Perinatal and Maternal Mortality Review Committee

He matenga ohorere, he wairua uiui, wairua mutungakore

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

Eleventh Annual Report of the Perinatal and Maternal Mortality Review Committee

Maternal mortality 2015

(Full report available online at www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/)

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Perinatal and Maternal Mortality Review Committee

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

- Dr Sue Belgrave (Chair), obstetrician, Waitemata DHB
- Dr Max Berry, neonatologist, University of Otago, Wellington
- Associate Professor Sue Crengle, general practitioner, public health physician, Department of Social and Preventive Medicine, Dunedin School of Medicine, Invercargill
- Ms Alison Eddy (Deputy Chair), midwife, Christchurch
- Dr Rose Elder, obstetrician and gynaecologist, Capital & Coast DHB
- Ms Gail McIver, midwife, Counties Manukau DHB
- Ms Linda Penlington, Sands New Zealand, Wairarapa.

Maternal Mortality Review Working Group

The Maternal Mortality Review Working Group (MMRWG) members in 2017 are:

- Dr Sarah Wadsworth (Chair), obstetrician, Counties Manukau DHB
- Dr Sue Belgrave (Chair PMMRC)
- Dr Eileen Bass, physician, Hutt Valley DHB
- Dr Rose Elder, obstetrician, Capital & Coast DHB
- Dr Lesley Dixon, midwife, Christchurch
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Executive Summary and Recommendations

Findings 2017 Report (Data 2015

Maternal mortality

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

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

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

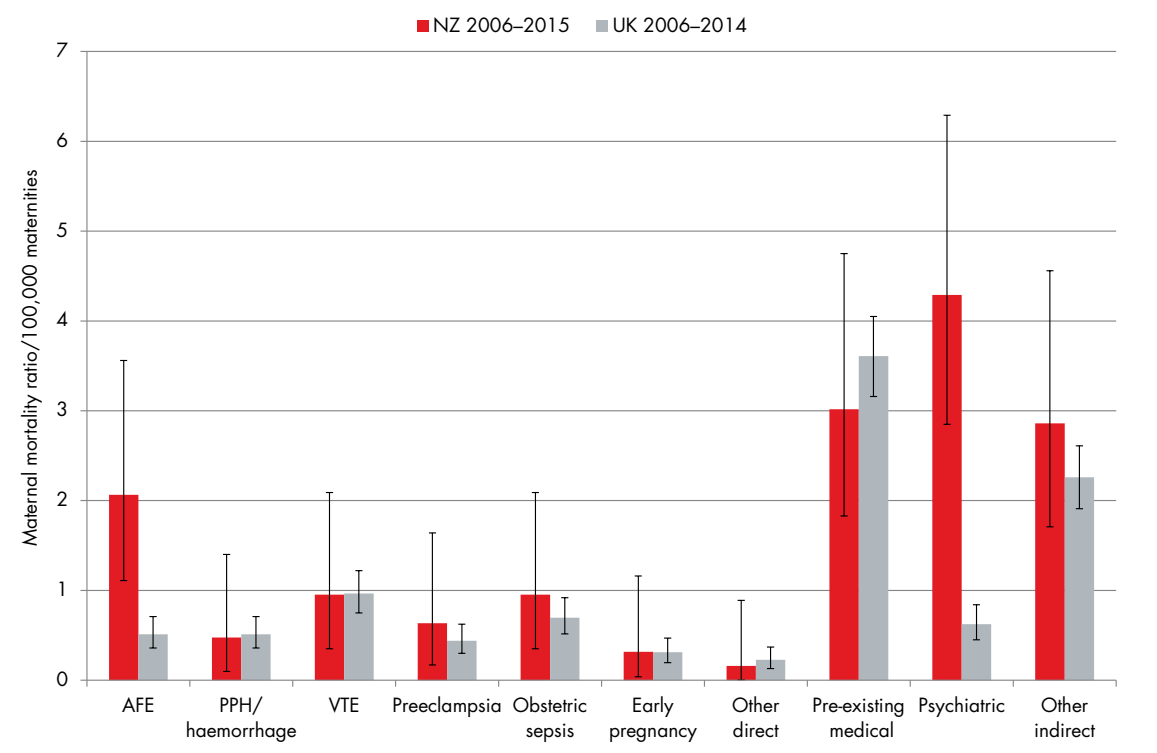
MMR = maternal mortality ratio
Rolling three-year maternal mortality ratio represented at final year of triennium.

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

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

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

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



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

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

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

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

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

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

Māori maternal mortality

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

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

Recommendations

Maternal mortality recommendations

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

Justification:

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

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

Māori maternal suicide

Recommendations from the Mortality Review Committees' Māori Caucus.

Improved awareness and responsiveness to the increased risk for Māori women

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

Justification:

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

Evidence:

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

Risk assessment

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

Justification:

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

Management

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

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

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

Justification:

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

Communication and coordination

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

Justification:

Over half of women had been seen by a general practitioner (GP) or at a Family Planning clinic (but mostly by a GP) in their final pregnancy. Forty percent of women were involved with mental health or alcohol and drug services during their final pregnancy. Some women had multiple services involved in their care – including midwifery, specialist obstetric and mental health services. Service related issues including poor communication between services, poor coordination, and inadequate follow up were identified as were potentially delayed and/or missed diagnoses of physical and/or mental health issues.

Child and Youth Mortality Review

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

Justification:

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

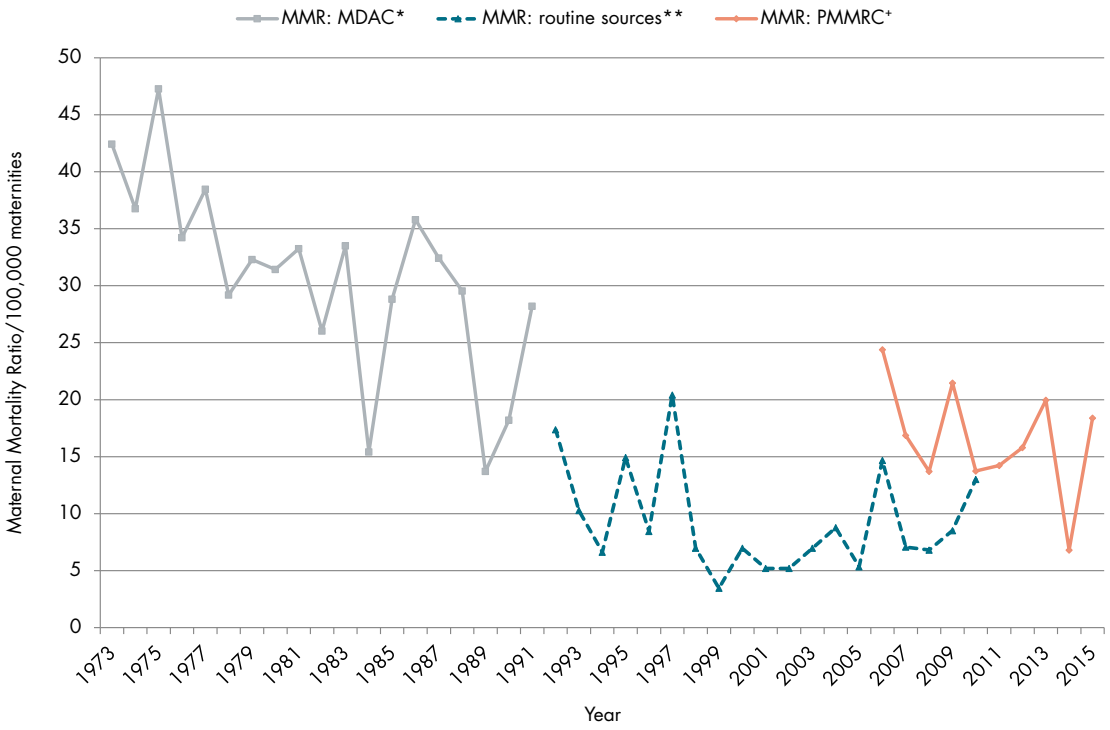
4 New Zealand Maternal Mortality 2015

4.1 Introduction

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

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

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



MMR = maternal mortality ratio.
MDAC = Maternal Deaths Assessment Committee.
* Data from the MDAC, including maternal deaths to three months postpartum.
** Data from routine New Zealand datasets (ie, the BDM Mortality Collection and the National Minimum Dataset, including maternal deaths to six weeks postpartum.
+ Data from the PMMRC, including maternal deaths to six weeks postpartum.

Prior to 1992, maternal mortality in New Zealand was reported by the Maternal Deaths Assessment Committee (MDAC). This committee stopped meeting in 1995, and maternal mortality was then reported from data held in the National Minimum Dataset (NMDS) of hospital discharges and in the Mortality Collection from BDM. During this period of reporting from national datasets, the maternal mortality ratio was considerably lower than it had been during the years of the existence of the MDAC. When the PMMRC was established in 2006, and maternal mortality ratio reported again in the context of mandatory facilitated reporting, the maternal mortality ratio appeared to increase again. In the years 2006–2015 the ratio was 16.7/100,000 maternities, 2.3 times higher than the 7.14/100,000

maternities reported from 1995 to 2005. In reality, the maternal mortality ratio reported from routine data from 1991 to 2006 was artefactually low (Figure 4.1).

As the PMMRC ascertainment process collects more cases than are found in routine datasets, the PMMRC estimate of the New Zealand maternal mortality ratio is necessarily higher, and a comparable ratio should be used when comparing New Zealand ratios with international ratios.

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

4.2 Methodology

Definitions

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

Maternal related death: death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes (WHO n.d.).

The cause of each death is sub-classified using the Confidential Enquiry into Maternal and Child Health classification system (Lewis 2007).

Direct maternal deaths: those resulting from obstetric complications of the pregnant state (pregnancy, labour or puerperium), from interventions, omissions, incorrect treatment or from a chain of events resulting from the above.

Indirect maternal deaths: those resulting from previous existing disease or disease that developed during pregnancy and was not due to direct obstetric causes but that was aggravated by the physiologic effects of pregnancy. All maternal deaths by suicide are included in the New Zealand data as indirect deaths.

Coincidental maternal deaths: deaths from unrelated causes that happen to occur in pregnancy or the puerperium.

These definitions exclude **late maternal deaths**, occurring between 42 days and one year following the birth, even though it is known that some pregnancy related deaths occur in this later period. The MMRWG may consider and review these deaths where they can be identified.

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

Maternal mortality ratio is the number of maternal related deaths per 100,000 maternities.

Maternities are defined here as all births at 20 weeks or beyond or weighing 400g or more if gestation was unknown. Pregnancies ending before 20 weeks are not included in this working definition because the absolute number of pregnancies ending before this time is unknown.

The term 'ratio' is used to describe 'incidence' of maternal mortality because cases included in the numerator may arise from pregnancies that end before 20 weeks. From 2006 to 2015, 29 percent of all maternal deaths (54 percent of antepartum (in pregnancy) maternal deaths and 13 percent of postpartum deaths) occurred under 20 weeks. As the total number of pregnancies ending before 20 weeks is unknown, the denominator cannot include all women at risk and thus the estimate cannot truly be called a 'rate'.

The variable definition of 'maternities' creates unnecessary confusion when making international comparisons. The WHO recommends 100,000 live births as the most available denominator in countries with limited vital statistics collection. In countries where fetal deaths are also collected, the WHO recommends the denominator be 100,000 live births plus fetal deaths of 20 weeks or greater gestation. The UK uses the number of pregnancies that result in a live birth at any gestation or a stillbirth at or after 24 completed weeks gestation (as only stillbirths at 24 or more weeks gestation are required to be notified by law) (Lewis 2007). Australia reports the number of women who gave birth to either a live or stillborn baby of 20 or more completed weeks gestation or weighing at least 400g at birth (as required to be reported to the National Perinatal Data Collection) (Sullivan et al 2008).

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

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

More details on the process of development of the tool to assess contributory factors and potentially avoidable death have been published (Farquhar et al 2011).

Case ascertainment and data collection

Since 2006, the PMMRC has requested that all clinicians aware of a maternal death notify either their PMMRC DHB local coordinator or the PMMRC national coordinator.

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

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

The MMRWG has developed a data collection tool for maternal deaths. Following notification of

a maternal death, the PMMRC national coordinator issues maternal death reporting forms to the appropriate local coordinator, who is then responsible for gathering the relevant clinical information from practitioners involved with the woman's care.

All completed reporting forms, along with relevant clinical information and reports from DHBs, Coronial Services and any other relevant investigative processes, are reviewed by designated members of the MMRWG, who present a summary of each case to the working group. The MMRWG then discusses each case in detail, including assessing the presence of contributory factors and potential avoidability.

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

The MMRWG has identified potentially avoidable maternal deaths since 2006. From 2009, the MMRWG started to use the same tool identifying contributory factors and potentially avoidable death as that used for perinatal deaths. The year 2015 was the 10th year of maternal death reporting under the auspices of the PMMRC. The number of maternal deaths each year is small. In this report, time trends in maternal mortality in New Zealand have been explored along with analyses that include all years of maternal mortality data (2006–2015).

PMMRC numerator data validation

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

At the end of each year, known deaths are cross-referenced with the Mortality Collection at the BDM Registry to ensure the collection is complete. This process ascertained a further nine indirect maternal deaths (due to suicide) in the 2006–2015 period.

Denominator data

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

4.3 Findings

Maternal mortality ratio

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

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

* Pulmonary embolism and sepsis.
MMR = maternal mortality ratio

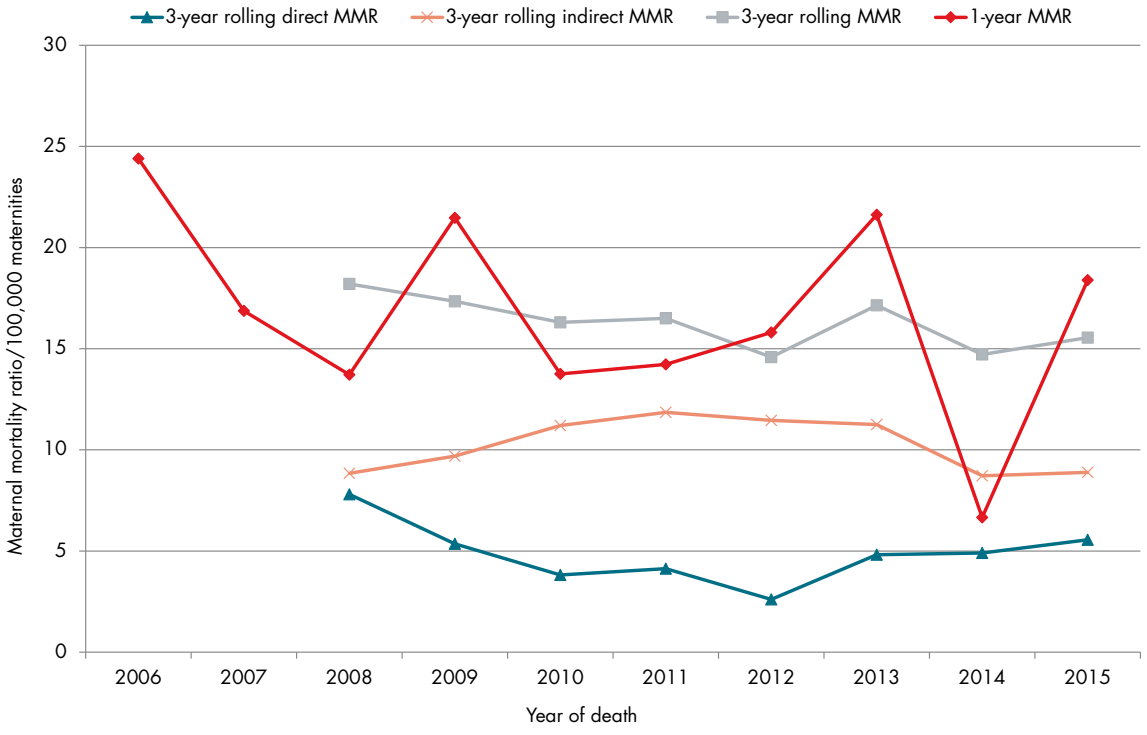
There has been no statistically significant change in maternal mortality ratio in New Zealand since data collection by the PMMRC began in 2006 (chi-squared test for trend p=0.25).

In 2015, 11 deaths within the definition of maternal mortality were reported to the PMMRC. One coincidental death was reported in 2015. The maternal mortality ratio in New Zealand was therefore 18.4/100,000 maternities (95% CI 9.2–32.9/100,000) for the year 2015. The three-year average maternal mortality ratio, calculated to obtain a more robust estimate of the New Zealand ratio given small and variable numbers of deaths per year, for 2013–2015, was 15.6/100,000 maternities (95% CI 10.8–22.5/100,000).

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

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

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



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

Figure 4.2 demonstrates maternal mortality ratios for each year, and rolling three-year average total direct and indirect maternal mortality ratios. The rolling three-year average ratios are represented as an estimate plotted at the final year of the three-year period. For example, the three-year ratio for 2006–2008 is plotted for 2008.

International comparisons

It is difficult to compare maternal mortality ratios internationally due to differences in definitions and variations in systems for ascertainment of maternal death.

Small differences in the denominator (number of maternities) result in very small changes when calculating the ratio, whereas small changes in the numerator (number of deaths) have a substantial impact on the ratio.

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

The maternal mortality ratio for the UK based on confidential enquiry data for the triennium 2012–2014 was 8.54/100,000 maternities (95% CI 7.40–9.81) (2.86/100,000 direct maternal mortality ratio; 5.68/100,000 indirect maternal mortality ratio) (Knight et al 2016).

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

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

The Australian ratio is very similar to the New Zealand ratio at 7.14/100,000 maternities reported for 1995–2005, when New Zealand was using routine data sources for case ascertainment, but significantly lower than the New Zealand maternal mortality ratio reported by the PMMRC. As noted in the Australian report published in 2014, 'the higher MMR [maternal mortality ratio] for New Zealand may reflect enhanced surveillance and centralised mortality review', and numerous international papers on ascertainment of maternal mortalities would support this statement (Johnson et al 2014). The report also notes that the limited national level maternal mortality review process has a 'significant impact on the quality and utility of the data collected' and limits the 'capacity for meaningful comparison of cases'.

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

In 2015, all 11 maternal deaths were reported to Coronial Services and the Coroner accepted jurisdiction. A post-mortem was performed for nine deaths.

The MMRWG recommends that where a coroner declines jurisdiction in the case of a maternal death, a post-mortem should be offered as part of full investigation of cause of death. The MMRWG reviewed the contribution of the 79 post-mortems performed from 2006–2015 in determining cause of maternal death. Clinical diagnosis was confirmed in 52 (66 percent) and changed in 11 (14 percent). There were additional clinical findings in 9 (11 percent), and the post-mortem was non-contributory in 7 (9 percent). The remaining 25 percent of maternal deaths (26) did not have a post-mortem.

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

Causes of maternal death

Direct causes

As noted above, direct causes of maternal mortality contribute approximately one-third of maternal deaths compared to two-thirds from indirect causes. Direct causes include AFE, postpartum haemorrhage, venous thromboembolism, pre-eclampsia and sepsis. In New Zealand, AFE contributes almost 40 percent of direct deaths. As noted in definitions, suicide is reported with indirect deaths in this report.

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

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

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

Practice Point: Amniotic Fluid Embolism

Diagnosis

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

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

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

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

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

Management

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

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

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

If maternal collapse occurs:

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

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

Previous PMMRC Recommendation (Fifth Report (PMMRC 2011))

Venous thromboembolism

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

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

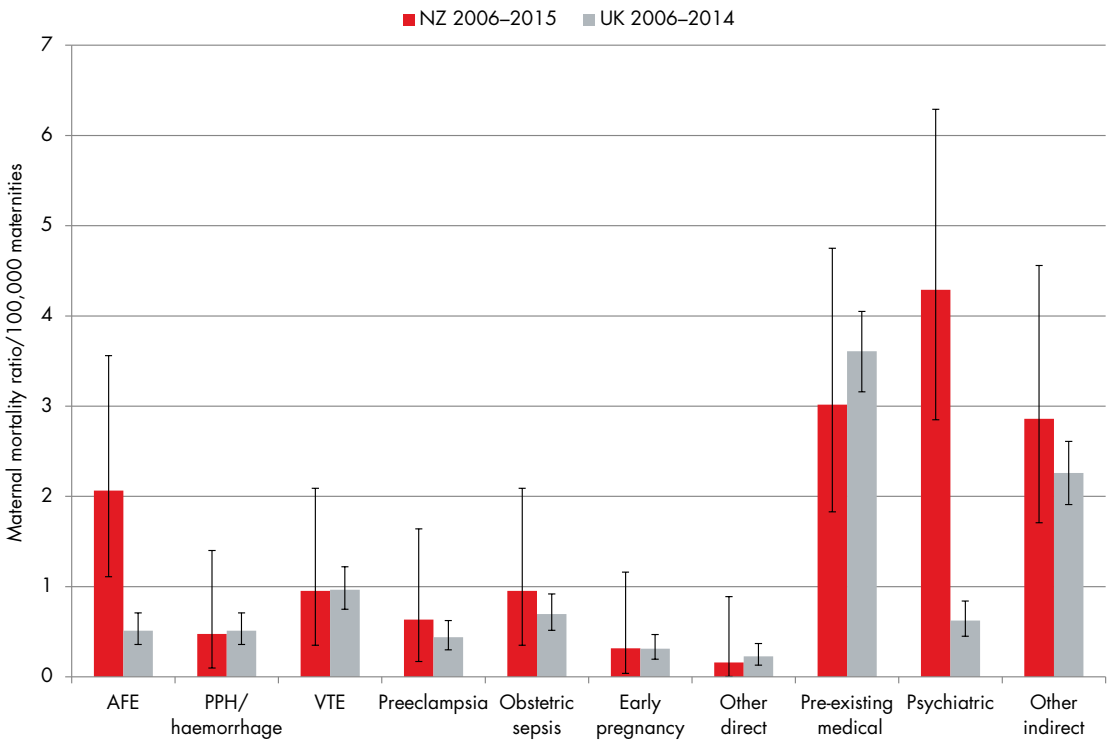
This paper includes a comprehensive review of the literature and tables and algorithms providing recommendations for prevention of VTE in pregnancy. The PMMRC supports the use of these and supports ongoing research to improve the knowledge in this area so that future guidelines can be based on high-level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

Risk factors for Pregnancy-Associated Venous Thromboembolism

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

Adapted with permission from McLintock et al 2012.

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



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

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

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

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

Previous PMMRC Recommendation (Fifth Report (PMMRC 2011))

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

Indirect causes

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

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

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

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

RECOMMENDATION:

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

Practice Point: Maternal Suicide

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

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

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

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

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

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

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

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

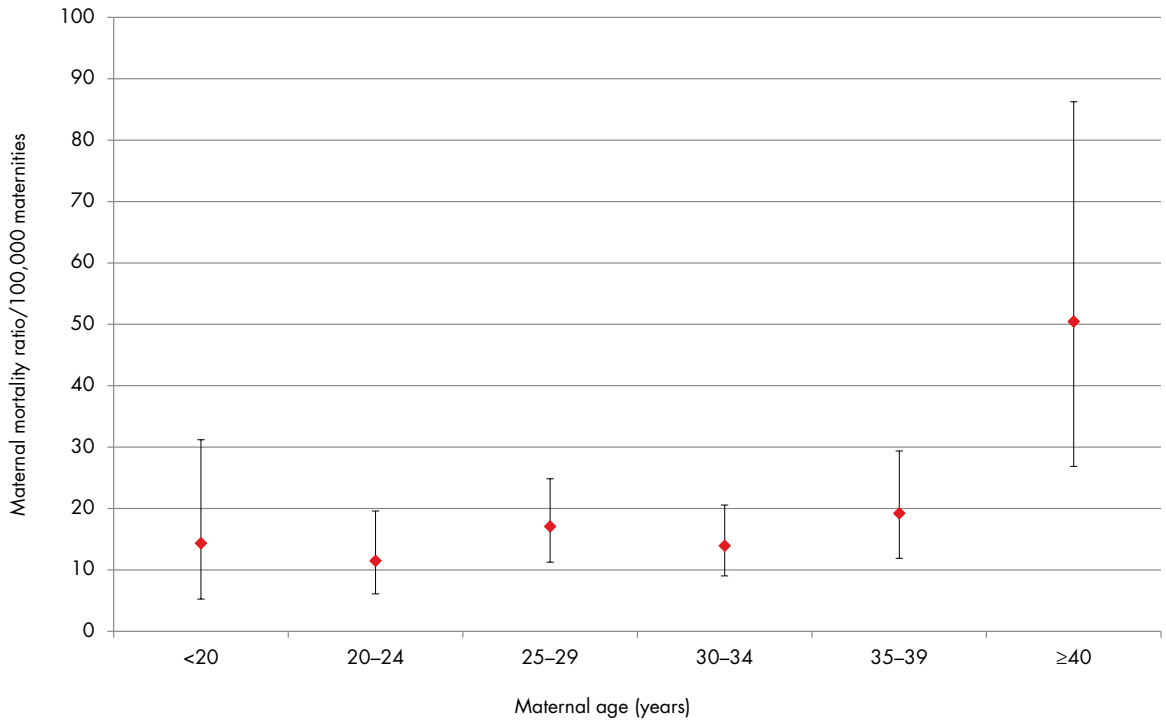
Pregnant and postpartum women who use substances often have complex social and mental health needs, and face additional barriers in accessing services.

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

Maternal mental health screening should be included as part of standard antenatal care, and women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if they are currently well.

Strategies are required to improve communication and coordination between the full range of primary maternity providers (eg LMC, GP) and secondary providers (eg mental health services, maternal mental health services, and maternity, including termination of pregnancy services).

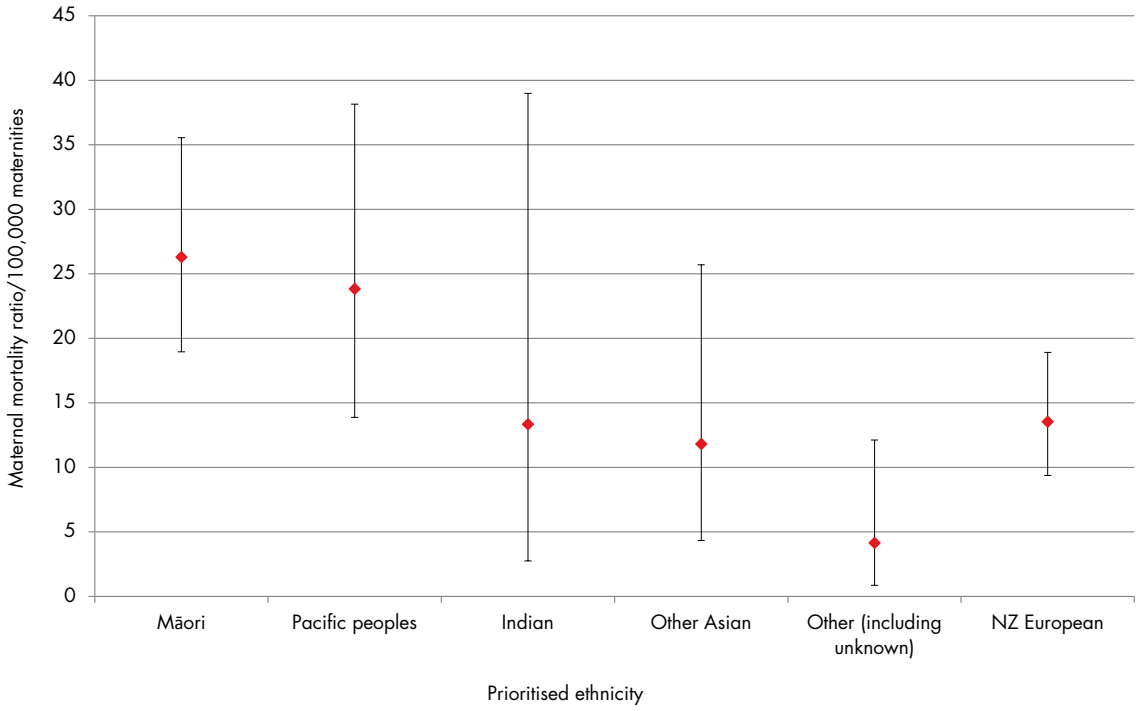
Figure 4.4: Maternal mortality ratios (per 100,000 maternities) by maternal age (with 95% CIs) 2006–2015



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

There have been 13 mortalities among mothers 40 years of age and older between 2006 and 2015, including seven direct and six indirect deaths. Numbers are small so it is hard to determine any statistically significant associations between age and cause of death, although suicide tends to be more often a cause of maternal death among younger women, and pre-existing medical conditions among older women.

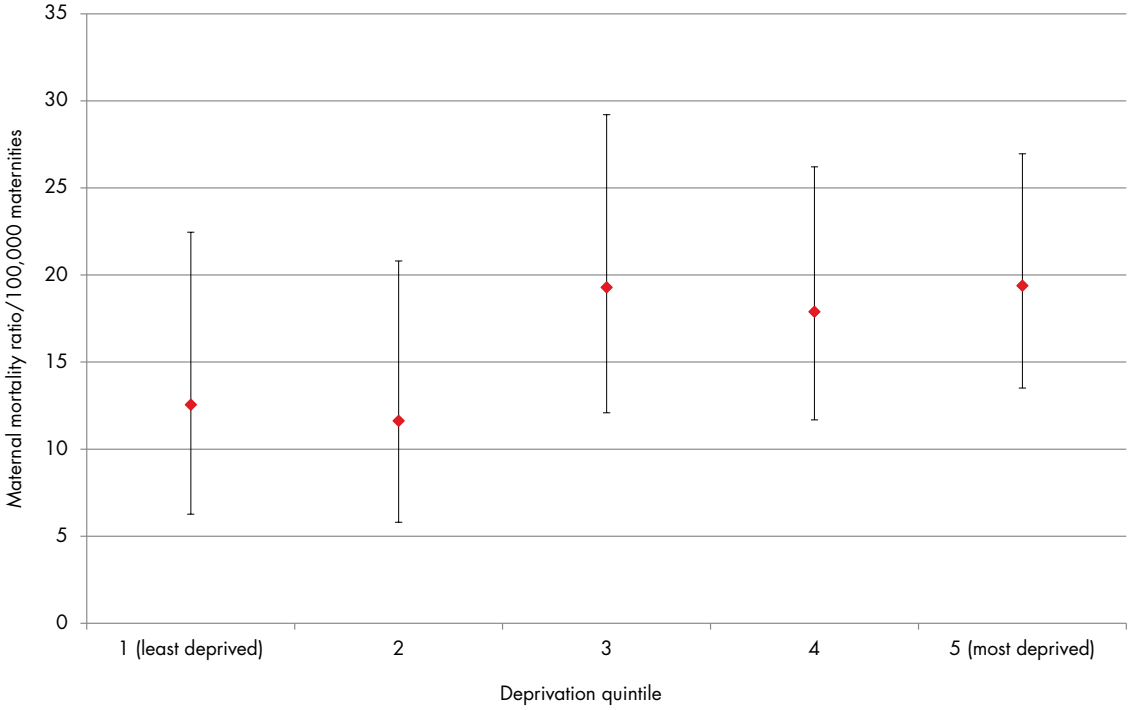
Figure 4.5: Maternal mortality ratios (per 100,000 maternities) by prioritised ethnicity (with 95% CIs) 2006–2015



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

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

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



The risk of maternal mortality appears to increase with increasing deprivation quintile. In previous reports, we used smaller area mesh block data for deprivation, and last year reported that the risk for women living in the most deprived 20 percent of residential areas from 2006 to 2014 was 2.5 times that of those in the least deprived 20 percent. In 2015, with a change to MAT data, we are using the larger census area unit for measuring deprivation, and the apparent association seen in Figure 4.6 is not statistically significant (chi-squared test for trend p=0.11).

The 2016 report on maternal deaths in the UK 2012–2014 reported that the relative risk of maternal mortality was 1.62 (95% CI 0.92–2.99) for women residing in the most deprived 'Index of Multiple Deprivation' quintile areas in England compared to women in the least deprived quintile areas (Knight et al 2016). The equivalent relative risk for 2006–2015 for New Zealand is 1.5 (95% CI 0.8–3.0).

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

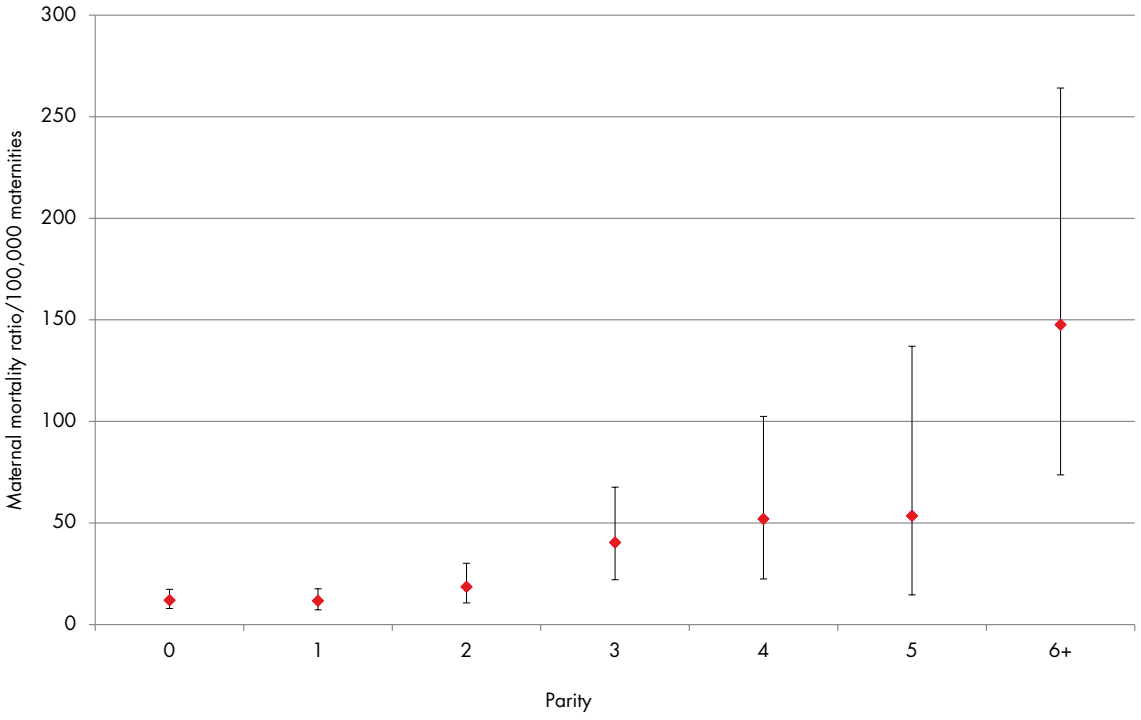


Figure 4.7 shows a clear association between maternal parity and maternal mortality ratio. There is a statistically significant increase in mortality for women in their fourth or later pregnancy compared to women who have had one, two or three births. Increased parity is likely to be confounded by the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

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

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

Clinical characteristics

Table 4.2: Clinical characteristics among maternal deaths 2006–2015

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

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

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

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

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

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

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

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

Of the postpartum deaths, half occurred after the baby's birth at term. A quarter occurred within the first day of birth and half within the first week. Postpartum deaths were more often due to direct causes (30/64) than antepartum deaths, 33 were indirect, and one was unclassifiable. The most common direct cause was AFE (12 deaths). Among the 33 indirect deaths, the most common cause was suicide (10 deaths). Pre-existing medical conditions were responsible for a further 18.

Table 4.4: Baby outcomes among maternal deaths 2006–2015

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

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

Perimortem caesarean section

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

Between 2006 and 2015 perimortem caesarean section was undertaken in 10 maternal deaths as part of the resuscitation of the mother to improve the chance of survival following a collapse. Seven babies were live born, three babies were stillborn and one live born baby died as an early neonatal death.

Contributory factors and potentially avoidable maternal deaths

Thirty-nine percent of maternal deaths were identified as potentially avoidable, and contributory factors were identified in 62 percent of maternal deaths in the years 2006–2015 Table 4.5. The presence of contributory factors and the assessment of potentially avoidable death did not vary by whether maternal deaths were classified as direct or indirect.

Contributory factors were identified in each of organisational and/or management, personnel, and barriers to access and/or engagement with care in 40 to 42 percent of cases overall, but barriers were less often identified among direct deaths (23 percent) than among indirect (56 percent).

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

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

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

4.4 Maternal Mortality Appended Tables

Table 4.6: Demographic characteristics among maternal deaths 2006–2015

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

* Defined prior to conception of the index pregnancy.

5 Māori Maternal Mortality 2015

5.1 Maternal Mortality

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

Table 5.1: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) 2006–2015

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

There is a statistically significantly higher maternal mortality ratio among Māori (26.3/100,000 maternities) compared to New Zealand European (13.5/100,000 maternities) mothers combining data from 2006–2015 (Table 5.1). However, rolling three-year ratios (Figure 5.1) show evidence of a convergence of rates by ethnicity in the most recent three-year period.

Figure 5.1: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) (with 95% CIs) 2006–2015

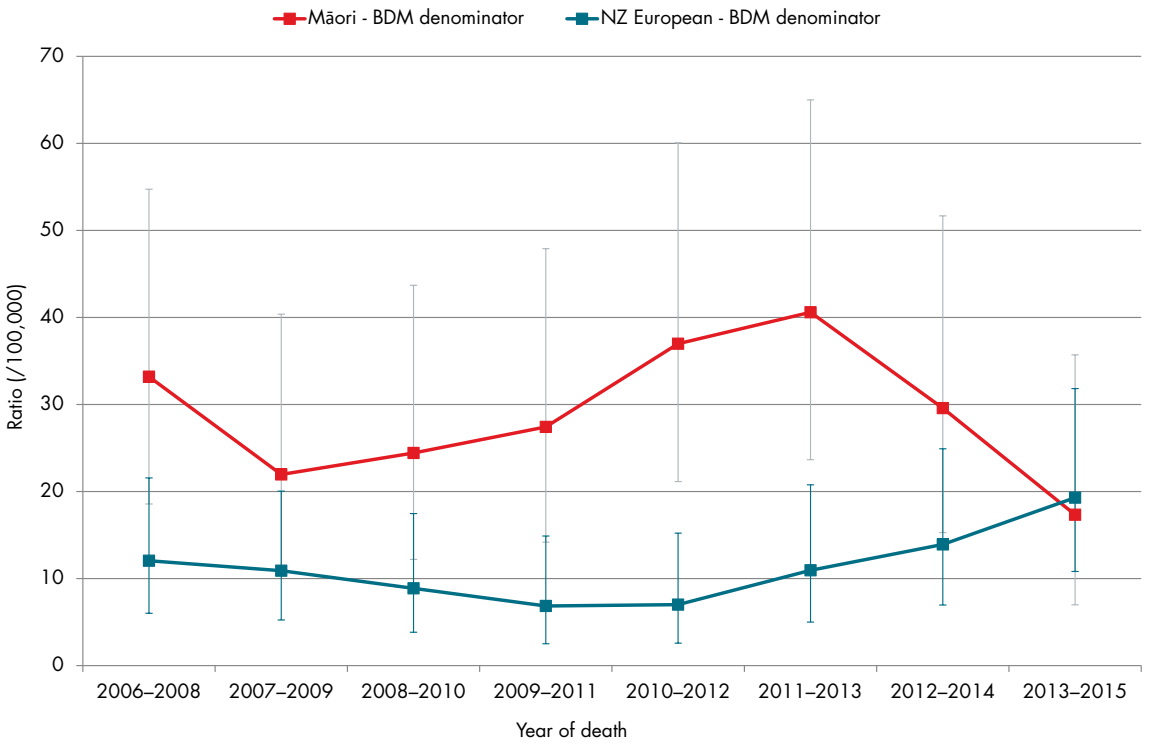


Table 5.2: Maternal mortality ratios (per 100,000 maternities) by ethnicity (Māori and New Zealand European) and maternal age 2006–2015

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

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

Table 5.3: Maternal mortality ratio (per 100,000 maternities) by ethnicity (Māori and New Zealand European) and time of death 2006–2015

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

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

Table 5.4: Ethnic-specific maternal cause of death by ethnicity (Māori and New Zealand European) 2006–2015

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

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

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

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

Table 5.5: Contributory factors and potentially avoidable maternal mortality by ethnicity (Māori and New Zealand European) 2006–2015

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

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

5.2 Māori Maternal Death by Suicide

Authors Associate Professor Sue Crengle and Dr Paula King

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

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

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

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

Tihei Mauri Ora!

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

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

Information about the women and their final pregnancy

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

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

Thirteen of the 15 deaths were due to hanging.

Table 5.6: Characteristics of Māori maternal suicides 2006–2015

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

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

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

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

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

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

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

Other factors that may have contributed to outcome

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

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

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

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

Summary

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

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

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

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

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

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

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

Practice Point: Māori women and risk factors for maternal suicide

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

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

This assessment should include:

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

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

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

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

Practice Point: Māori women and maternal suicide

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

Symptoms include:

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

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

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

Māori women should have access to culturally appropriate mental health and/or alcohol and drug care.

During pregnancy and the postpartum period there may be more than one mental health team involved—in such cases there should be one identified individual who coordinates care.

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

5.3 Recommendations

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

The Mortality Review Committees' Māori Caucus recommends:

Improved awareness and responsiveness to the increased risk for Māori women

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

Risk assessment

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

See 'Practice Point: Māori women and risk factors for maternal suicide' on page 31.

Management

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

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

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

See 'Practice Point: Māori women and maternal suicide' on page 32.

Communication and coordination

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

Child and Youth Mortality Review

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

5.4 Māori Maternal Mortality Appended Tables

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

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

* Denominator is MAT; numerator is PMMRC.