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

Seventh Annual Report of the Perinatal and Maternal Mortality Review Committee

Reporting mortality 2011

Third Report to the Health Quality & Safety Commission New Zealand

JUNE 2013

"He mate nga ohorere, he wairua uiui, wairua mutunga-kore. The grief of a sudden, untimely death will never be forgotten."

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- The lead maternity carers and district health board (DHB) clinicians throughout New Zealand and the local coordinators within each DHB who completed the rapid reporting and classification forms that provide the data within this report.
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- The University of Otago's Mortality Review Data Group, which established and maintains the perinatal mortality website and collated the data and produced the tables and figures in the perinatal mortality and neonatal encephalopathy sections.
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- The members of the Maternal Mortality Review Working Group (MMRWG), who worked on the maternal mortality report.
- The members of the Neonatal Encephalopathy Working Group (NEWG), who worked on the neonatal encephalopathy report.
- The members of the Australasian Maternity Outcomes Surveillance Systems Working Group (AMOSSWG) and the University of New South Wales, who provided the maternal morbidity data and report.
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- The Health Quality & Safety Commission, which has been involved in all stages of the development of this report and, in particular, Deon York.

Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) members in 2013 are:

- Professor Cynthia Farquhar (Chair), obstetrician and gynaecologist, and clinical epidemiologist, the University of Auckland
- Ms Sue Bree, midwife, Bay of Islands
- Ms Linda Penlington, Sands New Zealand, Wairarapa
- Ms Gail McIver, midwife, Counties Manukau DHB
- Dr Sue Belgrave, obstetrician, Waitemata DHB
- Dr Beverley Lawton, GP, researcher and director of Women's Health Research Centre, Wellington
- Dr Sue Crengle, Māori health researcher, GP, public health physician, Waitemata and Southern DHBs
- Dr Maggie Meeks, neonatologist, Canterbury DHB
- Ms Alison Eddy, midwife, Canterbury DHB
- Dr Graham Sharpe, anaesthetist, Capital & Coast DHB.

Maternal Mortality Review Working Group

The Maternal Mortality Review Working Group (MMRWG) members in 2013 are:

- Dr Alastair Haslam (Chair), obstetrician and gynaecologist, Waikato DHB
- Dr Claire McLintock, obstetric physician and haematologist, Auckland DHB
- Dr Sue Belgrave, obstetrician and gynaecologist, Waitemata DHB
- Ms Alison Eddy, midwife, Christchurch
- Dr Lesley Dixon, midwife, Christchurch
- Professor Cynthia Farquhar, Chair PMMRC
- Dr Liz MacDonald, perinatal psychiatrist, Canterbury DHB
- Dr Kate White, pathologist, MidCentral DHB
- Dr John Walker, anaesthetist, Auckland DHB
- Dr Graham Sharpe, PMMRC member
- Dr Alec Ekeroma, obstetrician, Counties Manukau DHB.

Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group (NEWG) members in 2013 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
- Ms Gail McIver, midwife, Counties Manukau 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 2013 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 intensive care unit 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 PMMRC's) report. This reports perinatal and maternal deaths from 1 January to 31 December 2011, including analysis of five years of perinatal mortality data from 2007 to 2011 and six years of maternal mortality data from 2006 to 2011, making it the most comprehensive report to date.

The maternity sector can be encouraged by some of the findings in this report. Using the World Health Organization international definition, there has been a significant reduction in New Zealand's perinatal related mortality rate in 2011. Moreover, from 2007 to 2011, rates of both term intrapartum and hypoxic peripartum deaths have decreased significantly.

While these results are indeed encouraging, it is important to acknowledge that 19 percent of all perinatal related deaths were identified as potentially avoidable in 2011. The role of socioeconomic deprivation is a pervasive feature with a significant increase in potentially avoidable perinatal related death with increasing socioeconomic deprivation.

There is a downward trend noted in this year's report in maternal mortality from 2006 to 2011. Thirty-five percent of all maternal deaths were found to be potentially avoidable due to factors associated with provision of or access to care. It is important to identify the contributory factors associated with these deaths to improve the quality of care provided.

The Neonatal Encephalopathy Working Group and Australasian Maternity Outcomes Surveillance System Working Group have reported on perinatal and maternal morbidity respectively in New Zealand for 2010 and 2011. The findings from these reviews will continue to contribute to our understanding of these serious conditions.

Also included in this report are the findings from an audit of babies who died in 2010 with central nervous system, cardiovascular and chromosomal congenital abnormalities, funded by the Commission's Health Quality and Safety Challenge.

This report represents a significant amount of work from the health care professionals across the country who provided these data, Professor Cindy Farquhar and the PMMRC, the PMMRC National Coordination Services and the Commission.

Professor Farquhar concludes as Chair of the PMMRC this year. As the foundation chair, she has been pivotal in the PMMRC's development. Since its inception, her vision has built a strong national system for reporting perinatal and maternal mortality and morbidity. Professor Farquhar's dedication, determination and drive have led to robust reporting that is key to understanding and improving maternity services in New Zealand.

On behalf of the Commission it is with utmost gratitude that I thank Professor Farquhar for leading this committee and developing this very important contribution to the quality of the health system in New Zealand.

Professor Alan Merry, ONZM

Chair, Health Quality & Safety Commission

Chair's Introduction

I am pleased to present the seventh report of the Perinatal and Maternal Mortality Review Committee (PMMRC). The aim of the PMMRC 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 2011. The data are the result of the collaborative efforts of the PMMRC, lead maternity carers, local coordinators and clinicians of the district health boards (DHBs), supported by the national PMMRC coordination service and the Mortality Review Data Group of the University of Otago. These data can be considered to be one measure of the quality and safety of New Zealand's maternity services.

It is now almost eight years since the PMMRC was established. Prior to the establishment of the committee in 2005, perinatal and maternal death data were collated from administrative data sources. It was our view that morbidity and mortality were under-reported and that we needed clinical staff to contribute data. Since 2005, we have established a web-based data system for all maternity providers to report on maternal and perinatal mortality and morbidity. Prior to the establishment of the PMMRC, only 8 of 21 DHBs undertook mortality review, and now all DHBs are undertaking this. We have also established a methodology for reporting potentially avoidable perinatal and maternal deaths that is multidisciplinary and can be used to identify areas for improvement in clinical care.

There have been some encouraging signs of improvement. In particular, this year we are reporting for the first time a decrease in intrapartum stillbirths at term, deaths from hypoxia around the time of birth and a reduction in the perinatal related mortality using the WHO definition (≥1000 grams, when babies with congentital abnormalities are not included).

The committee has previously raised concerns about the adequacy of maternal and perinatal mental health services across the country. The Ministry of Health undertook a review, and in 2012, the *Health Beginnings* report was published calling for an increase in maternal and perinatal mental health services. New funding for the implementation of the recommendations of this report has been announced in the 2013 Budget, which we welcome.

The PMMRC report in 2010 called for a review of the maternity services at Counties Manukau DHB because of the higher rate of perinatal deaths over several years. We welcomed the publication of the external review in 2012 and look forward to the wide-ranging recommendations being implemented.

We also welcome the development of the Ministry of Health's Maternity Quality initiative, which includes a number of changes to improve care that the PMMRC has called for, such as improving maternity records, developing a national maternity record and developing a programme in order to improve access to midwifery care for women.

This is my last report as Chair. I would like to thank the committee and working group members, the staff and board of the Health Quality & Safety Commission, the staff of the Ministry of Health, the DHB local coordinators and the many midwives, doctors and nurses who have reported the data and assisted the work of the committee. I consider that we are all working together to improve outcomes for women and their families. While we have made some progress on reporting maternal and perinatal deaths and morbidity, there is more to be done in improving outcomes. I look forward to seeing the progress over the coming years.

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 findings 2013 report (data 2011)

Perinatal related mortality and morbidity

1. There were 665 perinatal related deaths in 2011. The total perinatal related mortality rate has not changed significantly since 2007 using the New Zealand definition. However, there has been a significant reduction in the perinatal related mortality rate using the World Health Organization (WHO) international definition of >1000 grams, when lethal and terminated abnormalities are excluded.
2. Rates of both term intrapartum death and hypoxic peripartum death decreased significantly from 2007 to 2011.
3. There has been a significant increase in perinatal related mortality among babies born in multiple pregnancies from 2007 to 2011.
4. Nineteen percent of all perinatal related deaths were identified as potentially avoidable in 2011. The most common contributory factors were barriers to access or engagement with care followed by personnel factors. Māori and Pacific mothers were significantly more likely to have potentially avoidable perinatal related deaths than New Zealand European mothers, and there was a significant increase in potentially avoidable perinatal related death with increasing socioeconomic deprivation.
5. An audit of babies who died in 2010 with potentially identifiable congenital abnormalities found that one in four women who had sought care with a primary health care provider before 14 weeks were not offered first or second trimester antenatal screening and that folate prophylaxis was infrequent and poorly documented.

Neonatal encephalopathy

6. One hundred and forty-nine (149) cases of neonatal encephalopathy were reported in New Zealand in 2010–2011 of whom 76 percent survived. The rate of neonatal encephalopathy in New Zealand in 2010–2011 was 1.27/1000 term births, and there was a significantly higher rate reported among residents of Waikato DHB.

7. Twenty-four percent of mothers of babies with neonatal encephalopathy had an acute severe peripartum event, eg, placental abruption.

8. Eighty-three percent of babies with neonatal encephalopathy had either an abnormal cord blood gas at birth or an Apgar score <7 at one minute.

9. Seventy-two percent of babies were cooled for neonatal encephalopathy, 76 percent of these within six hours.

10. In 16 percent of cases of neonatal encephalopathy, there were contributory factors associated with unsatisfactory neonatal resuscitation.

11. Of survivors with neonatal encephalopathy, 34 percent had electroencephalopathy (EEG) and 68 percent a magnetic resonance imaging (MRI) scan prior to discharge.

Maternal mortality and morbidity

12. There were eight maternal deaths in 2011.

13. There is a downward trend in the maternal mortality ratio from 2006 to 2011. Although this trend was not statistically significant, this may reflect the small number of cases and lack of statistical power.

14. Thirty-five percent of maternal deaths were identified as potentially avoidable between 2006 and 2011.

15. Contributory factors related to organisation and management, personnel or barriers to access and engagement with care were present in 55 percent of all maternal deaths between 2006 and 2011.

16. Among personnel, organisation and management factors, the most common sub-categories identified between 2006 and 2011 were lack of policies, protocols or guidelines, identified in 14 cases, in particular, lack of guidelines and protocols for massive blood transfusion, screening and management of women with maternal mental health, and management of hypertension in pregnancy, although the number of deaths related to each of these causes was small.

17. Two years of surveillance of New Zealand severe maternal morbidity (2010–2011) have shown rates of eclampsia of 2.0/10,000 maternities, placenta accreta of 3.9/10,000 maternities, and peripartum hysterectomy 4.5/10,000 maternities.

Recommendations

These recommendations should be considered alongside previous recommendations from the PMMRC, listed as 'Summary of Key PMMRC Recommendations and Progress (Data 2006–2010)', on page 8.

Perinatal related mortality

1. The PMMRC endorses all recommendations of the audit of congenital abnormalities. These recommendations can be viewed in full in Appendix B or at *http://www.hqsc.govt.nz/assets/Other-Topics/QS-challenge-reports/Detecting-abnormalities-earlier-in-pregnancy-Final-Report.pdf.*

   Key recommendations from the audit include:

   - all primary care providers (if first contact of a pregnant woman with the health service) should offer first trimester screening and facilitate expeditious registration
   - achieving optimal use of periconceptual folate by young women in New Zealand requires a policy for fortification of bread
   - the National Screening Unit review the cost benefit of the current algorithms in the first and second trimester screening programme so they are calibrated for maximal sensitivity for all chromosomal abnormalities
   - the National Screening Unit review false negative screening tests
   - the New Zealand National Maternal Fetal Medicine Network regularly audit time from referral to review to ensure that the majority of women are seen within seven days as recommended.

2. In order to reduce perinatal related mortality associated with multiple pregnancy, the following is advised:

   - All women undergoing assisted reproduction be offered single embryo transfer.
   - The use of clomiphene for fertility treatment requires monitoring of hormonal response with ultrasound to determine the number of follicles.
   - Lead maternity carers (LMCs) note that the referral guidelines recommend transfer of clinical responsibility for care of all women with multiple pregnancies to obstetrician-led care. *http://www.health.govt.nz/publication/guidelines-consultation-obstetric-and-related-medical-services-referral-guidelines*

Neonatal encephalopathy

3. Strategies to reduce neonatal encephalopathy include:

   - continually improving the standard of neonatal resuscitation by all health professionals involved in providing peripartum care
   - local review of the apparent higher neonatal encephalopathy rate in Waikato DHB.

4. In cases of neonatal encephalopathy:

   - all babies with encephalopathy should undergo investigation to predict prognosis including formal neurological examination, cerebral MRI and, if available, formal EEG
   - all parents of an affected child should have a formal discussion with the neonatologist/paediatrician providing care in order to review the prognosis and ongoing care of their child.

Maternal mortality

5. In maternal deaths, where a coroner declines jurisdiction, post-mortem should be offered as part of full investigation of cause of death.

6. Women with pre-existing medical conditions (such as epilepsy, hypertension or mental health) should have individualised pre-conceptual counselling about their condition and the medication they are taking. Health professionals providing care to these women need to communicate the importance of continuing their medication in pregnancy, if appropriate, and to advise women to seek early medical review.

Additional recommendation for the Ministry of Health

7. The National Maternity Collection (MAT), linked to birth registration ethnicity data, be available for use by the mortality review committees. Access to these data would allow the PMMRC to report the independent associations between ethnicity, maternal age, socioeconomic status and perinatal related death, adjusting for smoking and maternal body mass index.

Summary of Key PMMRC Recommendations and Progress (Data 2006–2010)

Below is a summary of progress regarding 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 is supporting all DHBs, through local Maternity Quality and Safety Programmes, to identify and implement actions to increase the number of women accessing primary maternity services in their first trimester. All DHBs are required in their 2013–14 Annual Plans to identify actions they will take to increase the number of women accessing primary maternity services in their first trimester. The National Maternity Monitoring Group, established as an advisory group to the Director General of Health has identified timely registration with maternity services as one of their five priority areas, and has undertaken a number of actions to raise the profile of the importance of early booking and identify and share good practice examples and initiatives being undertaken by DHBs. Many DHBs have initiated media and social media campaigns, and recently the New Zealand College of Midwives, supported by the Ministry of Health, launched the Find Your Midwife website which further supports women to find and book with an LMC. The Ministry of Health is in the process of revising the DHB funded Pregnancy and Parenting Education service specifications to focus on providing information for pregnancy and parenting as well as education for targeted groups.
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 review of the service specification for DHB funded Pregnancy and Parenting Education proposes to focus education and support more intensively on high needs and vulnerable pregnant women and families including teenage mothers. The Ministry is progressing work to support the Maternal Tobacco Health Target that seeks to ensure that 90 percent of pregnant women are provided brief advice and cessation support to help them quit smoking at first contact with primary maternity services. Most DHBs have comprehensive maternal tobacco cessation programmes and initiatives, some being specifically targeted to teen mothers. The Ministry is supporting all DHBs, through local Maternity Quality and Safety Programmes, to identify and implement actions to increase the number of women accessing primary maternity services in their first trimester. A particular focus for many DHBs is how to best engage specific populations including teen mothers.

Recommendation	Progress
Perinatal mortality	
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.	All DHBs have established local Maternity Quality and Safety Programmes. These bring together maternity stakeholders from DHBs, community based clinicians, and consumer representatives to identify local quality improvement priorities and undertake continuous quality improvement actions. These include development and dissemination of policies and guidelines, review of maternity data and outcomes, local clinical review and continuing education and workforce development. The Ministry of Health expects the PMMRC report recommendations to be disseminated through the professional networks created as part of the Maternity Quality and Safety Programme. The development of local quality improvement priorities and delivery of a DHB's maternity quality and safety work programme is being overseen and supported by the Ministry of Health and the National Maternity Monitoring Group.
4. Birth information	
Accurate, robust and timely clinical data on all pregnancies are 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 supporting a number of informatics projects to enable better capture, reporting and use of perinatal outcomes data. The Ministry has worked with the PMMRC in the previous year to provide data from the recently redeveloped maternity information system and is further developing this system to capture additional primary maternity data over the coming year.
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 has worked with the PMMRC in the previous year to provide data from the recently redeveloped maternity information system and is further developing this system to capture additional primary maternity data over the coming year.
All babies, whether stillborn or live born, should be assigned a National Health Index (NHI) number at the time of birth.	Stillborn babies are given an NHI number in 18 of 20 DHBs.
Continued support and funding is required for DHBs and LMCs for collection of complete perinatal mortality statistics.	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.	The Ministry has commissioned research into barriers to accessing maternity services in South Auckland and Porirua. This information has been shared with the review of maternity services carried out by Counties Manakau DHB (see below) and is informing projects aimed at the integration of maternity, well child and primary health services.

Recommendation	Progress
Perinatal mortality	
5. DHB diparities	
Further research is warranted to understand the higher rate of perinatal related mortality in the Counties Manukau region.	An independent review was commissioned by Counties Manukau DHB of the excess perinatal related mortality in the region and published in late 2012. A copy of this report can be obtained at: *http://www.countiesmanukau.health.nz/News_Publications/Reports/report-external-maternitycare-review.pdf*. This is an ongoing process of quality improvement
6. Ethnicity	
New legislation should enable Births, Deaths and Marriages to accept NHI data and update the routine NHI dataset with regard to ethnicity.	Progressing Memorandums of Understanding between Births, Deaths and Marriages and the Ministry of Health has been proposed as one solution. This will be progressed further in the coming year. This item is again raised in recommendation 7 in this year's report.
Clinicians and LMCs should be encouraged to collect accurate ethnicity details at the time of booking.	This is a focus of a number of DHBs' Maternity Quality and Safety Programmes with regard to improving data collection and addressing inequalities. The development of a nationwide Maternity Clinical Information System for DHBs should assist with standardising ethnicity data.
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.	Research into barriers to access is being undertaken by in a number of DHBs as part of local Maternity Quality and Safety Programmes and in response to the National Maternity Monitoring Group selecting timely registration with primary maternity services as a priority in 2012–13. Media and social media activities are underway in a number of DHBs as part of local Maternity Quality and Safety Programmes. Local innovations and resources with regard to early booking and access to care are being shared with all DHBs through national networks The New Zealand College of Midwives, supported by the Ministry of Health, launched the Find Your Midwife website which further supports women to find and book with an LMC.
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.	As per previous comments regarding activities being undertaken by DHBs as part of local Maternity Quality and Safety Programmes.
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.	The Ministry of Health expects that this recommendation will be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

Recommendation	Progress
Perinatal mortality	
8. Smoking cessation	
All health professionals who provide care to pregnant women should offer smoking cessation advice.	It is intended that information about advice to quit will be collected at the point of booking into a maternity facility and will feed into the National Maternity Clinical Information System. The Ministry is progressing work to support the Maternal Tobacco Health Target that seeks to ensure that 90 percent of pregnant women are provided brief advice and cessation support to help them quit smoking at first contact with primary maternity services. Most DHBs have comprehensive maternal tobacco cessation programmes and initiatives. Maternal Tobacco use is a priority of the National Maternity Monitoring Group who has worked with the Ministry of Health in 2012–13 to analyse maternal tobacco use and support the implementation of the Maternal Tobacco Health Target.
9. 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 and a priority of the National Maternity Monitoring Group. The Ministry is developing evidence based guidelines for the Screening, Diagnosis and Management of Gestational Diabetes in New Zealand. Once completed, these will be implemented by all DHBs as part of their Maternity Quality and Safety Programmes. 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. It is expected that LMCs screen for family violence and all DHBs have in place screening for family violence when people are admitted to hospital.
10. 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 Maternal Fetal Medicine Network. The care of multiple pregnancies is the subject of a further recommendation (2) this year. This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
11. Detection of fetal growth restiction	
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 (SGA) infants. If SGA is confirmed by ultrasound at term, timely delivery is recommended.	Some obstetric databases have included the GROW programme for use by clinicians. This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

Recommendation	Progress
Perinatal mortality	
12. Antepartum haemorrhage	
All women with bleeding during pregnancy, regardless of the apparent cause, should be monitored more closely for fetal growth and preterm birth.	This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
13. Maternal gestational weight gain	
Pregnant women should be given an indication of ideal weight gain in pregnancy according to their body mass index (BMI).	The Ministry of Health is developing evidence based guidelines for weight management in pregnancy This is also being addressed by the Ministry of Health's review of DHB funded Pregnancy and Parenting Education and obesity policy development.
14. 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 published guidance on observation of mother and baby in the immediate postpartum in 2012. This guidance supports safe sleeping in postnatal wards. Further guidance for safe sleeping policies has been developed and is available for all DHBs via Change for Our Children.
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 Ministry has funded 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 (www.whakawhetu.co.nz). Updated information on SUDI prevention has also been incorporated into the redevelopment of the WCTO Practitioners Handbook, nearing completion, and the parent-held Well Child Health Book, reviewed in 2012.
15. 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 finalised and all DHBs are required to implement them.
The low uptake of post-mortems among 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.

Recommendation	Progress
Perinatal mortality	
16. Neonatal encephalopathy	
Arterial and venous 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.	These recommendations should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
Maternal mortality	
17. 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 Coronial Services.
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 National Health IT Board is progressing this recommendation through the development and roll out of a nationally standardised Maternity Clinical Information System, which will support more consistent and comprehensive data capture by DHBs and support better communication between primary and secondary care through the use of 'shared view' of the maternity information available to primary care, primary maternity and women receiving maternity care.
Pregnant women who are identified with pre-existing medical disease during pregnancy should be referred appropriately.	This is reflected in the Referral Guidelines for LMCs. A further recommendation (6) has been added this year.
18. Seatbelts during pregnancy	
There is a need for greater public awareness of the importance of wearing a seatbelt during pregnancy. All pregnant women should know that three-point seatbelts 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 and distributed through DHBs.
19. Maternal mental health	
Maternal mental health services should be integrated into maternity services.	The Ministry of Health supports the recommendation that maternal mental health services be integrated into maternity services. This is in line with best practice. The Ministry has developed Perinatal and Infant Mental Health guidance (*Healthy Beginnings*) that is consistent with this recommendation. It proposes collaboration across maternal health, child health and mental health.
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.

Recommendation	Progress
Maternal mortality	
19. Maternal mental health	
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.	This recommendation is supported by the Ministry of Health publication *Healthy Beginnings: Developing perinatal and infant mental health services in New Zealand.* Budget 2013 is putting an extra $18.2 million over four years into dedicated maternal mental health beds and new specialist community services around the North Island for around 650 mothers and their babies a year.
The PMMRC notes the publication of the Healthy Beginnings report in January 2012 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.	See above.
20. 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 should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
21. Hypertension in pregnancy	
Health care practitioners should follow the evidence-based management of hypertension in pregnancy recommended by the Society of Obstetric Medicine of Australia and New Zealand.	This can be found at *http://www.somanz.org/pdfs/somanz_guidelines_2008.pdf.* This item is again raised in Section 2 in this year's report.
22. Postpartum haemorrhage	
Acute obstetric units should develop a massive transfusion protocol to respond to major obstetric haemorrhage.	A national guideline for the treatment of postpartum haemorrhage is being finalised for distribution to professional colleges and DHBs. This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

Recommendation	Progress
Maternal mortality	
23. Emergency obstetric training	
All staff involved in the care of pregnant women should undertake regular training in the 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. At DHB level, 'skills and drills' sessions take place for all practitioners. A number of DHBs are supporting DHB and community based clinicians to attend multidisciplinary emergency obstetric training programmes such as PROMPT.
24. 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.	Immunisation against influenza for pregnant women is available free of charge. Influenza immunisation promotion has included specific promotion to pregnant women.

1 Perinatal Mortality 2011

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 2011 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 for eligible women, except in the case of private obstetricians, who have the right to charge co-payments 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 whom 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 (*http://www.health.govt.nz/publication/guidelines-consultation-obstetric-and-related-medical-services-referral-guidelines*).

1.2 Methodology

Data sources

The perinatal deaths presented in this report occurred between 1 January and 31 December 2011. 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 LMCs 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, determining contributory factors and potentially avoidable deaths 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 and/or local coordinators 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). The local coordinator also includes post-mortem and histology reports with the classification form (Ministry of Health 2012a).

Contributory factors and potentially avoidable mortality

The assessment of contributory factors and potentially avoidable perinatal death 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. In 2012, the form was modified, and technology, equipment and environment factors were incorporated into the remaining categories where appropriate. 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.

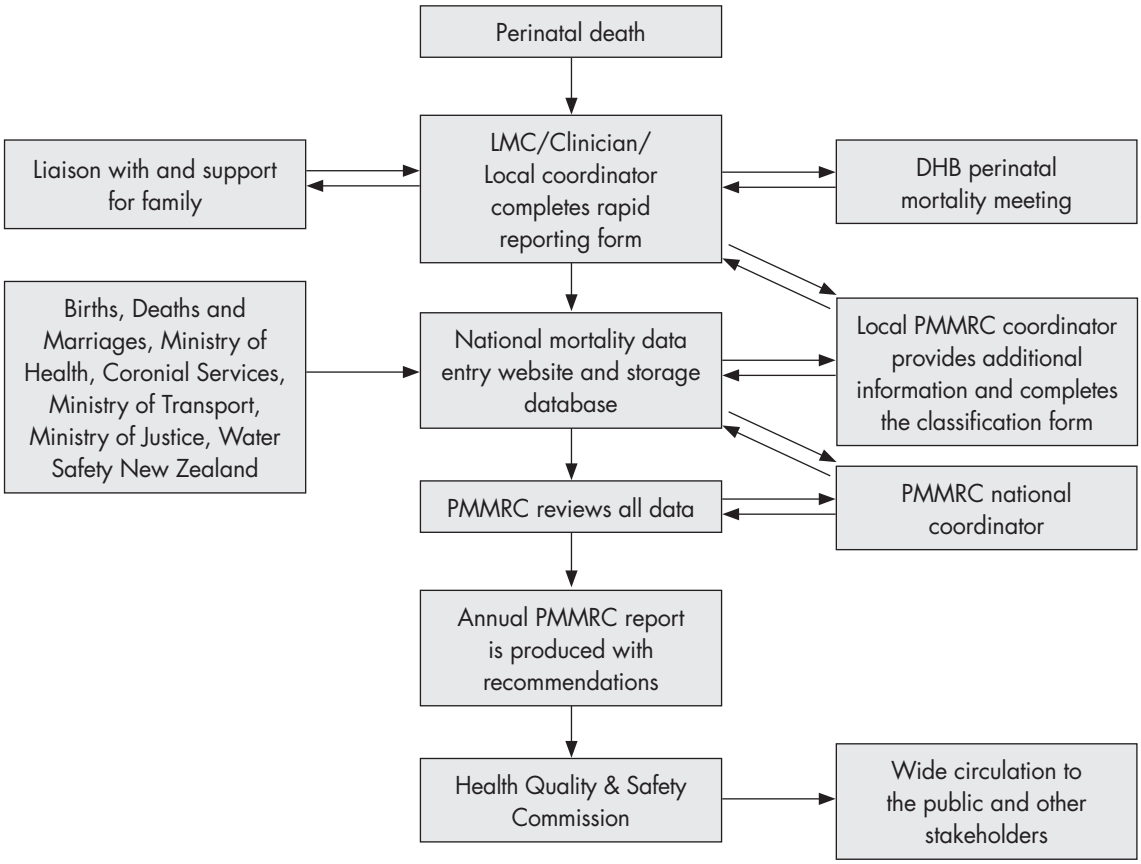
The Maternal Mortality Review Working Group (MMRWG) has identified potentially avoidable maternal deaths since 2006. From 2009, the MMRWG started to use the same tool identifying contributory factors and potential avoidability as that used for perinatal deaths.

The clinical notes for a random sample of deaths in 2009 (excluding congenital abnormality and SUDI deaths) were used in a study to validate the PMMRC local process for the identification of contributory factors and potentially avoidable perinatal related mortality. This was done by comparing the findings of local review for identification of contributory factors and potentially avoidable perinatal related mortality with a multidisciplinary independent panel using the same methodology.

Clinical notes from 48 perinatal related deaths were reviewed by both panels. There was substantial agreement (Kappa 0.63) in identification of contributory factors but only moderate agreement (Kappa 0.50) in identification of potentially avoidable perinatal related deaths between local and independent review. Analysis of non-concordant cases identified areas where modification of the tool and further education of local reviewers might improve the local process. The full results of this study will be available on the PMMRC website when published.

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 *http://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 is undertaken by the national coordinator by comparing these data with clinical records from the relevant DHBs.

The audit in 2010 included perinatal deaths due to congenital anomalies associated with cardiac, neural tube or chromosomal abnormalities and the quality of maternity care and investigations provided. This was funded by the Health Quality & Safety Commission's Challenge 2012. The full report is available at *http://www.hqsc.govt.nz/assets/Other-Topics/QS-challenge-reports/Detecting-abnormalities-earlier-in-pregnancy-Final-Report.pdf*. A summary of findings is included in section 1.8 and the key findings and recommendations as Appendix B.

The audit also included assessing the accuracy, completeness and PSANZ classification in the PMMRC data against the clinical notes from the GP, LMC and DHB. As part of the audit of data, the national coordinator assigns a perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) (as applicable) to all audited deaths and compares them with the original classification.

In 2010, there were 137 perinatal related deaths (19.5 percent) due to cardiac, neural tube or chromosomal abnormalities that were audited. The information provided below relates to the audit of these 137 deaths.

There were no cases where the audited and original primary classification varied; in two (1 percent), the subcategory varied. Two babies were entered as termination of pregnancy in the PMMRC dataset while both babies died prior to induction of labour and so were stillbirths.

The majority of data fields agreed; however, there were some differences between the clinical record data and the rapid reporting forms.

Maternal height and weight were missing from the PMMRC dataset for six deaths (4 percent) when the data were available in the clinical notes. There were some differences in height and weight both between the two datasets and within them, as recorded by different clinicians.

Smoking data varied from the PMMRC dataset in seven deaths. Two cases of marijuana use were identified from the notes but were not recorded on the rapid reporting form. Both the notes and the rapid reporting forms recorded 15 cases of alcohol use during pregnancy although only five of these were for the same patients.

Preconceptual folate data were in agreement in 55 (40 percent) of deaths. Of those recorded on the rapid reporting form as not taking preconceptual folate, only one was confirmed as taking preconceptual folate. Of those recorded as unknown preconceptual folate status, three were recorded as taking preconceptual folate in the clinical notes. Antenatal folate data from the notes and rapid reporting forms were in agreement in 64 cases (47 percent). Of those recorded as not taking antenatal folate on the rapid reporting form, 11 were confirmed as taking folate, and of those recorded as unknown antenatal folate status, 27 were taking antenatal folate.

Lead maternity carer at registration differed in 16 cases (12 percent) and was unknown but available in the clinical notes in one case.

Date of registration and date of first visit differed by more than one week in 45 cases (33 percent). There were 43 cases (31 percent) with unknown date of first contact on the rapid reporting form, but data were available in the clinical notes.

The data on testing for gestational diabetes were incorrect on the rapid reporting form in 19 deaths (14 percent); unknown was entered in nine deaths but the clinical notes advised two were tested and seven were not, and 10 women not tested on the rapid reporting form were tested.

These findings were presented to the PMMRC local coordinators to improve data collection.

The audit of 2011 data is not yet complete and will include term intrapartum and unexplained antenatal deaths. This audit includes assessing the accuracy, completeness and PSANZ classification in the PMMRC data and the quality of maternity care and investigations provided.

Denominator data

New Zealand birth registrations

The denominator data used in this report consist of New Zealand birth registrations during the 2006–2011 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 dataset and NMDS 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 neonatal deaths.

New Zealand National Maternity Collection (MAT)

The MAT (National Maternity Collection) is a relatively new initiative combining data from LMC claims for payment data with hospital discharge data and is currently not available for use by the Mortality Review Committees as a denominator. The dataset does not yet include demographic and antenatal information (including ethnicity, smoking and BMI) on 13.5 percent of mothers in 2011 whose antenatal care was provided by a hospital LMC service. 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 peoples, to register with an LMC later in pregnancy, to smoke and to have higher BMI (National Women's Hospital 2012). Given these limitations, the data need to be interpreted with caution. Nevertheless, these national data should provide the best available estimates of BMI, parity, smoking, LMC registration and gestation at registration 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

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.

Figures

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.

Confidence intervals

Ninety-five percent confidence intervals (CIs) for perinatal mortality rates have been computed using the methods for vital statistics described by the Centers for Disease Control and Prevention (CDC) (Heron 2011). Ninety-five percent 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 27, 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.

Statistical testing

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.

Where tests for trend have been used, a score test for linear trend of the log odds has been performed in STATA9 using the 'tabodds' function or in EpiInfo using the chi-squared test for trend. A p value of <0.05 has been used to indicate statistical significance.

Missing data

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, although 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.

Multiple year data

In this report, the figures illustrating perinatal related mortality rate include combined data for the five full years that the PMMRC has collected data (2007–2011) where it has been shown there is no trend over time. This increases the numbers and so improves the confidence around the estimates given. In general, the data for the 2011 year alone are presented in table form in the text and the combined five-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 (including Other European and Not Stated) 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.

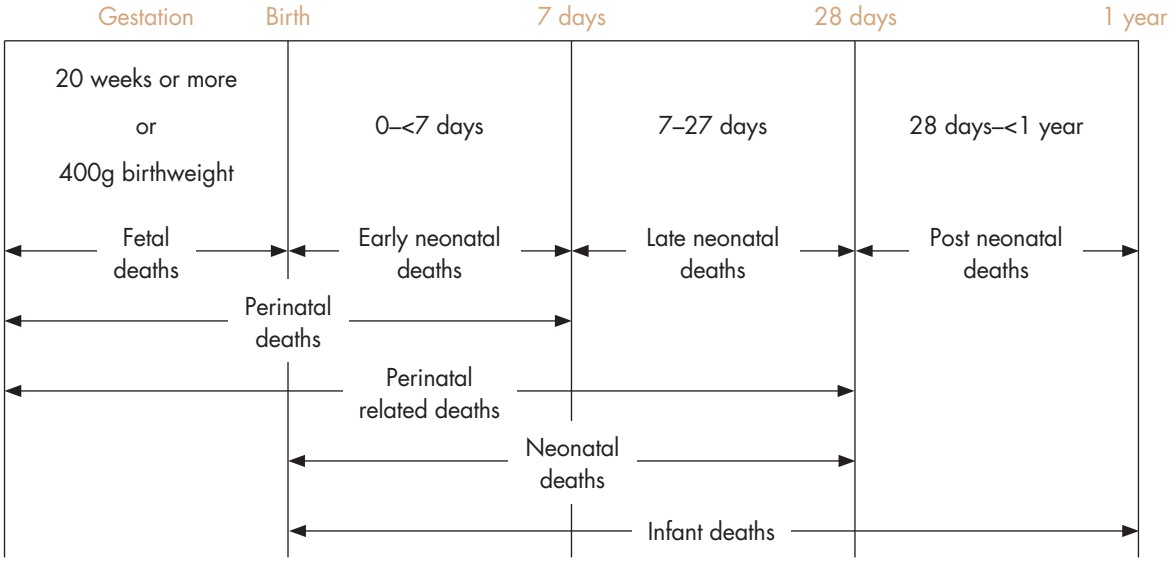
In 2008–2010, sole/combination and prioritised ethnicity outputs were presented in this report. In 2011, ethnicity has been reported as prioritised ethnicity (as outlined in Ethnicity Data Protocols for the Health and Disability Sector (Ministry of Health 2004; and as reported in the 2006–2008 PMMRC reports). This method is frequently used in health statistics in New Zealand. It prioritises minority ethnic groups which 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.

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 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. Where a termination of pregnancy died after birth, the pregnancy is included as a termination of pregnancy and therefore as a fetal death rather than as a neonatal death.

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 UK definition of perinatal mortality, which was developed for the surveillance of perinatal deaths in the UK and is based on the UK legal definition of stillbirths, which excludes fetal deaths before 24 weeks gestation (CMACE 2011a).

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 perinatal related deaths classified by the PSANZ perinatal death classification system as PSANZ-PDC 1 (congenital abnormality) and neonatal deaths classified by the PSANZ neonatal death classification system as PSANZ-NDC 1 (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.

International (WHO) perinatal mortality rates have been included in the report this year as recommended by the WHO (WHO 2006) to facilitate international comparison. These are rates of fetal death, neonatal death, perinatal mortality and perinatal related mortality of babies weighing ≥1000g, or ≥28 weeks if birthweight is unknown per 1000 total births of babies ≥1000g, or ≥28 weeks if birthweight is unknown. Babies without birthweight or gestation are to be included if they have been registered.

Customised birthweight centiles adjust newborn size for maternal weight, height, ethnicity and parity, as well as for infant sex and gestation at birth. Customised centile calculators are available online from the Gestation Network (*http://www.gestation.net*). For fetal deaths, the gestation at the time of estimated death (not birth) is used to calculate the birthweight centile. If gestation at death is unknown or gestation at death is <20 weeks or is seven days or more prior to birth, then customised centile is not calculated.

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.

Registration with a lead maternity carer (LMC) is the process by which a woman selects her LMC and occurs at the time of the first antenatal visit. *Registration* (previously known as booking) occurs when a woman chooses her LMC. From the time of registration, the LMC is responsible for the woman's maternity care. Date of registration is synonymous with the start of antenatal care.

Neonatal encephalopathy is 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 subclassified into organisational/management, personnel, technology/equipment and environmental, and those relating to barriers to access and engagement in care. In 2011, contributory factors under technology/equipment and environmental were reclassified into organisational and management or barriers as appropriate.

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

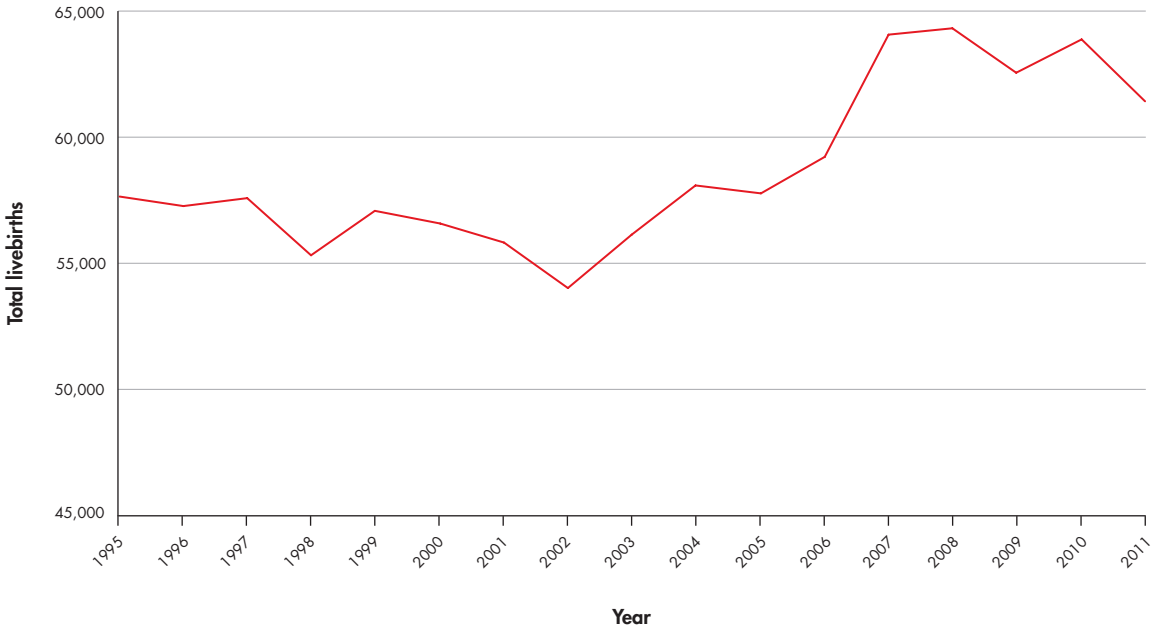
Place of birth is defined as:

- Home: A home environment does not have to be the mother's own home.
- Birthing unit: Stand-alone birthing centre.
- Hospital level 1: A hospital with no neonatal or caesarean section facilities.
- Hospital level 2: A hospital that is unable to provide long-term ventilation for babies.
- Hospital level 3: A hospital with full neonatal intensive care including facilities for long-term ventilation.
- Other: For example, car, ambulance.
- Not registered: The woman has not registered at any facility.

1.4 Births in New Zealand

New Zealand birth registrations 2011

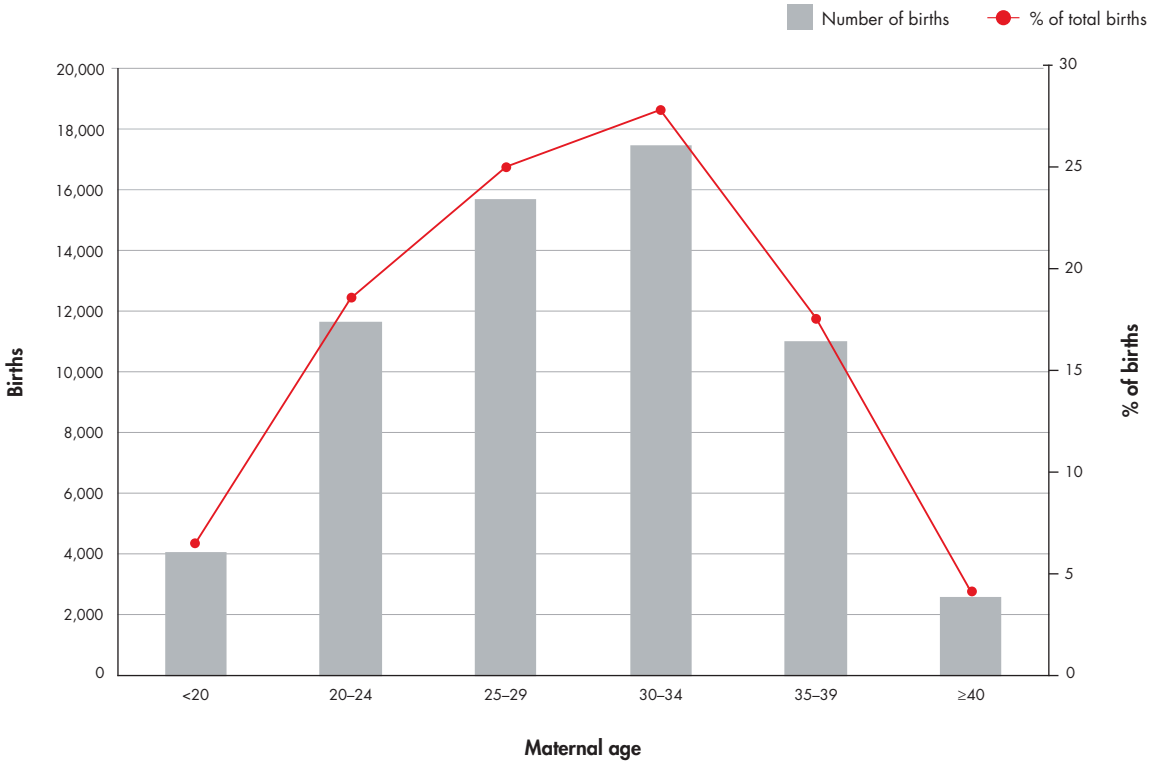
Figure 3: Total live birth registrations in New Zealand 1995–2011



Amended from Statistics New Zealand.

Maternal age

Figure 4: Distribution of maternal age among birth registrations in New Zealand 2011 (total births = 62,604)



The mean age of mothers in New Zealand in 2011 was 29.2 years. The greatest number of births in New Zealand occurred among mothers in the five-year age band of 30–34 years (27.9 percent). In 2011 in New Zealand, 6.5 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 2011, the denominator birth registration dataset included two ethnicities for 24.6 percent of all babies registered compared with two ethnicities for 14.0 percent of mothers registered. The set included three ethnicities for 6.0 percent of babies and three ethnicities for 1.4 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 2011 birth registration set are given in Table 1 below.

Table 1: Total ethnicity for mother and baby among birth registrations in 2011

	Ethnicity total response (baby)		Ethnicity total response (mother)	
	n=62,604		n=62,604	
	n	%	n	%
Māori	18,150	29.0	14,244	22.8
Pacific peoples	10,400	16.6	7,841	12.5
Indian	2,793	4.5	2,529	4.0
Other Asian	5,688	9.1	5,427	8.7
Other[1]	5,642	9.0	6,297	10.1
NZ European	40,807	65.2	36,159	57.8

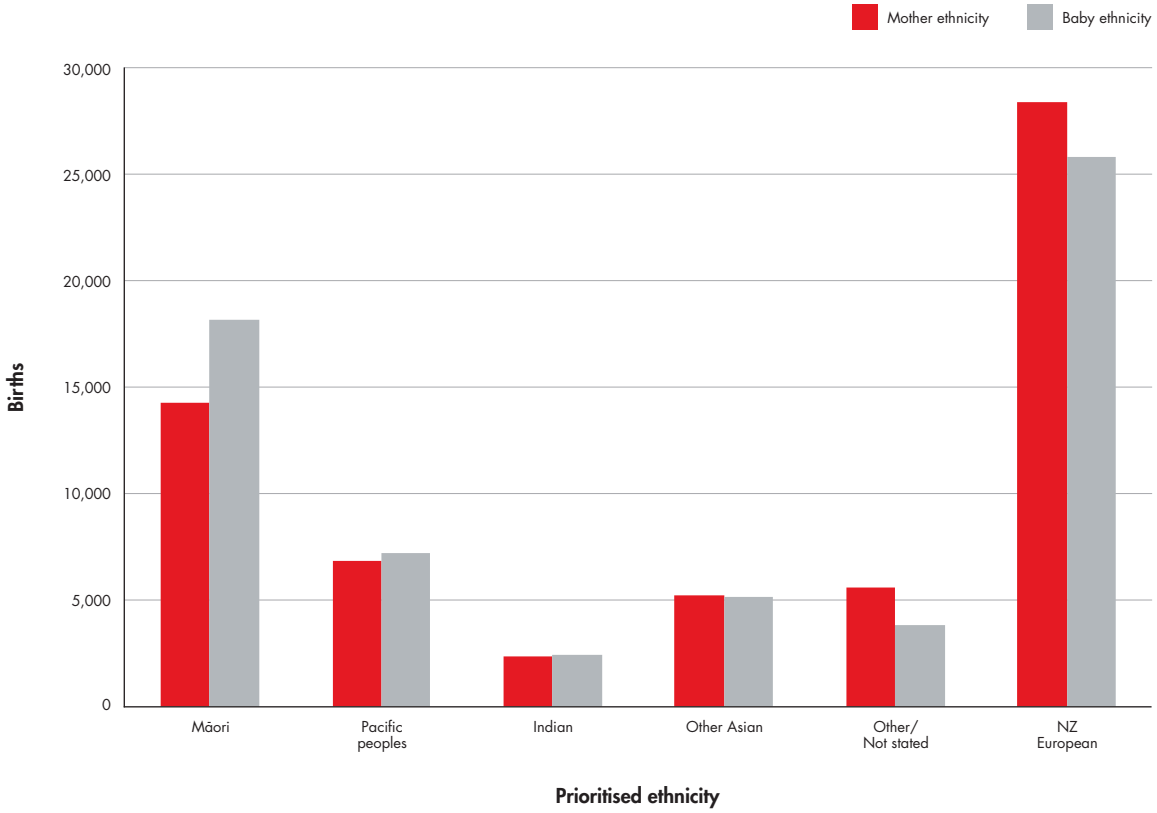
1 Includes not stated or unrecognisable response (n=9 babies, n=58 mothers).

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

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.

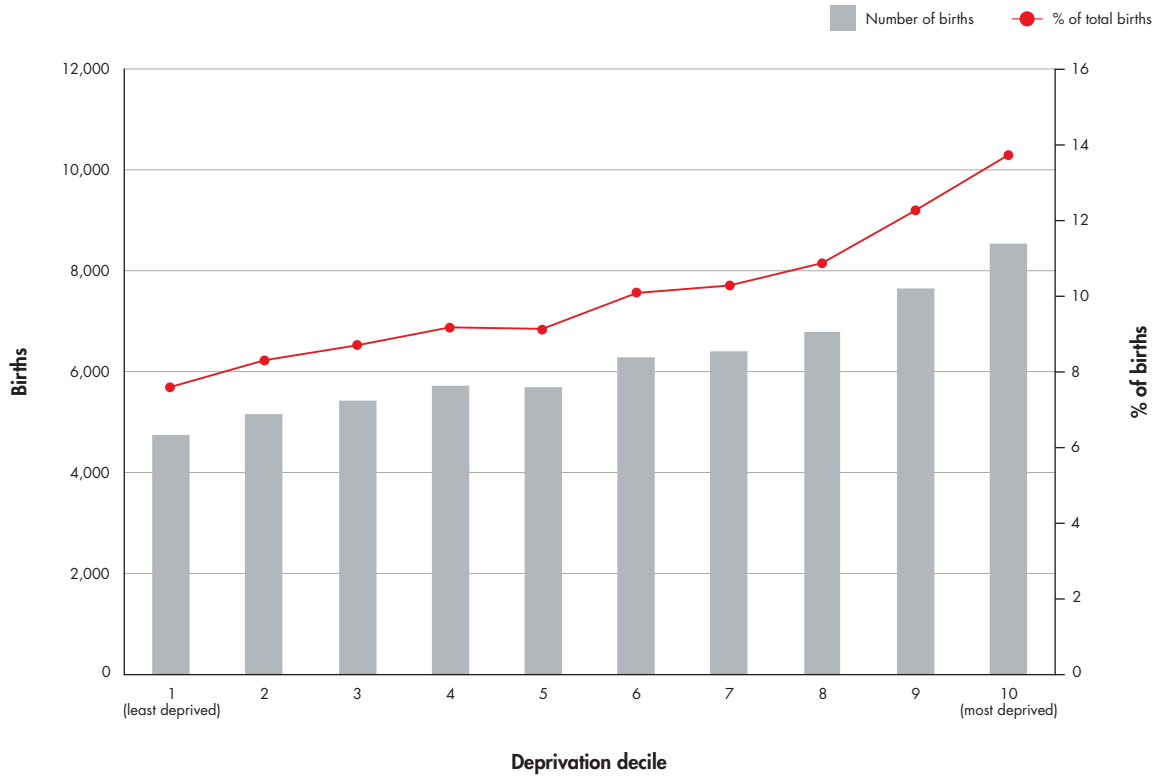
Prioritised ethnicity assigns only one ethnicity per person, prioritising responses according to the following hierarchy: Māori, Pacific peoples, Indian, Other Asian, Other (including other European and missing responses) and New Zealand European. Using prioritised ethnicity output, 45.3 percent of mothers identified as New Zealand European, 22.8 percent as Māori, 10.9 percent as Pacific peoples, 3.7 percent as Indian, 8.4 percent as Other Asian and 8.9 percent as Other ethnicities. The distribution of prioritised ethnicity among mothers and babies in the 2011 birth registration dataset is shown in Figure 5, with further information provided in Table 11 and Table 84.

Figure 5: Distribution of prioritised ethnicity (mother and baby) among births in New Zealand 2011 (total births = 62,604)



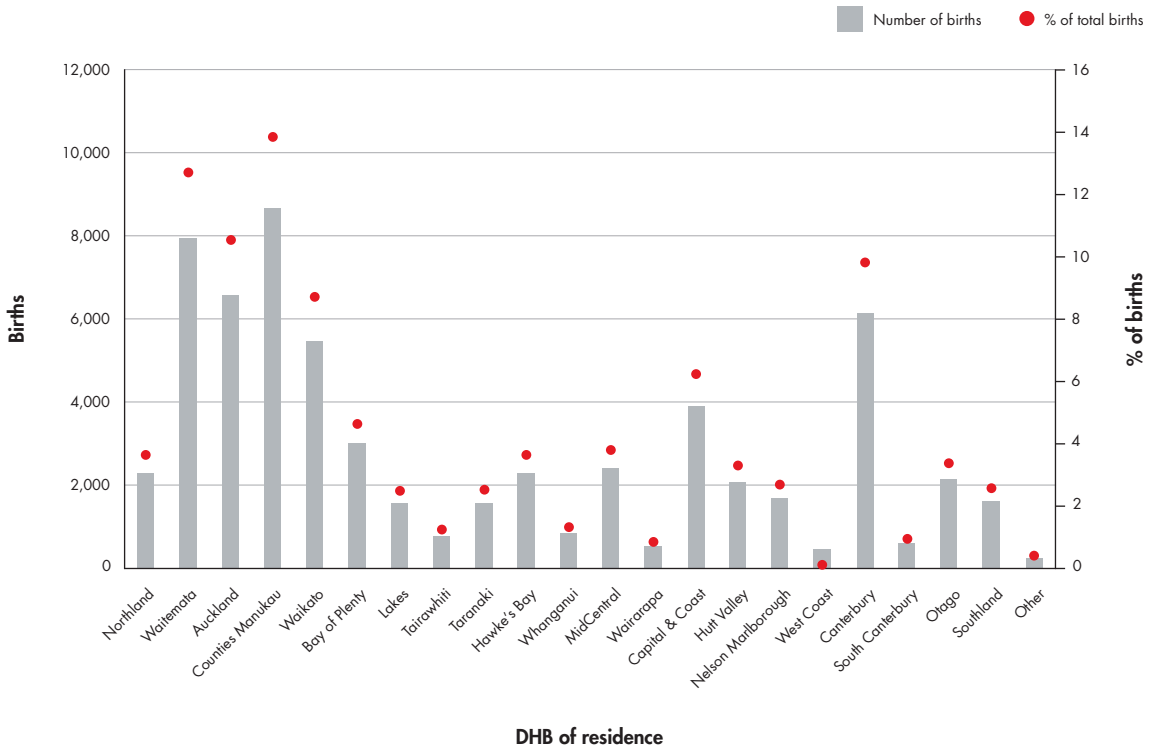
Socioeconomic deprivation and DHB of residence

Figure 6: Distribution of deprivation deciles (NZDep2006) among birth registrations in 2011 (total births excluding unknown = 62,354)



The proportion of babies born in the most deprived decile areas in New Zealand (13.6 percent) is greater than the proportion in any other decile areas, and the proportion of births increases with increasing deprivation score (NZDep2006).

Figure 7: Distribution of births by DHB of maternal residence among birth registrations in 2011 (total births = 62,604)



Associations between demographic variables

Socioeconomic deprivation and DHB of residence

Figure 8: Distribution of deprivation quintiles (NZDep2006) by maternal ethnicity (prioritised) among births registered in 2011 (total births = 62,604)

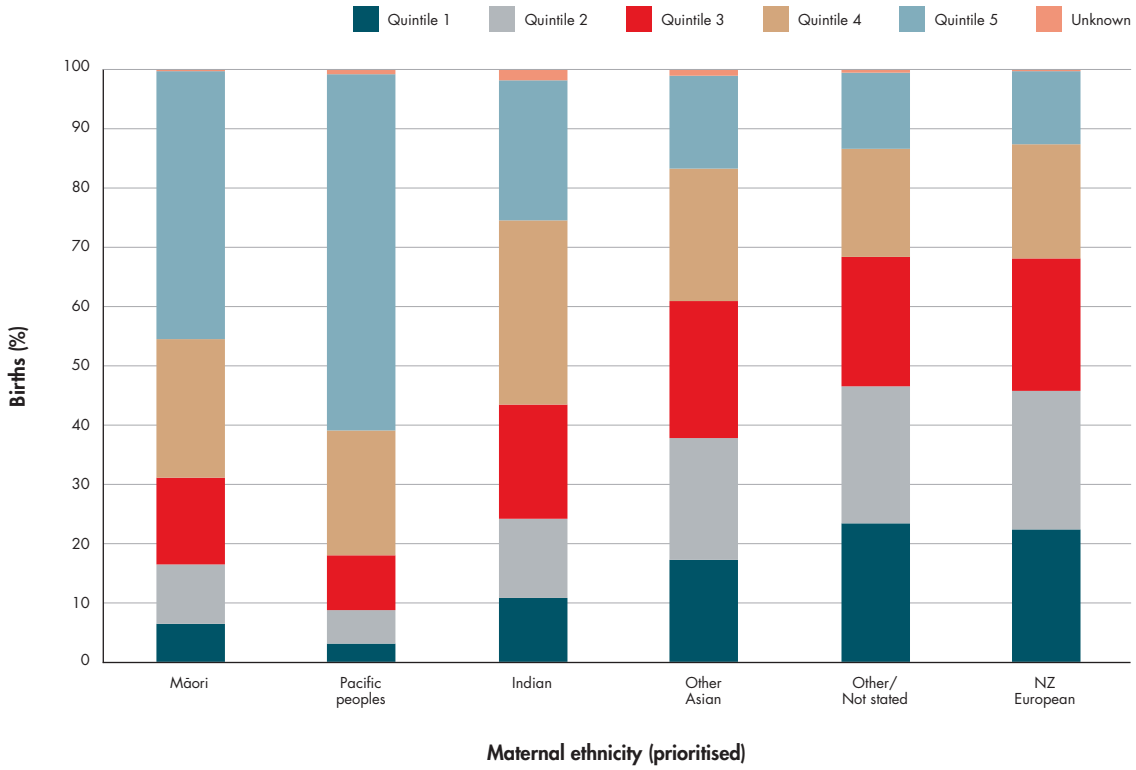
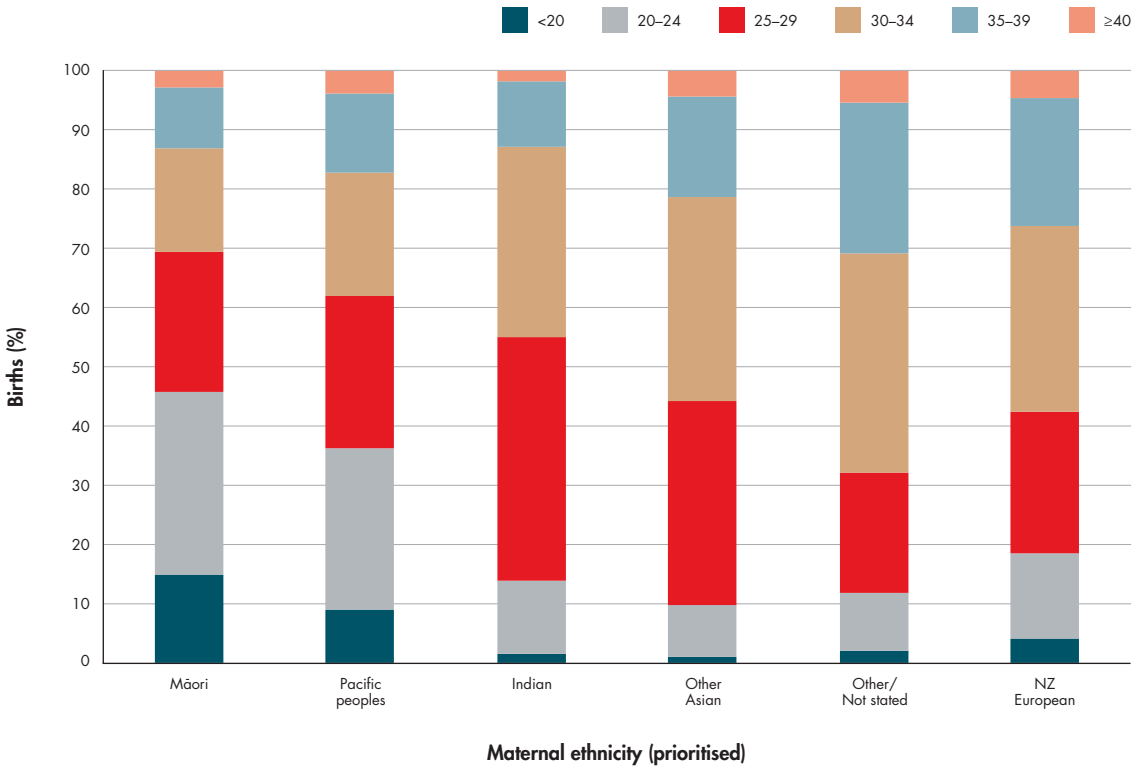


Figure 8 demonstrates the distribution of deprivation quintiles across prioritised ethnicity. There is an unequal distribution of deprivation (NZDep2006) by ethnicity with a higher proportion of Māori and Pacific women living in the most deprived (NZDep2006 decile 9–10) areas than European or Asian women.

Age and ethnicity

Figure 9: Distribution of maternal age by maternal ethnicity (prioritised) among birth registrations in 2011 (total births = 62,604)

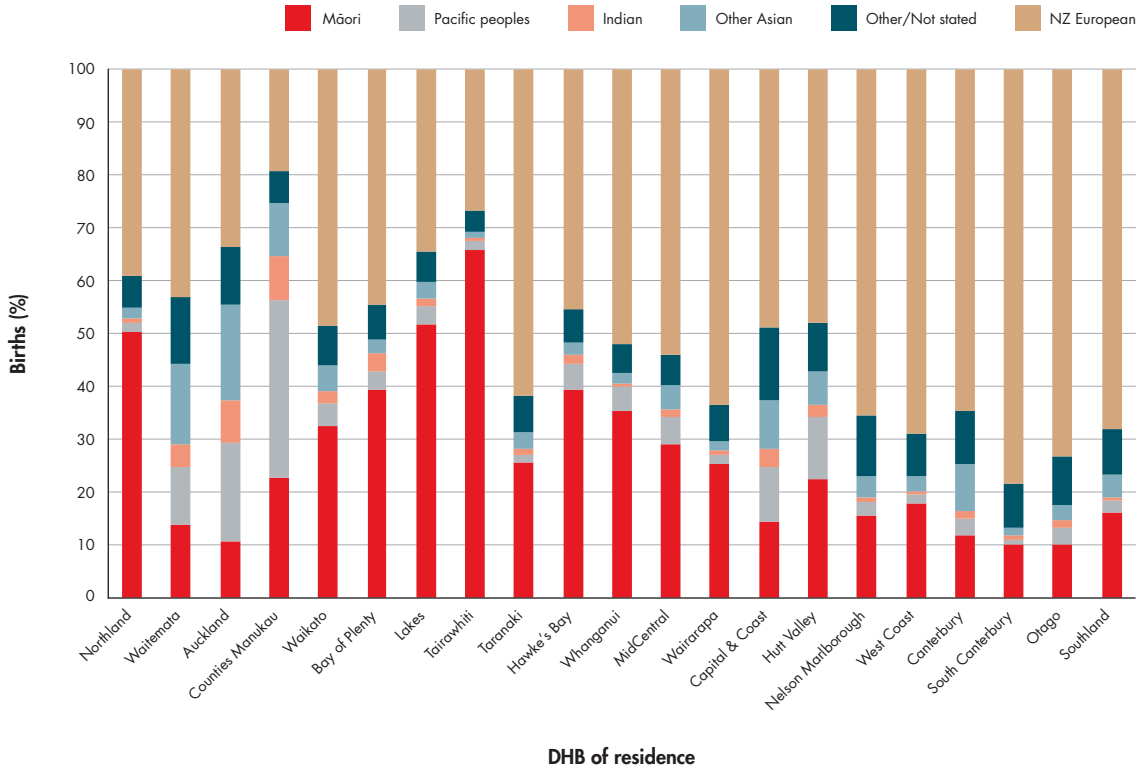


Mothers who identify themselves as Māori have the youngest age distribution. The differences in maternal age distribution by ethnicity may reflect both differences in the age distribution of the underlying population as well as differences in maternal age at birth by ethnicity.

DHB of residence, ethnicity and socioeconomic deprivation

DHB and ethnicity

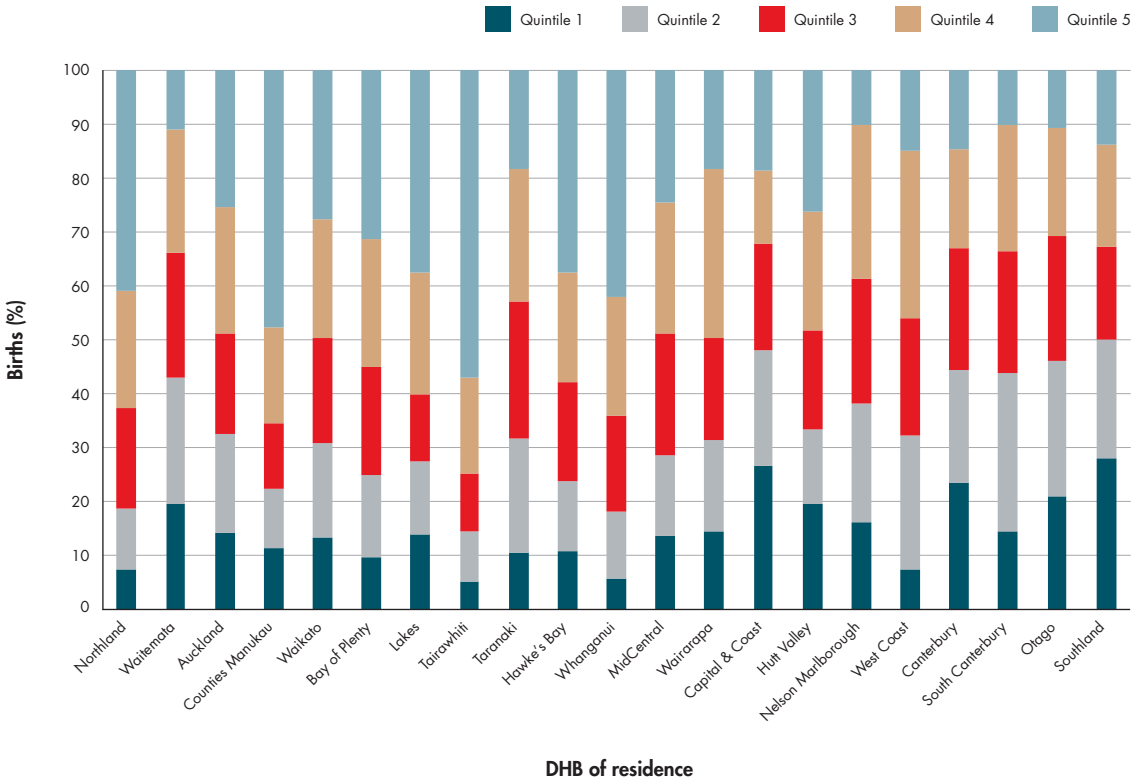
Figure 10: Distribution of maternal ethnicity (prioritised) by DHB of maternal residence, among birth registrations in 2011 (total births = 62,361)



There is 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 mothers.

DHB and socioeconomic deprivation

Figure 11: Distribution of deprivation quintile (NZDep2006) by DHB of maternal residence, among birth registrations in 2011 (total births = 62,352)



The distribution of births by New Zealand deprivation index quintile (NZDep2006) 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 2011

Table 2: Summary of New Zealand perinatal mortality rates 2011

	Using NZ definition		Using UK definition[1]	
	n	Rate	n	Rate
Total births	62,604		62,416	
Fetal deaths (terminations of pregnancy and stillbirths)[2]	501	8.0	278	4.5
Terminations of pregnancy	171	2.7	62	
Stillbirths	330	5.3	216	3.5
Early neonatal deaths <7 days	139		139	
Late neonatal deaths 7–27 days	25		25	
Neonatal deaths <28 days[3]	164	2.6	164	2.6
Perinatal mortalities[4]	640	10.2	417	6.7
Perinatal related mortalities[5]	665	10.6	442	7.1
Perinatal mortalities excluding lethal and terminated fetal abnormalities[6]	445	7.1	308	4.9
Perinatal related mortalities excluding lethal and terminated fetal abnormalities[6]	461	7.4	324	5.2

1 Rates calculated using UK 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 perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality.

The PMMRC perinatal related mortality rates are calculated from numerator data provided by LMCs, clinicians and DHB local coordinators, reviewed by local perinatal mortality review committees and collated centrally by a national coordinator, and denominator data from the registration of all births in New Zealand in a year. This differs from the methodology used by the Ministry of Health in its reports 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 2011 year in New Zealand.

Table 3: Summary of New Zealand perinatal mortality rates 2007–2011

	2007		2008		2009		2010		2011	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Total births	65,603		65,872		63,665		65,124		62,604	
Fetal deaths (terminations of pregnancy and stillbirths)[1]	511	7.8	524	8.0	540	8.5	494	7.6	501	8.0
Terminations of pregnancy	143	2.2	145	2.2	137	2.2	151	2.3	171	2.7
Stillbirths	368	5.6	379	5.8	403	6.3	343	5.2	330	5.3
Early neonatal deaths <7 days	134		133		136		165		139	
Late neonatal deaths 7–27 days	33		43		46		45		25	
Neonatal deaths <28 days[2]	167	2.6	176	2.7	182	2.9	210	3.2	164	2.6
Perinatal mortalities[3]	645	9.8	657	10.0	676	10.6	659	10.1	640	10.2
Perinatal related mortalities[4]	678	10.3	700	10.6	722	11.3	704	10.8	665	10.6
Perinatal mortalities (excluding lethal and terminated fetal abnormalities)[5]	460	7.0	488	7.4	508	8.0	462	7.1	445	7.1
Perinatal related mortalities (excluding lethal and terminated fetal abnormalities)[5]	479	7.3	516	7.9	539	8.5	493	7.6	461	7.4

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 perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality.

The perinatal mortality rates for the first five years of PMMRC data collection are presented in Table 3 and Figure 12. There have been fluctuations over these five years; however, the variations in individual and summary rates are more likely to be due to random variation than any true change in rates.

Figure 12: Perinatal related mortality rates using New Zealand definitions (per 1000 births) 2007–2011

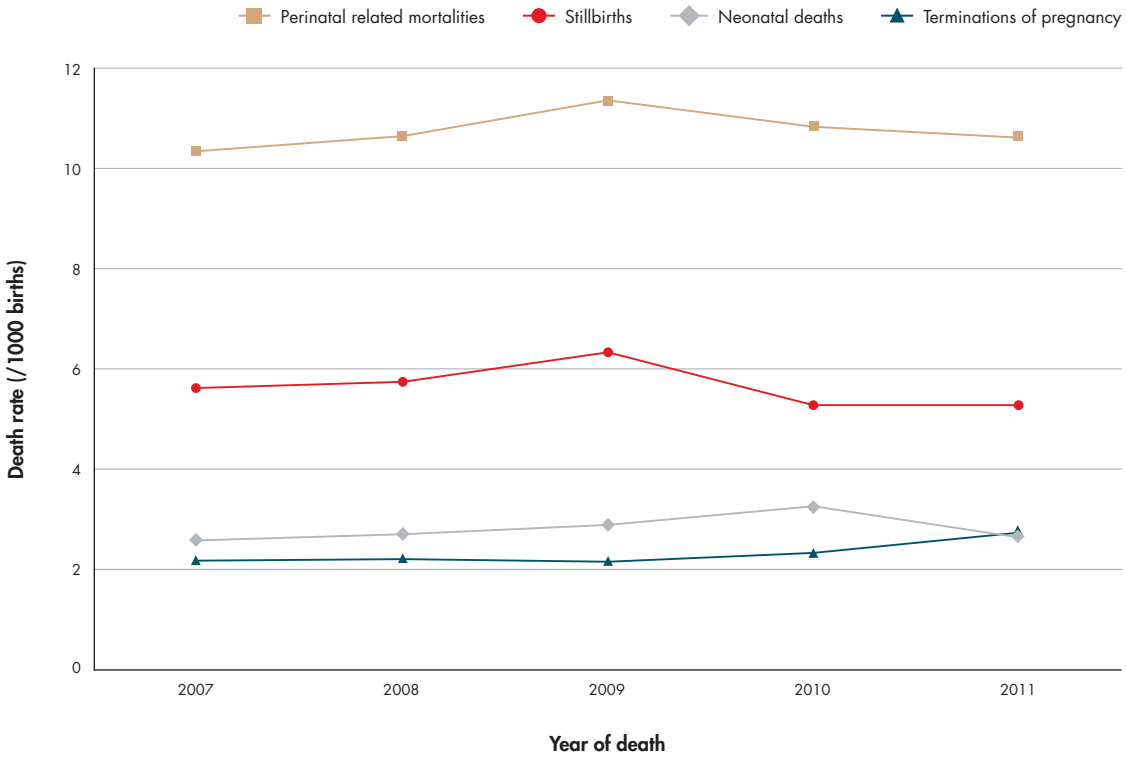
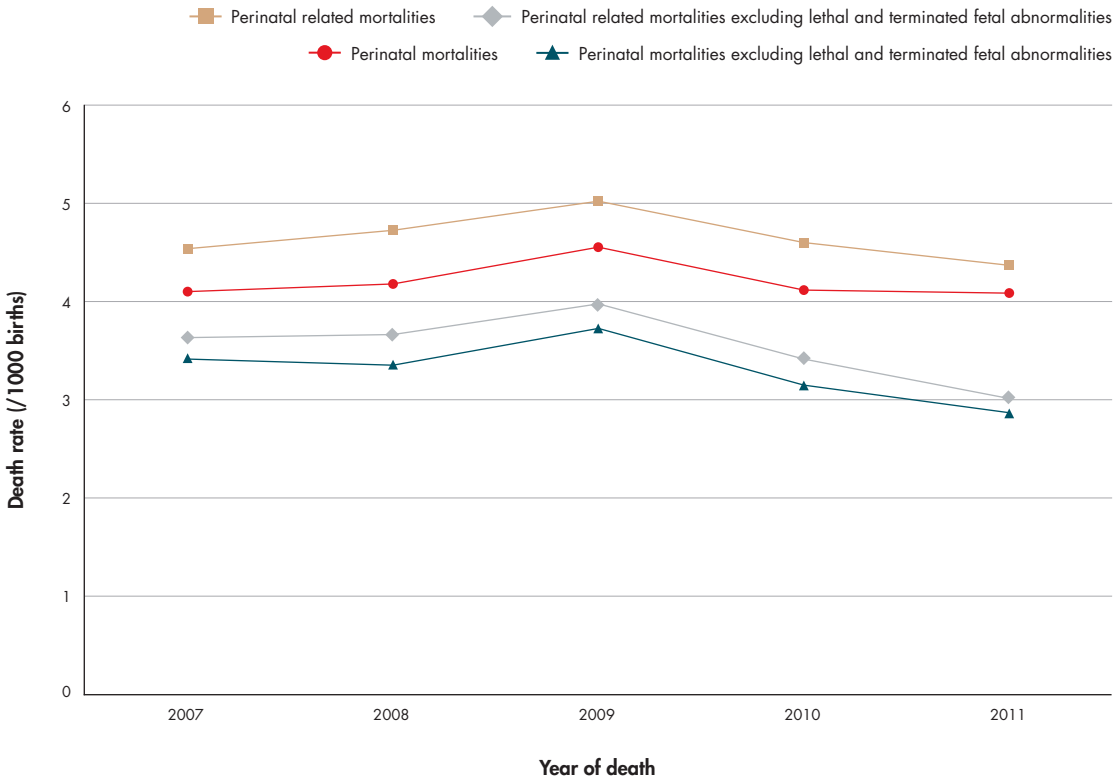


Figure 12 demonstrates perinatal related mortality rates for 2007–2011. There is no apparent change in overall rates over this time period.

International comparisons

It can be difficult to make international comparisons of mortality data due to differences in definitions. The WHO definition is recommended to facilitate international comparison (WHO 2006). The WHO definition reports weight-specific ratios for deaths and births of at least 1000g or 28 weeks if birthweight is unknown (including babies where neither is known but the death or birth is recorded). The exclusion of births below 1000g/28 weeks means most babies who die from spontaneous preterm birth are excluded, along with late terminations of pregnancy.

Figure 13: Perinatal mortality rates using international definitions 2007–2011



'Perinatal related mortality' includes late neonatal deaths (7–27 days) while 'perinatal mortality' excludes late neonatal mortalities.

Figure 13, illustrating perinatal related mortality rates for 2007–2011 using the WHO definition, shows no change in perinatal mortality and perinatal related mortality; however, there has been a significant decrease in perinatal related mortality when congenital abnormalities are excluded (p=0.05). The data are included in Table 80 in Appendix A.

In 2009, the UK reported a perinatal mortality rate of 7.6/1000 total births, a stillbirthrate 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 2011, 6.7/1000 total births (95% CI 6.1–7.4), 3.5/1000 total births (95% CI 3.0–4.0) and 2.6/1000 live births (95% CI 2.3–3.1), respectively). The 2009 data are the most recent published from the UK.

In 2009 (the most recently published data), 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). In 2011, the comparable rate in New Zealand was 10.6/1000 births (95% CI 9.8–11.5).

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) 2011

Perinatal death classification (PSANZ-PDC)	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Congenital abnormality	126	73.7	26	7.9	50	30.5	202	30.4
Perinatal infection	3	1.8	9	2.7	8	4.9	20	3.0
Hypertension	5	2.9	12	3.6	4	2.4	21	3.2
Antepartum haemorrhage	4	2.3	48	14.5	26	15.9	78	11.7
Maternal conditions	10	5.8	13	3.9	3	1.8	26	3.9
Specific perinatal conditions	9	5.3	51	15.5	13	7.9	73	11.0
Hypoxic peripartum death	-	-	8	2.4	11	6.7	19	2.9
Fetal growth restriction	3	1.8	37	11.2	4	2.4	44	6.6
Spontaneous preterm	11	6.4	32	9.7	41	25.0	84	12.6
Unexplained antepartum death	-	-	94	28.5	-	-	94	14.1
No obstetric antecedent	-	-	-	-	4	2.4	4	0.6

Figure 14: Relative distribution of fetal and neonatal deaths by perinatal death classification (PSANZ-PDC) 2011

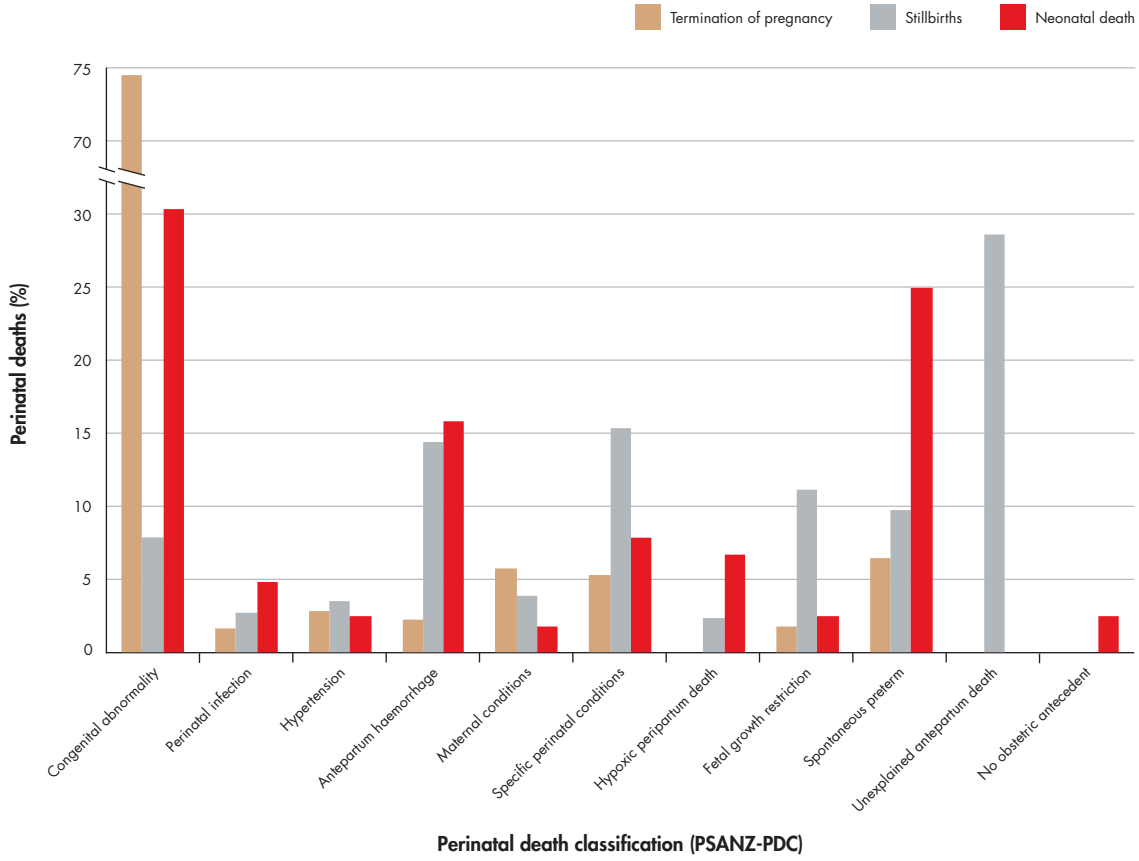


Figure 14 shows the distribution of cause of death (PSANZ-PDC) within late terminations of pregnancy, stillbirths and neonatal deaths. In 2011, 74 percent of terminations of pregnancy were congenital abnormalities compared to 8 percent of stillbirths and 31 percent of neonatal deaths.

Figure 15: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates by year 2007–2011

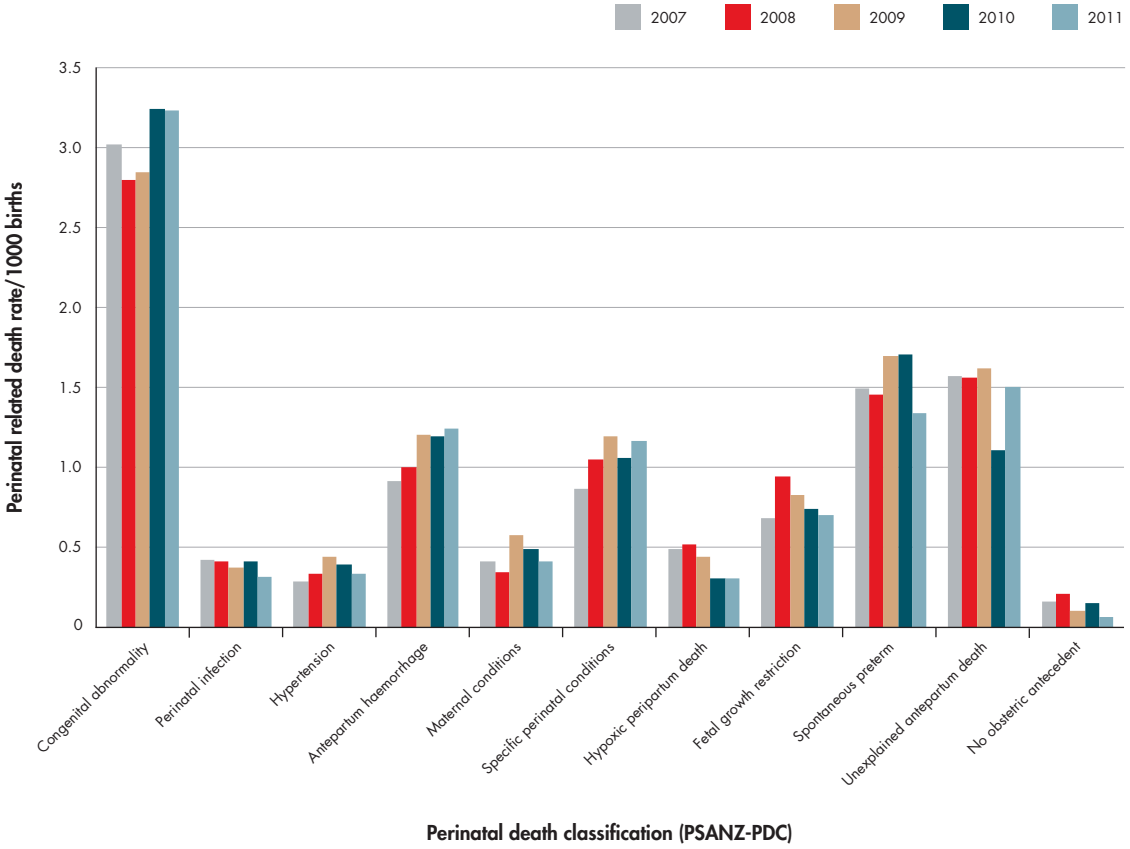


Figure 15 shows trends over the five years 2007–2011 in the rates of PSANZ-PDC specific causes of death.

There has been a significant increasing trend in the rate of perinatal related death due to antepartum haemorrhage (p=0.04) and a decreasing trend in the rate of hypoxic peripartum deaths (p=0.02) over the five years of reporting. There has also been a drop in the rate of deaths with no obstetric antecedent, due to a drop in the numbers of SUDI deaths, but this decrease was not statistically significant, possibly due to small numbers.

It is encouraging to see a decreasing rate of hypoxic peripartum death from 2007 to 2011. The PMMRC hopes that this trend will continue with an increased emphasis on these cases where potentially avoidable death has been shown to be common (see Figure 32). The PMMRC plans to review 2011 term intrapartum stillbirths in 2013.

It is not known why there is an increasing rate of death due to antepartum haemorrhage.

In 2012, an audit of perinatal related death from chromosomal, cardiac and central nervous system abnormalities was undertaken by the PMMRC. The key findings and recommendations from this study are highlighted in section 1.8 and included as Appendix B, and the full report can be found at *http://www.hqsc.govt.nz/assets/Other-Topics/QS-challenge-reports/Detecting-abnormalities-earlier-in-pregnancy-Final-Report.pdf.*

Stillbirth

There were 330 stillbirths in 2011 (5.3/1000 total births), consistent with numbers in 2010. The stillbirth rates in the past two years were lower than in the previous three years; however, as noted under Table 3, it is not possible to conclude that this reflects more than random variation.

The largest numbers of stillbirths consistently fall in the 'unexplained' category. In 2011, 29 percent of stillbirths fell into this category (21 percent in 2010). The most frequently identified antecedent causes (PSANZ-PDC) of stillbirth continue to be antepartum haemorrhage, specific perinatal conditions, fetal growth restriction and spontaneous preterm birth, each responsible for 10–15 percent of stillbirths.

Thirty-four percent of stillbirths from 24 weeks were unexplained in 2011, consistent with reporting from 2007 to 2009, and not supporting the suggestion in 2010 that a drop of this proportion to 24 percent may have represented a change in investigation of perinatal death in New Zealand.

Of 94 unexplained stillbirths in 2011, 38 (40 percent) were at term. Unexplained stillbirths accounted for 42 percent of stillbirths at term in 2011.

Of the 94 unexplained stillbirths, all but three were offered post-mortem. Forty-eight percent had optimal investigation, and a further 39 percent had partial investigation (defined as no post-mortem; investigations may have included placental pathology, MRI, ultrasound scan or x-ray). Thirteen percent (12 babies) of unexplained deaths were uninvestigated, not having a post-mortem, placental histology or karyotype undertaken.

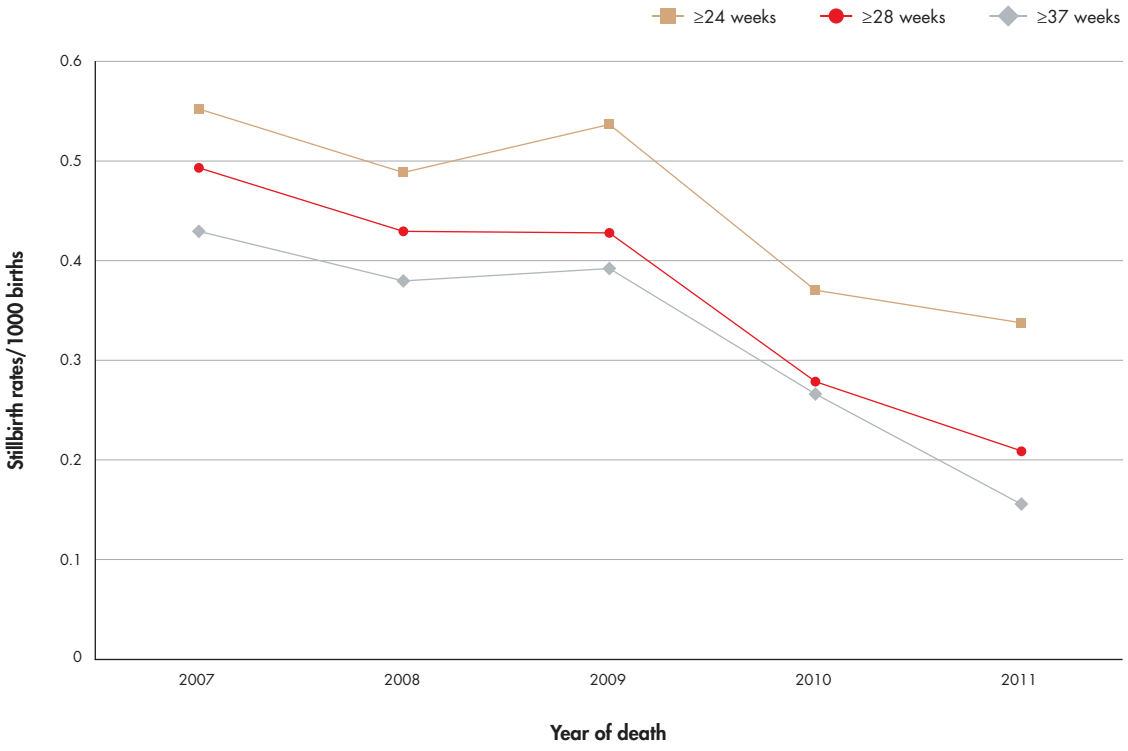
Intrapartum stillbirth

Table 5: Timing of stillbirths relative to labour by gestation 2011

Timing of stillbirth	All stillbirths		Stillbirths ≥24 weeks		Stillbirths ≥37 weeks		Stillbirths ≥37 weeks without congenital abnormality	
	n=330		n=216		n=91		n=81	
	n	%	n	%	n	%	n	%
Antepartum	233	70.6	170	78.7	71	78.0	65	80.2
Intrapartum – total	70	21.2	25	11.6	12	13.2	9	11.1
Intrapartum – first stage	24	7.3	13	6.0	5	5.5	4	4.9
Intrapartum – second stage	5	1.5	4	1.9	3	3.3	3	3.7
Intrapartum – unknown stage	41	12.4	8	3.7	4	4.4	2	2.5
Unknown	27	8.2	21	9.7	8	8.8	7	8.6

Of the 70 stillbirths in labour, 25 occurred at or beyond 24 weeks, 21 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 0.34/1000 births 24 weeks and beyond without lethal congenital abnormality in 2011 (see Figure 16).

Figure 16: Intrapartum stillbirth rate (per 1000 births) by gestation (weeks) excluding lethal abnormalities 2007–2011



As illustrated in Figure 16, there has been a statistically significant reduction in the intrapartum stillbirth rate among babies of all gestations from 24 weeks gestation.

Intrapartum deaths of babies born at term without congenital abnormality

There were 97 intrapartum stillbirths at term of babies who did not die of congenital abnormality recorded in the five years 2007–2011. The intrapartum stillbirth rate for babies born at term who did not die of congenital abnormality was 0.16/1000 in 2011 (0.43/1000 in 2007, 0.38 in 2008, 0.39 in 2009 and 0.27 in 2010).

Over these five years, there were 50 deaths from hypoxic peripartum death (PSANZ-PDC 7), 16 in 2007, 14 in 2008, 9 in 2009, 7 in 2010 and 4 in 2011. The hypoxic peripartum death-specific intrapartum stillbirth rate for babies born at term who did not die of congenital abnormality reduced from 0.26/1000 in 2007 to 0.07/1000 in 2011 (chi-squared test for linear trend $p<0.003$).

Other causes of term intrapartum death appear unchanged – perinatal infection (9), hypertension (4), antepartum haemorrhage (11), maternal conditions (2), specific perinatal conditions (5), fetal growth restriction (8) and unexplained antepartum death (8).

Termination of pregnancy

The rate of late termination of pregnancy has increased in the last two years, and this trend is significant ($p=0.04$). It is not apparent that this is due to an increase in any one underlying cause of death (PSANZ-PDC).

Congenital abnormality was the underlying cause of death in 74 percent of late terminations of pregnancy.

There were 35 terminations performed after 24 weeks gestation. The primary antecedent classifications for these cases were congenital abnormality in 30 and perinatal infection, maternal condition and specific perinatal conditions in the remainder.

Table 6: Clinical details of neonatal deaths 2011

	Total		Congenital abnormalities		Neonatal deaths excluding congenital abnormalities							
					20–23 weeks		24–27 weeks		28–36 weeks		≥37 weeks	
	n=164		n=50		n=53		n=26		n=12		n=23	
	n	%	n	%	n	%	n	%	n	%	n	%
Age at death												
≤1 day	105	64.0	26	52.0	51	96.2	12	46.2	7	30.4	9	39.1
2–7 days	36	22.0	15	30.0	1	1.9	9	34.6	3	13.0	8	34.8
8–14 days	8	4.9	5	10.0	1	1.9	1	3.8	1	4.3	-	-
15–21 days	6	3.7	3	6.0	-	-	2	7.7	-	-	1	4.3
22–28 days	9	5.5	1	2.0	-	-	2	7.7	1	4.3	5	21.7
Place of death												
Home	14	8.5	6	12.0	1	1.9	-	-	1	4.3	6	26.1
Hospital				-								
Delivery suite	57	34.8	17	34.0	29	54.7	6	23.1	-	-	5	21.7
Antenatal ward	-	-	-	-	-	-	-	-	-	-	-	-
Postnatal ward	4	2.4	1	2.0	2	3.8	-	-	-	-	1	4.3
Neonatal unit	61	37.2	21	42.0	5	9.4	19	73.1	7	30.4	9	39.1
Operating theatre	6	3.7	-	-	1	1.9	1	3.8	3	13.0	1	4.3
Emergency department	5	3.0	1	2.0	4	7.5	-	-	-	-	-	-
Other	9	5.5	1	2.0	8	15.1	-	-	-	-	-	-
Unknown	1	0.6	1	2.0	-	-	-	-	-	-	-	-
Other	5	3.0	1	2.0	2	3.8	-	-	1	4.3	1	4.3
Unknown	2	1.2	1	2.0	1	1.9	-	-	-	-	-	-
Apgar 5 minutes												
0–3	72	43.9	14	28.0	34	64.2	8	30.8	5	21.7	11	47.8
4–5	14	8.5	4	8.0	3	5.7	5	19.2	2	8.7	-	-
6–7	24	14.6	12	24.0	1	1.9	8	30.8	2	8.7	1	4.3
≥8	31	18.9	15	30.0	1	1.9	4	15.4	2	8.7	9	39.1
Unknown	23	14.0	5	10.0	14	26.4	1	3.8	1	4.3	2	8.7
Resuscitation at birth												
Yes	82	50.0	24	48.0	10	18.9	25	96.2	10	43.5	13	56.5
No	81	49.4	26	52.0	42	79.2	1	3.8	2	8.7	10	43.5
Unknown	1	0.6	-	-	1	1.9	-	-	-	-	-	-
Outcome of resuscitation												
Baby resuscitated and transferred to another clinical care area	63	76.8	22	91.7	5	50.0	20	80.0	7	53.8	9	69.2
Baby unable to be resuscitated	19	23.2	2	8.3	5	50.0	5	20.0	3	23.1	4	30.8

There were 164 neonatal deaths in 2011, 139 (85 percent) occurring within the first seven days of life. The neonatal death rate has fluctuated over the five years 2007–2011, but these differences are probably due to chance.

The differences in primary death classification (underlying cause of death) seen in Figure 15 for all perinatal deaths are also apparent in the neonatal death data (ie, a reduction in deaths from hypoxic peripartum injury and an increase in antepartum haemorrhage death), but numbers are small.

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

Fifty (31 percent) of babies who died in the neonatal period died from a congenital abnormality, and 14 (28 percent) of these were chromosomal abnormalities. All of these babies died following birth at or beyond 24 weeks, most commonly following birth at term.

Conversely, babies who died in the neonatal period of causes other than congenital abnormality, more often died following preterm birth. Fifty-three (46 percent) of these babies were born before 24 weeks, and 79 (69 percent) were born before 28 weeks. This highlights the burden of preterm birth on neonatal mortality.

Thirty-five babies died in the neonatal period after birth from 28 weeks onwards of causes other than congenital abnormalities. These babies died from neurological causes (15), infection (8), other (8) and cardio-respiratory disorders (4).

Of the neurological deaths, 14 died from hypoxic ischaemic encephalopathy (HIE), eight of whom had recorded complications of pregnancy or labour. In six cases, there was evidence of non-reassuring fetal status in a normally grown infant.

Of the eight neonatal deaths, following birth at 28 weeks or beyond, from infection, two were due to viral infections and six bacterial, of which three were acquired Group B *Streptococcus* infection.

There were five cases of SUDI among the neonatal deaths in 2011 (10 in 2008, seven in 2009 and eight in 2010). Four of these five mothers were Māori, three were smokers and two babies were co-sleeping.

Resuscitation

Twelve babies without lethal congenital abnormalities born at 24 or more weeks gestation (four born at term) were unable to be resuscitated at birth. The primary neonatal death classification for these infants was prematurity or its complications in six, infection in one and HIE in five.

Figure 17: Primary neonatal death classification (PSANZ-NDC) 2011 (n=164)

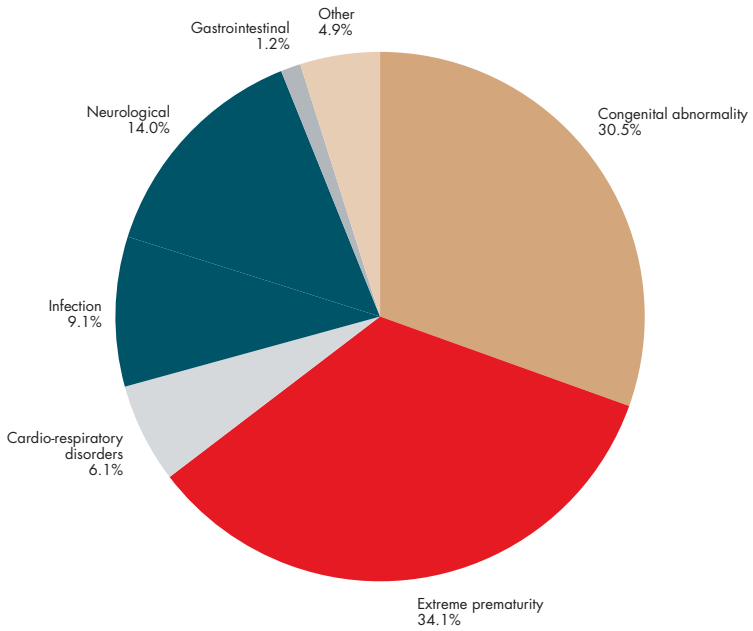


Figure 18: Distribution of neonatal death classification (PSANZ-NDC) among neonatal deaths without lethal congenital abnormality by gestational age group 2007–2011

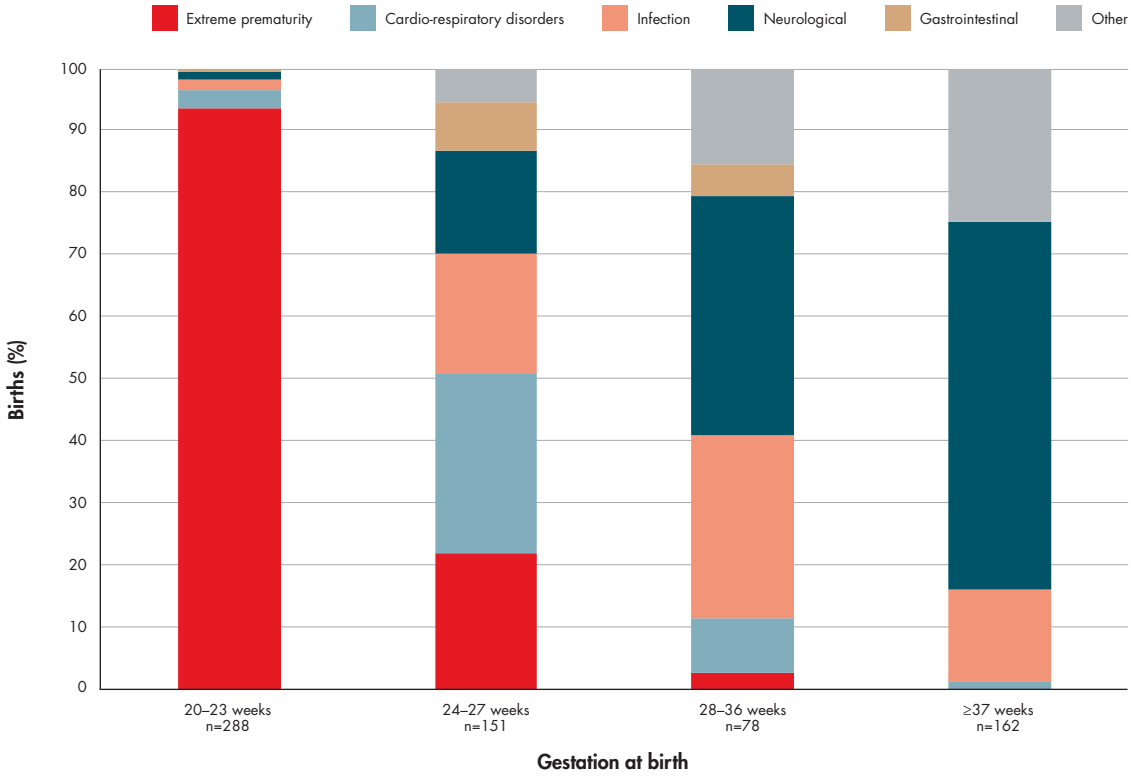


Figure 18 shows the distribution of cause of neonatal death (PSANZ-NDC) among different gestation groups, after excluding congenital abnormality. Extreme prematurity is the cause of death of the vast majority of babies born alive between 20 and 24 weeks. Prematurity is the principal cause in about 20 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 HIE.

Figure 19: Neonatal death rate (per 1000 livebirths) by gestation and baby ethnicity (prioritised) 2007–2011 (excluding congenital abnormalities)

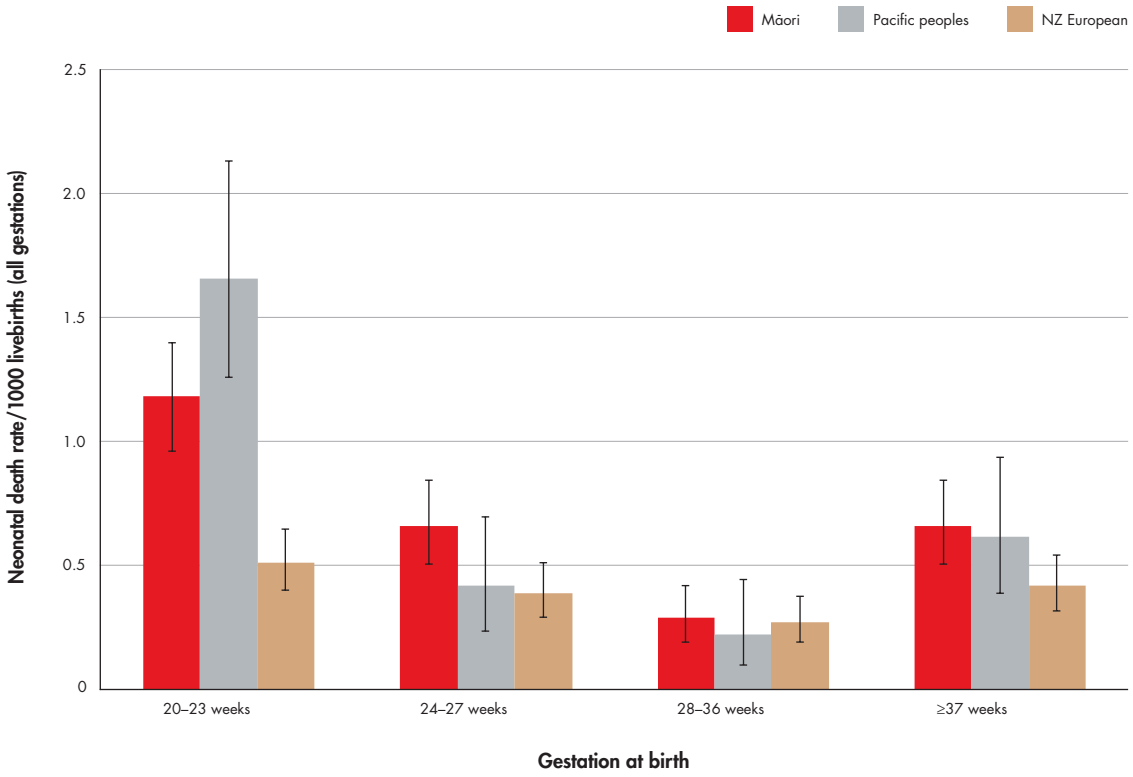


Figure 19 illustrates the rate of neonatal death excluding congenital abnormalities (as a proportion of total live births) at each gestation by prioritised ethnicity for Māori, Pacific and New Zealand European babies. This shows that Māori and Pacific neonates were significantly more likely to die at 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, reflecting the higher rates of preterm birth among these ethnic groups. 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.

Table 7: Association between obstetric antecedent cause of death (PSANZ-PDC) and neonatal cause of death (PSANZ-NDC) among all neonatal deaths 2011

Perinatal death classification (PSANZ-PDC)	Total	Neonatal death classification (PSANZ-NDC)						
		Congenital abnormality	Extreme prematurity	Cardio-respiratory disorders	Infection	Neurological	Gastro-intestinal	Other
Congenital abnormality	**50**	50	-	-	-	-	-	-
Perinatal infection	**8**	-	-	-	8	-	-	-
Hypertension	**4**	-	1	1	-	2	-	-
Antepartum haemorrhage	**26**	-	18	4	-	4	-	-
Maternal conditions	**3**	-	1	-	1	1	-	-
Specific perinatal conditions	**13**	-	6	-	1	2	-	4
Hypoxic peripartum death	**11**	-	-	1	-	10	-	-
Fetal growth restriction	**4**	-	-	1	1	1	-	1
Spontaneous preterm	**41**	-	30	3	2	3	2	1
No obstetric antecedent	**4**	-	-	-	2	-	-	2

All neonatal deaths are assigned at least one neonatal death classification (PSANZ-NDC), along with an obstetric antecedent cause (PSANZ-PDC). Table 7 demonstrates how these classification systems relate to each other. For example, death from extreme prematurity followed spontaneous preterm birth (30) but also antepartum haemorrhage (18) and specific perinatal conditions (6), hypertension and maternal conditions. Neurological deaths are common in neonates, but in a least 50 percent of cases, there was an underlying obstetric cause other than hypoxic peripartum death.

Demography of perinatal deaths

Gender

Table 8: Perinatal related death rates (per 1000 births) by gender 2011

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,604		n=171			n=330			n=164			n=665		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gender														
Male	32,112	51.3	78	45.6	2.43	175	53.0	5.45	88	53.7	2.76	341	51.3	10.62
Female	30,492	48.7	90	52.6	2.95	150	45.5	4.92	76	46.3	2.51	316	47.5	10.36
Unknown	-	-	3	1.8	-	5	1.5	-	-	-	-	8	1.2	-

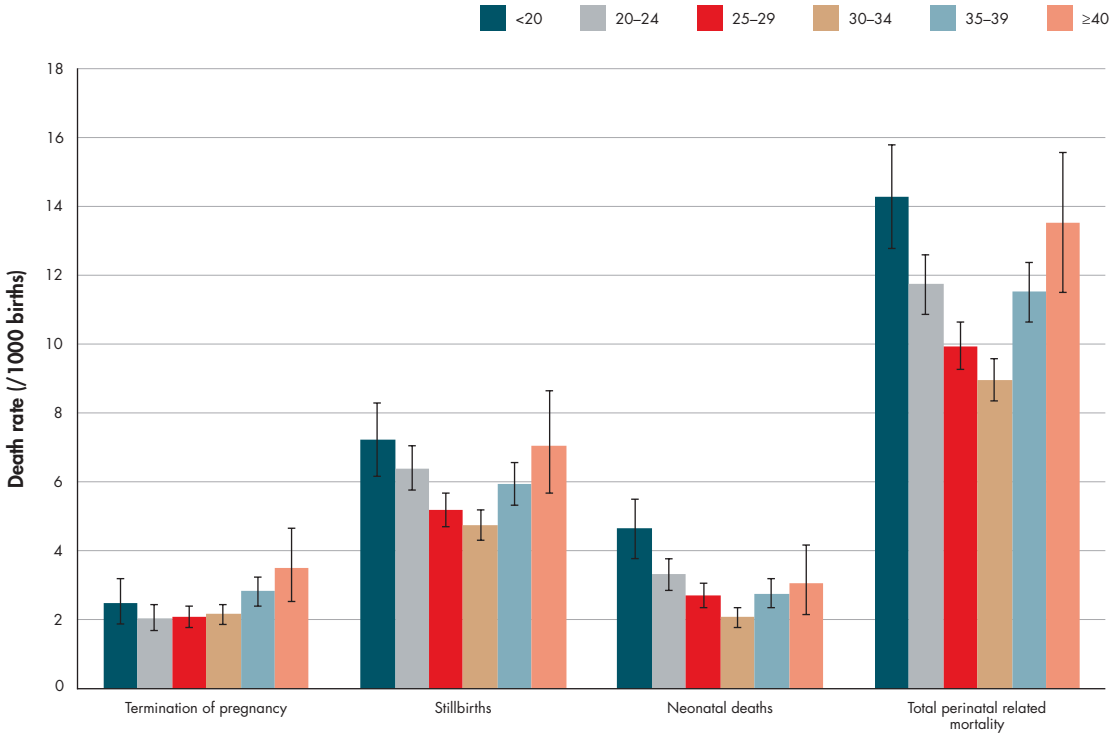
There were no statistically significant differences in perinatal related mortality rates between male and female babies in 2011.

Maternal age

Table 9: Perinatal related death rates (per 1000 births) by maternal age 2011

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,604		n=171			n=330			n=164			n=665		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Maternal age														
<20	4,093	6.5	17	9.9	4.15	23	7.0	5.62	24	14.6	5.92	64	9.6	15.64
20–24	11,674	18.6	25	14.6	2.14	64	19.4	5.48	27	16.5	2.33	116	17.4	9.94
25–29	15,736	25.1	34	19.9	2.16	75	22.7	4.77	38	23.2	2.43	147	22.1	9.34
30–34	17,464	27.9	46	26.9	2.63	75	22.7	4.29	38	23.2	2.19	159	23.9	9.10
35–39	11,049	17.6	41	24.0	3.71	76	23.0	6.88	28	17.1	2.56	145	21.8	13.12
≥40	2,588	4.1	8	4.7	3.09	17	5.2	6.57	9	5.5	3.51	34	5.1	13.14

Figure 20: Perinatal related death rates (per 1000 births) by maternal age (with 95% CIs) 2007–2011



There is no evidence of a significant increase or decrease in perinatal related mortality rate within any of the age categories presented over the five years of data and so the rates have again been combined in Figure 20. By increasing numbers in the numerator and denominator, combining data improves the accuracy of the estimates in the analysis.

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.

Maternal age and perinatal related mortality

Teenagers can be considered as high risk, often because they have barriers to antenatal care. Further exploration is necessary to better understand these barriers to access and to enable care provision that is acceptable.

Individualised strategies may support improved outcomes. This may involve education, social services, health care provision, whānau ora, housing, transportation and integration of services that target the specific needs of mothers at both ends of the age spectrum.

Figure 21: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates by maternal age (with 95% CIs) 2007–2011

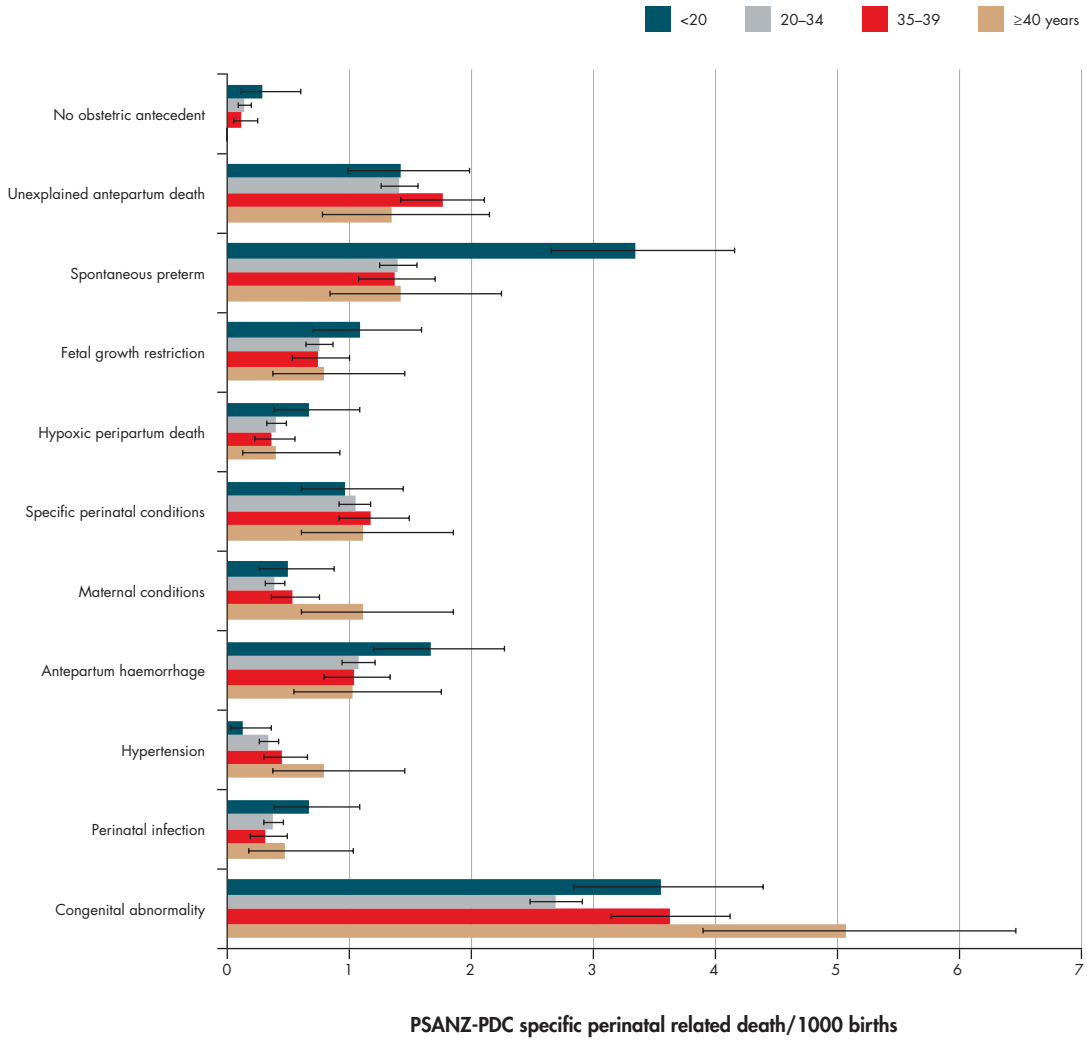


Figure 21 shows the cause of death (PSANZ-PDC) specific perinatal related mortality rates for teenage mothers compared with mothers aged 20–35, 35–39 and 40 and over. Spontaneous preterm birth is significantly more often the cause of perinatal related death in teenage mothers compared to mothers of all other ages. Maternal conditions and congenital abnormalities are significantly more common antecedent causes of perinatal death in older mothers compared to mothers aged 20–34.

There are significant linear trends with increasing age in the rates of death from maternal conditions (p=0.006), principally diabetes and hypertension (p=0.001).

There are higher rates of perinatal related mortality among teenage mothers from antepartum haemorrhage, fetal growth restriction and hypoxic peripartum death, but none of these differences is statistically significant given the data currently available. This may be a result of low numbers of these causes of death, or the apparent increase may be due to chance.

The association between age and congenital abnormality is as expected, with increasing rates with age from the age group 20–34. For further detail on the association between demographic factors and congenital abnormalities, see section 1.8.

Ethnicity

The use of maternal versus baby ethnicity has a small effect on the magnitude of the ethnicity specific mortality rates but not on the comparison between ethnicities. For this reason, only maternal data and figures are given in this section. Similar tables including baby ethnicity data are presented in Appendix A (Tables 85–87).

The figures illustrate rates based on the combined data for 2007–2011. Combined data are presented as there have been no significant ethnic-specific changes in perinatal related mortality rates and because the larger numbers allow for more robust estimates with tighter CIs.

Table 10, showing total ethnicity responses for perinatal related deaths in 2011, has been included for completeness.

Table 10: Total responses for mother and baby ethnicity among perinatal related deaths 2011

	Baby ethnicity total response among perinatal related deaths		Mother ethnicity total response among perinatal related deaths	
	n=665		n=665	
	n	%	n	%
Māori	210	31.6	177	26.6
Pacific peoples	104	15.6	87	13.1
Indian	36	5.4	36	5.4
Other Asian	56	8.4	52	7.8
Other	59	8.9	71	10.7
New Zealand European	383	57.6	341	51.3

* Totals do not sum to 100 percent, as individuals may be counted in more than one ethnic group.

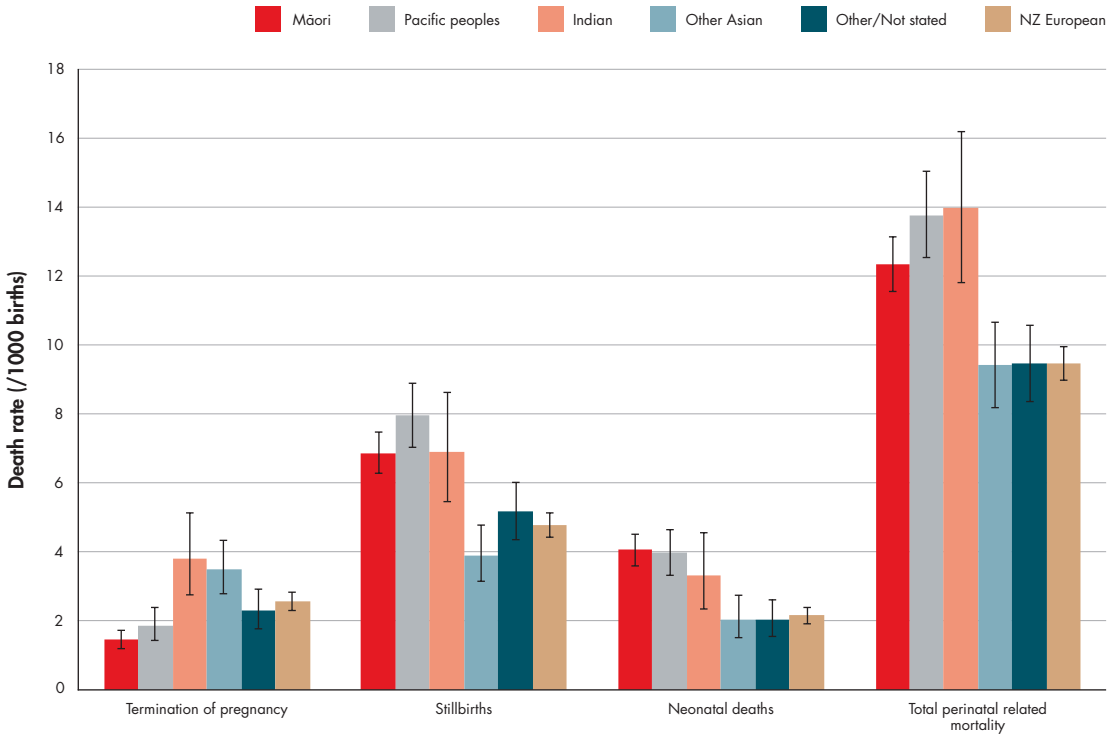
Mothers' ethnicity for the PMMRC set of perinatal related deaths has been extracted, in order of priority, from BDM registration of birth (77 percent) or PMMRC rapid response forms (23 percent). Babies' ethnicity for the PMMRC set of perinatal deaths has been extracted, in order of priority, from BDM registration of birth (77 percent), BDM registration of death (6 percent) or PMMRC rapid response forms (17 percent). One baby had no ethnicity data available.

Table 11: Perinatal related death rates (per 1000 births) by maternal ethnicity (prioritised) 2011

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,604		n=171			n=330			n=164			n=665		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	14,244	22.8	31	18.1	2.18	95	28.8	6.67	51	31.1	3.61	177	26.6	12.43
Pacific peoples	6,832	10.9	13	7.6	1.90	40	12.1	5.85	25	15.2	3.69	78	11.7	11.42
Indian	2,338	3.7	11	6.4	4.70	19	5.8	8.13	5	3.0	2.17	35	5.3	14.97
Other Asian	5,231	8.4	21	12.3	4.01	20	6.1	3.82	10	6.1	1.93	51	7.7	9.75
Other/ Not stated	5,576	8.9	17	9.9	3.05	31	9.4	5.56	16	9.8	2.89	64	9.6	11.48
NZ European	28,383	45.3	78	45.6	2.75	125	37.9	4.40	57	34.8	2.02	260	39.1	9.16

There has been no statistically significant change in perinatal related mortality rates over the five years from 2007 to 2011 within any ethnic group.

Figure 22: Perinatal related death rates (per 1000 births) by maternal ethnicity (prioritised) (with 95% CIs) 2007–2011



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). 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 Indian and Asian mothers.

Because of the differences in the associations between ethnicity and different types of perinatal related death, all figures show the specific mortality 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.

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. Indian mothers have a higher risk of late termination of pregnancy compared to all ethnicities other than Other Asian and also have a higher rate of stillbirth compared to Other Asian and New Zealand European mothers. Indian mothers have a significantly higher rate of neonatal mortality compared to New Zealand European mothers.

There is no statistically significant difference in the rate of late termination, stillbirth or neonatal death between Māori and Pacific mothers.

Other risk factors for perinatal death that are associated with ethnicity and may confound the association include age, socioeconomic status, obesity and smoking.

Figure 23: Stillbirth rates (per 1000 births) overall and at term by maternal ethnicity (prioritised) (with 95% CIs) 2007–2011

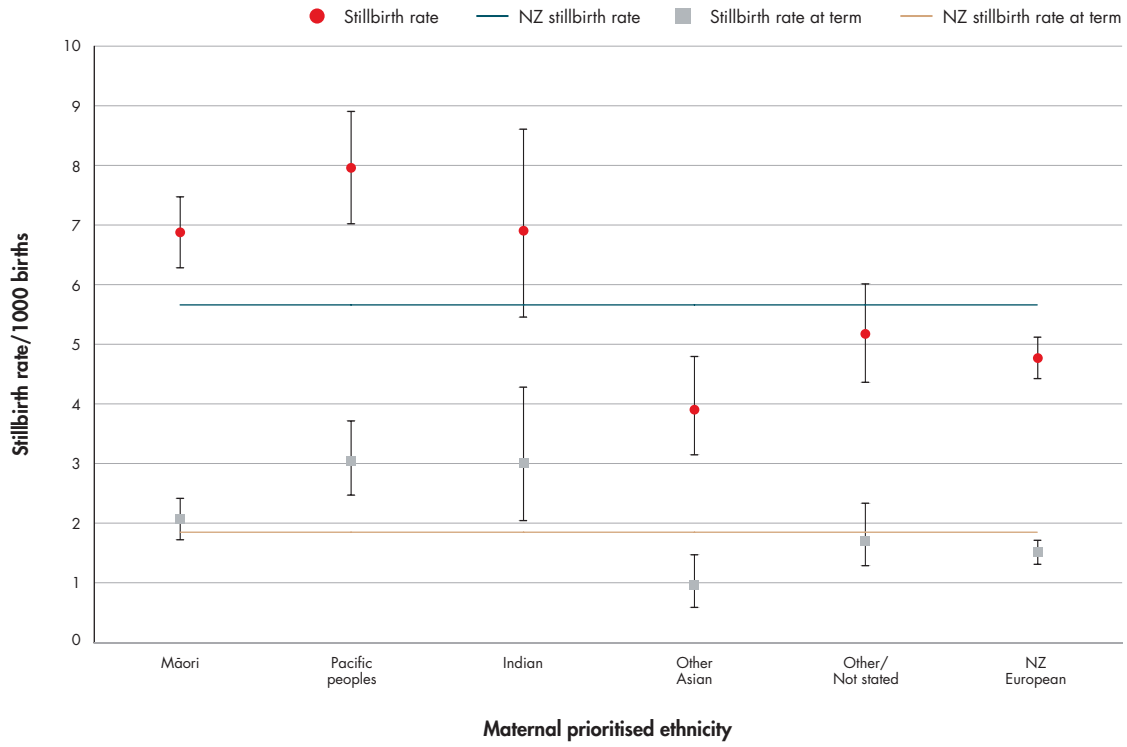


Figure 23 shows term and overall stillbirth rates by ethnicity, demonstrating that even stillbirth is a heterogeneous group. In particular, there is no increase in risk of stillbirth at term for Māori mothers, but there is a significant increase for Pacific and Indian mothers.

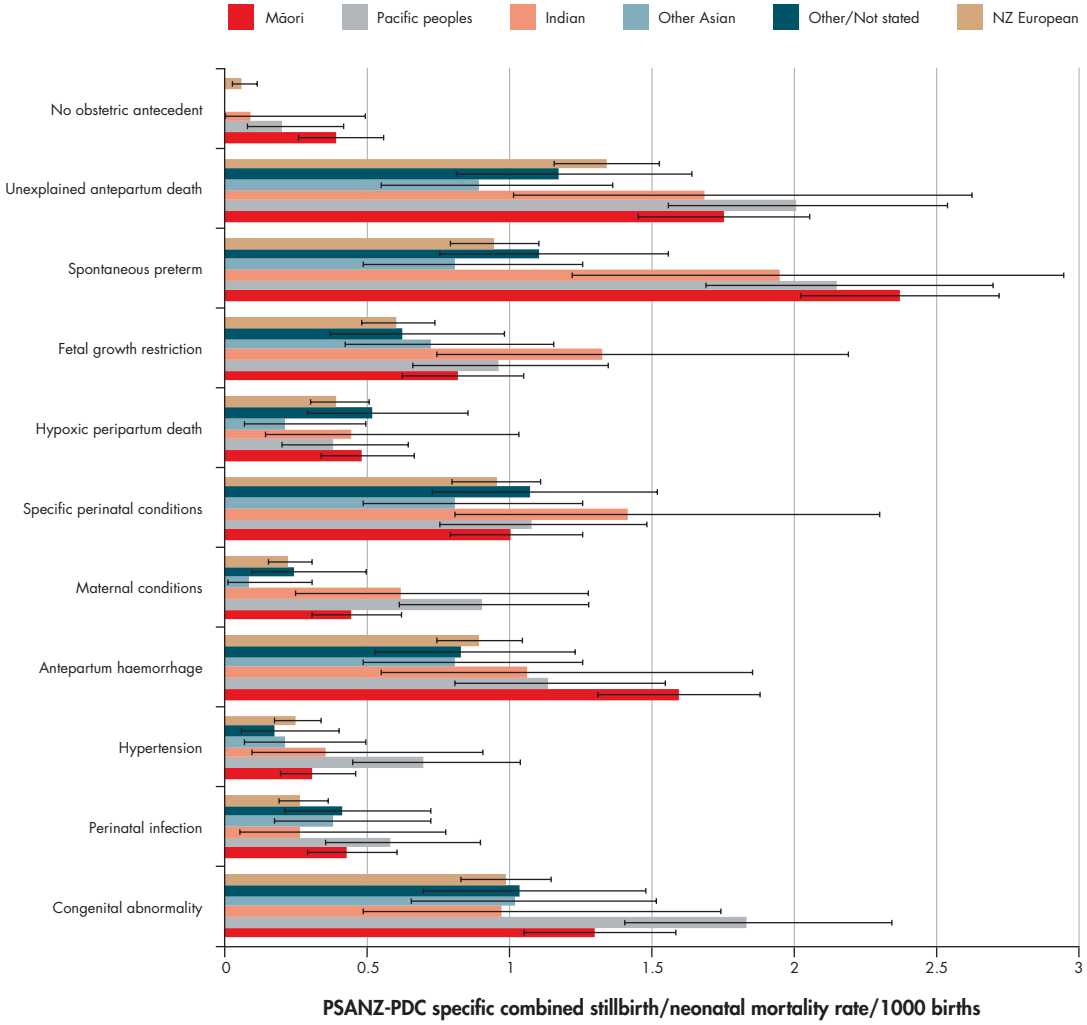
The Auckland Stillbirth Study (Stacey et al 2011) reported that ethnicity was not associated with late stillbirth (>28 weeks) after adjusting for maternal BMI, suggesting that maternal BMI may explain some or all of the excess stillbirths at term for Pacific and Indian mothers. It is hoped that the improvement in national maternity data collection in New Zealand will facilitate the analyses required to clarify the interrelationship between various confounding factors.

Figure 24 below shows perinatal death classification (PSANZ-PDC) specific perinatal related death rates (excluding termination of pregnancy) for all mothers by prioritised ethnicity.

Additional risk for Māori, Pacific and Indian mothers was evident for all causes of death other than hypoxic peripartum death and specific perinatal conditions, although the differences were not always statistically significant (depicted in the figures where the CIs do not overlap) and sometimes vary by ethnicity.

Higher rates of stillbirth and neonatal death from congenital abnormality in Pacific mothers probably reflects lower rates of termination of pregnancy but may also be related to increased obesity, known to be associated with increased risk of congenital abnormalities (Stothard et al 2009).

Figure 24: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by ethnicity (prioritised maternal) 2007–2011



Socioeconomic disadvantage

Table 12: Perinatal related death rates (per 1000 births) by deprivation quintile (NZDep2006) 2011

Deprivation quintile	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Perinatal related deaths		
	n=62,604		n=171			n=330			n=164			n=665		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	9,904	15.8	36	21.1	3.63	57	17.3	5.76	17	10.4	1.73	110	16.5	11.11
2	11,125	17.8	31	18.1	2.79	55	16.7	4.94	31	18.9	2.81	117	17.6	10.52
3	11,969	19.1	26	15.2	2.17	54	16.4	4.51	26	15.9	2.19	106	15.9	8.86
4	13,174	21.0	41	24.0	3.11	72	21.8	5.47	28	17.1	2.14	141	21.2	10.70
5 (most deprived)	16,182	25.8	36	21.1	2.22	92	27.9	5.69	58	35.4	3.61	186	28.0	11.49
Unknown	250	0.4	1	0.6	-	-	-	-	4	2.4	-	5	0.8	-

Figure 25: Perinatal related death rates (per 1000 births) by deprivation quintile (NZDep2006) (with 95% CIs) 2007–2011

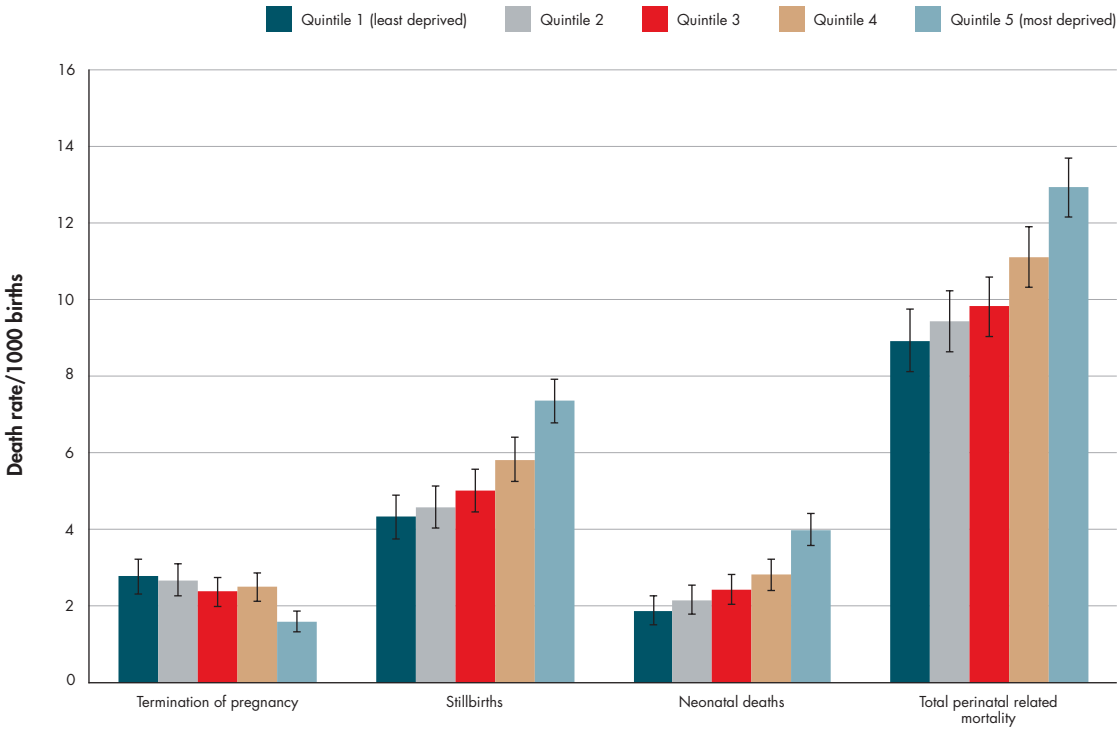


Figure 25 includes combined data from 2007 to 2011 and shows a significantly lower rate of late termination (≥20 weeks) among the most deprived mothers (quintile 5) but a significantly increased rate of stillbirth and neonatal death in this group compared to all less-deprived quintiles. There are striking increases in stillbirth and neonatal death rates with increasing socioeconomic deprivation (NZDep2006).

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 26: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile (NZDep2006) (with 95% CIs) 2007–2011

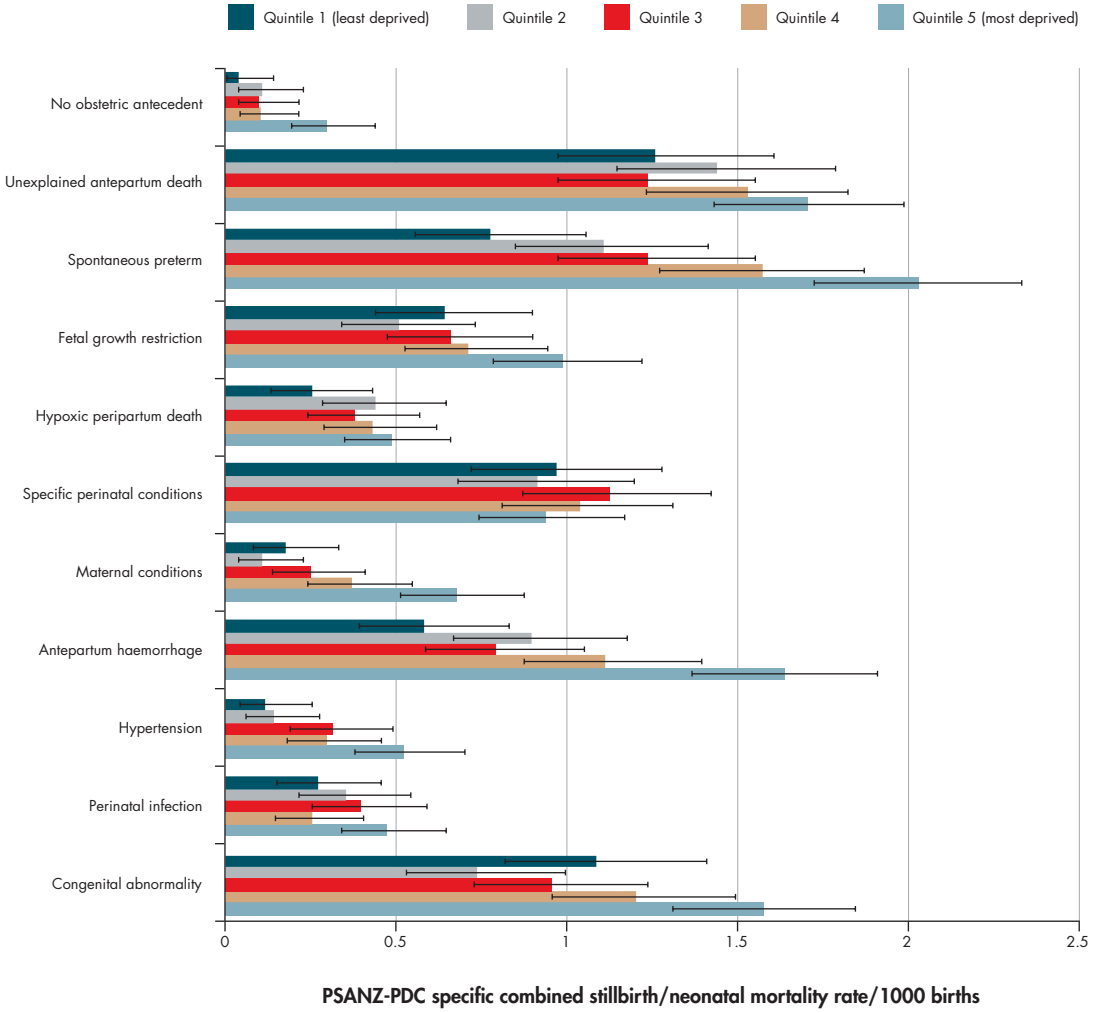


Figure 26 shows combined stillbirth and neonatal death rates for each antecedent cause (PSANZ-PDC) by deprivation quintile – quintile 1 (least deprived) at the top of each cause down to quintile 5 (most deprived) at the bottom. The aim of this analysis is to determine whether all antecedent causes of stillbirth and neonatal death are increased by increasing deprivation or whether only specific causes are associated with increasing deprivation.

There is a significant increasing trend in (combined) stillbirth and neonatal death with increasing deprivation quintile due to all causes other than hypoxic peripartum death, specific perinatal conditions and perinatal infection.

We would like to present the independent associations between ethnicity, maternal age, socioeconomic status and perinatal related death, adjusting for smoking and maternal BMI. We believe it is potentially misleading to present these analyses without inclusion of all of these important variables.

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.

District health board (DHB) of residence

Figure 27: Perinatal related death rates (per 1000 births) by DHB of residence (mother) compared to New Zealand perinatal related mortality (with 95% CIs) 2007–2011

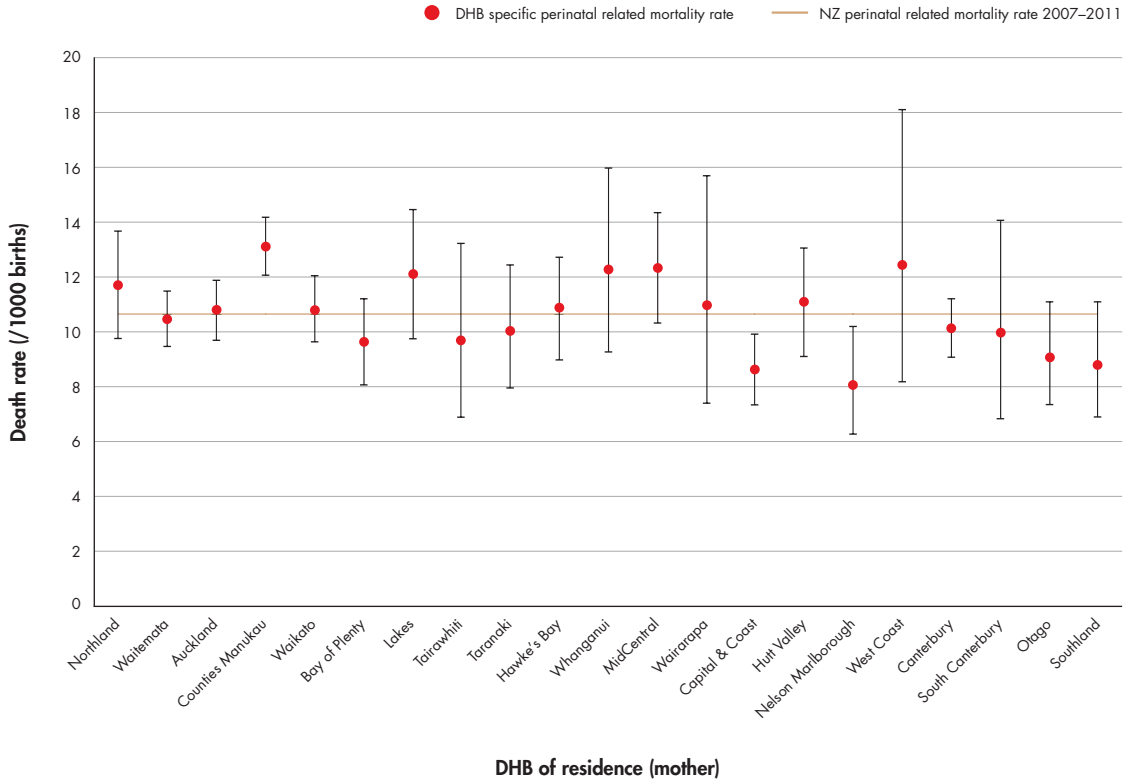


Figure 27 shows the crude rates of perinatal related mortality per 1000 total births by DHB of residence for 2007–2011. Five-year rates are presented in an attempt to reduce the fluctuations due to small numbers, which are apparent in one-year data. These are crude rates and have not been standardised for sociodemographic or other population differences between regions (which are illustrated in section 1.4).

The CIs, 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 five-year perinatal related mortality rate in the Counties Manukau DHB (CMDHB) region (13.1/1000 births) exceeded the national rate (10.6/1000 births), consistent with previous reports. There has been no significant change in the perinatal related mortality rate among residents of CMDHB over the five-year period.

The five-year perinatal related mortality rates in the Capital & Coast and Nelson Marlborough regions were significantly lower than the national rate over the five-year period. The perinatal related mortality rate has not changed over the five years in these DHB regions, except in Nelson Marlborough, which had an unusually large number of deaths in 2007.

Last year, adjusted perinatal related mortality was calculated for CMDHB. As noted under the section on socioeconomic disadvantage, the PMMRC would like to undertake robust multivariate analysis of the independent predictors of perinatal related mortality, adjusting for DHB of residence, ethnicity, age, socioeconomic status, smoking and obesity. Currently, we do not have access to the MAT dataset to enable this; however, even if these data were available, the MAT dataset does not include appropriate ethnicity variables to facilitate these analyses.

An independent review was commissioned by Counties Manukau DHB of the excess perinatal related mortality in the region and published in late 2012. A copy of this report can be obtained at *http://www.countiesmanukau.health.nz/News_Publications/Reports/report-external-maternitycare-review.pdf*, and a summary of the findings is included in the text box below.

Counties Manukau DHB review: summary

Counties Manukau DHB commissioned a panel to identify why its perinatal mortality rates, particularly among Māori and Pacific women, were higher than the national rate. The panel identified nine key areas where changes could assist in improving the outcomes, especially for the high-needs population of the district. The panel emphasised that the report was not a criticism of maternity services by the DHB, but a review to help the board to understand the areas where a high-needs population needs extra input in order to improve the health of mothers and their babies.

Counties Manukau has large Māori and Pacific peoples populations, large numbers of women who have their children while young and high levels of maternal obesity, smoking and diabetes, all of which contribute to high perinatal mortality. This is compounded by issues of access to good-quality maternity care early enough to make a difference.

The panels recommendations include to:

- appoint a dedicated project manager to ensure the recommendations are implemented
- educate the community on the importance of early pregnancy assessment, preferably before 10 weeks of pregnancy
- review ultrasound services to ensure adequate access is available to all pregnant women
- prioritise vulnerable and high-needs women and ensure they get continuity of care with a consistent care provider
- improve the availability of LMC care throughout the district
- urgently seek a review of section 88 of the Public Health and Disability Act 2000 with the Ministry of Health to seek incentives for midwives to be able to provide services in a high-needs, high-deprivation area
- review the delivery of contraception and termination services available to the population
- review the specific delivery of services to Māori and Pacific women to ensure that the education material is appropriate and reflects the cultural needs of these groups
- reinforce strategies to reduce the number of pregnant women who smoke and to reduce pre-pregnancy obesity and optimise weight gain in pregnancy
- implement an integrated IT system that enables all of a woman's care providers to access the same information.

DHB-specific reports

In 2012, each DHB was supplied with a DHB-specific report of perinatal related deaths for the period 2007–2010. The report included demographic characteristics of women giving birth where the DHB was the DHB of residence for the mother, details on causes of death and population screening and how these compared to New Zealand as a whole. DHB-specific key findings and recommendations were also provided. These reports were sent to key representatives in each DHB, and feedback and a response to the recommendations was requested from each DHB.

A summary of the commonalities of these reports is included in the box below.

DHB specific reports on perinatal related mortality 2007–2010

- DHBs that were found to have higher rates of intrapartum death and neurological death were advised to review these cases. Further, these deaths will be the subject of a national audit in 2013.
- Areas where mothers have greater socioeconomic advantage, are more often New Zealand European, and less often teenagers, generally had lower rates of overall perinatal related mortality.
- Reported screening for diabetes and family violence among mothers whose babies had died was universally low.
- Although reports were provided to all DHBs, some areas birth too few babies for many conclusions to be drawn.

Multiple births

Table 13: Perinatal related death rates (per 1000 births) and multiple[1] births 2011

			Fetal deaths											
	Total births		Termination of pregnancy			Stillbirths			Neonatal deaths			Perinatal related deaths		
	n=62,604		n=171			n=330			n=164			n=665		
Type of birth	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Singleton	60,793	97.1	153	89.5	2.52	279	84.5	4.59	137	83.5	2.27	569	85.6	9.36
Multiple	1,811	2.9	18	10.5	9.94	51	15.5	28.16	27	16.5	15.50	96	14.4	53.01
Multiples (1/2 died)			1	0.6		17	5.2		12	7.3		30	4.5	
Multiples (2/2 died)			15	8.8		31	9.4		14	8.5		60	9.0	
Multiples (1/3 died)			2	1.2		3	0.9		1	0.6		6	0.9	
Twin	1,778	2.8	16	9.4	9.00	48	14.5	27.00	26	15.9	14.62	90	13.5	50.62
Dichorionic diamniotic			7	4.1		21	6.4		19	11.6		47	7.1	
Monochorionic diamniotic			8	4.7		24	7.3		7	4.3		39	5.9	
Monoamniotic			-	-		-	-		-	-		-	-	
Unknown			1	0.6		3	0.9		-	-		4	0.6	

1 Multiples include twins, triplets and higher-order births.

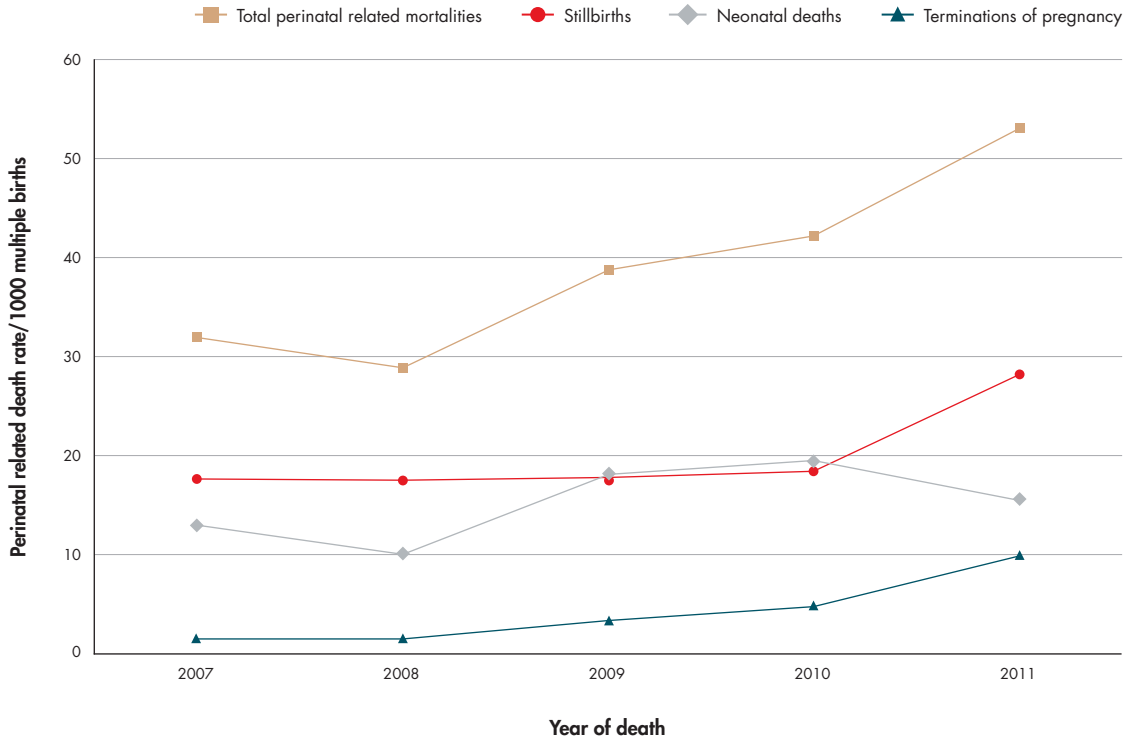
Three percent of births are babies born in multiple pregnancies, while 14 percent of perinatal related deaths are babies from multiple pregnancies. The perinatal related mortality rate in 2011 for babies from multiple births was 53/1000 multiple births, almost six times that in singleton births.

Ninety-six perinatal related deaths occurred in multiple pregnancies, 90 of these from twin pregnancies. Among the twin pregnancy deaths, 30 sets of twins died, and in 30 pregnancies, one twin died.

Table 14: Perinatal related death rates among babies born in multiple pregnancies 2007–2011

Year	Total births	Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=39		n=188		n=140		n=367	
		n	Rate	n	Rate	n	Rate	n	Rate
2007	2,033	3	1.48	36	17.71	26	13.04	65	31.97
2008	1,940	3	1.55	34	17.53	19	9.98	56	28.87
2009	1,803	6	3.33	32	17.75	32	18.13	70	38.82
2010	1,896	9	4.75	35	18.46	36	19.44	80	42.19
2011	1,811	18	9.94	51	28.16	27	15.50	96	53.01

Figure 28: Perinatal related death rates (per 1000 births) among babies born in multiple pregnancies 2007–2011



The perinatal related mortality rate in multiple pregnancies has increased significantly in the five years from 2007 to 2011, as shown in Table 14 and Figure 28. The most obvious increase is in terminations of pregnancy, which may reflect a recent increase in awareness of the requirement for registration of births where fetal reduction has been performed early in pregnancy but delivery of the baby occurred after 20 weeks.

Cause of death among multiple pregnancy deaths

Figure 29: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) for multiple and singleton births (with 95% CIs) 2007–2011

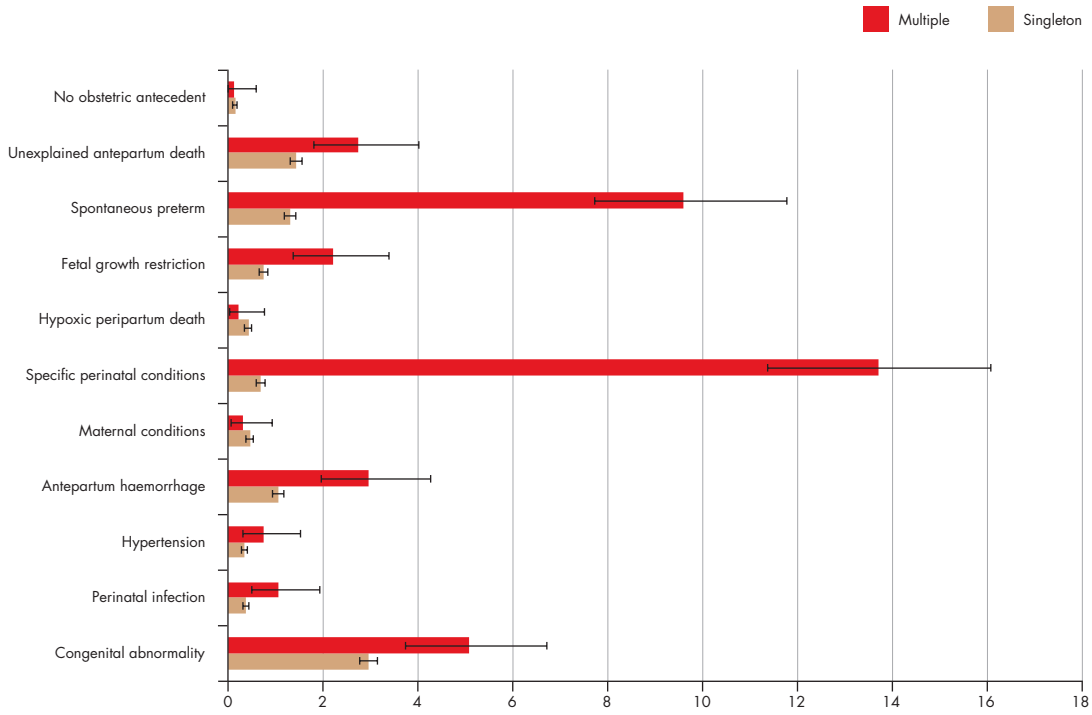


Figure 29 shows cause specific perinatal related mortality rates for multiple and singleton pregnancies.

Multiple pregnancies have significantly higher death rates from congenital abnormality, perinatal infection, antepartum haemorrhage, specific perinatal conditions (twin–twin syndrome predominantly), fetal growth restriction, spontaneous preterm birth and unexplained antepartum death.

The distribution of causes of death is slightly different in multiple pregnancies compared to singleton pregnancies. The most common reason for perinatal related death among multiple pregnancies is specific perinatal conditions (most often twin–twin syndrome in monochorionic twins). However, spontaneous preterm birth is disproportionately higher among multiple pregnancies and is more often a cause of death than congenital abnormalities, even though these are also more often a cause of death in multiple compared to singleton pregnancies.

Increased congenital abnormalities among monochorionic diamniotic (MCDA) multiple births are not an unexpected finding, structural abnormalities being more common, associated from the split of one fertilised ovum, and chromosomal because both twins generally will have the abnormality as they share their DNA. It is not possible to ascertain whether this pattern is apparent because of the lack of denominator data for type (for example, MCDA twin) of multiple pregnancy.

Figure 30: Perinatal related death risk (per 1000 babies remaining in utero) by gestational age at birth and plurality 2007–2011

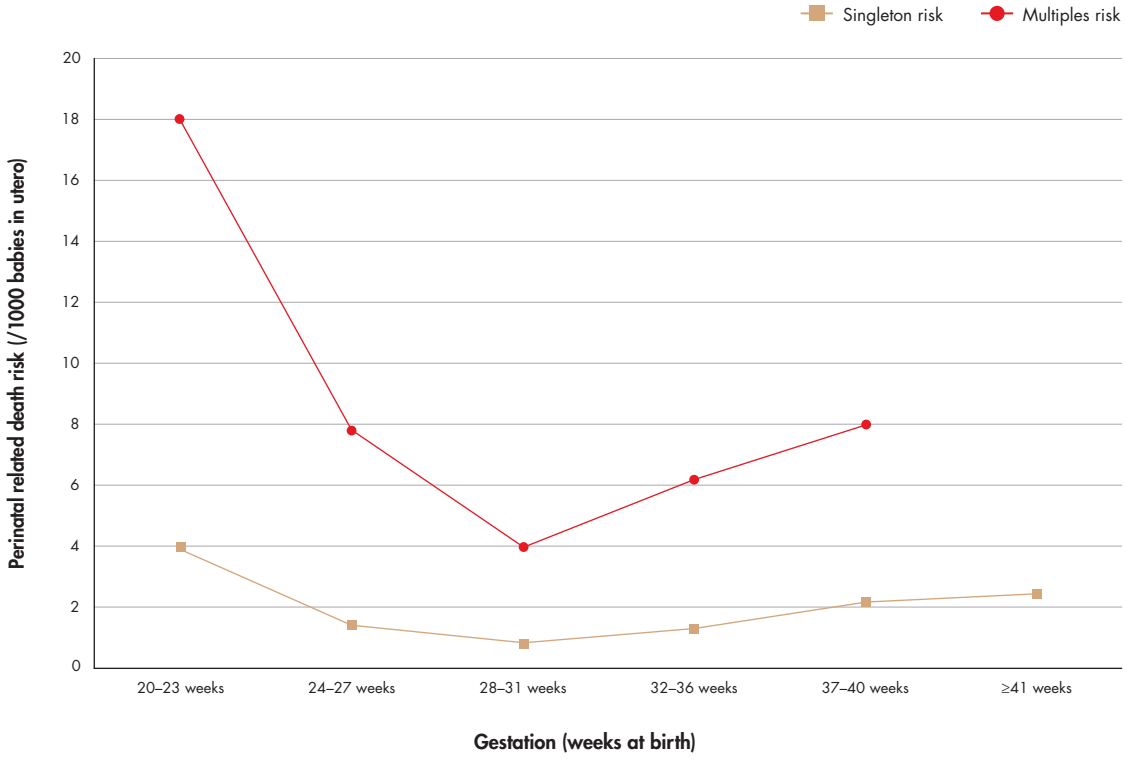


Figure 30 demonstrates the in utero perinatal related death risk by gestation for multiple pregnancies compared to singletons. As shown, while the risk of mortality is higher at all gestations for multiple births, the greatest excess of risk occurs between 20 and 24 weeks. Babies in multiple pregnancies who die at 20–24 weeks most often die of spontaneous preterm birth and specific perinatal conditions. Unlike singleton pregnancies, congenital abnormalities are an infrequent cause of perinatal related death at this gestation.

Table 15: Chorionicity and number of babies lost among twin perinatal related deaths 2007–2011

	2007		2008		2009		2010		2011		Total	
	n=64		n=52		n=59		n=78		n=90		n=343	
	n	%	n	%	n	%	n	%	n	%	n	%
Twin type												
Dichorionic diamniotic	29	45.3	26	49.1	20	32.8	36	45.6	47	52.2	158	45.5
Monochorionic diamniotic	30	46.9	26	49.1	33	54.1	33	41.8	39	43.3	161	46.4
Monoamniotic	2	3.1	-	-	5	8.2	7	8.9	-	-	14	4.0
Unknown	3	4.7	1	1.9	3	4.9	3	3.8	4	4.4	14	4.0
Loss of twin pairs or one twin												
Both twins died	35	54.7	26	49.1	32	52.5	48	60.8	60	66.7	201	57.9
One twin died	29	45.3	27	50.9	29	47.5	31	39.2	30	33.3	146	42.1

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.

Laser treatment has been offered as a treatment in New Zealand since May 2010 to ameliorate the risks associated with monochorionic twinning, and the PMMRC awaits outcome data from two-and five-year follow-up studies. The goal of this treatment is to achieve better outcomes for babies, specifically to reduce the risk of cerebral palsy. Prior to May 2010, some mothers travelled to Australia for laser treatment. Some of these babies may have been born and died in Australia and may not have been included in New Zealand perinatal mortality statistics.

The cause of death among monochorionic and monoamniotic twins was twin–twin transfusion syndrome in 56 percent (97 of 174) of perinatal related deaths from 2007 to 2011. Thirty-one (32 percent) of these 97 babies received laser treatment.

Multiple birth and infertility treatment 2007–2011

Table 16: Contribution of fertility treatment to perinatal related mortality by plurality 2007–2011

	Singleton perinatal related deaths		Multiple perinatal related deaths		Perinatal related deaths	
	n=3,102		n=367		n=3,469	
	n	%	n	%	n	%
Clomiphene	30	1.0	13	3.5	43	1.2
Follicle stimulating hormone (FSH)	-	-	4	1.1	4	0.1
In vitro fertilisation (IFV) (including ICSI)[1]	69	2.2	51	13.9	120	3.5
Any of clomiphene/FSH/IVF	**99**	**3.2**	**62**	**16.9**	**161**	**4.6**

1 ICSI = Intracytoplasmic sperm injection.

Among perinatal related deaths 2007–2011, 161 (4.6 percent) were known to have undertaken fertility treatment involving clomiphene, FSH and/or IVF. Fertility treatments, however, contribute to a greater extent to multiple deaths than to singleton deaths. The total number of births arising from assisted reproduction technology (ART) pregnancies in New Zealand is currently unknown. Ninety-nine deaths occurred in singleton pregnancies (3 percent of singleton deaths) and 62 in multiple pregnancies (17 percent of multiple birth deaths).

Twenty-one babies born in multiple pregnancies who died in 2011 were conceived with fertility treatment compared to 7–12 in previous years.

Fertility treatment was significantly more common among dichorionic diamniotic (DCDA) twins who died (23 percent) than among MCDA twins who died (11 percent). IVF alone was significantly more common among DCDA twins (19 percent) than among MCDA or monoamniotic twins (10 percent), suggesting that the increased rate of twinning following IVF is due to multiple embryo replacement.

Recommendation

In order to reduce perinatal related mortality associated with multiple pregnancy, the following is advised:

- All women undergoing assisted reproduction be offered single embryo transfer.
- The use of clomiphene for fertility treatment requires monitoring of hormonal response with ultrasound to determine the number of follicles.

Best practice in multiple pregnancies

Scanning

- Chorionicity is an important distinction to be reported on all scans for multiple pregnancy and is reliably diagnosed by ultrasound scan prior to 15 weeks gestation.
- Two weekly scans from 16 weeks are recommended for monochorionic twins, initially for the early diagnosis of twin–twin syndrome and later to review growth.

Advice to women

- Women with multiple pregnancies should be advised of the increased risk of preterm birth and antepartum haemorrhage and to seek care early if concerns arise.

Transfer of care

- Transfer of clinical responsibility for care to obstetrician-led care is recommended in the maternity referral guideline for all multiple pregnancies, regardless of chorionicity. Care arrangements between primary and secondary services will vary depending on local services and the wishes of the woman. *http://www.health.govt.nz/publication/guidelines-consultation-obstetric-and-related-medical-services-referral-guidelines*
- Referral to tertiary-level care is recommended for:
  - monoamniotic twin pregnancies
  - pregnancies complicated by:
    - discordant fetal growth
    - fetal anomaly
    - twin–twin transfusion syndrome (NICE 2011).

Maternal age, ethnicity, BMI and fertility treatment in multiple pregnancy deaths

The associations among deaths in multiple pregnancies between fertility treatment and age are as might be expected, with fertility treatment uncommon under age 30 but more common than spontaneous multiple pregnancy at 35 years and older. There were 31 deaths associated with mothers aged 35–39 and nine among mothers of 40 years and over in women who had fertility treatment and multiple pregnancies (in the five-year period).

Among multiple pregnancy deaths, women who had fertility treatment were more likely to have normal BMI than those with spontaneous multiple pregnancies, although in the five-year period, there were 23 deaths to mothers with BMI in the range 25–29.99 and four in the range 30–34.99.

Mothers of Pacific and Māori ethnicity were under-represented among multiple pregnancy deaths where fertility treatment had been given.

Fetal reduction procedures

In the five years 2007–2011, 11 babies died in multiple pregnancies where a reduction procedure had been performed. All but one of these multiple pregnancies was associated with fertility treatment, in almost all cases associated with clomiphene therapy and quadruplet or triplet pregnancies. Of these 11, only two babies were fetal reductions in the second trimester. The PMMRC do not require reporting of first trimester reductions as perinatal related deaths. The remaining nine babies died at 20 or more weeks gestation following the reduction procedure due to complications in the surviving fetus following the reduction procedure in almost all cases.

Maternal body mass index (BMI)

Table 17: Maternal body mass index (BMI) among perinatal related deaths 2011

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Maternal BMI								
<18.50	3	1.8	11	3.3	5	3.0	19	2.9
18.50–24.99	80	46.8	122	37.0	66	40.2	268	40.3
25.00–29.99	46	26.9	104	31.5	39	23.8	189	28.4
30.00–34.99	16	9.4	46	13.9	21	12.8	83	12.5
35.00–39.99	13	7.6	25	7.6	16	9.8	54	8.1
≥40	3	1.8	10	3.0	6	3.7	19	2.9
Unknown	10	5.8	12	3.6	11	6.7	33	5.0

In 2011, BMI data were available for 95 percent of mothers of perinatal related deaths. At least half (51.9 percent) of the mothers of perinatal related deaths were overweight or obese, and 23.5 percent were obese (BMI >30) in 2011. There is a dose-dependent relationship between obesity and poor pregnancy outcomes, including perinatal death (Stacey et al 2011).

The rate of overweight (BMI >25) at registration 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. The lack of a clear association between BMI and perinatal mortality may be due to the incompleteness of the MAT dataset for a proportion of the birthing population where BMI is likely to be high.

Maternal smoking and drug use

Table 18: Maternal smoking at the time of perinatal related death 2011

Currently smoking	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Yes	27	15.8	89	27.0	45	27.4	161	24.2
No	144	84.2	238	72.1	117	71.3	499	75.0
Unknown	-	-	3	0.9	2	1.2	5	0.8

Twenty-seven percent of mothers of stillborn babies and 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. Forty non-smokers at birth are recorded as having stopped smoking during pregnancy (Table 19). This means that at least 33 percent of mothers of stillbirths and 34 percent of mothers of neonatal deaths were smoking at the start of pregnancy.

Table 19: Maternal smoking history and perinatal related death 2011

Smoking history *(among current non-smokers)*	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=144		n=238		n=117		n=499	
	n	%	n	%	n	%	n	%
Never smoked	99	68.8	158	66.4	71	60.7	328	65.7
Stopped before this pregnancy	15	10.4	36	15.1	19	16.2	70	14.0
Stopped <16 weeks gestation	5	3.5	14	5.9	8	6.8	27	5.4
Stopped ≥16 weeks gestation	4	2.8	6	2.5	3	2.6	13	2.6
Unknown	21	14.6	24	10.1	16	13.7	61	12.2

The rate of smoking at registration among women with data in the New Zealand National Maternity Collection (MAT) in the years 2008, 2009 and 2010 was 16 percent. In 2011, the rate was 15.3 percent at registration, and 14.1 percent of mothers reporting smoking at two weeks postpartum.

Smoking rates are strongly associated with maternal ethnicity (Morton et al 2010).

Published studies consistently demonstrate that smoking is associated with preterm and SGA birth, placental abruption, stillbirth and perinatal mortality. Smoking cessation is one of few known effective intervention strategies for stillbirth prevention. However, of eligible mothers (current and past smokers) of stillbirths and neonatal deaths, only 30 percent were known to be offered smoking cessation support, as data were not available within the PMMRC dataset for almost half of eligible women.

Table 20: Maternal smoking cessation support offered and perinatal related death 2011

Smoking cessation support offered *(among current smokers and non-smokers other than those who have 'never smoked')*	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=72		n=169		n=91		n=332	
	n	%	n	%	n	%	n	%
No	15	20.8	37	21.9	22	24.2	74	22.3
Yes – by LMC only	10	13.9	32	18.9	17	18.7	59	17.8
Yes – referred to external agents	3	4.2	21	12.4	10	11.0	34	10.2
Unknown	44	61.1	79	46.7	42	46.2	165	49.7

Other drugs

Table 21: Maternal alcohol and drug use and perinatal related death 2011

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Alcohol and drug use								
Yes	12	7.0	39	11.8	20	12.2	71	10.7
No	137	80.1	253	76.7	125	76.2	515	77.4
Unknown	22	12.9	38	11.5	19	11.6	79	11.9
Specific drugs								
Alcohol	8	4.7	28	8.5	12	7.3	48	7.2
Amphetamine/P	-	-	2	0.6	-	-	2	0.3
Ecstasy	1	0.6	1	0.3	-	-	2	0.3
Marijuana	6	3.5	17	5.2	8	4.9	31	4.7
Methadone	-	-	3	0.9	1	0.6	4	0.6
Other	-	-	1	0.3	-	-	1	0.2
Unknown	-	-	1	0.3	1	0.6	2	0.3

Data were obtained on the use of alcohol and recreational drugs by 88 percent of mothers whose babies died in 2011. Alcohol was reportedly used by 48 (7.2 percent) of all mothers and marijuana by 4.7 percent. Other recreational drugs were reported as used by fewer than 1 percent of mothers. There are no national data on alcohol consumption and marijuana use in pregnancy with which to compare these figures.

In the sixth PMMRC report (PMMRC 2012), it was reported that 232 women drank alcohol during pregnancy, and 110 reported using marijuana over the years 2007–2010, although data were missing on 18 percent of mothers overall. A further analysis of these mothers and pregnancies where perinatal death occurred revealed the following: "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 22: Perinatal related death rates (per 1000 births) by gestation and birthweight 2011

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,604		n=171			n=330			n=164			n=665		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gestation at birth (weeks)														
20–23	257	0.4	128	74.9	*	114	34.5	*	53	32.3	*	295	44.4	*
24–27	248	0.4	23	13.5	92.74	36	10.9	145.16	28	17.1	148.15	87	13.1	350.81
28–31	521	0.8	11	6.4	21.11	34	10.3	65.26	13	7.9	27.31	58	8.7	111.32
32–36	3,938	6.3	8	4.7	2.03	55	16.7	13.97	23	14.0	5.94	86	12.9	21.84
37–40	46,578	74.4	1	0.6	0.02	82	24.8	1.76	39	23.8	0.84	122	18.3	2.62
≥41	11,039	17.6	-	-	-	9	2.7	0.82	8	4.9	0.73	17	2.6	1.54
Unknown	23	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Birthweight (g)														
<500	234	0.37	103	60.2	*	109	33.0	*	34	20.7	*	246	37.0	*
500–999	291	0.46	43	25.1	147.77	55	16.7	189.00	48	29.3	248.70	146	22.0	501.72
1000–1499	355	0.57	11	6.4	30.99	23	7.0	64.79	10	6.1	31.15	44	6.6	123.94
1500–1999	800	1.28	8	4.7	10.00	24	7.3	30.00	15	9.1	19.53	47	7.1	58.75
2000–2499	2,347	3.75	3	1.8	1.28	31	9.4	13.21	11	6.7	4.76	45	6.8	19.17
2500–2999	8,361	13.36	1	0.6	0.12	41	12.4	4.90	18	11.0	2.16	60	9.0	7.18
3000–3499	20,854	33.31	1	0.6	0.05	22	6.7	1.05	15	9.1	0.72	38	5.7	1.82
3500–3999	20,029	31.99	-	-	-	15	4.5	0.75	8	4.9	0.40	23	3.5	1.15
4000–4499	7,703	12.30	-	-	-	7	2.1	0.91	3	1.8	0.39	10	1.5	1.30
≥4500	1,601	2.56	-	-	-	-	-	-	2	1.2	1.25	2	0.3	1.25
Unknown	29	0.05	1	0.6	-	3	0.9	-	-	-	-	4	0.6	-

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

Table 22 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 2011 and a denominator compiled from birth registrations in 2011 (ie, some babies born prior to 2011 will be included in the denominator and some born in 2011 will be registered in later years).

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

There is a statistically 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.

Figure 31: Perinatal related death risk (per 1000 babies remaining in utero) by gestational age at birth 2007–2011

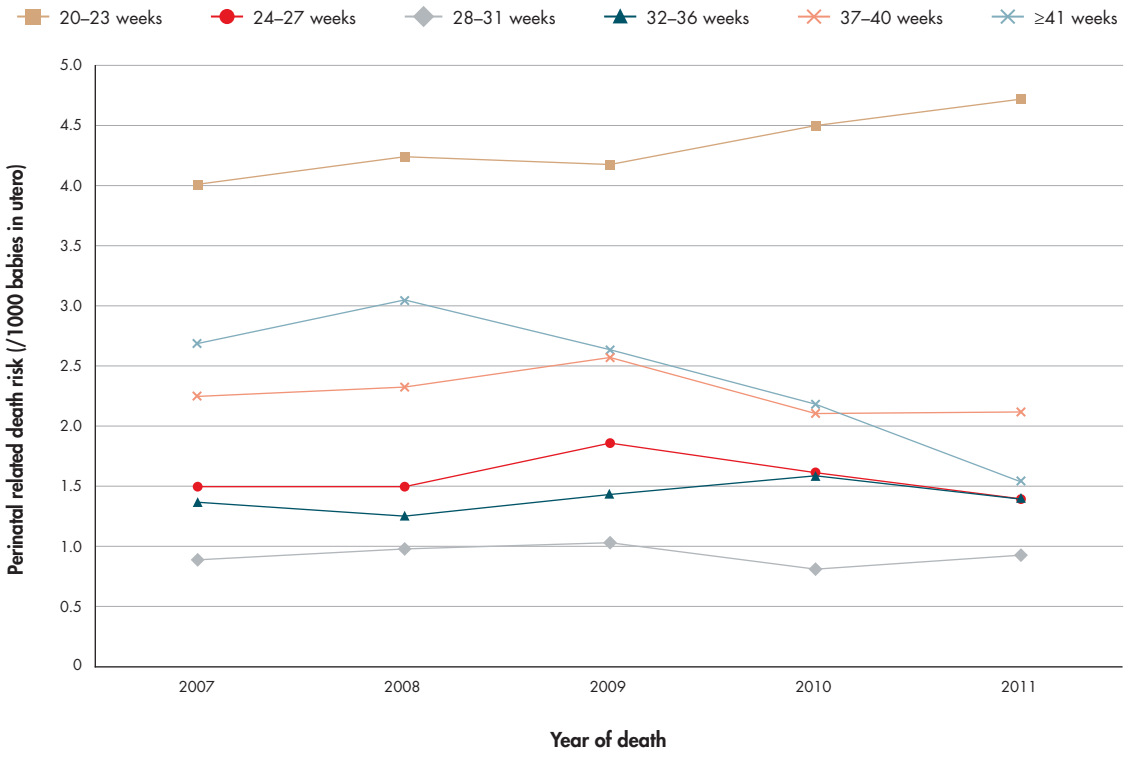


Figure 31 shows perinatal related death risk by gestational age at birth as a proportion of pregnancies remaining in utero. This provides an estimate of the risk of perinatal related death for a continuing pregnancy at that gestation.

The greatest risk to pregnancy is in the period from 20 to 23 weeks followed by the risk at term. There is statistically significant increasing risk of perinatal related death at 20–23 weeks in the five years from 2007 to 2011 and a significant reduction after 40 weeks. This is probably related to the concurrent reduction in hypoxic peripartum deaths.

There is no significant increase in risk of stillbirth or perinatal death for babies in utero after 41 weeks compared to babies in utero at 37–40 weeks. This may be a reflection of current practice to monitor and appropriately induce post-term.

Obstetric antecedent and neonatal cause of death by gestational age

Table 23: Primary obstetric antecedent cause (PSANZ-PDC) of fetal death by gestational age 2007–2011

Perinatal death classification (PSANZ-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	**759**	509	67.1	106	14.0	49	6.5	49	6.5	36	4.7	10	1.3
Perinatal infection	**84**	25	29.8	13	15.5	8	9.5	10	11.9	20	23.8	8	9.5
Hypertension	**95**	14	14.7	26	27.4	18	18.9	20	21.1	15	15.8	2	2.1
Antepartum haemorrhage	**250**	137	54.8	21	8.4	20	8.0	29	11.6	41	16.4	2	0.8
Maternal conditions	**125**[1]	50	40.0	19	15.2	11	8.8	16	12.8	27	21.6	2	1.6
Specific perinatal conditions	**269**	92	34.2	41	15.2	24	8.9	48	17.8	62	23.0	2	0.7
Hypoxic peripartum death	**58**	-	-	-	-	-	-	4	6.9	39	67.2	15	25.9
Fetal growth restriction	**231**	32	13.9	40	17.3	39	16.9	52	22.5	55	23.8	13	5.6
Spontaneous preterm	**222**[1]	168	75.7	37	16.7	10	4.5	7	3.2	-	-	-	-
Unexplained antepartum death	**475**	80	16.8	47	9.9	48	10.1	96	20.2	178	37.5	26	5.5
Total	**2,568**	**1,107**	**43.1**	**350**	**13.6**	**227**	**8.8**	**331**	**12.9**	**473**	**18.4**	**80**	**3.1**

1 Gestation of two babies unknown.

Table 23 and Table 24 include 2007–2011 (five-year) data. This provides more stable estimates of the association between PSANZ-PDC and gestation at perinatal related death, as numbers in some categories are small.

Table 24: Primary obstetric antecedent cause (PSANZ-PDC) of neonatal death by gestational age 2007–2011

Perinatal death classification (PSANZ-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	**217**	1	0.5	5	2.3	37	17.1	70	32.3	79	36.4	25	11.5
Perinatal infection	**42**	13	31.0	8	19.0	2	4.8	4	9.5	9	21.4	6	14.3
Hypertension	**21**	2	9.5	11	52.4	5	23.8	2	9.5	1	4.8	-	-
Antepartum haemorrhage	**109**	69	63.3	22	20.2	5	4.6	8	7.3	4	3.7	1	0.9
Maternal conditions	**19**	4	21.1	5	26.3	2	10.5	2	10.5	5	26.3	1	5.3
Specific perinatal conditions	**75**	36	48.0	15	20.0	2	2.7	11	14.7	10	13.3	1	1.3
Hypoxic peripartum death	**75**	-	-	-	-	-	-	3	4.0	51	68.0	21	28.0
Fetal growth restriction	**21**	1	4.8	4	19.0	3	14.3	2	9.5	9	42.9	2	9.5
Spontaneous preterm	**274**	163	59.5	86	31.4	14	5.1	11	4.0	-	-	-	-
No obstetric antecedent	**46**	-	-	-	-	-	-	3	6.5	35	76.1	8	17.4
Total	**899**	**289**	**32.1**	**156**	**17.4**	**70**	**7.8**	**116**	**12.9**	**203**	**22.6**	**65**	**7.2**

Spontaneous preterm birth is the most commonly assigned obstetric antecedent 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 39 percent and 27 percent respectively over the five years 2007–2011. Hypertension, other maternal conditions and fetal growth restriction are uncommon obstetric antecedent causes of neonatal death.

Table 25: Primary neonatal cause (PSANZ-NDC) of neonatal death by gestational age 2007–2011

Primary neonatal cause (PSANZ-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	**220**	1	0.5	5	2.3	37	16.8	71	32.3	81	36.8	25	11.4
Extreme prematurity	**305**	270	88.5	33	10.8	2	0.7	-	-	-	-	-	-
Cardio-respiratory disorders	**61**	8	13.1	44	72.1	6	9.8	1	1.6	2	3.3	-	-
Infection	**81**	5	6.2	29	35.8	12	14.8	11	13.6	17	21.0	7	8.6
Neurological	**155**	4	2.6	25	16.1	9	5.8	21	13.5	70	45.2	26	16.8
Gastrointestinal	**17**	1	5.9	12	70.6	3	17.6	1	5.9	-	-	-	-
Other	**60**	-	-	8	13.3	1	1.7	11	18.3	33	55.0	7	11.7
Total	**899**	**289**	**32.1**	**156**	**17.4**	**70**	**7.8**	**116**	**12.9**	**203**	**22.6**	**65**	**7.2**

Extreme prematurity is the cause of death in a third of neonatal deaths. 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.

Maternity care

Antenatal caregiver

Table 26: Perinatal related deaths and maternal registration status 2011

Was the mother booked with an LMC?	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Yes	**166**	**97.1**	**312**	**94.5**	**151**	**92.0**	**629**	**94.6**
Self-employed midwife	112	65.5	226	68.5	97	59.1	435	65.4
Hospital	38	22.2	57	17.3	35	21.3	130	19.5
General practitioner	2	1.2	7	2.1	7	4.3	16	2.4
Obstetrician (private)	13	7.6	22	6.7	9	5.5	44	6.6
Unknown LMC	1	0.6	-	-	3	1.8	4	0.6
No	**5**	**2.9**	**18**	**5.5**	**13**	**7.9**	**36**	**5.4**

These data relating to registration for maternity care of a mother with an LMC remain unchanged from 2010. Ninety-four percent of mothers were registered for maternity care with an LMC prior to their baby's death; 65 percent with a self-employed midwife, 20 percent with hospital-based LMC services and small numbers with other providers.

In 2011, the national MAT dataset recorded the LMC at registration as a self-employed midwife for 80.6 percent of mothers, a self-employed obstetrician for 5.5 percent, a general practitioner for 1.1 percent and a hospital LMC or no LMC for the remaining 12.4 percent of mothers.

Table 27: Gestation at registration among perinatal related deaths (women registered with a lead maternity carer (LMC)) 2011

Gestation at registration	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=166		n=312		n=151		n=629	
	n	%	n	%	n	%	n	%
<10 weeks	74	44.6	115	36.9	63	41.7	252	40.1
10–13 weeks	37	22.3	115	36.9	36	23.8	188	29.9
14–19 weeks	27	16.3	47	15.1	24	15.9	98	15.6
≥20 weeks	20	12.0	26	8.3	15	9.9	61	9.7
Unknown	8	4.8	9	2.9	13	8.6	30	4.8

Table 28: Gestation at registration by lead maternity carer (LMC) among perinatal related deaths (women registered with an LMC) 2011

Lead maternity carer (LMC)	n	Gestation (weeks) at registration									
		<10		10–13		14–19		≥20		Unknown	
		n	%	n	%	n	%	n	%	n	%
Self-employed midwife	435	187	43.0	131	30.1	59	13.6	35	8.0	23	5.3
Hospital	130	33	25.4	37	28.5	33	25.4	25	19.2	2	1.5
General practitioner	16	5	31.3	6	37.5	4	25.0	1	6.3	-	-
Obstetrician (private)	44	27	61.4	14	31.8	2	4.5	-	-	1	2.3
Unknown	4	-	-	-	-	-	-	-	-	4	100.0

Table 27 and Table 28 show gestation at registration for mothers registered with an LMC whose babies died in 2011. This is the first year these data have been reported, as in previous years, data have been missing for more than 30 percent of mothers.

Seventy percent of mothers who registered with a lead maternity carer (LMC) were registered with an LMC before 14 weeks and 40 percent by 10 weeks. Only 10 percent registered at 20 weeks or later. Women who registered with private obstetricians were the earliest to register, followed by mothers registered with self-employed midwives.

These data compare to 72.0 percent of mothers registered with a self-employed LMC before 14 weeks and 11.4 percent registered at 20 weeks or later in the MAT dataset. Further data and analysis are required to determine the appropriateness of antenatal care among women with perinatal related mortality.

Table 29: Lead maternity carer (LMC) at registration and birth among stillbirths and neonatal deaths 2011

LMC at registration	Total		LMC at birth							
			Self-employed midwife		Hospital		General practitioner		Obstetrician (private)	
	n=460		n=186		n=244		n=5		n=25	
	n	%	n	%	n	%	n	%	n	%
Self-employed midwife	323	70.2	182	56.3	141	43.7	-	-	-	-
Hospital	92	20.0	3	3.3	89	96.7	-	-	-	-
General practitioner	14	3.0	-	-	9	64.3	5	35.7	-	-
Obstetrician (private)	31	6.7	1	3.2	5	16.1	-	-	25	80.6
Total	**460**		**186**	**40.4**	**244**	**53.0**	**5**	**1.1**	**25**	**5.4**

The changes in caregiver from registration to birth in this context are likely to represent appropriate transfer of at-risk mothers for secondary or tertiary care. It was unusual for transfers to occur from a hospital service to a primary care provider among these perinatal related deaths.

In 2011, the national MAT dataset recorded the registered LMC at birth as a self-employed midwife for 79.6 percent of mothers, a self-employed obstetrician for 5.7 percent, a general practitioner for 0.9 percent and a hospital LMC or no LMC for the remaining 13.5 percent of mothers.

Screening for diabetes in pregnancy

Table 30: Screening for diabetes among registered women with no pre-existing diabetes and where stillbirth and neonatal death occurred at or beyond 28 weeks gestation 2011

Screened for diabetes	n=253	
	n	%
Yes	193	76.3
No	46	18.2
Unknown	13	5.1
Declined	1	0.4

Screening for diabetes in pregnancy is recommended for all women between 24 and 28 weeks by the Ministry of Health, the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) and the New Zealand College of Midwives (NZCOM).

Over the five years since the PMMRC started reporting, it has been difficult to accurately estimate the proportion of women screened for diabetes, as these data have often been missing in the PMMRC dataset. However, in 2011, screening status was only unknown in 5 percent of eligible cases. As more data have been returned each year, it has become evident that the screening rate was higher than initially estimated. It is not known whether the improvement in screening from 57 percent in 2007 to 76 percent in 2011 is due to the improvement in data collection alone or whether there has also been an increase in penetrance of screening in the population.

Screening for family violence in pregnancy

Table 31: Perinatal related deaths and screening for family violence 2011

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Experienced family violence								
Yes	7	4.1	8	2.4	2	1.2	17	2.6
No	69	40.4	152	46.1	70	42.7	291	43.8
Not asked	40	23.4	94	28.5	44	26.8	178	26.8
Unknown	55	32.2	76	23.0	48	29.3	179	26.9
Referral to relevant support								
Yes	6	85.7	8	100.0	1	50.0	15	88.2
No	-	-	-	-	-	-	-	-
Unknown	1	14.3	-	-	1	50.0	2	11.8

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

Data on screening for family violence are not well reported to the PMMRC. Unlike data on screening for diabetes, data on screening for family violence have not improved in the past five years.

Of the 17 disclosures in 2011, 15 were known to have been referred for support.

Vaginal bleeding in pregnancy

Table 32: Perinatal related deaths and vaginal bleeding during pregnancy 2011

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Yes	33	19.3	110	33.3	66	40.2	209	31.4
No	124	72.5	199	60.3	87	53.0	410	61.7
Unknown	14	8.2	21	6.4	11	6.7	46	6.9
Gestation[1]								
<20 weeks	17	9.9	62	18.8	29	17.7	108	16.2
≥20 weeks	24	14.0	86	26.1	58	35.4	168	25.3

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

Antepartum haemorrhage (bleeding at or beyond 20 weeks) was reported in 26 percent of stillbirths and 35 percent of neonatal deaths in 2011.

There were 78 perinatal related deaths where the primary cause of death was antepartum haemorrhage in 2011 and a further 39 cases where primary cause of death was spontaneous preterm birth where there was a history of bleeding at or after 20 weeks.

Recommended best practice for antepartum haemorrhage can be found on page 75.

Antepartum haemorrhage has been defined as bleeding from or into the genital tract, occurring from 20 weeks of pregnancy and prior to the birth of the baby; however, vaginal bleeding may occur at any gestation.

PMMRC data confirm that 2011 perinatal mortalities associated with preterm labour and/or small for gestational age (SGA) infants were more likely to have vaginal bleeding reported (at any gestation, both before and after 20 weeks) than perinatal mortalities associated with other causes. This is consistent with international studies that have also found greater risk of perinatal mortality and low birthweight associated with vaginal bleeding in pregnancy at any gestation (Magann et al 2005; McCormack et al 2008).

Complications are more likely when vaginal bleeding is from placental causes (placental abruption or placenta praevia) than non-placental or incidental causes. Although there are some known risks for placental abruption, about 70 percent occur in pregnancies without identified risks.

When there has been vaginal bleeding (at any stage of gestation), there is an increased likelihood of an SGA baby, fetal growth restriction and preterm labour. These effects may increase the likelihood of fetal compromise in labour.

Best practice for antepartum haemorrhage (vaginal bleeding in pregnancy)

Advice to practitioners

- Encourage and support women to change modifiable risk factors (such as smoking and drug use).
- Encourage women to report any vaginal bleeding to their LMC or care provider promptly.
- All women with antepartum haemorrhage should be offered referral for consultation with an obstetrician (as per the referral guidelines).

Care for women experiencing vaginal bleeding will vary depending on:

- the nature and amount of bleeding
- whether it is a single episode or recurrent episodes
- any other known associated clinical features such as placenta praevia, abruption (the sensitivity of ultrasound for the detection of retroplacental clot (abruption) is poor), hypertension, multiple pregnancy, smoking and drug use.

Establishing whether urgent intervention is needed to stabilise the mother's condition and prevent maternal or fetal compromise is a priority. Transfer or admission to a secondary facility for further assessment may be needed. Severe cases may require transfer by emergency services.

Practitioners should consider:

- frequency of antenatal assessments or visits may need to be increased
- there may be an increased need for ongoing obstetrician involvement in care
- the need for customised growth charts and other measures of fetal wellbeing (such as fetal movements) and ultrasound scans to monitor growth
- the optimal setting for labour and birth, particularly if bleeding has been recurrent or ongoing or has been more than light in nature
- the optimal method of fetal monitoring in labour.

Postpartum haemorrhage should be anticipated in women who have experienced antepartum haemorrhage.

Antenatal corticosteroids

Among neonatal deaths of babies born between 24 and 32 weeks gestation, corticosteroids were given to 34 of 46 babies (74 percent). Among deaths of babies born from 20 to 23 weeks gestation, a further six of 53 babies also received antenatal corticosteroids.

Table 33: Perinatal related deaths and small for gestational age (customised SGA) 2011(singleton births without congenital abnormalities)

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
Singleton deaths ≥20 weeks, excluding congenital abnormalities	n	%	n	%	n	%	n	%
	n=30		**n=257**		**n=93**		**n=380**	
SGA[1]	21	70.0	106	41.2	36	38.7	163	42.9
Singleton deaths ≥24 weeks, excluding congenital abnormalities	**n=6**		**n=177**		**n=52**		**n=235**	
SGA[1]	2	33.3	64	36.2	14	26.9	80	34.0

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. Customised birthweight centiles were not calculated if gestation at death was under 20 weeks, was unknown or if a week or more had elapsed between fetal death and birth (because of the unknown effect on birthweight of prolonged time in utero after known fetal death). This adjustment has altered the proportion of SGA stillborn babies, as a proportion of stillborn babies reported in previous years should not have had customised centiles calculated.

In 2011, 36 percent of singleton babies who were stillborn and delivered from 24 weeks without congenital abnormality were small by customised birthweight centile. Twenty-seven percent of neonatal deaths of singleton babies born at 24 weeks or more without congenital abnormality were SGA.

Antenatal identification of small for gestational age (SGA) infants

Table 34: Antenatal diagnosis of small for gestational age (customised SGA) singletons among stillbirths and neonatal deaths at 24 weeks gestation or more excluding congenital abnormalities 2007–2011

		Suspected growth restriction									
		No		Yes and confirmed by scan		Yes but normal growth on scan		Yes but no scan performed		Unknown	
	Total	n	%	n	%	n	%	n	%	n	%
SGA stillbirths	**354**	205	57.9	73	20.6	25	7.1	13	3.7	38	10.7
SGA neonatal deaths	**79**	28	35.4	32	40.5	4	5.1	3	3.8	12	15.2

SGA was suspected in the antenatal period in 28 percent of stillborn SGA babies and 46 percent of SGA neonatal deaths of normally formed singleton babies at 24 weeks or more over the five years 2007–2011. The proportion (and absolute numbers) of stillbirths and neonatal deaths where SGA was not suspected has not changed over the five years reported despite attempts to implement the use of customised fundal height measurement and indicated ultrasound scans using GROW (*http://www.gestation.net*).

Place of birth and antenatal transfer

Table 35: Intended place of birth versus actual place of birth among stillbirths and neonatal deaths 2011

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	18	3	16.7	-	-	-	-	9	50.0	6	33.3	-	-	-	-
Birthing unit	35	-	-	6	17.1	-	-	5	14.3	24	68.6	-	-	-	-
Hospital level 1	17	-	-	-	-	-	-	2	11.8	15	88.2	-	-	-	-
Hospital level 2	175	-	-	-	-	-	-	146	83.4	26	14.9	2	1.1	1	0.6
Hospital level 3	217	3	1.4	-	-	2	0.9	3	1.4	208	95.9	1	0.5	-	-
Other	1	-	-	-	-	-	-	-	-	1	100.0	-	-	-	-
Not registered	6	2	33.3	-	-	-	-	-	-	4	66.7	-	-	-	-
Unknown	25	3	12.0	1	4.0	-	-	2	8.0	18	72.0	1	4.0	-	-
Total	**494**	**11**	**2.2**	**7**	**1.4**	**2**	**0.4**	**167**	**33.8**	**302**	**61.1**	**4**	**0.8**	**1**	**0.2**

Transfer from an intended to an actual place of birth was common among stillbirths and neonatal deaths. These transfers were generally from an intended birth at a low-risk facility (at home, birthing unit or level 1 hospital) to a facility with capacity for higher-risk births (level 2 or 3 hospital facility).

In 2011, 15 (9 percent) of neonatal deaths were transferred in labour. Thirteen neonatal deaths (8 percent) were transferred in labour to a level 3 hospital facility.

In the five years from 2007 to 2011, 13 perinatal related deaths (0.4 percent of all perinatal related deaths) were intended births at home; the primary antecedent cause of death was hypoxic peripartum death in five, and perinatal infection, maternal condition, unexplained and no obstetric antecedent in the remainder.

According to unpublished data from the New Zealand National Maternity Collection (MAT), 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 in 2011.

Table 36: Perinatal related deaths and maternal outcome 2011

Maternal outcome	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Alive and generally well	168	98.2	321	97.3	161	98.2	650	97.7
Alive but with serious morbidity	3	1.8	8	2.4	3	1.8	14	2.1
Maternal death	-	-	1	0.3	-	-	1	0.2

There was one maternal death associated with stillbirth in 2011. Maternal deaths are discussed in section 2. Fourteen mothers whose babies died suffered serious morbidity as a consequence of pregnancy, including postpartum haemorrhage, cardiac conditions, uterine rupture, obstetric sepsis, pre-eclampsia and renal disease.

Investigation of perinatal related deaths

Table 37: Perinatal related deaths and completeness of perinatal investigations 2011

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Optimum post-mortem/ Karyotype completed[1]	90	52.6	146	44.2	64	39.0	300	45.1
Post-mortem	60	35.1	137	41.5	50	30.5	247	37.1
Karyotype	38	22.2	13	3.9	12	7.3	63	9.5
Partial investigations only[2]	60	35.1	148	44.8	75	45.7	283	42.6
No investigation[3]	12	7.0	30	9.1	20	12.2	62	9.3
Unknown	9	5.3	6	1.8	5	3.0	20	3.0

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 2011. 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 37 percent of perinatal related deaths in 2011. These rates are unchanged from 2010.

The rate of optimal investigation was 36 percent in 2006, 46 percent in 2007, 49 percent in 2008, 41 percent in 2009 and 45 percent in 2010.

Rates of optimal investigation of perinatal death by DHB for 2007–2011 are given in Table 99. 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. The lowest rates of offer of post-mortem were in Northland and Southland DHB regions.

Table 38: Perinatal related deaths and rate of offer and decline of post-mortem examination 2011

Post-mortem examination offered	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Post-mortem offered and parental consent given	58	33.9	133	40.3	53	32.3	244	36.7
Post-mortem offered and parents declined	90	52.6	178	53.9	87	53.0	355	53.4
Post-mortem not offered	23	13.5	19	5.8	19	11.6	61	9.2
Unknown	-	-	-	-	5	3.0	5	0.8

Rates of offer and decline of a post-mortem are fairly consistent across the years. In 2011, a post-mortem was offered to 90 percent of parents. A post-mortem was declined following request in 53 percent of cases overall. A post-mortem was apparently not offered in 9 percent of perinatal related deaths (6 percent of stillbirths and 12 percent of neonatal deaths).

The proportion of parents who were offered a post-mortem did not vary significantly by ethnicity in 2011 as in previous years. However, there was a significant difference in the proportion of those offered who consented by ethnicity. In 2011, 76 percent of Māori parents offered a post-mortem declined, 68 percent of Pacific peoples, 60 percent Other Asian, 55 percent Indian, 50 percent New Zealand European and 43 percent Other.

From 2007 to 2011, data on the usefulness of the post-mortem 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 24 percent of cases, resulting in altered counselling to parents for future pregnancies. In 52 percent of cases, there was no change in diagnosis, and the post-mortem did not change the advice given to parents. In 11 percent of cases, further information was gained, but this did not change the clinical diagnosis. In a further 13 percent of cases, the post-mortem did not demonstrate an obvious cause of death or significant abnormality.

1.7 Contributory factors and potentially avoidable perinatal related deaths

Table 39: Contributory factors and potentially avoidable perinatal related deaths 2011

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=330		n=164		n=665	
	n	%	n	%	n	%	n	%
Contributory factors								
Present	28	16.4	100	30.3	61	37.2	189	28.4
Absent	141	82.5	226	68.5	99	60.4	466	70.1
Missing data	2	1.2	4	1.2	4	2.4	10	1.5
Potentially avoidable								
Yes	16	9.4	73	22.1	37	22.6	126	18.9
Contributory factors present but not potentially avoidable	11	6.4	24	7.3	20	12.2	55	8.3
Contributory factors present but avoidability unknown	1	0.6	3	0.9	4	2.4	8	1.2

As part of local perinatal mortality review, the multidisciplinary team is asked to assess whether there are factors that may have contributed to the perinatal death. In 2011, the subcategories were condensed to organisational/management, personnel and barriers to access or engagement with care. The previous infrequently used subcategories of environment and technology/equipment have been rationalised under organisational/management or barriers.

If contributory factors are identified, the local reviewing committee is asked to assess whether the perinatal death was potentially avoidable. A description of the process for assessment of contributory factors and potentially avoidable death is included in section 1.2, and the revised tool is included as Appendix D.

The list of contributory factors the committees were asked to consider are listed in Table 40. Assignment of factors is not mutually exclusive either across factors or within a factor. Contributory factors and potentially avoidable death were assessed for all but 18 perinatal related deaths (2.7 percent) in 2011. Contributory factors were reported in 28.4 percent of perinatal related deaths in 2011 (28.8 percent of cases assessed compared to 27.9 percent of cases assessed in 2010 and 26.5 percent of cases assessed in 2009).

In 2011, 18.9 percent of perinatal related deaths were thought to be potentially avoidable at local review. This is 19.5 percent of assessed cases compared to 18 percent in 2010 and 15.4 percent in 2009. As the increase in the proportion of potentially avoidable deaths is small, the three years of data have been combined in later analyses.

The distribution of contributory factors is similar across the three years, with barriers to access or engagement with care the most common, followed by personnel factors and organisation or management factors. No antenatal care and infrequent care or late registration for antenatal care were common 'other' examples of barriers to access or engagement and so these were included as separate categories for data collection this year.

Table 40: Detail of contributory factors among perinatal related deaths 2011

Contributory factors present?	n=665	
	n	%
	189	**28.4**
Organisational/Management factors	**43**	**6.5**
Poor organisational arrangements of staff	6	
Inadequate education and training	3	
Lack of policies, protocols or guidelines	13	
Inadequate numbers of staff	3	
Poor access to senior clinical staff	3	
Failure or delay in emergency response	2	
Delay in procedure *(eg, caesarean section)*	5	
Inadequate systems/process for sharing of clinical information between services	-	
Delay access to test results or inaccurate results	4	
Equipment *(eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)*	3	
Building and design functionality *(eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)*	43	
Other	21	
Not stated	1	
Personnel factors	**57**	**8.6**
Knowledge and skills of staff were lacking	16	
Delayed emergency response by staff	3	
Failure to maintain competence	2	
Failure of communication between staff	12	
Failure to seek help/supervision	14	
Failure to offer or follow recommended best practice	25	
Lack of recognition of complexity or seriousness of condition by carer	4	
Other	9	
Not stated	1	

Table 40: Detail of contributory factors among perinatal related deaths 2011 *(continued)*

Contributory factors present?	n=665	
	n	%
	189	**28.4**
Barriers to access or engagement with care	**131**	**19.7**
No antenatal care	24	
Infrequent care or late booking	46	
Declined treatment or advice	14	
Obesity impacted on delivery of optimal care (*eg, ultrasound scan*)	-	
Substance use	18	
Family violence	9	
Lack of recognition of complexity or seriousness of condition	29	
Maternal mental illness	3	
Cultural barriers	16	
Language barriers	7	
Not eligible to access free care	4	
Environment *(eg, isolated, long transfer, weather prevented transport)*	12	
Other	21	
Not stated	1	

Contributory factors and potentially avoidable perinatal related death and PSANZ-PDC

Figure 32: Contributory factors and potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2011

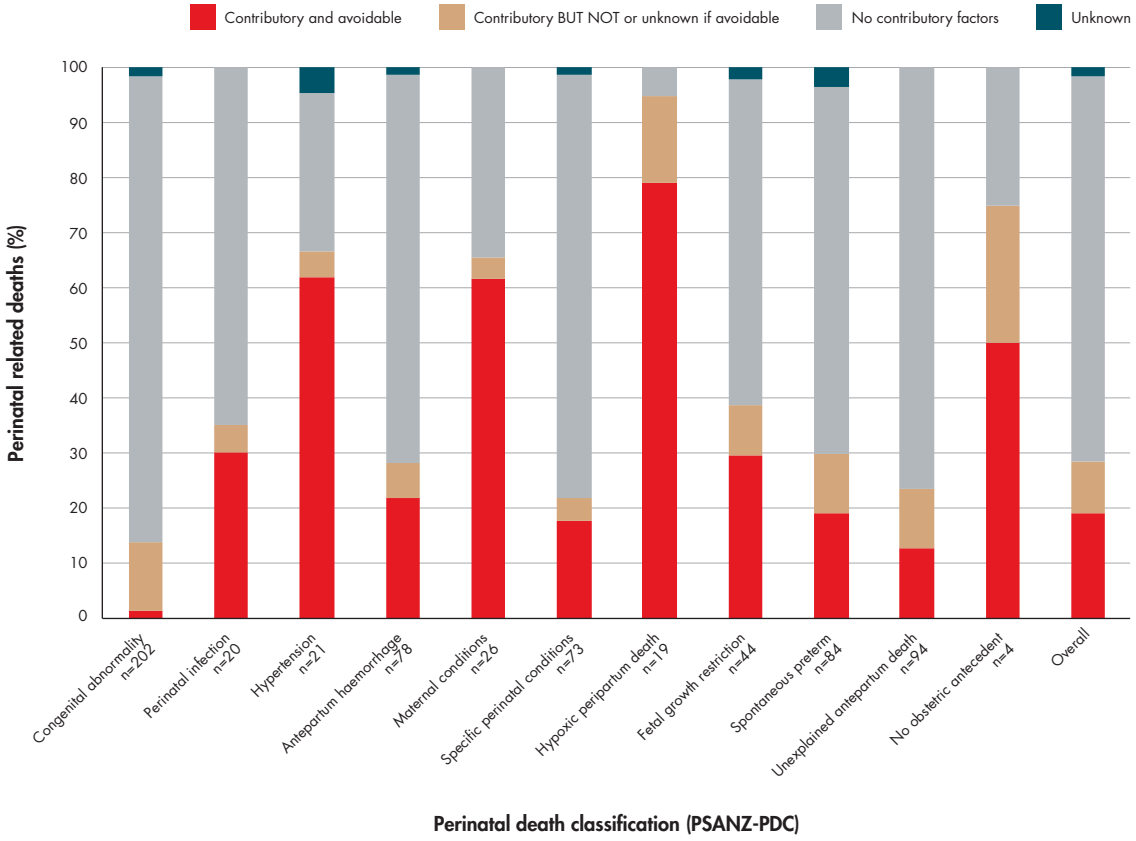
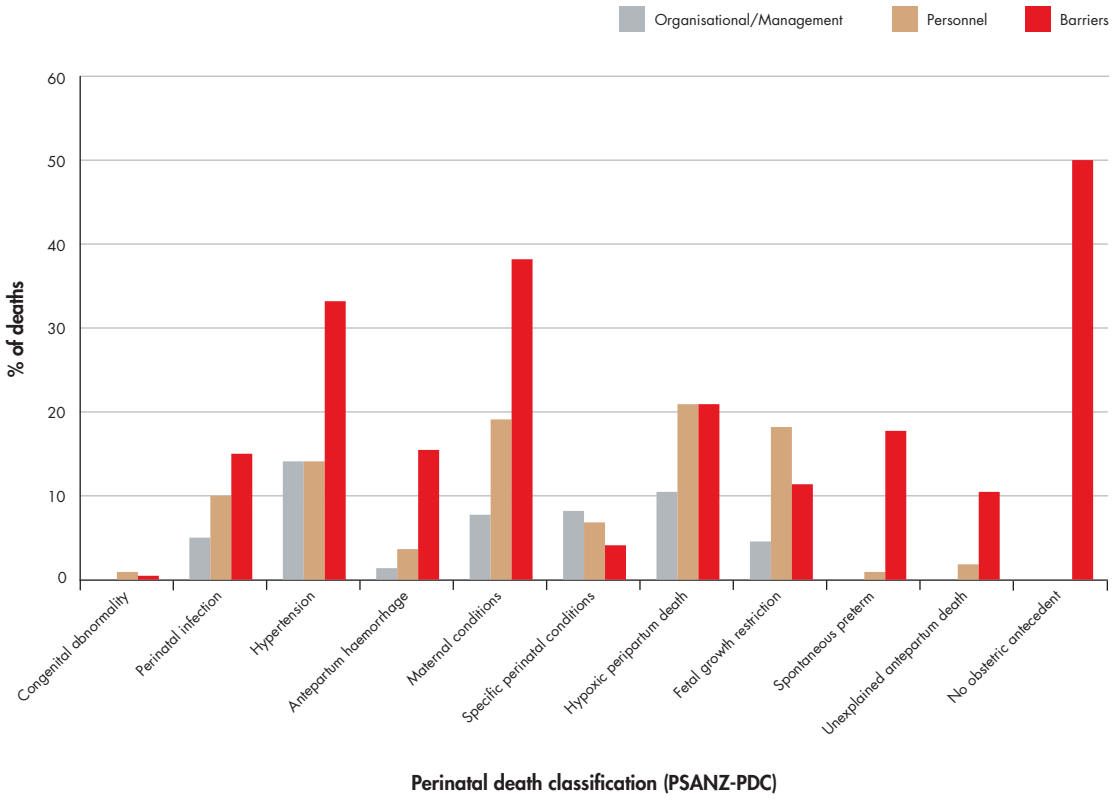


Figure 32 shows the proportion of perinatal related deaths where contributory factors were present (red and brown bars), whether the death was potentially avoidable (red bars) or whether there were no contributory factors identified (grey) or data were unavailable (dark blue) by perinatal death classification (PSANZ-PDC). While numbers within each PSANZ-PDC category are small, the proportions with contributory factors present and where deaths were determined to be potentially avoidable have been similar from 2009 to 2011. These data would suggest that quality improvement initiatives should be directed towards improving the management of hypertension and diabetes in pregnancy, improving fetal surveillance in labour and prevention of SUDI.

Figure 33: Contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by perinatal death classification (PSANZ-PDC) 2011



In 2011, local review committees were asked to determine, specifically, which of the contributory factors identified made the perinatal related death potentially avoidable. In 17 of the 189 cases assessed as potentially avoidable, more than one contributory factor was identified. When this occurred, the death was included in both or all three contributory factor categories.

In 17 (40 percent) of 43 deaths where organisational/management factors were identified, these were identified as the contributory factors that made the death potentially avoidable compared to 35 of 57 (61 percent) of personnel factors identified and 72 of 131 (55 percent) of barriers to access or engagement with care. These were not statistically significant differences.

As can be seen from Figure 33, barriers to access or engagement with care was the most common reason identified for potentially avoidable perinatal related death. However, personnel factors were identified most commonly or as often as other factors in hypoxic peripartum and fetal growth restriction. These data would suggest that quality improvement initiatives to reduce mortality from hypertension, diabetes and SUDI should focus on barriers to access and engagement, while improving fetal surveillance in labour requires focus on human factors.

Contributory factors and potentially avoidable perinatal related death and maternal ethnicity

Figure 34: Contributory factors and potentially avoidable perinatal related death by maternal ethnicity (prioritised) (95% CIs surround the estimate of the proportion of cases within each ethnicity where death was potentially avoidable) 2009–2011

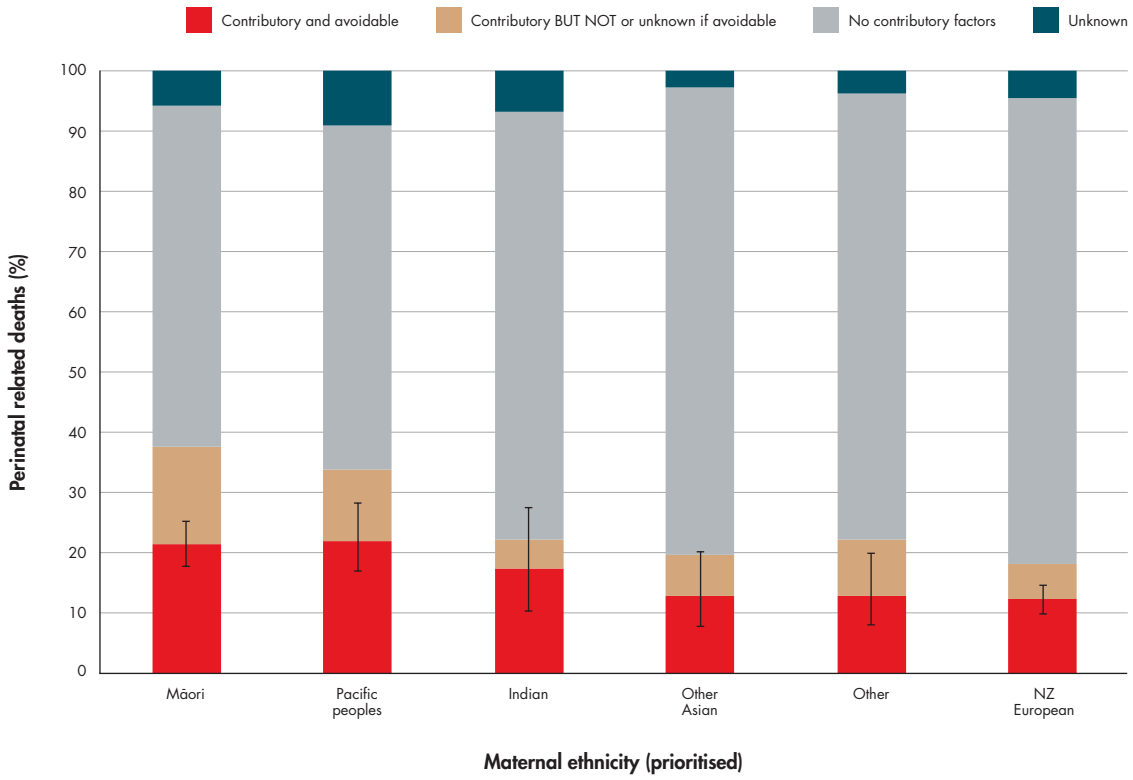


Figure 34 explores whether contributory factors and potentially avoidable death vary by maternal (prioritised) ethnicity. Ninety-five percent CIs surround the estimate of potentially avoidable perinatal related deaths. The estimates are highest for Māori mothers (22 percent) and Pacific mothers (22 percent) and are significantly higher than the estimate for New Zealand European mothers (12 percent).

Figure 35: Contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by maternal prioritised ethnicity (with 95% CIs) 2011

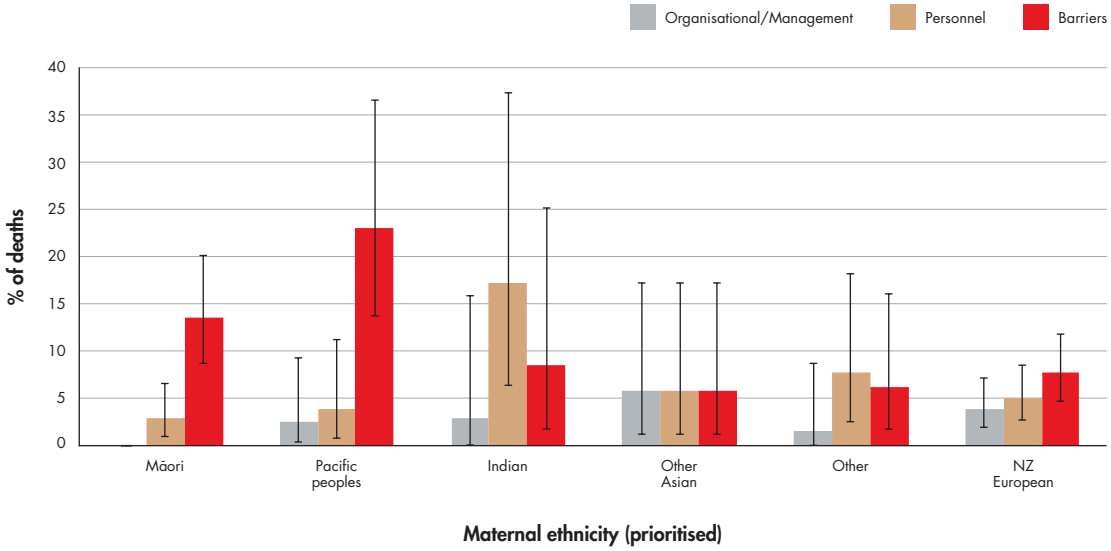


Figure 35 shows the particular contributory factors pertaining to potentially avoidable perinatal related deaths by prioritised ethnicity. As this is only one year of data, the numbers are small and so CIs are wide. However, the data would suggest that there are important differences in the pattern of contributory factors leading to potentially avoidable death by ethnicity, with barriers to access and engagement with care of particular importance among Pacific mothers and personnel factors prominent for Indian mothers. The relevant six Indian and 18 Pacific peoples perinatal related deaths were spread across causes of death.

Contributory factors and potentially avoidable perinatal related death and deprivation quintile (NZDep2006)

Figure 36: Contributory factors and potentially avoidable perinatal related death by New Zealand deprivation quintile (NZDep2006) 2009–2011

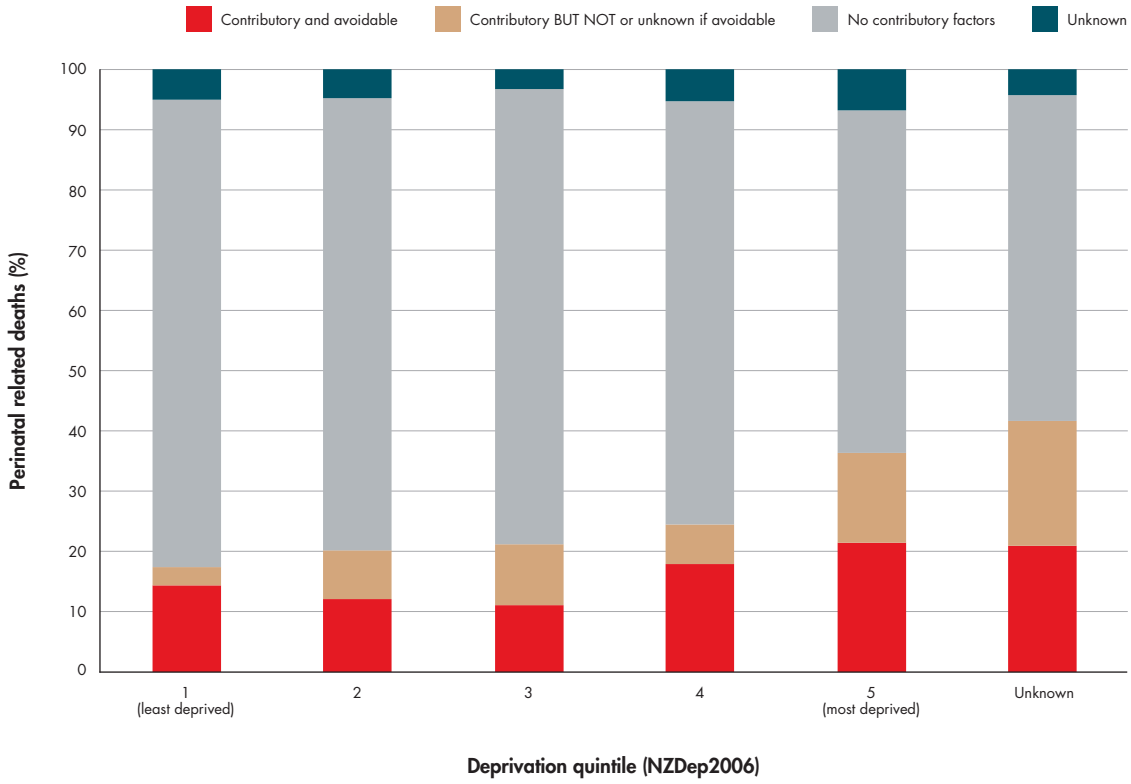


Figure 36 looks at whether contributory factors and potentially avoidable death vary by maternal deprivation quintile (NZDep2006). There is a significant linear trend for increasing potentially avoidable perinatal related deaths with increasing deprivation quintile from 1 (least deprived) to 5 (most deprived) ($p<0.0001$).

1.8 Specific analyses in perinatal related mortality

Congenital abnormalities and perinatal related death 2007–2011

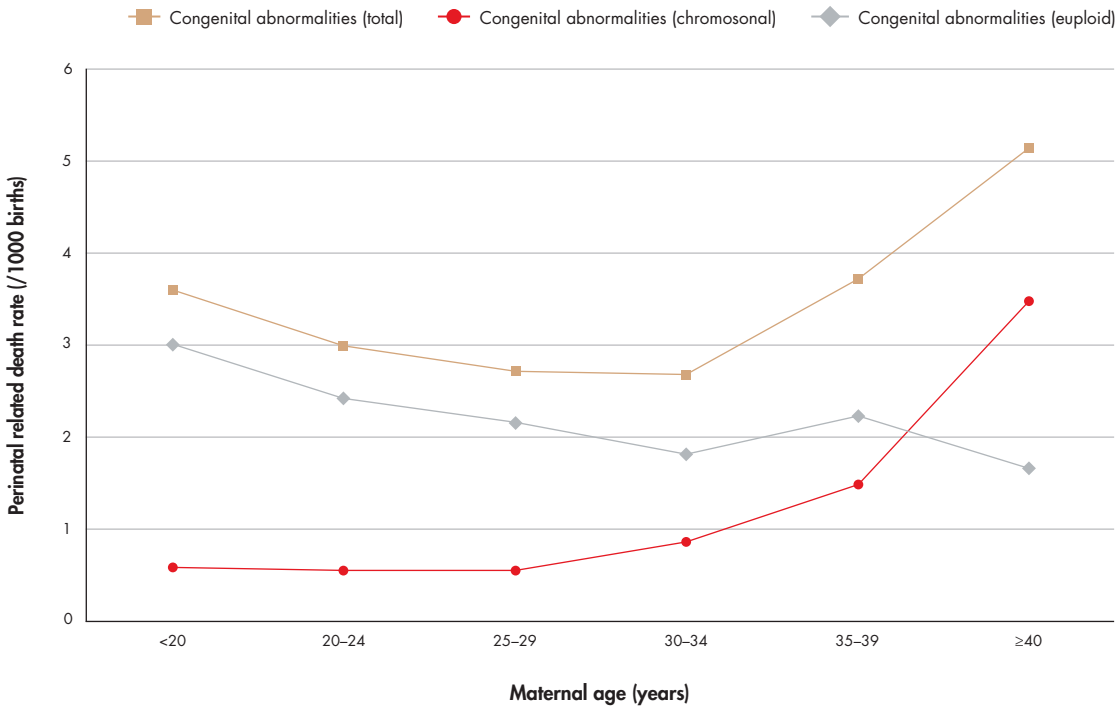
Congenital abnormality was the most common antecedent cause of perinatal related death in New Zealand from 2007 to 2011. As a primary, secondary or tertiary cause, it was a cause of death in 993 (28.6 percent) of perinatal related deaths, contributing to 607 (81.3 percent) of terminations of pregnancy, 165 (9.1 percent) of stillbirths and 221 (24.6 percent) of neonatal deaths. Congenital abnormality as a cause of death includes both lethal and terminated abnormalities.

Table 41: Perinatal death classification (PSANZ-PDC) in cases where congenital abnormality contributed to cause of death 2007–2011

Perinatal death classification (PSANZ-PDC)		Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=607		n=165		n=221		n=993	
		n	%	n	%	n	%	n	%
1.1	Central nervous system	157	25.9	20	12.1	21	9.5	198	19.9
1.2	Cardiovascular system	78	12.9	18	10.9	40	18.1	136	13.7
1.3	Urinary system	33	5.4	7	4.2	26	11.8	66	6.6
1.4	Gastrointestinal system	7	1.2	12	7.3	4	1.8	23	2.3
1.5	Chromosomal	190	31.3	61	37.0	47	21.3	298	30.0
1.6	Metabolic	2	0.3	1	0.6	11	5.0	14	1.4
1.7	Multiple/Non-chromosomal syndromes	73	12.0	23	13.9	36	16.3	132	13.3
1.8	Other congenital abnormality	63	10.4	11	6.7	36	16.3	110	11.1
1.9	Unspecified congenital abnormality	4	0.7	12	7.3	-	-	16	1.6

The most common antecedent congenital abnormalities were central nervous system, cardiovascular system and chromosomal abnormalities, though the patterns differed by mode of perinatal related death.

Figure 37: Perinatal related death rates associated with congenital abnormality overall and chromosomal and euploid abnormalities (per 1000 births) by maternal age 2007-2011



The associations between demographic variables and perinatal related deaths from congenital abnormalities, and from chromosomal and euploid (non-chromosomal) congenital abnormalities are given in Table 42. Figure 37 demonstrates the association between maternal age and congenital abnormalities. As can be seen, the association between maternal age and increasing perinatal related death is 'U' shaped. Chromosomal abnormalities (PSANZ-PDC 1.5) increase with increasing maternal age; while aneuploid abnormalities are more common among younger women.

Table 42: Rates of perinatal related death from congenital abnormality (per 1000 births with 95% CI) by maternal prioritised ethnicity, age and socioeconomic status (NZDep2006) 2007–2011

	Total births	Congenital abnormalities (total)			Congenital abnormalities (chromosomal)			Congenital abnormalities (euploid)		
	n	n	Rate	95% CI	n	Rate	95% CI	n	Rate	95% CI
Maternal prioritised ethnicity										
Māori	74,681	187	2.50	2.15–2.86	51	0.68	0.51–0.90	136	1.82	1.52–2.13
Pacific peoples	34,415	114	3.31	2.70–3.92	31	0.90	0.61–1.28	83	2.41	1.92–2.99
Indian	11,300	47	4.16	3.06–5.53	10	0.88	0.42–1.63	37	3.27	2.31–4.51
Other Asian	23,567	94	3.99	3.22–4.88	32	1.36	0.93–1.92	62	2.63	2.02–3.37
Other/Not stated	28,943	84	2.90	2.31–3.59	27	0.93	0.61–1.36	57	1.97	1.49–2.55
NZ European	149,962	467	3.11	2.83–3.40	147	0.98	0.82–1.14	320	2.13	1.90–2.37
Maternal age										
<20	23,937	86	3.59	2.87–4.44	14	0.58	0.32–0.98	72	3.01	2.35–3.79
20–24	58,983	173	2.93	2.50–3.37	33	0.56	0.39–0.79	140	2.37	1.98–2.77
25–29	79,523	214	2.69	2.33–3.05	44	0.55	0.40–0.74	170	2.14	1.82–2.46
30–34	89,982	241	2.68	2.34–3.02	77	0.86	0.68–1.07	164	1.82	1.54–2.10
35–39	57,800	213	3.69	3.19–4.18	86	1.49	1.19–1.84	127	2.20	1.82–2.58
≥40	12,643	65	5.14	3.97–6.55	44	3.48	2.53–4.67	21	1.66	1.03–2.54
Unknown	-	1	-	-	-	-	-	1	-	-
NZ deprivation quintile 2006 (maternal residence)										
1 (least deprived)	51,629	177	3.43	2.92–3.93	62	1.20	0.92–1.54	115	2.23	1.82–2.63
2	57,026	163	2.86	2.42–3.30	58	1.02	0.77–1.31	105	1.84	1.49–2.19
3	60,623	180	2.97	2.54–3.40	58	0.96	0.73–1.24	122	2.01	1.66–2.37
4	67,476	218	3.23	2.80–3.66	58	0.86	0.65–1.11	160	2.37	2.00–2.74
5 (most deprived)	84,373	249	2.95	2.58–3.32	60	0.71	0.54–0.92	189	2.24	1.92–2.56
Unknown	1,741	6	-	-	2	-	-	4	-	-

Audit of prevention, detection and management of congenital abnormalities in pregnancy 2010

In 2012, the PMMRC won a Health Quality & Safety Commission grant to audit prevention, detection and management of congenital abnormalities in a cohort of perinatal related deaths. The audit included the 35 central nervous system, 29 cardiovascular and 73 chromosomal abnormality deaths in 2010 and involved an audit of LMC, general practice and hospital notes and an independent review of ultrasound scans performed from 10 weeks gestation to detection of the abnormality. The methods and findings of this audit are available in full at *http://www.hqsc.govt.nz/assets/Other-Topics/QS-challenge-reports/Detecting-abnormalities-earlier-in-pregnancy-Final-Report.pdf*, and the executive summary is provided in Appendix B. This audit relates only to babies with a lethal or terminated congenital abnormality resulting in perinatal related death at 20 weeks or beyond and may not be generalised to all congenital abnormalities in New Zealand.

The audit recommended that enhancement of the current birth defects register, to include congenital abnormalities where a baby did not survive, would enhance further audit of prevention, detection and management of congenital abnormalities in New Zealand.

The following is a summary of key findings and related recommendations from this report.

Gestation at registration with LMC

Audit findings

First contact with a health professional in pregnancy was with a GP in the majority of cases. First contact occurred within 10 weeks in 74 percent of cases and within 14 weeks in 85 percent. However, there was often a significant delay before registration with an LMC.

Recommendations

- Education of all women is required about the importance of registration with an LMC before 10 weeks.
- As GPs are often the first point of contact for pregnant women, it is essential that they are able to facilitate expeditious registration with an LMC. In the near future, this will be facilitated by the national Find Your Midwife website (*http://www.findyourmidwife.co.nz*).

Folate supplementation

Folate reduces the risk of neural tube defects by 72 percent (De-Regil Luz et al 2010) if taken prior to and during the first six weeks of pregnancy. The Ministry of Health recommends low-risk women who are planning a pregnancy or are pregnant to take 0.8mg folate and high-risk women to take 5mg (previous neural tube defects, family history of neural tube defects, on insulin for diabetes or other medications) (Ministry of Health 2010) – see *http://www.health.govt.nz/our-work/life-stages/maternity-and-breastfeeding/supplement-tablet-take-when-pregnant-or-breastfeeding*.

Audit findings

Folate supplements were either not taken or not documented as taken in the periconceptual period by 93 percent of women and not documented or not taken by 46 percent of women in the antenatal period. Inadequate detail was available to assess the adequacy of dosage of folate taken.

Of the 21 babies in the audit diagnosed with neural tube defects, 13 women (62 percent) were documented as taking antenatal folate and one as taking periconceptual folate.

Recommendations

- Use, timing of use and dosage of folate taken by pregnant women in the periconceptual period should be documented by LMCs and GPs as part of the woman's obstetric record. A media campaign is required to educate women on the recommended timing and dosage of periconceptual folate.
- New Zealand should reconsider evidence on fortification of bread with folate.

Screening for congenital abnormalities

First trimester screening includes a nuchal ultrasound scan (between 11 weeks and 13 weeks and 6 days) and a blood test (between 9 weeks and 13 weeks and 6 days) and is calibrated for maximal sensitivity for trisomy 21, though it may detect other abnormalities with an excess of chromosomal material. Second trimester screening involves a blood test between 14 and 20 weeks (ideally between 15 and 17 weeks). It has similar sensitivity to first trimester screening for identifying trisomy 21 (National Screening Unit 2012).

Audit findings

First or second trimester screening was not offered to 23 percent of women who presented to a health care professional prior to 20 weeks (Figure 38).

Fourteen 'screen-detectable' abnormalities were not detected, three of which were neural tube defects and the remainder mostly trisomies other than trisomy 21.

Recommendations

- As GPs are often the first point of contact for pregnant women, it is essential that they are able to effectively offer first trimester screening.
- The National Screening Unit should review the current algorithms used in New Zealand's first and second trimester screening programme, which is calibrated for trisomy 21, and consider the cost-benefit of using algorithms calibrated for maximal sensitivity for all chromosomal abnormalities.
- The National Screening Unit should review the efficiency and adequacy of the programme's guidelines for reporting results for nuchal translucency in a patient who has not had a serum sample taken to avoid delays in reporting risk from the nuchal scan.
- The National Screening Unit should review false negative screening tests.

Ultrasound

Audit findings

We requested 131 scans on 82 women for review. Twenty-five scans (19 percent) for 17 women were unavailable. Five cases were detected at independent review earlier than they were reported.

Recommendation

- Radiology services should retain copies of ultrasound scans to allow review and audit.

Referral to specialist services

The New Zealand Maternal Fetal Medicine Network advises that referral to review should be no longer than one week (Health Point 2012).

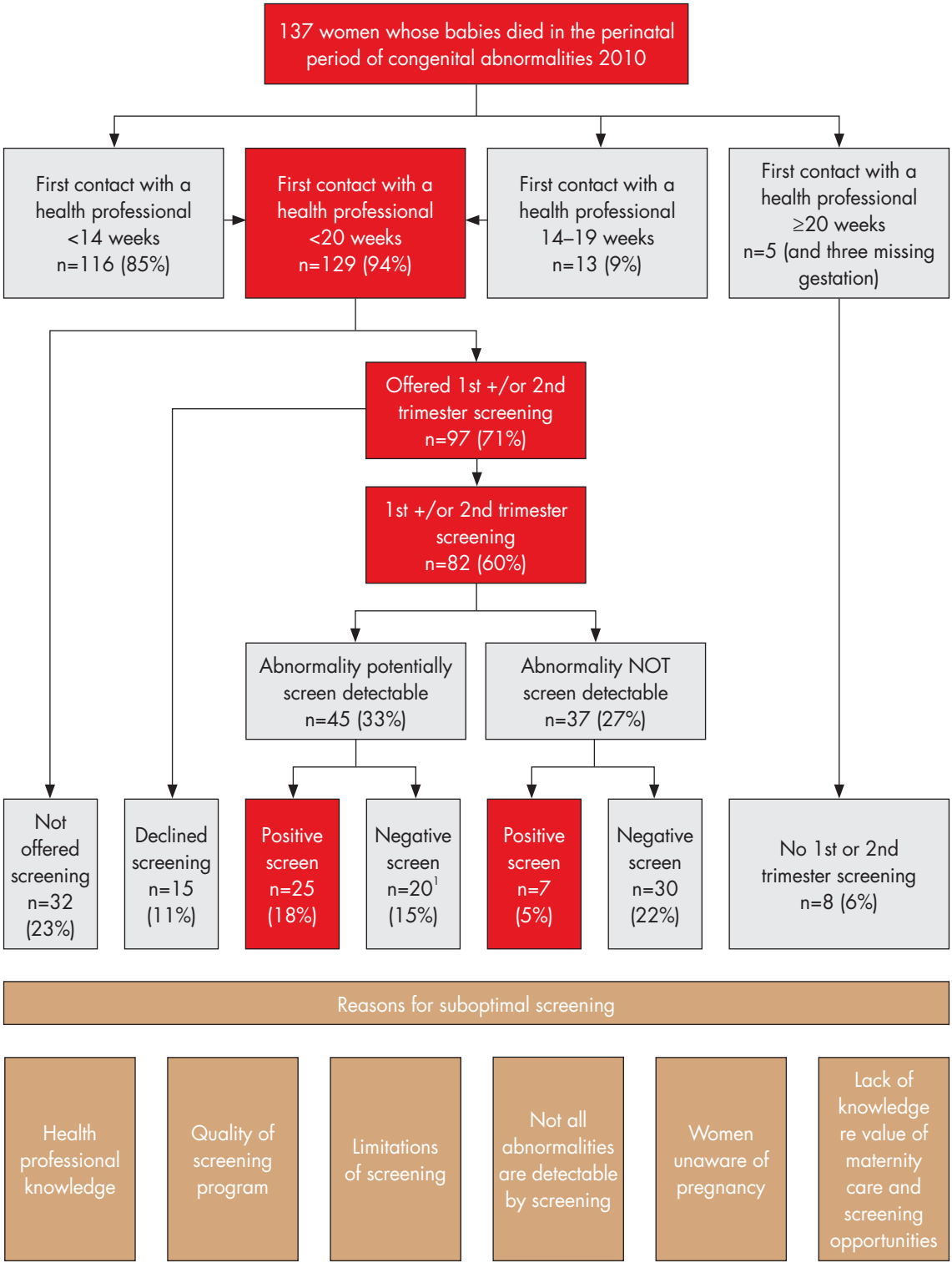
Audit findings

The time from referral to review by a maternal fetal medicine specialist was a median of six days, but 31 percent of women were seen later than one week after referral.

Recommendation

- The New Zealand Maternal Fetal Medicine Network should regularly audit time from referral to review to ensure that the majority of women are seen within seven days as recommended.

Figure 38: Outcomes of first and second trimester nuchal translucency and serum screening among perinatal related deaths from congenital central nervous system, cardiovascular and chromosomal abnormalities 2010



From *Improving quality and safety in maternity services: can we improve prevention, detection and management of congenital abnormalities in pregnancy?* (http://www.hqsc.govt.nz/assets/Other-Topics/QS-challenge-reports/Detecting-abnormalities-earlier-in-pregnancy-Final-Report.pdf)

1 Includes six cases of spina bifida who did NOT have second trimester serum testing so would not have been detected.

Spontaneous preterm birth as a cause of perinatal related death 2007–2011

For the purposes of this analysis, spontaneous preterm has been defined as any perinatal related death where spontaneous preterm birth was entered as a perinatal death classification (PSANZ-PDC 9) whether or not it was the primary PSANZ-PDC.

Table 43: Perinatal death classification (PSANZ-PDC) among spontaneous preterm deaths 2007–2011

Perinatal death classification (PSANZ-PDC)	Primary PSANZ-PDC		Secondary PSANZ-PDC		Tertiary PSANZ-PDC	
	n=709		n=709		n=709	
	n	%	n	%	n	%
Congenital abnormality	11	1.6	1	0.1	-	-
Perinatal infection	14	2.0	15	2.1	5	0.7
Hypertension	-	-	-	-	-	-
Antepartum haemorrhage	134	18.9	52	7.3	1	0.1
Maternal conditions	13	1.8	13	1.8	6	0.8
Specific perinatal conditions	34	4.8	4	0.6	3	0.4
Hypoxic peripartum death	-	-	8	1.1	-	-
Fetal growth restriction	6	0.8	8	1.1	4	0.6
Spontaneous preterm	497	70.1	203	28.6	9	1.3

Spontaneous preterm birth was a cause of death in 709 (20 percent) of perinatal related deaths from 2007 to 2011, contributing to 40 percent of neonatal deaths, 17 percent of stillbirths and 5 percent of terminations of pregnancy. Spontaneous preterm birth was the second most often assigned primary cause of perinatal related death in this period (14.3 percent) after congenital abnormality (28.1 percent).

Spontaneous preterm birth was assigned as the primary PSANZ-PDC in 70 percent of cases where spontaneous preterm birth was a cause of perinatal related death. Antepartum haemorrhage was assigned as the primary PSANZ-PDC in 19 percent of cases where spontaneous preterm birth was a cause of death.

Forty percent (285/709) of spontaneous preterm birth cases were associated with prolonged rupture of the membranes.

Table 44: Primary neonatal death classification (PSANZ-NDC) among neonatal deaths where spontaneous preterm birth was assigned as a perinatal death classification (PSANZ-PDC) 2007–2011

Neonatal death classification (PSANZ-NDC)	Neonatal deaths	
	n=359	
	n	%
Congenital abnormality	5	1.4
Extreme prematurity	225	62.7
Cardio-respiratory disorders	41	11.4
Infection	33	9.2
Neurological	33	9.2
Gastro-intestinal	12	3.3
Other	10	2.8

The primary neonatal cause of death (PSANZ-NDC) assigned to the spontaneous preterm cases where the baby died in the neonatal period was extreme prematurity in 63 percent of cases, but cardio-respiratory disorders, infection and neurological causes also contributed approximately 10 percent each.

Neonatal resuscitation

Resuscitation was attempted for 41 babies under 24 weeks, with successful resuscitation and transfer to another clinical area in 22 cases, 19 recorded as 23 weeks and three at 22 weeks. All 22 week babies died on the day of birth.

Ethnicity, age and socioeconomic status

Table 45: Perinatal related death rates from spontaneous preterm birth (per 1000 births) and relative risks (95% CI) by maternal prioritised ethnicity, age, and socioeconomic status (NZDep2006) 2007–2011

	Total births	Spontaneous preterm deaths			
	n	n	Rate	Relative risk	95% CI
Maternal prioritised ethnicity					
Māori	74,681	266	3.56	2.31	1.94–2.76
Pacific peoples	34,415	96	2.79	1.81	1.43–2.30
Indian	11,300	31	2.74	1.78	1.22–2.59
Other Asian	23,567	36	1.53	0.99	0.70–1.41
Other/Not stated	28,943	49	1.69	1.10	0.81–1.50
NZ European	149,962	231	1.54	1.00	-
Maternal age					
<20	23,937	104	4.34	2.90	2.24–3.74
20–24	58,983	160	2.71	1.81	1.44–2.27
25–29	79,523	161	2.02	1.35	1.07–1.70
30–34	89,982	135	1.50	1.00	-
35–39	57,800	121	2.09	1.40	1.09–1.78
≥40	12,643	28	2.21	1.48	0.98–2.22
NZ deprivation quintile 2006 (maternal residence)					
1 (least deprived)	51,629	69	1.34	1.00	-
2	57,026	113	1.98	1.48	1.10–2.00
3	60,623	107	1.77	1.32	0.98–1.79
4	67,476	162	2.40	1.80	1.36–2.38
5 (most deprived)	84,373	245	2.90	2.17	1.66–2.84
Unknown	1,741	13	-	-	-

Babies with Māori, Pacific or Indian mothers are more likely to die from spontaneous preterm birth than those with New Zealand European mothers. The risk is not higher among non-Indian Asian and Other ethnicities. Both babies of young mothers and older mothers are more likely to die from spontaneous preterm birth. There is an increase in risk of death from spontaneous preterm birth for mothers who are more deprived as measured by NZDep2006 deprivation quintile.

These associations are demonstrated in the PSANZ-PDC specific cause of death by age, ethnicity and socioeconomic status figures (Figures 21, 24 and 26).

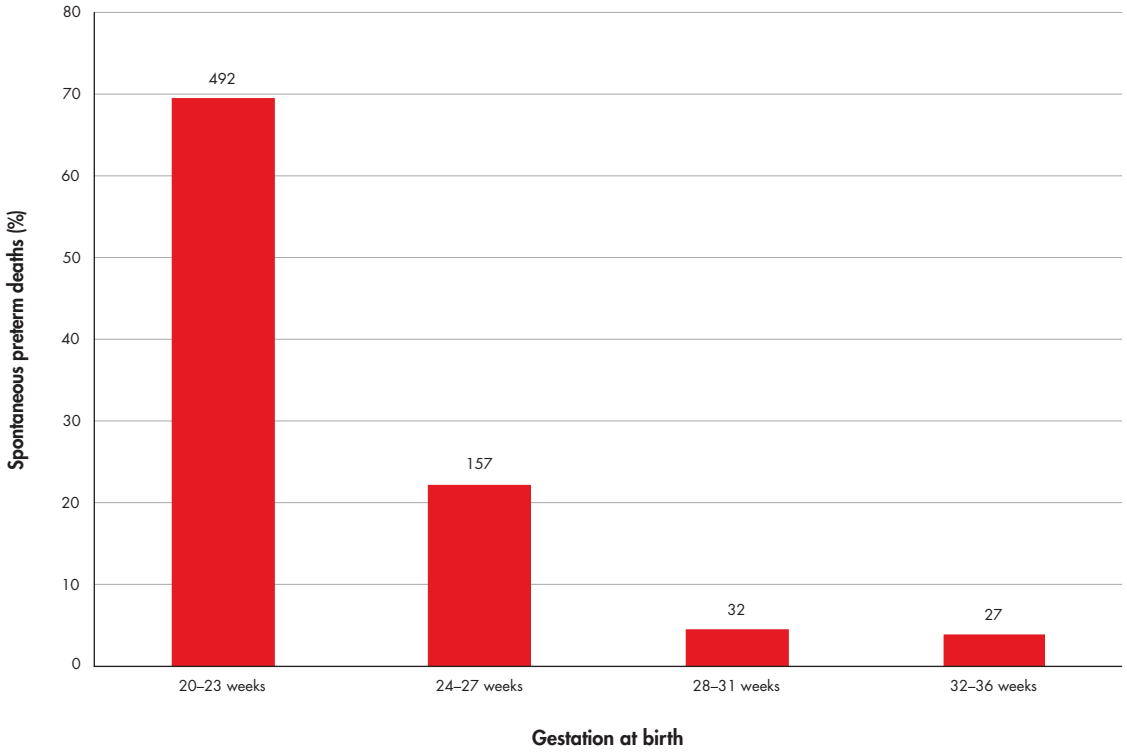
Smoking

Thirty-six percent of mothers of spontaneous preterm deaths were smoking at the time of their baby's birth, and this is considerably higher than rates of smoking for New Zealand mothers overall (14.1 percent of mothers at two weeks postpartum[1]), consistent with previous research supporting an association between smoking and preterm birth.

Drugs and alcohol

As noted on page 65, analysis of 2007–2010 data showed that both alcohol and marijuana use were associated with perinatal related death due to spontaneous preterm birth. However, women who reported alcohol and marijuana use were more likely to be young, Māori, smokers and from socioeconomically deprived areas, all of which are associated with perinatal death from spontaneous preterm birth and therefore may be confounders of any association between spontaneous preterm death and alcohol and marijuana use.

Figure 39: Spontaneous preterm perinatal related death and gestation at birth 2007–2011



1 MAT data.

The majority of deaths from spontaneous preterm birth (492/709 (69 percent)) occurred among births prior to 24 weeks. Seventy-seven percent of stillbirths and 61 percent of neonatal deaths from spontaneous preterm birth were born prior to 24 weeks. Most of the remainder (22 percent) were born between 24 and 27 weeks. Preterm birth prevention is required to make an important impact on death due to spontaneous preterm birth, as only those babies (31 percent) born at or after 24 weeks have a chance to survive in most neonatal facilities today.

Small for gestational age (SGA)

Overall, 39 percent of deaths from spontaneous preterm birth were small for gestational age (SGA) by customised birthweight centile. The rate of SGA among perinatal related deaths varies by cause of death and also by gestation, with higher rates in babies dying under 24 weeks. This difference in SGA rate by gestation is apparent within deaths from spontaneous preterm birth, with a rate of 44 percent among births under 24 weeks.

The elevated rate of SGA might suggest that babies who die following spontaneous preterm birth have pregnancy problems prior to their spontaneous preterm birth.

Table 46: Perinatal related death rates from spontaneous preterm birth (per 1000 births) and relative risk (95% CI) for multiple pregnancies 2007–2011

	Total births	Spontaneous preterm			
	n	n	Rate	Relative risk	95% CI
Singleton	313,385	577	1.84	1.00	-
Multiple	9,483	132	13.92	7.56	6.26–9.12

Babies born in multiple pregnancies are over seven times more likely to suffer perinatal related death from spontaneous preterm birth than singletons. Gestation of birth does not differ significantly between multiple and singleton deaths from spontaneous preterm birth.

Gestation of registration with a lead maternity carer (LMC)

Only in 2011 were there adequate data on gestation at registration with an LMC to report these data.

Among spontaneous preterm deaths, 70 percent of mothers registered by 13 weeks gestation and 89 percent by 20 weeks. Although this does not reach the suggested standard of registration by 10 weeks, it is similar to gestation at registration for New Zealand births as a whole. This does not support the argument that more timely antenatal care might have an impact on mortality from this common cause.

Table 47: Risk factors among spontaneous preterm perinatal related deaths 2007–2011

	Spontaneous preterm deaths	
	n=709	
	n	%
Bleeding in pregnancy		
Bleeding <20 weeks	186	26.2
Bleeding ≥20 weeks	385	54.3
Cervical surgery	66	9.3
Urinary tract infection	92	13.0
Previous preterm birth	153	21.6
Previous miscarriage	175	24.7
Previous termination of pregnancy	108	15.2

More than 50 percent of women who had perinatal related deaths from spontaneous preterm birth had an antepartum haemorrhage (bleeding at or beyond 20 weeks). This compares to a background rate of approximately 6 percent.[2] A quarter of women had bleeding prior to 20 weeks, and of these, 77 percent continued to bleed beyond 20 weeks. Recommended best practice for bleeding in pregnancy is outlined on page 75.

Among spontaneous preterm deaths, 9 percent of women had a history of cervical surgery, and 13 percent had a history of urinary tract infection including any diagnoses made in this pregnancy.

Antenatal steroids

Among neonatal deaths from spontaneous preterm birth of babies born from 24 to 32 weeks, 72 percent of mothers were started on a course of corticosteroids before birth. Each year, a further 6–11 mothers of babies born at less than 24 weeks were also prescribed antenatal steroids.

Contributory factors and potentially avoidable perinatal related death

Contributory factors were reported in 32 percent of deaths from spontaneous preterm birth in the years 2009–2011 (when these were reported), and 20 percent of deaths from spontaneous preterm birth were thought to be potentially avoidable.

In 2011, barriers to access or engagement with care were identified as a main contributing factor in 22 potentially avoidable perinatal related deaths from spontaneous preterm birth (17 percent of deaths in 2011 from spontaneous preterm birth). Personnel factors were identified in a further eight cases (6 percent).

Summary

Spontaneous preterm birth is the second most common cause of perinatal related death in New Zealand. Forty percent of these deaths are associated with prolonged rupture of the membranes and 54 percent with antepartum haemorrhage.

The majority of deaths from spontaneous preterm birth (69 percent) occur under 24 weeks and so are only amenable to prevention. Forty-four percent of these under 24 week preterm babies who died were small for gestational age by customised centiles, suggesting a common pathology for these conditions.

The rate of spontaneous preterm birth as a cause of perinatal related death is higher in Māori, Pacific and Indian mothers, mothers at the extremes of age and with higher levels of socioeconomic deprivation. Spontaneous preterm birth is also associated with smoking, alcohol and marijuana use.

Seventeen percent of deaths in 2011 from spontaneous preterm birth might have been avoided if barriers to access or engagement with care had been addressed.

2 *National Women's Annual Clinical Report 2011* (http://nationalwomenshealth.adhb.govt.nz/Portals/0/Annual%20Reports/Final_2011_ACR_PDF_24_July_2012.pdf)

2 New Zealand Maternal Mortality 2011

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 also reviews 'indirect' deaths, in particular (but not solely) those related to surgery, psychiatric illness and family violence.

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), Alec Ekeroma (obstetrician and gynaecologist), Alison Eddy (midwife), Claire McLintock (obstetric physician and haematologist), Graham Sharpe (anaesthetist) and John Walker (anaesthetist). In 2012, they were joined by Kate White (forensic pathologist), Lesley Dixon (midwife), Liz McDonald (psychiatrist) and Sue Belgrave (obstetrician and gynaecologist). 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 year 2011 represents the sixth 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, time trends in maternal mortality in New Zealand have been explored along with analyses that include all six years of maternal mortality data.

The MMRWG noted in the 2009 PMMRC report that the Ministry of Health published two publications reporting maternal mortality – 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 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 subclassified 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 that was aggravated by the physiologic effects of pregnancy.
- **Coincidental maternal deaths**: deaths from unrelated causes that 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 variable definition of 'maternities' 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. The UK 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 only stillbirths at 24 or more weeks gestation are 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 et al 2007).

Contributory factors are organisational/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 facilities, distance) and barriers to accessing/engaging with care (for example, unregistered pregnancies, language barriers) that the MMRWG considered were present in the death reviewed. In 2011, technology/equipment and environmental factors have been reassigned to organisational/management and barriers to access and engagement with care. 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 et al 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 Coronial Services, 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 Coronial Services.

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.

All completed reporting forms, along with relevant clinical information, and reports from DHBs, Coronial Services and the Health and Disability Commissioner are reviewed by designated members of the MMRWG, who present a summary of each 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 to 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 to 2008 and completed the tool for identifying contributory factors. For 2009 to 2011 deaths, the working group applied the new tool in reviewing the maternal deaths. The findings of the expert panel review of deaths from 2006 to 2008 combined with the committee's reviews for 2009 to 2011 are presented in this report.

2.4 Findings

Table 48: Maternal mortality ratio (per 100,000 maternities) and cause of maternal death 2006–2011

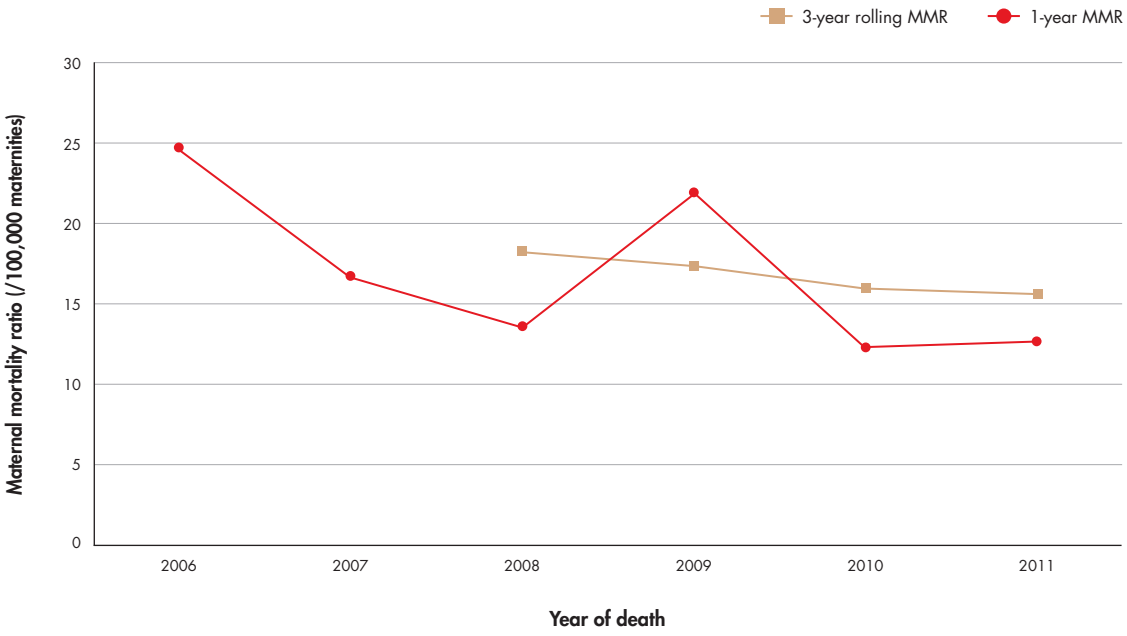
Classification and cause of maternal death	2006	2007	2008	2009	2010	2011	2006–2011	
							n=65	
	n	n	n	n	n	n	n	%
Maternities	**60,659**	**65,603**	**65,872**	**63,665**	**65,124**	**62,604**	**–**	**–**
Direct maternal death	**6**	**5**	**4**	**5**	**1**	**2**	**23**	**35**
Amniotic fluid embolism	3	–	1	4	1	–	9	14
Postpartum haemorrhage	1	1	1	–	–	–	3	5
Venous thrombo-embolism	–	1	1*	–	–	1	3	5
Peripartum cardiomyopathy	–	1	–	–	–	–	1	2
Pre-eclampsia/Eclampsia	–	2	1	1	–	–	4	6
Sepsis	2	–	–	–	–	1	3	5
Indirect maternal death	**7**	**5**	**5**	**9**	**7**	**5**	**38**	**58**
Pre-existing medical condition	2	4	2	1	2	4	15	23
Sepsis	–	1	–	5	1	–	7	11
Intracranial haemorrhage	1	–	–	–	1	–	2	3
Suicide	4	–	3	3	3	1	14	22
Unclassifiable	**2**	**1**	**–**	**–**	**–**	**1**	**4**	**6**
Total maternal deaths	**15**	**11**	**9**	**14**	**8**	**8**	**65**	**100**
Single-year MMR	24.7	16.8	13.7	22	12.3	12.8	–	–
Three-year rolling MMR	–	–	**06–08**	**07–09**	**08–10**	**09–11**	–	–
	–	–	18.2	17.4	15.9	15.7	–	–
Coincidental deaths	**1**	**3**	**1**	**0**	**3**	**3**	**11**	**–**

* Pulmonary embolism and sepsis.

Two direct and five indirect maternal deaths were reported to the MMRWG in 2011. There were 62,604 maternities in 2011, making the maternal mortality ratio 12.8/100,000 in 2011 (95% CI 5.5–25.2). As the number of maternal deaths is small in any one year in New Zealand, there may be large variations in the ratio from year to year.

Figure 40 demonstrates maternal mortality ratios for each year and three-year rolling ratios. The three-year rolling ratios are represented as an estimate plotted at the final year of the three-year period. For example, the three-year ratio for 2006–2008 is plotted for 2008. The three-year rolling MMR for 2009–2011 was 15.7 (95% CI 10.6–22.4)

Figure 40: Maternal mortality ratios (per 100,000 maternities) (one-year and three-year rolling) 2006–2011



The peak of mortality in 2009 (one-year MMR) may be due to the epidemic occurrence of three confirmed (and one probable) deaths from A H1N1 influenza. The apparent downward trend in maternal mortality ratio is not statistically significant (chi-squared test for trend in one-year ratios p=0.14).

In 2011, we identified three coincidental deaths, associated with trauma and cancer.

International comparisons

It is difficult to compare maternal mortality ratios internationally due to differences in definitions and variations in systems for ascertainment of maternal death. Small differences in the denominator (number of maternities) result in very small changes when calculating the ratio, whereas changes in the numerator (number of deaths) have a substantial impact on the ratio. It has been calculated that countries with poor case ascertainment may be under-reporting 30–63 percent of cases (Donati et al 2011, European Perinatal Health Report 2004). Low maternal mortality ratios may therefore be due to a failure of the maternity sector in that country to ascertain all maternal deaths. The United States Centers for Disease Control and Prevention only report on direct maternal deaths due to difficulty with case ascertainment of all maternal deaths (Xu et al 2010).

This is important when making comparisons to international maternal mortality ratios, which are generally calculated using routine surveillance data. The in-depth ascertainment of maternal deaths used in the PMMRC process in New Zealand results in a higher degree of accuracy. Anything other than mandatory reporting is likely to result in lower maternal mortality ratios.

Figure 41: Maternal mortality ratios (per 100,000 maternities) comparing New Zealand, Australia and the UK, illustrating the impact of different methods of surveillance

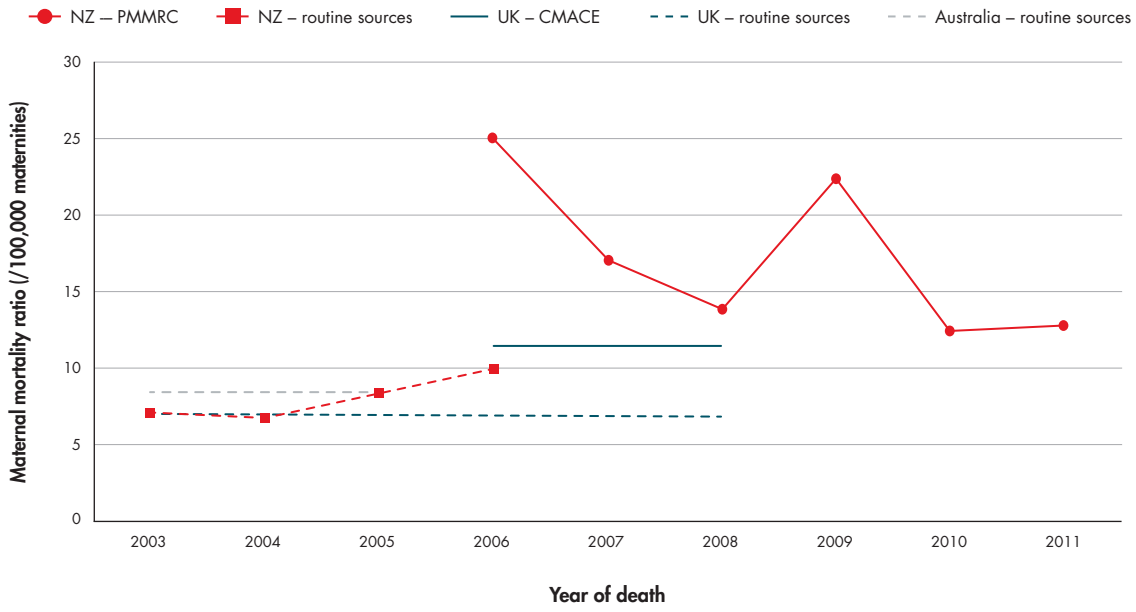


Figure 41 illustrates the impact of routine surveillance versus mandatory reporting. The ratios from routine surveillance in New Zealand and the UK, represented by broken lines, are both lower than the ratios from mandatory reporting (solid lines). No system of mandatory reporting is yet in place in Australia.

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).

Table 49: Reporting of maternal deaths to New Zealand Coronial Services 2006–2011

Year	Maternal deaths	Maternal death reported to Coronial Services	
	n	n	%
2006	15	13	87
2007	11	8	73
2008	9	9	100
2009	14	14	100
2010	8	8	100
2011	8	8	100

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 Coronial Services 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 past four years, all maternal deaths have been reported to Coronial Services.

In three cases in 2011, a coroner did not take jurisdiction in the death, and a post-mortem was not carried out. In many cases, the review committee finds autopsy findings of great value in assigning cause of death.

Role of post-mortem in determining the cause of maternal death

Of the 47 post-mortems performed between 2006 and 2011, 77 percent were performed by a forensic pathologist and 23 percent by a general pathologist. The number of post-mortems performed by a forensic pathologist has increased from 42 percent in 2006 to 100 percent in 2010 and 2011.

The MMRWG assessed the role of the post-mortem in determining the cause of death for 2006–2011:

- The clinical diagnosis was confirmed in 64 percent of cases.
- The clinical diagnosis was changed in 19 percent of deaths, including finding a cause of death when cause was unknown prior to post-mortem and resolution of a differential diagnosis.
- The clinical diagnosis was not altered but the post-mortem identified additional clinical findings in 11 percent of deaths.
- The clinical diagnosis was inconclusive in 6 percent of deaths in that it did not demonstrate an obvious cause of death or significant abnormality.

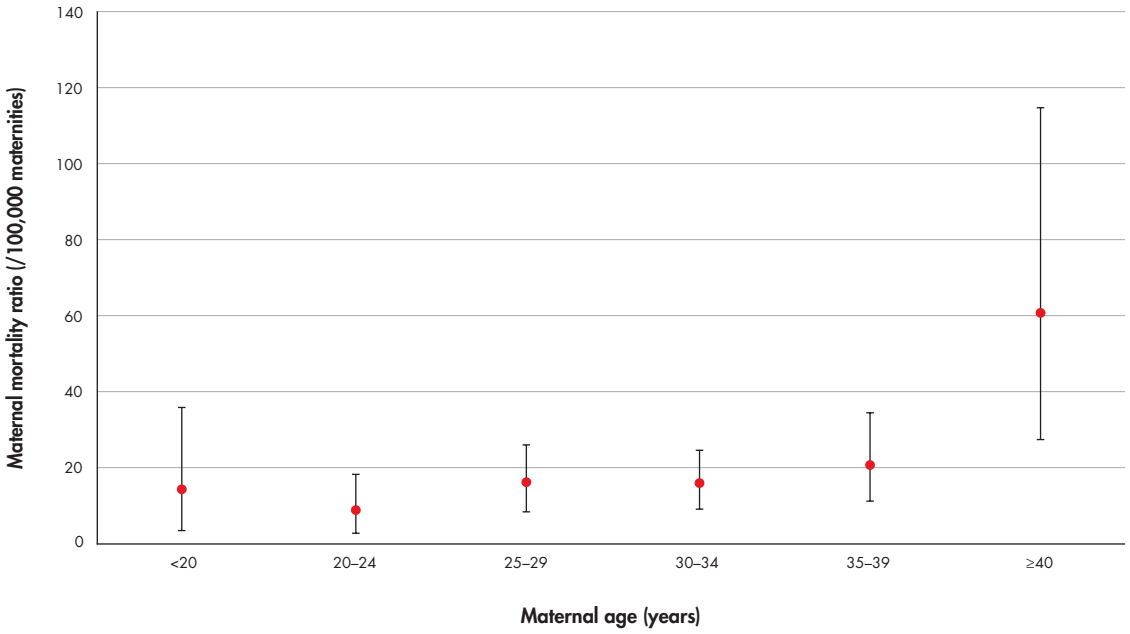
Recommendation

Where a coroner declines jurisdiction in the case of a maternal death, post-mortem should be offered as part of full investigation of cause of death.

Demographic characteristics among maternal deaths

The demographic section and the following section on time and place of death have been updated to include 2011 data with 2006–2010 data to increase the power for exploring associations between these factors and maternal death, and to characterise the relative burden of these deaths between community and hospital services.

Figure 42: Maternal mortality ratio (per 100,000 maternities) by maternal age 2006–2011



Older maternal age (≥40 years) is associated with a significantly higher maternal mortality ratio compared to women aged 20–34 years. The shape of this graph mirrors very closely that for the UK data presented in Saving mothers' lives: 2006–08 (CMACE 2011b). There have been nine deaths in this older age group from 2006 to 2011.

Table 50: Demographic characteristics among maternal deaths 2006–2011

	Maternities[1]		Maternal deaths		Maternal mortality ratio
	n=383,527		n=65		
	n	%	n	%	/100,000 maternities
Maternal age					
<20	28,419	7.41	4	6	14.08
20–24	69,696	18.17	6	9	8.61
25–29	94,004	24.51	15	23	15.96
30–34	108,176	28.21	17	26	15.72
35–39	68,369	17.83	14	22	20.48
≥40	14,863	3.88	9	14	60.55
Ethnicity					
Māori	88,975	23.2	26	40	29.22
Pacific peoples	40,543	10.57	15	23	37.00
Indian	13,226	3.45	3	5	22.68
Other Asian	27,103	7.07	3	5	11.07
Other (including unknown)	34,538	9.01	3	5	8.69
NZ European	179,142	46.71	15	23	8.37
Deprivation quintile (NZDep2006)					
1 (least deprived)	61,595	16.06	8	12	12.99
2	67,688	17.65	5	8	7.39
3	71,704	18.70	9	14	12.55
4	79,783	20.80	19	29	23.81
5 (most deprived)	100,370	26.17	24	37	23.91
Unknown	2,387	0.62			

1 Denominator data from Births, Deaths and Marriages birth registrations.

Figure 43: Maternal mortality ratio (per 100,000 maternities) by prioritised ethnicity 2006–2011

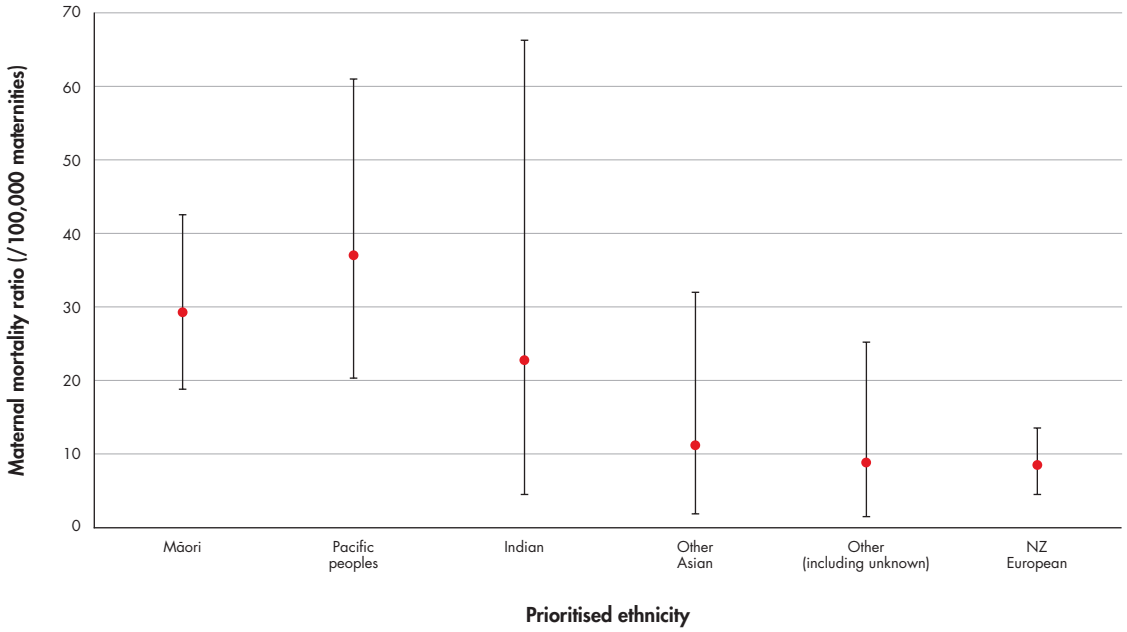
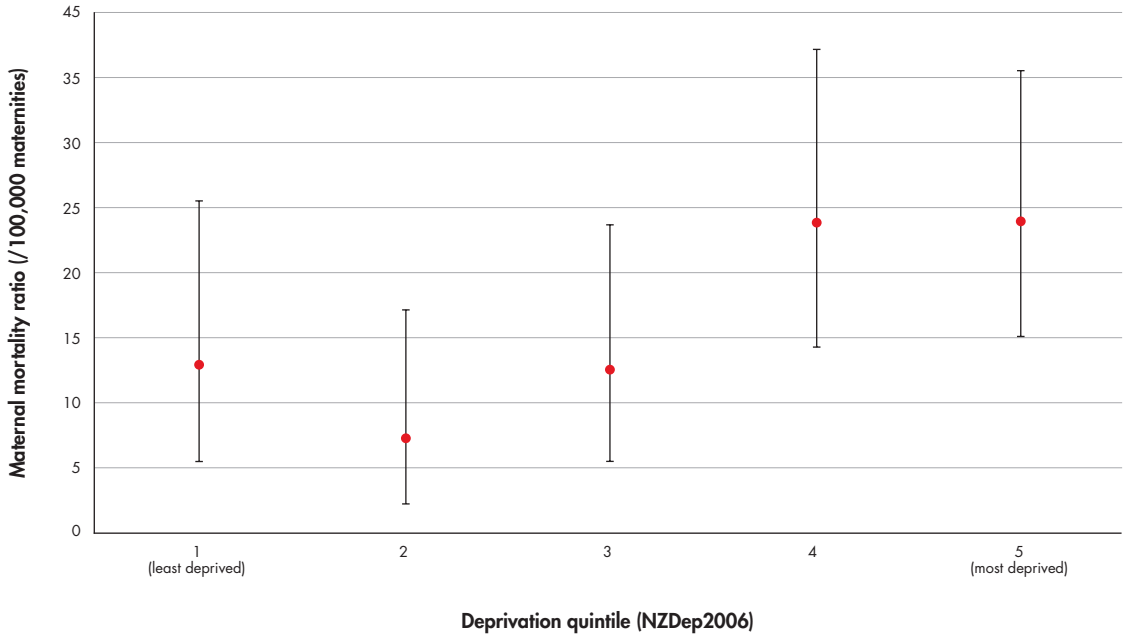


Figure 43 shows that Māori and Pacific women had a higher maternal mortality ratio when compared to New Zealand European women. The distribution of cause of death did not differ significantly by ethnicity.

Figure 44: Maternal mortality ratio (per 100,000 maternities) by deprivation quintile (NZDep2006) 2006–2011



There is a statistically significant trend of increasing maternal mortality ratio with increasing deprivation (chi-squared test for trend p=0.008). Again, this graph mirrors very closely (although the ratios are slightly higher) that for the UK data presented in Saving mothers' lives: 2006–08 (CMACE 2011b).

Table 51: Clinical characteristics among maternal deaths 2006–2011

	Maternal deaths	
	n=65	
	n	%
Parity[1]		
0	16	25
1–3	30	46
4+	19	29
BMI		
<18.5	3	5
18.5–24.99	22	34
25–29.99	14	22
30–34.99	10	15
≥35	14	22
Unknown	2	3
Smoking history		
Yes	20	31
No	42	65
Unknown	3	5
Family violence history		
Yes	9	14
No	32	49
Not asked	10	15
Unknown	14	22

1 Defined prior to conception of the index pregnancy.

Over the years 2006–2011, 16 (25 percent) of mothers who died were having their first baby, while 19 (29 percent) had had more than four prior births.

Thirty-eight (58 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.

Twenty mothers (31 percent) 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.

Family violence was known to be present in nine cases (14 percent). The high prevalence of family violence in the lives of women who died in or soon after pregnancy was discussed in some detail in the sixth report of the PMMRC (PMMRC 2012). Evidence of family violence among deaths from any cause from 2006 to 2008 was reported in 12 percent of cases in the UK in Saving mothers' lives: 2006–08 (CMACE 2011b).

Table 52: Details of place and timing of maternal mortalities 2006–2011

	Maternal deaths	
	n=65	
	n	%
Place of baby's birth		
Community (not in a health care facility)	3	5
Hospital	42	65
Baby not born at time of mother's death	20	31
Place of maternal death		
Hospital	42	65
Community	23	35
Time of death related to pregnancy		
Antepartum	24	37
Postpartum	41	63
	Antepartum maternal deaths	
	n=24	
	n	%
Gestation at antepartum maternal death		
<20 weeks	9	38
20–27 weeks	8	33
28–36 weeks	3	13
37–42 weeks	4	17
	Postpartum maternal deaths	
	n=41	
	n	%
Gestation at birth among postpartum maternal deaths		
<20 weeks	6	15
20–27 weeks	4	10
28–36 weeks	12	29
37–42 weeks	19	46
Postnatal day at postpartum maternal death		
≤1 day	13	32
2–7 days	4	10
8–14 days	8	20
15–28 days	8	20
29–42 days	7	17
Unknown	1	2

Two-thirds of maternal deaths occurred in hospital compared to a third in the community. 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 after birth near term.

Although postpartum deaths most often occurred on the first day, significant numbers were spread out to six weeks postpartum.

Contributory factors and potentially avoidable maternal deaths

This section reports the findings of independent review of potential avoidability of all maternal deaths in 2006–2011 using the recently published tool designed for this purpose (Farquhar et al 2011).

Table 53: Contributory factors and potentially avoidable maternal death 2006–2011

	Maternal deaths	
	n=65	
	n	%
Was death potentially avoidable?		
Yes	23	35
No	39	60
Unknown	3	5
Contributory factors present	**36**	**55**
Organisational/Management	**21**	**32**
Poor organisational arrangements of staff	4	
Inadequate education and training	6	
Lack of policies, protocols or guidelines	14	
Inadequate numbers of staff	1	
Poor access to senior clinical staff	2	
Failure or delay in emergency response	4	
Delay in procedure, for example, caesarean section	4	
Inadequate systems/process for sharing of clinical information between services	7	
Delayed access to test results or inaccurate results	1	
Lack of maintenance of equipment	1	
Personnel	**21**	**32**
Knowledge and skills of staff were lacking (includes failure to maintain competence)	9	
Delayed emergency response by staff	6	
Failure of communication between staff	8	
Failure to seek help/supervision	5	
Failure to offer or follow recommended best practice	4	
Lack of recognition of complexity or seriousness of condition	11	
Other	10	

Table 53: Contributory factors and potentially avoidable maternal death 2006–2011 *(continued)*

	Maternal deaths	
	n=65	
	n	%
Barriers to access/engagement with care	**26**	**40**
No or infrequent antenatal care or late booking	11	
Declined treatment or advise	2	
Substance abuse	4	
Family violence	4	
Lack of recognition of complexity or seriousness of condition	10	
Maternal mental illness	5	
Language barriers	2	
Cultural barriers	1	
Not eligible to access free care	1	
Geography, for example, long transfer	3	

The working group identified 35 percent of maternal deaths as potentially avoidable in the six years 2006–2011. Contributory factors were identified in 55 percent of maternal deaths in the years 2006–2011.

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 in New Zealand.

While the terms used in each of these reports differ, the results demonstrate consistency and build confidence in the processes used by the MMRWG. Although the absolute numbers are small, pre-existing medical conditions, suicide and amniotic fluid embolism continue to be the leading causes of maternal mortality in New Zealand. In 2011, there were four deaths from pre-existing medical conditions and one from suicide (five out of the eight maternal deaths). Detailed discussion about these causes of death was provided in the sixth annual report (PMMRC 2012).

The most common contributory factor subcategory identified in the years 2006–2011 was lack of policies, protocols or guidelines, identified in 14 cases. In particular, a lack of guidelines and protocols for (1) massive blood transfusion, (2) screening and management of women with maternal mental health and (3) management of hypertension in pregnancy, were identified, although the number of deaths related to each of these causes was small.

Recommendations from 2011 review

In maternal deaths, where a coroner declines jurisdiction, post-mortem should be offered as part of full investigation of cause of death.

Women with pre-existing medical conditions (such as epilepsy, hypertension or mental health) should have individualised pre-conceptual counselling about their condition and the medication they are taking. Health professionals providing care to these women need to communicate the importance of continuing their medication in pregnancy, if appropriate, and to advise women to seek early medical review.

Review of previous recommendations on maternal mortality

- **Maternal mental health** has been the subject of recommendations, including recommendations for antenatal screening, particularly in association with termination of pregnancy. The importance of antenatal screening for a history of maternal mental health disorders was also highlighted in the Healthy Beginnings report (Ministry of Health 2012b).

  Good practice point:

  Women who are pregnant should be screened for mental health and appropriately referred for specialist support when identified. This includes women who have termination of pregnancy. Clear pathways are required when referring to mental health services, and should involve case management, transition planning and liaison with all necessary services.

- The MMRWG supports the **management of hypertension guidelines**, developed by the Society of Obstetric Medicine of Australia and New Zealand, which can be found at *http://www.somanz.org/pdfs/somanz_guidelines_2008.pdf.*

  Good practice point:

  Health practitioners caring for women who have been diagnosed with either pre-eclampsia or gestational hypertension should note they are at increased risk of cardiovascular mortality and morbidity including hypertension and coronary heart disease in pregnancy and postnatally.

- **Massive transfusion protocols** are available in some New Zealand DHBs. A national guideline is due to be distributed in 2013.

3 Neonatal Encephalopathy 2010–2011

Neonatal encephalopathy cohort 2010–2011

Case definition: "Neonatal encephalopathy (NE): a clinically defined syndrome of disturbed neurological function within the first week of life in the term (≥37 weeks) infant, manifested by difficulty in initiating and maintaining respiration, depression of tone and reflexes, subnormal level of consciousness and often seizures." This dataset includes Sarnat stages moderate and severe only.

Although hypoxia-ischemia is the predominant pathology, reported cases of term infants with NE are included in this dataset whatever the cause. Therefore, the full cohort includes a small number of cases where hypoglycaemia may have led to NE, where there is a congenital abnormality of the central nervous system causing NE or where infection is associated with an NE-like illness.

Methodology

Cases were identified with the assistance of the New Zealand Paediatric Surveillance Unit (NZPSU) and the collection of data facilitated by paediatricians, LMCs and the national coordination service of the PMMRC, as described in detail in the fifth report of the PMMRC (PMMRC 2011).

Denominator data, as used elsewhere is this report, are the birth registration dataset of New Zealand collated by Births, Deaths and Marriages (BDM). For calculation of rates, the denominator set was restricted to births at term (as is the numerator).

For further information on data analysis, please refer to section 1.2.

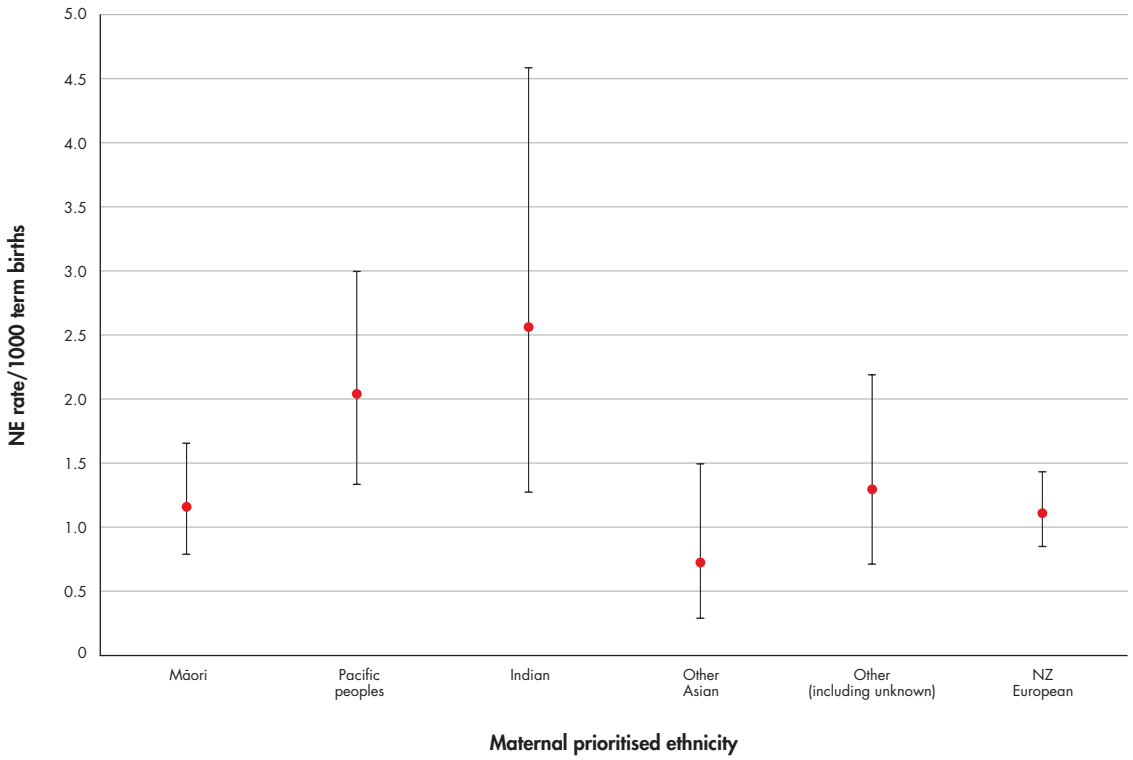
Preliminary findings

In 2010–2011, 149 cases were reported using the surveillance system described. The rate of NE as a proportion of all registered births is 1.17/1000 (95% CI 0.99–1.37) registered births (149/127,728). The rate can also be reported as 1.27/1000 births at term (≥37 weeks) (95% CI 1.07–1.49) as the definition is limited to term births. There are no directly comparable international data, as noted in the fifth report of the PMMRC (PMMRC 2011)

Table 54: Prioritised maternal ethnicity of neonatal encephalopathy babies 2010–2011

Ethnicity (Source BDM birth BDM death NE form)	NZ registered births ≥37 weeks		NE cases		Rate (/1000 births) Term only	
	n=117,499		n=149			
	n	%	n	%	/1000	95% CI
Māori	26,534	22.6	31	20.8	1.17	0.79–1.66
Pacific peoples	12,689	10.8	26	17.4	2.05	1.34–3.00
Indian	4,296	3.7	11	7.4	2.56	1.28–4.58
Other Asian	9,637	8.2	7	4.7	0.73	0.29–1.50
Other/Not stated	10,747	9.1	14	9.4	1.30	0.71–2.19
NZ European	53,596	45.6	60	40.3	1.12	0.85–1.44

Figure 45: Neonatal encephalopathy rates (per 1000 term births) by prioritised maternal ethnicity 2010–2011



There is a non-significant increase in the rate of neonatal encephalopathy among babies of Pacific and Indian mothers. Further analysis will be performed including 2012 data, and if this difference is statistically significant, further work will be undertaken to explore the reasons for this.

An increase in neonatal encephalopathy among Indian and Pacific mothers is consistent with the pattern of association seen between prioritised ethnicity and term stillbirth (Figure 46).

Figure 46: Stillbirth rates (per 1000 term births) by prioritised maternal ethnicity compared to New Zealand rates (with 95% CIs) 2007–2011

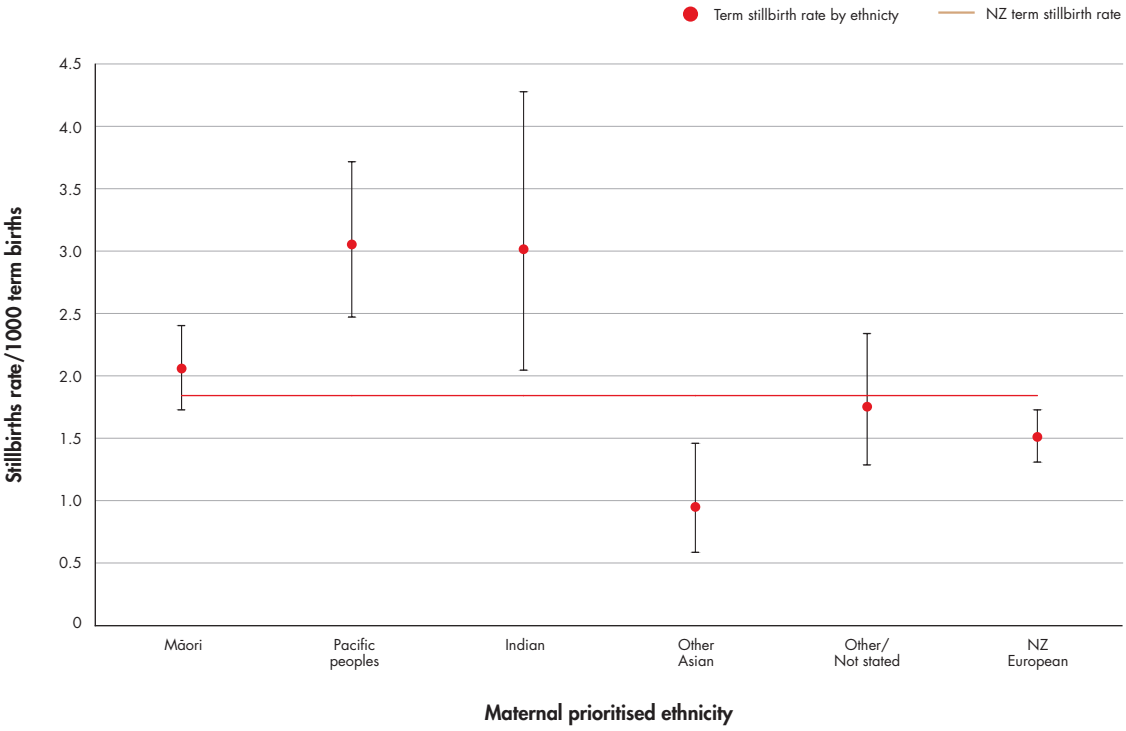
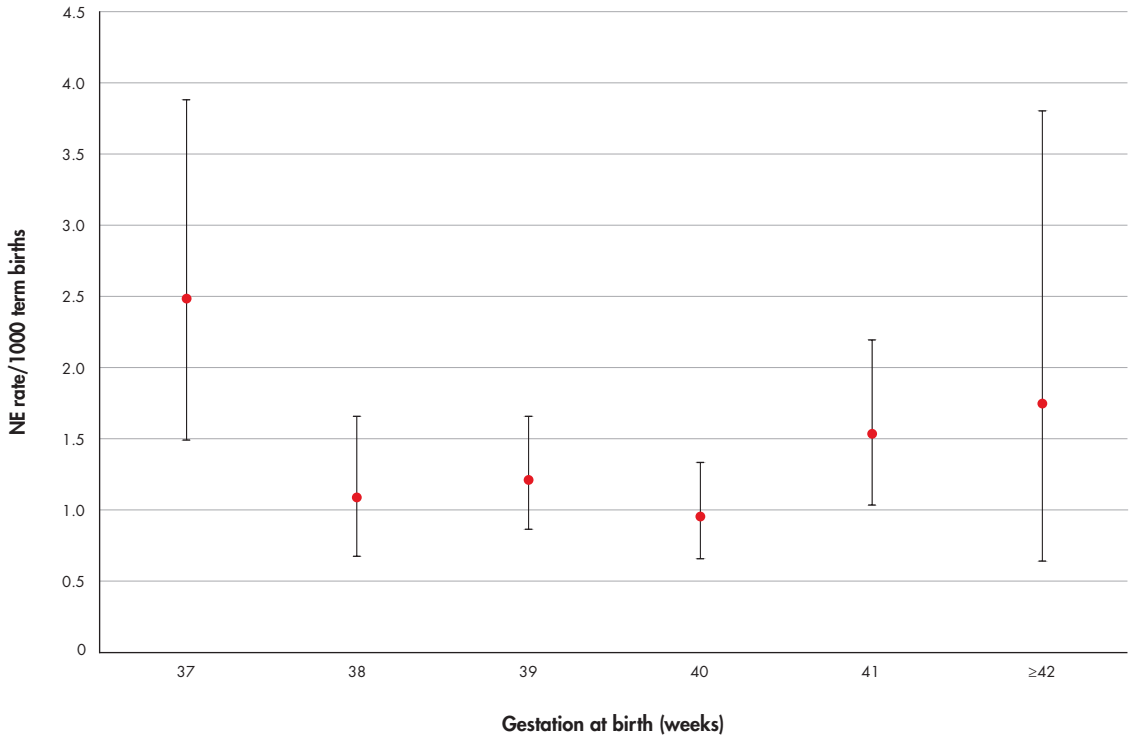


Table 55: Neonatal encephalopathy rate (per 1000 term births) by gestation, gender, birthweight and plurality 2010–2011

	NZ registered births ≥37 weeks		NE cases		Rate (/1000 term births)	
	n=117,499		n=149			
	n	%	n	%	/1000	95% CI
Gestation at birth (weeks)						
37	7,656	6.5	19	12.8	2.48	1.49–3.88
38	19,304	16.4	21	14.1	1.09	0.67–1.66
39	32,021	27.3	39	26.2	1.22	0.87–1.66
40	35,589	30.3	34	22.8	0.96	0.66–1.34
41	19,492	16.6	30	20.1	1.54	1.04–2.20
≥42	3,437	2.9	6	4.0	1.75	0.64–3.80
Gender						
Male	60,105	51.2	85	57.0	1.41	1.13–1.75
Female	57,394	48.8	64	43.0	1.12	0.86–1.42
Birth weight (g)						
<2500	2,213	1.9	7	4.7	3.16	1.27–6.52
2500–3999	96,177	81.9	120	80.5	1.25	1.02–1.47
4000–4499	15,806	13.5	16	10.7	1.01	0.58–1.64
≥4500	3,258	2.8	6	4.0	1.84	0.68–4.01
Plurality						
Singleton	115,881	98.6	146	98.0	1.26	1.06–1.46
Twins	1,618	1.4	3	2.0	1.85	0.38–5.42

Figure 47: Neonatal encephalopathy rates (per 1000 births) by gestation at birth 2010–2011



There is a significantly higher rate of neonatal encephalopathy at 37 weeks compared to 40 weeks. As 37 weeks is at the borderline between term and preterm, it is possible that these babies are different from babies born later, with the reason for their 'early birth' predisposing to neonatal encephalopathy. Having said this, the babies diagnosed with neonatal encephalopathy at 37 weeks did not have a higher rate of SGA than babies at later gestations.

It is reassuring that there is no apparent increase in risk at 42 weeks. This is consistent with the absence of an increase in risk of stillbirth at 42 weeks and may reflect an active policy to intervene in prolonged pregnancies in New Zealand.

There is no significant association between a baby's gender or multiple pregnancy and the risk of neonatal encephalopathy. However, the majority of multiple pregnancies birth before term, and this competing risk makes neonatal encephalopathy less likely.

There is a non-significantly higher risk of neonatal encephalopathy among babies under 2500g. This may be due to early gestation or to growth restriction (which is discussed further below). An excess of risk in babies >4500g is possible, but numbers are too small to know whether this difference is significant.

Table 56: Small for gestational age (by customised birthweight centiles) among neonatal encephalopathy babies by survivorship 2010–2011

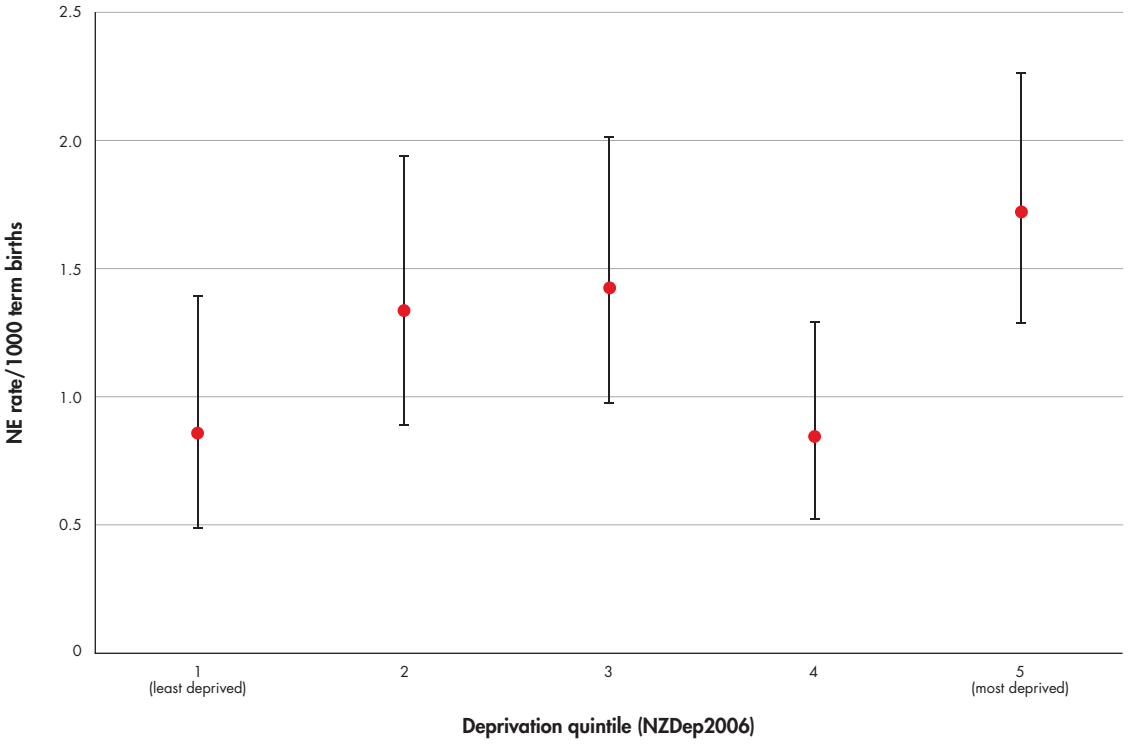
	NE cases		Deceased		Survivors	
	n=149		n=36		n=113	
	n	%	n	%	n	%
Small for gestational age	27	18.1	10	27.8	17	15.0
Appropriate for gestational age	107	71.8	22	61.1	85	75.2
Large for gestational age	15	10.1	4	11.1	11	9.7

Eighteen percent of all neonatal encephalopathy cases were small for gestational age by customised birthweight centiles. Twenty-eight percent of babies who died were small for gestational age compared to 15 percent of survivors. While this difference was not statistically significant (p=0.2), it would suggest that small, possibly growth-restricted, babies are at higher risk of dying from neonatal encephalopathy. This would be consistent with the apparent vulnerability of SGA babies to stillbirth and neonatal death.

Table 57: Neonatal encephalopathy rates per 1000 term births by maternal age and deprivation quintile (NZDep2006) 2010–2011

	NZ registered births ≥37 weeks		NE cases		Rate (/1000 term births)	
	n=117,499		n=149			
	n	%	n	%	/1000	95% CI
Maternal age (years)						
<20	7,953	6.8	9	6.0	1.13	0.52–2.15
20–34	84,321	71.8	109	73.2	1.29	1.05–1.54
35–39	20,518	17.5	25	16.8	1.22	0.79–1.80
≥40	4,707	4.0	6	4.0	1.27	0.47–2.77
Deprivation quintile						
1 (least deprived)	18,655	15.9	16	10.7	0.86	0.49–1.39
2	20,897	17.8	28	18.8	1.34	0.89–1.94
3	22,422	19.1	32	21.5	1.43	0.98–2.01
4	24,812	21.1	21	14.1	0.85	0.52–1.29
5 (most deprived)	30,163	25.7	52	34.9	1.72	1.29–2.26
Unknown	550	0.5	-	-	-	-

Figure 48: Neonatal encephalopathy rates (per 1000 term births) by deprivation quintile (NZDep2006) 2010–2011



There is no significant association seen between maternal age or deprivation quintile and neonatal encephalopathy.

Table 58: Neonatal encephalopathy rates per1000 term births by DHB of maternal residence 2010–2011

DHB of residence	NZ registered births ≥37 weeks		NE cases		Rate (/1000 term births)	
	n=117,499		n=149			
	n	%	n	%	/1000	95% CI
Northland	4,401	3.7	4	2.7	0.91	0.25–2.33
Waitemata	14,835	12.6	16	10.7	1.08	0.62–1.75
Auckland	12,343	10.5	12	8.1	0.97	0.50–1.70
Counties Manukau	16,135	13.7	25	16.8	1.55	1.00–2.29
Waikato	10,244	8.7	23	15.4	2.25	1.42–3.37
Bay of Plenty	5,512	4.7	7	4.7	1.27	0.51–2.62
Lakes	2,959	2.5	6	4.0	2.03	0.74–4.41
Tairawhiti	1,442	1.2	3	2.0	2.08	0.43–6.08
Taranaki	2,953	2.5	2	1.3	-	-
Hawke's Bay	4,235	3.6	3	2.0	0.71	0.15–2.07
Whanganui	1,611	1.4	1	0.7	-	-
MidCentral	4,412	3.8	3	2.0	0.68	0.14–1.99
Wairarapa	1,019	0.9	1	0.7	-	-
Capital and Coast	7,251	6.2	10	6.7	1.38	0.66–2.54
Hutt Valley	3,878	3.3	8	5.4	2.06	0.89–4.06
Nelson Marlborough	3,141	2.7	1	0.7	-	-
West Coast	798	0.7	1	0.7	-	-
Canterbury	11,822	10.1	17	11.4	1.44	0.84–2.30
South Canterbury	1,135	1.0	3	2.0	2.64	0.55–7.72
Otago	3,836	3.3	3	2.0	0.78	0.16–2.29
Southland	3,038	2.6	-	-	-	-
Unknown	499	0.4	-	-	-	-

* No rate estimates are given for DHBs where number of cases reported was fewer than three.

DHB of maternal residence has been used to explore differences in place of birth. This is consistent with PMMRC analyses and is used to eliminate the impact of tertiary units that more often care for high-risk cases.

Figure 49 shows the crude rates of neonatal encephalopathy per 1000 term births by DHB of residence for 2010–2011. The two-year data are presented together to increase the robustness of the estimates. These are crude rates and have not been standardised for sociodemographic differences between regions (which are illustrated in section 1.4).

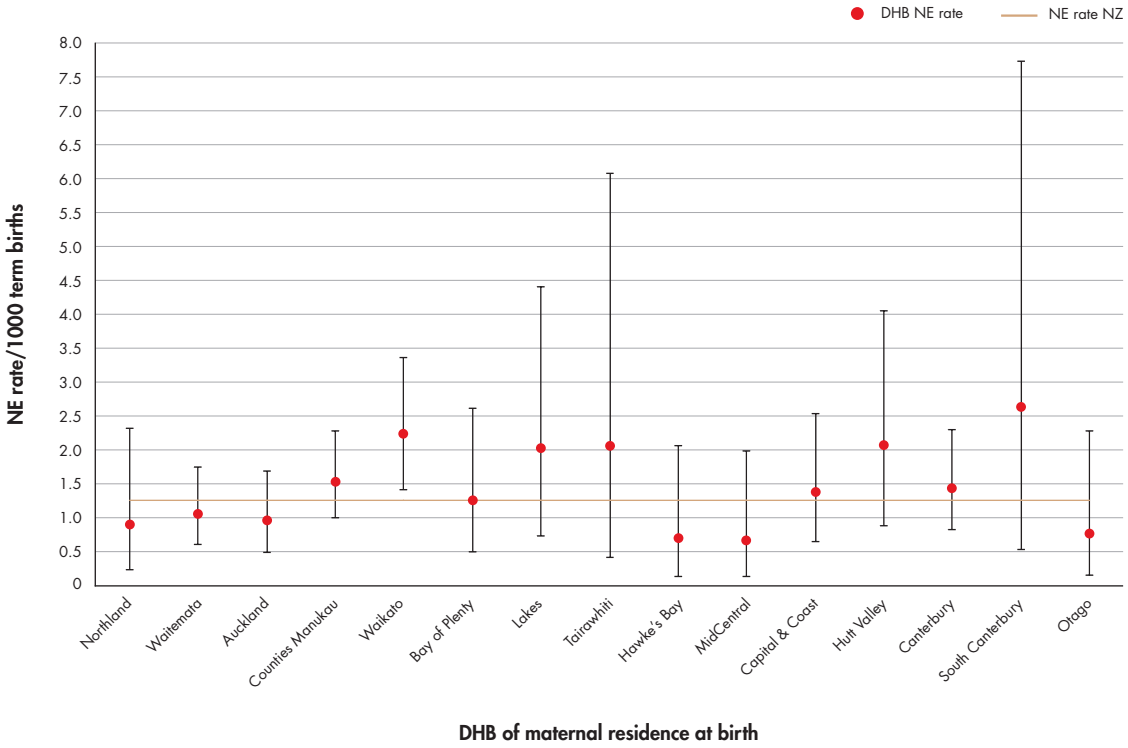
The CIs, represented by the error bars above and below the point estimate for each area, span the range of values that are consistent with the point estimate given the size of the population in the area. If these ranges do not include the national rate, represented by the horizontal line, the rate in that area was statistically significantly different from the national rate. Rates were not assigned to areas where fewer than three cases were reported.

There is a significantly higher rate of term neonatal encephalopathy for babies born in the Waikato DHB area. This is the only statistically significant difference, although Lakes, Tairawhiti, Hutt Valley and South Canterbury have similarly high estimates. It is possible that this outlier is a chance finding or that it is the result of greater ascertainment in the Waikato region. Further years of data are required to confirm this finding and to determine whether other DHBs also have rates significantly above the national rate.

Recommendations from 2011 review

The Neonatal Encephalopathy Working Group recommends local review of the apparent higher neonatal encephalopathy rate in Waikato DHB.

Figure 49: Neonatal encephalopathy rates[1] (per 1000 term births) by DHB of maternal residence (with 95% CIs) compared to New Zealand neonatal encephalopathy rate 2010–2011



1 No estimates are given for DHBs where number of cases reported was fewer than three.

Table 59: Neonatal encephalopathy by maternal smoking, parity, body mass index (BMI) and gestation at first antenatal visit compared to New Zealand term births 2010–2011

	NE cases		MAT data[1]	
	n=149		n=100,795	
	n	%	n	%
Smoker	33	22.1	13,882	13.8
Unknown smoking status	3	2.0	3,936	3.9
Parity				
Nulliparous	81	54.4	41,138	40.8
Primiparous	42	28.2	34,048	33.8
Multiparous (≥2)	26	17.4	25,608	25.4
Maternal BMI				
<18.50 (<19 for MAT data)	2	1.3	2,789	2.8
18.50–24.99	46	30.9	46,650	46.3
25.00–29.99	51	34.2	28,673	28.4
≥30.00	32	21.5	22,595	22.4
Missing data for height and or weight	18	12.1	1	0.0
Gestation first antenatal visit				
≤13 weeks	83	55.7	71,169	70.6
14–19 weeks	17	11.4	17,364	17.2
≥20 weeks	22	14.8	12,262	12.2
Unknown	27	18.1	-	-

1 Excludes births where no stated LMC at birth as these births do not have smoking, BMI or gestation at first antenatal visit in the MAT dataset.

The demographic characteristics of mothers in the neonatal encephalopathy dataset have been compared to characteristics of mothers included in the New Zealand maternity dataset (MAT), which includes births among mothers with self-employed LMCs but excludes mothers whose antenatal care at birth was provided by hospital LMC services. Because hospital LMC births are excluded from the MAT dataset at this point, comparisons should be interpreted with caution.

The smoking rate at birth among mothers of babies with neonatal encephalopathy was higher (22 percent) compared to mothers at two weeks postpartum in the MAT dataset (14 percent). Neonatal encephalopathy at term was more common among nulliparous mothers and among overweight mothers than mothers with normal BMI. Neonatal encephalopathy was not significantly associated with first antenatal visit in first trimester. This analysis was limited by missing data.

Table 60: LMC at registration and birth among neonatal encephalopathy cases 2010-2011

LMC at booking	NE cases n=149		LMC at birth											
			Not registered		GP		Self-employed midwife		Private obstetrician		Hospital-employed midwife		Hospital clinic/ obstetrician	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Not registered	2	1.3	1	50.0	-	-	-	-	-	-	-	-	1	50.0
GP	4	2.7	-	-	1	25.0	-	-	-	-	1	25.0	2	50.0
Self-employed midwife	116	77.9	-	-	-	-	85	73.3	-	-	1	0.9	30	25.9
Private obstetrician	3	2.0	-	-	-	-	-	-	3	100.0	-	-	-	-
Hospital-employed midwife	13	8.7	-	-	-	-	1	7.7	-	-	7	53.8	5	38.5
Hospital clinic/ obstetrician	10	6.7	-	-	-	-	-	-	-	-	-	-	10	100.0
Unknown	1	0.7	-	-	-	-	1	100.0	-	-	-	-	-	-
Total	**149**		**1**	**0.7**	**1**	**0.7**	**87**	**58.4**	**3**	**2.0**	**9**	**6.0**	**48**	**32.2**

In the New Zealand maternity dataset (MAT), 80.3 percent of mothers of babies birthing at term were registered with a self-employed midwife LMC, 12.6 percent with a hospital LMC or unregistered, 5.6 percent with a private obstetrician LMC and 1.5 percent with a GP LMC. At birth, in the MAT dataset of all births at term in New Zealand in 2010–2011, 79.2 percent were registered with a self-employed midwife LMC, 13.9 percent with a hospital LMC or unregistered, 5.5 percent with a private obstetrician LMC and 1.3 percent with a GP LMC.

The distribution of LMCs at registration is essentially the same for the neonatal encephalopathy dataset as it is for all births; however, in the neonatal encephalopathy dataset, there have been transfers of LMC care during pregnancy so that, at birth, the LMC is more often a hospital LMC. These transfers are likely to have occurred due to perceived increase in risk.

Family violence screening

Family violence screening data were unavailable in 37 percent of cases of neonatal encephalopathy in 2010–2011.

Table 61: Antenatal complications and maternal outcome among neonatal encephalopathy cases 2010–2011

	NE cases n=149	
	n	%
Antenatal complications		
Antepartum haemorrhage (≥20 weeks vaginal bleeding)	19	12.8
Hypertension (gestational or not otherwise specified)	18	12.1
Pre-eclampsia	1	0.7
Gestational hypertension	6	4.0
Trauma	3	2.0
Induction of labour	35	23.5
Maternal outcome		
Deceased	1	0.7
Alive but with serious morbidity	4	2.7
Alive and well	144	96.6

While there are few national data on complications of pregnancy, the proportion of cases where there was antepartum haemorrhage, hypertension in pregnancy or induction of labour does not appear especially high. There were three cases where trauma was reported – one vehicular and two of physical violence.

In five cases, there was an acute severe maternal complication such as massive postpartum haemorrhage, cardiac arrest or rupture of an aneurysm.

Table 62: Actual and intended place of birth among neonatal encephalopathy babies 2010–2011

Intended place of birth	NE cases n=149		Actual place of birth: Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3	
	n	%	n	%	n	%	n	%	n	%	n	%
Home	8	5.4	4	50.0	-	-	-	-	3	37.5	1	12.5
Birthing unit	15	10.1	-	-	6	40.0	-	-	2	13.3	7	46.7
Hospital level 1	9	6.0	-	-	-	-	4	44.4	1	11.1	4	44.4
Hospital level 2	51	34.2	-	-	-	-	-	-	49	96.1	2	3.9
Hospital level 3	64	43.0	1	1.6	-	-	1	1.6	1	1.6	61	95.3
Unknown	2	1.3	-	-	-	-	-	-	-	-	2	100.0
Total	**149**		**5**	**3.4**	**6**	**4.0**	**5**	**3.4**	**56**	**37.6**	**77**	**51.7**

In 25 cases (17 percent), the birth occurred at a place other than that initially intended. There may be various reasons for this. In 11 cases, transfer occurred in labour; six from home or a birthing unit to a level 2 or 3 hospital. Four of the women whose babies had NE birthed at home and planned to do so; the other was registered to deliver at hospital but went into rapid labour.

Table 63: Peripartum complications among neonatal encephalopathy babies 2010-2011

	NE cases	
	n=149	
	n	%
Acute peripartum events	**37**	**24.8**
Cord prolapse	5	3.4
Abruption	14	9.4
Uterine rupture	3	2.0
Shoulder dystocia	11	7.4
Maternal cardiac arrest/Maternal collapse	2	1.3
Vasa praevia	1	0.7
Head entrapment in breech	1	0.7
Liquor		
Blood stained	15	10.1
Meconium (thick 32, thin 21)	53	35.6

Acute serious events peripartum were reported in 36 cases (24 percent) of neonatal encephalopathy. This included any of cord prolapsed, abruption, uterine rupture, shoulder dystocia, maternal arrest or collapse, vasa praevia and head entrapment at breech birth. In seven of these cases, a prelabour caesarean was performed.

Of these 36 babies with an acute peripartum complication, 34 had either abnormal cord gases or an Apgar score <7 at five minutes.

Table 64: Mode of birth and indications for operative birth among neonatal encephalopathy babies 2010–2011

	NE cases	
	n=149	
	n	%
Normal vaginal birth	**63**	**42.3**
Operative vaginal birth	**22**	**14.8**
Forceps	7	4.7
Ventouse	14	9.4
Unknown	1	0.7
Vaginal breech birth	**3**	**2.0**
Caesarean section birth	**61**	**40.9**
Elective (no indication given)	**2**	**1.3**
Prelabour emergency	**19**	**12.8**
Antepartum haemorrhage/Abruption	3	2.0
Suspected fetal distress	12	8.1
Other	3	2.0
Unknown	1	0.7
In labour emergency	**40**	**26.8**
Antepartum haemorrhage/Abruption	3	2.0
Suspected fetal distress	25	16.8
Failure to progress/Cephalopelvic disproportion	4	2.7
Malpresentation	1	0.7
Other	6	4.0
Unknown	1	0.7
Attempt at operative vaginal birth before caesarean	**4**	**2.7**

Babies with neonatal encephalopathy were more likely to have had an operative birth than might be expected in the population as a whole. This compares to a national caesarean section rate of 23.6 percent in 2010 (Ministry of Health 2012c). This is not surprising given that, in 24 percent of cases, there was an acute peripartum event associated with the birth, and that a large proportion of babies had abnormal gases or Apgars or both (see Table 65).

Table 65: Immediate newborn wellbeing among neonatal encephalopathy babies 2010–2011

	NE cases	
	n=149	
	n	%
Apgar scores		
Apgar score <5 at 1 minute	119	79.9
Apgar score <7 at 1 minute	134	89.9
Apgar score <7 at 5 minutes	115	77.2
Apgar score <7 at 10 minutes	77	51.7
Apgar score <9 at 10 minutes	104	69.8
Gases: summary data		
Normal (none of pH ≤7.2, BE ≤-10, lactate ≥6)	12	8.1
Abnormal (any of pH ≤7.2, BE ≤-10, lactate ≥6)	102	68.5
No gases reported	35	23.5
No gases and Apgar <7 at 1 minute	22	14.8
No gases and Apgar ≥7 at 1 minute	13	8.7

Cord gas data were summarised as follows: abnormal gas was defined if either arterial or venous gas results reported a pH ≤7.2, a base excess lower than -10 or a lactate of 6 or more. Normal was defined if none of these criteria was met.

Eighty percent of neonatal encephalopathy cases had an Apgar score of 0–4 at one minute, and 77 percent had an Apgar score under 7 at five minutes. Cord gas data were unavailable (presumed not taken) in 24 percent of cases but abnormal in 68 percent of cases. Among cases without gases, almost two-thirds had Apgar scores under 7 at one minute.

These data suggest that the majority of babies diagnosed with neonatal encephalopathy are asphyxiated at birth. In some cases, this was associated with an acute peripartum event, but in other cases, there is concern with regard to potential failure to recognise and or respond to increased risk in labour.

To establish whether neonatal encephalopathy was potentially avoidable and what factors could be highlighted to prevent this outcome, the Neonatal Encephalopathy Working Group plans to undertake multidisciplinary review of those cases in 2010–2011 with abnormal gases and/or Apgar scores where there was no identifiable peripartum acute event or prelabour caesarean.

Neonatal data

Table 66: Induced cooling among neonatal encephalopathy babies 2010–2011

	NE cases		NE cases 2010		NE cases 2011	
	n=149		n=82		n=67	
	n	%	n	%	n	%
Cooling						
Yes	107	71.8	56	68.3	51	76.1
No	42	28.2	26	31.7	16	23.9
Type of cooling	n=107		n=56		n=51	
Total body	105	98.1	54	96.4	51	100.0
Selected head	2	1.9	2	3.6	-	-
Age at cooling						
≤6 hours	81	75.7	44	78.6	37	72.5
>6 hours	18	16.8	10	17.9	8	15.7
Missing or invalid date or time data	8	7.5	2	3.6	6	11.8

Seventy-two percent of babies had induced cooling. Although there was a small increase from 2010 to 2011, this was not statistically significant. Of the babies in this dataset, 86 percent had abnormal gases (as previously described) or a five-minute Apgar score less than 7. Of the babies who did receive cooling, 94 percent had abnormal gases or an Apgar score <7 at five minutes. Of the babies not cooled, 28 (67 percent) had abnormal gases or an Apgar score <7 at five minutes. Although there is no international benchmark data to determine the optimal rate of neonatal cooling, the presented data suggest that there may be a small number of babies currently not receiving cooling who might benefit from this therapy.

Seventy-six percent of babies had their cooling commenced within the six-hour window recommended for maximum benefit. This is an area where there is some opportunity for improvement in care.

While in some instances there may be valid reasons for delay or a decision not to apply induced cooling, it may be possible to improve recognition and early intervention, even if this is passive cooling prior to transport to a level 3 centre where active cooling can be induced.

Table 67: Neonatal resuscitation and induced cooling therapy among neonatal encephalopathy babies 2010–2011

	NE cases		Induced cooling			
			Yes		No	
	n=149		n=107		n=42	
	n	%	n	%	n	%
Resuscitation at birth						
Yes	135	90.6	104	77.0	31	23.0
No	14	9.4	3	21.4	11	78.6
Type of resuscitation at birth						
Oxygen only	2	1.5	2	100.0	-	-
IPPV with mask	80	59.3	58	72.5	22	27.5
IPPV with ETT	90	66.7	73	81.1	17	18.9
Cardiac massage	72	53.3	56	77.8	16	22.2
Adrenalin	34	25.2	23	67.6	11	32.4

Ninety-one percent of babies required resuscitation at birth, and in half of cases, cardiac massage was required.

Table 68: Contributory factors to unsatisfactory neonatal resuscitation among neonatal encephalopathy babies 2010–2011

	NE cases	
	n=149	
	n	%
Were there any features that caused or contributed to an unsatisfactory neonatal resuscitation?		
Yes	23	15.4
Unsure	16	10.7
No	98	65.8
Missing	12	8.1
If yes, were they:		
Organisational/Management	10	6.7
Personnel or training	13	8.7
Technology or equipment	2	1.3
Environment	3	2.0
Barriers to access or engagement with care	5	3.4

The question "Were there any features that caused or contributed to an unsatisfactory neonatal resuscitation?" was answered by the neonatologist completing the form, who was generally not also the person responsible for neonatal resuscitation.

It was determined that, in 16 percent of cases, resuscitation was unsatisfactory, and the most common reasons noted for this were organisational/management and personnel or training factors.

Recommendation

Strategies to reduce neonatal encephalopathy include continually improving the standard of neonatal resuscitation by all health practitioners involved in providing peripartum care.

Table 69: Early neonatal management among neonatal encephalopathy cases by induced cooling therapy status 2010–2011

	NE cases		Induced cooling			
			Yes		No	
	n=149		n=107		n=42	
	n	%	n	%	n	%
Respiratory and ventilation management						
Mechanical ventilation	113	75.8	93	62.4	20	13.4
Nitric oxide	29	19.5	23	15.4	6	4.0
Infection						
Positive blood culture	4	2.7	2	50.0	2	50.0
Antibiotics	127	85.2	101	79.5	26	20.5
Anticonvulsant therapy	102	68.5	77	75.5	25	24.5
Phenobarbitone	95	63.8	70	73.7	25	26.3
Phenytoin	26	17.4	18	69.2	8	30.8
Benzodiazepines	33	22.1	24	72.7	9	27.3
Other	4	2.7	2	50.0	2	50.0

Mechanical ventilation was required in 76 percent of babies and nitric oxide in 20 percent. Only four babies had positive blood cultures (all Group B *Streptococcus* infections), although 86 percent were prescribed prophylactic antibiotics. Anticonvulsants were also commonly used. None of these treatments varied by whether babies were cooled or not.

Table 70: Severity of encephalopathy among neonatal encephalopathy babies 2010–2011

Severity data	NE cases		Deceased		Survivors	
	n=149		n=36		n=113	
	n	%	n	%	n	%
Sarnat stage						
Moderate	96	64.4	1	1.0	95	99.0
Severe	53	35.6	35	66.0	18	34.0
Deceased	36	24.2	-	-	-	-

As shown in Table 70, one-third of the cohort had severe encephalopathy by Sarnat stage, and almost all of the babies who died (35/36) were in this group.

Table 71: Severity of encephalopathy and use of induced cooling therapy among neonatal encephalopathy babies 2010–2011

			Induced cooling			
	NE cases		Yes		No	
	n=149		n=107		n=42	
	n	%	n	%	n	%
Sarnat stage						
Moderate	96	64.4	71	74.0	25	26.0
Severe	53	35.6	36	67.9	17	32.1
Deceased						
Yes	36	24.2	19	52.8	17	47.2
No	113	75.8	88	77.9	25	22.1
Age at death (days defined as past midnight)	n=36		n=19		n=17	
0	7	19.4	-	-	7	100.0
1	10	27.8	6	60.0	4	40.0
2	4	11.1	3	75.0	1	25.0
3	4	11.1	2	50.0	2	50.0
4	2	5.6	2	100.0	-	-
5	4	11.1	4	100.0	-	-
6	2	5.6	1	50.0	1	50.0
8	1	2.8	1	100.0	-	-
10	1	2.8	-	-	1	100.0
40	1	2.8	-	-	1	100.0

Use of induced cooling did not vary by Sarnat stage. However, babies who died were less likely to be cooled than babies who survived (p=0.003). Five of the babies who died did not have abnormal gases or Apgar score <7 at five minutes, suggesting later onset encephalopathy.

Table 72: Type of birth facility and transfer prior to or in labour among neonatal encephalopathy cases by induced cooling status 2010–2011

Intended place of birth	NE cases		Induced cooling			
			Yes		No	
	n=149		n=107		n=42	
	n	%	n	%	n	%
Type of birth facility						
Home	5	3.4	1	20.0	4	80.0
Birthing unit	6	4.0	5	83.3	1	16.7
Hospital level 1	5	3.4	4	80.0	1	20.0
Hospital level 2	56	37.6	40	71.4	16	28.6
Hospital level 3	77	51.7	57	74.0	20	26.0
Transfer prior to labour	11	7.4	8	72.7	3	27.3
Transfer in labour	12	8.1	7	58.3	5	41.7

Table 73: Examination on discharge of neonatal encephalopathy survivors 2010–2011

Investigations	NE survivors	
	n=113	
	n	%
Examination on discharge		
Normal	57	50.4
Mild or moderate abnormality	31	30.1
Severe abnormality	4	3.5
Not examined	5	4.4
Examined but finding unknown	4	3.5
Missing data	9	8.0

Examination on discharge was reported in 88 percent of cases; it is not clear whether the remainder of babies were not examined or whether this is a documentation or reporting issue.

Table 74: Follow-up investigations among neonatal encephalopathy survivors, by induced cooling status 2010–2011

Investigations	NE survivors		Induced cooling			
			Yes		No	
	n=113		n=88		n=25	
	n	%	n	%	n	%
EEG (investigation done)[1]	**103**	**91.2**	**81**	**92.0**	**22**	**88.0**
EEG investigation done at ≤3 days of life[2]	65	57.5	53	60.2	12	48.0
EEG investigation done at >3 days of life[3]	38	33.6	28	31.8	10	40.0
No EEG or unknown	10	8.8	7	8.0	3	12.0
Results of EEG at >3 days of life						
Severely abnormal	4	3.5	3	3.4	1	4.0
Mildly abnormal	27	23.9	19	21.6	8	32.0
Normal	6	5.3	5	5.7	1	4.0
Missing result	1	0.9	1	1.1	-	-
MRI (investigation done)[4]	**76**	**67.3**	**59**	**67.0**	**17**	**68.0**
No MRI or Unknown	37	32.7	29	33.0	8	32.0
Results of MRI						
Moderately/Severely abnormal	27	23.9	19	21.6	8	32.0
Normal or only mildly abnormal	47	41.6	38	43.2	9	36.0
Unknown result	2	1.8	2	2.3	-	-

1 EEG = electroencephalogram.

2 Typically cot-side monitoring such as BRAINZ.

3 Typically formal EEG >3 days only.

4 MRI = magnetic resonance imaging of the brain.

Table 74 shows the rates of prognostic investigations performed in this cohort of neonatal encephalopathy babies. Of survivors, approximately one-third had an EEG after three days of life and two-thirds an MRI. Seventy-nine percent of survivors had either an MRI or an EEG after three days, leaving 21 percent who would appear to have had neither.

Although some degree of prognostication is possible based on severity of encephalopathy alone, formal neurological examination after one week of age and investigation with MRI plus or minus EEG will considerably improve the quality of information that can be provided.

Recommendation

- All babies with encephalopathy should undergo investigation to predict prognosis including formal neurological examination, cerebral MRI and, if available, formal EEG.
- All parents of an affected child should have a formal discussion with the neonatologist/paediatrician providing care in order to review the prognosis and ongoing care of their child.

Table 75: Neonatal outcome among neonatal encephalopathy survivors 2010–2011

Investigations	NE survivors	
	n=113	
	n	%
Feeding on discharge		
Full sucking feeds	90	79.6
Full sucking feeds + support	4	3.5
Feeding support	18	15.9
Missing data	1	0.9
Respiratory support on discharge		
No support	104	92.0
Suctioning only	2	1.8
Oxygen only	4	3.5
Suctioning and oxygen	1	0.9
Missing data	2	1.8
Anticonvulsants on discharge	13	11.5
Missing data/Unknown	3	2.7
Ongoing support service involvement	79	69.9
Missing data/Unknown	11	9.7

Seventy-one percent were discharged home and the remainder were generally discharged to a lower-level unit or postnatal facility. At the time of discharge, 20 percent of babies were requiring at least some tube feeding, 8 percent required respiratory support and 12 percent were receiving anticonvulsants.

Seventy percent were referred for further follow-up, most often for neurodevelopmental therapy (46 percent), home care (19 percent) and paediatric outpatient clinic (36 percent).

4 Australasian Maternity Outcomes Surveillance System (AMOSS) 2010–2011

The Australasian Maternity Outcomes Surveillance System (AMOSS) 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 requiring admission to intensive care
- eclampsia
- BMI >50.

In New Zealand, we have decided to continue gathering data on peripartum hysterectomy and placenta accreta/increta/percreta during 2012, while in Australia, data collection has been completed. A summary of the cases reported in 2010–2011 is listed below. Detailed analysis of the completed conditions has begun, and the PMMRC hopes to have the results available for publication later this year.

The denominator used for rates/ratios is births registered in New Zealand in the collection period, as described in section 1.2. This is noted as rate/ratio, as many conditions surveyed may occur prior to 20 weeks, while the denominator is births from 20 weeks.

Table 76: New Zealand and Australasian rates (per 10,000 maternities) of AMOSS notifiable conditions 2010–2011

	Data collection period	NZ registered births	NZ cases	NZ rate	Australasian rate/ratio[2]	95% CI[2]
		n	n			
Amniotic fluid embolism	2010–2011	127,728	7	0.6	0.4	0.3–0.6
Antenatal pulmonary embolism	2010–2011	127,728	9	0.7	1.2	1.0–1.4
Eclampsia	2010–2011	127,728	25	2	2.2	1.8–2.6
Influenza with intensive care admission	2010	65,124	8	1.2	1.9	1.4–2.8
Placenta accreta	2010–2011	127,728	50[1]	3.9	4.2	3.8–4.8
Peripartum hysterectomy	2010–2011	127,728	56[1]	4.4	6	5.5–6.5
BMI >50	2010	65,124	297	45.6	26.8	24.9–28.7

1 Twenty-five women had placenta accreta and peripartum hysterectomy.

2 Ellwood D. 2013. Reducing the Impact of PPH. Health Round Table presentation, Sydney.

Amniotic fluid embolism (AFE) is defined as all women identified with AFE by either a clinical diagnosis of AFE or a pathological/post-mortem diagnosis.

Antenatal pulmonary embolism (APE) is defined as all women identified as having a pulmonary embolism that is confirmed using suitable imaging, confirmed at surgery or post-mortem or a clinician has made a diagnosis of pulmonary embolism with signs and symptoms consistent with pulmonary embolism present and the patient has received a course of anticoagulation therapy (>1 week duration).

Eclampsia is defined as any woman having convulsions during pregnancy or in the first 10 days postpartum, together with at least two of the following features within 24 hours of the convulsion(s): hypertension, proteinuria, thrombocytopenia or raised plasma ALT or AST.

Influenza with intensive care admission is defined as all women admitted to intensive care and subsequently diagnosed with influenza who are (A) pregnant or who have (B) given birth within 42 days of admission to intensive care.

Placenta accreta is defined as all women identified as having placenta accreta (or increta or percreta) either diagnosed by antenatal imaging, at operation or by pathology specimen.

Peripartum hysterectomy is defined as any woman whose pregnancy terminates and who has a hysterectomy in the same clinical episode or within six weeks postpartum when the indication for hysterectomy is related to the pregnancy or the birth.

Amniotic fluid embolism, antenatal pulmonary embolism and influenza with intensive care admission were rare conditions in New Zealand despite two years of surveillance. These conditions will not be discussed further in this chapter because of small numbers but will be included in analyses of the complete AMOSS dataset in collaboration with the Australasian group.

Table 77: Eclampsia, placenta accreta and peripartum hysterectomy rates (per 10,000 maternities) by maternal prioritised ethnicity and age 2010–2011

Demographic characteristics	Total births 2010–2011		Eclampsia			Placenta accreta			Peripartum hysterectomy		
	n=127,728		n=25			n=50			n=56		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity											
Māori	29,121	22.8	5	20	1.7	10	20	3.4	10	18	3.4
Pacific peoples	13,831	10.8	2	8	1.5	4	8	2.9	5	9	3.6
Indian	4,716	3.7	4	16	8.5	2	4	4.2	3	5	6.4
Other Asian	10,319	8.1	2	8	1.9	2	4	1.9	2	4	1.9
Other/Not stated	11,608	9.1	3	12	2.6	7	14	6	8	14	6.9
NZ European	58,133	45.5	8	32	1.4	21	42	3.6	23	41	4
Missing			1	4		4	8		5	9	
Maternal age											
<25	32,522	15.5	14	56	4.3	1	2	0.3	3	5	0.9
25–29	31,969	25	4	16	1.3	8	16	2.5	11	20	3.4
30–34	35,431	27.7	4	16	1.1	13	26	3.7	12	21	3.5
≥35	27,806	21.8	3	12	1.1	28	56	10.1	30	54	10.8

Table 78: Maternal smoking, parity and previous caesarean section status among women with eclampsia, placenta accreta and peripartum hysterectomy 2010–2011

	Eclampsia		Placenta accreta		Peripartum hysterectomy	
	n=25		n=50		n=56	
	n	%	n	%	n	%
Smoking						
Yes	7	28	8	16	8	14
No	18	72	38	76	45	80
Missing	-	-	4	8	3	5
Parity						
0	16	64	9	18	8	14
1–2	5	20	23	46	24	43
≥3	4	16	18	36	24	43
Previous caesarean section						
Any prior caesarean section	3	12	34	68	34	61
1			13	26	17	30
2			10	20	7	13
≥3			11	22	10	18

Eclampsia

The rate of eclampsia in New Zealand in the years 2010–2011 was 2.0 per 10,000 maternities (95% CI 1.3–2.9). This is similar to the rate of 2.7/10,000 maternities reported in the United Kingdom Obstetric Surveillance System (UKOSS) (Knight 2007) review of eclampsia, conducted between February 2005 and February 2006. The Scottish Confidential Audit of Severe Maternal Morbidity (SCASMM), which has been in operation since 2003, has noted a progressive fall in the rate of eclampsia, with only seven cases reported in 2011, a rate of 1.2 per 10,000 births compared to rates in the order of 3/10,000 in the early 2000s (Healthcare Improvement Scotland 2013).

Peripartum hysterectomy

Peripartum hysterectomy was reported in 56 women in New Zealand between 2010–2011, a rate of 4.4 per 10,000 maternities in New Zealand. The International Network of Obstetric Survey Systems (INOSS), set up in 2010 to promote cooperation and collaboration across and between existing population-based obstetric survey systems, compared peripartum hysterectomy rates across a number of European countries and New Zealand/Australia over this same time period. The overall rate of peripartum hysterectomy among a total of 2,230,631 women was 4.5/10,000, with the lowest rate of 3/10,000 recorded in the Netherlands, increasing to 3.4/10,000 in Denmark, 4.1/10,000 in the UK, 4.2/10,000 in Finland, 4.9/10,000 in France and 5.2/10,000 in Lower Saxony, Germany (Personal communication Professor Knight. Taken from abstract presented at 23rd European Congress of Perinatal Medicine, Paris, June 2012).

In the New Zealand data, there was a 10-fold increased risk of peripartum hysterectomy in women over 35 years of age compared to woman younger than 25 years of age. The majority of women who had peripartum hysterectomy had had a previous caesarean section. Placenta accreta was reported in 45 percent of women who had peripartum hysterectomy in New Zealand compared to 36 percent in the UK. A single maternal death was reported in this group of women.

Placenta accreta

Placenta accreta is the general term used to refer to abnormal attachment of the placenta to the uterine wall due to invasion of the placental trophoblast through to the myometrium and, for this report, includes all levels of invasion. The abnormal placentation prevents separation of the placenta from the uterus in the third stage of labour and is associated with an increased risk of major postpartum haemorrhage. Previous caesarean section (CS) or uterine surgery are considered to be the most important risk factors for placenta accreta and increasing rates of CS may account for the increasing rates of this disorder over the past decades. In a 12-month period in the UK from 2010 to 2011, only 134 confirmed cases of placenta accreta were reported to UKOSS, a rate of 1.7/10,000 maternities compared to the rate of 3.9/10,000 (95% CI 2.9–5.2) in New Zealand. Peripartum hysterectomy was carried out in 50 percent of women with placenta accreta in New Zealand and in 59 percent of women in the UK. The mean blood volume loss in women with accreta in the UK was 3050ml, and almost 80 percent of women with placenta accreta in the UK had a blood transfusion. As with peripartum hysterectomy, the majority of women (68 percent) who had placenta accreta had one or more prior CS.

Table 79: Maternal outcomes among women with eclampsia, placenta accreta and peripartum hysterectomy 2010–2011

Outcomes	Eclampsia		Placenta accreta		Peripartum hysterectomy	
	n=25		n=50		n=56	
	n	%	n	%	n	%
Preterm birth	11	44	29	58	17	30
Caesarean birth	18	72	39	78	43	77
Intensive care admission	12	48	16	32	32	57
Maternal death	–	–	–	–	1	2

Discussion

These preliminary data from New Zealand AMOSS provide valuable information about the rates of these severe maternal complications in our obstetric population. In the future, more detailed analysis will provide an opportunity to assess contributory risk factors and approaches to management that will help inform clinicians looking after pregnant women and allow them to develop appropriate clinical care and management pathways.

We look forward to being able to consider our data with other international groups, and this will be possible because of the collaboration with UKOSS and INOSS, which are using similar methodology and definitions.

Finally, data collection for pregnant women with rheumatic heart disease and gestational breast cancer has begun in Australia and New Zealand, and networks are currently being established with clinicians across New Zealand to notify cases. Future conditions to be studied include massive blood transfusion and intensive care admissions.

National Coordinator Report

The PMMRC national coordination services include the following personnel:

Michelle Gallagher, Jacinta James, Boa Kim and Ursula Foley – administration support
Nicola Arroll – research assistant
Vicki Masson – national coordinator
Dr Lynn Sadler – perinatal epidemiologist.

The national coordination services are provided to facilitate the PMMRC's collection and analysis 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.
- Completing a validation study of the PMMRC methodology for determining contributory factors and potential avoidability in perinatal related mortality. This involved the comparison of local and independent review using the PMMRC tool for determining contributory factors and potential avoidability.
- Completing 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.
- Commencing the data collection for the audit of perinatal related deaths in 2011. Deaths included in this audit are babies that died from 37 weeks gestation (1) in the intrapartum period and (2) unexplained antenatal deaths.

Coordinating perinatal and maternal morbidity data collection

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

Training and supporting the PMMRC DHB local coordinators

- Coordinating 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.
- Planning, preparing and supporting explanations for the analysis of the perinatal and maternal data in this report.
- Writing a draft of the report and supporting preparation of the report for publication.
- 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:

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

Appendices

Appendix A: Additional tables

Table 80: New Zealand perinatal mortality rates (per 1000 births) using the international definition 2007–2011

	2007		2008		2009		2010		2011	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Total births	65,050		65,303		63,153		64,574		62,078	
Fetal deaths (terminations of pregnancy and stillbirths)[1]	211	3.2	207	3.2	229	3.6	199	3.1	190	3.1
Terminations of pregnancy	6	0.1	14	0.2	9	0.1	17	0.3	24	0.4
Stillbirths	205	3.2	193	3.0	220	3.5	182	2.8	166	2.7
Early neonatal deaths <7 days	57		67		59		68		64	
Late neonatal deaths 7–27 days	28		35		30		31		18	
Neonatal deaths <28 days[2]	85	1.3	102	1.6	89	1.4	99	1.5	82	1.3
Perinatal mortalities[3]	268	4.1	274	4.2	288	4.6	267	4.1	254	4.1
Perinatal related mortalities[4]	296	4.6	309	4.7	318	5.0	298	4.6	272	4.4
Perinatal mortalities excluding lethal and terminated fetal abnormalities[5]	223	3.4	220	3.4	236	3.7	204	3.2	179	2.9
Perinatal related mortalities excluding lethal and terminated fetal abnormalities[5]	237	3.6	240	3.7	252	4.0	221	3.4	188	3.0

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 perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality.

Table 81: Intrapartum stillbirth rates (per 1000 births) by gestation excluding lethal abnormalities 2007–2011

Gestation at birth	2007			2008			2009			2010			2011		
	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate
≥24 weeks	36	65,270	0.55	32	65,469	0.49	34	63,382	0.54	24	64,767	0.37	21	62,237	0.34
≥28 weeks	32	64,988	0.49	28	65,209	0.43	27	63,116	0.43	18	64,497	0.28	13	62,012	0.21
≥37 weeks	26	60,572	0.43	23	60,597	0.38	23	58,699	0.39	16	59,875	0.27	9	57,602	0.16

Table 82: Perinatal related death rates (per 1000 births) by maternal age 2007–2011

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=322,868		n=747			n=1,823			n=899[1]			n=3,469[1]		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<20	23,937	7.4	59	7.9	2.46	173	9.5	7.23	110	12.2	4.64	342	9.9	14.29
20–24	58,983	18.3	121	16.2	2.05	377	20.7	6.39	194	21.6	3.32	692	20.0	11.73
25–29	79,523	24.6	166	22.2	2.09	412	22.6	5.18	213	23.7	2.70	791	22.8	9.95
30–34	89,982	27.9	194	26.0	2.16	428	23.5	4.76	185	20.6	2.07	807	23.3	8.97
35–39	57,800	17.9	163	21.8	2.82	344	18.9	5.95	158	17.6	2.76	665	19.2	11.51
≥40	12,643	3.9	44	5.9	3.48	89	4.9	7.04	38	4.2	3.04	171	4.9	13.53

1 Includes one missing maternal age.

Table 83: PSANZ-PDC specific perinatal related death rates (per 1000 births) by maternal age 2007–2011

Perinatal death classification (PSANZ-PDC)	Maternal age											
	<20			20–34			35–39			≥40		
	n=23,937			n=228,488			n=57,800			n=12,643		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality[1]	85	24.9	3.55	616	26.9	2.70	210	31.58	3.63	64	37.4	5.06
Perinatal infection	16	4.7	0.67	86	3.8	0.38	18	2.71	0.31	6	3.5	0.47
Hypertension	3	0.9	0.13	77	3.4	0.34	26	3.91	0.45	10	5.8	0.79
Antepartum haemorrhage	40	11.7	1.67	246	10.7	1.08	60	9.02	1.04	13	7.6	1.03
Maternal conditions	12	3.5	0.50	88	3.8	0.39	31	4.66	0.54	14	8.2	1.11
Specific perinatal condition	23	6.7	0.96	239	10.4	1.05	68	10.23	1.18	14	8.2	1.11
Hypoxic peripartum	16	4.7	0.67	91	4.0	0.40	21	3.16	0.36	5	2.9	0.40
Fetal growth restriction	26	7.6	1.09	173	7.6	0.76	43	6.47	0.74	10	5.8	0.79
Spontaneous preterm	80	23.4	3.34	320	14.0	1.40	79	11.88	1.37	18	10.5	1.42
Unexplained antepartum	34	9.9	1.42	322	14.1	1.41	102	15.34	1.76	17	9.9	1.34
No obstetric antecedent	7	2.0	0.29	32	1.4	0.14	7	1.05	0.12	-	-	-

1 Excludes one maternal age missing.

Table 84: Perinatal related death rates (per 1000 births) by baby ethnicity (prioritised) 2011

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,604		n=171			n=330			n=164			n=665		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (baby)														
Māori	18,150	29.0	43	25.1	2.37	107	32.4	5.90	60	36.6	3.33	210	31.6	11.57
Pacific peoples	7,189	11.5	15	8.8	2.09	40	12.1	5.56	25	15.2	3.50	80	12.0	11.13
Indian	2,429	3.9	11	6.4	4.53	18	5.5	7.41	5	3.0	2.08	34	5.1	14.00
Other Asian	5,149	8.2	22	12.9	4.27	20	6.1	3.88	10	6.1	1.96	52	7.8	10.10
Other/ Not stated	3,841	6.1	10	5.8	2.60	22	6.7	5.73	12	7.3	3.15	44	6.6	11.46
NZ European	25,846	41.3	70	40.9	2.71	123	37.3	4.76	52	31.7	2.03	245	36.8	9.48

Table 85: Perinatal related death rates (per 1000 births) by maternal and baby ethnicity (prioritised) 2007–2011

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=322,868		n=747			n=1,823			n=899			n=3,469		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	74,681	23.1	109	14.6	1.46	513	28.1	6.87	300	33.4	4.05	922	26.6	12.35
Pacific peoples	34,415	10.7	64	8.6	1.86	274	15.0	7.96	136	15.1	3.99	474	13.7	13.77
Indian	11,300	3.5	43	5.8	3.81	78	4.3	6.90	37	4.1	3.31	158	4.6	13.98
Other Asian	23,567	7.3	82	11.0	3.48	92	5.0	3.90	48	5.3	2.05	222	6.4	9.42
Other/ Not stated	28,943	9.0	66	8.8	2.28	150	8.2	5.18	58	6.5	2.02	274	7.9	9.47
NZ European	149,962	46.4	383	51.3	2.55	716	39.3	4.77	320	35.6	2.15	1,419	40.9	9.46
Ethnicity (mother)														
Māori	94,840	29.4	161	21.6	1.70	619	34.0	6.53	338	37.6	3.59	1,118	32.2	11.79
Pacific peoples	36,030	11.2	66	8.8	1.83	274	15.0	7.60	138	15.4	3.87	478	13.8	13.27
Indian	11,818	3.7	43	5.8	3.64	77	4.2	6.52	40	4.4	3.42	160	4.6	13.54
Other Asian	23,131	7.2	83	11.1	3.59	94	5.2	4.06	45	5.0	1.96	222	6.4	9.60
Other/ Not stated	19,745	6.1	46	6.2	2.33	112	6.1	5.67	34	3.8	1.74	192	5.5	9.72
NZ European	137,304	42.5	348	46.6	2.53	647	35.5	4.71	304	33.8	2.23	1,299	37.4	9.46

Table 86: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (excluding termination of pregnancy) by maternal ethnicity (prioritised) among births registered in 2007–2011

Perinatal death classification (PSANZ-PDC)	Prioritised Māori			Prioritised Pacific peoples			Prioritised Indian			Prioritised Other Asian			Prioritised Other/ Not stated			Prioritised NZ European		
	n=74,681			n=34,415			n=11,300			n=23,567			n=28,973			n=149,962		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	97	11.9	1.30	63	15.4	1.83	11	9.6	0.97	24	17.1	1.02	30	14.4	1.04	148	14.3	0.99
Perinatal infection	32	3.9	0.43	20	4.9	0.58	3	2.6	0.27	9	6.4	0.38	12	5.8	0.41	40	3.9	0.27
Hypertension	23	2.8	0.31	24	5.9	0.70	4	3.5	0.35	5	3.6	0.21	5	2.4	0.17	37	3.6	0.25
Antepartum haemorrhage	119	14.6	1.59	39	9.5	1.13	12	10.4	1.06	19	13.6	0.81	24	11.5	0.83	134	12.9	0.89
Maternal conditions	33	4.1	0.44	31	7.6	0.90	7	6.1	0.62	2	1.4	0.08	7	3.4	0.24	33	3.2	0.22
Specific perinatal conditions	75	9.2	1.00	37	9.0	1.08	16	13.9	1.42	19	13.6	0.81	31	14.9	1.07	143	13.8	0.95
Hypoxic peripartum death	36	4.4	0.48	13	3.2	0.38	5	4.3	0.44	5	3.6	0.21	15	7.2	0.52	59	5.7	0.39
Fetal growth restriction	61	7.5	0.82	33	8.0	0.96	15	13.0	1.33	17	12.1	0.72	18	8.7	0.62	90	8.7	0.60
Spontaneous preterm	177	21.8	2.37	74	18.0	2.15	22	19.1	1.95	19	13.6	0.81	32	15.4	1.10	142	13.7	0.95
Unexplained antepartum death	131	16.1	1.75	69	16.8	2.00	19	16.5	1.68	21	15.0	0.89	34	16.3	1.17	201	19.4	1.34
No obstetric antecedent	29	3.6	0.39	7	1.7	0.20	1	0.9	0.09	-	-	-	-	-	-	9	0.9	0.06

Table 87: Stillbirth rates (per 1000 births) by maternal ethnicity (prioritised) (with 95% CIs) 2007–2011

Ethnicity (mother)	Total births	Stillbirths			
	n	n	%	Rate	95%CI
Gestation ≥20 weeks					
Māori	74,681	513	28.1	6.87	6.27–7.46
Pacific peoples	34,415	274	15.0	7.96	7.02–8.90
Indian	11,300	78	4.3	6.90	5.46–8.61
Other Asian	23,567	92	5.0	3.90	3.15–4.79
Other/Not stated	28,943	150	8.2	5.18	4.35–6.01
NZ European	149,962	716	39.3	4.77	4.42–5.12
Total	**322,868**	**1,823**		**5.65**	
Gestation ≥37 weeks					
Māori	68,253	141	25.8	2.07	1.72–2.41
Pacific peoples	31,799	97	17.7	3.05	2.47–3.72
Indian	10,295	31	5.7	3.01	2.05–4.27
Other Asian	21,962	21	3.8	0.96	0.59–1.46
Other/Not stated	26,762	47	8.6	1.76	1.29–2.34
NZ European	138,231	210	38.4	1.52	1.31–1.72
Total	**297,302**	**547**		**1.84**	

Table 88: Distribution of births by deprivation decile (NZDep2006) 2011

Deprivation decile (NZDep2006)	Total births	
	n=62,604	
	n	%
1 (least deprived)	4,738	7.6
2	5,166	8.3
3	5,411	8.6
4	5,714	9.1
5	5,695	9.1
6	6,274	10.0
7	6,397	10.2
8	6,777	10.8
9	7,646	12.2
10 (most deprived)	8,536	13.6
Unknown	250	0.4

Table 89: Perinatal related death rates (per 1000 births) by deprivation quintile (NZDep2006) 2007–2011

Deprivation quintile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=322,868		n=747			n=1,823			n=899			n=3,469		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	51,629	16.0	143	19.1	2.77	223	12.2	4.32	95	10.6	1.85	461	13.3	8.93
2	57,026	17.7	153	20.5	2.68	262	14.4	4.59	122	13.6	2.16	537	15.5	9.42
3	60,623	18.8	144	19.3	2.38	304	16.7	5.01	147	16.4	2.44	595	17.2	9.81
4	67,476	20.9	169	22.6	2.50	393	21.6	5.82	188	20.9	2.81	750	21.6	11.12
5 (most deprived)	84,373	26.1	135	18.1	1.60	621	34.1	7.36	334	37.2	3.99	1,090	31.4	12.92
Unknown	1,741	0.5	3	0.4	-	20	1.1	-	13	1.4	-	36	1.0	-

Table 90: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile (NZDep2006) 2007–2011

Perinatal death classification (PSANZ-PDC)	Quintile 1 (least deprived)			Quintile 2			Quintile 3			Quintile 4			Quintile 5 (most deprived)		
	n=51,629			n=57,026			n=60,623			n=67,476			n=84,373		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	56	17.6	1.08	42	10.9	0.74	58	12.9	0.96	81	31.1	1.20	133	29.9	1.58
Perinatal infection	14	4.4	0.27	20	5.2	0.35	24	5.3	0.40	17	5.0	0.25	40	4.3	0.47
Hypertension	6	1.9	0.12	8	2.1	0.14	19	4.2	0.31	20	1.2	0.30	44	2.4	0.52
Antepartum haemorrhage	30	9.4	0.58	51	13.3	0.89	48	10.6	0.79	75	7.5	1.11	138	9.0	1.64
Maternal conditions	9	2.8	0.17	6	1.6	0.11	15	3.3	0.25	25	2.5	0.37	57	2.8	0.68
Specific perinatal conditions	50	15.7	0.97	52	13.5	0.91	68	15.1	1.12	70	9.3	1.04	79	9.0	0.94
Hypoxic peripartum death	13	4.1	0.25	25	6.5	0.44	23	5.1	0.38	29	5.6	0.43	41	4.3	0.49
Fetal growth restriction	33	10.4	0.64	29	7.6	0.51	40	8.9	0.66	48	6.2	0.71	83	7.6	0.98
Spontaneous preterm	40	12.6	0.77	63	16.4	1.10	75	16.6	1.24	106	16.1	1.57	171	14.2	2.03
Unexplained antepartum death	65	20.4	1.26	82	21.4	1.44	75	16.6	1.24	103	14.9	1.53	144	15.2	1.71
No obstetric antecedent	2	0.6	0.04	6	2	0.11	6	1.3	0.10	7	0.6	0.10	25	1.4	0.30

Table 91: Perinatal related death rates (per 1000 births) by DHB of maternal residence 2011

Maternal domicile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,604		n=171			n=330			n=164			n=665		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	2,270	3.6	5	2.9	2.20	10	3.0	4.41	6	3.7	2.66	21	3.2	9.25
Waitemata	7,938	12.7	19	11.1	2.39	43	13.0	5.42	11	6.7	1.40	73	11.0	9.20
Auckland	6,580	10.5	32	18.7	4.86	36	10.9	5.47	6	3.7	0.92	74	11.1	11.25
Counties Manukau	8,670	13.8	27	15.8	3.11	54	16.4	6.23	34	20.7	3.96	115	17.3	13.26
Waikato	5,440	8.7	13	7.6	2.39	32	9.7	5.88	19	11.6	3.52	64	9.6	11.76
Bay of Plenty	2,988	4.8	8	4.7	2.68	12	3.6	4.02	6	3.7	2.02	26	3.9	8.70
Lakes	1,561	2.5	2	1.2	1.28	10	3.0	6.41	5	3.0	3.23	17	2.6	10.89
Tairawhiti	760	1.2	2	1.2	2.63	2	0.6	2.63	3	1.8	3.97	7	1.1	9.21
Taranaki	1,579	2.5	1	0.6	0.63	11	3.3	6.97	4	2.4	2.55	16	2.4	10.13
Hawke's Bay	2,275	3.6	8	4.7	3.52	11	3.3	4.84	11	6.7	4.88	30	4.5	13.19
Whanganui	834	1.3	3	1.8	3.60	5	1.5	6.00	1	0.6	1.21	9	1.4	10.79
MidCentral	2,380	3.8	8	4.7	3.36	11	3.3	4.62	6	3.7	2.54	25	3.8	10.50
Wairarapa	535	0.9	-	-	-	2	0.6	3.74	1	0.6	1.88	3	0.5	5.61
Capital & Coast	3,903	6.2	10	5.8	2.56	13	3.9	3.33	11	6.7	2.84	34	5.1	8.71
Hutt Valley	2,071	3.3	6	3.5	2.90	15	4.5	7.24	4	2.4	1.95	25	3.8	12.07
Nelson Marlborough	1,658	2.6	3	1.8	1.81	6	1.8	3.62	1	0.6	0.61	10	1.5	6.03
West Coast	439	0.7	-	-	-	3	0.9	6.83	2	1.2	4.59	5	0.8	11.39
Canterbury	6,151	9.8	13	7.6	2.11	34	10.3	5.53	21	12.8	3.44	68	10.2	11.06
South Canterbury	590	0.9	-	-	-	1	0.3	1.69	1	0.6	1.70	2	0.3	3.39
Otago	2,129	3.4	7	4.1	3.29	11	3.3	5.17	6	3.7	2.84	24	3.6	11.27
Southland	1,610	2.6	4	2.3	2.48	8	2.4	4.97	4	2.4	2.50	16	2.4	9.94
Other[1]	243	0.4	-	-	-	-	-	-	1	0.6	-	1	0.2	-

1 Other includes Overseas, Unknown and Other.

Table 92: Perinatal related death rates (per 1000 births) by DHB of maternal residence 2007–2011

Maternal domicile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=322,868		n=747			n=1,823			n=899			n=3,469		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	11,768	3.6	19	2.5	1.61	77	4.2	6.54	42	4.7	3.60	138	4.0	11.73
Waitemata	39,763	12.3	126	16.9	3.17	217	11.9	5.46	73	8.1	1.85	416	12.0	10.46
Auckland	33,529	10.4	116	15.5	3.46	168	9.2	5.01	78	8.7	2.35	362	10.4	10.80
Counties Manukau	44,447	13.8	99	13.3	2.23	316	17.3	7.11	169	18.8	3.84	584	16.8	13.14
Waikato	28,311	8.8	65	8.7	2.30	147	8.1	5.19	95	10.6	3.38	307	8.8	10.84
Bay of Plenty	15,040	4.7	25	3.3	1.66	69	3.8	4.59	51	5.7	3.41	145	4.2	9.64
Lakes	8,342	2.6	10	1.3	1.20	58	3.2	6.95	33	3.7	3.99	101	2.9	12.11
Tairawhiti	4,028	1.2	6	0.8	1.49	20	1.1	4.97	13	1.4	3.25	39	1.1	9.68
Taranaki	8,077	2.5	11	1.5	1.36	50	2.7	6.19	20	2.2	2.50	81	2.3	10.03
Hawke's Bay	11,872	3.7	27	3.6	2.27	63	3.5	5.31	39	4.3	3.31	129	3.7	10.87
Whanganui	4,558	1.4	12	1.6	2.63	32	1.8	7.02	12	1.3	2.66	56	1.6	12.29
MidCentral	11,838	3.7	36	4.8	3.04	73	4.0	6.17	37	4.1	3.15	146	4.2	12.33
Wairarapa	2,729	0.8	7	0.9	2.57	15	0.8	5.50	8	0.9	2.96	30	0.9	10.99
Capital & Coast	20,183	6.3	44	5.9	2.18	93	5.1	4.61	37	4.1	1.85	174	5.0	8.62
Hutt Valley	11,009	3.4	29	3.9	2.63	67	3.7	6.09	26	2.9	2.38	122	3.5	11.08
Nelson Marlborough	8,552	2.6	15	2.0	1.75	35	1.9	4.09	19	2.1	2.23	69	2.0	8.07
West Coast	2,171	0.7	3	0.4	1.38	12	0.7	5.53	12	1.3	5.57	27	0.8	12.44
Canterbury	33,081	10.2	60	8.0	1.81	184	10.1	5.56	92	10.2	2.80	336	9.7	10.16
South Canterbury	3,207	1.0	5	0.7	1.56	18	1.0	5.61	9	1.0	2.83	32	0.9	9.98
Otago	10,557	3.3	20	2.7	1.89	58	3.2	5.49	18	2.0	1.72	96	2.8	9.09
Southland	8,274	2.6	12	1.6	1.45	48	2.6	5.80	13	1.4	1.58	73	2.1	8.82
Other[1]	1,532	0.5	-	-	-	3	0.2	-	3	0.3	-	6	0.2	-

1 Other includes Overseas, Unknown and Other.

Table 93: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) for multiple and singleton births (with 95% CIs) 2007–2011

Perinatal death classification (PSANZ-PDC)	Singleton				Multiple			
	n=313,385				n=9,483			
	n	%	Rate	95% CI	n	%	Rate	95% CI
Congenital abnormality	928	29.92	2.96	2.77–3.15	48	13.08	5.06	3.73–6.71
Perinatal infection	116	3.74	0.37	0.30–0.44	10	2.72	1.05	0.51–1.94
Hypertension	109	3.51	0.35	0.28–0.41	7	1.91	0.74	0.30–1.52
Antepartum haemorrhage	331	10.67	1.06	0.94–1.17	28	7.63	2.95	1.96–4.27
Maternal conditions	142	4.58	0.45	0.38–0.53	3	0.82	0.32	0.07–0.92
Specific perinatal conditions	214	6.90	0.68	0.59–0.77	130	35.42	13.71	11.35–16.07
Hypoxic peripartum death	131	4.22	0.42	0.35–0.49	2	0.54	0.21	0.03–0.76
Fetal growth restriction	231	7.45	0.74	0.64–0.83	21	5.72	2.21	1.37–3.39
Spontaneous preterm	406	13.09	1.30	1.17–1.42	91	24.80	9.60	7.73–11.78
Unexplained antepartum death	449	14.47	1.43	1.30–1.57	26	7.08	2.74	1.79–4.02
No obstetric antecedent	45	1.45	0.14	-	1	0.27	0.11	-

Table 94: Perinatal related death risk (per 1000 babies remaining in utero) by gestational age at birth and plurality 2007–2011

	Singleton				Multiples			
	Total births	Total deaths			Total births	Total deaths		
	n	n	%	Risk	n	n	%	Risk
Gestation at birth (weeks)								
20–23	1,130	1,225	39.5	3.91	148	171	46.6	18.03
24–27	1,140	433	14.0	1.39	270	73	19.9	7.82
28–31	2,081	261	8.4	0.84	631	36	9.8	3.97
32–36	15,814	395	12.7	1.28	4,157	52	14.2	6.17
37–40	233,676	642	20.7	2.19	4,261	34	9.3	7.95
≥41	59,351	144	4.6	2.42	14	1	0.3	62.50
Unknown	193	2	0.1	-	2	-	-	-

Table 95: Perinatal related death risk (per 1000 babies in utero) 2007–2011

	2007			2008			2009			2010			2011		
	Total births	n	Risk	Total births	n	Risk	Total births	n	Risk	Total births	n	Risk	Total births	n	Risk
Gestation at birth (weeks)															
20–23	246	263	4.01	316	279	4.24	200	266	4.18	248	293	4.50	257	295	4.71
24–27	304	98	1.50	279	98	1.49	281	118	1.86	298	105	1.62	248	87	1.40
28–31	539	58	0.89	574	64	0.98	527	65	1.03	551	52	0.81	521	58	0.93
32–36	3,912	88	1.36	4,075	81	1.25	3,930	90	1.44	4,116	102	1.59	3,938	86	1.40
37–40	47,925	136	2.24	48,492	141	2.33	46,950	151	2.57	47,992	126	2.10	46,578	122	2.12
≥41	12,625	34	2.68	12,090	37	3.05	11,721	31	2.63	11,890	26	2.18	11,039	17	1.54
Unknown	52	1	-	46		-	56	1	-	29		-	23		-

Table 96: Perinatal related deaths by primary and associated obstetric antecedent cause of death (PSANZ-PDC) 2011

Perinatal death classification (PSANZ-PDC)	Primary PSANZ-PDC		Associated PSANZ-PDC 1		Associated PSANZ-PDC 2		Assigned PSANZ-PDCs	
	n=665		n=665		n=665		n=665	
	n	%	n	%	n	%	n	%
Congenital abnormality	202	30.4	5	0.8	1	0.2	208	31.3
Perinatal infection	20	3.0	5	0.8	5	0.8	30	4.5
Hypertension	21	3.2	1	0.2	1	0.2	23	3.5
Antepartum haemorrhage	78	11.7	15	2.3	-	-	93	14.0
Maternal conditions	26	3.9	9	1.4	3	0.5	38	5.7
Specific perinatal condition	73	11.0	8	1.2	1	0.2	82	12.3
Hypoxic peripartum	19	2.9	5	0.8	-	-	24	3.6
Fetal growth restriction	44	6.6	25	3.8	2	0.3	71	10.7
Spontaneous preterm	84	12.6	49	7.4	-	-	133	20.0
Unexplained antepartum	94	14.1	-	-	-	-	94	14.1
No obstetric antecedent	4	0.6	-	-	-	-	4	0.6

Table 97: Neonatal deaths by primary and associated neonatal death classification (PSANZ-NDC) 2011

Neonatal death classification (PSANZ-NDC)	Primary PSANZ-NDC		Associated PSANZ-NDC 1		Associated PSANZ-NDC 2		Assigned PSANZ-NDCs	
	n=164		n=164		n=164		n=164	
	n	%	n	%	n	%	n	%
Congenital abnormality	50	30.5	1	0.6	-	-	51	31.1
Extreme prematurity	56	34.1	1	0.6	-	-	57	34.8
Cardio-respiratory disorders	10	6.1	11	6.7	-	-	21	12.8
Infection	15	9.1	4	2.4	-	-	19	11.6
Neurological	23	14.0	6	3.7	1	0.6	30	18.3
Gastrointestinal	2	1.2	1	0.6	-	-	3	1.8
Other	8	4.9	4	2.4	-	-	12	7.3

Table 98: Optimal investigation of perinatal related death by DHB of maternal residence 2011

DHB of maternal residence	Perinatal related deaths	Offered post-mortem		Optimal investigation	
	n=665				
	n	n	%	n	%
Northland	21	15	71.4	6	28.6
Waitemata	73	60	82.2	36	49.3
Auckland	74	64	86.5	34	45.9
Counties Manukau	115	104	90.4	42	36.5
Waikato	64	56	87.5	27	42.2
Bay of Plenty	26	23	88.5	10	38.5
Lakes	17	17	100.0	8	47.1
Tairawhiti	7	7	100.0	5	71.4
Taranaki	16	14	87.5	4	25.0
Hawke's Bay	30	29	96.7	15	50.0
Whanganui	9	7	77.8	3	33.3
MidCentral	25	25	100.0	11	44.0
Wairarapa	3	2	66.7	2	66.7
Capital & Coast	34	32	94.1	24	70.6
Hutt Valley	25	23	92.0	10	40.0
Nelson Marlborough	10	9	90.0	6	60.0
West Coast	5	5	100.0	1	20.0
Canterbury	68	68	100.0	34	50.0
South Canterbury	2	2	100.0	1	50.0
Otago	24	24	100.0	14	58.3
Southland	16	13	81.3	7	43.8
Overseas	1	-	-	-	-

Table 99: Optimal investigation of perinatal related death by DHB of maternal residence 2007–2011

DHB of maternal residence	Perinatal related deaths	Offered post-mortem		Optimal investigation	
	n=3,469				
	n	n	%	n	%
Northland	138	96	69.6	37	26.8
Waitemata	416	337	81.0	215	51.7
Auckland	362	315	87.0	202	55.8
Counties Manukau	584	537	92.0	215	36.8
Waikato	307	256	83.4	122	39.7
Bay of Plenty	145	109	75.2	38	26.2
Lakes	101	86	85.1	21	20.8
Tairawhiti	39	34	87.2	17	43.6
Taranaki	81	70	86.4	20	24.7
Hawke's Bay	129	116	89.9	67	51.9
Whanganui	56	47	83.9	16	28.6
MidCentral	146	129	88.4	71	48.6
Wairarapa	30	26	86.7	16	53.3
Capital & Coast	174	149	85.6	117	67.2
Hutt Valley	122	112	91.8	71	58.2
Nelson Marlborough	69	54	78.3	36	52.2
West Coast	27	21	77.8	9	33.3
Canterbury	336	306	91.1	188	56.0
South Canterbury	32	26	81.3	14	43.8
Otago	96	89	92.7	51	53.1
Southland	73	53	72.6	23	31.5
Overseas	6	3	50.0	2	33.3

Table 100: Contributory factors and potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2011

Perinatal death classification (PSANZ-PDC)	Perinatal related deaths	Contributory and avoidable		Contributory BUT NOT or unknown if avoidable		No contributory factors		Unknown	
	n=665								
	n	n	%	n	%	n	%	n	%
Congenital abnormality	202	3	1.5	25	12.4	171	84.7	3	1.5
Perinatal infection	20	6	30.0	1	5.0	13	65.0	-	-
Hypertension	21	13	61.9	1	4.8	6	28.6	1	4.8
Antepartum haemorrhage	78	17	21.8	5	6.4	55	70.5	1	1.3
Maternal conditions	26	16	61.5	1	3.8	9	34.6	-	-
Specific perinatal conditions	73	13	17.8	3	4.1	56	76.7	1	1.4
Hypoxic peripartum death	19	15	78.9	3	15.8	1	5.3	-	-
Fetal growth restriction	44	13	29.5	4	9.1	26	59.1	1	2.3
Spontaneous preterm	84	16	19.0	9	10.7	56	66.7	3	3.6
Unexplained antepartum death	94	12	12.8	10	10.6	72	76.6	-	-
No obstetric antecedent	4	2	50.0	1	25.0	1	25.0	-	-

Table 101: Contributory factor(s) in potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2011

Perinatal death classification (PSANZ-PDC)	Perinatal related deaths	Potentially avoidable					
		Organisational/ Management		Personnel		Barriers	
	n	n	%	n	%	n	%
Congenital abnormality	202	-	-	2	1.0	1	0.5
Perinatal infection	20	1	5.0	2	10.0	3	15.0
Hypertension	21	3	14.3	3	14.3	7	33.3
Antepartum haemorrhage	78	1	1.3	3	3.8	12	15.4
Maternal conditions	26	2	7.7	5	19.2	10	38.5
Specific perinatal conditions	73	6	8.2	5	6.8	3	4.1
Hypoxic peripartum death	19	2	10.5	4	21.1	4	21.1
Fetal growth restriction	44	2	4.5	8	18.2	5	11.4
Spontaneous preterm	84	-	-	1	1.2	15	17.9
Unexplained antepartum death	94	-	-	2	2.1	10	10.6
No obstetric antecedent	4	-	-	-	-	2	50.0

Table 102: Contributory factors and potentially avoidable perinatal related death by maternal ethnicity (prioritised) (95% CIs surround the estimate of the proportion of cases within each ethnicity where death was potentially avoidable) 2009–2011

Maternal ethnicity (prioritised)	Perinatal related deaths	Contributory and avoidable			Contributory BUT NOT or unknown if avoidable		No contributory factors		Unknown	
	n=2091									
	n	n	%	95% CI	n	%	n	%	n	%
Māori	575	124	21.6	17.8–25.4	93	16.2	325	56.5	33	5.7
Pacific peoples	290	64	22.1	17.0–28.2	34	11.7	166	57.2	26	9.0
Indian	103	18	17.5	10.4–27.6	5	4.9	73	70.9	7	6.8
Other Asian	147	19	12.9	7.8–20.2	10	6.8	114	77.6	4	2.7
Other	162	21	13.0	8.0–19.8	15	9.3	120	74.1	6	3.7
NZ European	814	100	12.3	9.9–14.7	47	5.8	630	77.4	37	4.5

Table 103: Contributory factor(s) in potentially avoidable perinatal related deaths by maternal prioritised ethnicity (with 95% CIs) 2011

Maternal ethnicity (prioritised)	Perinatal related deaths	Potentially avoidable								
		Organisational/ Management			Personnel			Barriers		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI
Māori	177	-	-	-	5	2.8	0.9–6.6	24	13.6	8.7–20.2
Pacific peoples	78	2	2.6	0.3–9.3	3	3.8	0.8–11.2	18	23.1	13.7–36.5
Indian	35	1	2.9	0.1–15.9	6	17.1	6.3–37.3	3	8.6	1.8–25.0
Other Asian	51	3	5.9	1.2–17.2	3	5.9	1.2–17.2	3	5.9	1.2–17.2
Other	64	1	1.6	0.0–8.7	5	7.8	2.5–18.2	4	6.3	1.7–16.0
NZ European	260	10	3.8	1.8–7.1	13	5.0	2.7–8.6	20	7.7	4.7–11.9

Table 104: Contributory factors and potentially avoidable perinatal related death by New Zealand deprivation quintile (NZDep2006) (95% CIs surround the estimate of the proportion of cases within quintile where death was potentially avoidable) 2009–2011

Deprivation quintile	Perinatal related deaths	Contributory and avoidable			Contributory BUT NOT or unknown if avoidable		No contributory factors		Unknown	
	n=2091									
	n	n	%	95% CI	n	%	n	%	n	%
1 (least deprived)	276	40	14.5	10.4–19.7	8	2.9	214	77.5	14	5.1
2	330	40	12.1	8.7–16.5	27	8.2	247	74.8	16	4.8
3	353	39	11.0	7.9–15.1	36	10.2	266	75.4	12	3.4
4	444	79	17.8	14.1–22.2	30	6.8	311	70.0	24	5.4
5 (most deprived)	664	143	21.5	18.0–25.1	98	14.8	377	56.8	46	6.9
Unknown	24	5	20.8	6.8–48.6	5	20.8	13	54.2	1	4.2

Table 105: Complete primary perinatal death classification (PSANZ-PDC) by type of perinatal related death 2011

	Perinatal death classification (PSANZ-PDC)	Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=330		n=164		n=665	
		n	%	n	%	n	%	n	%
	Congenital abnormality								
1.1	Central nervous system	31	18.1	5	1.5	5	3.0	41	6.2
1.2	Cardiovascular system	20	11.7	1	0.3	6	3.7	27	4.1
1.3	Urinary system	8	4.7	2	0.6	6	3.7	16	2.4
1.4	Gastrointestinal system	1	0.6	2	0.6	1	0.6	4	0.6
1.5	Chromosomal	32	18.7	9	2.7	14	8.5	55	8.3
1.6	Metabolic	-	-	-	-	3	1.8	3	0.5
1.7	Multiple/Non-chromosomal syndromes	19	11.1	4	1.2	6	3.7	29	4.4
1.8	Other congenital abnormality	-	-	-	-	-	-	-	-
1.81	Musculoskeletal	9	5.3	1	0.3	4	2.4	14	2.1
1.82	Respiratory	-	-	-	-	1	0.6	1	0.2
1.83	Diaphragmatic hernia	1	0.6	-	-	3	1.8	4	0.6
1.84	Haematological	3	1.8	-	-	-	-	3	0.5
1.85	Tumours	2	1.2	-	-	-	-	2	0.3
1.88	Other specified congenital abnormality	-	-	-	-	1	0.6	1	0.2
1.9	Unspecified congenital abnormality	-	-	2	0.6	-	-	2	0.3
	Perinatal infections								
2.1	Bacterial	-	-	-	-	-	-	-	-
2.11	Group B *Streptococcus*	-	-	-	-	3	1.8	3	0.5
2.12	*E. coli*	-	-	-	-	1	0.6	1	0.2
2.18	Other bacterial	-	-	2	0.6	1	0.6	3	0.5
2.19	Unspecified bacterial	-	-	1	0.3	-	-	1	0.2
2.2	Viral	-	-	-	-	-	-	-	-
2.21	*Cytomegalovirus*	1	0.6	1	0.3	1	0.6	3	0.5
2.22	Parvovirus	-	-	3	0.9	1	0.6	4	0.6
2.23	Herpes simplex virus	-	-	-	-	1	0.6	1	0.2
2.3	Protozoal (*eg, Toxoplasma*)	2	1.2	1	0.3	-	-	3	0.5
2.8	Other specified organism	-	-	1	0.3	-	-	1	0.2
	Hypertension								
3.1	Chronic hypertension: essential	-	-	1	0.3	-	-	1	0.2
3.2	Chronic hypertension: secondary, eg, renal disease	-	-	1	0.3	-	-	1	0.2
3.4	Gestational hypertension	-	-	2	0.6	1	0.6	3	0.5
3.5	Pre-eclampsia	2	1.2	7	2.1	3	1.8	12	1.8
3.6	Pre-eclampsia superimposed on chronic hypertension	3	1.8	1	0.3	-	-	4	0.6

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=330		n=164		n=665	
		n	%	n	%	n	%	n	%
	Antepartum haemorrhage (APH)								
4.1	Placental abruption	2	1.2	25	7.6	11	6.7	38	5.7
4.11	Placental abruption: With laboratory evidence of thrombophilia	-	-	4	1.2	-	-	4	0.6
4.2	Placenta praevia	-	-	1	0.3	-	-	1	0.2
4.3	Vasa praevia	-	-	1	0.3	-	-	1	0.2
4.8	Other APH	-	-	4	1.2	7	4.3	11	1.7
4.9	APH of undetermined origin	2	1.2	13	3.9	8	4.9	23	3.5
	Maternal conditions								
5.1	Termination of pregnancy for maternal psychosocial indications	5	2.9	-	-	-	-	5	0.8
5.2	Diabetes/Gestational diabetes	2	1.2	4	1.2	1	0.6	7	1.1
5.4	Maternal sepsis	-	-	2	0.6	-	-	2	0.3
5.5	Antiphospholipid syndrome	-	-	3	0.9	-	-	3	0.5
5.51	Other maternal thrombophilia (if considered cause of death)	-	-	1	0.3	-	-	1	0.2
5.8	Other specified maternal conditions	3	1.8	3	0.9	2	1.2	8	1.2
	Specific perinatal conditions								
6.1	Twin–twin transfusion	3	1.8	13	3.9	2	1.2	18	2.7
6.2	Fetomaternal haemorrhage	-	-	11	3.3	1	0.6	12	1.8
6.3	Antepartum cord complications (e.g. cord haemorrhage; true knot with evidence of occlusion)	-	-	-	-	-	-	-	-
6.32	True knot with evidence of occlusion	-	-	6	1.8	-	-	6	0.9
6.38	Other	-	-	12	3.6	-	-	12	1.8
6.4	Uterine abnormalities, eg, bicornuate uterus, cervical incompetence	1	0.6	3	0.9	6	3.7	10	1.5
6.6	Alloimmune disease	-	-	-	-	-	-	-	-
6.68	Alloimmune disease: Other	-	-	1	0.3	-	-	1	0.2
6.7	Idiopathic hydrops	2	1.2	1	0.3	-	-	3	0.5
6.8	Other specific perinatal conditions (includes iatrogenic conditions such as rupture of membranes after amniocentesis, termination of pregnancy for suspected but unconfirmed congenital abnormality.	-	-	-	-	-	-	-	-
6.81	Rupture of membranes after amniocentesis	-	-	1	0.3	-	-	1	0.2
6.88	Other	3	1.8	3	0.9	4	2.4	10	1.5

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=330		n=164		n=665	
		n	%	n	%	n	%	n	%
	Hypoxic peripartum death								
7.1	With intrapartum complications	-	-	-	-	-	-	-	-
7.11	With intrapartum complications: Uterine rupture	-	-	1	0.3	-	-	1	0.2
7.12	With intrapartum complications: Cord prolapse	-	-	2	0.6	2	1.2	4	0.6
7.18	With intrapartum complications: Other	-	-	1	0.3	1	0.6	2	0.3
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	7	4.3	9	1.4
7.9	Unspecified hypoxic peripartum death	-	-	2	0.6	1	0.6	3	0.5
	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)	3	1.8	28	8.5	2	1.2	33	5.0
8.2	With chronic villitis	-	-	1	0.3	-	-	1	0.2
8.3	No placental pathology	-	-	3	0.9	-	-	3	0.5
8.4	No examination of placenta	-	-	1	0.3	2	1.2	3	0.5
8.8	Other specified placental pathology	-	-	4	1.2	-	-	4	0.6
	Spontaneous preterm								
9.1	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery	-	-	-	-	-	-	-	-
9.11	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: With chorioamnionitis	1	0.6	2	0.6	14	8.5	17	2.6
9.12	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Without chorioamnionitis	-	-	8	2.4	5	3.0	13	2.0
9.13	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: No examination of placenta	-	-	-	-	3	1.8	3	0.5
9.17	No clinical signs of chorioamnionitis, no examination of placenta	1	0.6	4	1.2	6	3.7	11	1.7
9.19	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Unspecified or not known whether placenta examined	-	-	-	-	1	0.6	1	0.2

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=330		n=164		n=665	
		n	%	n	%	n	%	n	%
	Spontaneous preterm								
9.2	Spontaneous preterm with membrane rupture ≥24 hours before delivery	-	-	-	-	1	0.6	1	0.2
9.21	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With chorioamnionitis	4	2.3	11	3.3	7	4.3	22	3.3
9.22	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Without chorioamnionitis	1	0.6	-	-	-	-	1	0.2
9.23	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	3	1.8	2	0.6	2	1.2	7	1.1
9.27	No clinical signs of chorioamnionitis, no examination of placenta	1	0.6	2	0.6	-	-	3	0.5
9.29	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Unspecified or not known whether placenta examined	-	-	1	0.3	1	0.6	2	0.3
9.3	Spontaneous preterm with membrane rupture of unknown duration before delivery	-	-	-	-	-	-	-	-
9.31	Spontaneous preterm with membrane rupture of unknown duration before delivery: With chorioamnionitis	-	-	2	0.6	-	-	2	0.3
9.32	Spontaneous preterm with membrane rupture of unknown duration before delivery: Without chorioamnionitis	-	-	-	-	1	0.6	1	0.2
	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)	-	-	13	3.9	-	-	13	2.0
10.2	With chronic villitis	-	-	1	0.3	-	-	1	0.2
10.3	No placental pathology	-	-	28	8.5	-	-	28	4.2
10.4	No examination of placenta	-	-	13	3.9	-	-	13	2.0
10.8	Other specified placental pathology	-	-	39	11.8	-	-	39	5.9
	No obsteric antecedent								
11.2	Postnatally acquired infection	-	-	-	-	2	1.2	2	0.3
11.9	Unknown/Undetermined	-	-	-	-	1	0.6	1	0.2
11.91	Unclassified Sudden Infant Death	-	-	-	-	1	0.6	1	0.2

Table 106: Complete primary neonatal death classification (PSANZ-NDC) for neonatal death 2011

Neonatal death classification (PSANZ-NDC)		Neonatal deaths n=164	
		n	%
	Congenital abnormality		
1.1	Central nervous system	5	3.0
1.2	Cardiovascular system	6	3.7
1.3	Urinary system	6	3.7
1.4	Gastrointestinal system	1	0.6
1.5	Chromosomal	14	8.5
1.6	Metabolic	3	1.8
1.7	Multiple/Non-chromosomal syndromes	6	3.7
1.8	Other congenital abnormality	-	-
1.81	Musculoskeletal	4	2.4
1.82	Respiratory	1	0.6
1.83	Diaphragmatic hernia	3	1.8
1.88	Other specified congenital abnormality	1	0.6
	Extreme prematurity		
2.1	Not resuscitated	46	28.0
2.2	Unsuccessful resuscitation	10	6.1
	Cardio-respiratory disorders		
3.1	Hyaline membrane disease/Respiratory distress syndrome (RDS)	3	1.8
3.4	Pulmonary hypoplasia	4	2.4
3.6	Pulmonary haemorrhage	2	1.2
3.8	Other	1	0.6
	Infection		
4.1	Bacterial	-	-
4.11	Congenital bacterial	-	-
4.111	Congenital bacterial: Group B *Streptococcus*	2	1.2
4.112	Congenital bacterial: *E. coli*	3	1.8
4.118	Congenital bacterial: Other bacterial	2	1.2
4.12	Acquired bacterial	-	-
4.121	Acquired bacterial: Group B *Streptococcus*	3	1.8
4.128	Acquired bacterial: Other specified bacterial	1	0.6
4.2	Viral	-	-
4.21	Congenital viral	-	-
4.211	Congenital viral: *Cytomegalovirus*	2	1.2
4.213	Congenital viral: Herpes simplex virus	1	0.6
4.218	Congenital viral: Other specified viral	1	0.6

Neonatal death classification (PSANZ-NDC)		Neonatal deaths	
		n=164	
		n	%
	Neurological		
5.1	Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)	15	9.1
5.2	Intracranial haemorrhage	-	-
5.21	Intraventrical haemorrhage	8	4.9
	Gastrointenstinal		
6.1	Necrotising enterocolitis	2	1.2
	Other		
7.2	Multisystem failure	-	-
7.28	Multisystem failure: Other specified	2	1.2
7.3	Trauma	-	-
7.32	Trauma: Non-accidental	1	0.6
7.9	Unknown/Undetermined	-	-
7.91	Unclassified Sudden Infant Death	-	-
7.911	Unclassified Sudden Infant Death: Bed sharing	2	1.2
7.912	Unclassified Sudden Infant Death: Not bed sharing	3	1.8

Appendix B: Improving quality and safety in maternity services: can we improve prevention, detection and management of congenital abnormalities in pregnancy?

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Executive summary and recommendations

The Perinatal and Maternal Mortality Review Committee (PMMRC) is responsible for reviewing and reporting on all perinatal deaths with a view to reducing these deaths. The data in this report relate to perinatal deaths from central nervous system, cardiovascular, and chromosomal congenital abnormalities in 2010 identified from the PMMRC dataset. The data only include deaths from 20 weeks gestation to 28 days after birth and therefore do not include miscarriages or terminations of pregnancy prior to 20 weeks, or surviving infants with these congenital abnormalities. It is an opportunistic dataset and likely includes all such perinatal deaths. However, in the absence of a register of all pregnancies and babies with congenital abnormalities it provides a "snapshot" of care to a group of mothers of babies with congenital abnormalities in New Zealand at this time.

Key findings

- First contact with a health professional in pregnancy was with a general practitioner in the majority of cases. First contact occurred within ten weeks in 74 percent of cases and within 14 weeks in 85 percent. However there was often a significant delay before registration with a lead maternity carer (LMC).
- Folate supplements were documented as having been taken by 54 percent of women in the antenatal period and by 7 percent prior to pregnancy.
- First or second trimester screening was offered to 75 percent of the women who presented prior to the cut off for screening. Of those women offered screening, 84 percent had some form of screening.
- The time from referral to review by a maternal fetal medicine (MFM) specialist was a median of six days which is less than the week that is advised by the New Zealand Maternal Fetal Medicine Network (Health Point 2012).
- The time from decision for termination of pregnancy to the procedure was between one and 12 days with a median of two days.
- Review of ultrasound images found some of the abnormalities could have been detected earlier.

Recommendations for pre-conceptual care

All women should receive pre-conceptual counselling

- To optimise maternal health by identifying current medical conditions, prescription medications, smoking, alcohol and drug use and BMI and recommendation for pre-conceptual folate.
- Education on nutrition, smoking cessation, alcohol and drug avoidance.
- To identify risks including previous obstetric history, family history of congenital abnormalities in either parent and refer appropriately.

Folate use in women of reproductive age

- Media campaign for pre-conceptual folate.
- Investigate further evidence on fortification of bread with folate.

Recommendations for antenatal care

- Education of all women is required about the importance of registration with a LMC before 10 weeks.
- As general practitioners are often the first point of contact for pregnant women, it is essential that they are able to effectively offer
    - First trimester screening
    - Facilitate expeditious registration with an LMC.
- If screening has not already been arranged then LMCs should offer all women first and second trimester screening, as required by the Ministry of Health since 2010, as this strategy will enable early diagnosis of a proportion of congenital abnormalities.

Recommendations for screening programme

- Review the current algorithms used in New Zealand's first and second trimester screening programme which is calibrated for Trisomy 21, and consider the cost benefit of using algorithms calibrated for maximal sensitivity for all chromosomal abnormalities.
- Education for general practitioner and LMC regarding screening, counselling and interpretation of results.
- Review the efficiency and adequacy of the program's guidelines for reporting results for nuchal translucency in a patient who has not had a serum sample taken to avoid delays in reporting risk from the nuchal scan.
- False negative screening tests should be reviewed by the screening unit.

Recommendations for documentation

- All LMCs should document pre-conceptual folate and antenatal folate use including when the woman commenced taking folate and the dose.
- LMCs must be encouraged to comply with the legal requirement to retain a copy of the woman's notes for ten years. This facilitates audit but is also important for ongoing clinical care.
- Radiology services retain a copy of the ultrasound.
- Ultrasound reports should be comprehensive, in particular meet the minimum requirements of reporting.

Recommendations for ultrasound services

- Ultrasound services provided by radiology and obstetric services should audit their images to ensure accurate measurements are obtained during scanning, in particular during the nuchal translucency scan.
- Provision of real time images to radiologists who specialise in obstetric ultrasound and then referral to MFM service multidisciplinary teams to allow specialist review of images in areas that do not have these services.

Recommendations for referral to specialist services

- Promote the current National Screening Unit referral guidelines regarding immediate referral to specialist services.
- The New Zealand National MFM Network should audit regularly time from referral to review in their service to ensure that the majority of women are seen within 7 days as recommended.
- Enhancement of the current birth defects register to include congenital abnormalities where a perinatal death occurred.

Appendix C: Classifications of the Perinatal Society of Australia and New Zealand (PSANZ 2009)[3]

7.4 PSANZ Perinatal mortality classification

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*)

3 Perinatal Society of Australia and New Zealand 2009

2.5 Fungal

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 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 (2012 version)

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/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

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

(eg, inadequate supervision of staff, lack of appropriate clinical management protocols or guidelines, 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 ☐
- Equipment (eg, faulty equipment, inadequate maintenance, quality of or lack of equipment) ☐
- Building and design functionality, eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location ☐
- Other – if other please state or provide any comments: ☐

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 caregiver ☐
- Other – If other please state or provide any comments: ☐

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)

- No antenatal care ☐
- Infrequent care or late booking ☐
- Declined treatment or advice ☐
- Obesity impacted on delivery of optimal care eg, USS ☐
- 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 ☐
- Environment eg, isolated, long transfer, weather prevented transport ☐
- Other – if other, please state or provide any comments: ☐

Was this death potentially avoidable? **Yes** ☐ **No** ☐

Complete this after considering the selected contributory factors above.

(If Yes, the absence of which contributory factor(s) might have meant the death was avoidable?)

Name of person completing this form:

Contact person for additional information:

Phone number:

Signed:

Date:

Appendix E: PMMRC DHB Local Coordinators (April 2013)

DHB	Progress	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* **Carol Chamley** *Midwife*	North Shore Hospital Waitakere Hospital
Auckland	**Professor Lesley** McCowan **Claire McLintock** *Obstetric Physician (AMOSS)*	Auckland City Hospital
Counties Manukau	**Dr Sarah Wadsworth** *Consultant Obstetrician* **Dr Graeme Parry** *Consultant Obstetrician* **Debbie Davies** *Midwife*	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	**Sheila Noakes** *Midwife* **Jenelle Sheridan** *Neonatal Nurse*	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 Bradford** *Midwife Educator* **Dr Steven Grant** *Consultant Obstetrician*	Palmerston North Hospital
Wairarapa	**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*	Nelson Hospital
West Coast		Grey Base Hospital
Canterbury	**Dianne Leishman** *Midwife* **Sonya Matthews** *Midwife*	Christchurch Women's Hospital
South Canterbury	**Dr John Weir** *Consultant Obstetrician*	Timaru Hospital
Southern	**Helen Flockton** Charge *Midwife* **Dr Helen Patterson** *Consultant Obstetrician* **Jenny Humphries** *Director of Nursing and Midwifery* **Mel Rackham** *Midwife*	Dunedin Hospital Southland Hospital

List of Abbreviations

AMOSS	Australasian Maternity Outcomes Surveillance System
APH	Antepartum haemorrhage
BDM	Births, Deaths and Marriages
BMI	Body mass index
CEMACH	Confidential Enquiry into Maternal and Child Health
CMACE	Centre for Maternal and Child Enquiries
CTG	Cardiotocograph
DHB	District Health Board
GROW	Gestation Related Optimal Weight
HIE	Hypoxic ischaemic encephalopathy
INOSS	International Network of Obstetric Survey Systems
LMC	Lead maternity carer
MAT	New Zealand National Maternity Collection
MMR	Maternal mortality ratio
MMRWG	Maternal Mortality Review Working Group
MRI	Magnetic resonance imaging
NE	Neonatal encephalopathy
NHI	National Health Index
NICE	National Institute for Clinical Excellence
NZCOM	New Zealand College of Midwives
NZDep	New Zealand Index of Deprivation score
NZPSU	New Zealand Paediatric Surveillance Unit
PMMRC	Perinatal and Maternal Mortality Review Committee
PPH	Postpartum haemorrhage
PSANZ	Perinatal Society of Australia and New Zealand
PSANZ-PDC	PSANZ perinatal death classification
PSANZ-NDC	PSANZ neonatal death classification
RANZCOG	Royal Australasian and New Zealand College of Obstetricians and Gynaecologists
Sands	Stillbirth and newborn death support
SCASMM	Scottish Confidential Audit of Severe Maternal Morbidity
SGA	Small for gestational age
SUDI	Sudden unexpected death in infancy
UKOSS	United Kingdom Obstetric Surveillance System

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He matenga ohorere, he wairua uiui, wairua mutungakore

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