & Safety Commission's Challenge 2012 and results of this will be published in our next report.

Denominator data

New Zealand birth registrations

The denominator data used in this report consist of New Zealand birth registrations during the 2006 to 2010 calendar years. The New Zealand birth registration dataset best approximates the number of births in a year in New Zealand. It is closer to the true number of births than the hospital discharge dataset as it includes births outside hospitals. Furthermore, it includes ethnicity data as notified by parents at birth registration. This source of ethnicity is also used for the numerator where a birth registration has been made. Ethnicity in the hospital discharge dataset (otherwise known as the national minimum dataset – NMDS) is also apparently provided by mothers for themselves and for their babies and becomes part of the National Health Index (NHI) dataset. However, comparisons of maternal and baby ethnicity in the birth registration and NMDS datasets have shown significant differences.

The birth registration dataset of New Zealand births is collated by Births, Deaths and Marriages (BDM) from birth notifications supplied by public and private hospitals and by LMCs in the case of home births. Births are only added to the birth registration dataset when the birth is registered by the parents, which can occur up to some years following birth. The registration dataset is based on date of registration and so includes births from previous years and fewer than all births from the current year. While this dataset is probably the most accurate representation of total number of births in a year, it does not truly represent the denominator.

A disadvantage of the birth registration dataset for reporting maternity analyses in New Zealand is that it includes limited maternity data. The dataset does not include an individual's unique NHI identification number (for either the mother or the baby), and so the data it contains cannot be linked to hospital discharge data or LMC data for further analyses.

The denominator birth registration dataset includes both live births and stillbirths. As this dataset relates to stillbirths registered in the calendar year and not deaths in the calendar year and does not record which babies died as neonates in this set, the full registration set has been used as the denominator for rates. The current year's fetal deaths have been removed from the denominator for calculation of neonatal death rates.

New Zealand National Maternity Collection (MAT)

For the first time, there are preliminary maternity data available on the majority of mothers who gave birth in New Zealand. These data are the MAT (National Maternity Collection), a new initiative combining data from LMC claims for payment with hospital discharge data, and are as yet unpublished and unavailable for use by the mortality review committees. The dataset does not include demographic and antenatal information (including ethnicity, smoking and Body Mass Index (BMI)) on 15.9 percent of mothers in 2010 whose antenatal care was not provided by a community LMC. These mothers are cared for by hospital services or have no antenatal care. This deficiency in the data will result in an element of bias in the reporting of demographic variables, as mothers receiving care from hospital LMC services are more likely to be of lower socioeconomic status, to be Māori and Pacific, to book later in pregnancy, to smoke and to have higher bodu mass index (BMI). Given these limitations, the data need to be interpreted with caution. Nevertheless, this is the first time national data have been collated and should provide the best available estimates of BMI and smoking rates in the maternity population of New Zealand. These comparative data, supplied by the Ministry of Health, have been included in the text in the relevant sections.

Data analysis

Percentages have been displayed with one decimal place or without decimal places when the denominator is small. In some cases, due to rounding, the percentages do not add to exactly 100 percent.

In figures where graphs have two y axes, the data relating to the left-side y axis are presented as bars, and the data relating to the right-side y axis are presented as points, joined by a line where they represent continuous or ordinal data.

Ninety-five percent confidence intervals (CIs) for perinatal mortality rates have been computed using the methods for vital statistics described by the Centres for Disease Control and Prevention (CDC) (Heron 2011). Ninety-five percent confidence intervals (CIs) for maternal mortality ratios have been computed using the Exact method. The CI represents the degree of uncertainty around the point estimate of the rate for the particular period. This uncertainty depends on the absolute number of deaths and the number of births from which the deaths arose. If the number of births is large, then the CI (that is, the level of uncertainty) is generally small; if the number of births is small, the CI is large. The CI represents the limits within which the 'true' rate is most likely to lie. This calculation is necessary when numbers are small because the point estimate of the rate calculated from the data given may by chance have taken a wide range of values. The CI describes this range.

It is possible to compare rates by looking at the CIs. If the CIs for two rates do not overlap, it is likely that the rates are different. This is equivalent to the rates being statistically significantly different at the $p<0.05$ level. If the CIs do overlap, the rates may or may not be different.

In Figure 28, which shows perinatal related mortality rates by the mother's DHB of residence, the CIs for perinatal related mortality rates by DHB have been plotted along with the national perinatal related mortality rate. If the CI for the DHB of residence rate does not include the national rate, then it is likely that this DHB of residence rate differs from the national average rate.

Where the text notes that there is a statistically significant difference or association, this indicates that a statistical test has been applied and that the p value is less than 0.05. Conversely, if a difference is said to be not statistically significant, then the p value is equal to or greater than 0.05. If the words 'statistically significant' are not used to describe a difference or association, it can be assumed that a statistical test has not been applied.

Cases that have missing data have still been included in the data tables and are generally discussed in the text. Percentages in the tables generally include missing data, though the text sometimes describes findings among women with complete data only. However, where missing data exceed 30 percent of all possible data points, the data have generally not been presented.

At the lower extremes of gestation and birthweight, denominator numbers are small. As the denominator set is registrations rather than births in the relevant year, the denominator is not an exact count of all births in the year. For this reason, perinatal related mortality rates at the lower extremes have not been reported.

In this report, the figures illustrating perinatal related mortality rate include combined data for the four full years that the PMMRC has collected data (2007–2010). This increases the numbers and so improves the confidence around the estimates given. The data for the 2010 year alone are presented in table form in the text and the combined four-year data in table form in Appendix A.

1.3 Definitions

Ethnicity

Maternal and baby ethnicities for perinatal related deaths were collected from two sources: from information supplied to the BDM Registrar (with priority given to information in the birth registration over information in the death registration) and from rapid reporting forms completed by LMCs (for example, in cases where the death had not been registered by the time of analysis), with information from BDM taking priority over data from rapid reporting forms. In both instances, ethnicity was recorded as that identified by the mother/parents. The ethnicity in the deaths dataset (held by BDM) is not validated. Death registration forms are usually completed by either the parents or a funeral director.

Maternal and baby ethnicities in the denominator birth registration set are those provided by the parent(s) to BDM at birth registration and are thus consistent with numerator data.

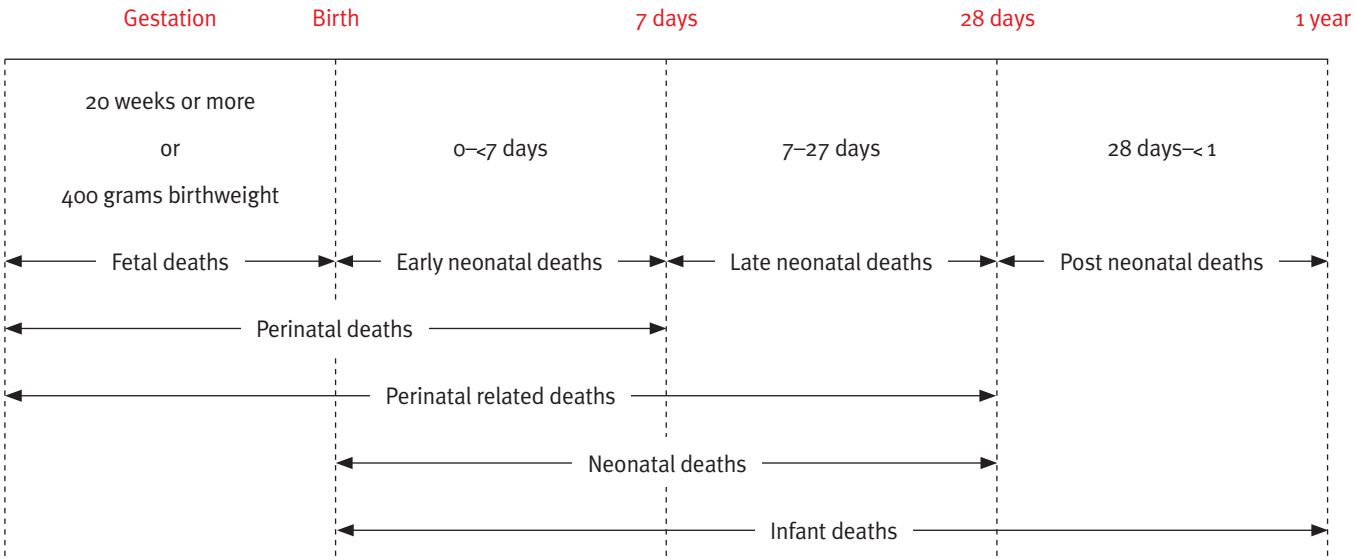
Multiple ethnicities can be identified for both mother and baby. The PMMRC followed the guidelines in Ethnicity Data Protocols for the New Zealand Health and Disability Sector (Ministry of Health 2004) for prioritising ethnicity for the 2006 and 2007 reports. These prioritised ethnicity into the following hierarchy: Māori, Pacific peoples, Indian, Other Asian, Other and New Zealand European. Indian has been identified as a separate ethnicity from Other Asian because local data would suggest that Indian pregnancies are at higher risk than Other Asian pregnancies.

In 2008, other methods of outputting ethnicity data were explored, and because this has an effect on perinatal related mortality rates by ethnicity, data for both prioritised and sole/combination ethnicity were reported and discussed. In 2009 and 2010, prioritised and sole/combination ethnicity have again been reported. Total responses for ethnicity, based on the level 2 data available (up to three ethnicities per individual) are provided for reference (Ministry of Health 2004; Statistics New Zealand 2005; Cormack and Harris 2009).

Maternal and baby ethnicity-specific perinatal related mortality rates have again been analysed. Maternal ethnicity-specific perinatal related mortality rates are presented in the body of the report, and baby ethnicity-specific perinatal related mortality rates are given in the appendices.

Mortality rates

Figure 2: Definitions of perinatal and infant mortality



(Adapted from NZHIS 2007 and Ministry of Health 2010)

Fetal death is the death of a fetus at 20 weeks gestation or beyond (≥20 weeks) or weighing at least 400g if gestation is unknown. Fetal death includes stillbirth and termination of pregnancy. Note that the term 'stillbirth' does not include terminations in this report.

Fetal death rate is calculated as fetal deaths per 1000 babies born at 20 weeks gestation or beyond or weighing at least 400g if gestation is unknown.

Neonatal death is the death of any baby showing signs of life at 20 weeks gestation or beyond (for the purposes of this PMMRC dataset) or weighing at least 400g if gestation is unknown. Early neonatal death is a death that occurs up until midnight of the sixth day of life. Late neonatal death is a death that occurs between the seventh day and midnight of the 27th day of life.

Neonatal death rate is calculated as neonatal deaths per 1000 live-born babies at 20 weeks gestation or beyond or weighing at least 400g if gestation is unknown.

Perinatal mortality rate is calculated in New Zealand as fetal deaths and early neonatal deaths per 1000 total babies born alive or born dead at 20 weeks gestation or beyond or weighing at least 400g if gestation is unknown.

In some places, this report refers to a United Kingdom definition of perinatal mortality, which comes from the Centre for Maternal and Child Enquiries (CMACE 2011a). This definition excludes fetal deaths before 24 weeks gestation.

Perinatal related mortality rate refers to fetal deaths and early and late neonatal deaths per 1000 total babies born at 20 weeks gestation or beyond or weighing at least 400g if gestation is unknown.

Lethal and terminated fetal abnormalities are all fetal deaths classified by the Perinatal Society of Australia and New Zealand (PSANZ) perinatal death classification system as PDC1 (congenital abnormality) and neonatal deaths classified by the PSANZ neonatal death classification system as NDC1 (congenital abnormality).

Intrapartum stillbirth rate calculates deaths of babies of at least 24 weeks gestation without congenital abnormality who entered labour alive but then died during labour as a rate per 1000 births 24 weeks and beyond without lethal congenital abnormality.

Customised birthweight centiles adjust newborn size for maternal weight, height, ethnicity and parity, as well as for infant sex and gestation at birth. Centile calculators are available online from the Gestation Network (www.gestation.net). For fetal deaths, the gestation at the time of estimated death (not birth) is used to calculate the birthweight centile.

The ***New Zealand Index of Deprivation 2006 (NZDep2006)*** is an area-based measure of socioeconomic deprivation based on variables from the Census of Population and Dwellings 2006 in New Zealand. The score is assigned according to maternal place of residence and is presented as a decile or quintile. Increasing deciles of deprivation, from least deprived at decile 1 to most deprived at decile 10, are associated with higher mortality and rates of many diseases (Salmond and Crampton 2002a, 2002b). Meshblock unit-level data are used throughout this report. Generally, data are presented as quintiles rather than deciles so that individual categories are large enough for analysis.

Lead maternity carer (LMC) is defined as the practitioner or caregiver service selected by the mother as the service that will have the legal, professional and practical responsibility for ensuring both she and her baby receive clinically appropriate care up to and following birth.

Neonatal encephalopathy is defined as a clinically defined syndrome of disturbed neurological function within the first week of life in the full-term infant, manifested by difficulty in initiating and maintaining respiration, depression of tone and reflexes, subnormal level of consciousness and often seizures.

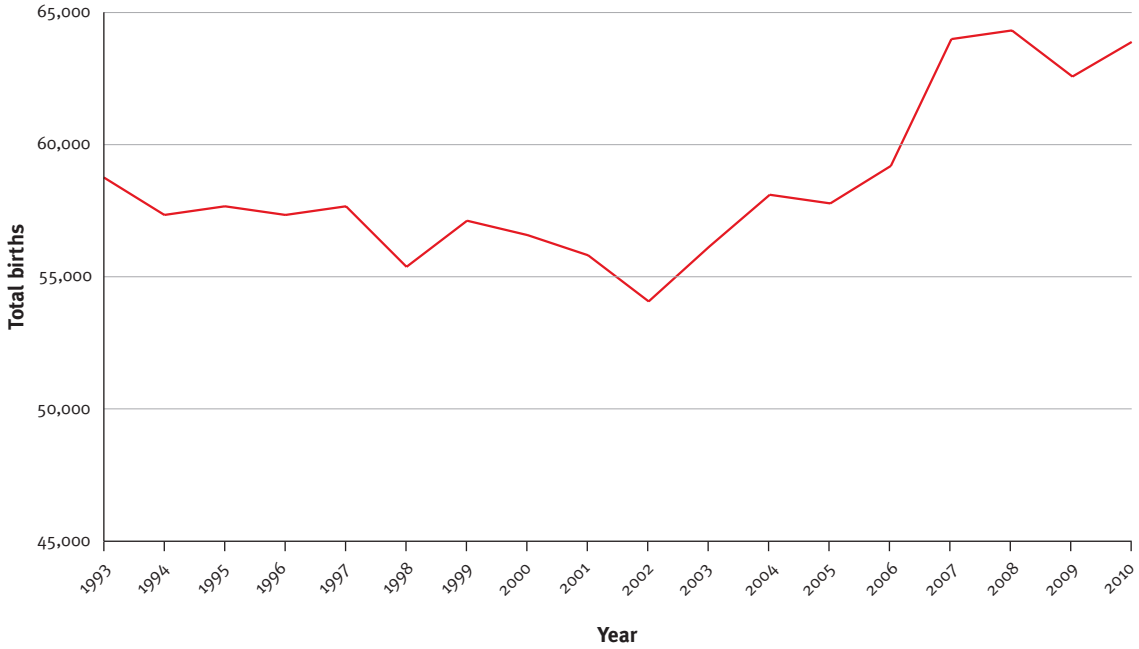
Contributory factors may be highly specific to the death or generalised to the system(s). These factors are commonly sub-classified into organisational and management, personnel, technology/equipment, environmental and those relating to barriers to access and engagement in care.

Potentially avoidable death is when the absence of a contributory factor may have prevented the death.

1.4 Births in New Zealand

New Zealand Birth Registrations 2010

Figure 3: Total live birth registrations in New Zealand 1993–2010

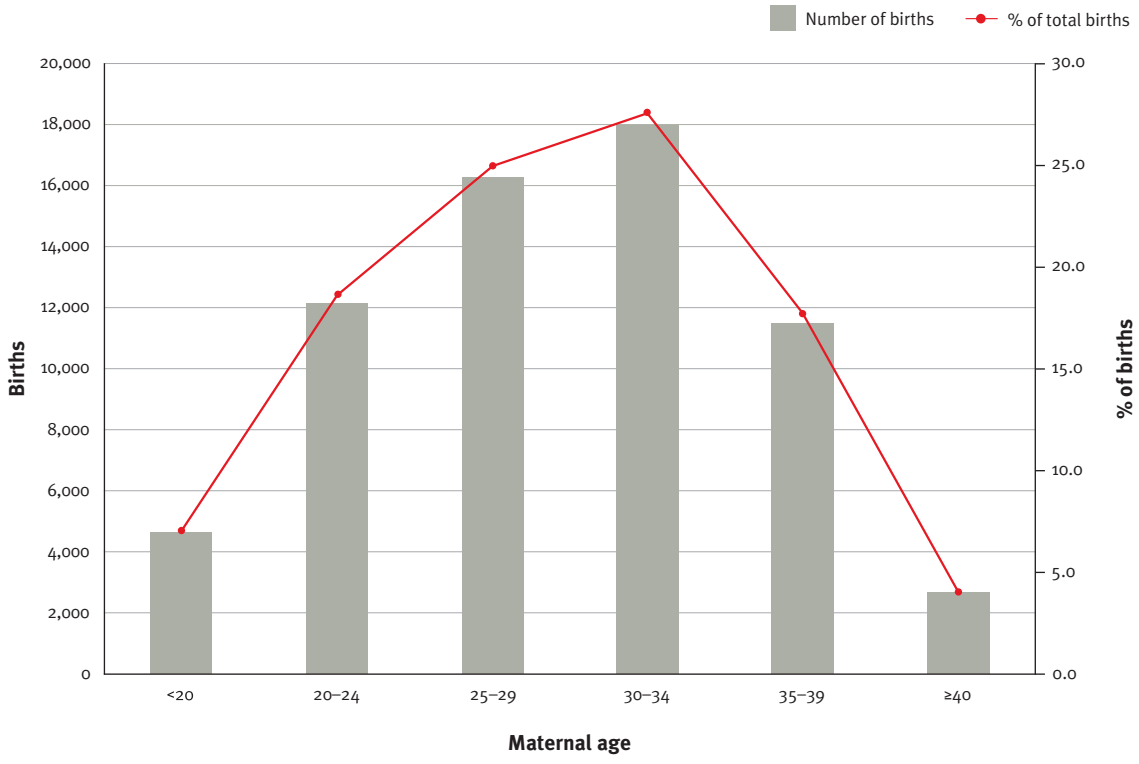


Amended from Statistics New Zealand

The marked rise in total registered births in New Zealand from 2006 has been sustained through 2010, as shown in Figure 3.

Maternal age

Figure 4: Distribution of maternal age among birth registrations in New Zealand 2010 (total births = 65,124)



The mean age of mothers in New Zealand in 2010 was 29.1 years. The greatest number of births in New Zealand occurred among mothers in the five-year age band of 30–34 years (27.6%). In 2010 in New Zealand, 7.1 percent of births were to teenage mothers and 4.1 percent to women 40 years or older.

Ethnicity

The process for collection of ethnicity data is outlined in section 1.3.

In 2010, the denominator birth registration dataset included two ethnicities for 24.2 percent of all babies registered compared with two ethnicities for 14.0 percent of mothers registered. The set included three ethnicities for 5.9 percent of babies and three ethnicities for 1.3 percent of mothers. This difference in the number of ethnicities a mother reports for herself compared with the number of ethnicities she gives for her baby means mortality rates will be different depending on whether the mother's or the baby's ethnicity is used in analyses. Total responses for maternal and baby ethnicity in the 2010 birth registration set are given in Table 1 below.

Table 1: Total responses for mother and baby ethnicity among birth registrations 2010

	Ethnicity total response (baby)		Ethnicity total response (mother)	
	n=65,124[1]		n=65,124[2]	
	n	%[1]	n	%[1]
Māori	19,019	29.2	14,877	22.8
Pacific Peoples	10,672	16.4	8,006	12.3
Indian	2,837	4.4	2,547	3.9
Other Asian	5,539	8.5	5,280	8.1
Other[1]	5,865	9.0	6,769	10.4
New Zealand European	42,781	65.7	37,839	58.1

1 Totals do not sum to 100% of births, as individuals may be counted in more than one ethnic group
2 Includes not stated or unrecognisable response (n = 33 babies, n = 201 mothers)

Table 1 includes all ethnicity responses given, and therefore total responses add to greater than 100 percent. As noted above, more ethnicities were given for babies than for mothers, and therefore the percent response is greater for almost all ethnicities for babies than for mothers.

Prioritised ethnicity assigns only one ethnicity per person, prioritising responses according to the following hierarchy: Māori, Pacific peoples, Indian, Other Asian, Other (including other European and missing responses) and New Zealand European. Using prioritised ethnicity output, 45.7 percent of mothers identified as New Zealand European, 22.8 percent as Māori, 10.7 percent as Pacific peoples, 3.7 percent as Indian, 7.8 percent as Other Asian and 9.3 percent as other ethnicities. The distribution of prioritised ethnicity among mothers and babies in the 2010 birth registration dataset is shown in Figure 5, with further information provided in Table 11 and Table 47.

Figure 5: Distribution of prioritised ethnicity (mother and baby) among births in New Zealand 2010 (total births = 65,124)

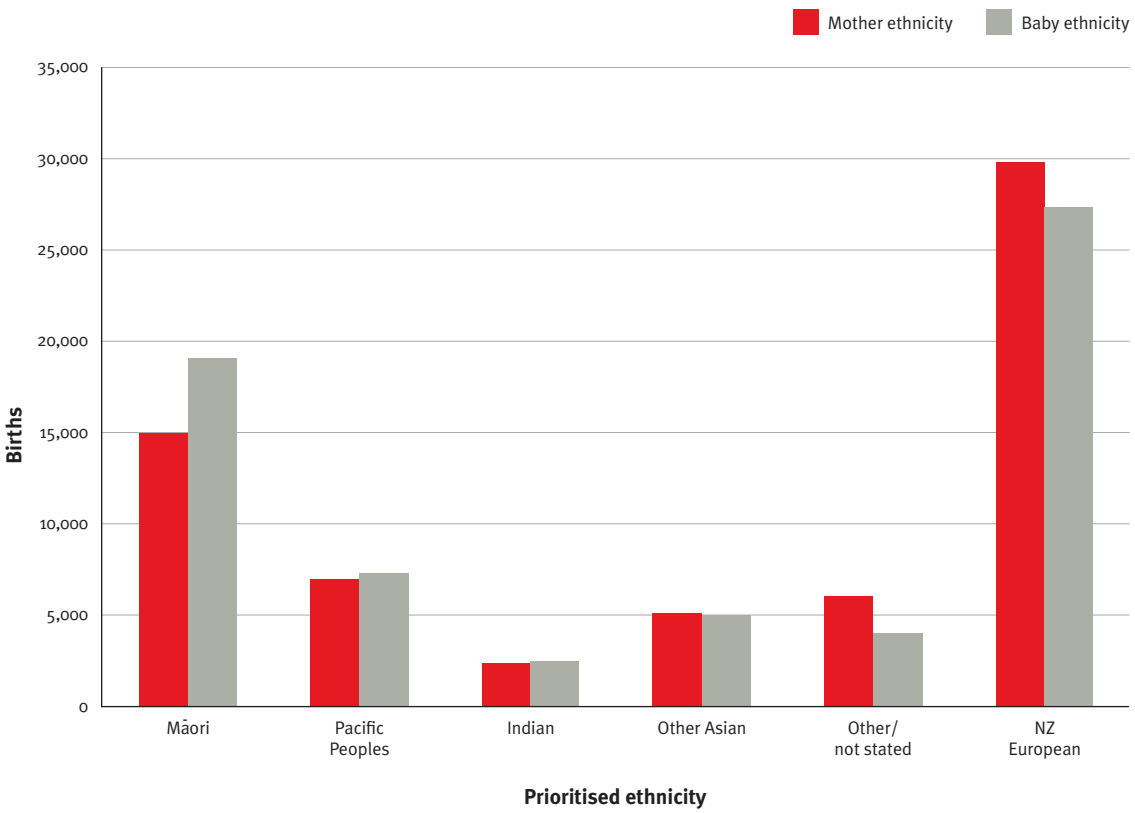


Figure 6: Distribution of sole/combination ethnicity (mother and baby) among birth registrations in 2010 (total births = 65,124)

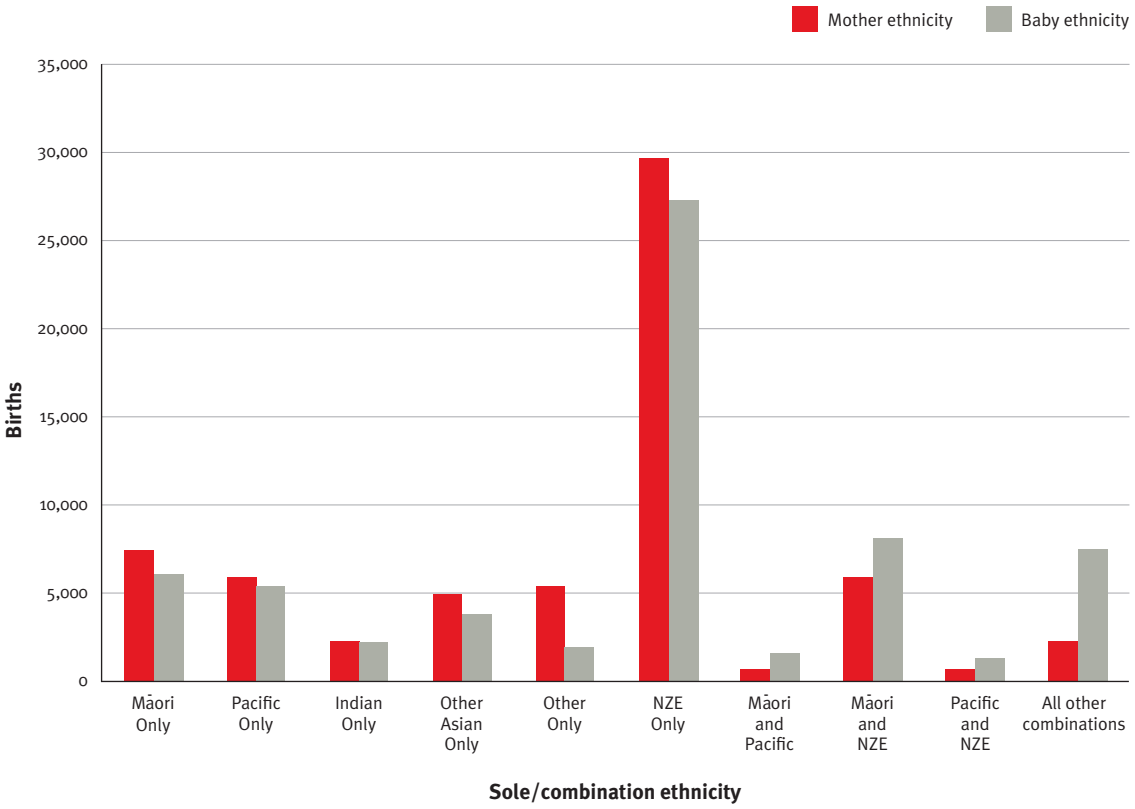
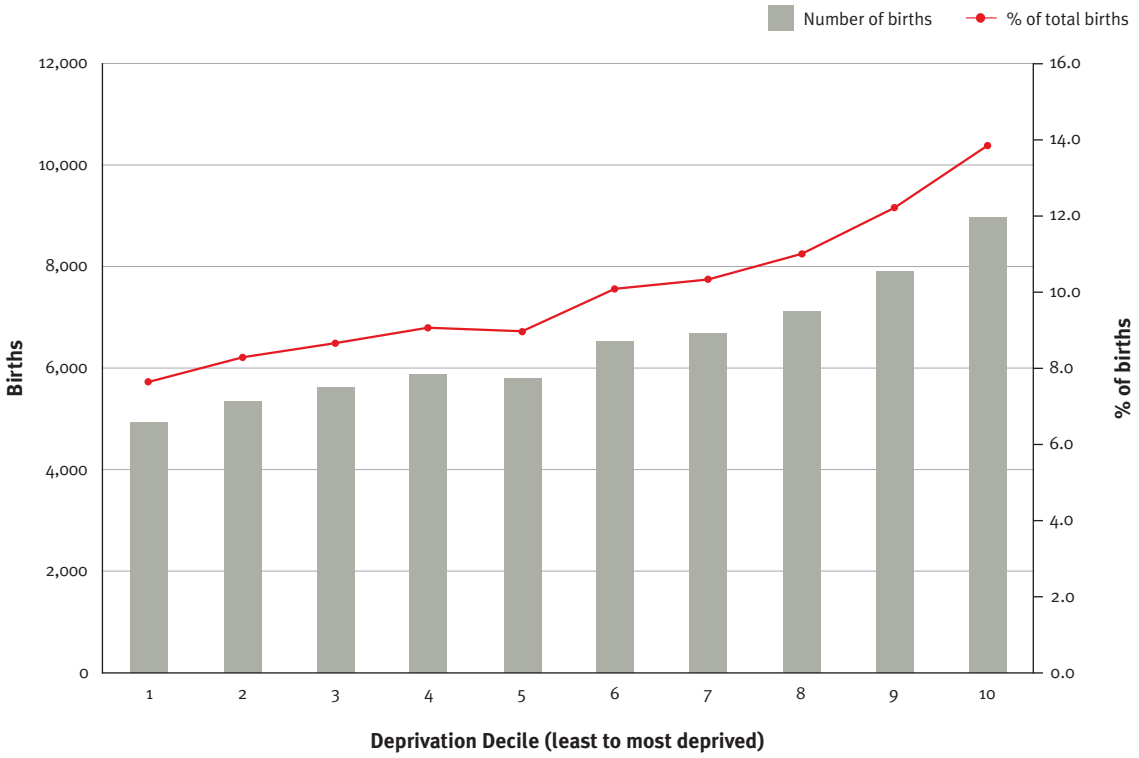


Figure 6 (with further information in Table 12 and Table 49) shows the distribution of sole/combination ethnicity for mothers and babies for all births registered in 2010. In sole/combination, each person is again represented in only one category. All groups described in the prioritised ethnicity variable are represented as sole ethnicity categories, along with the more common combined responses. The remainder are included as 'all other combinations'. Because babies are assigned more than one ethnicity more often than mothers, babies are more likely to be represented in the combined groups than their mothers.

Roughly half of the mothers and babies who stated Māori as an ethnicity also gave a second ethnicity. If the mothers/babies identified with two ethnicities have different perinatal related mortality rates to those identified as Māori alone, this will provide a different view of the data to that seen using prioritised ethnicity, and it may be useful in identifying which babies are at increased risk of perinatal related mortality.

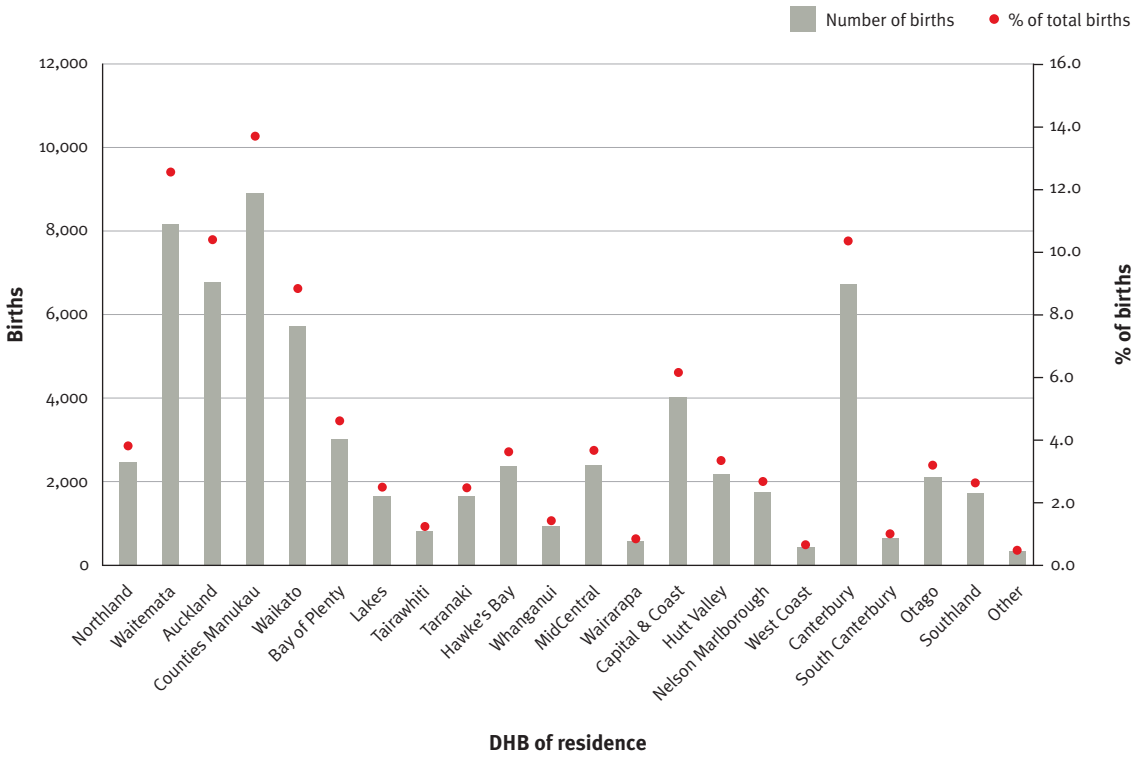
Socioeconomic deprivation and DHB of residence

Figure 7: Distribution of deprivation deciles (NZDep2006) among births in New Zealand 2010 (total births excluding unknown = 64,759)



The proportion of babies born in the most deprived decile area in New Zealand (13.8%) is greater than the proportion in any other decile area, and the proportion of births increases fairly consistently with increasing deprivation.

Figure 8: Distribution of births by DHB of maternal residence among birth registrations in 2010 (total births = 65,124)



In 2010, 36 percent of babies were born to parents residing in the three Auckland DHB regions of Waitemata, Auckland and Counties Manukau and 40 percent in the Auckland and Northland region. Twenty percent were born to parents residing in the South Island.

Associations between demographic variables

Socioeconomic deprivation and DHB of residence

Figure 9: Distribution of deprivation quintiles (NZDep2006) by maternal ethnicity (prioritised) among birth registrations in 2010 (total births = 65,124)

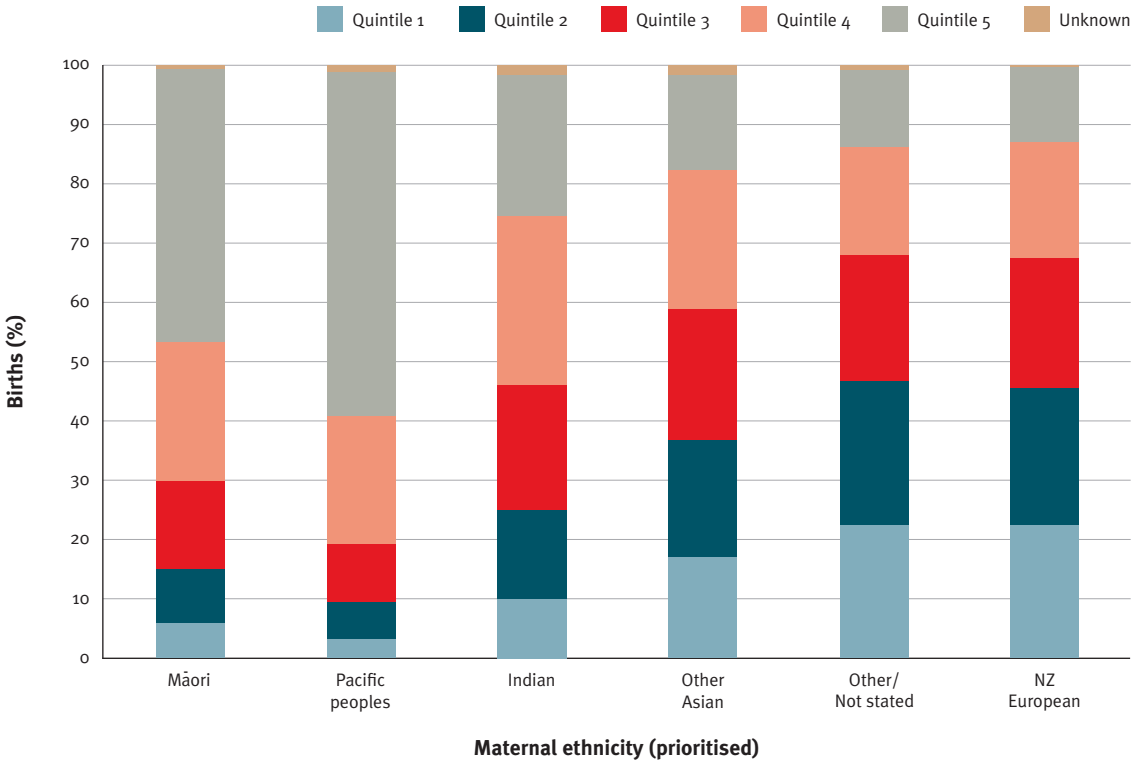


Figure 10: Distribution of deprivation quintiles (NZDep2006) by maternal ethnicity (sole/combination) among birth registrations in 2010 (total births = 65,124)

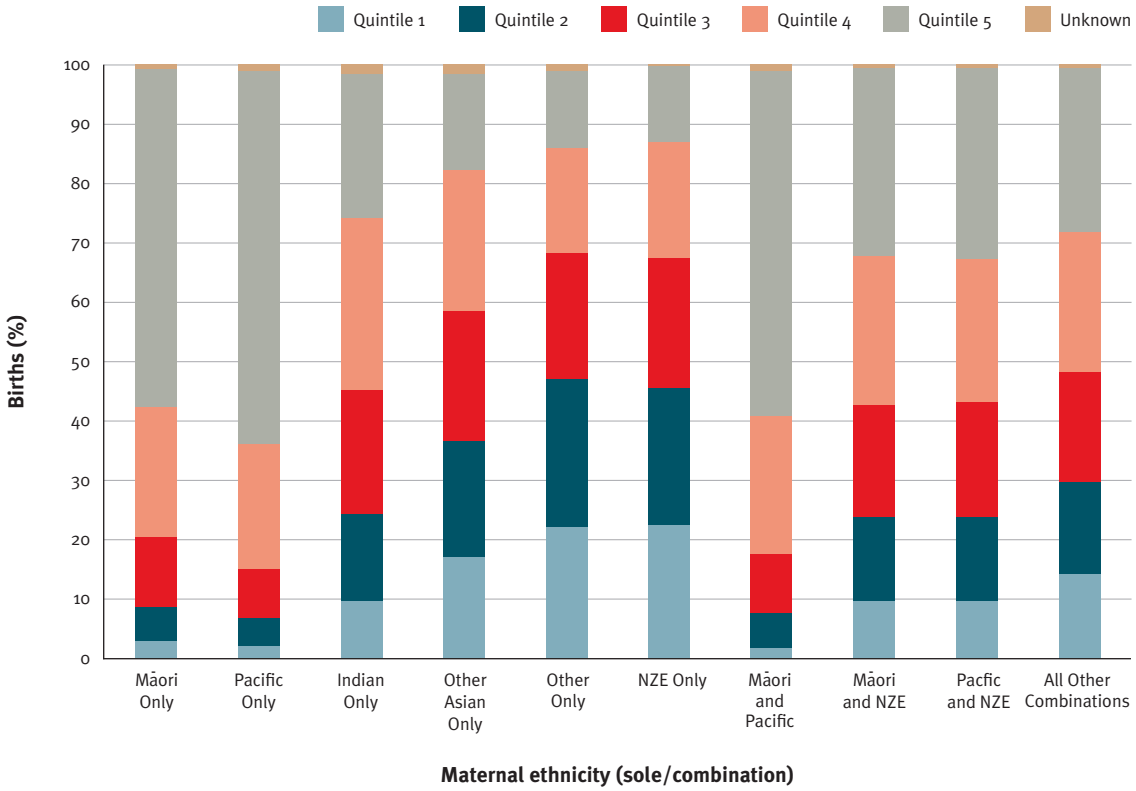


Figure 9 and Figure 10 show the association between maternal ethnicity and deprivation quintiles. Figure 9 demonstrates the distribution of deprivation quintiles across prioritised ethnicity, while Figure 10 uses sole/combination ethnicity. Both figures suggest an unequal distribution of deprivation (NZDep2006) by ethnicity with a higher proportion of Māori and Pacific women living in the most deprived (NZDep2006 decile 9–10) areas than European or Asian women. Area deprivation among the sole categories of Māori and Pacific peoples and the Māori-Pacific combined group (Figure 10) is greater than that seen among Māori and Pacific peoples using prioritised ethnicity (Figure 9). The categories of combined Māori and Pacific with New Zealand European describe two groups with lower levels of socioeconomic deprivation.

Age and ethnicity

Figure 11: Distribution of maternal age by maternal ethnicity (prioritised) among birth registrations in 2010 (total births = 65,124)

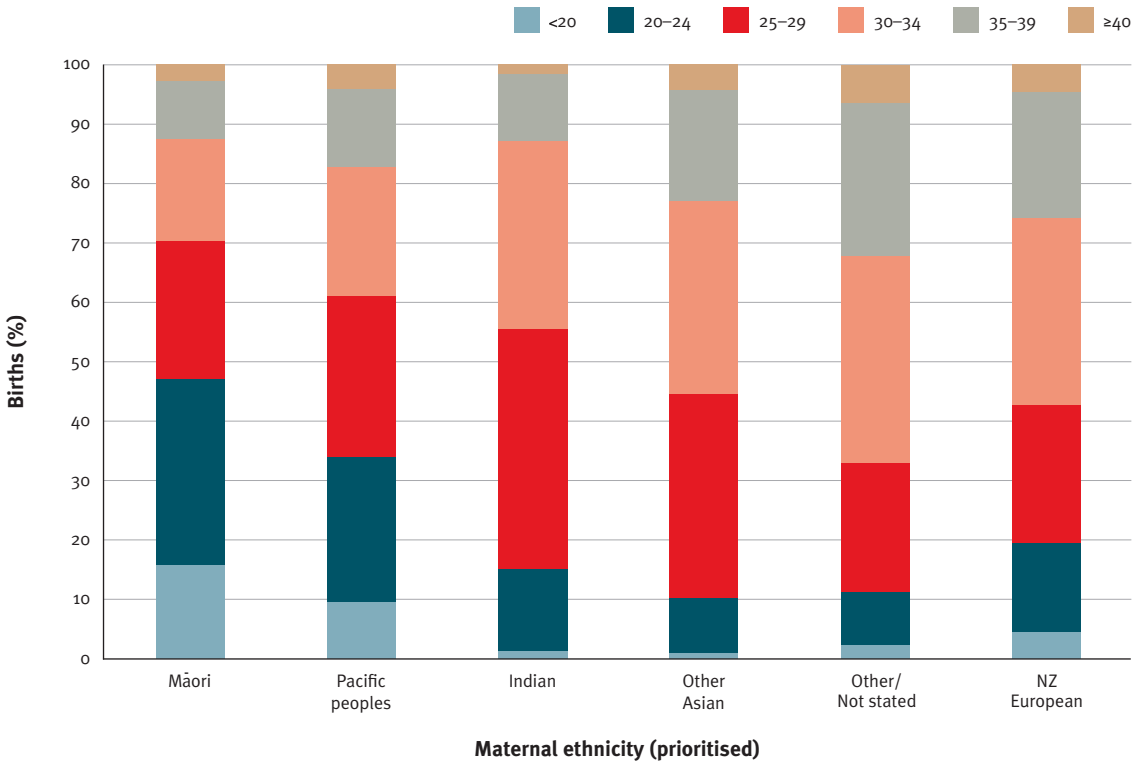


Figure 12: Distribution of maternal age by maternal ethnicity (sole/combination) among birth registrations in 2010 (total births = 65,124)

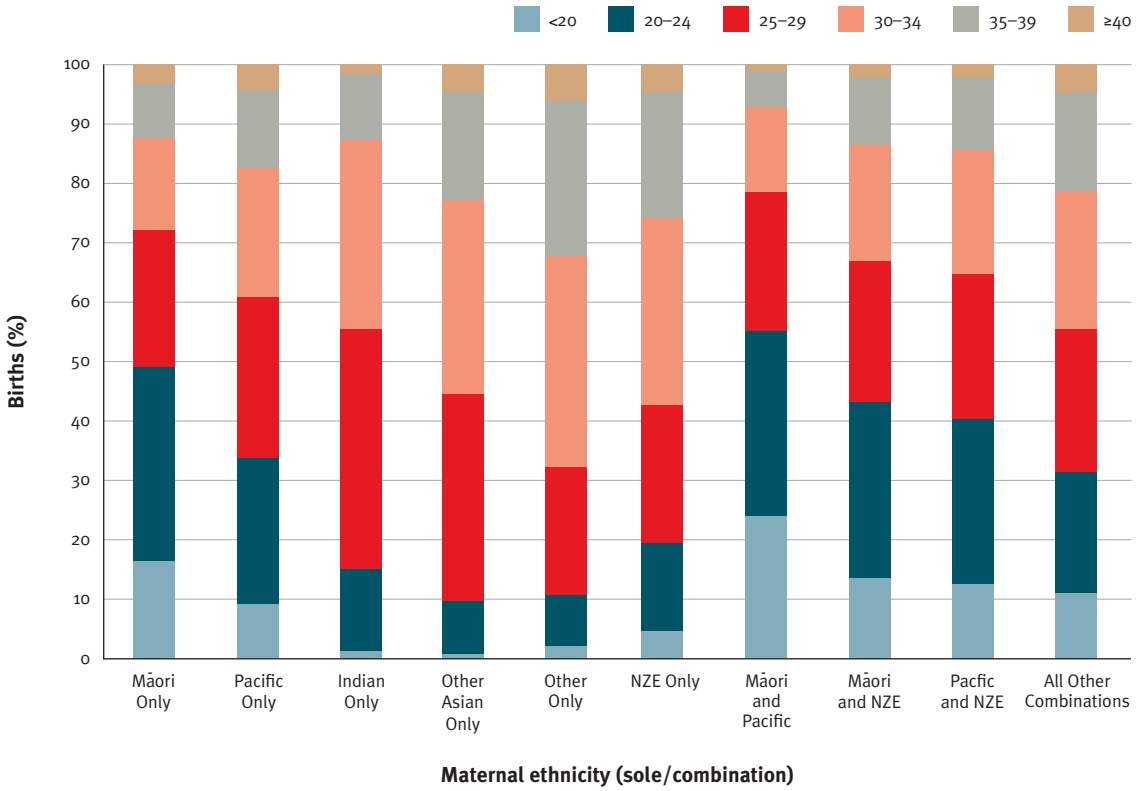
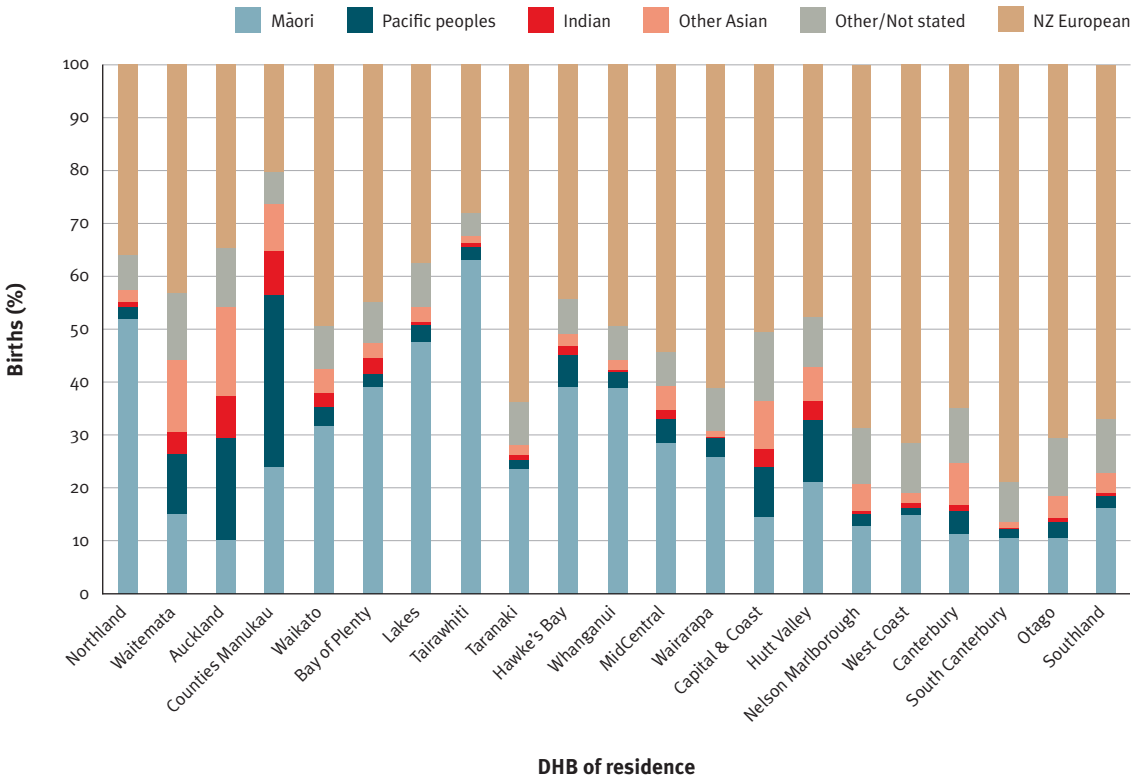


Figure 12 demonstrates the differences in age of mothers according to maternal ethnicity among births registered in New Zealand in 2010. Mothers who identify themselves as combined Māori and Pacific have the youngest age distribution, followed by mothers identifying as sole Māori. The differences in maternal age distribution by ethnicity may reflect both differences in the age distribution of the underlying populations as well as different maternal age at birth by ethnicity.

DHB of residence, ethnicity and socioeconomic deprivation

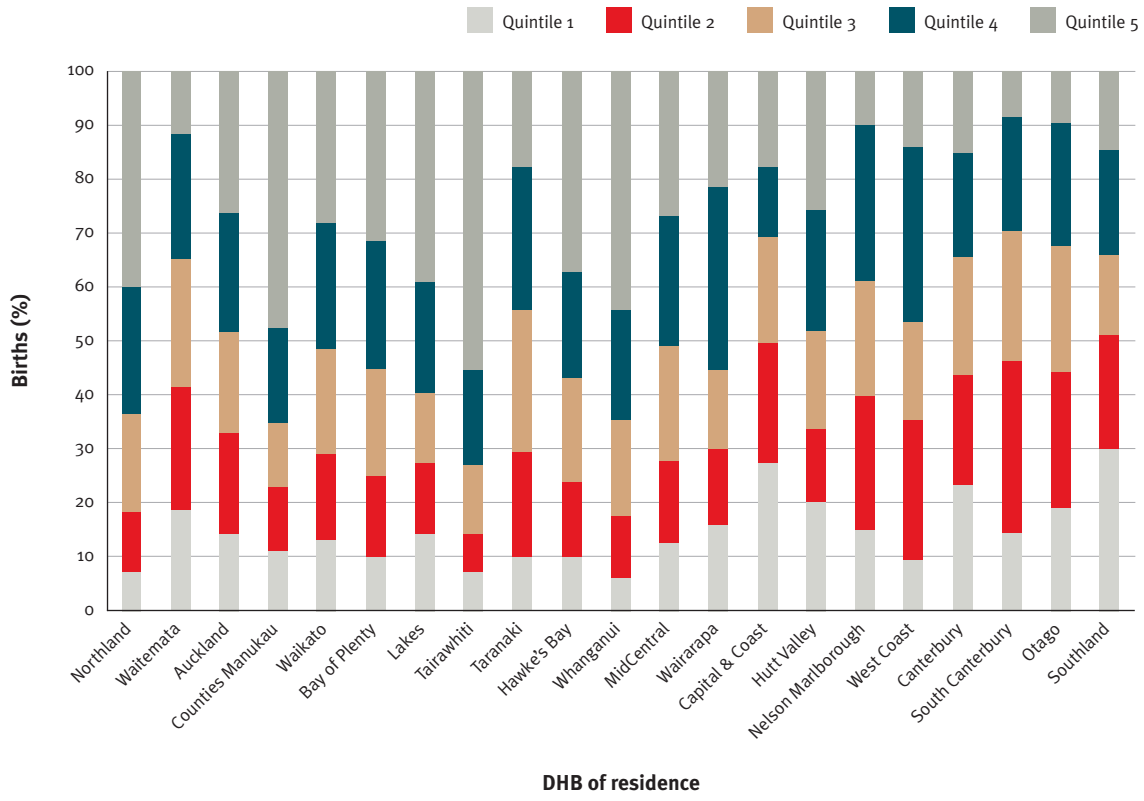
DHB and ethnicity

Figure 13: Distribution of maternal ethnicity (prioritised) by DHB of maternal residence, among birth registrations in 2010 (total births = 64,811)



There is a wide variation in distribution of maternal ethnicity across the different regions in New Zealand. In the South Island (the six DHBs on the right of the figure), the proportion of New Zealand European mothers giving birth is higher than in the North Island. Northland, Lakes and Tairawhiti have the highest proportions of births to Māori mothers of any region, and Auckland and Counties Manukau have the highest proportion of births to Pacific peoples.

Figure 14: Distribution of deprivation quintile (NZDep2006) by DHB of maternal residence, among birth registrations in 2010 (total births (excluding unknown) = 64,759)



The distribution of births by New Zealand deprivation index quintile (NZ Dep2006) is also not uniform across the country, with the greatest number of births in the highest deprivation quintile areas occurring in the Tairawhiti and Counties Manukau regions. This is consistent with population distribution of deprivation decile areas in New Zealand.

1.5 Perinatal mortality 2010

Table 2: Summary of New Zealand perinatal mortality rates 2010

	Using NZ definition		Using UK definition[1]	
	n	Rate	n	Rate
Total births	65,124		64,961	
Fetal deaths (terminations of pregnancy and stillbirths)	494	7.6[2]	296	4.6
Terminations of pregnancy	153	2.3	62	
Stillbirths	341	5.2	234	3.6
Early neonatal deaths <7 days	165		165	
Late neonatal deaths 7–27 days	45		45	
Neonatal deaths <28 days	210	3.2[3]	210	3.2
Perinatal mortalities	659	10.1[4]	461	7.1
Perinatal related mortalities	704	10.8[5]	506	7.8
Perinatal mortalities excluding lethal and terminated fetal abnormalities[6]	462	7.1	375	5.8
Perinatal related mortalities excluding lethal and terminated fetal abnormalities[6]	493	7.6	406	6.2

1 Rates calculated using United Kingdom (CEMACH) definition for perinatal mortality: babies stillborn after 24 weeks gestation and deaths of live-born babies per 1000 live births and stillbirths (CEMACH 2006)
2 Fetal death rate per 1000 babies born (includes terminations and stillbirths)
3 Neonatal death rate per 1000 live-born babies
4 Fetal deaths and early neonatal deaths per 1000 babies born
5 Fetal deaths and early and late neonatal deaths per 1000 babies born
6 Lethal and terminated fetal abnormalities are all fetal deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality

The PMMRC calculates perinatal related mortality rates using numerator data provided by LMCs, reviewed by local perinatal mortality review committees and collated centrally by a national coordinator and denominator data from the registration of births in a year. This differs from the methodology used by the Ministry of Health and so the rates presented in this report may differ slightly from those reported in Ministry documents. The PMMRC believes that this report presents as complete a set of perinatal related deaths as can currently be achieved for the 2010 year in New Zealand.

Table 3: Summary of New Zealand Perinatal mortality rates 2007–2010

	2007		2008		2009		2010	
	n	Rate	n	Rate	n	Rate	n	Rate
Total births	65,603		65,872		63,665		65,124	
Fetal deaths (terminations of pregnancy and stillbirths)	511	7.8[1]	524	8.0[1]	540	8.5[1]	494	7.6
Terminations of pregnancy	143	2.2	145	2.2	137	2.2	153	2.3
Stillbirths	368	5.6	379	5.8	403	6.3	341	5.2
Early neonatal deaths <7 days	134		133		136		165	
Late neonatal deaths 7–27 days	33		43		46		45	
Neonatal deaths <28 days	167	2.6[2]	176	2.7[2]	182	2.9[2]	210	3.2
Perinatal mortalities	645	9.8[3]	657	10.0[3]	676	10.6[3]	659	10.1
Perinatal related mortalities	678	10.3[4]	700	10.6[4]	722	11.3[4]	704	10.8
Perinatal mortalities (excluding lethal and terminated fetal abnormalities)[5]	460	7.0	488	7.4	508	8.0	462	7.1
Perinatal related mortalities (excluding lethal and terminated fetal abnormalities)[5]	479	7.3	516	7.9	539	8.5	493	7.6

1 Fetal death rate per 1000 babies born (includes terminations and stillbirths)
2 Neonatal death rate per 1000 live-born babies
3 Fetal deaths and early neonatal deaths per 1000 babies born
4 Fetal deaths and early and late neonatal deaths per 1000 babies born
5 Lethal and terminated fetal abnormalities are all fetal deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality

The perinatal mortality rates for the first four years of PMMRC data collection are presented in Table 3. We note that there were 46 fewer fetal deaths (62 fewer stillbirths and 16 more late terminations) in 2010 and 28 more neonatal deaths (mostly early neonatal deaths) than in 2009. However, the variations in individual and summary rates over the four years are more likely to be due to random variation than any true change in rates.

International comparisons

In 2009, the United Kingdom reported a perinatal mortality rate of 7.6/1000 total births, a stillbirth rate of 5.2/1000 total births and a neonatal mortality rate of 3.2/1000 live births (CMACE 2011a). The comparable New Zealand rates for 2009 are 7.5/1000 total births, 4.7/1000 total births and 2.9/1000 live births (and for 2010, 7.1/1000 total births, 4.6/1000 total births and 3.2/1000 live births, respectively).

In 2009, Australia reported a perinatal mortality rate (equivalent to our perinatal related mortality rate), excluding data from the state of Victoria, of 9.8/1000 births (95% CI 9.4–10.3) (AIHW National Perinatal Statistics Unit 2011). The comparable New Zealand rate for 2009 was significantly higher at 11.3/1000 (95% CI 10.5–12.2).

1.6 Investigation of perinatal related mortality

Causes of perinatal death

Obstetric antecedent classification

Table 4: Perinatal related deaths by primary obstetric antecedent cause (PSANZ-PDC) 2010

Perinatal death classification (PDC)	Fetal deaths				Neonatal deaths		Total perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Congenital abnormality	130	85.0	35	10.3	46	21.9	211	30.0
Perinatal infection	3	2.0	16	4.7	8	3.8	27	3.8
Hypertension	3	2.0	17	5.0	6	2.9	26	3.7
Antepartum haemorrhage	-	-	46	13.5	32	15.2	78	11.1
Maternal conditions	5	3.3	23	6.7	4	1.9	32	4.5
Specific perinatal conditions	6	3.9	45	13.2	18	8.6	69	9.8
Hypoxic peripartum death	-	-	7	2.1	13	6.2	20	2.8
Fetal growth restriction	3	2.0	39	11.4	6	2.9	48	6.8
Spontaneous preterm	3	2.0	41	12.0	67	31.9	111	15.8
Unexplained antepartum death	-	-	72	21.1	-	-	72	10.2
No obstetric antecedent	-	-	-	-	10	4.8	10	1.4

Figure 15: Relative distribution of fetal and neonatal deaths by perinatal death classification (PSANZ–PDC) 2010

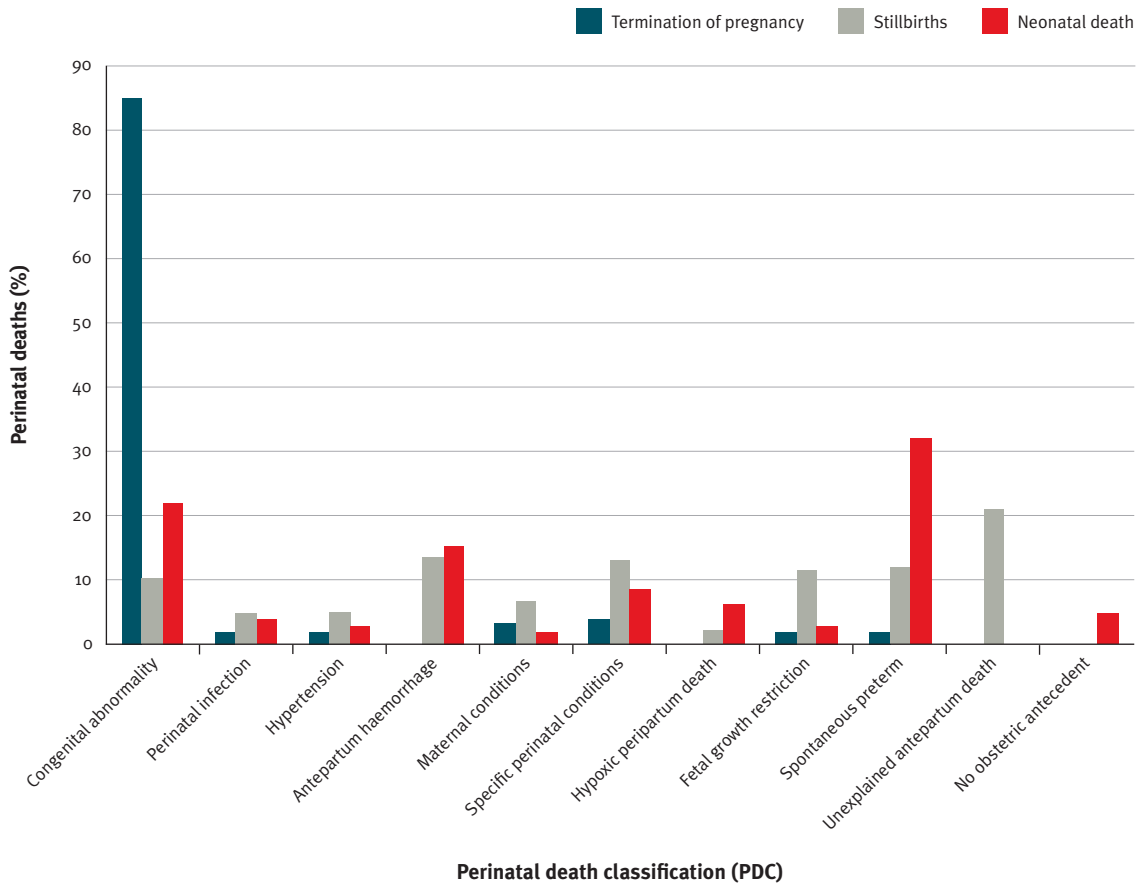
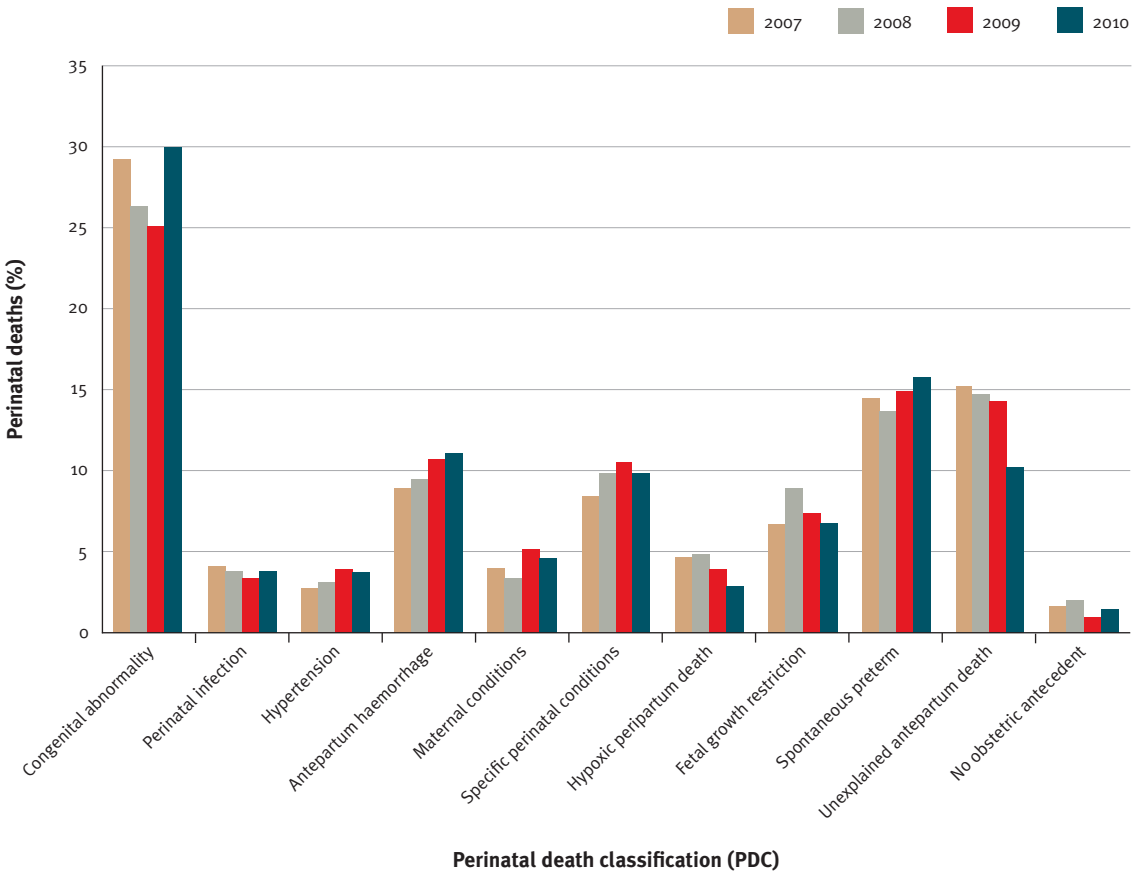


Figure 15 shows the distribution of cause of death (PSANZ-PDC) within terminations of pregnancy, stillbirths and neonatal deaths. For example, 85 percent of terminations of pregnancy were due to congenital abnormalities compared to 10 percent of stillbirths and 22 percent of neonatal deaths. Figure 16 shows total perinatal related deaths by PSANZ-PDC cause of death for 2007–2010, demonstrating little change in the distribution over these four years of reporting.

Figure 16: Relative distribution of perinatal death classifications (PSANZ–PDC) among perinatal related deaths (2007–2010)



Stillbirth

There were 341 stillbirths in 2010 (5.2/1000 total births), 60 fewer than in 2009 (6.3/1000 total births). As noted under table 3, the variations in individual and summary rates over the four years 2007-2010 are more likely to be due to random variation than any true change in rates.

The largest numbers of stillbirths were in the 'unexplained' category. Twenty-one percent of stillbirths fell into this category in 2010. As in 2007–2009, the most frequently identified antecedent causes (PSANZ-PDC) of stillbirth were antepartum haemorrhage, specific perinatal conditions, fetal growth restriction and spontaneous preterm birth, each responsible for 10–15 percent of stillbirths.

Of stillbirths from 24 weeks, 24 percent fell into the 'unexplained' category in 2010. In the years 2007–2009, there have been at least 30 percent in this category. This decrease is not statistically significant (p=0.13) but may represent a change in investigation of perinatal death in New Zealand.

Of the 72 unexplained stillbirths in 2010, 22 (31%) were at term. Unexplained stillbirth accounted for 24 percent of stillbirth at term in 2010 – significantly fewer than in 2007–2009 (38–41%).

A post-mortem was offered in 96 percent of cases of unexplained stillbirth in 2010 (88% in 2009). A post-mortem was completed in 35 percent of all cases. Partial investigation was undertaken in a further 50 percent (defined as no post-mortem; investigations may have included placental pathology, MRI, ultrasound scan or x-ray). Fifteen percent of unexplained deaths were uninvestigated, not having a post-mortem, placental histology or karyotype undertaken.

Intrapartum stillbirth

Table 5: Timing of stillbirths relative to labour 2010

Timing of stillbirth	Stillbirths	
	n=341	
	n	%
Antepartum	232	68.0
Intrapartum - first stage	22	6.5
Intrapartum - second stage	11	3.2
Intrapartum - unknown stage	38	11.1
Unknown	38	11.1

There were at least 71 stillbirths in labour in 2010. Timing of stillbirth was unknown in 38 cases. These numbers have remained unchanged since 2007. Of the 71 stillbirths in labour, 24 occurred at or beyond 24 weeks in babies who did not die of congenital abnormality. The intrapartum stillbirth rate (in-labour deaths of babies of 24 weeks and beyond, excluding deaths caused by lethal congenital abnormality) was 0.37/1000 births 24 weeks and beyond without lethal congenital abnormality (0.44, 0.49 and 0.54/1000 births in 2007, 2008 and 2009, respectively).

Intrapartum deaths of babies born at or beyond 24 weeks without congenital abnormality

The majority of intrapartum deaths of babies born at or beyond 24 weeks without congenital abnormality were:

- term (16 of 24 (67%) of those who died at 24 or more weeks)
- not small for gestational age (SGA) (75%).

The primary antecedent cause (PDC) was perinatal infection (3), hypertension (2), antepartum haemorrhage (5), hypoxic peripartum death (7), fetal growth restriction (1) and spontaneous preterm birth (6).

Thirteen (54%) were deemed by a local review committee to have contributory factors, and 10 (42%) were deemed to have been potentially avoidable. As in 2009 when 35 percent were reported as potentially avoidable, this rate is significantly higher than potentially avoidable stillbirths overall (21% in 2010). The most common groups of contributory factors in these cases were personnel and organisational/management factors, and the most common specific factors identified were failure to follow best practice, staff lacking knowledge and skills and failure or delay in emergency response. A post-mortem was offered in almost all of the 24 cases (88 percent), but adequate investigation (a post-mortem) was completed in fewer than 50 percent.

Intrapartum deaths of babies born at term without congenital abnormality

The intrapartum stillbirth rate for babies born at term who did not die of congenital abnormality was 0.27/1000 in 2010 (0.40/1000 in 2008 and 0.39/1000 in 2009). Of 85 term stillbirths without lethal congenital abnormality, 16 (19%) occurred in labour, and 7 of these were hypoxic peripartum deaths.

Termination of pregnancy

Consistent with previous years, the predominant antecedent cause of death among terminations beyond 20 weeks was congenital abnormality (n=130 – 85%), the most common being chromosomal abnormalities.

While it might be desirable for terminations to occur earlier in pregnancy, both to reduce the risk for mothers and increase the options for method of termination, this is unlikely to occur, as there has been a shift in practice towards an anatomy scan at 19–20 weeks. This change in practice follows the increasing need for a second scan after a first scan at 16 weeks because of poor fetal visibility secondary to maternal obesity.

There were 39 terminations performed after 24 weeks gestation. The primary antecedent classifications for these cases were congenital abnormality in 29 and perinatal infection, hypertension, fetal growth restriction and specific perinatal conditions in the remainder.

Table 6: Clinical details of neonatal deaths 2010

	Total		Neonatal deaths from congenital abnormalities		Neonatal deaths excluding congenital abnormalities							
					20–23 weeks		24–27 weeks		28–36 weeks		37+ weeks	
	n=210		n=46		n=80		n=33		n=18		n=33	
	n	%	n	%	n	%	n	%	n	%	n	%
Age at death												
≤1 day	130	61.9	23	50.0	76	95.0	14	42.4	6	18.2	11	33.3
2–7 days	39	18.6	9	19.6	3	3.8	8	24.2	7	21.2	12	36.4
8–14 days	20	9.5	6	13.0	-	-	8	24.2	2	6.1	4	12.1
15–21 days	8	3.8	1	2.2	1	1.3	2	6.1	2	6.1	2	6.1
22–28 days	13	6.2	7	15.2	-	-	1	3.0	1	3.0	4	12.1
Place of death												
Home	16	7.6	6	13.0	1	1.3	2	6.1	1	3.0	6	18.2
Hospital				-								
Delivery suite	70	33.3	10	21.7	52	65.0	4	12.1	-	-	4	12.1
Antenatal ward	-	-	-	-	-	-	-	-	-	-	-	-
Postnatal ward	3	1.4	1	2.2	-	-	2	6.1	-	-	-	-
Neonatal unit	84	40.0	19	41.3	6	7.5	24	72.7	17	51.5	18	54.5
Operating theatre	2	1.0	1	2.2	-	-	-	-	-	-	1	3.0
Emergency department	8	3.8	1	2.2	6	7.5	-	-	-	-	1	3.0
Other	24	11.4	8	17.4	14	17.5	-	-	-	-	2	6.1
Unknown	-	-	-	-	-	-	-	-	-	-	-	-
Other	1	0.5	-	-	-	-	1	3.0	-	-	-	-
Unknown	2	1.0	-	-	1	1.3	-	-	-	-	1	3.0
Apgar 5 minutes												
0–3	96	45.7	9	19.6	57	71.3	14	42.4	5	15.2	11	33.3
4–5	16	7.6	8	17.4	-	-	2	6.1	3	9.1	3	9.1
6–7	26	12.4	9	19.6	4	5.0	6	18.2	4	12.1	3	9.1
≥8	49	23.3	19	41.3	2	2.5	10	30.3	5	15.2	13	39.4
Unknown	23	11.0	1	2.2	17	21.3	1	3.0	1	3.0	3	9.1
Resuscitation at birth												
Yes	103	49.0	23	50.0	11	13.8	32	97.0	16	48.5	21	63.6
No	105	50.0	23	50.0	67	83.8	1	3.0	2	6.1	12	36.4
Unknown	2	1.0	-	-	2	2.5	-	-	-	-	-	-
Outcome of resuscitation												
Baby resuscitated and transferred to another clinical care area	85	82.5	20	87.0	7	63.6	24	75.0	16	76.2	18	85.7
Baby unable to be resuscitated	18	17.5	3	13.0	4	36.4	8	25.0	-	-	3	14.3

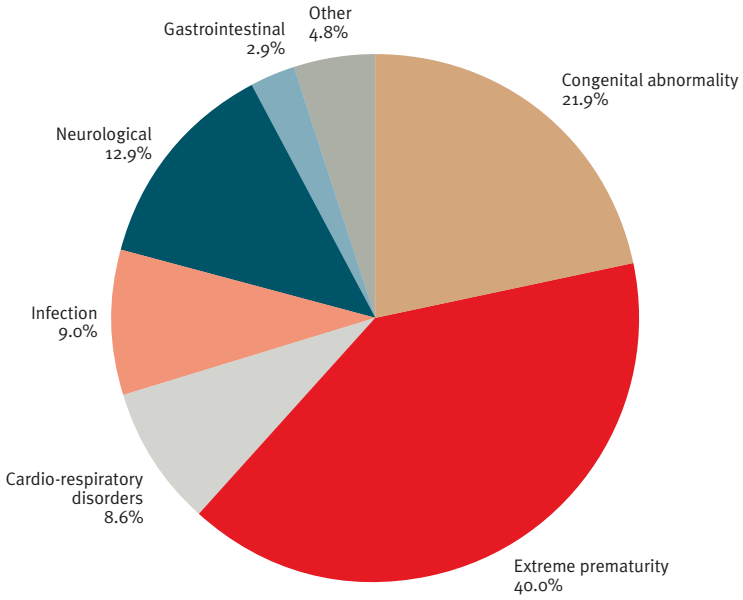
Neonatal deaths in Table 6 have been categorised as those due to congenital abnormalities and then by gestational age: pre–viable (<24 weeks), very preterm (24–27 weeks), late preterm (28–36 weeks) and term (≥37 weeks).

Not surprisingly, babies who die in the neonatal period who were born at 28 weeks or more without lethal congenital abnormalities were less likely to die on the first day of life (33%), and less likely to have Apgar scores under 4 at five minutes (31%) than neonatal deaths at earlier gestations.

Eleven babies without lethal congenital abnormalities born at 24 or more weeks gestation (three born at term) were unable to be resuscitated at birth. The primary death classification for seven of these eleven babies was spontaneous preterm birth (24–26 weeks gestation). The remainder were antepartum haemorrhage, specific perinatal conditions, hypoxic peripartum death and fetal growth restriction.

There were eight cases of sudden unexpected death in infancy (SUDI) among the neonatal deaths in 2010 (10 in 2008 and 7 in 2009). All mothers were Māori or Pacific, seven were from deprivation quintiles 4 and 5 (most deprived), six were smokers and seven babies were co-sleeping.

Figure 17: Primary neonatal death classification (PSANZ–NDC) 2010 (n=210)



In New Zealand during 2010, congenital abnormality (21.9%), extreme prematurity (40%) and neurological conditions (12.9%) were the three most common primary neonatal causes of death.

Figure 18: Distribution of neonatal death classification (PSANZ-NDC) among neonatal deaths without lethal congenital abnormality by gestational age group 2007–2010

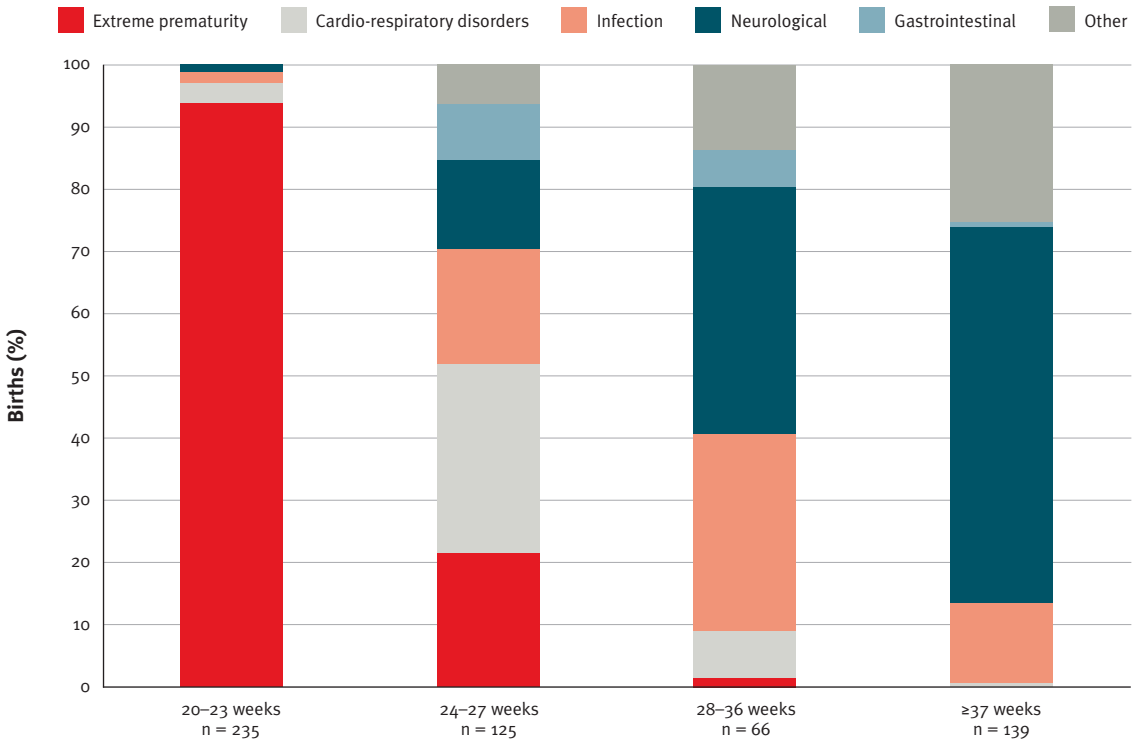


Figure 18 shows the distribution of cause of neonatal death (NDC) among different gestation groups, after excluding congenital abnormality. Extreme prematurity is the cause of death of the vast majority of babies born alive between 20 and 24 weeks. Prematurity is the principal cause in about 20 percent of live births from 24–27 weeks, although the approximately 30 percent of babies dying from cardio-respiratory disorders mostly died of hyaline membrane disease, bronchopulmonary dysplasia and pulmonary hypoplasia, which are recognised complications of premature birth. Among babies from 28 weeks, who have a high survival rate from preterm birth, neurological disorders are the most important cause of death. Neurological causes of death both at 28–36 weeks and at term are almost exclusively from hypoxic ischaemic encephalopathy (HIE). The babies dying from HIE at term in 2010 will form part of the neonatal encephalopathy (NE) dataset under investigation by the NE working group of the PMMRC. A proportion of these deaths may be preventable with improved perinatal care. This is supported by approximately half of term HIE deaths being identified by local review committees as potentially avoidable.

Figure 19: Neonatal death rate (per 1000) by gestation and baby ethnicity (prioritised) (2007–2010) (excluding congenital abnormalities)

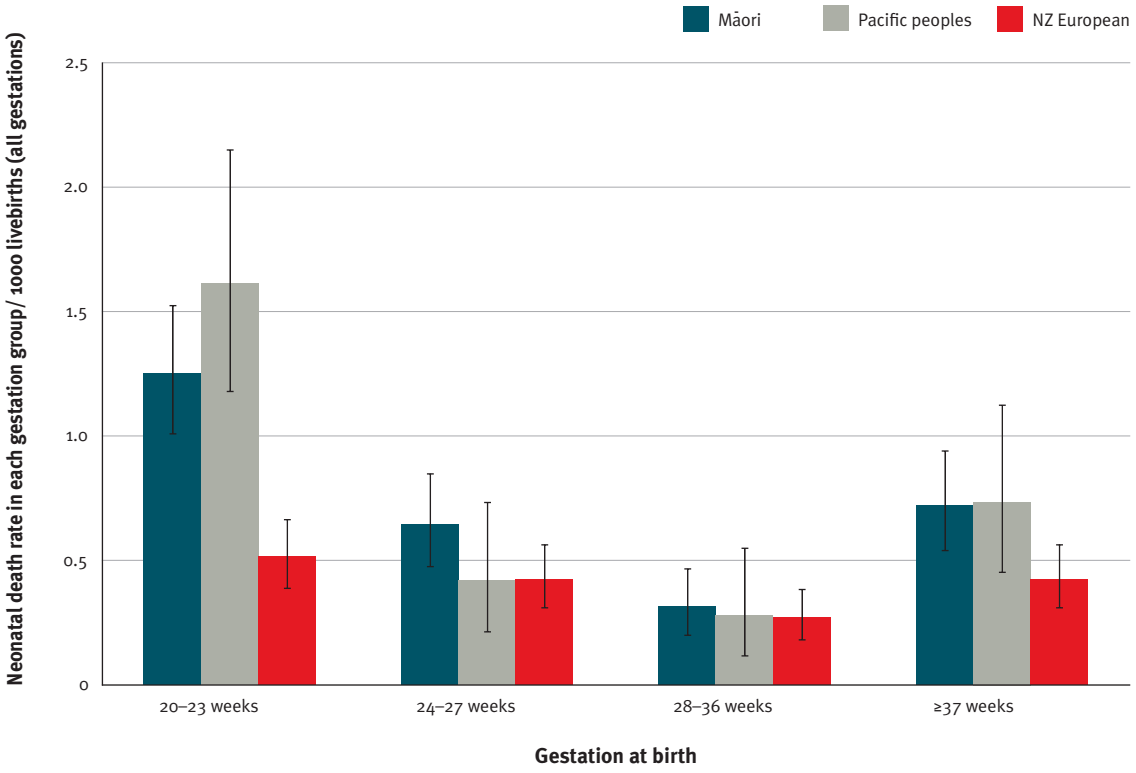


Figure 19 illustrates the rate of neonatal death excluding congenital abnormalities (as a proportion of total live births) at each gestation by prioritised ethnicity for Māori, Pacific and New Zealand European babies. This shows that Māori and Pacific neonates were significantly more likely to die at 20–23 weeks than at any later gestation and that both Māori and Pacific neonates were more likely to die at 20–23 weeks than New Zealand European neonates. The neonatal death rates by gestation were more similar for New Zealand European neonates, although they were significantly more likely to die at 20–23 weeks than at 28–36 weeks. The excess of deaths at 20–23 weeks is due to spontaneous preterm birth.

Table 7: Association between obstetric antecedent cause of death (PSANZ-PDC) and neonatal cause of death (PSANZ-NDC) among all neonatal deaths 2010

Perinatal death classification (PDC)	Total	Neonatal death classification (NDC)						
		Congenital abnormality	Extreme prematurity	Cardio-respiratory disorders	Infection	Neurological	Gastro-intestinal	Other
Congenital abnormality	46	46	-	-	-	-	-	-
Perinatal infection	8	-	4	-	4	-	-	-
Hypertension	6	-	1	3	2	-	-	-
Antepartum haemorrhage	32	-	22	4	-	3	3	-
Maternal conditions	4	-	-	1	-	2	1	-
Specific perinatal conditions	18	-	10	2	1	4	-	1
Hypoxic peripartum death	13	-	-	-	-	13	-	-
Fetal growth restriction	6	-	1	1	-	4	-	-
Spontaneous preterm	67	-	46	7	10	1	2	1
No obstetric antecedent	10	-	-	-	2	-	-	8
Total	**210**	**46**	**84**	**18**	**19**	**27**	**6**	**10**

All neonatal deaths are assigned at least one neonatal death classification (NDC), along with an obstetric antecedent cause (PDC). Table 7 demonstrates how these classification systems relate to each other. For example, death from extreme prematurity followed spontaneous preterm birth (46) but also antepartum haemorrhage (22) and specific perinatal conditions (10).

Demography of perinatal deaths

Gender

Table 8: Perinatal related death rates (per 1000) by gender 2010

	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Total perinatal related deaths		
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gender														
Male	33,537	51.5	79	51.6	2.36	173	50.7	5.16	133	63.3	4.00	385	54.7	11.48
Female	31,587	48.5	74	48.4	2.34	165	48.4	5.22	77	36.7	2.46	316	44.9	10.00
Unknown	-	-	-	-	-	3	0.9	-	-	-	-	3	0.4	-

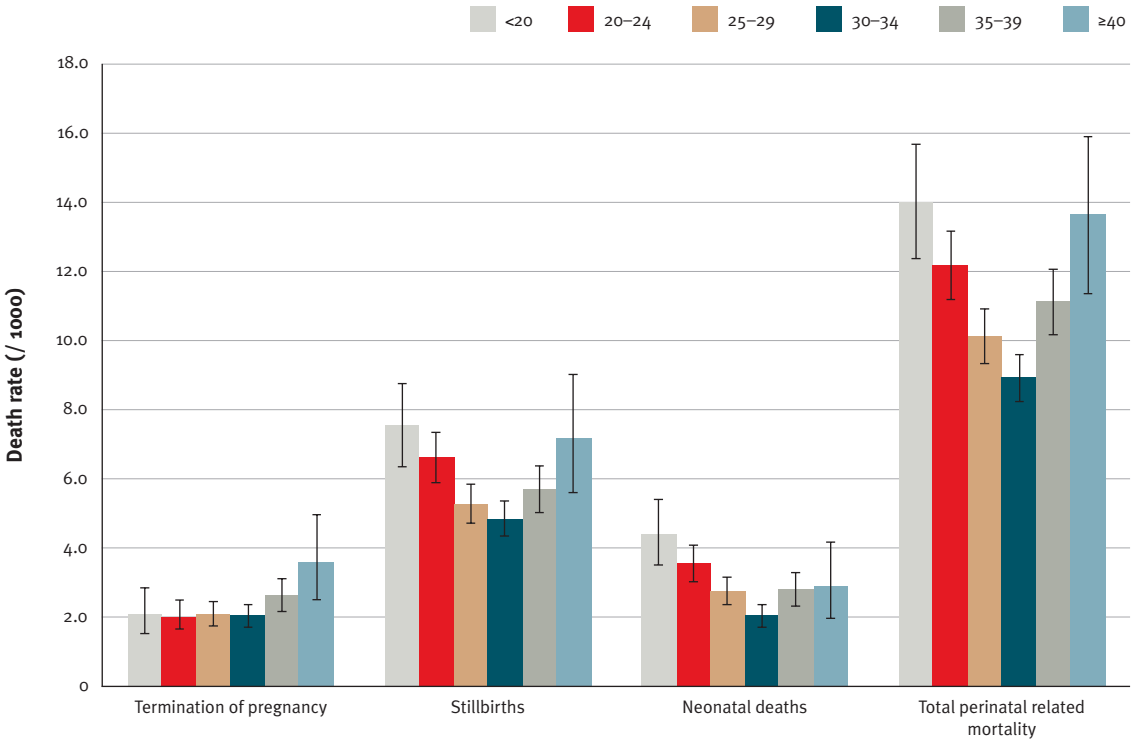
There was no statistically significant difference in perinatal related mortality rate between male and female babies in 2010, although male babies were more likely to die as neonates.

Maternal age

Table 9: Perinatal related death rates (per 1000) by maternal age 2010

	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Total perinatal related deaths		
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Maternal age														
<20	4,624	7.1	10	6.5	2.16	27	7.9	5.84	19	9.0	4.14	56	8.0	12.11
20–24	12,123	18.6	37	24.2	3.05	89	26.1	7.34	38	18.1	3.17	164	23.3	13.53
25–29	16,233	24.9	32	20.9	1.97	77	22.6	4.74	54	25.7	3.35	163	23.2	10.04
30–34	17,969	27.6	32	20.9	1.78	80	23.5	4.45	36	17.1	2.02	148	21.0	8.24
35–39	11,502	17.7	31	20.3	2.70	54	15.8	4.69	49	23.3	4.29	134	19.0	11.65
≥40	2,673	4.1	11	7.2	4.12	14	4.1	5.24	14	6.7	5.29	39	5.5	14.59

Figure 20: Perinatal related death rates (per 1000) by maternal age (with 95% CIs) 2007–2010



A consistent association between maternal age and perinatal related mortality is seen in New Zealand and across the developed world, with the highest rates at the extremes of age. The association is more complicated than this, as shown in Figure 20, with higher rates of late termination and stillbirth among mothers aged 40 and over and high rates of stillbirth and neonatal death among teenage mothers (<20 years of age). The association between young maternal age and perinatal mortality is most likely confounded by socioeconomic deprivation and smoking. As noted in the 2009 PMMRC report, approximately half of teenage mothers whose babies die reside in the highest deprivation quintile areas, and approximately half are current smokers. They are a high-risk group who often have inadequate access to antenatal care and may require increased postnatal care and support. Care provided should be acceptable, accessible, available and of high quality.

Figure 21: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000) by maternal age (<20, 20–39, ≥40) (with 95% CIs) 2007–2010

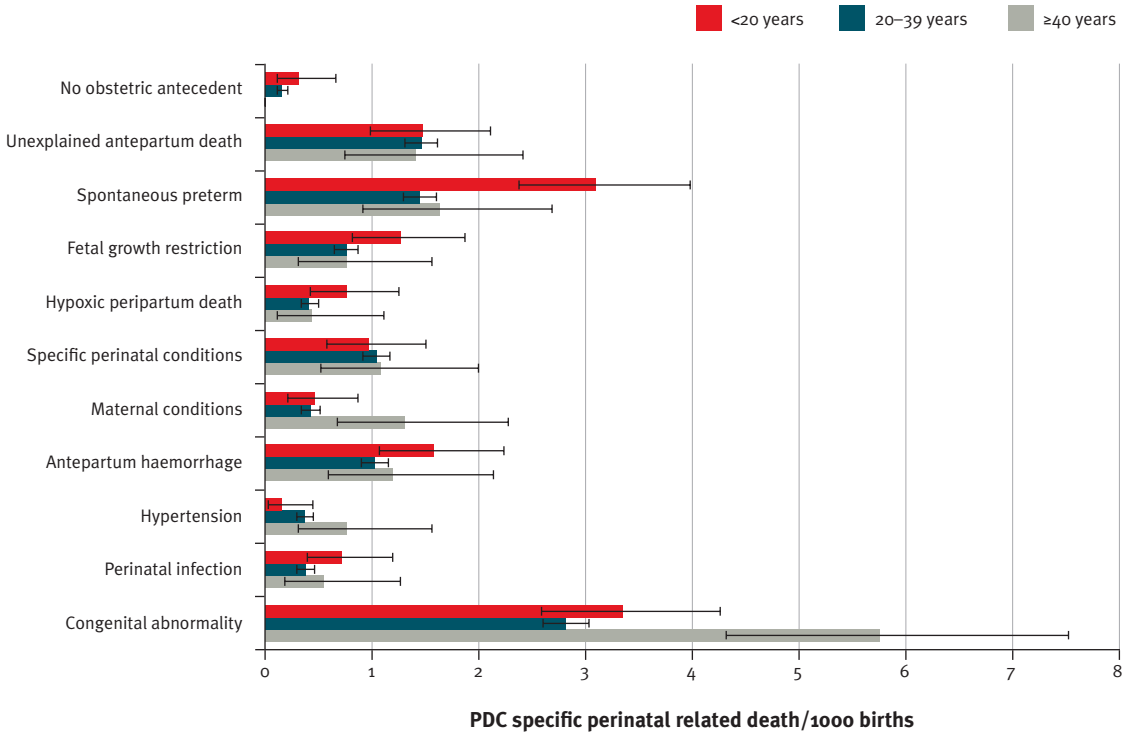


Figure 21 shows the cause of death (PDC) specific perinatal related mortality rates for teenage mothers compared with mothers 20 to 39 and mothers 40 and over. Spontaneous preterm birth is significantly more often the cause of perinatal related death in teenage mothers compared to mothers aged 20 to 39. Maternal conditions and congenital abnormalities are significantly more common antecedent causes of perinatal death in older mothers compared to women in the 20 to 39 year age bracket. This is not an unexpected finding but is a reminder that the issues facing mothers at opposite ends of the age spectrum are very different and supports education and clinical strategies that target the specific needs of at-risk mothers.

Ethnicity

Analyses using maternal ethnicity are presented in the body of the report. Similar tables including baby ethnicity data are presented in Appendix A (Tables 46–49).

Ethnicity has been reported as prioritised ethnicity (as outlined in Ethnicity Data Protocols for the Health and Disability Sector (Ministry of Health 2004)) and as reported in the 2006–2008 PMMRC reports and as sole/combination categories. Both of these methods of describing ethnicity allocate each individual to a single mutually exclusive ethnicity category. Both of these methods are presented, as the data would suggest that the prioritisation method alone may not represent the disparities in perinatal related mortality by ethnicity adequately. The analysis suggests that people who define themselves with more than one ethnicity may be exposed to different risks from those who define themselves by one ethnicity.

The prioritised ethnicity allocates each individual to a single ethnic group using the hierarchy Māori, Pacific peoples, Indian, Other Asian, Other groups (including Other European and Not Stated) and finally New Zealand European. This method is frequently used in health statistics in New Zealand. It prioritises minority ethnic groups who might otherwise be swamped by New Zealand European, but by ignoring multiple responses, it does not follow the principle of allowing individuals to identify themselves in the groups with which they most feel affinity. It is a simple system that results in relatively few groups for analysis.

Sole/combination ethnicity also results in a single category for each individual but produces a larger number of groups, which may make analysis and interpretation more difficult. This method was used in the PMMRC report forthe firsttime in 2008 (PMMRC 2008). The sole/combination groups presented were developed after considering

advice given by New Zealand Statistics (Ministry of Health 2004) and using a pragmatic approach based on the perinatal related mortality data. Therefore the categories used in this report are Māori, Pacific peoples, Indian, Other Asian, Other, New Zealand European, Māori/New Zealand European, Māori/Pacific peoples, Pacific peoples/New Zealand European and 'combinations not elsewhere defined'.

The data tables provided in this section relate to perinatal related deaths in 2010 collated by the PMMRC and births registered in the 2010 year. Table 10, showing total ethnicity responses for perinatal related deaths in 2010, has been included for completeness. The figures illustrate rates based on the combined data for 2007–2010. The inclusion of 2007–2010 data in the figures results in larger numbers and thus more robust estimates with tighter confidence intervals.

Table 10: Total responses for mother and baby ethnicity among perinatal related deaths 2010

	Baby ethnicity total response among perinatal related deaths		Mother ethnicity total response among perinatal related deaths	
	n=704		n=704	
	n	%[1]	n	%[1]
Māori	235	32.6	193	26.8
Pacific Peoples	138	19.2	122	16.9
Indian	40	5.6	40	5.6
Other Asian	60	8.3	56	7.8
Other	51	7.1	58	8.1
New Zealand European	404	56.1	352	48.9

1 Totals do not sum to 100 percent of births as individuals may be counted in more than one ethnic group

Mothers' ethnicity for the PMMRC set of perinatal related deaths has been extracted, in order of priority, from BDM registration of birth (75%) or PMMRC rapid response forms (25%). Babies' ethnicity for the PMMRC set of perinatal deaths has been extracted, in order of priority, from BDM registration of birth (75%), BDM registration of death (6%) or PMMRC rapid response forms (19%). One baby had no ethnicity data available.

Table 11: Perinatal related death rates (per 1000) by maternal ethnicity (prioritised) 2010

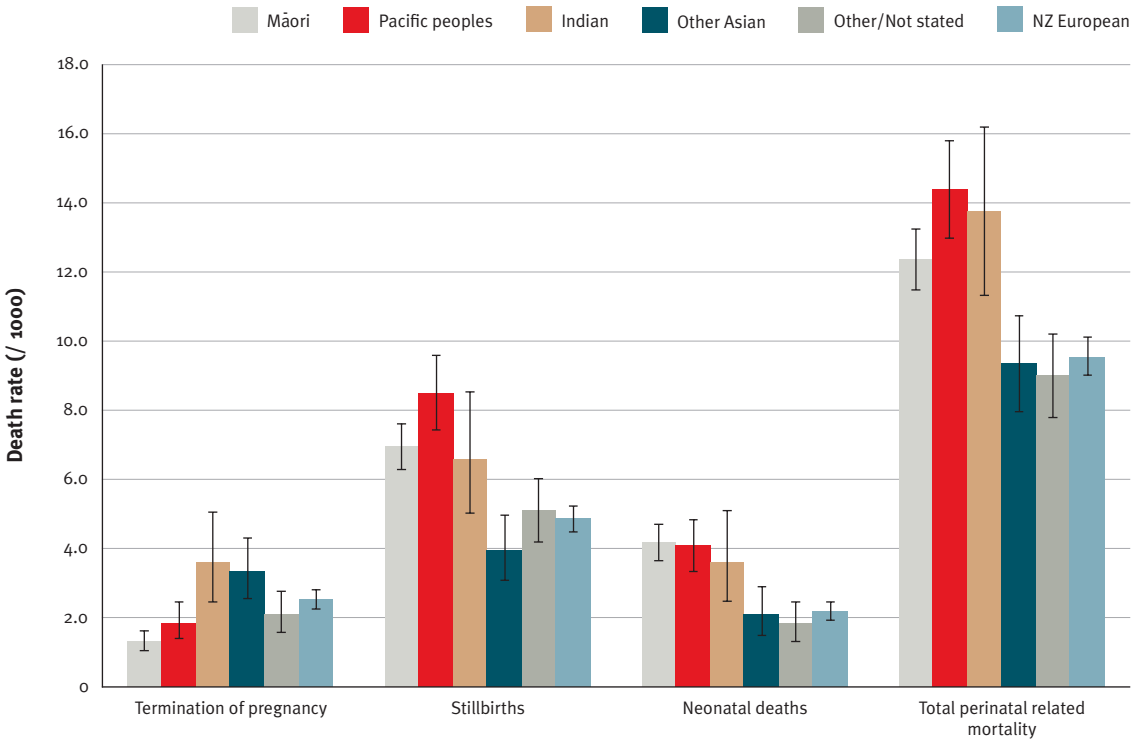
	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	14,877	22.8	19	12.4	1.28	104	30.5	6.99	70	33.3	4.74	193	27.4	12.97
Pacific Peoples	6,999	10.7	21	13.7	3.00	54	15.8	7.72	32	15.2	4.62	107	15.2	15.29
Indian	2,378	3.7	4	2.6	1.68	21	6.2	8.83	10	4.8	4.25	35	5.0	14.72
Other Asian	5,088	7.8	17	11.1	3.34	23	6.7	4.52	14	6.7	2.77	54	7.7	10.61
Other/ Not stated	6,032	9.3	16	10.5	2.65	16	4.7	2.65	16	7.6	2.67	48	6.8	7.96
NZ European	29,750	45.7	76	49.7	2.55	123	36.1	4.13	68	32.4	2.30	267	37.9	8.97

The relationship between ethnicity and perinatal related mortality is complicated, in that the association between ethnicity and mortality varies by type of death (for example, termination, stillbirth or neonatal death). Irrespective of how ethnicity is described (prioritised or sole/combination), Māori mothers have lower rates of late termination of pregnancy compared to Asian (including Indian and Other Asian), New Zealand European and Other mothers. Pacific mothers also have lower rates of late termination compared to Asian mothers.

The differences described in ethnic-specific late termination have a marked effect on the ethnic-specific perinatal related mortality rate, as shown in the figures to follow, and disguise the ethnic trends seen in stillbirth and neonatal deaths. For this reason, all figures show the specific rates for termination of pregnancy, stillbirth and neonatal death as well as the overall perinatal related mortality rates, and in some instances, terminations of pregnancy are excluded from analyses.

The use of maternal versus baby ethnicity has a small effect on the magnitude of the ethnic-specific mortality rates but not on the comparison between ethnicities.

Figure 22: Perinatal related death rates (per 1000) by maternal ethnicity (prioritised) (with 95% CIs) 2007–2010



Prioritised Māori and Pacific maternal ethnicities are associated with increased risk of stillbirth and neonatal death compared with New Zealand European, Other (non-Indian) Asian and Other maternal ethnicities. Numbers of Indian mothers are small, but it would appear that these mothers have a higher risk of late termination of pregnancy compared to all ethnicities except Other Asian and also have a higher rate of stillbirth and neonatal mortality compared to non-Māori/non-Pacific mothers.

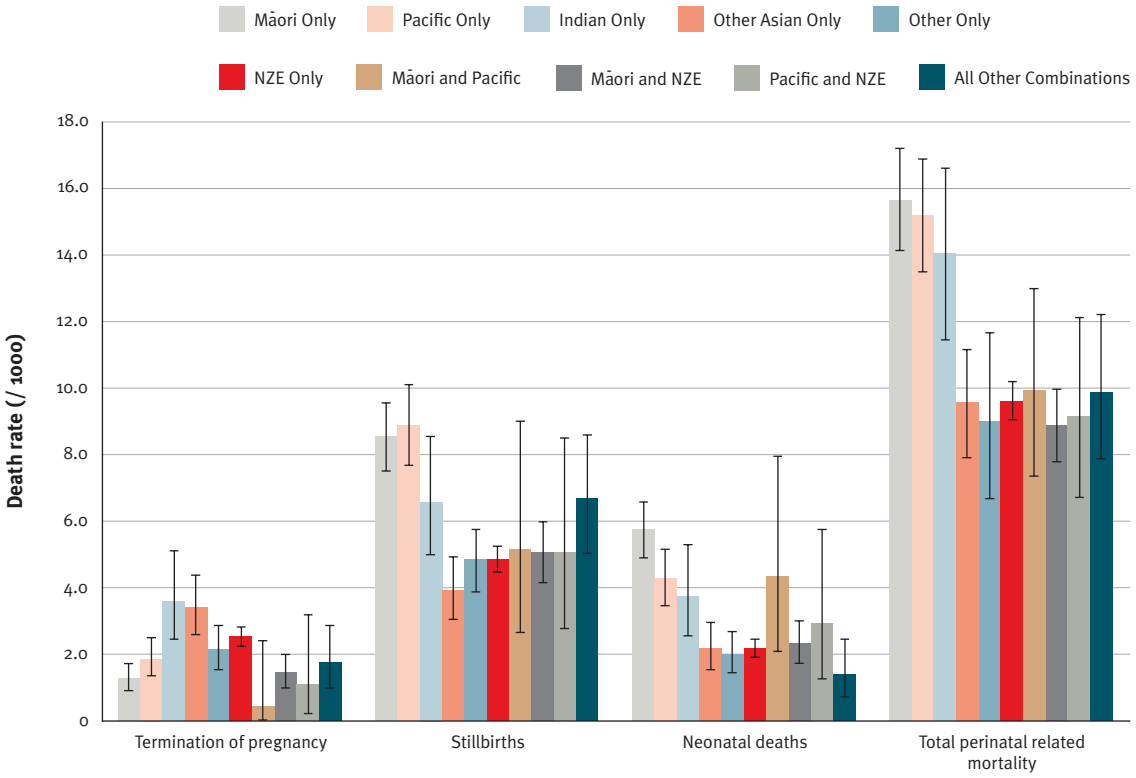
There is no statistically significant difference in the rate of late termination, stillbirth or neonatal death between Māori and Pacific mothers, although it seems likely that stillbirth rates are higher among Pacific mothers.

Table 12: Perinatal related death rates (per 1000) by maternal ethnicity (sole/combination) 2010

	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Sole/combination ethnicity (mother)														
Māori only	7,396	11.4	11	7.2	1.49	60	17.6	8.11	44	21.0	6.01	115	16.3	15.55
Pacific only	5,919	9.1	16	10.5	2.70	47	13.8	7.94	28	13.3	4.78	91	12.9	15.37
Indian only	2,296	3.5	4	2.6	1.74	20	5.9	8.71	10	4.8	4.40	34	4.8	14.81
Other Asian only	4,897	7.5	17	11.1	3.47	21	6.2	4.29	14	6.7	2.88	52	7.4	10.62
Other only [1]	5,353	8.2	15	9.8	2.80	12	3.5	2.24	15	7.1	2.82	42	6.0	7.85
NZE only	29,750	45.7	76	49.7	2.55	123	36.1	4.13	68	32.4	2.30	267	37.9	8.97
Māori and Pacific	638	1.0	1	0.7	1.57	1	0.3	1.57	4	1.9	6.29	6	0.9	9.40
Māori and NZE	5,929	9.1	6	3.9	1.01	33	9.7	5.57	17	8.1	2.89	56	8.0	9.45
Pacific and NZE	703	1.1	3	2.0	4.27	4	1.2	5.69	2	1.0	2.87	9	1.3	12.80
All other combinations	2,243	3.4	4	2.6	1.78	20	5.9	8.92	8	3.8	3.61	32	4.5	14.27

1 Other only includes not stated

Figure 23: Perinatal related death rates (per 1000) by maternal ethnicity (sole/combination categories) (with 95% CIs) 2007–2010



The sole/combination method of categorising ethnicity provides further information on the association between ethnicity and perinatal mortality risk, especially for Māori and Pacific mothers. This is because mothers who identify as combined ethnicities (including Māori and Pacific) appear to be at lower risk than those identifying with sole groups. The reasons for this are not evident from these data, but the association between sole/combination ethnicity and socioeconomic deprivation and age, illustrated in the denominator data in Figure 10 and Figure 12, show that ethnicity is a marker for at least these factors. Other risk factors for perinatal death that are associated with ethnicity and may be represented by this variable include obesity and smoking. The Auckland Stillbirth Study (Stacey 2011) has reported that ethnicity is not associated with late stillbirth (≥28 weeks) after adjusting for maternal BMI.

The same excess of stillbirth and neonatal death associated with Māori and Pacific (and possibly Indian) ethnicity compared to Other Asian, Other and New Zealand European ethnicity are seen using sole/combination ethnicity as with prioritised ethnicity. The stillbirth and neonatal death rates are higher for sole Māori and sole Pacific than for prioritised Māori and Pacific (Figure 23 compared with Figure 22). It appears that Māori who also identify as New Zealand European are at lower risk than the sole Māori group. It also seems likely that this applies to Pacific mothers who also identify as New Zealand European. The mortality rates for the combined Pacific and Māori group are difficult to interpret as the numbers are small (the confidence intervals are wide). However, it appears that this group may also be at lower risk than mothers who identify as sole Pacific and sole Māori.

Figures 24 and 25 below show PDC specific perinatal related death rates (excluding termination of pregnancy) for Māori, Pacific and New Zealand European mothers (prioritised and sole/combination ethnicity). Additional risk for Māori and Pacific mothers was evident for only some causes of death. These included spontaneous preterm birth, possibly due in part to higher smoking rates, higher rates of obesity and higher socioeconomic deprivation among Māori and Pacific mothers.

Figure 24: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000) (excluding termination of pregnancy) by ethnicity (prioritised maternal) 2007–2010

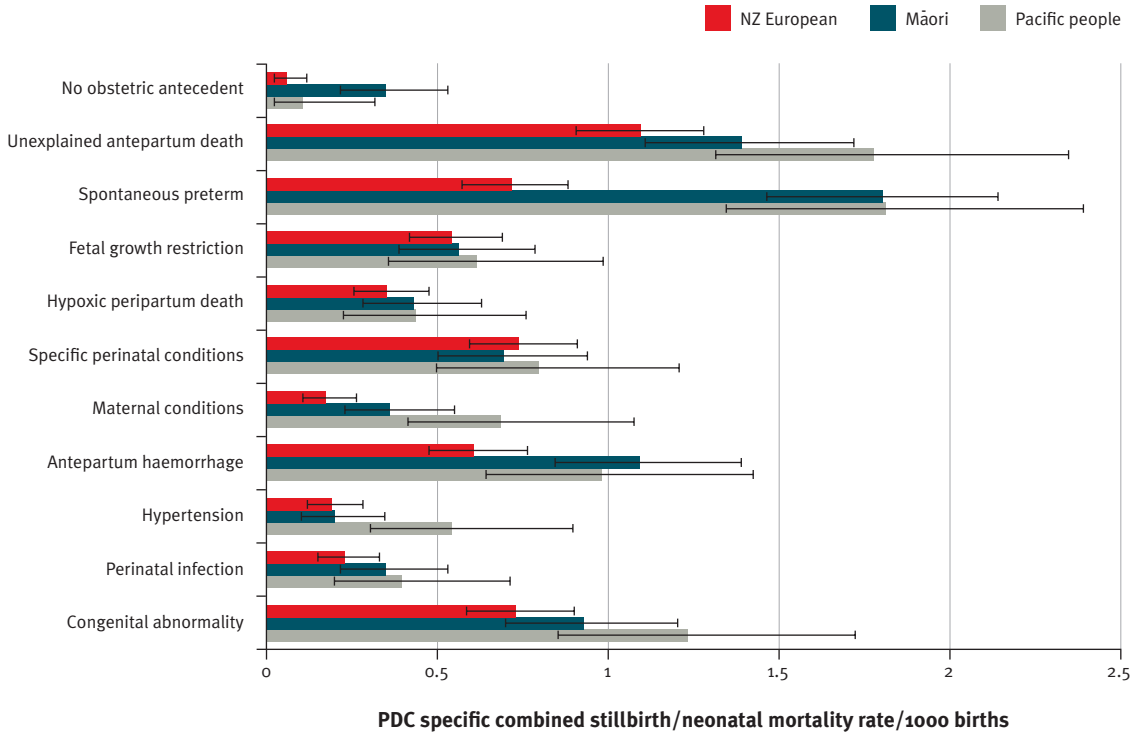
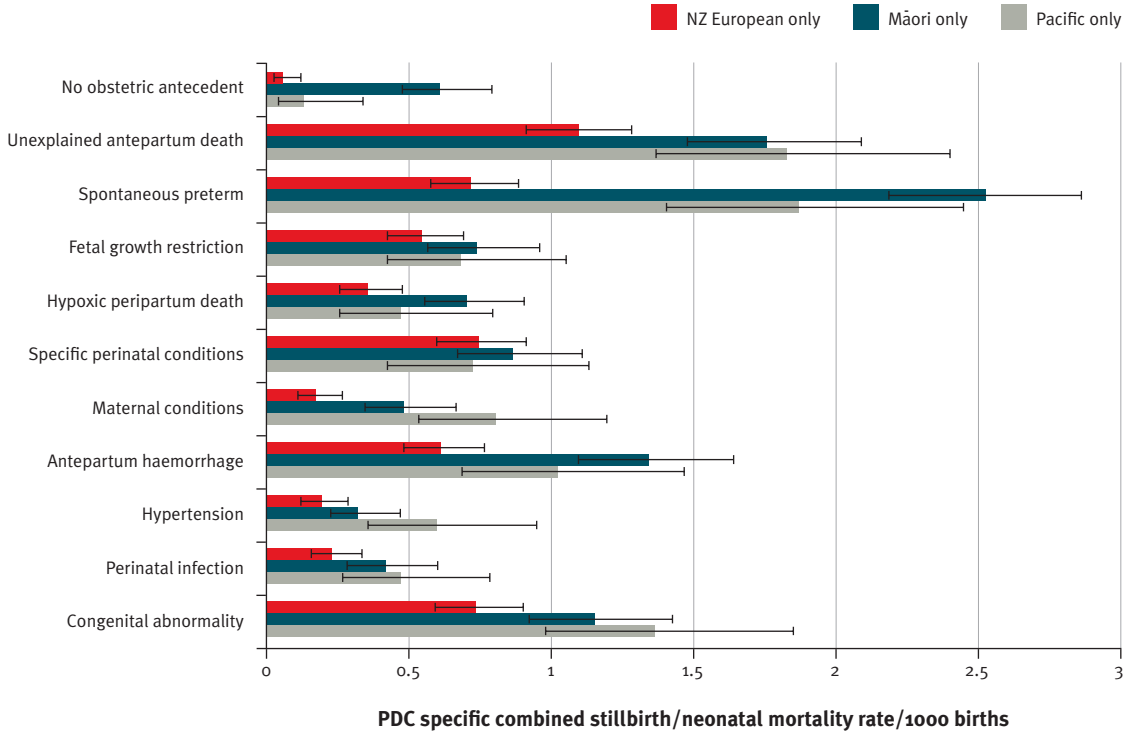


Figure 25: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000) (excluding termination of pregnancy) by ethnicity (sole/combination maternal) 2007–2010



Neonatal deaths with no obstetric antecedent, mostly sudden expected death in infancy (SUDI), are more common in babies of sole Māori mothers than Pacific or New Zealand European mothers.

Unexplained antepartum death is more common among sole Māori and sole Pacific mothers. Hypoxic peripartum death is more common among sole Māori mothers. Maternal conditions (largely diabetes) and congenital abnormalities are more common causes of stillbirth and neonatal death among sole Māori and sole Pacific mothers, antepartum haemorrhage is more common among sole Māori (possibly related to high rates of smoking) and hypertension is more common among sole Pacific mothers (possibly related to obesity). Many of these disparities in antecedent causes of stillbirth and neonatal death among sole Māori and Pacific mothers may be related to high rates of barriers to access and engagement with antenatal care seen among Māori and Pacific mothers compared to mothers of other ethnicities (see Figure 31 on page 72).

Higher rates of stillbirth and neonatal death from congenital abnormality in Māori and Pacific mothers probably reflects the lower rates of termination of pregnancy among these mothers but may also be related to increased obesity, known to be associated with increased risk of congenital abnormalities, among Māori and Pacific mothers.

Socioeconomic disadvantage

Table 13: Perinatal related death rates (per 1000) by deprivation quintile (NZDep2006) 2010

Deprivation quintile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1	10,304	15.8	25	16.3	2.43	31	9.1	3.01	27	12.9	2.63	83	11.8	8.06
2	11,485	17.6	38	24.8	3.31	50	14.7	4.35	27	12.9	2.37	115	16.3	10.01
3	12,311	18.9	31	20.3	2.52	54	15.8	4.39	38	18.1	3.11	123	17.5	9.99
4	13,797	21.2	26	17.0	1.88	72	21.1	5.22	38	18.1	2.77	136	19.3	9.86
5	16,862	25.9	32	20.9	1.90	128	37.5	7.59	77	36.7	4.61	237	33.7	14.06
Unknown	365	0.6	1	0.7	-	6	1.8	-	3	1.4	-	10	1.4	-

Figure 26: Perinatal related death rates (per 1000) by deprivation quintile (NZDep2006) (with 95% CIs) 2007–2010

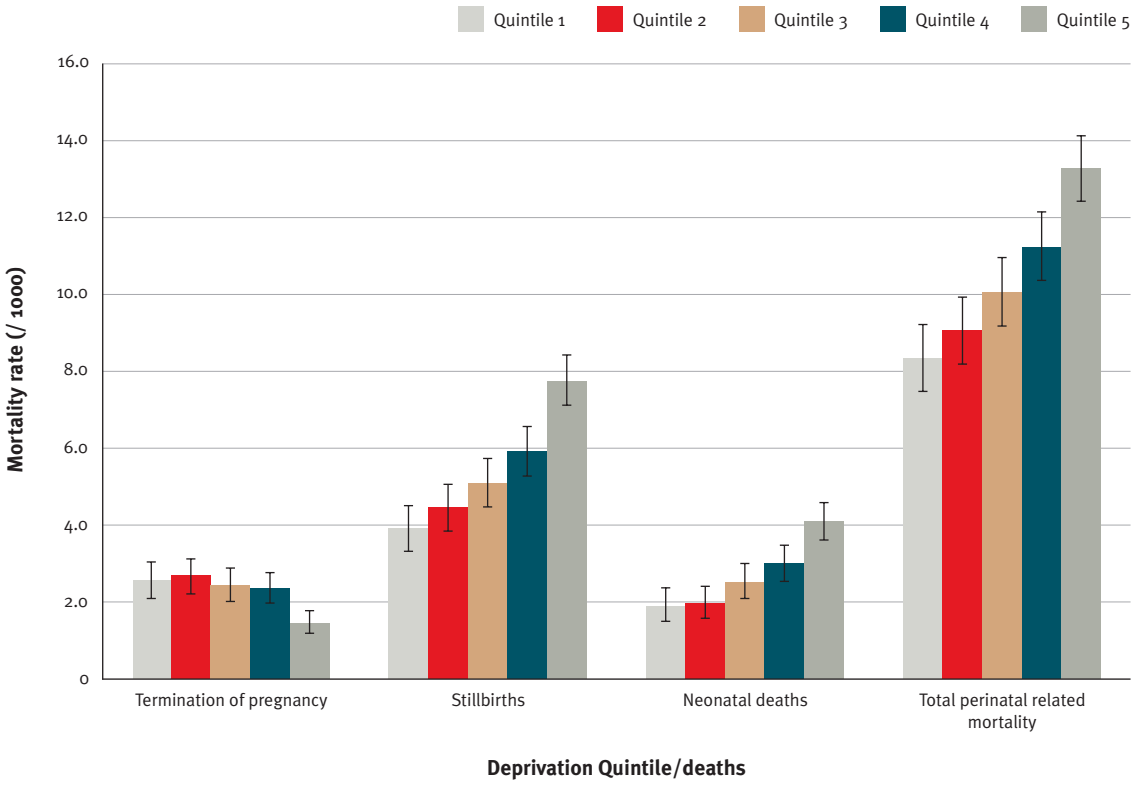
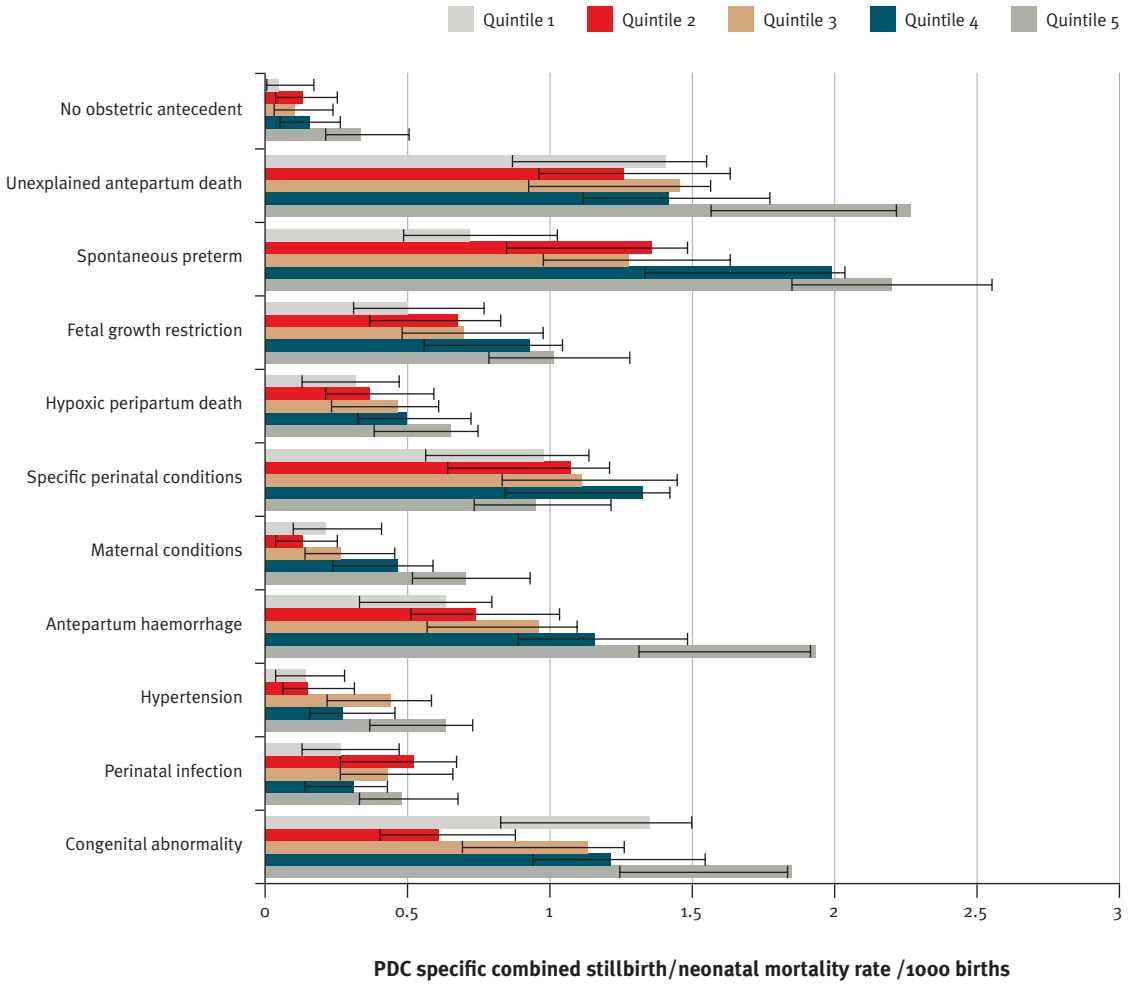


Figure 26 includes combined data from 2007–2010 and shows a significantly lower rate of late termination (≥20 weeks) among the most deprived mothers (quintile 5) but a significantly increased rate of stillbirth and neonatal death in this group compared to all less-deprived quintiles. The trend towards increasing stillbirth and neonatal death with increasing socioeconomic deprivation becomes more evident as more data are collected. Without data to explore this association, it is possible that socioeconomic deprivation is a surrogate for higher BMI, higher parity and smoking, along with limited access and engagement with antenatal care.

Figure 27: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000) (excluding termination of pregnancy) by deprivation quintile (NZDep2006) (with 95% CIs) 2007–2010



Combined stillbirth and neonatal death rates have been presented for each antecedent cause (PDC) in Figure 27 by deprivation quintile. The aim of this analysis is to determine whether all antecedent causes of stillbirth and neonatal death are increased by increasing deprivation or whether there are some specific causes that increase with deprivation. There is a significant increasing trend in stillbirth and neonatal death due to all causes, other than specific perinatal conditions and perinatal infection, with increasing deprivation quintile.

It is not clear why there is also a significantly higher rate of stillbirth and neonatal death from congenital abnormality in quintile 1 compared to quintile 2.

Figure 28: Perinatal related death rates (per 1000) by DHB of residence (mother) compared to New Zealand perinatal related mortality (with 95% CIs) 2007–2010

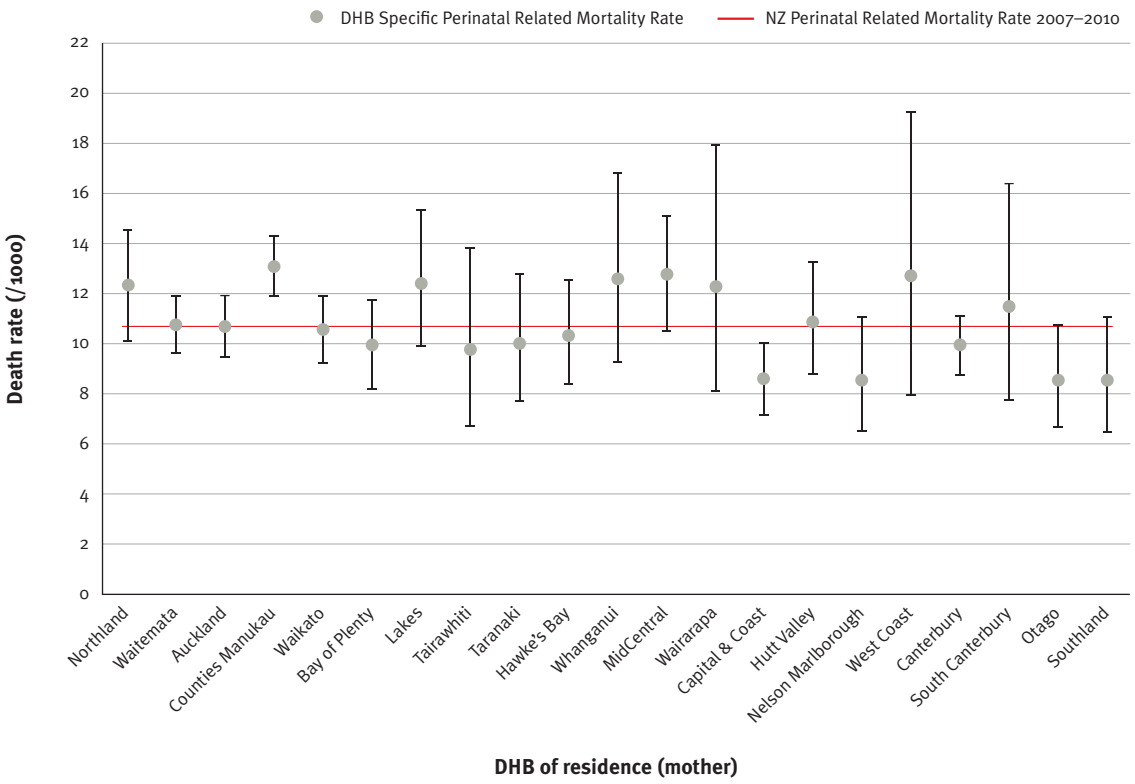


Figure 28 shows the rates of perinatal related mortality per 1000 total births by DHB of residence for 2007–2010. Four-year rates are presented in an attempt to reduce the fluctuations due to small numbers, which are apparent in one-year data.

The confidence intervals, represented by the error bars above and below the point estimate for each area, span the range of values that are consistent with the point estimate given the size of the population in the area. If these ranges do not include the national rate, represented by the horizontal line, the rate in that area was statistically significantly different from the national rate.

The four-year perinatal related mortality rate in the Counties Manukau DHB (CMDHB) region (13.1/1000 births) exceeded the national rate (10.8/1000 births), consistent with previous reports, although the rate in CMDHB in 2010 alone was 12.1/1000.

Demographic and socioeconomic characteristics vary by DHB, as shown in Section 1.4. Age, ethnicity and deprivation quintile-specific perinatal mortality rates were calculated for CMDHB compared to the remainder of the country for the combined years 2007–2010. Ethnicity and deprivation score (NZDep06) contributed to excess perinatal mortality in CMDHB but age did not. Therefore, a standardised perinatal related mortality rate, adjusted for ethnicity and deprivation, was calculated for CMDHB (10.9/1000 births) and for the rest of New Zealand (10.5/1000 births). This is an absolute difference of one perinatal related death per 2000 births. This standardised analysis shows that the excess of perinatal related mortality in the univariate analysis seen in CMDHB is explained by differences in the sociodemographic structure of the population.

What this means is that if CMDHB had the same ethnic and sociodemographic structure make up as the rest of the country, then the perinatal death rates are likely to be similar. Pacific and Maori mothers and socioeconomically deprived mothers in the remainder of the country are at similar risk as those mothers in CMDHB.

The higher proportion of vulnerable mothers among the birthing population in the CMDHB region compared to other regions is responsible for the significantly higher crude perinatal related mortality rate in CMDHB. Thus a reduction in crude perinatal related mortality rate might be achieved in the Counties Manukau region by addressing the social and health needs of Māori and Pacific and socioeconomically deprived mothers.

Independent associations between demographic variables and stillbirth

Multivariate analyses of the associations between ethnicity, age and socioeconomic status and stillbirth, published in the PMMRC 2008 report, showed that these demographic factors were all independently associated with stillbirth. Women under the age of 20 and over the age of 40, Pacific and Māori (sole ethnicity) women and women residing in areas with deprivation deciles of 8 or above all independently have an increased risk of stillbirth. Variables representing important risk factors, such as smoking, body mass index (BMI), access to care and medical complications of pregnancy, all of which have been associated with risk of perinatal death in other studies and may be confounding the associations seen in this analysis, were not able to be tested because of a lack of detailed information about all women who give birth in New Zealand. The New Zealand National Maternity Collection (MAT), compiled from LMC claims for payment and hospital discharge data and matched against the New Zealand BDM registration dataset for complete ascertainment of births, is currently unavailable for use by the mortality review committees. Once this dataset is made available, a more thorough analysis may be possible.

Multiple births

Table 14: Perinatal related death rates (per 1000) and multiple births 2010

			Fetal deaths											
	Total births		Termination of pregnancy			Stillbirths			Neonatal deaths			Perinatal related deaths		
	n=65,124		n=153			n=341			n=210			n=704		
Type of birth	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Singleton	63,228	97.1	144	94.1	2.28	306	89.7	4.84	174	82.9	2.77	624	88.6	9.87
Multiple[1]	1,896	2.9	9	5.9	4.75	35	10.3	18.46	36	17.1	19.44	80	11.4	42.19
Multiples (1/2 died)	-	-	7	4.6	-	11	3.2	-	12	5.7	-	30	4.3	-
Multiples (2/2 died)	-	-	2	1.3	-	23	6.7	-	23	11.0	-	48	6.8	-
Multiples (1/3 died)	-	-	-	-	-	1	0.3	-	1	0.5	-	2	0.3	-
Twin	1,842	2.8	9	5.9	4.89	34	10.0	18.46	35	16.7	19.00	78	11.1	42.35
Dichorionic diamniotic	-	-	1	0.7	-	13	3.8	-	21	10.0	-	35	5.0	-
Monochorionic diamniotic	-	-	5	3.3	-	15	4.4	-	12	5.7	-	32	4.5	-
Monoamniotic	-	-	2	1.3	-	5	1.5	-	-	-	-	7	1.0	-
Unknown	-	-	1	0.7	-	1	0.3	-	2	1.0	-	4	0.6	-

1 Multiple includes twins, triplets and higher order births

Among perinatal deaths in 2010, 11 percent were born in a multiple pregnancy. Babies born in multiple pregnancies had a perinatal related mortality rate of 42.2/1000, more than four times the rate of singletons. In twin pregnancies alone, the perinatal mortality rate was 42.4/1000.

It is known that twin babies who share a placenta (monochorionic) contribute disproportionately to twin deaths. These deaths generally occur as a result of communicating circulations in the placenta. A reduction in the occurrence of these deaths is expected as a result of the availability of laser therapy for twin–twin transfusion syndrome. In 2010, of 39 monochorionic multiple pregnancy deaths, 21 (54%) were due to twin–twin transfusion syndrome. The cause of death among monochorionic twins was twin–twin transfusion syndrome in 60 percent of perinatal related deaths from 2007–2010.

Early assessment of chorionicity (before 14 weeks) by ultrasound scan and early referral of monochorionic twins to tertiary care are critical to improving outcomes in monochorionic twins.

Multiple birth and infertility treatment (2007–2010)

Perinatal death among multiple births was strongly associated with use of in vitro fertilisation (IVF) and clomiphene therapy. Fifteen percent (41 of 271) of perinatal related deaths among babies from multiple pregnancies in 2007–2010 were conceived with IVF, follicle-stimulating hormone (FSH) therapy or clomiphene therapy compared to 3 percent in singleton pregnancies. This is a reflection of the increased rate of twinning following IVF and ovulation induction. Fertility treatment was more common among dichorionic diamniotic (DCDA) twins who died (21%) than among monochorionic diamniotic (MCDA) twins (12%). IVF alone was more common among DCDA twins (17%) than among MCDA twins (11%), suggesting that the increased rate of twinning following IVF is due to multiple embryo replacement, although this difference was not statistically significant (p=0.16).

Maternal body mass index (BMI)

Table 15: Maternal body mass index (BMI) among perinatal related deaths 2010

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=152		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Maternal BMI								
<18.50	2	1.3	6	1.8	9	4.3	17	2.4
18.50–24.99	74	48.4	127	37.2	68	32.4	269	38.2
25.00–29.99	32	20.9	84	24.6	54	25.7	170	24.1
30.00–34.99	15	9.8	42	12.3	37	17.6	94	13.4
35.00–39.99	11	7.2	30	8.8	20	9.5	61	8.7
≥40	2	1.3	25	7.3	8	3.8	35	5.0
Unknown	17	11.1	27	7.9	14	6.7	58	8.2

In 2010, BMI data were available for 92 percent of mothers of perinatal related deaths. At least half (51.2%) of the mothers of perinatal related deaths were overweight or obese, and 27.1 percent were obese (BMI >30) in 2010. There is a dose-dependent relationship between obesity and poor pregnancy outcomes, including perinatal death (Stacey 2011).

For the first time, there are preliminary maternity data available on the majority of mothers who gave birth in New Zealand in a year. These data are from the MAT (National Maternity Collection), a new initiative combining data from LMC claims for payment with hospital discharge data, and are as yet unpublished. The dataset does not include demographic and antenatal information (including ethnicity, smoking and BMI) on 15.9 percent of mothers in 2010 whose antenatal care was not provided by a community LMC. These mothers are cared for by hospital services or have no antenatal care. This deficiency in the data will result in an element of bias in the reporting of demographic variables, as mothers receiving care from hospital LMC services are more likely to be of lower socioeconomic status, to be Māori or Pacific, to book later in pregnancy, to smoke and to have a higher BMI. Given these limitations, the data need to be interpreted with caution. Nevertheless, this is the first time near complete national data have been collected and these data should provide the best available estimates of BMI and smoking rates in the maternity population of New Zealand.

The rate of overweight (BMI >25) at booking among women with data in the National Maternity Collection (MAT) in the years 2008, 2009 and 2010 was 50 percent. The rate of obesity (BMI >30) in the same years was 21–22 percent. This would suggest that there is an association between perinatal related death and overweight and obesity in New Zealand, although the data are currently incomplete for the whole population of women giving birth.

Appropriate weight gain in pregnancy

- Obesity is associated with increased risk in pregnancy.
- Excessive weight gain is associated with increased risk (regardless of baseline BMI) of gestational diabetes, large babies, Caesarean birth and possibly pre-eclampsia.

Best practice

- Calculate a BMI based on measured height and pre-pregnancy weight (or current if unknown).
- Advise pregnant women what a healthy weight gain in pregnancy is for them according to their pre-pregnancy or early pregnancy body mass index (see Institute of Medicine guidelines 2009 reproduced below).
- Weigh and record weight at each antenatal visit and give feedback to encourage success. Promote healthy eating and exercise.

Simple dietary advice for pregnant women

- You don't need to eat for two – the increased daily food requirement in pregnancy is equivalent to one slice of whole grain bread or two apples.
- Drink water rather than sweetened drinks, and eat fruit and vegetables.
- Cook meals at home and reduce the amount of white on the plate (rice, potatoes, bread).

Appropriate weight gain in pregnancy (Institute of Medicine of the National Academies 2009)

Prepregnancy BMI	Recommended weight gain in pregnancy (kg)	Appropriate rate of weight gain in second and third Trimester (kg/week)
Underweight (<18.5)	13–18	0.5 (0.5–0.6)
Normal weight (18.5–24.9)	11–16	0.5 (0.4–0.5)
Overweight (25–29.9)	7–11	0.3 (0.2–0.3)
Obese (>30)	5– 9	0.2 (0.2–0.3)

Addition 2017 – View resources: http://www.health.govt.nz/publication/guidance-healthy-weight-gain-pregnancy

Maternal smoking and drug use

Table 16: Maternal smoking at time of perinatal related death 2010

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Maternal smoking (current)								
Yes	25	16.3	118	34.6	61	29.0	204	29.0
No	123	80.4	220	64.5	143	68.1	486	69.0
Unknown	5	3.3	3	0.9	6	2.9	14	2.0

Smoking data at the time of perinatal death were available for all but 2 percent of mothers in 2010. Thirty-five percent of mothers of stillborn babies and 29 percent of mothers of babies who died after birth were recorded as smoking at the time of their baby's death. As smoking status can change during pregnancy, the PMMRC collects data on smoking in and prior to pregnancy. Thirty non-smokers at birth are recorded as having stopped smoking during pregnancy.

Smoking cessation support is a priority area for the Ministry of Health, and so these data are also collected for mothers of perinatal deaths. Unfortunately, smoking cessation support data are not provided in more than 50 percent of cases and so are not currently available for reporting. Given that smoking cessation is one of few known effective intervention strategies for stillbirth prevention, it is disappointing that these data are so frequently unavailable.

The rate of smoking at booking among women with data in the New Zealand National Maternity Collection (MAT) (see note under Maternal BMI on page 51) in the years 2008, 2009 and 2010 was 16 percent.

Australia's Mothers and Babies 2009 (AIHW National Perinatal Statistics Unit 2011) reported an average rate of 14.5 percent for smoking at any time during pregnancy from the states where data were collected. Smoking rates are strongly associated with maternal ethnicity (National Women's Hospital 2010, Morton 2010).

Published studies consistently demonstrate that smoking is associated with preterm and SGA birth, placental abruption, stillbirth and perinatal mortality.

Smoking cessation

All health professionals who provide care to pregnant women should offer smoking cessation advice.

- A = ask about smoking.
- B = brief advice to be smokefree.
- C = cessation support.

Nicotine replacement therapy can be offered to pregnant women – see *New Zealand Smoking Cessation Guidelines* (Ministry of Health 2007).

Women should be informed that stopping smoking before 15 weeks gestation is associated with outcomes similar to non-smokers (stillbirth, preterm birth and SGA).

Other drugs

Data were obtained on the use of alcohol and recreational drugs from 84 percent of mothers whose babies died in 2010. Alcohol was reportedly used by 8.8 percent of all mothers and marijuana by 3.4 percent. No other recreational drug was reportedly used by more than 1 percent of mothers.

Over the years 2007–2010, 232 women reportedly drank alcohol during pregnancy, and 110 reported using marijuana, although data were missing on 18 percent of mothers overall. There are no national data on alcohol consumption and marijuana use in pregnancy with which to compare these figures.

Both alcohol and marijuana were associated with perinatal death due to spontaneous preterm birth and death without obstetric antecedent – principally SIDS, postnatally acquired infection, accidents and SUDI deaths – when compared to mothers whose babies died who did not report alcohol or marijuana use. Women whose babies died and who reported alcohol and marijuana use were more likely to be Māori, smokers from socioeconomically deprived areas and under age 25. These factors are all also associated with perinatal death from spontaneous preterm birth and from SUDI. It may be that marijuana and alcohol use in pregnancy are underlying reasons why these social determinants are associated with perinatal death.

Gestation and birthweight

Table 17: Perinatal related death rates (per 1000) by gestation and birthweight 2010

	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gestation at birth														
20–23 weeks	248	0.4	106	69.3	*	107	31.4	*	80	38.1	*	293	41.6	*
24–27 weeks	298	0.5	28	18.3	93.96	44	12.9	147.65	33	15.7	146.02	105	14.9	352.35
28–31 weeks	551	0.8	6	3.9	10.89	32	9.4	58.08	14	6.7	27.29	52	7.4	94.37
32–36 weeks	4,116	6.3	9	5.9	2.19	67	19.6	16.28	26	12.4	6.44	102	14.5	24.78
37–40 weeks	47,992	73.7	4	2.6	0.08	77	22.6	1.60	45	21.4	0.94	126	17.9	2.63
≥41 weeks	11,890	18.3	-	-	-	14	4.1	1.18	12	5.7	1.01	26	3.7	2.19
Unknown	29	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Birthweight														
<500g	224	0.34	89	58.2	*	104	30.5	*	46	21.9	*	239	33.9	*
500–999g	323	0.50	46	30.1	142.41	54	15.8	167.18	65	31.0	291.48	165	23.4	510.84
1000–1499g	420	0.64	11	7.2	26.19	30	8.8	71.43	13	6.2	34.30	54	7.7	128.57
1500–1999g	782	1.20	3	2.0	3.84	32	9.4	40.92	11	5.2	14.73	46	6.5	58.82
2000–2499g	2,371	3.64	2	1.3	0.84	26	7.6	10.97	14	6.7	5.98	42	6.0	17.71
2500–2999g	8,665	13.31	1	0.7	0.12	36	10.6	4.15	15	7.1	1.74	52	7.4	6.00
3000–3499g	21,565	33.11	-	-	-	28	8.2	1.30	25	11.9	1.16	53	7.5	2.46
3500–3999g	20,863	32.04	-	-	-	22	6.5	1.05	15	7.1	0.72	37	5.3	1.77
4000–4499g	8,181	12.56	-	-	-	3	0.9	0.37	4	1.9	0.49	7	1.0	0.86
≥4500g	1,678	2.58	-	-	-	3	0.9	1.79	2	1.0	1.19	5	0.7	2.98
Unknown	52	0.08	1	0.7	19.23	3	0.9	-	-	-	-	4	0.6	-

* Denominator data unreliable where asterisk is present, and therefore rates have not been calculated

Table 17 provides estimates of mortality rates by gestation and birthweight. At the lower extremes of gestation and birthweight, denominator numbers are small. As the denominator set is registrations rather than births in the relevant year, the denominator is not an exact count of all births in the year. For this reason, perinatal related mortality rates at the lower extremes have not been reported.

Few babies born at 20–23 weeks or weighing under 500g survive. Some years, such as this, more babies appear to have died in the 20–23 week and <500g categories than were born. This is in part a consequence of the use of a numerator that is deaths in 2010 and a denominator compiled from birth registrations in 2010.

The majority of perinatal deaths occur in babies under 28 weeks and under 1000g. Perinatal death is uncommon after 31 weeks and above 1499g.

Table 18: Perinatal related death rates (per 1000)(or risks per 1,000 babies remaining in utero) by gestation and birthweight 2007–2010

	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Total perinatal related deaths		
	n=260,264		n=578			n=1,491			n=735			n=2,804		
	n	%	n	%	Rate	n	%	Risk[1]	n	%	Rate	n	%	Risk[1]
Gestation at birth														
20–23 weeks	1,010	0.4	440	76.1	*	425	28.5	1.63	236	32.1	*	1,101	39.3	4.23
24–27 weeks	1,162	0.4	88	15.2	75.73	203	13.6	0.78	128	17.4	146.96	419	14.9	1.61
28–31 weeks	2,191	0.8	23	4.0	10.50	159	10.7	0.62	57	7.8	28.37	239	8.5	0.92
32–36 weeks	16,033	6.2	22	3.8	1.37	246	16.5	0.96	93	12.7	5.90	361	12.9	1.39
37–40 weeks	191,359	73.5	5	0.9	0.03	386	25.9	1.61	164	22.3	0.86	555	19.8	2.13
≥41 weeks	48,326	18.6	-	-	-	70	4.7	1.44	57	7.8	1.18	127	4.5	0.49
Unknown	183	0.1	-	-	-	2	0.1	-	-	-	-	2	0.1	-
Birthweight								**Rate**						**Rate**
<500g	872	0.34	344	59.5	*	403	27.0	*	133	18.1	*	880	31.4	*
500–999g	1,297	0.50	185	32.0	142.64	278	18.6	214.34	227	30.9	272.18	690	24.6	532.00
1000–1499g	1,669	0.64	26	4.5	15.58	117	7.8	70.10	47	6.4	30.80	190	6.8	113.84
1500–1999g	3,171	1.22	14	2.4	4.42	115	7.7	36.27	38	5.2	12.49	167	6.0	52.66
2000–2499g	9,530	3.66	5	0.9	0.52	113	7.6	11.86	46	6.3	4.89	164	5.8	17.21
2500–2999g	34,640	13.31	1	0.2	0.03	162	10.9	4.68	58	7.9	1.68	221	7.9	6.38
3000–3499g	85,354	32.80	-	-	-	154	10.3	1.80	86	11.7	1.01	240	8.6	2.81
3500–3999g	83,546	32.10	-	-	-	80	5.4	0.96	57	7.8	0.68	137	4.9	1.64
4000–4499g	32,815	12.61	-	-	-	39	2.6	1.19	31	4.2	0.95	70	2.5	2.13
≥4500g	7,081	2.72	-	-	-	13	0.9	1.84	9	1.2	1.27	22	0.8	3.11
Unknown	289	0.11	3	0.5	-	17	1.1	-	3	0.4	-	23	0.8	-

* Denominator data unreliable where asterisk is present, and therefore rates have not been calculated

1 Risk of stillbirth or perinatal related mortality per 1,000 babies remaining in utero

Table 18 shows four-year data (2007–2010) for perinatal death rates by gestation and birthweight. Instead of calculating stillbirth and perinatal related death rate as a proportion of births at each gestational age grouping, in this table, risks of death are given as a proportion of pregnancies remaining in utero at each gestation. This provides an estimate of the risk of stillbirth or perinatal related death for a continuing pregnancy at that gestation.

These data show that the greatest risk to pregnancy is in the period from 20–23 weeks and again at term. There is no increase in risk of stillbirth or perinatal death for babies in utero at 41+ weeks compared to babies in utero at 37–40 weeks. This may be a reflection of current practice to induce post term.

There is, however, a significant increase in stillbirth, neonatal death and perinatal related mortality for babies with birthweight of 4000g or greater compared to babies with birthweight of 3500–3999g.

Obstetric antecedent and neonatal cause of death by gestational age

Table 19: Primary obstetric antecedent cause (PSANZ-PDC) of fetal death by gestational age 2007–2010

Perinatal death classification (PDC)	Total	20–23 weeks		24–27 weeks		28–31 weeks		32–36 weeks		37–40 weeks		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	607	413	68.0	85	14.0	37	6.1	36	5.9	29	4.8	7	1.2
Perinatal infection	72	21	29.2	11	15.3	7	9.7	8	11.1	18	25.0	7	9.7
Hypertension	78	10	12.8	22	28.2	17	21.8	15	19.2	12	15.4	2	2.6
Antepartum haemorrhage	198	105	53.0	15	7.6	15	7.6	23	11.6	38	19.2	2	1.0
Maternal conditions	103[1]	35	34.0	17	16.5	8	7.8	14	13.6	26	25.2	2	1.9
Specific perinatal conditions	209	70	33.5	33	15.8	21	10.0	37	17.7	46	22.0	2	1.0
Hypoxic peripartum death	50	-	-	-	-	-	-	2	4.0	36	72.0	12	24.0
Fetal growth restriction	191	20	10.5	37	19.4	30	15.7	48	25.1	44	23.0	12	6.3
Spontaneous preterm	180[1]	132	73.3	31	17.2	9	5.0	7	3.9	-	-	-	-
Unexplained antepartum death	381	59	15.5	40	10.5	38	10.0	78	20.5	142	37.3	24	6.3
Total	**2,069**	**865**	**41.8**	**291**	**14.1**	**182**	**8.8**	**268**	**13.0**	**391**	**18.9**	**70**	**3.4**

1 Gestation of two babies unknown

Table 19 and Table 20 include 2007–2010 (four-year) data in this report. This provides more stable estimates of the association between PDC and gestation at perinatal related death. Because congenital abnormality most often results in fetal death following termination of pregnancy, these cases predominate among deaths before 24 weeks.

Unexplained stillbirth most commonly occurs near term, accounting for 36 percent of stillbirths at 37–40 weeks.

In the four years 2007–2010, 9 percent of fetal deaths were assigned spontaneous preterm birth as primary obstetric antecedent cause of death. Three-quarters of these deaths occurred before 24 weeks.

Table 20: Primary obstetric antecedent cause (PSANZ-PDC) of neonatal death by gestational age 2007–2010

Perinatal death classification (PDC)	Total	20–23 weeks		24–27 weeks		28–31 weeks		32–36 weeks		37–40 weeks		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	167	1	0.6	3	1.8	30	18.0	53	31.7	58	34.7	22	13.2
Perinatal infection	34	13	38.2	4	11.8	2	5.9	3	8.8	7	20.6	5	14.7
Hypertension	17	1	5.9	10	58.8	4	23.5	2	11.8	-	-	-	-
Antepartum haemorrhage	83	53	63.9	13	15.7	4	4.8	8	9.6	4	4.8	1	1.2
Maternal conditions	16	2	12.5	4	25.0	2	12.5	2	12.5	5	31.3	1	6.3
Specific perinatal conditions	62	32	51.6	12	19.4	1	1.6	8	12.9	8	12.9	1	1.6
Hypoxic peripartum death	64	-	-	-	-	-	-	2	3.1	44	68.8	18	28.1
Fetal growth restriction	17	1	5.9	3	17.6	3	17.6	2	11.8	6	35.3	2	11.8
Spontaneous preterm	233	133	57.1	79	33.9	11	4.7	10	4.3	-	-	-	-
No obstetric antecedent	42	-	-	-	-	-	-	3	7.1	32	76.2	7	16.7
Total	**735**	**236**	**32.1**	**128**	**17.4**	**57**	**7.8**	**93**	**12.7**	**164**	**22.3**	**57**	**7.8**

Spontaneous preterm birth is the most assigned obstetric cause of neonatal death, identified in almost a third of cases.

In contrast to fetal death, where congenital abnormality occurs at early gestations associated with termination of pregnancy, congenital abnormality is a common cause of neonatal death among babies born at or near term. Congenital abnormality and hypoxic peripartum death were the most common causes of neonatal death at term, responsible for 36 percent and 28 percent respectively over the four years 2007–2010. Hypertension, other maternal conditions and fetal growth restriction are uncommon obstetric antecedent causes of neonatal death.

Table 21: Primary neonatal cause (PSANZ-NDC) of neonatal death by gestational age 2007–2010

Primary neonatal cause of death classification (NDC)	Total	20–23 weeks		24–27 weeks		28–31 weeks		32–36 weeks		37–40 weeks		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	170	1	0.6	3	1.8	30	17.6	54	31.8	60	35.3	22	12.9
Extreme prematurity	249	221	88.8	27	10.8	1	0.4	-	-	-	-	-	-
Cardio-respiratory disorders	51	7	13.7	38	74.5	4	7.8	1	2.0	1	2.0	-	-
Infection	66	4	6.1	23	34.8	11	16.7	10	15.2	12	18.2	6	9.1
Neurological	131	3	2.3	18	13.7	8	6.1	18	13.7	61	46.6	23	17.6
Gastrointestinal	16	-	-	11	68.8	3	18.8	1	6.3	1	6.3	-	-
Other	52	-	-	8	15.4	-	-	9	17.3	29	55.8	6	11.5
Total	**735**	**236**	**32.1**	**128**	**17.4**	**57**	**7.8**	**93**	**12.7**	**164**	**22.3**	**57**	**7.8**

Spontaneous preterm birth or extreme prematurity predominate as obstetric/neonatal causes of death in neonates. Eighty-nine percent of these deaths from prematurity are in babies born before 24 weeks gestation.

At gestations of 24 weeks or later, congenital abnormality and neurological conditions predominate. Of the 131 neonates dying of neurological disorders in the four years from 2007–2010, 109 (83%) died from hypoxic ischaemic encephalopathy.

Maternity care

Antenatal caregiver

Table 22: Perinatal related deaths and maternal booking status 2010

Was the mother booked with a Lead Maternity Carer?	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Total perinatal related deaths	
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Yes	148	96.7	321	94.1	195	92.9	664	94.3
Self employed Midwife	95	62.1	234	68.6	132	62.9	461	65.5
Hospital	30	19.6	66	19.4	48	22.9	144	20.5
General Practitioner	9	5.9	11	3.2	7	3.3	27	3.8
Obstetrician (private)	14	9.2	10	2.9	8	3.8	32	4.5
No	4	2.6	19	5.6	14	6.7	37	5.3
Unknown	1	0.7	1	0.3	1	0.5	3	0.4

Ninety-four percent of mothers were booked with an LMC prior to their baby's death. Sixty-six percent booked with a self-employed midwife, 4 percent with a general practitioner, 5 percent with a private obstetrician and 21 percent with hospital-based LMC services. The MAT dataset 2010 records 84.1 percent of mothers booked with a private/community LMC and 15.9 percent with a hospital/DHB LMC or no LMC.

It is not clear from the perinatal mortality data reported what the timing was of the first antenatal visit (missing for 33% of women in 2010) and the total numbers of visits (missing for 39% of women in 2010), as these data are poorly collected.

Table 23: Lead maternity carer at booking and birth among stillbirths and neonatal deaths 2010

Lead Maternity Carer at Booking	Lead Maternity Carer at birth											
	Total		Self employed Midwife		Hospital		General Practitioner		Obstetrician (private)		Unknown	
	n=516		n=187		n=314		n=2		n=11		n=2	
	n	%	n	%	n	%	n	%	n	%	n	%
Self employed Midwife	366	70.9	184	50.3	180	49.2	-	-	-	-	2	0.5
Hospital	114	22.1	2	1.8	112	98.2	-	-	-	-	-	-
General Practitioner	18	3.5	1	5.6	15	83.3	2	11.1	-	-	-	-
Obstetrician (private)	18	3.5	-	-	7	38.9	-	-	11	61.1	-	-
Total	**516**		**187**	**36.2**	**314**	**60.9**	**2**	**0.4**	**11**	**2.1**	**2**	**0.4**

In 2010, among the women booked with an LMC at the time of their baby's death, 71 percent were first booked with a self-employed midwife, 22 percent under a hospital midwife, clinic or obstetrician, 4 percent with a general practitioner and 4 percent with a private obstetrician. At birth, 61 percent were booked with a hospital service, 36 percent with a self-employed midwife and 2 percent with a private obstetrician.

Screening for diabetes in pregnancy

Table 24: Screening for diabetes among booked women with no pre-existing diabetes and where perinatal death occurred at or beyond 28 weeks gestation 2010

Screened For Diabetes	n=265	
	n	%
Yes	179	67.5
No	49	18.5
Unknown	37	14.0

Screening for diabetes in pregnancy is recommended for all women between 24 and 28 weeks by the Ministry, the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) and the New Zealand College of Midwives (NZCOM). In 2010, 19 percent of mothers of babies who died were not screened for diabetes between 24 and 28 weeks pregnancy. The rate of screening did not vary between self-employed midwives and hospital clinic LMCs.

A lack of screening could mask a higher rate of mortality due to diabetes.

Screening for family violence in pregnancy

Table 25: Perinatal related deaths and screening for family violence 2010

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Experienced family violence								
Yes	3	2.0	22	6.5	6	2.9	31	4.4
No	69	45.1	140	41.1	73	34.8	282	40.1
Not asked	39	25.5	75	22.0	34	16.2	148	21.0
Unknown	42	27.5	104	30.5	97	46.2	243	34.5
Referral to relevant support								
Yes	1	33.3	13	59.1	5	83.3	19	61.3
No	1	33.3	3	13.6	-	-	4	12.9
Unknown	1	33.3	6	27.3	1	16.7	8	25.8

In 2002, the Ministry published national guidelines for family violence interventions (Ministry of Health 2002).

Data on screening for family violence are not well reported to the PMMRC. More than 30 percent of the data again in 2010 were missing or reported as unknown.

There were 31 disclosures of family violence among mothers of perinatal related deaths in 2010, and of these, 61 percent are known to have been referred for support.

Vaginal bleeding in pregnancy

Table 26: Perinatal related deaths and vaginal bleeding during pregnancy 2010

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Yes	16	10.5	112	32.8	85	40.5	213	30.3
No	111	72.5	193	56.6	102	48.6	406	57.7
Unknown	26	17.0	36	10.6	23	11.0	85	12.1
Gestation[1]								
< 20 weeks	15	9.8	58	17.0	35	16.7	108	15.3
≥ 20 weeks	3	2.0	91	26.7	73	34.8	167	23.7

1 Multiple bleeds can occur in pregnancy and can occur both before and after 20 weeks

Bleeding at or beyond 20 weeks was reported in at least 27 percent of stillbirths and 35 percent of neonatal deaths.

Forty-four percent of babies who died in 2010 following spontaneous preterm birth had a history of bleeding at or after 20 weeks.

Antenatal corticosteroids

Among neonatal deaths of babies born between 24 and 32 weeks gestation, corticosteroids were given to 37 of 47 babies (79%). Among deaths of babies born from 20–23 weeks gestation, a further 10 of 80 babies also received antenatal corticosteroids.

Antenatal identification of small for gestational age (SGA) infants

Table 27: Perinatal related deaths and small for gestational age (SGA) 2010

All perinatal deaths	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
SGA[1]	86	56.2	185	54.3	80	38.1	351	49.9
Perinatal deaths ≥24 weeks	**n=47**		**n=234**		**n=130**		**n=411**	
SGA[1]	16	34.0	106	45.3	40	30.8	162	39.4
Perinatal deaths ≥24 weeks; excluding lethal congenital abnormality	**n=13**		**n=203**		**n=84**		**n=300**	
SGA[1]	7	53.8	88	43.3	20	23.8	115	38.3

1 SGA: birthweight less than 10th customised centile

Customised birthweight centiles adjust for gender, gestation, ethnicity, maternal age, parity and BMI. SGA has been defined as a customised birthweight less than the 10th centile.

SGA was evident in 38 percent of perinatal related deaths at 24 weeks or beyond overall and specifically in 43 percent of stillborn babies and 24 percent of neonates whose deaths were not due to congenital abnormality. This is significantly more frequent than the expected rate of 10 percent in the population and is a consistent finding across the four years the PMMRC has been collecting data.

Table 28: Antenatal diagnosis of small for gestational age (SGA) among stillbirths and neonatal deaths at 24 weeks gestation or more excluding congenital abnormalities 2007–2010

	Total	Suspected growth restriction									
		No		Yes and confirmed by scan		Yes but normal growth on scan		Yes but no scan performed		Unknown	
		n	%	n	%	n	%	n	%	n	%
SGA Stillbirths	419	219	52.3	101	24.1	23	5.5	15	3.6	61	14.6
SGA Neonatal deaths	86	27	31.4	39	45.3	4	4.7	2	2.3	14	16.3

Twenty-four percent of SGA stillborn babies and 45 percent of SGA neonatal deaths born at 24 weeks or beyond who did not die of congenital abnormality were suspected to be SGA antenatally, and this was confirmed by scan before birth. Only a few babies suspected to be growth restricted did not have a scan before birth. However, SGA was not suspected in the antenatal period in 52 percent of stillborn SGA babies and 31 percent of SGA neonatal deaths of normally formed babies at 24 weeks or more over the four years 2007–2010. (Status was unknown in about 15 percent of both SGA stillbirths and SGA neonatal deaths.)

Of the 101 stillbirths with antenatally confirmed SGA, the PDC was growth restriction in 39 (growth restriction was an associated condition in a further 25 cases), hypertension in 18, specific perinatal conditions in 16, unexplained antepartum death in nine, perinatal infection in eight, maternal conditions in six, antepartum haemorrhage in three and spontaneous preterm in two. Twenty-five of these stillbirths were from multiple pregnancies. Fifty (50%) of these stillbirths were at least 30 weeks gestation at birth. Almost 80 percent of the 101 SGA stillbirths diagnosed antenatally had a customised birthweight centile of 0 or 1st centile. These findings suggest that fetal surveillance and decision making following the antenatal diagnosis of growth restriction could be improved.

Management of small for gestational age (SGA) pregnancies

Height and weight should be measured at the first antenatal visit and a customised growth chart GROW (www.gestation.net) used to record fundal height to improve the recognition of SGA infants.

When using GROW, the woman needs to be offered a referral for ultrasound assessment if:

- the first fundal-symphysis height measurement plots below 10th centile line on the customised chart
- based on consecutive measurements, growth is static (flat) or there is concern about it being slow
- growth does not follow the slope of the curves on the chart or growth declines through a centile line.

Following ultrasound assessment, the estimated fetal weight is plotted on the customised growth chart.

- If it is normal, revert to serial fundal-symphysis height measurement.
- If it is abnormal, refer for urgent obstetric review as per the maternity referral guidelines (Ministry of Health 2012a).
- If SGA is confirmed by ultrasound at term, timely delivery is recommended.

Note that women at high risk of SGA (such as previous SGA) need serial scans.

Amended from New Zealand College of Midwives Consensus Statement: Assessment of fetal wellbeing during pregnancy (NZCOM 2012).

Table 29: Intended place of birth versus actual place of birth among stillbirths and neonatal deaths 2010

Intended place of birth	Total	Actual place of birth													
		Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3		Other		Unknown	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home	12	2	16.7	-	-	-	-	5	41.7	4	33.3	-	-	1	8.3
Birthing unit	32	-	-	3	9.4	-	-	4	12.5	22	68.8	3	9.4	-	-
Hospital level 1	33	-	-	-	-	4	12.1	15	45.5	11	33.3	3	9.1	-	-
Hospital level 2	199	4	2.0	1	0.5	-	-	154	77.4	38	19.1	2	1.0	-	-
Hospital level 3	238	1	0.4	-	-	1	0.4	1	0.4	233	97.9	1	0.4	1	0.4
Other	2	-	-	-	-	-	-	1	50.0	1	50.0	-	-	-	-
Unknown	35	5	14.3	-	-	-	-	8	22.9	20	57.1	1	2.9	1	2.9
Total	**551**	**12**	**2.2**	**4**	**0.7**	**5**	**0.9**	**188**	**34.1**	**329**	**59.7**	**10**	**1.8**	**3**	**0.5**

Transfer from an intended to an actual place of birth was common among stillbirths and neonatal deaths. These transfers were generally from intended birth at home, birthing unit, or level 1 hospital to level 2 or 3 hospital facility.

In 2010, 19 (9%) neonatal deaths were transferred in labour. Eleven neonatal deaths (5%) were transferred in labour to a level 3 hospital facility. In seven cases, the obstetric antecedent cause of death was spontaneous preterm birth. Antecedent cause of death in the remainder of cases was congenital abnormality, maternal condition, specific perinatal condition and fetal growth restriction.

Overall, six stillborn babies and six babies who died in the first month of life were born at home (1.7% of perinatal related deaths). Two of these were intended births at home. Of the 10 unintended home births, the antecedent causes of death were perinatal infection, antepartum haemorrhage, maternal conditions and unexplained antepartum death.

According to unpublished data from the New Zealand National Maternity Collection (MAT) (see note under Maternal BMI on page 51), 3.2 percent of babies born in 2010 were intended home births.

Maternal outcome

The table below reports the outcome of the mothers whose babies died in the perinatal period.

Table 30: Perinatal related deaths and maternal outcome 2010

Maternal outcome	Fetal deaths				Neonatal deaths		Total perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Alive and generally well	153	100.0	336	98.5	207	98.6	696	98.9
Alive but with serious morbidity	-	-	3	0.9	3	1.4	6	0.9
Dead	-	-	2	0.6	-	-	2	0.3

There were two maternal mortalities due to motor vehicle accidents associated with perinatal mortality in 2010, and these are discussed in more detail in Section 2. There were six serious morbidities among mothers whose babies died, related to sepsis, obstetric haemorrhage and maternal medical conditions.

Investigation of perinatal deaths

Table 31: Perinatal related deaths and completeness of perinatal investigations 2010

Perinatal death investigation	Fetal deaths				Neonatal deaths		Total perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Optimum PM/Karyotype completed[1]	96	62.7	139	40.8	80	38.1	315	44.7
Post-mortem	57	37.3	127	37.2	70	33.3	254	36.1
Karyotype	42	27.5	17	5.0	11	5.2	70	9.9
Partial investigations only[2]	49	32.0	144	42.2	99	47.1	292	41.5
No investigation[3]	8	5.2	58	17.0	31	14.8	97	13.8

1 Optimal investigation or post mortem was defined as karyotype confirming congenital abnormality or fully completed post mortem
2 No post-mortem; investigations may have included placental pathology, MRI, ultrasound scan or x-ray
3 No post-mortem, placental pathology, MRI, ultrasound scan or x-ray

Overall, 45 percent of perinatal related deaths were optimally investigated in 2010. Optimal investigation was defined as a post-mortem or a karyotype alone where it confirmed the diagnosis for a chromosomal abnormality. A post-mortem was performed in 36 percent of perinatal related deaths in 2010.

The rate of optimal investigation was 36 percent in 2006, 46 percent in 2007, 49 percent in 2008 and 41 percent in 2009.

Data have been pooled for 2007–2010 to look at the rates of optimal investigation of perinatal death by DHB of residence. As was seen in individual years' data, there was considerable variation in the rate of optimal investigation by DHBs of residence (Table 59). In DHB areas where lower rates of optimal investigation were evident, a post-mortem was offered in the majority of cases, with the lowest rate at 70 percent of all perinatal related deaths.

Table 32: Perinatal related deaths and rate of offer and decline of post-mortem examination 2010

Post-mortem examination offered	Fetal deaths				Neonatal deaths		Total perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Post-moterm offered and parental consent given	57	37.3	127	37.2	70	33.3	254	36.1
Post-mortem offered and parents declined	73	47.7	182	53.4	101	48.1	356	50.6
Post-mortem not offered	18	11.8	18	5.3	25	11.9	61	8.7
Unknown	5	3.3	14	4.1	14	6.7	33	4.7

Rates of offer and decline of a post-mortem are fairly consistent across the years. In 2010, a post-mortem was offered to 87 percent of parents. A post-mortem was declined following request in 51 percent of cases overall. A post-mortem was apparently not offered in 9 percent of perinatal related deaths (5% of stillbirths and 12% of neonatal deaths).

In their 2009 report, CMACE recorded a drop in the rate of post-mortem following stillbirth from 55 percent in 2000 to 45 percent in 2009 and following neonatal deaths from 29 percent in 2000 to 18 percent in 2009. In the United Kingdom in 2009, a post-mortem was not offered following 3 percent of stillbirths and 13 percent of neonatal deaths.

The proportion of parents who were offered a post-mortem did not vary significantly by ethnicity in 2010 as in previous years. However, there was a significant difference in the proportion of those offered who consented by ethnicity in 2010. In 2010, 70 percent of Māori parents offered a post-mortem declined, 62 percent of Pacific peoples, 56 percent Other Asian, 53 percent Indian, 52 percent New Zealand European and 48 percent Other.

From 2007–2010, data on the usefulness of post-mortems performed (as assessed by the PMMRC local coordinators) were collected in three-quarters of cases. Among the 75 percent of post-mortems where an assessment was made, the post-mortem changed the clinical diagnosis in 31 percent of cases, resulting in altered counselling to parents for future pregnancies. In 57 percent of cases, there was no change in diagnosis, and the post-mortem did not change the advice given to parents. In 7 percent of cases, further information was gained, but this did not change the clinical diagnosis. In a further 4 percent of cases, the post-mortem did not demonstrate an obvious cause of death or significant abnormality.

1.7 Contributory factors and potential avoidability in perinatal related deaths

Table 33: Contributory factors and potential avoidability in perinatal related deaths 2010

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=153		n=341		n=210		n=704	
	n	%	n	%	n	%	n	%
Contributory factors								
Present	13	8.5	106	31.1	73	34.8	192	27.3
Absent	139	90.8	227	66.6	131	62.4	497	70.6
Missing data	1	0.7	8	2.3	6	2.9	15	2.1
Potential avoidability								
Yes	4	2.6	70	20.5	50	23.8	124	17.6
Contributory factors present but not potentially avoidable	9	5.9	36	10.6	21	10.0	66	9.4
Contributory factors present but avoidability unknown	-	-	-	-	2	1.0	2	0.3

Again in 2010, the PMMRC data collection included information on assessment by local perinatal mortality review committees of factors that may have contributed to the perinatal death. If there were contributory factors, the local reviewing committee was asked to assess whether the perinatal death was potentially avoidable. A description of the process for assessment of contributory factors and potential avoidability is included in section 1.2, and the tool used is included as Appendix D.

The contributory factors the committees were asked to consider are listed in Table 34. Each group of factors includes a list of sub-factors. Assignment of factors was not mutually exclusive either across factors or within a factor. In some cases, more than one factor was identified. Contributory factors and potential avoidability were assessed for all but 15 perinatal related deaths (2.1%) in 2010 (compared to 82 (11.4%) in 2009). Contributory factors were reported in 27.3 percent of perinatal related deaths in 2010. This is 27.9 percent of cases assessed in 2010 compared to 26.5 percent of cases assessed in 2009. In 2010, 17.6 percent of perinatal related deaths were thought to be potentially avoidable at local review (18% of assessed cases) compared to 13.6 percent in 2009 (15.4% of cases assessed). As the apparent increase in potential avoidability from 2009 to 2010 is not statistically significant (p=0.2), the two years of data have been combined in later analyses.

Table 34: Detail of contributory factors among perinatal related deaths 2010

Contributory factors present?	n=704	
	n	%
	192	**27.3**
Organisational/management factors	**28**	**4.0**
Poor organisational arrangements of staff	2	
Inadequate education and training	4	
Lack of policies, protocols or guidelines	3	
Inadequate numbers of staff	3	
Poor access to senior clinical staff	4	
Failure or delay in emergency response	5	
Delay in procedure eg, caesarean section	8	
Delay access to test results or inaccurate results	1	
Other	9	
Not stated	-	
Personnel factors	**48**	**6.8**
Knowledge and skills of staff were lacking	12	
Delayed emergency response by staff	4	
Failure to maintain competence	1	
Communication between staff was inadequate	7	
Failure to seek help/supervision	5	
Failure to follow recommended best practice	21	
Other	9	
Not stated	1	
Technology and Equipment factors	**3**	**0.4**
Essential equipment not available	1	
Lack of maintenance of equipment	1	
Malfunction/failure of equipment	1	
Failure/lack of information technology	-	
Other	2	
Not stated	-	
Environmental factors	**14**	**2.0**
Geography	9	
Building and design functionality limited clinical response	-	
Other	5	
Not stated	-	

Barriers to access or engagement with care	**135**	**19.2**
Substance use	16	
Family violence	7	
Lack of recognition of complexity or seriousness of condition	23	
Maternal mental illness	9	
Cultural barriers	4	
Language barriers	6	
Not eligible to access free care	2	
Other	84	
Not stated	8	

The distribution of contributory factors was very similar in 2010 to 2009, with barriers to access or engagement with care the most common (19%), followed by personnel factors (7%) and organisational and management factors (4%). Technology, equipment and environmental factors were all uncommonly identified. The most frequently noted factors under 'other' barriers to access or engagement with care were no antenatal care, late booking with antenatal care, non-attendance at antenatal visits and not following advice or treatment.

It was not possible within the current database structure to identify which contributory factor(s) might have meant the death was potentially avoidable. However, among the 48 deaths with personnel contributory factors, 40 (83%) were assessed as potentially avoidable. Among the 135 deaths with barriers identified, 80 (59%) were potentially avoidable. Deaths with organisational and management factors were potentially avoidable in 71 percent of cases.

The data collection tool has now been modified to include, as sub-factors, frequently noted factors under barriers to access or engagement with care 'other', and to identify which contributory factor(s) might have meant the death was potentially avoidable.

Figure 29: Contributory factors and potential avoidability among perinatal related deaths by perinatal death classification (PSANZ-PDC) 2010

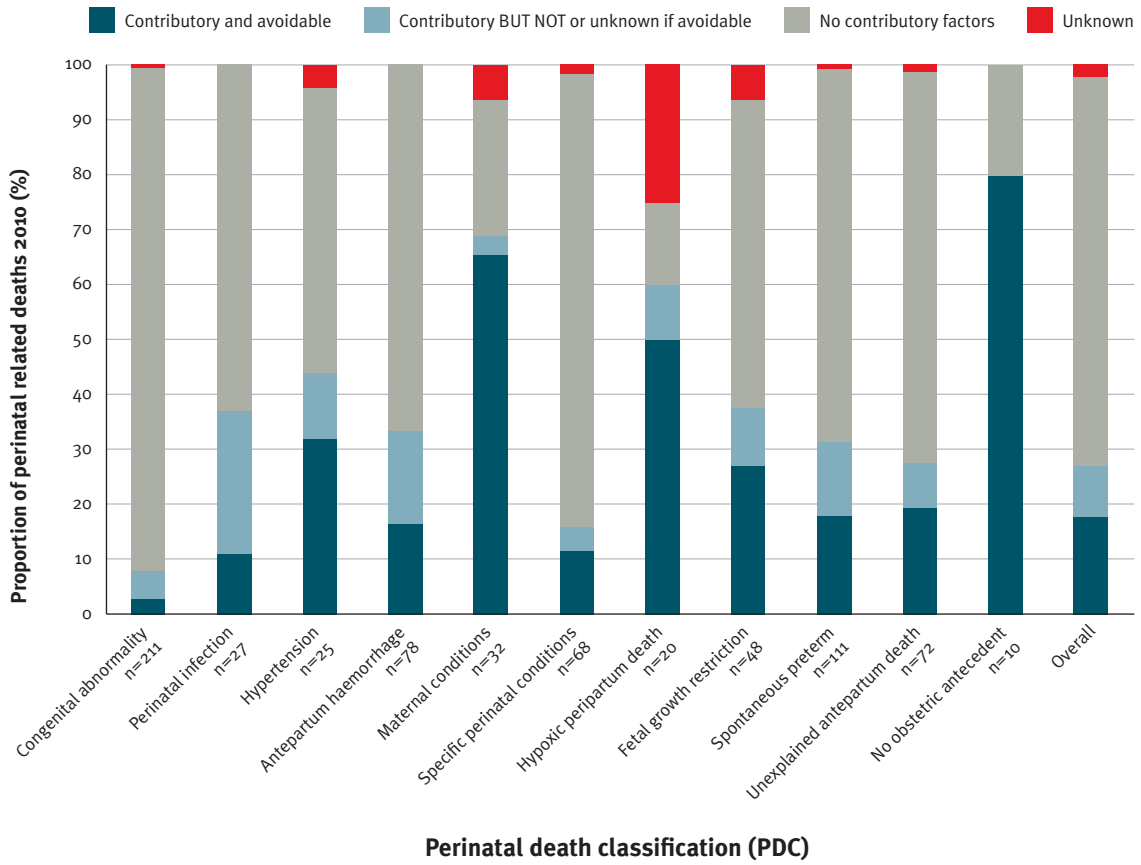


Figure 29 shows the proportion of perinatal related deaths where contributory factors were present (dark and pale blue bars), whether the death was potentially avoidable (dark blue bars) or whether there were no contributory factors identified (grey bars) or data were unavailable (red bars) by PDC. While numbers within each PDC category are small, the frequencies of contributory factors and of potential avoidability are very similar to 2009, supporting the validity of these findings. These data may therefore be useful in directing quality improvement.

Figure 30: Absolute numbers of perinatal related deaths with contributory factors by perinatal death classification (PSANZ-PDC) 2010

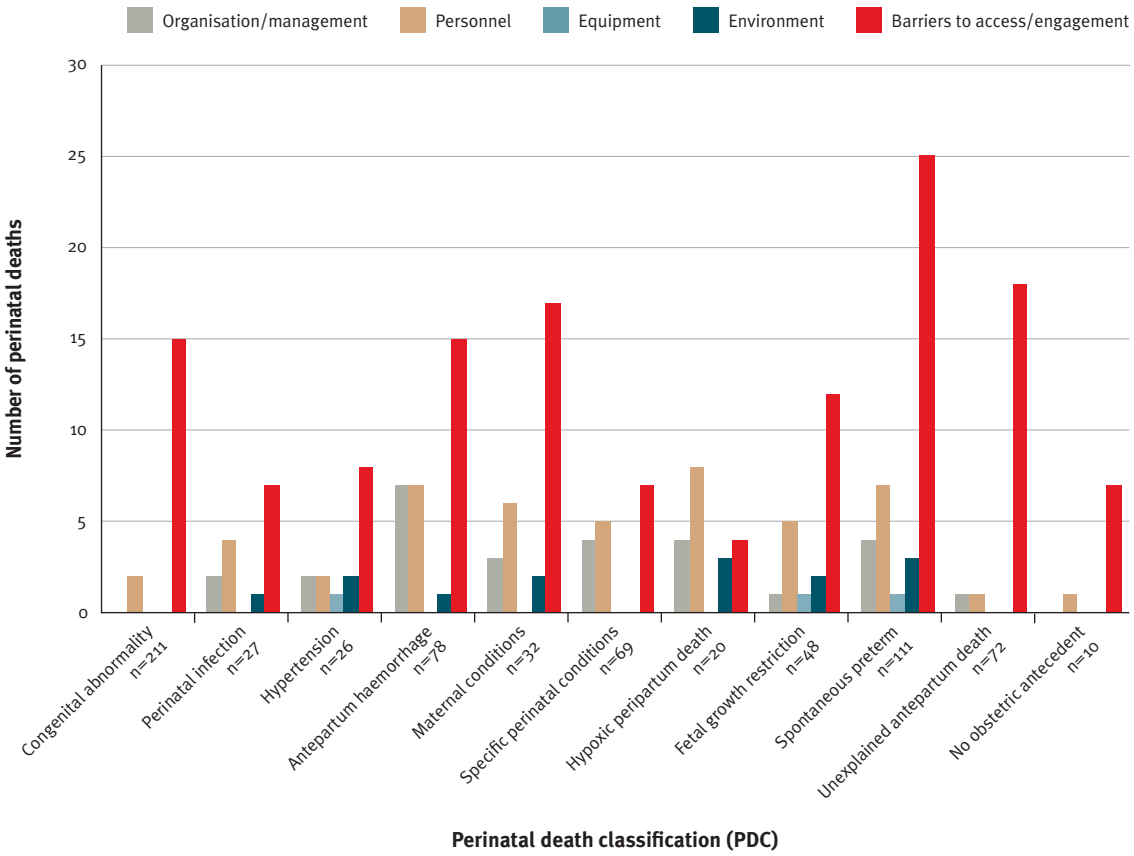


Figure 30 shows absolute numbers of deaths associated with particular contributory factors by primary antecedent cause of death. It is apparent that barriers to access and engagement with care are the most common contributory factor numerically, with the greatest potential impact on deaths from congenital abnormality, antepartum haemorrhage, maternal conditions, spontaneous preterm birth and unexplained antepartum death. Access and engagement with maternity care has been overwhelmingly identified as the major contributory factor in perinatal related death in New Zealand and, as such, needs to be the focus of quality improvement in maternity care.

In 2010, barriers to access and engagement with care were identified in 135 cases. However, in 84 instances, the options listed in the data collection tool did not cover the specific issue. The data collection tool will be amended for 2012 in an attempt to collect better information on this important issue.

Figure 31: Contributory factors and potential avoidability by maternal ethnicity (prioritised) (95% CIs surround the estimate of proportion of cases within each ethnicity where death was potentially avoidable) 2009 and 2010

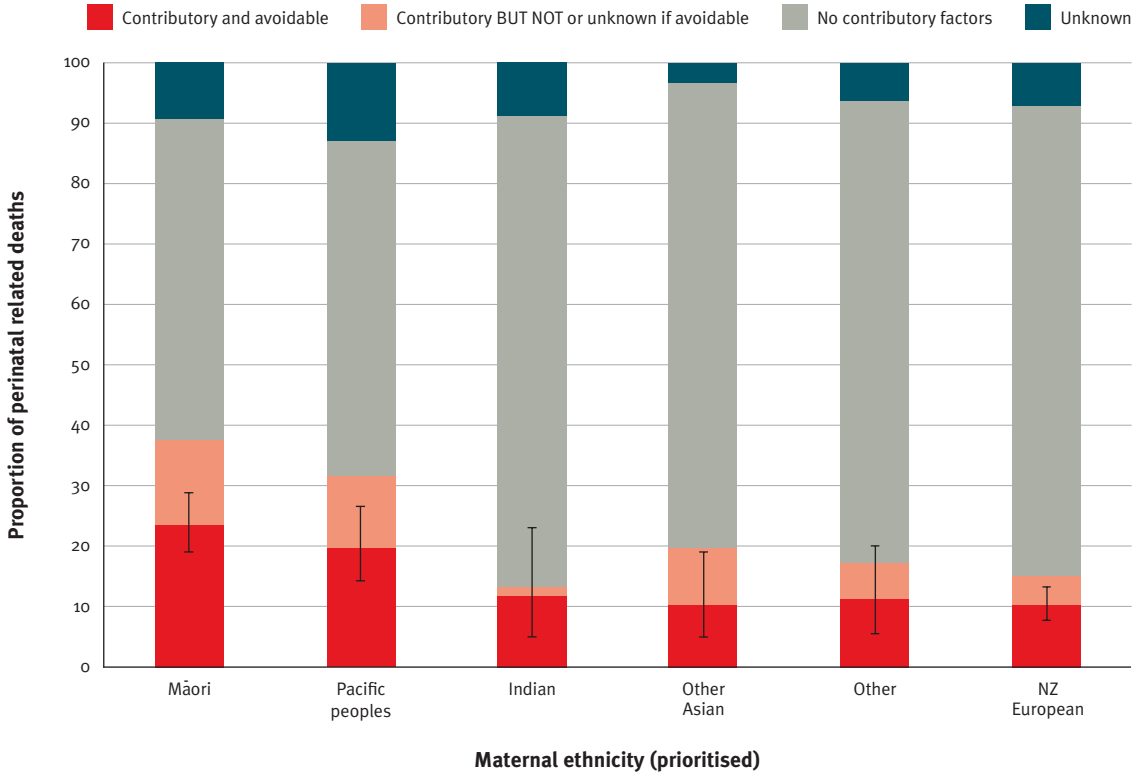


Figure 32: Proportion of perinatal related deaths associated with specific contributory factors by maternal ethnicity (prioritised) 2009 and 2010

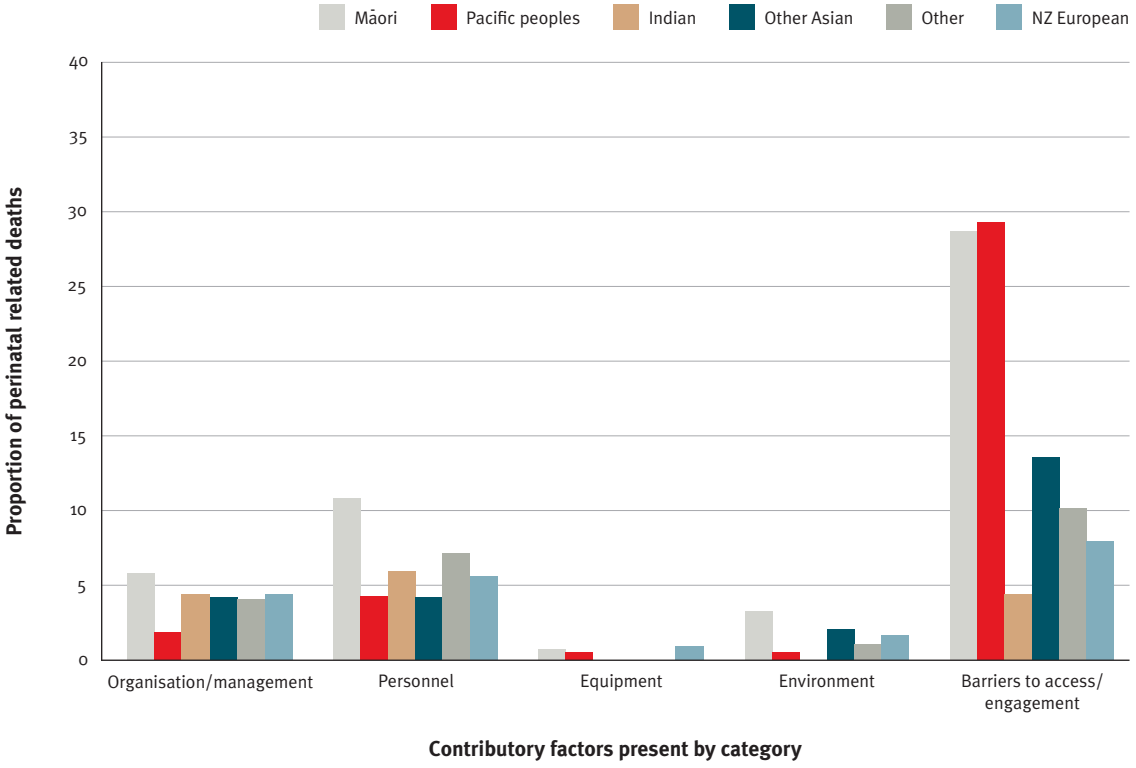


Figure 31 and Figure 32 include data from 2009 and 2010. Figure 31 explores whether contributory factors and potential avoidability vary by maternal (prioritised) ethnicity. Ninety-five percent confidence intervals surround the estimate of potentially avoidable perinatal related deaths. The estimates of potential avoidability are highest for Māori mothers (24%) and Pacific mothers (20%) and are significantly higher than the estimate for New Zealand European (10%).

Figure 32 shows the proportion of deaths in each maternal ethnic group associated with each type of contributory factor for 2009 and 2010 combined. Thirty percent of perinatal related deaths among Māori and Pacific mothers were noted to have access and/or engagement with care as a contributory factor, although it is not known from the current data how many of these deaths were potentially avoidable.

Recommendations 2010: Perinatal related mortality

- **Small for gestational age**
  - If SGA is confirmed by ultrasound at term, timely delivery is recommended.
- **Maternal gestational weight gain**
  - Pregnant women should be given an indication of ideal weight gain in pregnancy according to their body mass index (see page 51).
- **Smoking cessation**
  - All health professionals who provide care to pregnant women should offer smoking-cessation advice.

2. NEW ZEALAND MATERNAL MORTALITY 2006–2010

2.1 Introduction

The terms of reference of the PMMRC require the committee to review 'direct' maternal deaths. A Maternal Mortality Review Working Group (MMRWG) was established in 2006 to develop a process for the national collection of data relating to maternal deaths. The group's aim is to review maternal deaths and identify potentially avoidable causes, with the expectation that this will lead to improvements in care.

The MMRWG is chaired by Alastair Haslam (obstetrician and gynaecologist.) Other members of the working group are Cynthia Farquhar (PMMRC Chair, obstetrician, gynaecologist and clinical epidemiologist), Claire McLintock (obstetric physician and haematologist), Jeannette McFarlane (pathologist), Jacqui Anderson (midwife), Alison Eddy (midwife), John Walker (anaesthetist), Mollie Wilson (health manager) and Cathy Hapgood (psychiatrist). In 2010, they were joined by Alec Ekeroma (obstetrician and gynaecologist) and Graham Sharpe (anaesthetist). Vicki Masson (PMMRC national coordinator) provides additional support. Lynn Sadler (epidemiologist) assists with data analysis and interpretation. The MMRWG meets three times a year.

The MMRWG aims to identify and review all 'direct' pregnancy-related deaths. It was decided in the first year of the working group to also review 'indirect' deaths, in particular (but not solely), those related to surgery, psychiatric illness and family violence. 2010 represents the fifth year of maternal death reporting under the auspices of the PMMRC. The number of maternal deaths in each year is small, which limits the analysis. In this report, we have attempted a more comprehensive analysis of five years of maternal mortality data than we have done in any of the first four years of review.

The MMRWG noted in the 2009 PMMRC report that the Ministry of Health published two publications reporting maternal mortality. These were *Hospital-based Maternity Events 2006* and *Hospital-based Maternity Events 2007*, summarising data stored in the National Minimum Dataset (NMDS) and maternal mortality data sourced from the Mortality Collection. Each publication has a section on maternal deaths. These reports and their predecessors have provided information on maternal deaths since the Maternal Mortality Review Committee ceased to exist in 1995. These publications present deaths by year of death registration rather than year of death and only report maternal deaths identified in the mortality collection. For these reasons, the publications report different maternal mortality ratios from those reported by the PMMRC. The PMMRC cross-checks cases from these publications to ensure the PMMRC dataset of maternal deaths is as complete as possible. It should be noted that, because the PMMRC ascertainment process collects more cases than are found from routine datasets, the PMMRC estimate of the New Zealand maternal mortality ratio is necessarily higher, and a comparable ratio should be used when comparing New Zealand ratios with international ratios. This point is highlighted and ratios are reported using each ascertainment method in the Eighth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom (CMACE 2011b).

2.2 Definitions

The definitions adopted by the MMRWG are based on the World Health Organization (WHO) definitions from the International Classification of Diseases (10th edition) (ICD 10) as follows:

Maternal related death: ***'death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.'***

The cause of each death is sub-classified using the CEMACH classification system (Lewis 2007).

- **Direct maternal deaths:** those resulting from obstetric complications of the pregnant state (pregnancy, labour or puerperium), from interventions, omissions, incorrect treatment or from a chain of events resulting from the above.
- **Indirect maternal deaths:** those resulting from previous existing disease or disease that developed during pregnancy and was not due to direct obstetric causes but which was aggravated by the physiologic effects of pregnancy.
- **Coincidental maternal deaths:** deaths from unrelated causes which happen to occur in pregnancy or the puerperium.

These definitions exclude **late maternal deaths**, occurring between 42 days and one year following the birth, even though it is known that some pregnancy-related deaths occur in this later period. The MMRWG may consider and review these deaths where they can be identified.

Maternal mortality ratio is the number of maternal-related deaths per 100,000 maternities.

Maternities are defined here as all live births plus fetal deaths at 20 weeks or beyond or weighing 400g or more if gestation was unknown. Pregnancies ending before 20 weeks are not included in this working definition because the absolute number of pregnancies ending before this time is unknown.

The definition for 'maternities' varies from country to country and creates unnecessary confusion when making international comparisons. The WHO recommends 100,000 live births as the most available denominator in countries with limited vital statistics collection. In countries where fetal deaths are also collected, the WHO recommends the denominator be 100,000 live births plus fetal deaths of 20 weeks or greater gestation. This is the denominator used in New Zealand by the PMMRC. In the UK, CMACE (formerly CEMACH) uses the number of pregnancies that result in a live birth at any gestation or a stillbirth at or after 24 completed weeks gestation (as required to be notified by law) (Lewis 2007). Australia reports the number of women who gave birth to either a live or stillborn baby of 20 or more completed weeks gestation or weighing at least 400g at birth (as required to be reported to the National Perinatal Data Collection) (Sullivan 2007).

Contributory factors are organisational and management factors (for example, delays in procedures or accessing results, lack of policies, protocols or guidelines), personnel factors (for example, failure to maintain competence), technology and equipment factors (for example, lack of maintenance of equipment), environmental factors (for example, inadequate

> "The group's aim is to review maternal deaths and identify potentially avoidable causes, with the expectation that this will lead to improvements in care."

facilities, distance) and barriers to accessing/engaging with care (for example, unbooked pregnancies, language barriers) that the MMRWG considered were present in the death reviewed. The subcategories within each group of factors considered are given in the PMMRC Contributory Factors Form (Appendix D).

A **potentially avoidable maternal death** is where the absence of the contributory factor(s) may have prevented the death.

More details on the process of development of the tool to assess contributory factors and potentially avoidable death have been published (Farquhar 2011).

2.3 Methodology

Since 2006, the PMMRC has requested local coordinators to notify all maternal deaths. Deaths are also brought to the MMRWG's attention by the coroner, from media reports or through other means. At the end of each year, known deaths are cross-referenced with the mortality collection at the Births, Deaths and Marriages (BDM) Registry to ensure the collection is complete. Since July 2007, all maternal deaths have been required to be notified to the coroner. In 2010, all cases were referred to the coroner, who required a post-mortem to be undertaken in all but three cases.

The MMRWG has developed a data collection tool for maternal deaths. Following notification of a maternal death, the PMMRC national coordinator issues maternal death reporting forms to the appropriate local coordinator, who is then responsible for gathering the relevant clinical information from practitioners involved with the woman's care.

Each completed reporting form, along with relevant clinical information, is reviewed by designated members of the MMRWG, who present a summary of the case and findings to the working group. The MMRWG then discusses each case in detail, including assessing the presence of contributory factors and potential avoidability.

From 2006–2008, the MMRWG of the PMMRC prospectively assessed potential avoidability of all maternal deaths but did not use a tool for identifying contributory factors. In early 2010, an expert panel that included a midwife researcher, an obstetrician and an epidemiologist, one of whom was also a member of the working group, considered each death from 2006–2008 and completed the tool for identifying contributory factors. For 2009 and 2010 deaths, the working group applied the new tool in reviewing the maternal deaths. The findings of the expert panel review of deaths from 2006–2008 combined with the committee's reviews for 2009 and 2010 are presented in this report.

2.4 Findings

Table 35: Maternal mortality ratio (per 100,000 maternities) and cause of maternal death 2006–2010

Classification and cause of maternal death	2006	2007	2008	2009	2010	2006–2010		
						n	%	Ratio
Direct maternal death	**6**	**5**	**4**	**5**	**1**	**21**	**37**	**6.5 (4.1–10.0) (95% CI)**
Amniotic fluid embolism	3	-	1	4	1	9	-	-
Postpartum haemorrhage	1	1	1	-	-	3	-	-
Pulmonary embolism	-	1	1[1]	-	-	2	-	-
Peripartum cardiomyopathy	-	1	-	-	-	1	-	-
Preeclampsia/Eclampsia	-	2	1	1	-	4	-	-
Sepsis	2	-	-	-	-	2	-	-
Indirect maternal death	**7**	**5**	**5**	**9**	**7**	**33**	**58**	**10.3 (7.1–14.4)**
Pre-existing medical condition	2	4	2	1	2	11	-	-
Non-obstetric sepsis	-	1	-	5	1	7	-	-
Intracranial haemorrhage	1	-	-	-	1	2	-	-
Suicide	4	-	3	3	3	13	-	-
Unclassifiable	**2**	**1**	**-**	**-**	**-**	**3**	**5**	**0.94 (0.19–2.7)**
Total	**15**	**11**	**9**	**14**	**8**	**57**		**17.8 (13.5–23.0)**

1 Pulmonary embolism and sepsis

One direct and seven indirect maternal deaths were reported to the MMRWG in 2010. There were 65,124 maternities in 2010, making the maternal mortality ratio in 2010 12.3/100,000. As the number of maternal deaths is small in one year in New Zealand, there may be large variations in the ratio from year to year. For this reason, the five-year ratio for 2006–2010 (17.8/100,000 – 95% confidence interval 13.5–23.0) has been reported this year. In 2010, we identified three coincidental deaths, all the result of motor vehicle accidents.

International comparisons

It is difficult to compare maternal mortality ratios internationally due to differences in definitions and differences in the extent of ascertainment of cases. For example, a recent publication from Italy estimates an under-reporting of 63 percent of maternal deaths (Donati 2011), and the Centers for Disease Control and Prevention in the United States only report on direct maternal deaths due to difficulty with case ascertainment (Xu 2010).

Small differences in the denominator for calculating the ratio result in very small changes compared to the impact of differences in the numerator due to routine surveillance versus in-depth ascertainment of maternal deaths such as by confidential enquiry or the PMMRC process in New Zealand.

The UK reported a maternal mortality ratio based on confidential enquiry data of 11.4/100,000 maternities (4.7/100,000 direct maternal mortality ratio; 6.7 indirect maternal mortality ratio) for the triennium 2006–2008 (CMACE 2011b). The New Zealand maternal mortality ratio for this triennium was significantly higher at 18.3/100,000 maternities with 95 percent CI 12.8–25.5 (7.9/100,000 direct maternal mortality ratio; 8.9/100,000 indirect maternal mortality ratio).

The PMMRC looks forward to the next Australian maternal mortality report, although difficulties in case ascertainment are acknowledged in Australia (Queensland Health 2011). The last Australian data were reported for the triennium 2003–2005 (Sullivan 2007).

Pandemic influenza A H1N1

In 2009, four women died from influenza, of which three women had confirmed pandemic influenza A H1N1 and one had suspected but untested H1N1 due to insufficient serum. The group is not aware of fatal H1N1 cases in pregnant women in 2010 and continues to recommend that the vaccine be offered to pregnant women and that oseltamivir may reduce the severity of illness.

Table 36: Reporting of maternal deaths to the New Zealand coroner 2006–2010

Maternal death reported to the coroner	2006	2007	2008	2009	2010	2006–2010	
						n	%
Yes	13	8	9	14	8	52	91
No	2	3	-	-	-	5	9

It is a statutory requirement in New Zealand that deaths of women giving birth or that appear to have been the result of a woman being pregnant or giving birth are reported to the coroner for consideration of the need for further investigation. Since 2007, there has been a specific tick box on the death certificate to remind practitioners of this requirement and to assist in ascertainment of all cases. In the three years from 2008–2010, all maternal deaths were reported to the coroner.

Of the 57 deaths in five years, 43 (75%) had a post-mortem.

Coincidental maternal deaths 2006–2010

During the five years from 2006–2010, eight mothers died of coincidental causes. These deaths were also reviewed but are not included in calculation of the maternal mortality ratio. All of these deaths occurred in the community; six were due to car accidents, and one each due to cancer and other accidental death. Six women were pregnant at the time of death and between 10 and 33 weeks gestation. Four deaths were found to be potentially avoidable due to not using a seatbelt while a passenger in a vehicle. Seven of the coincidental deaths were coroners' cases.

Demographic characteristics among maternal deaths

Twelve (21%) of mothers who died were having their first baby. Fourteen mothers (25%) had had more than four births previously.

Sixty percent of mothers who died were overweight or obese (BMI >25) – not significantly higher than the 50 percent of mothers whose demographic data are in the National Maternity Collection (MAT) in the years 2008, 2009 and 2010.

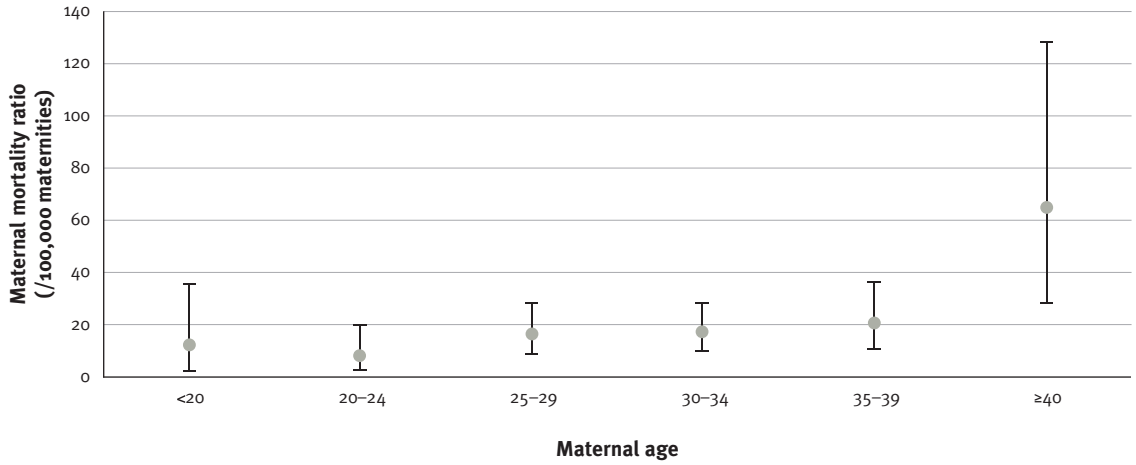
Sixteen mothers (28%) were smokers compared to 16 percent of mothers whose demographic data are in the National Maternity Collection (MAT) in the years 2008, 2009 and 2010.

Table 37: Demographic characteristics among maternal deaths 2006–2010

	2006–2010 maternities[1]		2006–2010 maternal deaths		Maternal Mortality Ratio
	n=320,923		n=57		
	n	%	n	%	/100,000 maternities
Maternal age					
<20	24326	7.6	3	5	12.3
20–24	58014	18.1	5	9	8.6
25–29	78268	24.4	13	23	16.6
30–34	90714	28.3	16	28	17.6
35–39	57326	17.9	12	21	20.9
≥40	12275	3.8	8	14	65.2
Ethnicity					
Māori	74731	23.3	22	39	29.4
Pacific peoples	33711	10.5	12	21	35.6
Indian	10888	3.4	3	5	27.6
Other Asian	21872	6.8	3	5	13.7
Other (including unknown)	28962	9.0	3	5	10.4
NZ European	150759	47.0	14	25	9.3
Deprivation index (NZDep2006) quintile					
1	51691	16.1	8	14	15.5
2	56563	17.6	4	7	7.1
3	59735	18.6	8	14	13.4
4	66609	20.8	18	32	27.0
5	84188	26.2	19	33	23.0
Unknown	2137	0.7			

1 Denominator data from Births Deaths and Marriages birth registrations

Figure 33: Maternal mortality ratio (per 100,000 maternities) by maternal age 2006–2010 (with 95% CIs)



As is evident from Figure 33, older maternal age (≥40 years) is associated with a significantly higher maternal mortality ratio than women aged 20–24 years. There were eight maternal deaths in New Zealand in the five-year period 2006–2010 among women in the age group 40 years plus – four direct (postpartum haemorrhage and amniotic fluid embolism) and four indirect, mostly related to chronic medical conditions.

Figure 34: Maternal mortality ratio (per 100,000 maternities) by maternal ethnicity (prioritised) 2006–2010 (with 95% CIs)

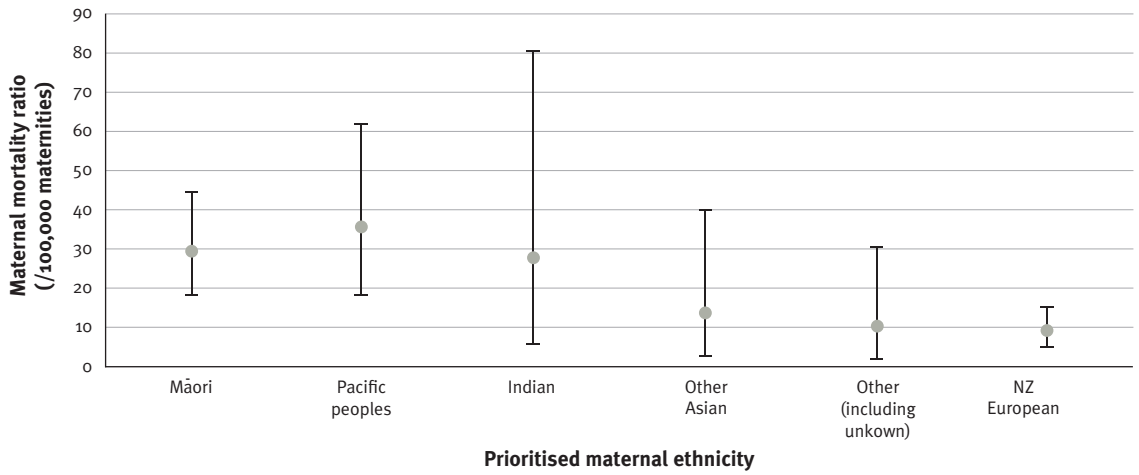
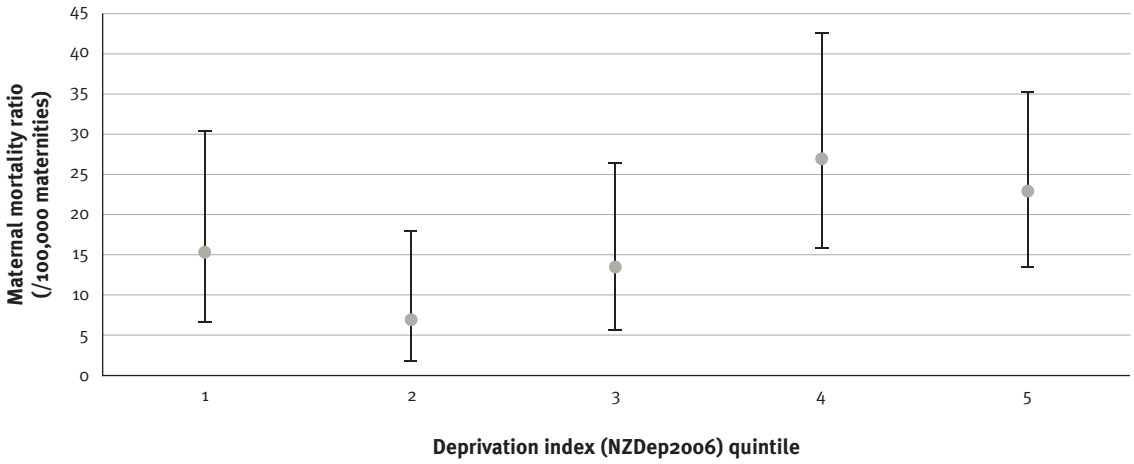


Figure 34 shows that Māori and Pacific mothers are more likely than New Zealand European mothers to die during pregnancy or in the six weeks postpartum. The most common causes of death among Māori and Pacific women were suicide, amniotic fluid embolism and pre-existing medical disease, as in the group as a whole. The estimate for Indian mothers was also higher than for New Zealand European mothers, but this difference was not statistically significant.

Figure 35: Maternal mortality ratio (per 100,000 maternities) by maternal deprivation quintile (NZDep2006) 2006–2010 (with 95% CIs)



There is no statistically significant association between deprivation quintile and maternal death in these data. This is an unexpected finding and may reflect the small number of deaths and the imprecision of the tool for measurement of individual deprivation rather than the true absence of an association.

Table 38: Details of place and timing of maternal mortalities 2006–2010

	Maternal mortalities 2006–2010	
	n=57	
	n	%
Place of baby's birth		
Community	3	5
Hospital	37	65
Not delivered	17	30
Place of maternal death		
Hospital	37	65
Community	20	35
Time of death related to pregnancy		
Antepartum	21	37
Postpartum	36	63
	Antenatal maternal deaths	
	n=21	
	n	%
Gestation at antepartum maternal death		
<20 weeks	6	29
20–27 weeks	8	38
28–36 weeks	3	15
37–42 weeks	4	19
	Postnatal maternal deaths	
	n=36	
	n	%
Gestation of birth among postpartum maternal deaths		
<20 weeks	5	14
20–27 weeks	2	6
28–36 weeks	12	33
37–42 weeks	17	47
Postnatal day at postpartum maternal death		
≤1 day	11	31
2–7 days	3	8
8–14 days	7	19
15–28 days	8	22
29–42 days	6	17
unknown	1	3

Two-thirds of maternal deaths occurred in hospital compared to a third in the community. Approximately 80 percent of mothers who had given birth in hospital and subsequently died in hospital, while only 30 percent of undelivered mothers died in hospital. A third of antepartum deaths were in hospital compared to all intrapartum and approximately 80 percent of postpartum deaths. Antepartum deaths were spread across pregnancy while postpartum deaths more often occurred near term.

Contributory factors and potentially avoidable maternal deaths

This section reports the findings of the working group's review of potential avoidability of all maternal deaths 2006–2010 and the findings of the expert group's review for 2006–2008 and the working group's review for 2009–2010 of contributory factors in maternal deaths using the recently published tool designed for this purpose (Farquhar 2011).

Table 39: Potential avoidability and contributory factors in maternal death 2006–2010

	2006–2010	
	n=57	
	n	%
Was death potentially avoidable?		
Yes	18	32
No	37	65
Unknown	2	4
Contributory factors present?	**30**	**53**
Organisation and/or management	**18**	**32**
Poor organisational arrangements of staff	4	
Inadequate education and training	6	
Lack of policies, protocols or guidelines	14	
Poor access to senior clinical staff	2	
Failure or delay in emergency response	4	
Delay in procedure e.g. Caesarean section	3	
Inadequate systems/process for sharing of clinical information between services	5	
Delayed access to test results or inaccurate results	1	
Personnel	**17**	**30**
Knowledge and skills of staff were lacking (includes failure to maintain competence)	8	
Delayed emergency response by staff	5	
Failure of communication between staff	8	
Failure to seek help/supervision	3	
Failure to offer or follow recommended best practice	2	
Lack of recognition of complexity or seriousness of condition	8	
Other	9	
Technology and equipment	**1**	**2**
Lack of maintenance of equipment	1	
Environment	**3**	**5**
Geography, e.g. Long transfer	3	
Barriers to access/engagement with care	**21**	**37**
No or infrequent antenatal care or late booking	11	
Substance abuse	4	
Family violence	3	
Lack of recognition of complexity or seriousness of condition	8	
Maternal mental illness	5	
Language barriers	1	
Not eligible to access free care	1	
Other	5	

In the five years 2006–2010, a third of maternal deaths were believed by the working group to be potentially avoidable.

Contributory factors were identified in 53 percent of maternal deaths in the years 2006–2010. Organisational or management factors were present in a third of deaths, as were personnel factors and barriers to access or engagement with care. The most frequently identified contributory factors were:

- lack of policies protocols or guidelines
- knowledge and skills of staff were lacking
- failure of communication between staff
- lack of recognition of complexity or seriousness of condition by the caregiver and the woman or her family
- late or infrequent attendance for antenatal care.

The CMACE review of maternal deaths for the triennium 2006–2008 reported substandard care in 61 percent of cases overall, with this contributing significantly to the death in 36 percent of cases. These figures are very similar to the rates of contributory factors and potentially avoidable death reported here.

Contributory factors identified in potentially avoidable maternal deaths 2006–2010

Organisation and/or management

- Poor organisational arrangements of staff.
- Inadequate education and training.
- Lack of policies, protocols or guidelines.
- Poor access to senior staff.
- Failure or delay in emergency response or procedure.
- Inadequate systems/process for sharing of clinical information between services.

Personnel

- Failure of communication between staff.
- Knowledge and skills of staff were lacking (includes failure to maintain competence).
- Delay in emergency response by staff.
- Failure to seek help/supervision.
- Lack of recognition of complexity or seriousness of condition.
- Failure to follow recommended best practice.

Environment

- Geography (ie, distance involved in accessing tertiary centre for care).

Barriers to accessing or engaging with care

- No or infrequent antenatal care.
- Substance use.
- Lack of recognition of complexity or seriousness of condition.
- Maternal mental illness.
- Family violence.
- Language barriers.

Family violence and maternal death 2006–2010

Family violence data were unavailable in 40 percent of cases, but it is of concern that, among those cases where data were available, family violence was identified during care or through the process of review in 24 percent of cases. Six of these eight women died from suicide.

New Zealand research (Fanslow and Robinson 2004) has shown that the lifetime prevalence of intimate partner violence among women in Aotearoa New Zealand is 33–39 percent, and of these women, 19–23 percent have reported experiencing severe intimate partner violence. Five percent of women will experience physical and/or sexual abuse by a partner or ex-partner annually.

Women who experience intimate partner violence are more likely to attend a health provider than women who are not (Fanslow and Robinson 2004).

Intimate partner violence during pregnancy has previously been found to be associated with fatal (homicide and suicide) and non-fatal adverse health outcomes for the pregnant woman and her baby (World Health Organisation 2011). Fanslow and Robinson's research in New Zealand showed that suicide attempts were three times more common among women who experienced moderate physical violence and eight times more common among those who experienced severe violence.

Currently, all District Health Boards in New Zealand are required to have partner abuse screening programmes although, as evidenced by Table 25, it appears that many pregnant women are still not being screened. It is known that women experiencing intimate partner violence can accurately and safely be identified in health-care settings. Health professionals have an opportunity to intervene and provide proactive referrals and assistance. Twenty (82%) of hospitals in New Zealand monitor partner abuse screening, yet only six (22%) report screening at least half of all eligible women (Violence Intervention Programme 2011).

Common causes of maternal deaths 2006–2010

In this review of deaths, in the five years from 2006–2010, the working group have focused on suicide, amniotic fluid embolism and maternal medical diseases for further comment as the most common categories of cause of maternal death in New Zealand.

2.5 Maternal mortality from suicide 2006–2010

There were 13 maternal deaths from suicide during the period 2006–2010 (almost a quarter of the total recorded maternal deaths), making suicide the leading cause of maternal mortality in New Zealand for this time period. All maternal suicides were reported to the coroner. As well as reviewing the records of these 13 deaths, the Maternal Mortality Review Working Group (MMRWG) also reviewed four late maternal deaths by suicide (these occurring between 42 days and one year postpartum).

Maternal deaths by suicide in New Zealand are classified as indirect maternal deaths. This is consistent with classifications used internationally and previous WHO guidelines. However, a recent WHO report (World Health Organization 2009) has suggested that maternal deaths by suicide in pregnancy from puerperal psychosis and postpartum depression be reclassified as direct maternal deaths. The MMRWG considered this recommendation but has continued to classify all maternal mortality by suicide as indirect at this stage.

Suicide is a significant cause of maternal death in other countries such as the UK and Australia but not the leading cause (CMACE 2011b; Austin 2007). In the most recent UK report into maternal mortality, cardiac disease was reported as the leading cause of maternal deaths (CMACE 2011b). Given the small number of cases in New Zealand and the variability year to year, it is not possible to draw strong conclusions from the data. It is worth noting, however, that New Zealand's case ascertainment process may influence the fact that suicide features as the leading cause of maternal death, as deaths from suicide may be under-reported in jurisdictions without specific maternal mortality review processes (Austin 2007).

New Zealand has a female suicide rate of 5.8/100,000 (2008) and 11.1/100,000 among younger women aged 15–24. The rate among young women has risen over the past 10 years and is highest among Māori. When ranked alongside rates for other OECD countries, the New Zealand 2008 suicide rate for females is in the upper third of the group. New Zealand's overall rate is similar to Australia's and significantly higher than that of the UK (Ministry of Health 2008a).

Features of maternal deaths from suicide

The number of deaths by suicide overall is small, and it is therefore difficult to draw firm conclusions from the data. However, there were a number of important features in the cases reviewed by the MDWG.

- Of the 13 deaths, seven (54%) occurred during pregnancy and 6 postpartum or post-termination of pregnancy. Pregnancy does not seem to have a protective influence over a mother's decision to take her own life. A similar percentage of antenatal deaths by suicide were noted in Australia (Austin 2007). However, UK maternal mortality data notes antenatal suicides were rare.

- The majority of suicides (11 of 13) occurred by violent means. This has been noted in maternal deaths by suicide in both Australia (Austin 2007) and the UK (CMACE 2011b). Death from violent methods is not different from other female suicides in younger women in New Zealand in recent times (Ministry of Health 2008a).

- Alcohol abuse or drug use was present in over half the women who died and had been used at the time of death in four instances.

- Family violence was known to be present in approximately half of the cases, and this is consistent with international findings (Devries 2011).

- Deaths by suicide are more common in Māori in New Zealand. Five of the 13 maternal deaths (38%) were Māori women, although this does not indicate a significantly higher rate among Māori mothers.

- A history of mental illness was present in seven out of 13 cases. All these women were in contact with mental health services during the perinatal period. Three had been hospitalised and were either in hospital or had been recently discharged at the time of death. All these women died as a result of worsening pre-existing mental illness in the perinatal period. The remaining six women had no known history of mental illness, although half of them had significant alcohol and drug abuse problems, and three were intoxicated at the time of death. They were young (most were 25 or under), and four of these were living in the most socioeconomically deprived areas (NZDep2006). Domestic violence was present in two of these cases – in three cases, it had not been asked about. In New Zealand in general, this age group has a higher rate of suicide than older women and appears to be especially vulnerable.

- None of the deaths followed a new episode of puerperal psychosis.

- Barriers to access/engagement with care were noted as a contributory factor in nine of the 13 deaths, and six were considered potentially avoidable.

- When a range of health service providers were involved in the woman's care, there was often a lack of coordination and information sharing between services to facilitate effective assessment and care planning. Lack of access to mental health clinical records by non-mental health clinical practitioners compounded this issue.

Discussion

Although the absolute numbers are small, suicide is the leading cause of maternal death in New Zealand. More than half of these deaths occurred in women with a past history of mental health disorder. It has been emphasised in previous reports that women with a history of serious mental illness are at high risk of relapse during pregnancy, and their condition may deteriorate rapidly. It is important that both maternity and mental health practitioners are aware of this (CMACE 2011b).

Young women who are socially disadvantaged, have a history of alcohol and drug use and are in unsupportive relationships are at risk perinatally as at other times. Young Māori women are especially vulnerable. This highlights the need to identify domestic violence and alcohol and other drug use early in pregnancy. The mental health needs of Māori women during pregnancy need to be identified and services delivered in culturally appropriate ways (Ministry of Health 2008b, 2012b). A whānau ora approach ensures services are responsive to the needs of the individual, their whānau and/or carers (New Zealand Guidelines Group 2008).

Previous PMMRC reports have recommended providers take a mental health history at booking and ensure those women with a known history of mental illness have a clear management plan, including contact with mental health services when necessary, even if they are currently well (National Institute for Health and Clinical Excellence 2007; New Zealand Guidelines Group 2008). It is essential to have clear referral pathways, sharing of information with primary care and accessible mental health services that lessen barriers to care and recognise that, from early pregnancy, specialist advice may be required (New Zealand Guidelines Group 2008). At times, practitioners will be providing care to women who are reluctant to engage with services. In these situations, support and advice should be available in order that appropriate options can be explored.

Currently, there is a disparity between need and availability of maternal mental health services in New Zealand. Although improved coordination of care, screening and referral is recommended, the current inadequate maternal mental health resources and lack of clear referral pathways can be a barrier to women accessing mental health assessment and treatment when it is required. Better coordination between existing services in the primary and specialist sectors and processes for sharing information between providers could deliver care that joins together what is available in each DHB in New Zealand, as recommended in the Ministry of Health report Healthy Beginnings (Ministry of Health 2012b).

For some years, the PMMRC, among other groups, has recommended a mother and baby unit in the North Island of New Zealand where currently no facility exists. However, this must be in addition to an improvement in the currently stretched resource.

2.6 Pre-existing medical conditions 2006–2010

Women with pre-existing medical disease accounted for 11 of 57 (19%) maternal deaths in the five years from 2006–2010. The overall numbers are small. However, these women were significantly more likely to be 35 or older and Māori or Pacific than the New Zealand maternity population.

Almost half (45%) were 35 years of age or older compared to 22 percent of all mothers in 2006–2010. Six women were Māori (55%) compared with 23 percent of registered mothers in 2006–2010. Eighty-one percent were recorded as being overweight or obese compared to 50 percent of women with data in the National Maternity Collection (MAT) in the years 2008, 2009 and 2010.

Five (45%) of the women had given birth to five or more children. Death occurred during pregnancy for five (45%), and six (55%) died in the postnatal period. Seven (64%) died in hospital and four (36%) in the community.

Four women had pre-existing cardiac disease, and three had neoplasms. In the UK, indirect maternal death due to cardiac disease is the most common cause of maternal death, and the most frequent causes of cardiac death were related to ischaemic heart disease and peripartum cardiomyopathy. In New Zealand, cardiac disease in pregnancy due to underlying valvular heart disease, including that due to rheumatic heart disease (RHD), is relatively more frequent. This may reflect the high rates of RHD in New Zealand, particularly among Māori and Pacific peoples. The proposed Australasian Maternity Outcomes Surveillance System (AMOSS) study of outcomes in pregnant women with RHD may contribute further to knowledge of morbidity and mortality associated with this serious maternal condition.

Six deaths were identified to be potentially avoidable, with barriers to access or engagement with care being the most common contributory factor followed by personnel and organisation and/or management factors.

2.7 Amniotic fluid embolism 2006–2010

Amniotic fluid embolism (AFE) was the third most common cause of maternal deaths over the five-year period, responsible for nine deaths. All mothers who died of amniotic fluid embolism were multigravidae and non-smokers, and all died in hospital. Three mothers died intrapartum and six postpartum. Two of the pregnancies were multiple pregnancies. Nine babies were live born, and there were two perinatal deaths. All cases were reported to the coroner.

Amniotic fluid embolism has previously been associated with induction of labour and with Caesarean section. Among the nine deaths reported here, five mothers were induced – four with prostaglandins and one with artificial rupture of membranes only. Six of the nine deliveries were by Caesarean section, either as emergency or perimortem.

A recent review looked at incidence, risk factors and outcomes in five countries (Australia, Canada, the Netherlands, US and UK). The only consistent associations were with maternal age over 35 and with induction of labour.

With regard to mode of birth, issues concerning the timing of the amniotic fluid embolism make the data difficult to interpret. However, there was a significant association with Caesarean delivery in the one country (UK) in which it was possible to investigate specifically cases where amniotic fluid embolism occurred after delivery. The case fatality rates for amniotic fluid embolism in this review were between 11 and 43 percent (Knight 2012).

In the New Zealand mortalities, presenting signs and symptoms included hypotension, premonitory feelings such as agitation, cardiac arrest and seizure.

In three cases, hysterectomy was performed to control bleeding, and eight required transfusion of blood products. Factor VIIA was not used in any case.

Overall, responses by clinicians appeared satisfactory, obstetricians being present within 15 minutes in eight cases, and anaesthetists within 15 minutes in seven. There is value in detailed local review to look at matters of teamwork and equipment.

In the opinion of the working group, none of the cases was potentially avoidable, but there were contributory factors in four cases, relating to organisation and management (three cases), personnel (two cases), physical environment (two cases), equipment (one case) and barriers to accessing care (one case).

This report is about fatal cases. In 2010 and 2011, six cases of amniotic fluid embolism were reported to the AMOSS data collection for New Zealand. Further data collection is required to accurately estimate the case fatality for this rare complication in New Zealand. The UK Obstetric Surveillance System (UKOSS) survey reported a case fatality rate of 20 percent for 60 cases of amniotic fluid embolism reported in the UK using the UKOSS reporting system.

A special report on amniotic fluid embolism was sent from the PMMRC to the Minister of Health in 2010 in response to concerns about an increase in cases in New Zealand (PMMRC 2011).

Recommendations 2010: Maternal mortality and morbidity

- Pregnant women who are identified with pre-existing medical disease during pregnancy should be referred appropriately.
- The committee notes the publication of the Healthy Beginnings report and supports the recommendations with particular regard to the establishment of mother and baby units in the North Island and the importance of screening for a history of mental health disorders.
- A comprehensive perinatal and infant mental health service includes:
    - screening and assessment
    - timely interventions including case management, transition planning and referrals
    - access to respite care and specialist inpatient care for mothers and babies
    - consultation and liaison services within the health system and with other agencies, for example, primary care and termination of pregnancy services.
- Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral.

3. NEONATAL ENCEPHALOPATHY WORKING GROUP REPORT

Background

The Neonatal Encephalopathy Working Group (NEWG) was established to reduce the morbidity and mortality associated with neonatal encephalopathy (see definition on page 19). Neonatal encephalopathy (NE) remains a major cause of brain injury in newborn infants, and it is recognised that NE infants are more likely to die around the time of birth (between 10–60%) and at least 25 percent of survivors will have long-term neurological problems such as cerebral palsy, neurodevelopmental delay, visual or hearing impairments and seizures.

The PMMRC reports that neurological conditions, most frequently peripartum hypoxic insult, are the third most common neonatal cause of death. Furthermore, in the 2009 PMMRC report, it was stated that contributory and avoidable factors were thought to be present in almost 50 percent of hypoxic peripartum deaths. While there are a number of older population studies looking at the prevalence of NE internationally, this project will be the first to collect and publish national data for New Zealand.

The aim of this project is to determine local rates of NE, report clinical associations, examine preventability and describe the clinical course and neonatal outcomes for affected infants. This year, we are reporting preliminary findings from the first year of data. The current report includes an estimate of the rate of NE, describes the labour and neonatal course and reports short-term outcomes for affected infants.

Methodology

The strategy for data collection was described in the fifth PMMRC report (PMMRC 2011). The NEWG acknowledge the support of the New Zealand Paediatric Surveillance Unit in the identification of cases. Rates were calculated using data from the New Zealand birth registration set (further described in section 1.2) and confidence intervals calculated using the Exact method. Maternal and infant ethnicity, maternal age, maternal BMI and LMC data will be reported from the two-year data collection.

Preliminary findings

In 2010, 82 cases were notified with moderate or severe NE. Fifty-nine infants survived the first 28 days of life. The overall NE rate is 1.26/1000 registered births (95% CI 1.02–1.56). Although this rate compares favourably to published studies that have reported rates greater than two per 1000 births, it should be noted that these studies are historical, with the data typically collected more than a decade ago, and varying definitions were used (Thornberg 1995; Badawi 1998a, 1998b). More recent Auckland-based studies have reported rates of 1.7–1.8/1000 births, but the cohorts were from centres that would serve a higher-risk population and thus would be expected to have a higher rate overall than the background population (West 2005a, 2005b).

Thirty-six babies (44%) were born by Caesarean section, 16 by Caesarean prior to labour. The following complications were reported: placental abruption, cord prolapse, cord accidents, uterine rupture, shoulder dystocia and maternal collapse. Meconium liquor was reported in 29 infants (35%). One-third of the cases had non-reassuring fetal status within the first hour of monitoring, and 70 percent were reported to have non-reassuring fetal status in the final two hours before birth. A further analysis is planned of cardiotocography (CTG) data with respect to intervention in labour so only basic descriptive data are reported for 2010.

Umbilical cord gases were performed in 72 percent (59 of 82) of infants. The reported findings are summarised in Table 40. Of the 14 infants who did not have cord gases performed but had Apgar scores at one minute below 7 (Table 40), suggesting depression at birth, eight (57%) were at level 2 or level 3 centres.

Table 40: Cord gases among babies with neonatal encephalopathy at term 2010

	NE babies	
	n=82	
	n	%
Normal (any of pH >7.2, BE ≥10, Lactate <6)	6	7
Abnormal	53	65
Not available	23	28
Not available plus Apgar <7 at 1 min	14	17
Not available plus Apgar >7 at 1 min	9	11

Birthweight and gestational age distribution are given in Figure 36 and Figure 37 compared to the New Zealand registered birth population at term (≥37 weeks). Note that the majority of cases occur within the range of 2500–4000g and 39–41 weeks gestation.

Figure 36: Distribution of birthweight among babies with neonatal encephalopathy and term birth registrations in New Zealand 2010

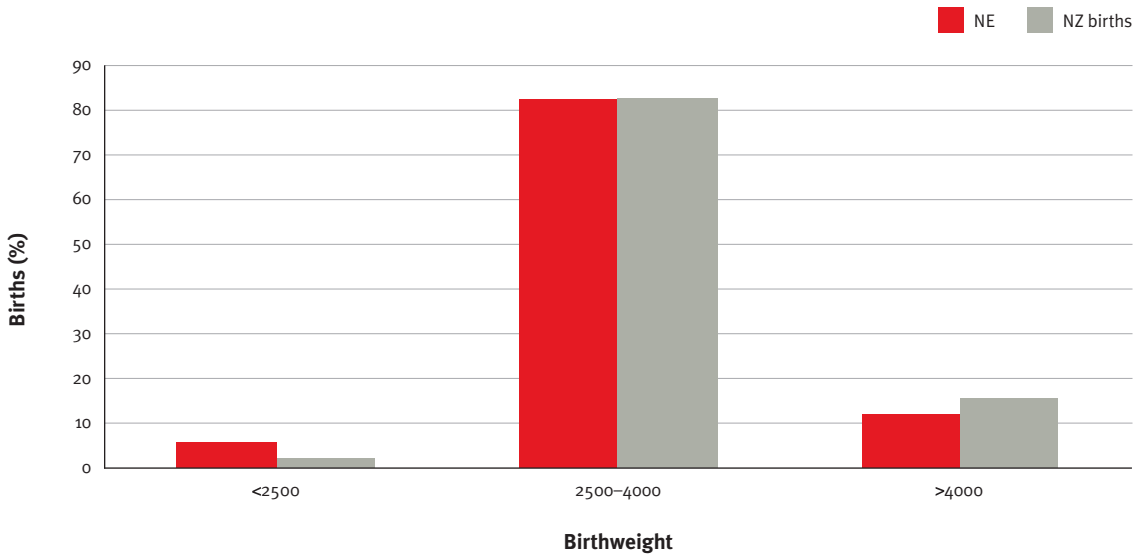
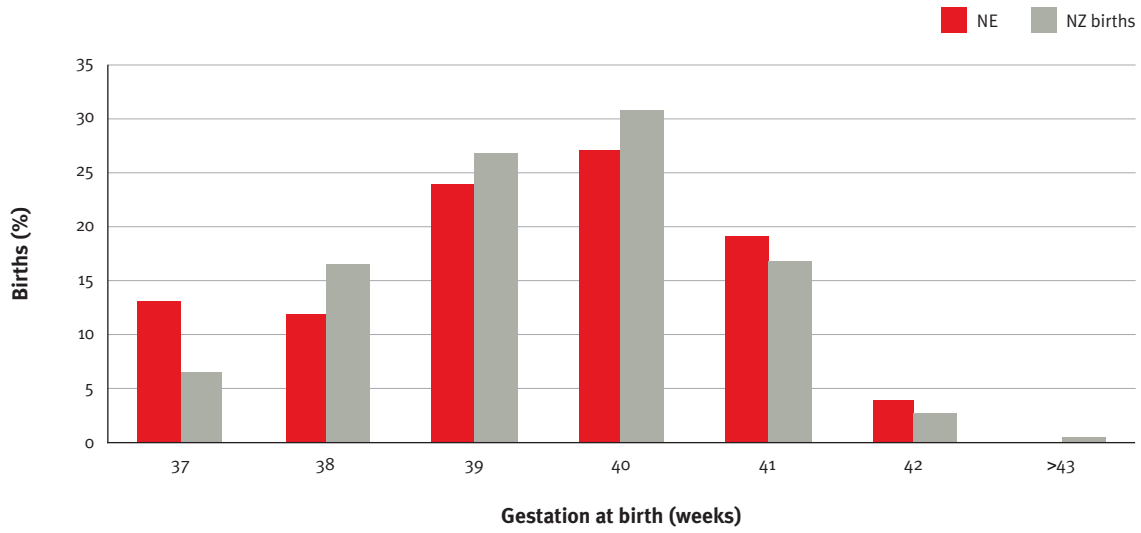


Figure 37: Distribution of gestation at birth among babies with neonatal encephalopathy and term birth registrations in New Zealand 2010



The majority of the affected infants (73 of 82–89%) received resuscitation at birth, with most requiring major respiratory support and approximately half cardiac massage. However, a small number received only free-flow oxygen (Table 41), and nine did not require resuscitation at birth.

Table 41: Resuscitation requirements for babies with neonatal encephalopathy 2010

	NE babies n=82	
	n[1]	%
Oxygen only	3	4
IPPV via mask	42	51
IPPV via ETT	52	63
Cardiac massage	42	51
Adrenaline/drugs	19	23

1 Some infants received more than one modality of resuscitation and so columns do not add to total of cases or to 100%

Figure 38: Distribution of one-minute Apgar score among babies with neonatal encephalopathy 2010

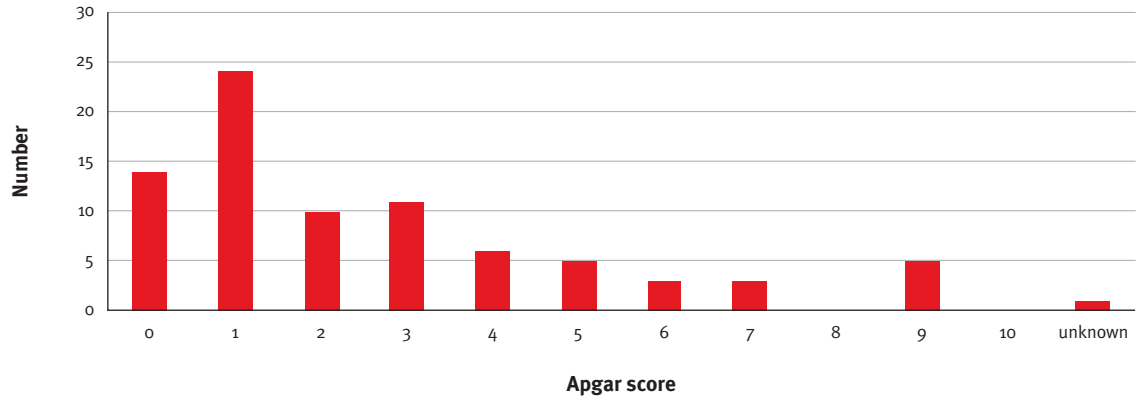
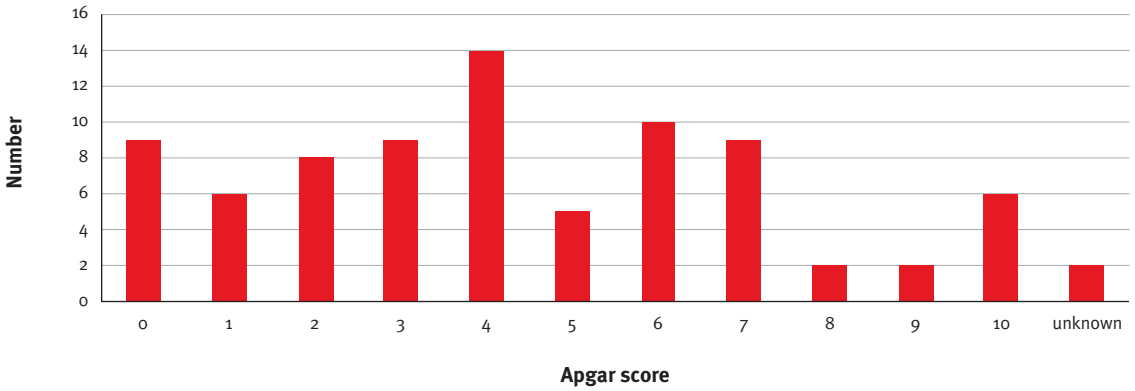


Figure 39: Distribution of five-minute Apgar score among babies with neonatal encephalopathy 2010



The one- and five-minute Apgar scores of the infants with NE are documented in Figure 38 and Figure 39 respectively. It should be noted that some infants had scores greater than 7 at one or both time points. This could indicate either poor recognition of a compromised infant or a secondary deterioration in condition after birth. It will be important to review these cases in the two-year dataset, but based on preliminary information, it is apparent that both occur.

Neonatal course

After admission to the level 2 or level 3 neonatal unit, 61 (74%) infants received mechanical ventilation for respiratory support, and an additional 19 (23%) received nitric oxide therapy for pulmonary hypertension. Treatment with anticonvulsant therapy was also common and occurred in 59 of 82 (72%). Treatment followed conventional approaches for this age group, with phenobarbitone used in 54 (66%), phenytoin in 14 (17%), benzodiazapines in 15 (18%) and other treatments in seven infants (9%).

Cooling[1] was performed in 55 of 82 cases (67%), using whole-body technique in 53 and selective head in two cases (Table 42). Cooling did not take place in 27 of 82 cases (33%). The NEWG plans to review cases where the infant was potentially eligible for cooling but was not cooled. Of the babies who were cooled, initiation was prior to six hours in 38 (46%), after six hours in 10 (12%) and unknown/unrecorded in 7 (9%).

Table 42: Cooling status by Sarnat stage among babies with neonatal encephalopathy 2010

Sarnat stage	NE cases (total)	Cooled		Not cooled	
		n=55		n=27	
		n	%	n	%
Moderate	49	34	62	15	56
Severe	33	21	38	12	44

1 Hypothermia is the only intervention that has been proven to improve outcome for infants with NE so it is important to ensure utilisation rates are high and timing is optimal, with initiation before six hours of age

Clinical grading of the neonatal encephalopathy is important for the estimation of prognosis following hypoxic ischaemic perinatal injury. NE was moderate in 49 infants (60%), the and severe in 33 (40%). However, for the group of infants who died (n=23), the staging was more severe, with 4 percent moderate and 96 percent severe.

Documentation of neurological injury using MRI has a proven role in assisting with prognostication following NE. However, 18 of the 59 survivors did not have an MRI.

Examination of the infant at discharge

Examination at discharge from the neonatal unit is important information, as resolution of the encephalopathy is part of the staging process and the persistence of abnormal neurological signs is associated with long-term adverse neurodevelopmental outcome.

Overall, 32 (54%) of the survivors were reported to have a normal examination; 14 (24%) mild or moderate abnormality and three (5%) severe abnormality. In a further 6 (10%), the exam findings were unknown or not documented.

At the time of discharge from the neonatal unit, it was noted that some babies required ongoing support, including 12 (20%), two (3%) requiring suctioning, four (7%) requiring oxygen and 11 (19%) requiring ongoing anticonvulsant treatment. Of the survivors, 40 (68%) were reported to have been referred to ongoing support services.

Ongoing analysis

This report has presented preliminary findings for the 2010 dataset, and further analysis is planned. As discussed, several aspects of the further analysis were planned a priori, but this early review has prompted three particular areas to examine.

- Infants who were reported to have significant hypoglycaemia as part of their encephalopathy.
- Infants who were not cooled.
- Infants with a one-minute Apgar score above 7.

Recommendations 2010: Neonatal encephalopathy

- Cord gases should be performed on all babies born with an Apgar <7 at one minute.
- If neonatal encephalopathy is clinically suspected in the immediate hours after birth, early consultation with a neonatal paediatrician is recommended in order to avoid a delay in commencing cooling.
- All babies with moderate or severe neonatal encephalopathy should undergo a formal neurological examination and have the findings clearly documented prior to discharge.

4. AUSTRALASIAN MATERNITY OUTCOMES SURVEILLANCE SYSTEM (AMOSS) WORKING GROUP REPORT

The Australasian Outcomes Surveillance System has now completed two full years of data collection on severe and rare disorders of pregnancy across almost 300 maternity units in New Zealand and Australia. In New Zealand, data collection has been completed for the following conditions.

- Influenza A requiring admission to intensive care.
- Eclampsia.
- BMI >50.

In New Zealand, we have decided to continue to gather data on peripartum hysterectomy and placenta accreta/increta/percreta, while in Australia, data collection has been completed. A summary of the cases reported is listed below. Detailed analysis of the completed conditions has begun. and we hope to have the results available for publication later this year.

Table 43: Australasian Maternity Outcomes Surveillance System conditions reported in New Zealand 2010–2011

AMOSS condition	Cases
Amniotic fluid embolism	6
Antenatal pulmonary embolism	10
Eclampsia	22
Placenta accreta	49[1]
Peripartum hysterectomy	53[1]
Influenza (ICU admission)	6
BMI >50	297

1 Some of these occurred in the same women

In both countries, we are continuing to gather data on:

- Amniotic fluid embolism
- Antenatal pulmonary embolism.

A number of original articles taken from the AMOSS study have been published, including a comparison of admissions to intensive care units in women with H1N1 influenza A in the UK and in New Zealand/Australia (Knight 2011) and a description of the process for ethics approval for AMOSS in New Zealand and Australia that shows how much more streamlined our national ethics process is compared to that in Australia (Vaughan 2011).

New conditions to be included in the AMOSS data collection from July 2012 are rheumatic heart disease in pregnancy and breast cancer first diagnosed in pregnancy.

Recent AMOSS publications

Knight M, Berg C, Brocklehurst P, Kramer M, Lewis G, Oats J, Roberts CL, Spong, C, Sullivan, EA, van Roosmalen J, Zwart J. 2012. Amniotic fluid embolism incidence, risk factors and outcomes: A review and recommendations. *BMC Pregnancy and Childbirth* 12:7. DOI: 10.1186/1471-2393-12-7

Vaughan G, Pollock W, Peek MJ, Knight M, Ellwood D, Homer CS, Pulver LJ, McLintock C, Ho MT, Sullivan EA. 2011. Ethical issues: the multi-centre low-risk ethics/governance review process and AMOSS. *Aust NZ J Obstet Gynaec*. DOI: 10.1111/j.1479-828X.2011.01390.x.

Homer CSE, Biggs J, Vaughan G, Sullivan EA. 2011. Mapping maternity services in Australia: location, classification and services. *Australian Health Review* 35: 222–229.

Nair P, Davies AR, Beca J, Bellomo R, Ellwood D, Forrest P, Jackson A, Pye R, Seppelt I, Sullivan E, Webb S, for the Australia and New Zealand Extracorporeal Membrane Oxygenation (ANZ ECMO), Influenza Investigators and the Australasian Maternity Outcomes Surveillance System. 2011. Extracorporeal membrane oxygenation for severe ARDS in pregnant and postpartum women during the 2009 H1N1 pandemic. *Intens Care Med* 37(4): 648–54.

5. ISSUES FOR PARENTS, FAMILIES AND WHĀNAU

In March 2012, the Ministry of Health released its 2011 Maternity Services Consumer Satisfaction Survey, which, for the first time, also surveyed bereaved mothers. Sands NZ was involved in the development of the survey and the implementation of the pilot survey.

Interestingly, some of the experiences of bereaved mothers in 2011 do not differ greatly from issues identified in the first PMMRC report released in October 2007. In order to reflect mothers' experiences and to illustrate how much the actions and interventions of health professionals can affect their experience of perinatal loss, verbatim comments from the Bereaved Mothers Survey are presented here (the link to the survey is listed at the end of this chapter). Some of the comments are taken directly from the survey; others (*in italics*) are from unpublished data made available to Sands New Zealand by the Ministry of Health as part of the ethics approval process.

This chapter of the report has echoed the same themes over the five PMMRC reports to the Minister of Health and the Health Quality & Safety Commission. In the first PMMRC report, the Supporting Parents and Families chapter listed the issues for bereaved parents, families and whānau identified by Sands New Zealand. They were:

- a lack of information
- the need for appropriate and affordable counselling
- feelings of isolation for parents who do not know how to access any support
- no one to answer specific questions related to their baby's death
- a lack of New Zealand resources
- the potential for complicated grief to translate into mental health challenges.

The following four reports (March 2009, November 2009, October 2010 and July 2011) highlighted the slow progress in the provision of information and support for parents and families, with the exception of the Ministry of Health's funding of the Sands Support Packs. These support packs are the central resource used throughout the country providing information to parents and families following their baby's death.

This year, for the first time, the voices of bereaved parents resonate through this chapter and reiterate the issues highlighted in the first report produced by the PMMRC.

Information

While 83 percent of the bereaved mothers felt that they were provided with all the information they needed about what would happen next and 65 percent received enough information about why their baby died, half said that, in hindsight, it would have been useful to have received additional information. That included information about Sands NZ or a support person/counsellor (15%), funeral preparations (10%) and practical information about the baby and making memories (12%). The theme that comes through the responses made by the bereaved mothers in this section is the need for someone to provide information and support.

> For somebody to have gotten in touch with Sands New Zealand; it would have been quite useful and helpful to talk to somebody who would have understood.
>
> Have somebody come in and verbally discuss it instead of just handing over a booklet.
>
> They didn't actually have a Sands New Zealand person come to see me until I got home; if I had had a Sands New Zealand person at the hospital, it would have been much more helpful. I would have known about photos and other things for memories. I would also have liked to have held her – I was scared to, but it would have been good to hold her. Staff were good to me, but they were dealing with live babies; they were not interested in dead ones.
>
> *Leading up to baby's death, I wasn't at all satisfied with the care that we got; there was [a] lack of information. We weren't given the full picture and not given all the facts about infection when waters break.*

Counselling/support

After leaving the hospital, 95 percent of respondents received some form of follow-up contact. Sixty-three percent identified their midwife as the most helpful or supportive person during this time, while 10 percent identified Sands NZ. Fourteen percent of the respondents said they would have liked to have some form of counselling to help them with their grief. Sands NZ stresses that it must be appropriate and affordable.

> Looking back, one thing I really needed was professional counselling. It is really, really difficult to handle.

> *The only one thing that we sort of felt slightly dissatisfied with was the counsellor at the hospital, who I think came across as slightly patronising. I don't know, she must see hundreds of people like me. I felt we got less information from the counsellor and more sort of sympathy and kindness from the midwives who were there, who looked after us.*

> It was a lot to take in. A counsellor would have been helpful. The social worker at the hospital had a lack of compassion and asked if we had a plot for my husband and I. I thought that was disgusting.

> *I just didn't get any support afterwards when I was home from anyone other than my friends and family.*

> Just if there was – if you could get some counselling. It was pretty traumatic for us and we struggled.

> *I guess my last one is when you're about talking about support and because it is for Sands New Zealand, I do support them wholly. I think for me they provided an excellent service; they were there and it's a shame it's not promoted more, and possibly supported more financially because I think it is something that is needed. It is such a quiet topic, a tapu topic almost, and there are people like that [who] have offered support. I actually went to counselling and I pulled out of counselling because I felt they weren't doing as much as what Sands New Zealand could do for me.*

Feelings of isolation for parents who do not know how to access any support

Despite a raised awareness of perinatal loss and increased coverage of Sands groups around the country, there are still many bereaved parents who feel alone and isolated.

> *I reckon midwives and hospital staff in maternity wards kind of need training about these kinds of situations. I mean it is an awkward situation because they are going to have to learn to help people through it and stuff. Just ignoring it isn't helping; it can do a lot of damage to mothers. It is their last time with their baby and they need support.*

> *Apart from that there is no real support unless you go and find it yourself. It would be helpful to have more knowledge and contact of local groups. I don't know if Sands New Zealand has a local group or not, or organisations like that for people that have gone through this sort of thing.*

> *I don't know if they can give permission for Sands New Zealand to call them; to actually get someone to initiate it, because you are so grief struck and the world just feels it has gone crap. I think a lot of people wouldn't have the energy or initiative to do that stuff for themselves...*

No one to answer specific questions related to their baby's death

In the survey, six percent of the respondents said the only additional information they wanted was to understand what happened and why their baby died. It is not always clear to women navigating the maternity services, especially women who are bereaved, how to access further information.

> *It's hard because babies die for all sorts of reasons, but if you are aware during a pregnancy that you're having a baby that is going to die before or afterwards because you've got something wrong or have been diagnosed with something, it would be useful to have someone to talk to.*

> *I have got one question and I've been asking a few people. I would like some information as well if possible on family relations with pre-eclampsia and HELLP syndrome.*

The only other thing is, after the loss I didn't know who to contact about what I should do about future pregnancies. If I needed to go back to the hospital or go to an LMC; who I could contact at the hospital to discuss it with. I guess what it is I didn't have a contact person that I could check in with or check what I could be doing as a next step.

A lack of New Zealand resources

The one thing that has changed in this area, as mentioned above, is the availability of the Sands Support Packs throughout the country. The Ministry of Health has been funding the production of the packs, and Learning Media has taken over their distribution, making them easier to access for both Sands groups and DHB resource coordinators.

> All the pamphlets we got I think through Sands New Zealand and … it was very clear, like we could look through each thing and [think] 'oh we need to do this' and … to plan that prior to birth. But again that is our situation; it doesn't work for everybody. But for us … getting that information prior was brilliant for us. We walked out at midnight very clear where we were going forward and what to do.

> We were given information by Sands New Zealand, but it was only about what would happen after the birth but not information about where we could go for funeral homes.

> When we got to the hospital to deliver the baby that was when they provided me with all these pamphlets on what to do when you have stillborn baby. They could have provided us with those pamphlets when we first found out that the baby was already dead. That would have given us two days to think about what we could do. Instead it was provided on the day they were to take the baby out, but your mind is only on what's happening.

The potential for complicated grief to translate into mental health challenges

While the notion of linking 'normal' grief to mental illness is contentious, Sands NZ sees enough bereaved parents in the days, weeks, months and years following a perinatal loss to know that, without good support and, at the very least, acknowledgement of their loss, there is potential for the bereaved parent to move along the continuum of grief towards illness.

> *I was shocked that I could not be accepted into maternal mental health because my baby had died. They would only see people if they had live babies. The result being I desperately needed them six months later when I was pregnant again. I believe I would not have needed them then had I had that initial support.*

> Some sort of counselling. It was a year later when I had the meltdown [and] I had to go for private counselling to deal with it. It would have been good if somebody could have visited me who had gone through the same situation.

This first-time survey of bereaved mothers confirms what many throughout the maternity system know – a small voluntary organisation provides quality support and information to bereaved parents following not only perinatal loss but any pregnancy, baby or infant loss. This section ends with acknowledgement from parents themselves of the work that Sands NZ does. This work is of immense value to parents, families and whānau across the country. It is work that is unpaid yet invaluable.

> *I think probably just the fact that the additional support that we got through Sands New Zealand was pretty phenomenal in terms of information and just experience of other people that have gone through it, and I think it's easy to underestimate how important that is, so I suppose it's encouragement for other women to access that support but also encouragement for the government to recognise that all that support [is] provided on a voluntary basis.*

> *I don't know if they can give permission for Sands New Zealand to call them; to actually get someone to initiate it, because you are so grief struck and the world just feels it has gone crap. I think a lot of people wouldn't have the energy or initiative to do that stuff for themselves, so if Sands New Zealand could get permission to give them a call, they actually might realise how interesting it really is, 'cause that was one of the best things, was actually having someone who has actually been through it.*

From the Bereaved Mothers Survey and these few unpublished reflections, recommendations are discernible.

- Health professionals should give information to parents and families as soon as possible, rather than waiting till after the baby is born or the family is leaving the hospital. The information in the Sands Support Packs covers a number of points that bereaved parents may wish to consider – from memory making to funeral planning.

- A more active connecting of bereaved mothers and families to support agencies (such as Sands) by health and caring professionals would be beneficial, rather than leaving families to do this on their own.

- A maternity service that is reliant on the unpaid voluntary services in the community to provide the majority of quality support to bereaved parents, families and whānau is a sad indictment on our attitudes towards perinatal loss. Perhaps this first step towards understanding the impact of such a loss, in the form of the Bereaved Mothers Survey, will lead to better support and information for this vulnerable part of our population.

The Maternity Services Consumer Satisfaction Survey 2011 is available at http://www.health.govt.nz/publication/maternity–consumer–survey–2011.

6. NATIONAL COORDINATOR REPORT 2010

The PMMRC national coordination services include the following personnel:

Michelle Gallagher – *Administration support*
Jacinta James – *Administration support*
Vicki Masson – *National coordinator*
Dr Lynn Sadler – *Perinatal epidemiology services*

The national coordination services are provided to facilitate the PMMRC's collection of data on both perinatal and maternal mortality and morbidity. The service encompasses the following areas and requirements.

Coordinating perinatal and maternal mortality data collection

- Providing support to LMCs, clinicians and local coordinators to complete the PMMRC data collection following a perinatal or maternal death.
- Coordinating the collection of information to enable the review of maternal deaths by the MMRWG.
- Ensuring the data's integrity by following up on missing data and checking the accuracy of the data provided and the PSANZ classification of cause of death.
- Noting issues for improving data collection and thus assisting with the development and enhancement of the PMMRC information systems.
- Working with the PMMRC, the University of Otago's Mortality Review Data Group and local coordinators to enhance the development of the PMMRC data forms and guidelines.
- Commencing a validation study of the PMMRC methodology for determining contributory factors and potential avoidability in perinatal related mortality – local compared to national review using the PMMRC Classification Form.
- Commencing an audit of perinatal related death in 2010 due to congenital anomaly associated with cardiac, neural tube or chromosomal abnormalities. Auditing the accuracy, completeness and the PSANZ classification in the PMMRC data and the quality of maternity care provided.

Coordinating perinatal and maternal morbidity data collection

- Supporting the Neonatal Encephalopathy and Australasian Maternity Outcomes Surveillance System (AMOSS) working groups with their reviews of perinatal and maternal morbidity data.
- Assisting with developing data collection forms and databases and promoting morbidity data collection in New Zealand through the PMMRC local coordinators' network.

Training and supporting the PMMRC DHB local coordinators

- Organising the annual PMMRC local coordinator workshop to train and support DHB local coordinators.
- Visiting DHBs and the PMMRC local coordinators and providing support and training for their role.
- Providing resources for local DHB review of perinatal related mortality.

Supporting the PMMRC

- Providing a report from the PMMRC database for each PMMRC meeting, noting issues relating to data quality, new clinical issues and any other concerns that have been raised.
- Assisting with planning, preparing and supporting explanations for the analysis of the perinatal and maternal data in this report.
- Assisting with planning and preparation for the PMMRC annual workshop.

Supporting families and whānau

- The national coordinator is available to answer queries from families and whānau regarding perinatal and maternal mortality and morbidity.
- Presenting information on the PMMRC findings and its role at conferences and workshops.

The PMMRC national coordinator services have working relationships with the:

- Health Quality & Safety Commission Mortality Review Secretariat
- University of Otago's Mortality Review Data Group
- Child and Youth Mortality Review Committee (CYMRC)
- Coronial Services of New Zealand
- Perinatal and Reproductive Epidemiology Research Unit (PRERU), The University of New South Wales
- Paediatric Surveillance Unit (PSU).

APPENDICES

Appendix A: Additional Tables

Table 44: Perinatal related deaths by maternal age 2007–2010

Maternal age	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Total perinatal related deaths		
	n=260,264		n=578			n=1,491			n=735[1]			n=2,804[1]		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<20	19,844	7.6	42	7.3	2.12	150	10.1	7.56	86	11.7	4.38	278	9.9	14.01
20–24	47,301	18.2	96	16.6	2.03	313	21.0	6.62	167	22.7	3.56	576	20.5	12.18
25–29	63,787	24.5	133	23.0	2.09	337	22.6	5.28	175	23.8	2.76	645	23.0	10.11
30–34	72,520	27.9	148	25.6	2.04	352	23.6	4.85	147	20.0	2.04	647	23.1	8.92
35–39	46,757	18.0	123	21.3	2.63	267	17.9	5.71	130	17.7	2.80	520	18.5	11.12
≥40	10,055	3.9	36	6.2	3.58	72	4.8	7.16	29	3.9	2.92	137	4.9	13.63

1 Includes one missing maternal age

Table 45: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates by maternal age (<20, 20-39, ≥40) 2007–2010

Perinatal death classification (PDC)	Maternal Age: <20			20–39			≥40		
	n=19,844			n=230,365			n=10,055		
	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality[1]	66	23.7	3.33	654	27.4	2.84	53	38.7	5.27
Perinatal infection	14	5.0	0.71	87	3.6	0.38	5	3.6	0.50
Hypertension	3	1.1	0.15	85	3.6	0.37	7	5.1	0.70
Antepartum haemorrhage	31	11.2	1.56	239	10.0	1.04	11	8.0	1.09
Maternal conditions	9	3.2	0.45	98	4.1	0.43	12	8.8	1.19
Specific perinatal condition	19	6.8	0.96	242	10.1	1.05	10	7.3	0.99
Hypoxic peripartum	15	5.4	0.76	95	4.0	0.41	4	2.9	0.40
Fetal growth restriction	25	9.0	1.26	176	7.4	0.76	7	5.1	0.70
Spontaneous preterm	61	21.9	3.07	337	14.1	1.46	15	10.9	1.49
Unexplained antepartum	29	10.4	1.46	339	14.2	1.47	13	9.5	1.29
No obstetric antecedent	6	2.2	0.30	36	1.5	0.16	-	-	-

1 Excludes one maternal age missing

Table 46: Perinatal related death rates (per 1000) by baby ethnicity (prioritised) 2010

	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Total perinatal related deaths		
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (baby)														
Māori	19,019	29.2	33	21.6	1.74	124	36.4	6.52	78	37.1	4.14	235	33.4	12.36
Pacific peoples	7,322	11.2	18	11.8	2.46	52	15.2	7.10	31	14.8	4.27	101	14.3	13.79
Indian	2,480	3.8	5	3.3	2.02	19	5.6	7.66	10	4.8	4.07	34	4.8	13.71
Other Asian	5,025	7.7	17	11.1	3.38	23	6.7	4.58	14	6.7	2.81	54	7.7	10.75
Other/Not stated	3,990	6.1	9	5.9	2.26	15	4.4	3.76	7	3.3	1.77	31	4.4	7.77
NZ European	27,288	41.9	71	46.4	2.60	108	31.7	3.96	70	33.3	2.58	249	35.4	9.12

Table 47: Perinatal related death rates (per 1000) by maternal and baby ethnicity (prioritised) 2007–2010

	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Total perinatal related deaths		
	n=260,264		n=578			n=1,491			n=735			n=2,804		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	60,437	23.2	78	13.5	1.29	418	28.0	6.92	249	33.9	4.15	745	26.6	12.33
Pacific peoples	27,583	10.6	51	8.8	1.85	234	15.7	8.48	111	15.1	4.07	396	14.1	14.36
Indian	8,962	3.4	32	5.5	3.57	59	4.0	6.58	32	4.4	3.61	123	4.4	13.72
Other Asian	18,336	7.0	61	10.6	3.33	72	4.8	3.93	38	5.2	2.09	171	6.1	9.33
Other/Not stated	23,367	9.0	49	8.5	2.10	119	8.0	5.09	42	5.7	1.81	210	7.5	8.99
NZ European	121,579	46.7	307	53.1	2.53	589	39.5	4.84	263	35.8	2.18	1159	41.3	9.53
Ethnicity (baby)														
Māori	76,690	29.5	118	20.4	1.54	512	34.3	6.68	278	37.8	3.66	908	32.4	11.84
Pacific peoples	28,841	11.1	51	8.8	1.77	234	15.7	8.11	113	15.4	3.96	398	14.2	13.80
Indian	9,389	3.6	32	5.5	3.41	59	4.0	6.28	35	4.8	3.76	126	4.5	13.42
Other Asian	17,982	6.9	61	10.6	3.39	74	5.0	4.12	35	4.8	1.96	170	6.1	9.45
Other/Not stated	15,904	6.1	38	6.6	2.39	89	6.0	5.60	22	3.0	1.39	149	5.3	9.37
NZ European	111,458	42.8	278	48.1	2.49	523	35.1	4.69	252	34.3	2.28	1053	37.6	9.45

Table 48: Perinatal related death rates (per 1000) by baby ethnicity (sole/combination) 2010

	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Sole/combination ethnicity (baby)														
Māori only	6,113	8.2	9	5.9	1.47	52	15.2	8.51	36	17.1	5.95	97	13.8	15.87
Pacific only	5,337	3.3	13	8.5	2.44	43	12.6	8.06	24	11.4	4.54	80	11.4	14.99
Indian only	2,171	5.8	5	3.3	2.30	19	5.6	8.75	10	4.8	4.66	34	4.8	15.66
Other Asian only	3,786	2.9	11	7.2	2.91	14	4.1	3.70	13	6.2	3.46	38	5.4	10.04
Other only	1,920	41.9	4	2.6	2.08	7	2.1	3.65	6	2.9	3.14	17	2.4	8.85
NZE only	27,288	2.4	71	46.4	2.60	108	31.7	3.96	70	33.3	2.58	249	35.4	9.12
Māori and Pacific	1,576	2.4	2	1.3	1.27	4	1.2	2.54	10	4.8	6.37	16	2.3	10.15
Māori and NZE	8,123	12.5	16	10.5	1.97	44	12.9	5.42	22	10.5	2.73	82	11.6	10.09
Pacific and NZE	1,312	2.0	3	2.0	2.29	7	2.1	5.34	4	1.9	3.07	14	2.0	10.67
All other combinations	7,498	11.5	19	12.4	2.53	43	12.6	5.73	15	7.1	2.02	77	10.9	10.27

Table 49: Perinatal related death rates (per 1000) by baby ethnicity (sole/combination) 2007–2010

	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Total perinatal related deaths		
	n=260,264		n=578			n=1,491			n=735			n=2,804		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Sole/combination ethnicity (mother)														
Māori only	31,326	12.0	40	6.9	1.28	267	17.9	8.52	178	24.2	5.74	485	17.3	15.64
Pacific only	23,550	9.0	44	7.6	1.87	209	14.0	8.87	100	13.6	4.29	353	12.6	15.15
Indian only	8,651	3.3	31	5.4	3.58	57	3.8	6.59	32	4.4	3.74	120	4.3	14.01
Other Asian only	17,656	6.8	60	10.4	3.40	69	4.6	3.91	38	5.2	2.17	167	6.0	9.53
Other only	20,754	8.0	44	7.6	2.12	100	6.7	4.82	41	5.6	1.99	185	6.6	8.98
NZE only	121,579	46.7	307	53.1	2.53	589	39.5	4.84	263	35.8	2.18	1,159	41.3	9.60
Māori and Pacific	2,333	0.9	1	0.2	0.43	12	0.8	5.14	10	1.4	4.31	23	0.8	9.91
Māori and NZE	23,072	8.9	33	5.7	1.43	117	7.8	5.07	53	7.2	2.31	203	7.2	8.86
Pacific and NZE	2,760	1.1	3	0.5	1.09	14	0.9	5.07	8	1.1	2.92	25	0.9	9.11
All other combinations	8,583	3.3	15	2.6	1.75	57	3.8	6.64	12	1.6	1.41	84	3.0	9.87
Sole/combination ethnicity (baby)														
Māori only	26,132	10.0	36	6.2	1.38	220	14.8	8.42	162	22.0	6.26	418	14.9	16.00
Pacific only	21,194	8.1	39	6.7	1.84	198	13.3	9.34	96	13.1	4.58	333	11.9	15.71
Indian only	8,186	3.1	29	5.0	3.54	56	3.8	6.84	31	4.2	3.83	116	4.1	14.17
Other Asian only	13,466	5.2	48	8.3	3.56	49	3.3	3.64	28	3.8	2.09	125	4.5	9.28
Other only	8,005	3.1	23	4.0	2.87	55	3.7	6.87	20	2.7	2.52	98	3.5	12.24
NZE only	111,458	42.8	278	48.1	2.49	523	35.1	4.69	252	34.3	2.28	1,053	37.6	9.45
Māori and Pacific	6,051	2.3	7	1.2	1.16	40	2.7	6.61	24	3.3	4.00	71	2.5	11.73
Māori and NZE	32,280	12.4	61	10.6	1.89	187	12.5	5.79	67	9.1	2.09	315	11.2	9.76
Pacific and NZE	5,243	2.0	8	1.4	1.53	26	1.7	4.96	14	1.9	2.69	48	1.7	9.16
All other combinations	28,249	10.9	49	8.5	1.73	137	9.2	4.85	41	5.6	1.46	227	8.1	8.04

Table 50: Perinatal death classification (PSANZ-PDC) specific perinatal related death rate (per 1000) (excluding termination of pregnancy) by maternal ethnicity (prioritised Māori, Pacific peoples, and NZ European) among registered births in 2007–2010

Perinatal death classification (PDC)	Prioritised Māori n=60,437			Prioritised Pacific peoples n=27,583			Prioritised NZ European n=121,579		
	n=667			n=345			n=852		
	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	74	11.1	1.22	51	14.8	1.85	118	13.8	0.97
Perinatal infection	28	4.2	0.46	17	4.9	0.62	33	3.9	0.27
Hypertension	20	3.0	0.33	18	5.2	0.65	31	3.6	0.25
Antepartum haemorrhage	97	14.5	1.60	34	9.9	1.23	103	12.1	0.85
Maternal conditions	30	4.5	0.50	28	8.1	1.02	28	3.3	0.23
Specific perinatal conditions	58	8.7	0.96	31	9.0	1.12	117	13.7	0.96
Hypoxic peripartum death	32	4.8	0.53	13	3.8	0.47	50	5.9	0.41
Fetal growth restriction	47	7.0	0.78	25	7.2	0.91	81	9.5	0.67
Spontaneous preterm	149	22.3	2.47	63	18.3	2.28	122	14.3	1.00
Unexplained antepartum death	105	15.7	1.74	59	17.1	2.14	161	18.9	1.32
No obstetric antecedent	27	4.0	0.45	6	1.7	0.22	8	0.9	0.07

Table 51: Perinatal death classification (PSANZ-PDC) specific perinatal related death rate (excluding termination of pregnancy) by maternal ethnicity (sole Māori, sole Pacific peoples, sole NZ European) among registered births in 2007–2010

Perinatal death classification (PDC)	Sole Māori n=31,326			Sole Pacific peoples n=23,550			Sole NZ European n=121,579		
	n=341			n=234			n=661		
	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	36	10.6	1.15	32	13.7	1.36	89	13.5	0.73
Perinatal infection	13	3.8	0.41	11	4.7	0.47	28	4.2	0.23
Hypertension	10	2.9	0.32	14	6.0	0.59	23	3.5	0.19
Antepartum haemorrhage	42	12.3	1.34	24	10.3	1.02	74	11.2	0.61
Maternal conditions	15	4.4	0.48	19	8.1	0.81	21	3.2	0.17
Specific perinatal conditions	27	7.9	0.86	17	7.3	0.72	90	13.6	0.74
Hypoxic peripartum death	22	6.5	0.70	11	4.7	0.47	43	6.5	0.35
Fetal growth restriction	23	6.7	0.73	16	6.8	0.68	66	10.0	0.54
Spontaneous preterm	79	23.2	2.52	44	18.8	1.87	87	13.2	0.72
Unexplained antepartum death	55	16.1	1.76	43	18.4	1.83	133	20.1	1.09
No obstetric antecedent	19	5.6	0.61	3	1.3	0.13	7	1.1	0.06

Table 52: Distribution of registered births by deprivation decile (NZDep2006) 2010

NZ Deprivation Index (Dep 2006)	Total births	
	n=65,124	
	n	%
1	4,949	7.6
2	5,355	8.2
3	5,617	8.6
4	5,868	9.0
5	5,796	8.9
6	6,515	10.0
7	6,684	10.3
8	7,113	10.9
9	7,902	12.1
10	8,960	13.8
Unknown	365	0.6

Table 53: Perinatal related death rates (per 1000) by deprivation quintile (NZDep2006) 2007–2010

Deprivation quintile	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=260,264		n=578			n=1,491			n=735			n=2,804		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1	41,725	16.0	107	18.5	2.56	163	10.9	3.91	78	10.6	1.88	348	12.4	8.34
2	45,901	17.6	122	21.1	2.66	204	13.7	4.44	89	12.1	1.95	415	14.8	9.04
3	48,654	18.7	119	20.6	2.45	248	16.6	5.10	122	16.6	2.53	489	17.4	10.05
4	54,302	20.9	128	22.1	2.36	321	21.5	5.91	161	21.9	2.99	610	21.8	11.23
5	68,191	26.2	99	17.1	1.45	529	35.5	7.76	276	37.6	4.09	904	32.2	13.26
Unknown	1,491	0.6	3	0.5	-	26	1.7	-	9	1.2	-	38	1.4	-

Table 54: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000) (excluding termination of pregnancy) by deprivation quintile (NZDep2006) 2007–2010

Perinatal death classification (PDC)	Quintile 1 n=41,725			Quintile 2 n=45,901			Quintile 3 n=48,654			Quintile 4 n=54,302			Quintile 5 n=68,191		
	n=241			n=293			n=370			n=482			n=805		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	47	19.5	1.13	28	9.6	0.61	46	12.4	0.95	66	31.1	1.22	105	29.9	1.54
Perinatal infection	11	4.6	0.26	20	6.8	0.44	21	5.7	0.43	14	5.0	0.26	33	4.3	0.48
Hypertension	5	2.1	0.12	7	2.4	0.15	18	4.9	0.37	15	1.2	0.28	36	2.4	0.53
Antepartum haemorrhage	22	9.1	0.53	34	11.6	0.74	39	10.5	0.80	63	7.5	1.16	110	9.0	1.61
Maternal conditions	9	3.7	0.22	5	1.7	0.11	13	3.5	0.27	21	2.5	0.39	48	2.8	0.70
Specific perinatal condition	34	14.1	0.81	41	14.0	0.89	54	14.6	1.11	60	9.3	1.10	65	9.0	0.95
Hypoxic peripartum	11	4.6	0.26	17	5.8	0.37	19	5.1	0.39	27	5.6	0.50	37	4.3	0.54
Fetal growth restriction	21	8.7	0.50	26	8.9	0.57	34	9.2	0.70	42	6.2	0.77	69	7.6	1.01
Spontaneous preterm	30	12.4	0.72	52	17.7	1.13	62	16.8	1.27	90	16.1	1.66	150	14.2	2.20
Unexplained antepartum	49	20.3	1.17	58	19.8	1.26	59	15.9	1.21	77	14.9	1.42	129	15.2	1.89
No obstetric antecedent	2	0.8	0.05	5	2	0.11	5	1.4	0.10	7	0.6	0.13	23	1.4	0.34

Table 55: Perinatal related death rates (per 1000) by DHB of maternal residence 2010

Maternal domicile	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=65,124		n=153			n=341			n=210			n=704		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	2,476	3.8	3	2.0	1.21	19	5.6	7.67	12	5.7	4.89	34	4.8	13.73
Waitemata	8,155	12.5	24	15.7	2.94	27	7.9	3.31	22	10.5	2.71	73	10.4	8.95
Auckland	6,751	10.4	24	15.7	3.56	34	10.0	5.04	20	9.5	2.99	78	11.1	11.55
Counties Manukau	8,908	13.7	22	14.4	2.47	58	17.0	6.51	29	13.8	3.29	109	15.5	12.24
Waikato	5,730	8.8	14	9.2	2.44	28	8.2	4.89	23	11.0	4.04	65	9.2	11.34
Bay of Plenty	3,000	4.6	5	3.3	1.67	11	3.2	3.67	11	5.2	3.69	27	3.8	9.00
Lakes	1,633	2.5	2	1.3	1.22	8	2.3	4.90	6	2.9	3.70	16	2.3	9.80
Tairawhiti	811	1.2	2	1.3	2.47	6	1.8	7.40	3	1.4	3.74	11	1.6	13.56
Taranaki	1,622	2.5	2	1.3	1.23	15	4.4	9.25	4	1.9	2.49	21	3.0	12.95
Hawke's Bay	2,359	3.6	7	4.6	2.97	16	4.7	6.78	11	5.2	4.71	34	4.8	14.41
Whanganui	916	1.4	1	0.7	1.09	5	1.5	5.46	4	1.9	4.40	10	1.4	10.92
MidCentral	2,389	3.7	9	5.9	3.77	13	3.8	5.44	10	4.8	4.22	32	4.5	13.39
Wairarapa	556	0.9	1	0.7	1.80	4	1.2	7.19	1	0.5	1.81	6	0.9	10.79
Capital & Coast	4,013	6.2	7	4.6	1.74	14	4.1	3.49	8	3.8	2.00	29	4.1	7.23
Hutt Valley	2,170	3.3	4	2.6	1.84	12	3.5	5.53	3	1.4	1.39	19	2.7	8.76
Nelson Marlborough	1,729	2.7	2	1.3	1.16	5	1.5	2.89	5	2.4	2.90	12	1.7	6.94
West Coast	435	0.7	2	1.3	4.60	2	0.6	4.60	2	1.0	4.64	6	0.9	13.79
Canterbury	6,729	10.3	15	9.8	2.23	44	12.9	6.54	25	11.9	3.75	84	11.9	12.48
South Canterbury	632	1.0	2	1.3	3.16	2	0.6	3.16	4	1.9	6.37	8	1.1	12.66
Otago	2,087	3.2	4	2.6	1.92	11	3.2	5.27	3	1.4	1.45	18	2.6	8.62
Southland	1,710	2.6	1	0.7	0.58	6	1.8	3.51	4	1.9	2.35	11	1.6	6.43
Other [1]	313	0.5	-	-	-	1	0.3	-	-	-	-	1	0.1	-

1 Other includes Overseas, Unknown and Other

Table 56: Perinatal related death rates (per 1000) by DHB of maternal residence 2007–2010

Maternal domicile	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=260,264		n=578			n=1,491			n=735			n=2,804		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	9,498	3.6	14	2.4	1.47	67	4.5	7.05	36	4.9	3.82	117	4.2	12.32
Waitemata	31,825	12.2	107	18.5	3.36	174	11.7	5.47	62	8.4	1.97	343	12.2	10.78
Auckland	26,949	10.4	85	14.7	3.15	131	8.8	4.86	72	9.8	2.69	288	10.3	10.69
Counties Manukau	35,777	13.7	73	12.6	2.04	261	17.5	7.30	135	18.4	3.81	469	16.7	13.11
Waikato	22,871	8.8	52	9.0	2.27	115	7.7	5.03	75	10.2	3.30	242	8.6	10.58
Bay of Plenty	12,052	4.6	17	2.9	1.41	57	3.8	4.73	46	6.3	3.84	120	4.3	9.96
Lakes	6,781	2.6	8	1.4	1.18	48	3.2	7.08	28	3.8	4.16	84	3.0	12.39
Tairawhiti	3,268	1.3	4	0.7	1.22	18	1.2	5.51	10	1.4	3.08	32	1.1	9.79
Taranaki	6,498	2.5	10	1.7	1.54	39	2.6	6.00	16	2.2	2.48	65	2.3	10.00
Hawke's Bay	9,597	3.7	19	3.3	1.98	52	3.5	5.42	28	3.8	2.94	99	3.5	10.32
Whanganui	3,724	1.4	9	1.6	2.42	27	1.8	7.25	11	1.5	2.98	47	1.7	12.62
MidCentral	9,458	3.6	28	4.8	2.96	62	4.2	6.56	31	4.2	3.31	121	4.3	12.79
Wairarapa	2,194	0.8	7	1.2	3.19	13	0.9	5.93	7	1.0	3.22	27	1.0	12.31
Capital & Coast	16,280	6.3	34	5.9	2.09	80	5.4	4.91	26	3.5	1.61	140	5.0	8.60
Hutt Valley	8,938	3.4	23	4.0	2.57	52	3.5	5.82	22	3.0	2.48	97	3.5	10.85
Nelson Marlborough	6,894	2.6	12	2.1	1.74	29	1.9	4.21	18	2.4	2.63	59	2.1	8.56
West Coast	1,732	0.7	3	0.5	1.73	9	0.6	5.20	10	1.4	5.81	22	0.8	12.70
Canterbury	26,930	10.3	47	8.1	1.75	150	10.1	5.57	71	9.7	2.66	268	9.6	9.95
South Canterbury	2,617	1.0	5	0.9	1.91	17	1.1	6.50	8	1.1	3.08	30	1.1	11.46
Otago	8,428	3.2	13	2.2	1.54	47	3.2	5.58	12	1.6	1.43	72	2.6	8.54
Southland	6,664	2.6	8	1.4	1.20	40	2.7	6.00	9	1.2	1.36	57	2.0	8.55
Other [1]	1,289	0.5	-	-	-	3	0.2	2.33	2	0.3	1.56	5	0.2	3.88

1 Other includes Overseas, Unknown and Other

Table 57: Perinatal related deaths by primary and associated perinatal death classification (PSANZ-PDC) 2010

Perinatal death classification (PDC)	Primary perinatal death classification		Associated PDC classification 1		Associated PDC classification 2		Assigned PDC classifications	
	n=704		n=704		n=704		n=704[1]	
	n	%	n	%	n	%	n	%
Congenital abnormality	211	30.0	3	0.4	-	-	214	30.4
Perinatal infection	27	3.8	6	0.9	1	0.1	34	4.8
Hypertension	26	3.7	2	0.3	-	-	28	4.0
Antepartum haemorrhage	78	11.1	14	2.0	-	-	92	13.1
Maternal conditions	32	4.5	10	1.4	4	0.6	46	6.5
Specific perinatal condition	69	9.8	2	0.3	-	-	71	10.1
Hypoxic peripartum	20	2.8	9	1.3	-	-	29	4.1
Fetal growth restriction	48	6.8	24	3.4	4	0.6	76	10.8
Spontaneous preterm	111	15.8	47	6.7	3	0.4	161	22.9
Unexplained antepartum	72	10.2	-	-	-	-	72	10.2
No obstetric antecedent	10	1.4	-	-	-	-	10	1.4

1 Babies may be represented in more than one row so totals do not sum to 100%

Table 58: Neonatal deaths by primary and associated neonatal death classification (PSANZ-NDC) 2010

Neonatal death classification (NDC)	Primary perinatal death classification		Associated NDC classification 1		Associated NDC classification 2		Assigned NDC classifications	
	n=210		n=210		n=210		n=210[1]	
	n	%	n	%	n	%	n	%
Congenital abnormality	46	21.9	-	-	-	-	46	21.9
Extreme prematurity	84	40.0	-	-	-	-	84	40.0
Cardio-respiratory disorders	18	8.6	16	7.6	5	2.4	39	18.6
Infection	19	9.0	1	0.5	1	0.5	21	10.0
Neurological	27	12.9	12	5.7	1	0.5	40	19.0
Gastrointestinal	6	2.9	3	1.4	-	-	9	4.3
Other	10	4.8	4	1.9	2	1.0	16	7.6

1 Babies may be represented in more than one row so totals do not sum to 100%

Table 59: Optimal investigation of perinatal related deaths by DHB of maternal residence 2010

DHB of maternal residence	Perinatal related deaths	Offered post-mortem		Optimal investigation	
	n	n	%	n	%
Northland	34	19	55.9	11	32.4
Waitemata	73	60	82.2	41	56.2
Auckland	78	67	85.9	47	60.3
Counties Manukau	109	101	92.7	43	39.4
Waikato	65	55	84.6	25	38.5
Bay of Plenty	27	25	92.6	7	25.9
Lakes	16	15	93.8	1	6.3
Tairawhiti	11	8	72.7	4	36.4
Taranaki	21	20	95.2	7	33.3
Hawke's Bay	34	31	91.2	21	61.8
Whanganui	10	10	100.0	2	20.0
MidCentral	32	30	93.8	12	37.5
Wairarapa	6	5	83.3	4	66.7
Capital & Coast	29	23	79.3	16	55.2
Hutt Valley	19	19	100.0	7	36.8
Nelson Marlborough	12	8	66.7	7	58.3
West Coast	6	5	83.3	2	33.3
Canterbury	84	78	92.9	39	46.4
South Canterbury	8	6	75.0	4	50.0
Otago	18	16	88.9	10	55.6
Southland	11	8	72.7	4	36.4
Overseas	1	1	100.0	1	100.0

Table 60: Optimal investigation of perinatal related deaths by DHB of maternal residence 2007–2010

DHB of maternal residence	Perinatal related deaths	Offered post-mortem		Optimal investigation	
	n	n	%	n	%
Northland	117	81	69.2	31	26.5
Waitemata	343	277	80.8	179	52.2
Auckland	288	251	87.2	168	58.3
Counties Manukau	469	433	92.3	173	36.9
Waikato	242	199	82.2	94	38.8
Bay of Plenty	120	87	72.5	29	24.2
Lakes	84	69	82.1	13	15.5
Tairawhiti	32	27	84.4	12	37.5
Taranaki	65	56	86.2	16	24.6
Hawke's Bay	99	87	87.9	52	52.5
Whanganui	47	40	85.1	13	27.7
MidCentral	121	104	86.0	60	49.6
Wairarapa	27	24	88.9	14	51.9
Capital & Coast	140	117	83.6	93	66.4
Hutt Valley	97	89	91.8	61	62.9
Nelson Marlborough	59	45	76.3	30	50.8
West Coast	22	16	72.7	8	36.4
Canterbury	268	238	88.8	154	57.5
South Canterbury	30	24	80.0	13	43.3
Otago	72	65	90.3	37	51.4
Southland	57	40	70.2	16	28.1
Overseas	5	3	60.0	2	40.0

Table 61: Complete primary perinatal death classification (PSANZ-PDC) by type of perinatal related death 2010

Perinatal death classification (PDC)		Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=153		n=341		n=210		n=704	
		n	%	n	%	n	%	n	%
	Congenital abnormality								
1.1	Central nervous system	27	17.6	3	0.9	6	2.9	36	5.1
1.2	Cardiovascular system	18	11.8	5	1.5	7	3.3	30	4.3
1.3	Urinary system	11	7.2	1	0.3	6	2.9	18	2.6
1.4	Gastrointestinal system	1	0.7	2	0.6	-	-	3	0.4
1.5	Chromosomal	42	27.5	18	5.3	12	5.7	72	10.2
1.6	Metabolic	-	-	-	-	1	0.5	1	0.1
1.7	Multiple/non chromosomal syndromes	14	9.2	4	1.2	6	2.9	24	3.4
1.8	Other congenital abnormality	-	-	-	-	-	-	-	-
1.81	Musculoskeletal	8	5.2	-	-	1	0.5	9	1.3
1.82	Respiratory	-	-	-	-	1	0.5	1	0.1
1.83	Diaphragmatic hernia	4	2.6	-	-	4	1.9	8	1.1
1.84	Haematological	-	-	1	0.3	1	0.5	2	0.3
1.85	Tumours	1	0.7	-	-	-	-	1	0.1
1.88	Other specified congenital abnormality	3	2.0	-	-	1	0.5	4	0.6
1.9	Unspecified congenital abnormality	1	0.7	1	0.3	-	-	2	0.3
	Perinatal infections								
2.1	Bacterial	-	-	-	-	-	-	-	-
2.11	Group B Streptococcus	-	-	3	0.9	5	2.4	8	1.1
2.12	E coli	-	-	1	0.3	2	1.0	3	0.4
2.13	Listeria monocytogenes	-	-	2	0.6	-	-	2	0.3
2.19	Unspecified bacterial	-	-	3	0.9	-	-	3	0.4
2.2	Viral	-	-	-	-	-	-	-	-
2.21	Cytomegalovirus	1	0.7	6	1.8	-	-	7	1.0
2.3	Protozoal, eg, Toxoplasma	2	1.3	1	0.3	-	-	3	0.4
2.9	Other unspecified organism	-	-	-	-	1	0.5	1	0.1

Perinatal death classification (PDC)		Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=153		n=341		n=210		n=704	
		n	%	n	%	n	%	n	%
	Hypertension								
3.2	Chronic hypertension: Secondary, eg, renal disease	1	0.7	-	-	-	-	1	0.1
3.3	Chronic hypertension: Unspecified	-	-	1	0.3	-	-	1	0.1
3.4	Gestational hypertension	-	-	1	0.3	-	-	1	0.1
3.5	Pre-eclampsia	2	1.3	12	3.5	4	1.9	18	2.6
3.51	Pre-eclampsia: With laboratory evidence of thrombophilia	-	-	1	0.3	-	-	1	0.1
3.6	Pre-eclampsia superimposed on chronic hypertension	-	-	-	-	1	0.5	1	0.1
3.61	Pre-eclampsia superimposed on chronic hypertension: With laboratory evidence of thrombophilia	-	-	1	0.3	1	0.5	2	0.3
3.9	Unspecified hypertension	-	-	1	0.3	-	-	1	0.1
	Antepartum haemorrhage (APH)								
4.1	Placental abruption	-	-	26	7.6	11	5.2	37	5.3
4.11	Placental abruption: With laboratory evidence of thrombophilia	-	-	1	0.3	2	1.0	3	0.4
4.2	Placenta praevia	-	-	-	-	3	1.4	3	0.4
4.3	Vasa praevia	-	-	1	0.3	-	-	1	0.1
4.8	Other APH	-	-	5	1.5	4	1.9	9	1.3
4.9	APH of undetermined origin	-	-	13	3.8	12	5.7	25	3.6
	Maternal conditions								
5.1	Termination of pregnancy for maternal psychosocial indications	2	1.3	-	-	-	-	2	0.3
5.2	Diabetes/gestational diabetes	2	1.3	14	4.1	2	1.0	18	2.6
5.31	Maternal injury: Accidental	-	-	2	0.6	-	-	2	0.3
5.32	Maternal injury: Non-accidental	-	-	1	0.3	-	-	1	0.1
5.4	Maternal sepsis	-	-	1	0.3	1	0.5	2	0.3
5.5	Antiphospholipid syndrome	-	-	3	0.9	1	0.5	4	0.6
5.8	Other specified maternal conditions	1	0.7	2	0.6	-	-	3	0.4

Perinatal death classification (PDC)		Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=153		n=341		n=210		n=704	
		n	%	n	%	n	%	n	%
	Specific perinatal conditions								
6.1	Twin-twin transfusion	4	2.6	11	3.2	7	3.3	22	3.1
6.2	Fetomaternal haemorrhage	-	-	7	2.1	1	0.5	8	1.1
6.31	Cord haemorrhage	-	-	1	0.3	-	-	1	0.1
6.32	True knot with evidence of occlusion	-	-	3	0.9	-	-	3	0.4
6.38	Other	-	-	15	4.4	-	-	15	2.1
6.39	Unspecified	-	-	-	-	-	-	-	-
6.4	Uterine abnormalities, eg, bicornuate uterus, cervical incompetence	-	-	2	0.6	8	3.8	10	1.4
6.64	Alloimmune disease: Alloimmune thrombocytopenia	1	0.7	1	0.3	-	-	2	0.3
6.7	Idiopathic hydrops	1	0.7	2	0.6	-	-	3	0.4
6.81	Rupture of membranes after amnicentesis	-	-	1	0.3	-	-	1	0.1
6.82	Termination of pregnancy for suspected but unconfirmed congenital abnormality	-	-	-	-	-	-	-	-
6.83	Fetal subdural haematoma	-	-	1	0.3	1	0.5	2	0.3
6.88	Other	-	-	1	0.3	1	0.5	2	0.3
	Hypoxic peripartum death								
7.1	With intrapartum complications	-	-	-	-	-	-	-	-
7.11	With intrapartum complications: Uterine rupture	-	-	-	-	1	0.5	1	0.1
7.12	With intrapartum complications: Cord prolapse	-	-	2	0.6	3	1.4	5	0.7
7.18	With intrapartum complications: Other	-	-	1	0.3	2	1.0	3	0.4
7.2	Evidence of non-reassuring fetal status in a normally grown infant (eg, abnormal fetal heart rate, fetal scalp ph/lactate, fetal pulse oximetry without intrapartum complications)	-	-	2	0.6	5	2.4	7	1.0
7.3	No intrapartum complications and no evidence of non-reassuring fetal status	-	-	-	-	1	0.5	1	0.1
7.9	Unspecified hypoxic peripartum death	-	-	2	0.6	1	0.5	3	0.4
	Fetal growth restriction (FGR)								
8.1	With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)	2	1.3	26	7.6	5	2.4	33	4.7
8.3	No placental pathology	-	-	4	1.2	1	0.5	5	0.7
8.4	No examination of placenta	1	0.7	1	0.3	-	-	2	0.3
8.8	Other specified placental pathology	-	-	8	2.3	-	-	8	1.1

Perinatal death classification (PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=153		n=341		n=210		n=704	
		n	%	n	%	n	%	n	%
	Spontaneous preterm								
9.1	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery	-	-	-	-	1	0.5	1	0.1
9.11	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: With chorioamnionitis	-	-	11	3.2	18	8.6	29	4.1
9.12	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Without chorioamnionitis	-	-	4	1.2	9	4.3	13	1.8
9.13	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: No examination of placenta	-	-	3	0.9	-	-	3	0.4
9.17	No clinical signs of chorioamnionitis, no examination of placenta	-	-	6	1.8	11	5.2	17	2.4
9.19	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Unspecified or not known whether placenta examined	-	-	-	-	6	2.9	6	0.9
9.2	Spontaneous preterm with membrane rupture ≥24 hours before delivery	-	-	-	-	-	-	-	-
9.21	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With chorioamnionitis	1	0.7	16	4.7	17	8.1	34	4.8
9.22	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Without chorioamnionitis	1	0.7	-	-	1	0.5	2	0.3
9.23	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	-	-	-	-	3	1.4	3	0.4
9.27	No clinical signs of chorioamnionitis, no examination of placenta	1	0.7	-	-	1	0.5	2	0.3
9.3	Spontaneous preterm with membrane rupture of unknown duration before delivery	-	-	-	-	-	-	-	-
9.37	No clinical signs of chorioamnionitis, no examination of placenta	-	-	1	0.3	-	-	1	0.1
	Unexplained antepartum death								
10.1	With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)	-	-	10	2.9	-	-	10	1.4
10.3	No placental pathology	-	-	19	5.6	-	-	19	2.7
10.4	No examination of placenta	-	-	14	4.1	-	-	14	2.0
10.8	Other specified placental pathology	-	-	27	7.9	-	-	27	3.8
10.9	Unspecified or not known whether placenta examined	-	-	2	0.6	-	-	2	0.3

Perinatal death classification (PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=153		n=341		n=210		n=704	
		n	%	n	%	n	%	n	%
	No obsteric antecedent								
11.2	Postnatally acquired infection	-	-	-	-	2	1.0	2	0.3
11.8	Other specified	-	-	-	-	1	0.5	1	0.1
11.9	Unknown/Undetermined	-	-	-	-	-	-	-	-
11.91	Unclassified Sudden Infant Death	-	-	-	-	7	3.3	7	1.0

Table 62: Complete primary neonatal death classification (PSANZ-NDC) for neonatal deaths 2010

NDC	Neonatal death classification (NDC)	Neonatal deaths n=210	
		n	%
	Congenital abnormality		
1.1	Central nervous system	6	2.9
1.2	Cardiovascular system	7	3.3
1.3	Urinary system	6	2.9
1.5	Chromosomal	12	5.7
1.6	Metabolic	1	0.5
1.7	Multiple/non chromosomal syndromes	6	2.9
1.8	Other congenital abnormality	-	-
1.81	Musculoskeletal	1	0.5
1.82	Respiratory	1	0.5
1.83	Diaphragmatic hernia	4	1.9
1.84	Haematological	1	0.5
1.88	Other specified congenital abnormality	1	0.5
	Extreme prematurity		
2.1	Not resuscitated	71	33.8
2.2	Unsuccessful resuscitation	13	6.2
	Cardio-respiratory disorders		
3.1	Hyaline membrane disease/Respiratory distress syndrome (RDS)	8	3.8
3.3	Primary persistent pulmonary hypertension	1	0.5
3.4	Pulmonary hypoplasia	3	1.4
3.5	Chronic neonatal lung disease (typically, bronchopulmonary dysplasia)	2	1.0
3.6	Pulmonary haemorrhage	3	1.4
3.8	Other	1	0.5
	Infection		
4.1	Bacterial	-	-
4.11	Congenital bacterial	1	0.5
4.111	Congenital bacterial: Group B Streptococcus	6	2.9
4.112	Congenital bacterial: E coli	3	1.4
4.119	Congenital bacterial: Unspecified bacterial	2	1.0
4.12	Acquired bacterial	-	-
4.122	Acquired bacterial: E coli	1	0.5
4.125	Acquired bacterial: Other Gram negative bacilli (other than E coli)	1	0.5
4.126	Acquired bacterial: Staphylococcus aureus	1	0.5
4.128	Acquired bacterial: Other specified bacterial	3	1.4

NDC	Neonatal death classification (NDC)	Neonatal deaths	
		n=210	
		n	%
4.2	Viral	-	-
4.22	Acquired viral	-	-
4.228	Acquired viral: Other specified viral	1	0.5
	Neurological		
5.1	Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)	24	11.4
5.2	Intracranial haemorrhage	-	-
5.21	Intraventrical haemorrhage	1	0.5
5.24	Subdural haemorrhage	1	0.5
5.8	Other	1	0.5
	Gastrointenstinal		
6.1	Necrotising enterocolitis	6	2.9
	Other		
7.8	Other specified	2	1.0
7.9	Unknown/undetermined	-	-
7.91	Unclassified Sudden Infant Death	-	-
7.911	Unclassified Sudden Infant Death: Bed sharing	7	3.3
7.912	Unclassified Sudden Infant Death: Not bed sharing	1	0.5

APPENDICES

Appendix B: Maternal Mental Health Survey

Introduction

Suicide is a leading cause of maternal death in New Zealand (PMMRC 2011) as in the UK (CMACE 2011b). Mental health problems are common during pregnancy and the postnatal period. At least one in 10 women experience depression during pregnancy, and a similar number are depressed following the birth of a child (O'Hara 1984; Bennett 2004; O'Hara and Swain 1996). Psychosis (a serious illness) complicates the early postnatal period after two in 1000 pregnancies, and women with some pre-existing mental health conditions such as bipolar disorder are at high risk of relapse (50–70%) even if they have been previously well (Weick 1991; Robertson 2005). Anxiety disorders are also common (Ross and McLean 2006), and there are some that are specific to the perinatal period such as tokophobia (Hofberg 2000). The Fifth Annual Report of the Perinatal and Maternal Mortality Review Committee (PMMRC) recommended that lead maternity carers (LMCs) ask about current mental health, past mental health and family history of mental health problems at the booking visit (PMMRC 2011). It is recommended that a woman's mental health history be shared between general practitioners (GPs) and LMCs when the LMC is other than the GP. It is suggested that women with a history of serious mental illness should be referred to mental health services for monitoring and support during pregnancy, until three months postnatal. These guidelines are supported by the New Zealand Guidelines Group and the NICE guidelines (New Zealand Guidelines Group 2008; National Institute for Health and Clinical Excellence 2007).

These guidelines require that LMCs enquire about a pregnant woman's mental health as part of her general history. LMCs need to feel comfortable in doing this and, if necessary, need to know where to seek further advice or where to refer women if required. This involves information sharing, and the interfaces between LMCs, GPs, maternal mental health services and generic mental health services are important. We set out to investigate whether, in fact, LMCs were routinely enquiring about mental health history, how comfortable they were in doing this and whether clear pathways for referral existed if needed. In addition, we asked about existing mental health services and whether there were difficulties in accessing services or problems in LMCs accessing support when deciding what management plan may be optimal for a particular woman. Questions were also asked about inpatient mental health facilities, as there is no mother and baby unit in the North Island to which mentally ill women can be admitted with their infants. In contrast, the South Island has such a unit in Christchurch. Maternal mental health services are configured differently throughout the 20 DHBs in New Zealand for a variety of reasons, and the aim was to understand any problems encountered by LMCs in daily practice.

Design

The Maternal Mental Health Services Survey was opened on Survey Monkey on 20 October 2010 and closed on 4 February 2011. Respondents were asked if they routinely asked women about their personal and family history of mental illness. They were asked if there was a specific referral pathway if a problem was identified and about access to services.

Questions asked were:

- Which DHB do you primarily work at?
- Which professional group do you identify with?
- Are there specific questions about the woman's personal and family history of mental illness included on the clinical notes that you routinely use when assessing a woman presenting for maternity care?
- Is there a specific referral pathway for women identified as having an existing mental health problem or being at high risk of developing mental health problems during pregnancy or postpartum?
- If past mental health history is identified, to which service(s) is a referral made?
- Describe the process for an acute mental health admission.
- If the mother is admitted, do the inpatient facilities allow her to be admitted with her baby?

- If the mother is admitted, is she admitted with the baby or separated?
- Do you have a specialised maternal mental health team?
- Can you refer a woman directly to this service?
- Do you have access to general psychiatric services?
- What other psychiatric/mental health services do you have available for high-risk women? Please describe.
- What psychiatric/maternal mental health services does your area lack?
- What is your level of comfort in asking a woman about her personal mental health history?
- Did you receive any training to ask questions about personal mental health history?
- Do you think you would benefit from more training?
- Do you have any further comments?

Results

The survey was conducted via Survey Monkey. It reached approximately 1000 LMCs and generated 398 responses in all. The respondents were midwives (89.6%), obstetricians (9.3%) and paediatricians (1.1%), and local PMMRC coordinators were also represented. LMCs from all DHBs were represented, but Canterbury participation was the highest at 17.7 percent of the total, which was disproportionately high for that DHB.

The majority of LMCs (74.2%) routinely ask specific questions about mental health history, but a significant 25.8 percent do not. Only 60.1 percent identified a specific referral pathway if a woman is identified as having an existing mental health problem or being at high risk.

4. Are there specific questions about the woman's personal and family history of mental illness included on the clinical notes that you routinely use when assessing a woman pressenting for maternity care?

	Response Percent	Response Count
Yes	73.9	266
No	22.8	82
Don't know	3.3	12
	answered question	360
	skipped question	10

5. Is there a specific referral pathway for women idetified as having an existing mental health problem or being at risk of developing mental health problems during prednancy or post-partum?

	Response Percent	Response Count
Yes	60.6	194
No	25.3	81
Don't know	14.1	45
	answered question	320
	skipped question	50

With respect to comfort in asking about mental health history, 44.8 percent reported that they were completely comfortable in enquiring about mental health history. However, 16.1 percent felt uncomfortable to some degree. Most LMCs (83.3%) felt they would benefit from more training to enquire about mental health history, and over half (55.6%) said they had never received any training in this area.

15. What is your level of comfort in asking a woman her personal mental health history?

	Response Percent	Response Count
Completely uncomfortable	7.1	22
Somewhat uncomfortable	8.4	26
Neither comfortable nor uncomfortable	12.6	39
Somewhat comfortable	25.8	80
Completely comfortable	46.1	143
	answered question	310
	skipped question	60

16. Did you receive any training to ask questions about personal mental health history?

	Response Percent	Response Count
Yes	42.1	131
No	55.0	171
Don't know	2.9	9
	answered question	311
	skipped question	59

17. Do you think you would benefit from more training?

	Response Percent	Response Count
Yes	83.5	258
No	8.7	27
Don't know	7.8	24
	answered question	309
	skipped question	61

Maternal mental health teams were available to 64.4 percent of respondents, and 75.6 percent said could refer directly to that service. A similar number (62.5%) had access to general psychiatric services. There are a number of different services to which women are referred if a significant mental health problem is identified. These include referrals most commonly to the general practitioner (28.3%), maternal mental health (33.8%), and mental health, including crisis or liaison services (23.4%). Referrals are less commonly made to social work (7.1%) or obstetricians (2.2%) and also referral to the mother-baby service (6.1%) for those in Canterbury. There were comments in the free text responses that LMCs were at times confused and felt unable to access what they needed or were unclear of the pathway, depending upon the severity of the issue identified.

The process by which an acute admission was dealt with was generally clear, most replies indicating that LMCs had access to acute mental health services in some form in their area. However, 8.3 percent had 'no idea' what the process was, 4.9 percent had experienced difficulties in the past and 1.7 percent had no prior experience and would be unsure what to do.

The question concerning what services are felt to be lacking was answered by 207 LMCs, of whom 50 (24.1%) felt that their area lacked a mother-baby unit. Access to services was also commonly felt to be a problem. Crisis situations were more easily dealt with than less acute problems for which expert advice or help was needed. A total of 32.3 percent of respondents felt that maternal mental health services were overwhelmed, poorly coordinated or insufficient. There were 14 percent who felt that there were problems with access to services. There were some comments (10) that a very good service existed.

Conclusions

Although the survey reached 1000 LMCs, there were 396 replies and considerably fewer for many of the qualitative responses. It was, however, an attempt to ask the providers of maternity care something about their experiences of dealing with women with mental health issues. Shortcomings were that we did not ask more specifically about the interface between LMCs and GPs. In addition, there were no questions about alcohol or drug use, although some of the responders were concerned about this issue. There were no specific questions about Māori, although in the replies, specific Māori services were highlighted as valued resources in some districts.

The data did not allow us to make comparisons between DHBs directly, but it did appear that those in Canterbury (who participated at the highest rate) were also both better trained (some had postgraduate qualifications in perinatal mental health) and more satisfied with services in that district.

It seems clear from this survey that the area of mental health is often not one where LMCs feel confident. Over half had never received any training to ask about mental health issues, and 83.3 percent felt they would benefit from more training. A minority (16.1%) said they were uncomfortable enquiring about mental health issues.

The survey did not specifically establish how much information about mental health history is shared by GPs at booking. However, it does seem clear that, when a mental health problem exists, there is a lack of clarification about whether a referral to another service is necessary, and if it is, what is the appropriate pathway. When a crisis occurs, there is clear support from GPs and acute mental health services. What is less clear is, when women have a significant history of a mental health problem or a current problem of moderate severity, what support should be offered and from which service. Many LMCs felt unsure about this, and also frustrated at being unable to access services themselves (referral is via the GP) when the problem was not a crisis.

There were many comments about the interface with general practice, and GPs were one of the most frequent services to which referrals were made if a mental health problem was identified, including in a crisis. A significant minority of LMCs (39.9 percent) did not know of the referral pathway when a woman was identified as either having a mental health disorder or being at high risk of developing one during pregnancy.

The lack of a mother and baby unit where women could be admitted with their infants in the postnatal period was identified as the main area where maternal mental health services were actually deficient. There were many comments that services were excellent but tended to be overwhelmed and were therefore difficult to access and had long waiting lists. A dedicated liaison maternal mental health clinician was identified as valuable when available, whereas 9.6 percent felt that their service lacked such a resource.

Recommendations

In order that the recommendations of the PMMRC can be implemented throughout New Zealand, it is important to understand whether LMCs feel that they can competently ask about a woman's mental health and are able to identify if any ongoing management is required from other services and seek an appropriate referral pathway where necessary.

The 20 DHBs in New Zealand are differently configured, so the referral pathway will look slightly different in each one. However, more training in mental health issues would be welcomed by most LMCs and clarity around the referral pathway when a woman is identified as requiring support from either primary care or mental health services. A specific liaison person may be an integral part of the pathway for many districts, as discussion about how to proceed is valuable and provides support to LMCs. Improved integration between maternity services, mental health services and primary care is recommended. This will ensure mental health problems are highlighted and managed appropriately in pregnancy and postpartum.

The lack of a facility where women who are acutely mentally unwell can be admitted with their babies was seen as a major gap in services. The PMMRC recommends that there be a mother and baby unit in the North Island.

Appendix C: Classifications of the Perinatal Society of Australia and New Zealand (PSANZ 2009)[2]

7.4 PSANZ Perinatal Mortality Classification (PSANZ-PDC)

7.4.1 PSANZ Perinatal Death Classification (PSANZ-PDC)

1. Congenital abnormality (including terminations for congenital abnormalities)

- 1.1 Central nervous system
- 1.2 Cardiovascular system
- 1.3 Urinary system
- 1.4 Gastrointestinal system
- 1.5 Chromosomal
- 1.6 Metabolic
- 1.7 Multiple/non-chromosomal syndromes
- 1.8 Other congenital abnormality
  - 1.81 Musculoskeletal
  - 1.82 Respiratory
  - 1.83 Diaphragmatic hernia
  - 1.84 Haematological
  - 1.85 Tumours
  - 1.88 Other specified congenital abnormality
- 1.9 Unspecified congenital abnormality

2. Perinatal infection

- 2.1 Bacterial
  - 2.11 Group B streptococcus
  - 2.12 E. coli
  - 2.13 Listeria monocytogenes
  - 2.14 Spirochaetal (eg, syphilis)
  - 2.18 Other bacterial
  - 2.19 Unspecified bacterial
- 2.2 Viral
  - 2.21 Cytomegalovirus
  - 2.22 Parvovirus
  - 2.23 Herpes simplex virus
  - 2.24 Rubella virus
  - 2.28 Other viral
  - 2.29 Unspecified viral
- 2.3 Protozoal (eg, Toxoplasma)
- 2.5 Fungal

2 Perinatal Society of Australia and New Zealand 2009

2.8 Other specified organism

2.9 Other unspecified organism

3. Hypertension

3.1 Chronic hypertension: essential

3.2 Chronic hypertension: secondary (eg, renal disease)

3.3 Chronic hypertension: unspecified

3.4 Gestational hypertension

3.5 Pre-eclampsia

3.51 With laboratory evidence of thrombophilia

3.6 Pre-eclampsia superimposed on chronic hypertension

3.61 With laboratory evidence of thrombophilia

3.9 Unspecified hypertension

4. Antepartum haemorrhage (APH)

4.1 Placental abruption

4.11 With laboratory evidence of thrombophilia

4.2 Placenta praevia

4.3 Vasa praevia

4.8 Other APH

4.9 APH of undetermined origin

5. Maternal conditions

5.1 Termination of pregnancy for maternal psychosocial indications

5.2 Diabetes/gestational diabetes

5.3 Maternal injury

5.31 Accidental

5.32 Non-accidental

5.4 Maternal sepsis

5.5 Antiphospholipid syndrome

5.51 Other maternal thrombophilia (if considered cause of death)

5.6 Obstetric cholestasis

5.8 Other specified maternal conditions

6. Specific perinatal conditions

6.1 Twin–twin transfusion

6.2 Fetomaternal haemorrhage

6.3 Antepartum cord complications

6.31 Cord haemorrhage

6.32 True knot with evidence of occlusion

6.38 Other

6.39 Unspecified

- 6.4 Uterine abnormalities (eg, bicornuate uterus, cervical incompetence)
- 6.5 Birth trauma (typically infants of >24 weeks gestation or >600g birthweight)
- 6.6 Alloimmune disease
  - 6.61 Rhesus
  - 6.62 ABO
  - 6.63 Kell
  - 6.64 Alloimmune thrombocytopenia
  - 6.68 Other
  - 6.69 Unspecified
- 6.7 Idiopathic hydrops
- 6.8 Other specific perinatal conditions
  - 6.81 Rupture of membranes after amniocentesis
  - 6.82 Termination of pregnancy for suspected but unconfirmed congenital abnormality
  - 6.83 Fetal subdural haematoma
  - 6.88 Other
  - 6.89 Unspecified

7. Hypoxic peripartum death (typically infants of >24 weeks gestation or >600g birthweight)

- 7.1 With intrapartum complications
  - 7.11 Uterine rupture
  - 7.12 Cord prolapse
  - 7.13 Shoulder dystocia
  - 7.18 Other
- 7.2 Evidence of non-reassuring fetal status in a normally grown infant (eg, abnormal fetal heart rate, fetal scalp pH/lactate, fetal pulse oximetry without intrapartum complications)
- 7.3 No intrapartum complications and no evidence of non-reassuring fetal status.
- 7.9 Unspecified hypoxic peripartum death

8. Fetal growth restriction (FGR)

- 8.1 With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)
- 8.2 With chronic villitis
- 8.3 No placental pathology
- 8.4 No examination of placenta
- 8.8 Other specified placental pathology
- 8.9 Unspecified or not known whether placenta examined

9. Spontaneous preterm (<37 weeks gestation)

- 9.1 Spontaneous preterm with intact membranes or membrane rupture <24 hours before delivery
  - 9.11 With chorioamnionitis confirmed on placental histopathology
  - 9.12 Without chorioamnionitis on placental histopathology
  - 9.13 With clinical evidence of chorioamnionitis, no examination of placenta

- 9.17 No clinical signs of chorioamnionitis, no examination of placenta
- 9.19 Unspecified or not known whether placenta examined

9.2 Spontaneous preterm with membrane rupture[3] 24 hours before delivery

- 9.21 With chorioamnionitis confirmed on placental histopathology
- 9.22 Without chorioamnionitis on placental histopathology
- 9.23 With clinical evidence of chorioamnionitis, no examination of placenta
- 9.27 No clinical signs of chorioamnionitis, no examination of placenta
- 9.29 Unspecified or not known whether placenta examined

9.3 Spontaneous preterm with membrane rupture of unknown duration before delivery

- 9.31 With chorioamnionitis confirmed on placental histopathology
- 9.32 Without chorioamnionitis on placental histopathology
- 9.33 With clinical evidence of chorioamnionitis, no examination of placenta
- 9.37 No clinical signs of chorioamnionitis, no examination of placenta
- 9.39 Unspecified or not known whether placenta examined

10. Unexplained antepartum death

10.1 With evidence of reduced vascular perfusion on Doppler studies and /or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)

10.2 With chronic villitis

10.3 No placental pathology

10.4 No examination of placenta

10.8 Other specified placental pathology

10.9 Unspecified or not known whether placenta examined

11. No obstetric antecedent

11.1 Sudden infant death syndrome (SIDS)

- 11.11 SIDS Category IA: classic features of SIDS present and completely documented.
- 11.12 SIDS Category IB: classic features of SIDS present but incompletely documented.
- 11.13 SIDS Category II: infant deaths that meet Category I except for one or more features.

11.2 Postnatally acquired infection

11.3 Accidental asphyxiation

11.4 Other accident, poisoning or violence (postnatal)

11.8 Other specified

11.9 Unknown/undetermined

- 11.91 Unclassified sudden infant death
- 11.92 Other unknown/undetermined

7.4.2 PSANZ Neonatal Death Classification (PSANZ-NDC)

1. Congenital abnormality (including terminations for congenital abnormalities)

- 1.1 Central nervous system
- 1.2 Cardiovascular system
- 1.3 Urinary system
- 1.4 Gastrointestinal system
- 1.5 Chromosomal
- 1.6 Metabolic
- 1.7 Multiple/non-chromosomal syndromes
- 1.8 Other congenital abnormality
  - 1.81 Musculoskeletal
  - 1.82 Respiratory
  - 1.83 Diaphragmatic hernia
  - 1.84 Haematological
  - 1.85 Tumours
  - 1.88 Other specified congenital abnormality
- 1.9 Unspecified congenital abnormality

2. Extreme prematurity (typically infants of ≤24 weeks gestation or ≤600g birthweight)

- 2.1 Not resuscitated
- 2.2 Unsuccessful resuscitation
- 2.9 Unspecified or not known whether resuscitation attempted

3. Cardio-respiratory disorders

- 3.1 Hyaline membrane disease/respiratory distress syndrome (RDS)
- 3.2 Meconium aspiration syndrome
- 3.3 Primary persistent pulmonary hypertension
- 3.4 Pulmonary hypoplasia
- 3.5 Chronic neonatal lung disease (typically, bronchopulmonary dysplasia)
- 3.6 Pulmonary haemorrhage
- 3.7 Pneumothorax
- 3.8 Other

4. Infection

- 4.1 Bacterial
  - 4.11 Congenital bacterial
    - 4.111 Group B streptococcus
    - 4.112 E. coli
    - 4.113 Listeria monocytogenes
    - 4.114 Spirochaetal (eg, syphilis)
    - 4.118 Other bacterial
    - 4.119 Unspecified bacterial

- 4.12 Acquired bacterial
  - 4.121 Group B streptococcus
  - 4.122 E. coli
  - 4.125 Other Gram-negative bacilli (other than E. coli)
  - 4.126 Staphylococcus aureus
  - 4.127 Coagulase negative Staphylococcus
  - 4.128 Other specified bacterial
  - 4.129 Unspecified bacterial
- 4.2 Viral
  - 4.21 Congenital viral
    - 4.211 Cytomegalovirus
    - 4.213 Herpes simplex virus
    - 4.214 Rubella virus
    - 4.218 Other specified viral
    - 4.219 Unspecified viral
  - 4.22 Acquired viral
    - 4.221 Cytomegalovirus
    - 4.223 Herpes simplex virus
    - 4.224 Rubella virus
    - 4.228 Other specified viral
    - 4.229 Unspecified viral
- 4.3 Protozoal (eg, Toxoplasma)
- 4.5 Fungal
- 4.8 Other
- 4.9 Unspecified organism

5. Neurological

- 5.1 Hypoxic ischaemic encephalopathy/perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)
- 5.2 Intracranial haemorrhage
  - 5.21 Intraventricular haemorrhage
  - 5.22 Subgaleal haemorrhage
  - 5.23 Subarachnoid haemorrhage
  - 5.24 Subdural haemorrhage
  - 5.28 Other intracranial haemorrhage
- 5.8 Other

6. Gastrointestinal

- 6.1 Necrotising enterocolitis
- 6.8 Other

7. Other

- 7.1 Sudden infant death syndrome (SIDS)
  - 7.11 SIDS Category IA: classic features of SIDS present and completely documented.
  - 7.12 SIDS Category IB: classic features of SIDS present but incompletely documented.
  - 7.13 SIDS Category II: infant deaths that meet Category I except for one or more features.
- 7.2 Multisystem failure
  - 7.21 Secondary to intrauterine growth restriction
  - 7.28 Other specified
  - 7.29 Unspecified/undetermined primary cause or trigger event
- 7.3 Trauma
  - 7.31 Accidental
  - 7.32 Non-accidental
  - 7.39 Unspecified
- 7.4 Treatment complications
  - 7.41 Surgical
  - 7.42 Medical
- 7.8 Other specified
- 7.9 Unknown/undetermined
  - 7.91 Unclassified sudden infant death
    - 7.911 Bed sharing
    - 7.912 Not bed sharing
  - 7.92 Other unknown/undetermined

Appendix D: PMMRC Classification of Contributory Factors and Potential Avoidability (2010 version)[3]

Systems Review – Contributory Factors

Contributory factors may be highly specific to the death or generalised to the system(s). Identifying contributory factors that occur and are inherent in the system is an important part of the review. These factors are commonly sub-classified into organisational and management, personnel, technology/equipment, environmental and those relating to barriers to access and engagement in care.

Please read options below and select if any of the following were present

1. Have any organisational and/or management factors been identified? **Yes** ☐ **No** ☐

(eg, inadequate supervision of staff, lack of appropriate clinical management protocols, lack of communication between services)
(If 'yes' please classify –select ALL relevant)

- Poor organisational arrangements of staff ☐
- Inadequate education and training ☐
- Lack of policies, protocols or guidelines ☐
- Inadequate numbers of staff ☐
- Poor access to senior clinical staff ☐
- Failure or delay in emergency response ☐
- Delay in procedure, eg, caesarean section ☐
- Delayed access to test results or inaccurate results ☐
- Other – if other, please state or provide any comments:

3 Contact info@hqsc.govt.nz for the most recent version

2. Have factors relating to personnel been identified? **Yes** ☐ **No** ☐

(eg, staff factors relating to professional care and service provision)
(If 'yes' please classify –select ALL relevant)

- Knowledge and skills of staff were lacking ☐
- Delayed emergency response by staff ☐
- Failure to maintain competence ☐
- Communication between staff was inadequate ☐
- Failure to seek help/supervision ☐
- Failure to follow recommended best practice ☐
- Lack of recognition of complexity or seriousness of condition by care giver ☐
- Other – If other please state or provide any comments:

3. Have factors relating to technology and equipment been identified? **Yes** ☐ **No** ☐

(eg, faulty equipment, inadequate quantity or inadequate maintenance, no equipment)
(If 'yes' please classify –select ALL relevant)

- Essential equipment not available ☐
- Lack of maintenance of equipment ☐
- Malfunction/failure of equipment ☐
- Failure/lack of Information Technology ☐
- Other – if other please state or provide any comments:

4. Have factors relating to the environment been identified? **Yes** ☐ **No** ☐

(eg, administration systems, physical environment–space, privacy, ease of access, lighting, noise power failure, operating theatre in distant location, very preterm baby born outside of level 3 neonatal unit, weather prevented transport)
(If 'yes' please classify – select ALL relevant)

- Geography, eg, mother or baby needed long transfer ☐
- Building and design functionality limited clinical response ☐
- Other – if other please state or provide any comments:

5. Have barriers to accessing/engaging with care been identified? **Yes** ☐ **No** ☐

(eg, no, infrequent or late booking for antenatal care, woman declined treatment/advice)
(If 'yes' please classify – select ALL relevant)

- Substance use ☐
- Family violence ☐
- Lack of recognition by the woman or family of the complexity or seriousness of condition ☐
- Maternal mental illness ☐
- Cultural barriers ☐
- Language barriers ☐
- Not eligible to access free care ☐
- Other – if other, please state or provide any comments:

6. Was the death potentially avoidable? **Yes** ☐ **No** ☐

Complete this after considering the ticked boxes above.

Comments:

Name of person completing this form:

Contact person for additional information:

Phone number:

Signed:

Date:

Appendix E: PMMRC DHB Local Coordinators

DHB	Local Coordinator	Contact Details
Northland	**Yvonne Morgan** *Clinical Charge Midwife* **Kristy Wolff** *Consultant Obstetrician*	Whangarei Hospital
Waitemata	**Dr Sue Belgrave** *Clinical Director of Obstetrics* **Claire Shears** *Midwife* **Lucy Casey** *Midwife (AMOSS)*	North Shore Hospital
Waitemata	**Carol Chamley** *Midwife*	Waitakere Hospital
Auckland	**Professor Lesley McCowan** *Professor* **Claire McLintock** *Obstetric Physician (AMOSS)*	Auckland City Hospital
Counties Manukau	**Dr Sarah Wadsworth** *Consultant Obstetrician* **Dr Graeme Parry** *Consultant Obstetrician*	Middlemore Hospital
Waikato	**Dr Alastair Haslam** *Consultant Obstetrician* **Sarah Waymouth** *Consultant Obstetrician* **Phil Weston** *Paediatrician* **Pauline Martyn** *Midwife*	Waikato Hospital
Bay of Plenty	**Margret Norris** *Midwife Leader*	Tauranga Hospital
Lakes	**Amanda Griffiths** *Midwife*	Rotorua Hospital
Tairawhiti	**Robyn Blakely** *Midwife*	Gisborne Hospital
Taranaki	**Susan Shands** *Midwife* **Belinda Chapman** *Midwife*	Taranaki Base Hospital
Hawke's Bay	**Dr Lynda Croft** *Consultant Obstetrician* **Sara Paley** *Midwifery Educator*	Hawke's Bay Hospital
Whanganui	**Lucy Pettit** *Midwife* **Robyn McDougal** *Midwife*	Whanganui Hospital
Midcentral	**Billie Clayton** *Midwife Educator* **Dr Steven Grant** *Consultant Obstetrician*	Palmerston North Hospital
Wairarapa	**Donna Thompson** *Team Leader Midwifery* **Michelle Thomas** *Midwife*	Masterton Hospital
Capital & Coast	**Dawn Elder** *Senior Lecturer, Paediatrics* **Dr Rose Elder** *Consultant Obstetrician* **Hazel Irvine** *Midwife*	Wellington Hospital
Hutt Valley	**Joanne McMullan** *Midwife*	Hutt Hospital
Nelson Marlborough	**Lois McTaggart** *Clinical Midwife Leader* **Kevin Hill** *Consultant Obstetrician*	Nelson Hospital
West Coast	**Jude Bruce** *Midwife* **Ruth Henderson** *Midwife*	Grey Base Hospital
Canterbury	**Dianne Leishman** *Midwife* **Sonya Matthews** *Midwife*	Christchurch Women's Hospital
South Canterbury	**Dr John Weir** *Consultant Obstetrician*	Timaru Hospital
Otago	**Helen Flockton** *Charge Midwife* **Dr Helen Patterson** *Consultant Obstetrician*	Dunedin Hospital
Southland	**Jenny Humphries** *Associate Director of Nursing and Midwifery, Maternal & Child* **Mel Rackham** *Midwife* **Marlene Scobbie** *Midwife* **Mel Welfare** *Midwife*	Southland Hospital

List of Abbreviations

AMOSS	Australasian Maternity Outcomes Surveillance System
CEMACH	Confidential Enquiry into Maternal and Child Health
CEMACE	Centre for Maternal and Child Enquiries
CTG	Cardiotocograph
DHB	District Health Board
LMC	Lead maternity carer
MMRWG	Maternal Mortality Review Working Group
MRI	Magnetic resonance imaging
NEWG	Neonatal Encephalopathy Working Group
NHI	National Health Index
NZDep	New Zealand Index of Deprivation score
PMMRC	Perinatal and Maternal Mortality Review Committee
PSANZ	Perinatal Society of Australia and New Zealand
PSANZ-PDC	PSANZ perinatal death classification
PSANZ-NDC	PSANZ neonatal death classification
PSU	Paediatric Surveillance Unit
SGA	Small for gestational age
SUDI	Sudden unexpected death in infancy

References and Bibliography

AIHW National Perinatal Statistics Unit. 2011. *Australia's Mothers and Babies 2009*. Sydney: Australian Institute of Health and Welfare.
URL: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=10737420980
Accessed: 12 March 2012.

Austin M, Kildea S, Sullivan E. 2007. Maternal mortality and psychiatric morbidity in the perinatal period: challenges and opportunities for prevention in the Australian setting. *MJA* 186(7): 364–367.
URL: https://www.mja.com.au/sites/default/files/issues/186_07_020407/aus10820_fm.pdf
Accessed: 28 March 2012.

Badawi N, Kurinczuk JJ, Keogh JM, Alessandri LM, O'Sullivan F, Burton PR, Pemberton PJ, Stanley FJ. 1998a. Intrapartum risk factors for newborn encephalopathy: the Western Australian case-control study. *British Medical Journal* 317(7172): 1554–8.
URL: http://www.bmj.com/content/317/7172/1554
Accessed: 28 March 2012.

Badawi N, Kurinczuk JJ, Keogh JM, Alessandri LM, O'Sullivan F, Burton PR, Pemberton PJ, Stanley FJ. 1998b. Antepartum risk factors for newborn encephalopathy: The Western Australian case-control study. *British Medical Journal* 317(7172): 1549–1553.
URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC28732/
Accessed: 28 March 2012.

Bennett HA, Einarson A, Taddio A, et al. 2004. Prevalence of depression during pregnancy: systematic review.
Obstetrics and Gynaecology 103: 698–709.
URL: http://journals.lww.com/greenjournal/Abstract/2004/04000/Prevalence_of_Depression_During_Pregnancy_.16.aspx
Accessed: 28 March 2012.

Centre for Maternal and Child Enquiries (CMACE). 2011a. *Perinatal Mortality 2009: United Kingdom*. London: Centre for Maternal and Child Enquiries.
URL: http://www.hqip.org.uk/assets/NCAPOP-Library/CMACE-Reports/35.-March-2011-Perinatal-Mortality-2009.pdf
Accessed: 12 March 2012.

Centre for Maternal and Child Enquiries (CMACE). 2011b. Saving mothers' lives: reviewing maternal deaths to make motherhood safer: 2006–08. The Eighth Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. *BJOG*, 118 (Suppl. 1):1–203.
URL: http://www.hqip.org.uk/assets/NCAPOP-Library/CMACE-Reports/6.-March-2011-Saving-Mothers-Lives-reviewing-maternal-deaths-to-make-motherhood-safer-2006-2008.pdf
Accessed: 12 March 2012.

Cormack D, Harris R. 2009. *Issues in Monitoring Màori Health and Ethnic Disparities: An update*. Wellington: Te Rōpū Rangahau Hauora a Eru Pomare.
URL: http://www.ethnicity.maori.nz/files/booklet_v3a.pdf
Accessed 3 May 2012.

Devries K et al. 2011. Violence against women is strongly associated with suicide attempts: evidence from the WHO multi-country study in women's health and domestic violence against women. *Social Science & Medicine* 73: 79–86.
URL: http://ac.els-cdn.com/S0277953611002802/1-s2.0-S0277953611002802-main.pdf?_tid=245a872ba7bb88737e262b4524974 01d&acdnat=1332881502_6c33fc3f9dc8df7e03d6aaefod4e1e5c
Accessed: 28 March 2012.

Donati S, Senatore S, Ronconi A and the Regional Maternal Mortality Working Group. 2011. Maternal mortality in Italy: a record-linkage study. *BJOG* 118: 872–879.
URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1471-0528.2011.02916.x/pdf
Accessed: 12 March 2012.

Fanslow J, Robinson E. 2004. Violence against women in New Zealand: prevalence and health consequences.
New Zealand Medical Journal 117(1206).
URL: http://journal.nzma.org.nz/journal/117-1206/1173/
Accessed: 12 March 2012.

Farquhar C, Sadler L, Haslam A, Masson V, et al. 2011. Beyond the numbers: classifying contributory factors and potentially avoidable maternal deaths in New Zealand, 2006 –2009. *Am J Obstet Gynecol* 205: 331.e1–8.
URL: http://www.hqsc.govt.nz/assets/PMMRC/NEMR-images-files-/Classifying-contributory-factors-and-potentialy-avoidable-maternal-deaths-in-NZ.pdf
Accessed: 12 March 2012.

Heron M. 2011 Deaths: Leading causes for 2007. *National Vital Statistics Reports*. Hyattsville, MD: National Centre for Health Statistics.
URL: http://www.cdc.gov/nchs/data/nvsr/nvsr59/nvsr59_08.pdf
Accessed: 2 May 2012.

Hofberg K, Brockington IF. 2000. Tokophobia: an unreasoning dread of childbirth: a series of 26 cases. *British Journal of Psychiatry* 176: 83–85.
URL: http://bjp.rcpsych.org/content/176/1/83.full.pdf+html
Accessed: 28 March 2012.

Institute of Medicine of the National Academies. 2009. *Weight Gain During Pregnancy: Re-examining the guidelines*. Washington: The National Academies Press.
URL: http://www.iom.edu/Reports/2009/Weight-Gain-During-Pregnancy-Reexamining-the-Guidelines.aspx
Accessed: 12 March 2012.

Knight M, Pierce M, Seppelt I, Kurinczuk J, Spark P, Brocklehurst P, McLintock C, Sullivan E, on behalf of the UK's Obstetric Surveillance System, the ANZIC Influenza Investigators and the Australasian Maternity Outcomes Surveillance System. 2011. Critical illness with AH1N1v influenza in pregnancy: a comparison of two population-based cohorts. *BJOG* 118: 232–239
URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1471-0528.2010.02736.x/full
Accessed: 28 March 2012.

Knight M, Berg C, Brocklehurst P, Kramer M, Lewis G, Oats J, Roberts CL, Spong, C, Sullivan, EA, van Roosmalen J, Zwart J. 2012. Amniotic fluid embolism incidence, risk factors and outcomes: a review and recommendations. *BMC Pregnancy and Childbirth* 12:7. DOI: 10.1186/1471-2393-12-7
Accessed: 12 March 2012.

Lewis G (ed). 2007. Saving Mothers' Lives: Reviewing maternal deaths to make motherhood safer – 2003–2005. *The Seventh Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom*. London: Confidential Enquiry into Maternal and Child Health (CEMACH).
URL: http://www.pbh.gov.br/smsa/bhpelopartonormal/estudos_cientificos/arquivos/saving_mothers_lives.pdf
Accessed: 28 March 2012.

Ministry of Health. 2002. *Family Violence Intervention Guidelines*. Wellington: Ministry of Health.
URL: http://webapps01.un.org/vawdatabase/uploads/Family%20Violence%20Intervention%20Guidelines%20Child%20and%20Partner%20Abuse.pdf
Accessed: 12 March 2012.

Ministry of Health. 2004. *Ethnicity Data Protocols for the Health and Disability Sector*. Wellington: Ministry of Health.
URL: http://www.moh.govt.nz/moh.nsf/0/038AA30B8A5EF30DCC256E7E007C98C4/$File/EthnicityDataProtocols.pdf
Accessed: 12 March 2012.

Ministry of Health. 2007. *New Zealand Smoking Cessation Guidelines*. Wellington: Ministry of Health.
URL: http://www.health.govt.nz/publication/new-zealand-smoking-cessation-guidelines
Accessed: 29 March 2012.

Ministry of Health. 2008a. *Suicide Facts: Deaths and intentional self-harm hospitalisations 2008*. Wellington: Ministry of Health.
URL: http://www.spinz.org.nz/file/downloads/pdf/suicide-facts-2008-dec2010.pdf
Accessed: 28 March 2012.

Ministry of Health. 2008b. *Te Puāwaiwhero: The Second Māori Mental Health and Addiction National Strategic Framework 2008–2015*. Wellington: Ministry of Health.
URL: http://www.cmdhb.org.nz/funded-services/mental-health/Workforce-Development/Publications/TePuawaiwhero-2008-2015.pdf
Accessed: 28 March 2012.

Ministry of Health. 2010. Fetal and Infant Deaths 2006. Wellington: Ministry of Health.
URL: http://www.moh.govt.nz/moh.nsf/Files/fetalinfantdeaths/$file/fetal-and-infant-deaths-2006.pdf
Accessed: 3 May 2012.

Ministry of Health. 2011. *Maternity Services Consumer Satisfaction Survey*.
URL: http://www.health.govt.nz/publication/maternity-consumer-survey-2011
Accessed: 28 March 2012.

Ministry of Health. 2012a. *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)*. Wellington: Ministry of Health.
URL: http://www.health.govt.nz/publication/guidelines-consultation-obstetric-and-related-medical-services-referral-guidelines
Accessed: 29 March 2012.

Ministry of Health. 2012b. Healthy Beginnings: *Developing perinatal and infant mental health services in New Zealand*. Wellington: Ministry of Health.
URL: http://www.health.govt.nz/publication/healthy-beginnings-developing-perinatal-and-infant-mental-health-services-new-zealand
Accessed: 28 March 2012.

Morton SMB, Atatoa Carr PE, Bandara DK, Grant CC, Ivory VC, Kingi TR, Liang R, Perese LM, Peterson E, Pryor JE, Reese E, Robinson EM, Schmidt JM, Waldie KE. 2010. *Growing Up in New Zealand: A longitudinal study of New Zealand children and their families*. Report 1: Before we are born. Auckland: Growing Up in New Zealand.

National Institute for Health and Clinical Excellence. 2007. *Antenatal and Postnatal Mental Health: Clinical management and service guidance*. London: National Institute for Health and Clinical Excellence.
URL: http://www.nice.org.uk/nicemedia/live/11004/30433/30433.pdf
Accessed: 12 March 2012.

National Women's Hospital. 2010. *National Women's Annual Clinical Report 2009*. Auckland: National Women's Hospital.
URL: http://nationalwomenshealth.adhb.govt.nz/Portals/0/Annual%20Reports/Annual%20Clinical%20Report%202011.pdf
Accessed: 12 March 2012.

New Zealand College of Midwives (NZCOM). 2012. *Consensus Statement: Assessment of fetal wellbeing during pregnancy. Ratified Special General Meeting February 22, 2012*.
URL: http://www.midwife.org.nz/index.cfm/3,108,559/antenatal-fetal-wellbeing.pdf
Accessed: 29 March 2012.

New Zealand Guidelines Group. 2008. *Identification of Common Mental Disorders and Management of Depression in Primary Care. An evidence-based best practice guideline*. Wellington: New Zealand Guidelines Group.
URL: http://www.nzgg.org.nz
Accessed: 28 March 2012.

NZHIS. 2007. *Fetal and Infant Deaths 2003 & 2004*. Wellington: Ministry of Health.
URL: http://www.moh.govt.nz/moh.nsf/Files/fetalinfantdeaths/$file/fetal200304.pdf
Accessed: 3 May 2012.

O'Hara M, Neunaber DJ, Zekowski EM. 1984. Prospective study of postpartum depression: prevalence, course and predictive factors. *Journal of Abnormal Psychology* 93: 158–171.
URL: http://psycnet.apa.org/index.cfm?fa=search.displayRecord&uid=1984-23277-001
Accessed: 28 March 2012.

O'Hara MW, Swain AM. 1996. Rates and risk of postpartum depression – a meta-analysis. *International Review of Psychiatry* 8: 37–54.
URL: http://informahealthcare.com/doi/abs/10.3109/09540269609037816
Accessed 28 March 2012.

Perinatal Society of Australia and New Zealand. 2009. *Clinical Practice Guideline for Perinatal Mortality. Section 7: Perinatal Mortality Classifications. Appendix 1*.
URL: http://www.psanz.com.au/files/Section_7_Version_2.2_April_2009.pdf
Accessed: 12 March 2012.

PMMRC, 2007. *First Report to the Minister of Health: June 2005 to June 2007*. Wellington: Perinatal and Maternal Mortality Review Committee (PMMRC).
URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/First-PMMRC-report-2005-07.pdf
Accessed: 12 March 2012.

PMMRC. 2008. *Fourth Report to the Minister of Health: June 2009 to June 2010*. Wellington: Perinatal and Maternal Mortality Review Committee (PMMRC).
URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/Third-PMMRC-report-2008-09.pdf
Accessed: 12 March 2012.

PMMRC. 2009. *Guidelines for the Completion of the Mother and Baby Forms Following a Perinatal Death* (version 5). Wellington: Perinatal and Maternal Mortality Review Committee (PMMRC).
URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/guidelines-mother-baby-forms-perinatal-death-v5.pdf
Accessed: 12 March 2012.

PMMRC. 2011. *Fifth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2009*. Wellington: Health Quality & Safety Commission 2011
URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/Fifth-PMMRC-report-2009.pdf
Accessed: 12 March 2012.

Queensland Health. 2011. *Maternal and Perinatal Quality Council Report 2011. Maternal and Perinatal Mortality and Morbidity in Queensland*. Brisbane: Queensland Health,
URL: http://www.health.qld.gov.au/maternity/docs/qmpqc-report-2011.pdf
Accessed: 28 March 2012.

Robertson E, Jones I, Haque S, et al. 2005. Risk of puerperal and non-puerperal recurrence of illness following bipolar affective puerperal (postpartum) psychosis. *British Journal of Psychiatry* 186: 258–259.
URL: http://bjp.rcpsych.org/content/186/3/258.short
Accessed: 28 March 2012.

Ross LE, McLean LM. 2006. Anxiety disorders during pregnancy and the post partum period: a systematic review. *Journal of Clinical Psychiatry* 67(8), 1285–1298.
URL: http://psycnet.apa.org/psycinfo/2006-11407-018
Accessed: 28 March 2012.

Salmond C, Crampton P. 2002a. *NZDep2001 Index of Deprivation*. Wellington: University of Otago.
URL: http://www.otago.ac.nz/wellington/research/hirp/projects/otago020194.html
Accessed 28 March 2012.

Salmond C, Crampton P. 2002b. *NZDep2001 Index of Deprivation: User manual*. Wellington: University of Otago, Wellington School of Medicine and Health Sciences.
URL: http://www.otago.ac.nz/wellington/otago020336.pdf
Accessed: 28 March 2012.

Stacey et al. 2011. Relationship between obesity, ethnicity and risk of late stillbirth: a case control study. *BMC Pregnancy and Childbirth* 11:3.
URL: http://www.biomedcentral.com/1471-2393/11/3
Accessed: 12 March 2012.

Statistics New Zealand. 2005. Statistical standards for ethnicity 2005. Wellington: Statistics New Zealand.
URL: http://www.stats.govt.nz/reports/analytical-reports/review-measurement-of-ethnicity/papers.aspx
Accessed: 3 May 2012.

Sullivan EA, Hall B, King JF. 2007. *Maternal deaths in Australia 2003–2005*. Maternal deaths series No. 3. Cat. no. PER 42. Sydney: AIHW National Perinatal Statistics Unit.
URL: http://www.aihw.gov.au/publication-detail/?id=6442468086
Accessed: 28 March 2012.

Thornberg E, Thiringer K, Odeback A, Milsom I. 1995. Birth asphyxia: incidence, clinical course and outcome in a Swedish population. *Acta Paediatrica* 84(8): 927–932.
URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1651-2227.1995.tb13794.x/pdf/
Accessed: 28 March 2012.

Vaughan G, Pollock W, Peek MJ, Knight M, Ellwood D, Homer CS, Pulver LJ, McLintock C, Ho MT, Sullivan EA. 2011. Ethical issues: the multi-centre low-risk ethics/governance review process and AMOSS. *The Australian and New Zealand Journal of Obstetrics* 52(2).
URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1479-828X.2011.01390.x/pdf
Accessed: 28 March 2012.

Violence Intervention Programme. 2011. *Hospital Responsiveness to Family Violence 2011, 84 Month Follow-up Evaluation Summary*.
URL: http://www.aut.ac.nz/__data/assets/pdf_file/0020/235640/ITRC-SUMMARY-FINAL-2011-WEB.pdf
Accessed: 12 March 2012.

Weick A, Kumar R, Hirst AD, et al. 1991. Increased sensitivity of dopamine receptors and recurrence of affective psychosis after childbirth. *British Medical Journal* 303: 613–16.
URL: http://www.jstor.org/stable/29712947
Accessed: 28 March 2012.

West CR, Curr L, Battin MR, Harding JE, McCowan LM, Belgrave S, Knight DB, Westgate JA. 2005a. Antenatal antecedents of moderate or severe neonatal encephalopathy in term infants – a regional review. *The Australian and New Zealand Journal of Obstetrics* 45(3): 207–210.
URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1479-828X.2005.00390.x/pdf
Accessed: 28 March 2012.

West CR, Harding JE, Knight DB, Battin MR. 2005b. Demographic characteristics and clinical course in infants with moderate or severe neonatal encephalopathy. *The Australian and New Zealand Journal of Obstetrics* 45(2): 151–154.
URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1479-828X.2005.00368.x/pdf
Accessed: 28 March 2012.

World Health Organization. 2009. *Report on the World Health Organization Working Group on Classification of Maternal Deaths and Severe Maternal Morbidities*.
URL: http://www.who.int/bulletin/volumes/87/10/09-071001/en/index.html
Accessed: 28 March 2012.

World Health Organization. 2011. *Intimate Partner Violence During Pregnancy: Information sheet*. Geneva: World Health Organisation.
URL: http://whqlibdoc.who.int/hq/2011/WHO_RHR_11.35_eng.pdf
Accessed: 12 March 2012.

Xu JQ, Kochanek KD, Murphy SL, Tejada-Vera B. 2010. *Deaths: Final data for 2007*. National vital statistics reports web release, vol. 58 no. 19. Hyattsville, MD: National Centre for Health Statistics.
URL: http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_19.pdf
Accessed: 12 March 2012.

Perinatal and Maternal Mortality Review Committee

He matenga ohorere, he wairua uiui, wairua mutungakore

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