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

Ninth Annual Report of the Perinatal and Maternal Mortality Review Committee

Reporting mortality 2013

Fifth Report to the Health Quality & Safety Commission New Zealand

JUNE 2015

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

PMMRC. 2015. *Ninth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2013.* Wellington: Health Quality & Safety Commission.

Published in June 2015 by the Perinatal and Maternal Mortality Review Committee, PO Box 25496, Wellington 6146, New Zealand

ISBN 978-0-478-38597-7 (Print)
ISBN 978-0-478-38598-4 (Online)

The document is available online at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc

Acknowledgements

The Perinatal and Maternal Mortality Review Committee (PMMRC) is grateful to the following groups and individuals for their assistance in the production of this report:

- 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 provided the data within this report
- the PMMRC National Coordination Service, managed by Professor Cindy Farquhar, which includes:
  - Vicki Masson, the national coordinator of the PMMRC, who ensured the sets of mothers and infants were complete and that the dataset was as complete and accurate as possible, and assisted in preparation of the report
  - Dr Lynn Sadler, epidemiologist at Auckland DHB and the University of Auckland, who designed the analysis and prepared the report
  - Ursula Foley, who provided administrative support
- the staff at Analytical Services, of the Ministry of Health, who provided denominator data for the births in 2007–2013
- the staff at the University of Otago's Mortality Review Data Group, particularly Joseph Hii, Kasia Szymanska and Alastair Anderson, who established and maintain the perinatal and maternal mortality website and collated the data and produced the tables and figures in the perinatal and maternal mortality and neonatal encephalopathy sections
- the members of the PMMRC, who provided advice and guidance for the analysis, determined the recommendations, and provided practice points for the report
- 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, including Faith Mahoney, who provided the maternal morbidity data and report
- Carl Kuschel and Norma Campbell, who provided peer review on an earlier version of the report. This final report does not necessarily reflect their views
- the Health Quality & Safety Commission, which has been involved in all stages of the development of this report.

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Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) members in 2015 are:

- Dr Sue Belgrave (Chair), obstetrician, Waitemata DHB
- Dr Max Berry, neonatologist, University of Otago, Wellington
- Dr Sue Crengle, Māori health researcher, general practitioner, public health physician, Invercargill
- Ms Alison Eddy (Deputy Chair), midwife, Christchurch
- Dr Rose Elder, obstetrician, Capital & Coast DHB
- Ms Gail McIver, midwife, Counties Manukau DHB
- Ms Linda Penlington, Sands New Zealand, Wairarapa.

Maternal Mortality Review Working Group

The Maternal Mortality Review Working Group (MMRWG) members in 2015 are:

- Dr Sue Belgrave (Chair PMMRC and acting Chair of MMRWG)
- Dr Eileen Bass, physician, Hutt Valley DHB
- Ms Alison Eddy, midwife, Christchurch
- Dr Rose Elder, obstetrician, Capital & Coast DHB
- Dr Lesley Dixon, midwife, Christchurch
- Dr Anne Hart, anaesthetist, Counties Manukau DHB
- Dr Liz MacDonald, perinatal psychiatrist, Canterbury DHB
- Dr Catherine Marnoch, physician, Waitemata DHB
- Dr Claire McLintock, obstetric physician and haematologist, Auckland DHB
- Dr John Walker, anaesthetist, Auckland DHB
- Dr Sarah Wadsworth, obstetrician, Counties Manukau DHB
- Dr Katharine Wallis, general practitioner, Auckland
- Dr Kate White, pathologist, MidCentral DHB.

Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group (NEWG) members in 2015 are:

- Dr Malcolm Battin (Chair), neonatal paediatrician, Auckland DHB
- Dr Astrid Budden, obstetrician and gynaecologist, Auckland DHB
- Professor Cynthia Farquhar, obstetrician and gynaecologist, and clinical epidemiologist, the University of Auckland
- Ms Anja Hale, neonatal nurse practitioner, Waikato DHB
- Dr Deborah Harris, neonatal nurse practitioner, Waikato DHB
- Ms Gail McIver, midwife, Counties Manukau DHB
- Ms Suzanne Miller, midwife, Wellington
- Dr Thorsten Stanley, paediatrician, Capital & Coast DHB
- Dr Alex Wallace, paediatrician and senior lecturer in paediatrics, Waikato DHB and the University of Auckland.

Australasian Maternity Outcomes Surveillance System Working Group

The Australasian Maternity Outcomes Surveillance System Working Group (AMOSSWG) members in 2015 are:

- Dr Claire McLintock (Chair), obstetric physician and haematologist, Auckland DHB
- Professor Cynthia Farquhar, obstetrician and gynaecologist, and clinical epidemiologist, the University of Auckland
- Dr Ted Hughes, anaesthetist and intensive care unit consultant, Waitemata DHB
- Ms Jo McMullan, midwife and local coordinator, Hutt Valley DHB
- Ms Estelle Mulligan, midwife, Counties Manukau DHB
- Dr Sarah Wadsworth, obstetrician and gynaecologist, Counties Manukau DHB
- Ms Kathleen Williamson, midwife, Hawke's Bay DHB.

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Foreword

This report considers perinatal and maternal mortality and morbidity from 1 January to 31 December 2013; perinatal mortality from 2007 to 2013; maternal mortality from 2006 to 2013; severe and rare maternal disorders of pregnancy from 2010 to 2013; and babies with neonatal encephalopathy from 2010 to 2013.

It is reassuring that there are early signs to indicate perinatal related mortality rates appear to be dropping.[1] I am also pleased to see there was a significant reduction in stillbirths, from 5.6/1000 births in 2007 to 5.1/1000 births in 2013.

These results are encouraging and reflect much well-coordinated work by many people over recent years.

However there are still improvements to be made. An example is spontaneous preterm birth, which is the special topic of this year's report. These accounted for 21 percent of all perinatal deaths from 2007 to 2013. Analysis shows that factors associated with these deaths include being of Māori, Pacific or Indian maternal ethnicity, increasing deprivation, multiple pregnancy, mothers under 25 years and mothers who smoke.

There were 12 maternal deaths recorded in 2013. Suicide and amniotic fluid embolism were among the most frequent causes of maternal mortality in 2006–2013. This is of particular concern, because New Zealand's rates are five times those for the UK for suicide, and seven times for amniotic fluid embolism. During 2015–2016 the Perinatal and Maternal Mortality Review Committee (PMMRC) will focus on these causes of maternal death and investigate further.

I would like to thank the dedicated team of people who have woven this substantial report together, in particular Dr Sue Belgrave and Alison Eddy who have led the PMMRC's important work, but also the other members of the PMMRC, the local coordinators in every DHB who collect the data, the National Coordination Service based at the University of Auckland, and the Mortality Review Committee staff at the Health Quality & Safety Commission.

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

1 2013 had the lowest perinatal related mortality rate since the PMMRC started keeping records, of 10.0/1000 births, even though the reduction is not statistically significant.

Chair's Introduction

This ninth annual report of the Perinatal and Maternal Mortality Review Committee (PMMRC) is my second as Chair.

This report adds to the wealth of information we have to help guide clinical practice in maternity. I acknowledge the grief of the families and whānau whose loss has contributed to this report and the clinicians providing care to and supporting these families and whānau.

This year we are reporting perinatal deaths from 2007 to 2013, maternal deaths from 2006 to 2013, severe and rare maternal disorders of pregnancy from 2010 to 2013 and babies with neonatal encephalopathy from 2010 to 2013.

Each year we strive to ensure the PMMRC annual report is useful to the maternity sector and for the first time we have asked key stakeholders to provide feedback on the new PMMRC recommendations presented in this report. In response to this feedback and comments from our peer reviewers we have changed the format of how we present the new recommendations, noting the justification and the evidence to support each one. We hope the sector will find this a useful addition to the report.

It is encouraging that there has been a significant reduction in stillbirths in 2013, and although not statistically significant, the perinatal related mortality rate in 2013 is the lowest rate reported since the PMMRC began collecting annual data in 2007.

We continue to report on contributory factors and potentially avoidable deaths. Barriers to access and/or engagement with care are more often identified among women living in areas of higher deprivation. This year we have asked maternity care providers to identify women with modifiable risks for perinatal related death and work with these women's communities and other health care providers to ensure that accessible and appropriate strategies are in place to address these risks.

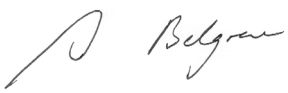
The focus of the special topic this year is spontaneous preterm birth leading to perinatal related death. These babies account for 21 percent of all perinatal related deaths from 2007 to 2013. There is increasing evidence for a range of interventions to prevent preterm birth and to manage women with threatened preterm birth to minimise the risk of mortality.

In 2013 there were 12 maternal deaths reported to the PMMRC. Suicide was the most common cause of maternal death in New Zealand during 2006–2013. We again highlight the importance of both the detection of mental illness and appropriate care for women during pregnancy and postnatally. While international comparisons are difficult it is of concern that the rates of death from suicide and amniotic fluid embolism are so much higher in New Zealand than in the UK. The PMMRC will complete further analysis of maternal suicide and amniotic fluid embolism in 2015 and report our findings in the 10th report.

The PMMRC collects data on both mortality and morbidity; the Australasian Maternity Outcomes Surveillance System (AMOSS) has completed four years of data collection on severe and rare disorders of pregnancy in New Zealand and Australia. This year we present preliminary data on amniotic fluid embolism, placenta accreta and rheumatic heart disease in New Zealand. I look forward to the publication of papers on the completed conditions in 2015.

The case review findings from a subset of babies diagnosed with neonatal encephalopathy (mortality and morbidity 2010–2013) will lead to further work streams to develop and implement strategies to improve perinatal care in 2015 and 2016.

This year I have had an opportunity to visit a number of district health boards (DHBs) to ask what their experience of PMMRC reporting processes has been and if they have any issues or suggestions for improvement. I was interested to hear how mortality reviews related to other reviews and quality initiatives within DHBs. I have been encouraged by the work that is currently happening in many DHBs, the focus on quality improvement and their work to improve outcomes for families.



Dr Sue Belgrave
Chair, Perinatal and Maternal Mortality Review Committee

Executive Summary and Recommendations

Terms of Reference and Mortality Definitions PMMRC

- The Perinatal and Maternal Mortality Review Committee (PMMRC) is responsible for reviewing maternal deaths and all deaths of infants born from 20 weeks gestation (or weighing at least 400g if gestation is unknown) to 28 completed days after birth.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.

Findings 2015 Report (Data 2013)

Perinatal related mortality

1. The perinatal related mortality rate in 2013 was 10.0/1000 births. This is the lowest rate reported since the PMMRC began collecting annual data in 2007 but is not a statistically significant reduction.
2. The rate of stillbirth was 5.1/1000 births in 2013, and has fallen statistically significantly since 2007 when it was 5.6/1000 births (p=0.015).
3. The rate of neonatal death was 2.6/1000 live births in 2013, and has not changed from 2007 to 2013.
4. The rate of termination of pregnancy from 20 weeks has risen significantly since 2007 from 2.2/1000 births to 2.3/1000 births in 2013 (p=0.03). This is due to an increase in terminations associated with conditions other than congenital abnormalities (eg, perinatal infection, hypertension, antepartum haemorrhage, intrauterine growth restriction and prolonged premature rupture of the membranes).
5. There was a significant reduction in perinatal related mortality (chi-squared for linear trend p=0.001 overall and p=0.0001 if congenital abnormality deaths are excluded) using the international definition, recommended by the World Health Organization, of perinatal related deaths from 1000g or 28 weeks if birthweight is unknown. This is due to significant reductions in hypoxic peripartum and unexplained antepartum deaths.

6. There was a significant reduction in the hypoxic peripartum perinatal related death rate, from 0.5/1000 in 2007 to 0.18/1000 births in 2013 (p=0.0003).

7. A multivariate analysis reported in the eighth report of the PMMRC showed that women who have a body mass index (BMI) >25, women who smoke in pregnancy, women of Indian ethnicity and women having their first birth are at increased risk of stillbirth independent of age and socioeconomic status. A combination of risks results in a higher risk of stillbirth as risks are independent of each other and so have a cumulative effect.

8. A multivariate analysis reported in the eighth report of the PMMRC showed that women of Māori and Pacific ethnicity, women who smoke in pregnancy, women living in areas of high socioeconomic deprivation and women having their first birth are at increased risk of neonatal death of babies born at 20–27 weeks independent of age and socioeconomic status. Women who smoke during pregnancy are also at increased risk of neonatal death of babies born from 28 weeks gestation, independent of ethnicity, socioeconomic deprivation, age, parity and BMI.

9. There was a significant increase from 2007 to 2013 in the perinatal related death rate among women under 20 years of age. This is associated with an increase in the proportion of births to Pacific mothers and mothers residing in the most deprived areas among under 20-year-old mothers.

10. The following district health board (DHB) areas have significantly higher unadjusted rates of perinatal related death than the New Zealand rate and may require additional assistance to address these issues:
    - Counties Manukau – all perinatal related mortality
    - Northland – stillbirth and neonatal death rate
    - Bay of Plenty – neonatal death rate.

11. There was a significant increase from 2007 to 2013 in the perinatal related mortality rate of babies born at 20–23 weeks (p=0.011) due to an increase in late termination of pregnancy. There was a 30 percent reduction in perinatal related mortality among babies born at 37–40 weeks (p=0.004) and a 50 percent reduction among babies born at 41+ weeks (p=0.002).

12. There was a reduction of 30 percent in the stillbirth rate at 37–40 weeks and 40 percent at 41+ weeks. In 2007 there were 117 stillbirths at term (37+ weeks) and in 2013 there were 69. The greatest reduction in absolute numbers of stillbirths at term in 2013 was a reduction of 30 percent in unexplained antepartum deaths and a reduction of 80 percent in hypoxic peripartum deaths from the 2007–2009 average. There was also a significant reduction in stillbirth at term from antepartum haemorrhage and perinatal infection.

13. There was a significant reduction of 78 percent in the intrapartum stillbirth rate (of babies from 24 weeks without congenital abnormality), from 0.54/1000 births in 2007 to 0.12/1000 births in 2013.

14. There were 152 neonatal deaths in 2013 in New Zealand. Of these, 49 (32 percent) died from spontaneous preterm birth.

15. Māori, Pacific and Indian neonates were significantly more likely to be born at 20–23 weeks and subsequently die than they were to die at any later gestation and also at least twice as likely to be born and die at 20–23 weeks as New Zealand European neonates. This is because of higher rates of preterm birth among these ethnic groups.

16. The increase in perinatal related deaths among multiples from 2007 noted in the previous two PMMRC reports remains statistically significant, although a reduction in death rate among multiples in the last two years is observed.

17. In 2013, 80 percent of eligible mothers were screened for diabetes. This is a higher rate than in previous years but it is not clear whether this is due to improved uptake or improved data reporting.

18. The data collected by the PMMRC on family violence screening continue to suggest that many women pass through the maternity service without being screened.

19. The rate of optimal investigation of perinatal related death at 53 percent was the highest rate since PMMRC data collection began in 2007, although this increase was not statistically significant. Among the 216 post-mortems in 2013 where value of the post-mortem was assessed, the post-mortem changed the clinical diagnosis in 41 cases (19 percent).

20. Among perinatal related deaths, 16 percent were assessed as potentially avoidable. The largest absolute number of potentially avoidable deaths in any cause of death category was 18 potentially avoidable deaths among deaths from maternal conditions (largely diabetes).

21. Barriers to access and/or engagement with care increase in frequency among women living in increasing levels of socioeconomic deprivation. One in six perinatal related deaths among women residing in the most socioeconomically deprived households might have been avoided by improved access to antenatal care.

22. Spontaneous preterm birth was a cause of death for almost 1000 babies from 2007 to 2013, accounting for 21 percent of all perinatal related deaths from 2007 to 2013.

23. Bleeding occurred at some time during pregnancy in 60 percent of women whose babies died from spontaneous preterm birth.

24. The majority of deaths (71 percent) from spontaneous preterm birth occurred among births prior to 24 weeks. Most of the remainder (21 percent) were born between 24 and 27 weeks.

25. Thirty-four percent of mothers whose babies died from spontaneous preterm birth were smokers, and this is considerably higher than rates of smoking for New Zealand mothers overall (15 percent of mothers at registration for antenatal care).

26. The relative risk of death due to spontaneous preterm birth is six to seven times higher among multiple pregnancies than among singleton pregnancies.

Maternal mortality

1. In 2013, there were 12 maternal deaths. The maternal mortality ratio in New Zealand was 20.0/100,000 maternities (95 percent confidence interval (CI) 11.4–34.9/100,000). The three-year average maternal mortality ratio for 2011–2013 was 16.8/100,000 maternities (95 percent CI 11.8–23.8/100,000). There has been no statistically significant change in the maternal mortality ratio in New Zealand since data collection by the PMMRC began in 2006.

2. Pre-existing medical disease, suicide and amniotic fluid embolism were the most frequent causes of maternal mortality in New Zealand in 2006–2013. Suicide continues to be the leading 'single' cause of maternal death in New Zealand.

3. The cause-specific maternal mortality ratio for deaths from amniotic fluid embolism from 2006 to 2013 was 5.6 times higher in New Zealand than in the UK 2006–2011 ($p<0.0001$).

4. The cause-specific maternal mortality ratio for deaths from suicide from 2006 to 2013 was seven times higher in New Zealand than in the UK 2006–2011 ($p<0.0001$).

5. The risk of maternal mortality is higher for women 40 years and older than for younger women.

6. The maternal mortality ratio for Māori and Pacific mothers is two to three times that of Other Asian, Other and New Zealand European mothers. The relative maternal mortality ratios for direct and indirect deaths were 3.2 and 2.9, demonstrating that the disparity between maternal mortality among Māori and Pacific peoples at highest risk and other ethnicities is not affected by whether the maternal deaths were direct or indirect.

7. The risk of maternal mortality increased significantly with increasing deprivation quintile in 2006–2013. The risk for women living in the most deprived 20 percent of residential areas from 2006 to 2013 was 2.4 times that of those in the least deprived 20 percent.

8. Thirty-six percent of maternal deaths were identified as potentially avoidable from 2006 to 2013. Contributory factors were identified in 61 percent of maternal deaths in the years 2006–2013. The presence of contributory factors and the assessment of potentially avoidable death did not vary by whether maternal deaths were classified as direct or indirect.

Neonatal encephalopathy

1. The rate of neonatal encephalopathy as a proportion of all registered births is 1.19/1000 (95 percent CI 1.06–1.33) registered births. The rate can also be reported as 1.29/1000 births at term (≥37 weeks) (95 percent CI 1.16–1.45) as the definition is limited to term births.

2. There is a higher rate of neonatal encephalopathy among Pacific mothers than New Zealand European mothers, among babies born at 37 weeks, and an increasing rate with increasing deprivation.

3. The majority of babies diagnosed with neonatal encephalopathy have evidence of asphyxia present at the time of birth.

4. The rate of induced cooling of babies with moderate and severe neonatal encephalopathy has increased significantly from 68 percent in 2010 to 83 percent in 2013 (p=0.03).

5. The unadjusted rate of neonatal encephalopathy among women resident in the Capital & Coast DHB area was significantly higher for 2010–2013 than the national rate.

6. The Neonatal Encephalopathy Working Group (NEWG) multidisciplinary review of 83 neonatal encephalopathy babies born in 2010–2011 with abnormal cord blood gases and/or Apgar scores where there was no identifiable peripartum acute event or prelabour Caesarean found contributory factors in 84 percent of cases and found that the severity of the neonatal encephalopathy was potentially avoidable in 55 percent. The key themes identified were risk assessment and management, use of recommended best practice, fetal surveillance, resuscitation, recognition of brain injury in the neonate, and documentation.

Maternal morbidity

1. There were 12 cases of amniotic fluid embolism in New Zealand from 2010 to 2013, giving a rate of 0.5/10,000 maternities. This is higher than rates reported from the UK and the Netherlands, but similar to Australia.

2. There were 69 cases of placenta accreta in New Zealand from 2010 to 2012, giving a rate of 3.6/10,000 maternities. Sixty-five percent of these women had a previous Caesarean section and 58 percent required a hysterectomy for treatment.

Recommendations

These recommendations should be considered alongside previous recommendations from the PMMRC (see the Appendix on page 156 and 'Summary of Key PMMRC 2014 Report Recommendations and Progress' on page 20.)

Recommendations 2015 report

The PMMRC has attempted to format the 2015 recommendations using the SMART framework – that is, specific, measurable, achievable, relevant and timely (Doran 1981).

However, some recommendations are intentionally non-specific. They may take longer to operationalise, particularly if there is a need to encourage deeper learning before improvements can occur.

The 2015 recommendations appear in the body of the document as the recommendation statement alone. In the Executive Summary they include a statement of justification explaining how the data in the report led to the recommendation and a statement of the evidence that supports the recommendation.

The draft recommendations were sent to key stakeholders for consultation. As a result of this process, considerable change was made. We would like to thank these people/organisations for their support of this process.

Methodology

1. **As a matter of urgency, the Ministry of Health update the National Maternity Collection (MAT), including the ethnicity data as identified by the parents in the birth registration process.**

Justification:
As at March 2015, the MAT is incomplete as it does not include 10–15 percent of registration data from DHBs that provide primary maternity care.

As a result of these missing data, it is not possible to undertake robust multivariate analyses including ethnicity, maternal age, socioeconomic status, lead maternity carer (LMC) and DHB of residence, adjusting for smoking and maternal BMI because early pregnancy data are not available for women under the care of hospital maternity services. Women under the care of hospital maternity services are at disproportionately higher risk of perinatal related mortality and differ from the remainder of the birthing population by ethnicity, socioeconomic deprivation and DHB of residence. It is likely that they also differ by smoking and BMI. By not including data about these women, analyses will be misleading.

The PMMRC has previously identified that there are important differences in ethnicity between the National Minimum Dataset (NMDS) and registration datasets which impact on the findings of analyses of the association between ethnicity and perinatal related mortality (PMMRC 2010).

Evidence:
DHBs have service specifications that require them to collect registration data. As at March 2015, the information technology project to transfer these data from DHBs to the Ministry of Health was incomplete.

The Births and Deaths Registration dataset is the preferred source of ethnicity data for mothers and babies, and is the principal source of ethnicity data for the majority of perinatal deaths in the PMMRC collection. These data are truly self-defined as the source is a form completed by the parent(s) and returned to the Registrar of Births, Deaths and Marriages. The MAT dataset sources ethnicity data from the National Health Index, NMDS and LMC datasets. While there is a protocol for collection of ethnicity data from contacts with the health system, historical evidence suggests that there are quality issues in these collections (Cormack 2010).

Perinatal mortality

1. **That all maternity care providers identify women with modifiable risk factors for perinatal related death and work individually and collectively to address these.**

   Strategies to address modifiable risk factors include:

   a. **improving uptake of periconceptual folate**

   b. **pre-pregnancy care for known medical disease such as diabetes**

   c. **access to antenatal care**

   d. **accurate height and weight measurement in pregnancy with advice on ideal weight gain**

   e. **prevention and appropriate management of multiple pregnancy**

   f. **smoking cessation**

   g. **antenatal recognition and management of fetal growth restriction**

   h. **prevention of preterm birth and management of threatened preterm labour**

   i. **following evidence-based recommendations for indications for induction of labour**

   j. **advice to women and appropriate management of decreased fetal movements.**

   All DHBs should report the availability and uptake of relevant services in their annual clinical report to ensure that these strategies are embedded and to identify areas for improvements.

Justification:
Multivariate analysis reported in the eighth report of the PMMRC identified Indian mothers, women with a high BMI, women who smoke in pregnancy and women having their first baby to be at increased risk of stillbirth. Women of Māori and Pacific ethnicity, women who smoke in pregnancy, women living in areas of high socioeconomic deprivation and women having their first baby were identified to be at increased risk of neonatal death. Each of these risk factors is independent of other risk factors and so women with more factors are at higher risk than women with one. Māori and Pacific women are at increased risk of neonatal mortality because of an increased risk of preterm birth. Age was not an independent risk factor after accounting for other factors.

The analysis in this report shows that there are differences in mortality and morbidity by DHB, and the PMMRC has specifically noted where DHB rates fall outside the national average, indicating where urgent work is required. The PMMRC also recognises (and describes in section 1.3 Births in New Zealand 2013) the differences in demography in different regions.

The following DHBs have significantly higher rates of specific deaths than the New Zealand rate and may require additional assistance to address these issues:

- Counties Manukau – all perinatal related mortality
- Northland – stillbirth and neonatal deaths
- Bay of Plenty – neonatal deaths.

Barriers to access and/or engagement with care were the most prevalent contributory factors to perinatal related death (16 percent in 2013) and of these, no antenatal care or infrequent care were the most common. These barriers were most often identified among deaths from spontaneous preterm birth.

Evidence:
The programmes and strategies outlined below may apply to individual maternity care providers or to organisations such as the Ministry of Health, primary health organisations, DHBs and professional colleges.

Periconceptual folate: Folate taken prior to pregnancy and continued up to 12 weeks gestation reduces occurrence and reoccurrence of neural tube defects (De-Regil et al 2010). Folate needs to be taken during the period the baby is developing so it is unlikely to be as effective for women who start folate after pregnancy has been diagnosed. For this reason many countries have instituted food supplementation with folate (RCOG 2003).

Preconception care for women with diabetes: Pre-existing diabetes with poor glycaemic control is associated with fetal abnormalities. From 2007 to 2013, there were 90 perinatal deaths where the Perinatal Society of Australia and New Zealand perinatal death classification (PSANZ-PDC) code was 5.2 (maternal condition: Diabetes/Gestational diabetes).

Antenatal care: High quality evidence for antenatal care is limited. A schedule of approximately 10 visits for nulliparous women and 7 visits for multiparous women is generally recommended (NICE 2008).

BMI: Excessive weight gain during pregnancy, regardless of pre-pregnancy weight, is associated with increased maternal and neonatal risks. The Institute of Medicine has made recommendations about the ideal weight gain in pregnancy (Institute of Medicine and National Research Council 2009) and this is highlighted in the eighth report of the PMMRC (see 'A health BMI in pregnancy', page 53). More detailed information is available from the Ministry of Health at:
http://www.health.govt.nz/publication/guidance-healthy-weight-gain-pregnancy.

A study from Christchurch published in 2014 showed that self-reported height and weight resulted in an under-reported BMI for 69 percent of women, and that as measured BMI increased, self-reported BMI was more likely to be lower and by a greater magnitude (Jeffs et al 2014).

Multiple pregnancy: Close management of ovulation induction and a single embryo transfer protocol for in vitro fertilisation are recommended to limit multiple pregnancies arising from assisted reproductive technologies.

The rate of multiple pregnancy is significantly reduced by a policy of single embryo transfer while the cumulative live birth rate is not reduced if repeated single embryo transfer is compared to one multiple embryo transfer (Pandian et al 2013).

Monochorionic pregnancies are responsible for a disproportionate number of perinatal related deaths in multiple pregnancies. Management of monochorionic pregnancies is outlined in the New Zealand Maternal Fetal Medicine Network (2010) guideline *Monochorionic Twin Pregnancy.*

The *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* (Ministry of Health 2012b) recommend transfer of care from primary to secondary care for any multiple pregnancy.

Smoking: *The New Zealand Guidelines for Helping People to Stop Smoking* (Ministry of Health 2014c) recommend routinely offering all smokers referral to a smoking cessation service. These services provide behavioural support which is effective in reducing smoking in late pregnancy and reducing the risk of preterm birth and low birthweight (Chamberlain et al 2013). Nicotine replacement therapy during pregnancy is considered to be safer than continuing to smoke.

Antenatal detection of fetal growth restriction: Observational evidence is available to support the antenatal recognition, surveillance and management of small for gestational age (SGA) babies. Some of this evidence is usefully outlined in the New Zealand Maternal Fetal Medicine Network (2013) *Guideline for the Management of Suspected Small for Gestational Age Singleton Pregnancies after 34 Weeks' Gestation,* and in the Royal College of Obstetricians and Gynaecologists (RCOG 2013) guideline *The Investigation and Management of the Small-for-Gestational-Age Fetus.* Further discussion of the detection of SGA can be found under recommendation 4.

Prevention of preterm birth and management of threatened preterm labour: Evidence supports a number of strategies (1) that may reduce the rate of spontaneous preterm birth and (2) to manage women who are likely to deliver preterm to reduce the risk of mortality and morbidity.

These strategies include addressing smoking (Been et al 2014), family violence, alcohol and substance use, and screening for and treating asymptomatic urinary tract infection. Evidence supports cervical length screening for women at risk (eg, because of previous preterm birth or following cervical excisional surgery) followed by cervical cerclage or vaginal progesterone for women with a shortened cervix (Conde-Agudelo et al 2013; Dodd et al 2013; Fonseca et al 2007).

Antenatal corticosteroids reduce neonatal mortality from preterm birth by approximately 30 percent (Roberts and Dalziel 2007). Magnesium sulphate infusion for women at risk of preterm birth reduces the risk of cerebral palsy by about 30 percent but does not alter risk of neonatal mortality (Doyle et al 2009). In utero transfer to tertiary facilities reduces mortality and morbidity in preterm babies (Chien et al 2001).

Smarter use of technologies such as quantitative fetal fibronectin and cervical length measurement increase the appropriate use of antenatal corticosteroids, magnesium sulphate and in utero transfer to improve mortality and morbidity for babies who deliver at early gestations, while also minimising overuse of medications, disruption to family lives, and hospital bed stays (Liggins Institute 2015; Kuhrt et al 2015).

Multiple pregnancies are more than six times more likely to suffer perinatal related death from spontaneous preterm birth compared to singleton pregnancies. Strategies to reduce iatrogenic multiple pregnancy include monitoring the use of ovulation induction agents and single embryo transfer in assisted reproductive treatments (Pandian et al 2013).

Induction of labour for postdates pregnancy: Induction of labour at 41 weeks or beyond significantly reduces perinatal deaths. The number needed to treat to prevent one death is 410 (Gülmezoglu 2012).

Fetal movements: A guideline for the management of women presenting with decreased fetal movements is available from the Australian and New Zealand Stillbirth Alliance, although the level of evidence supporting this guideline is limited (Preston et al 2010).

2. Offer education to all clinicians so they are proficient at screening women, and are aware of local services and pathways to care, for the following:

- **a. family violence**
- **b. smoking**
- **c. alcohol and other substance use.**

Justification:
There were 35 perinatal related deaths from 2009 to 2013 where there were barriers to access and/or engagement with care identified due to family violence.

There have been low rates of screening for family violence among mothers of babies who die in the perinatal period reported to the PMMRC since collection of data began in 2007 in spite of the existence of the Ministry of Health Violence Intervention Programme. There is a paucity of national data on family violence in pregnancy and on use of alcohol and other substances in pregnancy.

Alcohol or other substances were used by one-quarter of New Zealand mothers who died from 2006 to 2012, and one-half of mothers who died from suicide (PMMRC 2014b).

Feedback from LMCs, DHBs and professional colleges suggests that there is a lack of confidence in the workforce in the availability of supportive services for women who disclose family violence or alcohol and substance use to their caregivers. Knowledge of the pathways to local support for care of women is an essential part of screening.

Feedback also suggests that, while there is frequently training in place for midwifery and nursing staff and this training is sometimes compulsory, the provision of, requirement for and uptake of training by medical staff is anecdotally less robust.

This is a complex area and screening and referral for family violence, smoking and alcohol and substance use requires confidence in conducting difficult conversations, and ensuring these conversations are culturally appropriate.

There is Ministry of Health targeted funding for maternity care providers to access family violence and smoking education but not for education around alcohol and other substance use. Discussion within the sector is required to determine how this education will be funded and provided.

See 'Practice Point: Alcohol in Pregnancy' on page 56 and 'Practice Point: Family Violence' on page 82.

Evidence:
Family violence: Maternal exposure to domestic violence is associated with increased risk of preterm birth. Women living with domestic violence are more likely to smoke and use other drugs and to be non-attenders to antenatal care. Violence continues into the postpartum period and in the long term is associated with violence to children (Chambliss 2008; Shah et al 2010).

Please refer to *Family Violence Intervention Guidelines: Child and Partner Abuse* (Ministry of Health 2002) for more information.

A systematic review published in 2012 reported good accuracy of screening tools in identifying intimate partner violence, noted that benefits depended on the population screened, and noted that potential adverse effects were minimal (Nelson et al 2012).

There are insufficient studies currently to comment on the effect of interventions to prevent family violence on perinatal mortality (Jahanfar et al 2013; Van Parys et al 2014).

Alcohol: Alcohol is a teratogen which passes freely through the placenta and reaches concentrations in the fetus that are as high as those in the mother. As well as risks of increased perinatal mortality, significant morbidities (such as fetal alcohol spectrum disorder; prematurity; brain damage; birth defects; growth restriction; developmental delay; and cognitive, social, emotional and behavioural deficits) are associated with alcohol consumption during pregnancy.

Brief, reliable screening tools are available to assist practitioners to recognise and refer women who drink alcohol in pregnancy. In 2012 the Ministry of Health published a practical guideline for practitioners on alcohol in pregnancy (Ministry of Health 2012c).

3. **That multi-disciplinary fetal surveillance training be mandatory for all clinicians involved in intrapartum care.**
    a. **This training includes risk assessment for mothers and babies throughout pregnancy as well as intrapartum observations.**
    b. **The aims include strengthening of supervision and support to promote professional judgment, interdisciplinary conversations and reflective practice.**

Justification:
Review of neonatal encephalopathy cases found the most frequent theme raised was fetal surveillance, including appropriate place of birth; choice of intrapartum fetal surveillance method; interpretation of fetal monitoring; escalation of recognised cardiotocograph (CTG) abnormalities; and management of CTG abnormalities.

The most prevalent personnel contributory factors among perinatal deaths reviewed from 2009 to 2013 were failure to offer or follow recommended best practice; lack of knowledge and skills; failure of communication between staff; failure to seek help/supervision; and lack of recognition of complexity or seriousness of the patient's condition by the caregiver. These factors were often associated with hypoxic peripartum death.

Evidence:
A systematic review of CTG training programmes including 20 studies found that 'training was associated with increased CTG knowledge and interpretive skills, higher interobserver agreement, better management of intrapartum CTG, and improved quality of care' (Pehrson et al 2011).

Studies from the UK and Queensland have reported significant reductions in hypoxic ischaemic encephalopathy and Apgar scores less than 7 at five minutes following introduction of universal or mandatory CTG education (Byford et al 2014; Draycott et al 2006).

Fetal surveillance training should incorporate the concepts outlined in the Royal Australian and New Zealand College of Obstetricians and Gynaecologists' (RANZCOG) *Intrapartum Fetal Surveillance Clinical Guidelines* (RANZCOG 2014a), which was endorsed by the New Zealand College of Midwives.

4. **There is observational evidence that improved detection of fetal growth restriction, accompanied by timely delivery, reduces perinatal morbidity and mortality. The PMMRC recommends (amended from previous PMMRC reports) that assessment of fetal growth should incorporate a range of strategies including:**
    a. **assessment and appropriate referral for risk factors for fetal growth restriction at first antenatal visit and throughout pregnancy**

b. **accurate measurement of maternal height and weight at first antenatal assessment**

c. **ongoing assessment of fetal growth by measuring fundal-symphysial height in a standardised way, recorded at each antenatal appointment, preferably by the same person**

d. **plotting of fundal height on a tool for detection of fetal growth restriction, such as a customised growth chart, from 26 weeks gestation**

e. **if fetal growth restriction is confirmed by ultrasound, appropriate referral and assessment of fetal and maternal wellbeing and timely delivery are recommended. The New Zealand Maternal Fetal Medicine guideline (2013) describes criteria for the management of small for gestational age (SGA) pregnancies after 34 weeks.**

The PMMRC supports the Ministry of Health initiative to explore the evidence and validate the use of customised growth charts in New Zealand, and to investigate the appropriate way to incorporate these into the national maternity record.

Justification:
Babies who die are at least 2.3 times, and possibly as much as 3.5 times, as likely to be SGA as all babies born in New Zealand, as measured using customised birthweight centiles.

Evidence:
Customised birthweight centiles have been shown to identify a higher proportion of babies who suffered perinatal mortality than population centiles (Anderson et al 2012).

International evidence shows that serial plotting of fundal height on a customised growth chart doubles antenatal detection of SGA (Roex et al 2012).

Observational data suggest that implementation of a standardised methodology to measure fundal height, including adequate training, led to a reduction in stillbirth in the UK (Gardosi et al 2013).

Maternal mortality

5. **Seasonal or pandemic influenza vaccination is recommended for all pregnant women regardless of gestation, and for women planning to be pregnant during the influenza season.**

   a. **Vaccination is also recommended for maternity care providers to reduce the risk to the women and babies under their care.**

   b. **The PMMRC recommends that the Ministry of Health consult with women and maternity care providers to address barriers to the uptake of influenza vaccination in pregnancy and implement strategies to increase access to and awareness of the benefit of vaccination.**

Justification:
Five women died from influenza in pregnancy from 2009 to 2013, none of whom had been immunised.

Despite national campaigns, uptake of influenza vaccination among pregnant women continues to be modest (NISG 2013).

This recommendation should be considered in association with calls for more effective vaccination in pregnancy against pertussis, because both influenza and pertussis vaccination provide protection to the newborn against these infections.

One baby in the years 2007–2013 died from neonatal pertussis infection in the first 27 days of life.

Evidence:
Pregnancy is a risk factor for poor outcome from influenza infection. Compared with non-pregnant populations, pregnant women with either seasonal or pandemic influenza are at increased risk of serious complications including hospitalisation, admission to intensive care units, cardiorespiratory complications (pneumonia, acute respiratory distress syndrome, respiratory failure) and death (Cantu and Tita 2013). These risks increase with gestation and are highest in the third trimester and in the first two weeks postpartum (Memoli et al 2013; Mertz et al 2013). Risks are also higher in pregnant women with comorbidities.

Influenza in pregnancy is also associated with adverse fetal outcomes including miscarriage, stillbirth, neonatal death, preterm birth and low birth weight, mainly due to consequences of severe maternal illness (Cantu and Tita 2013; Memoli et al 2013).

Inactivated influenza vaccination in pregnancy is effective in reducing the rate of influenza illness in pregnant women and provides protection from influenza to the infant for up to six months after birth (Naleway et al 2014; Zaman et al 2008).

Resources for influenza in pregnancy relevant to the New Zealand setting are available on the websites of RANZCOG (RANZCOG 2014b) and the National Influenza Specialist Group (NISG 2015).

Mothers are the most common source of infant infection with pertussis. Health care personnel are also an important source. The highest risk of infant death from pertussis is during the first six months of life. Passive antibodies following maternal vaccination pass to the baby and help to protect the baby from infection until the time when the baby starts his/her immunisation programme at six weeks of age. The ideal time for maternal vaccination is from 30 to 36 weeks gestation. Immunisation before 20 weeks gestation is not recommended (Auckland Regional Public Health Service, nd).

See 'Practice Point: Influenza in Pregnancy' on page 126.

6. All pregnant women with epilepsy on medication should be referred to a physician.

a. Women with a new diagnosis of epilepsy or a change in seizure frequency should be referred urgently.

b. The PMMRC recommends a review of epilepsy in the *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)*.

Justification:
Three women died of sudden unexpected death in epilepsy from 2006 to 2013. All three had sub-optimal levels of anticonvulsants.

Evidence:
The Confidential Enquiries into Maternal Deaths in the UK found women with epilepsy are 10 times more likely to die in pregnancy than women without epilepsy (Kapoor and Wallace 2014; Lewis et al 2011) and sudden unexpected death in epilepsy remains the major cause of death in pregnant or postpartum women with epilepsy (Kapoor and Wallace 2014; Kelso and Wills 2014).

The pharmacokinetics of anti-epileptic drugs is affected by pregnancy, particularly lamotrigine and also levetiracetam, phenytoin and carbamazepine, and may lead to loss of seizure control (Harden et al 2009; Hoeritzauer et al 2012).

There has been a change to epilepsy medications recommended in pregnancy to less teratogenic medications and these new medications need to be titrated/increased as pregnancy advances.

Currently the *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* state that women with controlled epilepsy are suitable for a consultation with their primary practitioner and that women with poorly controlled epilepsy or on multiple medications require a transfer of care to a specialist service. However, given the increased risks for pregnant women with epilepsy, the PMMRC recommends that all women with epilepsy on medication are referred for specialist input.

See 'Practice Point: Epilepsy in Pregnancy' on page 127.

Neonatal encephalopathy

7. Widespread multidisciplinary education is required on the recognition of neonatal encephalopathy with a particular emphasis on babies with evidence of intrapartum asphyxia (eg, babies who required resuscitation) for all providers of care for babies in the immediate postpartum period.

This should include:

a. recognition of babies at increased risk by their history

b. **signs suggestive of encephalopathy**

c. **knowledge of clinical pathways to induced cooling if required.**

See 'Practice Point: Recognising the Baby at Risk of Neonatal Encephalopathy' on page 147 outlining babies at risk.

Justification:
Review of contributory factors for hypoxic peripartum deaths, and the more recent review of neonatal encephalopathy cases, consistently identifies high rates of personnel contributory factors and high rates of potentially avoidable death and morbidity. The neonatal encephalopathy case review identified neonatal recognition of encephalopathy as one key issue.

Evidence:
Induced cooling (therapeutic hypothermia) reduces the risk of mortality or developmental disability in babies with moderate or severe neonatal encephalopathy by 25 percent and is most beneficial if commenced as soon as diagnosis is made and at least within six hours of birth. This requires vigilance in assessment and observation of newborn babies and readily accessible referral and transfer systems between primary and secondary maternity services and neonatal units.

Information on recognition of babies at risk of neonatal encephalopathy who might benefit from induced cooling and on implementation of a therapeutic hypothermia programme can be found in 'Establishing a hypothermia service for infants with suspected hypoxic ischemic encephalopathy' (Saliba et al 2015).

Local arrangements between the six individual tertiary centres and the centres that transfer to them should include ongoing education, guidelines on selection for cooling therapy and clear routes of communication to cover discussion of individual cases. The New Zealand Neonatal Network is preparing an overarching national guideline on neonatal encephalopathy and therapeutic hypothermia including prediction of outcome and follow-up recommendations.

Data on babies receiving induced cooling in New Zealand are currently collected by the NEWG and also by the Australia and New Zealand Neonatal Network.

8. **That all DHBs review local incident cases of neonatal encephalopathy. The findings of these reviews should be shared at a multidisciplinary local forum and form the basis of quality improvement activities as appropriate.**

   a. **Capital & Coast DHB should review cases of neonatal encephalopathy from 2010 to 2013.**

Justification:
Comparison of individual DHB neonatal encephalopathy rates to the national rate has identified two DHBs with rates significantly above the average – Waikato DHB (identified in the seventh and eighth reports of the PMMRC) and Capital & Coast DHB (identified in this report).

The rate of potentially avoidable deaths among hypoxic peripartum perinatal related deaths is consistently greater than 50 percent. There has been a significant reduction in hypoxic peripartum perinatal related deaths from 2007 to 2013. Although these things may not be linked, it suggests that a significant proportion of hypoxic peripartum injury is potentially avoidable. This was also reported in a paper from Scotland (Becher et al 2007).

The NEWG reviewed 83 neonatal encephalopathy cases born in 2010 and 2011, and found the death or severity of morbidity to be potentially avoidable in 55 percent of cases.

Evidence:
A review of neonatal encephalopathy deaths and survivors using the confidential enquiries into stillbirths and deaths in infancy model in the UK identified suboptimal care in more than 50 percent of cases, with the majority involving the care provided by health professionals (Draper et al 2002). A similar approach applied locally was validated in a study in Scotland reviewing deaths and neonatal encephalopathy due to intrapartum events (Kernaghan and Penney 2006).

Overview of the 2015 Report of the PMMRC

Perinatal mortality

Perinatal related mortality rate

In 2013, the perinatal related mortality rate in New Zealand was 10/1000 births or one baby death for every 100 babies born. This was the lowest rate since the PMMRC started collecting data on baby deaths, but not yet low enough to be sure that the apparent reduction is not due to chance.

The perinatal related mortality rate in New Zealand is similar to the rate reported by England and Wales for 2013 and by Australia for 2012.

Stillbirth rate

The rate of stillbirth in New Zealand has dropped significantly since 2007. In 2007, there was one stillbirth for every 180 births but in 2013 there was one stillbirth for every 200 births, which is a small but significant improvement. The reduction in stillbirths is a reduction in babies dying at term (from 37 weeks onwards).

The reduction has occurred among babies dying before birth without a known cause (unexplained antepartum death), babies dying from lack of oxygen around the time of birth (hypoxic peripartum death), babies dying following bleeding in pregnancy and babies dying of infections prior to birth. There has been an 80 percent reduction in babies dying of lack of oxygen in labour and a 30 percent reduction in babies dying without an identified cause.

Neonatal death rate

The rate of neonatal death has not changed in New Zealand since 2007.

Late termination of pregnancy rate

There has been a significant increase in the rate of terminations of pregnancy from 20 weeks since 2007. This is because of an increase in late terminations in mothers with very early ruptured membranes, perinatal infections, high blood pressure and serious bleeding in pregnancy.

Teen mothers

There has been an increase in the rate of perinatal death among teen mothers (mothers under 20 years old).

In 2013, 3436 teen mothers gave birth, one-third fewer than the 5091 in 2007.

A higher proportion of teen mothers in 2013 were Pacific than in 2007, and more were living with socio-economic deprivation. Both of these factors are associated with increased risk of perinatal death and so may explain some of the increase in the perinatal death rate among young mothers.

Analyses reported in the PMMRC report last year showed that young age is not directly associated with perinatal related death. Young age is associated with higher risk of perinatal death because teen mothers are more likely to be having their first baby, to smoke, to be overweight and to live with socioeconomic deprivation.

Māori, Pacific and Indian mothers

Māori, Pacific and Indian mothers have higher risks of perinatal deaths than mothers of Other Asian and New Zealand European ethnicity for reasons other than having their first baby, smoking, obesity and socioeconomic deprivation, but it is not known why.

DHB perinatal mortality differences

There are differences in perinatal related mortality rates according to the DHB area where mothers live. These rates are calculated from the number of deaths among mothers who live in the DHB area and are not adjusted for differences in age, ethnicity, smoking, obesity and deprivation, which vary by DHB, even though it is known that these factors affect mortality. The PMMRC does not adjust for these factors because they are highlighting areas in the country where health care services need to respond to address these higher rates.

It is not assumed that there are any differences in the quality of care provided by LMCs or hospitals that provide care in these DHB areas, but that there are differences in the needs of families who live in these regions. This year the report highlights the higher perinatal death rate in the Counties Manukau DHB area, the higher stillbirth and neonatal death rates in the Northland DHB area, and the higher neonatal death rate in the Bay of Plenty DHB area. The PMMRC recommends that these DHBs examine why their rates are significantly higher than national rates.

Screening in pregnancy

There was an increase in the proportion of mothers who were screened for diabetes in pregnancy prior to their baby dying, although it is not certain that this is due to an increase in screening. It may be due to an improvement in the completeness of data provided by LMCs to the PMMRC.

There are still many mothers who do not seem to be asked about family violence during their pregnancy, even though family violence is a health issue and known to lead to poor perinatal outcomes.

Every time we screen for family violence we are giving an educational message that family violence is common, it affects people's health, it is okay to talk about it and help is available now or in the future. It doesn't matter if we get a 'yes' or 'no' answer; asking is the intervention.

Where intimate partner violence occurs, there is a 30 to 60 percent chance that child abuse is also occurring (Edleson 1999).

This PMMRC report includes a practice point highlighting education for health providers on screening for family violence (page 82).

Investigation of perinatal death

In 2013, the rate of optimal investigation of perinatal deaths was 53 percent. While this is still low, it is higher than in previous years. The PMMRC has highlighted the importance of post-mortem investigation of perinatal deaths to clinicians and LMCs so families are fully informed and supported in making this decision. The PMMRC has also advocated for an increase in perinatal pathologists to provide post-mortem services.

In 2013, a post-mortem changed the clinical diagnosis of cause of a baby's death for 19 percent of families who agreed to post-mortem.

Spontaneous preterm birth

Spontaneous preterm birth was a cause of perinatal death for almost 1000 babies from 2007 to 2013. It is the cause of death for 21 percent of perinatal deaths.

We know that death from spontaneous preterm birth is more common in multiple pregnancies, among smokers, among users of marijuana and alcohol, among mothers living with socioeconomic deprivation, among young mothers and among Māori and Pacific mothers. Some of these risk factors are independent of the others so that the co-occurrence of more than one factor further increases the risk for that woman.

Bleeding occurred at some time during pregnancy in 60 percent of women whose babies died from spontaneous preterm birth. Bleeding is an important indicator of increased risk and women need to be advised of this and counselled to report any indication that labour might be starting early. Bleeding is also associated with fetal growth restriction and so, for both of these reasons, is an important indicator of a pregnancy at risk. This is true even when there are small amounts of bleeding and when the reason for the bleeding is not clear.

It may be possible to reduce the risk of preterm birth for some women, and treatments are available to reduce the morbidity and mortality of babies who are born early.

Modifiable risk factors and labour

While most babies are fit to withstand the stress of labour, some are not. Some of these babies will die in labour or suffer from hypoxic damage (due to lack of oxygen around the time of birth) which may lead to neonatal death or to neonatal encephalopathy. In this report and previous reports of the PMMRC, local review of hypoxic peripartum deaths and national review of babies with neonatal encephalopathy has identified a high rate of potentially avoidable morbidity and mortality. It is reassuring that there has been a significant reduction in perinatal mortality in this group between 2007 and 2013.

The key issues identified are risk assessment and management, adequate fetal surveillance in labour and early recognition of brain injury in the newborn to facilitate early treatment with induced cooling. Risk assessment is dynamic and occurs in pregnancy, at the start of labour, and throughout labour. A combination of risks is likely to increase the danger to the mother and the baby more than any one factor alone. Risk assessment may indicate the need for a change in location of birth to a place where more rigorous surveillance and operative facilities to expedite birth are available.

A clinical practice point on page 147 provides information on recognising the baby at risk of neonatal encephalopathy.

Potentially avoidable deaths

Approximately 16 percent of perinatal deaths were assessed at review to be potentially avoidable in 2013. This means that if at least one of the factors identified as contributing to the death had been absent then the death may not have occurred. The largest absolute number of potentially avoidable perinatal deaths was among deaths due to maternal conditions (18 deaths), most of which are diabetes.

Barriers to access and/or engagement with antenatal care are more common for women living with socioeconomic deprivation. One in six perinatal related deaths among women residing in the most socioeconomically deprived households might potentially have been avoided by improved access to antenatal care.

Maternal mortality

In 2013, there were 12 maternal deaths. The maternal mortality ratio in New Zealand for 2011–2013 was 16.8/100,000 maternities, which is one maternal death for every 6000 babies born at 20 weeks or more. New Zealand has a comprehensive system for the reporting of maternal deaths and this probably explains the higher rate of mortality seen in New Zealand compared to Australia, which does not have a comprehensive national surveillance system.

Maternal deaths are more common among Māori and Pacific mothers, and mothers aged 40 years and older, and increase with increasing socioeconomic deprivation.

Causes of maternal death

Maternal deaths are reported as direct or indirect. Direct deaths are due to diseases or complications of pregnancy such as bleeding and sepsis. There has been a trend in developed countries, including New Zealand, towards a reduction in direct deaths.

However, there is a six times higher rate of direct deaths due to amniotic fluid embolism in New Zealand compared to the UK. It is not known why and the PMMRC is planning further work to investigate this during 2015–2016.

Indirect deaths result from pre-existing conditions or non-pregnancy related conditions which are worsened by pregnancy. Indirect deaths have been seen to increase in the UK and in the USA. There has been a trend towards an increase in these deaths in New Zealand as well. This may be associated with mothers having babies at an older average age and with increasing obesity in the population.

The most common indirect cause of death in New Zealand is maternal suicide, and maternal suicide is seven times more common in New Zealand than in the UK. This comparative analysis has also led to the PMMRC planning to do further analysis of death from suicide in 2015–2016.

Practice points for improved maternal health

In this report, the Maternal Mortality Working Group of the PMMRC has written practice points for clinicians on epilepsy, influenza in pregnancy, sepsis in and after pregnancy, and perimortem Caesarean section.

It is recommended that women with epilepsy who are on medication should be reviewed by a physician in pregnancy because some epileptic medications need to be increased during pregnancy.

The PMMRC recommends that pregnant women are vaccinated against influenza and whooping cough (pertussis) to protect both mother and baby.

Neonatal encephalopathy

There is a higher rate of neonatal encephalopathy among Pacific mothers than New Zealand European mothers, among babies born at 37 weeks, and among mothers living with socioeconomic deprivation.

The majority of babies diagnosed with neonatal encephalopathy have evidence of asphyxia (lack of oxygen) present at the time of birth. Therefore education in fetal surveillance during labour to detect this is important for all clinicians involved in intrapartum care.

The rate of induced cooling of babies with moderate and severe neonatal encephalopathy has increased significantly from 68 percent in 2010 to 83 percent in 2013. Receiving induced cooling means that babies diagnosed with neonatal encephalopathy have a lower risk of subsequent disability.

The unadjusted rate of neonatal encephalopathy among women resident in the Capital & Coast DHB area was significantly higher for 2010–2013 than the national rate. The PMMRC has recommended that Capital & Coast DHB review all of their cases from 2010 to 2013.

Maternal morbidity

Twelve women who had an amniotic fluid embolism were reported in New Zealand between 2010 and 2013.

There were 69 women who had placenta accreta (excessively adherent or embedded into the uterine wall) reported in New Zealand from 2010 to 2012. Forty-five of these women had previously had a Caesarean section. More than half of the 69 women required a hysterectomy because of this placental disorder.

Summary of Key PMMRC 2014 Report Recommendations and Progress

The following summarises progress made against recommendations published in last year's report (June 2014).

Recommendations (June 2014)	Progress to date (June 2015)
As smoking is a significant modifiable risk factor for both stillbirth and neonatal death, every effort must be made to encourage women to engage in effective smoking cessation programmes prior to, during and after pregnancy.	This recommendation has been reiterated by the National Maternity Monitoring Group (NMMG) and in 2013 they recommended that the Ministry of Health include an indicator around maternal tobacco use (to support the work of the maternity indicator in the Better Help for Smokers to Quit target). This was accepted and actioned by the Ministry of Health. The NMMG Annual Report 2013 and further recommendations can be found at this link: http://www.health.govt.nz/system/files/documents/publications/nnmg-annual-report-2013-4-11-13_web.pdf The Ministry of Health and a wide range of non-governmental organisations have made significant progress on leading New Zealand to the aspirational goal of being smokefree by 2025. Women who are or intend to become pregnant are included in this goal. See the following websites for more information, training and support to reach this goal: • http://www.health.govt.nz/new-zealand-health-system/health-targets/about-health-targets/health-targets-better-help-smokers-quit • http://www.health.govt.nz/our-work/preventative-health-wellness/tobacco-control/pathway-smokefree-new-zealand-2025-innovation-fund • http://www.health.govt.nz/publication/new-zealand-guidelines-helping-people-stop-smoking • http://LearnOnline.health.nz • http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz • http://innov8smokefree.co.nz/Te+Hapu+Ora+for+Midwives • http://www.quit.org.nz/23/reasons-to-quit/smoking-and-pregnancy • http://www.heartfoundation.org.nz/programmes-resources/health-professionals/smoking-cessation-training
A high BMI at booking is an independent risk factor for stillbirth, public health initiatives to prevent obesity prior to pregnancy should be supported. Optimal weight gain according to BMI should be emphasised and encouraged during pregnancy.	From 2015, the Ministry of Health will report high maternal BMI as one of the New Zealand Maternity Clinical Indicators. This is expected to support DHBs and maternity services to adequately plan for the care of obese pregnant women, as well as identify DHBs that should prioritise strategies that support healthy weight gain in pregnancy. *The Health Promotion Agency* The Health Promotion Agency manages the HealthEd resource service on behalf of the Ministry of Health. The booklet *Eating for Healthy Pregnant Women/Ngā Kai Totika mā te Wahine Hapū* was first written in 2010 and updated in 2014. See https://www.healthed.govt.nz/resource/eating-healthy-pregnant-womenng%C4%81-kai-totika-m%C4%81-te-wahine-hap%C5%AB

Recommendations (June 2014)	Progress to date (June 2015)
	Ministry of Health The Ministry has a web page and resources targeted for women to maintain healthy weight while pregnant. The Ministry developed a guideline with a multi-disciplinary group in 2014 and this is available at: http://www.health.govt.nz/your-health/healthy-living/pregnancy/healthy-weight-gain-during-pregnancy *Healthy Families NZ initiative* Implementation of this initiative began in September 2014. It is funded by the Ministry of Health. The Healthy Families NZ programme encourages families to live healthy lives – by making good food choices, being physically active, sustaining a healthy weight, being smokefree and drinking alcohol only in moderation. It is part of the Government's approach to promoting good health. See http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz *Investment in workforce development* It was announced in July 2013 that the Government is investing $2.28 million in a new workforce development programme for health professionals who care for pregnant women and babies. The training programme aims to give frontline health workers the latest evidence-based research into how pregnancy and early life events can influence long-term health outcomes. The new programme will be run by Gravida: National Centre for Growth and Development, which focuses on discovering what 'early life' events affect long-term health outcomes. Gravida has collaborated with the National Heart Foundation to deliver this project as well as Plunket, the New Zealand College of Midwives and Tipu Ora. http://www.gravida.org.nz/news-and-events/news/2-3m-to-help-mums-and-families-make-good-food-choices-for-their-children/ Health Navigator New Zealand*; Everybody; and* Live to 100 *websites* Health Navigator is a charitable trust that provides trusted information for clinicians and consumers. The *Health Navigator New Zealand* website is a collaborative, non-profit initiative led by clinicians and consumers in response to the need for a central place to find reliable and trustworthy health information and self-help resources. *Health Navigator New Zealand* incorporates the *Everybody* and *Live to 100* websites. See www.healthnavigator.org.nz The *Live to 100* website has a page dedicated to weight gain in pregnancy with consumer friendly text to guide women who are pregnant. See http://liveto100.everybody.co.nz/nutrition/weight-gain-in-pregnancy

Recommendations (June 2014)	Progress to date (June 2015)
There is a need to recognise the independent impact of socioeconomic deprivation on perinatal death, specifically on preterm birth, which after congenital abnormality is the leading cause of perinatal death. Addressing the impact of poverty requires wider societal commitment as has been highlighted in the recent Health Select Committee report on improving child health outcomes. The PMMRC supports the implementation of the recommendations. This report can be found at: http://www.parliament.nz/resource/en-nz/50DBSCH_SCR6007_1/3fe7522067fdab6c601fb31fe0fd24eb6befae4a	The PMMRC notes the significant progress made in response to the recommendations of the Health Select Committee report of 2013. The PMMRC also endorses the briefing by the Health Select Committee of April 2014 which recommends that the Government progress all 104 accepted and partially accepted recommendations according to their timelines, and monitor and reconsider the remainder. The briefing of April 2014 is available at this link: http://www.parliament.nz/resource/en-nz/50DBSCH_SCR6184_1/6d54bb084931c065649d52c1604e2a99b3e8a03c The following initiatives demonstrate cross-agency commitment and collaboration to address the determinants of health. This list is not comprehensive, but indicative. *Healthy Families NZ Initiative* *See update above.* See http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz *Child Poverty Monitor* The Child Poverty Monitor was first published in 2013 and the technical report provides data on a set of indicators that assess aspects of child poverty in New Zealand and their implications for child wellbeing. It is supported by the partnership between the Office of the Children's Commissioner, the University of Otago's New Zealand Child and Youth Epidemiology Service and the JR McKenzie Trust. http://www.nzchildren.co.nz/index.php *Vulnerable Children Act 2014* On 1 July 2014 the Vulnerable Children Act and other associated legislation passed into law. The Act forms a significant part of comprehensive measures to protect and improve the wellbeing of vulnerable children and strengthen our child protection system. Five chief executives of government agencies are jointly accountable for acting together to develop and implement a plan to protect our children from harm, working with families/whānau and communities. *The Children's Action Plan* The Children's Action Plan operationalises the Vulnerable Children Act. Children's teams have been set up across the country. Their role is to work with identified vulnerable children and: • focus on the individual child • get the right people working together • include iwi/Māori, health, education, welfare and social services • make a plan to support each child using the local community • be responsible for keeping the plan on track • be responsible for the safety and wellbeing of each child they work with.
Maternity workforce education programmes and DHB guidelines should incorporate the third edition of the RANZCOG Fetal Surveillance Guidelines (which are supported by the New Zealand College of Midwives). These are available at: https://www.ranzcog.edu.au/intrapartum-fetal-surveillance-clinical-guidelines.html	To date, 12 of the 20 DHBs advise they have implemented the RANZCOG Fetal Surveillance Guidelines into their workforce education programmes and policy guidelines.

Recommendations (June 2014)	Progress to date (June 2015)
The PMMRC recommends that Northland, Tairawhiti and South Canterbury DHBs review all cases of intrapartum related death at term in their area to identify opportunities for improvement.	Northland, Tairawhiti and South Canterbury DHBs have advised they have reviewed the cases of intrapartum related death at term in their DHBs as recommended.
Maternal mortality	
Women who are unstable or clinically unwell should be cared for in the most appropriate place within each unit in order for close observation to occur. When observations are abnormal, clear documentation, early review by a senior clinician and development of a detailed management plan are required.	Twelve DHBs have responded supporting this recommendation and advised unstable or clinically unwell women are cared for in the most appropriate place within their hospital. All DHBs report through their Maternity Quality and Safety Programmes on their implementation of the *Referral Guidelines*. *Ministry of Health* In 2012 the Ministry of Health published the revised *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines*). These guidelines are for use by LMCs and DHBs. The aim is to improve the safety and quality of maternity care and to ensure women are referred by their LMC to the most appropriate level of care for their particular condition. They are to be used in conjunction with the Maternity Services Notice 2007. The Ministry of Health intends to review the *Referral Guidelines* by December 2016.
Women with serious pre-existing medical conditions require a multidisciplinary management plan for the pregnancy, birth and postpartum period. This plan must be communicated to all relevant caregivers.	*Ministry of Health* DHBs are required to staff appropriately under the Primary, Secondary and Tertiary Maternity Facilities and Services Specifications. Link to Service Coverage Schedule document: http://www.nsfl.health.govt.nz/apps/nsfl.nsf/menumh/Accountability+Documents Link to Maternity Services Specifications: http://www.nsfl.health.govt.nz/apps/nsfl.nsf/pagesmh/444 Information about support for pregnant women and their babies who have, or may have, pre-existing medical conditions is available at: http://www.health.govt.nz/your-health/services-and-support/health-care-services/maternity-services/pregnancy-and-newborn-screening Updated as at December 2014.
Neonatal encephalopathy	
All DHBs should undertake local review of cases of neonatal encephalopathy to identify areas for improvement in care including adequacy of resuscitation and cooling.	In 2015 the NEWG will conduct a survey of clinicians to determine if and how DHBs are reviewing babies with neonatal encephalopathy, including the pregnancy and intrapartum care of the mother and neonatal care of the baby.
The NEWG and the PMMRC support the development of a guideline for the investigation and management of neonatal encephalopathy.	The development of a neonatal encephalopathy guideline is on the 2015 work plan of the Neonatal Network.

Parents, Families, Whānau

Compiled by Linda Penlington

This section of the report is designed for parents, families and whānau of the babies who died during 2013.

This report from the Perinatal and Maternal Mortality Review Committee (PMMRC) is the ninth annual report. What is becoming clear to those of us who work with the PMMRC is that positive, measurable changes are occurring in the mortality rate for our families here in New Zealand. There will sadly, and unavoidably, be deaths of our babies (and sometimes their mothers) but the purpose of this review group, and this report each year, it to see where and when we can make changes to the way we do things to try to minimise those deaths.

The PMMRC looks at all types of process in the baby-delivering world. We look at each case individually (led of course initially by your own lead maternity carer (LMC) and district health board (DHB) at an intensively detailed level) and look for trends in poor outcomes, as well as trends in great outcomes. Of course the medical issues in each case are scrutinised, but we also look at the processes from when a mother registers with antenatal care through to delivery, as well as the personnel involved at each level, how information about risk is communicated to families, and how systems can be improved in all of those stages.

There's a huge amount of data collected about the mother's health and lifestyle before pregnancy, during pregnancy and in the weeks after delivery. All of this complex information takes time to sort through, and even more time to accumulate enough information over a few years to start to see trends. This is the important part of all the previous years' work, and the work going forward.

In a nutshell, we can start to see what possibly went wrong in some cases, and therefore make changes to minimise those losses in the future.

So, what's actually improved and changed?

The most encouraging discovery is that the rate of stillbirth has dropped significantly since 2007. In true numbers that means that 30 fewer families had to experience the horror that is the loss of their child. This falls mostly into the group who lost their baby during labour and who were 37+ weeks pregnant, and those over 28 weeks where the baby's death before birth was determined to be unexplained. Progress indeed.

Two other findings this year are worth a mention. Firstly, the losses of babies in multiple pregnancies have remained unchanged and this is still statistically significant. These numbers give more and more weight to the idea that singleton pregnancies are far safer than multiple pregnancies, and if and where possible (ie, in vitro fertilisation), only one embryo should be implanted.

Secondly, another interesting discovery is that despite the fact that the numbers of post-mortems being completed on these babies has not risen overall, during the 2013 year 41 cases (19 percent) of the post-mortem being carried out revealed a different cause of death from that previously thought. So that strongly indicates that as parents, even if we think we know the reason that the baby died, we should request a post-mortem to be absolutely sure. After all, the two biggest questions we have are 'Did I do anything wrong?' and 'Is this going to happen again?' Sometimes even a post-mortem can't tell us why the baby died, but we can absolutely find out what didn't cause the death. That information gives us the clarity to determine how to approach any future pregnancies, and information for the caregivers to approach with specific knowledge and caution for you and others in a similar situation.

In conclusion, while this report may seem daunting, it contains all the data required for groups like the PMMRC, DHBs and LMCs to start to see where lives can be saved. If you are reading this report and have lost either a mother or your baby, please understand that their lives have not been in vain: their lives and deaths have been noted and provide precious and crucial information for the ongoing understanding in the possible prevention of future losses for you and other families. Their lives have been important, and will not be forgotten.

From the PMMRC group to you, the reader, thank you for your bravery, your honesty and candour with the information you have provided. It is valued, useful, life-saving and enormously helpful. Kia kaha.

1 Perinatal Mortality 2013

1.1 Introduction

In New Zealand, maternity care is funded by the Ministry of Health. Maternity care is provided by 20 district health boards (DHBs) nationally and by lead maternity carers (LMCs), who receive funding from the Ministry of Health. 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 of Health provide guidelines about appropriate care for mothers with risk factors.

The *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* provide information about referring pregnant women, transferring clinical responsibility and transferring care in emergencies (Ministry of Health 2012b).

1.2 Methodology

Data sources

The perinatal deaths presented in this report occurred between 1 January and 31 December 2013. For fetal deaths, the date of birth is used in place of 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 (eg, her past medical and obstetric history and details of the birth), and the other form contains information on the baby. The questions are reviewed and adjusted annually to ensure the data collection remains relevant and robust.

After local review, a multidisciplinary team led by 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. The local coordinator also submits the post-mortem and histology reports with the classification form.

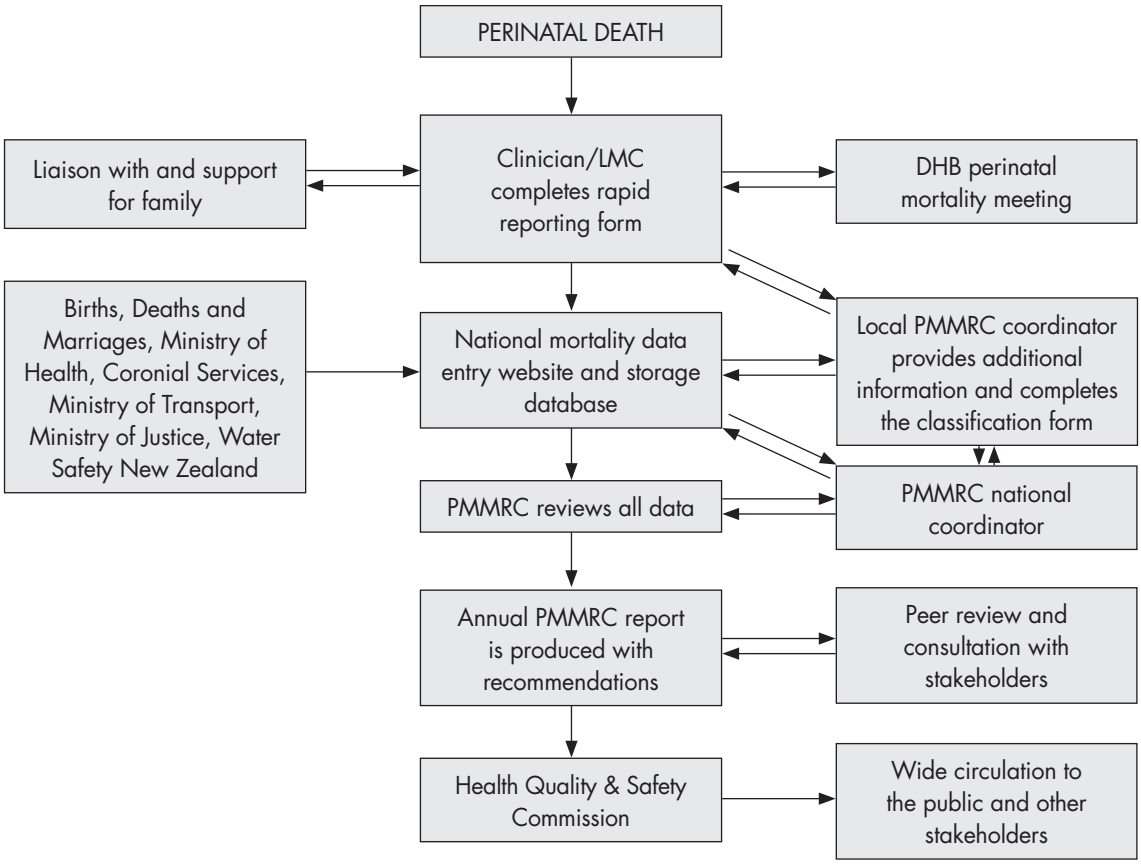
Contributory factors and potentially avoidable mortality

An assessment of contributory factors and potentially avoidable perinatal related death is completed by a multidisciplinary team led by the PMMRC local coordinators following local review and submitted along with the PSANZ classification of perinatal death. The PMMRC contributory factors and potentially avoidable perinatal death form includes questions that identify contributory factors related to organisation and management, personnel and barriers to accessing and/or engaging with care. A death is considered potentially avoidable if the absence of the contributory factors may have prevented the death. From 2011, local coordinators were asked to indicate the main contributory factor(s) in identifying the death as potentially avoidable. A copy of the form can be found at http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/.

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 potentially avoidable death as that used for perinatal deaths.

Figure 1.1 outlines the PMMRC process. A user guide describing the definitions and data elements used by the PMMRC (PMMRC 2014a) is available online at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/1566/.

Figure 1.1: 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 PSANZ classifications.

Audit of perinatal related death data 2012

Each year, an audit is undertaken to compare the data submitted to the PMMRC with clinical records to assess the accuracy and completeness of the data, including review of the PSANZ perinatal mortality classification.

The audit of 2012 data focused on potentially avoidable perinatal related deaths, identified using the PMMRC process as described above (contributory factors and potentially avoidable mortality), and compared the PMMRC data to clinical records from GPs, LMCs and DHBs.

The 2012 audit reviewed 82 perinatal related deaths (76 mothers), three late terminations of pregnancy, 41 stillbirths and 38 neonatal deaths. The information provided below relates to the audit of these 82 perinatal related deaths.

There were eight deaths (10 percent) where the auditor's and the original primary perinatal death classification (PSANZ-PDC) varied. This included three deaths where the secondary classification allocated was considered at audit to be the primary classification; that is, antepartum haemorrhage (PSANZ-PDC 4) leading to preterm labour (PSANZ-PDC 9). In seven deaths (9 percent) there was a change in the sub-category allocated and an additional sub-category was allocated in two deaths. The PMMRC data were updated to reflect these findings.

The 2012 audit's focus was potentially avoidable perinatal deaths and included a disproportionate number of women who had little or no contact with a GP, LMC or DHB. There was often information missing from both the clinical notes and the PMMRC data. While the vast majority of data fields audited concurred with the clinical notes, there were missing data or discrepancies in 60 deaths (73 percent).

Clinical information was missing or incorrectly noted in 35 deaths (42 percent), past obstetric history in 11 deaths (13 percent), gestation of registration in 11 deaths (13 percent), designation of LMC in nine deaths (11 percent) and height and weight in 11 deaths (13 percent).

These findings were presented to the PMMRC local coordinators at their annual meeting to highlight areas for improvement, along with a reminder of the importance of complete and accurate data. Training on the PSANZ classification of cause of death focused on the identification of the antecedent cause and allocation of sub-categories.

The audit of 2012 data will include a comparison of the local PMMRC process for identifying contributory factors to anonymised independent review and will be published in the PMMRC 10th report.

Denominator data

New Zealand birth registrations

The denominator data used in this report consist of New Zealand birth registrations during the 2006–2013 calendar years. The New Zealand birth registration dataset 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 mother and baby ethnicity between the birth registration dataset and NMDS in previous years have shown significant differences.

The birth registration dataset of New Zealand births is collated by 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 representative of the 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 retain 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 indicate which babies died as neonates, 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 the calculation of neonatal death rates.

New Zealand National Maternity Collection (MAT)

The New Zealand National Maternity Collection (MAT) is a relatively new initiative combining data collected by LMCs, which is required to enable claims for payment, with hospital discharge data. This dataset now represents the best approximation of live births in New Zealand in any year and provides data on body mass index (BMI), parity, smoking, LMC registration and gestation at registration for the maternity population of New Zealand.

The PMMRC would prefer to use this dataset as the denominator for analysis as it includes clinical variables which are known predictors of perinatal related death.

However, there are some limitations to the use of the MAT dataset at this time.

- DHBs cannot currently provide registration data such as BMI and smoking on the approximately 15 percent of mothers for whom they provide primary maternity care (recorded in the MAT dataset as 'No LMC' or 'Other'). These mothers more often reside in areas of higher deprivation (New Zealand Index of Deprivation (NZDep)), are more often of Pacific and Indian ethnicity, and more often reside in Counties Manukau, Auckland, West Coast, Nelson Marlborough, Northland and Whanganui DHB areas. As these sociodemographic factors, along with associated clinical variables such as smoking, parity and BMI, are also known to be associated with perinatal related mortality rates, these systematically missing data between the numerator (deaths) and denominator (all births) may result in bias in analysis findings. It is not known when these issues will be resolved.

- More than 90 percent of the smoking and BMI data are missing from the MAT dataset for live births in 2007.

- The MAT and the PMMRC datasets derive and define ethnicity differently. Maternal ethnicity is derived from BDM birth registration in the PMMRC dataset, while the MAT dataset 'derives ethnicity from ethnic codes reported to NMDS (National Minimum Dataset for hospital discharges) for birth and postnatal events, LMC Labour & Birth claims and NHI at time of delivery. The three highest priority ethnic codes that reach a threshold proportion are stored in the Aggregated Pregnancy table' (National Health Board Business Unit 2011). It is possible that this difference may introduce numerator–denominator bias.

Until the MAT dataset is complete, MAT data are referenced when no other denominator data exist, but with a statement noting that the data are incomplete.

The birth registration dataset has been used as the denominator in the analyses in this report. This also allows current data to be compared with previous years.

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 (Heron 2011). 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 (ie, 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 1.21, 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 rates sometimes include combined data for the seven full years that the PMMRC has collected data (2007–2013) 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 2013 year alone are presented in table form in the text. The combined seven-year data is available in table form at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/.

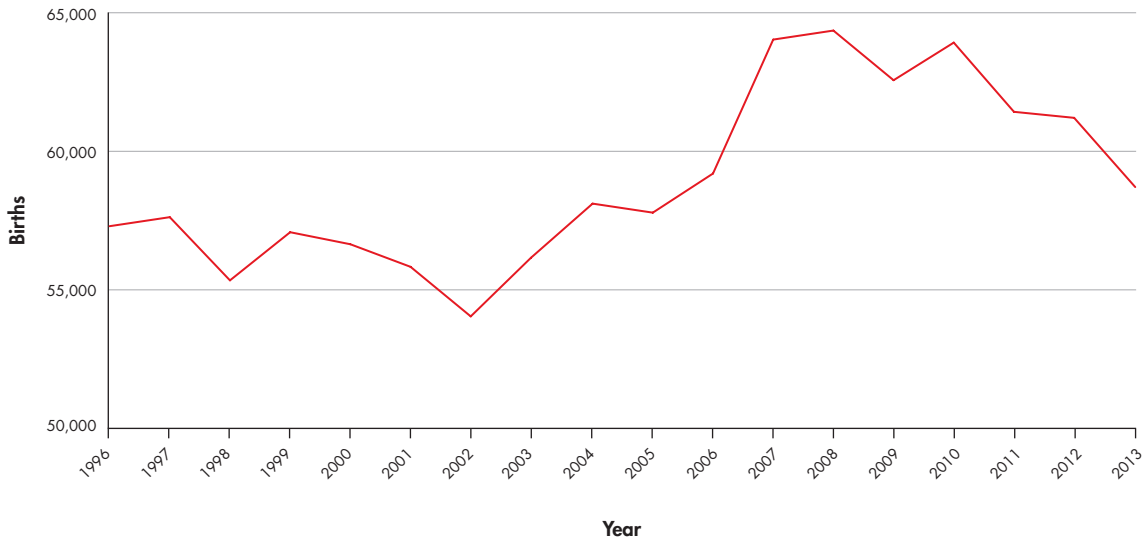
Recommendation

As a matter of urgency, the Ministry of Health update the National Maternity Collection (MAT), including the ethnicity data as identified by the parents in the birth registration process.

1.3 Births in New Zealand 2013

New Zealand birth registrations 2013

Figure 1.2: Total live birth registrations in New Zealand 1996–2013

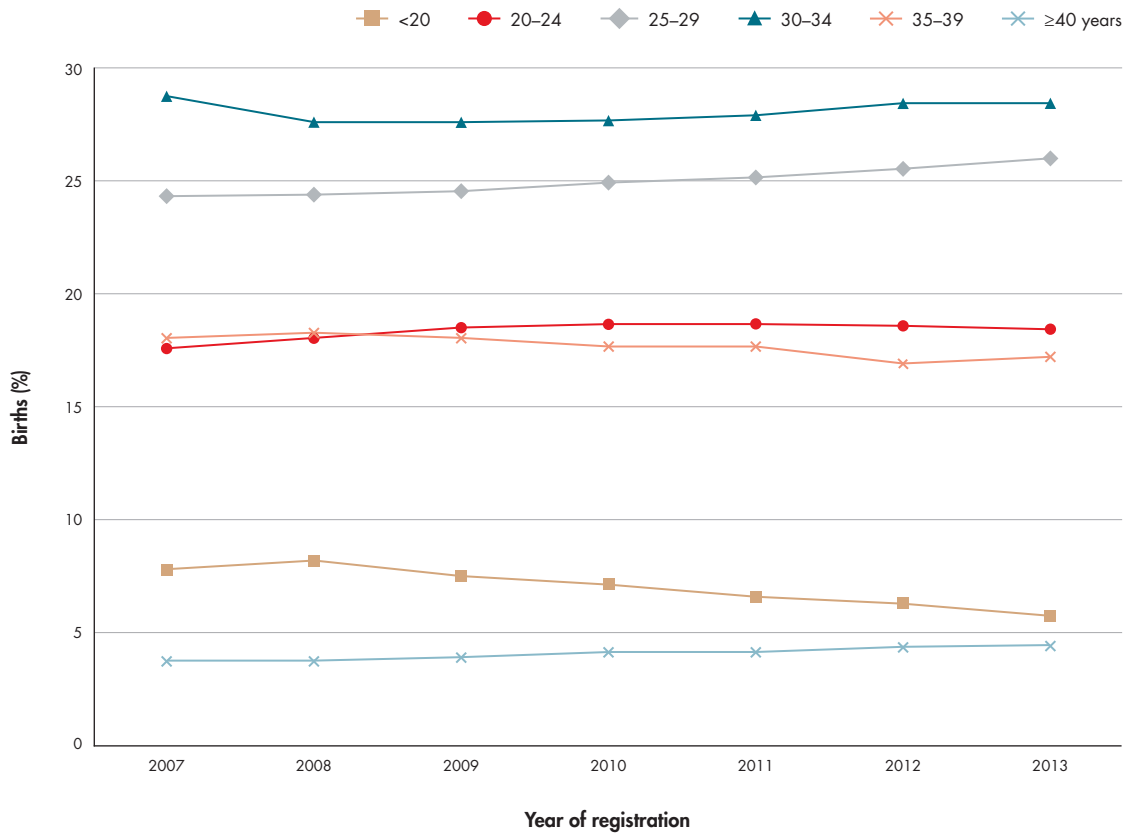


Amended from Statistics New Zealand
http://www.stats.govt.nz/browse_for_stats/population/births/BirthsAndDeaths_HOTPYeDec13.aspx

There has been a decline in total births in New Zealand in the years 2011 to 2013 from the record high levels in 2007–2010.

Maternal age

Figure 1.3: Trends in maternal age among birth registrations in New Zealand 2007–2013



The mean age of mothers in New Zealand in 2013 was 29.32 years, which is statistically significantly older than 29.15 in 2007.

The greatest number of births in New Zealand continues to be among mothers in the five-year age band of 30–34 years (28.43 percent).

The proportion of births to mothers under 20 years has been falling since 2008, and was statistically significantly lower for 2013 (5.72 percent) than 2007 (7.76 percent).

The proportion of births to mothers aged 40 years and older increased significantly from 3.76 percent in 2007 to 4.41 percent in 2013.

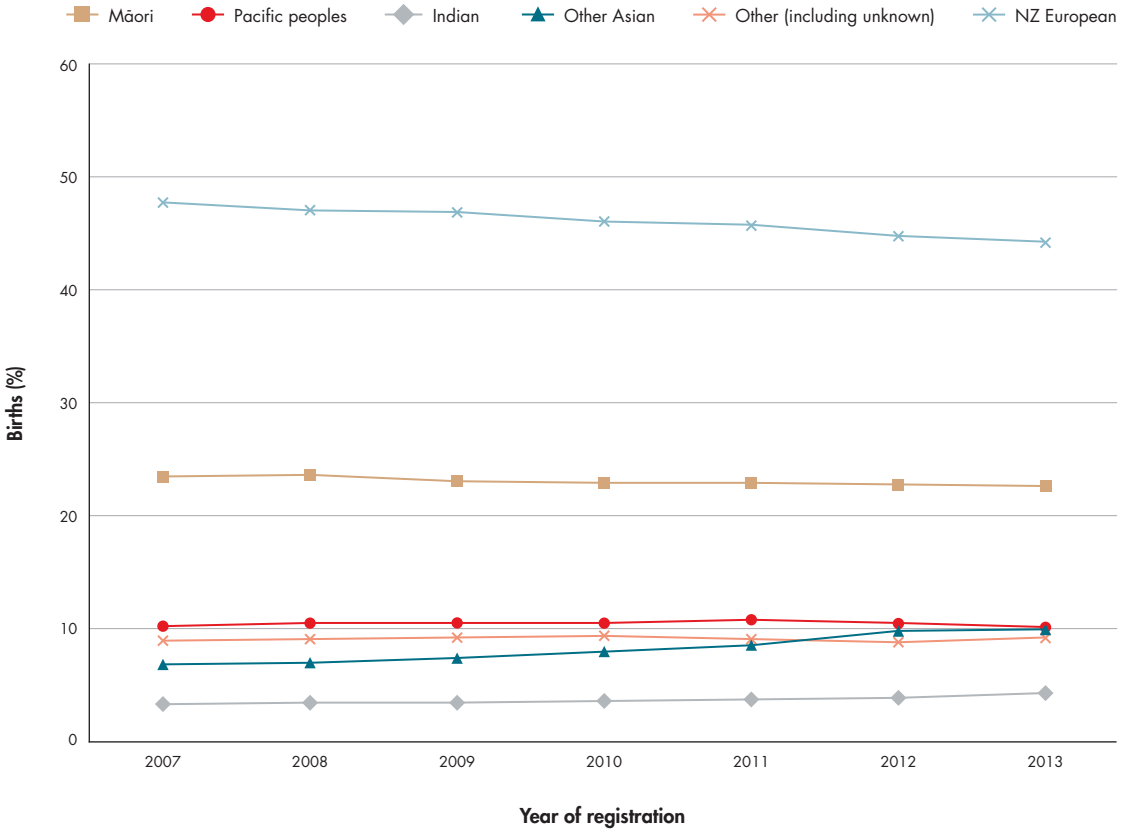
Ethnicity

The process for collection of ethnicity data is outlined in 'Definitions' at the back of the report (page 166).

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, 43.7 percent of mothers identified as New Zealand European, 22.5 percent as Māori, 10.3 percent as Pacific peoples, 4.5 percent as Indian, 10.0 percent as Other Asian and 9.0 percent as Other ethnicities in 2013.

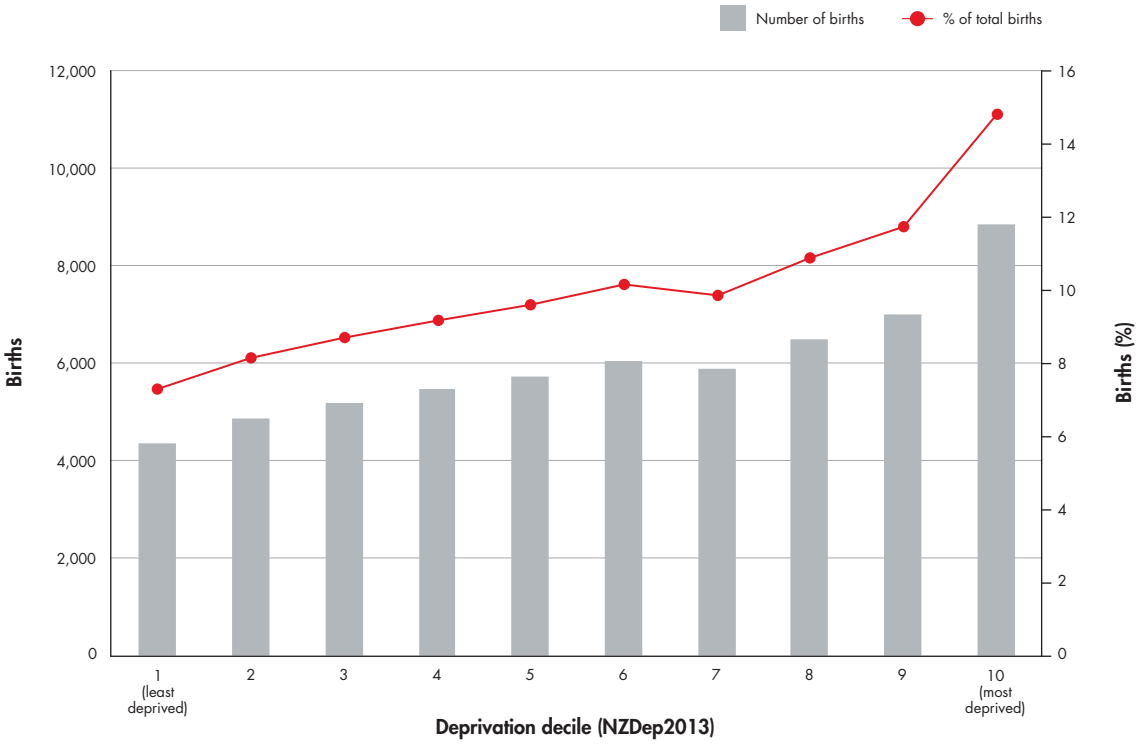
Figure 1.4: Trends in maternal prioritised ethnicity among birth registrations in New Zealand 2007–2013



The distribution of ethnicity among birthing mothers has changed significantly from 2007 to 2013 (Figure 1.4). There has been a statistically significant increase in the proportion of Indian, Other Asian and women of Other ethnicities birthing in New Zealand, and a significant decrease in the proportion of New Zealand European mothers (47.7 percent to 43.7 percent) and Māori mothers (23.5 percent to 22.5 percent). There has been no change in the proportion of Pacific mothers.

Socioeconomic deprivation

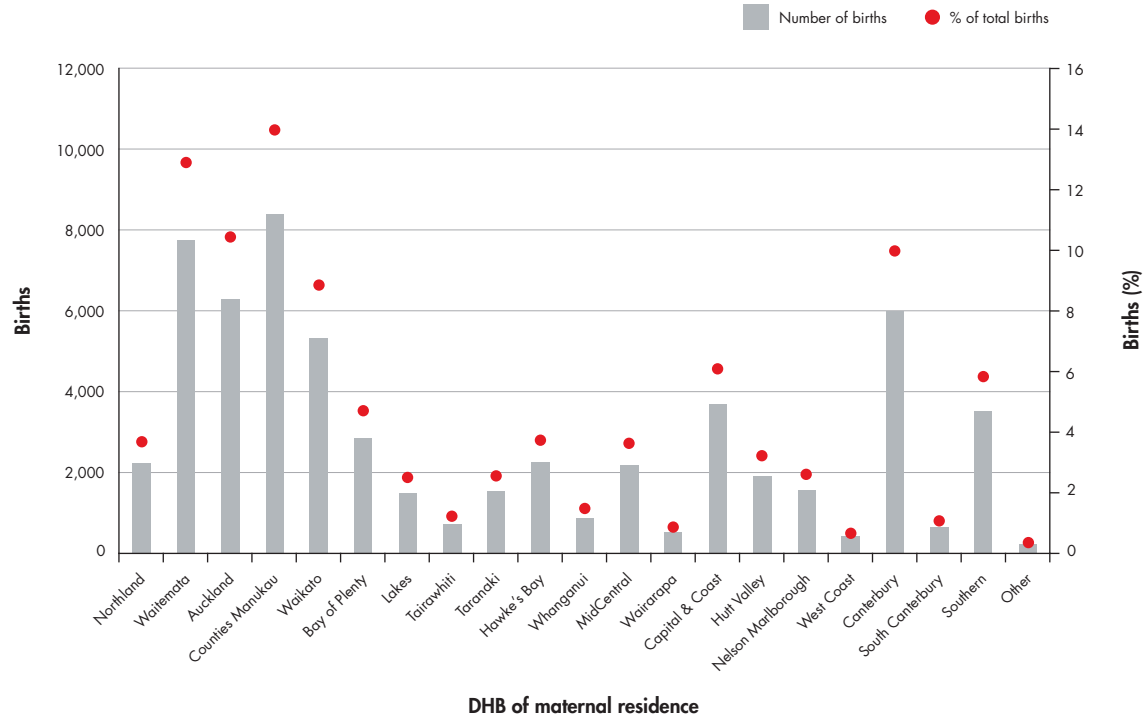
Figure 1.5: Distribution of deprivation deciles (NZDep2013) among birth registrations in 2013 (total births excluding unknown=59,807)



Proportionately more babies are born to women residing in the higher deciles (6–10) compared to lower deciles (1–5).

DHB of residence

Figure 1.6: Distribution of births by DHB of maternal residence among birth registrations in 2013 (total births=60,039)



The greatest proportion of births occurs among women residing in Counties Manukau, Waitemata, Auckland, Canterbury and Waikato DHB regions. Twenty percent of births are to mothers domiciled in the South Island.

Associations between demographic variables

Socioeconomic deprivation and ethnicity

Figure 1.7: Distribution of deprivation quintiles (NZDep2013) by maternal prioritised ethnicity among births registered in 2013 (total births=60,039)

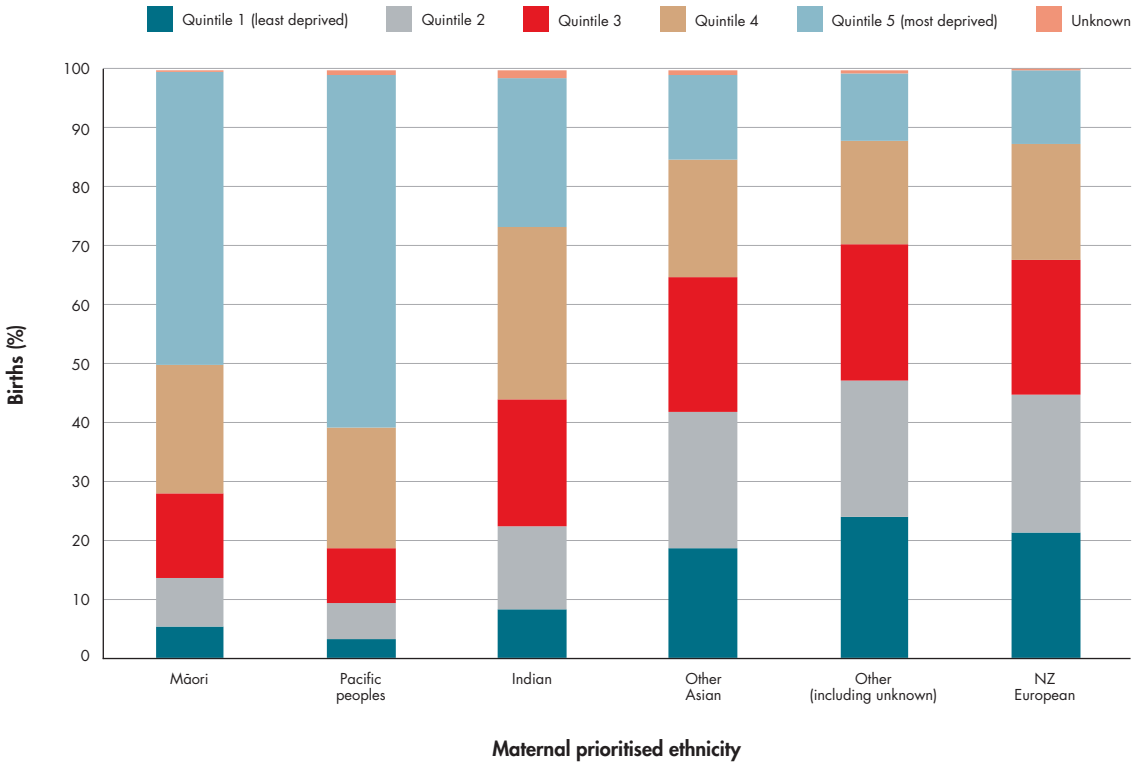
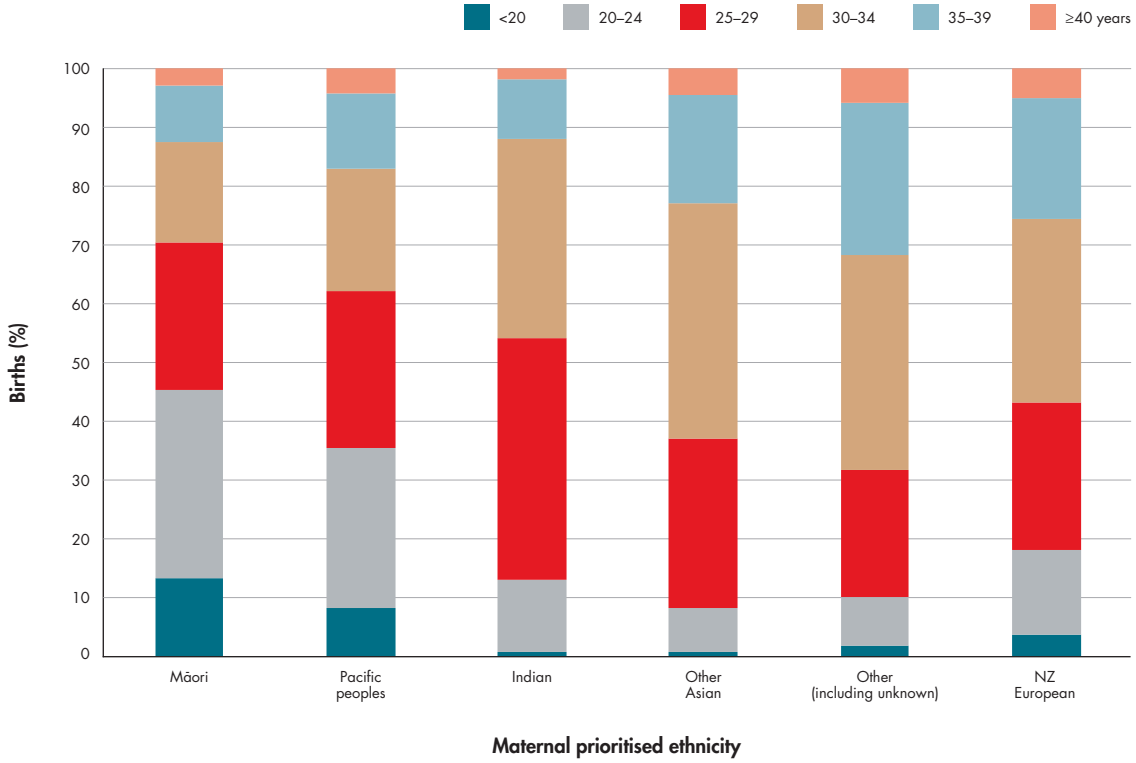


Figure 1.7 shows the distribution of deprivation quintiles within maternal ethnic groups. There is an unequal distribution of deprivation by ethnicity. There is no difference in distribution between New Zealand European and Other, but all other ethnicities differ significantly from each other. Pacific mothers are living in significantly more deprived (NZDep2013 deciles 9–10) areas than any other ethnic group. Māori mothers live in more deprived areas than all ethnic groups other than Pacific peoples. Indian mothers live in more deprived areas than Other Asian, Other and New Zealand European mothers. Other Asian mothers live in more deprived areas than New Zealand European and Other ethnicities.

Age and ethnicity

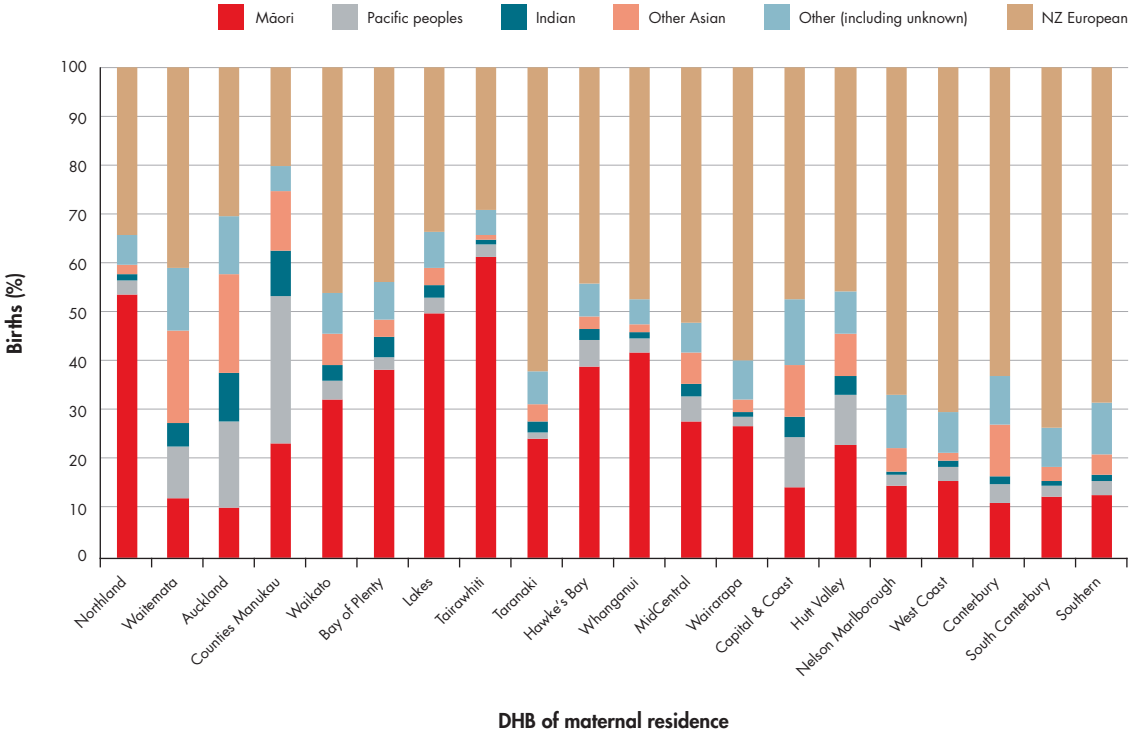
Figure 1.8: Distribution of maternal age by maternal prioritised ethnicity among birth registrations in 2013 (total births=60,039)



Mothers who identify themselves as Māori had the youngest age distribution. That is, a higher proportion of Māori mothers were in the younger age groups. 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 and ethnicity

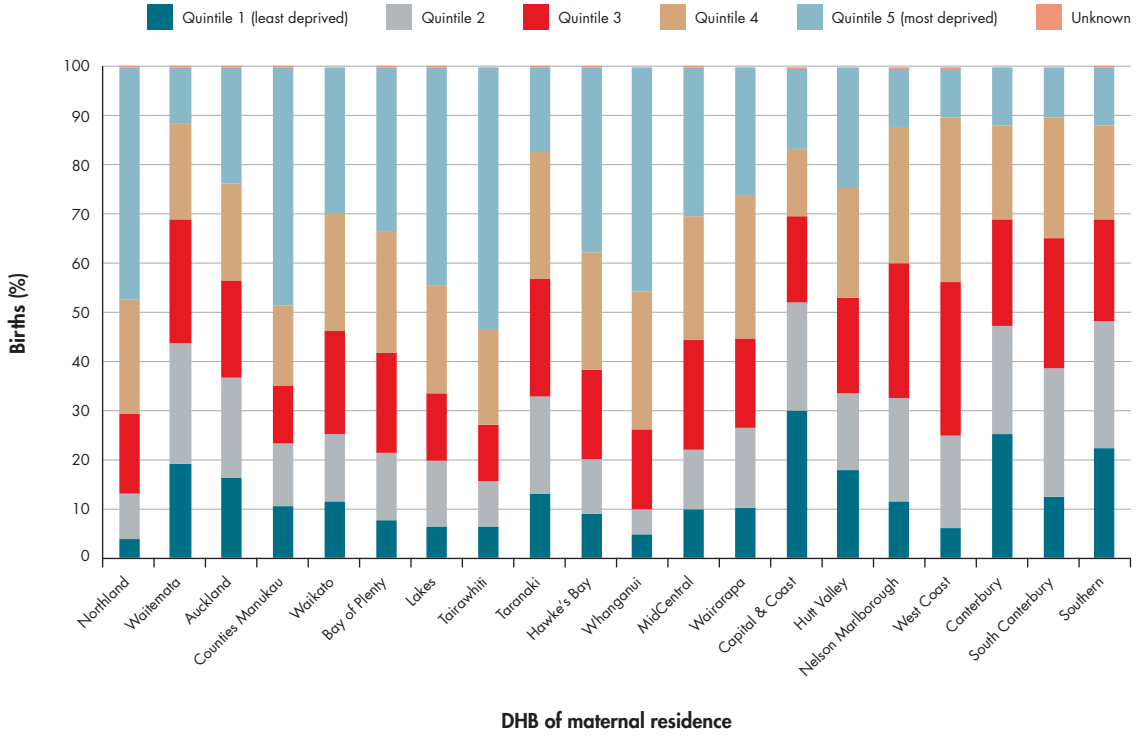
Figure 1.9: Distribution of maternal prioritised ethnicity by DHB of maternal residence among birth registrations in 2013 (total births excluding unknown DHB=59,840)



There is wide variation in distribution of maternal ethnicity across the different regions in New Zealand. The five DHBs on the right-hand end of Figure 1.9, which are the DHBs in the South Island, have a higher proportion of New Zealand European mothers (more than 60 percent) than any DHB 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 and Indian mothers. Counties Manukau has the lowest proportion of New Zealand European mothers (21 percent) of any DHB in the country.

DHB and socioeconomic deprivation

Figure 1.10: Distribution of deprivation quintiles (NZ Dep2013) by DHB of maternal residence among birth registrations in 2013 (total births excluding unknown DHB=59,840)



The distribution of births by NZDep quintile is also not uniform across the country. The highest proportion of births in the highest deprivation quintile areas occur in the Tairawhiti (53 percent), Counties Manukau (48.5 percent), Northland (47.2 percent), Whanganui (45.8 percent) and Lakes (44.5 percent) DHB regions. The highest proportion of births in the lowest deprivation quintile areas occur in Capital & Coast (30.0 percent), Canterbury (25.4 percent) and Southern (22.4 percent) DHB regions. This is consistent with population distribution of deprivation decile areas in New Zealand.

1.4 Perinatal Mortality 2013

Perinatal mortality rates

Table 1.1: Summary of New Zealand perinatal mortality rates 2013

	Using NZ definition		Using UK definition*	
	n	Rate	n	Rate
Total births	60,039		59,888	
Fetal deaths (terminations of pregnancy and stillbirths)#	446	7.4	262	4.4
Terminations of pregnancy	139	2.3	60	1.0
Stillbirths	307	5.1	202	3.4
Early neonatal deaths <7 days	121		121	
Late neonatal deaths 7–27 days	31		31	
Neonatal deaths <28 days+	152	2.6	152	2.5
Perinatal mortalities^	567	9.4	383	6.4
Perinatal related mortalities•	598	10.0	414	6.9
Perinatal mortalities excluding lethal and terminated fetal abnormalities~	417	6.9	299	5.0
Perinatal related mortalities excluding lethal and terminated fetal abnormalities~	436	7.3	318	5.3

* 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 (CMACE 2011a).
\# Fetal death rate per 1000 babies born (includes terminations and stillbirths).
\+ Neonatal death rate per 1000 live born babies.
^ Fetal deaths and early neonatal deaths per 1000 babies born.
• Fetal deaths and early and late neonatal deaths per 1000 babies born.
~ 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 considers that this report presents as complete a set of perinatal related deaths as can currently be achieved for the 2013 year in New Zealand.

Table 1.2: Summary of New Zealand perinatal mortality rates 2007–2013

	2007		2008		2009		2010		2011		2012		2013	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Total births	65,602		65,872		63,665		65,124		62,604		62,425		60,039	
Fetal deaths (terminations of pregnancy and stillbirths)*	512	7.8	524	8.0	547	8.6	497	7.6	503	8.0	492	7.9	446	7.4
Terminations of pregnancy	143	2.2	145	2.2	138	2.2	151	2.3	171	2.7	172	2.8	139	2.3
Stillbirths	369	5.6	379	5.8	409	6.4	346	5.3	332	5.3	320	5.1	307	5.1
Early neonatal deaths <7 days	134		134		137		165		138		142		121	
Late neonatal deaths 7–27 days	34		43		46		45		25		36		31	
Neonatal deaths <28 days#	168	2.6	177	2.7	183	2.9	210	3.2	163	2.6	178	2.9	152	2.6
Perinatal mortalities+	646	9.8	658	10.0	684	10.7	662	10.2	641	10.2	634	10.2	567	9.4
Perinatal related mortalities^	680	10.4	701	10.6	730	11.5	707	10.9	666	10.6	670	10.7	598	10.0
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	461	7.0	488	7.4	513	8.1	463	7.1	445	7.1	445	7.1	417	6.9
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	481	7.3	516	7.8	544	8.5	494	7.6	461	7.4	467	7.5	436	7.3

* Fetal death rate per 1000 babies born (includes terminations and stillbirths).
\# Neonatal death rate per 1000 live born babies.
\+ Fetal deaths and early neonatal deaths per 1000 babies born.
^ Fetal deaths and early and late neonatal deaths per 1000 babies born.
• 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 related mortality rate in New Zealand in 2013, which includes late terminations of pregnancy, stillbirths and early and late neonatal deaths, from 20 weeks gestation to 27 days of life, was 10.0 per 1000 total births. This is the lowest rate reported in New Zealand since the PMMRC began targeted ascertainment of perinatal related deaths in 2007. The reduction in perinatal related mortality in 2013 is not statistically significant (Figure 1.11).

There has been a significant fall in the stillbirth rate between 2007 and 2013 (score test for linear trend p=0.015), and a significant rise in the late termination of pregnancy rate (score test for linear trend p=0.03).

Figure 1.11: Perinatal related mortality rates using New Zealand definitions (per 1000 births) 2007–2013

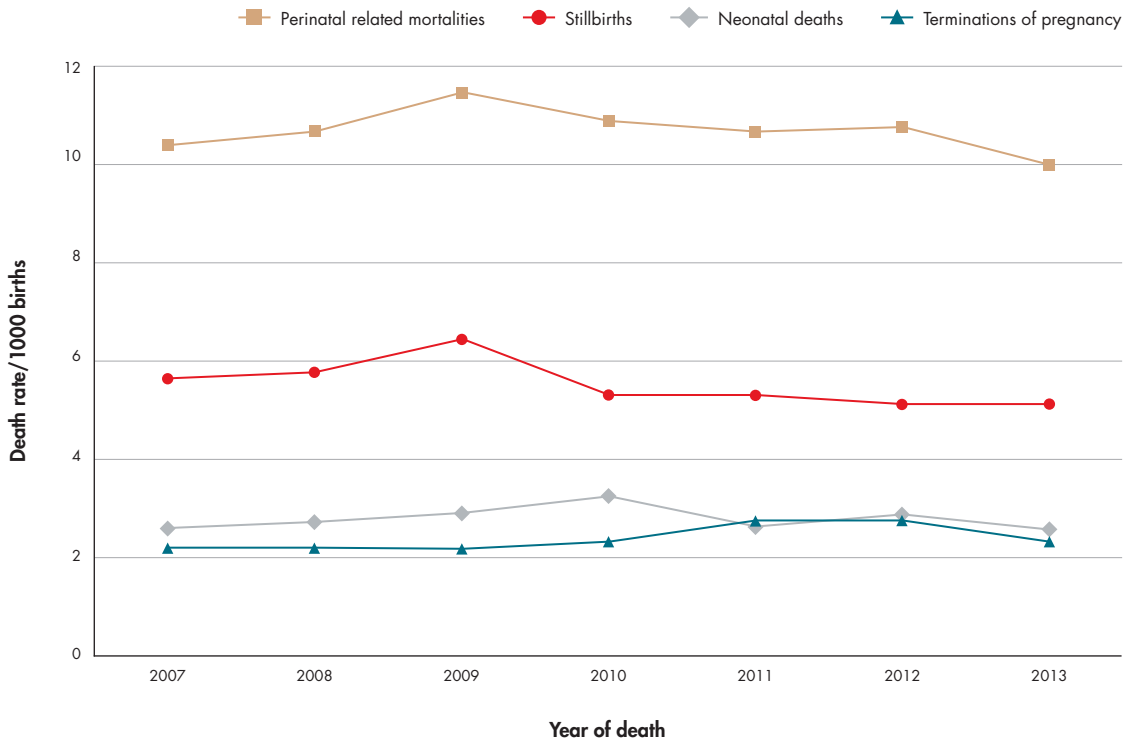
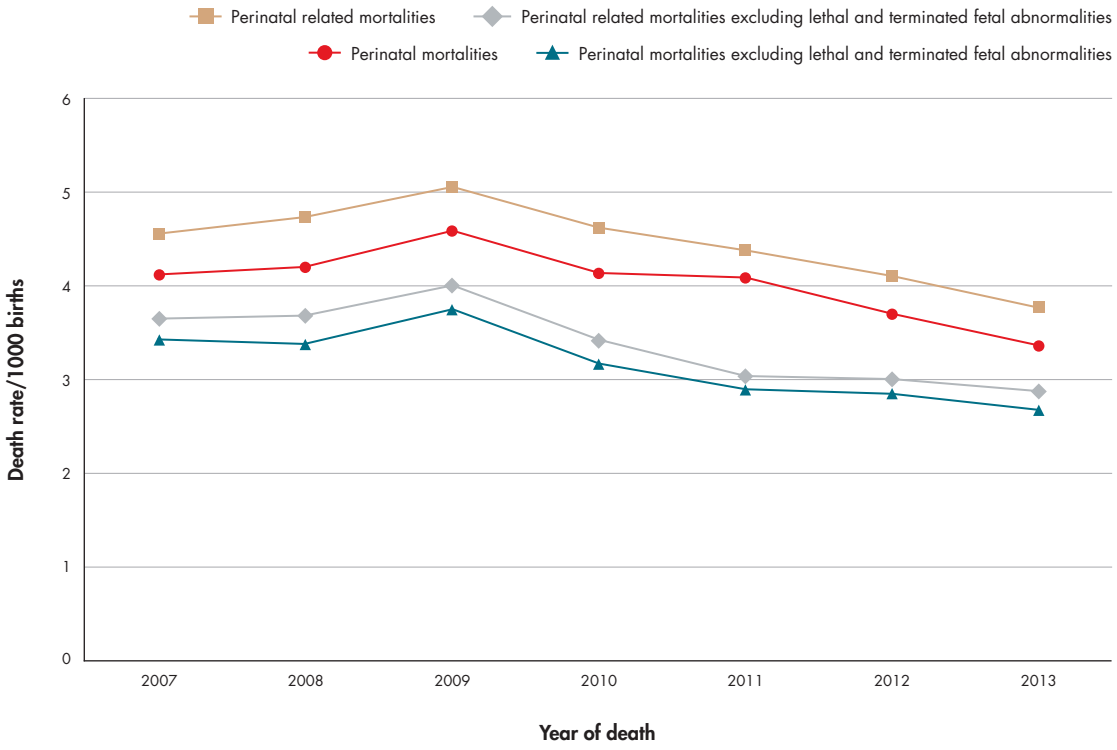


Figure 1.12: Perinatal related mortality rates using international definitions 2007–2013



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

There is a significant reduction in perinatal related mortality (chi-squared for linear trend p=0.001 overall and p=0.0001 if congenital abnormality deaths are excluded) using the international definition, recommended by the World Health Organization (WHO), of perinatal related deaths from 1000g or 28 weeks if birthweight is unknown (see 'Definitions' on page 166) (Figure 1.12).

There is a significant reduction in perinatal related mortality using the international definition recommended by the WHO (p=0.001).

There is a statistically significant difference in perinatal related mortality using the international rate definition because the significant decrease in stillbirth rate is reflected in the international rate while the significant increase in terminations is not apparent in the international rate as it excludes births below 1000g or 28 weeks.

Table 1.3: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rate using international definition (≥1000g or ≥28 weeks if birthweight unknown) 2007–2013

Year of death	2007		2008		2009		2010		2011		2012		2013		Chi-squared test for trend (p)
Total births (international definition)	n=65,050		n=65,303		n=63,153		n=64,574		n=62,078		n=61,892		n=59,552		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Perinatal death classification (PSANZ-PDC)															
Congenital abnormality	58	0.89	69	1.06	64	1.01	77	1.19	84	1.35	64	1.03	50	0.84	0.78
Perinatal infection	16	0.25	16	0.25	15	0.24	13	0.20	12	0.19	9	0.15	9	0.15	0.081
Hypertension	7	0.11	7	0.11	13	0.21	11	0.17	9	0.14	3	0.05	5	0.08	0.31
Antepartum haemorrhage	23	0.35	25	0.38	24	0.38	23	0.36	17	0.27	13	0.21	18	0.30	0.11
Maternal conditions	14	0.22	9	0.14	19	0.30	19	0.29	7	0.11	17	0.27	22	0.37	0.10
Specific perinatal conditions	29	0.45	23	0.35	32	0.51	30	0.46	32	0.52	21	0.34	24	0.40	0.76
Hypoxic peripartum death	33	0.51	34	0.52	28	0.44	20	0.31	20	0.32	20	0.32	11	0.18	0.00030
Fetal growth restriction	29	0.45	32	0.49	31	0.49	31	0.48	18	0.29	32	0.52	21	0.35	0.34
Spontaneous preterm	9	0.14	7	0.11	10	0.16	19	0.29	8	0.13	10	0.16	5	0.08	0.80
Unexplained antepartum death	67	1.03	73	1.12	75	1.19	45	0.70	61	0.98	46	0.74	53	0.89	0.033
No obstetric antecedent	11	0.17	14	0.21	7	0.11	10	0.15	4	0.06	9	0.15	6	0.10	0.11

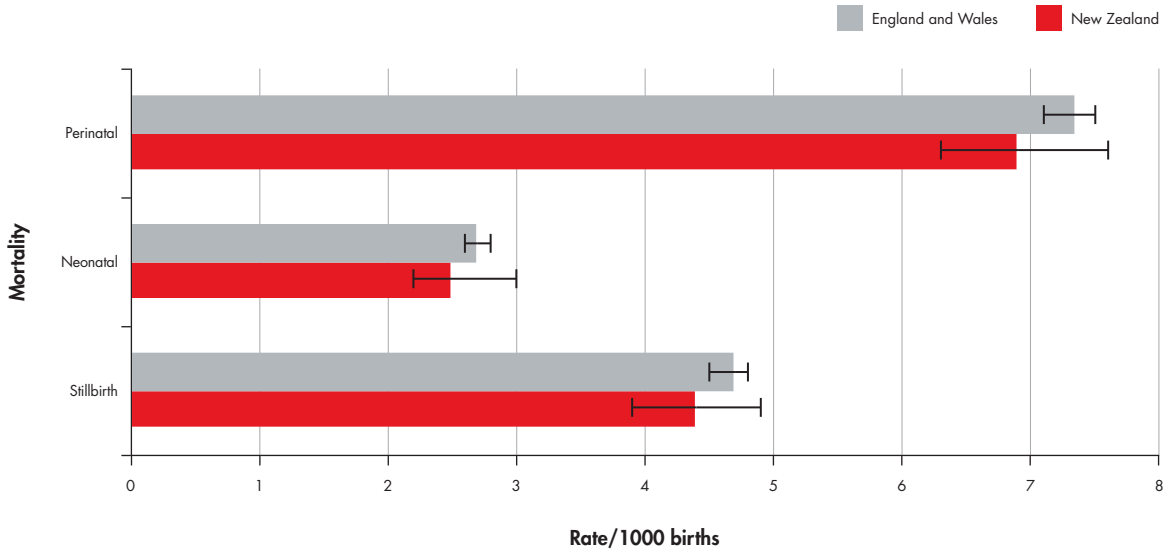
Table 1.3 shows the cause of death (PSANZ-PDC) specific perinatal related death rates using the international definition of perinatal death. As indicated by the chi-squared test for trend results, there has been a statistically significant reduction in hypoxic peripartum deaths and unexplained antepartum deaths ($p<0.05$) from 2007 to 2013.

International comparisons

It can be difficult to make international comparisons of mortality data due to differences in definitions and ascertainment of cases.

At time of print, there have been updated data reported from England and Wales. These data are presented in Figure 1.13, showing non-significantly lower rates for New Zealand using UK definitions of mortality from 24 weeks. Tables and figures in the eighth report of the PMMRC demonstrated that perinatal (related) mortality rates in New Zealand in 2011 and 2012, using comparable definitions, were not statistically significantly different to rates in the UK and Australia.

Figure 1.13: Perinatal mortality rates in New Zealand and England and Wales using UK definitions 2013 (with 95% CIs)



Causes of perinatal related death

Obstetric antecedent classification

Table 1.4: Perinatal related deaths by primary perinatal death classification (PSANZ-PDC) 2013

Perinatal death classification (PSANZ-PDC)	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Congenital abnormality	108	77.7	21	6.8	29	19.1	158	26.4
Perinatal infection	2	1.4	10	3.3	8	5.3	20	3.3
Hypertension	2	1.4	8	2.6	3	2.0	13	2.2
Antepartum haemorrhage	5	3.6	44	14.3	25	16.4	74	12.4
Maternal conditions	4	2.9	22	7.2	8	5.3	34	5.7
Specific perinatal conditions	10	7.2	39	12.7	14	9.2	63	10.5
Hypoxic peripartum death	-	-	3	1.0	8	5.3	11	1.8
Fetal growth restriction	2	1.4	44	14.3	2	1.3	48	8.0
Spontaneous preterm	6	4.3	25	8.1	49	32.2	80	13.4
Unexplained antepartum death	-	-	91	29.6	-	-	91	15.2
No obstetric antecedent	-	-	-	-	6	3.9	6	1.0

Figure 1.14: Relative distribution of fetal and neonatal deaths by perinatal death classification (PSANZ-PDC) 2013

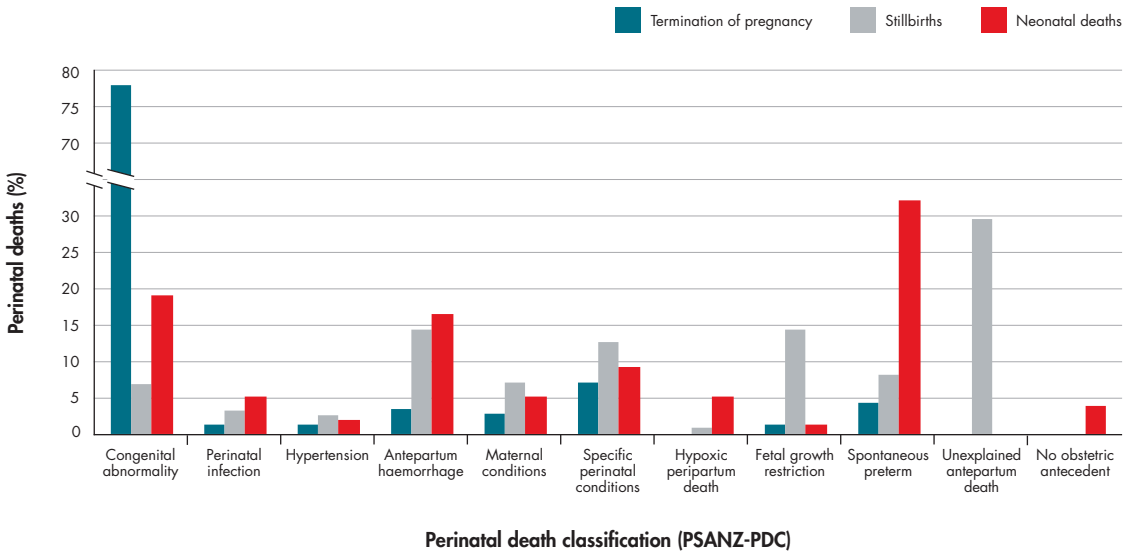


Figure 1.14 shows the distribution of cause of death (PSANZ-PDC) within late terminations of pregnancy, stillbirths and neonatal deaths for 2013. This figure demonstrates the predominance of congenital abnormalities among late terminations of pregnancy and the relative importance of unexplained antepartum death. Spontaneous preterm birth is the predominant cause of neonatal death.

Epidemiology and perinatal mortality

Gender

Table 1.5: Perinatal related death rates (per 1000 births) by gender 2013

Gender	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=60,039		n=139			n=307			n=152			n=598		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Male	30,795	51.3	69	49.6	2.24	147	47.9	4.77	88	57.9	2.88	304	50.8	9.87
Female	29,244	48.7	69	49.6	2.36	157	51.1	5.37	64	42.1	2.21	290	48.5	9.92
Unknown	-	-	1	0.7	-	3	1.0	-	-	-	-	4	0.7	-

There were no statistically significant differences in perinatal related mortality rates between male and female babies in 2013.

Maternal age

Table 1.6: Perinatal related death rates (per 1000 births) by maternal age 2013

Maternal age (years)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=60,039		n=139			n=307			n=152			n=598		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<20	3,436	5.7	8	5.8	2.33	27	8.8	7.86	30	19.7	8.82	65	10.9	18.92
20–24	11,024	18.4	27	19.4	2.45	56	18.2	5.08	30	19.7	2.74	113	18.9	10.25
25–29	15,573	25.9	26	18.7	1.67	73	23.8	4.69	40	26.3	2.58	139	23.2	8.93
30–34	17,069	28.4	43	30.9	2.52	79	25.7	4.63	25	16.4	1.48	147	24.6	8.61
35–39	10,291	17.1	26	18.7	2.53	44	14.3	4.28	19	12.5	1.86	89	14.9	8.65
≥40	2,646	4.4	9	6.5	3.40	28	9.1	10.58	8	5.3	3.07	45	7.5	17.01

There was a statistically significant increase in the perinatal related mortality rate (excluding deaths with congenital abnormalities) among under 20-year-old mothers from 2007 to 2013 (p=0.03).

From 2007 to 2013 there has been a significant reduction in the number of births to mothers under 20 years old. There has been a significant increase in the proportion of Pacific mothers ($p<0.0001$) among under 20-year-old mothers, and an increase in the proportion of mothers living in the most deprived areas (highest quintile of deprivation) ($p=0.006$). There has been no change in the proportion of Pacific mothers in the population as a whole. As Pacific ethnicity and living in higher deprivation are associated with increased perinatal related mortality, these demographic changes may explain at least some of the increase in mortality among under 20-year-old mothers.

Almost half of teenage mothers in New Zealand reside in the most deprived 20 percent of households, and two-thirds are Māori or Pacific peoples. Forty-five percent of teenage mothers of babies who die are current smokers compared to 27 percent of all mothers of babies who die and 15.3 percent of mothers at registration with an LMC in New Zealand (http://www.health.govt.nz/publication/maternity-tables-2011).

Figure 1.15: Perinatal related death rates (per 1000 births) by maternal age (with 95% CIs) 2007–2013

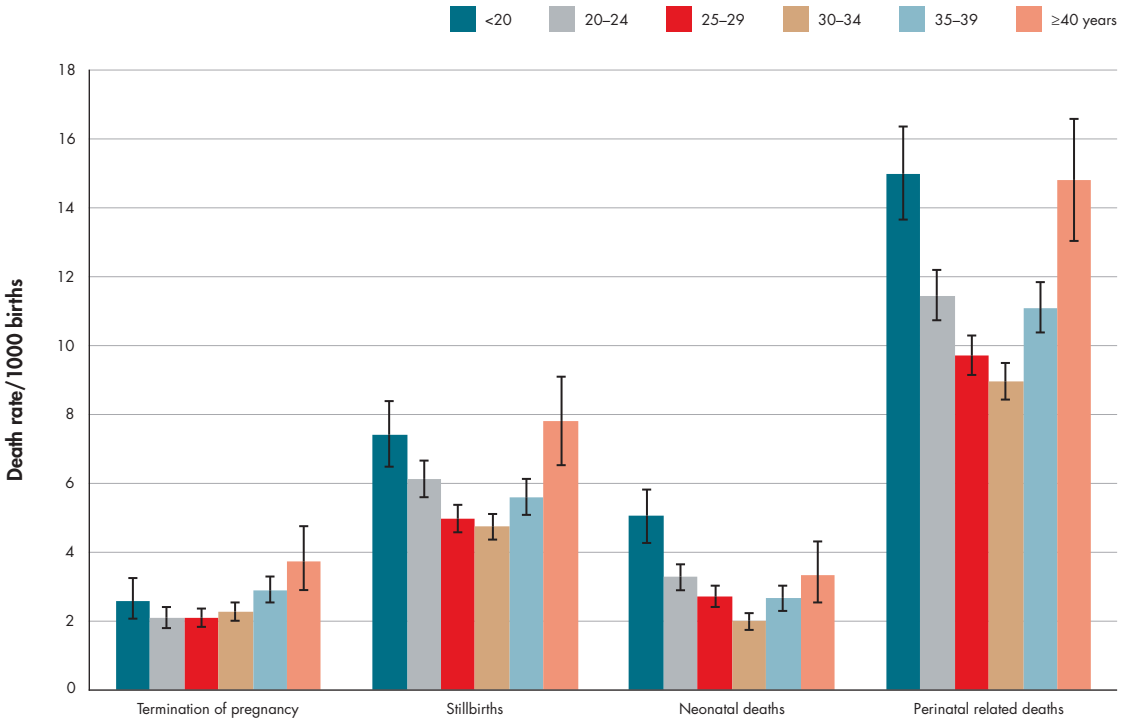


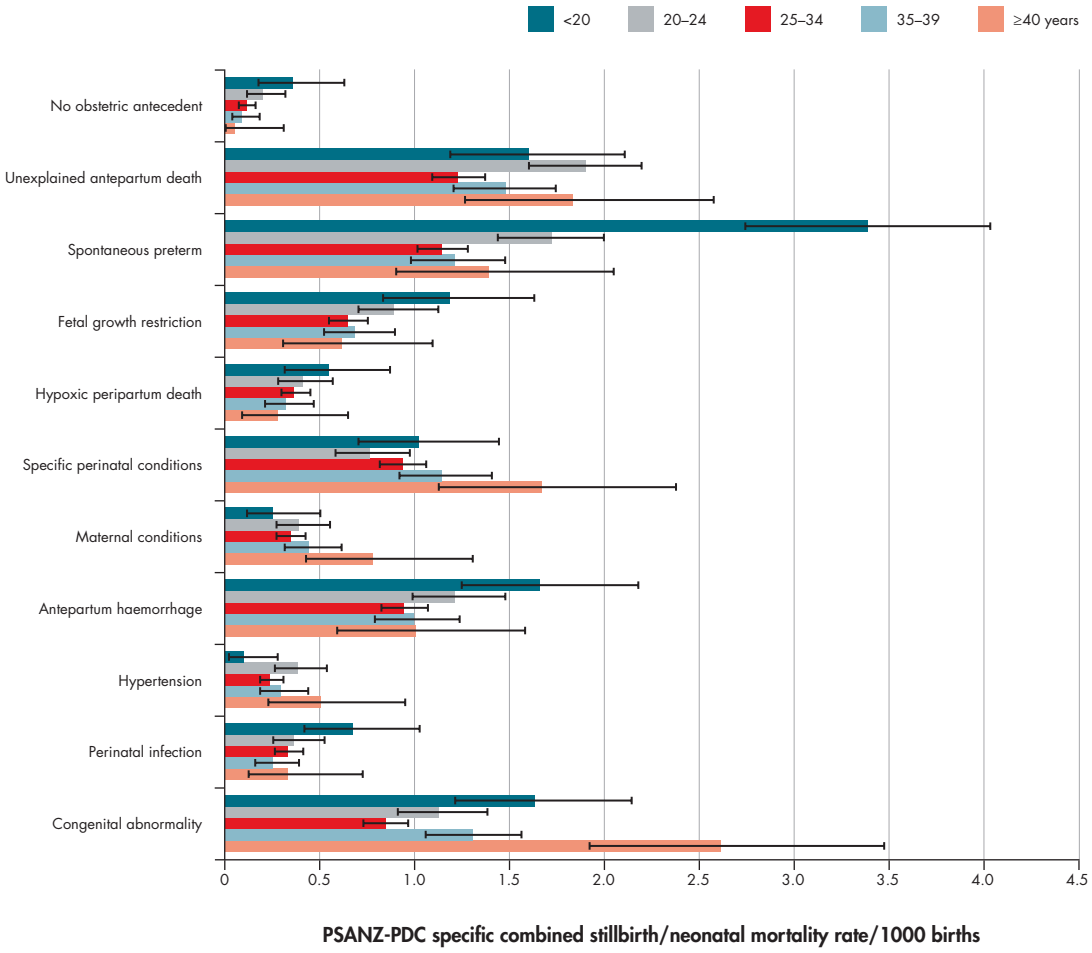
Figure 1.15 illustrates the unadjusted association between maternal age and perinatal related mortality, with the highest mortality rates among mothers under the age of 20 years and mothers aged 40 years and older.

The mothers with the lowest risk of perinatal mortality are those aged 30–34 years.

The association of maternal age with perinatal related mortality is not the same for termination of pregnancy, stillbirth and neonatal death. Mothers under 20 have the highest risk for neonatal death, while mothers of 40 and older have the highest risk of late termination of pregnancy and stillbirth. However, in all of termination of pregnancy, stillbirth and neonatal death categories, there is an apparent 'U' shaped curve with highest risk at the extremes of maternal age (Figure 1.15).

The multivariate analysis reported in the eighth PMMRC report showed the association between maternal age and stillbirth and neonatal death was no longer significant after adjusting for socioeconomic status, ethnicity, BMI, smoking and parity.

Figure 1.16: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (excluding termination of pregnancy) by maternal age (with 95% CIs) 2007–2013



Spontaneous preterm birth is twice as often the cause of perinatal related death among babies of teenage mothers than of mothers of any other age category.

There is a significant trend of increasing stillbirth/neonatal death from specific perinatal conditions and maternal conditions with increasing maternal age.

There is a significant trend of increasing neonatal death without obstetric antecedent, and stillbirth/neonatal death from fetal growth restriction, antepartum haemorrhage and perinatal infection with decreasing maternal age.

The higher rate of combined stillbirth and neonatal death among teenage mothers and mothers 40 and older compared to mothers 25–34 years of age from congenital abnormalities is due to euploid (non-chromosomal) abnormalities among teenage mothers and due to chromosomal abnormalities for mothers 35 years and older.

Ethnicity

The use of maternal ethnicity (rather than 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 provided in the body of this report. Tables A10 and A11 using baby ethnicity are available online at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/.

Table 1.7: Perinatal related death rates (per 1000 births) by maternal prioritised ethnicity 2013

Ethnicity (mother)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=60,039		n=139			n=307			n=152			n=598		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Māori	13,488	22.5	24	17.3	1.78	82	26.7	6.08	49	32.2	3.66	155	25.9	11.49
Pacific peoples	6,161	10.3	9	6.5	1.46	45	14.7	7.30	29	19.1	4.75	83	13.9	13.47
Indian	2,705	4.5	8	5.8	2.96	18	5.9	6.65	11	7.2	4.11	37	6.2	13.68
Other Asian	6,002	10.0	23	16.5	3.83	15	4.9	2.50	8	5.3	1.34	46	7.7	7.66
Other (including unknown)	5,454	9.1	17	12.2	3.12	26	8.5	4.77	4	2.6	0.74	47	7.9	8.62
NZ European	26,229	43.7	58	41.7	2.21	121	39.4	4.61	51	33.6	1.96	230	38.5	8.77

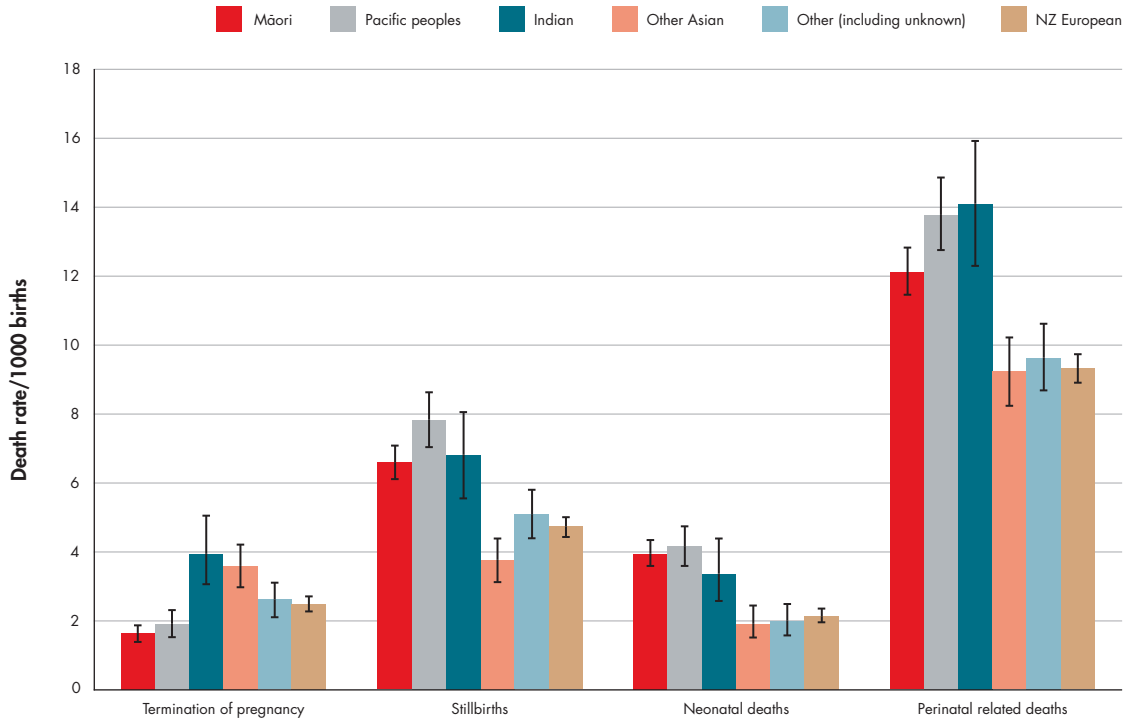
From 2007 to 2013 there has been no statistically significant change in overall perinatal related death rates within any ethnic group (Table A6 is available at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/).

The overall perinatal related death rate for Māori, Pacific and Indian mothers is statistically significantly higher than among Other Asian, Other and New Zealand European mothers (Figure 1.17). These associations are evident for stillbirth and neonatal deaths, but the association of ethnicity with late termination of pregnancy shows a different pattern.

Māori mothers have lower rates of late termination of pregnancy compared to Indian, Other Asian, Other and New Zealand European mothers.

Indian and Other Asian mothers have significantly higher rates of late termination of pregnancy compared to Māori, Pacific and New Zealand European mothers.

Figure 1.17: Perinatal related death rates (per 1000 births) by maternal prioritised ethnicity (with 95% CIs) 2007–2013



Socioeconomic status, obesity and smoking are risk factors for perinatal death that are also associated with ethnicity and may, therefore, confound the association between ethnicity and perinatal death.

Figure 1.18: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by maternal prioritised ethnicity 2007–2013

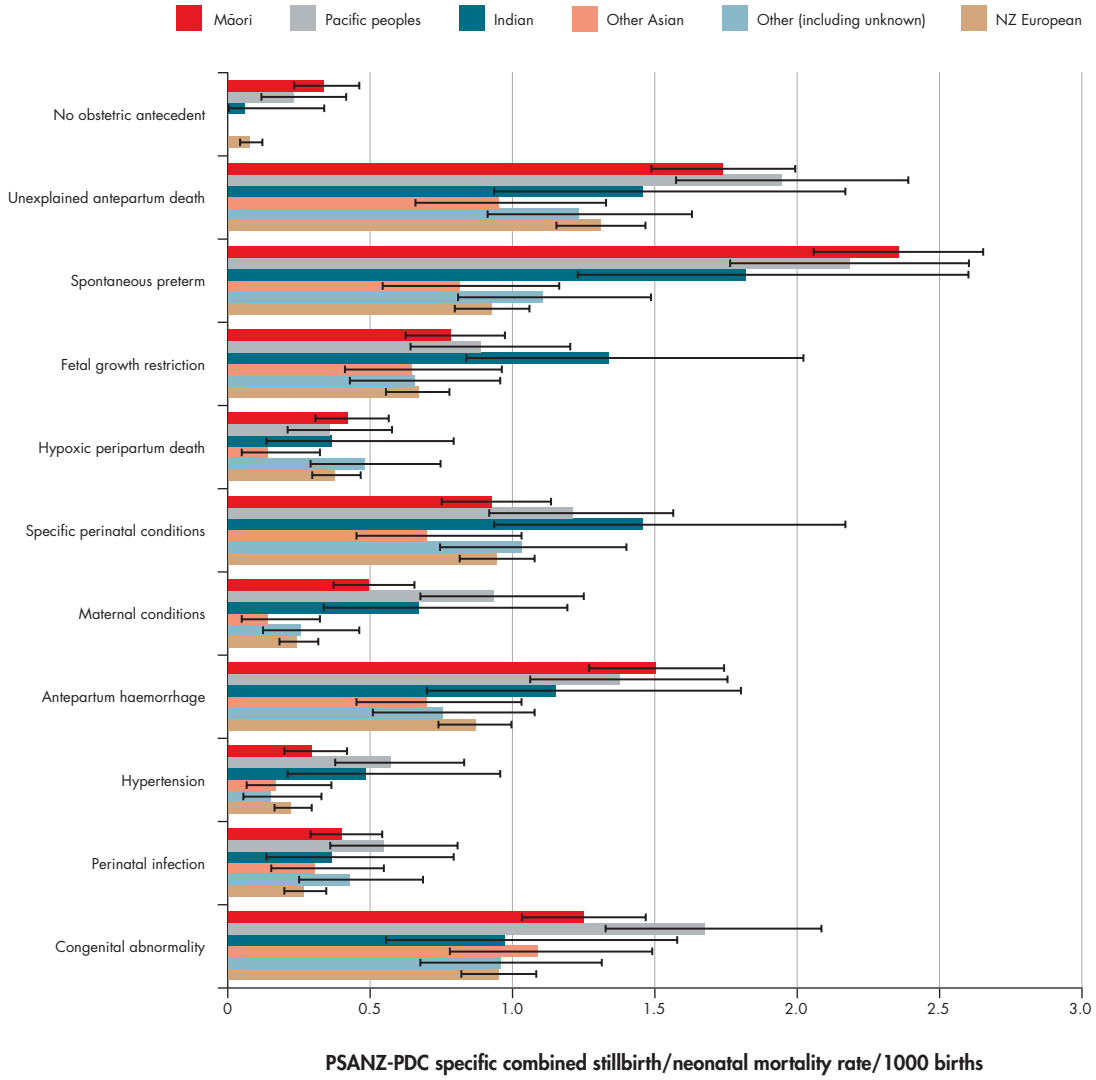


Figure 1.18 shows perinatal death classification (PSANZ-PDC) specific stillbirth and neonatal death rates (excluding termination of pregnancy) for all mothers by prioritised ethnicity including data from 2007–2013.

Other Asian (non-Indian) and New Zealand European mothers had significantly lower rates of death classified as unexplained antepartum death than Māori and Pacific mothers.

Māori, Pacific and Indian mothers had significantly higher rates of death classified as spontaneous preterm than Other Asian and New Zealand European mothers.

Indian mothers had significantly higher rates of death from fetal growth restriction than New Zealand European mothers.

Māori and Pacific mothers had significantly higher rates of death associated with maternal conditions and antepartum haemorrhage than Other Asian and New Zealand European mothers.

The death rate associated with hypertension was significantly higher among Pacific mothers than Other Asian, Other and New Zealand European mothers.

Pacific mothers experienced a higher rate of stillbirth and neonatal death associated with congenital abnormalities compared to New Zealand European mothers. This probably reflects lower rates of late 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).

Socioeconomic disadvantage

Table 1.8: Perinatal related death rates (per 1000 births) by deprivation quintile (NZDep2013) 2013

Deprivation quintile (NZDep2013)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=60,039		n=139			n=307			n=152			n=598		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	9,183	15.3	27	19.4	2.94	29	9.4	3.16	15	9.9	1.64	71	11.9	7.73
2	10,651	17.7	23	16.5	2.16	36	11.7	3.38	17	11.2	1.60	76	12.7	7.14
3	11,777	19.6	28	20.1	2.38	69	22.5	5.86	32	21.1	2.74	129	21.6	10.95
4	12,366	20.6	30	21.6	2.43	53	17.3	4.29	33	21.7	2.69	116	19.4	9.38
5 (most deprived)	15,830	26.4	30	21.6	1.90	113	36.8	7.14	52	34.2	3.31	195	32.6	12.32
Unknown	232	0.4	1	0.7	-	7	2.3	-	3	2.0	-	11	1.8	-

Figure 1.19: Perinatal related death rates (per 1000 births) by deprivation quintile (with 95% CIs) 2007–2013

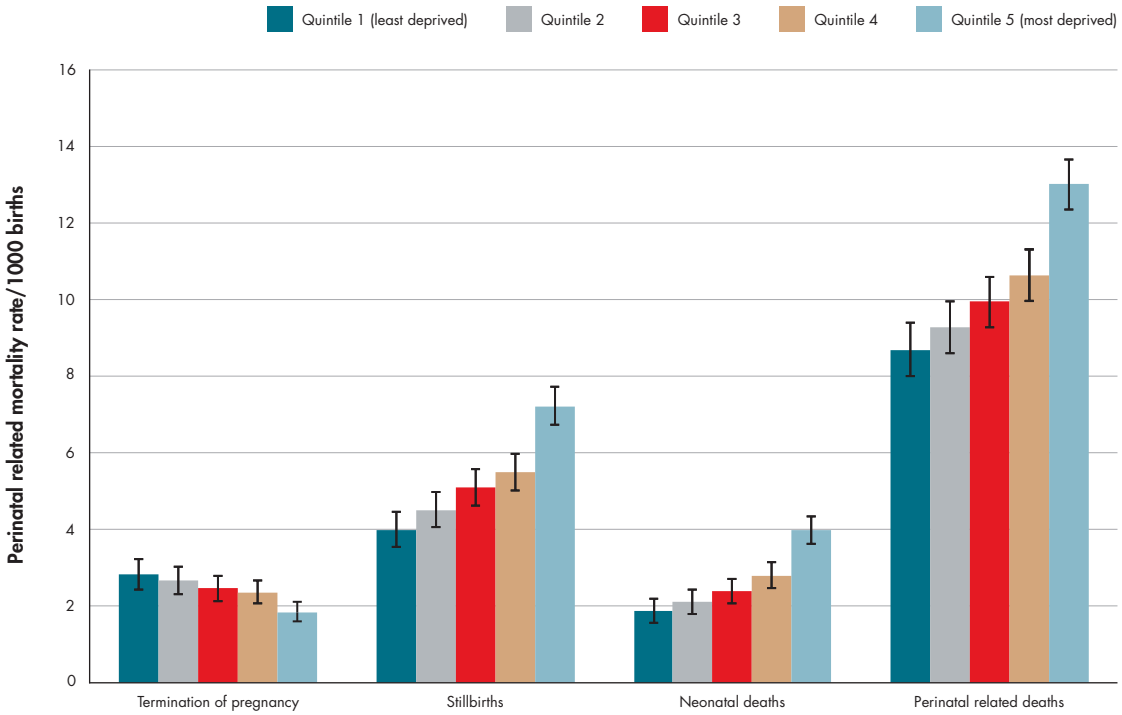


Figure 1.19 includes combined data from 2007 to 2013, showing the association between quintiles of socioeconomic deprivation (measured by NZDep2006 for 2006–2012 and NZDep2013 for 2013) and perinatal related mortality. It shows a significant decrease in late termination of pregnancy rate and significant increases in stillbirth and neonatal death rates, with increasing quintile of socioeconomic deprivation.

There has been no significant change in the association between any quintile of socioeconomic deprivation and perinatal related mortality rate over the years 2007–2013.

Figure 1.20: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile (with 95% CIs) 2007–2013

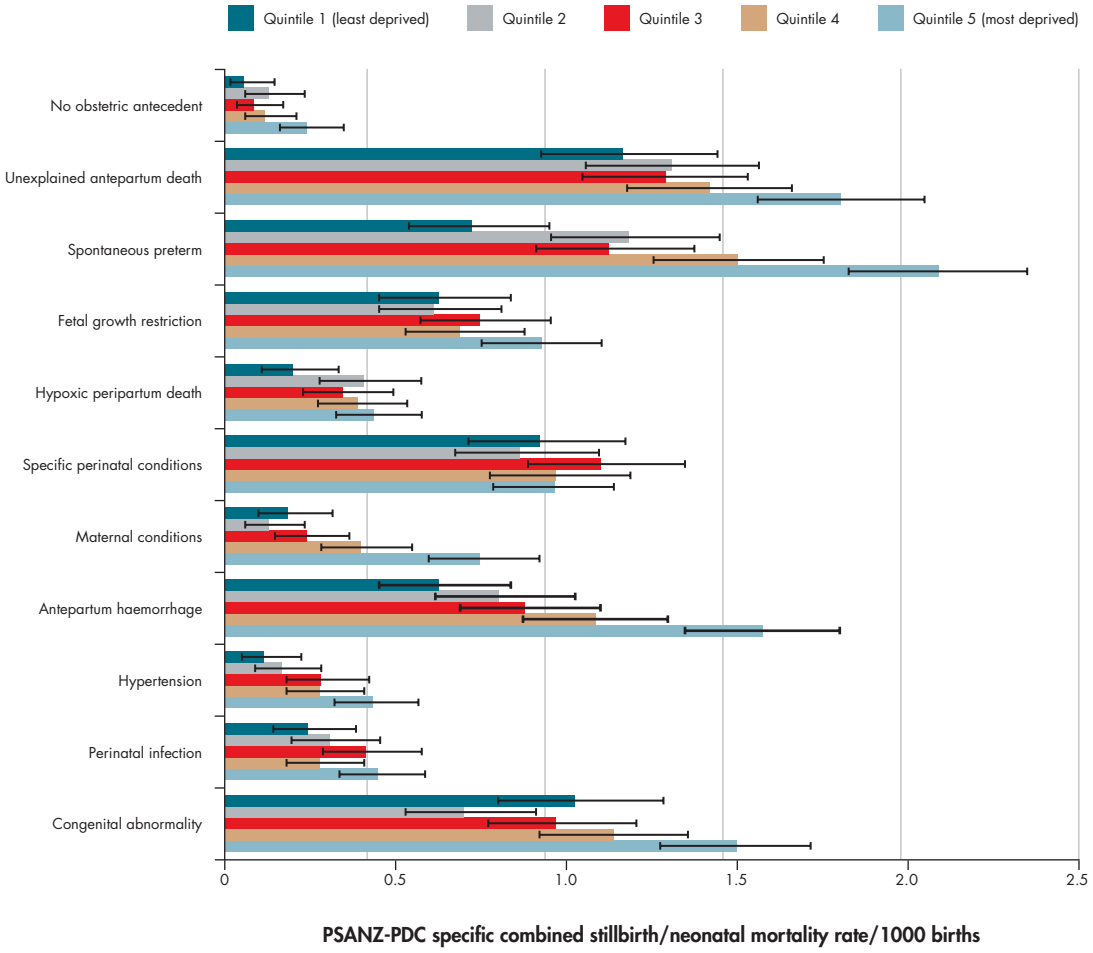


Figure 1.20 shows combined stillbirth and neonatal death rates for each antecedent cause (PSANZ-PDC) by deprivation quintile – quintile 1 (least deprived) at the top of each cause down to quintile 5 (most deprived) at the bottom. The aim of this analysis is to determine how antecedent causes of combined stillbirth and neonatal death are associated with increasing deprivation.

There is a significant increasing trend in (combined) stillbirth and neonatal death rate due to all causes other than specific perinatal conditions (mostly complications associated with multiple pregnancy) with increasing deprivation quintile.

Maternal BMI

Table 1.9: Maternal body mass index (BMI) among perinatal related deaths 2013

Maternal BMI (kg/m²)	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
<18.50	6	4.3	3	1.0	1	0.7	10	1.7
18.50–24.99	76	54.7	112	36.5	39	25.7	227	38.0
25.00–29.99	30	21.6	86	28.0	46	30.3	162	27.1
30.00–34.99	13	9.4	43	14.0	26	17.1	82	13.7
35.00–39.99	9	6.5	26	8.5	18	11.8	53	8.9
≥40	4	2.9	28	9.1	15	9.9	47	7.9
Unknown	1	0.7	9	2.9	7	4.6	17	2.8

Table 1.9 provides data on BMI for mothers of perinatal related deaths 2013. These data are from the PMMRC dataset and were obtained from LMCs. More than half (57.6 percent) of the mothers of perinatal related deaths in 2013 were overweight or obese. There are currently no complete national data on the rate of obesity among pregnant women.

A multivariate analysis reported in the eighth report of the PMMRC demonstrated that increasing BMI over 25kg/m² is an independent risk factor for stillbirth after adjusting for confounding due to ethnicity, maternal age, smoking, parity and socioeconomic deprivation decile.

Public health initiatives to prevent obesity should be supported. Optimal weight gain according to BMI should be discussed and encouraged during pregnancy. The Ministry of Health publishes guidance on healthy weight gain in pregnancy on its website (Ministry of Health 2014a).

Maternal smoking, alcohol and substance use

Table 1.10: Maternal smoking, alcohol and substance use at the time of perinatal related death 2013

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Currently smoking								
Yes	26	18.7	77	25.1	35	23.0	138	23.1
No	113	81.3	230	74.9	116	76.3	459	76.8
Smoking history (among current non-smokers)								
Never smoked	89	64.0	173	56.4	73	48.0	335	56.0
Stopped before this pregnancy	17	12.2	33	10.7	24	15.8	74	12.4
Stopped <16 weeks gestation	2	1.4	8	2.6	6	3.9	16	2.7
Stopped ≥16 weeks gestation	2	1.4	8	2.6	1	0.7	11	1.8
Unknown	3	2.2	8	2.6	12	7.9	23	3.8
Unknown	-	-	-	-	1	0.7	1	0.2
Alcohol and substance use								
Yes	13	9.4	22	7.2	15	9.9	50	8.4
No	115	82.7	268	87.3	117	77.0	500	83.6
Unknown	11	7.9	17	5.5	20	13.2	48	8.0
Specific drugs								
Alcohol	8	5.8	14	4.6	12	7.9	34	5.7
Amphetamine/P	-	-	1	0.3	3	2.0	4	0.7
Herbal highs	-	-	-	-	1	0.7	1	0.2
Marijuana	7	5.0	8	2.6	6	3.9	21	3.5
Methadone	-	-	-	-	1	0.7	1	0.2

Twenty-three percent of mothers of babies who died in 2013 were recorded as current smokers. A further 4.5 percent of mothers stopped smoking at some time during pregnancy. Among mothers of stillborn babies the smoking rate was higher, with 30.3 percent of mothers of stillborn babies smoking for some of their pregnancy.

Multivariate analysis including New Zealand births from 2008 to 2012, reported in the eighth report of the PMMRC, found that smoking was an independent risk factor for stillbirth and neonatal death after adjusting for confounding due to ethnicity, maternal age, BMI, parity and socioeconomic deprivation decile (NZDep2006). The adjusted odds of stillbirth for smokers compared to non-smokers were 1.56 (95 percent CI 1.33–1.84). The adjusted odds of neonatal death were 1.6 (95 percent CI 1.13–2.26) for babies born at 20–27 weeks, and 1.9 (95 percent CI 1.34–2.69) for babies born from 28 weeks.

Published studies consistently demonstrate that smoking is associated with preterm and small for gestational age (SGA) birth, placental abruption, stillbirth and perinatal mortality. Smoking is a modifiable risk factor for perinatal related mortality. The earlier that a woman stops smoking during pregnancy, the better the outcome for her and her baby.

Table 1.11: Maternal smoking cessation support offered and perinatal related death 2013

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=50		n=134		n=78		n=262	
	n	%	n	%	n	%	n	%
No	15	30.0	44	32.8	20	25.6	79	30.2
Yes – by LMC only	18	36.0	38	28.4	14	17.9	70	26.7
Yes – referred to external agents	3	6.0	10	7.5	8	10.3	21	8.0
Yes – referral declined	-	-	4	3.0	2	2.6	6	2.3
Unknown	14	28.0	38	28.4	34	43.6	86	32.8

LMC = lead maternity carer.

Of eligible mothers (current and past smokers) of stillbirths and neonatal deaths in 2013, 37 percent were recorded as having been offered smoking cessation support. While this is an increase from 2011 and 2012, the number recorded as not receiving cessation support has also increased, and these increases are associated with a reduction in missing and unknown data from 47 percent in 2011 to 33 percent in 2013. It is not possible to know whether the true proportion of referrals has increased.

In 2014, the Ministry of Health released New Zealand guidelines for helping people to stop smoking, called *The New Zealand Guidelines for Helping People to Stop Smoking* (Ministry of Health 2014c).

A multivariate analysis reported in the eighth report of the PMMRC showed that women who have a BMI >25, women who smoke in pregnancy, women of Indian ethnicity and women having their first birth are at increased risk of stillbirth, independent of age and socioeconomic status.

Women of Māori and Pacific ethnicity, women who smoke in pregnancy, women living in areas of high socioeconomic deprivation and women having their first birth are at increased risk of neonatal death of babies born at 20–27 weeks, independent of age and socioeconomic status. Women who smoke during pregnancy are also at increased risk of neonatal death of babies born from 28 weeks gestation, independent of ethnicity, socioeconomic deprivation, age, parity and BMI.

A combination of risks means a higher risk of stillbirth or neonatal death as risks are independent of each other and so have a cumulative effect.

Alcohol

Data were obtained on alcohol and substance use among 92 percent of mothers whose babies died in 2013. Alcohol was reportedly used by 8 percent of mothers and marijuana by 3.5 percent. It is likely that alcohol and substance use are under-reported. There are no national data on alcohol consumption and marijuana use in pregnancy with which to compare these figures.

Alcohol consumption in pregnancy has been associated with increased risk of miscarriage, stillbirth, preterm birth and sudden infant death syndrome. The increased risk of stillbirth has been noted with increasing moderate alcohol intake (≥5 drinks/week has a 2–3 times increased risk of stillbirth that is attributable mainly to fetoplacental dysfunction).

Alcohol is a teratogen which passes freely through the placenta and reaches concentrations in the fetus that are as high as those in the mother. As well as risks of increased perinatal mortality, significant morbidities (such as fetal alcohol spectrum disorder; prematurity; brain damage; birth defects; growth restriction; developmental delay; and cognitive, social, emotional and behavioural deficits) are associated with alcohol consumption during pregnancy.

There is no safe level of drinking or safe time to drink alcohol during pregnancy, therefore complete abstinence is advised.

Brief, reliable screening tools are available to assist practitioners to recognise and refer women who drink alcohol in pregnancy. In 2012 the Ministry of Health published a practical guideline for practitioners on alcohol in pregnancy, which is available online (Ministry of Health 2012c).

Practitioners working with pregnant women need to be aware of the risks of alcohol in pregnancy, skilled in asking about and detecting alcohol use in pregnancy and have local knowledge of their area's referral resources.

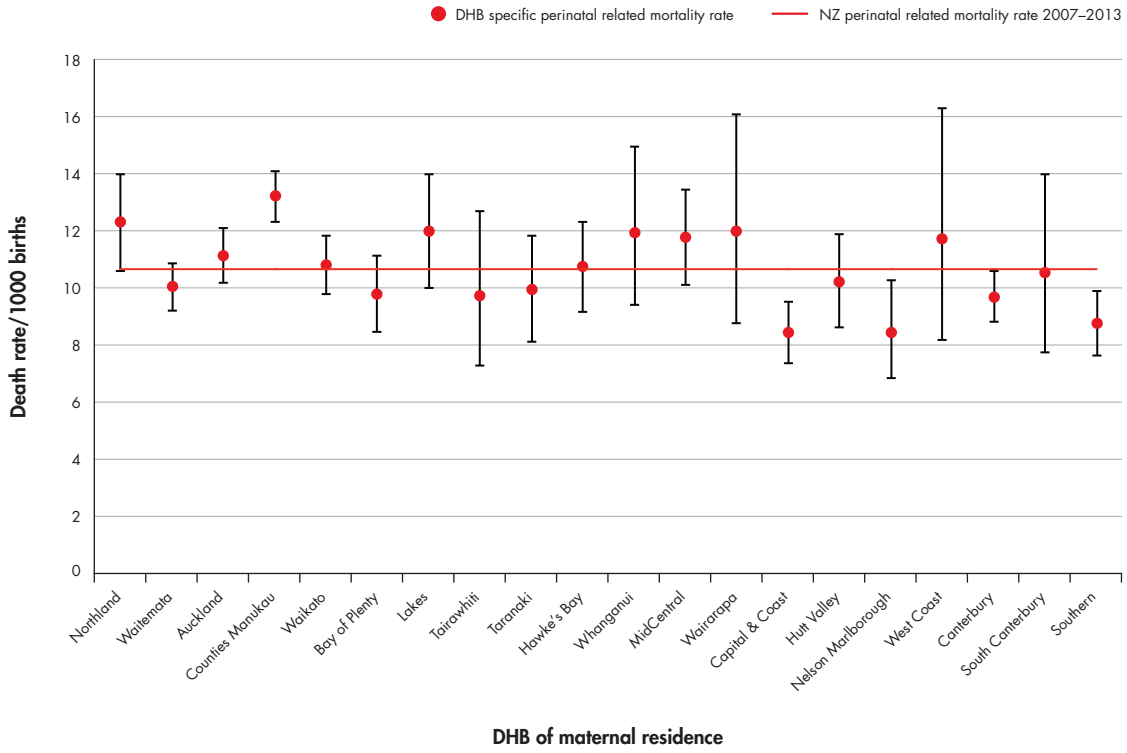
PRACTICE POINT: ALCOHOL IN PREGNANCY

- As early in pregnancy as possible, ask all women about, and assess, alcohol consumption.
- Advise women on the potential risks and consequences of the use of alcohol in pregnancy and advise them not to drink while pregnant.
- When there are concerns about alcohol consumption, use a recognised assessment screening tool to determine the level of drinking (eg, the AUDIT-C Assessment Tool which is included in the Ministry of Health Alcohol in Pregnancy guidance).
- Be aware of which specialist referral services are available locally and refer women who need assistance to these services.
  - Alcohol services should prioritise pregnant women.
  - Where alcohol services do not exist, DHBs need to consider how women can receive this support.
- When there are concerns about alcohol consumption during pregnancy, ask about it often, offer advice and refer again to specialist services as necessary. Document all discussions, advice and referrals.
- Be cognisant of the potential impact of alcohol consumption on the growth and wellbeing of the fetus/baby while providing care during pregnancy, labour and the postnatal period.
- Be conversant with signs of fetal alcohol syndrome.
- Follow up and refer women and babies postnatally if there have been concerns about alcohol consumption during pregnancy.

Addition 2017 - View Resources: http://www.health.govt.nz/system/files/documents/publications/alcohol-pregnancy-practical-guide-health-professionals.pdf

DHB of residence

Figure 1.21: Crude perinatal related death rates (per 1000 births) by DHB of residence (mother) compared to New Zealand perinatal related mortality (with 95% CIs) 2007–2013



The CIs, represented by the error bars above and below the point estimates (in Figures 1.21, 1.22 and 1.23), 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. If the ranges for adjacent DHBs do not cross, then adjacent DHB rates are significantly different.

These crude mortality rate figures (Figures 1.21, 1.22 and 1.23) are provided to illustrate to DHBs those regions in New Zealand where perinatal health needs are greater and where increased focus and resource may be required. Figure 1.21 includes all perinatal related mortalities (ie, stillbirth, neonatal death and late termination of pregnancy). Figures 1.22 and 1.23 show stillbirth and neonatal death rates by DHB of residence respectively. In some regions the stillbirth and neonatal death rates are not consistently above or below the national rate. This is not necessarily surprising given that the risk factors for each vary (see adjusted associations between demographic variables and stillbirth and neonatal death on pages 67 and 76 of the eighth report of the PMMRC (PMMRC 2014b)). Differences in socioeconomic deprivation and ethnicity by DHB are shown in Figures 1.9 and 1.10.

The perinatal related mortality rate among residents of Counties Manukau DHB has been statistically significantly higher compared to the national rate since the first report of 2007 data and this rate is the highest reported by any DHB.

Figures 1.22 and 1.23 show significantly higher rates of stillbirth and neonatal death at Northland DHB than the national rates, although the total perinatal related mortality in Northland does not differ significantly from the national rate. This finding suggests a lower rate of late termination of pregnancy in the Northland region. Like Counties Manukau DHB, Northland is a region with high levels of socioeconomic deprivation.

In the Bay of Plenty DHB region the neonatal death rate is significantly higher than the national rate while the stillbirth rate is consistent with the national rate (Figures 1.22 and 1.23).

Perinatal related mortality rates in Capital & Coast, Nelson Marlborough, Canterbury and Southern DHBs were significantly lower than the national rate.

Figure 1.22: Crude stillbirth rate (per 1000 births) by DHB of residence (mother) compared to New Zealand stillbirth rate (with 95% CIs) 2007–2013

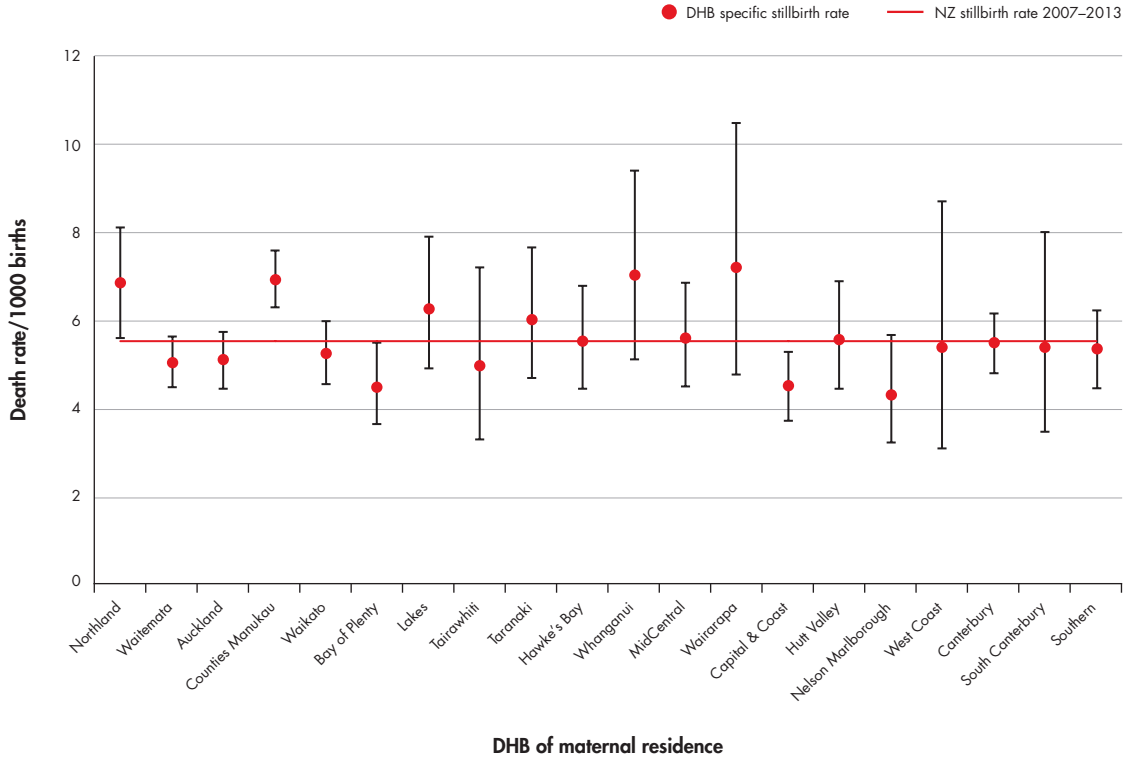
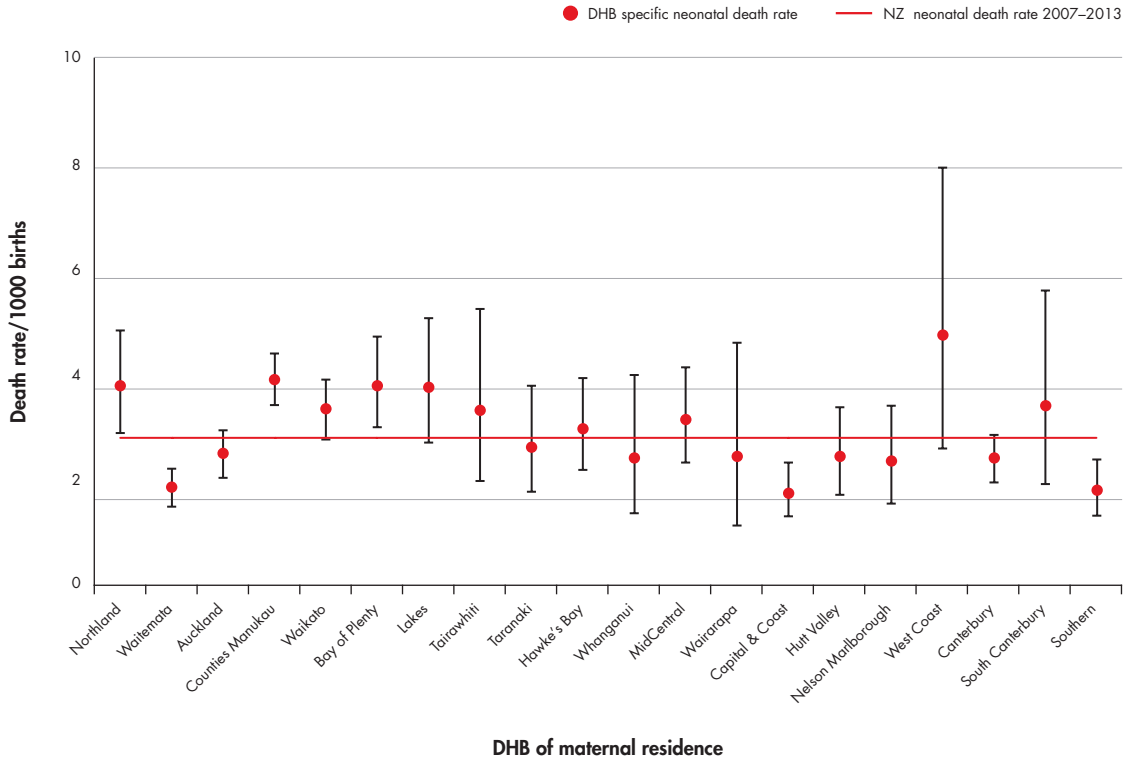


Figure 1.23: Crude neonatal death rate (per 1000 births) by DHB of residence (mother) compared to New Zealand neonatal death rate (with 95% CIs) 2007–2013



Figures 1.22 and 1.23 illustrate stillbirth and neonatal death rates respectively by DHB of residence, providing further information for DHBs on where there might be issues for their regions. There are greater variations from the national rate among neonatal death rates by DHB than stillbirth rates, which is consistent with the stronger associations between socioeconomic status and neonatal death.

In 2012, DHB specific reports on perinatal related deaths in 2007–2010 were provided to DHBs. These reports will be provided to DHBs again in 2016.

Gestation and birthweight

Table 1.12: Perinatal related death rates (per 1000 births) by gestation and birthweight 2013

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=60,039		n=139			n=307			n=152			n=598		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gestation at birth (weeks)														
20–23	232	0.4	105	75.5	*	105	34.2	*	64	42.1	*	274	45.8	*
24–27	259	0.4	24	17.3	92.66	38	12.4	146.72	19	12.5	96.45	81	13.5	312.74
28–31	472	0.8	5	3.6	10.59	32	10.4	67.80	12	7.9	27.59	49	8.2	103.81
32–36	3,771	6.3	4	2.9	1.06	63	20.5	16.71	24	15.8	6.48	91	15.2	24.13
37–40	45,508	75.8	1	0.7	0.02	60	19.5	1.32	28	18.4	0.62	89	14.9	1.96
≥41	9,775	16.3	-	-	-	9	2.9	0.92	5	3.3	0.51	14	2.3	1.43
Unknown	22	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Birthweight (g)														
<500	196	0.33	82	59.0	*	110	35.8	*	31	20.4	*	223	37.3	*
500–999	290	0.48	45	32.4	155.17	53	17.3	182.76	52	34.2	270.83	150	25.1	517.24
1000–1499	333	0.55	7	5.0	21.02	18	5.9	54.05	6	3.9	19.48	31	5.2	93.09
1500–1999	746	1.24	2	1.4	2.68	17	5.5	22.79	16	10.5	22.01	35	5.9	46.92
2000–2499	2,250	3.75	3	2.2	1.33	31	10.1	13.78	10	6.6	4.51	44	7.4	19.56
2500–2999	8,181	13.63	-	-	-	31	10.1	3.79	6	3.9	0.74	37	6.2	4.52
3000–3499	19,850	33.06	-	-	-	15	4.9	0.76	13	8.6	0.66	28	4.7	1.41
3500–3999	19,364	32.25	-	-	-	18	5.9	0.93	13	8.6	0.67	31	5.2	1.60
4000–4499	7,288	12.14	-	-	-	7	2.3	0.96	3	2.0	0.41	10	1.7	1.37
≥4500	1,509	2.51	-	-	-	2	0.7	1.33	2	1.3	1.33	4	0.7	2.65
Unknown	32	0.05	-	-	-	5	1.6	-	-	-	-	5	0.8	-

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

Table 1.12 provides estimates of mortality rates by gestation at birth and birthweight. Few babies born at 20–23 weeks or weighing under 500g survive. In some years, such as 2013, 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 2013 and a denominator compiled from birth registrations in 2013 (ie, some babies born prior to 2013 will be included in the denominator and some born in 2013 will be registered in later years). For this reason, perinatal related mortality rates at the lower extremes have not been reported.

Figure 1.24: Perinatal related mortality risk (per 1000 ongoing pregnancies) by gestational age at birth 2007–2013

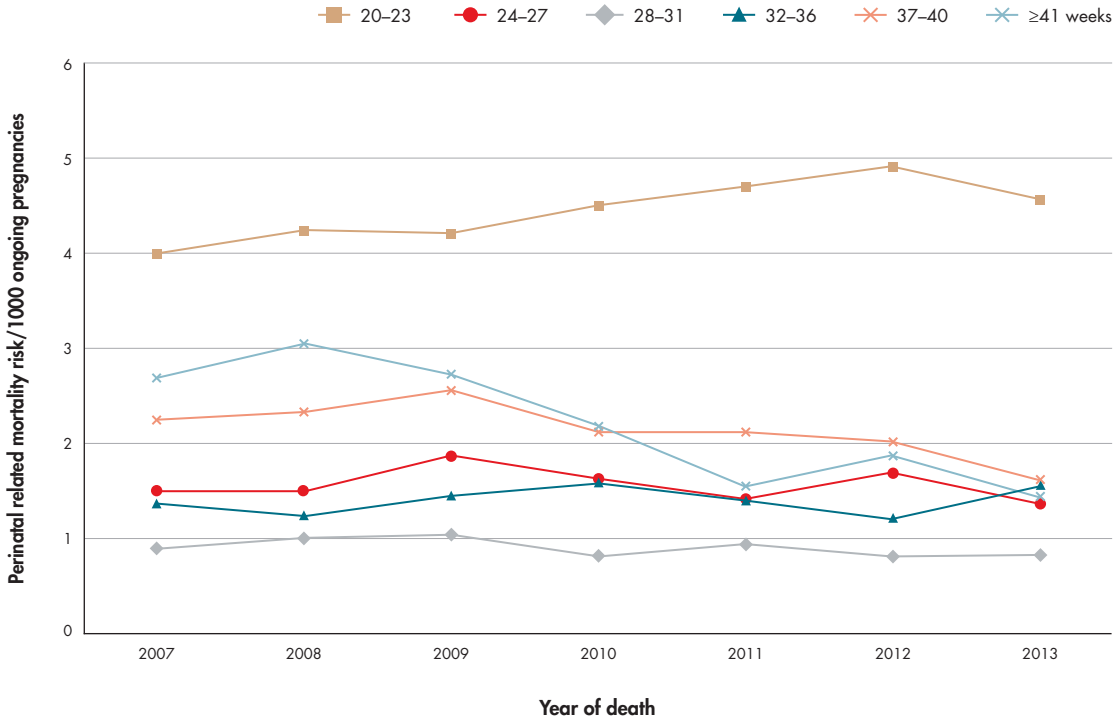


Figure 1.24 shows perinatal related death risk by gestational age group at birth as a proportion of pregnancies remaining in utero. This provides an estimate of the risk of perinatal related death for a continuing pregnancy at that gestation. For example, the risk of any type of perinatal related death in 2013 was approximately 1 in 220 among women of 20 to 23 weeks gestation, and 1 in 620 among women who were between 37 and 40 weeks gestation.

There has been a small but statistically significant increase in the risk of perinatal related death at 20–23 weeks in the years from 2007 to 2013 (chi-squared test for trend p=0.011) from 1:250 in 2007 to 1:220 in 2013.

The risks of perinatal related death among women at 37–40 weeks gestation and women at 41 or more weeks gestation have reduced significantly by 30 percent (chi-squared test for trend p=0.004) and 50 percent (chi-squared test for trend p=0.002) respectively from 2007 to 2013.

Obstetric antecedent (PSANZ-PDC) and neonatal (PSANZ-NDC) cause of death by gestational age

Table 1.13: Perinatal death classification (PSANZ-PDC) of fetal death by gestational age 2007–2013

Perinatal death classification (PSANZ-PDC)	Total	20–23		24–27		28–31		32–36		37–40		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	**1,050**	704	67.0	149	14.2	63	6.0	76	7.2	46	4.4	12	1.1
Perinatal infection	**113**	38	33.6	15	13.3	12	10.6	12	10.6	27	23.9	9	8.0
Hypertension	**118**	21	17.8	35	29.7	20	16.9	22	18.6	18	15.3	2	1.7
Antepartum haemorrhage	**338**	191	56.5	27	8.0	29	8.6	42	12.4	47	13.9	2	0.6
Maternal conditions	**181#**	71	39.2	23	12.7	17	9.4	27	14.9	41	22.7	2	1.1
Specific perinatal conditions	**372**	136	36.6	59	15.9	34	9.1	62	16.7	79	21.2	2	0.5
Hypoxic peripartum death	**74**	-	-	-	-	-	-	4	5.4	49	66.2	21	28.4
Fetal growth restriction	**321**	39	12.1	61	19.0	53	16.5	70	21.8	81	25.2	17	5.3
Spontaneous preterm	**296#**	230	77.7	45	15.2	12	4.1	9	3.0	-	-	-	-
Unexplained antepartum death	**644**	126	19.6	73	11.3	60	9.3	129	20.0	224	34.8	32	5.0
Total	**3,507**	**1,556**	**44.4**	**487**	**13.9**	**300**	**8.6**	**453**	**12.9**	**612**	**17.5**	**99**	**2.8**

Gestation of two babies unknown.

Table 1.14: Perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) of neonatal deaths by gestational age 2007–2013

Death classification (PSANZ)	Total	20–23		24–27		28–31		32–36		37–40		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Perinatal death classification (PSANZ-PDC)													
Congenital abnormality	**283**	3	1.1	6	2.1	43	15.2	93	32.9	109	38.5	29	10.2
Perinatal infection	**57**	17	29.8	9	15.8	5	8.8	5	8.8	12	21.1	9	15.8
Hypertension	**29**	5	17.2	13	44.8	6	20.7	4	13.8	1	3.4	-	-
Antepartum haemorrhage	**156**	96	61.5	36	23.1	8	5.1	9	5.8	6	3.8	1	0.6
Maternal conditions	**34**	8	23.5	6	17.6	5	14.7	5	14.7	9	26.5	1	2.9
Specific perinatal conditions	**107**	54	50.5	17	15.9	8	7.5	13	12.1	14	13.1	1	0.9
Hypoxic peripartum death	**92**	-	-	-	-	1	1.1	4	4.3	62	67.4	25	27.2
Fetal growth restriction	**29**	1	3.4	6	20.7	4	13.8	4	13.8	12	41.4	2	6.9
Spontaneous preterm	**381**	236	61.9	113	29.7	17	4.5	15	3.9	-	-	-	-
No obstetric antecedent	**61**	-	-	-	-	-	-	4	6.6	44	72.1	13	21.3
Neonatal death classification (PSANZ-NDC)													
Congenital abnormality	**290**	3	1.0	6	2.1	43	14.8	96	33.1	113	39.0	29	10.0
Extreme prematurity	**435**	391	89.9	43	9.9	1	0.2	-	-	-	-	-	-
Cardio-respiratory disorders	**82**	10	12.2	57	69.5	9	11.0	2	2.4	4	4.9	-	-
Infection	**108**	6	5.6	41	38.0	16	14.8	14	13.0	20	18.5	11	10.2
Neurological	**205**	8	3.9	35	17.1	17	8.3	26	12.7	89	43.4	30	14.6
Gastrointestinal	**21**	2	9.5	14	66.7	4	19.0	1	4.8	-	-	-	-
Other	**88**	-	-	10	11.4	7	8.0	17	19.3	43	48.9	11	12.5
Total	**1,229**	**420**	**34.2**	**206**	**16.8**	**97**	**7.9**	**156**	**12.7**	**269**	**21.9**	**81**	**6.6**

Tables 1.13 and 1.14 include data on the cause of death (PSANZ-PDC and PSANZ-NDC) by gestation at birth including deaths from 2007 to 2013 for fetal and neonatal deaths. Combining data provides more stable estimates of the association between PSANZ-PDC and gestation at birth of perinatal related deaths, as numbers in some categories are small.

Similar proportions of all fetal and neonatal deaths occur among births at 20–23 weeks gestation (44 and 34 percent respectively).

Congenital abnormality is the most prevalent cause of fetal death and the second most prevalent cause of neonatal deaths, but fetal deaths with congenital abnormality are most common at 20–23 weeks associated with late termination of pregnancy, while neonatal deaths with congenital abnormality are more common proximate to term.

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

Hypoxic peripartum death is the second most common cause of neonatal death at term, responsible for 87 deaths between 2007 and 2013 although hypoxic peripartum death was responsible for only 8 deaths at term in 2013 compared to 15 in 2007.

Fifty-seven neonates died from 2007–2013 without obstetric antecedent cause, 5 in 2013 compared to 10 in 2007.

Stillbirth

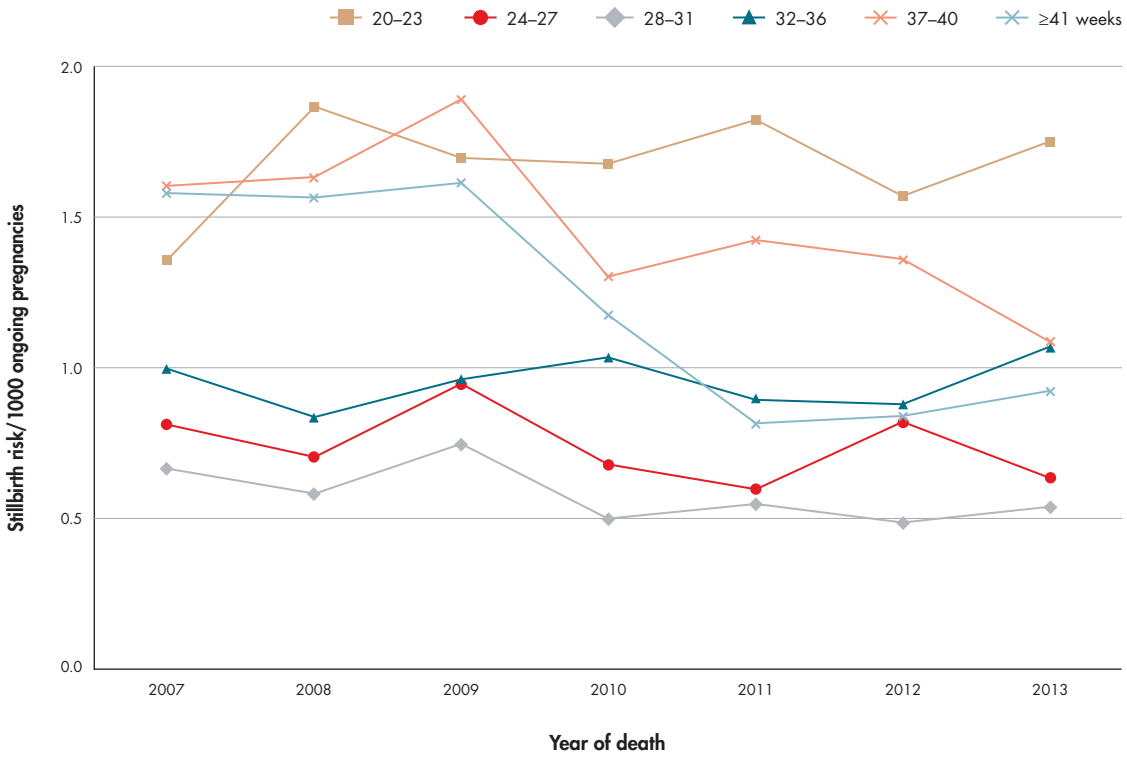
There has been a significant reduction in the rate of stillbirth from 2007 to 2013 (score test for linear trend p=0.015).

The largest numbers of stillbirths consistently fall in the unexplained antepartum death category (30 percent in 2013) accounting for between 71 and 103 deaths per year in New Zealand from 2007 to 2013.

The most frequently identified causes (PSANZ-PDC) of stillbirth were antepartum haemorrhage, specific perinatal conditions and fetal growth restriction, responsible for 44, 39 and 44 stillbirths (13–14 percent) in 2013 respectively.

Stillbirth and gestation

Figure 1.25: Stillbirth risk (per 1000 ongoing pregnancies) by gestational age at birth and year 2007–2013



There has been a statistically significant reduction in the risk of stillbirth at 37–40 weeks gestation (p=0.003) and 41 weeks gestation and over (p=0.015).

This represents a reduction in risk of approximately 30 and 40 percent respectively for women with ongoing pregnancies at these gestations. In 2007 there were 117 stillbirths at 37 weeks or later gestation compared to 69 in 2013.

The greatest absolute reduction in stillbirths at term (≥37 weeks at birth) has occurred in unexplained antepartum deaths (a reduction of 14 deaths in 2013 compared to the average number of deaths in 2007–2009; chi-squared test for trend p=0.054) and hypoxic peripartum deaths (a reduction of 9 deaths in 2013 compared to the average number of deaths in 2007–2009; chi-squared test for trend p=0.003), representing approximately 30 percent of unexplained antepartum deaths and 80 percent of hypoxic peripartum deaths in 2007–2009. There has also been a significant reduction in stillbirth at 37 or more weeks from antepartum haemorrhage (p=0.003) and from perinatal infection (p=0.018).

Table 1.15: Perinatal death classification (PSANZ-PDC) specific stillbirth rates at term (≥37 weeks) (per 1000 births) 2007–2013

Perinatal death classification (PSANZ-PDC)	2007		2008		2009		2010		2011		2012		2013		Chi-squared test for trend (p)
	n=60,550		n=60,582		n=58,671		n=59,882		n=57,617		n=57,380		n=55,283		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	9	0.15	9	0.15	9	0.15	6	0.10	10	0.17	7	0.12	4	0.07	0.31
Perinatal infection	7	0.12	6	0.10	9	0.15	7	0.12	3	0.05	-	-	3	0.05	0.018
Hypertension	1	0.02	2	0.03	8	0.14	3	0.05	3	0.05	3	0.05	-	-	0.59
Antepartum haemorrhage	10	0.17	10	0.17	10	0.17	11	0.18	3	0.05	3	0.05	2	0.04	0.0025
Maternal conditions	7	0.12	4	0.07	8	0.14	9	0.15	1	0.02	7	0.12	7	0.13	0.91
Specific perinatal condition	12	0.20	8	0.13	14	0.24	12	0.20	16	0.28	10	0.18	7	0.13	0.80
Hypoxic peripartum death	18	0.30	14	0.23	10	0.17	7	0.12	7	0.12	11	0.19	3	0.05	0.0027
Fetal growth restriction	13	0.22	19	0.32	10	0.17	15	0.25	12	0.21	18	0.32	11	0.20	0.98
Unexplained antepartum death	40	0.66	46	0.76	52	0.89	22	0.37	36	0.63	28	0.49	32	0.58	0.054

Unexplained antepartum death at term

Of 91 unexplained antepartum deaths in 2013, approximately one-third (32) were born at term (≥37 weeks). Of these 32, three died prior to term (but were born at term) with the remaining 26 most commonly dying at 38–40 weeks gestation. Unexplained antepartum deaths accounted for 31 percent of all perinatal related deaths at term.

Term unexplained antepartum death was reviewed in detail in the eighth report of the PMMRC.

Intrapartum stillbirth

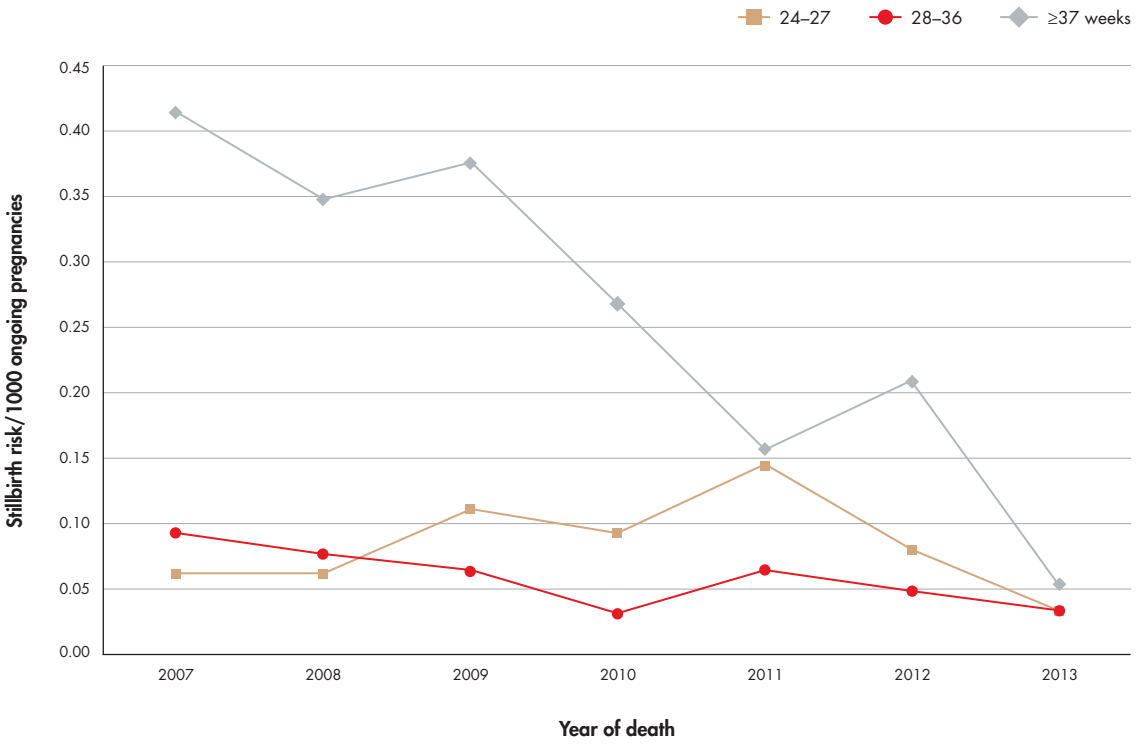
Table 1.16: Timing of stillbirths relative to labour by gestation 2013

Timing of stillbirth	All stillbirths		Stillbirths ≥24 weeks		Stillbirths ≥37 weeks		Stillbirths ≥37 weeks without congenital abnormality	
	n=307		n=202		n=69		n=65	
	n	%	n	%	n	%	n	%
Antepartum	234	76.2	181	89.6	54	78.3	52	80.0
Intrapartum – total	52	16.9	9	4.5	5	7.2	3	4.6
Intrapartum – first stage	19	6.2	5	2.5	3	4.3	3	4.6
Intrapartum – second stage	2	0.7	-	-	-	-	-	-
Intrapartum – unknown stage	31	10.1	4	2.0	2	2.9	-	-
Unknown	21	6.8	12	5.9	10	14.5	10	15.4

There were 52 known stillbirths in labour in 2013. Of these, three occurred at term in babies without congenital abnormality. This compares with 25 at term in babies without congenital abnormality in 2007.

The intrapartum stillbirth rate (in labour deaths of babies of 24 weeks and beyond, excluding deaths caused by lethal congenital abnormality) was 0.12/1000 births 24 weeks and beyond without lethal congenital abnormality in 2013. This compares to 0.54/1000 births in 2007, a reduction of 78 percent since 2007.

Figure 1.26: Intrapartum stillbirth risk (per 1000 ongoing pregnancies) by gestation at birth (weeks) excluding congenital abnormalities 2007–2013



There has been a statistically significant reduction in the intrapartum stillbirth rate for babies born at term, excluding those with congenital abnormalities (Figure 1.26).

Intrapartum stillbirths and neonatal hypoxic peripartum deaths (PSANZ-PDC 7) were reported in detail in the eighth report of the PMMRC.

Termination of pregnancy

There has been a significant increase in the rate of late termination of pregnancy in 2007–2013 (score test for linear trend p=0.03).

As reported in the eighth report of the PMMRC, there has been no significant change in the numbers or rate of late terminations associated with congenital abnormality. The increase is among late terminations of pregnancy associated with conditions other than congenital abnormalities, including perinatal infection, hypertension, antepartum haemorrhage, maternal conditions, specific perinatal conditions, fetal growth restriction and spontaneous preterm birth sequelae.

There were 26 terminations performed after 24 weeks gestation in 2013. The primary antecedent classifications for these cases were congenital abnormality in 21 and perinatal infection, specific perinatal conditions and fetal growth restriction in the remainder.

Neonatal death

There were 152 neonatal deaths in 2013. Of these, 32 (21 percent) were associated with congenital abnormality. Of the remaining 120, approximately half (63) were born from 20–23 weeks, of whom 55 died in the first day of life. All 63 died of complications of extreme prematurity. Fifty-one of these cases were associated with antecedent spontaneous preterm birth and/or antepartum haemorrhage. Progress in preventing these antenatal conditions holds the key to an improvement in neonatal death at early gestations.

There has been no significant change in neonatal death rates or neonatal death classifications from 2007 to 2013. Neonatal death classifications (PSANZ-NDC) by year 2007–2013 can be found in Table A21 at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/.

Table 1.17: Clinical details of neonatal deaths 2013

	Total		Congenital abnormalities		Neonatal deaths excluding congenital abnormalities							
					20–23		24–27		28–36		≥37 weeks	
	n=152		n=32		n=63		n=19		n=21		n=17	
	n	%	n	%	n	%	n	%	n	%	n	%
Age at death (days)												
0	88	57.9	11	34.4	56	88.9	9	47.4	8	38.1	4	23.5
1–6	33	21.7	9	28.1	5	7.9	5	26.3	7	33.3	7	41.2
7–13	19	12.5	10	31.3	2	3.2	3	15.8	2	9.5	2	11.8
14–20	5	3.3	2	6.3	-	-	1	5.3	1	4.8	1	5.9
21–27	7	4.6	-	-	-	-	1	5.3	3	14.3	3	17.6
Place of death												
Home	13	8.6	1	3.1	2	3.2	2	10.5	2	9.5	6	35.3
Hospital												
Delivery suite	52	34.2	5	15.6	45	71.4	2	10.5	-	-	-	-
Antenatal ward	2	1.3	-	-	1	1.6	1	5.3	-	-	-	-
Postnatal ward	3	2.0	1	3.1	1	1.6	-	-	1	4.8	-	-
Neonatal unit	53	34.9	13	40.6	5	7.9	13	68.4	13	61.9	9	52.9
Operating theatre	7	4.6	4	12.5	-	-	-	-	3	14.3	-	-
Emergency department	3	2.0	-	-	2	3.2	1	5.3	-	-	-	-
Other	18	11.8	8	25.0	6	9.5	-	-	2	9.5	2	11.8
Unknown	1	0.7	-	-	1	1.6	-	-	-	-	-	-
Apgar 5 minutes												
0–3	69	45.4	10	31.3	34	54.0	8	42.1	10	47.6	7	41.2
4–5	17	11.2	7	21.9	6	9.5	2	10.5	-	-	2	11.8
6–7	15	9.9	6	18.8	1	1.6	3	15.8	4	19.0	1	5.9
≥8	27	17.8	9	28.1	3	4.8	3	15.8	6	28.6	6	35.3
Unknown	24	15.8	-	-	19	30.2	3	15.8	1	4.8	1	5.9
Resuscitation at birth												
Yes	66	43.4	15	46.9	7	11.1	18	94.7	16	76.2	10	58.8
No	86	56.6	17	53.1	56	88.9	1	5.3	5	23.8	7	41.2
Outcome of resuscitation												
Baby resuscitated and transferred to another clinical care area	56	36.8	14	43.8	5	7.9	14	73.7	13	61.9	10	58.8
Baby unable to be resuscitated	10	6.6	1	3.1	2	3.2	4	21.1	3	14.3	-	-

Neonatal deaths in Table 1.17 have been categorised as those due to congenital abnormalities and then by gestational age where congenital abnormalities have been excluded: extreme preterm (<24 weeks), very preterm (24–27 weeks), late preterm (28–36 weeks) and term (≥37 weeks).

In the extreme preterm population, the majority (56/63 (89 percent)) did not receive resuscitation in the delivery unit. In the very preterm population, all but one baby received resuscitation.

Seventeen babies without congenital abnormalities died during the neonatal period after birth at term, nine from neurological causes and five from sudden infant death in infancy (SUDI).

The five deaths from SUDI among the neonatal deaths in 2013 compare to 10, 7, 8, 5 and 6 in 2008–2012 respectively. Four of the five SUDI deaths in 2013 were associated with bed sharing, and the mothers of four of the five deaths were smokers. One baby was under 37 weeks gestation and all were appropriately grown by customised birthweight centiles.

Figure 1.27: Distribution of neonatal death classification (PSANZ-NDC) among neonatal deaths without lethal congenital abnormality by gestational age group 2007–2013

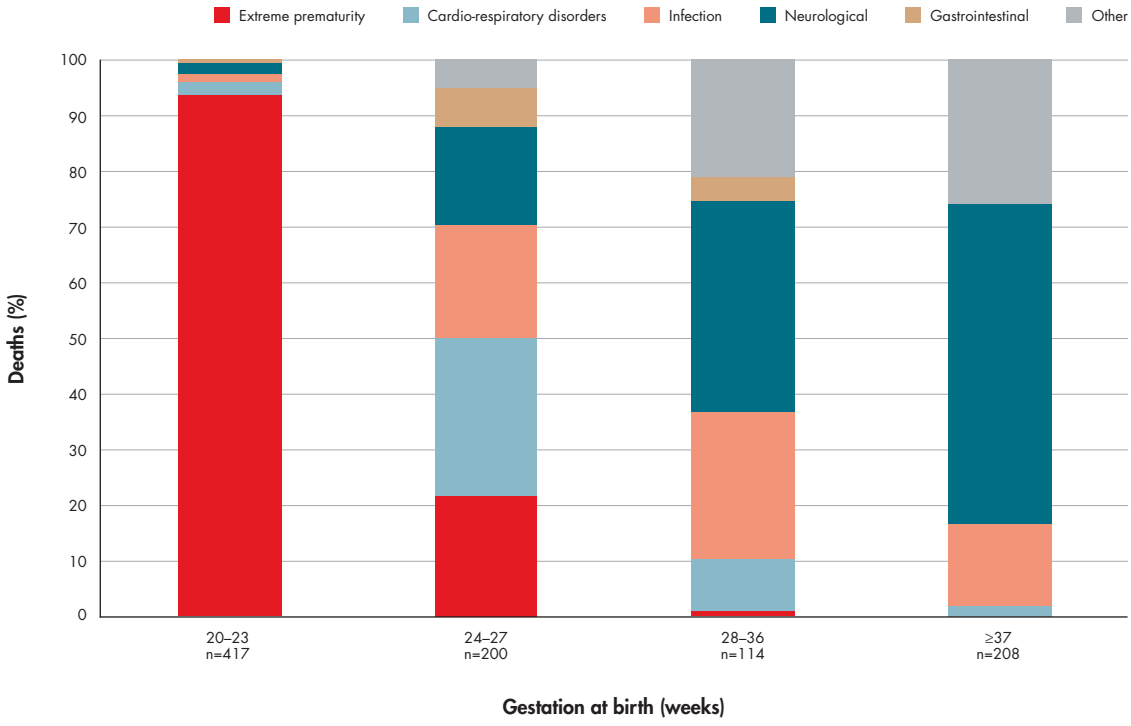


Figure 1.27 shows the distribution of cause of neonatal death (PSANZ-NDC) among extreme preterm, very preterm, late preterm and term babies, after excluding congenital abnormality.

Extreme prematurity was given as the cause of death in almost all live born babies at 20–23 weeks. For those babies live born at 24–27 weeks, prematurity as the principal cause of death had reduced to around 20 percent but a further 57 babies (30 percent) were classified as dying from cardio-respiratory disorders after birth (hyaline membrane disease (27), pulmonary hypoplasia (13), pulmonary haemorrhage (9), bronchopulmonary dysplasia (3), other (3)). At 28–36 weeks, when death due to respiratory conditions and intraventricular haemorrhage is less common, other neurological disorders become the predominant cause of death. In this dataset, the neurological cause of death both in 28–36 week and term infants is almost exclusively hypoxic ischaemic in origin (damage to the brain due to lack of oxygen in the peripartum period).

Figure 1.28: Neonatal death rate (per 1000 live births) by gestation and prioritised baby ethnicity 2007–2013 (excluding congenital abnormalities)

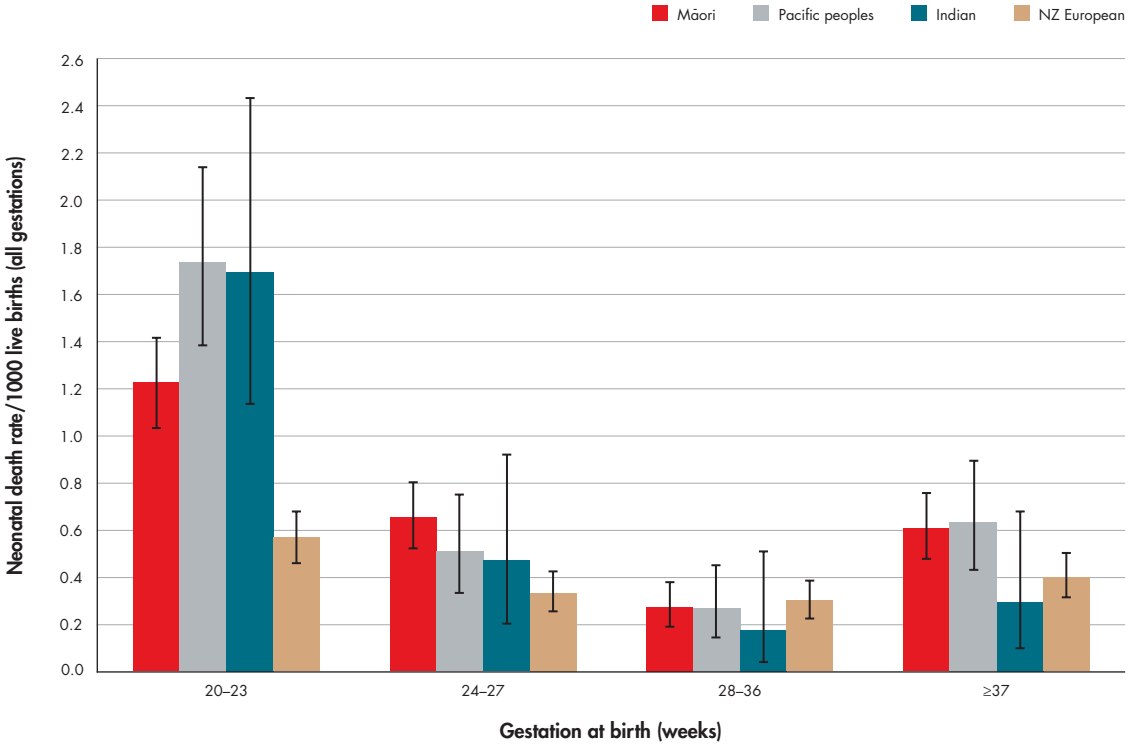


Figure 1.28 shows the rate of neonatal death excluding congenital abnormalities (as a proportion of total live births) at each gestation by prioritised ethnicity for Māori, Pacific, Indian and New Zealand European babies.

Māori, Pacific and Indian neonates were significantly more likely to be born at 20–23 weeks and subsequently die than they were to die at any later gestation and also at least twice as likely to be born and die at 20–23 weeks as New Zealand European neonates. This is because of higher rates of preterm birth among these ethnic groups. Successful interventions to prevent preterm birth would reduce the ethnic disparities in neonatal and perinatal mortality.

The neonatal death rates by gestation were more similar for New Zealand European neonates, although they were significantly more likely to die after birth at 20–23 weeks than birth at 28–36 weeks.

Table 1.18: Association between perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) among all neonatal deaths 2013

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	**29**	29	-	-	-	-	-	-
Perinatal infection	**8**	-	4	-	4	-	-	-
Hypertension	**3**	-	1	-	-	2	-	-
Antepartum haemorrhage	**25**	-	16	1	2	5	-	1
Maternal conditions	**8**	3	1	-	1	3	-	-
Specific perinatal conditions	**14**	-	5	-	-	3	1	5
Hypoxic peripartum death	**8**	-	-	1	-	7	-	-
Fetal growth restriction	**2**	-	-	-	1	-	-	1
Spontaneous preterm	**49**	-	35	4	3	5	-	2
No obstetric antecedent	**6**	-	-	-	1	-	-	5

All neonatal deaths are assigned at least one neonatal death classification (PSANZ-NDC), along with a perinatal death classification (PSANZ-PDC). Table 1.18 demonstrates how these classification systems relate to each other. For example, death from extreme prematurity followed spontaneous preterm birth (35) but also antepartum haemorrhage (16), specific perinatal conditions (5), perinatal infection, hypertension and maternal conditions. Neurological deaths are common (25 cases). In more than half of these deaths (18), there was an underlying primary obstetric cause other than hypoxic peripartum death.

Multiple birth

Table 1.19: Perinatal related death rates (per 1000 births) and multiple* births 2013

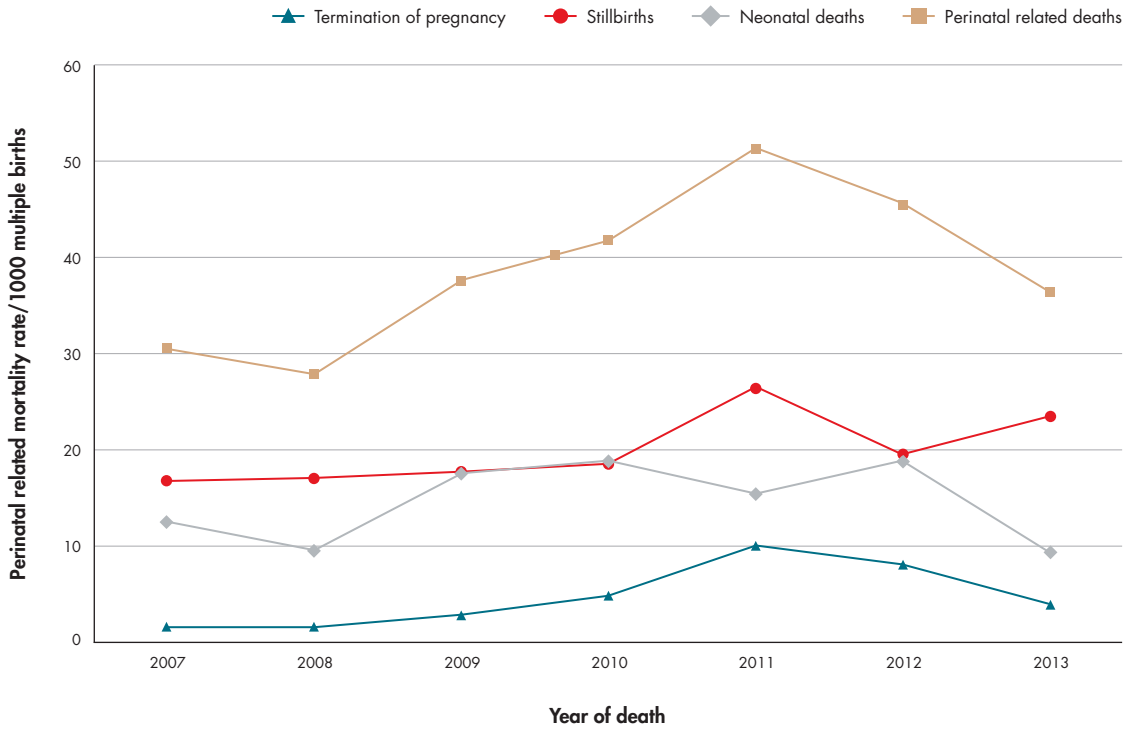
Type of birth	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=60,039		n=139			n=307			n=152			n=598		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Singleton	58,286	97.1	132	95.0	2.26	266	86.6	4.56	136	89.5	2.35	534	89.3	9.16
Multiple	1,753	2.9	7	5.0	3.99	41	13.4	23.39	16	10.5	9.38	64	10.7	36.51
Multiples (1/2 died)			2	1.4		11	3.6		6	3.9		19	3.2	
Multiples (2/2 died)			5	3.6		28	9.1		9	5.9		42	7.0	
Multiples (1/3 died)			-	-		2	0.7		-	-		2	0.3	
Twin	1,720	2.9	7	5.0	4.07	39	12.7	22.67	15	9.9	8.96	61	10.2	35.47
Dichorionic diamniotic			4	2.9		9	2.9		11	7.2		24	4.0	
Monochorionic diamniotic			3	2.2		27	8.8		4	2.6		34	5.7	
Monoamniotic			-	-		-	-		-	-		-	-	
Unknown			-	-		3	1.0		-	-		3	0.5	

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

In 2013, 64 perinatal related deaths occurred in multiple pregnancies. The majority of these (61) were twin pregnancies with one twin dying in 19 twin pregnancies and both twins dying in 21 twin pregnancies.

The perinatal related mortality rate in 2013 among babies born in multiple pregnancies was 37/1000 babies or 1 in every 27 babies born at 20 weeks or beyond in a multiple pregnancy. This compares to approximately 1 in every 110 singleton babies born at 20 weeks or beyond.

Figure 1.29: Perinatal related death rates (per 1000 births) among babies born in multiple pregnancies 2007–2013



Although there is considerable variation in the perinatal related mortality rate from 2007 to 2013, probably reflective of small numbers in both the numerator and the denominator, there remains a statistically significant increase (chi-squared test for linear trend p=0.003). This rise was analysed in detail in the seventh annual report of the PMMRC (PMMRC 2013).

Cause of death among multiple pregnancy deaths

The most common cause of death among babies dying in multiple pregnancies is specific perinatal conditions, of which twin–twin transfusion syndrome is the most common. Spontaneous preterm birth is the second most common cause of death in multiple pregnancies, occurring seven times more commonly than in singleton pregnancies.

Multiple pregnancies also have significantly higher perinatal related death rates from congenital abnormality, perinatal infection, antepartum haemorrhage, fetal growth restriction and unexplained antepartum death than singleton pregnancies.

While the risk of mortality is higher at all gestational ages for multiples than singletons, the greatest excess of risk is between 20 and 24 weeks and the cause of death at this gestation is most often spontaneous preterm birth or specific perinatal condition.

Table 1.20: Chorionicity and number of babies lost among twin perinatal related deaths 2007–2013

	2007		2008		2009		2010		2011		2012		2013		Total	
	n=60		n=49		n=57		n=76		n=86		n=73		n=61		n=462	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Twin type																
Dichorionic diamniotic	29	48.3	20	40.8	19	33.3	37	48.7	42	48.8	26	35.6	24	32.9	197	42.6
Monochorionic diamniotic	29	48.3	25	51.0	33	57.9	31	40.8	37	43.0	42	57.5	34	46.6	231	50.0
Monoamniotic	2	3.3	-	-	4	7.0	5	6.6	2	2.3	2	2.7	-	-	15	3.2
Other multiple	-	-	4	8.2	-	-	1	1.3	2	2.3	1	1.4	-	-	8	1.7
Unknown	-	-	-	-	1	1.8	2	2.6	3	3.5	2	2.7	3	4.1	11	2.4
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	48	66.7	42	66.7	291	63.0
One twin died	25	45.3	23	50.9	25	47.5	28	39.2	26	33.3	25	33.3	19	33.3	171	37.0

It is known that twin babies who share a placenta (monochorionic) contribute disproportionately to twin deaths, generally from twin–twin transfusion syndrome as a result of communicating circulations in the placenta.

From 2007 to 2013, 500 multiple pregnancy perinatal related deaths were reported. Of these, 199 (40 percent) were dichorionic diamniotic multiples, 232 (46 percent) monochorionic diamniotic, 15 (3 percent) monoamniotic, 40 (8 percent) were higher order multiples and 14 (3 percent) were reported as unknown chorionicity.

Fifty-nine percent (137) of perinatal related deaths of monochorionic twins in New Zealand from 2007–2013 were due to twin–twin transfusion syndrome.

Multiple birth and infertility treatment 2007–2013

Table 1.21: Contribution of fertility treatment to perinatal related mortality by plurality 2007–2013

Fertility treatment	Singleton perinatal related deaths		Multiple perinatal related deaths		Perinatal related deaths	
	n=4,238		n=500		n=4,738	
	n	%	n	%	n	%
Clomiphene	38	0.9	18	3.6	56	1.2
Follicle stimulating hormone (FSH)	2	0.0	4	0.8	6	0.1
In vitro fertilisation (including ICSI)	97	2.3	59	11.8	156	3.3
Any of Clomiphene/FSH/IVF	**135**	**3.2**	**76**	**15.2**	**211**	**4.5**

ICSI = intracytoplasmic sperm injection.
IVF = in vitro fertilisation.

Two hundred and eleven (4.5 percent) perinatal related deaths in 2007–2013 were reported to have been of babies conceived using one of Clomiphene, follicle-stimulating hormone (FSH) and/or in vitro fertilisation (IVF) for fertility treatment. Fertility treatment is more common among multiple pregnancy deaths (15.2 percent) than singleton pregnancy deaths (3.2 percent).

Sixteen of forty deaths of triplets or higher order multiples (40 percent) from 2007 to 2013 were associated with use of Clomiphene, FSH and/or IVF treatment.

Vaginal bleeding in pregnancy

Table 1.22: Perinatal related deaths and vaginal bleeding during pregnancy 2013

Vaginal bleeding	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Yes	19	13.7	92	30.0	71	46.7	182	30.4
No	114	82.0	194	63.2	67	44.1	375	62.7
Unknown	6	4.3	21	6.8	14	9.2	41	6.9
Gestation* (weeks)								
<20 weeks	17	12.2	57	18.6	34	22.4	108	18.1
≥20 weeks	8	5.8	71	23.1	67	44.1	146	24.4

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

Antepartum haemorrhage (bleeding at or beyond 20 weeks) continues to be strongly associated with perinatal related death, especially among stillbirths (23.1 percent of stillbirths) and neonatal deaths (44.1 percent of deaths) in 2013.

Vaginal bleeding at any stage in pregnancy is associated with increased risk of an SGA baby and preterm labour, which in turn may increase the risk of fetal compromise in labour.

There was a significant association between maternal current smoking and antepartum haemorrhage as the primary antecedent cause of death. Forty percent of mothers of these deaths were smokers compared to 30 percent of all mothers of stillbirths and neonatal deaths in 2007–2013 ($p<0.0001$). This analysis does not determine whether smoking causes death from antepartum haemorrhage or whether smoking is a confounding factor in another causative relationship with antepartum haemorrhage.

Small for gestational age infants

Customised birthweight centiles adjust for gender, gestation, maternal ethnicity, age, parity and BMI, and are calculated using actual birthweight and gestation at death in utero or gestation at birth. SGA has been defined as a customised birthweight less than the 10th centile. Customised birthweight centiles were not calculated if gestation at death was less than 20 weeks, was unknown or if a week or more had elapsed between fetal death and birth (because of the unknown effect of prolonged time in utero following fetal death on birthweight).

Figure 1.30: Small for gestational age (customised SGA) by gestation among perinatal related deaths (excluding multiples and congenital abnormalities) 2007–2013

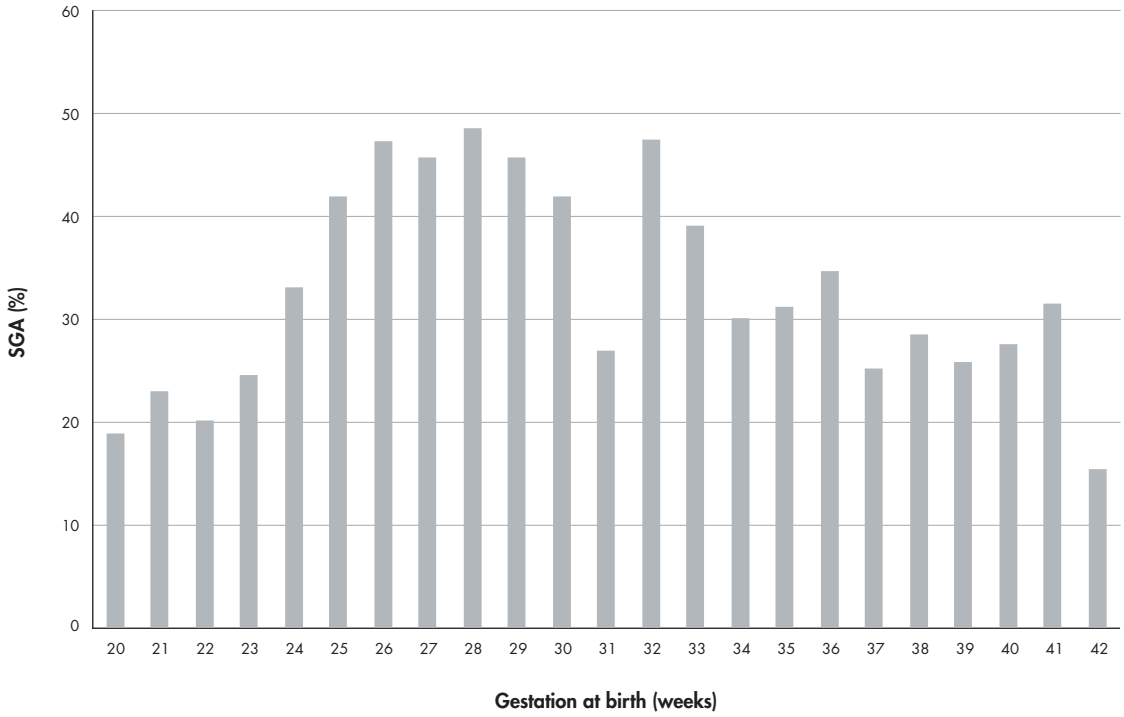


Figure 1.30 includes singleton perinatal related deaths, excluding congenital abnormalities, and shows how the proportion of SGA babies varies by gestation at birth.

The proportion of SGA among babies born from 20 weeks with known birthweight centile, excluding multiples and congenital abnormalities, ranges between 15 and 49 percent, with an average of 30 percent. Although the proportion of babies who would be SGA by customised centiles in the total population of births in New Zealand is currently unknown (because height and weight are not included in the maternity dataset), it is likely to be between 10 and 15 percent as the 10th centile is calculated as the optimal weight for gestation for healthy pregnancies. This would suggest that babies who die are at least twice, and possibly as much as three times, as likely to be SGA as all babies born in New Zealand, as measured using this tool.

Table 1.23: Perinatal related deaths and small for gestational age (customised SGA) among singleton deaths without congenital abnormalities 2013

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
Singleton deaths ≥20 weeks, excluding congenital abnormalities	n	%	n	%	n	%	n	%
	n=25		**n=246**		**n=106**		**n=377**	
SGA	10	40.0	79	32.1	11	10.4	100	26.5
Singleton deaths ≥24 weeks, excluding congenital abnormalities	**n=6**		**n=158**		**n=53**		**n=217**	
SGA	5	83.3	59	37.3	7	13.2	71	32.7

SGA = small for gestational age (birthweight less than 10th customised centile).

Of singleton babies who delivered from 24 weeks without congenital abnormality, 37 percent of those who were stillborn, and 13 percent of those who died in the first 27 days of life, were small by customised birthweight centile. Of these 66 babies in 2013, the primary cause of death was fetal growth restriction in 33 (50 percent), antepartum haemorrhage in 8 (12 percent) and unexplained in 13 (20 percent), with the remaining 12 spread in smaller numbers across all other perinatal death classifications.

The proportion of SGA stillbirths and neonatal deaths of all births from 2007 to 2013 has not changed significantly.

Maternity care

Antenatal caregiver

Table 1.24: Perinatal related deaths and maternal registration status 2013

Was the mother registered with a lead maternity carer (LMC)?	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Yes	137	98.6	289	94.1	138	90.8	564	94.3
Self-employed midwife	101	72.7	224	73.0	96	63.2	421	70.4
Hospital	24	17.3	45	14.7	37	24.3	106	17.7
General practitioner	4	2.9	2	0.7	2	1.3	8	1.3
Obstetrician (private)	7	5.0	16	5.2	2	1.3	25	4.2
Unknown LMC	1	0.7	2	0.7	1	0.7	4	0.7
No	2	1.4	18	5.9	14	9.2	34	5.7

These data relate to registration for maternity care (or booking). The proportion of unregistered mothers among mothers of babies who die in the perinatal period has remained unchanged over the years from 2007 to 2013. However, over this period there has been an increase in registration with self-employed midwives and a decrease in antenatal care provided by DHB (hospital) primary services, consistent with the trend among all births.

Table 1.25: Gestation at registration by lead maternity carer (LMC) among perinatal related deaths 2013

Lead maternity carer	Total	Gestation (weeks) at registration									
		<10		10–13		14–19		≥20		Unknown	
		n	%	n	%	n	%	n	%	n	%
Self-employed midwife	421	169	40.1	147	34.9	63	15.0	32	7.6	10	2.4
Hospital	106	22	20.8	32	30.2	37	34.9	15	14.2	-	-
General practitioner	8	3	37.5	2	25.0	1	12.5	-	-	2	25.0
Obstetrician (private)	25	14	56.0	8	32.0	-	-	1	4.0	2	8.0
Unknown LMC	4	-	-	-	-	3	75.0	-	-	1	25.0
Total	**564**	**208**	**36.9**	**189**	**33.5**	**104**	**18.4**	**48**	**8.5**	**15**	**2.7**

Seventy percent of mothers whose babies died and who registered with an LMC were registered by 13 weeks in 2013. Nine percent of mothers 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 and general practitioners.

Table 1.26: Lead maternity carer (LMC) at registration and birth among stillbirths and neonatal deaths 2013

Lead maternity carer at registration	Total		LMC at birth									
			Self-employed midwife		Hospital		General practitioner		Obstetrician (private)		Not stated/ Unknown	
	n=427		n=146		n=258		n=0		n=19		n=4	
	n	%	n	%	n	%	n	%	n	%	n	%
Self-employed midwife	320	37.5	145	45.3	171	53.4	-	-	1	0.3	3	0.9
Hospital	82	9.6	1	1.2	81	98.8	-	-	-	-	-	-
General practitioner	4	0.5	-	-	4	100.0	-	-	-	-	-	-
Obstetrician (private)	18	2.1	-	-	-	-	-	-	18	100.0	-	-
Unknown LMC	3	0.4	-	-	2	11.1	-	-	-	-	1	5.6
Total	**427**		**146**	**34.2**	**258**	**60.4**	**-**	**-**	**19**	**4.4**	**4**	**0.9**

Among stillbirths and neonatal deaths, 34 percent were registered with a self-employed midwife, 4 percent with a private obstetrician and 60 percent with a hospital service at the time of birth.

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.

Screening for diabetes in pregnancy

Table 1.27: Screening for diabetes among registered women with no pre-existing diabetes and where stillbirth and neonatal death occurred at or beyond 28 weeks gestation 2007–2013

Screened for diabetes	2007		2008		2009		2010		2011		2012		2013	
	n=285		n=295		n=302		n=265		n=253		n=235		n=212	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Yes	166	58.2	162	54.9	199	65.9	179	67.5	195	77.1	177	75.3	170	80.2
No	68	23.9	71	24.1	52	17.2	49	18.5	45	17.8	48	20.4	30	14.2
Unknown	51	17.9	62	21.0	51	16.9	37	14.0	11	4.3	6	2.6	8	3.8
Declined	-	-	-	-	-	-	-	-	2	0.8	4	1.7	4	1.9

It is difficult to be certain whether uptake of diabetes screening has improved among perinatal related deaths as there were considerable missing data prior to 2011. Between 75 and 80 percent of mothers of perinatal related deaths who were eligible were screened for diabetes between 2011 and 2013.

Screening for diabetes in pregnancy is recommended for all women between 24 and 28 weeks by the Ministry of Health, RANZCOG and the New Zealand College of Midwives.

The Ministry of Health has published a national guideline – *Screening, Diagnosis and Management of Gestational Diabetes in New Zealand: A Clinical Practice Guideline* (Ministry of Health 2014b), which is available online.

Screening for and experience of family violence in pregnancy

Table 1.28: Perinatal related deaths and screening for family violence 2013

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Experienced family violence in this pregnancy								
Yes	-	-	6	2.0	6	3.9	12	2.0
No	72	51.8	159	51.8	63	41.4	294	49.2
Not asked	28	20.1	67	21.8	26	17.1	121	20.2
Unknown	39	28.1	75	24.4	57	37.5	171	28.6
Referral to relevant support								
Yes	-	-	3	50.0	5	83.3	8	66.7
No	-	-	-	-	-	-	-	-
Unknown	-	-	3	50.0	1	16.7	4	33.3

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. There remain 50 percent of women whose babies died where no data were reported on whether they were screened for or experienced family violence.

Of the 12 disclosures in 2013, 8 were reported to have been referred for support.

PRACTICE POINT: FAMILY VIOLENCE

Intimate partner violence is associated with significant adverse pregnancy outcomes for both mother and baby. These outcomes include increased risks of:

- antepartum haemorrhage
- preterm labour and birth
- intrauterine growth restriction
- perinatal death
- low birth weight
- maternal mortality
- termination of pregnancy
- maternal anxiety, depression, alcohol and drug abuse (Boy & Salihu 2004; Janssen et al 2003; Sarkar 2008).

Identifying and responding to violence is an important and appropriate role for health care providers to undertake. It is recommended that practitioners routinely ask all women about family violence during pregnancy and offer referral to appropriate agencies for ongoing support and safety planning.

The Ministry of Health's *Family Violence Intervention Guidelines* (Ministry of Health 2002) are a practical tool to help health providers make safe and effective interventions to assist victims of violence and abuse.

It is recommended that all practitioners access appropriate training to allow them to ask about family violence and respond when it is identified. Family violence education is available to practitioners through DHB Violence Intervention Programmes and the New Zealand College of Midwives.

Addition 2017 - View Resources: http://www.health.govt.nz/our-work/preventative-health-wellness/family-violence

Place of birth and antenatal transfer

Table 1.29: Intended place of birth versus actual place of birth among stillbirths and neonatal deaths 2013

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	**6**	-	-	-	-	-	-	3	50.0	3	50.0	-	-	-	-
Birthing unit	**37**	2	5.4	1	2.7	-	-	6	16.2	28	75.7	-	-	-	-
Hospital level 1	**22**	1	4.5	-	-	2	9.1	9	40.9	9	40.9	1	4.5	-	-
Hospital level 2	**171**	1	0.6	-	-	1	0.6	136	79.5	30	17.5	2	1.2	1	0.6
Hospital level 3	**187**	2	1.1	-	-	-	-	1	0.5	182	97.3	-	-	2	1.1
Other	**4**	-	-	-	-	-	-	-	-	3	75.0	1	25.0	-	-
Not registered	**29**	7	24.1	1	3.4	-	-	6	20.7	14	48.3	1	3.4	-	-
Unknown	**3**	1	33.3	-	-	-	-	-	-	2	66.7	-	-	-	-
Total	**459**	**14**	**3.1**	**2**	**0.4**	**3**	**0.7**	**161**	**35.1**	**271**	**59.0**	**5**	**1.1**	**3**	**0.7**

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).

Investigation of perinatal related deaths

Table 1.30: Perinatal related deaths and completeness of perinatal death investigations 2013

Perinatal death investigation	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Optimal investigation*	91	65.5	165	53.7	63	41.4	319	53.3
Post-mortem	53	38.1	151	49.2	48	31.6	252	42.1
Karyotype	25	18.0	12	3.9	6	3.9	43	7.2
Clinical examination/investigations confirm diagnosis	24	17.3	7	2.3	15	9.9	46	7.7
Partial investigations only#	39	28.1	112	36.5	76	50.0	227	38.0
No investigation+	9	6.5	28	9.1	12	7.9	49	8.2
Unknown	-	-	2	0.7	1	0.7	3	0.5

* Optimal investigation is defined as post-mortem or karyotype confirming congenital abnormality or clinical examination/investigation confirming diagnosis.
\# No post-mortem; investigations may have included placental pathology, MRI, ultrasound scan or x-ray.
\+ No post-mortem, placental pathology, MRI, ultrasound scan or x-ray.
MRI = magnetic resonance imaging.

Optimal perinatal death investigation is defined as a post-mortem, a karyotype alone where it confirms the diagnosis for a chromosomal abnormality, or clinical examination and/or investigations confirming diagnosis. The rates of optimal investigation were 46, 49, 41, 45, 45 and 44 percent respectively in 2007–2012. At 53 percent in 2013, optimal investigation is at the highest level yet.

Optimal investigation rates vary by DHB. These data are available in Table A22 at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/.

Table 1.31: Perinatal related deaths and rate of offer and decline of post-mortem examination 2013

Post-mortem examination offered	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Post-mortem offered and parental consent given	53	38.1	151	49.2	48	31.6	252	42.1
Post-mortem offered and parents declined	76	54.7	143	46.6	88	57.9	307	51.3
Post-mortem not offered	9	6.5	11	3.6	12	7.9	32	5.4
Unknown	1	0.7	2	0.7	4	2.6	7	1.2

The rate of offer of post-mortem is high overall at 93 percent of all perinatal related deaths; however, decline rates continue to be high. Post-mortem is more often not offered to parents of neonatal deaths compared to parents of stillbirths.

In 2013, data on the usefulness of the post-mortem performed (as assessed by the PMMRC local coordinators) were available in 86 percent of cases.

Among the 216 post-mortems in 2013 where an assessment was made, the post-mortem changed the clinical diagnosis in 41 cases (19 percent), resulting in altered counselling to parents for future pregnancies.

In 118 cases (55 percent), there was no change in diagnosis, and the post-mortem did not change the advice given to parents. In 30 cases (14 percent), further information was gained, but this did not change the clinical diagnosis. In a further 27 cases (13 percent), the post-mortem did not demonstrate an obvious cause of death or significant abnormality.

Contributory factors and potentially avoidable perinatal related deaths

Table 1.32: Contributory factors and potentially avoidable perinatal related deaths 2013

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Contributory factors								
Present	12	8.6	90	29.3	58	38.2	160	26.8
Absent	127	91.4	212	69.1	89	58.6	428	71.6
Missing data	-	-	5	1.6	5	3.3	10	1.7
Potentially avoidable								
Yes	2	1.4	58	18.9	35	23.0	95	15.9
Contributory factors present but not potentially avoidable	9	6.5	30	9.8	23	15.1	62	10.4
Contributory factors present but avoidability unknown	1	0.7	2	0.7	-	-	3	0.5

As part of local perinatal mortality review, the multidisciplinary team assesses whether there are organisational and/or management factors, personnel factors and barriers to access and/or engagement with care factors that may have contributed to the perinatal death. If contributory factors are identified, the local multidisciplinary team is asked to assess whether the perinatal death was potentially avoidable. Assignment of factors is not mutually exclusive either across factors or within a factor. A description of the process for assessment of contributory factors and potentially avoidable death is included in section 1.2 Methodology. The tool used is available on the PMMRC website (http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/). Contributory factors were recorded by local multidisciplinary teams in 26.8 percent of perinatal related deaths in 2013, and in 29.3 percent of stillbirths and 38.2 percent of neonatal deaths (Table 1.32). These figures have remained consistent since these data were first reported in 2009.

In 95 cases (59 percent of cases where contributory factors were identified), or 15.9 percent of perinatal related deaths, the local review group determined these deaths were potentially avoidable. This is a lower rate than the 18.5 percent potentially avoidable in 2012, but is not statistically significantly lower.

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

Figure 1.31: Contributory factors and potentially avoidable perinatal related deaths by perinatal death classification (PSANZ-PDC) 2013

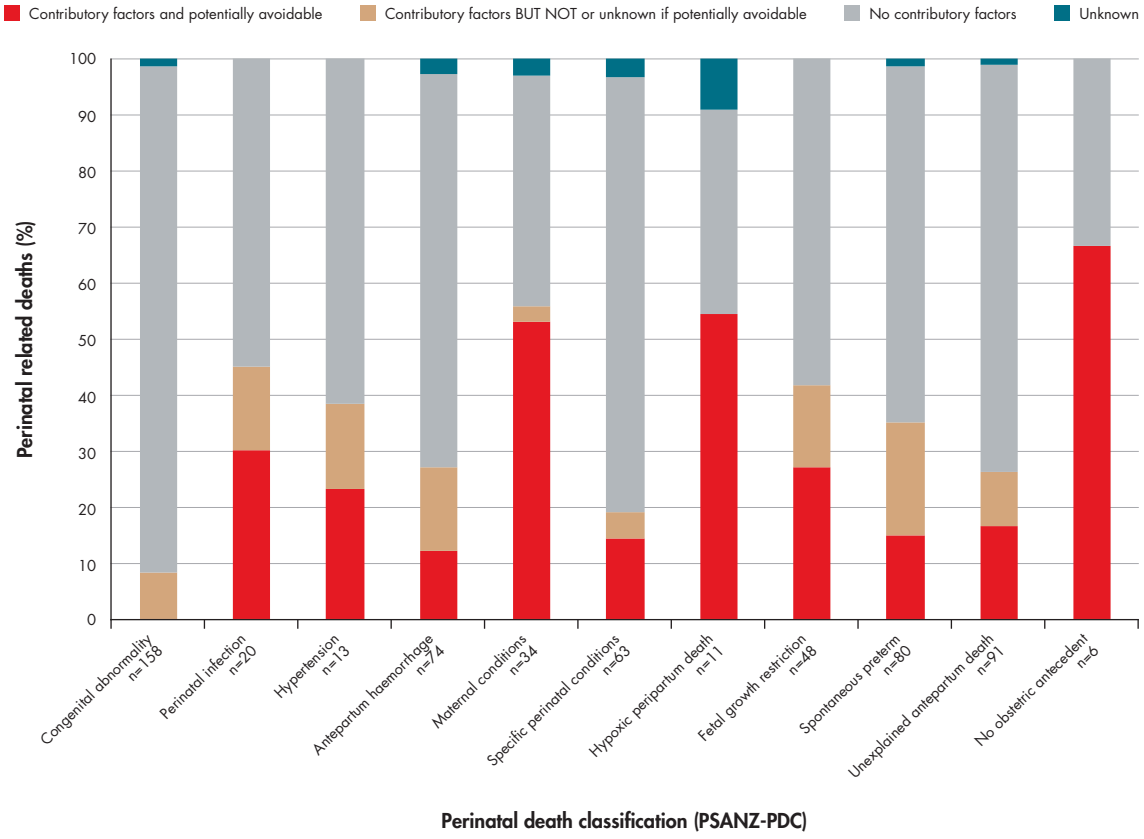
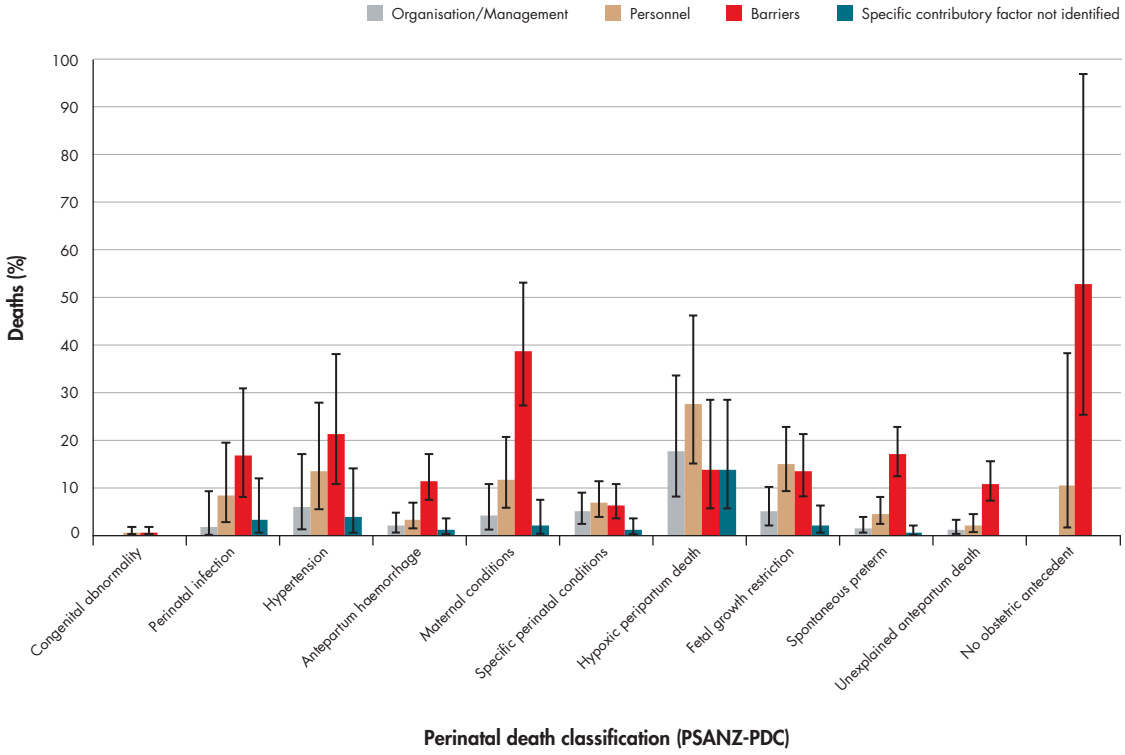


Figure 1.31 shows the proportion of perinatal related deaths where contributory factors were present (the lower two sections of the stacked bars), and whether the death was potentially avoidable (lowest section of the stacked bar) by perinatal death classification (PSANZ-PDC). While numbers within some PSANZ-PDC categories are small, the proportions with contributory factors present and where deaths were determined to be potentially avoidable differ markedly by cause of death.

Potentially avoidable perinatal related deaths

The highest number of potentially avoidable deaths in one cause of death (PSANZ-PDC) category in 2013 was 18 deaths among deaths from maternal conditions, predominantly deaths from diabetes.

Figure 1.32: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths in each PSANZ-PDC category) by perinatal death classification (PSANZ-PDC) 2011–2013



From 2011, local multidisciplinary review teams were asked to determine, specifically, which of the contributory factors identified contributed to the perinatal related death being potentially avoidable. In some cases, more than one contributory factor was identified. When this occurred, the death was included in both or all three contributory factor categories.

Figure 1.32 demonstrates the importance of addressing issues of access and/or engagement with the maternity service as it is the main contributory factor identified in many causes of perinatal death from 2011 to 2013. Personnel issues were also prominent, being identified in more than 10 percent of perinatal deaths associated with hypertensive disease (7), maternal conditions (11), hypoxic peripartum deaths (14), deaths from fetal growth restriction (21) and deaths with no obstetric antecedent (2).

Table 1.33: Detail of contributory factors among perinatal related deaths 2009–2013

Contributory factors	2009		2010		2011		2012		2013	
	n	%	n	%	n	%	n	%	n	%
Organisational/Management factors	**37**	**5.1**	**30**	**4.1**	**42**	**5.8**	**32**	**4.4**	**32**	**4.4**
Poor organisational arrangements of staff	10		2		7		3		-	
Inadequate education and training	10		5		5		4		3	
Lack of policies, protocols or guidelines	10		4		13		4		5	
Inadequate numbers of staff	-		3		3		3		-	
Poor access to senior clinical staff	2		4		3		1		2	
Failure or delay in emergency response	5		5		2		3		5	
Delay in procedure *(eg, Caesarean section)*	3		10		6		8		11	
Inadequate systems for sharing of clinical information	-		-		-		-		1	
Delayed access to test results or inaccurate results	6		1		6		5		1	
Equipment *(eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)*	4		3		4		4		2	
Building and design functionality *(eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)*	-		-		-		1		2	
Other	6		4		13		7		6	
Not stated	-		-		-		-		2	
Personnel factors	**49**	**6.8**	**48**	**6.6**	**56**	**7.7**	**52**	**7.2**	**45**	**6.2**
Knowledge and skills of staff were lacking	17		13		18		16		13	
Delayed emergency response by staff	9		4		3		3		3	
Failure to maintain competence	4		1		2		1		-	
Failure of communication between staff	11		8		13		8		7	
Failure to seek help/supervision	8		5		14		3		3	
Failure to offer or follow recommended best practice	30		26		31		30		19	
Lack of recognition of complexity or seriousness of condition by caregiver	2		-		4		14		12	
Other	-		1		-		2		3	
Not stated	1		1		1		-		2	
Barriers to access and/or engagement with care	**123**	**17.0**	**142**	**19.6**	**131**	**18.1**	**134**	**18.5**	**119**	**16.4**
No antenatal care	9		21		24		37		28	
Infrequent care or late booking	9		35		46		45		45	
Declined treatment or advice	4		12		16		22		25	
Obesity impacted on delivery of optimal care *(eg, USS)*	1		6		-		5		7	
Substance use	24		17		18		17		8	
Family violence	6		9		11		3		6	

Table 1.33: Detail of contributory factors among perinatal related deaths 2009–2013 (Continued)

Contributory factors	2009		2010		2011		2012		2013	
	n	%	n	%	n	%	n	%	n	%
Barriers to access and/or engagement with care (Continued)										
Lack of recognition of complexity or seriousness of condition by the woman and/or family	10		30		32		27		32	
Maternal mental illness	4		9		3		7		1	
Cultural barriers	10		4		18		2		4	
Language barriers	2		7		7		6		2	
Not eligible to access free care	3		2		4		5		1	
Environment *(eg, isolated, long transfer, weather prevented transport)*	12		12		12		13		6	
Other	13		11		11		10		19	
Not stated	44		8		1		1		1	

USS = ultrasound scan.

Table 1.33 lists the identified contributory factors by year from 2009 to 2013. There are no significant differences in the rate of organisation and management factors, personnel factors and barriers factors identified by year. In 2009, the first year the tool was used, many barriers were recorded under 'not stated' and so this year is not easily comparable with the later years.

Organisation and management factors

The dominant organisation and management factors identified are lack of policies, protocols and guidelines (36 deaths in 5 years) and delay in a procedure (38). Lack of policies, protocols and guidelines were most often associated with hypoxic peripartum deaths (10), hypertension (6) and maternal conditions (7). Delay in a procedure was identified among hypoxic peripartum deaths (10) and antepartum haemorrhage (8).

In 2014, the RANZCOG Australasian guideline for intrapartum fetal surveillance was published (RANZCOG 2014a), endorsed by the New Zealand College of Midwives.

Also in 2014, the Ministry of Health released a national clinical practice guideline on screening, diagnosis and management of gestational diabetes in New Zealand (Ministry of Health 2014b).

Personnel factors

The most prevalent personnel contributory factors were failure to offer or follow recommended best practice (135 cases); lack of knowledge and skills (77); failure of communication between staff (46); failure to seek help/supervision (33); and lack of recognition of complexity or seriousness of the patient's condition by the caregiver (32).

Failure to offer or follow recommended best practice was most commonly associated with hypoxic peripartum death (25 cases), most often in those cases where there was evidence of non-reassuring fetal status but no acute intrapartum complication.

Failure to offer or follow recommended best practice was also frequently identified among deaths due to fetal growth restriction (22), specific perinatal conditions (20), hypertension (13), maternal conditions (11) and spontaneous preterm birth (11).

Contributory factors around knowledge and skills of staff were also predominantly among hypoxic peripartum death (18 deaths) and in those cases where there was evidence of non-reassuring fetal status but no acute intrapartum complication. This was also identified in 16 cases of death from fetal growth restriction.

Failure of communication between staff, failure to seek help or supervision and lack of recognition of complexity or seriousness of the patient's condition were all also more prevalent among hypoxic peripartum deaths.

Barriers to access and/or engagement with care

Barriers to access and/or engagement with care were the most common contributory factors, identified in 16–20 percent of perinatal related deaths in 2009–2013.

Of the barriers listed, the most prevalent were no or infrequent antenatal care (292 deaths), offered but declined treatment or advice (79), lack of recognition by the woman or her family of the complexity or seriousness of her condition (131), barriers to access or engagement due to cultural factors (38) and environmental barriers (55). Although less frequent, there were significant numbers of deaths where there were barriers to access or engagement identified due to family violence (35), maternal mental illness (24), language (24) and ineligibility for free care (15).

No or infrequent antenatal care was most commonly identified among deaths with congenital abnormalities (38 cases), antepartum haemorrhage (38), maternal conditions (34), spontaneous preterm birth (75) and unexplained antepartum death (32). Among deaths where no or infrequent antenatal care was identified as a contributory factor, these deaths were identified to be potentially avoidable in more than 50 percent of those who died of maternal conditions, spontaneous preterm birth and unexplained antepartum death.

Of contributory factors associated with decline of treatment or advice, 25 deaths were due to diabetes and all of these cases were identified as potentially avoidable.

Failure by the woman or her family to recognise the complexity or seriousness of the woman's condition was most frequently associated with deaths from diabetes (25 cases), spontaneous preterm birth (24) and unexplained antepartum death (24).

Contributory factors and potentially avoidable perinatal related death and maternal ethnicity

Figure 1.33: Contributory factors and potentially avoidable perinatal related deaths by maternal prioritised ethnicity (95% CIs surround the estimate of the proportion of cases within each ethnicity where death was potentially avoidable) 2009–2013

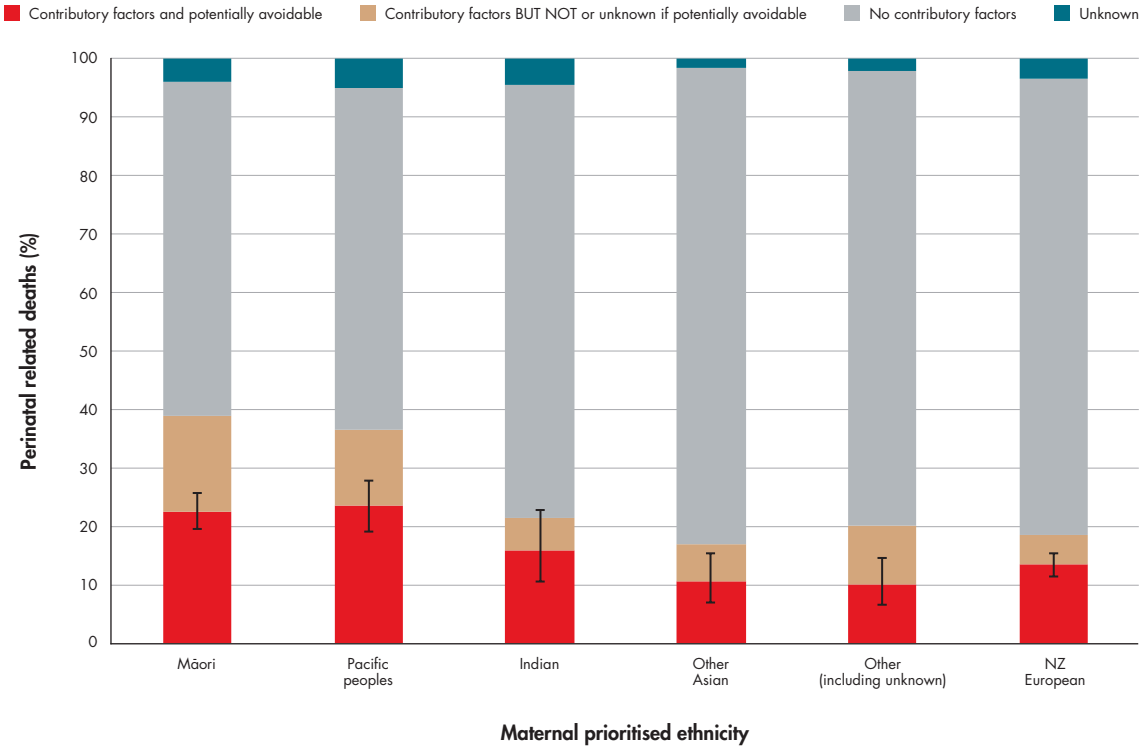


Figure 1.33 illustrates that potentially avoidable perinatal related deaths (the lowest of the stacked bars) were more frequent among deaths to Māori and Pacific mothers (23 percent of deaths) than among New Zealand European, Other Asian (excluding Indian) and Other ethnicity mothers in 2009–2013.

Figure 1.34: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by maternal prioritised ethnicity (with 95% CIs) 2011–2013

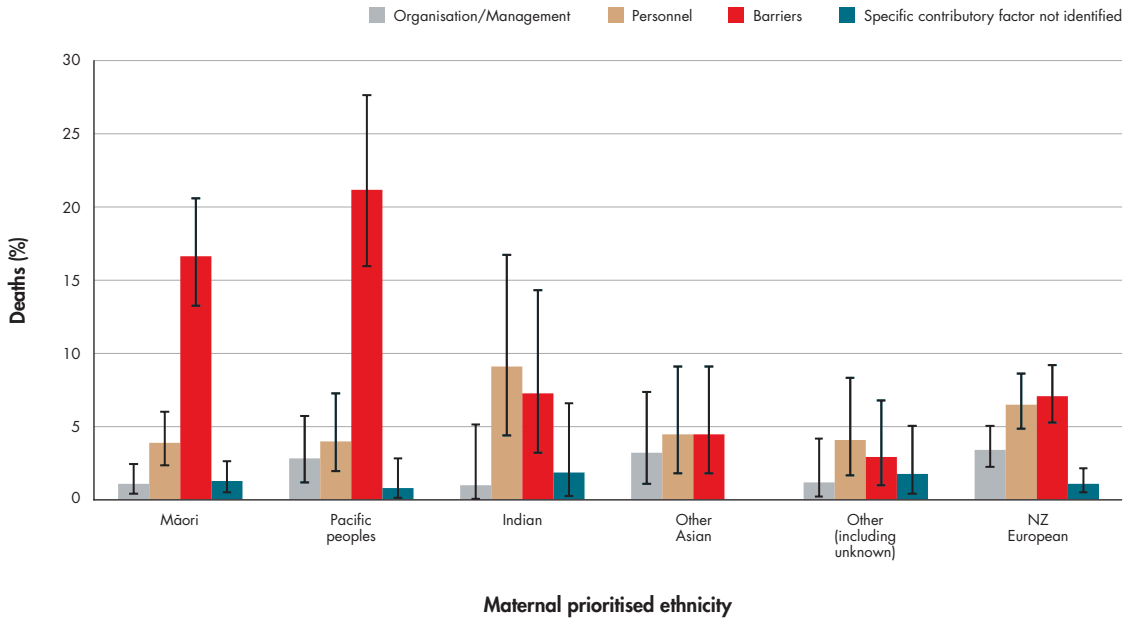
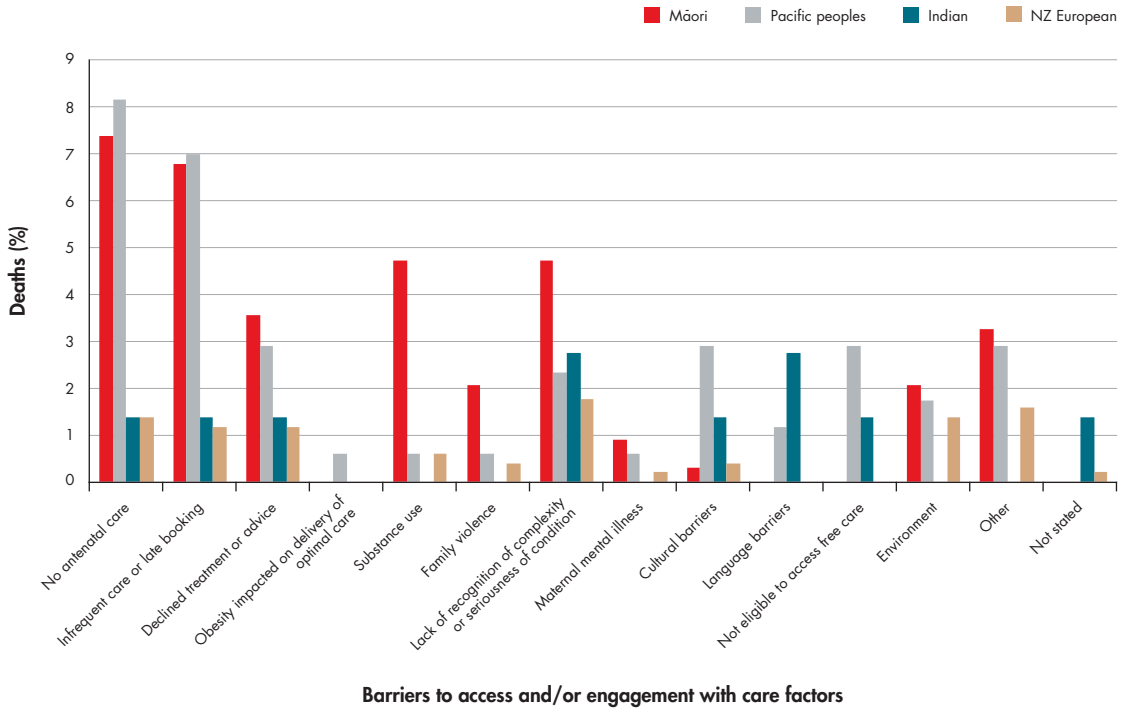


Figure 1.34 shows that the main contributory factors identified as responsible for potentially avoidable perinatal related deaths vary by prioritised ethnicity.

The 95 percent CIs show that there is no significant difference in the identification of personnel and organisation and/or management factors by ethnicity, but that barriers to access and/or engagement with care were significantly more frequent for Māori and Pacific mothers than for New Zealand European, Other and Other Asian mothers.

Barriers to access and/or engagement with care and ethnicity

Figure 1.35: Specific barriers to access and/or engagement with care in potentially avoidable perinatal related deaths (as a percentage of all perinatal related deaths) by maternal prioritised ethnicity (Māori, Pacific peoples, Indian and New Zealand European) 2011–2013



Specific types of barriers to access and/or engagement with care in potentially avoidable deaths are shown in Figure 1.35 if barriers were a main contributory factor in potentially avoidable death. More than one type of barrier to access and/or engagement with care may have been specified. The proportion of deaths where barriers to access and/or engagement with care were identified as a main contributory factor to potentially avoidable perinatal death is 11 percent (of all perinatal related deaths) (17 percent among Māori deaths, 21 percent among Pacific, 7 percent among Indian and 7 percent among New Zealand European) (Figure 1.34).

The most frequent barriers identified in perinatal deaths of Māori and Pacific mothers are 'no antenatal care' and 'infrequent or late booking for antenatal care'.

These were reported in approximately 7 percent of deaths, meaning that 1 in 14 Māori and Pacific women whose babies died experienced a barrier to accessing or engaging with antenatal care that was assessed as having contributed to the baby's death.

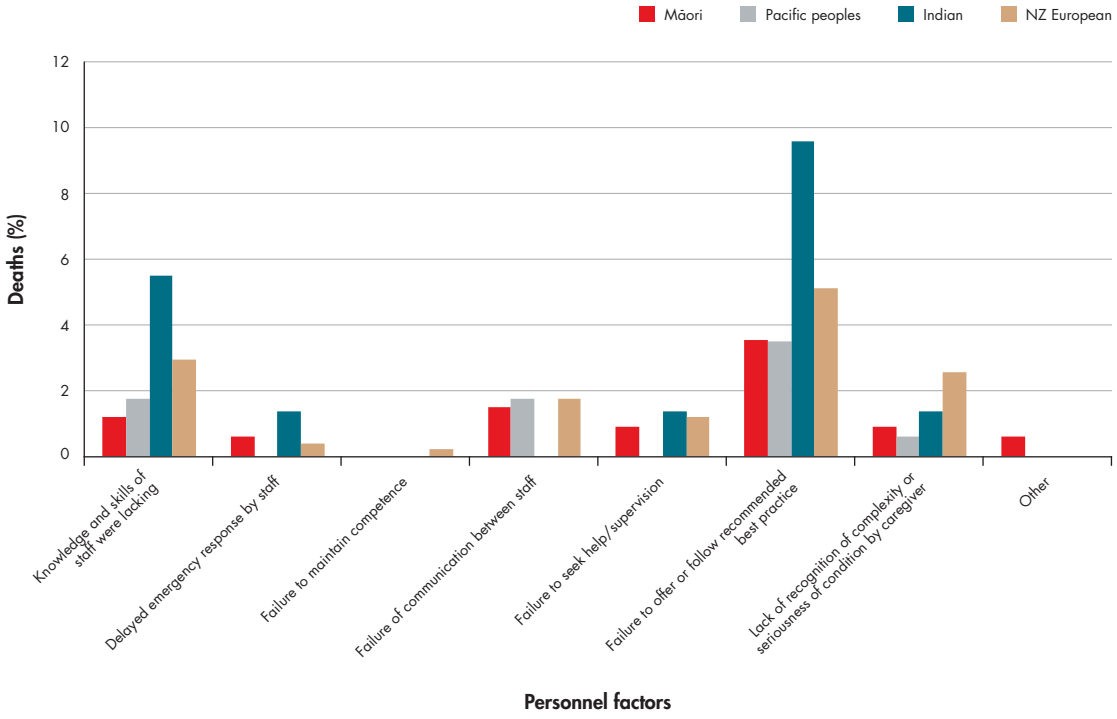
This finding supports the Ministry of Health National Maternity Monitoring Group (NMMG) requirement for DHBs to improve early registration among at-risk groups in New Zealand (NMMG 2013).

There are also higher rates of barriers to access and/or engagement with care due to 'substance use' and 'lack of recognition by the woman or her family of the complexity or seriousness of the woman's condition' leading to potentially avoidable death among Māori mothers.

Personnel factors and ethnicity

In 2011–2013, the proportion of potentially avoidable deaths due to personnel was 5.2 percent of all perinatal related deaths (4 percent among Māori, 4 percent among Pacific, 9 percent among Indian and 6.5 percent among New Zealand European mothers) (Figure 1.34). In 2011–2013, there were 101 cases where personnel factors contributed to potentially avoidable deaths and the specific factors are shown in Figure 1.36.

Figure 1.36: Specific personnel factors in potentially avoidable perinatal related deaths (as a percentage of all perinatal related deaths) by maternal prioritised ethnicity (Māori, Pacific peoples, Indian and New Zealand European) 2011–2013



The proportion of perinatal related deaths due to failure to offer or follow recommended best practice was significantly higher among Indian (10 percent) than among Māori (3.5 percent) or Pacific (3.5 percent) mothers ($p \leq 0.05$). The proportion of perinatal related deaths due to a lack of knowledge and skills among staff was significantly higher among Indian (5.5 percent) than Māori (1 percent) ($p < 0.05$), but not significantly different from Pacific or New Zealand European mothers.

Among Indian mothers whose babies died, failure to offer or follow recommended best practice contributed to the death of 1 in 10 perinatal deaths, and lack of knowledge and skills of staff contributed to the death of 1 in 18 perinatal deaths.

There were no statistically significant differences between Māori and Pacific or New Zealand European mothers, although this may be due to small numbers in the analyses.

Organisation and management factors and ethnicity

In 2011–2013, there were 45 cases where organisation and management factors contributed to potentially avoidable deaths. The number of potentially avoidable deaths due to organisation and management factors was too small for further analysis.

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

Figure 1.37: Contributory factors and potentially avoidable perinatal related deaths by deprivation quintile 2009–2013

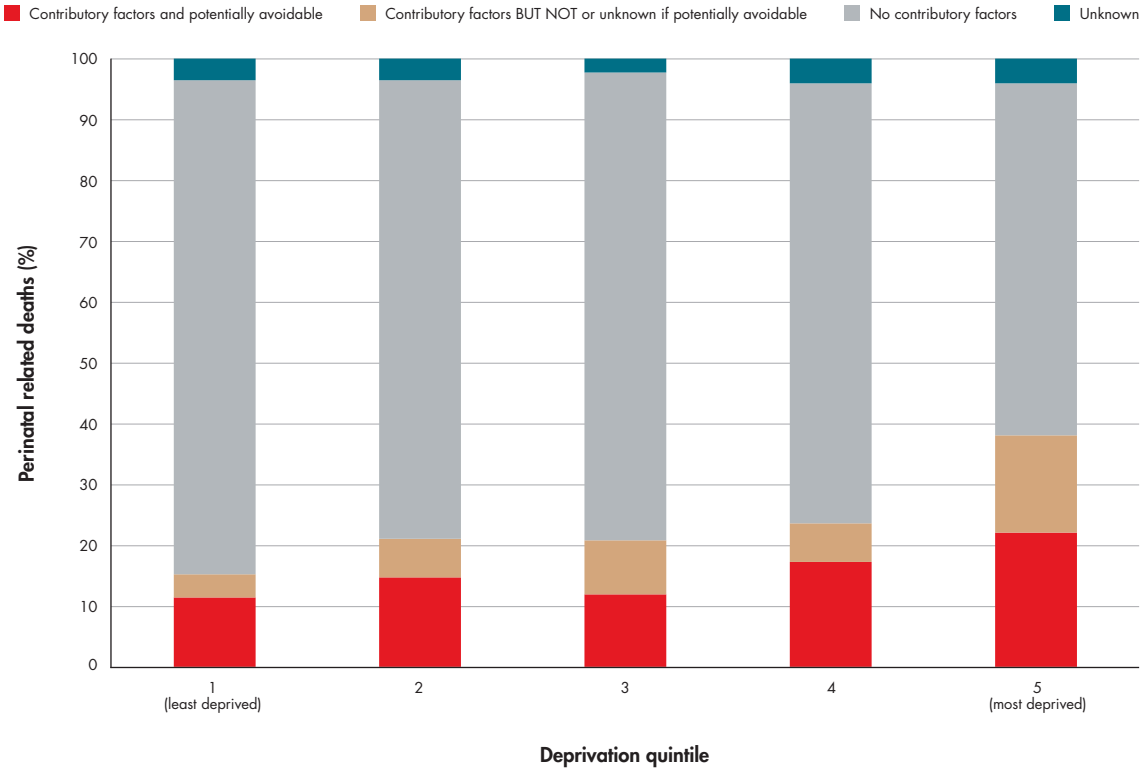


Figure 1.37 looks at whether contributory factors and potentially avoidable death vary by maternal deprivation quintile. There is a significant linear trend for increasing potentially avoidable perinatal related deaths with increasing deprivation quintile from 1 (least deprived) to 5 (most deprived) ($p<0.0001$).

Potentially avoidable perinatal related deaths were more frequent among deaths to Māori and Pacific mothers and among women living in increasing levels of socioeconomic deprivation.

Figure 1.38: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by deprivation quintile (with 95% CIs) 2011–2013

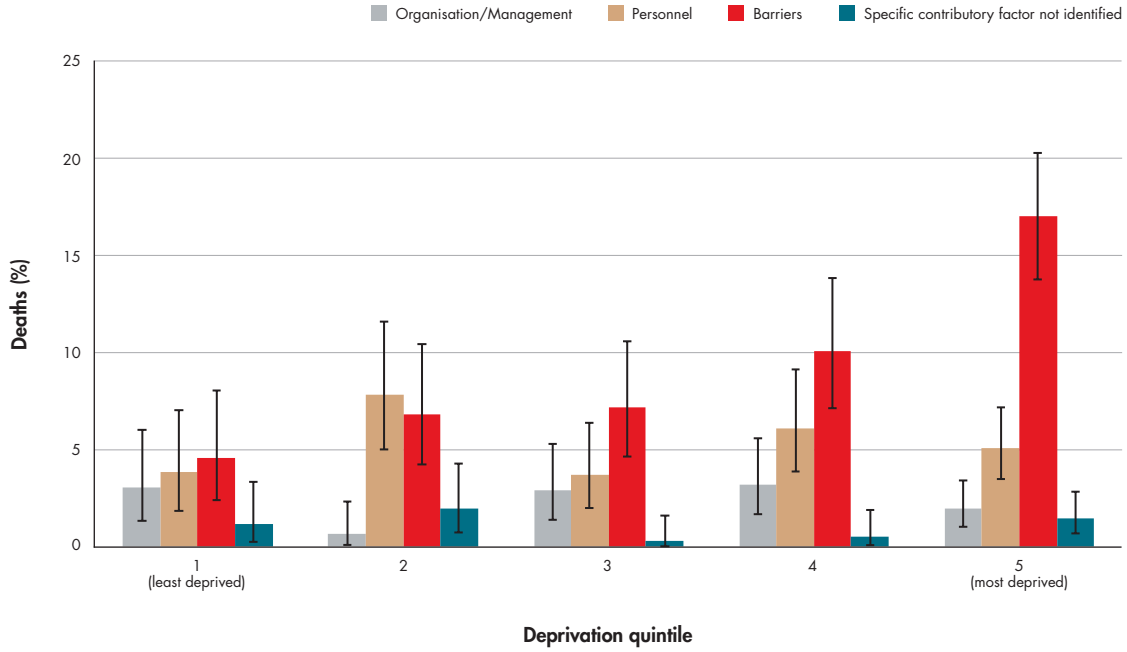


Figure 1.38 illustrates that there is no significant association between the proportion of cases where organisation and management and personnel factors were the main contributing factors in potentially avoidable death with increasing deprivation. However, there is an increase in the proportion of cases where barriers to access and/or engagement with care are the main contributory factor in potentially avoidable perinatal death with increasing deprivation. Barriers to access and/or engagement with care were reported as the main contributing factor in a potentially avoidable death in approximately 17 percent of perinatal related deaths in women residing in the highest deprivation quintile areas.

One in six perinatal related deaths among women residing in the most socioeconomically deprived households might have been avoided by improved access to antenatal care.

Maternal outcome

Table 1.34 reports the health outcome of the mothers whose babies died in the perinatal period in 2013.

Table 1.34: Perinatal related deaths and maternal outcome 2013

Maternal outcome	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=139		n=307		n=152		n=598	
	n	%	n	%	n	%	n	%
Alive and generally well	139	100.0	298	97.1	150	98.7	587	98.2
Alive but with serious morbidity	-	-	4	1.3	2	1.3	6	1.0
Maternal death	-	-	5	1.6	-	-	5	0.8

There were five maternal deaths associated with perinatal related deaths in 2013, including deaths from suicide, maternal sepsis (non-obstetric) and pre-existing maternal conditions. Six mothers whose babies died suffered serious morbidity as a consequence of pregnancy, including antepartum and postpartum haemorrhage, rheumatic heart disease and non-obstetric sepsis.

Special Topic 2013: Spontaneous Preterm Birth Leading to Perinatal Related Death

For the purposes of this analysis, 'spontaneous preterm birth as a cause of perinatal related death' 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 classification (PSANZ-PDC).

Perinatal related death associated with spontaneous preterm birth was chosen as a special topic this year because, after congenital abnormality, it is the most common cause of perinatal related death. If the rates of preterm birth among the more vulnerable mothers in New Zealand were equivalent to those in the less vulnerable, there would be considerable reduction in perinatal related deaths.

There is new evidence around strategies to prevent spontaneous preterm birth, including cervical length screening, cervical cerclage and vaginal progesterone.

Spontaneous preterm birth was a cause of death for almost 1000 babies from 2007 to 2013, accounting for 20.9 percent of all perinatal related deaths from 2007 to 2013. Of the 989 babies who died from spontaneous preterm birth, 61 (6.2 percent) were terminations of pregnancy for complications associated with preterm birth such as prolonged premature rupture of the membranes, 416 (42.1 percent) stillbirths and 512 (51.8 percent) neonatal deaths. There has been no significant change in the rate of spontaneous preterm perinatal related death over these seven years.

Table 1.35: Perinatal death classification (PSANZ-PDC) assignments among spontaneous preterm perinatal related deaths 2007–2013

Perinatal death classification (PSANZ-PDC)	Primary PSANZ-PDC		Secondary PSANZ-PDC		Tertiary PSANZ-PDC	
	n=989		n=989		n=989	
	n	%	n	%	n	%
Congenital abnormality	16	1.6	1	0.1	-	-
Perinatal infection	24	2.4	20	2.0	6	0.6
Hypertension	1	0.1	-	-	-	-
Antepartum haemorrhage	190	19.2	73	7.4	3	0.3
Maternal conditions	20	2.0	18	1.8	8	0.8
Specific perinatal conditions	53	5.4	5	0.5	3	0.3
Hypoxic peripartum death	-	-	10	1.0	-	-
Fetal growth restriction	7	0.7	13	1.3	5	0.5
Spontaneous preterm	678	68.6	297	30.0	14	1.4

Table 1.35 shows all perinatal death classifications coded among the babies who died with spontaneous preterm as one PSANZ-PDC cause. The primary PSANZ-PDC is the cause considered to be the antecedent cause of death.

Spontaneous preterm was assigned as the primary PSANZ-PDC in 69 percent of cases where spontaneous preterm 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-five percent (441/989) of spontaneous preterm perinatal related deaths were associated with prolonged premature rupture of the membranes (≥24 hours).

Table 1.35 also shows that perinatal infection was a primary or associated classification in 50 spontaneous preterm perinatal related deaths (5 percent) and antepartum haemorrhage in 266 (27 percent).

The primary neonatal cause of death (PSANZ-NDC) assigned to the spontaneous preterm neonatal deaths was extreme prematurity in 64 percent of cases, but cardio-respiratory disorders, infection and neurological causes also contributed approximately 10 percent each.

Table 1.36: Neonatal death classification (PSANZ-NDC) among neonatal deaths where spontaneous preterm was assigned as a perinatal death classification (PSANZ-PDC) 2007–2013

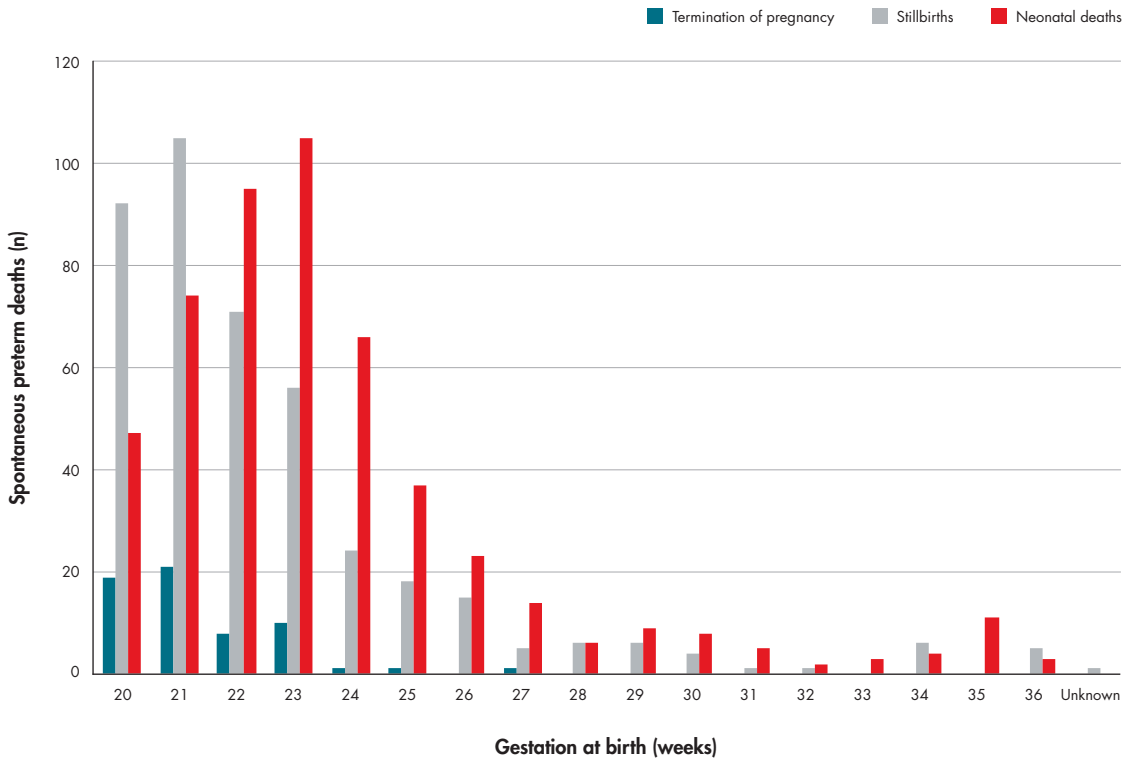
Neonatal death classification (PSANZ-NDC)	Primary PSANZ-NDC		Secondary PSANZ-NDC		Tertiary PSANZ-NDC	
	n=512		n=512		n=512	
	n	%	n	%	n	%
Congenital abnormality	9	1.8	-	-	-	-
Extreme prematurity	328	64.1	-	-	1	0.2
Cardio-respiratory disorders	56	10.9	32	6.3	5	1.0
Infection	45	8.8	12	2.3	4	0.8
Neurological	46	9.0	22	4.3	3	0.6
Gastrointestinal	13	2.5	4	0.8	-	-
Other	15	2.9	7	1.4	-	-

Neonatal resuscitation

Resuscitation was attempted for 58 babies under 24 weeks, with 31 (53 percent) successfully resuscitated and transferred to another clinical area. These babies subsequently died.

Gestation

Figure 1.39: Spontaneous preterm perinatal related deaths and gestation at birth 2007–2013



The majority of deaths from spontaneous preterm birth (703/989 (71 percent)) occurred among births prior to 24 weeks. Seventy-eight percent of stillbirths (324) and 63 percent of neonatal deaths (321) from spontaneous preterm birth were born prior to 24 weeks. Most of the remainder (21 percent) were born between 24 and 27 weeks.

Termination of pregnancy contributes small numbers to spontaneous preterm perinatal related deaths, the majority following complications of premature rupture of the membranes.

Effective interventions to prevent preterm birth are required to make an impact on deaths due to spontaneous preterm birth.

Ethnicity, age and socioeconomic deprivation

Table 1.37: Spontaneous preterm perinatal related death rates (per 1000 total births) with 95% confidence intervals by maternal prioritised ethnicity, age, deprivation quintile and plurality 2007–2013

	Total births 2007–2013	Spontaneous preterm deaths		
	n	n	Rate	95% CI
Maternal prioritised ethnicity				
Māori	102,312	359	3.51	3.15–3.87
Pacific peoples	47,207	145	3.07	2.57–3.57
Indian	16,464	47	2.85	2.10–3.80
Other Asian	35,768	50	1.40	1.04–1.84
Other (including unknown)	39,714	69	1.74	1.35–2.20
NZ European	203,866	319	1.56	1.39–1.74
Maternal age (years)				
<20	31,287	146	4.67	3.91–5.42
20–24	81,572	223	2.73	2.37–3.09
25–34	235,838	425	1.80	1.63–1.97
35–39	78,645	152	1.93	1.63–2.24
≥40	17,985	43	2.39	1.73–3.22
Unknown	4	-	-	-
Deprivation quintile				
1 (least deprived)	70,579	96	1.36	1.10–1.66
2	78,604	160	2.04	1.72–2.35
3	84,493	155	1.83	1.55–2.12
4	93,083	212	2.28	1.97–2.58
5 (most deprived)	116,387	349	3.00	2.68–3.31
Unknown	2,185	17	-	-
Plurality				
Singleton	432,346	822	1.90	1.77–2.03
Multiple	12,985	167	12.86	10.91–14.81

Babies of Māori, Pacific or Indian mothers are more likely to die from spontaneous preterm birth than those with New Zealand European and Other Asian (non-Indian) mothers. 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 socioeconomically deprived as measured by deprivation quintile.

These associations are demonstrated in the PSANZ-PDC specific cause of death by age, ethnicity and socioeconomic status figures (Figures 1.16, 1.18 and 1.20).

The independent associations of maternal ethnicity, age and deprivation with death from spontaneous preterm birth are explored in the section below. The national data do not currently support robust analysis of other potential confounders such as smoking and BMI.

Figure 1.40: Spontaneous preterm perinatal related mortality rate (per 1000 births) by deprivation quintile adjusting for maternal prioritised ethnicity (Māori and New Zealand European) 2007–2013

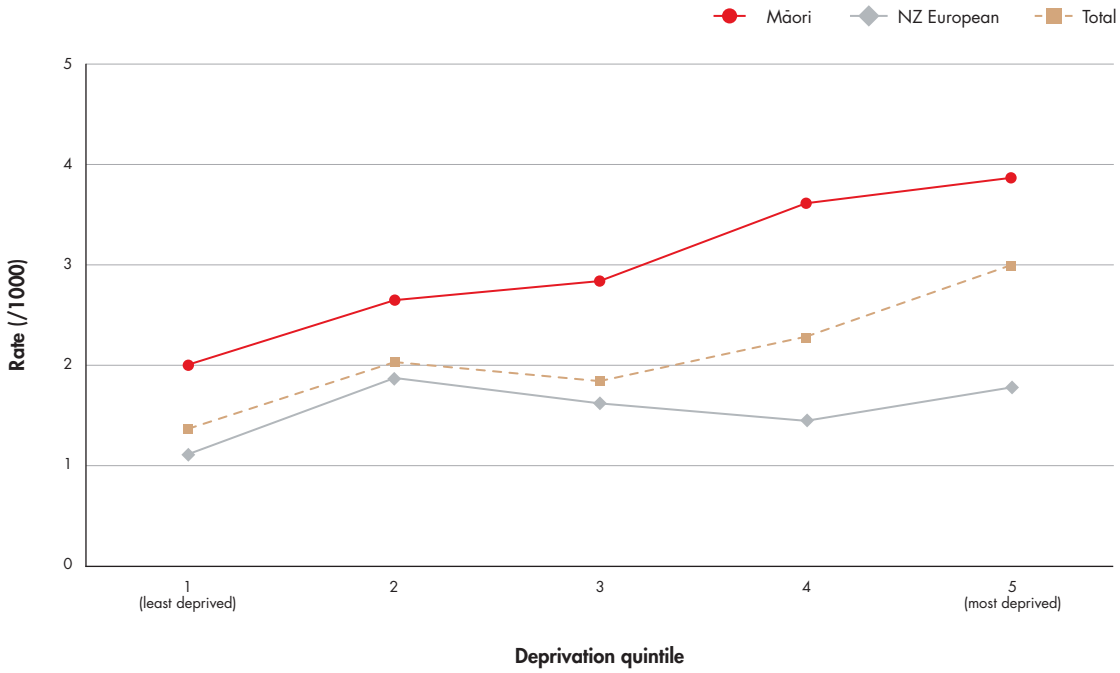


Figure 1.40 shows that the effects of deprivation and ethnicity on the rate of death from spontaneous preterm birth are independent of each other among Māori and New Zealand European mothers. (Only Māori and New Zealand European are included in this analysis due to small numbers in some categories for other ethnic groups.) Mothers who live in areas of higher socioeconomic deprivation have higher rates of perinatal related death from spontaneous preterm birth (which is not explained by their ethnicity) and Māori mothers have an increased rate of death from spontaneous preterm birth compared to New Zealand European mothers (which is not explained by increased socioeconomic deprivation).

Figure 1.41: Burden of perinatal related deaths due to spontaneous preterm birth by deprivation and maternal prioritised ethnicity (Māori, Pacific peoples and New Zealand European) 2007–2013

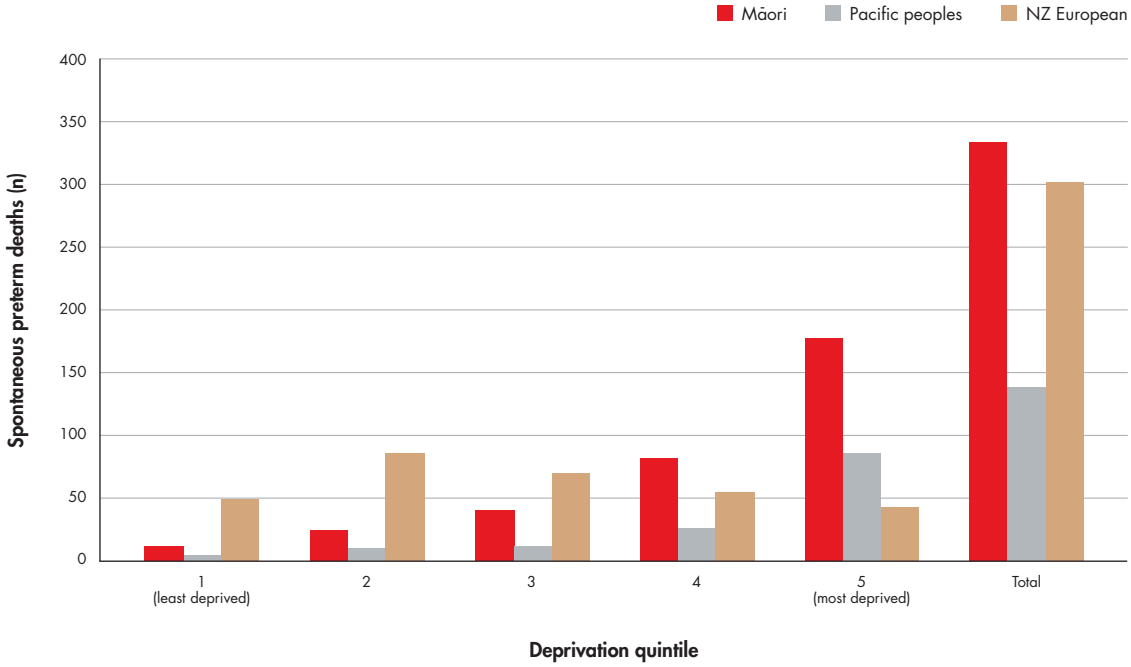


Figure 1.41 demonstrates the numbers of Māori, Pacific and New Zealand European babies who died from spontaneous preterm birth in 2007–2013, in total, and by deprivation quintile. It shows how large the burden of disease is for Māori and Pacific mothers living in the most deprived 20 percent of households in New Zealand.

Figure 1.42: Spontaneous preterm perinatal related mortality rate (per 1000 births) by maternal age adjusting for prioritised ethnicity (Māori and New Zealand European) 2007–2013

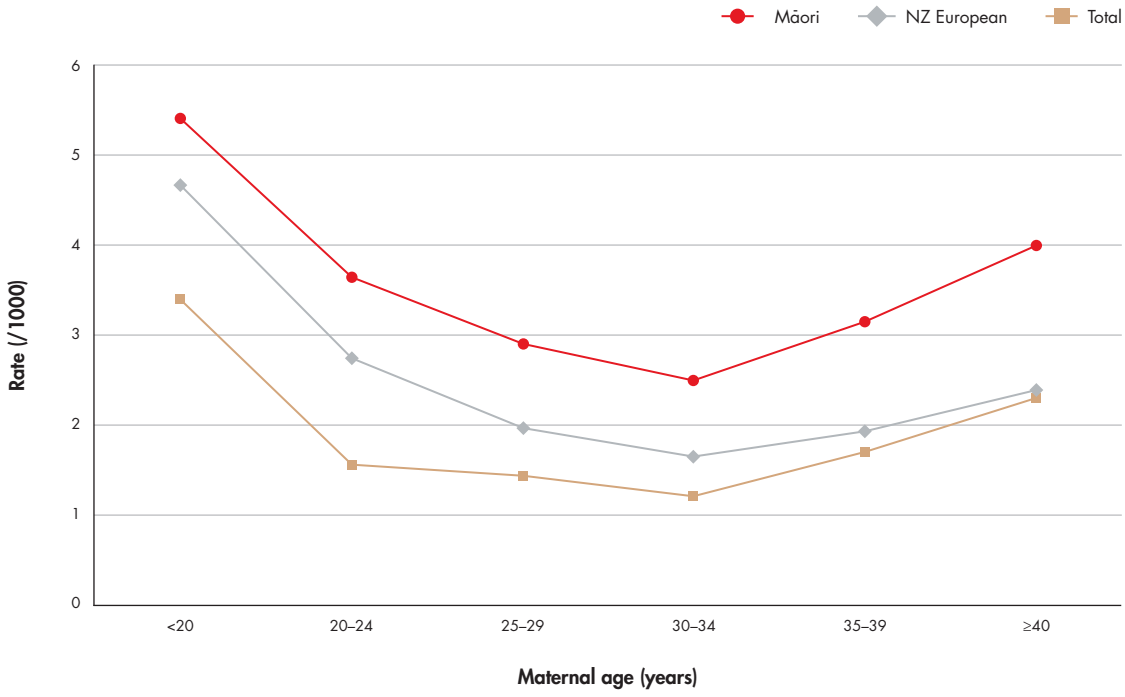


Figure 1.42 shows that the effect of age on perinatal related death due to preterm birth persists after controlling for ethnicity among Māori and New Zealand European mothers. Further, the relative risk for Māori mothers compared to New Zealand European mothers does not change after controlling for maternal age.

Multiple pregnancies are more than six times more likely to suffer perinatal related death from spontaneous preterm birth than singleton pregnancies.

Available strategies to reduce iatrogenic multiple pregnancy should be adhered to. This includes monitoring response to ovulation induction and single embryo transfer in IVF. (See Appendix: Summary of Key PMMRC Recommendations and Progress 2006–2013.)

Clinical risk factors

Table 1.38: Past obstetric history and other risk factors in pregnancy among spontaneous preterm perinatal related deaths 2007–2013

	Spontaneous preterm deaths	
	n=989	
	n	%
Bleeding in pregnancy		
Any bleeding in pregnancy	598	60.5
Bleeding <20 weeks only	63	6.4
Bleeding ≥20 weeks only	320	32.4
Bleeding <20 AND ≥20 weeks	215	21.7
Cervical surgery	83	8.4
Urinary tract infection	81	8.2
Previous miscarriage	265	26.8
Previous termination of pregnancy	154	15.6
	Spontaneous preterm deaths multipara	
	n=531	
	n	%
Previous preterm birth	199	37.5

Fifty-four 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 (National Women's Annual Clinical Report 2013). Twenty-two percent of women began bleeding prior to 20 weeks which continued beyond 20 weeks and a further 32 percent started bleeding from 20 weeks.

Bleeding occurred at some time during pregnancy in 60 percent of women whose babies died from spontaneous preterm birth.

Women who experience bleeding in pregnancy, especially at 20 weeks or later, should be counselled about signs of preterm labour and encouraged to seek advice if further symptoms arise such as further bleeding, pain and rupture of the membranes.

Among women who had perinatal related deaths from spontaneous preterm birth, 8 percent had a history of cervical surgery and 8 percent had a history of urinary tract infection in the index pregnancy.

Among women who had perinatal related deaths from spontaneous preterm birth and who had previously birthed, 37 percent had experienced a prior preterm birth (<37 weeks). Previous preterm birth is a known predictor of repeat preterm birth.

Women who are at increased risk of preterm birth because of previous preterm birth or previous cervical surgery should have a cervical length measured at 20 weeks. Women with short cervical length (<25mm) should be referred to an obstetrician to discuss whether cervical cerclage or intravaginal progesterone therapy might be efficacious in reducing risk.

Research is currently investigating the role of universal screening with ultrasound measurement of cervical length to identify women at increased risk of preterm birth and whether these women's risk would be reduced by use of intravaginal progesterone. Consideration of the possible consequences of such a programme is required before this approach can be considered in the New Zealand context.

Smoking, alcohol and substance use

Thirty-four percent of mothers whose babies died from spontaneous preterm birth had a current smoking history, which is higher than rates of smoking for New Zealand mothers overall (15.3 percent of mothers at registration for pregnancy care in New Zealand among women under the care of a self-employed LMC (Ministry of Health 2011; Growing Up in New Zealand 2010–2014) and than the 25 percent of mothers whose babies died of other causes, consistent with previous research supporting an association between smoking and preterm birth.

There is evidence for a causative relationship between smoking and preterm birth and there are effective strategies for smoking prevention. All pregnant women should be screened for smoking and offered smoking cessation services if appropriate.

Among the 85 percent of women for whom there are data on alcohol and drug use, there is a statistically significant association between alcohol and marijuana use and perinatal death from spontaneous preterm birth. Among mothers whose babies died from spontaneous preterm birth, 49 (6.1 percent) reported using marijuana at some time during pregnancy compared to 4.4 percent of mothers whose babies died of other causes. One hundred and nine mothers whose babies died of spontaneous preterm birth (13.6 percent) reported drinking alcohol in pregnancy compared to 8.3 percent of mothers whose babies died of other causes. However, alcohol and marijuana are highly correlated with tobacco smoking, which may confound any association with death from spontaneous preterm birth.

Our data suggest that alcohol and substance use are associated with spontaneous preterm birth. Practitioners working with pregnant women need to be skilled in asking about and detecting alcohol and substance use in pregnancy and have local knowledge of their area's referral resources.

See 'Practice Point: Alcohol in Pregnancy' on page 56.

Small for gestational age

Figure 1.43: Small for gestational age (customised SGA) among singleton perinatal related deaths excluding congenital abnormalities by gestation and cause of death (spontaneous preterm (PSANZ-PDC9) and other causes of death (PSANZ Other PDC)) 2007–2013

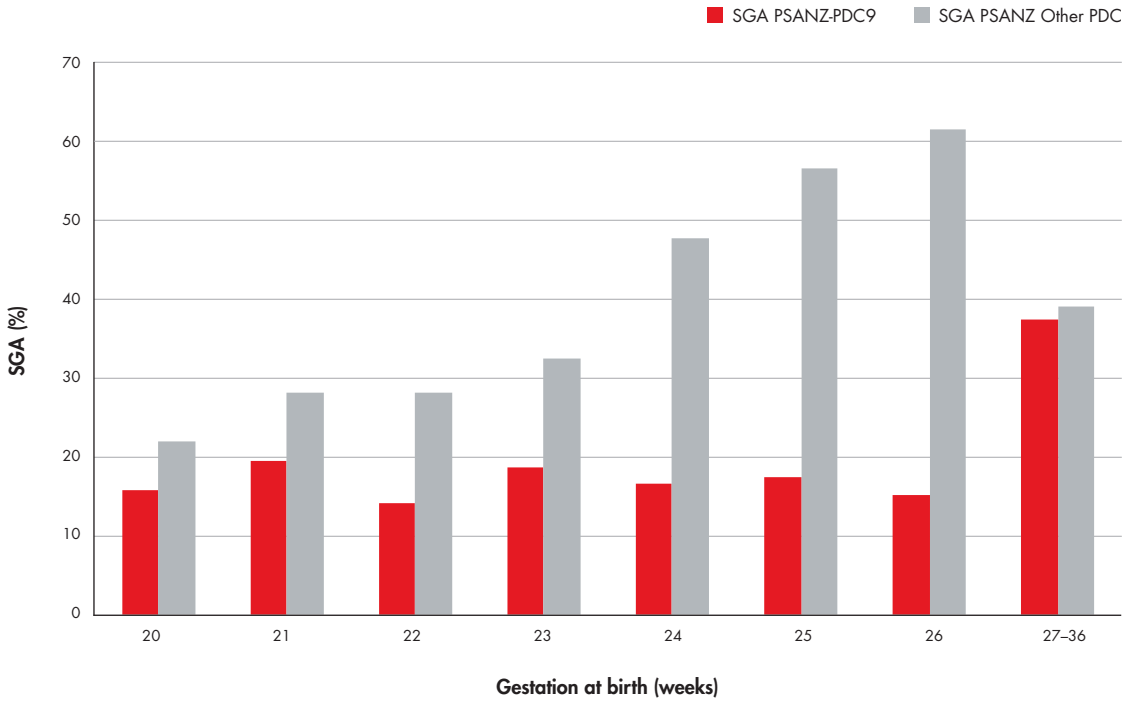


Figure 1.43 shows that the proportion of SGA babies is lower among deaths from spontaneous preterm birth than among babies dying from other causes (even after excluding congenital abnormalities).

Antenatal steroids

Among neonatal deaths from spontaneous preterm birth of babies born from 24 to 32 weeks, 71 percent of mothers were started on a course of corticosteroids before birth. Each year, a further 6 to 11 mothers of babies born at less than 24 weeks were also prescribed antenatal steroids.

Antenatal steroids reduce rates of neonatal death and the severity of respiratory distress syndrome in babies born from 23 to 34 weeks gestation and should be offered whenever possible to mothers at risk of preterm birth. Repeated doses may be required and readers are advised to consult the recently published antenatal corticosteroids clinical practice guideline (Liggins Institute 2015).

Other interventions which have been shown to reduce morbidity and mortality from preterm birth include magnesium sulphate for threatened preterm labour and in utero transfer.

Contributory factors and potentially avoidable perinatal related death

Data in this section are presented for the three years 2011–2013 because prior to this period local perinatal mortality multidisciplinary review groups were not asked to identify the key contributory factors when deaths were identified as potentially avoidable.

Contributory factors were present in 143 cases (35 percent) in the three years 2011–2013 where spontaneous preterm birth was the cause of perinatal related death, organisation and/or management factors in 5 percent of cases, personnel factors in 8 percent and barriers to access and/or engagement with care in 28 percent.

Table 1.39 lists the sub-categories identified where any of organisation/management, personnel or barriers were chosen as contributing factors (first two columns). The right-hand columns in the table show the sub-categories that had been identified as contributory when the major categories of organisation/management, personnel or barriers were identified as the main factor in potentially avoidable perinatal death due to spontaneous preterm birth. These data suggest the type of contributory factors that predominate in death due to spontaneous preterm birth.

Organisation and/or management and personnel factors were seldom identified as key contributory factors in potentially avoidable deaths due to spontaneous preterm birth (2 and 6 percent respectively) but barriers to access and/or engagement with care were identified in 15 percent of all spontaneous preterm deaths.

Table 1.39: Contributory factors and main contributory factor(s) in potentially avoidable deaths among spontaneous preterm perinatal related deaths 2011–2013

Contributory factor	Spontaneous preterm deaths			
	n=411			
	Any contributory factors		Main contributory factor(s) in potentially avoidable deaths	
	n	%	n	%
Organisational/Management factors	**21**	**5.1**	**7**	**1.7**
Poor organisational arrangements of staff	2	0.5	1	0.2
Inadequate education and training	3	0.7	1	0.2
Lack of policies, protocols or guidelines	4	1.0	1	0.2
Failure or delay in emergency response	1	0.2	-	-
Delay in procedure *(eg, Caesarean section)*	3	0.7	1	0.2
Delayed access to test results or inaccurate results	2	0.5	-	-
Equipment *(eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)*	1	0.2	-	-
Other	5	1.2	3	0.7
Personnel factors	**31**	**7.5**	**24**	**5.8**
Knowledge and skills of staff were lacking	6	1.5	4	1.0
Delayed emergency response by staff	1	0.2	1	0.2
Failure of communication between staff	4	1.0	4	1.0
Failure to seek help/supervision	5	1.2	5	1.2
Failure to offer or follow recommended best practice	12	2.9	10	2.4
Lack of recognition of complexity or seriousness of condition by caregiver	2	0.5	1	0.2
Other	3	0.7	2	0.5
Barriers to access and/or engagement with care	**115**	**28.0**	**60**	**14.6**
No antenatal care	53	12.9	36	8.8
Infrequent care or late booking	34	8.3	16	3.9
Declined treatment or advice	11	2.7	8	1.9
Obesity impacted on delivery of optimal care *(eg, USS)*	2	0.5	-	-
Substance use	16	3.9	10	2.4
Family violence	7	1.7	6	1.5
Lack of recognition of complexity or seriousness of condition by the woman and/or family	24	5.8	13	3.2
Maternal mental illness	5	1.2	3	0.7
Cultural barriers	6	1.5	2	0.5
Language barriers	3	0.7	-	-
Not eligible to access free care	3	0.7	3	0.7
Environment *(eg, isolated, long transfer, weather prevented transport)*	10	2.4	9	2.2
Other	7	1.7	3	0.7

Recommendations: Perinatal Mortality

1. **That all maternity care providers identify women with modifiable risk factors for perinatal related death and work individually and collectively to address these.**

   Strategies to address modifiable risk factors include:

   a. improving uptake of periconceptual folate
   b. pre-pregnancy care for known medical disease such as diabetes
   c. access to antenatal care
   d. accurate height and weight measurement in pregnancy with advice on ideal weight gain
   e. prevention and appropriate management of multiple pregnancy
   f. smoking cessation
   g. antenatal recognition and management of fetal growth restriction
   h. prevention of preterm birth and management of threatened preterm labour
   i. following evidence-based recommendations for indications for induction of labour
   j. advice to women and appropriate management of decreased fetal movements.

   All DHBs should report the availability and uptake of relevant services in their annual clinical reports to ensure that these strategies are embedded and to identify areas for improvement.

2. **Offer education to all clinicians so they are proficient at screening women, and are aware of local services and pathways to care, for the following:**

   a. family violence
   b. smoking
   c. alcohol and other substance use.

3. **That multi-disciplinary fetal surveillance training be mandatory for all clinicians involved in intrapartum care.**

   a. This training includes risk assessment for mothers and babies throughout pregnancy as well as intrapartum observations.
   b. The aims include strengthening of supervision and support to promote professional judgment, interdisciplinary conversations and reflective practice.

4. **There is observational evidence that improved detection of fetal growth restriction, accompanied by timely delivery, reduces perinatal morbidity and mortality. The PMMRC recommends (amended from previous PMMRC reports) that assessment of fetal growth incorporates a range of strategies including:**

   a. assessment and appropriate referral for risk factors for fetal growth restriction at first antenatal visit and throughout pregnancy
   b. accurate measurement of maternal height and weight at first antenatal assessment
   c. ongoing assessment of fetal growth by measuring fundal-symphysial height in a standardised way, recorded at each antenatal appointment, preferably by the same person
   d. plotting of fundal height on a tool for detection of fetal growth restriction, such as a customised growth chart, from 26 weeks gestation
   e. if fetal growth restriction is confirmed by ultrasound, appropriate referral and assessment of fetal and maternal wellbeing, and timely delivery are recommended. The New Zealand Maternal Fetal Medicine Guideline (2013) describes criteria for the management of small for gestational age (SGA) pregnancies after 34 weeks.

   The PMMRC supports the Ministry of Health initiative to explore the evidence and validate the use of customised growth charts in New Zealand, and to investigate the appropriate way to incorporate these into the national maternity record.

2 Maternal Mortality 2013

2.1 Introduction

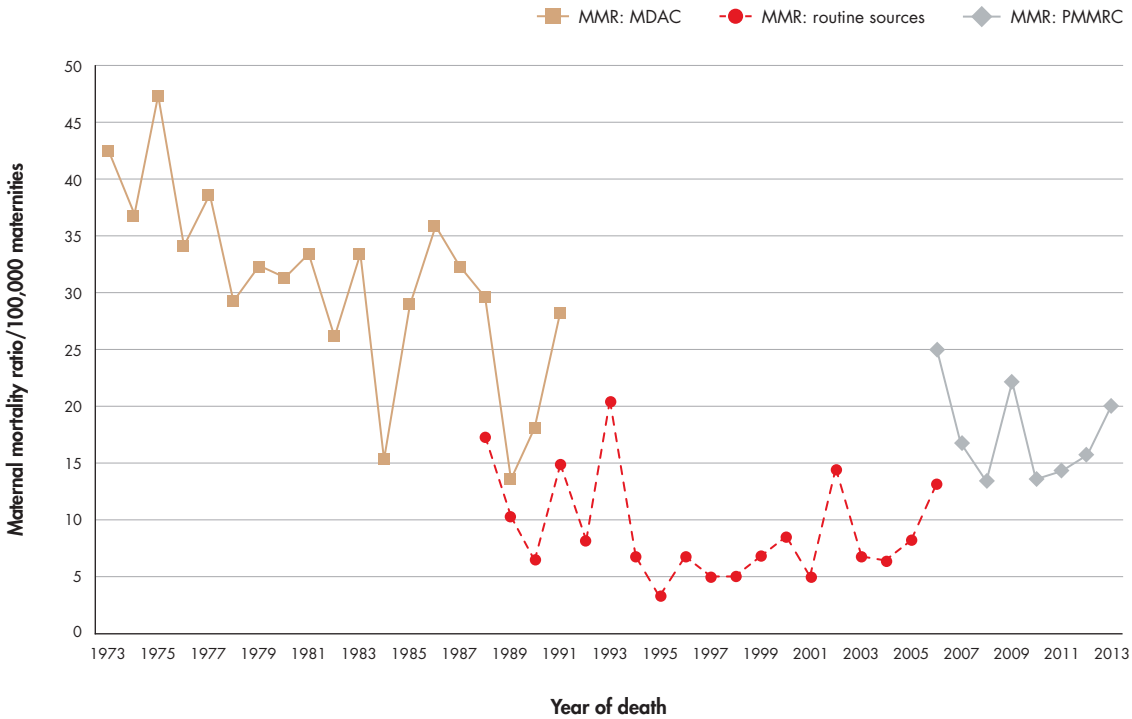
The New Zealand Maternal Mortality Review Working Group (MMRWG) was established in 2006 to develop a process for the national collection of data, to review maternal deaths and identify potentially avoidable causes, with the expectation that this would lead to improvements in care.

The terms of reference of the PMMRC require the committee to review 'direct' maternal deaths. The MMRWG also reviews 'indirect' deaths, in particular (but not solely) those related to medical conditions exacerbated by pregnancy and those related to mental health.

The Chair of the MMRWG, Graham Sharpe (anaesthetist), stood down during 2014, and Sue Belgrave (PMMRC Chair, obstetrician and gynaecologist) stepped in to Chair the working group until a new appointment is made. Other members of the working group are listed on page ii of this report. Vicki Masson (PMMRC national coordinator) provides support to the MMRWG.

The year 2013 was the eighth year of maternal death reporting under the auspices of the PMMRC. The number of maternal deaths each year is small. In this report, time trends in maternal mortality in New Zealand have been explored along with analyses that include all years of maternal mortality data (2006–2013).

Figure 2.1: New Zealand maternal mortality ratios (MMR) by mortality data source 1973–2013



MDAC = data from the New Zealand Maternal Deaths Assessment Committee; including maternal deaths to 3 months postpartum
Routine sources = data from routine New Zealand datasets, ie, the Mortality Collection (BDM) and hospital discharge datasets (NMDS); including maternal deaths to 6 weeks postpartum
PMMRC = data from the New Zealand Perinatal and Maternal Mortality Review Committee; including maternal deaths to 6 weeks postpartum

Prior to 1992, maternal mortality in New Zealand was reported by the Maternal Deaths Assessment Committee (MDAC). This committee stopped meeting in 1995, and maternal mortality was then reported from data held in the NMDS of hospital discharges and in the Mortality Collection from BDM. During this period of reporting from national datasets, the maternal mortality ratio was considerably lower than it had been during the years of the existence of the MDAC. When the PMMRC was established in 2006, and maternal mortality ratio reported again in the context of mandatory facilitated reporting, the maternal mortality ratio appeared to increase again. In the years 2006–2013 the reported ratio was 17.6/100,000 maternities, 2.5 times higher than the 7.14/100,000 maternities reported from 1995 to 2005. In reality, the maternal mortality ratio reported from routine data from 1991 to 2006 was artefactually low.

As the PMMRC ascertainment process collects more cases than are found in 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.

As outlined in recent reports, incomplete ascertainment of cases in the absence of mandatory and facilitated reporting leads to under-reporting of maternal mortality internationally (Johnson et al 2014; Knight et al 2014; PMMRC 2014b).

Figure 2.1 demonstrates clearly the futility of comparing the rates reported between countries with and without established, well-supported surveillance.

2.2 Definitions

The definitions adopted by the MMRWG are based on the WHO definitions from the International Classification of Diseases (10th edition) 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.' (WHO nd)

The cause of each death is sub-classified using the Confidential Enquiry into Maternal and Child Health (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. All maternal deaths by suicide are included in the New Zealand data as indirect deaths.
- **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 births 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 term 'ratio' is used to describe 'incidence' of maternal mortality because cases included in the numerator may arise from pregnancies that end before 20 weeks. From 2006 to 2013, 26 percent of all maternal deaths (48 percent of antepartum (in pregnancy) maternal deaths and 14 percent of postpartum deaths) occurred under 20 weeks. As the total number of pregnancies ending before 20 weeks is unknown, the denominator cannot include all women at risk and thus the estimate cannot truly be called a 'rate'.

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. 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 2008).

Contributory factors are organisational and/or management factors (eg, delays in procedures or accessing results; lack of policies, protocols or guidelines; lack of maintenance of equipment), personnel factors (eg, failure to maintain competence) and barriers to access and/or engagement with care (eg, unregistered pregnancies, language barriers, distance from adequate facilities) that the MMRWG considered influenced care in the death reviewed. The subcategories within each group of factors considered are given in the 'PMMRC Classification of Contributory Factors and Potential Avoidability Form' (http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/).

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 that all clinicians aware of a maternal death notify either their PMMRC DHB local coordinator or the PMMRC national coordinator.

Deaths are brought to the MMRWG's attention in the main by PMMRC DHB local coordinators (47 percent) and other clinicians within DHBs (42 percent). Other sources include pathologists, Coronial Services and media reports. Often multiple notifications are received.

At the end of each year, known deaths are cross-referenced with the mortality collection at the BDM Registry to ensure the collection is complete. This process ascertained a further six indirect maternal deaths (due to suicide) in the 2006–2013 period.

Since July 2007, it has been a statutory requirement that all maternal deaths are notified to Coronial Services and a specific tick box on the death certificate reminds practitioners of the statutory requirement to report and to assist in ascertainment of all cases.

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

All completed reporting forms, along with relevant clinical information, and reports from DHBs, Coronial Services and any other relevant investigative processes are reviewed by designated members of the MMRWG, who present a summary of each case 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 whether maternal deaths were potentially avoidable 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 (Farquhar et al 2011). For 2009–2013 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 PMMRC's reviews for 2009–2013 are presented in this report.

In 2013, a dedicated maternal mortality database was developed by the University of Otago's Mortality Review Data Group. All maternal mortality cases from 2006 have been entered by the PMMRC national coordinator, thus improving the quality of, and access to, the MMRWG's data.

2.4 Findings

Maternal mortality ratio

Table 2.1: Maternal mortality ratio (per 100,000 maternities) and cause of maternal death 2006–2013

	2006	2007	2008	2009	2010	2011	2012	2013	2006–2013	
									n=89	
	n	n	n	n	n	n	n	n	n	%
Maternities	60,659	65,602	65,872	63,665	65,124	62,604	62,425	60,039	-	-
Direct maternal death	**6**	**5**	**4**	**5**	**1**	**2**	**2**	**5**	**30**	**33.7**
Amniotic fluid embolism	3	-	1	4	1	-	1	2	12	13.5
Postpartum haemorrhage	1	1	1	-	-	-	-	-	3	3.4
Venous thromboembolism	-	1	1*	-	-	1	-	-	3	3.4
Peripartum cardiomyopathy	-	1	-	-	-	-	-	-	1	1.1
Pre-eclampsia/Eclampsia	-	2	1	1	-	-	-	-	4	4.5
Sepsis	2	-	-	-	-	1	1	2	6	6.7
Ectopic pregnancy	-	-	-	-	-	-	-	1	1	1.1
Indirect maternal death	**7**	**5**	**5**	**9**	**8**	**6**	**8**	**6**	**54**	**60.7**
Pre-existing medical condition	2	4	2	1	2	4	4	2	21	23.6
Sepsis	-	1	-	5	1	-	-	1	8	9.0
Intracranial haemorrhage	1	-	-	-	1	-	1	1	4	4.5
Suicide	4	-	3	3	4	2	3	2	21	23.6
Unclassifiable	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**5**	**5.6**
Total maternal deaths	**15**	**11**	**9**	**14**	**9**	**9**	**10**	**12**	**89**	**100.0**
Single-year MMR	24.7	16.8	13.7	22.0	13.8	14.4	16.0	20.0	-	-
Three-year rolling MMR	-	-	**06–08**	**07–09**	**08–10**	**09–11**	**10–12**	**11–13**	-	-
			18.2	17.4	16.4	16.7	14.7	16.8	-	-
Coincidental deaths	**1**	**3**	**1**	**-**	**3**	**3**	**5**	**-**	**16**	**-**

* Pulmonary embolism and sepsis.
MMR = maternal mortality ratio.

There has been no statistically significant change in maternal mortality ratio in New Zealand since data collection by the PMMRC began in 2006.

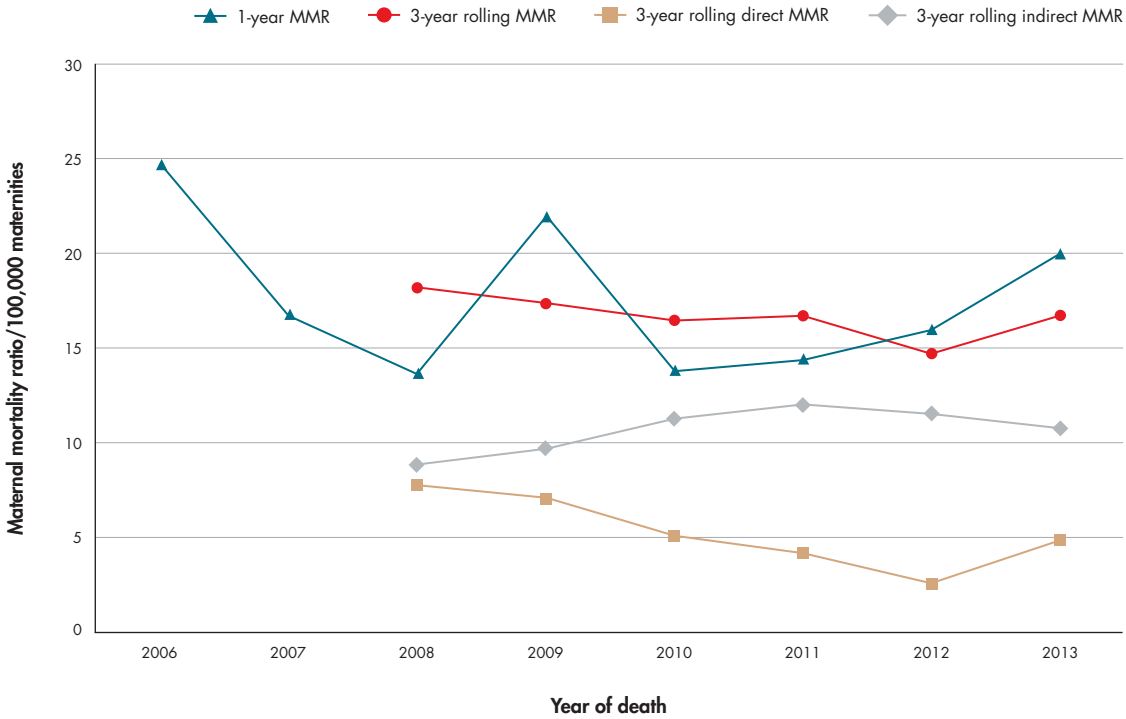
In 2013, 12 deaths within the definition of maternal mortality were reported to the PMMRC. There were no coincidental deaths reported in 2013. The maternal mortality ratio in New Zealand was therefore 20.0/100,000 maternities (95 percent CI 11.4–34.9/100,000) for the year 2013. The three-year average maternal mortality ratio, calculated to obtain a more robust estimate of the New Zealand ratio given small and variable numbers of deaths per year, for 2011–2013, was 16.8/100,000 maternities (95 percent CI 11.8–23.8/100,000).

In 2013, there were five direct deaths, two from amniotic fluid embolism (AFE), two from sepsis and one from ectopic pregnancy. There were six indirect deaths, two from pre-existing medical conditions, one from sepsis, one from intracranial haemorrhage and two suicide deaths. There was one death where cause was not able to be classified.

The maternal mortality ratio for direct deaths alone for the most recent five years of data (2009–2013) was 4.8/100,000 maternities (95 percent CI 2.9–7.9/100,000), and for indirect deaths 11.8/100,000 maternities (95 percent CI 8.6–16.2/100,000).

Pre-existing medical disease, suicide and AFE were the most frequent causes of maternal mortality in New Zealand in 2006–2013. Suicide continues to be the leading 'single' cause of maternal death in New Zealand. Suicide will be the focus of further work in 2015–2016 and this will be reported in the PMMRC report 2016.

Figure 2.2: Maternal mortality ratios (MMR) (per 100,000 maternities) (one-year and three-year rolling) 2006–2013



3-year rolling MMR represented at final year of triennium.

Figure 2.2 demonstrates maternal mortality ratios for each year, and three-year rolling average total, direct and indirect maternal mortality ratios. The three-year rolling average 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.

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 without dedicated maternal mortality confidential enquiry systems have poorer case ascertainment leading to under-reporting of 15–93 percent of cases (Cliffe et al 2008; Deneux-Tharaux et al 2005; Donati et al 2011; EURO-PERISTAT Project et al 2008; Johnson and Sullivan 2013; Knight et al 2014). This fact is well illustrated by Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries (MBRRACE) in the 2009–2012 report for the UK and Ireland, which reported a maternal mortality ratio for 2009–2011 of 5.57/100,000 from routine statistics and a ratio of twice that at 10.63/100,000 from the confidential enquiry process (Knight et al 2014).

The maternal mortality ratio for England and Ireland based on confidential enquiry data was 10.12/100,000 maternities (3.25/100,000 direct maternal mortality ratio; 6.87 indirect maternal mortality ratio) for the triennium 2010–2012 (CMACE 2011b). This was significantly lower than the maternal mortality ratio in the two previous triennia but higher than that in 1985–1987. Over this time interval, there was a decrease in direct maternal mortality ratio but an increase in the indirect maternal mortality ratio.

The New Zealand maternal mortality ratio for the triennium 2010–2012 was significantly higher than that reported by the UK at 14.7/100,000 maternities with 95 percent CI 10.2–21.3/100,000, (direct maternal mortality ratio 2.7/100,000 maternities (1.1–6.6/100,000); indirect maternal mortality ratio 11.6/100,000 maternities (7.6–17.5/100,000)). Thus, the New Zealand direct maternal mortality ratio was very similar to the UK ratio for this triennium, but the indirect ratio was significantly higher. This may reflect in part differing demography of birthing women in the two countries.

As with the UK direct and indirect ratios, New Zealand has observed a (non-significant) trend towards a reduction of direct maternal mortality alongside a (non-significant) increase of indirect maternal mortality (Figure 2.2).

The Australian maternal mortality ratio was 6.8/100,000 women who gave birth from 2006 to 2010 (direct ratio 2.7/100,000; indirect 3.9/100,000). The ratios for New Zealand were significantly higher at 18.1, 6.5 and 10.6/100,000 maternities respectively. The Australian ratio is very similar to the New Zealand ratio at 7.14/100,000 maternities reported for 1995–2005 when New Zealand was using routine data sources for case ascertainment. As noted in the Australian report published in 2014, 'the higher MMR [maternal mortality ratio] for New Zealand may reflect enhanced surveillance and centralised mortality review' and numerous international papers on ascertainment of maternal mortalities would support this statement (Johnson et al 2014).

Reporting of maternal deaths to New Zealand Coronial Services 2006–2012

In 2013, all 12 maternal deaths were reported to Coronial Services and jurisdiction taken in 11 maternal deaths.

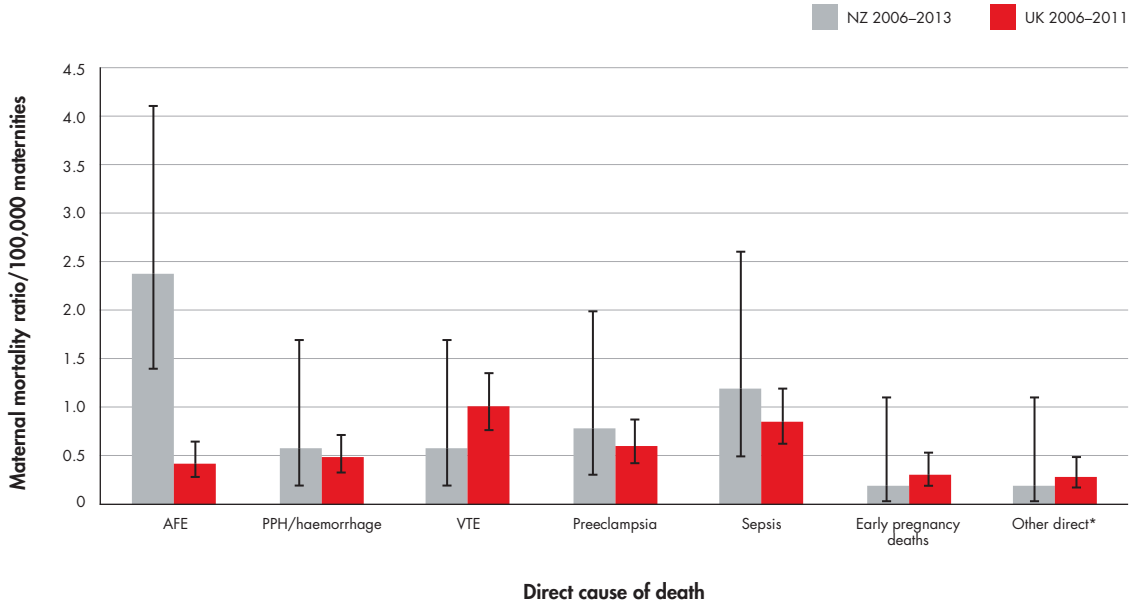
The MMRWG recommends that where a coroner declines jurisdiction in the case of a maternal death, post-mortem should be offered as part of full investigation of cause of death. The MMRWG reviewed the role of post-mortem in determining cause of maternal death from 2006 to 2013 and found clinical diagnosis was confirmed in 40 (45 percent), changed in 11 (12 percent), additional clinical findings in 8 (9 percent) and clinical diagnosis inconclusive in 6 (7 percent).

Causes of maternal death

Direct causes

As noted above, direct causes of maternal mortality contribute approximately one-third of maternal deaths compared to two-thirds from indirect causes. Direct causes include AFE, postpartum haemorrhage, thrombo-embolic disease, pre-eclampsia, sepsis and deaths in early pregnancy. In New Zealand, AFE contributes 40 percent of direct deaths, with the next most common being deaths from obstetric sepsis.

Figure 2.3: Cause specific direct maternal mortality ratios in New Zealand 2006–2013 and the UK 2006–2011 (with 95% CIs)



* Includes anaesthesia, cardiomyopathy, other.
AFE = amniotic fluid embolism.
PPH = postpartum haemorrhage.
VTE = venous thromboembolism.

Figure 2.3 shows cause specific maternal mortality ratios for direct maternal deaths, comparing ratios for New Zealand and England and Ireland. The most notable difference is in deaths from AFE, which over the periods compared was 5.6 times higher in New Zealand than in the UK ($p<0.0001$). The highest cause specific ratio for AFE in the UK in any triennium since 1985 was 0.80/100,000, one-third of the rate in New Zealand from 2006 to 2013. The similarity of the direct maternal mortality ratio for New Zealand to that in the UK overall and for all other direct causes raises a concern for New Zealand.

The Australasian Maternity Outcomes Surveillance System (AMOSS) reports an incidence of AFE (fatal and non-fatal cases) in New Zealand and Australia combined of 5.4 cases/100,000 (95% CI 3.5–7.2 per 100,000) women giving birth from 20 weeks in 2010–2011 (McDonnell et al, in press), and a mortality ratio of 0.8/100,000 (95% CI 0.1–1.5/100,000). The UK Obstetric Surveillance System (UKOSS) reported an AFE incidence of 1.7 cases/100,000 maternities (95 percent CI 1.4–2.1/100,000) for 2005–2013, which is approximately one-third the rate reported in New Zealand and Australia (Fitzpatrick et al 2015; Nair et al 2014).

The potential explanations for this 5.6-fold discrepancy in mortality are that (1) AFE is over-diagnosed in Australasia, (2) AFE is under-diagnosed in the UK (as suggested by the UKOSS estimate of total incidence), (3) there are higher rates of risk factors for AFE such as induction of labour, syntocinon augmentation and Caesarean section in Australasia, or (4) there is potential for improvement in the management of AFE in New Zealand to reduce the case fatality rate.

The MMRWG plans an in-depth review of cases of mortality and morbidity from AFE in 2015–2016 using cases ascertained by the PMMRC mortality review and AMOSS.

Some data on AFE cases reported to AMOSS (2010–2013) can be found in section 4 of this report.

Indirect causes

As noted above, indirect causes of maternal mortality have trended upwards in New Zealand since 2006. Pre-existing medical disease and suicide were the most frequent causes of maternal mortality in New Zealand in 2006–2013, suicide being the leading 'single' cause of maternal death in New Zealand (4.2/100,000 maternities). In comparison, cause specific maternal mortality ratio for psychiatric causes for the UK for 2009–2011 was 0.55/100,000 maternities, and 0.85/100,000 maternities is the highest ratio reported from the UK since 1994–1996 (Figure 2.4). The New Zealand ratio for psychiatric maternal deaths is 7.5 times that reported for the UK, and although the numbers of deaths in New Zealand are small (n=21), the difference is highly statistically significant (p<0.0001).

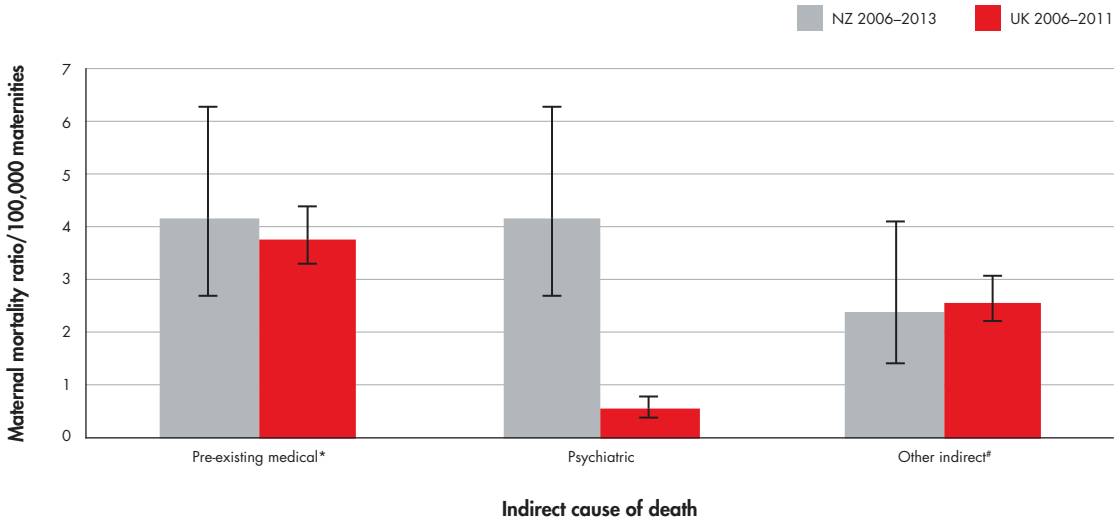
Of the 21 suicide deaths reported to the PMMRC in 2006–2013, 43 percent were reported by sources other than DHB local coordinators or clinicians (six were notified only through the Mortality Collection database, and three directly from pathologists). This compares to only 10 percent of non-suicide maternal deaths reported by sources other than DHB local coordinators or clinicians (three by pathologists, one from Coronial Services and three via the media).

Of the 21 suicides included in the ratio, 11 were deaths of women at less than 20 weeks gestation, five prior to birth and six after miscarriage or termination of pregnancy.

As noted previously, international comparisons are difficult because of uncertainty around case ascertainment. However, the reported data show that maternal suicide is seven times more common in New Zealand than in the UK, while all other indirect causes occur with similar incident rates.

The MMRWG plans further work on maternal suicide with relevant members of the sector in 2015–2016.

Figure 2.4: Cause specific indirect maternal mortality ratios in New Zealand 2006–2013 and the UK 2006–2011 (with 95% CIs)



* Includes cardiac, indirect neurological, indirect malignancy.

\# Includes non-obstetric sepsis.

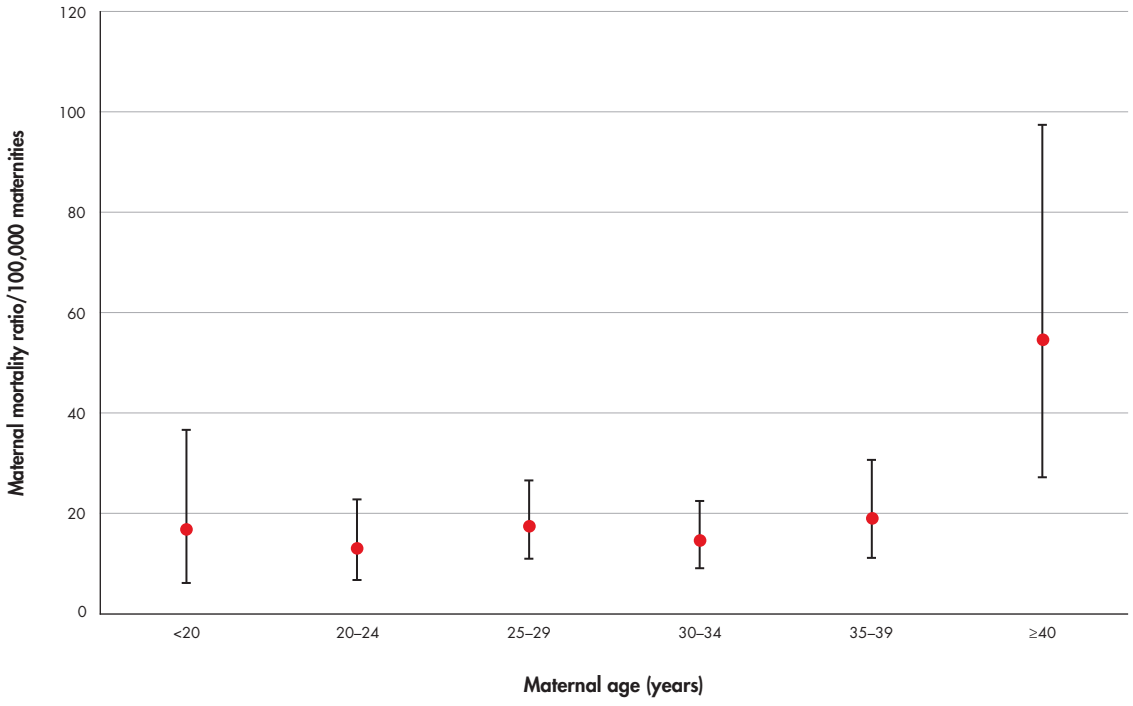
PRACTICE POINT: MATERNAL SUICIDE

- Maternal mental health services should be integrated into maternity services.
- 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.
- Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral.
- 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.

(PMMRC previous recommendations)

Demographic characteristics

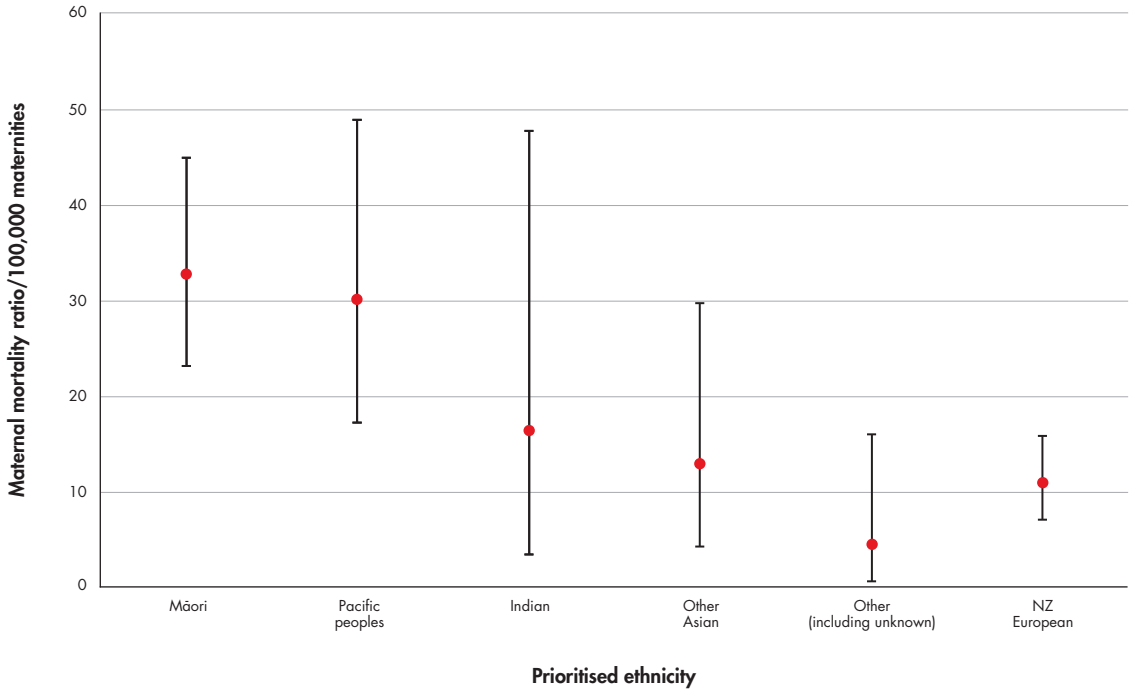
Figure 2.5: Maternal mortality ratios (per 100,000 maternities) by maternal age 2006–2013



Mothers aged 40 years and over contributed 12 percent of maternal deaths but only 4 percent of maternities. The maternal mortality ratio for mothers aged 40 years and over was 54.4/100,000 maternities compared to 16.1/100,000 among mothers aged less than 40 years.

There have been 11 mortalities among mothers 40 years and older between 2006 and 2013, including six direct and five indirect deaths.

Figure 2.6: Maternal mortality ratios (per 100,000 maternities) by prioritised ethnicity 2006–2013

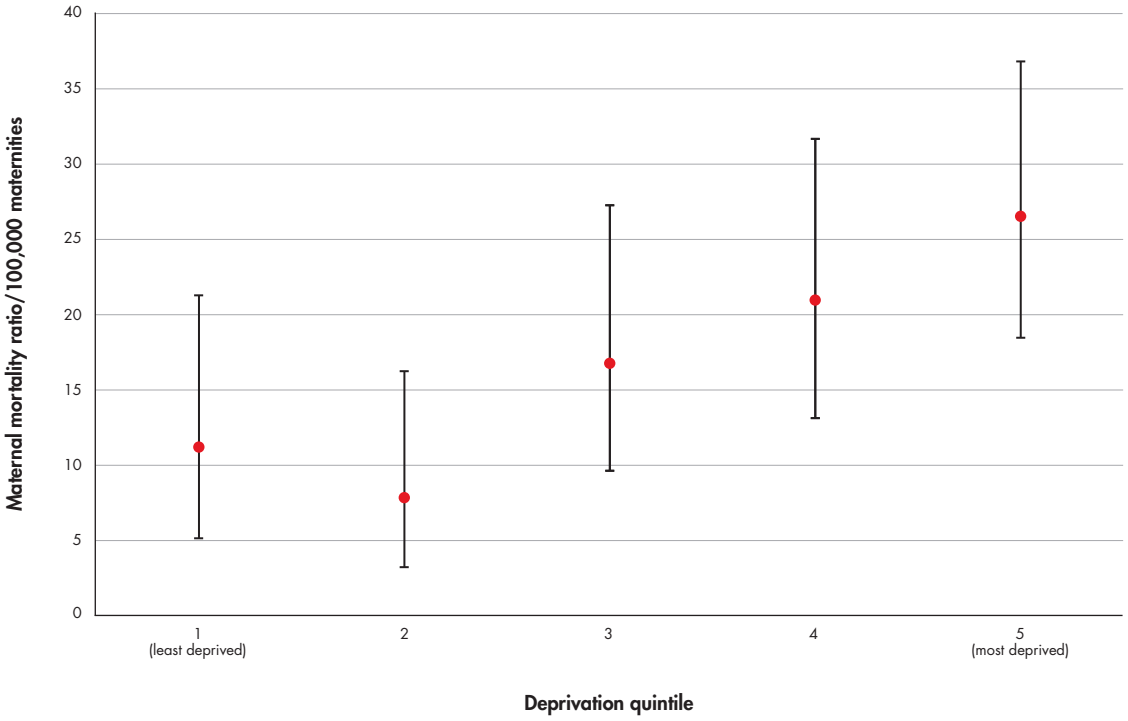


The maternal mortality ratio for Māori and Pacific mothers is two to three times that of Other Asian, Other and New Zealand European mothers. Maternal mortality among Māori and Pacific mothers is statistically significantly higher than among New Zealand European.

The maternal mortality ratio (direct deaths only) for Māori and Pacific peoples was 11.2/100,000 (95 percent CI 11.2–17.5) compared to 3.5/100,000 (1.8–6.3) for all other ethnicities combined. For indirect deaths the ratios were respectively 19.4/100,000 (13.4–27.3) compared to 6.7/100,000 (4.1–10.2).

The relative maternal mortality ratios for direct and indirect deaths were 3.2 and 2.9 demonstrating that the disparity in maternal mortality between Māori and Pacific peoples at highest risk and other ethnicities is not affected by whether the maternal deaths were direct or indirect.

Figure 2.7: Maternal mortality ratios (per 100,000 maternities) by deprivation quintile 2006–2013



The risk of maternal mortality increased significantly with increasing deprivation quintile in 2006–2013. The risk for women living in the most deprived 20 percent of residential areas from 2006 to 2013 was 2.4 times that of those in the least deprived 20 percent.

The 2014 report on maternal deaths in the UK 2009–2012 reported that the relative risk of maternal mortality was 1.48 (95% CI 1.00–2.29) for women residing in the most deprived 'Index of Multiple Deprivation' quintile areas compared to women in the least deprived quintile areas consistent with the relative risk for 2006–2013 for New Zealand of 2.4 (1.1–4.9) (Knight et al 2014).

Clinical characteristics

Table 2.2: Clinical characteristics among maternal deaths 2006–2013

	Maternal deaths	
	n=89	
	n	%
Parity*		
0	23	25.8
1–3	42	47.2
4+	22	24.7
Unknown)	2	2.2
BMI (kg/m²)		
<18.5	3	3.4
18.5–24.99	29	32.6
25–29.99	16	18.0
30–34.99	18	20.2
≥35	19	21.3
Unknown	4	4.5
Current smoker		
Yes	31	34.8
No	55	61.8
Unknown	3	3.4
Family violence in this pregnancy		
Yes	9	10.1
No	46	51.7
Not asked	21	23.6
Unknown	13	14.6

* Defined prior to conception of the index pregnancy.

Over the years 2006–2013, approximately one-quarter of mothers who died were having their first baby, while a further quarter had had four or more prior births.

Due to missing data in the MAT for women receiving primary maternity care from a hospital service, it is not possible to calculate an accurate maternal mortality ratio by parity, BMI or smoking. This is an important limitation of the MAT data in New Zealand at this time.

However, excluding women receiving primary maternity care from a hospital maternity service, 40.7 percent of women were identified as nulliparous in the MAT, suggesting that nulliparous women are less likely to suffer a death related to pregnancy than women having subsequent births. This association is likely to be confounded by age, which is associated with parity and with risk of maternal death.

The rate of smoking among mothers who died (35 percent) is high compared to previous estimates of smoking among mothers in New Zealand (eg, excluding women receiving primary maternity care from a hospital maternity service, 15.3 percent of women were identified as smokers at registration for pregnancy care in New Zealand (http://www.health.govt.nz/publication/maternity-tables-2011).

Family violence was known to be present in the index pregnancy in at least 10 percent of maternal deaths in 2006–2013, and family violence status was unknown in a further 38 percent. Evidence of family violence among deaths from any cause from 2006 to 2008 was reported in 12 percent of cases in the UK maternal mortality report *Saving Mothers' Lives* (CMACE 2011b). In the recent report of maternal deaths in the UK – *Saving Lives, Improving Mothers' Care* (Knight et al 2014) – domestic abuse prior to or during pregnancy was reported in 4.1 percent of deaths but data were missing for 60.7 percent of cases. A practice point on family violence screening is included in section 1.4 on page 82.

There were no statistically significant differences in parity, BMI, smoking status or family violence history according to whether the maternal death was classified as direct or indirect.

Table 2.3: Details of place and timing of maternal mortalities 2006–2013

	Maternal deaths	
	n=89	
	n	%
Place of baby's birth		
Community (not in a health care facility)	4	4.5
Hospital	53	59.6
Baby not born at time of mother's death	31	34.8
Unknown	1	1.1
Place of maternal death		
Hospital	57	64.0
Community	32	36.0
Time of death related to pregnancy		
Antepartum (Antepartum/Intrapartum)	31	34.8
Postpartum	58	65.2
	Antepartum maternal death	
	n=31	
	n	%
Gestation at antepartum maternal death (weeks)		
<20	15	48.4
20–27	9	29.0
28–36	6	19.4
37–42	1	3.2
	Postpartum maternal death	
	n=58	
	n	%
Gestation at birth of postpartum maternal death (weeks)		
<20	8	13.8
20–27	7	12.1
28–36	13	22.4
37–42	30	51.7
Postnatal day at postpartum maternal death (days)		
0	15	25.9
1–6	13	22.4
7–13	7	12.1
14–27	12	20.7
28–41	10	17.2
Unknown	1	1.7

Two-thirds of maternal deaths occurred in hospital and one-third in the community.

Approximately a third of maternal deaths occurred during pregnancy, half prior to 20 weeks and almost all of the remainder prior to term (37 weeks).

Of postpartum deaths, one-half occurred after the baby's birth at term. A quarter occurred within the first day of birth and almost one-half within the first week.

Table 2.4: Baby outcomes among maternal deaths 2006–2013

Baby outcome	Maternal deaths		Antepartum/ Intrapartum maternal death		Postpartum maternal death	
	n=89		n=31		n=58	
	n	%	n	%	n	%
Maternal death <20 weeks	23	25.8	15	48.4	8	13.8
Maternal death ≥20 weeks						
Did not deliver	16	18.0	16	51.6	-	-
Stillborn	5	5.6	-	-	5	8.6
Early neonatal death	4	4.5	-	-	4	6.9
Late neonatal death	-	-	-	-	-	-
Alive after one month of age	41	46.1	-	-	41	70.7

One-quarter of maternal deaths from 2006 to 2013 occurred in the first 20 weeks of pregnancy, two-thirds of these prior to the baby's birth.

Sixty-six mothers (74 percent) died at or after 20 weeks gestation. Of these mothers, 16 (24 percent) died prior to the baby's birth and the babies did not deliver; there were nine perinatal deaths (14 percent) and 41 (62 percent) babies survived.

Of babies born alive, 91 percent survived beyond one month of age.

Perimortem Caesarean section

Perimortem Caesarean section was undertaken in eight maternal deaths as part of the resuscitation of the mother to improve the chance of survival following a collapse from 2006 to 2013. Five babies were live born, three babies were stillborn and one live born baby died as an early neonatal death. When appropriately undertaken, perimortem Caesarean section can save the life of both the mother and the infant.

PRACTICE POINT: PERIMORTEM CAESAREAN SECTION

Perimortem Caesarean section should be considered at the start of cardio-pulmonary resuscitation in pregnant women >20 weeks gestation. Perimortem Caesarean section is undertaken for maternal survival, not fetal, and should be carried out within 5 minutes of cardiac arrest to aid successful resuscitation if there is no return of spontaneous circulation. Irreversible hypoxic brain damage can occur after 4–6 minutes in pregnant women (Knight et al 2014). There is no need to confirm fetal viability prior to performing perimortem Caesarean section.

Perimortem Caesarean section facilitates maternal resuscitation by:

- relieving aorto-caval compression by the gravid uterus thus improving cardiac output
- improving ventilation and effectiveness of chest compressions
- removing metabolic/cardiovascular demands of the fetus and placenta.

Recommendations for perimortem Caesarean section:

- **perform within five minutes of cardiac arrest if no return of spontaneous circulation with standard resuscitation**
- **operate at site of cardiac arrest – do not move to operating theatre**
- **ensure manual displacement of the uterus and early intubation/ventilation**
- **no anaesthetic is required**
- **no need for consent (duty of care)**
- **a scalpel is the only essential equipment***
- **use the incision that will give most rapid access****
- **activate the massive transfusion protocol at the time of decision for perimortem Caesarean section (Knight et al 2014).**

Secure haemostasis after return of circulation. Be aware of potential for development of disseminated intravascular coagulopathy and bleeding with return of circulation.

* A pre-mounted scalpel blade (size 20) and two cord clamps should be kept available on the resuscitation trolley to ensure that there are no delays if perimortem Caesarean section is necessary.

** A midline abdominal incision and a classical uterine incision will give the most rapid access, but a transverse approach can be used if the operator is more comfortable with that incision (Knight et al 2014).

Table 2.5: Contributory factors and potentially avoidable maternal death 2006–2013

	Maternal deaths		Direct maternal deaths		Indirect maternal deaths		Unclassifiable	
	n=89		n=30		n=54		n=5	
	n	%	n	%	n	%	n	%
Was death potentially avoidable?								
Yes	32	36.0	11	36.7	21	38.9	-	-
No	53	59.6	19	63.3	33	61.1	1	20.0
Unknown	4	4.5	-	-	-	-	4	80.0
Contributory factors present	**54**	**60.7**	**19**	**63.3**	**34**	**63.0**	**1**	**20.0**
Organisational/Management factors	**33**	**37.1**	**15**	**50.0**	**18**	**33.3**	**-**	**-**
Poor organisational arrangements of staff	6		3		3		-	
Inadequate education and training	11		6		5		-	
Lack of policies, protocols or guidelines	21		9		12		-	
Inadequate numbers of staff	1		1		-		-	
Poor access to senior clinical staff	3		1		2		-	
Failure or delay in emergency response	4		3		1		-	
Delay in procedure *(eg, Caesarean section)*	2		1		1		-	
Inadequate systems/process for sharing of clinical information between services	13		3		10		-	
Delayed access to test results or inaccurate results	2		2		-		-	
Equipment *(eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)*	1		1		-		-	
Building and design functionality *(eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)*	3		3		-		-	
Other	7		3		4		-	
Personnel factors	**33**	**37.1**	**13**	**43.3**	**19**	**35.2**	**1**	**20.0**
Knowledge and skills of staff were lacking	15		6		8		1	
Delayed emergency response by staff	8		5		3		-	
Failure of communication between staff	11		4		7		-	
Failure to seek help/supervision	7		3		4		-	
Failure to offer or follow recommended best practice	5		-		4		1	
Lack of recognition of complexity or seriousness of condition by caregiver	20		7		13		-	
Other	1		1		-		-	

Table 2.5: Contributory factors and potentially avoidable maternal death 2006–2013 (Continued)

	Maternal deaths		Direct maternal deaths		Indirect maternal deaths		Unclassifiable	
	n=89		n=30		n=54		n=5	
	n	%	n	%	n	%	n	%
Barriers to access and/or engagement with care	**35**	**39.3**	**7**	**23.3**	**28**	**51.9**	**-**	**-**
No antenatal care	4		-		4		-	
Infrequent care or late booking	9		4		5		-	
Declined treatment or advice	11		2		9		-	
Obesity impacted on delivery of optimal care *(eg, USS)*	4		2		2		-	
Substance use	8		-		8		-	
Family violence	5		-		5		-	
Lack of recognition of complexity or seriousness of condition by the woman and/or family	15		2		13		-	
Maternal mental illness	7		-		7		-	
Cultural barriers	1		-		1		-	
Language barriers	2		-		2		-	
Not eligible to access free care	1		-		1		-	
Environment *(eg, isolated, long transfer, weather prevented transport)*	1		1		-		-	
Other	5		-		5		-	

USS = ultrasound scan.

Thirty-six percent of maternal deaths were identified as potentially avoidable from 2006 to 2013. Contributory factors were identified in 61 percent of maternal deaths in the years 2006–2013. The presence of contributory factors and the assessment of potentially avoidable death did not vary by whether maternal deaths were classified as direct or indirect.

Contributory factors were identified in each of organisational/management, personnel and barriers to access and/or engagement with care in around a third of cases overall, but barriers were less often identified among direct deaths than among indirect.

Similar rates were identified in the Centre for Maternal and Child Enquiries (CMACE) review of maternal deaths in the UK for the triennium 2006–2008, which reported substandard care in 61 percent of cases overall, with this contributing significantly to the death in 36 percent of cases. In *Saving Lives, Improving Mothers' Care* (Knight et al 2014), for deaths in the UK and Ireland reviewed by the confidential enquiry process (a subset of all deaths), improvements in care were reported in 71 percent of cases, and improvements in care which may have made a difference to outcome in 52 percent of deaths.

2.5 Points Arising from Maternal Deaths in 2013

Obstetric sepsis 2006–2013

In 2013, two women died of obstetric sepsis. Between 2006 and 2013 there were six direct maternal deaths from obstetric sepsis. Of these six deaths, five were postpartum deaths at 2, 3, 7, 22 and 28 days postpartum. Three were associated with Group A streptococcus. A common feature in these deaths was vague, seemingly unrelated symptoms followed by sudden severe collapse.

An increase in maternal deaths from obstetric sepsis was noted in the 2011 UK triennial report and advice on prevention was published (CMACE 2011b, Chapter 7: Sepsis).

PRACTICE POINT: POSTPARTUM SEPSIS

- Severe sepsis can develop at any time throughout the postpartum period and disease progression may be rapid.
- Symptoms may be less distinctive than in the non-pregnant population and a high index of suspicion is required.
- Common symptoms include fever, diarrhoea, vomiting and lethargy. The most common site of infection is the genital tract and genital tract sepsis may present with severe pain (including back pain) and tenderness unrelieved by usual medication.
- All health professionals should be aware of the symptoms and signs of maternal sepsis and of the rapid, potentially lethal course of severe sepsis and septic shock.
- Suspicion of significant sepsis should trigger urgent referral for assessment, antibiotic therapy and supportive treatment.
- Postpartum women and their families should be made aware of the need to seek medical care if unwell, and the need to re-present promptly if the symptoms worsen because of the potential for rapid deterioration.

Influenza 2006–2013

Five women died from influenza in pregnancy from 2009 to 2013. None of these women had been immunised. All presented in pregnancy, and three were delivered of live babies by Caesarean section within three days of admission to hospital.

Pregnancy is a risk factor for poor outcome from influenza infection. Compared with non-pregnant populations, pregnant women with either seasonal or pandemic influenza are at increased risk of serious complications including hospitalisation, admission to intensive care units, cardio-respiratory complications (pneumonia, acute respiratory distress syndrome, respiratory failure) and death (Cantu and Tita 2013). These risks increase with gestation and are highest in the third trimester and in the first two weeks postpartum (Memoli et al 2013; Mertz et al 2013). Risks are also higher in pregnant women with comorbidities.

Influenza in pregnancy is also associated with adverse fetal outcomes including miscarriage, stillbirth, neonatal death, preterm birth and low birth weight, mainly due to consequences of severe maternal illness (Cantu and Tita 2013; Memoli et al 2013).

Inactivated influenza vaccination in pregnancy is effective in reducing the rate of influenza illness in pregnant women and provides protection from influenza to the infant for up to six months after birth (Naleway et al 2014; Zaman et al 2008). Despite national campaigns, uptake of influenza vaccination among pregnant women continues to be modest (NISG 2013). There is an ongoing need across the sector to improve knowledge and access to immunisation during pregnancy. There is also a need to better understand the barriers to access and uptake of immunisations during pregnancy.

Resources on influenza in pregnancy relevant to the New Zealand setting are available on the websites of RANZCOG (2014b) and the National Influenza Specialist Group (NISG 2015).

PRACTICE POINT: INFLUENZA IN PREGNANCY

Pregnant women at any gestation and women planning pregnancy during the influenza season should be offered immunisation against influenza (usually available March to July) because they are at increased risk of severe outcomes. Influenza immunisation is free for pregnant women.

Influenza should be suspected in women presenting with respiratory or influenza-like illness (ILI) and antiviral therapy commenced before the results of confirmatory testing with nasopharyngeal swab are available.

All pregnant women with ILI and pneumonia should receive appropriate antibiotics to treat moderate severity community-acquired pneumonia.

'Red flags' requiring immediate hospitalisation and specialist review include:

a. **temperature >38°C or <36°C**
b. **heart rate >110 beats per minute**
c. **respiratory rate >20 breaths per minute (counted over 60 seconds)**
d. **systolic blood pressure <90mmHg (or >40mmHg fall from baseline)**
e. **O_2 saturation <95%**
f. **new onset confusion or altered mental state.**

Repeated presentation for non-resolving symptoms may be a sign of a potentially worsening condition and require a full assessment and specialist referral.

Practitioners should have a low threshold for admitting a pregnant woman with ILI to hospital, and specialist physician and obstetrician review is recommended.

Women not responding to standard therapy should be discussed with a specialist respiratory centre.

Epilepsy 2006–2013

Three women died of sudden unexpected death in epilepsy (SUDEP) from 2006 to 2013. All three had sub-optimal levels of anticonvulsants at the time of death. Two of these deaths were considered potentially avoidable at review. Contributory factors in these deaths included organisational issues around access to appropriate neurological advice, communication between services and lack of recognition of the seriousness of the condition by the woman and/or family.

The Confidential Enquiries into Maternal Deaths in the UK have found women with epilepsy are 10 times more likely to die in pregnancy than women without epilepsy (Kapoor and Wallace 2014; Lewis et al 2011) and SUDEP remains the major cause of death in pregnant or postpartum women with epilepsy (Kapoor and Wallace 2014; Kelso and Wills 2014).

Risk factors for SUDEP in pregnant women, similar to the non-pregnant population, include:

- frequency of seizures – particularly if not seizure-free for one year
- generalised tonic-clonic seizure disorder
- seizures occurring during sleep
- witnessed seizures
- poor adherence to anti-epileptic drug regimens
- co-existence of learning disability (Tomson et al 2005)
- changes in anti-epileptic drug requirements due to pregnancy (Edey et al 2014).

The pharmacokinetics of anti-epileptic drugs are affected by pregnancy, particularly lamotrigine, and also levetiracetam, phenytoin and carbamazepine, and may lead to loss of seizure control (Harden et al 2009; Hoeritzauer et al 2012). The results of a study assessing the metabolism and effects of these anti-epileptic drugs in pregnancy is awaited (EMPiRE 2014).

Reports also highlight the association of the following with epilepsy related deaths:

- delayed or no referral, or barriers of access to specialist services
- difficult social circumstances (Kelso and Wills 2014; Lewis et al 2011).

Currently the *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* state that women with controlled epilepsy are suitable for a consultation with their primary practitioner (GP) (Code 1051), and those women with poorly controlled epilepsy or on multiple medications require a transfer of care to a specialist service (Code 1052). However, given the increased risks for pregnant women with epilepsy, the PMMRC recommends that all women with epilepsy on medication are referred for specialist input.

PRACTICE POINT: EPILEPSY IN PREGNANCY

1. The PMMRC recommends that all pregnant women with epilepsy on medication be referred to a physician. Women with a new diagnosis of epilepsy or a change in seizure frequency should be referred urgently.
2. The dose of anti-epileptic drugs may need to proactively increase. In particular, lamotrigine and levetiracetam should be increased in the second and third trimesters.
3. Labour and birth care for women with epilepsy should be provided in a secondary or tertiary obstetric hospital (NICE 2012).
4. Communicate and document the plan of care for the woman, her family/whānau, and all practitioners involved in her care.
    - Advise women with epilepsy and their family/whānau that the risks of seizures and SUDEP are increased during pregnancy and postpartum.
    - Review first aid procedures for a witnessed seizure with the family and consider modifiable risk factors, such as:
        - not sleeping alone
        - not bathing alone
        - not caring for young children alone
        - not driving if recent seizure.

Recommendations: Maternal Mortality

1. **Seasonal or pandemic influenza vaccination is recommended for all pregnant women regardless of gestation, and for women planning to be pregnant during the influenza season.**
    a. Vaccination is also recommended for maternity care providers to reduce the risk to the women and babies under their care.
    b. The PMMRC recommends the Ministry of Health consult with women and maternity care providers to address barriers to the uptake of influenza vaccination in pregnancy and implement strategies to increase access to and awareness of the benefit of vaccination.
2. **All pregnant women with epilepsy on medication should be referred to a physician.**
    a. Women with a new diagnosis of epilepsy or a change in seizure frequency should be referred urgently.
    b. The PMMRC recommends a review of epilepsy in the *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)*.

3 Neonatal Encephalopathy 2010–2013

3.1 Methodology

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 2 or 3 equivalent to moderate and severe only.

Although hypoxia-ischemia is the predominant pathology, reported cases of term infants with neonatal encephalopathy are included in this dataset whatever the cause. Therefore, the full cohort includes a small number of cases where neonatal encephalopathy is associated with hypoglycaemia, congenital abnormality of the central nervous system or infection.

Cases were initially identified with the assistance of the New Zealand Paediatric Surveillance Unit 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). Since 2012, cases have been notified by key clinicians in neonatal units and the PMMRC local coordinators.

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

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

3.2 Findings

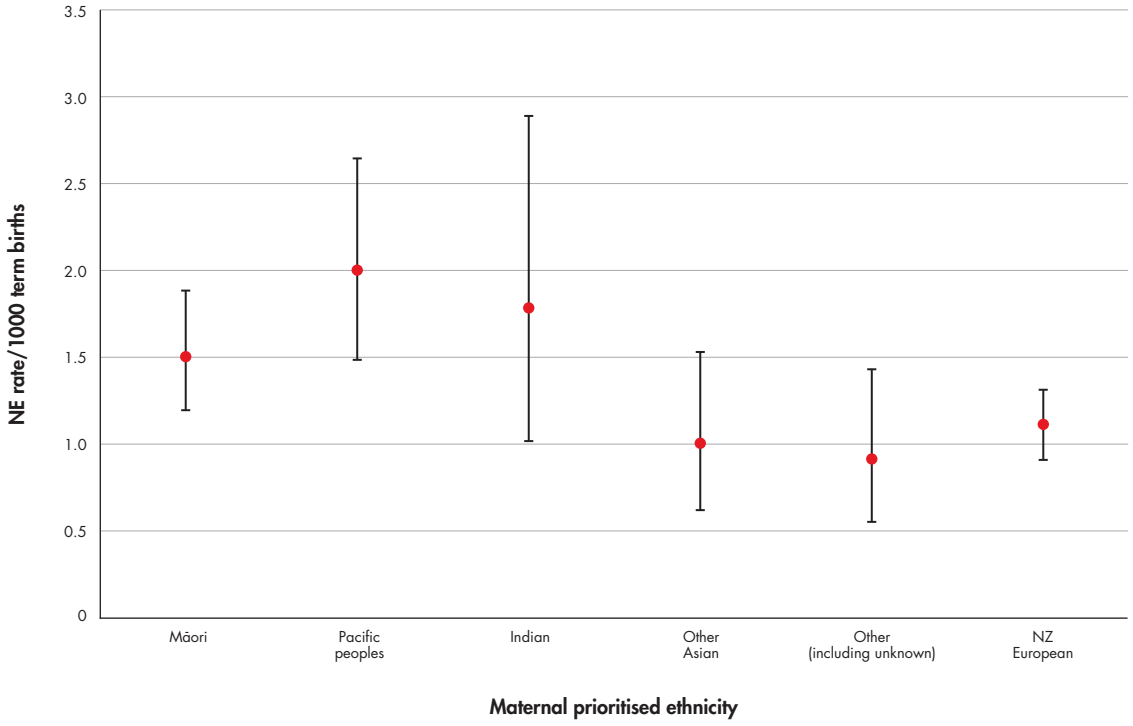
Two hundred and ninety-eight cases of neonatal encephalopathy have been reported from 2010 to 2013 (82 in 2010, 67 in 2011, 79 in 2012 and 70 in 2013) using the surveillance system described. Of these cases, 59 babies (19.8 percent) died prior to hospital discharge.

The rate of neonatal encephalopathy as a proportion of all registered births is 1.19/1000 (95 percent CI 1.06–1.33) registered births. The rate can also be reported as 1.29/1000 births at term (≥37 weeks) (95 percent CI 1.16–1.45) as the definition is limited to term births.

International comparison

In a 2013 paper, Lee et al estimated that in countries with a neonatal mortality rate <5/1000 births, such as New Zealand, the median incidence of neonatal encephalopathy associated with intrapartum events (including mild neonatal encephalopathy) was 1.60/1000 births (range 0.68–3.75/1000) for 1980 to 2013 with evidence of reduced incidence over time from some studies. This would suggest that at 1.19/1000 births for moderate and severe neonatal encephalopathy, the New Zealand rate is likely to be within international incidence rates. Case fatality rate among babies with severe neonatal encephalopathy was 76.8 percent (range 61.9–91.7 percent) compared to 59 percent in the New Zealand cohort. Of survivors reported in the Lee paper, 26.4 percent (range 22.1–30.8 percent) developed moderate to severe neurodevelopmental impairment and 14 percent (range 8.8–19.2 percent) mild neurodevelopment impairment.

Figure 3.1: Neonatal encephalopathy rates (per 1000 term births) by maternal prioritised ethnicity 2010–2013



There appears to be a higher rate of neonatal encephalopathy among babies of Māori, Pacific and Indian mothers compared to Other Asian, Other and New Zealand European mothers. However, only the difference between Pacific peoples and New Zealand European is statistically significant at $p<0.05$.

The rate of neonatal encephalopathy among babies of Pacific mothers is almost double that among babies of New Zealand European mothers.

Table 3.1: Neonatal encephalopathy rate (per 1000 term births) by gestation, gender, birthweight and plurality 2010–2013

	NZ registered births ≥37 weeks		NE babies		Rate (/1000 term births)	
	n=230,162		n=298			
	n	%	n	%	/1000	95% CI
Gestation at birth (weeks)						
37	15,448	6.7	33	11.1	2.14	1.47–3.00
38	38,726	16.8	51	17.1	1.32	0.98–1.73
39	64,255	27.9	69	23.2	1.07	0.84–1.36
40	68,329	29.7	73	24.5	1.07	0.84–1.34
41	37,307	16.2	65	21.8	1.74	1.34–2.22
≥42	6,097	2.6	7	2.3	1.15	0.46–2.37
Gender						
Male	117,538	51.1	165	55.4	1.40	1.19–1.62
Female	112,624	48.9	133	44.6	1.18	0.98–1.38
Birthweight (g)						
<2,500	4,430	1.9	13	4.4	2.93	1.56–5.02
2,500–3,999	188,473	81.9	243	81.5	1.29	1.13–1.45
4,000–4,499	30,792	13.4	29	9.7	0.94	0.63–1.35
≥4,500	6,386	2.8	13	4.4	2.04	1.08–3.48
Unknown	81	0.0	-	-	-	-
Plurality						
Singleton	227,163	98.7	292	98.0	1.29	1.14–1.43
Twins	2,999	1.3	6	2.0	2.00	0.73–4.35

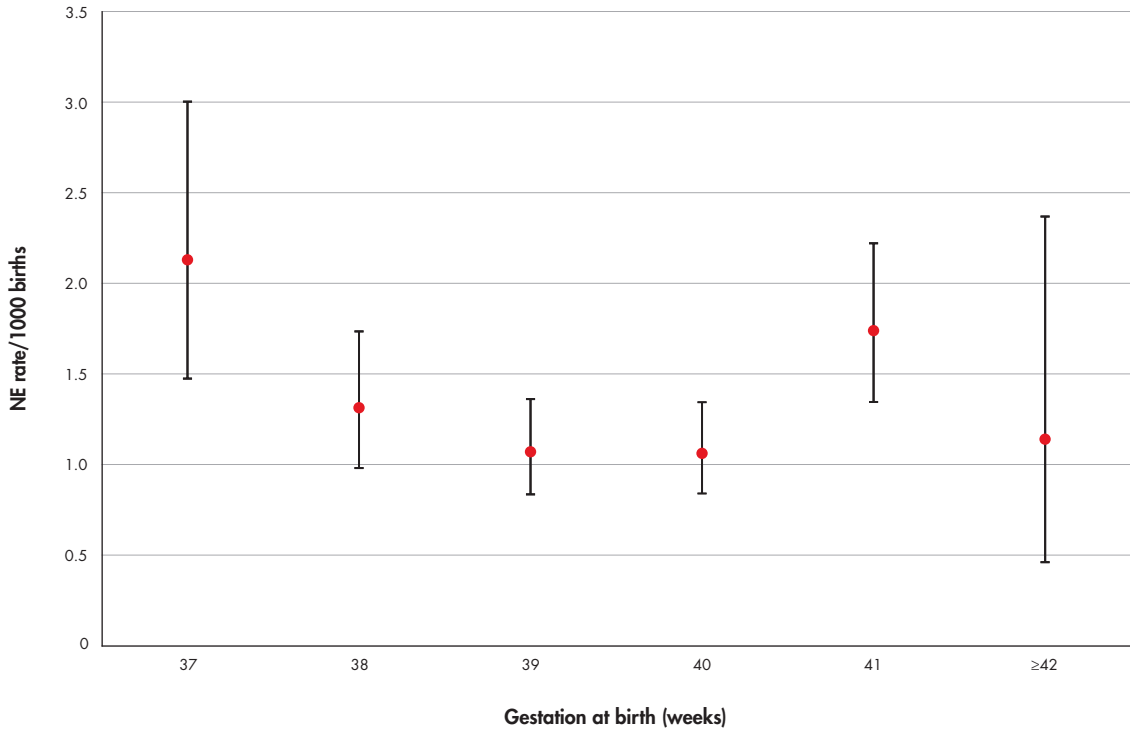
There is no significant association between a baby's gender and the risk of neonatal encephalopathy.

The number of multiple births in the cohort is small but the risk of neonatal encephalopathy is 60 percent higher relative to singleton term births. This difference is not statistically significant and may underestimate the true risk among multiple births due to the generally higher proportion of multiples delivered by elective Caesarean. Among the six twin babies represented, four were second twins and three were born by emergency Caesarean after normal vaginal delivery of the first twin. Four of the six twin babies were 37 weeks gestation at birth.

The relative risk of neonatal encephalopathy for babies born at term with birthweight under 2500g is 2.4 (1.4–4.1) compared to babies born at term weighing 2500–4499g.

There may be a higher risk in babies ≥4500g compared to babies weighing 2500–4499g, but numbers are small and the difference is not statistically significant.

Figure 3.2: Neonatal encephalopathy rates (per 1000 births) by gestation at birth 2010–2013



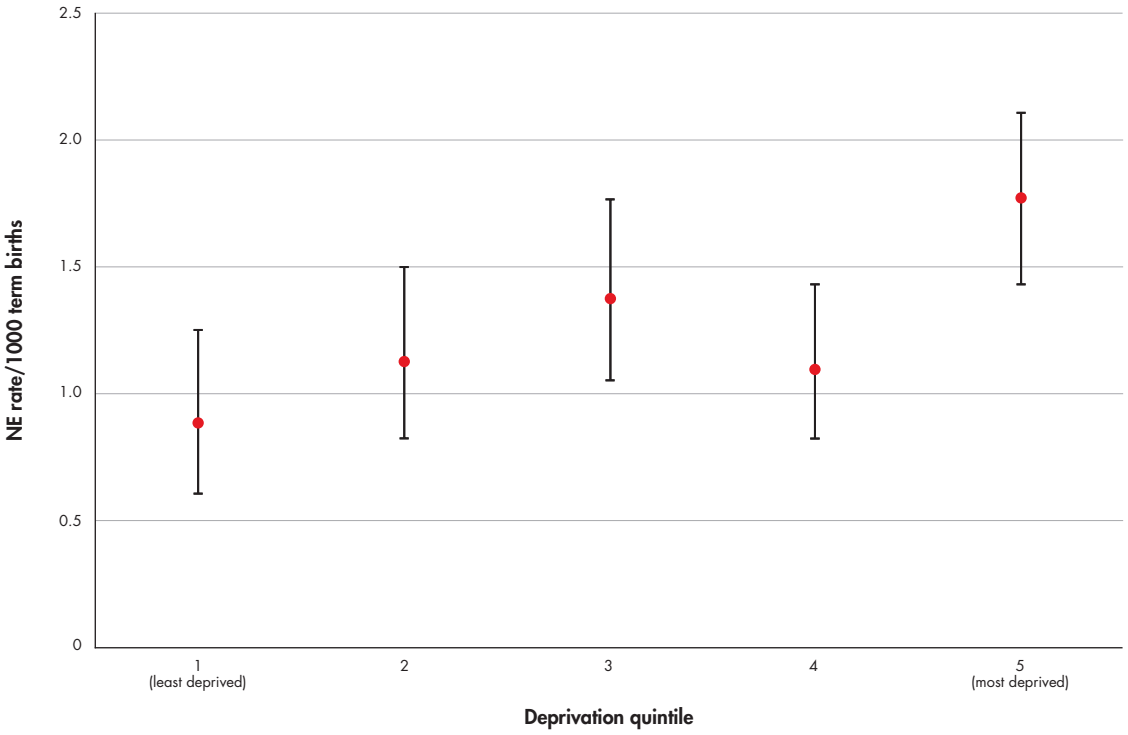
The rate of neonatal encephalopathy at 37 weeks is double the rate at 39 and 40 weeks, and higher at 41 weeks compared to 40 weeks (Figure 3.2).

Neonatal encephalopathy babies born at 37 weeks (n=33) were statistically significantly more likely to be multiples (n=4) and to have gestational diabetes (n=4) than neonatal encephalopathy babies born after 37 weeks, and more likely to be induced (n=10) and to be seen by an obstetrician (n=27) than neonatal encephalopathy babies born at 38–40 weeks. Neonatal encephalopathy babies born at 37 weeks were not significantly more likely to be SGA, to have evidence of infection or to have a sentinel event in labour.

There is a statistically significant increase in the rate of neonatal encephalopathy at 41 weeks compared to 40 weeks. The rate at ≥42 weeks is not consistent with increasing risk with increasing gestation but this estimate is based on small numbers (n=7) (thus large CIs) and could be consistent with either conclusion.

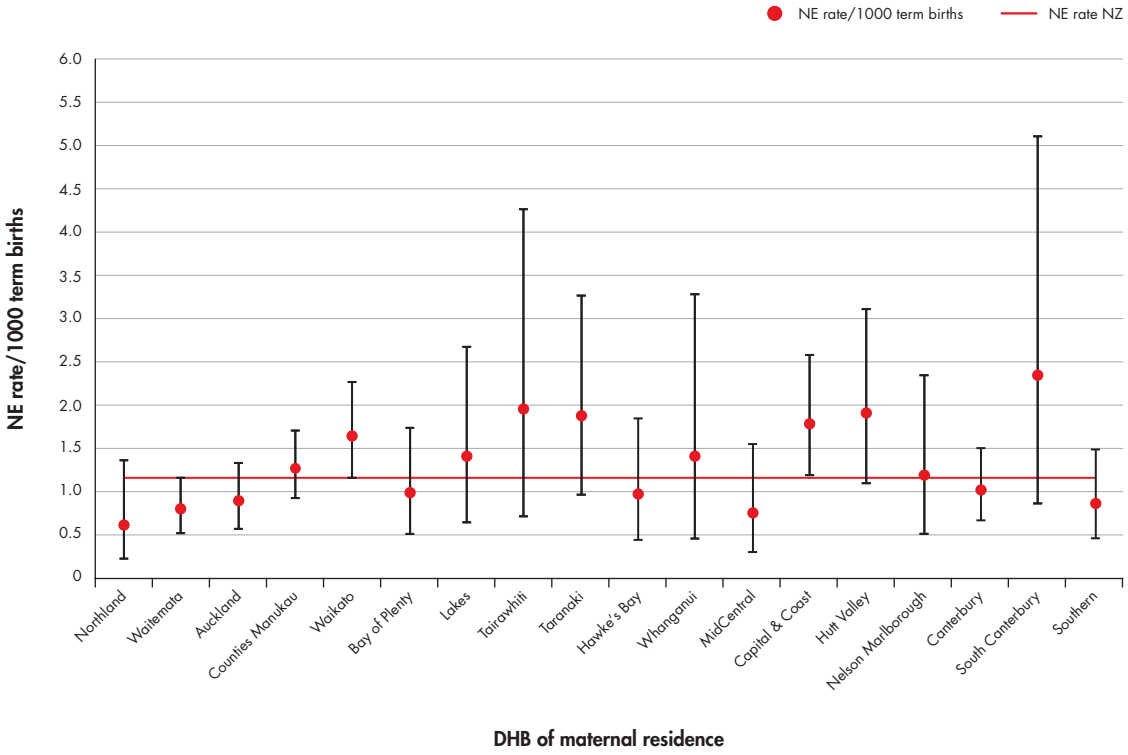
There is no significant association seen between maternal age and neonatal encephalopathy.

Figure 3.3: Neonatal encephalopathy rates (per 1000 term births) by deprivation quintile 2010–2013



There is a significant increase in the risk of neonatal encephalopathy with increasing deprivation quintile from least deprived to most deprived (chi-squared test for trend p=0.0006) (Figure 3.3). The risk among mothers living in the most deprived quintile areas was double that of mothers in the least deprived quintile.

Figure 3.4: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence* (with 95% CIs) compared to New Zealand neonatal encephalopathy rate 2010–2013



* Excludes any DHB with fewer than three cases.

Figure 3.4 shows the unadjusted rates of neonatal encephalopathy per 1000 term births by DHB of residence for 2010–2013.

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 as these estimates are not robust.

The rate for the four years 2010–2013 was statistically significantly higher among babies of mothers residing in the Capital & Coast DHB area.

In the seventh and eighth reports of the PMMRC, a significantly higher rate was observed in the Waikato DHB area compared to the national rate. Only 5 cases were reported in the Waikato area in 2013 compared to 14, 9 and 9 in 2010, 2011 and 2012.

Table 3.2: Maternal smoking, parity, body mass index (BMI) and gestation at first antenatal visit among neonatal encephalopathy cases 2010–2013

	NE cases	
	n=298	
	n	%
Currently smoking		
Yes	61	20.5
No	233	78.2
Unknown	4	1.3
Parity*		
Primiparous	168	56.4
Multiparous (≥2)	130	43.6
Maternal BMI (kg/m^2)		
<18.50	2	0.7
18.50–24.99	94	31.5
25.00–29.99	88	29.5
≥30.00	92	30.9
Missing data for height and/or weight	22	7.4
Gestation first antenatal visit (weeks)		
≤13	166	55.7
14–19	43	14.4
≥20	44	14.8
Unknown	45	15.1

* Defined after birth of the index case.

Smoking, parity, BMI and gestation at registration data for babies with neonatal encephalopathy are presented for 2010–2013; however, there are no complete national data for these antenatal variables. The MAT does not include smoking, parity and BMI data at registration for mothers registering for antenatal care with hospital maternity services, who are likely to be different to women registered with LMCs, limiting the usefulness of the set to estimate national rates of these factors.

The smoking rate at birth among mothers of babies with neonatal encephalopathy was 20.5 percent.

Fifty-six percent of mothers of babies with neonatal encephalopathy at term were nulliparous. It is likely that this is higher than the national rate suggesting an increased risk of neonatal encephalopathy among first compared to subsequent births.

At least 60 percent of mothers of babies with neonatal encephalopathy were overweight or obese.

Analysis of trimester at first antenatal visit is limited by missing data, but shows that at least 30 percent of mothers in this series had their first antenatal visit after the first trimester. The Ministry of Health recommends that mothers register with an LMC prior to 12 weeks gestation.

Place of birth

Table 3.3: Actual and intended place of birth among neonatal encephalopathy cases 2010–2013

Intended place of birth	NE cases n=298		Actual place of birth									
			Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3	
	n	%	n	%	n	%	n	%	n	%	n	%
Home	9	3.0	5	55.6	-	-	-	-	3	33.3	1	11.1
Birthing unit	32	10.7	1	3.1	11	34.4	-	-	3	9.4	17	53.1
Hospital level 1	15	5.0	-	-	-	-	5	33.3	3	20.0	7	46.7
Hospital level 2	112	37.6	-	-	-	-	2	1.8	108	96.4	2	1.8
Hospital level 3	125	41.9	1	0.8	-	-	1	0.8	1	0.8	122	97.6
Unknown	5	1.7	-	-	-	-	-	-	2	40.0	3	60.0
Total	**298**		**7**	**2.3**	**11**	**3.7**	**8**	**2.7**	**120**	**40.3**	**152**	**51.0**

In 42 cases (14 percent), the birth occurred at a place other than that initially intended. In 21 cases, transfer occurred in labour; 14 from home or a birthing unit to level 2 or 3 hospitals. Five of the women whose babies were diagnosed as having neonatal encephalopathy birthed at home and planned to do so from 2010 to 2013; the other two homebirths were registered to birth at a birthing unit and level 3 hospital.

Table 3.4: Customised birthweight, antenatal complications and maternal outcome among neonatal encephalopathy cases by Sarnat stage 2010–2013

	NE cases		Sarnat stage			
			Moderate		Severe	
	n=298		n=202		n=96	
	n	%	n	%	n	%
Customised birthweight centiles						
Small for gestational age	60	20.1	41	20.3	19	19.8
Appropriate for gestational age	209	70.1	138	68.3	71	74.0
Large for gestational age	29	9.7	23	11.4	6	6.3
Antenatal complications						
Antepartum haemorrhage (≥20 weeks vaginal bleeding)	30	10.1	19	9.4	11	11.5
Hypertension	37	12.4	30	14.9	7	7.3
Pre-eclampsia	4	1.3	4	2.0	-	0.0
Gestational hypertension	12	4.0	12	5.9	-	0.0
Unspecified hypertension	21	7.0	14	6.9	7	7.3
Trauma	5	1.7	2	1.0	3	3.1
Induction of labour	69	23.2	48	23.8	21	21.9
Maternal outcome						
Deceased	3	1.0	1	0.5	2	2.1
Alive but with serious morbidity	6	2.0	1	0.5	5	5.2
Alive and well	289	97.0	200	99.0	89	92.7

Twenty percent of babies with neonatal encephalopathy were SGA by customised birthweight centile. While the rate of SGA in the overall population using customised centiles is not known, it is likely to be between 10 and 15 percent, and if so SGA is over-represented among neonatal encephalopathy babies. Ten percent of babies were large for gestational age, which is probably within normal limits for the population as a whole.

There were three maternal deaths and six cases of acute severe maternal complication such as massive postpartum haemorrhage, cardiac arrest or rupture of an aneurysm. These severe maternal outcomes almost always occurred with severe Sarnat stage encephalopathy.

Table 3.5: Peripartum complications and mode of birth among neonatal encephalopathy cases 2010–2013

	Total NE cases n=298	
	n	%
Acute peripartum events	71	23.8
Cord prolapse	11	3.7
Abruption	23	7.7
Uterine rupture	6	2.0
Shoulder dystocia	19	6.4
Breech complication	7	2.3
Other complication	7	2.3
Liquor		
Blood stained	27	9.1
Meconium	98	32.9
Thick meconium	64	21.5
Thin meconium	34	11.4
Mode of birth		
Normal vaginal birth	124	41.6
Operative vaginal birth	41	13.8
Forceps	15	5.0
Ventouse	24	8.1
Unknown	2	0.7
Vaginal breech birth	5	1.7
Caesarean section birth	128	43.0
Elective (no indication given)	6	2.0
Prelabour emergency	28	9.4
Antepartum haemorrhage/Abruption	4	1.3
Suspected fetal distress	19	6.4
Other	4	1.3
Unknown	1	0.3
In labour emergency	94	31.5
Antepartum haemorrhage/Abruption	6	2.0
Suspected fetal distress	63	21.1
Failure to progress/Cephalopelvic disproportion	10	3.4
Malpresentation	1	0.3
Other	13	4.4
Unknown	1	0.3
Attempt at operative vaginal birth before Caesarean	7	2.3

Acute serious events peripartum were reported in 71 cases (24 percent) of neonatal encephalopathy. This included any of cord prolapse, placental abruption, uterine rupture, shoulder dystocia, complications of breech birth, maternal arrest or collapse, vasa praevia and complications of multiple birth. In eight of these cases, a prelabour Caesarean was performed.

Of these 71 babies with an acute peripartum event, 67 (94 percent) had either abnormal cord gases or an Apgar score <7 at five minutes.

The operative birth rate among babies with neonatal encephalopathy (57 percent) was higher than that of the maternity general population. The national Caesarean section rate was 23.6 percent and the assisted vaginal birth rate 8.9 percent in 2010 for all gestations (Ministry of Health 2012a). The high operative birth rate is consistent with the 24 percent incidence of acute peripartum events, and with the high proportion of babies with abnormal gases or Apgar scores or both (Table 3.6). It also suggests that a problem was suspected in labour; however, even if this was the case, it did not protect the babies from neonatal encephalopathy.

Neonatal characteristics and care

Table 3.6: Immediate newborn wellbeing among neonatal encephalopathy babies 2010–2013

	2010		2011		2012		2013		Total	
	n=82		n=67		n=79		n=70		n=298	
	n	%	n	%	n	%	n	%	n	%
Apgar scores										
Apgar score <5 at 1 minute	65	79.3	54	80.6	62	78.5	58	82.9	239	80.2
Apgar score <7 at 1 minute	73	89.0	61	91.0	70	88.6	65	92.9	269	90.3
Apgar score <7 at 5 minutes	61	74.4	54	80.6	62	78.5	57	81.4	234	78.5
Apgar score <7 at 10 minutes	39	47.6	38	56.7	49	62.0	32	45.7	158	53.0
Apgar score <9 at 10 minutes	52	63.4	52	77.6	62	78.5	52	74.3	218	73.2
Cord blood gases: summary data										
Normal (none of pH ≤7, BE ≤-12, lactate ≥6)	12	14.6	14	20.9	11	13.9	12	17.1	49	16.4
Abnormal (any of pH ≤7, BE ≤-12, lactate ≥6)	47	57.3	41	61.2	55	69.6	48	68.6	191	64.1
No gases reported	23	28.0	12	17.9	13	16.5	10	14.3	58	19.5
No gases and Apgar <7 at 1 minute	14	17.1	8	11.9	8	10.1	7	10.0	37	12.4
No gases and Apgar ≥7 at 1 minute	8	9.8	4	6.0	5	6.3	3	4.3	20	6.7
No gases and unknown Apgar	1	1.2	-	-	-	-	-	-	1	0.3

BE = base excess.

Cord gas data were summarised as follows (note a change of definition this year in line with international publications (Buchmann and Velaphi 2009; Kumar and Paterson-Brown 2010)): abnormal gas was defined if either arterial or venous blood gas pH was equal to or lower than 7.0, base excess equal to or lower than –12mmol/l or lactate of 6mmol/l or more. Normal was defined if none of these criteria were met.

Eighty percent of neonatal encephalopathy cases had an Apgar score of 0–4 at one minute, and 78 percent had an Apgar score <7 at five minutes. Cord gas data were unavailable (presumed not taken) in 20 percent of cases overall, but the proportion of cases with no cord gas reported has reduced significantly from 28 percent in 2010 to 14 percent in 2013 (chi-squared test for trend p=0.03). Cord gases were abnormal

in at least 64 percent of cases. Among cases without gases, almost two-thirds had Apgar scores <7 at one minute, suggesting compromise at birth.

These data suggest that the majority of babies diagnosed with neonatal encephalopathy have evidence of asphyxia present at the time of birth. In some cases, this was associated with an acute peripartum event.

The Neonatal Encephalopathy Working Group (NEWG) have undertaken a multidisciplinary review of 83 neonatal encephalopathy babies born in 2010–2011 with abnormal cord blood gases and/or Apgar scores where there was no identifiable peripartum acute event or prelabour Caesarean.

The review found contributory factors in 84 percent of cases and found that the severity of the neonatal encephalopathy was potentially avoidable in 55 percent. In 52 percent of cases, severity of neonatal encephalopathy was assessed as potentially avoidable due to personnel issues. The key themes identified were risk assessment and management, use of recommended best practice, fetal surveillance, resuscitation and recognition of brain injury in the neonate, and documentation.

The NEWG believes that well considered and broadly implemented initiatives to address these issues in New Zealand have the potential to reduce the rate, and morbidity from, neonatal encephalopathy. The full findings of this review will be published in 2015–2016.

Table 3.7: Induced cooling therapy among neonatal encephalopathy babies 2010–2013

Cooling	2010		2011		2012		2013		Total	
	n=82		n=67		n=79		n=70		n=298	
	n	%	n	%	n	%	n	%	n	%
Yes	56	68.3	51	76.1	62	78.5	58	82.9	227	76.2
No	26	31.7	16	23.9	17	21.5	12	17.1	71	23.8
Age at cooling	**n=56**		**n=51**		**n=62**		**n=58**		**n=227**	
≤6 hours	46	82.1	39	76.5	53	85.5	47	81.0	185	81.5
>6 hours	10	17.9	8	15.7	9	14.5	11	19.0	38	16.7
Missing or invalid date or time data	-	-	4	7.8	-	-	-	-	4	1.8

The rate of induced cooling of babies with moderate and severe neonatal encephalopathy has increased significantly from 68 percent in 2010 to 83 percent in 2013 (chi-squared test for trend p=0.03).

Of all babies with neonatal encephalopathy in this dataset, 262 (88 percent) in 2010–2013 had abnormal gases (as previously described) or an Apgar score <7 at five minutes. Of the babies who did receive cooling, 214/227 (94 percent) had abnormal gases or an Apgar score <7 at five minutes. Of the babies not cooled, 48/71 (68 percent) had abnormal gases or an Apgar score <7 at five minutes.

The presented data suggest that there may be a small number of babies currently not receiving cooling who might benefit from this therapy.

Eighty-two percent of babies had their cooling commenced within the six-hour window recommended for maximum benefit, and this has not changed from 2010 to 2013.

Of the 38 who received induced cooling beyond the six-hour window, five were born at a birthing unit and three at a level 1 hospital. The remainder were born at level 2 and 3 hospitals.

Table 3.8: Neonatal resuscitation and early neonatal management by Sarnat stage among neonatal encephalopathy babies 2010–2013

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=298		n=202		n=96	
	n	%	n	%	n	%
Resuscitation at birth						
Yes	274	91.9	184	91.1	90	93.8
No	24	8.1	18	8.9	6	6.3
Type of resuscitation at birth						
Oxygen only	4	1.3	3	1.5	1	1.0
IPPV with mask	182	61.1	126	62.4	56	58.3
IPPV with ETT	171	57.4	101	50.0	70	72.9
Cardiac massage	117	39.3	59	29.2	58	60.4
Adrenaline	58	19.5	18	8.9	40	41.7
Respiratory and ventilation management						
Mechanical ventilation	233	78.2	150	74.3	83	86.5
Nitric oxide	58	19.5	37	18.3	21	21.9
Infection						
Positive blood culture	11	3.7	6	3.0	5	5.2
Antibiotics	265	88.9	187	92.6	78	81.3
Anticonvulsant therapy	207	69.5	136	67.3	71	74.0
Phenobarbitone	196	65.8	127	62.9	69	71.9
Phenytoin	53	17.8	25	12.4	28	29.2
Benzodiazepines	68	22.8	43	21.3	25	26.0
Other	8	2.7	4	2.0	4	4.2

ETT = endotracheal tube.
IPPV = intermittent positive pressure ventilation.

Ninety-two percent of neonatal encephalopathy babies required resuscitation at birth, with cardiac massage and adrenalin during resuscitation more common among babies with severe than moderate Sarnat stage neonatal encephalopathy.

Table 3.9: Contributory factors to unsatisfactory neonatal resuscitation among neonatal encephalopathy babies 2010–2013

	2010		2011		2012		2013		Total	
	n=82		n=67		n=79		n=70		n=298	
	n	%	n	%	n	%	n	%	n	%
Were there any features that caused or contributed to an unsatisfactory neonatal resuscitation?										
Yes	12	14.6	11	16.4	13	16.5	10	14.3	46	15.4
Unsure	11	13.4	5	7.5	3	3.8	11	15.7	30	10.1
No	53	64.6	45	67.2	62	78.5	46	65.7	206	69.1
Missing	6	7.3	6	9.0	1	1.3	3	4.3	16	5.4
If yes, were they:										
Organisational/Management	5	6.1	5	7.5	5	6.3	6	8.6	21	7.0
Personnel or training	6	7.3	7	10.4	6	7.6	3	4.3	22	7.4
Technology or equipment	-	-	2	3.0	2	2.5	1	1.4	5	1.7
Environment	2	2.4	1	1.5	3	3.8	2	2.9	8	2.7
Barriers to access and/or engagement with care	3	3.7	2	3.0	1	1.3	3	4.3	9	3.0

The question 'Were there any features that caused or contributed to an unsatisfactory neonatal resuscitation?' was answered by the neonatologist completing the data capture form. This was usually not the person responsible for neonatal resuscitation.

It was determined that, in 14 percent of cases in 2013, resuscitation was less than optimal. This proportion has not changed since 2010.

Table 3.10: Use of cooling and outcomes of encephalopathy by Sarnat stage among neonatal encephalopathy babies 2010–2013

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=298		n=202		n=96	
	n	%	n	%	n	%
Induced cooling						
Yes	227	76.2	160	70.5	67	29.5
No	71	23.8	42	59.2	29	40.8
Deceased						
Yes	59	19.8	2	3.4	57	96.6
No	239	80.2	200	83.7	39	16.3
Age at death (days defined as past midnight)	n=59		n=2		n=57	
0	14	23.7	1	7.1	13	92.9
1	12	20.3	-	-	12	100.0
2	9	15.3	1	11.1	8	88.9
3	8	13.6	-	-	8	100.0
4	4	6.8	-	-	4	100.0
5	6	10.2	-	-	6	100.0
6	2	3.4	-	-	2	100.0
8	1	1.7	-	-	1	100.0
9	1	1.7	-	-	1	100.0
10	1	1.7	-	-	1	100.0
40	1	1.7	-	-	1	100.0

Fifty-nine babies (20 percent) from the cohort of 298 neonatal encephalopathy babies died prior to discharge. Ninety-six babies (32 percent) of the cohort had severe encephalopathy by Sarnat stage and almost all of the babies who died (57/59) were in this group. Five further babies are known to have died after discharge.

Use of induced cooling did not vary significantly by Sarnat stage (79 percent among moderate and 70 percent severe Sarnat stage). However, babies who died were less likely to be cooled (54 percent) than babies who survived (82 percent) ($p<0.001$). Of the 59 babies who died, 9 (15 percent) did not have abnormal gases or an Apgar score <7 at five minutes, suggesting later onset encephalopathy.

The age at which neonatal encephalopathy babies died was related to whether they were cooled. Approximately half of the 27 babies not cooled who died, died in the first day (14 babies), while none of the cooled babies died on the first day. This might suggest that the babies not cooled, eight of whom were born in tertiary units, were too sick to be cooled.

Table 3.11: Type of birth facility and transfer prior to or in labour among neonatal encephalopathy cases by induced cooling status 2010–2013

	NE cases		Induced cooling			
			Yes		No	
	n=298		n=227		n=71	
	n	%	n	%	n	%
Type of birth facility						
Home	7	2.3	3	42.9	4	57.1
Birthing unit	11	3.7	10	90.9	1	9.1
Hospital level 1	8	2.7	6	75.0	2	25.0
Hospital level 2	120	40.3	88	73.3	32	26.7
Hospital level 3	152	51.0	120	78.9	32	21.1
Transfer prior to labour	19	6.4	13	68.4	6	31.6
Transfer in labour	21	7.0	14	66.7	7	33.3

Table 3.11 shows that type of birth facility is not significantly associated with induced cooling.

Neonatal outcomes

Table 3.12: Investigations and neonatal outcome by Sarnat stage of neonatal encephalopathy survivors 2010–2013

Investigations	2010		2011		2012		2013		Total NE survivors		Sarnat stage			
											Moderate		Severe	
	n=59		n=54		n=67		n=59		n=239		n=200		n=39	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Examination on discharge/transfer														
Normal	32	54.2	25	46.3	30	44.8	24	40.7	111	46.4	104	52.0	7	17.9
Mild or moderate abnormality	14	23.7	20	37.0	19	28.4	23	39.0	76	31.8	63	31.5	13	33.3
Severe abnormality	3	5.1	1	1.9	5	7.5	5	8.5	14	5.9	2	1.0	12	30.8
Not examined	1	1.7	4	7.4	7	10.4	5	8.5	17	7.1	15	7.5	2	5.1
Examined but finding unknown	3	5.1	1	1.9	5	7.5	2	3.4	11	4.6	7	3.5	4	10.3
Missing data	6	10.2	3	5.6	1	1.5	-	-	10	4.2	9	4.5	1	2.6
EEG (investigation done)	54	91.5	49	90.7	54	80.6	56	94.9	213	89.1	177	88.5	36	92.3
EEG investigation done at ≤3 days of life*	40	67.8	25	46.3	34	50.7	50	84.7	149	62.3	120	60.0	29	74.4
EEG investigation done at >3 days of life#	7	11.9	9	16.7	7	10.4	6	10.2	29	12.1	23	11.5	6	15.4
EEG investigation done at unknown days of life	7	11.9	15	27.8	13	19.4	-	-	35	14.6	34	17.0	1	2.6
No EEG or unknown	5	8.5	5	9.3	13	19.4	3	5.1	26	10.9	23	11.5	3	7.7
Results of EEG at >3 days of life														
Severely abnormal	2	3.4	1	1.9	-	-	2	3.4	5	2.1	1	0.5	4	10.3
Mildly abnormal	3	5.1	5	9.3	2	3.0	2	3.4	12	5.0	10	5.0	2	5.1
Normal	2	3.4	3	5.6	5	7.5	2	3.4	12	5.0	12	6.0	-	-
MRI (investigation done)	41	69.5	35	64.8	43	64.2	50	84.7	169	70.7	131	65.5	38	97.4
No MRI or unknown	18	30.5	19	35.2	24	35.8	9	15.3	70	29.3	69	34.5	1	2.6

Table 3.12: Investigations and neonatal outcome by Sarnat stage of neonatal encephalopathy survivors 2010–2013 (Continued)

Investigations	2010		2011		2012		2013		Total NE survivors		Sarnat stage			
											Moderate		Severe	
	n=59		n=54		n=67		n=59		n=239		n=200		n=39	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Results of MRI														
Moderately/Severely abnormal	16	27.1	11	20.4	17	25.4	22	37.3	66	27.6	39	19.5	27	69.2
Normal or only mildly abnormal	24	40.7	23	42.6	24	35.8	27	45.8	98	41.0	88	44.0	10	25.6
Unknown result	1	1.7	1	1.9	2	3.0	1	1.7	5	2.1	4	2.0	1	2.6

* Typically cot-side monitoring such as BRAINZ.
# Typically formal EEG >3 days only.
EEG = electroencephalogram.
MRI = magnetic resonance imaging.

Table 3.12 shows the rates of prognostic investigations performed in this cohort of neonatal encephalopathy babies. At most, six survivors (10 percent) in 2013 had an electroencephalogram (EEG) after three days of life. Eighty-five percent of survivors in 2013 had magnetic resonance imaging (MRI), and of these 44 percent were moderately or severely abnormal.

All but one surviving baby with severe Sarnat stage neonatal encephalopathy had an MRI during the years 2010–2013. Sixty-nine percent of babies with severe Sarnat stage neonatal encephalopathy had a moderately or severely abnormal MRI.

Table 3.13: Neonatal outcome at discharge home among neonatal encephalopathy survivors 2010–2013

	2010		2011		2012		2013		Total NE survivors discharged home	
	n=38		n=40		n=50		n=31		n=159	
	n	%	n	%	n	%	n	%	n	%
Feeding on discharge										
Full sucking feeds	28	73.7	38	95.0	41	82.0	24	77.4	131	82.4
Feeding support	7	18.4	1	2.5	5	10.0	6	19.4	19	11.9
Missing data	3	7.9	1	2.5	4	8.0	1	3.2	9	5.7
Respiratory support on discharge										
No support	36	94.7	39	97.5	48	96.0	28	90.3	151	95.0
Suctioning only	1	2.6	-	-	1	2.0	2	6.5	4	2.5
Oxygen only	1	2.6	1	2.5	-	-	-	-	2	1.3
Missing data	-	-	-	-	1	2.0	1	3.2	2	1.3
Anticonvulsants on discharge	7	18.4	2	5.0	2	4.0	6	19.4	17	10.7
Missing data/Unknown	1	2.6	-	-	-	-	-	-	1	0.6
Ongoing support service involvement	31	81.6	33	82.5	43	86.0	29	93.5	136	85.5
Missing data/Unknown	-	-	2	5.0	1	2.0	1	3.2	4	2.5

Sixty-seven percent of neonatal encephalopathy survivors were discharged home (159/239) and the remainder were generally discharged to a lower-level unit or postnatal facility.

At the time of discharge home, 12 percent of neonatal encephalopathy babies were requiring at least some tube feeding, 4 percent were requiring respiratory support and 11 percent were receiving anticonvulsants.

Eighty-six percent of neonatal encephalopathy babies discharged home were referred for further follow-up, most often for neurodevelopmental therapy, home care and paediatric outpatient clinic.

PRACTICE POINT: RECOGNISING THE BABY AT RISK OF NEONATAL ENCEPHALOPATHY

All practitioners working across primary, secondary and tertiary maternity settings need to be mindful of the potential for neonatal encephalopathy and skilled at identifying which babies may go on to develop neonatal encephalopathy. The early initiation of advanced care (including cooling where appropriate) is an important contributor to the baby's outcome.

Practitioners who are supporting women to give birth in primary settings (and who may therefore have delayed access to secondary or tertiary level care) should liaise early with the local paediatric service when they identify a neonate who may be compromised, to discuss the baby's care prior to and during transfer and to ensure timeliness of transfer. Good lines of communication for contacting the local DHB paediatrician for advice are essential to the provision of optimal care.

Recognising the neonate who may go on to develop neonatal encephalopathy

A number of factors have been associated with the potential for a newborn to develop neonatal encephalopathy, and the presence of these factors should prompt consideration of paediatric consultation. These include:

- an abnormal cardiotocograph in labour
- an Apgar score ≤7 at five minutes of age
- decreased tone, or absent primitive reflexes
- difficulty establishing or maintaining respirations
- requiring resuscitation at birth (especially if this has included assisted ventilation or use of drugs)
- being slower than usual to initiate feeding
- abnormal level of consciousness (eg, hyper alert, irritable or lethargic)
- a weak or absent cry
- seizure activity.

All practitioners involved in the care of newborn babies are encouraged to participate in regular education and skills updates to maintain their competence and confidence with managing initial neonatal care. This should include:

- education about, and use of, customised growth charts
- fetal surveillance education
- contemporaneous documentation of intrapartum events and the sharing of antenatal and labour notes at handover with other practitioners involved in the care of mother and baby
- annual neonatal resuscitation updates
- education that supports recognition of brain injury in the neonate
- regular breastfeeding education to enable identification of disturbances to normal newborn patterns of breastfeeding initiation.

The findings of the NEWG indicate that early identification of 'at-risk' babies, and timely collaboration with the paediatric service, have the potential to reduce the rate of morbidity from neonatal encephalopathy in New Zealand.

The following documents provide guidance for practice:

Dawson J, Walker K. 2015. The compromised neonate. In Pairman S, Pincombe J, Thorogood C, et al (eds), *Midwifery: preparation for practice* (3rd ed, pp. 1182–202). Chatswood, NSW: Churchill Livingstone Elsevier.

Ministry of Health. 2012. *Guidelines for consultation with obstetric and related medical services (referral guidelines).* Wellington: Ministry of Health. URL: http://www.midwife.org.nz/quality-practice/multidisciplinary-guidelines.

Ministry of Health. 2012. *Observations of the mother and baby in the immediate postnatal period: consensus statements guiding practice.* Wellington: Ministry of Health. URL: http://www.midwife.org.nz/quality-practice/multidisciplinary-guidelines.

New Zealand College of Midwives. 2012. *Assessment of fetal well-being during pregnancy: consensus statement.* URL: http://www.midwife.org.nz/quality-practice/nzcom-consensus-statements.

RANZCOG. 2014. *Intrapartum fetal surveillance clinical guidelines* (3rd ed.). East Melbourne: RANZCOG. URL: http://www.midwife.org.nz/quality-practice/multidisciplinary-guidelines.

Recommendations: Neonatal Encephalopathy

1. **Widespread multidisciplinary education is required on the recognition of neonatal encephalopathy with a particular emphasis on babies with evidence of intrapartum asphyxia (eg, babies who required resuscitation) for all providers of care for babies in the immediate postpartum period.**

   This should include:

   a. recognition of babies at increased risk by their history

   b. signs suggestive of encephalopathy

   c. knowledge of clinical pathways to induced cooling if required.

   (Note 'Practice Point: Recognising the Baby at Risk of Neonatal Encephalopathy' above.)

2. **That all DHBs review local incident cases of neonatal encephalopathy. The findings of these reviews should be shared at a multidisciplinary local forum and form the basis of quality improvement activities as appropriate.**

   a. Capital & Coast DHB should review cases of neonatal encephalopathy from 2010 to 2013.

4 Australasian Maternity Outcomes Surveillance System (AMOSS) 2010–2013

The AMOSS has now completed four years of data collection on severe and rare disorders of pregnancy across almost 300 maternity units in New Zealand and Australia. The collection of rare disease data via this methodology improves the accuracy of reporting data, which are poorly collected by routine means.

In New Zealand, data collection has been completed for the following conditions:

- influenza requiring admission to intensive care
- eclampsia
- placenta accreta
- peripartum hysterectomy
- antenatal pulmonary embolism
- BMI >50.

A summary of the cases reported in 2010–2013 in New Zealand is provided below.

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

Table 4.1: New Zealand rates/ratios (per 10,000 maternities) of AMOSS notifiable conditions 2010–2013

	Data collection period	NZ registered births n	Cases n	Rate/ratio
Influenza with intensive care admission	2010	65,124	8	1.2
Eclampsia	2010–2011	127,728	25	2.0
Placenta accreta	2010–2012	190,153	69*	3.6
Peripartum hysterectomy	2010–2012	190,153	84	4.4
Amniotic fluid embolism	2010–2013	250,192	12	0.5
Antenatal pulmonary embolism	2010–2013	250,192	24	1.0
BMI >50	2011	65,604	297	45.6
Rheumatic heart disease	Oct 2012–Dec 2013#	75,645	84	11.1
Gestational breast cancer	2012–2013	122,464	7	0.6

* 32 accreta without peripartum hysterectomy; 37 accreta and peripartum hysterectomy.
# Registered births in Oct–Dec 2012 calculated as one-quarter of registered births in 2012.

Current/Completed AMOSS conditions

Antenatal pulmonary embolism 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 alanine transaminase or aspartate transaminase.

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.

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.

Gestational breast cancer is defined as all women identified as having a first diagnosis of breast cancer during current pregnancy or within six weeks of giving birth.

Massive transfusion for obstetric bleeding is defined as all women who receive five or more units of red blood cells within four hours for obstetric haemorrhage. Massive transfusion data collection began mid-2014.

Amniotic fluid embolism
Amniotic fluid embolism (AFE) is defined by a clinical diagnosis of AFE (acute hypotension or cardiac arrest, acute hypoxia and coagulopathy in the absence of any other potential explanation for the symptoms and signs observed) or a pathological/post-mortem diagnosis (presence of fetal squames/debris in the pulmonary circulation).

Table 4.2: Demography and past obstetric history among New Zealand AFE cases reported 2010–2013

	AFE	
	n=12 mothers	
	n	%
Age (median (range))	31	(16-45)
Ethnicity		
Māori	5	42
Other Asian	4	33
NZ European	2	17
Other	1	8
Smoking in pregnancy	3	25
Parity		
0	6	50
≥1	6	50
Previous Caesarean section	2	17
Multiple pregnancy	1	8

Table 4.3: Details of labour and delivery of New Zealand AFE cases 2010–2013

	AFE	
	n=12 mothers	
	n	%
AFE occurred in labour	11	92
Induction of labour	4	33
Prostaglandin for induction of labour	2	17
Labour augmented	1	8
Membranes ruptured spontaneously	7	58
Caesarean birth	6	50
Elective	1	8
Emergency	5	42

Table 4.4: Outcome among New Zealand AFE cases 2010–2013

	AFE	
	n=12 mothers	
	n	%
Admitted to ICU or HDU	9	75
Required blood products	11	92
Maternal death*	4	33
Perinatal death	1	8

* Died within one day of event (3) and day 23 (1).

The rate of AFE in New Zealand is 0.5/10,000 maternities (or approximately three cases per year), which is higher than rates reported in other prospective case series from the UK (0.19 cases per 10,000 maternities) and the Netherlands (0.25 cases per 10,000 maternities) (Knight et al 2012). The AMOSS data combining cases of AFE from Australia and New Zealand between January 2010 and December 2011 (AMOSS ANZ cohort) reported a rate of 0.54/10,000 maternities (33 cases) (McDonnell et al, in press). AFE has a case fatality rate of 33 percent in New Zealand, compared to rates reported in the UK (UKOSS data) and the Netherlands of 19 percent and 11 percent (Knight et al 2014). The overall maternal mortality rate due to AFE was 0.8 deaths per 100,000 maternities in both the UKOSS (Knight et al 2012) and the AMOSS ANZ cohort (McDonnell et al, in press) compared to a maternal mortality rate of 2.4/100,000 maternities in New Zealand from 2006 to 2013.

Induction of labour has been identified as a risk factor for AFE in the UK and in the Netherlands, associated with a 3.5-fold and 5.6-fold increase in the rate of AFE, respectively (Knight et al 2012). Induction of labour was recorded in 47 percent (28 of 60 cases) of UK women who had AFE (Knight et al 2010) and in a similar proportion of women in the combined AMOSS ANZ cohort (12 of 33 cases; 36 percent). Increased maternal age was associated with AFE in the UK population with women older than 35 years of age having a 2.7-fold increase in the risk of AFE. Both the UKOSS and the AMOSS ANZ cohort report that around 50 percent of women who present with AFE are more than 35 years of age.

AFE is a severe condition that frequently requires admission to an intensive care unit with 85 percent of women in the AMOSS ANZ cohort requiring admission to either an intensive care unit (n=20) or a high

dependency unit (n=8). Of the 14 women in the AMOSS ANZ cohort who required cardiopulmonary resuscitation, nine survived. This highlights the importance of ensuring that all staff that provide care to pregnant women retain competency in resuscitation. In women who survive the cardiopulmonary compromise, coagulopathy and haemorrhage, often severe, will follow and the majority of women require transfusion support and other obstetric interventions. In the AMOSS ANZ cohort 85 percent of women required either blood and/or plasma products and one in five women required a hysterectomy to control bleeding.

AFE remains a rare condition in New Zealand with only 12 women with this condition over a four-year period. It is unpredictable and this emphasises the need for continued vigilance in clinicians who provide care for pregnant women to ensure that they respond rapidly to clinical emergencies where prompt recognition and treatment has the potential to save a woman's life.

Placenta accreta

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.

Table 4.5: Demography of New Zealand placenta accreta cases 2010–2012

	Placenta accreta	
	n=69	
	n	%
Age (mean (sd))	34.5	5.5
Smoker	12	17
Parity		
0	14	20
1	17	25
>1	38	55
Ethnicity		
Māori	16	23
Pacific	6	9
Asian	6	9
Other	5	7
NZ European	32	46
Missing	4	6

Table 4.6: Clinical and surgical details among New Zealand placenta accreta cases 2010–2012

	Placenta accreta	
	n=69	
	n	%
Type of morbidly adherent placenta		
Placenta accreta	50	72
Placenta increta	6	9
Placenta percreta	13	19
Diagnosis before delivery	34	49
Investigations		
CT scan	1	1
MRI scan	16	23
Transabdominal ultrasound	41	59
Transvaginal ultrasound	14	20
Organs infiltrated by placenta		
Bladder	9	13
Myometrium	59	86
Ureter	1	1
Other (2 broad ligament; 2 cervix)	4	6
Hysterectomy	40	58
Planned hysterectomy prior to Caesarean	15	22
Type of hysterectomy		
Total	18	26
Subtotal	18	26
Missing	4	6
Total number of surgical procedures		
1	18	26
≥2	18	26
Placenta left in situ	3	4
Estimated blood loss >1000mls	28	41
Blood products received	15	22
Organ damage (due to surgery)		
Bladder	8	12
Other (fallopian tube; small bowel)	2	3
Ureter	3	4
Disseminated intravascular coagulation (DIC)	3	4

Table 4.7: Risk factors among New Zealand placenta accreta cases 2010–2012

	Placenta accreta	
	n=69	
	n	%
Placenta praevia diagnosed before delivery	34	49
Grade 1	1	1
Grade 2	1	1
Grade 3	3	4
Grade 4	29	42
APH	19	28
Placenta praevia previous pregnancy	10	14
Previous uterine surgery	37	54
Dilation and curettage	3	4
Evacuation of retained products of pregnancy	6	9
Manual removal	3	4
Myomectomy	1	1
Termination of pregnancy	7	10
Previous Caesarean	45	65
1	19	28
2–3	19	28
4–6	7	10
Assisted conception	5	7

There were 69 cases of morbidity adherent placenta reported for the years 2010 to 2012 and the majority of cases were placenta accreta. Almost half were diagnosed before labour and 58 percent had a hysterectomy. Sixty-five percent of the women had had a previous Caesarean section. In 20 percent of cases the morbidly adherent placenta occurred in the first pregnancy. If the diagnosis is made prior to labour then management should include multidisciplinary planning for surgery.

The New Zealand rate of placenta accreta was 3.6 per 10,000 maternities during 2010–2012. In the UK the rate was 1.7 per 10,000 maternities (Fitzpatrick et al 2012).

Rheumatic heart disease in pregnancy

Rheumatic heart disease (RHD) is defined as all women identified with RHD diagnosed before or during the index pregnancy, using the following criteria:

- pregnant and confirmed ongoing RHD on latest echocardiogram or
- pregnant and an historic echocardiography diagnosis of definite RHD where recent echo details are not available.

The AMOSS RHD in Pregnancy study is identifying all women with confirmed RHD who deliver in a New Zealand hospital or maternity unit from October 2012 to December 2014. This report provides interim findings for the 84 women who met the RHD echocardiography criteria and delivered between October 2012 and December 2013.

RHD is a rare disease in most developed countries but is prevalent in New Zealand. The RHD rate in pregnancy is unknown. Māori and Pacific peoples have among the highest documented rates of RHD in the world. Pacific children have rates more than 50 times and Māori children more than 30 times higher than New Zealand European children (Milne et al 2012; Sharpe 2012; Webb and Wilson 2013).

The increased cardiac demands of pregnancy can worsen clinical symptoms in women with known RHD and unmask undiagnosed RHD. Knowledge of the impact of RHD on women in pregnancy is based on studies of severe RHD in non-pregnant adults. This study aims to provide a robust evidence base for clinical practice related to RHD in pregnancy.

Cases were ascertained via DHB local coordinators for the PMMRC, midwives, obstetricians, cardiologists and district nurses giving rheumatic fever prophylaxis in the community. Case ascertainment is supplemented by the DHBs running hospital discharge reports for any current or historic RHD related codes for all women giving birth in the study period.

Data were extracted from clinical records by one researcher during site visits.

Interim findings

Eighty-four pregnancies have been identified fulfilling the inclusion criteria for the period October 2012 to December 2013, although data collection is currently incomplete. Of these women, 50 percent were Māori, 46 percent were Pacific peoples and the remaining 4 percent were of a South East Asian ethnicity. Their average age was 26.4 years with a range from 15 to 43 years.

The median parity was 1 with a range from 0 to 8, and average BMI was 31.6 with a range from 18 to 59 kg/m^2. Thirty-one percent of women continued to smoke in pregnancy.

Twenty-one percent of women had an adult episode of acute rheumatic fever, either a first or a recurrent episode. Severe valvular disease, either prior or current, was evident among 33 percent of women, and 23 percent required increased medical therapy or surgical intervention during the index pregnancy.

No maternal deaths were reported.

Twelve percent of babies were born preterm and there were two stillbirths.

Appendix: Summary of Key PMMRC Recommendations and Progress 2006–2013 Reports

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).	From 2015, the Ministry of Health will monitor and report timely LMC registration (within first 12 weeks) by DHB and primary health organisation and drive improved access through the Integrated Performance and Incentive Framework Healthy Start measures. This builds on the timely registration target set for DHBs through 2014/15 and 2015/16 DHB Annual Planning Guidance and implemented by DHB Maternity Quality and Safety Programmes. Timely registration with an LMC has also been a priority of the NMMG since 2012 and is a current Maternity Clinical Indicator. The NMMG monitors the indicators that are used each year to measure maternity outcomes and reported back to 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 supports women to find and book an LMC. http://www.findyourmidwife.co.nz/ The Ministry of Health has revised 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. The TAHA Well Pacific Mother & Infant Service has launched a smart phone app with information for pregnancy and parenting. This can be accessed at: www.tapuaki.org.nz
2. Teenage mothers (<20 years old)	
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.	DHBs can set up multi-agency Maternity Care, Child Wellbeing and Protection Groups as part of the Violence Intervention Programmes and the Children's Action Plan to identify pregnant women with high social and support needs to ensure they can access the support services and agencies they require. LMCs are able to refer women to the groups when they identify women who need assistance. This includes young pregnant women. All DHBs have established local Maternity Quality and Safety Programmes. These equip DHBs to identify and address local issues and report publically. The Pregnancy and Parenting Information Education Service Specification requires: • DHBs to provide 30 percent of all their pregnant population with quality information and education with a focus on first-time mothers • DHBs to develop targeted programmes for specific groups that are culturally appropriate and attractive. In 2013 Waitemata DHB maternity service produced *Resources for Teenage Parents in the Waitemata DHB Region*. (See http://www.healthpoint.co.nz/download,445629.do)

Recommendation	Progress
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 equip DHBs to identify and address local issues and report publically.
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 has worked with the PMMRC to provide data from the maternity information system and continues to develop this system to capture maternity data.
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 BDM 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. *See update directly above.*
All babies, whether stillborn or live born, should be assigned a National Health Index (NHI) at the time of birth.	Stillborn babies are given an NHI in 18 of 20 DHBs. The two DHBs yet to do this have advised they are working towards assigning NHIs to stillborn babies at the time of birth.
Continued support and funding is required for DHBs and LMCs for collection of complete perinatal mortality statistics.	The Ministry of Health funds DHBs 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.	Review of perinatal mortality is expected as part of local Maternity Quality and Safety Programmes, which equip DHBs and the wider maternity sector to identify and address local issues and risk factors.
The MAT, linked to birth registration ethnicity data, should 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 BMI.	This dataset has been made available to the PMMRC from 2014. *See Recommendation 1 in the Executive Summary of this PMMRC report.*

Recommendation	Progress
5. DHB disparities	
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 greater perinatal related mortality in the region and published in late 2012. A copy of this report and the resulting Maternity Review Action Plan which describes the actions Counties Manukau DHB will take as a maternity care system in response can be obtained at: http://www.countiesmanukau.health.nz/assets/About-CMH/Reports-and-planning/Maternity/2014-maternity-review-action-plan.pdf This is an ongoing process of quality improvement.
6. Ethnicity	
New legislation should enable BDM to accept NHI data and update the routine NHI dataset with regard to ethnicity.	Memorandums of Understanding between BDM and the Ministry of Health have been proposed as one solution. This will be progressed further in 2015.
Clinicians and LMCs should be encouraged to collect accurate ethnicity details at the time of booking.	The development of a nationwide Maternity Clinical Information System for DHBs should assist with standardising ethnicity data. The Primary Care Ethnicity Data Audit Toolkit has been produced and is to be implemented by June 2015. See http://www.health.govt.nz/publication/primary-care-ethnicity-data-audit-toolkit
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.	Investigation into barriers to access is part of each DHB's Maternity Quality and Safety Programme. The *Find Your Midwife* website is active and being used to support women to find and book with an LMC. http://www.findyourmidwife.co.nz/ *See update on Recommendation 1, Early booking, above.*
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.	*See update directly above.* The Language Line can be accessed at: http://ethniccommunities.govt.nz/story/participating-agencies#Hospitals The TAHA Well Pacific Mother & Infant Service has launched a smart phone app with information on pregnancy and parenting. This can be accessed at: www.tapuaki.org.nz
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.	Every year the Ministry of Health expects that this recommendation will be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

Recommendation	Progress
8. Screening for gestational diabetes, smoking and family violence	
LMCs should follow the Ministry of Health pregnancy guidelines for: • diabetes screening • smoking cessation • family violence screening. Screening for family violence should be a routine part of maternity care and documented.	In 2014 the Ministry of Health published two new guides: • *Diabetes in Pregnancy: Quick reference guide for health professionals on the screening, diagnosis and treatment of gestational diabetes in New Zealand* http://www.health.govt.nz/publication/diabetes-pregnancy-quick-reference-guide-health-professionals-screening-diagnosis-and-treatment • *Screening, Diagnosis and Management of Gestational Diabetes in New Zealand: A clinical practice guideline* http://www.health.govt.nz/publication/screening-diagnosis-and-management-gestational-diabetes-new-zealand-clinical-practice-guideline 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. This may not be in the woman's ongoing notes if that could increase her risk. 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. *Smoking – see update in Summary of Key PMMRC 2014 Report Recommendations and Progress.*
9. Multiple pregnancies	
All women with a multiple pregnancy should be offered an early specialist consultation, including ultrasound diagnosis of chorionicity prior to 14 weeks gestation. Women with high-risk monochorionic multiple pregnancies require fortnightly scans and specialist care.	Twelve DHBs have responded supporting this recommendation and advised their DHB recognises monochorionic multiple pregnancies as high risk that require early specialist care. Eight DHBs note further work is required to ensure GP and LMCs refer women with multiple pregnancies for ultrasound diagnosis of chorionicity prior to 14 weeks and specialist care early on confirmation of monochorionic pregnancy. *The Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* list multiple pregnancy as a reason for transfer of clinical responsibility with a clear pathway for determining a plan of care that may or may not involve the LMC. Advice is available through the New Zealand Maternal Fetal Medicine Network. The care of multiple pregnancies was the subject of a further recommendation (2) in the seventh annual PMMRC report in 2013. This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
In order to reduce perinatal related mortality associated with multiple pregnancy, the following is advised. All women undergoing assisted reproduction should 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. LMCs should note that the Referral Guidelines recommend transfer of clinical responsibility for care of all women with multiple pregnancies to obstetrician-led care.	These recommendations have been promoted through the Ministry of Health's Maternity Quality and Safety Programme and the Health Quality & Safety Commission.

Recommendation	Progress
10. Audit of congenital abnormalities	
All primary care providers (if first contact of a pregnant woman with the health service) should offer first trimester screening and facilitate expeditious registration.	The National Screening Unit offers online education for health practitioners who provide services within the antenatal and newborn screening programmes. These can be accessed at: https://www.nsu.govt.nz/health-professionals/antenatal-screening-down-syndrome-and-other-conditions/education-material
Achieving optimal use of periconceptual folate by young women in New Zealand requires a policy for fortification of bread.	This recommendation will be carried forward as it is not a current policy priority. There is general agreement for this policy in principle.
The National Screening Unit should 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 is currently reviewing the detection rate and false positive rate, which involves collation of data from screening, cytogenetics and birth outcomes.
The National Screening Unit should review false negative screening tests.	The National Screening Unit will be implementing a review of all cases not detected by screening for trisomy 21, 18 and 13.
The National 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.	2014 update – the New Zealand Maternal Fetal Medicine Network has completed an audit of fetal cardiac referrals and identified areas for improvement for access to a cardiology opinion. Paediatric cardiology and fetal medicine video consultation has been established to address this issue. No further update 2015.
11. Antepartum haemorrhage	
All women with bleeding during pregnancy, regardless of the apparent cause, should be monitored more closely for fetal growth and preterm birth.	The expectation is that this recommendation is included in all ongoing professional education.
12. Sudden unexpected death in infancy (SUDI)	
National guidelines should be developed for safe sleeping arrangements in postnatal wards to improve ward safety and to model safe sleeping practices that parents can follow after discharge.	The Ministry of Health 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*. http://www.changeforourchildren.co.nz/files/docs/pepi-pod%20programme%20report_2012.pdf
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 of Health has published *Safe Sleep Essentials: Preventing Sudden Unexpected Death in Infancy (SUDI)*. http://www.health.govt.nz/publication/safe-sleep-essentials-preventing-sudden-unexpected-death-infancy-sudi
13. Access to perinatal investigation and supporting parents	
The Ministry of Health should require DHBs to ensure all providers of maternity services provide support to parents, families and whānau who have experienced perinatal and maternal loss, including providing access to information, counselling and clinical follow-up.	The Ministry of Health requires DHBs to provide appropriate services to support parents, families and whānau who have experienced perinatal and maternal loss, including providing access to information, counselling and clinical follow-up. Service specifics are available here: http://www.nsfl.health.govt.nz/apps/nsfl.nsf/pagesmh/444 Bereaved families are now included in the Maternity Consumer Forum supported by the Ministry of Health.

Recommendation	Progress
The low uptake of post-mortems amongst families who experience perinatal loss should be investigated.	The Ministry of Health undertakes research into uptake of post-mortems. The Ministry will publish the 2014 Consumer Survey report in 2015, which includes a survey of bereaved women and investigates access to and uptake of post-mortems.
The reasons for the difference in rates of optimally investigated perinatal deaths between DHBs needs investigation.	Part of the reason for differences in rates of optimally investigated perinatal deaths between DHBs is regional shortages of perinatal pathologists. Paediatric pathology is one of the services currently being considered by the National Health Board for national planning and funding. Rates of investigated deaths will be considered once planning and funding arrangements for paediatric pathology have been determined.
Maternal mortality	
14. Maternal information	
Support is required for national reporting of maternal deaths.	From 2007 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 Maternity Clinical Information System is working with a variety of IT programs to improve communication between primary and secondary sectors.
15. 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. http://www.hqsc.govt.nz/assets/PMMRC/Resources/Pregnancy-Seatbelt-A2-Poster.pdf
16. Maternal mental health	
Maternal mental health services should be integrated into maternity services.	The Ministry of Health will work with providers to support service improvement and will report progress implementing the Ministry of Health's *Rising to the Challenge* 100 actions over the next five years here. The *Rising to the Challenge* document is available online: http://www.health.govt.nz/system/files/documents/publications/rising-to-the-challenge-mental-health-addiction-service-development-plan.pdf
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.	Maternal mental health is currently included as a compulsory education topic within the Midwifery Council's Recertification programme. All practising midwives are required to participate in this education. See 'Practice Point: Maternal Suicide' (page 115). See the following guidelines: *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* http://www.health.govt.nz/publication/guidelines-consultation-obstetric-and-related-medical-services-referral-guidelines *Identification of Common Mental Disorders and Management of Depression in Primary Care* http://www.health.govt.nz/system/files/documents/publications/depression_guideline.pdf

Recommendation	Progress
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.	A three-bed mother and baby unit has been opened in the Child and Family Unit in Starship Hospital in Auckland. It has been operational since September 2014. It is expected that the planned expansion of community-based supporting mental health services across other North Island DHBs will be in place by 30 June 2015.
The committee 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 (eg, primary care and termination of pregnancy services).	The Ministry of Health has provided the implementation document *Rising to the Challenge* to support DHBs to plan and provide their service. See http://www.health.govt.nz/system/files/documents/publications/rising-to-the-challenge-mental-health-addiction-service-development-plan.pdf *See update directly above.*
Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral.	By law, counselling must be offered to all women considering an abortion in New Zealand. The counselling should comply with the *Standards of Practice for the Provision of Counselling* guidelines laid down by the Abortion Supervisory Committee. http://www.abortionservices.org.nz/docs/guides98.pdf
17. Team approach to care	
Women with complex medical conditions require a multidisciplinary approach to care, often across more than one DHB. Each woman requiring such care should be assigned a key clinician to facilitate her care. Pregnant women who are admitted to hospital for medical conditions not related to pregnancy need to have specific pathways for perinatal care.	The Ministry of Health expects maternity services (LMCs and DHBs) to ensure all women in New Zealand have access to continuity of maternity care, and expects DHBs to ensure 95 percent of pregnant women in their region receive continuity of primary maternity care (12 DHBs have advised they meet or exceed this). DHBs are also expected in the New Zealand Maternity Standards to provide or accommodate continuity of specialist secondary or tertiary care where possible.
18. 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: https://somanz.org/documents/HTPregnancyGuidelineJuly2014.pdf The Ministry of Health will fund the development of a multidisciplinary clinical guideline for the treatment of hypertension in pregnancy in 2015–2016. This was a recommendation from the National Maternity Monitoring group.
19. 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 has been finalised and distributed to professional colleges and DHBs. This can be accessed at: http://www.health.govt.nz/publication/national-consensus-guideline-treatment-postpartum-haemorrhage

Recommendation	Progress
Neonatal encephalopathy	
20. Neonatal encephalopathy	
Arterial and venous cord gases should be performed on all babies born with an Apgar score <7 at one minute.	These recommendations should become part of ongoing professional development and be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
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.	This report includes a 'Practice Point: Recognising the Baby at Risk of Neonatal Encephalopathy' (see page 147).
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.	Neonatal resuscitation is an annual continuing education requirement for midwives. The New Zealand Resuscitation Council provides training for clinicians to deliver newborn life support courses in their region or organisations. See http://www.nzrc.org.nz/training/ ACC has facilitated a cross-Ministry initiative to look at reducing the incidence of treatment injury by developing a strategy to address the issues raised by the Neonatal Encephalopathy Working Group. Waikato DHB advised they continue to review babies diagnosed with neonatal encephalopathy.
In cases of neonatal encephalopathy: • all babies with encephalopathy should undergo investigation to predict prognosis including formal neurological examination, cerebral magnetic resonance imaging (MRI) and, if available, formal electroencephalography (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.	These recommendations should become a part of ongoing professional development and be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

List of Abbreviations

ACC	Accident Compensation Corporation
AFE	Amniotic fluid embolism
AMOSS	Australasian Maternity Outcomes Surveillance System
APH	Antepartum haemorrhage
BDM	Births, Deaths and Marriages
BE	Base excess
BMI	Body mass index (kg/m2)
CEMACH	Confidential Enquiry into Maternal and Child Health
CI	Confidence interval
CMACE	Centre for Maternal and Child Enquiries
DHB	District health board
EEG	Electroencephalograph
ETT	Endotracheal tube
FSH	Follicle-stimulating hormone
GP	General practitioner
ICSI	Intracytoplasmic sperm injection
ILI	Influenza-like illness
IPPV	Intermittent positive pressure ventilation
IVF	In vitro fertilisation
LMC	Lead maternity carer
MAT	New Zealand National Maternity Collection
MBRRACE	Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries
MDAC	Maternal Deaths Assessment Committee
MMR	Maternal mortality ratio
MMRWG	Maternal Mortality Review Working Group
MRI	Magnetic resonance imaging
NE	Neonatal encephalopathy
NEWG	Neonatal Encephalopathy Working Group
NHI	National Health Index
NICE	National Institute for Health and Care Excellence, UK
NISG	National Influenza Specialist Group
NMDS	National Minimum Dataset
NMMG	National Maternity Monitoring Group
NZDep	New Zealand Index of Deprivation

PMMRC	Perinatal and Maternal Mortality Review Committee
PPH	Postpartum haemorrhage
PSANZ	Perinatal Society of Australia and New Zealand
PSANZ-NDC	PSANZ neonatal death classification
PSANZ-PDC	PSANZ perinatal death classification
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
RHD	Rheumatic heart disease
Sands	Stillbirth and Newborn Death Support
SGA	Small for gestational age
SUDEP	Sudden unexpected death in epilepsy
SUDI	Sudden unexpected death in infancy
UK	United Kingdom
UKOSS	UK Obstetric Surveillance System
USS	Ultrasound scan
VTE	Venous thromboembolism
WHO	World Health Organization

Definitions

Ethnicity

Mother 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 (eg, 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.

Mother 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.

Ethnicity has been reported as prioritised ethnicity. This method is frequently used in health statistics in New Zealand.

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 protocols 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 New Zealand data suggest that pregnancies of Indian women are at higher risk than those of Other Asian women.

Where multiple ethnic groups are recorded for an individual, the process prioritises minority ethnic groups that might otherwise be swamped by New Zealand European. In doing so, it does not allow individuals to identify a group with which they most feel affinity. It is a simple system that results in relatively few groups for analysis and, when used across different datasets, ensures a standardised process is used.

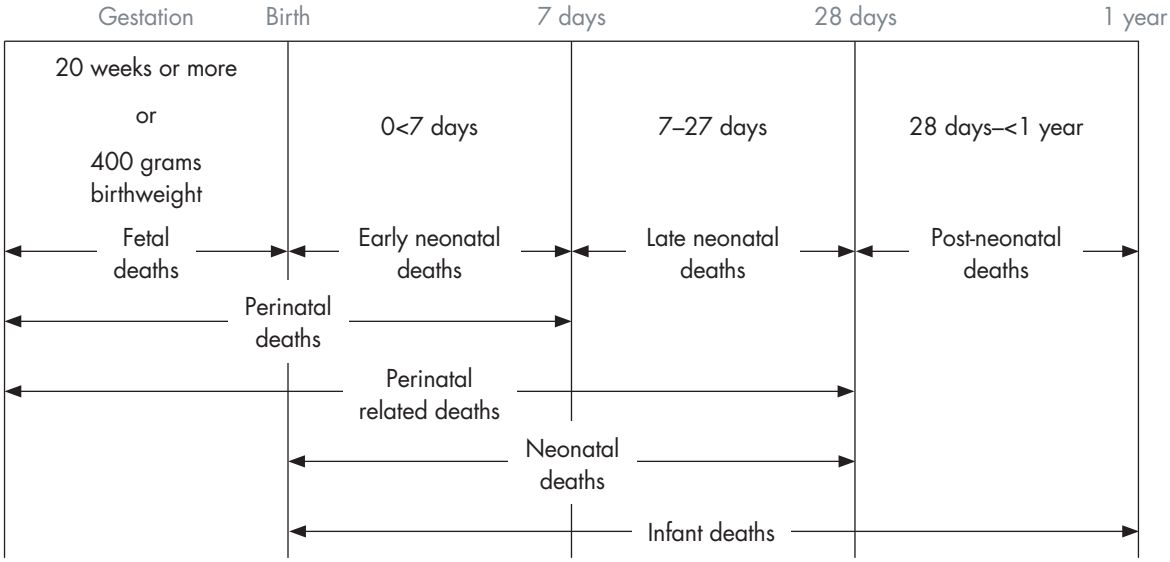
In 2013, mothers' ethnicity for the PMMRC dataset of perinatal related deaths has been extracted, in order of priority, from BDM registration of birth (74 percent) or PMMRC rapid response forms (26 percent). Babies' ethnicity for the PMMRC dataset of perinatal deaths has been extracted, in order of priority, from BDM registration of birth (74 percent), BDM registration of death (4 percent) or PMMRC rapid response forms (22 percent).

In 2013, the denominator birth registration dataset included two ethnicities for 24.9 percent of all babies registered compared with two ethnicities for 14.1 percent of mothers registered. The dataset included three ethnicities for 6.1 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 may be different depending on whether the mother's or the baby's ethnicity is used in analyses.

Mother and baby ethnicity specific perinatal related mortality rates have again been reported. Maternal ethnicity specific mortality rates are presented in the body of the report, and baby ethnicity specific perinatal related mortality rates are provided at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2123/.

Perinatal and infant mortality

Definitions of perinatal and infant mortality



(Adapted from New Zealand Health Information Service 2007 and Ministry of Health 2010)

Fetal death

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.

Termination of pregnancy

Termination of pregnancy is the interruption of an ongoing pregnancy. This report only includes termination of pregnancy from 20 weeks gestation.

Fetal death rate

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

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

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

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

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.

International (WHO) perinatal mortality rates

International (WHO) perinatal mortality rates are 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.

Lethal and terminated fetal abnormalities

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

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

Customised birthweight centiles

Customised birthweight centiles adjust newborn weight for maternal weight, height, ethnicity and parity, as well as for infant sex and gestation at birth. 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.

New Zealand Index of Deprivation 2006 and 2013 (NZDep2006/2013)

The New Zealand Index of Deprivation 2006/2013 (NZDep2006/2013) is an area-based measure of socioeconomic deprivation based on variables from the Census of Population and Dwellings in 2006 and 2013 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 (Atkinson et al 2014; Salmond and Crampton 2002). 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.

NZDep2013 deciles have been assigned to births and deaths in 2013 while NZDep2006 has been used for previous years. It was not possible to assign NZDep2013 to deaths prior to 2013 as in 2013 some meshblocks split and the new meshblock for individuals in historical datasets was not available.

Lead maternity carer (LMC)

Lead maternity carer (LMC) is defined as the practitioner or caregiver who provides a woman and her baby with continuity of care throughout pregnancy, labour and birth and the postnatal period as described in the Maternity Services Notice Part DA.

Registration with a lead maternity carer (LMC)

Registration with a lead maternity carer (LMC) is the process by which a woman selects her LMC and this generally occurs at the time of the first antenatal visit with the LMC. Upon registration the LMC assumes clinical responsibility for maternity care. Clinical responsibility for care may transfer from the LMC to another service or provider if a woman's condition warrants transfer of clinical responsibility to a specialist.

Neonatal encephalopathy

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

Contributory factors were defined as modifiable components of the health system and issues of quality of care that cover a broad spectrum of organisation and/or management, personnel and access and/or engagement with care factors.

Potentially avoidable death

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

Place of birth

Place of birth is defined for the data collection 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.

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Perinatal and Maternal Mortality Review Committee

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