

Major morbidities associated with childbirth in Victoria



Topic 1: Obstetric haemorrhage and associated hysterectomy

February 2004

**The Consultative Council on Obstetric and Paediatric
Mortality and Morbidity**

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1. Summary

Introduction

This study aimed to describe the incidence, risk factors and trends for postpartum haemorrhage and associated hysterectomy in the Victorian population.

Relevant literature on postpartum haemorrhage was reviewed. Data were extracted from the Victorian Perinatal Data Collection Unit (VPDCU) databases, Department of Human Services. This is a mandatory reporting system of all births in Victoria at or beyond 20 weeks gestation. Data on postpartum haemorrhage were analysed from the most recently available database (2002), and data on hysterectomy were analysed over four years (1999-2002). Hysterectomy cases were validated using the Victorian Admitted Episodes Database (VAED).

Postpartum haemorrhage

In 2002, a total of 61,959 women gave birth in Victoria. Of those, 5669 were reported as having a postpartum haemorrhage (9.2%). This rate was comparable to that reported in New Zealand and slightly higher than rates for South Australia, Northern Territory, British Columbia and England. It should be noted that these differences may be related to differing reporting and coding practices.

A number of factors were associated with postpartum haemorrhage, including: Maternal country of birth - Asia or Oceania; nulliparity; labour after a previous caesarean section; baby of low or high birthweight; multiple birth; giving birth at a larger or Level 3 hospital; public patient status; shorter gestation; prolonged labour; brow presentation; delivery by forceps, vacuum extraction or emergency caesarean; episiotomy; perineal tear; retained placenta; placenta praevia; abruptio placentae; puerperal infection; laceration of the cervix or vaginal wall; polyhydramnios; and hypertension.

Hysterectomy associated with postpartum haemorrhage

During the years 1999-2002, a total of 264,224 women gave birth in Victoria. There were 23,354 cases of postpartum haemorrhage (9.5%) and 132 hysterectomy cases (0.05%). This rate was comparable to those reported from population studies in New Zealand, British Columbia and Nova Scotia, and lower than those found in several Northern American hospital-based studies.

Risk factors for hysterectomy included: increasing parity; uterine rupture during labour; placenta praevia; abruptio placentae; retained placenta or previous caesarean delivery.

Trends 1992-2002

Examination of data from 1992-1998 showed that the rates of postpartum haemorrhage averaged 6.2% and were fairly constant during this period. There appeared to be a marked increase in postpartum haemorrhage rates from 1998-1999 but this is likely to be due to a change in the reporting of postpartum haemorrhage at this time. Postpartum haemorrhage rates from 1999 to 2002 averaged 9.5% and were constant. Over the period 1999-2002, hysterectomy rates increased and this trend was significant. Caesarean rates also increased during this time and may have contributed to increasing hysterectomy rates.

Mortality due to obstetric haemorrhage

From 1992-2002, nine women died as a direct result of obstetric haemorrhage, seven from postpartum haemorrhage.

Conclusions

Many of the risk factors associated with postpartum haemorrhage and hysterectomy in this Victorian population have been reported previously. Multivariate analysis is required to fully explore the relationships between these factors, and control for any confounding. The increasing rates of hysterectomy may be related to changes in the obstetric population, as well as changes in obstetric practice, and require close monitoring. It is anticipated that this study may contribute to evidence-based policy development and practice.

2. Introduction

As maternal mortality decreases in the developed world, there has been increasing interest in maternal morbidity as an indicator of the quality of obstetric care. Maternal mortality represents 'the tip of the iceberg' with many women suffering serious morbidity for every maternal death that occurs¹. In an English multi-centre study, examining severe pre-eclampsia, haemorrhage, sepsis and uterine rupture, severe obstetric morbidity occurred in 12 out of every 1000 maternities. Maternal death directly attributable to these conditions occurred in 0.10 per 1000 maternities².

In Victoria, the Consultative Council on Obstetric and Paediatric Mortality and Morbidity (CCOPMM) routinely collects information on maternal and perinatal mortality and has published Annual Reports since 1962. Recent funding from the Programs Branch, Metropolitan Health and Aged Care Services Division, Department of Human Services (DHS), has enabled the employment of a Research Officer for 12 months to investigate and report on some of the major causes of maternal morbidity in Victoria.

2.1 Aim for this project

The aim of the overall project is to provide information on selected major morbidities associated with childbirth in Victoria. The resulting reports will be distributed to DHS and maternity service providers. It is anticipated that the information will assist DHS and other relevant agencies to develop appropriate policy interventions and service improvements.

Four topics related to maternal morbidity will be examined. These topics have been selected because they are relatively frequent and severe, and are issues about which clinicians have recently voiced concern. Postpartum haemorrhage is the most common type of obstetric haemorrhage and is the subject of this report, which describes postpartum haemorrhage and associated hysterectomy in the population of women giving birth in Victoria.

2.2 Background information on postpartum haemorrhage

2.2.1 Definition

Defining postpartum haemorrhage is problematic, as it is based on subjective clinical assessment and underestimation of blood loss following delivery is common³.

The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) describes postpartum haemorrhage as a blood loss of 500ml or more for a vaginal delivery and 750ml or more for a post-caesarean haemorrhage⁴.

Primary or early postpartum haemorrhage is defined as occurring within the first 24 hours of delivery, while haemorrhage that occurs more than 24 hours, but less than 6 weeks, after delivery is referred to secondary or late postpartum haemorrhage⁵. Primary postpartum haemorrhage is much more common⁶ and is the focus of this report.

It has been argued that the ICD-10-AM definition of postpartum haemorrhage is now of diminishing clinical relevance as most healthy pregnant women can cope with such loss without any problems and efforts should be concentrated on *major* postpartum haemorrhage⁷. This has been defined as a blood loss in excess of 1000ml and reported to occur after 1.3% of deliveries in Britain⁷. In general, the degree of haemodynamic compromise or shock reflects the severity of blood loss. However, some women may become compromised with a relatively small blood loss, including those who have severe hypertension, or those who are anaemic, dehydrated or of short stature⁸.

The American College of Obstetrics and Gynecology advocates that postpartum haemorrhage be defined as either a 10% change in haematocrit between admission and the postpartum period, or a need for erythrocyte transfusion⁹. This is a retrospective approach and may not be useful to a clinician faced with excessive bleeding. In addition, the need for transfusion is complicated by differing practice patterns and attitudes to transfusion by both patients and physicians⁸.

2.2.2 Prevalence

Postpartum haemorrhage has been reported to occur in approximately 5-15% of maternities⁸. Using the American College of Obstetrics and Gynecology definition of postpartum haemorrhage, vaginal deliveries were reported as having a 3.9%¹⁰ incidence of haemorrhage and caesarean deliveries a 6.4% incidence in one American study¹¹. In the United Kingdom, the risk of severe, possibly life-threatening haemorrhage occurs in 6.7 per 1000 maternities².

2.2.3 Mortality

Along with thromboembolism, pregnancy-induced hypertension, amniotic fluid embolism and sepsis, haemorrhage remains a leading cause of maternal death^{12 13}. In Australia during 1994-96, the rate of postpartum haemorrhage as a principal or contributory cause of death was 6.5 per million maternities¹³. In the United Kingdom the rate of direct deaths from obstetric haemorrhage was 3.3 per million maternities¹². While death resulting from postpartum haemorrhage is rare in developed countries, severe complications including hypovolaemic shock, disseminated intravascular coagulopathy (DIC), renal failure, hepatic failure and adult respiratory distress syndrome are more common⁷.

In developing countries, the risk of maternal death from postpartum haemorrhage is much higher and has been estimated to be approximately one in 1000 deliveries¹⁴. Poor nutritional status, lack of easy access to treatment, and inadequate intensive care and blood bank facilities contribute to high morbidity and mortality rates in these countries¹⁵.

2.2.4 Causes and risk factors

The most common causes of postpartum haemorrhage are uterine atony (which occurs in approximately 50% of cases), retained placenta or placental fragments, and lower genital tract lacerations. Less common causes include uterine inversion, uterine rupture, placenta accreta and coagulation disorders⁶.

Many factors affect a woman's risk of postpartum haemorrhage. The documented risk factors for postpartum haemorrhage include:

- Nulliparity¹⁵
- Maternal obesity^{7 15}
- Macrosomia^{7 6 15 8}
- Antepartum haemorrhage^{7 15}
- Previous postpartum haemorrhage^{7 15}
- Abruptio placentae⁷
- Placenta praevia^{7 8}
- Multiple pregnancy^{7 6 15 8}
- Polyhydramnios^{6 8}
- Operative delivery, especially emergency caesarean^{7 15}
- Augmented labour¹⁵
- Prolonged labour¹⁵
- Rapid labour^{6 8}
- Intra-amniotic infections^{6 8}
- Fibroid uterus⁸
- Uterine abnormalities⁸

- Previous uterine surgery⁸.

Grand multiparity is commonly cited as a risk factor for postpartum haemorrhage^{8 16 6} however some authors have disputed this^{7 10}. Advancing maternal age has also been cited as a risk factor⁷.

Despite identification of risk factors, postpartum haemorrhage still occurs unpredictably in low-risk women¹⁵. It has been estimated that up to 26% of women who go on to develop obstetric haemorrhage significant enough to require hysterectomy will not be identified by screening using broad inclusion risk factors¹⁷.

2.2.5 Management of the third stage of labour

Active management of the third stage of labour involves the routine administration of a uterotonic, as a precautionary measure aimed at reducing the risk of postpartum haemorrhage. Active management is associated with reduced blood loss, reduced incidence of postpartum anaemia and less need for blood transfusion during puerperium¹⁸. It is standard practice in Victorian maternity hospitals.

2.2.6 Medical management of postpartum haemorrhage

Maternal deaths from postpartum haemorrhage have been associated with sub-standard care^{12 19}. In a report from France²⁰, sub-standard care was identified in 38% of cases of severe obstetric haemorrhage. Lack of a 24 hour on-site anaesthetist and smaller sized maternity units (<500 births per year) were the main factors associated with sub-standard care in that study.

The management of major postpartum haemorrhage requires a multidisciplinary approach with rapid and good communication between clinical specialities¹⁵. An outline of the management of postpartum haemorrhage can be found in a number of publications^{15 8 5}. Recommendations for its management were made by The Confidential Enquiries into Maternal Deaths in the United Kingdom¹² and are listed in Appendix 1.

Hysterectomy

Surgical procedures, such as uterine packing, uterine and internal iliac artery ligation, B-Lynch suture, and hysterectomy are used to manage severe postpartum haemorrhage²¹. Hysterectomy is considered to be the procedure of last resort and therefore is usually reserved for situations where more conservative measures have failed.

Common indications for peripartum hysterectomy include postpartum haemorrhage associated with abnormal placentation (placenta praevia or accreta), uterine atony, uterine trauma or uterine rupture²². Apart from the obvious effect on future fertility, there is considerable morbidity associated with peripartum hysterectomy. In one study, 50% of patients suffered postoperative infections, 21% had respiratory complications, 9% had urologic injury, and 3% required re-operation secondary to persistent surgical bleeding²³.

3. Methodology

3.1 Project team

The CCOPMM project team comprised Kerry Haynes, Research Officer; Christine Stone, Consultant Epidemiologist and James King, Chair, CCOPMM.

The project was supported by the Programs Branch, Metropolitan Health and Aged Care Services Division, DHS. The staff in this branch who were involved in the project were Therese Cotter, Gil Dwyer and Trevor Sutherland.

3.2 Clinical reference group

A clinical reference group was established to advise and inform the project. The group is a sub-committee of the Maternity Services Advisory Committee and includes representation from consumers, midwives and obstetricians, as follows:

- Pauline Ahearne, Maternity Coalition
- Mary-Anne Biro, Victoria University of Technology
- Julie Collette, Mercy Hospital for Women
- Euan Wallace, Monash Medical Centre.

3.3 Data sources

The data used for this report were extracted from the Victorian Perinatal Data Collection Unit (VPDCU) databases, DHS. This is a mandatory reporting system of all births in Victoria at or beyond 20 weeks gestation.

Data on postpartum haemorrhage (with or without hysterectomy) were analysed from the 2002 database. This was the most recently available data and had been validated for postpartum haemorrhage (see below). When examining the hysterectomy cases, data from the previous four years - 1999, 2000, 2001 and 2002 were analysed, as the number of hysterectomy cases was relatively small. This time period was chosen because the definition of postpartum haemorrhage on the VPDCU form was changed immediately prior to this, from a blood loss of greater than 600ml to the current definition of greater than 500ml. The trend data in Section 6 of this report, clearly demonstrates the impact of this change on the reported frequency of postpartum haemorrhage.

Data on maternal mortality was provided by the CCOPMM.

3.3.1 Validity of VPDCU data

The validity of certain VPDCU database variables has been examined (VPDCU, unpublished data). The reporting of primary postpartum haemorrhage was found to be very reliable, with 96.9% of forms consistent with hospital records. A total of 644 forms from 2002 were validated against hospital medical records and/or computer system entries, and of these, only 20 forms reported incorrect data.

Other data items used in compiling this report were examined in an earlier validation study (see Appendix 2). The results showed that hospital medical records and VPDCU forms were in agreement more than 90% of the time for a number of data items. However reporting of maternal medical conditions; obstetric complications; procedures and operations; and complications of labour, birth or the postnatal period was less reliable.

3.3.2 Validation of hysterectomy cases

Validation of hysterectomy cases was undertaken by comparing data from the VPDCU database with data from the Victorian Admitted Episodes Database (VAED). Both databases were searched for hysterectomy cases associated with postpartum haemorrhage for the period 1999-2000.

A total of 111 hysterectomy cases associated with postpartum haemorrhage were found on the VPDCU; 99 cases were found on both the VPDCU and VAED databases.

In 25 cases, hysterectomy was recorded on the VAED but not the VPDCU database. Individual forms submitted to the VPDCU relating to these cases were reviewed. Ten cases were found where hysterectomy had been reported to the VPDCU but were not coded or entered on the database. In 13 cases hysterectomy had not been reported to the VPDCU. A maternal death was associated with haemorrhage in one of these cases and hysterectomy was confirmed by consulting records from the CCOPMM. Another case had a malignancy and was excluded from the study. A decision was made to include the other 11 cases from the VAED where hysterectomy had not been reported to the VPDCU. Two hysterectomy records from the VAED could not be matched with hysterectomy cases from the VPDCU and were excluded from the study, as they were considered to be miscoded.

VPDCU forms relating to the 12 cases where hysterectomy was recorded on the VPDCU database but not the VAED were also reviewed. Hysterectomy had been reported on all of these forms. One woman with a double uterus had a spontaneous rupture of a rudimentary horn, and was excluded from the study. Six cases were transferred to another hospital after the birth and this may explain why these hysterectomy cases were not associated with the birth admission on the VAED. These 11 cases were included in the study.

This validation exercise resulted in 132 hysterectomy cases associated with postpartum haemorrhage being included in the study: 110 of the original 111 cases from the VPDCU database plus an additional 22 cases found on the VAED.

3.4 Data analysis

Data were analysed using SPSS (version 10). Results are expressed as the percentage of the cohort with the outcome of interest for the whole population, and for selected subgroups. Odds ratios (OR) with 95% confidence intervals (CI) are reported for postpartum haemorrhage. Because of the small number of cases, rate ratios (RR) are given for hysterectomy data. Confidence intervals not including unity indicate significance at the $p=0.05$ level.

In most sections of the report the population of women who gave birth was used as the denominator for calculations. When examining particular issues, subsets of the population were used as denominators, for example, only women who had given birth by vaginal delivery or multiparous women, because only those women were at risk from the particular factor of interest.

The total population used in the calculations appears at the top of each set of analyses in the tables. There were missing values in some variables, therefore totals may not be the same for each variable.

The data provided in this report should be interpreted with caution, as multiple analyses have been performed. With multiple analyses, using the confidence limits of 95% means that one in 20 findings may be identified as statistically significant by chance alone.

The risk factors examined in this report were selected based on review of the literature and expert clinical advice. The selection was limited by the data that were available on the VPDCU databases.

3.5 Definitions

A postpartum haemorrhage is recorded on the VPDCU database if the clinician reports this diagnosis, or if blood loss is reported as greater than 500ml. ICD-10-AM codes are assigned and include the following categories:

- Third-stage haemorrhage associated with trapped or retained placenta (ICD-10-AM code O72.0)
- Other immediate postpartum haemorrhage (ICD-10-AM code O72.1)
- Haemorrhage associated with postpartum coagulation defects (ICD-10-AM code O72.3)

A decision was made to include the small number of postpartum haemorrhage cases reported as delayed and secondary (ICD-10-AM code O72.2) as it was noted that most of these cases were also reported in the 'other immediate postpartum haemorrhage' category. As secondary postpartum haemorrhages can occur up to six weeks after delivery, it is likely that the majority of these cases are not reported to the VPDCU.

Hysterectomy includes subtotal, total and obstetrical hysterectomies. For continuity, VPDCU uses codes originating in an earlier edition of the ICD (codes 5682, 5683, 5744). Only hysterectomy cases associated with postpartum haemorrhage were included. Hysterectomy cases that were excluded were either elective hysterectomies (not associated with haemorrhage) or those due to malignancies or structural abnormalities.

Definitions and ICD-10-AM codes of other conditions used in this report are provided in Appendix 3.

4. Postpartum haemorrhage

In 2002, a total of 61,959 women gave birth in Victoria. Of those, 5669 women were reported to the VPDCU as having postpartum haemorrhages (9.2%).

Of the postpartum haemorrhage cases, 8% were reported as haemorrhages associated with retained or trapped placentas and 0.3% as haemorrhages associated with postpartum coagulation defects. A small number (0.5%) were classified as delayed and secondary postpartum haemorrhages.

The VPDCU notifiers' guide defines postpartum haemorrhage as a blood loss of greater than 500ml from the birth canal during the third stage and for 24 hours afterwards. The diagnosis reported to the VPDCU is based on subjective clinical assessment and the severity of the haemorrhage is not recorded.

In this study, a number of factors were examined as indicators of severity. Of the women with postpartum haemorrhage, approximately 2.2% were admitted to an Intensive Care (ICU) or High Dependency Unit^a and 2.6% had transfusions. It is likely these proportions are under-estimations as admissions to Intensive Care or High Dependency Units or transfusions are not reliably reported to the VPDCU.

Hospital postnatal length of stay is also an indicator of severity of postpartum haemorrhage. Figure 4.1 shows a similar distribution for women who had postpartum haemorrhages and for those who did not, although greater proportions of women who had postpartum haemorrhages stayed in hospital for 3 days or more, compared to the other women. When public and private patients are examined separately, 3.9% of public patients who had had a postpartum haemorrhage stayed for seven days or longer, compared to 2.2% of other women in public hospitals, whereas 8.8% of private patients who had a postpartum haemorrhage stayed for seven days or longer, compared to 4.5% of other women in private hospitals.

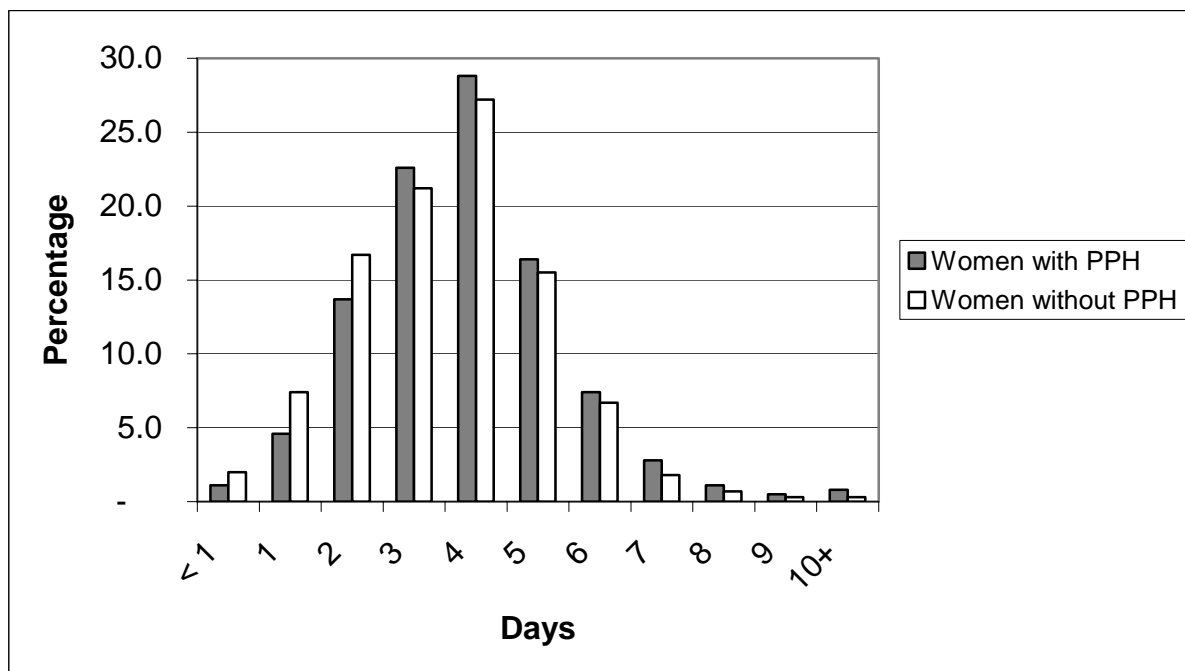
The relatively small differences between women having postpartum haemorrhages and other women, in terms of hospital stay, may indicate that many women who are reported to have a postpartum haemorrhage are not so adversely affected by it that they are required to have prolonged hospital stays. In other words, the term 'postpartum haemorrhage' as defined in this study, includes a range of severities.

Another, more concrete, indicator of severe postpartum haemorrhage is hysterectomy. Of the women with postpartum haemorrhage in 2002, 48 women (0.85%) had hysterectomies. This is 0.08% of the population giving birth or 7.7 women in 10,000.

In 2002, two women died following postpartum haemorrhage (see Section 7).

^a 'Admitted to ICU/High Dependency Care' is used to identify women who require high dependency care, ie. care that is more intensive than that provided in a ward situation. Depending on the hospital, this care may take place in a labour ward, High Dependency Unit, ICU, coronary care unit or any other specialist unit.

Fig 4.1: Hospital postnatal length of stay 2002



4.1 Factors associated with postpartum haemorrhage

This section of the report examines the statistical association between postpartum haemorrhage and a range of potential risk factors, using 2002 data. The risk factors examined fall into seven categories: socio-demographics, maternal reproductive history, factors related to the infant, hospital, pregnancy and delivery (general), vaginal delivery only and maternal medical conditions. Tables 4.1-4.7 display data relating to these risk factors and key points from the tables are provided following each table.

Table 4.1: Socio-demographic risk factors for postpartum haemorrhage

Factor	PPH	Total	% PPH	OR	95%CI
Total	5669	61959	9%		
Maternal age					
Less than 20	184	1917	10%	1.10	0.94-1.28
20-24	684	7472	9%	1.04	0.95-1.14
25-29	1612	16852	10%	1.09	1.02-1.17
30-34	2030	22993	9%	ref	
35-39	952	10712	9%	1.01	0.93-1.09
40 and over	207	2013	10%	1.18	1.02-1.38
Maternal country of birth					
Australian born non-ATSI	4025	47055	9%	ref	
Australian born ATSI	38	416	9%	1.07	0.77-1.50
Oceania inc NZ ^b	198	1601	12%	1.51	1.30-1.76
UK inc Eire	145	1813	8%	0.93	0.78-1.10
Europe	196	1992	10%	1.17	1.00-1.36
Mid East	127	1407	9%	1.06	0.88-1.28
Nth America	33	373	9%	1.04	0.72-1.49
Sth America	33	363	9%	1.07	0.75-1.53
Africa	106	1033	10%	1.22	1.00-1.50
Asia ^b	759	5787	13%	1.61	1.49-1.75

4.1.1 Socio-demographics - key points

Women who had higher odds of a postpartum haemorrhage were born in Oceania (including New Zealand) or Asia, compared to women who were born in Australia and were non-Aboriginal or Torres Strait Islanders (non-ATSI).

^b The country groupings are based on Australian Bureau of Statistics definitions. *Oceania* includes: Fiji, New Caledonia, New Zealand, Norfolk Island, Papua New Guinea, Antarctica and Other Pacific Islands (eg. Tonga, Samoa, Cook Islands, Nauru). *Asia* includes: Bangladesh, Burma, Cambodia, China, Christmas Islands, Cyprus, Hong Kong, India, Indonesia and Timor, Japan, Korea, Laos, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam.

Table 4.2: Maternal reproductive history risk factors for postpartum haemorrhage

Factor	PPH	Total	% PPH	OR	95%CI
All women	5669	61959	9%		
Parity ^a					
None	2811	25932	11%	ref	
One	1707	21787	8%	0.70	0.66-0.74
Two	733	9391	8%	0.70	0.64-0.76
Three	250	3073	8%	0.73	0.64-0.83
Four	95	1047	9%	0.82	0.66-1.02
Five or more	73	729	10%	0.92	0.72-1.17
Multiparous women	2858	36027	8%		
No. previous caesareans					
0	2179	28018	8%	ref	
1	566	6441	9%	1.14	1.04-1.26
2	93	1274	7%	0.93	0.75-1.16
3	20	294	7%	0.87	0.55-1.37
Previous birth a caesarean?					
No	2254	28732	8%	ref	
Yes	604	7295	8%	1.06	0.97-1.16
Interval between pregnancies					
> 35 months	933	11928	8%	ref	
24-35 months	739	9625	8%	0.98	0.89-1.08
12-23 months	792	10397	8%	0.97	0.88-1.07
< 12 months	108	1273	8%	1.09	0.89-1.35
Labour after any previous caesarean					
No	2583	33428	8%	ref	
Yes	275	2599	11%	1.41	1.24-1.61

^a Parity refers to the number of births prior to the index birth. The results for parity and gravidity showed similar patterns, therefore gravidity has not been included.

4.1.2 Maternal reproductive history - key points

- Women having their first birth had higher odds of having a postpartum haemorrhage, compared to multiparous women.
- The risk of postpartum haemorrhage appears to increase slightly with increasing parity, however this trend was not statistically significant (chi square for trend 2.57, p=0.109).
- For multiparous women, the risk of postpartum haemorrhage did **not** appear to be associated with:
 - number of previous caesareans
 - whether the previous birth was a caesarean
 - the interval between pregnancies.
- Women who laboured after having had a caesarean (for any previous birth) had higher odds of having a postpartum haemorrhage.

Table 4.3: Infant related risk factors for postpartum haemorrhage

Factor	PPH	Total	% PPH	OR	95%CI
Total	5669	61959	9%		
Baby's birthweight (gm)					
Less than 1500	111	856	13%	1.62	1.32-1.98
1500 to 2499	280	2919	10%	1.15	1.01-1.31
2500 to 3999	4285	50735	8%	ref	
4000 & greater	992	7441	13%	1.67	1.55-1.80
Plurality					
Singleton	5474	60868	9%	ref	
Twin	184	1072	17%	2.10	1.78-2.46
Triplet	11	19	58%	13.9	5.59-34.6
Baby birth condition					
Liveborn	5632	61588	9%	ref	
Stillborn	37	371	10%	1.10	0.78-1.55

4.1.3 Infant related risk factors - key points

- Women who had low (less than 1500 grams) or high (4000 grams and higher) birthweight babies had higher odds of having a postpartum haemorrhage.
- Women having multiple births had higher odds of having a postpartum haemorrhage.

Table 4.4: Hospital related risk factors for postpartum haemorrhage

Factor	PPH	Total	% PPH	OR	95%CI
Total	5669	61959	9%		
Hospital size (no. births)					
≥ 2000	2938	28195	10%	ref	
1000-1999	1302	15989	8%	0.76	0.71 - 0.82
100-999	1325	16386	8%	0.76	0.71 - 0.81
50-99	73	938	8%	0.73	0.57 - 0.92
<50	25	289	9%	0.81	0.54 - 1.23
Home births	6	162	4%	0.33	0.15 - 0.75
Patient accommodation status					
Public	4107	38825	11%	ref	
Private	1562	23134	7%	0.61	0.58 - 0.65
Place of birth					
Hospital	5511	60118	9%	ref	
Birth centre	118	1432	8%	0.89	0.74 - 1.08
Home	29	331	9%	0.95	0.65 - 1.39
In-transit	11	78	14%	1.63	0.86 - 3.08
Hospital category					
Metro public	1485	15780	9%	ref	
Level 3	1733	11874	15%	1.65	1.53 - 1.77
Private	1175	19450	6%	0.62	0.57 - 0.67
Country base	579	7193	8%	0.84	0.76 - 0.93
Other country	691	7500	9%	0.98	0.89 - 1.07
Homebirths	6	162	4%	0.37	0.16 - 0.84

4.1.4 Hospital related factors – key points

Women who had higher odds of having a postpartum haemorrhage:

- Gave birth in larger hospitals (greater than 1999 births per annum)
- Were patients in Level 3 hospitals
- Were public patients.

Women who delivered in smaller and rural hospitals did not appear to have higher odds of having a postpartum haemorrhage.

N.B The data were not adjusted for referral practices.

Table 4.5: Pregnancy and delivery related risk factors for postpartum haemorrhage

Factor	PPH	Total	%PPH	OR	95%CI
All women	5669	61959	9%		
Estimated gestation					
20-27 wks	62	460	13%	1.58	1.21-2.07
28-31 wks	68	425	16%	1.94	1.49-2.51
32-36 wks	363	3427	11%	1.20	1.08-1.35
37-41 wks	5093	56877	9%	ref	
> 41 wks	82	763	11%	1.22	0.97-1.54
Presentation					
Vertex	5314	58454	9%	ref	
Breech	258	2878	9%	0.98	0.86-1.12
Malpositions	80	569	14%	1.64	1.29-2.08
Labour spontaneous or induced					
Spontaneous	2912	34982	8%	ref	
No labour	881	9610	9%	1.11	1.03-1.20
Induced	1876	17367	11%	1.33	1.25-1.42
Vaginal or caesarean delivery					
Vaginal	3861	44982	9%	ref	
Caesarean	1806	16972	11%	1.27	1.20 - 1.35
Baby delivery type					
Spontaneous cephalic	2694	36790	7%	ref	
Forceps	660	3960	17%	2.53	2.31 - 2.78
Vacuum extraction	480	3937	12%	1.76	1.58 - 1.95
Vaginal breech	27	295	9%	1.28	0.86 - 1.90
Elective c/s ^a	712	8710	8%	1.13	1.03 - 1.23
Emergency c/s ^a	1094	8262	13%	1.93	1.79 - 2.08
Women who laboured	4788	52349	9%		
Prolonged labour					
No	4350	49962	9%	ref	
Yes	438	2387	18%	2.36	2.11 - 2.63
Precipitate labour					
No	4456	48055	9%	ref	
Yes	332	4294	8%	0.82	0.73 - 0.92

^a With or without labour

4.1.5 Pregnancy and delivery related factors - key points

Women who had higher odds of having a postpartum haemorrhage had:

- Shorter gestations
- Malpresentations
- Induced labours
- Prolonged labours
- Forceps or vacuum extraction deliveries, or emergency caesarean sections (with or without labour).

Table 4.6: Vaginal delivery related risk factors for postpartum haemorrhage

Factor	PPH	Total	%PPH	OR	95%CI
Women who had vaginal deliveries	3861	44982	8%		
Perineal status					
Intact perineum	1161	18628	6%	ref	
Episiotomy only	1162	9424	12%	2.12	1.94-2.30
Tear with or without an episiotomy	1538	16930	9%	1.50	1.39-1.63
Degree of tear					
Intact perineum or episiotomy only	2323	28052	8%	ref	
First and second degree	1398	16313	9%	1.04	0.97-1.11
Third and fourth degree	140	617	23%	3.25	2.68-3.94

4.1.6 Vaginal delivery related factors – key points

Table 4.6 examines the risk factors for postpartum haemorrhage related to episiotomy and perineal tears, therefore it only applies to women who had vaginal deliveries (n=44,982).

Women who had higher odds of postpartum haemorrhage had episiotomies and/or perineal tears. The odds were even higher in women who had third or fourth degree tears.

Table 4.7: Risk factors for postpartum haemorrhage associated with selected medical conditions

Condition	PPH	Total	%PPH	OR	95% CI
All women	5669	61959	9%		
Hypertension (including pre-eclampsia)					
No	5115	57418	9%	ref	
Yes	554	4541	12%	1.42	1.29 - 1.56
Polyhydramnios					
No	5633	61737	9%	ref	
Yes	36	222	16%	1.93	1.35 - 2.76
Uterine inertia					
No	5605	61401	9%	ref	
Yes	64	558	11%	1.29	0.99 - 1.68
Uterine rupture during labour					
No	5657	61941	9%	ref	
Yes	12	18	67%	19.9	7.47 - 53.0
Postpartum inversion of uterus					
No	5665	61953	9%	ref	
Yes	4	6	67%	19.9	3.64 - 109
Laceration of cervix or vaginal wall					
No	5556	61429	9%	ref	
Yes	113	530	21%	2.73	2.21 - 3.36
Retained placenta					
No	5183	60805	9%	ref	
Yes	486	1154	42%	7.81	6.92 - 8.81
Placenta praevia					
No	5483	61394	9%	ref	
Yes	186	565	33%	5.00	4.19 - 5.98
Abruptio placentae					
No	5587	61660	9%	ref	
Yes	82	299	27%	3.79	2.94 - 4.90
Other antepartum haemorrhage					
No	5420	60264	9%	ref	
Yes	249	1695	15%	1.74	1.52 - 2.00
Amniotic fluid embolism					
No	5667	61953	9%	ref	
Yes	2	6	33%	4.97	0.91 - 27.1
Puerperal infection					
No	5364	60534	9%	ref	
Yes	305	1425	21%	2.80	2.46 - 3.19
Pre-existing coagulation defects					
No	5634	61661	9%	ref	
Yes	35	298	12%	1.32	0.93 - 1.88

4.1.7 Medical condition related risk factors – key points

Women with a number of conditions had higher odds of having a postpartum haemorrhage. These conditions (in order of decreasing odds ratios) included:

- Retained placenta
- Placenta praevia
- Abruptio placentae
- Puerperal infection
- Laceration of the cervix or vaginal wall
- Polyhydramnios
- Other antepartum haemorrhage (not classified elsewhere)
- Hypertension (including pre-existing and gestational hypertension, pre-eclampsia and eclampsia).

Very few women were reported as having uterine rupture during labour or postpartum inversion of the uterus. The small numbers result in wide confidence intervals suggesting an instability in the estimate.

In this analysis, women with uterine inertia paradoxically did not appear to be at increased risk of postpartum haemorrhage. This may be related to under-reporting of the condition to the VPDCU as uterine inertia has previously been reported as a major cause of postpartum haemorrhage⁵.

Women with pre-existing coagulation defects did not have higher odds of having a postpartum haemorrhage. This may be because they were more likely to receive treatment to prevent haemorrhage during delivery. It could also be due to under-reporting of these conditions.

4.2 Rates of postpartum haemorrhage in other populations

Reported rates of postpartum haemorrhage in three other Australian states, as well as New Zealand, the Canadian province of British Columbia and England were tabulated to facilitate comparison (see Table 4.8). An American study of national hospital discharge survey data was also included.

The Victorian rate of postpartum haemorrhage in 2002 was 9.2%. This was comparable to the rate reported by the New Zealand Ministry of Health²⁴, and slightly higher than rates reported by perinatal data collection units in South Australia²⁵, Northern Territory²⁶, British Columbia²⁷ and the National Health Service reporting on English data²⁸. The rates of postpartum haemorrhage reported by the Queensland Health Department²⁹ and a study using hospital discharge data in the United States³⁰ were considerably lower. These differences may be related to differing data sources and methods of reporting postpartum haemorrhage, rather than a differing incidence of the condition.

Table 4.8: Reported rates of postpartum haemorrhage

State/Country	Year	PPH (n)	PPH rate	Classification of PPH
<i>Victoria</i>	<i>2002</i>	<i>5669</i>	<i>9.2%</i>	<i>ICD-10-AM</i>
South Australia ²⁵	2001	1113	6.4%	
Northern Territory ²⁶	1999	184	5.2%	
Queensland ²⁹	2000	270	0.6%	
New Zealand ²⁴	2001	4657	8.7%	ICD-10-AM
British Columbia ²⁷	2001	2460	6.1%	>500ml blood loss for vaginal delivery, >1000 ml for Caesarean delivery
NHS, England ²⁸	2001-02	35800	6.6%	ICD-10
United States ³⁰	1993-97	378600	2.0%	ICD-9-CM, National hospital discharge survey data

5. Hysterectomy associated with postpartum haemorrhage

Hysterectomy was examined as an indicator of severe postpartum haemorrhage. During the years 1999-2002, a total of 246,224 women gave birth, and there were 23,354 cases of postpartum haemorrhage (9.5%) and 138 cases of hysterectomy (0.06%). Of the 138 hysterectomy cases, 126 were reported as having had a postpartum haemorrhage. Five further cases had placenta praevia and one of those also had abruptio placentae. Another case had placenta accreta, detected during an elective repeat caesarean section. In these six cases, it is likely that the hysterectomies were performed to prevent postpartum haemorrhage, so they have been included in our postpartum haemorrhage and associated hysterectomy group (n=132, 0.05% of maternities).

The small number of women who had hysterectomies during the study period limited the number and type of statistical analyses that could be performed. Statistical analysis of key factors, chosen on the basis of clinical judgement and importance are provided in Table 5.1.

Table 5.1: Risk factors for hysterectomy associated with postpartum haemorrhage

	Hysterectomy	Total	% Hyst	RR	95%CI
All women	132	246224	0.05%		
Parity					
None	23	101942	0.02%	ref	
One or two	76	124184	0.06%	2.71	1.70 - 4.32
Three or more	33	20097	0.16%	7.28	4.28 - 12.4
Placenta praevia					
No	62	244095	0.03%	ref	
Yes	70	2129	3.29%	129	92.0 - 182
Abruptio placentae					
No	122	245096	0.05%	ref	
Yes	10	1128	0.89%	17.8	9.35 - 33.9
Retained placenta					
No	116	241810	0.05%	ref	
Yes	16	4414	0.36%	7.57	4.48 - 12.7
Uterine rupture during labour					
No	123	246167	0.05%	ref	
Yes	9	57	15.8%	316	160 - 621
Multiparous women	109	144282	0.08%		
Previous caesarean					
No	38	114807	0.03%	ref	
Yes	71	29475	0.24%	7.28	4.91 - 10.8

5.1 Risk factors for hysterectomy associated with postpartum haemorrhage - key points

The odds of hysterectomy associated with postpartum haemorrhage increased with increasing parity. This trend was statistically significant (Chi square for trend 71.7, $p < 0.00001$).

Women with a number of medical conditions also had higher odds of having a hysterectomy. These conditions (in order of decreasing rate ratios) included:

- Uterine rupture during labour
- Placenta praevia
- Abruptio placentae
- Retained placenta
- Previous caesarean section.

5.2 Rates of hysterectomy in other populations

Research studies or population-based perinatal statistics which focused on either emergency hysterectomy, obstetric hysterectomy or hysterectomy due to haemorrhage were reviewed. The majority of cases of emergency hysterectomy and obstetric hysterectomy were related to haemorrhage so have been included in Table 5.2 to facilitate comparison of hysterectomy rates in different populations.

The rate of hysterectomy associated with postpartum haemorrhage in Victoria from 1999-2002 was 0.05%. This is comparable to the rates reported by the New Zealand Ministry of Health²⁴ and perinatal databases in British Columbia²⁷ and Nova Scotia²² (see Table 5.2). Several North American studies using hospital data^{31 23 32 17 33} found higher rates of hysterectomy ranging from 0.10-0.27%, whereas a Norwegian hospital-based study³⁴ reported a lower rate of 0.02%.

Table 5.2 Reported rates of emergency hysterectomy

Location	Year	Hyst. (n)	Hyst. rate	Hysterectomy classification
<i>Victoria</i>	<i>1999-2002</i>	<i>132</i>	<i>0.05%</i>	<i>Hysterectomy associated with postpartum haemorrhage</i>
New Zealand ²⁴	2001	18	0.03%	Obstetric hysterectomy
British Columbia ²⁷	2001	20	0.05%	Hysterectomy associated with postpartum haemorrhage
Nova Scotia ²²	1988-2000	76	0.05%	Emergency obstetric hysterectomy
Winthrop-University hospital, New York ³¹	1991-1997	48	0.14%	Emergency peripartum hysterectomy
Brigham and Women's Hospital, Boston ²³	1983-1991	117	0.16%	Emergency peripartum hysterectomy
University Medical Centre, Stony Brook, New York ³²	1990-1995	39	0.27%	Emergency peripartum hysterectomy
Los Angeles County/University of Southern California Women's Hospital ¹⁷	1978-1982	70	0.10%	Hysterectomy for obstetric haemorrhage
Los Angeles County/University of Southern California Women's Hospital ³³	1985-1990	123	0.13%	Emergency peripartum haemorrhage
Haukeland University Hospital, Bergen, Norway ³⁴	1981-1996	11	0.02%	Peripartum hysterectomy

6. Trends in postpartum haemorrhage and associated hysterectomy 1992-2002

In order to identify any changes in postpartum haemorrhage or hysterectomy rates over the last decade in Victoria, VPDCU data from 1992 to 2002 were examined. Table 6.1 shows postpartum haemorrhage cases as a proportion of all maternities, and hysterectomy cases as a proportion of postpartum haemorrhage cases and of maternities during this period.

Table 6.1 PPH and associated hysterectomy 1992-2002

Year	PPH (n)	Total no. maternities	%PPH	Hyst (n)	%Hyst. of PPH cases	%Hyst. of maternities
1992	3547	65404	5.42%	12	0.34%	0.018%
1993	3632	63795	5.69%	18	0.50%	0.028%
1994	4041	63983	6.32%	12	0.30%	0.019%
1995	4147	62734	6.61%	25	0.60%	0.040%
1996	4063	62028	6.55%	8	0.20%	0.013%
1997	3957	61312	6.45%	19	0.48%	0.031%
1998	3853	61071	6.31%	21	0.55%	0.034%
1999*	5771	61588	9.37%	20	0.35%	0.032%
2000*	6268	61571	10.18%	28	0.45%	0.045%
2001*	5642	61106	9.23%	36	0.64%	0.059%
2002*	5673	61959	9.16%	48	0.85%	0.077%

* 1999-2002 data were validated with VAED data (see methods section)

Figures 6.1-6.4 show trends for postpartum haemorrhage and associated hysterectomy from 1992-2002.

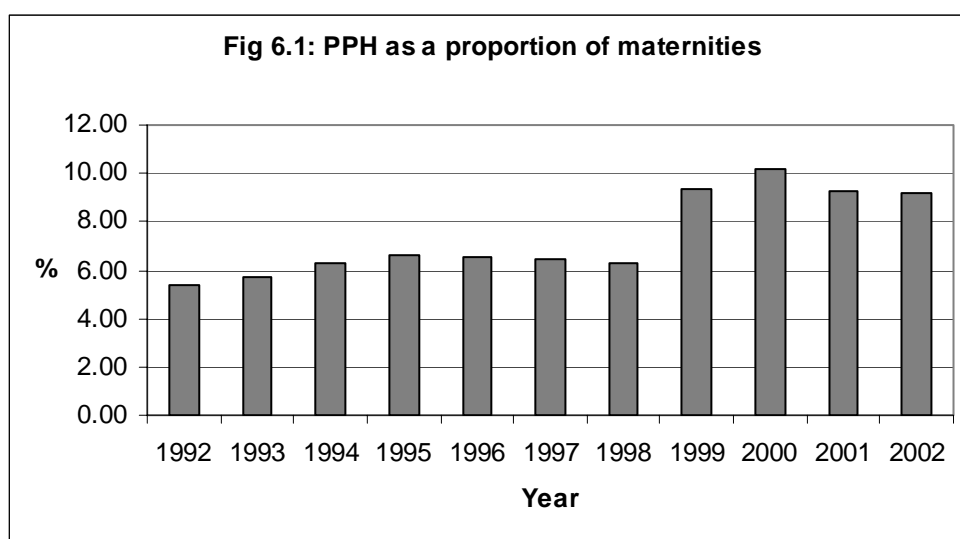


Fig 6.2: Number of hysterectomy cases

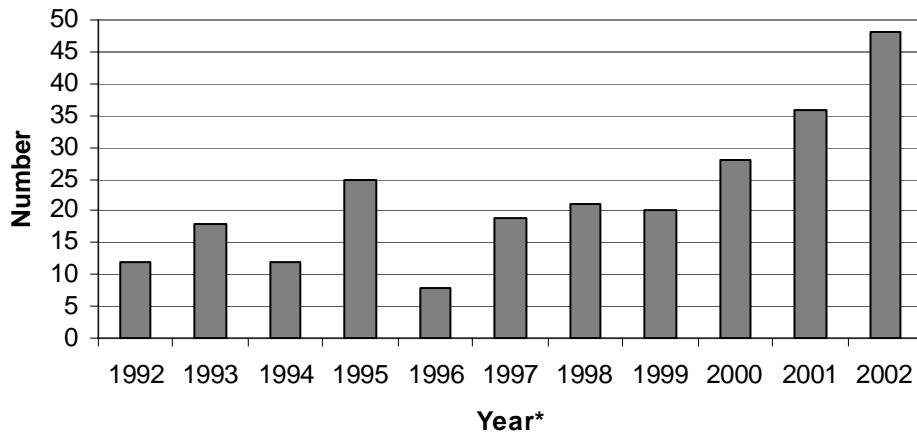


Fig 6.3: Hysterectomy as a proportion of maternities

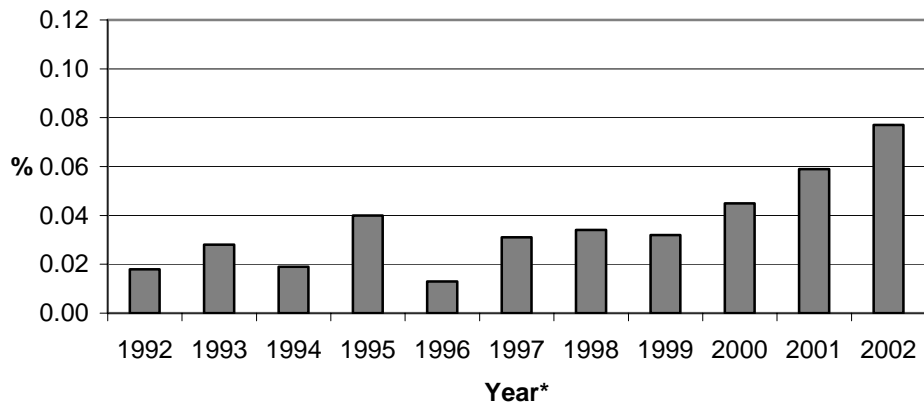
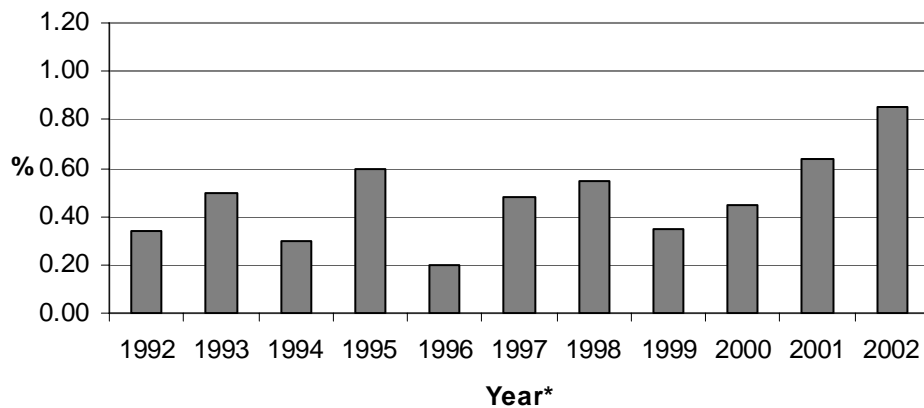


Fig 6.4: Hysterectomy as a proportion of PPH cases



* Data from 1999-2002 were validated with the VAED

In order to explore the impact of other changes in obstetrics that had been taking place during the same period, rates of women delivering by caesarean section, those delivering after previous caesarean sections or having placenta praevia were calculated as proportions of maternities (see Table 6.2). The trends were analysed: hysterectomy rates (Chi square for trend 12.7, $p=0.0004$), caesarean rates (Chi square for trend 408.1, $p< 0.00001$) and previous caesarean rates (Chi square for trend 95.32, $p<0.00001$) significantly increased from 1999 to 2002. Placenta praevia rates appeared to increase and this increase approached statistical significance (Chi square for trend 3.5, $p=0.06$).

Table 6.2 Rates of caesarean deliveries and placenta praevia 1999-2002

Year	Caesarean deliveries (%)	Previous caesarean (%)	Placenta praevia (%)
1999	22.8	11.2	0.800
2000	23.4	11.5	0.884
2001	25.2	12.2	0.862
2002	27.4	12.9	0.912

6.1 Trend data - key points

- The rates of postpartum haemorrhage remained fairly constant from 1992 to 1998, with an average of 6.2%.
- There appears to be a marked increase in rates of postpartum haemorrhage from 1998 to 1999. This is likely to be due to a change in reporting of postpartum haemorrhage, resulting from a change in definition of postpartum haemorrhage on the VPDCU form from a blood loss of 600ml to that of 500ml.
- The rates of postpartum haemorrhage were reasonably constant from 1999 to 2002, averaging 9.5%.
- The number of hysterectomy cases each year is relatively low and minor fluctuations can be expected. There appears to be random variation from 1992-1998. From 1999-2002 the rate of hysterectomy associated with postpartum haemorrhage appears to be increasing consistently and this trend is statistically significant.
- Changes in obstetric practice over the last decade, such as changes in the obstetric population as well as increasing numbers of caesarean sections, need to be considered when examining the trend data.
- The years 1999-2002 were the focus of this study, as coding practices were consistent during this period, therefore only hysterectomy cases occurring in these years were validated with the VAED.

7. Mortality due to obstetric haemorrhage

In Victoria, from 1992-2002, nine women died as a direct result of obstetric haemorrhage (see Table 7.1). Two were due to antepartum haemorrhage (APH).

Seven had postpartum haemorrhages (PPH). Of those, four had deliveries by caesarean section (C/S) and three had vaginal deliveries (V/D). Five had hysterectomies.

Table 7.1: Deaths in Victoria from obstetric haemorrhage 1992-2002

Year	Clinical details	Cause of death
1993	Dead on arrival at hospital, following APH (abruptio) at home	Abruptio placentae
1995	Recurrent APH. Ultrasound at 31 weeks showed no placenta praevia. Severe APH at 33 weeks → cardiac arrest. Post mortem showed placenta praevia	Placenta praevia
1995	Emergency C/S for FTP ^a . PPH → hysterectomy and IAL ^b . Transferred by air ambulance to ICU (moribund on arrival)	Amniotic fluid embolism
1998	Concealed pregnancy. Delivered at home, term, unattended	PPH
2000	Emergency C/S at 34 weeks for placenta praevia. PPH → hysterectomy	Amniotic fluid embolism
2000	Jehovah's witness. Abruptio/IUFD ^c . Induction. V/D. PPH → hyperbaric unit	PPH
2001	Semi-elective C/S at 30 weeks. Fibroid uterus, broad ligament haemorrhage-packs, oncologist, hysterectomy. Cardiac arrest despite blood, FFP ^d , platelets	Intra operative haemorrhage
2002	Vacuum extraction → PPH → hysterectomy	Amniotic fluid embolism
2002	32 weeks. Twins, C/S for abruptio. PPH → hysterectomy → ICU → laparotomy	Amniotic fluid embolism

^a Failure to progress, ^b Iliac artery ligation, ^c Intrauterine fetal death, ^d Fresh frozen plasma

8. Discussion

This study used data routinely collected by the VPDCU to examine the incidence, risk factors and trends for postpartum haemorrhage and associated hysterectomy in a Victorian population.

8.1 Methodological issues

There were a number of advantages in using VPDCU data. The data are readily available in electronic form, include more than 99% of the population of Victorian women having hospital births, and have been routinely collected since 1982, allowing the analysis of trends.

Some of the variables found on the VPDCU database are reliably reported and recorded. For example, when postpartum haemorrhage cases reported to the VPDCU (as a 'tick box' item) were validated against hospital records, it was found that there was agreement between the two data sources more than 90% of the time. However other factors of importance to this study, such as maternal medical conditions, were less well reported as they were entered on the form as free text. Therefore it is likely that many of these conditions are under-reported in this study. This may mean that the effect of some factors were under-estimated and some associations were not able to be detected. It is also possible that in reporting a major event, such as a hysterectomy, risk factors are more likely to be reported. This reporting bias may result in being more likely to detect an association with known risk factors.

Hysterectomy was reported as free text on the VPDCU form. When hysterectomy cases recorded on the VPDCU database were validated with hysterectomy cases recorded on the VAED, an additional 22 cases were detected, indicating the importance of using more than one data source to improve case ascertainment.

A disadvantage of using retrospective data was that some previously reported risk factors for postpartum haemorrhage, such as whether a woman had experienced a previous postpartum haemorrhage or was obese⁷, were not reported to the VPDCU, so could not be included.

A major limitation of this study was the inability to distinguish minor from severe postpartum haemorrhage (apart from very severe haemorrhages requiring hysterectomy). The incidence of transfusions related to postpartum haemorrhage would have been a useful indicator of severity and has been used in other studies², however transfusions were not reliably reported to the VPDCU. Admissions to ICU may have also been a useful indicator of severe morbidity, however the data collected by the VPDCU did not separate those requiring intensive care from those who required any level of care more intensive than that provided in a ward situation.

8.2 Postpartum haemorrhage

In 2002, 9.2% of women giving birth in Victoria had a postpartum haemorrhage. This is similar to the reported rate in New Zealand²⁴ and slightly higher than those reported in the Northern Territory²⁶ and South Australia²⁵, England²⁸ and British Columbia²⁷. Caution should be exercised in comparing these rates, as reporting and classification procedures vary.

A number of risk factors for postpartum haemorrhage were found amongst Victorian women in this study, using univariate analysis. However, it is likely that there are interrelationships between some of these factors and multivariate analysis is required to control for any confounding variables. Most of the risk factors for postpartum haemorrhage detected in this study have been reported in previous studies, including:

- Asian birth of mother (previously found to be a risk factor in vaginal deliveries¹⁰, but not for caesarean deliveries¹¹)
- Nulliparity^{15 10}

- Macrosomia^{7 6 15 8}
- Multiple pregnancy^{7 6 15 8 10}
- Prolonged labour^{15 10}
- Operative delivery, especially emergency caesarean^{7 15}
- Episiotomy¹⁰
- Cervical, vaginal, perineal lacerations¹⁰
- Induced labour. (In one study¹⁰, labour induction had no significant association with haemorrhage after logistic regression analysis. The authors suggested that much of the effect could be explained by the reason for induction and in their study, the observed increased risk in induced labours could be explained by pre-eclampsia.)
- Placenta praevia^{7 8}
- Retained placenta^{8 5 16}
- Abruptio placentae⁷
- Intra-amniotic infections^{6 8}
- Polyhydramnios^{6 8}
- Severe pre-eclampsia/hypertension¹⁰.

Uterine rupture^{8 5} and postpartum inversion of the uterus^{8 16 5} have also been shown to be risk factors for postpartum haemorrhage. In this study, very small numbers of women were reported to have these conditions. This resulted in wide confidence intervals suggesting an instability in the estimate.

Previous uterine surgery, including previous caesarean section, has been reported as a risk factor for postpartum haemorrhage⁸. The current study found no association between postpartum haemorrhage and whether the previous birth was a caesarean or the number of previous caesarean deliveries. However, labour after a previous caesarean delivery was a risk factor for postpartum haemorrhage.

Grand multiparity is frequently cited as a risk factor for postpartum haemorrhage^{8 16 6} however some authors have disputed this^{7 10}. In the current study, multiparity was not a risk factor for postpartum haemorrhage, however women of higher parity were at increased risk of hysterectomy associated with postpartum haemorrhage. This may indicate that multiparity is a risk factor for severe postpartum haemorrhage, alternatively, it may reflect practice differences, in that hysterectomy may be more readily performed to prevent severe haemorrhage in multiparous women.

A number of the risk factors for postpartum haemorrhage examined in this study have not been reported elsewhere. They were:

- Mother born in Oceania (including New Zealand)
- Public patient and birth in a larger or Level 3 hospital. A possible explanation for this could be that women with risk factors for postpartum haemorrhage are more likely to be referred to larger hospitals (where they are more likely to be public patients). A confounding factor is that these hospitals are also more likely to reliably report their data to the VPDCU.
- Shorter gestation and low birthweight baby. Others have reported that pre-term delivery by caesarean section was not a risk factor for postpartum haemorrhage after controlling for other variables, such as pre-eclampsia¹¹.

In contrast, some of the previously reported risk factors for postpartum haemorrhage were not identified as significant risk factors in this study.

- Uterine inertia (which includes uterine atony), has been widely acknowledged as a major cause of postpartum haemorrhage^{16 5 6}, however it did not appear to be a risk factor in this study. This is likely to be due to under-reporting of the condition.
- Likewise, the presence of a pre-existing coagulation defect had been previously reported as a risk factor^{5 6 8} but was not identified as one in this study. This may be due to under-reporting of the condition or alternatively, women known to have these conditions may be more likely to receive preventative treatment for haemorrhage.

- Rapid labour. Some authors^{6 8} have reported rapid labour as a risk factor for haemorrhage, while others did not find an association¹⁰.

8.3 Hysterectomy associated with postpartum haemorrhage

The rate of hysterectomy associated with postpartum haemorrhage in Victoria during 1999-2002 was 0.05%. This rate is consistent with findings from perinatal data collection units in New Zealand²⁴, British Columbia²⁷ and Nova Scotia²², and less than rates of emergency hysterectomy reported in several North American hospital-based studies^{31 23 32 17 33}. When comparing these rates, the type of hysterectomies included in each study should be considered: most included all emergency hysterectomy cases, while some only included obstetric hysterectomy cases and one used the same classification as used in this study 'hysterectomy associated with postpartum haemorrhage'. However, comparison between studies is possible as the majority of emergency or obstetric hysterectomies are due to haemorrhage. The higher rates of hysterectomy found in the North American hospital-based studies may be due to the higher proportions of complex cases, including those requiring hysterectomy, that were treated at those hospitals. In the small sample examined in the Norwegian study³⁴, the hysterectomy rate appeared to be low. This may be related to the study population or reflect differences in the obstetric population or practices in that country.

A number of studies have examined the indicators and risk factors for emergency hysterectomy. One of the risk factors for hysterectomy in this study was increasing parity. Others have also found an increase in hysterectomy rates with increasing parity, and showed that much of this increase could be explained by the influence of placenta praevia and prior caesarean section²³.

The following medical conditions were identified as risk factors for both postpartum haemorrhage and hysterectomy:

- Placenta praevia
- Abruptio placentae
- Retained placenta
- Uterine rupture during labour.

Consistent with these findings, abnormal placentation, uterine rupture during labour and unspecified uterine bleeding have been previously reported as common indications for hysterectomy^{23 32}.

In a study using data from 1978 to 1982, Clark et al¹⁷ reported that uterine atony was the most common cause of emergency peripartum hysterectomy followed by placenta accreta. Later studies^{33 23} found that placenta accreta had become the most frequent cause with uterine atony taking second place. This increase in placenta accreta as a major indication for hysterectomy may be attributed to the increase over the past two decades in caesarean births, which is a known risk factor for abnormal adherent placentation²³. It may also be a result of better pharmacological treatment of uterine atony decreasing the need for hysterectomy for this indication^{31 23}.

Previous caesarean section was a risk factor for hysterectomy and this has been reported by others³⁵. In our study, 54% of hysterectomy cases had had previous caesarean sections and 53% had placenta praevia, with 37% having both conditions. As the incidence of caesarean section rises, the likelihood of these two factors concurring also increases, thus increasing the risk of hysterectomy³⁵.

It is of interest that previous caesarean section was not identified as a risk factor for postpartum haemorrhage, and this may be due to its relationship with parity (which was also a risk factor for hysterectomy but not for postpartum haemorrhage).

From 1999-2002, postpartum haemorrhage rates remained relatively constant but there was a significant increase in hysterectomy rates. Caesarean section rates also increased during this period. It is possible that the increase in hysterectomy (due to **severe** postpartum haemorrhage) may, at least in part, be attributed to increased numbers of pregnant women having had a prior caesarean delivery, and this should be closely monitored in the future.

8.4 Implications for practice

This study provides information about postpartum haemorrhage and associated hysterectomy in Victoria. It is anticipated the information will be used by DHS and other relevant agencies to contribute to policy development, and by hospitals to inform practice in the prevention and management of postpartum haemorrhage.

A study in the United Kingdom found that 93% of consultant maternity units had clinical guidelines for the management of postpartum haemorrhage⁷. Some Victorian hospitals have clinical guidelines for postpartum haemorrhage, but there does not appear to be a common approach or an auspicing authority for such guidelines. The NSW Health Department recently produced a framework for the prevention, early recognition and management of postpartum haemorrhage³⁶. The information in this report may assist in the formulation of a similar framework for Victoria.

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APPENDIX 1: Recommendations made by The Confidential Enquiries into Maternal Deaths in the United Kingdom¹²

Obstetric haemorrhage: Key recommendations

- Every unit should have a protocol for the management of haemorrhage and this should be reviewed and rehearsed on a regular basis. It should also be included as part of life support training. All members of staff, including those in the blood bank, must know exactly what to do to ensure that large quantities of cross-matched blood can be delivered without delay.
- The speed with which obstetric haemorrhage can become life threatening emphasises the need for women at known risk of haemorrhage to be delivered in a hospital with a blood bank on site and appropriate laboratory facilities, including haematological advice and therapy.
- Placenta praevia, particularly in patients with a previous uterine scar, may be associated with uncontrollable uterine haemorrhage at delivery and caesarean hysterectomy may be necessary. A very experienced operator is essential and a consultant must be readily available.
- On-call consultant obstetricians must consider all available interventions to stop haemorrhage such as radical surgery or embolisation of uterine arteries, involving surgical or radiological colleagues as required.
- It is essential that both obstetricians and anaesthetists be involved, at an early stage, in planning the elective management of very-high-risk cases.
- If haemorrhage occurs, experienced consultant obstetric and anaesthetic staff must attend.
- It is recommended that guidelines for the management of women at known high risk of haemorrhage (below) be followed.

Recommendations for the management of women at known risk of haemorrhage

Where a delivery is known to be one with a higher risk of major bleeding, for example placenta praevia, especially with previous caesarean section, myomectomy scars, uterine fibroids, placental abruption or previous third-stage complications, the following steps are essential.

- Possible prepartum anaemia should be checked and corrected in the antenatal period if possible.
- All elective or emergency surgery should be performed by a consultant.
- Any anaesthetic should be given by a consultant.
- Adequate intravenous access (two large-bore cannulae) should be in place before surgery starts.
- At least four units of blood should be cross-matched and immediately available.
- A central venous pressure line should be in place, either pre-operatively or whenever it is apparent that bleeding is excessive.
- If bleeding is excessive, the obstetrician should consider either embolism of uterine arteries by an interventional radiologist or further surgical procedures, such as internal iliac ligation, hysterectomy, B-Lynch suture or Billings suture. Any obstetrician who does not feel competent to perform any of the above should immediately call a colleague to assist or, if necessary, a vascular surgeon.

- The advice of a consultant haematologist should be sought to assist in the management of coagulopathy, for example due to disseminated intravascular coagulation or massive transfusion. The most appropriate blood product replacement is dependent on the result of coagulation tests and full blood count and may involve cryoprecipitate, fresh frozen plasma and platelets.

APPENDIX 2: Summary of the validation study of the Perinatal Morbidity Statistics Form 1999

This study was undertaken to assess the reliability of data reported on the Perinatal Morbidity Statistics Form used by VPDCU.

The validation involved completing 'mock' forms with data obtained from hospital medical records and comparing these with the 'real' forms received by the VPDCU, having been completed by hospital midwives around the time of the birth.

Forms recording births in July 1999 were selected. Twenty randomly selected hospitals took part. A total of 676 randomly selected forms were validated. This was equivalent to approximately 1% of births.

Table 1 lists the data items of interest to this study and shows the number (and percent) of forms that did not match for a particular data item.

Table 1: Discrepancies between the medical record and the form used by VPDCU

Item	Errors	Percentage
<i>(Number items = Number of forms = 676 unless otherwise stated)</i>		
Public/private patient	6	0.8
Mother's country of birth	(648) 6	0.9
Mother's aboriginality	(552) 10	1.8
Actual place of birth	26	3.8
Hospital	2	0.2
Marital status	24	3.5
Birthdate (mother)	4	0.5
Total previous pregnancies	(919) 43	4.6
Was last birth a caesarean?	(66) 0	0
Total no. previous caesareans	(76) 0	0
Estimated gestation	77	11.3
Labour	109	16.1
Presentation	2	0.2
Type of birth	6	0.8
Plurality	0	0
Baby's birthweight	4	0.5
Discharge status of baby	0	0

Table 2: Recording of complications and procedures

Condition	Recorded on form	Missed on form	Total validated	% Missed
Maternal medical conditions	119	76	195	38.9
Obstetric complications	252	181	433	41.8
Procedures and operations	74	24	98	24.4
Complications of labour, birth or postnatal	256	134	390	34.3

APPENDIX 3: Codes and definitions of conditions referred to in this report

Conditions referred to in this report are listed below. The relevant ICD-10-AM codes are listed in brackets next to each condition. Where appropriate, definitions using ICD-10-AM coding are also given.

Polyhydramnios (O40.9)

Puerperal infection

- Puerperal sepsis (O85.9)
- Other puerperal infections (O86.0, O86.1, O86.2, O86.3, O86.4, O86.8)
- Infection of the amniotic sac and membranes (O41.1)
- Pyrexia during labour, not elsewhere classified (O75.2)
- Other infection during labour (O75.3)

Uterine inertia

- Other uterine inertia (O62.2)
 - Atony of uterus
 - Desultory labour
 - Hypotonic uterine dysfunction (not otherwise specified)
 - Irregular labour
 - Poor contractions
 - Uterine inertia (not otherwise specified)

Uterine rupture

- Rupture of uterus during labour (O71.1)

Amniotic fluid embolism (O88.1)

Postpartum inversion of uterus (O71.2)

Laceration of cervix or vaginal wall

- Obstetric laceration of cervix (O71.3)
- Obstetric high vaginal laceration alone (O71.4)

Retained placenta

- Third stage haemorrhage (O72.0)
 - Haemorrhage associated with retained or trapped placenta
 - Retained placenta, not otherwise specified
- Retained placenta without haemorrhage (O73.0)

Hypertension

- Pre-existing hypertension complicating pregnancy, childbirth and the puerperium (O10.0, O10.1, O10.2, O10.3, O10.4, O10.9)
- Pre-existing hypertensive disorder with superimposed proteinuria (O11.9)
- Gestational (pregnancy-induced) hypertension without significant proteinuria (O13.9)
- Gestational (pregnancy-induced) hypertension with significant proteinuria (O14.0, O14.1, O14.9)
- Eclampsia (O15.0, O15.1, O15.2, O15.9)
- Unspecified hypertension (O16.9).

Placenta praevia

- Placenta praevia specified as without haemorrhage (O44.0)
- Placenta praevia with haemorrhage (O44.1)

Abruptio placentae

- Premature separation of placenta (O45.0, O45.8, O45.9)

Other antepartum haemorrhage

- Antepartum haemorrhage, not elsewhere classified (O46.0, O46.8, O46.9)

Pre-existing coagulation defects

- Hereditary factor VIII deficiency (D66.9)
- Hereditary factor IX deficiency (D67.9)
- Other coagulation defects (D68.0, D68.1, D68.2, D68.3, D68.4, D68.8, D68.9)
- Purpura or other haemorrhagic conditions (D69.0, D69.1, D69.2, D69.3, D69.4, D69.5, D69.6, D69.8, D69.9)

Prolonged labour

- Prolonged first stage of labour (O63.0)
- Prolonged second stage of labour (O63.1)
- Delayed delivery of second twin (O63.2)
- Long labour, unspecified (O63.9)

When labour is actively managed, as it is in hospital, it is termed prolonged if delivery is not imminent after 18 hours of established labour⁴.

Precipitate labour (O62.3)