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*

# Tenth Annual Report of the Perinatal and Maternal Mortality Review Committee

## Reporting Mortality 2014

Sixth Report to the Health Quality & Safety Commission New Zealand

JUNE 2016

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

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- the Health Quality & Safety Commission, which has been involved in all stages of the development of this report.


New Zealand Government

## Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) members in 2016 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 2016 are:

- Dr Sarah Wadsworth (Chair), obstetrician, Counties Manukau DHB
- Dr Sue Belgrave (Chair PMMRC)
- 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 Katharine Wallis, general practitioner, Auckland
- Dr Kate White, pathologist, MidCentral DHB.

## Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group (NEWG) members in 2016 are:

- Dr Malcolm Battin (Chair), neonatal paediatrician, Auckland DHB
- Dr Astrid Budden, obstetrician and gynaecologist, Auckland DHB
- Ms Anne Jackson, neonatal nurse practitioner, Canterbury DHB
- Ms Anja Hale, 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 Jutta van den Boom, neonatal paediatrician, Waitemata DHB
- Dr Alex Wallace, paediatrician and senior lecturer in paediatrics, Waikato DHB and the University of Auckland
- Dr Kristy Wolff, obstetrician and gynaecologist, Northland DHB.

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# Foreword

The Health Quality and Safety Commission (the Commission) welcomes the tenth report of the Perinatal and Maternal Mortality Review Committee (the PMMRC).

This report considers perinatal and maternal mortality and morbidity from 1 January to 31 December 2014; perinatal mortality from 2007 to 2014; maternal mortality from 2006 to 2014; and babies with neonatal encephalopathy from 2010 to 2014. This report also includes special topics on two causes of maternal mortality: suicide and amniotic fluid embolism

The perinatal related mortality rate, using the New Zealand definition, has been stable overall for the years 2007 to 2014. As noted in the report, the rate in 2014 was 11.2 per 1000 births, equivalent to one baby dying in pregnancy or during the first 28 days of life for every 100 babies born. Interestingly if the World Health Organization's recommended international definition for perinatal death had been used, there would have been a significant reduction in the death rate.

There were four maternal deaths recorded in 2014, the lowest rate since the PMMRC began reporting in 2006. The three-year average mortality ratio for 2012-2014 was 14.9/100,000 maternities.

While these results are encouraging, 13 percent of perinatal deaths were identified as being potentially avoidable. The proportion of potentially avoidable deaths was higher for babies of Māori and Pacific mothers, at 22 percent. The main contributory factors among these deaths were barriers to access and/or engagement with care, which were associated with 17 and 19 percent of perinatal related deaths among babies of Māori and Pacific mothers respectively. Clearly more still needs to be done to ensure Māori and Pacific mothers receive the same level of maternity care as the rest of the population.

The review of maternal suicides from 2006 to 2013 found that many of these women had two or more risk factors for major depression, but that these factors were not always recognised, and that communication between services was not always adequate. These deaths are part of the wider problem of suicide in New Zealand – another area where more work is needed.

This report would not be possible without the substantial contribution of a dedicated team of people: the local coordinators across the country who provide data; Dr Sue Belgrave and the PMMRC; National Coordination Service based at the University of Auckland; New Zealand Mortality Review Data Group based at the University of Otago; and the Mortality Review Committee staff at the Commission.

On behalf of the Commission, I sincerely thank Dr Belgrave for leading this committee's important work.

Professor Alan Merry, ONZM, FRSNZ

*Chair, Health Quality & Safety Commission*

# Chair's Introduction

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

This report adds to the wealth of data we have previously reported on, and will continue to help guide clinical practice in maternity and highlight areas that need ongoing focus for improvement. When we review and report on this data we are mindful this information has come from families and whānau who have grieved over the loss of babies and mothers. The purpose of our review is to reduce mortality and morbidity in the hope of reducing distress to future families and whānau.

The PMMRC reports to the Health Quality & Safety Commission (the Commission) and is part of the quality framework in health care in New Zealand.

In the 10th report we are reporting on perinatal deaths from 2007 to 2014, maternal deaths from 2006 to 2014 and neonatal encephalopathy from 2010 to 2014.

For the first time our report has not been published in a printed format. Our report size has increased over time and in order to maintain the level of detail and keep the report and appendices together, we have decided on an online format for this and future reports.

We have changed the categories of preterm gestational age to reflect changes in survival in very preterm babies and potential changes in practice and management of pregnancies at these early gestations. In this report we are reporting losses at 20–22 weeks, 23–24 weeks, 25–27 weeks and 28–36 weeks.

The overall perinatal mortality has not changed since we began reporting in 2007; however, there continues to be a significant reduction in perinatal related mortality using the international definition of perinatal deaths from 1000g or 28 weeks if the birthweight is unknown. The significant reduction of stillbirth at term persists, and there has been a significant reduction in deaths occurring during labour. We continue to report difficulties with access and engagement with care among Māori and Pacific mothers and the increasing risk of stillbirth and neonatal death with increasing socioeconomic deprivation.

In 2014 there were four maternal deaths, which is the lowest number of deaths in a single year in New Zealand since we began reporting in 2006. This is reassuring, but it does not reach statistical significance. In our ninth report (PMMRC 2015) we reported a significantly higher rate of deaths from suicide and amniotic fluid embolism in New Zealand when compared to the UK, and we are reporting the findings of our review of all deaths due to these causes from 2006 to 2013. Our review of deaths from amniotic fluid embolism suggests improvements in the recognition and resuscitation of mothers with amniotic fluid embolism may improve the chance of survival for some mothers. In our fifth report (PMMRC 2011) we recommended all clinicians involved in the care of pregnant women should undertake regular multidisciplinary training in the management of obstetric emergencies. Consideration should be given to making this training mandatory.

We report on progress on all previous recommendations made by the PMMRC, some of which have been incorporated into the work stream of the maternity quality and safety programmes within DHBs.

The review of severe acute maternal morbidity (SAMM) undertaken by the University of Otago has been transferred to the Commission. Following advice from an expert advisory group, a Maternal Morbidity Working Group has been established under the umbrella of the PMMRC. The Maternal Morbidity Working Group will incorporate the review of rare and serious conditions of pregnancy and post-partum by the Australasian Maternity Outcomes Surveillance System (AMOSS) working group of the PMMRC and the review of severe acute maternal morbidity.

I wish to acknowledge the women and families/whānau for their support, and also the maternity practitioners and coordinators in each DHB who provide the data to inform our report and recommendations.

Dr Sue Belgrave

*Chair, Perinatal and Maternal Mortality Review Committe*

# Parents, Families, Whānau

First of all, on behalf of the Perinatal and Maternal Mortality Review Commitee (the PMMRC) and Sands New Zealand, I am so very sorry for the loss of your precious child. If you are reading this, you have a hole in your heart that is the shape of the child(ren) you have lost, and it all seems so grossly unfair. And it is. I too have lost a child, and as such I represent all bereaved parents on the PMMRC, so our point of view is heard, considered and understood.

Having a premature baby is very difficult. It is natural to feel a mixture of emotions, some negative, some positive. Many families and whānau of premature babies feel some or all of the following: overwhelmed, shocked, traumatised, worried, powerless, full of grief, angry, guilty, hopeful, intense love for your baby, longing to be with or hold your baby, and of course a profound sense of loss.

The point of this section of the report is to provide you with the 'non-technical' feedback as to how important your baby's life is, and how real lessons have come from his or her short life. As you are probably aware, a review of your baby's case was undertaken within your own District Health Board (DHB) shortly after they died and your baby's case has been analysed at a national level by the PMMRC. The DHB review is to determine the cause of your baby's death and to ensure the correct care was provided to you and your child. Both reviews look for factors that may have contributed to your baby's death and areas for improvement so that, where possible, fewer families have to go through this life-changing situation. So, what can we learn from cases in 2014 (and beyond)?

Advances in neonatal medicine have worked wonders. Not long ago, extremely premature babies, or those born with very serious health problems, would inevitably have died. Today neonatologists can resuscitate babies born at ever-earlier stages of gestation. And very ill babies also benefit from advances in neonatal intensive care. Infant lives can be prolonged. Unfortunately some babies will not survive for long whatever is done for them. Others will live to leave hospital, but face severe health problems.

The question that any parent is likely to ask when a decision must be made about whether or not to resuscitate the baby is 'What will happen to my baby?' Sometimes the only honest answer the doctor can give to that question is 'I don't know.' Many reasons might be advanced to urge giving the baby the benefit of the doubt, to resuscitate the infant and see how they progress. Your natural instincts may have suggested that your parental love will and should have given the baby a chance at life, however small. This is the tricky part, both medically and emotionally. Medical guidelines sometimes suggest some babies should not be offered aggressive intensive care. But your instincts may suggest that an extremely premature newborn life be given the same value as the lives of older babies. In New Zealand of course, all babies are entitled to appropriate care, even if this subjects the baby to intrusive and painful procedures. The ideal remains the 'partnership of care' with both the families/whānau and the team of doctors. This is the case for all babies, not just the extremely premature ones, but the balance of these issues remains difficult for all involved, especially with trying to find a balance of 'head over heart'.

And here you sit, reading this, wishing your baby had survived and that you had no participation in a conversation like this at all. So, what can you do now? The first step is to recognise and accept your feelings; both now and at the time of your baby's life. Try to talk to someone about how you feel or have felt, perhaps your partner, a friend, your midwife, your family or whānau, or a Sands representative. It is never too late to talk about (or write about) your feelings and the rollercoaster that comes with an extremely premature delivery.

The second step is to understand that, even though your baby died (whether premature or not), his or her life mattered, not just to you, but to the medical team that helped directly, to the DHB in which you live, and in the bigger picture too. Every single case of loss teaches us something. No lesson is unimportant. And it is the PMMRC's purpose to learn whatever we can to make sure fewer families have to walk in the shoes you find yourselves in. We can't bring the babies back, but your babies' little lives have helped others in the future to survive.

This may have been a little life, but is not a little loss. There have been wonderfully positive things happen as a result of what your child has taught us medically. And for you, the families and whānau of these tiny champions, there are people out there who understand how you feel and are there to help, no matter when you need it, no matter what happened.

Kia kaha. You are not alone.

*Linda Penlington*

# Executive Summary

## Terms of Reference and Mortality Definitions

### Terms of reference of the Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) is responsible for reviewing perinatal and maternal mortality and other mortality and morbidity as directed by the Health Quality & Safety Commission.

### Mortality definitions used by the PMMRC

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.

Termination of pregnancy includes any interrupted pregnancy from 20 weeks whether the baby was stillborn or live born.

Neonatal death is the death of any baby showing signs of life at 20 weeks gestation or beyond 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 is fetal and early neonatal death from 20 weeks gestation (or weighing at least 400g if gestation is unknown) until less than seven days of age.

Perinatal related mortality is fetal deaths (including terminations of pregnancy and stillbirths) and neonatal deaths (up to 28 days) per 1000 total babies born at 20 weeks or beyond, or weighing at least 400g if gestation is unknown.

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 is unknown. The maternal mortality ratio is calculated per 100,000 maternities.

In this 2016 report, gestational age categories have been changed in line with national and international evidence of survival of babies born at 23 weeks, which is more in line with survival at 24 weeks than at 20–22 weeks. And so, throughout this report, gestational age has been categorised as 20–22 weeks, 23–24 weeks, 25–27 weeks, and then 28–31, 32–36, 37–40 and ≥41 weeks, as previously.

## Findings 2016 Report (Data 2014)

### Perinatal mortality

#### Perinatal mortality rates

1. There were 656 perinatal related deaths reported to the PMMRC in 2014. The perinatal related mortality rate was 11.2/1000 births (1 death per 89 births). There has been no significant change in overall perinatal related mortality in New Zealand from 2007 to 2014.
2. There continues to be a significant reduction in perinatal related mortality, and more specifically in stillbirth, using the international definition of perinatal deaths from 1000g or 28 weeks if birthweight is unknown.
3. The significant reduction in stillbirths and increase in terminations of pregnancy noted previously persists during the period 2007–2014. In 2014, the stillbirth rate was 5.5/1000 births and the termination of pregnancy rate was 2.5/1000 births.
4. In 2014, the neonatal mortality rate was 3.1/1000 births and has not changed significantly since 2007.

5. The previously reported significant reduction in stillbirth at term persists. This is independent of a reduction in births at 40 and 41+ weeks. There are numerous reasons why this might have occurred, such as:
    a. improved peripartum care (suggested by a reduction in hypoxic peripartum death rate)
    b. a reduction in deaths from perinatal infection
    c. a reduction in deaths from antepartum haemorrhage
    d. increased iatrogenic early birth of at-risk babies
    e. a reduction in smoking.
6. A statistically significant reduction in intrapartum stillbirth risk as a proportion of ongoing pregnancies at term since 2007 is still evident in 2014 ($p<0.0001$). This is consistent with and probably due to a significant reduction in hypoxic peripartum deaths ($p=0.0004$).

## Demographic associations

7. Perinatal related mortality is more common at the extremes of maternal age. The perinatal related mortality rate among mothers under 20 and over 40 years of age was 16/1000 births in 2014 compared to 10/1000 births among mothers 30–34 years of age, who had the lowest rate. Analysis in 2014 found that age was not independently associated with stillbirth or neonatal death after adjusting for ethnicity, socioeconomic deprivation, smoking, parity and body mass index (BMI).
8. Increasing socioeconomic deprivation is associated with increasing stillbirth and neonatal death rates and inversely associated with late termination of pregnancy rates. In 2014, stillbirth rates per 1000 births varied from 4.4 for mothers living in the least deprived areas to 6.8 for mothers living in the most deprived areas. Multivariate analyses in 2014 found that socioeconomic deprivation was independently associated with only neonatal death after birth from 20 to 27 weeks.
9. The perinatal related mortality rates among women residing in Counties Manukau and Northland District Health Board (DHB) regions were significantly higher than the national rate of 10.73/1000 births from 2007-2014. The perinatal related mortality rate in Counties Manukau DHB region for 2007-2014 was 13.39/1000 births (95% Confidence Interval (CI) 12.53-14.27). The perinatal related mortality rate in Northland DHB region for 2007-2014 was 12.47/1000 births (95% CI 10.86-14.07).
10. The neonatal mortality rates among women residing in Waikato and Bay of Plenty DHB regions were significantly higher than the national rate of 2.83/1000 live births from 2007-2014. The neonatal mortality rate for 2007-2014 in the Bay of Plenty DHB region was 3.89/1000 births (95% CI 3.13-4.77). The neonatal mortality rate for 2007-2014 in the Waikato DHB region was 3.43/1000 live births (95% CI 2.88-3.97).

## Māori disparities

11. Perinatal related mortality is more common among the children of Māori, Pacific and Indian mothers than Other Asian, Other, and New Zealand European mothers. Specifically, stillbirth and neonatal mortality are more common among the children of Māori, Pacific and Indian mothers, while termination of pregnancy is less common among Māori and Pacific mothers.
12. Babies of Māori and Pacific mothers continue to have increased crude perinatal related mortality rates from stillbirth and neonatal death. However, analyses in 2014 showed that only the association with neonatal death from 20–27 weeks was significant after adjustment for the effects of socioeconomic deprivation, maternal age, smoking, parity and BMI (PMMRC 2014a).
13. Māori and Pacific perinatal related deaths are less likely to be optimally investigated than deaths in all other ethnic groups. While more Māori and Pacific perinatal related deaths are partially investigated than those of other ethnicities, overall they are less likely to have any investigation (optimal or partial) than babies of other ethnicities. Talking with health professionals about their experiences of offering post-mortem investigations to families/whānau and to Māori whānau who have experienced a death and listening to their stories of being offered post-mortem might help to inform practice changes.
14. The proportion of potentially avoidable perinatal related deaths was higher among babies of Māori and Pacific mothers, at 22 percent, than all other ethnicities due to an excess of barriers to access and/or engagement with care among potentially avoidable deaths, which were associated with 17 and 19 percent of perinatal related deaths in these ethnic groups.

## Stillbirth

15. In 2015, a review of the placental pathology of unexplained antepartum deaths showed that 17 percent of babies

classified as unexplained antepartum death from 2007 to 2013 were misclassified: 4 percent because there was another underlying pathology and 13 percent because there was a placental abnormality which has been shown to be consistently associated with perinatal related death. There is no current category in the Perinatal Society of Australia and New Zealand perinatal death classification (PSANZ-PDC) for these latter placental causes of death.

## Neonatal mortality

16. Resuscitation was attempted for 7 of 21 (33 percent) neonatal deaths at 23 weeks compared to 16 of 18 deaths (89 percent) at 24 weeks.

## Screening

17. There has been a significant increase in screening for diabetes among eligible mothers whose babies died from 2007 to 2014.
18. There has been no change in the proportion of mothers screened for family violence in pregnancy among mothers of perinatal related deaths from 2007 to 2014.

## Contributory factors and potentially avoidable perinatal related death

19. In 2014, one-quarter of perinatal related deaths was determined at local review to have contributory factors and approximately half (13 percent) of these to be potentially avoidable deaths.
20. The most common main contributory factors to potentially avoidable perinatal related deaths are consistently access and/or engagement with care factors, responsible for 8 to 12 percent of perinatal related deaths each year from 2011 to 2014. Personnel factors are the main contributory factor to avoidable perinatal related death in 5 to 6 percent of perinatal related deaths.
21. The largest numbers of potentially avoidable deaths in 2014 were among deaths due to maternal conditions (17), fetal growth restriction (14), and unexplained antepartum deaths (13).
22. Barriers to access and/or engagement with care contribute to most of the potentially avoidable deaths due to maternal conditions.
23. The proportion of potentially avoidable perinatal related deaths increases with increasing socioeconomic deprivation, due to increasing contribution from barriers to access and/or engagement with care.

## Neonatal encephalopathy

1. In 2014 there were 55 cases of moderate and severe neonatal encephalopathy reported to the national dataset. This is the lowest number of cases reported since data were first collected in 2010 (82 cases in 2010, 67 in 2011, 79 in 2012, 70 in 2013). While this is encouraging, there is no statistically significant reduction in rate, and the observed drop in 2014 may reflect random variation.
2. The neonatal encephalopathy rate for 2010–2014 was 1.14/1000 total births (95% CI 1.03–1.27), or 1.24/1000 term births (95% CI 1.12–1.38).
3. Taranaki and Capital & Coast DHBs are represented as having statistically significantly higher neonatal encephalopathy rates than the national rate for 2010–2014. The rate at Waikato DHB, a previous outlier, is now consistent with the national rate.
4. Mothers having their first birth are over-represented among mothers of babies with neonatal encephalopathy.
5. There has been a statistically significant reduction in the proportion of babies diagnosed with neonatal encephalopathy who do not have cord gases reported from 2010 to 2014 (chi-squared test for trend p=0.02).
6. The proportion of babies with moderate or severe neonatal encephalopathy who were treated with induced cooling increased from 2010 to 2013 and has remained stable at 82 percent in 2014. The proportion of those cooled who were cooled within six hours as recommended for maximal benefit at 87 percent remains high.
7. There has been an increasing trend in the proportion of surviving babies who had a magnetic resonance imaging (MRI) investigation since collection of neonatal encephalopathy data began in 2010 to 2014, from 70 percent in 2010 to 86 percent in 2014 (chi-squared test for trend p=0.008).

## Maternal mortality

1. In 2014, only four deaths within the definition of maternal mortality were reported to the PMMRC. There has been no statistically significant change in maternal mortality ratio in New Zealand since data collection by the PMMRC began in 2006.
2. 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 2012–2014, was 14.9/100,000 maternities (95% CI 10.2–21.7/100,000).
3. Review of suicide deaths between 2006 and 2013 found:
    a. many women had two or more risk factors for major affective disorder
    b. lack of recognition of risk factors (and multiple factors) and lack of communication between services (primary and secondary and across disciplines) was evident, especially among post-termination suicides
    c. two-thirds of women had a prior psychiatric history
    d. alcohol and other substance use (often polysubstance use) and smoking were common
    e. a third of women had been previously exposed to family violence
    f. relationship stress was a feature of almost all deaths.
4. Review of 13 amniotic fluid embolism (AFE) deaths between 2006 and 2013 and five morbidities between 2010 and 2013 found:
    a. AFE deaths were not over-diagnosed in New Zealand
    b. fatal AFE cases were not more severe in New Zealand
    c. resuscitation could have been improved in some cases.
5. Maternal mortality is more common among mothers 40 years of age and older, and Māori and Pacific women, and increases with increased socioeconomic deprivation.
6. Mothers who died were significantly more likely to be obese, and to be current smokers, than all mothers birthing in New Zealand.
7. Alcohol and substance use and family violence are common among maternal deaths in New Zealand.
8. Thirty-six percent of maternal deaths were identified as potentially avoidable from 2006 to 2014, and contributory factors were identified in a further 26 percent. Contributory factors and potentially avoidable death were similarly identified in direct and indirect maternal deaths.

# Recommendations

## Perinatal epidemiology

**That the Perinatal Society of Australia and New Zealand perinatal death classification (PSANZ-PDC) system be modified to allow the classification of babies dying with placental pathology outside of unexplained antepartum death.**

**Justification:**

A review of 177 placental pathology reports from unexplained stillbirths from 2007 to 2013 found that 23 (13 percent) could be assigned a placental cause of death, for which there is no category in the PSANZ-PDC system. These deaths are not unexplained.

The PMMRC will apply these changes in its use of the PSANZ-PDC system beginning 2017.

## Rates of perinatal related mortality and neonatal encephalopathy

**That district health boards with rates of perinatal related mortality and neonatal encephalopathy significantly higher than the national rate review, or continue to review, the higher rate of mortality or morbidity in their area and identify areas for improvement.**

**Justification:**

The perinatal related mortality rate among women residing in Counties Manukau and Northland DHB regions were significantly higher than the national rate of 10.73/1000 births from 2007-2014.

The perinatal related mortality rate in Counties Manukau DHB region for 2007-2014 was 13.39/1000 births (95% CI 12.53-14.27). The perinatal related mortality rate in Northland DHB region for 2007-2014 was 12.47/1000 births (95% CI 10.86-14.07).

The PMMRC is aware of initiatives by both of these DHBs to address the rates in their areas and acknowledges it may take some time to see an impact on mortality.

The neonatal mortality rates among women residing in Waikato and Bay of Plenty DHB regions were significantly higher than the national rate of 2.83/1000 live births from 2007-2014.

There were 91 neonatal deaths reported from 2007-2014 in the Bay of Plenty DHB region and so the neonatal mortality rate was 3.89/1000 births (95% CI 3.13-4.77). There were 151 neonatal deaths reported from 2007-2014 in the Waikato DHB region and so the neonatal mortality rate was 3.43/1000 live births (95% CI 2.88-3.97).

The neonatal encephalopathy rates for Taranaki and Capital & Coast DHBs are significantly higher than the national rate for 2010-2014. There were 17 cases of neonatal encephalopathy diagnosed among babies whose mothers were resident in Taranaki DHB area from 2010-2014. The rate in Taranaki was 2.37/1000 term births (95% CI 1.38–3.79). There were 32 cases of neonatal encephalopathy diagnosed among babies whose mothers were resident in the Capital & Coast DHB area from 2010-2014. The rate in Capital & Coast was 1.84/term births (95%CI 1.26-2.59). The national rate from 2010-2014 was 1.24/1000 term births.

This is not a new finding for Capital & Coast DHB and the PMMRC is aware of the review of neonatal encephalopathy currently underway in the DHB.

**Evidence:**

Audits of perinatal deaths are required to understand causes and focus prevention efforts (Lancet Stillbirth series 2016).

Previous reports have shown that review of neonatal encephalopathy using a confidential enquiry methodology revealed suboptimal care in more than 50 percent of cases (Draper et al 2002; Kernaghan 2006).

## Maternal mortality

**That a Perinatal and Infant Mental Health Network be established to provide an interdisciplinary and national forum to discuss perinatal mental health issues.**

**Justification:**

This recommendation highlights and supports a *Healthy Beginnings* 2012 recommendation (Ministry of Health 2012b).

An interface between services is important for the perinatal period when multiple services may be involved – primary care, maternity, general mental health, perinatal mental health, alcohol and other drugs, social services, and termination of pregnancy services. Better processes are required for sharing information and ensuring a consistent approach to care.

Consistency in screening and consistency of maternal mental health access pathways are required.

**Evidence:**

This is in keeping with recommendations within the UK, including the National Institute for Health and Care Excellence (NICE) guidelines on antenatal and postnatal mental health (NICE 2014), which recommend the establishment of perinatal mental health clinical networks of perinatal clinicians and resources and other stakeholders including service users, and the Scottish Intercollegiate Guidelines Network (SIGN) guidelines on the management of perinatal mood disorders (SIGN 2012).

The 2008 Ministry of Health guideline about management of depression in primary care describes the evidence around screening for depression (NZGG 2008).

Information on the establishment of a perinatal mental health network in the UK is described in a summary entitled Joining Up Care in Maternal Mental Health: Setting Up a Perinatal Mental Health Network (RCOG 2016).

**As recommended in the fifth report of the PMMRC (PMMRC 2011):**

**'All clinicians involved in the care of pregnant women should undertake regular multidisciplinary training in management of obstetric emergencies.'**

**Justification:**

The maternal mortality ratio from AFE in New Zealand is 5.6 times higher than in the UK. The retrospective review from 2006-2013 was based on only 18 cases, and as such, it was difficult to draw definitive conclusions. However, the analysis suggests resuscitation could have been improved in some cases.

**Evidence:**

Systematic review of multidisciplinary training in obstetric emergencies showed it was associated with improved clinician knowledge or skills (Calvert et al 2013). It has also been shown to be associated with an improvement of 5 minute Apgar scores and hypoxic ischaemic encephalopathy (Merien et al 2010).

# Overview of the 2016 Report of the PMMRC

## Perinatal mortality

### Perinatal related mortality rate

The perinatal related mortality rate in New Zealand includes stillborn babies from 20 weeks gestation and deaths of live born babies to 27 days of life. In 2014 the perinatal related mortality rate was 11.2/1000 births. It has not changed between 2007 and 2014.

There has been a significant reduction in perinatal related mortality using the World Health Organization (WHO) international definition for perinatal related deaths from 1000g or 28 weeks if birthweight is unknown. This reduction is due to a significant reduction in stillbirths at term. This is independent of a reduction in total births at 40 and 41+ weeks. There are numerous reasons why this might have occurred such as:

- improved peripartum care – this is supported by the observed reduction in hypoxic peripartum death rate
- a reduction in deaths from perinatal infection
- a reduction in deaths from antepartum haemorrhage
- increased early birth of at-risk babies, which is observed as a reduction in births at 40 and 41+ weeks and an increase in births at 36–39 weeks
- a reduction in smoking, which is known to be associated with perinatal death.

The reduction in intrapartum stillbirth risk at term, which has been observed since 2007, remains highly significant (p=0.0001). This is consistent with and probably due to a significant reduction in hypoxic peripartum deaths (p=0.0004).

### Demographic associations

Perinatal related mortality is more common at the extremes of maternal age. Analysis in 2014 found that age was not independently associated with stillbirth or neonatal death after adjusting for ethnicity, socioeconomic deprivation, smoking, parity and body mass index (BMI).

Perinatal related mortality is more common among the children of Māori, Pacific and Indian mothers than Other Asian, Other, and New Zealand European mothers. After adjusting for the effects of socioeconomic deprivation, maternal age, parity, smoking and BMI, only neonatal death of babies born at 20–27 weeks was significantly more common among babies of Māori and Pacific mothers. Babies of Indian mothers remained at increased risk of stillbirth after adjusting for these factors.

Increasing socioeconomic deprivation is associated with increasing stillbirth and neonatal death rates, and with reduced late termination of pregnancy rates. Multivariate analyses in 2014 found that socioeconomic deprivation was independently associated only with neonatal death after birth from 20 to 27 weeks.

The perinatal related mortality rate among women residing in Counties Manukau and Northland DHB regions were significantly higher than the national rate.

The neonatal mortality rates among women residing in Waikato and Bay of Plenty DHB regions were significantly higher than the national rate.

### Neonatal mortality

In this report, we have changed the gestational age categories for neonates. Babies born at 23 weeks are now classified with babies born at 24 weeks rather than with babies born at 20–22 weeks. This is because some babies at 23 weeks have been shown to have good quality survival, while babies at 20–22 weeks are pre-viable. Resuscitation was attempted for 7 of 21 neonatal deaths (33 percent) at 23 weeks and 16 of 18 deaths (89 percent) at 24 weeks.

### Screening

There has been a significant increase, from 2007 to 2014, in screening for diabetes among mothers without pre-existing diabetes where perinatal death occurred at 28 weeks or later.

There has been no change in the proportion of mothers screened for family violence in pregnancy from 2007 to 2014.

### Investigation of perinatal death

In 2015, we reviewed the placental pathology reports of 177 unexplained antepartum deaths between 2007 and 2013. Of these, 23 (13 percent) had placental pathology which likely explained the stillbirth and seven were reclassified as due to infection or bleeding. There is no current category in the PSANZ-PDC system, which we use in New Zealand to classify perinatal deaths, for isolated placental causes of death. For this reason we are recommending a change in the classification system.

Babies of Māori and Pacific mothers who die in the perinatal period are less likely to be optimally investigated (by post-mortem, karyotype or clinical examination, or investigation confirming diagnosis) than babies from other ethnic groups. Māori and Pacific mothers' babies are more likely to have no investigation following perinatal death than babies of other ethnicities. Talking with health professionals about their experiences of offering post-mortem investigations to families/whānau and to Māori whānau who have experienced a death and listening to their stories of being offered post-mortem might help to inform practice changes.

## Contributory factors and potentially avoidable perinatal related death

In 2014, one-quarter of deaths were determined when reviewed to have contributory factors (organisation and/or management, personnel, or barriers to access and/or engagement with care factors associated with the death). Of the deaths where contributory factors were identified, approximately half (13 percent) were believed to be potentially avoidable.

The factors that are most often associated with potentially avoidable deaths are factors related to barriers to access and/or engagement with care, which were responsible for 8 to 12 percent of perinatal related deaths each year from 2011 to 2014. Personnel factors were the main contributory factor to potentially avoidable death in 5 to 6 percent of deaths.

The proportion of potentially avoidable deaths was higher among babies of Māori and Pacific mothers, at 22 percent, than all other ethnicities. The main contributory factors among these deaths are barriers to access and/or engagement with care, which were associated with 17 and 19 percent of perinatal related deaths in these ethnic groups.

The proportion of potentially avoidable perinatal related deaths increases with increasing socioeconomic deprivation, and this is also associated with an increase in barriers to access and/or engagement with care.

### Neonatal encephalopathy

From 2016 the neonatal encephalopathy data collection will include babies diagnosed with neonatal encephalopathy from 35 weeks at birth. This is because these babies are managed in the same way as term babies with encephalopathy.

In 2014 there were 55 cases of moderate and severe neonatal encephalopathy reported to the national dataset. This is the lowest number of cases reported since data collection started in 2010. There were 82 cases reported in 2010, 67 in 2011, 79 in 2012, and 70 in 2013. This is not a statistically significant reduction in the rate of neonatal encephalopathy, but it looks like an encouraging trend. The neonatal encephalopathy rate for 2010–2014 was 1.14/1000 total births (ie, approximately one baby of every 1000 born).

Taranaki and Capital & Coast DHBs are represented as having statistically significantly higher neonatal encephalopathy rates than the national rate for 2010–2014. Waikato DHB was previously noted to have a higher rate than the national rate, but now has a rate that is consistent with the national rate.

There have been improvements in the management of babies with neonatal encephalopathy. These include:

- a significant increase in the proportion of babies diagnosed with neonatal encephalopathy who had cord blood gases taken
- an increase in the proportion of babies with moderate or severe neonatal encephalopathy who were treated with induced cooling. The proportion of those cooled who were cooled within six hours as recommended for maximal benefit at 87 percent remains high
- an increase in the proportion of surviving babies who had an MRI investigation as part of their management.

### Maternal mortality

In 2014, only four deaths of mothers during pregnancy or within the first 42 days of the end of pregnancy were reported in New Zealand.

The three-year average maternal mortality ratio for 2012–2014 was 14.9/100,000 maternities (births from 20 weeks of pregnancy).

In 2015, the PMMRC reviewed the 22 maternal suicide deaths from 2006 to 2013. This review found:

- many women had two or more risk factors for major depression, and there was a lack of recognition of risk factors, and of communication between services, especially among post-termination suicides
- two-thirds of women had a prior psychiatric history
- alcohol and other substance use (often polysubstance use) and smoking were common
- a third of women had been previously exposed to family violence
- relationship stress was a feature of almost all deaths.

In 2015, the PMMRC reviewed 13 deaths and five survivors of AFE and found:

- the maternal mortality ratio from AFE in New Zealand is 5.6 times higher than in the UK, and the retrospective review concluded that death from AFE was accurately diagnosed in New Zealand
- there was no evidence that fatal cases were more severe in New Zealand, and in fact the data suggested that maybe the opposite was true
- the review suggested resuscitation could have been improved in some cases of AFE death and concluded that all clinicians involved in maternity care need to be able to recognise the possibility of AFE early in its presentation and need to be able to respond with timely and effective resuscitation.

Thirty-six percent of maternal deaths were identified as potentially avoidable from 2006-2014, and contributory factors were identified in a further 26 percent.

# Summary of Key PMMRC 2015 Report Recommendations and Progress

| Recommendations (PMMRC 9th Report) | Progress to date (June 2016) |
|---|---|
| **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. | The dataset has been made available to the PMMRC from 2014. However, we acknowledge that the dataset still does not include registration data from all DHBs that are providing primary maternity care. The Ministry of Health is working towards a solution for including registration ethnicity data in the MAT dataset, but this has not been achieved at this time. |
| **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.<br>Strategies to address modifiable risk factors include:<br>a. improving uptake of peri-conceptual folate<br>b. pre-pregnancy care for known medical disease such as diabetes<br>c. access to antenatal care<br>d. accurate height and weight measurement in pregnancy with advice on ideal weight gain<br>e. prevention and appropriate management of multiple pregnancy<br>f. smoking cessation<br>g. antenatal recognition and management of fetal growth restriction<br>h. prevention of preterm birth and management of threatened preterm labour<br>i. following evidence-based recommendations for indications for induction of labour<br>j. advice to women and appropriate management of decreased fetal movements.<br>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. | DHBs are implementing strategies to address modifiable risk factors, and the Ministry of Health will also require DHBs to report on these strategies in their Annual Maternity Quality and Safety Reports.<br>DHB strategies include early screening and encouraging women to:<br>• engage early with a lead maternity carer (LMC)<br>• take folic acid and iodine<br>• eat well and be active<br>• avoid alcohol, recreational drugs and smoking.<br>Examples of DHB programmes include '5 Things to Do in the First 10 Weeks' and 'As Soon As Pregnant (ASAP)', which both promote the importance of:<br>• booking with a midwife as soon as you are pregnant<br>• avoiding smoking, alcohol and recreational drugs<br>• taking folic acid and iodine<br>• making a decision about screening tests<br>• eating well and staying active.<br>See the following websites for more information:<br>http://www.healthpoint.co.nz/public/obstetric-and-gynaecology/capital-coast-dhb-womens-health-obstetrics/im:322319/<br>http://www.bopdhb.govt.nz/media/57530/bop-dhb-maternity-annual-report-2014.pdf<br>The 'Healthy Babies, Healthy Futures' programme provides ethnically specific workshops, text messaging and support for new mothers, pregnant women and their families.<br>See the following website for more information: http://hbhf.org.nz/<br>Some DHBs have established a GP Liaison role within the hospital, which encourages pre-pregnancy and first trimester primary care. A pregnancy information pack has been developed to give to women at their first presentation to any health professional. This pack contains information about a wide variety of pregnancy issues including folate, smoking, diet and immunisation. |
| 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:<br>a. family violence<br>b. smoking<br>c. alcohol and other substance use. | **Family violence**<br>All DHBs have measures in place for screening of family violence when women are admitted to hospital. They offer regular education sessions and training workshops to midwives and clinicians to help them identify, screen and refer women experiencing family violence. The shaken baby prevention programme has also been rolled out at a number of DHBs.<br>The Violence Intervention Programme supports health sector family violence programmes throughout New Zealand.<br>See http://www.health.govt.nz/our-work/preventative-health-wellness/family-violence |

| Recommendations (PMMRC 9th Report) | Progress to date (June 2016) |
|---|---|
| | 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.<br><br>**Smoking**<br>Smoking cessation programmes are a national health priority. The Ministry of Health, DHBs and a wide range of non-governmental organisations have made significant progress on leading New Zealand towards being smokefree by 2025.<br>See the following websites for more information:<br>http://www.quit.org.nz/23/reasons-to-quit/smoking-and-pregnancy<br>http://www.heartfoundation.org.nz/programmes-resources/health-professionals/smoking-cessation-training<br>http://innov8smokefree.co.nz/Te+Hapu+Ora+for+Midwives.html<br>http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz<br>http://learnonline.health.nz<br><br>**Alcohol and other substance use**<br>DHBs offer regular education sessions and training workshops to midwives and clinicians to help them identify, screen and refer women with alcohol and substance use. |
| 3. That multi-disciplinary fetal surveillance training be mandatory for all clinicians involved in intrapartum care.<br>a. This training includes risk assessment for mothers and babies throughout pregnancy as well as intrapartum observations.<br>b. The aims include strengthening of supervision and support to promote professional judgement, interdisciplinary conversations and reflective practice. | Some DHBs reported that mandatory attendance at multi-disciplinary fetal surveillance training was required for all core staff. Other DHBs have responded that multi-disciplinary fetal surveillance training is occurring but is not compulsory.<br>LMCs and obstetric staff are encouraged to attend/undertake the online programme or workshop.<br>Other initiatives include education meetings where cardiotocograph (CTG) recordings from emergency caesareans or abnormal CTGs are reviewed as part of reflective practice, and all staff who provide intrapartum care are encouraged to undertake a 'fresh eyes' approach to CTG interpretation. |
| 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:<br>a. assessment and appropriate referral for risk factors for fetal growth restriction at first antenatal visit and throughout pregnancy<br>b. accurate measurement of maternal height and weight at first antenatal assessment<br>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<br>d. plotting of fundal height on a tool for detection of fetal growth restriction, such as a customised growth chart, from 26 weeks gestation | The Ministry of Health supports the implementation of the UK Perinatal Institute's GROW system for assessing fetal growth in New Zealand. Work is underway to obtain a national licence so DHBs can implement the package, which includes clinician education and the customised GROW chart.<br>The Ministry expects that each DHB will be responsible for implementing the GROW system for local clinicians, including their LMC workforce. |

| Recommendations (PMMRC 9th Report) | Progress to date (June 2016) |
|---|---|
| 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.<br>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. | |
| **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.<br>a. Vaccination is also recommended for maternity care providers to reduce the risk to the women and babies under their care.<br>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. | Immunisation against influenza is specifically promoted to pregnant women and available to all pregnant women free of charge.<br>The Ministry of Health immunisation team annually provides information and resources to clinicians and the public to support this recommendation.<br>The Health Promotion Agency immunisation programme theme for 2016 is Protecting Baby Begins at Pregnancy. Further information is available at: https://www.healthed.govt.nz/resource/protecting-baby-starts-pregnancy<br>A survey was recently conducted amongst pregnant women and women who had given birth in the last 12 months to understand their knowledge and attitudes towards influenza. The survey included attitudes to immunisation against influenza and whooping cough, and enablers and barriers to immunisation in pregnancy.<br>See the following website for more information: http://www.health.govt.nz/publication/immunisation-pregnant-women-audience-research-pregnant-women<br>A website has also been developed to help midwives, nurses and childbirth educators to quickly and easily find useful information and resources about immunisation in New Zealand. See http://learnonline.health.nz/ |
| 6. All pregnant women with epilepsy on medication should be referred to a physician.<br>a. Women with a new diagnosis of epilepsy or a change in seizure frequency should be referred urgently.<br>b. The PMMRC recommends a review of epilepsy in the Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines). | The referral guidelines are due to be revised and work is expected to begin at the end of 2016. This recommendation will be taken to the referral guidelines working group. |
| **Neonatal encephalopathy** | |
| 7. Widespread multidisciplinary education is required on the recognition of neonatal encephalopathy. This should include:<br>a. recognition of babies at increased risk by their history<br>b. signs suggestive of encephalopathy<br>c. knowledge of clinical pathways to induced cooling if required. | ACC has facilitated a cross-Ministry initiative to look at reducing the incidence of treatment injury by developing strategies to address the issues raised by the Neonatal Encephalopathy Working Group.<br>See 'Practice Point: Recognising the Baby at Risk of Neonatal Encephalopathy' in the ninth report of the PMMRC: http://www.hqsc.govt.nz/assets/PMMRC/Publications/PMMRC_Ninth_Report_Practice_Points.pdf |

| Recommendations (PMMRC 9th Report) | Progress to date (June 2016) |
|---|---|
| 8. That all DHBs review local incident cases of neonatal encephalopathy (Sarnat stages 2 and 3).<br>The findings of these reviews should be shared at multidisciplinary local forum and form the basis of quality improvements as appropriate. | Most DHBs have advised they review local incident cases of neonatal encephalopathy, which are conducted at a multi-disciplinary level to identify areas of learning and improvement.<br>The Ministry of Health has advised the Maternity Quality and Safety Coordinators of this recommendation. |
| 8a. Capital & Coast DHB should review cases of neonatal encephalopathy from 2010 to 2013. | Work commenced in 2015 on retrospectively reviewing 28 cases of neonatal encephalopathy that were diagnosed between 2010 and 2013. The review consisted of a multidisciplinary team reviewing the notes with the assistance of an expert in 'human factors'.<br>A template has been devised to consider the management and outcomes for these babies. |

# 1 Perinatal Mortality 2014

## 1.1 Introduction

### Maternity care in New Zealand

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 2012a).

## 1.2 Methodology

### Important changes to the methods in this 10th report of the PMMRC

In this report, gestational age categories have been changed, in line with national and international evidence of survival of babies born at 23 weeks (Gallagher et al 2014; Ishii et al 2013), which is more in line with survival at 24 weeks than at 20–22 weeks. And so throughout this report, gestational age has been categorised as 20–22 weeks, 23–24 weeks, 25–27, and then 28–31, 32–36, 37–40, and ≥41, as previously.

This year we have included 2014 New Zealand National Maternity Collection (MAT) data for some demographic variables such as smoking, parity, body mass index (BMI) and maternity care, but not as a denominator for all analyses. To use this dataset as a denominator for all analyses requires the inclusion of ethnicity at registration from the Births, Deaths and Marriages (BDM) dataset.

There were two late notifications in 2015: one termination of pregnancy in 2013 and one stillbirth in 2010. These cases have been included in the updated rates tables and figures but not in the analyses throughout the report. These will be included in all analyses in the 11th report in 2017.

### Data sources

The perinatal deaths presented in this report occurred between 1 January and 31 December 2014. 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 PSANZ-PDC for cause of death, 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 LMCs, local coordinators, the Ministry of Health and 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 (listed in Appendix E). The local coordinator also submits the post-mortem and histology reports with the classification form.

## Contributory factors and potentially avoidable mortality

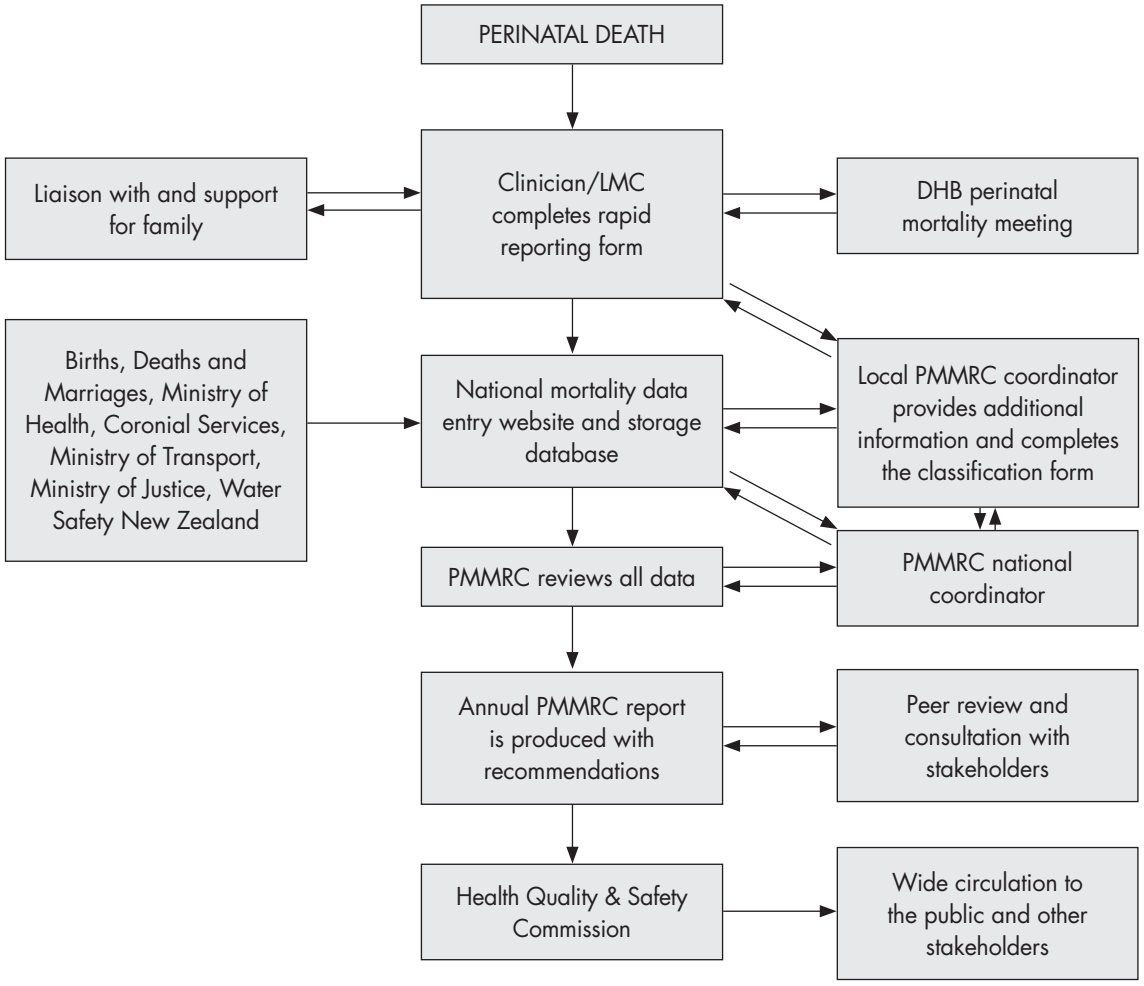
An assessment of contributory factors and potentially avoidable perinatal related death is completed by a multidisciplinary team led by the PMMRC local coordinators following local review and submitted along with the PSANZ classification of perinatal death. The PMMRC contributory factors and potentially 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 in Appendix F.

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 2014b) is available online at:

http://www.hqsc.govt.nz/assets/PMMRC/Publications/guidelines-mother-baby-forms-perinatal-death-v8.pdf

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 discusses complicated cases with a PMMRC member with expertise in PSANZ classifications.

## Audit of perinatal related death data 2013

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 2013 data focused on accuracy of data submitted to the PMMRC compared to that in the clinical records from LMCs and DHBs.

The 2013 audit reviewed 60 perinatal related deaths (58 mothers), 14 late terminations of pregnancy, 29 stillbirths and 17 neonatal deaths. The following information relates to the audit of these 60 perinatal related deaths.

There was one death (2 percent) where the auditor's and the original primary perinatal death classification (PSANZ-PDC) varied; the primary classification was considered at audit to be antepartum haemorrhage (PSANZ-PDC4) followed by the allocated classification of spontaneous preterm labour (PSANZ-PDC9). There was one death (2 percent) where there was a change in the sub-category allocated.

There were three deaths (5 percent) where the audit identified contributory factors that were not identified in the data submitted to the PMMRC, and all three deaths were considered at audit to be potentially avoidable. There was one death (2 percent) where the death was determined to be potentially avoidable at local review but not considered potentially avoidable at audit. The PMMRC data were updated to reflect these findings.

Clinical information was missing or incorrectly noted in 18 deaths (30 percent), past obstetric history in two deaths (3 percent), gestation of registration in 11 deaths (18 percent), smoking in three deaths (5 percent) and family violence in nine deaths (15 percent).

At times there was 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 some missing data or discrepancies in 30 deaths (50 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 submission and further training on the PSANZ classification of cause of death and assessment of contributory factors.

## Denominator data

### *New Zealand birth registrations*

The denominator data used in this report consist of New Zealand birth registrations during the 2006–2014 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 easily be linked to hospital discharge data or LMC data for further analyses.

The current year's fetal death numbers have been removed from the denominator for the calculation of neonatal death rates.

## New Zealand National Maternity Collection (MAT)

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 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 are now providing registration data such as BMI, parity and smoking for some of the mothers for whom they provide primary maternity care. This accounts in 2014 for up to 9 percent of women who are currently recorded in the MAT dataset as 'DHB', 'No LMC', 'Other' or 'Missing LMC'. Some of these women did not register with an LMC and some registered with a DHB LMC, but these data have not been provided to MAT. Mothers receiving primary maternity care from DHBs mostly reside in Counties Manukau, Auckland, West Coast, Nelson Marlborough, Northland and Whanganui DHB areas. They are more likely to reside in areas of higher deprivation (New Zealand Index of Deprivation (NZDep)) and are more often Pacific and Indian ethnicity. 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.
- 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) birth and postnatal events, LMC Labour and 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.

### *Tables*

In any table where there are denominator data (from the birth registration dataset), the table includes a column for the absolute number of births and the proportion of all births in the time period, distributed by the levels of the variable of interest. There are columns for the absolute number of deaths that were terminations of pregnancy, stillbirths, neonatal deaths and total perinatal deaths, the proportions within each of these by the variable of interest, and the rate of death as a proportion of all births in that category of the variable of interest.

For example, Table 1.4 looks at perinatal related deaths by maternal age for 2014. There were 10,289 births registered to mothers 20–24 years of age in 2014, which was 17.5 percent of all births. There were 63 stillbirths among mothers 20–24 years of age, which was 19.4 percent of all stillbirths in 2014. The stillbirth rate was 63/10,289 births or 6.12 stillbirths per 1000 births in 2014 to women 20–24 years of age.

### *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 each rate dose not overlap the estimate of the other rate, 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 does overlap the estimate, the rates may or may not be different.

### *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.

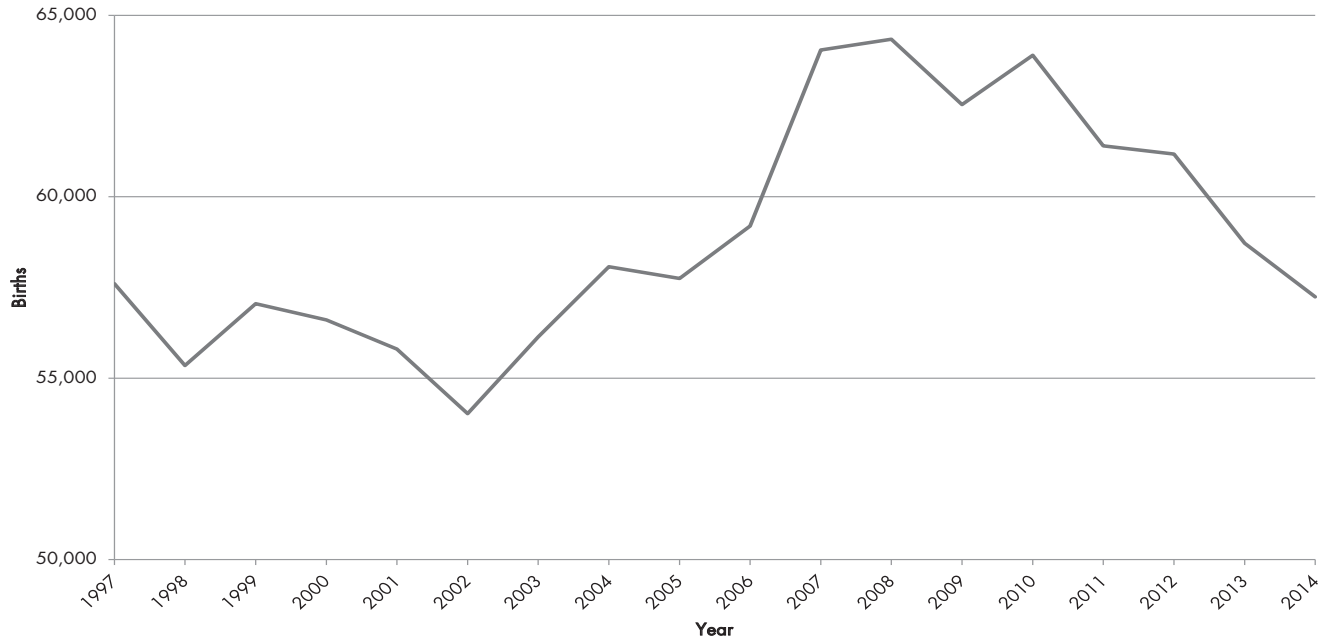
At the lower extremes of gestation and birthweight, denominator numbers are small. As the denominator set is registrations rather than births in the relevant year, the denominator is not an exact count of all births in the year. For this reason, perinatal related mortality rates at the lower extremes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

### *Multiple year data*

In this report, the figures illustrating perinatal related mortality rates sometimes include combined data for the eight full years that the PMMRC has collected data (2007–2014). This increases the numbers and so improves the confidence around the estimates given. In general, the data for the 2014 year alone are presented in table form in the text and the combined eight-year data in table form in the appendices to each section.

## 1.3 Births in New Zealand 2014

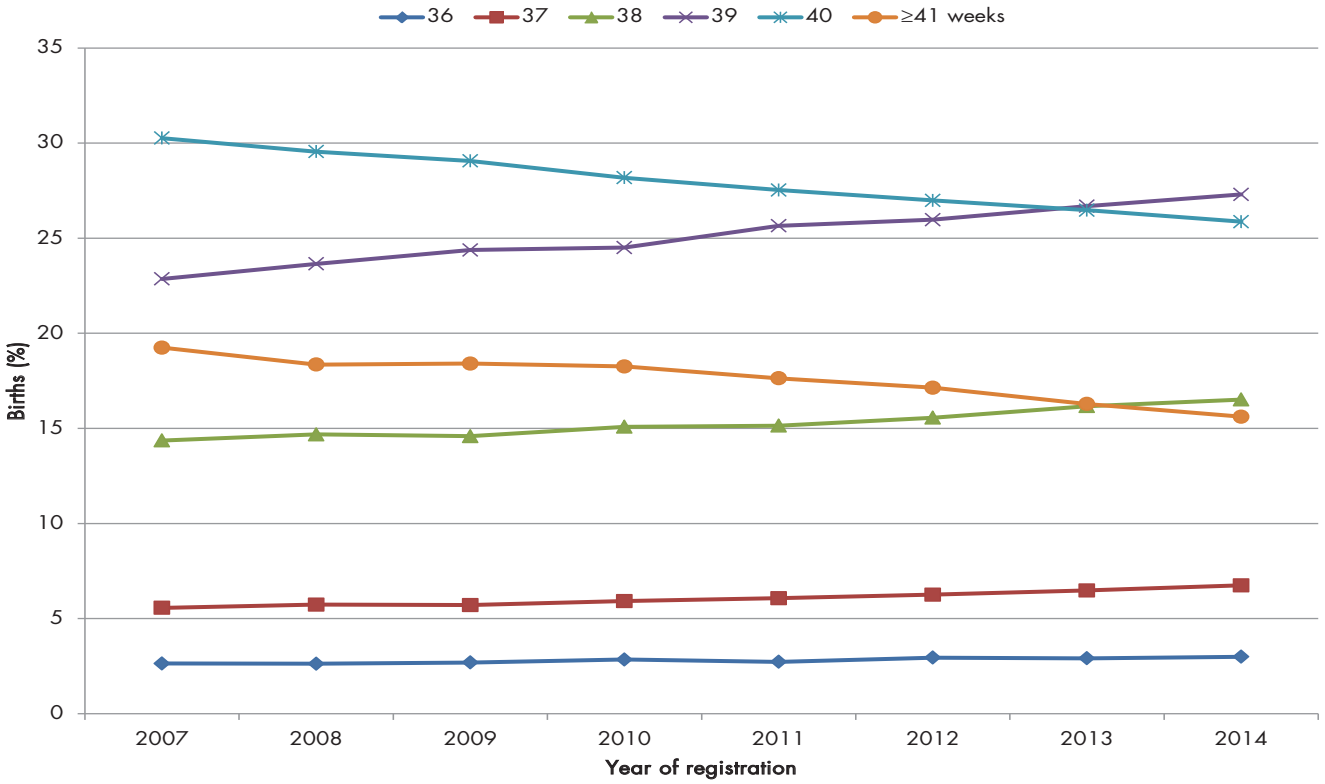
Figure 1.2: Total live birth registrations in New Zealand 1997–2014




Amended from Statistics New Zealand (2015)
http://www.stats.govt.nz/browse_for_stats/population/births/BirthsAndDeaths_HOTPYeDec14.aspx
http://www.stats.govt.nz/~/media/Statistics/Browse%20for%20stats/BirthsAndDeaths/HOTPYeDec14/bd-Dec14-all-tables.xls

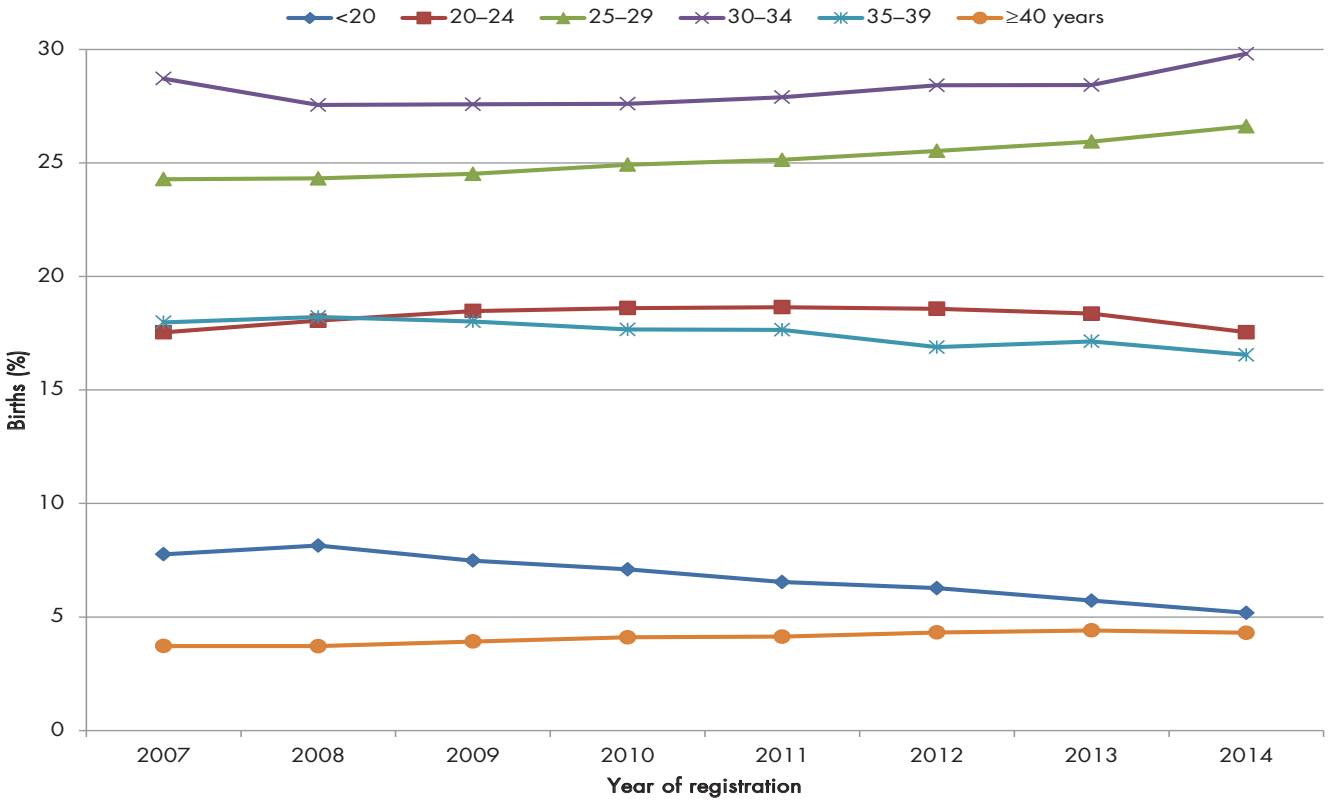
Total births in New Zealand have dropped in the years since the peaks in 2007–2010 back to previous levels. There were 58,647 total births registered fitting the PMMRC definition in 2014.

Figure 1.3: Trends in gestation at birth (36 weeks and beyond) among birth registrations in New Zealand 2007–2014




There has been a significant change in the distribution of gestation at birth in New Zealand between 2007 and 2014 (Figure 1.3). Specifically there has been a significant reduction in total births at 40 and 41+ weeks and a significant increase in births at 36, 37, 38 and 39 weeks gestation. This suggests that there has been an increase in iatrogenic births at and near term.

Figure 1.4: Trends in maternal age among birth registrations in New Zealand 2007–2014



There has been a consistent reduction in births among mothers under 20 years of age from 2008 so that these now constitute 5.2 percent of births (Figure 1.4). The majority of births in New Zealand are to women aged 25–29 (26.6 percent) and 30–34 (29.8 percent). There has been a small increase in mothers birthing at 40 years of age and older from 2007 to 2014, with 4.3 percent of mothers 40 or older in 2014.

The greatest changes in maternal ethnicity from 2007 to 2014 are an increase in births among Other Asian mothers and a reduction in the proportion to New Zealand European mothers, who now make up 11.2 and 42.8 percent of mothers respectively (Figure 1.5).

In 2014, 22.1 percent of mothers identified to BDM as Māori and 10.0 percent as Pacific.

Figure 1.5: Trends in maternal prioritised ethnicity among birth registrations in New Zealand 2007–2014

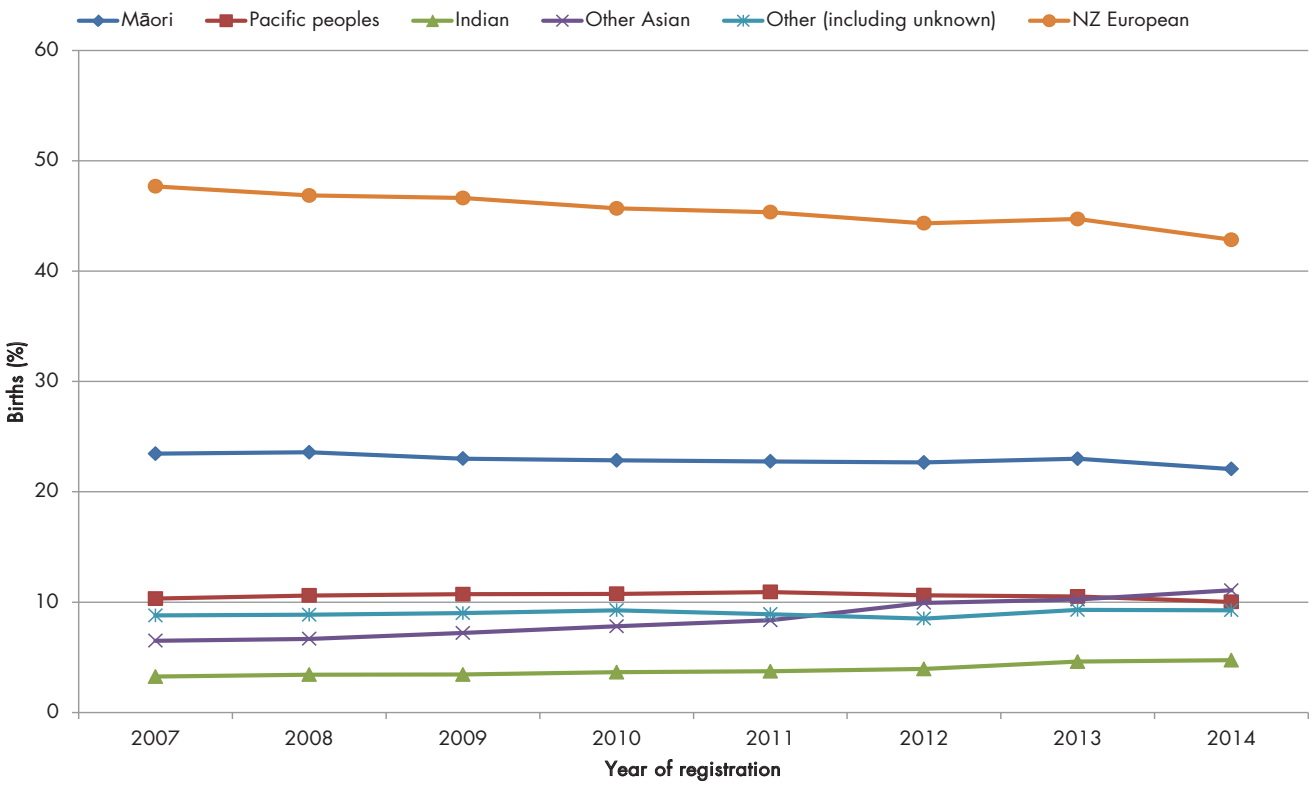


Figure 1.6: Distribution of deprivation deciles (NZDep2013) among birth registrations in 2014 (total births excluding unknown=58,369)

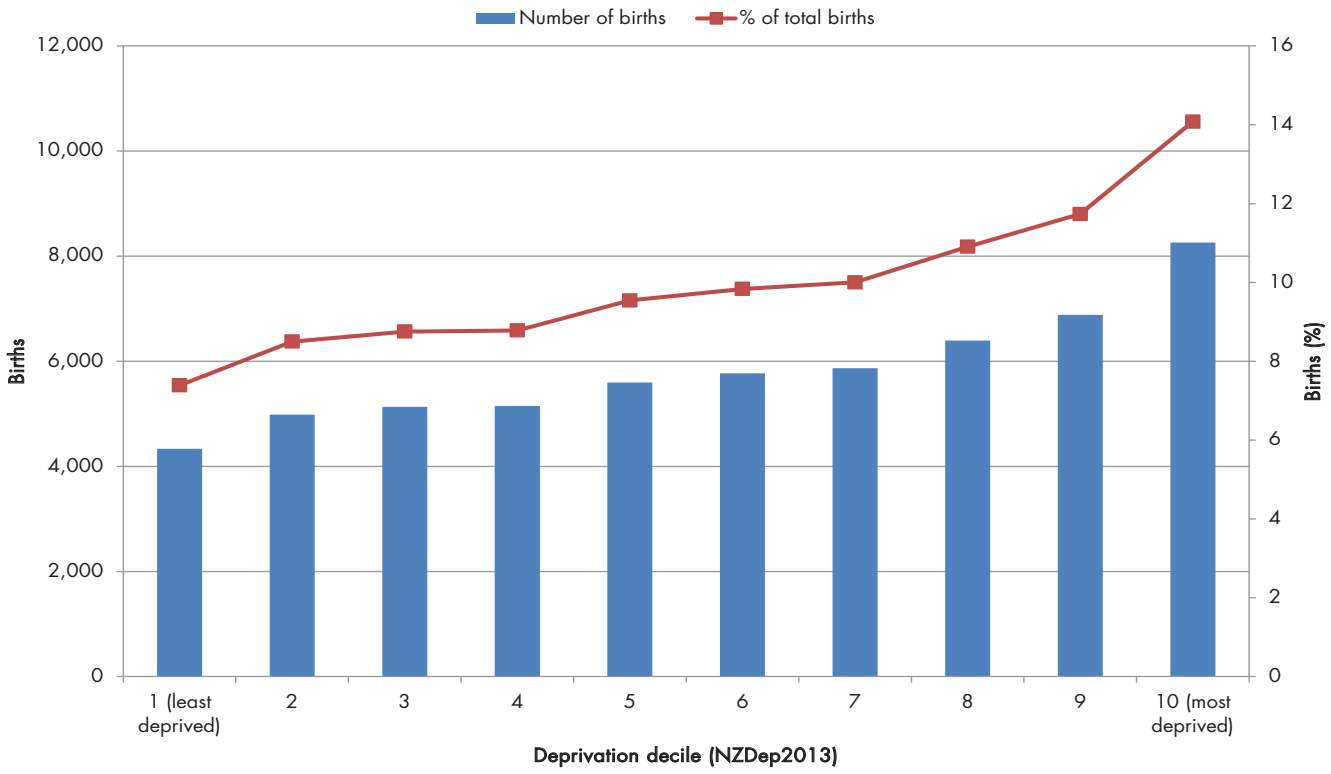



Figure 1.7: Distribution of births by DHB of maternal residence among birth registrations in 2014 (total births=58,647)

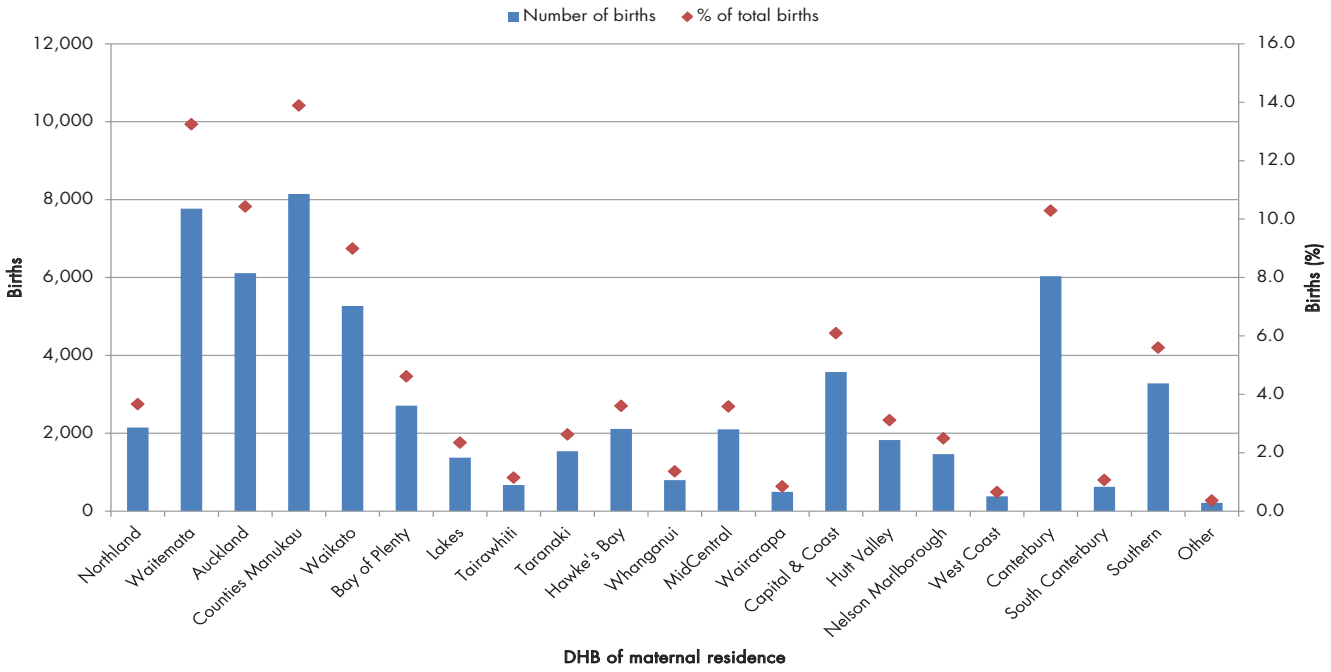


Figure 1.8: Distribution of deprivation quintiles (NZDep2013) by maternal prioritised ethnicity among births registered in 2014 (total births=58,647)

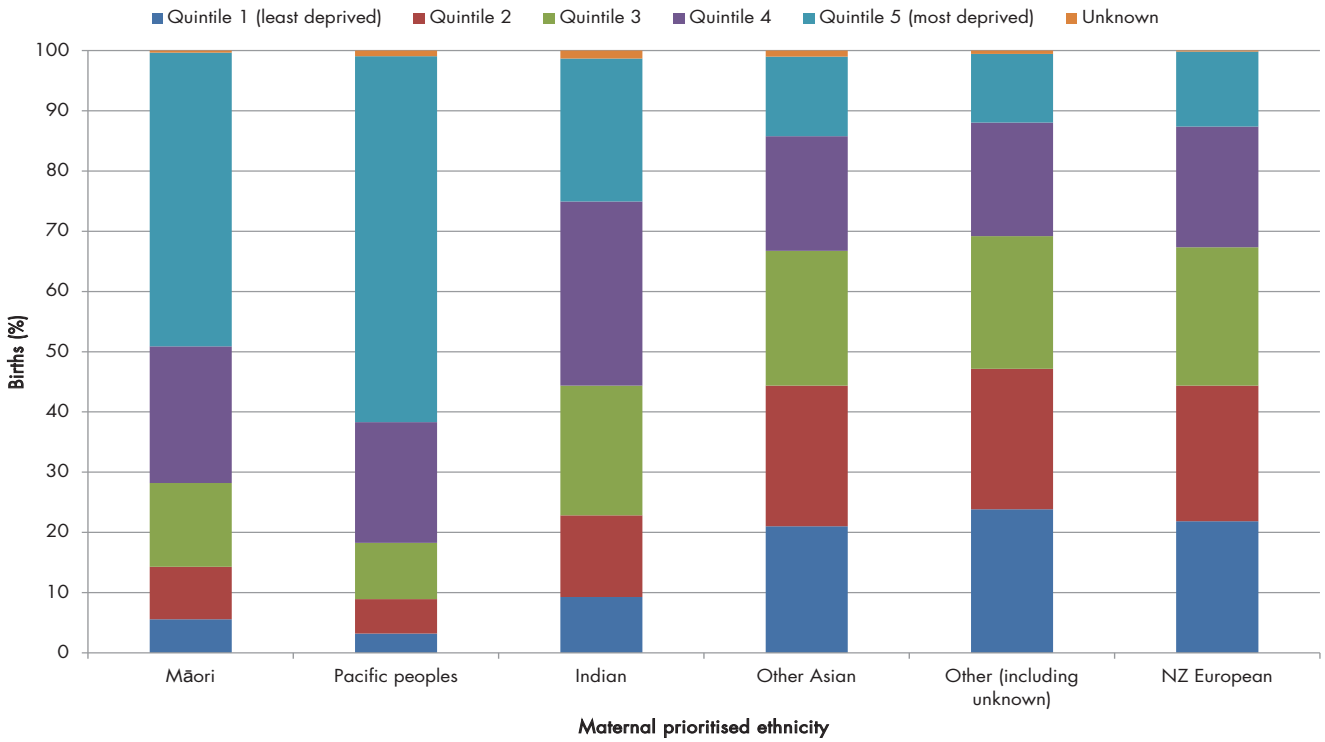



Figure 1.9: Distribution of maternal age by maternal prioritised ethnicity among birth registrations in 2014 (total births=58,647)

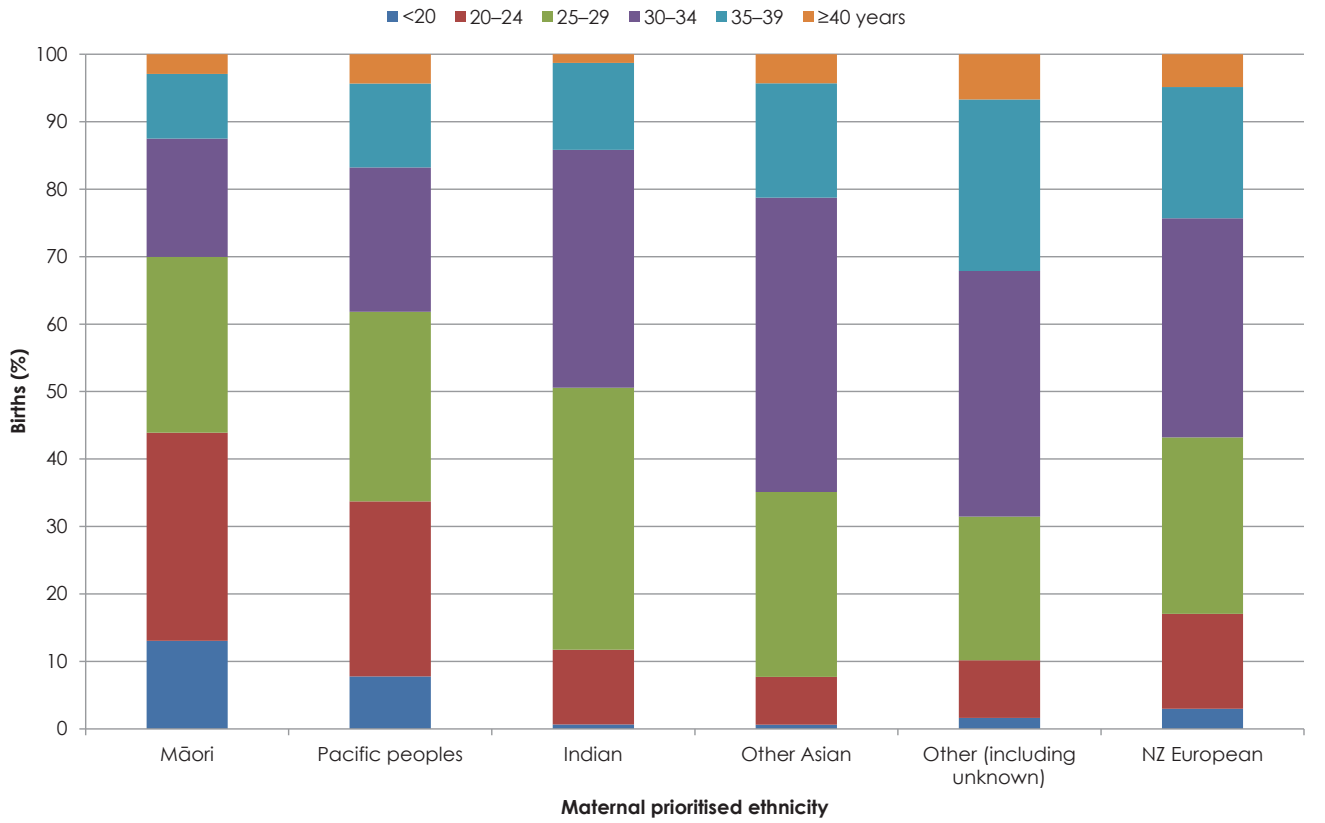


Figure 1.10: Distribution of maternal prioritised ethnicity by DHB of maternal residence among birth registrations in 2014 (total births excluding unknown DHB=58,433)

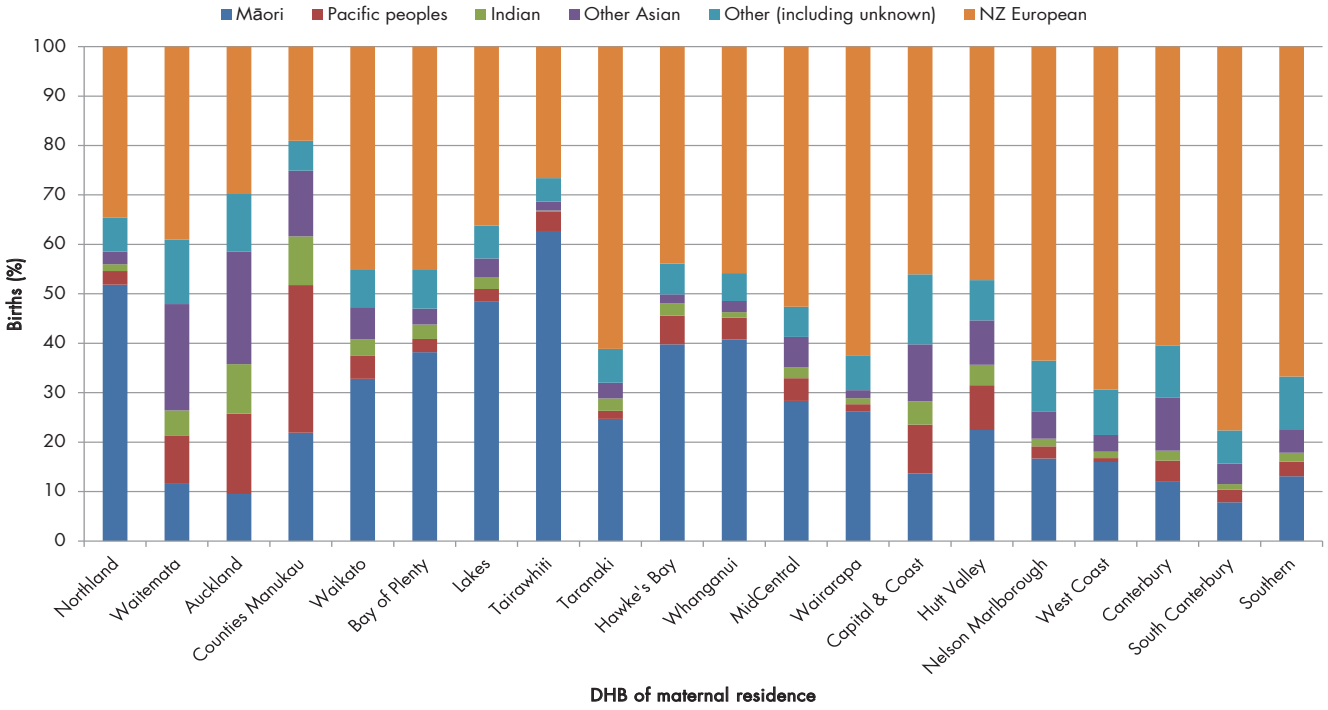
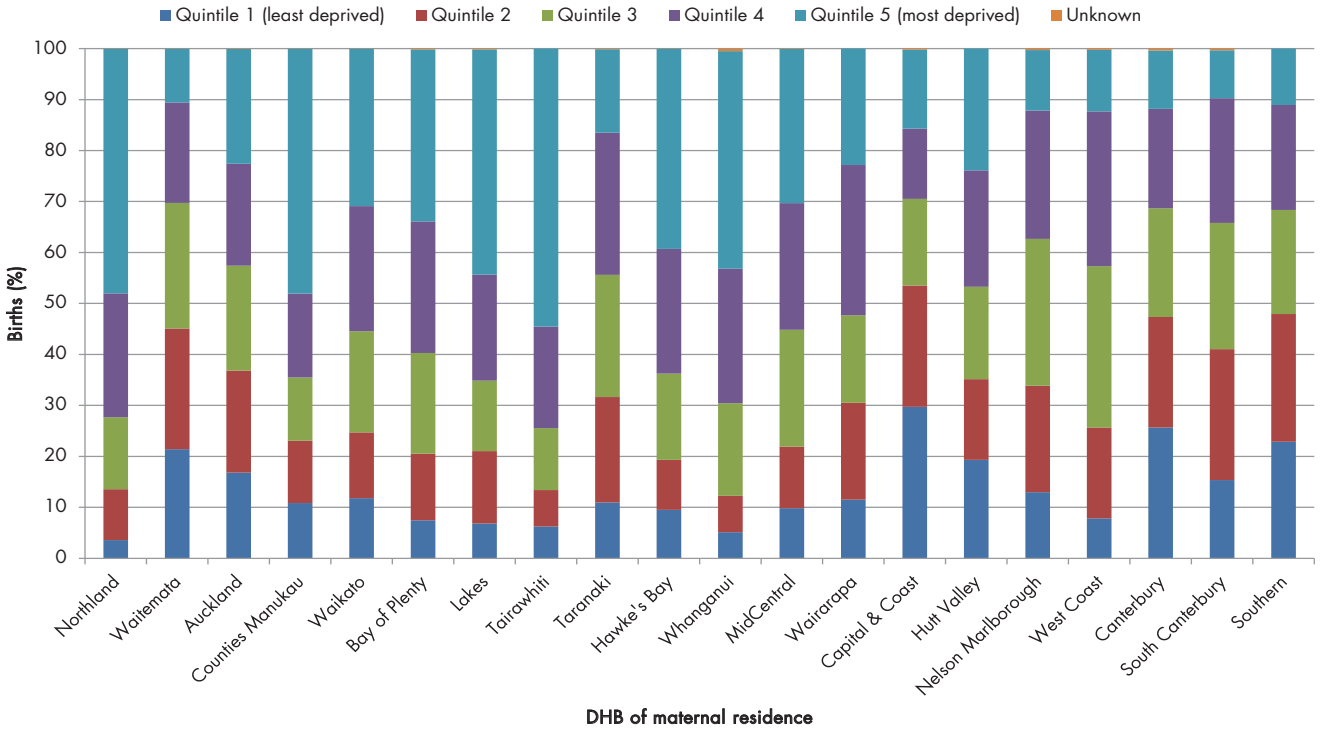



Figure 1.11: Distribution of deprivation quintile (NZ Dep2013) by DHB of maternal residence, among birth registrations in 2014 (total births excluding unknown DHB=58,433)



# 1.4 Perinatal Mortality 2014

## Perinatal mortality rates

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 of Health documents.

The PMMRC considers that this report presents as complete a set of perinatal related deaths as can currently be achieved for the 2014 year in New Zealand.

Table 1.1: Summary of New Zealand perinatal mortality rates 2014

| | Using NZ definition | | Using UK definition* | |
|---|---|---|---|---|
| | n | Rate | n | Rate |
| Total births | 58,647 | | 58,477 | |
| Fetal deaths (terminations of pregnancy and stillbirths)# | 474 | 8.1 | 259 | 4.4 |
| Terminations of pregnancy | 149 | 2.5 | 64 | 1.1 |
| Stillbirths | 325 | 5.5 | 195 | 3.3 |
| Early neonatal deaths <7 days | 150 | | 150 | |
| Late neonatal deaths 7–27 days | 32 | | 32 | |
| Neonatal deaths <28 days+ | 182 | 3.1 | 182 | 3.1 |
| Perinatal mortalities^ | 624 | 10.6 | 409 | 7.0 |
| Perinatal related mortalities• | 656 | 11.2 | 441 | 7.5 |
| Perinatal mortalities excluding lethal and terminated fetal abnormalities~ | 446 | 7.6 | 310 | 5.3 |
| Perinatal related mortalities excluding lethal and terminated fetal abnormalities~ | 465 | 7.9 | 329 | 5.6 |

* 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 2011).
# 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 2014, which includes late terminations of pregnancy, stillbirths, and early and late neonatal deaths, from 20 weeks gestation to 27 days of life, was 11.2 per 1000 total births.

There has been no statistically significant change in overall perinatal related mortality, using the New Zealand definition, from 2007 to 2014.

However, the significant decrease in the stillbirth rate and significant increase in the termination of pregnancy rate from 2007 to 2014, which was reported previously, persists (chi-squared test for trend p=0.04, p=0.04 respectively).

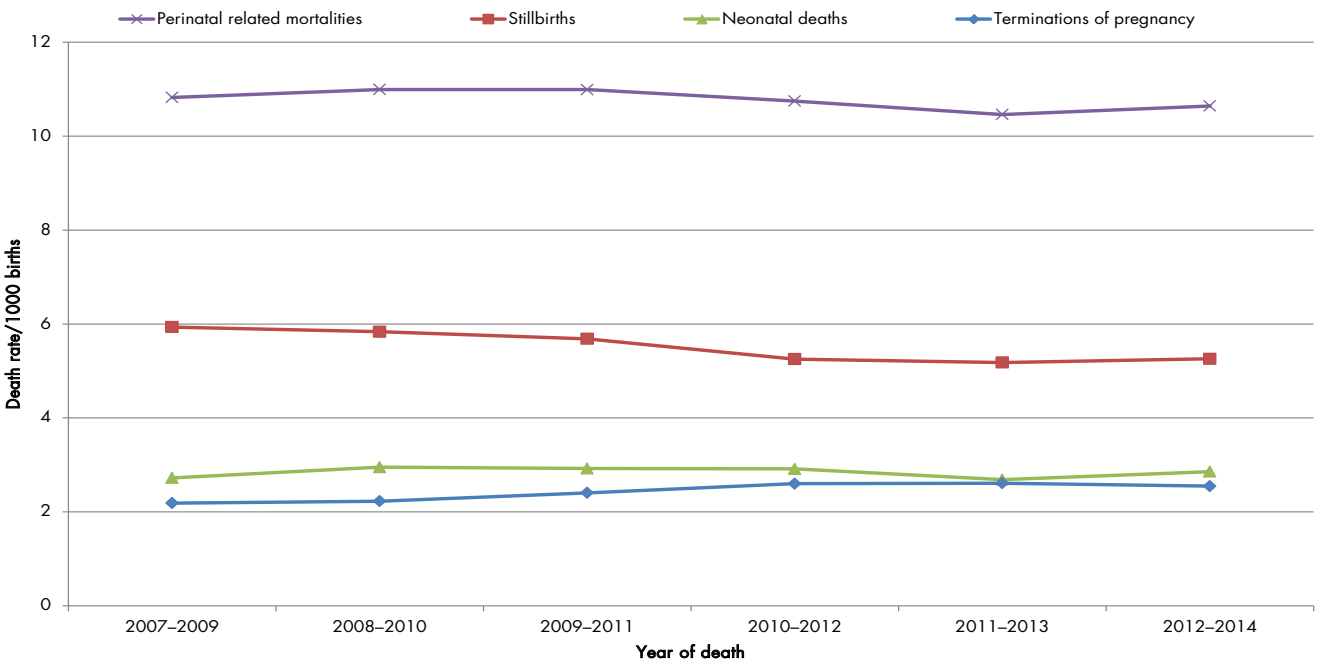
There has been a significant increase in perinatal related deaths from maternal conditions and a significant reduction in hypoxic peripartum deaths from 2007 to 2014 (chi-squared test for trend p=0.02 and p=0.0004 respectively) (Table 1.24).

Table 1.2: Summary of New Zealand perinatal mortality rates 2007–2014

| | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Rate | 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 | | 58,647 | |
| Fetal deaths (terminations of pregnancy and stillbirths)* | 513 | 7.8 | 524 | 8.0 | 547 | 8.6 | 498~ | 7.6 | 503 | 8.0 | 492 | 7.9 | 448~ | 7.5 | 474 | 8.1 |
| Terminations of pregnancy | 144 | 2.2 | 145 | 2.2 | 138 | 2.2 | 151 | 2.3 | 171 | 2.7 | 172 | 2.8 | 141~ | 2.3 | 149 | 2.5 |
| Stillbirths | 369 | 5.6 | 379 | 5.8 | 409 | 6.4 | 347~ | 5.3 | 332 | 5.3 | 320 | 5.1 | 307 | 5.1 | 325 | 5.5 |
| Early neonatal deaths <7 days | 133 | | 134 | | 137 | | 165 | | 138 | | 142 | | 122 | | 150 | |
| Late neonatal deaths 7–27 days | 34 | | 43 | | 46 | | 45 | | 25 | | 36 | | 31 | | 32 | |
| Neonatal deaths <28 days# | 167 | 2.6 | 177 | 2.7 | 183 | 2.9 | 210 | 3.2 | 163 | 2.6 | 178 | 2.9 | 153 | 2.6 | 182 | 3.1 |
| Perinatal mortalities+ | 646 | 9.8 | 658 | 10.0 | 684 | 10.7 | 663~ | 10.2 | 641 | 10.2 | 634 | 10.2 | 570~ | 9.5 | 624 | 10.6 |
| Perinatal related mortalities^ | 680 | 10.4 | 701 | 10.6 | 730 | 11.5 | 708~ | 10.9 | 666 | 10.6 | 670 | 10.7 | 601~ | 10.0 | 656 | 11.2 |
| Perinatal mortalities excluding lethal and terminated fetal abnormalities• | 462 | 7.0 | 488 | 7.4 | 515 | 8.1 | 465 | 7.1 | 445 | 7.1 | 445 | 7.1 | 418 | 7.0 | 446 | 7.6 |
| Perinatal related mortalities excluding lethal and terminated fetal abnormalities• | 482 | 7.3 | 516 | 7.8 | 546 | 8.6 | 496 | 7.6 | 461 | 7.4 | 467 | 7.5 | 437 | 7.3 | 465 | 7.9 |

* 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.
~ Included one late notification.

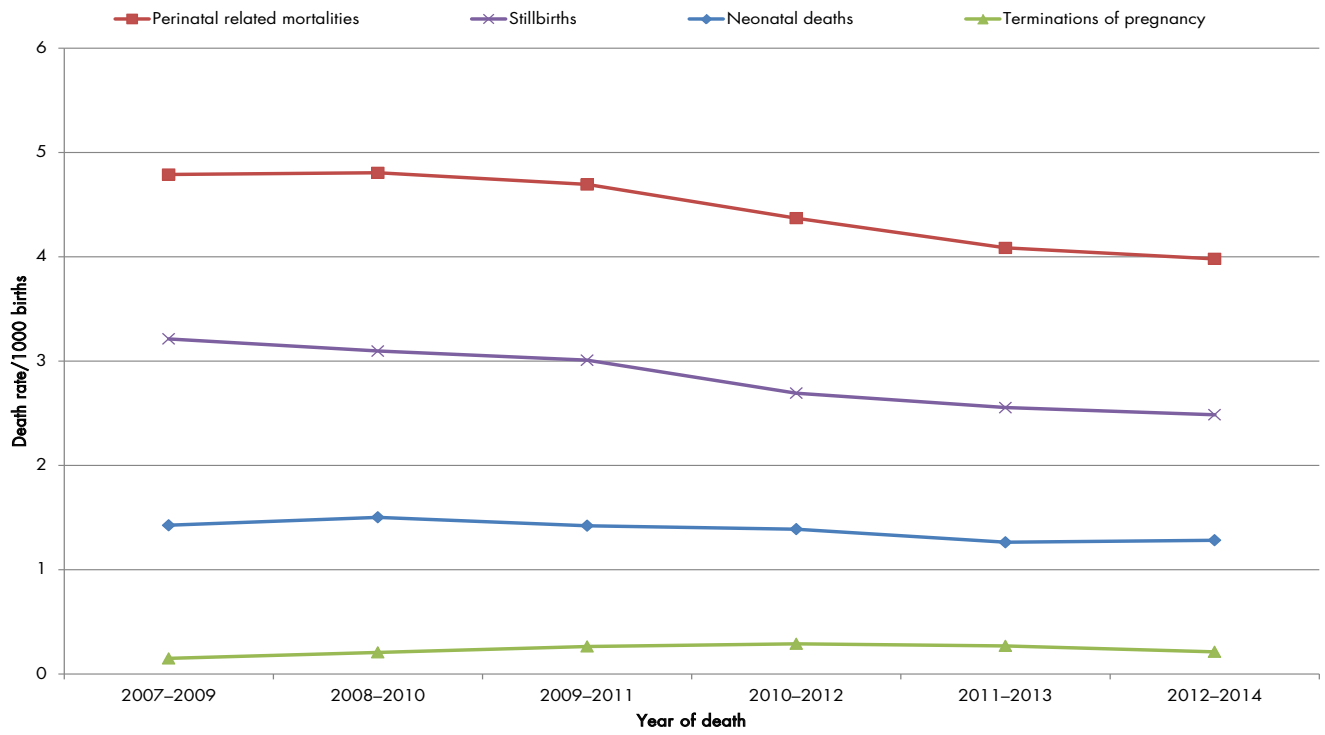
Figure 1.12: Perinatal related mortality rolling three-year rates using New Zealand definitions (per 1000 births) 2007–2014




There has been a significant decrease in the perinatal related mortality and stillbirth rates from 2007 to 2014 (chi-squared test for trend p=0.0013, p=0.0002) using the international definition recommended by the World Health Organization (WHO) of perinatal related deaths from 1000g or from 28 weeks if birthweight is unknown. There has been no significant change in neonatal death or termination of pregnancy rates using the international definition from 2007 to 2014.

Statistically significant reductions in death from antepartum haemorrhage and hypoxic peripartum deaths are at least part responsible for the significant reduction in perinatal related mortality using the international definition.

Figure 1.13: Perinatal related mortality rolling three-year rates using international definitions 2007–2014



## International comparisons

Direct international comparisons of perinatal mortality rates are difficult due to differences in definitions and in ascertainment of cases.

The perinatal mortality rate (stillbirths and deaths under seven days) in England and Wales in 2014 was 6.7/1000 births. The stillbirth rate in England and Wales was 4.7/1000 births in 2014, and the neonatal death rate was 2.7/1000 births (Office for National Statistics 2015). The equivalent rates in New Zealand in 2014 were 7.0/1000 (95% CI 6.3–7.7), 4.4/1000 (95% CI 3.9–5.0), and 3.1/1000 births (95% CI 2.7–3.6) (Table 1.1). All rates in England and Wales are within the 95% CIs of rates from New Zealand and so are not statistically significantly different.

Australia's Mothers and Babies 2013 reported a perinatal death rate of 10/1000 total births for 2013 (Australian Institute of Health and Welfare 2015). The equivalent rate for New Zealand (called perinatal related death rate in New Zealand) was also 10/1000 births.

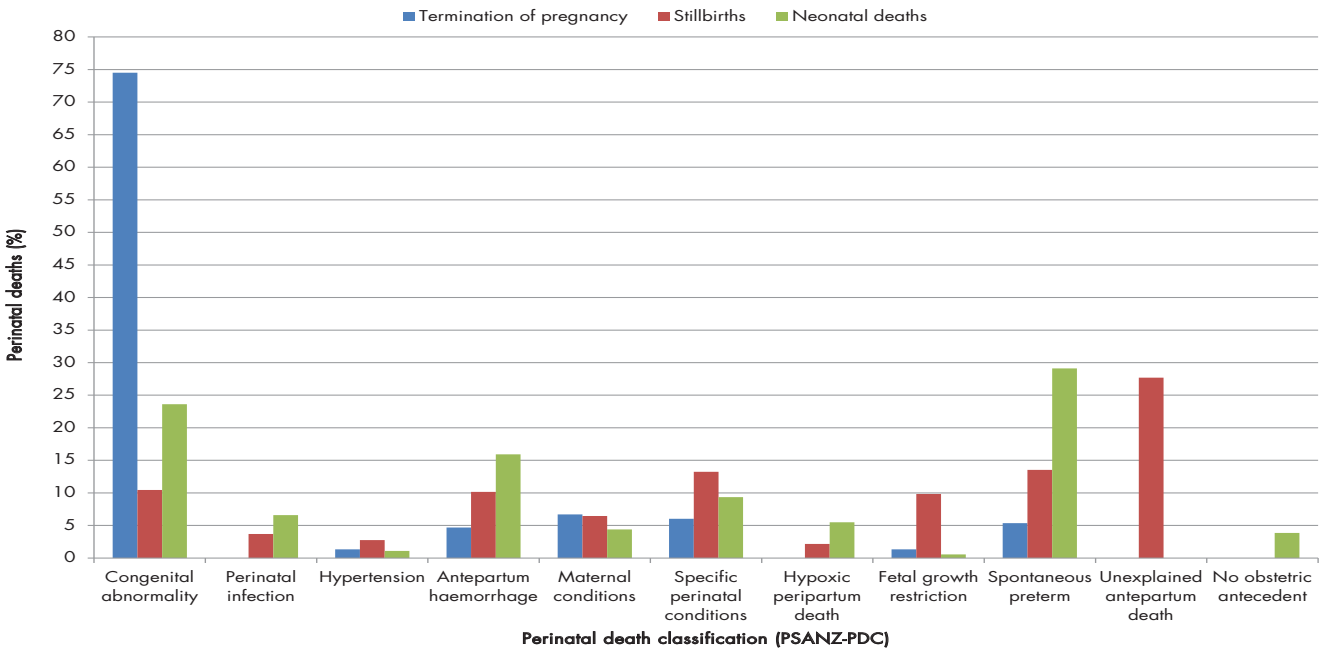
## Causes of perinatal related death

Table 1.3: Perinatal related deaths by primary perinatal death classification (PSANZ-PDC) 2014

| Perinatal death classification (PSANZ-PDC) | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| Congenital abnormality | 111 | 74.5 | 34 | 10.5 | 43 | 23.6 | 188 | 28.7 |
| Perinatal infection | - | - | 12 | 3.7 | 12 | 6.6 | 24 | 3.7 |
| Hypertension | 2 | 1.3 | 9 | 2.8 | 2 | 1.1 | 13 | 2.0 |
| Antepartum haemorrhage | 7 | 4.7 | 33 | 10.2 | 29 | 15.9 | 69 | 10.5 |
| Maternal conditions | 10 | 6.7 | 21 | 6.5 | 8 | 4.4 | 39 | 5.9 |
| Specific perinatal conditions | 9 | 6.0 | 43 | 13.2 | 17 | 9.3 | 69 | 10.5 |
| Hypoxic peripartum death | - | - | 7 | 2.2 | 10 | 5.5 | 17 | 2.6 |
| Fetal growth restriction | 2 | 1.3 | 32 | 9.8 | 1 | 0.5 | 35 | 5.3 |
| Spontaneous preterm | 8 | 5.4 | 44 | 13.5 | 53 | 29.1 | 105 | 16.0 |
| Unexplained antepartum death | - | - | 90 | 27.7 | - | - | 90 | 13.7 |
| No obstetric antecedent | - | - | - | - | 7 | 3.8 | 7 | 1.1 |

Congenital abnormalities are the most common cause of perinatal related death (28.7 percent) using the PSANZ classification system, and 59 percent of these are deaths by termination of pregnancy. The second most common reason for perinatal related death is spontaneous preterm birth (16 percent).

Figure 1.14: Relative distribution of fetal and neonatal deaths by perinatal death classification (PSANZ-PDC) 2014




## Epidemiology and perinatal mortality

### Gender

There is no significant association between gender and perinatal related mortality rate in New Zealand (Table 1.27).

## Maternal age

Maternal age is significantly associated with perinatal related death. Termination of pregnancy, stillbirth and neonatal death are all more frequent at the extremes of maternal age, although there are significant differences in the relationships among these (Figure 1.15). For example, although the 'U-shaped' association is evident for neonatal deaths, neonatal death is significantly more common among mothers under 20 years of age than all other ages of mothers, including mothers 40 years of age and older. Maternal age from 25 to 35 years is associated with the lowest rates of perinatal related mortality.

There have been significant changes in the distribution of maternal age in New Zealand from 2007 to 2014 with a reduction in mothers under 20 years of age and an increase in mothers aged 25–34 years and 40 years and older (Figure 1.4).

Previous analyses have suggested that age is not an independent risk factor for stillbirth and neonatal death after adjusting for the effects of socioeconomic status, ethnicity, BMI, smoking and parity (PMMRC 2014a).

Table 1.4: Perinatal related mortality rates (per 1000 births) by maternal age 2014

| Maternal age (years) | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| <20 | 3,040 | 5.2 | 9 | 6.0 | 2.96 | 26 | 8.0 | 8.55 | 15 | 8.2 | 4.99 | 50 | 7.6 | 16.45 |
| 20–24 | 10,289 | 17.5 | 19 | 12.8 | 1.85 | 63 | 19.4 | 6.12 | 33 | 18.1 | 3.23 | 115 | 17.5 | 11.18 |
| 25–29 | 15,607 | 26.6 | 39 | 26.2 | 2.50 | 78 | 24.0 | 5.00 | 48 | 26.4 | 3.10 | 165 | 25.2 | 10.57 |
| 30–34 | 17,480 | 29.8 | 36 | 24.2 | 2.06 | 89 | 27.4 | 5.09 | 48 | 26.4 | 2.77 | 173 | 26.4 | 9.90 |
| 35–39 | 9,705 | 16.5 | 29 | 19.5 | 2.99 | 53 | 16.3 | 5.46 | 30 | 16.5 | 3.12 | 112 | 17.1 | 11.54 |
| ≥40 | 2,526 | 4.3 | 17 | 11.4 | 6.73 | 15 | 4.6 | 5.94 | 8 | 4.4 | 3.21 | 40 | 6.1 | 15.84 |
| Unknown | - | - | - | - | - | 1 | 0.3 | - | - | - | - | 1 | 0.2 | - |

Figure 1.15: Perinatal related mortality rates (per 1000 births) by maternal age (with 95% CIs) 2007–2014

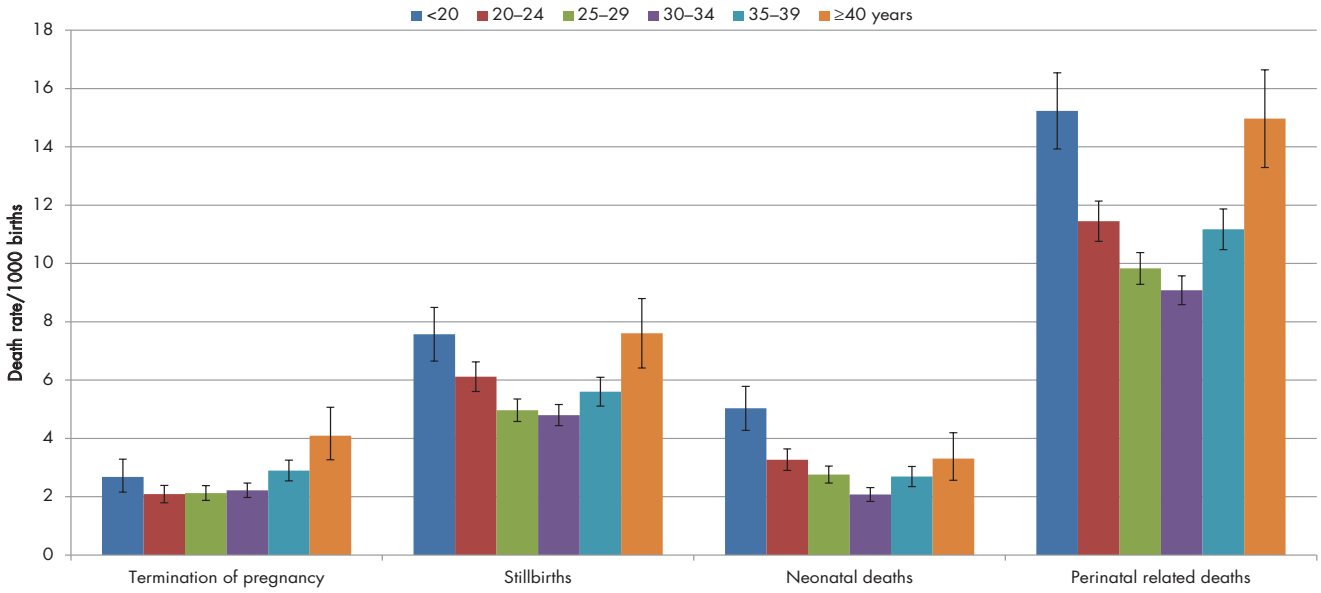
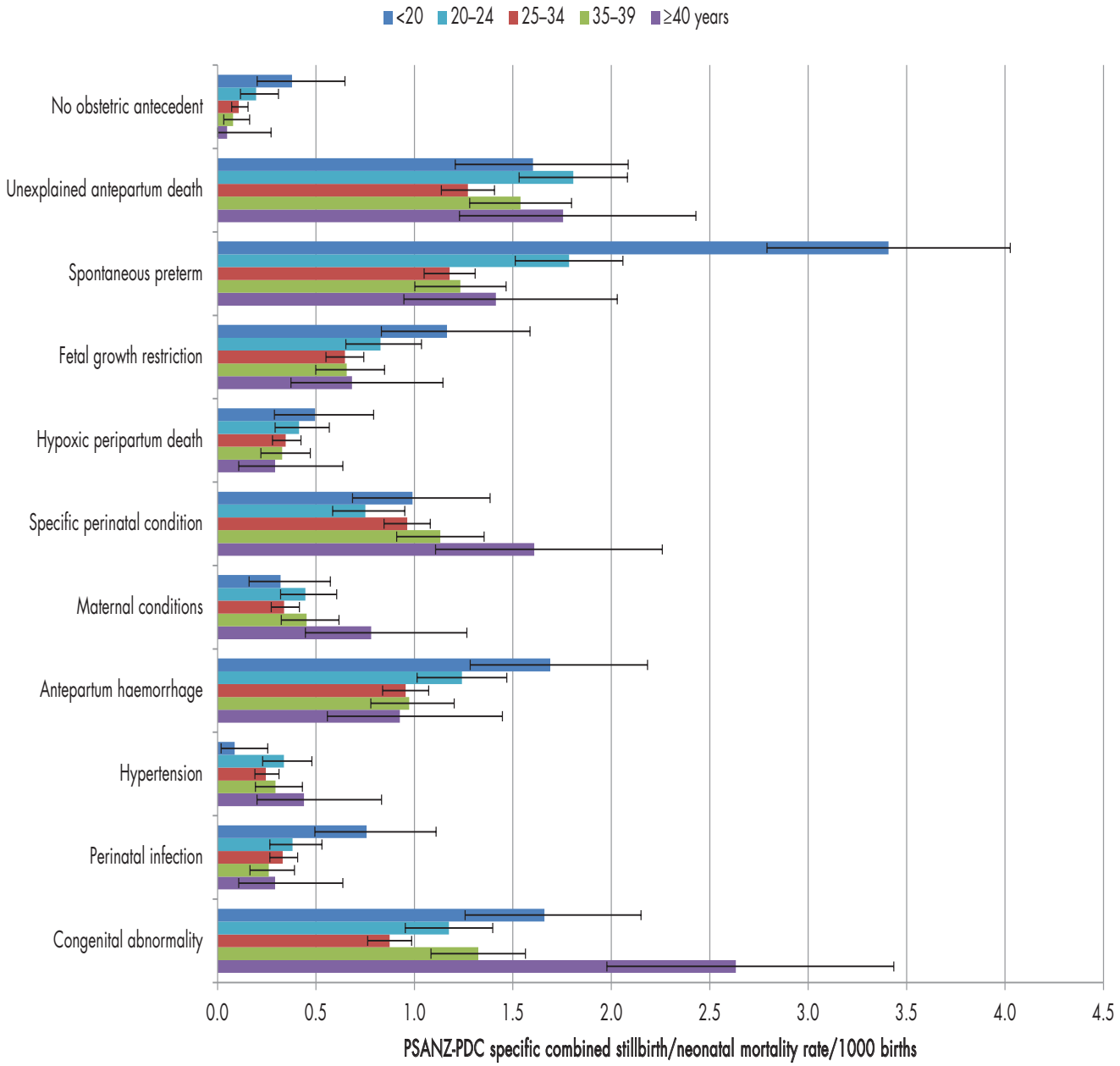


Figure 1.16 illustrates the association between maternal age and cause specific stillbirth and neonatal mortality. Especially noticeable are the associations between young maternal age and death from spontaneous preterm birth, fetal growth restriction, and antepartum haemorrhage, and the association of stillbirth and neonatal death from congenital abnormality with both extremes of maternal age.

The higher rate of combined stillbirth and neonatal death from congenital abnormalities among teenage mothers is due to euploid (non-chromosomal) abnormalities, and among mothers 40 and older it is due to chromosomal abnormalities.

Figure 1.16: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by maternal age (with 95% CIs) 2007–2014



## Ethnicity

Table 1.5: Perinatal related mortality rates (per 1000 births) by maternal prioritised ethnicity 2014

| Ethnicity (mother) | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| Māori | 12,942 | 22.1 | 20 | 13.4 | 1.55 | 88 | 27.1 | 6.80 | 58 | 31.9 | 4.52 | 166 | 25.3 | 12.83 |
| Pacific peoples | 5,878 | 10.0 | 9 | 6.0 | 1.53 | 47 | 14.5 | 8.00 | 27 | 14.8 | 4.64 | 83 | 12.7 | 14.12 |
| Indian | 2,777 | 4.7 | 12 | 8.1 | 4.32 | 18 | 5.5 | 6.48 | 15 | 8.2 | 5.46 | 45 | 6.9 | 16.20 |
| Other Asian | 6,493 | 11.1 | 20 | 13.4 | 3.08 | 19 | 5.8 | 2.93 | 11 | 6.0 | 1.70 | 50 | 7.6 | 7.70 |
| Other (including unknown) | 5,431 | 9.3 | 19 | 12.8 | 3.50 | 21 | 6.5 | 3.87 | 12 | 6.6 | 2.23 | 52 | 7.9 | 9.57 |
| NZ European | 25,126 | 42.8 | 69 | 46.3 | 2.75 | 132 | 40.6 | 5.25 | 59 | 32.4 | 2.37 | 260 | 39.6 | 10.35 |

There is significantly higher perinatal related mortality among the children of mothers of Māori, Pacific and Indian ethnicity compared to mothers of Other Asian, Other (includes Other European, Middle Eastern, Latin American, African), and New Zealand European ethnicity. Termination of pregnancy deaths are significantly less common among Māori and Pacific mothers than mothers of all other ethnicities, and significantly more common among Indian and Other Asian mothers than among New Zealand European and Other ethnicity mothers.

Figure 1.17: Perinatal related mortality rates (per 1000 births) by maternal prioritised ethnicity (with 95% CIs) 2007–2014

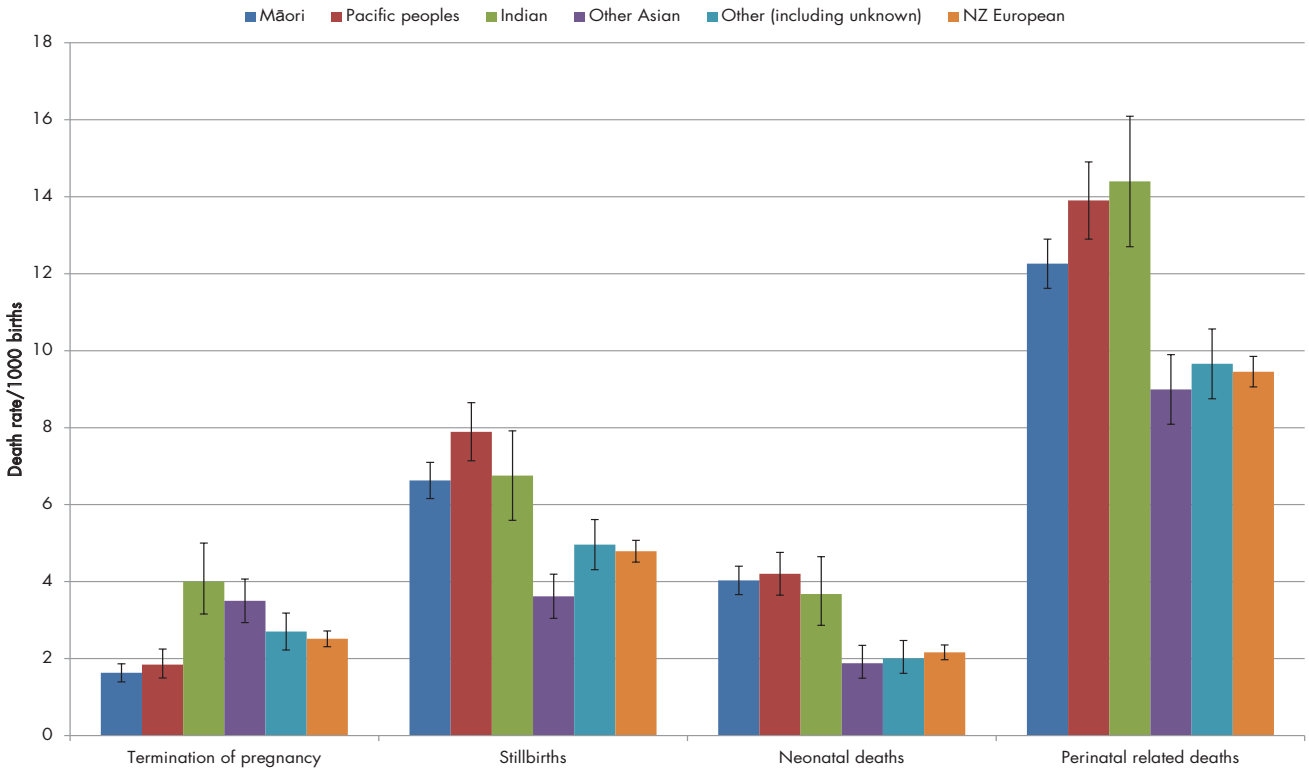



Figure 1.18 illustrates the associations between maternal prioritised ethnicity and cause specific combined stillbirth and neonatal mortality rates.

Babies of Māori and Pacific mothers are at increased risk of combined stillbirth or neonatal mortality, compared to at least two other ethnic groups, from death without obstetric antecedent (mostly sudden unexpected death in infancy (SUDI)), unexplained antepartum death, spontaneous preterm birth, maternal conditions, and antepartum haemorrhage. Babies of Pacific mothers are also at increased risk of stillbirth or neonatal death from hypertension and congenital abnormality.

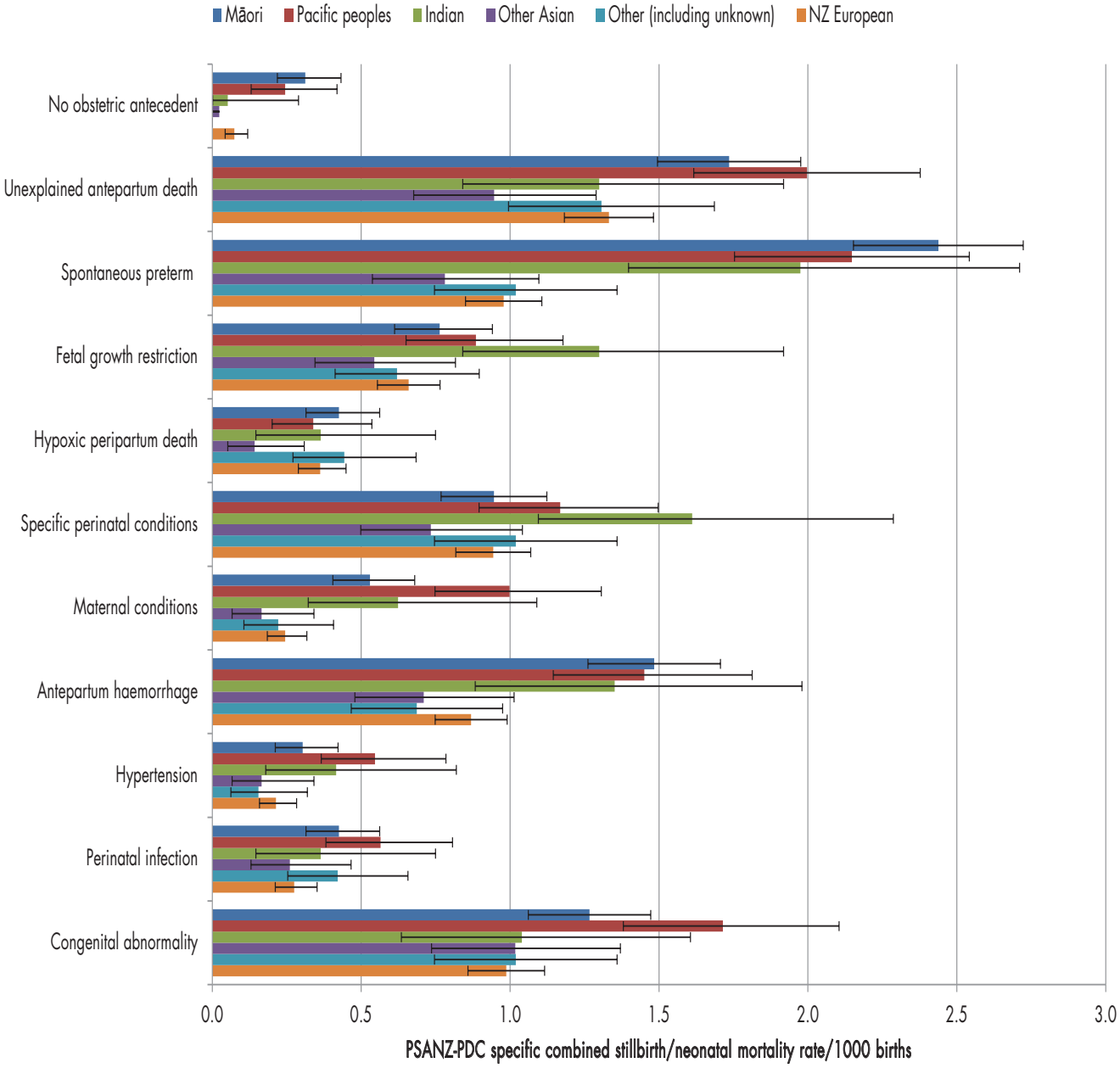
### *Māori perinatal related mortality*

Multivariate analysis of stillbirths and neonatal deaths from 2007 to 2012 showed that only the association of Māori ethnicity with neonatal death from 20-27 weeks was significant after adjustment for the effects of socioeconomic deprivation, maternal age, smoking, parity and BMI (PMMRC 2014a). This analysis highlights the importance of addressing amenable factors such as smoking, BMI, and socioeconomic deprivation in order to reduce Māori stillbirths and late neonatal deaths.

### *Indian perinatal related mortality*

It is more difficult to determine the important causes for increased stillbirth or neonatal mortality rates among babies of Indian mothers as absolute numbers of deaths and births are small. However, there are significant increases in risk compared to at least two other ethnic groups, from spontaneous preterm birth, fetal growth restriction, and specific perinatal conditions (most commonly twin-to-twin transfusion, feto-maternal haemorrhage, and alloimmune disease).

Figure 1.18: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding termination of pregnancy) by maternal prioritised ethnicity 2007–2014



## Socioeconomic disadvantage

Table 1.6: Perinatal related mortality rates (per 1000 births) by deprivation quintile (NZDep2013) 2014

| Deprivation quintile (NZDep2013) | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| 1 (least deprived) | 9,317 | 15.9 | 31 | 20.8 | 3.33 | 41 | 12.6 | 4.40 | 13 | 7.1 | 1.41 | 85 | 13.0 | 9.12 |
| 2 | 10,283 | 17.5 | 23 | 15.4 | 2.24 | 51 | 15.7 | 4.96 | 19 | 10.4 | 1.86 | 93 | 14.2 | 9.04 |
| 3 | 11,366 | 19.4 | 37 | 24.8 | 3.26 | 53 | 16.3 | 4.66 | 34 | 18.7 | 3.02 | 124 | 18.9 | 10.91 |
| 4 | 12,262 | 20.9 | 28 | 18.8 | 2.28 | 76 | 23.4 | 6.20 | 43 | 23.6 | 3.54 | 147 | 22.4 | 11.99 |
| 5 (most deprived) | 15,141 | 25.8 | 27 | 18.1 | 1.78 | 103 | 31.7 | 6.80 | 72 | 39.6 | 4.80 | 202 | 30.8 | 13.34 |
| Unknown | 278 | 0.5 | 3 | 2.0 | - | 1 | 0.3 | - | 1 | 0.5 | - | 5 | 0.8 | - |

Figure 1.19: Perinatal related mortality rates (per 1000 births) by deprivation quintile (with 95% CIs) 2007–2014

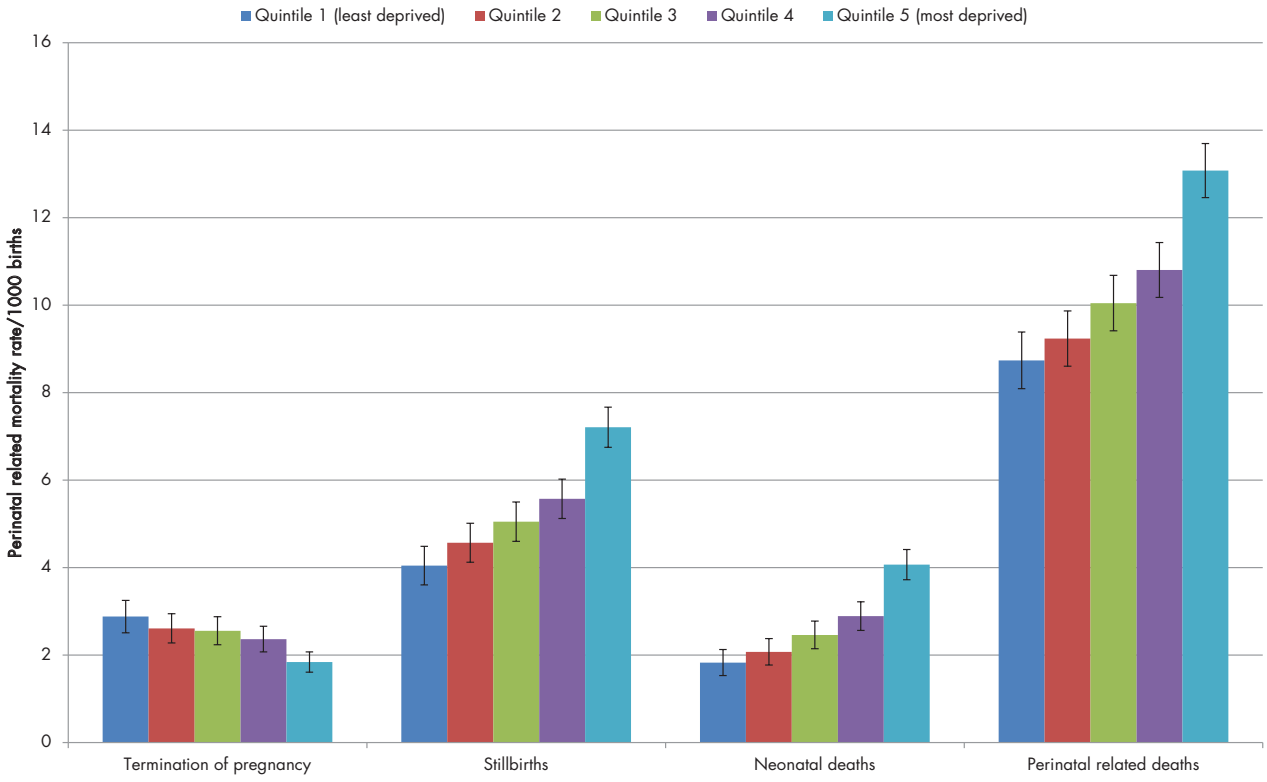



Figure 1.19 illustrates the clear associations between increased socioeconomic deprivation and perinatal related mortality. Paradoxically, there is an increase in perinatal related death from termination of pregnancy with decreasing socioeconomic deprivation and an increase in stillbirth and neonatal death with increasing deprivation.

The increase in death from termination of pregnancy among babies of mothers with decreasing deprivation may be due to increased access to antenatal diagnostic and/or termination of pregnancy services, or to increased risk of abnormalities and diseases leading to termination of pregnancy.

Similarly, the mechanisms for increased stillbirth and neonatal death with increasing socioeconomic deprivation are not well described, and similarly may involve a combination of access and disease risk factors. The importance of access is supported by the association between socioeconomic status and access and/or engagement with care contributory factors to perinatal related death (Figure 1.34).

In multivariate analysis, increasing socioeconomic deprivation was independently associated with increased risk of neonatal mortality after birth at 20 to 27 weeks.

Figure 1.20: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile (with 95% CIs) 2007–2014

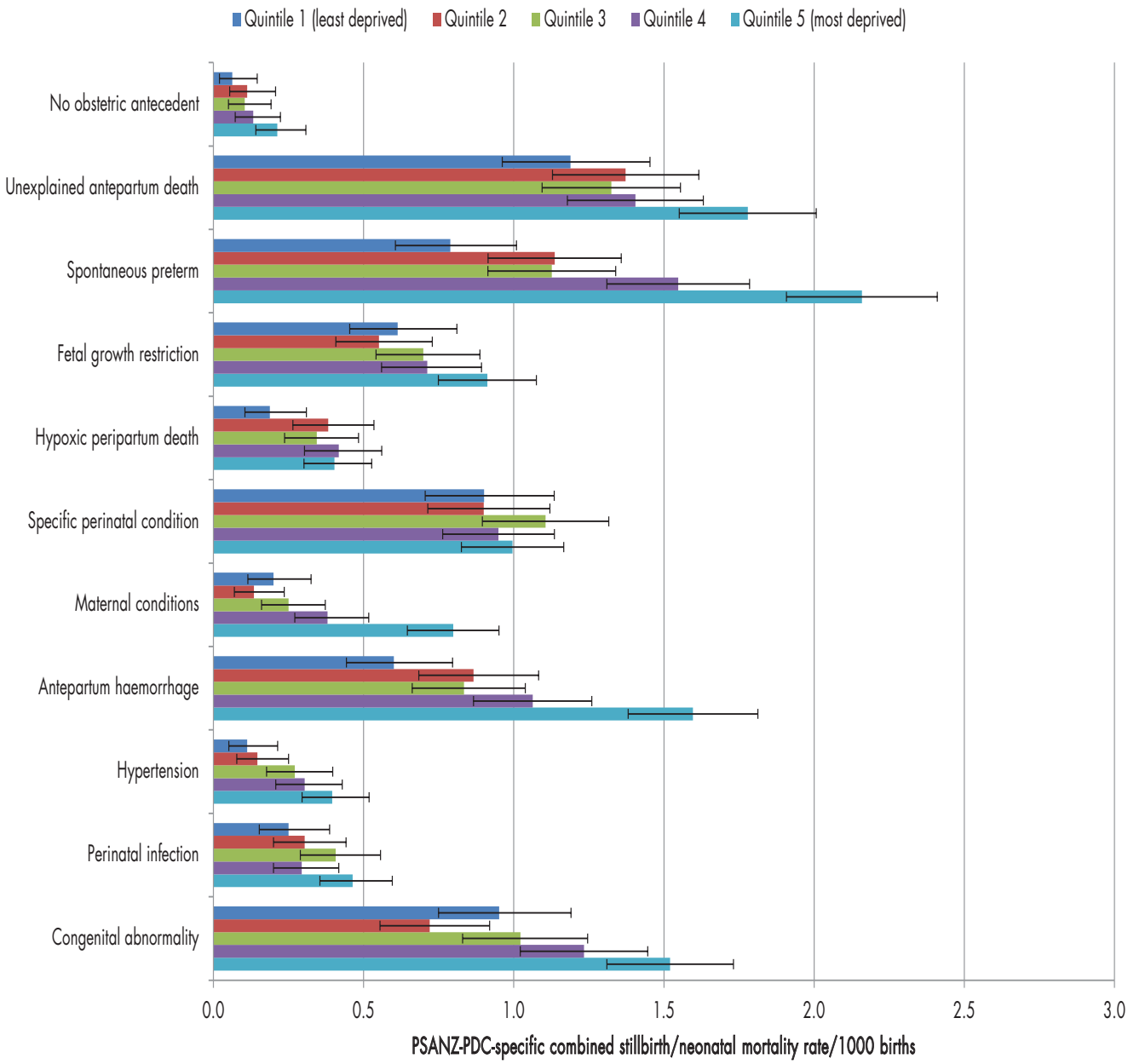


Figure 1.20 illustrates the associations between socioeconomic deprivation quintile and cause specific stillbirth and neonatal mortality rates. There is a significant increase in all causes of stillbirth and neonatal death other than specific perinatal conditions (mostly complications associated with multiple pregnancy) with increasing socioeconomic deprivation.

## Body mass index

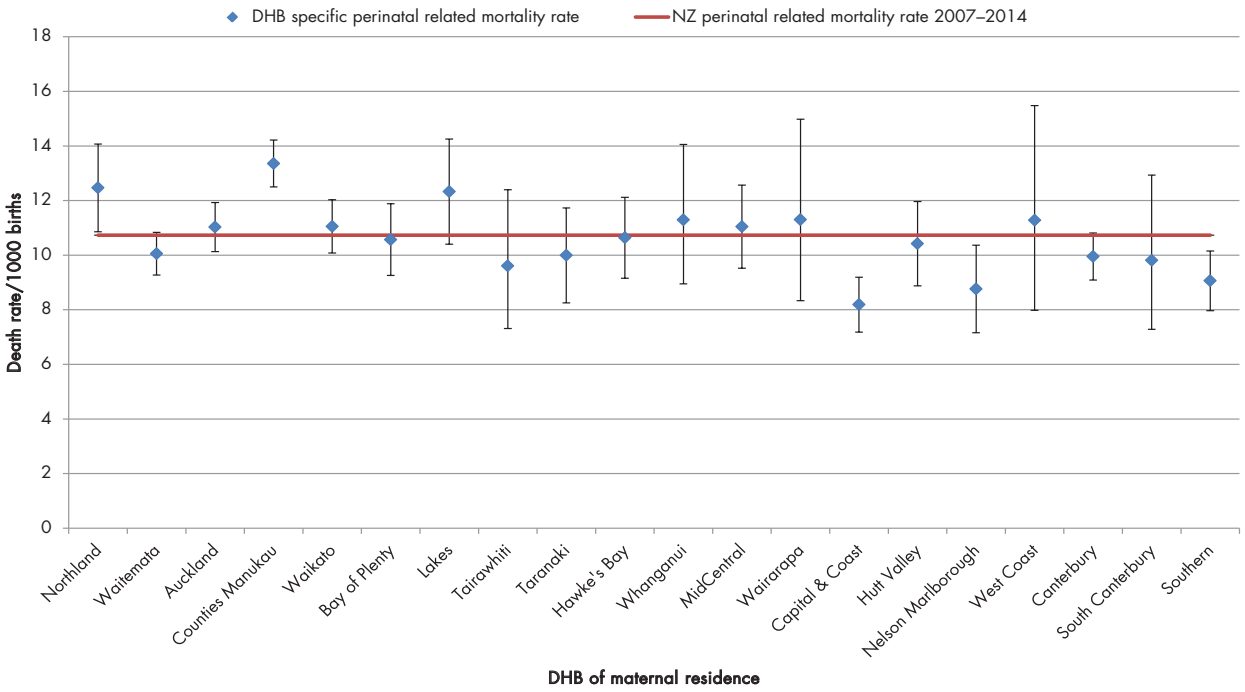
Table 1.7: Maternal body mass index (BMI) among perinatal related deaths 2014

| Maternal BMI (kg/m²) | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| <18.50 | 1 | 0.7 | 11 | 3.4 | 3 | 1.6 | 15 | 2.3 |
| 18.50–24.99 | 78 | 52.3 | 124 | 38.2 | 68 | 37.4 | 270 | 41.2 |
| 25.00–29.99 | 42 | 28.2 | 83 | 25.5 | 49 | 26.9 | 174 | 26.5 |
| 30.00–34.99 | 13 | 8.7 | 48 | 14.8 | 33 | 18.1 | 94 | 14.3 |
| 35.00–39.99 | 9 | 6.0 | 31 | 9.5 | 14 | 7.7 | 54 | 8.2 |
| ≥40 | 3 | 2.0 | 24 | 7.4 | 12 | 6.6 | 39 | 5.9 |

Among mothers of babies who died in the perinatal period in 2014, 28.4 percent had a reported BMI of 30 or higher, and this was 31.7 percent among mothers of stillbirths. The MAT dataset reported 24.8 percent of mothers of births in 2014 had a BMI of 30 or higher. Approximately 5 percent of mothers have missing BMI data in MAT. It is unlikely that including these data would negate the apparent higher rate of obesity among mothers of perinatal related deaths. This finding is consistent with reported findings of an association between obesity and perinatal mortality (American Congress of Obstetricians and Gynecologists 2015).

## DHB of residence

Figure 1.21: Crude perinatal related mortality rates (per 1000 births) by DHB of residence (mother) compared to New Zealand perinatal related mortality (with 95% CIs) 2007–2014




The red line in Figure 1.21 represents the New Zealand rate of perinatal related mortality for 2007–2014 (10.73/1000 births). DHB rates are compared to the national rate, represented by the point estimate for 2007–2014 and a 95% CI. If the CI includes the New Zealand rate then the DHB rate is not statistically significantly different from the national rate. But where the CI does not include the national rate this means that the regional rate is significantly different.

Perinatal related mortality rates for Capital & Coast, Nelson Marlborough and Southern DHBs are significantly lower than the national rate, and the rates for Northland and Counties Manukau DHBs are significantly higher than the national rate.

As with all factors associated with perinatal related mortality presented in this report, the association is univariate and does not account for potential confounding factors, and does not explain the causes for increased or decreased mortality. It is possible that different regions are able to provide more or better care to mothers and babies; but also probable that the differences are explained by significant differences in demographic risk factors by region, as illustrated in section 1.3: Births in New Zealand 2014.

Stillbirth and neonatal death rates by DHB are shown in Figures 1.35 and 1.36. The neonatal death rate among women residing in Waikato and Bay of Plenty DHB regions were significantly higher than the national rate of 2.83/1000 live births from 2007 to 2014.

DHB specific reports, comparing the intervals 2007–2010 and 2011–2014, will be provided to all regions in 2016.

## Maternal smoking, alcohol and substance use

Table 1.8: Maternal smoking, alcohol and substance use at the time of perinatal related death 2014

| | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| **Currently smoking** | | | | | | | | |
| Yes | 13 | 8.7 | 83 | 25.5 | 44 | 24.2 | 140 | 21.3 |
| No | 135 | 90.6 | 241 | 74.2 | 138 | 75.8 | 514 | 78.4 |
| **Smoking history (among current non-smokers)** | | | | | | | | |
| Never smoked | 99 | 66.4 | 180 | 55.4 | 92 | 50.5 | 371 | 56.6 |
| Stopped before this pregnancy | 26 | 17.4 | 43 | 13.2 | 23 | 12.6 | 92 | 14.0 |
| Stopped <16 weeks gestation | 6 | 4.0 | 11 | 3.4 | 18 | 9.9 | 35 | 5.3 |
| Stopped ≥16 weeks gestation | - | - | 4 | 1.2 | 2 | 1.1 | 6 | 0.9 |
| Unknown | 4 | 2.7 | 3 | 0.9 | 3 | 1.6 | 10 | 1.5 |
| Unknown | 1 | 0.7 | 1 | 0.3 | - | - | 2 | 0.3 |
| **Alcohol and substance use** | | | | | | | | |
| Yes | 9 | 6.0 | 31 | 9.5 | 14 | 7.7 | 54 | 8.2 |
| No | 131 | 87.9 | 269 | 82.8 | 154 | 84.6 | 554 | 84.5 |
| Unknown | 9 | 6.0 | 25 | 7.7 | 14 | 7.7 | 48 | 7.3 |
| **Specific drugs** | | | | | | | | |
| Alcohol | 8 | 5.4 | 16 | 4.9 | 10 | 5.5 | 34 | 5.2 |
| Amphetamine/P | - | - | 5 | 1.5 | - | - | 5 | 0.8 |
| Herbal highs | - | - | - | - | 1 | 0.5 | 1 | 0.2 |
| Marijuana | 1 | 0.7 | 10 | 3.1 | 6 | 3.3 | 17 | 2.6 |
| Methadone | 1 | 0.7 | 2 | 0.6 | - | - | 3 | 0.5 |

There has been a decrease in the proportion of current smokers among mothers of perinatal related deaths from around 30 percent in 2007–2009 to 21 percent in 2014. This is associated with other changes in demography among the birthing population (eg, an increase in the proportion of Other Asian mothers, a reduction in births among women under 20 years of age who have a high rate of smoking) and probably reflects a reduction in smoking in the general population. The New Zealand Health Survey data show a statistically significant reduction in current smoking among women in New Zealand from 18.9 percent in 2006/2007 to 15.0 percent in 2014/2015 (Ministry of Health 2015a).

However, smoking rates are higher among mothers of babies who died than among mothers in the birthing population in New Zealand. In the MAT dataset the proportion of women smoking either at registration or at two weeks postpartum in 2014 among women with known smoking status was 15.9 percent.

## Table 1.9: Maternal smoking cessation support offered and perinatal related death 2014

| 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=49 | | n=144 | | n=90 | | n=283 | |
| | n | % | n | % | n | % | n | % |
| No | 25 | 51.0 | 43 | 29.9 | 25 | 27.8 | 93 | 32.9 |
| Yes – by LMC only | 11 | 22.4 | 30 | 20.8 | 15 | 16.7 | 56 | 19.8 |
| Yes – referred to external agents | 1 | 2.0 | 12 | 8.3 | 15 | 16.7 | 28 | 9.9 |
| Yes – referral declined | 7 | 14.3 | 31 | 21.5 | 14 | 15.6 | 52 | 18.4 |
| Unknown | 5 | 10.2 | 28 | 19.4 | 21 | 23.3 | 54 | 19.1 |

LMC = lead maternity carer.

In 2014, among mothers of perinatal related deaths, smoking cessation support was offered to approximately half of mothers.

## Gestation and birthweight and perinatal related mortality

In this report, gestational age categories have been changed in line with national and international evidence of survival of babies born at 23 weeks, which is more in line with survival at 24 weeks than at 20–22 weeks. And so throughout this report, gestational age has been categorised as 20–22 weeks, 23–24 weeks, 25–27, and then 28–31, 32–36, 37–40, and ≥41, as previously.

Table 1.10: Perinatal related mortality rates (per 1000 births) by gestation and birthweight 2014

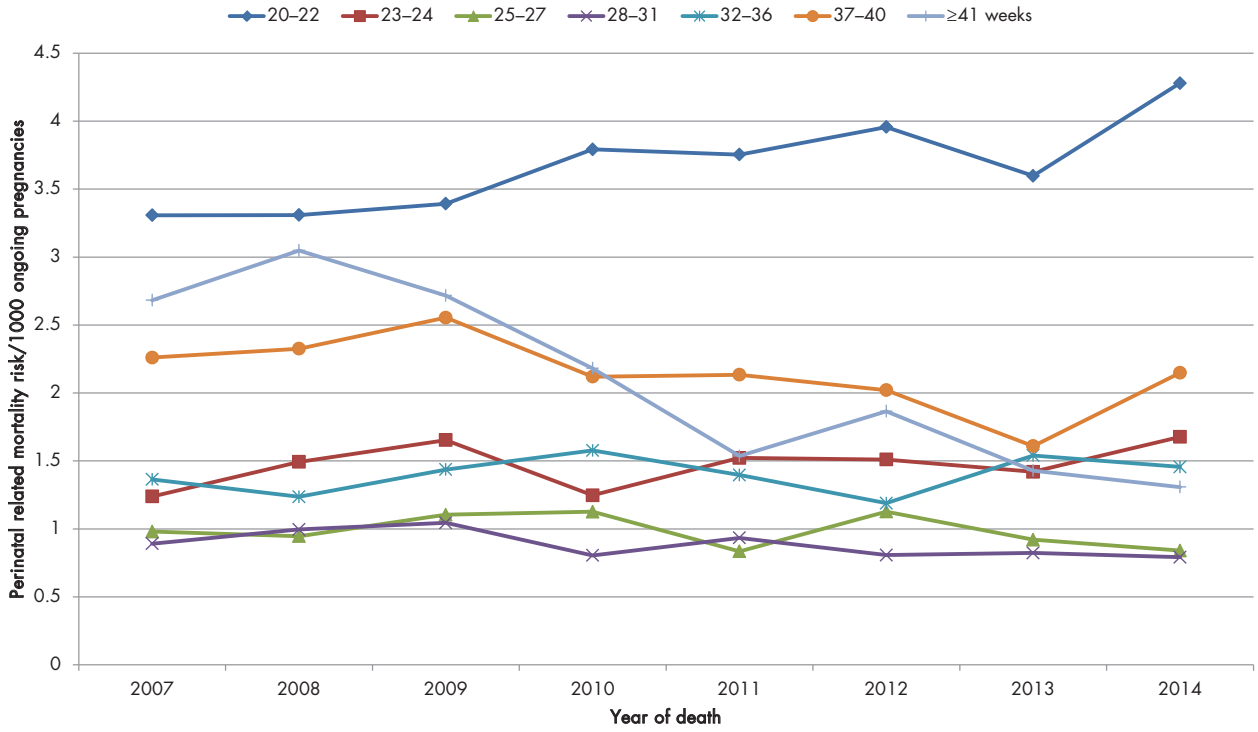
| | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| **Gestation at birth (weeks)** | | | | | | | | | | | | | | |
| 20–22 | 207 | 0.4 | 90 | 60.4 | * | 109 | 33.5 | * | 52 | 28.6 | * | 251 | 38.3 | * |
| 23–24 | 136 | 0.2 | 31 | 20.8 | * | 28 | 8.6 | * | 39 | 21.4 | * | 98 | 14.9 | * |
| 25–27 | 183 | 0.3 | 10 | 6.7 | 54.64 | 25 | 7.7 | 136.61 | 14 | 7.7 | 94.59 | 49 | 7.5 | 267.76 |
| 28–31 | 457 | 0.8 | 7 | 4.7 | 15.32 | 31 | 9.5 | 67.83 | 8 | 4.4 | 19.09 | 46 | 7.0 | 100.66 |
| 32–36 | 3,661 | 6.2 | 5 | 3.4 | 1.37 | 57 | 17.5 | 15.57 | 22 | 12.1 | 6.11 | 84 | 12.8 | 22.94 |
| 37–40 | 44,826 | 76.4 | 6 | 4.0 | 0.13 | 72 | 22.2 | 1.61 | 38 | 20.9 | 0.85 | 116 | 17.7 | 2.59 |
| ≥41 | 9,157 | 15.6 | - | - | - | 3 | 0.9 | 0.33 | 9 | 4.9 | 0.98 | 12 | 1.8 | 1.31 |
| Unknown | 20 | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - |
| **Birthweight (g)** | | | | | | | | | | | | | | |
| <500 | 242 | 0.4 | 88 | 59.1 | * | 116 | 35.7 | * | 45 | 24.7 | * | 249 | 38.0 | * |
| 500–999 | 305 | 0.5 | 47 | 31.5 | 154.10 | 59 | 18.2 | 193.44 | 55 | 30.2 | 276.38 | 161 | 24.5 | 527.87 |
| 1000–1499 | 339 | 0.6 | 6 | 4.0 | 17.70 | 22 | 6.8 | 64.90 | 12 | 6.6 | 38.59 | 40 | 6.1 | 117.99 |
| 1500–1999 | 636 | 1.1 | 4 | 2.7 | 6.29 | 18 | 5.5 | 28.30 | 12 | 6.6 | 19.54 | 34 | 5.2 | 53.46 |
| 2000–2499 | 2,185 | 3.7 | 2 | 1.3 | 0.92 | 28 | 8.6 | 12.81 | 13 | 7.1 | 6.03 | 43 | 6.6 | 19.68 |
| 2500–2999 | 8,147 | 13.9 | - | - | - | 31 | 9.5 | 3.81 | 13 | 7.1 | 1.60 | 44 | 6.7 | 5.40 |
| 3000–3499 | 19,781 | 33.7 | 1 | 0.7 | 0.05 | 27 | 8.3 | 1.36 | 18 | 9.9 | 0.91 | 46 | 7.0 | 2.33 |
| 3500–3999 | 18,491 | 31.5 | - | - | - | 15 | 4.6 | 0.81 | 11 | 6.0 | 0.60 | 26 | 4.0 | 1.41 |
| 4000–4499 | 7,013 | 12.0 | - | - | - | 6 | 1.8 | 0.86 | 2 | 1.1 | 0.29 | 8 | 1.2 | 1.14 |
| ≥4500 | 1,482 | 2.5 | - | - | - | - | - | - | 1 | 0.5 | 0.67 | 1 | 0.2 | 0.67 |

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

There has been a reduction in the numbers of deaths of babies 4000g and above and in the rate of these deaths. This is in line with the reduction in perinatal related mortality at term.

In parallel there has been a reduction in births of babies at 40+ weeks and coincidentally a reduction in births of babies 4000g and above. This is presumably due to increased iatrogenic birth at term, probably both induction of labour and elective caesarean birth. It is probable that this explains at least some of the reduction in term perinatal related stillbirth.

Figure 1.22: Perinatal related mortality risk (per 1000 ongoing pregnancies) by gestational age at birth 2007–2014




There is a statistically significant increase in perinatal related mortality risk among ongoing pregnancies at 20–22 weeks gestation (p=0.0016) (Table 1.41). Specifically there is a significant increase in stillbirth and neonatal death among ongoing pregnancies at 20–22 weeks gestation (p=0.019, p=0.0052 respectively) (Table 1.42) but no increase in termination of pregnancy at this gestation.

There is a significant reduction in perinatal related mortality risk among pregnancies at term (37–40 and 41+ weeks at birth), (p=0.017, p=0.00028 respectively) (Table 1.41).

Perinatal death classification (PSANZ-PDC and PSANZ-NDC) of fetal and neonatal deaths by gestational age at birth are available in Tables 1.43 and 1.44.

### Stillbirth

The significant reduction from 2007 to 2014 in perinatal related mortality from 37 weeks is due to a significant reduction in stillbirths (Figure 1.23) due to perinatal infection, antepartum haemorrhage and from hypoxic peripartum death (Table 1.45). Neonatal death rates have remained unchanged.

Figure 1.23: Stillbirth risk (per 1000 ongoing pregnancies) by gestational age at birth and year 2007–2014

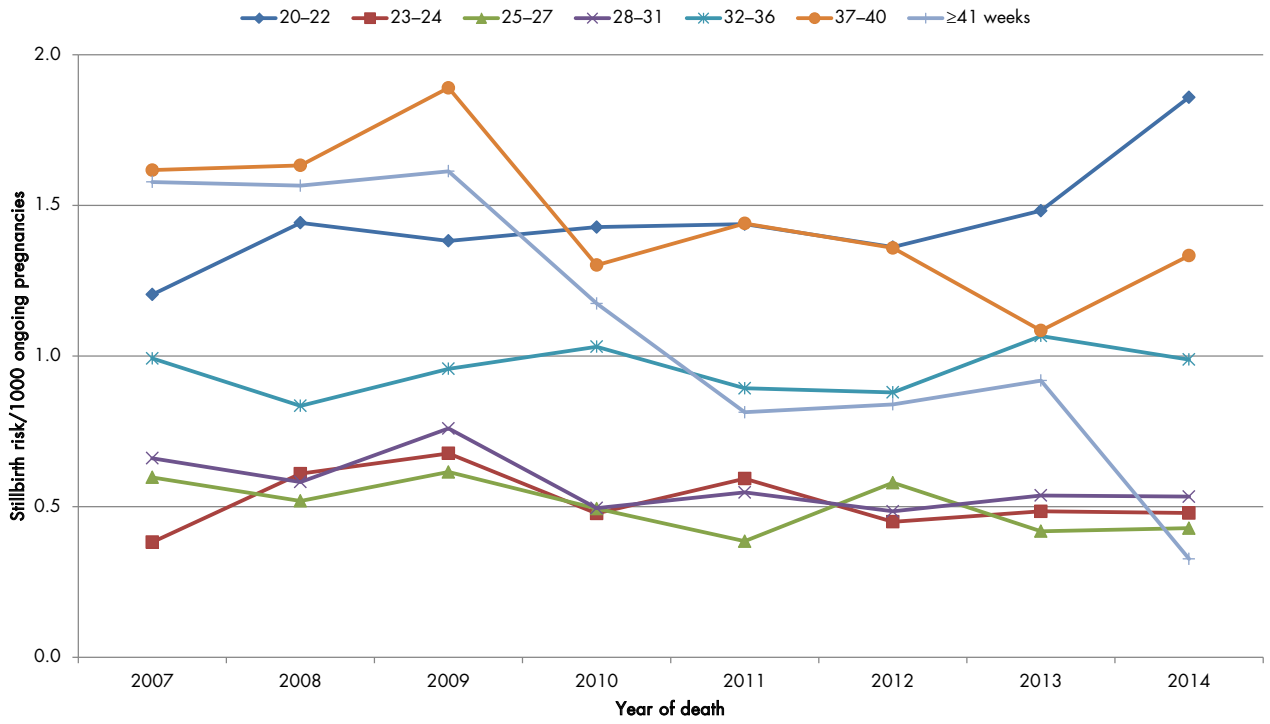
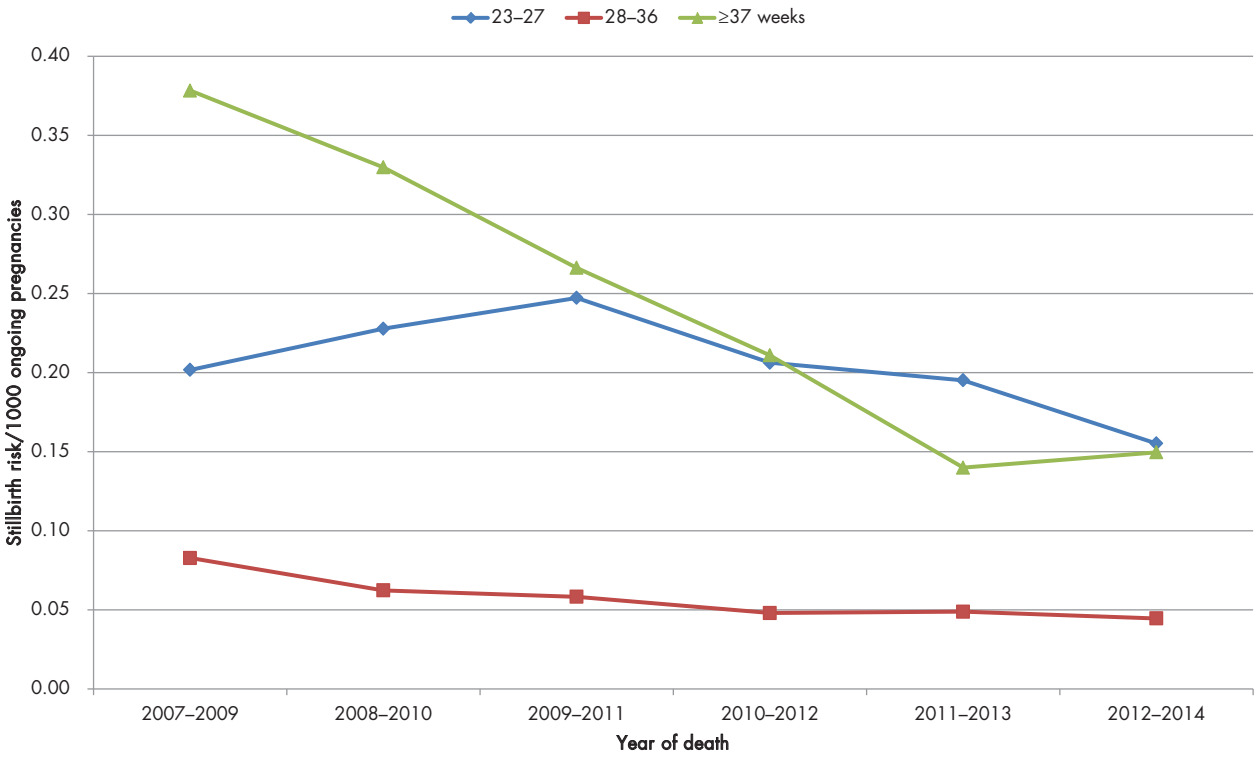



Table 1.11: Timing of stillbirths relative to labour by gestation 2014

| Timing of stillbirth | All stillbirths | | Stillbirths ≥23 weeks | | Stillbirths ≥37 weeks | | Stillbirths ≥37 weeks without congenital abnormality | |
|---|---|---|---|---|---|---|---|---|
| | n=325 | | n=216 | | n=75 | | n=68 | |
| | n | % | n | % | n | % | n | % |
| **Antepartum** | 218 | 67.1 | 175 | 81.0 | 54 | 72.0 | 50 | 73.5 |
| **Intrapartum – total** | 75 | 23.1 | 25 | 11.6 | 13 | 17.3 | 10 | 14.7 |
| Intrapartum – first stage | 33 | 10.2 | 12 | 5.6 | 6 | 8.0 | 6 | 8.8 |
| Intrapartum – second stage | 9 | 2.8 | 5 | 2.3 | 3 | 4.0 | 3 | 4.4 |
| Intrapartum – unknown stage | 33 | 10.2 | 8 | 3.7 | 4 | 5.3 | 1 | 1.5 |
| **Unknown** | 32 | 9.8 | 16 | 7.4 | 8 | 10.7 | 8 | 11.8 |

In 2014, there were 25 known intrapartum deaths from 23 weeks, and 13 at term (37+ weeks gestation).

Figure 1.24: Intrapartum stillbirth rolling three-year risks (per 1000 ongoing pregnancies) by gestation at birth (weeks) excluding congenital abnormalities 2007–2014




There has been a statistically significant reduction in intrapartum stillbirth risk as a proportion of ongoing pregnancies at term. This is consistent with and probably due to a significant reduction in hypoxic peripartum deaths.

In 2014, there were 17 hypoxic peripartum deaths. Sixteen were from 37 weeks, six of whom contributed to the 10 intrapartum stillbirths at term in 2014 (the remaining four intrapartum stillbirths were due to fetal growth restriction, maternal conditions, unexplained antepartum death). In 2007 there were 25 intrapartum stillbirths at term. Eighteen were hypoxic peripartum deaths (the remaining seven were due to perinatal infection, antepartum haemorrhage, specific perinatal conditions, and fetal growth restriction).

There appears to be a small reduction in intrapartum stillbirths at 23–27 and 28–36 weeks gestation, but this is not statistically significant (chi-squared test for trend p=0.65 and p=0.16 respectively).

## Unexplained antepartum death

In 2015, a review of the placental and post-mortem pathology of unexplained antepartum deaths showed that 17 percent of babies classified as unexplained antepartum death from 2007 to 2013 were misclassified, 4 percent because there was another underlying pathology, and 13 percent because there was a placental abnormality which has been shown to be consistently associated with perinatal related death. There is no current category in the PSANZ-PDC for these latter placental abnormalities and so the PMMRC has recommended a change to the PSANZ classification to allow these babies to be identified as having a cause of death.

## Termination of pregnancy

There has been a significant increase in the late termination of pregnancy rate from 2007 to 2014 (chi-squared test for trend p=0.04) from 2.2/1000 total births in 2007 to 2.5/1000 total births in 2014.

Terminations of pregnancy from 20 weeks gestation at issue contributed 22.7 percent of perinatal related deaths in 2014; 74.5 percent of these were associated with congenital abnormalities.

There were 28 terminations of pregnancy after 24 weeks in 2014. The primary antecedent classifications for these deaths were congenital abnormality in 16, and hypertension, maternal conditions, specific perinatal conditions, fetal growth restriction, and spontaneous preterm birth in the remainder.

## Neonatal death

There were 182 neonatal deaths in 2014 contributing 27.7 percent of all perinatal related mortalities. Almost one-quarter (24.7 percent) of neonatal deaths were babies with congenital abnormalities. Of the remainder, 38 percent died before 23 weeks and 66 percent before 25 weeks. Twenty-four neonates (17.5 percent) died at term.

None of the neonatal deaths at 20–22 weeks were resuscitated at birth, while 7/21 (33 percent) at 23 weeks and 16/18 (89 percent) at 24 weeks were resuscitated. One-third of term neonates who died were not resuscitated. These babies died of infection after one week or died of SUDI.

The association between PSANZ-PDC and PSANZ-NDC cause of death classifications for 2014 is shown in Table 1.47.

Table 1.12: Clinical details of neonatal deaths 2014

| | Total | | Congenital abnormalities | | Neonatal deaths excluding congenital abnormalities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 20–22 | | 23–24 | | 25–27 | | 28–36 | | ≥37 weeks | |
| | n=182 | | n=45 | | n=52 | | n=39 | | n=12 | | n=10 | | n=24 | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| **Age at death (days)** | | | | | | | | | | | | | | |
| 0 | 95 | 52.2 | 17 | 37.8 | 46 | 88.5 | 20 | 51.3 | 4 | 33.3 | 3 | 30.0 | 5 | 20.8 |
| 1–6 | 55 | 30.2 | 15 | 33.3 | 6 | 11.5 | 10 | 25.6 | 7 | 58.3 | 5 | 50.0 | 12 | 50.0 |
| 7–13 | 10 | 5.5 | 5 | 11.1 | - | - | 2 | 5.1 | - | - | 1 | 10.0 | 2 | 8.3 |
| 14–20 | 14 | 7.7 | 3 | 6.7 | - | - | 5 | 12.8 | 1 | 8.3 | 1 | 10.0 | 4 | 16.7 |
| 21–27 | 8 | 4.4 | 5 | 11.1 | - | - | 2 | 5.1 | - | - | - | - | 1 | 4.2 |
| **Place of death** | | | | | | | | | | | | | | |
| Home | 13 | 7.1 | 8 | 17.8 | - | - | - | - | - | - | 1 | 10.0 | 4 | 16.7 |
| Hospital | | | | | | | | | | | | | | |
| Delivery suite | 63 | 34.6 | 10 | 22.2 | 37 | 71.2 | 12 | 30.8 | 2 | 16.7 | 1 | 10.0 | 1 | 4.2 |
| Antenatal ward | 5 | 2.7 | 2 | 4.4 | 2 | 3.8 | 1 | 2.6 | - | - | - | - | - | - |
| Postnatal ward | 5 | 2.7 | 1 | 2.2 | 2 | 3.8 | 1 | 2.6 | - | - | - | - | 1 | 4.2 |
| Neonatal unit | 70 | 38.5 | 20 | 44.4 | - | - | 21 | 53.8 | 9 | 75.0 | 6 | 60.0 | 14 | 58.3 |
| Operating theatre | 5 | 2.7 | 2 | 4.4 | - | - | 2 | 5.1 | - | - | - | - | 1 | 4.2 |
| Emergency department | 4 | 2.2 | - | - | 1 | 1.9 | - | - | - | - | - | - | 3 | 12.5 |
| Other | 14 | 7.7 | 1 | 2.2 | 10 | 19.2 | 2 | 5.1 | - | - | 1 | 10.0 | - | - |
| Other | 3 | 1.6 | 1 | 2.2 | - | - | - | - | 1 | 8.3 | 1 | 10.0 | - | - |
| **Apgar 5 minutes** | | | | | | | | | | | | | | |
| 0–3 | 93 | 51.1 | 13 | 28.9 | 43 | 82.7 | 18 | 46.2 | 5 | 41.7 | 3 | 30.0 | 11 | 45.8 |
| 4–5 | 18 | 9.9 | 9 | 20.0 | 2 | 3.8 | 3 | 7.7 | - | - | 3 | 30.0 | 1 | 4.2 |
| 6–7 | 21 | 11.5 | 7 | 15.6 | - | - | 8 | 20.5 | 3 | 25.0 | 2 | 20.0 | 1 | 4.2 |
| ≥8 | 34 | 18.7 | 12 | 26.7 | - | - | 7 | 17.9 | 3 | 25.0 | 2 | 20.0 | 10 | 41.7 |
| Unknown | 16 | 8.8 | 4 | 8.9 | 7 | 13.5 | 3 | 7.7 | 1 | 8.3 | - | - | 1 | 4.2 |
| **Resuscitation at birth** | | | | | | | | | | | | | | |
| Yes | 81 | 44.5 | 21 | 46.7 | - | - | 23 | 59.0 | 11 | 91.7 | 10 | 100.0 | 16 | 66.7 |
| No | 101 | 55.5 | 24 | 53.3 | 52 | 100.0 | 16 | 41.0 | 1 | 8.3 | - | - | 8 | 33.3 |
| **Outcome of resuscitation** | | | | | | | | | | | | | | |
| Baby resuscitated and transferred to another clinical care area | 70 | 38.5 | 19 | 42.2 | - | - | 22 | 56.4 | 8 | 66.7 | 8 | 80.0 | 13 | 54.2 |
| Baby unable to be resuscitated | 10 | 5.5 | 2 | 4.4 | - | - | 1 | 2.6 | 3 | 25.0 | 2 | 20.0 | 2 | 8.3 |
| Unknown | 1 | 0.5 | - | - | - | - | - | - | - | - | - | - | 1 | 4.2 |

## PRACTICE POINT: CARE FOR PREGNANT WOMEN AT RISK OF DELIVERING AT THE LOWER EXTREMES OF GESTATIONAL AGE

Care for pregnant women at risk of birthing at the lower extremes of gestational age (23+0 to 24+6) remains a complex area of perinatal medicine.

Practice variation reflects the medical complexity or co-morbidity of individual cases, locality, and resource availability, as well as parental wishes.

Resuscitation has been offered across all New Zealand tertiary neonatal centres to infants born at 23–24 weeks gestation. Overall mortality is higher than at more mature gestations, but high quality survival is possible.

In the context of threatened preterm labour or women requiring iatrogenic preterm birth at 23+0 to 24+6 weeks gestation, provision of an appropriate care pathway must recognise the needs of the mother as well as the baby. Mode of birth is an important part of this discussion as a caesarean section at this gestation not only has risks for the mother at the time of this birth but also has significant implications for subsequent pregnancies and may not improve neonatal outcomes.

Integrated care for women in threatened preterm labour or women requiring iatrogenic preterm birth at 23+0 to 24+6 weeks gestation should include open discussion between the family and the LMC, obstetric, and neonatal or paediatric services.

Morbidity and mortality for infants born at 23+0 to 24+6 weeks gestation reduces significantly if they deliver in a tertiary centre. Early consultation with tertiary obstetrics/neonates is recommended.

Parents and whānau should be counselled that babies at 23 weeks gestation who have not been prepared for early birth (eg, antenatal steroids, magnesium sulphate) may occasionally appear more vigorous than anticipated at birth. Admission to a neonatal intensive care unit of an unprepared baby is likely to result in severe morbidity and/or mortality.

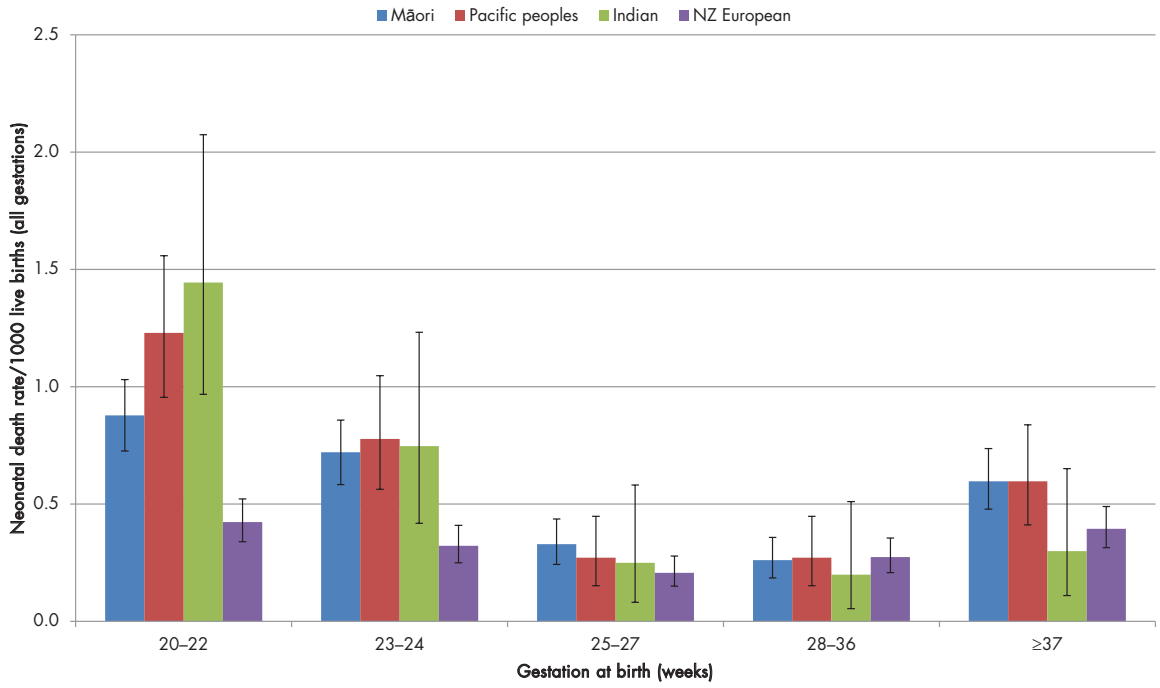
### Points for particular consideration in the context of imminent birth at 23+0 to 24+6 weeks gestation

Parents and whānau should be counselled antenatally about the possible range of outcomes for the baby. Where possible this discussion should be in a tertiary centre and reflect local institutional outcome data as well as current international data on long-term outcomes, particularly in relation to neurodevelopmental and cognitive outcomes. Parents and whānau should be included in decision-making and be aware of the range of possible interventions at this gestation.

Appropriate care options include:

1. Palliative
    a. No maternal corticosteroids or magnesium sulphate
    b. No fetal monitoring or operative birth
    c. A palliative care pathway for the baby from birth
2. Active
    a. Maternal corticosteroids and magnesium sulphate
    b. Fetal monitoring and intervention as agreed with parents and whānau prior to labour
    c. Resuscitation of baby at birth followed by neonatal intensive care unit care

Figure 1.25: Neonatal death rate (per 1000 live births) by gestation and prioritised baby ethnicity 2007–2014 (excluding congenital abnormalities)




Babies of Māori, Pacific and Indian mothers are significantly more likely to die as neonates after birth at 20–22 and 23–24 weeks compared to babies of New Zealand European mothers (excluding babies dying with congenital abnormalities) (Figure 1.25). The principal cause of neonatal death at 20–24 weeks is spontaneous preterm birth (Figure 1.26).

Babies of Māori, Pacific and Indian mothers are not significantly more likely to die after birth from 25-36 weeks than babies of New Zealand European mothers. However, as illustrated in Figure 1.25, neonatal death at term is more common among babies of Māori and Pacific mothers than babies of New Zealand European mothers.

Figure 1.26: Distribution of neonatal death classification (PSANZ-NDC) among neonatal deaths without lethal congenital abnormality by gestational age group 2007–2014

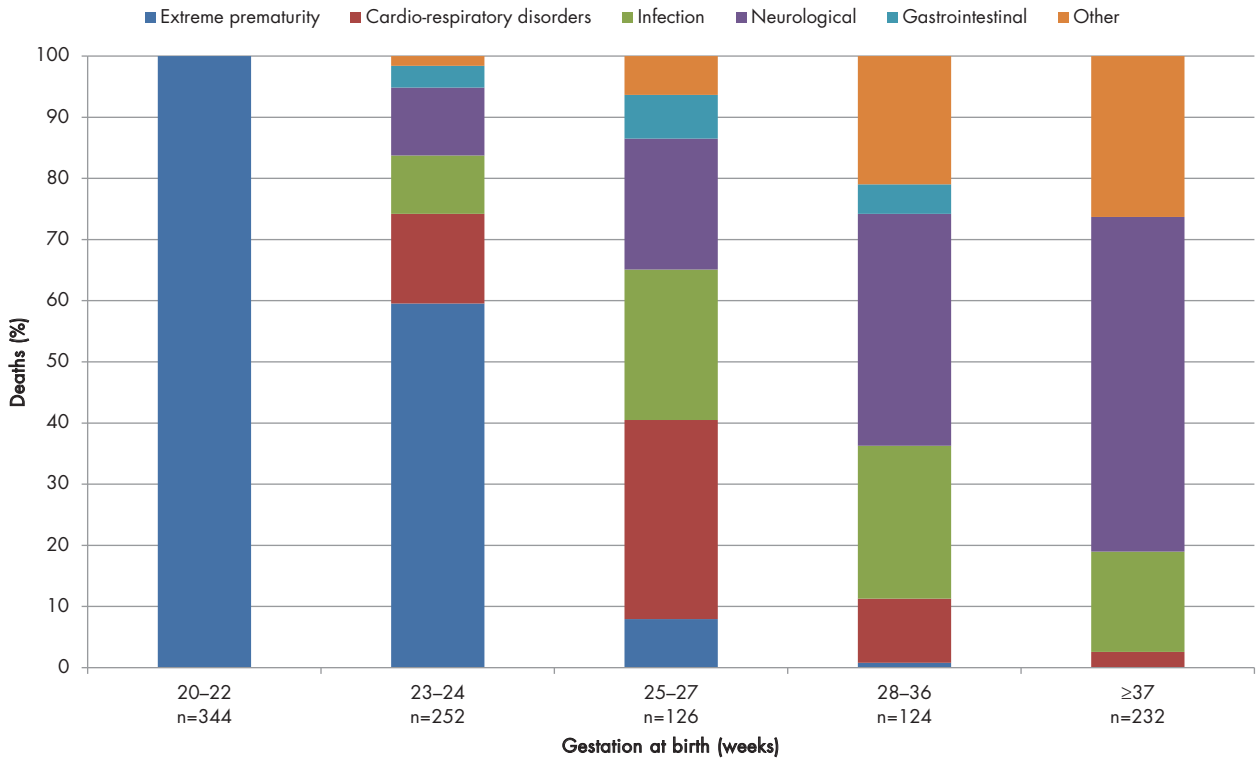



Figure 1.26 illustrates the changing distribution of cause of death among neonates with increasing gestation at birth. Disease associated with extreme prematurity predominates at 20–24 weeks, while neurological causes become apparent from 23 weeks and are responsible for the majority of deaths at term.

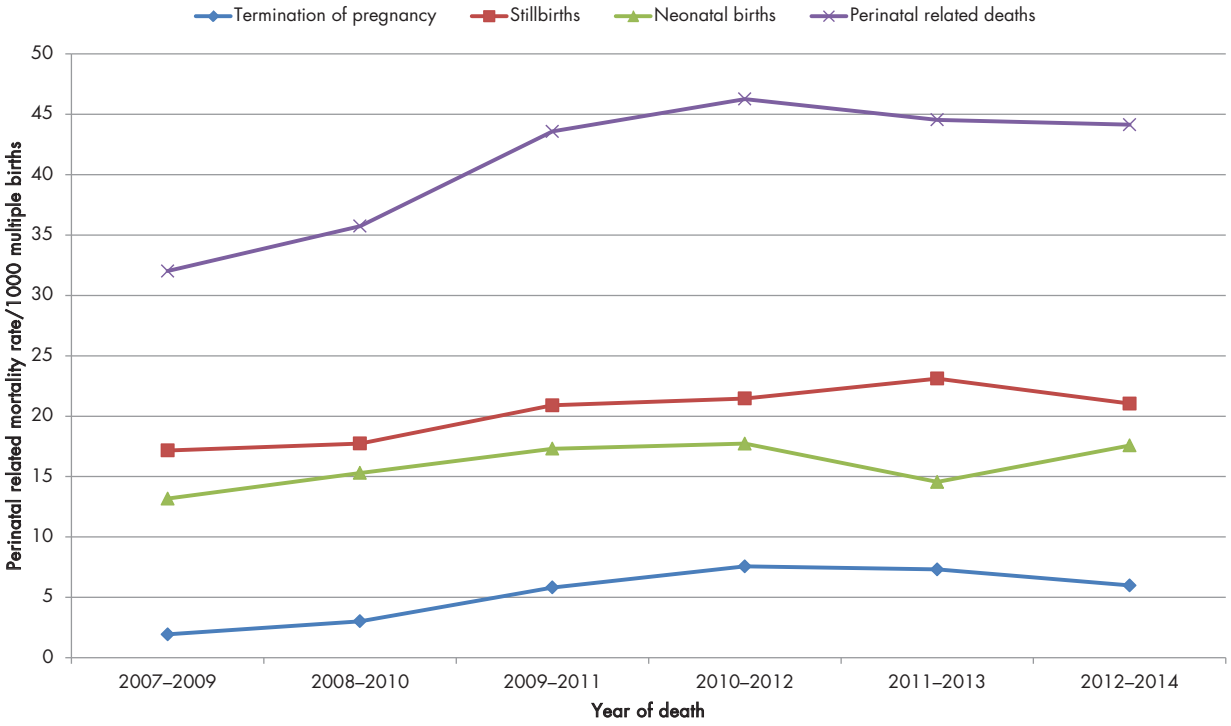
## Multiple birth

Table 1.13: Perinatal related mortality rates (per 1000 births) and multiple* births 2014

| Type of birth | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| **Singleton** | 56,972 | 97.1 | 139 | 93.3 | 2.44 | 291 | 89.5 | 5.11 | 142 | 78.0 | 2.51 | 572 | 87.2 | 10.04 |
| **Multiple** | 1,675 | 2.9 | 10 | 6.7 | 5.97 | 34 | 10.5 | 20.30 | 40 | 22.0 | 24.52 | 84 | 12.8 | 50.15 |
| Multiples (1/2 died) | | | 4 | 2.7 | | 10 | 3.1 | | 10 | 5.5 | | 24 | 3.7 | |
| Multiples (2/2 died) | | | 3 | 2.0 | | 24 | 7.4 | | 27 | 14.8 | | 54 | 8.2 | |
| Multiples (1/3 died) | | | 1 | 0.7 | | - | - | | - | - | | 1 | 0.2 | |
| Multiples (2/3 died) | | | 2 | 1.3 | | - | - | | - | - | | 2 | 0.3 | |
| Multiples (3/3 died) | | | - | - | | - | - | | 3 | 1.6 | | 3 | 0.5 | |
| **Twin** | 1,636 | 2.8 | 7 | 4.7 | 4.28 | 34 | 10.5 | 20.78 | 37 | 20.3 | 23.20 | 78 | 11.9 | 47.68 |
| Dichorionic diamniotic | | | 2 | 1.3 | | 15 | 4.6 | | 23 | 12.6 | | 40 | 6.1 | |
| Monochorionic diamniotic | | | 4 | 2.7 | | 17 | 5.2 | | 14 | 7.7 | | 35 | 5.3 | |
| Monoamniotic | | | 1 | 0.7 | | 2 | 0.6 | | - | - | | 3 | 0.5 | |

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

Figure 1.27: Perinatal related mortality rolling three-year rates (per 1000 births) among babies born in multiple pregnancies 2007–2014




There has been a significant increase in perinatal related deaths among multiple births from 2007 to 2014, although there has been no apparent increase since 2011 (chi-squared test for trend p=0.00023) (Table 1.48). The increase in perinatal deaths among multiple births is due to an increase in terminations of pregnancy and neonatal deaths (chi-squared test for trend p=0.0013 and p=0.028 respectively).

From 2007 to 2014, 344 twins died in pregnancies involving the death of both twins, while 195 babies died while their twin sibling survived. Some babies from twin pregnancies died after 28 days or were born before 20 weeks and so are not defined as perinatal related deaths and are excluded from the data.

Just over half of deaths among multiple pregnancies are from monochorionic twin pregnancies, where the zygote divides after fertilisation leading to identical twins (Table 1.49). Death most commonly occurs due to twin-to-twin transfusion syndrome as a result of communicating circulations in the placenta. As only approximately 30 percent of all twin pregnancies are monochorionic, this is a reminder of the higher rate of mortality (and morbidity) among these babies.

Multiple pregnancies should be referred for specialist care (Ministry of Health 2012a). Chorionicity should be determined by ultrasound scan in early pregnancy. Fortnightly scans from 16 weeks gestation are then advised for monochorionic twins. Urgent referral (within 24 hours) to a regional fetal medicine unit is advised if there is a possible diagnosis of twin-to-twin transfusion syndrome as this condition can deteriorate rapidly (Parry 2015).

Table 1.14: Contribution of fertility treatment to perinatal related mortality by plurality 2007–2014

| Fertility treatment | Singleton perinatal related deaths | | Multiple perinatal related deaths | |
|---|---|---|---|---|
| | n=4,823 | | n=584 | |
| | n | % | n | % |
| Clomiphene | 42 | 0.9 | 21 | 3.6 |
| Follicle stimulating hormone (FSH) | 3 | 0.1 | 4 | 0.7 |
| In vitro fertilisation (including ICSI) | 113 | 2.3 | 70 | 12.0 |
| Any of clomiphene/FSH/IVF | 156 | 3.2 | 90 | 15.4 |

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

Fertility treatment is over-represented among multiple pregnancy deaths. Among deaths of babies in multiple pregnancies, 15 percent were born to mothers who were given clomiphene or follicle stimulating hormone (FSH) or had in vitro fertilisation (IVF). Three percent of mothers of singleton babies who died received these fertility treatments.

## Vaginal bleeding in pregnancy

Table 1.15: Perinatal related deaths and vaginal bleeding during pregnancy 2014

| Vaginal bleeding | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| Yes | 28 | 18.8 | 123 | 37.8 | 89 | 48.9 | 240 | 36.6 |
| No | 116 | 77.9 | 184 | 56.6 | 84 | 46.2 | 384 | 58.5 |
| Unknown | 5 | 3.4 | 18 | 5.5 | 9 | 4.9 | 32 | 4.9 |
| **Gestation*** | | | | | | | | |
| <20 weeks | 21 | 14.1 | 52 | 16.0 | 36 | 19.8 | 109 | 16.6 |
| ≥20 weeks | 15 | 10.1 | 103 | 31.7 | 78 | 42.9 | 196 | 29.9 |

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

Vaginal bleeding in pregnancy is commonly found in association with perinatal related death. Overall, 37 percent of mothers of babies who died in 2014 had some vaginal bleeding during pregnancy, and 30 percent had vaginal bleeding in the second half of pregnancy. Of those mothers who had bleeding before 20 weeks, almost 60 percent continued to have bleeding beyond 20 weeks.

Antepartum haemorrhage was the antecedent cause of death for 10.5 percent of perinatal related deaths in 2014, 10 percent of stillbirths and 16 percent of neonatal deaths.

## Small for gestational age infants

Table 1.16: Perinatal related deaths and small for gestational age (customised SGA) among singleton deaths without congenital abnormalities 2014

| | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n | % | n | % | n | % | n | % |
| **Singleton deaths 20–22 weeks, excluding congenital abnormalities** | **n=18** | | **n=84** | | **n=35** | | **n=137** | |
| SGA | 8 | 44.4 | 15 | 17.9 | 5 | 14.3 | 28 | 20.4 |
| **Singleton deaths 23–36 weeks, excluding congenital abnormalities** | **n=13** | | **n=110** | | **n=42** | | **n=165** | |
| SGA | 4 | 30.8 | 45 | 40.9 | 6 | 14.3 | 55 | 33.3 |
| **Singleton deaths ≥37 weeks, excluding congenital abnormalities** | **n=0** | | **n=64** | | **n=23** | | **n=87** | |
| SGA | - | - | 17 | 26.6 | 3 | 13.0 | 20 | 23.0 |

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

Table 1.16 shows the absolute numbers and proportions of customised small for gestational age (SGA) babies among singleton perinatal related deaths without congenital abnormality in 2014.

The overall rate of customised SGA among singleton deaths without congenital abnormalities in 2014 was 26.5 percent, which is perhaps at least twice the rate expected in the population of births in New Zealand.

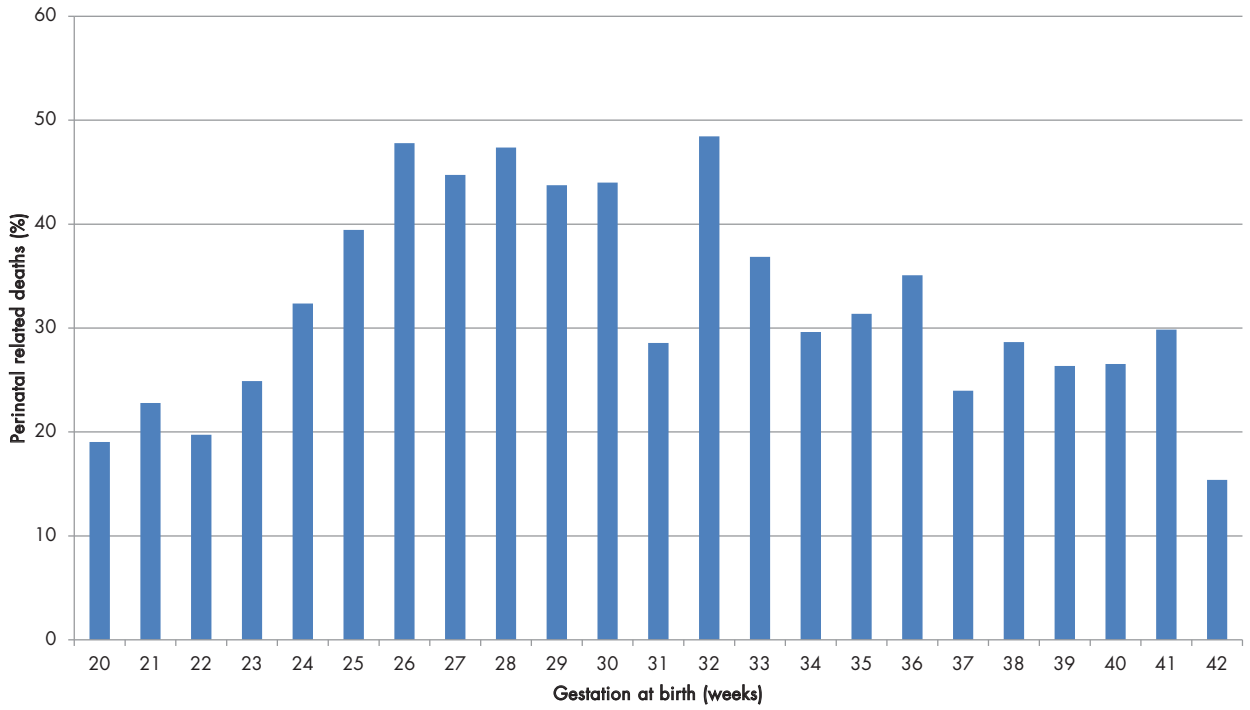
Customised SGA is defined as the lowest 10 percent of 'optimal' birthweights (Anderson et al 2012), so we would expect a rate in the general population of more than 10 percent, but there are currently no New Zealand normative data as maternal height and weight are not captured in the MAT dataset.

At the Auckland tertiary maternity unit in New Zealand the rate of SGA in the whole birthing population was 14.1 percent in 2014 (Auckland District Health Board 2015).

Customised SGA was more common among singleton deaths without congenital abnormalities at 23–36 weeks than at 20–22 weeks (p=0.013) and more common at 23–36 weeks than at term (p=0.09). These association are illustrated in Figure 1.28.

Twenty perinatal related deaths of singleton babies without congenital abnormalities at term in 2014 (23 percent) were babies who were SGA. The primary antecedent cause of death classification for these term SGA babies was most commonly unexplained antepartum death (10) and fetal growth restriction (7).

Figure 1.28: Small for gestational age (customised SGA) by gestation among perinatal related deaths (excluding multiples and congenital abnormalities) 2007–2014




## Maternity care and place of birth

Table 1.17: Perinatal related deaths and maternal registration status 2014

| Was the mother registered with a lead maternity carer (LMC)? | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| **Yes** | 141 | 94.6 | 308 | 94.8 | 175 | 96.2 | 624 | 95.1 |
| Self-employed midwife | 119 | 79.9 | 249 | 76.6 | 137 | 75.3 | 505 | 77.0 |
| Hospital | 15 | 10.1 | 40 | 12.3 | 30 | 16.5 | 85 | 13.0 |
| General practitioner | - | - | 1 | 0.3 | 1 | 0.5 | 2 | 0.3 |
| Obstetrician (private) | 7 | 4.7 | 15 | 4.6 | 7 | 3.8 | 29 | 4.4 |
| Unknown LMC | - | - | 3 | 0.9 | - | - | 3 | 0.5 |
| **No** | 8 | 5.4 | 17 | 5.2 | 7 | 3.8 | 32 | 4.9 |

Ninety-five percent of the mothers of babies who died in the perinatal period were registered with an LMC prior to diagnosis of perinatal related death. Registration status did not vary by whether the death was a termination of pregnancy, stillbirth or neonatal death.

Seventy-seven percent of mothers were registered with a self-employed midwife LMC, 13 percent with a hospital maternity service, and 4 percent with a private obstetrician. The MAT dataset shows that in 2014, 85 percent of all mothers booked with a self-employed midwifery LMC, 5.6 percent with a private obstetrician, and very few with a GP. The remaining women are registered with DHB maternity services or are unregistered. These data are currently incomplete in the MAT dataset and so perinatal related mortality rates by LMC at registration are not provided.

Of mothers registered prior to perinatal death, 46.5 percent were registered before 10 weeks gestation, 77.6 percent before 14 weeks, and 7.7 percent after 19 weeks (Table 1.50).

In previous PMMRC reports, data have been provided on LMC at birth among stillbirths and neonatal deaths. These data are not given this year as there is a lack of clarity in the data between change of LMC and transfer of clinical responsibility.

Table 1.18: Intended place of birth versus actual place of birth among stillbirths and neonatal deaths 2014

| Intended place of birth | Actual place of birth | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Home | | Birthing unit | | Hospital level 1 | | Hospital level 2 | | Hospital level 3 | | Other | | Unknown | |
| | | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| Home | **13** | 1 | 7.7 | 1 | 7.7 | 1 | 7.7 | 7 | 53.8 | 3 | 23.1 | - | - | - | - |
| Birthing unit | **33** | 2 | 6.1 | 2 | 6.1 | - | - | 5 | 15.2 | 23 | 69.7 | 1 | 3.0 | - | - |
| Hospital level 1 | **19** | - | - | - | - | 4 | 21.1 | 3 | 15.8 | 11 | 57.9 | 1 | 5.3 | - | - |
| Hospital level 2 | **173** | 4 | 2.3 | 1 | 0.6 | 2 | 1.2 | 144 | 83.2 | 19 | 11.0 | 2 | 1.2 | 1 | 0.6 |
| Hospital level 3 | **241** | 2 | 0.8 | 1 | 0.4 | - | - | 5 | 2.1 | 231 | 95.9 | 2 | 0.8 | - | - |
| Other | **2** | - | - | - | - | - | - | - | - | 2 | 100.0 | - | - | - | - |
| Not registered | **19** | 4 | 21.1 | 1 | 5.3 | 1 | 5.3 | 2 | 10.5 | 9 | 47.4 | 2 | 10.5 | - | - |
| Unknown | **7** | - | - | - | - | - | - | 2 | 28.6 | 4 | 57.1 | - | - | 1 | 14.3 |
| **Total** | **507** | **13** | **2.6** | **6** | **1.2** | **8** | **1.6** | **168** | **33.1** | **302** | **59.6** | **8** | **1.6** | **2** | **0.4** |

Table 1.18 shows the intended place of birth and actual place of birth for stillbirths and neonatal deaths in 2014. This shows that more than half of mothers of babies who died who were intending to birth their babies at home, in a birth unit or in a level 1 hospital ultimately birthed their baby in a level 2 or 3 hospital. This suggests that risk was evident and acted upon prior to birth.

Six babies of the 46 whose birth was intended at home or in a birthing unit actually birthed in either of these places. These babies were born at 21, 29, 34, 38 (2) and 39 weeks gestation, three were stillbirths and three were neonatal deaths.

## Screening in pregnancy

### *Diabetes*

Table 1.19: Screening for diabetes among registered women with no pre-existing diabetes and where stillbirth and neonatal death occurred at or beyond 28 weeks gestation 2007–2014

| Screened for diabetes | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=286 | | n=295 | | n=303 | | n=265 | | n=254 | | n=235 | | n=212 | | n=223 | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| Yes | 167 | 58.4 | 162 | 54.9 | 199 | 65.7 | 179 | 67.5 | 195 | 76.8 | 177 | 75.3 | 170 | 80.2 | 183 | 86.3 |
| No | 68 | 23.8 | 71 | 24.1 | 52 | 17.2 | 49 | 18.5 | 45 | 17.7 | 48 | 20.4 | 30 | 14.2 | 25 | 11.8 |
| Unknown | 51 | 17.8 | 62 | 21.0 | 52 | 17.2 | 37 | 14.0 | 12 | 4.7 | 6 | 2.6 | 8 | 3.8 | 8 | 3.8 |
| Declined | - | - | - | - | - | - | - | - | 2 | 0.8 | 4 | 1.7 | 4 | 1.9 | 7 | 3.3 |

From 2007 to 2014, there has been a steady increase in the proportion of mothers of babies who died in the perinatal period, and who were eligible for screening, who were screened for diabetes. In 2014, 86 percent of mothers of stillborn babies and neonates who died within a month of birth were screened for diabetes. Over the period there has been a significant reduction in unscreened mothers.

## Family violence

Table 1.20: Perinatal related deaths and screening for family violence 2007–2014

| | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=680 | | n=701 | | n=730 | | n=707 | | n=666 | | n=670 | | n=599 | | n=656 | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| **Experienced family violence in this pregnancy** | | | | | | | | | | | | | | | | |
| Yes | 18 | 2.6 | 24 | 3.4 | 22 | 3.0 | 31 | 4.4 | 17 | 2.6 | 17 | 2.5 | 12 | 2.0 | 18 | 2.7 |
| No | 305 | 44.9 | 270 | 38.5 | 306 | 41.9 | 282 | 39.9 | 291 | 43.7 | 317 | 47.3 | 295 | 49.2 | 314 | 47.9 |
| Not asked | 215 | 31.6 | 226 | 32.2 | 145 | 19.9 | 148 | 20.9 | 178 | 26.7 | 137 | 20.4 | 121 | 20.2 | 186 | 28.4 |
| Unknown | 142 | 20.9 | 181 | 25.8 | 257 | 35.2 | 246 | 34.8 | 180 | 27.0 | 199 | 29.7 | 171 | 28.5 | 138 | 21.0 |
| **Referral to relevant support** | | | | | | | | | | | | | | | | |
| Yes | 12 | 66.7 | 16 | 66.7 | 13 | 59.1 | 19 | 61.3 | 15 | 88.2 | 12 | 70.6 | 8 | 66.7 | 11 | 61.1 |
| No | 1 | 5.6 | - | - | 3 | 13.6 | 4 | 12.9 | - | - | 1 | 5.9 | - | - | 2 | 11.1 |
| Unknown | 5 | 27.8 | 8 | 33.3 | 6 | 27.3 | 8 | 25.8 | 2 | 11.8 | 4 | 23.5 | 4 | 33.3 | 5 | 27.8 |

There has been no change in the proportion of mothers screened for family violence in pregnancy among mothers of perinatal related deaths. There are numerous studies describing the association between family violence and adverse maternity outcomes. There is evidence that screening tools have good accuracy in the identification of women experiencing intimate partner violence; however, there is insufficient evidence on the effect of interventions to prevent family violence on perinatal mortality.

An updated Ministry of Health guideline on routine inquiry for family violence in pregnancy is anticipated in 2016.

## First and second trimester screening for congenital anomalies

In 2013, an audit of screening among perinatal deaths associated with congenital abnormalities was published showing that among deaths from congenital cardiovascular, central nervous system, and chromosomal abnormalities, and whose first contact with a health professional was within 20 completed weeks gestation, 97 of 129 (75 percent) were offered first or second trimester (MSS1/MSS2) screening, suggesting that a barrier to access may exist for some women. Of those offered screening, 15 (15 percent) declined (Arroll et al 2013).

Among women birthing in New Zealand in 2014, 70.8 percent completed either first or second trimester screening for Down syndrome and other conditions. This screening provides a risk result for trisomy 21, 18, and 13 and some other rare genetic disorders. Rates of participation varied from 47.8 to 86.9 percent by DHB of residence, 36.4 to 88.4 percent by maternal ethnicity, and from 85.3 to 52.6 percent by increasing socioeconomic deprivation (National Screening Unit 2016).

In 2016, the PMMRC started collection of data on MSS1 and MSS2 screening among pregnancies leading to perinatal related death.

## PRACTICE POINT: ANTENATAL SCREENING FOR DOWN SYNDROME AND OTHER CONDITIONS

All women who are less than 20 weeks pregnant must be advised of the availability of antenatal screening for Down syndrome and other conditions.

Knowing local services and referral pathways is important as detection of fetal anomalies offers women information that may help them prepare for the birth and care of their child. This includes giving birth in a setting that has access to specialist medical or surgical care, having access to support services, the possibility of considering termination, or palliative care in the newborn period.

Antenatal screening for Down syndrome and other conditions provides a risk estimate for Down syndrome (trisomy 21), Edwards syndrome (trisomy 18), Patau syndrome (trisomy 13) and some other rare genetic disorders.

Antenatal screening for Down syndrome and other conditions is optional for pregnant women. The right to decline screening, tests or further investigations should be made clear by the health practitioner.

Screening has a detection rate of 78 to 80 percent for trisomy 21, 18 and 13, which means that out of 100 pregnant women with a fetus with one of trisomy 21, 18 or 13, 78–80 will be detected by this screening.

Timing is critical for screening; women can choose first or second trimester screening.

First trimester combined screening should be completed between 9 weeks and 13 weeks 6 days gestation. The recommended timing for the blood test is 9 to 10 weeks and the nuchal translucency (NT) scan is at 12 weeks.

OR

Second trimester maternal screening should be completed between 14 and 20 weeks gestation. The recommended timing for the blood test is 14 to 18 weeks.

Women should be made aware that they need to complete both the blood test and the scan to receive a risk result for first trimester screening. The health practitioner requesting screening must fill in all sections of the screening request form (including accurate measurement of height and weight) to ensure that the woman receives an accurate risk assessment.

The blood tests are free but there is often a part charge for the NT scan. Women should be advised that second trimester screening is available if they are unable to access an NT scan.

A low risk result does not mean no risk and may falsely reassure parents. A false negative result where a woman receives a low risk result and later has a baby with trisomy 21 appears to have a greater level of impact and parenting stress (Petticrew et al 2000).

Informed decision-making for this screening must include a discussion about the screened conditions and the decisions that may need to be made as a result of participation.

The National Screening Unit has produced a range of resources and guidelines, including a discussion aid as a support for health practitioners to help women make informed decisions about screening for themselves and their babies. While it can be used for all women, it has been designed to enhance discussions about screening where there are communication difficulties, including women who are deaf, have low literacy levels, have learning disabilities, or are migrants/former refugees (National Screening Unit nd, National Screening Unit 2013).

### View resources:

https://www.nsu.govt.nz/pregnancy-newborn-screening/antenatal-screening-down-syndrome-and-other-conditions/information

https://www.nsu.govt.nz/system/files/page/antenatal_screening_for_down_syndrome_and_other_conditions_guidelines_for_health_practitioners.pdf

https://www.nsu.govt.nz/resources/about-screening-discussion-aid-health-practitioners

## Investigation of perinatal related deaths

Table 1.21: Perinatal related deaths and perinatal death investigations by ethnicity 2007–2014

| Post-mortem examination offered | Māori | | Pacific peoples | | Indian | | Other Asian | | Other (including unknown) | | NZ European | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=1,413 | | n=738 | | n=277 | | n=380 | | n=436 | | n=2,165 | | n=5,409 | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| Post-mortem offered and parental consent given | 337 | 23.8 | 222 | 30.1 | 127 | 45.8 | 168 | 44.2 | 208 | 47.7 | 1,009 | 46.6 | 2,071 | 38.3 |
| Post-mortem offered and parents declined | 892 | 63.1 | 435 | 58.9 | 132 | 47.7 | 166 | 43.7 | 173 | 39.7 | 882 | 40.7 | 2,680 | 49.5 |
| Post-mortem not offered | 146 | 10.3 | 64 | 8.7 | 15 | 5.4 | 39 | 10.3 | 43 | 9.9 | 220 | 10.2 | 527 | 9.7 |
| Unknown | 38 | 2.7 | 17 | 2.3 | 3 | 1.1 | 7 | 1.8 | 12 | 2.8 | 54 | 2.5 | 131 | 2.4 |
| **Optimum investigation*** | 439 | 31.1 | 274 | 37.1 | 141 | 50.9 | 224 | 58.9 | 250 | 57.3 | 1,189 | 54.9 | 2,517 | 46.5 |
| Post-mortem | 339 | 24.0 | 222 | 30.1 | 128 | 46.2 | 168 | 44.2 | 207 | 47.5 | 1,007 | 46.5 | 2,071 | 38.3 |
| Karyotype | 84 | 5.9 | 49 | 6.6 | 12 | 4.3 | 57 | 15.0 | 44 | 10.1 | 214 | 9.9 | 460 | 8.5 |
| Clinical examination/investigations confirm diagnosis | 25 | 1.8 | 16 | 2.2 | 4 | 1.4 | 12 | 3.2 | 9 | 2.1 | 51 | 2.4 | 117 | 2.2 |
| **Partial investigations only#** | 607 | 43.0 | 349 | 47.3 | 113 | 40.8 | 134 | 35.3 | 140 | 32.1 | 746 | 34.5 | 2,089 | 38.6 |
| **No investigation+** | 319 | 22.6 | 99 | 13.4 | 21 | 7.6 | 15 | 3.9 | 34 | 7.8 | 176 | 8.1 | 664 | 12.3 |
| **Unknown** | 48 | 3.4 | 16 | 2.2 | 2 | 0.7 | 7 | 1.8 | 12 | 2.8 | 54 | 2.5 | 139 | 2.6 |

* Optimal investigation is defined as post-mortem or karyotype confirming congenital abnormality or clinical examination/investigation confirming diagnosis. Note: more than 1 option can be selected.

# 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.

Just on half of the deaths of babies in the perinatal period in 2014 were optimally investigated. Of the remainder, 12 percent were not investigated and 38 percent were partially investigated (Table 1.51). There has been no significant change in the rate of optimal investigation from 2007 to 2014. However there has been a significant increase in the proportion of babies who have been partially investigated (Chi square test for linear trend p=0.02) and a significant decrease in the proportion of babies with no investigation after death from 2007-2014 (Chi square test for linear trend p=0.0004).

Māori and Pacific perinatal related deaths are less likely to be optimally investigated than deaths in all other ethnic groups. While more Māori and Pacific perinatal related deaths are partially investigated than other ethnicities, overall they are less likely to have any investigation (optimal or partial) than babies of other ethnicities (Table 1.21).

There is no difference in the proportion of parents and whānau offered post-mortem by ethnicity but Māori and Pacific parents and whānau are less likely to give consent for post-mortem. Requesting post-mortems from recently bereaved family may be challenging for some health professionals and this may be more so if the professional is aware that, for some Māori whānau, post-mortems are not an acceptable practice. It is possible that this knowledge affects the way health professionals discuss this with whānau and this, in turn, may impact on consent rates for optimum and partial post-mortem investigation. Talking with health professionals about their experience of discussing post-mortem investigations with families/ whānau would provide valuable information about this process, and whether there are differences in approaches across ethnic groups. Similarly, talking with Māori whānau who have experienced a death and listening to their stories of being offered post-mortem might help to inform practice changes.

In 2014, data on the usefulness of post-mortem were available for 212 (83 percent) of cases where post-mortem was performed. These data showed that in 123 deaths (58 percent) the post-mortem confirmed the clinical diagnosis, in 32 (15 percent) the post-mortem changed the diagnosis and resulted in altered counselling to parents for future pregnancies, in 35 (17 percent) additional information was gained but this did not change the clinical diagnosis, and in 22 (10 percent) of deaths, the post-mortem was inconclusive.

There are currently no data collected on the offer of partial post-mortem. Options for partial investigation are listed in the text box below.

Table 1.51 and 1.52 report the completeness of perinatal investigation and offer and decline of post-mortem for 2014.

### Perinatal death investigations

If families and whānau decline post-mortem examination they should be counselled on the other options, which while not as helpful in finding a cause for perinatal death as post-mortem may still contribute valuable information.

Other investigations include:

- placental pathology
- external examination by a perinatal pathologist, geneticist or paediatrician
- clinical photographs
- full body X-ray or babygram
- magnetic resonance imaging (MRI)
- needle biopsy of a particular organ or tissue
- ultrasound of specific organs.

None of these investigations will provide information that is as accurate as that obtained by a post-mortem examination but they provide more information than no examination at all.

The findings of significant placental pathology can explain the cause of death and provide critical information for management and counselling of any future pregnancies.

**Further information to help families and whānau** who are trying to decide whether or not to consent to a post-mortem can be found at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/32/

## Maternal outcome

There were two maternal deaths associated with perinatal related deaths in 2014, including one death from obstetric haemorrhage and one from a pre-existing medical condition. Ten mothers whose babies died experienced serious morbidity in pregnancy, including pre-eclampsia, antepartum and postpartum haemorrhage, intracranial haemorrhage, obstetric sepsis, morbidity associated with pre-existing medical conditions, and injuries in a motor vehicle accident (Table 1.54).

## Contributory factors and potentially avoidable perinatal related death

Table 1.22: Contributory factors and potentially avoidable perinatal related deaths 2014

| | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| **Contributory factors** | | | | | | | | |
| Present | 16 | 10.7 | 101 | 31.1 | 51 | 28.0 | 168 | 25.6 |
| Absent | 133 | 89.3 | 220 | 67.7 | 131 | 72.0 | 484 | 73.8 |
| Missing data | - | - | 4 | 1.2 | - | - | 4 | 0.6 |
| **Potentially avoidable** | | | | | | | | |
| Yes | 4 | 2.7 | 55 | 16.9 | 28 | 15.4 | 87 | 13.3 |
| Contributory factors present but not potentially avoidable | 12 | 8.1 | 46 | 14.2 | 23 | 12.6 | 81 | 12.3 |

In 2014, one-quarter of perinatal related deaths were determined at local review to have contributory factors, and approximately half of these (13 percent) were determined to be potentially avoidable deaths.

Table 1.57 lists all contributory factors by year of perinatal related death for 2009–2014. The following text box provides a list of contributory factors.

## Contributory Factors for Mortality and Morbidity

### Organisation/management factors

- Poor organisational arrangements of staff
- Inadequate education and training
- Lack of policies, protocols or guidelines
- Inadequate numbers of staff
- Poor access to senior clinical staff
- Failure or delay in emergency response
- Delay in procedure (eg, caesarean section)
- Inadequate systems/process for sharing of clinical information between services
- Delayed access to test results or inaccurate results
- Equipment (eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)
- Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)

### Personnel factors

- Knowledge and skills of staff were lacking
- Delayed emergency response by staff
- Failure to maintain competence
- Failure of communication between staff
- Failure to seek help/supervision
- Failure to offer or follow recommended best practice
- Lack of recognition of complexity or seriousness of condition by care giver

### Barriers to access and/or engagement with care

- No antenatal care
- Infrequent care or late booking
- Declined treatment or advice
- Obesity impacted on delivery of optimal care (eg, ultrasound scan)
- Substance use
- Family violence
- Lack of recognition of complexity or seriousness of condition
- Maternal mental illness
- Cultural barriers
- Language barriers
- Not eligible to access free care
- Environment (eg, isolated, long transfer, weather prevented transport)

The most common main contributory factors to potentially avoidable perinatal related deaths are consistently access and/or engagement with care factors, responsible for 8 to 12 percent of perinatal related deaths each year from 2011 to 2014. Personnel factors are the main contributory factor to avoidable perinatal related death in 5 to 6 percent of perinatal related deaths.

Figure 1.29: Contributory factors and potentially avoidable perinatal related deaths by perinatal death classification (PSANZ-PDC) 2014

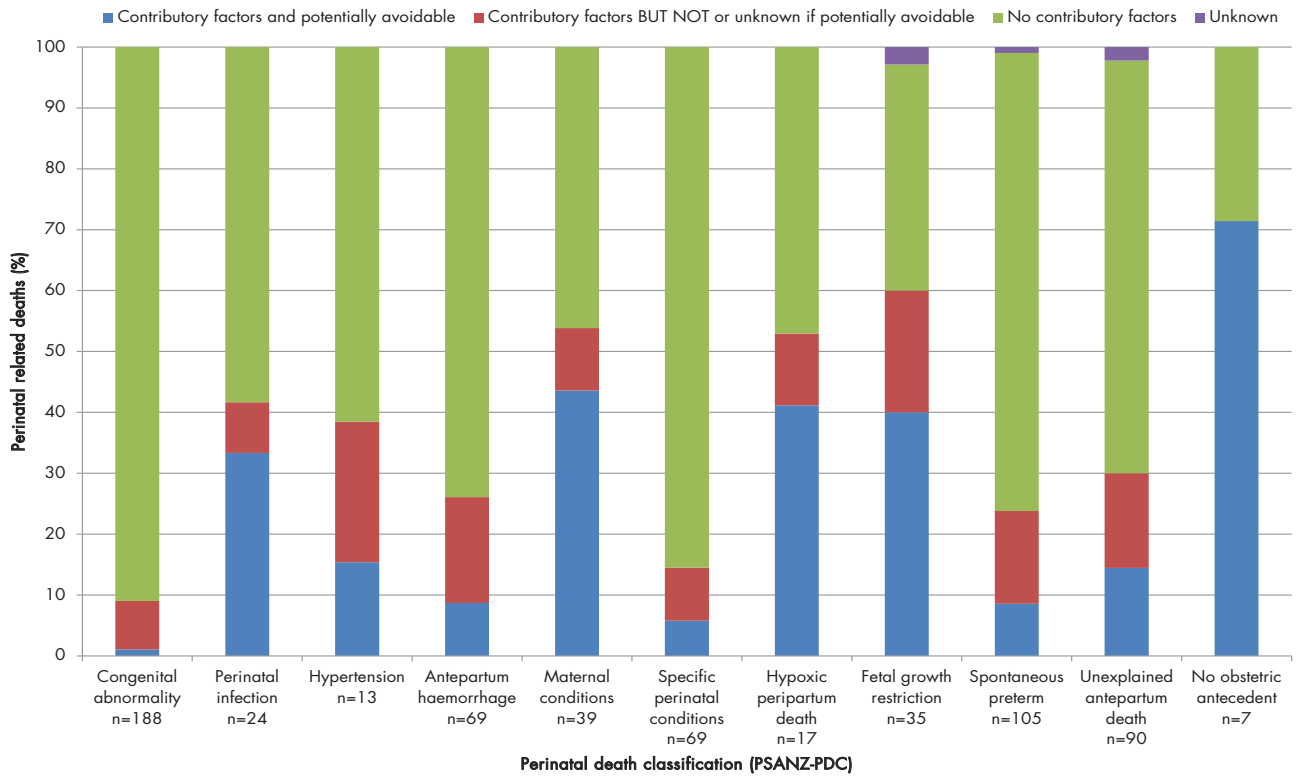



Figure 1.29 illustrates the proportion of perinatal related deaths which were assessed as having contributory factors and to be potentially avoidable in 2014. The bottom bar (blue) represents potentially avoidable deaths, the second bar (red) deaths with contributory factors not assessed as potentially avoidable, and the top bar (green) deaths without contributory factors.

The greatest proportion of potentially avoidable deaths were identified among deaths from perinatal infection (8) (33 percent), maternal conditions (17) (44 percent), hypoxic peripartum deaths (7) (41 percent), fetal growth restriction (14) (40 percent), and deaths without obstetric antecedent (5) (71 percent).

As the number of deaths varies considerably by cause, the proportion of potentially avoidable deaths does not necessarily also represent the largest absolute number of potentially avoidable deaths. The largest numbers of potentially avoidable deaths were among deaths due to maternal conditions (17), fetal growth restriction (14), and unexplained antepartum deaths (13) (Table 1.58).

Figure 1.30: 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) 2011–2014

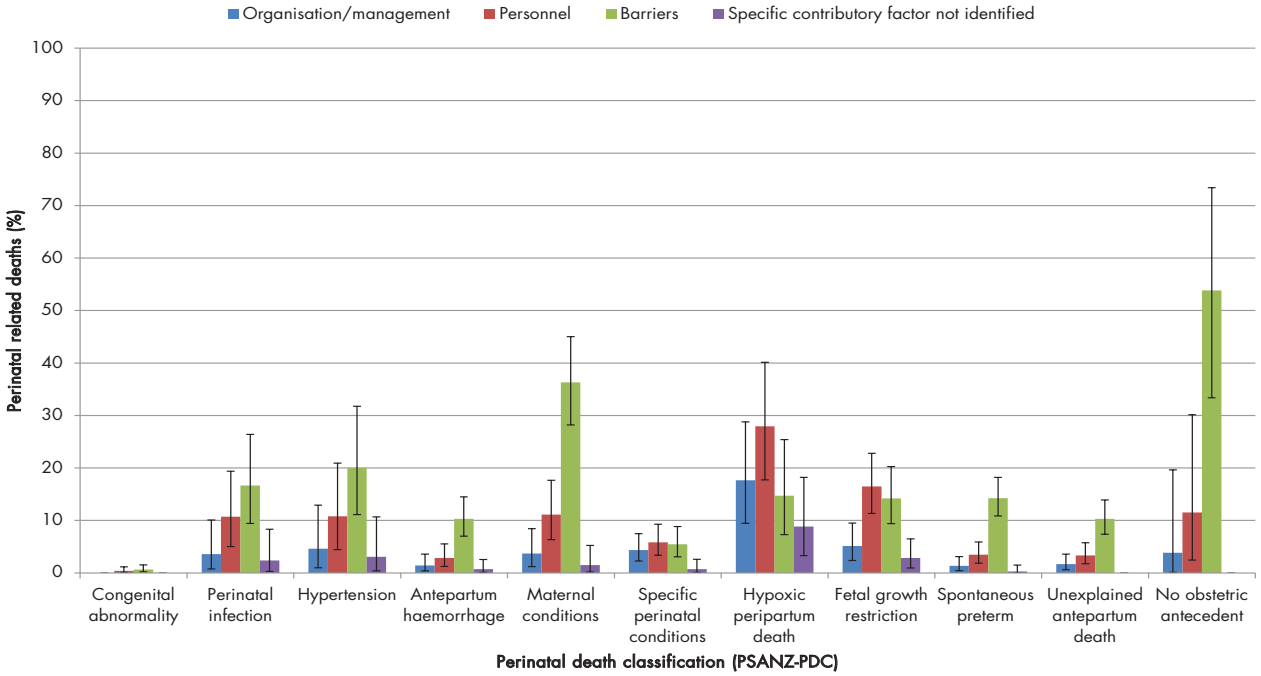



Figure 1.30 illustrates the main contributory factors in potentially avoidable perinatal related deaths by cause of death (PSANZ-PDC). If more than one main contributory factor was identified then the death is attributed to both contributory factors.

For example, among 135 perinatal deaths from maternal conditions during 2011–2014, organisation and management factors were responsible for five deaths (4 percent), personnel for 15 (11 percent), and barriers to access and/or engagement with care for 49 (36 percent). In two potentially avoidable deaths no main contributory factor was specified (Table 1.58).

The proportion of potentially avoidable perinatal related deaths was higher among babies of Māori and Pacific mothers, at 22 percent, than all other ethnicities (Figure 1.31). This is due to an excess of barriers to access and/or engagement with care among potentially avoidable deaths, which were responsible for 17 and 19 percent of perinatal related deaths in these ethnic groups (Figure 1.32).

Figure 1.31: 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) 2009–2014

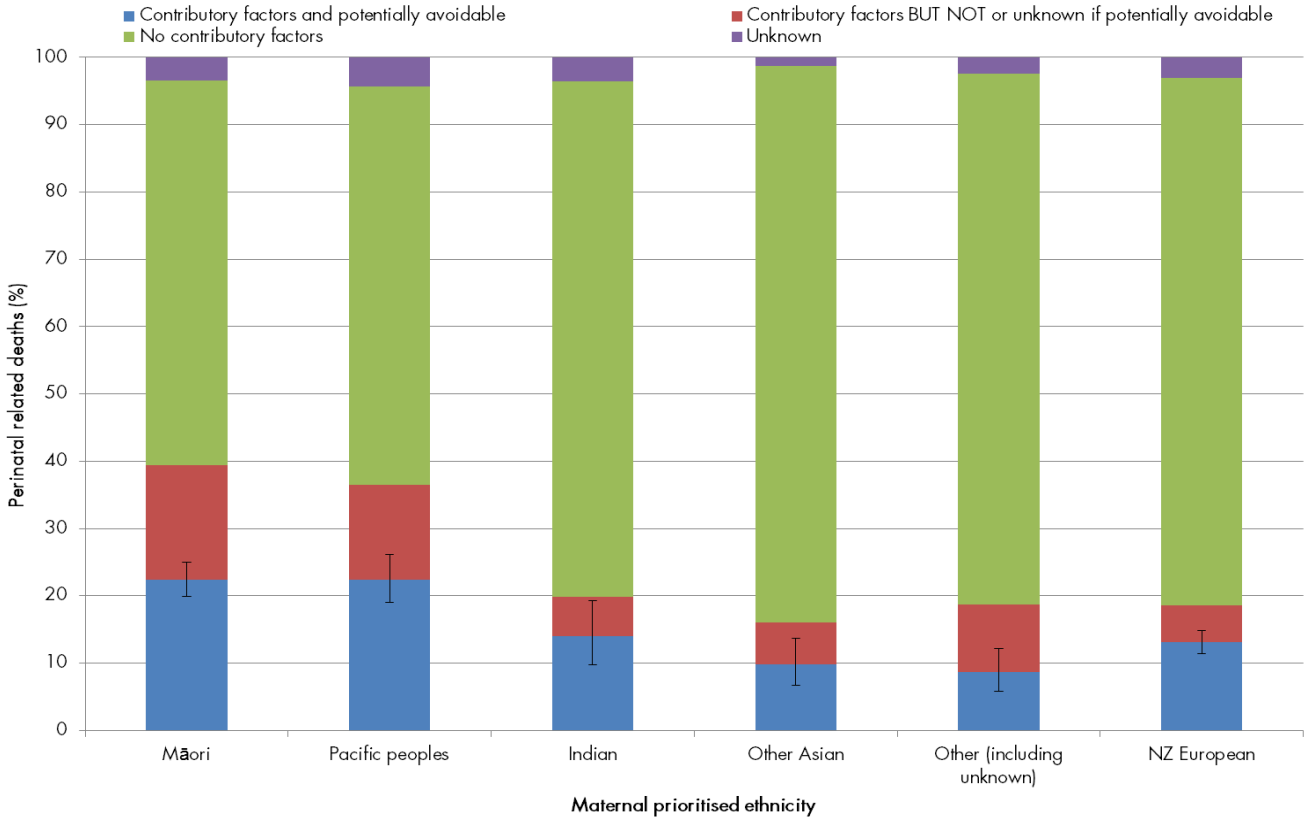



Figure 1.32: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by maternal prioritised ethnicity (with 95% CIs) 2011–2014

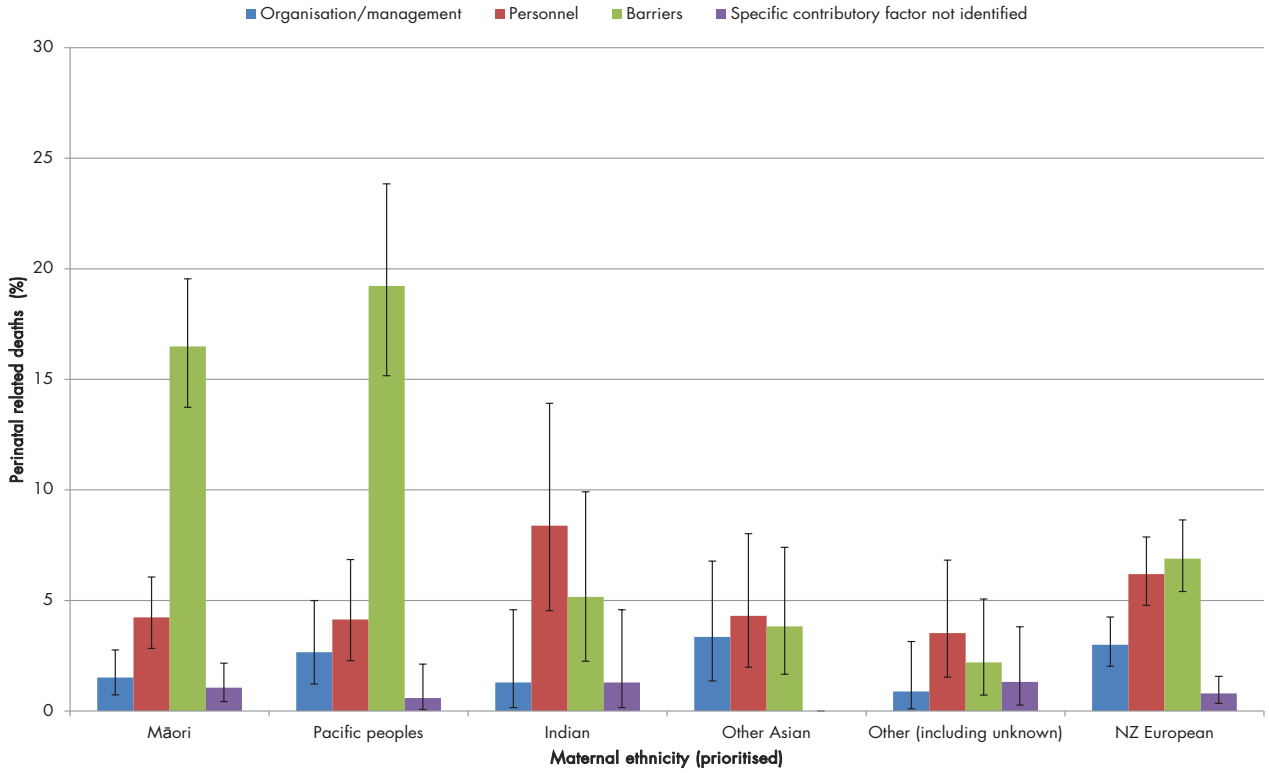
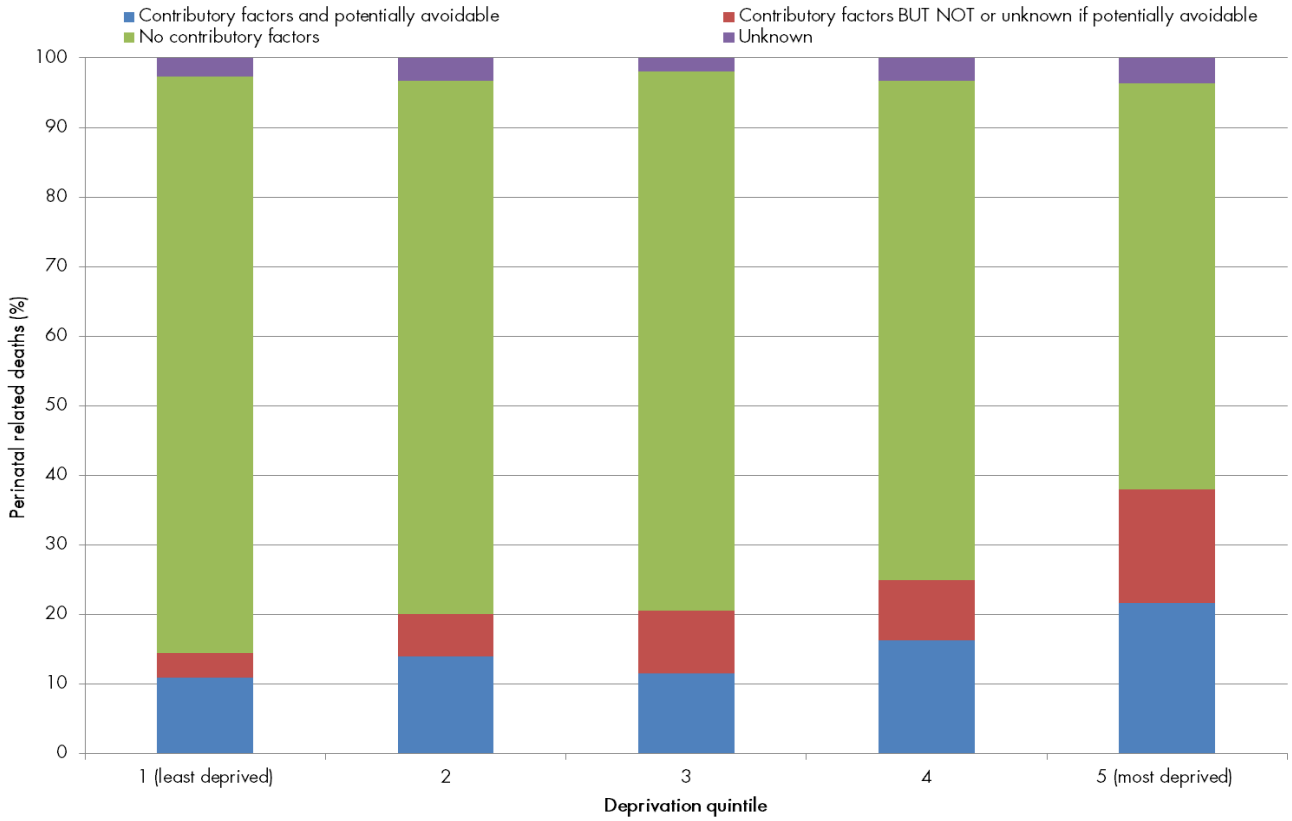
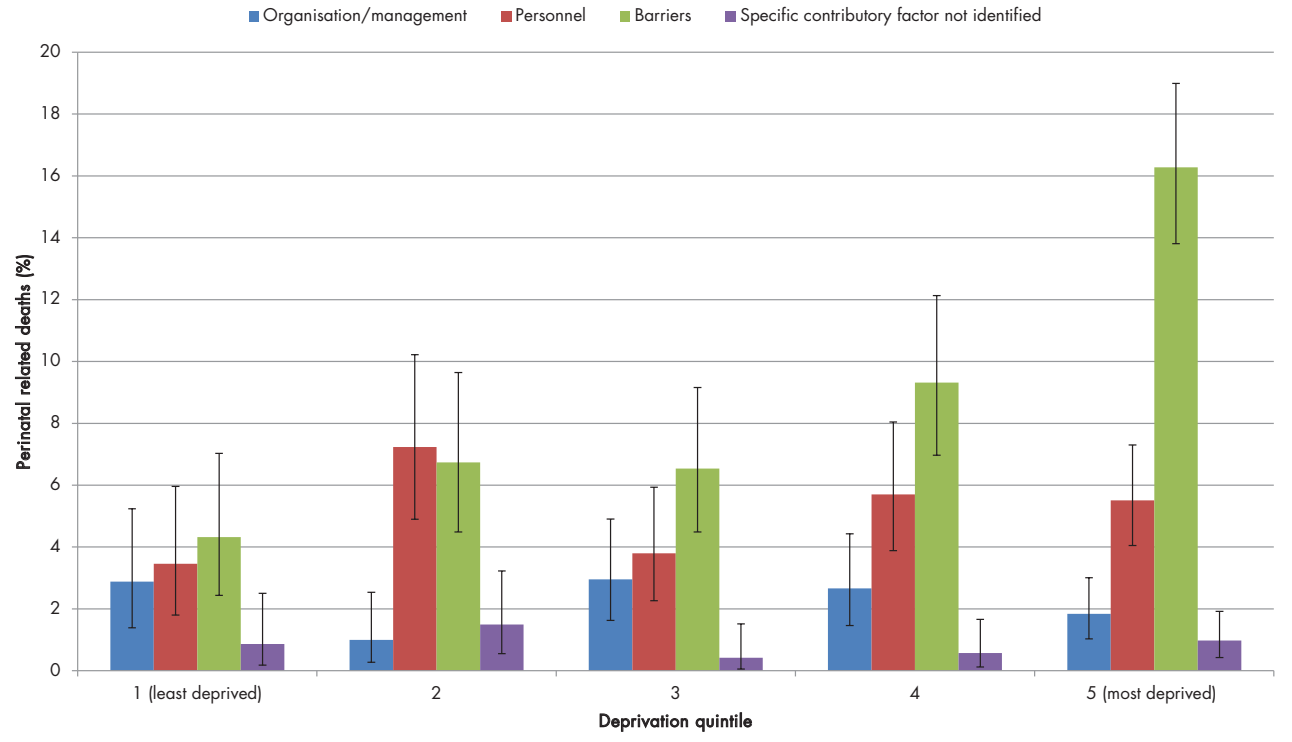


Figure 1.33: Contributory factors and potentially avoidable perinatal related deaths by deprivation quintile 2009–2014




The proportion of potentially avoidable perinatal related deaths increases with increasing socioeconomic deprivation, due to increasing contribution from barriers to access and/or engagement with care. (Tables 1.62 and 1.63)

Figure 1.34: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by deprivation quintile (with 95% CIs) 2011–2014



# 1.5 Perinatal Mortality Appended Tables and Figures

## Table 1.23: New Zealand perinatal mortality rates (per 1000 births) using the international definition 2007–2014

| | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate |
| Total births | 65,050 | | 65,303 | | 63,153 | | 64,574 | | 62,078 | | 61,892 | | 59,552 | | 58,097 | |
| Fetal deaths (terminations of pregnancy and stillbirths)* | 212 | 3.26 | 207 | 3.17 | 231 | 3.66 | 199 | 3.08 | 191 | 3.08 | 166 | 2.79 | 155 | 2.60 | 161 | 2.70 |
| Terminations of pregnancy | 6 | 0.09 | 14 | 0.21 | 9 | 0.14 | 17 | 0.26 | 24 | 0.39 | 13 | 0.22 | 12 | 0.20 | 13 | 0.22 |
| Stillbirths | 206 | 3.17 | 193 | 2.96 | 222 | 3.52 | 182 | 2.82 | 167 | 2.69 | 153 | 2.57 | 143 | 2.40 | 148 | 2.49 |
| Early neonatal deaths <7 days | 57 | | 67 | | 59 | | 68 | | 64 | | 54 | | 45 | | 59 | |
| Late neonatal deaths 7–27 days | 28 | | 35 | | 30 | | 31 | | 18 | | 24 | | 24 | | 23 | |
| Neonatal deaths <28 days# | 85 | 1.31 | 102 | 1.56 | 89 | 1.41 | 99 | 1.53 | 82 | 1.32 | 78 | 1.31 | 69 | 1.16 | 82 | 1.38 |
| Perinatal mortalities+ | 269 | 4.14 | 274 | 4.20 | 290 | 4.59 | 267 | 4.13 | 255 | 4.11 | 220 | 3.69 | 200 | 3.36 | 220 | 3.69 |
| Perinatal related mortalities^ | 297 | 4.57 | 309 | 4.73 | 320 | 5.07 | 298 | 4.61 | 273 | 4.40 | 244 | 4.10 | 224 | 3.76 | 243 | 4.08 |
| Perinatal mortalities excluding lethal and terminated fetal abnormalities• | 224 | 3.44 | 220 | 3.37 | 238 | 3.77 | 204 | 3.16 | 179 | 2.88 | 169 | 2.84 | 159 | 2.67 | 167 | 2.80 |
| Perinatal related mortalities excluding lethal and terminated fetal abnormalities• | 238 | 3.66 | 240 | 3.68 | 254 | 4.02 | 221 | 3.42 | 188 | 3.03 | 179 | 3.01 | 171 | 2.87 | 177 | 2.97 |

* Fetal death rate per 1000 babies born (includes terminations and stillbirths).
# Neonatal death rate per 1000 liveborn 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.

Table 1.24: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) 2007–2014

| Perinatal death classification (PSANZ-PDC) | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | Total | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=65,602 | | n=65,872 | | n=63,665 | | n=65,124 | | n=62,604 | | n=62,425 | | n=60,039 | | n=58,647 | | | | |
| | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | % | |
| Congenital abnormality | 197 | 3.00 | 185 | 2.81 | 182 | 2.86 | 211 | 3.24 | 203 | 3.24 | 201 | 3.22 | 158 | 2.63 | 188 | 3.21 | 1,525 | 28.2 | 0.55 |
| Perinatal infection | 29 | 0.44 | 28 | 0.43 | 25 | 0.39 | 28 | 0.43 | 21 | 0.34 | 19 | 0.30 | 20 | 0.33 | 24 | 0.41 | 194 | 3.6 | 0.29 |
| Hypertension | 19 | 0.29 | 22 | 0.33 | 29 | 0.46 | 27 | 0.41 | 21 | 0.34 | 18 | 0.29 | 13 | 0.22 | 13 | 0.22 | 162 | 3.0 | 0.088 |
| Antepartum haemorrhage | 63 | 0.96 | 66 | 1.00 | 79 | 1.24 | 78 | 1.20 | 78 | 1.25 | 60 | 0.96 | 74 | 1.23 | 69 | 1.18 | 567 | 10.5 | 0.27 |
| Maternal conditions | 27 | 0.41 | 23 | 0.35 | 38 | 0.60 | 32 | 0.49 | 26 | 0.42 | 36 | 0.58 | 34 | 0.57 | 39 | 0.66 | 255 | 4.7 | 0.020 |
| Specific perinatal conditions | 57 | 0.87 | 71 | 1.08 | 76 | 1.19 | 69 | 1.06 | 73 | 1.17 | 70 | 1.12 | 63 | 1.05 | 69 | 1.18 | 548 | 10.1 | 0.26 |
| Hypoxic peripartum death | 33 | 0.50 | 34 | 0.52 | 28 | 0.44 | 20 | 0.31 | 20 | 0.32 | 20 | 0.32 | 11 | 0.18 | 17 | 0.29 | 183 | 3.4 | 0.00035 |
| Fetal growth restriction | 46 | 0.70 | 62 | 0.94 | 53 | 0.83 | 48 | 0.74 | 44 | 0.70 | 49 | 0.78 | 48 | 0.80 | 35 | 0.60 | 385 | 7.1 | 0.27 |
| Spontaneous preterm | 98 | 1.49 | 94 | 1.43 | 110 | 1.73 | 113 | 1.74 | 84 | 1.34 | 102 | 1.63 | 81 | 1.35 | 105 | 1.79 | 787 | 14.5 | 0.63 |
| Unexplained antepartum death | 100 | 1.52 | 102 | 1.55 | 103 | 1.62 | 71 | 1.09 | 92 | 1.47 | 86 | 1.38 | 91 | 1.52 | 90 | 1.53 | 735 | 13.6 | 0.79 |
| No obstetric antecedent | 11 | 0.17 | 14 | 0.21 | 7 | 0.11 | 10 | 0.15 | 4 | 0.06 | 9 | 0.14 | 6 | 0.10 | 7 | 0.12 | 68 | 1.3 | 0.13 |

Table 1.25: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rate using international definition (≥1000g or ≥28 weeks if birthweight unknown) 2007–2014

| Total births (international definition) | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=65,050 | | n=65,303 | | n=63,153 | | n=64,574 | | n=62,078 | | n=61,892 | | n=59,552 | | n=58,097 | | |
| | n | Rate | 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 | 85 | 1.37 | 64 | 1.03 | 50 | 0.84 | 64 | 1.10 | 0.68 |
| Perinatal infection | 16 | 0.25 | 16 | 0.25 | 15 | 0.24 | 13 | 0.20 | 12 | 0.19 | 9 | 0.15 | 9 | 0.15 | 12 | 0.21 | 0.16 |
| Hypertension | 7 | 0.11 | 7 | 0.11 | 14 | 0.22 | 11 | 0.17 | 9 | 0.14 | 3 | 0.05 | 5 | 0.08 | 6 | 0.10 | 0.25 |
| Antepartum haemorrhage | 23 | 0.35 | 25 | 0.38 | 24 | 0.38 | 23 | 0.36 | 17 | 0.27 | 13 | 0.21 | 18 | 0.30 | 11 | 0.19 | 0.019 |
| Maternal conditions | 14 | 0.22 | 9 | 0.14 | 19 | 0.30 | 19 | 0.29 | 7 | 0.11 | 17 | 0.27 | 22 | 0.37 | 14 | 0.24 | 0.18 |
| Specific perinatal conditions | 29 | 0.45 | 23 | 0.35 | 32 | 0.51 | 30 | 0.46 | 32 | 0.52 | 21 | 0.34 | 24 | 0.40 | 25 | 0.43 | 0.79 |
| Hypoxic peripartum death | 33 | 0.51 | 34 | 0.52 | 28 | 0.44 | 20 | 0.31 | 20 | 0.32 | 20 | 0.32 | 11 | 0.18 | 17 | 0.29 | 0.00035 |
| Fetal growth restriction | 29 | 0.45 | 32 | 0.49 | 31 | 0.49 | 31 | 0.48 | 18 | 0.29 | 32 | 0.52 | 21 | 0.35 | 19 | 0.33 | 0.14 |
| Spontaneous preterm | 9 | 0.14 | 7 | 0.11 | 10 | 0.16 | 19 | 0.29 | 8 | 0.13 | 10 | 0.16 | 5 | 0.08 | 9 | 0.15 | 0.84 |
| Unexplained antepartum death | 68 | 1.05 | 73 | 1.12 | 75 | 1.19 | 45 | 0.70 | 61 | 0.98 | 46 | 0.74 | 53 | 0.89 | 59 | 1.02 | 0.12 |
| No obstetric antecedent | 11 | 0.17 | 14 | 0.21 | 7 | 0.11 | 10 | 0.15 | 4 | 0.06 | 9 | 0.15 | 6 | 0.10 | 7 | 0.12 | 0.13 |

Table 1.26: Neonatal death classification (PSANZ-NDC) specific neonatal death rates (per 1000 live births) 2007–2014

| Neonatal death classification (PSANZ-NDC) | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=65,602 | | n=65,872 | | n=63,665 | | n=65,124 | | n=62,604 | | n=62,425 | | n=60,039 | | n=58,647 | |
| | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate | n | Rate |
| Congenital abnormality | 38 | 0.58 | 43 | 0.66 | 43 | 0.68 | 46 | 0.71 | 50 | 0.81 | 38 | 0.61 | 32 | 0.54 | 44 | 0.76 |
| Extreme prematurity | 57 | 0.88 | 52 | 0.80 | 58 | 0.92 | 84 | 1.30 | 54 | 0.87 | 68 | 1.10 | 63 | 1.06 | 69 | 1.19 |
| Cardio-respiratory disorders | 11 | 0.17 | 11 | 0.17 | 11 | 0.17 | 18 | 0.28 | 11 | 0.18 | 14 | 0.23 | 6 | 0.10 | 16 | 0.28 |
| Infection | 14 | 0.22 | 21 | 0.32 | 12 | 0.19 | 19 | 0.29 | 15 | 0.24 | 16 | 0.26 | 12 | 0.20 | 15 | 0.26 |
| Neurological | 31 | 0.48 | 33 | 0.50 | 40 | 0.63 | 28 | 0.43 | 23 | 0.37 | 25 | 0.40 | 25 | 0.42 | 24 | 0.41 |
| Gastrointestinal | 2 | 0.03 | 0 | 0.00 | 8 | 0.13 | 5 | 0.08 | 2 | 0.03 | 3 | 0.05 | 1 | 0.02 | 3 | 0.05 |
| Other | 14 | 0.22 | 17 | 0.26 | 11 | 0.17 | 10 | 0.15 | 8 | 0.13 | 14 | 0.23 | 14 | 0.23 | 11 | 0.19 |

Table 1.27: Perinatal related mortality rates (per 1000 births) by gender 2014

| Gender | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| Male | 30,329 | 51.3 | 85 | 57.0 | 2.80 | 176 | 54.2 | 5.80 | 96 | 52.7 | 3.19 | 357 | 54.4 | 11.77 |
| Female | 28,318 | 48.7 | 60 | 40.3 | 2.12 | 145 | 44.6 | 5.12 | 86 | 47.3 | 3.06 | 291 | 44.4 | 10.28 |
| Unknown | - | - | 4 | 2.7 | - | 4 | 1.2 | - | - | - | - | 8 | 1.2 | - |

Table 1.28: Perinatal related mortality rate (per 1000 births) by maternal age excluding congenital abnormalities 2007–2014

| Maternal age (years) | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | |
| <20 | 42 | 5,091 | 8.25 | 70 | 5,365 | 13.05 | 61 | 4,764 | 12.80 | 42 | 4,624 | 9.08 | 44 | 4,093 | 10.75 | 46 | 3,914 | 11.75 | 56 | 3,436 | 16.30 | 36 | 3,040 | 11.84 | 0.074 |
| 20–24 | 106 | 11,506 | 9.21 | 101 | 11,892 | 8.49 | 117 | 11,764 | 9.95 | 115 | 12,116 | 9.49 | 87 | 11,674 | 7.45 | 95 | 11,596 | 8.19 | 88 | 11,024 | 7.98 | 85 | 10,289 | 8.26 | 0.14 |
| 25–29 | 124 | 15,931 | 7.78 | 114 | 16,020 | 7.12 | 126 | 15,609 | 8.07 | 115 | 16,231 | 7.09 | 106 | 15,736 | 6.74 | 109 | 15,937 | 6.84 | 105 | 15,573 | 6.74 | 117 | 15,607 | 7.50 | 0.37 |
| 30–34 | 110 | 18,838 | 5.84 | 120 | 18,150 | 6.61 | 125 | 17,560 | 7.12 | 110 | 17,978 | 6.12 | 105 | 17,464 | 6.01 | 118 | 17,742 | 6.65 | 101 | 17,069 | 5.92 | 131 | 17,480 | 7.49 | 0.38 |
| 35–39 | 81 | 11,794 | 6.87 | 89 | 11,997 | 7.42 | 97 | 11,472 | 8.46 | 91 | 11,502 | 7.91 | 96 | 11,049 | 8.69 | 68 | 10,540 | 6.45 | 57 | 10,291 | 5.54 | 74 | 9,705 | 7.62 | 0.41 |
| ≥40 | 19 | 2,440 | 7.79 | 22 | 2,447 | 8.99 | 20 | 2,495 | 8.02 | 23 | 2,673 | 8.60 | 23 | 2,588 | 8.89 | 31 | 2,696 | 11.50 | 30 | 2,646 | 11.34 | 21 | 2,526 | 8.31 | 0.28 |
| Unknown | - | 2 | - | - | 1 | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |

Table 1.29: Perinatal related mortality rate (per 1000 births) by maternal prioritised ethnicity excluding congenital abnormalities 2007–2014

| Maternal ethnicity | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | |
| Māori | 145 | 15,384 | 9.43 | 147 | 15,530 | 9.47 | 168 | 14,646 | 11.47 | 158 | 14,877 | 10.62 | 129 | 14,244 | 9.06 | 121 | 14,143 | 8.56 | 119 | 13,488 | 8.82 | 134 | 12,942 | 10.35 | 0.51 |
| Pacific peoples | 67 | 6,774 | 9.89 | 80 | 6,987 | 11.45 | 87 | 6,823 | 12.75 | 73 | 6,999 | 10.43 | 56 | 6,832 | 8.20 | 76 | 6,631 | 11.46 | 69 | 6,161 | 11.20 | 68 | 5,878 | 11.57 | 0.83 |
| Indian | 16 | 2,131 | 7.51 | 20 | 2,263 | 8.84 | 22 | 2,190 | 10.05 | 28 | 2,378 | 11.77 | 26 | 2,338 | 11.12 | 25 | 2,459 | 10.17 | 29 | 2,705 | 10.72 | 29 | 2,777 | 10.44 | 0.30 |
| Other Asian | 15 | 4,264 | 3.52 | 30 | 4,394 | 6.83 | 23 | 4,590 | 5.01 | 31 | 5,088 | 6.09 | 30 | 5,231 | 5.74 | 32 | 6,199 | 5.16 | 21 | 6,002 | 3.50 | 29 | 6,493 | 4.47 | 0.33 |
| Other (including unknown) | 35 | 5,768 | 6.07 | 37 | 5,835 | 6.34 | 44 | 5,732 | 7.68 | 30 | 6,032 | 4.97 | 45 | 5,576 | 8.07 | 40 | 5,317 | 7.52 | 34 | 5,454 | 6.23 | 29 | 5,431 | 5.34 | 0.85 |
| NZ European | 204 | 31,281 | 6.52 | 202 | 30,863 | 6.55 | 202 | 29,684 | 6.81 | 176 | 29,750 | 5.92 | 175 | 28,383 | 6.17 | 173 | 27,676 | 6.25 | 165 | 26,229 | 6.29 | 176 | 25,126 | 7.00 | 0.98 |

Table 1.30: Perinatal related mortality rate (per 1000 births) by deprivation quintile excluding congenital abnormalities 2007–2014

| Deprivation quintile | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | |
| 1 (least deprived) | 50 | 10,813 | 4.62 | 57 | 10,431 | 5.46 | 52 | 10,177 | 5.11 | 51 | 10,304 | 4.95 | 77 | 9,904 | 7.77 | 47 | 9,767 | 4.81 | 44 | 9,183 | 4.79 | 57 | 9,317 | 6.12 | 0.32 |
| 2 | 61 | 11,610 | 5.25 | 79 | 11,580 | 6.82 | 76 | 11,225 | 6.77 | 77 | 11,485 | 6.70 | 82 | 11,125 | 7.37 | 82 | 10,928 | 7.50 | 51 | 10,651 | 4.79 | 65 | 10,283 | 6.32 | 0.93 |
| 3 | 80 | 12,063 | 6.63 | 87 | 12,192 | 7.14 | 90 | 12,088 | 7.45 | 85 | 12,311 | 6.90 | 75 | 11,969 | 6.27 | 73 | 12,093 | 6.04 | 99 | 11,777 | 8.41 | 81 | 11,366 | 7.13 | 0.63 |
| 4 | 112 | 13,395 | 8.36 | 104 | 13,768 | 7.55 | 127 | 13,342 | 9.52 | 98 | 13,797 | 7.10 | 97 | 13,174 | 7.36 | 84 | 13,241 | 6.34 | 83 | 12,366 | 6.71 | 105 | 12,262 | 8.56 | 0.21 |
| 5 (most deprived) | 172 | 17,245 | 9.97 | 184 | 17,554 | 10.48 | 185 | 16,530 | 11.19 | 176 | 16,862 | 10.44 | 127 | 16,182 | 7.85 | 176 | 16,184 | 10.87 | 153 | 15,830 | 9.67 | 153 | 15,141 | 10.11 | 0.50 |
| Unknown | 7 | 476 | - | 5 | 347 | - | 16 | 303 | - | 9 | 365 | - | 3 | 250 | - | 5 | 212 | - | 7 | 232 | - | 4 | 278 | - | - |

## Table 1.31: Perinatal related mortality rates (per 1000 births) by maternal age 2007–2014

| | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Total perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=503,978 | | n=1,209 | | | n=2,787 | | | n=1,413 | | | n=5,409 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| **Maternal age (years)** | | | | | | | | | | | | | | |
| <20 | 34,327 | 6.8 | 92 | 7.6 | 2.68 | 260 | 9.3 | 7.57 | 171 | 12.1 | 5.03 | 523 | 9.7 | 15.24 |
| 20–24 | 91,861 | 18.2 | 192 | 15.9 | 2.09 | 562 | 20.2 | 6.12 | 298 | 21.1 | 3.27 | 1,052 | 19.4 | 11.45 |
| 25–29 | 126,644 | 25.1 | 269 | 22.2 | 2.12 | 629 | 22.6 | 4.97 | 347 | 24.6 | 2.76 | 1,245 | 23.0 | 9.83 |
| 30–34 | 142,281 | 28.2 | 316 | 26.1 | 2.22 | 683 | 24.5 | 4.80 | 293 | 20.7 | 2.07 | 1,292 | 23.9 | 9.08 |
| 35–39 | 88,350 | 17.5 | 256 | 21.2 | 2.90 | 495 | 17.8 | 5.60 | 236 | 16.7 | 2.69 | 987 | 18.2 | 11.17 |
| ≥40 | 20,511 | 4.1 | 84 | 6.9 | 4.10 | 156 | 5.6 | 7.61 | 67 | 4.7 | 3.31 | 307 | 5.7 | 14.97 |
| Unknown | 4 | 0.0 | - | - | - | 2 | 0.1 | - | 1 | 0.1 | - | 3 | 0.1 | - |

## Table 1.32: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding termination of pregnancy) by maternal age 2007–2014

| Perinatal death classification (PSANZ-PDC) | Maternal age (years) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | <20 | | | 20–24 | | | 25–34 | | | 35–39 | | | ≥40 | | |
| | n=34,327 | | | n=91,861 | | | n=268,925 | | | n=88,350 | | | n=20,511 | | |
| | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| Congenital abnormality* | 57 | 13.2 | 1.66 | 108 | 12.6 | 1.18 | 235 | 12.0 | 0.87 | 117 | 16.0 | 1.32 | 54 | 24.2 | 2.63 |
| Perinatal infection | 26 | 6.0 | 0.76 | 35 | 4.1 | 0.38 | 89 | 4.6 | 0.33 | 23 | 3.1 | 0.26 | 6 | 2.7 | 0.29 |
| Hypertension | 3 | 0.7 | 0.09 | 31 | 3.6 | 0.34 | 66 | 3.4 | 0.25 | 26 | 3.6 | 0.29 | 9 | 4.0 | 0.44 |
| Antepartum haemorrhage | 58 | 13.5 | 1.69 | 114 | 13.3 | 1.24 | 257 | 13.2 | 0.96 | 86 | 11.8 | 0.97 | 19 | 8.5 | 0.93 |
| Maternal conditions | 11 | 2.6 | 0.32 | 41 | 4.8 | 0.45 | 91 | 4.7 | 0.34 | 40 | 5.5 | 0.45 | 16 | 7.2 | 0.78 |
| Specific perinatal condition | 34 | 7.9 | 0.99 | 69 | 8.0 | 0.75 | 259 | 13.3 | 0.96 | 100 | 13.7 | 1.13 | 33 | 14.8 | 1.61 |
| Hypoxic peripartum death | 17 | 3.9 | 0.50 | 38 | 4.4 | 0.41 | 93 | 4.8 | 0.35 | 29 | 4.0 | 0.33 | 6 | 2.7 | 0.29 |
| Fetal growth restriction | 40 | 9.3 | 1.17 | 76 | 8.8 | 0.83 | 174 | 8.9 | 0.65 | 58 | 7.9 | 0.66 | 14 | 6.3 | 0.68 |
| Spontaneous preterm# | 117 | 27.1 | 3.41 | 164 | 19.1 | 1.79 | 317 | 16.2 | 1.18 | 109 | 14.9 | 1.23 | 29 | 13.0 | 1.41 |
| Unexplained antepartum death | 55 | 12.8 | 1.60 | 166 | 19.3 | 1.81 | 342 | 17.5 | 1.27 | 136 | 18.6 | 1.54 | 36 | 16.1 | 1.76 |
| No obstetric antecedent | 13 | 3.0 | 0.38 | 18 | 2.1 | 0.20 | 29 | 1.5 | 0.11 | 7 | 1.0 | 0.08 | 1 | 0.4 | 0.05 |

* Excludes two maternal age missing.
\# Excludes one maternal age missing.

## Table 1.33: Perinatal related mortality rates (per 1000 births) by baby prioritised ethnicity 2014

| | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| **Ethnicity (baby)** | | | | | | | | | | | | | | |
| Māori | 16,567 | 28.2 | 27 | 18.1 | 1.63 | 101 | 31.1 | 6.10 | 61 | 33.5 | 3.71 | 189 | 28.8 | 11.41 |
| Pacific peoples | 6,231 | 11.5 | 7 | 4.7 | 1.12 | 46 | 14.2 | 7.38 | 28 | 15.4 | 4.53 | 81 | 12.3 | 13.00 |
| Indian | 2,951 | 3.9 | 13 | 8.7 | 4.41 | 19 | 5.8 | 6.44 | 15 | 8.2 | 5.14 | 47 | 7.2 | 15.93 |
| Other Asian | 6,418 | 8.2 | 19 | 12.8 | 2.96 | 21 | 6.5 | 3.27 | 12 | 6.6 | 1.88 | 52 | 7.9 | 8.10 |
| Other (including unknown) | 3,704 | 6.1 | 9 | 6.0 | 2.43 | 20 | 6.2 | 5.40 | 8 | 4.4 | 2.18 | 37 | 5.6 | 9.99 |
| NZ European | 22,776 | 41.3 | 74 | 49.7 | 3.25 | 118 | 36.3 | 5.18 | 58 | 31.9 | 2.57 | 250 | 38.1 | 10.98 |

## Table 1.34: Perinatal related mortality rates (per 1000 births) by maternal and baby prioritised ethnicity 2007–2014

| | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=503,978 | | n=1,209 | | | n=2,787 | | | n=1,413 | | | n=5,409 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| **Ethnicity (mother)** | | | | | | | | | | | | | | |
| Māori | 115,254 | 22.9 | 188 | 15.6 | 1.63 | 764 | 27.4 | 6.63 | 461 | 32.6 | 4.03 | 1,413 | 26.1 | 12.26 |
| Pacific peoples | 53,085 | 10.5 | 98 | 8.1 | 1.85 | 419 | 15.0 | 7.89 | 221 | 15.6 | 4.20 | 738 | 13.6 | 13.90 |
| Indian | 19,241 | 3.8 | 77 | 6.4 | 4.00 | 130 | 4.7 | 6.76 | 70 | 5.0 | 3.68 | 277 | 5.1 | 14.40 |
| Other Asian | 42,261 | 8.4 | 148 | 12.2 | 3.50 | 153 | 5.5 | 3.62 | 79 | 5.6 | 1.88 | 380 | 7.0 | 8.99 |
| Other (including unknown) | 45,145 | 9.0 | 122 | 10.1 | 2.70 | 224 | 8.0 | 4.96 | 90 | 6.4 | 2.01 | 436 | 8.1 | 9.66 |
| NZ European | 228,992 | 45.4 | 576 | 47.6 | 2.52 | 1,097 | 39.4 | 4.79 | 492 | 34.8 | 2.16 | 2,165 | 40.0 | 9.45 |
| **Ethnicity (baby)** | | | | | | | | | | | | | | |
| Māori | 146,703 | 29.1 | 267 | 22.1 | 1.82 | 925 | 33.2 | 6.31 | 514 | 36.4 | 3.53 | 1,706 | 31.5 | 11.63 |
| Pacific peoples | 55,729 | 11.1 | 100 | 8.3 | 1.79 | 419 | 15.0 | 7.52 | 225 | 15.9 | 4.08 | 744 | 13.8 | 13.35 |
| Indian | 20,219 | 4.0 | 80 | 6.6 | 3.96 | 132 | 4.7 | 6.53 | 72 | 5.1 | 3.60 | 284 | 5.3 | 14.05 |
| Other Asian | 41,543 | 8.2 | 145 | 12.0 | 3.49 | 158 | 5.7 | 3.80 | 76 | 5.4 | 1.84 | 379 | 7.0 | 9.12 |
| Other (including unknown) | 30,875 | 6.1 | 72 | 6.0 | 2.33 | 171 | 6.1 | 5.54 | 59 | 4.2 | 1.93 | 302 | 5.6 | 9.78 |
| NZ European | 208,909 | 41.5 | 545 | 45.1 | 2.61 | 982 | 35.2 | 4.70 | 467 | 33.1 | 2.25 | 1,994 | 36.9 | 9.54 |

## Table 1.35: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding termination of pregnancy) by maternal prioritised ethnicity 2007–2014

| Perinatal death classification (PSANZ-PDC) | Māori | | | Pacific peoples | | | Indian | | | Other Asian | | | Other (including unknown) | | | NZ European | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=115,254 | | | n=53,085 | | | n=19,241 | | | n=42,261 | | | n=45,145 | | | n=228,992 | | |
| | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| Congenital abnormality | 146 | 11.9 | 1.27 | 91 | 14.2 | 1.71 | 20 | 10.0 | 1.04 | 43 | 18.5 | 1.02 | 47 | 15.0 | 1.04 | 226 | 14.2 | 0.99 |
| Perinatal infection | 49 | 4.0 | 0.43 | 30 | 4.7 | 0.57 | 7 | 3.5 | 0.36 | 11 | 4.7 | 0.26 | 19 | 6.1 | 0.42 | 63 | 4.0 | 0.28 |
| Hypertension | 35 | 2.9 | 0.30 | 29 | 4.5 | 0.55 | 8 | 4.0 | 0.42 | 7 | 3.0 | 0.17 | 7 | 2.2 | 0.16 | 49 | 3.1 | 0.21 |
| Antepartum haemorrhage | 171 | 14.0 | 1.48 | 77 | 12.0 | 1.45 | 26 | 13.0 | 1.35 | 30 | 12.9 | 0.71 | 31 | 9.9 | 0.69 | 199 | 12.5 | 0.87 |
| Maternal conditions | 61 | 5.0 | 0.53 | 53 | 8.3 | 1.00 | 12 | 6.0 | 0.62 | 7 | 3.0 | 0.17 | 10 | 3.2 | 0.22 | 56 | 3.5 | 0.24 |
| Specific perinatal conditions | 109 | 8.9 | 0.95 | 62 | 9.7 | 1.17 | 31 | 15.5 | 1.61 | 31 | 13.4 | 0.73 | 46 | 14.6 | 1.02 | 216 | 13.6 | 0.94 |
| Hypoxic peripartum death | 49 | 4.0 | 0.43 | 18 | 2.8 | 0.34 | 7 | 3.5 | 0.36 | 6 | 2.6 | 0.14 | 20 | 6.4 | 0.44 | 83 | 5.2 | 0.36 |
| Fetal growth restriction | 88 | 7.2 | 0.76 | 47 | 7.3 | 0.89 | 25 | 12.5 | 1.30 | 23 | 9.9 | 0.54 | 28 | 8.9 | 0.62 | 151 | 9.5 | 0.66 |
| Spontaneous preterm | 281 | 22.9 | 2.44 | 114 | 17.8 | 2.15 | 38 | 19.0 | 1.97 | 33 | 14.2 | 0.78 | 47 | 15.0 | 1.04 | 224 | 14.1 | 0.98 |
| Unexplained antepartum death | 200 | 16.3 | 1.74 | 106 | 16.6 | 2.00 | 25 | 12.5 | 1.30 | 40 | 17.2 | 0.95 | 59 | 18.8 | 1.31 | 305 | 19.2 | 1.33 |
| No obstetric antecedent | 36 | 2.9 | 0.31 | 13 | 2.0 | 0.24 | 1 | 0.5 | 0.05 | 1 | 0.4 | 0.02 | - | - | - | 17 | 1.1 | 0.07 |

## Table 1.36: Distribution of births by deprivation decile (NZDep2013) 2014

| NZ Deprivation Index (NZDep 2013) | Total births n=58,647 | |
|---|---|---|
| | n | % |
| 1 (least deprived) | 4,333 | 7.4 |
| 2 | 4,984 | 8.5 |
| 3 | 5,133 | 8.8 |
| 4 | 5,150 | 8.8 |
| 5 | 5,597 | 9.5 |
| 6 | 5,769 | 9.8 |
| 7 | 5,866 | 10.0 |
| 8 | 6,396 | 10.9 |
| 9 | 6,883 | 11.7 |
| 10 (most deprived) | 8,258 | 14.1 |
| Unknown | 278 | 0.5 |

## Table 1.37: Perinatal related deaths by deprivation quintile 2007–2014

| Deprivation quintile | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=503,978 | | n=1,209 | | | n=2,787 | | | n=1,413 | | | n=5,409 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| 1 (least deprived) | 79,896 | 15.9 | 230 | 19.0 | 2.88 | 323 | 11.6 | 4.04 | 145 | 10.3 | 1.83 | 698 | 12.9 | 8.74 |
| 2 | 88,887 | 17.6 | 232 | 19.2 | 2.61 | 406 | 14.6 | 4.57 | 183 | 13.0 | 2.07 | 821 | 15.2 | 9.24 |
| 3 | 95,859 | 19.0 | 245 | 20.3 | 2.56 | 484 | 17.4 | 5.05 | 234 | 16.6 | 2.46 | 963 | 17.8 | 10.05 |
| 4 | 105,345 | 20.9 | 249 | 20.6 | 2.36 | 587 | 21.1 | 5.57 | 302 | 21.4 | 2.89 | 1,138 | 21.0 | 10.80 |
| 5 (most deprived) | 131,528 | 26.1 | 242 | 20.0 | 1.84 | 948 | 34.0 | 7.21 | 530 | 37.5 | 4.07 | 1,720 | 31.8 | 13.08 |
| Unknown | 2,463 | 0.5 | 11 | 0.9 | - | 39 | 1.4 | - | 19 | 1.3 | - | 69 | 1.3 | - |

## Table 1.38: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile 2007–2014

| Perinatal death classification (PSANZ-PDC) | Quintile 1 (least deprived) | | | Quintile 2 | | | Quintile 3 | | | Quintile 4 | | | Quintile 5 (most deprived) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=79,896 | | | n=88,887 | | | n=95,859 | | | n=105,345 | | | n=131,528 | | |
| | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| Congenital abnormality | 76 | 16.2 | 0.95 | 64 | 10.9 | 0.72 | 98 | 13.6 | 1.02 | 130 | 14.6 | 1.23 | 200 | 13.5 | 1.52 |
| Perinatal infection | 20 | 4.3 | 0.25 | 27 | 4.6 | 0.30 | 39 | 5.4 | 0.41 | 31 | 3.5 | 0.29 | 61 | 4.1 | 0.46 |
| Hypertension | 9 | 1.9 | 0.11 | 13 | 2.2 | 0.15 | 26 | 3.6 | 0.27 | 32 | 3.6 | 0.30 | 52 | 3.5 | 0.40 |
| Antepartum haemorrhage | 48 | 10.3 | 0.60 | 77 | 13.1 | 0.87 | 80 | 11.1 | 0.83 | 112 | 12.6 | 1.06 | 210 | 14.2 | 1.60 |
| Maternal conditions | 16 | 3.4 | 0.20 | 12 | 2.0 | 0.14 | 24 | 3.3 | 0.25 | 40 | 4.5 | 0.38 | 105 | 7.1 | 0.80 |
| Specific perinatal condition | 72 | 15.4 | 0.90 | 80 | 13.6 | 0.90 | 106 | 14.8 | 1.11 | 100 | 11.2 | 0.95 | 131 | 8.9 | 1.00 |
| Hypoxic peripartum death | 15 | 3.2 | 0.19 | 34 | 5.8 | 0.38 | 33 | 4.6 | 0.34 | 44 | 4.9 | 0.42 | 53 | 3.6 | 0.40 |
| Fetal growth restriction | 49 | 10.5 | 0.61 | 49 | 8.3 | 0.55 | 67 | 9.3 | 0.70 | 75 | 8.4 | 0.71 | 120 | 8.1 | 0.91 |
| Spontaneous preterm | 63 | 13.5 | 0.79 | 101 | 17.1 | 1.14 | 108 | 15.0 | 1.13 | 163 | 18.3 | 1.55 | 284 | 19.2 | 2.16 |
| Unexplained antepartum death | 95 | 20.3 | 1.19 | 122 | 20.7 | 1.37 | 127 | 17.7 | 1.32 | 148 | 16.6 | 1.40 | 234 | 15.8 | 1.78 |
| No obstetric antecedent | 5 | 1.1 | 0.06 | 10 | 1.7 | 0.11 | 10 | 1.4 | 0.10 | 14 | 1.6 | 0.13 | 28 | 1.9 | 0.21 |

## Table 1.39: Perinatal related mortality rates (per 1000 births) by DHB of maternal residence 2014

| DHB of maternal residence | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=58,647 | | n=149 | | | n=325 | | | n=182 | | | n=656 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| Northland | 2,149 | 3.7 | 6 | 4.0 | 2.79 | 14 | 4.3 | 6.51 | 6 | 3.3 | 2.82 | 26 | 4.0 | 12.10 |
| Waitemata | 7,768 | 13.2 | 30 | 20.1 | 3.86 | 30 | 9.2 | 3.86 | 20 | 11.0 | 2.59 | 80 | 12.2 | 10.30 |
| Auckland | 6,114 | 10.4 | 24 | 16.1 | 3.93 | 18 | 5.5 | 2.94 | 20 | 11.0 | 3.29 | 62 | 9.5 | 10.14 |
| Counties Manukau | 8,144 | 13.9 | 17 | 11.4 | 2.09 | 69 | 21.2 | 8.47 | 30 | 16.5 | 3.72 | 116 | 17.7 | 14.24 |
| Waikato | 5,270 | 9.0 | 10 | 6.7 | 1.90 | 36 | 11.1 | 6.83 | 22 | 12.1 | 4.21 | 68 | 10.4 | 12.90 |
| Bay of Plenty | 2,707 | 4.6 | 8 | 5.4 | 2.96 | 23 | 7.1 | 8.50 | 13 | 7.1 | 4.86 | 44 | 6.7 | 16.25 |
| Lakes | 1,375 | 2.3 | 7 | 4.7 | 5.09 | 8 | 2.5 | 5.82 | 6 | 3.3 | 4.41 | 21 | 3.2 | 15.27 |
| Tairawhiti | 673 | 1.1 | 1 | 0.7 | 1.49 | 2 | 0.6 | 2.97 | 2 | 1.1 | 2.99 | 5 | 0.8 | 7.43 |
| Taranaki | 1,539 | 2.6 | 2 | 1.3 | 1.30 | 7 | 2.2 | 4.55 | 7 | 3.8 | 4.58 | 16 | 2.4 | 10.40 |
| Hawke's Bay | 2,114 | 3.6 | 5 | 3.4 | 2.37 | 12 | 3.7 | 5.68 | 4 | 2.2 | 1.91 | 21 | 3.2 | 9.93 |
| Whanganui | 799 | 1.4 | - | - | - | 2 | 0.6 | 2.50 | 3 | 1.6 | 3.76 | 5 | 0.8 | 6.26 |
| MidCentral | 2,100 | 3.6 | 3 | 2.0 | 1.43 | 8 | 2.5 | 3.81 | 1 | 0.5 | 0.48 | 12 | 1.8 | 5.71 |
| Wairarapa | 495 | 0.8 | - | - | - | 2 | 0.6 | 4.04 | 1 | 0.5 | 2.03 | 3 | 0.5 | 6.06 |
| Capital & Coast | 3,571 | 6.1 | 1 | 0.7 | 0.28 | 12 | 3.7 | 3.36 | 10 | 5.5 | 2.81 | 23 | 3.5 | 6.44 |
| Hutt Valley | 1,827 | 3.1 | 5 | 3.4 | 2.74 | 15 | 4.6 | 8.21 | 2 | 1.1 | 1.11 | 22 | 3.4 | 12.04 |
| Nelson Marlborough | 1,463 | 2.5 | 2 | 1.3 | 1.37 | 8 | 2.5 | 5.47 | 6 | 3.3 | 4.13 | 16 | 2.4 | 10.94 |
| West Coast | 382 | 0.7 | - | - | - | 1 | 0.3 | 2.62 | 2 | 1.1 | 5.25 | 3 | 0.5 | 7.85 |
| Canterbury | 6,033 | 10.3 | 20 | 13.4 | 3.32 | 34 | 10.5 | 5.64 | 15 | 8.2 | 2.51 | 69 | 10.5 | 11.44 |
| South Canterbury | 626 | 1.1 | 1 | 0.7 | 1.60 | 2 | 0.6 | 3.19 | 0 | 0.0 | 0.00 | 3 | 0.5 | 4.79 |
| Southern | 3,284 | 5.6 | 5 | 3.4 | 1.52 | 22 | 6.8 | 6.70 | 11 | 6.0 | 3.38 | 38 | 5.8 | 11.57 |
| Other* | 214 | 0.4 | 2 | 1.3 | - | - | - | - | 1 | 0.5 | - | 3 | 0.5 | - |

Other includes Overseas, Unknown and Other

## Table 1.40: Perinatal related mortality rates (per 1000 births) by DHB of maternal residence 2007–2014

| DHB of maternal residence | Total births | | Fetal deaths | | | | | | Neonatal deaths | | | Perinatal related deaths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Termination of pregnancy | | | Stillbirths | | | | | | | | |
| | n=503,978 | | n=1,209 | | | n=2,787 | | | n=1,413 | | | n=5,409 | | |
| | n | % | n | % | Rate | n | % | Rate | n | % | Rate | n | % | Rate |
| Northland | 18,531 | 3.7 | 37 | 3.1 | 2.00 | 127 | 4.6 | 6.85 | 67 | 4.7 | 3.65 | 231 | 4.3 | 12.47 |
| Waitemata | 63,269 | 12.6 | 206 | 17.0 | 3.26 | 309 | 11.1 | 4.88 | 121 | 8.6 | 1.93 | 636 | 11.8 | 10.05 |
| Auckland | 52,509 | 10.4 | 191 | 15.8 | 3.64 | 254 | 9.1 | 4.84 | 134 | 9.5 | 2.57 | 579 | 10.7 | 11.03 |
| Counties Manukau | 69,778 | 13.8 | 167 | 13.8 | 2.39 | 496 | 17.8 | 7.11 | 269 | 19.0 | 3.89 | 932 | 17.2 | 13.36 |
| Waikato | 44,415 | 8.8 | 98 | 8.1 | 2.21 | 242 | 8.7 | 5.45 | 151 | 10.7 | 3.43 | 491 | 9.1 | 11.05 |
| Bay of Plenty | 23,555 | 4.7 | 41 | 3.4 | 1.74 | 117 | 4.2 | 4.97 | 91 | 6.4 | 3.89 | 249 | 4.6 | 10.57 |
| Lakes | 12,735 | 2.5 | 30 | 2.5 | 2.36 | 79 | 2.8 | 6.20 | 48 | 3.4 | 3.80 | 157 | 2.9 | 12.33 |
| Tairawhiti | 6,140 | 1.2 | 9 | 0.7 | 1.47 | 29 | 1.0 | 4.72 | 21 | 1.5 | 3.44 | 59 | 1.1 | 9.61 |
| Taranaki | 12,707 | 2.5 | 17 | 1.4 | 1.34 | 74 | 2.7 | 5.82 | 36 | 2.5 | 2.85 | 127 | 2.3 | 9.99 |
| Hawke's Bay | 18,520 | 3.7 | 43 | 3.6 | 2.32 | 102 | 3.7 | 5.51 | 52 | 3.7 | 2.83 | 197 | 3.6 | 10.64 |
| Whanganui | 7,085 | 1.4 | 16 | 1.3 | 2.26 | 46 | 1.7 | 6.49 | 18 | 1.3 | 2.56 | 80 | 1.5 | 11.29 |
| MidCentral | 18,289 | 3.6 | 53 | 4.4 | 2.90 | 98 | 3.5 | 5.36 | 51 | 3.6 | 2.81 | 202 | 3.7 | 11.04 |
| Wairarapa | 4,248 | 0.8 | 9 | 0.7 | 2.12 | 29 | 1.0 | 6.83 | 10 | 0.7 | 2.38 | 48 | 0.9 | 11.30 |
| Capital & Coast | 31,264 | 6.2 | 62 | 5.1 | 1.98 | 136 | 4.9 | 4.35 | 58 | 4.1 | 1.87 | 256 | 4.7 | 8.19 |
| Hutt Valley | 16,798 | 3.3 | 39 | 3.2 | 2.32 | 98 | 3.5 | 5.83 | 38 | 2.7 | 2.28 | 175 | 3.2 | 10.42 |
| Nelson Marlborough | 13,125 | 2.6 | 23 | 1.9 | 1.75 | 59 | 2.1 | 4.50 | 33 | 2.3 | 2.53 | 115 | 2.1 | 8.76 |
| West Coast | 3,370 | 0.7 | 5 | 0.4 | 1.48 | 17 | 0.6 | 5.04 | 16 | 1.1 | 4.78 | 38 | 0.7 | 11.28 |
| Canterbury | 51,156 | 10.2 | 104 | 8.6 | 2.03 | 283 | 10.2 | 5.53 | 122 | 8.6 | 2.40 | 509 | 9.4 | 9.95 |
| South Canterbury | 5,097 | 1.0 | 9 | 0.7 | 1.77 | 26 | 0.9 | 5.10 | 15 | 1.1 | 2.96 | 50 | 0.9 | 9.81 |
| Southern | 29,247 | 5.8 | 48 | 4.0 | 1.64 | 160 | 5.7 | 5.47 | 57 | 4.0 | 1.96 | 265 | 4.9 | 9.06 |
| Other* | 2,140 | 0.4 | 2 | 0.2 | - | 6 | 0.2 | - | 5 | 0.4 | - | 13 | 0.2 | - |

* Other includes Overseas, Unknown and Other.

Figure 1.35: Crude stillbirth rate (per 1000 births) by DHB of residence (mother) compared to New Zealand stillbirth rate (with 95% CIs) 2007–2014

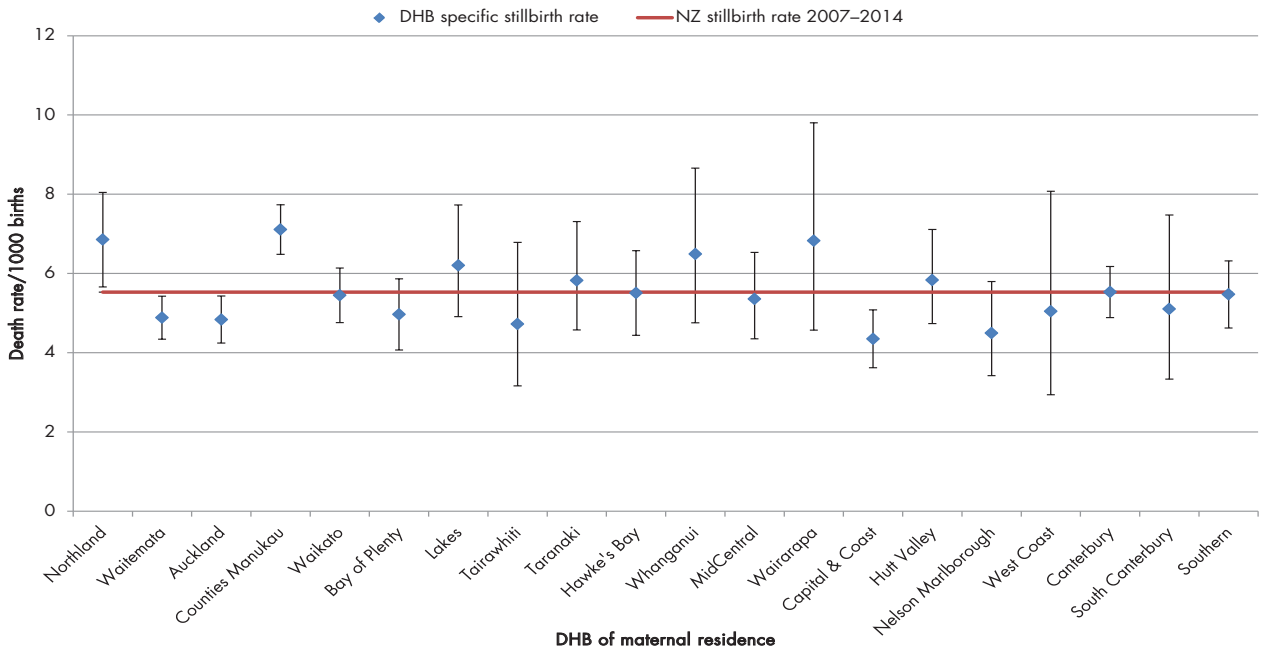



Figure 1.36: Crude neonatal death rate (per 1000 live births) by DHB of residence (mother) compared to New Zealand neonatal death rate (with 95% CIs) 2007–2014

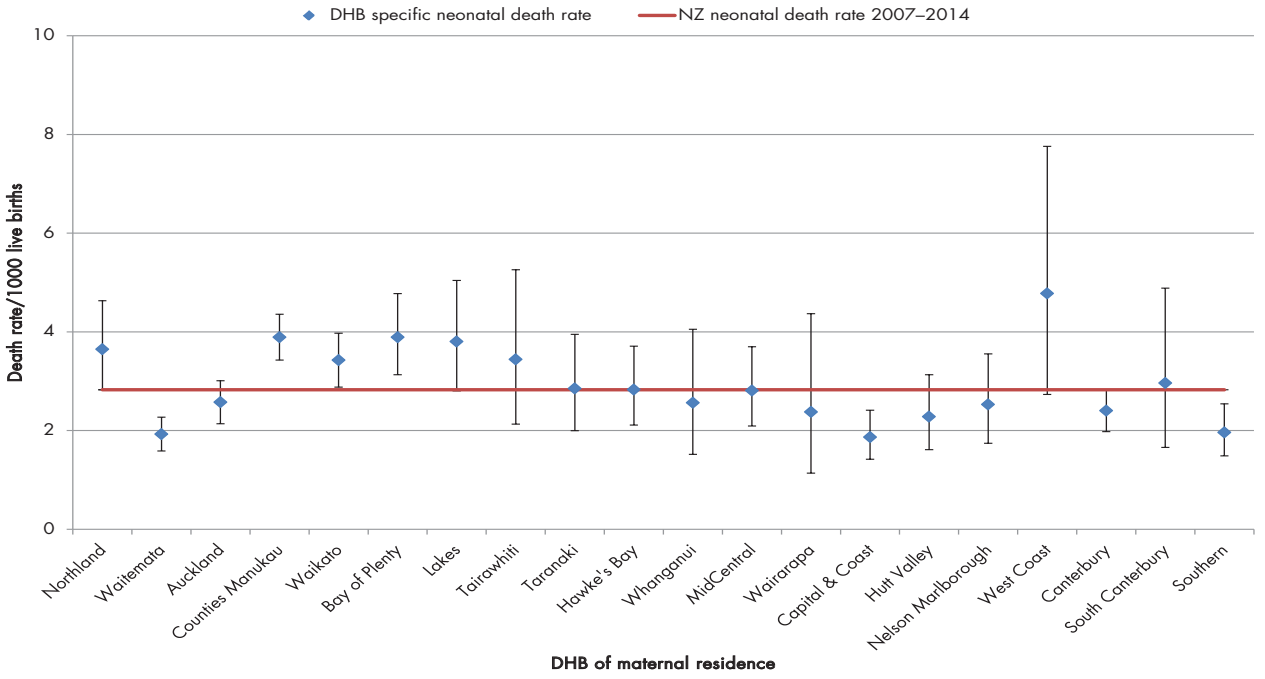


Table 1.41: Perinatal related mortality risk (per 1000 ongoing pregnancies) 2007–2014

| | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | |
| **Gestation at birth (weeks)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20–22 | 200 | 217 | 3.31 | 234 | 218 | 3.31 | 151 | 216 | 3.39 | 195 | 247 | 3.79 | 208 | 235 | 3.75 | 207 | 247 | 3.96 | 179 | 216 | 3.60 | 207 | 251 | 4.28 | 0.002 |
| 23–24 | 106 | 81 | 1.24 | 130 | 98 | 1.49 | 117 | 105 | 1.65 | 117 | 81 | 1.25 | 110 | 95 | 1.52 | 98 | 94 | 1.51 | 116 | 85 | 1.42 | 136 | 98 | 1.68 | 0.20 |
| 25–27 | 244 | 64 | 0.98 | 231 | 62 | 0.95 | 213 | 70 | 1.10 | 234 | 73 | 1.13 | 187 | 52 | 0.83 | 209 | 70 | 1.13 | 196 | 55 | 0.92 | 183 | 49 | 0.84 | 0.44 |
| 28–31 | 539 | 58 | 0.89 | 574 | 65 | 1.00 | 527 | 66 | 1.04 | 551 | 52 | 0.81 | 521 | 58 | 0.93 | 519 | 50 | 0.81 | 472 | 49 | 0.82 | 457 | 46 | 0.79 | 0.17 |
| 32–36 | 3,912 | 88 | 1.36 | 4,075 | 80 | 1.24 | 3,930 | 90 | 1.44 | 4,116 | 101 | 1.58 | 3,938 | 86 | 1.40 | 3,992 | 73 | 1.19 | 3,771 | 91 | 1.54 | 3,661 | 84 | 1.46 | 0.53 |
| 37–40 | 47,925 | 137 | 2.26 | 48,492 | 141 | 2.33 | 46,950 | 150 | 2.55 | 47,992 | 127 | 2.12 | 46,578 | 123 | 2.13 | 46,680 | 116 | 2.02 | 45,508 | 89 | 1.61 | 44,826 | 116 | 2.15 | 0.017 |
| ≥41 | 12,625 | 34 | 2.68 | 12,090 | 37 | 3.05 | 11,721 | 32 | 2.72 | 11,890 | 26 | 2.18 | 11,039 | 17 | 1.54 | 10,700 | 20 | 1.87 | 9,775 | 14 | 1.43 | 9,157 | 12 | 1.31 | 0.00028 |
| Unknown | 51 | 1 | - | 46 | - | - | 56 | 1 | - | 29 | - | - | 23 | - | - | 20 | - | - | 22 | - | - | 20 | - | - | - |

Table 1.42: Termination of pregnancy, stillbirth and neonatal death rates (per 1000 ongoing pregnancies) by gestation group and year 2007–2014

| Gestation at birth (weeks) | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=65,602 | | | n=65,872 | | | n=63,665 | | | n=65,124 | | | n=62,604 | | | n=62,425 | | | n=60,039 | | | n=58,647 | | | |
| | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | Total births | n | Risk | |
| **Termination of pregnancies** | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20–22 | 200 | 103 | 1.57 | 234 | 94 | 1.43 | 151 | 88 | 1.38 | 195 | 92 | 1.41 | 208 | 107 | 1.71 | 207 | 118 | 1.89 | 179 | 81 | 1.35 | 207 | 90 | 1.53 | 0.54 |
| 23–24 | 106 | 22 | 0.34 | 130 | 25 | 0.38 | 117 | 31 | 0.49 | 117 | 20 | 0.31 | 110 | 29 | 0.46 | 98 | 32 | 0.51 | 116 | 32 | 0.53 | 136 | 31 | 0.53 | 0.030 |
| 25–27 | 244 | 10 | 0.15 | 231 | 14 | 0.21 | 213 | 9 | 0.14 | 234 | 20 | 0.31 | 187 | 15 | 0.24 | 209 | 14 | 0.23 | 196 | 16 | 0.27 | 183 | 10 | 0.17 | 0.42 |
| 28–31 | 539 | 6 | 0.09 | 574 | 7 | 0.11 | 527 | 4 | 0.06 | 551 | 6 | 0.09 | 521 | 11 | 0.18 | 519 | 5 | 0.08 | 472 | 5 | 0.08 | 457 | 7 | 0.12 | 0.68 |
| ≥32 | 64,462 | 3 | 0.05 | 64,657 | 5 | 0.08 | 62,601 | 6 | 0.10 | 63,998 | 13 | 0.20 | 61,555 | 9 | 0.15 | 61,372 | 3 | 0.05 | 59,054 | 5 | 0.08 | 57,644 | 11 | 0.19 | 0.12 |
| Unknown | 51 | - | - | 46 | - | - | 56 | - | - | 29 | - | - | 23 | - | - | 20 | - | - | 22 | - | - | 20 | - | - | - |
| **Stillbirths** | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20–22 | 200 | 79 | 1.20 | 234 | 95 | 1.44 | 151 | 88 | 1.38 | 195 | 93 | 1.43 | 208 | 90 | 1.44 | 207 | 85 | 1.36 | 179 | 89 | 1.48 | 207 | 109 | 1.86 | 0.019 |
| 23–24 | 106 | 25 | 0.38 | 130 | 40 | 0.61 | 117 | 43 | 0.68 | 117 | 31 | 0.48 | 110 | 37 | 0.59 | 98 | 28 | 0.45 | 116 | 29 | 0.48 | 136 | 28 | 0.48 | 0.69 |
| 25–27 | 244 | 39 | 0.60 | 231 | 34 | 0.52 | 213 | 39 | 0.62 | 234 | 32 | 0.49 | 187 | 24 | 0.39 | 209 | 36 | 0.58 | 196 | 25 | 0.42 | 183 | 25 | 0.43 | 0.11 |
| 28–31 | 539 | 43 | 0.66 | 574 | 38 | 0.58 | 527 | 48 | 0.76 | 551 | 32 | 0.50 | 521 | 34 | 0.55 | 519 | 30 | 0.48 | 472 | 32 | 0.54 | 457 | 31 | 0.53 | 0.13 |
| 32–36 | 3,912 | 64 | 0.99 | 4,075 | 54 | 0.83 | 3,930 | 60 | 0.96 | 4,116 | 66 | 1.03 | 3,938 | 55 | 0.89 | 3,992 | 54 | 0.88 | 3,771 | 63 | 1.07 | 3,661 | 57 | 0.99 | 0.65 |
| 37–40 | 47,925 | 98 | 1.62 | 48,492 | 99 | 1.63 | 46,950 | 111 | 1.89 | 47,992 | 78 | 1.30 | 46,578 | 83 | 1.44 | 46,680 | 78 | 1.36 | 45,508 | 60 | 1.08 | 44,826 | 72 | 1.33 | 0.0028 |
| ≥41 | 12,625 | 20 | 1.58 | 12,090 | 19 | 1.57 | 11,721 | 19 | 1.61 | 11,890 | 14 | 1.17 | 11,039 | 9 | 0.81 | 10,700 | 9 | 0.84 | 9,775 | 9 | 0.92 | 9,157 | 3 | 0.33 | 0.00054 |
| Unknown | 51 | 1 | - | 46 | - | - | 56 | 1 | - | 29 | - | - | 23 | - | - | 20 | - | - | 22 | - | - | 20 | - | - | - |
| **Neonatal deaths** | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20–22 | 200 | 35 | 0.53 | 234 | 29 | 0.44 | 151 | 40 | 0.63 | 195 | 62 | 0.95 | 208 | 38 | 0.61 | 207 | 44 | 0.70 | 179 | 46 | 0.77 | 207 | 52 | 0.89 | 0.0032 |
| 23–24 | 106 | 34 | 0.52 | 130 | 33 | 0.50 | 117 | 31 | 0.49 | 117 | 30 | 0.46 | 110 | 29 | 0.46 | 98 | 34 | 0.55 | 116 | 24 | 0.40 | 136 | 39 | 0.67 | 0.58 |
| 25–27 | 244 | 15 | 0.23 | 231 | 14 | 0.21 | 213 | 22 | 0.35 | 234 | 21 | 0.32 | 187 | 13 | 0.21 | 209 | 20 | 0.32 | 196 | 14 | 0.23 | 183 | 14 | 0.24 | 0.98 |
| 28–31 | 539 | 9 | 0.14 | 574 | 20 | 0.31 | 527 | 14 | 0.22 | 551 | 14 | 0.22 | 521 | 13 | 0.21 | 519 | 15 | 0.24 | 472 | 12 | 0.20 | 457 | 8 | 0.14 | 0.56 |
| 32–36 | 3,912 | 21 | 0.33 | 4,075 | 21 | 0.32 | 3,930 | 25 | 0.40 | 4,116 | 26 | 0.41 | 3,938 | 23 | 0.37 | 3,992 | 16 | 0.26 | 3,771 | 24 | 0.41 | 3,661 | 22 | 0.38 | 0.72 |
| 37–40 | 47,925 | 39 | 0.64 | 48,492 | 42 | 0.69 | 46,950 | 38 | 0.65 | 47,992 | 45 | 0.75 | 46,578 | 39 | 0.68 | 46,680 | 38 | 0.66 | 45,508 | 28 | 0.51 | 44,826 | 38 | 0.70 | 0.70 |
| ≥41 | 12,625 | 14 | 1.10 | 12,090 | 18 | 1.48 | 11,721 | 13 | 1.10 | 11,890 | 12 | 1.01 | 11,039 | 8 | 0.72 | 10,700 | 11 | 1.03 | 9,775 | 5 | 0.51 | 9,157 | 9 | 0.98 | 0.11 |
| Unknown | 51 | - | - | 46 | - | - | 56 | - | - | 29 | - | - | 23 | - | - | 20 | - | - | 22 | - | - | 20 | - | - | - |

Table 1.43: Perinatal death classification (PSANZ-PDC) of fetal death by gestational age 2007–2014

| Perinatal death classification (PSANZ-PDC) | Total | 20–22 | | 23–27 | | 28–31 | | 32–36 | | 37–40 | | ≥41 weeks | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % | n | % | n | % | n | % |
| Congenital abnormality | **1,199** | 690 | 57.5 | 284 | 23.7 | 72 | 6.0 | 84 | 7.0 | 57 | 4.8 | 12 | 1.0 |
| Perinatal infection | **125** | 36 | 28.8 | 25 | 20.0 | 12 | 9.6 | 14 | 11.2 | 29 | 23.2 | 9 | 7.2 |
| Hypertension | **131** | 17 | 13.0 | 45 | 34.4 | 24 | 18.3 | 25 | 19.1 | 18 | 13.7 | 2 | 1.5 |
| Antepartum haemorrhage | **382** | 179 | 46.9 | 73 | 19.1 | 29 | 7.6 | 47 | 12.3 | 52 | 13.6 | 2 | 0.5 |
| Maternal conditions | **212*** | 62 | 29.2 | 52 | 24.5 | 21 | 9.9 | 32 | 15.1 | 43 | 20.3 | 2 | 0.9 |
| Specific perinatal conditions | **424** | 132 | 31.1 | 91 | 21.5 | 39 | 9.2 | 72 | 17.0 | 87 | 20.5 | 3 | 0.7 |
| Hypoxic peripartum death | **81** | - | - | - | - | - | - | 5 | 6.2 | 54 | 66.7 | 22 | 27.2 |
| Fetal growth restriction | **355** | 25 | 7.0 | 81 | 22.8 | 61 | 17.2 | 81 | 22.8 | 90 | 25.4 | 17 | 4.8 |
| Spontaneous preterm | **350*** | 237 | 67.7 | 89 | 25.4 | 14 | 4.0 | 10 | 2.9 | - | - | - | - |
| Unexplained antepartum death | **735** | 123 | 16.7 | 105 | 14.3 | 67 | 9.1 | 145 | 19.7 | 262 | 35.6 | 33 | 4.5 |
| **Total** | **3,994** | **1,501** | **37.6** | **845** | **21.2** | **339** | **8.5** | **515** | **12.9** | **692** | **17.3** | **102** | **2.6** |

* Gestation of two babies unknown.

## Table 1.44: Perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) of neonatal deaths by gestational age 2007–2014

| Death classification (PSANZ) | Total | 20–22 | | 23–27 | | 28–31 | | 32–36 | | 37–40 | | ≥41 weeks | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % | n | % | n | % | n | % |
| **Perinatal death classification (PSANZ-PDC)** | | | | | | | | | | | | | |
| Congenital abnormality | **326** | 2 | 0.6 | 9 | 2.8 | 46 | 14.1 | 108 | 33.1 | 130 | 39.9 | 31 | 9.5 |
| Perinatal infection | **69** | 15 | 21.7 | 18 | 26.1 | 5 | 7.2 | 6 | 8.7 | 14 | 20.3 | 11 | 15.9 |
| Hypertension | **31** | 2 | 6.5 | 17 | 54.8 | 7 | 22.6 | 4 | 12.9 | 1 | 3.2 | - | - |
| Antepartum haemorrhage | **185** | 92 | 49.7 | 68 | 36.8 | 8 | 4.3 | 10 | 5.4 | 6 | 3.2 | 1 | 0.5 |
| Maternal conditions | **42** | 8 | 19.0 | 10 | 23.8 | 6 | 14.3 | 8 | 19.0 | 9 | 21.4 | 1 | 2.4 |
| Specific perinatal conditions | **124** | 52 | 41.9 | 34 | 27.4 | 8 | 6.5 | 13 | 10.5 | 16 | 12.9 | 1 | 0.8 |
| Hypoxic peripartum death | **102** | - | - | - | - | 1 | 1.0 | 4 | 3.9 | 69 | 67.6 | 28 | 27.5 |
| Fetal growth restriction | **30** | 1 | 3.3 | 6 | 20.0 | 4 | 13.3 | 4 | 13.3 | 12 | 40.0 | 3 | 10.0 |
| Spontaneous preterm | **436** | 174 | 39.9 | 225 | 51.6 | 20 | 4.6 | 17 | 3.9 | - | - | - | - |
| No obstetric antecedent | **68** | - | - | - | - | - | - | 4 | 5.9 | 50 | 73.5 | 14 | 20.6 |
| **Neonatal death classification (PSANZ-NDC)** | | | | | | | | | | | | | |
| Congenital abnormality | **334** | 2 | 0.6 | 8 | 2.4 | 46 | 13.8 | 113 | 33.8 | 134 | 40.1 | 31 | 9.3 |
| Extreme prematurity | **505** | 344 | 68.1 | 160 | 31.7 | 1 | 0.2 | - | - | - | - | - | - |
| Cardio-respiratory disorders | **98** | - | - | 79 | 80.6 | 11 | 11.2 | 2 | 2.0 | 6 | 6.1 | - | - |
| Infection | **124** | - | - | 55 | 44.4 | 16 | 12.9 | 15 | 12.1 | 24 | 19.4 | 14 | 11.3 |
| Neurological | **229** | - | - | 55 | 24.0 | 17 | 7.4 | 30 | 13.1 | 95 | 41.5 | 32 | 14.0 |
| Gastrointestinal | **24** | - | - | 18 | 75.0 | 5 | 20.8 | 1 | 4.2 | 0 | 0.0 | - | - |
| Other | **99** | - | - | 12 | 12.1 | 9 | 9.1 | 17 | 17.2 | 48 | 48.5 | 13 | 13.1 |
| **Total** | **1,413** | **346** | **24.5** | **387** | **27.4** | **105** | **7.4** | **178** | **12.6** | **307** | **21.7** | **90** | **6.4** |

Table 1.45: Perinatal death classification (PSANZ-PDC) specific stillbirth rates at term (≥37 weeks) (per 1000 births) 2007–2014

| Perinatal death classification (PSANZ-PDC) | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | 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=53,983 | | |
| | n | Rate | 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 | 11 | 0.19 | 7 | 0.12 | 4 | 0.07 | 7 | 0.13 | 0.41 |
| Perinatal infection | 7 | 0.12 | 6 | 0.10 | 9 | 0.15 | 7 | 0.12 | 3 | 0.05 | 0 | 0.00 | 3 | 0.05 | 2 | 0.04 | 0.0071 |
| Hypertension | 1 | 0.02 | 2 | 0.03 | 8 | 0.14 | 3 | 0.05 | 3 | 0.05 | 3 | 0.05 | - | - | - | - | 0.16 |
| Antepartum haemorrhage | 10 | 0.17 | 10 | 0.17 | 10 | 0.17 | 11 | 0.18 | 3 | 0.05 | 3 | 0.05 | 2 | 0.04 | 5 | 0.09 | 0.0047 |
| Maternal conditions | 7 | 0.12 | 4 | 0.07 | 8 | 0.14 | 9 | 0.15 | 1 | 0.02 | 7 | 0.12 | 7 | 0.13 | 2 | 0.04 | 0.45 |
| Specific perinatal condition | 12 | 0.20 | 8 | 0.13 | 14 | 0.24 | 12 | 0.20 | 16 | 0.28 | 10 | 0.18 | 7 | 0.13 | 7 | 0.13 | 0.43 |
| Hypoxic peripartum death | 18 | 0.30 | 14 | 0.23 | 10 | 0.17 | 7 | 0.12 | 7 | 0.12 | 11 | 0.19 | 3 | 0.05 | 6 | 0.11 | 0.0020 |
| Fetal growth restriction | 13 | 0.22 | 19 | 0.32 | 10 | 0.17 | 15 | 0.25 | 12 | 0.21 | 18 | 0.32 | 11 | 0.20 | 8 | 0.15 | 0.44 |
| Unexplained antepartum death | 41 | 0.68 | 46 | 0.76 | 52 | 0.89 | 22 | 0.37 | 36 | 0.63 | 28 | 0.49 | 32 | 0.58 | 38 | 0.71 | 0.21 |

Table 1.46: Intrapartum stillbirth rates (per 1000 ongoing pregnancies) by gestation excluding congenital abnormalities 2007–2014

| Gestation at birth (weeks) | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | Chi-squared test for trend (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | n | N | Rate | |
| 23–27 | 8 | 65,256 | 0.12 | 13 | 65,495 | 0.20 | 18 | 63,356 | 0.28 | 13 | 64,780 | 0.20 | 16 | 62,254 | 0.26 | 10 | 62,091 | 0.16 | 10 | 59,744 | 0.17 | 8 | 58,311 | 0.14 | 0.65 |
| 28–36 | 6 | 64,938 | 0.09 | 5 | 65,164 | 0.08 | 5 | 63,060 | 0.08 | 2 | 64,472 | 0.03 | 4 | 61,992 | 0.06 | 3 | 61,827 | 0.05 | 2 | 59,470 | 0.03 | 3 | 58,031 | 0.05 | 0.16 |
| ≥37 | 25 | 60,522 | 0.41 | 21 | 60,552 | 0.35 | 22 | 58,643 | 0.38 | 16 | 59,850 | 0.27 | 9 | 57,582 | 0.16 | 12 | 57,353 | 0.21 | 3 | 55,262 | 0.05 | 10 | 53,950 | 0.19 | 0.000019 |

Table 1.47: Association between perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) among all neonatal deaths 2014

| 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 | **43** | 42 | - | 1 | - | - | - | - |
| Perinatal infection | **12** | - | 5 | - | 7 | - | - | - |
| Hypertension | **2** | - | - | 1 | - | - | 1 | - |
| Antepartum haemorrhage | **29** | - | 19 | 3 | - | 7 | - | - |
| Maternal conditions | **8** | 2 | 3 | 1 | 1 | 1 | - | - |
| Specific perinatal conditions | **17** | - | 14 | 2 | - | 1 | - | - |
| Hypoxic peripartum death | **10** | - | - | - | 2 | 7 | - | 1 |
| Fetal growth restriction | **1** | - | - | - | - | - | - | 1 |
| Spontaneous preterm | **53** | - | 28 | 7 | 4 | 8 | 2 | 4 |
| No obstetric antecedent | **7** | - | - | 1 | 1 | - | - | 5 |

Table 1.48: Perinatal related mortality rates among babies born in multiple pregnancies 2007–2014

| Year of death | Total multiple births | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|---|
| | | Termination of pregnancy | | Stillbirths | | | | | |
| | | n=69 | | n=291 | | n=224 | | n=584 | |
| | | n | Rate | n | Rate | n | Rate | n | Rate |
| 2007 | 2,033 | 3 | 1.48 | 34 | 16.72 | 25 | 12.53 | 62 | 30.50 |
| 2008 | 1,940 | 3 | 1.55 | 33 | 17.01 | 18 | 9.45 | 54 | 27.84 |
| 2009 | 1,803 | 5 | 2.77 | 32 | 17.75 | 31 | 17.55 | 68 | 37.71 |
| 2010 | 1,896 | 9 | 4.75 | 35 | 18.46 | 35 | 18.90 | 79 | 41.67 |
| 2011 | 1,811 | 18 | 9.94 | 48 | 26.50 | 27 | 15.47 | 93 | 51.35 |
| 2012 | 1,749 | 14 | 8.00 | 34 | 19.44 | 32 | 18.81 | 80 | 45.74 |
| 2013 | 1,753 | 7 | 3.99 | 41 | 23.39 | 16 | 9.38 | 64 | 36.51 |
| 2014 | 1,675 | 10 | 5.97 | 34 | 20.30 | 40 | 24.52 | 84 | 50.15 |
| **Chi-squared test for trend (p)** | | **0.0013** | | **0.088** | | **0.028** | | **0.00023** | |

## Table 1.49: Chorionicity and number of babies lost among twin perinatal related deaths 2007–2014

| | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=60 | | n=49 | | n=57 | | n=76 | | n=86 | | n=73 | | n=61 | | n=78 | | n=540 | |
| | n | % | 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 | 40 | 54.8 | 237 | 43.9 |
| Monochorionic diamniotic | 29 | 48.3 | 25 | 51.0 | 33 | 57.9 | 31 | 40.8 | 37 | 43.0 | 42 | 57.5 | 34 | 46.6 | 35 | 47.9 | 266 | 49.3 |
| Monoamniotic | 2 | 3.3 | - | - | 4 | 7.0 | 5 | 6.6 | 2 | 2.3 | 2 | 2.7 | - | - | 3 | 4.1 | 18 | 3.3 |
| Other multiple | - | - | 4 | 8.2 | - | - | 1 | 1.3 | 2 | 2.3 | 1 | 1.4 | - | - | - | - | 8 | 1.5 |
| Unknown | - | - | - | - | 1 | 1.8 | 2 | 2.6 | 3 | 3.5 | 2 | 2.7 | 3 | 4.1 | - | - | 11 | 2.0 |
| **Loss of twin pairs or one twin** | | | | | | | | | | | | | | | | | | |
| Both twins died | 34 | 54.7 | 26 | 49.1 | 32 | 52.5 | 48 | 60.8 | 60 | 66.7 | 48 | 66.7 | 42 | 66.7 | 54 | 66.7 | 344 | 63.7 |
| One twin died | 26 | 45.3 | 23 | 50.9 | 25 | 47.5 | 28 | 39.2 | 26 | 33.3 | 25 | 33.3 | 19 | 33.3 | 24 | 33.3 | 196 | 36.3 |

## Table 1.50: Gestation at registration by lead maternity carer (LMC) among perinatal related deaths 2014

| Lead maternity carer | Total | Gestation (weeks) at registration | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | <10 | | 10–13 | | 14–19 | | ≥20 | | Unknown | |
| | | n | % | n | % | n | % | n | % | n | % |
| Self-employed midwife | 505 | 248 | 49.1 | 147 | 29.1 | 61 | 12.1 | 40 | 7.9 | 9 | 1.8 |
| Hospital | 85 | 25 | 29.4 | 34 | 40.0 | 15 | 17.6 | 7 | 8.2 | 4 | 4.7 |
| General practitioner | 2 | - | - | 1 | 50.0 | - | - | 1 | 50.0 | - | - |
| Obstetrician (private) | 29 | 17 | 58.6 | 11 | 37.9 | - | - | - | - | 1 | 3.4 |
| Unknown LMC | 3 | - | - | 1 | 33.3 | - | - | - | - | 2 | 66.7 |
| **Total** | **624** | **290** | **46.5** | **194** | **31.1** | **76** | **12.2** | **48** | **7.7** | **16** | **2.6** |

## Table 1.51: Perinatal related deaths and completeness of perinatal death investigations 2014

| Perinatal death investigation | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| **Optimum investigation*** | 93 | 62.4 | 154 | 47.4 | 77 | 42.3 | 324 | 49.4 |
| Post-mortem | 58 | 38.9 | 138 | 42.5 | 60 | 33.0 | 256 | 39.0 |
| Karyotype | 28 | 18.8 | 20 | 6.2 | 11 | 6.0 | 59 | 9.0 |
| Clinical examination/investigations confirm diagnosis | 14 | 9.4 | 6 | 1.8 | 14 | 7.7 | 34 | 5.2 |
| **Partial investigations only#** | 44 | 29.5 | 120 | 36.9 | 88 | 48.4 | 252 | 38.4 |
| **No investigation+** | 12 | 8.1 | 51 | 15.7 | 17 | 9.3 | 80 | 12.2 |

* Optimal investigation is defined as post-mortem or karyotype confirming congenital abnormality or clinical examination/investigation confirming diagnosis. Note: more than 1 option can be selected.
# 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.

## Table 1.52: Perinatal related deaths and rate of offer and decline of post-mortem examination 2014

| Post-mortem examination offered | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| Post-mortem offered and parental consent given | 58 | 38.9 | 138 | 42.5 | 59 | 32.4 | 255 | 38.9 |
| Post-mortem offered and parents declined | 75 | 50.3 | 173 | 53.2 | 113 | 62.1 | 361 | 55.0 |
| Post-mortem not offered | 14 | 9.4 | 12 | 3.7 | 8 | 4.4 | 34 | 5.2 |
| Unknown | 2 | 1.3 | 2 | 0.6 | 2 | 1.1 | 6 | 0.9 |

Table 1.53: Optimal investigation of perinatal related death by DHB of maternal residence 2014

| DHB of maternal residence | Perinatal related deaths | Offered post-mortem | | Optimal investigation* | |
|---|---|---|---|---|---|
| | n=656 | | | | |
| | n | n | % | n | % |
| Northland | 26 | 22 | 84.6 | 10 | 38.5 |
| Waitemata | 80 | 75 | 93.8 | 33 | 41.3 |
| Auckland | 62 | 59 | 95.2 | 36 | 58.1 |
| Counties Manukau | 116 | 113 | 97.4 | 59 | 50.9 |
| Waikato | 68 | 68 | 100.0 | 24 | 35.3 |
| Bay of Plenty | 44 | 39 | 88.6 | 20 | 45.5 |
| Lakes | 21 | 19 | 90.5 | 14 | 66.7 |
| Tairawhiti | 5 | 5 | 100.0 | 1 | 20.0 |
| Taranaki | 16 | 16 | 100.0 | 6 | 37.5 |
| Hawke's Bay | 21 | 17 | 81.0 | 10 | 47.6 |
| Whanganui | 5 | 5 | 100.0 | 4 | 80.0 |
| MidCentral | 12 | 9 | 75.0 | 8 | 66.7 |
| Wairarapa | 3 | 3 | 100.0 | 2 | 66.7 |
| Capital & Coast | 23 | 23 | 100.0 | 8 | 34.8 |
| Hutt Valley | 22 | 21 | 95.5 | 18 | 81.8 |
| Nelson Marlborough | 16 | 15 | 93.8 | 7 | 43.8 |
| West Coast | 3 | 3 | 100.0 | 2 | 66.7 |
| Canterbury | 69 | 63 | 91.3 | 42 | 60.9 |
| South Canterbury | 3 | 3 | 100.0 | 1 | 33.3 |
| Southern | 38 | 35 | 92.1 | 19 | 50.0 |
| Overseas | 3 | 3 | 100.0 | - | - |

* Optimal investigation is defined as post-mortem or karyotype confirming congenital abnormality or clinical examination/investigation confirming diagnosis.

## Table 1.54: Perinatal related deaths and maternal outcome 2014

| Maternal outcome | Fetal deaths | | | | Neonatal deaths | | Perinatal related deaths | |
|---|---|---|---|---|---|---|---|---|
| | Termination of pregnancy | | Stillbirths | | | | | |
| | n=149 | | n=325 | | n=182 | | n=656 | |
| | n | % | n | % | n | % | n | % |
| Alive and generally well | 149 | 100.0 | 314 | 96.6 | 180 | 98.9 | 643 | 98.0 |
| Alive but with serious morbidity | - | - | 8 | 2.5 | 2 | 1.1 | 10 | 1.5 |
| Maternal death | - | - | 2 | 0.6 | - | - | 2 | 0.3 |
| Unknown | - | - | 1 | 0.3 | - | - | 1 | 0.2 |

## Table 1.55: Perinatal related deaths by primary and associated perinatal death classification (PSANZ-PDC) 2014

| Perinatal death classification (PSANZ-PDC) | Primary PSANZ-PDC | | Associated PSANZ-PDC 1 | | Associated PSANZ-PDC 2 | | Assigned PSANZ-PDCs | |
|---|---|---|---|---|---|---|---|---|
| | n=656 | | n=656 | | n=656 | | n=656 | |
| | n | % | n | % | n | % | n | %* |
| Congenital abnormality | 188 | 28.7 | 11 | 1.7 | 0 | 0.0 | 194 | 29.6 |
| Perinatal infection | 24 | 3.7 | 4 | 0.6 | 0 | 0.0 | 28 | 4.3 |
| Hypertension | 13 | 2.0 | 4 | 0.6 | 1 | 0.2 | 18 | 2.7 |
| Antepartum haemorrhage | 69 | 10.5 | 28 | 4.3 | 1 | 0.2 | 98 | 14.9 |
| Maternal conditions | 39 | 5.9 | 7 | 1.1 | 0 | 0.0 | 45 | 6.9 |
| Specific perinatal condition | 69 | 10.5 | 7 | 1.1 | 0 | 0.0 | 72 | 11.0 |
| Hypoxic peripartum death | 17 | 2.6 | 5 | 0.8 | 0 | 0.0 | 21 | 3.2 |
| Fetal growth restriction | 35 | 5.3 | 15 | 2.3 | 4 | 0.6 | 54 | 8.2 |
| Spontaneous preterm | 105 | 16.0 | 72 | 11.0 | 3 | 0.5 | 179 | 27.3 |
| Unexplained antepartum death | 90 | 13.7 | 0 | 0.0 | 0 | 0.0 | 90 | 13.7 |
| No obstetric antecedent | 7 | 1.1 | 0 | 0.0 | 0 | 0.0 | 7 | 1.1 |

* Percentages are not mutually exclusive.

## Table 1.56: Neonatal deaths by primary and associated neonatal death classification (PSANZ-NDC) 2014

| Neonatal death classification (PSANZ-NDC) | Primary PSANZ-NDC | | Associated PSANZ-NDC 1 | | Associated PSANZ-NDC 2 | | Assigned PSANZ-NDCs | |
|---|---|---|---|---|---|---|---|---|
| | n=182 | | n=182 | | n=182 | | n=182 | |
| | n | % | n | % | n | % | n | %* |
| Congenital abnormality | 44 | 24.2 | 3 | 1.6 | 0 | 0.0 | 45 | 24.7 |
| Extreme prematurity | 69 | 37.9 | 0 | 0.0 | 0 | 0.0 | 69 | 37.9 |
| Cardio-respiratory disorders | 16 | 8.8 | 12 | 6.6 | 3 | 1.6 | 26 | 14.3 |
| Infection | 15 | 8.2 | 3 | 1.6 | 2 | 1.1 | 19 | 10.4 |
| Neurological | 24 | 13.2 | 7 | 3.8 | 1 | 0.5 | 32 | 17.6 |
| Gastrointestinal | 3 | 1.6 | 0 | 0.0 | 0 | 0.0 | 3 | 1.6 |
| Other | 11 | 6.0 | 4 | 2.2 | 0 | 0.0 | 15 | 8.2 |

* Percentages are not mutually exclusive.

## Table 1.57: Detail of contributory factors among perinatal related deaths 2009–2014

| Contributory factors | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n | % | n | % |
| **Any contributory factor** | **173** | **23.7** | **191** | **27.0** | **188** | **28.2** | **184** | **27.5** | **161** | **26.9** | **168** | **25.6** |
| **Organisational/Management factors** | **37** | **5.1** | **30** | **4.1** | **42** | **5.8** | **32** | **4.4** | **31** | **4.2** | **25** | **3.4** |
| Poor organisational arrangements of staff | 10 | | 2 | | 7 | | 3 | | 0 | | 5 | |
| Inadequate education and training | 10 | | 5 | | 5 | | 4 | | 3 | | 3 | |
| Lack of policies, protocols or guidelines | 10 | | 4 | | 13 | | 4 | | 6 | | 4 | |
| Inadequate numbers of staff | 0 | | 3 | | 3 | | 3 | | 0 | | 3 | |
| Poor access to senior clinical staff | 2 | | 4 | | 3 | | 1 | | 2 | | 0 | |
| Failure or delay in emergency response | 5 | | 5 | | 2 | | 3 | | 5 | | 7 | |
| Delay in procedure (eg, caesarean section) | 3 | | 10 | | 6 | | 8 | | 11 | | 2 | |
| Inadequate systems for sharing of clinical information | 0 | | 0 | | 0 | | 0 | | 1 | | 2 | |
| Delayed access to test results or inaccurate results | 6 | | 1 | | 6 | | 5 | | 1 | | 2 | |
| Equipment (eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment) | 4 | | 3 | | 4 | | 4 | | 2 | | 3 | |
| Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location) | 0 | | 0 | | 0 | | 1 | | 2 | | 0 | |
| Other | 6 | | 4 | | 13 | | 7 | | 6 | | 2 | |
| Not stated | 0 | | 0 | | 0 | | 0 | | 0 | | 2 | |
| **Personnel factors** | **49** | **6.7** | **47** | **6.4** | **56** | **7.7** | **52** | **7.1** | **45** | **6.2** | **53** | **7.3** |
| Knowledge and skills of staff were lacking | 17 | | 13 | | 18 | | 16 | | 13 | | 12 | |
| Delayed emergency response by staff | 9 | | 4 | | 3 | | 3 | | 3 | | 4 | |
| Failure to maintain competence | 4 | | 1 | | 2 | | 1 | | 0 | | 0 | |
| Failure of communication between staff | 11 | | 8 | | 13 | | 8 | | 7 | | 6 | |
| Failure to seek help/supervision | 8 | | 5 | | 14 | | 3 | | 3 | | 2 | |
| Failure to offer or follow recommended best practice | 31 | | 26 | | 31 | | 30 | | 19 | | 27 | |
| Lack of recognition of complexity or seriousness of condition by care giver | 2 | | 0 | | 4 | | 14 | | 12 | | 23 | |
| Other | 0 | | 1 | | 0 | | 2 | | 3 | | 2 | |
| Not stated | 0 | | 0 | | 1 | | 0 | | 2 | | 0 | |
| **Barriers to access and/or engagement with care** | **123** | **16.8** | **143** | **19.6** | **131** | **17.9** | **134** | **18.4** | **120** | **16.4** | **123** | **16.8** |
| No antenatal care | 24 | | 26 | | 24 | | 37 | | 29 | | 21 | |
| Infrequent care or late booking | 27 | | 37 | | 46 | | 45 | | 46 | | 42 | |
| Declined treatment or advice | 12 | | 14 | | 17 | | 22 | | 26 | | 27 | |
| Obesity impacted on delivery of optimal care (eg, USS) | 1 | | 6 | | 0 | | 5 | | 7 | | 2 | |
| Substance use | 25 | | 17 | | 18 | | 17 | | 8 | | 13 | |
| Family violence | 6 | | 9 | | 11 | | 4 | | 6 | | 13 | |
| Lack of recognition of complexity or seriousness of condition by the woman and/or family | 11 | | 30 | | 32 | | 27 | | 32 | | 25 | |
| Maternal mental illness | 4 | | 9 | | 3 | | 7 | | 1 | | 7 | |
| Cultural barriers | 10 | | 4 | | 18 | | 2 | | 4 | | 2 | |
| Language barriers | 2 | | 7 | | 7 | | 6 | | 2 | | 2 | |
| Not eligible to access free care | 3 | | 2 | | 4 | | 5 | | 1 | | 2 | |
| Environment (eg, isolated, long transfer, weather prevented transport) | 12 | | 12 | | 12 | | 13 | | 6 | | 11 | |
| Other | 14 | | 11 | | 11 | | 11 | | 19 | | 10 | |
| Not stated | 4 | | 0 | | 0 | | 0 | | 0 | | 0 | |

USS = ultrasound scan.

Table 1.58: Contributory factors and potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2014

| Perinatal death classification (PSANZ-PDC) | Perinatal related deaths | Contributory factors and potentially avoidable | | Contributory factors BUT NOT or unknown if potentially avoidable | | No contributory factors | | Unknown | |
|---|---|---|---|---|---|---|---|---|---|
| | n=656 | n | % | n | % | n | % | n | % |
| Congenital abnormality | 188 | 2 | 1.1 | 15 | 8.0 | 171 | 91.0 | - | - |
| Perinatal infection | 24 | 8 | 33.3 | 2 | 8.3 | 14 | 58.3 | - | - |
| Hypertension | 13 | 2 | 15.4 | 3 | 23.1 | 8 | 61.5 | - | - |
| Antepartum haemorrhage | 69 | 6 | 8.7 | 12 | 17.4 | 51 | 73.9 | - | - |
| Maternal conditions | 39 | 17 | 43.6 | 4 | 10.3 | 18 | 46.2 | - | - |
| Specific perinatal conditions | 69 | 4 | 5.8 | 6 | 8.7 | 59 | 85.5 | - | - |
| Hypoxic peripartum death | 17 | 7 | 41.2 | 2 | 11.8 | 8 | 47.1 | - | - |
| Fetal growth restriction | 35 | 14 | 40.0 | 7 | 20.0 | 13 | 37.1 | 1 | 2.9 |
| Spontaneous preterm | 105 | 9 | 8.6 | 16 | 15.2 | 79 | 75.2 | 1 | 1.0 |
| Unexplained antepartum death | 90 | 13 | 14.4 | 14 | 15.6 | 61 | 67.8 | 2 | 2.2 |
| No obstetric antecedent | 7 | 5 | 71.4 | - | - | 2 | 28.6 | - | - |

Table 1.59: Main contributory factor(s) in potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2011–2014

| Perinatal death classification (PSANZ-PDC) | Perinatal related deaths | Organisation/ Management | | Personnel | | Barriers | | Specific contributory factor not identified | |
|---|---|---|---|---|---|---|---|---|---|
| | n | n | % | n | % | n | % | n | % |
| Congenital abnormality | 750 | - | - | 3 | 0.4 | 5 | 0.7 | - | - |
| Perinatal infection | 84 | 3 | 3.6 | 9 | 10.7 | 14 | 16.7 | 2 | 2.4 |
| Hypertension | 65 | 3 | 4.6 | 7 | 10.8 | 13 | 20.0 | 2 | 3.1 |
| Antepartum haemorrhage | 281 | 4 | 1.4 | 8 | 2.8 | 29 | 10.3 | 2 | 0.7 |
| Maternal conditions | 135 | 5 | 3.7 | 15 | 11.1 | 49 | 36.3 | 2 | 1.5 |
| Specific perinatal conditions | 275 | 12 | 4.4 | 16 | 5.8 | 15 | 5.5 | 2 | 0.7 |
| Hypoxic peripartum death | 68 | 12 | 17.6 | 19 | 27.9 | 10 | 14.7 | 6 | 8.8 |
| Fetal growth restriction | 176 | 9 | 5.1 | 29 | 16.5 | 25 | 14.2 | 5 | 2.8 |
| Spontaneous preterm | 372 | 5 | 1.3 | 13 | 3.5 | 53 | 14.2 | 1 | 0.3 |
| Unexplained antepartum death | 359 | 6 | 1.7 | 12 | 3.3 | 37 | 10.3 | - | - |
| No obstetric antecedent | 26 | 1 | 3.8 | 3 | 11.5 | 14 | 53.8 | - | - |

Table 1.60: Contributory factors and potentially avoidable perinatal related death by maternal prioritised ethnicity (95% CIs surround the estimate of the proportion of cases within each ethnicity where death was potentially avoidable) 2009–2014

| Maternal ethnicity | Perinatal related deaths | Contributory factors and potentially avoidable | | | Contributory factors BUT NOT or unknown if potentially avoidable | | No contributory factors | | Unknown | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n=4,028 | n | % | 95% CI | n | % | n | % | n | % |
| Māori | 1,064 | 238 | 22.4 | 19.90–24.99 | 181 | 17.0 | 608 | 57.1 | 37 | 3.5 |
| Pacific peoples | 553 | 124 | 22.4 | 19.01–26.13 | 78 | 14.1 | 327 | 59.1 | 24 | 4.3 |
| Indian | 222 | 31 | 14.0 | 9.69–19.23 | 13 | 5.9 | 170 | 76.6 | 8 | 3.6 |
| Other Asian | 305 | 30 | 9.8 | 6.74–13.74 | 19 | 6.2 | 252 | 82.6 | 4 | 1.3 |
| Other (including unknown) | 325 | 28 | 8.6 | 5.80–12.21 | 33 | 10.2 | 256 | 78.8 | 8 | 2.5 |
| NZ European | 1,559 | 204 | 13.1 | 11.45–14.86 | 86 | 5.5 | 1,222 | 78.4 | 47 | 3.0 |

Table 1.61: Main contributory factor(s) in potentially avoidable perinatal related deaths by maternal prioritised ethnicity (with 95% CIs) 2011–2014

| Maternal ethnicity | Perinatal related deaths | Potentially avoidable | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Organisation/management | | | Personnel | | | Barriers | | | Specific contributory factor not identified | | |
| | n | n | % | 95% CI | n | % | 95% CI | n | % | 95% CI | n | % | 95% CI |
| Māori | 661 | 10 | 1.5 | 0.73–2.76 | 28 | 4.2 | 2.83–6.06 | 109 | 16.5 | 13.74–19.54 | 7 | 1.1 | 0.43–2.17 |
| Pacific peoples | 338 | 9 | 2.7 | 1.22–4.99 | 14 | 4.1 | 2.28–6.85 | 65 | 19.2 | 15.17–23.84 | 2 | 0.6 | 0.07–2.12 |
| Indian | 155 | 2 | 1.3 | 0.16–4.58 | 13 | 8.4 | 4.54–13.92 | 8 | 5.2 | 2.25–9.92 | 2 | 1.3 | 0.16–4.58 |
| Other Asian | 209 | 7 | 3.3 | 1.36–6.78 | 9 | 4.3 | 1.99–8.02 | 8 | 3.8 | 1.67–7.40 | 0 | 0.0 | - |
| Other (including unknown) | 227 | 2 | 0.9 | 0.11–3.15 | 8 | 3.5 | 1.53–6.83 | 5 | 2.2 | 0.72–5.07 | 3 | 1.3 | 0.27–3.81 |
| NZ European | 1,001 | 30 | 3.0 | 2.03–4.25 | 62 | 6.2 | 4.78–7.87 | 69 | 6.9 | 5.40–8.64 | 8 | 0.8 | 0.35–1.57 |

Table 1.62: Contributory factors and potentially avoidable perinatal related death by deprivation quintile (95% CIs surround the estimate of the proportion of cases within quintile where death was potentially avoidable) 2009–2014

| Deprivation quintile | Perinatal related deaths | Contributory factors and potentially avoidable | | | Contributory factors BUT NOT or unknown if potentially avoidable | | No contributory factors | | Unknown | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n=4,028 | n | % | 95% CI | n | % | n | % | n | % |
| 1 (least deprived) | 514 | 56 | 10.9 | 8.34–13.91 | 18 | 3.5 | 426 | 82.9 | 14 | 2.7 |
| 2 | 614 | 86 | 14.0 | 11.36–17.01 | 37 | 6.0 | 471 | 76.7 | 20 | 3.3 |
| 3 | 722 | 83 | 11.5 | 9.26–14.05 | 65 | 9.0 | 560 | 77.6 | 14 | 1.9 |
| 4 | 832 | 135 | 16.2 | 13.78–18.91 | 72 | 8.7 | 598 | 71.9 | 27 | 3.2 |
| 5 (most deprived) | 1,293 | 280 | 21.7 | 19.44–24.00 | 211 | 16.3 | 755 | 58.4 | 47 | 3.6 |
| Unknown | 53 | 15 | 28.3 | 16.79–42.35 | 7 | 13.2 | 25 | 47.2 | 6 | 11.3 |

Table 1.63: Main contributory factor(s) in potentially avoidable perinatal related deaths by deprivation quintile (with 95% CIs) 2011–2014

| Deprivation quintile | Perinatal related deaths | Potentially avoidable | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Organisation/management | | | Personnel | | | Barriers | | | Specific contributory factor not identified | | |
| | n | n | % | 95% CI | n | % | 95% CI | n | % | 95% CI | n | % | 95% CI |
| 1 (least deprived) | 347 | 10 | 2.9 | 1.39–5.24 | 12 | 3.5 | 1.80–5.96 | 15 | 4.3 | 2.44–7.03 | 3 | 0.9 | 0.18–2.51 |
| 2 | 401 | 4 | 1.0 | 0.27–2.53 | 29 | 7.2 | 4.90–10.22 | 27 | 6.7 | 4.48–9.65 | 6 | 1.5 | 0.55–3.23 |
| 3 | 474 | 14 | 3.0 | 1.62–4.91 | 18 | 3.8 | 2.27–5.94 | 31 | 6.5 | 4.49–9.15 | 2 | 0.4 | 0.05–1.52 |
| 4 | 526 | 14 | 2.7 | 1.46–4.43 | 30 | 5.7 | 3.88–8.04 | 49 | 9.3 | 6.97–12.13 | 3 | 0.6 | 0.12–1.66 |
| 5 (most deprived) | 817 | 15 | 1.8 | 1.03–3.01 | 45 | 5.5 | 4.05–7.30 | 133 | 16.3 | 13.81–18.99 | 8 | 1.0 | 0.42–1.92 |
| Unknown | 26 | 3 | 11.5 | - | - | - | - | 9 | 34.6 | - | - | - | - |

## Table 1.64: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2014

| | Perinatal death classification (PSANZ-PDC) | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2007–2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n=680 | n=701 | n=730 | n=707 | n=666 | n=670 | n=599 | n=656 | n=5,409 |
| | | n | n | n | n | n | n | n | n | n |
| | **Congenital abnormality** | | | | | | | | | |
| 1.1 | Central nervous system | 44 | 42 | 35 | 36 | 41 | 35 | 32 | 47 | 312 |
| 1.2 | Cardiovascular system | 20 | 31 | 23 | 29 | 27 | 23 | 23 | 24 | 200 |
| 1.3 | Urinary system | 9 | 16 | 8 | 18 | 16 | 12 | 13 | 10 | 102 |
| 1.4 | Gastrointestinal system | 7 | 3 | 4 | 3 | 4 | 4 | 1 | 6 | 32 |
| 1.5 | Chromosomal | 60 | 48 | 62 | 72 | 55 | 64 | 46 | 62 | 469 |
| 1.6 | Metabolic | 3 | 1 | 6 | 1 | 3 | 3 | 1 | 2 | 20 |
| 1.7 | Multiple/Non-chromosomal syndromes | 31 | 20 | 22 | 24 | 29 | 29 | 17 | 16 | 188 |
| 1.8 | Other congenital abnormality | | | | | | | | | |
| 1.81 | Musculoskeletal | 4 | 4 | 7 | 9 | 14 | 11 | 16 | 8 | 73 |
| 1.82 | Respiratory | 1 | 1 | 1 | 1 | 1 | 1 | - | - | 6 |
| 1.83 | Diaphragmatic hernia | 4 | 5 | 7 | 8 | 4 | 6 | 2 | 4 | 40 |
| 1.84 | Haematological | - | - | - | 2 | 3 | 1 | 2 | - | 8 |
| 1.85 | Tumours | 3 | 5 | 1 | 1 | 2 | 2 | 1 | 3 | 18 |
| 1.88 | Other specified congenital abnormality | 10 | 3 | 1 | 5 | 1 | 6 | 4 | 1 | 31 |
| 1.9 | Unspecified congenital abnormality | 1 | 6 | 5 | 2 | 3 | 4 | - | 5 | 26 |
| | **Perinatal infection** | | | | | | | | | |
| 2.1 | Bacterial | - | - | - | - | - | - | - | - | - |
| 2.11 | Group B *Streptococcus* | 9 | 4 | 8 | 8 | 3 | - | 3 | 6 | 41 |
| 2.12 | *E. coli* | 2 | 3 | 4 | 3 | 1 | 1 | 3 | 2 | 19 |
| 2.13 | *Listeria monocytogenes* | 1 | 2 | 2 | 2 | - | 1 | 3 | 3 | 14 |
| 2.14 | Spirochaetal (eg, syphilis) | - | - | - | - | - | 1 | - | - | 1 |
| 2.18 | Other bacterial | 1 | 6 | 1 | - | 3 | 3 | 3 | 5 | 22 |
| 2.19 | Unspecified bacterial | 2 | 3 | 1 | 3 | 1 | 3 | - | 3 | 16 |
| 2.2 | Viral | | | | | | | | | |
| 2.21 | *Cytomegalovirus* | 3 | 6 | 4 | 7 | 3 | 3 | 3 | 1 | 30 |
| 2.22 | Parvovirus | 3 | 1 | - | - | 4 | 4 | - | - | 12 |
| 2.23 | Herpes simplex virus | 2 | 1 | 1 | - | 1 | - | 3 | - | 8 |
| 2.28 | Other viral | - | - | 1 | - | - | - | - | - | 1 |
| 2.29 | Unspecified viral | 2 | 1 | - | - | - | - | - | - | 3 |
| 2.3 | Protozoal (eg, *Toxoplasma*) | 1 | - | - | 3 | 3 | 1 | - | 3 | 11 |

## Continued Table 1.64: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2014

| | Perinatal death classification (PSANZ-PDC) | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2007–2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n=680 | n=701 | n=730 | n=707 | n=666 | n=670 | n=599 | n=656 | n=5,409 |
| | | n | n | n | n | n | n | n | n | n |
| 2.5 | Fungal | - | - | - | - | - | - | - | 1 | 1 |
| 2.8 | Other specified organism | - | - | - | - | 1 | - | - | - | 1 |
| 2.9 | Other unspecified organism | 3 | 1 | 3 | 2 | 1 | 2 | 2 | - | 14 |
| | **Hypertension** | | | | | | | | | |
| 3.1 | Chronic hypertension: essential | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 2 | 14 |
| 3.2 | Chronic hypertension: secondary, (eg, renal disease) | - | 3 | - | 1 | 1 | - | - | 1 | 6 |
| 3.3 | Chronic hypertension: unspecified | - | 2 | 1 | 1 | - | - | 1 | 1 | 6 |
| 3.4 | Gestational hypertension | 2 | 1 | 3 | 1 | 3 | 2 | 1 | 1 | 14 |
| 3.5 | Pre-eclampsia | 12 | 10 | 15 | 18 | 12 | 8 | 6 | 7 | 88 |
| 3.51 | Pre-eclampsia: With laboratory evidence of thrombophilia | - | - | 2 | 1 | - | 1 | - | - | 4 |
| 3.6 | Pre-eclampsia superimposed on chronic hypertension | 4 | 2 | 5 | 1 | 4 | 4 | 2 | 1 | 23 |
| 3.61 | Pre-eclampsia superimposed on chronic hypertension: With laboratory evidence of thrombophilia | - | 1 | - | 2 | - | - | - | - | 3 |
| 3.9 | Unspecified hypertension | - | 1 | 2 | 1 | - | - | - | - | 4 |
| | **Antepartum haemorrhage (APH)** | | | | | | | | | |
| 4.1 | Placental abruption | 37 | 40 | 44 | 37 | 38 | 29 | 39 | 22 | 286 |
| 4.11 | Placental abruption: With laboratory evidence of thrombophilia | 3 | 5 | 2 | 3 | 4 | 2 | 1 | - | 20 |
| 4.2 | Placenta praevia | 3 | - | 5 | 3 | 1 | 1 | - | 2 | 15 |
| 4.3 | Vasa praevia | 1 | - | 1 | 1 | 1 | - | - | - | 4 |
| 4.8 | Other APH | 10 | 7 | 9 | 9 | 11 | 4 | 15 | 22 | 87 |
| 4.9 | APH of undetermined origin | 9 | 14 | 18 | 25 | 23 | 24 | 19 | 23 | 155 |
| | **Maternal conditions** | | | | | | | | | |
| 5.1 | Termination of pregnancy for maternal psychosocial indications | 4 | 5 | 3 | 2 | 5 | 4 | 1 | 4 | 28 |
| 5.2 | Diabetes/Gestational diabetes | 12 | 7 | 14 | 18 | 7 | 16 | 16 | 11 | 101 |
| 5.3 | Maternal injury | - | - | - | - | - | - | - | 1 | 1 |
| 5.31 | Maternal injury: Accidental | 2 | - | 1 | 2 | - | 3 | - | 5 | 13 |
| 5.32 | Maternal injury: Non-accidental | - | 3 | 1 | 1 | - | - | 1 | 2 | 8 |
| 5.4 | Maternal sepsis | 1 | - | 3 | 2 | 2 | 1 | 4 | 1 | 14 |
| 5.5 | Antiphospholipid syndrome | 3 | 2 | 6 | 4 | 3 | - | 2 | 5 | 25 |
| 5.51 | Other maternal thrombophilia (if considered cause of death) | - | 1 | - | - | 1 | 1 | - | - | 3 |
| 5.6 | Obstetric cholestasis | - | - | - | - | - | - | - | 1 | 1 |
| 5.8 | Other specified maternal conditions | 5 | 5 | 10 | 3 | 8 | 11 | 10 | 9 | 61 |

## Continued Table 1.64: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2014

| | Perinatal death classification (PSANZ-PDC) | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2007–2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n=680 | n=701 | n=730 | n=707 | n=666 | n=670 | n=599 | n=656 | n=5,409 |
| | | n | n | n | n | n | n | n | n | n |
| | **Specific perinatal conditions** | | | | | | | | | |
| 6.1 | Twin–twin transfusion | 17 | 15 | 32 | 22 | 18 | 23 | 21 | 15 | 163 |
| 6.2 | Fetomaternal haemorrhage | 6 | 4 | 13 | 8 | 12 | 8 | 2 | 5 | 58 |
| 6.3 | Antepartum cord complications (eg, cord haemorrhage; true knot with evidence of occlusion) | 15 | 12 | - | - | - | - | - | - | 27 |
| 6.31 | Cord haemorrhage | - | 2 | 1 | 1 | - | 2 | 2 | 1 | 9 |
| 6.32 | True knot with evidence of occlusion | - | 1 | 2 | 3 | 6 | 1 | 2 | 2 | 17 |
| 6.38 | Other | - | 1 | 8 | 15 | 12 | 6 | 6 | 5 | 53 |
| 6.4 | Uterine abnormalities, eg, bicornuate uterus, cervical incompetence | 10 | 15 | 12 | 10 | 10 | 14 | 12 | 14 | 97 |
| 6.5 | Birth trauma (typically infants of >24 weeks gestation or >600g birthweight) | - | - | 1 | - | - | - | - | - | 1 |
| 6.6 | Alloimmune disease | | | | | | | | | |
| 6.61 | Alloimmune disease: Rhesus | - | - | - | - | - | 1 | 1 | - | 2 |
| 6.64 | Alloimmune disease: Alloimmune thrombocytopenia | 1 | - | 1 | 2 | - | - | - | 2 | 6 |
| 6.7 | Idiopathic hydrops | - | 7 | 2 | 3 | 3 | 5 | 4 | 2 | 26 |
| 6.8 | Other specific perinatal conditions (includes iatrogenic conditions such as rupture of membranes after amniocentesis, termination of pregnancy for suspected but unconfirmed congenital abnormality) | | | | | | | | | |
| 6.81 | Rupture of membranes after amniocentesis | 2 | 4 | - | 1 | 1 | 2 | 1 | - | 11 |
| 6.82 | Termination of pregnancy for suspected but unconfirmed congenital abnormality | - | - | - | - | - | - | 3 | - | 3 |
| 6.83 | Fetal subdural haematoma | - | 2 | - | 2 | - | - | - | 1 | 5 |
| 6.88 | Other | 6 | 8 | 4 | 2 | 11 | 8 | 9 | 21 | 69 |
| 6.89 | Unspecified | - | - | - | - | - | - | - | 1 | 1 |
| | **Hypoxic peripartum death** | | | | | | | | | |
| 7.1 | With intrapartum complications | | | | | | | | | |
| 7.11 | With intrapartum complications: Uterine rupture | 1 | 1 | 2 | 1 | 1 | 1 | - | - | 7 |
| 7.12 | With intrapartum complications: Cord prolapse | 2 | 1 | 1 | 5 | 4 | 2 | - | 1 | 16 |
| 7.13 | With intrapartum complications: Shoulder dystocia | 1 | 1 | 2 | - | - | - | - | - | 4 |
| 7.18 | With intrapartum complications: Other | 6 | 4 | 2 | 3 | 2 | 3 | 1 | 3 | 24 |
| 7.2 | Evidence of non-reassuring fetal status in a normally grown infant (eg, abnormal fetal heart rate, fetal scalp ph/lactate, fetal pulse oximetry without intrapartum complications) | 16 | 11 | 13 | 7 | 9 | 11 | 7 | 10 | 84 |
| 7.3 | No intrapartum complications and no evidence of non-reassuring fetal status | 1 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 12 |
| 7.9 | Unspecified hypoxic peripartum death | 6 | 14 | 7 | 3 | 3 | 1 | - | 2 | 36 |
| | **Fetal growth restriction (FGR)** | | | | | | | | | |
| 8.1 | With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction) | 34 | 37 | 28 | 33 | 33 | 30 | 31 | 20 | 246 |
| 8.2 | With chronic villitis | 1 | - | 1 | - | 1 | - | 3 | - | 6 |
| 8.3 | No placental pathology | 2 | 9 | 6 | 5 | 3 | 2 | 3 | 3 | 33 |

## Continued Table 1.64: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2014

| | Perinatal death classification (PSANZ-PDC) | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2007–2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n=680 | n=701 | n=730 | n=707 | n=666 | n=670 | n=599 | n=656 | n=5,409 |
| | | n | n | n | n | n | n | n | n | n |
| 8.4 | No examination of placenta | 4 | 3 | 3 | 2 | 3 | 4 | 1 | 3 | 23 |
| 8.8 | Other specified placental pathology | 4 | 12 | 14 | 8 | 4 | 13 | 10 | 9 | 74 |
| 8.9 | Unspecified or not known whether placenta examined | 1 | 1 | 1 | - | - | - | - | - | 3 |
| | **Spontaneous preterm** | | | | | | | | | |
| 9.1 | Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery | - | - | - | - | - | - | - | 2 | 2 |
| 9.11 | Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: With chorioamnionitis | 19 | 17 | 26 | 29 | 17 | 23 | 25 | 30 | 186 |
| 9.12 | Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Without chorioamnionitis | 17 | 15 | 13 | 14 | 13 | 6 | 5 | 11 | 94 |
| 9.13 | Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: No examination of placenta | - | 1 | - | 3 | 3 | - | 5 | 4 | 16 |
| 9.17 | No clinical signs of chorioamnionitis, no examination of placenta | 12 | 4 | 14 | 17 | 11 | 13 | 4 | 10 | 85 |
| 9.19 | Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Unspecified or not known whether placenta examined | 6 | 10 | 10 | 6 | 1 | 6 | 2 | 1 | 42 |
| 9.2 | Spontaneous preterm with membrane rupture ≥24 hours before delivery | - | - | - | - | - | - | - | - | - |
| 9.21 | Spontaneous preterm with membrane rupture ≥24 hours before delivery: With chorioamnionitis | 18 | 25 | 26 | 34 | 22 | 23 | 32 | 25 | 205 |
| 9.22 | Spontaneous preterm with membrane rupture ≥24 hours before delivery: Without chorioamnionitis | 3 | 5 | 3 | 2 | 1 | 8 | 2 | 1 | 25 |
| 9.23 | Spontaneous preterm with membrane rupture ≥24 hours before delivery: With clinical evidence of chorioamnionitis, no examination of placenta | 1 | 4 | 3 | 4 | 7 | 3 | 3 | 3 | 28 |
| 9.27 | No clinical signs of chorioamnionitis, no examination of placenta | 4 | 2 | 4 | 2 | 3 | 9 | 1 | 12 | 37 |
| 9.29 | Spontaneous preterm with membrane rupture ≥24 hours before delivery: Unspecified or not known whether placenta examined | 2 | 3 | 3 | - | 3 | 2 | - | - | 13 |
| 9.3 | Spontaneous preterm with membrane rupture of unknown duration before delivery | | | | | | | | | |
| 9.31 | Spontaneous preterm with membrane rupture of unknown duration before delivery: With chorioamnionitis | 6 | 1 | 2 | - | 2 | 3 | 1 | 2 | 17 |
| 9.32 | Spontaneous preterm with membrane rupture of unknown duration before delivery: Without chorioamnionitis | 3 | 1 | 1 | - | 1 | - | - | 3 | 9 |
| 9.33 | Spontaneous preterm with membrane rupture of unknown duration before delivery: With clinical evidence of chorioamnionitis, no examination of placenta | - | 3 | - | - | - | 1 | - | - | 4 |
| 9.37 | No clinical signs of chorioamnionitis, no examination of placenta | - | - | 2 | 1 | - | 2 | 1 | - | 6 |
| 9.39 | Spontaneous preterm with membrane rupture of unknown duration before delivery: Unspecified or not known whether placenta examined | 7 | 3 | 3 | 1 | - | 3 | - | 1 | 18 |
| | **Unexplained antepartum death** | | | | | | | | | |
| 10.1 | With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction) | 14 | 14 | 13 | 10 | 11 | 17 | 7 | 9 | 95 |
| 10.2 | With chronic villitis | 3 | - | 1 | - | 3 | 2 | 1 | 1 | 11 |
| 10.3 | No placental pathology | 31 | 25 | 28 | 21 | 27 | 12 | 29 | 18 | 191 |
| 10.4 | No examination of placenta | 18 | 25 | 21 | 14 | 13 | 20 | 12 | 17 | 140 |
| 10.8 | Other specified placental pathology | 28 | 31 | 34 | 24 | 38 | 34 | 42 | 45 | 276 |
| 10.9 | Unspecified or not known whether placenta examined | 6 | 7 | 6 | 2 | - | 1 | - | - | 22 |

## Continued Table 1.64: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2014

| | Perinatal death classification (PSANZ-PDC) | 2007 n=680 n | 2008 n=701 n | 2009 n=730 n | 2010 n=707 n | 2011 n=666 n | 2012 n=670 n | 2013 n=599 n | 2014 n=656 n | 2007–2014 n=5,409 n |
|---|---|---|---|---|---|---|---|---|---|---|
| | **No obstetric antecedent** | | | | | | | | | |
| 11.1 | Sudden infant death syndrome (SIDS) | | | | | | | | | |
| 11.11 | SIDS Category IA: Classic features of SIDS present, completely documented | - | - | - | - | - | - | 1 | - | 1 |
| 11.13 | SIDS Category II: Infant deaths that meet Category I except for one or more features | 1 | - | 2 | - | - | - | - | - | 3 |
| 11.2 | Postnatally acquired infection | 1 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | 13 |
| 11.3 | Accidental asphyxiation | 1 | 2 | - | - | - | 1 | - | 1 | 5 |
| 11.4 | Other accident, poisoning or violence (postnatal) | - | 1 | - | - | 1 | 1 | - | - | 3 |
| 11.8 | Other specified | - | 1 | - | 1 | - | 1 | 1 | 1 | 5 |
| 11.9 | Unknown/Undetermined | 1 | 1 | - | - | - | 2 | - | 1 | 5 |
| 11.91 | Unclassified sudden infant death | 7 | 7 | 3 | 7 | 1 | 1 | 3 | 3 | 32 |
| 11.92 | Other Unknown/Undetermined | - | - | 1 | - | - | - | - | - | 1 |

Table 1.65: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2007–2014

| | Neonatal death classification (PSANZ-NDC) | 2007 n=167 n | 2008 n=177 n | 2009 n=183 n | 2010 n=210 n | 2011 n=163 n | 2012 n=178 n | 2013 n=153 n | 2014 n=182 n | 2007–2014 n=1,413 n |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Congenital abnormality** | | | | | | | | | |
| 1.1 | Central nervous system | 2 | 2 | 6 | 6 | 5 | 4 | 4 | 6 | 35 |
| 1.2 | Cardiovascular system | 9 | 12 | 6 | 7 | 6 | 3 | 5 | 7 | 55 |
| 1.3 | Urinary system | 4 | 7 | 3 | 6 | 6 | 4 | 2 | 2 | 34 |
| 1.4 | Gastrointestinal system | 2 | 1 | - | - | 1 | 2 | 1 | 2 | 9 |
| 1.5 | Chromosomal | 6 | 7 | 8 | 12 | 14 | 11 | 5 | 11 | 74 |
| 1.6 | Metabolic | 1 | 1 | 5 | 1 | 3 | 3 | 1 | 2 | 17 |
| 1.7 | Multiple/Non-chromosomal syndromes | 9 | 6 | 8 | 6 | 6 | 4 | 9 | 6 | 54 |
| 1.8 | Other congenital abnormality | | | | | | | | | |
| 1.81 | Musculoskeletal | - | - | - | 1 | 4 | 1 | 2 | 3 | 11 |
| 1.82 | Respiratory | - | 1 | - | 1 | 1 | 1 | - | - | 4 |
| 1.83 | Diaphragmatic hernia | 2 | 4 | 7 | 4 | 3 | 3 | - | 3 | 26 |
| 1.84 | Haematological | - | - | - | 1 | - | - | 1 | - | 2 |
| 1.85 | Tumours | 1 | 2 | - | - | - | - | 1 | 1 | 5 |
| 1.88 | Other specified congenital abnormality | 2 | - | - | 1 | 1 | 2 | 1 | 1 | 8 |
| | **Extreme prematurity** | | | | | | | | | |
| 2.1 | Not resuscitated | 48 | 37 | 52 | 71 | 45 | 60 | 58 | 68 | 439 |
| 2.2 | Unsuccessful resuscitation | 9 | 15 | 6 | 13 | 9 | 8 | 4 | 1 | 65 |
| 2.9 | Unspecified or not known whether resuscitation attempted | - | - | - | - | - | - | 1 | - | 1 |
| | **Cardio-respiratory disorders** | | | | | | | | | |
| 3.1 | Hyaline membrane disease/Respiratory distress syndrome (RDS) | 6 | 7 | 5 | 8 | 3 | 5 | 1 | 8 | 43 |
| 3.2 | Meconium aspiration syndrome | - | - | - | - | - | - | 1 | 1 | 2 |
| 3.3 | Primary persistent pulmonary hypertension | - | - | - | 1 | - | 2 | 1 | - | 4 |
| 3.4 | Pulmonary hypoplasia | 3 | 4 | 2 | 3 | 5 | 1 | 1 | 5 | 24 |
| 3.5 | Chronic neonatal lung disease (typically, bronchopulmonary dysplasia) | - | - | 2 | 2 | - | 1 | - | - | 5 |
| 3.6 | Pulmonary haemorrhage | - | - | 2 | 3 | 2 | 2 | 2 | - | 11 |
| 3.7 | Pneumothorax | - | - | - | - | - | - | - | 1 | 1 |
| 3.8 | Other | 2 | - | - | 1 | 1 | 3 | - | 1 | 8 |

## Continued Table 1.65: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2007–2014

| | Neonatal death classification (PSANZ-NDC) | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2007–2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n=167 | n=177 | n=183 | n=210 | n=163 | n=178 | n=153 | n=182 | n=1,413 |
| | | n | n | n | n | n | n | n | n | n |
| | **Infection** | | | | | | | | | |
| 4.1 | Bacterial | | | | | | | | | |
| 4.11 | Congenital bacterial | | | | | | | | | |
| 4.111 | Congenital bacterial: Group B *Streptococcus* | 4 | 4 | 2 | 6 | 2 | - | 2 | 2 | 22 |
| 4.112 | Congenital bacterial: *E. coli* | 1 | - | - | 3 | 3 | 3 | 1 | 1 | 12 |
| 4.113 | Congenital bacterial: *Listeria monocytogenes* | - | 1 | - | - | - | - | - | 2 | 3 |
| 4.118 | Congenital bacterial: Other bacterial | - | 3 | 2 | - | 2 | 2 | 1 | 3 | 13 |
| 4.119 | Congenital bacterial: Unspecified bacterial | 3 | - | 1 | 3 | - | 2 | 1 | 2 | 12 |
| 4.12 | Acquired bacterial | | | | | | | | | |
| 4.121 | Acquired bacterial: Group B *Streptococcus* | - | - | - | - | 3 | 1 | - | - | 4 |
| 4.122 | Acquired bacterial: *E. coli* | - | 3 | - | 1 | - | - | - | - | 4 |
| 4.125 | Acquired bacterial: Other Gram negative bacilli (other than *E. coli*) | 1 | 1 | - | 1 | - | 1 | 1 | - | 5 |
| 4.126 | Acquired bacterial: *Staphylococcus aureus* | 1 | 2 | - | 1 | - | 1 | 1 | 2 | 8 |
| 4.127 | Acquired bacterial: Coagulase negative *Staphylococcus* | - | 3 | - | - | - | - | - | 1 | 4 |
| 4.128 | Acquired bacterial: Other specified bacterial | - | - | 2 | 3 | 1 | 1 | 1 | - | 8 |
| 4.129 | Acquired bacterial: Unspecified bacterial | 1 | 1 | - | - | - | - | - | - | 2 |
| 4.2 | Viral | | | | | | | | | |
| 4.21 | Congenital viral | | | | | | | | | |
| 4.211 | Congenital viral: *Cytomegalovirus* | - | 1 | - | - | 2 | - | - | - | 3 |
| 4.213 | Congenital viral: Herpes simplex virus | 2 | - | - | - | 1 | - | 3 | - | 6 |
| 4.218 | Congenital viral: Other specified viral | - | - | - | - | 1 | 1 | - | - | 2 |
| 4.22 | Acquired viral | | | | | | | | | |
| 4.223 | Acquired viral: Herpes simplex virus | - | - | 1 | - | - | 1 | 1 | - | 3 |
| 4.228 | Acquired viral: Other specified viral | - | 1 | - | 1 | - | 1 | - | - | 3 |
| 4.229 | Acquired viral: Unspecified viral | - | 1 | - | - | - | - | - | - | 1 |
| 4.5 | Fungal | - | - | - | - | - | - | - | 1 | 1 |
| 4.9 | Unspecified organism | 1 | - | 4 | - | - | 2 | - | 1 | 8 |
| | **Neurological** | | | | | | | | | |

## Continued Table 1.65: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2007–2014

| | Neonatal death classification (PSANZ-NDC) | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2007–2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n=167 | n=177 | n=183 | n=210 | n=163 | n=178 | n=153 | n=182 | n=1,413 |
| | | n | n | n | n | n | n | n | n | n |
| 5.1 | Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight) | 26 | 28 | 31 | 25 | 15 | 18 | 16 | 13 | 172 |
| 5.2 | Intracranial haemorrhage | | | | | | | | | |
| 5.21 | Intraventrical haemorrhage | 5 | 2 | 7 | 1 | 8 | 6 | 8 | 10 | 47 |
| 5.22 | Subgaleal haemorrhage | - | 1 | 1 | - | - | - | - | - | 2 |
| 5.23 | Subarachnoid haemorrhage | - | 1 | - | - | - | - | - | - | 1 |
| 5.24 | Subdural haemorrhage | - | - | - | 1 | - | - | 1 | - | 2 |
| 5.28 | Other intracranial haemorrhage | - | - | 1 | - | - | - | - | 1 | 2 |
| 5.8 | Other | - | 1 | - | 1 | - | 1 | - | - | 3 |
| | **Gastrointestinal** | | | | | | | | | |
| 6.1 | Necrotising enterocolitis | 2 | - | 6 | 5 | 2 | 2 | 1 | 3 | 21 |
| 6.8 | Other | - | - | 2 | - | - | 1 | - | - | 3 |
| | **Other** | | | | | | | | | |
| 7.1 | Sudden infant death syndrome (SIDS) | | | | | | | | | |
| 7.11 | SIDS Category IA: Classic features of SIDS present and completely documented | - | - | - | - | - | - | 1 | - | 1 |
| 7.13 | SIDS Category II: Infant deaths that meet category I except for one or more features | 1 | - | 2 | - | - | - | - | - | 3 |
| 7.2 | Multisystem failure | - | - | - | - | - | - | - | 1 | 1 |
| 7.21 | Multisystem failure: Secondary to intrauterine growth restriction | - | - | 3 | - | - | - | 2 | - | 5 |
| 7.28 | Multisystem failure: Other specified | - | - | 1 | - | 2 | 1 | 2 | 1 | 7 |
| 7.29 | Multisystem failure: Unspecified/undetermined primary cause or trigger event | - | - | - | - | - | 1 | - | - | 1 |
| 7.3 | Trauma | | | | | | | | | |
| 7.31 | Trauma: Accidental | - | 3 | - | - | - | 3 | 1 | 1 | 8 |
| 7.32 | Trauma: Non accidental | - | - | - | - | 1 | - | - | - | 1 |
| 7.4 | Treatment complications | 3 | - | - | - | - | - | - | - | 3 |
| 7.42 | Treatment complications: Medical | - | 2 | - | - | - | - | - | 1 | 3 |
| 7.8 | Other specified | - | 3 | - | 2 | - | 2 | 4 | 2 | 13 |
| 7.9 | Unknown/Undetermined | - | 1 | - | - | - | 2 | - | 1 | 4 |
| 7.91 | Unclassified sudden infant death | 10 | 1 | - | - | - | - | - | - | 11 |
| 7.911 | Unclassified sudden infant death: Bed sharing | - | 7 | 4 | 7 | 3 | 5 | 4 | 3 | 33 |
| 7.912 | Unclassified sudden infant death: Not bed sharing | - | - | 1 | 1 | 2 | - | - | 1 | 5 |

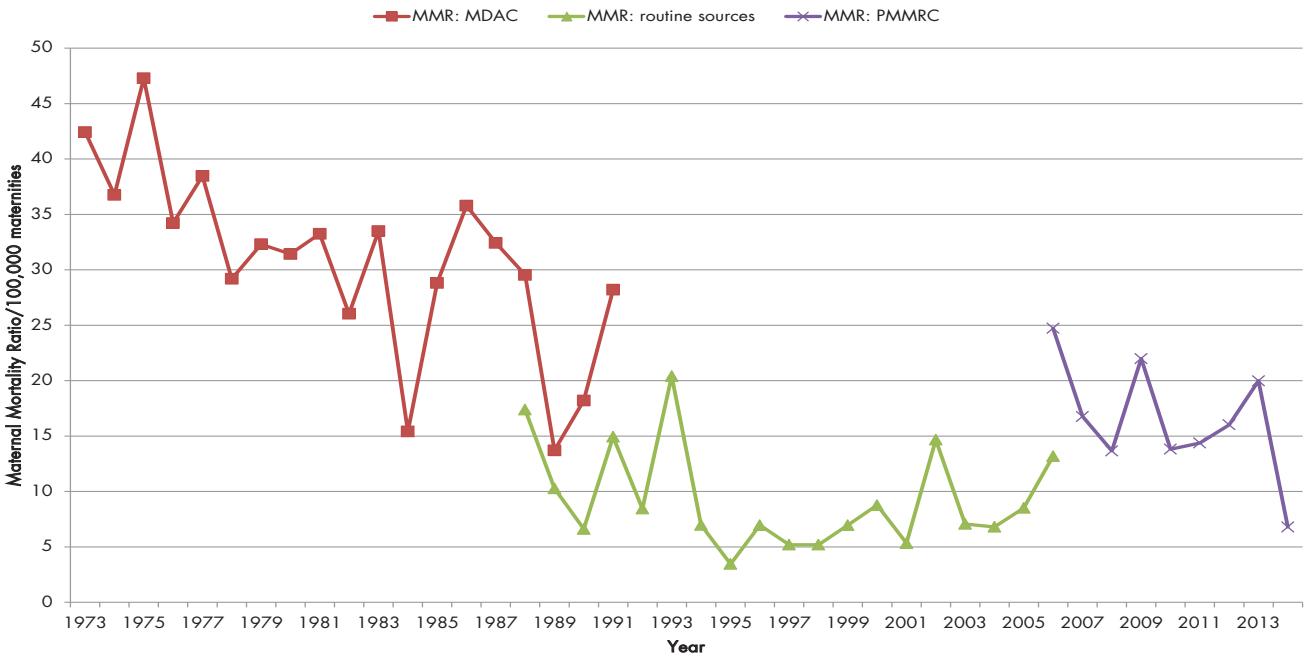
# 2 New Zealand Maternal Mortality 2014

## 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 to 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.

Figure 2.1: New Zealand maternal mortality ratio by mortality data source 1973–2014




MMR = maternal mortality ratio.
MDAC = Maternal Deaths Assessment Committee.
* Data from the MDAC, including maternal deaths to three months postpartum.
# Data from routine New Zealand datasets (ie, the Mortality Collection (BDM) and hospital discharge datasets (NMDS)) including maternal deaths to six weeks postpartum.
+ Data from the PMMRC, including maternal deaths to six 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 National Minimum Data Set (NMDS) of hospital discharges and in the Mortality Collection from Birth Deaths and Marriages (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 2006–2014 the ratio was 16.7/100,000 maternities, 2.3 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 (Figure 2.1).

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 2014a).

## 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 n.d.).

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 2014, 27 percent of all maternal deaths (50 percent of antepartum (in pregnancy) maternal deaths and 13 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 2007).

**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 (Appendix F).

**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 seven indirect maternal deaths (due to suicide) in the 2006–2014 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 2009–2014 deaths, the working group applied the new tool in reviewing the maternal deaths. The findings of the expert panel review of deaths from 2006 to 2008 combined with the committee's reviews for 2009–2014 are presented in this report.

The year 2014 was the ninth 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 (2006–2014).

# 2.4 Findings

## Maternal mortality ratio

Table 2.1: Maternal mortality ratio (per 100,000 maternities) and cause of maternal death 2006–2014

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2006–2014 | | 2006–2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | n=94 | | Cause specific ratio |
| | n | n | n | n | n | n | n | n | n | n | % | /100,000 maternities |
| **Maternities** | 60,659 | 65,602 | 65,872 | 63,665 | 65,124 | 62,604 | 62,425 | 60,039 | 58,647 | - | - | |
| **Direct maternal death** | **6** | **5** | **4** | **5** | **1** | **2** | **2** | **5** | **2** | **32** | **34.0** | **5.67** |
| Amniotic fluid embolism | 3 | - | 1 | 4 | 1 | - | 1 | 2 | - | 12 | 12.8 | 2.13 |
| Obstetric haemorrhage | | | | | | | | | | | | |
| <20/40 gestation | - | 1 | - | - | - | - | - | 1 | - | 2 | 2.1 | 0.35 |
| ≥20/40 gestation | 1 | - | 1 | - | - | - | - | - | 1 | 3 | 3.2 | 0.53 |
| Venous thrombo-embolism | - | 1 | 1* | - | - | 1 | - | - | 1 | 4 | 4.3 | 0.71 |
| Peripartum cardiomyopathy | - | 1 | - | - | - | - | - | - | - | 1 | 1.1 | 0.18 |
| Pre-eclampsia/Eclampsia | - | 2 | 1 | 1 | - | - | - | - | - | 4 | 4.3 | 0.71 |
| Obstetric sepsis | 2 | - | - | - | - | 1 | 1 | 2 | - | 6 | 6.4 | 1.06 |
| **Indirect maternal death** | **7** | **5** | **5** | **9** | **8** | **6** | **8** | **7** | **1** | **56** | **59.6** | **9.92** |
| Pre-existing medical condition | | | | | | | | | | | | |
| Cardiac | 1 | 1 | 1 | - | 1 | 1 | 4 | - | - | 9 | 9.6 | 1.59 |
| Neurological | 1 | 1 | - | 1 | 1 | 2 | 1 | 2 | - | 9 | 9.6 | 1.59 |
| Other pre-existing medical condition | 1 | 2 | 1 | - | 1 | 1 | - | 1 | 1 | 8 | 8.5 | 1.42 |
| Non-obstetric sepsis | - | 1 | - | 5 | 1 | - | - | 1 | - | 8 | 8.5 | 1.42 |
| Suicide | 4 | - | 3 | 3 | 4 | 2 | 3 | 3 | - | 22 | 23.4 | 3.90 |
| **Unclassifiable** | **2** | **1** | **-** | **-** | **-** | **1** | **-** | **1** | **1** | **6** | **6.4** | **1.06** |
| **Total maternal deaths** | **15** | **11** | **9** | **14** | **9** | **9** | **10** | **13** | **4** | **94** | **100.0** | **16.65** |
| Single-year MMR | 24.7 | 16.8 | 13.7 | 22.0 | 13.8 | 14.4 | 16.0 | 21.7 | 6.8 | - | - | - |
| Three-year rolling MMR | - | - | 06–08 | 07–09 | 08–10 | 09–11 | 10–12 | 11–13 | 12–14 | - | - | - |
| | | | 18.2 | 17.4 | 16.4 | 16.7 | 14.7 | 17.3 | 14.9 | - | - | - |
| **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.

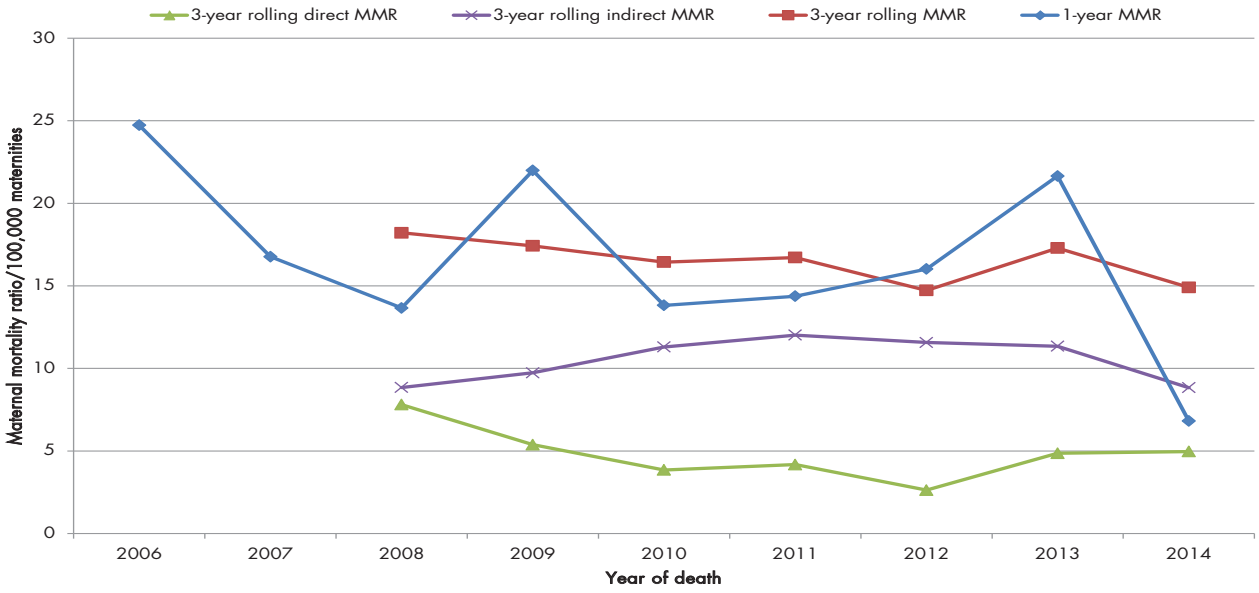
In 2014, only four deaths within the definition of maternal mortality were reported to the PMMRC. There were no coincidental deaths reported in 2014. The maternal mortality ratio in New Zealand was therefore 6.8/100,000 maternities (95% CI 1.9–17.5/100,000) for the year 2014. The three-year average maternal mortality ratio, calculated to obtain a more robust estimate of the New Zealand ratio given small and variable numbers of deaths per year, for 2012–2014, was 14.9/100,000 maternities (95% CI 9.8–21.7/100,000).

In 2014, there were two direct deaths, one from postpartum haemorrhage and one from venous thromboembolism. There was one indirect death from a pre-existing medical condition. 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 (2010–2014) was 3.9/100,000 maternities (95% CI 2.0-6.8/100,000), and for indirect deaths 9.7/100,000 maternities (95% CI 6.6–13.9/100,000).

Suicide (22), amniotic fluid embolism (12), and pre-existing medical diseases (26) are the most frequent causes of maternal mortality in New Zealand during 2006–2014. Suicide continues to be the leading 'single' cause of maternal death in New Zealand. Suicide and AFE deaths from 2006 to 2014 are discussed in detail later in this chapter.

Figure 2.2: Maternal mortality ratios (per 100,000 maternities) (one-year and three-year rolling) 2006–2014




MMR = maternal mortality ratio.
Three-year rolling maternal mortality ratio 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 small 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 to 93 percent of cases (Cliffe et al 2008; Deneux-Tharaux et al 2005; Donati et al 2011; EURO-PERISTAT 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-UK) 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 the United Kingdom based on confidential enquiry data for the triennium 2011–2013 was 9.02/100,000 maternities (2.91/100,000 direct maternal mortality ratio; 6.11/100,000 indirect maternal mortality ratio) (Knight et al 2015). This was significantly lower than the maternal mortality ratio in the two previous triennia and similar to that reported for the 1985–1987 triennium. 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 2011–2013 was significantly higher than that reported by the UK at 17.3/100,000 maternities with 95% CI 12.2–24.4/100,000 (direct maternal mortality ratio 4.9/100,000 maternities (2.6–9.2/100,000); indirect maternal mortality ratio 11.3/100,000 maternities (7.4–17.3/100,000)). Thus, the New Zealand direct maternal mortality ratio was not statistically different 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.

In 2008–2012, there were 105 maternal deaths in Australia that occurred within 42 days of the end of pregnancy, representing a maternal mortality ratio of 7.1 deaths per 100,000 women who gave birth in Australia. The number of maternal deaths increased each year from 2008 to 2012. It is uncertain whether this is an actual increase or reflects improvements in case ascertainment (Humphrey et al 2015).

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). The report also notes that the limited national level maternal mortality review process has a 'significant impact on the quality and utility of the data collected' and limits the 'capacity for meaningful comparison of cases'. Australia also classifies some maternal deaths in a different manner to New Zealand, so inter-country comparisons between categories are also limited.

## Reporting of maternal deaths to New Zealand Coronial Services 2006–2014

In 2014, all four maternal deaths were reported to Coronial Services and jurisdiction taken. A post-mortem was performed in all four deaths.

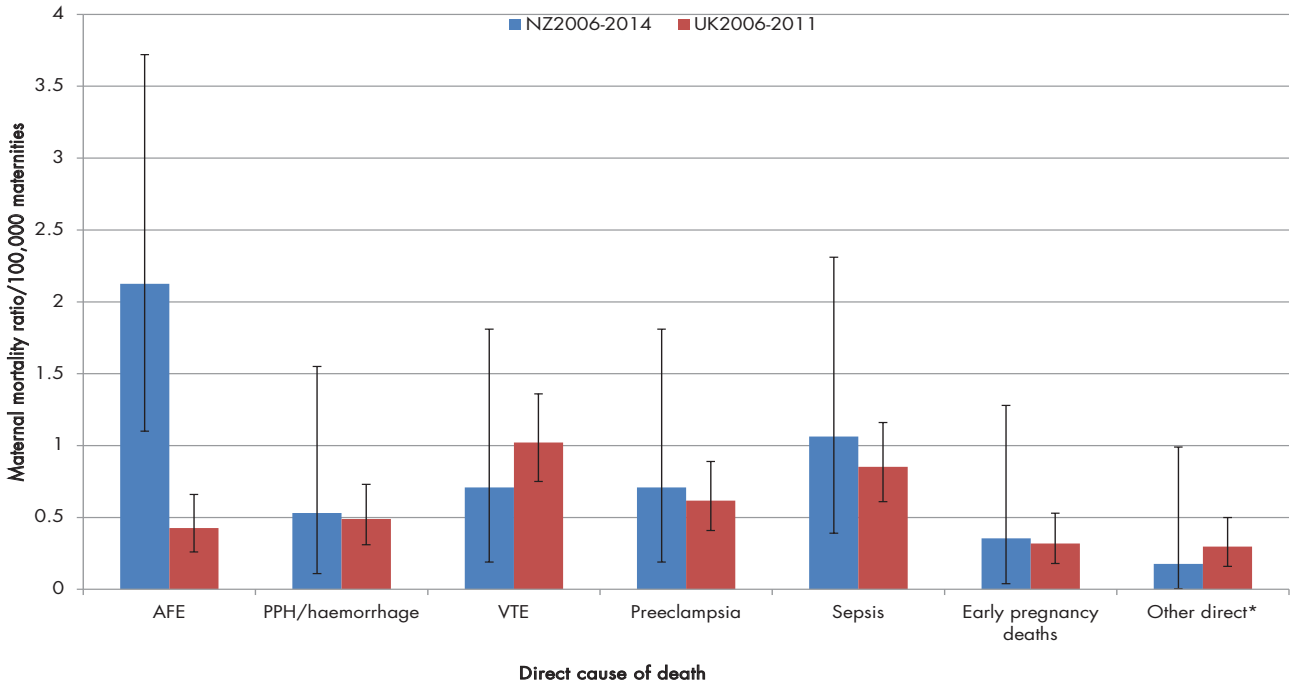
The MMRWG recommends that where a coroner declines jurisdiction in the case of a maternal death, a post-mortem should be offered as part of full investigation of cause of death. The MMRWG reviewed the role of post-mortems in determining cause of maternal death from 2006 to 2014 and found clinical diagnosis was confirmed in 44 (47 percent), was changed in 11 (12 percent), there were additional clinical findings in 9 (10 percent), and the clinical diagnosis was inconclusive in 6 (6 percent). The remaining 26 percent of maternal deaths (24) did not have a post-mortem.

## 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 and sepsis. In New Zealand, AFE contributes almost 40 percent of direct deaths.

Figure 2.3: Cause specific direct maternal mortality ratios in New Zealand 2006–2014 and the UK 2006–2011 (with 95% CIs)



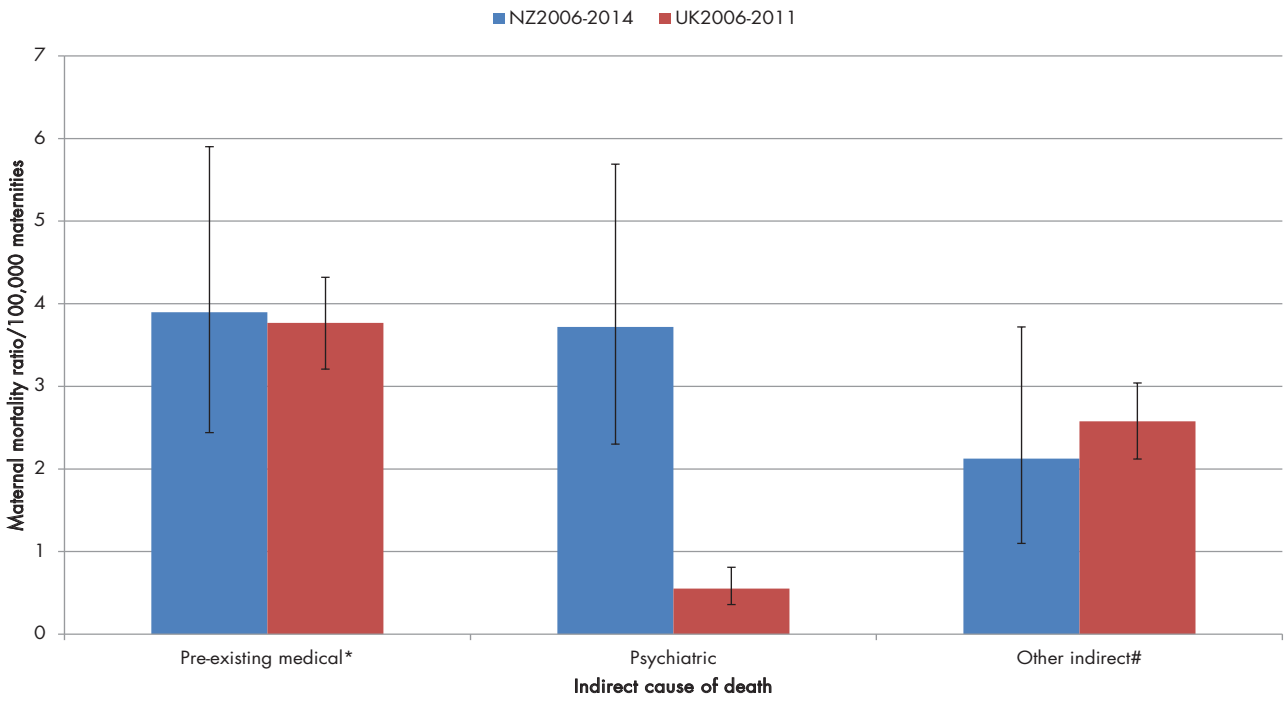

* Includes anaesthesia, cardiomyopathy, other.
AFE = amniotic fluid embolism.
PPH = postpartum haemorrhage.
VTE = venous thromboembolism.

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 five 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 the rate in New Zealand from 2006 to 2014. The similarity of the direct maternal mortality ratio for New Zealand to that in the UK overall and for all other direct causes raised a concern for New Zealand, which led to a review of AFE cases. Further review of amniotic fluid embolism deaths 2006–2013 can be found in Section 2.5.

### *Indirect causes*

Pre-existing medical disease and suicide were the most frequent causes of maternal mortality in New Zealand in 2006–2014, suicide being the leading 'single' cause of maternal death in New Zealand (3.7/100,000 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 6.7 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 ($p<0.0001$). Further review of maternal suicide deaths 2006–2013 can be found in Section 2.6.

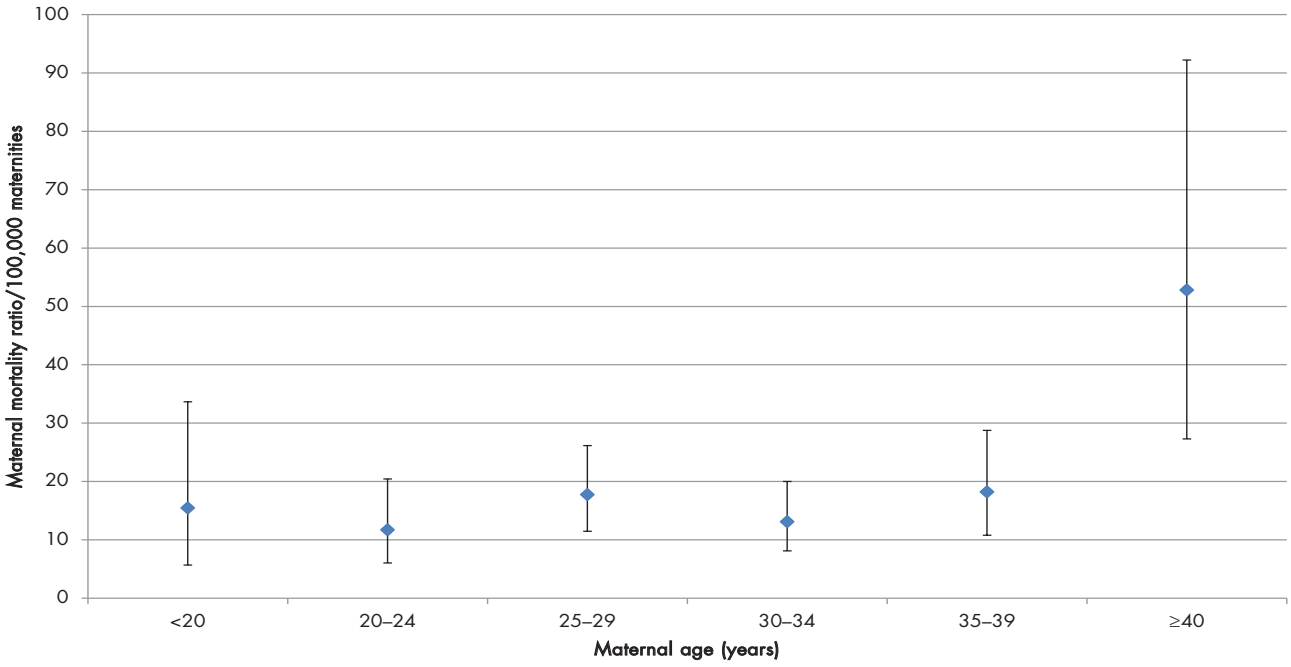
Figure 2.4: Cause specific indirect maternal mortality ratios in New Zealand 2006–2014 and the UK 2006–2011 (with 95% CIs)




* Includes cardiac, indirect neurological, indirect malignancies.
# Includes non-obstetric sepsis.

## Demographic characteristics

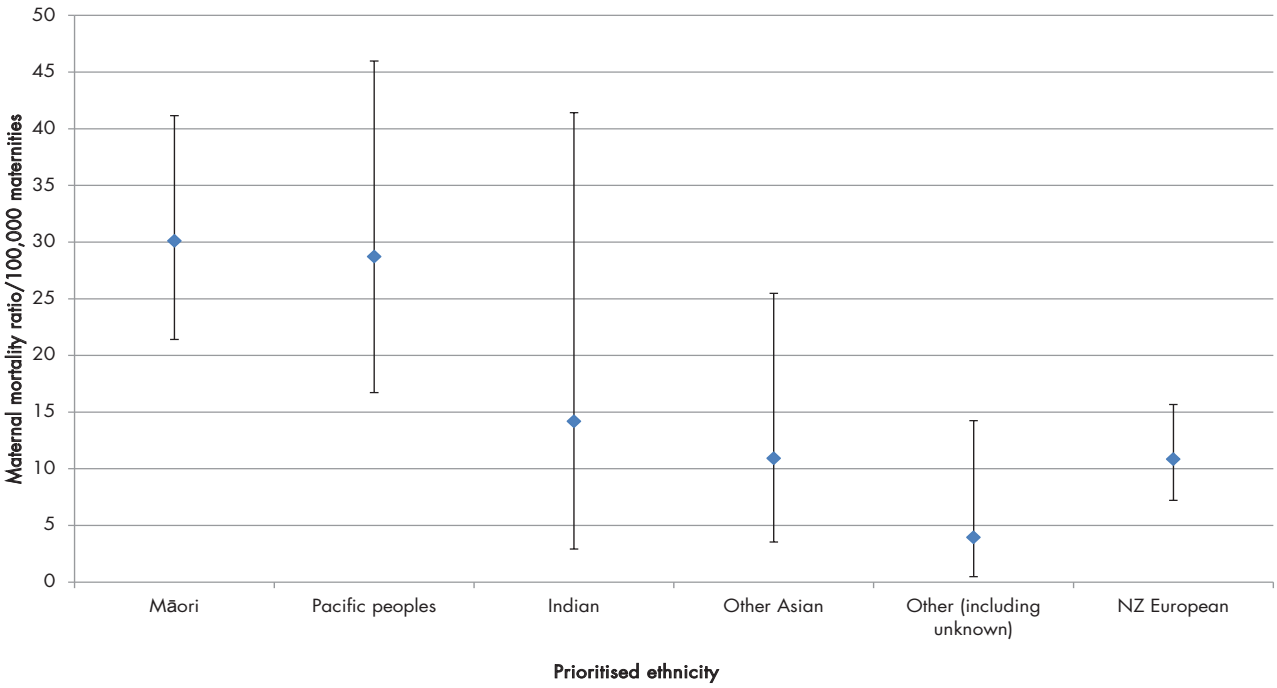
Figure 2.5: Maternal mortality ratios (per 100,000 maternities) by maternal age 2006–2014



Mothers aged 40 years and older contributed 13 percent of maternal deaths but only 4 percent of maternities from 2006 to 2014. The maternal mortality ratio for mothers aged 40 years and older was 52.8/100,000 maternities compared to 15.1/100,000 among mothers under 40 years of age during this period.

There have been 12 mortalities among mothers 40 years of age and older between 2006 and 2014, including seven direct and five indirect deaths. Numbers are small so it is hard to determine any statistically significant associations between age and cause of death, although suicide tends to be more often a cause of maternal death among younger women, and pre-existing medical conditions among older women.

Figure 2.6: Maternal mortality ratios (per 100,000 maternities) by prioritised ethnicity 2006–2014

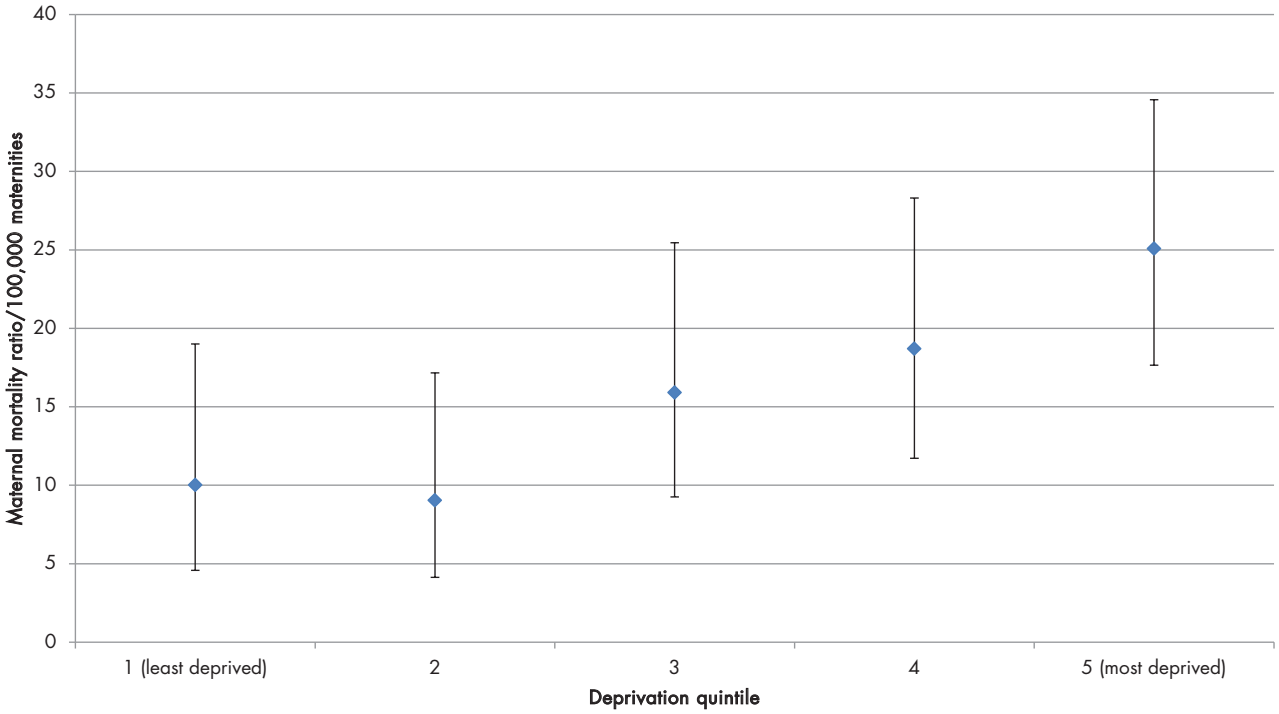



The maternal mortality ratio for Māori and Pacific mothers is two to three times that of Other Asian, Other, and New Zealand European mothers. Maternal mortality among Māori and Pacific mothers is statistically significantly higher than among New Zealand European, Other Asian and Other ethnicity mothers.

The maternal mortality ratio (direct deaths only) for Māori and Pacific peoples was 10.6/100,000 (95% CI 6.5–16.4) compared to 3.2/100,000 (1.6–5.6) for all other ethnicities combined. For indirect deaths the ratios were respectively 18.0/100,000 (12.5–25.2) compared to 5.9/100,000 (3.7–8.9).

The maternal mortality ratios for Māori and Pacific combined for both direct and indirect deaths were approximately three times those for all other ethnicities.

Figure 2.7: Maternal mortality ratios (per 100,000 maternities) by deprivation quintile 2006–2014




The risk of maternal mortality increased significantly with increasing deprivation quintile during 2006–2014. The risk for women living in the most deprived 20 percent of residential areas from 2006 to 2014 was 2.5 times that of those in the least deprived 20 percent.

These analyses do not attempt to separate out the independent effects of ethnicity, maternal age and socioeconomic status, which are likely to have inter-related effects on maternal mortality.

The 2015 report on maternal deaths in the UK 2011–2013 reported that the relative risk of maternal mortality was 1.44 (95% CI 0.87–2.46) for women residing in the most deprived 'Index of Multiple Deprivation' quintile areas in England compared to women in the least deprived quintile areas (Knight et al 2015). The equivalent relative risk for 2006–2014 for New Zealand is 2.5 (1.2–5.2).

## Clinical characteristics

Table 2.2: Clinical characteristics among maternal deaths 2006–2014

| | Maternal deaths | |
|---|---|---|
| | n=94 | |
| | n | % |
| **Parity*** | | |
| 0 | 25 | 26.6 |
| 1–3 | 45 | 47.9 |
| 4+ | 22 | 23.4 |
| Unknown | 2 | 2.1 |
| **BMI (kg/m$^2$)** | | |
| <18.5 | 3 | 3.2 |
| 18.5–24.99 | 30 | 31.9 |
| 25–29.99 | 16 | 17.0 |
| 30–34.99 | 19 | 20.2 |
| ≥35 | 22 | 23.4 |
| Unknown | 4 | 4.3 |
| **Current smoker** | | |
| Yes | 32 | 34.0 |
| No | 59 | 62.8 |
| Unknown | 3 | 3.2 |
| **Alcohol and substance use** | | |
| Yes | 23 | 24.5 |
| No | 64 | 68.1 |
| Unknown | 7 | 7.4 |
| **Family violence in this pregnancy** | | |
| Yes | 9 | 9.6 |
| No | 48 | 51.1 |
| Not asked | 22 | 23.4 |
| Unknown | 15 | 16.0 |

* Defined prior to conception of the index pregnancy.

Over the years 2006–2014, approximately one-quarter of mothers who died were having their first baby, while a further quarter had had four or more prior births. In 2014, 39.7 percent of women birthed their first baby in New Zealand, and 4.9 percent birthed their fourth or later baby, according to data from the MAT dataset.

The data suggest 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.

Of the 94 maternal deaths from 2006 to 2014, 41 (44 percent) had a BMI of 30 or more. Although the MAT dataset is missing BMI data for 5 percent of mothers who birthed in 2014, and the missing data are for women who probably had higher than average BMI, the proportion of women birthing in 2014 in New Zealand with known BMI who had a BMI of 30 or higher was significantly lower than that among maternal deaths at 25 percent.

The rate of smoking among mothers who died (34 percent) is high compared to smoking among mothers birthing in New Zealand in 2014 (15.9 percent of mothers smoking at either registration or two weeks postpartum).

Family violence was known to be present in the index pregnancy in at least 10 percent of maternal deaths in 2006–2014, and family violence status was unknown in a further 39 percent. Evidence of family violence prior to or during pregnancy among deaths from any cause from 2011 to 2013 in the UK was reported in 7 percent of cases, with data missing for 42 percent of cases (Knight et al 2015).

## Table 2.3: Details of place and timing of maternal mortalities 2006–2014

| | Maternal deaths | |
|---|---|---|
| | n=94 | |
| | n | % |
| **Place of baby's birth** | | |
| Community (not in a health care facility) | 4 | 4.3 |
| Hospital | 55 | 58.5 |
| Baby not born at time of mother's death | 34 | 36.2 |
| Unknown | 1 | 1.1 |
| **Place of maternal death** | | |
| Hospital | 59 | 62.8 |
| Community | 35 | 37.2 |
| **Time of death related to pregnancy** | | |
| Antepartum (Antepartum/Intrapartum) | 34 | 36.2 |
| Postpartum | 60 | 63.8 |
| | **Antepartum maternal death** | |
| | n=34 | |
| | n | % |
| **Gestation at antepartum maternal death (weeks)** | | |
| <20 | 17 | 50.0 |
| 20–27 | 9 | 26.5 |
| 28–36 | 7 | 20.6 |
| 37–42 | 1 | 2.9 |
| | **Postpartum maternal death** | |
| | n=60 | |
| | n | % |
| **Gestation at birth of postpartum maternal death (weeks)** | | |
| <20 | 8 | 13.3 |
| 20–27 | 7 | 11.7 |
| 28–36 | 13 | 21.7 |
| 37–42 | 32 | 53.3 |
| **Postnatal day at postpartum maternal death (days)** | | |
| 0 | 16 | 26.7 |
| 1–6 | 14 | 23.3 |
| 7–13 | 7 | 11.7 |
| 14–27 | 12 | 20.0 |
| 28–41 | 10 | 16.7 |
| Unknown | 1 | 1.7 |

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

Approximately a third (36 percent) 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, half occurred after the baby's birth at term. A quarter occurred within the first day of birth and half within the first week.

Table 2.4: Baby outcomes among maternal deaths 2006–2014

| Baby outcome | Maternal deaths | | Antepartum/Intrapartum maternal death | | Postpartum maternal death | |
|---|---|---|---|---|---|---|
| | n=94 | | n=34 | | n=60 | |
| | n | % | n | % | n | % |
| **Maternal death <20 weeks** | 25 | 26.6 | 17 | 50.0 | 8 | 13.3 |
| **Maternal death ≥20 weeks** | | | | | | |
| Did not deliver | 17 | 18.1 | 17 | 50.0 | - | - |
| Stillborn | 6 | 6.4 | - | - | 6 | 10.0 |
| Early neonatal death | 4 | 4.3 | - | - | 4 | 6.7 |
| Late neonatal death | - | - | - | - | - | - |
| Alive after one month of age | 42 | 44.7 | - | - | 42 | 70.0 |

One-quarter (27 percent) of maternal deaths from 2006 to 2014 occurred in the first 20 weeks of pregnancy, two-thirds of these prior to the baby's birth.

Sixty-nine mothers (73 percent) died at or after 20 weeks gestation. Of these mothers, 17 (25 percent) died prior to the baby's birth and the babies did not deliver; there were 10 perinatal deaths (14 percent) and 42 (61 percent) babies survived.

Of babies born alive coincident with maternal death (46), 42 (91 percent) survived beyond one month of age.

### Perimortem caesarean section

Perimortem caesarean section can save the life of both the mother and the infant.

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 2014. Five babies were live born, three babies were stillborn and one live born baby died as an early neonatal death.

## Contributory factors and potentially avoidable maternal deaths

Thirty-six percent of maternal deaths were identified as potentially avoidable from 2006 to 2014. Contributory factors were identified in 62 percent of maternal deaths in the years 2006 to 2014. 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 38 to 40 percent of cases overall, but barriers were less often identified among direct deaths (25 percent) than among indirect (54 percent).

Similar rates were identified in the MBRRACE-UK in-depth review of maternal deaths in the UK for the years 2009–2013, which reported substandard care in 59 percent of cases overall, with this contributing significantly to the death in 38 percent of cases.

## Table 2.5: Contributory factors and potentially avoidable maternal death 2006–2014

| | Maternal deaths | | Direct maternal deaths | | Indirect maternal deaths | | Unclassifiable | |
|---|---|---|---|---|---|---|---|---|
| | n=94 | | n=32 | | n=56 | | n=6 | |
| | n | % | n | % | n | % | n | % |
| **Was death potentially avoidable?** | | | | | | | | |
| Yes | 34 | 36.2 | 13 | 40.6 | 21 | 37.5 | - | - |
| No | 56 | 59.6 | 19 | 59.4 | 35 | 62.5 | 2 | 33.3 |
| Unknown | 4 | 4.3 | - | - | - | - | 4 | 66.7 |
| **Contributory factors present** | **58** | **61.7** | **21** | **65.6** | **36** | **64.3** | **1** | **16.7** |
| **Organisational/Management factors** | **36** | **38.3** | **16** | **50.0** | **20** | **35.7** | **-** | **0.0** |
| Poor organisational arrangements of staff | 6 | | 3 | | 3 | | - | |
| Inadequate education and training | 11 | | 6 | | 5 | | - | |
| Lack of policies, protocols or guidelines | 22 | | 10 | | 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 | 14 | | 3 | | 11 | | - | |
| Delayed access to test results or inaccurate results | 3 | | 2 | | 1 | | - | |
| 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 | 8 | | 3 | | 5 | | - | |
| **Personnel factors** | **37** | **39.4** | **15** | **46.9** | **21** | **37.5** | **1** | **16.7** |
| Knowledge and skills of staff were lacking | 16 | | 7 | | 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 | 8 | | 2 | | 5 | | 1 | |
| Lack of recognition of complexity or seriousness of condition by care giver | 22 | | 7 | | 15 | | - | |
| Other | 1 | | 1 | | - | | - | |

## Continued Table 2.5: Contributory factors and potentially avoidable maternal death 2006–2014

| | Maternal deaths | | Direct maternal deaths | | Indirect maternal deaths | | Unclassifiable | |
|---|---|---|---|---|---|---|---|---|
| | n=94 | | n=32 | | n=56 | | n=6 | |
| | n | % | n | % | n | % | n | % |
| **Barriers to access and/or engagement with care** | **38** | **40.4** | **8** | **25.0** | **30** | **53.6** | **-** | **-** |
| No antenatal care | 5 | | 1 | | 4 | | - | |
| Infrequent care or late booking | 9 | | 4 | | 5 | | - | |
| Declined treatment or advice | 13 | | 3 | | 10 | | - | |
| Obesity impacted on delivery of optimal care (eg, USS) | 4 | | 2 | | 2 | | - | |
| Substance use | 9 | | - | | 9 | | - | |
| Family violence | 7 | | 1 | | 6 | | - | |
| Lack of recognition of complexity or seriousness of condition by the woman and/or family | 17 | | 3 | | 14 | | - | |
| Maternal mental illness | 8 | | - | | 8 | | - | |
| Cultural barriers | 1 | | - | | 1 | | - | |
| Language barriers | 2 | | - | | 2 | | - | |
| Not eligible to access free care | 1 | | - | | 1 | | - | |
| Environment (eg, isolated, long transfer, weather prevented transport) | 2 | | 1 | | 1 | | - | |
| Other | 6 | | - | | 6 | | - | |

USS = ultrasound scan.

# 2.5 Review of amniotic fluid embolism 2006–2013

## Background

Amniotic fluid embolism (AFE) is an unpredictable, rare, and often rapidly fatal complication of pregnancy where amniotic fluid or fetal cells enter the maternal circulation and cause an allergic-type reaction. This usually occurs around the time of birth.

### Justification for review

The ninth report of the PMMRC (PMMRC 2015) reported 12 AFE deaths and a cause specific maternal mortality ratio for AFE in New Zealand for 2006–2013 of 2.37/100,000 maternities (95% CI 1.23–4.14), 5.6 times that reported in the UK ($p<0.0001$).

The potential explanations for this 5.6-fold discrepancy in mortality are that (1) AFE is over-diagnosed in New Zealand; (2) there are higher rates of risk factors for AFE such as induction of labour and caesarean section in New Zealand; or that (3) there is potential for improvement in the management of AFE in New Zealand to reduce the case fatality rate.

### International comparisons

A review of incidence and mortality in the UK, Netherlands, USA, Canada and Australia (Knight et al 2012) showed that incidence varied by data collection methodology, but mortality ratios did not. Incidence rates varied from 1.9/100,000 maternities in the UK to 6.1/100,000 in Australia. Mortality ratios varied from 0.4/100,000 live births in the Netherlands 1993–2005 to 1.3 in the USA from 1997–2005. In New Zealand the mortality ratio was 2.37/100,000 maternities (95% CI 1.23–4.14) for 2006–2013. Although this is a later time period, these data would suggest that the AFE mortality ratio in New Zealand is significantly higher than in most other first world countries.

Risk factors for AFE identified from the 2012 review by Knight et al and reported across most countries include maternal age, placenta praevia or abruption, induction of labour, and caesarean section or operative vaginal modes of birth.

The caesarean section rate in New Zealand in 2014 was 25.9 percent compared to 26.2 percent for 2013–2014 in the UK, and the induction rate in New Zealand was 24.4 percent compared to 25.0 percent in the UK. The similarity in these rates does not support a higher rate of risk factors for AFE as an explanation for the higher rate in New Zealand compared to the UK.

## Review of cases 2006–2013

### Methodology

Cases included 13 maternal deaths (nine from 2006 to 2009 and four from 2010 to 2013) where AFE was diagnosed, and eight non-fatal cases reported to the Australasian Maternity Outcomes Surveillance System (AMOSS) from 2010 to 2013. Table 2.1 reports 12 deaths attributed to AFE; however, this further review includes an additional case where the MMRWG attributed the main cause of death as postpartum haemorrhage with inadequate resuscitation rather than AFE.

The hypotheses addressed in the review included the following:

- AFE is over-diagnosed in New Zealand.
- The management of AFE in New Zealand is associated with a high case fatality rate due to delayed recognition or suboptimal resuscitation.

A sub-group of the MMRWG extracted data from each case individually using the original case records. The specific UK Obstetric Surveillance System (UKOSS)/AMOSS case definition, as outlined in the text box below, was used. Each sub-group member reviewed specific cases prior to meeting. Cases where there were concerns related to the validity of the diagnosis were discussed by the whole group to determine if they fit the diagnostic criteria.

#### Diagnostic criteria for amniotic fluid embolism

EITHER

a) A clinical diagnosis of AFE (acute hypotension or cardiac arrest, acute hypoxia (including respiratory distress, chest tightness and restlessness) and coagulopathy in the absence of any other potential explanation for the symptoms and signs observed)

AND/OR

b) A pathological/post-mortem diagnosis (presence of fetal squames/debris in the pulmonary circulation).

## Findings

The review found that these diagnostic criteria were met in all 13 fatal cases, but that these diagnostic criteria were not reached in three of the eight cases where women did not die (morbidity cases). The diagnosis was supported by the pathological finding of fetal squames or hair in the lungs at post-mortem in eight of the 11 (73 percent) deaths where a post-mortem was performed. Of the fatal cases that did not have post-mortem confirmation, all had cardiac arrest as part of their presentation, and all but one had coagulopathy. This last case had a raised tryptase.

Removing the three morbidity cases where the diagnostic criteria were not reached from the time period 2010–2013 reduces the New Zealand incidence of AFE to 3.6/100,000 maternities (9/250,192) (95% CI 1.6–6.8), and increases the case-fatality rate to 44 percent (4/9) during the same time period. The incidence rate is difficult to compare as discussed above, and the case fatality rate is at the upper end of the range reported (19–43 percent) (Knight et al 2012).

The findings presented here pertain to the 18 cases (13 mortality and 5 morbidity) confirmed on further review.

### *Presentation of AFE*

The median age of women at presentation was 33 years and the median parity was two. Ten of the 18 cases had labour induced: seven with prostaglandin and four with syntocinon. No spontaneous labour was augmented with syntocinon. Membranes were artificially ruptured in eight cases. No cases of placenta praevia were reported in this cohort.

There were eight caesarean births, four of which were perimortem. Of the four caesarean sections that were not performed as part of resuscitation, AFE appeared to occur after commencement of surgery but prior to birth in two cases and after birth in two cases. There were 10 spontaneous vaginal births.

Seven of the 18 women presented with symptoms of AFE in the first stage of labour or at the time of birth, and in the remaining 11 cases symptoms developed after birth.

The median number of presenting features of AFE was 4.5 (range 1–8). In the UKOSS review, the median number of features of AFE that women presented with was 4 (range 1–9).

Cardiac arrest occurred in 12 of the 13 fatal cases (92 percent) and was the first presenting sign in two cases (15 percent). Cardiac arrest did not occur in any non-fatal case. Time at cardiac arrest was available for 10 of 12 cases. Arrest occurred within two minutes of onset of symptoms in three cases, within 36 minutes in a further two cases, and from 1 hour and 10 minutes to 4 hours and 21 minutes in the remaining five cases. In the UK series, 87 percent of those who died presented with cardiac arrest (compared to 36 percent of those who survived); cardiac arrest was the first recognised event in 26 percent of women who died compared to 5 percent of women who survived.

Acute fetal compromise occurred in five cases, and was the presenting feature in three cases. Coagulopathy was evident in 14 cases, but was not the first sign in any case. Maternal hypotension was reported in 13 cases and was the presenting sign in two cases, one fatal and one non-fatal. Maternal haemorrhage occurred in 15 cases and was the presenting sign in three cases. None of these symptoms was associated with fatality or survival.

Premonitory symptoms, such as restlessness, numbness, agitation and tingling, occurred in 11 cases and were recognised as the first sign in two cases. Five women who died had premonitory symptoms which were not recognised as being due to AFE before another event occurred: seizure (1), acute fetal compromise (2), hypotension (1), haemorrhage (1). Of the deaths that did not have premonitory symptoms, one presented with shortness of breath, one with a seizure and two with cardiac arrest.

Five women had seizures and this was the first presenting sign for two women, both of whom died.

### *Management*

Of the 12 cases where there was data on the time between first symptom and AFE first being considered, the median time was 27 minutes (range 0–145 minutes). This is consistent with 33 minutes (zero minutes to two days) in the UKOSS data.

All five surviving AFE cases occurred in level 3 maternity units. Of the 13 AFE-related deaths, six occurred in level 3 units, five in level 2, one in a birthing unit, and one at home (Fisher's Exact p=0.10 for survival given birth in a level 3 unit compared to all other places of birth).

Perimortem caesarean section was performed in four cases, at 4, 14, 14, and 84 minutes after the AFE was considered to have occurred.

Five women had a hysterectomy (28 percent), and these women all died. This is consistent with the UKOSS data. In the UK series, 26 percent of women had a hysterectomy; 40 percent of those who died or had permanent neurological damage and 21 percent of those without a severe outcome.

Among the AFE deaths in New Zealand, women who received cryoprecipitate (n=6) died a median of 38 hours and 9 minutes after the AFE occurred whereas women who did not receive cryoprecipitate (n=7) died a median of 99 minutes after first signs of AFE. All five women who survived received cryoprecipitate but it was given to only 46 percent of the women who died (6 of 13 women) in the New Zealand series (Fisher's Exact test p=0.10). These data are consistent with UKOSS data that found women who died or had permanent neurological damage were less likely to have received cryoprecipitate.

The UKOSS study also found that women who didn't get cryoprecipitate died earlier than those who did, however this might be due to insufficient time, given the severity of the maternal condition, to administer cryoprecipitate.

Recombinant factor VIIa was given to three women with AFE who died and in one woman who survived. All survivors received platelets and fresh frozen plasma compared with nine of the 13 deaths. Only one death and one survivor received fibrinogen.

In New Zealand median time from AFE presentation to death was 3 hours 22 minutes (range 4 minutes to 23 days). Nine women died within 5.1 hours of presentation and the remaining four women died after 1 day. In the UK, median time from first presentation of AFE to death was 1 hour and 42 minutes.

### *Adequacy of resuscitation*

At review, ongoing resuscitation was thought to be suboptimal in five of the 13 fatal cases (38 percent) and 20 percent (1 in 5) of non-fatal cases. Issues noted included delayed transfer to an area of appropriate acuity associated with delayed onset of treatment, inadequate transfusion in two cases (needed products consistent with the Massive Transfusion Protocol), inadequate fluid management, and non-standard response to cardiac arrest (delay in cardiopulmonary resuscitation).

## Implication of findings

New Zealand has a comparatively high rate of maternal mortality due to AFE, and the case fatality rate is also high. However, the actual number of cases, fatal and non-fatal, is small. While some comparison is possible with the UKOSS AFE cases, the limited numbers mean that it is hard to draw definitive conclusions, but some issues have been raised by this retrospective review.

AFE incidence appears to have been over-estimated during the collection of data for the AMOSS project, and this is consistent with previous reports of difficulties with different methods of case ascertainment (Knight et al 2012). However AFE mortality ratios do not appear to be affected by case ascertainment methodologies, and this is consistent with the confirmation of all fatal cases of AFE in this New Zealand review.

The case fatality rate in New Zealand is high compared to the UK (44 percent compared to 19 percent). However, the numbers are small and the difference is not statistically significant.

Of note, there were no survivors in the group of women with AFE in New Zealand who presented with cardiac arrest. This may reflect the severity of cases of AFE in this cohort but could also be due to suboptimal resuscitation.

The median time from first symptoms or signs of AFE to death in New Zealand was 3 hours and 22 minutes compared to 1 hour and 42 minutes in the UK. This may not be a significant difference but suggests that the cases dying in New Zealand are less severe rather than more severe at presentation. This interpretation assumes that death is less often avoidable from the acute anaphylactoid response to AFE, but possibly remediable from the severe coagulopathy which then unfolds.

Specific issues raised around resuscitation included transfer to an appropriate area for intensive management, early institution of appropriate blood replacement using a massive transfusion protocol, and following standard resuscitation protocols for cardiac arrest.

## Summary

The maternal mortality ratio from AFE in New Zealand is 5.6 times higher than in the UK. Retrospective review of the data does not support the hypothesis that AFE is over-diagnosed in New Zealand. Further, the comparability of induction and caesarean section rates between New Zealand and the UK does not support the hypothesis that higher rates of these risk factors leads to a higher incidence of AFE.

In addition, the review does not provide any evidence to suggest that fatal cases were more severe in New Zealand than in the UK series.

The data suggest that resuscitation could have been improved in some cases. All clinicians involved in maternity care need to be able to recognise the possibility of AFE early in its presentation and need to be able to respond with timely and effective resuscitation.

In its fifth report (PMMRC 2011) the PMMRC recommended that all clinicians involved in the care of pregnant women should undertake regular multidisciplinary training in management of obstetric emergencies. Consideration should be given to making this training mandatory.

## PRACTICE POINT: AMNIOTIC FLUID EMBOLISM

### Diagnosis

Consider AFE in the differential diagnosis when women present with acute behavioural changes such as sudden anxiety, agitation (eg, removing IV lines, oxygen masks, aggression) and dyspnoea in labour or immediately postpartum (within 30 minutes).

Any of the following that occur during labour, caesarean birth, dilation and evacuation or within 30 minutes postpartum without other explanation should alert the practitioner to the possibility of AFE (Thongrong et al 2013):

- acute hypotension
- cardiac arrest
- acute hypoxaemia or respiratory distress
- severe haemorrhage or coagulopathy.

**Common signs and symptoms** (adapted from Thongrong et al 2013)

| System | Signs and symptoms |
|---|---|
| General – prodromal | Tingling, numbness, lightheaded, chest pain, vomiting, cough |
| Respiratory | Dyspnoea, bronchospasm, pulmonary oedema, acute respiratory distress |
| Cardiovascular | Cyanosis, hypotension, transient hypertension, chest pain, cardiopulmonary arrest |
| Neurological | Seizures, headache, loss of consciousness |
| Haematological | Coagulopathy, disseminated intravascular coagulation |
| Fetus | Fetal bradycardia |

### Management

A combination of early recognition with early and aggressive resuscitation is essential to achieve favourable outcomes for mothers and babies (RCOG 2011).

If you have any concern regarding the possible diagnosis of AFE:

- If in a primary birthing setting and there is any indication/symptom of AFE, arrange urgent transfer to secondary/tertiary care as a life threatening condition.
- Involve senior obstetric, anaesthetic, intensive, midwifery and neonatal staff early.

If maternal collapse occurs:

- Commence/continue cardiopulmonary resuscitation (CPR) if there is evidence of cardiac arrest or circulatory insufficiency such as profound hypotension, loss of consciousness or absence of a palpable pulse.
- Instigate Left Uterine Displacement (LUD) in women with a palpable uterus. This is ideally done manually but can be done with left tilt if there is inadequate staffing to allow manual displacement. Ensure CPR is performed on a firm surface.
- Perimortem caesarean section needs to be considered at the commencement of CPR, and if there is no return of circulation, aim for delivery within five minutes. (See 'Practice Point: Perimortem Caesarean Section' in the ninth report of the PMMRC: http://www.hqsc.govt.nz/assets/PMMRC/Publications/PMMRC_Ninth_Report_Practice_Points.pdf )
- Initiate the massive transfusion protocol, including the use of cryoprecipitate.
- Lifesaving interventions such as defibrillation and medication should not be withheld in the setting of pregnancy.

**All clinicians involved in the care of pregnant women should undertake regular multidisciplinary training in management of obstetric emergencies (previous PMMRC recommendation).**

# 2.6 Review of maternal suicide deaths 2006–2013

## Background

### Justification for review

The ninth report of the PMMRC (PMMRC 2015) reported a cause specific maternal mortality ratio for suicide in New Zealand that was 7.5 times that reported in the UK ($p<0.0001$).

There were 22 maternal deaths from suicide from 2006 to 2013. The suicide specific maternal mortality ratio in New Zealand for the eight years from 2006 to 2013 is 4.3/100,000 maternities.

### Previous PMMRC review of maternal suicide

The sixth report of the PMMRC (PMMRC 2012) reviewed maternal suicide as it was noted to be the leading cause of maternal death at that time.

### Health Quality & Safety Commission survey of LMCs 2010–2011 (PMMRC 2012)

The results of a maternal mental health survey of LMCs undertaken by the Health Quality & Safety Commission in 2010–2011 on behalf of the PMMRC were also reported in the sixth report of the PMMRC.

There were 398 respondents, which was 40 percent of those contacted. The respondents were midwives (89.6 percent), obstetricians (9.3 percent) and paediatricians (1.1 percent).

Three-quarters of respondents routinely screened pregnant women for depression using specific questions, and 61 percent said there was a specific referral pathway for women identified as being at risk of developing mental health problems during or after pregnancy. Only 46 percent felt completely comfortable asking women about their mental health history, and 84 percent felt they would benefit from more training. At the time, 32 percent of respondents felt that services for maternal mental health were overwhelmed, poorly coordinated or insufficient.

### International comparisons

As noted previously, international comparisons of maternal mortality are difficult because of uncertainty around case ascertainment and differences in classification methods. 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 mortality ratios (Figure 2.4).

Nine of the 21 New Zealand suicide deaths (43 percent) noted in the ninth report of the PMMRC were reported by either the Mortality Collection or by pathologists, compared to reporting of 10 percent of other causes of maternal mortality (which are reported almost entirely by DHB local coordinators or clinicians). This would suggest that suicide ascertainment may not occur in the same way as ascertainment of other causes of maternal mortality and so may be undercounted in some countries.

#### *United Kingdom*

The UK's most recent maternal mortality report details deaths for the triennium 2011 to 2013 and lessons learned from deaths 2009–2013 (Knight et al 2015). There were 19 deaths in the 2011–13 triennium from psychiatric causes, a ratio of 0.80/100,000 (CI 0.48–1.25). Deaths from psychiatric causes represent the fifth most common individual cause of maternal death in the UK during or up to six weeks after the end of pregnancy.

The UK also reported on late maternal deaths (deaths occurring more than six weeks and up to one year after the end of pregnancy). This report noted that deaths from psychiatric causes in the UK make a significant contribution to late maternal deaths, making up almost a quarter of late maternal deaths, which suggests that the first year postpartum poses a greater risk than the antepartum period in the UK. One hundred and one women died by suicide and 58 women died as a consequence of substance use either during pregnancy or up to one year after the end of pregnancy in the UK between 2009 and 2013. A further two women died from other mental health related causes, making a total of 161 women who died from mental health related causes during or up to one year after the end of pregnancy. There was no evidence of higher risk among teen mothers or mothers of black or other minority ethnic groups, but an apparent increase in risk among women in higher socioeconomic deprivation groups. Domestic abuse was noted to have 'ever' occurred in 17 percent of cases, and 24 percent of the women were known to social services.

Of the 101 deaths from suicide; 57 percent had a diagnosis of recurrent mental health disorder (ie, mental health history), 82 percent died by violent means (most often hanging), 14 women had comorbid substance use (usually polysubstance use, rarely alcohol alone). Fifty-one percent of suicide deaths were noted to be potentially avoidable ('improvements to care were noted which would have made a difference to the outcome'), and a further 18 percent had contributory factors only ('improvements to care were noted which would not have made a difference to outcome'). However, there were insufficient records to classify quality of care in 19 percent of cases.

### *Australia*

It is difficult to make comparisons with Australian maternal (suicide) deaths due to Australia's limited maternal mortality review process, likely incomplete case ascertainment and differences in approach to categorisation of deaths.

Australia's most recent maternal mortality report covers deaths from 2006 to 2010 (Johnson et al 2014). Out of the 99 reported maternal deaths, 13 were from 'psychosocial morbidity'. Nine of these deaths were by suicide, and the other four by homicide (2) and overdose (2). The maternal mortality ratio for deaths from psychosocial morbidity was 0.9/100,000 maternities. Maternal deaths from psychosocial morbidity were the second leading cause of indirect maternal deaths in this reporting period.

Eight (62 percent) of these deaths occurred antenatally. A previous psychiatric history was noted for eight women (62 percent) with four (31 percent) having contact with a psychiatric service perinatally.

## New Zealand initiatives

In the last few years there have been a number of national initiatives aiming to improve the mental health care of women in pregnancy and the postpartum period.

The Healthy Beginnings report (Ministry of Health 2012b) provided guidance to DHBs, planners, funders and providers of mental health services, and alcohol or other drug services around meeting the needs of the mothers and babies in their services. The report highlighted a number of issues; for example, under-provision of services for mothers with alcohol or other drug problems, a need for services to be flexible and adaptable for the group they are serving, for clinicians to be appropriately skilled, and, at the time, the lack of mother and baby mental health beds in the North Island.

Following on from Healthy Beginnings, new funding was made available to the Northern region of the North Island to expand the continuum of acute mental health services available for mothers and babies. This has led to the establishment of three mother and baby beds at Starship Hospital in Central Auckland, and is proving a valuable resource in the treatment of acutely unwell mothers with their babies. There also has been development and extension of services across the continuum of care, including increased resourcing of community mental health perinatal services, and extension of respite and non-governmental organisation services. This includes 24-hour perinatal phone advice for general mental health services dealing with acute presentations of mothers.

The importance of having clearly defined pathways of care has previously been identified, with a significant proportion of LMCs reporting feeling confused about where to refer mothers who were mentally unwell (PMMRC 2012). Anecdotally, it is still likely that maternal mental health services throughout New Zealand operate with different models of care and referral processes. Pathways for maternal mental health care have been a focus of the work plan of the National Maternity Monitoring Group (NMMG) in New Zealand (NMMG 2013). The NMMG was established by the Director General of Health in 2012 to provide oversight of the New Zealand maternity system.

DHBs have been asked to report to the NMMG specifying their pathways of care – this is a work in progress but should ultimately lead to clear, consistent and easily accessible pathways of care.

Midwives attend a mandatory Practice Day once every three years as part of the Midwifery Council's Recertification Programme, along with other compulsory and elective education activities. One of the key topics included within the current Practice Day (for the current three-year recertification cycle (2014–2017)) is maternal mental health. The focus of this education has been on the midwifery role of screening, identifying and referring women with mental health concerns. The feedback from midwives attending these workshops has identified an interest in ongoing access to more in-depth education on maternal mental health.

There are a range of other maternal mental health ongoing education programmes available throughout New Zealand. However, the accessibility and content of these programmes vary. A funded, nationally consistent approach is desirable, similar to the education provided for smoking cessation and family violence.

An important initiative in the area of suicide review has been the establishment of the Suicide Mortality Review Committee in 2014. The group has been set up for a time-limited trial period with the goals of providing additional information about trends in suicide deaths, identification of intervention points, and to consider how a more permanent suicide group would function and operate.

The importance and ongoing need for New Zealand initiatives has been underlined by the findings of this current report – that is, maternal suicide remains a leading cause of death, and our national rate is much higher than the UK.

## Maternal suicide deaths 2006–2013 (n=22)

During the years 2006–2013, 22 women in New Zealand died during or within six weeks of pregnancy of suicide. For 13 women the suicide occurred in pregnancy, six before 20 weeks and seven between 20 weeks and term. Two deaths occurred after term births, five after termination of pregnancy, and two following miscarriage.

Approximately two-thirds of the 22 suicides were deaths due to hanging. This is consistent with suicide among young people outside of pregnancy. Hanging, strangulation and suffocation collectively were the predominant method used for suicide by both males and females in all life-stage age groups in New Zealand in 2012. Poisonings generally increased with age, particularly for female suicides, to nearly the same proportion as hanging, strangulation and suffocation (Ministry of Health 2015c).

National review of cases by the maternal working group found that there were contributory factors to 14 (64 percent) deaths. There were barriers to access and/or engagement with care in 13 cases (59 percent) and organisation and management and personnel factors in eight cases (36 percent). Lack of policies, protocols or guidelines and inadequate systems for sharing of clinical information between services were noted to be contributory factors in four and three post-termination suicides respectively.

Seven cases (32 percent) were assessed as potentially avoidable.

Table 2.6: Maternal suicide deaths and demographic characteristics 2006–2013

| | Total births 2006–2013 n=505,990 | | Maternal deaths suicide n=22 | | | |
|---|---|---|---|---|---|---|
| | n | % | n | % | ratio | 95% CI |
| **Ethnicity (prioritised)** | | | | | | |
| Māori | 116,606 | 23.05 | 12 | 55 | 10.3 | 5.9–18.0 |
| Pacific | 53,335 | 10.54 | 2 | 9 | 3.7 | 1.0–13.7 |
| Indian | 18,390 | 3.63 | | | * | |
| Other Asian | 39,304 | 7.77 | 1 | 5 | * | |
| Other (including unknown) | 45,309 | 8.95 | | | * | |
| New Zealand European | 233,046 | 46.06 | 7 | 32 | 3 | 1.5–6.2 |
| **Deprivation quintile** | | | | | | |
| 1 (least deprived) | 80,545 | 15.92 | 3 | 14 | 3.7 | 1.3–11.0 |
| 2 | 89,266 | 17.64 | 2 | 9 | 2.2 | 0.6–8.2 |
| 3 | 95,574 | 18.89 | 4 | 18 | 4.2 | 1.6–10.8 |
| 4 | 105,390 | 20.83 | 3 | 14 | 2.8 | 1.0–8.4 |
| 5 (most deprived) | 132,384 | 26.16 | 10 | 45 | 7.6 | 4.1–13.9 |
| Unknown | 2,831 | 0.56 | | | | |
| **Age (years)** | | | | | | |
| <20 | 35,769 | 7.07 | 6 | 27 | 16.8 | 7.7–36.6 |
| 20–24 | 92,282 | 18.24 | 4 | 18 | 4.3 | 1.7–11.1 |
| 25–29 | 125,511 | 24.81 | 6 | 27 | 4.8 | 2.2–10.4 |
| 30–34 | 143,005 | 28.26 | 3 | 14 | 2.1 | 0.7–6.2 |
| 35–39 | 89,213 | 17.63 | 2 | 9 | 2.2 | 0.6–8.2 |
| ≥40 | 20,205 | 3.99 | 1 | 5 | * | |
| **Parity#** | n=55,863 (MAT 2014) | | | | | |
| 0 | 22,164 | 39.7 | 11 | 50 | | |
| 1–3 | 30,966 | 55.4 | 8 | 36 | | |
| 4+ | 2733 | 4.9 | 2 | 9 | | |
| Unknown | | | 1 | 5 | | |

* * not estimated where n≤1
# Defined prior to conception of the index pregnancy.

Maternal death by suicide was more common among Māori mothers and young mothers (<20 years old), and increased with increasing socioeconomic deprivation, but none of these trends was statistically significant.

Table 2.7: Maternal suicide deaths, psychiatric history, family violence history, and history of alcohol and other substance use 2006–2013

| | Maternal deaths n=22 | |
|---|---|---|
| | n | % |
| **Psychiatric history** | | |
| 'Prior' psychiatric history | 14 | 64 |
| Psychiatric history in previous pregnancy | 4 | 18 |
| New psychiatric illness diagnosed this pregnancy | 2 | 9 |
| New psychiatric illness diagnosed postnatally | 2 | 9 |
| Received psychiatric care during pregnancy | 6 | 27 |
| Deliberate self-harm before pregnancy | 8 | 36 |
| Deliberate self-harm during pregnancy | 5 | 23 |
| Family psychiatric history | 9 | 41 |
| **Alcohol and other substance use** | | |
| Yes | 11 | 50 |
| No | 9 | 41 |
| Unknown | 2 | 9 |
| **Substance use** (more than one selected) | | |
| Alcohol | 10 | 45 |
| Amphetamine/P | 3 | 14 |
| Marijuana | 4 | 18 |
| **Family violence in this pregnancy** | | |
| Yes | 5 | 23 |
| No | 10 | 45 |
| Not asked | 2 | 9 |
| Unknown | 5 | 23 |
| **Family violence ever** | | |
| Yes | 8 | 36 |
| No | 1 | 5 |
| Unknown | 5 | 23 |
| Missing | 7 | 32 |
| **Current smoker** | | |
| Yes | 11 | 50 |
| No | 9 | 41 |
| Unknown | 2 | 9 |

Data were not available for all maternities to provide a comparison for suicides in Table 2.7, but it is evident that women who die by suicide in and soon after pregnancy are vulnerable, with high rates of substance use (50 percent), high rates of smoking (50 percent), and high rates of exposure to family violence both before the index pregnancy (36 percent) and in the index pregnancy (23 percent). Numbers are small and the differences are not statistically significant, but these characteristics tended to occur less commonly among women who died by suicide later in pregnancy (20 weeks to term) (p=0.08 for all associations).

## Review of cases

This section describes the findings of a review of reports from the initial contemporaneous independent review of the 22 cases of suicide from 2006 to 2013 by the MMRWG. This review was undertaken by a subgroup of the MMRWG with each case reviewed by two members of the subgroup. The findings of each team were discussed and consensus of opinion was reached on important themes raised. The suicides were grouped as follows for the purposes of this review:

- antenatal (suicides in pregnancy and prior to 20 weeks gestation (6) and suicides in pregnancy from 20 weeks but prior to birth (7))
- postnatal (suicides after termination of pregnancy (5), suicides after miscarriage (2), and suicides after live births (2)).

### *Antenatal suicides in pregnancy and prior to 20 weeks gestation*

There were six deaths from suicide early in pregnancy. These occurred between 3 and 15 weeks, three between 3 and 6 weeks. Of these women, three were in their teens. Four were of Māori and two of Pacific ethnicity.

Four of these women had a past history of mental illness, including postnatal depression, prior suicide attempts or self-harm; three had a history of alcohol or other substance use; and three had a history of family violence. It was common for women to have two or three of these risk factors. Five of these six women had relationship difficulties at the time of their suicide.

These women did not readily access services, only three having consulted with primary care (general practice) in this pregnancy.

It was often difficult to identify where to request health care provider information to conduct the death review.

### *Antenatal suicides from 20 weeks but prior to birth*

There were seven deaths among pregnant women from 20 weeks gestation. These women had some differences from the other groups of maternal deaths from suicide. They were less often Māori ($p<0.01$), and none were teenagers ($p=0.05$). They were also less often smokers, alcohol or other substance users or exposed to family violence, although these differences were not statistically significant ($p=0.08$). All of these women were living in areas where specialist perinatal services were available.

#### Women with pre-existing illness

Four women had pre-existing significant mental health history of severe/significant and complex disease. Although they may have been well or stable prior to pregnancy (not in every case), in all cases the pregnancy seemed to be a catalyst for a deterioration in mental wellbeing.

All four were under the care of specialist mental health services during the pregnancy, and at the point of suicide. Maternal mental health services were involved or had been referred to in three cases. Interfaces between services were an issue for two women with barriers between the public and private sector, maternal mental health and general adult mental health.

Admission could have been considered in two cases and may have helped with diagnostic clarification/risk management. It should be noted that in New Zealand, admission during pregnancy is usually to an adult general mental health in-patient unit (rather than a Mother and Baby unit) and this may impact on the decision to admit.

Overall, these women's clinical presentation seemed to be complicated/fluctuant. There was often frequent contact with mental health services and a changing clinical picture in some (which may have falsely reassured clinicians), with an unclear diagnosis.

In one case maternal mental health was not involved and had not been referred to. All pregnant or breastfeeding women with serious mental illness should have at least a consultation with maternal mental health. We also note that maternal mental health services often interface with other services such as general adult services, and thus good communication and information sharing is paramount. It is also noted that maternal mental health services often operate with different models of care, which may make referral processes and information sharing more difficult.

#### Women without pre-existing illness

For the three women without a significant mental health history, the limited information available suggested relationship stress was a significant factor. Of note, information on family violence and family psychiatric history did not appear to have been collected in all cases.

### General themes relevant to all cases from 20 weeks but prior to birth

Information sharing between various services was a theme in three cases, in relation to mental health history, and when a number of agencies or services were involved, not all providers had access to all of the relevant information.

It was difficult to assess the quality of confiding/supportive relationships from the information that was available, although in general these women seemed to be lacking in social support. Relationship stress of some sort, either currently or previously seemed to be a clear theme in almost every case, including the women with significant history. This highlights the importance of examining suicides in their full social context to inform on potential improvements in service provision, including public education.

Disconnection from the pregnancy or unborn baby was also a theme that was noted in two of the cases.

In summary, the women who died from suicide in pregnancy from 20 weeks were older, more likely to have severe and complex mental illness, and often had major relationship stress and problems with their primary support system. Disconnection from the pregnancy was noted in two cases, and may have been a 'red flag'.

### *Postnatal deaths after live births (2)*

Only two of the 22 deaths from suicide were following term birth. Both were of Māori ethnicity. Alcohol or drug use and family violence were present. Both women were in their mid-twenties, had a history of mental health illness, and issues with access and/or health service engagement were identified.

### *Postnatal deaths after termination of pregnancy (5)*

Five of the 22 maternal deaths by suicide that occurred between 2006 and 2013 followed termination of pregnancy. These women were aged 25 years or under and three were in their teens. Four women identified as Māori. These are high rates of young and Māori women among deaths by suicide after termination of pregnancy, but given the small sample size it is not possible to say whether this is a significant feature or whether it differs from all women undergoing early termination of pregnancy.

The risks identified in review of these cases included young age, drug and alcohol use, history of sexual assault, current mental health illness and dysfunctional relationships. All of the women who committed suicide following termination had three or four of these factors identified.

Multiple services were involved in the care of these women during pregnancy and leading up to their death (2–5 services) including primary care, mental health, drug and alcohol, termination of pregnancy, maternity, and Child, Youth and Family services. The full extent of women's mental health history was not known by all services because of a lack of communication. Further, the accumulation of risk factors was not identified by any one service.

### *Postnatal deaths after miscarriage (2)*

Two suicides followed first trimester miscarriage. One of these women had a history of mental health illness. There was no evidence of either woman receiving pregnancy loss counselling.

## Summary

The Healthy Beginnings report (Ministry of Health 2012b) provided guidance around meeting the mental health needs of mothers and babies. Following this, new funding resulted in the provision of three mother–baby unit beds in Auckland, and development and extension of services across the continuum of care.

However, there remains a lack of clearly defined pathways for many DHBs. The NMMG has taken some leadership in this area. There is an impression that LMCs still feel unsupported in the provision of maternal mental health support.

A review of the 22 maternal deaths by suicide between 2006 and 2013 produced the following findings:

- Thirteen maternal deaths by suicide occurred during the antenatal period: six before 20 weeks and seven beyond 20 weeks; two occurred after miscarriage; five occurred after termination; and two occurred after term births.
- Approximately two-thirds of the deaths were due to hanging, consistent with deaths by suicide among all young women in New Zealand.
- Maternal death by suicide was more common among Māori women and among teenagers, and the ratio increased with increasing socioeconomic deprivation, but none of these demographic trends was statistically significant.
- Two-thirds of women had a prior psychiatric history and one-third had a history of deliberate self-harm prior to pregnancy.
- Alcohol and other substance use (often polysubstance use) and smoking were common.
- A third of women had a history of family violence at some time in their lives.
- Women who died by suicide while pregnant in the first 20 weeks of pregnancy (6) often had two or three risk factors, such as a history of mental illness, a history of self-harm, alcohol and other substance use, and family violence. This was also true of women who died by suicide after termination of pregnancy (5).
- Lack of communication between services and lack of recognition of multiple risk factors, or of a crisis plan for at-risk women, was evident among women who died after termination of pregnancy.
- Women who died by suicide while pregnant in the second half of pregnancy (7) were older and less often Māori. They did not tend to have a history of alcohol or substance use or family violence. Four of these women had a history of pre-existing and often complex illness, which deteriorated in pregnancy. All were under care, although there were some communication issues between services.
- Relationship stress was a feature of almost all women who died by suicide in pregnancy.

## PRACTICE POINT: MATERNAL SUICIDE

Pregnancy and the postpartum period are not protective against mental illness, and can be a trigger for onset and for deterioration of mental illness.

Early during a woman's contact with services, ask about:

- past or present mental illness
- past or present treatment by a specialist mental health service, including in-patient care
- family history of severe mental illness, including perinatal mental illness in a first degree relative.

Women who have a history of severe mental illness should be referred to a secondary mental health service even if currently well, as their risk of relapse in the postpartum period may be high. They need an appropriate mental health birth plan and monitoring for the peripartum period.

Any of the following suggests a serious mental illness and requires urgent assessment by mental health services, including early consultant psychiatrist review and consultation with perinatal mental health services:

- suicidal ideation (especially if violent)
- psychotic symptoms
- recent significant change in mental state including fluctuating or emergence of new symptoms
- pervasive guilt or hopelessness
- ongoing beliefs of inadequacy as a mother
- a sense of estrangement or disconnection from the infant.

Women should have continuity of, and culturally appropriate, mental health care. During pregnancy and the postpartum period there may be more than one mental health team involved – in such cases there should be one identified individual who coordinates care.

All clinicians involved in a woman's care need relevant mental health history and current knowledge of a woman's pregnancy to support them to provide the best care. Routine sharing of relevant information across general practice, LMC and mental health services interfaces will enable better informed care. Any concerns regarding risk need to be clearly communicated by all clinicians involved.

Pregnant and postpartum women who use substances often have complex social and mental health needs, and face additional barriers in accessing services.

### Previous PMMRC Recommendations

1. Maternal mental health screening should be included as part of standard antenatal care, and women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if they are currently well.
2. Strategies are required to improve communication and coordination between the full range of primary maternity providers (eg, LMC, GP) and secondary providers (eg, mental health services, maternal mental health services, maternity, including termination of pregnancy services).

# 2.7 Maternal Mortality Appended Tables

## Table 2.8: Demographic characteristics among maternal deaths 2006–2014

| | Maternities | | Maternal deaths | | | | | | | | | | | Maternal mortality ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2006–2014 | | |
| | n=564,637 | | n=15 | n=11 | n=9 | n=14 | n=9 | n=9 | n=10 | n=13 | n=4 | n=94 | | /100,000 maternities |
| | n | % | n | n | n | n | n | n | n | n | n | n | % | |
| **Maternal age (years)** | | | | | | | | | | | | | | |
| <20 | 38,809 | 6.9 | - | - | 1 | 1 | 1 | 1 | 2 | - | - | 6 | 6.4 | 15.46 |
| 20–24 | 102,571 | 18.2 | 3 | 2 | - | - | - | 1 | 3 | 3 | - | 12 | 12.8 | 11.70 |
| 25–29 | 141,118 | 25.0 | 3 | 1 | 3 | 4 | 3 | 3 | 1 | 5 | 2 | 25 | 26.6 | 17.72 |
| 30–34 | 160,485 | 28.4 | 2 | 5 | 3 | 4 | 1 | 1 | 2 | 3 | - | 21 | 22.3 | 13.09 |
| 35–39 | 98,918 | 17.5 | 4 | 2 | 2 | 3 | 2 | 2 | 2 | - | 1 | 18 | 19.1 | 18.20 |
| ≥40 | 22,731 | 4.0 | 3 | 1 | - | 2 | 2 | 1 | - | 2 | 1 | 12 | 12.8 | 52.79 |
| **Ethnicity (prioritised)** | | | | | | | | | | | | | | |
| Māori | 129,548 | 22.9 | 9 | 2 | 4 | 4 | 3 | 5 | 8 | 4 | - | 39 | 41.5 | 30.10 |
| Pacific peoples | 59,213 | 10.5 | 1 | 2 | - | 6 | 3 | 3 | - | 1 | 1 | 17 | 18.1 | 28.71 |
| Indian | 21,167 | 3.7 | 1 | 1 | - | 1 | - | - | - | - | - | 3 | 3.2 | 14.17 |
| Other Asian | 45,797 | 8.1 | - | - | 2 | 1 | - | - | - | 2 | - | 5 | 5.3 | 10.92 |
| Other (including unknown) | 50,740 | 9.0 | 1 | 1 | - | - | - | - | - | - | - | 2 | 2.1 | 3.94 |
| NZ European | 258,172 | 45.7 | 3 | 5 | 3 | 2 | 3 | 1 | 2 | 6 | 3 | 28 | 29.8 | 10.85 |
| **Deprivation quintile** | | | | | | | | | | | | | | |
| 1 (least deprived) | 89,862 | 15.9 | - | 2 | 1 | 1 | 3 | - | - | 2 | - | 9 | 9.6 | 10.02 |
| 2 | 99,549 | 17.6 | - | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 9 | 9.6 | 9.04 |
| 3 | 106,940 | 18.9 | 4 | - | 1 | 4 | 1 | 1 | 2 | 3 | 1 | 17 | 18.1 | 15.90 |
| 4 | 117,652 | 20.8 | 4 | 2 | 4 | 5 | 3 | 2 | - | 2 | - | 22 | 23.4 | 18.70 |
| 5 (most deprived) | 147,525 | 26.1 | 7 | 5 | 1 | 4 | 2 | 5 | 7 | 5 | 1 | 37 | 39.4 | 25.08 |
| Unknown | 3,109 | 0.6 | - | - | - | - | - | - | - | - | - | - | - | - |

# 3 Neonatal encephalopathy 2014

## 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.

From 2016 the Neonatal Encephalopathy Working Group has widened the inclusion criteria for the neonatal encephalopathy cohort and will include cases from 35 weeks at birth in line with international literature and practice of cooling down to this age (The American College of Obstetricians and Gynecologists 2014).

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).

In this report, the MAT dataset of births in 2014 has been used to provide comparative data for some demographic and clinical characteristics; for example, smoking, BMI, parity and maternity care.

For information on data analysis methods, please refer to Perinatal Mortality 2014 section 1.2: Methodology.

## 3.2 Findings

In 2014 there were 55 cases of moderate and severe neonatal encephalopathy reported to the national dataset. This is the lowest number of cases reported since 2010 when data were first collected (82 cases in 2010, 67 in 2011, 79 in 2012, 70 in 2013). While this is encouraging, there is no statistically significant reduction in rate and the observed drop in 2014 may reflect random variation.

The neonatal encephalopathy rate for 2010–2014 was 1.14/1000 total births (95% CI 1.02–1.26), or 1.24/1000 term births (95% CI 1.11–1.37).

### International comparisons

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 (Lee et al 2013). This would suggest that at 1.14/1000 births for moderate and severe neonatal encephalopathy, New Zealand is 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 et al 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) developed mild neurodevelopment impairment.

### Demography and neonatal encephalopathy

Mothers of Māori, Pacific and Indian ethnicity are at increased risk of having a baby with neonatal encephalopathy, although only the rate in Pacific mothers is significantly higher than that of Other Asian, Other, and New Zealand European mothers. Increasing socioeconomic deprivation is also associated with increased risk of neonatal encephalopathy. There is no statistically significant association between maternal age and neonatal encephalopathy risk. Maternal Pacific ethnicity remains a predictor of neonatal encephalopathy after adjusting for gestation at birth, year of birth, deprivation quintile, multiple pregnancy and maternal age.

Figure 3.1: Neonatal encephalopathy rates (per 1000 term births) by maternal prioritised ethnicity 2010–2014

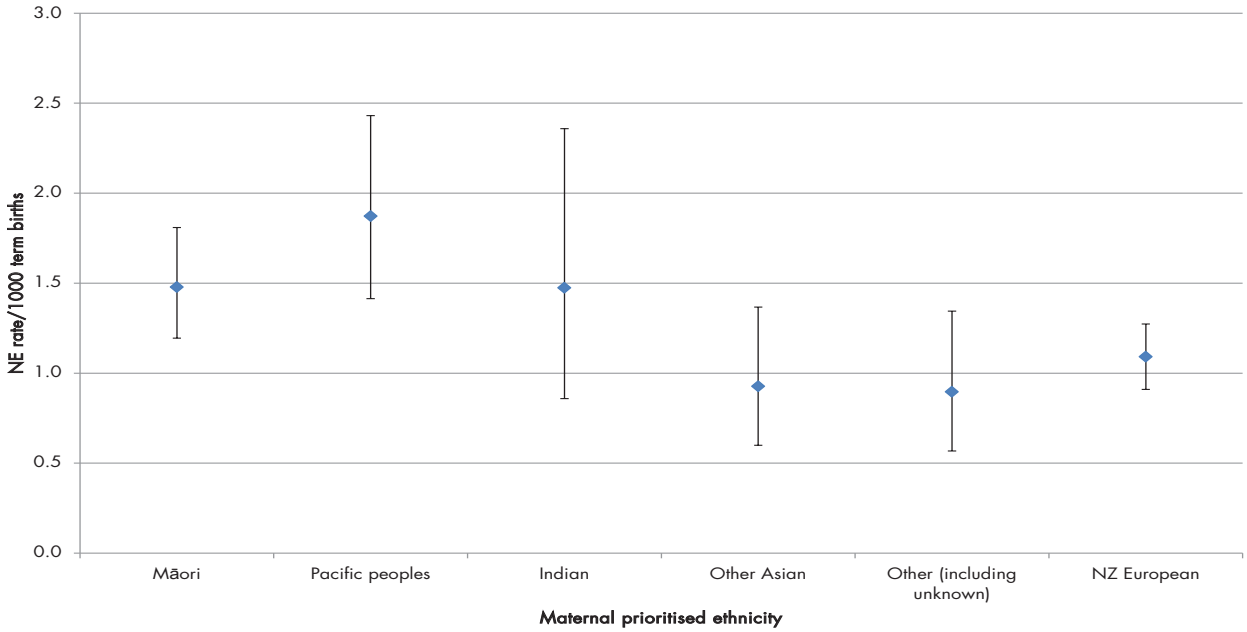
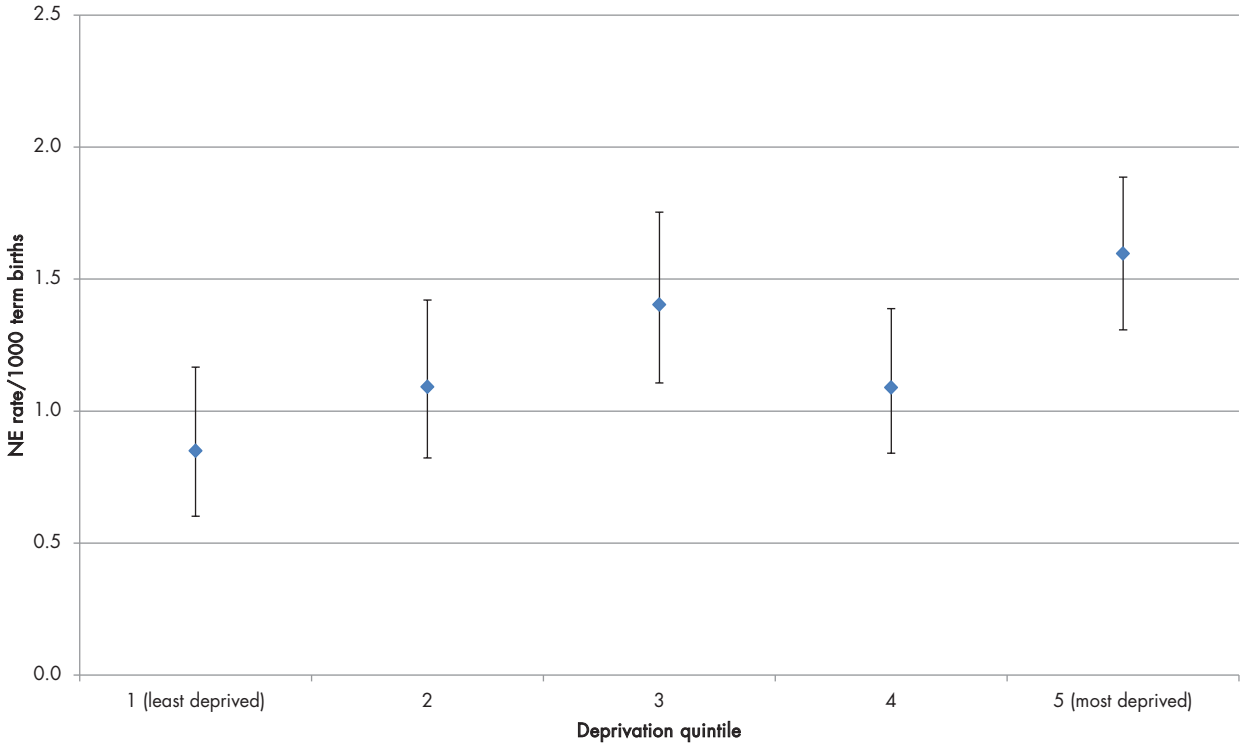
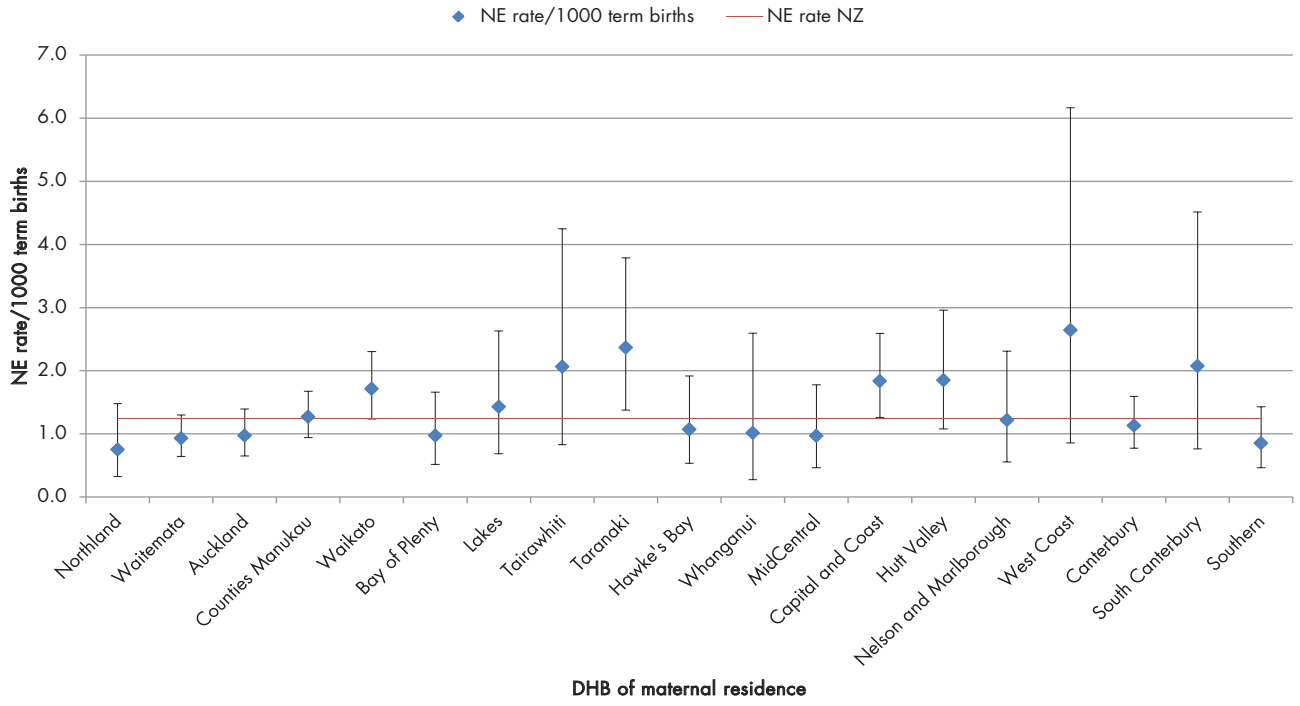



Figure 3.2: Neonatal encephalopathy rates (per 1000 term births) by deprivation quintile 2010–2014



## DHB of maternal residence

Figure 3.3: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence* (with 95% CIs) compared to New Zealand neonatal encephalopathy rate 2010-2014




* Excludes any DHB with fewer than three cases.

Figure 3.3 includes combined data for neonatal encephalopathy by DHB of maternal residence for 2010–2014.

In 2014, Taranaki DHB has become an outlier DHB with a statistically significantly higher neonatal encephalopathy rate than the national rate when cases are combined for the years 2010–2014. Capital & Coast DHB was identified as an outlier in the 9th PMMRC report (PMMRC 2015). The rate at Waikato DHB, a previous outlier, is now consistent with the national rate. Numbers of cases reported by both Capital & Coast and Waikato DHBs are lower (but not statistically significantly lower) in the years since they were first noted to be outliers.

There have been 17 cases reported among mothers resident in Taranaki DHB from 2010 to 2014, and the rate overall for these five years was 2.37/1000 term births (95% CI 1.38–3.79). There have been 32 cases reported among mothers resident in Capital & Coast DHB from 2010 to 2014, and the rate overall for these five years was 1.84/1000 term births (95%CI 1.26-2.59).

## Gestation, gender, birthweight and plurality

Table 3.1: Neonatal encephalopathy rate (per 1000 term births) by gestation, gender, birthweight and plurality 2010–2014

| | NZ registered births ≥37 weeks | | NE babies | | Rate (/1000 term births) | |
|---|---|---|---|---|---|---|
| | n=284,145 | | n=353 | | | |
| | n | % | n | % | /1000 | 95% CI |
| **Gestation at birth (weeks)** | | | | | | |
| 37 | 19,402 | 6.8 | 39 | 11.0 | 2.01 | 1.43–2.75 |
| 38 | 48,413 | 17.0 | 58 | 16.4 | 1.20 | 0.91–1.55 |
| 39 | 80,267 | 28.2 | 79 | 22.4 | 0.98 | 0.78–1.23 |
| 40 | 83,502 | 29.4 | 87 | 24.6 | 1.04 | 0.83–1.29 |
| 41 | 45,344 | 16.0 | 82 | 23.2 | 1.81 | 1.44–2.24 |
| ≥42 | 7,217 | 2.5 | 8 | 2.3 | 1.11 | 0.48–2.18 |
| **Gender** | | | | | | |
| Male | 145,348 | 51.2 | 197 | 55.8 | 1.36 | 1.17–1.54 |
| Female | 138,797 | 48.8 | 156 | 44.2 | 1.12 | 0.95–1.30 |
| **Birthweight (g)** | | | | | | |
| <2,500 | 5,488 | 1.9 | 15 | 4.2 | 2.73 | 1.53–4.51 |
| 2,500–3,999 | 232,923 | 82.0 | 291 | 82.4 | 1.25 | 1.11–1.39 |
| 4,000–4,499 | 37,781 | 13.3 | 33 | 9.3 | 0.87 | 0.60–1.23 |
| ≥4,500 | 7,859 | 2.8 | 14 | 4.0 | 1.78 | 0.97–2.99 |
| Unknown | 94 | 0.0 | - | - | - | - |
| **Plurality** | | | | | | |
| Singleton | 280,478 | 98.7 | 347 | 98.3 | 1.24 | 1.11–1.37 |
| Twins | 3,667 | 1.3 | 6 | 1.7 | 1.64 | 0.60–3.56 |

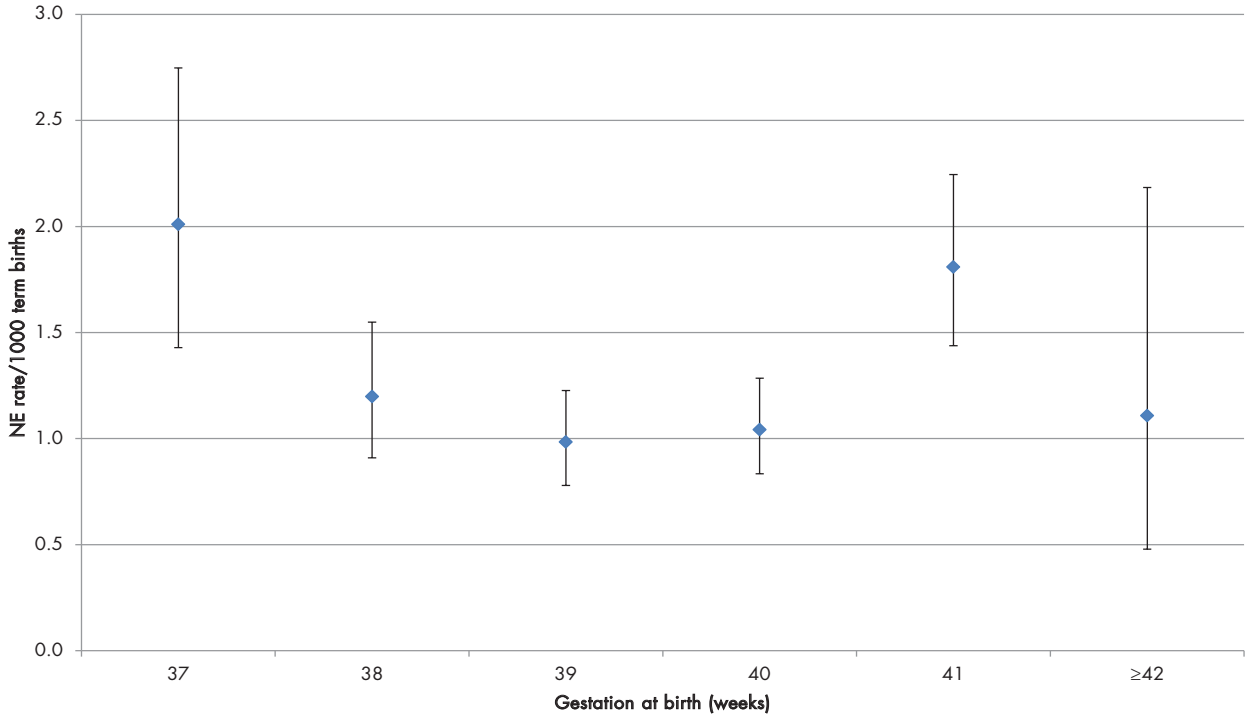
There is a significant association between gestation at birth and neonatal encephalopathy risk. There is a significantly higher rate of neonatal encephalopathy among babies born at 37 and at 41 weeks than among babies born at 38-40 weeks. The risk at 42 weeks and above is difficult to estimate as numbers are small and the CIs are necessarily wide.

There is no significant association between baby sex and neonatal encephalopathy.

Babies <2500g at term were significantly more likely to suffer neonatal encephalopathy than babies 2500–4499g.

There is no significant increase in neonatal encephalopathy among multiple births at term compared to singleton births.

Figure 3.4: Neonatal encephalopathy rates (per 1000 term births) by gestation at birth 2010–2014



## Maternal smoking, parity, BMI and gestation at first antenatal visit

Table 3.2: Maternal smoking, parity, body mass index (BMI) and gestation at first antenatal visit among neonatal encephalopathy cases 2010–2014

| | NE cases n=353 | |
|---|---|---|
| | n | % |
| **Currently smoking** | | |
| Yes | 68 | 19.3 |
| No | 281 | 79.6 |
| Unknown | 4 | 1.1 |
| **Parity*** | | |
| Primiparous (=1) | 201 | 56.9 |
| Multiparous (≥2) | 152 | 43.1 |
| **Maternal BMI (kg/m²)** | | |
| <18.50 | 2 | 0.6 |
| 18.50–24.99 | 111 | 31.4 |
| 25.00–29.99 | 107 | 30.3 |
| ≥30.00 | 110 | 31.2 |
| Missing data for height and or weight | 23 | 6.5 |
| **Gestation first antenatal visit (weeks)** | | |
| ≤13 | 207 | 58.6 |
| 14–19 | 50 | 14.2 |
| ≥20 | 50 | 14.2 |
| Unknown | 46 | 13.0 |

* Defined after birth of the index case.

Table 3.2 shows the smoking, parity, BMI and antenatal care characteristics of mothers of babies diagnosed with neonatal encephalopathy from 2010 to 2014.

The MAT dataset is still incomplete in 2014 due to incomplete data for about 5 percent of New Zealand mothers who were under DHB primary maternity care. While these missing data may alter background rates, missing data represent a small proportion of all mothers and so the MAT data likely provides the best current estimate of true national maternal averages for smoking, BMI and parity. An overview of the MAT dataset can be found in Perinatal Mortality 2014 section 1.2: Methodology.

Among all mothers birthing in New Zealand with data in the MAT dataset in 2014, 15.9 percent were smokers either at registration or at two weeks postpartum, compared to 19.3 percent of mothers of babies diagnosed with neonatal encephalopathy.

Mothers having their first birth are over-represented among mothers of babies with neonatal encephalopathy (56.9 percent) compared to 39.7 percent of all births in New Zealand in 2014.

Among mothers of babies diagnosed with neonatal encephalopathy, 31 percent had a BMI of 30 or greater compared to 24.8 percent among all mothers birthing in New Zealand in 2014, suggesting an increase in risk of neonatal encephalopathy with increased maternal BMI. This is consistent with increased risk of other adverse perinatal outcomes with increasing maternal BMI (Aune et al 2014; Cedergren 2004).

At least some of the association between BMI and neonatal encephalopathy, and smoking and neonatal encephalopathy, may be due to confounding factors such as socioeconomic status.

## Customised birthweight, antenatal complications and maternal outcome

Table 3.3: Customised birthweight, antenatal complications and maternal outcome among neonatal encephalopathy cases by Sarnat stage 2010–2014

| | NE cases | | Primiparous (=1) | | Multiparous (≥2) | | Sarnat stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Moderate | | Severe | |
| | n=353 | | n=201 | | n=152 | | n=239 | | n=114 | |
| | n | % | n | % | n | % | n | % | n | % |
| **Customised birthweight centiles** | | | | | | | | | | |
| Small for gestational age | 67 | 19.0 | 41 | 20.4 | 26 | 17.1 | 48 | 20.1 | 19 | 16.7 |
| Appropriate for gestational age | 256 | 72.5 | 148 | 73.6 | 108 | 71.1 | 167 | 69.9 | 89 | 78.1 |
| Large for gestational age | 30 | 8.5 | 12 | 6.0 | 18 | 11.8 | 24 | 10.0 | 6 | 5.3 |
| **Antenatal complications** | | | | | | | | | | |
| APH (≥20 weeks vaginal bleeding) | 36 | 10.2 | 19 | 9.5 | 17 | 11.2 | 24 | 10.0 | 12 | 10.5 |
| Hypertension | 44 | 12.5 | 29 | 14.4 | 15 | 9.9 | 34 | 14.2 | 10 | 8.8 |
| Pre-eclampsia | 5 | 1.4 | 4 | 2.0 | 1 | 0.7 | 5 | 2.1 | - | - |
| Gestational hypertension | 14 | 4.0 | 10 | 5.0 | 4 | 2.6 | 13 | 5.4 | 1 | 0.9 |
| Unspecified hypertension | 2 | 0.6 | 2 | 1.0 | - | - | 1 | 0.4 | 1 | 0.9 |
| **Maternal trauma (antenatal)*** | 6 | 1.7 | 4 | 2.0 | 2 | 1.3 | 3 | 1.3 | 3 | 2.6 |
| **Induction of labour** | 85 | 24.1 | 58 | 28.9 | 27 | 17.8 | 61 | 25.5 | 24 | 21.1 |
| **Augmentation of labour** | 130 | 36.8 | 92 | 45.8 | 38 | 25.0 | 101 | 42.3 | 29 | 25.4 |
| **Epidural anaesthesia** | 94 | 26.6 | 71 | 35.3 | 23 | 15.1 | 72 | 30.1 | 22 | 19.3 |
| **Maternal outcome** | | | | | | | | | | |
| Deceased | 3 | 0.8 | 1 | 0.5 | 2 | 1.3 | 1 | 0.4 | 2 | 1.8 |
| Alive but with serious morbidity | 8 | 2.3 | 3 | 1.5 | 5 | 3.3 | 3 | 1.3 | 5 | 4.4 |
| Alive and well | 342 | 96.9 | 197 | 98.0 | 145 | 95.4 | 235 | 98.3 | 107 | 93.9 |

* Vehicular, violent personal injury, other.
APH = antepartum haemorrhage.

Among babies with neonatal encephalopathy, 19 percent were small by customised centile, and this is probably higher than expected (around 12 percent in the birthing population). Maternal height and weight, which are required to calculate centile, are not collected in the MAT dataset, only BMI, and so customised birthweight centile is not available for the population as a comparison. The rate of SGA in the birthing population is likely to be greater than 10 percent because the algorithm for calculating customised centile is based on an optimal birthweight after excluding at-risk pregnancies (Anderson et al 2012).

The national rate of induction of labour (all births) was 24.4 percent in 2014 (28.7 percent among women having their first baby and 20.4 percent among women having subsequent babies), which is the same as that among mothers of babies diagnosed with neonatal encephalopathy (24.1 percent, 28.9 percent and 17.8 percent respectively) (Ministry of Health 2015b).

Among mothers of babies diagnosed with neonatal encephalopathy, 26.6 percent had an epidural in labour compared to a national rate in 2014 of 27.1 percent (42.4 percent of women having their first baby, and 15.3 percent of women having subsequent babies).

Over the five years of neonatal encephalopathy data collection, there have been three cases associated with maternal death and eight with severe maternal morbidity. Of these 11 babies, seven had severe neonatal encephalopathy (64 percent) compared with 32 percent severe neonatal encephalopathy among all 353 cases. The numbers are small and this high proportion of severe disease associated with adverse maternal outcome may be due to chance.

## Peripartum complications and mode of birth

Table 3.4: Peripartum complications and mode of birth among neonatal encephalopathy cases 2010–2014

| | Total NE cases | |
|---|---|---|
| | n=353 | |
| | n | % |
| **Acute peripartum events** | 82 | 23.2 |
| Cord prolapse | 13 | 3.7 |
| Abruption | 27 | 7.6 |
| Uterine rupture | 7 | 2.0 |
| Shoulder dystocia | 21 | 5.9 |
| Breech complication | 8 | 2.3 |
| Other complication | 9 | 2.5 |
| **Liquor** | | |
| Blood stained | 30 | 8.5 |
| Thick meconium | 75 | 21.2 |
| Thin meconium | 41 | 11.6 |
| **Mode of birth** | | |
| **Normal vaginal birth** | **140** | **39.7** |
| **Operative vaginal birth** | **52** | **14.7** |
| Forceps | 20 | 5.7 |
| Ventouse | 30 | 8.5 |
| Unknown | 2 | 0.6 |
| **Vaginal breech birth** | **7** | **2.0** |
| **Caesarean section birth** | **154** | **43.6** |
| **Elective** | **8** | **2.3** |
| **Prelabour emergency** | **33** | **9.3** |
| Antepartum haemorrhage/Abruption | 5 | 1.4 |
| Suspected fetal distress | 22 | 6.2 |
| Failed induction | 1 | 0.3 |
| Other | 5 | 1.4 |
| **In labour emergency** | **113** | **32.0** |
| Antepartum haemorrhage/Abruption | 8 | 2.3 |
| Suspected fetal distress | 80 | 22.7 |
| Failure to progress/Cephalopelvic disproportion | 10 | 2.8 |
| Other | 14 | 4.0 |
| Unknown | 1 | 0.3 |
| **Attempt at operative vaginal birth before caesarean** | **8** | **2.3** |

Acute peripartum events were reported in 82 cases (23 percent). Of these, abruption (27 cases) and shoulder dystocia (21 cases) were the most common. Other complications included amniotic fluid embolism, maternal collapse, complications at birth of the second twin, vasa praevia and drug error. Blood stained liquor was noted in 9 percent of cases and meconium in 33 percent.

Among babies diagnosed with neonatal encephalopathy, 44 percent were born by caesarean section, 32 percent by in labour Caesarean section, which was most often performed for suspected fetal distress. This compares with a national caesarean section rate of 25.9 percent among all births in 2014 (Ministry of Health 2015b).

Seven babies (2.0 percent) were breech vaginal births at term, compared to 0.5 percent vaginal breech births in New Zealand in 2014 (Ministry of Health 2015b).

## Place of birth

From 2010 to 2014, there were seven babies with neonatal encephalopathy who were birthed at home as intended. This is 2.0 percent of all cases of moderate or severe encephalopathy. In 2014, 3.4 percent of babies were born at home in New Zealand (9.1 percent in a primary unit, 41 percent in a level 2 hospital and 46.4 percent in a tertiary hospital) (Ministry of Health 2015b).

More detail on intended and actual place of birth can be found in Table 3.13.

Table 3.5: Type of birth facility and transfer prior to or in labour among neonatal encephalopathy cases by induced cooling status 2010–2014

| | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NE cases | Induced cooling | | NE cases | Induced cooling | | NE cases | Induced cooling | | NE cases | Induced cooling | | NE cases | Induced cooling | |
| | N | n | % | N | n | % | N | n | % | N | n | % | N | n | % |
| **Type of birth facility** | | | | | | | | | | | | | | | |
| Home | 2 | - | - | 3 | 1 | 33.3 | - | - | - | 2 | 2 | 100.0 | 3 | 3 | 100.0 |
| Birthing unit | 3 | 2 | 66.7 | 3 | 3 | 100.0 | 4 | 4 | 100.0 | 1 | 1 | 100.0 | 4 | 4 | 100.0 |
| Hospital level 1 | 3 | 2 | 66.7 | 2 | 2 | 100.0 | 2 | 2 | 100.0 | 1 | - | - | - | - | - |
| Hospital level 2 | 27 | 19 | 70.4 | 29 | 21 | 72.4 | 30 | 20 | 66.7 | 34 | 28 | 82.4 | 24 | 20 | 83.3 |
| Hospital level 3 | 47 | 33 | 70.2 | 30 | 24 | 80.0 | 43 | 36 | 83.7 | 32 | 27 | 84.4 | 24 | 18 | 75.0 |
| **Transfer prior to labour** | 7 | 6 | 85.7 | 4 | 2 | 50.0 | 4 | 2 | 50.0 | 3 | 2 | 66.7 | 6 | 5 | 83.3 |
| **Transfer in labour** | 3 | 3 | 100.0 | 7 | 3 | 42.9 | 7 | 5 | 71.4 | 4 | 3 | 75.0 | 3 | 2 | 66.7 |

Table 3.5 shows rates of induced cooling by place of birth and by transfer prior to or during labour. These data suggest there is no association between place of birth and receiving induced cooling among babies with moderate and severe neonatal encephalopathy.

## Immediate newborn wellbeing

Table 3.6: Immediate newborn wellbeing among neonatal encephalopathy babies 2010–2014

| | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=82 | | n=67 | | n=79 | | n=70 | | n=55 | | n=353 | |
| | n | % | n | % | n | % | n | % | n | % | n | % |
| **Apgar scores** | | | | | | | | | | | | |
| Apgar score <3 at 1 minute | 48 | 58.5 | 41 | 61.2 | 47 | 59.5 | 40 | 57.1 | 37 | 67.3 | 213 | 60.3 |
| Apgar score <5 at 1 minute | 65 | 79.3 | 54 | 80.6 | 62 | 78.5 | 58 | 82.9 | 49 | 89.1 | 288 | 81.6 |
| Apgar score <7 at 1 minute | 73 | 89.0 | 61 | 91.0 | 70 | 88.6 | 65 | 92.9 | 53 | 96.4 | 322 | 91.2 |
| Apgar score <7 at 5 minutes | 61 | 74.4 | 54 | 80.6 | 62 | 78.5 | 57 | 81.4 | 43 | 78.2 | 277 | 78.5 |
| Apgar score <7 at 10 minutes | 39 | 47.6 | 38 | 56.7 | 49 | 62.0 | 32 | 45.7 | 29 | 52.7 | 187 | 53.0 |
| Apgar score <9 at 10 minutes | 52 | 63.4 | 52 | 77.6 | 62 | 78.5 | 52 | 74.3 | 45 | 81.8 | 263 | 74.5 |
| **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 | 7 | 12.7 | 56 | 15.9 |
| Abnormal (any of pH ≤7, BE ≤–12, lactate ≥6) | 47 | 57.3 | 41 | 61.2 | 55 | 69.6 | 48 | 68.6 | 40 | 72.7 | 231 | 65.4 |
| No gases reported | 23 | 28.0 | 12 | 17.9 | 13 | 16.5 | 10 | 14.3 | 8 | 14.5 | 66 | 18.7 |
| No gases and Apgar <7 at 1 minute | 14 | 17.1 | 8 | 11.9 | 8 | 10.1 | 7 | 10.0 | 8 | 14.5 | 45 | 12.7 |
| No gases and Apgar ≥7 at 1 minute | 8 | 9.8 | 4 | 6.0 | 5 | 6.3 | 3 | 4.3 | - | - | 20 | 5.7 |
| No gases and unknown Apgar | 1 | 1.2 | - | - | - | - | - | - | - | - | 1 | 0.3 |

BE = base excess.

Sixty percent of the babies diagnosed with moderate or severe neonatal encephalopathy from 2010 to 2014 had an Apgar score under 3 at one minute, 82 percent under 5 at one minute, 79 percent under 7 at five minutes, and 53 percent still had a score under 7 at 10 minutes. Sixty-five percent had abnormal arterial or venous cord blood gases (defined as pH of ≤7.0 and/or base excess of ≤–12mmol/l and/or lactate of ≥6mmol/l), and a further 13 percent who had no gas result had an Apgar score of ≤6 at one minute. These data indicate the majority of babies diagnosed with moderate and severe neonatal encephalopathy have evidence of asphyxia at birth.

There has been a statistically significant reduction in the proportion of babies without cord gases reported since 2010 (chi-squared test for trend p=0.02).

In 2014, all eight babies who did not have a cord gas taken at birth had an Apgar score <7 at one minute of age.

## Induced cooling

Table 3.7: Induced cooling therapy among neonatal encephalopathy babies 2010–2014

| Cooling | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=82 | | n=67 | | n=79 | | n=70 | | n=55 | | n=353 | |
| | n | % | n | % | n | % | n | % | n | % | n | % |
| Yes | 56 | 68.3 | 51 | 76.1 | 62 | 78.5 | 58 | 82.9 | 45 | 81.8 | 272 | 77.1 |
| No | 26 | 31.7 | 16 | 23.9 | 17 | 21.5 | 12 | 17.1 | 10 | 18.2 | 81 | 22.9 |
| **Age at cooling** | **n=56** | | **n=51** | | **n=62** | | **n=58** | | **n=45** | | **n=272** | |
| ≤6 hours | 46 | 82.1 | 39 | 76.5 | 53 | 85.5 | 47 | 81.0 | 39 | 86.7 | 224 | 82.4 |
| >6 hours | 10 | 17.9 | 8 | 15.7 | 9 | 14.5 | 11 | 19.0 | 6 | 13.3 | 44 | 16.2 |
| Unknown time | - | - | 4 | 7.8 | - | - | - | - | - | - | 4 | 1.5 |

Induced cooling has been shown to reduce mortality by 25 percent and neurodevelopmental disability in survivors of neonatal encephalopathy by 23 percent (Jacobs et al 2013).

The increase in proportion of babies with moderate or severe neonatal encephalopathy who were treated with induced cooling from 2010 to 2013 has remained stable at 82 percent in 2014. The proportion of those cooled who were cooled within six hours as recommended for maximal benefit at 87 percent remains high.

A review of babies who were not cooled and cooled outside of the six-hour recommended window from 2011 to 2014 will be completed in 2016.

Table 3.8: Neonatal resuscitation and early neonatal management by Sarnat stage among neonatal encephalopathy babies 2010–2014

| | NE babies | | Sarnat stage | | | |
|---|---|---|---|---|---|---|
| | | | Moderate | | Severe | |
| | n=353 | | n=239 | | n=114 | |
| | n | % | n | % | n | % |
| **Resuscitation at birth** | | | | | | |
| Yes | 326 | 92.4 | 218 | 91.2 | 108 | 94.7 |
| No | 27 | 7.6 | 21 | 8.8 | 6 | 5.3 |
| **Type of resuscitation at birth** | | | | | | |
| Oxygen only | 4 | 1.1 | 3 | 1.3 | 1 | 0.9 |
| IPPV with mask | 221 | 62.6 | 153 | 64.0 | 68 | 59.6 |
| IPPV with ETT | 201 | 56.9 | 120 | 50.2 | 81 | 71.1 |
| Cardiac massage | 140 | 39.7 | 70 | 29.3 | 70 | 61.4 |
| Adrenaline | 66 | 18.7 | 21 | 8.8 | 45 | 39.5 |
| **Respiratory and ventilation management** | | | | | | |
| Mechanical ventilation | 283 | 80.2 | 182 | 76.2 | 101 | 88.6 |
| Nitric oxide | 78 | 22.1 | 51 | 21.3 | 27 | 23.7 |
| **Infection** | | | | | | |
| Positive blood culture | 13 | 3.7 | 8 | 3.3 | 5 | 4.4 |
| Antibiotics | 320 | 90.7 | 224 | 93.7 | 96 | 84.2 |
| **Anticonvulsant therapy** | 248 | 70.3 | 161 | 67.4 | 87 | 76.3 |
| Phenobarbitone | 232 | 65.7 | 148 | 61.9 | 84 | 73.7 |
| Phenytoin | 64 | 18.1 | 29 | 12.1 | 35 | 30.7 |
| Benzodiazepines | 82 | 23.2 | 49 | 20.5 | 33 | 28.9 |
| Other | 13 | 3.7 | 7 | 2.9 | 6 | 5.3 |

ETT = endotracheal tube.
IPPV = intermittent positive pressure ventilation.

Table 3.8 (along with Table 3.6) further illustrates the poor condition of many babies who develop neonatal encephalopathy at birth. Over the five years, 92 percent of babies required resuscitation at birth, the majority of whom required intermittent positive pressure ventilation, with 49 percent requiring cardiac massage and 19 percent requiring adrenalin.

The 18 babies who were not resuscitated at birth from 2011 to 2014 are currently being reviewed to ascertain if these babies had an alternative explanation for the encephalopathy or were not recognised as being at risk (of encephalopathy) at birth.

## Outcomes of babies with neonatal encephalopathy

Table 3.9: Use of cooling and outcomes of encephalopathy by Sarnat stage among neonatal encephalopathy babies 2010–2014

| | | | Sarnat stage | | | |
|---|---|---|---|---|---|---|
| | NE babies | | Moderate | | Severe | |
| | n=353 | | n=239 | | n=114 | |
| | n | % | n | % | n | % |
| **Induced cooling** | | | | | | |
| Yes | 272 | 77.1 | 191 | 70.2 | 81 | 29.8 |
| No | 81 | 22.9 | 48 | 59.3 | 33 | 40.7 |
| **Deceased** | | | | | | |
| Yes | 70 | 19.8 | 3 | 4.3 | 67 | 95.7 |
| No | 283 | 80.2 | 236 | 83.4 | 47 | 16.6 |

Babies with severe neonatal encephalopathy were less likely to receive induced cooling (71 percent compared to 80 percent; p=0.06) and this is presumably because many of the severe babies are considered too unwell for cooling and are represented among the excess mortality in this group (59 percent compared to 1 percent). Of babies with neonatal encephalopathy who died, 21 percent died within the first day, 63 percent within the first three days, and 94 percent died within the first week of birth. A further four babies died after one week but within six weeks of birth, and a further eight babies died after discharge from three months to five years of age.

## Investigations and neonatal outcome by Sarnat stage (survivors)

Table 3.10: Investigations and neonatal outcome by Sarnat stage of neonatal encephalopathy survivors 2010–2014

| Investigations | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | Total NE survivors | | Sarnat stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Moderate | | Severe | |
| | n=59 | | n=54 | | n=67 | | n=59 | | n=44 | | n=283 | | n=236 | | n=47 | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| **Examination on discharge/transfer** | | | | | | | | | | | | | | | | |
| Normal | 32 | 54.2 | 25 | 46.3 | 30 | 44.8 | 24 | 40.7 | 17 | 38.6 | 128 | 45.2 | 120 | 50.8 | 8 | 17.0 |
| Mild or moderate abnormality | 14 | 23.7 | 20 | 37.0 | 19 | 28.4 | 23 | 39.0 | 17 | 38.6 | 93 | 32.9 | 75 | 31.8 | 18 | 38.3 |
| Severe abnormality | 3 | 5.1 | 1 | 1.9 | 5 | 7.5 | 5 | 8.5 | 3 | 6.8 | 17 | 6.0 | 3 | 1.3 | 14 | 29.8 |
| Not examined | 1 | 1.7 | 4 | 7.4 | 7 | 10.4 | 5 | 8.5 | 2 | 4.5 | 19 | 6.7 | 17 | 7.2 | 2 | 4.3 |
| Examined but finding unknown | 3 | 5.1 | 1 | 1.9 | 5 | 7.5 | 2 | 3.4 | 2 | 4.5 | 13 | 4.6 | 9 | 3.8 | 4 | 8.5 |
| Missing data | 6 | 10.2 | 3 | 5.6 | 1 | 1.5 | - | - | 3 | 6.8 | 13 | 4.6 | 12 | 5.1 | 1 | 2.1 |
| **EEG investigation done at ≤3 days of life*** | 40 | 67.8 | 25 | 46.3 | 34 | 50.7 | 50 | 84.7 | 40 | 90.9 | 189 | 66.8 | 153 | 64.8 | 36 | 76.6 |
| **MRI (investigation done)** | 41 | 69.5 | 35 | 64.8 | 43 | 64.2 | 50 | 84.7 | 38 | 86.4 | 207 | 73.1 | 161 | 68.2 | 46 | 97.9 |
| No MRI or Unknown | 18 | 30.5 | 19 | 35.2 | 24 | 35.8 | 9 | 15.3 | 6 | 13.6 | 76 | 26.9 | 75 | 31.8 | 1 | 2.1 |
| **Results of MRI** | | | | | | | | | | | | | | | | |
| Moderately/Severely abnormal | 16 | 27.1 | 11 | 20.4 | 17 | 25.4 | 22 | 37.3 | 13 | 29.5 | 79 | 27.9 | 49 | 20.8 | 30 | 63.8 |
| Normal or only mildly abnormal | 24 | 40.7 | 23 | 42.6 | 24 | 35.8 | 27 | 45.8 | 25 | 56.8 | 123 | 43.5 | 108 | 45.8 | 15 | 31.9 |
| Unknown result | 1 | 1.7 | 1 | 1.9 | 2 | 3.0 | 1 | 1.7 | - | - | 5 | 1.8 | 4 | 1.7 | 1 | 2.1 |

* Typically cot-side monitoring such as BrainZ.
EEG = electroencephalogram.
MRI = magnetic resonance imaging.

There has been an increasing trend in the proportion of surviving babies who had an MRI investigation since collection of neonatal encephalopathy data began, from 70 percent in 2010 to 86 percent in 2014 (chi-squared test for trend p=0.008). All but one surviving baby diagnosed with severe neonatal encephalopathy had an MRI during 2010–2014.

Of survivors during 2010–2014, 28 percent had a moderately or severely abnormal MRI and 44 percent had a normal or only mildly abnormal scan. Twenty-seven percent of survivors during 2010–2014 did not have an MRI.

## 3.3 Neonatal Encephalopathy Appended Tables

Table 3.11: Neonatal encephalopathy rate (per 1000 term births) by prioritised maternal ethnicity, maternal age and deprivation quintile 2010–2014

| | NZ registered births ≥37 weeks | | NE cases | | Rate (/1000 births) Term only | |
|---|---|---|---|---|---|---|
| | n=284,145 | | n=353 | | | |
| | n | % | n | % | /1000 | 95% CI |
| **Maternal ethnicity** | | | | | | |
| Māori | 63,585 | 22.4 | 94 | 26.6 | 1.48 | 1.19–1.81 |
| Pacific peoples | 29,910 | 10.5 | 56 | 15.9 | 1.87 | 1.41–2.43 |
| Indian | 11,538 | 4.1 | 17 | 4.8 | 1.47 | 0.86–2.36 |
| Other Asian | 26,992 | 9.5 | 25 | 7.1 | 0.93 | 0.60–1.37 |
| Other (including unknown) | 25,672 | 9.0 | 23 | 6.5 | 0.90 | 0.57–1.34 |
| NZ European | 126,448 | 44.5 | 138 | 39.1 | 1.09 | 0.91–1.27 |
| **Maternal age (years)** | | | | | | |
| <20 | 17,383 | 6.1 | 22 | 6.2 | 1.27 | 0.79–1.92 |
| 20–34 | 206,606 | 72.7 | 262 | 74.2 | 1.27 | 1.11–1.42 |
| 35–39 | 48,472 | 17.1 | 56 | 15.9 | 1.16 | 0.87–1.50 |
| ≥40 | 11,684 | 4.1 | 13 | 3.7 | 1.11 | 0.59–1.90 |
| **Deprivation quintile** | | | | | | |
| 1 (least deprived) | 44,715 | 15.7 | 38 | 10.8 | 0.85 | 0.60–1.17 |
| 2 | 50,385 | 17.7 | 55 | 15.6 | 1.09 | 0.82–1.42 |
| 3 | 54,890 | 19.3 | 77 | 21.8 | 1.40 | 1.11–1.75 |
| 4 | 59,689 | 21.0 | 65 | 18.4 | 1.09 | 0.84–1.39 |
| 5 (most deprived) | 73,272 | 25.8 | 117 | 33.1 | 1.60 | 1.31–1.89 |
| Unknown | 1,194 | 0.4 | 1 | 0.3 | - | - |

## Table 3.12: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence 2010–2014

| DHB of residence | NZ registered births ≥37 weeks | 2010 | 2011 | 2012 | 2013 | 2014 | Total NE cases | Rate (/1000 term births) | |
|---|---|---|---|---|---|---|---|---|---|
| | n=283,241 | n=82 | n=67 | n=79 | n=70 | n=55 | n=353 | | |
| | n | n | n | n | n | n | n | /1000 | 95% CI |
| Northland | 10,661 | 2 | 2 | 2 | 1 | 1 | 8 | 0.75 | 0.32–1.48 |
| Waitemata | 36,551 | 10 | 6 | 4 | 5 | 9 | 34 | 0.93 | 0.64–1.30 |
| Auckland | 29,872 | 4 | 8 | 4 | 8 | 5 | 29 | 0.97 | 0.65–1.39 |
| Counties Manukau | 39,385 | 14 | 11 | 14 | 6 | 5 | 50 | 1.27 | 0.94–1.67 |
| Waikato | 25,136 | 14 | 9 | 9 | 5 | 6 | 43 | 1.71 | 1.24–2.30 |
| Bay of Plenty | 13,372 | 3 | 4 | 2 | 3 | 1 | 13 | 0.97 | 0.52–1.66 |
| Lakes | 6,996 | 2 | 4 | 2 | 1 | 1 | 10 | 1.43 | 0.69–2.63 |
| Tairawhiti | 3,395 | 1 | 2 | 2 | 1 | 1 | 7 | 2.06 | 0.83–4.25 |
| Taranaki | 7,187 | 2 | - | 6 | 5 | 4 | 17 | 2.37 | 1.38–3.79 |
| Hawke's Bay | 10,267 | 2 | 1 | 3 | 2 | 3 | 11 | 1.07 | 0.53–1.92 |
| Whanganui | 3,945 | 1 | - | 2 | 1 | - | 4 | 1.01 | 0.28–2.60 |
| MidCentral | 10,344 | 2 | 1 | 2 | 3 | 2 | 10 | 0.97 | 0.46–1.78 |
| Wairarapa | 2,424 | 1 | - | - | - | 1 | 2 | 0.83 | 0.10–2.98 |
| Capital and Coast | 17,423 | 6 | 4 | 9 | 10 | 3 | 32 | 1.84 | 1.26–2.59 |
| Hutt Valley | 9,191 | 4 | 4 | 2 | 5 | 2 | 17 | 1.85 | 1.08–2.96 |
| Nelson and Marlborough | 7,393 | - | 1 | 2 | 5 | 1 | 9 | 1.22 | 0.56–2.31 |
| West Coast | 1,893 | - | 1 | 2 | - | 2 | 5 | 2.64 | 0.86–6.16 |
| Canterbury | 28,343 | 11 | 6 | 7 | 2 | 6 | 32 | 1.13 | 0.77–1.59 |
| South Canterbury | 2,892 | 1 | 2 | 2 | 1 | - | 6 | 2.07 | 0.76–4.52 |
| Southern | 16,435 | 2 | 1 | 3 | 6 | 2 | 14 | 0.85 | 0.47–1.43 |
| Other | 1,040 | - | - | - | - | - | - | - | - |

Other includes Overseas, Unknown and Other

Table 3.13: Actual and intended place of birth among neonatal encephalopathy cases 2010–2014

| Intended place of birth | NE cases | | Actual place of birth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=353 | | Home | | Birthing unit | | Hospital level 1 | | Hospital level 2 | | Hospital level 3 | |
| | n | % | n | % | n | % | n | % | n | % | n | % |
| Home | 12 | 3.4 | 7 | 58.3 | - | - | - | - | 3 | 25.0 | 2 | 16.7 |
| Birthing unit | 39 | 11.0 | 1 | 2.6 | 15 | 38.5 | - | - | 4 | 10.3 | 19 | 48.7 |
| Hospital level 1 | 18 | 5.1 | - | - | - | - | 5 | 27.8 | 3 | 16.7 | 10 | 55.6 |
| Hospital level 2 | 138 | 39.1 | 1 | 0.7 | - | - | 2 | 1.4 | 131 | 94.9 | 4 | 2.9 |
| Hospital level 3 | 140 | 39.7 | 1 | 0.7 | - | - | 1 | 0.7 | 1 | 0.7 | 137 | 97.9 |
| Unknown | 6 | 1.7 | - | - | - | - | - | - | 2 | 33.3 | 4 | 66.7 |
| **Total** | **353** | | **10** | **2.8** | **15** | **4.2** | **8** | **2.3** | **144** | **40.8** | **176** | **49.9** |

# Appendix A: Summary of Key PMMRC Recommendations and Progress 2006–2012 data

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| **Perinatal mortality** | |
| **Birth information** | |
| All babies, whether stillborn or live born, should be assigned a National Health Index (NHI) at the time of birth. | All DHBs are now issuing NHIs to stillborn babies at time of birth. |
| **Ethnicity** | |
| Clinicians and LMCs should be encouraged to collect accurate ethnicity details at the time of booking. | DThe emerging Maternity Clinical Information System should assist clinicians and LMCs to collect accurate standardised ethnicity data. This process is currently operating in South Canterbury, MidCentral, Whanganui and Counties Manukau DHBs. In 2016/2017 there are plans to roll it out to a further six DHBs. The Primary Care Ethnicity Data Audit Toolkit has been produced and was implemented June 2015. See http://www.health.govt.nz/publication/primary-care-ethnicity-data-audit-toolkit |
| **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. | All DHBs are aware of the need to take actions that will increase the number of women who book before 10 weeks gestation. Barriers to early booking are being investigated and actions will be embedded in each respective DHB Maternal Quality and Safety Programme. Many DHBs are promoting media and social media campaigns such as the 'Find Your Midwife' website, which supports women to find and book with an LMC. See the following website for more information: http://www.findyourmidwife.co.nz/<br>The regional programme '5 Things to Do in the First 10 Weeks' has been effective and widely supported. Key messages from this campaign are to:<br>• engage early with a LMC<br>• take folic acid and iodine<br>• make decisions about screening tests<br>• eat well and be active<br>• avoid alcohol, recreational drugs and smoking.<br>The Ministry of Health advises that media campaigns and initiatives should be targeted at local level for best results. |
| 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. | Some initiatives have been developed to improve access to antenatal care services for women who are isolated for social, cultural or language reasons. These include:<br>• The Language Line. See http://ethniccommunities.govt.nz/story/using-language-line<br>• The TAHA Well Pacific Mother & Infant Service, which launched a smart phone application that provides information on pregnancy and parenting. See www.tapuaki.org.nz |

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| **Disparities** | |
| 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 | There are a number of cross-agency initiatives that are underway to respond to, and reduce, the impact of socioeconomic deprivation on perinatal death and child health. These include:<br>• The Healthy Families New Zealand Initiative. See http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz<br>• The Child Poverty Monitor. This was first published in 2013 and 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 Office of the Children's Commissioner, Child and Youth Epidemiology Service (University of Otago), and the JR McKenzie Trust. See http://www.nzchildren.co.nz/<br>• The Vulnerable Children Act 2014. On 1 July 2014 the Vulnerable Children Act was passed into law. The Act is a significant part of a range of comprehensive measures to protect and improve the wellbeing of vulnerable children and strengthen the child protection system. The chief executives of five government agencies are accountable for acting together to develop and implement a plan to protect our children from harm, working with families, whānau and communities.<br>• 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 to work with vulnerable children, and across a range of local iwi and Māori, health, education, welfare and social organisations.<br>• Social Sector Trials. These have been established to test innovative ideas to improve social, health and educational outcomes in communities around New Zealand. One of the trials has a specific health focus. See http://www.health.govt.nz/our-work/preventative-health-wellness/social-sector-trials<br>• Well Child/Tamariki Ora. The Ministry of Health is investigating how to more effectively integrate the Well Child/Tamariki Ora programme and GP practice services to be more attractive and responsive to women and families who are socially deprived or have socially complex needs. |
| Possible causes for the increase in perinatal related death of babies born to Pacific women, Māori women, women under the age of 20 or over the age of 40 and women who live in areas of high socioeconomic deprivation should be researched. This information is necessary in order to develop appropriate strategies to reduce these possibly preventable deaths. | The Ministry of Health expects that perinatal mortality will be annually reviewed as part of the local Maternity Quality and Safety Programmes. Findings from the review process will assist DHBs and the wider maternity sector to identify and address local issues and risk factors. |
| Further research is warranted to understand the higher rate of perinatal related mortality in the Counties Manukau region. | An independent review of perinatal mortality in their region was commissioned by Counties Manukau DHB in late 2012. The recommendations from this review are being implemented in an ongoing process of quality improvement. The review report is available at: http://www.countiesmanukau.health.nz/assets/About-CMH/Reports-and-planning/Maternity/2014-2015-Maternity-Quality-Safety-Programme.pdf |

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| Clinicians and LMCs should be aware that Pacific women, Māori women, women under 20 or over 40 years of age and those women who live in areas of high socioeconomic deprivation are at higher risk of a perinatal death. | The Ministry of Health expects that this awareness will be promoted within the Maternity Quality and Safety Programme of each DHB. |
| **Public health initiatives** | |
| A high body mass index (BMI) at booking is an independent risk factor for stillbirth. Public health initiatives to prevent obesity prior to pregnancy should be supported. | 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 plan for the care of obese pregnant women, as well as identify DHBs that should prioritise strategies that support healthy weight gain in pregnancy.<br>Other initiatives that support this recommendation include:<br>• Eating for Healthy Pregnant Women/Ngā Kai Totika mā te Wahine Hapā. This is a public health resource and was updated in 2014. See https://www.healthed.govt.nz/system/files/resource-files/HE1805_5.pdf<br>• A Ministry of Health web page provides information about healthy weight gain during pregnancy and provides links to helpful resources. See http://www.health.govt.nz/your-health/healthy-living/pregnancy/healthy-weight-gain-during-pregnancy<br>• The Healthy Families NZ initiative. This initiative encourages families to live healthy lives – by making good food choices, being physically active, sustaining a healthy weight, being smoke free and drinking alcohol only in moderation. It is funded by the Ministry of Health and commenced in September 2014. See http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz<br>• Investment in workforce development. In July 2013 the government announced it is investing $2.28 million in a new workforce development programme for health professionals who care for pregnant women and babies. The training programme will be implemented by Gravida and aims to give frontline health workers the latest evidence-based research into how pregnancy and early life events can influence long-term health outcomes. See http://www.gravida.org.nz/news-and-events/news/2-3m-to-help-mums-and-families-make-good-food-choices-for-their-children |
| **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.<br>Women with high-risk monochorionic multiple pregnancies require fortnightly scans and specialist care. | This recommendation is promoted through the Ministry of Health's Maternity Quality and Safety Programme. All DHBs recognise that monochorionic multiple pregnancies require early specialist care and are high risk.<br>Advice is available through the New Zealand Maternal Fetal Medicine Network. See http://www.healthpoint.co.nz/public/new-zealand-maternal-fetal-medicine-network/?solo=otherList&index=5 |

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| In order to reduce perinatal related mortality associated with multiple pregnancies, the following is advised.<br>• All women undergoing assisted reproduction be offered single embryo transfer.<br>• The use of clomiphene for fertility treatment requires monitoring of hormonal response with ultrasound to determine the number of follicles.<br>• LMCs note that the referral guidelines recommend transfer of clinical responsibility for care of all women with multiple pregnancies to obstetrician-led care. | The recommendations have been promoted through the Ministry of Health's Maternity Quality and Safety Programme.<br>Clomiphene is being replaced with other medications such as Letrizole, which has a much lower risk of multiple pregnancy.<br>The Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines) list multiple pregnancies 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. |
| **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 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<br>**See 'Practice Point: Antenatal Screening for Down Syndrome and Other Conditions' (page 48).**<br>The importance of timely registration has been promoted through the NMMG. The 2015 NMMG Annual Report can be accessed at: http://www.health.govt.nz/publication/national-maternity-monitoring-group-annual-report-2015 |
| Achieving optimal use of periconceptual folate by young women in New Zealand requires a policy for fortification of bread. | The Ministry of Health advice to women planning to become pregnant is to take folic acid supplements and continue to do so when pregnant. There is voluntary fortification of bread by some manufacturers. |
| The National Screening Unit review the cost benefit of the current algorithms in the first and second trimester screening programme so they are calibrated for maximal sensitivity for all chromosomal abnormalities. | The National Screening Unit has commenced a project to provide feedback to radiology practitioners on the quality of nuchal translucency (NT) and crown rump length (CRL) measurements. This project includes best practice guidelines for NT and CRL measurements. Further information, including guidelines and videos, can be found at http://www.nsu.govt.nz. Further analysis is occurring on investigating new technology (non-invasive prenatal testing) to be included in publicly funded screening. |
| The National Screening Unit review false negative screening tests. | The National Screening Unit is reviewing the cases not detected through screening (false negative). This analysis includes a review of information provided for screening including the completeness of information on request forms provided to the laboratory, the impact of changes to the measurements and any trends in demographic information of women. |
| The National Maternal Fetal Medicine Network regularly audit time from referral to review to ensure that the majority of women are seen within seven days as recommended. | The New Zealand Maternal Fetal Medicine Network completed an audit at Auckland DHB in 2015, which confirmed that almost all women who had their referral triaged for review in less than seven days were seen in this timeframe. |

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| **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 will be updating its publication Preventing Sudden Unexpected Death in Infancy in 2017. See http://www.health.govt.nz/your-health/pregnancy-and-kids/first-year/helpful-advice-during-first-year/safe-sleep<br>The Ministry of Health has published guidance on observation of mother and baby in the immediate postpartum period in 2012. This guidance supports safe sleeping in postnatal wards: http://www.health.govt.nz/publication/observation-mother-and-baby-immediate-postnatal-period-consensus-statements-guiding-practice<br>Guidance on safe sleeping and the Pāpi-pod Sleep Space Programme is also available on the Change for Our Children website. See http://www.changeforourchildren.co.nz/pepi_pod_programme |
| **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 for counselling and clinical follow-up.<br>See http://www.nsfl.health.govt.nz/apps/nsfl.nsf/pagesmh/444<br>The 2015 Survey of Bereaved Women found that 74 percent of women were satisfied or very satisfied with care they received. Most women surveyed stated that they had received enough information, care and support. The full survey can be found at: https://www.health.govt.nz/system/files/documents/publications/2015-survey-of-bereaved-women-sep15.pdf |
| The low uptake of post-mortems amongst families who experience perinatal loss should be investigated. | The 2015 Survey of Bereaved Women looked at the information provided to women and their decisions about post-mortem examination.<br>The full report can be found at: https://www.health.govt.nz/system/files/documents/publications/2015-survey-of-bereaved-women-sep15.pdf |
| The reasons for the difference in rates of optimally investigated perinatal deaths between DHBs needs investigation. | DHBs with post-mortem rates less than 50 percent were asked to provide a progress update on their implementation of this recommendation.<br>DHBs reported that geographical distances, the length of time families are separated from their babies, and family cultural beliefs can all be barriers to parents agreeing to a post-mortem.<br>Further information to help families and whānau who are trying to decide whether or not to consent to a post-mortem can be found at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/32/ |
| **Maternal mortality** | |
| **Maternal information** | |
| 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 operating in five DHBs: South Canterbury, Tairawhiti, MidCentral, Whanganui and Counties Manukau. Significant work is being undertaken by Counties Manukau DHB to ensure the system works well in a secondary tertiary maternity facility. The Ministry of Health intends for this system to roll out to a further six DHBs in 2016/2017. Both the NMMG and the Maternity Quality and Safety Programme are working towards improved communication between primary and secondary services. |

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| **Maternal mental health** | |
| Maternal mental health services should be integrated into maternity services. | Under the Ministry of Health's Rising to the Challenge: Mental Health and Addiction Service Development Plan 2012–2017, the Ministry will work with providers to support service improvement and will report on implementation progress over the next five years. The Rising to the Challenge document is available online:<br>http://www.health.govt.nz/publication/rising-challenge-mental-health-and-addiction-service-development-plan-2012-2017 |
| 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. | Midwives attend a mandatory Practice Day once every three years as part of the Midwifery Council's Recertification Programme. One of the key topics included within the current Practice Day is maternal mental health. The focus of this education has been on the midwifery role of screening, identifying and referring women with mental health concerns.<br>This recommendation has been revised and included in the practice point on maternal suicide:<br>• Maternal mental health screening should be included as part of standard antenatal care.<br>**See 'Practice Point: Maternal Suicide' (page 130).** |
| Access should be provided to a mother and baby unit in the North Island. | Following on from the Healthy Beginnings report, a three-bed mother-and-baby unit was opened in the Child and Family Unit in Starship Hospital in Auckland. This is a valuable resource in the treatment of acutely unwell mothers with their babies.<br>Services have also been developed and extended across the continuum of care, including increased resourcing of community mental health perinatal services, and extension of respite and non-governmental organisation services. This includes 24-hour perinatal phone advice for general mental health services managing acute presentations of mothers. |
| Women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if well.<br>Clinicians are reminded that the most common cause of maternal death in New Zealand is suicide. | This recommendation has been revised and included in the practice point on maternal suicide.<br>• Maternal mental health screening should be included as part of standard antenatal care.<br>• Women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if they are currently well.<br>**See 'Practice Point: Maternal Suicide' (page 130).** |
| 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.<br>A comprehensive perinatal and infant mental health service includes:<br>• screening and assessment<br>• timely interventions including case management, transition planning and referrals<br>• access to respite care and specialist inpatient care for mothers and babies<br>• consultation and liaison services within the health system and with other agencies; for example, primary care and termination of pregnancy services. | This recommendation has been revised and included in the practice point on maternal suicide.<br>• Maternal mental health screening should be included as part of standard antenatal care.<br>• Women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if they are currently well.<br>• Strategies are required to improve communication and coordination between the full range of primary maternity providers (eg, LMC, GP) and secondary providers (eg, mental health services, maternal mental health services, maternity, including termination of pregnancy services).<br>**See 'Practice Point: Maternal Suicide' (page 130).** |

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral. | The services providing termination of pregnancy to women advise that they comply with the Standards of Practice for the Provision of Counselling laid down by the Abortion Supervisory Committee. These are monitored as part of re-licencing. See http://www.abortionservices.org.nz/docs/guides98.pdf<br>It was noted that there were minimal opportunities in relation to training in the field of post-termination of pregnancy counselling practice. |
| **Team approach to care** | |
| Women with complex medical conditions require a multidisciplinary approach to care, including a multidisciplinary management plan for the pregnancy, birth and postpartum period. This plan must be communicated to all relevant caregivers. 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 for DHBs to ensure 95 percent of pregnant women in their region receive continuity of primary maternity care. As outlined in the New Zealand Maternity Standards, DHBs are also expected to provide or accommodate continuity of specialist secondary or tertiary care where possible.<br>DHBs are required to staff appropriately under the primary, secondary and tertiary maternity facilities and services specifications.<br>See the following links for more information:<br>http://www.nsfl.health.govt.nz/apps/nsfl.nsf/menumh/Accountability+Documents<br>http://www.nsfl.health.govt.nz/apps/nsfl.nsf/pagesmh/444<br>Information about support for pregnant women and their babies who have, or may have, pre-existing medical conditions is available at:<br>http://www.health.govt.nz/your-health/services-and-support/health-care-services/maternity-services/pregnancy-and-newborn-screening |
| 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. | DHBs support this recommendation and advise that unstable or clinically unwell women are cared for in the most appropriate place within their hospital. They also indicated that detailed management plans are developed if observations are abnormal.<br>In 2016 the Ministry of Health intends to revise The Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines) developed for 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. |
| **Emergency obstetric training** | |
| All clinicians involved in care of pregnant women should undertake regular multidisciplinary training in management of obstetric emergencies. | The Midwifery Council requires that midwives attend training in resuscitation and management of obstetric emergencies annually.<br>A number of DHBs are supporting DHB and community-based clinicians to attend multidisciplinary emergency obstetric training programmes, with some DHBs making such training compulsory for medical staff every two years.<br>Consideration should be given to making this training mandatory.<br>**See 'Practice Point: Amniotic Fluid Embolism' (page 121).** |
| **Investigation of maternal deaths** | |
| In maternal deaths, where the coroner declines jurisdiction, a post-mortem should be offered as part of full investigation of cause of death. | DHBs have advised that in cases of maternal death where the coroner declines jurisdiction, a post-mortem is offered as part of full investigation of cause of death. |

| Recommendation PMMRC 1st – 8th Reports | Progress to date (June 2016) |
|---|---|
| **Neonatal encephalopathy** | |
| Arterial and venous cord gases should be performed on all babies born with an Apgar <7 at one minute; and 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. | The Ministry of Health expects this recommendation will become part of ongoing professional development and will be discussed with each DHB Maternity Quality and Safety Programme. |
| Strategies to reduce neonatal encephalopathy include continually improving the standard of neonatal resuscitation by all health professionals involved in providing peripartum care. | Neonatal resuscitation is an annual continuing education requirement for all midwives.<br>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/<br>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. |
| In cases of neonatal encephalopathy (Sarnat stages 2 and 3):<br>• 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)<br>• 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. | Most DHBs have advised that all babies with moderate or severe neonatal encephalopathy (Sarnat stages 2 and 3) undergo investigation to predict prognosis.<br>Parents have a formal discussion with the neonatologist/ paediatrician providing care to review the prognosis and ongoing care of their child. |

# Previous PMMRC recommendations that have been implemented

| Recommendation | Progress June 2016 |
|---|---|
| **Perinatal mortality** | |
| **Early booking** | |
| All women should commence maternity care before 10 weeks. This enables:<br>• opportunity to offer screening for congenital abnormalities, sexually transmitted infections, family violence and maternal mental health, with referral as appropriate<br>• education around nutrition, smoking, alcohol and drug use and other at-risk behaviour<br>• recognition of underlying medical conditions, with referral to secondary care as appropriate<br>• identification of at-risk women (maternal age, obesity, maternal mental health problems, multiple pregnancy, socioeconomic deprivation, maternal medical conditions). | This recommendation has been integrated into core work by the NMMG, Ministry of Health. |
| **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:<br>• maternity care before 10 weeks<br>• smoking cessation, prevention of preterm birth, screening for fetal growth restriction<br>• antenatal education<br>• undertaking research on the best model of care<br>• engagement with the Ministry of Education regarding education in the school setting. | This recommendation has been integrated into core work by the NMMG, Ministry of Health. |
| **Contributory factors and potentially avoidable perinatal deaths** | |
| Key stakeholders providing health and social services to women at risk should work together and identify:<br>• reasons for barriers to accessing maternity care<br>• interventions to address barriers.<br>Clinical services and clinicians have the following responsibilities:<br>• continuing education<br>• local review linked to quality improvement<br>• up-to-date policies and guidelines that are implemented and audited<br>• culture of teamwork<br>• culture of practice reflection on patient outcomes linked to quality improvement<br>• staff arrangements ensuring timely access to specialist services.<br>Ministry of Health to develop a plan to translate these recommendations into clinical practice. | This recommendation has been integrated into core work by the NMMG, Ministry of Health. |

| Recommendation | Progress June 2016 |
|---|---|
| **Birth information** | |
| Continued support and funding is required for DHBs and LMCs for collection of complete perinatal mortality statistics. | This recommendation has been integrated into core work by the Ministry of Health. |
| **Antepartum haemorrhage** | |
| All women with bleeding during pregnancy, regardless of the apparent cause, should be monitored more closely for fetal growth and preterm birth. | This recommendation has been integrated into core work by the Ministry of Health. |
| **Sudden unexpected death in infancy (SUDI)** | |
| 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. | This recommendation has been integrated into core work by the Ministry of Health. |
| **Maternal mortality** | |
| **Maternal information** | |
| Support is required for national reporting of maternal deaths. | The Ministry of Health funds DHBs in their reporting of mortality data and collection of complete perinatal mortality statistics. |
| **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. See http://www.hqsc.govt.nz/assets/PMMRC/Resources/Pregnancy-Seatbelt-A2-Poster.pdf |
| **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 accessed at:<br>https://somanz.org/documents/HTPregnancyGuidelineJuly2014.pdf<br>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 NMMG. |
| **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 developed and distributed to professional colleges and DHBs. This can be accessed at: http://www.health.govt.nz/publication/national-consensus-guideline-treatment-postpartum-haemorrhage |

# Appendix B: List of Abbreviations

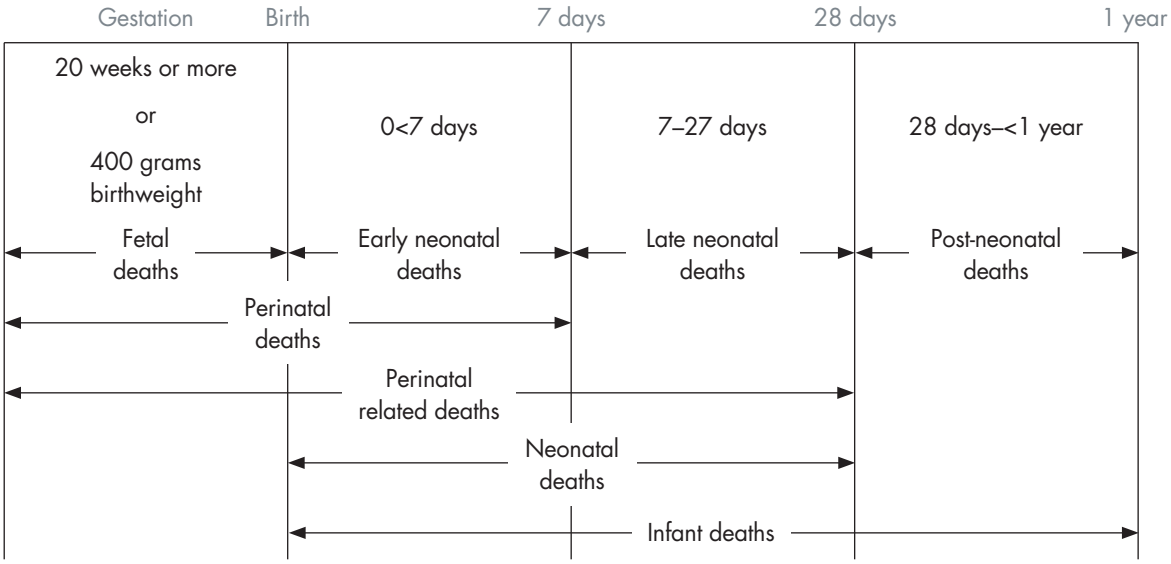
| | |
|---|---|
| **ACC** | Accident Compensation Corporation |
| **AFE** | Amniotic fluid embolism |
| **AMOSS** | Australasian Maternity Outcomes Surveillance System |
| **APH** | Antepartum haemorrhage |
| **BDM** | Births, Deaths and Marriages |
| **BE** | Base excess |
| **BMI** | Body mass index (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 |
| **NT** | Nuchal translucency |

| | |
|---|---|
| **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 |
| **Sands** | Stillbirth and Newborn Death Support |
| **SGA** | Small for gestational age |
| **SIGN** | Scottish Intercollegiate Guidelines Network |
| **SUDI** | Sudden unexpected death in infancy |
| **UK** | United Kingdom |
| **UKOSS** | UK Obstetric Surveillance System |
| **USS** | Ultrasound scan |
| **VTE** | Venous thromboembolism |
| **WHO** | World Health Organization |

# Appendix C: Definitions

## Perinatal related mortality rate

### 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 2011).

### 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 (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.

## Other definitions

### Contributory factors

Contributory factors are 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.

### 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.

### 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 follows the guidelines in Ethnicity Data Protocols for the New Zealand Health and Disability Sector (Ministry of Health 2004) for prioritising ethnicity. 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 2014, mothers' ethnicity for the PMMRC dataset of perinatal related deaths has been extracted, in order of priority, from BDM registration of birth (71 percent) or PMMRC rapid response forms (29 percent). Babies' ethnicity for the PMMRC dataset of perinatal deaths has been extracted, in order of priority, from BDM registration of birth (71 percent), BDM registration of death (7 percent) or PMMRC rapid response forms (22 percent).

In 2014, the denominator birth registration dataset included two ethnicities for 24.8 percent of all babies registered compared with two ethnicities for 14.0 percent of mothers registered. The dataset included three ethnicities for 6.1 percent of babies and three ethnicities for 1.3 percent of mothers. This difference in the number of ethnicities a mother reports for herself compared with the number of ethnicities she gives for her baby means mortality rates 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.

### 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.

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.

### New Zealand Index of Deprivation 2006 and 2013 (NZDep2006/2013)

The New Zealand Index of Deprivation 2006 and 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 (Atkinson et al 2014; Salmond et al 2007).

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 et al 2007). 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.

### 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.

### Potentially avoidable death

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

### Registration with a lead maternity carer (LMC)

Registration with a lead maternity carer (LMC) is the process by which a woman selects her LMC. 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.

# Appendix D: References and Bibliography


American College of Obstetricians and Gynecologists. 2014. Executive Summary: Neonatal Encephalopathy and Neurologic Outcome, Second Edition. Obstetrics and Gynecology 123: 896–901. URL: http://pediatrics.aappublications.org/content/133/5/e1482 (accessed April 2016).

American Congress of Obstetricians and Gynecologists. 2015. 156 Obesity in Pregnancy (Replaces Committee Opinion Number 549, January 2013). URL: http://www.acog.org/Resources-And-Publications/Practice-Bulletins-List (accessed April 2016).

Anderson NH, Sadler LC, Stewart AW, et al. 2012. Maternal and pathological pregnancy characteristics in customised birthweight centiles and identification of at-risk small-for-gestational- age infants: a retrospective cohort study. BJOG 119(7): 848–56. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1471-0528.2012.03313.x/abstract (accessed April 2016).

Arroll N, Farquhar C, Sadler L, et al. 2013. Can we improve the prevention and detection of congenital abnormalities? An audit of early pregnancy care in New Zealand. The New Zealand Medical Journal 126(1380): 46–56. URL: https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2013/vol-126-no-1380/article-arroll (accessed April 2016).

Atkinson J, Salmond C, Crampton P. 2014. NZDep2013 Index of Deprivation. Wellington: Department of Public Health, University of Otago. URL: http://www.otago.ac.nz/wellington/otago069936.pdf (accessed April 2016).

Auckland District Health Board. 2015. National Women's Annual Clinical Report 2014. URL: http://nationalwomenshealth.adhb.govt.nz/Portals/0/Annual Reports/ACR master MOH July 2015.pdf (accessed April 2016).

Aune D, Saugstad OD, Henriksen T, et al. 2014. Maternal body mass index and the risk of fetal death, stillbirth, and infant death: a systematic review and meta-analysis. JAMA 311(15): 1536–46. URL: http://jama.jamanetwork.com/article.aspx?articleid=1860462 (accessed April 2016).

Australian Bureau of Statistics. 2016. Causes of Death, Australia, 2014. Canberra: Australian Bureau of Statistics. URL: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by Subject/3303.0~2014~Main Features~Summary of Findings~1 (accessed April 2016).

Australian Institute of Health and Welfare. 2015. Australia's mothers and babies 2013—in brief. Perinatal statistics series no. 31. Cat no. PER 72. Canberra: Australian Institute of Health and Welfare. URL: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129554140 (accessed April 2016).

Calvert K, McGurgan P, Debenham E, Gratwick F, Maouris P. Emergency obstetric simulation training: how do we know where we are going, if we don't know where we have been? Aust N Z J Obstet Gynaecol. 2013 Dec;53(6):509-16. URL: http://www.ncbi.nlm.nih.gov/pubmed/24033002 (accessed May 2016).

Cedergren MI. 2004. Maternal morbid obesity and the risk of adverse pregnancy outcome. Obstetrics and Gynecology 103(2): 219–24. URL: http://journals.lww.com/greenjournal/Abstract/2004/02000/Maternal_Morbid_Obesity_and_the_Risk_of_Adverse.2.aspx?trendmd-shared=0 (accessed April 2016).

Cliffe S, Black D, Bryant J, et al. 2008. Maternal deaths in New South Wales, Australia: A data linkage project. Australian and New Zealand Journal of Obstetrics and Gynaecology 48: 255–60. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1479-828X.2008.00878.x/abstract (accessed April 2016).

CMACE. 2011. Perinatal Mortality 2009: United Kingdom. London: Centre for Maternal and Child Enquiries. URL: http://www.publichealth.hscni.net/sites/default/files/Perinatal Mortality 2009.pdf (accessed April 2016).

Deneux-Tharaux C, Berg C, Bouvier-Colle M-H, et al. 2005. Underreporting of Pregnancy-Related Mortality in the United States and Europe. Obstetrics and Gynecology 106(4): 684–92. URL: http://www.invs.sante.fr/publications/2006/mortalite_maternelle/annexe_6_3_etude.pdf (accessed April 2016).

Donati S, Senatore S, Ronconi A, et al. 2011. Maternal mortality in Italy: a record-linkage study. BJOG 118(7): 872–79. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1471-0528.2011.02916.x/abstract (accessed April 2016).

Draper E, Kurinczuk J, Lamming C, et al. 2002. A confidential enquiry into cases of neonatal encephalopathy. Archives of Disease in Childhood: Fetal and Neonatal Edition 87(3): F176–80. URL: http://fn.bmj.com/content/87/3/F176.full (accessed April 2016).

EURO-PERISTAT, with SCPE, EUROCAT and EURONEOSTAT. 2008. European Perinatal Health Report: Data from 2004. URL: http://www.europeristat.com/images/doc/EPHR/european-perinatal-health-report.pdf (accessed April 2016).

Farquhar C, Sadler L, Masson V, et al. 2011. Beyond the numbers: classifying contributory factors and potentially avoidable maternal deaths in New Zealand, 2006–2009. American Journal of Obstetrics & Gynecology 205(4): 331.e1–8. URL: http://www.sciencedirect.com/science/article/pii/S0002937811009616 (accessed April 2016).

Fitzpatrick K, Tuffnell D, Kurinczuk J, et al. 2015. Incidence, risk factors, management and outcomes of amniotic-fluid embolism: a population-based cohort and nested case-control study. BJOG: An International Journal of Obstetrics & Gynaecology. URL: http://onlinelibrary.wiley.com/doi/10.1111/1471-0528.13300/abstract (accessed April 2016).

Gallagher K, Martin J, Keller M, et al. 2014. European variation in decision-making and parental involvement during preterm birth. Archives of Disease in Childhood – Fetal Neonatal Edition 99(3): F245–9. URL: http://fn.bmj.com/content/99/3/F245.long (accessed April 2016).

Heron M. 2011. Deaths: Leading Causes for 2007. National Vital Statistics Reports 59(8). URL: http://www.cdc.gov/nchs/data/nvsr/nvsr59/nvsr59_08.pdf (accessed April 2016).

Humphrey M, Bonello M, Chughtai A, et al. 2015. Maternal deaths in Australia 2008–2012. Maternal deaths series no. 5. Cat. No. PER 70. Canberra: Australian Institute of Health and Welfare. URL: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129551117 (accessed April 2016).

Ishii N, Kono Y, Yonemoto N, et al. 2013. Outcomes of Infants Born at 22 and 23 Weeks' Gestation. Pediatrics 132(1): 62–71. URL: http://pediatrics.aappublications.org/content/132/1/62.long (accessed April 2016).

Jacobs S, Berg M, Hunt R, et al. 2013. Cooling for newborns with hypoxic ischaemic encephalopathy (Review). Cochrane Database of Systemic Reviews 1. URL: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003311.pub3/abstract (accessed April 2016).

Johnson S, Bonello M, Li Z, et al. 2014. Maternal deaths in Australia 2006–2010, Maternal deaths series no. 4. Cat. no. PER 61. Canberra: Australian Institute of Health and Welfare. URL: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129548375 (accessed April 2016).

Johnson S, Sullivan E. 2013. Reporting maternal death in Australia. O&G Magazine 15(1): 15–6. URL: http://www.ranzcog.edu.au/editions/doc_view/1308-00-vol-15-no-1-autumn-2013-complete-issue.html (accessed April 2016).

Kernaghan D, Penney G. 2006. Do panels vary when assessing intrapartum adverse events? The reproducibility of assessments by hospital risk management groups. Quality and Safety in Health Care 15: 359–62. URL: http://qualitysafety.bmj.com/content/15/5/359.abstract (accessed April 2016).

Knight M, Berg C, Brocklehurst P, et al. 2012. Amniotic fluid embolism incidence, risk factors and outcomes: a review and recommendations. BMC Pregnancy and Childbirth 12(1): 7. URL: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3305555&tool=pmcentrez&rendertype=abstract (accessed April 2016).

Knight M, Kenyon S, Brocklehurst P, et al. (eds) on behalf of MBRRACE-UK. 2014. Saving Lives, Improving Mothers' Care – Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009–2012. Oxford: National Perinatal Epidemiology Unit. URL: https://www.npeu.ox.ac.uk/downloads/files/mbrrace-uk/reports/Saving Lives Improving Mothers Care report 2014 Full.pdf (accessed April 2016).

Knight M, Tuffnell D, Kenyon S, et al. (eds) on behalf of MBRRACE-UK. 2015. Saving Lives, Improving Mothers' Care – Surveillance of maternal deaths in the UK 2011–13 and lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009–13. Oxford: National Perinatal Epidemiology Unit. URL: https://www.npeu.ox.ac.uk/mbrrace-uk/reports (accessed April 2016).

Lancet Ending preventable stillbirths Series 2016: An Executive Summary for The Lancet's Series. URL: http://www.thelancet.com/pb/assets/raw/Lancet/stories/series/stillbirths2016-exec-summ.pdf (accessed May 2016).

Lee AC, Kozuki N, Blencowe H, et al. 2013. Intrapartum-related neonatal encephalopathy incidence and impairment at regional and global levels for 2010 with trends from 1990. Pediatric Research 74(1): 50–72. URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3873711/ (accessed April 2016).

Lewis G (ed). 2007. Saving Mothers' Lives: Reviewing maternal deaths to make motherhood safer – 2003–2005. The Seventh Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom. London: Confidential Enquiry into Maternal and Child Health. URL: http://www.publichealth.hscni.net/sites/default/files/Saving%20Mothers'%20Lives%202003-05%20.pdf (accessed April 2016).

Merién A, van de Ven J, Mol B, Houterman S, Oei S. Obstet Gynecol. Multidisciplinary team training in a simulation setting for acute obstetric emergencies: a systematic review. 2010 May;115(5):1021-31. URL: http://www.ncbi.nlm.nih.gov/pubmed/20410778 (accessed May 2016).

Ministry of Health. 2004. Ethnicity Data Protocols for the Health and Disability Sector. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/ethnicitydataprotocols.pdf (accessed April 2016).

Ministry of Health. 2007. Report on Maternity: Maternal and Newborn Information. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/maternityreport04.pdf (accessed April 2016).

Ministry of Health. 2010. Fetal and Infant Deaths 2006. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/fetal-and-infant-deaths-2006.pdf (accessed April 2016).

Ministry of Health. 2012a. Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines). Wellington. URL: http://www.health.govt.nz/system/files/documents/publications/referral-glines-jan12.pdf (accessed April 2016).

Ministry of Health. 2012b. Healthy Beginnings: Developing perinatal and infant mental health services in New Zealand. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/healthy-beginnings-final-jan2012.pdf.pdf (accessed April 2016).

Ministry of Health. 2014. Guidance for Healthy Weight Gain in Pregnancy. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/guidance-for-healthy-weight-gain-in-pregnancy-jun14-v2.pdf (accessed April 2016).

Ministry of Health. 2015a. Annual update of Key Results 2014/15: New Zealand Health Survey. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/annual-update-key-results-2014-15-nzhs-dec15-1.pdf (accessed April 2016).

Ministry of Health. 2015b. Report on Maternity. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/report-on-maternity-2014-dec15.pdf (accessed April 2016).

Ministry of Health. 2015c. Suicide Facts: Deaths and intentional self-harm hospitalisations 2012. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/suicide-facts-2012-may15-v2.pdf (accessed April 2016).

National Health Board Business Unit. 2011. National Maternity Collection Data Mart Data Dictionary. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/mat-dict-v1-0.pdf (accessed April 2016).

National Screening Unit. 2016. [In Progress] Antenatal screening for Down syndrome and other conditions. Monitoring report: 1 July 2010 to 30 June 2014. Wellington: Ministry of Health. URL: https://www.nsu.govt.nz/ (accessed April 2016).

National Screening Unit. (nd). About Screening Discussion Aid for Health Practitioners. Wellington: Ministry of Health. URL: https://www.nsu.govt.nz/resources/about-screening-discussion-aid-health-practitioners (accessed April 2016).

National Screening Unit. 2013 . Antenatal screening and testing for Down syndrome and other conditions. Wellington: Ministry of Health. URL: https://www.nsu.govt.nz/pregnancy-newborn-screening/antenatal-screening-down-syndrome-and-other-conditions/information (accessed April 2016).

New Zealand Health Information Service. 2007. Fetal and Infant Deaths 2003 & 2004. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/fetal200304.pdf (accessed April 2016).

NICE. 2014 Antenatal and postnatal mental health: clinical management and service guidance. The National Institute for Health and Care Excellence, NICE guidelines [CG192]. URL: https://www.nice.org.uk/guidance/cg192 (accessed April 2016).

NMMG. 2013. Annual Report 2013. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/nnmg-annual-report-2013-4-11-13_web.pdf (accessed April 2016).

NZGG. 2008. Identification of Common Mental Disorders and Management of Depression in Primary Care. An Evidence-based Best Practice Guideline. Wellington: New Zealand Guidelines Group. URL: http://www.health.govt.nz/publication/identification-common-mental-disorders-and-management-depression-primary-care (accessed April 2016).

Office for National Statistics. 2015. Deaths Registered in England and Wales: 2014. Titchfield: Office for National Statistics. URL: http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregistrationsummarytables/2015-07-15 (accessed April 2016).

Parry E, on behalf of the New Zealand Maternal Fetal Medicine Network. 2015. Multiple pregnancy. URL: http://www.healthpoint.co.nz/downloadinfo,138318,otherList,rbsj87jmuiv8xjc1vz09.do (accessed April 2016).

Petticrew M, Sowden A, Lister-Sharp D, et al. 2001. False-negative results in screening programs. Medical, psychological, and other implications. International Journal of Technology Assessment in Health Care 17(2): 164–70. URL: http://www.journalslibrary.nihr.ac.uk/hta/volume-4/issue-5#hometab0 (accessed April 2016).

PMMRC. 2007. First Report to the Minister of Health: June 2005 to June 2007. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/First-PMMRC-report-2005-07.pdf (accessed April 2016).

PMMRC. 2011. Fifth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2009. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/Fifth-PMMRC-report-2009-Lkd.pdf (accessed April 2016).

PMMRC. 2012. Sixth Annual Report of the Perinatal and Maternal Mortality Review Committee. Reporting mortality 2010. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/PMMRC-6th-Report-2010-Lkd.pdf (accessed April 2016).

PMMRC. 2014a. Eighth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2012. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/eighth-PMMRC-report-June-2014.pdf (accessed April 2016).

PMMRC. 2014b. Guidelines for the completion of the mother and baby forms following a perinatal death January 2014 Version 8. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/guidelines-mother-baby-forms-perinatal-death-v8.pdf (accessed April 2016).

PMMRC. 2015. Ninth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2013. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/Ninth-PMMRC-report-FINAL-Jun-2015.pdf (accessed April 2016).

PSANZ. 2009. Clinical Practice Guideline for Perinatal Mortality. Section 7: Perinatal Mortality Classifications. Perinatal Society of Australia and New Zealand. URL: http://www.stillbirthalliance.org.au/doc/Section_7_Version_2.2_April_2009.pdf (accessed April 2016).

RCOG. 2011. Maternal Collapse in Pregnancy and the Puerperium. Royal College of Obstetricians and Gynaecologists Green-top Guideline 56. URL: https://www.rcog.org.uk/globalassets/documents/guidelines/gtg56.pdf (accessed April 2016).

RCOG. 2016. Joining up care in maternal mental health: Setting up a perinatal mental health network. URL: https://www.rcog.org.uk/globalassets/documents/news/iwd2016/rcog-iwd2016-checklist–perinatal-mental-health-network.pdf (accessed April 2016).

Sadler L, Masson V, Armstrong S, et al. 2014. Rethinking placental pathology in the PSANZ classification of unexplained stillbirth at term? In Journal of Paediatrics and Child Health 50: Special Issue: Abstracts of the 18th Congress of the Perinatal Society of Australia and New Zealand (PSANZ), 6–9 April 2014 (p. A450 Oral Abstracts). URL: http://onlinelibrary.wiley.com/doi/10.1111/jpc.12528/full (accessed April 2016).

Salmond C, Crampton P, Atkinson J. 2007. NZDep2006 Index of Deprivation. Wellington: Department of Public Health, University of Otago. URL: http://www.otago.ac.nz/wellington/otago020337.pdf (accessed April 2016).

SIGN. 2012. SIGN 127: Management of perinatal mood disorders. Edinburgh: Scottish Intercollegiate Guidelines Network. URL: http://www.sign.ac.uk/pdf/sign127.pdf (accessed April 2016).

Statistics New Zealand. 2015. Births and Deaths: Year ended December 2014. Wellington: Statistics New Zealand. URL: http://www.stats.govt.nz/browse_for_stats/population/births/BirthsAndDeaths_HOTPYeDec14.aspx (accessed April 2016).

Sullivan E, Hall B, King J. 2008. Maternal deaths in Australia. Canberra: Australian Institute of Health and Welfare. URL: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=10737421514 (accessed April 2016).

Thongrong C, Kasemsiri P, Hofmann JP, et al. 2013. Amniotic fluid embolism. International Journal of Critical Illness and Injury Science 3(1): 51–7. URL: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC3665120 (accessed April 2016).

WHO. (nd). Maternal mortality ratio (per 100 000 live births). Geneva: World Health Organization. URL: http://www.who.int/healthinfo/statistics/indmaternalmortality/en/ (accessed April 2016).

WHO. 2006. Neonatal and Perinatal Mortality: Country, Regional and Global Estimates. Geneva: World Health Organization. URL: http://apps.who.int/iris/bitstream/10665/43444/1/9241563206_eng.pdf (accessed April 2016).

# Appendix E: Classifications of the Perinatal Society of Australia and New Zealand (PSANZ 2009)

## PSANZ Perinatal mortality classification

### PSANZ perinatal death classification (PSANZ-PDC)

**1. Congenital abnormality (including terminations for congenital abnormalities)**

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

**2. Perinatal infection**

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

**3. Hypertension**

- 3.1 Chronic hypertension: essential
- 3.2 Chronic hypertension: secondary (eg, renal disease)
- 3.3 Chronic hypertension: unspecified
- 3.4 Gestational hypertension
- 3.5 Pre-eclampsia
  - 3.51 With laboratory evidence of thrombophilia
- 3.6 Pre-eclampsia superimposed on chronic hypertension
  - 3.61 With laboratory evidence of thrombophilia
- 3.9 Unspecified hypertension

**4. Antepartum haemorrhage (APH)**

- 4.1 Placental abruption
  - 4.11 With laboratory evidence of thrombophilia
- 4.2 Placenta praevia
- 4.3 Vasa praevia
- 4.8 Other APH
- 4.9 APH of undetermined origin

**5. Maternal conditions**

- 5.1 Termination of pregnancy for maternal psychosocial indications
- 5.2 Diabetes/Gestational diabetes
- 5.3 Maternal injury
  - 5.31 Accidental
  - 5.32 Non-accidental
- 5.4 Maternal sepsis
- 5.5 Antiphospholipid syndrome
  - 5.51 Other maternal thrombophilia (if considered cause of death)
- 5.6 Obstetric cholestasis
- 5.8 Other specified maternal conditions

**6. Specific perinatal conditions**

- 6.1 Twin–twin transfusion
- 6.2 Fetomaternal haemorrhage
- 6.3 Antepartum cord complications
  - 6.31 Cord haemorrhage
  - 6.32 True knot with evidence of occlusion
  - 6.38 Other
  - 6.39 Unspecified
- 6.4 Uterine abnormalities (eg, bicornuate uterus, cervical incompetence)
- 6.5 Birth trauma (typically infants of >24 weeks gestation or >600g birthweight)
- 6.6 Alloimmune disease
  - 6.61 Rhesus
  - 6.62 ABO
  - 6.63 Kell
  - 6.64 Alloimmune thrombocytopenia

6.68 Other
6.69 Unspecified

6.7 Idiopathic hydrops

6.8 Other specific perinatal conditions
6.81 Rupture of membranes after amniocentesis
6.82 Termination of pregnancy for suspected but unconfirmed congenital abnormality
6.83 Fetal subdural haematoma
6.88 Other
6.89 Unspecified

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

7.1 With intrapartum complications
7.11 Uterine rupture
7.12 Cord prolapse
7.13 Shoulder dystocia
7.18 Other

7.2 Evidence of non-reassuring fetal status in a normally grown infant (eg, abnormal fetal heart rate, fetal scalp pH/lactate, fetal pulse oximetry without intrapartum complications)

7.3 No intrapartum complications and no evidence of non-reassuring fetal status.

7.9 Unspecified hypoxic peripartum death

**8. Fetal growth restriction (FGR)**

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

8.2 With chronic villitis

8.3 No placental pathology

8.4 No examination of placenta

8.8 Other specified placental pathology

8.9 Unspecified or not known whether placenta examined

**9. Spontaneous preterm (<37 weeks gestation)**

9.1 Spontaneous preterm with intact membranes or membrane rupture <24 hours before delivery
9.11 With chorioamnionitis confirmed on placental histopathology
9.12 Without chorioamnionitis on placental histopathology
9.13 With clinical evidence of chorioamnionitis, no examination of placenta
9.17 No clinical signs of chorioamnionitis, no examination of placenta
9.19 Unspecified or not known whether placenta examined

9.2 Spontaneous preterm with membrane rupture >24 hours before delivery
9.21 With chorioamnionitis confirmed on placental histopathology
9.22 Without chorioamnionitis on placental histopathology
9.23 With clinical evidence of chorioamnionitis, no examination of placenta
9.27 No clinical signs of chorioamnionitis, no examination of placenta
9.29 Unspecified or not known whether placenta examined

9.3 Spontaneous preterm with membrane rupture of unknown duration before delivery
9.31 With chorioamnionitis confirmed on placental histopathology
9.32 Without chorioamnionitis on placental histopathology

9.33 With clinical evidence of chorioamnionitis, no examination of placenta

9.37 No clinical signs of chorioamnionitis, no examination of placenta

**10. Unexplained antepartum death**

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

10.2 With chronic villitis

10.3 No placental pathology

10.4 No examination of placenta

10.8 Other specified placental pathology

10.9 Unspecified or not known whether placenta examined

**11. No obstetric antecedent**

11.1 Sudden infant death syndrome (SIDS)

11.11 SIDS Category IA: classic features of SIDS present and completely documented

11.12 SIDS Category IB: classic features of SIDS present but incompletely documented

11.13 SIDS Category II: infant deaths that meet Category I except for one or more features

11.2 Postnatally acquired infection

11.3 Accidental asphyxiation

11.4 Other accident, poisoning or violence (postnatal)

11.8 Other specified

11.9 Unknown/Undetermined

11.91 Unclassified sudden infant death

11.92 Other unknown/undetermined

## PSANZ neonatal death classification (PSANZ-NDC)

**1. Congenital abnormality (including terminations for congenital abnormalities)**

1.1 Central nervous system

1.2 Cardiovascular system

1.3 Urinary system

1.4 Gastrointestinal system

1.5 Chromosomal

1.6 Metabolic

1.7 Multiple/Non-chromosomal syndromes

1.8 Other congenital abnormality

1.81 Musculoskeletal

1.82 Respiratory

1.83 Diaphragmatic hernia

1.84 Haematological

1.85 Tumours

1.88 Other specified congenital abnormality

1.9 Unspecified congenital abnormality

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

2.1 Not resuscitated

2.2 Unsuccessful resuscitation
2.9 Unspecified or not known whether resuscitation attempted

**3. Cardio-respiratory disorders**

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

**4. Infection**

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

**5. Neurological**

5.1 Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)

5.2 Intracranial haemorrhage

- 5.21 Intraventricular haemorrhage
- 5.22 Subgaleal haemorrhage
- 5.23 Subarachnoid haemorrhage
- 5.24 Subdural haemorrhage
- 5.28 Other intracranial haemorrhage

5.8 Other

**6. Gastrointestinal**

6.1 Necrotising enterocolitis

6.8 Other

**7. Other**

7.1 Sudden infant death syndrome (SIDS)

- 7.11 SIDS Category IA: classic features of SIDS present and completely documented
- 7.12 SIDS Category IB: classic features of SIDS present but incompletely documented
- 7.13 SIDS Category II: infant deaths that meet Category I except for one or more features

7.2 Multisystem failure

- 7.21 Secondary to intrauterine growth restriction
- 7.28 Other specified
- 7.29 Unspecified/Undetermined primary cause or trigger event

7.3 Trauma

- 7.31 Accidental
- 7.32 Non-accidental
- 7.39 Unspecified

7.4 Treatment complications

- 7.41 Surgical
- 7.42 Medical

7.8 Other specified

7.9 Unknown/Undetermined

- 7.91 Unclassified sudden infant death
  - 7.911 Bed sharing
  - 7.912 Not bed sharing
- 7.92 Other unknown/undetermined

# Appendix F: PMMRC Classification of Contributory Factors and Potential Avoidability (2014 Version)

## Systems review – contributory factors

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

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

**Have any organisational and/or management factors been identified?**

(eg, inadequate supervision of staff, lack of appropriate clinical management protocols or guidelines, lack of communication between services) **Yes** ☐ **No** ☐

*If 'yes' please classify – select ALL relevant:*

| | | |
|---|---|---|
| Poor organisational arrangements of staff | ☐ | ☐ |
| Inadequate education and training | ☐ | ☐ |
| Lack of policies, protocols or guidelines | ☐ | ☐ |
| Inadequate numbers of staff | ☐ | ☐ |
| Poor access to senior clinical staff | ☐ | ☐ |
| Failure or delay in emergency response | ☐ | ☐ |
| Delay in procedure (eg, caesarean section) | ☐ | ☐ |
| Delayed access to test results or inaccurate results | ☐ | ☐ |
| Inadequate systems/process for sharing of clinical information between services | ☐ | ☐ |
| Equipment (eg, faulty equipment, inadequate maintenance, quality of or lack of equipment) | ☐ | ☐ |
| Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location) | ☐ | ☐ |

Other – if other please state or provide any comments:

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

(eg, staff factors relating to professional care and service provision)

*If 'yes' please classify – select ALL relevant:*

| | | |
|---|---|---|
| Knowledge and skills of staff were lacking | ☐ | ☐ |
| Delayed emergency response by staff | ☐ | ☐ |
| Failure to maintain competence | ☐ | ☐ |
| Communication between staff was inadequate | ☐ | ☐ |
| Failure to seek help/supervision | ☐ | ☐ |
| Failure to follow recommended best practice | ☐ | ☐ |
| Lack of recognition of complexity or seriousness of condition by caregiver | ☐ | ☐ |

Other – if other please state or provide any comments:

**Have barriers to access and/or engagement with care been identified?** **Yes** ☐ **No** ☐

(eg, no, infrequent or late booking for antenatal care, woman declined treatment/advice)

*If 'yes' please classify – select ALL relevant:*

| | | |
|---|---|---|
| No antenatal care | ☐ | ☐ |
| Infrequent care or late booking | ☐ | ☐ |
| Declined treatment or advice | ☐ | ☐ |
| Obesity impacted on delivery of optimal care (eg, ultrasound scan) | ☐ | ☐ |
| Substance use | ☐ | ☐ |
| Family violence | ☐ | ☐ |
| Lack of recognition by the woman or family of the complexity or seriousness of condition | ☐ | ☐ |

| | | |
|---|---|---|
| Maternal mental illness | ☐ | ☐ |
| Cultural barriers | ☐ | ☐ |
| Language barriers | ☐ | ☐ |
| Not eligible to access free care | ☐ | ☐ |
| Environment (eg, isolated, long transfer, weather prevented transport) | ☐ | ☐ |

Other – if other, please state or provide any comments:

| |
|---|
| |

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

Complete this after considering the selected contributory factors above.

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

| | | |
|---|---|---|
| Organisation and/or management | ☐ | ☐ |
| Personnel | ☐ | ☐ |
| Barriers to access and/or engagement with care | ☐ | ☐ |

**Name of person completing this form:**

**Contact person for additional information:**

**Phone number:**

**Signed:**

**Date:**

# Appendix G: PMMRC DHB Local Coordinators (April 2016)

| DHB | DHB local coodinator | Contact details |
|---|---|---|
| Northland | **Yvonne Morgan** Clinical Charge Midwife<br>**Dr Kristy Wolff** Obstetrician | Whangarei Hospital |
| Waitemata | **Dr Sue Belgrave** Clinical Director of Obstetrics<br>**Sharon Williams** Midwife<br>**Carol Chamley** Midwife | North Shore Hospital<br><br>Waitakere Hospital |
| Auckland | **Professor Lesley McCowan** Obstetrician<br>**Teresa Krishnan** Midwife Manager | Auckland City Hospital |
| Counties Manukau | **Dr Sarah Wadsworth** Obstetrician<br>**Dr Graeme Parry** Obstetrician<br>**Debbie Davies** Midwife | Middlemore Hospital |
| Waikato | **Dr Sarah Waymouth** Obstetrician<br>**Tracey Williams** Midwife | Waikato Hospital |
| Bay of Plenty | **Margret Norris** Midwife Leader | Tauranga Hospital |
| Lakes | **Amanda Griffiths** Midwife | Rotorua Hospital |
| Tairawhiti | **Sheila Noakes** Midwife<br>**Maryclare Reilly** Midwife | Gisborne Hospital |
| Taranaki | **Sharon Howe** Midwife<br>**Belinda Chapman** Midwife | Taranaki Base Hospital |
| Hawke's Bay | **Dr Lynda Croft** Obstetrician<br>**Sara Paley** Midwifery Educator | Hawke's Bay Hospital |
| Whanganui | **Lucy Pettit** Midwife<br>**Jo McDonnell** Midwife | Whanganui Hospital |
| MidCentral | **Carole Collins** Midwife Educator<br>**Dr Steven Grant** Consultant Obstetrician | Palmerston North Hospital |
| Wairarapa | **Michelle Thomas** Midwife | Masterton Hospital |
| Capital & Coast | **Dr Rose Elder** Consultant Obstetrician<br>**Hazel Irvine** Midwife | Wellington Hospital |
| Hutt Valley | **Joanne McMullan** Midwife | Hutt Hospital |
| Nelson Marlborough | **Lois McTaggart** Clinical Midwife Leader<br>**Graham Cross** Midwife | Nelson Hospital<br>Wairau Hospital |
| West Coast | **Denise Stacey** Midwife | Grey Base Hospital |
| Canterbury | **Dianne Leishman** Midwife<br>**Sonya Matthews** Midwife | Christchurch Women's Hospital |
| South Canterbury | **Hanna Leier** Midwife | Timaru Hospital |
| Southern | **Helen Flockton** Charge Midwife<br>**Sheridan Massey** Midwife<br>**Tracey Morris** Midwife<br>**Dr Jana Morgan** Obstetrician<br>**Jenny Humphries** Director of Nursing and Midwifery<br>**Melanie McTainsh** Midwife | Dunedin Hospital<br><br><br><br><br>Southland Hospital |

Perinatal and Maternal Mortality Review Committee

*He matenga ohorere, he wairua uiui, wairua mutungakore*

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