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

Eleventh Annual Report of the Perinatal and Maternal Mortality Review Committee

Reporting mortality and morbidity 2015

Seventh Report to the Health Quality & Safety Commission New Zealand

JUNE 2017

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- the lead maternity carers and district health board (DHB) clinicians throughout New Zealand and the local coordinators within each DHB who completed the rapid reporting and classification forms that provided the data within this report
- the PMMRC National Coordination Service, managed by Professor Cindy Farquhar, which includes:
    - Vicki Masson, the national coordinator of the PMMRC, who ensured the sets of mothers and infants were complete and that the dataset was as complete and accurate as possible, and assisted in preparation of the report
    - Dr Lynn Sadler, epidemiologist at Auckland DHB and the University of Auckland, who designed the analysis and prepared the report
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- the Maternal Morbidity Working Group (MMWG), who contributed the maternity morbidity chapter
- Dr Lee Taylor, who provided peer review on an earlier version of the report. This final report does not necessarily reflect her views
- the Health Quality & Safety Commission, which has been involved in all stages of the development of this report.

Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) members in 2017 are:

- Dr Sue Belgrave (Chair), obstetrician, Waitemata DHB
- Dr Max Berry, neonatologist, University of Otago, Wellington
- Associate Professor Sue Crengle, general practitioner, public health physician, Department of Social and Preventive Medicine, Dunedin School of Medicine, Invercargill
- Ms Alison Eddy (Deputy Chair), midwife, Christchurch
- Dr Rose Elder, obstetrician and gynaecologist, 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 2017 are:

- Dr Sarah Wadsworth (Chair), obstetrician, Counties Manukau DHB
- Dr Sue Belgrave (Chair PMMRC)
- Dr Eileen Bass, physician, Hutt Valley DHB
- 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
- Jo McMullan, midwife, Capital & Coast DHB
- Dr Kate White, pathologist, MidCentral DHB.

Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group (NEWG) members in 2017 are:

- Dr Jutta van den Boom (Chair), neonatal paediatrician, Waitemata DHB
- Dr Malcolm Battin, neonatal paediatrician, Auckland DHB
- Dr Astrid Budden, obstetrician and gynaecologist, Auckland DHB
- Ms Anja Hale, neonatal nurse practitioner, Waikato DHB
- Ms Anne Jackson, neonatal nurse practitioner, Canterbury DHB
- Ms Gail McIver, midwife, Counties Manukau DHB
- Ms Suzanne Miller, midwife, Wellington
- Dr Thorsten Stanley, paediatrician, Capital & Coast DHB
- Dr Kristy Wolff, obstetrician and gynaecologist, Northland DHB.

Maternal Morbidity Working Group

The Maternal Morbidity Working Group (MMWG) members in 2017 are:

- Arawhetu Gray (Co-Chair), planning and funding, Capital & Coast DHB
- Mr John Tait (Co-Chair), chief medical officer, Capital & Coast DHB
- Pauline Dawson, research midwife, Dunedin School of Medicine
- Dr Lesley Dixon, midwife, New Zealand College of Midwives
- Dr Matthew Drake, anaesthetist, Auckland DHB
- Prof Cindy Farquhar, obstetrician and gynaecologist, University of Auckland
- Jim Green, chief executive officer, Hauora Tairāwhiti
- Dr Seton Henderson, intensivist, Canterbury DHB
- Dr Claire McLintock, haematologist and obstetric physician, Auckland DHB
- Linda Penlington, consumer representative
- Dr Craig Skidmore, gynaecologist and obstetrician, Hawke's Bay DHB
- Jenny Warren, consumer representative.

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Foreword

The Health Quality & Safety Commission (the Commission) welcomes the 11th 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 2015; perinatal mortality from 2007 to 2015; maternal mortality from 2006 to 2015; and babies with neonatal encephalopathy from 2010 to 2015.

In this report the PMMRC have also introduced data and discussion related to Māori. We need to focus our lens on outcomes for Māori mothers and infants, as the inequity between Māori and non-Māori continues. The outlying causes of stillbirth and neonatal death among babies of Māori mothers are spontaneous preterm birth, antepartum haemorrhage, maternal conditions (mostly diabetes-related), and hypertension. There is a significantly higher, almost double, maternal mortality ratio among Māori mothers than New Zealand European mothers. Tragically, Māori women are over-represented among maternal suicides. The main contributory factors amongst these deaths continue to be barriers to access and/or engagement with care, which the PMMRC will be working with the sector to improve.

Also new to the PMMRC report is the work of the Maternal Morbidity Working Group (MMWG). In May 2016 we welcomed this working group dedicated to reducing maternal morbidity to the PMMRC. The MMWG transitioned to the Commission from the existing Severe Acute Maternal Morbidity (SAMM) research group based at the University of Otago. Supported and funded by the Ministry of Health, the group will be active through to June 2019. The MMWG is responsible for nationally reviewing incidences of women who are pregnant or have recently delivered who are also very ill, and developing quality improvement initiatives alongside the maternal health services. This group is supporting the work of the PMMRC to improve the quality and experience of maternity care for women, babies and whānau, informed by robust, consistent, reportable and women-centred maternal morbidity review.

The perinatal related mortality rate in 2015 is the lowest reported since the PMMRC began collecting data in 2007 and is significantly lower than the rate for the years 2007–2014 combined.

We are pleased to report a statistically significant reduction in fetal deaths (stillbirths and late terminations of pregnancy combined) from 2007 to 2015, and an ongoing statistically significant reduction in stillbirths.

The neonatal death rate has not changed significantly in New Zealand from 2007 to 2015, and note that the PMMRC have indicated that this will be a key are of investigation for 2017–2018. There have been significant reductions in neonatal mortality in the United Kingdom (UK), Australia and Scandinavia, and we will look to learn from those experiences.

This report would not be possible without the substantial contribution of a dedicated team of people: the local coordinators across the country who provide these data; Dr Sue Belgrave and the PMMRC; the National Coordination Service based at the University of Auckland; the New Zealand Mortality Review Data Group based at 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 is the 11th annual report of the Perinatal and Maternal Mortality Review Committee (the PMMRC) and my fourth as Chair.

We acknowledge the grief of families and whānau who have lost babies and mothers in 2015. Their information is presented in this report. The goal of the PMMRC is not only to accurately report mortality and morbidity but also to work with the wider maternity community to reduce deaths and enhance maternity care in New Zealand. We report on perinatal deaths from 2007 to 2015, maternal deaths from 2006–2015, and babies with neonatal encephalopathy from 2010 to 2015.

The perinatal related mortality rate in 2015 (9.7/1000 births) is the lowest reported since the PMMRC began collecting data in 2007. However, the trend in overall perinatal related mortality is not statistically significant. A statistically significant reduction in stillbirths continues to be evident, and a statistically significant reduction in fetal death (stillbirths and late terminations of pregnancy combined) is reported for the first time.

New initiatives in the 2017 report are the development of a Māori chapter, a change in dataset to enable multivariable analysis, and an initial report of the Maternal Morbidity Working Group (MMWG).

This year we include a chapter on Māori perinatal and maternal mortality in collaboration with the Mortality Review Committees' Māori Caucus. The main areas of concern for Māori are the maternal suicide rate, especially of young Māori women, and the loss of babies to very preterm labour.

The PMMRC has recommended in previous reports that the New Zealand National Maternity Collection (MAT) dataset be available in order to report independent associations of perinatal death. The change of denominator from the Births, Deaths and Marriages (BDM) birth registration dataset to the MAT dataset has allowed us to use more clinical information but unfortunately not to perform multivariable analysis of perinatal related deaths as planned. This analysis was unable to adjust adequately for differences in the populations of women living in different DHBs across the country with regard to smoking, BMI, and parity due to missing registration data among women under DHB primary maternity services at some DHBs. The missing data from some DHBs in the MAT dataset is selectively from the women who are most likely to suffer a perinatal loss. Without this information, we are unable to make valid comparisons of care and outcomes between DHBs.

In 2015 we report an unusually high number of deaths at 41 weeks. A further review of these deaths has highlighted the importance of risk assessment leading up to term and appropriate induction of labour for recognised indications. This is a topic for discussion at our annual conference and has led to a recommendation for an interdisciplinary consensus guideline on induction of labour.

The neonatal mortality rate is unchanged over the time we have been reporting. However, there has been a reduction in other countries. This will be a focus in our next report.

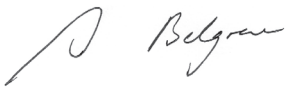
The establishment of the MMWG is an important initiative with the aim of reducing the incidence and severity of acute severe maternal morbidity. The initial areas of focus are maternal sepsis and unplanned peripartum hysterectomy. The in-depth reviews with inclusion of women's stories will guide recommendations for improvement in care.

There has been no significant change in the maternal death rate since the PMMRC began reporting in 2006. Our challenges are our rates of suicide and deaths from amniotic fluid embolism. Work with the

Ministry of Health is continuing on the Perinatal and Infant Mental Health Network, and the PMMRC supports the wider national review on suicide. Amniotic fluid embolism will be discussed further at our conference this year, and we include the practice point from the 10th report to highlight the importance of early recognition and management.

Although there appears to be a downward trend in rates of neonatal encephalopathy (NE) from 2010–2015, it is not statistically significant. NE is associated with maternal ethnicity, socioeconomic deprivation, gestation, birthweight and nulliparity. The framework for assessment of potential avoidability in reviews of NE has highlighted areas for improvement in care and has informed and assisted the establishment of the Neonatal Encephalopathy Taskforce, which has the long-term aim of reducing the burden of NE on New Zealand families.

We also recognise the challenges of the clinicians working with women and their families and whānau.



Dr Sue Belgrave

Chair, Perinatal and Maternal Mortality Review Committee

Parents, Families, Whānau

This foreword is designed for parents, families and whānau of the babies who died during the 2015 year.

Let me introduce myself. My name is Linda and my eldest daughter died shortly after birth. Her name was Georgia, and she fell into the 'unexplained death' category at the time (1999). I sit on the PMMRC and my job with this group is to represent you and me: bereaved parents. So, chances are, you and I understand child loss in a way that not all clinicians do. This is not a position any of us wanted to be in, or have any idea how to live with in the beginning. The shock and grief can seem to be a bottomless pit, and the unfairness of it all seems overwhelming.

This report from the PMMRC is the 11th annual edition of the report. What is becoming clear to those of us who work with the PMMRC is that positive, measurable changes are occurring in the mortality rate for our families here in New Zealand. There will sadly, and unavoidably, be deaths for our babies (and sometimes their mothers), but the purpose of this review group, and this report each year, is to see where and when we can make changes to the way we do things to try to minimise those deaths.

The PMMRC investigates all processes involved in the delivery of a baby. Everything is considered, from the medical details about the baby and the mother, the staff involved, the processes, the equipment and resources, the size of hospital where the mother lived, the transportation to a bigger hospital (if required) and even the weather, if this played a part. This is done through a review of your baby's case within your own district health board (DHB) shortly after your baby died. 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. Each individual death is added to the national information so that trends can be identified.

As well as scrutinising the medical issues in each death, we also look at the processes from when a mother registers with antenatal care, the processes during the delivery of your baby, the personnel involved at each level, how information about risk is communicated to you the families, and how systems can be improved in all of those stages. There is a huge amount of information collected about each mother and baby, from before pregnancy, during pregnancy and in the weeks after birth. All of this complex information takes time to sort through, and it takes even more time to accumulate enough information over a few years to start to see trends.

In a nutshell, we can begin to see what possibly went wrong in some deaths, and therefore make changes to prevent future losses. In 2015 there were fewer deaths of babies up to 28 days of age than any other year since reporting began in 2007.

I realise that if you are reading this, then things have probably not gone well for you. Let me explain why your baby's short life and your whole experience make a difference.

Without all the details of your pregnancy, we cannot learn how to try to avoid this happening again, either to you or to other families with circumstances similar to yours. Sometimes, it is only in hindsight that we can try to understand the complications that led to a loss. This is why your story, and the stories of other families, are so important to ongoing understanding of perinatal loss.

Post-mortem examinations are valuable to help find why a baby has died. In my own case, I was hugely relieved to find that there was nothing I could have done to stop Georgia's death, and that I did not accidentally do something to make her sick. My partner and I were also desperate to know if any future baby of ours was going to die. Whilst there was no guarantee, we got some relief when we learned that there were no congenital (inherited) problems and that we could go ahead and have more babies. So, along with a post-mortem providing information to add to that obtained from other babies' deaths to help the PMMRC with review, it was for us as parents the only source of courage we had to try and have a

healthy baby (incidentally, we went on to have live twins five years later).

On behalf of the PMMRC, I want to say how desperately sorry we are that you are in this position. From my own point of view, I get it. Your loss is a massive life-changing event, and it can seem overwhelming. Sands is an international organisation here in New Zealand designed to support you and your family. Go to www.sands.org.nz for information on physical support groups in your area, virtual support groups online, and a host of articles and reading materials that you may find helpful. I can tell you that whilst your pain will not lessen, it does get easier to carry around over time.

This may have been a little life, but is not a little loss. Many thanks for reading this, and I hope it has helped you understand how the PMMRC and the maternity services in New Zealand are working to improve outcomes for our mothers and babies.

Kia kaha.

Linda Penlington

Executive Summary and Recommendations

Terms of Reference and Mortality Definitions PMMRC

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 ongoing 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 that occurs up until midnight of the 27th day of life. **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 midnight of the sixth day of life.

Perinatal related mortality is fetal deaths (including terminations of pregnancy and stillbirths) and neonatal deaths (up to midnight of the 27th day of life) per 1000 total babies born at 20 weeks or beyond, or weighing at least 400g if gestation was unknown.

A **maternal death** is the death of a woman while pregnant or within 42 days of termination of pregnancy (miscarriage, termination or birth), 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.

Findings 2017 Report (Data 2015)

Significant changes to the report 2017

1. The 11th report introduces chapters on Māori perinatal and maternal mortality and the Maternal Morbidity Working Group (MMWG).

2. The New Zealand National Maternity Collection (MAT) dataset has been substituted for the Births, Deaths and Marriages (BDM) birth registration dataset as the denominator for analyses because it is the most complete record of births in a year and it contains more maternity clinical data.

Demography

3. From 2007 to 2015, there was a reduction in mothers under 20 years old, fewer mothers smoking, and fewer births at 40 and 41+ weeks among all births in New Zealand.

4. The change to using the MAT denominator in place of birth registrations has made a difference to the associations seen between ethnicity and perinatal related mortality. It is not known whether the ethnicity variable derived in the MAT dataset is the best approximation of self-defined ethnicity.

Perinatal related mortality

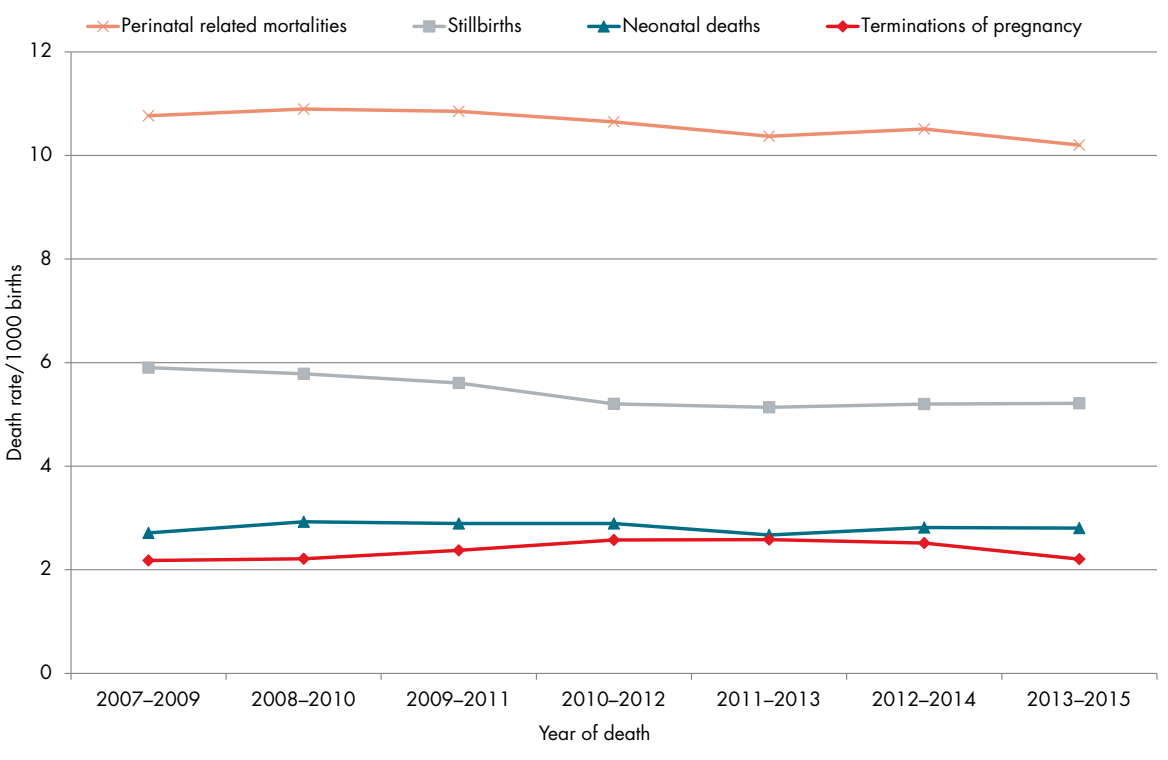
5. The perinatal related mortality rate in 2015, at 9.7/1000 births, is the lowest reported since the PMMRC began collecting data in 2007, but the test for trend is not statistically significant over this time. The rate in 2015 is, however, significantly lower than the rate for the years 2007–2014 combined (p=0.025), and the overall perinatal related mortality rate at 10.0 and 9.7/1000 in two of the past three years was lower than in any single year from 2007 to 2012.

Summary of New Zealand perinatal mortality rates 2015 (Table 3.1)

	Using NZ definition		Using UK definition*	
	n	Rate	n	Rate
Total births	59,808		59,551	
Fetal deaths (terminations of pregnancy and stillbirths)#	412	6.89	-	-
Terminations of pregnancy	107	1.79	-	-
Stillbirths	305	5.10	212	3.56
Early neonatal deaths <7 days	131	2.21	76	1.28
Late neonatal deaths 7–27 days	35	0.59	34	0.57
Neonatal deaths <28 days+	166	2.79	110	1.85
Perinatal mortalities^	543	9.08	288	4.84
Perinatal related mortalities•	578	9.66	322	5.41
Perinatal mortalities excluding lethal and terminated fetal abnormalities~	402	6.72	249	4.18
Perinatal related mortalities excluding lethal and terminated fetal abnormalities~	420	7.02	266	4.47

*Rates calculated using UK definition for perinatal mortality: births from 24 weeks excluding terminations of pregnancy (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 Perinatal Society of Australia and New Zealand perinatal death classification (PSANZ-PDC) of congenital abnormality and neonatal deaths with Perinatal Society of Australia and New Zealand neonatal death classification (PSANZ-NDC) of congenital abnormality.

Perinatal related mortality rolling three-year rates (per 1000 births) using New Zealand definitions 2007–2015 (Figure 3.2)



6. There is an ongoing statistically significant reduction in stillbirths from 2007 to 2015 (chi-squared test for trend p=0.0099).

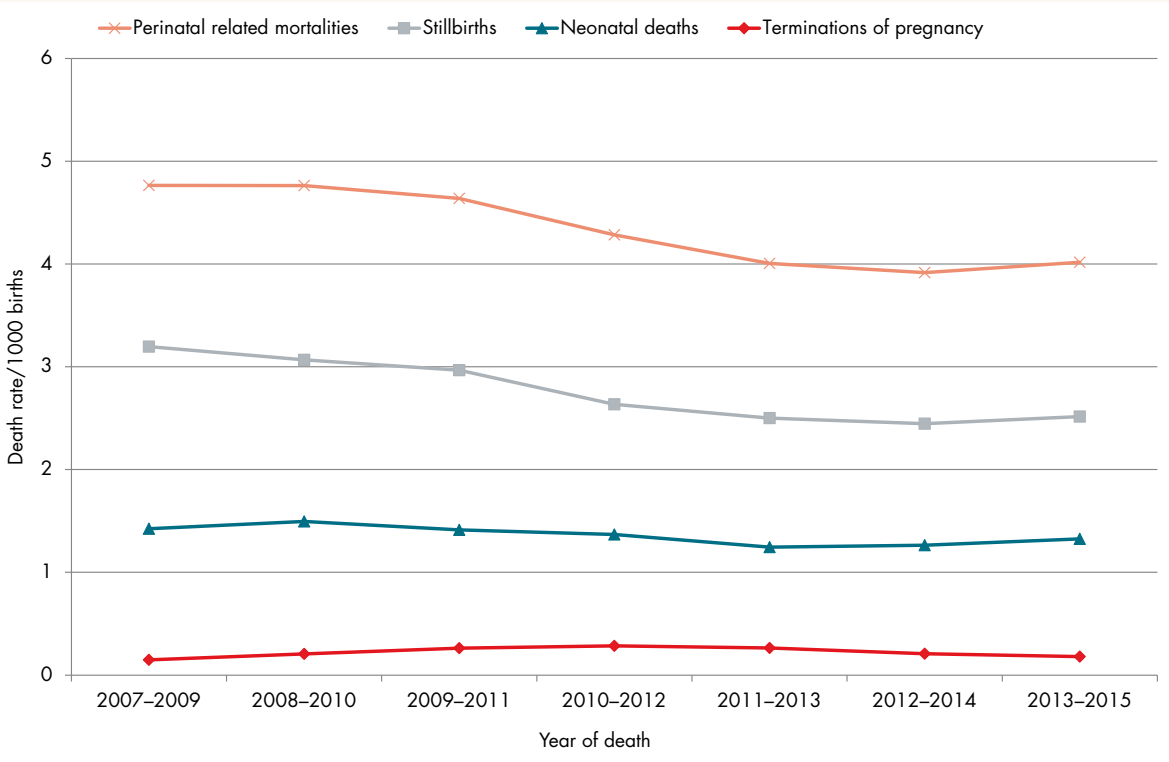
7. There is a statistically significant reduction in fetal deaths (stillbirths and late terminations of pregnancy combined) reported for the first time, from 2007 to 2015 (chi-squared test for trend p=0.035).

8. The late termination of pregnancy rate in 2015 was lower than any previously reported year (1.8/1000 births) and significantly lower than the years 2007–2014 combined (p=0.004), although the test for trend is not statistically significant.

9. There is a significant reduction in hypoxic peripartum deaths among total perinatal related deaths (births from 20 weeks) from 2007 to 2015 (chi-squared test for trend p=0.00031) and a trend to reduced deaths from fetal growth restriction (chi-squared test for trend p=0.053).

10. There is a significant reduction in stillbirths (p=0.00023), fetal deaths (p=0.0006) and overall perinatal related mortality rate (p=0.0011) using the international definition (≥1000g or 28 weeks if birthweight is unknown).

Perinatal related mortality rolling three-year rates (per 1000 births) using international definitions 2007–2015 (Figure 3.3)



11. Statistically significant reductions in hypoxic peripartum death (p=0.0003), and death from antepartum haemorrhage (p=0.031) and fetal growth restriction (p=0.015) are in part responsible for the significant reduction in perinatal related mortality using the international definition (from 1000g or 28 weeks if birthweight is unknown).

12. The neonatal death rate has not changed significantly in New Zealand from 2007 to 2015. This will be investigated in detail in 2017–2018. Meanwhile there have been significant reductions in neonatal mortality in the UK (from 2004 to 2014), Australia, and Scandinavia.

13. Mothers in their first pregnancy have higher stillbirth and neonatal death rates compared to women who are having their second birth, and mothers in their fourth or later pregnancies have higher rates of stillbirth compared to women who are having their second birth.

14. Multivariable analysis of perinatal related deaths from 2008 to 2015 showed that maternal ethnicity, age, deprivation decile, and multiple pregnancy were, variably, independent predictors of late termination of pregnancy, stillbirth and/or neonatal death. (It should be noted however that the numerator denominator bias arising from use of ethnicity derived from the PMMRC dataset in the numerator and MAT dataset in the denominator in this analysis may have led to inaccurate estimates of risk. This issue is outlined and discussed with regard to Māori mothers and babies in the Māori chapter. It is expected that this issue can be resolved by the inclusion of birth registration ethnicity data (BDM) in the MAT dataset in future years (as recommended again this year as it related specifically to Māori, by the Mortality Review Committees' Māori Caucus)).

Adjusted odds ratios for perinatal related mortality, termination of pregnancy, stillbirth, and neonatal death 2011–2015 (Table 3.12)

	Perinatal related mortality			Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirth			Neonatal mortality		
	n=494,210			n=494,210			n=494,210			n=490,578		
	OR adjusted	95%CI		OR adjusted	95%CI		OR adjusted	95%CI		OR adjusted	95%CI	
Ethnicity*												
Māori	0.90	0.83	0.97	0.53	0.44	0.64	0.93	0.83	1.03	1.18	1.02	1.36
Pacific	1.09	1.00	1.20	0.65	0.52	0.82	1.17	1.03	1.33	1.32	1.11	1.57
Indian	1.50	1.32	1.71	1.36	1.04	1.78	1.46	1.21	1.75	1.74	1.36	2.22
Other Asian	0.94	0.84	1.05	1.30	1.07	1.57	0.76	0.64	0.90	0.91	0.72	1.15
Other	0.69	0.62	0.77	0.76	0.62	0.93	0.69	0.59	0.81	0.62	0.49	0.78
New Zealand European	1.00			1.00			1.00			1.00		
Age#												
<20	1.62	1.45	1.81	1.62	1.25	2.12	1.49	1.28	1.75	1.81	1.49	2.20
20–24	1.11	1.01	1.21	1.18	0.97	1.43	1.11	0.98	1.25	1.05	0.89	1.23
25–29	1.00			1.00			1.00			1.00		
30–34	0.97	0.89	1.05	1.03	0.87	1.23	1.00	0.89	1.12	0.85	0.73	1.00
35–39	1.19	1.09	1.30	1.29	1.07	1.55	1.16	1.02	1.31	1.17	0.99	1.38
≥40	1.51	1.32	1.72	1.80	1.38	2.34	1.47	1.22	1.78	1.34	1.03	1.74
Deprivation decile# (per unit)	1.05	1.03	1.06	0.99	0.97	1.02	1.05	1.03	1.07	1.08	1.06	1.11
Year of birth#	0.99	0.98	1.01	1.00	0.97	1.03	0.99	0.97	1.00	1.00	0.98	1.03
Sex+												
Male	1.00			1.00			1.00			1.00		
Female	0.95	0.90	1.00	1.03	0.91	1.16	0.97	0.90	1.05	0.85	0.76	0.94
Multiple pregnancy*	4.28	3.91	4.69	2.07	1.60	2.67	4.01	3.52	4.56	6.73	5.80	7.81

* Data for numerator from the PMMRC dataset.
# Data for numerator from the MAT dataset.
+ Data for numerator from the MAT dataset, then the PMMRC dataset if MAT data are missing.
OR = odds ratio.
CI = confidence interval.

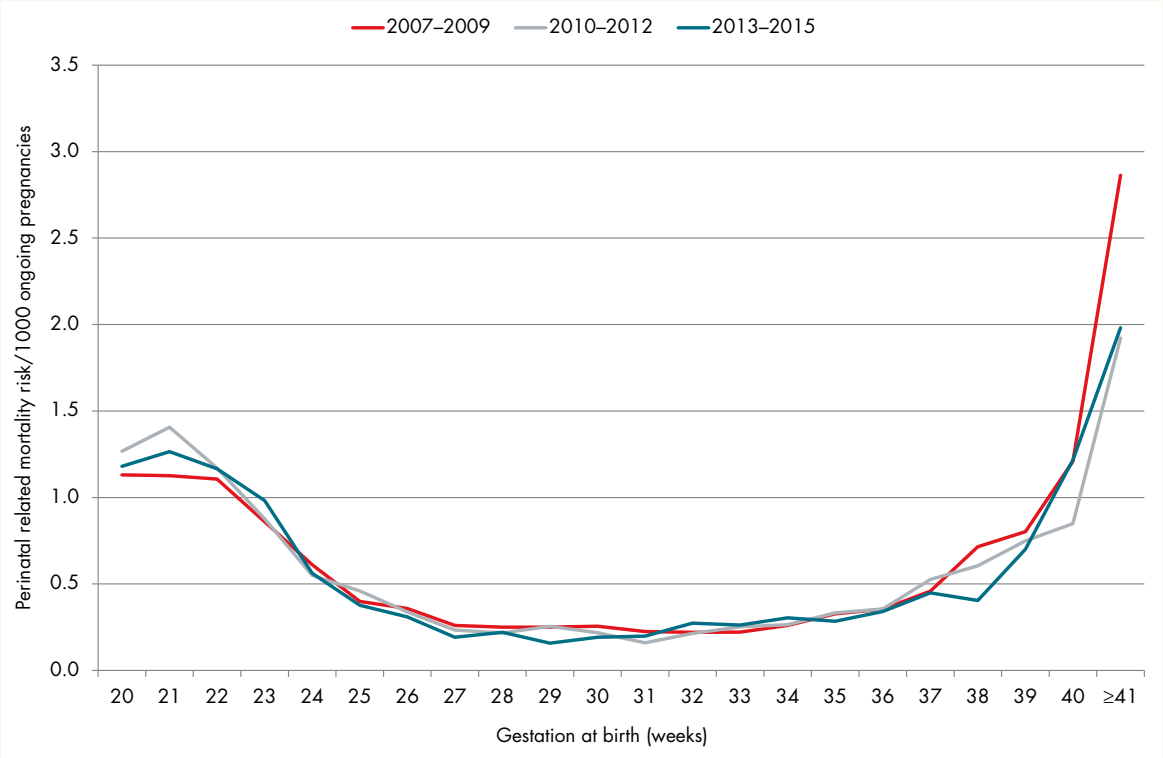
15. There is a significantly higher rate of perinatal related mortality than the national rate among residents of Counties Manukau DHB. There is a significantly higher stillbirth rate than the national rate among residents of Counties Manukau DHB. There is a significantly higher neonatal death rate than the national rate among residents of Counties Manukau and Waikato DHBs.

16. There continues to be a statistically significant reduction in perinatal related death at 37–38 weeks (p=0.025) and at 41 weeks and above (p=0.047) and a significant reduction in stillbirths at 37–40 weeks (p=0.0018) from 2007 to 2015 using chi-squared test for trend. The rate of stillbirth at 41 weeks and beyond for 2015 is higher than in any year from 2007 to 2014.

    a. Review of the 17 stillbirths in 2015 from 41 weeks without congenital abnormality, against the *Auckland Consensus Guideline on Induction of Labour* (Wise et al 2014) and against best practice for antenatal assessment in women with risk factors, found the care provided did not follow the guideline and/or best practice in 6 of the 17 stillbirths. This related to best practice

to perform serial growth scans following antepartum haemorrhage; best practice for obstetric review and/or to perform serial growth scans for BMI >35 in three pregnancies; and to offer induction of labour for diabetes with suspected small for gestational age (SGA) pregnancies, and for hypertension.

Perinatal related mortality risk by gestational age at birth and year (per 1000 ongoing pregnancies) 2007–2015 (Figure 3.15)



17. In 2015, one-quarter of perinatal related deaths were determined at local review to have contributory factors, and just over half of these (14 percent) were determined to be potentially avoidable deaths.

Investigation of perinatal related mortality

18. In 2015, 52 percent of babies who died in the perinatal period were optimally investigated (Table 3.57). Of the remainder, 8 percent were not investigated and 40 percent were partially investigated. There is a statistically significant increase from 2007 to 2015 in optimal investigation among perinatal related deaths, an increase in partial investigation, and a decrease in no investigation.

19. Perinatal death investigation continues to be significantly less frequent among babies of Māori and Pacific mothers than other ethnicities (20 percent had no investigation).

20. In 2015, data on the usefulness of post-mortem were available for 205 (83 percent) of deaths where post-mortem was performed, showing that in 118 deaths (48 percent) the post-mortem confirmed the clinical diagnosis, in 40 (16 percent) the post-mortem changed the diagnosis and resulted in altered counselling to parents for future pregnancies, in 27 (11 percent) additional information was gained but this did not change the clinical diagnosis, and in 20 (8 percent) of deaths, the post-mortem was non-contributory.

Maternal mortality

21. In 2015, 11 deaths within the definition of maternal mortality were reported to the PMMRC. One coincidental death was reported in 2015.

22. The maternal mortality ratio in New Zealand was 15.6/100,000 maternities (95% confidence interval (CI) 10.8–22.5/100,000) for the three years 2013–2015. There has been no statistically significant change in maternal mortality ratio in New Zealand since data collection by the PMMRC began in 2006 (chi-squared test for trend p=0.25).

Maternal mortality ratios (per 100,000 maternities) (rolling one-year and three-year) 2006–2015 (Figure 4.2)

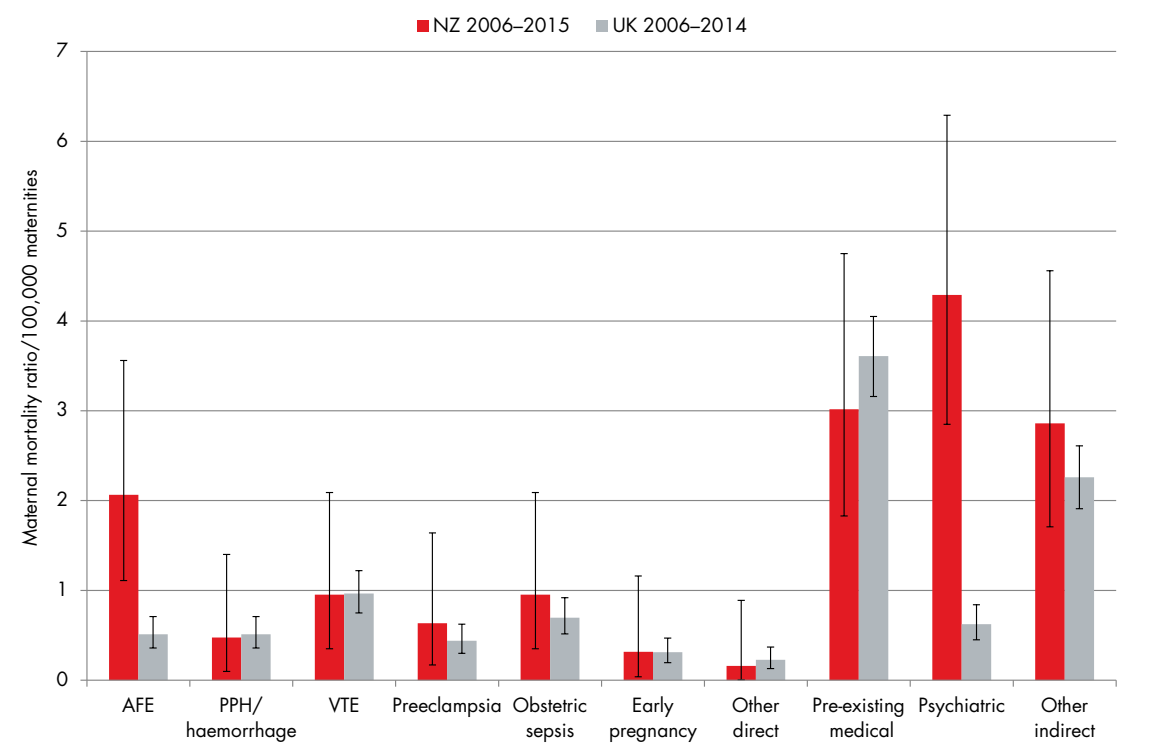
MMR = maternal mortality ratio
Rolling three-year maternal mortality ratio represented at final year of triennium.

23. In 2015, there were three direct deaths (one from amniotic fluid embolism and two from venous thromboembolism) and eight indirect deaths (five from suicide and three from pre-existing medical conditions).

24. Suicide continues to be the leading single cause of maternal death in New Zealand.

25. The maternal mortality ratio in New Zealand continues to be significantly higher than that in the UK (8.54/100,000 maternities for the 2012–2014 triennium). Specifically, maternal death from amniotic fluid embolism is four times higher and maternal death from suicide seven times higher than in the UK.

Cause-specific maternal mortality ratios in New Zealand 2006–2015 and the UK 2006–2014 (with 95% CIs) (Figure 4.3)



AFE = amniotic fluid embolism.
PPH = postpartum haemorrhage.
VTE = venous thromboembolism.
'Other direct' includes anaesthesia, cardiomyopathy, other.
'Pre-existing medical' includes cardiac, indirect neurological, indirect malignancies.
In New Zealand data, 'Other indirect' includes only non-obstetric sepsis.

26. From 2006 to 2015 the Maternal Mortality Review Working Group (MMRWG) found that post-mortem resulted in a change in clinical diagnosis in 10 percent (n=11) of maternal deaths. One quarter of mothers who died did not have a post-mortem examination.

27. Women aged 40 and older, Māori and Pacific mothers, and mothers who have had three previous births at ≥20 weeks are at higher risk of maternal mortality.

28. More than half of the mothers who died in pregnancy or the peripartum period were overweight or obese, and 34 percent were known smokers.

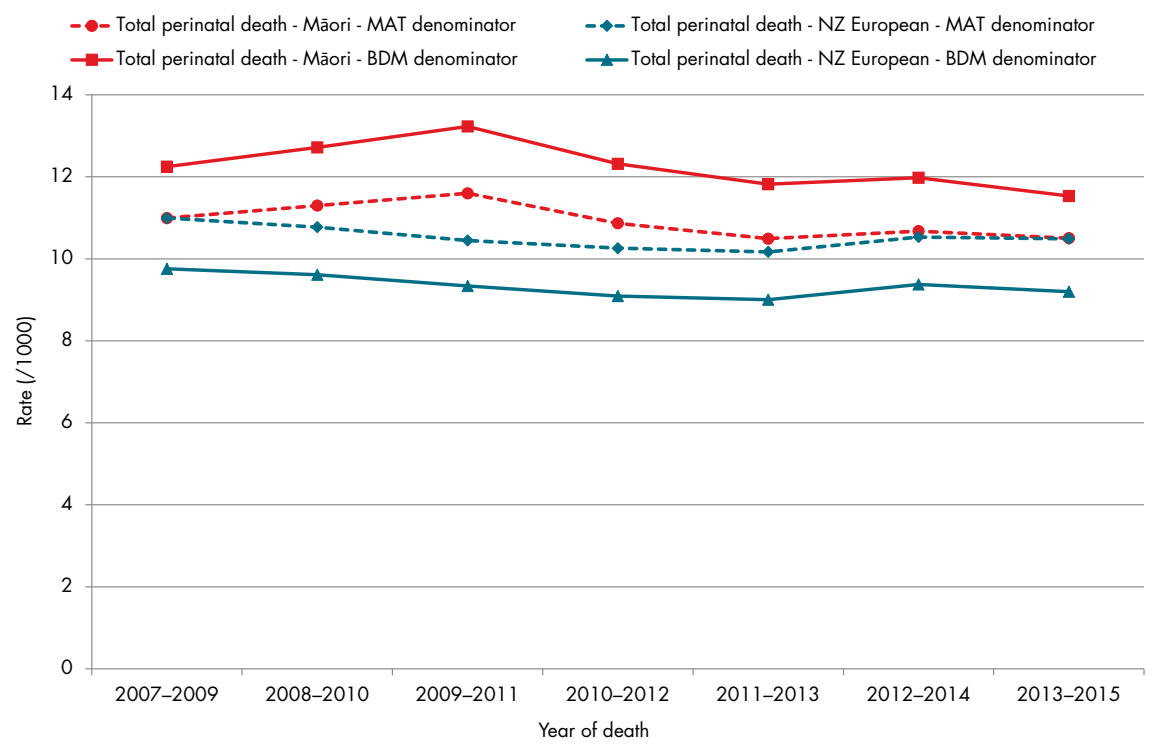
29. Alcohol or substance use was noted in a quarter of mothers who died, and a history of family violence was noted in at least 9 percent.

30. Contributory factors were identified in 62 percent of maternal deaths in the years 2006–2015, and 39 percent were identified as potentially avoidable.

Māori perinatal and maternal mortality

31. There are considerable differences demonstrated in comparative perinatal related mortality rates between Māori and New Zealand European mothers when using different denominators (BDM versus MAT). It is hypothesised that the birth registration dataset provides the best source of ethnicity data (given this is provided by parents when they register their child's birth) and eliminates numerator–denominator bias as these data are provided by BDM to the PMMRC for deaths.

Perinatal related mortality rolling three-year rates (per 1000 births) by ethnicity and year (Māori and New Zealand European 2007–2015) using MAT and BDM denominator data (Figure 5.1)



32. After adjusting for measured maternal age, deprivation decile, baby sex, year of birth, and multiple pregnancy, odds of perinatal related mortality (2008–2015) were lower for Māori mothers compared to New Zealand European mothers (adjusted odds ratio (OR) 0.91 (95% CI 0.84–0.99)). However, there is an excess of neonatal deaths of babies born under 28 weeks gestation to Māori mothers (adjusted OR 1.46 (95% CI 1.18–1.81)).

33. There is a significant reduction in neonatal mortality rate for New Zealand European babies born at 23–24 weeks compared to those born at 20–22 weeks, but no similar reduction in risk among Māori babies.

34. Māori and New Zealand European mothers have similar risks of perinatal related mortality irrespective of age. However, there are more perinatal deaths among Māori mothers under 20 years as there are more than twice as many young Māori mothers as New Zealand European.

35. There is a more prominent increase in death from spontaneous preterm birth with increasing deprivation quintile among Māori mothers than among New Zealand European mothers.

36. There is a statistically significantly higher maternal mortality ratio among Māori compared to New Zealand European mothers combining data from 2006–2015 (26.3 and 13.5 respectively); relative risk (RR) 1.94 (95% CI 1.24–3.06).

37. Māori women are over-represented among maternal suicides.

Neonatal encephalopathy

38. In 2015, there were 70 babies diagnosed with moderate and severe neonatal encephalopathy (NE) reported to the national dataset. There have been 423 babies reported from 2010–2015. The rate of NE for this period is 1.24/1000 term births. Although there appears to be a downward trend in rates, there is no statistically significant trend from 2010 to 2015.

39. NE is associated with maternal ethnicity, socioeconomic deprivation, gestation, birthweight, and nulliparity.

40. Pacific mothers are at increased risk of having a baby with NE compared to Other Asian, Other, and New Zealand European mothers. Mothers of Māori and Indian ethnicity are at increased risk of having a baby with NE compared to mothers of Other Asian and Other ethnicities.

41. Increasing socioeconomic deprivation is associated with increased risk of NE.

42. Waikato, Taranaki, and Capital & Coast district health boards (DHBs) continue to have statistically higher unadjusted rates of NE compared to the national rate.

43. Acute peripartum events were reported in 101 cases (24 percent) of all 423 cases in 2010–2015, of which abruption (31 cases) and shoulder dystocia (26 cases) were the most common.

44. There is no apparent association between level of facility of birth and NE.

45. In 2015, 80 percent of babies born in New Zealand with moderate or severe NE were managed with induced cooling. A review of 22 babies with severe NE who were not cooled revealed 20 were appropriately not cooled. Review of 32 babies with moderate NE who were not cooled revealed nine babies where transfer to a tertiary unit and cooling was possible and may have been indicated.

46. In 2015, the proportion of those cooled who were cooled within six hours of birth as recommended for maximal benefit was 79 percent.

47. Eighty-one of the 423 babies with NE during 2010–2015 (19.4 percent) died in the perinatal period (<28 days). A further nine babies are known to have died after discharge from three months to five years of age.

48. Of survivors during 2010–2015, 28 percent had a moderately or severely abnormal MRI (21 percent of moderate and 66 percent of severe cases) and 46 percent had a normal or only mildly abnormal scan (49 percent of moderate and 30 percent of severe cases). Twenty-five percent of survivors during 2010–2015 did not have a magnetic resonance imaging (MRI) scan (30 percent of moderate and 2 percent of severe cases).

Recommendations

The Mortality Review Committees' Māori Caucus reiterate, "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." (PMMRC recommendation ninth report 2015).

Justification:

The analyses in the Māori perinatal and maternal mortality chapter provide clear evidence of the issues around fit for purpose ethnicity data collection. Use of data from the same source for numerator and denominator (birth registration (BDM)) is demonstrated in Figure 5.1 to Figure 5.5 in comparison to using a numerator ethnicity variable from birth registration (BDM) in the numerator and MAT in the denominator.

The sharing of BDM ethnicity data with the MAT dataset would allow maternity analyses the power to explore and address ethnic inequities, using an ethnicity definition akin to the Census definition, within a health dataset (MAT) which includes a wealth of maternity data.

Evidence:

BDM includes ethnicity data provided by parents within six weeks of the birth of their baby in their own time and space. This collection is theoretically akin to Census data. These data are currently provided to the PMMRC for perinatal deaths, but are not made available for the denominator (MAT) set for analysis. BDM currently provide data on a regular basis to match against the MAT dataset to ensure that the MAT dataset includes all births.

The PMMRC recommend the Ministry of Health:

a. **urgently require DHBs to provide complete and accurate registration data to the MAT dataset (as required of LMCs providing services to pregnant women in order to receive funding for those services). Specifically this should include women who present for birthing at DHB facilities without previous antenatal LMC registration and women who are provided primary maternity care by DHB maternity services**

b. **require that the MAT dataset include complete registration and antenatal data on live and stillborn babies from 20 weeks gestation (including terminations of pregnancy).**

Justification:

Parity, BMI and smoking data, which are collected at the registration visit, were more often missing from the MAT dataset among mothers whose babies died and among mothers receiving their primary maternity care from DHB services. Mothers receiving primary maternity care from DHB services are women who were unregistered for antenatal care prior to their birth admission and women who were unable to access LMC care in the community.

Adjusted analyses including these variables could not be progressed because BMI, smoking, and parity data were not missing at random. This means that it was not possible to provide robust adjusted estimates of perinatal related mortality risk by DHB or to adjust for parity, BMI, or smoking in estimates for ethnicity, age, and socioeconomic status.

Therefore, it is not possible to reassure women in New Zealand that DHBs where the perinatal mortality,

termination of pregnancy, stillbirth and neonatal death rates are significantly higher (or lower) than the national average are providing care which is at the standard of the national average. (Similarly it cannot be assumed that other DHBs might not have higher rates than expected if analyses were able to adjust for known risk factors). It has been assumed that differences in mortality rates by DHB are due to differences in the populations served eg by ethnicity, BMI, socioeconomic status, age, smoking, and parity, but this cannot be confirmed without the provision of accurate data from these facilities to enable appropriate analyses.

Adjusted estimates could be calculated among women under LMC care alone (self-employed midwifery, private obstetrician and general practitioner care). However excluding women receiving other models of care, because women receiving no or DHB care were systematically different from those with LMC care by their risk profile and ethnicity, had an important effect on adjusted estimates for significant variables such as ethnicity and DHB.

Multivariable analyses in this report adjust only for ethnicity, socioeconomic status, age, baby sex, multiple pregnancy, and year of birth.

Evidence:

During the years 2008-2015, 97-98 percent of BMI, smoking and parity data were missing among the 8 percent of women who were either unregistered with an LMC prior to birth or who registered with a DHB providing primary maternity services and not providing data to the MAT dataset. During this time period, more than 10 percent of data were missing from residents of five DHBs, one of which was missing 48 percent of these data. These 8 percent of women are significantly different from women receiving care from LMCs by ethnicity, socioeconomic status and age and so their absence from the multivariable analysis has a significant effect on the adjusted risk estimates.

In 2015, 16 percent of women residing in Counties Manukau, 13 percent residing in Nelson Marlborough, and 6 percent residing in Hawkes Bay DHB areas had not had these data included in the MAT dataset, even though only 4-5 percent of data were missing for New Zealand overall. Five percent or less of smoking, BMI and parity data were missing from any other DHB region.

The PMMRC investigate why there has been no reduction in neonatal mortality in New Zealand.

Justification:

Neonatal mortality has remained static in New Zealand since 2007. The multivariable analyses in this report provide evidence of inequities for Māori in neonatal mortality, specifically among neonatal deaths after birth from 20 to 28 weeks.

Evidence:

There have been significant reductions reported in neonatal mortality in the UK, Australia and Scandinavia (Manktelow et al 2016; Australian Institute of Health and Welfare 2016; Heino and Gissler 2016).

The PMMRC supports the development of a national interdisciplinary clinical practice guideline on the indications and timing for induction of labour, to guide clinicians to offer induction when appropriate (that is, where evidence shows that benefit to mother and/or baby outweighs risk) and to avoid induction when not appropriate.

Justification:

In 2015 there was an increase in perinatal related mortality risk from 41 weeks compared to the lower rates of recent years. The risk in 2015 (3.19 per 1000 ongoing pregnancies) was the same as the risk in 2008 (3.15) and higher than the rates in any year from 2009 to 2014.

Review of the 17 stillbirths from 41 weeks without congenital abnormality in 2015, against the *Auckland Consensus Guideline on Induction of Labour* (Wise et al 2014), and against best practice for antenatal assessment in women with risk factors, found the care provided did not follow the guideline and/or best practice in 6 of the 17 stillbirths. This related to best practice to perform serial growth scans following antepartum haemorrhage; best practice for obstetric review and/or to perform serial growth scans for BMI >35; and to offer induction of labour for increased risk.

Evidence:

A clinical practice guideline on the induction of labour is ideally based on high quality research and formulates guidance on the indications, timing, and methods of induction; provides guidance on the balance of risk and benefit to the mother and/or baby where there is increased risk of perinatal mortality; and provides guidance on enhanced maternal and fetal surveillance where this is an alternative to induction of labour or where a mother declines the offer of induction of labour.

In 2014 the DHBs in the Auckland region collaborated to publish a consensus guideline on induction of labour which could be operationalised as local guidelines by individual DHBs within the region taking into account local characteristics and resources (Wise et al 2014). This guideline document was used by the PMMRC to audit stillbirths from 41 weeks in 2015. It is timely to update this interdisciplinary guideline incorporating up to date evidence.

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:

There is a significantly higher rate of perinatal related mortality than the national rate among residents of Counties Manukau DHB (Figure 3.13)

There is a significantly higher stillbirth rate than the national rate among residents of Counties Manukau DHB (Figure 3.28)

There is a significantly higher neonatal death rate than the national rate among residents of Counties Manukau and Waikato DHBs (Figure 3.29)

Waikato, Taranaki and Capital and Coast DHBs have significantly higher rates of neonatal encephalopathy than the national rate (Figure 6.4).

Evidence:

Audits of perinatal deaths are required to understand causes and focus prevention efforts (*The Lancet* 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 recommendations

The PMMRC recommend the HQSC establish a permanent Suicide Mortality Review Committee.

Justification:

The suicide-specific maternal mortality ratio in New Zealand from 2006 to 2015 was seven times that in the UK for 2006 to 2014 (RR 6.9 (95%CI 4.2-11.1)). The background rate of suicide among young women in New Zealand is high.

There is a lack of visibility of suicide out to one year postpartum in New Zealand. In the UK, the postpartum period from six weeks out to one year has been shown to be a more vulnerable time for women than pregnancy and the immediate postpartum period (Knight et al 2016). Suicide review will provide insight into the broader factors influencing suicide rates in New Zealand.

Māori maternal suicide

Recommendations from the Mortality Review Committees' Māori Caucus.

Improved awareness and responsiveness to the increased risk for Māori women

Primary care (GPs, FPA), LMCs, TOP services, alcohol and drug services, and secondary and tertiary providers of maternity, obstetric, mental health, and maternal mental health services should improve their systems, guidelines and professional development to ensure that they are responsive to the identified increased risk for Māori women.

Justification:

Māori women are over-represented among maternal suicides with Māori women accounting for 56 percent of maternal suicides between 2006 and 2015. Most of the Māori women who died from suicide experienced multiple risk factors.

Evidence:

Culturally competent, responsive health services supported by an informed culturally competent workforce will improve access to high quality care, and health outcomes for pregnant Māori women.

Risk assessment

Comprehensive assessment of risk factors for Māori women should be undertaken at diagnosis of pregnancy and/or on first presentation for antenatal care. This should be undertaken for all Māori women, regardless of age, including those who are seeking termination of pregnancy.

Justification:

Just over a quarter of the suicides occurred following a TOP. Nearly half of the suicides occurred in women 24 years of age and younger. Most women who died from suicide experienced multiple risk factors. Early recognition of these risk factors, particularly where there are multiple factors, will assist health services and professionals to provide better services for these women. **See 'Practice Point: Māori women and maternal suicide' on page 161.**

Management

a. **Where Māori women exhibit symptoms suggesting serious mental illness or distress, an urgent mental health assessment, including consultant psychiatrist review and consultation with perinatal mental health services, on the same day these symptoms are first noted should be undertaken**
b. **Māori women who have a history of serious mental illness and are currently well should be referred to specialist mental health services for a mental health birth plan, and monitored closely by their maternity care provider +/- mental health services. Where such a woman has a miscarriage, the GP should be notified immediately and an explicit process for early follow up that includes a review of mental health status agreed with the GP.**
c. **The referring doctor of women who undergo a TOP is expected to provide a free post-TOP follow up consultation 10-14 days after the procedure (Report of a Standards Committee to the Abortion Supervisory Committee 2009). The referring doctor should actively follow up Māori women referred for TOP to ensure this consultation is completed and review mental health status during this consultation.**

Justification:

Half of the women had self-harmed or attempted suicide prior to or during the final pregnancy. Nearly half of the women in this review identified as having mental health issues were not referred to mental health services, or it is unclear if a referral was made or appropriately acted on. Post-TOP consultations were not mentioned in any of the reviews for deaths that occurred post-TOP. **See 'Practice Point: Māori women and maternal suicide' on page 161.**

Communication and coordination

Communication and coordination between primary care (GPs, FPA), LMCs, TOP services, alcohol and drug services, and secondary providers of maternity, obstetric, mental health, and maternal mental health services should be improved and enhanced using a variety of means including but not limited to case management, integrated notes systems, and electronic transfer of information.

Justification:

Over half of women had been seen by a general practitioner (GP) or at a Family Planning clinic (but mostly by a GP) in their final pregnancy. Forty percent of women were involved with mental health or alcohol and drug services during their final pregnancy. Some women had multiple services involved in their care – including midwifery, specialist obstetric and mental health services. Service related issues

including poor communication between services, poor coordination, and inadequate follow up were identified as were potentially delayed and/or missed diagnoses of physical and/or mental health issues.

Child and Youth Mortality Review

Child and Youth Mortality Review Committee (CYMRC) consider including information about whether female suicide cases were pregnant in the 12 months prior to their deaths in addition to the pregnancy status information currently collected.

Justification:

In the UK, the postpartum period from six weeks out to one year has been shown to be a more vulnerable time for women than pregnancy and the immediate postpartum period (Knight et al 2016). PMMRC review maternal suicide deaths from six weeks to one year postpartum when they are aware of them and it is determined appropriate to do so. However, the PMMRC have no certainty that case ascertainment is complete for this extended period as there is no current requirement for notification of cases beyond the first six postpartum weeks. The CYMRC reviews all deaths for women up to the age of 25 years and could potentially include pregnancy in the previous twelve months in their data collection and review.

Overview of the 2017 Report of the PMMRC

Significant changes to the report 2017

This year, the report introduces two new chapters. The first, in collaboration with the Mortality Review Committees' Māori Caucus, reports Māori perinatal and maternal mortality. This chapter includes a discussion of the definitions of ethnicity in the denominator datasets and their appropriateness for use for reporting perinatal mortality statistics. It includes analyses comparing Māori and New Zealand European perinatal and maternal mortality, and a review of Māori maternal suicide. Specific recommendations have been proposed based on this review. The second new chapter describes the current and future work of the newly formed Maternal Morbidity Working Group (MMWG) of the PMMRC.

The New Zealand National Maternity Collection (MAT) dataset has been used instead of the Births, Deaths and Marriages (BDM) birth registration dataset as the denominator for all analyses because it is the most complete record of births in a year and it contains more maternity clinical data. Therefore, this year the PMMRC reports associations between parity, smoking and body mass index (BMI) at registration with maternity care and perinatal mortality. Tables and figures also illustrate the associations between parity and maternal mortality and neonatal encephalopathy.

Most analyses in this report that involve current associations with mortality use data from 2011 to 2015. This is because there has been a significant reduction in some rates since the PMMRC started reporting in 2007. Time trend data are provided in two-year groupings or as rolling three-year rates.

Demography of births in New Zealand

There have been some changes in the make-up of the New Zealand birthing population since the PMMRC started reporting mortality rates in 2007. Fewer mothers were under 20 years of age (4.7 percent in 2015 compared to 7.9 percent in 2007) and fewer mothers are smoking in pregnancy. There were fewer births at 40 and more weeks of gestation and more births at 36 to 39 weeks gestation.

Perinatal related mortality

Perinatal related mortality rates

In New Zealand, perinatal mortality is reported from 20 weeks gestation, and all terminations of pregnancy from 20 completed weeks gestation are included. The perinatal related mortality rate in 2015 was 9.7/1000 births (approximately one death (late termination or stillbirth or neonatal death) for every 100 births from 20 weeks). This is the lowest rate reported since the PMMRC began collecting data in 2007. However, the rate in 2015 is significantly lower than the rate for the years 2007–2014 combined. From 2007 to 2015 there was a significant reduction in stillbirths.

New Zealand uses the Perinatal Society of Australia and New Zealand (PSANZ) classification of cause of perinatal death. There was a significant reduction in hypoxic peripartum deaths from 2007 to 2015 and a trend to reduced deaths from fetal growth restriction.

International comparisons of perinatal mortality

International comparison of perinatal mortality rates can be difficult because many countries do not collect information on births and deaths down to 20 weeks of gestation. For this reason, the PMMRC report mortality rates using the World Health Organization's (WHO's) international definition in

addition to the New Zealand definition. The international definition includes births and deaths from 1000g (or from 28 weeks if birthweight is not known). Because very early perinatal deaths are excluded from this definition, and the cause of death in very early perinatal deaths is different from the cause of death at later gestations, this makes a difference to the findings described above using the New Zealand definition.

If we consider the international definition, there was a significant reduction in the overall perinatal related mortality rate (p=0.0011) and in the stillbirth rate (p=0.00023) from 2007 to 2015. There were significant reductions in hypoxic peripartum death (p=0.0003), death from antepartum haemorrhage (p=0.031) and fetal growth restriction (p=0.015).

Using the UK definition, New Zealand perinatal mortality and stillbirth rates (defined from 24 weeks and excluding terminations of pregnancy and deaths where gestation was unknown) were significantly lower than UK rates in 2014, and the neonatal death rate was the same. New Zealand perinatal mortality rates (using the international definition from 1000g or 28 weeks and excluding terminations of pregnancy) were consistent with Scandinavian rates in 2014, excepting neonatal mortality, which was higher in New Zealand. The perinatal related mortality rate (using the New Zealand definition) in New Zealand in 2014 was significantly higher (11.2/1000 births) than the Australian rate (9.6/1000 births).

The neonatal death rate has not changed significantly in New Zealand from 2007 to 2015. This will be investigated in detail in 2017–2018. Meanwhile there have been significant reductions in neonatal mortality in the UK (from 2004 to 2014), Australia and Scandinavia. In the UK, there have been reductions in neonatal mortality among babies born from 22 to 27 weeks, but no increase in survival of these babies has been seen in New Zealand.

Ethnicity and perinatal related mortality

Adjusted analyses described in this year's report suggest that Māori mothers have a higher rate of neonatal death, but that overall there is no significant difference in perinatal related mortality between babies born to Māori mothers and babies born to New Zealand European mothers.

Babies born to Indian mothers have significantly higher late termination of pregnancy, stillbirth and neonatal death rates compared to New Zealand European mothers. Babies born to Pacific mothers have significantly lower late termination of pregnancy rates, and significantly higher stillbirth and neonatal death rates compared to New Zealand European mothers.

The outlying causes of stillbirth and neonatal death among babies of Māori mothers are spontaneous preterm birth, antepartum haemorrhage, maternal conditions (mostly due to diabetes), hypertension, and deaths with no obstetric antecedent. (For a description of conditions included in each PSANZ perinatal death classification (PSANZ-PDC) category, see Classifications of the Perinatal Society of Australia and New Zealand (PSANZ 2009).

The outlying causes of stillbirth and neonatal death among babies of Pacific mothers are spontaneous preterm birth, maternal conditions, specific perinatal conditions, antepartum haemorrhage, hypertension, perinatal infection, congenital abnormality, and deaths with no obstetric antecedent.

Outlying causes of death among babies of Indian mothers are spontaneous preterm birth, fetal growth restriction, specific perinatal conditions, and antepartum haemorrhage. There may be an excess of other causes among babies of Indian mothers, but as numbers are small and confidence intervals are large, it is hard to confirm.

Other clinical predictors of mortality

Mothers in their first pregnancy have higher stillbirth and neonatal death rates compared to women who are having their second birth, and mothers in their fourth or later pregnancies have higher rates of stillbirth.

After maternal age, ethnicity, multiple pregnancy, baby sex, and year of birth were accounted for, increasing socioeconomic deprivation was associated with an increase in the odds of stillbirth and of neonatal death. Mother's age (<20 years and ≥40 years) was associated with increased odds of late termination of pregnancy, stillbirth and neonatal death.

Gestation and perinatal mortality

There is a significant reduction from 2007 to 2015 in perinatal related death at 37–38 weeks and at 41 weeks and above. There is a significant reduction in stillbirths at 37–40 weeks from 2007 to 2015.

A number of initiatives to improve pregnancy care and/or to reduce perinatal death may be responsible for these reductions in mortality in late pregnancy since the PMMRC started reporting and making recommendations in 2007. Some changes in demography and the distribution of risk factors may also have had a small effect. Possible explanations for the observed reduction in perinatal mortality include:

- reduced births among teenage women
- reduced rates of smoking among pregnant women
- reduced births at 40 weeks and beyond (presumably associated with increased rates of iatrogenic birth by induction or elective caesarean for at-risk pregnancies)
- structured review and reporting of perinatal deaths at all New Zealand DHBs
- increased education around the risks of SGA
- introduction of the GROW tool for recognition of reduced fetal growth and the Maternal Fetal Network guideline for management of SGA from 34 weeks gestation
- the Maternity Quality and Safety Programme
- introduction of learning from the maternal sleep position studies suggesting that left-sided sleep is associated with reduced odds of late stillbirth.

The rate of stillbirth at 41 weeks and beyond for 2015 was, however, higher than in any year from 2007 to 2014. Review of the 17 stillbirths from 41+0 weeks without congenital abnormality, against the *Auckland Consensus Guideline on Induction of Labour* (Wise et al 2014) and against best practice for antenatal assessment in women with risk factors, found the care provided did not follow the guideline and/or best practice in six of the 17 stillbirths. This related to best practice to perform serial growth scans following antepartum haemorrhage; best practice for obstetric review and/or to perform serial growth scans for BMI >35 in three pregnancies; and to offer induction of labour for diabetes with suspected SGA, and for hypertension.

Potentially avoidable perinatal mortality

Part of the local review of perinatal related mortality is assessment of contributory factors to perinatal related mortality and an assessment of whether deaths were potentially avoidable. In 2015, one-quarter of perinatal related deaths were determined at local review to have contributory factors, and just over half of these (14 percent overall) were determined to be potentially avoidable deaths.

Investigation of perinatal related mortality

There has been a significant increase in optimal investigation of perinatal deaths since 2007, and in 2015, 52 percent of babies who died were optimally investigated. There has also been a significant increase in the babies who have partial investigations (40 percent in 2015) and a significant fall in deaths that have no investigation (8 percent in 2015).

To help caregivers and parents discuss the merits of post-mortem investigation, the PMMRC collects data on the usefulness of the investigation in adding to knowledge about cause of death. In 2015, data on the usefulness of post-mortem were available for 205 (83 percent) of deaths where post-mortem was performed. In 118 deaths (48 percent) the post-mortem confirmed the clinical diagnosis. In 40 (16 percent) the post-mortem changed the diagnosis and resulted in altered counselling to parents for future pregnancies. In 27 (11 percent) additional information was gained, but this did not change the clinical diagnosis, and in 20 (8 percent) of the deaths, the post-mortem was non-contributory.

Perinatal death investigation rates continue to be significantly lower among babies of Māori and Pacific mothers compared to babies of mothers of other ethnicities. Compared to the overall 8 percent rate of no investigation of perinatal death, there is no investigation of 19.8 percent of babies of Māori mothers and 12 percent of babies of Pacific mothers.

Maternal mortality

Maternal mortality ratio

Maternal deaths are deaths of pregnant women or women within six weeks after pregnancy. Maternal mortality is expressed as a ratio compared to births from 20 weeks gestation even though maternal deaths may occur in or after pregnancy prior to 20 weeks (eg, after early termination of pregnancy or miscarriage). In 2015, 11 maternal deaths were reported to the PMMRC. One coincidental death (death of a pregnant woman or within six weeks of the end of a pregnancy which was unrelated to pregnancy; eg, death in a road traffic accident) was reported in 2015.

The maternal mortality ratio in New Zealand was 15.6/100,000 maternities for the three years 2013–2015. There has been no statistically significant change in maternal mortality ratio in New Zealand since data collection by the PMMRC began in 2006.

In 2015, there were three direct deaths (one from amniotic fluid embolism and two from venous thromboembolism) and eight indirect deaths (five from suicide and three from pre-existing medical conditions).

Suicide continues to be the leading single cause of maternal death in New Zealand.

International comparisons

The maternal mortality ratio in New Zealand is significantly higher than that in the UK, which was 8.54/100,000 maternities for the three years 2012–2014. Specifically, maternal death from amniotic fluid embolism is four times higher and maternal death from suicide seven times higher in New Zealand than in the UK.

Demography

Women aged 40 years and older, Māori and Pacific mothers, and mothers who have had three previous births from 20 weeks are at higher risk of maternal mortality.

More than half of the mothers who died in pregnancy or the peripartum period were overweight or obese, and 34 percent were known smokers.

Alcohol or substance use was noted in a quarter of mothers who died, and a history of family violence was noted in at least 9 percent.

Maternal post-mortem

Post-mortem resulted in a change in clinical diagnosis in 10 percent (n=11) of maternal deaths from 2006 to 2015. New or additional information was made available in a further 25 percent of women who had a post-mortem. However, one quarter of mothers who died did not have a post-mortem.

Potentially avoidable maternal death

Contributory factors were identified in 62 percent of maternal deaths in the years 2006–2015, and 39 percent were identified as potentially avoidable.

Māori perinatal and maternal mortality

Perinatal mortality

The change in denominator for this report from the BDM birth registration dataset to the MAT dataset creates a particular problem for the analysis of mortality by ethnicity because the MAT dataset includes a derived variable (an algorithm to include the ethnicity from more than one dataset) for ethnicity, which differs from the self-defined variable in the BDM birth registration dataset. This variable increases the proportion of Māori in the MAT dataset and decreases the proportion of New Zealand Europeans. The potential effect of this on mortality rates if the PMMRC ethnicity is used for perinatal deaths is to reduce Māori perinatal mortality rates and to increase New Zealand European perinatal mortality rates. In the Māori mortality chapter, rates are given using both the birth registration (BDM) and maternity (MAT) denominators to illustrate the effect of these differences. Using the BDM denominator, Māori perinatal mortality rates are higher than New Zealand European perinatal mortality rates. Using the MAT denominator, Māori perinatal mortality rates are the same as New Zealand European perinatal mortality rates. To view these differences see Figure 5.1—Figure 5.5 in the main report.

It is believed that the BDM birth registration dataset would provide the best source of ethnicity data because this is the ethnicity given by parents when they register their child's birth. It is also the ethnicity collected by the PMMRC for perinatal deaths and cases of neonatal encephalopathy.

After adjusting for measured potential confounders, overall perinatal related mortality does not differ between Māori and New Zealand European mothers. However, there is an excess of neonatal deaths of babies born under 28 weeks gestation to Māori mothers.

Māori and New Zealand European mothers have similar rates of perinatal related mortality by age. However, there are more perinatal deaths among Māori mothers under age 20 as there are more than twice as many Māori mothers under 20 years as New Zealand European.

Maternal mortality

There is a significantly higher (almost double) maternal mortality ratio among Māori mothers (26.3 per 100,000 births from 20 weeks) compared to New Zealand European mothers (13.5 per 100,000 births from 20 weeks) combining data from 2006–2015.

Māori women are over-represented among maternal suicides.

Neonatal encephalopathy

Neonatal encephalopathy rates

Six years (2010–2015) and 423 neonatal encephalopathy (NE) cases have been described in this report. The rate of NE for this period was 1.24 cases per 1000 term births. Seventy cases were reported in 2015. Although there appears to be a downward trend in rates, there is no statistically significant trend from 2010–2015.

Eighty-one of the 423 babies with NE from 2010–2015 (19.4 percent) died in the perinatal period (<28 days). A further nine babies are known to have died after discharge from three months to five years of age.

From 2016 the Neonatal Encephalopathy Working Group (NEWG) widened the inclusion criteria for the NE cohort and will include cases from 35 weeks gestation at birth in line with international literature and practice of cooling of babies of this age. These numbers will be included from next year, although rates of NE at term will continue to be reported.

Demography of neonatal encephalopathy

NE is associated with maternal ethnicity, socioeconomic deprivation, gestation, birthweight, nulliparity, and baby sex.

Pacific mothers are at increased risk of having a baby with NE compared to Other Asian, Other, and New Zealand European mothers. Mothers of Māori and Indian ethnicity are at increased risk of having a baby with NE compared to mothers of Other Asian and Other ethnicities.

Waikato, Taranaki, and Capital & Coast DHBs continue to have statistically higher unadjusted rates of NE compared to the national rate. Adjusted rates were not calculated.

Induced cooling

In 2015, 80 percent of babies born in New Zealand with moderate or severe NE were treated with induced cooling.

In the dataset from 2011 to 2014 (4 years), 54 neonates were reported as not receiving full body cooling for NE. On further review 20 of the 22 severe NE infants were appropriately not cooled. In the moderate group it was determined that 23 of the 32 infants were appropriately not cooled. Of the remaining nine infants, transfer to a tertiary unit was possible and cooling may have been indicated.

This review will lead to a new item in the dataset asking for the reason infants were ‘not cooled’.

Summary of Key PMMRC 2016 Report Recommendations and Progress

Recommendation (PMMRC 10th report)	Progress to date (updated June 2017)
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.	The PMMRC is working with PSANZ on the revision of the PSANZ-PDC system. The revised version will be in use from January 2018.
Perinatal mortality	
That district health boards with rates of perinatal related mortality significantly higher than the national rate review, or continue to review, the higher rate of mortality in their area and identify areas for improvement.	**Perinatal related mortality rates** **Counties Manukau** The recommendations from an independent review of perinatal mortality in Counties Manukau in 2012 are being implemented in an ongoing process of quality improvement. In 2017 further work will commence on the following initiatives: • preterm birth • information for women and families in eight languages • counselling for women and families who have experienced a perinatal loss. **Neonatal mortality rates** **Waikato** Waikato DHB has undertaken a review of all neonatal deaths due to neurological causes from 2010 to 2014. Initiatives were identified to address modifiable risk factors in the following areas: • improving early pregnancy care • management of pregnancy in obese women • management of diabetes in pregnancy • smoking cessation • maternal immunisation • diagnosis and management of preterm labour • management of high-risk pregnancies. In 2017 further work will commence on the following initiatives: • intrapartum care and documentation • education sessions to share learnings from reviews. **Bay of Plenty** Bay of Plenty DHB has undertaken audits reviewing every perinatal death from 2010 to 2016. Initiatives were identified to address modifiable risk factors in the following areas: • improving access to antenatal care • smoking cessation • prediction, diagnosis and management of preterm labour • management of multiple pregnancies • management of pregnancies at increased risk of fetal growth restriction • management of decreased fetal movements • optimising the management of pregnancy in obese women.

Recommendation (PMMRC 10th report)	Progress to date (updated June 2017)
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.	The PMMRC and the MMRWG are working with the Ministry of Health to clarify the remit and purpose of this network, to ensure supportive links with pre-existing regional perinatal and infant mental health networks, and to identify a work plan consistent with the needs of DHBs.
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.	Sixteen DHBs provide multidisciplinary training in management of obstetric emergencies; this is provided in-house for all but one secondary hospital. Three DHBs have indicated attendance is mandatory for all obstetric, midwifery (core and lead maternity carer) and anaesthetic clinicians. One additional DHB indicated attendance was mandatory for all DHB obstetric, midwifery and anaesthetic staff. A further eight DHBs indicated it was mandatory, but only for some disciplines. The most common areas identified as barriers to attendance were staffing and cost to attend. The most common areas identified as enablers to attendance were payment by the DHB and providing cover for staff to attend.
Neonatal encephalopathy	
That district health boards with rates of neonatal encephalopathy significantly higher than the national rate review, or continue to review, the higher rate of morbidity in their area and identify areas for improvement.	**Taranaki** Taranaki DHB reviews all unexpected admissions to the neonatal unit; this includes cases of NE. Current quality improvement initiatives include: • improvements to the obstetric emergency call system • multidisciplinary training in obstetric emergencies for all clinicians at both Taranaki Base and Hawera hospitals • fetal surveillance training • newborn life support training (New Zealand Resuscitation Council) • an improvement in numbers and rostering of obstetric doctors. Taranaki DHB will continue to monitor and review all NE cases and implement quality improvements where indicated. **Capital & Coast** Capital & Coast DHB has reviewed all term infants diagnosed with NE from 2010 to 2014. The benefit of multidisciplinary reviews was recognised and the review team recommends ongoing resourcing and support of multidisciplinary reviews of adverse events. On completion of the review document the findings were fed back to the steering group and further assessment and implementation of the findings and recommendations will be undertaken. The review is being presented at the national PMMRC annual conference in June 2017.

1 Introduction and Methodology

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

Each of chapters 3–6 of the 11th report includes mortality or morbidity specific methodology. Included here are details of the denominator datasets used throughout this report and statistical methods, which apply to all chapters. A list of abbreviations and definitions can be found in Appendix B: List of Abbreviations and Appendix C: Definitions.

Denominator data

New Zealand birth registrations

The birth registration dataset of New Zealand births is collated by Births, Deaths and Marriages (BDM) from birth notifications supplied by public and private hospitals, and by LMCs in the case of home births. Births are only added to the birth registration dataset when the birth is registered by the parents, which can occur up to some years following birth. The registration dataset is based on date of registration and so includes births from previous years and fewer than all births from the current year. While this dataset is 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.

In 2015 (11th report), the birth registration dataset is used as the denominator to illustrate issues with the measurement of ethnicity in the Māori chapter.

New Zealand National Maternity Collection

The New Zealand National Maternity Collection (MAT) is a relatively new initiative combining data

collected by LMCs, which are required to enable claims for payment, with hospital discharge data.

In this report (2015 data, 11th report), we have changed the denominator dataset for most analyses from the BDM dataset of birth registrations in the calendar year to the MAT dataset, which includes all births in the calendar year. We believe this is the most accurate record of all births in New Zealand in a year, and this dataset has the advantage of including maternity data. Details of the development of an appropriate denominator dataset using the MAT dataset, details of the merge with the MAT dataset to create a compatible numerator, and specific limitations of the MAT dataset are described in Appendix D.

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, 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 3.4 looks at perinatal related deaths by maternal age for 2015. There were 10,145 births registered to mothers 20–24 years of age in 2015, which was 17.0 percent of all births. There were 43 stillbirths among mothers 20–24 years of age, which was 14.1 percent of all stillbirths in 2015. The stillbirth rate was 43/10,145 births or 4.24 stillbirths per 1000 births in 2015 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 CI. If the CI for each rate does 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 CI 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 STATA13 using the 'tabodds' function or in EpiInfo using the chi-squared test for trend or the chi-squared test for trends in proportions using R. A p-value of <0.05 has been used to indicate statistical significance.

Multivariable analysis using logistic regression has been performed using 'logistic' in STATA13.

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 and almost all babies will not survive. If the denominator set does not include all births for whatever reason, then it will appear that more babies died than were born. For this reason, perinatal related mortality rates at the lower extremes have not been reported.

Multiple-year data

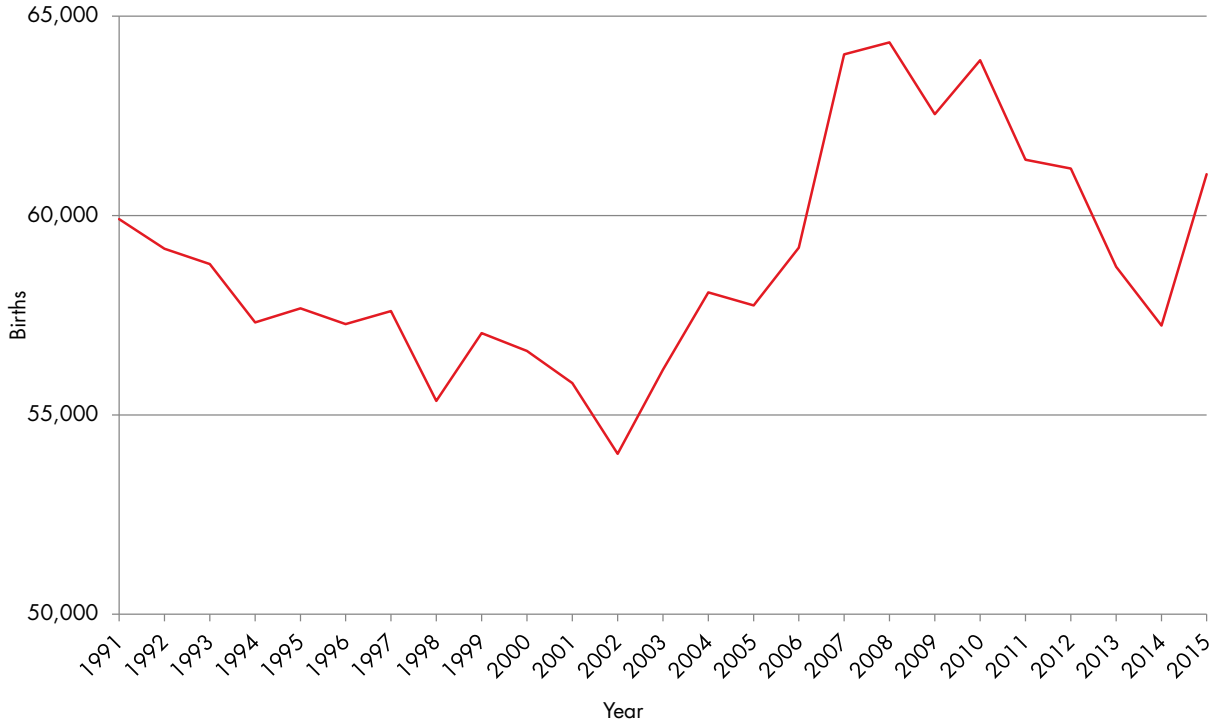
In this report, the figures illustrating perinatal related mortality rates sometimes include combined data for the most recent five years that the PMMRC has collected data (2011–2015). This increases the numbers and so improves the confidence around the estimates given, while restricting to the most recent five years of data to minimise the impact of changes over time on rates.

In some tables two years of data have been combined so that all years of data collection since the inception of the PMMRC can be included within the limitations of space in one horizontal table. Individual year data can be accessed by searching previous PMMRC reports (http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/).

In general, the data for the 2015 year alone are presented in table form in the text and the combined five or nine-year data in table form in the appendices to each section.

2 Births in New Zealand 2015

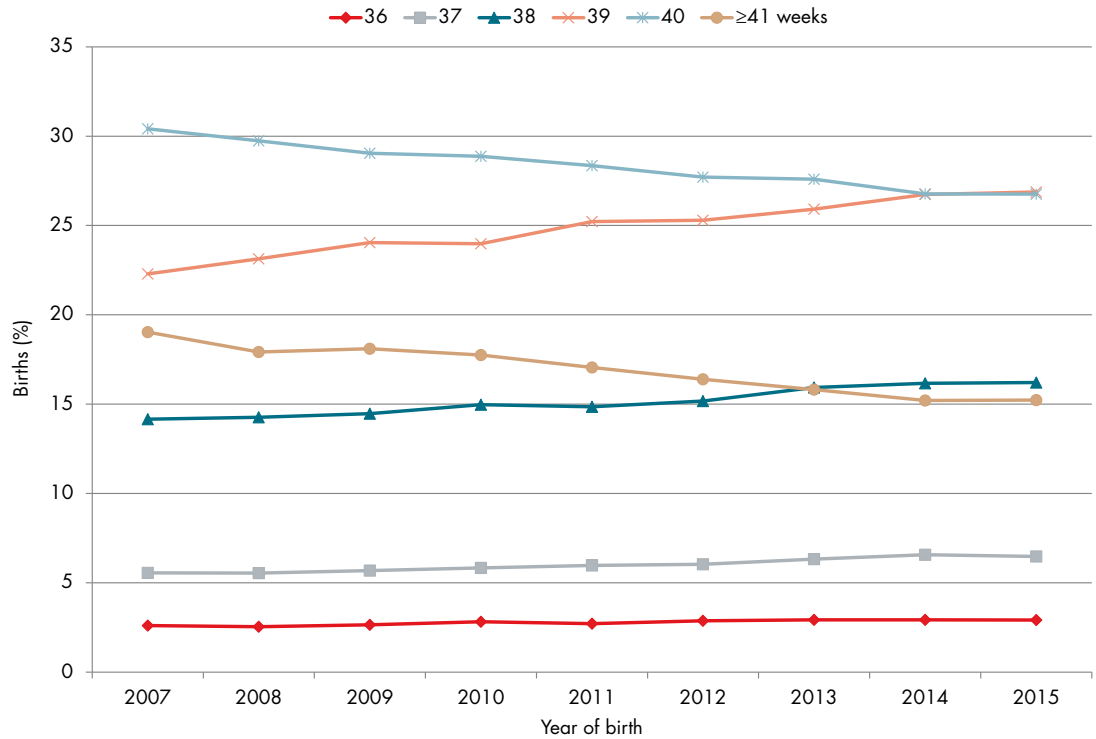
Figure 2.1: Total live birth registrations in New Zealand 1991–2015



Amended from Statistics New Zealand (2015).
http://www.stats.govt.nz/browse_for_stats/population/births/BirthsAndDeaths_HOTPYeDec15.aspx
http://www.stats.govt.nz/~/media/Statistics/Browse%20for%20stats/BirthsAndDeaths/HOTPYeDec15/bd-Dec15-all-tables.xls

There were 61,038 live births registered in New Zealand in 2015.

Figure 2.2: Trends in gestation at birth (36 weeks and beyond) among births in New Zealand 2007–2015



There has been a significant change in the distribution of gestation at birth in New Zealand since 2007 (Figure 2.2).

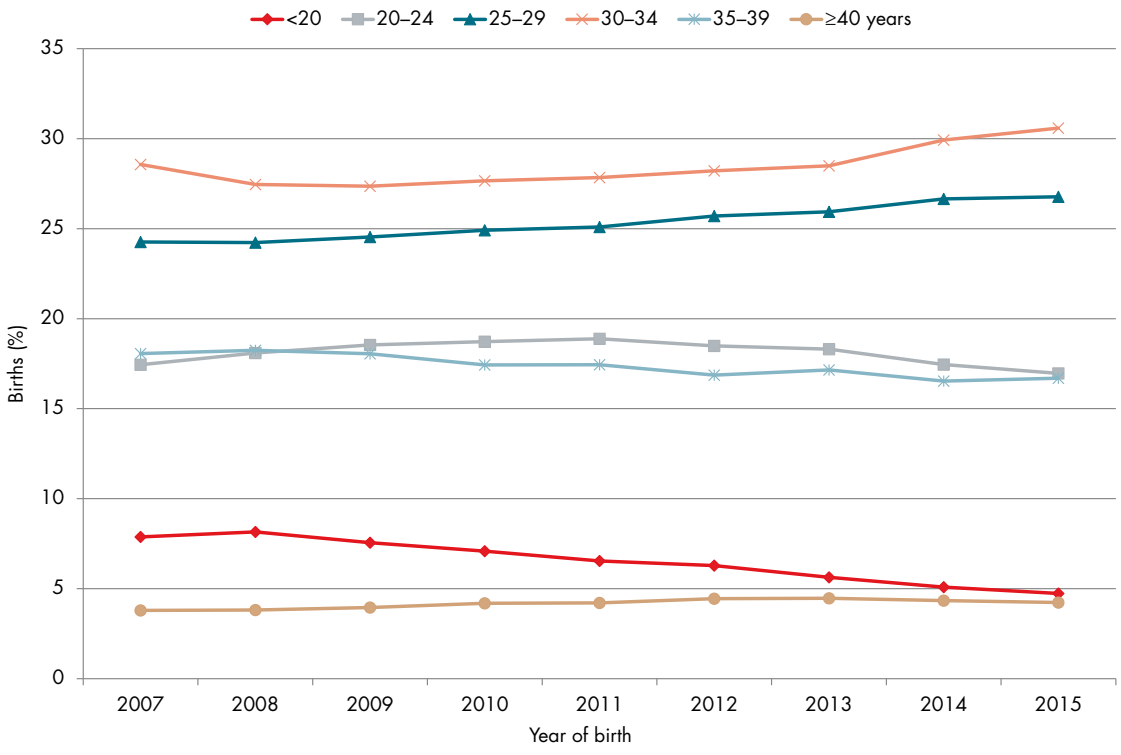
Specifically there has been a significant reduction in total births at 40 and 41+ weeks and a significant increase in births at 36, 37, 38 and 39 weeks gestation. This suggests that there has been an increase in iatrogenic births at and near term.

Table 2.1: Trends in birthweight among births in New Zealand 2007–2015

Birthweight (g)	2007–2008		2009–2010		2011–2012		2013–2014		2015		Chi-squared test for trend (p)
	n	%	n	%	n	%	n	%	n	%	
<500	422	0.3	440	0.3	481	0.4	471	0.4	187	0.3	-
500–999	664	0.5	678	0.5	611	0.5	611	0.5	273	0.5	0.21
1000–1499	799	0.6	812	0.6	723	0.6	652	0.5	376	0.6	0.19
1500–1999	1,561	1.2	1,509	1.2	1,502	1.2	1,397	1.2	649	1.1	0.11
2000–2499	4,566	3.5	4,630	3.5	4,624	3.7	4,372	3.6	2,161	3.6	0.040
2500–2999	16,554	12.7	16,777	12.8	16,204	12.8	16,033	13.3	7,966	13.3	<0.0001
3000–3499	40,392	30.9	41,034	31.4	39,907	31.5	38,373	31.9	18,998	31.8	<0.0001
3500–3999	39,418	30.1	39,517	30.2	38,090	30.1	36,051	30	18,051	30.2	0.32
4000–4499	15,430	11.8	15,307	11.7	14,572	11.5	13,613	11.3	6,732	11.3	<0.0001
≥4500	3,461	2.6	3,184	2.4	3,031	2.4	2,794	2.3	1,252	2.1	<0.0001
Unknown	7,559	5.8	6,778	5.2	6,794	5.4	5,864	4.9	3,163	5.3	-

There has been a significant change in the distribution of birthweight since 2007. Specifically, there has been a reduction in babies born weighing 4000g or more, and an increase in babies born weighing 2000g to 3500g. This is consistent with the changes in gestation at birth.

Figure 2.3: Trends in maternal age among births in New Zealand 2007–2015



There has been a consistent reduction in births among mothers under 20 years of age from 2008 so that these now constitute fewer than 5 percent of births (Figure 2.3). The majority of births in New Zealand are to women aged 25–29 (26.8 percent) and 30–34 (30.6 percent). There was a small increase in mothers birthing at 40 years of age and older from 2007 to 2010, but the proportion has been steady at 4.2–4.5 percent since 2010. In 2015, 4.2 percent of mothers were 40 or older.

The greatest changes in maternal ethnicity from 2007 to 2015 are an increase in the proportion of births among Other Asian mothers and a reduction in the proportion to New Zealand European mothers, who now make up 10.4 and 37.2 percent of mothers respectively (Figure 2.4).

There has also been a small decrease in the proportions of mothers identifying as Māori and Pacific peoples. In 2015, 24.9 percent of mothers identified to BDM as Māori and 10.3 percent as Pacific.

Figure 2.4: Trends in maternal prioritised ethnicity among births in New Zealand 2007–2015

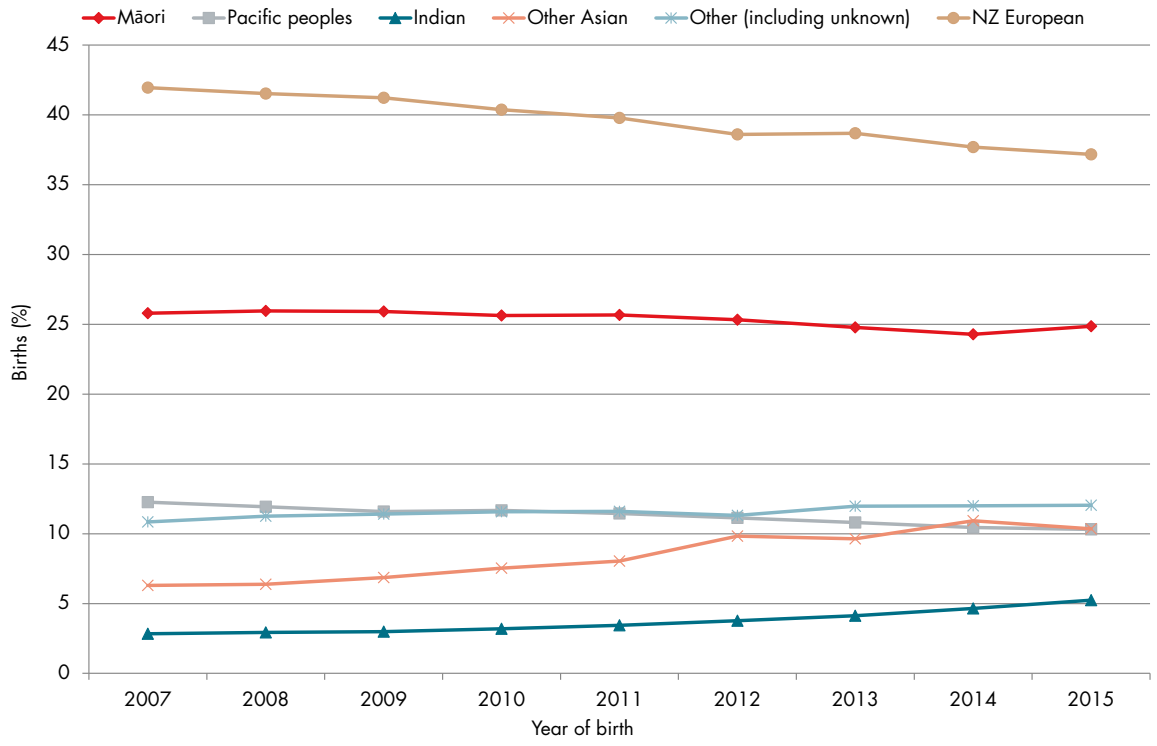


Figure 2.5: Distribution of deprivation deciles (NZDep2013) among births in 2015 (total births excluding unknown=59,326)

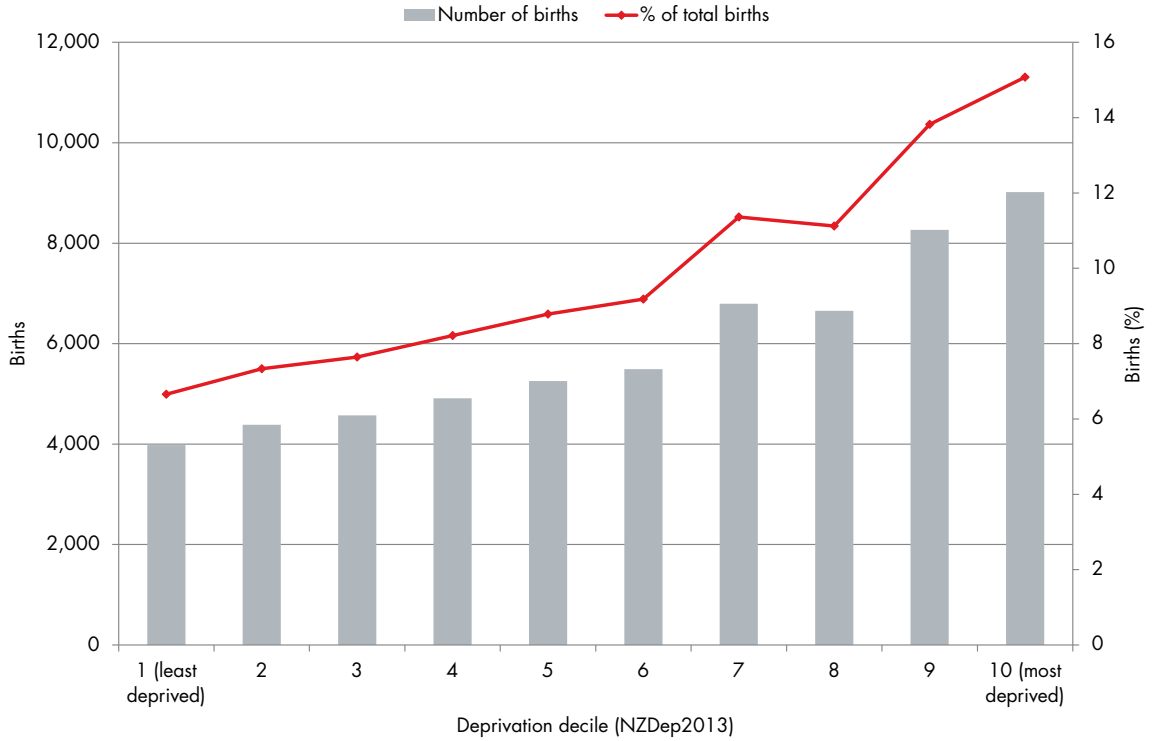
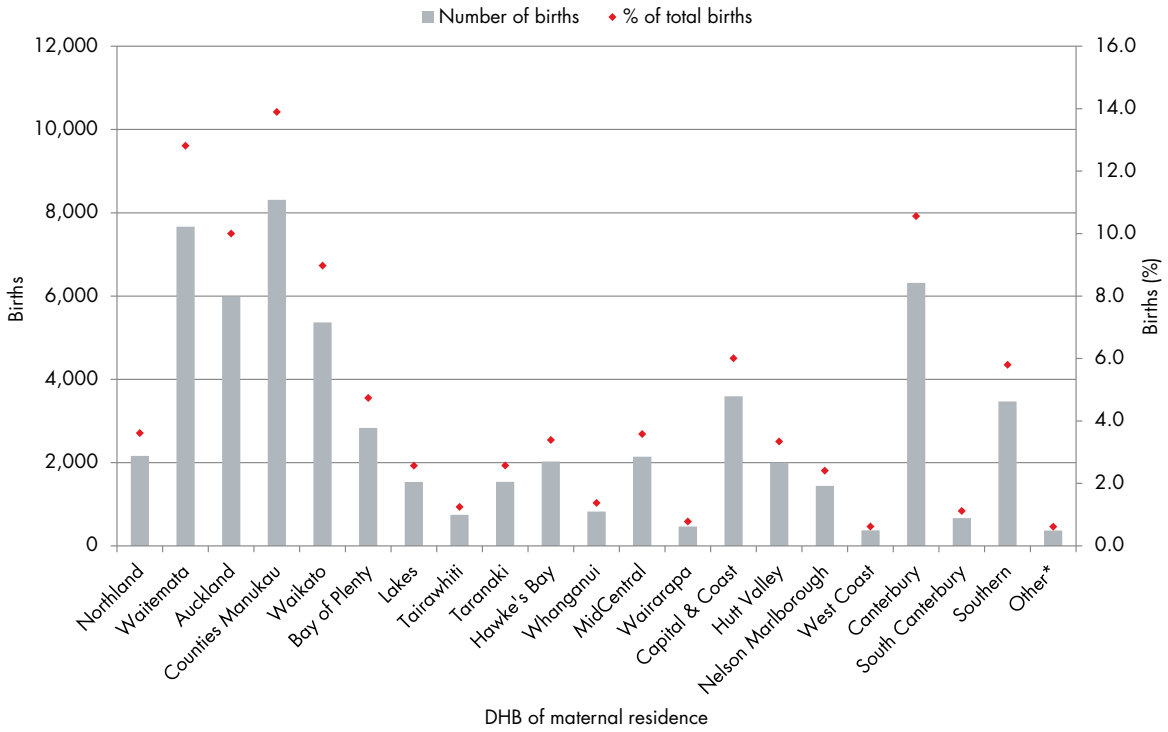


Figure 2.6: Distribution of births by DHB of maternal residence among births in 2015 (total births=59,808)



* Other includes Overseas, Unknown and Other.

Figure 2.7: Distribution of deprivation quintiles (NZDep2013) by maternal prioritised ethnicity among births in 2015 (total births=59,808)

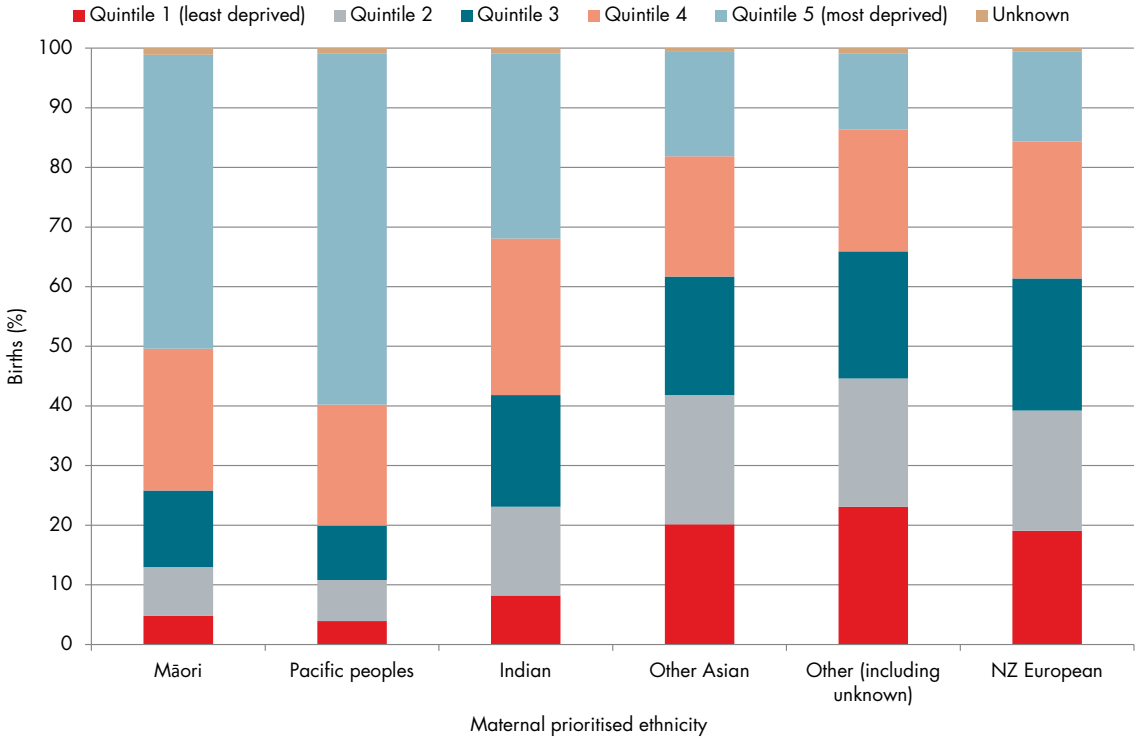


Figure 2.8: Distribution of maternal age by maternal prioritised ethnicity among births in 2015 (total births excluding unknown maternal age=59,801)

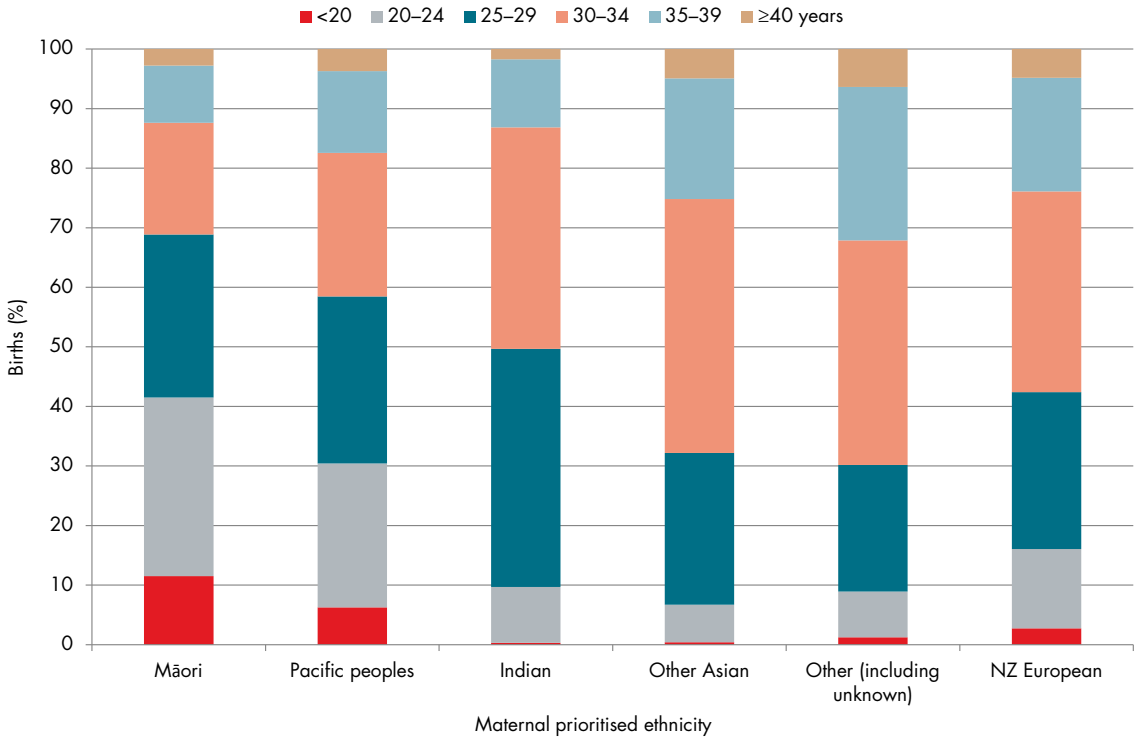


Figure 2.9: Distribution of maternal prioritised ethnicity by DHB of maternal residence among births in 2015 (total births excluding unknown DHB=59,442)

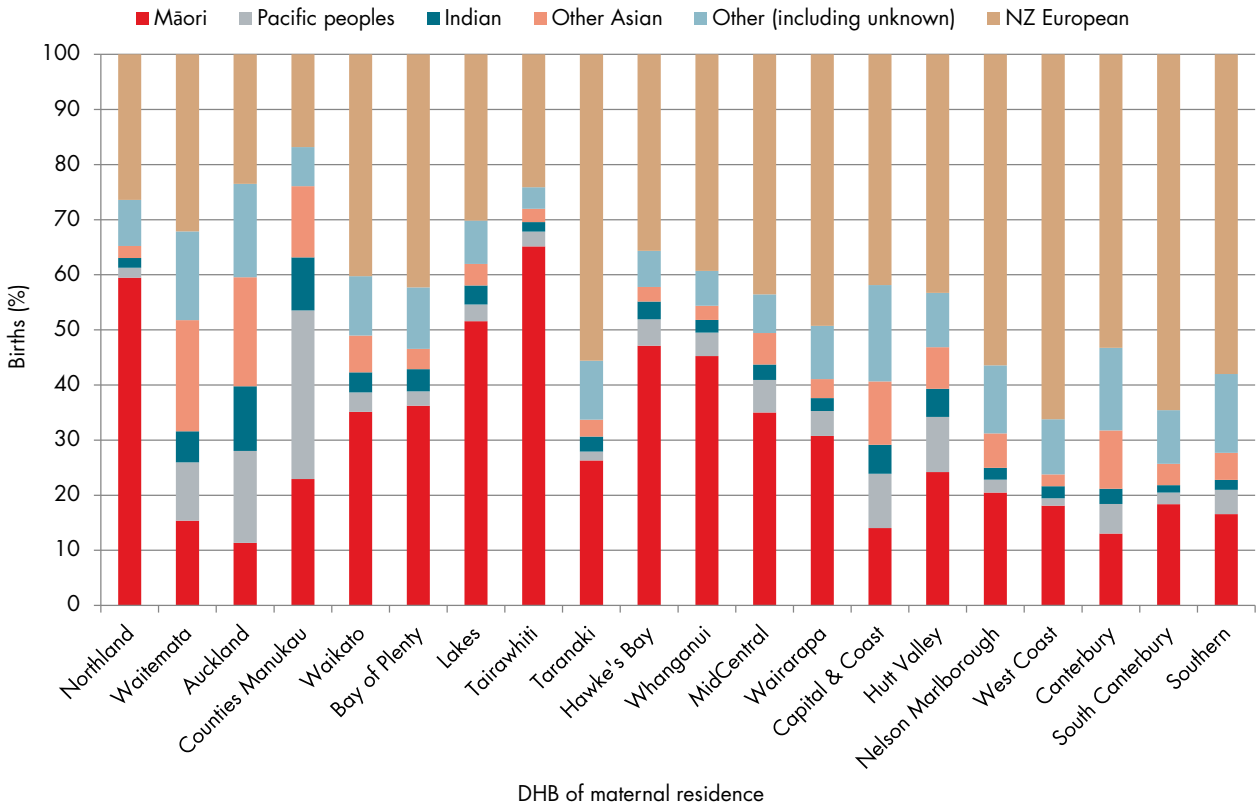
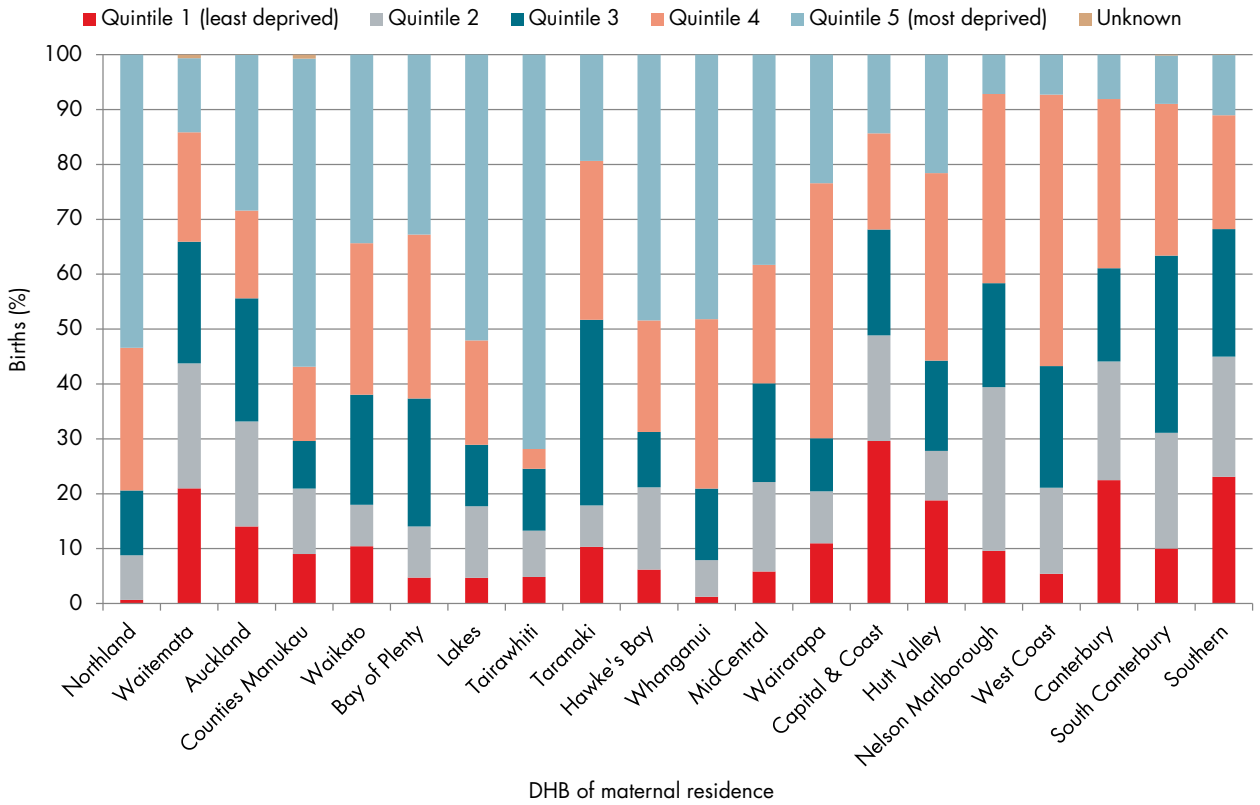


Figure 2.10: Distribution of deprivation quintiles (NZDep2013) by DHB of maternal residence among births in 2015 (total births excluding unknown DHB=59,442)



3 Perinatal Mortality 2015

3.1 Methods

Perinatal mortality numerator data

The perinatal deaths presented in this report occurred between 1 January and 31 December 2015. 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 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 Perinatal Society of Australia and New Zealand perinatal death classifications (PSANZ-PDCs) for cause of death, determining contributory factors and potentially avoidable deaths, and ensuring appropriate, timely follow-up with parents.

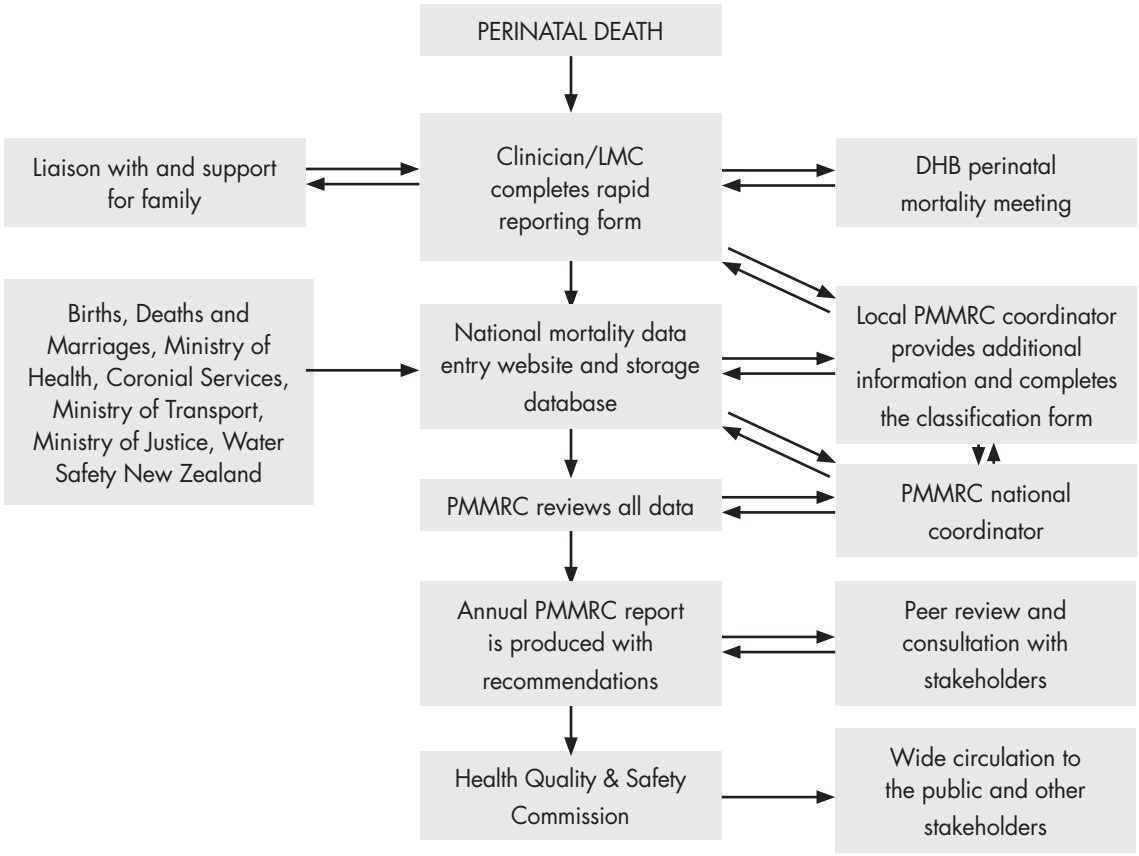
The dataset of perinatal deaths is a compilation of data submitted by LMCs, local coordinators, the Ministry of Health and BDM. A website commissioned by the PMMRC and run by the University of Otago enables web-based data entry. LMCs and/or local coordinators are required to complete rapid reporting 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 PSANZ system of classification of cause of perinatal death (PSANZ 2009). This system includes both perinatal and neonatal classifications. The local coordinator also submits the post-mortem and histology reports with the classification form.

Figure 3.1 outlines the PMMRC process. A user guide describing the definitions and data elements used by the PMMRC is available online at: https://www.hqsc.govt.nz/assets/PMMRC/Publications/guidelines-mother-baby-forms-perinatal-death-v10.pdf.

Figure 3.1: Flow of information in the PMMRC's perinatal data collection process



PMMRC numerator 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.

There were three late notifications added to the perinatal mortality dataset in 2016: two stillbirths and one termination of pregnancy, all in 2014. These deaths have been included in all analyses for this report.

Audit of perinatal numerator data 2013–2015

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-PDC.

The audit for the PMMRC's 11th report focused on 52 babies who met the criteria for neonatal encephalopathy, comparing the accuracy of data submitted to the PMMRC to that in the clinical records from LMCs and DHBs.

The audit reviewed 52 babies who meet the criteria for neonatal encephalopathy from 2013–2015 and who were the subjects of a national review, including 10 babies who died. The following information relates to the audit of these 52 cases of neonatal encephalopathy.

Nine of the 10 neonatal deaths occurred within the first four weeks of life. The perinatal death classification (PSANZ-PDC) and the neonatal death classification (PSANZ-NDC) were all considered to be correct at audit.

The majority of data items were entered correctly, with over 95 percent of data items correct. Information was missing or incorrectly noted around past obstetric history, gestation at registration with an LMC, LMC at birth and antenatal procedures (Doppler ultrasound).

The neonatal encephalopathy and perinatal mortality databases were updated to reflect these findings.

The PMMRC data collection forms were amended in 2016 to ensure that LMC at booking, LMC at birth, and LMC with clinical responsibility are collected accurately.

Contributory factors and potentially avoidable perinatal related 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-PDC. The PMMRC contributory factors and potentially avoidable perinatal death form includes questions that identify contributory factors related to organisational and/or 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. See the 'Contributory Factors for Mortality and Morbidity' on page 78.

3.2 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 MAT dataset of all births in New Zealand in a year. The use of MAT data in the denominator is a change to PMMRC reporting in 2015 and is discussed in more detail in section "1.2 Methodology"'.

The calculation of perinatal related mortality by the PMMRC differs from the methodology used by the Ministry of Health in its reports, 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 2015 year in New Zealand.

Table 3.1: Summary of New Zealand perinatal mortality rates 2015

	Using NZ definition		Using UK definition*	
	n	Rate	n	Rate
Total births	59,808		59,551	
Fetal deaths (terminations of pregnancy and stillbirths)#	412	6.89	-	-
Terminations of pregnancy	107	1.79	-	-
Stillbirths	305	5.10	212	3.56
Early neonatal deaths <7 days	131	2.21	76	1.28
Late neonatal deaths 7–27 days	35	0.59	34	0.57
Neonatal deaths <28 days+	166	2.79	110	1.85
Perinatal mortalities^	543	9.08	288	4.84
Perinatal related mortalities•	578	9.66	322	5.41
Perinatal mortalities excluding lethal and terminated fetal abnormalities~	402	6.72	249	4.18
Perinatal related mortalities excluding lethal and terminated fetal abnormalities~	420	7.02	266	4.47

* Rates calculated using UK definition for perinatal mortality: births from 24 weeks excluding terminations of pregnancy (CMACE 2011a).
# Fetal death rate per 1000 babies born (includes terminations and stillbirths).
+ Neonatal death rate per 1000 live born babies.
^ Fetal deaths and early neonatal deaths per 1000 babies born.
• Fetal deaths and early and late neonatal deaths per 1000 babies born.
~ Lethal and terminated fetal abnormalities are all perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths. with PSANZ-NDC of congenital abnormality.

The perinatal related mortality rate in New Zealand in 2015, which includes late terminations of pregnancy, stillbirths, and early and late neonatal deaths, from 20 weeks gestation to 27 days of life, was 9.7 per 1000 total births.

The perinatal related mortality rate in 2015 is the lowest reported since the PMMRC began collecting data in 2007, but the test for trend is not statistically significant over this time. The rate in 2015 is, however, significantly lower than the rate for the years 2007–2014 combined (p=0.025), and the overall perinatal related mortality rate at 10.0 and 9.7/1000 in two of the past three years was lower than in any single year during 2007–2012.

The significant decrease in the stillbirth rate from 2007 to 2015, reported previously, persists (chi-squared test for trend p=0.0099).

There is a statistically significant trend to a reduction in fetal deaths (stillbirths and late terminations of pregnancy combined) reported for the first time, from 2007 to 2015 (p=0.035) and, although the test for trend is not statistically significant, the late termination of pregnancy rate in 2015 was lower than any previously reported year (1.8/1000 births) and significantly lower than the years 2007–2014 combined (p=0.004). The neonatal death rate has not changed from 2007 to 2015.

Table 3.2: Summary of New Zealand perinatal mortality rates 2007–2015

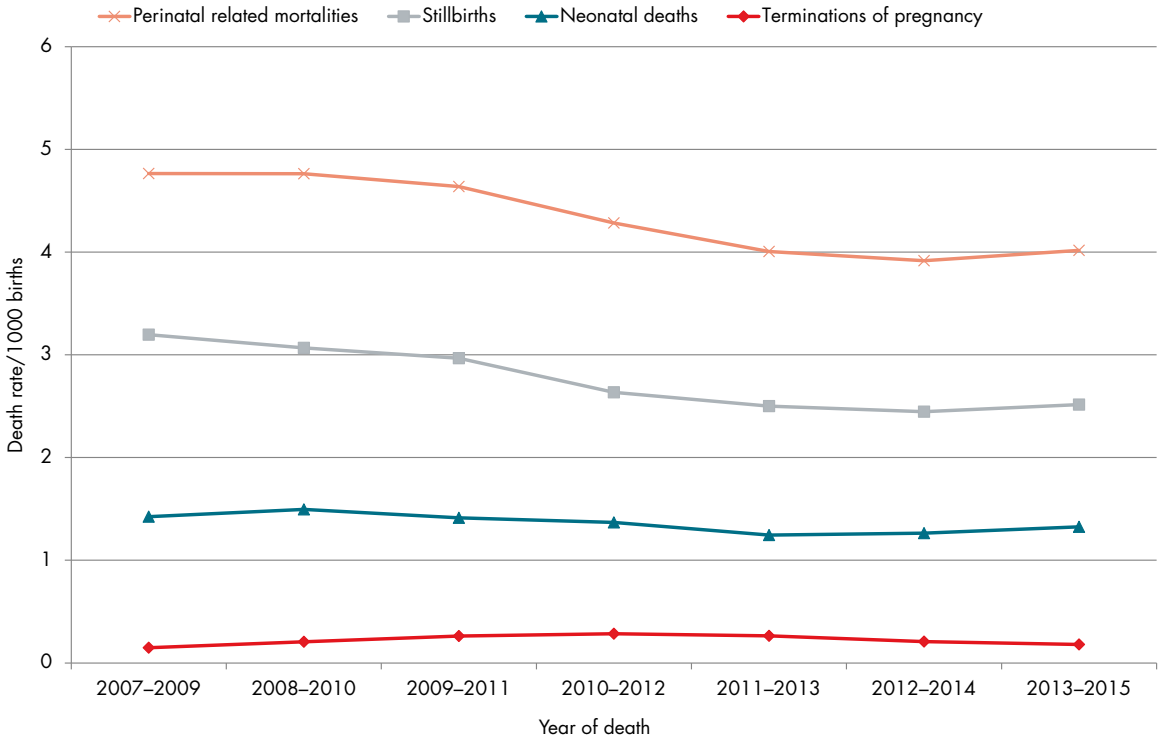
	2007—2008		2009—2010		2011—2012		2013—2014		2015		Chi-squared test for trend (p)
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Total births	130,826		130,666		126,539		120,231		59,808		
Fetal deaths (terminations of pregnancy and stillbirths)*	1,037	7.9	1,045	8.0	995	7.9	924~	7.7	412	6.9	0.035
Terminations of pregnancy	289	2.2	289	2.2	343	2.7	290	2.4	107	1.8	0.92
Stillbirths	748	5.7	756	5.8	652	5.2	634	5.3	305	5.1	0.0099
Early neonatal deaths <7 days	267		302		281		272		131		0.28
Late neonatal deaths 7–27 days	77		91		61		63		35		0.40
Neonatal deaths <28 days#	344	2.7	393	3.0	342	2.7	335	2.8	166	2.8	0.57
Perinatal mortalities+	1,304	10.0	1,347	10.3	1,276	10.1	1196~	9.9	543	9.1	0.18
Perinatal related mortalities^	1,381	10.6	1,438	11.0	1,337	10.6	1259~	10.5	578	9.7	0.13
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	950	7.3	981	7.5	891	7.0	866	7.2	402	6.7	0.20
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	998	7.6	1,043	8.0	929	7.3	904	7.5	420	7.0	0.12

* 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 2 late notification.

Figure 3.2: Perinatal related mortality rolling three-year rates (per 1000 births) using New Zealand definitions 2007–2015

There has been a significant reduction in hypoxic peripartum deaths among total perinatal related deaths (births from 20 weeks) from 2007 to 2015 (chi-squared test for trend p=0.00031) and a trend to reduced deaths from fetal growth restriction (chi-squared test for trend p=0.053) (Table 3.26).

Figure 3.3: Perinatal related mortality rolling three-year rates (per 1000 births) using international definitions 2007–2015



There has been a significant decrease in the perinatal related mortality, fetal death, and stillbirth rates from 2007 to 2015 (chi-squared test for trend p=0.0011, p=0.0006, 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. The perinatal related mortality rate (international definition) was 4.75/1000 births in 2007 and 4.2/1000 births in 2015.

There has been no significant change in neonatal death or termination of pregnancy rates using the international definition from 2007 to 2015, although at 0.7/1000 the neonatal death rate (international definition) is the lowest reported from 2007 to 2015.

Statistically significant reductions in hypoxic peripartum death (p=0.0003), and death from antepartum haemorrhage (p=0.031) and fetal growth restriction (p=0.015) are in part responsible for the significant reduction in perinatal related mortality using the international definition (from 1000g or 28 weeks if birthweight is unknown) (Table 3.27).

International comparisons

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

In the 2014 report from Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK (MBRRACE-UK) (Manktelow et al 2016) it is noted that while all late fetal losses and stillbirths from 22+0 weeks and neonatal deaths of babies live born from 20+0 weeks should be reported, the definition of reported mortality excludes births less than 24+0 weeks gestation and terminations of pregnancy and deaths where gestation is unknown.

The perinatal mortality rate (stillbirths and neonatal deaths under seven days) in the UK in 2014 using the above definition was 5.34/1000 births (NZ 4.7 (95% CI 4.1–5.2)), and the perinatal related mortality rate was 5.88/1000 (NZ 5.1 (95% CI 4.6–5.7)). The stillbirth rate in the UK was 4.12/1000 births in 2014 (NZ 3.3 (95% CI 2.8–3.7)), and the neonatal death rate was 1.76/1000 live births (NZ 1.8 (95% CI 1.5–2.2)). Perinatal mortality and stillbirth rates in New Zealand were significantly lower than in the UK, and the neonatal death rate was the same for 2014.

Rates from the four Scandinavian countries, from the *Pohjoismaiset Perinataalitilastot 2014* (Heino and Gissler 2016), using routinely collected data, the international definition, and excluding terminations of pregnancy, were reported as stillbirth 1.8–2.8/1000 births (NZ 2014 2.49), neonatal death 0.7–1.1 (NZ 1.38), and perinatal mortality 2.3–3.96 (NZ 3.69). It is difficult to compare across countries as demography and background rates of contributing factors vary – for example, only 2 percent of mothers in Scandinavia are under 20 years of age (NZ 5.2 percent), and the preterm birth rate in Scandinavian countries varies from 5.1–5.8 percent (NZ 7.3 percent). In summary, New Zealand perinatal mortality rates were consistent with Scandinavian rates, excepting neonatal mortality, which was higher in New Zealand.

Australia's Mothers and Babies 2014 reported a perinatal mortality rate of 14/1000 among babies of indigenous mothers and 9/1000 among babies of non-indigenous mothers (Australian Institute of Health and Welfare 2016). The overall perinatal related mortality rate reported for Australia was 9.6/1000 births in 2014 compared to 11.2/1000 in 2014 in New Zealand.

Causes of perinatal related death

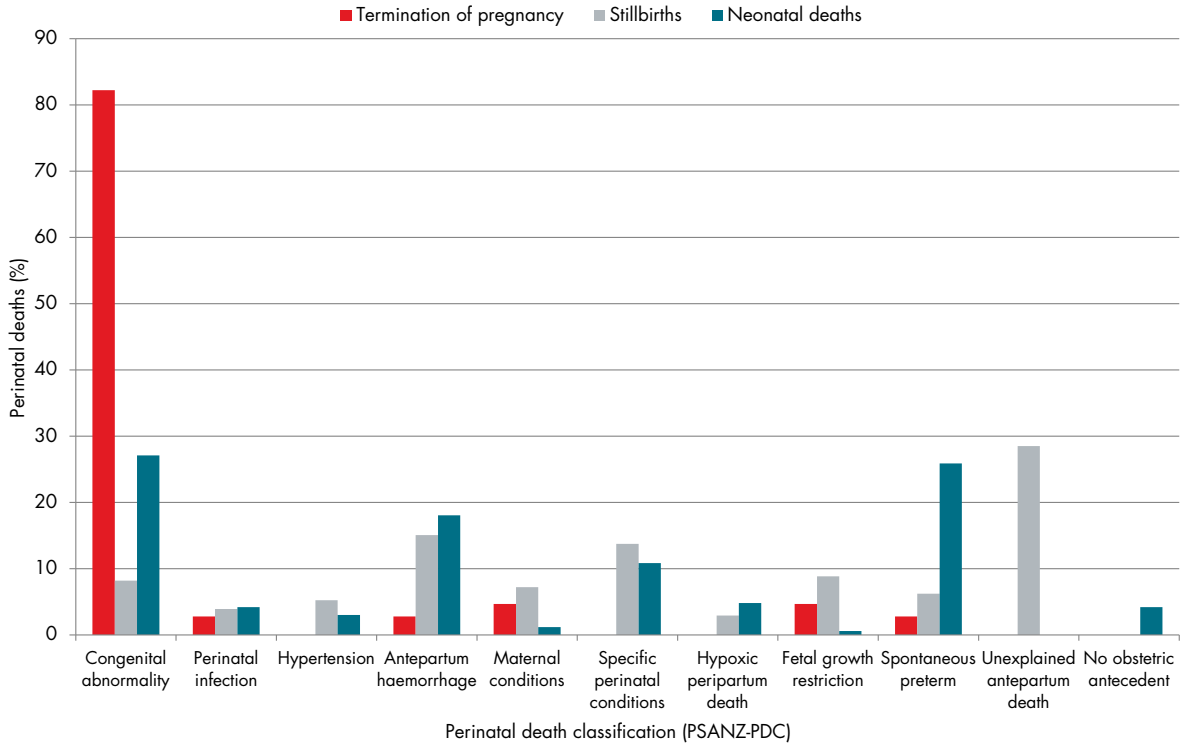
Table 3.3: Perinatal related deaths by primary perinatal death classification (PSANZ-PDC) 2015

Perinatal death classification (PSANZ-PDC)	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Congenital abnormality	88	82.2	25	8.2	45	27.1	158	27.3
Perinatal infection	3	2.8	12	3.9	7	4.2	22	3.8
Hypertension	-	-	16	5.2	5	3.0	21	3.6
Antepartum haemorrhage	3	2.8	46	15.1	30	18.1	79	13.7
Maternal conditions	5	4.7	22	7.2	2	1.2	29	5.0
Specific perinatal conditions	-	-	42	13.8	18	10.8	60	10.4
Hypoxic peripartum death	-	-	9	3.0	8	4.8	17	2.9
Fetal growth restriction	5	4.7	27	8.9	1	0.6	33	5.7
Spontaneous preterm	3	2.8	19	6.2	43	25.9	65	11.2
Unexplained antepartum death	-	-	87	28.5	-	-	87	15.1
No obstetric antecedent	-	-	-	-	7	4.2	7	1.2

Congenital abnormalities are the most common cause of perinatal related death (27.3 percent) using the PSANZ classification system, and 56 percent of these are deaths by termination of pregnancy.

In 2015 compared to 2014, there were significantly fewer perinatal related deaths from spontaneous preterm birth (11.2 percent), demoting spontaneous preterm birth to the fourth most common cause of perinatal related death in 2015, after unexplained antepartum death (15.1 percent) and antepartum haemorrhage (13.7 percent).

Figure 3.4: Relative distribution of fetal and neonatal deaths by perinatal death classification (PSANZ-PDC) 2015



Sex

There is no significant association between the sex of the baby and perinatal related mortality rate in New Zealand (Table 3.29).

Maternal age

Figure 3.5 illustrates the crude associations between maternal age and perinatal related mortality from 2011–2015.

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 3.5). 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, 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 2015. A chi-squared test for trend shows a significant reduction in the proportion of mothers under 20 years of age and mothers 35–39 years of age, and an increase in mothers aged 20–34 years and 40 years and older (Figure 2.3).

After adjusting for the effects of socioeconomic status, ethnicity, multiple pregnancy, DHB of residence, sex of baby, and year of birth, mothers aged 40 years and older had significantly higher odds ratios for late termination of pregnancy, stillbirth, and neonatal death compared to mothers aged 25–29 years (Table 3.12). Mothers aged 35–39 years had significantly higher odds ratios for late termination of pregnancy ad stillbirth compared to mothers aged 25–29 years. Age under 20 years was associated with significantly higher odds ratios for termination of pregnancy, stillbirth and neonatal death compared to mothers aged 25–29 years (Table 3.12).

Table 3.4: Perinatal related mortality rates (per 1000 births) by maternal age 2015

Maternal age (years)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<20	2,835	4.7	5	4.7	1.76	22	7.2	7.76	18	10.8	6.41	45	7.8	15.87
20–24	10,145	17.0	14	13.1	1.38	43	14.1	4.24	29	17.5	2.87	86	14.9	8.48
25–29	16,013	26.8	27	25.2	1.69	88	28.9	5.50	35	21.1	2.20	150	26.0	9.37
30–34	18,294	30.6	38	35.5	2.08	77	25.2	4.21	43	25.9	2.37	158	27.3	8.64
35–39	9,981	16.7	20	18.7	2.00	56	18.4	5.61	31	18.7	3.13	107	18.5	10.72
≥40	2,533	4.2	3	2.8	1.18	19	6.2	7.50	10	6.0	3.98	32	5.5	12.63
Unknown	7	0.0	-	-	-	-	-	-	-	-	-	-	-	-

Figure 3.5: Perinatal related mortality rates (per 1000 births) by maternal age (with 95% CIs) 2011–2015

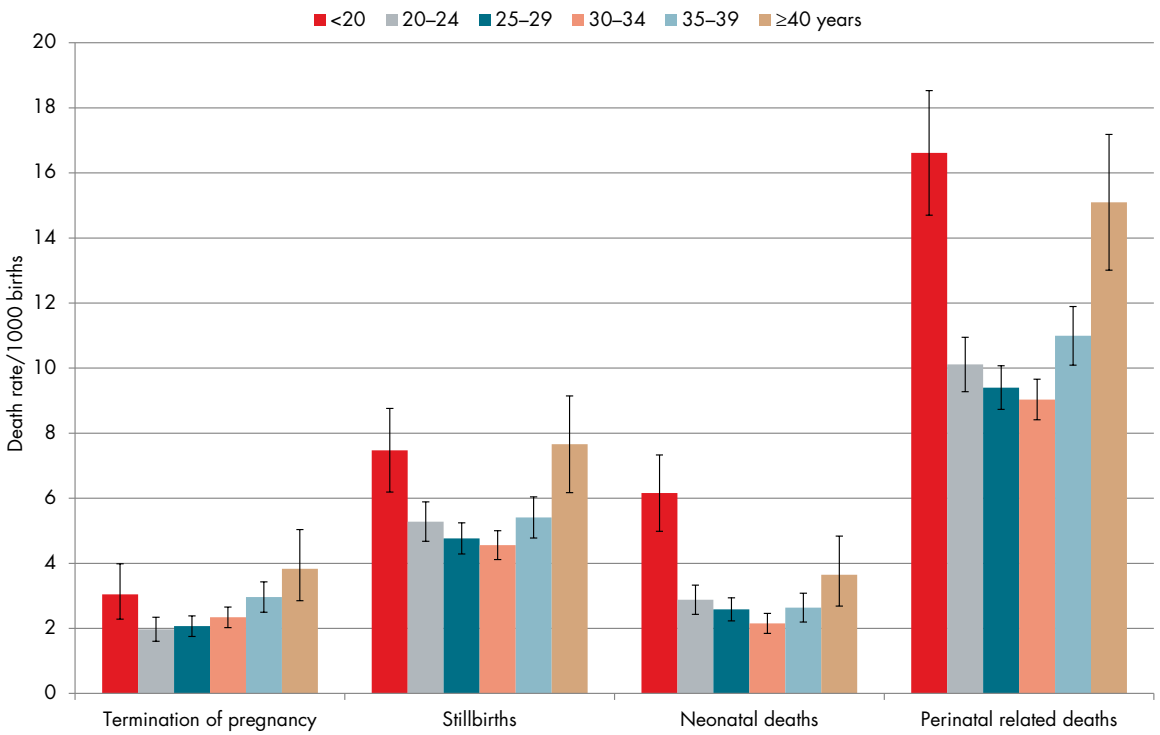
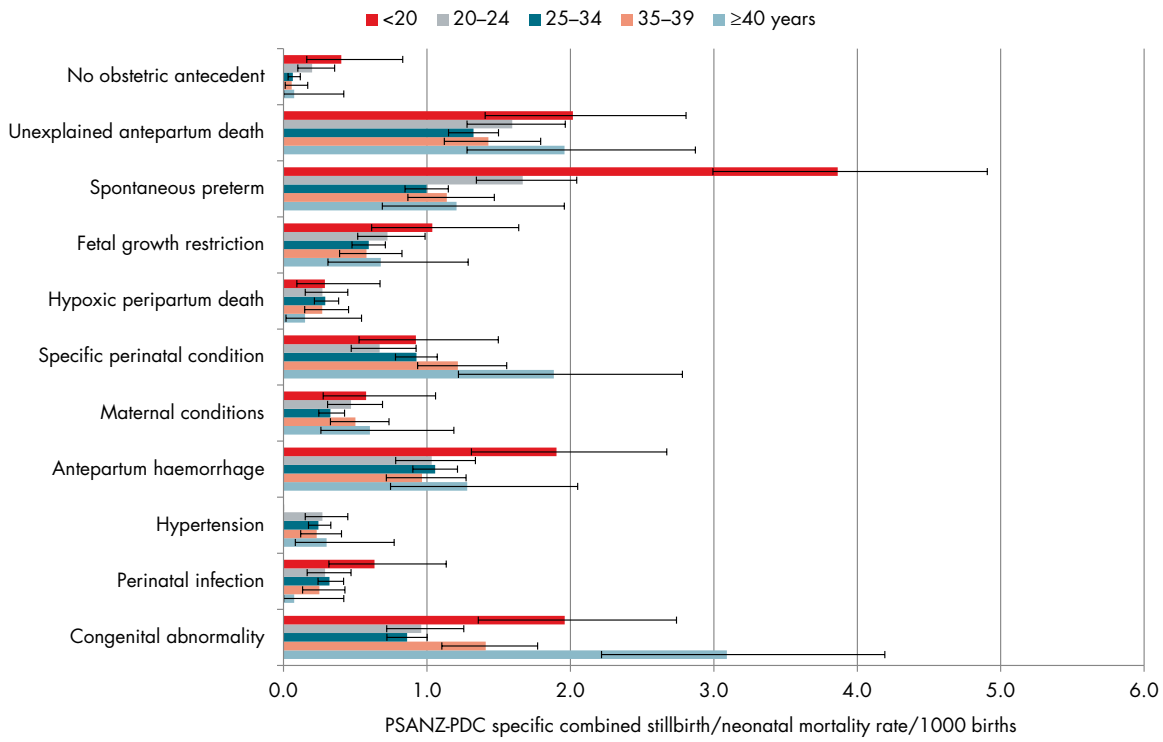


Figure 3.6 illustrates the association between maternal age and cause-specific stillbirth and neonatal mortality (late termination of pregnancy excluded). Especially noticeable are the associations between mothers under 20 years of age and death from spontaneous preterm birth, fetal growth restriction, and antepartum haemorrhage, and the association of stillbirth and neonatal death from congenital abnormality with both extremes of maternal age. Perinatal death from specific perinatal conditions (deaths associated with twinning) is also significantly associated with advanced 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 3.6: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding termination of pregnancy) by maternal age (with 95% CIs) 2011–2015



Ethnicity

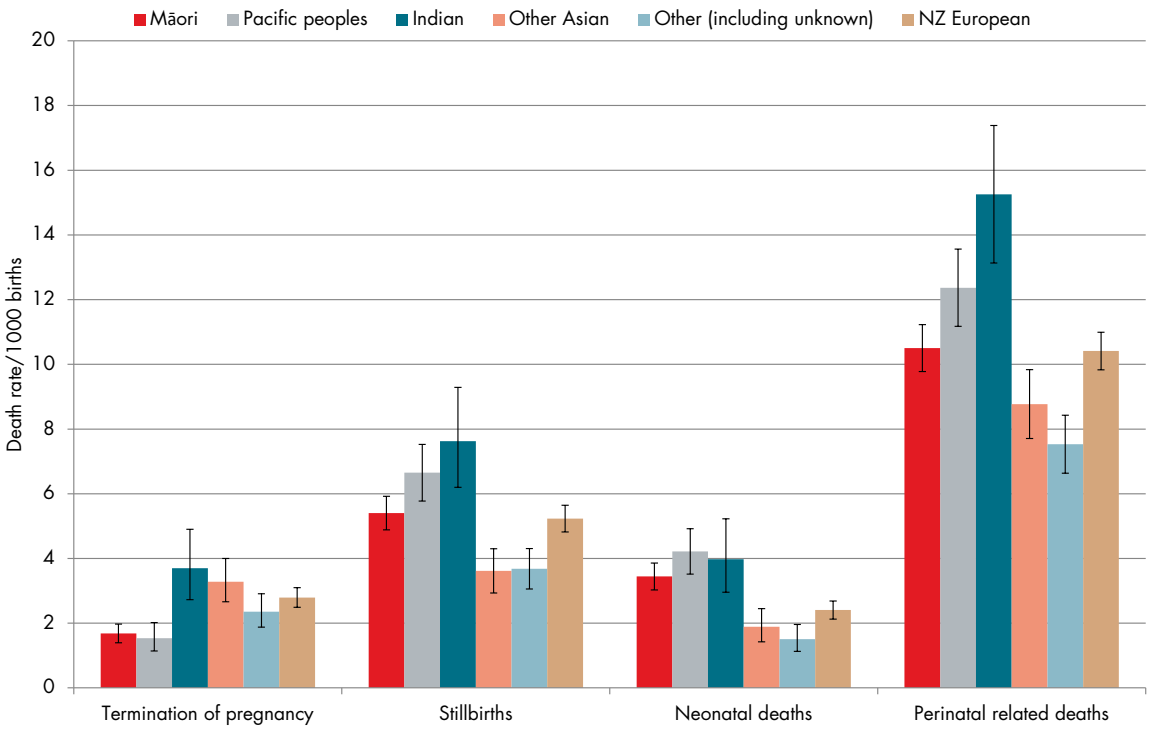
Table 3.5: Perinatal related mortality rates (per 1000 births) by maternal prioritised ethnicity 2015

Ethnicity (mother)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Māori	14,873	24.9	20	18.7	1.34	71	23.3	4.77	52	31.3	3.52	143	24.7	9.61
Pacific peoples	6,165	10.3	4	3.7	0.65	39	12.8	6.33	28	16.9	4.57	71	12.3	11.52
Indian	3,137	5.2	2	1.9	0.64	28	9.2	8.93	13	7.8	4.18	43	7.4	13.71
Other Asian	6,194	10.4	11	10.3	1.78	27	8.9	4.36	15	9.0	2.44	53	9.2	8.56
Other (including unknown)	7,205	12.0	12	11.2	1.67	26	8.5	3.61	6	3.6	0.84	44	7.6	6.11
NZ European	22,234	37.2	58	54.2	2.61	114	37.4	5.13	52	31.3	2.36	224	38.8	10.07

The distribution of perinatal related mortality by ethnicity differs in this year's report compared to previous years of PMMRC reporting as a result of the change in denominator of all births from the BDM dataset to the MAT dataset. The definition of ethnicity differs between these datasets and this is responsible for the differences. This is discussed further in chapter 5.

There is significantly higher perinatal related mortality (2011–2015) among the children of mothers of Pacific and Indian ethnicities compared to mothers of Māori, Other Asian, Other (includes Other European, Middle Eastern, Latin American, African), and New Zealand European ethnicity.

Figure 3.7: Perinatal related mortality rates (per 1000 births) by maternal prioritised ethnicity (with 95% CIs) 2011–2015



The distribution of stillbirth by ethnicity mirrors that of perinatal related mortality. However, the distribution of neonatal mortality shows a different pattern, with a significantly higher neonatal mortality rate among the children of Māori, Pacific and Indian mothers than among 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.

Multivariable analyses to determine the independent effect of ethnicity after adjusting for age, deprivation decile, baby sex, multiple pregnancy, and year of birth showed that Māori mothers were at lower risk of termination of pregnancy (0.53 (95% CI 0.44-0.64)) and at higher risk of neonatal death (1.18 (95% CI 1.02-1.36)) compared to New Zealand European mothers (Table 3.12).

After adjusting, Pacific mothers had decreased odds for late termination of pregnancy compared to New Zealand European mothers but increased odds for both stillbirth (1.17 (95% CIs 1.03-1.33)) and neonatal death (1.32 (95% CI 1.11-1.57)).

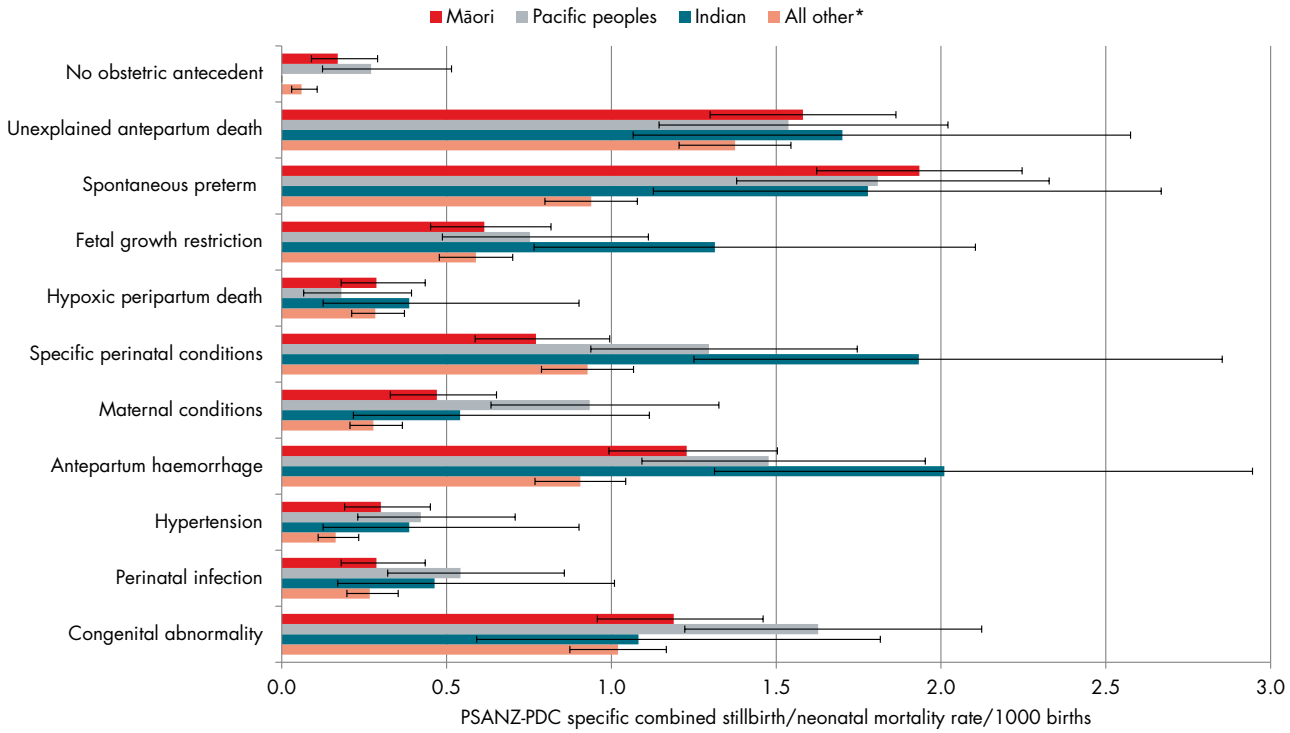
Indian mothers had significantly increased odds for late termination of pregnancy (1.36 (95% CI 1.04-1.78)), stillbirth (1.46 (95% CI 1.21-1.75)) and neonatal death (1.74 (95% CI 1.36-2.22)) compared to New Zealand European mothers.

Other Asian (non-Indian) women had increased odds of late termination of pregnancy (1.30 (1.07-1.57)) but lower odds of stillbirth (0.76 (0.62-0.93)) compared to New Zealand European mothers.

Women of Other ethnicities, including Other European, Middle Eastern, Latin American, African, had lower odds of all of late termination of pregnancy (0.76 (95% CI 0.62-0.93)), stillbirth (0.69 (95% CI 0.59-0.81)), and neonatal mortality (0.62 (95% CI 0.49-0.78))compared to New Zealand European women.

These adjusted estimates were limited by the inability to include parity, BMI, and smoking in the multivariable models due to missing data.

Figure 3.8: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding termination of pregnancy) by maternal prioritised ethnicity (with 95% CIs) 2011–2015



* 'All other' includes New Zealand European, Other Asian, Other (including unknown).

Figure 3.8 illustrates the associations between maternal prioritised ethnicity and cause-specific combined stillbirth and neonatal mortality rates.

The outlying causes of stillbirth and neonatal death among babies of Māori mothers are spontaneous preterm birth, antepartum haemorrhage, maternal conditions (mostly due to diabetes), hypertension, and deaths with no obstetric antecedent. For a description of conditions included in each PSANZ-PDC category, see Table 3.70. An in-depth discussion of Māori perinatal related mortality can be found in chapter 5.

The outlying causes of stillbirth and neonatal death among babies of Pacific mothers are spontaneous preterm birth, maternal conditions, specific perinatal conditions, antepartum haemorrhage, hypertension, perinatal infection, congenital abnormality, and deaths with no obstetric antecedent.

Outlying causes of death among babies of Indian mothers are spontaneous preterm birth, fetal growth restriction, specific perinatal conditions, and antepartum haemorrhage. There may be an excess of other causes among babies of Indian mothers, but as numbers are small and confidence intervals are large, it is hard to confirm.

Socioeconomic deprivation

Table 3.6: Perinatal related mortality rates (per 1000 births) by deprivation quintile (NZDep2013) 2015

Deprivation quintile (NZDep2013)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	8,366	14.0	20	18.7	2.39	36	11.8	4.30	19	11.4	2.29	75	13.0	8.96
2	9,483	15.9	22	20.6	2.32	44	14.4	4.64	17	10.2	1.81	83	14.4	8.75
3	10,746	18.0	20	18.7	1.86	44	14.4	4.09	25	15.1	2.34	89	15.4	8.28
4	13,447	22.5	22	20.6	1.64	69	22.6	5.13	46	27.7	3.44	137	23.7	10.19
5 (most deprived)	17,284	28.9	23	21.5	1.33	110	36.1	6.36	57	34.3	3.32	190	32.9	10.99
Unknown	482	0.8	-	-	-	2	0.7	-	2	1.2	-	4	0.7	-

Figure 3.9: Perinatal related mortality rates (per 1000 births) by deprivation quintile (NZDep2013) 2015

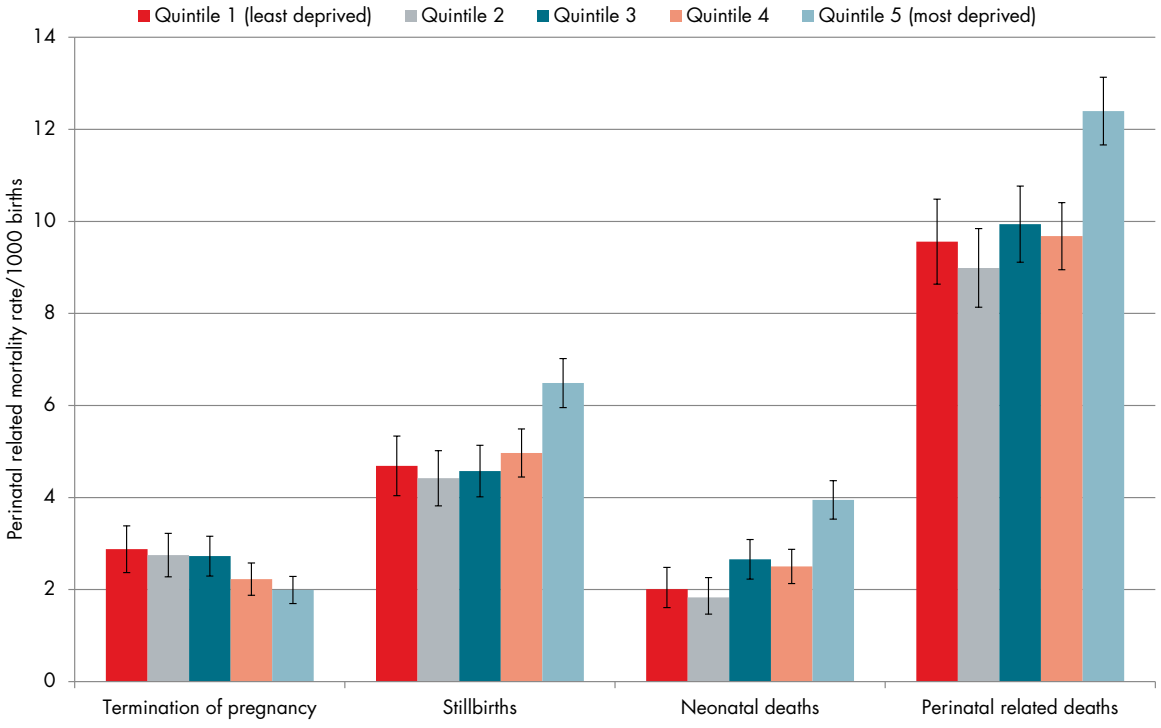


Figure 3.9 illustrates an association between increased socioeconomic deprivation and perinatal related mortality. This association is less obvious in this report than previously. It is likely this is due to the change in area of domicile, which underpins the measure of deprivation, this year from the small geographic area represented by mesh block in the BDM dataset to the larger census area unit measure available in the MAT dataset.

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 barriers to access and/or engagement with care contributory factors to perinatal related death (Figure 3.27).

Multivariable analysis, adjusting for maternal ethnicity, age, multiple pregnancy, year of birth, and sex of baby, found increasing socioeconomic deprivation (measured by deprivation decile) was significantly associated with increased risk of stillbirth and neonatal mortality but there was no increase in risk for late termination of pregnancy.

Figure 3.10: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile (with 95% CIs) 2011–2015

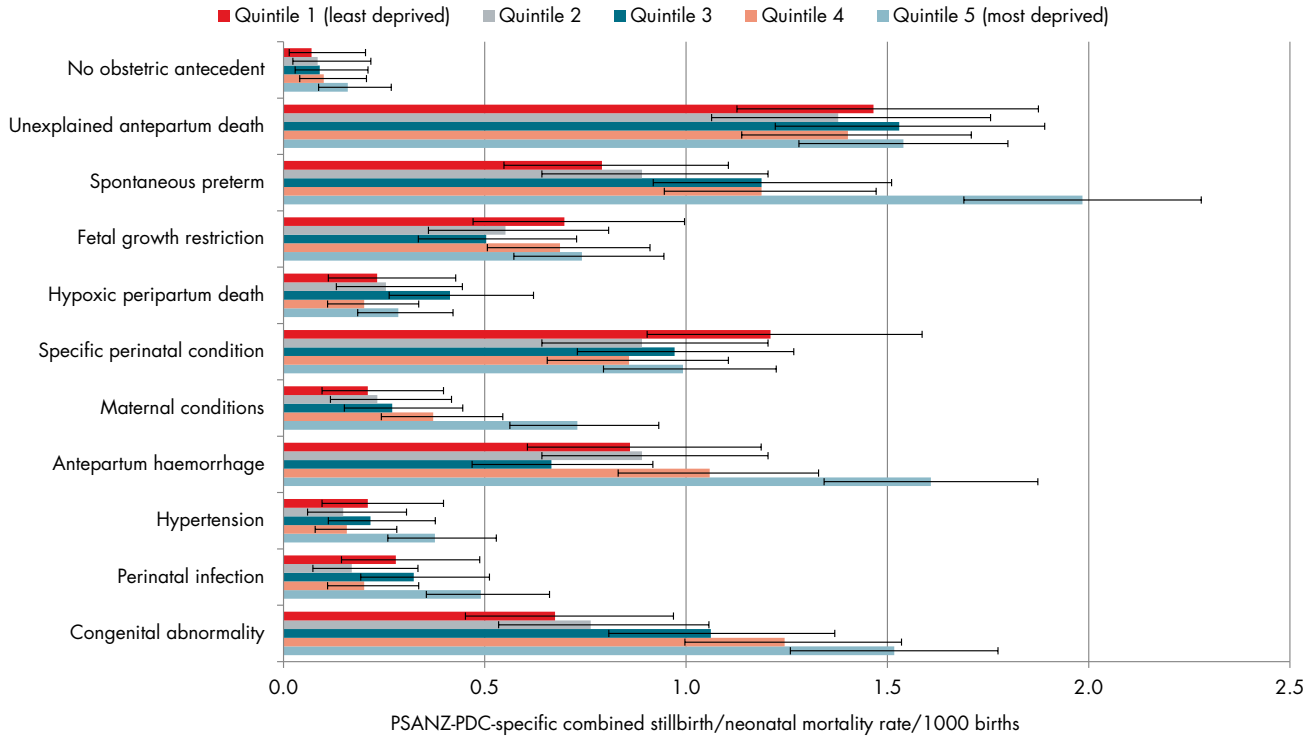


Figure 3.10 illustrates the associations between socioeconomic deprivation quintile and cause-specific stillbirth and neonatal mortality rates. There is a significant increase in spontaneous preterm birth, maternal conditions, antepartum haemorrhage, hypertension, perinatal infection, and congenital abnormalities as causes of stillbirth and neonatal death with increasing socioeconomic deprivation. The suggested increase in death without obstetric antecedent is not statistically significant (p=0.11).

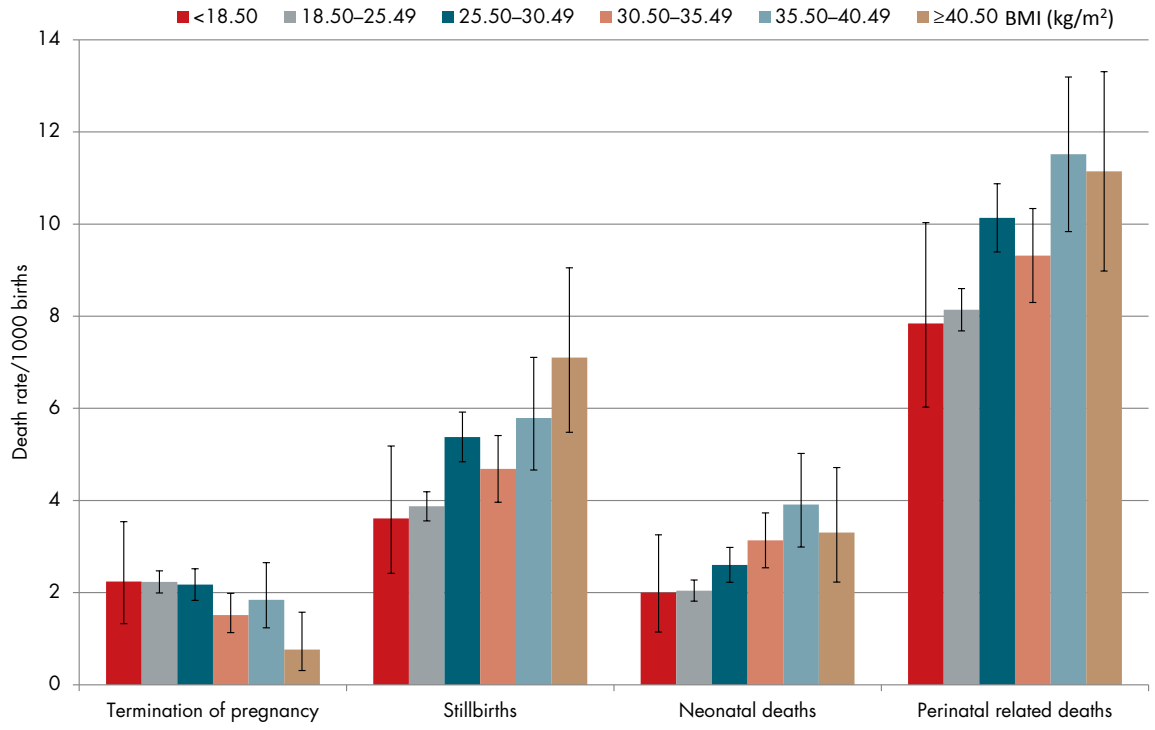
Body mass index

Table 3.7: Perinatal related death rates (per 1000 births) by maternal body mass index (BMI)* 2015

Maternal BMI (kg/m2)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=102			n=296			n=164			n=562		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<18.50	1,591	2.7	1	1.0	0.63	3	1.0	1.89	4	2.4	2.52	8	1.4	5.03
18.50–25.49	28,814	48.2	47	46.1	1.63	110	37.2	3.82	64	39.0	2.23	221	39.3	7.67
25.50–30.49	14,236	23.8	27	26.5	1.90	81	27.4	5.69	34	20.7	2.41	142	25.3	9.97
30.50–35.49	7,012	11.7	9	8.8	1.28	26	8.8	3.71	27	16.5	3.87	62	11.0	8.84
35.50–40.49	3,355	5.6	4	3.9	1.19	25	8.4	7.45	13	7.9	3.91	42	7.5	12.52
≥40.50	1,984	3.3	-	-	-	12	4.1	6.05	5	3.0	2.54	17	3.0	8.57
Unknown	2,816	4.7	14	13.7	-	39	13.2	-	17	10.4	-	70	12.5	-

* MAT data numerator and denominator.

Figure 3.11: Perinatal related death rates (per 1000 births) by maternal body mass index (BMI)* (with 95% CIs) 2011–2015



* MAT data numerator and denominator.

The use of MAT data has facilitated the analysis of perinatal related mortality rates by BMI. MAT data have been used for all numerator data in the tables and figures. See section "1.2 Methodology"' for explanation. Due to the format of the provided data, the WHO categories have been modified slightly.

Figure 3.11 shows the significant association between maternal BMI and perinatal related mortality. These are unadjusted for potential confounders.

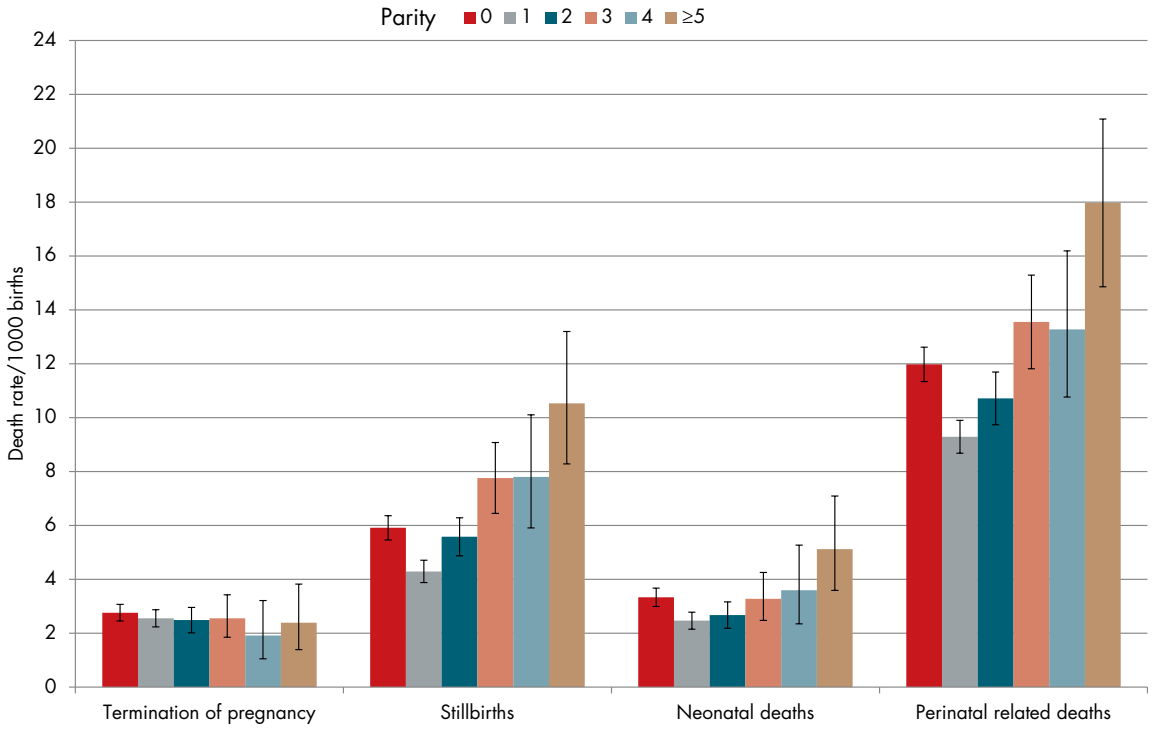
There is a significant increase in stillbirth and neonatal death with increasing BMI and a reduction in late termination of pregnancy with increasing BMI.

Parity

Table 3.8: Perinatal related mortality rates (per 1000 births) by parity 2015

Parity	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
0	22,746	38.0	47	43.9	2.07	141	46.2	6.20	61	36.7	2.70	249	43.1	10.95
1	19,149	32.0	32	29.9	1.67	72	23.6	3.76	57	34.3	2.99	161	27.9	8.41
2	8,594	14.4	20	18.7	2.33	44	14.4	5.12	30	18.1	3.52	94	16.3	10.94
3	3,301	5.5	5	4.7	1.51	21	6.9	6.36	10	6.0	3.05	36	6.2	10.91
4	1,464	2.4	3	2.8	2.05	12	3.9	8.20	6	3.6	4.14	21	3.6	14.34
≥5	1,284	2.1	-	-	-	15	4.9	11.68	2	1.2	1.58	17	2.9	13.24
Unknown	3,270	5.5	-	-	-	-	-	-	-	-	-	-	-	-

Figure 3.12: Perinatal related death rates (per 1000 births) by maternal parity (with 95% CIs) 2011–2015



The change to using the MAT data means that rates of perinatal related mortality can be presented by parity for the first time. For these analyses, numerator data are obtained from the PMMRC dataset and denominator data from the MAT dataset. These are univariable analyses – that is, they do not adjust for probable confounding factors such as maternal age, socioeconomic status, BMI, smoking status and complications of pregnancy.

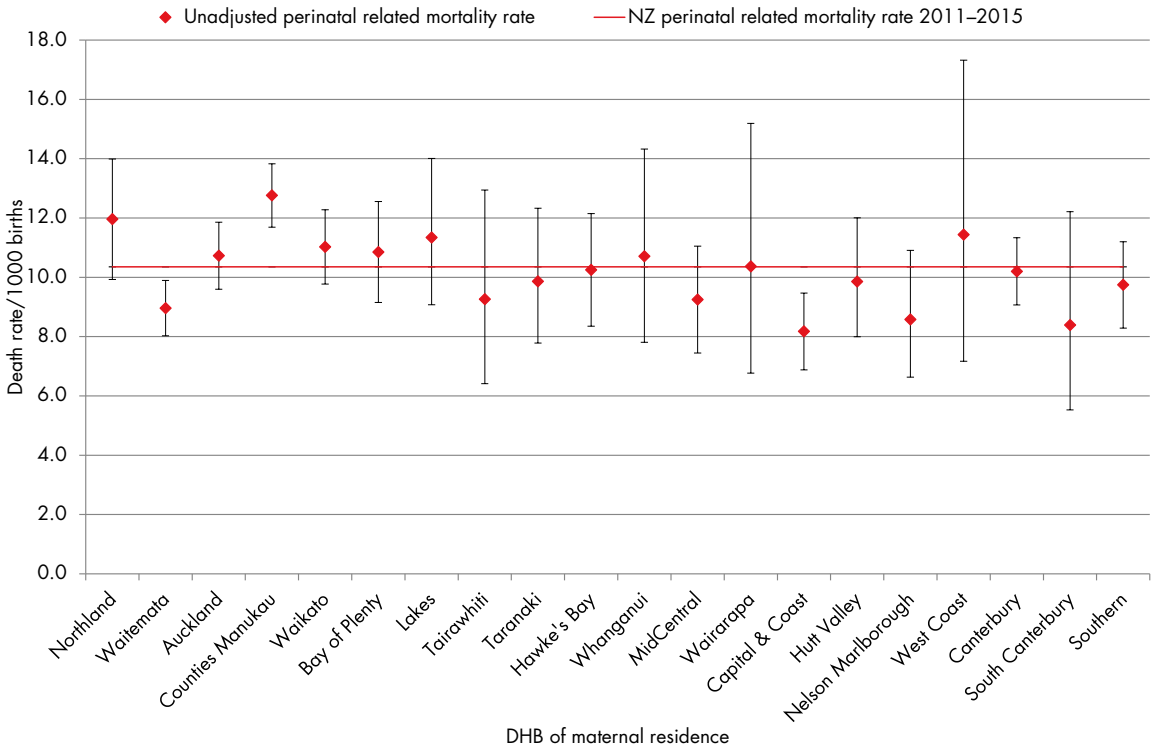
There is an increase in perinatal related mortality rate among nulliparous women (women having their first baby) compared to women having their second baby. There is increasing risk for women having their third and subsequent babies compared to their second, and this risk increases up to at least the sixth baby (parity 5). The risk for subsequent births is more difficult to estimate as the numbers of women in these parity groups are small, so the rate for the sixth or later births has been aggregated. The perinatal related mortality rate for women having their first baby approximates the risk for women having their fourth and fifth baby. The risk for women having their sixth or later baby is double the risk of women having their second baby.

There is an increase in risk of stillbirth and neonatal death among nulliparous women compared to women having their second baby. There is increasing risk for women having their third and subsequent babies compared to their second, and this risk increases up to the sixth baby (parity 5). Stillbirth risk for women having their first baby is similar to that of women having their third babies, and neonatal risk is similar to that of women having their third or fourth baby.

There is no significant trend in rate of late termination of pregnancy with increasing parity; however, the rate of late termination of pregnancy is higher among women having their first baby than among women having a subsequent baby.

DHB of residence

Figure 3.13: Unadjusted perinatal related mortality rates (per 1000 births) by DHB of residence (mother) compared to average perinatal related mortality (with 95% CIs) 2011–2015



The red line in Figure 3.13 represents the New Zealand rate of perinatal related mortality for 2011–2015 (10.0/1000 births). DHB rates are compared to the national rate, represented by the point estimate for 2011–2015 and a 95 percent CI. This analysis has been limited to 2011–2015 because there have been significant changes in the perinatal related mortality rate since 2007, and changes in

maternity care over the same time, and it was no longer appropriate to group all years. The use of data from 2011–2015 is consistent with a number of analyses in the perinatal report this year.

There is a significantly higher rate of perinatal related mortality than the national rate among residents of Counties Manukau DHB.

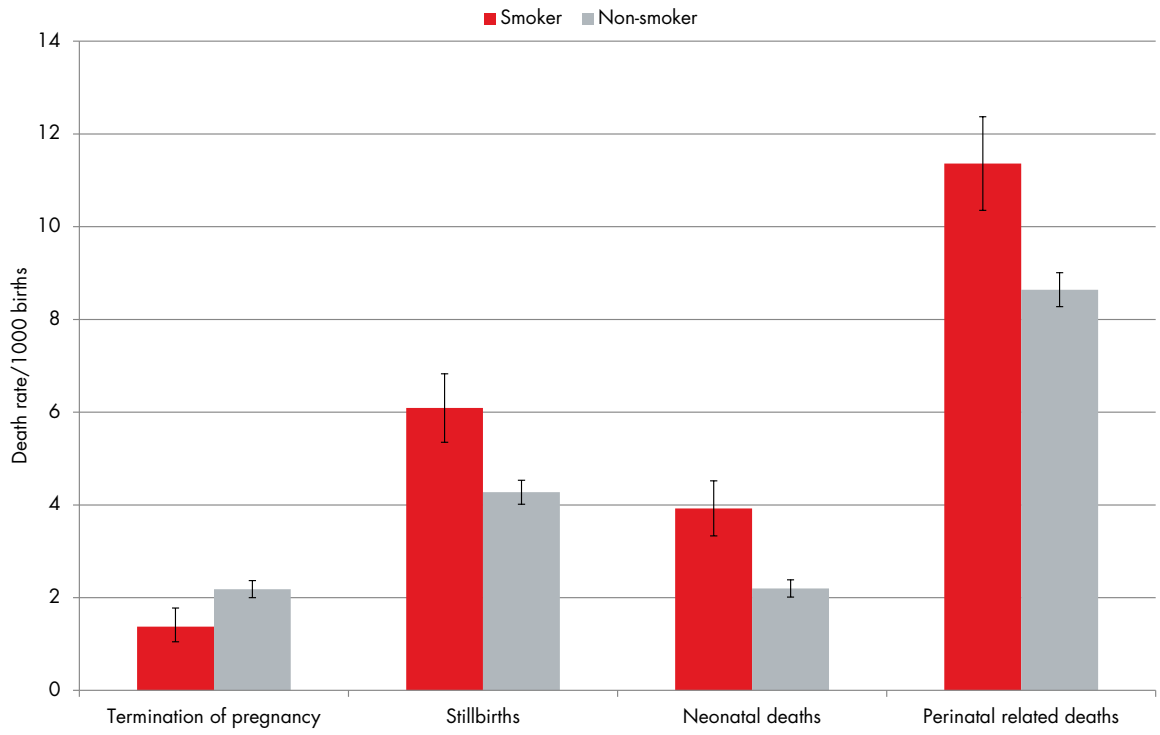
Figures describing the rates of stillbirth and neonatal death compared to the national rates can be found in the appended Figure 3.28 and Figure 3.29.

There is a significantly higher stillbirth rate than the national rate among residents of Counties Manukau DHB (Figure 3.28).

There is a significantly higher neonatal death rate than the national rate among residents of Counties Manukau and Waikato DHBs (Figure 3.29).

Maternal smoking, alcohol and substance use

Figure 3.14: Perinatal related mortality rates (per 1000 births) by smoking* at registration with maternity care* (with 95% CIs) 2011–2015



* MAT data numerator and denominator.

Table 3.9: Perinatal related mortality rates (per 1000 births) by smoking at registration with maternity care* 2015

Maternal smoking at registration	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=102			n=296			n=164			n=562		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Smoker	8,088	13.5	10	9.8	1.24	45	15.2	5.56	40	24.4	4.98	95	16.9	11.75
Non-smoker	49,063	82.0	79	77.5	1.61	215	72.6	4.38	107	65.2	2.19	401	71.4	8.17
Unknown	2,657	4.4	13	12.7	-	36	12.2	-	17	10.4	-	66	11.7	-

* MAT data numerator and denominator.

The use of the MAT dataset denominator has facilitated the analysis of perinatal related mortality rates by smoking. MAT smoking data have been used for both numerator and denominator in the tables and figures reporting perinatal related mortality rates. The proportion of smokers in the PMMRC dataset is presented in Table 3.10 with data on smoking cessation, along with other data without a denominator. (See "Appendix D: Compiling the MAT Denominator and Numerator Data" for a more detailed description of the datasets.)

Among women who birthed in New Zealand in 2015 whose data are included in the MAT dataset, 13.5 percent (or 14.2 percent of mothers with smoking data available) were smokers at registration with their LMC. Smoking data at registration were missing for 4.4 percent of mothers overall, and for 11.7 percent of mothers of babies who died in the perinatal period.

The smoking rate among mothers of babies who died was 16.9 percent at registration with an LMC according to data from the MAT dataset (or 19.2% of mothers with known smoking data) compared to a smoking rate of 21.1 percent at the time of death in the PMMRC dataset.

Figure 3.14 shows that significantly more women who had a neonatal death or a stillbirth were smokers. It is possible that the true relative risk for smokers will differ from that presented here as it is likely that the rate of smoking among mothers with missing smoking data in the MAT dataset differs from that among mothers with data.

Table 3.10: Maternal smoking, alcohol and substance use at the time of perinatal related death 2015

	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Currently smoking								
Yes	14	13.1	61	20.0	47	28.3	122	21.1
No	93	86.9	243	79.7	119	71.7	455	78.7
Smoking history (among current non-smokers)								
Never smoked	75	70.1	200	65.6	84	50.6	359	62.1
Stopped before this pregnancy	11	10.3	26	8.5	21	12.7	58	10.0
Stopped <16 weeks gestation	5	4.7	10	3.3	10	6.0	25	4.3
Stopped ≥16 weeks gestation	2	1.9	6	2.0	2	1.2	10	1.7
Unknown	-	-	1	0.3	1	0.6	2	0.3
Unknown	-	-	1	0.3	-	-	1	0.2
Alcohol and substance use								
Yes	9	8.4	25	8.2	19	11.4	53	9.2
No	91	85.0	257	84.3	130	78.3	478	82.7
Unknown	7	6.5	23	7.5	17	10.2	47	8.1
Specific drugs								
Alcohol	5	4.7	19	6.2	15	9.0	39	6.7
Amphetamine/P	-	-	2	0.7	2	1.2	4	0.7
Herbal highs	-	-	1	0.3	-	-	1	0.2
Marijuana	5	4.7	8	2.6	7	4.2	20	3.5
Methadone	-	-	-	-	1	0.6	1	0.2

There has been a decrease in the proportion of current smokers among mothers of babies who died in the perinatal period from around 30 percent in 2007–2009 to 21 percent in 2015. This is associated with other changes in demography among the birthing population (eg, an increase in the proportion of Other Asian mothers who have low rates of smoking, and 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).

Table 3.11: Maternal smoking cessation support offered and perinatal related death 2015

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=32		**n=104**		**n=82**		**n=218**	
	n	%	n	%	n	%	n	%
No	9	28.1	28	26.9	22	26.8	59	27.1
Yes – by LMC only	6	18.8	10	9.6	18	22.0	34	15.6
Yes – referred to external agents	3	9.4	8	7.7	7	8.5	18	8.3
Yes – referral declined	6	18.8	39	37.5	24	29.3	69	31.7
Unknown	8	25.0	19	18.3	11	13.4	38	17.4

In 2015, smoking cessation support was offered to approximately half of smoking or recently smoking, mothers of babies who died.

Table 3.12: Adjusted odds ratios for perinatal related mortality, termination of pregnancy, stillbirth, and neonatal death 2008–2015

	Perinatal related mortality			**Fetal deaths**						**Neonatal mortality**		
				Termination of pregnancy			**Stillbirth**					
	n=494,210			**n=494,210**			**n=494,210**			**n=490,578**		
	OR adjusted	95%CI		OR adjusted	95%CI		OR adjusted	95%CI		OR adjusted	95%CI	
Ethnicity*												
Maori	0.90	0.83	0.97	0.53	0.44	0.64	0.93	0.83	1.03	1.18	1.02	1.36
Pacific	1.09	1.00	1.20	0.65	0.52	0.82	1.17	1.03	1.33	1.32	1.11	1.57
Indian	1.50	1.32	1.71	1.36	1.04	1.78	1.46	1.21	1.75	1.74	1.36	2.22
Other Asian	0.94	0.84	1.05	1.30	1.07	1.57	0.76	0.64	0.90	0.91	0.72	1.15
Other	0.69	0.62	0.77	0.76	0.62	0.93	0.69	0.59	0.81	0.62	0.49	0.78
New Zealand European	1.00			1.00			1.00			1.00		
Age#												
<20	1.62	1.45	1.81	1.62	1.25	2.12	1.49	1.28	1.75	1.81	1.49	2.20
20–24	1.11	1.01	1.21	1.18	0.97	1.43	1.11	0.98	1.25	1.05	0.89	1.23
25–29	1.00			1.00			1.00			1.00		
30–34	0.97	0.89	1.05	1.03	0.87	1.23	1.00	0.89	1.12	0.85	0.73	1.00
35–39	1.19	1.09	1.30	1.29	1.07	1.55	1.16	1.02	1.31	1.17	0.99	1.38
≥40	1.51	1.32	1.72	1.80	1.38	2.34	1.47	1.22	1.78	1.34	1.03	1.74
Deprivation decile# (per unit)	1.05	1.03	1.06	0.99	0.97	1.02	1.05	1.03	1.07	1.08	1.06	1.11
Year of birth#	0.99	0.98	1.01	1.00	0.97	1.03	0.99	0.97	1.00	1.00	0.98	1.03
Sex+												
Male	1.00			1.00			1.00			1.00		
Female	0.95	0.90	1.00	1.03	0.91	1.16	0.97	0.90	1.05	0.85	0.76	0.94
Multiple pregnancy*	4.28	3.91	4.69	2.07	1.60	2.67	4.01	3.52	4.56	6.73	5.80	7.81

* Data for numerator from the PMMRC dataset.
# Data for numerator from the MAT dataset.
+ Data for numerator from the MAT dataset, then the PMMRC dataset if MAT data are missing.
OR = odds ratio.
CI = confidence interval.

Table 3.12 provides odds ratios (ORs) for perinatal related mortality, late termination of pregnancy, stillbirth, and neonatal death adjusted for co-variables included in the model. Significant associations are highlighted in red.

Gestation and birthweight and perinatal related mortality

Table 3.13: Perinatal related mortality rates (per 1000 births) by gestation and birthweight 2015

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gestation at birth (weeks)														
20–22	168	0.3	66	61.7	*	73	23.9	*	36	21.7	*	175	30.3	*
23–24	117	0.2	27	25.2	*	32	10.5	*	33	19.9	*	92	15.9	*
25–27	206	0.3	8	7.5	38.83	31	10.2	150.49	13	7.8	77.84	52	9.0	252.43
28–31	456	0.8	3	2.8	6.58	29	9.5	63.60	9	5.4	21.23	41	7.1	89.91
32–36	3,635	6.1	3	2.8	0.83	48	15.7	13.20	27	16.3	7.53	78	13.5	21.46
37–40	45,646	76.3	-	-	-	72	23.6	1.58	39	23.5	0.86	111	19.2	2.43
≥41	9,105	15.2	-	-	-	20	6.6	2.20	9	5.4	0.99	29	5.0	3.19
Unknown	475	0.8	-	-	-	-	-	-	-	-	-	-	-	-
Birthweight (g)														
<500	187	0.31	63	58.9	*	99	32.5	*	26	15.7	*	188	32.5	*
500–999	273	0.46	36	33.6	131.87	48	15.7	175.82	54	32.5	285.71	138	23.9	505.49
1000–1499	376	0.63	6	5.6	15.96	16	5.2	42.55	12	7.2	33.90	34	5.9	90.43
1500–1999	649	1.09	1	0.9	1.54	27	8.9	41.60	8	4.8	12.88	36	6.2	55.47
2000–2499	2,161	3.61	-	-	-	19	6.2	8.79	14	8.4	6.54	33	5.7	15.27
2500–2999	7,966	13.32	-	-	-	31	10.2	3.89	21	12.7	2.65	52	9.0	6.53
3000–3499	18,998	31.76	-	-	-	34	11.1	1.79	19	11.4	1.00	53	9.2	2.79
3500–3999	18,051	30.18	-	-	-	23	7.5	1.27	6	3.6	0.33	29	5.0	1.61
4000–4499	6,732	11.26	-	-	-	4	1.3	0.59	4	2.4	0.59	8	1.4	1.19
≥4500	1,252	2.09	-	-	-	3	1.0	2.40	1	0.6	0.80	4	0.7	3.19
Unknown	3,163	5.29	1	0.9	-	1	0.3	-	1	0.6	-	3	0.5	-

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

There has been a reduction in stillbirth rate at term (Table 3.47), and a parallel reduction in perinatal related mortality rate of babies 3000–3499g (chi-squared test for trend p=0.024) and 4000–4499g (p=0.00035) from 2007 to 2015 (Table 3.48).

A combination of fewer births beyond term and the known lower risk of stillbirth at term but prior to 40 weeks, explain a small part of the reduction in stillbirths at term. A further reduction in term stillbirth risk may be due to appropriate iatrogenic birth (induction of labour or elective Caesarean) for risks identified at term. However the extent of this reduction cannot be estimated from the data available.

Figure 3.15: Perinatal related mortality risk (per 1000 ongoing pregnancies) by gestational age at birth and year 2007–2015

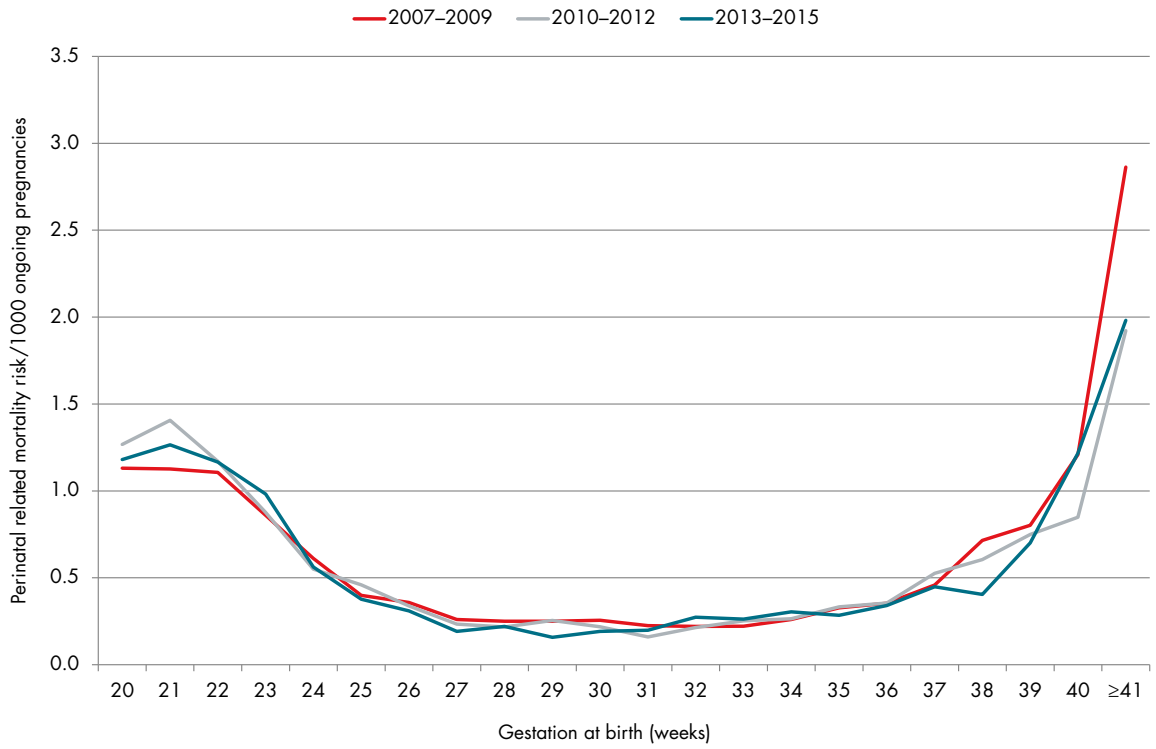


Figure 3.15 shows perinatal related mortality risk by gestation for three 3-year cohorts. It illustrates the higher mortality risk for babies from 20 to 24 weeks gestation and the marked increase in risk again near to term.

The apparent increase in risk at 20–22 weeks seen in the earlier two time cohorts (2007–2012) is no longer statistically significant due to a decrease in deaths at 20–22 weeks in 2015.

There is a statistically significant decrease in perinatal related mortality risk from 2007 to 2015 at 28–31 weeks (p=0.044), 37–38 weeks (p=0.025) and ≥41 weeks (p=0.047) (Table 3.46).

Of note in 2015 is an increase in perinatal related mortality risk from 41+0 weeks compared to the lower rates of recent years. The risk in 2015 (3.19 per 1000 ongoing pregnancies) was the same as the risk in 2008 (3.15) and higher than the rates in any year from 2009 to 2014. There were 29 deaths from 41 weeks in 2015 (20 stillbirths and 9 neonatal deaths). The number of neonatal deaths is consistent with previous years. Twenty stillbirths is the largest number since 2007, and there were no more than nine stillbirths per year for the past four years (2011–2014). In 2015, stillbirths from 41 weeks included deaths from congenital abnormality (PSANZ-PDC1), perinatal infection (PSANZ-PDC2), hypertension (PSANZ-PDC3), antepartum haemorrhage (PSANZ-PDC4), maternal conditions (PSANZ-PDC5), specific perinatal conditions (PSANZ-PDC6), hypoxic peripartum death (PSANZ-PDC7), fetal growth restriction (PSANZ-PDC8), and unexplained (PSANZ-PDC10).

Review of the 17 stillbirths from 41+0 weeks without congenital abnormality, against the *Auckland Consensus Guideline on Induction of Labour* (Wise et al 2014) and against best practice for antenatal assessment in women with risk factors, found the care provided did not follow the guideline and/or best practice in 6 of the 17 stillbirths. This related to best practice to perform serial growth scans following antepartum haemorrhage; best practice for obstetric review and/or to perform serial growth scans for BMI >35; and to offer induction of labour for increased risk.

For the remaining 11 stillbirths, no antenatal risk factors were identified.

Management of Pregnancy after 41 Weeks

- Women with uncomplicated pregnancies should be offered induction of labour between 41+0 and 42+0 weeks to avoid the risks of prolonged pregnancy, including an increased risk of perinatal mortality (NICE 2008).
- Women with risk factors for perinatal related mortality or complications of pregnancy should be offered obstetric assessment and induction of labour at earlier gestations.
- Women from 41+0 weeks pregnancy should be counselled about the limitations of research on increased fetal surveillance to reduce perinatal mortality after 41+0 weeks. Suggested surveillance includes ultrasound scan for fetal growth and liquor volume (by estimation of deepest pocket), cardiotocography (CTG), and prompt assessment in response to reported reduction in fetal movements.

RECOMMENDATION:

The PMMRC supports the development of a national interdisciplinary clinical practice guideline on the indications and timing for induction of labour, to guide clinicians to offer induction when appropriate (that is, where evidence shows that benefit to mother and/or baby outweighs risk) and to avoid induction when not appropriate.

Perinatal death classification (PSANZ-PDC and PSANZ-NDC) of fetal and neonatal deaths by gestational age at birth for 2011–2015 is available in Table 3.49 and Table 3.50.

Stillbirth

The significant reduction from 2007 to 2015 in perinatal related mortality is due to a significant reduction in stillbirths, specifically at 37–40 weeks (chi-squared test for trend p=0.0018) (Table 3.47). There has been a statistically significant reduction in hypoxic peripartum death from 2007 to 2015 (p=0.0087) (Table 3.51). There is no significant reduction in stillbirths from 41 weeks, as shown in previous years (chi-squared test for trend p=0.18), due to the large number of stillbirths at 41 weeks in 2015 (Table 3.47).

Figure 3.16: Stillbirth risk (per 1000 ongoing pregnancies) by gestational age at birth and year 2007–2015

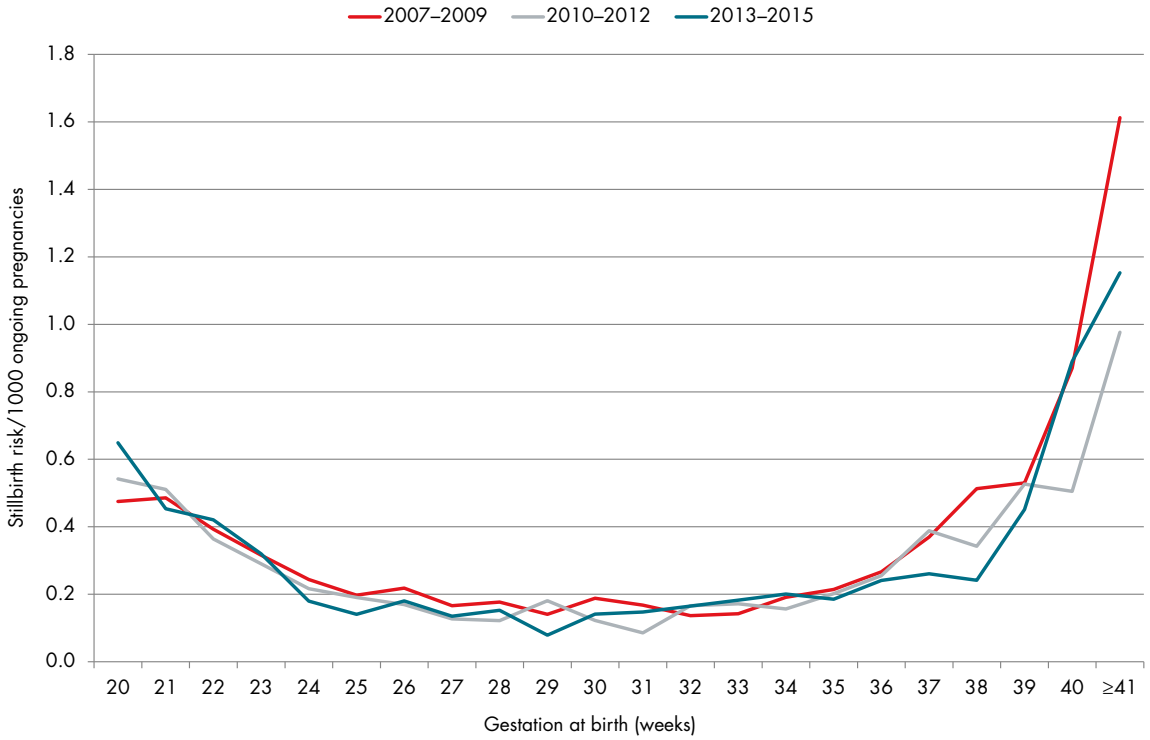
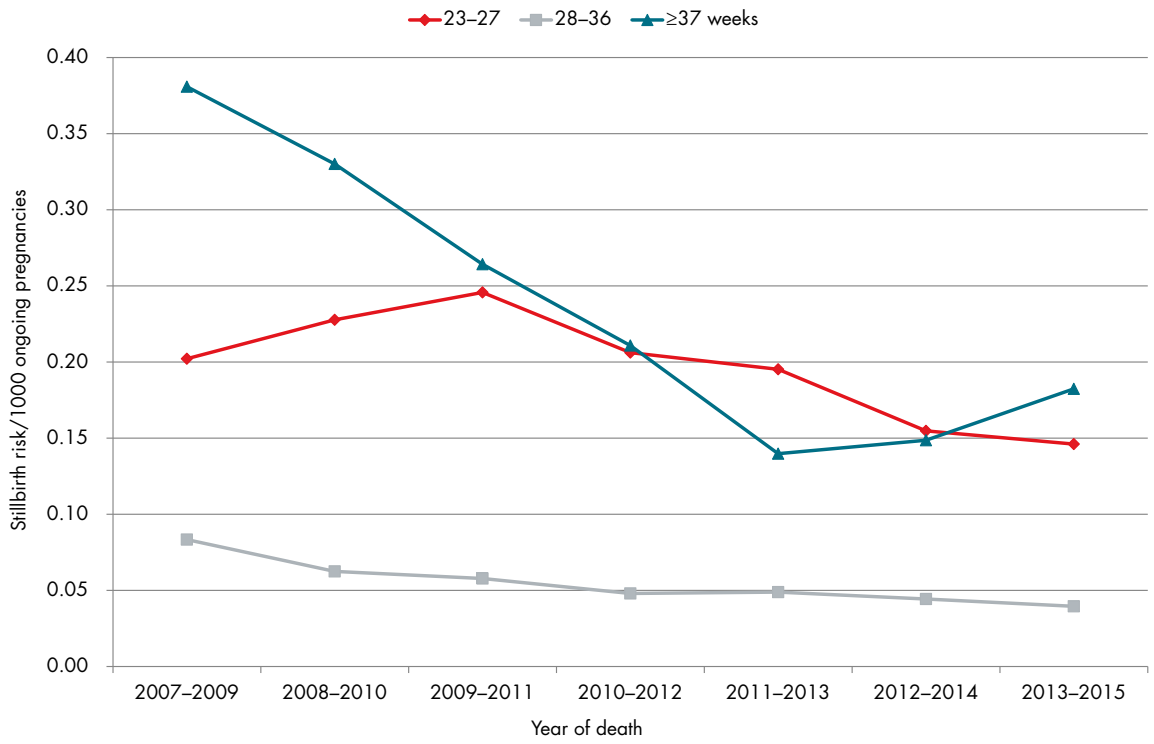


Table 3.14: Timing of stillbirths relative to labour by gestation 2015

Timing of stillbirth	All Stillbirths		Stillbirths ≥23 weeks		Stillbirths ≥37 weeks		Stillbirths ≥37 weeks without congenital abnormality	
	n=305		n=232		n=92		n=87	
	n	%	n	%	n	%	n	%
Antepartum	219	71.8	184	79.3	63	68.5	61	70.1
Intrapartum – total	68	22.3	34	14.7	20	21.7	17	19.5
Intrapartum – first stage	24	7.9	17	7.3	12	13.0	11	12.6
Intrapartum – second stage	8	2.6	4	1.7	3	3.3	3	3.4
Intrapartum – unknown stage	36	11.8	13	5.6	5	5.4	3	3.4
Unknown	18	5.9	14	6.0	9	9.8	9	10.3

In 2015, there were 34 known intrapartum deaths from 23 weeks, and 20 at term (>37 weeks gestation). After a marked and statistically significant fall in term intrapartum deaths from 2007 to 2013, there has been a rise in numbers in the last two years. The reduction from 2007 remains significant (chi-squared test for trend p=0.0014). Intrapartum deaths at 23–27 (p=0.34) and 28–36 weeks (p=0.095) have not reduced significantly (Figure 3.17).

Figure 3.17: Intrapartum stillbirth rolling three-year risks (per 1000 ongoing pregnancies) by gestation at birth (weeks) excluding congenital abnormalities 2007–2015



This is consistent with and probably due to a significant reduction in hypoxic peripartum deaths.

In 2015, as in 2014, there were 17 hypoxic peripartum deaths. Sixteen were from 37 weeks, nine of which contributed to the 17 intrapartum stillbirths (without congenital abnormality) at term in 2015 (the remaining eight term intrapartum stillbirths were due to perinatal infection, hypertension, antepartum haemorrhage, and fetal growth restriction). In 2007 there were 25 intrapartum stillbirths at term, 18 of which were hypoxic peripartum deaths.

Termination of pregnancy

The late termination of pregnancy rate in 2015 was lower than any previously reported year (1.8/1000 births) and significantly lower than the years 2007–2014 combined (p=0.004). However, the test for trend is not statistically significant over the years 2007–2015.

There were 107 late terminations of pregnancy reported in 2015.

Terminations of pregnancy from 20 weeks gestation at birth contributed 18.5 percent of perinatal related deaths in 2014; 82.2 percent of these were associated with congenital abnormalities.

There were 14 terminations of pregnancy after 24 weeks in 2015. The primary antecedent classifications for these deaths were congenital abnormality in 11, and maternal conditions and fetal growth restriction in the remainder.

Neonatal death

The neonatal death rate has not changed significantly in New Zealand from 2007 to 2015. Meanwhile there have been significant reductions in neonatal mortality in the UK (from 2004 to 2014), Australia, and Scandinavia (Manktelow et al 2016; Australian Institute of Health and Welfare 2016; Heino and Gissler 2016).

RECOMMENDATION:

The PMMRC investigate why there has been no reduction in neonatal mortality in New Zealand.

There were 166 neonatal deaths in 2015 contributing 28.7 percent of all perinatal related mortalities. Over one-quarter (27.1 percent) of neonatal deaths were babies with congenital abnormalities. Of the remainder, 30 percent died before 23 weeks and 56 percent before 25 weeks. Twenty neonates (12 percent) died at term.

An attempt was made to resuscitate one of 36 neonatal deaths at 20–22 weeks, while 10/20 (50 percent) at 23 weeks and 11/13 (85 percent) at 24 weeks were resuscitated. One-half of term neonates who died were not resuscitated. These babies died of congenital abnormality, perinatal infection, hypoxic peripartum death or died without obstetric antecedent (postnatal infection, accidental asphyxiation or sudden unexpected death in infancy (SUDI)).

Of the seven deaths from SUDI among the neonatal deaths in 2015, six deaths were associated with unsafe sleep, and these mothers were smokers. Two babies were small for gestational age (SGA) by customised birthweight centiles.

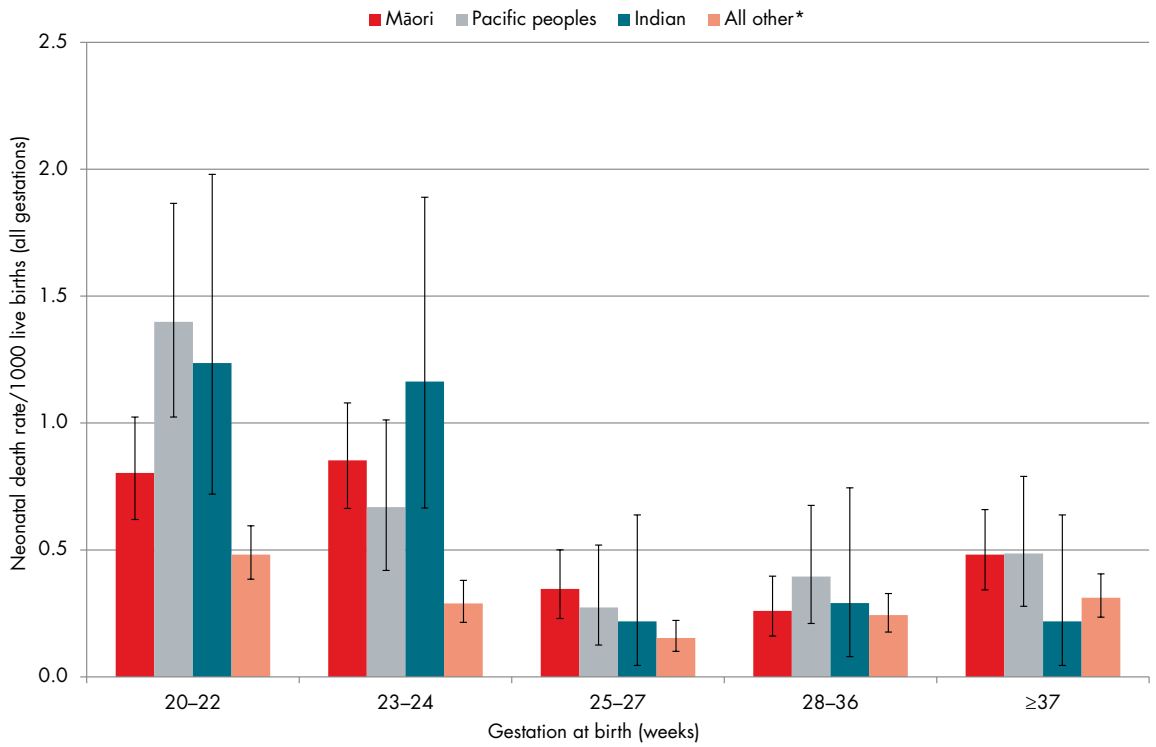
The association between PSANZ-PDC and PSANZ-NDC cause of death classifications for 2015 is shown in Table 3.53.

Table 3.15: Clinical details of neonatal deaths 2015

	Total		Congenital abnormalities		Neonatal deaths excluding congenital abnormalities									
					20–22		23–24		25–27		28–36		≥37 weeks	
	n=166		n=45		n=36		n=32		n=11		n=22		n=20	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Age at death (days)														
0	73	44.0	16	35.6	31	86.1	16	50.0	1	9.1	6	27.3	3	15.0
1–6	58	34.9	12	26.7	5	13.9	11	34.4	8	72.7	14	63.6	8	40.0
7–13	20	12.0	11	24.4	-	-	3	9.4	1	9.1	2	9.1	3	15.0
14–20	7	4.2	3	6.7	-	-	2	6.3	-	-	-	-	2	10.0
21–27	8	4.8	3	6.7	-	-	-	-	1	9.1	-	-	4	20.0
Place of death														
Home	13	7.8	5	11.1	1	2.8	-	-	-	-	-	-	7	35.0
Hospital														
Delivery suite	48	28.9	11	24.4	21	58.3	12	37.5	-	-	2	9.1	2	10.0
Antenatal ward	3	1.8	-	-	3	8.3	-	-	-	-	-	-	-	-
Postnatal ward	3	1.8	2	4.4	-	-	-	-	-	-	-	-	1	5.0
Neonatal unit	73	44.0	17	37.8	-	-	17	53.1	11	100.0	19	86.4	9	45.0
Operating theatre	5	3.0	3	6.7	1	2.8	-	-	-	-	1	4.5	-	-
Emergency department	3	1.8	1	2.2	1	2.8	-	-	-	-	-	-	1	5.0
Other	17	10.2	6	13.3	9	25.0	2	6.3	-	-	-	-	-	-
Other	1	0.6	-	-	-	-	1	3.1	-	-	-	-	-	-
Apgar 5 minutes														
0–3	78	47.0	13	28.9	*	*	18	56.3	2	18.2	12	54.5	8	40.0
4–5	13	7.8	7	15.6	*	*	3	9.4	2	18.2	-	-	-	-
6–7	24	14.5	8	17.8	*	*	8	25.0	1	9.1	6	27.3	1	5.0
≥8	38	22.9	17	37.8	*	*	1	3.1	5	45.5	4	18.2	11	55.0
Unknown	13	7.8	-	-	*	*	2	6.3	1	9.1	-	-	-	-
Resuscitation at birth														
Yes	87	52.4	24	53.3	*	*	21	65.6	11	100.0	19	86.4	11	55.0
No	79	47.6	21	46.7	*	*	11	34.4	-	-	3	13.6	9	45.0
Outcome of resuscitation														
Baby resuscitated and transferred to another clinical care area	73	44.0	19	42.2	*	*	17	53.1	10	90.9	17	77.3	10	50.0
Baby unable to be resuscitated	12	7.2	4	8.9	*	*	4	12.5	-	-	2	9.1	1	5.0
Unknown	2	1.2	1	2.2	*	*	-	-	1	9.1	-	-	-	-

* Not reported.

Figure 3.18: Neonatal death rates (per 1000 live births) by gestation and prioritised baby ethnicity (with 95% CIs) 2011–2015 (excluding congenital abnormalities)



* 'All other' includes New Zealand European, Other Asian, Other (including unknown).

After excluding babies dying with 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 those of New Zealand European and other ethnicity mothers. Babies of Māori mothers are significantly more likely to die after birth at 25–27 weeks and from 37 weeks than babies of mothers of New Zealand European and other ethnicities (Figure 3.18). Babies of Pacific mothers are significantly more likely to die after birth from 37 weeks than babies of mothers of New Zealand European and other ethnicities (Figure 3.18).

The principal cause of neonatal death at 20–24 weeks is spontaneous preterm birth (Figure 3.19).

Figure 3.19: Distribution of neonatal death classification (PSANZ-NDC) among neonatal deaths without lethal congenital abnormality by gestational age group 2011–2015

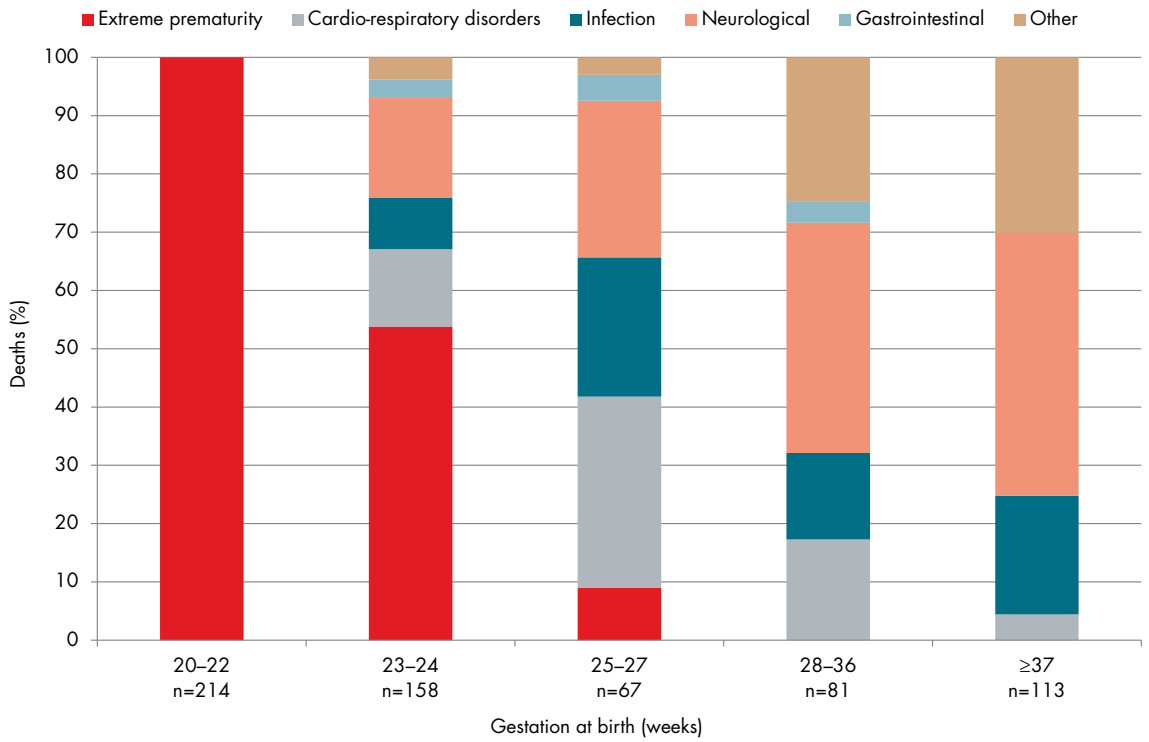


Figure 3.19 illustrates the changing distribution of cause of death with increasing gestation at birth among live born babies. Disease associated with extreme prematurity predominates at 20–24 weeks, while neurological causes become apparent from 23 weeks and become the most common cause of death from 28 weeks.

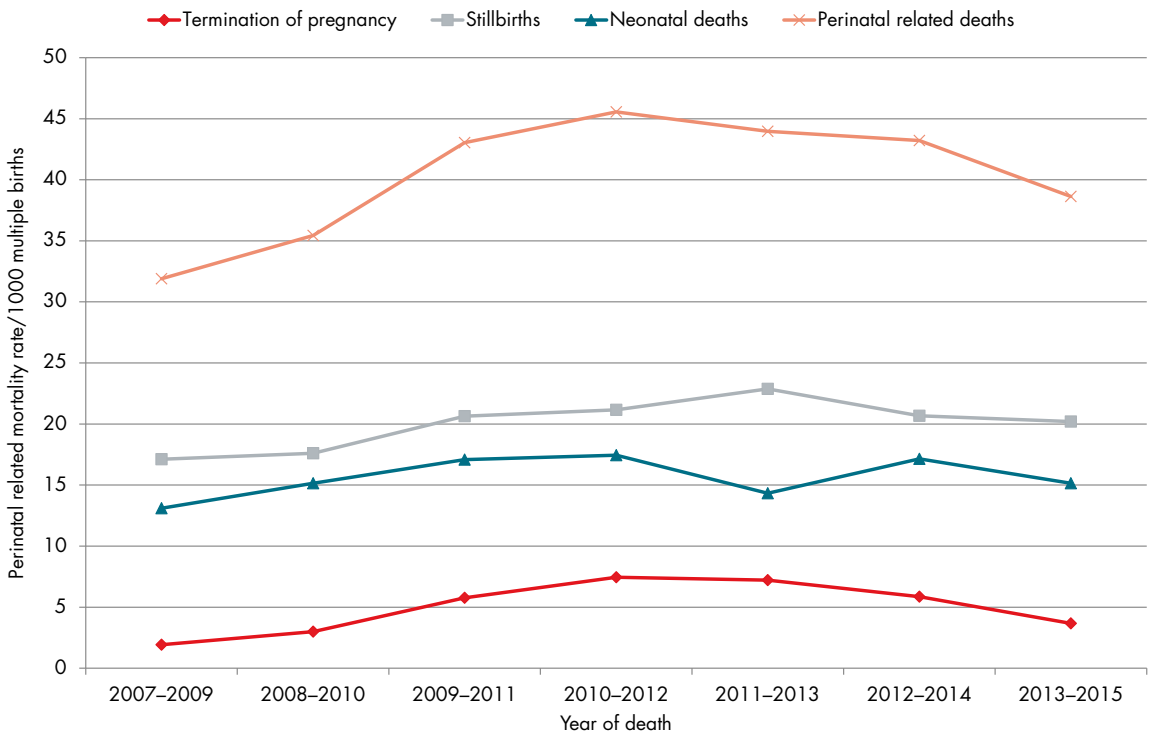
Multiple birth

Table 3.16: Perinatal related mortality rates (per 1000 births) and multiple* births 2015

Type of birth	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808#		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Singleton	57,837	96.7	105	98.1	1.82	276	90.5	4.77	146	88.0	2.54	527	91.2	9.11
Multiple	1,667	2.8	2	1.9	1.20	29	9.5	17.40	20	12.0	12.22	51	8.8	30.59
Multiples (1/2 died)			2	1.9		14	4.6		10	6.0		26	4.5	
Multiples (2/2 died)			-	-		15	4.9		9	5.4		24	4.2	
Multiples (1/3 died)			-	-		-	-		-	-		-	-	
Multiples (2/3 died)			-	-		-	-		-	-		-	-	
Multiples (3/3 died)			-	-		-	-		-	-		-	-	
Twin	1,625	2.7	2	1.9	1.23	29	9.5	17.85	19	11.4	11.92	50	8.7	30.77
Dichorionic diamniotic			2	1.9		13	4.3		10	6.0		25	4.3	
Monochorionic diamniotic			-	-		12	3.9		9	5.4		21	3.6	
Monoamniotic			-	-		4	1.3		-	-		4	0.7	

* Multiples include twins, triplets and higher-order births.
# Includes 304 unknowns.

Figure 3.20: Perinatal related mortality rolling three-year rates (per 1000 births) among babies born in multiple pregnancies 2007–2015



There has been a significant increase in perinatal related deaths among multiple births from 2007 to 2015, although there has been no apparent increase since 2011 (chi-squared test for trend p=0.046) (Table 3.54). The perinatal related death rate among multiple births in 2015 was 30.61/1000 total births, which is the same as the estimate in 2007 (30.88). The relative risk of perinatal related mortality among multiple compared to singleton pregnancies from 2011–2015 was 4.5.

From 2007 to 2015, 368 twins died in pregnancies involving the death of both twins, while 222 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.

Table 3.17: Contribution of fertility treatment to perinatal related mortality by plurality 2011–2015

Fertility treatment	Singleton perinatal related deaths		Multiple perinatal related deaths		Perinatal related deaths	
	n=2,799		n=372		n=3,174	
	n	%	n	%	n	%
Clomiphene	23	0.8	16	4.3	39	1.2
Follicle stimulating hormone (FSH)	3	0.1	3	0.8	6	0.2
In vitro fertilisation (IVF) (including ICSI)	73	2.6	39	10.5	112	3.5
Any of clomiphene/FSH/IVF	97	3.5	56	15.1	153	4.8

ICSI = Intracytoplasmic sperm injection.

Fertility treatment is over-represented among multiple pregnancy deaths. Among deaths of babies in multiple pregnancies from 2011–2015, 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 3.18: Perinatal related deaths and vaginal bleeding during pregnancy 2015

Vaginal bleeding	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Yes	18	16.8	98	32.1	72	43.4	188	32.5
No	81	75.7	194	63.6	90	54.2	365	63.1
Unknown	8	7.5	13	4.3	4	2.4	25	4.3
Gestation*								
<20 weeks only	12	11.2	28	9.2	9	5.4	49	8.5
≥20 weeks only	2	1.9	45	14.8	36	21.7	83	14.4
<20 weeks and ≥20 weeks	4	3.7	25	8.2	27	16.3	56	9.7

* 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, 33 percent of mothers of babies who died in 2015 had some vaginal bleeding during pregnancy. Fourteen percent of mothers had new bleeding starting from 20 weeks, 10 percent had bleeding both before and after 20 weeks, and 8 percent had bleeding only prior to 20 weeks. Of those mothers who had bleeding before 20 weeks whose babies subsequently died in the perinatal period, about half (53 percent) continued to have bleeding beyond 20 weeks.

Antepartum haemorrhage was the primary antecedent cause of death in 2015 for 13.7 percent of perinatal related deaths, 15.1 percent of stillbirths and 18.1 percent of neonatal deaths (Table 3.3).

Small for gestational age infants

Table 3.19: Perinatal related deaths and small for gestational age (customised SGA) among singleton deaths without congenital abnormalities 2015

	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n	%	n	%	n	%	n	%
Singleton deaths 20–22 weeks, excluding congenital abnormalities	n=8		n=60		n=30		n=98	
SGA	2	25.0	13	21.7	1	3.3	16	16.3
Singleton deaths 23–36 weeks, excluding congenital abnormalities	n=11		n=111		n=53		n=175	
SGA	5	45.5	45	40.5	14	26.4	64	36.6
Singleton deaths ≥37 weeks, excluding congenital abnormalities	n=0		n=82		n=20		n=102	
SGA	-	-	22	26.8	6	30.0	28	27.5

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

Table 3.19 shows the absolute numbers and proportions of customised SGA babies among singleton perinatal related deaths without congenital abnormality in 2015.

The overall rate of customised SGA among singleton deaths without congenital abnormalities in 2015 was 28.8 percent, which is 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, required for the calculation of customised centiles, were not available in the MAT dataset this year.

At the Auckland tertiary maternity unit in New Zealand the rate of SGA in the birthing population was 15.0 percent in 2015 (Auckland District Health Board 2016).

Customised SGA was more common among singleton deaths without congenital abnormalities at 23–36 weeks than at 20–22 weeks (p=0.0004), more common at 23–36 weeks than at term (p=0.05) and more common at term than at 20–22 weeks (p=0.06). These associations are illustrated in Figure 3.21.

Twenty-eight singleton babies without congenital abnormalities (of 102) died with SGA at term in 2015 (27.5 percent). The primary antecedent cause of death classification for these term SGA babies was most commonly fetal growth restriction (11), followed by unexplained antepartum death (6).

Figure 3.21: Small for gestational age (customised SGA) by gestation among perinatal related deaths (excluding multiples and congenital abnormalities) 2011–2015

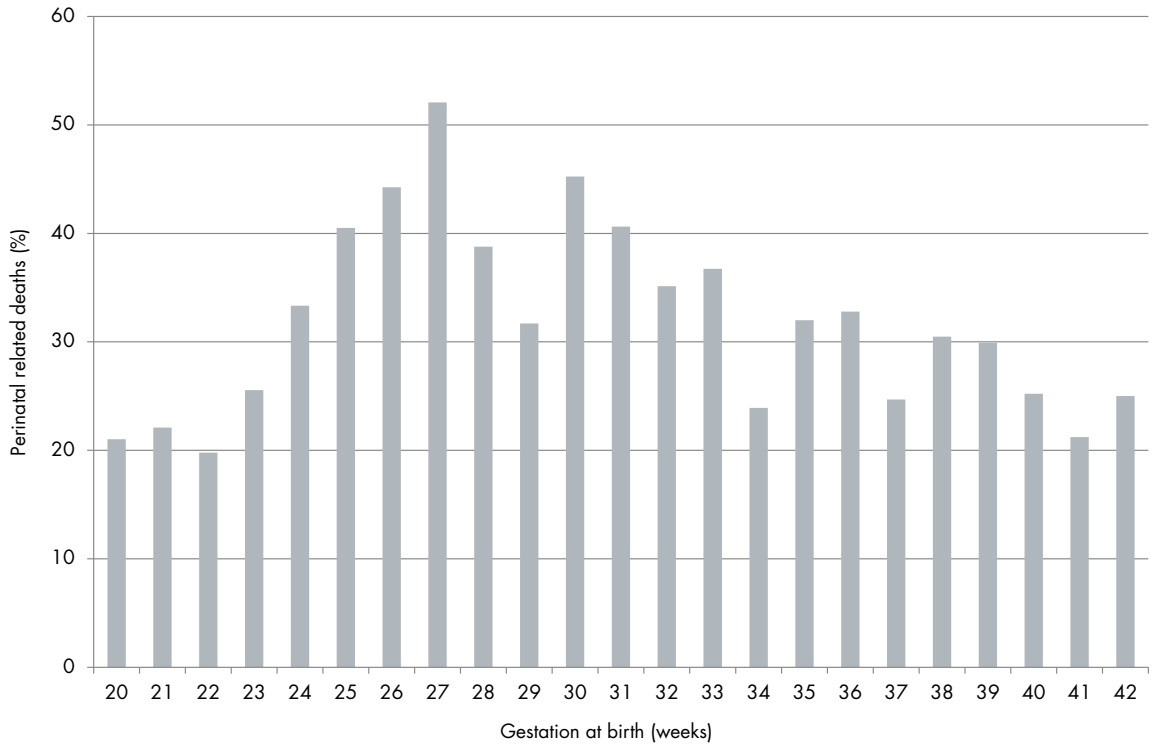


Table 3.20: Perinatal related deaths and maternal registration status 2015

Was the mother registered with a lead maternity carer (LMC)?	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Yes	103	96.3	285	93.4	162	97.6	550	95.2
Self-employed midwife	86	80.4	236	77.4	124	74.7	446	77.2
DHB care	10	9.3	39	12.8	29	17.5	78	13.5
General practitioner	-	-	-	-	-	-	-	-
Obstetrician (private)	7	6.5	10	3.3	9	5.4	26	4.5
Other	-	-	-	-	-	-	-	-
No	4	3.7	20	6.6	4	2.4	28	4.8

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. Mothers of stillborn babies tended more often to not be registered with an LMC (6.6 percent) than mothers of babies who died in the neonatal period (2.4 percent) (p=0.05). The proportion of mothers registered with an LMC in New Zealand in 2015 is unknown as the data for mothers registered with a DHB for primary maternity care are incomplete as not all facilities provide data to the MAT dataset.

Seventy-seven percent of the mothers of babies who died in the perinatal period were registered with a self-employed midwife LMC, 13.5 percent with a hospital primary maternity service, and 4.5 percent with a private obstetrician. The MAT dataset shows that in 2015, 86.3 percent of mothers booked with a self-employed midwifery LMC, 5.5 percent with a private obstetrician, and very few (0.3 percent) with a GP. The remaining women are registered with DHB maternity services or are unregistered. These data are currently incomplete in the MAT dataset.

Of mothers registered for LMC care prior to perinatal related death in 2015, 46.9 percent were registered before 10 weeks gestation, 75.3 percent before 14 weeks, and 9.5 percent after 19 weeks (Table 3.56).

Table 3.21: Intended place of birth versus actual place of birth among stillbirths and neonatal deaths 2015

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	10	3	30.0	-	-	-	-	3	30.0	4	40.0	-	-	-	-
Birthing unit	43	-	-	7	16.3	-	-	7	16.3	28	65.1	1	2.3	-	-
Hospital level 1	15	-	-	-	-	3	20.0	4	26.7	8	53.3	-	-	-	-
Hospital level 2	173	1	0.6	-	-	-	-	143	82.7	28	16.2	-	-	1	0.6
Hospital level 3	204	4	2.0	1	0.5	-	-	2	1.0	197	96.6	-	-	-	-
Other	4	-	-	-	-	-	-	-	-	4	100.0	-	-	-	-
Not registered	22	1	4.5	-	-	-	-	5	22.7	12	54.5	2	9.1	2	9.1
Total	**471**	**9**	**1.9**	**8**	**1.7**	**3**	**0.6**	**164**	**34.8**	**281**	**59.7**	**3**	**0.6**	**3**	**0.6**

Table 3.21 shows the intended place of birth and actual place of birth for stillbirths and neonatal deaths in 2015. Thirteen of 68 mothers (19 percent) intending to birth in a primary setting (home, birthing unit or level 1 hospital) birthed in their intended location. These babies were born at 20, 22 (2), 37, 39 (3), 40 (5), and 41 weeks gestation; four were stillbirths and nine were neonatal deaths. The primary antecedent causes of death for these babies in 2015 were congenital abnormality (4), antepartum haemorrhage (2), hypoxic peripartum death (2), fetal growth restriction (1), unexplained (2), and no obstetric antecedent (2). Of the mothers who did not give birth in their intended location, 40 (59 percent) birthed in a tertiary hospital and 14 (21 percent) in a secondary hospital, presumably because of identified risk.

The proportion of perinatal deaths birthed in primary settings is small compared to national rates of birthing in these settings (home 3.4 percent, birthing units and level 1 hospital combined 9.1 percent in 2014) (Ministry of Health 2015b).

Screening in pregnancy

Diabetes

In 2015, 80 percent of mothers who were at or beyond 28 weeks gestation and had no known pre-existing diabetes and who gave birth to stillborn babies and neonates who died within a month of birth were screened for diabetes. From 2007 to 2015 there has been a significant reduction in unscreened mothers. In 2016, the PMMRC began to collect data on the uptake of HbA1c screening in line with the national guideline on diabetes in pregnancy (Ministry of Health 2014).

Family violence

Table 3.22: Perinatal related deaths and screening for family violence 2007–2015

	2007—2008		2009—2010		2011—2012		2013—2014		2015	
	n=1,381		n=1,438		n=1,337		n=1,257		n=578	
	n	%	n	%	n	%	n	%	n	%
Experienced family violence in this pregnancy										
Yes	42	3.0	53	3.7	34	2.5	30	2.4	25	4.3
No	575	41.6	588	40.9	608	45.5	612	48.6	346	59.9
Not asked	441	31.9	293	20.4	315	23.6	307	24.4	104	18.0
Unknown	323	23.4	504	35.0	380	28.4	310	24.6	103	17.8
Referral to relevant support										
Yes	28	66.7	32	60.4	27	79.4	19	63.3	20	80.0
No	1	2.4	7	13.2	1	2.9	2	6.7	4	16.0
Unknown	13	31.0	14	26.4	6	17.6	9	30.0	1	4.0

For the first time since the PMMRC started reporting family violence screening among mothers of babies who died in the perinatal period, there has been a significant increase in the proportion of mothers screened ($p<0.0001$ for 2015 compared to 2014).

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.

The Ministry of Health guideline on routine inquiry for family violence in pregnancy was updated in June 2016 (Fanslow et al 2016).

First and second trimester screening for congenital anomalies

Among women birthing in New Zealand in 2015, 72 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 51.5 to 84.2 percent by DHB of residence, 33.7 to 92.3 percent by maternal ethnicity, and from 88.9 to 54.2 percent from least to most socioeconomically deprived (National Screening Unit 2017).

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

Investigation of perinatal related deaths

Table 3.23: Perinatal related deaths and perinatal death investigations by ethnicity 2011–2015

Post-mortem examination offered	Māori		Pacific peoples		Indian		Other Asian		Other (including unknown)		NZ European		Perinatal related deaths	
	n=805		n=411		n=198		n=262		n=272		n=1,226		n=3,174	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Post-mortem offered and parental consent given	186	23.1	126	30.7	92	46.5	116	44.3	132	48.5	575	46.9	1,227	38.7
Post-mortem offered and parents declined	553	68.7	250	60.8	96	48.5	119	45.4	110	40.4	560	45.7	1,688	53.2
Post-mortem not offered	54	6.7	31	7.5	7	3.5	26	9.9	25	9.2	79	6.4	222	7.0
Unknown	12	1.5	4	1.0	3	1.5	1	0.4	5	1.8	12	1.0	37	1.2
Optimum investigation*	259	32.2	167	40.6	101	51.0	160	61.1	165	60.7	690	56.3	1,542	48.6
Post-mortem	186	23.1	126	30.7	92	46.5	116	44.3	132	48.5	575	46.9	1,227	38.7
Karyotype	54	6.7	33	8.0	8	4.0	42	16.0	30	11.0	126	10.3	293	9.2
Clinical examination/ investigations confirm diagnosis	34	4.2	19	4.6	5	2.5	13	5.0	10	3.7	56	4.6	137	4.3
Partial investigations only#	380	47.2	192	46.7	84	42.4	90	34.4	81	29.8	451	36.8	1,278	40.3
No investigation+	159	19.8	48	11.7	12	6.1	8	3.1	22	8.1	74	6.0	323	10.2
Unknown	7	0.9	4	1.0	1	0.5	4	1.5	4	1.5	11	0.9	31	1.0

* Optimal investigation is defined as post-mortem or karyotype confirming congenital abnormality or clinical examination/investigation confirming diagnosis.
Note: More than one 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.

In 2015, 52 percent of babies who died in the perinatal period were optimally investigated (Table 3.57). Of the remainder, 8 percent were not investigated and 40 percent were partially investigated. There is a statistically significant trend to increasing optimal investigation among perinatal related deaths. This apparent improvement in optimal investigation rate is probably explained by a change in definition of optimal investigation allowing clinical examination/investigations to confirm the diagnosis of 21 to 43 cases per year from 2012. The trends to an increase in partial investigation ($p=0.0016$) and a decrease in no investigation ($p<0.0001$) have continued in 2015 and probably reflect a true improvement.

In 2015, 43 percent of perinatal related deaths, 54 percent of stillbirths, and 42 percent of neonatal deaths underwent post-mortem. This compares to fewer than 50 percent of stillbirths and only a quarter of neonatal deaths in the UK (Manktelow et al 2016) in an environment where around 90 percent of parents are offered post-mortem. In 2015, the rate of placental pathology in New Zealand was 82

percent among stillbirths, similar to the UK rate of 88 percent.

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 deaths among other ethnicities (Table 3.23). From 2007 to 2015, there has been a significant improvement in the rate of optimal and partial investigation, and a decrease in no investigation for babies of Māori mothers. No significant change has occurred among babies of Pacific mothers.

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

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/.

In 2015, data on the usefulness of post-mortem were available for 205 (83 percent) of the cases where post-mortem was performed. These data showed that in 118 deaths (48 percent) the post-mortem confirmed the clinical diagnosis, in 40 (16 percent) the post-mortem changed the diagnosis and resulted in altered counselling to parents for future pregnancies, in 27 (11 percent) additional information was gained but this did not change the clinical diagnosis, and in 20 (8 percent) the post-mortem was inconclusive.

Table 3.57 and Table 3.58 report the completeness of perinatal investigation and offer and decline of post-mortem for 2015.

Maternal outcome

There were two maternal deaths associated with perinatal related deaths in 2015, both classified as indirect maternal deaths. Nine mothers whose babies died experienced serious morbidity in pregnancy, including pre-eclampsia, obstetric haemorrhage, uterine trauma, obstetric sepsis, morbidity associated with pre-existing medical conditions, and injuries in a motor vehicle accident (Table 3.60).

Contributory factors and potentially avoidable perinatal related death

Table 3.24: Contributory factors and potentially avoidable perinatal related deaths 2015

	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Contributory factors								
Present	6	5.6	88	28.9	52	31.3	146	25.3
Absent	100	93.5	216	70.8	112	67.5	428	74.0
Missing data	1	0.9	1	0.3	2	1.2	4	0.7
Potentially avoidable								
Yes	1	0.9	50	16.4	30	18.1	81	14.0
Contributory factors present but not potentially avoidable	5	4.7	36	11.8	22	13.3	63	10.9
Contributory factors present but avoidability unknown	-	-	2	0.7	-	-	2	0.3

In 2015, one-quarter of perinatal related deaths were determined at local review to have contributory factors, and just over half of these (14 percent) were determined to be potentially avoidable deaths.

Table 3.63 lists all the contributory factors identified by year of perinatal related death for 2009–2015. The following text box provides a list of the contributory factors framework used in the PMMRC reviews.

Contributory Factors for Mortality and Morbidity

Organisational and/or 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 barriers to access and/or engagement with care factors, responsible for 8 to 12 percent of perinatal related deaths each year from 2011 to 2015. Personnel factors are the main contributory factor to avoidable perinatal related death in 5 to 6 percent of perinatal related deaths, and organisational and/or management factors in 3 to 4 percent.

Figure 3.22: Contributory factors and potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2015

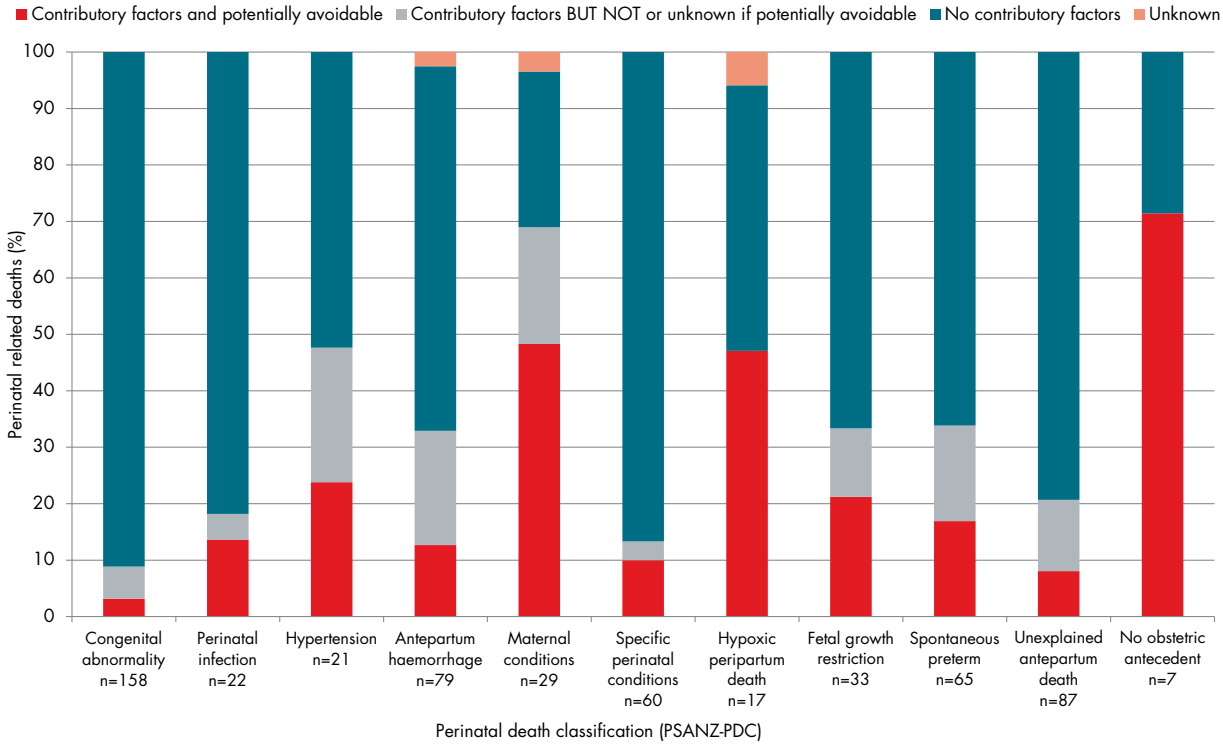


Figure 3.22 illustrates the proportion of perinatal related deaths which were assessed as having contributory factors and to be potentially avoidable in 2015. The bottom bar (red) represents potentially avoidable deaths, the second bar (grey) deaths with contributory factors not assessed as potentially avoidable, and the top bar (blue) deaths without contributory factors.

The greatest proportion of potentially avoidable deaths in 2015 were identified among deaths from hypertension (5) (24 percent), maternal conditions (14) (48 percent), hypoxic peripartum deaths (8) (47 percent), fetal growth restriction (7) (21 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. In 2015, the largest numbers of potentially avoidable deaths were among deaths due to maternal conditions (14), spontaneous preterm birth (11), and antepartum haemorrhage (10) (Table 3.64).

Figure 3.23: 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) (with 95% CIs) 2011–2015

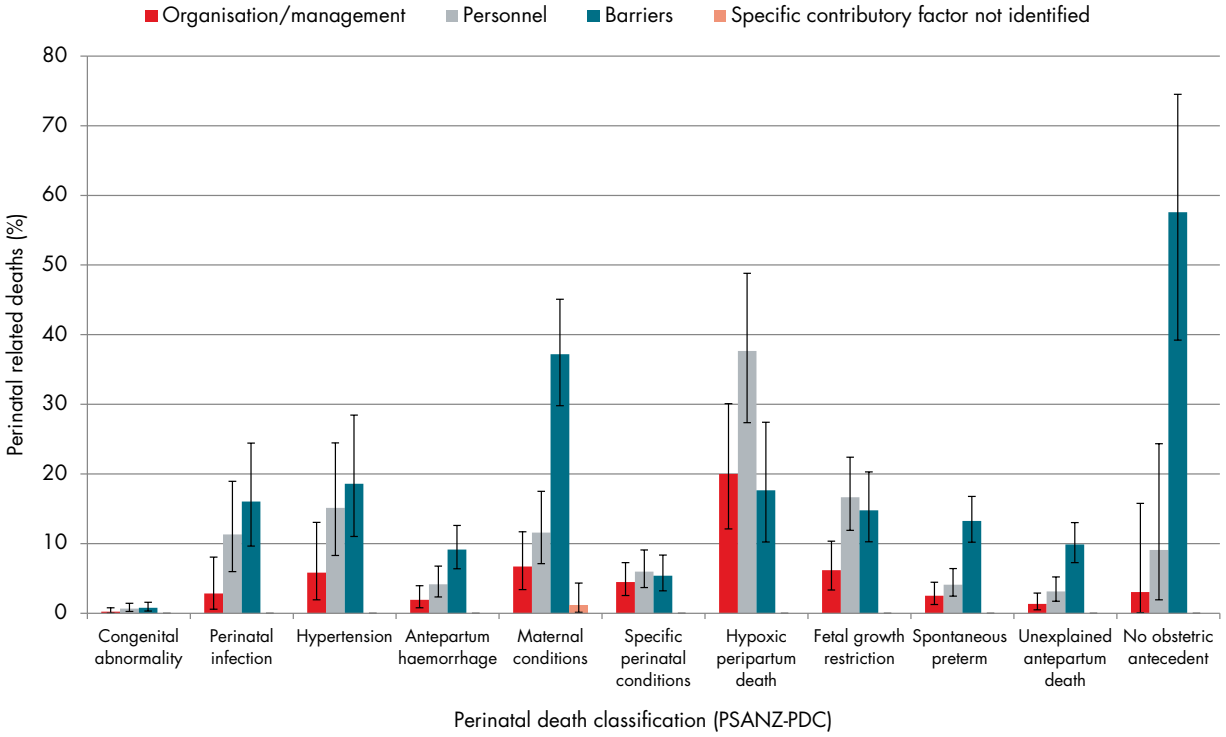


Figure 3.23 illustrates the main contributory factors in potentially avoidable perinatal related deaths by cause of death (PSANZ-PDC). If more than one main contributory factor was identified then the death is attributed to both contributory factors.

For example, among 85 hypoxic peripartum deaths during 2011–2015, organisational and/or management factors were the main factor in 17 potentially avoidable deaths (20 percent), personnel in 32 (38 percent), and barriers to access and/or engagement with care for 15 (18 percent) (Table 3.65).

The proportion of potentially avoidable perinatal related deaths was higher among babies of Māori and Pacific mothers than all other ethnicities, at 22 and 24 percent respectively (Figure 3.24). 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 3.25).

Figure 3.24: 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) 2011–2015

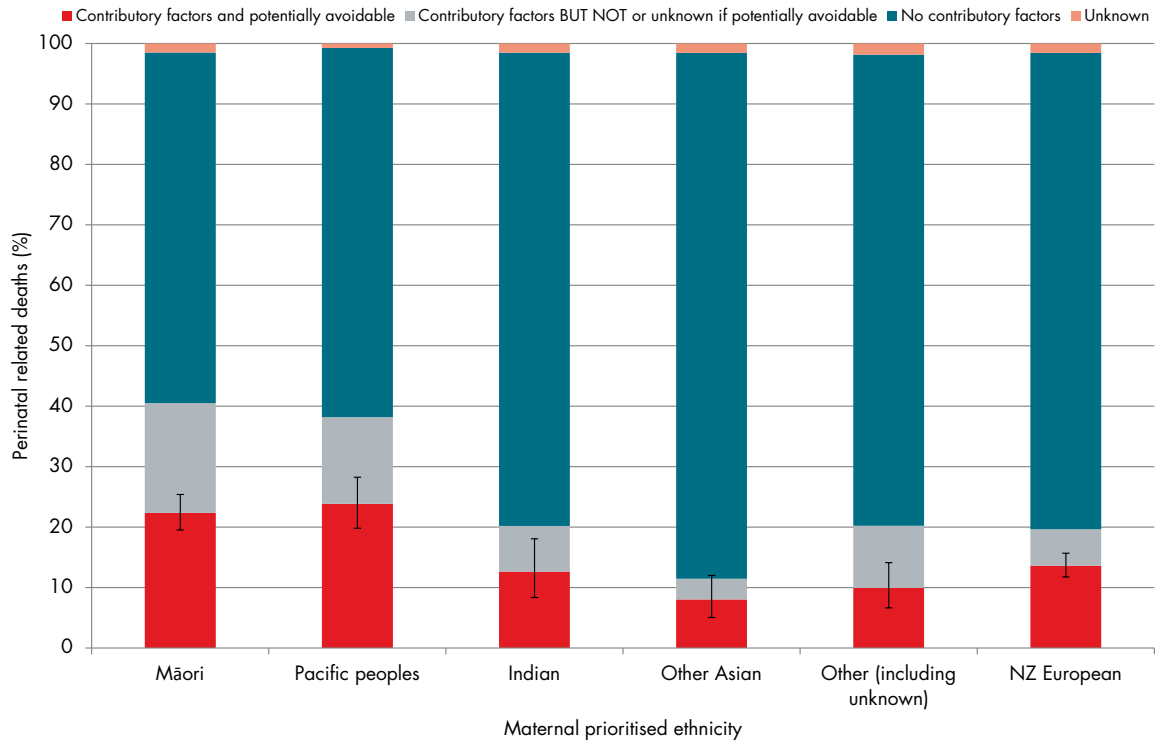


Figure 3.25: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by maternal prioritised ethnicity (with 95% CIs) 2011–2015

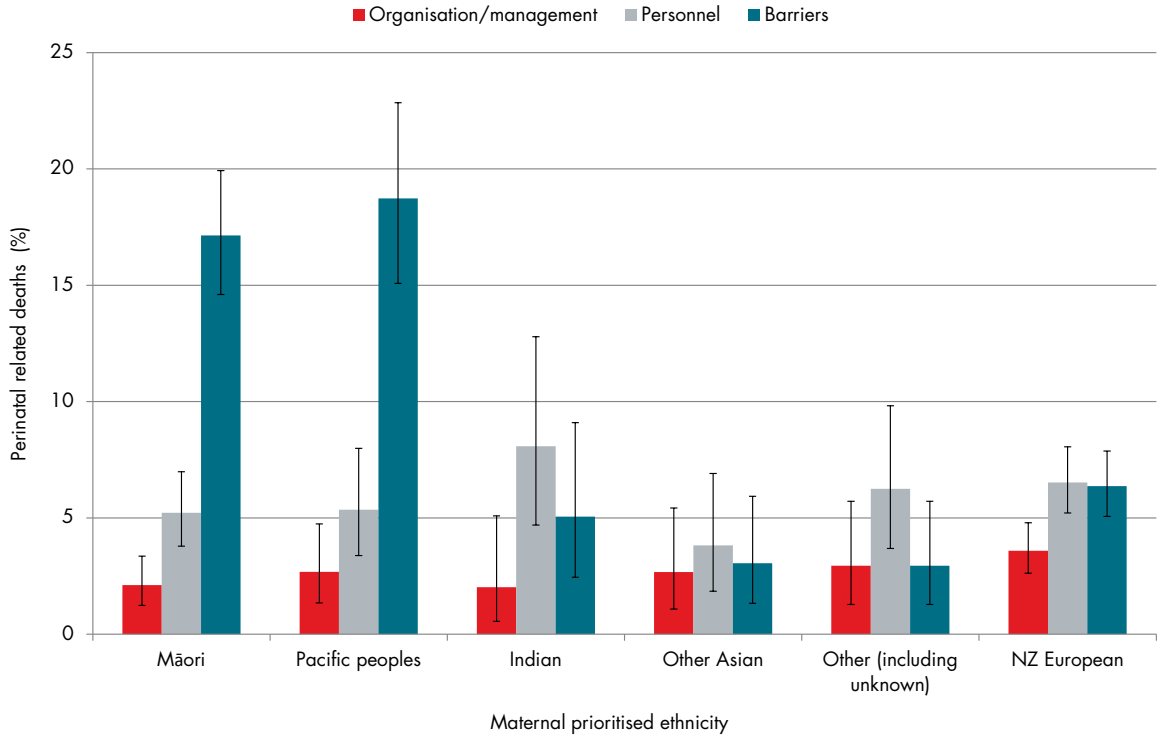
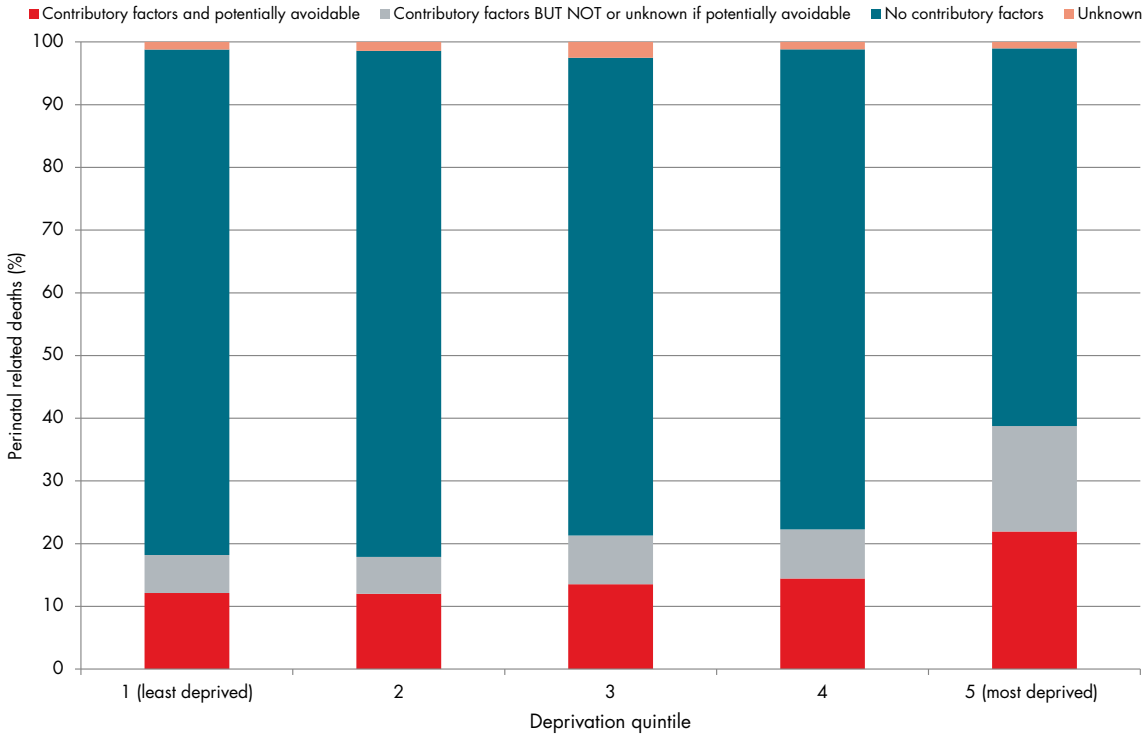
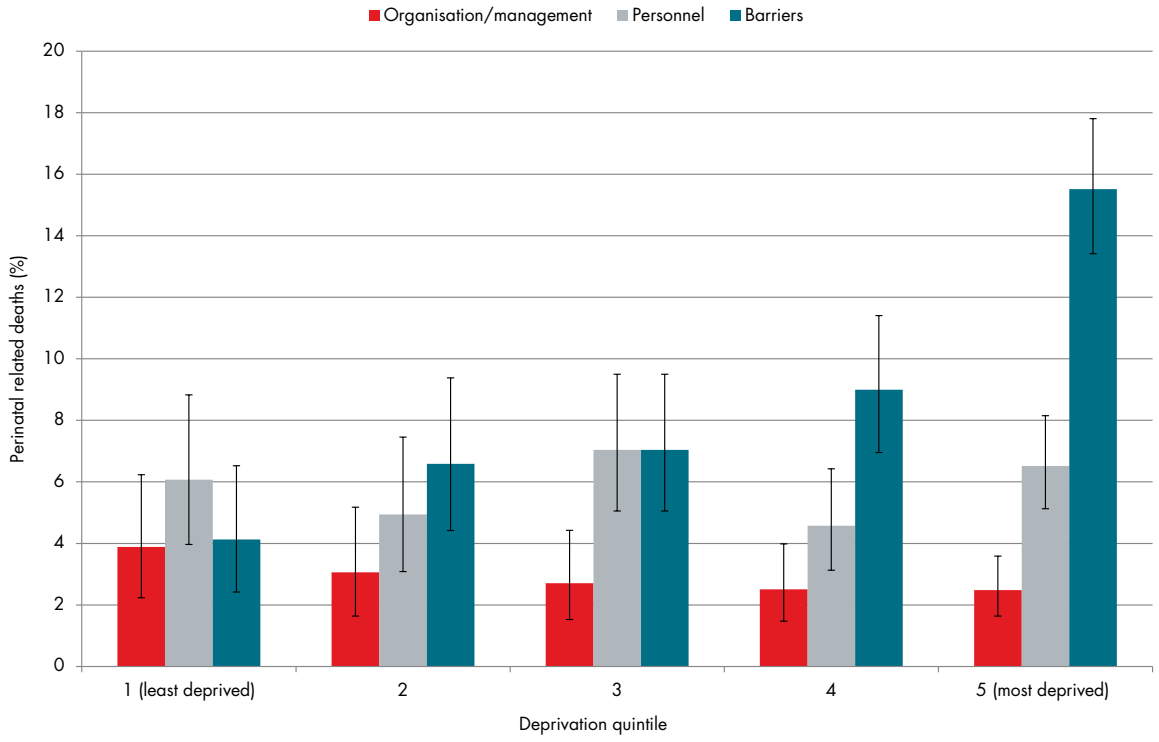


Figure 3.26: Contributory factors and potentially avoidable perinatal related deaths by deprivation quintile 2009–2015



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 (Table 3.68 and Table 3.69).

Figure 3.27: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by deprivation quintile (with 95% CIs) 2011–2015



3.3 Perinatal Mortality Appended Tables and Figures

Table 3.25: New Zealand perinatal mortality rates (per 1000 births) using the international definition 2007–2015

	2007—2008		2009—2010		2011—2012		2013—2014		2015		Chi-squared test for trend (p)
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Total births	129,725		129,530		125,423		119,134		59,344		
Fetal deaths (terminations of pregnancy and stillbirths)*	419	3.2	430	3.3	357	2.8	317	2.7	164	2.8	0.0006
Terminations of pregnancy	20	0.2	26	0.2	37	0.3	25	0.2	7	0.1	0.63
Stillbirths	399	3.1	404	3.1	320	2.6	292	2.5	157	2.6	0.00023
Early neonatal deaths <7 days	124		127		119		104		57		0.75
Late neonatal deaths 7–27 days	63		61		42		47		28		0.40
Neonatal deaths <28 days#	187	1.4	188	1.5	161	1.2	151	1.2	85	0.7	0.46
Perinatal mortalities+	543	4.2	557	4.3	476	3.8	421	3.5	221	3.7	0.0016
Perinatal related mortalities^	606	4.7	618	4.8	518	4.1	468	3.9	249	4.2	0.0011
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	444	3.4	442	3.4	349	2.8	327	2.7	177	3.0	0.00036
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	478	3.7	475	3.7	368	2.9	349	2.9	188	3.2	0.00011

* 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.

Table 3.26: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) 2007–2015

Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		Chi-squared test for trend (p)
	n=130,826		n=130,666		n=126,539		n=120,231		n=59,808		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	382	2.92	393	3.01	404	3.19	348	2.89	158	2.64	0.63
Perinatal infection	57	0.44	53	0.41	40	0.32	44	0.37	22	0.37	0.29
Hypertension	41	0.31	56	0.43	39	0.31	26	0.22	21	0.35	0.21
Antepartum haemorrhage	129	0.99	157	1.20	138	1.09	144	1.20	79	1.32	0.12
Maternal conditions	50	0.38	70	0.54	62	0.49	73	0.61	29	0.48	0.075
Specific perinatal conditions	128	0.98	145	1.11	143	1.13	132	1.10	60	1.00	0.58
Hypoxic peripartum death	67	0.51	48	0.37	40	0.32	28	0.23	17	0.28	0.00031
Fetal growth restriction	108	0.83	101	0.77	93	0.73	84	0.70	33	0.55	0.053
Spontaneous preterm	192	1.47	223	1.71	187	1.48	186	1.55	65	1.09	0.22
Unexplained antepartum death	202	1.54	175	1.34	178	1.41	181	1.51	87	1.45	0.74
No obstetric antecedent	25	0.19	17	0.13	13	0.10	13	0.11	7	0.12	0.13

Table 3.27: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) using international definition (≥1000g or ≥28 weeks if birthweight unknown) 2007–2015

Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		Chi-squared test for trend (p)
	n=129,725		n=129,530		n=125,423		n=119,134		n=59,344		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	127	0.98	141	1.09	149	1.19	114	0.96	61	1.03	0.90
Perinatal infection	32	0.25	28	0.22	21	0.17	21	0.18	12	0.20	0.22
Hypertension	14	0.11	25	0.19	12	0.10	11	0.09	10	0.17	0.63
Antepartum haemorrhage	48	0.37	47	0.36	30	0.24	29	0.24	17	0.29	0.031
Maternal conditions	23	0.18	38	0.29	24	0.19	36	0.30	15	0.25	0.24
Specific perinatal conditions	52	0.40	62	0.48	53	0.42	49	0.41	32	0.54	0.71
Hypoxic peripartum death	67	0.52	48	0.37	40	0.32	28	0.24	17	0.29	0.00030
Fetal growth restriction	61	0.47	62	0.48	50	0.40	41	0.34	14	0.24	0.015
Spontaneous preterm	16	0.12	29	0.22	19	0.15	14	0.12	14	0.24	0.54
Unexplained antepartum death	141	1.09	120	0.93	107	0.85	112	0.94	50	0.84	0.063
No obstetric antecedent	25	0.19	17	0.13	13	0.10	13	0.11	7	0.12	0.13

Table 3.28: Neonatal death classification (PSANZ-NDC) specific neonatal death rates (per 1000 live births) 2007–2015

Neonatal death classification (PSANZ-NDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		Chi-squared test for trend (p)
	n=129,789		n=129,621		n=125,544		n=119,307		n=59,396		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	81	0.62	89	0.69	88	0.70	76	0.64	45	0.76	0.49
Extreme prematurity	109	0.84	142	1.09	122	0.97	132	1.11	51	0.86	0.25
Cardio-respiratory disorders	22	0.17	29	0.22	25	0.20	22	0.18	16	0.27	0.26
Infection	35	0.27	31	0.24	31	0.25	27	0.23	7	0.12	0.20
Neurological	64	0.49	68	0.52	48	0.38	49	0.41	31	0.52	0.37
Gastrointestinal	2	0.02	13	0.10	5	0.04	4	0.03	2	0.03	0.72
Other	31	0.24	21	0.16	23	0.18	25	0.21	14	0.24	0.94

Table 3.29: Perinatal related mortality rates (per 1000 births) by sex 2015

Sex	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Male	30,497	51.0	52	48.6	1.71	148	48.5	4.85	90	54.2	2.97	290	50.2	9.51
Female	28,937	48.4	55	51.4	1.90	157	51.5	5.43	76	45.8	2.65	288	49.8	9.95
Unknown	374	0.6	-	-	-	-	-	-	-	-	-	-	-	-

Table 3.30: Perinatal related mortality rates (per 1000 births) by maternal age and year excluding congenital abnormalities 2007–2015

Maternal age (years)	2007—2008			2009—2010			2011—2012			2013—2014			2015			Chi-squared test for trend (p)
	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	
<20	112	10,452	10.7	104	9,535	10.9	92	8,077	11.4	93	6,423	14.5	35	2,826	12.4	0.062
20–24	207	23,178	8.9	231	24,272	9.5	181	23,582	7.7	174	21,439	8.1	69	10,128	6.8	0.020
25–29	238	31,649	7.5	241	32,224	7.5	215	32,056	6.7	222	31,541	7.0	112	15,976	7.0	0.28
30–34	230	36,541	6.3	235	35,861	6.6	223	35,362	6.3	232	35,026	6.6	110	18,246	6.0	0.88
35–39	170	23,677	7.2	189	23,099	8.2	164	21,609	7.6	131	20,187	6.5	75	9,951	7.5	0.49
≥40	41	4,961	8.3	43	5,293	8.1	54	5,457	9.9	51	5,265	9.7	19	2,520	7.5	0.62
Unknown	-	2	-	-	2	-	-	1	-	1	5	-	-	7	-	-

Table 3.31: Perinatal related mortality rates (per 1000 births) by maternal prioritised ethnicity and year excluding congenital abnormalities 2007–2015

Maternal ethnicity	2007—2008			2009—2010			2011—2012			2013—2014			2015			Chi-squared test for trend (p)
	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	
Māori	292	33,739	8.7	326	33,520	9.7	250	32,091	7.8	254	29,354	8.7	110	14,804	7.4	0.12
Pacific peoples	147	15,743	9.3	160	15,086	10.6	133	14,207	9.4	137	12,714	10.8	54	6,132	8.8	0.72
Indian	36	3,743	9.6	50	4,010	12.5	51	4,527	11.3	58	5,226	11.1	37	3,124	11.8	0.61
Other Asian	45	8,242	5.5	54	9,335	5.8	62	11,212	5.5	50	12,272	4.1	41	6,173	6.6	0.90
Other (including unknown)	72	14,371	5.0	74	14,955	4.9	86	14,413	6.0	64	14,326	4.5	27	7,166	3.8	0.20
NZ European	406	54,239	7.5	379	52,985	7.2	347	49,286	7.0	341	45,639	7.5	151	22,097	6.8	0.59

Table 3.32: Perinatal related mortality rates (per 1000 births) by deprivation quintile and year excluding congenital abnormalities 2007–2015

Deprivation quintile	2007—2008			2009—2010			2011—2012			2013—2014			2015			Chi-squared test for trend (p)
	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	
1 (least deprived)	107	17,773	6.0	106	18,030	5.9	124	17,684	7.0	102	16,827	6.1	54	8,325	6.5	0.65
2	141	19,011	7.4	157	19,197	8.2	167	18,975	8.8	116	18,613	6.2	55	9,429	5.8	0.097
3	168	23,323	7.2	178	24,139	7.4	150	23,333	6.4	181	21,361	8.5	68	10,685	6.4	0.94
4	219	30,855	7.1	226	30,227	7.5	181	29,354	6.2	191	26,923	7.1	99	13,380	7.4	0.69
5 (most deprived)	358	37,777	9.5	372	37,028	10.0	303	35,330	8.6	308	34,806	8.8	140	17,198	8.1	0.074
Unknown	5	1,338	-	4	1,270	-	4	1,060	-	6	1,001	-	4	479	-	-

Table 3.33: Perinatal related mortality rates (per 1000 births) by maternal age 2011–2015

Maternal age (years)	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=306,578		n=740			n=1,591			n=843			n=3,174		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<20	17,393	5.7	53	7.2	3.05	130	8.2	7.47	106	12.6	6.16	289	9.1	16.62
20–24	55,279	18.0	109	14.7	1.97	292	18.4	5.28	158	18.7	2.88	559	17.6	10.11
25–29	79,766	26.0	165	22.3	2.07	380	23.9	4.76	205	24.3	2.59	750	23.6	9.40
30–34	88,867	29.0	208	28.1	2.34	405	25.5	4.56	190	22.5	2.15	803	25.3	9.04
35–39	51,944	16.9	154	20.8	2.96	281	17.7	5.41	136	16.1	2.64	571	18.0	10.99
≥40	13,316	4.3	51	6.9	3.83	102	6.4	7.66	48	5.7	3.65	201	6.3	15.09
Unknown	13	0.0	-	-	-	1	0.1	-	-	-	-	1	0.0	-

Table 3.34: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding termination of pregnancy) by maternal age 2011–2015

Perinatal death classification (PSANZ-PDC)	Maternal age (years)														
	<20			20–24			25–34			35–39			≥40		
	n=17,341			n=55,175			n=168,275			n=51,796			n=13,267		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality*	34	14.4	1.96	53	11.8	0.96	145	12.3	0.86	73	17.5	1.41	41	27.3	3.09
Perinatal infection	11	4.7	0.63	16	3.6	0.29	54	4.6	0.32	13	3.1	0.25	1	0.7	0.08
Hypertension	-	-	-	15	3.3	0.27	41	3.5	0.24	12	2.9	0.23	4	2.7	0.30
Antepartum haemorrhage	33	14.0	1.90	57	12.7	1.03	178	15.1	1.06	50	12.0	0.97	17	11.3	1.28
Maternal conditions	10	4.2	0.58	26	5.8	0.47	55	4.7	0.33	26	6.2	0.50	8	5.3	0.60
Specific perinatal condition	16	6.8	0.92	37	8.2	0.67	156	13.2	0.93	63	15.1	1.22	25	16.7	1.88
Hypoxic peripartum death	5	2.1	0.29	15	3.3	0.27	49	4.2	0.29	14	3.4	0.27	2	1.3	0.15
Fetal growth restriction	18	7.6	1.04	40	8.9	0.72	100	8.5	0.59	30	7.2	0.58	9	6.0	0.68
Spontaneous preterm#	67	28.4	3.86	92	20.4	1.67	168	14.2	1.00	59	14.1	1.14	16	10.7	1.21
Unexplained antepartum death	35	14.8	2.02	88	19.6	1.59	223	18.9	1.33	74	17.7	1.43	26	17.3	1.96
No obstetric antecedent	7	3.0	0.40	11	2.4	0.20	11	0.9	0.07	3	0.7	0.06	1	0.7	0.08

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

Table 3.35: Perinatal related mortality rates (per 1000 births) by baby prioritised ethnicity 2015

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (baby)														
Māori	15,915	26.6	25	23.4	1.57	78	25.6	4.90	58	34.9	3.67	161	27.9	10.12
Pacific peoples	6,122	10.2	3	2.8	0.49	41	13.4	6.70	27	16.3	4.44	71	12.3	11.60
Indian	3,339	5.6	4	3.7	1.20	30	9.8	8.98	14	8.4	4.24	48	8.3	14.38
Other Asian	6,130	10.2	10	9.3	1.63	27	8.9	4.40	15	9.0	2.46	52	9.0	8.48
Other (including unknown)	6,345	10.6	7	6.5	1.10	21	6.9	3.31	6	3.6	0.95	34	5.9	5.36
NZ European	21,957	36.7	58	54.2	2.64	108	35.4	4.92	46	27.7	2.11	212	36.7	9.66

Table 3.36: Perinatal related mortality rates (per 1000 births) by maternal and baby prioritised ethnicity 2011–2015

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=306,578		n=740			n=1,591			n=843			n=3,174		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	76,637	25.0	129	17.4	1.68	414	26.0	5.40	262	31.1	3.44	805	25.4	10.50
Pacific peoples	33,230	10.8	51	6.9	1.53	221	13.9	6.65	139	16.5	4.22	411	12.9	12.37
Indian	12,978	4.2	48	6.5	3.70	99	6.2	7.63	51	6.0	3.97	198	6.2	15.26
Other Asian	29,867	9.7	98	13.2	3.28	108	6.8	3.62	56	6.6	1.89	262	8.3	8.77
Other (including unknown)	36,112	11.8	85	11.5	2.35	133	8.4	3.68	54	6.4	1.50	272	8.6	7.53
NZ European	117,754	38.4	329	44.5	2.79	616	38.7	5.23	281	33.3	2.41	1,226	38.6	10.41
Ethnicity (baby)														
Māori	81,551	26.6	173	23.4	2.12	489	30.7	6.00	293	34.8	3.62	955	30.1	11.71
Pacific peoples	33,186	10.8	51	6.9	1.54	222	14.0	6.69	140	16.6	4.25	413	13.0	12.45
Indian	13,885	4.5	52	7.0	3.75	103	6.5	7.42	51	6.0	3.71	206	6.5	14.84
Other Asian	29,702	9.7	94	12.7	3.16	111	7.0	3.74	56	6.6	1.90	261	8.2	8.79
Other (including unknown)	31,290	10.2	43	5.8	1.37	103	6.5	3.29	43	5.1	1.38	189	6.0	6.04
NZ European	116,964	38.2	327	44.2	2.80	563	35.4	4.81	260	30.8	2.24	1,150	36.2	9.83

Table 3.37: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding termination of pregnancy) by maternal prioritised ethnicity 2011–2015

Perinatal death classification (PSANZ-PDC)	Māori			Pacific peoples			Indian			Other Asian			Other (including unknown)			NZ European		
	n=76,510			n=33,177			n=12,935			n=29,776			n=36,008			n=117,461		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	91	13.5	1.19	54	15.0	1.63	14	9.3	1.08	29	17.7	0.97	30	16.0	0.83	128	14.3	1.09
Perinatal infection	22	3.3	0.29	18	5.0	0.54	6	4.0	0.46	6	3.7	0.20	9	4.8	0.25	34	3.8	0.29
Hypertension	23	3.4	0.30	14	3.9	0.42	5	3.3	0.39	3	1.8	0.10	5	2.7	0.14	22	2.5	0.19
Antepartum haemorrhage	94	13.9	1.23	49	13.6	1.48	26	17.3	2.01	26	15.9	0.87	21	11.2	0.58	119	13.3	1.01
Maternal conditions	36	5.3	0.47	31	8.6	0.93	7	4.7	0.54	6	3.7	0.20	6	3.2	0.17	39	4.3	0.33
Specific perinatal conditions	59	8.7	0.77	43	11.9	1.30	25	16.7	1.93	24	14.6	0.81	27	14.4	0.75	119	13.3	1.01
Hypoxic peripartum death	22	3.3	0.29	6	1.7	0.18	5	3.3	0.39	3	1.8	0.10	8	4.3	0.22	41	4.6	0.35
Fetal growth restriction	47	7.0	0.61	25	6.9	0.75	17	11.3	1.31	11	6.7	0.37	13	7.0	0.36	84	9.4	0.72
Spontaneous preterm	148	21.9	1.93	60	16.7	1.81	23	15.3	1.78	20	12.2	0.67	27	14.4	0.75	125	13.9	1.06
Unexplained antepartum death	121	17.9	1.58	51	14.2	1.54	22	14.7	1.70	35	21.3	1.18	41	21.9	1.14	176	19.6	1.50
No obstetric antecedent	13	1.9	0.17	9	2.5	0.27	-	-	-	1	0.6	0.03	-	-	-	10	1.1	0.09

Table 3.38: Distribution of births by deprivation decile (NZDep2013) 2015

Deprivation decile (NZDep 2013)	Total births n=59,808	
	n	%
1 (least deprived)	3,981	6.7
2	4,385	7.3
3	4,571	7.6
4	4,912	8.2
5	5,255	8.8
6	5,491	9.2
7	6,794	11.4
8	6,653	11.1
9	8,267	13.8
10 (most deprived)	9,017	15.1
Unknown	482	0.8

Table 3.39: Perinatal related mortality rates (per 1000 births) by deprivation quintile 2011–2015

Deprivation quintile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=306,578		n=740			n=1,591			n=843			n=3,174		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	43,097	14.1	124	16.8	2.88	202	12.7	4.69	86	10.2	2.01	412	13.0	9.56
2	47,287	15.4	130	17.6	2.75	209	13.1	4.42	86	10.2	1.83	425	13.4	8.99
3	55,733	18.2	152	20.5	2.73	255	16.0	4.58	147	17.4	2.66	554	17.5	9.94
4	70,052	22.8	156	21.1	2.23	348	21.9	4.97	174	20.6	2.50	678	21.4	9.68
5 (most deprived)	87,854	28.7	175	23.6	1.99	570	35.8	6.49	344	40.8	3.95	1,089	34.3	12.40
Unknown	2,555	0.8	3	0.4	-	7	0.4	-	6	0.7	-	16	0.5	-

Table 3.40: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile 2011–2015

Perinatal death classification (PSANZ-PDC)	Quintile 1 (least deprived)			Quintile 2			Quintile 3			Quintile 4			Quintile 5 (most deprived)		
	n=42,989			n=47,169			n=55,586			n=69,903			n=87,675		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	29	10.1	0.67	36	12.2	0.76	59	14.7	1.06	87	16.7	1.24	133	14.6	1.52
Perinatal infection	12	4.2	0.28	8	2.7	0.17	18	4.5	0.32	14	2.7	0.20	43	4.7	0.49
Hypertension	9	3.1	0.21	7	2.4	0.15	12	3.0	0.22	11	2.1	0.16	33	3.6	0.38
Antepartum haemorrhage	37	12.8	0.86	42	14.2	0.89	37	9.2	0.67	74	14.2	1.06	141	15.4	1.61
Maternal conditions	9	3.1	0.21	11	3.7	0.23	15	3.7	0.27	26	5.0	0.37	64	7.0	0.73
Specific perinatal condition	52	18.1	1.21	42	14.2	0.89	54	13.4	0.97	60	11.5	0.86	87	9.5	0.99
Hypoxic peripartum death	10	3.5	0.23	12	4.1	0.25	23	5.7	0.41	14	2.7	0.20	25	2.7	0.29
Fetal growth restriction	30	10.4	0.70	26	8.8	0.55	28	7.0	0.50	48	9.2	0.69	65	7.1	0.74
Spontaneous preterm	34	11.8	0.79	42	14.2	0.89	66	16.4	1.19	83	15.9	1.19	174	19.0	1.98
Unexplained antepartum death	63	21.9	1.47	65	22.0	1.38	85	21.1	1.53	98	18.8	1.40	135	14.8	1.54
No obstetric antecedent	3	1.0	0.07	4	1.4	0.08	5	1.2	0.09	7	1.3	0.10	14	1.5	0.16

Table 3.41: Perinatal related mortality rates (per 1000 births) by maternal body mass index (BMI) at registration with maternity care* 2011–2015

Maternal BMI (kg/m2)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=306,578		n=711			n=1,530			n=836			n=3,077		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<18.50	8,034	2.6	18	2.5	2.24	29	1.9	3.61	16	1.9	2.00	63	2.0	7.84
18.50–25.49	148,638	48.5	332	46.7	2.23	576	37.6	3.88	302	36.1	2.04	1,210	39.3	8.14
25.50–30.49	70,839	23.1	154	21.7	2.17	381	24.9	5.38	183	21.9	2.60	718	23.3	10.14
30.50–35.49	34,346	11.2	52	7.3	1.51	161	10.5	4.69	107	12.8	3.13	320	10.4	9.32
35.50–40.49	15,719	5.1	29	4.1	1.84	91	5.9	5.79	61	7.3	3.91	181	5.9	11.51
≥40.50	9,152	3.0	7	1.0	0.76	65	4.2	7.10	30	3.6	3.30	102	3.3	11.15
Unknown	19,850	6.5	119	16.7	-	227	14.8	-	137	16.4	-	483	15.7	-

* MAT data numerator and denominator.

Table 3.42: Perinatal related mortality rates (per 1000 births) by parity 2011–2015

Parity	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=306,578		n=740			n=1,591			n=843			n=3,174		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
0	112,664	36.7	311	42.0	2.76	666	41.9	5.91	372	44.1	3.33	1,349	42.5	11.97
1	96,025	31.3	245	33.1	2.55	412	25.9	4.29	235	27.9	2.46	892	28.1	9.29
2	43,031	14.0	107	14.5	2.49	240	15.1	5.58	114	13.5	2.67	461	14.5	10.71
3	17,268	5.6	44	5.9	2.55	134	8.4	7.76	56	6.6	3.28	234	7.4	13.55
4	7,308	2.4	14	1.9	1.92	57	3.6	7.80	26	3.1	3.59	97	3.1	13.27
≥5	7,124	2.3	17	2.3	2.39	75	4.7	10.53	36	4.3	5.12	128	4.0	17.97
Unknown	23,158	7.6	2	0.3	-	7	0.4	-	4	0.5	-	13	0.4	-

Table 3.43: Perinatal related mortality rates (per 1000 births) by DHB of maternal residence 2015

DHB of maternal residence	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=59,808		n=107			n=305			n=166			n=578		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	2,159	3.6	5	4.7	2.32	14	4.6	6.48	5	3.0	2.34	24	4.2	11.12
Waitemata	7,665	12.8	13	12.1	1.70	29	9.5	3.78	16	9.6	2.10	58	10.0	7.57
Auckland	5,980	10.0	10	9.3	1.67	30	9.8	5.02	15	9.0	2.53	55	9.5	9.20
Counties Manukau	8,311	13.9	13	12.1	1.56	40	13.1	4.81	32	19.3	3.88	85	14.7	10.23
Waikato	5,366	9.0	3	2.8	0.56	30	9.8	5.59	18	10.8	3.38	51	8.8	9.50
Bay of Plenty	2,831	4.7	4	3.7	1.41	17	5.6	6.00	5	3.0	1.78	26	4.5	9.18
Lakes	1,535	2.6	2	1.9	1.30	9	3.0	5.86	2	1.2	1.31	13	2.2	8.47
Tairawhiti	746	1.2	1	0.9	1.34	6	2.0	8.04	1	0.6	1.35	8	1.4	10.72
Taranaki	1,540	2.6	2	1.9	1.30	7	2.3	4.55	6	3.6	3.92	15	2.6	9.74
Hawke's Bay	2,026	3.4	5	4.7	2.47	6	2.0	2.96	3	1.8	1.49	14	2.4	6.91
Whanganui	822	1.4	-	-	-	8	2.6	9.73	4	2.4	4.91	12	2.1	14.60
MidCentral	2,143	3.6	6	5.6	2.80	8	2.6	3.73	5	3.0	2.35	19	3.3	8.87
Wairarapa	465	0.8	-	-	-	3	1.0	6.45	2	1.2	4.33	5	0.9	10.75
Capital & Coast	3,593	6.0	8	7.5	2.23	19	6.2	5.29	10	6.0	2.80	37	6.4	10.30
Hutt Valley	1,997	3.3	2	1.9	1.00	11	3.6	5.51	7	4.2	3.53	20	3.5	10.02
Nelson Marlborough	1,441	2.4	2	1.9	1.39	6	2.0	4.16	3	1.8	2.09	11	1.9	7.63
West Coast	370	0.6	2	1.9	5.41	3	1.0	8.11	1	0.6	2.74	6	1.0	16.22
Canterbury	6,316	10.6	20	18.7	3.17	36	11.8	5.70	17	10.2	2.72	73	12.6	11.56
South Canterbury	669	1.1	-	-	-	2	0.7	2.99	5	3.0	7.50	7	1.2	10.46
Southern	3,467	5.8	9	8.4	2.60	19	6.2	5.48	7	4.2	2.04	35	6.1	10.10
Other*	366	0.6	-	-	-	2	0.7	-	2	1.2	-	4	0.7	-

* Other includes Overseas, Unknown and Other.

Table 3.44: Perinatal related mortality rates (per 1000 births) by DHB of maternal residence 2011–2015

DHB of maternal residence	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=306,578		n=740			n=1,591			n=843			n=3,174		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	11,121	3.6	25	3.4	2.25	72	4.5	6.47	36	4.3	3.27	133	4.2	11.96
Waitemata	39,506	12.9	115	15.5	2.91	164	10.3	4.15	75	8.9	1.91	354	11.2	8.96
Auckland	32,160	10.5	117	15.8	3.64	151	9.5	4.70	77	9.1	2.41	345	10.9	10.73
Counties Manukau	42,711	13.9	107	14.5	2.51	273	17.2	6.39	165	19.6	3.90	545	17.2	12.76
Waikato	27,027	8.8	49	6.6	1.81	156	9.8	5.77	93	11.0	3.47	298	9.4	11.03
Bay of Plenty	14,373	4.7	28	3.8	1.95	77	4.8	5.36	51	6.0	3.57	156	4.9	10.85
Lakes	7,581	2.5	24	3.2	3.17	40	2.5	5.28	22	2.6	2.93	86	2.7	11.34
Tairawhiti	3,671	1.2	6	0.8	1.63	16	1.0	4.36	12	1.4	3.29	34	1.1	9.26
Taranaki	7,805	2.5	9	1.2	1.15	42	2.6	5.38	26	3.1	3.35	77	2.4	9.87
Hawke's Bay	10,925	3.6	29	3.9	2.65	56	3.5	5.13	27	3.2	2.49	112	3.5	10.25
Whanganui	4,203	1.4	7	0.9	1.67	27	1.7	6.42	11	1.3	2.64	45	1.4	10.71
MidCentral	10,920	3.6	31	4.2	2.84	45	2.8	4.12	25	3.0	2.31	101	3.2	9.25
Wairarapa	2,508	0.8	2	0.3	0.80	19	1.2	7.58	5	0.6	2.01	26	0.8	10.37
Capital & Coast	18,713	6.1	36	4.9	1.92	75	4.7	4.01	42	5.0	2.26	153	4.8	8.18
Hutt Valley	9,946	3.2	18	2.4	1.81	57	3.6	5.73	23	2.7	2.33	98	3.1	9.85
Nelson Marlborough	7,696	2.5	13	1.8	1.69	35	2.2	4.55	18	2.1	2.35	66	2.1	8.58
West Coast	1,923	0.6	4	0.5	2.08	11	0.7	5.72	7	0.8	3.67	22	0.7	11.44
Canterbury	30,586	10.0	77	10.4	2.52	167	10.5	5.46	68	8.1	2.24	312	9.8	10.20
South Canterbury	3,217	1.0	4	0.5	1.24	11	0.7	3.42	12	1.4	3.75	27	0.9	8.39
Southern	17,649	5.8	37	5.0	2.10	92	5.8	5.21	43	5.1	2.45	172	5.4	9.75
Other*	2,337	0.8	2	0.3	-	5	0.3	-	5	0.6	-	12	0.4	-

* Other includes Overseas, Unknown and Other.

Figure 3.28: Unadjusted stillbirth rates (per 1000 births) by DHB of residence (mother) compared to average stillbirth rates (with 95% CIs) 2011–2015

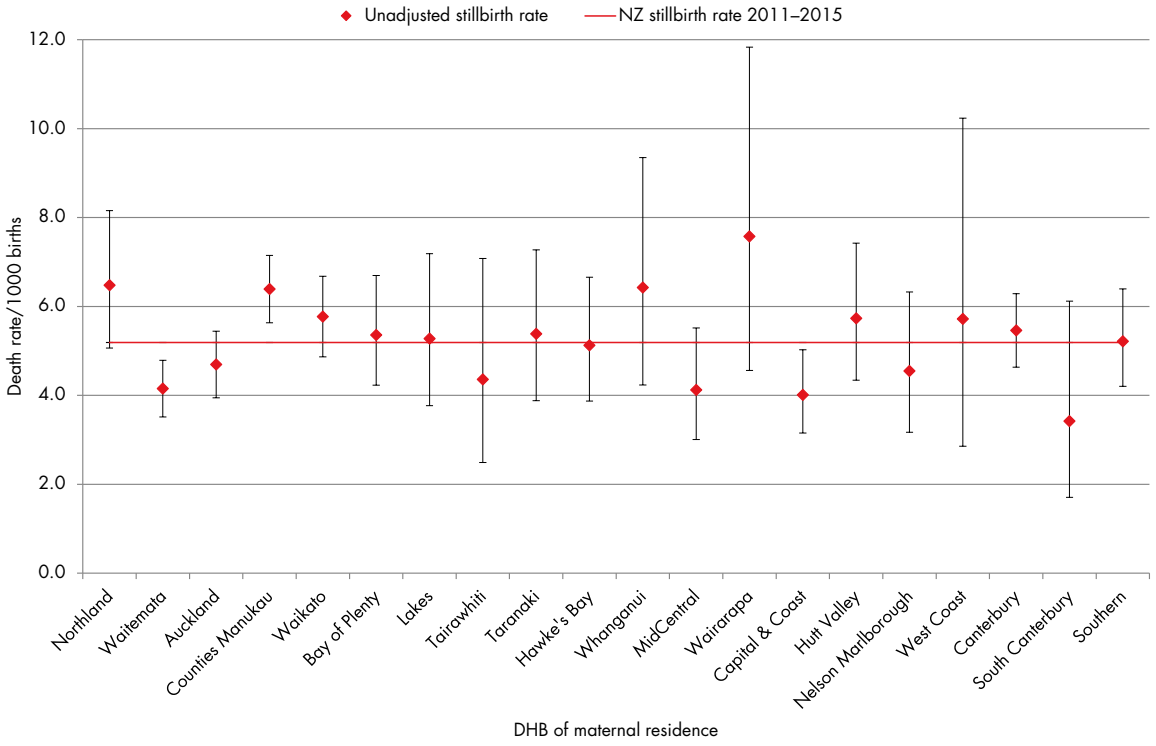


Figure 3.29: Unadjusted neonatal mortality rates (per 1000 births) by DHB of residence (mother) compared to average neonatal mortality (with 95% CIs) 2011–2015

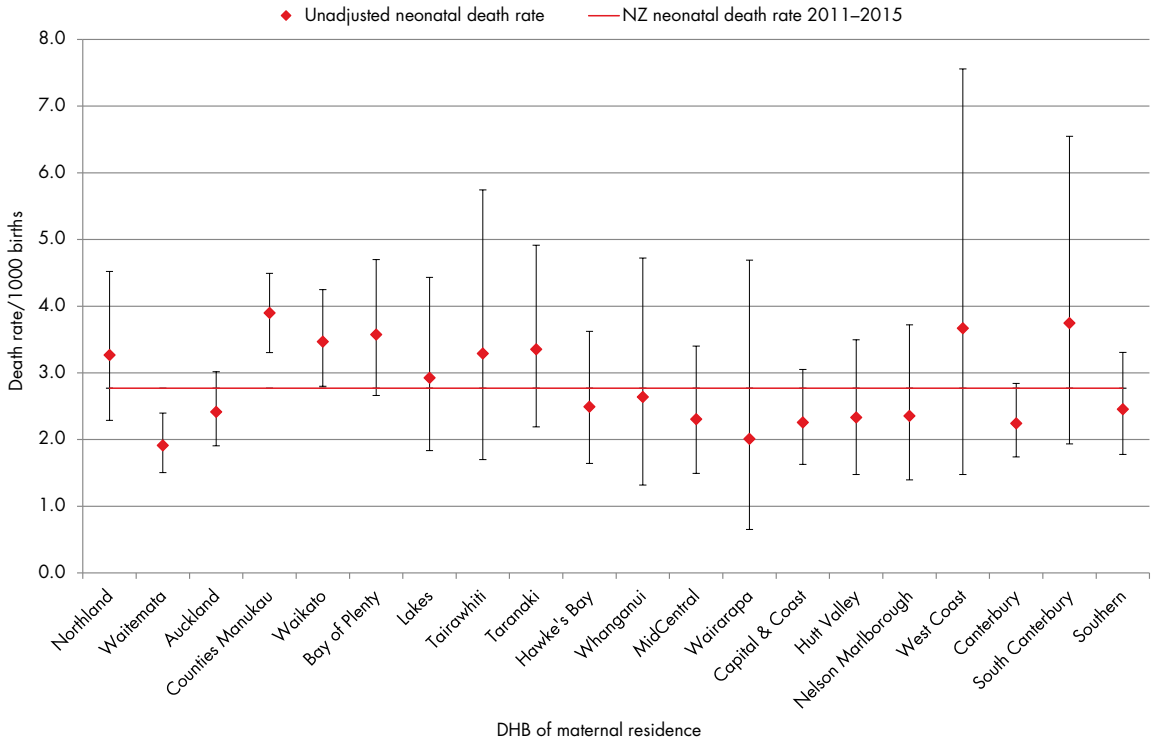


Table 3.45: Perinatal related mortality rates (per 1000 births) by smoking at registration with maternity care* 2011–2015

Maternal smoking at registration	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=306,578		n=711			n=1,530			n=836			n=3,077		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Smoker	42,858	14.0	59	8.3	1.38	261	17.1	6.09	167	20.0	3.93	487	15.8	11.36
Non-smoker	245,435	80.1	536	75.4	2.18	1,049	68.6	4.27	536	64.1	2.20	2,121	68.9	8.64
Unknown	18,285	6.0	116	16.3	-	220	14.4	-	133	15.9	-	469	15.2	-

* MAT data numerator and denominator.

Table 3.46: Perinatal related mortality risk (per 1000 ongoing pregnancies) 2007–2015

	2007—2008			2009—2010			2011—2012			2013—2014			2015			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	
Gestation at birth (weeks)																
20–22	411	435	3.37	440	464	3.58	461	482	3.85	459	470	3.93	168	175	2.95	0.34
23–24	248	179	1.39	258	186	1.44	247	189	1.52	260	183	1.54	117	92	1.55	0.24
25–27	473	126	0.98	465	143	1.11	402	122	0.98	373	104	0.88	206	52	0.88	0.22
28–31	1,088	122	0.95	1,098	118	0.92	1,013	108	0.87	929	95	0.80	456	41	0.70	0.041
32–36	7,799	169	1.33	7,976	191	1.50	7,829	160	1.30	7,430	176	1.50	3,635	78	1.34	0.89
37–38	25,858	124	1.04	26,755	140	1.17	26,598	129	1.12	27,046	94	0.85	13,567	42	0.77	0.025
39–40	69,054	154	1.65	69,218	137	1.48	67,425	110	1.24	64,326	111	1.34	32,079	69	1.68	0.32
≥41	24,166	71	2.94	23,422	58	2.48	21,156	37	1.75	18,653	26	1.39	9,105	29	3.19	0.047
Unknown	1,729	1	-	1,034	1	-	1,408	-	-	755	-	-	475	-	-	

Table 3.47: Termination of pregnancy, stillbirth and neonatal death rates (per 1000 ongoing pregnancies) by gestation group and year 2007–2015

Gestation at birth (weeks)	2007—2008			2009—2010			2011—2012			2013—2014			2015			Chi-squared test for trend (p)
	n=130,826			n=130,666			n=126,539			n=120,231			n=59,808			
	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	411	197	1.53	440	180	1.39	461	225	1.80	459	173	1.45	168	66	1.11	0.36
23–24	248	47	0.37	258	51	0.39	247	61	0.49	260	63	0.53	117	27	0.46	0.067
25–27	473	24	0.19	465	29	0.22	402	29	0.23	373	26	0.22	206	8	0.14	0.95
28–31	1,088	13	0.10	1,098	10	0.08	1,013	16	0.13	929	12	0.10	456	3	0.05	0.74
≥32	126,877	8	0.06	127,371	19	0.15	123,008	12	0.10	117,455	16	0.14	58,386	3	0.05	0.57
Unknown	1,729	-	-	1,034	-	-	1,408	-	-	755	-	-	475	-	-	
Stillbirths																
20–22	411	174	1.35	440	182	1.40	461	175	1.40	459	199	1.67	168	73	1.23	0.24
23–24	248	65	0.51	258	74	0.57	247	65	0.52	260	57	0.48	117	32	0.54	0.77
25–27	473	73	0.57	465	71	0.55	402	60	0.48	373	50	0.42	206	31	0.52	0.18
28–31	1,088	81	0.63	1,098	80	0.62	1,013	64	0.52	929	63	0.53	456	29	0.49	0.070
32–36	7,799	118	0.93	7,976	126	0.99	7,829	109	0.89	7,430	121	1.03	3,635	48	0.82	0.84
37–40	94,912	197	1.65	95,973	189	1.58	94,023	161	1.40	91,372	132	1.20	45,646	72	1.32	0.0018
≥41	24,166	39	1.61	23,422	33	1.41	21,156	18	0.85	18,653	12	0.64	9,105	20	2.20	0.18
Unknown	1,729	1	-	1,034	1	-	1,408	-	-	755	-	-	475	-	-	
Neonatal deaths																
20–22	40	64	0.50	78	102	0.79	61	82	0.66	87	98	0.83	29	36	0.61	0.049
23–24	136	67	0.52	133	61	0.47	121	63	0.51	140	63	0.53	58	33	0.56	0.52
25–27	376	29	0.23	365	43	0.33	313	33	0.27	297	28	0.24	167	13	0.22	0.68
28–31	994	28	0.22	1,008	28	0.22	933	28	0.23	854	20	0.17	424	9	0.15	0.35
32–36	7,673	43	0.34	7,836	51	0.40	7,709	40	0.33	7,300	46	0.39	3,584	27	0.46	0.43
37–40	94,715	81	0.68	95,779	83	0.70	93,861	77	0.67	91,233	66	0.60	45,574	39	0.71	0.84
≥41	24,127	32	1.33	23,389	25	1.07	21,138	19	0.90	18,641	14	0.75	9,085	9	0.99	0.14
Unknown	1,728	-	-	1,033	-	-	1,408	-	-	755	-	-	475	-	-	

Table 3.48: Perinatal related mortality rates (per 1000 births) by birthweight and year (2007–2015)

Birthweight (g)	2007–2008			2009–2010			2011–2012			2013–2014			2015			Chi-squared test for trend (p)
	N	n	Rate	N	n	Rate	N	n	Rate	N	n	Rate	N	n	Rate	
<500	422	429	-	440	461	-	481	501	-	471	475	-	187	188	-	-
500–999	664	340	512.05	678	354	522.12	611	314	513.91	611	312	510.64	273	138	505.49	0.90
1000–1499	799	88	110.14	812	103	126.85	723	90	124.48	652	71	108.90	376	34	90.43	0.39
1500–1999	1,561	83	53.17	1,509	85	56.33	1,502	71	47.27	1,397	70	50.11	649	36	55.47	0.62
2000–2499	4,566	84	18.40	4,630	80	17.28	4,624	89	19.25	4,372	87	19.90	2,161	33	15.27	0.93
2500–2999	16,554	110	6.64	16,777	111	6.62	16,204	102	6.29	16,033	81	5.05	7,966	52	6.53	0.17
3000–3499	40,392	121	3.00	41,034	119	2.90	39,907	89	2.23	38,373	74	1.93	18,998	53	2.79	0.024
3500–3999	39,418	68	1.73	39,517	69	1.75	38,090	52	1.37	36,051	57	1.58	18,051	29	1.61	0.48
4000–4499	15,430	38	2.46	15,307	33	2.16	14,572	15	1.03	13,613	18	1.32	6,732	8	1.19	0.00035
≥4500	3,461	13	3.76	3,184	9	2.83	3,031	3	0.99	2,794	5	1.79	1,252	4	3.19	0.13
Unknown	7,559	7	-	6,778	14	-	6,794	11	-	5,864	9	-	3,163	3	-	-

Table 3.49: Perinatal death classification (PSANZ-PDC) of fetal death by gestational age 2011–2015

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	706	391	55.4	179	25.4	40	5.7	58	8.2	30	4.2	8	1.1
Perinatal infection	64	19	29.7	17	26.6	8	12.5	6	9.4	10	15.6	4	6.3
Hypertension	67	11	16.4	24	35.8	8	11.9	15	22.4	8	11.9	1	1.5
Antepartum haemorrhage	229	126	55.0	38	16.6	16	7.0	30	13.1	18	7.9	1	0.4
Maternal conditions	136	41	30.1	32	23.5	19	14.0	22	16.2	21	15.4	1	0.7
Specific perinatal conditions	255	78	30.6	56	22.0	22	8.6	46	18.0	50	19.6	3	1.2
Hypoxic peripartum death	39	-	-	-	-	-	-	3	7.7	24	61.5	12	30.8
Fetal growth restriction	196	19	9.7	47	24.0	34	17.3	36	18.4	53	27.0	7	3.6
Spontaneous preterm	193	142	73.6	40	20.7	7	3.6	4	2.1	-	-	-	-
Unexplained antepartum death	446	84	18.8	76	17.0	33	7.4	81	18.2	159	35.7	13	2.9
Total	**2,331**	**911**	**39.1**	**509**	**21.8**	**187**	**8.0**	**301**	**12.9**	**373**	**16.0**	**50**	**2.1**

Table 3.50: Perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) of neonatal deaths by gestational age 2011–2015

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	204	2	1.0	8	3.9	18	8.8	67	32.8	95	46.6	14	6.9
Perinatal infection	42	10	23.8	9	21.4	3	7.1	4	9.5	10	23.8	6	14.3
Hypertension	19	2	10.5	11	57.9	3	15.8	2	10.5	1	5.3	-	-
Antepartum haemorrhage	132	62	47.0	59	44.7	4	3.0	5	3.8	2	1.5	-	-
Maternal conditions	28	7	25.0	6	21.4	4	14.3	7	25.0	4	14.3	-	-
Specific perinatal conditions	80	35	43.8	18	22.5	9	11.3	8	10.0	9	11.3	1	1.3
Hypoxic peripartum death	46	-	-	-	-	1	2.2	3	6.5	31	67.4	11	23.9
Fetal growth restriction	14	-	-	3	21.4	1	7.1	2	14.3	7	50.0	1	7.1
Spontaneous preterm	245	98	40.0	119	48.6	14	5.7	14	5.7	-	-	-	-
No obstetric antecedent	33	-	-	-	-	-	-	1	3.0	23	69.7	9	27.3
Neonatal death classification (PSANZ-NDC)													
Congenital abnormality	209	2	1.0	7	3.3	18	8.6	71	34.0	97	46.4	14	6.7
Extreme prematurity	305	214	70.2	91	29.8	-	-	-	-	-	-	-	-
Cardio-respiratory disorders	63	-	-	44	69.8	11	17.5	3	4.8	5	7.9	-	-
Infection	65	-	-	30	46.2	5	7.7	7	10.8	15	23.1	8	12.3
Neurological	128	-	-	45	35.2	10	7.8	22	17.2	40	31.3	11	8.6
Gastrointestinal	11	-	-	8	72.7	3	27.3	-	-	-	-	-	-
Other	62	-	-	8	12.9	10	16.1	10	16.1	25	40.3	9	14.5
Total	**843**	**216**	**25.6**	**233**	**27.6**	**57**	**6.8**	**113**	**13.4**	**182**	**21.6**	**42**	**5.0**

Table 3.51: Perinatal death classification (PSANZ-PDC) specific stillbirth rates (per 1000 births) 2007–2015

Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		Chi-squared test for trend (p)
	n=130,826		n=130,666		n=126,539		n=120,231		n=59,808		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	63	0.48	67	0.51	62	0.49	55	0.46	25	0.42	0.67
Perinatal infection	36	0.28	33	0.25	19	0.15	22	0.18	12	0.20	0.057
Hypertension	25	0.19	42	0.32	20	0.16	17	0.14	16	0.27	0.31
Antepartum haemorrhage	94	0.72	99	0.76	79	0.62	78	0.65	46	0.77	0.44
Maternal conditions	33	0.25	49	0.38	32	0.25	43	0.36	22	0.37	0.30
Specific perinatal condition	91	0.70	105	0.80	93	0.73	82	0.68	42	0.70	0.67
Hypoxic peripartum death	33	0.25	18	0.14	20	0.16	10	0.08	9	0.15	0.0087
Fetal growth restriction	94	0.72	83	0.64	79	0.62	77	0.64	27	0.45	0.097
Unexplained antepartum death	202	1.54	175	1.34	178	1.41	181	1.51	87	1.45	0.74

Table 3.52: Intrapartum stillbirth rates (per 1000 ongoing pregnancies) by gestation excluding congenital abnormalities 2007–2015

Gestation at birth (weeks)	2007—2008			2009—2010			2011—2012			2013—2014			2015			Chi-squared test for trend (p)
	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	
23–27	21	128,494	0.16	31	128,970	0.24	26	124,444	0.21	18	118,814	0.15	8	59,070	0.14	0.34
28–36	11	127,835	0.09	7	128,324	0.05	7	123,873	0.06	5	118,258	0.04	2	58,780	0.03	0.095
≥37	46	119,020	0.39	38	119,335	0.32	21	115,117	0.18	13	109,971	0.12	17	54,718	0.31	0.0014

Table 3.53: Association between perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) among all neonatal deaths 2015

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	45	45	-	-	-	-	-	-
Perinatal infection	7	-	3	-	3	1	-	-
Hypertension	5	-	-	1	1	2	-	1
Antepartum haemorrhage	30	-	20	2	-	7	-	1
Maternal conditions	2	-	-	-	-	1	-	1
Specific perinatal conditions	18	-	9	3	1	2	1	2
Hypoxic peripartum death	8	-	-	-	-	8	-	-
Fetal growth restriction	1	-	-	-	-	-	-	1
Spontaneous preterm	43	-	19	10	1	10	1	2
No obstetric antecedent	7	-	-	-	1	-	-	6

Table 3.54: Perinatal related mortality rates among babies born in multiple pregnancies 2007–2015

Year of death	Total multiple births	Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=71		n=320		n=244		n=635	
		n	Rate	n	Rate	n	Rate	n	Rate
2007	2,011	3	1.49	34	16.91	25	12.66	62	30.83
2008	1,924	3	1.56	33	17.15	18	9.53	54	28.07
2009	1,849	5	2.70	32	17.31	31	17.11	68	36.78
2010	1,906	9	4.72	35	18.36	35	18.80	79	41.45
2011	1,827	18	9.85	48	26.27	27	15.33	93	50.90
2012	1,804	14	7.76	34	18.85	32	18.22	80	44.35
2013	1,745	7	4.01	41	23.50	16	9.43	64	36.68
2014	1,727	10	5.79	34	19.69	40	23.77	84	48.64
2015	1,667	2	1.20	29	17.40	20	12.22	51	30.59
Chi-squared test for trend (p)		**0.10**		**0.33**		**0.23**		**0.047**	

Table 3.55: Chorionicity and number of babies lost among twin perinatal related deaths 2007–2015

	2007—2008		2009—2010		2011—2012		2013—2014		2015		Total	
	n=109		n=133		n=159		n=139		n=50		n=590	
	n	%	n	%	n	%	n	%	n	%	n	%
Twin type												
Dichorionic diamniotic	49	45.0	56	42.1	68	42.8	64	46.0	25	50.0	262	44.4
Monochorionic diamniotic	54	49.5	64	48.1	79	49.7	69	49.6	21	42.0	287	48.6
Monoamniotic	2	1.8	9	6.8	4	2.5	3	2.2	4	8.0	22	3.7
Other multiple	4	3.7	1	0.8	3	1.9	-	-	-	-	8	1.4
Unknown	-	-	3	2.3	5	3.1	3	2.2	-	-	11	1.9
Loss of twin pairs or one twin												
Both twins died	60	55.0	80	60.2	108	67.9	96	69.1	24	48.0	368	62.4
One twin died	49	45.0	53	39.8	51	32.1	43	30.9	26	52.0	222	37.6

Table 3.56: Gestation at registration by lead maternity carer among perinatal related deaths 2015

Lead maternity carer	Total	Gestation (weeks) at registration									
		<10		10–13		14–19		≥20		Unknown	
		n	%	n	%	n	%	n	%	n	%
Self-employed midwife	446	227	50.9	123	27.6	53	11.9	35	7.8	8	1.8
DHB care	78	17	21.8	26	33.3	19	24.4	16	20.5	-	-
Obstetrician (private)	26	14	53.8	7	26.9	4	15.4	1	3.8	-	-
Total	**550**	**258**	**46.9**	**156**	**28.4**	**76**	**13.8**	**52**	**9.5**	**8**	**1.5**

Table 3.57: Perinatal related deaths and completeness of perinatal death investigations 2015

Perinatal death investigation	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Optimum investigation*	67	62.6	165	54.1	69	41.6	301	52.1
Post-mortem	44	41.1	154	50.5	50	30.1	248	42.9
Karyotype	23	21.5	12	3.9	11	6.6	46	8.0
Clinical examination/investigations confirm diagnosis	6	5.6	3	1.0	12	7.2	21	3.6
Partial investigations only #	35	32.7	104	34.1	90	54.2	229	39.6
No investigation +	4	3.7	35	11.5	7	4.2	46	8.0
Unknown	1	0.9	1	0.3	-	-	2	0.3

* Optimal investigation is defined as post-mortem or karyotype confirming congenital abnormality or clinical examination/investigation confirming diagnosis.
Note: More than one 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.

Table 3.58: Perinatal related deaths and rates of offer and decline of post-mortem examination 2015

Post-mortem examination offered	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Post-mortem offered and parental consent given	44	41.1	154	50.5	50	30.1	248	42.9
Post-mortem offered and parents declined	55	51.4	139	45.6	98	59.0	292	50.5
Post-mortem not offered	8	7.5	9	3.0	12	7.2	29	5.0
Unknown	-	-	3	1.0	6	3.6	9	1.6

Table 3.59: Optimal investigation of perinatal related death by DHB of maternal residence 2015

DHB of maternal residence	Perinatal related deaths	Offered post-mortem		Optimal investigation*	
	n=578				
	n	n	%	n	%
Northland	24	22	91.7	10	41.7
Waitemata	58	54	93.1	33	56.9
Auckland	55	50	90.9	35	63.6
Counties Manukau	85	79	92.9	40	47.1
Waikato	51	50	98.0	19	37.3
Bay of Plenty	26	26	100.0	13	50.0
Lakes	13	13	100.0	5	38.5
Tairawhiti	8	6	75.0	1	12.5
Taranaki	15	14	93.3	7	46.7
Hawke's Bay	14	12	85.7	7	50.0
Whanganui	12	9	75.0	7	58.3
MidCentral	19	19	100.0	10	52.6
Wairarapa	5	5	100.0	3	60.0
Capital & Coast	37	37	100.0	21	56.8
Hutt Valley	20	18	90.0	14	70.0
Nelson Marlborough	11	9	81.8	7	63.6
West Coast	6	6	100.0	3	50.0
Canterbury	73	69	94.5	46	63.0
South Canterbury	7	5	71.4	2	28.6
Southern	35	34	97.1	16	45.7
Overseas	4	3	75.0	2	50.0

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

Table 3.60: Perinatal related deaths and maternal outcome 2015

Maternal outcome	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=107		n=305		n=166		n=578	
	n	%	n	%	n	%	n	%
Alive and generally well	107	100.0	295	96.7	165	99.4	567	98.1
Alive but with serious morbidity	-	-	9	3.0	-	-	9	1.6
Maternal death	-	-	1	0.3	1	0.6	2	0.3

Table 3.61: Perinatal related deaths by primary and associated perinatal death classification (PSANZ-PDC) 2015

Perinatal death classification (PSANZ-PDC)	Primary PSANZ-PDC		Associated PSANZ-PDC 1		Associated PSANZ-PDC 2		Assigned PSANZ-PDCs	
	n=578		n=578		n=578		n=578	
	n	%	n	%	n	%	n	%*
Congenital abnormality	158	27.3	7	1.2	2	0.3	163	28.2
Perinatal infection	22	3.8	4	0.7	-	-	26	4.5
Hypertension	21	3.6	7	1.2	2	0.3	30	5.2
Antepartum haemorrhage	79	13.7	24	4.2	2	0.3	105	18.2
Maternal conditions	29	5.0	2	0.3	-	-	31	5.4
Specific perinatal condition	60	10.4	1	0.2	1	0.2	62	10.7
Hypoxic peripartum death	17	2.9	10	1.7	2	0.3	28	4.8
Fetal growth restriction	33	5.7	30	5.2	1	0.2	62	10.7
Spontaneous preterm	65	11.2	65	11.2	5	0.9	134	23.2
Unexplained antepartum death	87	15.1	1	0.2	-	-	87	15.1
No obstetric antecedent	7	1.2	-	-	-	-	7	1.2

* Percentages are not mutually exclusive.

Table 3.62: Neonatal deaths by primary and associated neonatal death classification (PSANZ-NDC) 2015

Neonatal death classification (PSANZ-NDC)	Primary PSANZ-NDC		Associated PSANZ-NDC 1		Associated PSANZ-NDC 2		Assigned PSANZ-NDCs	
	n=166		n=166		n=166		n=166	
	n	%	n	%	n	%	n	%*
Congenital abnormality	45	27.1	4	2.4	-	-	46	27.7
Extreme prematurity	51	30.7	-	-	-	-	51	30.7
Cardio-respiratory disorders	16	9.6	7	4.2	2	1.2	20	12.0
Infection	7	4.2	3	1.8	-	-	10	6.0
Neurological	31	18.7	5	3.0	1	0.6	37	22.3
Gastrointestinal	2	1.2	-	-	-	-	2	1.2
Other	14	8.4	3	1.8	-	-	17	10.2

* Percentages are not mutually exclusive.

Table 3.63: Detail of contributory factors among perinatal related deaths 2009–2015

Contributory factors	2009—2010		2011—2012		2013—2014		2015	
	n	%	n	%	n	%	n	%
Any contributory factor	**364**	**25.3**	**372**	**27.8**	**331**	**26.3**	**146**	**25.3**
Organisational and/or management factors	**67**	**4.7**	**73**	**5.5**	**56**	**4.4**	**32**	**4.4**
Poor organisational arrangements of staff	12		10		5		-	
Inadequate education and training	15		9		6		2	
Lack of policies, protocols or guidelines	14		20		10		10	
Inadequate numbers of staff	3		6		3		1	
Poor access to senior clinical staff	6		4		2		-	
Failure or delay in emergency response	10		5		12		2	
Delay in procedure (eg, caesarean section)	13		15		13		2	
Inadequate systems for sharing of clinical information	-		5		4		11	
Delayed access to test results or inaccurate results	7		11		4		5	
Equipment (eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)	7		8		7		3	
Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)	-		1		2		1	
Other	10		10		2		3	
Not stated	-		4		3		7	
Personnel factors	**96**	**6.7**	**107**	**8.0**	**98**	**7.8**	**55**	**7.5**
Knowledge and skills of staff were lacking	30		34		25		19	
Delayed emergency response by staff	13		6		7		2	
Failure to maintain competence	5		3		-		-	
Failure of communication between staff	19		21		13		11	
Failure to seek help/supervision	13		17		5		6	
Failure to offer or follow recommended best practice	57		61		50		27	
Lack of recognition of complexity or seriousness of condition by care giver	2		18		35		27	
Other	1		2		4		2	
Barriers to access and/or engagement with care	**266**	**18.5**	**265**	**19.8**	**241**	**19.1**	**106**	**14.5**
No antenatal care	50		62		50		22	
Infrequent care or late booking	64		91		88		33	
Declined treatment or advice	26		39		53		28	
Obesity impacted on delivery of optimal care (eg, ultrasound scan)	7		5		9		4	
Substance use	42		36		21		13	
Family violence	15		15		19		13	
Lack of recognition of complexity or seriousness of condition by the woman and/or family	42		60		59		31	
Maternal mental illness	13		10		8		4	
Cultural barriers	14		20		6		1	
Language barriers	9		13		4		4	
Not eligible to access free care	5		9		3		2	
Environment (eg, isolated, long transfer, weather prevented transport)	24		25		17		7	
Other	26		20		22		9	
Not stated	2		-		-		-	

Table 3.64: Contributory factors and potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2015

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=578	n	%	n	%	n	%	n	%
Congenital abnormality	158	5	3.2	9	5.7	144	91.1	-	-
Perinatal infection	22	3	13.6	1	4.5	18	81.8	-	-
Hypertension	21	5	23.8	5	23.8	11	52.4	-	-
Antepartum haemorrhage	79	10	12.7	16	20.3	51	64.6	2	2.5
Maternal conditions	29	14	48.3	6	20.7	8	27.6	1	3.4
Specific perinatal conditions	60	6	10.0	2	3.3	52	86.7	-	-
Hypoxic peripartum death	17	8	47.1	-	-	8	47.1	1	5.9
Fetal growth restriction	33	7	21.2	4	12.1	22	66.7	-	-
Spontaneous preterm	65	11	16.9	11	16.9	43	66.2	-	-
Unexplained antepartum death	87	7	8.0	11	12.6	69	79.3	-	-
No obstetric antecedent	7	5	71.4	-	-	2	28.6	-	-

Table 3.65: Main contributory factor(s) in potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2011–2015

Perinatal death classification (PSANZ-PDC)	Perinatal related deaths	Organisation/ management		Personnel		Barriers		Specific contributory factor not identified	
	n	n	%	n	%	n	%	n	%
Congenital abnormality	910	2	0.2	6	0.7	7	0.8	-	-
Perinatal infection	106	3	2.9	12	11.4	17	16.2	-	-
Hypertension	86	5	5.8	13	15.1	16	18.6	-	-
Antepartum haemorrhage	361	7	1.9	15	4.2	33	9.2	-	-
Maternal conditions	164	11	6.1	19	11.7	61	38.0	2	1.2
Specific perinatal conditions	335	15	4.5	20	6.0	18	5.4	-	-
Hypoxic peripartum death	85	17	20.0	32	37.6	15	17.6	-	-
Fetal growth restriction	210	13	6.2	35	16.7	31	14.8	-	-
Spontaneous preterm	438	11	2.5	18	4.1	58	13.1	-	-
Unexplained antepartum death	446	6	1.6	14	3.1	44	10.1	-	-
No obstetric antecedent	33	1	3.0	3	9.1	19	57.6	-	-

Table 3.66: 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) 2011–2015

Maternal ethnicity	Perinatal related deaths	Contributory factors and potentially avoidable			Contributory factors BUT NOT or unknown if potentially avoidable		No contributory factors		Unknown	
	n=3,174	n	%	95% CI	n	%	n	%	n	%
Māori	805	180	22.4	19.53–25.40	146	18.1	467	58.0	12	1.5
Pacific peoples	411	98	23.8	19.80–28.27	59	14.4	251	61.1	3	0.7
Indian	198	25	12.6	8.34–18.07	15	7.6	155	78.3	3	1.5
Other Asian	262	21	8.0	5.03–11.99	9	3.4	228	87.0	4	1.5
Other (including unknown)	272	27	9.9	6.64–14.11	28	10.3	212	77.9	5	1.8
NZ European	1,226	167	13.6	11.75–15.67	74	6.0	966	78.8	19	1.5

Table 3.67: Main contributory factor(s) in potentially avoidable perinatal related deaths by maternal prioritised ethnicity (with 95 % CIs) 2011–2015

Maternal ethnicity	Perinatal related deaths	Potentially avoidable								
		Organisation/ management			Personnel			Barriers		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI
Māori	805	17	2.1	1.23–3.36	42	5.2	3.79–6.99	138	17.1	14.60–19.93
Pacific peoples	411	11	2.7	1.34–4.74	22	5.4	3.38–7.99	77	18.7	15.08–22.85
Indian	198	4	2.0	0.55–5.09	16	8.1	4.69–12.79	10	5.1	2.45–9.09
Other Asian	262	7	2.7	1.08–5.43	10	3.8	1.85–6.91	8	3.1	1.33–5.93
Other (including unknown)	272	8	2.9	1.28–5.71	17	6.3	3.68–9.82	8	2.9	1.28–5.71
NZ European	1,226	44	3.6	2.62–4.79	80	6.5	5.21–8.06	78	6.4	5.06–7.88

Table 3.68: 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) 2011–2015

Deprivation quintile	Perinatal related deaths	Contributory factors and potentially avoidable			Contributory factors BUT NOT or unknown if potentially avoidable		No contributory factors		Unknown	
	n=3,174	n	%	95% CI	n	%	n	%	n	%
1 (least deprived)	412	50	12.1	9.14–15.69	25	6.1	332	80.6	5	1.2
2	425	51	12.0	9.07–15.47	25	5.9	343	80.7	6	1.4
3	554	75	13.5	10.80–16.67	43	7.8	422	76.2	14	2.5
4	678	98	14.5	11.89–17.33	53	7.8	519	76.5	8	1.2
5 (most deprived)	1,089	239	21.9	19.52–24.52	183	16.8	656	60.2	11	1.0
Unknown	16	5	31.3	11.02–58.66	2	12.5	7	43.8	2	12.5

Table 3.69: Main contributory factor(s) in potentially avoidable perinatal related deaths by deprivation quintile (with 95 % CIs) 2011–2015

Deprivation quintile	Perinatal related deaths	Potentially avoidable								
		Organisation/management			Personnel			Barriers		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI
1 (least deprived)	412	16	3.9	2.24–6.23	25	6.1	3.96–8.83	17	4.1	2.42–6.52
2	425	13	3.1	1.64–5.17	21	4.9	3.08–7.45	28	6.6	4.42–9.38
3	554	15	2.7	1.52–4.43	39	7.0	5.05–9.50	39	7.0	5.05–9.50
4	678	17	2.5	1.47–3.98	31	4.6	3.13–6.43	61	9.0	6.95–11.41
5 (most deprived)	1,089	27	2.5	1.64–3.59	71	6.5	5.13–8.15	169	15.5	13.42–17.81
Unknown	16	3	18.8	-	-	-	-	5	31.3	-

Table 3.70: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2015

	Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=1,381		n=1,438		n=1,337		n=1,259		n=578		n=5,415	
		n	%	n	%	n	%	n	%	n	%	n	%
	Congenital abnormality												
1.1	Central nervous system	86	6.2	71	4.9	76	5.7	80	6.4	23	4.0	313	5.8
1.2	Cardiovascular system	51	3.7	52	3.6	50	3.7	47	3.7	28	4.8	200	3.7
1.3	Urinary system	25	1.8	26	1.8	28	2.1	23	1.8	10	1.7	102	1.9
1.4	Gastrointestinal system	10	0.7	7	0.5	8	0.6	7	0.6	6	1.0	32	0.6
1.5	Chromosomal	108	7.8	134	9.3	119	8.9	109	8.7	47	8.1	470	8.7
1.6	Metabolic	4	0.3	7	0.5	6	0.4	3	0.2	6	1.0	20	0.4
1.7	Multiple/Non-chromosomal syndromes	51	3.7	46	3.2	58	4.3	33	2.6	21	3.6	188	3.5
1.8	Other congenital abnormality												
1.81	Musculoskeletal	8	0.6	16	1.1	25	1.9	24	1.9	8	1.4	73	1.3
1.82	Respiratory	2	0.1	2	0.1	2	0.1	-	-	-	-	6	0.1
1.83	Diaphragmatic hernia	9	0.7	15	1.0	10	0.7	6	0.5	4	0.7	40	0.7
1.84	Haematological	-	-	2	0.1	4	0.3	2	0.2	-	-	8	0.1
1.85	Tumours	8	0.6	2	0.1	4	0.3	4	0.3	1	0.2	18	0.3
1.88	Other specified congenital abnormality	13	0.9	6	0.4	7	0.5	5	0.4	-	-	31	0.6
1.9	Unspecified congenital abnormality	7	0.5	7	0.5	7	0.5	5	0.4	4	0.7	26	0.5
	Perinatal infection												
2.1	Bacterial												
2.11	Group B *Streptococcus*	13	0.9	16	1.1	3	0.2	9	0.7	6	1.0	41	0.8
2.12	*E. coli*	5	0.4	7	0.5	2	0.1	5	0.4	-	-	19	0.4
2.13	*Listeria monocytogenes*	3	0.2	4	0.3	1	0.1	6	0.5	2	0.3	14	0.3
2.14	Spirochaetal (eg, syphilis)	-	-	-	-	1	0.1	-	-	-	-	1	0.0
2.18	Other bacterial	7	0.5	1	0.1	6	0.4	8	0.6	2	0.3	22	0.4
2.19	Unspecified bacterial	5	0.4	4	0.3	4	0.3	3	0.2	4	0.7	16	0.3
2.2	Viral												
2.21	*Cytomegalovirus*	9	0.7	11	0.8	6	0.4	4	0.3	3	0.5	30	0.6
2.22	Parvovirus	4	0.3	-	-	8	0.6	-	-	1	0.2	12	0.2

Table 3.70: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2015 (Continued)

	Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=1,381		n=1,438		n=1,337		n=1,259		n=578		n=5,415	
		n	%	n	%	n	%	n	%	n	%	n	%
2.23	Herpes simplex virus	3	0.2	1	0.1	1	0.1	3	0.2	-	-	8	0.1
2.28	Other viral	-	-	1	0.1	-	-	-	-	-	-	1	0.0
2.29	Unspecified viral	3	0.2	-	-	-	-	-	-	-	-	3	0.1
2.3	Protozoal (eg, *Toxoplasma*)	1	0.1	3	0.2	4	0.3	3	0.2	1	0.2	11	0.2
2.5	Fungal	-	-	-	-	-	-	1	0.1	-	-	1	0.0
2.8	Other specified organism	-	-	-	-	1	0.1	-	-	-	-	1	0.0
2.9	Other unspecified organism	4	0.3	5	0.3	3	0.2	2	0.2	3	0.5	14	0.3
	Hypertension												
3.1	Chronic hypertension: essential	3	0.2	2	0.1	4	0.3	5	0.4	2	0.3	14	0.3
3.2	Chronic hypertension: secondary, (eg, renal disease)	3	0.2	1	0.1	1	0.1	1	0.1	1	0.2	6	0.1
3.3	Chronic hypertension: unspecified	2	0.1	2	0.1	-	-	2	0.2	-	-	6	0.1
3.4	Gestational hypertension	3	0.2	4	0.3	5	0.4	2	0.2	1	0.2	14	0.3
3.5	Pre-eclampsia	22	1.6	33	2.3	20	1.5	13	1.0	13	2.2	88	1.6
3.51	Pre-eclampsia: With laboratory evidence of thrombophilia	-	-	3	0.2	1	0.1	-	-	1	0.2	4	0.1
3.6	Pre-eclampsia superimposed on chronic hypertension	6	0.4	6	0.4	8	0.6	3	0.2	2	0.3	23	0.4
3.61	Pre-eclampsia superimposed on chronic hypertension: With laboratory evidence of thrombophilia	1	0.1	2	0.1	-	-	-	-	-	-	3	0.1
3.9	Unspecified hypertension	1	0.1	3	0.2	-	-	-	-	1	0.2	4	0.1
	Antepartum haemorrhage (APH)												
4.1	Placental abruption	77	5.6	81	5.6	67	5.0	61	4.8	20	3.5	286	5.3
4.11	Placental abruption: With laboratory evidence of thrombophilia	8	0.6	5	0.3	6	0.4	1	0.1	2	0.3	20	0.4
4.2	Placenta praevia	3	0.2	8	0.6	2	0.1	2	0.2	-	-	15	0.3
4.3	Vasa praevia	1	0.1	2	0.1	1	0.1	-	-	2	0.3	4	0.1
4.8	Other APH	17	1.2	18	1.3	15	1.1	38	3.0	36	6.2	88	1.6
4.9	APH of undetermined origin	23	1.7	43	3.0	47	3.5	42	3.3	19	3.3	155	2.9
	Maternal conditions												
5.1	Termination of pregnancy for maternal psychosocial indications	9	0.7	5	0.3	9	0.7	5	0.4	3	0.5	28	0.5
5.2	Diabetes/Gestational diabetes	19	1.4	32	2.2	23	1.7	27	2.1	12	2.1	101	1.9
5.3	Maternal injury	-	-	-	-	-	-	1	0.1	-	-	1	0.0
5.31	Maternal injury: Accidental	2	0.1	3	0.2	3	0.2	5	0.4	3	0.5	13	0.2
5.32	Maternal injury: Non-accidental	3	0.2	2	0.1	-	-	3	0.2	1	0.2	8	0.1
5.4	Maternal sepsis	1	0.1	5	0.3	3	0.2	5	0.4	2	0.3	14	0.3
5.5	Antiphospholipid syndrome	5	0.4	10	0.7	3	0.2	7	0.6	2	0.3	25	0.5
5.51	Other maternal thrombophilia (if considered cause of death)	1	0.1	-	-	2	0.1	-	-	1	0.2	3	0.1

Table 3.70: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2015 (Continued)

	Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=1,381		n=1,438		n=1,337		n=1,259		n=578		n=5,415	
		n	%	n	%	n	%	n	%	n	%	n	%
5.6	Obstetric cholestasis	-	-	-	-	-	-	1	0.1	-	-	1	0.0
5.8	Other specified maternal conditions	10	0.7	13	0.9	19	1.4	19	1.5	5	0.9	61	1.1
	Specific perinatal conditions												
6.1	Twin–twin transfusion	32	2.3	54	3.8	41	3.1	36	2.9	7	1.2	163	3.0
6.2	Fetomaternal haemorrhage	10	0.7	21	1.5	20	1.5	7	0.6	13	2.2	58	1.1
6.3	Antepartum cord complications (eg, cord haemorrhage; true knot with evidence of occlusion)	27	2.0	-	-	-	-	-	-	-	-	27	0.5
6.31	Cord haemorrhage	2	0.1	2	0.1	2	0.1	3	0.2	1	0.2	9	0.2
6.32	True knot with evidence of occlusion	1	0.1	5	0.3	7	0.5	4	0.3	1	0.2	17	0.3
6.38	Other	1	0.1	23	1.6	18	1.3	11	0.9	9	1.6	53	1.0
6.4	Uterine abnormalities, eg, bicornuate uterus, cervical incompetence	25	1.8	22	1.5	24	1.8	26	2.1	14	2.4	97	1.8
6.5	Birth trauma (typically infants of >24 weeks gestation or >600g birthweight)	-	-	1	0.1	-	-	-	-	-	-	1	0.0
6.6	Alloimmune disease												
6.61	Alloimmune disease: Rhesus	-	-	-	-	1	0.1	1	0.1	-	-	2	0.0
6.64	Alloimmune disease: Alloimmune thrombocytopenia	1	0.1	3	0.2	-	-	2	0.2	-	-	6	0.1
6.68	Alloimmune disease: Other	-	-	-	-	-	-	-	-	1	0.2	-	-
6.7	Idiopathic hydrops	7	0.5	5	0.3	8	0.6	6	0.5	5	0.9	26	0.5
6.8	Other specific perinatal conditions (includes iatrogenic conditions such as rupture of membranes after amniocentesis, termination of pregnancy for suspected but unconfirmed congenital abnormality)												
6.81	Rupture of membranes after amniocentesis	6	0.4	1	0.1	3	0.2	1	0.1	1	0.2	11	0.2
6.82	Termination of pregnancy for suspected but unconfirmed congenital abnormality	-	-	-	-	-	-	3	0.2	-	-	3	0.1
6.83	Fetal subdural haematoma	2	0.1	2	0.1	-	-	1	0.1	1	0.2	5	0.1
6.88	Other	14	1.0	6	0.4	19	1.4	30	2.4	7	1.2	69	1.3
6.89	Unspecified	-	-	-	-	-	-	1	0.1	-	-	1	0.0
	Hypoxic peripartum death												
7.1	With intrapartum complications												
7.11	With intrapartum complications: Uterine rupture	2	0.1	3	0.2	2	0.1	-	-	3	0.5	7	0.1
7.12	With intrapartum complications: Cord prolapse	3	0.2	6	0.4	6	0.4	1	0.1	2	0.3	16	0.3

Table 3.70: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2015 (Continued)

	Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=1,381		n=1,438		n=1,337		n=1,259		n=578		n=5,415	
		n	%	n	%	n	%	n	%	n	%	n	%
7.13	With intrapartum complications: Shoulder dystocia	2	0.1	2	0.1	-	-	-	-	-	-	4	0.1
7.18	With intrapartum complications: Other	10	0.7	5	0.3	5	0.4	4	0.3	1	0.2	24	0.4
7.2	Evidence of non-reassuring fetal status in a normally grown infant (eg, abnormal fetal heart rate, fetal scalp ph/lactate, fetal pulse oximetry without intrapartum complications)	27	2.0	20	1.4	20	1.5	17	1.4	6	1.0	84	1.6
7.3	No intrapartum complications and no evidence of non-reassuring fetal status	3	0.2	2	0.1	3	0.2	4	0.3	3	0.5	12	0.2
7.9	Unspecified hypoxic peripartum death	20	1.4	10	0.7	4	0.3	2	0.2	2	0.3	36	0.7
	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)	71	5.1	61	4.2	63	4.7	51	4.1	17	2.9	246	4.5
8.2	With chronic villitis	1	0.1	1	0.1	1	0.1	3	0.2	3	0.5	6	0.1
8.3	No placental pathology	11	0.8	11	0.8	5	0.4	6	0.5	1	0.2	33	0.6
8.4	No examination of placenta	7	0.5	5	0.3	7	0.5	4	0.3	3	0.5	23	0.4
8.8	Other specified placental pathology	16	1.2	22	1.5	17	1.3	20	1.6	7	1.2	75	1.4
8.9	Unspecified or not known whether placenta examined	2	0.1	1	0.1	-	-	-	-	2	0.3	3	0.1
	Spontaneous preterm												
9.1	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery												
9.11	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: With chorioamnionitis	36	2.6	55	3.8	40	3.0	56	4.4	18	3.1	187	3.5
9.12	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Without chorioamnionitis	32	2.3	27	1.9	19	1.4	18	1.4	6	1.0	96	1.8
9.13	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: No examination of placenta	1	0.1	3	0.2	3	0.2	9	0.7	-	-	16	0.3

Table 3.70: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2015 (Continued)

Perinatal death classification (PSANZ-PDC)		2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=1,381		n=1,438		n=1,337		n=1,259		n=578		n=5,415	
		n	%	n	%	n	%	n	%	n	%	n	%
9.17	No clinical signs of chorioamnionitis, no examination of placenta	16	1.2	31	2.2	24	1.8	14	1.1	8	1.4	85	1.6
9.19	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Unspecified or not known whether placenta examined	16	1.2	16	1.1	7	0.5	3	0.2	-	-	42	0.8
9.2	Spontaneous preterm with membrane rupture ≥24 hours before delivery												
9.21	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With chorioamnionitis	43	3.1	60	4.2	45	3.4	56	4.4	24	4.2	204	3.8
9.22	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Without chorioamnionitis	8	0.6	5	0.3	9	0.7	3	0.2	1	0.2	25	0.5
9.23	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	5	0.4	7	0.5	10	0.7	6	0.5	2	0.3	28	0.5
9.27	No clinical signs of chorioamnionitis, no examination of placenta	6	0.4	6	0.4	12	0.9	13	1.0	2	0.3	37	0.7
9.29	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Unspecified or not known whether placenta examined	5	0.4	3	0.2	5	0.4	-	-	2	0.3	13	0.2
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	7	0.5	2	0.1	5	0.4	3	0.2	2	0.3	17	0.3
9.32	Spontaneous preterm with membrane rupture of unknown duration before delivery: Without chorioamnionitis	4	0.3	1	0.1	1	0.1	3	0.2	-	-	9	0.2
9.33	Spontaneous preterm with membrane rupture of unknown duration before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	3	0.2	-	-	1	0.1	-	-	-	-	4	0.1
9.37	No clinical signs of chorioamnionitis, no examination of placenta	-	-	3	0.2	2	0.1	1	0.1	-	-	6	0.1

Table 3.70: Perinatal related death and primary perinatal death classification (PSANZ-PDC) 2007–2015 (Continued)

	Perinatal death classification (PSANZ-PDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=1,381		n=1,438		n=1,337		n=1,259		n=578		n=5,415	
		n	%	n	%	n	%	n	%	n	%	n	%
9.39	Spontaneous preterm with membrane rupture of unknown duration before delivery: Unspecified or not known whether placenta examined	10	0.7	4	0.3	4	0.3	1	0.1	-	-	19	0.4
	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)	28	2.0	23	1.6	28	2.1	16	1.3	5	0.9	95	1.8
10.2	With chronic villitis	3	0.2	1	0.1	5	0.4	2	0.2	3	0.5	11	0.2
10.3	No placental pathology	56	4.1	50	3.5	39	2.9	46	3.7	11	1.9	191	3.5
10.4	No examination of placenta	43	3.1	35	2.4	33	2.5	30	2.4	17	2.9	141	2.6
10.8	Other specified placental pathology	59	4.3	58	4.0	72	5.4	87	6.9	50	8.7	276	5.1
10.9	Unspecified or not known whether placenta examined	13	0.9	8	0.6	1	0.1	-	-	1	0.2	22	0.4
	No obstetric antecedent												
11.1	Sudden infant death syndrome (SIDS)												
11.11	SIDS Category IA: Classic features of SIDS present, completely documented	-	-	-	-	-	-	1	0.1	-	-	1	0.0
11.13	SIDS Category II: Infant deaths that meet Category I except for one or more features	1	0.1	2	0.1	-	-	-	-	-	-	3	0.1
11.2	Postnatally acquired infection	3	0.2	3	0.2	5	0.4	2	0.2	1	0.2	13	0.2
11.3	Accidental asphyxiation	3	0.2	-	-	1	0.1	1	0.1	1	0.2	5	0.1
11.4	Other accident, poisoning or violence (postnatal)	1	0.1	-	-	2	0.1	-	-	-	-	3	0.1
11.8	Other specified	1	0.1	1	0.1	1	0.1	2	0.2	-	-	5	0.1
11.9	Unknown/Undetermined	2	0.1	-	-	2	0.1	1	0.1	-	-	5	0.1
11.91	Unclassified sudden infant death	14	1.0	10	0.7	2	0.1	6	0.5	4	0.7	32	0.6
11.92	Other Unknown/Undetermined	-	-	1	0.1	-	-	-	-	1	0.2	1	-

Table 3.71: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2007–2015

	Neonatal death classification (PSANZ-NDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=344		n=393		n=342		n=335		n=166		n=1,580	
		n	%	n	%	n	%	n	%	n	%	n	%
	Congenital abnormality												
1.1	Central nervous system	4	1.2	12	3.1	9	2.6	10	3.0	3	1.8	38	2.4
1.2	Cardiovascular system	21	6.1	13	3.3	9	2.6	12	3.6	6	3.6	61	3.9
1.3	Urinary system	11	3.2	9	2.3	10	2.9	4	1.2	3	1.8	37	2.3
1.4	Gastrointestinal system	3	0.9	-	-	3	0.9	3	0.9	3	1.8	12	0.8
1.5	Chromosomal	13	3.8	20	5.1	25	7.3	16	4.8	12	7.2	86	5.4
1.6	Metabolic	2	0.6	6	1.5	6	1.8	3	0.9	6	3.6	23	1.5
1.7	Multiple/Non-chromosomal syndromes	15	4.4	14	3.6	10	2.9	15	4.5	6	3.6	60	3.8
1.8	Other congenital abnormality												
1.81	Musculoskeletal	-	-	1	0.3	5	1.5	5	1.5	2	1.2	13	0.8
1.82	Respiratory	1	0.3	1	0.3	2	0.6	-	-	-	-	4	0.3
1.83	Diaphragmatic hernia	6	1.7	11	2.8	6	1.8	3	0.9	3	1.8	29	1.8
1.84	Haematological	-	-	1	0.3	-	-	1	0.3	-	-	2	0.1
1.85	Tumours	3	0.9	-	-	-	-	2	0.6	1	0.6	6	0.4
1.88	Other specified congenital abnormality	2	0.6	1	0.3	3	0.9	2	0.6	-	-	8	0.5
	Extreme prematurity												
2.1	Not resuscitated	85	24.7	123	31.3	105	30.7	126	37.6	46	27.7	485	30.7
2.2	Unsuccessful resuscitation	24	7.0	19	4.8	17	5.0	5	1.5	5	3.0	70	4.4
2.9	Unspecified or not known whether resuscitation attempted	-	-	-	-	-	-	1	0.3	-	-	1	0.1
	Cardio-respiratory disorders												
3.1	Hyaline membrane disease/ Respiratory distress syndrome (RDS)	13	3.8	13	3.3	8	2.3	9	2.7	7	4.2	50	3.2
3.2	Meconium aspiration syndrome	-	-	-	-	-	-	2	0.6	-	-	2	0.1
3.3	Primary persistent pulmonary hypertension	-	-	1	0.3	2	0.6	1	0.3	1	0.6	5	0.3
3.4	Pulmonary hypoplasia	7	2.0	5	1.3	6	1.8	6	1.8	3	1.8	27	1.7
3.5	Chronic neonatal lung disease (typically, bronchopulmonary dysplasia)	-	-	4	1.0	1	0.3	-	-	-	-	5	0.3
3.6	Pulmonary haemorrhage	-	-	5	1.3	4	1.2	2	0.6	1	0.6	12	0.8
3.7	Pneumothorax	-	-	-	-	-	-	1	0.3	-	-	1	0.1
3.8	Other	2	0.6	1	0.3	4	1.2	1	0.3	4	2.4	12	0.8
	Infection												
4.1	Bacterial												
4.11	Congenital bacterial												
4.111	Congenital bacterial: Group B *Streptococcus*	8	2.3	8	2.0	2	0.6	4	1.2	1	0.6	23	1.5
4.112	Congenital bacterial: *E. coli*	1	0.3	3	0.8	6	1.8	2	0.6	2	1.2	14	0.9
4.113	Congenital bacterial: *Listeria monocytogenes*	1	0.3	-	-	-	-	2	0.6	1	0.6	4	0.3

Table 3.71: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2007–2015

Neonatal death classification (PSANZ-NDC)		2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=344		n=393		n=342		n=335		n=166		n=1,580	
		n	%	n	%	n	%	n	%	n	%	n	%
4.118	Congenital bacterial: Other bacterial	3	0.9	2	0.5	4	1.2	4	1.2	1	0.6	14	0.9
4.119	Congenital bacterial: Unspecified bacterial	3	0.9	4	1.0	2	0.6	3	0.9	-	-	12	0.8
4.12	Acquired bacterial												
4.121	Acquired bacterial: Group B *Streptococcus*	-	-	-	-	4	1.2	-	-	-	-	4	0.3
4.122	Acquired bacterial: *E. coli*	3	0.9	1	0.3	-	-	-	-	-	-	4	0.3
4.125	Acquired bacterial: Other Gram negative bacilli (other than *E. coli)*	2	0.6	1	0.3	1	0.3	1	0.3	1	0.6	6	0.4
4.126	Acquired bacterial: *Staphylococcus aureus*	3	0.9	1	0.3	1	0.3	3	0.9	1	0.6	9	0.6
4.127	Acquired bacterial: Coagulase negative *Staphylococcus*	3	0.9	-	-	-	-	1	0.3	-	-	4	0.3
4.128	Acquired bacterial: Other specified bacterial	-	-	5	1.3	2	0.6	1	0.3	-	-	8	0.5
4.129	Acquired bacterial: Unspecified bacterial	2	0.6	-	-	-	-	-	-	-	-	2	0.1
4.2	Viral												
4.21	Congenital viral												
4.211	Congenital viral: *Cytomegalovirus*	1	0.3	-	-	2	0.6	-	-	-	-	3	0.2
4.213	Congenital viral: Herpes simplex virus	2	0.6	-	-	1	0.3	3	0.9	-	-	6	0.4
4.218	Congenital viral: Other specified viral	-	-	-	-	2	0.6	-	-	-	-	2	0.1
4.22	Acquired viral												
4.223	Acquired viral: Herpes simplex virus	-	-	1	0.3	1	0.3	1	0.3	-	-	3	0.2
4.228	Acquired viral: Other specified viral	1	0.3	1	0.3	1	0.3	-	-	-	-	3	0.2
4.229	Acquired viral: Unspecified viral	1	0.3	-	-	-	-	-	-	-	-	1	0.1
4.5	Fungal	-	-	-	-	-	-	1	0.3	-	-	1	0.1
4.9	Unspecified organism	1	0.3	4	1.0	2	0.6	1	0.3	-	-	8	0.5
	Neurological												
5.1	Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)	54	15.7	56	14.2	33	9.6	29	8.7	19	11.4	191	12.1
5.2	Intracranial haemorrhage												
5.21	Intraventrical haemorrhage	7	2.0	8	2.0	14	4.1	18	5.4	12	7.2	59	3.7
5.22	Subgaleal haemorrhage	1	0.3	1	0.3	-	-	-	-	-	-	2	0.1
5.23	Subarachnoid haemorrhage	1	0.3	-	-	-	-	-	-	-	-	1	0.1
5.24	Subdural haemorrhage	-	-	1	0.3	-	-	1	0.3	-	-	2	0.1
5.28	Other intracranial haemorrhage	-	-	1	0.3	-	-	1	0.3	-	-	2	0.1
5.8	Other	1	0.3	1	0.3	1	0.3	-	-	-	-	3	0.2

Table 3.71: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2007–2015

	Neonatal death classification (PSANZ-NDC)	2007—2008		2009—2010		2011—2012		2013—2014		2015		2007–2015	
		n=344		n=393		n=342		n=335		n=166		n=1,580	
		n	%	n	%	n	%	n	%	n	%	n	%
	Gastrointestinal												
6.1	Necrotising enterocolitis	2	0.6	11	2.8	4	1.2	4	1.2	2	1.2	23	1.5
6.8	Other	-	-	2	0.5	1	0.3	-	-	-	-	3	0.2
	Other												
7.1	Sudden infant death syndrome (SIDS)												
7.11	SIDS Category IA: Classic features of SIDS present and completely documented	-	-	-	-	-	-	1	0.3	-	-	1	0.1
7.13	SIDS Category II: Infant deaths that meet category I except for one or more features	1	0.3	2	0.5	-	-	-	-	-	-	3	0.2
7.2	Multisystem failure												
7.21	Multisystem failure: Secondary to intrauterine growth restriction	-	-	3	0.8	-	-	2	0.6	1	0.6	6	0.4
7.28	Multisystem failure: Other specified	-	-	1	0.3	3	0.9	4	1.2	2	1.2	10	0.6
7.29	Multisystem failure: Unspecified/undetermined primary cause or trigger event	-	-	-	-	1	0.3	-	-	-	-	1	0.1
7.3	Trauma												
7.31	Trauma: Accidental	3	0.9	-	-	3	0.9	2	0.6	2	1.2	10	0.6
7.32	Trauma: Non accidental	-	-	-	-	1	0.3	-	-	-	-	1	0.1
7.4	Treatment complications	3	0.9	-	-	-	-	-	-	-	-	3	0.2
7.41	Treatment complications: Surgical	-	-	-	-	-	-	-	-	1	0.6	1	0.1
7.42	Treatment complications: Medical	2	0.6	-	-	-	-	1	0.3	-	-	3	0.2
7.8	Other specified	3	0.9	2	0.5	2	0.6	6	1.8	2	1.2	15	0.9
7.9	Unknown/Undetermined	1	0.3	-	-	3	0.9	1	0.3	-	-	5	0.3
7.91	Unclassified sudden infant death	11	3.2	-	-	-	-	-	-	1	0.6	12	0.8
7.911	Unclassified sudden infant death: Bed sharing	7	2.0	11	2.8	8	2.3	7	2.1	5	3.0	38	2.4
7.912	Unclassified sudden infant death: Not bed sharing	-	-	2	0.5	2	0.6	1	0.3	-	-	5	0.3

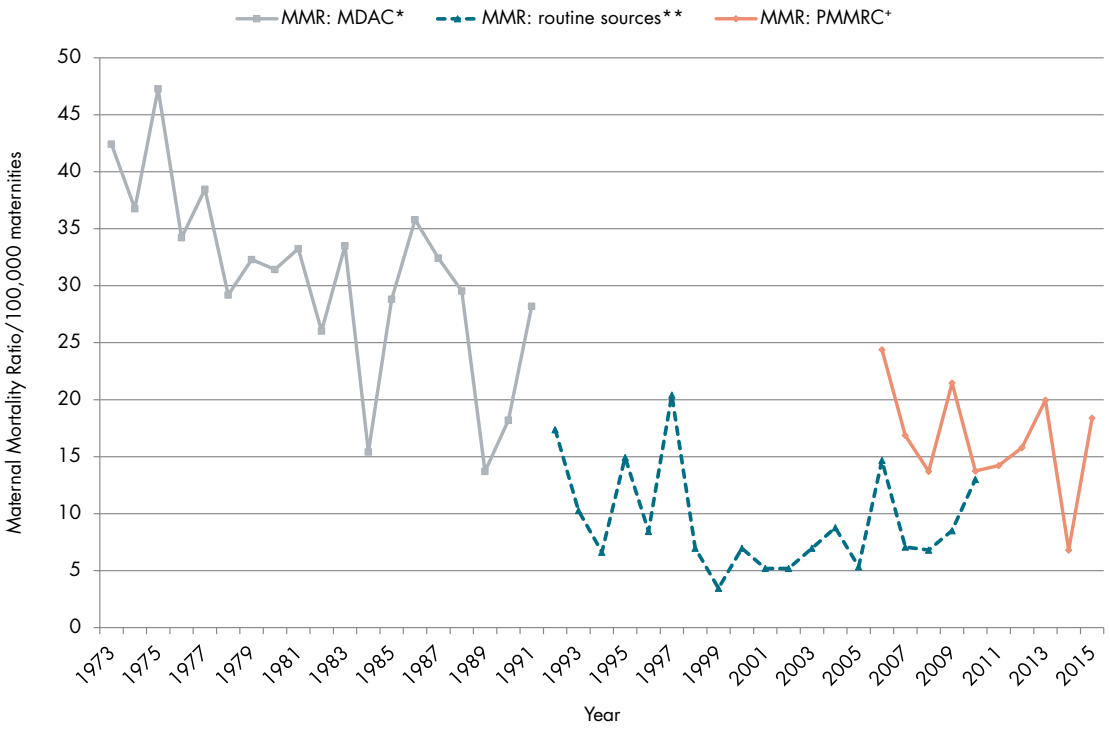
4 New Zealand Maternal Mortality 2015

4.1 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 4.1: New Zealand maternal mortality ratio (per 100,000 maternities) by mortality data source 1973–2015



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 BDM Mortality Collection and the National Minimum Dataset, 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 Dataset (NMDS) of hospital discharges and in the Mortality Collection from BDM. During this period of reporting from national datasets, the maternal mortality ratio was considerably lower than it had been during the years of the existence of the MDAC. When the PMMRC was established in 2006, and maternal mortality ratio reported again in the context of mandatory facilitated reporting, the maternal mortality ratio appeared to increase again. In the years 2006–2015 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 4.1).

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 2014).

4.2 Methodology

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 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.

In the latest report of the UK surveillance system (Knight et al 2016), suicide has been reported as a direct death in line with *The WHO Application of ICD-10 to Deaths during Pregnancy, Childbirth and Puerperium: ICD MM* (WHO 2012). The MMRWG acknowledges the importance of continuing to be able to benchmark against other jurisdictions; however, they have chosen not to change the classification of suicide in this report of deaths 2006–2015. Suicide is the single most common cause of maternal death in New Zealand and represents a separate work stream apart from other direct and indirect causes of maternal death. Retaining the current classification allows New Zealand to compare deaths from psychiatric causes to those in the UK for 2006–2014 (Figure 4.3).

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 2015, 29 percent of all maternal deaths (54 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 2008).

Contributory factors are organisational and/or management factors (eg, delays in procedures or accessing results; lack of policies, protocols or guidelines; lack of maintenance of equipment), personnel factors (eg, failure to maintain competence) and barriers to access and/or engagement with care (eg, unregistered pregnancies, language barriers, distance from adequate facilities) that the MMRWG considered contributed to the death. The subcategories within each group of factors considered are given in the 'Contributory Factors for Mortality and Morbidity' on page 78.

A potentially avoidable maternal death is where the absence of the contributory factor(s) may have prevented the death. From 2010, the MMRWG was asked to indicate the main contributory factor(s) in identifying the death as potentially avoidable.

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).

Case ascertainment and data collection

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.

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.

Reports from local multidisciplinary review of maternal death are valuable in 1) informing the DHB of possible areas for improvement in care and 2) providing the MMRWG national review with insight into organisational and management factors that may not be apparent from clinical notes review alone.

The 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. The year 2015 was the 10th 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 (2006–2015).

PMMRC numerator data validation

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

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 nine indirect maternal deaths (due to suicide) in the 2006–2015 period.

Denominator data

In this report, the MAT dataset has been used as the denominator set, in contrast to the BDM birth registration dataset used in previous years. This has had an impact on the magnitude of associations between ethnicity and socioeconomic deprivation and mortality and morbidity, as discussed elsewhere (section "1.2 Methodology"' and chapter 5), and has facilitated the presentation of the association between parity and maternal mortality in this chapter. Maternal mortality ratios by BMI and smoking have not been presented because analyses undertaken for the perinatal chapter highlighted systematic differences between PMMRC data and MAT data for these variables suggesting a potential numerator–denominator bias issue in calculating these rates with our current data sources.

4.3 Findings

Maternal mortality ratio

Table 4.1: Maternal mortality ratio (per 100,000 maternities) and cause of maternal death 2006–2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2006–2015 n=105		2006–2015 Cause specific ratio /100,000 maternities
	n	n	n	n	n	n	n	n	n	n	n	%	
Maternities	61,487	65,201	65,625	65,207	65,459	63,264	63,275	60,134	60,097	59,808	-	-	
Direct maternal death	**6**	**5**	**4**	**5**	**1**	**2**	**2**	**5**	**2**	**3**	**35**	**33.3**	**5.56**
Amniotic fluid embolism	3	-	1	4	1	-	1	2	-	1	13	12.4	2.06
Obstetric haemorrhage													
<20 weeks gestation	-	1	-	-	-	-	-	1	-	-	2	1.9	0.32
≥20 weeks gestation	1	-	1	-	-	-	-	-	1	-	3	2.9	0.48
Venous thromboembolism	-	1	1*	-	-	1	-	-	1	2	6	5.7	0.95
Peripartum cardiomyopathy	-	1	-	-	-	-	-	-	-	-	1	1.0	0.16
Pre-eclampsia/Eclampsia	-	2	1	1	-	-	-	-	-	-	4	3.8	0.64
Obstetric sepsis	2	-	-	-	-	1	1	2	-	-	6	5.7	0.95
Indirect maternal death	**7**	**5**	**5**	**9**	**8**	**6**	**8**	**7**	**1**	**8**	**64**	**61.0**	**10.17**
Pre-existing medical condition													
Cardiac	1	1	1	-	1	1	4	-	-	-	9	8.6	1.43
Neurological	1	1	-	1	1	2	1	2	-	1	10	9.5	1.59
Other pre-existing medical condition	1	2	1	-	1	1	-	1	1	2	10	9.5	1.59
Non-obstetric sepsis	-	1	-	5	1	-	-	1	-	-	8	7.6	1.27
Suicide	4	-	3	3	4	2	3	3	-	5	27	25.7	4.29
Unclassifiable	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**6**	**5.7**	**0.95**
Total maternal deaths	**15**	**11**	**9**	**14**	**9**	**9**	**10**	**13**	**4**	**11**	**105**	**100.0**	**16.68**
Single-year MMR	24.4	16.9	13.7	21.5	13.7	14.2	15.8	21.6	6.7	18.4	-	-	-
Rolling three-year MMR	**-**	**-**	**06-08**	**07-09**	**08-10**	**09-11**	**10-12**	**11-13**	**12-14**	**13-15**	**-**	**-**	**-**
			18.2	17.3	16.3	16.5	14.6	17.1	14.7	15.6	-	-	-
Coincidental deaths	**1**	**3**	**1**	**-**	**3**	**3**	**5**	**-**	**-**	**1**	**17**	**-**	**-**

* Pulmonary embolism and sepsis.
MMR = maternal mortality ratio

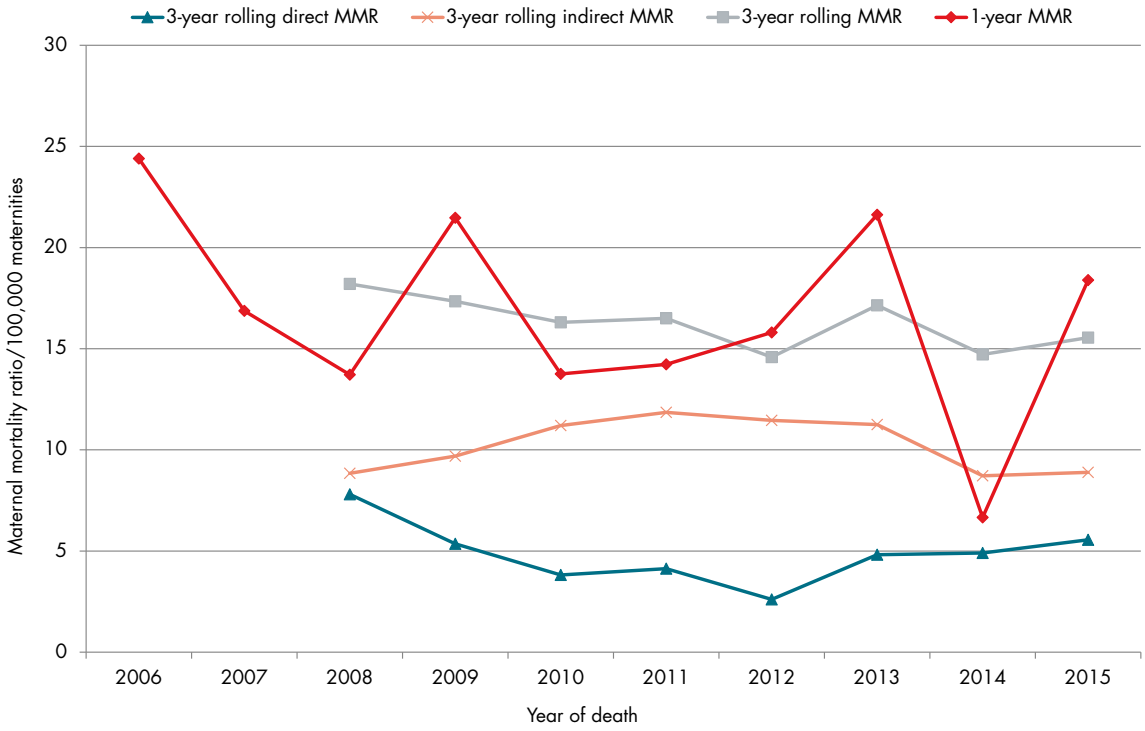
There has been no statistically significant change in maternal mortality ratio in New Zealand since data collection by the PMMRC began in 2006 (chi-squared test for trend p=0.25).

In 2015, 11 deaths within the definition of maternal mortality were reported to the PMMRC. One coincidental death was reported in 2015. The maternal mortality ratio in New Zealand was therefore 18.4/100,000 maternities (95% CI 9.2–32.9/100,000) for the year 2015. 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 2013–2015, was 15.6/100,000 maternities (95% CI 10.8–22.5/100,000).

In 2015, there were three direct deaths (one from amniotic fluid embolism and two from venous thromboembolism) and eight indirect deaths (five from suicide and three from pre-existing medical conditions).

Suicide (27), amniotic fluid embolism (AFE) (13), and pre-existing medical diseases (29) were the most frequent causes of maternal mortality in New Zealand during 2006–2015. Suicide continues to be the leading 'single' cause of maternal death in New Zealand. Suicide and AFE deaths from 2006 to 2013 were discussed in detail in the 10th report of the PMMRC (PMMRC 2016).

Figure 4.2: Maternal mortality ratios (per 100,000 maternities) (rolling one-year and three-year) 2006–2015



MMR = maternal mortality ratio.
Rolling three-year maternal mortality ratio represented at final year of triennium.

Figure 4.2 demonstrates maternal mortality ratios for each year, and rolling three-year average total direct and indirect maternal mortality ratios. The rolling three-year 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 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 UK based on confidential enquiry data for the triennium 2012–2014 was 8.54/100,000 maternities (95% CI 7.40–9.81) (2.86/100,000 direct maternal mortality ratio; 5.68/100,000 indirect maternal mortality ratio) (Knight et al 2016).

The New Zealand maternal mortality ratio for the triennium 2012–2014 was significantly higher than that reported by the UK at 14.7/100,000 maternities with 95% CI 9.7–21.4 (direct maternal mortality ratio 4.9/100,000 maternities (95% CI 2.2–9.3); indirect maternal mortality ratio 8.7/100,000 maternities (95% CI 5.0–14.2)).

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, but significantly lower than the New Zealand maternal mortality ratio reported by the PMMRC. 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'.

Reporting of maternal deaths to New Zealand Coronial Services 2006–2015

In 2015, all 11 maternal deaths were reported to Coronial Services and the Coroner accepted jurisdiction. A post-mortem was performed for nine 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 contribution of the 79 post-mortems performed from 2006–2015 in determining cause of maternal death. Clinical diagnosis was confirmed in 52 (66 percent) and changed in 11 (14 percent). There were additional clinical findings in 9 (11 percent), and the post-mortem was non-contributory in 7 (9 percent). The remaining 25 percent of maternal deaths (26) did not have a post-mortem.

The MMRWG recommends that post-mortem is always offered to families in cases of maternal death.

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, venous thromboembolism, pre-eclampsia and sepsis. In New Zealand, AFE contributes almost 40 percent of direct deaths. As noted in definitions, suicide is reported with indirect deaths in this report.

Figure 4.3 shows cause-specific maternal mortality ratios for all maternal deaths, comparing ratios for New Zealand and the UK. The most notable differences are in deaths from AFE and suicide.

Over the periods compared, the ratio of deaths from AFE was four times higher in New Zealand than in the UK (relative risk (RR) 4.0 (95% CI 2.1–7.6)). The highest cause-specific ratio for AFE in the UK in any triennium since 1985 was 0.80/100,000, less than half the ratio in New Zealand from 2006 to 2015 (2.08/100,000 maternities).

Further review of amniotic fluid embolism deaths 2006–2013 found that further attention to early recognition and prompt resuscitation might improve outcomes for AFE in New Zealand. The findings of the review were reported in the 10th report of the PMMRC (PMMRC 2016).

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 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 (Fifth Report (PMMRC 2011))

Venous thromboembolism

Risk factors for increased risk of venous thromboembolism (VTE) in pregnancy have been identified (see the '"Risk factors for Pregnancy-Associated Venous Thromboembolism"' text box below), but the evidence for management of risk is as yet limited. A comprehensive review of the available evidence is included in a 2012 Australasian opinion paper titled 'Recommendations for the prevention of pregnancy-associated venous thromboembolism' (McLintock et al 2012). As stated by the authors:

"The recommendations contained herein were reached by consensus and represent the opinion of the panel. The absence of randomised clinical trials in this area limits the strength of evidence that can be used, and it is acknowledged that they represent level C evidence. The panel advocates for appropriate clinical studies to be carried out in this patient population to address the inadequacy of present evidence."

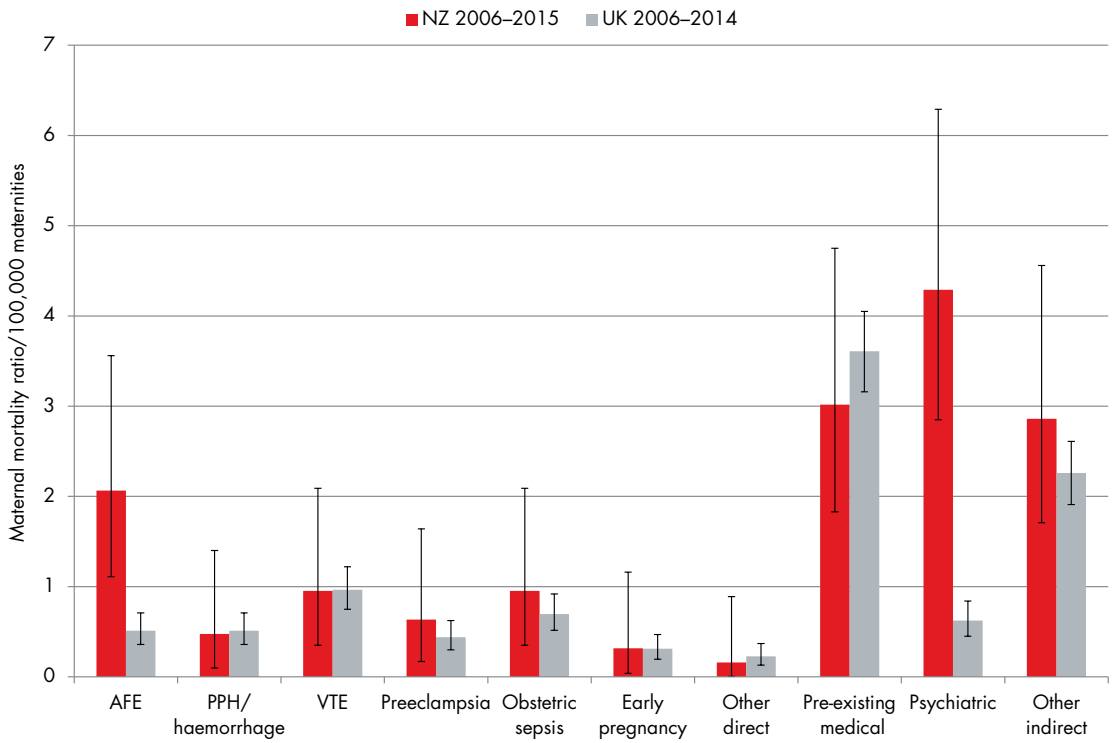
This paper includes a comprehensive review of the literature and tables and algorithms providing recommendations for prevention of VTE in pregnancy. The PMMRC supports the use of these and supports ongoing research to improve the knowledge in this area so that future guidelines can be based on high-level evidence. The recommendations outlined in this paper are supported in the Health Quality & Safety Commission's *National Policy Framework: VTE Prevention in Adult Hospitalised Patients in NZ* (Health Quality & Safety Commission 2012, p 25).

Risk factors for Pregnancy-Associated Venous Thromboembolism

Clinical risk factors	**Adjusted OR**
Previous VTE	24.8
Age >35	1.4–1.7
Obesity (BMI >30kg / m2)	1.7–5.3
Active medical illness	2.1–8.7
Smoking	1.7–3.4
Family history VTE	2.9–4.1
Immobility	7.7–10.1
Varicose vein	2.4
Multiparity (>2)	1.6–2.9
Multiple pregnancy	1.6–4.2
Pre-eclampsia	3.0–5.8
Assisted reproduction technology	2.6–4.3
Hyperemesis	2.5
Additional postpartum risk factors	
Planned caesarean section	1.3–2.7
Emergency caesarean section	2.7–4.0
Placental abruption	2.5–16.6
Postpartum infection	4.1–20.2
Postpartum haemorrhage	1.3–12.0

Adapted with permission from McLintock et al 2012.

Figure 4.3: Cause-specific maternal mortality ratios (per 100,000 maternities) in New Zealand 2006–2015 and the UK 2006–2014 (with 95% CIs)



AFE = amniotic fluid embolism.
PPH = postpartum haemorrhage.
VTE = venous thromboembolism.
'Other direct' includes anaesthesia, cardiomyopathy, other.
'Pre-existing medical' includes cardiac, indirect neurological, indirect malignancies.
In New Zealand data, 'Other indirect' includes only non-obstetric sepsis.

Survey of Multidisciplinary Training (MDT) in Management of Obstetric Emergencies

In 2016/17, 21 PMMRC local coordinators from 20 DHBs completed a survey on MDT in their DHB. The survey was developed in consultation with the PMMRC, the MMRWG, the MMWG, Practical Obstetric Multi-Professional Training (PROMPT) trainers and the National Maternity Monitoring Group (NMMG).

- Sixteen DHBs (six tertiary and 10 secondary) provide MDT for maternity clinicians. Five tertiary and five secondary hospitals also hold MDT training in primary units.
- MDT is a full day and is provided in-house for all but one DHB.
- All MDTs include maternal collapse and post-partum haemorrhage, 89% eclampsia and shoulder dystocia, 78% cord prolapse, 67% APH, 61% unexpected breech, 44% neonatal resuscitation, and 50% sepsis.
- The instructors at 11 DHBs have attended 'Train the Trainer' days with PROMPT, and four attended formal training with other courses (eg, Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG), Managing Obstetric Emergencies and Trauma (MOET)).
- The following are estimates of clinicians attending in the previous three years:
    - Midwives – hospital – 14 responses – 36 to 100% (average 80%). Six DHBs reported 100% attendance.
    - Midwives – LMC – 14 responses – 8 to 100% (average 62%). Four DHBs reported 100% attendance.
    - Obstetricians – 15 responses – 6 to 100% (average 65%). Five DHBs reported 100% attendance.
    - Anaesthetists – 11 responses – 5 to 100% (average 27%). One DHB reported 100% attendance.
    - (Responses for other disciplines are small so not reported.)
- Three DHBs have indicated attendance is mandatory for all obstetric, midwifery (core and LMC) and anaesthetic clinicians. One other DHB indicated attendance was mandatory for all DHB obstetric, midwifery and anaesthetic staff. A further eight DHBs indicated it was mandatory but only for some disciplines.
- Attendance varied from annually to three-yearly.
- Fee structure varied from no payment to self-funding.
- Fifteen DHBs responded they provide backfill for staff; however, 16 of 18 responses named 'backfill/staffing' as a barrier to attendance.
- Five responses named 'cost' as a barrier to attendance.
- Eight of 17 responses named 'free/subsidised' and six 'backfill/staffing' as enablers to attendance.

Previous PMMRC Recommendation (Fifth Report (PMMRC 2011))

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

Indirect causes

Pre-existing medical disease and suicide were the most frequent causes of maternal mortality in New Zealand in 2006–2015, suicide being the leading 'single' cause of maternal death in New Zealand (4.3/100,000 maternities). A further five maternal deaths from suicide were reported in 2015, the largest number in a single year since the PMMRC began reporting in 2006.

In comparison, the cause-specific maternal mortality ratio for psychiatric causes for the UK for 2009–2014 was 0.63/100,000 maternities, and 0.85/100,000 maternities is the highest ratio reported from the UK since 1994–1996 (Figure 4.3). The New Zealand ratio for psychiatric maternal deaths from 2006 to 2015 is almost seven times that reported for the UK for 2006–2014 (RR 6.9 (95% CI 4.2–11.1)). Further review of maternal suicide deaths 2006–2013 was reported in the 10th report of the PMMRC, and specific analysis and commentary on Māori deaths from maternal suicide can be found in chapter 5 of this report.

Repeat themes arising in recent maternal suicide reviews include lack of recognition of the risk for pregnant women presenting with suicidal ideation and failure to refer promptly for assessment and treatment, lack of information sharing between services, and discontinuation or changes of antidepressant medication in pregnancy without full discussion of risks and or clinical oversight.

In 2016, the MMRWG recommended that a perinatal and infant mental health network, akin to that in the UK, be established to provide an interdisciplinary and national forum to discuss perinatal mental health issues such as service delivery, case identification, and pathways that cross a number of sectors, including primary care, mental health and maternity. This is in the early stages, with the PMMRC and MMRWG working with the Ministry of Health to clarify the remit and purpose of this network, to ensure supportive links with pre-existing local networks, and to identify a work plan consistent with the needs of DHBs.

RECOMMENDATION:

The PMMRC recommend the HQSC establish a permanent Suicide Mortality Review Committee.

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 (new or increasing thoughts)
- suicide attempts
- 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 service interfaces will enable better-informed care, and any concerns regarding risk need to be clearly communicated to all clinicians involved.

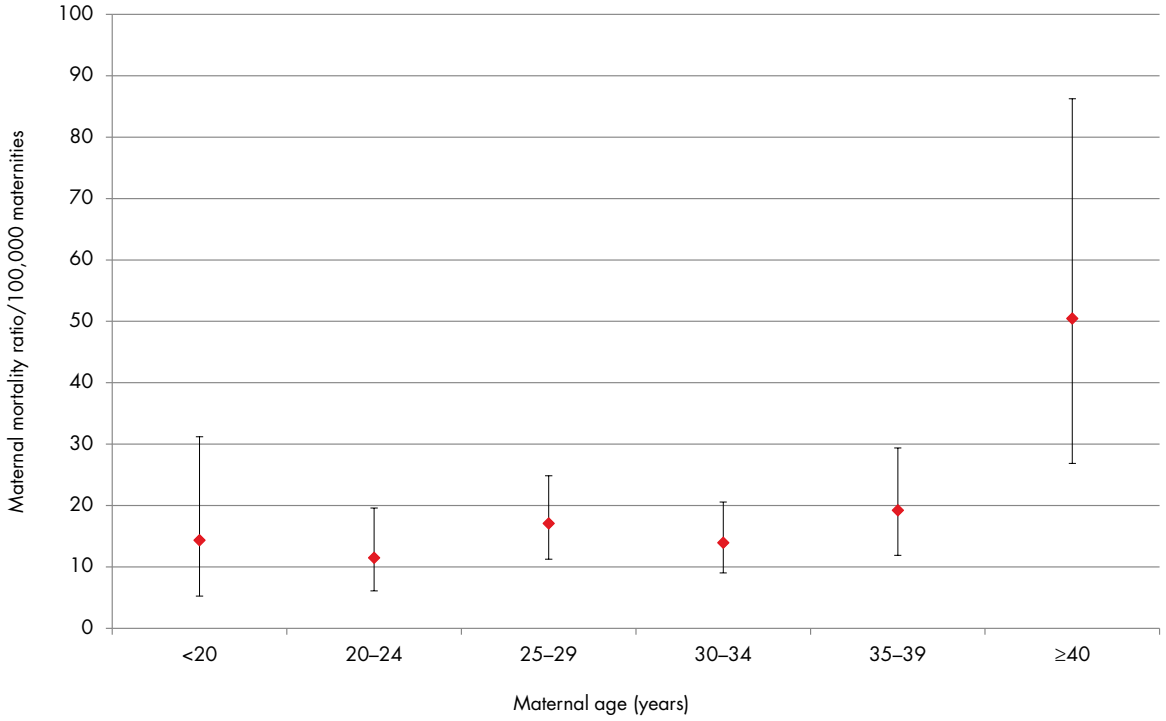
Pregnant and postpartum women who use substances often have complex social and mental health needs, and face additional barriers in accessing services.

Previous PMMRC Recommendations (revised in the 10th PMMRC report)

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.

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, and maternity, including termination of pregnancy services).

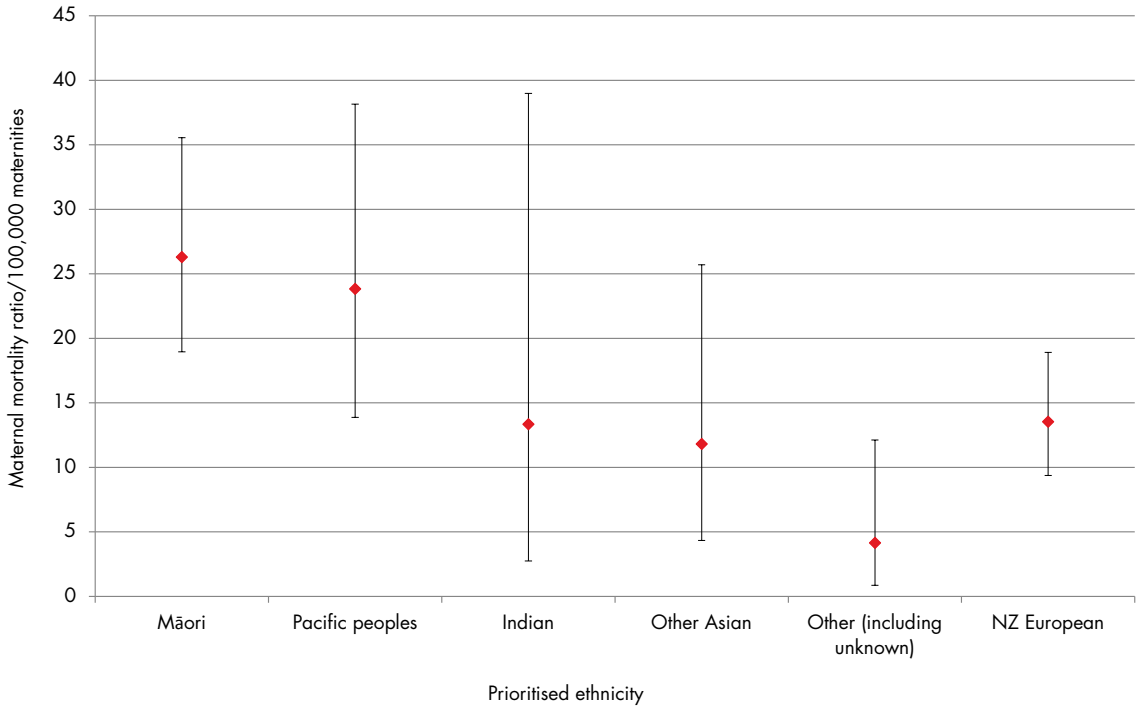
Figure 4.4: Maternal mortality ratios (per 100,000 maternities) by maternal age (with 95% CIs) 2006–2015



Mothers aged 40 years and older contributed 12 percent of maternal deaths but only 4 percent of maternities from 2006 to 2015. The maternal mortality ratio for mothers aged 40 years and older was three times higher, at 50.5/100,000 maternities, compared to 15.4/100,000 among mothers under 40 years of age during this period.

There have been 13 mortalities among mothers 40 years of age and older between 2006 and 2015, including seven direct and six 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.

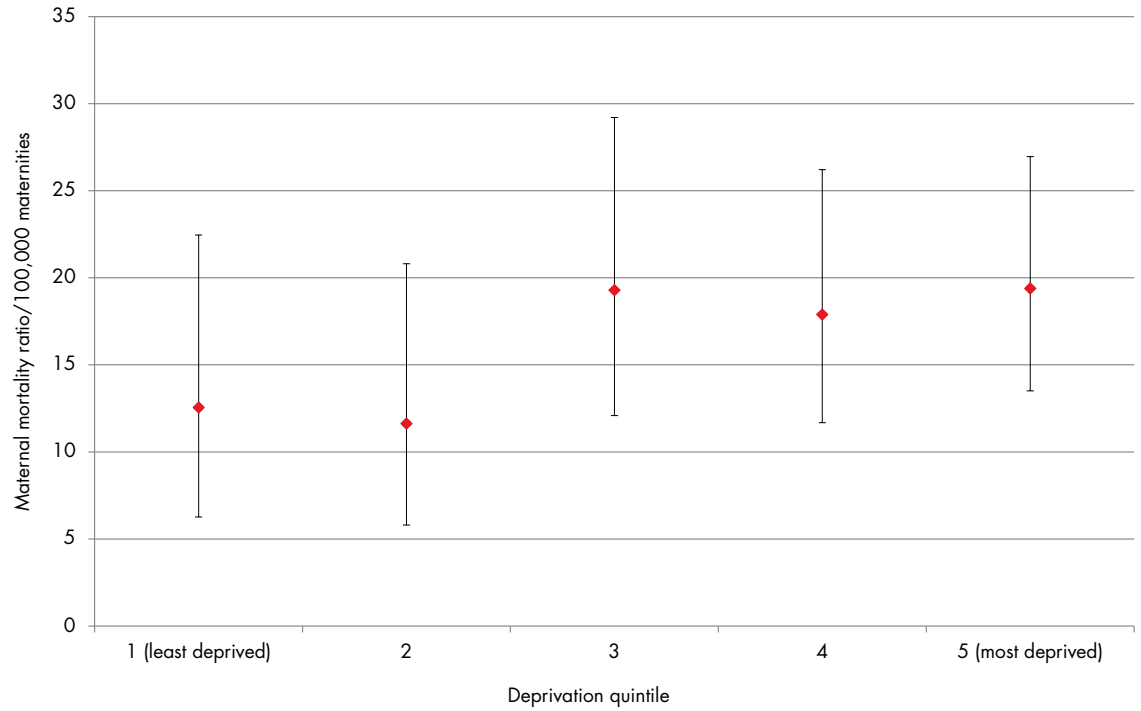
Figure 4.5: Maternal mortality ratios (per 100,000 maternities) by prioritised ethnicity (with 95% CIs) 2006–2015



The maternal mortality ratio for Māori and Pacific mothers from 2006–2015 was almost twice that of New Zealand European mothers (RR 1.9 (95% CI 1.2–3.1) and RR 1.8 (95% CI 1.0–3.2) respectively).

A discussion of Māori maternal mortality can be found in chapter 5.

Figure 4.6: Maternal mortality ratios (per 100,000 maternities) by deprivation quintile (with 95% CIs) 2006–2015



The risk of maternal mortality appears to increase with increasing deprivation quintile. In previous reports, we used smaller area mesh block data for deprivation, and last year reported that 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. In 2015, with a change to MAT data, we are using the larger census area unit for measuring deprivation, and the apparent association seen in Figure 4.6 is not statistically significant (chi-squared test for trend p=0.11).

The 2016 report on maternal deaths in the UK 2012–2014 reported that the relative risk of maternal mortality was 1.62 (95% CI 0.92–2.99) 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 2016). The equivalent relative risk for 2006–2015 for New Zealand is 1.5 (95% CI 0.8–3.0).

Figure 4.7: Maternal mortality ratios (per 100,000 maternities) by maternal parity (with 95% CIs) 2006–2015

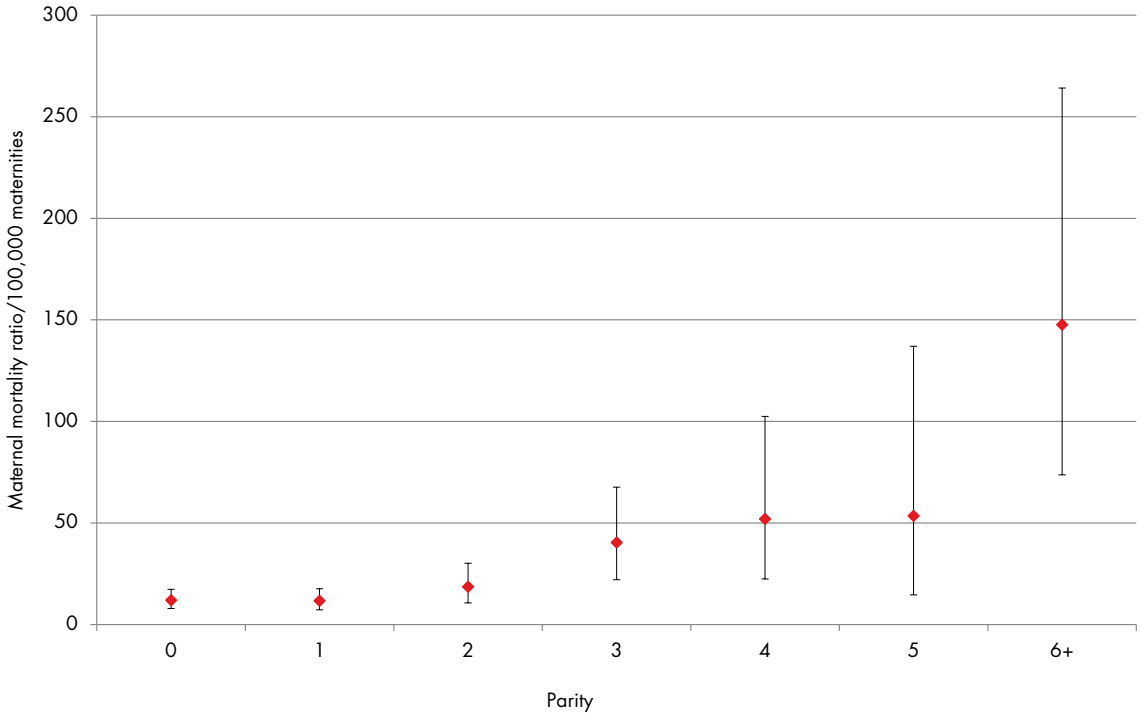


Figure 4.7 shows a clear association between maternal parity and maternal mortality ratio. There is a statistically significant increase in mortality for women in their fourth or later pregnancy compared to women who have had one, two or three births. Increased parity is likely to be confounded by the effects of other related variables such as socioeconomic status, age, obesity, smoking, and worsening chronic medical illnesses.

The distribution of cause of direct and indirect deaths varied by parity. There were nine direct deaths among nulliparous women, most commonly from pre-eclampsia (3) or VTE (3). There were 15 indirect deaths among nulliparous women, 12 of which were from suicide.

There were 25 direct deaths among multiparous women, of which 12 were from amniotic fluid embolism. Among 48 indirect deaths, 14 were due to suicide and the remainder spread fairly evenly across non-obstetric sepsis (8), pre-existing cardiac disease (7), pre-existing neurological disease (10) and other pre-existing medical diseases (9).

Clinical characteristics

Table 4.2: Clinical characteristics among maternal deaths 2006–2015

	Maternal deaths n=105	
	n	%
BMI (kg/m2)		
<18.5	3	2.9
18.5–24.99	35	33.3
25–29.99	18	17.1
30–34.99	22	21.0
≥35	23	21.9
Unknown	4	3.8
Current smoker		
Yes	36	34.3
No	66	62.9
Unknown	3	2.9
Alcohol and substance use		
Yes	26	24.8
No	71	67.6
Unknown	8	7.6
Family violence in this pregnancy		
Yes	9	8.6
No	55	52.4
Not asked	23	21.9
Unknown	18	17.1

Maternal mortality ratios by BMI and smoking in pregnancy are not presented, as explained in the methods. However, more than half of the mothers who died in pregnancy or the peripartum period were overweight or obese, and 34 percent were known smokers (Table 4.2).

Alcohol or substance use was noted in a quarter of mothers who died and a history of family violence in at least 9 percent. Information on family violence was unavailable for 39 percent, unknown in 17 percent and no screening was undertaken in 22 percent. Evidence of family violence prior to or during pregnancy among deaths from any cause from 2012 to 2014 in the UK was reported in 6 percent of cases, with data missing for 40 percent of cases (Knight et al 2016).

Table 4.3: Details of place and timing of maternal mortalities 2006–2015

	Maternal deaths n=105	
	n	%
Place of baby's birth		
Community (not in a health care facility)	4	3.8
Hospital	60	57.1
Baby not born at time of mother's death	40	38.1
Unknown	1	1.0
Place of maternal death		
Hospital	65	61.9
Community	40	38.1
Time of death related to pregnancy		
Antepartum (antepartum/intrapartum)	41	39.0
Postpartum	64	61.0
	Antepartum maternal death n=41	
	n	%
Gestation at antepartum maternal death (weeks)		
<20	22	53.7
20–27	9	22.0
28–36	9	22.0
37–42	1	2.4
	Postpartum maternal death n=64	
	n	%
Gestation at birth of postpartum maternal death (weeks)		
<20	8	12.5
20–27	8	12.5
28–36	15	23.4
37–42	33	51.6
Postnatal day at postpartum maternal death (days)		
0	17	26.6
1–6	16	25.0
7–13	8	12.5
14–27	12	18.8
28–41	10	15.6
Unknown	1	1.6

Approximately two-thirds of maternal deaths occurred in hospital and one-third in the community. The high frequency of community deaths makes maternal mortality review challenging because collecting full details of the woman's clinical and social history and engagement with health care in preparation for the review is often resource intensive with a need to connect with a variety of sources.

Approximately a third (39 percent) of maternal deaths occurred during pregnancy, half prior to 20 weeks and almost all of the remainder prior to term (37 weeks). Of the 41 deaths during pregnancy, three quarters were indirect and the most common cause was suicide (17 deaths). Five of the 41

deaths in pregnancy were direct (AFE, haemorrhage, sepsis and VTE), 31 indirect (suicide, pre-existing medical disease, and sepsis), and five were unclassifiable.

Of the 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. Postpartum deaths were more often due to direct causes (30/64) than antepartum deaths, 33 were indirect, and one was unclassifiable. The most common direct cause was AFE (12 deaths). Among the 33 indirect deaths, the most common cause was suicide (10 deaths). Pre-existing medical conditions were responsible for a further 18.

Table 4.4: Baby outcomes among maternal deaths 2006–2015

Baby outcome	Maternal deaths		Antepartum/ Intrapartum maternal death		Postpartum maternal death	
	n=105		n=41		n=64	
	n	%	n	%	n	%
Maternal death <20 weeks	30	28.6	22	53.7	8	12.5
Maternal death ≥20 weeks						
Did not deliver	18	17.1	18	43.9	-	-
Stillborn	6	5.7	-	-	6	9.4
Early neonatal death	5	4.8	-	-	5	7.8
Late neonatal death	-	-	-	-	-	-
Alive after one month of age	46	43.8	1	2.4	45	70.3

Seventy-five mothers (71 percent) died at or after 20 weeks gestation. Of these mothers, 18 (24 percent) died prior to the baby's birth and the babies were not born; there were 11 perinatal deaths (15 percent) and 46 (61 percent) babies survived.

Perimortem caesarean section

Perimortem caesarean section needs to be considered at the commencement of CPR following maternal collapse to enable effective resuscitation. Perimortem caesarean section can save the life of both the mother and the infant.

Between 2006 and 2015 perimortem caesarean section was undertaken in 10 maternal deaths as part of the resuscitation of the mother to improve the chance of survival following a collapse. Seven 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-nine percent of maternal deaths were identified as potentially avoidable, and contributory factors were identified in 62 percent of maternal deaths in the years 2006–2015 Table 4.5. 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 and/or management, personnel, and barriers to access and/or engagement with care in 40 to 42 percent of cases overall, but barriers were less often identified among direct deaths (23 percent) than among indirect (56 percent).

Similar rates were identified in the MBRRACE-UK in-depth review of maternal deaths in the UK for the years 2009–2014, which reported improvements to care may have made a difference to outcome in 42 percent of cases overall, and improvements to care which would have made no difference to outcome for a further 12 percent of cases.

Table 4.5: Contributory factors and potentially avoidable maternal death 2006–2015

	Maternal deaths		Direct maternal deaths		Indirect maternal deaths		Unclassifiable	
	n=105		n=35		n=64		n=6	
	n	%	n	%	n	%	n	%
Was death potentially avoidable?								
Yes	41	39.0	14	40.0	27	42.2	-	-
No	60	57.1	21	60.0	37	57.8	2	33.3
Unknown	4	3.8	-	-	-	-	4	66.7
Contributory factors present	**65**	**61.9**	**22**	**62.9**	**42**	**65.6**	**1**	**16.7**
Organisational/management factors	**42**	**40.0**	**17**	**48.6**	**25**	**39.1**	**-**	**-**
Poor organisational arrangements of staff	6		3		3		-	
Inadequate education and training	12		6		6		-	
Lack of policies, protocols or guidelines	24		11		13		-	
Inadequate numbers of staff	1		1		-		-	
Poor access to senior clinical staff	4		2		2		-	
Failure or delay in emergency response	5		3		2		-	
Delay in procedure (eg, caesarean section)	2		1		1		-	
Inadequate systems/process for sharing of clinical information between services	19		3		16		-	
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	10		4		6		-	
Personnel factors	**42**	**40.0**	**15**	**42.9**	**26**	**40.6**	**1**	**16.7**
Knowledge and skills of staff were lacking	18		7		10		1	
Delayed emergency response by staff	9		5		4		-	
Failure of communication between staff	11		4		7		-	
Failure to seek help/supervision	8		3		5		-	
Failure to offer or follow recommended best practice	12		2		9		1	
Lack of recognition of complexity or seriousness of condition by care giver	27		8		19		-	
Other	1		1		-		-	
Barriers to access and/or engagement with care	**44**	**41.9**	**8**	**22.9**	**36**	**56.3**	**-**	**-**
No antenatal care	6		1		5		-	
Infrequent care or late booking	9		4		5		-	
Declined treatment or advice	14		3		11		-	
Obesity impacted on delivery of optimal care (eg, ultrasound scan)	4		2		2		-	
Substance use	11		-		11		-	
Family violence	9		1		8		-	
Lack of recognition of complexity or seriousness of condition by the woman and/or family	18		3		15		-	
Maternal mental illness	13		-		13		-	
Cultural barriers	1		-		1		-	
Language barriers	2		-		2		-	
Not eligible to access free care	1		-		1		-	
Environment (eg, isolated, long transfer, weather prevented transport)	4		1		3		-	
Other	10		1		9		-	

4.4 Maternal Mortality Appended Tables

Table 4.6: Demographic characteristics among maternal deaths 2006–2015

	Maternities		Maternal deaths												
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2006–2015		
	n=629,557		n=15	n=11	n=9	n=14	n=9	n=9	n=10	n=13	n=4	n=11	n=105		Maternal mortality ratio
	n	%	n	n	n	n	n	n	n	n	n	n	n	%	/100,000 maternities
Maternal age (years)															
<20	41,848	6.7	-	-	1	1	1	1	2	-	-	-	6	5.7	14.34
20–24	113,387	18.1	3	2	-	-	-	1	3	3	-	1	13	12.4	11.47
25–29	158,144	25.2	3	1	3	4	3	3	1	5	2	2	27	25.7	17.07
30–34	179,440	28.6	2	5	3	4	1	1	2	3	-	4	25	23.8	13.93
35–39	109,312	17.4	4	2	2	3	2	2	2	-	1	3	21	20.0	19.21
≥40	25,769	4.1	3	1	-	2	2	1	-	2	1	1	13	12.4	50.45
Unknown	17	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethnicity (prioritised)															
Māori	159,681	25.4	9	2	4	4	3	5	8	4	-	3	42	40.0	26.30
Pacific peoples	71,351	11.4	1	2	-	6	3	3	-	1	1	-	17	16.2	23.83
Indian	22,491	3.6	1	1	-	1	-	-	-	-	-	-	3	2.9	13.34
Other Asian	50,823	8.1	-	-	2	1	-	-	-	2	-	1	6	5.7	11.81
Other (including unknown)	72,305	11.5	1	1	-	-	-	-	-	-	-	1	3	2.9	4.15
NZ European	251,266	40.0	3	5	3	2	3	1	2	6	3	6	34	32.4	13.53
Deprivation quintile															
1 (least deprived)	87,648	14.0	1	2	1	2	3	-	-	1	-	1	11	10.5	12.55
2	94,606	15.1	1	1	1	1	-	1	2	2	2	-	11	10.5	11.63
3	114,050	18.2	4	1	2	2	-	4	1	3	2	3	22	21.0	19.29
4	145,356	23.1	3	3	2	4	3	-	3	4	-	4	26	24.8	17.89
5 (most deprived)	180,525	28.7	6	4	3	5	3	4	4	3	-	3	35	33.3	19.39
Unknown	5,732	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-
Parity*															
0	226,124	35.9	2	4	5	1	3	1	4	3	2	2	27	25.7	11.94
1–3	309,732	49.2	7	4	3	8	4	5	5	7	2	7	52	49.5	16.79
4+	30,304	4.8	5	3	1	5	2	3	1	2	-	1	23	21.9	75.90
Unknown	63,397	10.1	1	-	-	-	-	-	-	1	-	1	3	2.9	4.73

* Defined prior to conception of the index pregnancy.

5 Māori Perinatal and Maternal Mortality 2015

5.1 Introduction

This specific chapter has been added to the 11th report of the PMMRC to explore the impact of perinatal and maternal mortality on Māori, to begin to explore the reasons behind any inequities found, to monitor improvements in outcomes, and to provide recommendations where there is a need for improvement.

5.2 Methods

Ethnicity is collected by health providers in New Zealand according to guidelines produced by the Ministry of Health. These data are collected centrally into various databases from which data is extracted to prepare this report. Ethnicity for babies who die is drawn firstly from the BDM birth registration dataset, then from the BDM death registration dataset, and then from the forms completed by the LMC after a death has occurred if neither of the former is available. Ethnicity for mothers of babies who die is drawn firstly from the BDM birth registration dataset and, if that is unavailable, then from the forms completed by the LMC after a death has occurred. Ethnicity for mothers who die is collected from the BDM death registration dataset and, if that is unavailable, from the forms completed by the LMC after a death has occurred. If ethnicity is extracted from different sources according to ethnicity, this might result in some bias of associations between death and ethnicity.

In 2015, 57 percent of Māori babies who died had their ethnicity extracted from the BDM birth registration dataset, 9 percent from the BDM death registration dataset, and 34 percent from the LMC rapid reporting form to the PMMRC. In contrast, in 2015, ethnicity of 78 percent of New Zealand European babies was extracted from the BDM birth registration dataset, 3 percent from the BDM death registration dataset, and 19 percent from the LMC rapid reporting form.

In 2015, 55 percent of ethnicity data for the mothers of Māori babies was extracted from the BDM birth registration dataset compared to 79 percent of New Zealand European, and the remainder of each from the LMC rapid reporting form.

From 2006 to 2015, ethnicity of mothers who died was obtained from the BDM death registration dataset for 93 percent of recorded Māori maternal deaths and 100 percent of New Zealand European maternal deaths.

In PMMRC reports prior to this 11th report, the denominator used for analyses was births registered by BDM in the year in which the deaths occurred. This denominator was used because it was believed to be the best estimate of birth numbers in a year. BDM ethnicity is collected from the parents when they register their child's birth, so it should be similar to Census ethnicity. Ethnicity of perinatal deaths (numerator) is also obtained from BDM.

This year (11th report) the PMMRC has moved to using the MAT dataset as the denominator, because it is now the best estimate of births in a year in New Zealand and because it is a rich source of maternity data. However, ethnicity is not collected in the same way as in the BDM birth registration dataset, and is defined using an algorithm from various datasets which provide data to the MAT. There is the potential that using this denominator may introduce numerator–denominator bias in the association between ethnicity and perinatal mortality. Therefore, in this chapter we have presented perinatal mortality rates using both the new MAT denominator and the old BDM denominator and compared them.

Numerator data in this chapter are sourced from the PMMRC dataset.

Prioritised ethnicity is reported, as recommended by the New Zealand Ministry of Health for health outcomes (Ministry of Health 2004).

Māori mortality has been compared to New Zealand European mortality rather than non-Māori because Pacific and Indian mothers also have higher maternal and perinatal mortality and morbidity rates, and including these ethnicities in the comparator group may underestimate the inequities for Māori mothers.

Maternal rather than baby ethnicity is used principally for analyses, consistent with the remainder of the report, because maternity care is provided to mothers.

The analyses in this chapter in most instances use all the available data for perinatal (2007–2015) and maternal (2006–2015) mortality to explore time trends and to ensure estimates are robust.

5.3 Perinatal Mortality

There is no excess unadjusted relative risk of total perinatal related mortality from 2011 to 2015 for Māori compared to New Zealand European using the PMMRC numerator with the MAT denominator. The rate of late termination of pregnancy among Māori mothers was approximately half that among New Zealand European mothers from 2011–2015 (RR 0.60 (95% CI 0.49–0.74)). The relative risk of neonatal death after birth at less than 28 weeks gestation was higher for Māori (RR 1.70 (95% CI 1.34–2.16)) (Table 5.1).

The unadjusted relative risk of total perinatal related mortality from 2011 to 2015 was higher for Māori compared to New Zealand European using the PMMRC numerator and the BDM denominator (1.28 (95% CI 1.17–1.40)). The rates of stillbirth and neonatal mortality were both elevated for Māori compared to New Zealand European, and the rate of late termination of pregnancy among Māori mothers was lower than that among New Zealand European mothers from 2011–2015 (RR 0.76 (95% CI 0.62–0.93)) (Table 5.1).

Table 5.1: Perinatal related mortality rates by ethnicity (Māori and New Zealand European) 2011–2015

Denominator is MAT births

	Māori			NZ European				
	n (MAT)=76,637			n (MAT)=117,754				
	n	%	Rate	n	%	Rate	RR	95% CI
Termination of pregnancy	129	16.02	1.68	329	26.84	2.79	0.60	0.49–0.74
Stillbirths	414	51.43	5.40	616	50.24	5.23	1.03	0.91–1.17
Neonatal death <28 weeks at birth	144	17.89	1.88	130	10.60	1.10	1.70	1.34–2.16
Neonatal death ≥28 weeks at birth	118	14.66	1.54	151	12.32	1.28	1.20	0.94–1.53
Total perinatal related mortality	**805**	**100.0**	**10.50**	**1,226**	**100.0**	**10.41**	**1.01**	**0.92–1.10**

Denominator is BDM birth registrations

	Māori			NZ European				
	n (MAT)=68,788			n (MAT)=133,794				
	n	%	Rate	n	%	Rate	RR	95% CI
Termination of pregnancy	129	16.02	1.88	329	26.84	2.46	0.76	0.62–0.93
Stillbirths	414	51.43	6.02	616	50.24	4.60	1.31	1.15–1.48
Neonatal death <28 weeks at birth	144	17.89	2.09	130	10.60	0.97	2.15	1.70–2.73
Neonatal death ≥28 weeks at birth	118	14.66	1.72	151	12.32	1.13	1.52	1.19–1.93
Total perinatal related mortality	**805**	**100.0**	**11.70**	**1,226**	**100.0**	**9.16**	**1.28**	**1.17–1.40**

Figure 5.1 to Figure 5.5 illustrate the association between ethnicity and perinatal mortality using alternately the MAT and BDM denominator datasets. Both are provided for continuity with previous reports and until it is possible to include the registration dataset parent-defined ethnicities in the MAT dataset so that analyses can use consistent numerator and denominator data which is collected as similarly as possible to Census ethnicity data.

RECOMMENDATION:

The Mortality Review Committees' Māori Caucus reiterate, "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." (PMMRC recommendation ninth report 2015)

Figure 5.1: Perinatal related mortality rolling three-year rates (per 1000 births) by ethnicity and year (Māori and New Zealand European 2007–2015) using MAT and BDM denominator data

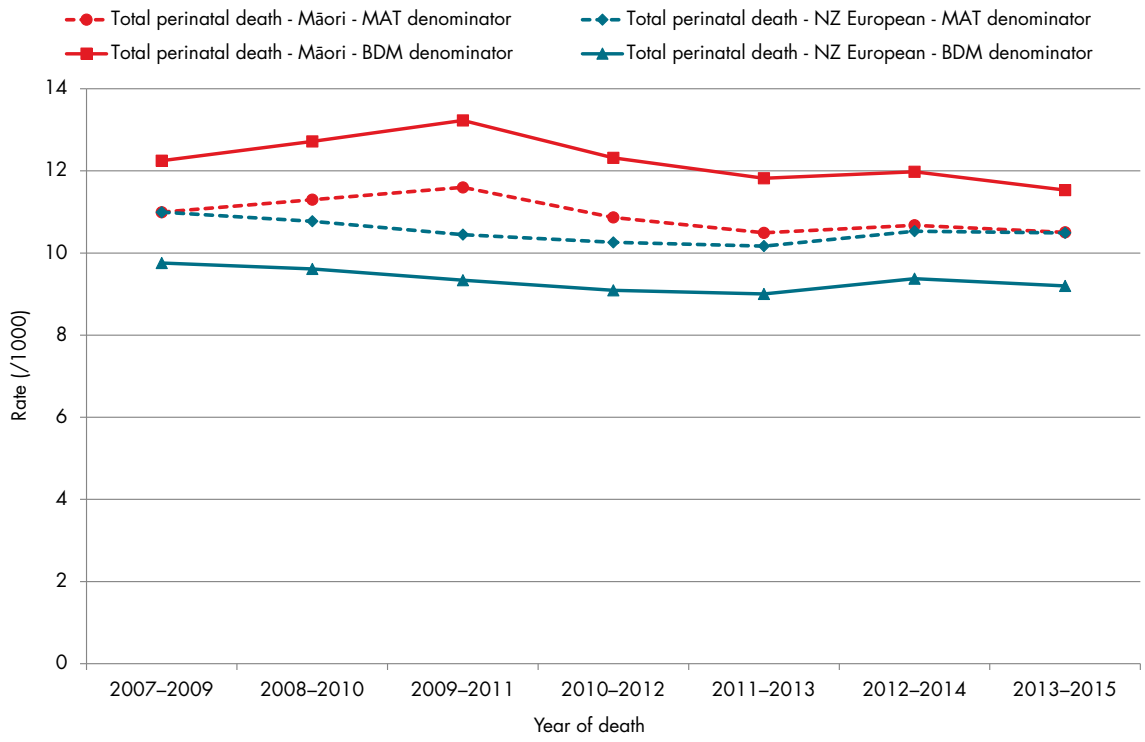
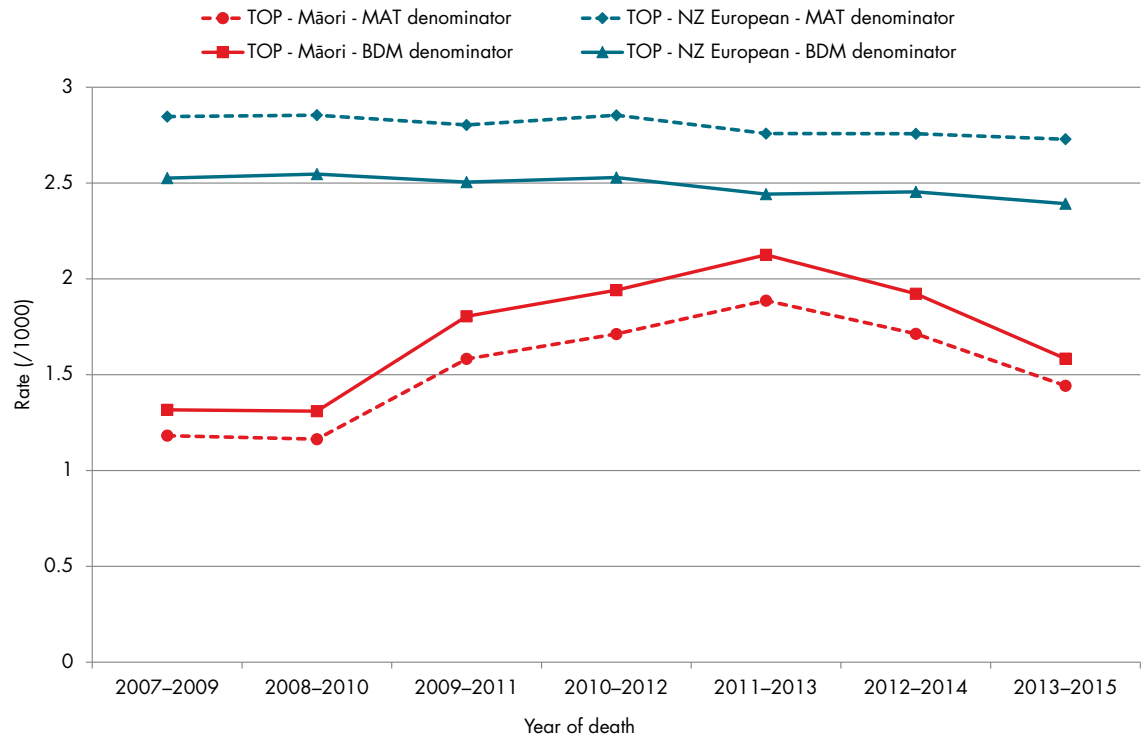
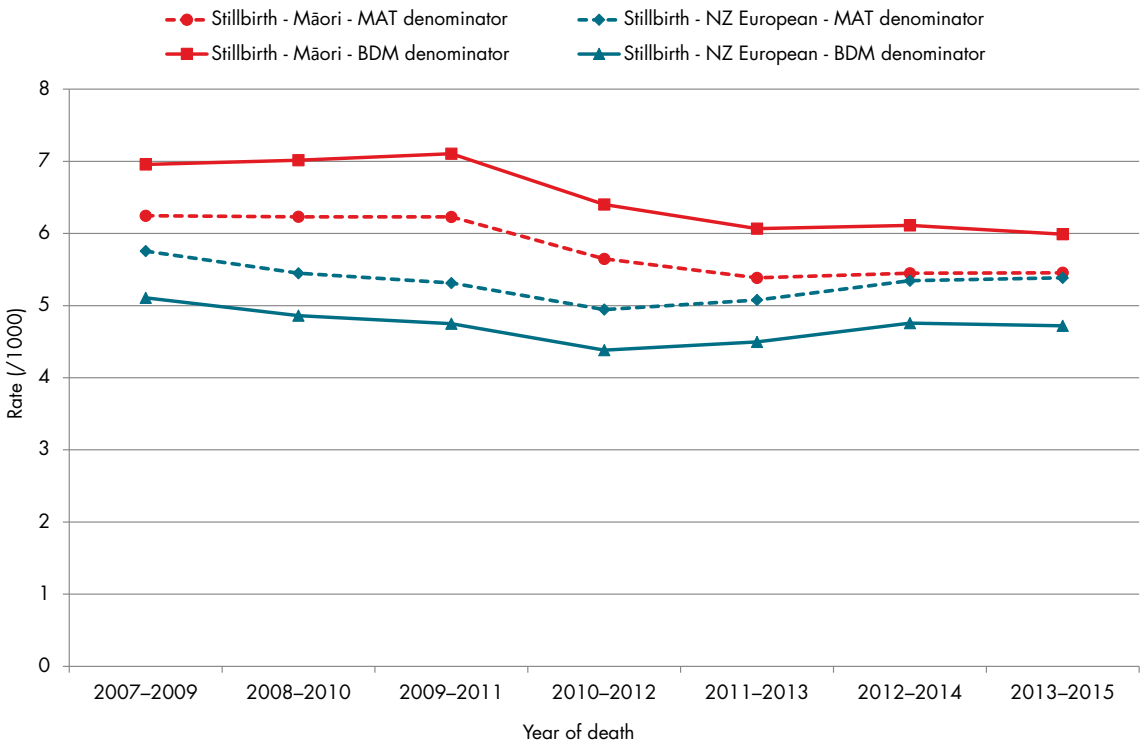


Figure 5.2: Termination of pregnancy rolling three-year rates (per 1000 births) by ethnicity and year (Māori and New Zealand European 2007–2015) using MAT and BDM denominator data



TOP = termination of pregnancy.

Figure 5.3: Stillbirth rolling three-year rates (per 1000 births) by ethnicity and year (Māori and New Zealand European 2007–2015) using MAT and BDM denominator data

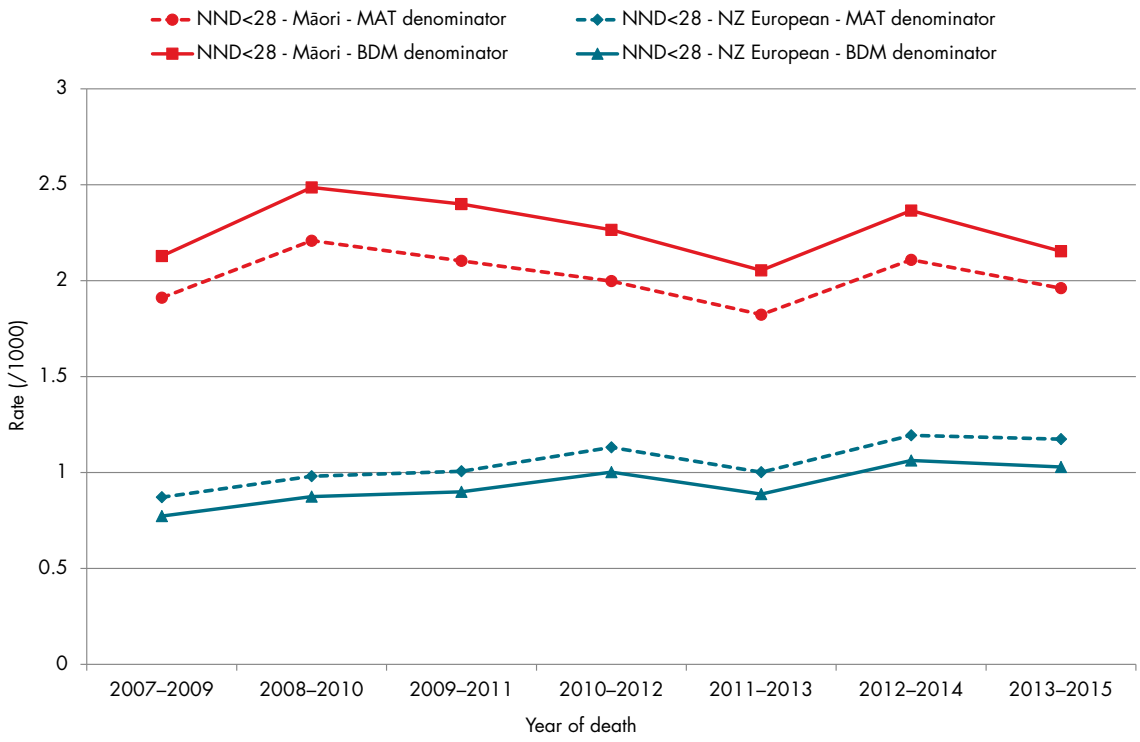


The use of the MAT ethnicity denominator data makes considerable difference to the comparison of Māori and New Zealand European rates. Using the MAT denominator reduces the apparent inequity between Māori and New Zealand European perinatal mortality rates.

There has been a significant reduction in stillbirth in New Zealand from 2007 to 2015. It appears that there has been a reduction among Māori and New Zealand European babies, although only the reduction among Māori babies is statistically significant (chi-squared test for trend 0.05 (BDM denominator) 0.04 (MAT denominator)).

There has been no statistically significant change in late termination of pregnancy rate among either New Zealand European or Māori mothers.

Figure 5.4: Neonatal death <28 weeks rolling three-year rates (per 1000 live births) by ethnicity and year (Māori and New Zealand European 2007–2015) using MAT and BDM denominator data

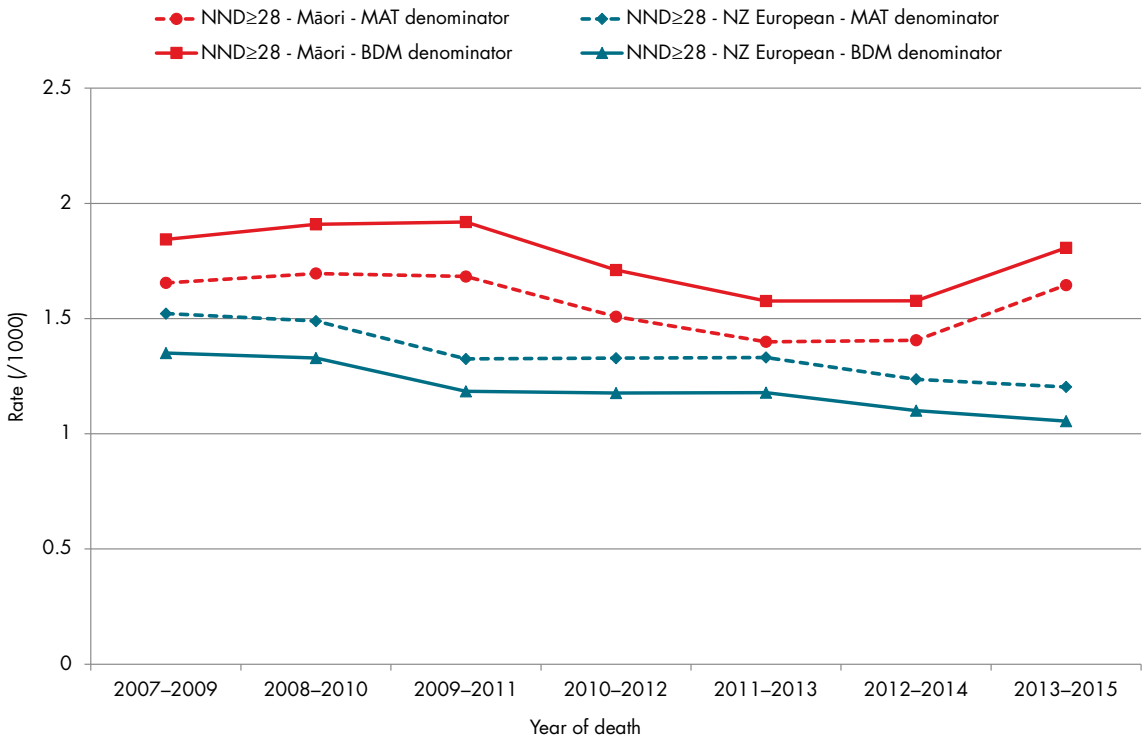


NND<28 = neonatal death at less than 28 weeks gestation.

The most apparent difference between Māori and New Zealand European perinatal mortality rates is among neonatal deaths of babies born at less than 28 weeks gestation, when the most common cause of death is spontaneous preterm birth (Figure 5.4).

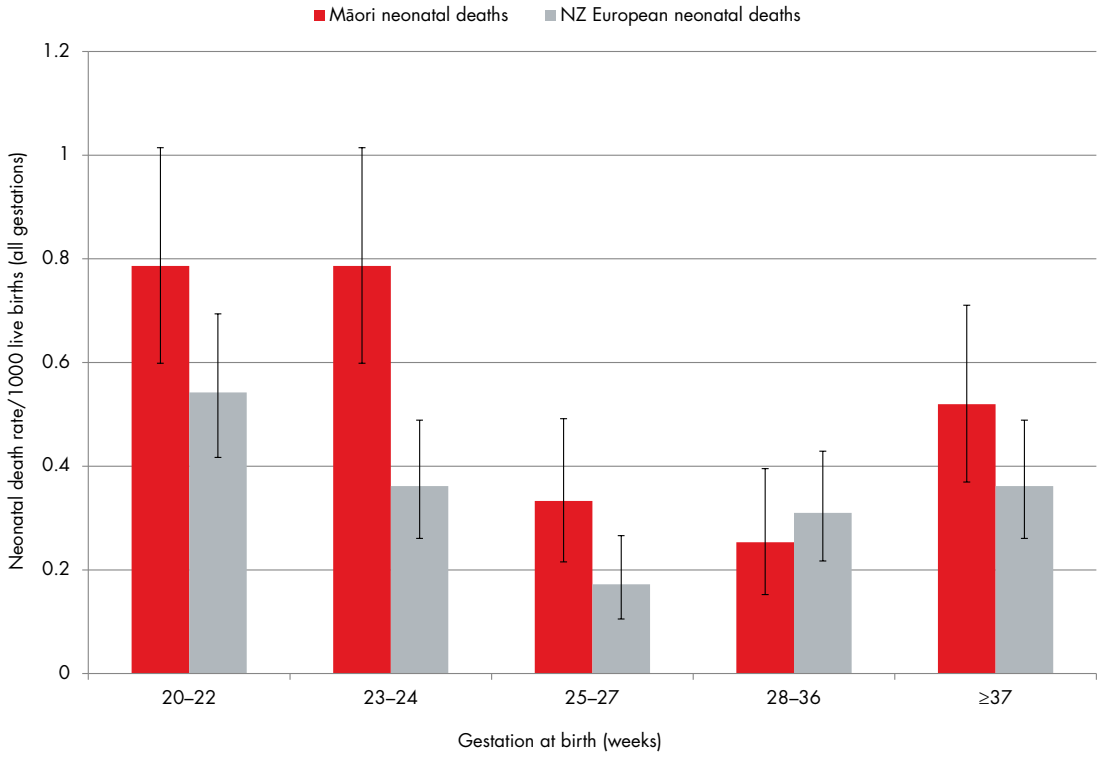
However, there is also a significant difference between Māori and New Zealand European mortality rates among neonatal deaths of babies born from 28 weeks gestation (Figure 5.5). The three year rolling rates for 2012 to 2014 and 2013 to 2015 suggest that, after a period of apparent reduction, the size of the inequity is increasing.

Figure 5.5: Neonatal death ≥28 weeks rolling three-year rates (per 1000 live births) by ethnicity and year (Māori and New Zealand European 2007–2015) using MAT and BDM denominator data



NND≥28 = neonatal death at or beyond 28 weeks gestation.

Figure 5.6: Neonatal death rates (per 1000 live births) by gestation and ethnicity (Māori and New Zealand European prioritised maternal ethnicity) (with 95% CIs) 2011–2015 (excluding congenital abnormalities)



After excluding babies dying with congenital abnormalities, babies of Māori mothers are significantly more likely to die as neonates at all gestational ages at birth represented except at 28 to 31 weeks compared to babies of New Zealand European mothers. There is a significant drop in the neonatal death rate from birth at 20–22 weeks to birth at 23–24 weeks among babies of New Zealand European mothers but no equivalent drop among babies of Māori mothers.

Comparisons of neonatal death rates among babies of Māori mothers compared to other ethnicities can be found in section 3.2 (Figure 3.18).

The principal cause of neonatal death at 20–24 weeks is spontaneous preterm birth (Figure 3.19).

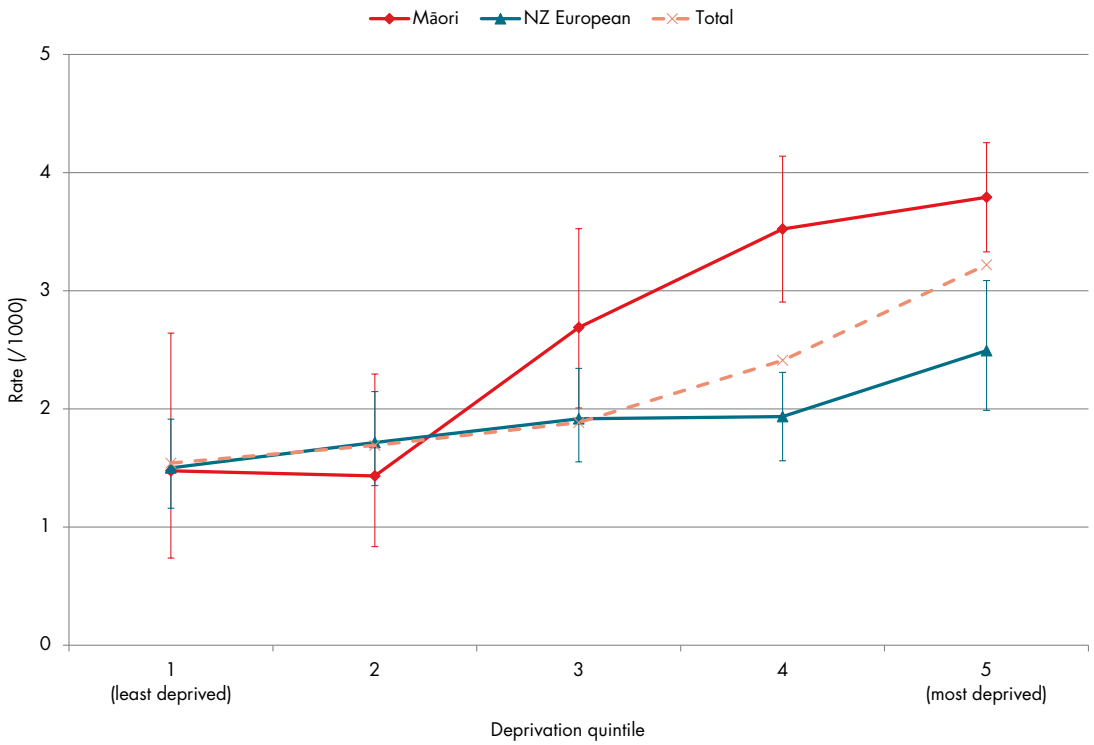
Table 5.2: Perinatal related mortality rates (per 1000 births) by maternal ethnicity (Māori and New Zealand European) and maternal age 2011–2015

Maternal age (years)	Māori				NZ European					
	n (MAT)=76,632				n (MAT)=117,752					
	n (MAT)	n	%	Rate	n (MAT)	n	%	Rate	RR	95% CI
<20	10,136	148	18.39	14.60	4,022	78	6.36	19.39	0.75	0.57–0.99
20–24	23,788	214	26.58	9.00	16,549	175	14.27	10.57	0.85	0.70–1.04
25–29	19,460	176	21.86	9.04	29,748	280	22.84	9.41	0.96	0.80–1.16
30–34	13,457	153	19.01	11.37	38,047	326	26.59	8.57	1.33	1.10–1.60
35–39	7,440	77	9.57	10.35	23,715	271	22.10	11.43	0.91	0.71–1.16
≥40	2,351	37	4.60	15.74	5,671	96	7.83	16.93	0.93	0.64–1.36
Total	**76,632**	**805**	**100.0**	**10.50**	**117,752**	**1,226**	**100.0**	**10.41**	**1.01**	**0.93–1.09**

Note: Unknown maternal age in MAT = 5 Māori and 2 NZ European.

Table 5.2 highlights the marked difference in age distribution between Māori and New Zealand European mothers and how this impacts on numbers of deaths. Māori perinatal mortality rates are similar to New Zealand European at all maternal age groups except <20 years, and 30–34 years. The perinatal related mortality rate for mothers under 20 years is lower among Māori mothers compared to New Zealand European mothers. However, as there are many more younger Māori mothers (10,136 from 2011 to 2015 compared to 4,022 New Zealand European), there are more Māori perinatal deaths(148 compared to 78). The rate of perinatal related death is higher among Māori compared to New Zealand European mothers aged 30–34 years.

Figure 5.7: Spontaneous preterm* perinatal related mortality rates (per 1000 births) by deprivation quintile adjusting for maternal ethnicity (prioritised) (with 95% CIs) 2007–2015



* Spontaneous preterm includes any baby dying where spontaneous preterm birth is a PSANZ-PDC whether it is the primary, secondary or third antecedent cause.

Figure 5.7 shows perinatal related death rates from spontaneous preterm birth by deprivation. Māori rates of perinatal death due to spontaneous preterm labour in the two least deprived quintiles are similar to New Zealand European rates. For both Māori and New Zealand European groups the rates of spontaneous preterm birth increase with increasing deprivation. However, the gradient of increase is more marked among Māori than New Zealand European mothers.

Figure 5.8: Burden of perinatal related death due to spontaneous preterm birth by deprivation and maternal ethnicity (prioritised) 2007–2015

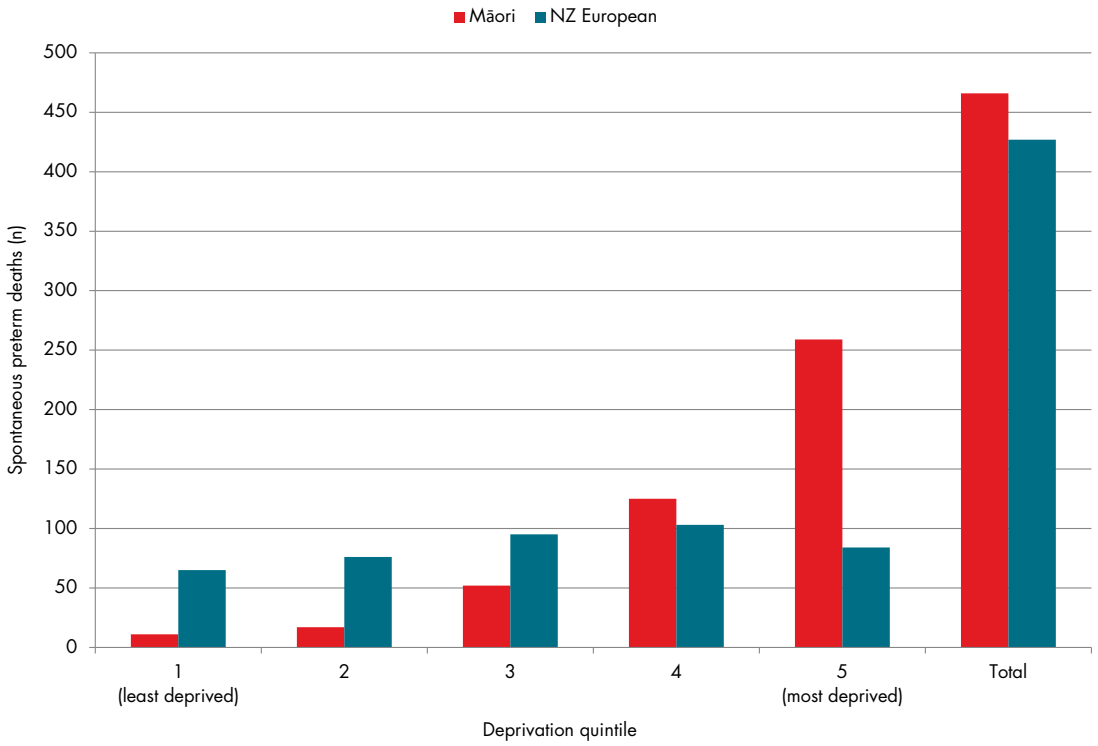
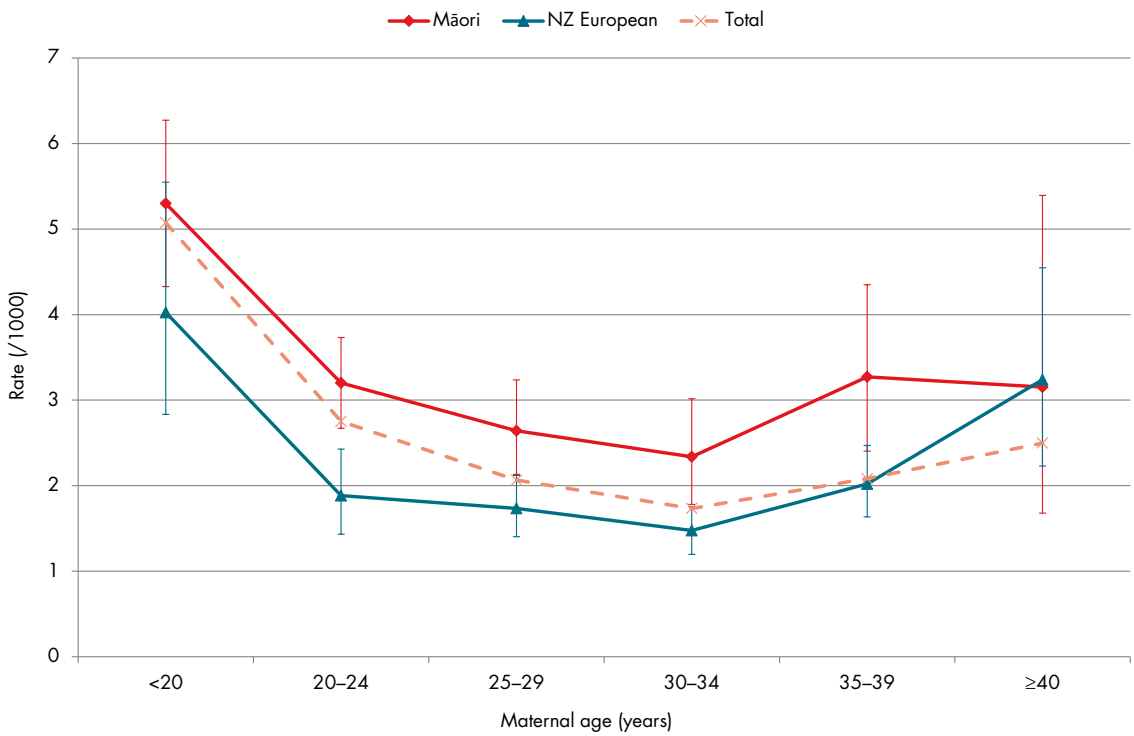


Figure 5.8 illustrates the absolute burden of spontaneous preterm birth by ethnicity. Māori mothers make up 25 percent of mothers and New Zealand European mothers make up 37 percent, and yet the absolute number of deaths from spontaneous preterm birth is higher among Māori than New Zealand European mothers. It also further illustrates, as in Figure 5.7, the much smaller social gradient among New Zealand European mothers.

Figure 5.9: Spontaneous preterm perinatal related mortality rates (per 1000 births) by maternal age adjusting for ethnicity (prioritised) (with 95% CIs) 2007–2015



Ethnicity does not explain the higher rate of perinatal related death from spontaneous preterm birth at the extremes of maternal age. Perinatal related death from spontaneous preterm birth is more common among Māori at all categories of maternal age except 40 years and older.

Table 5.3: Ethnic-specific primary death classification (PSANZ–PDC) and neonatal death classification (PSANZ–NDC) by ethnicity (Māori and New Zealand European) 2011–2015

Death classification (PSANZ)	Māori			NZ European				
	n (MAT)=76,637			n (MAT)=117,754				
	n	%	Rate	n	%	Rate	RR	95% CI
Perinatal death classification (PSANZ-PDC)								
Congenital abnormality	188	23.35	2.45	384	31.32	3.26	0.75	0.63–0.90
Perinatal infection	25	3.11	0.33	39	3.18	0.33	0.98	0.60–1.63
Hypertension	25	3.11	0.33	30	2.45	0.25	1.28	0.75–2.18
Antepartum haemorrhage	98	12.17	1.28	133	10.85	1.13	1.13	0.87–1.47
Maternal conditions	44	5.47	0.57	49	4.00	0.42	1.38	0.92–2.07
Specific perinatal conditions	66	8.20	0.86	135	11.01	1.15	0.75	0.56–1.01
Hypoxic peripartum death	22	2.73	0.29	41	3.34	0.35	0.82	0.49–1.38
Fetal growth restriction	48	5.96	0.63	92	7.50	0.78	0.80	0.57–1.14
Spontaneous preterm	155	19.25	2.02	137	11.17	1.16	1.74	1.38–2.19
Unexplained antepartum death	121	15.03	1.58	176	14.36	1.49	1.06	0.84–1.33
No obstetric antecedent	13	1.61	0.17	10	0.82	0.08	2.00	0.88–4.56
Neonatal death classification (PSANZ-NDC)								
Congenital abnormality	60	22.90	0.80	78	27.76	0.67	1.19	0.85–1.67
Extreme prematurity	86	32.82	1.15	87	30.96	0.75	1.53	1.13–2.06
Cardio-respiratory disorders	34	12.98	0.45	18	6.41	0.16	2.92	1.65–5.17
Infection	19	7.25	0.25	21	7.47	0.18	1.40	0.75–2.60
Neurological	37	14.12	0.49	55	19.57	0.47	1.04	0.69–1.58
Gastrointestinal	5	1.91	0.07	2	0.71	0.02	3.87	0.75–19.93
Other	21	8.02	0.28	20	7.12	0.17	1.62	0.88–3.00

There is a significantly higher rate of total perinatal related death of babies of Māori mothers compared to New Zealand European mothers from spontaneous preterm birth (RR 1.74 (95% CI 1.38–2.19)), and of neonatal death (relative risk of death from extreme prematurity 1.53 (95% CI 1.13–2.06) and from cardio-respiratory disorders (RR 2.92 (95% CI 1.65–5.17)) (Table 5.3).

Multivariable analysis

Table 5.4 shows the crude and adjusted odds of total perinatal related mortality from 2008–2015 for Māori mothers compared to New Zealand European mothers adjusting for maternal age, deprivation decile, year of birth, baby sex, and multiple birth.

As noted previously, the definition of ethnicity is limited by the datasets available and current knowledge of which measure is the best of maternal ethnicity. This analysis uses PMMRC data for numerator and MAT for denominator as in the univariate tables above.

There are considerable missing parity, smoking, and BMI data from early pregnancy, principally from women under the care of DHB maternity clinics at hospitals where these data are not, and/or were not previously, sent to the Ministry of Health. The principal contributors to these missing data were Auckland

DHB (28 percent) and Counties Manukau DHB (16 percent) until 2012, and, since 2013, Counties Manukau DHB (49%). Due to the distribution of these missing data in relation to the deaths and to important predictor variables, and therefore potential confounding, only variables present for almost all women in the numerator and denominator have been included in the final multivariable model.

Table 5.4: Rates, and crude and adjusted odds ratios, for perinatal related mortality among Māori and New Zealand European births 2008–2015

	Births	Perinatal related deaths		OR crude			OR adjusted		
	n=325,778	n=3,340		n=325,662			n=296,992		
	n	n	Rate	OR	95%CI		OR	95%CI	
Ethnicity*									
Māori	127,299	1,323	10.39	1.02	0.95	1.10	0.91	0.84	0.99
New Zealand European	198,479	2,017	10.16	1.00					
Age#									
<20	26,398	380	9.28	1.56	1.38	1.77	1.55	1.36	1.77
20–24	66,921	668	9.98	1.08	0.97	1.20	1.07	0.96	1.19
25–29	79,672	739	9.28						
30–34	86,170	772	8.96	0.97	0.87	1.07	0.95	0.86	1.06
35–39	53,828	590	10.96	1.18	1.06	1.32	1.16	1.04	1.30
≥40	12,780	191	14.95	1.62	1.38	1.90	1.54	1.30	1.81
Missing data	9	0							
Deprivation decile (MAT) (median(IQR)) (per unit)	7 (4-9)	7 (4-9)		1.04	1.02	1.05	1.04	1.03	1.06
Year of birth (per year)#				0.99	0.98	1.01	0.99	0.98	1.01
Sex+									
Male	166,275	1,746	10.50						
Female	157,201	1,573	10.01	0.95	0.89	1.02	0.94	0.88	1.01
Indeterminate or unknown	2,302	21	9.12						
Plurality*									
Singleton	313,440	2,902	9.26						
Multiple	9,853	394	39.99	4.46	4.00	4.96	4.37	3.91	4.88
Unknown	2,485	44							

* Numerator from the PMMRC dataset.
# Numerator from the MAT dataset.
+ Numerator from the MAT dataset or the PMMRC if missing in the MAT.
IQR = interquartile range.

The analyses in Table 5.4 and Table 5.5 use the PMMRC numerator and MAT denominator for ethnicity. Using this combination of numerator and denominator there is no significant difference in the unadjusted odds of perinatal related mortality for Māori mothers compared to New Zealand European. After adjusting for the potential confounders listed in the table, Māori mothers were less likely to have a child die in the perinatal period than New Zealand European mothers. (OR 0.91 (95% CI 0.84-0.99)).

Table 5.5: Rates, and crude and adjusted odds ratios, for neonatal mortality among live born babies to Māori and New Zealand European mothers at less than 28 weeks gestation 2008–2015

	Live births	Neonatal deaths <28 weeks		OR crude			OR adjusted		
	n=323,366	n=458		n=323,336			n=294,786		
	n	n	Rate	OR	95%CI		OR	95%CI	
Ethnicity*									
Māori	126,427	250	1.98	1.87	1.56	2.25	1.46	1.18	1.81
New Zealand European	196,939	208	1.06	1.00					
Age#									
<20	26,149	72	2.75	1.93	1.44	2.60	1.71	1.26	2.33
20–24	66,441	94	1.41	0.99	0.75	1.30	0.89	0.67	1.17
25–29	79,149	113	1.43						
30–34	85,585	82	0.96	0.67	0.50	0.89	0.71	0.53	0.95
35–39	53,392	75	1.40	0.98	0.73	1.32	1.05	0.78	1.42
≥40	12,641	22	1.74	1.22	0.77	1.93	1.28	0.81	2.04
Missing data	9	0							
Deprivation decile (MAT) (median(IQR)) (per unit)	7 (4-9)	8 (5-9)		1.14	1.10	1.18	1.10	1.06	1.15
Year of birth (per year)#				1.02	0.98	1.06	1.02	0.98	1.06
Sex+									
Male	165,035	249	1.51						
Female	156,048	207	1.33	0.88	0.73	1.06	0.88	0.73	1.06
Indeterminate or unknown	2,283	2							
Plurality*									
Singleton	311,298	332	1.07	1.00			1.00		
Multiple	9,611	118	12.28	11.64	9.43	14.38	11.94	9.61	14.84
Unknown	2,457	8							

* Numerator from the PMMRC dataset.
# Numerator from the MAT dataset.
+ Numerator from the MAT dataset or the PMMRC if missing in the MAT.
IQR = interquartile range.

Table 5.5 shows the crude and adjusted odds of neonatal death after birth at less than 28 weeks gestation for Māori mothers compared to New Zealand European mothers (using the PMMRC numerator and MAT denominator for ethnicity). Babies of Māori mothers were significantly more likely to suffer neonatal death after birth at less than 28 weeks than babies of New Zealand European mothers even after adjusting for maternal age, deprivation decile, year of birth, multiple pregnancy, and baby sex (OR 1.46 (95% CI 1.18–1.81)).

Table 5.6: Contributory factors to perinatal related deaths (excluding termination of pregnancy) by ethnicity (Māori and New Zealand European) 2011–2015

	Māori		NZ European			
	n (MAT)=676		n (MAT)=897			
	n	%	n	%	RR	95% CI
Any Contributory factor	304	44.97	222	24.75	1.82	1.58–2.09
Potentially avoidable	175	25.89	158	17.61	1.47	1.21–1.78
Organisational/management factors	35	5.18	61	6.80	0.76	0.51–1.14
Poor organisational arrangements of staff	2	0.30	8	0.89		
Inadequate education and training	1	0.15	11	1.23		
Lack of policies, protocols or guidelines	4	0.59	19	2.12		
Inadequate numbers of staff	-	-	3	0.33		
Poor access to senior clinical staff	2	0.30	3	0.33		
Failure or delay in emergency response	6	0.89	8	0.89		
Delay in procedure (eg, caesarean section)	7	1.04	8	0.89		
Inadequate systems/process for sharing of clinical information between services	5	0.74	9	1.00		
Delayed access to test results or inaccurate results	3	0.44	8	0.89		
Equipment (eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)	5	0.74	5	0.56		
Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatres in a distant location)	1	0.15	-	-		
Other	7	1.04	3	0.33		
Personnel factors	64	9.47	100	11.15	0.85	0.63–1.14
Knowledge and skills of staff were lacking	18	2.66	36	4.01		
Delayed emergency response by staff	3	0.44	8	0.89		
Failure to maintain competence	-	-	2	0.22		
Failure of communication between staff	12	1.78	20	2.23		
Failure to seek help/supervision	8	1.18	10	1.11		
Failure to offer or follow recommended best practice	38	5.62	47	5.24		
Lack of recognition of complexity or seriousness of condition by care giver	16	2.37	32	3.57		
Other	3	0.44	2	0.22		
Barriers to access and/or engagement with care	259	38.31	126	14.05	2.73	2.26–3.29
No antenatal care	64	9.47	22	2.45		
Infrequent care or late booking	103	15.24	24	2.68		
Declined treatment or advice	42	6.21	34	3.79		
Obesity impacted on delivery of optimal care (eg, ultrasound scan)	4	0.59	2	0.22		
Substance use	43	6.36	16	1.78		
Family violence	25	3.70	8	0.89		
Lack of recognition of complexity or seriousness of condition	58	8.58	46	5.13		
Maternal mental illness	11	1.63	3	0.33		
Cultural barriers	5	0.74	2	0.22		
Environment (eg, isolated, long transfer, weather prevented transport)	18	2.66	20	2.23		
Other	28	4.14	12	1.34		

Contributory factors were identified significantly more often among perinatal deaths of babies born to Māori mothers compared to New Zealand European mothers (RR 1.82 (95% CI 1.58–2.09)) and they were more often assessed to be potentially avoidable (RR 1.47 (95% CI 1.21–1.78)). There was no significant difference in the proportion of organisational and/or management factors and personnel factors identified by local reviewers, but significantly more barriers to access and/or engagement with care were identified.

5.4 Maternal Mortality

Table 5.7: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) 2006–2015

	Māori		NZ European			
	n=160,018		n=251,931			
	n	Ratio	n	Ratio	RR	95% CI
Maternal deaths	42	26.25	34	13.50	1.94	1.24–3.06

As ethnicity for a mother who dies cannot be obtained directly from the mother, numerator–denominator bias is likely to be less apparent in these data when using the MAT denominator (supported by unpublished analyses), therefore only estimates using MAT data are provided.

There is a statistically significantly higher maternal mortality ratio among Māori (26.3/100,000 maternities) compared to New Zealand European (13.5/100,000 maternities) mothers combining data from 2006–2015 (Table 5.7). However, rolling three-year ratios (Figure 5.10) show evidence of a convergence of rates by ethnicity in the most recent three-year period.

Figure 5.10: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) (with 95% CIs) 2006–2015

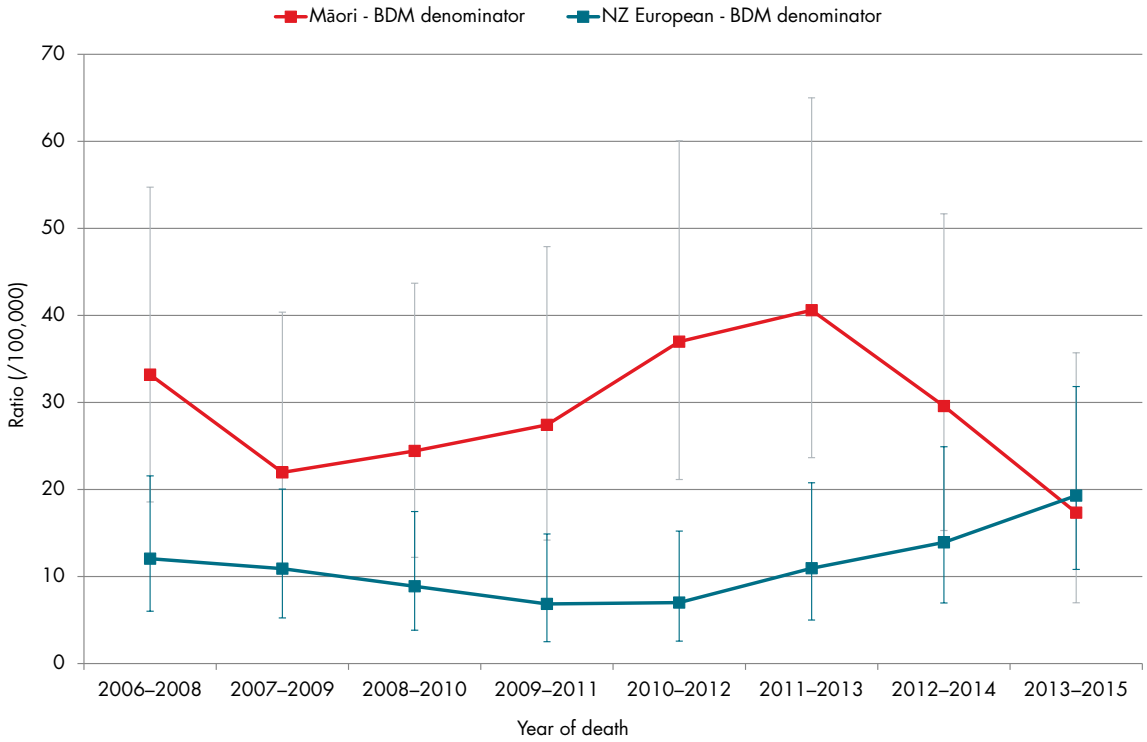


Table 5.8: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) and maternal age 2006–2015

Maternal age (years)	Māori			NZ European				
	n (MAT)=160,018			n (MAT)=251,931				
	N	n	Ratio	N	n	Ratio	RR	95% CI
<25	72,352	11	15.20	45,088	5	11.09	1.37	0.48–3.95
25–29	39,011	13	33.32	60,692	7	11.53	2.89	1.15–7.24
30–34	28,108	5	17.79	82,545	11	13.33	1.33	0.46–3.84
35–39	15,969	10	62.62	52,462	8	15.25	4.11	1.62–10.40
≥40	4,572	3	65.62	11,141	3	26.93	2.44	0.49–12.07
Unknown	6	-	-	3	-	-	-	-
Total	**160,018**	**42**	**26.25**	**251,931**	**34**	**13.50**	**1.94**	**1.24–3.06**

This table, along with Table 5.2, is a reminder of the different age distribution of Māori mothers compared to New Zealand European mothers. As numbers of deaths are small, especially when separated by age group, it is difficult to conclude much about the association between age and maternal mortality risk, although it is likely that there is an increased mortality risk in older women in both groups, as there is among New Zealand mothers overall (Figure 4.4). At all ages there was a higher relative risk for Māori compared to New Zealand European mothers, but this was not always statistically significant.

Table 5.9: Maternal mortality ratio (per 100,000 maternities) by ethnicity (Māori and New Zealand European) and time of death 2006–2015

Time of death	Māori		NZ European			
	n (MAT)=160,018		n (MAT)=251,931			
	n	Ratio	n	Ratio	RR	95% CI
Antepartum (including intrapartum)	16	10.00	15	5.95	1.68	0.83–3.40
Postpartum	26	16.25	19	7.54	2.15	1.19–3.89

There was a statistically significantly higher maternal mortality ratio in the postpartum period for Māori mothers compared to European mothers. A similar magnitude effect is seen in the antepartum period, suggesting that there are inequities in the rates at both times.

Table 5.10: Ethnic-specific maternal cause of death by ethnicity (Māori and New Zealand European) 2006–2015

	Māori			NZ European				
	n (MAT)=160,018			n (MAT)=251,931				
	n	%	Ratio	n	%	Ratio	RR*	95% CI
Cause of death								
Direct	**12**	**28.6**	**7.50**	**10**	**29.4**	**3.97**	**1.89**	**0.82–4.37**
Amniotic fluid embolism	7	16.7	4.37	3	8.8	1.19		
Obstetric haemorrhage	-	-	-	2	5.9	0.79		
Venous thromboembolism	1	2.4	0.62	2	5.9	0.79		
Peripartum cardiomyopathy	1	2.4	0.62	-	-	-		
Pre-eclampsia/Eclampsia	-	-	-	2	5.9	0.79		
Obstetric sepsis	3	7.1	1.87	1	2.9	0.40		
Indirect	**28**	**67**	**17.50**	**20**	**58.8**	**7.94**	**2.20**	**1.24–3.91**
Pre-existing medical condition:								
Cardiac	6	14.3	3.75	2	5.9	0.79		
Neurological	3	7.1	1.87	5	14.7	1.98		
Other pre-existing medical condition	3	7.1	1.87	4	11.8	1.59		
Non-obstetric sepsis	1	2.4	0.62	1	2.9	0.40		
Suicide	15	35.7	9.37	8	23.5	3.18	2.95	1.25–6.96
Unclassifiable	**2**	**5**	**1.25**	**4**	**11.8**	**1.59**		

* Relative risks are calculated only where at least five cases are reported.

There were more direct and indirect maternal deaths among Māori compared to New Zealand European mothers, although the difference among direct deaths does not reach statistical significance.

Māori mothers were almost three times more likely to die from suicide (RR 2.95 (95% CI 1.25–6.96)).

Table 5.11: Contributory factors and potentially avoidable maternal mortality by ethnicity (Māori and New Zealand European) 2006–2015

	Māori		NZ European			
	n (MAT)=42		n (MAT)=34			
	n	%	n	%	RR	95% CI
Was death potentially avoidable?						
Yes	15	35.7	14	41.2	0.87	0.49–1.54
No	13	31.0	9	26.5	1.17	0.57–2.40
Unknown	14	33.3	11	32.4	1.03	0.54–1.97
Contributory factors present	28	66.7	22	64.7	1.03	0.74–1.43
Organisational/management factors	19	45.2	14	41.2	1.10	0.65–1.85
Poor organisational arrangements of staff	2	4.8	4	11.8		
Inadequate education and training	5	11.9	6	17.6		
Lack of policies, protocols or guidelines	9	21.4	10	29.4		
Inadequate numbers of staff	-	-	-	-		
Poor access to senior clinical staff	1	2.4	3	8.8		
Failure or delay in emergency response	2	4.8	2	5.9		
Delay in procedure (eg, caesarean section)	1	2.4	-	-		
Inadequate systems/process for sharing of clinical information between services	10	23.8	7	20.6		
Delayed access to test results or inaccurate results	-	-	2	5.9		
Equipment (eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)	1	2.4	-	-		
Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatres in a distant location)	3	7.1	-	-		
Other	4	9.5	3	8.8		
Personnel factors	15	35.7	16	47.1	0.76	0.44–1.30
Knowledge and skills of staff were lacking	5	11.9	7	20.6		
Delayed emergency response by staff	5	11.9	2	5.9		
Failure of communication between staff	4	9.5	6	17.6		
Failure to seek help/supervision	4	9.5	-	-		
Failure to offer or follow recommended best practice	3	7.1	5	14.7		
Lack of recognition of complexity or seriousness of condition by care giver	10	23.8	11	32.4		
Barriers to access and/or engagement with care	24	57.1	13	38.2	1.49	0.91–2.47
No antenatal care	4	9.5	2	5.9		
Infrequent care or late booking	5	11.9	1	2.9		
Declined treatment or advice	8	19.0	5	14.7		
Obesity impacted on delivery of optimal care (eg, ultrasound scan)	1	2.4	-	-		
Substance use	9	21.4	2	5.9		
Family violence	7	16.7	2	5.9		
Lack of recognition of complexity or seriousness of condition	7	16.7	7	20.6		
Maternal mental illness	6	14.3	6	17.6		
Environment (eg, isolated, long transfer, weather prevented transport)	2	4.8	2	5.9		
Other	5	11.9	2	5.9		

There was no difference between Māori and New Zealand European mothers in the proportion of contributory factors identified or in deaths assessed as potentially avoidable at national review.

5.5 Māori Maternal Death by Suicide

Authors Associate Professor Sue Crengle and Dr Paula King

He mea tika kia mahara rātou kua whetūrakatia i te paepae o Matariki, o Rehua hoki.

Kore rawa e mimiti te puna roimata, te puna aroha, ki kā tini aitua e haere nei he huna mai tā Hine-Nui-te-Pō.

E kā kakano o te kōpū, kāre e takihia ou taki tuatahi ki te ao ora, moe mai rā i roto i te rakimarie o tā tātou nei Kaihaka i ruka rawa.

Āpiti hono tātai hono, te huka mate ki te huka mate, Āpiti hono tātai hono, te hunga ora ki te huka ora.

Tihei Mauri Ora!

The information described in this section was obtained from national maternal mortality reviews, the 2015–16 national re-review by the MMRWG (PMMRC 2016, pp 122–131) and, where the woman was under 25 years, supplemented by reviews undertaken by the Child and Youth Mortality Review Committee (CYMRC). The information used in the mortality review processes is obtained from the health professionals associated with the woman and her care, the coroner's report and findings, and in the CYMRC reviews from other agencies that may have had involvement with the young person. The depth of information available from these sources is quite variable, so it is possible that factors described for some women may also have been relevant to other women but were not documented.

Māori women are over-represented among maternal suicides. Overall, between 2006 and 2015, 27 women who were pregnant or within six weeks of pregnancy committed suicide. Fifteen (56 percent) of these women were Māori.

Information about the women and their final pregnancy

Just under half of the women were under 25 years of age; 20 percent were aged 18–24 years and 27 percent were under 17 years old. The remainder (53 percent) of the women were 25 years of age or older. Most of the Māori women who died following a termination of pregnancy and one who died after miscarriage were under 25 years of age. A higher proportion of Māori deaths were in the age group 24 years and younger compared to non-Māori maternal suicide deaths. (PMMRC 2016)

Eight (53 percent) deaths occurred during the pregnancy, four (27 percent) occurred following a termination of pregnancy, and three (20 percent) occurred after a miscarriage or a live birth. Most of the deaths during pregnancy (6 of 8 cases) occurred in the first 20 weeks, and in two deaths there was no information available that confirmed the woman was aware she was pregnant. Eight women died within six weeks of a live birth or termination of pregnancy. This differs from non-Māori, for whom there were fewer deaths during pregnancy less than 20 weeks gestation (n=2), more deaths between 20 weeks gestation and birth (n=6), and fewer deaths following a termination of pregnancy/live birth/miscarriage (n=2) (PMMRC 2016, pp 122–131).

Thirteen of the 15 deaths were due to hanging.

Table 5.12: Characteristics of Māori maternal suicides 2006–2015

	Māori maternal suicides n=15	
	n	%
Time of death in relation to pregnancy		
Post termination of pregnancy	4	27
During pregnancy	8	53
Postpartum/Post miscarriage	3	20
Age at death		
24 years and younger	7	47
≥25 years	8	53
Time of death		
<20/40 weeks gestation	6	40
≥20/40 weeks gestation	2	13
≤7 days after birth/termination of pregnancy	2	13
8 days to 6 weeks after birth/termination of pregnancy	5	33
Lead maternity carer involvement		
Not applicable*	8	53
Yes	3	20
No	4	20
Previous pregnancies		
Nil	3	20
Live births	6	40
Unknown#	6	40
Children in care of others	4	27
Child, Youth and Family involved during final pregnancy	2	13
Antenatal barriers to care+	3	20
Postnatal issues		
Not home/Missing some postnatal visits	2	13
Delayed/Missed diagnosis of mental/physical health problem	4	27
GP/Family Planning involved		
Yes	9	60
No	3	13
Reviews suggest had involvement^	3	20
Mental health or alcohol and drug services involved during pregnancy and prior to death	6	40
Other life stressors at time of death		
Relationship problems	12	80
Other life stressors	6	40
Substance use at time of death		
Alcohol	3	20
Other drugs	2	13
Substance use during pregnancy	7	47
Mental health service involvement prior to pregnancy		
No identified previous mental health issues	5	33
Yes	3	20
Identified mental health issue and no involvement•	7	47
Self-harm/Suicide attempts prior to or during the final pregnancy	8	53
Family history of mental health/suicide	4	27
Family violence	11	73

* Termination of pregnancy/unaware that was pregnant/miscarriage.
# Termination of pregnancy only; combination live birth/miscarriage/termination of pregnancy.
+ Eg, transport/missing some antenatal visits.
^ Eg, early dating ultrasound scan, early booking with midwife.
• Not referred/referred but not seen or unclear if had been seen/unclear if had been referred or seen.

Factors associated with the pregnancy and the period between pregnancy and death

For just over half of the women (8 cases; 53 percent) the involvement of an LMC in the pregnancy was not indicated because the woman may have been unaware she was pregnant, had a planned termination of pregnancy or had an early miscarriage. Four cases were not under an LMC's care at the time of death, and three were. Some antenatal and postnatal visits were missed in all three cases where an LMC was involved. The reviews of these cases document difficulties such as transport and phone difficulties that impacted on this care.

Other services were involved with the women during their pregnancy and prior to their death. Most of the women (9 cases; 60 percent) had seen a GP (or in a small number of cases, a Family Planning service) during their pregnancy. Mental health services or alcohol and drug services were involved with six women during or after pregnancy prior to their deaths. In some cases multiple services were involved (eg, midwives, secondary and tertiary specialist obstetric and mental health services, and GPs). Child, Youth and Family was notified/involved in two cases but the extent of their involvement is not clear from the review notes. In three cases the reviews documented poor communication between the various services involved. Potentially delayed or missed diagnosis of physical and/or mental health issues was identified in five reviews. Poor coordination and/or lack of follow-up were identified in three cases.

For 12 (80 percent) of the women their relationship with their partner/ex-partner was a source of stress due to recent break ups, arguments and, in six cases, family violence. For a number of these women other stressors such as financial concerns, legal proceedings, housing difficulties, limited phone availability, transport difficulties, exposure to drug/alcohol use by others around her, and fetal abnormality were also noted.

Alcohol, with or without other drugs, was identified at post-mortem in three women (20 percent). Alcohol use alone or in combination with other drugs, or use of other drugs alone during the final pregnancy was identified in seven women; in one case referral to alcohol and drug services was mentioned in the patient's notes but it is unclear if this had been acted on. Two women were seeing alcohol and drug services prior to pregnancy and may have had ongoing involvement with these services during the pregnancy.

Other factors that may have contributed to outcome

The majority of women (11 cases, 73 percent) had a documented history of witnessing or experiencing family violence as a child, and/or family violence as an adult, and/or sexual abuse or assault.

A past history of mental health issues was common (10 cases). A referral that resulted in the woman being seen at mental health services was only documented in two deaths.

Eight women (53 percent) had self-harmed or attempted suicide prior to or during the final pregnancy. A history of mental health illness and/or suicide among family members was documented in four women's cases.

Four women (27 percent) had existing children who were in the care of other people.

Summary

This section highlights patterns of findings that may be associated with increased risk of suicide for Māori women. Early identification of these patterns among pregnant Māori women may provide health professionals opportunities to intervene in order to prevent suicides in the future. The deaths of all women under the age of 25 are reviewed by the CYMRC. It would be possible to estimate whether suicide rates among pregnant and non-pregnant Māori women are different from these reviews. For women 25 years of age and older there is no comprehensive multiagency review of deaths due to suicide, which makes it very difficult to assess whether suicide rates between pregnant and non-pregnant women in this age group differ.

Just under half of the suicides occurred in young women. Most of these women were under 17 years of age and a fifth were aged 18–24 years. This differs from the pattern seen in non-Māori women.

Over half of women had been seen by a GP or at a Family Planning clinic (but mostly by a GP) in the final pregnancy. Forty percent of women were involved with mental health or alcohol and drug services during their final pregnancy. In addition, 47 percent were documented as having an identified mental health issue and were either not referred, referred but not seen, or it was unclear if they had been referred or seen by mental health services. Some women had multiple services involved in their care – including midwifery, specialist obstetric and mental health services. Service related issues including poor communication between services, poor coordination, and inadequate follow-up were identified, as were potentially delayed and/or missed diagnoses of physical and/or mental health issues.

A number of stressors affecting the women were also identified. Difficulties in the women's relationships with their partners or ex-partners were noted in the majority (80 percent) of cases. Other significant stressors included financial or legal concerns, difficulties with housing, and availability of phones and transport.

Experiencing family violence and sexual abuse/assault as a child and/or as an adult was also very common.

A past history of mental health issues, regardless of whether the woman was seen by mental health services, is a common factor, as is a history of self-harm or previous suicide attempts. Alcohol and drug use during the final pregnancy was noted in review of just under half of the women's cases.

Most of the women who died from suicide experienced multiple risk factors. Early recognition of these risk factors, particularly where there are multiple factors, will assist health services and professionals to provide better services for these women.

Practice Point: Māori women and risk factors for 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.

Comprehensive assessment of risk factors for Māori women should be undertaken at confirmation of pregnancy and/or on first presentation for antenatal care. This assessment should be done for all Māori women, regardless of age, including those seeking a termination of pregnancy.

This assessment should include:

- Assessment of current social situation including relationship with partner/ex-partner, whānau supports, and social stressors such as financial issues, housing, whether their other children are in care of other people, and phone and transport availability.
- Previous and current experience of family violence, sexual abuse and assault.
- Past history of mental health issues including self-harm and previous suicide attempts, use of alcohol and other drugs, and family history of mental health illnesses or suicide.
- History of TOP or miscarriage in the previous twelve months.

Where Māori women have symptoms suggesting serious mental illness, urgent referral is indicated.

Māori women who have a history of serious mental illness that are currently well should be referred to a secondary mental health service. See **'Practice Point: Māori women and maternal suicide'.**

If risk factor(s) are identified, the impact of these on the woman's health and wellbeing should be discussed and appropriate referral(s) made. Assessment of the impact of these risk factors should continue throughout pregnancy and the postnatal period.

Practice Point: Māori women and maternal suicide

Where Māori women exhibit symptoms suggesting serious mental illness, an urgent mental health assessment, including consultant psychiatrist review and consultation with perinatal mental health services, on the same day these symptoms are first noted should be undertaken.

Symptoms include:

- Recent significant change in mental state including fluctuating or emergence of new symptoms
- Suicidal ideation (new or increasing)
- Suicide attempts
- Psychotic symptoms
- Pervasive guilt or hopelessness
- Ongoing beliefs of inadequacy as a mother
- A sense of estrangement or disconnection from the infant.

Māori women who have a history of serious mental illness that are currently well should be referred to a specialist mental health service as they may have increased risk of relapse during pregnancy, in the peripartum or postnatal period. They need an appropriate mental health birth plan and monitoring for the peripartum period. Close monitoring by their maternity care provider +/- mental health services during these periods is required. Mental health services should assure rapid access to their services if there is a deterioration in a woman's mental health. Where such a woman has a miscarriage, the GP should be notified immediately and an explicit process for early follow up, that includes a review of mental health status, agreed with the GP.

Doctors who refer Māori women for TOPs should actively follow up these women to ensure they have their free post-TOP check. This check should specifically include assessment of mental health status.

Māori women should have access to culturally appropriate mental health and/or alcohol and drug 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 Māori women's need relevant mental health/substance use history and current knowledge of a woman's pregnancy to support them to provide the best care. Routine communication and sharing of relevant information across all services providing care to the women during pregnancy and the postpartum period will enable high quality, better informed care. Any concerns regarding risk need to be clearly communicated to all clinicians involved.

5.6 Recommendations

In addition to the maternal mortality practice points and noted previous recommendations developed by the PMMRC, the following recommendations are made.

The Mortality Review Committees' Māori Caucus recommends:

Improved awareness and responsiveness to the increased risk for Māori women

Primary care (GPs, FPA), LMCs, TOP services, alcohol and drug services, and secondary and tertiary providers of maternity, obstetric, mental health, and maternal mental health services should improve their systems, guidelines and professional development to ensure that they are responsive to the identified increased risk for Māori women.

Risk assessment

Comprehensive assessment of risk factors for Māori women should be undertaken at diagnosis of pregnancy and/or on first presentation for antenatal care. This should be undertaken for all Māori women, regardless of age, including those who are seeking termination of pregnancy.

See 'Practice Point: Māori women and risk factors for maternal suicide' on page 160.

Management

a. Where Māori women exhibit symptoms suggesting serious mental illness or distress, an urgent mental health assessment, including consultant psychiatrist review and consultation with perinatal mental health services, on the same day these symptoms are first noted should be undertaken

b. Māori women who have a history of serious mental illness and are currently well should be referred to specialist mental health services for a mental health birth plan, and monitored closely by their maternity care provider +/- mental health services. Where such a woman has a miscarriage, the GP should be notified immediately and an explicit process for early follow up that includes a review of mental health status agreed with the GP.

c. The referring doctor of women who undergo a TOP is expected to provide a free post-TOP follow up consultation 10–14 days after the procedure (Report of a Standards Committee to the Abortion Supervisory Committee 2009). The referring doctor should actively follow up Māori women referred for TOP to ensure this consultation is completed and review mental health status during this consultation.

See 'Practice Point: Māori women and maternal suicide' on page 161.

Communication and coordination

Communication and coordination between primary care (GPs, FPA), LMCs, TOP services, alcohol and drug services, and secondary providers of maternity, obstetric, mental health, and maternal mental health services should be improved and enhanced using a variety of means including but not limited to case management, integrated notes systems, and electronic transfer of information.

Child and Youth Mortality Review

Child and Youth Mortality Review Committee (CYMRC) consider including information about whether female suicide cases were pregnant in the 12 months prior to their deaths in addition to the pregnancy status information currently collected.

5.7 Māori Perinatal and Maternal Mortality Appended Tables and Figures

Table 5.13: Perinatal related mortality rates (per 1000 births) by ethnicity (Māori and New Zealand European) and year 2007–2015 (MAT denominator)

	Birth (MAT)	Termination of pregnancy		Stillbirths		Neonatal death <28 weeks at birth		Neonatal death ≥28 weeks at birth		Total perinatal death	
	n	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Māori											
2007	16,819	20	1.19	106	6.30	26	1.56	27	1.62	179	10.64
2008	17,035	11	0.65	100	5.87	31	1.83	28	1.65	170	9.98
2009	16,900	29	1.72	111	6.57	40	2.39	29	1.73	209	12.37
2010	16,779	19	1.13	105	6.26	41	2.46	29	1.74	194	11.56
2011	16,242	31	1.91	95	5.85	24	1.49	26	1.61	176	10.84
2012	16,031	34	2.12	77	4.80	33	2.07	19	1.19	163	10.17
2013	14,899	24	1.61	82	5.50	29	1.96	21	1.42	156	10.47
2014	14,592	20	1.37	89	6.10	34	2.35	24	1.66	167	11.44
2015	14,873	20	1.34	71	4.77	24	1.62	28	1.89	143	9.61
NZ European											
2007	27,358	76	2.78	157	5.74	28	1.03	36	1.33	297	10.86
2008	27,252	87	3.19	148	5.43	23	0.85	51	1.89	309	11.34
2009	26,883	69	2.57	164	6.10	20	0.75	37	1.39	290	10.79
2010	26,431	74	2.80	127	4.80	36	1.37	32	1.22	269	10.18
2011	25,170	77	3.06	126	5.01	23	0.92	35	1.40	261	10.37
2012	24,429	66	2.70	123	5.03	27	1.11	34	1.40	250	10.23
2013	23,265	58	2.49	121	5.20	23	1.00	28	1.21	230	9.89
2014	22,656	70	3.09	132	5.83	34	1.51	25	1.11	261	11.52
2015	22,234	58	2.61	114	5.13	23	1.04	29	1.31	224	10.07

Table 5.14: Perinatal related mortality rates (per 1000 births) by ethnicity (Māori and New Zealand European) and year 2007–2015 (BDM birth registrations denominator)

	Birth registrations	Termination of pregnancy		Stillbirths		Neonatal death <28 weeks at birth		Neonatal death ≥28 weeks at birth		Total perinatal death	
	n	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Māori											
2007	15,384	20	1.30	106	6.89	26	1.70	27	1.77	179	11.64
2008	15,530	11	0.71	100	6.44	31	2.01	28	1.82	170	10.95
2009	14,646	29	1.98	111	7.58	40	2.76	29	2.00	209	14.27
2010	14,877	19	1.28	105	7.06	41	2.78	29	1.97	194	13.04
2011	14,244	31	2.18	95	6.67	24	1.70	26	1.84	176	12.36
2012	14,143	34	2.40	77	5.44	33	2.35	19	1.35	163	11.53
2013	13,488	24	1.78	82	6.08	29	2.17	21	1.57	156	11.57
2014	12,942	20	1.55	89	6.88	34	2.65	24	1.87	167	12.90
2015	13,971	20	1.43	71	5.08	24	1.73	28	2.02	143	10.24
NZ European											
2007	31,281	76	2.43	157	5.02	28	0.90	36	1.16	297	9.49
2008	30,863	87	2.82	148	4.80	23	0.75	51	1.67	309	10.01
2009	29,684	69	2.32	164	5.52	20	0.68	37	1.26	290	9.77
2010	29,750	74	2.49	127	4.27	36	1.22	32	1.08	269	9.04
2011	28,383	77	2.71	126	4.44	23	0.82	35	1.24	261	9.20
2012	27,676	66	2.38	123	4.44	27	0.98	34	1.24	250	9.03
2013	26,229	58	2.21	121	4.61	23	0.88	28	1.07	230	8.77
2014	25,126	70	2.79	132	5.25	34	1.36	25	1.00	261	10.39
2015	26,380	58	2.20	114	4.32	23	0.88	29	1.11	224	8.49

Table 5.15: Neonatal death rates (per 1000 live births) by gestation and ethnicity (Māori and New Zealand European prioritised mother ethnicity) 2011–2015 (excluding congenital abnormalities)

Gestation at birth (weeks)	Māori				NZ European					
	Live births	Neonatal deaths			Live births	Neonatal deaths				
	n (MAT)	n	%	Rate	n (MAT)	n	%	Rate	RR	95% CI
20–22	74	59	29.35	0.79	61	63	31.03	0.54	1.45	1.02–2.07
23–24	127	59	29.35	0.79	87	42	20.69	0.36	2.17	1.46–3.23
25–27	246	25	12.44	0.33	246	20	9.85	0.17	1.93	1.07–3.48
28–36	5,566	19	9.45	0.25	8,087	36	17.73	0.31	0.82	0.47–1.42
≥37	69,020	39	19.40	0.52	107,654	42	20.69	0.36	1.44	0.93–2.22
Total	**75,033**	**201**	**100.0**	**2.68**	**116,135**	**203**	**100.0**	**1.75**	**1.53**	**1.26–1.86**

Table 5.16: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) and year* 2006–2015

	Maternal mortality ratio			Rolling three-year ratio	
	n	n	ratio		
Māori					
2006	15,848	9	56.79		
2007	16,819	2	11.89		
2008	17,035	4	23.48	30.18	2006–2008
2009	16,900	4	23.67	19.70	2007–2009
2010	16,779	3	17.88	21.69	2008–2010
2011	16,242	5	30.78	24.04	2009–2011
2012	16,031	8	49.90	32.62	2010–2012
2013	14,899	4	26.85	36.04	2011–2013
2014	14,592	-	-	26.36	2012–2014
2015	14,873	3	20.17	15.78	2013–2015
New Zealand European					
2006	26,253	3	11.43		
2007	27,358	5	18.28		
2008	27,252	3	11.01	13.60	2006–2008
2009	26,883	2	7.44	12.27	2007–2009
2010	26,431	3	11.35	9.93	2008–2010
2011	25,170	1	3.97	7.64	2009–2011
2012	24,429	2	8.19	7.89	2010–2012
2013	23,265	6	25.79	12.35	2011–2013
2014	22,656	3	13.24	15.64	2012–2014
2015	22,234	6	26.99	22.01	2013–2015

* Denominator is MAT; numerator is PMMRC.

6 Neonatal Encephalopathy 2015

6.1 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 (Nelson and Leviton 1991). This dataset includes Sarnat stages 2 or 3 equivalent to moderate and severe only.

The introduction of induced cooling has made the definition of NE more difficult as cooling is frequently initiated before many of the defining signs of NE have appeared, and has been used for increasingly milder cases. This is evident from data in the UK TOBY Cooling Register with a decrease in the proportion of infants with suspected clinical seizures before cooling started, an increase in Apgar scores and in first blood base excess from 2007 to 2011 (Azzopardi et al 2012). It is usual to include babies who warrant cooling in the dataset even though they may, due to the ameliorative effects of the cooling, never reach the level of morbidity consistent with moderate NE.

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

Case ascertainment

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 (NEWG) widened the inclusion criteria for the NE cohort and will include cases from 35 weeks gestation at birth in line with international literature and practice of cooling from this gestation (American College of Obstetricians and Gynecologists 2014).

PMMRC numerator 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.

At the end of each year, PMMRC DHB local coordinators and key clinicians in special care and neonatal units are contacted to ensure the collection is complete.

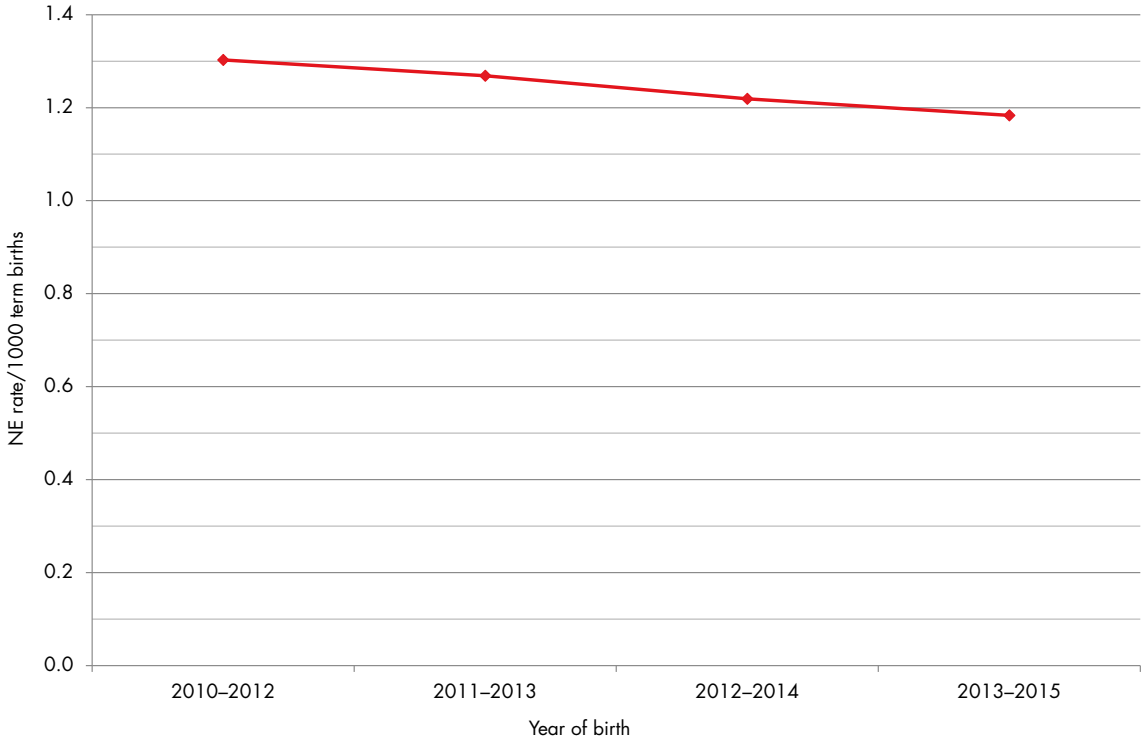
Denominator data

Denominator data, as used elsewhere in this 11th report for the first time, are the births included in the MAT dataset collated by the Ministry of Health. For calculation of rates, the denominator set was restricted to births at term (as is the numerator).

6.2 Findings

In 2015 there were 70 cases of moderate and severe NE reported to the national dataset. There have been 423 cases reported from 2010–2015, making the NE rate for 2010–2015 1.15/1000 births (95% CI 1.04–1.26) (423/368,647 births) or 1.24/1000 term births (95% CI 1.13–1.36) (423/339,781 term births). Although there appears to be a downward trend in the NE rate (Figure 6.1), there is no significant trend (chi-squared test for trend p=0.39).

Figure 6.1: Neonatal encephalopathy rates (per 1000 term births) (rolling three-year) 2010–2015



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 NE associated with intrapartum events (including mild NE) 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 1.15/1000 births for moderate and severe NE, New Zealand is within international incidence rates. Case fatality rate among babies with severe NE 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. These outcomes largely reflect the pre-cooling era.

The UK TOBY Cooling Register reported results on 48 percent of trial participants at two years of age. Although this is limited follow-up, it was felt that these children were not systematically different from all children entered in the trial. Cerebral palsy was clinically diagnosed in 22 percent (Azzopardi et al 2012).

In 2017, the NEWG has looked at preliminary data from the B4 School Check programme in New

Zealand relating to babies reported to the NEWG in the first two years of the cohort. Details of these findings will be included in the 2018 report.

Demography and neonatal encephalopathy

In this 11th report, the PMMRC has moved to reporting using the MAT dataset as the denominator for rates. While this denominator has a number of advantages in that it is the best record of births in New Zealand in a year and it includes a wealth of maternity data, the use of the MAT dataset raises the issue of the measurement of ethnicity in different routine datasets. A comparison of Figure 6.2 with Figure 3.1 in the 10th PMMRC report ('Neonatal encephalopathy rates (per 1000 term births) by maternal prioritised ethnicity 2010–2014') illustrates this (PMMRC 2016). In the report last year, the NE rate for babies of Māori mothers was reported as 1.48/1000 term babies (95% CI 1.19–1.81), and this year it is reported as 1.32/1000 term births (95% CI 1.07–1.56). It is not certain which of these is correct. The issue of ethnicity differences in the BDM and MAT denominator datasets is discussed further in section "1.2 Methodology" and chapter 5.

Mothers of Pacific ethnicity are at increased risk of having a baby with NE compared to Other Asian, Other, and New Zealand European mothers. Mothers of Māori and Indian ethnicity are at increased risk of having a baby with NE compared to mothers of Other Asian and Other ethnicities.

Increasing socioeconomic deprivation is associated with increased risk of NE. There has been a fairly consistent finding across the years of lower risk among mothers living in deprivation quintile 4 compared with quintiles 2, 3, and 5, although numbers are small and there is huge variation in the association by year. There is no obvious explanation for this finding.

There is no statistically significant association between maternal age and NE risk.

Maternal Pacific ethnicity remained a predictor of NE after adjusting for gestation at birth, year of birth, deprivation quintile, multiple pregnancy and maternal age (PMMRC 2016).

Figure 6.2: Neonatal encephalopathy rates (per 1000 term births) by maternal prioritised ethnicity (with 95% CIs) 2010–2015

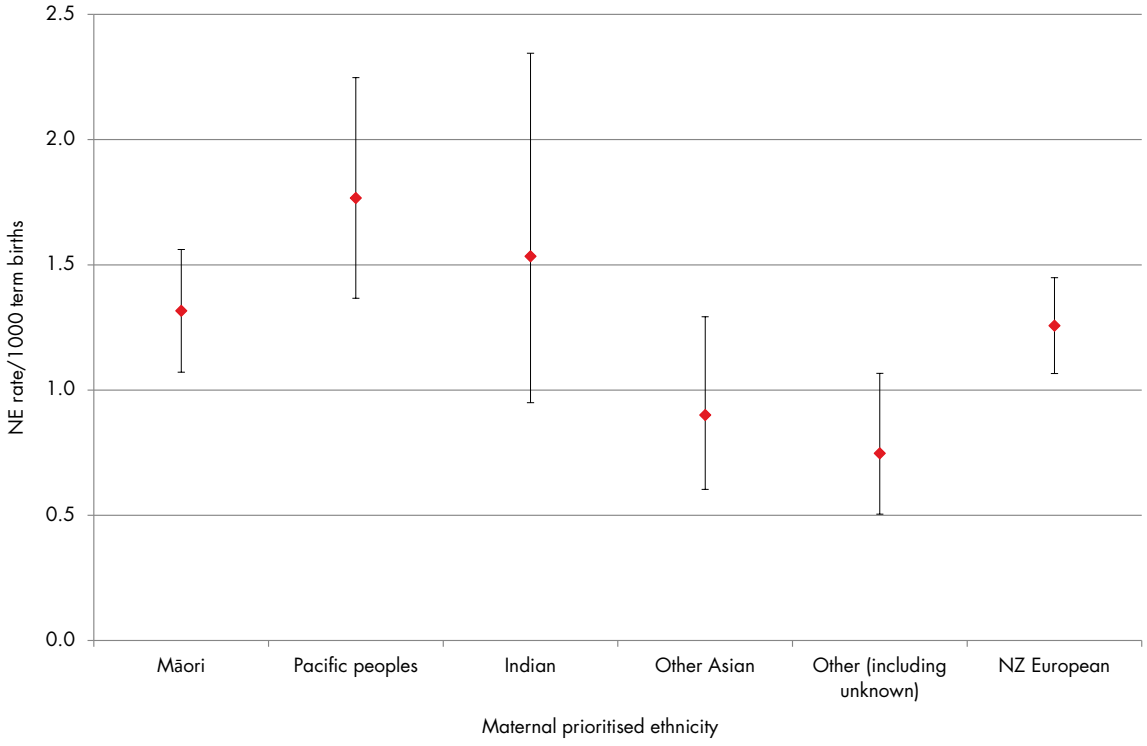
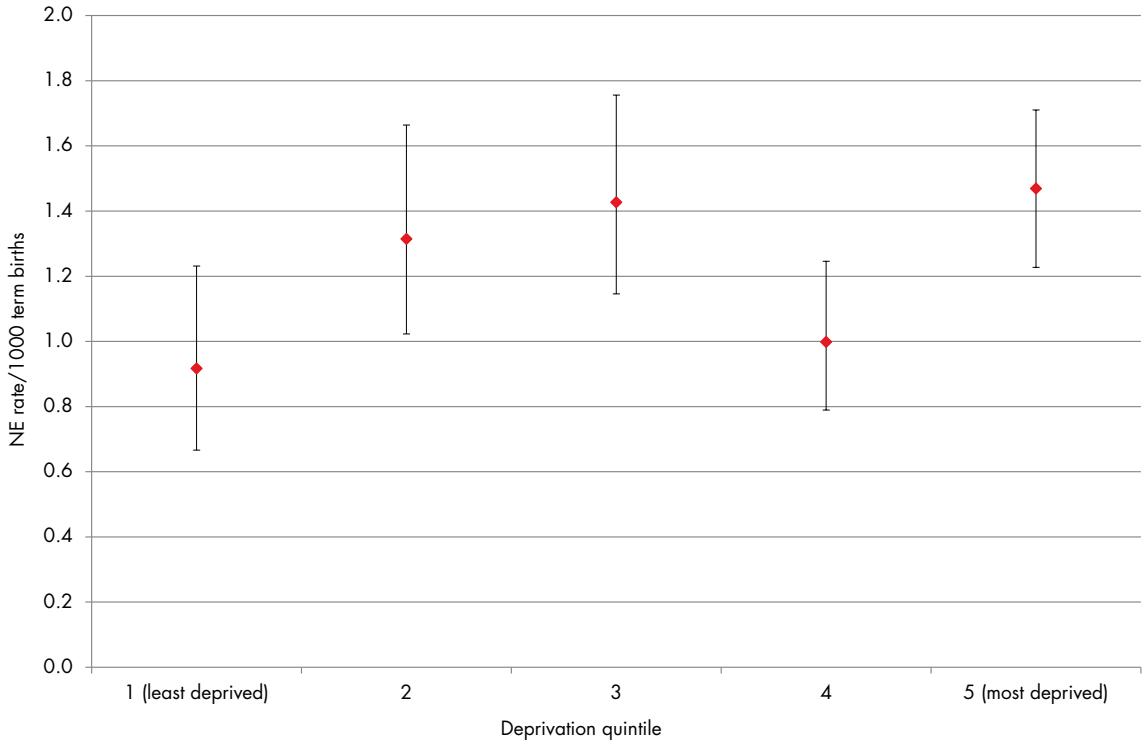
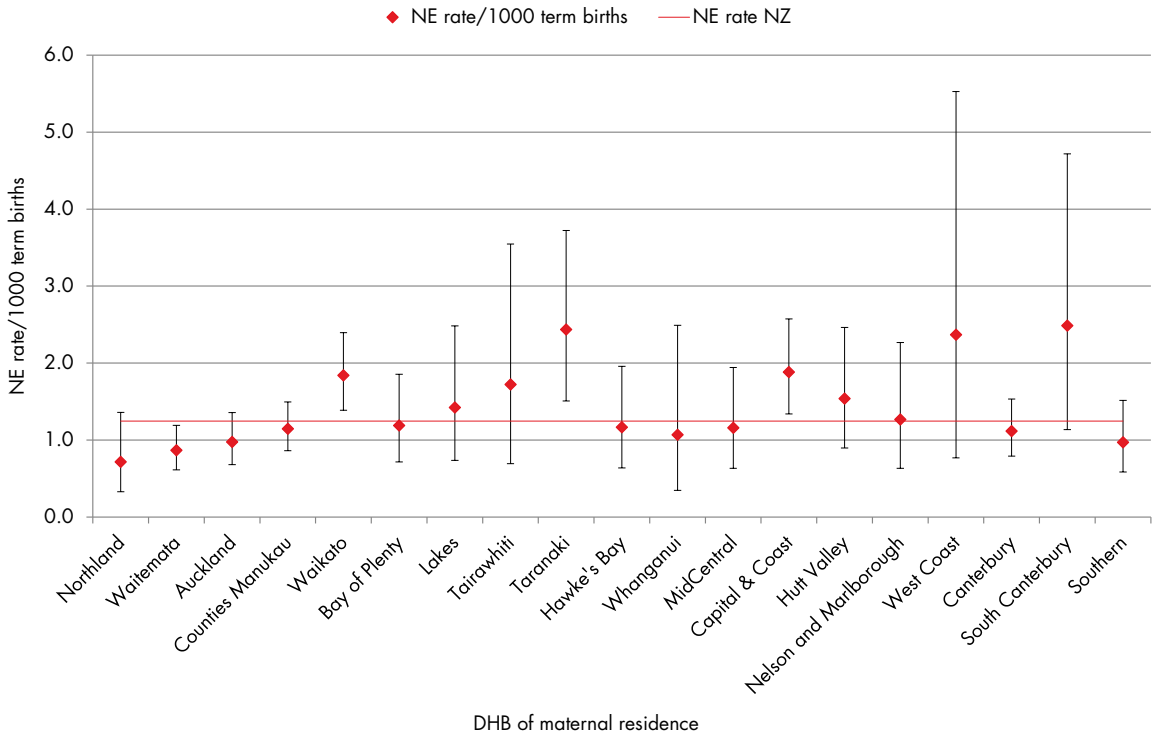


Figure 6.3: Neonatal encephalopathy rates (per 1000 term births) by deprivation quintile (with 95% CIs) 2010–2015



DHB of maternal residence

Figure 6.4: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence* compared to New Zealand neonatal encephalopathy rates (with 95% CIs) 2010–2015



* Excludes any DHB with fewer than three cases.

Figure 6.4 includes combined data for NE by DHB of maternal residence for 2010–2015.

Waikato, Taranaki, and Capital & Coast DHBs, all previously identified as outliers, have statistically higher rates of NE than the national rate. All DHBs should be routinely identifying and undertaking multidisciplinary review of cases of moderate and severe NE. In 2017, the NEWG will be asking DHBs to report on whether, and how, they have reviewed the cases reported to the NEWG from their DHB as occurring in 2016.

Previous PMMRC Recommendation (Eighth Report (PMMRC 2014))

That all DHBs review local incident cases of neonatal encephalopathy (Sarnat stages 2 and 3). The findings of these reviews should be shared at multidisciplinary local forums and form the basis of quality improvements as appropriate.

Gestation, sex, birthweight and plurality

Table 6.1: Neonatal encephalopathy rates (per 1000 term births) by gestation, sex, birthweight, plurality, parity 2010–2015

	NZ registered births ≥37 weeks		NE babies		Rate (/1000 term births)	
	n=339,781		n=423			
	n	%	n	%	/1000	95% CI
Gestation at birth (weeks)						
37	23,044	6.8	47	11.1	2.04	1.50–2.71
38	57,781	17.0	70	16.5	1.21	0.94–1.53
39	95,379	28.1	98	23.2	1.03	0.83–1.25
40	103,048	30.3	105	24.8	1.02	0.82–1.21
41	52,561	15.5	94	22.2	1.79	1.45–2.19
≥42	7,968	2.3	9	2.1	1.13	0.52–2.14
Sex						
Male	173,772	51.1	235	55.6	1.35	1.18–1.53
Female	165,992	48.9	188	44.4	1.13	0.97–1.29
Unknown	17	0.0	-	-	-	-
Birthweight (g)						
<2,500	6,190	1.8	16	3.8	2.58	1.48–4.20
2,500–3,999	267,004	78.6	355	83.9	1.33	1.19–1.47
4,000–4,499	42,472	12.5	37	8.7	0.87	0.61–1.20
≥4,500	8,595	2.5	15	3.5	1.75	0.98–2.88
Unknown	15,520	4.6	-	-	-	-
Plurality						
Singleton	334,243	98.4	414	97.9	1.24	1.12–1.36
Multiple	4,235	1.2	9	2.1	2.13	0.97–4.03
Unknown	1,303	0.4	-	-	-	-
Parity*						
0	123,932	36.5	241	57.0	1.94	1.70–2.19
1	107,534	31.6	98	23.2	0.91	0.74–1.11
2	48,222	14.2	43	10.2	0.89	0.65–1.20
3	18,860	5.6	21	5.0	1.11	0.69–1.70
≥4	15,768	4.6	20	4.7	1.27	0.77–1.96
Unknown	25,465	7.5	-	-	-	-

* Defined after birth of the index case.

There is a significant association between gestation at birth and NE risk (Table 6.1, Figure 6.5). There is a significantly higher rate of NE 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.

The higher rate of NE reported among male babies (1.35/1000 term males) compared to female babies (1.13/1000 term females) almost reaches statistical significance (p=0.069).

Babies <2500g at term were twice as likely to suffer NE than babies 2500–4000g, and almost three times as likely as babies 4000–4500g.

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

Figure 6.5: Neonatal encephalopathy rates (per 1000 term births) by gestation at birth (with 95% CIs) 2010–2015

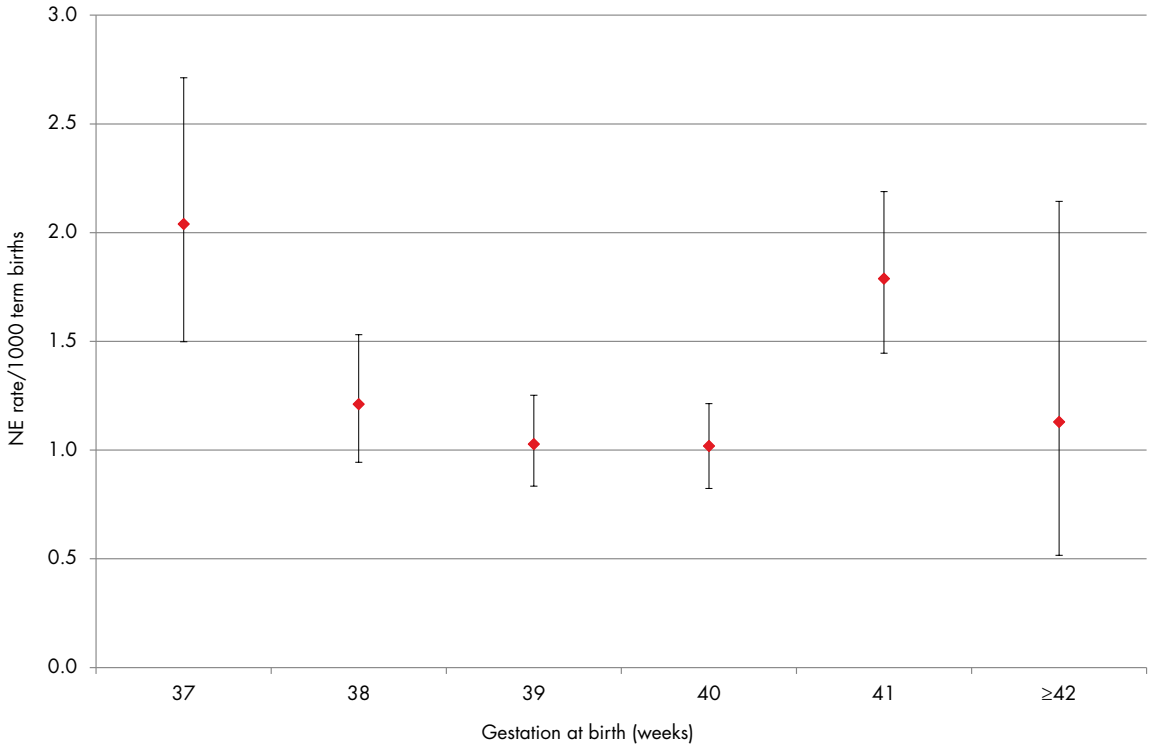
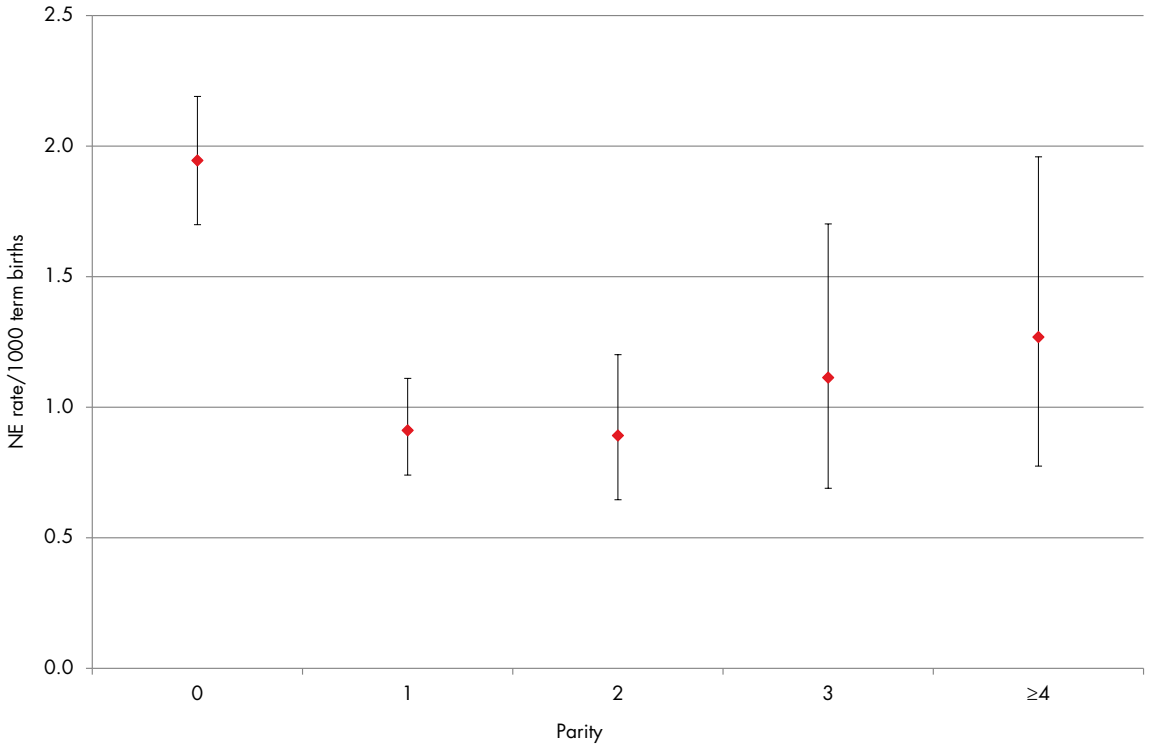


Figure 6.6 shows the association between parity and rate of NE. This is possible for the first time this year because of the use of the MAT denominator. PMMRC data are presented in the numerator and MAT data in the denominator. The rate of NE among first births is twice that among second and third births, and 1.7 times that of fourth births, but not significantly higher than fifth or later births (p=0.06) (Figure 6.6).

Figure 6.6: Neonatal encephalopathy rates (per 1000 term births) by parity prior to index birth (with 95% CIs) 2010–2015



Maternal smoking, BMI and gestation at first antenatal visit

Table 6.2: Maternal smoking, body mass index (BMI) and gestation at first antenatal visit among neonatal encephalopathy cases 2010–2015

	NE cases n=423	
	n	%
Currently smoking		
Yes	80	18.9
No	339	80.1
Unknown	4	0.9
Maternal BMI (kg/m2)		
<18.50	3	0.7
18.50–25.49	152	35.9
25.50–30.49	123	29.1
≥30.50	121	28.6
Missing data for height and or weight	24	5.7
Gestation first antenatal visit (weeks)		
≤13	262	61.9
14–19	56	13.2
≥20	58	13.7
Unknown	47	11.1

As described in section "1.2 Methodology"', the numerator data in the PMMRC dataset for smoking and BMI are not congruent with the MAT data. To calculate rates of NE by smoking and BMI, the NE numerator data need to be merged with the MAT dataset. This is planned for the next PMMRC report.

Table 6.2 shows smoking, BMI and gestation at first antenatal visit for cases identified from 2010–2015.

Among all mothers birthing in New Zealand with data in the MAT dataset in 2015, 14.2 percent of mothers with smoking data in the MAT dataset were smokers at registration with LMC care, compared to 18.9 percent of mothers of babies diagnosed with NE, suggesting an association between smoking and NE.

Among mothers of babies diagnosed with NE, 28.6 percent had a BMI of 30.5 or greater compared to 20.6 percent among all mothers birthing in New Zealand in 2015, suggesting an increase in risk of NE 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 NE, and smoking and NE, may be due to confounding factors such as socioeconomic status.

Customised birthweight, antenatal complications and maternal outcome

Table 6.3: Customised birthweight centiles, antenatal complications and maternal outcome among neonatal encephalopathy cases by Sarnat stage 2010–2015

	NE cases		Primiparous (=1)		Multiparous (≥2)		Sarnat stage			
							Moderate		Severe	
	n=423		n=241		n=182		n=293		n=130	
	n	%	n	%	n	%	n	%	n	%
Customised birthweight centiles										
Small for gestational age	77	18.2	44	18.3	33	18.1	55	18.8	22	16.9
Appropriate for gestational age	312	73.8	184	76.3	128	70.3	210	71.7	102	78.5
Large for gestational age	34	8.0	13	5.4	21	11.5	28	9.6	6	4.6
Antenatal complications										
APH (≥20 weeks vaginal bleeding)	45	10.6	23	9.5	22	12.1	30	10.2	15	11.5
Hypertension	53	12.5	38	15.8	15	8.2	41	14.0	12	9.2
Pre-eclampsia	6	1.4	5	2.1	1	0.5	6	2.0	-	0.0
Gestational hypertension	18	4.3	14	5.8	4	2.2	17	5.8	1	0.8
Unspecified hypertension	29	6.9	19	7.9	10	5.5	18	6.1	11	8.5
Maternal trauma (antenatal)*	8	1.9	5	2.1	3	1.6	4	1.4	4	3.1
Induction of labour	102	24.1	65	27.0	37	20.3	75	25.6	27	20.8
Augmentation of labour	158	37.4	109	45.2	49	26.9	124	42.3	34	26.2
Epidural anaesthesia	114	27.0	83	34.4	31	17.0	89	30.4	25	19.2
Maternal outcome										
Deceased	4	0.9	1	0.4	3	1.6	2	0.7	2	1.5
Alive but with serious morbidity	10	2.4	3	1.2	7	3.8	5	1.7	5	3.8
Alive and well	409	96.7	237	98.3	172	94.5	286	97.6	123	94.6

* Vehicular, violent personal injury, other.

Among babies with NE from 2010–2015, 18 percent were small by customised birthweight centile, and this is higher than expected (around 12 percent in the birthing population), suggesting SGA babies are at higher risk of NE.

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 NE (24.1 percent, 27.0 percent and 20.3 percent respectively) (Ministry of Health 2015b).

Among mothers of babies diagnosed with NE, 27.0 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 NE data collection, there have been four cases associated with maternal death and 10 with severe maternal morbidity. Of these 14 babies, seven had severe NE (50 percent) compared with 31 percent severe NE among all 423 cases of NE.

Peripartum complications and mode of birth

Acute peripartum events were reported in 101 cases (24 percent). Of these, abruption (31 cases) and shoulder dystocia (26 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 NE, 43 percent were born by caesarean section, 31 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).

Eight babies (1.9 percent) were breech vaginal births at term, compared to 0.5 percent vaginal breech births in New Zealand in 2014 (Ministry of Health 2015b).

In 2016–2017 the NEWG has reviewed the maternity and early neonatal care of 48 babies born with NE in 2013–2015 who had an acute peripartum event. The findings of these reviews will be reported in the 12th report of the PMMRC in 2018.

Table 6.4: Peripartum complications and mode of birth among neonatal encephalopathy cases 2010–2015

	Total NE cases	
	n=423	
	n	%
Acute peripartum events	101	23.9
Cord prolapse	17	4.0
Abruption	31	7.3
Uterine rupture	9	2.1
Shoulder dystocia	26	6.1
Breech complication	9	2.1
Other complication	9	2.1
Liquor		
Blood stained	36	8.5
Thick meconium	89	21.0
Thin meconium	53	12.5
Mode of birth		
Normal vaginal birth	171	40.4
Operative vaginal birth	62	14.7
Forceps	25	5.9
Ventouse	35	8.3
Unknown	2	0.5
Vaginal breech birth	8	1.9
Caesarean section birth	182	43.0
Elective	9	2.1
Prelabour emergency	40	9.5
Antepartum haemorrhage/Abruption	5	1.2
Suspected fetal distress	28	6.6
Failed induction	1	0.2
Other	6	1.4
In labour emergency	133	31.4
Antepartum haemorrhage/Abruption	10	2.4
Suspected fetal distress	94	22.2
Failure to progress/Cephalopelvic disproportion	11	2.6
Other	17	4.0
Unknown	1	0.2
Attempt at operative vaginal birth before caesarean	12	2.8

Place of birth

From 2010 to 2015, there were eight babies with NE who were birthed at home as intended. This is 1.9 percent of all cases of moderate or severe NE (Table 6.12). Eleven babies diagnosed with NE (2.6 percent) birthed at home. 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).

Previous PMMRC reports have shown that there is no association between place of birth and induced cooling among babies born in New Zealand with moderate and severe NE. More detail on intended and actual place of birth can be found in Table 6.12.

LMC and neonatal encephalopathy rates

Consideration was given in this report to including rates of NE by LMC at registration because these data are collected by the NEWG, are available in the MAT denominator dataset, and because this question has been raised nationally (Wernham et al 2016).

However, these data have not been included in this report for two reasons. Firstly, the denominator data do not accurately represent the models of maternity care available during the time period 2010–2015. For example, there is no category for the model of shared GP and DHB primary care previously available at Counties Manukau DHB. Women under primary care at DHBs who are not currently providing data to the Ministry of Health are recorded as 'no LMC care', which cannot be separated from women who were truly not registered with an LMC. Secondly, New Zealand has an integrated model of maternity care, with referral guidelines (Ministry of Health 2012a) outlining processes and guidance for consultation, referral, and transfer of responsibility for care in response to maternal need that does not facilitate division of care by individual caregiver, and so the numerator data are not fit for the purpose either.

The NEWG has previously reported on case review of cases of NE where there was no acute peripartum event (Sadler et al 2016) and are currently undertaking review of cases where there was an acute peripartum event. During this latter review, specific effort has been made to identify the responsible clinician at various intervals in the process, and to identify instances where there was delay in recognising a need for consultation and/or referral or a delay in providing consultation and/or transfer, and these data will be presented with the results of this review. The original case review did not specifically look at the potential role of the caregiver, or a group of caregivers, in the aetiology of NE, but also did not find this to be an identified contributing factor.

Immediate newborn wellbeing

Table 6.5: Immediate newborn wellbeing among neonatal encephalopathy babies 2010–2015

	2010		2011		2012		2013		2014		2015		Total	
	n=82		n=67		n=79		n=70		n=55		n=70		n=423	
	n	%	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	38	54.3	251	59.3
Apgar score <5 at 1 minute	65	79.3	54	80.6	62	78.5	58	82.9	49	89.1	50	71.4	338	79.9
Apgar score <7 at 1 minute	73	89.0	61	91.0	70	88.6	65	92.9	53	96.4	58	82.9	380	89.8
Apgar score <7 at 5 minutes	61	74.4	54	80.6	62	78.5	57	81.4	43	78.2	49	70.0	326	77.1
Apgar score <7 at 10 minutes	39	47.6	38	56.7	49	62.0	32	45.7	29	52.7	34	48.6	221	52.2
Apgar score <9 at 10 minutes	52	63.4	52	77.6	62	78.5	52	74.3	45	81.8	47	67.1	310	73.3
Cord blood gases: summary data														
Normal (none of pH ≤7, BE ≤–12, lactate ≥6)	12	14.6	14	20.9	11	13.9	13	18.6	7	12.7	8	11.4	65	15.4
Abnormal (any of pH ≤7, BE ≤–12, lactate ≥6)	47	57.3	41	61.2	55	69.6	48	68.6	40	72.7	47	67.1	278	65.7
No gases reported	23	28.0	12	17.9	13	16.5	9	12.9	8	14.5	15	21.4	80	18.9
No gases and Apgar score <7 at 1 minute	14	17.1	8	11.9	8	10.1	6	8.6	8	14.5	6	8.6	50	11.8
No gases and Apgar score ≥7 at 1 minute	8	9.8	4	6.0	5	6.3	3	4.3	-	-	9	12.9	29	6.9
No gases and unknown Apgar score	1	1.2	-	-	-	-	-	-	-	-	-	-	1	0.2

BE = base excess.

Fifty-nine percent of the babies diagnosed with moderate or severe NE from 2010 to 2015 had an Apgar score under 3 at one minute, 80 percent under 5 at one minute, 77 percent under 7 at five minutes, and 52 percent still had a score under 7 at 10 minutes. Sixty-six 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 12 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 NE have evidence of asphyxia at birth.

There was a statistically significant reduction in the proportion of babies without cord gases reported from 2010 (28%) to 2014 (15%) (chi-squared test for trend p=0.02), but the proportion without cord gases increased to 21 percent in 2015. In 2015, nine of the 15 babies who did not have a cord gas taken had an Apgar score of 8 or 9 at one minute, and therefore cord gas may not have been indicated.

The practice of collection and review of umbilical cord bloods may vary by DHB. For reference, the Auckland DHB guideline on management of umbilical cord blood results is given below.

Management of Umbilical Cord Blood Results

Management of umbilical cord lactate results

Cord lactates should be taken and processed within 10 minutes of cord clamping.

Umbilical cord lactate result	Action
Less than 6.0	Document results
6.0 or above	Send paired umbilical cord gases

Management of umbilical cord gas results

Umbilical cord gases can be analysed within one hour of birth if clamped immediately after delivery. Both umbilical cord arterial and venous gases should be analysed.

Umbilical cord gas result	Action
pH less than 7.0 or base excess less than or equal to –12 mmol/L	Call paediatrician for review.
pH 7.0–7.15 or base excess –11 to –7 mmol/L Or umbilical cord gas result not available and cord lactate greater than or equal to 6.0 mmol/L	Monitor baby for signs of neonatal encephalopathy (hypotonia, poor feeding, lethargy, weak or absent suck/gag or Moro reflex, seizures). Call paediatrician if any concerns.
pH above 7.15 *and* base excess above –7 mmol/L	Document results.

(Auckland District Health Board 2017)

Induced cooling

Table 6.6: Induced cooling therapy among neonatal encephalopathy babies 2010–2015

Cooling	2010		2011		2012		2013		2014		2015		Total	
	n=82		n=67		n=79		n=70		n=55		n=70		n=423	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Yes	56	68.3	51	76.1	62	78.5	58	82.9	45	81.8	56	80.0	328	77.5
No	26	31.7	16	23.9	17	21.5	12	17.1	10	18.2	14	20.0	95	22.5
Age at cooling	n=56		n=51		n=62		n=58		n=45		n=56		n=328	
≤6 hours	46	82.1	39	76.5	53	85.5	47	81.0	39	86.7	44	78.6	268	81.7
>6 hours	10	17.9	8	15.7	9	14.5	11	19.0	6	13.3	11	19.6	55	16.8
Unknown time	-	-	4	7.8	-	-	-	-	-	-	1	1.8	5	1.5

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

In 2015, 80 percent of babies born in New Zealand with moderate or severe NE were treated with induced cooling. The proportion of those cooled who were cooled within six hours of birth as recommended for maximal benefit was 79 percent. There has been little change in this rate over the years of data collection.

In the dataset from 2011 to 2014 (four years) 54 neonates were reported as not receiving full body cooling for NE. Twenty-two of these have been diagnosed with severe NE (grade III) and 32 with moderate NE (grade II). Eighteen out of the 22 severe NE cases died, and one of the moderate group.

Upon reviewing these cases, it seemed 20 of the 22 severe case infants were appropriately not cooled, reasons including early neonatal death, withdrawal of care, disseminated infection, and one late presentation with seizures on day 2. In only two severe cases cooling could have possibly been initiated; one infant was transferred to level 3 at 12h, the other developed seizures at 4h of age with normal cord gases.

In the moderate group it was determined that 23 were appropriately not cooled, reasons ranging from late presentations, to NE not related to hypoxic ischemic encephalopathy (HIE), and one case was considered but did not proceed to cooling. Of the remaining nine infants, cooling may have been indicated, as low pH on cord gases and earlier consultation could have prompted a transfer to a tertiary unit.

This review will lead to an addition to the dataset asking for 'reason not cooled'.

Neonatal resuscitation

Table 6.7: Neonatal resuscitation and early neonatal management by Sarnat stage among neonatal encephalopathy babies 2010–2015

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=423		n=293		n=130	
	n	%	n	%	n	%
Resuscitation at birth						
Yes	387	91.5	266	90.8	121	93.1
No	36	8.5	27	9.2	9	6.9
Type of resuscitation at birth						
Oxygen only	5	1.2	4	1.4	1	0.8
IPPV with mask	268	63.4	191	65.2	77	59.2
IPPV with ETT	233	55.1	141	48.1	92	70.8
Cardiac massage	166	39.2	88	30.0	78	60.0
Adrenaline	74	17.5	25	8.5	49	37.7
Respiratory and ventilation management						
Mechanical ventilation	339	80.1	223	76.1	116	89.2
Nitric oxide	94	22.2	61	20.8	33	25.4
Infection						
Positive blood culture	16	3.8	11	3.8	5	3.8
Antibiotics	386	91.3	275	93.9	111	85.4
Anticonvulsant therapy	300	70.9	201	68.6	99	76.2
Phenobarbitone	276	65.2	179	61.1	97	74.6
Phenytoin	82	19.4	39	13.3	43	33.1
Benzodiazepines	102	24.1	62	21.2	40	30.8
Other	32	7.6	23	7.8	9	6.9

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

Table 6.7 (along with Table 6.5) further illustrates the poor condition of many babies who develop NE at birth. Among the cohort of 423 NE babies from 2010–2015, 92 percent were resuscitated at birth, 39 percent required cardiac massage, 17.5 percent adrenalin, and 55 percent intubation and intermittent positive pressure ventilation.

In the dataset from 2011 to 2014 (four years), 18 neonates were reported as not receiving resuscitation at birth. Sixteen of these were reported as moderate and two as severe NE/HIE. On reviewing these cases, it seemed that in 10 cases, although there was no apparent need for resuscitation at birth, NE/HIE was recognised on clinical grounds/cord pH, and two of these neonates received body cooling. Other reasons for no resuscitation at birth were later presentation with parechovirus encephalitis (day 7), *Streptococcus* A sepsis day 2, inborn error of metabolism day 5, and four vascular events which would not have benefitted from earlier recognition and/or body cooling. One baby was retrospectively diagnosed with moderate HIE (on MRI) after developing seizures at 32h, and it remains unclear whether earlier recognition was possible.

Table 6.8: Use of cooling and outcomes of encephalopathy by Sarnat stage among neonatal encephalopathy babies 2010–2015

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=423		n=293		n=130	
	n	%	n	%	n	%
Induced cooling						
Yes	328	77.5	236	72.0	92	28.0
No	95	22.5	57	60.0	38	40.0
Deceased						
Yes	82	19.4	5	6.1	77	93.9
No	341	80.6	288	84.5	53	15.5

Babies with severe NE were significantly less likely to receive induced cooling (71 percent compared to 81 percent; p=0.03). 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 2 percent). Of the 80 babies with NE who died within the perinatal period, 18 (22 percent) died within the first day, 60 (74 percent) within the first three days, and 72 (89 percent) died within the first week of birth. A further eight babies died after one week but within four weeks of birth, and two babies died in the post-neonatal period (five and six weeks). As of the year ended December 2015, a further nine babies died after discharge from three months to five years of age.

Investigations and neonatal outcome by Sarnat stage (survivors)

Table 6.9: Investigations and neonatal outcome by Sarnat stage of neonatal encephalopathy survivors 2010–2015

Investigations	2010		2011		2012		2013		2014		2015		Total NE survivors		Sarnat stage			
															Moderate		Severe	
	n=59		n=54		n=67		n=59		n=44		n=58		n=341		n=288		n=53	
	n	%	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	29.0	50.0	157	46.0	149	51.7	8	15.1
Mild or moderate abnormality	14	23.7	20	37.0	19	28.4	23	39.0	17	38.6	14.0	24.1	107	31.4	88	30.6	19	35.8
Severe abnormality	3	5.1	1	1.9	5	7.5	5	8.5	3	6.8	4.0	6.9	21	6.2	3	1.0	18	34.0
Not examined	1	1.7	4	7.4	7	10.4	5	8.5	2	4.5	3.0	5.2	22	6.5	19	6.6	3	5.7
Examined but finding unknown	3	5.1	1	1.9	5	7.5	2	3.4	2	4.5	2.0	3.4	15	4.4	11	3.8	4	7.5
Missing data	6	10.2	3	5.6	1	1.5	-	-	3	6.8	6.0	10.3	19	5.6	18	6.3	1	1.9
EEG investigation done at ≤3 days of life*	40	67.8	25	46.3	34	50.7	50	84.7	40	90.9	51.0	87.9	240	70.4	198	68.8	42	79.2
MRI (investigation done)	41	69.5	35	64.8	43	64.2	50	84.7	38	86.4	48.0	82.8	255	74.8	203	70.5	52	98.1
No MRI or Unknown	18	30.5	19	35.2	24	35.8	9	15.3	6	13.6	10.0	17.2	86	25.2	85	29.5	1	1.9
Results of MRI																		
Moderately/Severely abnormal	16	27.1	11	20.4	17	25.4	22	37.3	13	29.5	15.0	25.9	94	27.6	59	20.5	35	66.0
Normal or only mildly abnormal	24	40.7	23	42.6	24	35.8	27	45.8	25	56.8	33.0	56.9	156	45.7	140	48.6	16	30.2
Unknown result	1	1.7	1	1.9	2	3.0	1	1.7	-	-	-	-	5	1.5	4	1.4	1	1.9

* Typically cot-side monitoring such as BrainZ.
EEG = electroencephalogram.
MRI = magnetic resonance imaging (of the brain).

There has been an increase in the proportion of surviving babies who had an MRI investigation since collection of NE data began, from 70 percent in 2010 to 86 percent in 2014 (83 percent in 2015).

Of survivors during 2010–2015, 28 percent had a moderately or severely abnormal MRI (21 percent of moderate and 66 percent of severe cases) and 46 percent had a normal or only mildly abnormal scan (49 percent of moderate and 30 percent of severe cases). Twenty-five percent of survivors during 2010–2015 did not have an MRI (30 percent of moderate and 2 percent of severe cases).

2016 Survey of DHBs and Discharge Examination for Babies Diagnosed with Neonatal Encephalopathy

In 2016 Clinical Directors of Neonatal Intensive Care and Special Care Baby Units were asked to provide details of discharge examination for babies diagnosed with NE.

This included:

- which tool, if any, was used for the discharge examination for babies diagnosed with NE
- if a formal tool was not used for the discharge examination for babies diagnosed with NE, whether they had considered using a formal tool (such as the Dubowitz examination)
- what they thought were the barriers to using a formal tool for the discharge examination
- details of where the result of examination was documented.

All six Level 3 Units advised that they use a formal tool to assist with the discharge examination for babies diagnosed with NE, either the Dubowitz examination or a modification of this. The practice was less consistent in the Level 2 Units. The barriers identified to the use of a formal tool included training in the use of the tool and interpretation of the findings given small numbers of babies diagnosed with NE in their DHBs.

Previous Recommendation (Seventh Report (PMMRC 2013))

In cases of neonatal encephalopathy (Sarnat stages 2 and 3):

All babies with encephalopathy should undergo investigation to predict prognosis, including formal neurological examination, cerebral magnetic resonance imaging (MRI) and, if available, formal electroencephalography (EEG)

All parents of an affected child should have a formal discussion with the neonatologist/paediatrician providing care in order to review the prognosis and ongoing care of their child.

6.3 Neonatal Encephalopathy Appended Tables

Table 6.10: Neonatal encephalopathy rates (per 1000 term births) by prioritised maternal ethnicity, maternal age and deprivation quintile 2010–2015

	NZ registered births ≥37 weeks		NE cases		Rate (/1000 term births)	
	n=339,781		n=423			
	n	%	n	%	/1000	95% CI
Maternal ethnicity						
Māori	84,321	24.8	111	26.2	1.32	1.07–1.56
Pacific peoples	37,362	11.0	66	15.6	1.77	1.37–2.25
Indian	13,689	4.0	21	5.0	1.53	0.95–2.35
Other Asian	32,213	9.5	29	6.9	0.90	0.60–1.29
Other (including unknown)	40,148	11.8	30	7.1	0.75	0.50–1.07
NZ European	132,048	38.9	166	39.2	1.26	1.07–1.45
Maternal age (years)						
<20	19,795	5.8	28	6.6	1.41	0.94–2.04
20–34	248,554	73.2	316	74.7	1.27	1.13–1.41
35–39	57,495	16.9	63	14.9	1.10	0.84–1.40
≥40	13,931	4.1	16	3.8	1.15	0.66–1.87
Unknown	6	0.0				
Deprivation quintile						
1 (least deprived)	47,980	14.1	44	10.4	0.92	0.67–1.23
2	52,482	15.4	69	16.3	1.31	1.02–1.66
3	62,378	18.4	89	21.0	1.43	1.15–1.76
4	78,121	23.0	78	18.4	1.00	0.79–1.25
5 (most deprived)	96,665	28.4	142	33.6	1.47	1.23–1.71
Unknown	2,155	0.6	1	0.2	-	-

Table 6.11: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence 2010–2015

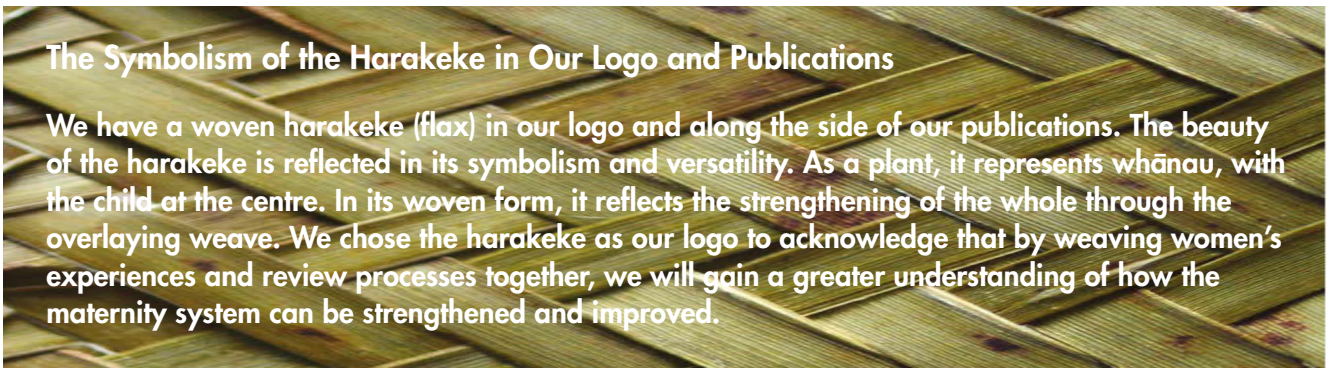
DHB of residence	NZ registered births ≥37 weeks	2010	2011	2012	2013	2014	2015	Total NE cases	Rate (/1000 term births)	
	n=339,781	n=82	n=67	n=79	n=70	n=55	n=70	n=423		
	n	n	n	n	n	n	n	n	/1000	95% CI
Northland	12,562	2	2	2	1	1	1	9	0.72	0.33–1.36
Waitemata	43,822	10	6	4	5	9	4	38	0.87	0.61–1.19
Auckland	35,869	4	8	4	8	5	6	35	0.98	0.68–1.36
Counties Manukau	47,137	14	11	14	6	5	4	54	1.15	0.86–1.49
Waikato	29,890	14	9	9	5	6	12	55	1.84	1.39–2.40
Bay of Plenty	16,000	3	4	2	3	1	6	19	1.19	0.71–1.85
Lakes	8,438	2	4	2	1	1	2	12	1.42	0.73–2.48
Tairawhiti	4,067	1	2	2	1	1	-	7	1.72	0.69–3.55
Taranaki	8,623	2	-	6	5	4	4	21	2.44	1.51–3.72
Hawke's Bay	12,006	2	1	3	2	3	3	14	1.17	0.64–1.96
Whanganui	4,686	1	-	2	1	-	1	5	1.07	0.35–2.49
MidCentral	12,099	2	1	2	3	2	4	14	1.16	0.63–1.94
Wairarapa	2,830	1	-	-	-	1	-	2	0.71	0.09–2.55
Capital & Coast	20,716	6	4	9	10	3	7	39	1.88	1.34–2.57
Hutt Valley	11,048	4	4	2	5	2	-	17	1.54	0.90–2.46
Nelson and Marlborough	8,682	-	1	2	5	1	2	11	1.27	0.63–2.27
West Coast	2,111	-	1	2	-	2	-	5	2.37	0.77–5.53
Canterbury	34,042	11	6	7	2	6	6	38	1.12	0.79–1.53
South Canterbury	3,621	1	2	2	1	-	3	9	2.49	1.14–4.72
Southern	19,574	2	1	3	6	2	5	19	0.97	0.58–1.52
Other	1,958	-	-	-	-	-	-	-	-	-

* Other includes Overseas, Unknown and Other.

Table 6.12: Actual and intended place of birth among neonatal encephalopathy cases 2010–2015

Intended place of birth	NE cases		Actual place of birth											
	n=423		Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3		Other	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home	15	3.5	8	53.3	-	-	-	-	5	33.3	2	13.3	-	-
Birthing unit	55	13.0	1	1.8	22	40.0	-	-	7	12.7	25	45.5	-	-
Hospital level 1	22	5.2	-	-	-	-	7	31.8	3	13.6	12	54.5	-	-
Hospital level 2	165	39.0	1	0.6	-	-	2	1.2	156	94.5	5	3.0	1	0.6
Hospital level 3	160	37.8	1	0.6	-	-	1	0.6	1	0.6	157	98.1	-	-
Unknown	6	1.4	-	-	-	-	-	-	2	33.3	4	66.7	-	-
Total	**423**		**11**	**2.6**	**22**	**5.2**	**10**	**2.4**	**174**	**41.1**	**205**	**48.5**	**1**	**0.2**

7 Maternal Morbidity



7.1 Introduction

A Maternal Morbidity Working Group (MMWG) was established in May 2016, as a working group of the PMMRC, responsible for reviewing maternal morbidity and developing recommendations and quality improvement initiatives to help reduce maternal morbidity in New Zealand. This chapter serves as the first annual report of the MMWG, and explains the importance of learning from maternal morbidity, progress so far, and plans for the future.

Severe acute maternal morbidity (also known as maternal 'near miss') can be defined as 'a very ill pregnant or recently delivered woman who would have died had it not been luck or good care was on her side' (Mantel et al 1998).

The PMMRC and other researchers (O'Malley et al 2016) use maternal death statistics and birth outcome records to measure the quality of maternity care. As maternity care has improved, the number of maternal deaths has decreased, and severe acute maternal morbidity has become another measure of the quality of maternity care in New Zealand (Lawton et al 2014; MacDonald et al 2016; Ministry of Health 2016; Sadler et al 2013) and in other developed countries (Say et al 2004). By reviewing cases of severe acute maternal morbidity, we can explore how our health system responds to women with serious and acute conditions, and identify potential improvements in maternity care.

To date, the largest audit of severe maternal morbidity in New Zealand is the Severe Acute Maternal Morbidity (SAMM) audit, run by the University of Otago and funded by the Ministry of Health. In this audit, clinicians met to review cases of severe maternal morbidity, defined as admission of a pregnant or postpartum woman to an intensive care unit, and determine whether the severe morbidity was potentially avoidable. The audit was external and multidisciplinary. In 2011, after a pilot at one DHB, the audit was extended to four DHBs, and then in 2013 introduced to all 20 DHBs (MacDonald et al 2016).

The results of the SAMM audit across the 20 DHBs are not yet published. The pilot within four DHBs (Lawton et al 2014) of 98 cases found 39 percent were identified as potentially avoidable and 37 percent as not avoidable but improvements in care were needed. The most common factors among potentially avoidable cases were related to clinical care: 71 percent of cases delayed or inappropriate treatment and 52 percent delayed or failure to diagnose or recognise high-risk status. The most common conditions were major postpartum haemorrhage (45 percent) and sepsis (17 percent), and 75 and 47 percent of these were potentially avoidable or needed improvement in care respectively.

An internal multidisciplinary review undertaken at Auckland DHB of two years of intensive care admissions of pregnant women and women in the postpartum period found similar results to the SAMM audit (Sadler et al 2013). Forty-eight percent of cases were identified as potentially avoidable, and contributory factors were found in a further 23 percent. The most common factor identified among potentially avoidable cases was lack of recognition of the complexity or seriousness of a condition by a caregiver (45 percent of cases). The most common conditions in potentially avoidable cases were again blood loss (27 percent of potentially avoidable cases) and sepsis (23 percent), which were two of the three most common reasons for admission to intensive care.

The role of the Maternal Morbidity Working Group

In March 2015, the Minister of Health announced that the SAMM audit would transition from its nascence as a research project to become a national review under the auspices of the Health Quality & Safety Commission (the Commission). The new programme transitioned to the Commission on 30 June 2016 as a working group of the PMMRC, incorporating the previous Australasian Maternity Obstetric Surveillance System (AMOSS) working group, and is funded until 30 June 2019. To provide governance for the programme, the MMWG was established comprising clinicians and consumers in the maternity sector. The terms of reference and membership can be found on the PMMRC web page (http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/maternal-morbidity-and-mortality-information/mmwg/).

The MMWG vision is 'better maternity outcomes for New Zealand women' and its aim is 'to improve the quality and experience of maternity care for women, babies and whānau, informed by robust, consistent, reportable and women-centred maternal morbidity review'.

To achieve this aim, the MMWG plans to:

- systematically review cases of severe maternal morbidity to identify 'potentially avoidable factors' and opportunities to improve care
- develop system-level recommendations, in collaboration with the sector, from the findings of these reviews
- develop and implement quality improvement initiatives, in collaboration with the sector, based on the recommendations.

The MMWG will collaborate with the national organisations who work to improve the care of pregnant women to ensure that their work streams are aligned.

MMWG activities in 2016

Since its establishment in May 2016, the MMWG has:

- developed and evaluated a methodology to review cases of severe maternal morbidity
- sought nominations and appointed members to multidisciplinary regional review panels, including consumers
- developed the terms of reference for these panels (available at http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/maternal-morbidity-and-mortality-information/mmwg/)
- added a section to the PMMRC website dedicated to introducing the MMWG's work, and providing resources and information for clinicians and consumers

- developed a process for women who have experienced severe maternal morbidity to share their experience, which will inform the review panels
- conducted a stocktake to identify the strengths of local review of severe maternal morbidity cases in DHBs
- visited DHBs to discuss maternal morbidity and the work programme, which has strengthened the relationship between maternity and critical care services.

7.2 Reviews of Serious Acute Maternal Morbidity

Guiding principles of reviews

In developing a methodology for reviewing severe maternal morbidity, the MMWG identified four guiding principles. Maternal morbidity reviews will:

- focus on systems and processes (ie, not review individual clinicians or assign blame)
- identify aspects of systems or processes that could potentially have avoided or lessened the severity of the morbidity
- include the wider context (be woman-centred) and include information from all care providers and the experience of the woman and her whānau (if provided)
- 'close the loop' and identify opportunities for quality improvement in the maternity sector.

Defining and identifying cases

There are a number of different ways to identify cases, including resource-intensive audits of clinical records, analysis of administrative health data (Say et al 2004), queries of clinical databases, and negative reporting by individual clinicians as used by AMOSS in Australia and New Zealand in recent years.

The previous SAMM audit in New Zealand selected a proportion of maternity admissions to intensive care units (ICUs) and high dependency units (HDUs) for panel review (Lawton et al 2014). Previous research has shown that nearly all maternity ICU admissions are cases of severe morbidity (ie, high specificity) and make up more than three quarters of all severe acute maternal morbidity (ie, high sensitivity) (Geller et al 2004; You et al 2012).

ICUs and HDUs (including HDU-level units in maternity services) in New Zealand notify the MMWG whenever a pregnant or recently pregnant woman is admitted to their unit. The MMWG received 121 notifications of admissions between September 2016 and December 2016, comparable to the number received in the SAMM audit in a similar period. Notifications include demographics, reason for admission, and treatment received.

Instead of selecting a proportion of cases for panel review, cases will be selected based on specific criteria, which will be reconsidered each year based on trends in maternal morbidity and feedback from the maternity sector. The conditions from 2016 for review are severe maternal sepsis and unplanned peripartum hysterectomy.

Severe maternal sepsis is caused by the body's reaction to infection (eg, pneumonia or urinary tract infection). We estimate that there could be up to 50 cases per year in New Zealand that meet our criteria for severe sepsis (Lawton et al 2014; Ministry of Health 2016). Sepsis is a focus for two reasons. First, the SAMM audit found that 24 percent of severe sepsis cases were potentially avoidable

(Lawton et al 2014). Second, less is known about the avoidable factors in severe maternal sepsis compared to other conditions like postpartum haemorrhage.

Peripartum hysterectomy is a surgical operation that removes a woman's uterus. It is a procedure used when a woman has massive bleeding during birth, and is a last-resort, life-saving operation. Sometimes hysterectomies are 'planned', if it is identified that a woman has a pre-existing complication that puts her at high risk of uncontrollable bleeding. There are approximately 30 peripartum hysterectomies in New Zealand each year (note that it is not possible to differentiate between planned and unplanned with national inpatient data) (Ministry of Health 2016). The focus is on unplanned peripartum hysterectomy because of its severity. In some situations, peripartum hysterectomy may be prevented by earlier identification of pre-existing complications, or earlier detection of a woman's deterioration.

Information included in the review

Information from care providers

Once a case is selected for review, the LMC, GP and hospital are contacted for copies of the clinical notes. DHBs are also asked to provide a copy of their local review of the case (eg, root cause analysis). Additionally, any organisational information that may have affected the woman's care is requested (eg, staffing levels).

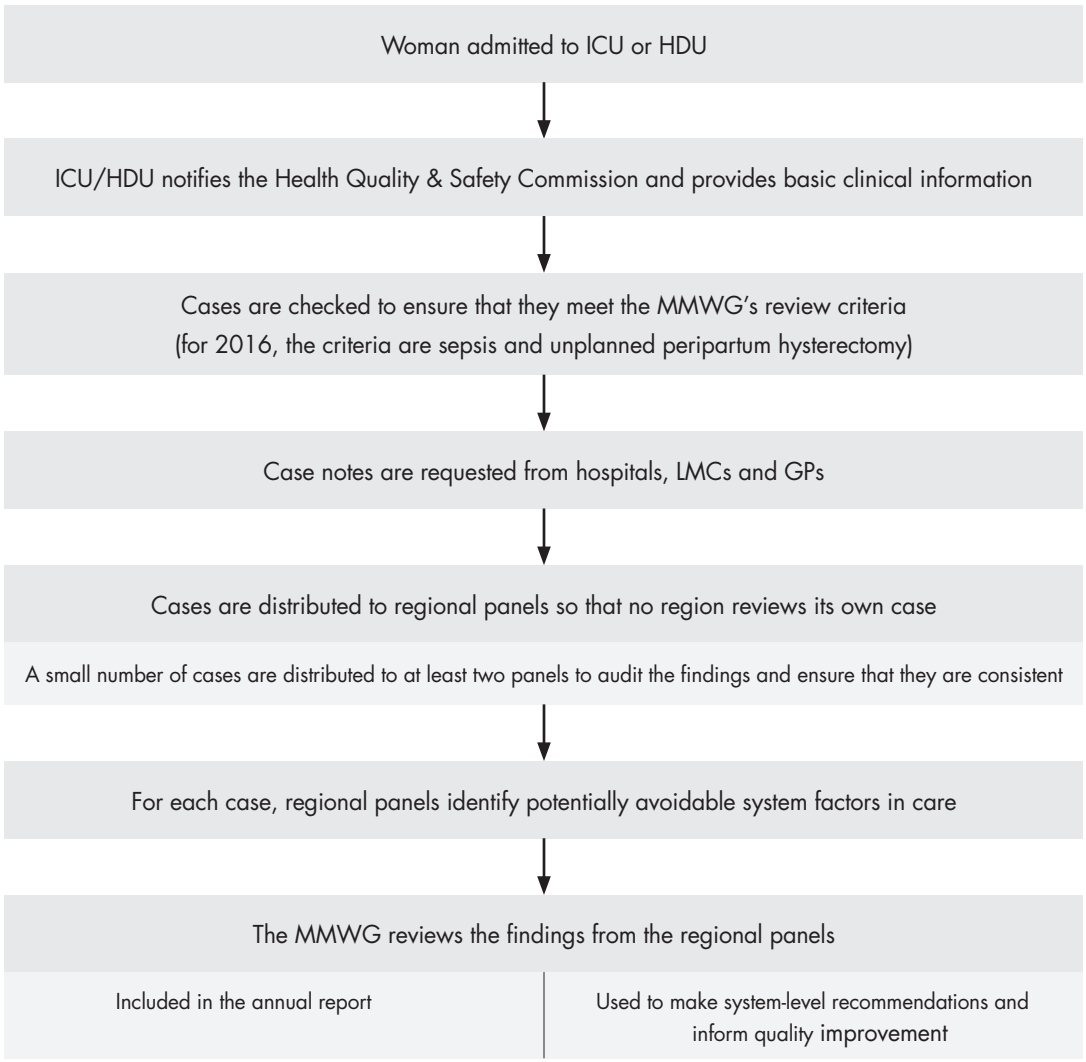
Including the consumer in our reviews

The MMWG values the woman's (consumer's) voice in our reviews, as she provides the context of her pregnancy and the care that she received.

A process has been developed to include the woman's story in the reviews. Women whose cases are selected for review will be approached in a sensitive and appropriate way, and offered the opportunity to tell us about their experience. Women can withdraw from the process at any time. The women will not be identifiable outside of the panel review process. To ensure anonymity, their experiences will be combined into 'composite stories' in the next annual report.

Written material has been developed for women whose cases are selected for review. This will be distributed to ICUs and HDUs and is available on the Commission's website in English, te reo Māori and Samoan. This includes information for women on 'Sharing your story about being very unwell while pregnant'. These are available at: http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/2833/.

Figure 7.1: Summary diagram of MMWG review methodology



Panel reviews

The review process builds on the previous SAMM audit with four maternal morbidity review panels to cover the Northern, Midland, Central and South Island regions. Nominations were sought for panel members from professional colleges, DHBs, previous SAMM panel members, and through the Commission's website. The panels are multi-disciplinary and include midwives, obstetricians, intensivists, GPs, and consumers. Each panel has at least one member with an understanding of Māori health.

The panels review cases using a modified version of the PMMRC's review tool. This tool is based on the London Protocol (Vincent and Amalberti 2016) and includes barriers to access and/or engagement with care factors, personnel factors, and organisational and/or management factors that may have affected care. (See the 'Contributory Factors for Mortality and Morbidity' on page 78.) The panels consider all of these factors to determine if the severity of the morbidity was potentially avoidable.

To ensure that the panel review process is consistent, all panel meetings will be co-chaired by the Maternity Specialist at the Commission. To ensure that the panel findings are consistent, a small number of cases will be reviewed by all of the panels, and the panels' findings compared.

Review findings will be used to develop recommendations and quality improvement initiatives, in collaboration with other national maternity groups and the maternity sector. Recommendations will be evidence-based and implementable.

7.3 Future Work

Improving local reviews and increasing sector capability

In October 2016, a survey was sent to stakeholders in the maternity sector asking about the current state of local reviews of maternal morbidity, their strengths, and support or changes that could improve them. The 68 responses to the survey will be used to assist DHBs and other health organisations to improve local review.

The regional review panels will contribute to capability in the sector. Regional panel members will be champions of review and quality improvement in their local DHBs. There are also five professional development positions on the panels, which were offered to clinicians who were identified as future leaders, but who were relatively early in their careers and did not score highly enough to otherwise be selected for the panel.

Measuring maternal morbidity in New Zealand

It is expected that over time there will be a decrease in the rates of severe maternal morbidity, but determining a reduction in the rates will be difficult as there is currently no consistent collection of severe maternal morbidity data across New Zealand.

At present, severe maternal morbidity is measured through manual notifications of maternal admissions to ICUs and HDUs. The MMWG's work in this area may increase engagement and therefore increase the number of manual notifications. The MMWG is exploring ways of using existing administrative datasets to reduce reliance on manual notifications into the future.

Continuing to work with the maternity sector

We would like to thank everyone who has provided input into our programme so far. Your active engagement has helped us to develop the maternal morbidity review methodology and to guide our thinking for future collaborative work. We look forward to continuing to work together to improve the quality and experience of maternity care for women, babies and whānau.

Appendix A: Summary of Key PMMRC Recommendations and Progress 2006–2013 Data

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
Perinatal mortality	
Methodology	
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. **Update 2017** The Ministry of Health is working towards a solution for including registration ethnicity data in the MAT dataset, and it is anticipated this will be completed in 2017.
Ethnicity	
Clinicians and LMCs should be encouraged to collect accurate ethnicity details at the time of booking.	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 **Update 2017** The Maternity Clinical Information System was intended to assist clinicians and LMCs to collect accurate standardised data, including ethnicity. The roll out of the Maternity Clinical Information System in DHBs has been problematic. A governance group is considering what shape this will take in the future.
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: • The Healthy Families New Zealand Initiative. See http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz • 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/ • 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. • 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.

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
	• 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 • 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
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: www.findyourmidwife.co.nz 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: • engage early with an LMC • take folic acid and iodine • make decisions about screening tests • eat well and be active • avoid alcohol, recreational drugs and smoking. 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: • The Language Line. See http://ethniccommunities.govt.nz/story/using-language-line • 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 – 9th reports	Progress to date (June 2017)
Perinatal mortality	
That all maternity care providers identify women with modifiable risk factors for perinatal related death and work individually and collectively to address these. Strategies to address modifiable risk factors include: a. improving uptake of periconceptual folate b. pre-pregnancy care for known medical disease such as diabetes c. access to antenatal care d. accurate height and weight measurement in pregnancy with advice on ideal weight gain e. prevention and appropriate management of multiple pregnancy f. smoking cessation g. antenatal recognition and management of fetal growth restriction h. prevention of preterm birth and management of threatened preterm labour i. following evidence-based recommendations for indications for induction of labour j. advice to women and appropriate management of decreased fetal movements. All DHBs should report the availability and uptake of relevant services in their annual clinical report to ensure that these strategies are embedded and to identify areas for improvements.	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 Programme reports. DHB strategies include early screening and encouraging women to: • engage early with an LMC • take folic acid and iodine • eat well and be active • avoid alcohol, recreational drugs and smoking. 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: • booking with a midwife as soon as you are pregnant • avoiding smoking, alcohol and recreational drugs • taking folic acid and iodine • making a decision about screening tests • eating well and staying active. See the following websites for more information: http://www.healthpoint.co.nz/public/obstetric-and-gynaecology/capital-coast-dhb-womens-health-obstetrics/im:322319/ http://www.bopdhb.govt.nz/media/57530/bop-dhb-maternity-annual-report-2014.pdf The 'Healthy Babies, Healthy Futures' programme provides ethnically specific workshops, text messaging and support for new mothers, pregnant women and their families. 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.
Offer education to all clinicians so they are proficient at screening women, and are aware of local services and pathways to care, for the following: a. family violence b. smoking c. alcohol and other substance use.	**Family violence.** 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. The Violence Inervention Programme supports health sector family violence programmes throughout New Zealand. See http://www.health.govt.nz/our-work/preventative-health-wellness/family-violence The PMMRC will be collaborating with the Family Violence Death Review Committee to further identify strategies to improve screening for family violence in the maternity setting. **Smoking.** 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. See the following websites for more information: http://www.quit.org.nz/23/reasons-to-quit/smoking-and-pregnancy https://www.smokefreesolutions.co.nz/innov8urpractice http://learnonline.health.nz **Alcohol and other substance use.** 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.

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
That multi-disciplinary fetal surveillance training be mandatory for all clinicians involved in intrapartum care. a. This training includes risk assessment for mothers and babies throughout pregnancy as well as intrapartum observations. b. The aims include strengthening of supervision and support to promote professional 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. LMCs and obstetric staff are encouraged to attend/undertake the online programme or workshop. 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.
There is observational evidence that improved detection of fetal growth restriction, accompanied by timely delivery, reduces perinatal morbidity and mortality. The PMMRC recommends (amended from previous PMMRC reports) that assessment of fetal growth should incorporate a range of strategies including: a. assessment and appropriate referral for risk factors for fetal growth restriction at first antenatal visit and throughout pregnancy b. accurate measurement of maternal height and weight at first antenatal assessment c. ongoing assessment of fetal growth by measuring fundal-symphysial height in a standardised way, recorded at each antenatal appointment, preferably by the same person d. plotting of fundal height on a tool for detection of fetal growth restriction, such as a customised growth chart, from 26 weeks gestation e. if fetal growth restriction is confirmed by ultrasound, appropriate referral and assessment of fetal and maternal wellbeing and timely delivery are recommended. The New Zealand Maternal Fetal Medicine guideline (2013) describes criteria for the management of small for gestational age (SGA) pregnancies after 34 weeks. The PMMRC supports the Ministry of Health initiative to explore the evidence and validate the use of customised growth charts in New Zealand, and to investigate the appropriate way to incorporate these into the national maternity record.	**Update 2017** The Growth Assessment Protocol (GAP) (based on GROW) from the UK Perinatal Institute is being progressed. The Perinatal Institute is making the GAP application freely available to clinicians; however, they need to be trained and accredited to use it. The Ministry of Health is working on ensuring funding is also available for evaluation of the GAP.
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. Other initiatives that support this recommendation include: • Eating for Healthy Pregnant Women/Ngā Kai Totika mā te Wahine Hapū. This is a public health resource and was updated in 2014. See https://www.healthed.govt.nz/resource/eating-healthy-pregnant-womenng%C4%81-kai-totika-m%C4%81-te-wahine-hap%C5%AB • 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 • 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 smokefree 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

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
	• 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 https://www.beehive.govt.nz/release/23m-help-mums-and-families-make-good-food-choices-their-children
Multiple pregnancies	
In order to reduce perinatal related mortality associated with multiple pregnancies, the following is advised. a. All women undergoing assisted reproduction be offered single embryo transfer. b. The use of clomiphene for fertility treatment requires monitoring of hormonal response with ultrasound to determine the number of follicles. c. 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. Clomiphene is being replaced with other medications such as letrozole, which has a much lower risk of multiple pregnancy. 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 **See 'Practice Point: Antenatal Screening for Down Syndrome and Other Conditions' (PMMRC 10th annual report).** The importance of timely registration has been promoted through the National Maternity Monitoring Group (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 and crown rump length measurements. This project includes best practice guidelines for nuchal translucency and crown rump length measurements. Further information, including guidelines and videos, can be found at 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 negatives). 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 – 9th reports	Progress to date (June 2017)
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 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 Guidance on safe sleeping and the Pēpi-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. See http://nsfl.health.govt.nz/service-specifications/current-service-specifications/maternity-service-specifications The *2015 Survey of Bereaved Women* found that 74 percent of women were satisfied or very satisfied with the 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. 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. 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. 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.	Both the NMMG and the Maternity Quality and Safety Programme are working towards improved communication between primary and secondary services. **Update 2017** The Maternity Clinical Information System was intended to assist clinicians and LMCs to collect accurate standardised data. The roll out of the Maternity Clinical Information System in DHBs has been problematic. A governance group is considering what shape this will take in the future.

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
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: http://www.health.govt.nz/publication/rising-challenge-mental-health-and-addiction-service-development-plan-2012-2017
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 (Ministry of Health 2012b). 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.
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-licensing. See http://www.abortionservices.org.nz/docs/guides98.pdf It was noted that there were minimal opportunities in relation to training in the field of post-termination of pregnancy counselling practice.
Maternal mortality	
Seasonal or pandemic influenza vaccination is recommended for all pregnant women regardless of gestation and for women planning to be pregnant during the influenza season. a. Vaccination is also recommended for maternity care providers to reduce the risk to the women and babies under their care. b. The PMMRC recommends that the Ministry of Health consult with women and maternity care providers to address barriers to the uptake of influenza vaccination in pregnancy and implement strategies to increase access to and awareness of the benefit of vaccination.	Immunisation against influenza is specifically promoted to pregnant women and available to all pregnant women free of charge. The Ministry of Health immunisation team annually provides information and resources to clinicians and the public to support this recommendation. The Health Promotion Agency immunisation programme theme for 2016 was P*rotecting Baby Begins at Pregnancy*. Further information is available at: https://www.healthed.govt.nz/resource/protecting-baby-starts-pregnancy 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. See the following website for more information: http://www.health.govt.nz/publication/immunisation-pregnant-women-audience-research-pregnant-women 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/
All pregnant women with epilepsy on medication should be referred to a physician. a. Women with a new diagnosis of epilepsy or a change in seizure frequency should be referred urgently. b. The PMMRC recommends a review of epilepsy in the *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)*.	**Update 2017** *The Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* are under review. Part of the review will be reviewing up-to-date evidence related to maternal epilepsy.

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
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. DHBs are required to staff appropriately under the primary, secondary and tertiary maternity facilities and services specifications. See the following links for more information: http://www.nsfl.health.govt.nz/apps/nsfl.nsf/menumh/Accountability+Documents http://nsfl.health.govt.nz/service-specifications/current-service-specifications/maternity-service-specifications Information about support for pregnant women and their babies who have, or may have, pre-existing medical conditions is available at: http://www.health.govt.nz/your-health/services-and-support/health-care-services/maternity-services/pregnancy-and-newborn-screening
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. *The Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* were 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. **Update 2017** The *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* are under review.
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.
Neonatal encephalopathy	
Widespread multidisciplinary education is required on the recognition of neonatal encephalopathy. This should include: a. recognition of babies at increased risk by their history b. signs suggestive of encephalopathy c. knowledge of clinical pathways to induced cooling if required.	The Accident Compensation Corporation (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 NEWG. 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
That all DHBs review local incident cases of neonatal encephalopathy (Sarnat stages 2 and 3). 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. The Ministry of Health has advised the Maternity Quality and Safety Programme coordinators of this recommendation.
Arterial and venous cord gases should be performed on all babies born with an Apgar score <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 within each DHB maternity quality and safety programme.

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
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. The New Zealand Resuscitation Council provides training for clinicians to deliver newborn life support courses in their region or organisations. See http://www.nzrc.org.nz/training/ ACC has facilitated a cross-Ministry initiative to look at reducing the incidence of treatment injury by developing a strategy to address the issues raised by the NEWG.
In cases of neonatal encephalopathy (Sarnat stages 2 and 3): • all babies with encephalopathy should undergo investigation to predict prognosis, including formal neurological examination, cerebral magnetic resonance imaging (MRI) and, if available, formal electroencephalography (EEG) • all parents of an affected child should have a formal discussion with the neonatologist/paediatrician providing care in order to review the prognosis and ongoing care of their child.	Most DHBs have advised that parents of babies with moderate or severe neonatal encephalopathy (Sarnat stages 2 and 3) have a formal discussion with the neonatologist/paediatrician providing care to review the prognosis and ongoing care of their child. **Update 2017** All six Level 3 Neonatal Units advised that they use a formal tool to assist with the discharge examination for babies diagnosed with NE, either the Dubowitz examination or a modification of this. The practice was less consistent in the Level 2 Units. The barriers identified to the use of a formal tool included training in the use of the tool and interpretation of the findings given small numbers of babies diagnosed with NE in their DHBs.

Previous PMMRC recommendations that have been implemented

Recommendation	No further update
Perinatal mortality	
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.
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.
Early booking	
All women should commence maternity care before 10 weeks. This enables: • opportunity to offer screening for congenital abnormalities, sexually transmitted infections, family violence and maternal mental health, with referral as appropriate • education around nutrition, smoking, alcohol and drug use and other at-risk behaviour • recognition of underlying medical conditions, with referral to secondary care as appropriate • identification of at-risk women (maternal age, obesity, maternal mental health problems, multiple pregnancy, socioeconomic deprivation, maternal medical conditions).	This recommendation has been integrated into core work by the NMMG.
Teenage mothers (<20 years old)	
LMCs should be aware that teenage mothers are at increased risk of stillbirth and neonatal death due to preterm birth, fetal growth restriction and perinatal infection. Maternity services need to address this risk, paying attention to: • maternity care before 10 weeks • smoking cessation, prevention of preterm birth, screening for fetal growth restriction • antenatal education • undertaking research on the best model of care • engagement with the Ministry of Education regarding education in the school setting.	This recommendation has been integrated into core work by the NMMG.
Disparities	
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 each DHB's maternity quality and safety programme.
Contributory factors and potentially avoidable perinatal deaths	
Key stakeholders providing health and social services to women at risk should work together and identify: • reasons for barriers to accessing maternity care • interventions to address barriers. Clinical services and clinicians have the following responsibilities: • continuing education • local review linked to quality improvement • up-to-date policies and guidelines that are implemented and audited • culture of teamwork • culture of practice reflection on patient outcomes linked to quality improvement • staff arrangements ensuring timely access to specialist services. Ministry of Health to develop a plan to translate these recommendations into clinical practice.	This recommendation has been integrated into core work by the NMMG.

Recommendation	No further update
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.
Multiple pregnancies	
All women with a multiple pregnancy should be offered an early specialist consultation, including ultrasound diagnosis of chorionicity prior to 14 weeks gestation. Women with high-risk monochorionic multiple pregnancies require fortnightly scans and specialist care.	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. 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
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.
Maternal mental health	
Clinicians and LMCs should be encouraged to conduct antenatal screening and document any mental health history to identify women who are at increased risk of mental illness.	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. This recommendation has been revised and included in the practice point on maternal suicide: • Maternal mental health screening should be included as part of standard antenatal care. **See 'Practice Point: Maternal Suicide' on page 129.**
Women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if well. Clinicians are reminded that the most common cause of maternal death in New Zealand is suicide.	This recommendation has been revised and included in the practice point on maternal suicide. • Maternal mental health screening should be included as part of standard antenatal care. • 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. **See 'Practice Point: Maternal Suicide' on page 129.**

Recommendation	No further update
The committee notes the publication of the Healthy Beginnings report in January 2012 and supports the recommendations with particular regard to the establishment of mother and baby units in the North Island and the importance of screening for a history of mental health disorders. A comprehensive perinatal and infant mental health service includes: • screening and assessment • timely interventions including case management, transition planning and referrals • access to respite care and specialist inpatient care for mothers and babies • consultation and liaison services within the health system and with other agencies; for example, primary care and termination of pregnancy services.	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. This recommendation has been revised and included in the practice point on maternal suicide: • Maternal mental health screening should be included as part of standard antenatal care. **See 'Practice Point: Maternal Suicide' on page 129.**
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: https://somanz.org/documents/HTPregnancyGuidelineJuly2014.pdf The Ministry of Health is funding the development of a multidisciplinary clinical guideline for the treatment of hypertension in pregnancy. 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

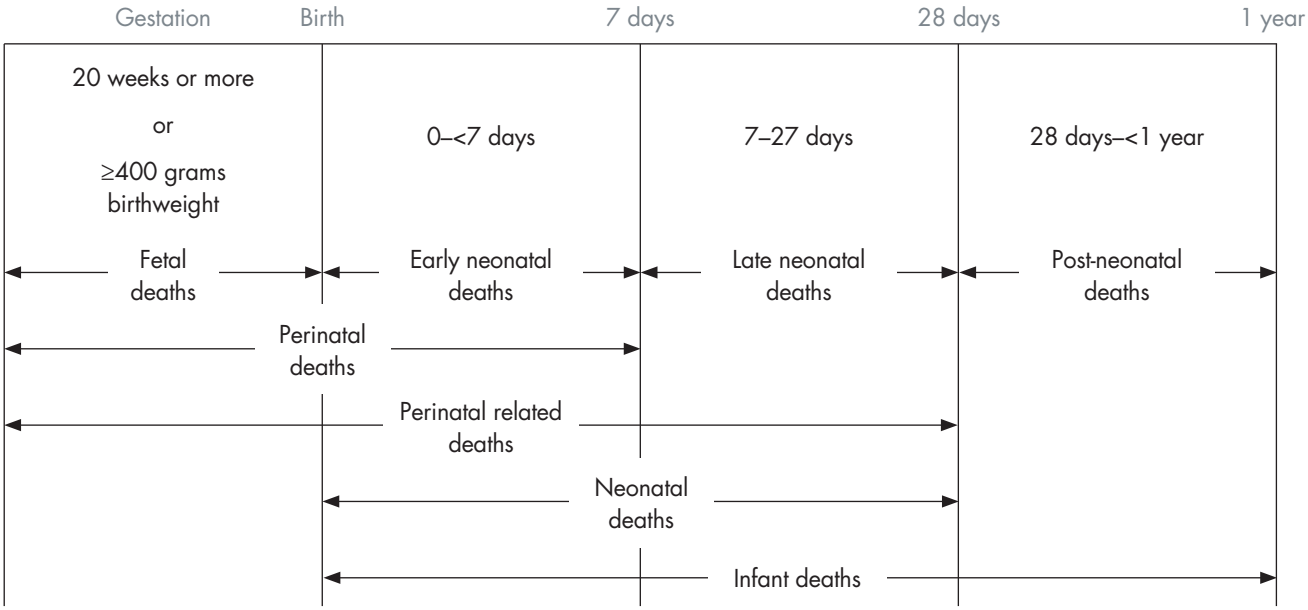
ACC	Accident Compensation Corporation
AFE	Amniotic fluid embolism
AMOSS	Australasian Maternity Outcomes Surveillance System
APH	Antepartum haemorrhage
BDM	Births, Deaths and Marriages
BMI	Body mass index (kg/m2)
CI	Confidence interval
CPR	Cardiopulmonary resuscitation
CTG	Cardiotocograph
CYMRC	Child and Youth Mortality Review Committee
DHB	District health board
EEG	Electroencephalograph
FSH	Follicle-stimulating hormone
GAP	Growth Assessment Protocol
GP	General practitioner
HDU	High dependency unit
HIE	Hypoxic ischemic encephalopathy
ICSI	Intracytoplasmic sperm injection
ICU	Intensive care unit
IPPV	Intermittent positive pressure ventilation
IVF	In vitro fertilisation
LMC	Lead maternity carer
MAT	New Zealand National Maternity Collection
MBRRACE-UK	Mothers and Babies: Reducing risk through audits and confidential enquiries across the UK
MDAC	Maternal Deaths Assessment Committee

MDT	Multidisciplinary training
MMR	Maternal mortality ratio
MMRWG	Maternal Mortality Review Working Group
MMWG	Maternal Morbidity Working Group
MRI	Magnetic resonance imaging
NE	Neonatal encephalopathy
NEWG	Neonatal Encephalopathy Working Group
NHI	National Health Index
NMDS	National Minimum Dataset
NMMG	National Maternity Monitoring Group
NZDep	New Zealand Index of Deprivation
OR	Odds ratio
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
RR	Relative risk
SAMM	Severe Acute Maternal Morbidity
Sands	Stillbirth and Newborn Death Support
SGA	Small for gestational age
SUDI	Sudden unexpected death in infancy
TOP	Termination of pregnancy
UK	United Kingdom
VTE	Venous thromboembolism
WHO	World Health Organization

Appendix C: Definitions

Perinatal and infant mortality

Definitions of perinatal and infant mortality



(Adapted from New Zealand Health Information Service 2007 and Ministry of Health 2010)

Fetal death

Fetal death is the death of a fetus at 20 weeks gestation or beyond (≥20 weeks) or weighing at least 400g if gestation is unknown. Fetal death includes stillbirth and termination of pregnancy. Note that the term 'stillbirth' does not include terminations in this report. Where a termination of pregnancy died after birth, the pregnancy is included as a termination of pregnancy and therefore as a fetal death rather than as a neonatal death.

Termination of pregnancy

Termination of pregnancy is the interruption of an ongoing pregnancy. This report only includes termination of pregnancy from 20 weeks gestation.

Fetal death rate

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

Neonatal death

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

Neonatal death rate

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

Perinatal mortality rate

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

In some places, this report refers to a UK definition of perinatal mortality, which was developed for the surveillance of perinatal deaths in the UK and is based on the UK legal definition of stillbirths, which excludes deaths before 24 weeks gestation and terminations of pregnancy (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 organisational and/or management factors, personnel factors, and barriers to 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 birth registration denominator set are those provided by the parent(s) to BDM at birth registration and are thus consistent with numerator data.

Mother and baby ethnicities in the MAT denominator set are 'derived from ethnic codes reported to NMDS birth and postnatal events, LMC Labour & Birth claims and NHI at time of delivery. The 3 highest priority ethnic codes that reach a threshold proportion are stored in the Aggregated Pregnancy table' (National Health Board Business Unit 2011).

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 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 2015, mothers' ethnicity for the PMMRC dataset of perinatal related deaths has been extracted, in order of priority, from BDM registration of birth (67 percent) or PMMRC rapid response forms (33 percent). Babies' ethnicity for the PMMRC dataset of perinatal deaths has been extracted, in order of priority, from BDM registration of birth (67 percent), BDM registration of death (6 percent) or PMMRC rapid response forms (27 percent).

In 2015, the denominator MAT dataset included two ethnicities for 27.0 percent of all babies registered compared with two ethnicities for 26.0 percent of mothers registered. The dataset included three ethnicities for 5.2 percent of babies and three ethnicities for 4.5 percent of mothers.

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 Section 88 Primary Maternity Services Notice 2007, Subpart 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). Census area unit-level data are used throughout this 11th report (in previous reports meshblock unit level data were used). 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 from 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 areas split and the new areas for individuals in historical datasets were 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 for example, if a woman's condition warrants transfer of clinical responsibility to a specialist.

Appendix D: Compiling the MAT Denominator and Numerator Data

1. **Denominator MAT data (all babies born ≥20 weeks):** The MAT is a dataset based on mothers. For reporting, the PMMRC requires a dataset based on babies. To create a MAT denominator dataset with the correct number of babies, the 'Delivery outcome' field for each MAT mother was used as an indicator of the number of babies who should be in the denominator dataset. For example, if the delivery outcome variable was 'Twin', then two babies were expected. 'Other multiple' was assumed as three babies. This method was modified (and overridden) in cases where a MAT mother was linked by NHI to a PMMRC dataset mother, and the PMMRC data were then used to determine the number of expected babies. An 'entry' or 'baby' was added for each expected baby. If there was no MAT baby linked where a baby was expected, then a baby was created with no MAT baby data (but with mother data from the delivery or mother set). If there were more babies in the MAT baby set than expected, only the expected number of babies was kept in the dataset (except if these were perinatal death babies who were always kept in the set). If there were no 'Delivery outcome' data for a mother, then one baby was expected and this baby was created, again without MAT baby data but including mother data.

2. **Numerator (perinatal related deaths):** The PMMRC asked the Ministry of Health to assist to merge the PMMRC perinatal related deaths with their MAT mother and baby records so that the consistency of data in the PMMRC data collection and in the MAT dataset could be examined.

   The MAT consists of two sets, one of mothers and another of babies. Stillborn babies are often not included in the MAT dataset and so need to be matched to a mother record.

   a. Mothers of babies who died in the perinatal period (PMMRC dataset) were matched to mothers in the MAT set (delivery dataset) by matching the mother NHI and the date of birth allowing a 28-day window either side of the recorded date of birth.

   b. Perinatal death babies (PMMRC dataset) were matched to MAT babies (birth set) by matching the baby NHI.

   c. Perinatal death babies (PMMRC dataset) were then matched to the mother MAT set (delivery dataset) using the matched PMMRC mother; that is, babies with no MAT birth (baby) dataset record were matched to their mother using the mother NHI.

   This process of matching resulted in a PMMRC to MAT match of 5783/5993 for 2007–2015 (96.5%) of PMMRC perinatal death babies.

3. The following are some specific limitations to the use of the MAT dataset.

   a. Deaths are included in the numerator set based on their year of death (as previously), but births are included in the MAT denominator according to their year of birth. Some babies are born in one year and die in the next, creating a numerator–denominator mismatch. For the purposes of these analyses, deaths will remain in the year of their death (to be comparable to previous years).

   b. More than 90 percent of the smoking and BMI data are missing from the MAT dataset in 2007.

c. As the PMMRC deaths have been merged where possible with records in the MAT dataset, data are now available from both the PMMRC dataset and the MAT denominator dataset for the mothers and babies of perinatal related deaths. It is therefore possible to examine the consistency of some of the collected data fields. Some variables have systematically different measurements in the PMMRC dataset compared to the MAT set; for example, BMI and smoking are systematically higher and more common in the PMMRC set than in the MAT set for the mothers of babies who died in the perinatal period. MAT data have therefore been used for the numerator as well as the denominator for BMI and smoking to avoid numerator–denominator bias (and as a consequence, the analysis is limited to mothers and babies where there was a successful match). For other variables (eg, parity) where the MAT and PMMRC data are variably inconsistent but not systematically different, the PMMRC data are used for the numerator deaths data because we believe these have been checked for accuracy more thoroughly than the MAT dataset and because it means all babies can be included in the analyses.

d. Not all registration data are provided to the MAT (specifically, BMI, parity and smoking are missing for some mothers provided primary maternity care by DHBs).

e. BMI in the MAT dataset is a numerical variable without decimal points. Individual women's height and weight were not available for the analysis this year. As BMI has been rounded in the MAT dataset, a BMI of 20 in this dataset actually means that the calculated BMI fell between 19.5 and 20.4. To allow for this, the WHO categories have been modified slightly (see Table 3.7).

f. Smoking data are collected at time of death in the PMMRC dataset but at time of registration with an LMC and at two weeks postpartum in the MAT dataset.

g. Gestational age, birthweight, parity, and plurality data for perinatal related deaths have been defined from the PMMRC dataset.

h. There are differences in the ethnicity defined for mothers and babies between the PMMRC dataset and the MAT dataset. In this report, ethnicity for perinatal related deaths has been defined by the data in the PMMRC dataset (primarily obtained from BDM registration). Denominator ethnicity is that defined in the MAT dataset. Ethnicity in the MAT is 'derived from ethnic codes reported to NMDS birth and postnatal events, LMC Labour & Birth claims and NHI at time of delivery. The 3 highest priority ethnic codes that reach a threshold proportion are stored in the Aggregated Pregnancy table' (National Health Board Business Unit 2011). Further analysis of the impact of differences in the collection and output of ethnicity data can be found in chapter 5.

i. In the MAT set, only census area unit based deprivation score is available as a measure of residence based deprivation. Previously, mesh block based deprivation score was used in PMMRC analyses. Census area units are larger than mesh blocks. Census area unit based deprivation score will be used for both numerator and denominator so that rates can still be presented.

Appendix E: References and Bibliography

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Appendix F: PMMRC DHB Local Coordinators (April 2017)

DHB	DHB Local Coordinator	Contact details
Northland	**Yvonne Morgan** Clinical Charge Midwife **Dr Kristy Wolff** Obstetrician	Whangarei Hospital
Waitemata	**Dr Sue Belgrave** Clinical Director of Obstetrics **Sharon Williams** Midwife **Liz Snookes** Midwife	North Shore Hospital Waitakere Hospital
Auckland	**Professor Lesley McCowan** Obstetrician **Debbie Greenwood** Midwife	Auckland City Hospital
Counties Manukau	**Dr Sarah Wadsworth** Obstetrician **Debbie Davies** Midwife	Middlemore Hospital
Waikato	**Dr Sarah Waymouth** Obstetrician **Dr Isobel Camano** Obstetrician **Tracey Williams** Midwife	Waikato Hospital
Bay of Plenty	**Margret Norris** Midwife Leader	Tauranga Hospital
Lakes	**Amanda Griffiths** Midwife	Rotorua Hospital
Tairawhiti	**Sheila Noakes** Midwife	Gisborne Hospital
Taranaki	**Belinda Chapman** Midwife **Laura Scholey** Midwife	Taranaki Base Hospital
Hawke's Bay	**Dr Lynda Croft** Obstetrician **Sara Paley** Midwifery Educator	Hawke's Bay Hospital
Whanganui	**Lucy Pettit** Midwife **Jo McDonnell** Midwife	Whanganui Hospital
MidCentral	**Carole Collins** Midwife Educator **Dr Steven Grant** Consultant Obstetrician	Palmerston North Hospital
Wairarapa	**Michelle Thomas** Midwife	Masterton Hospital
Capital & Coast	**Dr Rose Elder** Consultant Obstetrician **Hazel Irvine** Midwife	Wellington Hospital
Hutt Valley	**Eleanor Martin** Midwife **Christine Hiess** Midwife	Hutt Hospital
Nelson Marlborough	**Lois McTaggart** Clinical Midwife Leader **Graham Cross** Clinical Midwife Manager	Nelson Hospital Wairau Hospital
West Coast	**Denise Stacey** Midwife	Grey Base Hospital
Canterbury	**Dianne Leishman** Midwife **Sonya Matthews** Midwife	Christchurch Women's Hospital
South Canterbury	**Teresa Back** Midwife	Timaru Hospital
Southern	**Jenny Humphries** Director of Nursing and Midwifery **Sheridan Massey** Midwife **Tracey Morris** Midwife **Dr Jana Morgan** Obstetrician **Meggan Zsemlye** Obstetrician	Dunedin Hospital Southland Hospital