Scottish Confidential Audit of Severe Maternal Morbidity

3rd Annual Report 2005

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Summary

Background and methods
1. During 2005, SPCERH identified and assessed cases of severe maternal morbidity throughout Scotland for a third consecutive year.

2. Fourteen categories of severe maternal morbidity were included – representing women with life-threatening illness. Clinical risk managers in each consultant-led maternity unit reported all women meeting the inclusion criteria to SPCERH on a monthly basis.

3. Eighteen maternity units participated during 2005. Monthly returns were received for all 216 unit/months (100%).

Rates of events
4. During 2005, 329 women met one or more of our definitions, giving a Scottish rate of severe maternal morbidity of 6.3 (5.6 - 7.0) per 1000 births (based on a denominator of 52,383 live births). The 2004 Scottish rate was 4.7 (4.2 - 5.4) per 1000 births. Rates in individual units in 2005 ranged from 2.1 (0.3 - 7.6) to 9.9 (6.9 - 13.9) per 1000 births. Differences between units are likely to reflect differences in case mix, population, and case ascertainment as well as differences in quality of care.

5. Major obstetric haemorrhage was the commonest category of severe morbidity, occurring in 235 women; Scottish rate, 4.5 (3.9 - 5.1) per 1000 births. The 2004 Scottish rate was 3.2 (2.8 - 3.8) per 1000 births.

6. Rates of: eclampsia, 0.4 (0.2 - 0.6); pulmonary oedema/respiratory dysfunction, 0.5 (0.2 - 0.8); renal/ liver dysfunction, 0.4 (0.2 - 0.6); intensive care admission, 1.7 (1.4 - 1.7) per 1000 births. Other categories of event occurred more rarely.

7. During 2005, there were three direct or indirect maternal deaths from relevant causes; giving a ‘near miss:death ratio’ of 109:1. During the 2003 to 2005 triennium, 845 women were reported with severe morbidity and there were 15 relevant maternal deaths; giving a ‘near miss:death ratio’ of 56:1. (Inevitably, small numbers mean that these estimates are imprecise.)

Quality of care

Major haemorrhage
8. Unit risk management teams assessed 209 cases of major obstetric haemorrhage (89% of those reported) using a structured proforma. Case definition: Estimated blood loss $\geq$2500ml, or transfused 5 or more units of blood or received treatment for coagulopathy (fresh frozen plasma, cryoprecipitate, platelets).

9. Estimated blood loss: mean, 3.8; median, 3; range 0.8-18 litres. Volume of blood transfused: mean, 4.8; median, 4; range 0-27 units. Fall in haemoglobin pre-bleed to post-bleed: mean, 3.8; median, 3.7; range, -4.3 to 9.7 g/dl.

10. Since 2003, use of conservative surgical treatments (principally uterine balloons and haemostatic [B-Lynch] suturing) has increased. During the 2003 to 2005 triennium, 64 women underwent balloon procedures (78% successful) and 52 underwent haemostatic suturing (81% successful). Hysterectomy was undertaken in 19 women in 2005 (a rate of 9% among women with major obstetric haemorrhage and of 0.36 per 1000 births). In 2004, hysterectomy was undertaken in 13% of women with major obstetric haemorrhage and 0.41 per 1000 births.
11. In general, cases were well-managed. Aspects of care which measured up well against national recommendations include:

- 96% received prophylactic oxytocics in the third stage of labour.
- 97% had intravenous access and 87% had clear evidence of use of two large bore cannulae.
- Few women (10%) were infused more than 3.5 litres of clear fluid before receiving blood (although this figure was only 6% in 2004).
- Basic monitoring was good with very frequent measurement of pulse, blood pressure and urine output documented in over 95% of women.

Aspects of care where there is scope for action planning and improvement include:

- A consultant obstetrician was present during the acute management of only 69% of women with major haemorrhage.
- A consultant anaesthetist was present, and a haematologist involved, in little over 50% of cases.
- Central venous pressure (CVP) lines were inserted in 33% of cases. There were 17 women with estimated blood loss in excess of 4 litres where no CVP line was used.
- Discussion of transfer to an intensive therapy unit (ITU) was documented in 24% of cases. There were 36 women with estimated blood loss in excess of 4 litres who were not admitted to ITU.

12. No long-standing, general systems errors were identified. Errors specific to the individual case were also uncommon; failure to follow protocol/plan was identified in 11% and avoidable delay in diagnosis/treatment in 9%.

13. Risk management teams graded the extent of sub-optimal care:

- 66% of cases were judged as ‘appropriate care, well managed’.
- 26% as ‘sub-optimal care – incidental’
- 5% as ‘sub-optimal care – minor’
- 2% as ‘sub-optimal care – major’

**Eclampsia**

14. Unit risk management teams also assessed 15 of 19 notified cases of eclampsia.

- Few women presented with the classic constellation of symptoms and signs of fulminating pre-eclampsia prior to fitting.
- A senior midwife, consultant obstetrician, and consultant anaesthetist were all present during the acute management of only four of 13 cases for which this information was recorded.
- Magnesium sulphate was used as the first-line anticonvulsant in all 12 cases for which this information was available.
- After the fit, women were well managed with frequent monitoring of vital signs and fluid balance and universal use of magnesium sulphate for prophylaxis against further fits.

15. Risk management teams graded the extent of sub-optimal care for 14 cases: nine were judged as ‘appropriate care’, two as ‘incidental sub-optimal’, two as ‘minor sub-optimal’, and one as ‘major suboptimal’.

**Learning points and action plans**

16. Risk management teams recorded learning points and local action plans for many cases of both haemorrhage and eclampsia.

17. Lessons relevant to the national context have been drawn from recurrent and important themes:

- Involve senior midwifery and medical staff and other disciplines (eg haematology) early.
- Improve documentation.
- Ensure staff awareness of local protocols; ensure that protocols and individual patient plans are followed.
- Adopt a ‘managed clinical network’ approach: In implementing local protocols, consider all settings where obstetric emergencies may present (eg accident & emergency; primary care).
- Avoid a philosophy of ‘blame culture’ and ‘inter-professional rivalries’. The team shares responsibility for failures and shares pride in successes.
Principal participants

The project was conceived and designed by the Scottish Clinical Assessors for the Confidential Enquiry into Maternal Deaths. This group acted as a Steering Committee throughout the year and provided an abundance of support and advice:

Dr Wang Liston    Eastern Obstetric Assessor (Chair)
Dr Burnett Lunan   Western Obstetric Assessor
Dr Russell Lees    Northern Obstetric Assessor
Dr Robert Nairn    Pathology Assessor
Dr John McClure    Anaesthetic Assessor
Mrs Joyce Linton   Midwifery Assessor

The following individuals are the designated maternity clinical risk managers in individual maternity units. They acted as principal reporters and data collectors in their units:

Sr Alison Hourston  Clinical Risk Manager  Aberdeen Maternity Hospital
Ms Laura Muir      Clinical Risk Manager  Ayrshire Central Hospital
Sr Karen McGhee     Midwife              Borders General Hospital
Mrs Margaret Hart   Staff Midwife        Caithness General Hospital
Katrina Hepburn     Sister, Labour suite  Cresswell Maternity Wing
Mrs Yvonne McLaren  Staff Midwife        Dr Gray's Hospital
Ms Annette Lobo     Clinical Midwifery Co-ordinator  Forth Park Hospital
Sr Sandra Coupar    Senior Midwife       Ninewells Hospital
Sr Helene Marshall  Clinical Risk Manager  Princess Royal Maternity
Sr Anne Ovens       Sister Midwife       Queen Mother’s Hospital
Kath Freeman        Midwife              Raigmore Hospital
Anne McGhee         Midwife              Royal Alexandra Hospital
Ms Sinead McNally   Risk Co-ordinator   Simpson Centre for Reproductive Health
Mrs Irene Woods     Senior Midwife       Southern General Hospital
Sr Anne Paterson    Practice Development Midwife  Stirling Royal Infirmary
Sr Karen McIntosh   Midwife              St John’s Hospital at Howden
Sr Kathryn Kearney  Midwife              Western Isles Hospital
Sr Geraldine Morgan  Midwife              Wishaw General Hospital

The following acted as lead obstetricians for the project in individual maternity units:

Dr Peter Danielian  Aberdeen Maternity Hospital
Dr Gordon Dobbie    Ayrshire Central Hospital
Dr Brian Magowan    Borders General Hospital
Dr David Evans      Dr Gray’s Hospital
Dr Paul Mensah      Dumfries & Galloway Royal Infirmary
Dr Tahir Mahmood    Forth Park Hospital
Dr Pal Agustsson    Ninewells Hospital
Dr Alan Mathers     Princess Royal Maternity Hospital
Dr Russell Lees     Raigmore Hospital
Dr Alan Cameron     Queen Mother’s Hospital
Dr Dina McLellan    Wishaw General Hospital

Lorraine Adamson and Jane Carmichael provided administrative support. The SPCERH Grantholders, Andrew Calder, Patricia Purton and Jim Chalmers provided support, advice and encouragement throughout. Gillian Penney and Dawn Kernaghan analysed the data and wrote the report.
Background to the audit

Maternal mortality has long been used as a measure of quality of care in maternity services. However, it is now acknowledged that mortality is too rare to be used alone as a quality indicator in a single developed country such as Scotland. Over the past decade, it has been suggested that the measurement and assessment of severe maternal morbidity, or ‘near misses’, may serve as a complementary measure.

Beginning in 2000, a series of pilot exercises was conducted by the Scottish Assessors for the Confidential Enquiry into Maternal Deaths to assess the feasibility of mounting a national mechanism for the identification and assessment of defined categories of severe maternal morbidity, or ‘near misses’. Following this pilot work, the Scottish Confidential Audit of Severe Maternal Morbidity has collected data on severe morbidity events in a uniform way, and using consistent definitions, in all consultant-led maternity units in Scotland for three full, consecutive years.

This document represents our Third Annual Report whereby findings and recommendations from the Confidential Audit are fed back to participating clinicians. We hope that maternity care professionals in Scotland find these Reports useful and complementary to the triennial reports of the UK-wide Confidential Enquiries into Maternal Deaths (CEMD). We hope that the Reports will promote reflective practice and action planning within individual maternity units. As always, SPCERH welcomes comments and suggestions on the content and format of our publications.
Audit methods

Case ascertainment

Inclusion criteria

There is debate surrounding what constitutes the optimum definition of severe obstetric morbidity. The aim is to identify a group of women who were very ill and whose lives were threatened. Fourteen categories of severe maternal morbidity have been included in the Scottish Confidential Audit since 2003. These were based on categories defined by Mantel et al working in South Africa and adapted for the Scottish context on the basis of our pilot experience and discussions with participants. These case definitions have now been retained for three consecutive years to permit year-on-year comparisons and aggregation of data over time. The 14 inclusion categories are summarised and defined in Table 1.

Table 1: Inclusion criteria used throughout 2003 to 2005

<table>
<thead>
<tr>
<th>Code</th>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Major obstetric haemorrhage</td>
<td>Estimated blood loss &gt;=2500ml, or transfused 5 or more units of blood or received treatment for coagulopathy (fresh frozen plasma, cryoprecipitate, platelets). (Includes ectopic pregnancy meeting these criteria).</td>
</tr>
<tr>
<td>2</td>
<td>Eclampsia</td>
<td>Seizure associated with antepartum, intrapartum or postpartum symptoms and signs of pre-eclampsia.*</td>
</tr>
<tr>
<td>3</td>
<td>Renal or liver dysfunction</td>
<td>Acute onset of biochemical disturbance, urea &gt;15mmol/l, creatinine&gt;400mmol/l, AST/ALT &gt;200u/l</td>
</tr>
<tr>
<td>4</td>
<td>Cardiac arrest</td>
<td>No detectable major pulse</td>
</tr>
<tr>
<td>5</td>
<td>Pulmonary oedema</td>
<td>Clinically diagnosed pulmonary oedema associated with acute breathlessness and O₂ saturation &lt;95%, requiring O₂, diuretics or ventilation.</td>
</tr>
<tr>
<td>6</td>
<td>Acute respiratory dysfunction</td>
<td>Requiring intubation or ventilation for &gt;60 minutes (not including duration of general anaesthetic)</td>
</tr>
<tr>
<td>7</td>
<td>Coma</td>
<td>Including diabetic coma. Unconscious for &gt; 12 hours</td>
</tr>
<tr>
<td>8</td>
<td>Cerebro-vascular event</td>
<td>Stroke, cerebral/cerebellar haemorrhage or infarction, subarachnoid haemorrhage, dural venous sinus thrombosis</td>
</tr>
<tr>
<td>9</td>
<td>Status epilepticus</td>
<td>Unremitting seizures in patient with known epilepsy</td>
</tr>
<tr>
<td>10</td>
<td>Anaphylactic shock</td>
<td>An allergic reaction resulting in collapse with severe hypotension, difficulty breathing and swelling/rash.</td>
</tr>
<tr>
<td>11</td>
<td>Septicaemic shock</td>
<td>Shock (systolic blood pressure &lt;80) in association with infection. No other cause for decreased blood pressure. Pulse of 120bpm or more.</td>
</tr>
<tr>
<td>12</td>
<td>Anaesthetic problem</td>
<td>Aspiration, failed intubation, high spinal or epidural anaesthetic</td>
</tr>
<tr>
<td>13</td>
<td>Massive pulmonary embolism</td>
<td>Increased respiratory rate (&gt;20/min), tachycardia, hypotension. Diagnosed as “high” probability on V/Q scan or positive spiral chest CT scan. Treated by heparin, thrombolysis or embolectomy.</td>
</tr>
<tr>
<td>14</td>
<td>Intensive care admission</td>
<td>Unit equipped to ventilate adults. Admission for one of the above problems or for any other reason. Include CCU admissions.</td>
</tr>
</tbody>
</table>

*Note clarification of definition.
Identification and reporting of cases

Risk Management leads in each consultant-led maternity unit notify SPCERH of all women meeting one or more of the ‘near miss’ definitions on a monthly basis. A ‘zero return’ is submitted for months when no events were identified. The SPCERH Administrator institutes reminders by letter, phone or Email if monthly returns are not received. Risk Managers submit a minimal dataset on each woman notified in order that SPCERH staff can confirm that she meets the inclusion criteria.

Data analysis

National and unit-level rates per 1000 births for each ‘near miss’ category are calculated using routinely published data on livebirth totals as denominators. Rates of severe maternal morbidity would most appropriately be calculated using a denominator of ‘maternities’. However, routinely published hospital-level data include totals of live births, but not of maternities. In practice, calculated rates are very similar regardless of whether the denominator used is maternities, livebirths, or total births. Data on the number of maternal deaths during 2005 (to permit calculation of a ‘near miss’:death ratio) were obtained from the Confidential Enquiry into Maternal Deaths (Scotland).

Case assessment

Cases of major obstetric haemorrhage and of eclampsia are subject to detailed case assessment. We have developed standardised, objective Case Assessment Proformas to allow local risk management teams to review the management of their own patients. The Assessment Proformas for major haemorrhage and eclampsia address both ‘protocol adherence’ (the extent to which management of an individual case adheres to recommendations in national guidelines) and ‘systems, or root cause’ analysis (based upon a previously validated questionnaire used by Neale et al.)

Analysis

Data from the completed Case Assessment Proformas are entered into SPSS databases. Descriptive statistics are derived.
Results

Numbers and rates of severe morbidity events

In 2005, we collected severe maternal morbidity data from 18 consultant-led maternity units in Scotland. The total number of ‘unit months’ available for reporting was 216. Completed monthly report forms were returned for all 216 unit months (100%).

During 2005, we received reports of 329 women who met one or more of our defined inclusion criteria. Using a denominator of 52382 live births (most recent available data, for year to 31st March 2005), the Scottish rate of severe maternal morbidity was 6.3/1000 births (95% CI, 5.6 - 7.0). For comparison, the Scottish rate in 2004 was 4.7/1000 (95% CI, 4.2 - 5.4). This increase is statistically significant (Chi-squared test, p=0.0010); however, we do not know if this increase is attributable to improved case ascertainment rather than a true increased rate of adverse events.

During 2005, there were three direct or indirect maternal deaths related to the categories covered by the Scottish Confidential Audit of Severe Maternal Morbidity; giving a ‘near miss:death ratio’ of 109:1. During the 2003 to 2005 triennium, 845 women were reported with severe morbidity and there were 15 relevant maternal deaths; giving a ‘near miss:death ratio’ of 56:1. (Inevitably, small numbers mean that these estimates are imprecise.)

In individual maternity units, 2005 rates of reported severe maternal morbidity ranged from 2.1/1000 births (95% CI, 0.3-7.6) to 9.9/1000 births (95% CI, 6.9 - 13.9).

Figure 1 summarises the unit-level rates of severe maternal morbidity for the three consecutive years of the Scottish Confidential Audit of Severe Maternal Morbidity (2003, 2004 and 2005). Maternity units are identified only by a number to preserve anonymity. Small numbers of cases in many units mean that confidence intervals are wide. Few units have rates of events which are significantly different from the overall Scottish rate. It must be borne in mind that differences in rates are likely to reflect case-mix and population differences, and differences in the diligence and efficiency of case ascertainment as well as differences in quality of care.

Figure 1 also summarises unit-level rates of severe maternal morbidity based on aggregated data for the triennium 2003 - 2005. Aggregation of data has served to narrow confidence intervals; it is still the case that few units have rates of events which are significantly different from the overall Scottish rate. These data are also shown in Table 2.

(Although only 18 maternity units participated in 2005, in Figure 1 and Table 2, units are numbered from 1 to 22. This is because 22 units participated at the outset of the Scottish Confidential Audit of Severe Maternal Morbidity in 2003. Unit identifier numbers have been kept consistent over time to facilitate comparisons and assessment of trends.)

We recognise that maternity unit 12 has a rate of reported severe maternal morbidity which is higher than the overall Scottish rate over the triennium. This finding is being explored with staff in the unit concerned.
**Figure 1:** Unit-level and Scottish rates of ‘near miss’ events, 2003 to 2005

2003

![Graph showing unit-level and Scottish rates of ‘near miss’ events in 2003.](image)

2004

![Graph showing unit-level and Scottish rates of ‘near miss’ events in 2004.](image)
Figure 1: Unit-level and Scottish rates of ‘near miss’ events, 2003 to 2005

Triennium 2003 - 2005

Rate / 1000 deliveries

Hospital codes
Table 2: Rates of severe maternal morbidity by individual maternity unit, 2003 to 2005

<table>
<thead>
<tr>
<th>UNIT CODE</th>
<th>Women experiencing severe maternal morbidity per 1000 live births</th>
<th>Rate (95% CI)</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>Triennium 2003-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>4.5</td>
<td>(2.5 - 7.5)</td>
<td>5.4</td>
<td>(3.3 - 8.5)</td>
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<tr>
<td>2</td>
<td></td>
<td></td>
<td>7.2</td>
<td>(2.9 - 14.8)</td>
<td>4.0</td>
<td>(1.1 - 10.3)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>2.0</td>
<td>(0.1 - 11.3)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>4.4</td>
<td>(1.2 - 11.1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>5.8</td>
<td>(2.9 - 10.3)</td>
<td>3.9</td>
<td>(1.8 - 7.3)</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>6.0</td>
<td>(3.6 - 9.5)</td>
<td>4.2</td>
<td>(2.2 - 7.1)</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>7.5</td>
<td>(5.3 - 10.4)</td>
<td>6.9</td>
<td>(4.8 - 9.5)</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>2.6</td>
<td>(1.0 - 5.4)</td>
<td>3.9</td>
<td>(1.9 - 6.9)</td>
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<td>9</td>
<td></td>
<td></td>
<td>5.7</td>
<td>(3.5 - 8.8)</td>
<td>3.1</td>
<td>(1.6 - 5.3)</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>4.7</td>
<td>(0.1 - 25.9)</td>
<td>0.0</td>
<td>(0.0 - 16.3)</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>4.1</td>
<td>(1.6 - 8.3)</td>
<td>3.9</td>
<td>(1.6 - 7.9)</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>9.1</td>
<td>(6.4 - 12.4)</td>
<td>11.3</td>
<td>(8.2 - 15.0)</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td>3.3</td>
<td>(0.7 - 9.7)</td>
<td>4.6</td>
<td>(1.3 - 11.9)</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>4.6</td>
<td>(3.0 - 6.7)</td>
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<td>(3.4 - 9.2)</td>
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</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td>2.9</td>
<td>(0.8 - 7.3)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td>8.6</td>
<td>(4.6 - 14.6)</td>
<td>6.0</td>
<td>(3.4 - 9.9)</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>5.1</td>
<td>(0.1 - 27.9)</td>
<td>4.8</td>
<td>(0.1 - 26.5)</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td>3.3</td>
<td>(1.8 - 5.4)</td>
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<tr>
<td>22</td>
<td></td>
<td></td>
<td>7.3</td>
<td>(3.3 - 13.8)</td>
<td>0.8</td>
<td>(0.0 - 4.5)</td>
</tr>
</tbody>
</table>

Scotland 5.3 (4.7 - 6.0) 4.7 (4.2 - 5.4) 6.3 (5.6 - 7.0) 5.4 (4.9 - 6.0)

Table 3 summarises the Scottish rate of each individual category of severe morbidity for each year from 2003 to 2005 and for the triennium as a whole. Many women met the definition for more than one inclusion criterion (e.g. suffered severe haemorrhage and admitted to ITU). In 2005, the 328 women reported experiencing a total of 417 events meeting our inclusion criteria. Of the 328 women, 252 fell into only one severe morbidity category; 65 fell into two categories; 10 into three categories; and one woman met the inclusion criteria for five separate severe morbidity categories.

Major obstetric haemorrhage was the most numerous category, occurring in 235 women in 2005 (72% of all women reported). The rate of major haemorrhage has increased significantly between 2004 and 2005 (from 3.2/1000 to 4.5/1000). This increase in haemorrhage accounts for much of the overall increase in severe morbidity between 2004 and 2005. The rate of women suffering non-haemorrhage severe morbidity events increased from 1.4 (1.1 - 1.8)/1000 to 1.8 (1.4 - 2.2)/1000. It should be noted that there is no consistent upward trend in severe morbidity over the three years studied to date.

The causes of severe maternal morbidity found in our study differ from the causes of maternal death found in the Confidential Enquiries. Major haemorrhage accounted for 69% of our cases of severe morbidity but for only 16% of direct maternal deaths in the UK in the 2000 to 2002 triennium. In contrast, venous thromboembolism was the principal cause of maternal death (28% of cases), but accounted for under 2% of our cases of severe morbidity. Thus, the pattern of morbidity and mortality appears to differ from the continuum described by Pattinson, with some clinical insults (e.g. major haemorrhage) being more amenable to alteration by prompt and appropriate treatment than others.
### Table 3: Numbers and rates of individual categories of severe maternal morbidity, 2003 to 2005

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>Triennium 2003-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Rate/1000 (95% CI)</td>
<td>n</td>
<td>Rate/1000 (95% CI)</td>
</tr>
<tr>
<td>1. Major Obstetric Haemorrhage</td>
<td>176</td>
<td>3.5 (3.0-4.1)</td>
<td>171</td>
<td>3.2 (2.8-3.8)</td>
</tr>
<tr>
<td>2. Eclampsia</td>
<td>19</td>
<td>0.4 (0.2-0.6)</td>
<td>17</td>
<td>0.3 (0.1-0.5)</td>
</tr>
<tr>
<td>3. Renal or liver dysfunction</td>
<td>25</td>
<td>0.5 (0.3-0.7)</td>
<td>14</td>
<td>0.2 (0.1-0.4)</td>
</tr>
<tr>
<td>4. Cardiac arrest</td>
<td>3</td>
<td>0.06 (0.0-0.2)</td>
<td>2</td>
<td>0.04 (0.0-0.1)</td>
</tr>
<tr>
<td>5. Pulmonary oedema</td>
<td>17</td>
<td>0.3 (0.2-0.5)</td>
<td>11</td>
<td>0.2 (0.1-0.3)</td>
</tr>
<tr>
<td>6. Acute respiratory dysfunction</td>
<td>22</td>
<td>0.4 (0.3-0.7)</td>
<td>25</td>
<td>0.4 (0.3-0.7)</td>
</tr>
<tr>
<td>7. Coma</td>
<td>0</td>
<td>0 (0-0.1)</td>
<td>0</td>
<td>0 (0-0.1)</td>
</tr>
<tr>
<td>8. Cerebrovascular event</td>
<td>8</td>
<td>0.2 (0.1-0.3)</td>
<td>3</td>
<td>0.06 (0.0-0.1)</td>
</tr>
<tr>
<td>9. Status epilepticus</td>
<td>0</td>
<td>0 (0-0.1)</td>
<td>0</td>
<td>0 (0-0.1)</td>
</tr>
<tr>
<td>10. Anaphylactic shock</td>
<td>4</td>
<td>0.1 (0.0-0.2)</td>
<td>0</td>
<td>0 (0-0.1)</td>
</tr>
<tr>
<td>11. Septicaemic shock</td>
<td>6</td>
<td>0.1 (0-0.3)</td>
<td>4</td>
<td>0.08 (0-0.2)</td>
</tr>
<tr>
<td>12. Anaesthetic problem</td>
<td>12</td>
<td>0.2 (0.1-0.4)</td>
<td>8</td>
<td>0.1 (0-0.3)</td>
</tr>
<tr>
<td>13. Massive pulmonary embolism</td>
<td>7</td>
<td>0.1 (0.1-0.3)</td>
<td>5</td>
<td>0.1 (0-0.2)</td>
</tr>
<tr>
<td>14. Intensive care or coronary care admission</td>
<td>76</td>
<td>1.5 (1.2-1.9)</td>
<td>82</td>
<td>1.5 (1.2-1.9)</td>
</tr>
<tr>
<td>Live births in Scotland</td>
<td>50,772</td>
<td>51,910</td>
<td>52,382</td>
<td>155,064</td>
</tr>
</tbody>
</table>
Assessment of cases of major obstetric haemorrhage

**Case definition:** Estimated blood loss $\geq 2500$ml, or transfused $\geq 5$ units of blood, or received treatment for coagulopathy (fresh frozen plasma, cryoprecipitate, platelets). (Includes ectopic pregnancy, miscarriage and abortion meeting these criteria).

Completed Case Assessment Proformas were received for 209 of the 235 notified cases of major obstetric haemorrhage (89%). Figure 2 summarises the numbers of eligible cases notified by each unit, and the numbers of completed Proformas returned. Again, units have been anonymised.

**Figure 2:** Major obstetric haemorrhage; cases notified and returned (2005)

![Bar chart showing completed and outstanding cases by hospital number](chart.png)

**Characteristics of women suffering major obstetric haemorrhage**

- Women’s age: mean 30.9; median, 31.0; range 16-46 years.
- The median number of previous births was one (range 0-11).
- Estimated blood loss: mean, 3.8; median, 3; range 0.8-18 litres.
- Volume of blood transfused: mean, 4.7; median, 4; range 0-27 units.

(These characteristics are similar to those reported in 2003 and 2004.)

- In 2005, we recorded the difference in haemoglobin pre-bleed to post-bleed. The mean was a fall of 3.8 g/dl; the median, a fall of 3.7 g/dl; and the range, a rise of 4.3 g/dl (from 7.6 to 11.9) to a fall of 9.7 g/dl (from 13.8 to 4.1). We recognise that there may be inconsistency among units in the timing of the post-bleed haemoglobin. For 2007, we plan to standardise the time of recording at Day 3.

**Reported causes of major obstetric haemorrhage**

Causes of haemorrhage are summarised in Table 4. The 15 causes in the ‘other’ category comprised: miscarriage (two women), coagulopathy secondary to pre-existing maternal conditions (three women), ectopic pregnancy, warfarin treatment, bleeding from arteriovenous malformation (each one woman), and seven women who had excessive bleeding at Caesarean section with no identifiable cause. The
The total number of causes exceeds 209 as many women were documented as having more than one cause. Uterine atony was the commonest cause, described in 104 women (50%). The distribution of causes is broadly similar to that found in 2004.

**Table 4:** Causes of major obstetric haemorrhage identified among 209 women (2005)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uterine atony</td>
<td>104</td>
<td>50</td>
</tr>
<tr>
<td>Retained placenta/ membranes</td>
<td>36</td>
<td>17</td>
</tr>
<tr>
<td>Vaginal laceration/ haematoma</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td>Extension to uterine incision</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>Placenta praevia</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>Abruption</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Cervical laceration</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Uterine rupture</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Broad ligament haematoma</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>

**Mode of delivery**

The mode of delivery for each of the 209 women is summarised in Table 5. Eleven women (5%) had a twin delivery. In total, 119 women (57%) were delivered by Caesarean section; 80 emergency (38%) and 39 elective (19%). Among the 80 women delivered by emergency caesarean section, it was documented that in 19 cases (24%) caesarean section was performed at full dilatation. (In the absence of population data on the proportion of caesarean sections performed at full dilatation, we can only speculate on whether this proportion is unduly high.)

**Table 5:** Mode of delivery for 209 women suffering major obstetric haemorrhage (2005)

<table>
<thead>
<tr>
<th>Mode</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency caesarean</td>
<td>80 (38%)</td>
</tr>
<tr>
<td>Spontaneous vaginal delivery</td>
<td>52 (25%)</td>
</tr>
<tr>
<td>Elective caesarean</td>
<td>39 (19%)</td>
</tr>
<tr>
<td>Forceps</td>
<td>22 (11%)</td>
</tr>
<tr>
<td>Ventouse</td>
<td>6 (3%)</td>
</tr>
<tr>
<td>Vaginal breech</td>
<td>5 (2%)</td>
</tr>
<tr>
<td>Ectopic pregnancy / miscarriage / unrecorded</td>
<td>5 (2%)</td>
</tr>
</tbody>
</table>

It is evident that women having spontaneous vaginal deliveries are under-represented among cases of major haemorrhage, and that women having caesarean section are over-represented. For the triennium 2003 to 2005, we have data on 517 cases of major obstetric haemorrhage. Figure 3 summarises the modes of delivery for these women along with modes of delivery for women in the Scottish population over the same period. During the triennium, 97,380 women delivered by spontaneous vertex delivery with 126 cases of major haemorrhage (rate, 1.3 / 1000); 23,879 women delivered by emergency Caesarean section with 212 cases of major haemorrhage (rate, 8.9 / 1000). Thus, the relative risk for major haemorrhage if delivered by emergency caesarean section, compared to spontaneous vertex delivery is 6.86. Similarly, 14,110 women delivered by elective Caesarean section with 89 cases of major haemorrhage (rate, 6.3 / 1000); giving a relative risk for major haemorrhage if delivered by elective caesarean section, compared to spontaneous vertex delivery of 4.87.
Figure 3: Modes of delivery for 517 women suffering major obstetric haemorrhage (SCASMM 2003-2005) and Scottish population (ISD data, triennium to 31 March 2005)

Were women managed according to national guidelines?

Items included in the Case Assessment Proforma allowed assessment of the extent to which case management followed recommendations in a number of national sources, principally the ‘SOGAP’ guideline on *The Management of Postpartum Haemorrhage*.3

Antepartum haemorrhage

(Antepartum haemorrhage was not addressed within the SOGAP guideline; but two audit standards were developed from other sources6,7)

**Standard:** *In the case of severe antepartum haemorrhage, the patient should be delivered as soon as possible.*

Twenty five women suffered antepartum haemorrhage. In 20 cases, local risk management teams considered that delivery had been ‘expedited by the most appropriate route’. (Teams felt the question did not apply in the remaining five cases.)

**Standard:** *Ideally, a consultant obstetrician is present when delivering women with known placenta praevia, but if not then immediately available.*

There were 23 cases where placenta praevia was identified as a cause of bleeding. All were delivered by caesarean section. In 18 cases (78%), a consultant obstetrician was present, or immediately available, at Caesarean section. In four of the remaining five cases, local risk management teams indicated that the issue of consultant availability was ‘not applicable’.
**Third stage prophylaxis**

**Standard:** *Prophylactic oxytocics should be offered routinely in the management of the third stage of labour.*

Of the 209 cases examined, 201 (96%) were documented as receiving third stage prophylaxis. In five cases, documentation was deficient and it could not be determined whether prophylaxis had been given. One woman refused prophylaxis; and in two cases prophylaxis was evidently not given but the reason was unclear.

**Recognition of risk factors**

Local risk management groups considered that 74 of the 209 cases (35%) had antenatal risk factors for postpartum haemorrhage (eg abruption, placenta praevia, multiple pregnancy). Of these 74 cases, 66 (89%) were identified and documented antenatally as being at high risk. An explicit plan was documented for 58 of these women and was followed in all but eight cases.

Local risk management groups considered that 139 of the 209 cases (66%) developed risk factors for postpartum haemorrhage during labour (eg prolonged labour, pyrexia, caesarean delivery). Of these 139 cases, 121 (87%) were identified and documented during labour as being at high risk. Appropriate action was taken in all but two cases.

**Communication**

**Standard:** *In the face of major PPH, call experienced midwife, obstetric registrar, anaesthetic registrar, porters; alert obstetric consultant, anaesthetic consultant, haematologist and blood transfusion service.*

Figure 4 summarises the grades of staff who were documented as being involved in the management of the 209 cases of major obstetric haemorrhage. It is noteworthy that (according to available documentation) a consultant obstetrician had ‘hands-on’ involvement in the acute care of only 69% of these women. This is similar to the 2004 figure of 68% and lower than the 2003 figure of 76%. However, in 2005 it was explicitly documented that a consultant was informed about the woman’s condition in a further 16% of cases. Thus, a consultant had direct involvement in 85% of cases (compared with 76% in 2004).

**Figure 4:** Grades of staff present or informed in management of 209 cases of major obstetric haemorrhage (2005)

During the 2003 to 2005 triennium, a consultant was present during the acute management of 368 of 517 women with major haemorrhage (71%). Mean estimated blood loss among cases where a consultant was present was 4097 mls, compared to 2932 mls among cases without consultant presence (p=0.000); mean volume of blood transfused among cases where a consultant was present was 6.1 units, compared to 3.3 units among cases without consultant presence (p=0.000). These
findings suggest that, in general, consultants were more likely to have hands-on involvement in the more severe cases of major haemorrhage.

Resuscitation

Standards: In the face of major PPH, achieve intravenous access with two 14 G cannulae; head down tilt; oxygen by mask; transfuse blood as soon as possible. Until blood is available, infuse crystalloid (maximum 2 L) and colloid (maximum 1.5 L). If cross-matched blood is unavailable once 3.5 L of clear fluids have been infused, give ‘O neg’ blood or un-cross-matched own group blood (according to local policies). If bleeding is unrelenting, give fresh frozen plasma (1 L) and cryoprecipitate (10 units) empirically even if results of coagulation studies are unavailable. Use the best available equipment to achieve rapid warmed infusion of fluids; do not use blood filters which slow infusions. Do not use dextrans in obstetric practice.

203 of the 209 women (97%) were documented as having intravenous access achieved; and 183 (87%) were documented as having the recommended two large bore cannulae (similar to performance in 2004). Of the 209 women, 180 (86%) were documented as having been given oxygen during resuscitation.

Of the 209 women, 188 (90%) were documented as receiving clear fluids (crystalloids and colloids) as part of resuscitation. Among these, the mean volume of clear fluid infused for initial resuscitation was 2.6 litres (range 0.5 - 6 litres). Twenty women (10%) received more than the recommended 3.5 litres. (In 2004, only 9 women (6%) received more than 3.5 litres of clear fluids before receiving blood.)

Among the 209 women who suffered a major obstetric haemorrhage, 28 (13%) apparently received no blood during resuscitation. (In a few of these cases, completion of the Case Assessment Proforma was poor and the true circumstances are unclear.) It does not appear that any of the non-transfused women actually refused blood. Only two of these women received more than the recommended maximum of 3.5 litres of clear fluids. The estimated blood loss among the non-transfused women ranged from 2.5 - 4 litres. Among these non-transfused women, the haemoglobin level recorded after the bleed ranged from 6.3 - 11.1 g/dl. Fourteen women had a post-bleed haemoglobin of <8 g/dl; this suggests that the need for blood transfusion during the acute episode was not recognised in a few women.

‘O neg’ blood was used in 19 women (9%) and un-crossmatched, group-specific blood in 16 women (8%). Among the 181 women who were clearly documented as having received blood, the mean volume transfused (crossmatched + uncrossmatched) was 5.5 units (range 1 to 27 units).

Blood products were widely used: fresh frozen plasma (2-16 units) in 78 women (37%); cryoprecipitate (1-30 units) in 25 women (12%); and platelets (1-14 units) in 34 women (16%).

The pattern of use of blood and blood products was similar to that observed in 2004.

Monitoring and investigation

Standards: In the face of major PPH, take blood for crossmatching (6 units), full blood count, and clotting screen. Monitor pulse and blood pressure continuously. Monitor urine output using a Foley catheter. Use central venous pressure monitoring (once appropriately experienced staff available for insertion). Consider transfer to intensive therapy unit.

Blood tests

Documentation was deficient in seven cases, with no evidence that blood had been crossmatched. The recommended 6 units (or more) were cross matched in 125 women (62%) (similar to performance in 2004). The remaining 77 women (38%) were crossmatched, but for less than the recommended 6 units.

It was documented that blood was obtained prior to transfusion for full blood count in 192 women (92%) and for coagulation studies in 172 (82%). Again, similar to performance in 2004.
Monitoring of vital signs

Blood pressure was recorded at least every 15 minutes in 201 women (96%); pulse was recorded continuously in 197 (94%); urine output was recorded at least hourly in 201 (96%). All of these findings are similar to those observed in 2004.

Central venous pressure (CVP) lines were inserted in 70 women (33%). Women with no CVP line included 17 with an estimated blood loss in of 4 litres or more and four who were transfused more than 10 units of blood during the acute episode. This pattern of utilisation of CVP lines is similar to that observed in 2004.

Intensive care

In only 50 women (24%) was there any documentation of consideration of transfer to an intensive care unit. Discussion with an intensive care consultant was documented in 48 cases (23%). Of these, 38 women (18%) were actually transferred. An additional 149 women (61% of the total) were documented as being cared for in a dedicated high dependency area of the labour ward. Thus, 89% of women with major obstetric haemorrhage were managed in a designated intensive care or high dependency care area. (Since 2004, the utilisation of formal ITU care has decreased slightly and the use of labour ward HDU care has increased.)

Women not admitted to intensive care included 36 with an estimated blood loss in of 4 litres or more and four who were transfused more than 10 units of blood during the acute episode.

Arresting the bleeding

Standards: Clinical examination must be undertaken to exclude causes of bleeding other than uterine atony. When uterine atony is perceived to be the cause of bleeding, the following measures should be instituted in turn until the bleeding stops: uterine compression, emptying the bladder, Syntocinon 10 units by slow IV injection, ergometrine 0.5 mg by slow IV injection, Syntocinon infusion, carboprost intramuscularly. If conservative measures fail to control haemorrhage, initiate surgical haemostasis sooner rather than later. The following interventions are reported to be effective and, depending on available facilities and expertise, should be undertaken, in turn, until the bleeding stops: At laparotomy, direct intramyometrial injection of carboprost (Haemabate) 0.5mg; Uterine artery embolisation; Bilateral ligation of uterine arteries; Bilateral ligation of internal iliac (hypogastric) arteries; Haemostatic uterine suturing (eg B-Lynch); Hysterectomy. Resort to hysterectomy sooner rather than later (especially in cases of placenta accreta or uterine rupture).

A total of 104 women (50% of the 209 women with major haemorrhage in 2005) had uterine atony identified as the only cause, or a contributory cause, of their bleeding. Of these, 52 (50%) were managed using non-surgical treatments (including intramyometrial carboprost) only. The remaining 52 women had one or more surgical interventions to control their bleeding.

Non-surgical treatments

Table 6 summarises the medical treatments used in all 104 women with uterine atony as a cause for their bleeding. All women received one or more of these treatments before resort to surgery. The commonest medical intervention was syntocinon by infusion, used in 96%. Intramuscular carboprost was also widely used (65%), with up to 8 doses being given. The choice of medical treatments was similar to that seen in 2003 and 2004.

<table>
<thead>
<tr>
<th>Therapy</th>
<th>Received (No.)</th>
<th>Received (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contraction rubbed up</td>
<td>59</td>
<td>57</td>
</tr>
<tr>
<td>Bimanual compression uterus</td>
<td>40</td>
<td>38</td>
</tr>
<tr>
<td>Syntocinon 5 iu* intravenous</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Ergometrine 0.5mg intravenous</td>
<td>45</td>
<td>43</td>
</tr>
<tr>
<td>Syntocinon infusion</td>
<td>100</td>
<td>96</td>
</tr>
<tr>
<td>Carboprost 0.25mg intramuscular</td>
<td>68</td>
<td>65</td>
</tr>
<tr>
<td>Carboprost intramyometrical</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>

**Surgical treatments**

The established surgical procedures listed in Table 7 were used in 71 of all 209 women with major haemorrhage (34%). (A further 44 women were documented as having ‘other’ procedures; in the main these were medical treatments [eg gemeprost] not considered above). A few of these women had ‘other’ surgical procedures (eg suturing of vaginal tears); the nature and significance of these procedures is unclear from the available documentation.

Table 7 summarises the use of surgical haemostatic procedures in each year from 2003 to 2005. It clearly shows the increasing use of intrauterine balloon techniques (from only six cases in 2003 to 37 cases in 2005) and of B-Lynch haemostatic suturing (from 10 cases in 2003 to 23 in 2005). Figure 5 summarises the Scottish experience with haemostatic surgical techniques during the triennium. Overall, balloon techniques were used in 64 women and hysterectomy avoided in 50 (78%) of these. B-Lynch suture techniques were used in 52 women and hysterectomy avoided in 42 (81%).

Table 7 shows that the proportion of women suffering major obstetric haemorrhage who underwent hysterectomy appears to be declining over time (from 15% in 2003 to 9% in 2005). This decline does not reach statistical significance (Chi-squared test for trend, p=0.076). Nevertheless, the data are encouraging and suggest that increasing use of effective conservative surgical techniques may be reducing the need for hysterectomy among women suffering major haemorrhage.

During the 2003 to 2005 triennium, 63 women underwent obstetric hysterectomy. This was the primary surgical haemostatic procedure in 34 cases (54%).

**Table 7:** Use of haemostatic surgical procedures among 517 women with major obstetric haemorrhage (triennium 2003 - 2005)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>2003 (n=152)</th>
<th>2004 (n=156)</th>
<th>2005 (n=209)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Successful</td>
<td>Women</td>
</tr>
<tr>
<td></td>
<td>undergoing</td>
<td>(hysterectomy</td>
<td>undergoing</td>
</tr>
<tr>
<td></td>
<td>procedure</td>
<td>avoided)</td>
<td>procedure</td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Intrauterine balloon</td>
<td>6</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Uterine artery embolisation</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Uterine artery ligation</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Iliac artery ligation</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B-Lynch suture</td>
<td>10</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>23</td>
<td>15</td>
<td>-</td>
</tr>
</tbody>
</table>
Figure 5: Use of haemostatic surgical procedures among 517 women with major obstetric haemorrhage (triennium 2003 - 2005)

- Balloon: 14 successful, 50 unsuccessful
- Uterine artery embolisation: 5 successful, 9 unsuccessful
- Uterine artery ligation: 7 successful, 7 unsuccessful
- Internal iliac ligation: 2 unsuccessful
- B-Lynch hysterectomy: 10 successful, 42 unsuccessful
- Hysterectomy: 63 unsuccessful

Legend: □ successful (hysterectomy avoided) □ unsuccessful (hysterectomy performed)
Did systems failures contribute to these instances of major obstetric haemorrhage?

The general adverse event analysis part of the Case Assessment Proforma was completed for 206 of the 209 (99%) cases of major obstetric haemorrhage reported in 2005. (The comparable figures in 2003 were 152/176; 86% and in 2004, 146/171; 85%.)

Problems or errors

The Case Assessment Proforma required local risk management teams to identify which of 14 categories of ‘problem’ were present in the context of each individual case. Teams were required to indicate if each identified problem was ‘specific to this event’ or ‘a longstanding general issue’ (or both). Responses are summarised in Table 8. It is reassuring that in 2005 (as in 2004), no longstanding ‘systems problems’ were identified.

In each year, the commonest types of problem identified were ‘Failure to follow protocol/plan’ and ‘Avoidable delay in diagnosis/treatment’. The only type of problem which appears to be increasing, rather than decreasing over time, is ‘Poor communication’. Nevertheless, in 2005 almost three quarters of cases had no identifiable problems or errors in management.

Table 8: Specific problems or errors identified

<table>
<thead>
<tr>
<th>Problem / Error Specific to individual case</th>
<th>2003 n=152</th>
<th>2004 n=146</th>
<th>2005 n=206</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Avoidable delay in diagnosis / treatment</td>
<td>25 16.4</td>
<td>21 14.4</td>
<td>19 9.2</td>
</tr>
<tr>
<td>2. Failure to follow protocol / plan</td>
<td>21 13.8</td>
<td>17 11.6</td>
<td>22 10.7</td>
</tr>
<tr>
<td>3. Appropriate conclusion / differential not made</td>
<td>14 9.2</td>
<td>5 3.4</td>
<td>5 2.4</td>
</tr>
<tr>
<td>4. Appropriate test not performed</td>
<td>12 7.9</td>
<td>7 4.8</td>
<td>3 1.5</td>
</tr>
<tr>
<td>5. Inadequate training / supervision of staff</td>
<td>12 7.9</td>
<td>6 4.1</td>
<td>9 4.4</td>
</tr>
<tr>
<td>6. Inadequate history / examination</td>
<td>8 5.3</td>
<td>5 3.4</td>
<td>4 1.9</td>
</tr>
<tr>
<td>7. Staff practising beyond their level of competence</td>
<td>6 3.9</td>
<td>5 3.4</td>
<td>6 2.9</td>
</tr>
<tr>
<td>8. Inadequate staffing (levels / skill mix)</td>
<td>4 2.6</td>
<td>2 1.4</td>
<td>3 1.5</td>
</tr>
<tr>
<td>9. Poor communication</td>
<td>4 2.6</td>
<td>9 6.2</td>
<td>11 5.3</td>
</tr>
<tr>
<td>10. Inadequate service from other departments eg BTS/labs</td>
<td>4 2.6</td>
<td>3 2.0</td>
<td>3 1.5</td>
</tr>
<tr>
<td>11. Test results not obtained / ignored</td>
<td>2 1.3</td>
<td>5 3.4</td>
<td>3 1.5</td>
</tr>
<tr>
<td>12. Lack of team work</td>
<td>2 1.3</td>
<td>5 3.4</td>
<td>2 1</td>
</tr>
<tr>
<td>13. No protocol available*</td>
<td>1 0.7</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>14. Defective equipment</td>
<td>1 0.7</td>
<td>5 3.4</td>
<td>0 0</td>
</tr>
<tr>
<td>15. Lack of equipment*</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>16. Inappropriate test performed</td>
<td>0 0</td>
<td>0 0</td>
<td>2 1</td>
</tr>
<tr>
<td>No problems recorded</td>
<td>105 69</td>
<td>92 63</td>
<td>152 74</td>
</tr>
</tbody>
</table>

*These problems not included in Proforma for 2004/2005
Contributing factors

Adverse events rarely occur due to one specific reason. They are usually due to a number of problems all occurring at the same time and resulting in an incident (as illustrated by the well known ‘swiss cheese’ model). Local risk management teams were asked to indicate which of six types of ‘contributory factors’ were operating in each case: organisational and management; work environment; team; individual staff; task; and patient.

Of the 206 cases studied, 110 (53%) had one or more contributory factors identified. In fact, contrary to the ‘swiss cheese’ model, the majority of these cases (95) had only one contributing factor identified; 11 cases had two contributing factors, and four had three contributing factors. Patient factors were the commonest contributors, being identified in 87 cases; team factors were the next commonest, occurring in 22 cases.

The low rate of multiple contributing factors may be due to the type of clinical events addressed in our Confidential Audit. All the patients had an adverse outcome (major haemorrhage) but not all had an adverse event (an incident resulting in patient harm due to medical management rather than the condition itself). Therefore an error cascade cannot be identified in all cases.

Preventability

Clearly, obstetric haemorrhage can never totally be prevented. However, haemorrhage can often be predicted, and its severity minimised. Questions in this section of the Proforma aimed to elicit the extent to which haemorrhage in individual cases was predicted and minimised. It is reassuring that risk management teams considered overall management to be ‘definitely’ or ‘probably’ appropriate in 87% of cases.

Table 9: Summary of responses regarding ‘preventability’ for 206 cases of major obstetric haemorrhage. (Answers incomplete in some Proformas; totals do not equal 206)
Overall assessment of quality of care

In the Confidential Enquiry into Maternal Deaths, it has been traditional for an overall assessment of 'substandard care' to be made for each case. We have adopted a similar approach in the Scottish Confidential Audit of Severe Maternal Morbidity. Following focus group work with participants, we have modified our terminology, asking risk management groups to assess 'sub-optimal', rather than 'substandard' care.

Cases where care was considered to be sub-optimal clearly provide lessons for future practice. However in this audit of severe morbidity, many women were managed exceptionally well. Lessons for future practice can also be learned from those cases where things went well, and examples of good practice, as well as sub-optimal practice, are highlighted in the sections which follow.

Overall assessments of sub-optimal care are summarised in Table 10. These assessments were made by local risk management teams after completion of the ‘protocol adherence’ and ‘systems analysis’ sections of the structured Case Assessment Proforma. Assessments are very similar to those observed in 2004 (Category 1, 60%; Category 2, 26%; Category 3, 5%; and Category 4, 2%).

Table 10: Overall assessments of sub-optimal care in 206 cases of major obstetric haemorrhage

<table>
<thead>
<tr>
<th>Category</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Appropriate care, well managed.</td>
<td>137</td>
<td>66</td>
</tr>
<tr>
<td>2 = Incidental sub-optimal care – Lessons can be learnt although it did not affect the final outcome.</td>
<td>53</td>
<td>26</td>
</tr>
<tr>
<td>3 = Minor sub-optimal care – Different management may have resulted in a different outcome.</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>4 = Major sub-optimal care – Different management might have been expected to result in a more favourable outcome. The management of this case contributed significantly to the morbidity of this patient.</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Learning points for future practice

Having completed the structured Case Assessment Proforma, risk management teams were requested to summarise 'lessons to be learnt from the case' and a 'local action plan'. Learning points were recorded on 131 of the 209 completed proformas (63%). Multiple separate learning points were noted in many of these cases. There were 93 learning points relating to good practice specifically highlighted and 74 relating to sub-optimal care.

Themes which occurred frequently among learning points from good practice included:

- Local protocol followed.
- Timely involvement of senior staff and of staff from other disciplines.
- Good teamwork.
- Good documentation.

Less common, but important, themes from good practice included:

- Successful use of intra-uterine balloon.
- Appropriate use of High Dependency facilities.
- Appropriate thromboprophylaxis in high risk patient.
Themes which occurred frequently among learning points from sub-optimal practice included:

- Local protocol not followed.
- Poor documentation.
- Delay in communication with senior staff or other disciplines.
- Delay in transfer to theatre.
- Non-attendance of consultant (obstetrician and anaesthetist).

Less common, but important, themes from sub-optimal practice included:

- Inter-staff conflict in front of the patient.
- Need for care when using oxytocin in women with a uterine scar.
- Need to raise awareness of ‘silent PPH’ (‘tricklers’ vs ‘gushers’).
- Language difficulties resulted in non-awareness of relevant past obstetric history.
- Lack of a local protocol for secondary PPH.
- Need to amend local protocol to cover specific circumstances (consultant presence at Caesarean section in 2nd stage of labour, at examination under anaesthesia, at Caesarean section for transverse lie, at rotational forceps delivery).

It was disappointing to note that some of the learning points documented conveyed a continuing sense of a ‘blame culture’ and of inter-professional rivalries. For example, one learning point read ‘Patient transfused incorrect blood in error (by anaesthetist)’; another, ‘Documentation by the midwives was good; medical staff did not document events well - even retrospectively’; and another ‘Documentation (midwifery) is poor’.

**Action planning**

Local action plans were documented in 71 cases (34%). Among the recurring or important themes were:

- Provide feedback to wider staff through a newsletter or meeting.
- Review content of local protocol.
- Review the use and implementation of existing protocols.
- Discussion / debriefing with individual staff.
- Provide laminated PPH checklists to record events in theatre for subsequent transcription to notes.
- Promote use of existing PPH checklist.
Illustrative cases

The following case vignettes have been chosen to illustrate the learning points and action plans summarised above.

This case illustrates the themes of delay in communication and failure to follow a local PPH protocol.

A 37 year old primigravida had a spontaneous vertex delivery at term. She delivered a baby weighing 4.5kg after a labour of 18 hours; however, these risk factors for PPH were not recognised as such nor documented in the notes. Following delivery of the placenta, she suffered an atonic PPH of 4000 mls. The experienced midwife managing the delivery called for assistance from the midwife in charge of labour suite and from the obstetric SHO. An obstetric registrar and consultant were subsequently called and attended within 15 minutes. The local protocol for PPH states that an anaesthetic registrar should be called once estimated blood loss exceeds 1500 mls. In this case, the anaesthetic registrar was not called until estimated blood loss reached 3000mls and an anaesthetic consultant was not alerted at all.

The obstetric registrar attempted to insert an intrauterine balloon catheter in the delivery room while awaiting the arrival of his consultant. This endeavour caused confusion among midwifery staff as the usual practice was to transfer women to theatre for this procedure. A second attempt at balloon tamponade, by the consultant in theatre, was successful in stopping the bleeding.

Following this case, the local protocol for PPH was amended to make it explicit which treatment options are appropriate within the delivery room and which warrant transfer to theatre.

This case again illustrates failure to follow a local protocol (in this case the use of the partogram).

A 32 year old para 1+0 woman was labouring in an ‘along-side’ low-risk midwifery unit. She had a previous spontaneous vertex delivery following a six-hour labour and delivery within a midwife-led unit was considered appropriate. On admission, the cervix was 6 cms dilated and the fetal head one fifth palpable. After a further 3 hours, the cervix had progressed to 9 cms dilated with no further descent of the fetal head. Assessment after a further 3 hours revealed no change in cervical dilatation nor in the station of the presenting part. At this point, referral to obstetric staff occurred. A caesarean section followed with difficulty in disimpacting the fetal head, an introperative blood loss of 4000 mls and ureteric damage. The haemorrhage was arrested by the use of haemostatic B-Lynch suturing.

The local risk management team considered that proper attention to the partogram would have resulted in earlier referral to obstetric care and reduced the risks of the caesarean delivery.

This case illustrates failure to follow a local protocol for operative vaginal delivery and also illustrates appropriate midwife-to-consultant communication in difficult circumstances.

A 29 year old primigravida was examined by an obstetric SHO at 4.00 am after being in the second stage of labour for 2 hours. The SHO made a management plan of trial of forceps under spinal anaesthetic and arranged for transfer of the patient to theatre. Despite a clear instruction in the local labour ward protocol book that a consultant should be present for all trials of forceps in theatre, the SHO made no effort to contact a senior colleague.

The SHO successfully delivered a large infant in good condition by means of Haig Ferguson’s forceps. However, the SHO had difficulty with perineal repair and was still suturing an hour later; by which time estimated blood loss was almost 2000 mls. In the meantime, the midwife present at delivery had called the midwife in charge of labour suite. The midwives asked the SHO if he required assistance but were assured that he was coping. Nevertheless, the midwife in charge took the initiative and contacted the consultant on call because of her concerns about the woman’s condition and evident distress. The consultant arrived within 10 minutes, diagnosed a sizable cervical tear and completed suturing under general anaesthetic.
Assessment of cases of eclampsia

Completed Case Assessment Proformas were returned for 15 of the 19 notified cases of eclampsia (79%). The 15 cases were managed in eight different maternity units.

Characteristics of women suffering eclampsia

The mean age was 24 years (range, 16-43 years). Of the 15 women, nine (60%) were primigravidae. Three of these had prior miscarriages or abortions; thus, 6/15 (40%) had no previous pregnancies of any gestation. These characteristics are similar to those of the 14 women with eclampsia assessed in 2004.

Features of eclamptic episodes

The median gestation at which eclampsia occurred was 36 weeks (range 23-40 weeks). In eight women (53%), eclampsia occurred antenatally and in seven (47%), postnatally.

A value for the last recorded blood pressure prior to the fit was available for all 15 women. Blood pressures were normal or only moderately elevated (median 140/85; systolic range, 104-172; diastolic range, 64-121 mmHg). Only two women had a last recorded diastolic blood pressure above 100 mmHg. A value for the degree of proteinuria prior to the fit was available for 13 women. Of these, eight (61%) had proteinuria of ‘+++’ or above.

As in 2004, few women presented with the classic constellation of symptoms and signs of fulminating pre-eclampsia prior to the fit. Four women were apparently asymptomatic. The only frequently occurring symptom was headache, which was documented in 10 of the 15 women.

Only eight of the 15 women (53%) were known to have pre-eclampsia (of any severity) prior to the fit. Three of these women were on labetalol prior to the fit. In contrast to 2004, when methyldopa and labetalol were used equally frequently, no woman in 2005 was on an antihypertensive other than labetalol. In one case, the local risk management team felt, in retrospect, that an antihypertensive should have been used. In the remaining four cases which were recognised as having some degree of pre-eclampsia prior to the fit, the local risk management team felt that an antihypertensive was not indicated as blood pressure was within normal limits.

None of the 15 women had been commenced on magnesium sulphate as prophylaxis prior to the fit.

Were women managed according to national guidelines?

The Case Assessment Proforma was designed to allow assessment to be made of the extent to which case management followed recommendations in the Royal College of Obstetricians and Gynaecologists Guideline on Management of Eclampsia (1999). This Guideline has now been superseded by The management of severe pre-eclampsia / eclampsia (2006). Thus in this year’s report, standards from this updated Guideline have been adopted.

Communication

**Standard:** The decision to deliver should be made once the woman is stable and with appropriate senior personnel present.

The disciplines and seniority of staff involved in managing each of the 15 cases are summarised in Figure 6. In 2005, a senior midwife, consultant obstetrician and consultant anaesthetist were all documented as present during initial management of only four of the 15 women (cases 1,3,12, and 15). In a further two cases (nos. 4 and 5), it was documented that the ‘missing’ senior clinicians were informed about the woman’s condition.
Documentation about staff in attendance was missing for cases 7 and 9. Case 2 was managed by an obstetric Senior Registrar and anaesthetic Registrar without apparent involvement of consultant staff.

Data on senior staff involvement for the 14 cases reported in 2004 are shown for comparison. Direct involvement of senior staff does not appear to have increased over time.

Figure 6: Summary of senior staff present or informed during acute management of women with eclampsia

2005

Resuscitation

**Standard:** The principles of management should follow the basic principles of airway, breathing, circulation.

Documentation was poor regarding the basics of resuscitation. Among 11 cases with reasonably complete documentation, the airway was secured in nine, oxygen was given in eight, venous access obtained in all 11, and left lateral tilt applied in seven.

Arresting the eclamptic fit and prevention of further fits

**Standards:** Magnesium sulphate is the therapy of choice to control seizures. A loading dose of 4 g should be given by infusion pump over 5 to 10 minutes, followed by a further infusion of 1 g per hour maintained for 24 hours after the last seizure.

Information on medication given to stop the first fit was available for 14 women. In two cases, there was spontaneous resolution of the fit and an anticonvulsant was not used. All 12 women who received an anticonvulsant received magnesium sulphate (two in combination with diazepam). Among cases where it was used, magnesium sulphate was given intravenously in all but one case (where the regimen was apparently administered intramuscularly).
Recurrent fits

**Standards:** Recurrent seizures should be treated with either a further bolus of 2 g magnesium sulphate or an increase in the infusion rate to 1.5 or 2.0 g per hour.

Magnesium sulphate was used for prevention of further fits in all 14 women for whom information was documented. All received magnesium sulphate infusion for 24 hours or longer after the fit.

Three women suffered recurrent fits after institution of magnesium sulphate prophylaxis. None received a further bolus of magnesium sulphate (in line with current RCOG recommendations) but two were documented as receiving diazepam to stop recurrent fitting.

Monitoring and management of magnesium toxicity

**Standards:** Magnesium toxicity can be assessed by clinical assessment as it causes a loss of deep tendon reflexes and respiratory depression. Intravenous calcium gluconate should be administered in the event of toxicity.

Documentation of monitoring of respiratory rate and deep tendon reflexes was deficient in some cases. However, it was explicitly documented that respiratory rate was monitored at least hourly in 4 cases and that deep tendon reflexes were monitored at least hourly in 11 cases. Bedside availability of calcium gluconate was explicitly documented in eight cases. In no case was it necessary to discontinue magnesium sulphate because of side effects or toxicity.

Treatment of hypertension

**Standards:** Antihypertensive treatment should be started in women with a systolic blood pressure over 160 mmHg or a diastolic blood pressure over 110 mmHg. In women with other markers of potentially severe disease, treatment can be considered at lower degrees of hypertension.

Labetalol, given orally or intravenously, nifedipine given orally, or intravenous hydralazine can be used for the acute management of severe hypertension.

For nine of the 15 cases, a maximum systolic blood pressure of >160 mmHg or diastolic >110 mmHg was explicitly documented. A total of 10 women received antihypertensives in the first 24 hours after the fit. Labetalol was the most commonly used agent (8 women). Hydralazine was used in two; no women received ‘other’ antihypertensives. Among women who received antihypertensives in the 24 hours following a fit, the route of administration was intravenous in seven, oral in two, and unspecified in the remaining case.

Fluid therapy

**Standards:** Fluid restriction is advisable to reduce the risk of fluid overload. In usual circumstances, total fluids should be limited to 80 ml/hr or 1 ml/kg/hr. Close fluid balance with charting of input and output is essential. A catheter with an hourly urometer is advisable in the acute situation.

Twelve of the 15 women were documented as having a Foley catheter in situ; data were missing for the remaining three women. Fourteen were documented as having fluid intake / output strictly charted during post-eclampsia management; with missing data in the remaining case. In 13 cases, urine output was measured at least hourly (missing data in two cases). In twelve of the 15 cases, it was explicitly documented that fluid intake was restricted in line with a previous standard (85ml / hr).
Monitoring and investigation

**Standards:** Assessment of the woman requires a full blood count, liver function and renal function tests. These should be repeated at least daily when the results are normal but more often if the clinical condition changes or if there are abnormalities.

Fourteen women were documented as having the following investigations performed during the first 24 hours: full blood count; urea, creatinine and electrolytes; uric acid / urate; liver function tests; clotting screen. In all cases, these investigations were repeated at intervals of less than 24 hours during the acute phase. In addition, all 14 women had repeated checks for proteinuria and continuous monitoring of oxygen saturation.

Data relating to these investigations were missing for the remaining case.

Organisation of services

**Standards:** The 2006 RCOG Guideline on *The management of severe pre-eclampsia / eclampsia* does not include a specific recommendation about the setting for care. Our previous audit standard was as follows: *Women who have suffered eclampsia should be managed in a delivery suite or other area equipped and staffed for high dependency care.*

Thirteen women were documented as remaining under high dependency care for at least 48 hours after the eclamptic fit. This was not the case for one woman and data were missing for the remaining case.

Overall assessment of suboptimal care

The Systems Analysis part of the Case Proforma was completed for 14 cases of eclampsia. Nine were judged as 'appropriate care'; two as 'incidental sub-optimal'; two as 'minor suboptimal'; and one as 'major suboptimal'.

Learning points and action plans

Learning points and/or local action plans were documented on the Case Assessment Proformas for 10 cases. As for cases of major haemorrhage, deficient documentation and avoidable delays in initiating treatment were highlighted in several cases. In several cases, eclampsia occurred in settings other than a consultant-led maternity unit: in women's homes, in accident & emergency departments or in maternity day care units. These cases highlighted the need to educate primary care staff on the clinical features of pre-eclampsia and of the need for eclampsia protocols and ‘eclampsia packs’ in A&E and day care settings.

As for cases of haemorrhage, several of the learning points conveyed a sense of continuing blame culture and ‘tribal boundaries’. For example, ‘Well managed due to midwifery staff’s skill and knowledge re advising new medical staff about protocol’ and ‘Consultant did not follow the protocol’.
**Illustrative Case**

This case illustrates the fact that eclampsia often occurs postnatally without classical preceding symptoms and signs. It highlights the challenges facing the ‘managed clinical network’ when an obstetric emergency occurs in a non-obstetric setting.

A 32 year old woman with one previous spontaneous vaginal delivery was delivered by elective Caesarean section at 39 weeks gestation because of breech presentation. Her pregnancy had been uneventful apart from a transient episode of hypertension (maximum blood pressure 160/100 mmHg) at 35 weeks. This episode was associated with a trace of proteinuria diagnosed as due to urinary tract infection. She was managed by twice weekly attendance at maternity day care and blood pressure was normal from 37 weeks onwards.

Following Caesarean section, recovery was uneventful and mother and baby were discharged home on the fourth postnatal day. At 03.30 am on the fifth postnatal day, the patient complained of severe headache and vomiting and her partner called out the General Practice Out of Hours Service. A General Practitioner attended and took the patient’s blood pressure as part of his examination. The patient was told that her blood pressure was high and that her Community Midwife would visit in the morning.

At 07.00 am on the same morning, the patient had a seizure. Her partner summoned an ambulance by a 999 call. The patient was taken to an accident and emergency department at a non-obstetric hospital. A diagnosis of eclampsia was made, the patient was stabilised and transferred by ambulance to the nearest obstetric unit. No anticonvulsant was administered as the fit had resolved spontaneously and magnesium sulphate was not instituted. A further fit occurred during ambulance transfer.

On arrival at the obstetric unit, intravenous magnesium sulphate was commenced and the patient managed in a high dependency area of the labour ward according to the unit eclampsia protocol. Management was conducted by a senior obstetric registrar and anaesthetic SHO. There is no indication that a consultant from either discipline was informed about the patient’s arrival or management.

The local risk management team highlighted the fact that no eclampsia protocol or ‘eclampsia pack’ containing magnesium sulphate was available to staff in the A&E department. These resources have now been provided.
Report References


