

# Scottish Confidential Audit of Severe Maternal Morbidity: reducing avoidable harm

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8<sup>th</sup> Annual Report

# **Scottish Confidential Audit of Severe Maternal Morbidity**

**8th Annual Report  
(Data from 2010)**

**Healthcare Improvement Scotland**

**Produced on behalf of the Reproductive Health Programme, Healthcare Improvement Scotland by:**

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## **Acknowledgements:**

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## Headline Summary

- Major obstetric haemorrhage (MOH) was the most common cause of severe morbidity in pregnancy, affecting 1 in 180 women giving birth.
- Guidelines for the management of MOH were not followed consistently.
- The care of MOH was assessed by maternity units as suboptimal in 1 in 5 cases.
- Only 59% of cases of MOH were reviewed by maternity units' risk management team.
- The quality of data collection varied and was poor from some units.

## What should happen next?

- A formal review of each maternity unit's own results should take place through local clinical governance arrangements.
- Each maternity unit should use their local data to achieve improvements in the management of major obstetric haemorrhage as part of the forthcoming national Maternity Care Quality Improvement Collaborative, particularly in the following areas:
  - consistent adherence to guidelines
  - direct involvement of senior staff
  - reliable antenatal risk assessment
  - adequate labour ward staffing 24 hours a day, and
  - formal clinical governance and risk management review of all cases.
- An adequate local resource should be provided to ensure robust case identification and complete submission of data.

# 1 Summary

This eighth annual report describes severe maternal morbidity fulfilling defined criteria reported from all 17 consultant-led maternity units in Scotland in 2010. Detailed assessments of cases of major obstetric haemorrhage and of eclampsia, and of their care in relation to national guidelines are reported.

## Overall data

- During 2010, 385 women were reported experiencing 455 morbidities. This was a rate of 6.5 per 1000 births or one in every 154 births.
- The distribution of deprivation and smoking status of those who experienced severe morbidity reflected the population of Scotland who gave birth in 2010. There was, however, a significantly higher rate of women with a body mass index (BMI) of greater than 35.
- The perinatal mortality rate among women suffering severe morbidity remains high. The rate in 2010 was 69 per 1000 births, exactly ten times the Scottish rate for all births.
- There are deficiencies in the completeness of data submission to the audit.

## Major obstetric haemorrhage (MOH)

### Data

- MOH was the most frequent cause of severe maternal morbidity. In 2010, 328 cases were reported to the audit, representing one major haemorrhage for every 180 births.
- The timing of events was similarly distributed throughout a 24 hour period.
- The use of interventional radiology is increasing. In 2010, information was also requested about the use of planned interventional radiology to prevent anticipated haemorrhage. Three cases were reported.
- Information on the use of blood cell salvage was also requested for the first time in 2010. It was attempted in six cases with only two obtaining a useful quantity of blood.

### Room for improvement

- Deficiencies in the care of women experiencing MOH were particularly identified in the following areas:
  - risk assessment and planning
  - consultant involvement
  - fluid management
  - pharmacological treatment of uterine atony, and
  - use of obstetric early warning observation charts
- A review by the local clinical governance or risk management team was carried out in 59% of cases.
- One in five women (22%) received suboptimal care as self assessed by maternity units. Four women (1%) received major suboptimal care.

## **Achievements**

- The reported level of “optimal care” for major obstetric haemorrhage was, at 78% of cases, the highest since the audit began.
- Direct involvement of consultant obstetricians in the care of women with MOH was, at 82%, the highest since the audit began.
- A continuing rise in the use of conservative surgical techniques has been associated with a highly significant fall in the rate of peripartum hysterectomy among women with major obstetric haemorrhage, from 15.1% in 2003 to 5.6% in 2010.

## **Eclampsia**

- Twelve cases of eclampsia were reported in 2010, equalling the lowest annual number reported to the audit
- The occurrence of eclampsia was evenly distributed throughout 24 hours.
- There were deficiencies in aspects of the monitoring of a minority of cases and only 42% were assessed as receiving optimal care.
- The involvement of consultants in both obstetrics and anaesthetics was the highest reported to date at 75% and 42% respectively.

## 2 Recommendations

A formal review of each maternity unit's own results should take place through local clinical governance arrangements and each unit should use their local data to achieve improvements detailed below as part of the forthcoming national Maternity Care Quality Improvement Collaborative.

### Data collection and submission

- Heads of midwifery and clinical directors should provide an adequate local resource and a robust method of case identification to ensure complete submission of local data.
- Local systems of communication should be established to ensure the capture of information about all cases where elective interventional radiology is used to prevent major obstetric haemorrhage (MOH).

### Prevention and planning

- Local clinical governance or risk management teams should assess all cases of severe maternal morbidity.
- Particular vigilance should be taken over fetal wellbeing in the presence of severe maternal morbidity.
- All pregnant women should be assessed for risk factors for MOH and an appropriate management plan should be recorded and followed.
- All pregnant women with a previous caesarean section should have ultrasonography in the third trimester for placental localisation and to assess the likelihood of placenta accreta.
- Planned blood cell salvage and elective interventional radiology should be considered for women suspected of placenta praevia and/or accreta.
- A consultant obstetrician should be present or immediately available at all emergency caesarean sections performed at full cervical dilatation.
- Maternity units require adequate staffing 24 hours a day to manage acute episodes of severe maternal morbidity.

### Management

- The recommended cascade of uterotonic agents in the management of haemorrhage due to uterine atony should be followed with, in particular, early use of ergometrine in the absence of hypertensive disease.
- In the likelihood or the presence of MOH, four units of blood should be cross matched in the first instance.
- Prior to the transfusion of blood, no more than 2000 mls of crystalloid solution and no more than 1500 mls of colloid (3500 mls in total) should be administered.
- A modified obstetric early warning chart should be used to monitor all women with severe morbidity.
- A consultant obstetrician should be directly involved in the management of all cases of MOH and of eclampsia.
- Staff in all maternity units should ensure that they are familiar with and have ready access to reminders of the standard recommendations for resuscitation, monitoring and investigation of women experiencing eclampsia and MOH.

### 3 Introduction

Since 2003, following a successful pilot<sup>1</sup>, a continuous audit of severe maternal morbidity in Scotland has been conducted, collecting data on consistently defined events in all consultant-led maternity units. The included events and their definitions are based on pilot work by Mantel et al in South Africa<sup>2</sup>. The categories and their definitions are described in Appendix 1. Web links to all previous annual reports are provided in Appendix 6.

Healthcare Improvement Scotland is committed to facilitating and effecting improvement in health care. This, the eighth annual report of the Scottish Confidential Audit of Severe Maternal Morbidity (SCASMM), particularly emphasises areas where improvement has been achieved in recent years and where challenges remain. Many of the recommendations are in line with published guidance and highlight deficiencies in practice which the audit has identified. Other information on the incidence and associations of severe morbidity in pregnancy will assist NHS boards and maternity units to provide and organise delivery of an appropriate service in line with the Refreshed Framework for Maternity Services recently published and promoted by the Scottish Government<sup>3</sup>. Although some limited unit specific data are reported here, each maternity unit will also receive a detailed report on its own performance highlighting particular local good practice and deficiencies in relation to clinical guidelines and to Scotland's overall performance.

This full report is available as a web-based version and is sent as an email attachment to a large number of health professionals working in reproductive health in Scotland. A summary will be included in the next newsletter of the Reproductive Health Programme of Healthcare Improvement Scotland.

The Reproductive Health Programme welcomes comments and suggestions on this report, its recommendations and on the continuing audit. These should be directed to Leslie Marr, Reproductive Health Programme Manager, at [leslie.marr@nhs.net](mailto:leslie.marr@nhs.net).



## 4 Methods

In each consultant-led maternity unit, a designated midwife co-ordinator notifies the Healthcare Improvement Scotland Reproductive Health Programme of all women meeting one or more of the severe morbidity definitions. A 'zero return' is submitted for months when no events are identified. If monthly returns are not received, the unit co-ordinator is contacted by telephone or email. The co-ordinators submit a minimum dataset on each woman who meets the inclusion criteria.

Cases of major obstetric haemorrhage and of eclampsia are subject to detailed case assessment. A more limited amount of additional information is requested for cases of successful preventative interventional radiology. If a case is submitted in the minimum dataset form but no detailed case assessment form is received, the unit co-ordinator is contacted by telephone or email. Missing or incomplete data may also be retrieved by the same method. No patient identifiable information is sent to Healthcare Improvement Scotland.

The audit would not be possible without the dedicated support and co-operation of the unit co-ordinators and their work is gratefully acknowledged. A list of the co-ordinators is included in Appendix 5.

A copy of the minimum dataset form (2010) is shown in Appendix 7. The form ('Form A') for use in 2012 is available on the Healthcare Improvement Scotland website and a link is provided in Appendix 6.

National rates per 1000 births for each severe morbidity category are calculated using routinely published data on births from the National Records of Scotland (NRS) as denominators<sup>4</sup>.

Standards of care were assessed against national guidelines current during 2010<sup>5,6</sup>.

Data received from each maternity unit are entered into an Access database. More comprehensive data on severe maternal haemorrhage and eclampsia are entered into Statistical Package for Social Sciences (SPSS) data files for subsequent analysis.

Further information on the detailed methodology is described in previous annual reports<sup>7</sup>.

## 5 Results

This main body of results describes rates and trends and concentrates on areas of clinical management where improvement has been identified and/or continuing challenges are apparent. New data on cell salvage and elective interventional radiology is also included as well as information on the sociodemographic features of women experiencing severe morbidity which has only been collected since 2009.

Detailed information obtained from all three of the reporting forms (morbidity notification, assessment of major obstetric haemorrhage and assessment of eclampsia) during 2010 is shown in Appendices 2, 3 and 4 respectively. Reference is made to the relevant appendix tables when appropriate.

### 5.1 All morbidities

During 2010, the details of 385 women experiencing a total of 455 morbidities fulfilling the audit criteria were reported. Dual (or more) morbidity was usually because of admission to intensive care as well as a defined condition. The rate of severe morbidity was 6.5 women per 1000 births registered at the National Records of Scotland (NRS)<sup>4</sup> (95% confidence interval, 5.9-7.2). This rate is not strictly comparable with that reported in previous annual SCASMM reports which have used live births as the denominator but there is no logic in excluding stillborn births. The most precise rate of morbidity would use all maternities as the denominator but this number is not known.

Because of small numbers of maternal deaths in any one year in Scotland, it is not appropriate to provide mortality/morbidity ratios for individual years. When the numbers of direct and indirect maternal deaths and of women with severe maternal morbidity are aggregated for the past three years (2008-2010), the ratio is one maternal death for 85 women with severe morbidity.

#### 5.1.1 Reporting from different units

Table 1 shows the distribution of women with severe maternal morbidity at the 17 consultant-led maternity units which contributed to the audit in 2010. The overall rate for Scotland is calculated including the 2 501 births which took place out with consultant led maternity units. It is assumed that all women with severe morbidity would come under the care of a consultant-led unit although a small number may have given birth elsewhere. With relatively small numbers of women with severe maternal morbidity in any individual unit, rates may fluctuate by chance from year to year. Part of this variation is due to intermittent reporting difficulties experienced in some units.

The funnel plot in figure 1 shows the overall rate in each unit compared to the Scottish mean rate in the past five years aggregated. This information has been updated from previous years so that all births (including stillbirths) are included. The rates at almost all units lie within 3 standard deviations of the mean. Units reporting low rates (below 3 standard deviations) tend to have had reporting difficulties (e.g. Southern General in several recent years and Edinburgh in 2010) or to be small (e.g. Elgin). It is more difficult to be certain of the reasons for the reporting of high rates (above 3 standard deviations). Aberdeen has consistently reported high rates and has a long record of extreme diligence in reporting all cases. It is possible, however, that Aberdeen has a genuine

statistically significant high rate of severe maternal morbidity although, as shown in Table 1 the Aberdeen rate of severe maternal morbidity for 2010 was below the Scottish average. The issue of variable rates from different units is discussed in detail in the sixth annual SCASMM report<sup>7</sup>.

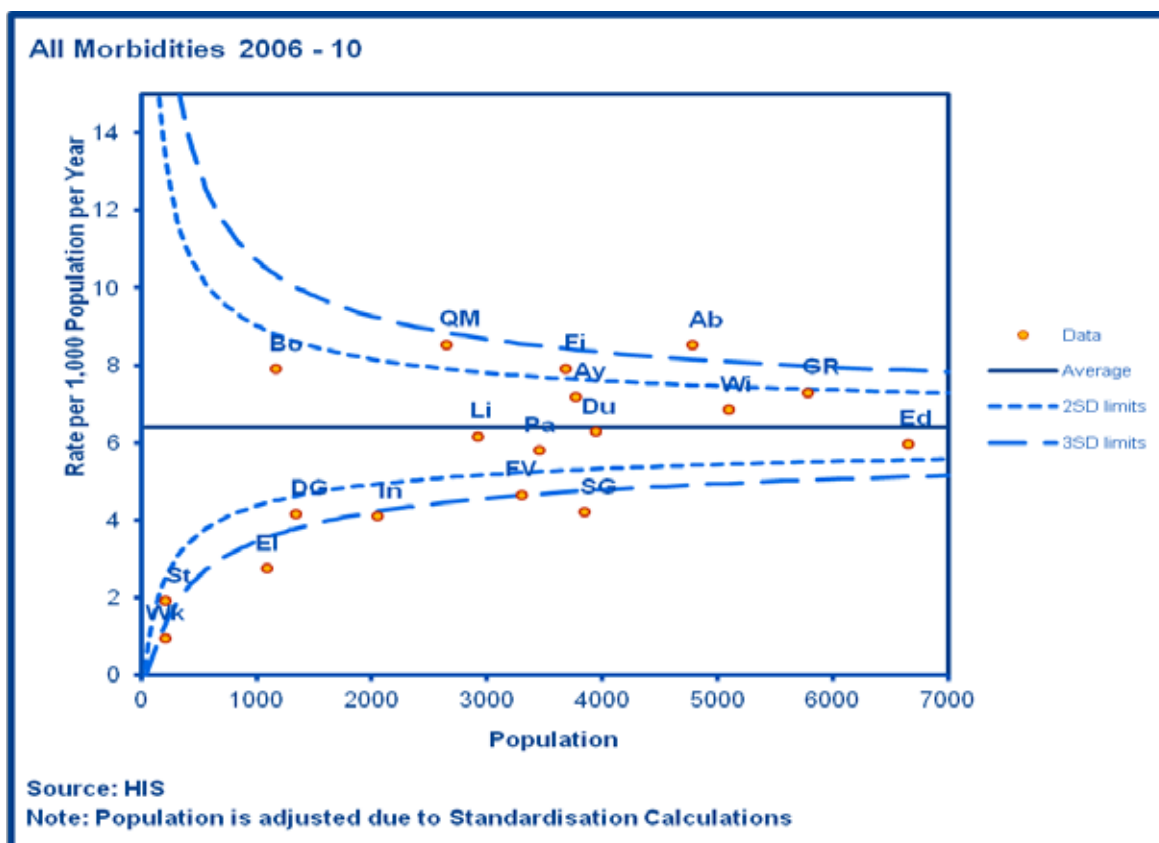
**Table 1: Rates of women experiencing severe maternal morbidity by individual maternity unit, 2010**

Location of Maternity Unit	Women experiencing severe maternal morbidity per 1000 births		
	Women with events reported 2010	All Births 2010	Rate per 1000 births [95% CI 2010]
Aberdeen	29	4881	5.9 [4.0 – 8.5]
Ayrshire	27	3744	7.2 [4.8 – 10.5]
Borders	9	1194	7.5 [3.4 – 14.3]
Dumfries	6	1323	4.5 [1.7 – 9.9]
Dundee	28	3956	7.1 [4.7 – 10.2]
Edinburgh	26	6911	3.8 [2.5 – 5.5]
Elgin	**	1093	2.7 [0.6 – 8.0]
Forth Park/Fife	26	3728	7.0 [4.6 – 10.2]
Glasgow Royal	67	6329	10.6 [8.2 – 13.4]
Inverness	12	2221	5.4 [2.8 – 9.4]
Livingston	14	2909	4.8 [2.6 – 8.1]
Paisley	24	3634	6.6 [4.2 – 9.8]
Southern General, Glasgow	45	5940	7.6 [5.5 – 10.1]
Stirling	29	3264	8.9 [6.0 – 12.8]
Stornoway	**	194	5.2 [0.1 – 28.7]
Wick	0	182	0
Wishaw	39	5078	7.7 [5.5 – 10.5]
<b>Scotland</b>	<b>385</b>	<b>59082*</b>	<b>6.5 [5.9 – 7.2]</b>

\*This total includes 2501 births outside consultant maternity units

\*\* denotes less than 5 reported cases in 2010

**Figure 1: Aggregated rates of severe maternal morbidity reported from different consultant maternity units, 2006-2010**



Each labelled point represents the rate of severe morbidity per 1000 births at each maternity unit; the continuous line is the Scottish average rate with the dashed lines 2 and 3 standard deviations from the mean. Explanation of labelling:

Ab = Aberdeen, Ay = Ayrshire (Ayrshire Central and Crosshouse), Bo = Borders, DG = Dumfries, Du = Dundee, Ed = Edinburgh, El = Elgin, Fi = Forth Park, Fife, GR = Glasgow Royal, In = Inverness, Li = Livingston, Pa = Paisley, QM = Queen Mothers (2006-2009 only), SG = Southern General (incorporating QM from 2010), FV = Stirling, St = Stornoway, Wk = Wick, Wi = Wishaw.

### 5.1.2 Categories of severe morbidity

The numbers and rates of each of the 14 categories of severe morbidity reported in 2010 are shown in Table 2. Major obstetric haemorrhage (MOH) remains the most frequent event, affecting 328 (85%) of the 385 women with severe morbidity, giving a rate of 5.55 per 1000 live births. The majority of the 84 women admitted to an intensive care unit (ICU) had experienced MOH (52 women, five of whom had additional severe morbidities), comprising 16% of all women with MOH. Twenty-three women were admitted to ICU for reasons other than the 13 defined causes of severe morbidity. Details of the reasons for ICU admission are shown in Appendix 2 (Tables A2.7 and A2.8).

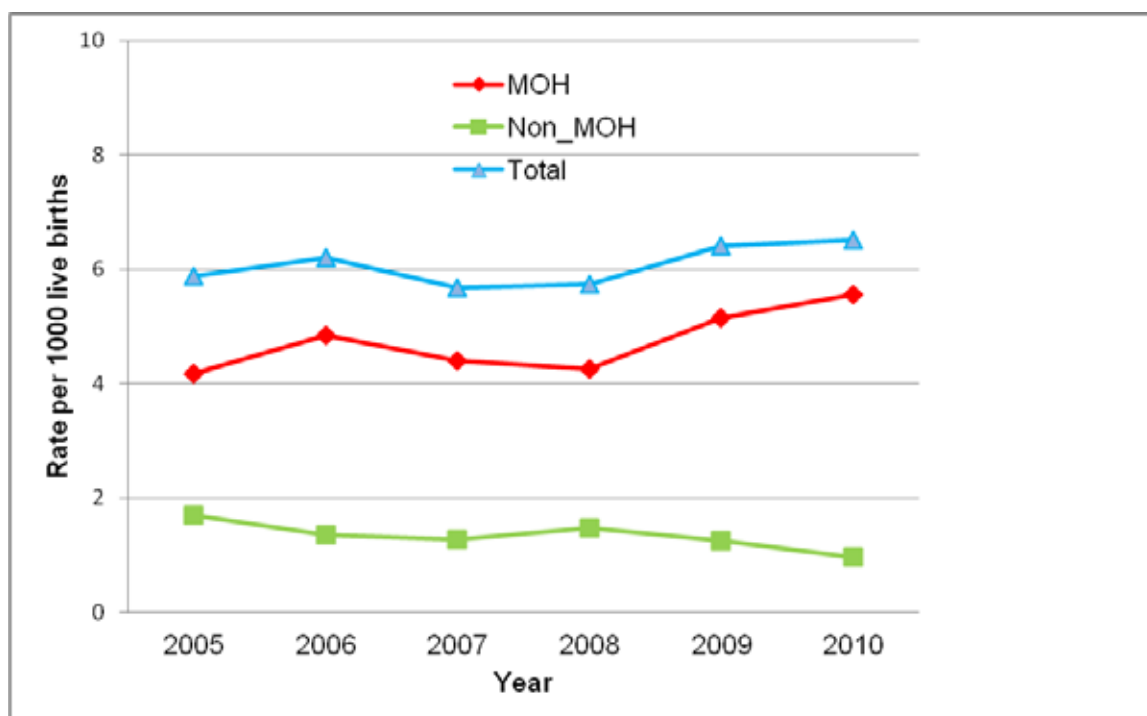
**Table 2: Numbers and rates of individual categories of severe maternal morbidity, 2010**

Category of severe maternal morbidity	Number. of events 2010	Rate per 1000 births [95% CI] 2010
Major obstetric haemorrhage	328	5.55 [4.94 – 6.16]
Eclampsia	12	0.20 [0.10 – 0.35]
Renal or liver dysfunction	10	0.17 [0.08 – 0.31]
Cardiac arrest	4	0.07 [0.02 – 0.17]
Pulmonary oedema	3	0.05 [0.01 – 0.15]
Acute respiratory dysfunction	3	0.05 [0.01 – 0.15]
Coma	0	0.00 [0.0 – 0.06]
Cerebro-vascular event	1	0.02 [0.0 – 0.09]
Status epilepticus	0	0.00 [0.0 – 0.06]
Anaphylactic shock	1	0.02 [0.0 – 0.09]
Septicaemic shock	1	0.02 [0.0 – 0.09]
Anaesthetic problem	3	0.05 [0.01 – 0.15]
Massive pulmonary embolism	0	0.00 [0.0 – 0.06]
Intensive care or coronary care admission	76	1.29 [1.01 – 1.60]

Total births in 2007 = 58108; 2008 = 60366; 2009 = 59363; 2010 = 59082; 2007-09 = 177837

Trends in the rates of severe morbidity since 2005 are shown in Figure 2. All morbidities other than MOH are combined as the numbers of each individual morbidity are very small. The rise in MOH is as likely to be due to improved reporting each year as to a genuine rise in the incidence.

**Figure 2: Rates of women with major obstetric haemorrhage and other morbidities 2005–2010**

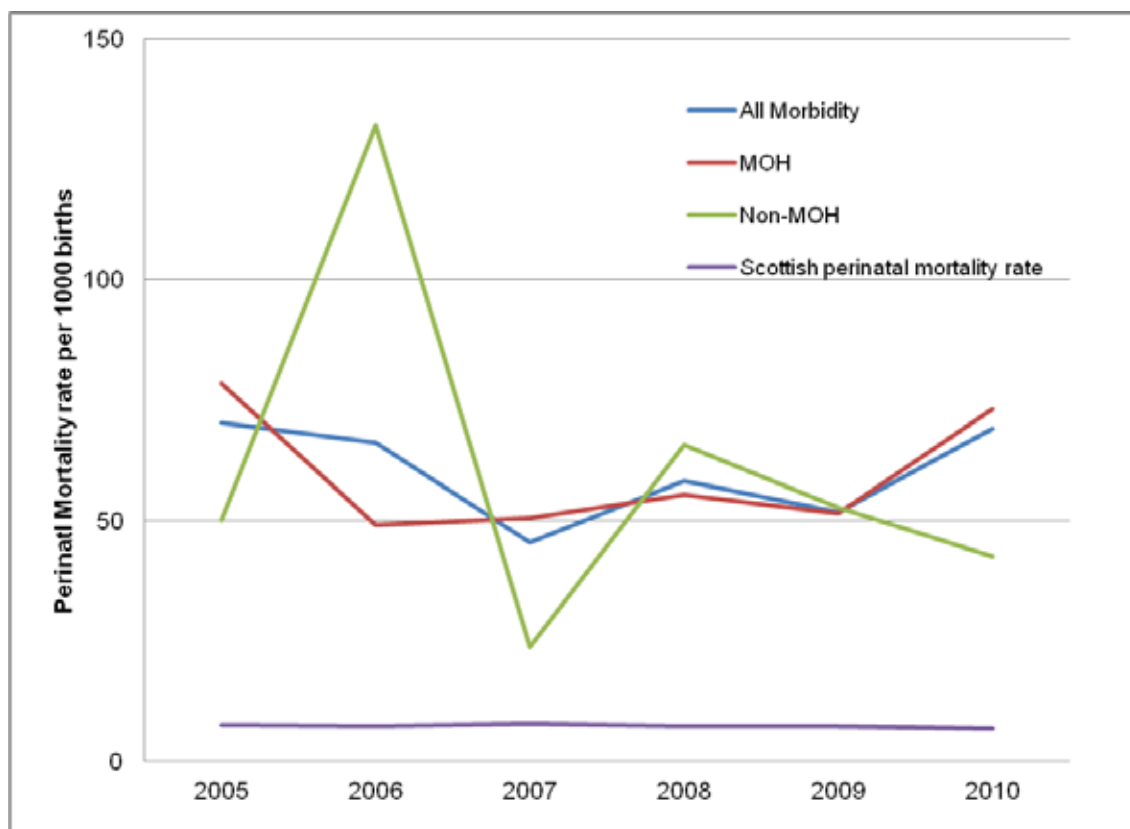


### 5.1.3 Perinatal mortality among women with severe morbidity

The perinatal mortality rate among women experiencing severe morbidity is high. This information was not collected before 2005 and has been inconsistently recorded since but was much more complete for 2010. The perinatal mortality rates shown in Figure 3 are of those for whom the information

was available. The numbers on which these rates are based are shown in Appendix 2 (Table A2.9). Women with all morbidities other than MOH are grouped together because of small numbers. In 2010 the perinatal mortality rate among the 348 women for whom the information was available was 69 per 1000 births to women with severe morbidity, compared to the overall rate in Scotland of 6.9 per 1000 births<sup>8</sup>.

**Figure 3: Perinatal mortality rates per 1000 births among women with severe morbidity, 2005-2010**



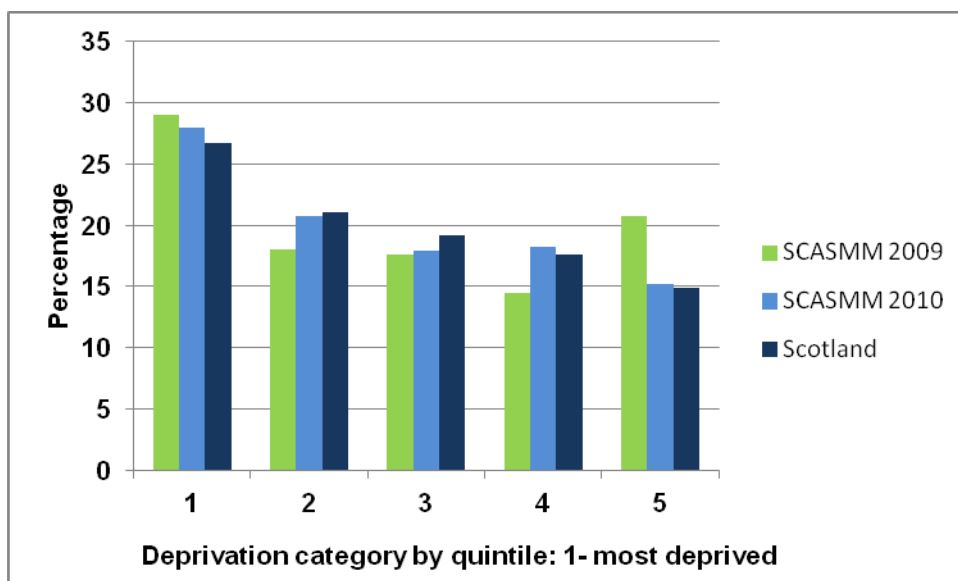
### 5.1.3 Sociodemographic factors

Data collection in 2009 included, for the first time, selected sociodemographic characteristics of women experiencing severe morbidity, namely deprivation decile, Body Mass Index (BMI) and smoking history.

In 2010, information on deprivation (as determined by the Scottish Index of Multiple Deprivation 2008<sup>9</sup>) was recorded for 90.1% of cases and for 83% of cases for BMI.

The distribution of births to women in deprivation quintiles is shown in Figure 4 which shows that 28% of women who experienced severe morbidity were in the most deprived quintile. The percentages of women in each quintile reflect the percentages of women who gave birth in Scotland in 2010 in each quintile (K Monteith, Information Analyst, Information Services Division. Personal Communication, 22 March 2012). The deprivation profile more closely mirrors the profile of all women giving birth in 2010 than was the case in 2009. This suggests that there is no association between the level of deprivation and the occurrence of severe morbidity, although numbers are small and will require to be aggregated for a number of years to be meaningful.

**Figure 4: Deprivation quintile of women with severe maternal morbidity and of all women giving birth in Scotland in 2009 and 2010**



Of the women who experienced severe maternal morbidity 8.4% had a BMI of greater than 35. A recent study found that 5.5% of the population of pregnant Scottish women had a BMI of greater than 35<sup>10</sup>. This difference is significant (p=0.033).

Among the 356 women who experienced severe morbidity and for whom the information was recorded, 67 (18.8%) smoked at booking compared with 19.4% of the pregnant population in Scotland in 2010 who smoked at booking (K. Monteith, Information Analyst, Information Services Division. Personal Communication, 28 March 2012).

## 5.2 Major obstetric haemorrhage (MOH)

### 5.2.1 Incidence, causes and associations

Detailed case assessment proformas were returned for 323 of the 328 women experiencing MOH meeting the criteria although not all forms were complete. The numbers and rates of MOH in the maternity units reporting to the audit in 2010 are shown in Table 3. The overall rate of MOH for Scotland was 5.6 per 1000 births [95% CI 5.0 – 6.2]. As with all morbidities, this rate is not directly comparable with that reported in previous years because of the revised denominator discussed above.

The aggregated rates of MOH reported from different units in the past five years are shown in a funnel plot (Figure 5). All units reported rates within or close to 3 standard deviations from the Scottish mean with outliers probably being accounted for by diligent or poor case reporting.

All other information for women with MOH reported here is based on the 323 women for whom detailed information is available.

Most MOH occurred within a consultant-led maternity unit in the postpartum period. Nineteen occurred in a community maternity unit and three at home (Table A3.4). There was no association between the time of day and the

likelihood of MOH (Figure A3.5) when three groupings (day, evening and night) were considered. The slight excess in daytime (09.00-17.00) events is likely to be due to those associated with elective caesarean sections.

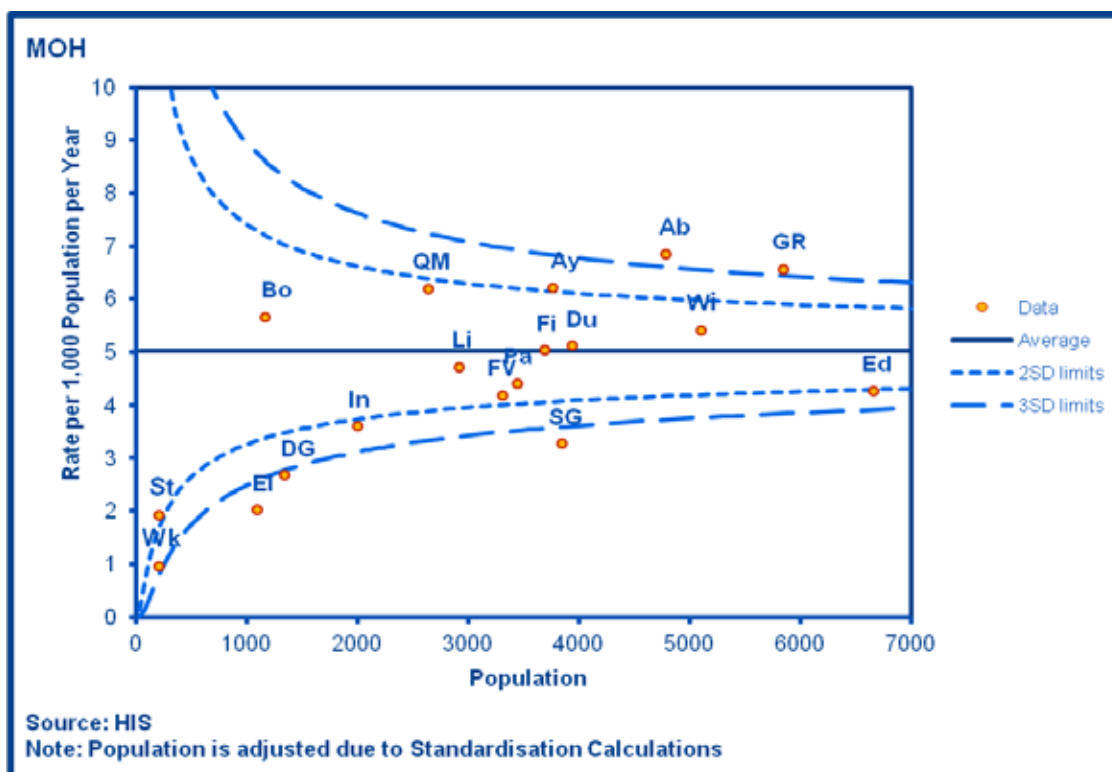
**Table 3: Major obstetric haemorrhage by individual unit, 2010**

<b>Maternity Unit</b>	<b>MOH</b>	<b>Reported rate per 1000 births [95% C.I.]</b>
Aberdeen	25	5.1 [3.3 – 7.6]
Ayrshire	25	6.7 [4.3 – 9.9]
Borders	6	5.0 [1.8 – 10.9]
Dumfries	4	3.0 [0.8 – 7.7]
Dundee	26	6.6 [4.3 – 9.6]
Edinburgh	20	2.9 [1.8 – 4.5]
Elgin	3	2.7 [0.6 – 8.0]
Forth Park, Fife	18	4.8 [2.9 – 7.6]
Glasgow Royal	64	10.1 [7.8 – 12.9]
Inverness	11	5.0 [2.5 – 8.9]
Livingston	9	3.1 [1.4 – 5.9]
Paisley	18	5.0 [2.9 – 7.8]
Southern General, Glasgow	37	6.2 [4.4 – 8.6]
Stirling	25	7.7 [5.0 – 11.3]
Stornoway	1	5.2 [0.1 – 28.7]
Wick	None reported	0
Wishaw	36	7.1 [5.0 – 9.8]
<b>Scotland</b>	<b>328</b>	<b>5.6 [5.0 – 6.2 ]*</b>

\*This rate is based on all births registered in Scotland including those delivered out with consultant maternity units



**Figure 5: Aggregated rates of major obstetric haemorrhage reported from different consultant led maternity units, 2006-2010**



Each labelled point represents the rate of severe morbidity per 1000 births at each maternity unit; the continuous line is the Scottish average rate with the dashed lines 2 and 3 standard deviations from the mean. Explanation of labelling:

Ab = Aberdeen, Ay = Ayrshire (Ayrshire Central and Crosshouse), Bo = Borders, DG = Dumfries, Du = Dundee, Ed = Edinburgh, El = Elgin, Fi = Forth Park, Fife, GR = Glasgow Royal, In = Inverness, Li = Livingston, Pa = Paisley, QM = Queen Mothers (2006-2009 only), SG = Southern General (incorporating QM from 2010), FV = Stirling, St = Stornoway, Wk = Wick, Wi = Wishaw.

The distribution of causes and of modes of delivery in 2010 was similar to previous years with uterine atony the most common cause and caesarean section the most frequent mode of delivery. Details are shown in Appendix 3 (Tables A3.6 and A3.7). A striking number of uterine ruptures (8) were reported in 2010, compared with a total of 15 in the previous four years combined.

The particular association between MOH and caesarean section at full dilatation was again confirmed (Table A3.8) but there was a less strong association between previous caesarean section and morbidly adherent placenta than in previous years (Table A3.9).

### 5.2.2 Planning for potential MOH

It is known that some pregnancies may be more likely to result in MOH (for example, previous post partum haemorrhage (PPH), multiple pregnancy, placenta praevia). Several questions are asked of each case of MOH to assess the degree of recognition of risk and subsequent planning of management which took place. The requested information is based on RCOG guidance<sup>5,11,12</sup>. A summary of this information follows:

## Risk assessment and planning

- 10 out of 53 women with a previous caesarean section (19%) did not have antenatal ultrasonography for placental localisation.
- 95 women (29%) of all 323 cases of MOH were potentially identifiable antenatally as being at high risk of haemorrhage.
- 85 of these 95 women (89%) were actually identified antenatally.
- An action plan was developed for 66 of these 85 women (78%).
- The action plan was followed completely for 55 of the 66 women (83%) and partially for a further 9, leaving 2 (3%) for whom the plan was ignored; therefore, of the 95 women identifiable antenatally 55 (57.9%) had an action plan developed and followed completely.

## Consultant involvement

Previous SCASMM reports have identified the particular risk of MOH when a caesarean section is performed at full dilatation and have recommended that a consultant obstetrician be present or immediately available at such procedures. In 2010, 33 women underwent such a caesarean section. An obstetric consultant was present for 30 (91%) of them and was “informed” of the remaining three.

## Planning for placenta praevia and/or accrete

In 20 cases, placenta praevia and/or accreta was known or suspected. Table 4 shows the reported planning and actions in these cases:

**Table 4: Planning and action for suspected placenta praevia/accrete**

Planning /action	Number of women [% of the 20 cases]
Elective Caesarean section planned	15 [75]
Obstetric consultant present for these reasons	18 [90]
Interventional radiology took place	2 [10]
Blood cell salvage was planned	3 [15]
Cell salvage took place	2 [10]

### 5.2.3 Uterotonic prophylaxis

In 2010, 139 women with MOH delivered vaginally. Twenty-two were reported as receiving more than one agent for prophylaxis of postpartum haemorrhage (the order of administration was not given). There were, therefore, 161 administrations of prophylactic uterotonic agents. The distribution of agents used is shown in Table 5 where the same information is also shown for 2009.

**Table 5: Prophylactic uterotonic agents administered during third stage among women delivering vaginally who experienced MOH, 2009 and 2010**

Prophylactic agent	Number of women (%)	
	2009 <sup>1</sup>	2010 <sup>2</sup>
Syntocinon	76 (59)	100 (72)
Syntometrine	52 (41)	43 (31)
Other <sup>3</sup>	0	18 (13)

<sup>1</sup>Prophylactic agent recorded for 128 of the 145 women who delivered vaginally

<sup>2</sup>Prophylactic agent recorded for all 139 women who delivered vaginally; 22 received more than one agent

<sup>3</sup>Ergometrine, misoprostol or gemeprost

Among the 180 women delivered by caesarean section and experiencing MOH in 2010, almost all (173 reported) received a syntocinon infusion as uterotonic prophylaxis in the third stage. Eight were reported as receiving syntometrine and 76 were given other agents, including 14 who were given ergometrine.

#### 5.2.4 Resuscitation and monitoring

RCOG guidelines on the management of PPH<sup>5</sup> describe the principles of resuscitation and monitoring which are applicable in all cases of MOH. The degree of adherence to these guidelines is detailed in Appendix 3, Tables A3.16-19. The information was incomplete for a few cases but the overall level of compliance was high. The most notable deficiencies were in the over administration of crystalloid fluid prior to blood transfusion in 20% of cases and in the reported use of an obstetric early warning chart (MOEWS) in only 76%, although some units report using an “ICU observation chart” which fulfils many of the same functions.

The guidelines suggest an initial crossmatching of four units of blood. This was indeed the modal number crossmatched (in 152 (52%) of the 294 women with the information available). Thirty women (10%), however, had only 0 – 2 units crossmatched and the most frequent amount crossmatched after four units was six (82 women, 28%). This latter figure suggests that some units still use older guidance<sup>13</sup> which recommended the initial crossmatching of six units. The mean number of units actually transfused (crossmatched and uncrossmatched) was 4.56, which suggests that the current guidance is correct.

#### 5.2.5 Management of MOH

##### Pharmacological treatment of established haemorrhage due to uterine atony

The most frequent cause of MOH is postpartum uterine atony. After “rubbing up the uterus” to encourage contractile activity, the use of uterotonic pharmacological agents is recommended in a specified order<sup>5</sup>. Of the 193 women with MOH caused by uterine atony 115 (59.6%) were reported to have received “rubbing up of the uterus”. The reported administration of uterotonic agents in 2009 and 2010 among the women who experienced uterine atony (regardless of mode of delivery) is shown in Table 6 where the agents are listed in the order in which their use is recommended (but not necessarily the order in which they were given). The highest number of separate administrations of uterotonic agents was eight (for one woman) but many of the multiple administrations were subsequent doses of an agent already used at least once.

**Table 6: Uterotonic agents used among 163 women with uterine atony in 2009 and 193 with uterine atony in 2010**

Uterotonic agent	Number (%) of women receiving agent	
	2009	2010
Syntocinon 5 iu iv	70 (43)	116 (60)
Ergometrine 0.5mg iv	70 (43)	120 (62)
Syntocinon iv infusion	135 (83)	185 (96)
Carboprost 0.25mg im	54 (33)	137 (71)
Misoprostol	n/a*	52 (27)
Gemeprost	n/a*	2 (1)

\*Information on these agents not available for 2009

The order in which the agents were administered was requested in 2010. Although reported rather erratically, a summary of the information extracted is shown in Tables 7 and 8. The most notable finding was the relative infrequency with which ergometrine was used, even among the first three agents used. Although recommended as the second agent for treatment, it was most frequently employed as the fourth agent, with a similar frequency to carboprost which is recommended as the fourth choice.

**Table 7: Use of pharmacological uterotonic agents as one of first three treatments for uterine atony causing MOH in 193 women in 2010\***

Uterotonic agent	Given as first agent	Given as one of the first three agents used
Syntocinon bolus	59	88
Ergometrine	3	60
Syntocinon infusion	20	131
Carboprost	2	37
Misoprostol/gemeprost	0	7

\*Numbers in the table are the number of women given this agent at these points in the cascade of treatment

**Table 8: Administration of ergometrine and carboprost as treatment for 193 women with uterine atony in 2010\***

Agent	Order in which agent was given							
	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
Ergometrine	3	29	28	30	6	1	0	1
Carboprost	2	7	28	35	23	10	2	0

\*Numbers in the table are the number of women given these agents at each point in the cascade of treatment

The guidelines also recommend the use of intra-myometrial carboprost if necessary following intramuscular agents. This was administered to nine women in 2009 and 18 in 2010.

### **Surgical treatment of major obstetric haemorrhage**

Of the 313 women for whom the information was available, an examination was conducted under anaesthetic for 233 (74%). In considering the surgical methods used to control major obstetric haemorrhage, procedures such as the removal of a retained placenta, additional or repeat suturing of caesarean section wounds and the control of bleeding from the lower genital tract are not described or discussed here. The audit has concentrated on the newer conservative surgical techniques to control MOH. In 2010, 107 conservative

techniques were used, controlling haemorrhage sufficiently to avoid a hysterectomy in 121 cases (88%). Individual procedures with their success rate in avoiding hysterectomy are shown for 2010 in Table 9.

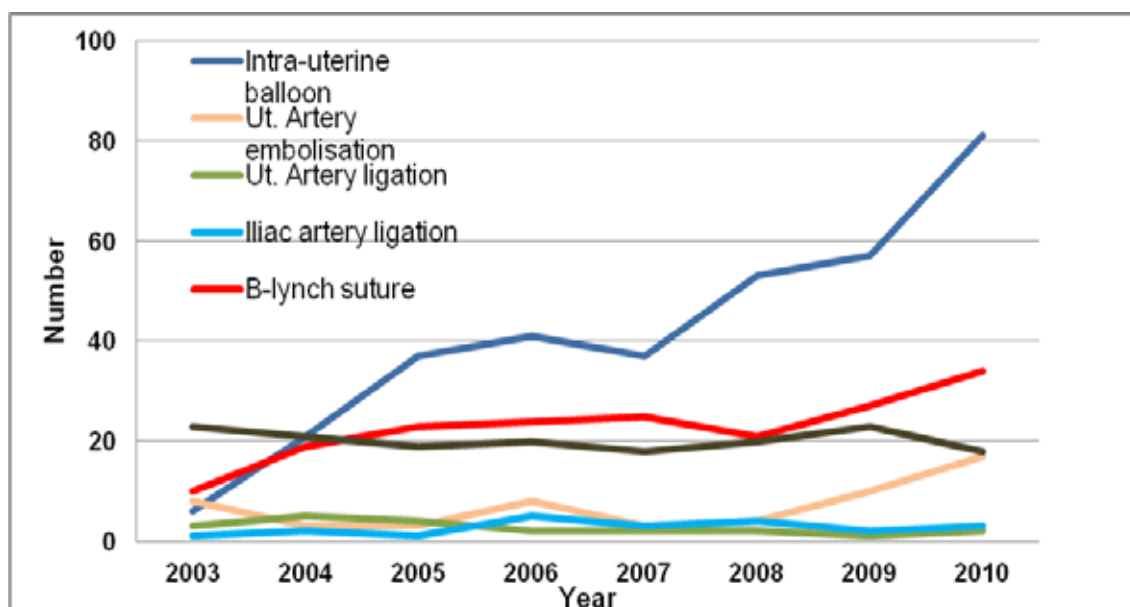
**Table 9: Use of haemostatic surgical procedures among 323 women with major obstetric haemorrhage, 2010**

Procedure	Women undergoing procedure		Successful (hysterectomy avoided)	
	Number	%*	Number	%
Intra-uterine balloon tamponade	81	25.1	77	95.1
Uterine artery embolisation [interventional radiology]	17	5.3	12	70.6
Bilateral ligation of uterine arteries	2	0.6	2	100
Bilateral ligation of internal iliac arteries	3	0.9	2	66.7
Haemostatic brace uterine suturing [eg B-Lynch]	34	10.5	28	82.3
Hysterectomy	18	5.6		

\*Percentage is of all 323 women experiencing MOH

Trends in the use of these techniques since the start of the audit are shown in Figure 6. The steady rise in intra-uterine balloon tamponade has been maintained as has that for uterine brace sutures after a levelling off in the middle years of the audit. What is notable is a rise in the use of interventional radiology (IR) to embolise bleeding uterine arteries since 2008. Table 9 and Figure 6 include cases where elective IR failed to prevent MOH. The two reported cases of successful IR (preventing MOH) in 2010 are described below and are not included in Table 9 or Figure 6.

**Figure 6: Numbers of haemostatic surgical procedures undertaken in cases of major obstetric haemorrhage by year, 2003-2010**



The overall combined success rate (ie avoiding a hysterectomy) of these procedures in the eight years of the audit is 80%, with a steady rise from 64% in 2003 (Figure 7). When individual techniques are considered (Figure 8), intra-uterine balloon tamponade appears to be the most successful, with a hysterectomy avoided in 87% of the 334 women in whom a balloon was placed.

Ligation of either uterine or iliac arteries had a success rate of only 50% among the 50 women on whom the procedure was carried out. However, the differing success rates for the four different procedures illustrated in Figure 8 is likely to be partly explained by the degree of difficulty and invasiveness of each procedure.

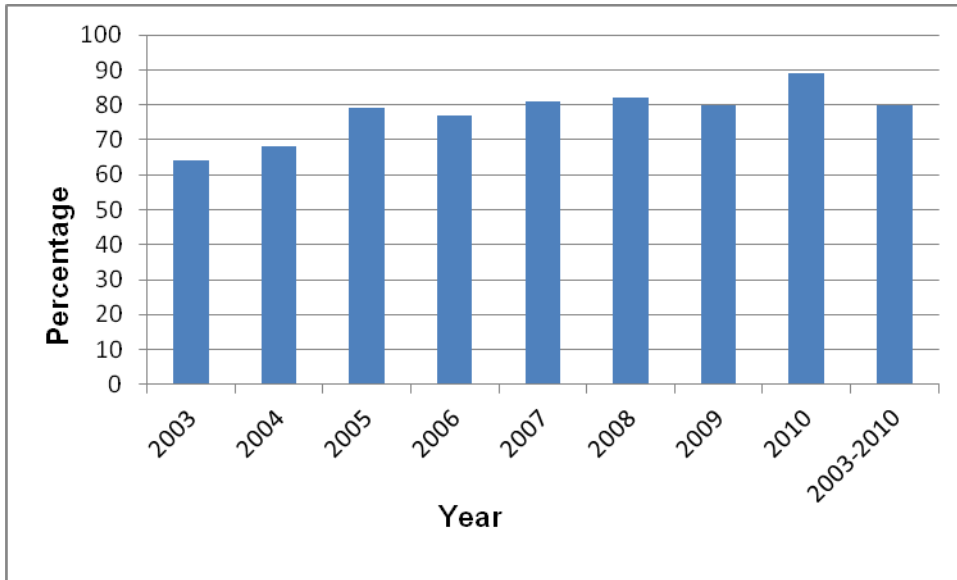
IR and/or ligation of uterine or iliac arteries are likely to be used only in cases of particularly severe haemorrhage and often after other procedures have failed. In addition, both of these procedures may be carried out in the face of continuing bleeding after a hysterectomy. In 2010, IR was performed in these circumstances after five hysterectomies. IR is often not readily available. Among the women who did not receive IR, the reason was provided for 277. In 53 cases, the technique was not available at that unit and in three cases no IR team was available. IR was not considered appropriate for the remaining 221.

In contrast, the relative ease of placement of an intrauterine balloon and its apparent safety mean that the threshold for this procedure is likely to be relatively low. This almost certainly explains the continuing steep rise in its use as familiarity grows. Although it may be the case that not all the intrauterine balloons now being placed are necessary, there has been an associated decline in hysterectomies.

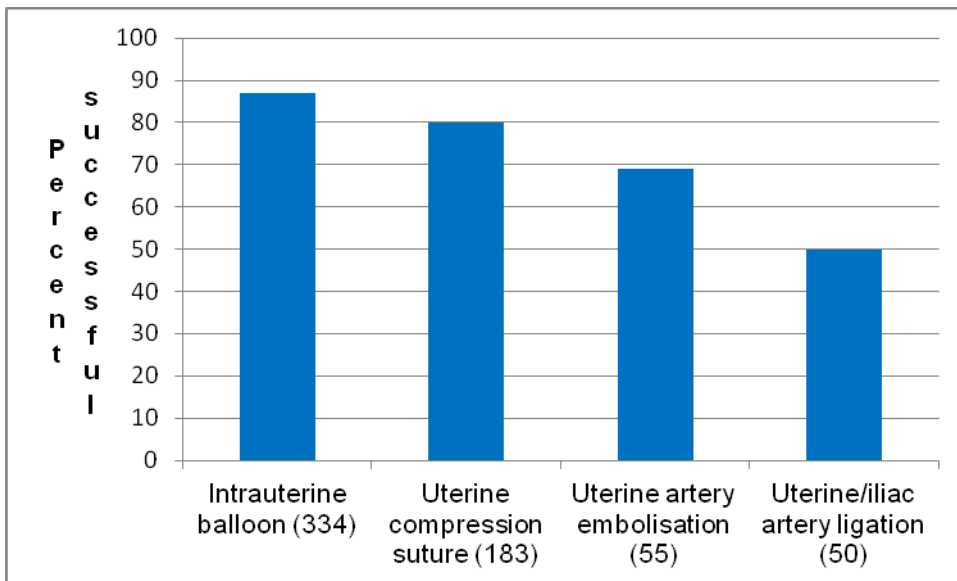
Although the number of peripartum hysterectomies has varied little from year to year (minimum 18, in 2007 and 2010, maximum 23, in 2003 and 2009), the rise in reported MOH and in the use of other haemostatic surgical procedures has been associated with a decline in the rate of hysterectomies performed on women experiencing MOH from 15.1% in 2003 to 5.6% in 2010 (Figure 9) and this is highly significant ( $p=0.001$ ,  $\chi^2$  test).

More than one procedure is necessary in a proportion of cases. In 2010, two procedures were necessary for 17 women, only one of whom required a hysterectomy. Three procedures were necessary for nine women, three of whom required a hysterectomy. The only woman who underwent four procedures did have a hysterectomy.

**Figure 7: Percentage success rate for all surgical haemostatic procedures combined (ie hysterectomy avoided) for 622 procedures performed on 1855 women with MOH, by year and combined 2003-2010**

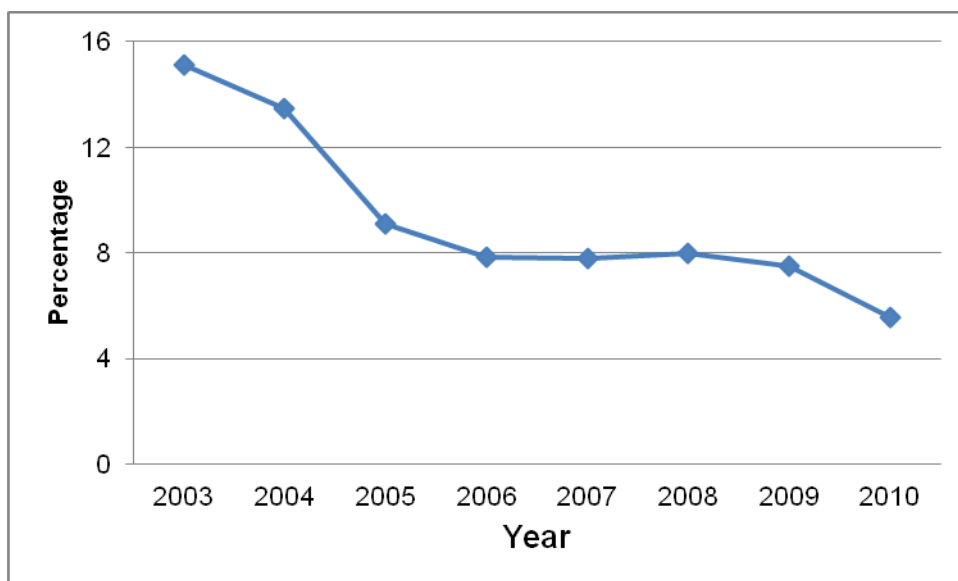


**Figure 8: Percentage success rate (ie hysterectomy avoided) for 622 surgical procedures performed on 1855 women with MOH, 2003-2010**



**Note: number in brackets at each procedure is the number of each performed**

**Figure 9: Rates of hysterectomy for women with major obstetric haemorrhage by year, 2003-2010**



### **Cell salvage**

Intraoperative cell salvage was recorded as being attempted on six occasions. A significant amount of blood was only obtained twice (1458 and 2700 ml). Cell salvage was not attempted for 310 women. A reason was given for 245 of these, as follows:

- Not appropriate in 132 cases
- Equipment not available in 73 cases
- No appropriate staff available in 40 cases.

In no cases was it recorded that equipment was not working.

### **Elective interventional radiology**

In 2010, an attempt was made to gather data about elective IR successfully performed to prevent major haemorrhage. Information was received for three cases, all of whom had placenta praevia with suspected placenta accreta. Temporary balloon occlusions of uterine arteries were performed at the time of caesarean section and major haemorrhage did not occur. It is likely that a number of other successful cases were not reported to the audit.

In three further cases, elective placement of temporary balloon occlusions failed to prevent major haemorrhage. Two of these had placenta praevia and one had multiple fibroids. Further treatment with intra-uterine balloon tamponade was necessary in two cases. None required a hysterectomy.

### **5.2.6 Quality of care of MOH**

Each unit's self assessment reported that, as in previous years, a small number of cases (four in 2010) experienced major suboptimal care but overall 78% received optimal care, the highest percentage since the audit began. There has been a steady rise in the reported percentage of cases receiving optimal care since 2007 (Table 10).

Good practice would suggest, and the 7<sup>th</sup> annual SCASMM report<sup>14</sup> recommended, that all reported cases of severe maternal morbidity should be assessed by the local risk management team. This information was requested



for the first time in 2010. Risk management assessment was reported to have taken place in 175 of the 297 cases of MOH for which the information was available (59%). Table 11 shows the risk management teams' assessment of the quality of care of those 175 cases. It also shows how the assessment of the other cases was carried out and the opinion formed. Risk management teams tended to rate care more poorly but this may be because they assessed the more complex or worrying cases.

**Table 10: Overall assessments of care in 1062 cases of major obstetric haemorrhage, 2007-2010**

Category	2007 Number [%]	2008 Number [%]	2009 Number [%]	2010 Number [%]
<b>Appropriate care</b> Well managed	150 [65]	161 [69]	201 [71]	232 [78]
<b>Incidental sub-optimal care</b> Lessons can be learned although it did not affect the final outcome	58 [25]	53 [23]	53 [19]	52 [18]
<b>Minor sub-optimal care</b> Different management may have resulted in a different outcome	16 [7]	15 [6]	23 [8]	9 [3]
<b>Major sub-optimal care</b> 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.	6 [3]	4 [2]	5 [2]	4 [1]

**Table 11: Assessment of care by opinion former among 297 case of major obstetric haemorrhage, 2010**

Category of care	2010, overall assessment of care	Risk management committee <sup>1</sup>	Clinical consensus <sup>2</sup>	Informal discussion <sup>3</sup>	Opinion of reporter <sup>4</sup>
Appropriate	232 (78%)	125	16	60	31
Incidental sub-optimal	52 (18%)	39	3	7	3
Minor sub-optimal	9 (3%)	7	1	1	0
Major sub-optimal	4 (1%)	4	0	0	0
<b>Total (%)<sup>5</sup></b>	<b>297 (100%)</b>	<b>175 (58.9)</b>	<b>20 (6.7)</b>	<b>68 (22.9)</b>	<b>34 (11.4)</b>

<sup>1</sup>Opinion formed by risk management team

<sup>2</sup>Opinion formed during formal clinical meeting but not risk management team

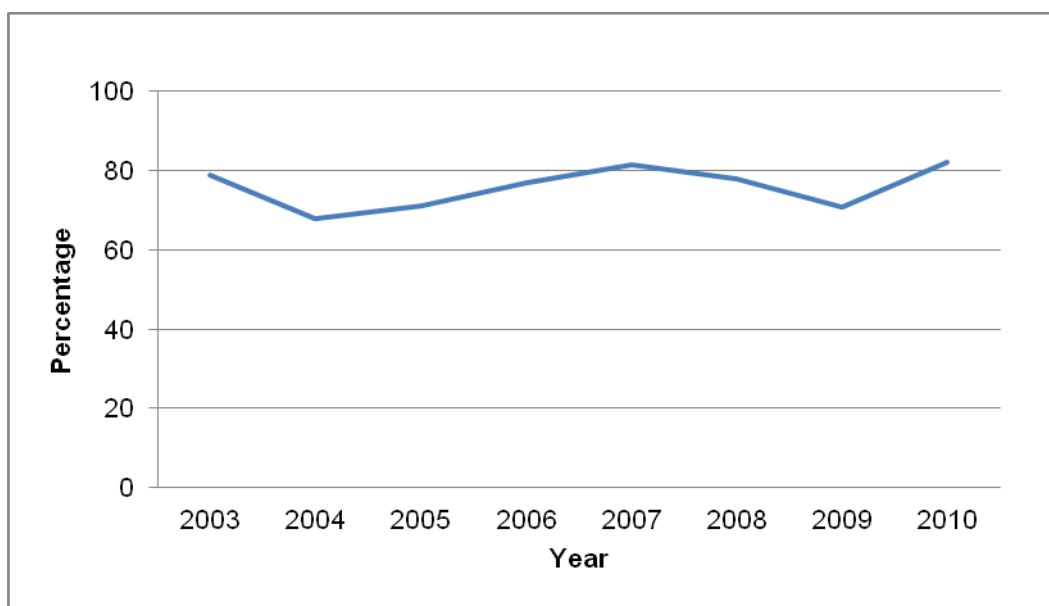
<sup>3</sup>Opinion formed as a result of informal discussion

<sup>4</sup>Opinion of the unit coordinator reporting to SCASMM

<sup>5</sup>Percentage in this row gives the distribution of opinion former among the 297 women.

A specific aspect of the quality of care which has been assessed throughout the audit has been the involvement of a consultant obstetrician. RCOG guidelines<sup>5</sup> recommend direct involvement by a consultant obstetrician in the management of MOH. The level of direct consultant obstetrician care has varied throughout the audit (Figure 10), but reached the highest proportion yet reported (82.2%) in 2010. The direct involvement of other staff is shown in Appendix 3 (Table A3.15).

**Figure 10: Percentage of cases of MOH with a consultant obstetrician present during acute management by year, 2003–2010**



### Quality of case records

The maintenance of good quality records is an essential part of clinical practice. In 2010, unit coordinators were asked for their opinion of the overall standard of the clinical records for each woman who experienced MOH and specifically about the documentation of the episode of MOH. The responses are shown in

appendix 3 (Table A3.21). As this section was considerably revised in 2010, no direct comparison can be made with previous years.

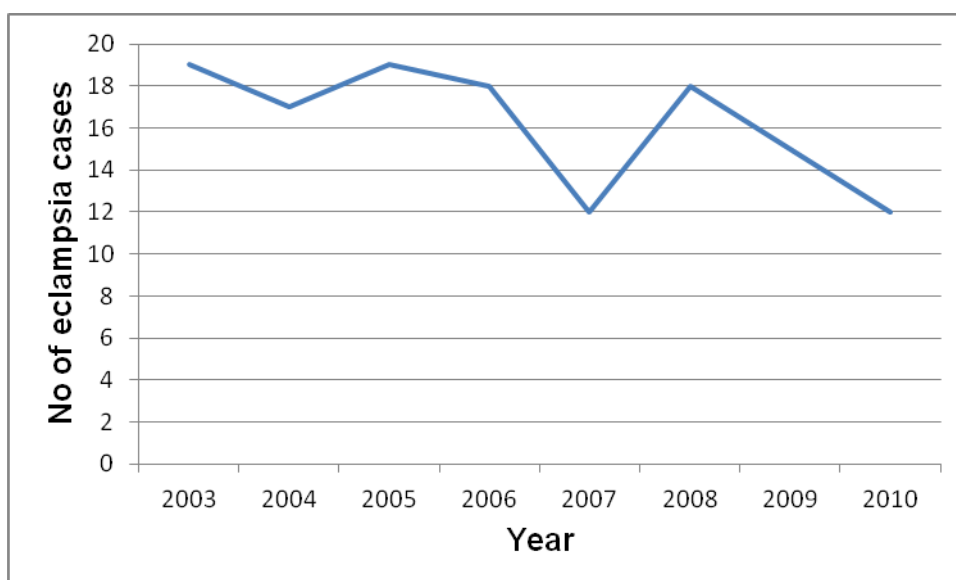
In two instances, the overall records were categorised as “chaotic” and two episodes of MOH were “poorly” documented with major omissions. However, 93% of case records were “excellent” or “good” as was the documentation of 92% of MOH incidents.

## 5.3 Eclampsia

### 5.3.1 Incidence, associations and circumstances

In 2010, 12 women were reported to the confidential audit as experiencing eclampsia. Figure 11 plots reported cases of eclampsia in Scotland since the audit commenced in 2003. The trend appears to be downwards but small numbers are liable to fluctuation from year to year.

**Figure 11: Eclampsia cases reported to SCASMM, 2003-2010**



Case assessment proformas were returned for all 12 women. Details of the responses are shown in Appendix 4. All but two of the women were primigravida. They were not overweight (mean BMI 25.7), one smoked and there was no clear association with deprivation.

All the eclamptic fits occurred in the third trimester with a mean gestation of 36 weeks. Four women experienced fits out with a maternity unit, two antepartum and two postpartum. There was no pattern to the time of day at which a fit occurred.

As in most recent years of the audit, blood pressures prior to the fit were not unduly high with a mean of 149/89, although the most recent reading in three cases was 2-3 weeks earlier. Six women had no significant proteinuria prior to the fit although two had not had their urine tested within the previous two weeks. Prodromal signs and/or symptoms were present in all but three women. None had been diagnosed with pre-eclampsia although two were on antihypertensive therapy. The mean post-eclampsia blood pressure was 162/99 with a range of 123-220/73-120.

### 5.3.1 Management and quality of care

The RCOG has produced guidelines for the management of eclampsia<sup>6</sup>. Data collected for SCASMM are compared with those guidelines. Most of the recommendations for resuscitation, treatment, investigation and monitoring are summarised in Appendix 4, Tables A4.10-12 where the number of women receiving each of the parameters in 2010 is shown. Not all features are relevant for every case and data are incomplete in some cases but most women appeared to receive appropriate care. Some features deemed essential for optimal management were not reported as being performed on all women, particularly as follows:

- In one woman it was reported that the airway was not secured, she was not given oxygen or nursed in the left lateral position and venous access was not obtained
- The urine output was not recorded in two women
- There was no documentation of fluid input and output in one woman
- Recommended blood tests were not carried out in up to three women and not repeated within six hours in two women
- Respiratory rates and deep tendon reflexes were not monitored frequently in four and seven women respectively
- Calcium gluconate was not available at the bedside of three women.

All of the units at which a woman had an eclamptic fit in 2010 reported that they had an eclampsia protocol and had an eclampsia treatment pack on the labour ward. The protocol was followed in eight cases but not in two and there was no information for the remaining two cases.

Self assessment at unit level found that five women (42%) received optimal care. For the second year in a row there was no significant suboptimal care (Table 12).

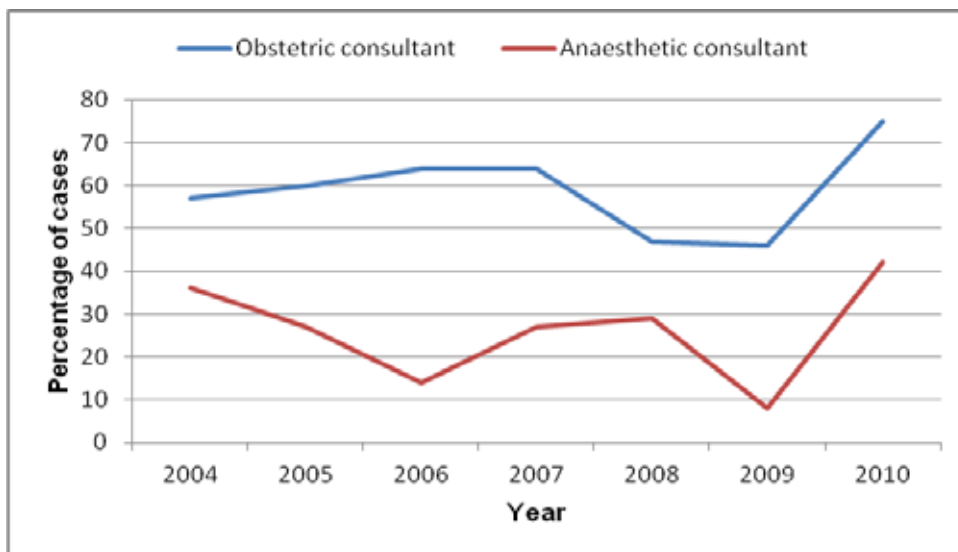
**Table 13: Unit level assessment of optimal and significantly suboptimal care of eclampsia, 2004–2010**

Year	Number of reported assessments	Received optimal care (%)	Received significantly sub-optimal care (%)
2004	13	8 (62)	2 (15)
2005	14	9 (64)	1 (7)
2006	14	10 (71)	0
2007	11	3 (27)	3 (27)
2008	17	7 (41)	1 (6)
2009	12	10 (83)	0
2010	12	5 (42)	0

Nine cases of eclampsia were discussed at a risk management meeting. An opinion of the quality of care for two further cases came from a clinical case presentation and an informal discussion (Table A4.14).

Direct involvement in the care of women with eclampsia by obstetric and anaesthetic consultants increased in 2010 to the highest recorded (75% for the former and 42% the latter). The percentage involvement since 2004 (when the collection of these data commenced is shown in Figure 12).

**Figure 12: Percentage of cases of eclampsia with direct involvement in care from obstetric and anaesthetic consultants, 2004 -2010**



All 12 of the case records and episode documentation were deemed “good” or “excellent” in 2010 (Table A4.15).

## 6 Discussion

The remit of Healthcare Improvement Scotland is to improve the quality of the provision of health care. SCASMM is now an established and nationally recognised activity and appears to be unique internationally. No other country has reported continuous audit of maternal morbidity in such detail over several years. While acknowledging areas where improvement has taken place during the lifetime of the audit, this eighth annual report and its recommendations place particular emphasis on areas where deficiencies in practice in relation to national guidelines were identified.

The definitions of severe morbidity used in SCASMM have stood the test of time and have allowed an analysis of temporal trends although the details requested of each case have changed and developed over time. Consistent reporting of key elements is integral to SCASMM but each annual report in recent years has placed different emphases. The sixth report<sup>7</sup>, for example, compared Scottish maternal morbidity data with other international reports, while the seventh concentrated on lessons which could be learned from individual cases. The seventh report<sup>14</sup> also, for the first time, furnished each maternity unit with an analysis of data from their own cases of severe maternal morbidity. Reports from maternity units suggest that this was well received and has stimulated discussion and improved practice. Maternity units will again receive this information for events in 2010. The unit reports highlight not only differences in clinical practice but also in the completeness of case recognition and reporting of information. The variation in the reported incidence of severe maternal morbidity from different units is most likely to be the result of differing degrees of diligence in case ascertainment and notification.

For the first time, in 2010, information was requested about cases where elective interventional radiology successfully prevented major haemorrhage. The number of cases reported was low but with increasing awareness of this added component of the audit, it is hoped that a fuller picture will emerge in future years. Allied to the information on cases when elective interventional radiology failed to prevent major haemorrhage, this information may help to strengthen guidance in this area. The use of blood cell salvage is a further new technique with a relatively weak evidence base for its use in obstetric practice<sup>5</sup>. It was reported as attempted in six cases in Scotland in 2010 with a sufficient quantity of useful blood obtained in only two. Experience in Scotland is clearly at an early stage and the audit will continue to collect information to assess its development and to inform practice.

Some notable improvements were identified in 2010. Care was deemed optimal in 78% of cases of major obstetric haemorrhage, the highest reported rate. Similarly, the direct involvement of a consultant obstetrician in the care of major haemorrhage was higher than previously reported, at 82%. Perhaps the most notable achievement has been the highly significant decline in the rate of peripartum hysterectomy among women with major obstetric haemorrhage since the commencement of the audit in 2003, when the rate was 15.1%, to 2010 when it was 5.6%.

Despite these improvements, detailed examination of the unit returns for 2010 showed a number of areas where there were deficiencies in clinical care and/or

there is potential for further improvement. These are summarised below and form the basis for many of the recommendations in this report.

- The perinatal mortality rate among women experiencing severe morbidity was ten times the rate for all births in Scotland in 2010. Particular diligence in monitoring fetal and neonatal wellbeing in these women is necessary.
- The direct involvement of consultant obstetricians and anaesthetists in the care of women with major obstetric haemorrhage and eclampsia fell short of the levels recommended by the RCOG. The attendance of a consultant obstetrician at caesarean sections undertaken at full dilatation should also be monitored.
- There were deficiencies in antenatal risk identification and action planning. In particular, the audit identified a failure to perform third trimester ultrasonography for placental localisation in all women with a previous caesarean section and inadequate forward planning for some women with placenta praevia and/or accreta.
- The cases of many women who experienced severe morbidity appear not to have been assessed by the maternity unit's risk management committee.
- The crossmatching of appropriate quantities of blood and fluid management prior to transfusion was not compliant with national guidelines in a number of cases.
- There was a "scattergun" approach to the pharmacological treatment of uterine atony causing postpartum haemorrhage. There was often no logic to the order in which drugs were administered. Ergometrine was a particularly neglected drug.
- The use of pharmacological agents for the prevention of postpartum haemorrhage also departed from national guidance with syntometrine still used frequently.
- Not all cases of severe morbidity were monitored using a modified obstetric early warning chart and documentation of morbidity events was often inadequate.
- A minority of women experiencing eclampsia do not receive optimum resuscitation, investigation or monitoring.

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## Appendix 1: Criteria and definitions for categories of Scottish Confidential Audit of Severe Maternal Morbidity (2003-2009)

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

## Appendix 2: Minimum data for all morbidities

The information in Appendix 2 was collected on the notification form for all categories of morbidity where data was available on the 385 women. The distribution of the different categories is tabled in the body of the report.

### A2.1 Age

**Mean:** 30.5 years (standard deviation 6.6 years)

**Range:** 15–48 years

**Median:** 30 years

Data available for 377 out of the 385 women who experienced severe morbidity

### A2.2 Gestation

**Mean:** 37.3 weeks (standard deviation 5.6 weeks)

**Range:** 4–42 weeks

Gestation at event (weeks)	Number of women <sup>1</sup>
< 12	4
12 – 23	6
24 – 31	24
32 – 36	51
37 or more	282

<sup>1</sup> Gestation not recorded for 18 women

### A2.3 Number of morbidities per woman

Number of morbidities	Number of women <sup>1</sup>
1	329
2	43
3	12
4	1

In total 455 morbidities were experienced by 385 women

### A2.4 Deprivation decile of women with severe morbidity, 2010

Scottish Index of Multiple Deprivation (SIMD) deciles	Number of Women <sup>1</sup>	Percentage [of women where deprec was completed]
1 Most deprived	52	15.0
2	45	13.0
3	27	7.8
4	45	13.0
5	37	10.7
6	25	7.2
7	26	7.5
8	37	10.7
9	30	8.6
10	23	6.6

<sup>1</sup> Data were available for 347 women out of the 385 [90.1%] who experienced severe morbidity.

## A2.5 Body Mass Index of women with severe morbidity, 2010

Body mass index	Number of women <sup>1</sup>	Percentage of women (of 345 where BMI was completed)
< 30	248	71.9
30-34	68	19.7
35-39	21	6.1
≥ 40	8	2.3
<b>Total</b>	345	

<sup>1</sup> Data was available for 345 women out of the 385 [89.6%] who experienced severe morbidity

## A2.6 Smoking History

Of the 356 women where smoking behaviour was recorded:

67 (18.8%) were smokers at the beginning of their pregnancy

22 (32.8 %) of the 67 smokers stated that they gave up during pregnancy

289 (81.2%) stated that they were non-smokers.

## A2.7 Women admitted to ICU, nature of morbidity

Nature of morbidity	Number of women <sup>1</sup>
Major obstetric haemorrhage (MOH)	47
Not categorised <sup>2</sup>	23
Renal/liver dysfunction	3
Eclampsia	1
Acute respiratory dysfunction	1
Anaphylactic shock	1
Septicaemic shock	1
Anaesthetic problem	1
Post- interventional radiology	1
MOH + acute respiratory dysfunction	2
MOH + renal/liver dysfunction	1
MOH + cardiac arrest	2
All	84

<sup>1</sup> Information unavailable for 13 women

<sup>2</sup> See Table A2.8 for details

## A2.8 “Uncategorised” reasons for ICU admissions

Reason for ICU admission	Number of women			
	2008	2009	2010	Total 2008-2010
Cardiac	11	6	4	21
Surgical	6	5	2	13
Sepsis	2	2	5	9
Chest infection	2	2	4	8
Renal	5	1	1	7
H1N1	0	3	1	4
MOH <threshold	1	2	1	4
Diabetes	0	0	2	2
Not recorded	1	0	1	2
Encephalopathy	1	0	0	1
Thrombosis	0	1	0	1
Trauma	0	0	1	1
Anaesthesia	0	0	1	1
<b>Total</b>	<b>29</b>	<b>22</b>	<b>23</b>	<b>74</b>

## A2.9 Perinatal outcome among women with severe morbidity, 2005-2010

	Women with information available					
	2005	2006	2007	2008	2009	2010
All morbidities	213	257	220	275	290	348
Major haemorrhage	153	204	178	199	233	301
Non-haemorrhage	60	53	42	76	57	47
	<b>Perinatal deaths (number)</b>					
	2005	2006	2007	2008	2009	2010
All morbidities	15	17	10	16	17	24
Major haemorrhage	12	10	9	11	14	22
Non-haemorrhage	3	7	1	5	3	2
	<b>Perinatal deaths (rate per 1000 with severe morbidity)</b>					
	2005	2006	2007	2008	2009	2010
All morbidities	70.4	66.1	45.5	58.2	58.6	69.0
Major haemorrhage	78.4	49.0	50.6	55.3	60.1	73.1
Non-haemorrhage	50.0	132.1	23.8	65.8	52.6	42.6
<b>Scottish perinatal mortality rate</b>	<b>7.7</b>	<b>7.4</b>	<b>7.8</b>	<b>7.4</b>	<b>7.4</b>	<b>6.9</b>

## Appendix 3: Additional data for Major Obstetric Haemorrhage

In 2010, 328 women were reported as suffering major obstetric haemorrhage (MOH). A detailed case assessment proforma was returned for 323 of them. Data was not complete for all cases. The information below and in the main body of the report on MOH is based on the 323 cases.

### A3.1 Age

Mean: 31 years (Standard deviation 6 years)

Median: 31 years

Range: 16 - 48

### A3.2 Parity

Para 0: 153

Para 1-4: 165

Para <sup>3</sup> 5: 4

### A3.3 Previous caesarean sections

Number of previous caesarean sections	Number of women <sup>1</sup>
None	243
One	37
Two	9
Three	4
Four	0

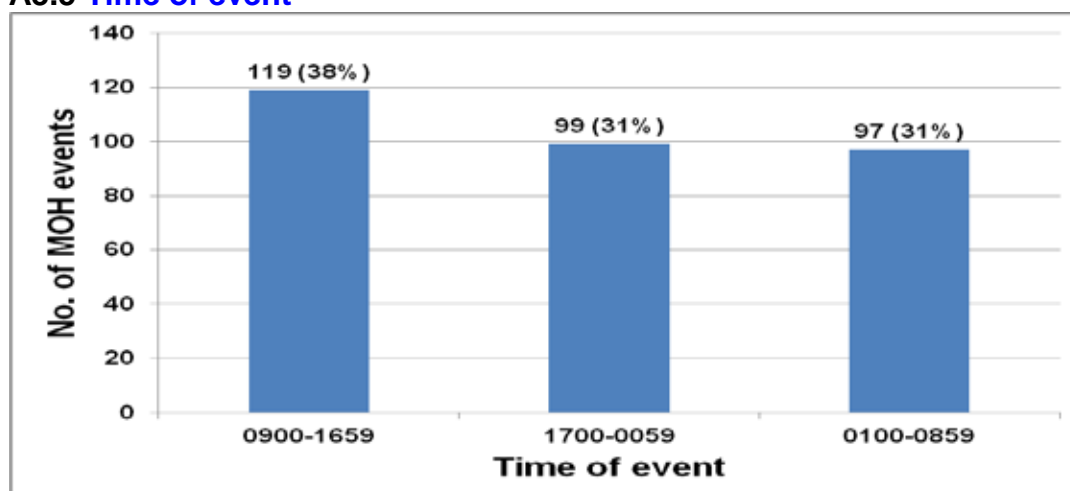
<sup>1</sup> Data missing for 32 women

### A3.4 Timing and location of commencement of haemorrhage

Haemorrhage commenced	Location				Total <sup>1</sup>
	Consultant led unit	Community maternity unit	In transport	At home/ outwith hospital	
Antepartum	23	6	0	2	31
Intrapartum	27	5	0	0	32
Postpartum	248	8	0	1	257
Total	298	19	0	3	320

<sup>1</sup> Data missing for 3 women

### A3.5 Time of event



(Data missing for 8 women)

**A3.6: Causes of major obstetric haemorrhage among 323 women in 2010 and among 1354 women in 2006-2010**

Cause	2010		2006-2010	
	Number	%	Number	%
Uterine atony	193	59.8	699	51.6
Retained placenta/membranes	50	16.7	241	17.8
Vaginal laceration/haematoma	54	18.1	234	17.3
Extension to uterine incision	69	23.1	225	16.6
Abruption	25	8.4	131	9.7
Placenta praevia	21	7.0	103	7.6
Cervical laceration	8	2.7	43	3.2
Morbidity adherent placenta	12	4.0	64	4.7
Broad ligament haematoma	3	1.0	25	1.8
Uterine rupture	8	2.7	23	1.7
Uterine inversion	1	0.3	7	0.5
Other*	14	4.7	93	6.9

\*5 with coagulopathy, 3 fibroids, 4 miscarriages (including 2 with hydatidiform moles), 1 ectopic pregnancy and 1 bleeding ovarian cyst

**A3.7: Mode of delivery for women with major obstetric haemorrhage 2003–2010 and for all women giving birth in Scotland**

Mode of delivery	Scotland 2010 (where known)*		2010		2003 - 2010	
	Number	%	Number	%	Number	%
Spontaneous vertex	33836	60.2	77	24.1	475	25.6
Breech	161	0.3	2	0.6	23	1.2
Ventouse	1563	2.8	7	2.2	53	2.9
Forceps	5515	9.8	53	16.6	270	14.6
Elective caesarean section	6475	11.5	29	9.1	226	12.2
Emergency caesarean section	8693	15.5	151	47.3	808	43.6
Total number of women	56243		319		1855	

\*Personal communication from K Monteith, Information Analyst, Information Services Division  
25<sup>th</sup> April 2012 Data from SMR02 returns, data not available for all women

**A3.8: Emergency caesarean sections performed at full dilatation among women experiencing MOH, 2004–2010**

Year	Caesareans performed at full dilation	
	Number	% of all emergency caesarean sections
2004	8	14
2005	19	24
2006	25	24
2007	22	19
2008	23	22
2009	30	25
2010	33	22

**A3.9: Association of morbidly adherent placenta with previous caesarean section 2006–2010**

	2006	2007	2008	2009	2010
Parous women with morbidly adherent placenta [number]	9	16	11	10	10
Without previous caesareans [number]	4	6	5	5	8
Without previous caesareans [%]	44	38	45	50	80
With previous caesareans [number]	5	10	6	5	2
With previous caesareans [%]	56	62	55	50	20
$\chi^2$ p-value	0.05	0.01	0.03	0.01	0.81

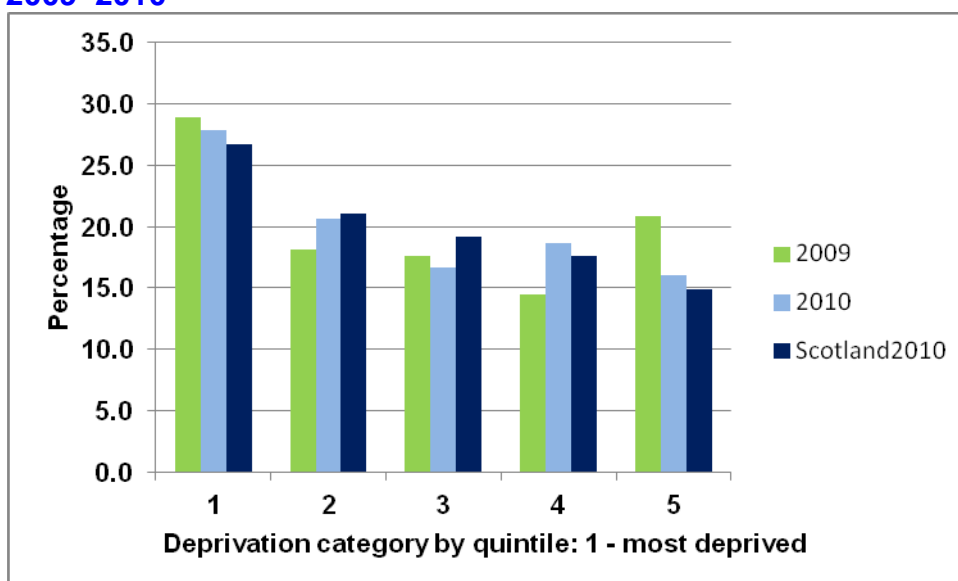
**A3.10 Deprivation**

SIMD deciles	No. Women 2009	Percentage [of 221 women who responded] 2009	No. Women 2010	Percentage [of 305 women who responded] 2010
1 (Most deprived)	34	15.4	46	15.1
2	30	13.6	39	12.8
3	20	9.0	21	6.9
4	20	9.0	42	13.8
5	25	11.3	29	9.5
6	14	6.3	22	7.2
7	17	7.7	23	7.5
8	15	6.8	34	11.1
9	19	8.6	27	8.9
10	27	12.2	22	7.2

Data missing for 18 women



### A3.11 Deprivation quintile of women with major obstetric haemorrhage, 2009–2010



### A3.12 BMI

BMI	2009		2010	
	Number of women	Percentage of women (of 277 where BMI was completed)	Number of women	Percentage of women (of 301 where BMI was completed)
< 30	206	74.4	221	73.4
30 - 34	36	13.0	57	18.9
35 - 39	18	6.5	17	5.6
> 39	17	6.1	6	2.0
Total	277		301	

**2009:** Mean 27.1 (Standard deviation 6.6) **2010:** Mean 26.9 (Standard deviation 5.4)  
 Range: 16 – 73 (Data missing for 29 women)      Range: 16 – 52.5 (Data missing for 22 women)

### A3.13 Smoking History

	2009 Number of women [%]	2010 Number of women [%]
Current smokers at booking	50 [18]	55 [18]
Non-smokers	225 [82]	255 [82]
Smoked during pregnancy	14 [5]	23 [4]
No information available	31 [11]	13 [7]

For current smokers:

No. per day	2009		2010	
	Number of Women	Percentage of 50 women who smoked	Number of Women	Percentage of 55 women who smoked
< 5	8	16	12	22
6 – 10	19	38	23	42
11 – 20	12	24	11	20
<sup>3</sup> 21	2	4	0	0

No information was available for 9 of the women in who were current smokers in 2009 and also for 9 of the women in 2010.

### A3.14 Blood loss and haemoglobin levels

Mean blood loss: 3 614ml (standard deviation 1 807ml)

Range: 1 200 – 15 000ml

Data missing for 1 woman

#### Haemoglobin levels

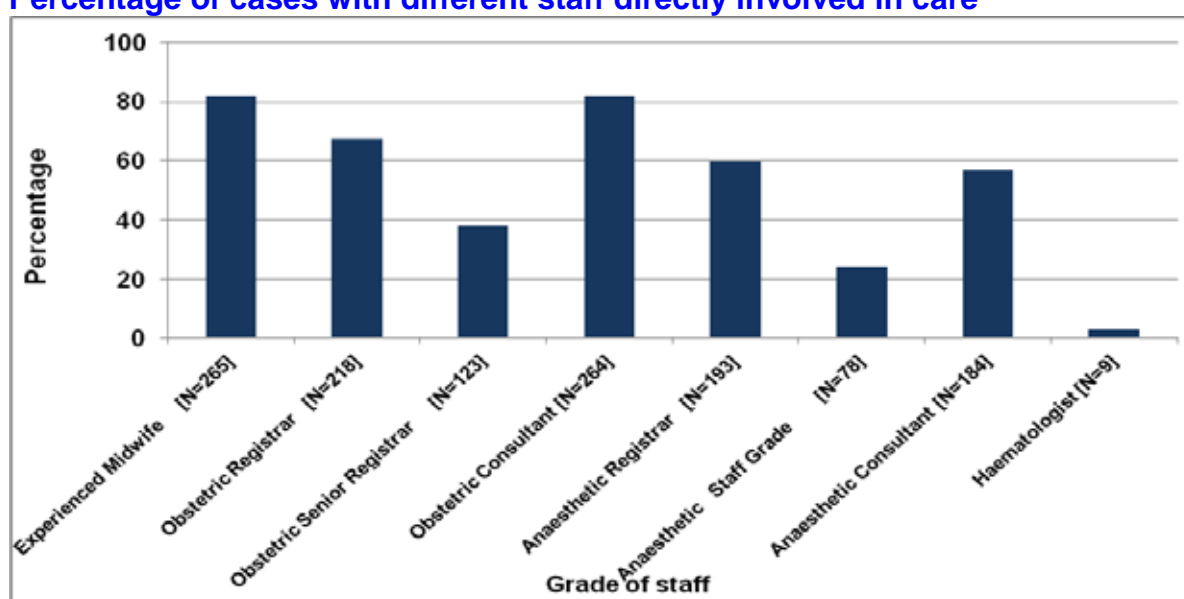
Time	Mean	Standard deviation	Range
Before MOH	11.7	1.2	6.6 – 14.8
First recorded after MOH <sup>1</sup>	9.3	1.4	5.0 – 13.1
Difference [Before- After] <sup>2</sup>	2.4	1.9	-4.0 – 7.7

<sup>1</sup>This may have been before or after transfusion and was not consistent

<sup>2</sup>Difference data missing for 17 women

### A3.15 Staff involvement

#### Percentage of cases with different staff directly involved in care<sup>1</sup>



<sup>1</sup> Percentage based on 323 women

### A3.16 Resuscitation

Resuscitation parameter	Number of Women <sup>1</sup>	Percentage of all women with MOH <sup>2</sup>
Venous access achieved	319	99
Two large bore cannulae sited	286	89
Oxygen given	257	80
Received blood transfusion	283 <sup>3</sup>	88

<sup>1</sup>Data missing for 1 – 37 women depending on data question

<sup>2</sup>Percentage is of all women including those with missing data

<sup>3</sup>39 women specifically recorded as not receiving blood transfusion, data missing for 19

Specialist equipment (blood warmer) was used in 146 cases.

### A3.17 Fluid given

Type of fluid	Mean (mls)	Range (mls)	% at or below guideline <sup>1</sup>	% above guideline
Crystalloid	1569	0 – 7000	79.9	20.1
Colloid	1056	0 – 3000	90.7	9.3
Total volume	2531	0 – 7000	88.1	11.9

<sup>1</sup> 2000mls for Crystalloid; 1,500mls for Colloid; 3,500mls for Total volume  
(Note that the mean total volume does not equal the added means due to different cases with missing values. Where both values were given the mean was 2585mls.)

### A3.18 Blood cross-matching and transfusion

#### Crossmatching

Number of units crossmatched	Number of women <sup>1</sup>	Number of women full blood count taken	Number of women where clotting screen taken
0	1	1	1
1	2	2	2
2	27	23	21
3	3	3	3
4	152	137	120
5	2	2	2
6	82	76	71
8	14	13	12
10	3	3	3
11	1	1	1
12	4	4	4
14	1	1	1
16	1	1	1
18	1	1	1
Total	294	268	243

<sup>1</sup> Data missing for 29 women

Mean [n = 294] number of units cross matched: 4.8 units (standard deviation 2.1 units)

Mode: 4 units (range 0 – 18 units)

#### Transfusion

Type of transfusion	Number of women transfused <sup>1</sup> [% of all transfused]	Mean units transfused [standard deviation]	Range transfused [units]
O negative blood	41 [14]	2.05 [0.80]	1 – 4
Group specific uncrossmatched blood	23 [8]	3.00 [1.35]	1 – 6
Crossmatched blood	243 [86]	4.19 [3.33]	1 – 24
All blood units <sup>1</sup>	256 [90]	4.56 [3.61]	1 - 24
Fresh frozen plasma	127 [45]	4.18 [2.30]	1 – 16
Cryoprecipitate	32 [11]	2.47 [1.48]	1 – 8
Platelets	69 [24]	1.59 [1.08]	1 – 6

<sup>1</sup> 283 women were transfused, but details of blood given were only available for 256 women

### A3.19 Investigations and monitoring

Investigation or monitoring parameter	Number of women <sup>1</sup>	Percentage of all women with MOH <sup>2</sup>
Obstetric early warning chart used	245	76
BP taken at least every 15 minutes	317	98
Pulse monitored at least every 15 minutes	317	98
Pulse oximeter used	318	98
Foley catheter placed	319	99
Urine output measured regularly	309	96
Central venous pressure line inserted	57	18
Arterial line inserted	91	28

<sup>1</sup> Data missing for 3 – 11 women depending on data question

<sup>2</sup> Percentage is of all women including those with missing data

### A3.20 High dependency or intensive care

Type of care	Number of women <sup>1</sup>	Percentage of all women with MOH <sup>2</sup>
Admitted to ICU	52	16
HD room on labour ward	238	74
Admitted to General HDU	7	2

<sup>1</sup> Data missing for 26 women

<sup>2</sup> Percentage is of all women including those with missing data

### A3.21 Clinical records and documentation

Overall standard of clinical case record	Number <sup>1</sup> of women [%]
Excellent: filed in clear sequence, easy to extract data	113 [36]
Good: mainly clear, but some features absent	181 [57]
Fair: significant deficiencies in filing	20 [6]
Poor: chaotic notes, difficult to find much information	2 [1]

<sup>1</sup> No information for 7 women

Documentation of MOH episode	Number <sup>1</sup> of women [%]
Excellent: easy to follow, entries signed and timed	139 [44]
Good: clear, though some gaps	151 [48]
Fair: significant gaps, not all entries signed and timed	23 [7]
Poor: major omissions, many unsigned, untimed entries	2 [1]

<sup>1</sup> No information for 8 women

### A3.22 Interventional radiology(IR): occlusive technique used in 17 cases of MOH utilising IR

Technique employed	Number of women <sup>1</sup>
Temporary balloon occlusion	2
Gelfoam/PVA	7
Temporary balloon occlusion + gelfoam	2
Temporary balloon occlusion + Coils	1
Coils	2
Embosphere	1
Amplatzer plug	1

<sup>1</sup> Not documented for 1 woman

## Appendix 4: Eclampsia

In 2010, 12 women were reported as experiencing eclampsia. Detailed case assessments were received for all 12 (100%).

### A4.1 Age

Mean: 25 years (standard deviation 6.7 years)

Range: 15 – 39 years

### A4.2 Parity

Para 0: 10 women

Para 1-2: 2 women

### A4.3 Deprivation code

SIMD deciles	Number of women	Percentage
1 (Most deprived)	2	16.7
2	2	16.7
3	1	8.3
4	0	0
5	2	16.7
6	1	8.3
7	0	0
8	0	0
9	1	8.3
10	1	8.3

Data missing for 2 women

### A4.4 Body Mass Index

Mean 24.6 (Standard deviation 4.9)

Range: 18 – 33.5

(Data missing for 1 woman)

### A4.5 Smoking History

Of the 12 women only 1 (8.3%) indicated at booking that she was a current smoker. She did not give up during her pregnancy but reported that she smoked less than 5 per day.

### A4.6 Gestation at eclamptic fit or at delivery if postpartum eclampsia

Mean: 36.0 weeks (standard deviation 4.3 weeks)

Range: 29 – 41 weeks

< 37 weeks: 6

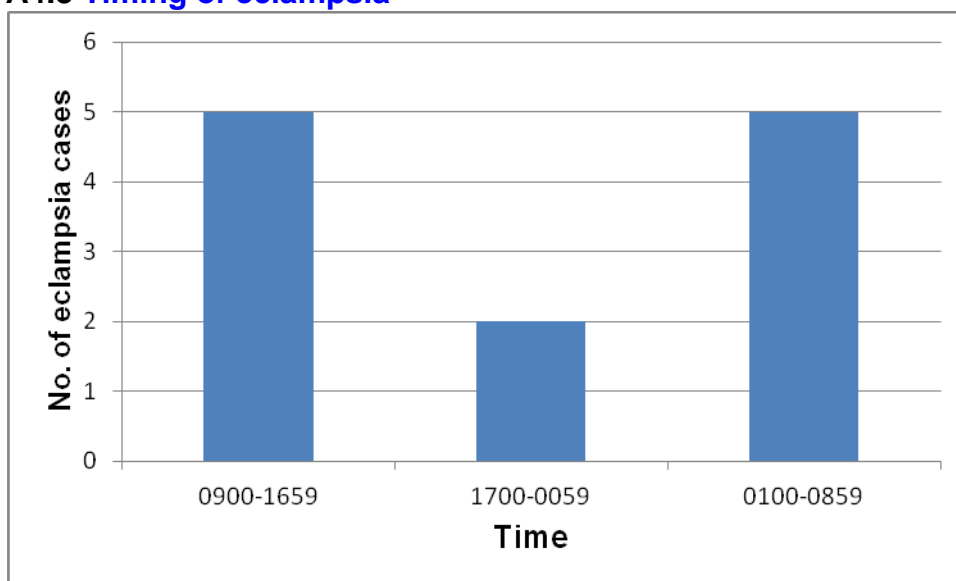
<sup>3</sup> 37 weeks: 6

#### A4.7 Timing and location of eclampsia

Haemorrhage commenced	Location <sup>1</sup>				Total
	Consultant-led unit	Community maternity unit	In transport	At home/outwith hospital	
Antepartum	2	-	-	2	4
Intrapartum	2	-	-	-	2
Postpartum	4	-	-	1	5
Total	8	-	-	3	11

<sup>1</sup> Location missing for 1 woman (with antepartum fit)

#### A4.8 Timing of eclampsia



#### A4.9 Prodromal symptoms and signs

Recorded signs and symptoms	Number of women
None	3
Headache	7
Visual disturbance	4
Nausea/vomiting	1
Upper abdominal pain	1
Oedema	8
Clonus	0
Right abdominal tenderness	0
Diagnosed with pre-eclampsia	0

#### A4.10 Staff involved in management of eclampsia

Staff directly involved	Number of women
Experienced midwife	10
Obstetric registrar	9
Obstetric senior registrar	3
Obstetric consultant	9
Anaesthetic registrar	2
Anaesthetic staff grade	4
Anaesthetic consultant	5

#### A4.11 Resuscitation

Resuscitation measure employed	Number of women <sup>1</sup>
Airway secured	8
Oxygen given	11
Venous access obtained	11
Tilted to left lateral position	10

<sup>1</sup>Data not always available for 1 to 3 women

#### A4.12 Treatment, investigation and monitoring

Listed here are a range of details of the management of women with eclampsia that would be consistent with good practice, or may be indicators of suboptimal care, together with the number of women who received each. Not all information was known for all women and not all women would be expected to require all features. Those features which would be consistent with optimal recommended practice for all (12) women are marked\*.

Feature of management	Number of women (max = 12)
<b>Treatment</b>	
Magnesium sulphate intravenous infusion*	12
Diazepam to control fit	1
Phenytoin to control fit	1
Magnesium Sulphate given for at least 24 hours*	8
Treated for acute severe hypertension	8
Treated with labetalol	6
Treated with hydrallazine	1
Treated with labetalol and nifedipine	1
<b>Investigation</b>	
Blood taken for: Full blood count*	12
Urate*	12
Urea, electrolytes, creatinine*	9
Liver function*	11
Coagulation screen*	11
Blood tests repeated within 6 hours*	10
CT or MRI scan performed	4
<b>Monitoring</b>	
Intensive care chart used*	10
Admitted to intensive care unit	1
Blood pressure (BP) taken every at least every 15 minutes*	11
BP taken with automatic sphygmomanometer	12
Pulse oximeter used*	12
Oxygen saturation monitored continuously*	11
Respiratory rate taken at least every 15 minutes*	8
Deep tendon reflexes tested every 15 minutes*	5
Foley's catheter placed*	12
Urine output measured frequently*	10
Fluid input and output strictly documented*	11
Central venous pressure line placed	3
Calcium gluconate available at bedside*	9

#### A4.13 Overall assessment of care

Category	Number of women
<b>Appropriate care</b> Well managed	5
<b>Incidental sub-optimal care</b> Lessons can be learned although it did not affect the final outcome	5
<b>Minor sub-optimal care</b> Different management may have resulted in a different outcome	2
<b>Major sub-optimal care</b> 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.	0

#### A4.14 Clinical records and documentation

Overall standard of clinical case record	Number of women [%]
Excellent: filed in clear sequence, easy to extract data	5 [42]
Good: mainly clear, but some features absent	7 [58]
Fair: significant deficiencies in filing	-
Poor: chaotic notes, difficult to find much information	-

<sup>1</sup> No information for 7 women

Documentation of eclampsia episode	Number of women [%]
Excellent: easy to follow, entries signed and timed	5 [42]
Good: clear, though some gaps	7 [58]
Fair: significant gaps, not all entries signed and timed	-
Poor: major omissions, many unsigned, untimed entries	-



## Appendix 5: SCASMM Co-ordinators

NHS Board	Hospital Name	Co-ordinator(s)
NHS Grampian	Aberdeen Maternity Hospital	Lynn Crawford
NHS Ayrshire & Arran	Ayrshire Maternity Unit	Attica Mustaqim
NHS Borders	Borders General Hospital	Karen Smail
NHS Highland	Caithness General Hospital	Philip Boabang
NHS Dumfries & Galloway	Cresswell Maternity Unit	Katrina Hepburn
NHS Grampian	Dr Gray's Hospital, Elgin	Yvonne Walters
NHS Fife	Forth Park Hospital	Annette Lobo
NHS Tayside	Ninewells Hospital	Fiona Dye
NHS Greater Glasgow and Clyde	Princess Royal Maternity Hospital	Alan Mathers Fiona McComb Margaret Young
NHS Greater Glasgow and Clyde	Queen Mother's Hospital	Anne Ovens Rebecca Speirs
NHS Highland	Raigmore Hospital	Caron Cruickshank Katherine Freeman
NHS Greater Glasgow and Clyde	Royal Alexandra Hospital	Gillian Burdge Anne McGhee Alan Mathers
NHS Lothian	Simpson Centre for Reproductive Health	Sinead McNally
NHS Greater Glasgow and Clyde	Southern General Hospital	Lisa Allan Julie Gillies
NHS Lothian	St John's Hospital, Livingston	Sarah Court Karen McIntosh
NHS Forth Valley	Stirling Royal Infirmary	Gail Bell
NHS Western Isles	Western Isles Hospital	Rawdha Al-Kamil Agnes Hodgart Kathryn Kearney
NHS Lanarkshire	Wishaw General Hospital	Geraldine Morgan

## **Appendix 6: Links to previous SCASMM reports and to 2012 data collection forms**

### **Data Collection Case Ascertainment Form 2012**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=a863b4df-7db2-415f-a98c-da4140f87d42&version=-1>

### **7<sup>th</sup> Annual SCASMM Report (2009)**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=7c8fc48a-dd38-45d7-be00-05a0ec1be61a&version=-1>

### **6<sup>th</sup> Annual SCASMM Report (2008)**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=c27f7f72-63c7-4619-a6e7-a2c90e6e85f6&version=-1>

### **5<sup>th</sup> Annual SCASMM Report (2007)**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=a2e81bfd-4f3d-469d-a568-2c64350ae57a&version=-1>

### **4<sup>th</sup> Annual SCASMM Report (2006)**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=f181adcb-971d-4c26-b5c1-b4da20eb94c2&version=-1>

### **3<sup>rd</sup> Annual SCASMM Report (2005)**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=ffb0aae2-9747-40cd-940d-58ab30beff91&version=-1>

### **2<sup>nd</sup> Annual SCASMM Report (2004)**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=db96ac4b-e7fb-4937-978e-6f24bf9b538b&version=-1>

### **1<sup>st</sup> Annual SCASMM Report (2003)**

<http://www.healthcareimprovementscotland.org/his/idoc.ashx?docid=32a7adc4-bbaa-447a-9064-978ea6e93098&version=-1>

## Appendix 7: Form A 2010

**FORM A – Notification of an event**

**SCOTTISH CONFIDENTIAL AUDIT OF SEVERE  
MATERNAL MORBIDITY (SCASMM) 2010**

Hospital name:  Completed by:

**Patient information**

Initials:   Age:  BMI:

Deprivation decile:  Gestation at pregnancy end:  Parity:  +   
(see rear for instructions) (completed weeks)

Did she smoke at booking? Yes  No  Did she give up during pregnancy? Yes  No

How many did she smoke per day? N/A  <5  6-10  11-20  >21

**Event information**

Date of event: Day  Month  Year  2010

Time of onset of event:  (24 hour clock)

Baby status:  
 Alive at end of first week  Stillbirth   
 First week death  Miscarriage

For any other details please use the "additional information" box on the rear of this form

Category (definitions on rear) Please tick all that apply	
1	Major obstetric haemorrhage*
2	Eclampsia†
3	Renal or liver dysfunction
4	Cardiac arrest
5	Pulmonary oedema
6	Acute respiratory dysfunction
7	Coma
8	Cerebro-vascular event
9	Status epilepticus
10	Anaphylactic shock
11	Septicaemic shock
12	Anaesthetic problem
13	Massive pulmonary embolism
14	ITU/CCU admission
15	Interventional radiology*

\* category 1 and 15: a completed Form B must be enclosed  
 † category 2: a completed Form C must be enclosed