Validation of local review for the identification of contributory factors and potentially avoidable perinatal deaths

Vicki L. MASSON, Cynthia M. FARQUHAR and Lynn C. SADLER
University of Auckland, Auckland, New Zealand

Background: Reporting on perinatal mortality commenced 2006 in New Zealand through the Perinatal and Maternal Mortality Review Committee (PMMRC). Following review of international models, a process was developed for use in local review to identify contributory factors and potentially avoidable perinatal deaths. Local review of 720 perinatal deaths in 2009 found contributory factors in 24% of deaths and 14% to be potentially avoidable.

Aims: To validate the process of local review for identification of contributory factors and potentially avoidable perinatal deaths.

Material and Methods: Records of 48 perinatal deaths were reviewed by an independent multidisciplinary panel using the same methodology as local review to determine agreement between local and independent review for identification of contributory factors and potentially avoidable perinatal death.

Results: Independent review found contributory factors in 54% of deaths compared to 40% by local review. Independent review identified eight deaths and local review identified one death with contributory factors not identified by the other review. Kappa statistic for agreement for identifying contributory factors was substantial [0.63 (0.42, 0.84)]. Independent review found 42% of deaths potentially avoidable compared to 23% by local review. Independent review identified 10 deaths and local review identified one death not identified by the other review. Kappa statistic for agreement for identifying potentially avoidable deaths was moderate [0.50 (0.26, 0.73)].

Conclusions: This study provides validation of local review for identification of contributory factors in perinatal death. The higher proportion of potentially avoidable perinatal deaths identified by independent review compared to local review requires further exploration.

Key words: contributory factors, mortality review, perinatal death, potentially avoidable, quality improvement.

Introduction

For most women, pregnancy results in a healthy baby. Unfortunately for some, pregnancy and birth carry risks and perinatal death or long-term disability may result. Globally, approximately five million babies die before birth and up to 28 days each year; with the majority of deaths occurring in low and middle income countries due to lack of resources and skilled healthcare attendants. In developed countries, 1 in 100 pregnancies end in perinatal death, in spite of adequate health care and resources being available.

In New Zealand, there are approximately 600 perinatal deaths and 60,000 births from 20 weeks gestation per year. A Perinatal and Maternal Mortality Review Committee (PMMRC) was established in 2006 to review and report on perinatal and maternal mortality with a view to improving outcomes. From 2007, clinicians have been required to provide demographic and clinical data on each perinatal death to a national database. Reporting the number and causes of perinatal deaths is important but does not always provide information on how to prevent deaths. In order to do this, the PMMRC established a process to report the contributory factors and if the perinatal deaths were potentially avoidable.

Following a review of international models a tool was developed by the PMMRC for use in local case review. This tool has categories for factors associated with the organisation and management of care, provision of the care by personnel, access to and/or engagement with care, technology/equipment and the environment. If contributory factors are identified the question ‘Was the death potentially avoidable?’ is asked. A potentially
avoidable death is a death where the absence of a contributory factor may have prevented the death.\textsuperscript{7,8} From 2009, clinicians have identified contributory factors and potentially avoidable perinatal deaths as part of local mortality review. Completing this process after local review was chosen as this was a pragmatic and efficient way to review 600–700 deaths annually.

While a number of studies identifying substandard care or potentially avoidable perinatal death have been published using similar methods,\textsuperscript{9–11} few studies have been published comparing the findings of local with independent perinatal mortality review using the same methodology for both local and independent review.\textsuperscript{12,13}

As this was a new process in New Zealand and to address concerns about the independence of local review the PMMRC sought to validate the process of local review and the use of this tool for the identification of contributory factors and potentially avoidable perinatal death.

Materials and Methods

In New Zealand, maternity care is funded by the Ministry of Health, provided by 20 District Health Boards (DHBs) nationally and by lead maternity carers (LMCs). LMCs may be self-employed midwives, general practitioners, private obstetricians or hospital-based midwives and obstetricians. The obstetric and related medical services referral guidelines provide information about referring pregnant women, transferring clinical responsibility and transferring care in emergencies.\textsuperscript{14}

District Health Boards (DHBs) were asked by the PMMRC to appoint local coordinators (midwives, obstetricians and/or neonatologists) to assist with the PMMRC processes of collecting data about, and local review of, perinatal mortalities.\textsuperscript{3,15} The concept of identifying contributory factors and potentially avoidable perinatal mortality was introduced to the PMMRC local coordinators in December 2008, and this was followed in March 2009 by a workshop in which specific training was given on the tool developed by the PMMRC. The training included presentation of four cases, discussion of the cases and identification of contributory factors and potentially avoidable perinatal mortality using this tool. Training is given individually to new local coordinators, and a workshop is held annually to provide ongoing training. Local coordinators are encouraged to contact the PMMRC National Coordinator with any queries.\textsuperscript{15} Further information on the contributory factor categories included and the application of the tool is available in previous publications.\textsuperscript{7,8}

When a perinatal death occurs, notification to the PMMRC is through an initial data collection form which is completed by the LMC or DHB midwife within 48 h of the death, and includes basic demographic information, past obstetric and clinical history and details of the index pregnancy and birth. On completion of all investigations, the death is reviewed at the local DHB-based Perinatal Mortality Meeting. While the PMMRC supports the local perinatal mortality meeting, each DHB undertakes this independently as part of their local quality program. The local perinatal mortality meeting is attended by DHB clinicians and LMCs including those involved in the case. If issues are identified that require addressing, these are actioned by the local quality processes outside of this meeting and the PMMRC process. The completion of the PMMRC Contributory Factors tool occurs after the local review utilising the discussion at the meeting. The PMMRC Classification Factors tool occurs after the local review utilising the discussion at the meeting. The PMMRC Classification Factors tool is completed by a local multidisciplinary panel, led by the PMMRC local coordinator; the care providers are not present for the completion of the contributory factors and potentially avoidable deaths assessment. This panel can be made up of some or all of the following: senior midwives, neonatologists, obstetricians and perinatal pathologists. A cause of death is determined using the Perinatal Society of Australia and New Zealand (PSANZ) classification system including a Perinatal Death Classification (PDC) and a Neonatal Death Classification (NDC) where appropriate.\textsuperscript{16} The multidisciplinary panel identifies any contributory factors by comparing care given to guidelines and evidence-based practice using the tool shown in Table 3. This table has been amended to only include the categories selected: for a full list of categories see: PMMRC 5th Report: Supplementary tables and appendices.\textsuperscript{7}

If contributory factors are present, the multidisciplinary panel determines whether the death was potentially avoidable.

The study group is a quasi-random selection of stillbirths and neonatal deaths (excluding deaths from congenital abnormality and deaths with no obstetric antecedent cause) obtained by selecting every fifth case number from the PMMRC database of perinatal deaths between 1 January and 31 December 2009 and includes babies from 20 weeks gestation (or at least 400 g if gestation not known), up until 28 completed days of life. The study group was identified for the primary purpose of routine audit to assess the completeness and accuracy of the perinatal mortality data collected by the PMMRC.

Deaths due to congenital abnormality were excluded as they are almost never associated with contributory factors (2% of cases in 2009) and are less likely to be potentially avoidable. It was therefore thought that they would not contribute to the study. Deaths with no obstetric antecedent cause are almost always associated with contributory factors and determined to be potentially avoidable and so were also excluded. Deaths with no obstetric antecedent are mostly due to Sudden Unexpected Death in Infancy (SUDI). These made up 1% of perinatal deaths in 2009, and six of the seven SUDI deaths were found to be potentially avoidable.\textsuperscript{7} Figure 1 illustrates the case selection; five deaths were only reviewed by the independent panel and are not included in the analysis.
Perinatal Death Classification (PDC), Neonatal Death Classification (NDC), maternal ethnicity and socioeconomic deprivation score (NZDep2006), contributory factors and potentially avoidable mortality data collected by the PMMRC were extracted from the 2009 PMMRC database. A copy of the mother’s and baby’s clinical notes including relevant pathology reports was requested from the clinical records department in the relevant DHB. The pregnancy notes contained copies of the pregnancy booking and clinical notes, labour record and cardiotocographs, correspondence, laboratory investigations and ultrasound reports. Some DHB records also contained copies of LMC maternity care records. Maternal self-identified ethnicity was extracted from the New Zealand Births Deaths and Marriages Register (Ministry of Justice) and if this was not available from the PMMRC Rapid Reporting Form (RRF) completed by the LMC. Multiple ethnicities may be identified. In New Zealand, ethnicity is prioritised for output statistics according to New Zealand protocols for the health sector using the following hierarchy: Māori, Pacific peoples, Indian, Other Asian, Other and New Zealand European.17

The New Zealand Deprivation Index 2006 (NZDep2006) is an area-based measure of socioeconomic deprivation based on variables from the 2006 Census of Population and Dwellings in New Zealand. The score is assigned according to maternal place of residence at the time of birth registration. In this analysis, deciles are combined to quintiles, the least deprived quintile being quintile 1 and the most deprived quintile 5.7

Ethics approval has been obtained for this study. Ethics reference: MEC/11/EXP/064 16 August 2011 (Health and Disability Ethics Committees).

Obstetricians, midwives and neonatologists from a university department of Obstetrics and Gynaecology and a public tertiary hospital in Auckland New Zealand were invited to be part of the independent panel for this review. Each case was reviewed by a three member panel with at least one midwife and one obstetrician present. The neonatologist was present for the review of all intrapartum and neonatal deaths. Any member who had previously been involved in the PMMRC review of perinatal deaths when employed by a DHB was excluded from the review of deaths from these DHBs. The panel received training from the PMMRC national coordinator on the PMMRC process for determining contributory factors and potentially avoidable mortality, as was provided for the local coordinators.

The independent panels met five times for 2 h to review eight to ten cases per meeting. The panel reviewed

Figure 1 Flow chart for comparison of local and independent review of contributory factors and potentially avoidable perinatal related death.
information on the mothers and babies including a copy of
the clinical notes, PMMRC Rapid Reporting Forms, the
DHB perinatal mortality report and post-mortem
investigations. The panel received a copy of the notes to
review prior to the meetings, and each member was asked
to summarise and present specific cases at the review
meeting. The independent panel was not aware of the
local determination of contributory factors and potentially
avoidable mortality.

After presentation, the case was discussed, and the
panel completed the contributory factors and potentially
avoidable mortality section of the PMMRC Classification
Form.

The data from the independent panel were entered onto
an Excel spreadsheet and merged with the extracted
PMMRC mortality data using STATA9 (Statacorp, TX,
USA) statistical software. The study sample was compared
to the remainder of perinatal deaths in 2009 to determine
whether the sample was representative of all similar deaths.
Analysis of the inter-panel agreement was undertaken using
the kappa statistic. Kappa was computed for agreement
between local and independent panels for the presence of
any contributory factor and for potentially avoidable
mortality along with a 95% confidence interval.

Kappa can be used in relatively small samples; however, good precision of kappa estimates would require
large sample sizes in the order of 1000 deaths. A sample
size was selected based on a realistic workload for the
independent panel. The estimates of kappa from the study
hence were likely to have relatively wide confidence
intervals.

The study was not powered to show any significant
differences in agreement by ethnicity, deprivation or
causes of death (PSANZ-PDC).

Results

In 2009, in New Zealand, there were 720 perinatal deaths,
534 excluding congenital abnormality and deaths with no
obstetric antecedent. Table 1 compares the study sample
to the remaining deaths, excluding deaths with congenital
abnormality and with no obstetric antecedent, in 2009
(486 deaths). All further results refer to the study group
of 48 perinatal deaths that were reviewed by both local
and independent panels. There were no differences
between the study sample and unstudied deaths in 2009
by the type of death, ethnicity, deprivation quintile (NZ
Dep 2006) or cause of death (PSANZ-PDC).

Independent review found 26 of the 48 deaths (54%) to
have contributory factors compared to 19 of 48 (40%) by
local review. The independent review identified a further
eight deaths to have a contributory factor, and local review
identified one death with a contributory factor not
identified by the independent panel. Twenty-one of the 48
deaths (44%) were identified by both reviews as having no
contributory factors. The kappa for agreement in the
identification of contributory factors was substantial
[kappa 0.63 (95% CI 0.42, 0.84)] (Table 2, Fig. 1).18

Table 1 Characteristics of perinatal-related deaths in the review
compared to the remainder of perinatal deaths in New Zealand
2009 (excluding deaths with congenital abnormality and with no
obstetric antecedent)

<table>
<thead>
<tr>
<th>Birth state</th>
<th>Study group</th>
<th>Other perinatal deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 48</td>
<td>n = 486</td>
</tr>
<tr>
<td>Total</td>
<td>n   %</td>
<td>n   %</td>
</tr>
<tr>
<td>Termination of pregnancy</td>
<td>–</td>
<td>26 5</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>35 73</td>
<td>339 70</td>
</tr>
<tr>
<td>Neonatal death</td>
<td>13 27</td>
<td>121 25</td>
</tr>
<tr>
<td>Prioritised maternal ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>18 38</td>
<td>142 29</td>
</tr>
<tr>
<td>Pacific peoples</td>
<td>5 10</td>
<td>82 17</td>
</tr>
<tr>
<td>Indian</td>
<td>1 2</td>
<td>21 4</td>
</tr>
<tr>
<td>Other Asian</td>
<td>2 4</td>
<td>21 4</td>
</tr>
<tr>
<td>Other</td>
<td>2 4</td>
<td>42 9</td>
</tr>
<tr>
<td>NZ European</td>
<td>20 42</td>
<td>178 37</td>
</tr>
<tr>
<td>Deprivation quintile (NZDep2006)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5 10</td>
<td>47 10</td>
</tr>
<tr>
<td>2</td>
<td>5 10</td>
<td>67 14</td>
</tr>
<tr>
<td>3</td>
<td>8 17</td>
<td>82 17</td>
</tr>
<tr>
<td>4</td>
<td>10 21</td>
<td>113 23</td>
</tr>
<tr>
<td>5</td>
<td>20 42</td>
<td>164 34</td>
</tr>
<tr>
<td>Unknown</td>
<td>–</td>
<td>13 3</td>
</tr>
<tr>
<td>Perinatal death classification (PSANZ-PDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perinatal infection</td>
<td>1 2</td>
<td>23 5</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1 2</td>
<td>27 6</td>
</tr>
<tr>
<td>Antepartum haemorrhage</td>
<td>13 27</td>
<td>64 13</td>
</tr>
<tr>
<td>Maternal conditions</td>
<td>3 6</td>
<td>34 7</td>
</tr>
<tr>
<td>Specific perinatal condition</td>
<td>3 6</td>
<td>73 15</td>
</tr>
<tr>
<td>Hypoxic peripartum death</td>
<td>4 8</td>
<td>24 5</td>
</tr>
<tr>
<td>Fetal growth restriction</td>
<td>4 8</td>
<td>49 10</td>
</tr>
<tr>
<td>Spontaneous preterm</td>
<td>9 19</td>
<td>99 20</td>
</tr>
<tr>
<td>Unexplained antepartum death</td>
<td>10 21</td>
<td>93 19</td>
</tr>
</tbody>
</table>

Independent review found 20 of the 48 deaths (42%) to
be potentially avoidable compared to 11 of 48 (23%) by
local review. Ten deaths were identified by both local and
independent review as potentially avoidable. The independent
review identified a further 10 deaths as potentially
avoidable and local review identified one death as
potentially avoidable not identified by the independent
panel. Twenty-seven of the 48 deaths (56%) were
identified by both reviews as not avoidable. The kappa for
agreement in the identification of potentially avoidable
perinatal mortality was moderate [kappa 0.50 (95% CI
0.26, 0.73)] (Table 2).

Consensus was reached by the members of the
independent panel in all deaths. In some deaths,
contributory factors were identified by both local and
independent review in more than one category and often
with multiple subfactors within these. These are presented in Table 3. At times contributory subfactors were identified consistently by both local and independent review; however, in some deaths, there was a difference in the choice of category allocated (organisation, personnel or environment factor). Contributory factors were not always identified by independent review around the organisation of staff and transfer to another facility.

**Comments**

The aim of this study was to compare local and independent review for the identification of contributory factors and potentially avoidable perinatal mortality. We have reported substantial agreement between local and independent review in identification of contributory factors (kappa 0.63) but only moderate agreement in identification of potentially avoidable perinatal death (kappa 0.50). Independent review found 14% more cases with contributory factors than local review and almost doubled the proportion of potentially avoidable deaths.

The development of the methodology was iterative and has been used for over 2500 perinatal deaths over six years of data collection. The methodology was developed from several sources including Root Cause Analysis and the London Protocol and adapted for perinatal data review in New Zealand. It can be considered as an abbreviated root cause analysis.

Limitations of the study included the small number of perinatal deaths reviewed limiting the power to precisely define the agreement between the two processes and preventing further exploration of agreement by other factors, such as ethnicity, deprivation and cause of death (PSANZ-PDC). Another limitation was that 2009 was the first year the tool was used by the PMMRC. It is possible that the study was too early in the process and that the quality of local review has improved as the PMMRC local
While it is not possible to prevent all perinatal deaths, some are potentially avoidable. Local review of perinatal deaths identified the majority of contributory factors identified by independent review but identified fewer potentially avoidable deaths. While both these steps are valid in the process of review, it is more important to identify and address the factors that contributed to the deaths to prevent deaths in the future. The identification of local contributory factors allows for changes to be made in a timely fashion, while summarising the findings of local review at a national level can identify trends that require further investigation. Further work is required to support local review of perinatal death and further evaluation will then be required.

The overall aim of reporting of contributory factors and potentially avoidable deaths was to improve care and reduce perinatal mortality. The PMMRC has reported five years of data using this process, and during this time, there has been a small but nonsignificant increase in the proportion of perinatal deaths assessed to have contributory factors and as potentially avoidable. In 2009 24% of perinatal deaths were reported to have contributory factors and in 2013 this was 27%, and in 2009 14% of deaths were assessed as potentially avoidable and in 2013 this was 16%. During this period, there has been a reduction in perinatal mortality, but this was not statistically significant. However, there have been significant reductions in specific areas of perinatal death. In 2013, the stillbirth rate was 5.1 per 1000 births, a statistically significantly reduction from 5.6 per 1000 births in 2007 ($P = 0.015$). Hypoxic peripartum perinatal-related death has also fallen statistically significantly since 2007, from a rate of 0.5 per 1000 to 0.18 per 1000 births in 2013 ($P = 0.0003$). It is not possible to conclude that these reductions have occurred as result of local review of cases but is encouraging to see the improvements in outcomes in this group of vulnerable infants.

### Acknowledgements

We thank the Health Quality and Safety Commission (HQSC) in New Zealand for financial support for the study and the Perinatal and Maternal Mortality Review Committee PMMRC for the use of this data. We are grateful to clinicians and the PMMRC Local Coordinators for providing the information to the committee and Dr John Thompson for statistical advice. Special thanks to the independent panel members for reviewing the deaths: Dr Kitty Bach, Dr Astrid Budden, Robin Cronin, Dr Deralie Flowers and Dr Tomasina Stacey.

### Role of the Funding Source

This work was undertaken on behalf of the Perinatal and Maternal Mortality Review Committee (PMMRC) as part of the PMMRC National Coordination Service contract with the HQSC to collect, analyse and report on perinatal mortality in New Zealand.

---

**Table 3 (Continued)**

<table>
<thead>
<tr>
<th>Contributory factor</th>
<th>Local review $n = 48$</th>
<th>Independent review $n = 48$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman declined treatment/advice</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Substance use</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Lack of recognition of complexity or seriousness of condition</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Cultural barriers</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Language barriers</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Family violence</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Amended – for full list of categories see PMMRC 5th Report.
References