Perinatal and Maternal Mortality Review Committee

He matenga ohorere, he wairua uiui, wairua mutungakore

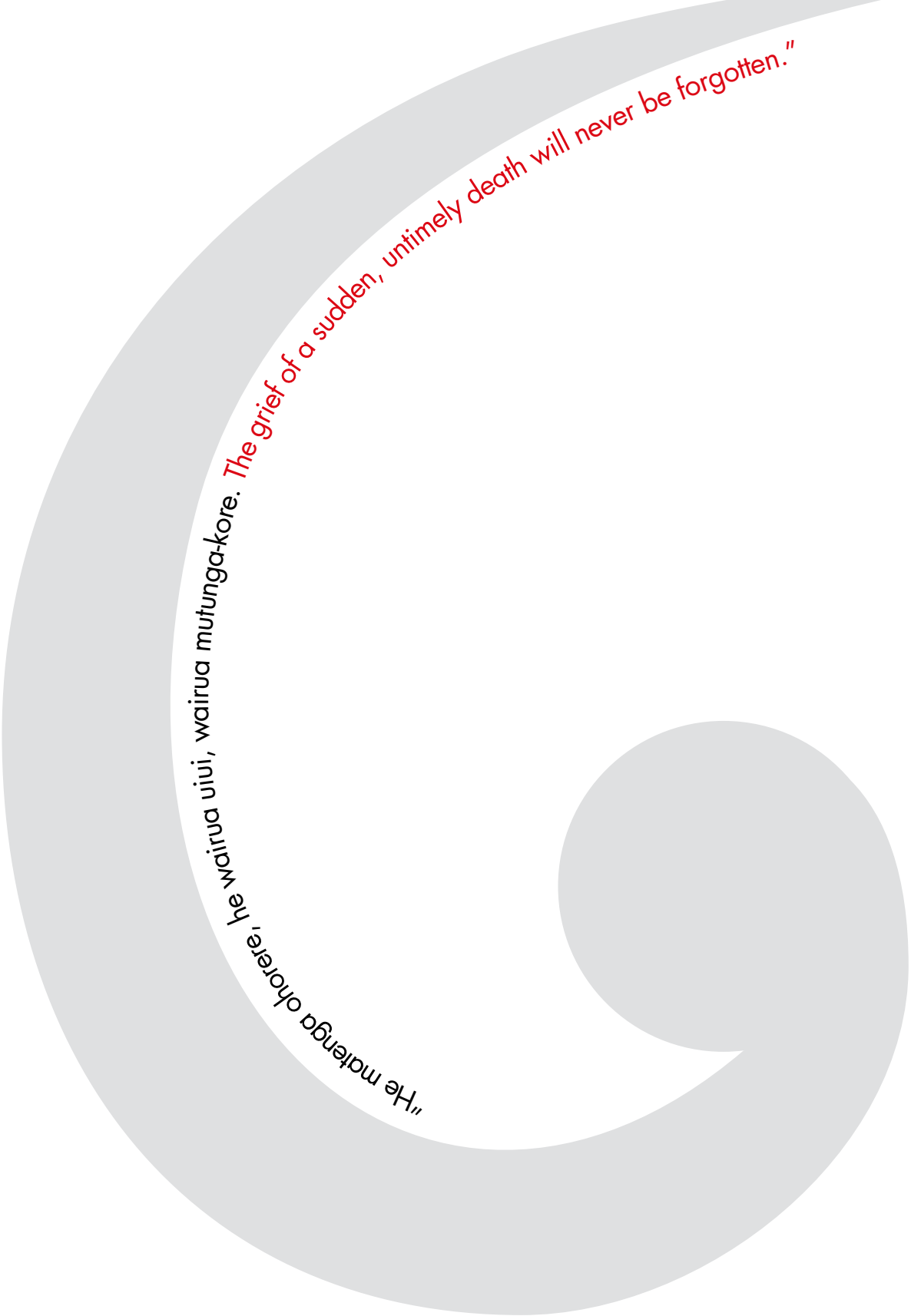
Health Quality & Safety Commission New Zealand
Kupu Taurangi Hauora o Aotearoa

Twelfth Annual Report of the Perinatal and Maternal Mortality Review Committee

Reporting mortality and morbidity 2016

Eighth Report to the Health Quality & Safety Commission New Zealand

JUNE 2018



PMMRC. 2018. Twelfth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2016. Wellington: Health Quality & Safety Commission.

Published in June 2018 by the Perinatal and Maternal Mortality Review Committee, PO Box 25496, Wellington 6146, New Zealand

ISBN 978-0-908345-66-3 (Print)
ISBN 978-0-908345-67-0 (Online)

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

Acknowledgements

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

- the lead maternity carers and district health board (DHB) clinicians throughout New Zealand and the local coordinators (www.hqsc.govt.nz/our-programmes/mrc/pmmrc/about-us/local-co-ordinators) within each DHB who assisted with the collection of 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 dataset was as complete and accurate as possible, and helped prepare this report
    - Dr Lynn Sadler, epidemiologist at Auckland DHB and the University of Auckland, who designed the analysis and prepared this report
    - Melissa Pells, who provided administrative support and helped prepare this report
- the staff at Analytical Services, Ministry of Health, who provided denominator data for the births in 2007–2016
- the University of Otago's Mortality Review Data Group, particularly Dr Gabrielle McDonald, Joseph Hii, Kasia Szymanska, Nick Wolfe and Stephen Chalmers, who established and maintain the perinatal and maternal mortality and morbidity websites and collated the data and produced the tables and figures in this report
- the members of the PMMRC, who provided advice and guidance for the analysis, determined the recommendations, and provided practice points for this report
- the Maternal Mortality Review Working Group (MMRWG), who worked on the maternal mortality report
- the Neonatal Encephalopathy Working Group (NEWG), who worked on the neonatal encephalopathy report
- the Mortality Review Committees' Māori Caucus, who provided advice on the neonatal mortality special topic chapter
- Dr Chris McKinley, who provided advice on the neonatal mortality special topic chapter
- Dr Ricci Harris and Dr Jane Alsweiler, who provided peer review on an earlier version of the report. This final report does not necessarily reflect their views
- Dr Carlene McLean from the Mortality Review Committees Secretariat of the Health Quality & Safety Commission, who has been involved in the development of this report
- the Accident Compensation Corporation (ACC) for providing additional funding for analysis and commentary of neonatal encephalopathy data.

Health Quality & Safety Commission New Zealand
Kupu Taurangi Hauora o Aotearoa

newzealand.govt.nz

Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) members in 2018 are:

- Dr Sue Belgrave (Chair), obstetrician, Waitemata DHB
- Dr Max Berry, neonatologist, University of Otago, Wellington
- Associate Professor Sue Crengle, general practitioner Invercargill, public health physician, Department of Social and Preventive Medicine, Dunedin School of Medicine
- Ms Robin Cronin, midwife, Auckland
- Ms Alison Eddy (Deputy Chair), midwife, Christchurch
- Dr Rose Elder, obstetrician and gynaecologist, Capital & Coast DHB
- Ms Lisa Paraku, Sands New Zealand, Hutt Valley
- Dr John Tait, obstetrician and gynaecologist, Chief Medical Officer, Capital & Coast DHB.

Maternal Mortality Review Working Group

The Maternal Mortality Review Working Group (MMRWG) members in 2018 are:

- Dr Sarah Wadsworth (Chair), obstetrician, Counties Manukau DHB
- Dr Eileen Bass, physician, Hutt Valley DHB
- Dr Sue Belgrave (Chair PMMRC)
- 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 Susan Tutty, general practitioner and GP liaison women's health, Counties Manukau DHB
- Dr Kate White, pathologist, MidCentral DHB
- Ms Karen Whiterod, clinical nurse specialist, Mental Health and Addiction Service, MidCentral Health.

Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group (NEWG) members in 2018 are:

- Dr Jutta van den Boom (Chair), neonatal paediatrician, Waitemata DHB
- Dr Malcolm Battin, neonatal paediatrician, Auckland DHB
- Dr Sue Belgrave (PMMRC Chair)
- Dr Kitty Bach, neonatal paediatrician, Auckland DHB
- Dr David Bailey, obstetrician and gynaecologist, Northland DHB
- Ms Karen Bennington, neonatal nurse practitioner, Capital & Coast DHB
- Ms Anne Jackson, neonatal nurse practitioner, Canterbury DHB
- Ms Suzanne Miller, midwife, Wellington
- Dr Kristy Wolff, obstetrician and gynaecologist, Northland DHB.

Contents

Contents continued

Contents continued

List of Figures

List of Figures continued

List of Figures continued

List of Tables

List of Tables continued

List of Tables continued

List of Tables continued

Foreword

The Health Quality & Safety Commission (the Commission) welcomes the 12th report of the Perinatal and Maternal Mortality Review Committee (the PMMRC). In this report, data on mortality of babies and infants from 2007 to 2016 is presented, on mothers from 2006 to 2016, and on morbidity relating to neonatal encephalopathy from 2010 to 2016.

Once again the PMMRC has produced a comprehensive overview of maternal and neonatal deaths in this country. The death of a mother or a baby is a devastating loss, and this work to inform efforts to minimise the number of these tragic events is very important.

It is reassuring to see that the rate of stillbirth continues its downward trend, and the rate for maternal deaths has dropped, with a significant reduction over the past 10 years; however, there is still inequity in mortality outcomes for Māori, Pacific and Indian mothers.

Sadly, there was no change in the overall neonatal death rate in New Zealand from 2007 to 2016, and, again, there is significant inequity in outcomes for Māori babies.

The report highlights several areas that need to be addressed relating to the persistent inequities in relation to deprivation, ethnicity, and age. The PMMRC will work on better understanding these inequitable outcomes, to inform efforts by the health sector to address them.

The PMMRC has highlighted areas where mortality or morbidity were considered to be potentially avoidable – it is in these areas that the PMMRC can and will influence change through robust, practical and evidence-based recommendations to the health sector.

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 members; the National Coordination Service, Auckland University; the New Zealand Mortality Review Data Group, Otago University; and the Mortality Review Committee staff at the Commission.

On behalf of the Commission, I sincerely thank the PMMRC Chair 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 12th annual report of the Perinatal and Maternal Mortality Review Committee (the PMMRC) and my last as Chair. It has been a privilege to Chair the PMMRC over recent years. I strongly believe that it is only with complete accurate data of perinatal and maternal death with informed analysis that we can make recommendations for change and monitor outcomes for women and their babies over time.

We acknowledge the grief of families and whānau who have lost babies and mothers in 2016. Each of the deaths reported represents the tragic loss of a loved child or mother.

We report on perinatal deaths from 2007 to 2016, maternal deaths from 2006 to 2016, and babies with neonatal encephalopathy from 2010 to 2016. It is no longer possible to publish a comprehensive review of perinatal and maternal mortality on a yearly basis due to budget constraints. The PMMRC has decided to focus on a special topic each year with the publication of basic tables and figures with limited commentary on areas outside the special topic. Maternal mortality will be reviewed in depth every three years. We acknowledge the Accident Compensation Commission for their support of the Neonatal Encephalopathy data reporting to allow this to be presented as in previous years.

In 2016 there were two maternal deaths in New Zealand. For the first time since the PMMRC began reviewing maternal death in 2006 we report a statistically significant reduction in maternal mortality.

Suicide continues to be the leading single cause of maternal death. The PMMRC welcomes the Ministry of Health extended funding for the Suicide Mortality Review Committee; however further work with the Ministry of Health is required to establish a Maternal and Infant Mental Health Network. It is imperative that mothers are able to access maternal mental health services that they need and that the care and services are equitable across the country. The UK has increased its funding of maternal mental health after considering the emotional and financial implications of maternal mental health on the health and outcome for the child (Bauer et al 2014), and we in New Zealand require the same level of commitment to tackle the issue of maternal mental health.

The perinatal related mortality rate in 2016 was 10.1 per1000 births. The statistically significant reduction in stillbirths reported in previous years continues.

In the PMMRC 12th Report the focus has been on neonatal mortality and neonatal encephalopathy (NE).

We have further explored neonatal deaths as it was noted in the 11th report that there had been no change in the overall neonatal death rate in New Zealand from 2007, while other countries had reported reductions in their neonatal death rates.

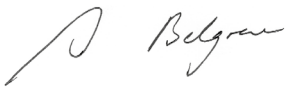
This analysis of all neonatal deaths has highlighted inequity of outcome for babies born to women aged less than 20 years and to women of Māori, Pacific and Indian ethnicities especially for babies born at 20 to 24 weeks gestation. This significantly higher rate of neonatal deaths persists after accounting for the effects of age, body mass index (BMI), socioeconomic status, parity, smoking, multiple pregnancy, baby sex, and year of birth. Inequity of outcomes by ethnicity will be explored further in the 13th report.

Birth in a tertiary centre is known to be associated with improved outcomes for early preterm babies. The PMMRC has recommended that strategies be developed to address inequities in care, and in access to tertiary care, for all women in early preterm labour, or who require delivery prior to 25 weeks, to achieve equity in outcome.

This year the babies diagnosed with Neonatal Encephalopathy (NE) were matched to their National Maternity Collection (MAT) record, which allowed for further analysis of associations of NE with smoking, BMI, parity, and customised birthweight centile. This analysis showed a relationship between parity and NE rates, an increase in risk of NE with increasing BMI and an increase in risk of NE for babies born small for gestational age.

The findings of a review of NE associated with acute peripartum events, completed for 47 babies diagnosed with NE from 2013 to 2015, are presented. In two-thirds of the cases, the mortality or severity of the morbidity were considered potentially avoidable. This highlights the need for multidisciplinary education on the prevention and recognition of NE and regular neonatal resuscitation training for all health care professionals involved in providing peri-partum care. The PMMRC acknowledge the support of ACC which contributed funding for the case review of NE associated with acute peripartum events.

As well as acknowledging the grief of the families and whānau, we would also like to acknowledge how difficult it is for clinicians who are impacted by the deaths of the women and babies they have cared for.



Dr Sue Belgrave

Chair, Perinatal and Maternal Mortality Review Committee

Parents, Families, Whānau

Tēnā koutou katoa,

It is my great honour to be asked to be the voice on behalf of bereaved parents, families and whānau as a member of the PMMRC. My name is Lisa Paraku. I hail from the beautiful Hauraki and I stand on behalf of my daughter Jasmine Lee, who was born perfect and still in 2006, her four siblings who died in early pregnancy, and my two sons who lived. I have been part of the Sands whānau since 2006, first as a consumer of Sands support services and later as a committee member and provider of the same services that my whānau remains grateful for.

To my fellow bereaved parents, families and whānau, can I offer the following mihi (greeting) to you:

Me mihi aroha nui ki a koe me tō whānau whānui – My love to you and to your entire family.
E ngā pēpē, moe mai rā – I acknowledge our precious babies, our grief and our journey.

I stand proud on behalf of your voice and I thank you for having me. I trust I represent you when I say that our hope following the loss of our precious pēpē or māmā is **'to be seen'** – to be listened to, understood and cared for in the way that we need, so that our grief journey can be a little more gentle.

To you, the good people of our New Zealand health system, I salute you and thank you for serving us. We are grateful and we would like to continue connecting with you so that our mutual experience is positive.

It is my greatest hope that the incredible work delivered by the collective expertise of the PMMRC and our wider support network is acknowledged and that **their recommendations are actioned with priority** by the government agencies that exist to serve the health and wellbeing of our New Zealand people. I ask this so that we, the parents, families and whānau, can experience a grief journey that is more gentle or so the resulting changes may save the lives of some of our pēpē and māmā.

The PMMRC report and its recommendations have been available since 2009 and we have seen some really positive change; however, an area that is particularly close to my heart is being highlighted again and again by our data. Along with the very valuable health practice point recommendations that this report delivers, there remains an alarming pattern of inequities in health care outcomes for our Māori, Pacific and Indian māmā and those who are under 20 years of age.

In my humble opinion, these priority populations need 'to be seen'. Can I be so bold as to ask on behalf of parents, whānau and families, that all of us who serve within our health system ask a simple question: Does this practice, policy, process serve this person(s)? Do I understand this person's world view and circumstance? If the answer is no, then let's reach out, start a conversation and continue to learn. Let's ask that **cultural competency training in all priority populations is made a priority,** that training and guidance is provided to all of us to identify implicit and explicit bias that shapes how we serve within our own systems, and when we are clear, then we, within our own sphere of influence, effect change, and together we shape our health system so that the ultimate goal can be achieved: equitable health outcomes for all.

I continue to tautoko (support) my predecessors' tono (requests):

I tautoko the voice of Linda Penlington (PMMRC 2016) regarding the value of post-mortem information, which has helped us at the PMMRC make recommendations that have seen positive change. We continue to see our Māori and Pacific people being less likely to agree to post-mortem for a variety of reasons. I wonder what we could do to make this process agreeable to our Māori and Pacific peoples and I remain hopeful that their voices, some of which are documented within the body of this report, are listened to and change is made so that post-mortem information in these priority populations can be gathered and shared to assist our grief journey and also to help others in similar situations.

I reiterate the voice of Vicki Culling (PMMRC 2012) that support service availability and access for our bereaved parents, families and whānau is so incredibly important during our grief journey. The deep grieving that is inevitable when we lose our most precious taonga, our pēpē and sometimes our māmā, can be made more gentle with support service guidance. Part of Vicki's request remains relevant today:

a. A more active connecting of bereaved mothers and families to support agencies (such as Sands) by health and caring professionals would be beneficial, rather than leaving families to do this on their own.
b. A maternity service that is reliant on the unpaid voluntary services in the community to provide the majority of quality support to bereaved parents, families and whānau is a sad indictment on our attitudes towards perinatal loss. Perhaps this first step towards understanding the impact of such a loss, in the form of the Bereaved Mothers Survey, will lead to better support and information for this vulnerable part of our population.

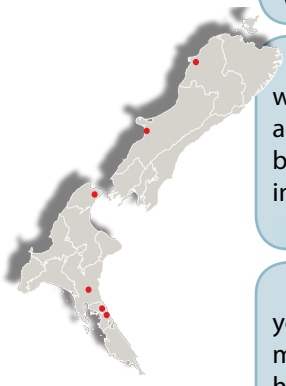
I close with a simple ask, that we all consider the guidance of my elders and achieve **'kanohi kitea'**, for our people to be seen, connected and empowered. To my bereaved parents, families and whānau, I trust the voice in these words in some way connects with you, and to my health professional whānau, we are grateful for you and we thank you. Together we can be better.

Nāu te rourou, nāku te rourou, ka ora ai te iwi.
With your knowledge and my knowledge, together we will all be well.

Nō reira, tēnā rā koutou katoa,
Lisa Paraku

Information for women, families and whānau about deaths of newborn babies in New Zealand 2007–2016

Findings from the Committee	What women, families and whānau need to know
Babies born too early who have died	
Approximately 70 babies die each year in New Zealand from being born prematurely from 20 to 24 weeks. Being born early is the most common cause of death of babies.	New Zealand needs a premature birth prevention initiative to help women avoid a premature birth.
Of the 729 babies who died from 2007 to 2016 due to being born too early (from 20 to 24 weeks), 119 babies were born to mothers who had already had a baby born early. Mothers who have already had a baby born early are more likely to have another early baby in future pregnancies.	There is treatment that can start early in your pregnancy to help stop your baby being born early. Please ask your midwife what you can do to stop your baby being born early.
3 out of 10 babies born alive without a birth defect at 23 weeks were alive at 4 weeks of age. 7 out of 10 babies born alive without a birth defect at 24 weeks were alive at 4 weeks. Some babies born at 23 and 24 weeks may have disabilities.	Parents, families and whānau need enough information about their baby's chance of survival or disability to help them make decisions about their baby's care.
Babies born from 23 to 26 weeks were more likely to be resuscitated and to survive if the babies were born in hospitals with a neonatal intensive care unit.	Babies born at 23 to 26 weeks have the best chance of survival if born in a hospital with a neonatal intensive care unit eg Auckland, Middlemore, Waikato, Wellington, Christchurch and Dunedin.
Mothers who are younger than 20 years old and Māori mothers were more likely to have their babies in hospitals or birthing units without a neonatal intensive care unit.	Please call your midwife, doctor or local hospital if you have signs and symptoms of early labour so you can receive care and transfer to a hospital with a neonatal intensive care unit if required.
Sudden unexpected death in infancy (SUDI)	
68 babies of all babies born from 2007 to 2016 died from sudden unexpected death in infancy (SUDI) before they were 4 weeks old. Babies should sleep in their own bassinet, wahakura or Pēpi Pod, on their back, with no pillow.	Please ask your midwife, doctor or nurse for a bassinet, wahakura or Pēpi Pod if you do not have one for your newborn baby.



Executive Summary

Significant changes to the 12th report

The 12th report has a new format from previous reports. It addresses neonatal mortality and neonatal encephalopathy in depth. The perinatal mortality section includes a slightly reduced selection of tables and figures compared to previous years. Maternal mortality includes a core selection of tables and figures only. Both of these sections include limited commentary that aims to address any new data or issues of particular importance in the current year. The PMMRC plans to analyse and report maternal mortality in detail every three years. Specific topics will be chosen each year for in-depth analysis and commentary. Maternal morbidity is reported in a separate document, which will be published on the Health Quality & Safety Commission website (www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/3369/).

Limited methods and definitions have been included in this document in appropriate chapters. A key to the datasets and mortality rates can be found in "Appendix D: Key datasets and definitions in the PMMRC 12th report". A comprehensive methodology and definitions document can be accessed at www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/3367/.

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.

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

12th report highlighted findings

Special topic: Neonatal mortality

Neonatal mortality has not reduced in New Zealand in the last 10 years as it has in other countries we compare our outcomes to such as the UK and Australia. The neonatal death rate was 2.6/1000 live births in 2007 and 2.5/1000 live births in 2016.

The majority of the analyses in the neonatal mortality chapter excluded babies born with congenital anomalies.

At 23 weeks gestation, resuscitation was attempted for 59 percent of live born babies without congenital anomalies and of these, 50 percent survived to 28 days. At 24 weeks gestation, resuscitation was attempted for 96 percent of live born babies without congenital anomalies and of these, 73 percent survived to 28 days.

Survival to 28 days of live born babies without congenital anomalies was 30 percent at 23 weeks and 70 percent at 24 weeks gestation.

Antenatal corticosteroids were less often given to mothers of babies who died after birth at 23 weeks than at 24 weeks.

Survival of live born babies from 23 to 26 weeks gestation was statistically significantly higher for babies born at tertiary units than babies born at secondary units, and significant differences were found in survival between tertiary units in New Zealand.

There were significantly higher neonatal death rates for babies without congenital anomalies of Māori, Pacific and Indian mothers compared to mothers of Other Asian, Other European and New Zealand European ethnic groupings.

After accounting for the effects of maternal age, body mass index (BMI), socioeconomic status, parity, smoking, multiple pregnancy, baby sex, and year of birth, there remained a higher risk of death after birth at 20 to 24 weeks gestation among babies of Māori, Pacific and Indian mothers, which suggests that there were other factors increasing risk for these women. The most common cause of neonatal death at 20 to 24 weeks gestation, responsible for almost 600 deaths in the 10 years from 2007 to 2016, was extreme prematurity.

More babies of Māori, Pacific and Indian mothers are born extremely preterm and so these ethnic groups are disproportionately affected by suboptimal care for mothers and babies at these gestations. This is compounded if there are also inequities in provision of care by ethnicity.

The in-depth analysis identified inequities by ethnicity and by maternal age (<20 years) in a number of care areas affecting neonatal survival. These related to access to antenatal care, access to tertiary neonatal facilities, treatment with antenatal corticosteroids, and attempted resuscitation at extreme preterm gestations. An analysis of care pathways was not undertaken. However, inequities by ethnicity are increasingly found in health care both in New Zealand and overseas, and are associated with implicit bias and racism. Therefore, the PMMRC has tried to address this issue in its recommendations along with trying to promote improvement strategies that might engage with priority population service users and their needs.

Neonatal encephalopathy

The PMMRC has been reporting data related to babies with moderate and severe neonatal encephalopathy (NE) since 2010. Fewer term babies were diagnosed with NE in 2016 (1.0/1000 term births) than in 2010 (1.4/1000), however this was not a statistically significant difference.

The Neonatal Encephalopathy Working Group (NEWG) has been encouraging district health board (DHB) local review of babies diagnosed with NE, and a survey of 2016 cases found 75 percent of cases were reviewed, although only 64 percent were reviewed with a multidisciplinary methodology.

A multivariable analysis is planned for 2018-2019 to investigate the independent predictors of NE among babies born at term now that data on NE cases have been merged with data from the national maternity collection (MAT).

Acute peripartum events, such as placental abruption and shoulder dystocia, were reported in 22 percent of babies diagnosed with NE from 2012 to 2016. In 2016, the NEWG reviewed a series of 47 babies with NE from 2013 to 2015 following an acute peripartum event. In two-thirds of the cases reviewed, the mortality or severe morbidity were considered potentially avoidable. Further detail of the review findings is provided in the neonatal encephalopathy chapter.

In 2016, 79 percent of babies born at term with moderate or severe NE were treated with induced cooling, and of those cooled, 77 percent were cooled within six hours of birth as recommended for maximal benefit. Of the 12 babies not cooled in 2016, two may have benefitted from cooling. Neonatal observation of babies with risk factors for NE and increased assessment of babies identified with probable asphyxia at birth were highlighted to optimise care.

Perinatal mortality

The perinatal related mortality rate, which includes all deaths from 20 weeks gestation to 27 days of life, was 10.1/1000 total births in 2016. While there has been no statistically significant reduction in perinatal related mortality overall since 2007, there has been a significant reduction by 11 percent in stillbirth rate from 5.7/1000 births in 2007 to 5.1/1000 births in 2016.

The PMMRC were able to define denominator data for small for gestational age babies (using customised birthweight centiles) for the first time this year using the New Zealand Maternity Collection (MAT) dataset. There was a statistically significant reduction in small for gestational age babies born from 2008 to 2016 and a statistically significant reduction in perinatal related mortality among small for gestational age babies.

Of note, the number of mothers aged under 20 giving birth in New Zealand has reduced by 50 percent from 2007 to 2016. However, in this time, there has been a significant increase in perinatal related mortality among mothers aged under 20 giving birth. Mothers under 20 years of age are at higher risk of perinatal related death from spontaneous preterm birth, antepartum haemorrhage, and perinatal infection than any other age group.

Maternal mortality

There has been a statistically significant reduction in maternal mortality in New Zealand from 2006 to 2016.

The maternal mortality ratio for the three years from 2014 to 2016 was 9.4/100,000 births at 20 weeks or beyond. This is the lowest ratio for a three year period since the PMMRC began reviewing maternal deaths in 2006.

Maternal suicide is the leading cause of maternal mortality in New Zealand. The rate of maternal suicide in New Zealand is seven times the rate in the United Kingdom. Māori women are over-represented among maternal suicides. Between 2006 and 2016, 16 (57 percent) of 28 women who died by suicide in pregnancy or within six weeks of pregnancy were Māori.

Following review of maternal mortality, emerging themes and practice points are identified to support clinical improvement. In this report, an emerging theme is the need for a consistent approach to the diagnosis of ectopic pregnancy and a practice point addresses evidence-based care for women with mental health issues.

12th report recommendations

Neonatal mortality recommendations

1. **The PMMRC recommends the Ministry of Health establish a multidisciplinary working group to review current evidence for implementation of a preterm birth prevention program such as that implemented in Western Australia, taking care to:**

    a. **identify and adequately resource evidence-based solutions**

    b. **ensure equitable access to screening and/or treatment for priority populations**

    c. **ensure that priority populations have a voice in the development of health policy, process and practice in order to achieve equitable health outcomes**

    d. **ensure that the outcomes of any implemented program, including equity of access, are evaluated.**

2. **Women with a previous preterm birth at less than 34 weeks are at increased risk of neonatal death.**

    The PMMRC recommends that LMCs and DHBs employ strategies to reduce preterm birth by targeting this high-risk group, including:

    a. **counselling at the time of a preterm birth to outline the strategies likely to be recommended for their next pregnancy, and advice to present for antenatal care as soon as they know they are pregnant**

    b. **ensuring that antenatal care is available to allow women to register as early as possible, and ensuring that early antenatal care includes attention to modifiable risk factors such as smoking, sexually transmitted infections, and urinary tract infections**

    c. **ensuring referral for specialist consultation in the first trimester to facilitate discussion of treatment options, which might include cervical cerclage or vaginal progesterone treatment and monitoring of cervical length using transvaginal ultrasound**

    d. **counselling around signs and symptoms of preterm birth and how to respond to these to optimise outcome.**

3. **Birth in a tertiary centre is associated with improved outcomes for preterm babies at the lower limits of viability (prior to 25 weeks gestation).**

    The PMMRC recommends the Ministry of Health leads the development of a national consensus pathway for the care of women in preterm labour or requiring delivery prior to 25 weeks gestation. The PMMRC recommends this pathway includes:

    a. **ensuring that all groups of women (irrespective of ethnicity, age, socioeconomic status or place of residence) are offered and provided the same level of care**

b. strategies for secondary units for management of women in threatened or early preterm labour, or who require delivery, prior to 25 weeks gestation. Including:

   i. administration of corticosteroids and magnesium sulphate

   ii. timely transfer from primary and secondary units to tertiary units

   iii. management of babies inadvertently born in their units at the lower limits of viability

c. ensuring that priority populations have a voice in the development of health policy, process and practice in order to achieve equitable health outcomes

d. guidance on monitoring that care provision is equitable by ethnicity, age, socioeconomic status and place of residence.

4. The PMMRC recommends DHBs make available appropriate information, including appropriate counselling, for parents, families and whānau about birth outcomes prior to 25 weeks gestation to enable shared decision making and planning of active care or palliative care options.

5. The PMMRC recommends that DHB maternity services audit the rates of antenatal corticosteroid administration, including repeat doses when indicated, to mothers of neonates live born at less than 34 weeks gestation, including auditing whether administration is equitable by ethnicity, DHB of residence, and maternal age.

6. The PMMRC recommends that tertiary obstetric and neonatal intensive care units investigate and address the difference between units in survival rates amongst infants born at 23 to 26 weeks gestation as part of their benchmarking and quality and safety initiatives.

7. The PMMRC recommends that regulatory bodies require cultural competency training of all individuals working across all areas of the maternity and neonatal workforce. Training should address awareness of, and strategies to reduce and minimise the impact of, implicit bias and racism.

8. The PMMRC recommends that the Ministry of Health and DHBs have a responsibility to ensure that midwifery staffing ratios and staffing acuity tools:

   a. enable active observation of mothers and babies who are undertaking skin-to-skin contact in the postnatal inpatient period

   b. allow for the identification of, and additional needs of, mothers who have increased risk factors for sudden unexpected death in infancy (SUDI).

9. The PMMRC recommends that lead maternity carers (LMCs) and DHBs ensure that every baby will have access to a safe sleep place on discharge from the hospital or birthing unit, or at home, that is their own place of sleep, on their back and with no pillow. If they do not have access to a safe sleep place, then a wahakura or Pēpi-Pod®[1] must be made available for the baby's use prior to discharge from hospital.

Neonatal encephalopathy recommendations

10. The PMMRC recommends that DHBs with rates of neonatal encephalopathy significantly higher than the national rate review, or continue to review, the higher rate of neonatal encephalopathy in their area and identify areas for improvement.

[1] A Pēpi-Pod® is a plastic box with a well-fitting mattress in the bottom. As well as the sleep space, these devices are always provided with safe sleep messaging.

Perinatal mortality recommendations

11. Maternity and primary care providers need to be aware of the increasing risk of perinatal mortality for mothers under 20 years of age in New Zealand. Inequity in perinatal mortality for babies born to mothers under 20 years of age needs to be actively addressed.

The PMMRC recommends the Ministry of Health and DHBs:

- **a. develop, in consultation with young mothers, acceptable and safe methods for mothers under 20 years of age to access and engage with care in order to achieve equitable health outcomes**
- **b. identify and adequately resource evidence-based solutions to address risks for mothers under 20 years of age, paying attention to smoking cessation, screening and treatment for infections, screening for fetal growth restriction, and providing adequate information about the causes and symptoms of preterm labour**
- **c. consider how they can support LMCs caring for mothers aged under 20 years.**

12. The PMMRC recommends that DHBs 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.

Maternal mortality recommendations

Maternal and Infant Mental Health Network

The 10th PMMRC report recommended that a Maternal and Infant Mental Health Network be established to provide an interdisciplinary and national forum to discuss perinatal mental health issues (PMMRC 2016). This work has progressed to development of service specifications for the network. We strongly reiterate the previous recommendation:

13. The PMMRC recommends that a Maternal and Infant Mental Health Network is funded by the Ministry of Health and that the network then determine an achievable work stream by the end of 2018 detailing work to be completed by the end of 2020, to include as potential areas of priority:

- **a. a stocktake of current mental health services available across New Zealand for pregnant and recently pregnant women to identify both the strengths of services and gaps or inequity in current services and skills in the workforce**
- **b. a national pathway for accessing maternal mental health services, including:**
  - **i. cultural appropriateness to ensure of service access and provision**
  - **ii. appropriate screening**
  - **iii. care for women with a history of mental illness**
  - **iv. communication and coordination.**

Summary of Key PMMRC 11th Report Recommendations and Progress

Recommendation (PMMRC 11th report)	Progress to date (updated 2018)
Epidemiology	
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)	The Ministry of Health has updated the MAT with ethnicity data as identified by parents during the birth registration process (sourced from Births, Deaths and Marriages (BDM)) for babies born in 2016 and 2017. The Ministry expects to complete the updating of live born baby records for babies born from 2012 to 2015 by June 2018. **Update 2018**
The PMMRC recommends 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).	**Ministry of Health** The Ministry of Health has advised it is looking to extend the National Maternity Record to feed all information into the MAT. The National Maternity Record includes antenatal, postnatal and neonatal care. To ensure maternity care records are consistent and completed across different care providers and regions, the Ministry is reviewing the Health Information Standards Organisation (HISO) standard set in relation to maternity care. This will be defined and agreed by the end of 2018. The Ministry is working with DHBs on the BadgerNet Maternity system to transfer data collected as part of the DHB primary maternity service to the MAT. This will improve the data completeness for women who receive primary maternity care from DHBs. **National Maternity Monitoring Group (NMMG)** The NMMG has asked the Ministry of Health to help prioritise and implement recommendations regarding the MAT dataset, and has written to DHBs asking that they take all steps possible to support the implementation of the recommendations. **Update 2018**
Perinatal mortality	
The PMMRC investigate why there has been no reduction in neonatal mortality in New Zealand.	Neonatal mortality is the focus of the special topic in this report.
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.	An interdisciplinary guideline for the indications and timing of induction of labour is currently in development. The group is using the Appraisal of Guidelines for Research and Evaluation (AGREE) tool to guide the guideline development and will ask the NMMG to ratify the guideline as a national one upon completion. The Ministry of Health will consider their decision and, if accepted, publish the guideline on the Ministry website as national guidance. **Update 2018**
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. Counties Manukau DHB – significantly higher rate of perinatal related mortality, significantly higher rate of stillbirth and neonatal death than the national rate. Waikato DHB – significantly higher rate of neonatal death and neonatal encephalopathy than the national rate.	**Perinatal related mortality rates** **Counties Manukau** Counties Manukau Health is committed to ensuring women get early access to quality maternity care. The Maternity Quality Workplan describes the work underway to improve maternity. See http://www.countiesmanukau.health.nz/assets/About-CMH/Reports-and-planning/Womens-health/2015-2016-CM-Health-MQSP-Annual-Report.pdf Counties Manukau DHB continues to highlight the impact the upstream determinants (such as income, education and housing) have on a range of health outcomes and continue to work with the Ministry of Health to explore these relationships more fully.

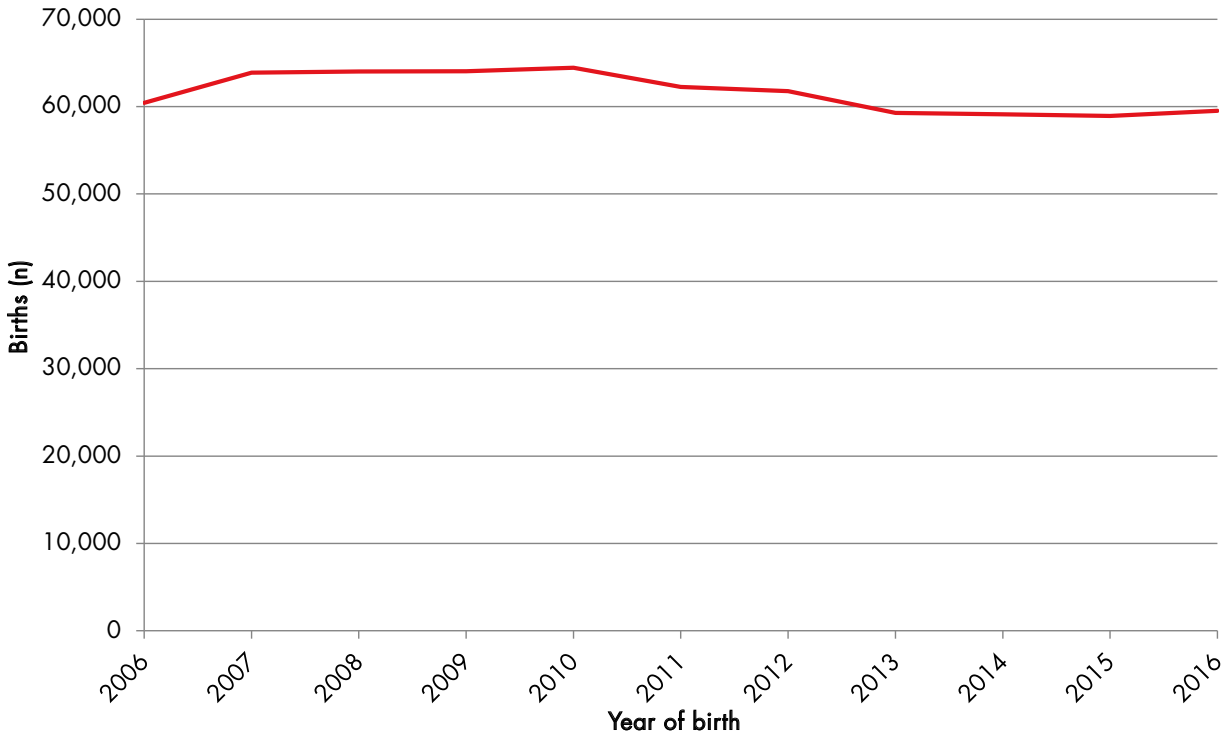
Recommendation (PMMRC 11th report)	Progress to date (updated 2018)
	Neonatal mortality rates **Waikato** A multi-disciplinary team reviews each neonatal death. The team note learning points from the death and make individual recommendations for the women. This case review session forms the basis of information for: • the follow-up appointment with the family/whānau • presentation to the monthly mortality meeting of health care professionals • reporting to the DHB mortality meeting. As appropriate, any teaching topics or contributing factors to the case are added to the 'Sharing the Learning' electronic newsletter. Each case is added to a database so the team can identify themes and link to a programme of work or identify a new programme of work in the DHB Maternity Quality and Safety Programme. The multi-disciplinary team continues to review all cases of NE cared for in the Neonatal Intensive Care Unit. **Update 2018**
Maternal mortality	
The PMMRC recommends the Health Quality & Safety Commission establish a permanent Suicide Mortality Review Committee.	The Ministry of Health has agreed to extend its funding for the Suicide Mortality Review Committee.
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 • Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) fetal surveillance training • newborn life support training (New Zealand Resuscitation Council) • local NE workshop on 27 April 2017 • education on recognition of NE and cooling management • Growth Assessment Protocol (GAP) on recognition and management of small for gestational age babies. Taranaki DHB will continue to monitor and review all NE cases and implement quality improvements where indicated. **Capital & Coast** Capital & Coast DHB continues to review all term infants diagnosed with NE in 2016. **Update 2018**

Recommendation (PMMRC 11th report)	Progress to date (updated 2018)
Recommendations from the Mortality Review Committees' Māori Caucus	
Māori Maternal Death by Suicide **Improved awareness and responsiveness to the increased risk for Māori women** Primary care (general practitioners (GPs), Family Planning Association (FPA)), LMCs, termination of pregnancy (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. **Management** 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. 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. 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 (Abortion Supervisory Committee 2009, Standard 79). 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. **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.	**New Zealand Nurses Organisation, Te Rūnanga o Aotearoa** further supports the 11th report recommendations, and believes these issues still remain relevant: 1. An explicit recommendation is required to ensure health professionals have a higher level of cultural awareness and competence. 2. Risk assessment is imperative. Professionals doing this must have an understanding of Māori models of wellbeing, including social context. 3. Management is a complex situation. It should not be the sole responsibility, or expected of, professionals who may have limited time and may not be the most culturally appropriate. 4. Communication is an imperative area for ongoing development. **The College of Nurses Aotearoa (NZ)** further endorses the 11th report recommendations and supports the development of much needed guidelines based on current evidence to reduce these worrying statistics. The College will disseminate the PMMRC findings further throughout the nursing workforce, and promote them with college members and on their website, to inform members of the importance of the PMMRC recommendations in supporting nursing care and support for Māori women. **The Royal New Zealand College of General Practitioners** The College team responsible for updating the General Practice Education Programme curriculum development has been alerted about the increased risk of maternal suicide for Māori women, and are considering adding the Eleventh report to the online learning platform for GP registrars. The College acknowledges the need to raise awareness among GPs about the increased mental health risk for Māori women. However, their standard 15-minute consultation, does not allow sufficient time to discuss pregnancy-related medical issues and mental health; some DHBs and PHOs do have funded extended GP appointments for patients identified as experiencing serious mental illness or addiction. It may be useful to explore whether fully funded extended appointments should be introduced to support routine mental health screening for all pregnant Māori women. There is a variability in the experience of GPs when referring women to an appropriate health provider; some of our members generally have good access to maternal mental health team and other secondary care services, others highlight poor access and delay in accessing the secondary care. Women in all areas should have access to necessary care and would support any initiative to improve the access to secondary care. Free post-TOP consultation - there is a variability in women returning to the referring doctor for a free post-termination of pregnancy (TOP) consultation; not many women return for a post termination check-up which indicates the need to actively follow up with women who undergo a TOP; also, the timeframe to provide the post TOP consultation is narrow, which limits the opportunity to review mental health status of Māori women. Monitoring Māori women with a history of serious mental illness - GPs can be unaware that a patient is pregnant if she seeks care directly from an LMC midwife. The College agrees that GPs should be notified when a woman has a miscarriage, however the process of notification is not very consistent at present and a lack of communication with midwives has been noted by some College members. The College supports the recommendation that the communication and coordination between service providers should be improved and enhanced. Options for information sharing include LMCs requesting access to shared electronic records from general practices and LMCs using electronic systems that GPs can interact with (eg hMAELTM, which is a secure communication channel for the health sector that uses a closed messaging system).

Recommendation (PMMRC 11th report)	Progress to date (updated 2018)
Recommendations from the Mortality Review Committees' Māori Caucus continued...	
	Royal Australian New Zealand College of Psychiatrists strongly support the principles outlined in the 'Practice Points on Māori Maternal Suicide' which covers the salient facts regarding screening and managing pregnant women with potential mental illness and other co-morbidities; referral to secondary mental health services is required for those pregnant women who may have a history of mental illness and if a woman presents with a range of symptoms indicating serious mental illness. In our view, a comprehensive mental health assessment is critical to ensure early intervention occurs and appropriate treatment and care plans are in place for all at risk pregnant women. We support all clinicians sharing relevant information to provide the pregnant women with the best care possible. An integrated model of care, across maternity and mental health services, is at the core of best practice service delivery ensuring the woman's mental and physical wellbeing are addressed concurrently. Increasing awareness of risk through education and developing greater communication and integration across the key health sector services are critical. Research from Australia indicates that increasing awareness of maternal mental illness in the community and amongst the non-mental health workforce can enhance the understanding of the mental health issues experienced during the perinatal period and improve the referral pathways for at risk women. The appropriate management of Māori women with potential mental health problems requires specialised skills and expertise that are dependent upon a well-resourced workforce. Developing a culturally responsive workforce must be a priority to ensure Māori maternal health is effectively managed within a kaupapa Māori context. The RANZCP strongly support the development of targeted strategies to improve the awareness and responsiveness to the increased risks experienced by Māori women. We strongly recommend that the key strategic aspects of this work are led by Māori to ensure a Te Ao Māori perspective is woven into any proposed approaches. There should be a greater collective focus on how the whānau are highly likely to be part of the solution in working to improve a woman's wellbeing. The RANZCP supports a comprehensive assessment of risk factors for Māori women being undertaken at the time the pregnancy is diagnosed and/or on first presentation for antenatal care. As long-term use of alcohol can exacerbate mental disorders, pregnant women with substance abuse disorders must have timely and appropriate access to treatment in order to reduce the negative impact on their wellbeing. The RANZCP strongly suggests that maternal mental health is discussed more often than every three years, as it is demonstrated in both this Report and literature that mental illness during the perinatal period is a complex issue and it is unlikely to decrease significantly in the short term. Specific applied cultural competency related to Māori concepts in pregnancy must form a fundamental part of any Midwifery certification. **Update 2018**
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.	The Otago Database Group have included this question on their form: 1.20 Was the deceased pregnant in the 12 months prior to their death? 1.20.1 Pregnant in prior 12 months – options: yes, no, unknown, not applicable **Update 2018**

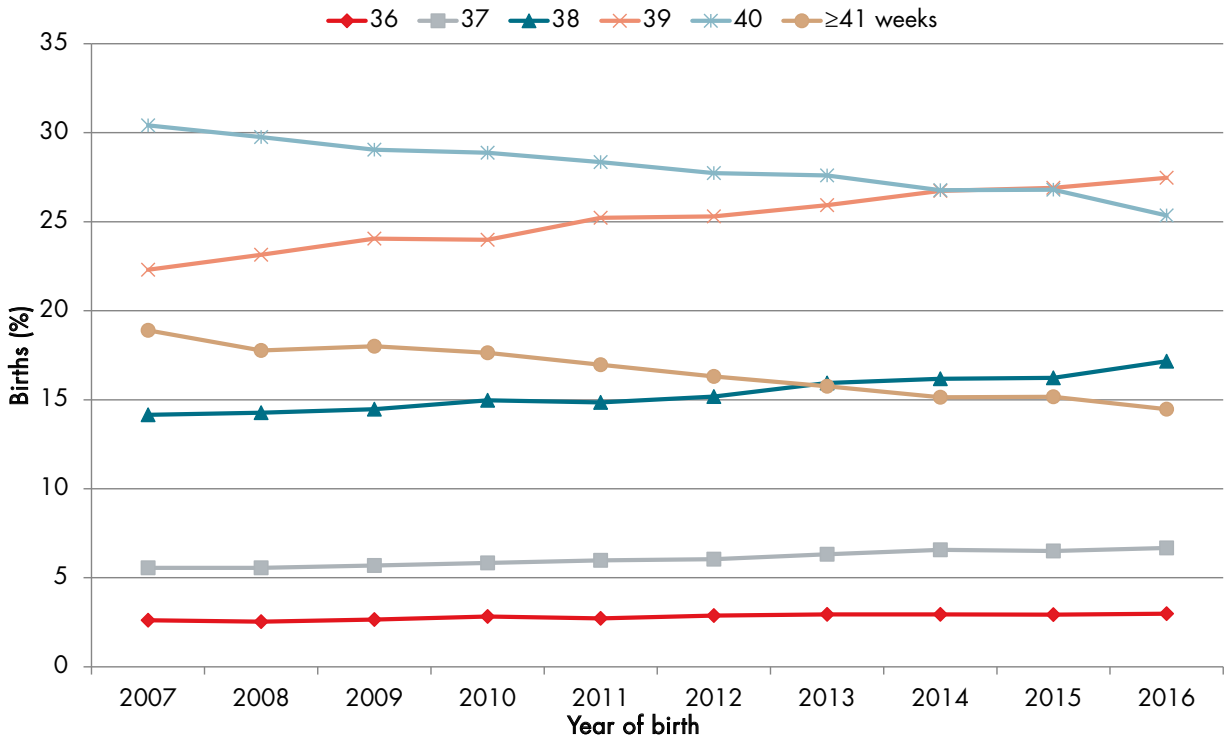
1 Births in New Zealand 2016

Figure 1.1: Births in New Zealand* 2006–2016



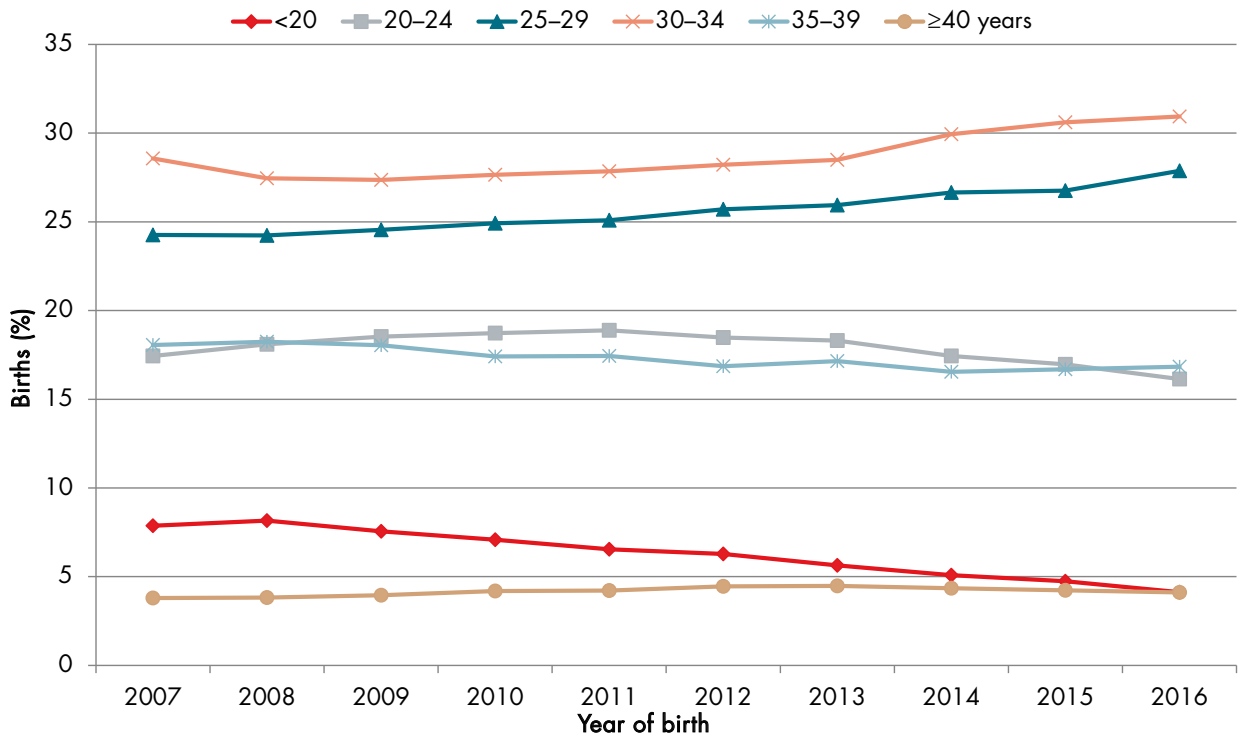
* Source of data: New Zealand Maternity Collection (MAT).
Note: Data relates to Table 4.1.

Figure 1.2: Trends in gestation at birth (36 weeks and beyond) among births in New Zealand 2007–2016



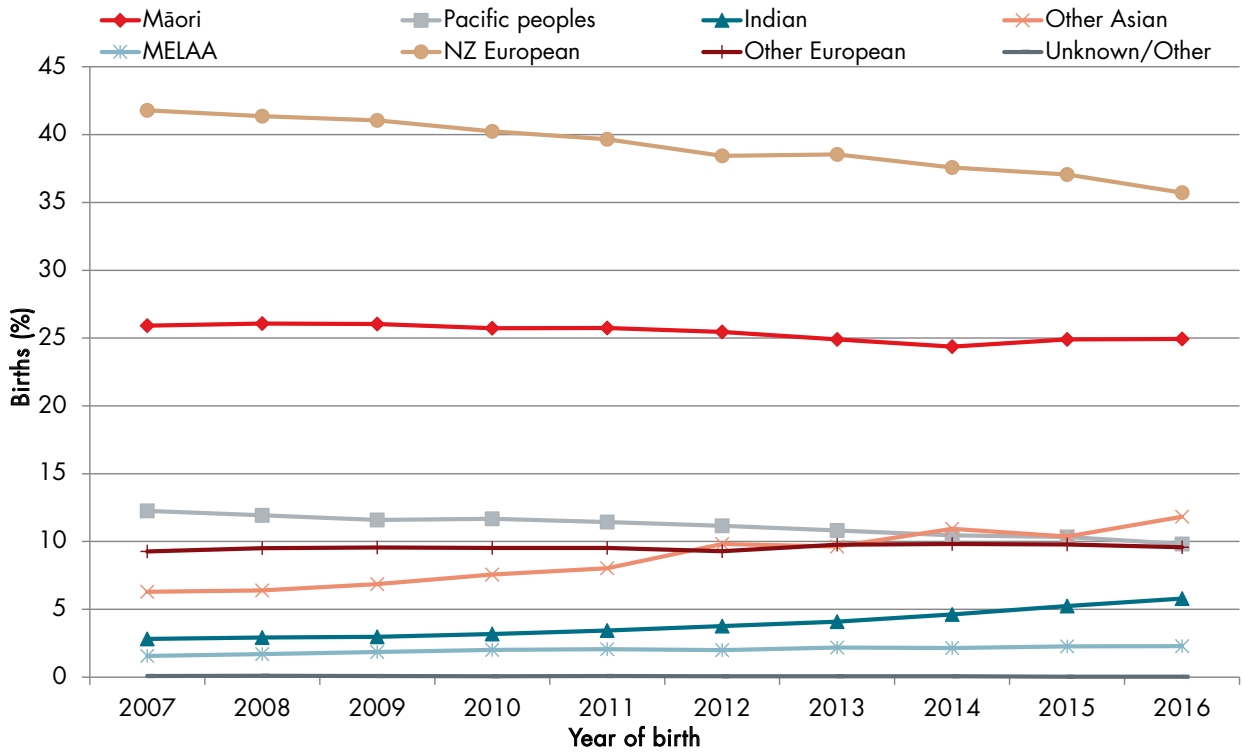
Note: Data relates to Table 4.25.

Figure 1.3: Trends in maternal age among births in New Zealand 2007–2016



Note: Data relates to Table 4.9.

Figure 1.4: Trends in maternal prioritised ethnicity among births in New Zealand 2007–2016



Note: Data relates to Table 4.14.
MELAA = Middle Eastern, Latin American or African.

2 Special Topic: Neonatal Mortality 2007–2016

There was no change in the overall neonatal death rate in New Zealand from 2007 to 2016. The neonatal death rate was 2.6 per 1000 live births in 2007 and 2.5 per 1000 live births in 2016. There have been reductions in neonatal death rates in Australia, the United Kingdom and Scandinavia and so for the 12th report the PMMRC focused on this area.

2.1 Key Findings

There was no change from 2007 to 2016 in the neonatal death rate excluding deaths with congenital anomalies from 20 to 24 weeks and from 25 to 34 weeks gestation. However, there was a significant reduction for babies born from 35 weeks gestation.

Ethnic differences in neonatal death of babies with congenital anomalies

Pacific mothers had significantly higher rates of neonatal death of babies with congenital anomalies than mothers of Māori, Other Asian, Other European and New Zealand European ethnic groupings. Māori, Indian, and New Zealand European mothers had significantly higher rates than Other European, and significantly lower rates than Pacific mothers.

For Pacific women, higher neonatal death rates with congenital anomalies may be at least partly related to lower rates of late termination leading to more stillbirths and neonatal deaths with lethal congenital anomalies. However, Pacific mothers had higher stillbirth and neonatal death rates and higher overall perinatal related death rates from congenital anomalies compared to Māori and Other European mothers who had similar (or higher) rates of termination of pregnancy. Further investigation is required to understand the reasons for this. Some of this ethnic difference for Pacific mothers and the differences in neonatal death rates for Māori, Indian, and New Zealand European mothers may be due to differences in care and/or differences in decisions to treat versus palliation. Further analysis of these differences requires data on babies surviving with congenital anomalies.

Ethnic differences in neonatal death of babies without congenital anomalies

There were significantly more neonatal deaths without congenital anomalies among babies of Māori, Pacific and Indian women than among women of Other Asian, Other European and New Zealand European ethnic groupings (Figure 2.6). Neonatal death rates were lower among Other Asian and Other European mothers than among mothers of all other ethnic groupings.

Neonatal deaths of babies of Indian mothers

Babies of Indian mothers had high neonatal death rates with and without congenital anomalies.

Sociodemographic factors associated with increased risk of neonatal death at 20 to 24 weeks gestation excluding death from congenital anomalies

The significantly higher neonatal death rate (without congenital anomalies) among babies of Māori, Pacific and Indian mothers compared to babies of Other Asian, Other European and New Zealand European mothers was most obvious at 20 to 24 weeks gestation.

A multivariable analysis was used to find which sociodemographic factors were associated with death at 20 to 24 weeks gestation after accounting for the effect of related factors. This analysis found that after adjustment for age, body mass index (BMI), socioeconomic status, parity, smoking, multiple pregnancy, baby sex, and year of birth, there remained a higher risk of death after birth at 20 to 24 weeks gestation among babies of Māori, Pacific and Indian mothers, which suggests that there were other factors increasing risk for these women.

Maternal age under 20 compared to 20 to 24 years, BMI of 35 and above, multiple pregnancy, smoking, increasing socioeconomic deprivation, and mothers having their first baby compared to mothers having their second baby were all associated with increased neonatal death independent of all the other factors. This analysis included sociodemographic factors and not important clinical risk factors such as medical illnesses and previous preterm birth because the data were not available.

The most common cause of neonatal death at 20 to 24 weeks gestation, responsible for almost 600 deaths in the 10 years from 2007 to 2016, was extreme prematurity.

If the inequity in neonatal deaths at 20 to 24 weeks gestation among Māori, Pacific, and Indian women compared with other ethnic groupings was eliminated, 31 excess neonatal deaths would have been prevented from 2007 to 2016.

Neonatal deaths among babies born at 23 to 26 weeks gestation without congenital anomalies

At 23 weeks gestation 29.5 percent of live born babies without congenital anomalies born in New Zealand at any unit or at home survived to 28 days, and at 24 weeks gestation 70 percent survived to 28 days.

Resuscitation was attempted at 23 weeks gestation for 59 percent of live births, of whom 50 percent survived to 28 days.

Among deaths of live born babies at 23 weeks gestation, only 11 percent of mothers had completed a course of antenatal corticosteroids to mature babies' lungs. At 24 to 31 weeks gestation 33 to 43 percent of mothers had completed a course of antenatal corticosteroids.

Inequities in survival of babies born at 23 to 26 weeks gestation without congenital anomalies

Survival of live born babies from 23 to 26 weeks gestation was statistically significantly higher for babies born at tertiary units than babies born at secondary units.

Babies of Māori, Pacific and Indian mothers are more likely to be born at extremely preterm gestations when survival is low. This contributes to the higher rate of neonatal deaths for babies of these mothers.

Inequities were also found in access to antenatal and neonatal care for extremely preterm births. For babies born alive at 23 to 26 weeks gestation:

- Babies were more likely to receive an attempt at resuscitation if they were born at a tertiary unit than if they were born at a secondary unit.
- Māori mothers were less likely to birth at a tertiary unit compared to mothers of all other ethnicities.
- Mothers under 20 years of age were less likely to birth in a tertiary unit compared to mothers who were 20 years and older. This applies to Māori and mothers of Other (predominantly European and Other Asian) ethnic groupings but has a greater impact on Māori because they are more likely to be mothers at under 20 years of age. Almost all Pacific mothers birth in a tertiary unit and there were no Indian mothers under 20 years of age among the live births at 23 to 26 weeks.

- Babies of Māori, Pacific and Indian mothers were less likely to receive an attempt at resuscitation and less likely to survive to 28 days. This has a disproportionate effect on Māori, Pacific and Indian mothers as they are more likely to birth at 23 to 26 weeks gestation than mothers of other ethnic groupings.
- Although not statistically significant, Māori, Pacific and Indian mothers were less likely to have received a completed course of antenatal corticosteroids than mothers of other (predominantly European) ethnic groupings.

Neonatal deaths among babies born at 25 to 34 weeks gestation without congenital anomalies

From 25 to 34 weeks gestation, 56 percent of deaths were associated with spontaneous preterm birth.

Babies of Pacific mothers had a significantly higher rate of neonatal death from perinatal infection and from antepartum haemorrhage than babies of mothers of Māori and Other (predominantly European and non-Indian Asian) ethnic groupings. Babies of Māori mothers had a significantly higher neonatal death rate from spontaneous preterm birth than babies of mothers of Indian and Other (predominantly European and non-Indian Asian) ethnic groupings (Figure 2.16).

Sudden unexpected death in infancy (SUDI)

SUDI death is the second most common category of death of live born babies without congenital anomalies born after 35 weeks gestation. Among the 68 neonatal deaths from SUDI from 2007 to 2016, 45 (66 percent) mothers were Māori and 12 (18 percent) were Pacific.

At the time of death only six of the 68 babies who were identified as SUDI deaths were in a recommended low-risk sleeping place; that is, in their own place of sleep, on their back and with no pillow. For two babies the place of sleep was unknown.

2.2 Recommendations

1. The PMMRC recommends the Ministry of Health establish a multidisciplinary working group to review current evidence for implementation of a preterm birth prevention program such as that implemented in Western Australia, taking care to:

a. identify and adequately resource evidence-based solutions

b. ensure equitable access to screening and/or treatment for priority populations

c. ensure that priority populations have a voice in the development of health policy, process and practice in order to achieve equitable health outcomes

d. ensure that the outcomes of any implemented program, including equity of access, are evaluated.

Justification

Approximately 60 live born non-anomalous babies died from prematurity per year in New Zealand from 2007 to 2016; almost all of these after birth from 20 to 24 weeks gestation. Prematurity is the most common reason for neonatal death in New Zealand. New Zealand has seen no improvement in neonatal mortality rate over the past 10 years.

The PMMRC has identified inequities in health care throughout their analyses that specifically impact Māori, Pacific and Indian ethnic groupings, young mothers under 20 years of age, and those living in areas of high deprivation.

If the inequity in neonatal deaths at 20 to 24 weeks gestation among Māori, Pacific, and Indian women compared with other ethnic groupings was eliminated, 31 excess neonatal deaths would have been prevented between 2007 and 2016.

Currently New Zealand has no national programme for screening for risk of preterm labour or for preventive treatment.

Evidence

Screening and prevention of preterm birth

Western Australia (WA) launched a campaign titled "the whole nine months" in 2014 which included adoption and dissemination of new clinical guidelines, a public health campaign, and a new central preterm birth prevention clinic for women at the highest risk (The Western Australian Preterm Birth Prevention Initiative 2014). The introduction of this programme has been associated with a reduction in singleton preterm birth of 7.6 percent in Western Australia (Newnham et al 2017).

Access to continuity of midwifery care and its impact on preterm birth

A Cochrane systematic review (Sandall et al 2016) on midwife-led continuity models of care compared with standard models of care for women during pregnancy, birth and early parenting showed that women randomised to continuity of midwifery care models experienced fewer fetal losses at less than 24 weeks gestation and fewer neonatal deaths. The groups of women who are more likely to experience preterm birth and neonatal death are least likely to register with lead maternity carer (LMC) midwives providing continuity of midwifery care (Ministry of Health 2017b).

---

2. Women with a previous preterm birth at less than 34 weeks are at increased risk of neonatal death.

The PMMRC recommends that LMCs and DHBs employ strategies to reduce preterm birth by targeting this high-risk group, including:

a. counselling at the time of a preterm birth to outline the strategies likely to be recommended for their next pregnancy, and advice to present for antenatal care as soon as they know they are pregnant

b. ensuring that antenatal care is available to allow women to register as early as possible, and ensuring that early antenatal care includes attention to modifiable risk factors such as smoking, sexually transmitted infections, and urinary tract infections

c. ensuring referral for specialist consultation in the first trimester to facilitate discussion of treatment options, which might include cervical cerclage or vaginal progesterone treatment and monitoring of cervical length using transvaginal ultrasound

d. counselling around signs and symptoms of preterm birth and how to respond to these to optimise outcome.

Justification

Women with a history of preterm birth are at significantly higher risk of a further preterm birth, and neonatal death (McManemy et al 2007) (Table 2.9).

Of the 729 babies who died after birth at 20 to 24 weeks, 305 were to multiparous mothers of singletons, and 119 (39 percent) of these had a history of previous preterm birth, including 64 (21 percent) who had a history of previous preterm birth between 20 and 28 weeks gestation (Table 2.9).

There was a significant difference by ethnicity in the trimester at registration with an LMC by ethnicity (Table 2.6).

Evidence

The use of vaginal progesterone and cervical cerclage, even in high-risk women, remains controversial, but these treatment options should be available to all women for whom preterm birth is a risk (Dodd et al 2013; Keelan and Newnham 2017). Meanwhile, strategies to optimise outcome for babies who are born preterm, such as antenatal corticosteroids, magnesium sulphate, transfer to a tertiary unit, and discussion around the outcomes and choices for babies born prior to 25 weeks gestation, should be available to all families/whānau.

There is limited evidence for dedicated preterm birth clinics as a means to reduce preterm birth rates (Whitworth et al 2011; Malouf and Redshaw 2017).

---

3. Birth in a tertiary centre is associated with improved outcomes for preterm babies at the lower limits of viability (prior to 25 weeks gestation).

The PMMRC recommends the Ministry of Health leads the development of a national consensus pathway for the care of women in preterm labour or requiring delivery prior to 25 weeks gestation. The PMMRC recommends this pathway includes:

- **a. ensuring that all groups of women (irrespective of ethnicity, age, socioeconomic status or place of residence) are offered and provided the same level of care**
- **b. strategies for secondary units for management of women in threatened or early preterm labour, or who require delivery, prior to 25 weeks gestation. Including:**
  - **i. administration of corticosteroids and magnesium sulphate**
  - **ii. timely transfer from primary and secondary units to tertiary units**
  - **iii. management of babies inadvertently born in their units at the lower limits of viability**
- **c. ensuring that priority populations have a voice in the development of health policy, process and practice in order to achieve equitable health outcomes**
- **d. guidance on monitoring that care provision is equitable by ethnicity, age, socioeconomic status and place of residence.**

Justification

The relative survival risk from 23 to 26 weeks was statistically significantly higher for babies born in a tertiary compared to a secondary hospital, with a relative risk of 1.27 (95% confidence interval (CI) 1.13–1.42) ($p<0.0001$).

Ethnic and age inequities were found in neonatal care, including access to neonatal care for extremely preterm births. For babies born alive at 23 to 26 weeks gestation:

- Māori, Pacific and Indian babies were less likely to receive an attempt at resuscitation and less likely to survive to 28 days of age.
- Māori mothers were more likely to birth at a secondary unit than a tertiary unit compared to mothers of all other ethnic groupings.
- Mothers under 20 years of age were more likely to birth in a secondary unit compared to mothers who were 20 years and older.

- Babies were more likely to receive an attempt at resuscitation if they were born at a tertiary unit than if they were born at a secondary unit.

These inequities have a disproportionate effect on Māori, Pacific and Indian mothers as they are more likely to birth at 23 to 26 weeks gestation than mothers of other ethnic groupings.

Evidence

Boland et al (2015) found improved survival for babies inborn at tertiary neonatal units between 22 and 27 weeks gestation compared to babies outborn in Victoria, Australia.

---

4. The PMMRC recommends DHBs make available appropriate information, including appropriate counselling, for parents, families and whānau about birth outcomes prior to 25 weeks gestation to enable shared decision making and planning of active care or palliative care options (see "Practice point: Care for women in preterm labour or requiring delivery at 23+0 to 24+6 weeks gestation").

Justification

Resuscitation was attempted at 23 weeks gestation for 153 (59 percent) of 258 live births, and for 391 (96 percent) of 406 live births at 24 weeks in 2007–2016 (Table 2.6). Attempted resuscitation varied by place of birth (that is, more often at tertiary than secondary hospitals, and more often at some tertiary units than others) and by ethnicity and maternal age.

From 2007 to 2016, at 23+0 to 23+6 weeks gestation, half of non-anomalous live born babies survived to 28 days when an attempt was made at resuscitation (76 survivors) and almost three quarters (73 percent) at 24 weeks (284 survivors). At 23 weeks gestation 30 percent of non-anomalous babies live born in New Zealand at any unit or at home survived to 28 days, and at 24 weeks gestation 70 percent survived to 28 days.

Evidence

These national outcomes compare to 46 percent survival of live born babies (inborn and outborn) at 23 weeks gestation and 77 percent survival at 24 weeks reported in Western Australia 2004–2010, where rates of provision of resuscitation are high (Sharp et al 2018).

Babies born alive at 23 and 24 weeks gestation and who survive have a long stay in neonatal units. At two years of age 42 percent of babies born at 23 weeks (8 of 19) and 26 percent of babies born at 24 weeks (8 of 31) were found to have moderate or severe morbidity such as neurodevelopmental disability and respiratory, gastrointestinal and renal complications of prematurity (Berry et al 2017). A systematic review estimated the risk of severe disability among children born at 23 weeks to be 20 percent (95% CI 5 to 52). This meta-analysis included six studies of 125 survivors. The risk of severe disability among children born at 24 weeks was between 5 to 44 percent. This meta-analysis included eight studies of 299 survivors. However, the certainty of the evidence for these outcomes was low to very low (Myrhaug et al 2017).

This information, along with consideration of the clinical indicators of outcome, may influence the decisions family and whānau will face.

5. The PMMRC recommends that DHB maternity services audit the rates of antenatal corticosteroid administration, including repeat doses when indicated, to mothers of neonates live born at less than 34 weeks gestation, including auditing whether administration is equitable by ethnicity, DHB of residence, and maternal age.

Justification

Of babies who died in the first 28 days after live birth, 11 percent at 23 weeks, 33 to 34 percent at 24 to 26 weeks, and 43 percent at 27 to 31 weeks gestation at birth had a complete course of antenatal corticosteroids. These data suggest that many babies at 23 weeks, and some at 24 to 26 weeks, were not optimally prepared for preterm birth.

Evidence

Planning for location of birth and preparation with administration of corticosteroids should be considered at 23+0 weeks gestation. Both overseas and in New Zealand, a 65 percent rate of completing a course of antenatal corticosteroids in babies who were live born, resuscitated and transferred to the neonatal intensive care unit has been reported, although 80 percent might be an appropriate and achievable goal (Kyser et al 2012; Berry et al 2017; Travers et al 2018). This would enable best outcomes for the baby if resuscitation is considered appropriate at the time of birth. See "Practice point: Care for women in preterm labour or requiring delivery at 23+0 to 24+6 weeks gestation" and the Antenatal Corticosteroid Clinical Practice Guidelines (Antenatal Corticosteroid Clinical Practice Guidelines Panel 2015).

6. The PMMRC recommends that tertiary obstetric and neonatal intensive care units investigate and address the difference between units in survival rates amongst infants born at 23 to 26 weeks gestation as part of their benchmarking and quality and safety initiatives.

Justification

There were statistically significant differences in survival rate by tertiary unit at gestations of 23 to 25 weeks ($p<0.001$; $p<0.001$; $p=0.047$ respectively) but not at 26 weeks ($p=0.058$). The units with the highest survival rates at 23 to 25 weeks gestation were Dunedin and Wellington, both of which are units known to have had an active approach to resuscitation at 23 weeks (93 percent and 94 percent compared to 35 percent to 68 percent in the remaining units; $p<0.001$).

There was a significant difference in the proportions of babies where resuscitation was attempted from 23 to 26 weeks gestation at tertiary units, with rates ranging from 87 percent (232/266) at Middlemore Hospital, 93 percent (137/148) at Christchurch, 94 percent (349/370) at Auckland, and 97 percent (209/215) at Waikato, to 98 percent (311/316) and 99 percent (93/94) at Wellington and Dunedin Hospitals ($p<0.001$).

Evidence

The finding that birth in the units with an active approach to resuscitation at 23 weeks gestation was associated with better survival out to 25 weeks is consistent with findings in previous reports (Smith et al 2012; Rysavy et al 2015). However, the role of other factors cannot be excluded.

New Zealand neonatal intensive care units have been aware that there are different approaches to resuscitation practice by unit and are working within the New Zealand Neonatal Network (www.starship.org.nz/for-health-professionals/new-zealand-child-and-youth-clinical-networks/newborn-clinical-network/) to develop a consensus statement to align practice across the country.

7. The PMMRC recommends that regulatory bodies require cultural competency training of all individuals working across all areas of the maternity and neonatal workforce. Training should address awareness of, and strategies to reduce and minimise the impact of, implicit bias and racism.

Justification

Māori, Pacific and Indian live born babies were statistically significantly less likely to have an attempt at resuscitation than babies of Other ethnic groupings (Table 2.7), and Māori and Pacific babies were significantly less likely to survive compared to babies of 'Other' ethnic groupings among all non-anomalous live born babies at 23 to 26 weeks gestation. Māori, Pacific and Indian mothers were less likely to have registered, or been able to register, with an LMC in the first trimester of pregnancy.

Pacific mothers had higher stillbirth and neonatal death rates and higher overall perinatal related death rates from congenital anomalies compared to Māori and Other European mothers who had similar (or higher) rates of termination of pregnancy.

While the reasons for these differences by ethnicity have not been elucidated in the analyses in this report, previous analysis on inequities by ethnicity in New Zealand suggest that institutional bias or implicit biases are likely to play at least some part.

Evidence

There is a large body of work in New Zealand (including this report) describing the inequities in access to care, quality of care, and health outcomes experienced by Māori and Pacific peoples. There is also a significant body of literature that clearly documents the association between exposure to racism/ethnic discrimination and adverse health outcomes internationally and in New Zealand (Harris et al 2006; Harris et al 2012a; Crengle et al 2012). Furthermore, in New Zealand, exposure to ethnic discrimination has been associated with lower levels of cervical (adjusted odds ratio (AOR) 0.51; 95% CI 0.30–0.87) and mammography screening (AOR 0.37; 95% CI 0.14–0.996) among eligible Māori women (Harris et al 2012b). In New Zealand people who report experiencing ethnic discrimination by health professionals are significantly more likely (both separately and for all experiences together) to report they were not always listened to carefully, their care was not always discussed as much as they wanted, and that they were not always treated with respect and dignity (combined AOR 1.57; 95% CI 1.15–2.14) (Harris et al 2012b). There is also evidence that exposure to discrimination is associated with adverse maternal and infant health outcomes (Thayer and Kuzawa 2015; Becares and Atatoa-Carr 2016; Hobbs et al 2017). The influence of clinicians' implicit racial/ethnic biases and explicit racial/ethnic stereotypes on their behaviours, cognition and decision making and the contribution of these to producing and maintaining ethnic inequities in health has been discussed for some time (see, for example, van Ryn and Fu 2003; van Ryn et al 2011) and more recently has received greater attention. In New Zealand, ethnic bias has been observed amongst medical students (Harris et al 2018).

The contribution that clinicians' biases per se make to ethnic health inequities is more difficult to quantify, as there are many factors that are involved in the development and maintenance of these inequities. Nevertheless, there is some evidence that these biases can impact on patient experience and clinical outcomes (Hall et al 2015; Ben et al 2017; Dehon et al 2017; Maina et al 2018). Cultural competence is one strategy used to improve health outcomes and eliminate ethnicity-related health inequities. In New Zealand, the medical colleges, the Medical Council of New Zealand and the Midwifery Council all require ongoing evidence of cultural competence training/activities. The assessment of cultural competence training and other interventions to address clinician bias is also complex. However, there is some evidence of effectiveness for cultural competence training (Horvat et al 2014; Truong et al 2014; Clifford et al 2015).

8. The PMMRC recommends that the Ministry of Health and DHBs have a responsibility to ensure that midwifery staffing ratios and staffing acuity tools:

a. enable active observation of mothers and babies who are undertaking skin-to-skin contact in the postnatal inpatient period

b. allow for the identification of, and additional needs of, mothers who have increased risk factors for sudden unexpected death in infancy (SUDI).

Justification

There were four deaths prior to discharge from hospital among the SUDI deaths from 2007 to 2016 reviewed for this report.

Evidence

The Ministry of Health's 2012 consensus statement *Observation of the Mother and Baby in the Immediate Postnatal Period* notes that sudden unexpected neonatal death in the first two days after birth is an increasingly recognised problem. Risk factors include unsupervised skin-to-skin contact, inexperienced mothers and mothers being left unsupervised in the immediate postnatal period. It also notes that mothers are less able to ensure a safe environment for breastfeeding or sleeping when they have experienced a long or complicated labour and birth, are under the influence of medications, or have some medical conditions.

Babies are more at risk of respiratory difficulties from a compromised airway where their mother or family/whānau have been or are exposed to medications, drugs, alcohol and/or smoking.

Skin-to-skin contact has been demonstrated to support increased breastfeeding; however, if risk factors for sudden unexpected neonatal death in hospital are present (such as smoke-exposed pregnancy, maternal tiredness, and the influence of medications) it is important to ensure that women are actively observed by someone who is capable of carrying out this responsibility confidently, and have immediate access to additional support when required.

9. The PMMRC recommends that lead maternity carers (LMCs) and DHBs ensure that every baby will have access to a safe sleep place on discharge from the hospital or birthing unit, or at home, that is their own place of sleep, on their back and with no pillow. If they do not have access to a safe sleep place, then a wahakura or Pēpi-Pod®[2] must be made available for the baby's use prior to discharge from hospital.

Justification

The review of SUDI deaths to 28 days from 2007 to 2016 found that at least 22 (32 percent) of the 68 babies reviewed who died did not have a usual safe place of their own to sleep. Usual place of sleep was not stated for a further 10 babies (15 percent).

Evidence

To keep babies safe while sleeping, all babies need to be in their own place of sleep (bassinet, cot, Pēpi-Pod or wahakura), free from adults or children who might accidentally suffocate them (Ministry of Health 2016).

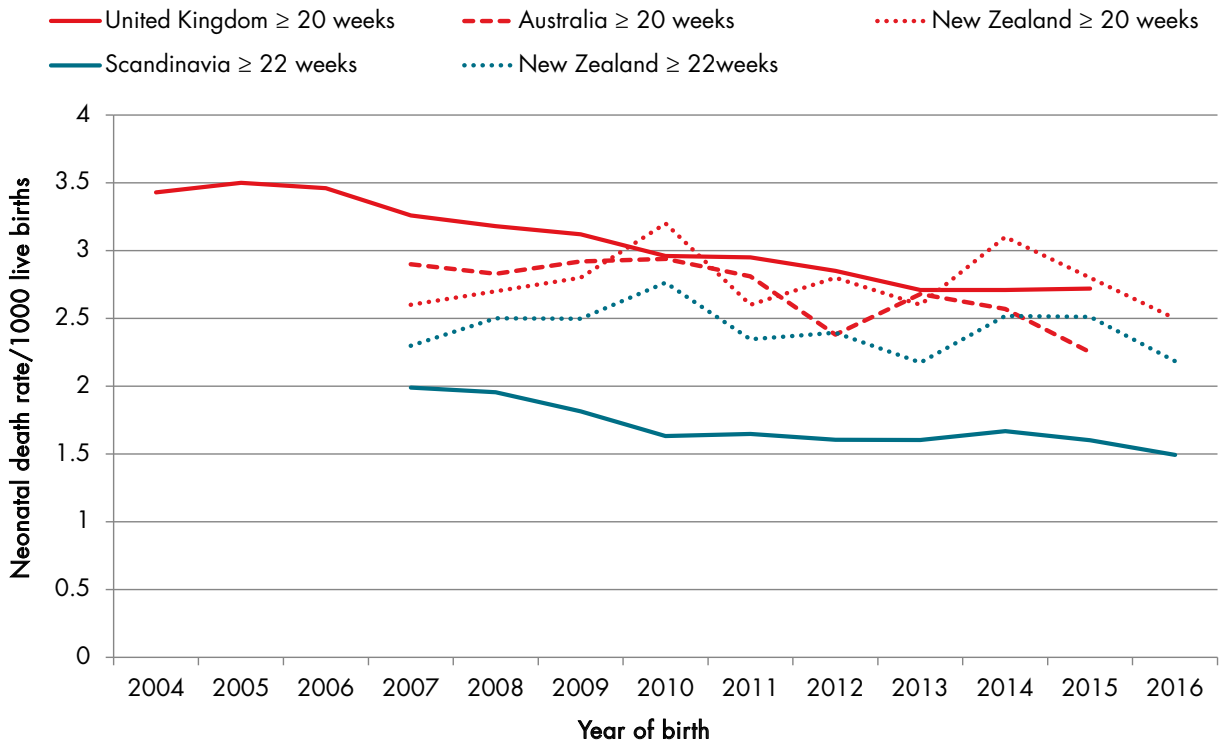
A randomised controlled trial with the wahakura found that they were at least as safe as bassinets, and in addition encouraged breastfeeding (Baddock et al 2017).

[2] A Pēpi-Pod® is a plastic box with a well-fitting mattress in the bottom. As well as the sleep space, these devices are always provided with safe sleep messaging.

2.3 Introduction

In 2017 the PMMRC decided to explore neonatal mortality in more detail as it was apparent that there had been no improvement in neonatal mortality rate in New Zealand from 2007, when the PMMRC began mandatory reporting and thus complete ascertainment and review of all perinatal related deaths. This was on a background of apparent improvement in neonatal mortality in other developed countries (Australia, UK, and Scandinavia) (Manktelow et al 2016; Australian Institute of Health and Welfare 2016; Heino and Gissler 2016) (Figure 2.1, Table 2.16).

Figure 2.1: Neonatal death rate (per 1000 live births) by gestation and country 2004-2016



Data sources and definitions

United Kingdom – live birth at ≥ 20 weeks gestation, or birthweight ≥ 400g if gestation is not available, who died before 28 completed days (routine data sources) (Manktelow et al 2016).

Australia – live birth at ≥ 20 weeks gestation, or birthweight ≥ 400g, who died before 28 completed days (routine data sources)(Australian Institute of Health and Welfare 2017; Australian Institute of Health and Welfare 2018).

Scandinavia – live birth at ≥ 22 weeks gestation who died before 28 completed days (routine data sources) (Heino and Gissler 2016).

New Zealand - live birth at ≥ 20 weeks gestation, or birthweight ≥ 400g if gestation is not available, who died before 28 completed days. Or live birth at ≥ 22 weeks gestation who died before 28 completed days (PMMRC).

From 2007 to 2016 there were 1,731 neonatal deaths in New Zealand from 20 weeks gestation (excluding terminations of pregnancy resulting in neonatal death).

2.4 Methodology

Neonatal deaths are usually reported per 1000 live births. In some analyses an alternative denominator per 1000 ongoing pregnancies is used to estimate risk. A quick reference for definition of rates and datasets used is available in "Appendix D: Key datasets and definitions in the PMMRC 12th report".

The analyses in this chapter use data from the PMMRC data collection, and from a merge of PMMRC deaths with denominator data from the National Maternity Collection (MAT). When analyses included parity, smoking, BMI, customised birthweight centile, or gestation at registration with an LMC, they were limited to mothers registered for care with an LMC (either a midwife, obstetrician or general

practitioner (GP)) claiming from the Section 88 Primary Maternity Services Notice from 2008. This is because these data were only reliably available for women under LMC care, and the variable for LMC was only accurate from 2008. These analyses included 79.9 percent of births in New Zealand in 2008, increasing to 92.1 percent in 2016.

When analyses used MAT data for the deaths (numerator), the analyses were necessarily limited to the deaths which were able to be merged with the MAT dataset, which was slightly fewer than the complete cohort in the PMMRC dataset. This was when rates were presented and there was a reason to believe that numerator-denominator bias might exist such as for analyses including smoking, BMI, customised birthweight centile, and trimester at first registration.

The findings begin with a description of neonatal death from congenital anomalies (n=414). Congenital anomalies were then excluded from the remainder of the analyses of neonatal deaths (n=1317).

Neonatal deaths without congenital anomalies were divided into three groups: birth at 20 to 24 weeks gestation, 25 to 34 weeks gestation, and 35 weeks and over. These gestation groupings were chosen for *a priori* reasons related to cause of death in the expectation that these categories would be the most useful in exploring the potential for improvements in neonatal mortality.

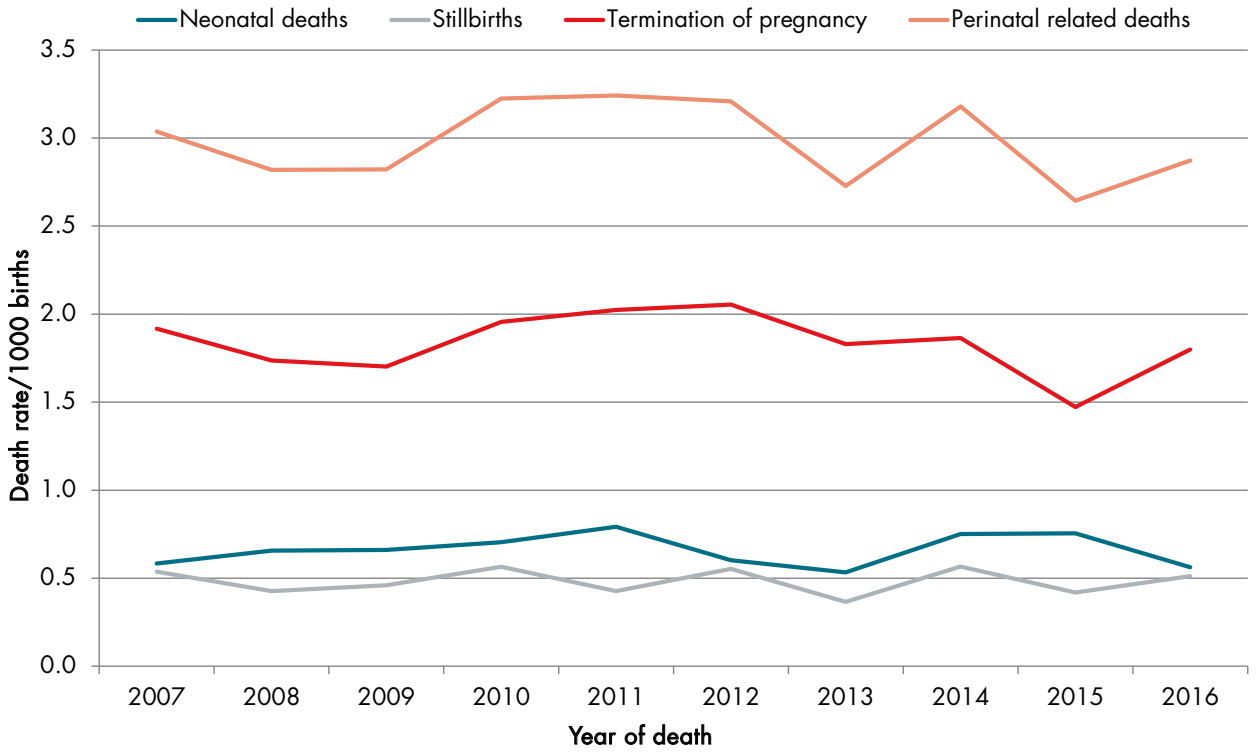
The analyses attempted to look at quality of maternity and neonatal care and to explore inequities in neonatal death rates to identify where reductions in neonatal deaths might be possible.

A full description of the methodology, definitions, and abbreviations common to PMMRC reporting can be found in *Methodology and Definitions for Perinatal and Maternal Mortality Review Committee (PMMRC) Reporting* (www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/3367/).

2.5 Findings

Perinatal related death and congenital anomalies

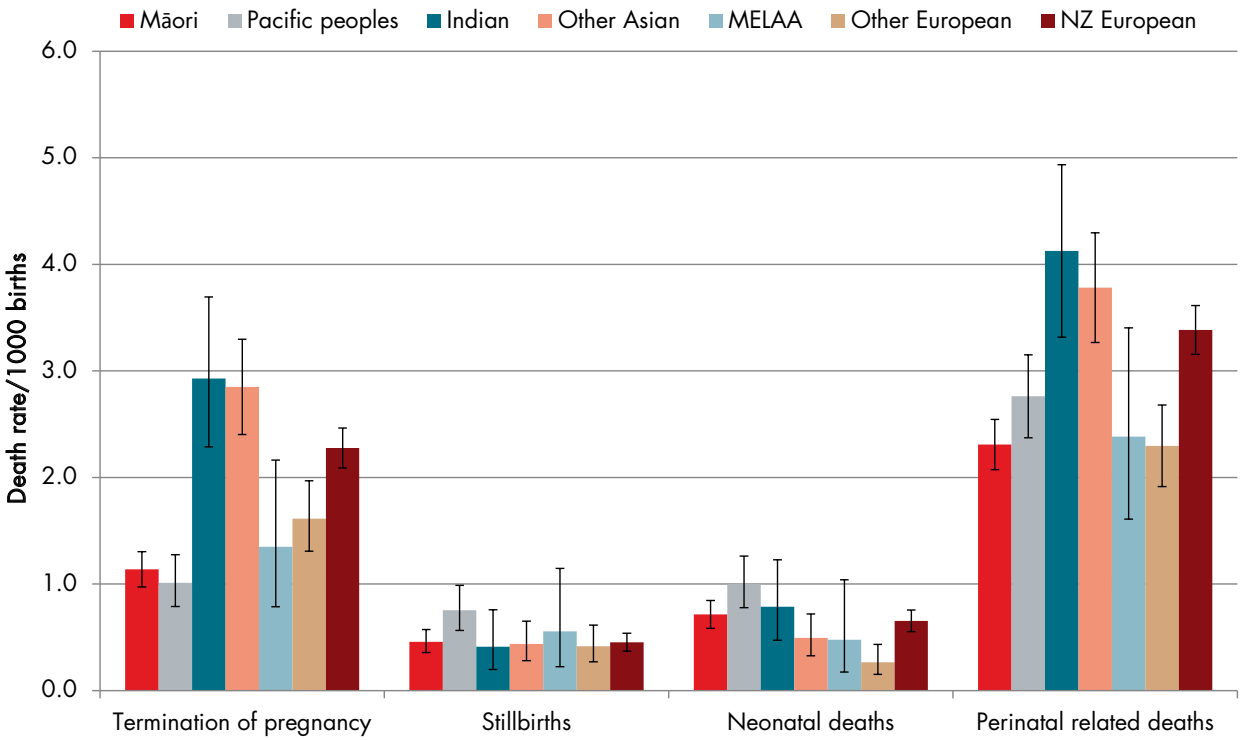
Figure 2.2: Congenital anomaly specific perinatal related mortality rates (per 1000 births) 2007–2016



There is no evidence of a change in perinatal related mortality from congenital anomaly from 2007 to 2016, including late termination of pregnancy, stillbirth, and neonatal death (Figure 2.2).

Ethnicity

Figure 2.3: Congenital anomaly specific perinatal related mortality rate (per 1000 births) by maternal ethnicity* 2007–2016



* Unknown/Other ethnicity is not represented.
MELAA = Middle Eastern, Latin American or African.

Late termination of pregnancy is the most common mode of death among babies dying with congenital anomaly (Figure 2.3). Indian, Other Asian and New Zealand European mothers had the highest rates of late termination of pregnancy associated with congenital anomaly, and this led to the highest rates of perinatal related death with congenital anomaly in these ethnic groupings.

Pacific mothers had significantly higher rates of stillbirth of babies with congenital anomalies than Māori, Other Asian, Other European and New Zealand European mothers. All other ethnic groupings have similar rates.

Pacific mothers had significantly higher rates of neonatal death of babies with congenital anomalies than Māori, Other Asian, Other European and New Zealand European mothers. Māori, Indian, and New Zealand European mothers had significantly higher rates than Other European.

For Pacific women, higher stillbirth and neonatal death rates with congenital anomalies may be at least partially related to lower rates of late termination leading to more stillbirths and neonatal deaths with lethal congenital anomalies. However, some of this ethnic difference in stillbirth and neonatal death rates for Pacific mothers and the differences in neonatal death rates for Māori, Indian, and New Zealand European mothers may be due to differences in care and/or differences in decisions to treat versus palliation. Further investigation of these deaths, including an analysis of the care pathway, and inclusion of data for infants surviving with congenital anomalies are needed to understand these findings further.

Table 2.1: Perinatal death classification (PSANZ-PDC) among neonatal deaths from congenital anomalies by gestational age at birth and place of birth 2007–2016

Perinatal death classification (PSANZ-PDC)	Total		Gestation (weeks)						Place of birth							
			20–24		25–34		≥35		Primary*		Secondary		Tertiary		Other/ unknown	
	n=414		n=7		n=129		n=278		n=18		n=101		n=291		n=4	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality																
Central nervous system	39	9.4	-	-	12	9.3	27	9.7	2	11.1	13	12.9	24	8.2	-	-
Cardiovascular system	65	15.7	-	-	11	8.5	54	19.4	5	27.8	15	14.9	43	14.8	2	50.0
Urinary system	41	9.9	1	14.3	20	15.5	20	7.2	4	22.2	11	10.9	26	8.9	-	-
Gastrointestinal system	12	2.9	-	-	4	3.1	8	2.9	-	-	3	3.0	8	2.7	1	25.0
Chromosomal	95	22.9	4	57.1	27	20.9	64	23.0	4	22.2	25	24.8	66	22.7	-	-
Metabolic	24	5.8	-	-	2	1.6	22	7.9	2	11.1	10	9.9	12	4.1	-	-
Multiple abnormality/non-chromosomal syndromes	60	14.5	1	14.3	24	18.6	35	12.6	-	-	9	8.9	51	17.5	-	-
Other congenital abnormality																
Musculoskeletal	15	3.6	-	-	5	3.9	10	3.6	-	-	4	4.0	11	3.8	-	-
Respiratory	4	1.0	-	-	1	0.8	3	1.1	-	-	2	2.0	2	0.7	-	-
Diaphragmatic hernia	30	7.2	-	-	11	8.5	19	6.8	-	-	5	5.0	25	8.6	-	-
Haematological	2	0.5	-	-	-	-	2	0.7	-	-	2	2.0	-	-	-	-
Tumours	6	1.4	1	14.3	4	3.1	1	0.4	-	-	-	-	6	2.1	-	-
Other	9	2.2	-	-	4	3.1	5	1.8	1	5.6	-	-	8	2.7	-	-
Unspecified	2	0.5	-	-	1	0.8	1	0.4	-	-	1	1.0	-	-	1	25.0
Maternal conditions																
Diabetes/Gestational diabetes	9	2.2	-	-	3	2.3	6	2.2	-	-	1	1.0	8	2.7	-	-
Other maternal conditions	1	0.2	-	-	-	-	1	0.4	-	-	-	-	1	0.3	-	-

* Home, birthing unit, Level 1 hospital

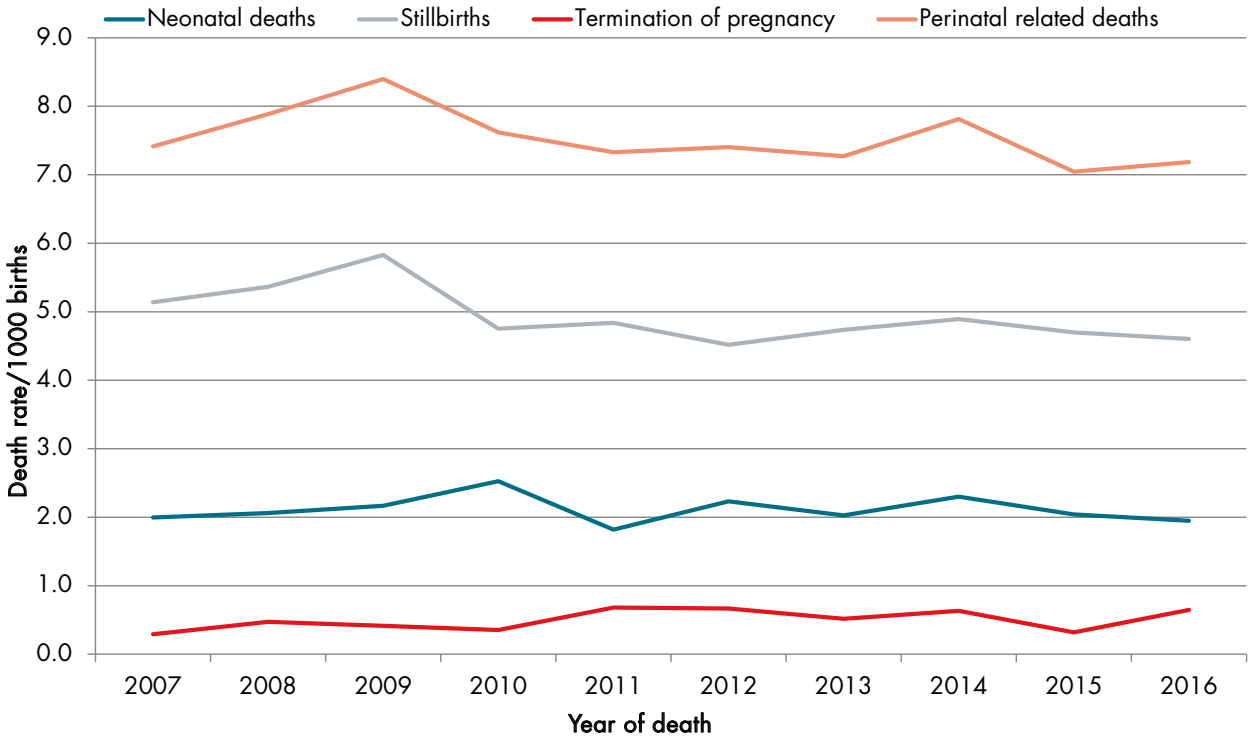
The most frequent congenital anomalies associated with neonatal death were chromosomal anomalies, anomalies of the cardiovascular system, and non-chromosomal syndromes (Table 2.1).

Without the total number of live births with congenital anomaly, it is not possible to know if survival with congenital anomaly differs by place of birth. However, the distribution of causes of death among neonatal deaths from congenital anomaly was broadly similar in secondary and tertiary units, except for a higher proportion of deaths from non-chromosomal syndromes and diaphragmatic hernia at tertiary hospitals, which would be consistent with the higher likelihood that these were diagnosed and referred prior to birth (Table 2.1).

Thirty-six percent of babies who died with congenital anomalies who were born outside a tertiary hospital were transferred to a tertiary hospital after birth (10/18 (56 percent) from primary and 32/101 (32 percent) from secondary care).

Neonatal deaths excluding deaths with congenital anomalies

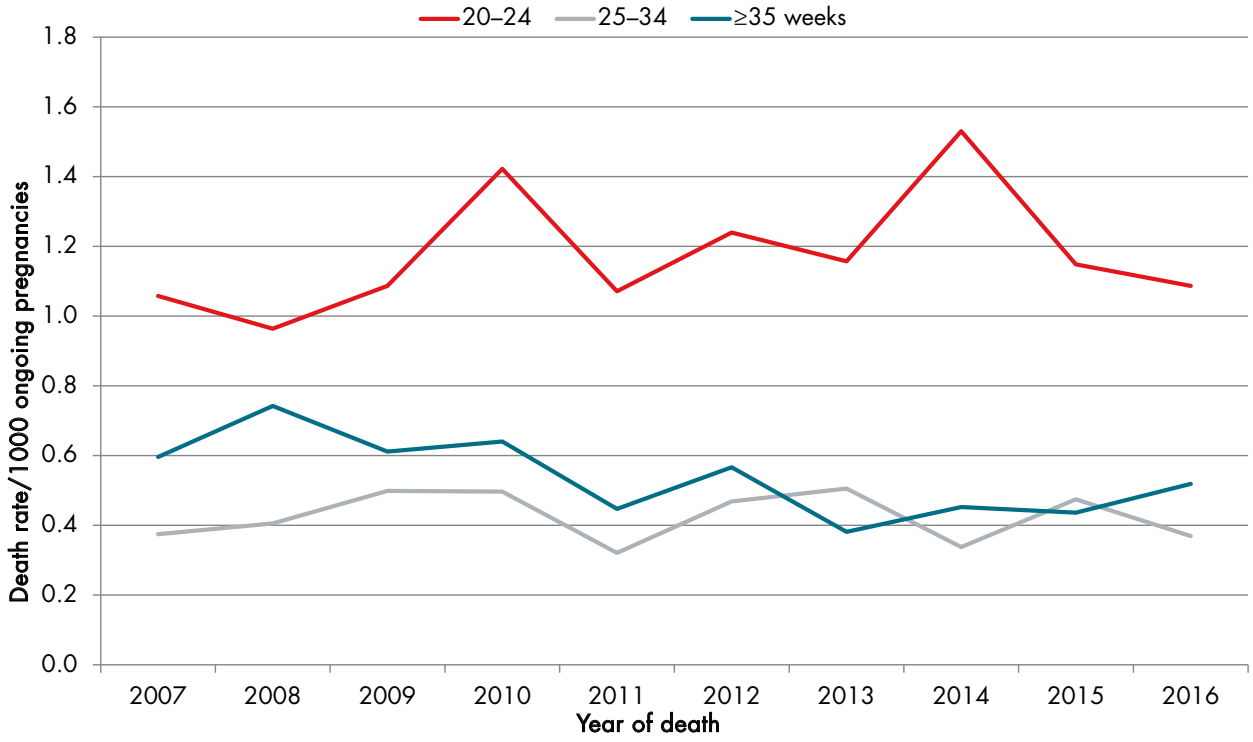
Figure 2.4: Perinatal related mortality rates excluding death with congenital anomaly 2007–2016



There was a reduction in stillbirth rate from 2007 to 2016 excluding death with congenital anomalies (score test for trend p=0.006). There has been an increase in termination of pregnancy rate excluding death with congenital anomalies (score test for trend p=0.04), but no change in neonatal death rate (score test for trend p=0.8) (Figure 2.4).

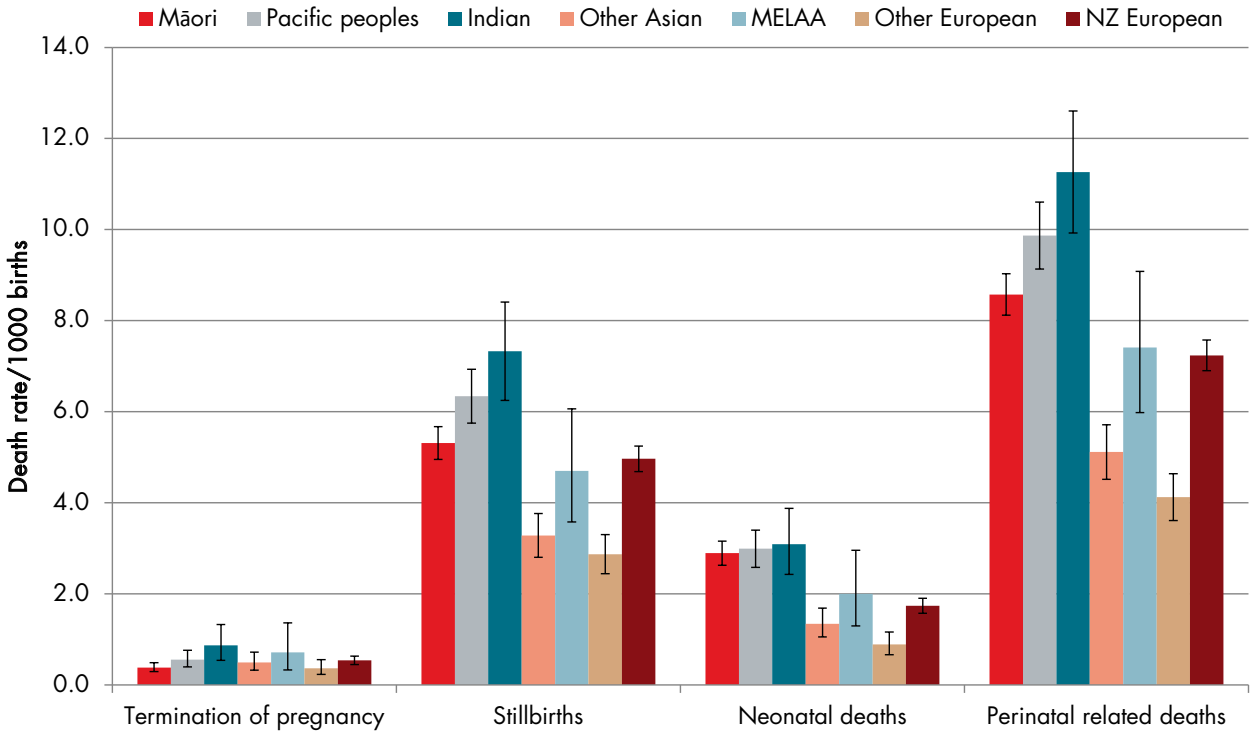
From 2007 to 2016 there has been no statistically significant change in neonatal deaths at 20 to 24 weeks or 25 to 34 weeks but a significant reduction in neonatal deaths from 35 weeks (score test for trend p=0.01) (Figure 2.5).

Figure 2.5: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and year of birth excluding congenital anomaly deaths 2007–2016



Ethnicity

Figure 2.6: Perinatal related mortality rates by maternal ethnicity* excluding death with congenital anomaly 2007–2016



* Unknown/Other ethnicity not represented.
MELAA = Middle Eastern, Latin American or African.

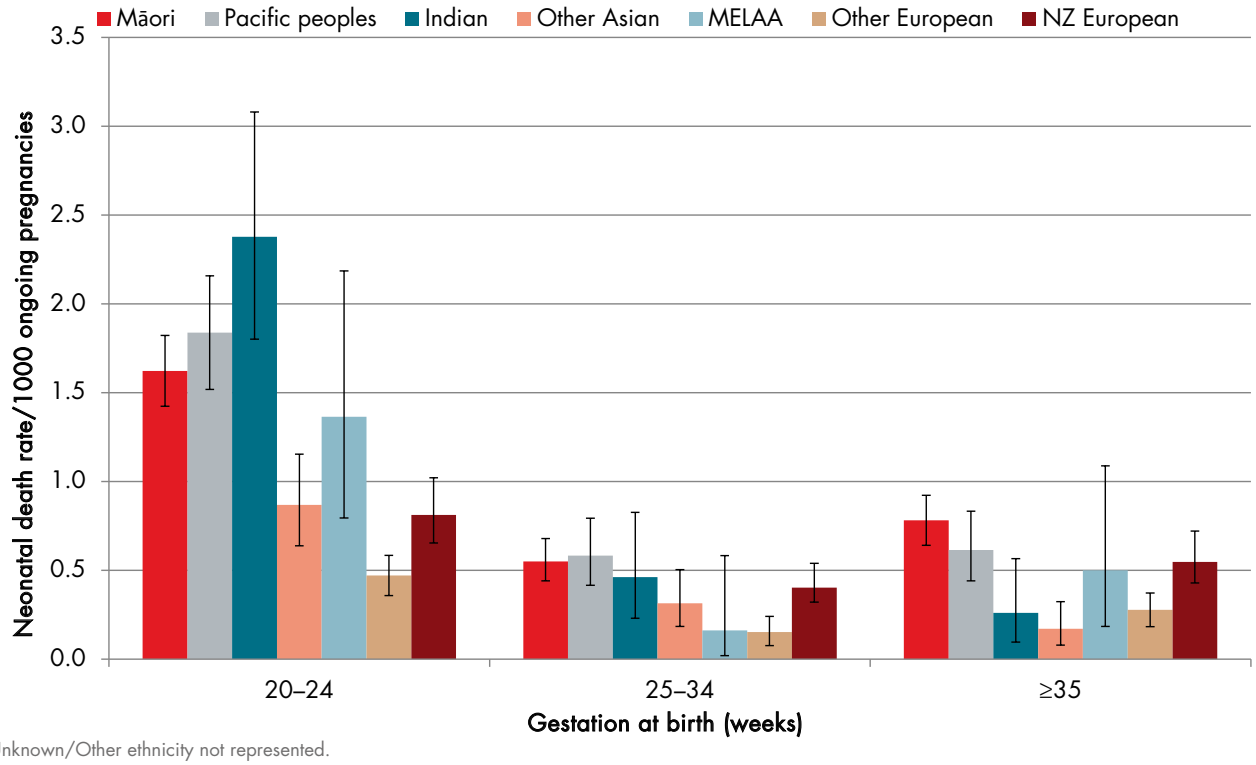
There were few late terminations of pregnancy for reasons other than congenital anomaly (Figure 2.6), and so these have little impact on non-anomalous perinatal related mortality.

There were significantly more neonatal deaths and more overall perinatal related deaths among babies of Māori, Pacific and Indian mothers than among mothers of Other Asian, Other European and New Zealand European ethnic groupings (Figure 2.6). Stillbirth rates were not significantly higher among Māori compared to New Zealand European mothers.

Stillbirth, neonatal death and overall perinatal related mortality was lower among babies of Other Asian and Other European mothers than among mothers of all other ethnic groupings.

It is notable that babies of Indian mothers had high perinatal mortality rates with and without congenital anomalies (Figure 2.3 and Figure 2.6).

Figure 2.7: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and maternal ethnicity excluding death with congenital anomaly 2007–2016



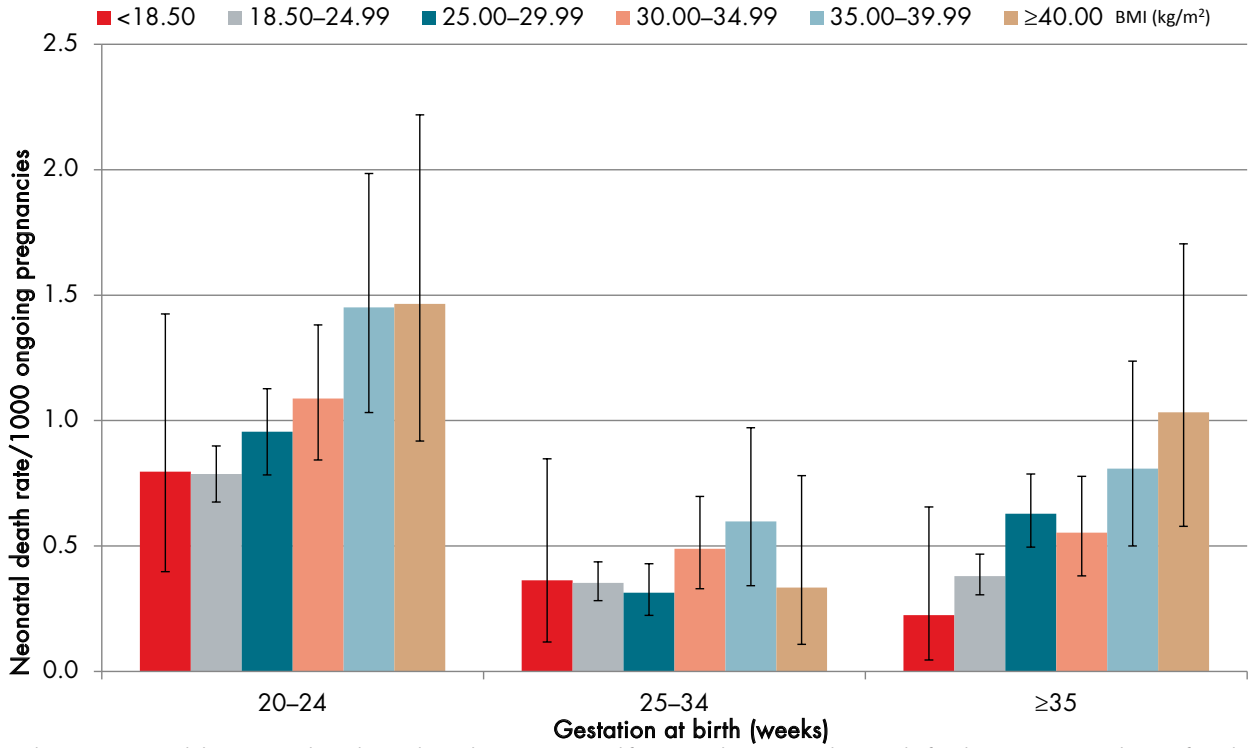
* Unknown/Other ethnicity not represented.
MELAA = Middle Eastern, Latin American or African.

There were more non-anomalous neonatal deaths among babies of Māori and Pacific women across all gestation groupings, although this was most evident at 20 to 24 weeks. Among babies born at 20 to 24 weeks gestation, the highest rate of neonatal death was among Indian babies (Figure 2.7).

Body mass index

There was a strong positive association between maternal BMI and non-anomalous neonatal death rate (Figure 2.8) at 20 to 24 weeks and from 35 weeks but the association with deaths between 25 and 34 weeks gestation is less obvious.

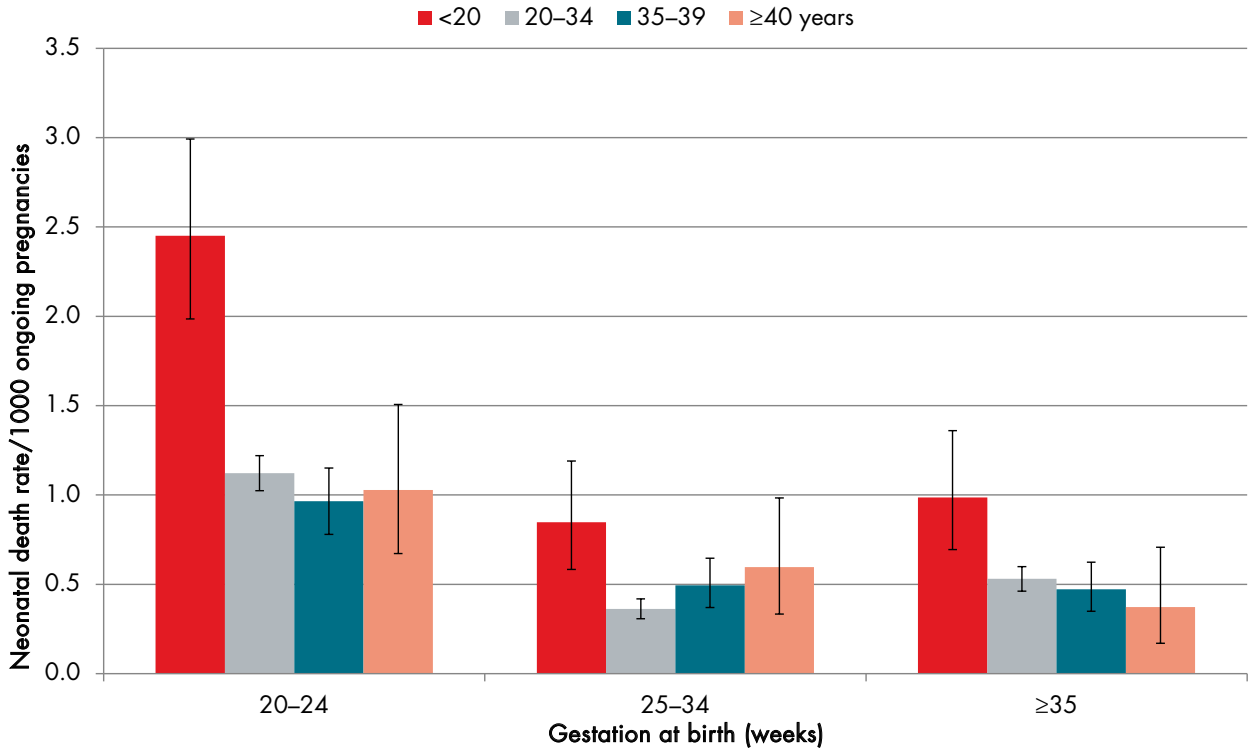
Figure 2.8: Neonatal death rates (per 1000 ongoing pregnancies) by gestation at birth and BMI excluding congenital anomalies 2008–2016*



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Maternal age

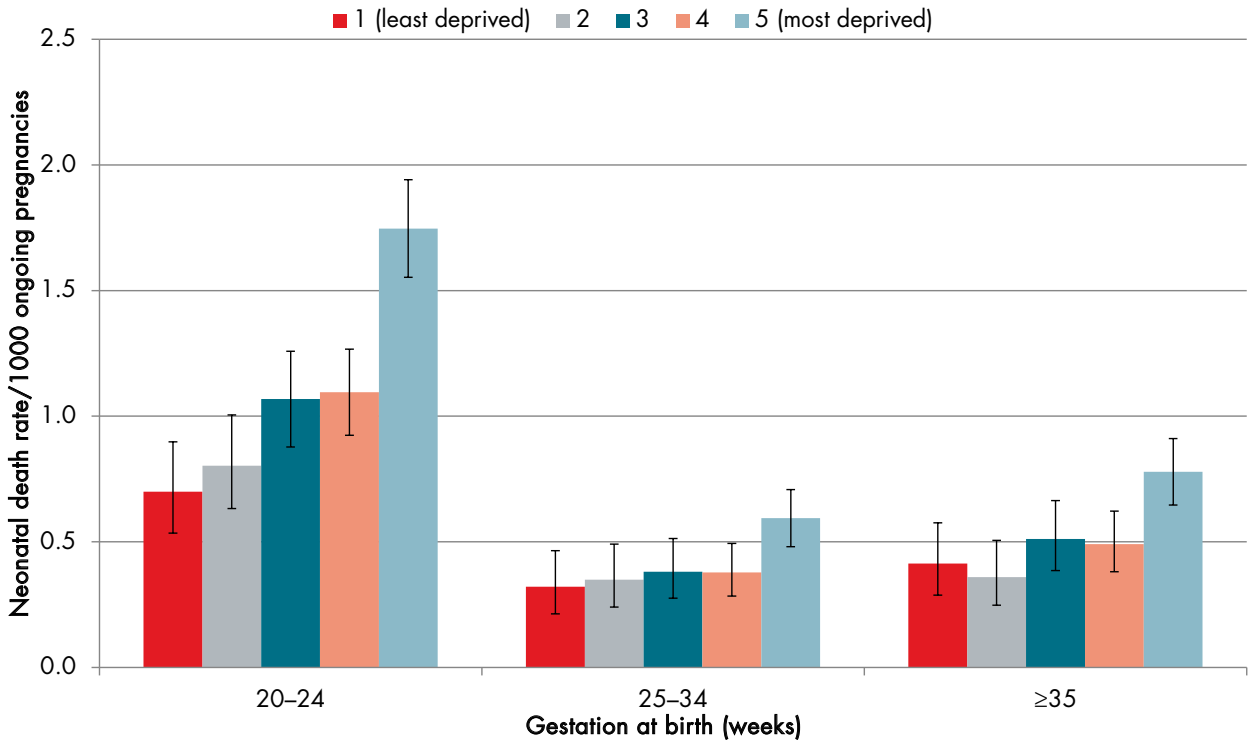
Figure 2.9: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and maternal age excluding death with congenital anomaly 2007–2016



Young mothers (under 20 years of age) had significantly higher rates of neonatal death at 20 to 24 weeks and from 35 weeks gestation than all age groupings, and higher rates than mothers aged 20 to 39 years old at 25 to 34 weeks gestation (Figure 2.9). The rates of neonatal death did not vary significantly by age grouping at any gestation for mothers aged 20 or older.

Socioeconomic deprivation

Figure 2.10: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and socioeconomic deprivation excluding congenital anomalies 2007–2016

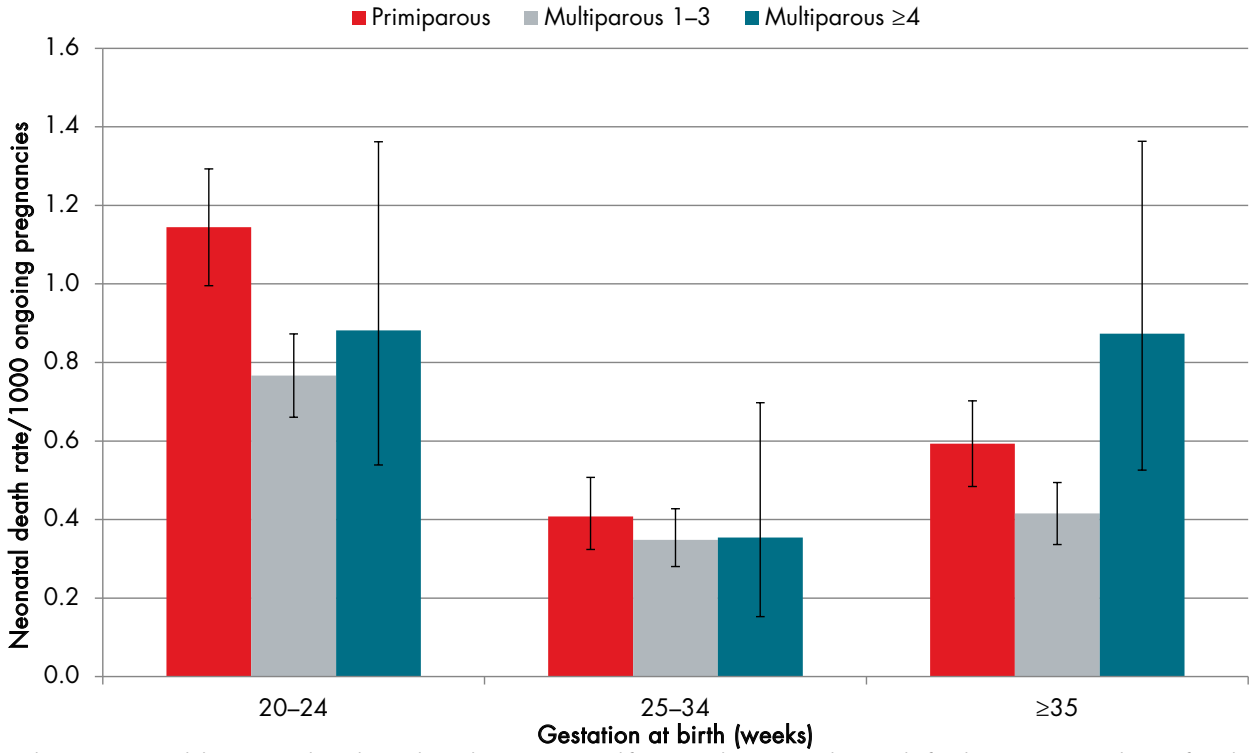


There was a statistically significant increase in neonatal death rate across all gestation groupings with increasing quintile of socioeconomic deprivation (chi square test for trend $p<0.0001$), although the gradient is more marked at 20 to 24 weeks gestation than at later gestations (Figure 2.10).

Parity

Women's first births were associated with significantly higher neonatal mortality than second to fourth births at 20 to 24 weeks and from 35 weeks gestation (Figure 2.11). Fifth births were significantly more at risk of neonatal death from 35 weeks than second to fourth births. Parity was not significantly associated with neonatal deaths from 25 to 34 weeks gestation.

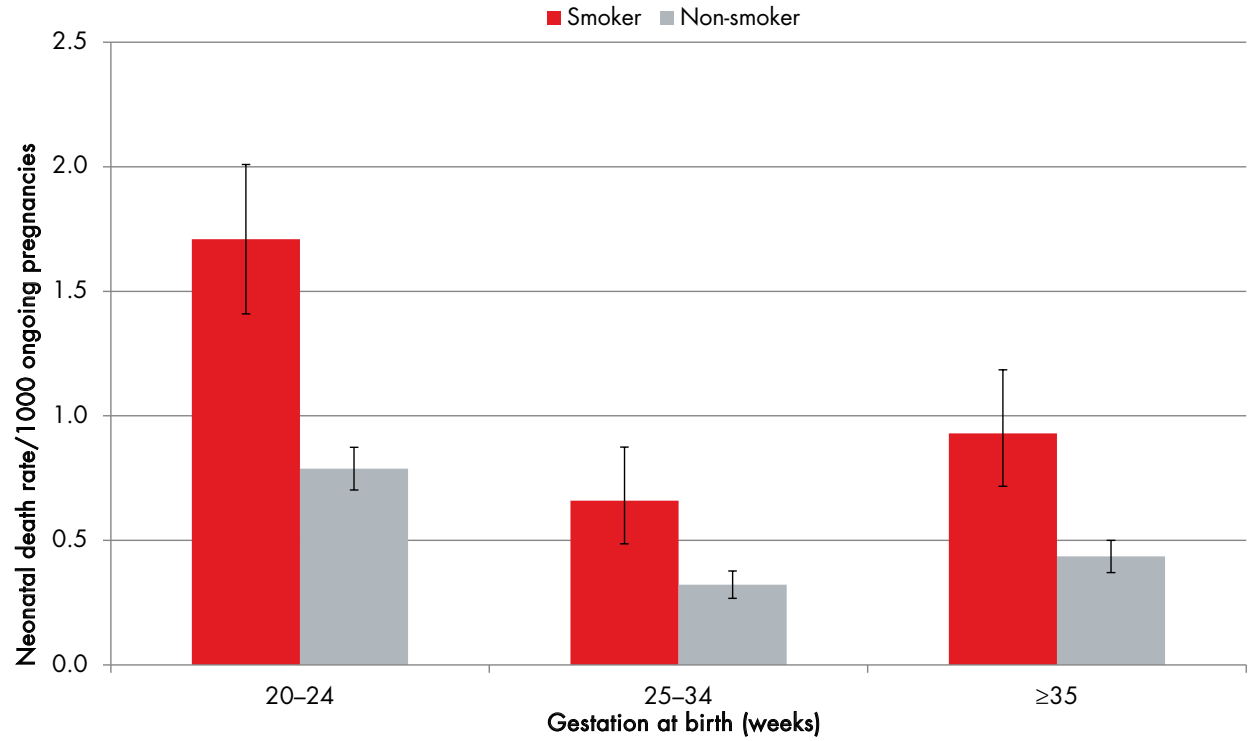
Figure 2.11: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and parity excluding death with congenital anomaly 2008–2016*



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Smoking

Figure 2.12: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and smoking excluding congenital anomaly deaths 2008–2016*



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Mothers who smoked were at significantly increased risk of neonatal death at all gestations.

Table 2.2: Clinical details of neonatal deaths by gestation 2007–2016

	Total		Congenital abnormalities		Neonatal deaths excluding congenital abnormalities											
					20–22		23–24		25–27		28–34		35–37		≥38 weeks	
	n=1,731		n=414		n=422		n=307		n=148		n=115		n=71		n=254	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Age at death (days)																
0	872	50.4	147	35.5	397	94.1	179	58.3	43	29.1	33	28.7	13	18.3	60	23.6
1–6	502	29.0	135	32.6	25	5.9	82	26.7	60	40.5	56	48.7	32	45.1	112	44.1
7–13	187	10.8	79	19.1	-	-	30	9.8	20	13.5	13	11.3	12	16.9	33	13.0
14–20	77	4.4	22	5.3	-	-	11	3.6	11	7.4	8	7.0	5	7.0	20	7.9
21–27	93	5.4	31	7.5	-	-	5	1.6	14	9.5	5	4.3	9	12.7	29	11.4
Level of birth																
Home	70	4.0	8	1.9	7	1.7	9	2.9	8	5.4	6	5.2	7	9.9	25	9.8
Birthing unit	33	1.9	7	1.7	3	0.7	-	-	1	0.7	1	0.9	-	-	21	8.3
Hospital Level 1	23	1.3	3	0.7	1	0.2	4	1.3	2	1.4	1	0.9	-	-	12	4.7
Hospital Level 2	487	28.1	101	24.4	140	33.2	64	20.8	20	13.5	29	25.2	29	40.8	104	40.9
Hospital Level 3	1,094	63.2	291	70.3	262	62.1	225	73.3	114	77.0	78	67.8	33	46.5	91	35.8
Other	19	1.1	2	0.5	8	1.9	5	1.6	3	2.0	-	-	-	-	1	0.4
Unknown	5	0.3	2	0.5	1	0.2	-	-	-	-	-	-	2	2.8	-	-
Place of death																
Home	142	8.2	43	10.4	4	0.9	5	1.6	2	1.4	6	5.2	18	25.4	64	25.2
Hospital														-		
Delivery suite	541	31.3	87	21.0	274	64.9	136	44.3	14	9.5	7	6.1	5	7.0	18	7.1
Antenatal ward	14	0.8	2	0.5	10	2.4	1	0.3	1	0.7	-	-	-	-	-	-
Postnatal ward	32	1.8	12	2.9	6	1.4	2	0.7	2	1.4	2	1.7	1	1.4	7	2.8
Neonatal unit	692	40.0	181	43.7	3	0.7	134	43.6	123	83.1	89	77.4	38	53.5	124	48.8
Operating theatre	53	3.1	20	4.8	3	0.7	5	1.6	3	2.0	8	7.0	2	2.8	12	4.7
Emergency department	50	2.9	6	1.4	23	5.5	9	2.9	1	0.7	1	0.9	2	2.8	8	3.1
Other	174	10.1	53	12.8	91	21.6	11	3.6	1	0.7	2	1.7	3	4.2	13	5.1
Unknown	5	0.3	3	0.7	1	0.2	-	-	-	-	-	-	-	-	1	0.4
Other	28	1.6	7	1.7	7	1.7	4	1.3	1	0.7	-	-	2	2.8	7	2.8
Inter hospital transfer																
To Level 2 Hospital	6	0.3	-	-	-	-	1	0.3	-	-	1	0.9	1	1.4	3	1.2
To Level 3 Hospital	194	11.2	44	10.6	3	0.7	17	5.5	23	15.5	20	17.4	17	23.9	70	27.6
No transfer	1,531	88.4	370	89.4	419	99.3	289	94.1	125	84.5	94	81.7	53	74.6	181	71.3

Table 2.2: Clinical details of neonatal deaths by gestation 2007–2016 (continued)

	Total		Congenital abnormalities		Neonatal deaths excluding congenital abnormalities											
					20–22		23–24		25–27		28–34		35–37		≥38 weeks	
	n=1,731		n=414		n=422		n=307		n=148		n=115		n=71		n=254	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Apgar 1 minute																
0–3	979	56.6	163	39.4	*	*	204	66.4	62	41.9	71	61.7	38	53.5	130	51.2
4–5	243	14.0	86	20.8	*	*	57	18.6	35	23.6	15	13.0	3	4.2	12	4.7
6–7	155	9.0	64	15.5	*	*	15	4.9	37	25.0	12	10.4	8	11.3	13	5.1
≥8	225	13.0	91	22.0	*	*	7	2.3	7	4.7	14	12.2	19	26.8	86	33.9
Unknown	129	7.5	10	2.4	*	*	24	7.8	7	4.7	3	2.6	3	4.2	13	5.1
Apgar 5 minutes																
0–3	812	46.9	105	25.4	*	*	163	53.1	43	29.1	49	42.6	27	38.0	110	43.3
4–5	164	9.5	61	14.7	*	*	35	11.4	15	10.1	15	13.0	6	8.5	17	6.7
6–7	227	13.1	89	21.5	*	*	54	17.6	38	25.7	23	20.0	6	8.5	15	5.9
≥8	369	21.3	144	34.8	*	*	29	9.4	45	30.4	25	21.7	28	39.4	97	38.2
Unknown	159	9.2	15	3.6	*	*	26	8.5	7	4.7	3	2.6	4	5.6	15	5.9
Resuscitation at birth																
Yes	873	50.4	223	53.9	*	*	186	60.6	143	96.6	103	89.6	50	70.4	156	61.4
No	850	49.1	189	45.7			118	38.4	5	3.4	11	9.6	21	29.6	97	38.2
Unknown	8	0.5	2	0.5	*	*	3	1.0	-	-	1	0.9	-	-	1	0.4
Outcome of resuscitation																
Baby resuscitated and transferred to another clinical care area	719	41.5	200	48.3	*	*	135	44.0	122	82.4	89	77.4	42	59.2	128	50.4
Baby unable to be resuscitated	150	8.7	22	5.3	*	*	50	16.3	20	13.5	14	12.2	8	11.3	27	10.6
Unknown	4	0.2	1	0.2	*	*	1	0.3	1	0.7	-	-	-	-	1	0.4
Customised birthweight centile																
Small for gestational age	473	27.3	201	48.6	56	13.3	53	17.3	57	38.5	43	37.4	20	28.2	43	16.9
Appropraite for gestational age	1,076	62.2	172	41.5	309	73.2	228	74.3	80	54.1	56	48.7	42	59.2	189	74.4
Large for gestational age	174	10.1	38	9.2	55	13.0	26	8.5	11	7.4	15	13.0	9	12.7	20	7.9
Unknown	8	0.5	3	0.7	2	0.5	-	-	-	-	1	0.9	-	-	2	0.8

* Not applicable.

Neonatal deaths among babies born at 20 to 24 weeks gestation without congenital anomalies

Of the 729 babies who died without congenital anomalies up to 28 days after live birth at 20 to 24 weeks gestation, from 2007 to 2016 (approximately 70 per year), 96 were born at 20 weeks, 137 at 21 weeks, 189 at 22 weeks, 184 at 23 weeks and 123 at 24 weeks.

Table 2.3: Perinatal death classification (PSANZ-PDC) by neonatal death classification (PSANZ-NDC) among neonatal deaths without congenital anomaly at 20–24 weeks 2007–2016

Perinatal death classification (PSANZ-PDC)	Neonatal death classification (PSANZ-NDC)						
	Extreme prematurity	Cardio-respiratory disorders	Infection	Neurological	Gastro-intestinal	Other	TOTAL
Perinatal infection	25	-	6	-	-	-	**31**
Hypertension	4	2	-	2	-	1	**9**
Antepartum haemorrhage	157	10	1	12	2	1	**183**
Maternal conditions	15	1	1	-	-	1	**18**
Specific perinatal conditions	84	2	4	3	1	1	**95**
Fetal growth restriction	1	-	-	-	-	-	**1**
Spontaneous preterm	312	32	13	24	6	5	**392**
TOTAL	**598**	**47**	**25**	**41**	**9**	**9**	**729**

The most common cause of neonatal death at 20 to 24 weeks gestation was extreme prematurity. The most common obstetric antecedents were spontaneous preterm labour (312 (52 percent)) and antepartum haemorrhage (157 (26 percent)) (Table 2.3).

Of the 157 babies where antepartum haemorrhage preceded death from extreme prematurity (Table 2.3), 55 (35 percent) were associated with placental abruption, 54 (34 percent) bleeding of undetermined origin, 47 (30 percent) other bleeding, and one placenta praevia.

Specific perinatal conditions contributed to a significant number of neonatal deaths from extreme prematurity (84 (14 percent)) (Table 2.3). The antecedent causes in these cases were twin-to-twin transfusion syndrome (31 (5 percent)), uterine anomalies (40 (7 percent)), rupture of membranes after amniocentesis (4), and other (9).

Perinatal infection was implicated as obstetric antecedent cause (PSANZ-PDC) or primary neonatal cause (PSANZ-NDC) of death in 50 (7 percent) deaths from 20 to 24 weeks gestation (Table 2.3). These included infections from Group B *Streptococcus* (10), *Escherichia coli* (13), other specified bacterial (12), unspecified bacterial (7), fungal (2), *Cytomegalovirus* (1), and other unspecified organism (5).

Mothers of 21 babies who died after birth at 23 weeks (11 percent) had a complete course of antenatal corticosteroids and 41 (33 percent) at 24 weeks. This compares to 34 percent of mothers respectively at 25 and 26 weeks (24/71, 17/50), and 43 percent (43/100) from 27 to 31 weeks. These data would suggest that many babies at 23 weeks were not prepared for active management or resuscitation over this time period in New Zealand.

Planning for location of birth and preparation with administration of antenatal corticosteroids should be considered at a gestation of 23+0 weeks gestation. Both overseas and in New Zealand, a 65 percent rate of completing a course of antenatal corticosteroids in babies who were live born, resuscitated

and transferred to the neonatal intensive care unit has been reported, although 80 percent might be an appropriate and achievable goal (Kyser et al 2012; Berry et al 2017; Travers et al 2018). This would enable best outcomes for the baby if resuscitation is considered appropriate at the time of birth (see "Practice point: Care for women in preterm labour or requiring delivery at 23+0 to 24+6 weeks gestation").

Of the 729 babies who died after birth at 20 to 24 weeks, 170 (23 percent) were twins or other multiples. Of the 305 multiparous mothers of singletons, 119 (39 percent) had a history of previous preterm birth, including 64 (21 percent) who had a history of previous preterm birth between 20 and 28 weeks gestation. Of babies who died after birth at 20 to 24 weeks, 15 percent of their mothers (18) had a cervical suture placed in this pregnancy.

Multivariable analysis

The multivariable analysis was limited to deaths merged with the MAT denominator dataset and to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice and births from 2008. This was because smoking, parity, and BMI data were only consistently available in the denominator for this population which comprises approximately 87 percent of the birthing population in New Zealand from 2008 to 2016.

The multivariable analysis (Table 2.4) estimates the independent association of the sociodemographic factors included in the model with extreme preterm neonatal death. Factors with a statistically significant independent association with neonatal death of non-anomalous babies after birth at 20 to 24 weeks gestation included maternal age under 20 years, BMI of 35 and over, multiple pregnancy, smoking, Māori, Pacific and Indian ethnicity, increasing deprivation decile, and first birth compared to later births.

The increased risk associated with Māori, Pacific and Indian ethnicity reflects unmeasured factors; for example, factors relating to access to health services and quality of care, rather than factors related to ethnicity per se. More detailed work is required to understand these factors. One important factor that contributes to ethnic differences in neonatal mortality at 20 to 24 weeks gestation is the proportion of all babies born to Māori (0.27 percent), Pacific (0.28 percent), and Indian (0.27 percent) mothers compared to mothers of all other ethnic groupings (0.12 percent) who are born at extremely early gestations (20 to 24 weeks) (Figure 2.13). Thus, to address inequity in neonatal mortality, the factors that lead to extreme preterm birth need to be identified and addressed. (See "Practice point: Care for women in preterm labour or requiring delivery at 23+0 to 24+6 weeks gestation").

If the inequity in neonatal deaths at 20 to 24 weeks gestation among Māori, Pacific, and Indian women compared with other ethnic groupings was eliminated, 31 excess neonatal deaths would have been prevented from 2007 to 2016.

Strategies that may reduce these inequities include providing improved access to continuity of midwifery care (Sandall et al 2016); early antenatal care for Māori, Pacific and Indian women, who have lower rates of registration with an LMC in the first trimester (Table 2.8); and access to obstetric services that provide specialised education, offer support and intervention for women with risk factors for preterm birth (Malouf and Redshaw 2017).

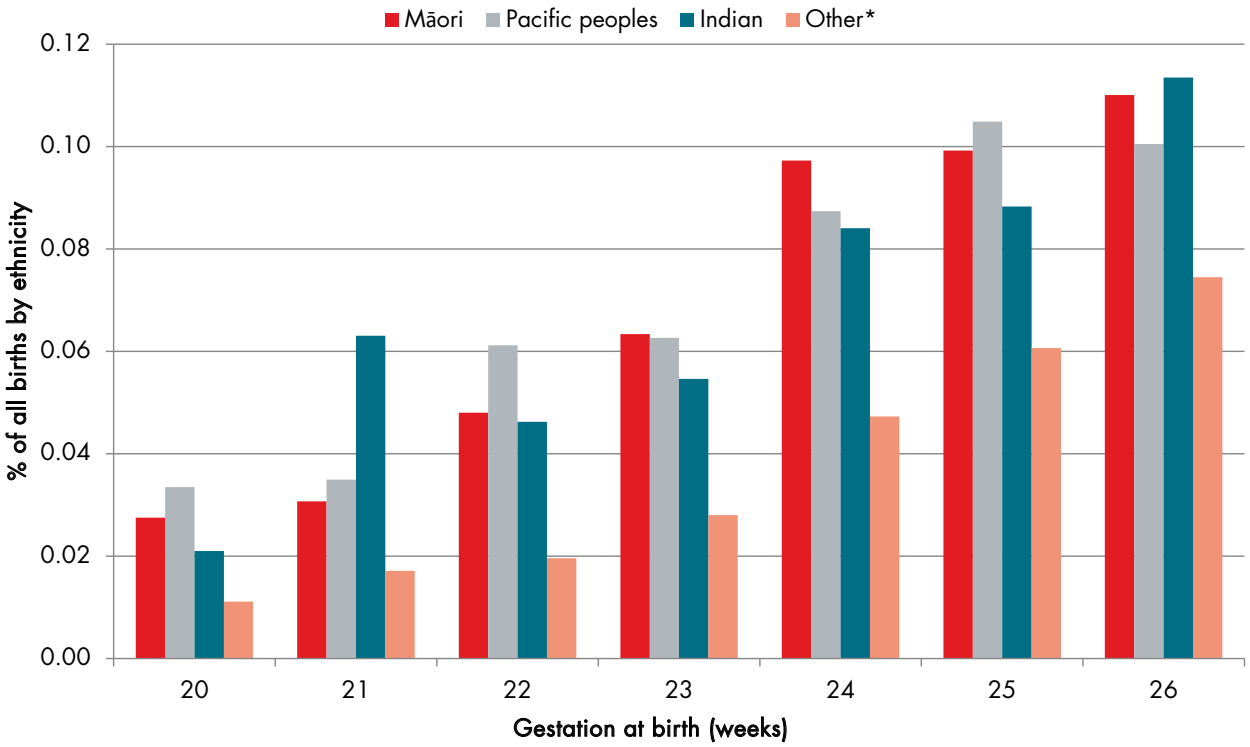
Although the Ministry of Health via the Maternity Quality and Safety Programme (Allen + Clarke 2015) and the Better Public Service Results 2 (early access to midwifery services) may impact on very preterm birth and neonatal deaths (Ministry of Health 2017a), much more is required to achieve an equitable start.

Table 2.4: Multivariable analysis of sociodemographic factors associated with neonatal death among babies born at 20–24 weeks gestation without congenital anomalies 2008–2016*

	Births	Deaths	Rate	Unadjusted OR	95% CI		Adjusted OR	95% CI	
	N=451,149	n=400	(/1000 live births)						
Maternal age									
<20	26,304	46	1.75	1.62	1.13	2.32	1.45	1.00	2.10
20–24	79,536	86	1.08	1			1		
25–29	117,379	102	0.87	0.8	0.6	1.07	0.99	0.73	1.33
30–34	132,713	92	0.69	0.64	0.48	0.86	0.94	0.68	1.3
35–39	77,894	60	0.77	0.71	0.51	0.99	1.13	0.79	1.63
≥40	17,323	14	0.81	0.75	0.42	1.31	1.09	0.6	1.96
BMI (kg/m²)									
<18.50	12,905	10	0.77	1.06	0.56	2	1.01	0.53	1.93
18.50–24.99	225,176	165	0.73				1		
25.00–29.99	116,370	109	0.94	1.28	1	1.63	1.17	0.91	1.49
30.00–34.99	57,630	59	1.02	1.4	1.04	1.88	1.21	0.89	1.64
35.00–39.99	25,164	36	1.43	1.95	1.36	2.8	1.65	1.13	2.40
≥40.00	13,904	21	1.51	2.06	1.31	3.25	1.70	1.06	2.72
Baby sex									
Female	219,335	187	0.85	1			1		
Male	231,814	213	0.92	1.08	0.89	1.31	1.09	0.89	1.32
Plurality									
Singleton	440,628	310	0.7	1			1		
Multiple pregnancy	10,521	90	8.55	12.3	9.68	15.51	13.9	10.9	17.6
Smoking									
Non-smoker	382,881	296	0.77	1			1		
Smoker	68,268	104	1.52	1.97	1.58	2.47	1.80	1.39	2.33
Ethnicity (maternal)									
New Zealand European	187,256	123	0.66				1		
Māori	114,734	139	1.21	1.56	1.27	1.92	1.42	1.08	1.88
Pacific	38,351	54	1.41	1.68	1.26	2.24	2.00	1.41	2.83
Indian	16,122	29	1.8	2.11	1.45	3.08	3.00	1.97	4.55
Other Asian	39,842	30	0.75	0.84	0.58	1.21	1.43	0.95	2.15
Other European	46,478	19	0.41	0.43	0.27	0.69	0.66	0.41	1.08
Other	86,320	6	0.07	0.81	0.36	1.81	1.15	0.51	2.62
Deprivation decile (per unit)				1.11	1.07	1.16	1.06	1.02	1.11
Parity									
Nulliparity (0)	186,131	204	1.1	1.44	1.14	1.8	1.45	1.14	1.83
1	150,628	115	0.76	1			1		
2	67,177	50	0.74	0.97	0.7	1.36	0.87	0.62	1.22
3	26,063	15	0.58	0.75	0.44	1.29	0.55	0.32	0.96
4	10,998	5	0.45	0.6	0.24	1.46	0.36	0.15	0.90
≥5	10,152	11	1.08	1.42	0.76	2.64	0.78	0.41	1.48
Year of birth (per year)				1.05	1.01	1.09	1.04	1	1.08

* Limited to deaths merged with the MAT denominator and to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.
OR = odds ratio.
CI = confidence interval.

Figure 2.13: Gestational age at birth by maternal ethnicity among live born babies born at 20–26 weeks without congenital anomalies 2007–2016



* Other ethnicity includes New Zealand and Other European; Other Asian; Middle Eastern, Latin American or African (MELAA); Other ethnicities; and unknown and not stated.

Deaths after birth at 23 to 26 weeks gestation among babies without congenital anomalies

The analyses in Table 2.5 to Table 2.7 and Figure 2.14 and Figure 2.15 are limited to deaths merged with the MAT dataset.

Resuscitation

Resuscitation was attempted at 23 weeks gestation for 153 of 258 live births (59 percent), and for 391 of 406 live births (96 percent) at 24 weeks (Table 2.5).

From 2007 to 2016, at 23+0 to 23+6 weeks gestation, half of non-anomalous live born babies survived to 28 days when an attempt was made at resuscitation (76 survivors) and almost three quarters (73 percent) at 24 weeks (284 survivors).

At 23 weeks gestation, 29.5 percent of all non-anomalous live born babies survived to 28 days, and at 24 weeks gestation 70 percent survived to 28 days. These data apply to all non-anomalous infants born in New Zealand at any unit or at home, irrespective of attempt at resuscitation. These national outcomes compare to 46 percent survival to hospital discharge of live born babies (inborn and outborn) at 23 weeks gestation and 77 percent survival at 24 weeks reported in Western Australia 2004–2010, where rates of provision of resuscitation are high (Sharp et al 2018).

Table 2.5: Survival (to 28 days) after birth at 23 and 24 weeks gestation 2007–2016

Total births	Gestation at birth (weeks)			
	23		24	
	n=627		n=629	
	n	%	n	%
Congenital anomalies who died (SB or TOP or NND)	143	22.8	84	13.4
Non-anomalous stillbirths	177	28.2	116	18.4
Non-anomalous termination of pregnancy	49	7.8	23	3.7
Non-anomalous live birth	**258**	**41.1**	**406**	**64.5**
No resuscitation	105	16.7	15	2.4
Resuscitation attempted*	153	24.4	391	62.2
Died <28 days	77	12.3	107	17
Survived to 28 days	76	12.1	284	45.2
Survival to 28 days				
Of all births	76	12.1	284	45.2
Of non-anomalous births	76	15.7	284	52.1
Of non-anomalous live births	76	29.5	284	70
Of resuscitated non-anomalous live births	76	49.7	284	72.6

* PMMRC data.
SB = stillborn.
TOP = termination of pregnancy.
NND = neonatal death.

In a recent report from Wellington of births from 2003 to 2012, survival rates at two years of inborn live born babies where resuscitation was attempted were 22/38 (58 percent) at 23 weeks and 36/60 (60 percent) at 24 weeks gestation (Berry et al 2017).

Table 2.6: Resuscitation, survival (to 28 days) and antenatal care by maternal ethnicity for live born babies at 23–26 weeks gestation without congenital anomalies 2007–2016

	Māori		Pacific		Indian		Other#		Chi-square test (p)
	n=578		n=244		n=81		n=774		
	n	%	n	%	n	%	n	%	
Resuscitation attempted	533	92.2	216	88.5	70	86.4	734	94.8	<0.001
Survival to 28 days – of live births	417	72.1	175	71.7	58	71.6	603	77.9	0.051
Survival to 28 days – of resuscitated live births	417	78.2	175	81.0	58	82.9	603	82.2	0.35
Antenatal care*	n=417		n=125		n=55		n=645		
First trimester	213	51.1	44	35.2	28	50.9	435	67.4	
Second trimester or no antenatal care	204	48.9	81	64.8	27	49.1	210	32.6	<0.001

* Limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice 2008–2016.
# Other ethnicity includes New Zealand and Other European; Other Asian; Middle Eastern, Latin American or African (MELAA); Other ethnicities; unknown and not stated.

Nationally, live born babies of Māori, Pacific and Indian mothers were statistically significantly less likely to have an attempt at resuscitation than babies of Other (predominantly non-Indian Asian and European) ethnicity mothers (Table 2.6). Babies of Māori and Pacific mothers were significantly less likely to survive compared to babies of mothers of other ethnic groupings among all non-anomalous live born babies at 23 to 26 weeks gestation (p=0.05).

The proportion of women who were able to register with an LMC in the first trimester of pregnancy was lower among Māori, Pacific and Indian mothers. The rates of first trimester registration among Māori, Pacific and Indian mothers will almost certainly be lower than these data suggest, as the analysis of antenatal care in Table 2.6 is limited to the 87 percent of women who engaged with a community midwife, private obstetrician or GP for their LMC.

Place of birth

The analysis in this section explores the effect of place of birth, specifically level of neonatal service at hospital of birth on survival, at current limits of viability. Transfer may have occurred after birth, but this analysis ONLY relates to place of birth. The analysis includes babies born at 25 and 26 weeks gestation to provide a broader clinical context.

Table 2.7: Survival (to 28 days) and level of hospital of birth among babies without congenital anomalies by gestation at birth 2007–2016

Hospital of birth	Gestation at birth (weeks)											
	23			24			25			26		
	survivors (n)	deaths (n)	survival %	survivors (n)	deaths (n)	survival %	survivors (n)	deaths (n)	survival %	survivors (n)	deaths (n)	survival %
Tertiary*	64	126	34	252	101	71	361	51	88	415	39	91
Secondary	12	47	20	28	16	64	29	11	73	58	7	89
Primary/home	0	4	0	1	1	50	4	2	67	11	1	92
Missing place of birth	0	5		3	4		7	6		8	3	
Tertiary unit only												
Middlemore	7	42	14	45	22	67	65	10	87	70	5	93
Christchurch	5	18	22	12	17	41	38	8	83	47	3	94
Dunedin	5	9	36	26	2	93	26	0	100	26	0	100
Waikato	6	13	32	33	17	66	56	14	80	63	13	83
Wellington	31	20	61	72	15	83	74	5	94	90	9	91
Auckland	10	24	29	64	28	70	102	14	88	119	9	93

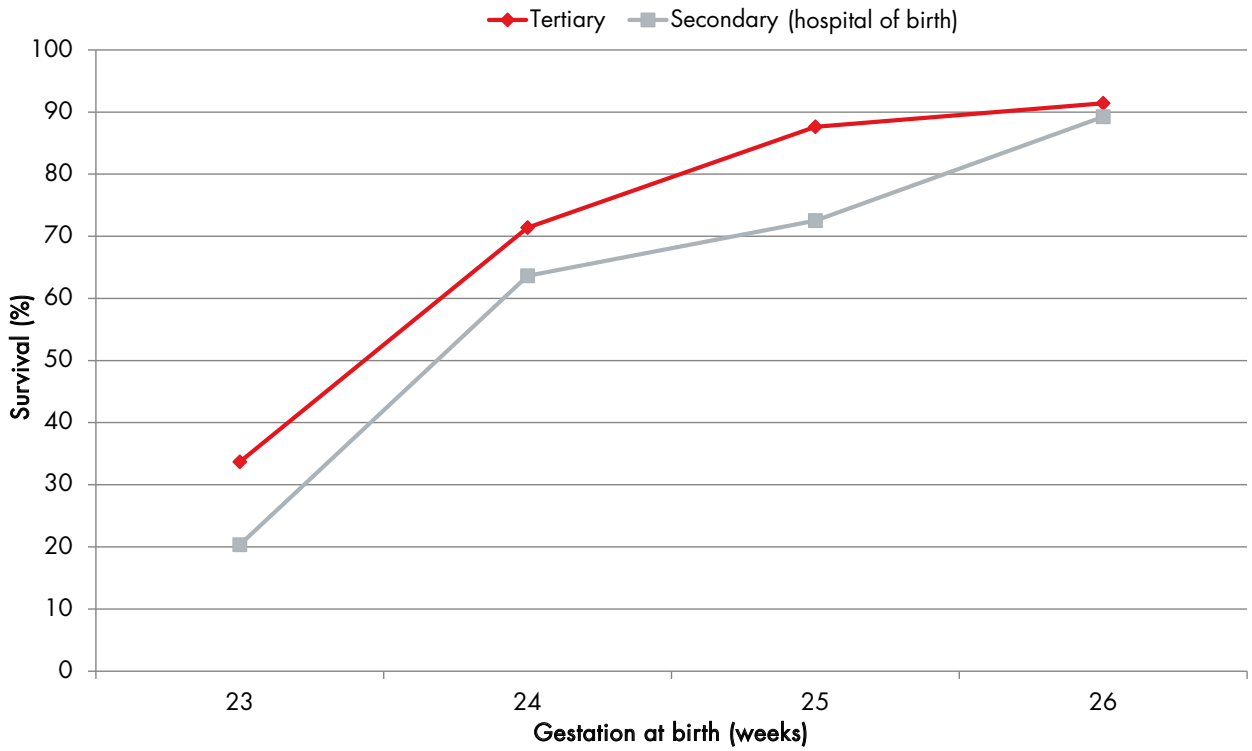
* Indicates neonatal intensive care available at hospital of birth; secondary unit survivors are transferred after birth.

At 23 weeks gestation, from 2007 to 2016, 190 non-anomalous babies were born at tertiary units (76 percent), 59 at secondary units, and nine at primary units or at home or birthplace was unknown (Table 2.7). At 24 weeks gestation, 353 (89 percent) non-anomalous babies were born at tertiary units, 44 at secondary units, and nine babies at primary units or at home or birthplace was unknown. Only small numbers of babies were born at primary units between 23 and 26 weeks gestation and so these data are not included in Figure 2.14.

The relative risk of survival after birth at 23 weeks for babies born at tertiary compared to those born at secondary units was 1.66 (95% CI 0.96–2.85); at 24 weeks, 1.12 (95% CI 0.89–1.42); at 25 weeks, 1.21 (95% CI 1.00–1.47); and at 26 weeks, 1.02 (95% CI 0.94–1.12). However, when considered together the relative risk of survival from 23 to 26 weeks was statistically significantly higher for babies born in a tertiary compared to a secondary hospital with a relative risk of 1.27 (95% CI 1.13–1.42) ($p<0.0001$) (Figure 2.14).

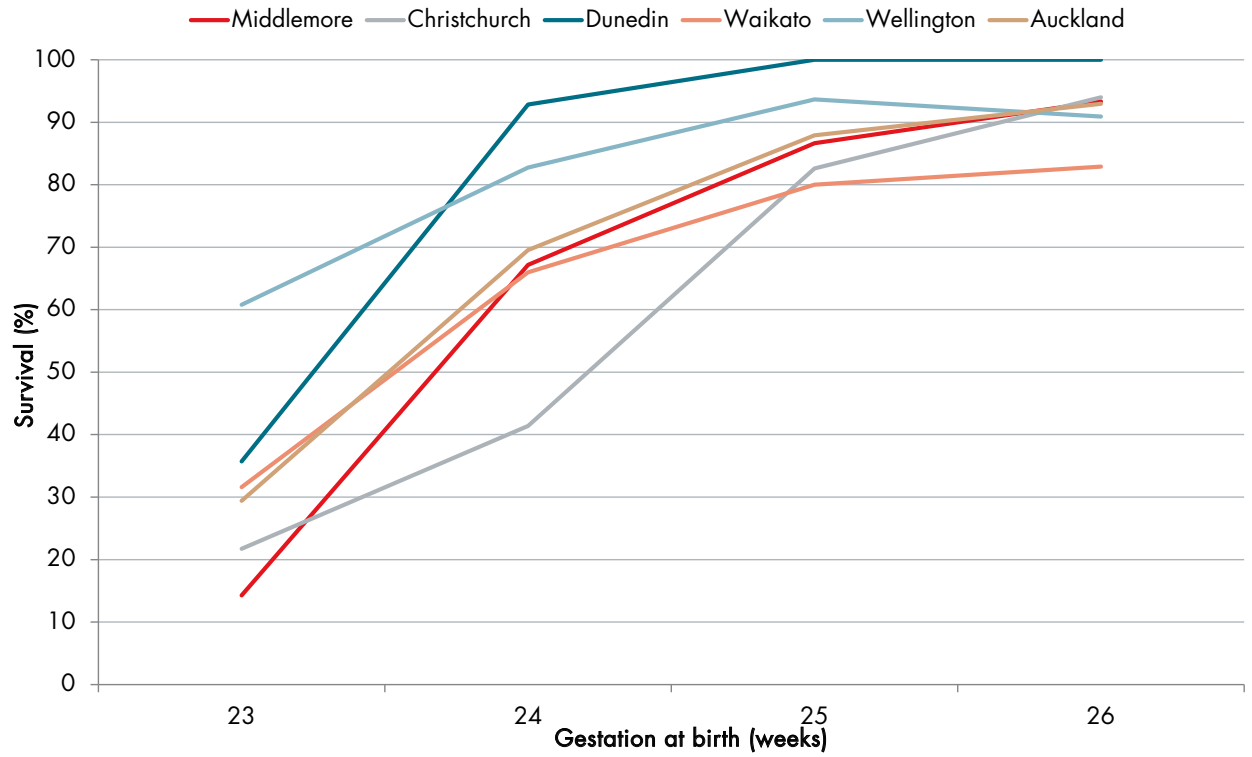
Boland et al (2015) also found improved survival for babies inborn at tertiary neonatal units between 22 and 27 weeks gestation compared to babies outborn in Victoria, Australia.

Figure 2.14: Survival (to 28 days) of live inborn babies without congenital anomaly by gestation at birth and level of hospital at birth 2007–2016



Survival to one year of live born babies without congenital anomaly after birth from 23 to 26 weeks gestation was also statistically significantly higher for babies born in tertiary compared to secondary maternity units from 2007 to 2015 (2016 data incomplete at publication; data not supplied) (p=0.006).

Figure 2.15: Survival (to 28 days) of live inborn babies by gestation at birth and tertiary unit of birth excluding death with congenital anomalies 2007–2016



There were statistically significant differences in survival rate to 28 days by tertiary unit at gestations of 23 to 25 weeks ($p<0.001$; $p<0.001$; $p=0.047$ respectively) but not at 26 weeks ($p=0.058$) (Figure 2.15). The units with the highest survival rates at 23 to 25 weeks gestation were Dunedin and Wellington, both of which are units known to have had an active approach to resuscitation at 23 weeks (93 percent and 94 percent compared to 35 percent to 68 percent in the remaining units; $p<0.001$) (data not given).

Survival to one year from 2007 to 2015 among live inborn babies without congenital anomaly, after birth at 23 to 26 weeks gestation, by tertiary unit of birth, was less than at 28 days but still differed by unit ($p<0.00001$) (data not supplied).

There was a significant difference in the proportions of babies where resuscitation was attempted from 23 to 26 weeks gestation at tertiary units, with rates ranging from 87 percent (232/266) at Middlemore Hospital, 93 percent (137/148) at Christchurch, 94 percent (349/370) at Auckland, and 97 percent (209/215) at Waikato, to 98 percent (311/316) and 99 percent (93/94) at Wellington and Dunedin Hospitals ($p<0.001$). The proportion of mothers completing a course of antenatal corticosteroids, transferred to the tertiary hospital in utero, and the proportion arriving with birth imminent, are all unknown for survivors, and so the contribution of these factors to outcome cannot be determined from these data. These factors may be important confounders in the association between tertiary unit of birth and survival. In addition, in 2010 and 2011 there were devastating earthquakes in Christchurch, which may have had some impact on neonatal outcomes.

The finding that birth in the units with an active approach to resuscitation at 23 weeks gestation was associated with better survival out to 25 weeks is consistent with findings in previous reports (Smith et al 2012; Rysavy et al 2015). However, the role of other factors cannot be excluded.

New Zealand neonatal intensive care units have been aware that there are different approaches to resuscitation practice by unit and are working within the New Zealand Neonatal Network (www.starship.org.nz/for-health-professionals/new-zealand-child-and-youth-clinical-networks/newborn-clinical-network/) to develop a consensus to align practice across the country.

Most importantly, the finding that there were differences in survival by unit suggests that further improvements are possible.

Table 2.8: Characteristics of mothers whose babies were live born at 23–26 weeks by level of hospital of birth excluding deaths with congenital anomalies 2007–2016

	Births 23–26 weeks		Level of hospital of birth								
			Tertiary		Secondary		Primary^		Missing		
	n=1,677		n=1,409		n=208		n=24		n=36		
	n	%	n	%	n	%	n	%	n	%	p*
Gestation at birth (weeks)											
23	258	15.4	190	13.5	59	28.4	4	16.7	5	13.9	
24	406	24.2	353	25.1	44	21.2	2	8.3	7	19.4	
25	471	28.1	412	29.2	40	19.2	6	25.0	13	36.1	
26	542	32.3	454	32.2	65	31.3	12	50.0	11	30.6	<0.001
Resuscitation attempt											
Attempted	1,553	92.6	1,331	94.5	170	81.7	20	83.3	32	88.9	<0.001
No attempt	124	7.4	78	5.5	38	18.3	4	16.7	4	11.1	
Ethnicity (maternal)											
Māori	578	34.5	455	32.3	97	46.6	12	50.0	14	38.9	
Pacific peoples	244	14.5	216	15.3	18	8.7	4	16.7	6	16.7	
Indian	81	4.8	76	5.4	4	1.9	-	-	1	2.8	
non-Māori non-Pacific non-Indian	774	46.2	662	47.0	89	42.8	8	33.3	15	41.7	<0.001
Maternal age											
<20	196	11.7	151	10.7	33	15.9	3	12.5	9	25.0	
20-34	1,140	68.0	949	67.4	151	72.6	17	70.8	23	63.9	
≥35	341	20.3	309	21.9	24	11.5	4	16.7	4	11.1	0.0053
Deprivation decile											
1 (least deprived)	180	10.7	160	11.4	19	9.1	1	4.2	-	-	
2	208	12.4	179	12.7	23	11.1	4	16.7	2	5.6	
3	253	15.1	215	15.3	28	13.5	4	16.7	6	16.7	
4	395	23.6	332	23.6	48	23.1	8	33.3	7	19.4	
5 (most deprived)	626	37.3	521	37.0	90	43.3	6	25.0	9	25.0	0.54
Missing	15	0.9	2	0.1	-	-	1	4.2	12	33.3	
Trimester at first LMC registration‡	n=1,112		Tertiary		Secondary		Primary^		Missing		
			n=913		n=157		n=18		n=24		
First trimester	708	63.7	599	65.6	95	60.5	4	22.2	10	41.7	
Second trimester	369	33.2	288	31.5	54	34.4	13	72.2	14	58.3	0.0031
No LMC antenatal care	30	2.7	25	2.7	5	3.2	-	-	-	-	
Invalid data	5	0.4	1	0.1	3	1.9	1	5.6	-	-	

^ Home, birthing unit, Level 1 hospital

* Statistical testing excludes missing data

‡ limited to mothers who were registered for care with an LMC (either a midwife, Obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice 2008–2016

Non-anomalous babies live born at 23 weeks gestation were more likely to have been born at a secondary unit than a tertiary unit; and live born babies at 23 to 26 weeks were more likely to receive an attempt at resuscitation if born at a tertiary unit than a secondary unit (Table 2.8). However, the reasons for these differences, including potential confounding factors, are not known and require further investigation.

In addition, Māori mothers and mothers under 20 years of age giving birth at 23 to 26 weeks gestation were more likely to birth in a secondary unit than mothers of all other ethnic groupings and mothers aged 20 years and older (Table 2.8).

Table 2.9: Perinatal death classification, pregnancy management and history of preterm birth by ethnicity among neonatal deaths 23–26 weeks without congenital anomalies 2007–2016

Neonatal deaths 23–26 weeks	Māori		Pacific peoples		Indian		Other*		Chi-square test (p)
	n=159		n=69		n=26		n=174		
	n	%	n	%	n	%	n	%	
Perinatal death classification (PSANZ-PDC)									
Perinatal infection	4	2.5	11	15.9	-	-	5	2.9	
Hypertension	7	4.4	-	-	-	-	11	6.3	
Antepartum haemorrhage	32	20.1	17	24.6	8	30.8	32	18.4	
Maternal conditions	1	0.6	2	2.9	1	3.8	7	4.0	
Specific perinatal conditions	15	9.4	5	7.2	2	7.7	20	11.5	
Fetal growth restriction	-	-	1	1.4	-	-	2	1.1	
Spontaneous preterm	100	62.9	33	47.8	15	57.7	97	55.7	0.002
Cervical suture in this pregnancy	11	6.9	5	7.2	2	7.7	3	1.7	0.094
Antenatal corticosteroids	35	22.0	11	15.9	5	19.2	52	29.9	0.093
Multiparous mothers	n=101		n=39		n=12		n=77		
History of preterm birth	44	43.6	18	46.2	2	16.7	23	29.9	0.075
Between 20 and 28 weeks	19	18.8	8	20.5	1	8.3	11	14.3	0.66

* Other ethnicity includes New Zealand and Other European; Other Asian; Middle Eastern, Latin American or African (MELAA); Other ethnicities; unknown and not stated.

Although not statistically significant (p=0.09), Māori, Pacific and Indian mothers whose babies died after birth at 23 to 26 weeks gestation were less likely to have received a completed course of antenatal corticosteroids than mothers of other (predominantly European) ethnic groupings (Table 2.9). Further, a history of prior preterm birth was more common among multiparous mothers of babies who died after birth at 23 to 26 weeks if they were Māori (44 percent) or Pacific (46 percent) than Other (30 percent) or Indian (17 percent) mothers, although this was not statistically significant (p=0.08).

Practice point: Care for women in preterm labour or requiring delivery at 23+0 to 24+6 weeks gestation

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

The clinical care pathway is individualised to reflect individual medical complexity and co-morbidity, parental wishes and resource availability.

All New Zealand tertiary neonatal centres offer resuscitation and neonatal intensive care to infants born at 23 and 24 weeks gestation. Overall mortality at 23 to 24 weeks is higher than at more mature gestations, but high-quality survival is possible.

Care of women with threatened preterm labour or who require iatrogenic preterm birth at 23+0 to 24+6 weeks gestation involves consideration of the needs of the mother as well as the baby. Mode of birth is an important part of this discussion as a caesarean section at this gestation not only has risks for the mother at the time of this birth but also has significant implications for subsequent pregnancies, and may not improve neonatal outcomes.

Integrated care for women in threatened preterm labour or women requiring iatrogenic birth at 23+0 to 24+6 weeks gestation should include open discussion between the family and the LMC, obstetric, and neonatal or paediatric services. Best clinical care may follow a palliative or intensive care pathway, according to the specific requirements of each clinical situation. Even if there is a plan for intensive care, at this gestation resuscitation of the newborn is not always successful.

Survival and outcomes for infants born at 23+0 to 24+6 weeks gestation are improved if they deliver in a tertiary centre. Early consultation with tertiary obstetrics/neonates is recommended.

Parents, families and whānau should be counselled that babies born at 23 weeks gestation who have not been prepared for early birth (eg, antenatal corticosteroids, magnesium sulphate) may appear vigorous at birth. Despite this, admission to a neonatal intensive care unit of an unprepared baby is still likely to result in severe morbidity and/or mortality.

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

Transfer to a tertiary centre for collaborative discussion and planning is optimal. Transfer is not only for those wanting active management but also for all to have a tertiary consultation. Parents, families and whānau should be counselled antenatally about the possible range of outcomes for the baby and this should be individualised to the clinical setting. These discussions should be led by senior obstetric and neonatal staff and should reflect local institutional outcome data as well as current international data on long-term outcomes, particularly in relation to neurodevelopmental and cognitive outcomes. Parents, families and whānau should be in the centre of decision-making and be aware of the range of possible interventions at this gestation.

Appropriate care options as agreed by parents and senior clinical team include:

1. Palliative
    a. No maternal corticosteroids or magnesium sulphate
    b. No fetal monitoring or operative birth
    c. A palliative care pathway for the baby from birth (stay with parents for comfort cares; no neonatal intensive care unit admission)
2. Active
    a. Maternal corticosteroids and magnesium sulphate
    b. Planning with parents, families and whānau, ideally prior to active labour, regarding whether or not there will be fetal monitoring and intervention (this should include the agreed plan for mode of birth)
    c. Senior neonatal assessment at birth with planned neonatal intensive care unit admission
3. Interim (for parents, families and whānau who require more time to make this decision)
    a. Maternal corticosteroids and magnesium sulphate
    b. Further discussion with parents, families and whānau, regarding whether or not there will be fetal monitoring and intervention.

Practice point: Prevention of preterm birth

Prevention of preterm birth requires a multifaceted holistic approach.

In New Zealand, Māori, Pacific and Indian mothers, mothers under 20 years of age, mothers who smoke and mothers living in areas of socioeconomic deprivation are at increased risk of preterm birth. Women who have delivered a previous preterm baby are at especially high risk.

Prevention strategies include:

1. Provision of services that enable registration with an LMC in the first trimester, including information for women on what LMCs are working in their area and how to access these LMCs.
2. Early access to smoking cessation services, recognition and support to address alcohol and substance abuse and family violence.
3. Screening and treating vaginal infections before 20 weeks (Sangkomkamhang et al 2015).
4. Screening for asymptomatic urinary tract infections.
5. Secondary/tertiary obstetric services that provide specialised education and offer support and intervention for women with risk factors for preterm birth* (Whitworth et al 2011).
6. Progesterone treatment has been demonstrated to reduce preterm birth in women with a short cervix (<25mm) on transvaginal ultrasound between 16 and 24 weeks gestation (Dodd et al 2013; Keelan and Newnham 2017).
7. Cervical cerclage for women with a short cervix (<25mm) and a history of previous preterm birth or treatment to their cervix (Dodd et al 2013).

* Current literature suggests some benefit of specialist clinics aimed at preventing preterm labour and delivery, but methodological weakness across these studies indicates caution, as the most positive reported outcomes are from retrospective cohort studies.

Deaths after birth at 25 to 34 weeks gestation among babies without congenital anomalies

Table 2.10: Perinatal death classification (PSANZ-PDC) by neonatal death classification (PSANZ-NDC) for neonatal deaths among births from 25–34 weeks without congenital anomalies 2007–2016

Perinatal death classification (PSANZ-PDC)	Neonatal death classification (PSANZ-NDC)						
	Extreme prematurity	Cardio-respiratory disorders	Infection	Neurological	Gastro-intestinal	Other	Total
Perinatal infection	-	-	17	-	2	-	**19**
Hypertension	1	9	7	6	3	-	**26**
Antepartum haemorrhage	2	9	6	23	3	2	**45**
Maternal conditions	-	2	5	7	1	1	**16**
Specific perinatal conditions	1	9	2	9	2	11	**34**
Hypoxic peripartum death	-	-	-	1	-	-	**1**
Fetal growth restriction	-	4	2	1	2	3	**12**
Spontaneous preterm	6	33	25	27	8	11	**110**
Total	**10**	**66**	**64**	**74**	**21**	**28**	**263**

From 25 to 34 weeks gestation, 147 (56 percent) of 263 deaths were associated with spontaneous preterm birth, although spontaneous preterm was not always the primary antecedent cause of death, as shown in Table 2.10 (that is, spontaneous preterm birth was identified as the secondary or tertiary perinatal death classification).

From 25 weeks, some live born babies die from complications of prematurity, most commonly respiratory distress syndrome (23) and pulmonary hypoplasia (24). Deaths of babies born from 25 to 34 weeks often occur in neonatal units and, aside from the direct consequences of preterm birth, are most often from infectious and neurological causes.

Neurological deaths (74) from 25 to 34 weeks were from hypoxic ischaemic encephalopathy (41), intraventricular haemorrhage (29), and other causes (4). Twenty-one of these neurological deaths occurred after birth at 25 weeks (16 from intraventricular haemorrhage), with 2 to 10 after birth at each of 26 to 34 weeks. Intracranial haemorrhage of any type was uncommon after 26 weeks gestation.

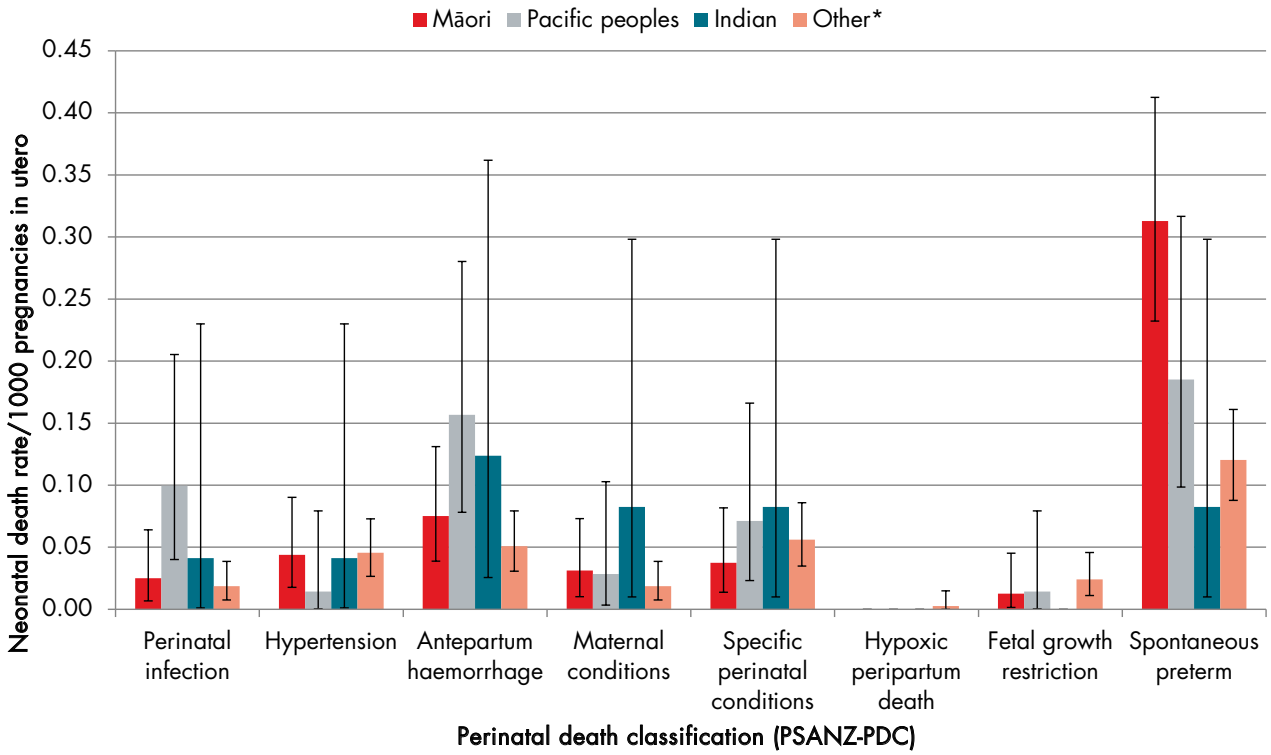
Of the 41 deaths after birth at 25 to 34 weeks gestation who died of hypoxic ischaemic encephalopathy, 27 were born in hospitals with a Level 3 neonatal intensive care unit. Of the 10 born in hospitals with a Level 2 neonatal unit, nine were transferred prior to death.

Of the 32 who died from intracranial haemorrhage, 24 were born in hospitals with a Level 3 neonatal intensive care unit, six in Level 2, and two at home.

Deaths with infection (either PSANZ-PDC or PSANZ-NDC) (66) were most commonly due to Group B *Streptococcus* (10), *Escherichia coli* (11), and *Staphylococcus aureus* (7). Forty-seven (72 percent) were born in hospitals with Level 3 neonatal intensive care units.

Twenty-one babies born from 25 to 30 weeks gestation (at 450 to 1590g) died from necrotising enterocolitis. Of these 21 babies, 18 were born in a hospital with a Level 3 neonatal intensive care unit.

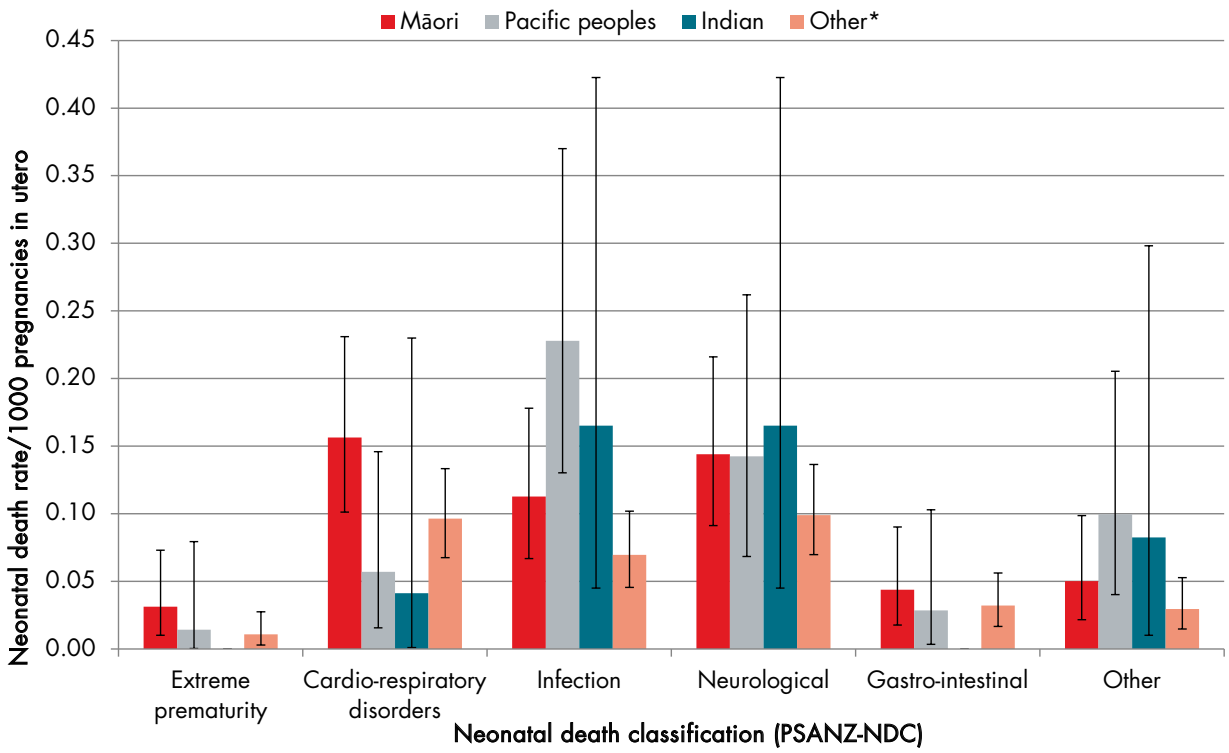
Figure 2.16: Cause-specific (PSANZ-PDC) neonatal death rate after birth at 25–34 weeks gestation excluding congenital anomalies per 1000 babies in utero from 25 weeks by maternal ethnicity 2007–2016



* Other ethnicity includes New Zealand and Other European; Other Asian; Middle Eastern, Latin American or African (MELAA); Other ethnicities; unknown and not stated.

Babies of Pacific mothers were significantly more likely to die from perinatal infection and from antepartum haemorrhage after birth at 25 to 34 weeks gestation than babies of Māori and Other ethnic groupings. Babies of Māori mothers were more likely to die from spontaneous preterm birth at 25 to 34 weeks gestation than babies of Indian and Other ethnic groupings (Figure 2.16).

Figure 2.17: Cause-specific (PSANZ-NDC) neonatal death rate after birth at 25–34 weeks gestation excluding congenital anomalies per 1000 babies in utero from 25 weeks by maternal ethnicity 2007–2016



* Other ethnicity includes New Zealand and Other European, Other Asian, MELAA, Other ethnicities; unknown and not stated.

Babies of Māori mothers were significantly more likely to die after birth at 25 to 34 weeks gestation from cardio-respiratory disorders (which are consequences of preterm birth) than babies of Pacific and Other (predominantly non-Indian Asian and European) ethnic groupings. Pacific babies were significantly more likely to die after birth at 25 to 34 weeks gestation from infection than babies of Māori or Other ethnic groupings (Figure 2.17).

These figures demonstrate that spontaneous preterm birth is still a major underlying obstetric problem in neonatal death after birth at 25 to 34 weeks gestation, though neonates may ultimately die due to failure of different systems – for example, cardio-respiratory, neurological and gastrointestinal – as well as from infection.

Deaths after birth from 35 weeks gestation among babies without congenital anomalies

Table 2.11: Perinatal death classification (PSANZ-PDC) by neonatal death classification (PSANZ-NDC) among births from 35 weeks gestation without congenital anomalies 2007–2016

Perinatal death classification (PSANZ-PDC)	Neonatal death classification (PSANZ-NDC)					
	Cardio-respiratory disorders	Infection	Neurological	Gastro-intestinal	Other	Total
Perinatal infection	-	36	3	-	1	**40**
Hypertension	-	-	2	-	-	**2**
Antepartum haemorrhage	-	-	11	-	-	**11**
Maternal conditions	-	1	7	-	1	**9**
Specific perinatal conditions	3	-	13	-	9	**25**
Hypoxic peripartum death	3	2	112	-	1	**118**
Fetal growth restriction	1	1	14	-	6	**22**
Spontaneous preterm	2	3	5	1	6	**17**
No obstetric antecedent	2	14	2	-	63	**81**
Total	**11**	**57**	**169**	**1**	**87**	**325**

The most common cause of death from 35 weeks gestation was neurological death due to peripartum injury (neurological death from hypoxic peripartum injury) (Table 2.11). These babies were included in the neonatal encephalopathy (NE) dataset and discussed in detail in chapter "3 Neonatal Encephalopathy 2016".

The second most common group of deaths of babies live born after 35 weeks gestation without congenital anomalies was SUDI deaths, accounting for 68 neonatal deaths from 2007 to 2016. These babies were included in the review of SUDI deaths in New Zealand in 2017 by the Child and Youth Mortality Review Committee (CYMRC 2017).

Infection and neonatal death after birth from 35 weeks

There were 61 babies who died due to perinatal or neonatal infection. The most common aetiology was Group B Streptococcus (14 congenital and 2 acquired).

A previous review of early onset neonatal Group B Streptococcal sepsis in New Zealand showed that in 31 percent of cases, intrapartum antibiotic prophylaxis was not provided when indicated based on maternal risk factors (Darlow et al 2016). Intrapartum prophylaxis should be provided according to the national consensus guideline (Darlow et al 2015).

Review of SUDI deaths from 35 weeks gestation

For the purpose of this review SUDI death included babies where the classification of cause of death was PSANZ-NDC 7.1 Sudden Infant Death Syndrome (4), PSANZ-NDC 7.31 Trauma – accidental (7) and PSANZ-NDC 7.91 Unclassified Sudden Infant death (57). This is in line with the revision of the PSANZ classification system in 2018 to report these deaths under the classification of 'Sudden unexpected death in infancy (SUDI)' (PSANZ 2018).

For these 68 babies identified as SUDI deaths after birth from 35 weeks gestation, the PMMRC Rapid Reporting and Classification forms, Coronial post-mortem reports, and where available, Coronial findings (62), SUDI liaison reports (26), DHB perinatal mortality reports and correspondence from clinicians were reviewed.

The appointment of SUDI liaison officers during 2009 has improved the information available on SUDI deaths considerably. Coroner's findings were not available for four of the seven SUDI deaths from 2015 and two of the six deaths from 2016.

Forty-four (65 percent) of mothers of babies who were SUDI deaths from 35 weeks were Māori and 12 (18 percent) were Pacific (Table 2.12). Eight deaths occurred in hospital (12 percent). Four babies died prior to discharge and were less than 32 hours of age, and four were readmitted and died in hospital after events at home.

The four babies who died in hospital prior to discharge were assessed as well at birth (Apgars 9 at 1 minute and 10 at 5 minutes) and were found collapsed during skin-to-skin contact or after breastfeeding. Most reported similar cases relate to unobserved prone skin-to-skin care, and maternal smoking has been reported as an important risk factor (Lavezzi et al 2004; Lavezzi and Matturri 2012). While there are important benefits from skin-to-skin care for babies born at 35 weeks or more, such as improved breastfeeding (Moore et al 2016), prone positioning, even on the mother's chest, is not without risk. Skin-to-skin care in the immediate postpartum period should be practiced according to Ministry of Health and multi-disciplinary consensus statement guidelines. Colour, tone, and respiration of the baby should be monitored at all times during periods of skin-to-skin contact (Ministry of Health 2012c).

Table 2.12: Demographic data and place of death among SUDI deaths from 35 weeks gestation 2007–2016

	SUDI deaths n=68	
	n	%
Ethnicity (maternal)		
Māori	44	64.7
Pacific peoples	12	17.6
Other	12	17.6
Deprivation quintile		
1 (least deprived)	4	5.9
2	7	10.3
3	5	7.4
4	20	29.4
5 (most deprived)	32	47.1
Place of birth		
Home/Born before arrival at birthing unit or hospital	5	7.4
Hospital level 1 or birthing unit	10	14.7
Hospital level 2	28	41.2
Hospital level 3	25	36.8
Place of death		
Hospital	8	11.8
Own home	52	76.5
Friend or relative's home	8	11.8
Age at death (days)		
0	1	1.5
1–6	12	17.6
7–13	16	23.5
14–20	14	20.6
21–27	25	36.8

The majority of mothers were known to have smoked in pregnancy 48 (71 percent). Smoking status in the postnatal period was unknown for 43 mothers as the smoking status was not recorded. However, 20 mothers were noted to smoke in the postnatal period. Whānau smoking status was unknown in 48 cases (68 percent). In 17 cases (25 percent), whānau were known to be smoking postnatally in the home.

Twelve caregivers (18 percent) were known to have been consuming alcohol on the night of the baby's death.

Two caregivers (3 percent) were known to use illicit drugs at the time of death. Methamphetamine was found on routine toxicology testing of three babies.

Table 2.13: Sleeping risk factors among SUDI deaths from 35 weeks gestation 2007–2016 by maternal ethnicity

	Total		Māori		Pacific		Non-Māori non-Pacific	
	n=68		n=44		n=12		n=12	
	n	%	n	%	n	%	n	%
Location of sleep at event or death								
Home	56	82	38	86	8	67	10	83
Family or friend's home	8	12	6	14	2	17		
Hospital	4	6	0		2	17	2	17
Stated place of sleep at event or death								
Cot	8	12	4	9	1	8	3	25
Pēpi-Pod®	1	1			1	8	0	
Single bed	5	7	4	9	1	8	0	
Double/Queen bed	46	68	30	68	9	75	7	58
Couch/Chair	6	9	4	9	0		2	17
Not stated	2	3	2	5	0		0	
Other persons sleeping with baby at event or death	54	79	35	80	10	83	9	75
Adults	36	53	22	50	6	50	8	67
Adults and siblings	18	26	13	30	4	33	1	8
Other sleep risk factors identified at event or death								
Pillow in bed	8	12	7	16	1	8		
Rolled blankets in bed	1	1	1	2				
Sleep position at time of death								
Back	39	57	25	57	8	67	6	50
Side	9	13	3	7	2	17	4	33
Front	2	3	2	5				
Not stated	18	26	14	32	2	17	2	17
Usual place of sleep								
Own sleeping place	36	53	24	55	5	42	7	58
Cot	31	46	20	45	4	33	7	17
Pēpi-Pod®	3	4	2	5	1	8		
Own bed	2	3	2	5				
Co-sleeping place	22	32	14	32	6	50	2	17
Bed	20	29	12	27	6	50	2	17
Couch	1	1	1	2	0		0	
On pillows	1	1	1	2	0		0	
Usual place of sleep not stated	10	15	6	15	1	2	3	25

At the time of the event or death, 56 babies (82 percent) were at home, eight babies (12 percent) were at a family or friend's home, and four babies (6 percent) were in hospital (Table 2.13). Four of the eight babies where the event occurred at home were resuscitated and transferred to hospital where they subsequently died.

At the time of death (or event leading to death) only six of the 68 babies who were identified as SUDI deaths were known to be in a recommended low-risk sleeping place; that is, in their own place of sleep, on their back and with no pillow. For two babies the place of sleep was unknown.

The majority were sleeping with an adult and/or siblings (79 percent), and just over half were reported as having their own (unshared) usual sleeping place (Table 2.13). Very few babies had a Pēpi-Pod® and no baby had wahakura recorded as their usual place of sleep. Nine babies (13 percent) had pillows or rolled blankets in the bed with them as an added risk factor at the time of death or event.

Family violence was documented in the maternal history of five SUDI deaths, but there was no information on screening for family violence for 25 women (37 percent). In four cases, Child, Youth and Family/Oranga Tamariki was involved with child protection at the time of death.

In some cases the mother or caregiver was known to have fallen asleep while feeding the baby (19 cases (28 percent)), and in a further 12 (18 percent) this was considered to be highly probable.

There were insufficient data available to comment on provision of SUDI prevention information to families.

Messages to caregivers

The PMMRC highlights the guidance from the Ministry of Health on safe sleep (Ministry of Health 2016).

Make every sleep a safe sleep

Sudden unexpected death is a risk to babies until they are about 12 months old, but most deaths can be prevented.

There are things that we can do to protect our babies. Although for some babies the cause of death is never found, most deaths happen when the babies are sleeping in an unsafe way.

Always follow these safe-sleep routines for your baby and your baby's bed.

Make sure that your baby is safe

To keep your baby safe while sleeping, make sure:

- they always sleep on their back to keep their airways clear
- they are in their own bassinet, cot or other baby bed (eg, Pēpi-Pod® or wahakura) – free from adults or children who might accidentally suffocate them
- they are put back in their own bed after feeding – don't fall asleep with them (to protect your back, feed your baby in a chair rather than in your bed)
- they have someone looking after them who is alert to their needs and free from alcohol or drugs
- they have clothing and bedding that keeps them at a comfortable temperature – one more layer of clothing than you would wear is enough; too many layers can make your baby hot and upset them
- they are in a room where the temperature is kept at 20°C.

You can check that your baby is warm but not too hot by feeling the back of their neck or their tummy (under the clothes). Baby should feel warm, but not hot or cold. Your baby will be comfortable when their hands and feet are a bit colder than their body.

Further information is available on this link: www.health.govt.nz/your-health/pregnancy-and-kids/first-year/first-6-weeks/keeping-baby-safe-bed-first-6-weeks.

Child and Youth Mortality Review Committee (CYMRC) Recommendations

The PMMRC supports the recommendations of the CYMRC 2017 report, *Sudden unexpected death in infancy (SUDI): Special report* (CYMRC 2017), as reiterated below.

Child and Youth Mortality Review Committee (CYMRC) Recommendations

Sudden unexpected death in infancy (SUDI): Special report (CYMRC 2017)

Recommendation 1:

The Ministry of Health leads and enables the development of a comprehensive SUDI Prevention Programme that includes effective SUDI prevention information and support products and services that are evidence based, and delivers equitable health outcomes for Māori and Pacific communities.

Recommendation 2:

The Ministry of Health's SUDI Prevention Programme incorporates:

- universal approaches that are accessible, culturally appropriate and effective for all pregnant women and their babies
- tailored approaches for priority populations most at risk of experiencing a SUDI death, specifically Māori and Pacific mothers, mothers under 25 years of age, and mothers who smoke.

Recommendation 3:

The Ministry of Health and DHBs fund and provide universal and targeted smokefree prevention information and support products and services that are culturally appropriate and known to be effective for Māori and Pacific women and their whānau and families. This includes interventions that:

- discourage people from taking up smoking at all, especially during pregnancy
- support people to stop smoking, especially during pregnancy
- support everyone living with, or caring for, pregnant women and babies to be smokefree.

Recommendation 4:

The Ministry of Health, in its contracts with DHBs, requires DHBs to prioritise, monitor and evaluate a SUDI Prevention Programme to ensure equitable benefits for priority population groups identified. This should include smokefree support packages and initiatives that support whānau and families to live in warmer, drier homes that are free from crowding.

Recommendation 5:

The Ministry of Health works with the Ministry for Vulnerable Children, Oranga Tamariki and other relevant government agencies to promote the SUDI Prevention Programme across government. The aim is for all health, social and housing agencies and providers in contact with pregnant women, and whānau and families with babies, to provide access to effective SUDI prevention interventions that deliver equitable health outcomes. These agencies and providers should ensure whānau and families have the income and housing support they need to live in warm, dry homes that are free from crowding. Critical contact points include, but are not limited to, visits with:

- lead maternity carers
- Well Child/Tamariki Ora providers
- primary care providers, especially for immunisation
- Family Start
- Work and Income services
- social housing services
- Whānau Ora providers.

Recommendation 6:

The Ministries of Health and Justice, and the Ministry for Vulnerable Children, Oranga Tamariki, the Chief Coroner and New Zealand Police work with whānau and families to develop a multi-agency protocol for the care of whānau and families after the sudden and unexpected death of a baby. The protocol could build on existing services and should:

- commence immediately during the first response of a SUDI investigation
- ensure professional case management and culturally appropriate counselling and support services to support bereaved whānau and families is provided during the investigation, and for one year following the death
- provide whānau and families with access to a paediatrician to interpret and discuss post-mortem results
- ensure immediate notification to the lead maternity carer, Well Child/Tamariki Ora provider and general practitioner, or named primary health provider, so ongoing care and support can be provided, including any additional health care and safeguards for subsequent babies
- prioritise timely information sharing between agencies during the investigation, including notification of death to all agencies involved with the infant to ensure whānau and families, as well as providers, are not further distressed by appointment notifications or home visits after the death of the baby.

The full report is available at: www.hqsc.govt.nz/assets/CYMRC/Publications/CYMRC_SUDI_Report.pdf.

Investigation of neonatal death

Table 2.14: Post-mortem investigation and placental pathology of neonatal deaths by gestation at birth (excluding deaths with congenital anomalies) 2007–2016

	Gestation at birth (weeks)					
	20–24		25–34		≥35	
	n=729		n=263		n=325	
	n	%	n	%	n	%
Adequacy of investigation of perinatal death						
Optimum*	131	18.0	94	35.7	240	73.8
Partial#	436	59.8	143	54.4	44	13.5
No investigation+	141	19.3	25	9.5	37	11.4
Unknown	21	2.9	1	0.4	4	1.2
Placental pathology						
No histological examination of placenta	162	22.2	57	21.7	158	48.6

* Optimum investigation is defined as post-mortem or karyotype confirming congenital anomaly 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.

Placental pathology should be routine standard of care for all babies born preterm and/or with intrauterine growth restriction, but especially those born at less than 32 weeks gestation. Accurate characterisation of placental disease may (i) inform long-term neurodevelopment risk to the baby and (ii) inform subsequent pregnancy management and risk of adverse pregnancy outcome.

Table 2.15: Contributory factors and potentially avoidable death by gestation at birth among neonatal deaths without congenital anomalies 2009–2016

Contributory factors	Gestation at birth (weeks)					
	20–24		25–34		≥35	
	n=599		n=213		n=242	
	n	%	n	%	n	%
Any contributory factor						
Organisational and/or management factors	**31**	**5.2**	**24**	**11.3**	**47**	**19.4**
Poor organisational arrangements of staff	4	0.7	1	0.5	6	2.5
Inadequate education and training	7	1.2	2	0.9	13	5.4
Lack of policies, protocols or guidelines	8	1.3	3	1.4	13	5.4
Inadequate numbers of staff	3	0.5	-	-	3	1.2
Poor access to senior clinical staff	1	0.2	3	1.4	7	2.9
Failure or delay in emergency response	1	0.2	5	2.3	14	5.8
Delay in procedure (eg, caesarean section)	1	0.2	6	2.8	11	4.5
Inadequate systems for sharing of clinical information	6	1.0	2	0.9	4	1.7
Delayed access to test results or inaccurate results	1	0.2	1	0.5	2	0.8
Equipment (eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)	3	0.5	5	2.3	6	2.5
Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)	-	-	-	-	3	1.2
Other	2	0.3	3	1.4	5	2.1
Not stated	3	0.5	-	-	1	0.4
Personnel factors	**50**	**8.3**	**28**	**13.1**	**81**	**33.5**
Knowledge and skills of staff were lacking	11	1.8	8	3.8	27	11.2
Delayed emergency response by staff	1	0.2	3	1.4	16	6.6
Failure to maintain competence	-	-	-	-	3	1.2
Failure of communication between staff	13	2.2	6	2.8	23	9.5
Failure to seek help/supervision	6	1.0	5	2.3	7	2.9
Failure to offer or follow recommended best practice	20	3.3	12	5.6	49	20.2
Lack of recognition of complexity or seriousness of condition by care giver	15	2.5	3	1.4	23	9.5
Other	2	0.3	3	1.4	1	0.4
Barriers to access and/or engagement with care	**121**	**20.2**	**66**	**31.0**	**108**	**44.6**
No antenatal care	45	7.5	15	7.0	10	4.1
Infrequent care or late booking	36	6.0	25	11.7	17	7.0
Declined treatment or advice	12	2.0	12	5.6	14	5.8
Obesity impacted on delivery of optimal care (eg, USS)	2	0.3	2	0.9	4	1.7
Substance use	15	2.5	9	4.2	12	5.0
Family violence	7	1.2	7	3.3	4	1.7
Lack of recognition of complexity or seriousness of condition by the woman and/or family	22	3.7	20	9.4	13	5.4
Maternal mental illness	6	1.0	2	0.9	1	0.4
Cultural barriers	3	0.5	3	1.4	4	1.7
Language barriers	3	0.5	3	1.4	3	1.2
Not eligible to access free care	3	0.5	-	-	2	0.8
Environment (eg, isolated, long transfer, weather prevented transport)	9	1.5	11	5.2	20	8.3
Other	4	0.7	6	2.8	45*	18.6
Potentially avoidable deaths	**90**	**15.0**	**50**	**23.5**	**142**	**58.7**

* Most of these related to SUDI deaths.

2.6 Neonatal Mortality 2007–2016: Appended Tables

Table 2.16: Neonatal death rate (per 1000 live births) by gestation and country 2004-2016

Year	≥20 weeks gestation			≥22 weeks gestation	
	United Kingdom	Australia	New Zealand	Scandinavia	New Zealand
	rate (/1000 live births)				
2004	3.43	*	*	*	*
2005	3.5	*	*	*	*
2006	3.46	*	*	*	*
2007	3.26	2.90	2.58	1.99	2.30
2008	3.18	2.83	2.72	1.96	2.50
2009	3.12	2.92	2.83	1.81	2.50
2010	2.96	2.94	3.23	1.63	2.76
2011	2.95	2.81	2.61	1.65	2.35
2012	2.85	2.38	2.84	1.60	2.39
2013	2.71	2.68	2.56	1.60	2.18
2014	2.71	2.57	3.05	1.67	2.52
2015	2.72	2.25	2.80	1.60	2.51
2016	NA	NA	2.51	1.49	2.18

* data not available

Data sources and definitions

United Kingdom – live birth at ≥ 20 weeks gestation, or birthweight ≥ 400g if gestation is not available, who died before 28 completed days (routine data sources) (Manktelow et al 2016).

Australia – live birth at ≥ 20 weeks gestation, or birthweight ≥ 400g, who died before 28 completed days (routine data sources)(Australian Institute of Health and Welfare 2017; Australian Institute of Health and Welfare 2018).

Scandinavia – live birth at ≥ 22 weeks gestation who died before 28 completed days (routine data sources) (Heino and Gissler 2016).

New Zealand - live birth at ≥ 20 weeks gestation, or birthweight ≥ 400g if gestation is not available, who died before 28 completed days. Or live birth at ≥ 22 weeks gestation who died before 28 completed days (PMMRC).

Table 2.17: Congenital anomaly specific perinatal related mortality rates (per 1000 births) 2007–2016

Year of death	Total births	Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
	N=628,529	n=1,155		n=304		n=414		n=1,873	
	N	n	Rate	n	Rate	n	Rate	n	Rate
2007	65,202	125	1.92	35	0.54	38	0.58	198	3.04
2008	65,624	114	1.74	28	0.43	43	0.66	185	2.82
2009	65,198	111	1.70	30	0.46	43	0.66	184	2.82
2010	65,445	128	1.96	37	0.57	46	0.70	211	3.22
2011	63,236	128	2.02	27	0.43	50	0.79	205	3.24
2012	63,274	130	2.05	35	0.55	38	0.60	203	3.21
2013	60,133	110	1.83	22	0.37	32	0.53	164	2.73
2014	60,073	112	1.86	34	0.57	45	0.75	191	3.18
2015	59,768	88	1.47	25	0.42	45	0.75	158	2.64
2016	60,576	109	1.80	31	0.51	34	0.56	174	2.87

Table 2.18: Congenital anomaly specific perinatal related mortality rate (per 1000 births) by maternal ethnicity 2007–2016

Maternal Ethnicity	Total births	Fetal deaths								Neonatal deaths				Perinatal related deaths			
		Termination of pregnancy				Stillbirths											
	N=628,529	n=1,155				n=304				n=414				n=1,873			
	N	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL
Māori	159,803	182	1.14	0.97	1.30	73	0.46	0.36	0.57	114	0.71	0.58	0.85	369	2.31	2.07	2.54
Pacific peoples	70,229	71	1.01	0.79	1.28	53	0.75	0.57	0.99	70	1.00	0.78	1.26	194	2.76	2.37	3.15
Indian	24,236	71	2.93	2.29	3.70	10	0.41	0.20	0.76	19	0.79	0.47	1.23	100	4.13	3.32	4.93
Other Asian	54,738	156	2.85	2.40	3.30	24	0.44	0.28	0.65	27	0.49	0.33	0.72	207	3.78	3.27	4.30
MELAA	12,584	17	1.35	0.79	2.16	7	0.56	0.22	1.15	6	0.48	0.18	1.04	30	2.38	1.61	3.40
Other European	60,070	97	1.61	1.31	1.97	25	0.42	0.27	0.61	16	0.27	0.15	0.43	138	2.30	1.91	2.68
NZ European	246,413	561	2.28	2.09	2.47	112	0.45	0.37	0.54	161	0.66	0.55	0.76	834	3.38	3.15	3.61
Unknown/Other	456	-	-	-	-	-	-	-	-	1	2.19	-	-	1	2.19	-	-

MELAA = Middle Eastern, Latin American or African.

Table 2.19: Perinatal related mortality rates excluding death with congenital anomaly 2007–2016

Year of death	Total births	Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
	N=626,718	n=312		n=3,099		n=1,317		n=4,728	
	N	n	Rate	n	Rate	n	Rate	n	Rate
2007	65,011	19	0.29	334	5.14	129	2.00	482	7.41
2008	65,449	31	0.47	351	5.36	134	2.06	516	7.88
2009	65,018	27	0.42	379	5.83	140	2.17	546	8.40
2010	65,245	23	0.35	310	4.75	164	2.53	497	7.62
2011	63,036	43	0.68	305	4.84	114	1.82	462	7.33
2012	63,079	42	0.67	285	4.52	140	2.23	467	7.40
2013	59,973	31	0.52	284	4.74	121	2.03	436	7.27
2014	59,887	38	0.63	293	4.89	137	2.30	468	7.81
2015	59,614	19	0.32	280	4.70	121	2.04	420	7.05
2016	60,406	39	0.65	278	4.60	117	1.95	434	7.18

Table 2.20: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and year of birth excluding congenital anomaly deaths 2007–2016

Year of death	Gestation at birth (weeks)								
	≥20	20–24		≥25	25–34		≥35	≥35	
	N=620,386	n=729		N=617,986	n=263		N=599,205	n=325	
	N	n	Risk	N	n	Risk	N	n	Risk
2007	64,275	68	1.06	64,065	24	0.37	62,089	37	0.60
2008	64,302	62	0.96	64,062	26	0.41	61,935	46	0.74
2009	64,414	70	1.09	64,169	32	0.50	62,138	38	0.61
2010	64,685	92	1.42	64,434	32	0.50	62,438	40	0.64
2011	62,540	67	1.07	62,283	20	0.32	60,388	27	0.45
2012	62,101	77	1.24	61,868	29	0.47	60,015	34	0.57
2013	59,608	69	1.16	59,361	30	0.51	57,635	22	0.38
2014	59,460	91	1.53	59,181	20	0.34	57,485	26	0.45
2015	59,191	68	1.15	58,989	28	0.47	57,273	25	0.44
2016	59,810	65	1.09	59,574	22	0.37	57,809	30	0.52

Table 2.21: Perinatal related mortality rates by maternal ethnicity excluding death with congenital anomaly 2007–2016

Maternal Ethnicity	Total births	Fetal deaths								Neonatal deaths				Perinatal related deaths			
		Termination of pregnancy				Stillbirths*											
	N=626,718	n=312				n=3,099				n=1,317				n=4,728			
	N	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL
Māori	159,421	61	0.38	0.29	0.49	847	5.31	4.96	5.67	459	2.90	2.63	3.16	1,367	8.57	8.12	9.03
Pacific peoples	70,022	39	0.56	0.40	0.76	444	6.34	5.75	6.93	208	2.99	2.58	3.40	691	9.87	9.13	10.60
Indian	24,147	21	0.87	0.54	1.33	177	7.33	6.25	8.41	74	3.09	2.43	3.88	272	11.26	9.93	12.60
Other Asian	54,545	27	0.50	0.33	0.72	179	3.28	2.80	3.76	73	1.34	1.05	1.69	279	5.12	4.51	5.72
MELAA	12,548	9	0.72	0.33	1.36	59	4.70	3.58	6.07	25	2.00	1.30	2.96	93	7.41	5.98	9.08
Other European	59,886	22	0.37	0.23	0.56	172	2.87	2.44	3.30	53	0.89	0.67	1.16	247	4.12	3.61	4.64
NZ European	245,695	133	0.54	0.45	0.63	1,220	4.97	4.69	5.24	425	1.74	1.57	1.90	1,778	7.24	6.90	7.57

* One unknown maternal ethnicity
MELAA = Middle Eastern, Latin American or African.

Table 2.22: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and maternal ethnicity excluding death with congenital anomaly 2007–2016

Maternal Ethnicity	Gestation at birth (weeks)													
	≥20	20–24				≥25	25–34				≥35	≥35			
	N=620,386	n=729				N=617,986	n=263				N=599,205	n=325			
	N	n	Risk	LL	UL	N	n	Risk	LL	UL	N	n	Risk	LL	UL
Māori	157,142	255	1.62	1.42	1.82	156,370	86	0.55	0.44	0.68	151,082	118	0.78	0.64	0.92
Pacific peoples	69,089	127	1.84	1.52	2.16	68,722	40	0.58	0.42	0.79	66,755	41	0.61	0.44	0.83
Indian	23,969	57	2.38	1.80	3.08	23,833	11	0.46	0.23	0.83	23,069	6	0.26	0.10	0.57
Other Asian	54,168	47	0.87	0.64	1.15	54,030	17	0.31	0.18	0.50	52,755	9	0.17	0.08	0.32
MELAA	12,456	17	1.36	0.80	2.19	12,395	2	0.16	0.02	0.58	12,002	6	0.50	0.18	1.09
Other European	59,452	28	0.47	0.31	0.68	59,280	9	0.15	0.07	0.29	57,680	16	0.28	0.16	0.45
NZ European	244,000	198	0.81	0.70	0.92	243,249	98	0.40	0.33	0.49	235,762	129	0.55	0.45	0.64
Unknown/Other	110	-				107	-				100	-			

MELAA = Middle Eastern, Latin American or African.

Table 2.23: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and BMI excluding congenital anomalies 2008–2016*

Maternal BMI (kg/m²)	Gestation at birth (weeks)														
	≥20		20–24			≥25		25–34			≥35		≥35 weeks		
	N=484,197		n=449			N=482,627		n=180			N=469,103		n=239		
	N	n	Risk	LL	UL	N	n	Risk	LL	UL	N	n	Risk	LL	UL
<18.50	13,812	11	0.80	0.40	1.42	13,767	5	0.36	0.12	0.85	13,360	3	0.22	0.05	0.66
18.50–24.99	241,362	190	0.79	0.68	0.90	240,670	85	0.35	0.28	0.44	233,925	89	0.38	0.31	0.47
25.00–29.99	124,559	119	0.96	0.78	1.13	124,129	39	0.31	0.22	0.43	120,777	76	0.63	0.50	0.79
30.00–34.99	61,584	67	1.09	0.84	1.38	61,381	30	0.49	0.33	0.70	59,604	33	0.55	0.38	0.78
35.00–39.99	26,867	39	1.45	1.03	1.98	26,743	16	0.60	0.34	0.97	25,960	21	0.81	0.50	1.24
≥40.00	15,011	22	1.47	0.92	2.22	14,939	5	0.33	0.11	0.78	14,517	15	1.03	0.58	1.70
Unknown	1,002	1				998	-				960	2			

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Table 2.24: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and maternal age excluding death with congenital anomaly 2007–2016

Maternal age (years)	Gestation at birth (weeks)														
	≥20		20–24			≥25		25–34			≥35		≥35		
	N=620,352		n=729			N=617,952		n=263			N=599,172		n=325		
	N	n	Risk	LL	UL	N	n	Risk	LL	UL	N	n	Risk	LL	UL
<20	39,175	96	2.45	1.98	2.99	38,932	33	0.85	0.58	1.19	37,503	37	0.99	0.69	1.36
20–34	448,166	503	1.12	1.02	1.22	446,520	162	0.36	0.31	0.42	433,683	230	0.53	0.46	0.60
35–39	107,726	104	0.97	0.78	1.15	107,333	53	0.49	0.37	0.65	103,857	49	0.47	0.35	0.62
≥40	25,285	26	1.03	0.67	1.51	25,167	15	0.60	0.33	0.98	24,129	9	0.37	0.17	0.71

Table 2.25: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and socioeconomic deprivation excluding congenital anomalies 2007–2016

Deprivation quintile	Gestation at birth (weeks)														
	≥20		20–24			≥25		25–34			≥35		≥35		
	N=620,386		n=729			N=617,986		n=263			N=599,205		n=325		
	N	n	Risk	LL	UL	N	n	Risk	LL	UL	N	n	Risk	LL	UL
1 (least deprived)	87,230	61	0.70	0.53	0.90	86,989	28	0.32	0.21	0.47	84,539	35	0.41	0.29	0.58
2	94,672	76	0.80	0.63	1.00	94,384	33	0.35	0.24	0.49	91,668	33	0.36	0.25	0.51
3	113,271	121	1.07	0.88	1.26	112,889	43	0.38	0.28	0.51	109,547	56	0.51	0.39	0.66
4	143,351	157	1.10	0.92	1.27	142,794	54	0.38	0.28	0.49	138,474	68	0.49	0.38	0.62
5 (most deprived)	177,481	310	1.75	1.55	1.94	176,593	105	0.59	0.48	0.71	170,813	133	0.78	0.65	0.91
Unknown	4,381	4				4,337	-				4,164	-			

Table 2.26: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and parity excluding death with congenital anomaly 2008–2016*

Parity	Gestation at birth (weeks)														
	≥20		20–24			≥25		25–34			≥35		≥35		
	N=484,197		n=449			N=482,627		n=180			N=469,103		n=239		
	N	n	Risk	LL	UL	N	n	Risk	LL	UL	N	n	Risk	LL	UL
Primiparous	199,252	228	1.14	1.00	1.29	198,504	81	0.41	0.32	0.51	192,161	114	0.59	0.48	0.70
Multiparous 1–3	262,236	201	0.77	0.66	0.87	261,501	91	0.35	0.28	0.43	255,151	106	0.42	0.34	0.49
Multiparous ≥4	22,678	20	0.88	0.54	1.36	22,591	8	0.35	0.15	0.70	21,761	19	0.87	0.53	1.36
Unknown	31	-				31	-				30	-			

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Table 2.27: Neonatal death rate (per 1000 ongoing pregnancies) by gestation at birth and smoking excluding congenital anomaly deaths 2008–2016*

Smoking	Gestation at birth (weeks)														
	≥20		20–24			≥25		25–34			≥35		≥35		
	N=484,197		n=449			N=482,627		n=180			N=469,103		n=239		
	N	n	Risk	LL	UL	N	n	Risk	LL	UL	N	n	Risk	LL	UL
Yes	73,131	125	1.71	1.41	2.01	72,777	48	0.66	0.49	0.87	69,929	65	0.93	0.72	1.18
No	410,997	324	0.79	0.70	0.87	409,781	132	0.32	0.27	0.38	399,105	174	0.44	0.37	0.50
Unknown	69	-				69	-				69	-			

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Table 2.28: Gestational age at birth by ethnicity among live born babies born at 20–26 weeks without congenital anomalies 2007–2016

Gestation at birth (weeks)	Māori		Pacific peoples		Indian		Other*	
	N=156,250		N=68,666		N=23,790		N=367,789	
	n	%	n	%	n	%	n	%
20	43	0.03	23	0.03	5	0.02	41	0.01
21	48	0.03	24	0.03	15	0.06	63	0.02
22	75	0.05	42	0.06	11	0.05	72	0.02
23	99	0.06	43	0.06	13	0.05	103	0.03
24	152	0.10	60	0.09	20	0.08	174	0.05
25	155	0.10	72	0.10	21	0.09	223	0.06
26	172	0.11	69	0.10	27	0.11	274	0.07

* Other ethnicity includes New Zealand and Other European; Other Asian; Middle Eastern, Latin American or African (MELAA); Other ethnicities and unknown; and not stated.

Table 2.29: Cause-specific (PSANZ-PDC) neonatal death rate after birth at 25–34 weeks gestation excluding congenital anomalies (per 1000 ongoing pregnancies from 25 weeks) by maternal ethnicity 2007–2016

Perinatal death classification (PSANZ-PDC)	Māori				Pacific peoples				Indian				Other*			
	N=159,803				N=70,229				N=24,236				N=373,805			
	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL
Perinatal infection	4	0.03	0.01	0.06	7	0.10	0.04	0.21	1	0.04	0.00	0.23	7	0.02	0.01	0.04
Hypertension	7	0.04	0.02	0.09	1	0.01	0.00	0.08	1	0.04	0.00	0.23	17	0.05	0.03	0.07
Antepartum haemorrhage	12	0.08	0.04	0.13	11	0.16	0.08	0.28	3	0.12	0.03	0.36	19	0.05	0.03	0.08
Maternal conditions	5	0.03	0.01	0.07	2	0.03	0.00	0.10	2	0.08	0.01	0.30	7	0.02	0.01	0.04
Specific perinatal conditions	6	0.04	0.01	0.08	5	0.07	0.02	0.17	2	0.08	0.01	0.30	21	0.06	0.03	0.09
Hypoxic peripartum death	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	0.00	0.01
Fetal growth restriction	2	0.01	0.00	0.05	1	0.01	0.00	0.08	-	-	-	-	9	0.02	0.01	0.05
Spontaneous preterm	50	0.31	0.23	0.41	13	0.19	0.10	0.32	2	0.08	0.01	0.30	45	0.12	0.09	0.16

* Other ethnicity includes New Zealand and Other European; Other Asian; Middle Eastern, Latin American or African (MELAA); Other ethnicities and unknown; and not stated.

Table 2.30: Cause-specific (PSANZ-NDC) neonatal death rate after birth at 25–34 weeks gestation excluding congenital anomalies (per 1000 ongoing pregnancies from 25 weeks) by maternal ethnicity 2007–2016

Neonatal death classification (PSANZ-NDC)	Māori				Pacific peoples				Indian				Other*			
	N=159,803				N=70,229				N=24,236				N=373,805			
	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL	n	Rate	LL	UL
Extreme prematurity	5	0.03	0.01	0.07	1	0.01	0.00	0.08	-	-	-	-	4	0.01	0.00	0.03
Cardio-respiratory disorders	25	0.16	0.10	0.23	4	0.06	0.02	0.15	1	0.04	0.00	0.23	36	0.10	0.07	0.13
Infection	18	0.11	0.07	0.18	16	0.23	0.13	0.37	4	0.17	0.04	0.42	26	0.07	0.05	0.10
Neurological	23	0.14	0.09	0.22	10	0.14	0.07	0.26	4	0.17	0.04	0.42	37	0.10	0.07	0.14
Gastro-intestinal	7	0.04	0.02	0.09	2	0.03	0.00	0.10	-	-	-	-	12	0.03	0.02	0.06
Other	8	0.05	0.02	0.10	7	0.10	0.04	0.21	2	0.08	0.01	0.30	11	0.03	0.01	0.05

* Other ethnicity includes New Zealand and Other European; Other Asian; Middle Eastern, Latin American or African (MELAA); Other ethnicities and unknown; and not stated.

Table 2.31: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2007–2016

	Neonatal death classification (PSANZ-NDC)	2007–2015 n=1,580		2016 n=148	
		n	%	n	%
	Congenital abnormality				
1.1	Central nervous system	38	2.4	1	0.7
1.2	Cardiovascular system	61	3.9	8	5.4
1.3	Urinary system	37	2.3	4	2.7
1.4	Gastrointestinal system	12	0.8	-	-
1.5	Chromosomal	86	5.4	9	6.1
1.6	Metabolic	23	1.5	1	0.7
1.7	Multiple/Non-chromosomal syndromes	60	3.8	6	4.1
1.8	Other congenital abnormality				
1.81	Musculoskeletal	13	0.8	2	1.4
1.82	Respiratory	4	0.3	-	-
1.83	Diaphragmatic hernia	29	1.8	1	0.7
1.84	Haematological	2	0.1	-	-
1.85	Tumours	6	0.4	-	-
1.88	Other specified congenital abnormality	8	0.5	1	0.7
	Extreme prematurity				
2.1	Not resuscitated	485	30.7	51	34.5
2.2	Unsuccessful resuscitation	69	4.4	2	1.4
2.9	Unspecified or not known whether resuscitation attempted	1	0.1	-	-
	Cardio-respiratory disorders				
3.1	Hyaline membrane disease/Respiratory distress syndrome (RDS)	50	3.2	4	2.7
3.2	Meconium aspiration syndrome	2	0.1	-	-
3.3	Primary persistent pulmonary hypertension	5	0.3	-	-
3.4	Pulmonary hypoplasia	27	1.7	4	2.7
3.5	Chronic neonatal lung disease (typically, bronchopulmonary dysplasia)	5	0.3	-	-
3.6	Pulmonary haemorrhage	12	0.8	1	0.7
3.7	Pneumothorax	1	0.1	-	-
3.8	Other	12	0.8	2	1.4
	Infection				
4.1	Bacterial				
4.11	Congenital bacterial				
4.111	Group B *Streptococcus*	23	1.5	4	2.7
4.112	*E. coli*	14	0.9	1	0.7
4.113	*Listeria monocytogenes*	4	0.3	-	-
4.118	Other bacterial	14	0.9	1	0.7
4.119	Unspecified bacterial	12	0.8	2	1.4
4.12	Acquired bacterial				
4.121	Group B *Streptococcus*	4	0.3	1	0.7
4.122	*E. coli*	4	0.3	-	-
4.125	Other Gram negative bacilli (other than *E. coli*)	6	0.4	-	-
4.126	*Staphylococcus aureus*	9	0.6	-	-
4.127	Coagulase negative *Staphylococcus*	4	0.3	-	-
4.128	Other specified bacterial	8	0.5	-	-
4.129	Unspecified bacterial	2	0.1	2	1.4

	Neonatal death classification (PSANZ-NDC)	2007–2015 n=1,580		2016 n=148	
		n	%	n	%
4.2	Viral				
4.21	Congenital viral				
4.211	*Cytomegalovirus*	3	0.2	-	-
4.213	Herpes simplex virus	6	0.4	-	-
4.218	Other specified viral	2	0.1	-	-
4.22	Acquired viral				
4.223	Herpes simplex virus	3	0.2	-	-
4.228	Other specified viral	3	0.2	-	-
4.229	Unspecified viral	1	0.1	-	-
4.5	Fungal	1	0.1	1	0.7
4.9	Unspecified organism	9	0.6	1	0.7
	Neurological				
5.1	Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)	191	12.1	14	9.5
5.2	Intracranial haemorrhage				
5.21	Intraventrical haemorrhage	59	3.7	6	4.1
5.22	Subgaleal haemorrhage	2	0.1	-	-
5.23	Subarachnoid haemorrhage	1	0.1	-	-
5.24	Subdural haemorrhage	2	0.1	1	0.7
5.28	Other intracranial haemorrhage	2	0.1	2	1.4
5.8	Other	3	0.2	-	-
	Gastrointestinal				
6.1	Necrotising enterocolitis	23	1.5	5	3.4
6.8	Other	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	0.1	-	-
7.13	SIDS Category II: Infant deaths that meet category I except for one or more features	3	0.2	-	-
7.2	Multisystem failure				
7.21	Multisystem failure: Secondary to intrauterine growth restriction	6	0.4	1	0.7
7.28	Multisystem failure: Other specified	10	0.6	2	1.4
7.29	Multisystem failure: Unspecified/undetermined primary cause or trigger event	1	0.1	-	-
7.3	Trauma				
7.31	Trauma: Accidental	10	0.6	2	1.4
7.32	Trauma: Non accidental	1	0.1	-	-
7.4	Treatment complications	2	0.1	-	-
7.41	Treatment complications: Surgical	2	0.1	-	-
7.42	Treatment complications: Medical	3	0.2	-	-
7.8	Other specified	15	0.9	1	0.7
7.9	Unknown/Undetermined	5	0.3	-	-
7.91	Unclassified sudden infant death	12	0.8	-	-
7.911	Unclassified sudden infant death: Bed sharing	38	2.4	3	2.0
7.912	Unclassified sudden infant death: Not bed sharing	5	0.3	1	0.7

3 Neonatal Encephalopathy 2016

3.1 Neonatal Encephalopathy Key Findings 2016

In 2016, there were 56 cases of neonatal encephalopathy (NE) in babies born from 37 weeks gestation reported to the PMMRC (1.0/1000 term births). In 2010, the rate was 1.4/1000 term births, but the reduction from 2010 to 2016 is not statistically significant.

From 2010 to 2016, 94 (20 percent) of 479 babies diagnosed with NE at term died within the neonatal period, and a further 13 are known to have died subsequently for a total mortality of 22 percent.

This year the babies diagnosed with NE were matched to their National Maternity Collection (MAT) record. Use of this dataset allowed analysis of associations of NE with smoking, body mass index (BMI), parity, gestation at registration with a lead maternity carer (LMC), and birthweight customised for gestational age.

There was no statistically significant association seen between NE and smoking or gestation at registration with a lead maternity carer (LMC).

There was, however, an increase in risk of NE with increasing BMI. The rate of NE was statistically significantly higher among mothers with a BMI of 30 and higher compared to a BMI of 18.50–24.99 (considered normal BMI).

There is a 'U-shaped' relationship between gestation and NE rates and between parity and NE rates, but these are somewhat linked. The risk is similar for nulliparous and multiparous women at 37 weeks, but the risk increases among nulliparous women with increasing gestation while the risk reduces with gestation among multiparous women (Figure 3.7).

Babies born small for gestational age as measured by customised birthweight centile were twice as likely to be diagnosed with NE compared to babies born with appropriate birthweight for gestational age. Babies born large for gestational age were significantly less likely to be diagnosed with NE.

A multivariable analysis is required to explore the independent predictors of NE among babies born at term, and this will be included in the work plan for 2018–2019.

Acute peripartum events were reported in 22 percent of NE cases from 2012 to 2016. In 2016, the NEWG reviewed a series of 47 babies with NE born from 2013 to 2015 following an acute peripartum event. In two-thirds of the cases reviewed, the mortality or severe morbidity were considered potentially avoidable. A summary of the review findings is provided in the text box titled "Summary of multidisciplinary review of neonatal encephalopathy associated with acute peripartum events 2013–2015" on page 82.

In an analysis of the rate of NE by place of birth, the rate of NE was found to be lower among term babies born at primary units than among those born at secondary and tertiary units. The rate of NE among babies born at home was also estimated as lower than at secondary and tertiary units but the difference was not statistically significant. The proportion of severe Sarnat stage cases, survival, and use of induced cooling were not statistically significantly different by place of birth.

In 2016, 79 percent of babies born at term with moderate or severe NE were treated with induced cooling, and of those cooled, 77 percent were cooled within six hours of birth as recommended for maximal benefit. The 12 babies not cooled in 2016 were reviewed. It was thought that two of these babies should have been referred/transferred for cooling, and the following points were emphasised:

- Neonatal observation is required for neonates with risk factors for NE.
- Regular assessment of Sarnat stage (hourly to 6 hours) is required for neonates identified with probable asphyxia to ensure cooling is not delayed for babies who deteriorate after their initial assessment (Battin 2015).

The Neonatal Encephalopathy Working Group (NEWG) audited review of 2016 NE cases at DHB of birth and found that while most cases (75 percent) were reviewed locally, only 64 percent had multidisciplinary review. Of those cases not reviewed, the most common reason given was that there was no resource locally for morbidity review.

3.2 Neonatal Encephalopathy Recommendations

1. The PMMRC recommends that DHBs with rates of neonatal encephalopathy significantly higher than the national rate review, or continue to review, the higher rate of neonatal encephalopathy in their area and identify areas for improvement.

Justification

Taranaki and Capital & Coast DHBs have significantly higher rates of NE than the national rate (Figure 3.4).

Evidence

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

3.3 Methodology

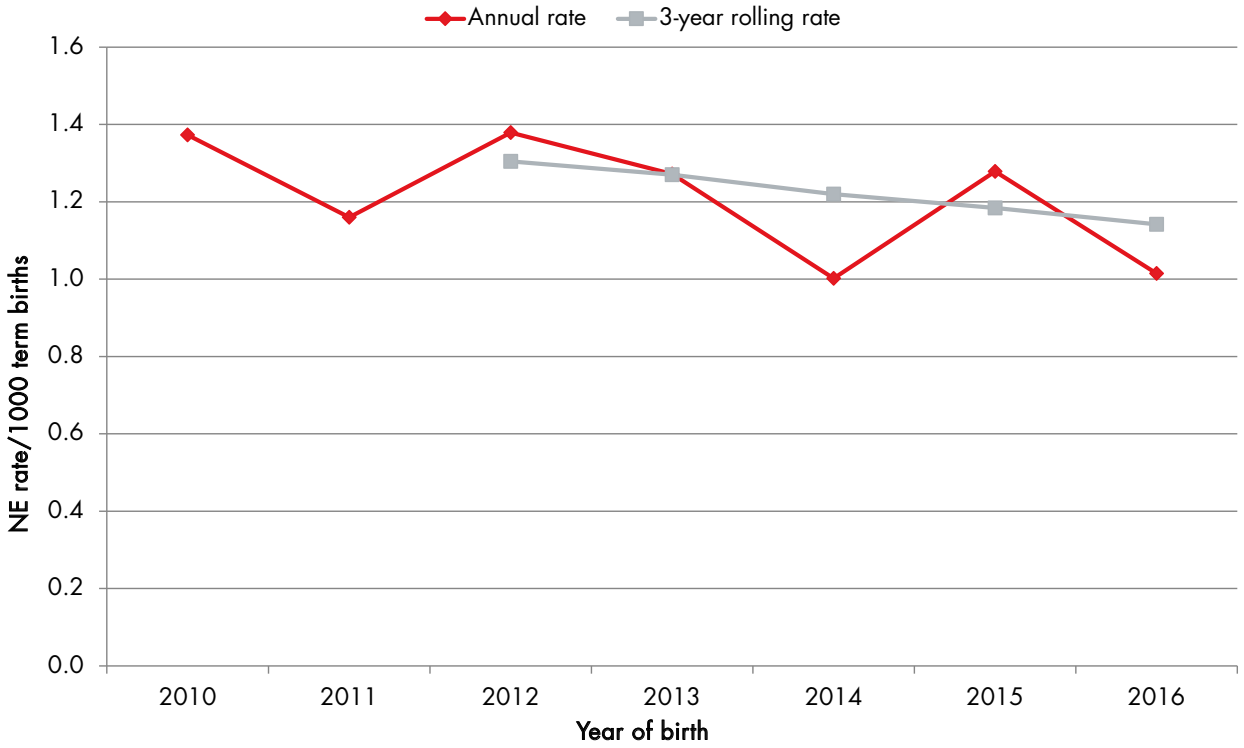
The methodology for the NE report is included with the 'Methodology and Definitions for PMMRC Reporting' document on the PMMRC website (www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/3367/).

NE cases reported at 35 and 36 weeks are not included in the majority of analyses in this chapter.

3.4 Findings

In 2016 there were 59 moderate and severe NE cases (56 from 37 weeks and 3 at 35 to 36 weeks) reported to the PMMRC. There have been 482 cases reported from 2010 to 2016 (479 from 37 weeks gestation at birth), making the NE rate for 2010–2016 1.11/1000 births (95% CI 1.01–1.21) (479/432,505 births from 20 weeks gestation or 400g if gestation unknown) or 1.21/1000 term births (95% CI 1.10–1.32) (479/394,712 term births). Although there is a downward trend apparent in the NE rate (Figure 3.1), from 1.4/1000 term births in 2010 to 1.0/1000 births in 2016, this is not a statistically significant trend (chi-square test for trend p=0.12).

Figure 3.1: Neonatal encephalopathy annual and 3-year rolling rates (per 1000 term births) 2010–2016



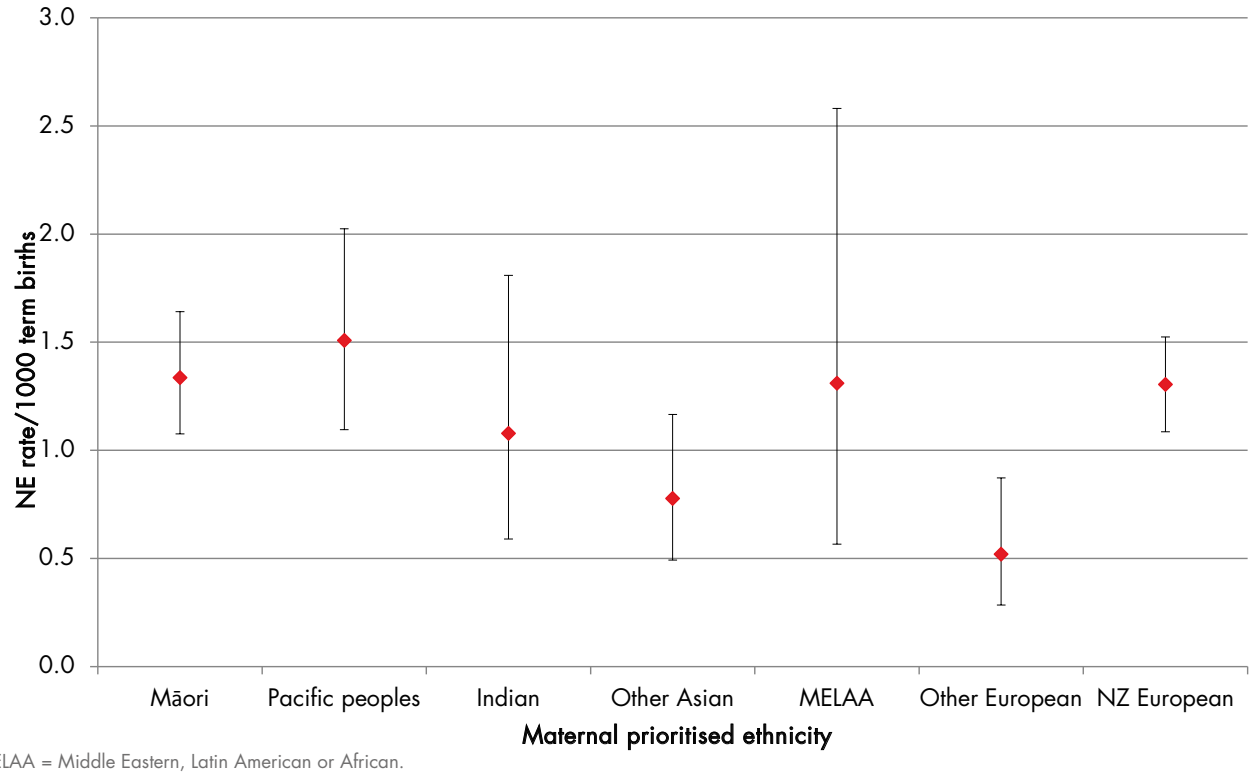
Three-year rolling NE rate represented at final year of triennium.

International comparisons

There are limited international data that can be used for comparison. One estimate of median incidence of NE associated with intrapartum events was 1.60/1000 births (range 0.68–3.75/1000) for 1980 to 2013 (Lee et al 2013). A more recent study from Spain (Arnaez et al 2018) reported an incidence equivalent to 1.09 per 1000 live births ≥35 weeks gestation. This would suggest that the currently reported rates for New Zealand are similar to other comparable health systems.

Demography and neonatal encephalopathy

Figure 3.2: Neonatal encephalopathy rates (per 1000 term births) by maternal prioritised ethnicity (with 95% CIs) 2012–2016

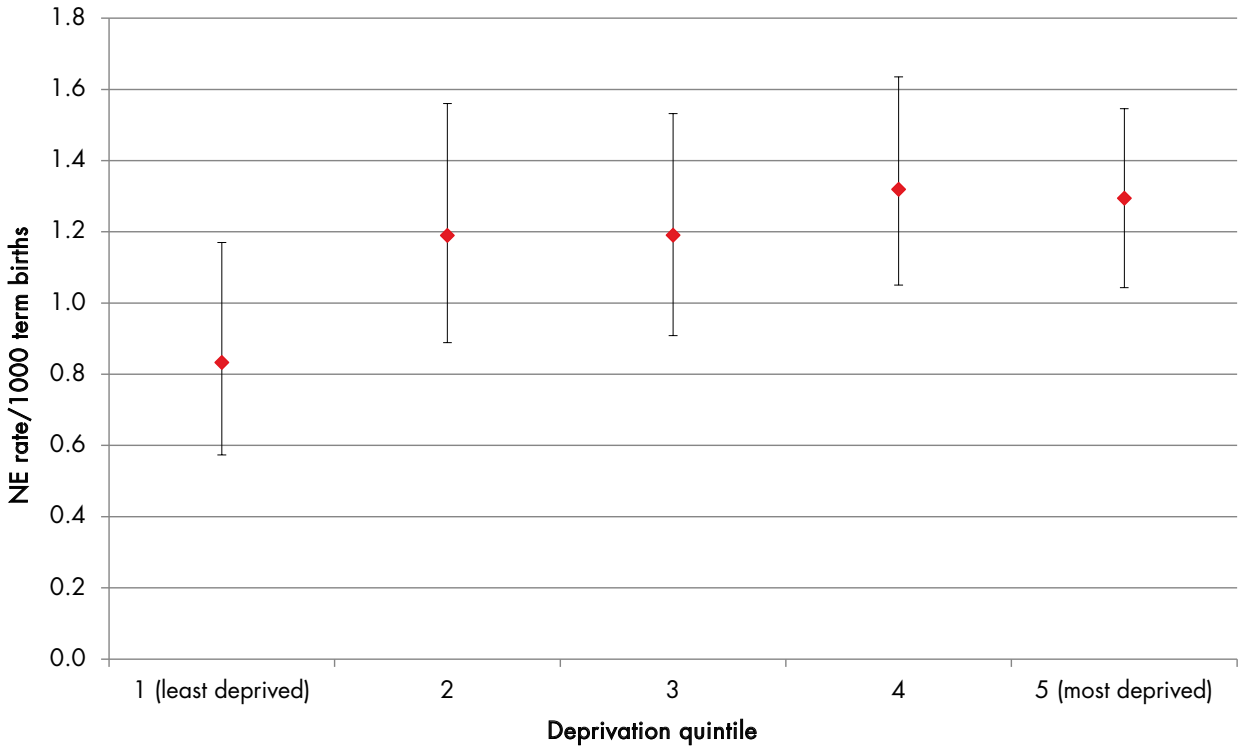


MELAA = Middle Eastern, Latin American or African.

There were statistically significant differences in NE rate by maternal ethnicity. Mothers of Other European (ie, European from countries other than New Zealand) ethnicity had the lowest rate of NE, which was significantly lower than the rate of Māori, Pacific, Indian, MELAA (Middle Eastern, Latin American or African), and New Zealand European mothers. The rate among mothers of non-Indian (Other) Asian ethnicity was lower than the rate among Māori, Pacific and New Zealand European mothers.

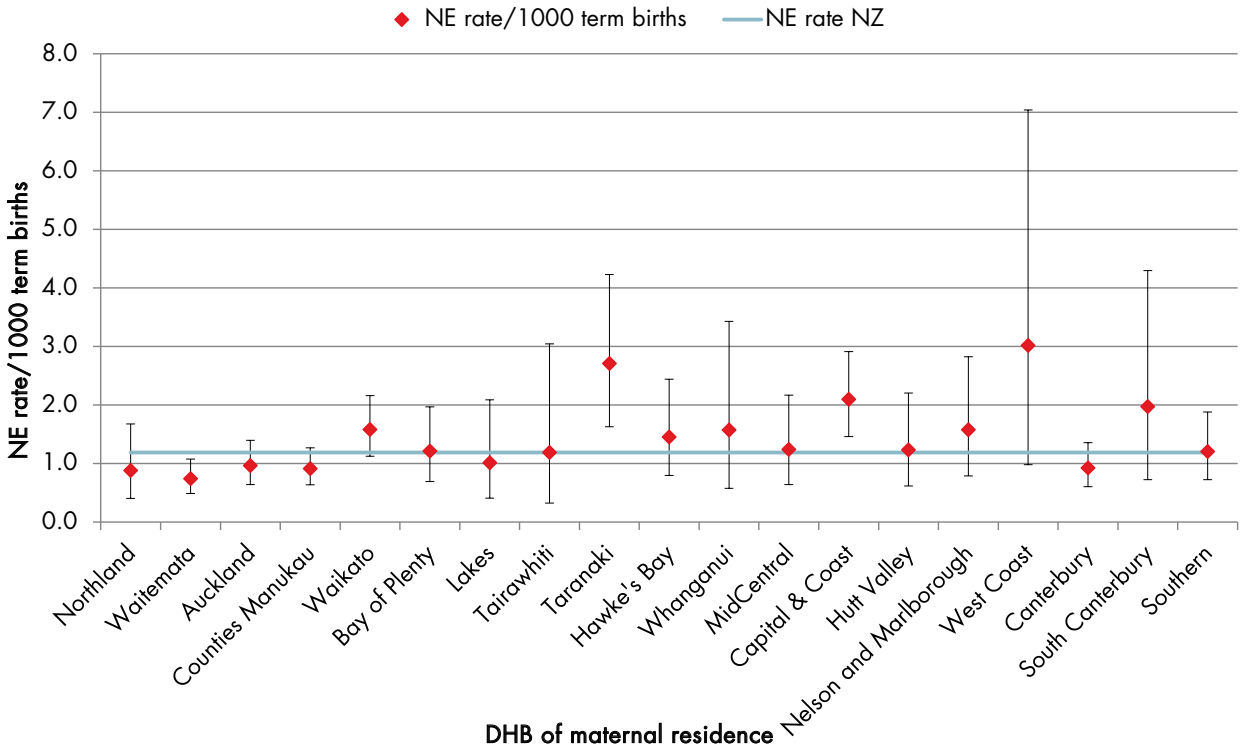
Although the rate of NE among mothers under 20 years of age (1.64/1000 term births) was higher than among mothers 20 to 34 years of age (1.20/1000) or 35 years and older (1.06/1000), this difference was not statistically significant.

Figure 3.3: Neonatal encephalopathy rates (per 1000 term births) by deprivation quintile (with 95% CIs) 2012–2016



DHB of maternal residence

Figure 3.4: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence* (compared to New Zealand neonatal encephalopathy rate) (with 95% CIs) 2012–2016



* Excludes any DHB with fewer than three cases.

Taranaki and Capital & Coast DHBs have statistically significantly 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.

Multidisciplinary review should include obstetricians, midwives (LMC midwives involved in primary care and hospital midwives), paediatricians, neonatal nurses, anaesthetists (where relevant), and any other relevant stakeholders who might be represented among those caring for pregnant women, women in labour and during birth, and babies in the neonatal period. The perspective and concerns of the parents, families and whānau should be considered at the review. Multidisciplinary review enables all perspectives to be presented and considered. Clinicians can learn and adjust clinical practice from the review of an adverse outcome. Sharing the conclusions from the multidisciplinary review with family/whānau may help them to better understand the event.

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.

Local review of neonatal encephalopathy at place of birth 2016

In 2017 PMMRC local coordinators were asked about review of babies born in their DHB who were diagnosed with NE.

Forty-four babies (75 percent) diagnosed with NE were reviewed within their DHB of birth. The review was multidisciplinary for 37 babies (64 percent) and 23 (38 percent) were reviewed as a serious adverse event. Twenty-two reviews (37 percent) were presented at local perinatal meetings. A complaint was submitted to the Health and Disability Commissioner (HDC) regarding eight babies (14 percent).

	DHB review of neonatal encephalopathy 2016*														
		Any DHB review		No DHB review		Perinatal meeting		DHB multi-disciplinary review		Serious adverse event		HDC		Coroner	
	N	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Morbidity	46	32	70	14	30	12	26	29	63	17	37	4	9		
Mortality	13	12	92	1	8	10	77	8	62	6	46	4	31	6	46
Total	**59**	**44**	**75**	**15**	**25**	**22**	**37**	**37**	**64**	**23**	**38**	**8**	**14**		

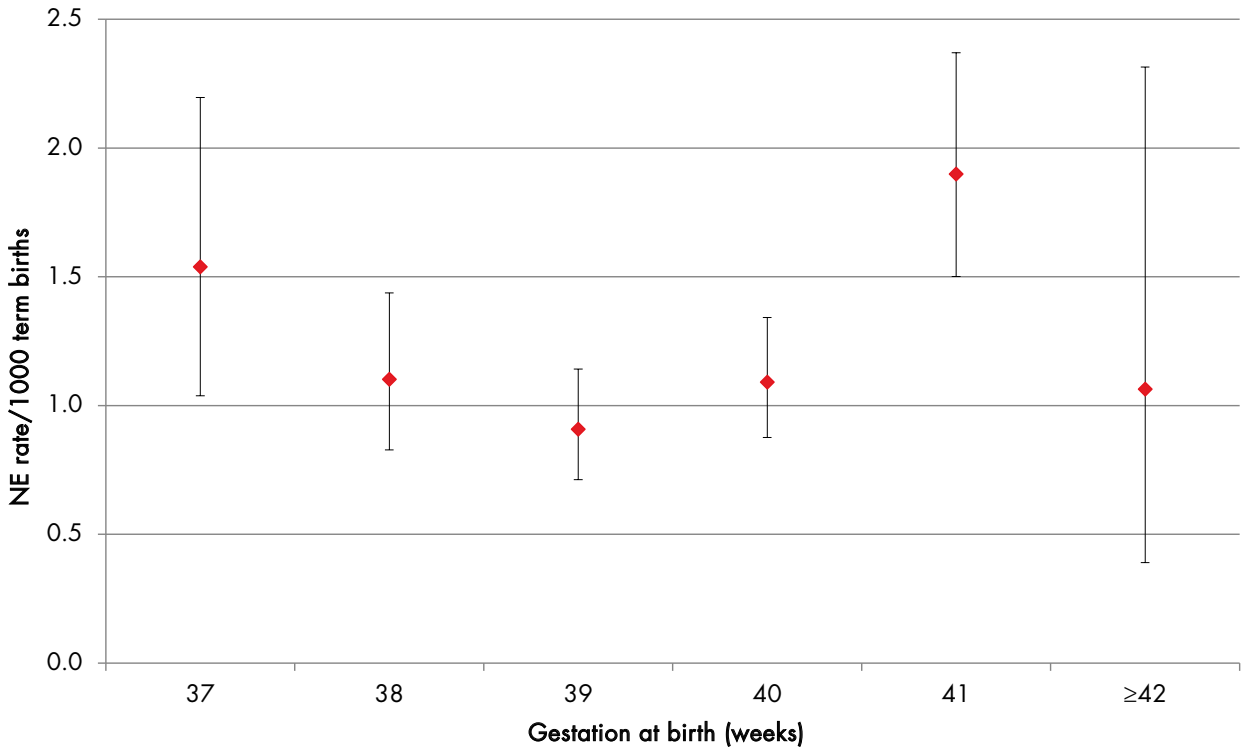
* Some babies are represented in multiple categories
HDC = Health and Disability Commissioner

Explanation of why NE cases were not reviewed included: no resources to review morbidity (5), baby born at home (2), reviewed by senior clinician who determined no further review required (2), NE presented after discharge (1), classified locally as NE stage 1 (1), and not aware of this NE case (1).

Table 3.1: Neonatal encephalopathy rate (per 1000 term births) by gestation, sex, birthweight, and plurality 2012–2016

	MAT births 2012–2016 ≥37 weeks		NE babies		Rate (/1000 term births)	
	N=277,193		n=330			
	n	%	n	%	/1000	95% CI
Gestation at birth (weeks)						
37	19,499	7.0	30	9.1	1.54	1.04–2.20
38	49,002	17.7	54	16.4	1.10	0.83–1.44
39	80,377	29.0	73	22.1	0.91	0.71–1.14
40	81,595	29.4	89	27.0	1.09	0.88–1.34
41	41,078	14.8	78	23.6	1.90	1.50–2.37
≥42	5,642	2.0	6	1.8	1.06	0.39–2.31
Sex						
Male	141,832	51.2	178	53.9	1.26	1.07–1.44
Female	135,346	48.8	152	46.1	1.12	0.94–1.30
Undetermined/unknown	15	0.0	-	-	-	-
Birthweight (g)						
<2,500	5,148	1.9	13	3.9	2.53	1.34–4.32
2,500–3,999	218,889	79.0	282	85.5	1.29	1.14–1.44
4,000–4,499	34,173	12.3	25	7.6	0.73	0.47–1.08
≥4,500	6,833	2.5	10	3.0	1.46	0.70–2.69
Unknown	12,150	4.4	-	-	-	-
Plurality						
Singleton	272,902	98.5	323	97.9	1.18	1.05–1.31
Multiple	3,241	1.2	7	2.1	2.16	0.87–4.45
Unknown	1,050	0.4	-	-	-	-

Figure 3.5: Neonatal encephalopathy rates (per 1000 term births) by gestation at birth (≥37 weeks) 2012–2016

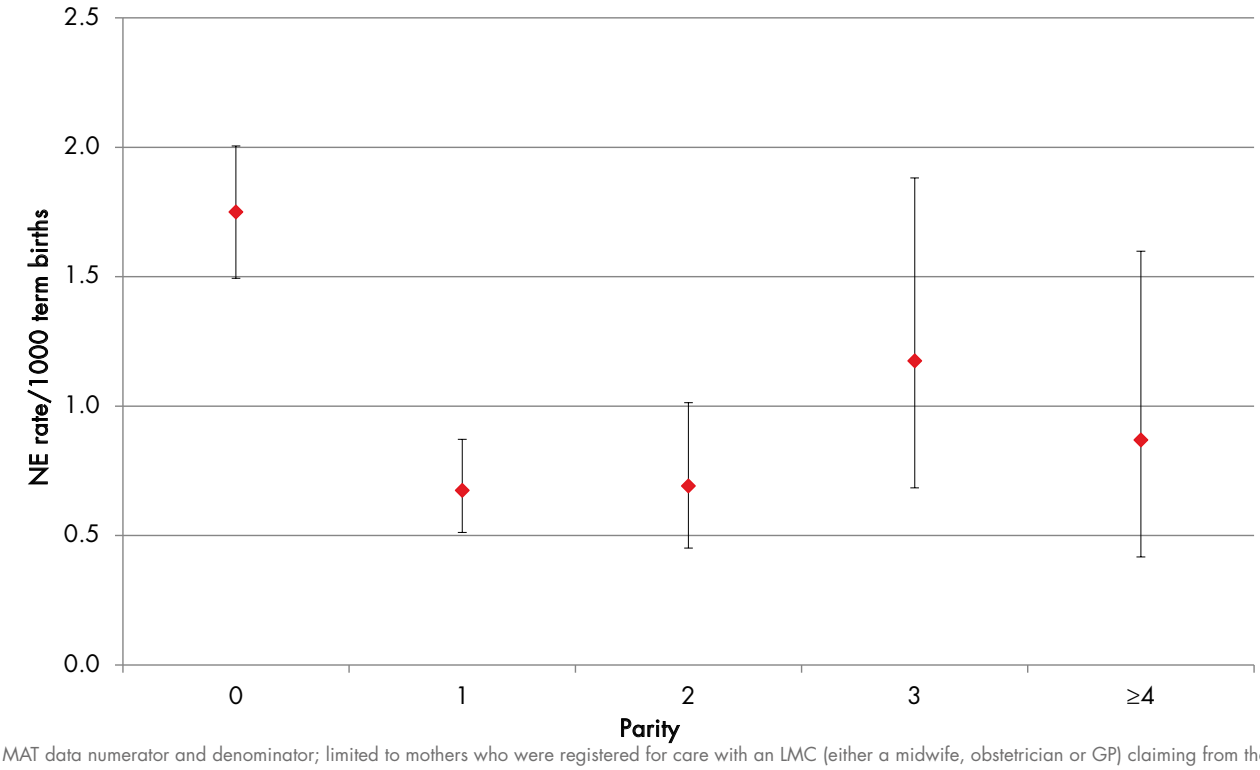


There was a significant association between gestation at birth and NE risk. The rate at 37 weeks gestation was significantly higher than the rate among babies born at 39 weeks. The rate at 41 weeks gestation was significantly higher than the rate among babies born at 38 to 40 weeks. The rate at 42 weeks and above was difficult to estimate as numbers are small and the confidence interval is necessarily wide.

The rate of NE reported among male babies (1.26/1000 term males) was higher compared to female babies (1.12/1000 term females) but the difference did not reach statistical significance.

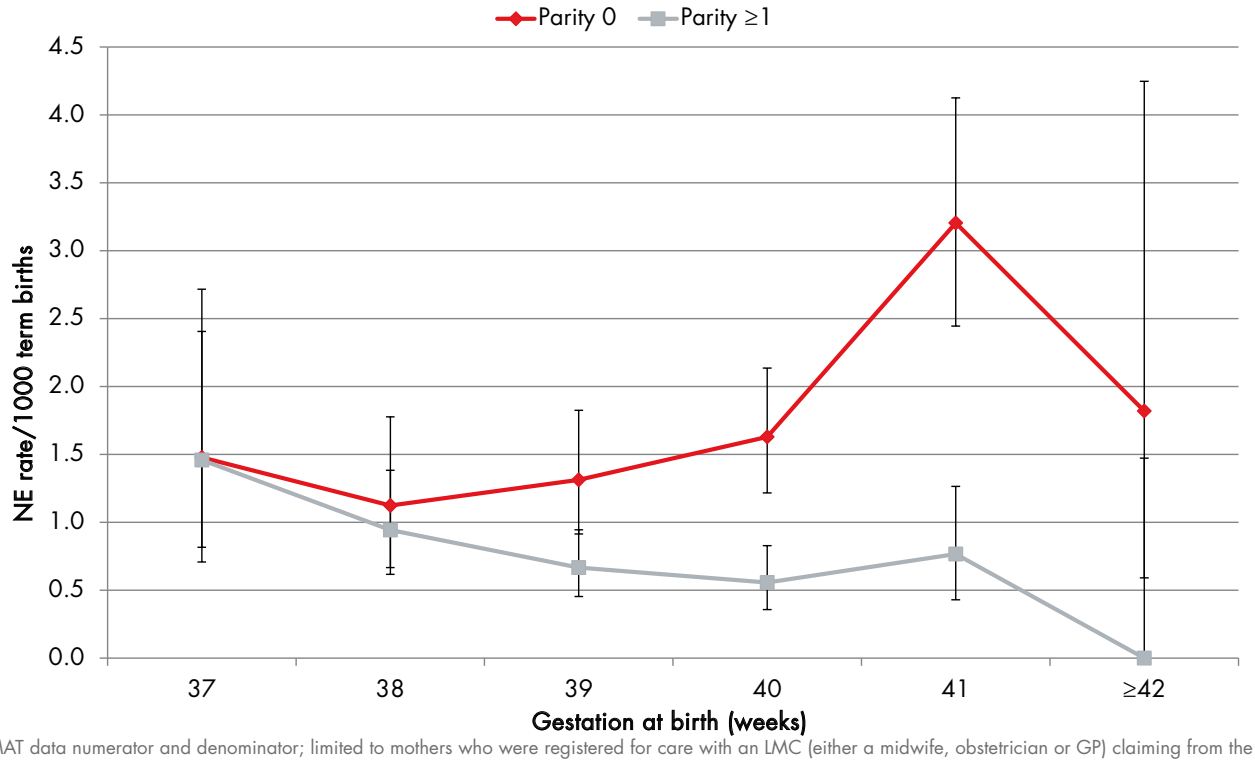
Numbers of babies born in multiple pregnancies at term with NE are small, so it is difficult to be certain whether a difference exists.

Figure 3.6: Neonatal encephalopathy rates (per 1000 term births) by parity prior to index birth 2012–2016*



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Figure 3.7: Neonatal encephalopathy rates (per 1000 term births) by parity and gestation 2012–2016*



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

The association between parity and NE is not as simple as it appears in Figure 3.6. The risk at 37 weeks was the same for mothers having the first or subsequent babies, but from 39 weeks, the rate of NE was higher among mothers having their first baby than mothers having later babies (Figure 3.7). For multiparous women the rate of NE reduced significantly after 37 weeks, while among nulliparous women, the risk remained similar from 37 to 40 weeks and then was significantly higher at 41 weeks.

Maternal smoking, BMI, gestation at first antenatal visit, customised birthweight centiles, and parity

Table 3.2: Maternal smoking, body mass index (BMI), gestation at first antenatal visit, customised birthweight centiles, and parity among neonatal encephalopathy babies* 2012–2016

	MAT births ≥37 weeks		NE cases		Rate (/1000 term births)	
	N=252,440		n=291			
	n	%	n	%	/1000	95% CI
Currently smoking						
Yes	35,836	14.2	47	16.2	1.31	0.96–1.74
No	216,593	85.8	244	83.8	1.13	0.99–1.27
Unknown	11	0.0	-	-	-	-
Maternal BMI (kg/m²)						
<18.50	7,094	2.8	3	1.0	0.42	0.09–1.24
18.50–24.99	122,564	48.6	121	41.6	0.99	0.81–1.16
25.00–29.99	65,471	25.9	78	26.8	1.19	0.94–1.49
30.00–34.99	33,225	13.2	50	17.2	1.50	1.12–1.98
35.00–39.99	15,105	6.0	24	8.2	1.59	1.02–2.36
≥40	8,606	3.4	15	5.2	1.74	0.98–2.87
Missing data for height and or weight	375	0.1	-	-	-	-
Gestation first antenatal visit (weeks)						
≤14	171,483	67.9	185	63.6	1.08	0.92–1.23
15–27	69,604	27.6	86	29.6	1.24	0.99–1.53
≥28	10,323	4.1	18	6.2	1.74	1.03–2.76
Postnatal registration	1,023	0.4	2	0.7	1.96	0.24–7.06
Unknown	7	0.0	-	-	-	-
Customised birthweight centiles						
Small for gestational age	22,971	9.1	57	19.6	2.48	1.88–3.21
Appropriate for gestational age	187,430	74.2	213	73.2	1.14	0.98–1.29
Large for gestational age	29,860	11.8	21	7.2	0.70	0.44–1.08
Unknown	12,179	4.8	-	-	-	-
Parity						
0	102,865	40.7	180	61.9	1.75	1.49–2.01
1	86,002	34.1	58	19.9	0.67	0.51–0.87
2	37,594	14.9	26	8.9	0.69	0.45–1.01
3	14,465	5.7	17	5.8	1.18	0.68–1.88
≥4	11,501	4.6	10	3.4	0.87	0.42–1.60
Unknown	13	0.0	-	-	-	-

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Table 3.2 shows unadjusted associations between smoking, BMI, parity, gestation at first antenatal visit, and customised birthweight centile and NE for 2012–2016. As these variables are not reliably available for women receiving primary maternity care from DHBs, these analyses are limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

There was no statistically significant association seen between smoking and NE, although the NE rate for smokers was higher than that for non-smokers. There was, however, an increase in risk of NE with increasing BMI. The rate of NE was statistically significantly higher among mothers with a BMI of 30 and higher compared to mothers with a BMI of 18.50–24.99 (considered normal BMI), and this was not a threshold effect, with rate increasing as BMI increased.

Although the rate of NE appears to increase among mothers who engage later with antenatal care during pregnancy, this was not statistically significant.

Babies born small for gestational age as measured by customised birthweight centile were twice as likely to be diagnosed with NE compared to babies born with appropriate birthweight for gestational age. Babies born large for gestational age were significantly less likely to be diagnosed with NE.

These are unadjusted findings. A multivariable analysis is required to explore the independent predictors of NE. This will be included in the work plan for 2018–2019.

Antenatal complications, interventions, and maternal outcome

Table 3.3: Antenatal complications, obstetric interventions, and maternal outcome among neonatal encephalopathy cases by parity and Sarnat stage 2012–2016

	NE cases		Primiparous		Multiparous		Sarnat stage			
							Moderate		Severe	
	n=330		n=202		n=128		n=235		n=95	
	n	%	n	%	n	%	n	%	n	%
Antenatal complications										
APH (≥20 weeks vaginal bleeding)	32	9.7	18	8.9	14	10.9	21	8.9	11	11.6
Hypertension	45	13.6	35	17.3	10	7.8	34	14.5	11	11.6
Pre-eclampsia	9	2.7	8	4.0	1	0.8	8	3.4	1	1.1
Gestational hypertension	14	4.2	10	5.0	4	3.1	12	5.1	2	2.1
Unspecified hypertension	22	6.7	17	8.4	5	3.9	14	6.0	8	8.4
Maternal trauma (antenatal)*	6	1.8	2	1.0	4	3.1	2	0.9	4	4.2
Induction/augmentation of labour										
Induction of labour	84	25.5	56	27.7	28	21.9	65	27.7	19	20.0
Induced or augmented labour (any method)	163	49.4	114	56.4	49	38.3	126	53.6	37	38.9
Oxytocin for induction or augmentation	80	24.2	58	28.7	22	17.2	64	27.2	16	16.8
Epidural anaesthesia	81	24.5	62	30.7	19	14.8	68	28.9	13	13.7
Maternal outcome										
Deceased	3	0.9	1	0.5	2	1.6	2	0.9	1	1.1
Alive but with serious morbidity	7	2.1	0	0.0	7	5.5	5	2.1	2	2.1
Alive and well	320	97.0	201	99.5	119	93.0	228	97.0	92	96.8

* Vehicular, violent personal injury, other.
Primiparous: parity = 0 defined prior to current birth.
Multiparous: parity ≥1 defined prior to current birth.
APH = antepartum haemorrhage.

Antepartum haemorrhage and hypertension in pregnancy complicated 10 percent and 14 percent of pregnancies where babies were diagnosed with NE respectively.

The national rate of induction of labour (all births) was 23.8 percent in 2015 (27.8 percent among women having their first baby and 19.9 percent among women having subsequent babies), which is similar to that among mothers of babies diagnosed with NE from 2012 to 2016 (25.5 percent, 27.7 percent and 21.9 percent respectively) (Ministry of Health 2017b).

Among mothers of babies diagnosed with NE, 24.5 percent had an epidural in labour (2012–2016) compared to a national rate in 2014 of 26.4 percent (41.3 percent of women having their first baby, and 14.8 percent of women having subsequent babies).

Over the five years of NE data collection from 2012 to 2016, there have been three babies diagnosed with NE associated with maternal death and seven with severe maternal morbidity. Of these 10 babies, three had severe NE.

Peripartum complications and mode of birth

Table 3.4: Peripartum complications and mode of birth among neonatal encephalopathy cases 2012–2016

	Total NE cases n=330	
	n	%
Acute peripartum events	73	22.1
Cord prolapse	10	3.0
Placental abruption	18	5.5
Uterine rupture	7	2.1
Shoulder dystocia	22	6.7
Breech complication	7	2.1
Other complication	12	3.6
Liquor		
Blood stained	24	7.3
Thick meconium	74	22.4
Thin meconium	41	12.4
Mode of birth		
Normal vaginal birth	128	38.8
Operative vaginal birth	50	15.2
Forceps	21	6.4
Ventouse	28	8.5
Unknown	1	0.3
Vaginal breech birth	6	1.8
Caesarean section birth	146	44.2
Elective	8	2.4
Prelabour emergency	30	9.1
Antepartum haemorrhage/Placental abruption	2	0.6
Suspected fetal distress	23	7.0
Failed induction	1	0.3
Other	4	1.2
In labour emergency	108	32.7
Antepartum haemorrhage/Placental abruption	7	2.1
Suspected fetal distress	82	24.8
Failure to progress/Cephalopelvic disproportion	8	2.4
Other	1	0.3
Unknown	10	3.0
Attempt at operative vaginal birth before caesarean	9	2.7

Acute peripartum events were reported in 73 cases (22 percent) in the five years from 2012 to 2016. Of these, abruption (18 babies) and shoulder dystocia (22 babies) were the most common. Other complications included amniotic fluid embolism, maternal collapse, complications at birth of the second twin, vasa praevia and drug error.

Among babies diagnosed with NE from 2012 to 2016, 44 percent were born by caesarean section. Thirty-three percent were born by in-labour emergency caesarean section, which was most often performed for suspected fetal distress (25 percent). This compares with a national caesarean section rate of 25.5 percent among all births in 2015 (Ministry of Health 2017b).

Six babies in the five-year period 2012–2016 (1.8 percent) were breech vaginal births at term, compared to 0.4 percent vaginal breech births in New Zealand in 2015 (Ministry of Health 2017b).

In 2016–2017 the NEWG reviewed the maternity and early neonatal care of 47 cases of NE from 2013–2015 associated with an acute peripartum event. The Accident Compensation Commission (ACC) funded this work. The following text box presents a summary of the findings of this review.

Summary of multidisciplinary review of neonatal encephalopathy associated with acute peripartum events 2013–2015

Forty-seven babies with NE were reviewed by a team including midwives, obstetricians, neonatologists, neonatal nurse practitioners and a human factors psychologist.

NE was associated with placental abruption (12), shoulder dystocia (11), cord prolapse (6), maternal collapse (5), uterine rupture (4), breech complications (4), and five other events.

Contributory factors were identified in 42 (89 percent) of the 47 cases reviewed. In 66 percent of cases, mortality or the severity of morbidity was determined to be potentially avoidable.

Specific areas for improvement highlighted

1. Support for recommended best practice around maternal weight measurement, fundal height measurement, serial scanning, screening for diabetes in pregnancy
2. Simulation training/skill enhancement around rare but known obstetric emergencies, including how to maintain skill in remote or small units where exposure is limited, linking midwifery, obstetric and emergency staff, considering the use of short emergency training events, and simulation training or credentialing for neonatal resuscitation
3. Checklists to assist with learning/action and documentation (eg, shoulder dystocia)
4. Reinforcing learning around difficult discussions and subsequent documentation of discussions, as they apply to assessment and management of risk related to antenatal and intrapartum care
5. Documentation of acute peripartum events, facilitated by debrief and collegial support
6. Reinforcement of regular assessment of the newborn with risk factors for NE
7. Maternal and fetal surveillance in labour: cardiotocography training, role of lactate estimation in labour
8. Transfer, especially of neonates from Level 1 or 2 facilities; availability of transports and support/coordination for neonatal retrieval
9. Process for NE review including where and how this is best done, local and/or independent or a mixture of both, consider inclusion of an anaesthetist in reviews
10. Incorporation of human factors items into the PMMRC review tool
11. Conceptualisation of human factors and how to capture and learn from an understanding of these.

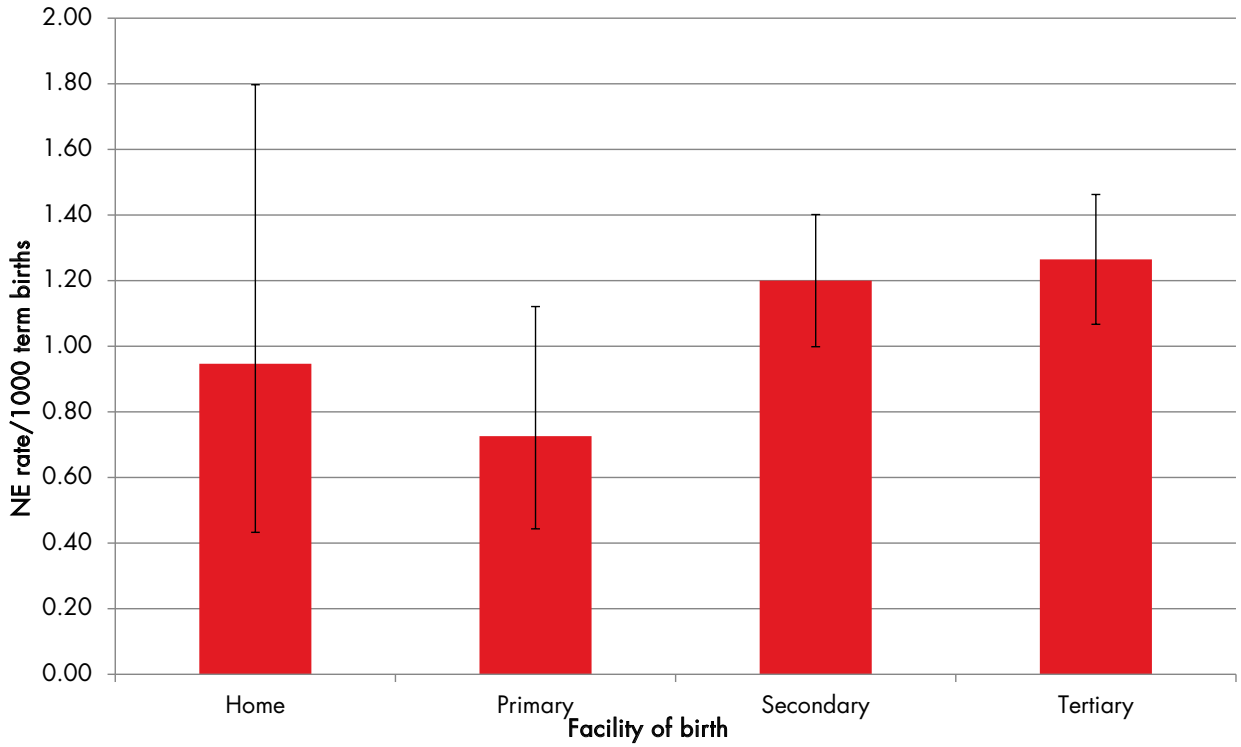
The findings from the first review of NE babies, without peripartum events (Sadler et al 2016), informed the ACC-led NE Taskforce's current work programme. This work and further review of evidence by the NE Taskforce led to four national initiatives:

- Fetal Growth Assessment Protocol (GAP)
- Fetal heart monitoring education
- Newborn observation chart and Newborn Early Warning Score (NEWS)
- Fetal cord blood lactate testing.

Working Groups have been established, comprising relevant experts and representatives, to deliver these projects with the NE Taskforce providing governance.

Place of birth

Figure 3.8: Neonatal encephalopathy rates (per 1000 term births) by place of birth (with 95% CIs) 2012–2016



From 2012 to 2016, 3.4 percent of babies were confirmed as born at home in New Zealand (defined by LMC claim for home-birthing fee), 9.9 percent in a primary unit (including birthing unit and Level 1 hospital), 41 percent in a Level 2 hospital and 45 percent in a tertiary hospital. One percent of births had unknown place of birth (Table 3.13).

The rate of NE was significantly lower among term babies born at primary units than among those born at secondary and tertiary units from 2012 to 2016. The rate of NE among term babies born at home was also estimated as lower than at secondary and tertiary units, but the difference was not statistically significant. There was no significant difference in the rate of NE between babies born at home and in primary units.

The proportions of severe Sarnat stage cases, survival, and use of induced cooling were not statistically significantly different by place of birth.

Immediate newborn wellbeing

Table 3.5: Immediate newborn wellbeing among neonatal encephalopathy babies 2010–2016

	2010		2011		2012		2013		2014		2015		2016		Total	
	n=82		n=67		n=79		n=70		n=55		n=70		n=56		n=479	
	n	%	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	39	55.7	37	66.1	289	60.3
Apgar score <5 at 1 minute	65	79.3	54	80.6	62	78.5	58	82.9	49	89.1	51	72.9	48	85.7	387	80.8
Apgar score <7 at 1 minute	73	89.0	61	91.0	70	88.6	65	92.9	53	96.4	59	84.3	51	91.1	432	90.2
Apgar score <7 at 5 minutes	61	74.4	54	80.6	62	78.5	57	81.4	43	78.2	50	71.4	46	82.1	373	77.9
Apgar score <7 at 10 minutes	39	47.6	38	56.7	49	62.0	32	45.7	29	52.7	35	50.0	33	58.9	255	53.2
Apgar score <9 at 10 minutes	52	63.4	52	77.6	62	78.5	52	74.3	45	81.8	48	68.6	44	78.6	355	74.1
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	6	10.7	71	14.8
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	42	75.0	320	66.8
No gases reported	23	28.0	12	17.9	13	16.5	9	12.9	8	14.5	15	21.4	8	14.3	88	18.4
No gases and Apgar <7 at 1 minute	14	17.1	8	11.9	8	10.1	6	8.6	8	14.5	6	8.6	6	10.7	56	11.7
No gases and Apgar ≥7 at 1 minute	8	9.8	4	6.0	5	6.3	3	4.3	-	-	9	12.9	2	3.6	31	6.5
No gases and unknown Apgar	1	1.2	-	-	-	-	-	-	-	-	-	-	-	-	1	0.2

BE = base excess.

Sixty percent of the babies diagnosed with moderate or severe NE from 2010 to 2016 had an Apgar score under 3 at one minute, 81 percent under 5 at one minute, 78 percent under 7 at five minutes, and 53 percent still had a score under 7 at 10 minutes. Sixty-seven 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 <7 at one minute. These data indicate the majority of babies diagnosed with moderate and severe NE have evidence of asphyxia at birth.

The reduction in the proportion of babies without cord gases reported from 2010 (28 percent) to 2016 (14 percent) was not statistically significant (score test for trend p=0.19).

The practice of collection and review of umbilical cord bloods may vary by DHB. Every birthing facility needs to ensure that umbilical cord gas results are reviewed and managed in a timely manner. 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 mmol/L	Document results
6.0 mmol/L 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 3.6: Induced cooling therapy among neonatal encephalopathy babies 2010–2016

Cooling	2010		2011		2012		2013		2014		2015		2016		Total	
	n=82		n=67		n=79		n=70		n=55		n=70		n=56		n=479	
	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	44	78.6	372	77.7
No	26	31.7	16	23.9	17	21.5	12	17.1	10	18.2	14	20.0	12	21.4	107	22.3
Age at cooling	n=56		n=51		n=62		n=58		n=45		n=56		n=44		n=372	
≤6 hours	46	82.1	39	76.5	53	85.5	47	81.0	39	86.7	44	78.6	34	77.3	302	81.2
>6 hours	10	17.9	8	15.7	9	14.5	11	19.0	6	13.3	11	19.6	10	22.7	65	17.5
Unknown time	-	-	4	7.8	-	-	-	-	-	-	1	1.8	-	-	5	1.3

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 2016, 79 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 77 percent. There has been little change in this rate over the years of data collection.

Review of the 54 neonates from 2011 to 2014[3] who were not cooled found that 20 of 22 Sarnat stage severe babies 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 could cooling possibly have been initiated; one infant was transferred to Level 3 at 12 hours, the other developed seizures at 4 hours of age with normal cord gases (PMMRC 2017).

[3] An extra late notification (to total 55 cases 2011–2014) included in Table 3.6 was not included in the review.

Of the 32 Sarnat stage moderate babies who were not cooled, it was found that 23 were appropriately not cooled. Reasons for not cooling included late presentation, NE unrelated to hypoxic ischemic encephalopathy, 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 transfer to a tertiary unit.

The 12 babies (four severe, eight moderate) not cooled in 2016 were reviewed. In some of these cases, documentation was insufficient to be certain whether an opportunity for cooling existed and did not describe the rationale for a decision not to cool. An update to the data collection tool requesting additional information on decision-making (in response to the previous review) should help with review of these cases in the future. There were, however, two babies with NE who on review should have been referred/transferred for cooling.

The following points arose from the review:

- Neonatal observation is required for neonates with risk factors for NE.
- Regular assessment of Sarnat stage (hourly to 6 hours) is required for neonates identified with probable asphyxia to ensure cooling is not delayed for babies who deteriorate after their initial assessment (Battin 2015).

Neonatal resuscitation

Table 3.7: Neonatal resuscitation and early neonatal management by Sarnat stage among neonatal encephalopathy babies 2012–2016

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=330		n=235		n=95	
	n	%	n	%	n	%
Resuscitation at birth						
Yes	305	92.4	216	91.9	89	93.7
No	25	7.6	19	8.1	6	6.3
Type of resuscitation at birth						
Oxygen only	4	1.2	4	1.7	-	-
IPPV with mask	226	68.5	167	71.1	59	62.1
IPPV with ETT	171	51.8	105	44.7	66	69.5
Cardiac massage	118	35.8	60	25.5	58	61.1
Adrenaline	44	13.3	15	6.4	29	30.5
Respiratory and ventilation management						
Mechanical ventilation	271	82.1	181	77.0	90	94.7
Nitric oxide	82	24.8	52	22.1	30	31.6
Infection						
Positive blood culture	13	3.9	10	4.3	3	3.2
Antibiotics	308	93.3	221	94.0	87	91.6
Anticonvulsant therapy	241	73.0	165	70.2	76	80.0
Phenobarbitone	212	64.2	140	59.6	72	75.8
Phenytoin	74	22.4	38	16.2	36	37.9
Benzodiazepines	91	27.6	56	23.8	35	36.8
Other	51	15.5	38	16.2	13	13.7

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

Among the cohort of 330 NE babies from 2012 to 2016, 92 percent were resuscitated at birth, 36 percent required cardiac massage, 13 percent adrenalin, and 52 percent intubation and intermittent positive pressure ventilation.

Outcomes of babies with neonatal encephalopathy

Table 3.8: Use of cooling and outcomes of encephalopathy by Sarnat stage among neonatal encephalopathy babies 2012–2016

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=330		n=235		n=95	
	n	%	n	%	n	%
Induced cooling						
Yes	265	80.3	195	83.0	70	73.7
No	65	19.7	40	17.0	25	26.3
Deceased						
Yes	58	17.6	5	2.1	53	55.8
No	272	82.4	230	97.9	42	44.2

Babies with severe Sarnat stage NE are less likely to be cooled, and this has been shown at review to be related to their severe ill-health. Of babies with moderate Sarnat stage NE from 2012 to 2016, 83 percent were treated with induced cooling.

Among the 58 deaths of babies with NE from 2012 to 2016, 53 (91 percent) were severe Sarnat stage. Of the babies with severe Sarnat stage NE who did not die, 35 (83 percent) were cooled.

From 2010 to 2016, 94 (20 percent) of 479 babies diagnosed with NE at term died within the first six weeks of life, and a further 13 are known to have died subsequently (22 percent).

The proportion of babies dying, in the first 28 days of age, per year has not changed significantly since 2010.

Ninety-two babies with NE died within the neonatal period (up to 28 days), 21 (23 percent) within the first day, 55 (60 percent) within the first three days, and 83 (90 percent) within the first week of birth. A further nine babies (10 percent) died after one week but within 28 days of birth, and two babies died in the post-neonatal period (at five and six weeks). As of the year ended December 2016, a further 13 babies died after discharge from three months to five years of age.

Investigations and neonatal outcome by Sarnat stage (survivors)

Table 3.9: Investigations and neonatal outcome by Sarnat stage of neonatal encephalopathy survivors 2010–2016

Investigations	2010		2011		2012		2013		2014		2015		2016		Total NE survivors		Sarnat stage			
																	Moderate		Severe	
	n=59		n=54		n=67		n=59		n=44		n=58		n=44		n=385		n=325		n=60	
	n	%	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	50.0	15	34.1	172	44.7	163	50.2	9	15.0
Mild or moderate abnormality	14	23.7	20	37.0	19	28.4	23	39.0	17	38.6	14	24.1	23	52.3	130	33.8	108	33.2	22	36.7
Severe abnormality	3	5.1	1	1.9	5	7.5	5	8.5	3	6.8	4	6.9	3	6.8	24	6.2	3	0.9	21	35.0
Not examined	1	1.7	4	7.4	7	10.4	5	8.5	2	4.5	3	5.2	-	-	22	5.7	19	5.8	3	5.0
Examined but finding unknown	3	5.1	1	1.9	5	7.5	2	3.4	2	4.5	2	3.4	-	-	15	3.9	11	3.4	4	6.7
Missing data	6	10.2	3	5.6	1	1.5	-	-	3	6.8	6	10.3	3	6.8	22	5.7	21	6.5	1	1.7
MRI (investigation done)	41	69.5	35	64.8	43	64.2	50	84.7	38	86.4	48	82.8	40	90.9	295	76.6	237	72.9	58	96.7
No MRI or Unknown	18	30.5	19	35.2	24	35.8	9	15.3	6	13.6	10	17.2	4	9.1	90	23.4	88	27.1	2	3.3
Results of MRI																				
Moderately/Severely abnormal	16	27.1	11	20.4	17	25.4	22	37.3	13	29.5	15	25.9	18	40.9	112	29.1	73	22.5	39	65.0
Normal or only mildly abnormal	24	40.7	23	42.6	24	35.8	27	45.8	25	56.8	33	56.9	21	47.7	177	46.0	159	48.9	18	30.0
Unknown result	1	1.7	1	1.9	2	3.0	1	1.7	-	-	-	-	1	2.3	6	1.6	5	1.5	1	1.7

MRI = magnetic resonance imaging (of the brain).

There has been a statistically significant increase in the proportion of surviving babies who had an MRI investigation since collection of NE data began, from 70 percent in 2010 to 91 percent in 2016 (score test for trend p=0.0001).

Of survivors during 2010–2016, 29 percent had a moderately or severely abnormal MRI (23 percent of moderate and 65 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-three percent of survivors during 2010–2016 did not have an MRI (27 percent of moderate and 3 percent of severe cases). In 2016 four surviving babies (9 percent) did not have an MRI.

From 2018, the NEWG will not collect or report electroencephalogram (EEG) investigation as this has been replaced by cot-side amplitude-integrated electroencephalography (aEEG). Data on cot-side aEEG will be collected going forward.

3.5 Neonatal Encephalopathy 2016: Appended Tables

Table 3.10: Neonatal encephalopathy rates (per 1000 term births) by prioritised maternal ethnicity, maternal age and deprivation quintile 2012–2016

	MAT births ≥37 weeks		NE cases		Rate (/1000 term births)	
	N=277,193		n=330			
	n	%	n	%	/1000	95% CI
Maternal ethnicity						
Māori	68,096	24.6	91	27.6	1.34	1.08–1.64
Pacific peoples	29,182	10.5	44	13.3	1.51	1.10–2.02
Indian	12,987	4.7	14	4.2	1.08	0.59–1.81
Other Asian	29,600	10.7	23	7.0	0.78	0.49–1.17
MELAA	6,107	2.2	8	2.4	1.31	0.57–2.58
Other European	26,937	9.7	14	4.2	0.52	0.28–0.87
NZ European	104,252	37.6	136	41.2	1.30	1.09–1.52
Unknown/Other	32	0.0	-	0.0	-	-
Maternal age (years)						
<20	14,064	5.1	23	7.0	1.64	1.04–2.45
20–34	205,362	74.1	246	74.5	1.20	1.05–1.35
35–39	46,399	16.7	49	14.8	1.06	0.78–1.40
≥40	11,352	4.1	12	3.6	1.06	0.55–1.85
Unknown	16	0.0	-	-	-	-
Deprivation quintile						
1 (least deprived)	39,616	14.3	33	10.0	0.83	0.57–1.17
2	43,699	15.8	52	15.8	1.19	0.89–1.56
3	50,412	18.2	60	18.2	1.19	0.91–1.53
4	62,925	22.7	83	25.2	1.32	1.05–1.64
5 (most deprived)	78,795	28.4	102	30.9	1.29	1.04–1.55
Unknown	1,746	0.6	-	-	-	-

MELAA = Middle Eastern, Latin American or African.

Table 3.11: Actual and intended place of birth among neonatal encephalopathy cases 2012–2016

Intended place of birth	NE cases		Actual place of birth											
	n=330		Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3		Other	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home	13	3.9	8	61.5	-	-	-	-	4	30.8	1	7.7	-	-
Birthing unit	48	14.5	1	2.1	17	35.4	-	-	7	14.6	23	47.9	-	-
Hospital level 1	16	4.8	-	-	-	-	3	18.8	3	18.8	10	62.5	-	-
Hospital level 2	131	39.7	1	0.8	-	-	2	1.5	124	94.7	3	2.3	1	0.8
Hospital level 3	118	35.8	-	-	-	-	-	-	1	0.8	117	99.2	-	-
Unknown	4	1.2	-	-	-	-	-	-	2	50.0	2	50.0	-	-
Total	330		10	3.0	17	5.2	5	1.5	141	42.7	156	47.3	1	0.3

Table 3.12: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence 2012–2016

DHB of residence	MAT births ≥37 weeks	2012	2013	2014	2015	2016	Total NE cases	Rate (/1000 term births)	
	N=277,193	n=79	n=70	n=55	n=70	n=56	n=330		
	n	n	n	n	n	n	n	/1000	95% CI
Northland	10,196	2	1	1	1	4	9	0.88	0.40–1.68
Waitemata	36,471	4	5	9	4	5	27	0.74	0.49–1.08
Auckland	28,982	4	8	5	6	5	28	0.97	0.64–1.40
Counties Manukau	38,365	14	6	5	4	6	35	0.91	0.64–1.27
Waikato	24,660	9	5	6	12	7	39	1.58	1.12–2.16
Bay of Plenty	13,182	2	3	1	6	4	16	1.21	0.69–1.97
Lakes	6,901	2	1	1	2	1	7	1.01	0.41–2.09
Tairawhiti	3,363	2	1	1	-	-	4	1.19	0.32–3.05
Taranaki	7,015	6	5	4	4	-	19	2.71	1.63–4.23
Hawke's Bay	9,622	3	2	3	3	3	14	1.45	0.80–2.44
Whanganui	3,810	2	1	-	1	2	6	1.57	0.58–3.43
MidCentral	9,656	2	3	2	4	1	12	1.24	0.64–2.17
Wairarapa	2,247	-	-	1	-	-	1	0.45	0.01–2.48
Capital & Coast	16,704	9	10	3	7	6	35	2.10	1.46–2.91
Hutt Valley	8,921	2	5	2	-	2	11	1.23	0.62–2.21
Nelson and Marlborough	6,971	2	5	1	2	1	11	1.58	0.79–2.82
West Coast	1,657	2	-	2	-	1	5	3.02	0.98–7.04
Canterbury	28,081	7	2	6	6	5	26	0.93	0.60–1.36
South Canterbury	3,038	2	1	-	3	-	6	1.97	0.72–4.30
Southern	15,787	3	6	2	5	3	19	1.20	0.72–1.88
Other*	1,564	-	-	-	-	-	-	-	-

* Other includes Overseas, Unknown and Other.

Table 3.13: Neonatal encephalopathy rates (per 1000 term births) by place of birth* 2012–2016

Facility of birth	MAT births ≥37 weeks		NE cases			
	N=277,193		n=324			
	n	%	n	%	Rate	95% CI
Home	9,505	3.4	9	2.8	0.95	0.43–1.80
Primary	27,551	9.9	20	6.2	0.73	0.44–1.12
Secondary	113,314	40.9	136	42.0	1.20	1.00–1.40
Tertiary	124,114	44.8	157	48.5	1.26	1.07–1.46
Unknown	2,709	1.0	2	0.6	-	-

* MAT data numerator and denominator

4 Perinatal Mortality 2016

4.1 Perinatal Mortality Key Findings 2016

The perinatal related mortality rate, which includes all deaths from 20 weeks gestation to 27 days of life (including late terminations of pregnancy, stillbirths, and early and late neonatal deaths), was 10.1 per 1000 total births in New Zealand in 2016. While there has been no statistically significant reduction in perinatal related mortality since 2007 using the New Zealand definition (chi-square test for trend p=0.06), there has been a significant reduction in perinatal related mortality from 1000g or 28 weeks (international definition (WHO 2006)) (p=0.0009) and a significant reduction in stillbirths (p=0.006 (New Zealand definition), p=0.0003 (international definition)).

There has been a highly significant reduction in perinatal related mortality, using the New Zealand definition, from hypoxic peripartum death (p=0.00005); and a highly significant reduction in perinatal mortality using the international definition (from 1000g or 28 weeks) from hypoxic peripartum death (p=0.00005), antepartum haemorrhage (p=0.009) and fetal growth restriction (p=0.001).

There was a statistically significant reduction in the proportion of small for gestational age babies born from 2008 to 2016 and a statistically significant reduction in perinatal related mortality among small for gestational age babies (score test for trend p=0.046) (Figure 4.17).

There has been no significant change in overall neonatal death rates or rates of death from termination of pregnancy. Neonatal deaths are the topic of a special report this year (chapter "2 Special Topic: Neonatal Mortality 2007–2016").

The number of mothers under 20 years of age halved from 2007 to 2016, while the perinatal related mortality among these mothers increased from 11.9/1000 births in 2007 to 21.9/1000 births in 2016 (p<0.005). Mothers under 20 years of age are at higher risk of perinatal related death (excluding congenital anomalies) from spontaneous preterm birth, fetal growth restriction, antepartum haemorrhage, and perinatal infection than any other age group.

There are also inequities in perinatal related death rates by ethnicity and socioeconomic deprivation. Pacific and Indian mothers have the highest rates of perinatal related mortality.

There has been a statistically significant reduction in stillbirths at 28 to 31 weeks (p=0.009) and at term (37 to 40 weeks) (p=0.003). There has been no change in stillbirth rate or perinatal related death rate at 41 weeks and beyond, although there has been a reduction in numbers of deaths (20 stillbirths and 34 perinatal related deaths in 2007 and 14 and 20 in 2016). This is because there were 29 percent fewer births at 41 weeks and beyond in 2016 (8766) compared to 2007 (12,325), presumably due to changing patterns of induction of labour and elective caesarean section. (There were 7 percent fewer births overall in 2016 compared to 2007).

Māori and Pacific babies who die in the perinatal period remain less likely to have any investigation of their death than babies born to mothers of all other ethnic groupings (Table 4.35). A discussion on equity of access to perinatal investigations for Māori is included in a text box later in this chapter (see "Perinatal death investigations, counsel and considerations").

4.2 Perinatal Mortality Recommendations

1. Maternity and primary care providers need to be aware of the increasing risk of perinatal mortality for mothers under 20 years of age in New Zealand. Inequity in perinatal mortality for babies born to mothers under 20 years of age needs to be actively addressed.

The PMMRC recommends the Ministry of Health and DHBs:

a. develop, in consultation with young mothers, acceptable and safe methods for mothers under 20 years of age to access and engage with care in order to achieve equitable health outcomes

b. identify and adequately resource evidence-based solutions to address risks for mothers under 20 years of age, paying attention to smoking cessation, screening and treatment for infections, screening for fetal growth restriction, and providing adequate information about the causes and symptoms of preterm labour

c. consider how they can support LMCs caring for mothers aged under 20 years.

Justification

The number of mothers under 20 years of age has halved from 2007 to 2016, and in this time there has been a significant increase in perinatal related mortality in this group (p=0.0045).

Mothers under 20 years of age were less likely to birth their 23 to 26 week babies in a tertiary unit compared to mothers who were 20 years and older (Table 2.9).

Evidence

Support services do exist in New Zealand for teenage mothers; however, these have not impacted on perinatal death for these mothers.

Nationally, women under 20 years of age are less likely to register for LMC care in the first trimester than women from any other age group (Ministry of Health 2017b).

2. The PMMRC recommends that DHBs 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.

Justification

There is a statistically significantly higher perinatal related mortality rate than the national rate among residents of Counties Manukau DHB (Figure 4.12). This is significantly higher for both stillbirth (Figure 4.13) and neonatal death (Figure 4.14).

There is a statistically significantly higher perinatal related mortality and stillbirth rate than the national rate among residents of Northland DHB (Figure 4.12 and Figure 4.13).

There is a statistically significantly higher stillbirth rate than the national rate among residents of Wairarapa DHB (Figure 4.13).

There is a statistically significantly higher neonatal death rate than the national rate among residents of Bay of Plenty DHB (Figure 4.14).

Evidence

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

4.3 Methodology

In this 12th report of the PMMRC, the perinatal chapter includes a reduced selection of tables and figures compared to recent past reports. The limited commentary addresses new data presented in the chapter.

The methodology for the perinatal mortality report is included with the 'Methodology and Definitions for PMMRC Reporting' document on the PMMRC website (www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/3367/).

4.4 Findings

Perinatal mortality rates

Figure 4.1: Perinatal related mortality rates (per 1000 births) using New Zealand definitions 2007–2016

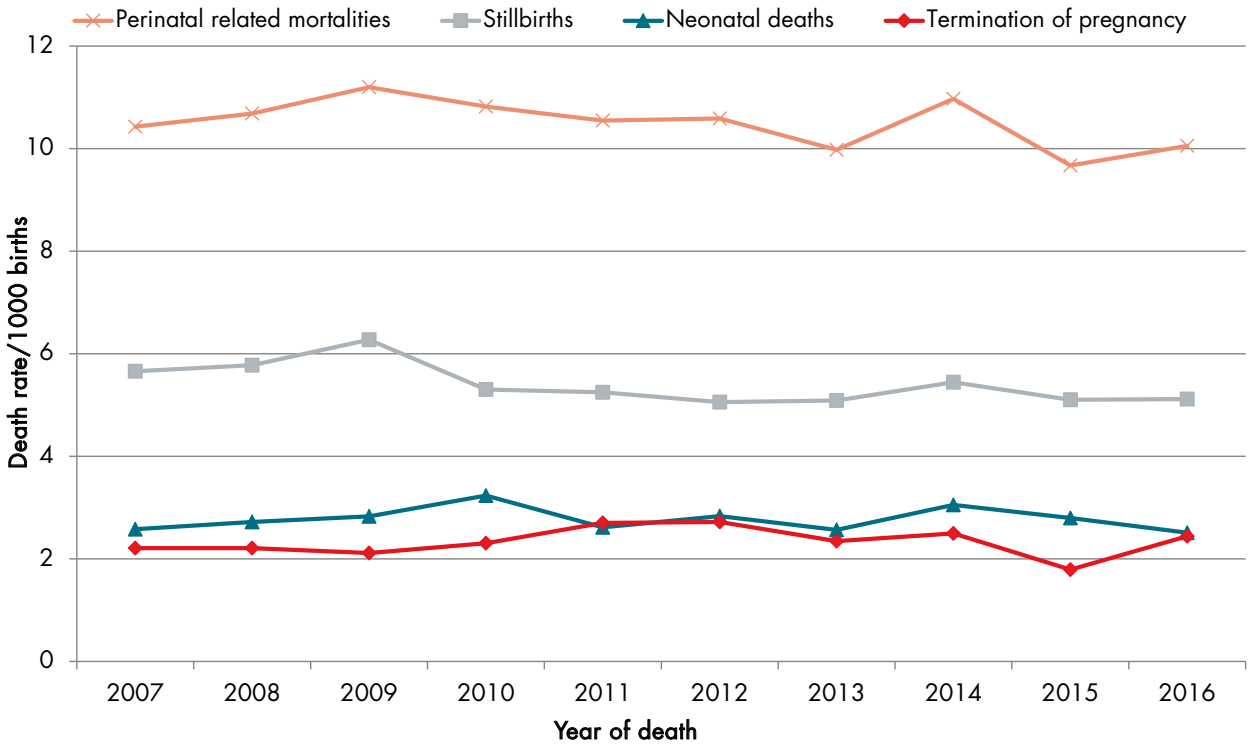


Figure 4.2: Perinatal related mortality rates (per 1000 births) using the international definition (≥1000g or ≥28 weeks if birthweight unknown) 2007–2016

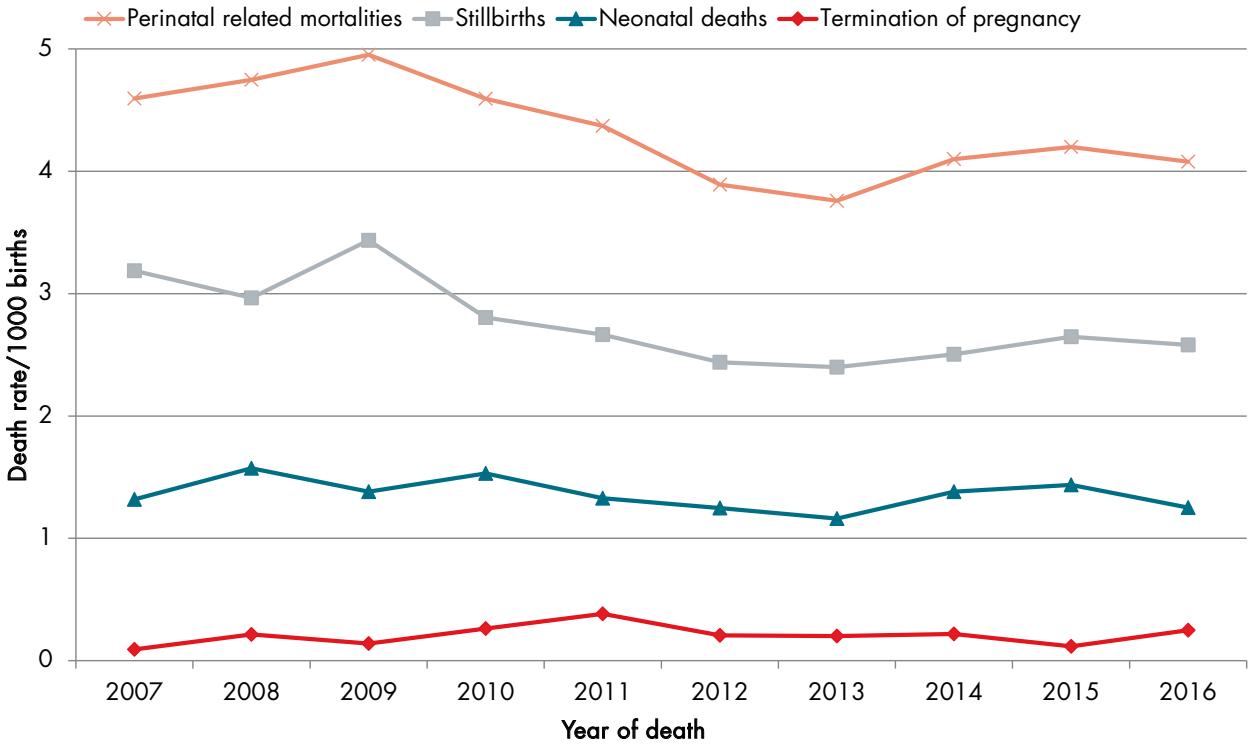


Table 4.1: Summary of New Zealand perinatal mortality rates using New Zealand definition (≥20 weeks or ≥400g if gestation unknown) 2007–2016

	n										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
Total births	65,202	65,624	65,198	65,445	63,236	63,274	60,133	60,073	59,768	60,576	
Fetal deaths (terminations of pregnancy and stillbirths)*	513	524	547	498	503	492	447	477	412	458~	0.037
Terminations of pregnancy	144	145	138	151	171	172	141	150	107	148	0.68
Stillbirths	369	379	409	347	332	320	306	327	305	310~	0.0053
Early neonatal deaths <7 days	133	134	137	165	139	142	122	150	131	121	0.71
Late neonatal deaths 7–27 days	34	43	46	45	25	36	31	32	35	30	0.26
Neonatal deaths <28 days#	167	177	183	210	164	178	153	182	166	151	0.86
Perinatal mortalities+	646	658	684	663	642	634	569	627	543	579~	0.097
Perinatal related mortalities^	680	701	730	708	667	670	600	659	578	609~	0.06
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	462	488	515	466	446	445	417	449	402	414	0.10
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	482	516	546	497	462	467	436	468	420	435	0.064

	Rate									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fetal deaths (terminations of pregnancy and stillbirths)*	7.9	8.0	8.4	7.6	8.0	7.8	7.4	7.9	6.9	7.6
Terminations of pregnancy	2.2	2.2	2.1	2.3	2.7	2.7	2.3	2.5	1.8	2.4
Stillbirths	5.7	5.8	6.3	5.3	5.3	5.1	5.1	5.4	5.1	5.1
Early neonatal deaths <7 days										
Late neonatal deaths 7–27 days										
Neonatal deaths <28 days#	2.6	2.7	2.8	3.2	2.6	2.8	2.6	3.1	2.8	2.5
Perinatal mortalities+	9.9	10.0	10.5	10.1	10.2	10.0	9.5	10.4	9.1	9.6
Perinatal related mortalities^	10.4	10.7	11.2	10.8	10.5	10.6	10.0	11.0	9.7	10.1
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	7.1	7.4	7.9	7.1	7.1	7.0	6.9	7.5	6.7	6.8
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	7.4	7.9	8.4	7.6	7.3	7.4	7.3	7.8	7.0	7.2

* Fetal death rate per 1000 babies born (includes terminations and stillbirths).
# Neonatal death rate per 1000 live born babies.
+ Fetal deaths and early neonatal deaths per 1000 babies born.
^ Fetal deaths and early and late neonatal deaths per 1000 babies born.
• Lethal and terminated fetal abnormalities are all perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality.
~ Included one late notification.

Table 4.2: New Zealand perinatal mortality rates (per 1000 births) using the international definition (≥1000g or ≥28 weeks if birthweight unknown) 2007–2016

	n										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
Total births	64,651	65,077	64,625	64,881	62,688	62,712	59,601	59,510	59,305	60,072	
Fetal deaths (terminations of pregnancy and stillbirths)*	212	207	231	199	191	166	155	162	164	170	0.00097
Terminations of pregnancy	6	14	9	17	24	13	12	13	7	15	0.43
Stillbirths	206	193	222	182	167	153	143	149	157	155	0.00028
Early neonatal deaths <7 days	57	67	59	68	65	54	45	59	57	53	0.61
Late neonatal deaths 7–27 days	28	35	30	31	18	24	24	23	28	22	0.28
Neonatal deaths <28 days#	85	102	89	99	83	78	69	82	85	75	0.30
Perinatal mortalities+	269	274	290	267	256	220	200	221	221	223	0.0018
Perinatal related mortalities^	297	309	320	298	274	244	224	244	249	245	0.00093
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	224	220	238	204	180	169	158	168	177	169	0.00024
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	238	240	254	221	189	179	170	178	188	182	0.000097

	Rate									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fetal deaths (terminations of pregnancy and stillbirths)*	3.3	3.2	3.6	3.1	3.0	2.6	2.6	2.7	2.8	2.8
Terminations of pregnancy	0.1	0.2	0.1	0.3	0.4	0.2	0.2	0.2	0.1	0.2
Stillbirths	3.2	3.0	3.4	2.8	2.7	2.4	2.4	2.5	2.6	2.6
Early neonatal deaths <7 days										
Late neonatal deaths 7–27 days										
Neonatal deaths <28 days#	1.3	1.6	1.4	1.5	1.3	1.2	1.2	1.4	1.4	1.3
Perinatal mortalities+	4.2	4.2	4.5	4.1	4.1	3.5	3.4	3.7	3.7	3.7
Perinatal related mortalities^	4.6	4.7	5.0	4.6	4.4	3.9	3.8	4.1	4.2	4.1
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	3.5	3.4	3.7	3.1	2.9	2.7	2.7	2.8	3.0	2.8
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	3.7	3.7	3.9	3.4	3.0	2.9	2.9	3.0	3.2	3.0

* 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.

Causes of perinatal related death

Table 4.3: Perinatal related deaths by perinatal death classification (PSANZ-PDC) 2016

Perinatal death classification (PSANZ-PDC)	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=148		n=309		n=151		n=608	
	n	%	n	%	n	%	n	%
Congenital abnormality	109	73.6	31	10.0	33	21.9	173	28.5
Perinatal infection	2	1.4	10	3.2	14	9.3	26	4.3
Hypertension	-	-	8	2.6	1	0.7	9	1.5
Antepartum haemorrhage	10	6.8	38	12.3	24	15.9	72	11.8
Maternal conditions	11	7.4	17	5.5	9	6.0	37	6.1
Specific perinatal conditions	4	2.7	53	17.2	12	7.9	69	11.3
Hypoxic peripartum death	-	-	4	1.3	9	6.0	13	2.1
Fetal growth restriction	4	2.7	33	10.7	4	2.6	41	6.7
Spontaneous preterm	8	5.4	25	8.1	39	25.8	72	11.8
Unexplained antepartum death	-	-	90	29.1	-	-	90	14.8
No obstetric antecedent	-	-	-	-	6	4.0	6	1.0

Table 4.4: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) using New Zealand definition 2007–2016

Perinatal death classification (PSANZ-PDC)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		Chi-square test for trend (p)
	N=65,202		N=65,624		N=65,198		N=65,445		N=63,236		N=63,274		N=60,133		N=60,073		N=59,768		N=60,576		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	197	3.02	185	2.82	182	2.79	211	3.22	203	3.21	201	3.18	160	2.66	189	3.15	158	2.64	173	2.86	0.52
Perinatal infection	29	0.44	28	0.43	25	0.38	28	0.43	21	0.33	19	0.30	20	0.33	24	0.40	22	0.37	26	0.43	0.56
Hypertension	19	0.29	22	0.34	29	0.44	27	0.41	21	0.33	19	0.30	13	0.22	13	0.22	21	0.35	9	0.15	0.022
Antepartum haemorrhage	64	0.98	66	1.01	79	1.21	78	1.19	78	1.23	60	0.95	75	1.25	69	1.15	79	1.32	72	1.19	0.14
Maternal conditions	27	0.41	23	0.35	38	0.58	32	0.49	26	0.41	36	0.57	34	0.57	39	0.65	29	0.49	37	0.61	0.035
Specific perinatal conditions	57	0.87	71	1.08	76	1.17	69	1.05	73	1.15	70	1.11	63	1.05	69	1.15	60	1.00	69	1.14	0.47
Hypoxic peripartum death	33	0.51	34	0.52	28	0.43	20	0.31	20	0.32	20	0.32	11	0.18	17	0.28	17	0.28	13	0.21	0.000052
Fetal growth restriction	48	0.74	62	0.94	53	0.81	48	0.73	44	0.70	49	0.77	48	0.80	36	0.60	33	0.55	41	0.68	0.039
Spontaneous preterm	99	1.52	94	1.43	110	1.69	113	1.73	85	1.34	102	1.61	80	1.33	106	1.76	65	1.09	72	1.19	0.036
Unexplained antepartum death	96	1.47	102	1.55	103	1.58	72	1.10	92	1.45	85	1.34	90	1.50	90	1.50	87	1.46	90	1.49	0.99
No obstetric antecedent	11	0.17	14	0.21	7	0.11	10	0.15	4	0.06	9	0.14	6	0.10	7	0.12	7	0.12	6	0.10	0.10

Table 4.5: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rate (per 1000 births) using international definition (≥1000g or ≥28 weeks if birthweight unknown) 2007–2016

Perinatal death classification (PSANZ-PDC)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		Chi-square test for trend (p)
	N=64,651		N=65,077		N=64,625		N=64,881		N=62,688		N=62,712		N=59,601		N=59,510		N=59,306		N=60,072		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	58	0.90	69	1.06	64	0.99	77	1.19	85	1.36	64	1.02	51	0.86	64	1.08	61	1.03	62	1.03	0.94
Perinatal infection	16	0.25	16	0.25	15	0.23	13	0.20	12	0.19	9	0.14	9	0.15	12	0.20	12	0.20	17	0.28	0.72
Hypertension	7	0.11	7	0.11	14	0.22	11	0.17	9	0.14	3	0.05	5	0.08	6	0.10	10	0.17	6	0.10	0.47
Antepartum haemorrhage	23	0.36	25	0.38	24	0.37	23	0.35	17	0.27	13	0.21	18	0.30	11	0.18	17	0.29	12	0.20	0.009
Maternal conditions	14	0.22	9	0.14	19	0.29	19	0.29	7	0.11	17	0.27	22	0.37	14	0.24	15	0.25	16	0.27	0.24
Specific perinatal conditions	29	0.45	23	0.35	32	0.50	30	0.46	32	0.51	21	0.33	24	0.40	25	0.42	32	0.54	27	0.45	0.71
Hypoxic peripartum death	33	0.51	34	0.52	28	0.43	20	0.31	20	0.32	20	0.32	11	0.18	17	0.29	17	0.29	13	0.22	0.000052
Fetal growth restriction	31	0.48	32	0.49	31	0.48	31	0.48	18	0.29	32	0.51	21	0.35	20	0.34	14	0.24	15	0.25	0.0011
Spontaneous preterm	9	0.14	7	0.11	10	0.15	19	0.29	9	0.14	10	0.16	5	0.08	9	0.15	14	0.24	8	0.13	0.81
Unexplained antepartum death	66	1.02	73	1.12	75	1.16	45	0.69	61	0.97	46	0.73	52	0.87	59	0.99	50	0.84	63	1.05	0.30
No obstetric antecedent	11	0.17	14	0.22	7	0.11	10	0.15	4	0.06	9	0.14	6	0.10	7	0.12	7	0.12	6	0.10	0.10

Table 4.6: Perinatal death classification (PSANZ-PDC) specific stillbirth rates (per 1000 births) 2007–2016

Perinatal death classification (PSANZ-PDC)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		Chi-square test for trend (p)
	N=65,202		N=65,624		N=65,198		N=65,445		N=63,236		N=63,274		N=60,133		N=60,073		N=59,768		N=60,576		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	35	0.54	28	0.43	30	0.46	37	0.57	27	0.43	35	0.55	22	0.37	34	0.57	25	0.42	31	0.51	0.89
Perinatal infection	21	0.32	15	0.23	16	0.25	17	0.26	10	0.16	9	0.14	10	0.17	12	0.20	12	0.20	10	0.17	0.039
Hypertension	13	0.20	12	0.18	24	0.37	18	0.28	12	0.19	9	0.14	8	0.13	9	0.15	16	0.27	8	0.13	0.13
Antepartum haemorrhage	46	0.71	49	0.75	53	0.81	46	0.70	48	0.76	31	0.49	44	0.73	33	0.55	46	0.77	38	0.63	0.28
Maternal conditions	20	0.31	13	0.20	26	0.40	23	0.35	13	0.21	19	0.30	22	0.37	21	0.35	22	0.37	17	0.28	0.51
Specific perinatal condition	38	0.58	53	0.81	60	0.92	45	0.69	51	0.81	42	0.66	39	0.65	43	0.72	42	0.70	53	0.87	0.76
Hypoxic peripartum death	18	0.28	15	0.23	11	0.17	7	0.11	9	0.14	11	0.17	3	0.05	7	0.12	9	0.15	4	0.07	0.0013
Fetal growth restriction	43	0.66	53	0.81	44	0.67	39	0.60	37	0.59	42	0.66	44	0.73	33	0.55	27	0.45	33	0.54	0.045
Spontaneous preterm	39	0.60	39	0.59	42	0.64	43	0.66	33	0.52	37	0.58	24	0.40	45	0.75	19	0.32	25	0.41	0.027
Unexplained antepartum death	96	1.47	102	1.55	103	1.58	72	1.10	92	1.45	85	1.34	90	1.50	90	1.50	87	1.46	90	1.49	0.99

Table 4.7: Neonatal death classification (PSANZ-NDC) specific neonatal death rates (per 1000 live births) 2007–2016

Neonatal death classification (PSANZ-NDC)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		Chi-square test for trend (p)
	N=64,689		N=65,100		N=64,651		N=64,947		N=62,733		N=62,782		N=59,686		N=59,596		N=59,356		N=60,119		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Congenital abnormality	38	0.59	43	0.66	43	0.67	46	0.71	50	0.80	38	0.61	32	0.54	44	0.74	45	0.76	34	0.57	0.93
Extreme prematurity	57	0.88	52	0.80	58	0.90	84	1.29	54	0.86	67	1.07	63	1.06	69	1.16	51	0.86	53	0.88	0.57
Cardio-respiratory disorders	11	0.17	11	0.17	11	0.17	18	0.28	11	0.18	14	0.22	6	0.10	16	0.27	16	0.27	11	0.18	0.42
Infection	14	0.22	21	0.32	12	0.19	19	0.29	15	0.24	17	0.27	12	0.20	15	0.25	7	0.12	14	0.23	0.29
Neurological	31	0.48	33	0.51	40	0.62	28	0.43	23	0.37	25	0.40	25	0.42	24	0.40	31	0.52	24	0.40	0.26
Gastrointestinal	2	0.03	-	-	8	0.12	5	0.08	2	0.03	3	0.05	1	0.02	3	0.05	2	0.03	5	0.08	0.73
Other	14	0.22	17	0.26	11	0.17	10	0.15	9	0.14	14	0.22	14	0.23	11	0.18	14	0.24	10	0.17	0.81

Maternal age

Figure 4.3: Perinatal related mortality rates (per 1000 births) by maternal age (with 95% CIs) 2012–2016

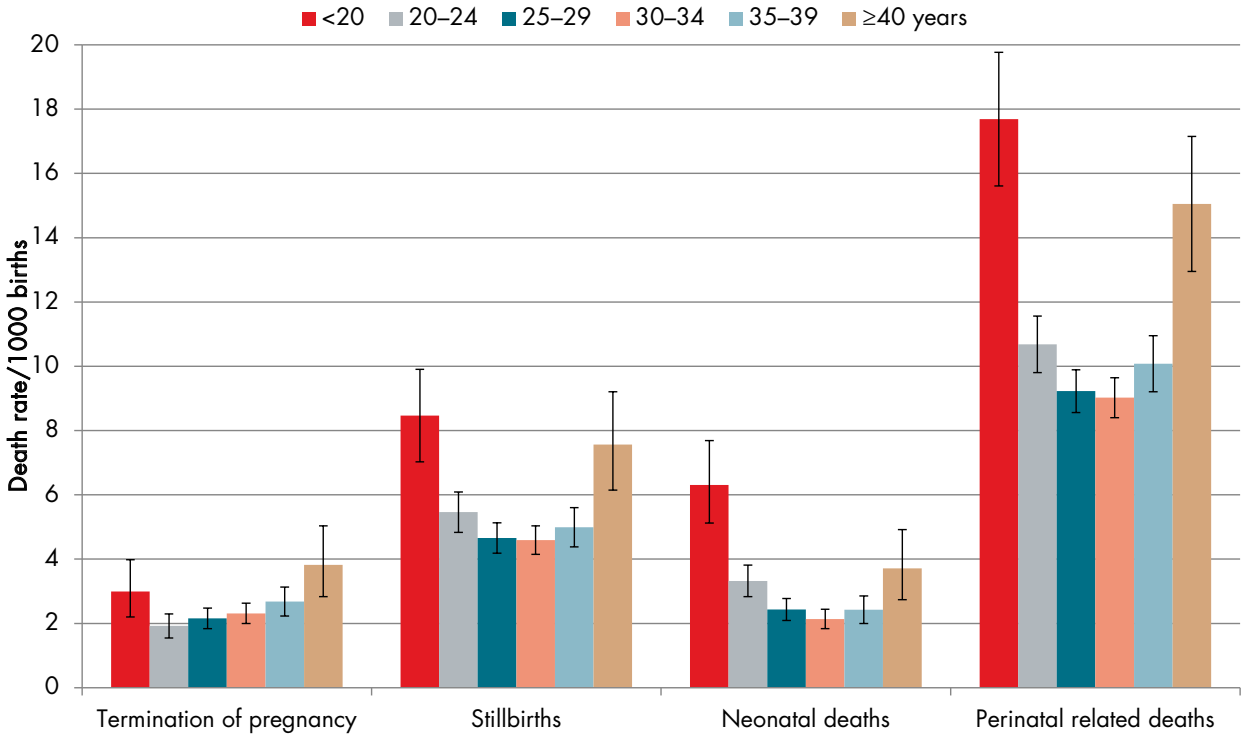


Table 4.8: Perinatal related mortality rates (per 1000 births) by maternal age 2012–2016

Maternal age (years)	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=303,824		n=718			n=1,567			n=830			n=3,115		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<20	15,713	5.2	47	6.5	2.99	133	8.5	8.46	98	11.8	6.31	278	8.9	17.69
20–24	53,090	17.5	102	14.2	1.92	290	18.5	5.46	175	21.1	3.32	567	18.2	10.68
25–29	80,748	26.6	174	24.2	2.15	376	24.0	4.66	195	23.5	2.43	745	23.9	9.23
30–34	89,996	29.6	208	29.0	2.31	413	26.4	4.59	191	23.0	2.14	812	26.1	9.02
35–39	51,095	16.8	137	19.1	2.68	255	16.3	4.99	123	14.8	2.43	515	16.5	10.08
≥40	13,087	4.3	50	7.0	3.82	99	6.3	7.56	48	5.8	3.71	197	6.3	15.05
Unknown	95	0.0	-	-	-	1	0.1	-	-	-	-	1	0.0	-

Table 4.9: Perinatal related mortality rate (per 1000 births) by maternal age and year 2007–2016

Maternal age (years)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
<20	61	5,118	85	5,336	80	4,911	57	4,625	65	4,127	63	3,968	65	3,381	51	3,046	45	2,828	54	2,490
20–24	140	11,371	133	11,871	142	12,085	164	12,258	116	11,938	126	11,695	115	11,005	116	10,478	86	10,137	124	9,775
25–29	161	15,819	153	15,901	169	16,004	162	16,308	147	15,865	149	16,264	139	15,599	165	16,012	150	15,990	142	16,883
30–34	163	18,626	169	18,015	169	17,838	149	18,100	160	17,607	163	17,852	147	17,134	175	17,981	158	18,292	169	18,737
35–39	124	11,777	125	11,974	138	11,764	136	11,396	145	11,024	119	10,671	89	10,314	111	9,937	107	9,977	89	10,196
≥40	31	2,463	35	2,504	32	2,567	40	2,730	34	2,650	50	2,805	45	2,679	40	2,598	32	2,524	30	2,481
Unknown	-	28	1	23	-	29	-	28	-	25	-	19	-	21	1	21	-	20	-	14

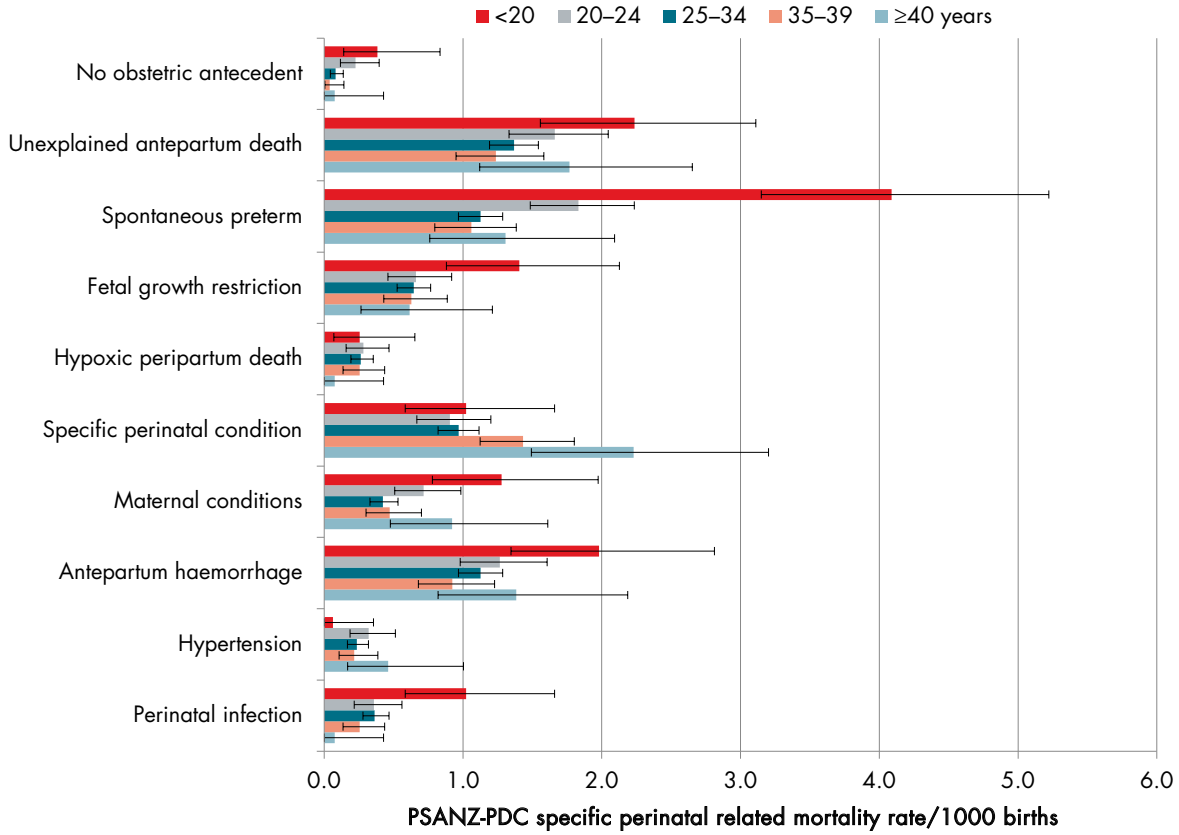
Maternal age (years)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	
<20	11.9	15.9	16.3	12.3	15.7	15.9	19.2	16.7	15.9	21.7	0.0046
20–24	12.3	11.2	11.8	13.4	9.7	10.8	10.4	11.1	8.5	12.7	0.12
25–29	10.2	9.6	10.6	9.9	9.3	9.2	8.9	10.3	9.4	8.4	0.11
30–34	8.8	9.4	9.5	8.2	9.1	9.1	8.6	9.7	8.6	9.0	0.98
35–39	10.5	10.4	11.7	11.9	13.2	11.2	8.6	11.2	10.7	8.7	0.13
≥40	12.6	14.0	12.5	14.7	12.8	17.8	16.8	15.4	12.7	12.1	0.75

Table 4.10: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding congenital anomaly) by maternal age 2012–2016

Perinatal death classification (PSANZ-PDC)	Maternal age (years)														
	<20			20–24			25–34			35–39			≥40		
	N=15,652			N=52,963			N=170,324			N=50,917			N=13,008		
	N	%	Rate	N	%	Rate	N	%	Rate	N	%	Rate	N	%	Rate
Perinatal infection	16	7.4	1.02	19	4.4	0.36	62	5.5	0.36	13	3.9	0.26	1	0.9	0.08
Hypertension	1	0.5	0.06	17	3.9	0.32	40	3.6	0.23	11	3.3	0.22	6	5.2	0.46
Antepartum haemorrhage	31	14.4	1.98	67	15.4	1.27	192	17.1	1.13	47	14.2	0.92	18	15.5	1.38
Maternal conditions	20	9.3	1.28	38	8.7	0.72	72	6.4	0.42	24	7.2	0.47	12	10.3	0.92
Specific perinatal condition	16	7.4	1.02	48	11.0	0.91	165	14.7	0.97	73	22.0	1.43	29	25.0	2.23
Hypoxic peripartum death	4	1.9	0.26	15	3.4	0.28	45	4.0	0.26	13	3.9	0.26	1	0.9	0.08
Fetal growth restriction	22	10.2	1.41	35	8.0	0.66	110	9.8	0.65	32	9.6	0.63	8	6.9	0.62
Spontaneous preterm*	64	29.8	4.09	97	22.2	1.83	192	17.1	1.13	54	16.3	1.06	17	14.7	1.31
Unexplained antepartum death	35	16.3	2.24	88	20.2	1.66	233	20.7	1.37	63	19.0	1.24	23	19.8	1.77
No obstetric antecedent	6	2.8	0.38	12	2.8	0.23	14	1.2	0.08	2	0.6	0.04	1	0.9	0.08

* Excludes one maternal age missing.

Figure 4.4: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding congenital anomaly) by maternal age (with 95% CIs) 2012–2016



The number of mothers under 20 years of age has halved from 2007 to 2016, but in this time there has been a significant increase in perinatal related mortality in this group (chi-square test for trend p=0.005).

Mothers under 20 years of age are at higher risk of perinatal related death (excluding congenital anomalies) from spontaneous preterm birth, fetal growth restriction, antepartum haemorrhage, and perinatal infection than any other age group (Figure 4.4).

When women under 20 years of age who gave birth in 2015–2016 were compared to women under 20 who gave birth in 2008–2009, women under 20 who gave birth in 2015–2016 were more often 19 years old than under 19 than in the earlier period (44.2 percent cf 38.9 percent); more often in deprivation quintile 5 (most deprived) (51.4 percent cf 46 percent); more often Māori (61.3 percent cf 56.6 percent), Pacific (13.7 percent cf 12.9 percent), or MELAA (0.9 percent cf 0.6 percent), and less often European (22.8 percent cf 28.4 percent) or Other Asian (0.9 percent cf 1.1 percent) ethnic groupings; more often had a BMI of 30 or higher (21.7 percent cf 14.3 percent), but were less often smokers (34.3 percent cf 36.1 percent); and more likely to have registered with an LMC in the first trimester (53.5 percent cf 35.4 percent) (Table 4.11).

Table 4.11: Demographic characteristics by time period (2008–2009 and 2015–2016) among mothers <20 years of age

	Births 2008–2009		Births 2015–2016		Chi-square test (p)
	N=10,247		N=5,318		
	n	%	n	%	
Termination of pregnancy (/1000 births)	20	2.0	14	2.6	0.39
Stillbirth (/1000 births)	89	8.7	41	7.7	0.53
Neonatal death (/1000 live births)	48	4.7	35	6.6	0.13
Age (years)					
<16	383	3.7	185	3.5	
16	885	8.6	406	7.6	
17	1,944	19.0	864	16.2	
18	3,048	29.7	1,511	28.4	
19	3,987	38.9	2,352	44.2	<0.001
Deprivation quintile					
1 (least deprived)	488	4.8	224	4.2	
2	852	8.3	407	7.7	
3	1,438	14.0	650	12.2	
4	2,631	25.7	1,263	23.7	
5 (most deprived)	4,718	46.0	2,732	51.4	<0.001
Missing	120	1.2	42	0.8	
Ethnicity (maternal)					
Māori	5,800	56.6	3,258	61.3	
Pacific peoples	1,326	12.9	729	13.7	
Indian	41	0.4	25	0.5	
Other Asian	109	1.1	47	0.9	
MELAA	61	0.6	47	0.9	
Other European	252	2.5	110	2.1	
NZ European	2,652	25.9	1,102	20.7	<0.001
Other/Unknown	6	0.1	-	-	
Limited to mothers who were registered for care with an LMC*	**N=7,677**		**N=4,773**		
Smoking at registration with LMC					
Yes	2,823	36.8	1,654	34.7	
No	4,849	63.2	3,119	65.3	0.015
Missing	5	0.1	-	-	
BMI at registration (kg/m^2)					
<18.50	337	4.4	159	3.3	
18.50-24.99	4,175	54.4	2,207	46.2	
25.00-29.99	2,041	26.6	1,365	28.6	
30.00-34.99	751	9.8	701	14.7	
35.00-39.99	250	3.3	238	5.0	
≥40.00	93	1.2	96	2.0	<0.001
Unknown	30	0.4	7	0.1	
First registration with LMC					
First trimester	2,719	35.4	2,552	53.5	
Second trimester	4,279	55.7	1,877	39.3	
Third trimester	626	8.2	310	6.5	
Postpartum	52	0.7	34	0.7	<0.001
Missing	1	0.0	-	-	

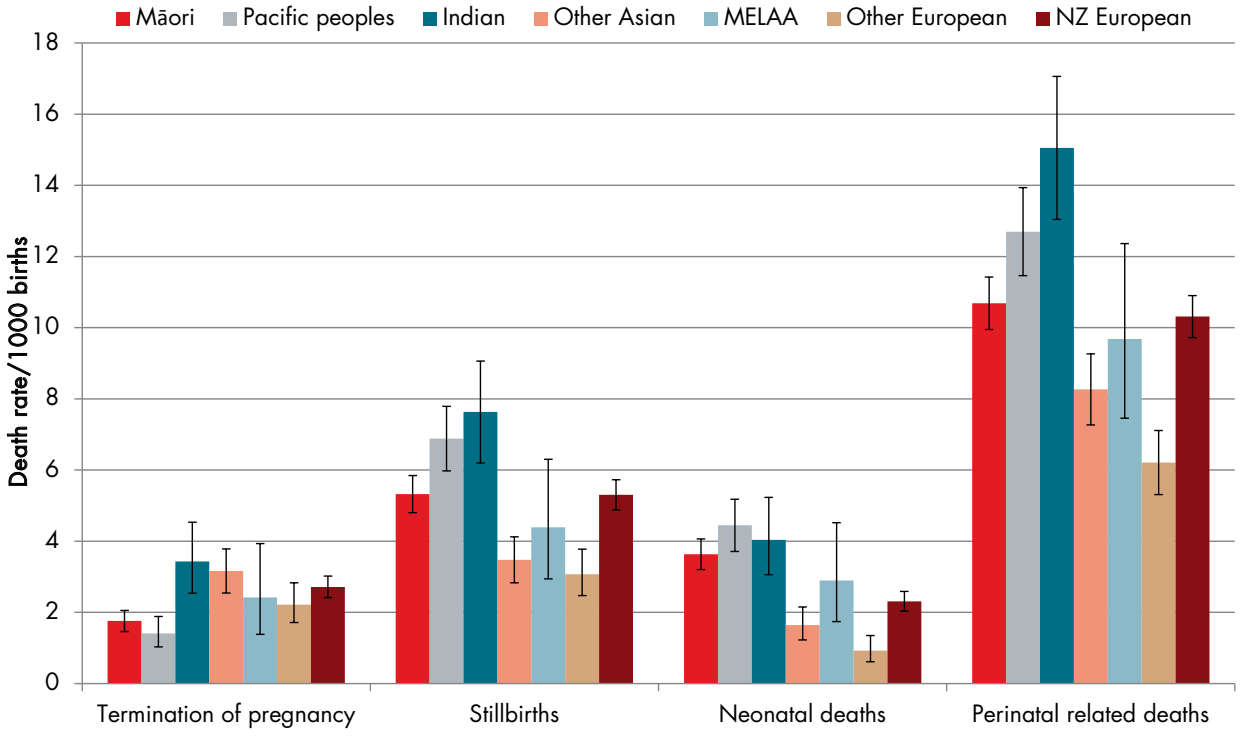
* LMC (either a midwife, Obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice
MELAA = Middle Eastern, Latin American or African

Table 4.12: Perinatal death classification (PSANZ-PDC) by time period (2008–2009 and 2015–2016) among babies of mothers <20 years of age

Perinatal death classification (PSANZ-PDC)	2008–2009 n=157		2015–2016 n=90		Chi-square test (p)
	n	%	n	%	
Congenital abnormality	33	21.0	22	24.4	
Perinatal infection	10	6.4	5	5.6	
Hypertension	1	0.6	1	1.1	
Antepartum haemorrhage	19	12.1	10	11.1	
Maternal conditions	5	3.2	9	10.0	
Specific perinatal conditions	10	6.4	2	2.2	
Hypoxic peripartum death	9	5.7	3	3.3	
Fetal growth restriction	17	10.8	5	5.6	
Spontaneous preterm birth	30	19.1	21	23.3	
Unexplained antepartum death	21	13.4	12	13.3	
No obstetric antecedent	2	1.3	-	-	0.33

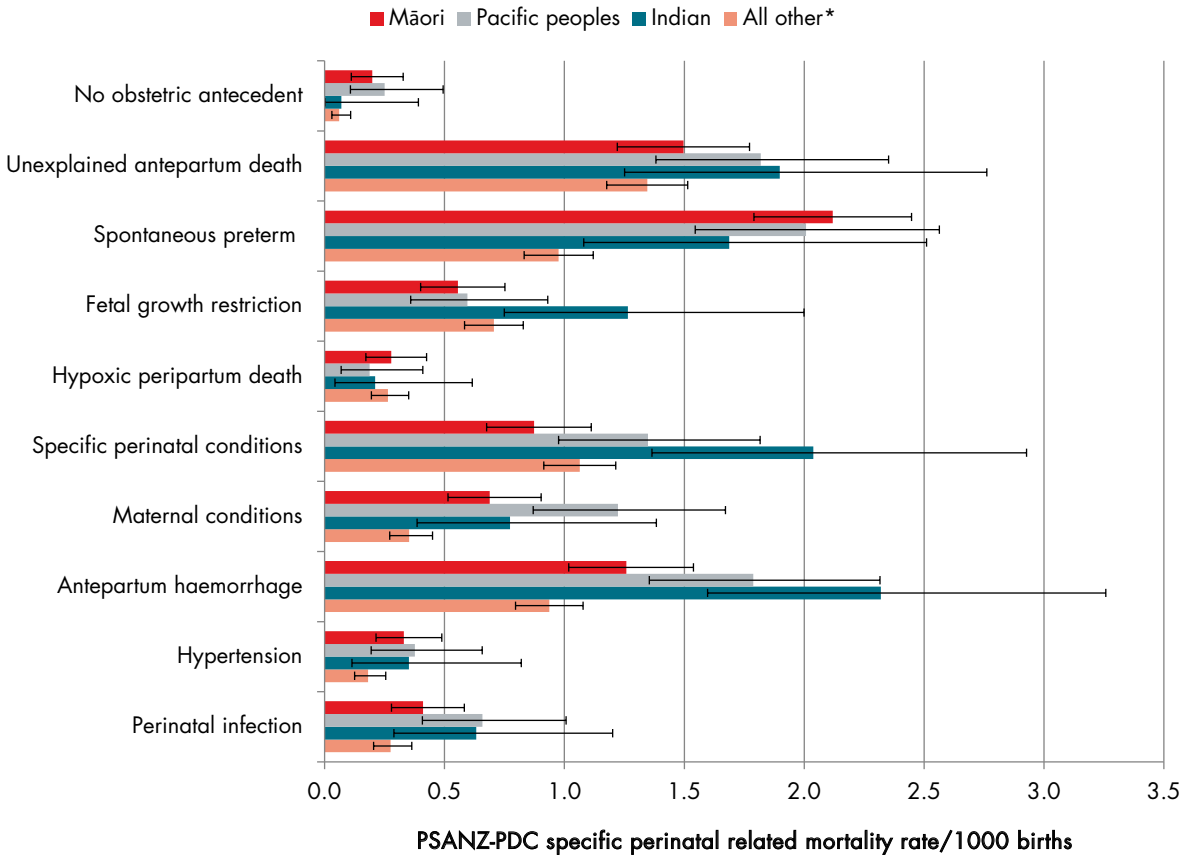
Maternal ethnicity

Figure 4.5: Perinatal related mortality rates (per 1000 births) by maternal prioritised ethnicity (with 95% CIs) 2012–2016



MELAA = Middle Eastern, Latin American or African

Figure 4.6: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding congenital anomaly) by maternal prioritised ethnicity 2012–2016



* 'All other' includes Other Asian; Middle Eastern, Latin American or African (MELAA); Other European; New Zealand European; Unknown/Other.

Table 4.13: Perinatal related mortality rates (per 1000 births) by maternal prioritised ethnicity 2012–2016

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=303,824		n=718			n=1,567			n=830			n=3,115		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	75,703	24.9	133	18.5	1.76	403	25.7	5.32	273	32.9	3.63	809	26.0	10.69
Pacific peoples	31,967	10.5	45	6.3	1.41	220	14.0	6.88	141	17.0	4.45	406	13.0	12.70
Indian	14,282	4.7	49	6.8	3.43	109	7.0	7.63	57	6.9	4.04	215	6.9	15.05
Other Asian	31,932	10.5	101	14.1	3.16	111	7.1	3.48	52	6.3	1.64	264	8.5	8.27
MELAA	6,611	2.2	16	2.2	2.42	29	1.9	4.39	19	2.3	2.89	64	2.1	9.68
Other European	29,308	9.6	65	9.1	2.22	90	5.7	3.07	27	3.3	0.93	182	5.8	6.21
NZ European	113,843	37.5	309	43.0	2.71	604	38.5	5.31	261	31.4	2.31	1,174	37.7	10.31
Unknown/Other	178	0.1	-	-	-	1	0.1	5.62	-	-	-	1	0.0	5.62

MELAA = Middle Eastern, Latin American or African

Table 4.14: Perinatal related mortality rate (per 1000 births) by maternal prioritised ethnicity and year 2007–2016

Maternal ethnicity	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
Māori	179	16,895	170	17,109	209	16,972	193	16,841	176	16,283	163	16,105	156	14,974	166	14,634	143	14,888	181	15,102
Pacific peoples	87	7,994	98	7,832	106	7,555	109	7,645	79	7,236	94	7,060	84	6,507	83	6,278	71	6,175	74	5,947
Indian	25	1,841	30	1,916	33	1,940	34	2,083	35	2,174	38	2,384	37	2,464	45	2,782	43	3,138	52	3,514
Other Asian	36	4,105	39	4,193	42	4,478	54	4,947	51	5,083	62	6,215	46	5,792	50	6,569	53	6,194	53	7,162
MELAA	17	1,019	12	1,121	12	1,205	5	1,319	13	1,309	16	1,266	10	1,309	15	1,295	15	1,353	8	1,388
NZ European	300	27,251	312	27,144	292	26,765	271	26,337	263	25,073	250	24,324	230	23,170	262	22,568	224	22,147	208	21,634
Other European	36	6,046	40	6,238	36	6,228	41	6,231	50	6,019	47	5,878	37	5,874	37	5,902	29	5,848	32	5,806
Unknown/Other	-	51	-	71	-	55	1	42	-	59	-	42	-	43	1	45	-	25	-	23

Maternal ethnicity	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	
Māori	10.6	9.9	12.3	11.5	10.8	10.1	10.4	11.3	9.6	12.0	0.92
Pacific peoples	10.9	12.5	14.0	14.3	10.9	13.3	12.9	13.2	11.5	12.4	0.89
Indian	13.6	15.7	17.0	16.3	16.1	15.9	15.0	16.2	13.7	14.8	0.71
Other Asian	8.8	9.3	9.4	10.9	10.0	10.0	7.9	7.6	8.6	7.4	0.08
MELAA	16.7	10.7	10.0	3.8	9.9	12.6	7.6	11.6	11.1	5.8	0.21
NZ European	11.0	11.5	10.9	10.3	10.5	10.3	9.9	11.6	10.1	9.6	0.09
Other European	6.0	6.4	5.8	6.6	8.3	8.0	6.3	6.3	5.0	5.5	0.51

MELAA = Middle Eastern, Latin American or African

Table 4.15: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding congenital abnormality) by maternal prioritised ethnicity 2012–2016

Perinatal death classification (PSANZ-PDC)	Māori			Pacific peoples			Indian			Other Asian			MELAA			Other European			NZ European		
	N=75,514			N=31,885			N=14,227			N=31,828			N=6,593			N=29,215			N=113,519		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Perinatal infection	31	5.0	0.41	21	6.4	0.66	9	5.6	0.63	8	5.3	0.25	1	2.1	0.15	5	4.6	0.17	36	4.4	0.32
Hypertension	25	4.0	0.33	12	3.7	0.38	5	3.1	0.35	4	2.7	0.13	2	4.3	0.30	2	1.8	0.07	25	3.1	0.22
Antepartum haemorrhage	95	15.3	1.26	57	17.4	1.79	33	20.6	2.32	25	16.7	0.79	7	14.9	1.06	13	11.9	0.44	125	15.4	1.10
Maternal conditions	52	8.4	0.69	39	11.9	1.22	11	6.9	0.77	8	5.3	0.25	4	8.5	0.61	4	3.7	0.14	48	5.9	0.42
Specific perinatal conditions	66	10.6	0.87	43	13.1	1.35	29	18.1	2.04	25	16.7	0.79	8	17.0	1.21	25	22.9	0.86	135	16.6	1.19
Hypoxic peripartum death	21	3.4	0.28	6	1.8	0.19	3	1.9	0.21	2	1.3	0.06	2	4.3	0.30	3	2.8	0.10	41	5.1	0.36
Fetal growth restriction	42	6.8	0.56	19	5.8	0.60	18	11.3	1.27	16	10.7	0.50	1	2.1	0.15	14	12.8	0.48	97	12.0	0.85
Spontaneous preterm*	160	25.8	2.12	64	19.6	2.01	24	15.0	1.69	21	14.0	0.66	10	21.3	1.52	16	14.7	0.55	129	15.9	1.14
Unexplained antepartum death	113	18.2	1.50	58	17.7	1.82	27	16.9	1.90	40	26.7	1.26	12	25.5	1.82	27	24.8	0.92	165	20.3	1.45
No obstetric antecedent	15	2.4	0.20	8	2.4	0.25	1	0.6	0.07	1	0.7	0.03	-	-	-	-	-	-	10	1.2	0.09

* 1 spontaneous preterm = unknown/other ethnicity
MELAA = Middle Eastern, Latin American or African

Socioeconomic deprivation

Figure 4.7: Perinatal related mortality rates (per 1000 births) by deprivation quintile (with 95% CIs) 2012–2016

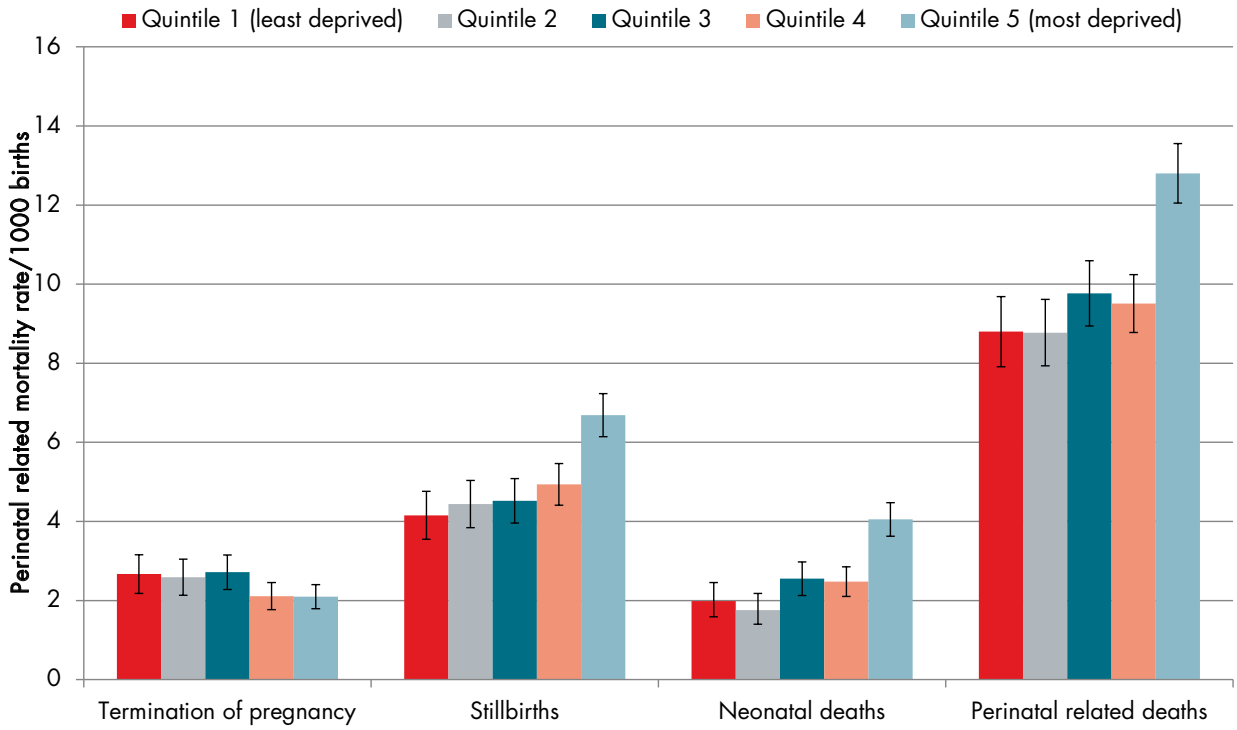


Table 4.16: Perinatal related mortality rates (per 1000 births) by deprivation quintile 2012–2016

Deprivation quintile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=303,824		n=718			n=1,567			n=830			n=3,115		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	43,073	14.2	115	16.0	2.67	179	11.4	4.16	85	10.2	1.99	379	12.2	8.80
2	47,523	15.6	123	17.1	2.59	211	13.5	4.44	83	10.0	1.76	417	13.4	8.77
3	54,870	18.1	149	20.8	2.72	248	15.8	4.52	139	16.7	2.55	536	17.2	9.77
4	68,668	22.6	145	20.2	2.11	339	21.6	4.94	169	20.4	2.48	653	21.0	9.51
5 (most deprived)	87,177	28.7	183	25.5	2.10	583	37.2	6.69	350	42.2	4.05	1,116	35.8	12.80
Unknown	2,513	0.8	3	0.4	-	7	0.4	-	4	0.5	-	14	0.4	-

Figure 4.8: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding congenital anomaly) by deprivation quintile (with 95% CIs) 2012–2016

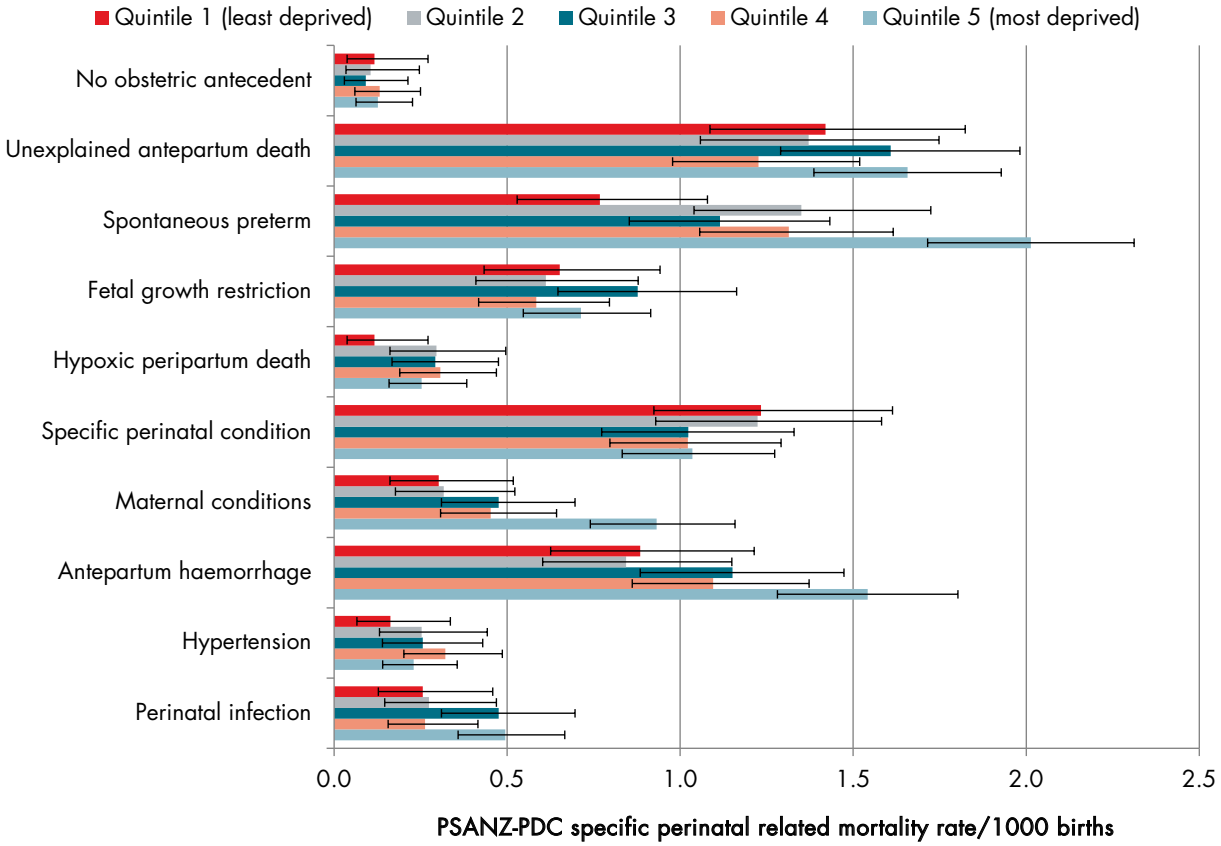


Table 4.17: Perinatal related mortality rate (per 1000 births) by deprivation quintile and year 2007–2016

Deprivation quintile	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
1 (least deprived)	72	9,124	97	8,782	75	9,098	79	9,034	103	8,827	80	8,976	61	8,312	93	8,599	75	8,366	70	8,820
2	93	9,566	87	9,545	107	9,536	105	9,778	99	9,558	89	9,537	77	9,386	77	9,330	83	9,477	91	9,793
3	131	11,419	134	12,057	119	12,097	118	12,169	116	11,694	106	11,775	124	10,796	118	10,705	89	10,738	99	10,856
4	172	15,628	142	15,395	179	15,182	154	15,198	153	14,801	140	14,721	113	13,567	138	13,473	137	13,435	125	13,472
5 (most deprived)	210	18,805	236	19,120	249	18,607	251	18,652	195	17,781	253	17,754	222	17,558	229	17,429	190	17,247	222	17,189
Unknown	2	660	5	725	1	678	1	614	1	575	2	511	3	514	4	537	4	505	1	446

Deprivation quintile	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	
1 (least deprived)	7.9	11.0	8.2	8.7	11.7	8.9	7.3	10.8	9.0	7.9	0.68
2	9.7	9.1	11.2	10.7	10.4	9.3	8.2	8.3	8.8	9.3	0.10
3	11.5	11.1	9.8	9.7	9.9	9.0	11.5	11.0	8.3	9.1	0.074
4	11.0	9.2	11.8	10.1	10.3	9.5	8.3	10.2	10.2	9.3	0.13
5 (most deprived)	11.2	12.3	13.4	13.5	11.0	14.3	12.6	13.1	11.0	12.9	0.66

Table 4.18: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1000 births) (excluding congenital anomaly) by deprivation quintile* 2012–2016

Perinatal death classification (PSANZ-PDC)	Quintile 1 (least deprived) N=42,961			Quintile 2 N=47,396			Quintile 3 N=54,710			Quintile 4 N=68,483			Quintile 5 (most deprived) N=86,906		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Perinatal infection	11	4.3	0.26	13	4.1	0.27	26	6.5	0.48	18	3.9	0.26	43	5.5	0.49
Hypertension	7	2.8	0.16	12	3.8	0.25	14	3.5	0.26	22	4.8	0.32	20	2.6	0.23
Antepartum haemorrhage	38	15.0	0.88	40	12.7	0.84	63	15.6	1.15	75	16.3	1.10	134	17.1	1.54
Maternal conditions	13	5.1	0.30	15	4.8	0.32	26	6.5	0.48	31	6.7	0.45	81	10.4	0.93
Specific perinatal condition	53	20.9	1.23	58	18.4	1.22	56	13.9	1.02	70	15.2	1.02	90	11.5	1.04
Hypoxic peripartum death	5	2.0	0.12	14	4.4	0.30	16	4.0	0.29	21	4.6	0.31	22	2.8	0.25
Fetal growth restriction	28	11.0	0.65	29	9.2	0.61	48	11.9	0.88	40	8.7	0.58	62	7.9	0.71
Spontaneous preterm	33	13.0	0.77	64	20.3	1.35	61	15.1	1.11	90	19.6	1.31	175	22.4	2.01
Unexplained antepartum death	61	24.0	1.42	65	20.6	1.37	88	21.8	1.61	84	18.3	1.23	144	18.4	1.66
No obstetric antecedent	5	2.0	0.12	5	1.6	0.11	5	1.2	0.09	9	2.0	0.13	11	1.4	0.13

* Excludes 11 unknown deprivation quintile.

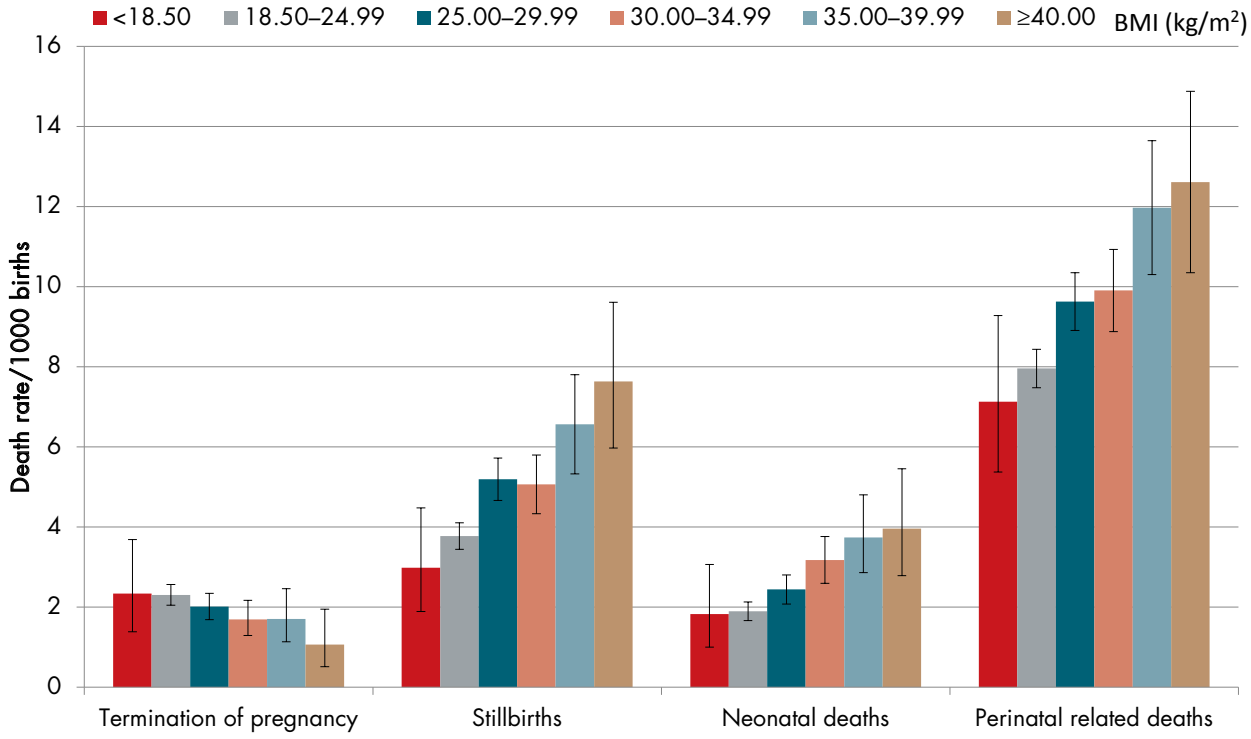
Body mass index

Table 4.19: Perinatal related mortality rates (per 1000 births) by maternal body mass index (BMI) at registration with maternity care* 2012–2016

Maternal BMI (kg/m²)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=274,141		n=566			n=1,260			n=649			n=2,475		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<18.50	7,714	2.8	18	3.2	2.33	23	1.8	2.98	14	2.2	1.82	55	2.2	7.13
18.50–24.99	132,842	48.5	306	54.1	2.30	501	39.8	3.77	250	38.5	1.89	1,057	42.7	7.96
25.00–29.99	71,054	25.9	143	25.3	2.01	369	29.3	5.19	172	26.5	2.44	684	27.6	9.63
30.00–34.99	36,145	13.2	61	10.8	1.69	183	14.5	5.06	114	17.6	3.18	358	14.5	9.90
35.00–39.99	16,455	6.0	28	4.9	1.70	108	8.6	6.56	61	9.4	3.74	197	8.0	11.97
≥40	9,435	3.4	10	1.8	1.06	72	5.7	7.63	37	5.7	3.96	119	4.8	12.61
Unknown	496	0.2	-	-	-	4	0.3	-	1	0.2	-	5	0.2	-

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

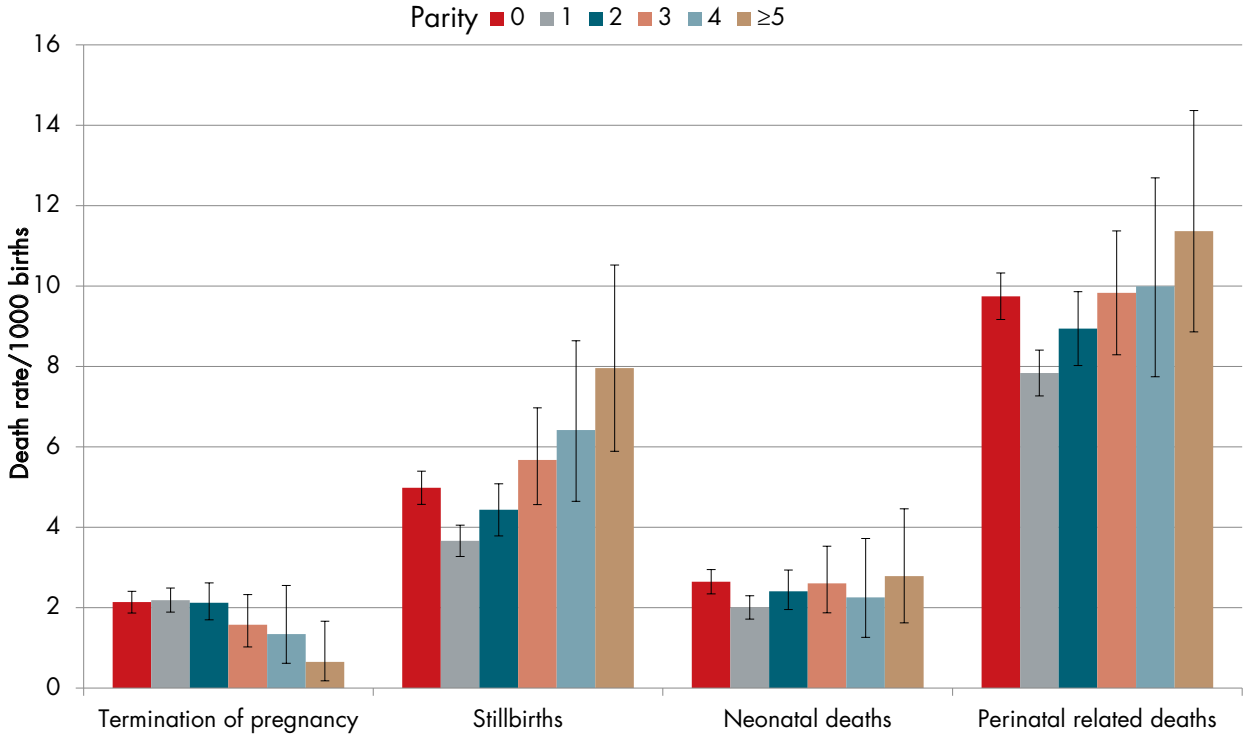
Figure 4.9: Perinatal related mortality rates (per 1000 births) by maternal body mass index (BMI)* (with 95% CIs) 2012–2016



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Parity

Figure 4.10: Perinatal related mortality rates (per 1000 births) by maternal parity* (with 95% CIs) 2012–2016



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

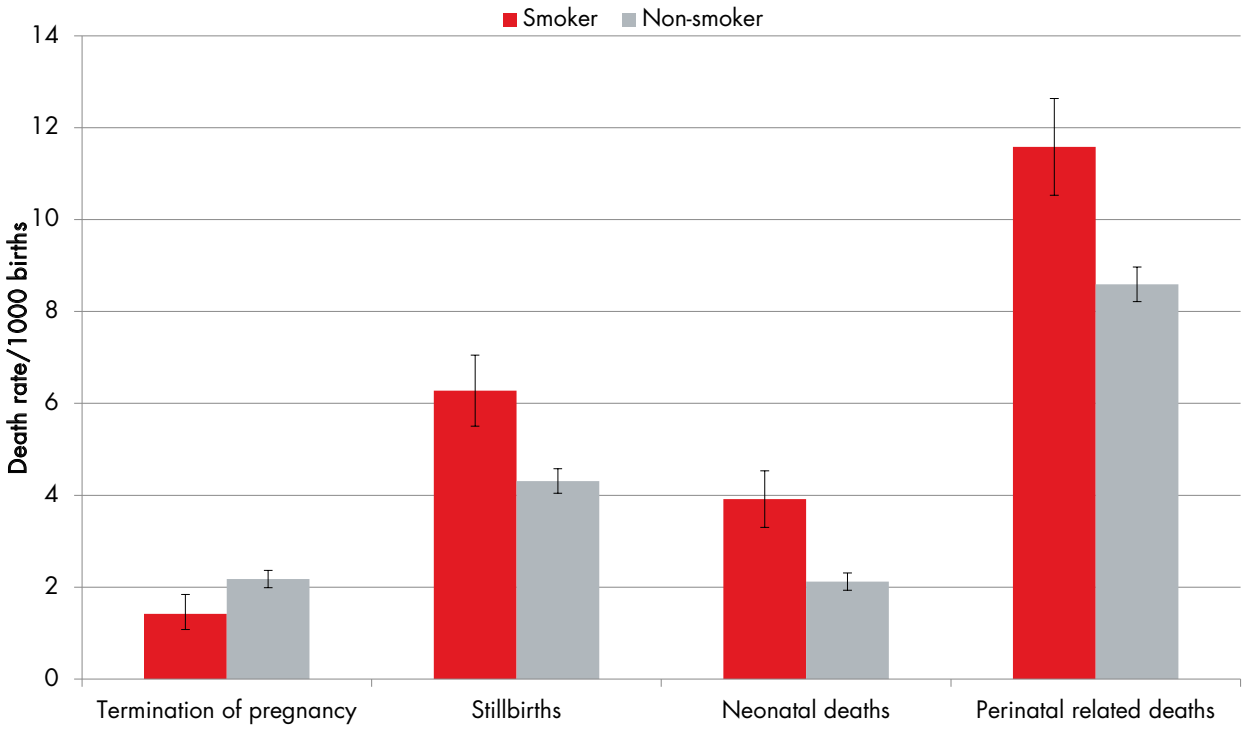
Table 4.20: Perinatal related mortality rates (per 1000 births) by parity 2012–2016*

Parity	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=274,141		n=566			n=1,260			n=649			n=2,475		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
0	112,359	41.0	240	42.4	2.14	560	44.4	4.98	295	45.5	2.64	1,095	44.2	9.75
1	92,366	33.7	202	35.7	2.19	338	26.8	3.66	184	28.4	2.00	724	29.3	7.84
2	40,593	14.8	86	15.2	2.12	180	14.3	4.43	97	14.9	2.41	363	14.7	8.94
3	15,869	5.8	25	4.4	1.58	90	7.1	5.67	41	6.3	2.60	156	6.3	9.83
4	6,703	2.4	9	1.6	1.34	43	3.4	6.42	15	2.3	2.26	67	2.7	10.00
≥5	6,157	2.2	4	0.7	0.65	49	3.9	7.96	17	2.6	2.79	70	2.8	11.37
Unknown	94	0.0	-	-	-	-	-	-	-	-	-	-	-	-

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Maternal smoking

Figure 4.11: Perinatal related mortality rates (per 1000 births) by smoking at registration with maternity care* (with 95% CIs) 2012–2016



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Table 4.21: Perinatal related mortality rates (per 1000 births) by smoking at registration with maternity care* 2012–2016

Maternal smoking at registration	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=274,141		n=566			n=1,260			n=649			n=2,475		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Smoker	40,143	14.6	57	10.1	1.42	252	20.0	6.28	156	24.0	3.92	465	18.8	11.58
Non-smoker	233,917	85.3	509	89.9	2.18	1,008	80.0	4.31	493	76.0	2.12	2,010	81.2	8.59
Unknown	81	0.0	-	-	-	-	-	-	-	-	-	-	-	-

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

DHB of residence

Figure 4.12: Unadjusted perinatal related mortality rates (per 1000 births) by DHB of residence (mother) compared to average perinatal related mortality (with 95% CIs) 2012–2016

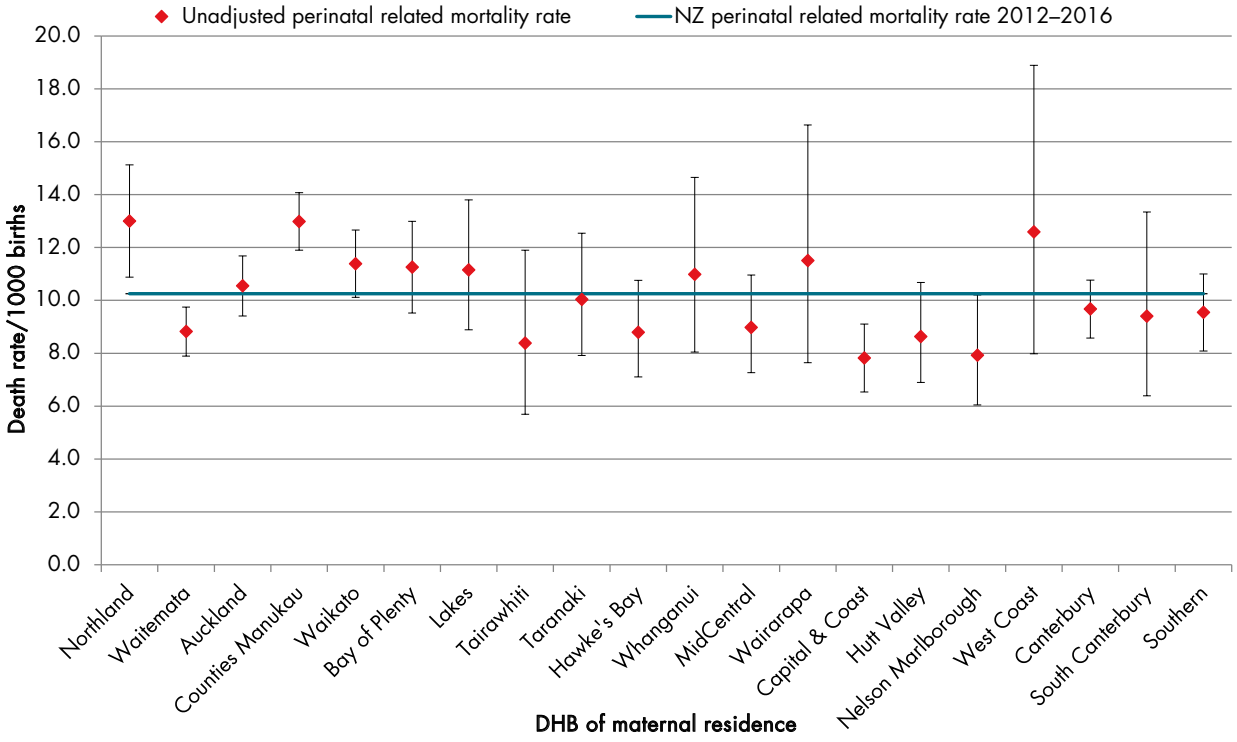


Figure 4.13: Unadjusted stillbirth rates (per 1000 births) by DHB of residence (mother) compared to average stillbirth rates (with 95% CIs) 2012–2016

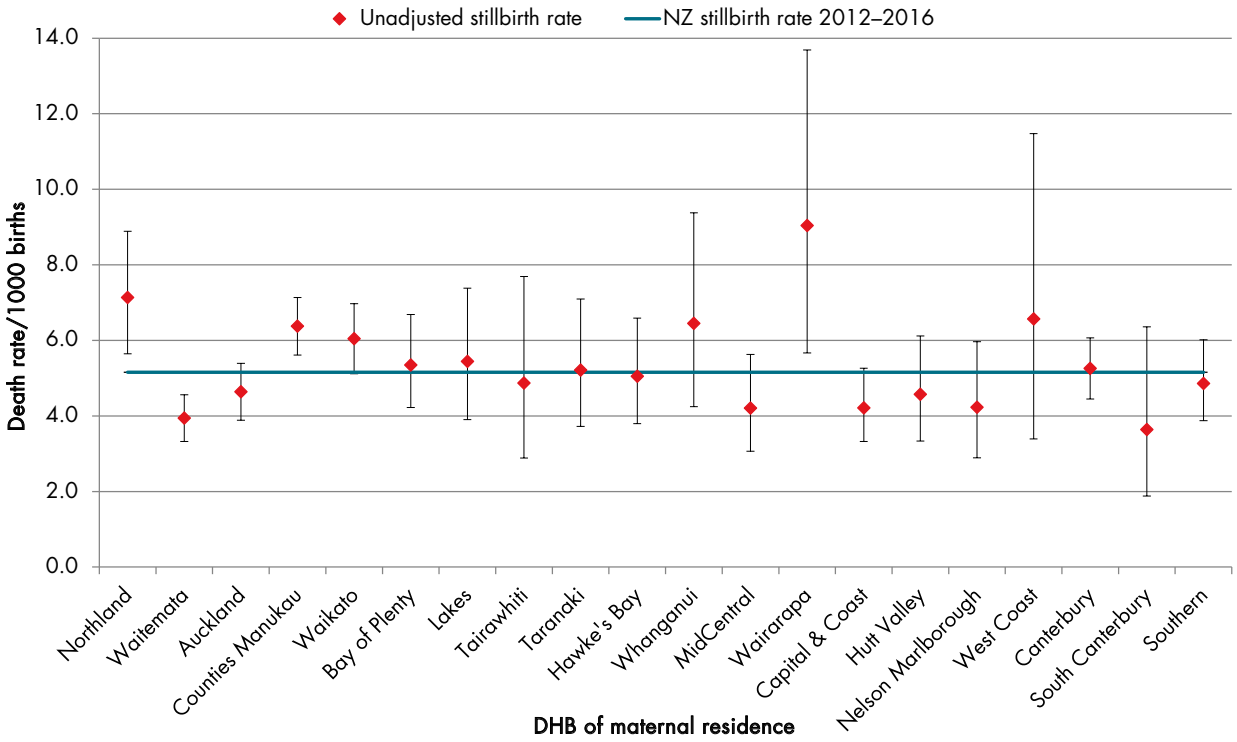


Figure 4.14: Unadjusted neonatal mortality rates (per 1000 live births) by DHB of residence (mother) compared to average neonatal mortality (with 95% CIs) 2012–2016

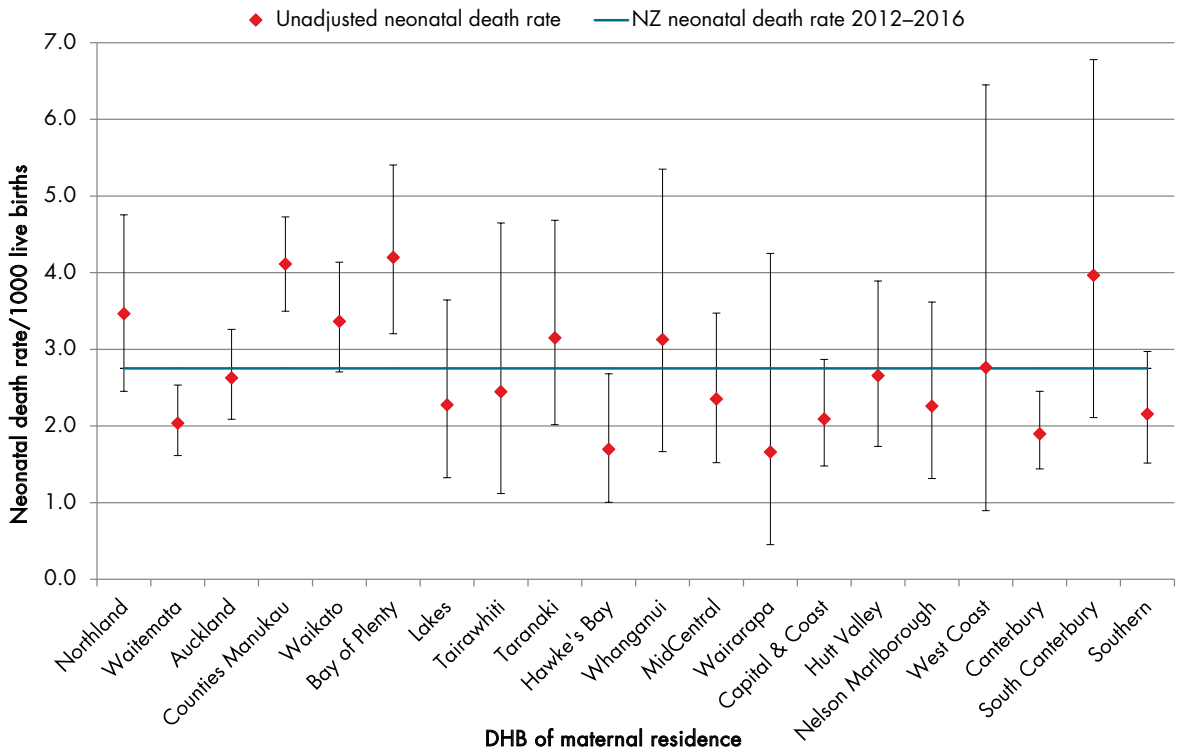


Table 4.22: Perinatal related mortality rates (per 1000 births) by DHB of maternal residence 2016

DHB of maternal residence	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=60,576		n=148			n=309			n=151			n=608		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	2,294	3.8	7	4.7	3.05	17	5.5	7.41	8	5.3	3.52	32	5.3	13.95
Waitemata	8,055	13.3	17	11.5	2.11	35	11.3	4.35	16	10.6	2.00	68	11.2	8.44
Auckland	5,975	9.9	19	12.8	3.18	31	10.0	5.19	11	7.3	1.86	61	10.0	10.21
Counties Manukau	8,355	13.8	27	18.2	3.23	51	16.5	6.10	40	26.5	4.83	118	19.4	14.12
Waikato	5,426	9.0	18	12.2	3.32	39	12.6	7.19	16	10.6	2.98	73	12.0	13.45
Bay of Plenty	2,934	4.8	5	3.4	1.70	13	4.2	4.43	15	9.9	5.14	33	5.4	11.25
Lakes	1,570	2.6	4	2.7	2.55	11	3.6	7.01	-	-	-	15	2.5	9.55
Tairawhiti	794	1.3	-	-	-	4	1.3	5.04	-	-	-	4	0.7	5.04
Taranaki	1,456	2.4	5	3.4	3.43	9	2.9	6.18	2	1.3	1.39	16	2.6	10.99
Hawke's Bay	2,091	3.5	1	0.7	0.48	9	2.9	4.30	2	1.3	0.96	12	2.0	5.74
Whanganui	816	1.3	2	1.4	2.45	5	1.6	6.13	3	2.0	3.71	10	1.6	12.25
MidCentral	2,113	3.5	3	2.0	1.42	11	3.6	5.21	6	4.0	2.86	20	3.3	9.47
Wairarapa	465	0.8	-	-	-	5	1.6	10.75	-	-	-	5	0.8	10.75
Capital & Coast	3,505	5.8	2	1.4	0.57	15	4.9	4.28	7	4.6	2.01	24	3.9	6.85
Hutt Valley	1,996	3.3	2	1.4	1.00	3	1.0	1.50	7	4.6	3.52	12	2.0	6.01
Nelson Marlborough	1,559	2.6	1	0.7	0.64	3	1.0	1.92	-	-	-	4	0.7	2.57
West Coast	320	0.5	2	1.4	6.25	4	1.3	12.50	-	-	-	6	1.0	18.75
Canterbury	6,388	10.5	13	8.8	2.04	30	9.7	4.70	11	7.3	1.73	54	8.9	8.45
South Canterbury	661	1.1	2	1.4	3.03	2	0.6	3.03	2	1.3	3.04	6	1.0	9.08
Southern	3,370	5.6	18	12.2	5.34	11	3.6	3.26	5	3.3	1.50	34	5.6	10.09
Other*	433	0.7	-	-	-	1	0.3	-	-	-	-	1	0.2	-

* Other includes Overseas, Unknown and Other.

Table 4.23: Perinatal related mortality rates (per 1000 births) by DHB of maternal residence 2012–2016

DHB of maternal residence	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=303,824		n=718			n=1,567			n=830			n=3,115		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	11,076	3.6	27	3.8	2.44	79	5.0	7.13	38	4.6	3.46	144	4.6	13.00
Waitemata	39,569	13.0	113	15.7	2.86	156	10.0	3.94	80	9.6	2.04	349	11.2	8.82
Auckland	31,476	10.4	104	14.5	3.30	146	9.3	4.64	82	9.9	2.63	332	10.7	10.55
Counties Manukau	42,201	13.9	107	14.9	2.54	269	17.2	6.37	172	20.7	4.11	548	17.6	12.99
Waikato	26,961	8.9	54	7.5	2.00	163	10.4	6.05	90	10.8	3.37	307	9.9	11.39
Bay of Plenty	14,392	4.7	25	3.5	1.74	77	4.9	5.35	60	7.2	4.20	162	5.2	11.26
Lakes	7,535	2.5	26	3.6	3.45	41	2.6	5.44	17	2.0	2.28	84	2.7	11.15
Tairawhiti	3,698	1.2	4	0.6	1.08	18	1.1	4.87	9	1.1	2.45	31	1.0	8.38
Taranaki	7,675	2.5	13	1.8	1.69	40	2.6	5.21	24	2.9	3.15	77	2.5	10.03
Hawke's Bay	10,690	3.5	22	3.1	2.06	54	3.4	5.05	18	2.2	1.70	94	3.0	8.79
Whanganui	4,188	1.4	6	0.8	1.43	27	1.7	6.45	13	1.6	3.13	46	1.5	10.98
MidCentral	10,699	3.5	26	3.6	2.43	45	2.9	4.21	25	3.0	2.35	96	3.1	8.97
Wairarapa	2,433	0.8	2	0.3	0.82	22	1.4	9.04	4	0.5	1.66	28	0.9	11.51
Capital & Coast	18,286	6.0	28	3.9	1.53	77	4.9	4.21	38	4.6	2.09	143	4.6	7.82
Hutt Valley	9,845	3.2	14	1.9	1.42	45	2.9	4.57	26	3.1	2.66	85	2.7	8.63
Nelson Marlborough	7,569	2.5	11	1.5	1.45	32	2.0	4.23	17	2.0	2.26	60	1.9	7.93
West Coast	1,827	0.6	6	0.8	3.28	12	0.8	6.57	5	0.6	2.76	23	0.7	12.59
Canterbury	30,810	10.1	78	10.9	2.53	162	10.3	5.26	58	7.0	1.90	298	9.6	9.67
South Canterbury	3,297	1.1	6	0.8	1.82	12	0.8	3.64	13	1.6	3.96	31	1.0	9.40
Southern	17,291	5.7	44	6.1	2.54	84	5.4	4.86	37	4.5	2.16	165	5.3	9.54
Other*	2,306	0.8	2	0.3	-	6	0.4	-	4	0.5	-	12	0.4	-

* Other includes Overseas, Unknown and Other.

Gestation and birthweight and perinatal related mortality

Perinatal related mortality risk (Figure 4.15), as a proportion of ongoing pregnancies (women who are still pregnant) at a specified gestation, is highest at the extremes of the perinatal period. Figure 4.15 shows that 27 to 32 weeks gestation is the time of lowest risk for perinatal related mortality for women who are still pregnant at that time, while the risk of perinatal related mortality is higher among women pregnant at 20 to 22 weeks and then rises to the highest risk among women still pregnant at 41 weeks. The number of women who are pregnant at each gestation (the denominator) obviously changes throughout and is the lowest at 41 weeks.

Figure 4.15: Perinatal related mortality risk (per 1000 ongoing pregnancies) by gestational age at birth and year 2008–2016

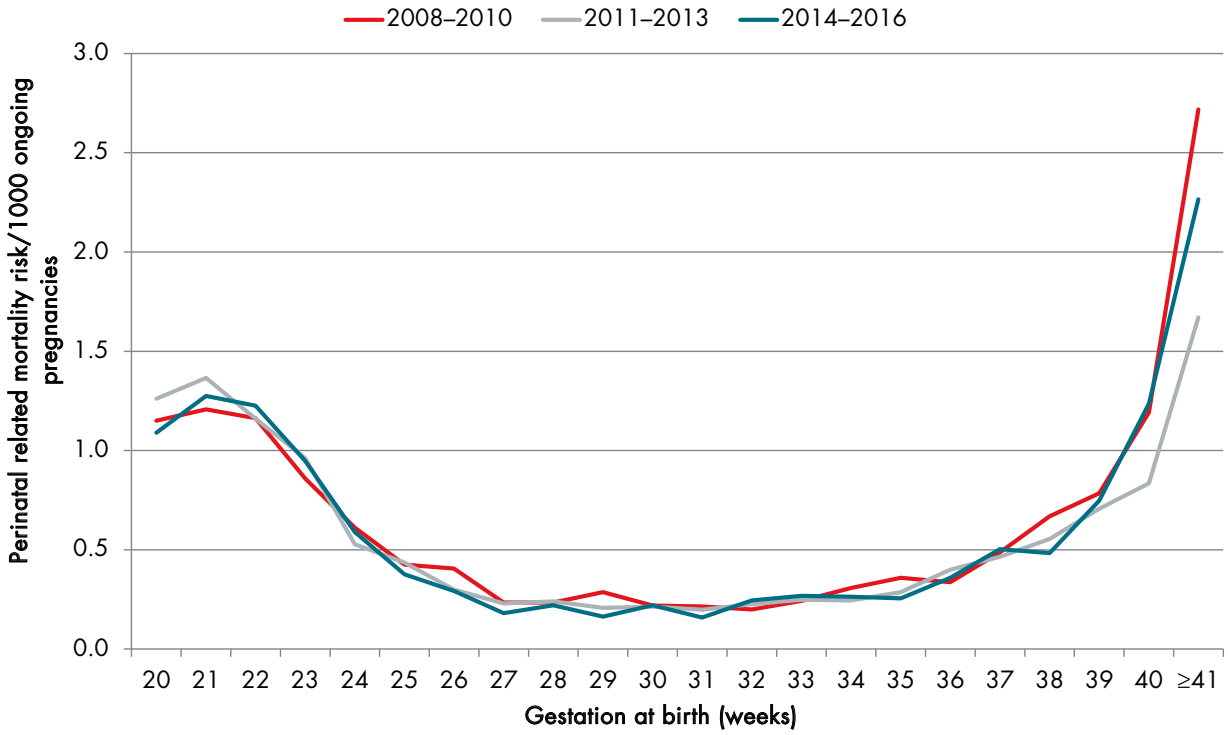


Table 4.24: Perinatal related mortality rates (per 1000 births) by gestation and birthweight 2016

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=60,576		n=148			n=309			n=151			n=608		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gestation at birth (weeks)														
20–22	205	0.3	87	58.8	*	83	26.9	*	44	29.1	*	214	35.2	*
23–24	125	0.2	32	21.6	256.00	29	9.4	232.00	23	15.2	359.38	84	13.8	672.00
25–27	185	0.3	13	8.8	70.27	26	8.4	140.54	11	7.3	75.34	50	8.2	270.27
28–31	477	0.8	14	9.5	29.35	22	7.1	46.12	12	7.9	27.21	48	7.9	100.63
32–36	3,793	6.3	2	1.4	0.53	60	19.4	15.82	16	10.6	4.29	78	12.8	20.56
37–40	46,429	76.6	-	-	-	75	24.3	1.62	39	25.8	0.84	114	18.8	2.46
≥41	8,766	14.5	-	-	-	14	4.5	1.60	6	4.0	0.69	20	3.3	2.28
Unknown	596	1.0	-	-	-	-	-	-	-	-	-	-	-	-
Birthweight (g)														
<500	198	0.3	65	43.9	*	111	35.9	*	29	19.2	*	205	33.7	*
500–999	303	0.5	62	41.9	204.62	43	13.9	141.91	46	30.5	232.32	151	24.8	498.35
1000–1499	359	0.6	9	6.1	25.07	20	6.5	55.71	7	4.6	21.21	36	5.9	100.28
1500–1999	710	1.2	4	2.7	5.63	17	5.5	23.94	13	8.6	18.87	34	5.6	47.89
2000–2499	2,209	3.6	2	1.4	0.91	25	8.1	11.32	13	8.6	5.96	40	6.6	18.11
2500–2999	8,218	13.6	-	-	-	33	10.7	4.02	12	7.9	1.47	45	7.4	5.48
3000–3499	19,487	32.2	-	-	-	40	12.9	2.05	10	6.6	0.51	50	8.2	2.57
3500–3999	17,978	29.7	-	-	-	11	3.6	0.61	16	10.6	0.89	27	4.4	1.50
4000–4499	6,628	10.9	-	-	-	4	1.3	0.60	3	2.0	0.45	7	1.2	1.06
≥4500	1,326	2.2	-	-	-	3	1.0	2.26	-	-	-	3	0.5	2.26
Unknown	3,160	5.2	6	4.1	-	2	0.6	-	2	1.3	-	10	1.6	-

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

Table 4.25: Perinatal related mortality risk (per 1000 ongoing pregnancies) 2007–2016

	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
Gestation at birth (weeks)																				
20–22	204	217	207	218	210	216	231	248	230	235	231	247	215	217	245	253	169	175	205	214
23–24	117	81	131	98	137	105	122	81	128	95	119	94	123	85	137	98	117	92	125	84
25–27	232	64	241	62	237	70	228	73	186	52	218	70	191	55	183	49	206	52	185	50
28–31	530	57	558	65	539	66	559	52	511	58	502	50	470	49	460	46	457	41	477	48
32–36	3,843	88	3,959	80	3,974	90	4,003	101	3,908	87	3,924	73	3,723	91	3,724	85	3,643	78	3,793	78
37–38	12,853	65	13,011	59	13,139	78	13,609	62	13,174	64	13,430	65	13,384	38	13,665	56	13,587	42	14,435	59
39–40	34,362	73	34,707	82	34,619	72	34,590	65	33,876	59	33,551	51	32,184	51	32,142	60	32,101	69	31,994	55
≥41	12,325	34	11,663	37	11,739	32	11,543	26	10,727	17	10,321	20	9,478	14	9,090	12	9,065	29	8,766	20
Unknown	736	1	1,147	-	604	1	560	-	496	-	978	-	365	-	427	-	423	-	596	-

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	
Gestation at birth (weeks)											
20–22	3.37	3.38	3.34	3.82	3.75	3.96	3.63	4.24	2.95	3.57	0.47
23–24	1.26	1.52	1.63	1.25	1.52	1.51	1.43	1.65	1.55	1.41	0.44
25–27	1.00	0.97	1.09	1.13	0.83	1.13	0.93	0.83	0.88	0.84	0.11
28–31	0.89	1.02	1.03	0.81	0.93	0.81	0.83	0.78	0.70	0.81	0.044
32–36	1.39	1.26	1.42	1.58	1.41	1.19	1.55	1.45	1.34	1.32	0.93
37–38	1.09	0.99	1.31	1.04	1.11	1.13	0.69	1.02	0.77	1.07	0.082
39–40	1.56	1.77	1.55	1.41	1.32	1.16	1.22	1.46	1.68	1.35	0.23
≥41	2.76	3.17	2.73	2.25	1.58	1.94	1.48	1.32	3.20	2.28	0.082

Table 4.26: Termination of pregnancy rate (per 1000 ongoing pregnancies) 2007–2016

Gestation at birth (weeks)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
Termination of pregnancies																				
20–22	204	103	207	94	210	88	231	92	230	107	231	118	215	83	245	91	169	66	205	87
23–24	117	22	131	25	137	31	122	20	128	29	119	32	123	32	137	31	117	27	125	32
25–27	232	10	241	14	237	9	228	20	186	15	218	14	191	16	183	10	206	8	185	13
28–31	530	6	558	7	539	4	559	6	511	11	502	5	470	5	460	7	457	3	477	14
≥32	63,383	3	63,340	5	63,471	6	63,745	13	61,685	9	61,226	3	58,769	5	58,621	11	58,396	3	58,988	2
Unknown	736	-	1,147	-	604	-	560	-	496	-	978	-	365	-	427	-	423	-	596	-

Gestation at birth (weeks)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	
Termination of pregnancies											
20–22	1.60	1.46	1.36	1.42	1.71	1.89	1.39	1.53	1.11	1.45	0.34
23–24	0.34	0.39	0.48	0.31	0.46	0.52	0.54	0.52	0.46	0.54	0.042
25–27	0.16	0.22	0.14	0.31	0.24	0.23	0.27	0.17	0.14	0.22	0.98
28–31	0.09	0.11	0.06	0.09	0.18	0.08	0.08	0.12	0.05	0.24	0.18
≥32	0.05	0.08	0.09	0.20	0.15	0.05	0.09	0.19	0.05	0.03	0.7

Table 4.27: Stillbirth risk (per 1000 ongoing pregnancies) 2007–2016

Gestation at birth (weeks)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
Stillbirths																				
20–22	204	79	207	95	210	88	231	94	230	90	231	85	215	88	245	110	169	73	205	83
23–24	117	25	131	40	137	43	122	31	128	37	119	28	123	29	137	28	117	32	125	29
25–27	232	39	241	34	237	39	228	32	186	24	218	36	191	25	183	25	206	31	185	26
28–31	530	43	558	38	539	48	559	32	511	34	502	30	470	32	460	31	457	29	477	22
32–36	3,843	64	3,959	54	3,974	60	4,003	66	3,908	55	3,924	54	3,723	63	3,724	58	3,643	48	3,793	60
37–40	47,215	98	47,718	99	47,758	111	48,199	78	47,050	83	46,981	78	45,568	60	45,807	72	45,688	72	46,429	75
≥41	12,325	20	11,663	19	11,739	19	11,543	14	10,727	9	10,321	9	9,478	9	9,090	3	9,065	20	8,766	14
Unknown	736	1	1,147	-	604	1	560	-	496	-	978	-	365	-	427	-	423	-	596	-

Gestation at birth (weeks)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	
Stillbirths											
20–22	1.23	1.47	1.36	1.45	1.43	1.36	1.47	1.84	1.23	1.38	0.43
23–24	0.39	0.62	0.67	0.48	0.59	0.45	0.49	0.47	0.54	0.49	0.63
25–27	0.61	0.53	0.61	0.50	0.38	0.58	0.42	0.42	0.52	0.44	0.12
28–31	0.67	0.59	0.75	0.50	0.55	0.49	0.54	0.52	0.49	0.37	0.0086
32–36	1.01	0.85	0.95	1.04	0.89	0.88	1.07	0.99	0.82	1.02	0.94
37–40	1.65	1.67	1.87	1.31	1.44	1.36	1.09	1.31	1.31	1.36	0.0028
≥41	1.62	1.63	1.62	1.21	0.84	0.87	0.95	0.33	2.21	1.60	0.44

Table 4.28: Neonatal death risk (per 1000 ongoing pregnancies) 2007–2016

Gestation at birth (weeks)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
Neonatal deaths																				
20–22	22	35	18	29	34	40	45	62	33	38	28	44	44	46	44	52	30	36	35	44
23–24	70	34	66	33	63	31	71	30	62	29	59	34	62	24	78	39	58	33	64	23
25–27	183	15	193	14	189	22	176	21	147	13	168	20	150	14	148	14	167	13	146	11
28–31	481	8	513	20	487	14	521	14	466	13	467	15	433	12	422	8	425	9	441	12
32–36	3,776	21	3,900	21	3,909	25	3,928	26	3,845	24	3,867	16	3,656	24	3,661	22	3,592	27	3,731	16
37–40	47,117	40	47,619	42	47,646	38	48,117	45	46,966	39	46,903	38	45,507	28	45,729	38	45,616	39	46,354	39
≥41	12,305	14	11,644	18	11,720	13	11,529	12	10,718	8	10,312	11	9,469	5	9,087	9	9,045	9	8,752	6
Unknown	735	-	1,147	-	603	-	560	-	496	-	978	-	365	-	427	-	423	-	596	-

Gestation at birth (weeks)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	
Neonatal deaths											
20–22	0.55	0.45	0.62	0.96	0.61	0.71	0.78	0.88	0.61	0.74	0.055
23–24	0.53	0.52	0.48	0.47	0.47	0.55	0.40	0.66	0.56	0.39	0.89
25–27	0.23	0.22	0.34	0.33	0.21	0.32	0.24	0.24	0.22	0.19	0.35
28–31	0.13	0.31	0.22	0.22	0.21	0.24	0.20	0.14	0.15	0.20	0.42
32–36	0.33	0.33	0.40	0.41	0.39	0.26	0.41	0.38	0.46	0.27	0.9
37–40	0.67	0.71	0.64	0.75	0.68	0.66	0.51	0.69	0.71	0.71	0.9
≥41	1.14	1.55	1.11	1.04	0.75	1.07	0.53	0.99	1.00	0.69	0.078

Table 4.29: Perinatal death classification (PSANZ-PDC) of fetal death by gestational age 2012–2016

Perinatal death classification (PSANZ-PDC)	Total	Gestational age (weeks)													
		20–22		23–24		25–27		28–31		32–36		37–40		≥41	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	**694**	371	53.5	131	18.9	58	8.4	43	6.2	58	8.4	27	3.9	6	0.9
Perinatal infection	**63**	19	30.2	11	17.5	6	9.5	9	14.3	6	9.5	9	14.3	3	4.8
Hypertension	**59**	7	11.9	7	11.9	16	27.1	8	13.6	13	22.0	7	11.9	1	1.7
Antepartum haemorrhage	**225**	131	58.2	24	10.7	10	4.4	14	6.2	26	11.6	18	8.0	2	0.9
Maternal conditions	**141**	45	31.9	17	12.1	10	7.1	16	11.3	25	17.7	25	17.7	3	2.1
Specific perinatal conditions	**252**	74	29.4	32	12.7	25	9.9	23	9.1	47	18.7	47	18.7	4	1.6
Hypoxic peripartum death	**34**	-	-	-	-	-	-	-	-	1	2.9	23	67.6	10	29.4
Fetal growth restriction	**193**	15	7.8	20	10.4	35	18.1	30	15.5	38	19.7	46	23.8	9	4.7
Spontaneous preterm	**182**	137	75.3	28	15.4	6	3.3	6	3.3	5	2.7	-	-	-	-
Unexplained antepartum death	**442**	85	19.2	30	6.8	38	8.6	29	6.6	81	18.3	162	36.7	17	3.8
Total	**2,285**	**884**	**38.7**	**300**	**13.1**	**204**	**8.9**	**178**	**7.8**	**300**	**13.1**	**364**	**15.9**	**55**	**2.4**

Table 4.30: Perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) of neonatal deaths by gestational age 2012–2016

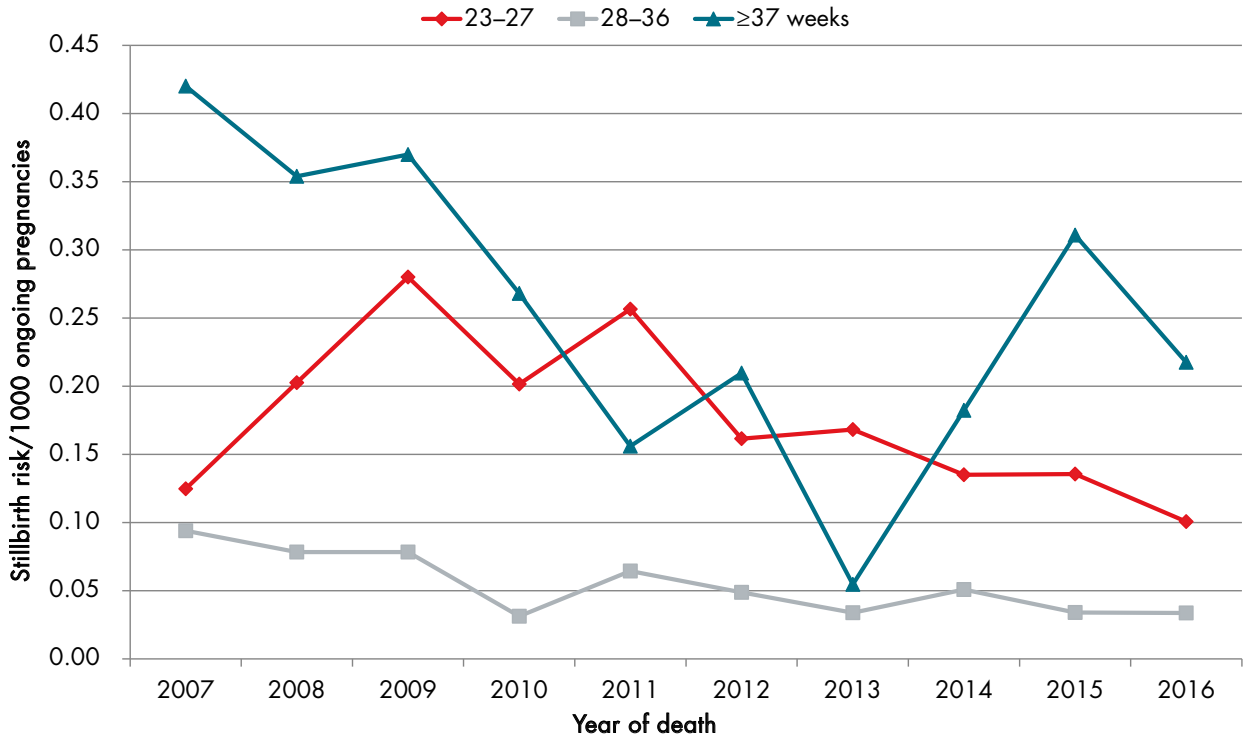
Death classification (PSANZ)	Total	Gestational age (weeks)													
		20–22		23–24		25–27		28–31		32–36		37–40		≥41	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Perinatal death classification (PSANZ-PDC)															
Congenital abnormality	**187**	4	2.1	1	0.5	5.0	2.7	15	8.0	59	31.6	90	48.1	13	7.0
Perinatal infection	**48**	10	20.8	3	6.3	5.0	10.4	4	8.3	4	8.3	15	31.3	7	14.6
Hypertension	**16**	2	12.5	5	31.3	5.0	31.3	2	12.5	2	12.5	-	-	-	-
Antepartum haemorrhage	**130**	64	49.2	38	29.2	17.0	13.1	4	3.1	5	3.8	2	1.5	-	-
Maternal conditions	**34**	11	32.4	2	5.9	2.0	5.9	4	11.8	10	29.4	5	14.7	-	-
Specific perinatal conditions	**79**	36	45.6	14	17.7	5.0	6.3	11	13.9	5	6.3	7	8.9	1	1.3
Hypoxic peripartum death	**44**	-	-	-	-	-	-	1	2.3	2	4.5	31	70.5	10	22.7
Fetal growth restriction	**14**	-	-	-	-	2.0	14.3	3	21.4	2	14.3	6	42.9	1	7.1
Spontaneous preterm	**243**	95	39.1	90	37.0	31.0	12.8	12	4.9	15	6.2	-	-	-	-
No obstetric antecedent	**35**	-	-	-	-	-	-	-	-	1	2.9	26	74.3	8	22.9
Neonatal death classification (PSANZ-NDC)															
Congenital abnormality	**193**	4	2.1	1	0.5	4.0	2.1	15	7.8	63	32.6	93	48.2	13	6.7
Extreme prematurity	**303**	218	71.9	81	26.7	4.0	1.3	-	-	-	-	-	-	-	-
Cardio-respiratory disorders	**63**	-	-	23	36.5	20.0	31.7	11	17.5	4	6.3	5	7.9	-	-
Infection	**65**	-	-	10	15.4	18.0	27.7	4	6.2	9	13.8	16	24.6	8	12.3
Neurological	**129**	-	-	27	20.9	18.0	14.0	11	8.5	22	17.1	40	31.0	11	8.5
Gastrointestinal	**14**	-	-	4	28.6	5.0	35.7	5	35.7	-	-	-	-	-	-
Other	**63**	-	-	7	11.1	3.0	4.8	10	15.9	7	11.1	28	44.4	8	12.7
Total	**830**	**222**	**26.7**	**153**	**18.4**	**72.0**	**8.7**	**56**	**6.7**	**105**	**12.7**	**182**	**21.9**	**40**	**4.8**

Table 4.31: Intrapartum stillbirth rates (per 1000 ongoing pregnancies) by gestation excluding congenital anomalies 2007–2016

Gestation at birth (weeks)	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
23–27	8	64,167	13	64,173	18	64,282	13	64,534	16	62,391	10	61,958	10	59,458	8	59,292	8	59,081	6	59,668
28–36	6	63,850	5	63,831	5	63,942	2	64,227	4	62,112	3	61,664	2	59,182	3	59,011	2	58,791	2	59,400
≥37	25	59,511	21	59,351	22	59,469	16	59,710	9	57,742	12	57,275	3	55,025	10	54,864	17	54,720	12	55,170

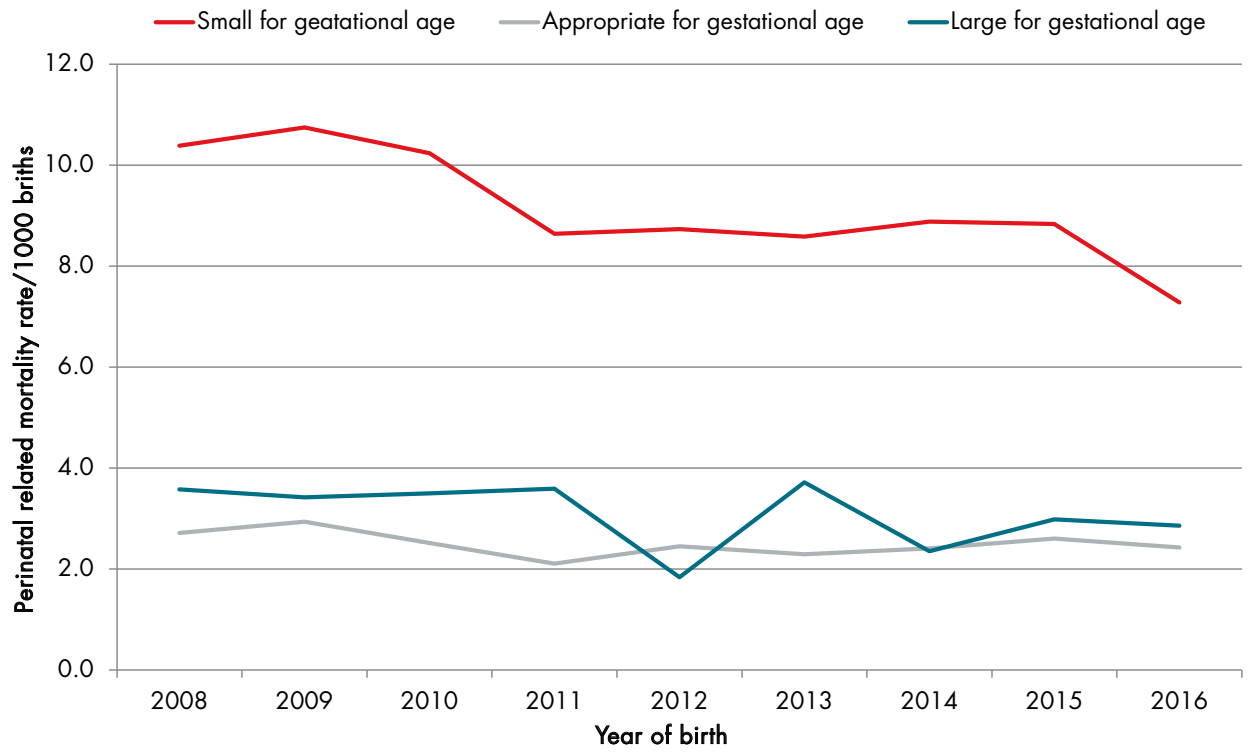
Gestation at birth (weeks)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Chi-square test for trend (p)
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	
23–27	0.12	0.20	0.28	0.20	0.26	0.16	0.17	0.13	0.14	0.10	0.11
28–36	0.09	0.08	0.08	0.03	0.06	0.05	0.03	0.05	0.03	0.03	0.065
≥37	0.42	0.35	0.37	0.27	0.16	0.21	0.05	0.18	0.31	0.22	0.0022

Figure 4.16: Intrapartum stillbirth risk (per 1000 ongoing pregnancies) by gestation at birth (weeks) excluding congenital anomalies 2007–2016



Small for gestational age infants

Figure 4.17: Perinatal related mortality rate by customised birthweight centile group among singleton births* from 26 weeks gestation without congenital anomalies 2008–2016



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Table 4.32: Perinatal related mortality rates by customised birthweight centile group among singleton births*from 26 weeks gestation without congenital anomalies 2008–2016

Year of death	Small for gestational age			Appropriate for gestational age			Large for gestational age			Unknown/missing data			Total		
	N=44,709	n=409		N=344,359	n=858		N=56,848	n=175		N=22,478	n=97		N=468,394	n=1,539	
	N	n	Rate	N	n	Rate	N	n	Rate	N	n	Rate	N	n	Rate
2008	4,815	50	10.38	36,487	99	2.71	6,153	22	3.58	2,706	17	6.28	50,161	188	3.75
2009	5,024	54	10.75	37,100	109	2.94	6,143	21	3.42	2,560	19	7.42	50,827	203	3.99
2010	5,081	52	10.23	38,178	96	2.51	6,293	22	3.50	2,694	7	2.60	52,246	177	3.39
2011	5,092	44	8.64	37,979	80	2.11	6,128	22	3.59	2,756	13	4.72	51,955	159	3.06
2012	5,039	44	8.73	39,203	96	2.45	6,535	12	1.84	2,240	6	2.68	53,017	158	2.98
2013	4,893	42	8.58	37,994	87	2.29	6,193	23	3.71	2,361	7	2.96	51,441	159	3.09
2014	4,954	44	8.88	38,667	93	2.41	6,377	15	2.35	2,259	5	2.21	52,257	157	3.00
2015	4,867	43	8.84	39,195	102	2.60	6,376	19	2.98	2,482	7	2.82	52,920	171	3.23
2016	4,944	36	7.28	39,556	96	2.43	6,650	19	2.86	2,420	16	6.61	53,570	167	3.12

* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

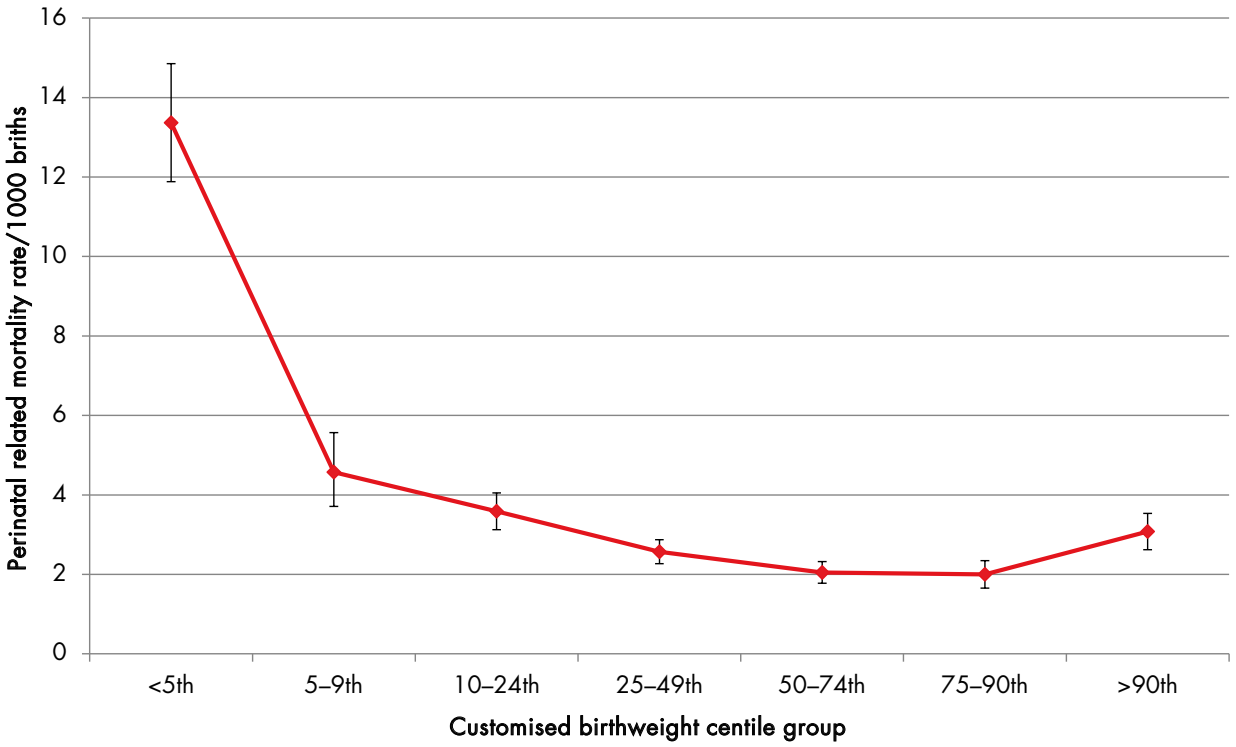
This year denominator data are available for analysis of perinatal related mortality by customised birthweight centile at a population level. This analysis was limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice, for whom maternal height, weight, and parity data are almost complete. The analysis was also limited to the years from 2008 as the variable denoting LMC was not reliable prior to 2008.

There has been a significant reduction in the proportion of babies born small for gestational age from 10.8 percent in 2008 to 10.4 percent in 2016 (chi square test for trend $p<0.0001$) using the same customised birthweight centile calculator for all years (www.gestation.net). Over the same period, there has been an increase in the proportion of babies born appropriate for gestational age ($p=0.001$), and no change in babies born large for gestational age ($p=1.0$).

Figure 4.17 shows perinatal related mortality rates for small, appropriate, and large for gestational age babies under LMC care over time. It illustrates that the rate of death is significantly higher (approximately three times higher) for small for gestational age babies as measured by customised birthweight centiles compared to appropriately grown and large for gestational age babies. It also shows a reduction in perinatal related mortality among small for gestational age babies from 2008 to 2016, which is statistically significant (score test for trend $p=0.046$). There may be a small reduction in perinatal related mortality rate for appropriate and large for gestational age babies but this is not statistically significant.

Figure 4.18 shows that the lowest perinatal related mortality rate by customised birthweight centile for babies born in New Zealand lies between the 50th to 90th customised birthweight centiles. The greatest risk of mortality is among babies below the 5th customised birthweight centile.

Figure 4.18: Perinatal related mortality rates (with 95% CIs) by customised birthweight centile group among singleton births from 26 weeks gestation without congenital anomalies 2008–2016*



* MAT data numerator and denominator; limited to mothers who were registered for care with an LMC (either a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Multiple birth

Figure 4.19: Perinatal related mortality rates (per 1000 births) among babies born in multiple pregnancies 2007–2016

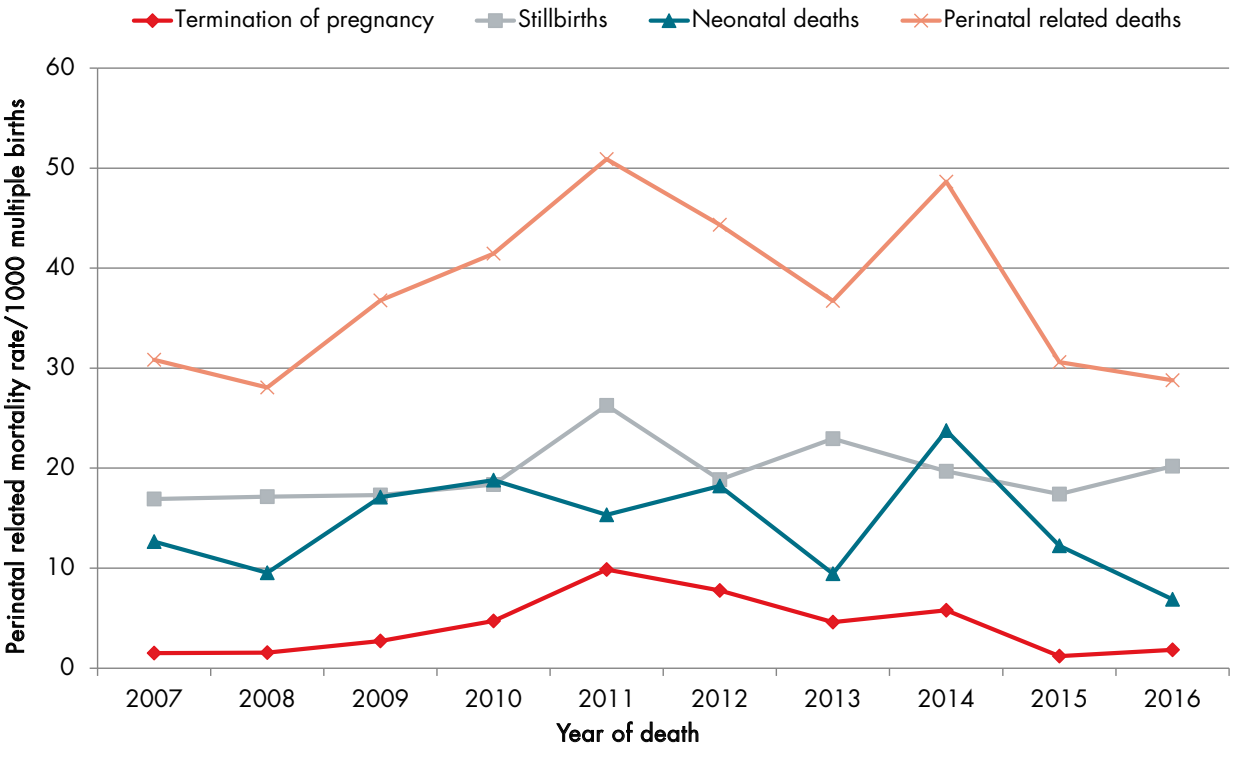


Table 4.33: Perinatal related mortality rates among babies born in multiple pregnancies 2007–2016

Year of death	Total multiple births	Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=72		n=319		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	1,743	8	4.59	40	22.95	16	9.44	64	36.72
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
2016	1,633	3	1.84	33	20.21	11	6.89	47	28.78
Chi-square test for trend (p)		**0.45**		**0.36**		**0.76**		**0.48**	

The perinatal related mortality rate among multiple pregnancies in 2016 was not significantly different from the rate in 2007 (Figure 4.19; Table 4.33). However, multiple births as a proportion of all births reduced significantly from 3.1 percent in 2007 to 2.7 percent in 2016 (Chi square test for trend p=0.0002), which is likely to have had an impact on absolute numbers of multiple pregnancy perinatal related deaths.

Investigation of perinatal related deaths

Table 4.34: Perinatal related deaths and completeness of perinatal death investigations 2016

Perinatal death investigation	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=148		n=309		n=151		n=608	
	n	%	n	%	n	%	n	%
Optimum investigation*	71	48.0	132	42.7	59	39.1	262	43.1
Post-mortem	35	23.6	122	39.5	48	31.8	205	33.7
Karyotype	35	23.6	17	5.5	9	6.0	61	10.0
Clinical examination/investigations confirm diagnosis	4	2.7	7	2.3	2	1.3	13	2.1
Partial investigations only #	65	43.9	132	42.7	68	45.0	265	43.6
Placental pathology performed+	76	51.4	236	76.4	97	64.2	409	67.3
No investigation ^	11	7.4	42	13.6	23	15.2	76	12.5
Unknown	1	0.7	3	1.0	1	0.7	5	0.8

* Optimum investigation is defined as post-mortem or karyotype confirming congenital anomaly 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.

+ Includes both placental histology with post-mortem and as part of partial investigation.

^ No post-mortem, placental pathology, MRI, ultrasound scan or x-ray.

Table 4.35: Perinatal related deaths and perinatal death investigations by ethnicity 2012–2016

Post-mortem examination offered	Māori		Pacific peoples		Indian		Other Asian		MELAA		NZ European		Other European		Perinatal related deaths^	
	n=809		n=406		n=215		n=264		n=64		n=1,174		n=182		n=3,115	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Post-mortem offered and parental consent given	192	23.7	123	30.3	94	43.7	116	43.9	25	39.1	552	47.0	87	47.8	1,190	38.2
Post-mortem offered and parents declined	550	68.0	250	61.6	111	51.6	127	48.1	31	48.4	540	46.0	77	42.3	1,686	54.1
Post-mortem not offered	53	6.6	28	6.9	6	2.8	20	7.6	8	12.5	71	6.0	15	8.2	201	6.5
Unknown	14	1.7	5	1.2	4	1.9	1	0.4	-	-	11	0.9	3	1.6	38	1.2
Optimum investigation*	264	32.6	157	38.7	106	49.3	164	62.1	30	46.9	668	56.9	112	61.5	1,502	48.2
Post-mortem	192	23.7	123	30.3	94	43.7	116	43.9	25	39.1	552	47.0	87	47.8	1,190	38.2
Karyotype	52	6.4	26	6.4	13	6.0	45	17.0	5	7.8	125	10.6	22	12.1	288	9.2
Clinical examination/investigations confirm diagnosis	37	4.6	16	3.9	4	1.9	14	5.3	1	1.6	56	4.8	8	4.4	136	4.4
Partial investigations only#	360	44.5	194	47.8	94	43.7	90	34.1	29	45.3	433	36.9	56	30.8	1,256	40.3
No investigation+	182	22.5	52	12.8	14	6.5	9	3.4	5	7.8	62	5.3	13	7.1	337	10.8
Unknown	3	0.4	3	0.7	1	0.5	1	0.4	-	-	11	0.9	1	0.5	20	0.6

* Optimum investigation is defined as post-mortem or karyotype confirming congenital anomaly 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.

^ One unknown ethnicity

MELAA = Middle Eastern, Latin American or African.

Perinatal death investigations, counsel and considerations

Authors Associate Professor Sue Crengle and Lisa Pakaru

The 12th PMMRC report found that, compared to other ethnic groupings, a smaller proportion of Māori and Pacific perinatal related deaths were investigated by post-mortem or investigated optimally (Table 4.35).

The New Zealand Multicentre Stillbirth Study found the decision to decline a post-mortem (70/169, 41.4 percent) was more common among women of Māori and Pacific ethnicity compared to European. The main reason for declining was that women 'did not want baby to be cut'. Ten percent (7/70) who declined said they would not make this decision again. No woman who consented regretted her decision (Cronin et al 2018).

With regard to Māori the Māori Affairs Select Committee report following their inquiry into whānau access to and management of tūpāpaku made a number of recommendations that are relevant to our work (Māori Affairs Select Committee 2017). These include the following applicable recommendations:

- that national standards are implemented across agencies (in this instance DHBs) to ensure that cultural needs are met
- that a formal communication procedure be developed and implemented having regard for tikanga Māori and the expectations of non-Māori
- that cultural competency training is made mandatory so that effective counsel can be provided to whānau
- that mortuary infrastructure, staffing and other resources enable Māori to meet their cultural obligations and also ensure post-mortem can be completed without delay
- that cultural considerations can differ between whānau, iwi and hapū.

From discussions with whānau involved in Sands and a number of Māori hui, the key considerations of whānau are:

- the need for Māori immediate whānau members to stay with the tūpāpaku from death to burial
- concerns about post-mortem and resulting report timeframes, which are dependent on multiple factors
- the transportation of babies, including being placed in the hold of a plane and passing over other tūpāpaku within the rohe
- the need for karakia including a safe space for whānau to perform it
- the return of all parts of the tūpāpaku so that the appropriate cultural process can be applied
- what the tūpāpaku will look like when returned
- the need for staff engaging with whānau to have appropriate cultural competency training so that the option of post-mortem is understood, that equitable options and outcomes are provided and that the lens applied to any discussion is free of bias
- that there is a framework in place that is flexible enough to work within whānau, iwi and hapū cultural needs.

A survey conducted with the PMMRC DHB local coordinators regarding transporting babies for post-mortem confirmed that services remain inconsistent across DHBs in Aotearoa New Zealand.

To improve Māori participation in post-mortem, there is an immediate need for national standards to be implemented across DHBs that ensure that cultural needs are met and that whānau experience is consistent and appropriate.

Requesting post-mortems from recently bereaved family may be challenging for some health professionals, and this may be more so if the professional is aware that, for some Māori whānau, post-mortems are not an acceptable practice. It is possible that this knowledge affects the way health professionals discuss post-mortem with whānau and this, in turn, may impact on consent rates for optimum and partial post-mortem investigation.

Talking with health professionals about their experience of discussing post-mortem investigations with families/whānau would provide valuable information about this process, and whether there are differences in approaches across ethnic groupings. Similarly, talking with Māori whānau who have experienced a death and listening to their stories of being offered post-mortem might help to inform practice changes.

Contributory factors and potentially avoidable perinatal related death

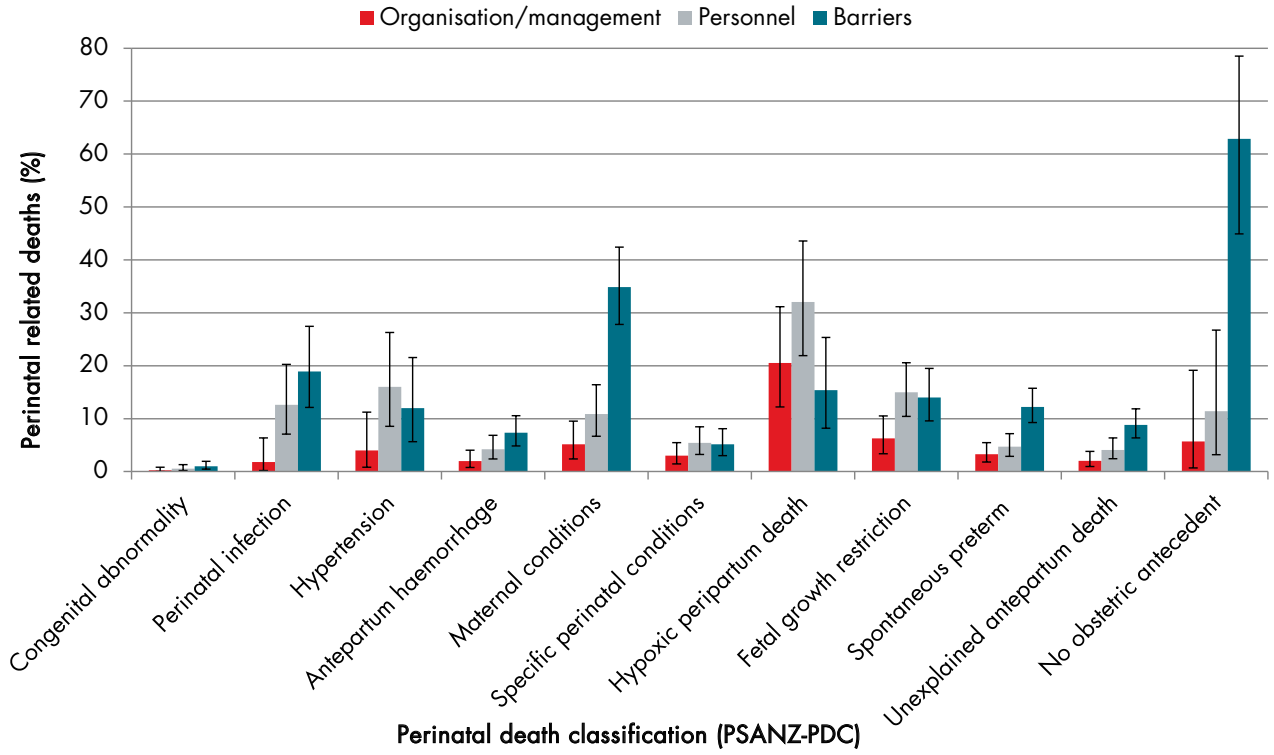
Table 4.36: Contributory factors and potentially avoidable perinatal related deaths 2016

	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=148		n=309		n=151		n=608	
	n	%	n	%	n	%	n	%
Contributory factors								
Present	14	9.5	89	28.8	67	44.4	170	28.0
Absent	133	89.9	217	70.2	82	54.3	432	71.1
Missing data	1	0.7	3	1.0	2	1.3	6	1.0
Potentially avoidable								
Yes	6	4.1	50	16.2	36	23.8	92	15.1
Contributory factors present but not potentially avoidable	8	5.4	37	12.0	31	20.5	76	12.5
Contributory factors present but avoidability unknown	-	-	1	0.3	-	-	1	0.2

Table 4.37: Detail of contributory factors among perinatal related deaths 2016

Contributory factors	2016	
	n	%
Any contributory factor	**170**	**28.0**
Organisational and/or management factors	**30**	**4.1**
Poor organisational arrangements of staff	4	
Inadequate education and training	7	
Lack of policies, protocols or guidelines	3	
Inadequate numbers of staff	3	
Poor access to senior clinical staff	4	
Failure or delay in emergency response	3	
Delay in procedure (eg, caesarean section)	4	
Inadequate systems for sharing of clinical information	11	
Delayed access to test results or inaccurate results	2	
Equipment (eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)	2	
Building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)	2	
Other	8	
Not stated	3	
Personnel factors	**51**	**7.0**
Knowledge and skills of staff were lacking	9	
Delayed emergency response by staff	5	
Failure to maintain competence	1	
Failure of communication between staff	10	
Failure to seek help/supervision	4	
Failure to offer or follow recommended best practice	29	
Lack of recognition of complexity or seriousness of condition by care giver	25	
Other	4	
Barriers to access and/or engagement with care	**125**	**17.1**
No antenatal care	24	
Infrequent care or late booking	46	
Declined treatment or advice	30	
Obesity impacted on delivery of optimal care (eg, USS)	7	
Substance use	25	
Family violence	17	
Lack of recognition of complexity or seriousness of condition by the woman and/or family	35	
Maternal mental illness	8	
Cultural barriers	4	
Language barriers	6	
Not eligible to access free care	7	
Environment (eg, isolated, long transfer, weather prevented transport)	5	
Other	14	

Figure 4.20: 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) 2012–2016*



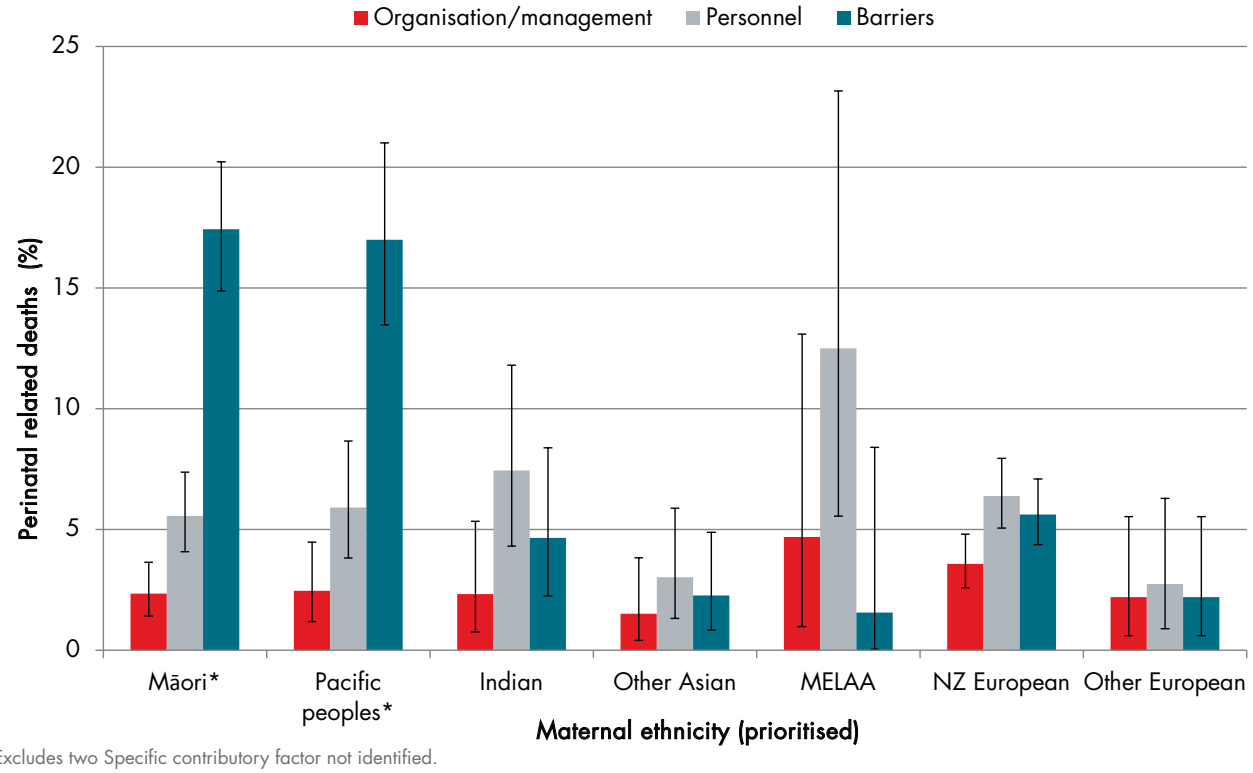
* Excludes two Specific contributory factor not identified.

Table 4.38: Main contributory factor(s) in potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2012–2016

Perinatal death classification (PSANZ-PDC)	Perinatal related deaths	Potentially avoidable								
		Organisation/management			Personnel			Barriers		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI
Congenital abnormality	881	2	0.2	0.03–0.82	5	0.6	0.18–1.32	9	1.0	0.47–1.93
Perinatal infection	111	2	1.8	0.22–6.36	14	12.6	7.07–20.26	21	18.9	12.11–27.45
Hypertension	75	3	4.0	0.83–11.25	12	16.0	8.55–26.28	9	12.0	5.64–21.56
Antepartum haemorrhage	355	7	2.0	0.80–4.02	15	4.2	2.38–6.87	26	7.3	4.84–10.55
Maternal conditions*	175	9	5.1	2.38–9.54	19	10.9	6.66–16.43	61	34.9	27.82–42.41
Specific perinatal conditions	331	10	3.0	1.46–5.49	18	5.4	3.25–8.46	17	5.1	3.02–8.10
Hypoxic peripartum death	78	16	20.5	12.20–31.16	25	32.1	21.93–43.58	12	15.4	8.21–25.33
Fetal growth restriction	207	13	6.3	3.39–10.50	31	15.0	10.41–20.58	29	14.0	9.59–19.50
Spontaneous preterm	425	14	3.3	1.81–5.47	20	4.7	2.90–7.17	52	12.2	9.27–15.73
Unexplained antepartum death	442	9	2.0	0.94–3.83	18	4.1	2.43–6.36	39	8.8	6.35–11.86
No obstetric antecedent	35	2	5.7	0.70–19.16	4	11.4	3.20–26.74	22	62.9	44.92–78.53

* Excludes two Specific contributory factor not identified.

Figure 4.21: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by maternal prioritised ethnicity (with 95% CIs) 2012–2016



* Excludes two Specific contributory factor not identified.
MELAA = Middle Eastern, Latin American or African.

Table 4.39: Main contributory factor(s) in potentially avoidable perinatal related deaths by maternal prioritised ethnicity (with 95% CIs) 2012–2016

Maternal ethnicity	Perinatal related deaths	Potentially avoidable								
		Organisation/management			Personnel			Barriers		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI
Māori*	809	19	2.3	1.42–3.64	45	5.6	4.09–7.37	141	17.4	14.88–20.22
Pacific peoples*	406	10	2.5	1.19–4.48	24	5.9	3.82–8.67	69	17.0	13.47–21.01
Indian	215	5	2.3	0.76–5.34	16	7.4	4.31–11.80	10	4.7	2.25–8.39
Other Asian	264	4	1.5	0.41–3.83	8	3.0	1.32–5.88	6	2.3	0.84–4.88
MELAA	64	3	4.7	0.98–13.09	8	12.5	5.55–23.15	1	1.6	0.04–8.40
NZ European	1,174	42	3.6	2.59–4.81	75	6.4	5.06–7.94	66	5.6	4.37–7.10
Other European	182	4	2.2	0.60–5.53	5	2.7	0.90–6.29	4	2.2	0.60–5.53
Unknown/Other	1	-	-	-	-	-	-	-	-	-

MELAA = Middle Eastern, Latin American or African.
* Excludes two Specific contributory factor not identified.

Figure 4.22: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by deprivation quintile (with 95% CIs) 2012–2016

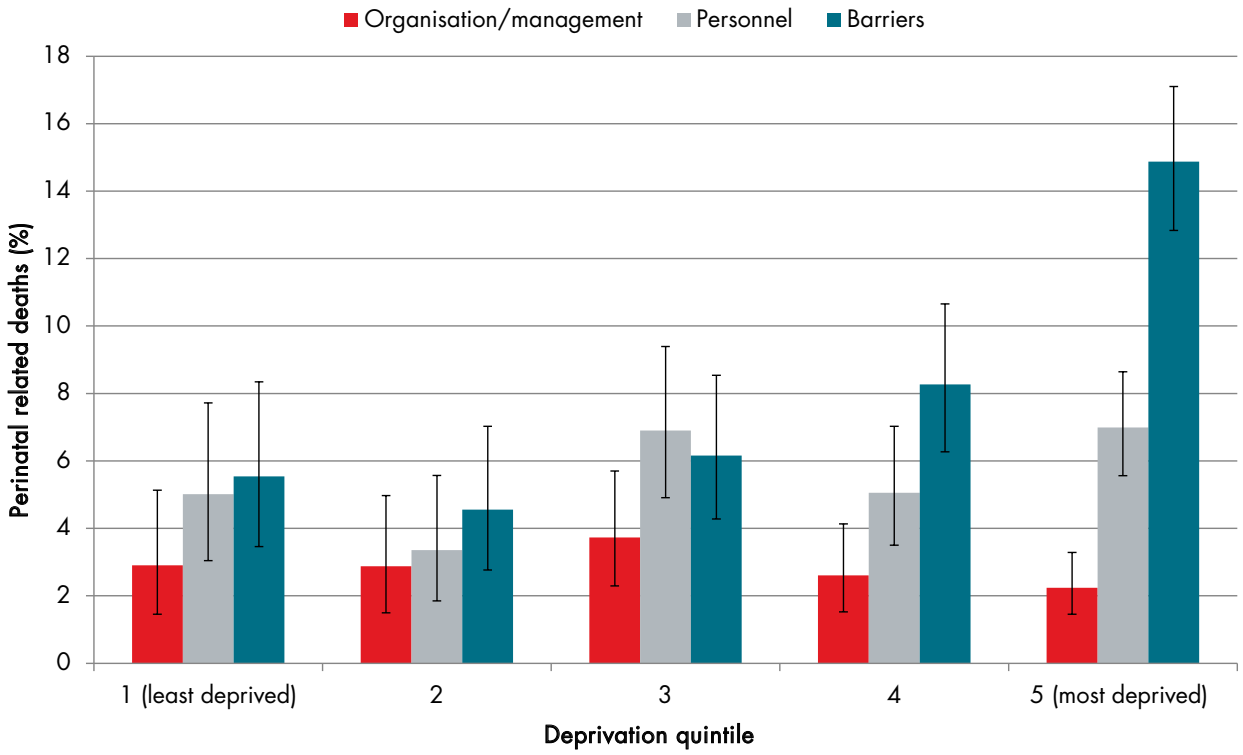


Table 4.40: Main contributory factor(s) in potentially avoidable perinatal related deaths by deprivation quintile (with 95% CIs) 2012–2016

Deprivation quintile	Perinatal related deaths	Potentially avoidable								
		Organisation/management			Personnel			Barriers		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI
1 (least deprived)	379	11	2.9	1.46–5.13	19	5.0	3.04–7.72	21	5.5	3.46–8.35
2*	417	12	2.9	1.50–4.97	14	3.4	1.85–5.57	19	4.6	2.77–7.02
3	536	20	3.7	2.29–5.70	37	6.9	4.91–9.39	33	6.2	4.28–8.54
4*	653	17	2.6	1.52–4.14	33	5.1	3.50–7.02	54	8.3	6.27–10.65
5 (most deprived)	1,116	25	2.2	1.45–3.29	78	7.0	5.56–8.65	166	14.9	12.84–17.10
Unknown	14	2	14.3	-	-	-	-	4	28.6	-

* Excludes two Specific contributory factor not identified.

Table 4.41: Perinatal related death and perinatal death classification (PSANZ-PDC) 2007–2016

	Perinatal death classification (PSANZ-PDC)	2007–2015 n=5,415		2016 n=608	
		n	%	n	%
	Congenital abnormality				
1.1	Central nervous system	313	5.8	26	4.3
1.2	Cardiovascular system	200	3.7	28	4.6
1.3	Urinary system	102	1.9	12	2.0
1.4	Gastrointestinal system	33	0.6	2	0.3
1.5	Chromosomal	470	8.7	60	9.9
1.6	Metabolic	20	0.4	1	0.2
1.7	Multiple/Non-chromosomal syndromes	188	3.5	22	3.6
1.8	Other congenital abnormality				
1.81	Musculoskeletal	73	1.3	12	2.0
1.82	Respiratory	6	0.1	1	0.2
1.83	Diaphragmatic hernia	40	0.7	3	0.5
1.84	Haematological	8	0.1	-	-
1.85	Tumours	18	0.3	1	0.2
1.88	Other specified congenital abnormality	31	0.6	2	0.3
1.9	Unspecified congenital abnormality	26	0.5	3	0.5
	Perinatal infection				
2.1	Bacterial				
2.11	Group B *Streptococcus*	41	0.8	8	1.3
2.12	*E. coli*	19	0.4	2	0.3
2.13	*Listeria monocytogenes*	14	0.3	2	0.3
2.14	Spirochaetal (eg, syphilis)	1	0.0	1	0.2
2.18	Other bacterial	22	0.4	5	0.8
2.19	Unspecified bacterial	16	0.3	6	1.0
2.2	Viral				
2.21	*Cytomegalovirus*	30	0.6	1	0.2
2.22	Parvovirus	12	0.2	-	-
2.23	Herpes simplex virus	8	0.1	-	-
2.28	Other viral	1	0.0	-	-
2.29	Unspecified viral	3	0.1	-	-
2.3	Protozoal (eg, Toxoplasma)	11	0.2	-	-
2.5	Fungal	1	0.0	-	-
2.8	Other specified organism	1	0.0	-	-
2.9	Other unspecified organism	14	0.3	1	0.2
	Hypertension				
3.1	Chronic hypertension: essential	15	0.3	1	0.2
3.2	Chronic hypertension: secondary, (eg, renal disease)	6	0.1	-	-
3.3	Chronic hypertension: unspecified	6	0.1	-	-
3.4	Gestational hypertension	14	0.3	1	0.2
3.5	Pre-eclampsia	88	1.6	5	0.8
3.51	Pre-eclampsia: With laboratory evidence of thrombophilia	4	0.1	2	0.3
3.6	Pre-eclampsia superimposed on chronic hypertension	23	0.4	-	-
3.61	Pre-eclampsia superimposed on chronic hypertension: With laboratory evidence of thrombophilia	3	0.1	-	-
3.9	Unspecified hypertension	4	0.1	-	-

Perinatal death classification (PSANZ-PDC)		2007–2015 n=5,415		2016 n=608	
		n	%	n	%
	Antepartum haemorrhage (APH)				
4.1	Placental abruption	286	5.3	25	4.1
4.11	Placental abruption: With laboratory evidence of thrombophilia	20	0.4	1	0.2
4.2	Placenta praevia	15	0.3	2	0.3
4.3	Vasa praevia	4	0.1	-	-
4.8	Other APH	88	1.6	13	2.1
4.9	APH of undetermined origin	156	2.9	31	5.1
	Maternal conditions				
5.1	Termination of pregnancy for maternal psychosocial indications	28	0.5	8	1.3
5.2	Diabetes/Gestational diabetes	101	1.9	12	2.0
5.3	Maternal injury	1	0.0	-	-
5.31	Maternal injury: Accidental	13	0.2	7	1.2
5.32	Maternal injury: Non-accidental	8	0.1	-	-
5.4	Maternal sepsis	14	0.3	6	1.0
5.5	Antiphospholipid syndrome	25	0.5	-	-
5.51	Other maternal thrombophilia (if considered cause of death)	3	0.1	-	-
5.6	Obstetric cholestasis	1	0.0	1	0.2
5.8	Other specified maternal conditions	61	1.1	3	0.5
	Specific perinatal conditions				
6.1	Twin–twin transfusion	163	3.0	18	3.0
6.2	Fetomaternal haemorrhage	58	1.1	6	1.0
6.3	Antepartum cord complications (eg, cord haemorrhage; true knot with evidence of occlusion)	27	0.5	-	-
6.31	Cord haemorrhage	9	0.2	1	0.2
6.32	True knot with evidence of occlusion	17	0.3	5	0.8
6.38	Other	53	1.0	8	1.3
6.4	Uterine abnormalities, eg, bicornuate uterus, cervical incompetence	97	1.8	14	2.3
6.5	Birth trauma (typically infants of >24 weeks gestation or >600g birthweight)	1	0.0	-	-
6.6	Alloimmune disease				
6.61	Alloimmune disease: Rhesus	2	0.0	-	-
6.64	Alloimmune disease: Alloimmune thrombocytopenia	6	0.1	1	0.2
6.68	Alloimmune disease: Other	-	-	1	0.2
6.7	Idiopathic hydrops	26	0.5	3	0.5
6.8	Other specific perinatal conditions (includes iatrogenic conditions such as rupture of membranes after amniocentesis, termination of pregnancy for suspected but unconfirmed congenital abnormality)				
6.81	Rupture of membranes after amniocentesis	11	0.2	1	0.2
6.82	Termination of pregnancy for suspected but unconfirmed congenital abnormality	3	0.1	-	-
6.83	Fetal subdural haematoma	5	0.1	2	0.3
6.88	Other	69	1.3	9	1.5
6.89	Unspecified	1	0.0	-	-

	Perinatal death classification (PSANZ-PDC)	2007–2015 n=5,415		2016 n=608	
		n	%	n	%
	Hypoxic peripartum death				
7.1	With intrapartum complications				
7.11	With intrapartum complications: Uterine rupture	7	0.1	1	0.2
7.12	With intrapartum complications: Cord prolapse	16	0.3	2	0.3
7.13	With intrapartum complications: Shoulder dystocia	4	0.1	-	-
7.18	With intrapartum complications: Other	24	0.4	1	0.2
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)	84	1.6	8	1.3
7.3	No intrapartum complications and no evidence of non-reassuring fetal status	12	0.2	1	0.2
7.9	Unspecified hypoxic peripartum death	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)	248	4.6	25	4.1
8.2	With chronic villitis	6	0.1	3	0.5
8.3	No placental pathology	33	0.6	-	-
8.4	No examination of placenta	23	0.4	3	0.5
8.8	Other specified placental pathology	75	1.4	10	1.6
8.9	Unspecified or not known whether placenta examined	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	187	3.5	20	3.3
9.12	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Without chorioamnionitis	96	1.8	1	0.2
9.13	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: No examination of placenta	16	0.3	1	0.2
9.17	No clinical signs of chorioamnionitis, no examination of placenta	85	1.6	15	2.5
9.19	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Unspecified or not known whether placenta examined	42	0.8	1	0.2
9.2	Spontaneous preterm with membrane rupture ≥24 hours before delivery				
9.21	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With chorioamnionitis	204	3.8	15	2.5
9.22	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Without chorioamnionitis	25	0.5	2	0.3
9.23	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	28	0.5	3	0.5
9.27	No clinical signs of chorioamnionitis, no examination of placenta	37	0.7	7	1.2
9.29	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Unspecified or not known whether placenta examined	14	0.3	1	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	17	0.3	4	0.7
9.32	Spontaneous preterm with membrane rupture of unknown duration before delivery: Without chorioamnionitis	9	0.2	-	-

Perinatal death classification (PSANZ-PDC)		2007–2015 n=5,415		2016 n=608	
		n	%	n	%
9.33	Spontaneous preterm with membrane rupture of unknown duration before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	4	0.1	-	-
9.37	No clinical signs of chorioamnionitis, no examination of placenta	6	0.1	1	0.2
9.39	Spontaneous preterm with membrane rupture of unknown duration before delivery: Unspecified or not known whether placenta examined	19	0.4	1	0.2
	Unexplained antepartum death				
10.1	With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)	93	1.7	6	1.0
10.2	With chronic villitis	11	0.2	2	0.3
10.3	No placental pathology	190	3.5	27	4.4
10.4	No examination of placenta	138	2.5	13	2.1
10.8	Other specified placental pathology	276	5.1	41	6.7
10.9	Unspecified or not known whether placenta examined	22	0.4	1	0.2
	No obstetric antecedent				
11.1	Sudden infant death syndrome (SIDS)				
11.11	SIDS Category IA: Classic features of SIDS present, completely documented	1	0.0	-	-
11.13	SIDS Category II: Infant deaths that meet Category I except for one or more features	3	0.1	-	-
11.2	Postnatally acquired infection	13	0.2	-	-
11.3	Accidental asphyxiation	5	0.1	2	0.3
11.4	Other accident, poisoning or violence (postnatal)	3	0.1	-	-
11.8	Other specified	5	0.1	1	0.2
11.9	Unknown/Undetermined	5	0.1	-	-
11.91	Unclassified sudden infant death	32	0.6	3	0.5
11.92	Other Unknown/Undetermined	1	0.0	-	-

5 New Zealand Maternal Mortality 2016

5.1 Maternal Mortality Key Findings

There has been a statistically significant reduction in maternal mortality in New Zealand from 2006 to 2016 (chi-square test for trend p=0.026).

In this 12th report, the PMMRC has identified maternal suicide and care for women in early pregnancy with a pregnancy of unknown location as areas of focus.

In 2016 there were two maternal deaths in New Zealand meeting the definition for direct or indirect death during pregnancy or within 42 days of termination of pregnancy, and five coincidental deaths. The maternal mortality ratio (maternal deaths/100,000 births at 20 weeks or beyond) for the triennium 2014–2016 was 9.42/100,000 (see Figure 5.1 and Figure 5.2). This is the lowest triennial ratio since the PMMRC started reporting in 2006.

In this report, New Zealand has adopted the World Health Organization (WHO) International Classification of Diseases – Maternal Mortality (ICD-MM) tenth revision (ICD-10) classification system. The most important change has been to include maternal suicide among direct maternal deaths. There have been only minor changes to the presentation of the remainder of the data to align with ICD-MM (Table 5.1). The adoption of this classification highlights the importance of maternal suicide by acknowledging suicide as a direct cause of maternal death, and facilitates international comparison of data.

There were more deaths reported among Māori mothers in New Zealand from 2006 to 2016 than among any other ethnicity (Table 5.2). However, the data suggest that there has been a reduction in the inequity seen from 2006 to 2016. The Māori maternal mortality ratio in 2014–2016 is statistically significantly lower than in 2006–2008 (Table 5.3).

Maternal suicide is the leading cause of maternal mortality in New Zealand. The rate of maternal suicide in New Zealand is seven times the rate in the United Kingdom. Māori women are over-represented among maternal suicides. Between 2006 and 2016, 16 of the 28 women who died by suicide in pregnancy or within six weeks of pregnancy (57 percent) were Māori. Further review of Māori maternal suicide found that 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 (PMMRC 2017).

Following review of maternal mortality, an emerging theme and practice point were identified to support consistency of approach amongst practitioners. The emerging theme relates to ectopic pregnancy (see "Ectopic pregnancy: Emerging themes in care of women with pregnancy of unknown location"), and the practice point integrates previously published practice points related to maternal suicide and psychosocial health (see "Practice point: Psychosocial health and maternal suicide"). An example of a maternal mental health birth plan is also provided.

5.2 Maternal Mortality Recommendations

Maternal and Infant Mental Health Network

The 10th PMMRC report recommended that a Maternal and Infant Mental Health Network be established to provide an interdisciplinary and national forum to discuss perinatal mental health issues

(PMMRC 2016). This work has progressed to development of service specifications for the network. We strongly reiterate the previous recommendation:

---

1. **The PMMRC recommends that a Maternal and Infant Mental Health Network is funded by the Ministry of Health; and that the network then determine an achievable work stream by the end of 2018, detailing work to be completed by the end of 2020, to include as potential areas of priority:**

a. **a stocktake of current mental health services available across New Zealand for pregnant and recently pregnant women to identify both the strengths of services and gaps or inequity in current services and skills in the workforce**

b. **a national pathway for accessing maternal mental health services, including:**

   i. **cultural appropriateness to ensure equity of service access and provision**

   ii. **appropriate screening**

   iii. **care for women with a history of mental illness**

   iv. **communication and coordination.**

Justification

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

When women have maternal mental health concerns there may be multiple services involved – primary care, maternity, termination of pregnancy, general mental health, perinatal mental health, alcohol and other drugs, and social services. Communication, support and sharing information to ensure a consistent approach to care is important. Maternal mental health services need to be equitable, available and accessible across the country with consistent pathways for engagement.

Evidence

As a number of different agencies are involved in the provision of mental health care during the perinatal period, there is a need for a strategic approach to the planning of services, including the development of integrated care pathways within a stepped-care framework. This is in keeping with recommendations within the UK, including the National Institute for Health and Care Excellence (NICE) guidelines on antenatal and postnatal mental health (NICE 2014), which recommend the establishment of perinatal mental health clinical networks of perinatal clinicians and resources and other stakeholders, including service users, and the Scottish Intercollegiate Guidelines Network (SIGN) guidelines on the management of perinatal mood disorders (SIGN 2012).

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

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

The cost to the public sector of perinatal mental health problems is five times the cost of improving services; 72 percent of these costs relate to the care of the child. Even a relatively modest improvement in outcomes as a result of better services would be sufficient to justify the additional spending to establish a Maternal and Infant Mental Health Network (Bauer et al 2014).

5.3 Methodology

The methodology for the maternal mortality report is included with the 'Methodology and Definitions for PMMRC Reporting' document on the PMMRC website (www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/3367/).

This report classifies suicide as a direct cause of death in keeping with the ICD-10 Maternal Mortality classification, which is used internationally. This is a change to previous reports where suicide was classified as an indirect cause. The change has been applied retrospectively to all deaths from 2006 to 2016.

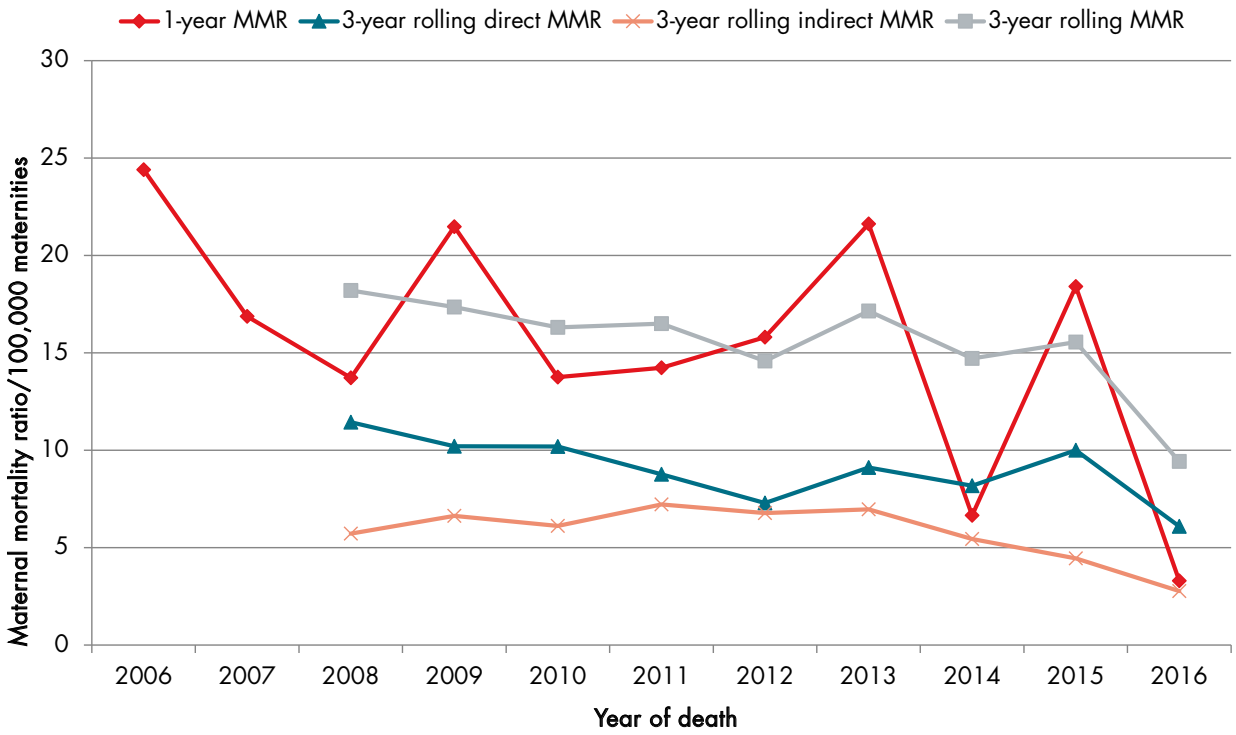
It is difficult to classify suicide as either direct or indirect as it represents a very mixed group of clinical histories. Some suicides can be considered direct (eg, as in the case of a postpartum psychosis in a previously well woman), but others can be indirect (eg, in the case of a woman with a previous history of mental illness/substance abuse and with multiple stressors). Separating suicides into direct or indirect, however, is often complicated; the required information is often missing, which is likely to lead to inaccurate classification. This resulted in a pragmatic approach in the past, grouping all suicides under indirect (pregnancy/childbirth is considered to have aggravated an underlying condition) by many national perinatal and maternal mortality review groups, including the New Zealand PMMRC.

The change in classification of suicides to direct (ie, a consequence of pregnancy/childbirth) follows the introduction of ICD-10 categories of maternal death in 2012 (WHO 2012). This is an international classification system, which most reporting countries will use. The *Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK (MBRRACE-UK) 2016* report presented suicides as both direct and indirect for comparability (Knight et al 2016).

It is important to point out that reporting suicide as direct will increase the apparent direct maternal mortality ratio in New Zealand, but without any change to the underlying number of deaths. However, by reclassifying suicide as direct, we will be consistent with other countries, and thus be able to directly compare data. Most importantly, the reclassification of suicide will raise awareness of suicide within New Zealand and internationally.

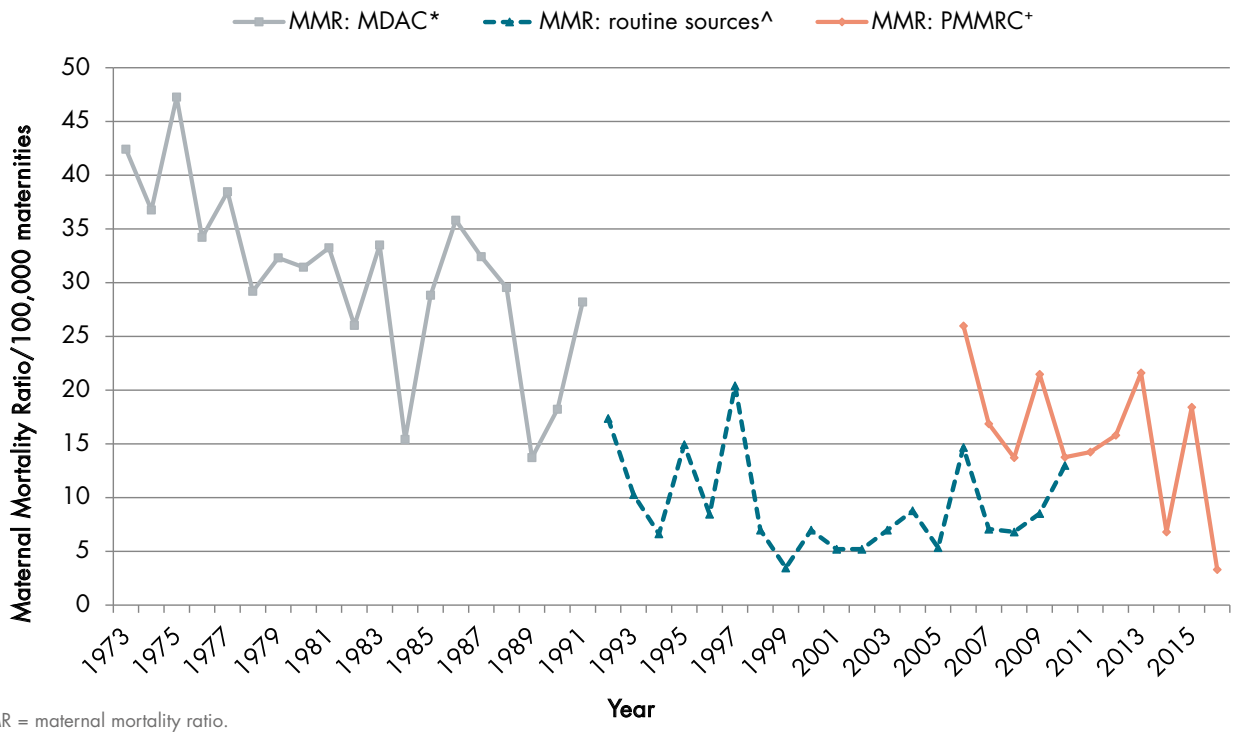
5.4 Findings

Figure 5.1: Maternal mortality ratios (per 100,000 maternities) (rolling one-year and three-year) 2006–2016



MMR = maternal mortality ratio.
Three-year rolling MMR represented at final year of triennium.

Figure 5.2: New Zealand maternal mortality ratio (per 100,000 maternities) by mortality data source 1973–2016



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 Births, Deaths and Marriages (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.

Table 5.1: Maternal mortality ratios (per 100,000 maternities) and cause of maternal death 2006–2016

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2006–2016 n=107		2006–2016 Cause specific ratio /100,000 maternities
	n	n	n	n	n	n	n	n	n	n	n	n	%	
Maternities	61,484	65,202	65,624	65,198	65,445	63,236	63,274	60,133	60,073	59,768	60,576	-	-	
Direct maternal death	**10**	**5**	**7**	**8**	**5**	**4**	**5**	**8**	**2**	**8**	**1**	**63**	**58.9**	**9.13**
Pregnancies with abortive outcome	-	1	-	-	-	-	-	1	-	-	-	2	1.9	0.29
Hypertensive disorders	-	2	1	1	-	-	-	-	-	-	-	4	3.7	0.58
Obstetric haemorrhage	1	-	1	-	-	-	-	-	1	-	-	3	2.8	0.43
Pregnancy-related infection	2	-	-	-	-	1	1	2	-	-	-	6	5.6	0.87
Other obstetric complications														
Amniotic fluid embolism	3	-	1	4	1	-	1	2	-	1	-	13	12.1	1.88
Venous thrombo-embolism	-	1	1*	-	-	1	-	-	1	2	-	6	5.6	0.87
Suicide	4	-	3	3	4	2	3	3	-	5	1	28	26.2	4.06
Other#	-	1	-	-	-	-	-	-	-	-	-	1	0.9	0.14
Indirect maternal death	**4**	**5**	**2**	**6**	**4**	**4**	**5**	**4**	**1**	**3**	**1**	**39**	**36.4**	**5.65**
Cardiac	2	1	1	-	1	1	4	-	-	-	-	10	9.3	1.45
Neurological	1	1	-	1	1	2	1	2	-	1	1	11	10.3	1.59
Infections not a direct result of pregnancy	-	1	-	5	1	-	-	1	-	-	-	8	7.5	1.16
Other non-obstetric complications+	1	2	1	-	1	1	-	1	1	2	-	10	9.3	1.45
Unknown/undetermined^	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	**5**	**4.7**	**0.72**
Total maternal deaths	**15**	**11**	**9**	**14**	**9**	**9**	**10**	**13**	**4**	**11**	**2**	**107**	**100.0**	**15.51**
Single-year MMR	24.40	16.87	13.71	21.47	13.75	14.23	15.80	21.62	6.66	18.40	3.30	-	-	-
Three-year rolling MMR	-	-	**06-08**	**07-09**	**08-10**	**09-11**	**10-12**	**11-13**	**12-14**	**13-15**	**14-16**	-	-	-
			18.20	17.34	16.30	16.51	14.59	17.15	14.72	15.56	9.42	-	-	-
Coincidental deaths	**1**	**3**	**1**	**-**	**3**	**3**	**5**	**-**	**-**	**1**	**5**	**22**	**-**	**-**

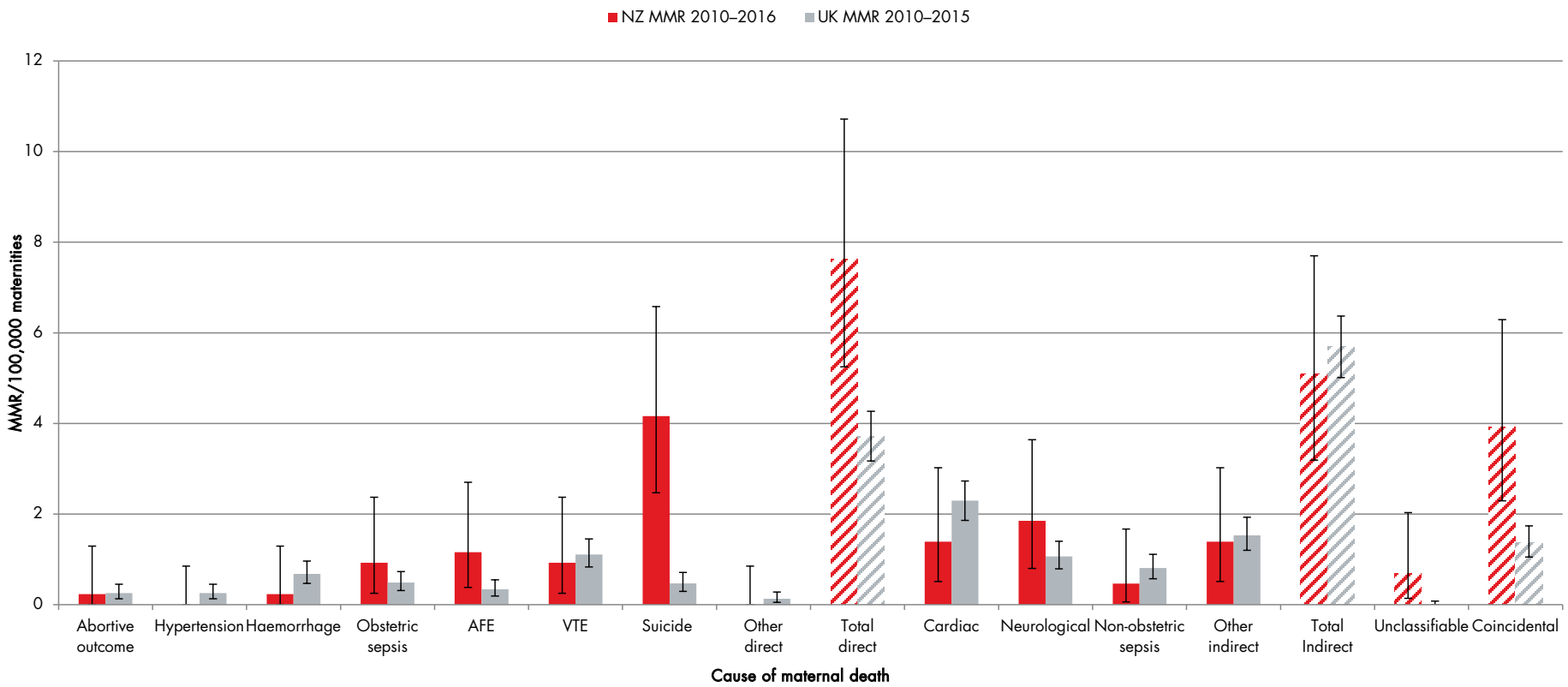
* Pulmonary embolism and sepsis .
# Other direct includes cardiomyopathy.
+ Other non-obstetric complications include endocrine, respiratory, neoplasm, other pre-existing medical.
^ Unknown/undetermined – 3 fully investigated, 2 no investigation.
MMR = maternal mortality ratio.

Table 5.2: Demographic characteristics among maternal deaths 2006–2016

	Maternities		Maternal deaths														
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016			2006–2016	
	N=690,013		n=15	n=11	n=9	n=14	n=9	n=9	n=10	n=13	n=4	n=11	n=2	n=107		Maternal mortality ratio	95% CI
	N	%	n	n	n	n	n	n	n	n	n	n	n	n	%	/100,000 maternities	
Maternal age (years)																	
<20	44,351	6.4	-	-	1	1	1	1	2	-	-	-	-	6	5.6	13.53	4.96–29.45
20–24	123,400	17.9	3	2	-	-	-	1	3	3	-	1	1	14	13.1	11.35	6.20–19.04
25–29	175,341	25.4	3	1	3	4	3	3	1	5	2	2	-	27	25.2	15.40	10.15–22.40
30–34	198,585	28.8	2	5	3	4	1	1	2	3	-	4	1	26	24.3	13.09	8.55–19.18
35–39	119,822	17.4	4	2	2	3	2	2	2	-	1	3	-	21	19.6	17.53	10.85–26.79
≥40	28,259	4.1	3	1	-	2	2	1	-	2	1	1	-	13	12.1	46.00	24.49–78.67
Unknown	255	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethnicity (prioritised)																	
Māori	175,729	25.5	9	2	4	4	3	5	8	4	-	3	1	43	40.2	24.47	17.71–32.96
Pacific peoples	77,528	11.2	1	2	-	6	3	3	-	1	1	-	-	17	15.9	21.93	12.77–35.11
Indian	26,006	3.8	1	1	-	1	-	-	-	-	-	-	-	3	2.8	11.54	2.38–33.71
Other Asian	58,144	8.4	-	-	2	1	-	-	-	2	-	1	-	6	5.6	10.32	3.79–22.46
MELAA	13,532	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other European	66,014	9.6	1	1	-	-	-	-	-	-	-	1	-	3	2.8	4.54	0.94–13.28
NZ European	272,556	39.5	3	5	3	2	3	1	2	6	3	6	1	35	32.7	12.84	8.94–17.86
Unknown/Other	504	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Deprivation quintile																	
1 (least deprived)	96,667	14.0	1	2	1	2	3	-	-	1	-	1	-	11	10.3	11.38	5.68–20.36
2	104,606	15.2	1	1	1	1	-	1	2	2	2	-	-	11	10.3	10.52	5.25–18.82
3	125,187	18.1	4	1	2	2	-	4	1	3	2	3	1	23	21.5	18.37	11.65–27.57
4	159,133	23.1	3	3	2	4	3	-	3	4	-	4	-	26	24.3	16.34	10.67–23.94
5 (most deprived)	198,084	28.7	6	4	3	5	3	4	4	3	-	3	1	36	33.6	18.17	12.73–25.16
Unknown	6,336	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parity																	
0	*	*	2	4	5	1	3	1	4	3	2	3	1	29	27.1	*	*
1–3	*	*	7	4	3	8	4	5	5	7	2	7	1	53	49.5	*	*
4+	*	*	5	3	1	5	2	3	1	2	-	1	-	23	21.5	*	*
Unknown	*	*	1	-	-	-	-	-	-	1	-	-	-	2	1.9	*	*

* Parity denominator data unreliable.
MELAA = Middle Eastern, Latin American or African

Figure 5.3: Cause-specific maternal mortality ratios (per 100,000 maternities) in New Zealand 2010–2016 and the UK 2010–2015 (with 95% CIs)



MMR = maternal mortality ratio.
AFE = amniotic fluid embolism.
VTE = venous thromboembolism.
'Other direct' includes cardiomyopathy.
'Other indirect' includes endocrine, respiratory, neoplasm, other pre-existing medical.
Coincidental includes motor vehicle accident, external causes of accidental injury, assault, malignancy not related to pregnancy.
The shaded bars represent total of direct, indirect, unclassifiable and coincidental deaths.

Table 5.3: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) and year 2006–2016

	Maternal mortality ratio		
	N	n	ratio
Māori			
2006–2008	49,930	15	30.04
2009–2011	50,096	12	23.95
2012–2014	45,713	12	26.25
2014–2016	44,624	4	8.96
New Zealand European			
2006–2008	80,538	11	13.66
2009–2011	78,175	6	7.68
2012–2014	70,062	11	15.70
2014–2016	66,349	10	15.07

Emerging themes and practice points

Ectopic pregnancy

Emerging themes in care of women with pregnancy of unknown location

Some women with ectopic pregnancy will not have typical symptoms or signs.

A high index of suspicion should be maintained in early pregnancy if the location of the pregnancy has not been confirmed on scan, as rupture of an ectopic pregnancy can be associated with catastrophic internal bleeding and death.

Early pregnancy scans need to be interpreted with human chorionic gonadotropin (hCG) levels. These should be interpreted with the advice of the gynaecology service or based on gynaecology protocols.

Timing of follow up and responsibility for follow up should be clearly planned and communicated.

Collapse in a woman of reproductive age should include a differential diagnosis of ectopic pregnancy.

Collapse due to ectopic pregnancy requires rapid assessment and surgical management, as delay increases the risk of cardiac arrest and death.

Practice point: Psychosocial health and 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.

Suicide is a leading cause of maternal mortality, with Māori women and young women (<20 years old) over-represented among maternal suicides.

Psychosocial health screening

Early during a woman's contact with health services, including request for termination of pregnancy, a comprehensive assessment of her psychosocial health and risk factors should be undertaken. This will involve identifying:

- her 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
- any previous and current experience of family violence, sexual abuse and assault
- a history of termination of pregnancy or miscarriage in the previous 12 months
- any past or present mental illness, including self-harm and previous suicide attempts, use of alcohol and other drugs
- any past or present treatment by a specialist mental health service, including in-patient care
- a family history of severe mental illness, including perinatal mental illness or suicide in a first degree relative.

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

Communication

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.

Care provision

Women who have a history of severe mental illness (eg, severe depression/bipolar disorder/psychosis) 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, with advice around avoiding sleep deprivation.

Mental health medications should not be stopped without review by a doctor and risk–benefit analysis. Consultation with a perinatal psychiatrist should be considered.

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.

Doctors who refer women for termination of pregnancy should actively follow up these women to ensure they have their free post-termination of pregnancy check, which should specifically include assessment of mental health status.

Acute mental health episodes

Any of the following identified at any time suggests a serious mental illness and requires urgent (same day) assessment by mental health services, including early consultant psychiatrist review and consultation with perinatal mental health services:

- suicidal ideation (new or increasing thoughts) and/or thoughts to harm baby or others
- 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.

Maternal Mental Health Birth Plan *(example)*

MATERNAL MENTAL HEALTH PRE-BIRTH PLAN FOR:

Name: _____ NHI: _____ EDD: ____/____/____ Date: ____/____/____

KEY CONTACTS: *(List all including contacts details for mental health professionals)*

Name: **Phone:**

BACKGROUND INFORMATION AND RATIONALE FOR PRE-BIRTH PLAN:

Brief social and psychiatric history. Risk of postpartum psychosis.

AREAS OF CONCERN:

Mental Health

Current mental health and what care has been provided. Current medications, planned changes, and safety in pregnancy and breastfeeding.

Alcohol and Other Drugs

Current and previous use.

Medical

Current medical conditions (non-mental health).

Social Situation

Family support – partner, extended family. Child protection services involvement, family violence.

Neonatal

Any additional monitoring or neonatal input that may be recommended.

PRE-BIRTH PLAN

ANTENATAL:

Details of antenatal care and secondary consultations.

Details of psychiatric care.

LABOUR/BIRTH:

Support persons during labour (who will be present).

Details of preferences for labour and birth. Use of PRN medications.

Any history of trauma. Previous birth experiences.

POSTPARTUM – HOSPITAL:

Consider single room/support person staying.

Preference to breastfeed/bottle feed.

Extended admission for additional support, monitoring of mental health, and establishment of breastfeeding.

POSTPARTUM – COMMUNITY:

Support and follow-up.

In the event that (Name) becomes unable to care for herself or her baby, the following things are to occur:

Signs and symptoms that (Name) is becoming unwell:

Things that (Name) can do to remain well:

Appendix A: Summary of Key PMMRC Recommendations and Progress 2006–2014 Data

Recommendation PMMRC 1st – 10th reports	Progress to date (2018)
Perinatal mortality	
Methodology	
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.	**Update 2018** The revision of the PSANZ-PDC system is complete. Improvements allow for the identification of babies dying with significant placental pathology. The new version has been used for the classification of cause of perinatal death as of 1 January 2018. These can be found at: https://sanda.psanz.com.au/assets/Uploads/Section-7-PSANZ-Classification-of-perinatal-deaths-V3-23032018.pdf.
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 anomaly 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. See https://www.healthpoint.co.nz/download,546672.do. 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: https://quit.org.nz/reasons-to-quit/smoking-and-pregnancy https://www.smokefreesolutions.co.nz/innov8urpractice http://www.health.govt.nz/our-work/preventative-health-wellness/healthy-families-nz 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 anomalies	
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 2016, p 57). 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://www.nsfl.health.govt.nz/apps/nsfl.nsf/pagesmh/444. 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 2018** *The Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* (Ministry of Health 2012a) are under review. This work will include reviewing up-to-date evidence related to maternal epilepsy and will be completed by June 2019.

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 2018** The *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)* are under review. This work will be completed by June 2019.
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.	**Update 2018** The Accident Compensation Corporation (ACC) NE Taskforce has produced four national initiatives to look at reducing the incidence of neonatal encephalopathy. These are as follows: • Fetal Growth Assessment Protocol (GAP) • Fetal heart monitoring education • Newborn observation chart and Newborn Early Warning Score (NEWS) • Fetal cord blood lactate testing. Working Groups have been established comprising relevant experts and representatives to deliver the projects. The NE Taskforce will be providing clinical governance for the implementation activities of the Working Groups. See 'Practice Point: Recognising the Baby at Risk of Neonatal Encephalopathy' in the ninth report (PMMRC 2015, p 147).

Recommendation PMMRC 1st – 9th reports	Progress to date (June 2017)
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. Local review at place of birth occurred in 63 percent of babies with NE born in 2016. For more details, see "Local review of neonatal encephalopathy at place of birth 2016" on page 75.
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.
Arterial and venous cord gas analysis 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 and reported within each DHB maternity quality and safety programme. See "Management of Umbilical Cord Blood Results" on page 85.
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: Psychosocial health and maternal suicide" on page 149.
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: Psychosocial health and maternal suicide" on page 149.

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: Psychosocial health and maternal suicide" on page 149.
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: References and Bibliography

Abortion Supervisory Committee. 2009. *Standards of care for women requesting induced abortion in New Zealand: Report of a Standards Committee to the Abortion Supervisory Committee*. URL: https://www.parliament.nz/resource/mi-nz/51SCJE_EVI_51DBHOH_PET63021_1_A442134/583f36ba6da6dfd77204dbf8d5f82ca6adb089bd (accessed April 2018).

Allen + Clarke. 2015. *Evaluation of the Maternity Quality and Safety Programme*. Wellington: Ministry of Health. URL: www.health.govt.nz/publication/evaluation-maternity-quality-and-safety-programme (accessed March 2018).

American College of Obstetricians and Gynecologists. 2014. Executive Summary: Neonatal Encephalopathy and Neurologic Outcome, Second Edition. *Obstetrics and Gynecology* 123: 896–901. URL: http://pediatrics.aappublications.org/content/133/5/e1482 (accessed April 2018).

Antenatal Corticosteroid Clinical Practice Guidelines Panel. 2015. *Antenatal corticosteroids given to women prior to birth to improve fetal, infant, child and adult health: New Zealand and Australian Clinical Practice Guidelines*. Liggins Institute, University of Auckland, Auckland. New Zealand. URL: http://www.ligginstrials.org/ANC_CPG/downloads/Antenatal_Corticosteroid_Clinical_Practice_Guidelines.pdf (accessed April 2018).

Arnaez J, García-Alix A, Arca G, et al. 2018. Population-based study of the national implementation of therapeutic hypothermia in infants with hypoxic-ischemic encephalopathy. *Therapeutic Hypothermia and Temperature Management* 8(1): 24–9. URL: http://doi.org/10.1089/ther.2017.0024 (accessed April 2018).

Atkinson J, Salmond C, Crampton P. 2014. *NZDep2013 Index of Deprivation*. Wellington: Department of Public Health, University of Otago. URL: http://www.otago.ac.nz/wellington/otago069936.pdf (accessed April 2018).

Auckland District Health Board. 2017. *Fetal Surveillance Policy*. URL: http://nationalwomenshealth.adhb.govt.nz/Portals/0/Documents/Policies/Fetal-Surveillance-Policy_.pdf (accessed March 2018).

Australian Institute of Health and Welfare 2016. *Australia's mothers and babies 2014 – in brief*. Perinatal statistics series no. 32. Cat no. PER 87. Canberra: Australian Institute of Health and Welfare. URL: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129557657 (accessed March 2018).

Australian Institute of Health and Welfare 2017. *Australia's mothers and babies 2015 – in brief*. Perinatal statistics series no. 33. Cat no. PER 91. Canberra: Australian Institute of Health and Welfare. URL: https://www.aihw.gov.au/reports/mothers-babies/australias-mothers-babies-2015-in-brief/data (accessed June 2018).

Australian Institute of Health and Welfare 2018. *Perinatal deaths in Australia: 2013–2014*. Cat. no. PER 94. Canberra: Australian Institute of Health and Welfare. URL: https://www.aihw.gov.au/getmedia/78784f2e-2f61-47ea-9908-84b34441ae0a/aihw-per-94.pdf.aspx?inline=true (accessed June 2018).

Baddock SA, Tipene-Leach D, Williams S, et al. 2017. Wahakura versus bassinet for safe infant sleep: a randomised trial. *Pediatrics* 139(2): e20160162. URL: http://pediatrics.aappublications.org/content/pediatrics/139/2/e20160162.full.pdf?download=true (accessed April 2018).

Battin M on behalf of the Newborn Clinical Network Clinical Reference Group. 2015. *Consensus Statement for Treatment of Neonatal Encephalopathy*. Newborn Clinical Network. URL: https://www.starship.org.nz/media/360500/neonatal_encephalopathy_october_2015.pdf (accessed March 2018).

Bauer A, Parsonage M, Knapp M, et al. 2014. *Costs of perinatal mental health problems*. London: London School of Economics and Political Science. URL: http://eprints.lse.ac.uk/59885/ (accessed April 2018).

Becares L, Atatoa-Carr P. 2016. The association between maternal and partner experienced racial discrimination and prenatal perceived stress, prenatal and postnatal depression: findings from the growing up in New Zealand cohort study. *International Journal for Equity in Health* 15(1): 155. URL: https://www.ncbi.nlm.nih.gov/pubmed/27658457 (accessed April 2018).

Ben J, Cormack D, Harris R, et al. 2017. Racism and health service utilisation: A systematic review and meta-analysis. *PLoS One* 12(12): e0189900. URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0189900 (accessed May 2018).

Berry MJ, Saito-Benz M, Gray C, et al. 2017. Outcomes of 23- and 24-weeks gestation infants in Wellington, New Zealand: A single centre experience. *Scientific Reports 7*: 12769. URL: https://doi.org/10.1038/s41598-017-12911-5 (accessed March 2018).

Boland RA, Dawson JA, Davis PG, et al. 2015. Why birthplace still matters for infants born before 32 weeks: Infant mortality associated with birth at 22–31 weeks' gestation in non-tertiary hospitals in Victoria over two decades. *Australian and New Zealand Journal of Obstetrics and Gynaecology 55*: 163–9. URL: https://doi.org/10.1111/ajo.12313 (accessed March 2018).

Clifford A, McCalman J, Bainbridge R, et al. 2015. Interventions to improve cultural competency in health care for Indigenous peoples of Australia, New Zealand, Canada and the USA: a systematic review. International Journal for Quality in Health Care 27(2): 89–98. URL: https://doi.org/10.1093/intqhc/mzv010 (accessed April 2018).

Crengle S, Robinson E, Ameratunga S, et al. 2012. Ethnic discrimination prevalence and associations with health outcomes: data from a nationally representative cross-sectional survey of secondary school students in New Zealand. BMC Public Health 12: 45. URL: https://doi.org/10.1186/1471-2458-12-45 (accessed April 2018).

Cronin R, Li M, Wise M, et al. 2018. Late stillbirth post mortem examination in New Zealand: Maternal decision-making. Australian and New Zealand Journal of Obstetrics and Gynaecology 2018: 1–7. URL: https://obgyn.onlinelibrary.wiley.com/doi/full/10.1111/ajo.12790 (accessed April 2018).

CYMRC. 2017. Sudden unexpected death in infancy (SUDI): Special report. June 2017. Wellington: CYMRC. URL: https://www.hqsc.govt.nz/assets/CYMRC/Publications/CYMRC_SUDI_Report.pdf (accessed March 2018).

Darlow BA, Campbell N, Austin N, et al. 2015. The prevention of early onset neonatal group B streptococcus infection: New Zealand Consensus Guidelines 2014. *The New Zealand Medical Journal* 128(145): 6727. URL: https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vol-128-no-1425-20-november-2015/6727 (accessed March 2018).

Darlow BA, Voss L, Lennon DR, et al. 2016. Early-onset neonatal group B streptococcus sepsis following national risk-based prevention guidelines. *Australian and New Zealand Journal of Obstetrics and Gynaecology 56*: 69–74. URL: http://dx.doi.org/10.1111/ajo.12378 (accessed March 2018).

Dehon E, Weiss N, Jones J, et al. 2017. A systematic review of the impact of physician implicit racial bias on clinical decision making. *Academic Emergency Medicine* 24(8): 895–904. URL: https://doi.org/10.1111/acem.13214 (accessed May 2018).

Dodd JM, Jones L, Flenady V, et al. 2013. Prenatal administration of progesterone for preventing preterm birth in women considered to be at risk of preterm birth. *Cochrane Database of Systematic Reviews 7*: CD004947. URL: http://cochranelibrary-wiley.com/doi/10.1002/14651858.CD004947.pub3/abstract (accessed May 2018).

Draper E, Kurinczuk J, Lamming C, et al. 2002. A confidential enquiry into cases of neonatal encephalopathy. *Archives of Disease in Childhood: Fetal and Neonatal Edition* 87(3): F176–80. URL: http://fn.bmj.com/content/87/3/F176.full (accessed April 2018).

Farquhar C, Sadler L, Masson V, et al. 2011. Beyond the numbers: classifying contributory factors and potentially avoidable maternal deaths in New Zealand, 2006–2009. *American Journal of Obstetrics & Gynecology* 205(4): 331.e1–8. URL: http://www.sciencedirect.com/science/article/pii/S0002937811009616 (accessed April 2018).

Hall WJ, Chapman MV, Lee KM, et al. 2015. Implicit racial/ethnic bias among health care professionals and its influence on health care outcomes: a systematic review. A*merican Journal of Public Health* 105(12): e60–76. URL: https://www.ncbi.nlm.nih.gov/pubmed/26469668 (accessed May 2018).

Harris R, Cormack D, Stanley J, et al. 2018. Ethnic bias and clinical decision-making among New Zealand medical students: an observational study. *BMC Medical Education* 18(1): 18. URL: https://doi.org/10.1186/s12909-018-1120-7 (accessed April 2018).

Harris R, Cormack D, Tobias M, et al. 2012a. The pervasive effects of racism: experiences of racial discrimination in New Zealand over time and associations with multiple health domains. *Social Science & Medicine* 74(3): 408–15. URL: http://dx.doi.org/10.1016/j.socscimed.2011.11.004 (accessed April 2018).

Harris R, Cormack D, Tobias M, et al. 2012b. Self-reported experience of racial discrimination and health care use in New Zealand: results from the 2006/07 New Zealand Health Survey. *American Journal of Public Health* 102(5): 1012–19. URL: http://dx.doi.org/10.2105/AJPH.2011.300626 (accessed April 2018).

Harris R, Tobias M, Jeffreys M, et al. 2006. Racism and health: the relationship between experience of racial discrimination and health in New Zealand. *Social Science & Medicine* 63(6): 1428–41. URL: http://dx.doi.org/10.1016/j.socscimed.2006.04.009 (accessed April 2018).

Heino A, Gissler M. 2016. *Pohjoismaiset perinataalitilastot 2014*. (Perinatal statistics in the Nordic countries 2014). Tilastoraportti-Statistikrapport-Statistical report/Terveyden ja hyvinvoinnin laitos (THL). URL: http://www.julkari.fi/bitstream/handle/10024/130261/Tr04_16.pdf?sequence=1 (accessed April 2018).

Hobbs MR, Morton SM, Atatoa-Carr P, et al. 2017. Ethnic disparities in infectious disease hospitalisations in the first year of life in New Zealand. *Journal of Paediatrics and Child Health* 53(3): 223–31. URL: https://doi.org/10.1111/jpc.13377 (accessed April 2018).

Horvat L, Horey D, Romios P, et al. 2014. Cultural competence education for health professionals. *Cochrane Database of Systematic Reviews 5*: CD009405. URL: http://dx.doi.org/10.1002/14651858.CD009405.pub2 (accessed April 2018).

Jacobs S, Berg M, Hunt R, et al. 2013. Cooling for newborns with hypoxic ischaemic encephalopathy (Review). *Cochrane Database of Systemic Reviews* 1: CD003311. URL: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003311.pub3/abstract (accessed March 2018).

Kernaghan D, Penney G. 2006. Do panels vary when assessing intrapartum adverse events? The reproducibility of assessments by hospital risk management groups. *Quality and Safety in Health Care* 15: 359–62. URL: http://qualitysafety.bmj.com/content/15/5/359.abstract (accessed April 2018).

Keelan JA, Newnham JP. 2017. Recent advances in the prevention of preterm birth. *F1000Research* 6: 1139. doi:10.12688/f1000research.11385.1.

Knight M, Nair M, Tuffnell D, et al (eds) on behalf of MBRRACE-UK. 2016. *Saving Lives, Improving Mothers' Care – Surveillance of maternal deaths in the UK 2012-14 and lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009–14*. Oxford: National Perinatal Epidemiology Unit. URL: https://www.npeu.ox.ac.uk/downloads/files/mbrrace-uk/reports/MBRRACE-UK%20Maternal%20Report%202016%20-%20website.pdf (accessed March 2018).

Kyser KL, Morriss FH Jr., Bell EF, et al. 2012. Improving survival of extremely preterm infants born between 22 and 25 weeks of gestation. *Obstetrics and Gynecology* 119(4): 795–800. URL: https://www.ncbi.nlm.nih.gov/pubmed/22433343 (accessed March 2018).

The Lancet. 2016. *Ending Preventable Stillbirths Series 2016: An Executive Summary for* The Lancet's *Series*. URL: http://www.thelancet.com/pb/assets/raw/Lancet/stories/series/stillbirths2016-exec-summ.pdf (accessed April 2018).

Lavezzi AM, Matturri L. 2012. Neuroanatomical dysmorphology of the medial superior olivary nucleus in sudden fetal and infant death. *Frontiers in Human Neuroscience* 6: 322. URL: http://doi.org/10.3389/fnhum.2012.00322 (accessed March 2018).

Lavezzi AM, Ottaviani G, Mauri M, et al. 2004. Hypoplasia of the arcuate nucleus and maternal smoking during pregnancy in sudden unexplained perinatal and infant death. *Neuropathology* 24: 284–9. URL: http://dx.doi.org/10.1111/j.1440-1789.2004.00558.x (accessed March 2018).

Lee AC, Kozuki N, Blencowe H, et al. 2013. Intrapartum-related neonatal encephalopathy incidence and impairment at regional and global levels for 2010 with trends from 1990. *Pediatric Research* 74(1): 50–72. URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3873711/ (accessed April 2018).

Lewis G (ed). 2007. *Saving Mothers' Lives: Reviewing maternal deaths to make motherhood safer – 2003–2005. The Seventh Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom*. London: Confidential Enquiry into Maternal and Child Health. URL: http://www.publichealth.hscni.net/sites/default/files/Saving%20Mothers'%20Lives%202003-05%20.pdf (accessed April 2018).

Maina IW, Belton TD, Ginzberg S, et al. 2018. A decade of studying implicit racial/ethnic bias in healthcare providers using the implicit association test. *Social Science & Medicine* 199: 219–29. URL: https://doi.org/10.1016/j.socscimed.2017.05.009 (accessed May 2018).

Malouf R, Redshaw M. 2017. Specialist antenatal clinics for women at high risk of preterm birth: a systematic review of qualitative and quantitative research. *BMC Pregnancy and Childbirth* 17: 51. URL: http://doi.org/10.1186/s12884-017-1232-9 (accessed March 2018).

Manktelow BN, Smith LK, Seaton SE, et al (eds) on behalf of the MBRRACE-UK Collaboration. 2016. *MBRRACE-UK Perinatal Mortality Surveillance Report, UK Perinatal Deaths for Births from January to December 2014. Leicester: The Infant Mortality and Morbidity Studies, Department of Health Sciences, University of Leicester*. URL: https://www.npeu.ox.ac.uk/downloads/files/mbrrace-uk/reports/MBRRACE-UK-PMS-Report-2014.pdf (accessed March 2018).

Māori Affairs Committee. 2017. *Inquiry into whānau access to and management of tūpāpaku*. URL: https://www.parliament.nz/resource/en-NZ/SCR_74938/3000078c67ea58eba1a0a30a4edb163c44a42c45 (accessed April 2018).

McManemy J, Cooke E, Amon E, et al. 2007. Recurrence risk for preterm delivery. *American Journal of Obstetrics & Gynecology* 196(6): 576-e1. URL: https://www.ajog.org/article/S0002-9378(07)00152-4/pdfSummary (accessed May 2018).

Ministry of Health. 2012a. *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/referral-glines-jan12.pdf (accessed April 2018).

Ministry of Health. 2012b. *Healthy Beginnings: Developing perinatal and infant mental health services in New Zealand*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/healthy-beginnings-final-jan2012.pdf.pdf (accessed March 2018).

Ministry of Health. 2012c. *Observation of Mother and Baby in the Immediate Postnatal Period: Consensus statements guiding practice*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/observation-mother-baby-immediate-postnatal-period-consensus-statements.pdf (accessed March 2018).

Ministry of Health. 2016. *Keeping baby safe in bed: the first 6 weeks*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/your-health/pregnancy-and-kids/first-year/first-6-weeks/keeping-baby-safe-bed-first-6-weeks (accessed April 2018).

Ministry of Health. 2017a. *Delivering better public services*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/delivering-better-public-services-result-actions-2-3-jun17.pdf (accessed March 2018).

Ministry of Health. 2017b. *Report on Maternity 2015*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/system/files/documents/publications/report-on-maternity-2015-updated_12122017.pdf (accessed March 2018).

Ministry of Health. 2017c. *Health Information Standards Organisation (HISO) Ethnicity Data Protocols*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/publication/hiso-100012017-ethnicity-data-protocols (accessed April 2018).

Moore ER, Bergman N, Anderson GC, et al. 2016. Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database of Systematic Reviews* 11: CD003519. URL: http://dx.doi.org/10.1002/14651858.CD003519.pub4 (accessed March 2018).

Monsieurs KG, Nolan JP, Bossaert LL, et al on behalf of the ERC Guidelines 2015 Writing Group. 2015. European Resuscitation Council Guidelines for Resuscitation 2015 Section 1. Executive summary. *Resuscitation* 95: 1–80. URL: http://dx.doi.org/10.1016/j.resuscitation.2015.07.038 (accessed April 2018).

Myrhaug HT, Brurberg KG, Hov L, et al. 2017. Prognosis and Follow-Up of Extreme Preterm Infants: A Systematic Review. *Folkehelseinstituttet*. URL: https://www.fhi.no/en/publ/2017/prognose-for-og-oppfolging-av-ekstremt-premature-barn-en-systematisk-oversi/ (accessed May 2018).

National Health Board Business Unit. 2011. *National Maternity Collection Data Mart Data Dictionary*. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/mat-dict-v1-0.pdf (accessed April 2018).

Nelson KB, Leviton A. 1991. How much of neonatal encephalopathy is due to birth asphyxia? *American Journal of Diseases of Children* 145(11): 1325–31. URL: http://jamanetwork.com/journals/jamapediatrics/fullarticle/515935 (accessed April 2018).

Newnham JP, White SW, Meharry S, et al. 2017. Reducing preterm birth by a statewide multifaceted program: an implementation study. *American Journal of Obstetrics & Gynecology* 216(5): 434-42. URL: https://www.ajog.org/article/S0002-9378(16)32063-4/abstract (accessed May 2018).

New Zealand Guidelines Group. 2008. *Identification of common mental disorders and management of depression in primary care. An evidence-based best practice guideline*. Wellington: New Zealand Guidelines Group. URL: https://www.health.govt.nz/system/files/documents/publications/depression_guideline.pdf (accessed March 2018).

New Zealand Maternal Fetal Medicine Network. 2013. *Guideline for the management of suspected small for gestational age singleton pregnancies after 34 weeks' gestation*. URL: https://www.asum.com.au/wp-content/uploads/2015/09/NZMFM-SGA-Guideline-September-2013.pdf (accessed May 2018).

NICE. 2014. *Antenatal and postnatal mental health: clinical management and service guidance*. London: National Institute for Health and Care Excellence. URL: https://www.nice.org.uk/guidance/cg192 (accessed March 2018).

NMMG. 2015. *National Maternity Monitoring Group Annual Report 2015*. Wellington: Ministry of Health. URL: http://www.health.govt.nz/system/files/documents/publications/national-maternity-monitoring-group-annual-report-2015-dec15.pdf (accessed April 2018).

PMMRC. 2007. *First Report to the Minister of Health: June 2005 to June 2007*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/First-PMMRC-report-2005-07.pdf (accessed April 2018).

PMMRC. 2011. *Fifth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2009*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/Fifth-PMMRC-report-2009-Lkd.pdf (accessed April 2018).

PMMRC. 2012. *Sixth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2010*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/PMMRC-6th-Report-2010-Lkd.pdf (accessed April 2018).

PMMRC. 2013. *Seventh Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2011*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/Seventh-PMMRC-Report-FINAL-June-2013.pdf (accessed April 2018).

PMMRC. 2014. *Eighth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2012*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/eighth-PMMRC-report-June-2014.pdf (accessed March 2018).

PMMRC. 2015. *Ninth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2013*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/PMMRC_9th_Report_-_edited_20170825.pdf (accessed April 2018).

PMMRC. 2016. T*enth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2014*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: http://www.hqsc.govt.nz/assets/PMMRC/Publications/tenth-annual-report-FINAL-NS-Jun-2016.pdf (accessed April 2016).

PMMRC. 2017. *Eleventh Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2015*. Wellington: Health Quality & Safety Commission, Perinatal and Maternal Mortality Review Committee. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/2017_PMMRC_Eleventh_Annual_Report.pdf (accessed April 2018).

PSANZ. 2018. *Clinical practice guideline for care around stillbirth and neonatal death*. Section 7: The PSANZ classification system for stillbirths and neonatal deaths. Perinatal Society of Australia and New Zealand. URL: https://sanda.psanz.com.au/assets/Uploads/Section-7-PSANZ-Classification-of-perinatal-deaths-V3-23032018.pdf (accessed May 2018).

Royal College of Obstetricians and Gynaecologists. 2016. *Joining up care in maternal mental health: setting up a perinatal mental health network*. London: Royal College of Obstetricians and Gynaecologists. URL: https://www.rcog.org.uk/globalassets/documents/news/iwd2016/rcog-iwd2016-checklist–perinatal-mental-health-network.pdf (accessed March 2018).

Rysavy MA, Li L, Bell EF, et al. 2015. Between-hospital variation in treatment and outcomes in extremely preterm infants. *The New England Journal of Medicine* 372: 1801–11. URL: http://www.nejm.org/doi/full/10.1056/NEJMoa1410689 (accessed March 2018).

Sadler L, Farquhar C, Masson V, et al. 2016. Contributory factors and potentially avoidable neonatal encephalopathy associated with perinatal asphyxia. *American Journal of Obstetrics and Gynecology*, 214(6): 747-e1. URL: http://dx.doi.org/10.1016/j.ajog.2015.12.037 (accessed April 2018).

Salmond C, Crampton P, Atkinson J. 2007. *NZDep2006 Index of Deprivation*. Wellington: Department of Public Health, University of Otago. URL: http://www.otago.ac.nz/wellington/otago020337.pdf (accessed April 2018).

Sandall J, Soltani H, Gates S, et al. 2016. Midwife-led continuity models versus other models of care for childbearing women. *Cochrane Database of Systematic Reviews* 4: CD004667. URL: http://dx.doi.org/10.1002/14651858.CD004667.pub5 (accessed March 2018).

Sangkomkamhang US, Lumbiganon P, Prasertcharoensuk W, et al. 2015. Antenatal lower genital tract infection screening and treatment programs for preventing preterm delivery. *Cochrane Database of Systematic Reviews 2*: CD006178. URL: http://cochranelibrary-wiley.com/doi/10.1002/14651858.CD006178.pub3/pdf (accessed May 2018).

Sharp M, French N, McMichael J, et al. 2018. Survival and neurodevelopmental outcomes in extremely preterm infants 22–24 weeks of gestation born in Western Australia. *Journal of Paediatrics and Child Health* 54(2): 188–93. URL: http://onlinelibrary.wiley.com/doi/10.1111/jpc.13678/full (accessed March 2018).

SIGN. 2012. *SIGN 127: Management of perinatal mood disorders*. Edinburgh: Scottish Intercollegiate Guidelines Network. URL: http://www.sign.ac.uk/assets/sign127.pdf (accessed March 2018).

Smith PB, Ambalavanan N, Li L, et al. 2012. Approach to infants born at 22 to 24 weeks' gestation: relationship to outcomes of more-mature infants. *Pediatrics* 129(6): e1508–16. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3362905/ (accessed March 2018).

Sullivan EA, Hall B, King JF. 2008. *Maternal deaths in Australia 2003–2005*. Maternal deaths series no. 3. Cat. no. PER 42. Canberra: Australian Institute of Health and Welfare. URL: http://www.aihw.gov.au/publication-detail/?id=6442468086 (accessed April 2018).

Thayer ZM, Kuzawa CW. 2015. Ethnic discrimination predicts poor self-rated health and cortisol in pregnancy: insights from New Zealand. *Social Science & Medicine* 128: 36–42. URL: http://dx.doi.org/10.1016/j.socscimed.2015.01.003 (accessed April 2018).

Travers CP, Carlo WA, McDonald SA, et al. 2018. Mortality and pulmonary outcomes of extremely preterm infants exposed to antenatal corticosteroids. *American Journal of Obstetrics and Gynecology* 218(1): 130.e1–13. URL: https://doi.org/10.1016/j.ajog.2017.11.554 (accessed March 2018).

Truong M, Paradies Y, Priest N. 2014. Interventions to improve cultural competency in healthcare: a systematic review of reviews. *BMC Health Services Research* 14(1): 99.

van Ryn M, Burgess DJ, Dovidio JF, et al. 2011. The impact of racism on clincian cognition, behavior, and clinical decision making. *Du Bois Review: Social Science Research on Race* 8(1): 199–218. URL: http://dx.doi.org/10.1017/S1742058X11000191 (accessed April 2018).

van Ryn M, Fu SS. 2003. Paved with good intentions: Do public health and human service providers contribute to racial/ethnic disparities in health? *American Journal of Public Health* 93(2), 248–55.

Whitworth M, Quenby S, Cockerill RO, et al. 2011. Specialised antenatal clinics for women with a pregnancy at high risk of preterm birth (excluding multiple pregnancy) to improve maternal and infant outcomes. Cochrane Database of Systematic Reviews 9: CD006760. URL: http://cochranelibrary-wiley.com/doi/10.1002/14651858.CD006760.pub2/full (accessed May 2018).

WHO. (nd). Maternal mortality ratio (per 100 000 live births). URL: http://www.who.int/healthinfo/statistics/indmaternalmortality/en/ (accessed April 2018).

WHO. 2006. *Neonatal and Perinatal Mortality: Country, Regional and Global Estimates*. Geneva: World Health Organization. URL: http://apps.who.int/iris/bitstream/10665/43444/1/9241563206_eng.pdf (accessed April 2018).

WHO. 2012. *The WHO Application of ICD-10 to deaths during pregnancy, childbirth and the puerperium: ICD-MM*. Geneva: World Health Organization. URL: http://apps.who.int/iris/bitstream/10665/70929/1/9789241548458_eng.pdf?ua=1 (accessed April 2018).

Appendix C: List of Abbreviations

ACC	Accident Compensation Corporation
aEEG	Amplitude-integrated electroencephalogram
AFE	Amniotic fluid embolism
AGA	Appropriate for gestational age
AGREE	Appraisal of Guidelines for Research and Evaluation
AOR	Adjusted odds ratio
APH	Antepartum haemorrhage
BBA	Born before arrival
BDM	Births, Deaths and Marriages
BMI	Body mass index (kg/m2)
CI	Confidence interval
CTG	Cardiotocograph
CYMRC	Child and Youth Mortality Review Committee
DHB	District health board
EEG	Electroencephalograph
FPA	Family Planning Association
GAP	Growth Assessment Protocol
GP	General practitioner
hCG	Human chorionic gonadotropin
HDC	Health and Disability Commissioner
HISO	Health Information Standards Organisation
ICD-10	ICD-MM tenth revision
ICD-MM	International Classification of Diseases – Maternal Mortality
IPPV	Intermittent positive pressure ventilation
LGA	Large for gestational age
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

MELAA	Middle Eastern, Latin American, or African
MMR	Maternal mortality ratio
MMRWG	Maternal Mortality Review Working Group
MMWG	Maternal Morbidity Working Group
MRI	Magnetic resonance imaging
NDC	Neonatal death classification
NE	Neonatal encephalopathy
NEWG	Neonatal Encephalopathy Working Group
NHI	National Health Index
NICE	National Institute for Health and Care Excellence
NMDS	National Minimum Dataset
NMMG	National Maternity Monitoring Group
NZDep	New Zealand Index of Deprivation
OR	Odds ratio
PDC	Perinatal death classification
PMMRC	Perinatal and Maternal Mortality Review Committee
PSANZ	Perinatal Society of Australia and New Zealand
PSANZ-NDC	PSANZ neonatal death classification
PSANZ-PDC	PSANZ perinatal death classification
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
Sands	Stillbirth and Newborn Death Support
SB	Stillborn
SGA	Small for gestational age
SIDS	Sudden infant death syndrome
SIGN	Scottish Intercollegiate Guidelines Network
SUDI	Sudden unexpected death in infancy
TOP	Termination of pregnancy
UK	United Kingdom
USS	Ultrasound scan
VTE	Venous thromboembolism
WHO	World Health Organization

Appendix D: Key datasets and definitions in the PMMRC 12th report

(for further information see 'Methodology and Definitions for PMMRC Reporting' document on the PMMRC website (www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/3367/)

Chapter	Analyses	Key definitions	Numerator dataset	Denominator dataset
3 Neonatal mortality special topic 5 Perinatal mortality	Deaths only (analyses without denominator)		PMMRC Customised birthweight centile (gestation in days)	NA
4 Neonatal Encephalopathy	Cases only		PMMRC	NA
6 Maternal mortality	Deaths only		PMMRC	NA
RATES				
3 Neonatal mortality special topic	Neonatal mortality rate	per 1000 live births per 1000 ongoing pregnancies (in utero)	PMMRC	MAT
5 Perinatal mortality	Stillbirth rate; Termination of pregnancy rate; Perinatal related mortality rate	per 1000 total births per 1000 ongoing pregnancies (in utero)	PMMRC	MAT
4 Neonatal Encephalopathy	NE rate	per 1000 births per 1000 term births (>=37 weeks gestation)	PMMRC	MAT
6 Maternal mortality	Maternal mortality ratio	per 100,000 maternities (babies from 20 weeks gestation or 400g if gestation unknown)	PMMRC	MAT
3 Neonatal mortality special topic 4 Neonatal Encephalopathy 5 Perinatal mortalities	Analyses of data contained in MAT but not in PMMRC e.g. neonatal survival		MAT: Limited to PMMRC cases merged with MAT	MAT
3 Neonatal mortality special topic 4 Neonatal Encephalopathy 5 Perinatal mortalities	Rates: parity, smoking, BMI, gestation at registration, customised birthweight centile		MAT: Limited to PMMRC cases merged with MAT and mothers who were registered for care with an LMC* Gestation (in weeks) and birthweight for calculation of birthweight centile (PMMRC); all other variables MAT	MAT: Limited to mothers who were registered for care with an LMC* Gestation (in weeks) from MAT
4 Neonatal Encephalopathy	Rates: place of birth		MAT: Limited to PMMRC cases merged with MAT	MAT
MULTIVARIABLE ANALYSIS				
3 Neonatal death special topic	Multivariable analysis		Limited to PMMRC cases merged with MAT; Limited to mothers who were registered for care with an LMC* Gestation, birth weight, plurality, parity, baby sex from PMMRC	MAT: Limited to mothers who were registered for care with an LMC*

MAT=New Zealand Maternity Collection of births from 20 weeks gestation NA not applicable LMC lead maternity carer

* either a midwife, Obstetrician or GP claiming from the Section 88 Primary Maternity Services Notice; limited to births from 2008