

**Scottish  
Confidential  
Audit  
of  
Severe  
Maternal  
Morbidity**

**5th Annual Report  
2007**



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## Summary

### 1. Background and methods

- 1.1 During 2007, The Scottish Programme for Clinical Effectiveness in Reproductive Health (SPCERH) identified cases of severe maternal morbidity throughout Scotland for a fifth consecutive year. The assessment of these cases and the production of this report were overseen by the Reproductive Health Programme of NHS Quality Improvement Scotland (NHS QIS) who took over many of the functions of the now discontinued SPCERH.

The current report includes presentation and analysis of trends emerging from 5 years of data collection.

- 1.2 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. Detailed self-assessment proformas were submitted from each unit for cases of major haemorrhage and of eclampsia.
- 1.3 All eighteen consultant-led units participated during 2007. Monthly returns were received for 205 of a possible 216 unit/months (95%). One unit failed to provide returns for 10 months.

### 2. Rates of events

- 2.1 During 2007, 330 women met one or more of the definitions, giving a Scottish rate of severe maternal morbidity of 5.7 (95% confidence interval 5.1 – 6.3) per 1000 births (based on a denominator of 57,781 live births). There has been no significant change in the rate during the 5 years of the audit. In 2007, rates in individual maternity units ranged from 2.2 (excluding the unit with insufficient reporting) to 11.7 per 1000 births. Differences among units are likely to reflect differences in case mix, population, and case ascertainment rather than differences in quality of care. For the first time, and after widespread consultation, this report gives information on morbidity events from named units. Anonymity is retained for earlier years.
- 2.2 Major obstetric haemorrhage was the commonest category of severe morbidity, occurring in 256 women giving a Scottish rate of 4.4 (3.9 – 4.9) per 1000 births. The previous upward trend in the reported rate of major obstetric haemorrhage has been reversed during 2007 and it may be that the changes have been those of natural fluctuation.
- 2.3 Rates of other morbidities (per 1000 births) were as follows:
- Eclampsia - 0.2 (95% confidence interval 0.1 – 0.3)
  - Pulmonary oedema/respiratory dysfunction - 0.2 (0.1 - 0.3)
  - Renal/ liver dysfunction - 0.3 (0.2 – 0.4)
  - Intensive care admission – 1.4 (1.1 – 1.7)

Other categories of event occurred more rarely.

- 2.4 During 2007, there were four direct or indirect maternal deaths from relevant causes (including one probable death from haemorrhage (not yet fully ascertained)); giving a 'near miss:death ratio' of 83:1. During the 5 years of the audit to date, 1527 women were reported with severe morbidity and there were 26 relevant maternal deaths; giving a 'near miss:death ratio' of 59:1. (Inevitably, small numbers mean that these estimates are imprecise.)

- 2.5 Perinatal mortality among women suffering severe morbidity during 2007 was 45.5/1000 births, substantially above the overall Scottish rate, although the perinatal outcome was not recorded in a significant number of cases.

### 3. Quality of care

#### 3.1 Major haemorrhage

Case definition: *Estimated blood loss  $\geq 2500\text{ml}$ , or transfused 5 or more units of blood or received treatment for coagulopathy (fresh frozen plasma, cryoprecipitate, platelets).*

- 3.1.1 Unit risk management teams assessed 231 cases of major obstetric haemorrhage (90% of those reported) using a structured proforma.
- 3.1.2 Only 23% of cases of severe haemorrhage experienced a normal delivery; 63% were delivered by Caesarean section (50% emergency and 13% elective). The majority of bleeds (58%) occurred for the first time post-partum.
- 3.1.3 As in previous years, the most frequent cause of major haemorrhage was uterine atony (45%), followed by extension to uterine incision (20%), followed by retained placenta (19%), and vaginal laceration/haematoma and placenta praevia (both 14%). There were 16 cases of morbidly adherent placenta, all in parous women, 10 of whom had a previous Caesarean section delivery.
- 3.1.4 The mean estimated blood loss was 3.6 litres (range 0.4 – 15); the mean volume of blood transfused was 4.2 units (range 0 – 20); and the mean fall in haemoglobin level pre and post-bleed was 2.2g/dl (range 5.2 rise – 7.6 fall).
- 3.1.5 In general, cases were well managed. Aspects of care which measured up well against national recommendations include:
- 95% received prophylactic oxytocics in the third stage of labour.
  - 99% had intravenous access and 90% had clear evidence of use of two large bore cannulae.
  - Few women (6%) were infused more than 3.5 litres of clear fluid before receiving blood.
  - Basic monitoring was good with very frequent recording of pulse, blood pressure and urine output in over 95% of women.
  - 82% of women were cared for in either an intensive therapy unit or high dependency area within the maternity unit.
- 3.1.6 Aspects of care where there is scope for action planning and improvement include:  
A consultant obstetrician was present during the acute management of only 81% of women. (Although this represents a steady improvement since the 2005 figure of 68%.)  
A consultant anaesthetist was present, and a haematologist involved, in only 37% of cases.  
Central venous pressure (CVP) lines were inserted in 23% of cases (the lowest utilisation of CVP monitoring over the 5 years of the *Scottish Confidential Audit*). There were 17 women with estimated blood loss in excess of 4 litres where no CVP line was used.
- 3.1.7 The use of conservative surgical techniques to control obstetric haemorrhage has increased substantially over the time scale of the *Scottish Confidential Audit*. Use of balloon tamponade increased from six cases in 2003 to 42 in 2006 with a slight decline to 37 in 2007; use of haemostatic brace suturing (eg B-Lynch suture) increased from 10 cases in 2003 to 25 in 2007. The Scottish experience over the 5 years of the *Scottish Confidential Audit* comprises 143 balloon procedures and 101 brace sutures and suggests a success rate (ie hysterectomy avoided) of 81% and 79% respectively.

- 3.1.8 The rate of peripartum hysterectomy in women with major haemorrhage has fallen significantly over the 5 years of the *Scottish Confidential Audit*, from 14% in 2003 to 8% in both 2006 and 2007.
- 3.1.9 No long-standing general systems errors were identified. Errors specific to the individual case were also uncommon; *avoidable delay in diagnosis/treatment* was identified in 6% and *failure to follow protocol/plan* in 8%. Deficiencies in at least one aspect of case record documentation were noted in 22% of cases.
- 3.1.10 Risk management teams graded the extent of sub-optimal care:
- 65% of cases were judged as 'appropriate care, well managed'
  - 25% as 'sub-optimal care – incidental'
  - 7% as 'sub-optimal care – minor'
  - 3% as 'sub-optimal care – major'

## 3.2 **Eclampsia**

- 3.2.1 Unit risk management teams also assessed 11 of 12 notified cases of eclampsia. These 12 cases are the lowest reported number in the 5 years of the audit which may in itself suggest an improvement in prevention.
- 3.2.2 Few women presented with the classic constellation of symptoms and signs of fulminating pre-eclampsia prior to fitting.
- 3.2.3 A senior midwife, consultant obstetrician, and consultant anaesthetist were all documented as present during the acute management of only 2 of the 10 cases for which information was available.
- 3.2.4 Magnesium sulphate was used as the first-line anticonvulsant for all but one woman (who received diazepam).
- 3.2.5 After the fit, women were generally well managed with frequent monitoring of vital signs and fluid balance and universal use of magnesium sulphate for prophylaxis against further fits.
- 3.2.6 Risk management teams graded the extent of sub-optimal care for all 11 cases: only 3 were judged as 'appropriate care', and 2 as 'incidental sub-optimal'. Two were judged as minor sub-optimal and 3 as major sub-optimal. Problems mainly related to recognition of the prodromal signs and symptoms of eclampsia.
- 3.3 **Learning Points**  
Risk management teams recorded learning points and action plans for many cases of haemorrhage and eclampsia. Learning points were drawn from instances of both good practice and of sub-optimal care. Most learning points mirrored those recorded in previous years (eg failure to follow local protocols; poor documentation; under-estimation of blood loss), but there continues to be highlighting of significant good practice, eg early involvement of senior staff, good teamwork and forward planning and preparation.

## 4. Conclusions

Five years of the *Confidential Audit* has created a unique database with the opportunity to examine trends in the incidence of severe maternal morbidity and in the management of certain common or important conditions. There are local and national benefits in this process which are described in the detailed conclusions. Also described is potential future work to gain further insights from the information collected.

## Introduction

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 small 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 5 consecutive years.

For the first 4 years, the study was conducted by the Scottish Programme for Clinical Effectiveness in Reproductive Health (SPCERH), an independent grant-funded organisation, largely funded by NHS Quality Improvement Scotland (NHS QIS). From January 2008, the Reproductive Health Programme of NHS QIS took over the supervision of the data collection and audit analysis and is responsible for the production of this report covering severe maternal morbidity reported during 2007. Included in this report is some analysis of trends over the 5 years of the audit.

This full report is only available on the NHS QIS website. A paper summary is available and is circulated widely to health professionals working in maternity care throughout Scotland.

This report, together with verbal presentations at national and local meetings, is the mechanism whereby findings and recommendations are fed back to participating clinicians. It is hoped that it will promote reflective practice and action planning by health professionals within individual maternity units.

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

## Case ascertainment

### Inclusion criteria

There is debate surrounding the optimum definition of severe maternal morbidity. Different studies have used varying categories and definitions. Even where there is widespread agreement about a category, inclusion criteria may differ. This is particularly true of major obstetric haemorrhage which is one of the commonest causes of severe morbidity. Different studies have used different amounts of measured or estimated blood loss or of blood transfused as thresholds for inclusion. This limits the value of comparison with other studies of other populations. The aim in all cases 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<sup>1</sup> and adapted for the Scottish context on the basis of the pilot experience<sup>2</sup> and discussions with participants. These case definitions have now been retained for 5 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 2007**

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.

## Participating units

At the initiation of the audit in 2003, there were 22 consultant-led maternity units in Scotland. Over time this has diminished to 18. For the first 4 years of audit reports the units were identified only by number, each unit being aware of their own number. In line with NHS QIS guidance and after national consultation, each maternity unit is named in this report. This more readily allows units to compare their results with other similar units. Units are not identified in retrospect so anonymity is retained for previous years and 5-year trends in this report only use aggregated data.

## Identification and reporting of cases

Risk Management leads in each consultant-led maternity unit notify the NHS QIS Reproductive Health Programme of all women meeting one or more of the severe morbidity definitions on a monthly basis. A 'zero return' is submitted for months when no events were identified. Reminders are sent by letter, phone or email if monthly returns are not received. Risk Managers submit a minimal dataset on each woman in order to confirm that she meets the inclusion criteria.

## Data analysis

National and unit-level rates per 1000 births for each severe morbidity category are calculated using routinely published data on live births 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, live births, or total births.) Data on the number of maternal deaths during 2007 (to permit calculation of a 'near miss:death ratio'<sup>3</sup>) were obtained from the Confidential Enquiry into Maternal Health (Scotland).

## Case assessment

Cases of major obstetric haemorrhage and of eclampsia are subject to detailed case assessment. Standardised objective Case Assessment Proformas have been developed to allow local risk management teams to review the management of their own patients. The Assessment Proformas for major haemorrhage and eclampsia address both 'guideline adherence' (the extent to which management of an individual case adheres to recommendations in national guidelines<sup>4,5</sup>) and 'systems, or root cause' analysis (based upon a previously validated questionnaire used by Neale *et al.*<sup>6</sup>).

Copies of the Case Assessment Proformas are available on the NHS QIS website.

## Analysis

Data from the completed Case Assessment Proformas are entered into SPSS datafiles for subsequent analysis.

## Results

### Numbers and rates of severe morbidity events

In 2007, severe maternal morbidity data was collected from all 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 205 unit months (95%). One unit (Southern General Hospital) failed to complete a return for 10 months and one (Stirling Royal Infirmary) for one month.

During 2007, reports were received of 330 women who met one or more of the defined inclusion criteria. Using a denominator of 57781 live births (data from General Register Office [Scotland]) the Scottish rate of severe maternal morbidity was 5.7/1000 births (95% CI, 5.1-6.3). For comparison, the Scottish rate for 2003-2006 was 5.5/1000 (95% CI, 5.2-5.8). There is no apparent trend in the overall rate of severe maternal morbidity over the 5 years of study to date (2003-2007).

During 2007, there were four 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 83:1. (From 2003-2006, 1197 women were reported with severe morbidity and there were 22 relevant maternal deaths; giving a 'near miss:death ratio' of 54:1. Inevitably, small numbers mean that these estimates are imprecise.)

In comparing reported rates of women with one or more causes of severe morbidity from individual units in 2007, the Southern General Hospital should be discounted as monthly returns from that unit were not received for 10 months. Excluding the Southern General Hospital, rates of women with reported severe maternal morbidity from individual maternity unit in 2007 ranged from 2.2/1000 births (95% CI, 0.3-4.7) to 11.7/1000 births (95% CI, 8.6-14.8). The data for 2007 is summarised in Table 2. Because of difficulty in obtaining updated information on the number of deliveries from some units, the data on numbers of births is not complete from all units. This, and the fact that births at home and at midwifery maternity units are not included in Table 2, means that the total number of births is lower than the number obtained from the General Register Office. It should also be noted that the births in Table 2 include all births (live and still) rather than live births only as has been reported in previous years' reports. In practice this makes a negligible difference to the rates of maternal morbidity and is, in any case, probably a better denominator as severe morbidity may well occur in conjunction with a stillbirth (see below). It is intended that future reports will use total births as the denominator for calculating rates of maternal morbidity.

**Table 2: Rates of women with severe maternal morbidity by individual maternity unit (2007)**

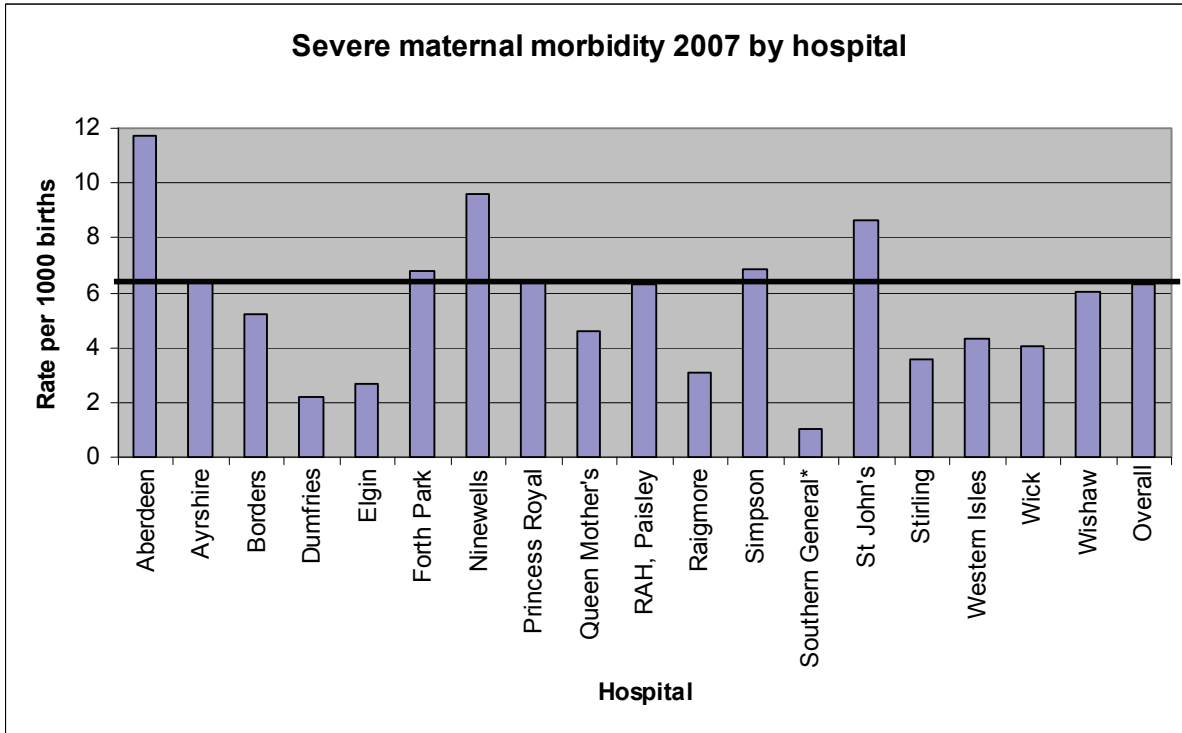
	<b>Women 2007</b>	<b>Births 2007</b>	<b>Rate /1000 births 2007</b>	<b>Lower 95% CI</b>	<b>Upper 95% CI</b>
Aberdeen	55	4697	11.7	8.6	14.8
Ayrshire	24	3770	6.4	3.9	8.9
Borders	6	1155	5.2	1.1	9.3
Dumfries	3	1351	2.2	-0.3	4.7
Elgin	3	1110	2.7	-0.4	5.8
Forth Park	25	3674	6.8	4.1	9.5
Ninewells	24	2505	9.6	5.8	13.4
Princess Royal	36	5645	6.4	4.3	8.5
Queen Mother's	16	3463	4.6	2.3	6.9
RAH, Paisley	18	2864	6.3	3.4	9.2
Raigmore	6	1963	3.1	0.6	5.6
Simpson	45	6558	6.9	4.9	8.9
Southern General*	2	1972			
St John's	24	2770	8.7	5.2	12.2
Stirling	12	3387	3.5	1.5	5.5
Western Isles	1	230	4.3	-4.2	12.8
Wick	1	249	4.0	-3.8	11.8
Wishaw	29	4814	6.0	3.8	8.2
Overall	330	52177**	6.3	5.6	7.0

\* Severe morbidity is likely to be underestimated in this hospital by a factor of 5, as monthly returns were not received for 10 months of the audit.

\*\*Total less than General Register Office figures – see text above.

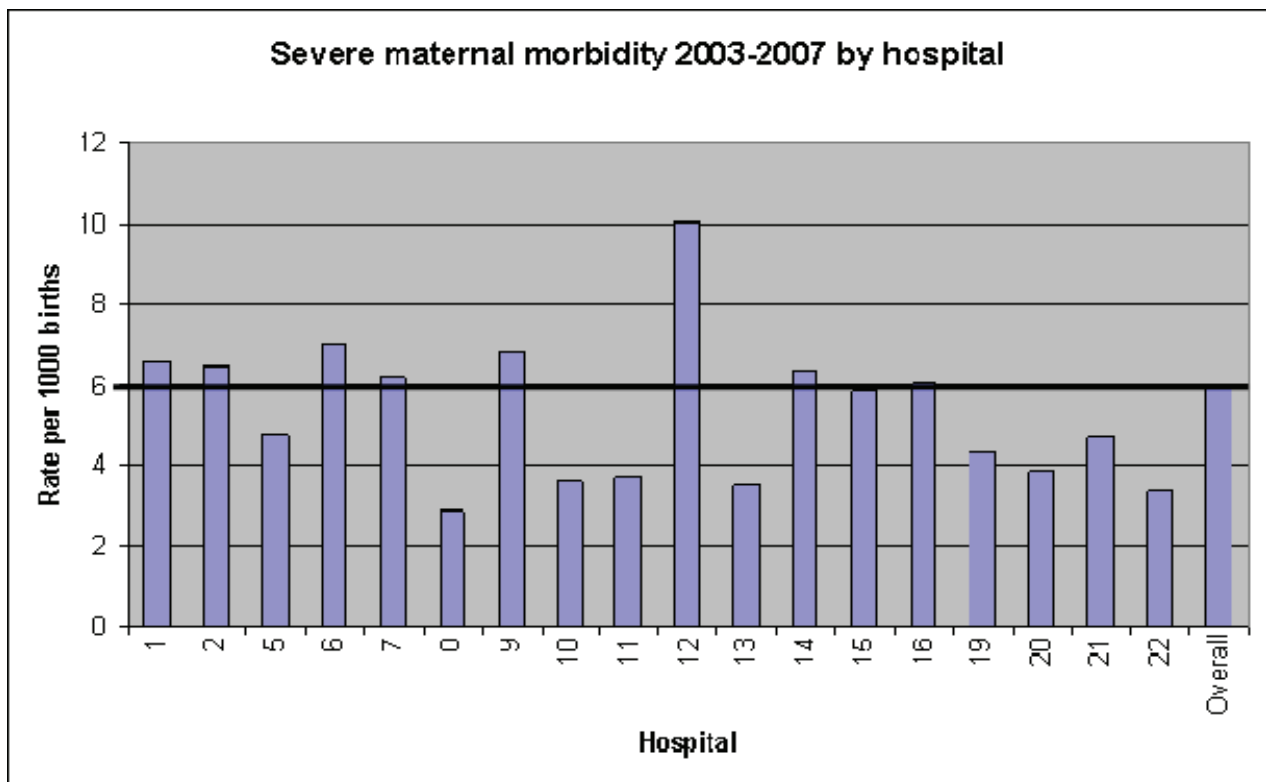
Figure 1A summarises the unit-level rates of women with severe maternal morbidity for 2007 and Figure 1B shows the aggregated rates for 5 years. These rates are women at each unit with reported morbidity divided by number of births at that unit for the same time period. The heavy horizontal line in each figure is the overall rate of morbidity at any of these hospitals. Anonymity has been retained for the aggregated data by unit. (Aggregating data for a number of years reduces the variation among units caused by small numbers and has the effect of ‘flattening out’ the differences among units.) Small numbers of cases in many units mean that confidence intervals are wide. Few units have rates which differ to any great extent from the overall rate. It must be borne in mind that differences in rates are more likely to reflect case-mix and population differences, and differences in the diligence and efficiency of case ascertainment, rather than differences in quality of care. The larger tertiary units are also more likely to manage particularly high risk cases.

**Figure 1A: Severe maternal morbidity by hospital (2007)**



\* Rate of severe morbidity in this hospital is likely to be underestimated by a factor of 5, as monthly returns were not received for 10 months of the audit. This will affect the overall rate and the 5 years' data to a lesser extent.

**Figure 1B: Severe maternal morbidity by hospital (2003-2007)**



(No data are shown for units 3,4,17 and 18 as these ceased to operate as consultant-led units during the timescale of the *Scottish Confidential Audit*.)

## Numbers and rates of morbidity categories

Table 3 summarises the Scottish rate of each individual category of severe morbidity for 2007 and aggregated for 2003-2007. Many women met the definition for more than one inclusion criterion (eg suffered severe haemorrhage **and** admitted to ITU). In 2007, the 330 women experienced a total of 402 events meeting the inclusion criteria. Of the 330 women, 265 fell into only one severe morbidity category; 60 fell into two categories; three into three categories; and two women met the inclusion criteria for four separate severe morbidity categories.

Major obstetric haemorrhage was the most numerous category, occurring in 256 women in 2007 (78% of all women reported). The rate of major obstetric haemorrhage increased from 3.3/1000 in 2003 to 4.9/1000 in 2006 but fell in 2007 to 4.0/1000.

**Table 3: Numbers and rates of individual categories of severe maternal morbidity, 2007 and aggregated for 2003-2007**

	Events 2007	Rate/1000 live births 2007	Lower 95% CI	Upper 95% CI	Events 2003-2007	Rate/1000 live births 2003-2007	Lower 95% CI	Upper 95% CI
Major obstetric haemorrhage	256	4.4	3.9	5.0	1097	4.0	3.8	4.2
Eclampsia	12	0.2	0.1	0.3	85	0.3	0.2	0.4
Renal or liver disfunction	20	0.3	0.2	0.5	99	0.4	0.3	0.4
Cardiac arrest	1	0.0	0.0	0.1	9	0.0	0.0	0.1
Pulmonary oedema	8	0.1	0.0	0.2	52	0.2	0.1	0.2
Acute respiratory dysfunction	6	0.1	0.0	0.2	45	0.2	0.1	0.2
Coma	2	0.0	0.0	0.1	2	0.0	0.0	0.0
Cerebrovascular event	2	0.0	0.0	0.1	17	0.1	0.0	0.1
Status epilepticus	0	0.0	0.0	0.0	3	0.0	0.0	0.0
Anaphylactic shock	2	0.0	0.0	0.1	7	0.0	0.0	0.0
Septicaemic shock	7	0.1	0.0	0.2	35	0.1	0.1	0.2
Anaesthetic problem	3	0.1	0.0	0.1	34	0.1	0.1	0.2
Massive pulmonary embolism	2	0.0	0.0	0.1	18	0.1	0.0	0.1
Intensive care or coronary care admission	81	1.4	1.1	1.7	342	1.2	1.1	1.4
<b>GRO live births Scotland</b>	<b>57781</b>				<b>274246</b>			

## Perinatal outcome among cases of severe maternal morbidity

Previous annual reports have not considered perinatal outcome but this has been available for the past 3 years. Table 4 shows the perinatal mortality rate among cases of severe maternal morbidity and also separated into those suffering major obstetric haemorrhage and those with other morbidities. In a number of cases the perinatal outcome was not reported and this does affect the accuracy of the numbers and rates in Table 4. Nonetheless, even if there were no perinatal deaths among those whose outcome was not reported, the perinatal mortality rate among these ill women is considerably higher than the overall Scottish rate of 7.7/1000 births in 2005, 7.4 in 2006 and 7.8 in 2007. There is a suggestion from the data available that the perinatal outcomes have improved with each year and this information will continue to be collected with an attempt to make it more complete.

**Table 4: Perinatal outcome among women with severe morbidity, 2005-2007**

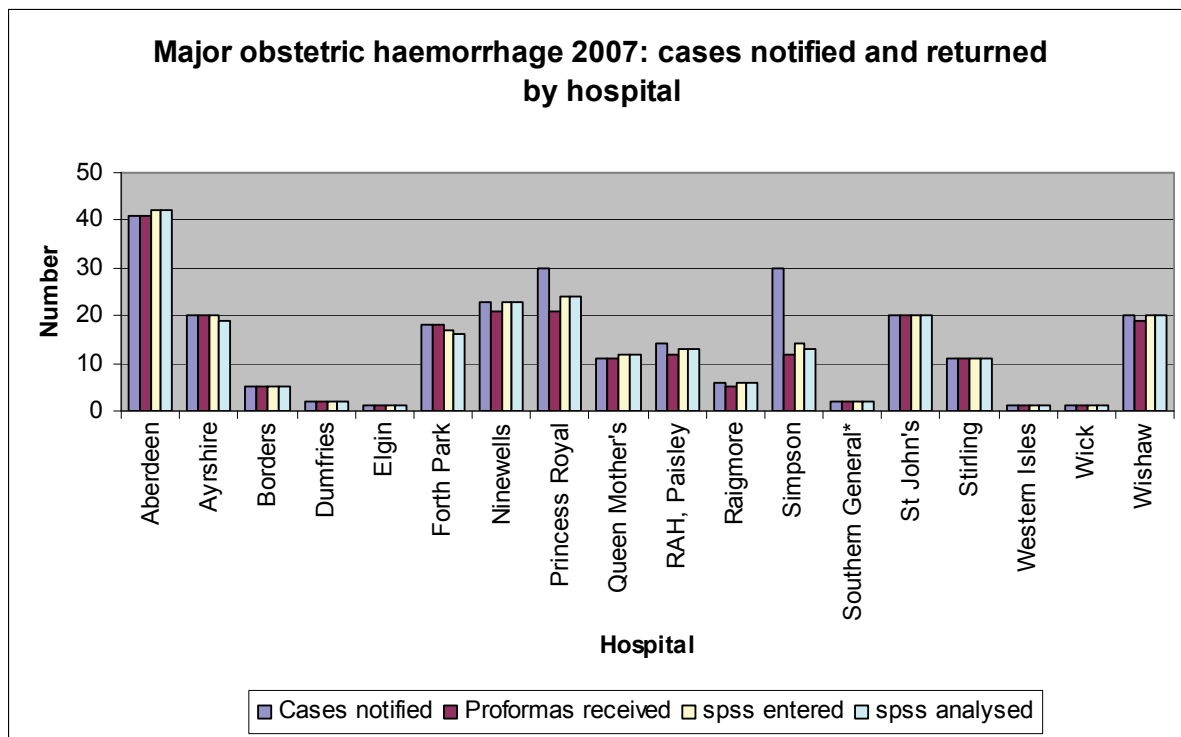
	Women with information available			Perinatal deaths (number)			Perinatal deaths (rate per 1000 with severe morbidity)		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
All morbidities	213	257	220	15	17	10	70.4	66.1	45.5
Major haemorrhage	153	204	178	12	10	9	78.4	49.0	50.6
Non-haemorrhage	60	53	42	3	7	1	50.0	132.1	23.8

## Assessment of cases of major obstetric haemorrhage

**Case definition:** Estimated blood loss  $\geq 2500\text{ml}$ , 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.)

In 2007, the morbidity audit identified 256 cases of major obstetric haemorrhage and the Confidential Enquiry into Maternal Health (Scotland) identified one maternal death due to haemorrhage. Completed case assessment proformas were received for 231 of the 256 notified cases of major obstetric haemorrhage (90%). In the process of data cleaning it was also noted that there were some discrepancies between proformas returned and entry onto the SPSS database. These discrepancies are illustrated in Figure 2. These difficulties arose largely because of the transitional nature of the data collection and processing in 2007-2008 when ownership and administration of the audit changed. The results presented below relate to the 231 women for whom sufficient information is available for analysis.

**Figure 2: Major obstetric haemorrhage: cases notified and returned by hospital (2007)**



### Characteristics of women suffering major obstetric haemorrhage

- Women's age: mean 30; median 30; range 15 to 43 years.
- The median number of previous births was 1 (range 0 to 5).
- 44% of women were primigravidae (102 of 231).
- 44 (34%) of the 129 parous women had had at least one previous Caesarean section delivery (information not recorded in one case). 13 had more than one previous Caesarean section.
- Estimated blood loss: mean 3.6; median 3.0; range 0.4 to 15 litres.
- Volume of blood transfused: mean 4.2; median 4.0; range 0 to 20 units.
- The difference in haemoglobin pre-bleed to post-bleed was recorded in 215 of the 231 women. The mean was a fall of 2.2 /dl; the median, a fall of 2.1 /dl; and the range, a rise of 5.2 /dl (from 5.8 to 11.0) to a fall of 7.6g/dl (from 14.4 to 6.8). The post-bleed recording was that taken on day 3.
- Ten women (4.3%) had a twin pregnancy.

Among the 224 women where the timing of the initial bleed which resulted in massive haemorrhage was recorded, 29 (12.9%) bled before labour, 66 (29.5%) intrapartum and 129 (57.6%) postpartum.

### Reported causes of major obstetric haemorrhage

Causes of haemorrhage among the 229 women for whom adequate information was available are summarised in Table 5. The total number of causes exceeds 229 as many women were documented as having more than one cause. Uterine atony was the most common cause, described in 103 women (45%). The distribution of causes is broadly similar to that found in previous years. Aggregated data for the causes of haemorrhage over 5 years is also shown in table 5.

**Table 5: Causes of major obstetric haemorrhage identified among 229 women in 2007 and among 1002 Women 2003-2007**

Cause	2007		2003-2007	
	Number	(%)	Number	(%)
Uterine atony	103	45	468	47
Retained placenta/ membranes	44	19	171	17
Vaginal laceration/ haematoma	31	14	135	13
Extension to uterine incision*	46	20		
Placenta praevia	33	14	120	12
Abruption	14	6	87	9
Cervical laceration	2	1	31	3
Uterine rupture	3	1	20	2
Broad ligament haematoma	5	2	29	3
Uterine inversion	2	1	5	0
Morbidly adherent placenta*	16	7		
Other*	15	7	235	23

\* The category 'other' incorporated 'extension to uterine incision' in 2003 but not later years; and 'morbidly adherent placenta' in 2003-2005 but not 2006 and 2007. Cause of bleeding was recorded as extension to uterine incision in 106 cases between 2004 and 2007 (12% of women in those years). Cause of bleeding was recorded as morbidly adherent placenta in 29 cases in 2006 and 2007 (6% of women in those years).

In 2007, 13 women had a cause of bleeding coded only as 'other', as follows:

- disseminated intravascular coagulopathy (2 cases)
- abdominal wall bleed (4 cases, two also on low molecular weight heparin)
- extra-uterine pregnancy (2 cases, one early ruptured ectopic pregnancy and one at 16 weeks)
- fibroid uterus (1 case)
- Asherman's syndrome with abnormal anatomy (1 case)
- intraperitoneal bleeding 5 days after Caesarean section (1 case)
- unknown (2 cases).

There were two further women with both a classified and an 'other' cause; one had uterine atony with coagulopathy and one had uterine evacuation for retained products of conception at miscarriage but had morbidly adherent placental tissue.

Twelve women had 'morbidly adherent placenta' (placenta accreta, percreta or increta) documented among their causes of bleeding. Of these 12 women, 7 (58%) had one or more previous caesarean deliveries (1 previous caesarean in 2 women; 2 previous caesareans in 3 women and 3 previous caesareans in 2 women). Among all 231 women with major haemorrhage, 44 (20%) had previous caesarean deliveries.

Table 6 shows this data for 2006 and 2007 among parous women with or without a previous Caesarean section. Prior to these years, information on morbidly adherent placenta was not collected. In both years there was an increased likelihood of the condition in the presence of a Caesarean section scar. Using this data in conjunction with the number of parous women each year who did not have a morbidly adherent placenta (with or without caesarean delivery) to assess statistical significance confirms the reported association between previous caesarean and morbidly adherent placenta.

**Table 6: Association of morbidly adherent placenta with previous Caesarean section 2006-2007**

	Parous women with morbidly adherent placenta (number)	Without previous caesareans (number)	Without previous caesareans (%)	With previous caesarean(s) (number)	With previous caesarean(s) (%)	X <sup>2</sup> significance
2006	9	4	44%	5	56%	0.05
2007	16	6	38%	10	62%	0.01

### Mode of delivery

The mode of delivery for each of the 226 appropriate women with available information is summarised in Table 7. (Mode of delivery was not applicable for those with haemorrhage associated with ectopic or abortion and was unrecorded for a few women.) Ten women (4%) had a twin delivery. In total, 142 women (63%) were delivered by Caesarean section; 113 emergency (50%) and 29 elective (13%). 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.

**Table 7: Mode of delivery for 226 women suffering major obstetric haemorrhage (2007)**

Mode	No. (%)
Emergency caesarean	113 (50%)
Spontaneous vaginal delivery	52 (23%)
Elective caesarean	29 (13%)
Forceps	27 (12%)
Ventouse	5 (2%)
Vaginal breech	0

Information on mode of delivery among women with major obstetric haemorrhage has been collected throughout the 5 years of the audit and is shown in Table 8. There has been no major change over the years with emergency Caesarean section always being the most frequent mode of delivery. Spontaneous vaginal delivery only occurred in 18-30% of women as compared to a rate of 60-70% among all women in Scotland in the same time period.

**Table 8: Mode of delivery for women with major obstetric haemorrhage 2003-2007**

	2007		2006		2005		2004		2003	
	no.	%	no.	%	no.	%	no.	%	no.	%
Emergency caesarean	113	50	105	42	81	40	59	38	73	48
Spontaneous vaginal	52	23	63	26	52	25	47	30	27	18
Elective caesarean	29	13	26	10	39	19	27	18	23	15
Forceps	27	12	41	17	22	11	19	8	17	11
Ventouse	5	2	6	2	6	3	6	4	6	4
Vaginal breech	0	0	6	2	5	2	2	1	5	3
<b>TOTAL WOMEN</b>	<b>226</b>		<b>247</b>		<b>205</b>		<b>160</b>		<b>151</b>	

Among the 113 women delivered by emergency Caesarean section, documentation was completed in 95 as to whether the Caesarean section was performed at full dilatation. This was the case in 20 of the 95 (22%). This information has been recorded since 2004 and is shown in Table 9. It has been fairly consistent for the past 3 years. 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 9: Caesarean sections performed at full dilation by year 2004-2007**

Year	Caesareans performed at full dilation	
	Number	%
2004	8	11
2005	20	22
2006	27	24
2007	22	21

## Management

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.<sup>4</sup>

### Antepartum haemorrhage

(Antepartum haemorrhage was not addressed within the SOGAP guideline; but two audit standards were developed from other sources<sup>6,7</sup>).

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

Twenty-nine women suffered bleeding in the antenatal period (some of these also suffered bleeding intrapartum or postpartum). In all but one case, local risk management teams considered that delivery had been 'expedited by the most appropriate route'.

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

There were 32 cases where placenta praevia was identified as a cause of bleeding and where the woman was delivered by elective or emergency Caesarean section. In 30 cases (94%), a consultant obstetrician was 'present or immediately available' at Caesarean section.

### **Third stage prophylaxis**

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

Of the 231 cases examined, 219 (95%) were documented as receiving third stage prophylaxis. Three women refused prophylaxis; and in three cases prophylaxis was evidently not offered though the reason was unclear. Of course, the 231 women studied include a small number with early pregnancy bleeding (ectopic, miscarriage or abortion) where the issue of third stage prophylaxis was irrelevant. Thus, we can conclude that third stage prophylaxis was used almost universally among women who experienced a major obstetric haemorrhage.

### **Recognition of risk factors**

Local risk management groups considered that 82 of the 227 cases with information available (36%) had antenatal risk factors for postpartum haemorrhage (eg abruption, placenta praevia, multiple pregnancy). Of these 82 cases, 70 (85%) were identified and documented antenatally as being at high risk. An explicit plan was documented for 59 of these women and was followed in all but two cases.

Local risk management groups considered that 157 of the 207 cases with information available (76%) developed risk factors for postpartum haemorrhage during labour (eg prolonged labour, pyrexia, caesarean delivery). Of these 157 cases, 133 (85%) were identified and documented during labour as being at high risk. Appropriate action was taken in all but six cases.

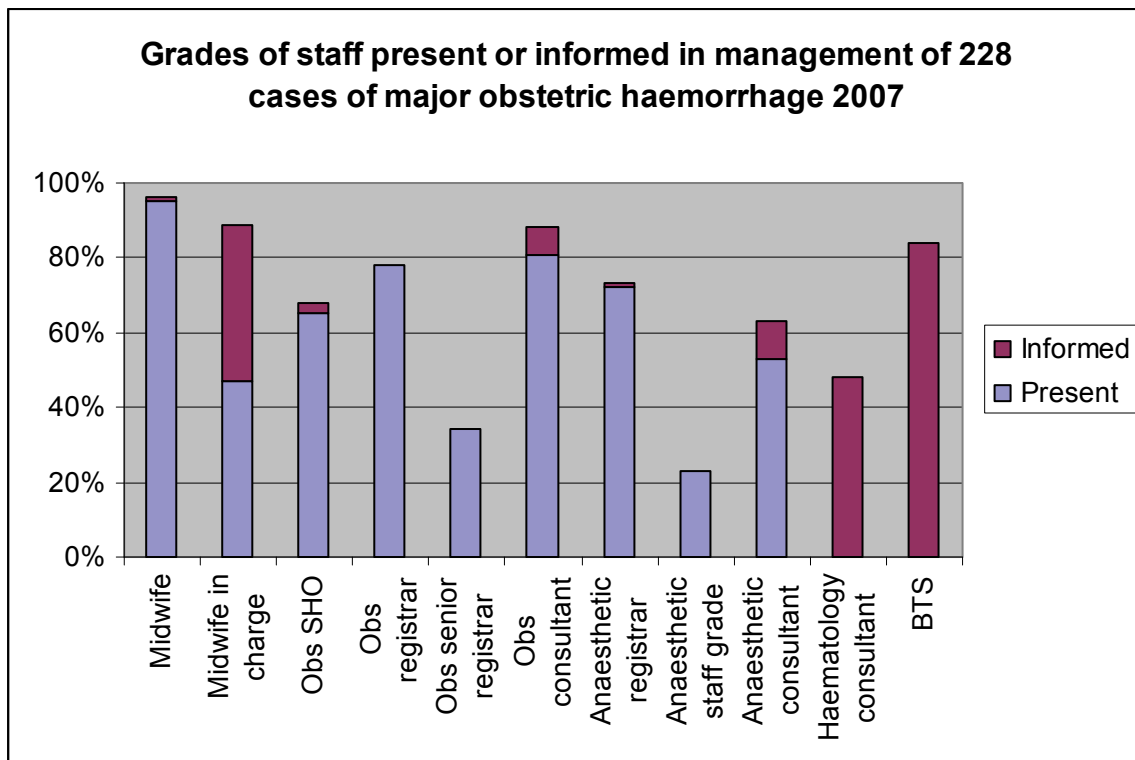
### **Communication**

**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.*

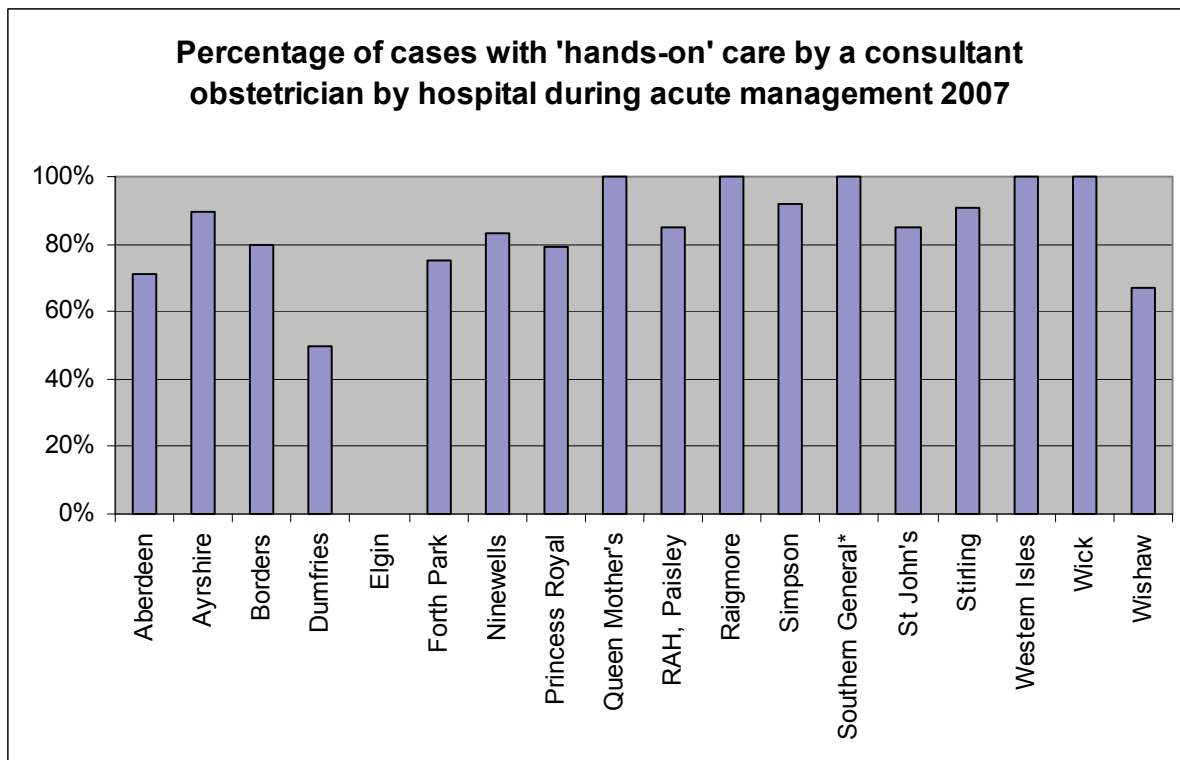
Figure 3 summarises the grades of staff that were documented as being involved in the management of the 228 cases of major obstetric haemorrhage for which the information was available. Names and grading of trainee medical staff have changed in recent years and future reports will reflect this but, as the 2007 questionnaire categorised staff as in previous reports, these names have been retained in this report but may have been subject to local interpretation. A consultant obstetrician had 'hands-on' involvement in the acute care of 185 (81%) of these women. There was variation among maternity units in the proportion of cases of major haemorrhage where a consultant obstetrician had 'hands-on' involvement. Unit-level findings are summarised in Figure 4.

Also shown is the rates for 'hands-on' consultant care in cases of major haemorrhage over the 5 years of this study with data aggregated for Scotland as a whole (Figure 5). It is encouraging that there is a trend for increasing consultant obstetrician involvement.

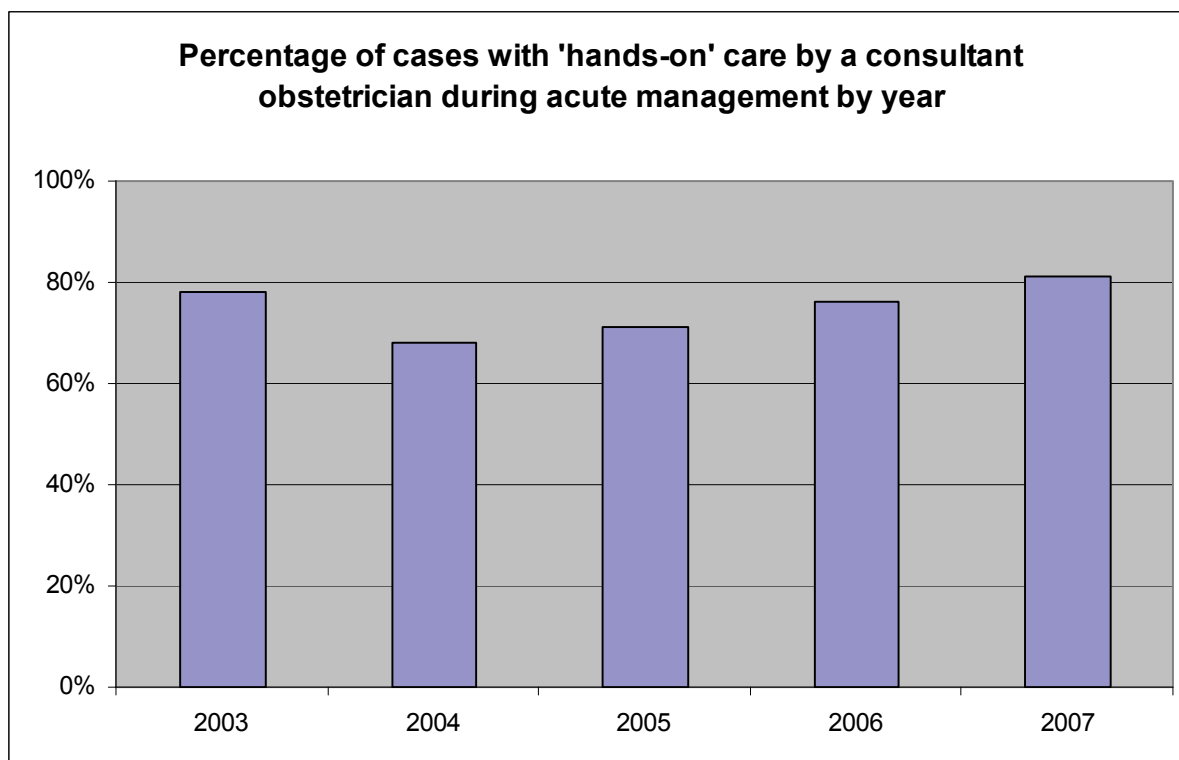
**Figure 3: Grades of staff present or informed in management of 228 cases of major obstetric haemorrhage (2007)**



**Figure 4: Percentage of cases with 'hands-on' care by a consultant obstetrician by hospital during acute management (2007)**



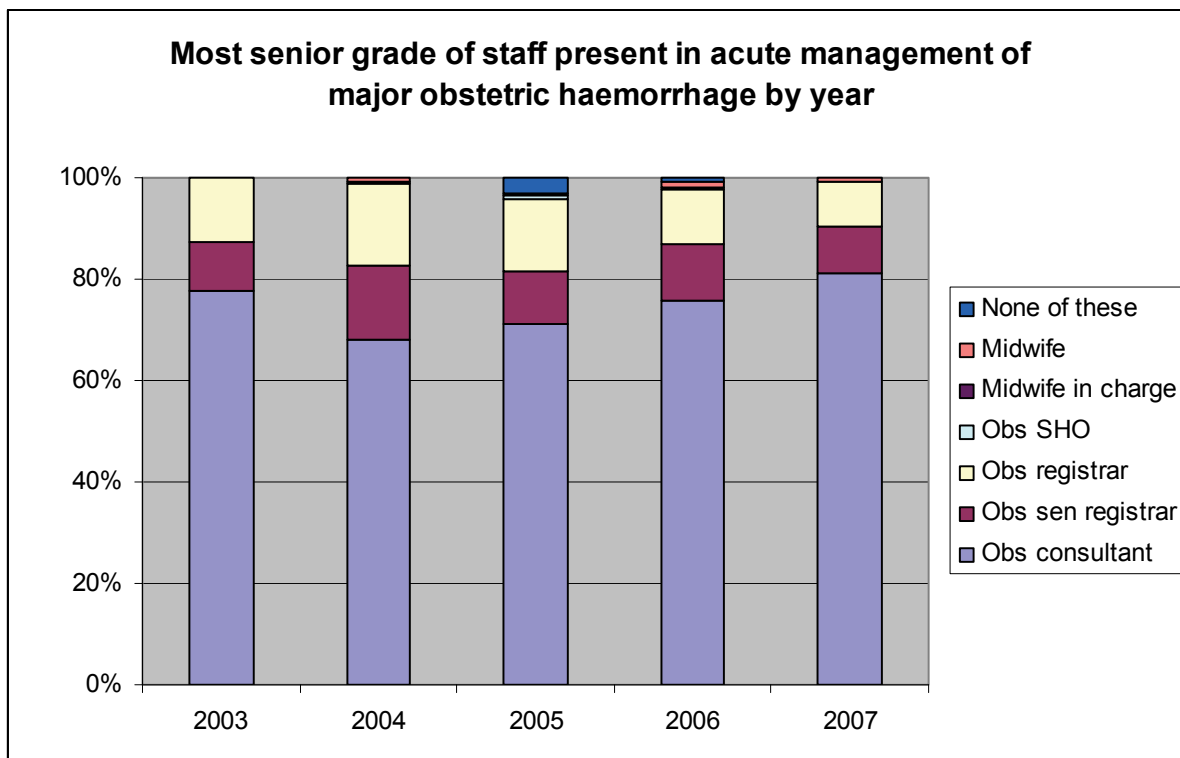
**Figure 5: Percentage of cases with 'hands-on' care by a consultant obstetrician during acute management by year**



According to the Case Assessment Proformas, there were 43 women who did not have 'hands-on' consultant care during their acute bleeding episode. Of these, 21 received care from an obstetric 'senior registrar' or staff grade and a further 20 received care from an obstetric registrar. The remaining two women received immediate care from a midwife only.

Figure 6 charts the level of involvement in the care of major obstetric haemorrhage in the 5 years of the audit. The only notable change has been the steady rise in direct consultant involvement which in 2007 was higher (at 81%) than in any previous year.

**Figure 6: Most senior grade of staff present in acute management of major obstetric haemorrhage by year**



### 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 uncross-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.*

Of the 228 women with available information, 227 (99%) were documented as having intravenous access achieved; and 205 (90%) as having the recommended two large bore cannulae; 204/216 (94%) were documented as having been given oxygen during resuscitation. All these findings are similar to those in previous years.

Of the 231 women, 149 (64%) 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 – 6.0 litres). Fifteen women received more than the recommended 3.5 litres prior to receiving blood; one of these received no blood transfusion.

Among the 231 women, 25 (11%) apparently received no blood during resuscitation although completion of the Case Assessment Proforma was not always clear on this point. The estimated blood loss among the non-transfused women ranged from 0.5 to 3.0 litres. The haemoglobin level among these non-transfused women recorded after the bleed ranged from 7.5 to 12.0 g/dl; and three non-transfused 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. Nevertheless, performance was better than in 2005 when 14 non-transfused women had a post-bleed haemoglobin of <8 g/dl.

The remaining 206 women received blood as part of resuscitation. 'O neg' blood was used in 31 women (13% of all women) and un-cross matched, group-specific blood in 17 women (7%). Among the 206 women who were clearly documented as having received blood, the mean volume transfused (cross matched + uncross matched) was 4.7 units (median, 4 units; range 1 to 20 units).

Thirty six women (15.6%) were transfused more than 6 units. This group may represent those with particularly life-threatening haemorrhage and further analysis of this group over 5 years is proposed.

Blood products were widely used: fresh frozen plasma (1-16 units) in 74 women (32%); cryoprecipitate (1-10 units) in 14 women (6%); and platelets (1-6 units) in 44 women (19%). The pattern of use of blood and blood products was broadly similar to that observed in previous years.

The Standards specifically state 'Use the best available equipment to achieve rapid warmed infusion of fluids'. A 'Level 1' or similar equipment to provide warm, rapid infusion was documented as having been used in only 112 (54%) of cases.

### **Monitoring and investigation**

**Standards:** *In the face of major PPH, take blood for cross-matching (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**

The recommended 6 units (or more) were cross matched in 114 women (49%). A further 113 women (49%) were cross matched, but for less than the recommended 6 units. Although our Standard specifies that cross-matching of six units is appropriate in the face of major obstetric haemorrhage, the proportion of cases in which this is done is declining slightly over the years. Given that the median volume of blood actually transfused in these women is 4 units, it may be that this amount does represent an appropriate standard for initial cross-matching (at least in centres with ready access to further supplies if required).

It was documented that blood was obtained prior to transfusion for full blood count in 204 women out of 224 with adequate information (91%) and for coagulation studies in 175/220 (80%). This performance is similar to that observed in previous years.

#### **Monitoring of vital signs**

Blood pressure was recorded at least every 15 minutes in 219 women (95%); pulse was recorded continuously in 217/224 documented (97%); urine output was recorded at least hourly in 223/230 documented (97%). All of these findings about basic monitoring are similar to those observed in previous years.

Central venous pressure (CVP) lines were inserted in 54 women (24%). This represents the lowest utilisation of CVP monitoring since the *Confidential Audit* began (2003, 29%; 2004, 32%; 2005, 33%; 2006, 24%). Women who had a CVP line inserted had significantly higher mean estimated blood loss compared to those with no CVP line (5.065 ml vs 3.069 ml; **p= <0.001**) and significantly higher mean volume of blood transfused (7.1 units vs 3.2 units; **p=<0.001**). Use of a CVP line was also significantly associated with presence of a consultant obstetrician (**p=0.012**) and with presence of a consultant anaesthetist (**p=0.001**). These findings indicate that CVP line monitoring was being used selectively, in the most severe cases of major haemorrhage. Nevertheless, women managed without a CVP line included 24 with an estimated blood loss of 4 litres or more.

#### **Intensive care**

In only 58 cases (25%), was there any documentation of consideration of transfer to an intensive care unit. Discussion with an intensive care consultant was documented in 50 cases (22%). Of these, 43 women (19%) were actually transferred; an additional 147 women (63% of the total) were

documented as being cared for in a dedicated high dependency area of the labour ward. Thus, 82% of these women with major obstetric haemorrhage were managed in a designated intensive care or high dependency care area. This is slightly fewer than in 2006, when 86% of women were thus managed.

### 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 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). (Note that at the time that current guidelines were formulated, the use of uterine tamponade by intra-uterine balloon was in its infancy and was not included in any guidelines).*

A total of 103 women (45% of the 231 women with major haemorrhage in 2007) had uterine atony identified as the only cause, or a contributory cause, of their bleeding. Of these, 51 (50%) were managed using non-surgical treatments only (excluding intramyometrial carboprost). The remaining women had one or more surgical interventions to control their bleeding.

### Non-surgical treatments

Table 10 summarises the physiological and pharmacological treatments used in all 103 women with uterine atony as a cause for their bleeding. All women received one or more of these treatments before resort to surgery. The most frequent medical intervention was syntocinon by infusion, used in 95%. Intramuscular carboprost was also widely used (62%). The choice of medical treatments was similar to that seen in previous years.

**Table 10: Medical treatments documented in 103 women with uterine atony (2007)**

Therapy	Received (No.)	Received (%)
Contraction rubbed up	72	70
Bimanual compression uterus	36	35
Syntocinon 5 iu intravenous	68	66
Ergometrine 0.5mg intravenous	59	57
Syntocinon infusion	97	94
Carboprost 0.25mg intramuscular	63	61

### Surgical treatments

Of the 231 women with major haemorrhage, 185 (80%) had an anaesthetic and at least an examination under anaesthesia. The established surgical procedures listed in Table 7 were used in 70 women (30%). (An additional 5 women received intramyometrial carboprost but no other 'surgical' procedure and an additional 38 had 'other' surgical procedures, such as suturing of vaginal tears). Subsequent discussion on surgical haemostasis refers to the 70 women treated with established surgical procedures.

Figure 5 summarises the use of surgical haemostatic procedures in each year from 2003 to 2007. It clearly shows the increasing use of intrauterine balloon techniques (from only 6 cases in 2003 to 42 cases in 2006 with a slight reduction to 37 in 2007) and of B-Lynch (and variants) haemostatic brace suturing (from 10 cases in 2003 to 25 in 2007).

Table 11 shows the number of women undergoing each procedure specifying which were the first procedures and how many successfully avoided hysterectomy. Most (57) of the 70 women had

only one such procedure. Nine women had two surgical haemostatic procedures, and 3 women had three and one had 4. As shown in Table 7, not only is balloon haemostasis now the most popular surgical haemostatic procedure overall, it is the most popular first-line procedure, being the first surgical procedure attempted in 30 of the 37 cases in which it was used.

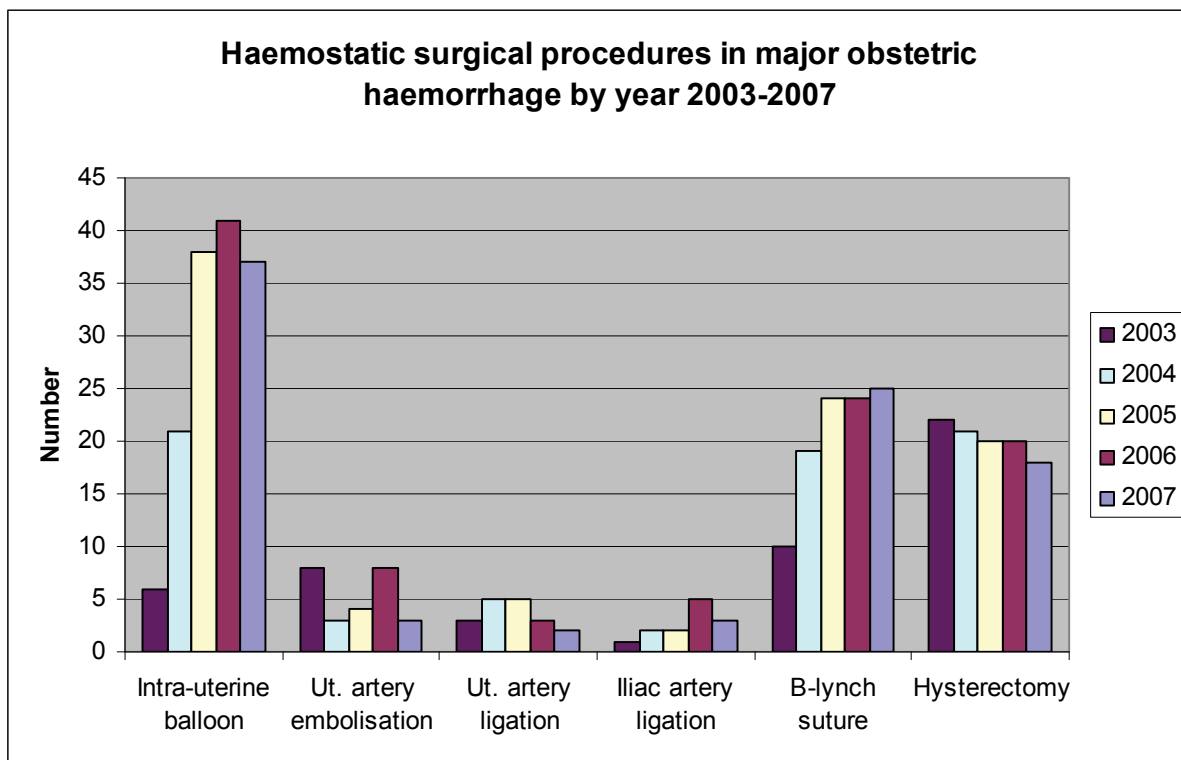
Table 11 and Figure 7 demonstrate the success of these conservative surgical techniques in avoiding hysterectomy during the 5 years covered by the Confidential Audit to date. Overall, balloon techniques were used in 143 women and hysterectomy may therefore have been avoided in 116 (81%) of these. B-Lynch suture techniques were used in 102 women and hysterectomy may have been avoided in 81 (79%). It is unlikely that all of these cases would have required a hysterectomy had conservative surgical techniques not have been available. The threshold for performing conservative surgery is almost certainly lower than that for hysterectomy.

In 2007, 18 women who met the definition of major haemorrhage underwent obstetric hysterectomy. Figure 8 demonstrates the decline in hysterectomy rates among women suffering major obstetric haemorrhage during the 5 years of the audit, from 14% in 2003 to 8% in 2006 and 2007. This decline is statistically significant (Chi-squared test for trend,  $p < 0.001$ ). Increasing use of effective conservative surgical techniques may be reducing the need for hysterectomy among women suffering major haemorrhage.

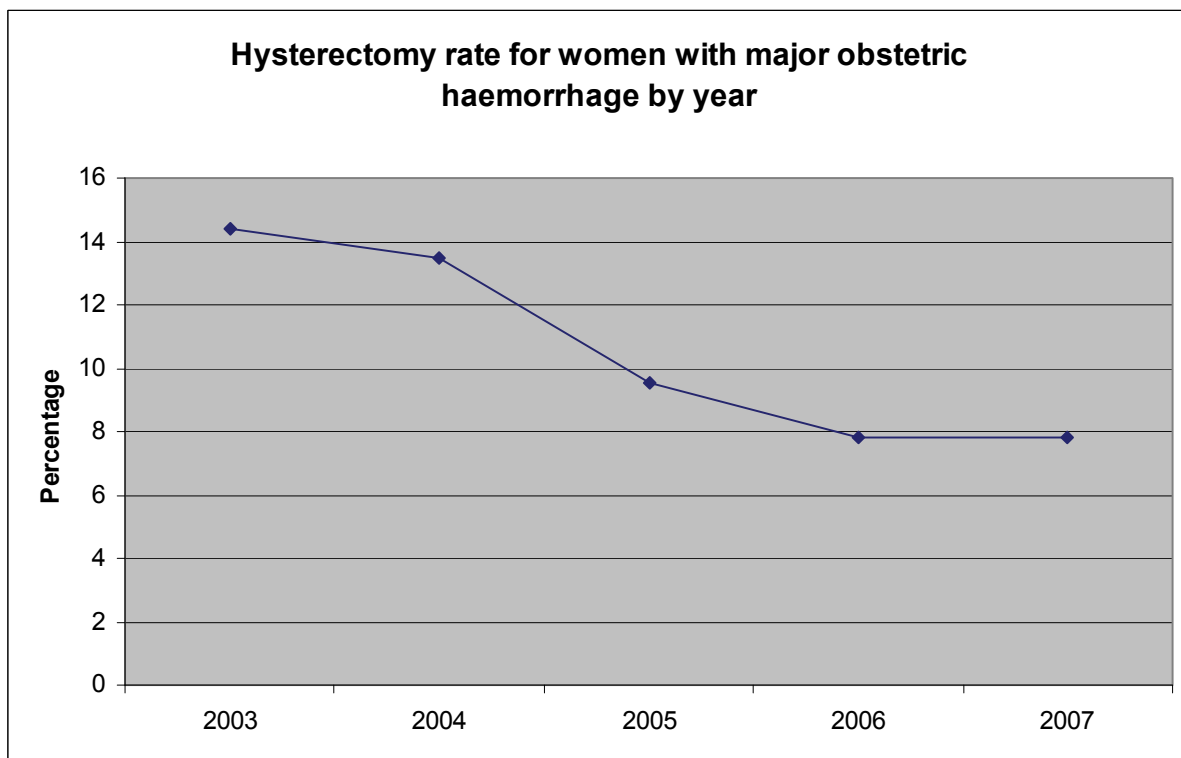
**Table 11: Use of haemostatic surgical procedures among 231 women with major obstetric haemorrhage (2007)**

Procedure	2007 (n=231)					
	Total women undergoing procedure		Successful (hysterectomy avoided)		Women undergoing procedure as first surgical procedure	
	No.	%	No.	%	No.	% of all undergoing procedure
Intrauterine balloon	37	16	30	81	30	81
Uterine artery embolisation	3	1	3	100	2	67
Uterine artery ligation	2	1	2	100	2	100
Iliac artery ligation	3	1	2	67	1	33
B-Lynch suture	25	11	20	80	14	56
Hysterectomy	18	8	-	-	10	56

**Figure 7: Numbers of haemostatic surgical procedures undertaken in cases of major obstetric haemorrhage by year (2003-2007)**



**Figure 8: Hysterectomy rate for women with major obstetric haemorrhage by year**



### **Did systems failures contribute to these instances of major obstetric haemorrhage?**

The *general adverse event analysis* part of the Case Assessment Proforma was completed (at least in part) for all 231 cases of major obstetric haemorrhage in 2007.

#### **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 12. It is reassuring that (as in previous years), no longstanding 'systems problems' were identified.

In each year, the most frequent types of problem identified have been 'Failure to follow protocol/plan' and 'Avoidable delay in diagnosis/treatment'. The proportion of cases with no identifiable problems or errors in management has increased (from 63% in 2004 to 79% in both 2006 and 2007).

**Table 12: Specific problems or errors identified**

<b>Problem / Error Specific to individual case</b>	<b>2007 n=231</b>	
	<b>No.</b>	<b>%</b>
1. Avoidable delay in diagnosis / treatment	13	6
2. Failure to follow protocol / plan	18	8
3. Appropriate conclusion / differential not made	6	3
4. Appropriate test not performed	0	-
5. Inadequate training / supervision of staff	7	3
6. Inadequate history / examination	4	2
7. Staff practising beyond their level of competence	4	2
8. Inadequate staffing (levels / skill mix)	4	2
9. Poor communication	11	5
10. Inadequate service from other departments eg BTS / labs	4	2
11. Test results not obtained / ignored	11	5
12. Lack of team work	4	2
13. Defective equipment	2	1
14. Inappropriate test performed	0	-
<b>No problems recorded</b>	<b>183</b>	<b>79</b>

#### **Medical records**

The Scottish Woman-held Maternity Record was introduced in 2007. The morbidity audit has the potential to monitor changes in documentation occurring as a result of this. During 2007, deficiencies were noted in case record documentation in 51 (22%) of the cases of major haemorrhage. The detailed breakdown of these deficiencies is shown in Table 13 where previous years are also shown for comparison. Because of slightly different descriptors in the 2003

questionnaire, comparisons with that year are not entirely valid. There has been no particular change in the proportion or type of deficiencies in the 5 years of the audit to date. It will be interesting to note if any changes occur as the use of the national hand-held maternity record has become universal in 2008.

**Table 13: Deficiencies in medical records, cases of major haemorrhage, 2003-2007**

	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
Incomplete medical records	16 (10%)	13 (9%)	8 (4%)	23 (9%)	13 (6%)
Progress notes inadequate	13 (8%)	17 (12%)	13 (6%)	24 (9%)	15 (7%)
Midwifery notes incomplete	13 (8%)	10 (7%)	8 (4%)	4 (2%)	4 (2%)
Procedure notes inadequate	13 (8%)	7 (5%)	10 (5%)	16 (6%)	5 (2%)
Reports missing	7 (5%)	5 (3%)	7 (4%)	10 (4%)	12 (5%)
Other documentation problems	21 (14%)	9 (6%)	5 (2%)	4 (2%)	20 (9%)

### **Contributing factors**

Local risk management teams were asked to indicate which of six types of ‘contributory factors’ were operating in each case. The types with the number reported in each category in 2007 were; organisational and management (2); work environment (4); team (20); individual staff (20); task (12); and patient (98). In 126 cases (55%) one or more of these contributory factors were present, most (105 of the 126) with only one factor.

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 as usually defined (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 the haemorrhage in an individual case was predicted and minimised. It is reassuring that risk management teams considered overall management to be ‘definitely’ or ‘probably’ appropriate in 88% of cases. In only 10 cases (4%) was it considered definitely sub-optimal.

**Table 14: Summary of responses regarding 'preventability' for 231 cases of major obstetric haemorrhage** (Answers incomplete in some Proformas; totals do not equal 231)

<b>Question and response</b>	<b>No.</b>	<b>%</b>
<b>1. What level of consensus on diagnosis or therapy was achieved by the reviewers of this case?</b>		
1 = A great deal	219	95%
2 = Some	6	3%
3 = Very little	1	0%
<b>2. How complicated was this case?</b>		
1 = Uncomplicated	86	37%
2 = Moderately complicated	121	52%
3 = Very complicated	20	9%
<b>3. What was the health of the patient prior to the major obstetric haemorrhage occurring?</b>		
1 = Fit and well	189	82%
2 = Other medical conditions but well	32	14%
3 = Unwell	5	2%
4 = Seriously unwell	1	0%
<b>4. Prior to the major haemorrhage, what was the degree of emergency in the care of the patient?</b>		
1 = Not urgent	85	37%
2 = Moderate	111	48%
3 = Critical and very urgent	32	14%
<b>5. What was the risk of a major obstetric haemorrhage occurring in this patient, given the obstetric intervention(s) involved?</b>		
1 = Low	49	21%
2 = Moderate	89	39%
3 = High	64	28%
4 = Not applicable	28	12%
<b>6. Was the overall management of the patient appropriate?</b>		
1 = Definitely well managed	136	59%
2 = Probably appropriate	67	29%
3 = Possibly sub-optimal	16	7%
4 = Definitely sub-optimal	10	4%

## 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 in the early stages of the audit, we modified our terminology and asked 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 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 15. 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 previous years.

**Table 15: Overall assessments of sub-optimal care in 231 cases of major obstetric haemorrhage (2007)**

Category		No.	%
1	<b>Appropriate care</b> Well managed.	150	65
2	<b>Incidental sub-optimal care</b> Lessons can be learnt although it did not affect the final outcome.	58	25
3	<b>Minor sub-optimal care</b> Different management may have resulted in a different outcome.	16	7
4	<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

## Learning points for future practice

Having completed the structured Case Assessment Proforma, risk management teams are requested to summarise 'lessons to be learned from the case' and a 'local action plan'. Learning points were recorded on 111 of the 231 completed proformas (48%). There were 57 learning points highlighted.

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

- timely involvement of senior staff
- good teamwork
- forward planning and preparation.

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
- under-estimation of blood loss.

These themes are similar to those reported in previous years.

## Action planning

Local action plans were documented in 57 cases (25%). Recurring themes were similar to those reported in previous years and included:

- provide feedback to wider staff through a newsletter or meeting
- review content of local protocol
- review the use and implementation of existing protocol
- discussion/debriefing with individual staff.

## Assessment of cases of eclampsia

Detailed assessment of cases of major haemorrhage has been undertaken throughout the 5 years of SCASMM to date. Since 2004, case assessment of a similar style has also been undertaken for women with eclampsia. Completed Case Assessment Proformas were returned for 11 of the 12 notified cases of eclampsia (92%) in 2006. The 11 cases were managed in four different maternity units. Five were reported from one unit, but, on their own admission, it is uncertain that 3 of them were indeed eclampsia. The findings described below relate to the 11 women for whom completed proformas were received.

### Characteristics of women suffering eclampsia

The mean age was 28.6 years (range, 19-38 years). Of the 11 women, five (45%) were primigravidae and the remaining six women had between one and three prior deliveries. These characteristics are similar to those of women with eclampsia assessed in previous years.

### Features of eclamptic episodes

The median gestation at which eclampsia occurred was 38 weeks (range 35-41 weeks). Eclampsia first occurred antenatally in five women, intrapartum in three women, and postpartum in three women. This is a smaller proportion presenting postpartum than in previous years when almost half of eclamptic episodes first occurred postpartum, but numbers are small.

A value for the last recorded blood pressure prior to the fit was available for 10 women. As in previous years, blood pressure was normal or only moderately elevated in most women (median 148/90; systolic range, 118-184; diastolic range, 75-110 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 nine women. Of these, only four had proteinuria of '+++ or above.

As in previous years, no women presented with the classic constellation of symptoms and signs of fulminating pre-eclampsia prior to the fit. Two women were apparently asymptomatic. The only frequently occurring symptom was headache, which was documented in nine of the 11 women; and the only frequently occurring clinical sign was oedema, in seven women all but one of whom also had a headache.

Six of the 11 women (55%) were known to have pre-eclampsia (of any severity) prior to the fit. Five women were on labetalol prior to the fit. There were no cases where the local risk management team felt, in retrospect, that an antihypertensive should have been used. None of the women had been commenced on magnesium sulphate as prophylaxis prior to the fit.

### Were women managed according to national guidelines?

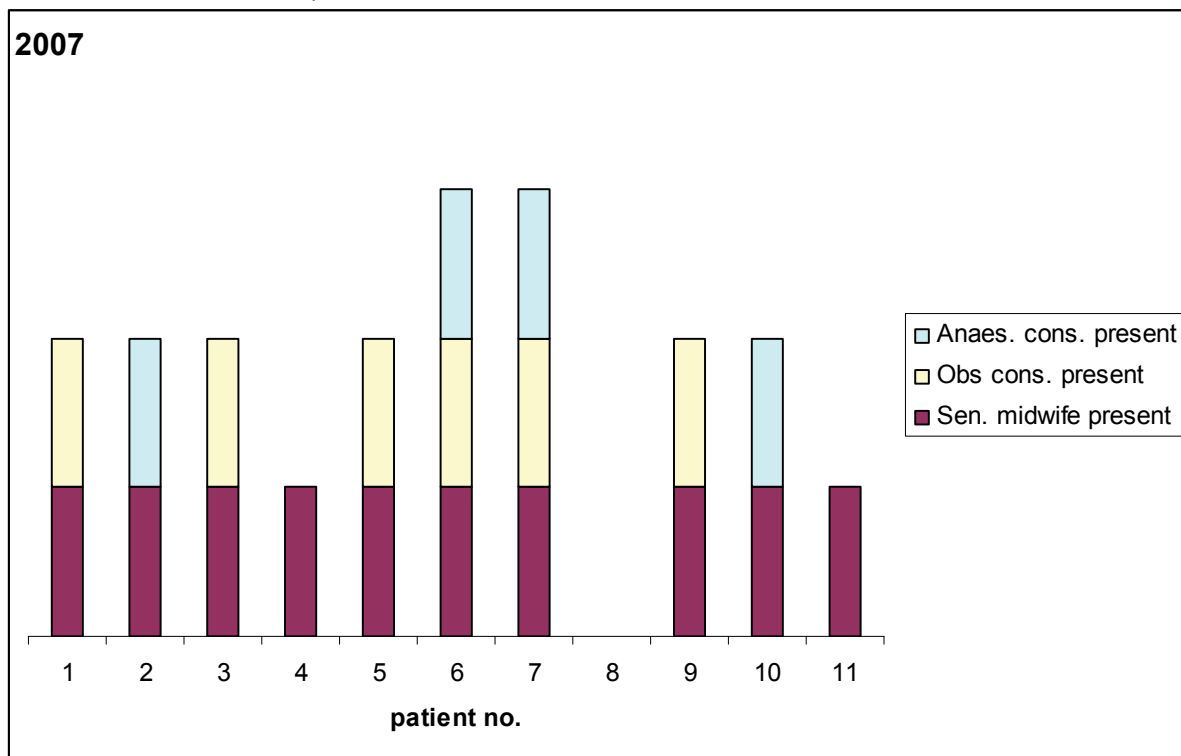
The Case Assessment Proforma allows assessment of the extent to which case management followed recommendations in the Royal College of Obstetricians and Gynaecologists Guideline *The management of severe pre-eclampsia / eclampsia* (2006).

### Communication

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

The disciplines of senior staff involved in hands-on acute-phase care of each of the 11 cases are summarised in Figure 9. In 2007, a senior midwife, consultant obstetrician, and consultant anaesthetist were all present during the initial management of only two of the 10 women for whom information was available. Data on senior staff involvement for the cases reported in 2004-2006 was similar. Direct involvement of senior staff has not increased over time.

**Figure 9: Summary of senior staff present during acute management of women with eclampsia, 2004-2007** (Blank entries represent patients managed entirely by junior staff or missing data.)



### Resuscitation

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

It was documented that the airway was secured in ten of the 11 cases; oxygen was also given in 10, venous access obtained in all 11, and left lateral tilt applied in 8 cases.

### 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 all 11 women. In 3 cases, there was spontaneous resolution of the fit and an anticonvulsant was not used. Ten of 11 women who received an anticonvulsant received magnesium sulphate. One woman apparently received diazepam as her initial anticonvulsant. Magnesium sulphate was given intravenously in all cases where it was used.

Magnesium sulphate was used for prevention of further fits in all 11 women. All received magnesium sulphate infusion for 24 hours or longer after the fit.

### **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.*

None of the 11 women suffered recurrent fits after institution of magnesium sulphate prophylaxis.

### **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.*

It was explicitly documented that respiratory rate was monitored at least hourly in 10 cases and that deep tendon reflexes were monitored at least hourly in 7 cases. Bedside availability of calcium gluconate was explicitly documented in only 4 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.*

In only 4 cases was treatment required for acute severe hypertension, sometimes at levels slightly below the levels recommended above. All were given labetalol. Hydralazine was given in one further 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.*

All 11 women were documented as having a Foley catheter in situ. Urine output was measured at least hourly in all cases.

### **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.*

All 11 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. All 11 women had continuous monitoring of oxygen saturation but proteinuria was only checked in 8 cases.

### **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.*

Ten women were documented as remaining under high dependency care for at least 48 hours after the eclamptic fit. Data were missing for the remaining case.

### **Overall assessment of sub-optimal care**

The Systems Analysis part of the Case Proforma was completed for all 11 cases of eclampsia. Only 3 were judged as 'appropriate care'; and a further 3 as 'incidental sub-optimal'. Two cases were judged as 'minor sub-optimal' and 3 as 'major sub-optimal'. The number assessed as having major sub-optimal care was more than in previous years (2 in 2004, 1 in 2005, 1 in 2006). Failures in early recognition and failures to summon appropriate staff and support of an appropriate seniority were the reasons that units assessed their care at this level.

### **Learning points and action plans**

Specific learning points and action plans were documented in 5 reported cases. In general, post-seizure management was reported as good; the most frequent failings were in the failure to recognize the significance of prodromal symptoms and signs, particularly rising blood pressure. Appropriate early actions might have prevented some cases of eclampsia. If the decline in reported cases is maintained in future years, this may suggest that early recognition and prevention is improving, although the communication failures recorded in case assessments in the preceding paragraph should be noted.

## Conclusions

This report concludes 5 years of the Scottish Confidential Audit of Severe Maternal Morbidity. It continues to be well supported and well received by the clinical community. It is clear that the system of voluntary reporting by individual maternity units works well (despite variable reporting from different units which is discussed further below) and that the categories of morbidity are robust. No evidence has emerged that significant causes of severe morbidity in pregnancy have been overlooked and the inclusion of all women who are admitted to intensive care ensures this. Indeed virtually all of the women admitted to intensive care have one of the other specified conditions included in the audit.

The Scottish system of ongoing reporting from all maternity units and thus covering all maternities in Scotland appears to be unique. Other attempts to measure 'near misses' in pregnancy worldwide have not been continuous over several years, have not covered whole populations but rather specific maternity units and/or have depended on nationally reported data<sup>7,8</sup> which may not be as accurate as information reported directly from maternity units, as was found in the pilot study for this Confidential Audit<sup>2</sup>. Examination of other studies of severe maternal morbidity also shows the difficulty in comparing studies because of different criteria and different definitions of commonly recognised causes. The most obvious example of this is major obstetric haemorrhage. All studies include this as a condition causing severe morbidity and it is universally the most common reported but definitions vary considerably. The Scottish audit uses a relatively high blood loss threshold of 2.5 litres, giving a rate over 5 years of 4.0/1000 live births; other studies define losses over 1.5 litres or only include cases with a defined minimum amount of blood transfusion. Thus, a recent audit from the three large maternity units in Dublin found a rate of only 1.5/1000<sup>7</sup> although the rate in a population based Dutch study was very similar to Scotland's at 4.5/1000<sup>8</sup>. International comparisons can, however, only become valid if universal criteria and definitions are adopted.

The continuing nature of the audit allows recognition of changes in time in the relative frequency of the causes of severe morbidity and in the management and self-assessment of important and/or common causes. This has the potential to provide valuable information for developing clinical guidelines. Clinical practice may overtake guidelines as is seen in the increasing use of conservative surgical techniques to control major haemorrhage during the lifespan of the confidential audit. Intrauterine balloon tamponade is not mentioned in the most recently published guidelines for the management of postpartum haemorrhage<sup>4</sup> but this audit shows that it is now an established and effective technique, almost certainly contributing to the decline in peripartum hysterectomies in Scotland in the past 5 years. The audit also provides a mechanism to monitor the apparent increase in morbidly apparent placentae as a cause for major haemorrhage and its association with previous Caesarean section delivery.

Apart from changes in the surgical management of major obstetric haemorrhage in the 5 years of the audit, perhaps the most striking feature of the 2007 report is the decline in reported cases of eclampsia. Only 12 were reported in 2007 compared to 18-20 in previous years and some of these 12 cases were not certainly eclampsia. The 5-year rate of 0.3/1000 live births is less than the 0.7/1000 reported from the Netherlands in a broadly similar study but the Dutch cases also included HELLP syndrome<sup>8</sup>. Unit level self-assessment reported a higher incidence of 'sub-optimal care' of eclampsia than in previous years, mainly in failing to recognise prodromal signs and symptoms, and it may be that the increasing rarity of eclampsia is contributing to this. In contrast to cases of major haemorrhage, the 5 years of the audit has not seen an increase in the involvement of senior staff in the management of eclampsia.

Major sub-optimal care has been rarely reported to the Confidential Audit in the management of major obstetric haemorrhage, running consistently at 3% of cases, with 65% being managed optimally. In contrast, there was substandard care in 58% (10/17) of women dying of obstetric haemorrhage in the most recent report into maternal deaths in the United Kingdom<sup>9</sup>. This suggests good care to women suffering major obstetric haemorrhage in Scotland is indeed saving lives. The benefits to maternity care in Scotland of continuing with the Confidential Audit of Severe Maternal morbidity have become clear from the production of annual reports and from formal and

informal feedback from maternity healthcare professionals and units. Collecting data nationally allows meaningful analysis of relatively rare events, giving insights into changing incidences and practices and providing a measure of quality of care especially with the self-assessment component of the audit. The information gained may be used for better identification of risk factors for severe morbidity and for the development of clinical guidelines. The expanding database can be a rich source for other studies, of which some possibilities are described below. At a local level, the involvement of all maternity units in the audit creates a feeling of national cohesion and shared learning and encourages multidisciplinary local risk management in a national context.

A continuing conundrum in the audit has been the variable rates of morbidity reported from different units. Some units have consistently reported higher or lower rates than others. Some of this is undoubtedly because of different case mixes and it would be expected that tertiary level units would attract higher risk cases while some small units may transfer out such cases. There is also variation in case ascertainment between units and the problems experienced by one unit in this 2007 report demonstrate this. Nonetheless, there may be other reasons for some of the variation and the NHS QIS Reproductive Health Programme hopes to investigate ways of exploring this further. A large database of index pregnancies who suffered severe morbidity has now been established (1527 women in 5 years). There is little information on the subsequent pregnancies of women who experience severe morbidity and there may be an opportunity to explore this issue although the anonymous and confidential nature of the audit means that there are practical difficulties with this. Information on the database might also be used to investigate risk factors among women suffering particularly severe and life threatening haemorrhage to aid in their early recognition and management.

This fifth report on the Scottish Confidential Audit of Severe Maternal Morbidity has been produced largely along the lines of earlier reports, although this full report is only available as a web-based version. A paper version of the summary and conclusions is also available. As the database expands and year-on-year trends become as important to analyse as individual years, the format of future reports will change somewhat, with more results presented in graphic or tabular form and less text other than to provide analysis and conclusions.

Feedback or comments on any aspects of this report or on future developments are welcome and should be addressed to the NHS QIS Reproductive Health Programme Co-ordinator, Leslie Marr at Elliott House, 8-10 Hillside Crescent, Edinburgh EH7 5EA; telephone 0131 623 4710; email [leslie.marr@nhs.net](mailto:leslie.marr@nhs.net).

## Appendix 1: 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:

<b>Dr Roch Cantwell</b>	Psychiatric Assessor
<b>Dr Russell Lees</b>	Northern Obstetric Assessor
<b>Ms Annette Lobo</b>	Midwifery Assessor
<b>Dr John McClure</b>	Chair and Anaesthetic Assessor
<b>Dr Hilary McPherson</b>	Eastern Obstetric Assessor
<b>Dr Robert Nairn</b>	Pathology Assessor
<b>Prof Jane Norman</b>	Western Obstetric Assessor
<b>Mrs Joyce Reekie</b>	Midwifery Assessor

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

<b>Lynn Crawford</b>	Clinical Risk Manager	Aberdeen Maternity Hospital
<b>Rosanna Ralston</b>	Clinical Risk Manager	Ayrshire Central Hospital
<b>Karen Smail</b>	Midwife	Borders General Hospital
<b>Margaret Hart</b>	Staff Midwife	Caithness General Hospital
<b>Katrina Hepburn</b>	Sister, Labour suite	Cresswell Maternity Wing
<b>Yvonne Walters</b>	Staff Midwife	Dr Gray's Hospital
<b>Annette Lobo</b>	Clinical Midwifery Co-ordinator	Forth Park Hospital
<b>Chrissie Hastings/ Fiona Dye</b>	Senior Midwife	Ninewells Hospital
<b>Helene Marshall</b>	Clinical Risk Manager	Princess Royal Maternity
<b>Anne Ovens</b>	Sister Midwife	Queen Mother's Hospital
<b>Kath Freeman</b>	Midwife	Raigmore Hospital
<b>Anne McGhee</b>	Midwife	Royal Alexandra Hospital
<b>Sinéad McNally</b>	Risk Co-ordinator	Simpson Centre for Reproductive Health
<b>Diana Clark</b>	Senior Midwife	Southern General Hospital
<b>Gail Bell</b>	Practice Development Midwife	Stirling Royal Infirmary
<b>Karen McIntosh</b>	Midwife	St John's Hospital at Howden
<b>Kathryn Kearney</b>	Midwife	Western Isles Hospital
<b>Geraldine Morgan</b>	Midwife	Wishaw General Hospital

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

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

The SPCERH Grantholders, Professor Andrew Calder (Edinburgh University) and Dr Jim Chalmers (NHS Information Services Division) provided support, advice and encouragement throughout. Lorraine Adamson (NHS QIS) computerised the information from hospitals. Joanne Abbotts (NHS QIS) analysed the data. Chris Lennox, Reproductive Health Clinical Advisor, NHS Quality Improvement Scotland wrote the report.

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