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Pronurturance at birth and risk of postpartum haemorrhage: biology, theory and new evidence

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DECLARATION BY AUTHOR

I certify that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university.

I acknowledge that I have read and understood the University's rules, requirements, procedures and policy relating to my higher degree research award and to my thesis. **I certify that I have complied** with the rules, requirements, procedures and policy of the University.

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ABSTRACT

Title: Pronurturance at Birth: Biology, Theory and New Evidence

Background: In spite of the almost universal adoption of the active management of the 3rd stage of labour, postpartum haemorrhage (PPH) rates continue to rise; reaching 19% or more in some obstetric units. Conversely, there is emerging evidence that women who experience continuity of midwifery care have lower rates of PPH. Continuity of midwifery care normally includes immediate skin-to-skin contact and early breastfeeding in the 3rd and 4th stages of labour to optimise release of endogenous oxytocin. The objective was to determine if skin-to-skin contact and breastfeeding at birth affected the rate of early PPH in a group of mixed risk Australian women.

Method: De-identified birth records (N=11,219) for the calendar years 2009 and 2010 were extracted from the electronic ObstetriX database which records public sector births in New South Wales, Australia. Excluded (n = 3,671) were all cases where skin-to-skin and breastfeeding immediately after birth was not possible leaving 7,548 cases for analysis. The outcome measure was PPH of 500 ml or more; the independent variables were 'skin-to-skin contact' and 'breastfeeding' at birth (the combination of these two variables I ultimately termed pronurturance). Analyses were conducted to determine the risk of PPH for women who experienced skin-to-skin contact and breastfeeding at birth in the 3rd and 4th stages of labour compared with those women who did not (regardless of the woman's risk status or mode of birth).

Results: Women who experienced skin-to-skin contact and breastfeeding at birth had an almost fourfold decrease in risk of PPH, (OR 0.26, 95% CI 0.20-0.33, $p < 0.001$). After adjustment for covariates women who experienced skin-to-skin contact and breastfeeding at birth were again less likely to have a PPH (OR 0.55, 95% CI 0.41-0.72, $p < 0.001$). This protective effect of 'pronurturance' on PPH held true in sub-analyses for both women at 'lower' risk (OR 0.22, 95% CI 0.17-0.30, $p < 0.001$) and 'higher' risk (OR 0.37, 95% CI 0.24-0.57, $p < 0.001$) of PPH.

Conclusion: These results suggest that skin-to-skin contact and breastfeeding in 3rd and 4th stages of labour was effective in reducing the risk of PPH in a group of mixed risk Australian women. The explanation of this finding is that skin-to-skin contact and breastfeeding promote optimal endogenous oxytocin release. Skin-to-skin contact and breastfeeding at birth has shown no known negative effects and should be encouraged for all women during 3rd and 4th stage labour care.

PUBLICATIONS DURING CANDIDATURE

Conference Papers

Saxton, A & Fahy, K 2013, Does psychologically enhanced 3rd and 4th stage labour care affect the rate of postpartum haemorrhage: A cohort study Passage to Motherhood Conference, 17th to 21st May, 2013, Gold Coast.

Saxton A, Fahy K, Rolfe M, Skinner V & Hastie C 2013, Does skin-to-skin contact combined with breastfeeding at birth affect the rate of postpartum haemorrhage: Results of a cohort study, Australian College of Midwives 28th Biennial Conference, 1st to 3rd October, 2013, Wrest Point Hotel, Hobart.

Saxton A, Fahy K, Rolfe M, Skinner V & Hastie C 2014, Does skin-to-skin contact and breastfeeding during third and fourth stage labour care affect the rate of early postpartum haemorrhage: Results of a cohort study, 30th International Congress of Midwives, 1st to 5th June, 2014, Prague, Czech Republic.

Saxton 2014, Can research inform clinical practice? *Skin-to-skin contact and breastfeeding immediately following birth appears to reduce the risk of postpartum haemorrhage by about 50%: Implication for practice, 28th November, 2014,* Charles Darwin University.

Saxton A 2014, The physiology underpinning skin-to-skin contact and breastfeeding at birth and effect on postpartum haemorrhage, Midwives on the Tweed Education Day, 7th November 2014, Gold Coast.

Saxton A 2015, The Oxytocin factor: effects during third and fourth stage labour care, 21st March 2015, Masonic Meeting, Weston, NSW.

Journal Publications

Saxton A, Fahy K & Hastie C 2014, 'Effects of skin-to-skin contact and breastfeeding at birth on the incidence of PPH: A physiologically based theory', *Women & Birth*, vol. 27, pp. 250-3.

Saxton A, Fahy K, Rolfe M, Skinner V & Hastie C 2015, 'Does skin-to-skin contact and breastfeeding at birth affect the rate of primary postpartum haemorrhage: Results of a cohort study. http://dx.doi.org/10.1016/j.midw.2015.07.008

OVERVIEW OF DISSERTATION

Question: '**does skin-to-skin contact and breastfeeding immediately after birth affect the rate of early postpartum haemorrhage?'**

In Chapter 1 introduced the study and set it within the global and Australian context. I presented the possibility that modern maternity settings and the way maternity care is provided may be contributing to increasing rates of postpartum haemorrhage (PPH). I have explained my background and interest in the topic. The significance and limitations of the study are presented. Chapter 2 presents the 'Conceptual Framework' which consists of three parts. Part 1 describes the biological, scientific understanding of the structure and function of the myometrium, including the neuro-hormonal regulation of uterine contraction, retraction and the maintenance of eutony and eulochia: this part of Chapter 2 has been published as a peer-reviewed paper (Saxton, Fahy & Hastie 2014). Part 2 discusses how a woman's thoughts and feelings, and where she focuses her attention, affects and are affected by the autonomic nervous system. The third part presents a new theory called Pronurturance Plus, which integrates concepts from Birth Territory Theory with concepts from Parts 1 and 2. Pronurturance Plus theory describes, explains and predicts the conditions under which a woman's endogenous oxytocin is optimised and post birth bleeding is minimised. Chapter 3 is also organised into two parts. Part 1 is a review of the research literature concerning the risk factors for PPH with an emphasis on identifying those factors that are the most likely causes of uterine atony. Part 2 describes and critically discusses the research literature of direct relevance to this study. Chapter 4 presents the methodology for the study. The research setting is described and the ethical dimensions of the study, including the values and principles guiding the research, are provided. The chapter includes a detailed account of the research design, settings, data collection and analysis methods. Chapter 5 presents the research findings, which have been accepted for publication as a peer-reviewed paper (Saxton et al. 2015). In Chapter 6, both theory and basic science are used to interrogate and interpret the quantitative findings in a search for an enhanced theoretical understanding of how the psychophysiology of the woman/baby can be optimised during labour and birth focussing on 3rd and 4th stages of labour. The key

arguments and evidence presented in this dissertation to answer the research question are summarised. In this final chapter the recommendations for policy, midwifery, medical practice and education are detailed.

STATEMENT OF CONTRIBUTION OF OTHERS

Published Paper Incorporated into Chapter 2

Saxton A, Fahy K & Hastie, C 2014 ‘Effects of skin-to-skin contact and breastfeeding at birth on the incidence of PPH: A physiologically based theory', *Women & Birth*, vol. 27, pp. 250-3.

Contribution to authorship

AS designed the guiding question with the support of her supervisors (KF and CH). AS conducted the literature searches and wrote the early drafts. All authors discussed the ideas in the literature as presented by AS reading the original literature if needed for clarity. AS drafted the article for publication and all authors discussed and reviewed the content of each draft as part of PhD supervision. AS wrote a full final draft of the article with support from her supervisors. All authors revised, edited and approved the final paper.

Percentage contribution to authorship: AS 65%, KF, 20%, CH 15%

Published Paper Incorporated into Chapter 5

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Contribution to authorship

AS designed the study and obtained ethical approval with the support of her supervisors; principally KF and CH AS, primarily supported by MR and VS developed the methodology for study. MR, VS and AS designed the statistical analyses. AS analysed the data and wrote the first draft of the paper with primary assistance from KF. All authors made substantial contribution to the interpretation of the results and contributed to writing the paper. All authors read and approved the final paper.

Percentage contribution to authorship: AS 60%, KF 20% MR10%, VS 5% CH 5%

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LIST OF ABBREVIATIONS USED IN THESIS

ACTH	Adrenocorticotropic Hormone
AIHW	Australian Institute of Health and Welfare
AMA	Australian Medical Association
APGAR	Appearance, Pulse, Grimace, Activity, Respiration
APH	Antepartum Haemorrhage
BBS	Belmont Birthing Service
BC	Birth Centre
B/F	Breastfeeding
BFHI	Baby Friendly Hospital Initiative
BMI	Body Mass Index
CI	Confidence Interval
CRH	Corticotropic Releasing Hormone
C/S	Caesarean Section
CTG	Cardiotocograph

Cx	Cervix
FIGO	International Federation of Gynaecologists and Obstetricians
GP	General Practitioner
HNE	Hunter New England
HNEAHS	Hunter New England Area Health Service
HPA axis	Hypothalamic-Pituitary-Adrenal axis
ICD	International Classification of Diseases
ICM	International Confederation of Midwives
NICU	Neonatal Intensive Care Unit
JHH	John Hunter Hospital
MDG	Millennium Development Goals
MFM	Maternal-Fetal-Medicine
ml	millilitre
MMR	Maternal Mortality Ratio
NHMRC	National Health& Medical Research

	Council
NICE	National Institute of Clinical Excellence
NICU	Neonatal Intensive Care Unit
NS	Non Significant
NSW	New South Wales
OR	Odds Ratio
OT	Oxytocin
PPH	Postpartum Haemorrhage
PRF	Proven Risk Factors
RANZCOG	Royal Australian New Zealand College of Obstetricians and Gynaecologists
RCT	Randomised Controlled Trial
RH	Rural Hospital
RR	Relative Risk
SCN	Special Care Nursery
S2S	Skin-to-skin

S2S and B/F	Skin-to-Skin and Breastfeeding
SPSS	Statistical Package for Social Sciences
SVD	Spontaneous Vaginal Delivery
TBA	Traditional Birth Attendant
TH	Tertiary Hospital
TRF	Traditional Risk Factors
TMH	The Maitland Hospital
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
UNFPA	United Nations Family Planning Association
WHO	World Health Organisation

CHAPTER 1

This dissertation answers the research question:

'***Does skin-to-skin contact and breastfeeding immediately following birth affect the rate of early postpartum haemorrhage?'***

I will be arguing that although this study was conducted in Australia, a resource-rich Western country, the findings may be applicable to all women because of the shared reproductive physiology (Chapter 2). This dissertation concerns the possibility that the combination of skin-to-skin contact at birth for mothers and their babies, together with breastfeeding, may reduce the rate of primary postpartum haemorrhage (PPH), defined in table 1.1, and subsequently maternal morbidity and mortality.

Postpartum haemorrhage (PPH) can have widespread, devastating effects. Not only are women at risk of dying, but in developing countries, if women do die, their babies are also less likely to survive. (Anderson et al. 2007; Horton 2005; Razzaque et al. 2013 ; Ronsmans et al. 2010; UNFPA 2012; Yamin et al. 2013).

This chapter introduces the present study and considers the problem of PPH both within the Australian (Western) and broader global context. Next is a critique of the medical research that claimed to be able to prevent PPH which forms part of the background to this study. My interest in this topic and my experience as a midwife and senior midwifery manager is detailed. The context for this study, the Hunter New England Area Health Service (HNEAHS), is then described. Finally the significance of the present study is justified and the remaining chapters are outlined.

Key biological and theoretical terms used are defined in Table 1.1 below.

Table 1.1 Definition of key terms

Term	Definition
Active management of 3rd stage of labour	The clinician intervenes by injecting into the mother's thigh/upper arm a prophylactic uterotonic drug Syntocinon 5-10 units with the birth of the baby's anterior shoulder. There is early clamping and cutting of the cord and the placenta is delivered with controlled cord traction (New South Wales Health. Primary Health & Community Partnerships 2005).
Atony	Lack of uterine tone and contractions during the third and fourth stage of labour (Breathnach & Geary 2009)
Breastfeeding at birth	Any attempt by the baby to nuzzle or suckle the mother's breast whilst the mother remains in the birthing unit, operating theatre environment or at home, in the first 30 minutes after birth; involves a multisensory experience for the woman and her baby (Uvnas-Moberg 2013a).
Correlation	A change in one variable is generally accompanied by changes in other variables in same or opposite direction (Field 2009).
Direct maternal death	A maternal death that is the result of a complication of the pregnancy, labour or birth or management of these (Say et al. 2014).
Endogenous Oxytocin	A naturally occurring hormone produced by the brain which has local and central effects (Gimpl & Farenholtz 2001). Local effects include contraction of the uterine muscle and milk ejection during lactation. Central effects relate to complex social and bonding behaviours (Uvnas-Moberg 2003).
Epidemiology	Is the science which studies causes, patterns and effects of health and disease conditions in defined populations (Field 2009).
Eulochia	The expected physiologically safe amount of blood loss following the birth of the baby until 6 weeks postpartum. This is a new term coined for this dissertation. The average blood loss at birth has been estimated at 500 ml or less.

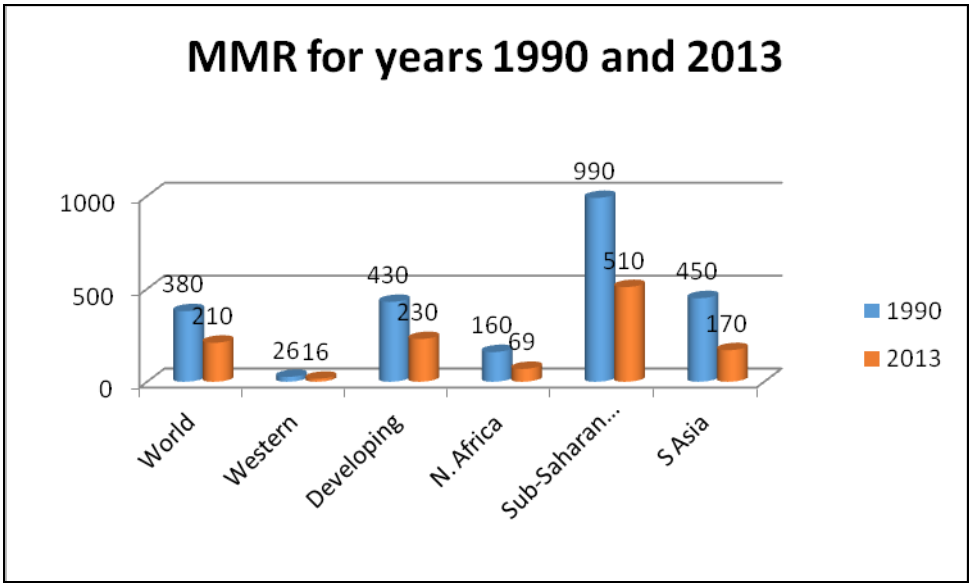
Eutony	Optimal physiological tone and functioning (contraction and retraction) of the uterus during the 3rd and 4th stages of labour (new term coined for this research).
Expectant management 3rd stage	The placenta delivers naturally and without the administration of a drug and without controlled cord traction (Begley et al. 2010).
Healthy baby	Babies who are 37+0 to 42+0 weeks gestation at time of birth and did not require admission to the neonatal unit. These babies will have an APGAR score of at least seven or more at five minutes of age. A stands for activity (muscle tone), P stands for pulse (heart rate), G stands for grimace (reflex response), A for appearance (colour) and R for respiratory rate (breathing) (Fraser & Cooper 2009). This score is an assessment of the baby's physical health, ascertained at one minute, five minutes and ten minutes of age: a score of zero, one or two is given for each of five signs. An APGAR score of less than seven at five minutes of age is an indicator of a compromised baby.
Indirect maternal death	A maternal death due to a pre-existing or newly developed health problem unrelated to the pregnancy (Say et al. 2014)
Maternal Mortality Ratio (MMR)	Number of maternal deaths during a given time period per 100, 000 live births during the same time period (Say et al. 2014)
Maternal mortality rate	Number of maternal deaths in a given period per 1000 women of reproductive age during the same time period (Say et al. 2014)
Neuro hormone	A hormone that is produced and released within the brain and which acts primarily on brain functions but also influences various sites within the body (Pert 1999)
ObstetriX data base	A midwife controlled computerised data base which tracks women from the first antenatal visit, through labour and birth and postpartum until the woman and her baby are discharged from the health service.

Physiological 3rd stage care (midwifery definition)	The midwife acts as a midwifery guardian to keep the birth territory safe, doing unobtrusive observations. The room is warm and dim. Woman is in upright position. Few words are spoken and when speaking, a soft voice is used. Baby immediately placed skin-to-skin (S2S) and spontaneous breastfeeding (B/F) encouraged. The woman and support persons know labour is not ended until placenta is extruded naturally without aid of artificial oxytocin. No mobile phones or cameras used for first hour after birth (Hastie & Fahy 2009)
Physiological 3rd stage care (NICE definition)	No routine use of uterotonic drugs No clamping of the cord until pulsation has stopped Delivery of the placenta by maternal effort (National Institute of Clinical Excellence 2014)
Postpartum haemorrhage	Blood loss of 500 ml or more and occurring within the first 24 hours after childbirth (New South Wales Health. Primary Health & Community Partnerships 2005; World Health Organisation 2012a). For the purpose of this study the term refers to blood loss after childbirth as recorded in ObstetriX whilst the woman remains in the birthing unit, operating theatre environment or at home.
Pronurturance	The combination of skin-to-skin contact and breastfeeding within 30 minutes of birth New term coined for this thesis
Psychophysiology	The discipline that studies mind-body interactions and the impact of the environment by integrating the traditional disciplines of anatomy, physiology and psychology (Cacioppo, Tassinary & Berntson 2007).
Skin-to-skin contact	The naked baby is positioned prone on the mother's bare chest immediately following birth and covered with a warmed blanket.

BACKGROUND

The United Nations Millennium Development Goal 5 (MDG 5) had a target of 75% reduction in maternal mortality by 2015 (United Nations 2000; World Health

Organisation 2012b). The maternal mortality ratio (MMR) is the statistic of choice for the World Health Organisation (WHO) to monitor women's death rates associated with reproduction. The MMR is an estimate that is based on available data, oral mortality reports and expert opinion (WHO, UNICEF, UNFPA, The World Bank & the United Nations Population Division 2014). The latest estimates of global maternal deaths were 2,443,000 for 2013 (all causes including direct and indirect) (Say et al. 2014). About 73% of maternal mortality was due to direct causes (n = 1,771,000), of these about 27% was due to obstetric haemorrhage (mostly PPH) (n = 479,941) (Say et al. 2014). Figure 1.1 shows the decrease (about 45%) in the MMR from 1990 compared with the statistics from 2013 (WHO et al. 2014).



Adapted from WHO et al. 2014, *Trends in Maternal Mortality: 1990-2013*

Figure 1.1 Comparison of 1990 with 2013 MMR by selected regions.

Although MMR has declined (from 1990 - 2013), the rate of decline implies that WHO will not meet the MDG target in as many countries as planned, given the reliance on oral and unpublished reports from the developing world (Bale, Stoll & Lucas 2003; Prata et al. 2010). Paradoxically, despite the overall decline in MMR, the rate of PPH continues to rise around the world (Alvarez et al. 2009; Ford et al. 2007a; Joseph et al. 2007; Knight et al. 2009; Lutomski et al. 2012; Mehrabadi et al. 2013) The

reduction in MMR in the developing world is most likely due to WHO providing education programmes (World health Organisation 2012a; World Health Organisation 2012b) on prevention, identification and management of PPH. However in some remote areas there is still limited access to qualified staff, hospital and contraception (UNFPA 2012). These factors may adversely impact on a woman's general health, which may explain why the PPH rates are continuing to rise in these areas. In the West this rise in PPH rates may be due to increasing medical intervention during labour and birth (Odent 2001a). Medical interventions may disrupt reproductive physiological processes such a release of endogenous oxytocin following birth as explained in Chapter 2, Part 1, thus preventing normal contraction and retraction of the uterus (Saxton et al. 2014). However ready access to intensive care services in the West means fewer women die from PPH. See below for detailed discussion on resuscitative measures.

Postpartum Haemorrhage Morbidity

In the Western world, PPH is the leading cause of maternal admission to the intensive care unit (B-Lynch et al. 2006). Low numbers of deaths from PPH in the Western world is due not so much to the effective prevention of PPH, but to the ability of the Western Health Care system to intervene to stop the bleeding and resuscitate women who haemorrhage. Medical interventions to stop postpartum haemorrhage include: the use of the Bakri balloon, a soft silicone intrauterine catheter that is inflated to provide direct pressure on bleeding vessels; blood and blood products and recourse to major surgery (Panda et al. 2009); manual removal of placentae, ligation of the internal iliac arteries and hysterectomies (Anderson & Etches 2007; Anderson, Etches & Smith 2000; Bibi et al. 2007; Cameron et al. 2006; Hazra et al. 2004; Rossi, Lee & Chmait 2010). All of the above interventions are supported by intensive care facilities at major hospitals (Brace, Kernaghan & Penney 2007). These resuscitative measures save the lives of women which would otherwise be lost.

Compared with women in the developing world, few Western women are haemodynamically affected by 500-1500 ml PPH because they are much less likely to be anaemic in pregnancy and are relatively healthier (Ford et al. 2007a). The first signs of haemodynamic compromise are an increasing respiratory rate, feeling

anxious and a rising pulse rate (Stables & Rankin 2005).

In the developing world, many women suffer from anaemia and may be malnourished (Milman 2012). Therefore, a smaller blood loss than the currently accepted definition of 500 ml or more may result in morbidity or even mortality for women with anaemia who bleed after giving birth. . As Figure 1.1 depicts MMR is lower in the Western world because women are generally healthier and there is ready access to intensive care services, (Naz et al. 2008; Rossi et al. 2010; Wise et al. 2010). In Australia, for example, for the five years 2006-2010, there were only seven (7) out of 39 direct maternal deaths related to obstetric haemorrhage giving an MMR of 0.6 (Johnson et al. 2014, p. 16). See Table 1.2 for details.

Table 1.2 Causes of direct maternal deaths, Australia 2006-2010

Cause	Number	Percentage (%)
Amniotic fluid embolism	9	23.1
Thromboembolism	8	20.5
Obstetric haemorrhage	7	17.9
Eclampsia	6	15.4
Sepsis	5	12.8
Early pregnancy death	3	7.7
Non obstetric haemorrhage	1	2.6
Total	39	100.0

In both the developing and Western world, PPH causes serious morbidity such as anaemia, psychological problems, problems with lactation, infertility and various surgical procedures including hysterectomy (Goldenberg & McClure 2011; Mousa & Walkinshaw 2001; Ojala et al. 2005; Shah & Wright, 2009; Thompson et al. 2010; Wise et al. 2010). However in the developing world, the consequences of a woman having a PPH are magnified as her baby is put at risk of malnutrition (Brady 2012) and /or death (Anderson et al. 2007; Horton 2005; Razzaque et al. 2013; Ronsmans et al. 2010). Unlike women in the western world, women in the developing world do not have ready access to contraception and have large families-all of which may impact adversely on their general health (Bale, Stoll & Lucas 2003).

Establishing the PPH rate for any period is complicated by the different definitions used across time. For example, in the 70s and 80s PPH was defined by Western Obstetricians as 600 ml or more of blood loss after birth (Cunningham et al. 2001)

and this amount matches my memory, as a senior midwifery manager for many decades, from the time. The definition of PPH was changed in NSW in 1990 to 500 ml or more for a vaginal birth and 750 ml or more for a caesarean section without any scientific rationale (Ford et al. 2007a). The definition was changed again to 500 ml or more for all births, including caesareans in 1998/99 and again without any scientific rationale (Knight et al. 2009).

The volume of blood loss defined as constituting a PPH differs in various states, territories and countries. Currently in Australia, states and territories do not have the same definition: definitions range from the WHO/International Classification of Diseases (ICD 10) definition of PPH, i.e. blood loss of greater than 500 ml occurring in the 24 hours following birth or any amount that adversely affects maternal physiology (International Classification of Diseases 2014; World Health Organisation 2012b) all the way through to reporting only PPH requiring blood transfusion (Hilder 2013; Knight et al. 2009). Interestingly NSW Health now has two definitions of PPH; at the state level for all maternity hospitals it is more than 499 ml (New South Wales Health, Primary Health & Community Partnerships 2005) but externally NSW Health only reports PPH requiring blood transfusion to the Perinatal Statistics Unit of the Australian Institute of Health and Welfare (AIHW) for inclusion in the published Australian Mothers and Babies Reports (Hilder 2013; Hilder et al. 2014). In other countries definitions also differ. In Belgium, reportable PPH is the same as that required for external reporting purposes in NSW, i.e. only reporting PPH when a blood transfusion was administered. In Canada, PPH is defined as 500 ml or more for a vaginal birth and *1000 ml* for caesarean section or "*if the physician made a notation in the woman's medical record"* (Knight et al. 2009, p.3). These differences in definitions across time and across jurisdictions make the comparison of PPH rates difficult or impossible.

In spite of these differences and regardless of the measure used, the literature agrees that PPH rates have been steadily rising in Australia and in the West (Cameron et al. 2006; Haynes, Stone & King 2004; Joseph et al. 2007; Knight et al. 2009). As described above, although the Maternal Mortality Ratio has declined in the developing world, the rate of PPH has not. According to Knight et al. (2009) the Australian PPH rate rose from 4.7% in 1994 (the first year data was published by

AIHW) to 6.9% in 2006. In contrast to the PPH rates (above), the actual 2010 PPH rate at the tertiary hospital where I worked was 24% (Marsh 2010). Chart audits, however, indicate that PPH rates from hospitals are under-reported by about 40% at the state and national level (Taylor et al. 2005) making meaningful comparisons on PPH rates between hospitals based data and national published data difficult.. So, in summary, regardless of definitions and how blood loss is measured, the PPH rates have been rising over the past 30 years and the actual PPH rates, if defined as 500 or 600 ml, are substantially higher than the national statistics report.

A major change in maternity care in the past 30 years has led to increasing rates of induction, augmentation, epidural and caesarean section. I wondered if increasing medicalisation in birth was a causal factor in the rising rates of PPH. Although a detailed analysis of this question is beyond the scope of my dissertation, some contextual discussion is justified as set out below when considering the medical treatments that have apparently affected PPH rates.

Correlation between Rising Medicalisation of Birth and Rising PPH Rates

Increasing rates of medicalisation of birth correlate with the rising rate of PPH (Belghiti et al. 2011; Grotegut et al. 2011; Odent 2001b; Rossen et al. 2010; Simpson & Thorman 2005). In the 1970s before published reports, hospital PPH rates were around 6%. My memory, as a senior midwifery manager for many decades, is that labour inductions/augmentations were relatively rare and caesarean section rates were under 10%. This compares with current statistics of labour induction rates in NSW of 27.3% (Hilder et al. 2014a). Low intervention rates in the 1970s is supported by the only published report found, which was from Western Australia (WA) for 1975-1978 which showed an increase in caesarean section rates from 4.1% to 7.1% (Stanley & Bedford 1980). This was just the beginning of a long climb upwards with the current caesarean rates in the city of Perth, WA ranging from 35.5% to 55.8%; regional hospital rates range from 15% to 30% (Jones 2013). The rates of induction and augmentation were not recorded in 1975 in WA statistics but they would have been very low.

A selection of medical interventions during labour and birth was extracted from Australia's Mothers and Babies reports from 1999 to 2012 (Hilder et al. 2014a; Laws & Hilder 2008; Laws, Li & Sullivan 2010; Li et al. 2012; Nassar & Sullivan 2001) to ascertain the correlation, if any, with PPH. See Figure 1.2.

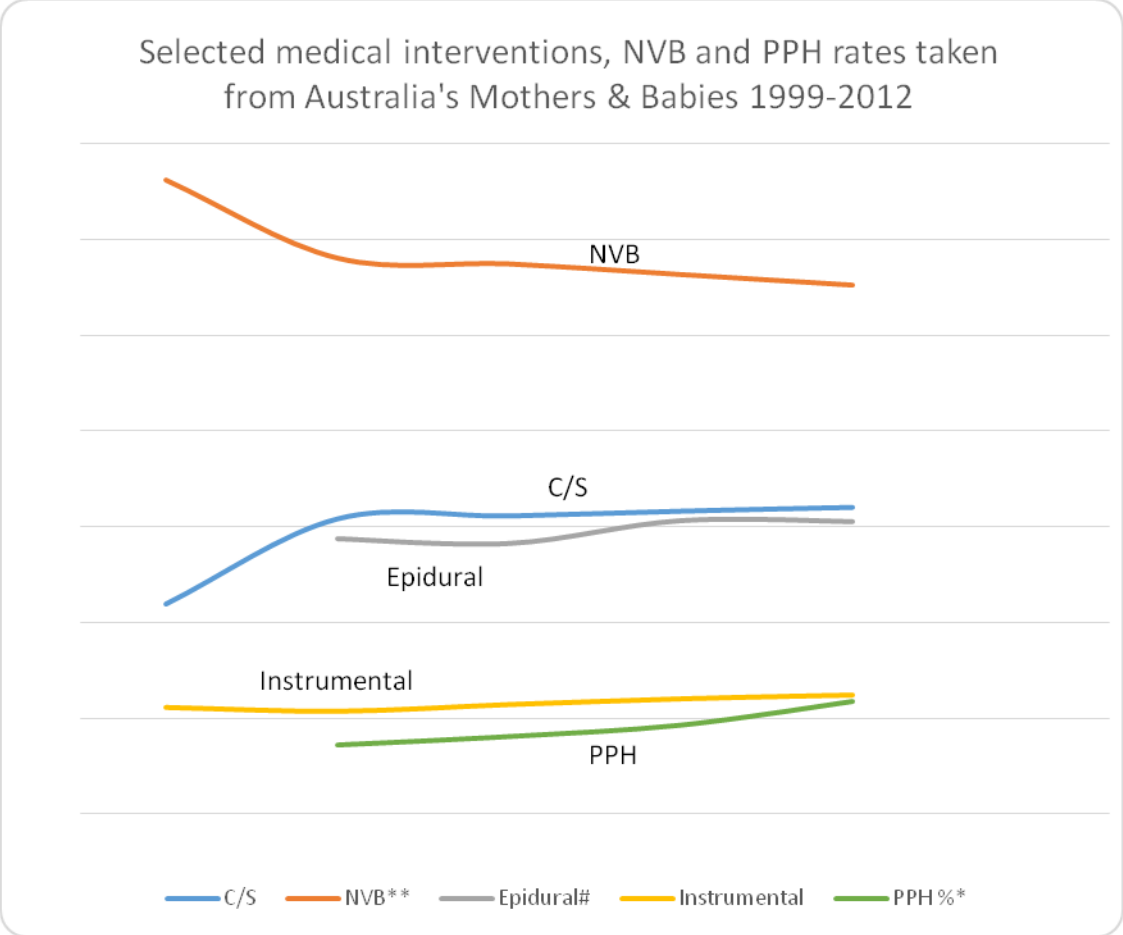


Figure 1.2 Rates of medical interventions in birth and PPH rates 1999-2012

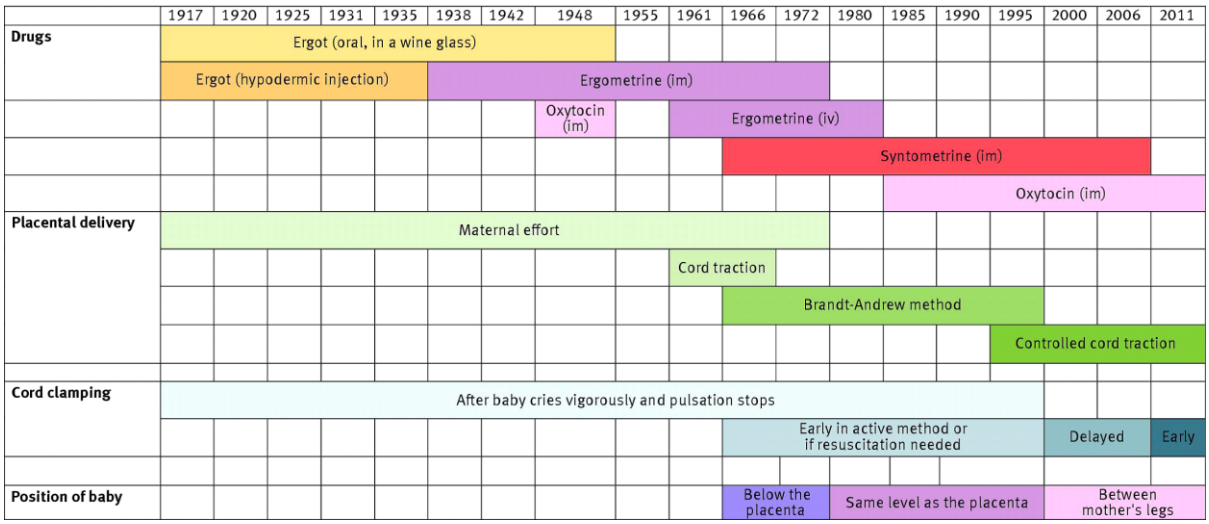
It should be noted that Normal Vaginal Birth (NVB**) includes breech births whether forceps were used for the after coming head or not (for NSW and WA since 2012). The definition of PPH*used was ≥600ml or with blood transfusion used (NSW only). Epidurals# included caudal blocks.

The trend lines in Figure 1.2 appear to demonstrate a prima facie case that increasing rates of medical interventions in labour and birth are associated with rising PPH rates. In Chapter 2, I present the argument and physiological evidence as to why medicalisation of birth is a major causal factor in atonic uterus; the cause of the

vast majority of PPHs (Cunningham 2010; Lutomski et al. 2012; Mehrabadi et al. 2013; Weeks 2015; Wickham 2011). The possible correlations in Figure 1.2, however, must be viewed with caution because of the different ways of defining and reporting PPH as described above. One major increase in medicalisation at birth has been to make the active management of the 3rd stage of labour mandatory for all women, at least in NSW where this study is located (New South Wales Health, Primary Health & Community Partnerships 2005).

Does the Active Management of the 3rd Stage of Labour Prevent PPH?

In the developed world maternity clinicians have little or no experience with providing physiological 3rd stage care. That lack of experience is because the medical model has controlled the vast majority of births and interfered with normal female physiology for a hundred years or more in the West (Alfaifel & Weeks 2012) without any reference to the physiology of labour and birth. There is no recognition that the highest levels of maternal endogenous oxytocin are released naturally during the 3rd and 4th stages of labour (Rahm et al. 2002), especially if the woman breast feeds her baby at that time (Chua et al. 1994). Disruption to normal physiology as detailed in Chapter 2, Part 1 is likely to result in PPH because of interference with the uptake of endogenous oxytocin at the receptor level (Odent 2001a; Saxton et al 2014).. See Figure 1.3 for 3rd stage management across the years.



Reproduced with permission from Alfaifel & Weeks (2012)

Figure 1.3 Management of the 3rd stage of labour across the years

The answer to prevention of PPH, is supposed to be the active management of the 3rd stage of labour. Active management is promoted by state, national and international health bodies including the International Federation of Gynaecologists and Obstetricians (FIGO), the International Confederation of Midwives (ICM) and WHO (International Confederation of Midwives & International Federation of Gynecology and Obstetrics 2003; World Health Organisation 2012b). Worldwide, however, in spite of active management, an estimated 10 maternal deaths occur every hour due to PPH (Say et al. 2014; Weeks 2015). The Cochrane systematic reviews, discussed below, have been most influential with health bodies mandating the active management of the 3rd stage of labour as evidence-based practice. In the following section, I briefly review the research regarding active versus expectant management of the 3rd stage of labour. My research question examines two elements of 3rd stage care (skin-to-skin contact and breastfeeding) which are related to, but more complete than, the definition of expectant management provided in Table 1.1 above.

The Cochrane Reviews of Active Versus Expectant Management

A randomised controlled trial (RCT) conducted in 1988 (Prendiville et al. 1988) claimed that active management of the 3rd stage of labour reduced the PPH rate to around 5.9% compared to 17.9% for expectant/physiological management (Odds Ratio (OR) 3.13, 95% Confidence Interval (CI) 2.3-4.2). The initial Prendiville study was followed by a number of RCTs (Jangsten et al. 2011; Kashanian et al. 2010; Rogers et al. 1998) and several Cochrane reviews (Begley et al. 2010; Begley et al. 2011; Begley et al. 2015; Prendiville, Elbourne & McDonald 2009) all purporting to show that active management of 3rd stage was superior to expectant management. The RCT by Prendiville et al. (1988) was the basis for the introduction of the mandatory policy of active management of the 3rd stage of labour in maternity units across Australia in 2002 (Ford et al. 2007a). In NSW, both active and physiological management of the 3rd stage of labour was used up until 2005; although active management was highly dominant during those years. In spite of the medical management of the 3rd stage of labour, the world is experiencing increasing rates of

PPH year after year (Cameron et al. 2006; Ford et al. 2007). New South Wales (NSW) Health did not mandate active management of the 3rd stage of labour for all women until 2005 (New South Wales Health. Primary Health and Community Partnerships, 2005) based on the Cochrane review in 2000 (Prendiville, Elbourne & McDonald 2000). The latest 3rd stage Cochrane Review (Begley et al. 2015) was based on a meta-analysis of RCTs from seven hospitals: six located in high-income countries and one in a low-income country. The evidence from this Cochrane review showed a reduction in risk of PPH (>1000 ml) (average risk ratio (RR) 0.34, 95% CI 0.14-0.87) for mixed risk women (n = 4636).). An analysis of the effects of active versus expectant management on the risk of PPH (≥500ml) was a secondary analysis in the latest review because of the adverse effects on women of routine active management for all women e.g. elevated blood pressure (Begley et al. 2015). In this review Begley et al. advocated that low risk women be given the choice of active or expectant management providing the risks and benefits of both are outlined so women can make an informed choice.

A number of criticisms undermine the validity and generalisability of the Cochrane Reviews of active versus expectant management of the 3rd stage of labour, including the latest review (Begley et al. 2015).

Firstly, in the underpinning trials, ,women were mostly allocated to their groups in the antenatal period (Begley 1990; Prendiville et al. 1988): occasionally they were allocated on admission to birthing units (Khan et al. 1997; Prendiville et al. 1988; Rogers et al. 1998). This allocation meant some women had changed risk status before and during labour. Putting women, who may develop risks into groups based on Intention To Treat (ITT) places them at increased risk of PPH, not because of group allocation but because 1) in the RCTs underpinning the Cochrane Reviews the midwives were being asked to swap between active and physiological 3rd stage care (based on the random allocation of the women) and these midwives had not been assessed for their knowledge, skill and confidence in physiological care (Fahy 2009). Secondly using mixed methods of 3rd stage care are well known to increase risk of PPH (Cunningham 2001;Khan et al.1997). Thirdly the definition of physiological care in the Cochrane reviews had only one mandatory common element i.e. not using artificial uterotonics prophylactically- I will reference back to biology in the following

Chapter 2, parts 1,2 and 3 to support the assertion that physiological 3rd stage care is much more complex, holistic and skilful than the Cochrane Reviews and the underpinning RCTs tested.

The Cochrane Reviews can be critiqued on the basis of not having clearer exclusion criteria (Fahy 2009). Women who did not have a physiological labour should not have been enrolled in the study at all because a decision to facilitate physiological 3rd stage care cannot be safely taken until after a physiological labour and birth (Dixon et al. 2011; Hastie & Fahy 2009). There is increasing evidence that interventions during labour and birth are more likely to result in PPH (Buckley 2009; Dixon et al. 2011; Fahy et al. 2010; Grotegut et al. 2011) due to disruption of normal physiological processes, such as release of endogenous oxytocin.

A careful reading of the RCTs and Cochrane systematic reviews of the management of the 3rd stage of labour do not take account of reproductive physiology (Fahy 2009). The lack of attention to reproductive physiology is unsafe, particularly for women whose 3rd stage labours were managed by withholding oxytocin in the wrong context, and with clinicians who were unskilled in facilitating a physiological 3rd stage. The differences between expectant and physiological care in 3rd stage of labour are highlighted in Table 1.1 and are well described in the midwifery literature (Fahy 2009; Fahy et al. 2010; Fry 2007). The midwifery definition of physiological care differs substantially from that of the current NICE guidelines (National Institute of Clinical Excellence 2014) also described in Table 1.1.

Finally, there was no checking of protocol compliance by the research team to ensure that the care was given as planned (Fahy 2009). Training and checking protocol compliance in the expectant care group was particularly crucial because active management had been institutionalised for years before the trials commenced. Indeed, the trials were all carried out in hospitals where active management of the 3rd stage of labour was the norm (Fahy 2009). Many midwives, therefore, did not have the knowledge or expertise to safely facilitate a physiological 3rd stage. These midwives then would have interfered with normal physiology as they were used to doing and inadvertently caused preventable PPH (Fahy 2009; Harris 2001).This criticism is strengthened by research carried out before the PPH trials (Featherstone

1999) where midwives were surveyed as to their understanding of physiological 3rd stage care with only 57% having the knowledge and confidence to carry out that type of care safely.

These criticisms of the randomised controlled trials underpinning the Cochrane Reviews demonstrate an unacknowledged bias towards active management by including women with risk factors for PPH in the expectant arm (Fahy 2009). The inclusion of women with risk factors in the expectant arm of the study was unsafe. What is not known is how effective physiological care is by skilled midwives for women at low risk of PPH at the end of the 2nd stage of labour. This dissertation goes some way to answering that question. Chapter 2 describes reproductive physiology with discussion on physiological 3rd stage of labour care.

Skin-to-skin and breastfeeding are two elements of physiological 3rd stage care. If these two elements show a decrease in PPH rates, as I hypothesise in this dissertation, then that is evidence towards the benefits of full physiological care in the 3rd stage of labour.

MY INTEREST AND BACKGROUND

I have practiced as a midwife for more than 40 years in a variety of settings in Australia. I have worked as a clinician in small rural and medium sized metropolitan hospitals and as a manager in large tertiary referral units. I have also worked as a homebirth midwife. From my broad experiences, I have observed increasing medicalisation of the childbearing process; an observation which is borne out by various Australian publications (Hilder et al. 2014a; Laws & Hilder 2008; Laws, Li & Sullivan 2010; Li et al. 2012; Nassar & Sullivan 2001; Lumby 2001, p. 33). The advent of accurate birth records in the Western world since the 1990's (Ford et al. 2007a; Joseph et al. 2007; Knight et al. 2009; Rouleau et al. 2009) has identified the rapid rise in the rate of PPH as a major issue in maternity services (Lumby 2001; Mander & Murphy-Lawless 2013).

My management role involved responsibility for 19 maternity units, which included a very busy tertiary referral unit, regional units and small rural units. Meetings with key

stakeholders to discuss maternity services outcomes occurred on a regular basis. The outcomes discussed at these meetings included the rates of PPH and what could be done to ameliorate or prevent recurrence, especially as we planned the introduction of midwife-led antenatal clinics for healthy women and continuity of care models. Recent research has shown these models result in lower PPH rates (Catling-Paull et al. 2013; Davis et al. 2012; Dixon et al. 2009; Fahy et al. 2010).

In my role as a homebirth midwife, I observed that women who experienced a homebirth with a known midwife did not, generally speaking, experience excessive blood loss following the birth. As the manager of tertiary referral units, I also observed that PPH rates for women birthing in a public hospital, with independent midwives with visiting rights, were also low. I was interested to understand why PPH rates were rising in the maternity service setting. What was different when midwives were primary caregivers and was there anything that could be done to halt and reverse the trend of increasing PPH rates.

A major impetus for starting this study was trying to understand why the rate of PPH had not reduced to around 6% as foreshadowed with the implementation of active management of the 3rd stage of labour (Prendiville et al. 1988) but had instead, continued to rise (Bateman et al. 2010; Cameron et al. 2006; Ford et al. 2007a; Knight et al. 2009). As will be explained in Chapter 3, part 1 the major cause of PPH is uterine atony which is thought to account for 70-90% of all PPH (Bateman et al. 2010; Driessen et al. 2011; Khan & Refaey 2012; Lutomski et al. 2012; Mehrabadi et al. 2013; Wickham 2011). I found the apparent necessity for all women to require artificial oxytocin for their 3rd stage of labour disturbing, because it implied human females are unique among mammals in having high rates of endogenous oxytocin deficiency during birth. Equally, because the rates of PPH are continuing to rise in Western countries, it suggests successive generations of Western women must have progressively less endogenous oxytocin and/or fewer oxytocin receptors (Kruska 1993; Odent 1998). Along with other researchers and theorists, I began to think that our model of maternity care was likely to be causing oxytocin deficit in women (Odent 2015). I was also recognising that the effects of the maternity care system could not be eliminated by using an artificial form of oxytocin (See Chapter 2 for more detail and discussion on physiology).

CONTEXT OF THE STUDY

The setting is three hospital maternity units, managed as a single entity within the former Hunter New England Area Health Service (HNEAHS). In 2010, NSW was divided into 15 Local Health Districts (eight metropolitan and seven rural) of which Hunter New England Health is one of the rural networks. See Figure 1.4 for Map of NSW Area Health Services and Figure 1.5 for Map of HNE Local Health Network (both adapted from http://www.hnehealth.nsw.gov.au).

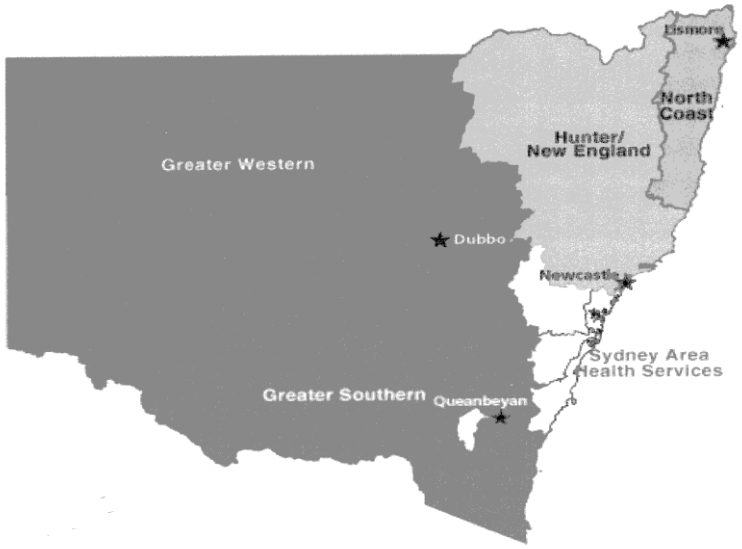


Figure 1.4 Map of NSW Area Health Services

Hunter New England Health is subdivided into seven clusters. The three study sites are in the Greater Newcastle cluster.

Figure 1.5 Map of Hunter New England Local Health Network

The three hospital maternity units in this study are: John Hunter Hospital (JHH), a principal tertiary referral unit, the Maitland Hospital (TMH) which is a regional unit and the Belmont Birthing Services (BBS). The BBS is a midwife-led model, providing continuity of care in a stand-alone birth centre or at-home for well women with normal, healthy pregnancies. There are approximately 6100 births per annum between the three maternity units. The electronic data base ObstetriX, the database of public sector births in NSW (Ashton 2010), is used in all three units to record maternity care and outcome details. The midwife transcribes data from a woman's paper medical record into the ObstetriX database at the point of care. The data includes antenatal, labour and delivery and postnatal care from first contact until the woman is discharged from the health service. The data used to answer the research question was retrieved from ObstetriX. Additional information regarding HNEAHS and ObstetriX is included in Chapter 4 Methodology and Appendices 4B and 4C.

The Australian Regulatory Context

Concern about high rates of medical interventions in birth, particularly caesarean section, has resulted in the formulation of a national maternity services plan in Australia (Newham 2010). The plan recommends that women have a choice of maternity service provider and also that the role of the hospital-based midwife should expand to include the community setting. Appropriately qualified midwives should, according to this plan, have access to Medicare and insurance/indemnity for home births. There has been strident opposition to the recommendations of the Newham (2010) plan by the Royal Australian and New Zealand College of Obstetricians and Gynaecologist (RANZCOG) and the Australian Medical Association (AMA). The Australian medical profession acknowledges that women have the right to be informed about various options of care, but vociferously opposes home birth for well women (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists 2014). This opposition is in spite of research from England that suggests the risk/odds of PPH is greater for an intended hospital birth than an intended home birth (OR 2.5, 95% CI 1.7-3.8) (Nove, Berrington & Mathews 2012). Additionally the 2014 guidelines on intrapartum care by the National Institute of). In Australia the PPH rate associated with homebirth is quite low as compared to hospital birth (Catling-Paull et al. 2013; Marsh 2010). The 2014 guidelines on intrapartum care by the National Institute of Clinical Excellence (NICE) include home birth as an option for well women (National Institute of Clinical Excellence 2014). There is no indication at this time (2015) that the AMA or RANZCOG will change its stance on homebirth.

(See Appendix 1 for more details of the Australian maternity care system and its development over the past 40 years).

Government Policies and Regulations Affecting Birth Care

In 2005 and 2006 NSW Health released two important policies on care in the 3rd and 4th stages of labour. The first policy, as mentioned previously, mandated the routine use of active management of 3rd stage of labour in all public maternity facilities. This policy challenged the physiological care that midwives and women experienced at

Belmont Birthing Service (Fahy et al. 2010; New South Wales Health, Primary Health & Community Partnerships 2005). The second policy, in line with the Baby Friendly Hospital Initiative (BFHI) was to encourage women to breastfeed their babies immediately following birth in an effort to improve the rate of sustained breastfeeding (New South Wales Health, Primary Health & Community Partnerships 2006; Pincombe et al. 2008; UNICEF & World Health Organisation 2009). Breastfeeding is an important population health measure as it is protective against a number of short and long term health problems for both mother and baby (Commonwealth of Australia 2009; Leon-Cava et al. 2002). In Australia whilst the rate of initiation of breastfeeding at birth is high (92%), by six months of age this rate declines to 14% (Commonwealth of Australia 2009). Whilst the primary focus of the skin-to-skin and breastfeeding policy in NSW was on increasing the initiation and sustainability of breastfeeding, there was no discussion that there may be other beneficial effects, such as reducing the risk of PPH.

SIGNIFICANCE OF THE RESEARCH PROJECT

This research project is significant because it may provide clear evidence that simply ensuring skin-to-skin contact for women and their babies at birth along with the multisensory process of breastfeeding may be protective against both the incidence and severity of PPH. Lower rates of PPH have the potential to decrease maternity morbidity and mortality across the world. Not only will women be healthier and in better condition for parenting their infants if their postpartum blood loss is minimised, but their ability to breastfeed will be improved (Crenshaw 2007; Leon-Cava et al. 2002; Mikiel-Kostyra, Mazur & Boltruszko 2002; Narvaez 2013; Odent 2001a; Trevathan 2013). With improved maternal health and early initiation and continuation of breastfeeding, infant mortality in the developing world may also decrease (Boschi-Pinto, Bahl & Martines 2009).

LIMITATIONS OF THE RESEARCH PROJECT

The limitations of this research include that it was not an RCT, believed to be the gold standard of research (Ho, Peterson & Masoudi 2008). However, there is emerging disquiet amongst some researchers that RCT's do not account for particular

circumstances and therefore the significance of any results from RCT's may be overestimated (Soltani 2008). Another limitation was that post-birth blood loss was visually estimated. Research has demonstrated that visual estimation of post birth blood loss is unreliable especially when there is a large blood loss with an underestimation of 30-50% (Glover 2003; Schorn 2010).). However visual estimation is usual practice in most maternity settings as well as research involving 3rd stage management.

DISSERTATION OVERVIEW

The remaining chapters are described in summary here. Chapter 2 presents the 'Conceptual Framework' divided into three parts. Part 1 reviews the biological, scientific understanding of the structure and function of the myometrium, including the neuro-hormonal regulation of uterine contraction, retraction and the maintenance of eutony and eulochia—this part of Chapter 2 has been published as a peer-reviewed paper (Saxton, Fahy & Hastie 2014). Part 2 discusses how a woman's thoughts and feelings, and where she focuses her attention, affects and are affected by the autonomic nervous system. The third part presents a new theory called Pronurturance Plus—which integrates concepts from Birth Territory Theory and Parts 1 and 2. Pronurturance Plus theory describes, explains and predicts the conditions under which a woman's endogenous oxytocin release and uptake is optimised and bleeding is minimised. Chapter 3 is also organised into two parts. Part 1 is a review of the research literature concerning the risk factors for PPH with an emphasis on identifying those factors that are the most likely causes of uterine atony. Part 2 describes and critically discusses the research literature of direct relevance to this study. Chapter 4 presents the methodology for the study. The research setting is described and the ethical dimensions of the study, including the values and principles guiding the research, are provided. The chapter includes a detailed account of the research design, setting, data collection and data analysis methods. Chapter 5 presents the research findings of this study; these findings have been accepted for publication as a peer-reviewed journal paper (Saxton et al. 2015). In Chapter 6, both theory and basic science are used to interrogate and interpret the quantitative findings in a search for an enhanced theoretical understanding of how the psychophysiology of the woman/baby can be optimised in labour and birth. The key

arguments and evidence presented in this dissertation to answer the research question are summarised. In this final chapter, the recommendations for policy, midwifery and medical practice and education are detailed.

CONCLUSION

In this chapter I have introduced the study and set it within the global and Australian context. I have presented the possibility that modern maternity settings and the way in which maternity care is provided may be contributing to the increasing rates of PPH. I have explained my background and my interest in the topic. The significance and limitations of the study are presented and finally, the content of the remaining chapters of this dissertation have been summarised.

CHAPTER 2 CONCEPTUAL FRAMEWORK

The present study concerning PPH was introduced in Chapter 1, including discussing the relevant international literature and the context of the study. In that chapter I argued that the present study is justified by current theory and evidence which supports the notion that simply ensuring skin-to-skin (S2S) contact for women and their babies and allowing spontaneous breastfeeding (B/F) in the first 30 minutes after the baby's birth may be protective of PPH (Catling-Paull et al. 2013; Davis et al. 2012; Dixon et al. 2009; Fahy et al. 2010; Hastie & Fahy 2009). Whether or not women and babies experience either or both S2S and B/F is recorded by midwives as 'Yes' or 'No' in ObstetriX, (the electronic data base)—see Chapter 4 for more details on ObstetriX.

Chapter 2 provides the physiological and theoretical frameworks for this study. In approaching this chapter, I want to first acknowledge that the best way to fully understand the living human body is to consider the whole organism: body and mind. The standard bio-medical ways of understanding human anatomy and physiology is based on cadaver anatomy. The human body and its functioning in the bio-medical model is conceptualised and taught as discrete parts, i.e. cells, tissues and organs. In reality, however, the body and mind function as an integrated whole; the subject of the branch of scientific enquiry known as psychophysiology (Cacioppo et al. 2007). In the theory presented in this chapter I seek to capture some of the dynamic interplay between various body systems and organs, and between the mind and body.

This chapter is guided by the question:

"**How does skin-to-skin and breastfeeding at birth affect the physiological functioning of the uterus as it relates to bleeding in the 3rd and 4th stages of labour?"**

In the study reported in this dissertation I defined the concept of 'Pronurturance' which was subsequently operationalised in the methods (See Chapter 4 for more detail). Pronurturance is the simple combination of S2S and B/F within 30 minutes of the baby's birth. The concept of Pronurturance—described and discussed in detail in

this chapter, was chosen because it encapsulates both S2S and B/F and emphasises what is already well known about the benefits of these at birth in terms of breastfeeding and bonding (Crenshaw 2007, Crenshaw 2010; Kennell & McGrath 2003; Klaus 1998; Uvnas-Moberg 2013a).

Key biological and theoretical terms used in this chapter are defined in tables within relevant chapter parts. Basic scientific terms are included in the Appendix 7 Glossary of Terms.

This chapter is divided into three parts:

Part 1 was published as a peer reviewed paper. In that paper I review the biological knowledge of reproductive physiology and the autonomic nervous system as it relates to uterine functioning in the 3rd and 4th stages of labour. Part 1 also describes and explains why skin-to-skin contact in the 3rd and 4th stages of labour optimises oxytocin release and uptake at the myometrium and should therefore minimise bleeding.

Part 2 draws upon advances in cognitive neuroscience and related mindfulness psychology to describe, predict and explain how a woman's thoughts, attention and feelings affects and is affected by her autonomic nervous system which, in turn, affects her reproductive psychophysiology.

Part 3 focuses on the functioning of the woman/baby dyad in the 3rd and 4th stages of labour. The theory of Birth Territory and Midwifery Guardianship (Fahy et al. 2008) together with concepts from Part 1 and 2 and are used to conceptualise a new theory, Pronurturance Plus, i.e. S2S and B/F with more concepts and propositions added. This new theory can be used to describe, explain and predict how the risk of postpartum haemorrhage should be reduced when Pronurturance Plus is practised as routine care in the first 30 minutes after birth.

PART 1

The paper as presented in Women and Birth (2014) follows:

Title: Effects of skin-to-skin contact and breastfeeding at birth on the incidence of PPH: A physiologically based theory

Authors: Anne Saxton, Kathleen Fahy, Carolyn Hastie

Abstract

Background: The importance of optimising maternal/baby psychophysiology has been integrated into contemporary midwifery theories but not in the detail required to really understand the underpinning biological basis.

Method: The functioning of the autonomic nervous system, as it relates to the uterus is reviewed. The physiology of myometrial cell contraction and relaxation is outlined. The main focus is on the factors that affect the availability and uptake of oxytocin and adrenaline/noradrenaline in the myometrial cells. These are the two key neuro-hormones, active in the 3rd and 4th stages of labour, that affect uterine contraction and retraction and therefore determine whether the woman will have an atonic PPH or not.

Discussion: The discussion explains and predicts the physiological functioning of the uterus during the 3rd and 4th stages of labour when skin-to-skin contact and breastfeeding occurs and when it does not.

Conclusion: This biologically based theory hypothesises that to achieve and maintain eutony and eulochia, midwives and birthing women should ensure early, prolonged and undisturbed skin-to-skin contact for mother and baby at birth including easy access for spontaneous breastfeeding.

Introduction

This paper presents a physiologically based theory that describes, explains and

predicts the mechanisms by which skin-to-skin contact and breastfeeding at birth may reduce the incidence of PPH (key terms used are defined in Table 2.1). The ideas for this theory have their roots in the practice, wide reading and writing of the three authors of this paper. The overall focus of this paper is on the neuro-hormonal control of the myometrium, including the regulation of uterine contraction and retraction that is essential to minimise blood loss in the 3rd and 4th stages of labour. First, the background literature concerning the importance of the 3rd and 4th stages of labour is presented. Next, the structure and function of the myometrium is summarised. Then, the functioning of the autonomic nervous system, as it relates to the uterus is described. Attention is then narrowed to the key neuro-hormonal factors, oxytocin and adrenaline/noradrenaline, which interact to affect the functioning of the uterus during the birthing process. The discussion section integrates this knowledge to explain and predict the physiological functioning of the uterus during 3rd and 4th stage labour both when skin-to-skin contact and breastfeeding occurs, and when they do not.

Table 2.1 Definitions of key terms

Term	Definition
Breastfeeding at birth	Any attempt by the baby to suckle the breast within 30 minutes after the birth.
Eulochia	The physiological vaginal blood loss during the 3rd and 4th stages of labour that does not cause signs of anaemia or shock. The volume of blood loss varies depending upon the woman's individual health status (New term developed during this study).
Eutony	Maintenance of physiological uterine contractility which ensures eulochia and prevents excessive bleeding (New term developed during this study).
Corticotrophin Releasing Hormone (CRH)	CRH plays a fundamental role in orchestrating the General Adaptation Syndrome which is also called the stress response. Released from the anterior pituitary CRH stimulates the release of beta-endorphin and ACTH, which in turn stimulates the release of cortisol, antidiuretic hormone and aldosterone. In addition, during labour CRH stimulates release and enhances effectiveness of prostaglandins and oxytocin (Blackburn 2013).
Cortisol	Cortisol is released by the adrenal cortex in response to stress. It spares available glucose for the brain, generates energy from stored reserves and prioritises glucose to those activities needed for survival over lower-priority activities (Blackburn 2013, pp. 642–3). Levels of circulating or salivary cortisol act as a marker for stress.
Mammal (Mammalia)	A class of animals characterised by breasts which secrete milk for the nourishment of their young (Onions 1973). Placental mammals (including humans) share the same

	reproductive physiology (Uvnas-Moberg 2013a; Odent 2001b).
Postpartum haemorrhage	1. Medical = blood loss greater than 499 ml (World Health Organisation 2009) 2. Physiological = blood loss of any volume that causes signs of shock or anaemia; the volume varies from woman to woman (new definition developed during this study)
Reproductive psychophysiology	Psychophysiology is a field of science that studies the ways in which the mind and body are mutually interactive. Thus, what a woman is thinking and/or feeling affects the physiological processes associated with her sexual response, pregnancy, labour, birth, breastfeeding and nurturing (Cacioppo et al. 2007).
Stress	Stress is an organism's total response to environmental stressors (perceived or real). Distress occurs when the stressors exceed the person's bodily or mental ability to adapt. Eustress is an optimal amount of stress to promote successful adaptation and thus resulting in health, growth and happiness (Seaward 2013).
Skin-to-skin contact at birth	The naked healthy newborn baby is placed prone on the mother's bare abdomen/chest (depending upon cord length) immediately after birth. The baby's head will, ideally, be on the maternal sternum with the woman in an upright or semi-upright position. In this position, the baby has ready access to the maternal nipple and can hear the mother's heart. Both mother and baby should be covered with a warmed blanket and left there undisturbed for at least an hour. The mother and baby are carefully and

	unobtrusively observed to ensure optimal adaptation of both following birth. This definition is consistent with, but more specific than, previous definitions (Finigan & Long 2012; Trevathan 2013; Vincent 2011).
3rd stage of labour	The period of time extending from the birth of the baby until the delivery of placenta and membranes (Fraser & Cooper 2009).
4th stage of labour	The first hour after the delivery of the placenta and membranes (old definition passed down in the oral tradition).
Theory	A theory presents a systematic view of phenomena by specifying the interrelationships between concepts using definitions and propositions with the purpose of explanation and prediction (Scott & Marshall 2005).

Background

Early mother-infant skin-to-skin contact and breastfeeding is associated with rapid changes to maternal and infant physiology: changes that are known to be important for bonding and breastfeeding (Olza-Fernandez et al. 2014; UNICEF and World Health Organisation 2009). Although there have been great advances in the understanding of reproductive physiology, it remains complex and incompletely understood (Blackburn 2013; Gimpl & Farenholtz 2001; Gratten et al. 2000). What is known is that there is an intricate interplay of multiple neuro-hormonal factors, e.g. prolactin, oxytocin, vasopressin, corticotrophin releasing hormone (CRH) and prostaglandins (pro-contraction), progesterone (pro-relaxation) and cytokines (Blackburn 2013; Silverthorn 2013). One recent review (Dixon et al. 2013) reports on the holistic interactions of the mind, body and behaviour during pregnancy, labour and birth. These authors focussed their discussion on labour up to the birth of the baby: they stopped short of examining the reproductive psychophysiology of 3rd and 4th stage labour. An even more recent review (Olza-Fernandez et al. 2014) explains how disturbances caused by medicalised interventions disrupt the neuroendocrine

mechanisms and thus the initiation of mother child attachment. This interference, they argue, has life-long negative sequelae for mothers and babies.

The importance of optimising maternal/baby psychophysiology during labour and birth has been integrated into contemporary theories and models of midwifery care (Dahlen et al. 2010; Fahy et al. 2011; Walsh & Downe 2010). These theories, however, are not fully grounded in reproductive psychophysiology. Similarly obstetric and midwifery text books have not included key biological knowledge in their discussions of labour and birth. For example, four prominent texts are silent on the autonomic nervous system (Cunningham 2010; Fraser & Cooper 2009; MacDonald & Magill-Cuerden 2011; Pairman et al. 2010) as is Coad and Dunstall's Anatomy and Physiology for Midwives (Coad & Dunstall 2011) and Blackburn's Maternal Fetal and Neonatal Physiology (Blackburn 2013). This paper makes a contribution to filling the gap as it provides a biologically-based theory about the effects of the autonomic nervous system and oxytocin on mammalian reproductive neurophysiology. We focus on the hypothesis that mother-infant skin-to-skin contact and early breastfeeding in 3rd and 4th stages of labour are integral psychophysiological processes of a 'sensitive period' in parturition (Olza-Fernandez et al. 2014) and key to optimal uterine tone. It is plausible that disruptions to these psychophysiological processes are contributing to the increasing rates of postpartum haemorrhage (PPH) in the Western world (Kramer et al. 2013; Ford et al. 2007a).

The Uterus as a Muscle

This section considers the muscle cells of the myometrium, which need to contract in a coordinated way to birth the baby and ensure eutony and eulochia. The uterus has three muscle layers; the perimetrium (outer), the myometrium (middle) and the endometrium (inner) layers. The middle layer of the myometrium is highly vascular; it also has a thick network of spiralling muscle fibres; these fibres act like 'living ligatures' to ensure that blood vessels in the uterus are occluded in the 3rd stage of labour, thus preventing postpartum haemorrhage (Blackburn 2013).

The myometrium is composed of thin and thick syncytial smooth muscle fibre filaments: actin and myosin (Payton & Brucker 1999). The initiation of muscle

contraction is an inherent quality of smooth muscle although it is mediated by neurological and hormonal activity. All myometrial cells have the potential to be the pacemaker of the uterus (Blackburn 2013). In well co-ordinated labour contractions the pacemaker is in the fundus (Blackburn 2013). Uterine contraction is dependent upon the availability of intracellular calcium which enters the cell after an action potential temporarily changes the permeability of the cell membrane. Calcium binds to myosin and the filaments slide over each other, shortening the cell (Blackburn 2013). These filaments are arranged in such a way that intracellular changes generated in one fibre can easily and quickly transfer to the next fibre via gap junctions (which are areas of low resistance in-between uterine muscle cells) (Blackburn 2013). Gap junctions are crucial because they allow the uterus to contract in a coordinated way. Control of smooth muscle activation is either mediated electromechanically, as discussed above, or receptor mediated, i.e. an agonist binds to a myometrial receptor site on the cell membrane. When oxytocin binds to a myometrial receptor, the ensuing action potential increases intracellular calcium, which causes the muscle cell to contract. Conversely, if adrenaline, a stress hormone, liberated when the sympathetic nervous system (see below) is dominant (MacDonald & Magill-Cuerden 2011), binds to the receptor site, calcium is prevented from entering the cell and the muscle relaxes (Ford et al. 2007a; Payton & Brucker 1999).

Neuro-hormonal regulation of uterine activity

The uterus is innervated by the autonomic nervous system comprised of two branches: the parasympathetic and the sympathetic. Interestingly, the sympathetic nerve fibres in the uterus degenerate during normal pregnancy and regenerate following birth, thus offering some protection to the foetus from sympathetic stimulation during pregnancy (Brauer 2008). The sympathetic and parasympathetic branches are active simultaneously via different neural pathways. The parasympathetic branch is dominant when the mammal feels safe as evidenced by calm behaviour (Uvnas-Moberg 2003). Optimal functioning of the reproductive system during labour and birth requires parasympathetic dominance even though a stress response, related to physical exertion, is occurring simultaneously. For example, when a woman feels in control and has a trusting relationship with

caregivers, the levels of the stress hormone cortisol in her peripheral circulation (an indicator of how much stress she is feeling) is relatively low, ensuring optimal blood flow and nervous stimulation to the uterus and other pelvic organs (Alehagen et al. 2005; Brauer 2008). By comparison, in a situation of fear, the whole body is under sympathetic dominance and adrenaline is released both as a neurotransmitter and as a hormone and blood is shunted away from all abdominal-pelvic organs to fuel the heart, lungs, brain and muscles for fight or flight. Clinical evidence of sympathetic stimulation includes hypervigilance, tachycardia, tachypnoea, pallor, sweating, high blood pressure and low urinary output (Craft et al. 2011). As previously mentioned, adrenaline competes with oxytocin on the myometrial binding sites, reducing, or in extreme cases, stopping uterine contractions. Sympathetic stimulation therefore, disrupts uterine functioning in labour and after birth. Fear, both theoretically and biologically, is seen as a major contributing factor to both prolonged labour and PPH.

Eustress and labour

When a mammal is under stress (either physical or psychological) not only is the sympathetic nervous system activated, but also a complex interplay of reactions occurs between the hypothalamus, pituitary, and adrenal glands (Craft et al. 2011). A certain amount and intensity of physical stress is good for the mind and body and is termed ‘eustress’ (Seaward 2013). The stress response can, however, become overwhelming leading to distress and dysfunction. Corticotrophin releasing hormone (CRH) is central to stimulating and orchestrating the body’s generalised response to the stressor, including the release of cortisol. We hypothesise that women need a level of eustress (precipitated by the pain and physical exertion of labour combined with the happy anticipation of the birth of the baby) which enables women to have the will and energy to stay motivated and active throughout labour. Abnormally high levels of stress however (brought on by fear for example), appear to disrupt uterine functioning by interfering with oxytocin release and uptake in myometrial cells.

Oxytocin

Oxytocin synthesis occurs in the hypothalamus from where it is transported to the posterior pituitary gland and stored (Blackburn 2013). Oxytocin is released from the

pituitary gland, in a pulsatile manner, directly into the blood stream (Uvnas-Moberg, 2003; Uvnas-Moberg 2013a). The maternal decidua synthesises oxytocin in labour, which acts locally (Coad & Dunstall 2011). The foetus also synthesises oxytocin, which enters the umbilical arteries and is delivered to the maternal decidua via the placental bed (Coad & Dunstall 2011). The pulses of oxytocin released from the pituitary gland increase in frequency and intensity throughout labour in a positive feedback loop resulting finally in the strong expulsive contractions of 2nd stage labour (Silverthorn 2013). Within the brain, oxytocin acts as a hormone, a neurotransmitter and neuromodulator (Gimpl & Farenholtz 2001; Uvnas-Moberg 2003). Oxytocin is released from nerve endings of the hypothalamus and dispersed to other nerve cells in the brain, primarily the amygdala and the primitive brain stem. Transmission of oxytocin is from nerve cell to nerve cell as well as along nerve fibres (Gimpl & Farenholtz 2001). Oxytocin acts on the amygdala to create a sense of calm and promotes nurturing behaviours between the woman and newborn baby (Uvnas-Moberg 2013a). The effects of oxytocin on the brain stem include the reduction of blood pressure and the lowering of heart and respiration rates whilst increasing blood flow to the skin of the chest and breast (Uvnas-Moberg 2013a)

Factors affecting oxytocin release and uptake

A wide range of maternal and foetal factors, including CRH, cortisol and prostaglandins, stimulate the pituitary gland to release oxytocin (Olza-Fernandez et al. 2014). How a woman feels profoundly influences her levels of oxytocin, concurrently her levels of oxytocin profoundly influences how she feels. How a woman perceives and responds to her experience and the environment may also cause fear and thus stimulate the stress response creating adrenaline (Handlin et al. 2009; Uvnäs-Moberg & Eriksson 1996; Uvnas-Moberg 2003). The mother/baby are so connected that the feelings they have reciprocally affect each other and therefore each other's oxytocin levels. Factors known to enhance the woman and foetal/newborn bio-behavioural state so that oxytocin is optimised, include pleasurable stimulation of the five senses whilst concurrently feeling safe and comfortable (Odent 2001b). Holding, seeing, hearing, smelling and stroking a (wanted) naked, newborn skin-to-skin causes an oxytocin rush in both the woman and the baby (Bartz & Hollander 2006; Olza-Fernandez et al. 2014; Uvnäs-Moberg &

Eriksson 1996;). Oxytocin continues to be released in large amounts during extended skin-to-skin contact when the newborn baby makes hand and leg movements, crawls to the mother's breast and seeks the nipple. When the newborn baby sucks on the nipple further oxytocin is released so that the mother and newborn baby are flooded with oxytocin in preparation for a lifelong, loving relationship (Odent 2001a; Olza-Fernandez et al. 2014; Uvnäs-Moberg & Eriksson 1996; Uvnas-Moberg 1998;). Helping women to stay in the moment and to let go of past problems and future fears also helps her to stay parasympathetically dominated, which is essential for optimal oxytocin release and the simultaneous inhibition of the sympathetic nervous system. The peaks of oxytocin released during the first hour after birth are significantly higher than at any other time in a woman's life (Nissan et al. 1995; Rahm et al. 2002). This same oxytocin contracts and retracts the uterine muscle fibres creating eutony and eulochia, a fact that is seldom discussed, because the focus in this first hour after birth is frequently on completing routine tasks like weighing, measuring and immunising.

Non-human, mammalian births provide a useful template for the observation of optimal physiological functioning in the immediate postnatal period (Olza-Fernandez et al. 2014). Immediately after the birth of the baby, the non-human mammalian mother and her newborn attach to each other and breastfeeding is quickly established. The mother and newborn stay in close proximity and the mother licks and nuzzles the newborn: without these oxytocin producing activities many newborn mammals die (Montagu 1984; Trevathan 2013). A human mother's hands provide oxytocin releasing stimulus as she strokes her naked newborn. When family or professionals interfere with maternal/ infant skin-to-skin contact then, we hypothesise, that oxytocin release and the associated positive benefits may be blocked or reduced and the sympathetic branch of the autonomic nervous system may become dominant.

Based on the physiology discussed above, we theorise that, women who do not experience skin-to-skin contact and breastfeeding in the 3rd and 4th stages of labour are more likely to experience PPH. We wondered if artificial oxytocin could be successfully substituted for endogenous oxytocin. However, peripheral injections of artificial oxytocin do not appear to cross the blood-brain barrier (Bartz & Hollander

2006; Uvnas-Moberg 2013) and therefore cannot have the same brain mediated effects (calmness and nurturing) as endogenous oxytocin. Also, when exogenous oxytocin is infused, it has a half-life of only 1 to 2 minutes (Ludwig & Leng 2006) which means that a continuous infusion is required to maintain uterine contractions. In comparison, endogenous oxytocin is released in a pulsatile manner, has a half-life of 20 to 30 minutes and rises to a crescendo in the 3rd and 4th stages of labour (Ludwig & Leng 2006). Thus physiological oxytocin release is much more effective in maintaining eutony and eulochia compared with the injection of artificial oxytocin.

Conclusion

This paper fills a gap in the literature as it provides a biologically based theory about the effects of the autonomic nervous system, and oxytocin, on mammalian reproductive neurophysiology. The paper provides physiological support for the thesis that skin-to-skin and breastfeeding at birth optimises psychophysiological functioning creating eutony and eulochia during the 'sensitive period' of the 3rd and 4th stages of labour. We have argued, and provided evidence for, the importance of the woman's mind and body to be functioning in an integrated, holistic way to optimise oxytocin synthesis and uptake.

Midwifery care has a key role to play in optimising the woman's reproductive psychophysiology because the midwife can positively influence the woman's external environment. By having a trusting relationship with the women, the midwife can also be aware of and facilitate the woman's positive response to her labour and therefore, the emotions that she feels and ultimately whether the woman's parasympathetic system dominates or not. We conclude that all women and babies should be enabled and supported to have immediate and prolonged skin-to-skin contact and breastfeeding at birth. In this way, women's' reproductive physiology is optimised so that, among other things, eutony and eulochia are achieved and the risk of PPH is minimised. We realise that much of what we have written has relevance to many other aspects of pregnancy, labour, birth, breastfeeding, mother/baby attachment and therefore the long term health and wellbeing of the mother and child—that is work under development.

Disclosure of Interests

The authors declare they have no competing interests.

Contribution to Authorship

AS designed the study with support from her supervisors. AS conducted the literature searches and wrote the draft of this article. All authors discussed and reviewed the content of each draft. AS wrote all the subsequent drafts with support from her supervisors. All authors read and approved the final paper.

----------End of Article----------

PART 2: COGNITIVE NEUROSCIENCE AND MINDFULNESS PSYCHOLOGY AT BIRTH

By itself pronurturance (S2S and B/F at birth) does not explain enough of the holistic psychophysiological responses that women undergo in the first 30 minutes after birth. Key concepts from cognitive science and mindfulness psychology are needed to be added to the concept of pronurturance to further explain and predict how to minimise the risk of PPH at birth. These concepts are integrated into the new theory of Pronurturance Plus which is discussed in Part 3.

The Attentional Networks

The attentional networks are cognitive processes that occur both consciously and unconsciously (Callejas et al. 2004; Petersen & Posner 2012; Posner 2011; Rothbart & Posner 2001). In cognitive neuroscience ‘attention’ refers to the person’s conscious awareness of some of the myriad of external and internal cues that flood the brain, via the senses and via thoughts. The person’s attention can be captured by random external and internal cues which the brain channels to the cerebral cortex for higher level processing and possible action (Handy & Kam 2015; Simon & Engstrom 2015). For example, the feelings associated with a stone in a shoe, leads the person to

attend to the sensations, decide what to do, stop and remove the stone.

Multiple levels of attentional networks have been identified (Petersen & Posner 2012; Posner 2011). Here I focus on four attentional networks that are relevant to the care of childbearing women in the 3rd and 4th stages of labour. These are: 1) the fascination, 2) the orienting, 3) the alerting and 4) the executive network (Fan & Posner 2004; Fan et al. 2005; Marković 2012; Petersen & Posner 2012).

The 'fascination attentional network' is dominant in creative and loving pursuits (Cacioppo et al. 2007; Marković 2012). When the fascination network is active, it is common to lose track of time and get 'lost' in the object of fascination, with the internal state of being experienced as calmness and/or pleasure (Marković 2012; Olendzki 2013). Helping women to stay calm and fascinated with their babies keeps the women in parasympathetic mode which, as described in Part 1 optimises reproductive physiology.

The orienting network is operating all the time when the person is awake. The orienting network is used to determine one's position in time and space and maintains a level of constant attention to the environment. The orienting network may be activated by a strong stimulus (e.g., a phone ringing, bright light or loud noise). The orienting attentional network is active in relation to cues coming from the environment via the five senses (Fan et al. 2005). If the environmental cues are perceived as potentially comforting or non-threatening then the parasympathetic nervous system remains dominant. If, however, the environmental cues are perceived as actually or potentially threatening then the alerting network is also activated which in turn activates the sympathetic nervous system. The link between the brain cells in alerting network and the autonomic nervous system is that the cells of the alerting network and the autonomic nervous system are modulated, in part, through norepinephrine (noradrenaline) (Odent 2001b; Posner & Fan 2008; Saxton et al. 2014; Uvnas-Moberg et al. 2005). As described in Part 1 (above) sympathetic stimulation interrupts the release and uptake of oxytocin, which increases the risk of atonic PPH (Saxton et al. 2014). The knowledge that attentional networks directly affect emotional and physiological states is an important link between cognitive neuroscience and mindfulness psychology (Cohen et al. 2011; Pert 1999) as

discussed below.

Mindfulness

Mindfulness practices can be used as a way to consciously use attentional networks to maintain parasympathetic dominance (Germer et al. 2013). 'Mindfulness' is a way of activating and maintaining selective and focused attention on a predetermined object, e.g., candle flame or phenomenon, e.g. the breath (Bishop et al. 2004; Brown & Ryan 2003; Handy & Kam 2015). Mindfulness practices include, but are not limited to: breath awareness and control, various forms of meditation, visualisation, body awareness, and 'in the moment' focussed attention in daily life.

Mindfulness practices developed in the Yogic and/or Buddhist traditions (Fulton & Seigel 2013; Raffone et al. 2010). Mindfulness has been taken into mainstream psychology and psychiatry where the focus is on mindfulness practices devoid of spiritual or dogmatic content (Germer et al. 2013). The interest is on the mental health benefits gained by a person learning how to self-regulate the autonomic nervous system through mindfulness practice and thereby modify anxiety, depression and compulsive behaviours (Germer et al. 2013). Using mindfulness a person can choose to focus their attention consciously. For example, a labouring woman can choose to concentrate on an inner image of holding her baby in her arms rather than focusing on clock time and thus maintain parasympathetic dominance. Practising mindfulness regularly throughout daily life (van den Hurk et al. 2010) makes it much easier to exercise voluntary control of attention in challenging situations like being in labour.

When the baby at the moment of birth is placed S2S with the woman, her immediate attention is captured by her baby, activating her fascination attentional network.. The newborn baby has high levels of adrenaline which make it wide-eyed, alert and ready to respond to her touch, eye contact and voice (Crenshaw 2007, 2010; Klaus 1998; Trevathan 2013). This mutual fascination between the woman and her baby, together with the multisensory experience of S2S and B/F, facilitates parasympathetic nervous system dominance and optimises metabolism of oxytocin in the 3rd and 4th stages of labour (Cacioppo et al. 2007; Cacioppo et al. 2010; Marković 2012; Uvnas-Moberg

2013a).

The peak emotional experience of the baby's birth, especially when Pronurturance is practised means that the woman is primed to be fascinated by her baby. Mindfulness strategies employed during the 3rd and 4th stages of labour promote the woman's loving fascination with her baby. However, a newly birthed woman is vulnerable to environmental distractions which can divert her attention. The midwife can ensure that environmental distractions are minimised during this time so that the woman's fascinated attention remains focussed on her baby and her autonomic nervous system stays parasympathetically dominated.

PART 3: PRONURTURANCE PLUS: A PPH RISK REDUCTION THEORY

A new theory called Pronurturance Plus is presented here in Part 3. This theory describes, explains and predicts the conditions under which a woman's endogenous oxytocin release and uptake is optimised. Pronurturance Plus theory integrates the knowledge described in Parts 1 and 2 (above) with concepts from Birth Territory Theory (Fahy et al. 2011; Hastie & Fahy 2009). Pronurturance Plus theory describes a PPH risk reduction strategy for midwifery care in the 3rd and 4th stages of labour. This new theory is an application and extension of Hastie and Fahy's theory of Psychophysiological 3rd stage Labour Care (Hastie & Fahy 2009). Their theory was based primarily upon Hastie's extensive woman-centred, reflective practice in which she noted that few women in her care had a PPH whereas most did not. Pronurturance Plus theory articulates and explains why the theory of Psychophysiological 3rd stage Labour Care is thought to be effective in practice. Hastie and Fahy (Hastie & Fahy 2009) wrote that their theory applied to women at low risk of PPH whereas Pronurturance Plus is theorised to apply to women at all levels of risk of PPH. I begin this section by defining (see Table 2.2) and discussing relevant key terms from Birth Territory Theory. Next, I summarise and integrate key concepts from Parts 1 and 2 concerning oxytocin, the autonomic nervous system and cognitive neuroscience, to develop the theory of Pronurturance Plus.

Table 2.2 Definitions of Key Terms from Birth Territory Theory

Key Term	Definition
Birth Territory	Comprises the physical terrain or birth space and jurisdictional control over that terrain. The birth territory varies on a continuum from a sanctum to a surveillance room (Fahy et al. 2011). Power within this space can be used integratively with the woman or disintegratively by the staff.
Sanctum	A quiet, warm, dimly lit, homelike environment designed to provide privacy and safety. An experience of sanctum enhances the woman's embodied sense of self which is reflected in optimal physiological function and emotional wellbeing (Fahy et al. 2008; Fahy et al. 2011).
Surveillance Room	Denotes a clinical environment designed to facilitate observation of the woman and her baby so as to optimise the ease and comfort of the staff (Fahy et al. 2008; Fahy et al. 2011).
Power: disintegrative	Disintegrative power is ego based use of one's power to satisfy one's own goal/s against the holistic best interests of the woman. The use of disintegrative power disrupts and undermines the woman's sense of integrated self and the woman emerges from her experience feeling diminished and weakened (Hastie 2008; Parratt 2008).
Power: integrative	Integrative power refers to the way that all forms of power in the birth room are integrated towards achieving the best birth possible both reproductively

	and experientially. When integrative power is operational, then the woman emerges from her labour feeling supported and good about herself regardless of whether medical interventions were needed (Hastie 2008; Parratt 2010).
Midwifery Guardianship	Refers to guarding the woman in her Birth Territory. Using her power integratively, the midwifery guardian protects the birth environment and nurtures the woman's sense of emotional, spiritual and physical safety (Fahy et al. 2011; Hastie 2008; Maloney & Gair 2015).
Midwifery Domination	A dominating midwife uses her power disintegratively to achieve the midwife's own goal/s. Midwifery domination undermines the woman's confidence and inner power thus interfering with the woman's labouring process and reducing her embodied strength and endurance (Fahy et al. 2011; Hastie 2008).

Birth Territory theory explains how the environment is crucial to the way the woman feels during labour and birth and why the woman's feelings are directly related to how her mind and body functions (Dixon et al. 2013; Fahy et al. 2011; Hastie 2008; Pert 1999). In this section of the dissertation, I concentrate on the 3rd and 4th stages of labour care. The midwifery guardian ensures, as far as possible, that the woman is protected, nurtured and supported emotionally and physically within the birthing space so the woman feels safe and knows she is the centre of attention of all within the birth territory (Fahy et al. 2008; Fahy et al. 2011; Hastie 2008). During the 3rd and 4th stages of labour the midwifery guardian ensures the healthy baby has immediate S2S contact and access to the woman's breast.

Pronurturance Plus Theory

Pronurturance Plus theory is designed to describe, explain and predict midwifery activity in the 3rd and 4th stages of labour to create eutony and eulochia. The key proposition from Pronurturance Plus theory is that pronurturance promotes the woman's fascinated attention and parasympathetic dominance which optimises her reproductive psychophysiology facilitating eutony and eulochia.

Pronurturance

The concept of pronurturance is defined as: S2S contact and B/F within 30 minutes of birth.

For this study, based on routinely collected data, pronurturance concepts (described above) were used. The theoretical concept of Pronurturance Plus, however, is larger and more complex than these terms (S2S and B/F) as it encompasses cognitive neuroscience and Birth Territory concepts. Natural physiological processes (S2S and B/F) are relevant to all types of birth; those births that are more complicated are likely to have disruptions to these processes (Odent 2001a). See Table 2.3 for key terms and definitions of Pronurturance Plus.

Table 2.3 Key terms and definitions for Pronurturance Plus theory

Term	Definition
Attentional networks	Cognitive processes that occur both consciously and unconsciously (Petersen & Posner 2012) and which directly affects the woman's emotional and physiological states during 3rd and 4th stage labour care.
Concept	A concept is an abstract idea of phenomena or a phenomenon (Chinn & Kramer 2010).
Conceptual framework	A conceptual framework identifies, defines and discusses the key concepts of relevance to the study (Chinn & Kramer 2010).

Mindfulness	The practice of maintaining a non-judgmental state of heightened or complete awareness of one's thoughts, emotions or experiences on a moment-to-moment basis (Germer et al. 2013).
Proposition	Propositions are statements of relationship between two or more concepts. Propositional statements provide theory with descriptive, explanatory or predictive powers (Chinn & Kramer 2010).

The theoretical framework, detailing the concepts for inclusion in Pronurturance Plus in 3rd and 4th stage labour care, is contained in Figure 2.1. These concepts should apply to all women in 3rd and 4th stages of labour, regardless of whether the 3rd stage of labour was managed physiologically or actively as discussed in Chapter 1.

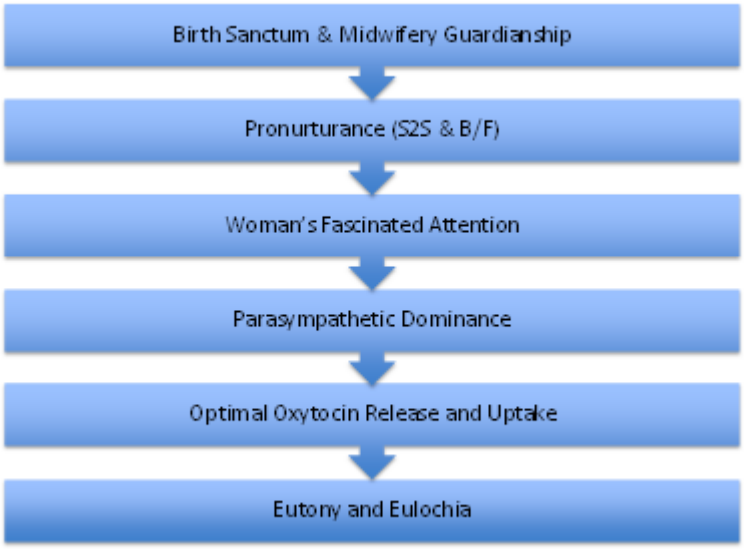


Figure 2.1 Theoretical framework: Pronurturance Plus

Midwifery activity in third and fourth stage labour care

This section describes, explains and predicts the actions the midwifery guardian can take to create the optimum conditions for maternal eutony and eulochia.

Following the birth of the baby, the midwife is mindful at all times of how the woman is feeling and keeping the environment dim, warm and peaceful by turning down bright lights and minimising distractors such as noisy phones (Odent 2001b; Fahy et al. 2008; Hastie & Fahy 2009). The warm environment ensures that high maternal adrenaline levels required to birth the baby now subside (Saito et al. 1991; Odent 2001b; Odent 2002) and the woman's fascination attentional network is activated (Cacioppo et al. 2010; Cacioppo et al. 2007). Adrenaline levels in the newborn are also high immediately after birth: adrenaline allows the baby to be wide-eyed and alert for that first hour after birth and ready to respond to maternal touch and voice (Anderson 2000; Field 2010; Odent 2002; Trevathan 2013; Uvnas-Moberg 2013b). Once the baby is born, he/she is immediately placed skin-to-skin on the mother's bare chest/abdomen and the midwife covers both with a warm blanket. Warmth and skin-to-skin contact will promote endogenous oxytocin release during the 3rd stage (Kennell & McGrath 2003; Odent 2002; Uvnas-Moberg 2013b). Skin-to skin contact and warmth at birth also provides a sense of safety for mother and newborn (Hugill 2015; Prescott 1996) allowing parasympathetic dominance and emergence of innate nurturing behaviours (Hugill 2015; Phillips 2013).

Once the placenta has been extruded, the midwifery guardian continues to monitor both mother and baby unobtrusively: knowing the importance of that first hour after birth when mother and newborn begin to attach and bond (Olza-Fernandez et al. 2014; Trevathan 2013; Uvnas-Moberg 2013b). Routine care for the baby such as immunization, measuring and weighing can be safely delayed for this time.

The mother and baby should be the centre of attention. The mother and the newborn have eye-to-eye contact, the mother touches and talks to the baby in a soft voice. The baby, using leg and arm movements crawls towards the mother's breast (Gangal 2007; Klaus 1998; Trevathan 2013). In the mother, these movements by the baby also assist with promoting oxytocin release which will contract the uterus strongly and promote haemostasis (Gangal 2007).

Midwives need to maintain watchful care of both the woman and baby whilst skin-to-skin is in progress to ensure that the baby's airway and breathing remain optimal: there have been reported cases of death and near death incidents for babies when

experiencing skin-to-skin contact without adequate unobtrusive vigilance by the midwife (Andres et al. 2011; Becher et al. 2012; Nakamura & Sano 2008; Poets et al. 2011).

The essential elements of Pronurturance Plus theory for 3rd and 4th stage labour care to optimise the woman's reproductive physiology and potentially reduce the risk of PPH are listed below.

Essential Elements of Pronurturance Plus Care

- Birth in a room that is warm, dim and where the woman feels safe,
- Midwifery Guardianship,
- Immediate and sustained pronurturance at birth,
- The woman is focused on the baby so that her fascination attentional network is dominant and her autonomic nervous system is parasympathetically dominated.

Parasympathetic dominance optimises endogenous oxytocin release and uptake facilitating eutony and eulochia. Pronurturance Plus theory provides midwives with a model for clinical practice which may be used in any setting and for all women no matter what their level of risk for PPH.

I recognise that what I have described above represents ideal care and that midwives working in busy maternity units are not always able to ensure this level of quality care. Notwithstanding busyness, however, midwives can strive to ensure that as many of these factors are operating during the time of the birth and immediately afterwards because the predicted benefits (discussed later in this dissertation) are so great.

As the retrospective cohort study used data from the ObstetriX data base (described more fully in Chapter 4 Methodology): many of the factors that are biologically and theoretically important are not coded in ObstetriX. Thus S2S and B/F only give an indication of the type of care given. This is also discussed more fully in the Findings, Discussion and Conclusions chapter.

CONCLUSION

In this chapter I have provided strong physiological support for the question, '**Does skin-to-skin contact and breastfeeding immediately after birth affect the rate of early postpartum haemorrhage?'** The physiological theory in Part 1, together with the theory of Pronurturance Plus has shown that the woman's mind and body need to be functioning in an integrated, holistic way in 3rd and 4th stages of labour in order to optimise oxytocin synthesis and uptake, and thereby creating eutony and eulochia. Midwifery guardianship is especially important in optimising reproductive psychophysiology because the midwife can positively influence the woman's external environment. By having a trusting relationship with the woman, the midwife can positively influence the woman's perception, attention and emotional reaction to the birth experience and her baby. The theory of Pronurturance Plus has described how creating and maintaining a birth sanctum, which is guarded by the midwife, allows the fascination aspect of the woman's attentional neural networks to be operational, her parasympathetic nervous system to be dominant which therefore optimises the functioning of the limbic system and brain stem to create the conditions for calm nurturance between mother and baby. In this way, oxytocin synthesis and uptake is optimised to create eutony and eulochia.

CHAPTER 3 REVIEW OF RELATED LITERATURE

This chapter reviews the research literature in two parts: Part I is a review of the research literature concerning the risk factors for PPH with an emphasis on identifying those factors that are the most likely causes of uterine atony. Knowing the factors which actually cause atony is important because these are the factors most likely to be amenable to skin-to-skin contact and breastfeeding in the 3rd and 4th stages of labour as a way of reducing PPH rates. As described in Chapter 2, there is strong, biologically-based, theoretical evidence that skin-to-skin contact and early breastfeeding should have a positive effect in reducing PPH rates by stimulating the release and uptake of endogenous oxytocin (Buckley 2002, 2005a, 2009; Chua et al. 1994; Handlin et al. 2009; Irons, Sriskandabalan, & Bullough, 1994; Matthiesen et al. 2001; Nissan et al. 1995; Odent 1998, 2011; Saxton et al. 2014; Saxton, Fahy & Hastie 2016; Uvnas-Moberg 2012a, 2012b).

In the discussion section of Part 1 (below), I highlight the gaps and disagreements between the reviewed studies. Then I critique the current understanding of a number of the 'causes' of PPH as listed in a policy directive from NSW Health (New South Wales, Primary & Community Partnerships 2005). I chose the criteria listed in this directive as the accepted list of causes of PPH because the directive was operational at the time the data for this study were collected. Each of the 'causes' is considered and critiqued in the light of the theoretical and biological framework presented in the previous chapter and current research evidence. Part 2 of this chapter comprises the review of research related to the question guiding the present study i.e. '**does skin-to-skin contact and breastfeeding immediately after birth affect the rate of early postpartum haemorrhage?'** Key terms used in this Chapter are defined in Table 3.1.

Table 3.1 Definition of key terms

Key Term	Definition

Cause	A ‘cause’ is a variable that has a direct physiological or pathophysiological relationship to the outcome of interest. In this case the ‘causes’ of atony and the ‘causes’ of PPH (Field 2009). A ‘cause’ can be distinguished from a ‘risk factor’ which is a co-variable with the outcome of interest but is not a ‘cause’ of the outcome, e.g. anaemia does not ‘cause’ PPH.
Mirror-neuron system	A special area in the brain which mirrors the actions and behaviours of others e.g. emotional states, such as fear and anxiety, pass from the clinician to the woman with an impact on labour and birth (Iacoboni et al. 2005; Odent 2013; Rizzolatti & Craighero 2004). Fear is also a pheronome and can be smelt (Odent 2001a).
Postpartum haemorrhage	Blood loss ≥ 500 ml (World Health Organisation 2009).
Severe postpartum haemorrhage	Blood loss ≥ 1000 ml (World Health Organisation 2009).
Psychophysiology	This is defined by the branches of psychology and biological sciences that study mind-body interactions and effects: reproductive psychophysiology concerns the ways in which thinking and feeling affect the physiological processes associated with sexual response, pregnancy, labour, birth, breastfeeding and nurturing (Fahy 2008, pp.11-20).
Uterine atony	Failure of the uterus to contract adequately after giving birth (World Health Organisation 2009). The focus in this study is on atony as the primary cause of PPH. I am concerned with both physiological and pathophysiological causes of atony (understanding that if there is traumatic PPH, for instance, it can also cause atony as a secondary effect (Odent 2001a).

3rd stage of labour	The time elapsing from the birth of the baby to delivery of placenta and membranes (Stables & Rankin 2005).
4th stage of labour	One or two hours from time of delivery of the placenta and membranes (The MedicineNet Doctors 2008).

PART 1: What are the risk factors for PPH

In 2012, and again in 2015, I conducted a literature search of research, published in English, for the years 1970 to the present. The question guiding that review was: ***what are the causes of uterine atony in the 3rd and 4th stages of human labour?*** The key words, were: postpartum haemorrhage, 'obstetric complications/uterine atony', 'causes or risk factors', and finally 'research'. In Scopus, the first data base searched, there were 2355 studies relating to obstetric complications/uterine atony. Adding the terms 'causes or risk factors for PPH' yielded 964 matches. These studies were further reduced by adding the term 'research' giving a final match of 118 studies. The titles and abstracts were examined. I excluded 114 studies which focussed on preventative pharmacological agents, surgical technologies or did not address the guiding question: leaving four (4) relevant studies for analysis. A similar search was conducted of the other data bases i.e. Embase, Ovid, Scopus and Medline; no new studies found.

Table 3.2 below summarises the relevant research studies that have investigated the observed increases in atonic PPH over the past decade or so.

Table 3.2 Summary of factors associated with PPH

Study Summary	**Factors strongly associated with PPH where atony is a component**
Mehrabadi et al. 2013 **Epidemiological investigation of a temporal increase in atonic PPH:A population-based retrospective cohort study** PPH defined as ≥500ml for vaginal birth or >1000ml for c/section. All birth N= 371 193 used ICD 9 and 10 codes (666.1 i.e. PPH and 072.1 i.e. uterine atony) Outcomes atonic PPH and severe atonic PPH requiring blood transfusion	Maternal age>40, Primiparity macrosomia ≥4000g, multiple pregnancy, induction, augmentation, 3rd and 4th degree perineal tears, chorioamnionitis, Forceps and/or vacuum
Lutomski et al. 2012 **Increasing trends in atonic PPH in Ireland: An 11 year population based cohort study** PPH define as >500ml after birth Total study population 649 019 of whom 16 909 had a PPH	Forceps and/or vacuum induced/augmented, emergency and elective c/sections, polyhydramnios, macrosomia, chorioamnionitis
Driessen et al. 2011 **Postpartum haemorrhage resulting from uterine atony after vaginal birth: Factors associated with severity** PPH defined as a change in HgB ≥4g/dl (i.e. about 1000ml) Total study population 4450 of whom 952 had a PPH as defined	History of previous PPH, primiparity, vaginal delivery with episiotomy, operative delivery with episiotomy, prophylactic uterotonics
Bateman et al. 2010 **The epidemiology of PPH in a large nationwide sample of deliveries** Severe atonic PPH defined as one requiring blood transfusion	Maternal age<20 Maternal age ≥40, APH,

Total study population 876 641 of whom 1634 had a PPH as defined	elective and emergency C/S, polyhydramnios, chorioamnionitis, multiple gestation, retained placenta

Discussion of Key Findings

For this chapter I hoped to distinguish, if possible, between risk factors and causes of PPH. A 'cause', of PPH is one where the biological mechanism is clear e.g. 'retained products of conception' is a cause of PPH because it prevents contraction and retraction of the uterus. A risk factor is one where the biological mechanism is unknown and, indeed, there may not be one e.g. 'family history' is a 'risk factor' (Oberg 2014). The traditional understanding of the causes of postpartum haemorrhage is the four T's (Atkins 1994; Kroencke 2012): Tone, Tissue, Trauma and Thrombin. The four T's are used as the basis for contemporary maternity student and staff emergency training e.g. the ALSO ® course (Anderson, Etches & Smith 2000). However, the distinction between 'causes' of PPH are not as clear as the four T's implies. For example, three of the four reviewed studies show that the researchers found a relationship between traumatic PPH and atonic PPH because they classified episiotomy, instrumental and caesarean delivery as atonic PPH. This co-relation is actually understandable because the pain and fear involved in surgical and instrumental deliveries causes adrenaline release, which, as described in Chapter 2, blocks Oxytocin uptake. What is clear is that if there is traumatic PPH, there will be a degree of atonic PPH as well.

All four reviewed studies used International Classification of Diseases (ICD) 9/10 codes to identify atonic PPH and its risk factors which would normally be seen as strength. Unfortunately, for these studies, they used different definitions for PPH and selected some different risk factors making comparisons across studies very difficult. Because of this lack of agreement about the risk factors of atonic PPH, I was in a quandary. I needed a list of accepted risk factors or 'causes' of PPH to use as a basis for variables in the study I was designing. I decided to use the NSWHealth list (New

South Wales Health, Primary Health & Community Partnerships 2010). The currently accepted causes of PPH, as listed by NSW Health (2010), are summarised in table 3.3 below with the link, which categorises each factor in terms of the 4 T's, and another column for my comments and critique as to whether these factors are seen as actual 'causes' of atonic PPH and should therefore be controlled for in this study.

Table 3.3 Current accepted risk factors for PPH with comments

Factor	4T Category	Examples	Comments and Critique
Previous history of primary PPH	**TONE**		A previous history is not a 'cause' of uterine atony, retained products, bleeding disorders or trauma. This category is neither descriptive nor conceptual. In my practice it often does not predict another PPH because the 'cause' of the first PPH does not exist in the second and subsequent birth.
Abnormal uterine anatomy	**TONE**	e.g. fibroids, uterine septum, previous uterine surgery including caesarean	Yes, a probable (but rare) cause because abnormal uterine anatomy may interfere with the effectiveness of uterine contractions.
Over distended uterus	**TONE**	e.g. due to multiple gestation, macrosomia or polyhydramnios	Not necessarily a cause of PPH. It may be that the bleeding associated with multiple births has more to do with causing fear in the woman, the interference in the birth of the second twin, resuscitating the baby which causes fear in the woman plus medical staff anxiety: all of which increase the woman's adrenaline blocking the

			release and uptake of the woman's endogenous oxytocin (Buckley 2009; Odent 2011; Uvnas-Moberg 2013).
Parity of 6 or greater	**TONE**		Not necessarily a cause of PPH. It may be that bleeding associated with higher parity is created by the fear that staff feel and engender in the woman. In some groups of women increased rates of PPH for high parity women has more to do with the ill health that accompanies non-dominant races, low socioeconomic status and social problems than the idea that the uterus is atonic (UNFPA 2012.)
Abnormalities of the placenta	**TISSUE or TONE**	e.g. low lying placenta, placenta accrete, percreta, placenta praevia, retained products	Yes, a well known cause of PPH but probably not a direct cause of uterine atony. Additionally, consistent with comments above about medical anxiety and intervention can cause fear in the woman which can cause or worsen PPH.
Antepartum haemorrhage	**UNEXPLAINED**		Antepartum haemorrhage is too broad a category to explain PPH. The APH may be due to mal-position of the placenta (above) or a fresh abruption in labour. There may be hypofibrigenaemia related to prolonged slow bleeding. Many cases of APH, however, do not lead to PPH.

Hb of less than 110 gm per litre	**UNEXPLAINED**		Not a 'cause' of PPH but makes the effect of any bleeding more pronounced. The low Hb is likely a reflection of poor maternal nutrition and, depending upon the level, may well interfere with the woman's normal physiology in the 3rd and 4th stage of labour.
Abnormalities of coagulation	**THROMBIN**	e.g., due to: fetal death in utero, hypertension, clotting diseases, anti-coagulant therapy, ante-partum haemorrhage, general infections	Not a primary cause because a number of these conditions are corrected in the antenatal or intrapartum period.
Obstetric or anaesthetic interventions	**TONE AND TRAUMA**	e.g. induction, augmentation, epidurals, forceps, vacuum, shoulder dystocia, episiotomy or tear requiring suturing	Yes, for two reasons. Obstetric and/or anaesthetic interventions cause maternal shock/fear/anxiety and thus block the effect of endogenous oxytocin (Lederman et al. 1978) plus some anaesthetic agents cause uterine muscle relaxation (Jonas 2009; Jones et al. 2012). The mechanism of how interventions cause uterine atony is not explored in the medical literature. A plausible explanation is dysfunction in psychophysiology.

Intrapartum haemorrhage	**UNEXPLAINED**		Not a direct cause of PPH. There could be a number of causal mechanisms; partial separation of the placenta plus or minus coagulation defects as for APH.
Uterine muscle exhaustion	**TONE**	Prolonged or abnormal labour	I do not accept this category as many women can have long labours without PPH. A plausible explanation is dysfunction in psychophysiology associated with the medical interventions that usually accompany prolonged and abnormal labour.
Intra-amniotic infection	**TONE**	Prolonged ruptured membranes (> 24 hours)	Yes, accepted
Drug induced uterine hypotonia	**TONE**	e.g., oxytocin, magnesium sulphate, nifedipine and salbutamol.	Yes, this cause most often is associated with the use of artificial oxytocin or tocolytic drugs (Bateman et al. 2010; Grotegut et al. 2011). Oxytocin, paradoxically, can cause uterine atony and PPH by causing uterine muscle exhaustion (Driessen et al. 2011).
Reference; New South Wales Health, Primary Health & Community Partnerships 2005.			

Conclusion Part 1

Table 3.3 ‘Current accepted risk factors for PPH’ above demonstrates risk factors but causes are not distinguished except for drug induced hypotonia. Many categories in this table have no theoretical explanation and therefore, are not amenable to implementing preventive strategies by dealing with the actual biological cause. This table also shows that the major association with PPH is uterine atony. The recommended prevention of atonic PPH is routine artificial oxytocin in the 3rd stage of labour. The underlying assumption being that birthing women, unique among mammals, are deficient in endogenous oxytocin. This assumption underpins the randomised control trials of the active vs physiological management of the 3rd stage of labour and the Cochrane Systematic Reviews of them as discussed in Chapter 1 (Begley et al. 2010; Begley et al. 2015; Elbourne et al 2001; Khan et al. 1997; Prendiville et al. 1988; Prendiville, Elbourne & McDonald 2009; Rogers et al. 1998; Thilaganathan et al.1993).

In deciding which factors to use as variables in the present study I accept the following factors have strong research evidence of being associated with PPH:

- chorioamnionitis, (Bateman et al. 2010; Lutomski et al. 2012; Mehrabadi et al. 2013)
- placental disorders, (Bateman et al. 2010)
- polyhydramnios, (Bateman et al. 2010; Lutomski et al.2012)
- multiple pregnancy, (Bateman et al. 2010; Mehrabadi et al. 2013)
- elective and emergency caesarean section, (Bateman et al. 2010; Lutomski et al. 2012)
- instrumental births (forceps and vacuum), (Driessen et al. 2011; Lutomski et al. 2012; Mehrabadi et al. 201

- induction/augmentation, (Bateman et al. 2010; Driessen et al. 2011; ; Lutomski et al. 2012; Mehrabadi et al. 2013)

These proven risk factors (PRFs) apart from exclusions (as discussed in Chapter 4), were used as covariates in the statistical model I created to test my hypothesis that S2S and B/F at birth should reduce the rate of primary PPH.

All the other 'risk factors' do not have sufficient research evidence to legitimise any claim that they have a moderate to severe impact on the incidence or severity of uterine atony as a cause of atonic PPH. When aggregated there were more than 57 risk factors for PPH because of the differing terminology and sub-categories used by the various studies. The strength of the evidence-base for these identified obstetric risk factors, however, is uncertain. It is probable that some of the 'known' risk factors are not associated with postpartum haemorrhage (PPH) and conversely it is possible that there are factors, such as genetic predisposition (Oberg et al. 2014) and other, as yet unknown factors, which are actually causing the increase in PPH rates.

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PART 3: S2S AND B/F AND PPH LITERAURE SEARCH

Prior to the introduction of synthetic oxytocin for the prevention of PPH there were, anecdotally, two longstanding and traditional methods used by midwives for the prevention of early PPH. These were nipple stimulation and putting the newborn baby to the mother's breast immediately after birth and usually before the delivery of the placenta. These actions stimulate the hypothalamic-pituitary-adrenal axis (HPA) resulting in release of endogenous oxytocin, especially in a term pregnancy and immediately after birth, causing the uterus to contract (Christensson et al. 1989; Chua et al. 1994; Irons, Sriskandabalan & Bullough 1994). Because of the low rates of early PPH at Belmont Birthing Service referred to in Chapter 1, I wondered if including the two elements of skin-to-skin contact and early breastfeeding to 3rd and 4th stage labour care would cause a reduction in primary PPH for women generally.

A literature search was conducted using the key words birth, skin-to-skin, kangaroo care, 3rd stage of labour, oxytocin, postpartum haemorrhage, breastfeeding and sucking/suckling. The data bases systematically searched were EMBASE, CINAHL, Scopus, The Cochrane Library, Medline and Maternal Infant Care. The time period was 1960 to the present. The limit was English language. There were 78 possible matches. Only papers directly relating to the guiding question were examined. The titles and/or abstracts were then read. It was noted that there were no papers which directly examined skin-to-skin contact in relation to PPH rates. Two partially relevant studies which examined breastfeeding immediately after birth in relation to post birth blood loss were found. A Cochrane review has been proposed by Abedi et al. (2013) which will examine the effect of nipple stimulation or breastfeeding in the prevention of acute PPH in 3rd stage of labour (Abedi, Jahanfar & Namvar 2013). However there is no inclusion of skin-to-skin contact or a combination of the two elements (skin-to-skin and breastfeeding) in this proposal.

The two partially relevant articles, which were found, were a randomised controlled trial (RCT) conducted in Malawi in South East Africa (Bullough, Msuku & Karonde 1989), and a quasi-experimental study conducted in Egypt (Sobhy & Mohamed 2004). Both studies (Bullough, Msuku & Kaonde 1989; Sobhy & Mohamed 2004) examined the effect of early breastfeeding on post birth bleeding and these arrived at contradictory results. Skin-to-skin contact was not defined in either study and therefore the babies may have been swaddled.

In the Bullough, Msuku & Karonde (1989) study traditional birth attendants (TBAs) were randomised to either the early suckling group or usual care group. TBAs were mostly illiterate and/or innumerate so the two groups were separated and given a two day refresher course on 3rd stage of labour management. The course content was identical except for the early suckling group who were taught to place the baby on the mother's chest once the cord was cut to encourage breastfeeding. Both groups of TBAs were taught to lay the newborn between the mother's legs and to wait three minutes before cutting the cord. Both TBA groups were taught to separate liquor, discard and then measure post birth blood loss. In Malawi usually after birth care involved giving the newborn baby immediately to relatives who would then care for the baby for a few hours in the belief that the mother needed to rest after the hard work of labour and that the newborn baby does not require an immediate feed.

The strength of the above research was the large number of women involved and that postpartum blood loss was measured. Another strong point was the quality control measure using a midwife to check the TBAs data keeping in the clinical setting. In this study the frequency of PPH was expected to be about 7.5%. Therefore a reduction to 5% would have been regarded as clinically significant. To detect this difference 3900 births would be required in the study and Bullough, Msuku & Karonde (1989) did use an appropriate sample size of 4227 women. PPH was defined as post birth blood loss greater than 500 ml during the 3rd stage of labour or within the first 24 hours after the birth. Randomisation was by TBA to reduce the likelihood of contamination by treatment groups. To avoid possible bias TBAs were not told that they were participating in a study. The early suckling group (experimental arm) had a PPH rate of 7.9% whilst the PPH rate for the controls was 8.4%. The

mean blood loss was 258 ml (experimental) and 256 ml (controls) and therefore not significantly different. The 3rd stage of labour was physiologically managed. There was no difference in the rate of PPH between mean analyses of the two TBA groups. However there was a significant difference ($p < 0.001$) in rates of PPH with increasing parity of the women.

A concurrent study was conducted to see how successfully newborn babies could breastfeed immediately after birth. In 76 spontaneous vaginal births the newborn babies were placed between their mothers legs and the cord was cut after three minutes. The babies were then encouraged to breastfeed. All of these babies sucked at the breast within 20 minutes of birth (20 within five minutes and 53 within 10 minutes). Blood loss was not measured in this small study.

The importance of this study is that it was not restricted to low risk women and the majority of the women would have given birth at home in their village, with a known caregiver. Given that this study was conducted in a developing country, where many women suffer from anaemia and may be malnourished, the findings may not generalise to Western countries

In the Egyptian study (Sobhy & Mohamed 2004) which was a quasi experimental study: primiparous (first time mothers) women (N = 100) were either allocated to an early breastfeeding group (n = 50) where breastfeeding commenced immediately after delivery of the placenta or to the late breastfeeding group (n = 50) where breastfeeding was commenced two hours after the birth. The postpartum blood loss was measured. Blood loss was documented on an observation checklist which also included information on uterine contractions, state of uterine fundus and the number of times the newborn sucked at the breast (Sobhy & Mohamed 2004). All of the women in this study were low risk primipara. The authors found that blood loss for the experimental group (< 150 ml) was significantly less than the control group (≥ 300 ml) in the fourth stage of labour ($p < 0.05$) and the more often the newborn sucked at the breast, the less the postpartum blood loss. This was an in hospital study and was conducted over a five month period from February to June 2000, inclusively.

Two additional studies, found in the reference sections of these two papers, examined the effect of early breastfeeding and/or nipple stimulation on uterine contractions during the 3rd stage of labour (Chua et al. 1994; Irons, Sriskandabalan & Bullough1994). Both studies found that uterine pressure was increased with nipple stimulation and/or breastfeeding during the 3rd stage of labour. The authors of both studies recommended further research because of the small sample sizes involved in both studies.

Regular literature searches have been conducted to find new relevant studies on causes of uterine atony and S2S and B/F and relationship to PPH.

CONCLUSION

Uterine atony as a cause of PPH has been poorly defined in the literature with very little agreement on the amount of blood loss which constitutes a PPH. No account has been taken of the model of care or the environment in which the women gave birth, although two of the authors suggested these two variables should be taken into consideration for future research.

There appears to be a gap in the literature regarding the effects of skin-to-skin contact and breastfeeding at birth and its effect, if any, on the rate of primary PPH. My study should make a contribution towards filling this gap.

CHAPTER 4 METHODOLOGY

INTRODUCTION

This chapter describes the methodology used to answer the research question: **'Does skin-to-skin contact and breastfeeding immediately after birth affect the rate of early postpartum haemorrhage (PPH)?'**

The chapter begins by presenting the study aim, design, settings and ethical considerations. The methods for data collection are then described and discussed; including consideration of the reliability and validity of the ObstetriX data base. Methods of analysis are then described and discussed, that is, descriptive statistics (including chi square) and logistic regression.

Aim: The aim was to evaluate the effect of skin-to-skin contact (S2S) and breastfeeding (B/F), immediately after birth between mother and baby on PPH rates.

STUDY DESIGN

A cross sectional, retrospective cohort design was used. Cohort studies are appropriate when researchers want to know the actual effects of variables under consideration in clinical practice. Cohort studies, like this one, can demonstrate an appropriate causal association between an intervention (S2S and B/F) and an outcome (PPH) especially when the study numbers are large (Grimes & Schultz; 2002; Mann 2003; Reeves et al. 2009).

SETTINGS

The setting included maternity services in three hospitals, John Hunter Hospital (JHH), The Maitland Hospital (TMH) and Belmont Birthing Service (BBS) that are managed as a single group within the Hunter New England Area Health Service (HNEAHS). The boundaries of HNEAHS define an area approximately the size of England and extend from the Queensland border in the north to Lake Macquarie in

the south (see Figure 1.4 for map). The John Hunter Hospital is the principal tertiary referral unit whose role delineation is Level 6. Role delineation of services describes the complexity of clinical activity undertaken by the service and the necessary qualifications of medical, nursing, midwifery and other health care professionals required to perform those services (Centre for Epidemiology and Evidence NSW Health 2013; Statewide Services Development Branch 2002). Levels range from 6, the most complex care with specialist obstetricians and highly skilled midwives, to Level 1, the lowest complexity of care. As a Level 6, JHH receives all complicated pregnancies for specialist care from across HNEAHS. Emergency and elective caesarean section services are available. The John Hunter Hospital has 13 staff specialist obstetricians, two of whom have additional qualifications in fetal medicine. There are 160 midwives to complement the medical staff. Birthing services are also provided for well, healthy women residing in the Newcastle area. A neonatal intensive care unit, the largest in Australia (41 cots), is attached to JHH and provides care for preterm (less than 37 weeks gestation) or ill babies and those babies requiring ventilator support.

A Midwife Service Manager is responsible for all aspects of service provision and budget. Midwives work within a medical model of care (Edwards 2005; Mander & Murphy-Lawless 2013). When a woman is admitted in labour her observations are entered on to a partograph (defined in Glossary of Terms) and the unborn baby is monitored for 30 minutes by cardio-tocograph trace (defined in Glossary of Terms). The labour is closely monitored and if a doctor decides the woman is not progressing according to the partograph parameters, the decision is made to augment the labour with artificial oxytocin, e.g., syntocinon. Routinely the 3rd stage of labour is actively managed with artificial oxytocin administered as an injection into the woman's thigh, the cord is cut and the placenta removed by controlled cord traction.

Belmont Birthing Services (BBS) is a midwife-led model providing continuity of care in a stand-alone birth centre or homebirth for well women with uncomplicated pregnancies. Well women residing in the Newcastle and Belmont areas are offered the choice of delivering at BBS, home or JHH. There is a Midwifery Manager who has responsibility for service provision and the budget. The seven midwives who work in

this service have all been credentialed as having the skills for intravenous cannulation, maternal and neonatal resuscitation including intubation and repair of vaginal tears and episiotomy. The number of women booking for this service is approximately 200 per annum. As these women are considered low risk (and the service role delineation is as a Level 1 service) there is no obstetric medical staff on site at BBS. However, medical staff at JHH are available for consultation 24 hours a day/seven days a week. Should transfer to JHH be required then it is only 20 minutes by ambulance or car depending on the need and urgency for transfer. At BBS labour and birth progress without intervention, that is, allowed to progress physiologically. The 3rd stage of labour is generally managed physiologically/naturally with the cord being left in situ until pulsation ceases and the placenta is delivered by maternal effort and/or gravity. There is no caesarean section service available. JHH and BBS have a combined birth rate of about 4500 births per annum.

The Maitland Hospital (TMH) is the third hospital in the group. The Maitland Hospital is a regional unit (designated as a Level 4) which provides care for women who are 34 weeks pregnant or beyond. As a Level 4 service Maitland Hospital has very few specialist obstetricians (2) and some private obstetricians (6) and 75 midwives. The service includes a special care nursery for sick babies who do not require ventilatory support. Caesarean section, elective and emergency services are available. The maternity service is headed by a Midwifery Manager who has the same responsibilities as the Service Manager at JHH. Maitland Hospital midwives provide care to approximately 1500 women per annum under a medical model similar to JHH.

ETHICS APPROVAL

Site Specific Approval to conduct the study was obtained from the senior managers at each site. The ethical issues to be considered were confidentiality and data security. No contact with women and midwives was required for data collection. The data was both de-identified and non-re-identifiable. Data security and storage is being managed in line with National Health and Medical Council Research Council (NHMRC) guidelines (National Health and Medical Research Council 2007). Ethical approval was granted in November, 2010. See Appendix 4A for Ethics approval.

DATA COLLECTION

Maternity care data is recorded electronically in ObstetriX which is the official data base for public sector births in New South Wales (NSW), Australia. Data is recorded in three separate folders: 1) pregnancy, 2) labour and birth, and 3) postnatal folders. Midwives, using the paper medical record as a guide, transcribe the data into the designated folders at the point of care. Each folder contains mandatory questions and the opportunity to enter free text. Further information about the ObstetriX data base, its development, uses and examples of screen shots is provided in Appendix 4B.

Accuracy of data in ObstetriX

There is some evidence to support the validity of midwife entered responses into an electronic data base. An American study (Stapleton 2011) examined 3966 variables and reviewed the consistency between the online data record with the woman's paper record as transcribed by the midwives working in a combination of five free standing birth centres and hospitals. All units were members of the American Association of Birth Centres on-line registry. The results showed a very a high level of consistency (97.1%) between the two sets of records. In Australia, a validation comparing the paper medical record with the electronic version (the Victorian Perinatal data form) demonstrated a similar level of consistency (96.3%) between the two records in 2003 (Knight et al. 2009). This form is completed by the birth attendant (usually the midwife).

Participants

The study population consists of all women who birthed a healthy baby during the two calendar years (2009 and 2010). De-identified data of 11,219 cases were extracted from the ObstetriX data base by the Clinical Midwife Informatics (CMI), whose role is to be custodian of the data base. The data base records 600 variables for each woman. However, for the purpose of this study only 83 variables were

extracted in line with a literature search on causes/risk factors of PPH. A list of the relevant variables, including risk factors of PPH, extracted from ObstetriX is included in Appendix 4C. The list of variables were further refined to correspond with the majority of variables associated with atonic PPH as identified in the most recent research articles on this topic (Mehrabadi et al. 2013; Bateman et al. 2010; Lutomski et al. 2012; Driessen et al. 2011) and discussed in Chapter 3.

Potential participants were all women who birthed a term baby (37+ 0 to 42+ 0 weeks gestation) with an APGAR score of seven or more at five minutes of age, during the two calendar years 2009/10. Inclusion criteria were selected because only these women and babies were well enough to experience immediate skin-to-skin and breastfeeding (Portney & Watkins 2009).

Exclusion criteria

The extracted data (n = 11219 cases) were reduced to 7548 cases by excluding the following cases:

- Stillbirths: some mothers opted for skin to skin contact; however these mothers were in the minority and breastfeeding was not possible; therefore the decision was made for these cases to be removed,
- Babies with a gestational age of less than 37 weeks or greater than 42 weeks: as there was a likelihood for these babies to be separated from their mothers immediately after birth by being admitted to the special care or intensive care nursery,
- Babies with an APGAR score of less than seven at five minutes of age: as these babies were admitted to the nursery for observation,
- Babies who were admitted to the nursery (special care or neonatal intensive care) for any reason,

- Multiple births as the second twin often has to be resuscitated and will be admitted to the nursery for observation. There were no triplets born during the study years,
- Mothers having general anaesthetic as these mothers had no opportunity for S2S and B/F,
- Emergency caesarean section; mothers do not get the opportunity for S2S contact due to midwifery staff only rostered to cover for elective caesarean sections, and
- Incomplete or contradictory data.

KEY VARIABLES

The outcome (dependent) variable was postpartum haemorrhage (PPH), defined as blood loss estimated of 500 ml or more after birth (New South Wales Health, Primary Health & Community Partnerships 2005; World Health Organisation 2009). In ObstetriX there are four categories of volume for blood loss after birth. The first category is less than 500 ml which is considered normal blood loss and was coded as 0. The remaining three volumes (500 ml to 999 ml, 1000 ml to 1499 ml and 1500 ml or more) were coded as 1 representing PPH (these values align with the 2005 document produced by New South Wales Health (New South Wales Health. Primary Health and Community Partnerships 2005).

The primary variable was 'Pronurturance status' defined as skin-to skin contact and breastfeeding (S2S and B/F defined in List of Abbreviations used in dissertation) in the 3rd and 4th stages of labour. There are two relevant dichotomous variables recorded in ObstetriX: one was skin-to-skin contact at birth (Yes/No) and the other was breastfeeding within 30 minutes of birth (Yes/No). A composite variable, skin-to-skin and breastfeeding was constructed to create pronurturance status: 1. Full = 'skin-to-skin & breastfeeding', 2. Partial = 'skin-to-skin but no breastfeeding'; 3. None = 'no skin-to-skin contact & no breastfeeding'. The other possible pronurturance status of 'no' to skin-to-skin but 'yes' to breastfeeding' was excluded due to its low numbers (less than 0·01%).

Medical risk covariates

Covariates were the medically accepted risk factors and their associated ObstetriX variable/s as presented in Table 4.1 (Cunningham et al. 2001; New South Wales Health. Primary Health & Community Partnerships 2005; Royal College of Obstetricians and Gynaecologists 2009).

Table 4.1 Medical risk factors for PPH and ObstetriX variables

Risk factor	ObstetriX Variable
Previous history of primary PPH	Not recorded in labour and delivery folder
Abnormal uterine anatomy	Elective caesarean section Previous caesarean section Mode of birth (includes caesarean section)
Over distended uterus	Abnormal liquor volume Macrosomia*
Parity of 5 or greater	Number of term and preterm pregnancies
Abnormalities of the placenta	Abnormal placental site Obstetric indication for c/section
Antepartum haemorrhage (APH)	APH after 20 weeks* Complication in labour Indication pre-labour intervention

Haemoglobin (Hb) < 110 g/l	Proven anaemia in pregnancy Thalassaemia*
Obstetric or anaesthetic intervention	Oxytocics in labour (induction/augmentation) Forceps/Vacuum Episiotomy Epidural Vaginal tear sutured General anaesthetic
Uterine muscle exhaustion	No specific ObstetriX variable
Intra amniotic infection	Chorioamnionitis*

*See Glossary of Terms for definitions

Elective caesarean sections (C/S) were included in the analysis as these women experienced S2S&B/F as part of routine care. The covariates/risk factors for PPH are listed in Table 4.2. These covariates align with those used by the authors of the four research articles (Bateman et al. 2010; Driessen et al. 2011; Lutomski et al. 2012; Mehrabadi et al. 2013) on causes/risk factors for atonic PPH as discussed in Chapter 3. The covariates include the proven factors (PRF) where the evidence from the literature is moderate to strong on causes/risk of atonic PPH, e.g., induction and those traditional factors (TRF) where the evidence is inconclusive or contradictory, e.g., maternal age.

Table 4.2 Covariates with categorisations

Covariate	Categorisation	Strength of Covariate (TRF or PRF)
Maternal age (years)	< 20, 20-24, 25-29, 30-34, 35-40, ≥ 40	TRF
Parity *	Primip, 1-2, 3-4, ≥ 5	TRF
Body Mass Index (BMI)	≤ 25, 25.01-30, 30.01-35, > 35	TRF
Current smoker	Yes/No	TRF
Gestational age (weeks)	37+0-40+0, 40+1-42+0	TRF
Birth weight (grams)	< 3000 g, 3000-3999 g, 4000-4499 g, ≥ 4500 g	TRF
Elective caesarean section	Yes/No	PRF
Epidural analgesia	Yes/No	TRF
Induction/Augmentation	Yes/No	PRF
3rd and 4th degree tears	Yes/No	TRF

Episiotomy	Yes/No	TRF
Placenta praevia*	Yes/No	PRF
Antepartum haemorrhage (APH)	Yes/No	PRF
Placental abruption	Yes/No	PRF
Polyhydramnios*	Yes/No	PRF
Forceps delivery	Yes/No	PRF
Vacuum delivery	Yes/No	PRF
3rd stage of labour (Active)	Yes/No	TRF

*Defined in Appendix 6 Glossary of Terms

Variables Coding

Variables in the ObstetriX data base are either string variables (words) or numeric variables (numbers). Variables, where possible, were dichotomised (see Glossary of Terms) into Yes or No and then were coded to 1 or 0 respectively.

STATISTICAL METHODS

Descriptive statistics, using numbers and percentages, were calculated to describe the characteristics, labour and obstetric outcomes for the whole cohort. Statistical

analyses were performed using SPSS Version 21. Significance was judged as $p < 0.05$.

Chi square (X^2) was used to test the relationship between the various levels of pronurturance and PPH.

Unadjusted and adjusted logistic regression, using odds ratios and their 95% confidence intervals, were used to quantify relationships with PPH. Unadjusted logistic regression was used to calculate the effects of the intervention, skin-to-skin contact and breastfeeding (S2S and B/F) with TRF and PRF covariates on PPH rates individually. Crude associations of PPH were assessed for categories of maternal age, parity, BMI (Body Mass Index) gestational age, birth weight, labour and birth outcomes and pronurturance status using tabulated numbers and percentages and Pearson chi- square tests of association (Field 2009).

The associations were quantified with unadjusted odds ratio (OR) and their 95% confidence intervals were calculated, using unadjusted binary logistic regression. Binary logistic regression is described in more detail in a later paragraph. Reference categories for explanatory variables in logistic regression were as follows: for maternal age it was 20-24 years, for parity it was 1-2, for gestational age it was 37+0 to 40+0 weeks, for birth weight it was < 3000 g, for smoking status it was non-smoker, for BMI it was lowest to 25, for elective caesarean section it was vaginal births/no previous caesarean section and for all other covariates, e.g., epidural analgesia, not having the attribute was the reference category.

Adjusted logistic regression was used to assess the effect of the various levels of pronurturance status, adjusting for the effects of the other covariates and demographic factors. This is important because it is necessary to know the strength of association between pronurturance and PPH when all covariates are added to the model (Field 2009).

The issue of multicollinearity was tested using linear regression and collinarity diagnostics (Field 2009).This is discussed more fully in the section on binary logistic regression.

Sensitivity of Model

Sensitivity analyses, using both unadjusted and adjusted logistic regression, were conducted to assess the strength of the association of different levels of pronurturance for women at higher and lower risk of PPH. The higher risk group (n = 2318) was created by including women who had any of the PRF for PPH (discussed above). The remainder of the cohort (n = 5320) constituted the lower risk group; it included women with the TRF for PPH, or none at all.

These full results are included in Appendix 5 Additional Results.

Potential Bias

As a retrospective study there is the possibility of reverse causation as a potential bias (Flegal et al. 2011). Reverse causation, that is, those women who were having an immediate PPH may have been prevented from experiencing S2S and/or B/F because the clinicians were treating a PPH is discussed in Chapter 5 Findings.

The possible effects for a previous PPH could not be controlled for due to the lack of data on this variable in the ObstetriX labour and delivery folder. The association between a previous PPH and a PPH at the index birth is well known (Ford et al. 2007b). There is, however, no known independent causal mechanism by which a previous PPH causes a subsequent PPH. Also, like most studies involving PPH, blood loss was visually estimated (Begley et al. 2010; Begley et al. 2011; Prendiville et al. 2009). It is unlikely this study was affected by any bias, either conscious or unconscious, due to visual estimation as data was drawn retrospectively and staff had no knowledge that this study would be conducted. The possible effects of prolonged labour could not be controlled for due to incompatibility between ObstetriX and SPSS. However most women with prolonged labour would have medical intervention, augmentation or operative deliveries and these are included as covariates in the model

Two Way Tables and Test of Association

Pearson chi-square test of associations was used to test whether two categorical variables were associated (Field 2009; Pallant 2005). Breastfeeding, S2S contact and early PPH are considered to be categorical variables. Skin-to-skin contact and PPH are two categorical variables with two categories in each variable resulting in a 2 x 2 table. However with pronurturance (3 levels) and PPH (2 levels) the result is a 3 x 2 table.

An assumption must be made that the lowest expected frequency in any cell must be 5 or more (Field 2009). All variables tested conformed with this assumption due to large sample size.

The Odds Ratio (OR) and 95% confidence interval (CI) are also given as part of the 2 x 2 table. The OR is used to assess the odds of an event occurring in one group compared to another group and is useful as an effect size statistic (Field 2009) as it gives clear and direct information to midwives about which treatment has the best odds of benefitting the woman. For example, how much more likely is it that a woman who had S2S and B/F immediately after birth will develop a PPH as compared to a woman who did not have S2S and B/F immediately after birth. An OR of 1 indicates that the two groups of women are equally likely to have a PPH. An OR of less than 1 indicates that the woman is less likely to experience PPH when she has S2S and B/F following the birth. An OR of greater than 1 indicates that a woman was more likely to experience PPH when she had S2S and B/F immediately following the birth.

Binary Logistic Regression

Logistic regression is able to predict an outcome, PPH, (dependent variable) from a predictor variable, S2S and B/F (independent variable) (Field 2009; Griffith 2010; Pallant 2005; Peng et al. 2002). Multiple regression predicts an outcome variable from several predictor variables. Logistic regression was calculated to predict the outcome variable (PPH) which is dependent and categorical. Logistic regression is

able to predict which category a woman is more likely to fit, given other reliable information.

Logistic regression, using univariable and multivariable (unadjusted and adjusted) analyses allowed assessment of how well the predictor, S2S and B/F (pronurturance) variable, was able to predict the outcome or the dependent variable (PPH). An accurate assessment of the classification of cases is also provided, highlighting the specificity and sensitivity of the model as well as positive and negative predictions (Field 2009; Pallant 2005). Logistic regressions were calculated for the primary dependent variable (PPH) which was able to be coded dichotomously and met the following important assumption that the sample size was large (n = 7548).

The data requirements were: an outcome dependent variable which is categorical and dichotomous and two or more categorical predictor independent variables (Agresti 2012; Field 2009; Pallant 2005; Tabachnick & Fidell 2001). All logistic regression calculations presented as part of this research project satisfy these assumptions

An independent predictor in logistic regression is considered significant if the 95% Confidence Interval (CI) value of the odds ratio falls either totally above or totally below 1 (Field 2009).

Also the issue of multicollinearity was addressed (see next section).

Multicollinearity For Logistic Regression

All of the independent (predictor) variables were checked for high inter-correlations which would mean that multicollinearity existed, posing a problem for logistic regression (Agresti 2012; Field 2009; Skinner 2007). Multicollinearity exists when the predictors in a regression model show strong correlations between them. A high collinearity level increases the probability that the good predictors of the outcome might be found non-significant, thereby being abandoned from the model (known as a Type 2 error, believing there is no effect when in reality there is). Low collinearity levels do not pose a threat to a logistic regression model but if predictors show strong

correlations (above 0.8) it is difficult to assess which predictor is important. Variance inflation factors (VIF) predict the strength of relationship between the predictor independent variables (Field 2009). Variance inflation factor values should not be greater than 10. Tolerance levels are related to the variance inflation factor, being its reciprocal (1/VIF). All tolerance levels for a multicollinearity check should be greater than 0.1 (Field 2009). See Appendix 5 Additional Results.

CONCLUSION

This chapter has described the HNEAHS, the sites included in the study, ethical considerations, the settings, the participants, exclusions and statistical methodology for the study when examining the research question ‘does S2S and B/F immediately after birth affect the rate of early PPH’.

Evaluating the effect of pronurturance (S2S and B/F) on PPH whilst also addressing (including adjusting for) other known/documented medical causes/risk factors/covariates of PPH enhances the statistical analysis.

Using chi square test of association, and univariable and multivariable logistic regression to analyse the data from the ObstetriX data base, which reflects actual clinical care in the work environment, midwives should be provided with sound statistical analyses on which to base changes to clinical practice. Such changes may include midwives encouraging women to have S2S and B/F immediately after birth as a risk reduction measure to reduce the incidence of PPH.

CHAPTER 5 FINDINGS

In this chapter the results are presented in the form in which it was accepted for publication in a peer reviewed journal Midwifery (Saxton et al. 2015). The findings paper was structured according to the 'Strengthening the Reporting of Observational Studies in Epidemiology' guidelines (von Elm et al. 2014). The reader may want to skip over the Background section as it is a summary of material already presented in Chapters 1, 2 and 3. Likewise, Design, Setting and Participant Selection and Key Variables have already been discussed in the previous 'Methods' chapter. The reader may, therefore, choose to begin reading under the heading 'Results'. First the maternal, fetal and obstetric characteristics of the participants are presented. Next the overall rate of PPH is given and then the numbers and percentages of PPH for women who had pronurturance versus women who did not have pronurturance. The chapter also reports on the association between PPH and the maternal, fetal and obstetric variables using unadjusted logistic regression and adjusted logistic regression. The paper ends with a summary and discussion of the results. The conclusion to the chapter anticipates the discussion and conclusion chapter that will end the dissertation. Demographic and dichotomous variables were analysed using descriptive statistics and are included as Appendix 5 Additional results. Also included in Appendix 5 are the full results of unadjusted and adjusted logistic regression analyses for women at higher and lower risk of PPH.

The paper as presented in Midwifery follows:

Title: Does skin-to-skin contact and breastfeeding at birth affect the rate of primary postpartum haemorrhage: Results of a cohort study

Authors: A. Saxton, K. Fahy, M. Rolfe, V. Skinner, C. Hastie.

ABSTRACT

Objective: To examine the effect of skin-to-skin contact and breastfeeding within 30 minutes of birth, on the rate of primary postpartum haemorrhage (PPH) in a sample of women who were at mixed-risk of PPH.

Design: Retrospective cohort study.

Setting: Two obstetric units plus a freestanding birth centre in Australia.

Participants: After excluding women (n = 3671) who did not have the opportunity for skin to skin and/or breastfeeding, I analysed de-identified birth records (n = 7548) extracted from the electronic data base ObstetriX for the calendar years 2009 and 2010.

Intervention: Skin and breastfeeding within 30 minutes of birth.

Measures: Outcome measure was PPH, that is, blood loss of 500 ml or more estimated at birth. Data was analysed using descriptive statistics and logistic regression (unadjusted and adjusted).

Findings: After adjustment for covariates, women who had neither skin to skin contact nor breastfeeding were almost twice as likely to have a PPH compared to women who had both skin to skin contact and breastfeeding (OR 0.55, 95% CI 0.41-0.72, $p < 0.001$). This apparently protective effect of skin contact and breastfeeding held true in sub-analyses for both women at 'lower' (OR 0.22, 95% CI 0.17-0.30, $p < 0.001$) and 'higher' risk (OR 0.37, 95% CI 0.24-0.57, $p < 0.001$).

Key conclusions and implication for practice: This study suggests that skin to skin contact and breastfeeding immediately after birth may be effective in reducing PPH rates for women at any level of risk of PPH. The greatest effect was for women at lower risk of PPH. The explanation is that pronurturance promotes endogenous oxytocin release. Childbearing women should be educated and supported to have skin contact and breastfeeding during the third and fourth stages of labour.

Key words: skin to skin, breastfeeding, postpartum haemorrhage, oxytocin, cohort study

INTRODUCTION

This paper reports on a large, retrospective cohort study concerning the effects of pronurturance, i.e., skin to skin and breastfeeding (S2S and B/F) in the first 30 minutes after birth on PPH rates. Key terms are defined in Table 5.1. The first author was the primary researcher for this study; collected the data and conducted the analyses.

.Table 5.1 Definition of key terms

Term	Definition
Active management of 3rd stage	The clinician intervenes by using a prophylactic uterotonic drug just before, with, or after birth of the baby. There is early clamping and cutting of the cord and the placenta is delivered with controlled cord traction (Begley et al. 2011).
Breastfeeding	Any attempt by the baby to suckle the breast within 30 minutes following birth. This definition is consistent with the definition in the ObstetriX database where midwives enter either breastfeeding or formula feeding according to the woman's wishes and the time of first observed feed.
4th stage of labour	The first hour after the delivery of the placenta and membranes (old definition passed down in the oral tradition).
Lower risk of PPH	For this study, lower risk, is defined as women who had normal vaginal births and excluding APH/placenta praevia, polyhydramnios, induction and augmentation.
Physiological care	The woman and midwife have a trusting relationship. The environment is calm, warm and dim. There is spontaneous delivery of the placenta during 3rd stage without resort to oxytocic drugs. The newborn baby is immediately placed S2S on the mothers bare chest/abdomen and allowed to seek the nipple.

Physiological management of 3rd stage	The cord is neither clamped nor cut until pulsation ceases. There is spontaneous delivery of placenta and membranes by gravity, maternal effort or nipple stimulation (Begley et al 2011).
Postpartum haemorrhage	WHO and NSW Health Definition = blood loss greater than 499 ml. In NSW at the time of the study the same definition applied to all births – including caesareans.
Skin-to-skin contact at birth	The naked healthy newborn baby is placed prone on the mother's bare abdomen/chest immediately after birth. In a position where the baby has ready access to the maternal nipple. Both mother and baby should be covered with a warmed blanket. This definition is consistent with the clinical practice at the 3 study sites and in the ObstetriX database where midwives provide a 'Yes' or 'No' to S2S.
3rd stage of labour	The period of time extending from the birth of the baby until the delivery of placenta and membranes.

BACKGROUND

Postpartum haemorrhage (PPH) is a major contributor to maternal morbidity and mortality (Alvarez et al. 2009; Corwin, Murray-Kolb & Beard 2003; Say et al. 2014; WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division 2014; Wise et al. 2010). The rate of PPH has been steadily rising in NSW, where current rates above 20% are not uncommon (Marsh 2011).This steady rise in PPH is occurring across the developed world (Bais et al. 2004; Cameron et al. 2006; Ford et al. 2007a; Knight et al. 2009). Uterine atony (lack of effective myometrial contraction) accounts for 80-90% of all PPH (Bateman et al. 2010; Driessen et al. 2011; Lutomski et al. 2012; Mehrabadi et al. 2013; Radon & Divers 2012; Wetta et al. 2013; Wickham 2011).

The main medical approach to preventing PPH is the active management of the 3rd stage of labour, where artificial oxytocin is administered to the woman at, during or immediately after the birth of the baby. A randomised control trial published in 1988 (Prendiville et al. 1988) and subsequent updates (Begley 1990; Begley et al. 2010; Begley et al. 2011; Prendiville et al. 2000) led the NSW Department of Health to direct that all women have their 3rd stage of labour actively managed (New South Wales Health, Primary Health & Community Partnerships 2005).

The Department of Health directive included a list of putative risk factors for PPH, some of which are not supported by research evidence nor is there a causal pathway, e.g., anaemia, age and grand multiparty.

The notion that pronurturance should be effective in reducing PPH rates is supported by theory and physiology (Coad & Dunstall 2011; Fry 2007; Hastie & Fahy 2009; Saxton et al. 2014; Stables & Rankin 2005; Tortora & Grabowski 2003). The physiological reason is that women have similar reproductive physiology as other female mammals where, in undisturbed birth, uterine atony and therefore PPH is rare (Abrams & Rutherford 2011). Left undisturbed, the newborn mammal remains in close contact with its mother (Fahy 2008, pp.11-20; Henry et al. 2009; Nisbett & Glander 1996) immediately searches for the breast and suckles thus causing oxytocin levels to peak in both the mother and newborn (Matthiesen et al. 2001; Nissan et al. 1995). For women, S2S contact and B/F (pronurturance) occur naturally when labour is peaceful and undisturbed—in that situation both the woman and baby are under the influence of the parasympathetic nervous and hormonal system; appropriately termed the state of 'calm and connect' (Uvnas-Moberg 2003). This serene state is crucial for optimal release and uptake of oxytocin at the myometrium (Coad & Dunstall 2011; Odent 2001; Saxton et al. 2014; Stables & Rankin 2005; Tortora & Grabowski 2003). When a woman is alert, over-excited or frightened she is under sympathetic stimulation and releases adrenaline. Adrenaline interferes with the uptake of oxytocin at the myometrial receptor site (Coad & Dunstall 2011; Gimpl & Farenholtz 2001; Odent 2001; Saxton et al. 2014; Stables & Rankin 2005; Tortora & Grabowski 2003) causing uterine atony. Midwifery models of care where midwives practice pronurturance demonstrate low rates of PPH (Catling-Paull et al. 2013;

Dixon et al. 2009; Fahy et al. 2010). Maybe the hyper-medicalisation of birth (Belghiti et al. 2011; Grotegut et al. 2011; Rossen et al. 2010; Simpson & Thorman 2005; Zwelling 2008) is interfering with innate pronurturance behaviours at birth.

REVIEW OF RELATED LITERATURE

There has been little research on the effect of either S2S or B/F on PPH. An extensive literature search revealed only two partially relevant research articles. These two studies arrived at conflicting results (Bullough, Msuku & Karonde 1989; Sobhy & Mohamed 2004). The first study, a large RCT (Bullough, Msuku & Karonde1989) was conducted in Malawi where the usual cultural practice is for relatives take the baby very shortly after birth. This RCT randomised the Traditional Birth Attendants (TBAs) to either promote B/F at birth or follow usual cultural practice. The B/F group (n = 2104) had a PPH rate of 7.9% compared with 8.4% for the control group (n = 2123), i.e., there was no significant difference. The lack of effect is surprising given the role of oxytocin in both breastfeeding and uterine contractions. Skin-to-skin contact apparently did not occur in either group because the babies were routinely wrapped and handed to the relatives. If the TBA was supposed to be practising early B/F then the wrapped baby was taken to the woman's nipple which is hardly conducive for optimal oxytocin release. The most likely explanation for the lack of difference between the two groups in this study is that asking illiterate TBAs in the intervention arm, to work against culture by keeping mothers and babies together was not effective. A small, quasi-experimental study, with 50 participants in each arm was conducted by Sobhy & Mohamed (2004). The timing of breastfeeding and blood loss was examined. One group of women started breastfeeding immediately after the birth of the placenta while the other group delayed the initiation of breastfeeding for two hours. The results indicated that early breastfeeding had a statistically significant effect ($p < 0.001$) on post birth blood loss. The early breastfeeding group of women lost less than 150 ml of blood; the later breastfeeding group lost 300 ml or more. As neither study was conducted in a Western country and the RCT used illiterate TBAs, it is difficult to have confidence that these results could be generalisable to the Australian context. Importantly, for the

present study, neither study investigated nor mentioned S2S contact.

RISK FACTORS FOR PPH

The NSW Health directive (New South Wales Health, Primary Health & Community Partnerships 2005) listed the risk factors for PPH but did not distinguish between risk factors with evidence and those based on tradition. The literature was searched to identify the risk factors that have been found to cause PPH. These risk factors were used as covariates to identify women at higher risk of PPH in our cohort (Bateman et al. 2010; Driessen et al. 2011; Lutomski et al. 2012; Mehrabadi et al. 2013). These proven risk factors (PRF) are;

1. coagulation defects (very rare),
2. placental anomalies (e.g., antepartum haemorrhage, placenta praevia and placenta accrete/percreta),
3. polyhydramnios,
4. induction/augmentation, and
5. operative births, including caesarean section

Uterine atony which is the most common cause of PPH is related to the last three groups of risk factors (Bateman al. 2010; Driessen et al. 2011; Lutomski et al. 2012; Mehrabadiet al. 2013).

The following factors, except for BMI and active management of 3rd stage, were included in the list of risk factors for PPH by NSW Health (New South Wales Health, Primary Health & Community Partnerships 2005). There is little or no evidence that these factors are associated with the current temporal rise in PPH (Ford et al. 2007a; Knight et al. 2009). As there is widespread and traditional acceptance of these factors as causative of PPH, they were included as covariates in the model for this study (Portney & Watkins 2009). These traditional factors (TRF) include:

1. Maternal age,

2. Parity,
3. Body Mass Index,
4. Gestational age,
5. Weight of the baby,
6. Current smoker,
7. Epidural, and
8. Perineal trauma, including episiotomy; 3rd and 4th degree tears.

Active management of the 3rd stage of labour has been included as a covariate because it has been implicated in PPH in three studies (Dixon et al. 2009; Driessen et al. 2011; Fahy et al. 2010).

RATIONALE

There have been no published studies on the effects of S2S contact together with B/F at birth on the effect on PPH rates; thus this study is justified. One study has shown the effectiveness of physiological 3rd stage care (defined in Table 5.1) in reducing PPH rates for women at low risk of PPH when compared with active management for a matched group of women (Fahy et al. 2010). This study investigates whether the provision of just two elements of physiological care (S2S contact and B/F) at birth would be beneficial in reducing PPH rates.

METHODS

Ethical Approval

This research used non-re-identifiable data and had both site specific and institutional ethical approval.

Design and Settings

This retrospective cohort study was conducted on the electronic birth records in the 2009 and 2010 period inclusive, from three sites: the Tertiary Hospital (TH), which is a referral centre with a neonatal intensive care unit attached. The Regional Hospital (RH) is a regional unit which caters for women who are 34 weeks pregnant or more. There is a special care nursery attached for sick babies not requiring ventilator support. In comparison, the freestanding Birth Centre (BC) is an offsite midwifery-led care unit, which offers continuity of care and home birth for low risk women.

Collectively, the three facilities provided care for just over 5500 women per annum in the study period. The majority of maternity care in both the TH and RH is under a medical model of care. Electronic fetal monitoring for 30 minutes for all women together with the commencement of a partograph on admission in labour was routine in both units. If labour did not progress according to partograph parameters, labour was augmented with syntocinon. Epidurals and opioids were commonly used for pain relief. The 3rd stage of labour was actively managed as defined in Chapter 1, Table 1. At the BC, intermittent fetal auscultation was practised. Labour pain was managed naturally (without pharmaceuticals) or with sterile water injections. Both the TH and BC were Baby Friendly (UNICEF and World Health Organisation 2009) accredited; The RH was working towards accreditation. Staff training on the benefits of early S2S and B/F for promoting breastfeeding and bonding (Bergman 2005; Bystrova et al. 2009; Crenshaw 2010) had been widely implemented at all sites. The practice in all three units was, as far as possible, to place the naked baby immediately on the mother's bare abdomen or chest and cover both with a warm blanket. The duration of S2S contact is not specified in ObstetriX; however, it was established practice to allow a minimum of 15 minutes or more. Skin-to-skin contact longer than 30 minutes in either the TH or RH is rare, given the high activity levels in these units. At the BC however, an hour or more is normal.

Data Source

ObstetriX is the electronic database for public sector births in NSW, Australia. All pregnancy, labour and birth data are recorded by the midwives in the paper based medical record and transcribed into the designated folders on the ObstetriX data base at the time that care is given. The labour and delivery folder was the data source for this study. This folder included antenatal identified medical risk factors for PPH, with the exception of a history of previous PPH.

Participants

Potential participants were all women who gave birth to a term baby (37+0 to 42+0) weeks gestation) with an Apgar score of seven or more at five minutes of age during the two years 2009 - 2010. Inclusion criteria were selected because only these women and babies were well enough to experience S2S and B/F (Portney & Watkins 2009). This group of women, who were at mixed risk for PPH, represents a typical Australian maternity services population, where the vast majority of births occur in hospital (Li et al. 2013). Women having an elective caesarean section were included in the study because pronurturance was part of routine care for these women.

Exclusions

Excluded from analysis were cases with incomplete data and cases where pronurturance was not possible (n = 3671). Emergency caesarean sections were excluded because midwives are not always available to facilitate pronurturance in the operating or recovery rooms. Details of type and numbers of exclusions can be found in Table 5.2.

Table 5.2 Exclusion criteria, numbers and reason for exclusion

Category excluded	Number	Reason
Stillbirths	107	Unable to B/F
Prematurity(<37+0 weeks)	1265	Admit to nursery/unable to have S2S and B/F
Low APGAR (< 7 at 5 min. of age)	269	Unable to have S2S and B/F
Post maturity (> 42+0)	42	Unable to have S2S and B/F as admitted to nursery
Twins	128	2nd baby admit to nursery
General anaesthetic	705	Unable to have S2S and B/F
Admit to nursery	46	Unable to have S2S and B/F
Emergency C/Section	1086	Unable to have S2S and B/F because no midwifery staff available
Incomplete/contradictory data	23	
Total Exclusions	**3671**	

Key Variables

The outcome variable was PPH of 500 ml or more (Chapter 1, Table 1). This definition of PPH applied to all NSW births (New South Wales Health, Primary Health & Community Partnerships 2005). This definition includes caesarean section births because current methods of caesarean section should result in blood loss similar to that associated with vaginal birth (Sharma et al. 2013; Stark 2012).

The independent variable

The intervention under investigation was Pronurturance. The acronyms 'S2S' and 'B/F' will be used in the methods and results section for clarity. Two dichotomous variables were created in relation to pronurturance status: 1) S2S 'Yes/No' and 2) B/F within 30 minutes (Yes/No). In order to investigate if pronurturance (S2S and B/F) has a cumulative effect on PPH reduction, three levels of pronurturance were created: 1) Full: S2S = yes & B/F = yes; 2) Partial: S2S = yes & B/F = no and 3) None: S2S = no & B/F = no. The remaining category: S2S = no & B/F=yes was excluded due to its low numbers (less than 0.01%).

The covariates

The proven risk factors (PRF) and traditional risk factors (TRF) for PPH were used in statistical modelling. The acronyms 'PRF' and 'TRF' will be used for brevity. There were two traditionally accepted risk factors (TRF) that could not be controlled for due to data retrieval problems: previous PPH and prolonged labour.

Statistical Methods

Descriptive statistics, using numbers and percentages, were calculated to describe the characteristics, labour and obstetric outcomes for the whole cohort. Statistical analyses were performed using SPSS Version 21. Significance was judged as $p < 0.05$. Chi square (X^2) was used to test the relationship between the levels of

Pronurturance and PPH.

Unadjusted and adjusted logistic regression, using odds ratios and their 95% confidence intervals, were used to quantify relationships with PPH. Unadjusted logistic regression was used to calculate the effects of the intervention and the covariates on PPH rates individually. Adjusted logistic regression was then used to assess the effects of the intervention on PPH rates whilst adjusting for the covariates. Following Agresti (2012), all covariates were retained in the adjusted modelling even if they did not show significance in the unadjusted model.

Sensitivity analyses, using both unadjusted and adjusted logistic regression, were conducted to assess the strength of the association of different levels of pronurturance for women at higher, and lower, risk of PPH. The higher risk group (n = 2318) was created by including women who had any of the PRF for PPH (discussed above). The remainder of cohort (n = 5320) constituted the lower risk group; it included women with the TRF for PPH, or none at all.

Potential Bias

The retrospective nature of this study is a potential bias because it creates the possibility of reverse causation, i.e., women who were having an immediate PPH may have been prevented from experiencing S2S and/or B/F because the clinicians were treating a PPH. Although we acknowledge this as a potential bias it is mediated by the following factors: 1) immediate, severe, PPH requiring maternal resuscitation is rare whereas in this study 14.7% of all women had PPH in the birth room; 2) the usual practice was to immediately place the baby on the mother's skin before the cord was cut and whilst the placenta was still in situ and finally 3) 94.5% of the sample of women in this study received S2S within 30 minutes. We believe these mediating factors weaken the critique that the reason for the higher PPH rate in women who did not receive pronurturance, was actually due to having a PPH which prevented pronurturance (i.e., not due to reverse causation).

Like most studies involving PPH, blood loss was visually estimated. This study is not

biased by visual estimation because the data was drawn retrospectively and staff had no knowledge that this study would be conducted. The effects of two TF; prolonged labour and a previous PPH could not be controlled for in this study.

RESULTS

Table 5.3 presents the study participants' characteristics, risk factors for PPH and their obstetric outcomes. The normal vaginal birth rate was 77.6% (95% C.I. 76.6-78.5). The PPH rate was 14.7% (95% C.I. 13.9-15.5).

Table 5.3 Characteristics, labour and obstetric outcomes for whole cohort (n = 7548)

Variable	Category	n (%)
Maternal age (years)	<20	633 (8.4)
	20-24	1344 (17.8)
	25-29	2302 (30.5)
	30-34	1977 (26.2)
	35-39	1070 (14.2)
	≥40	222 (2.9)
Parity	Primipara	2871 (31.0)
	1-2	3846 (50.9)
	3-4	710 (9.4)
	≥5	121 (1.6)
Body Mass Index (BMI)	Normal ≤25	4088 (54.1)

	Overweight 25.01-30	1772 (23.5)
	Obese >30.01-35	977 (12.9)
	Morbidly obese >35	711 (9.4)
Current smoker	No	5996 (79.4)
	Yes	1552 (20.6)
Gestational age (weeks)	37+0 - 40+0	6069 (80.4)
	40+1- 42+0	1479 (19.6)
Birth weight (grams)	<3000	1030 (13.6)
	3000-3999	5371 (71.2)
	4000-4499	1003 (13.3)
	≥4500	144 (1.9)
Postpartum haemorrhage (PPH)	No	6438 (85.3)
	Yes	1110 (14.7)
Normal vaginal birth (NVB)	No	1693 (22.4)
	Yes	5855 (77.6)
Elective c/section	No	6751 (89.4)
	Yes	797 (10.6)
Epidural	No	6667 (88.3)
	Yes	881 (11.7)

Induction/augmentation	No	5719 (75.8)
	Yes	1829 (24.2)
3rd and 4th degree tears	No	7285 (96.5)
	Yes	261 (3.5)
Episiotomy	No	6812 (90.2)
	Yes	736 (9.8)
Placenta praevia	No	7500 (99.4)
	Yes	48 (0.6
APH	No	7436 (98.5)
	Yes	112 (1.5)
Polyhydramnios	No	7840 (99.1)
	Yes	68 (0.9)
Forceps	No	7175 (95.1)
	Yes	373 (4.9)
Vacuum	No	7095 (94.0)
	Yes	453 (6.0)
3rd stage management	Physiological	411 (5.4)
	Active	7137 (94.6)

Main Outcomes

Descriptive statistics showed that 94.5% of women experienced S2S but only 41.8% experienced both S2S and B/F. Women who had S2S and B/F had a PPH rate of 9.8% (C.I. 8.7-10.8) compared with 29.5% (C.I. 25.1-33.8) for women who had neither S2S nor B/F. See Table 5.4 that demonstrates the effect of having B/F in conjunction with S2S, i.e., pronurturance, on reducing the rate of PPH.

Table 5.4 Pronurturance and PPH for whole cohort (n = 7548)

Pronurturance	Number (%)	No PPH n (%)	PPH n (%)	95% C.I.
Yes- both S2S&B/F	3152 (41.8)	2844 (90.2)	308 (9.8)	8.7-10.8
Partial-S2S No B/F	3975 (52.7)	3297 (82.9)	678 (17.1)	15.9-18.2
None- No S2S No B/F	421 (5.6)	297 (70.5)	124 (29.5)	25.1-33.8
X^2 (2, n = 7548) = 151.69, p < 0.001				

Table 5.5 presents the unadjusted and adjusted odds ratios for women who had any level of pronurturance. The full model is presented; however, statistical significance is only highlighted for the pronurturance variables. Women who had S2S and B/F had an almost fourfold reduction in the risk of PPH. After adjusting for all potential covariates, the risk of PPH for women who had S2S and B/F was almost halved.

Table 5.5 Logistic regression results for whole cohort (n = 7548)

Variable	Unadjusted		Adjusted	
Pronurturance	**OR**	**95% CI**	**aOR**	**95% CI**
Full-S2S&B/F	0.26***	0.20-0.33	0.55***	0.41-0.72
Partial-S2S No B/F	0.49***	0.30-0.62	0.78	0.61-1.00
None-No S2S No B/F (ref)	1.00		1.00	
Maternal age (years)				
< 20	0.94	0.72-1.22	0.96	0.73-1.26
20-24 (ref)	1.00		1.00	
25-29	0.96	0.80-1.16	0.97	0.80-1.18
30-34	0.88	0.72-1.06	0.87	0.70-1.07
35-39	0.83	0.66-1.1.04	0.81	0.63-1.04
≥ 40	1.19	0.82-1.72	1.15	0.77-1.72
Parity				
Primip	1.32	1.15-1.51	1.19	1.01-1.40

1-2 (ref)	1.00		1.00	
3-4	0.85	0.67-1.09	0.89	0.69-1.16
≥5	0.57	0.30-1.10	0.59	0.30-1.15
BMI				
≤25 (ref)	1.00		1.00	
25.01 - 30	1.29	1.10-1.50	1.19	1.01-1.40
30.01-35	1.26	1.04-1.53	1.11	0.91-1.37
> 35 to highest	1.29	1.03-1.60	1.02	0.81-1.29
Current smoker#	0.75	0.64-0.89	0.87	0.72-1.04
Gestational age				
37+0-40+0 weeks (ref)	1.00		1.00	
40+1-42+0 weeks	1.18	1.01-1.38	1.17	1.00-1.40
Birth weight				
< 3000 g (ref)	1.00		1.00	
3000 g-3999 g	1.26	1.03-1.55	1.27	1.02-1.57
4000 g-4499 g	1.65	1.29-2.12	1.67	1.27-2.18

≥4500 g	2.50	1.64-3.82	2.66	1.69-4.18
Labour and Birth				
Elective c/section#	3.13	2.65-3.70	3.21	2.61-4.00
Epidural #	1.48	1.24-1.77	1.09	0.87-1.35
Induction/augmentation#	1.34	1.17-1.55	1.27	1.07-1.51
3rd & 4th degree tear#	1.81	1.35-2.43	1.45	1.06-2.00
Episiotomy#	2.00	1.66-2.40	1.44	1.11-1.89
Placenta praevia#	2.66	1.44-4.91	2.10	1.09-4.05
APH#	0.97	0.57-1.65	0.85	0.48-1.49
Polyhydramnios#	1.65	0.93-2.94	1.14	0.62-2.10
Forceps#	2.58	2.05-3.26	1.42	1.00-2.01
Vacuum#	1.16	0.90-1.50	0.99	0.74-1.33
3rd stage active mgt t#	3.72	2.34-5.93	2.38	1.48-3.82

not having the attribute was the reference category

***p < 0.001

Table 5.6 shows that for the group of women who had a lower risk of PPH, having S2S and B/F was associated with the lowest rate of PPH. In the lower risk group, the

highest rate of PPH, was for those women who had neither S2S nor B/F. Women in this lower risk group, who had S2S without B/F had an intermediate rate of PPH. Likewise in the higher risk group, the lowest rate of PPH, was for those women who had S2S and B/F. The highest rate of PPH, in the higher risk group, was for those women who had neither S2S nor B/F. Women, in this group, who had S2S without B/F, had an intermediate rate of PPH. Interestingly, women who had neither S2S nor B/F had a similar rate of PPH, regardless of the women's risk status (higher vis a vis lower).

Table 5.6 Pronurturance and rate of PPH for lower risk (n = 5230) and higher risk (n = 2318) women

Variable	Women at lower risk				Women at higher risk			
Pronurturance	**n (%)**	**No PPH n (%)**	**PPH n (%)**	**95% CI**	**n (%)**	**No PPH n (%)**	**PPH n (%)**	**95%CI**
Full-S2S&B/F	2338 (44.7)	2138 (91.4)	200 (8.6)	7.4-9.7	814 (35.1)	706 (86.7)	108 (13.3)	10.9-15.6
Partial S2S NoB/F	2590 (49.5)	2187 (84.4)	403 (15.6)	14.2-17.0	1385 (59.7)	1110 (80.1)	275 (19.9)	17.8-22.0
None No S2S No B/F	302 (5.8)	219 (70.5)	83 (27.5)	22.4-32.5	119 (5.1)	84 (70.6)	35 (29.4)	21.1-37.7
X^2 (2, n = 5230) = 125.14, p < 0.001					X^2 (2, n = 2318) = 26.04, p < 0.001			

Table 5.7 shows the results of unadjusted and adjusted logistic regression for the women at lower and higher risk of PPH.

For women in the lower risk group, having both S2S and B/F reduced their risk of PPH almost fivefold. Adjustment for covariates showed little change in risk of PPH. Also, for lower risk women, having S2S but no B/F halved their risk of PPH in the unadjusted and adjusted models. For women at higher risk of PPH, who had S2S and B/F, their risk of PPH was reduced almost threefold. For women in the higher risk group, after adjustment for covariates, their risk of PPH, was halved if they had both S2S and B/F. For women in the higher risk group who had S2S and no B/F there was an apparent small reduction in the risk of PPH but in the adjusted model this was not statistically significant.

Table 5.7 Logistic regression unadjusted and adjusted for pronurturance and PPH for lower (n = 5230) and higher risk (n = 2318) women

Variable	Lower risk unadjusted		Lower risk adjusted[#]		Higher risk unadjusted		Higher risk adjusted[##]	
Pronurturance	**OR**	**95%CI**	**OR**	**OR 95%CI**	**OR**	**95%CI**	**OR**	**95%CI**
Full-S2S&B/F	0.22***	0.17-0.30	0.24***	0.18-0.32	0.37**	0.24-0.57	0.54**	0.34-0.87
S2S No B/F	0.44***	0.34-0.58	0.45***	0.34-0.59	0.60	0.39-0.90	0.76	0.49-1.18
None-No S2S No B/F (ref)	1.00		1.00		1.00		1.00	

Lower risk women: adjusted for maternal age, BMI, current smoker, gestational age, birth weight, epidural, 3rd and 4th degree tears, episiotomy and active management 3rd stage

Higher risk women: adjusted for elective caesarean section, induction/augmentation, APH, placenta praevia, polyhydramnios, forceps and vacuum

***p < 0.001

** p = 0.01

The full results are available from the author

DISCUSSION

This study aimed to examine the effect of pronurturance on the rate of PPH in a sample of women who were at mixed-risk for PPH. The main finding is that pronurturance appears to reduce the risk of PPH. The unadjusted OR suggests an approximate 75% reduction in the risk when pronurturance had occurred. This result is equivalent of an OR effect size of 3.8, that is, a medium-large effect (Field 2009). When all covariates were added to the logistic regression model, there remained an almost 50% reduction in the risk of PPH for the women who had pronurturance. These results are in the same direction as the Sobhy and Mohamed study (2004) where only B/F in the fourth stage of labour was found to reduce the amount of blood loss at birth. This study only considered one (B/F) of the two elements of pronurturance. No previous study has considered the effects of both S2S and B/F on PPH rates.

The claim that pronurturance is effective in reducing PPH rates is further supported by the effect of partial pronurturance, which had an intermediate rate of PPH. Not having S2S and B/F, regardless of the woman's risk status, was associated with similar rates of PPH in the lower and higher risk groups. The absence of pronurturance, therefore, may be a strong risk factor for PPH; particularly for women at lower risk of PPH.

The physiological explanation is that both S2S and B/F stimulate the release of endogenous oxytocin (Chua et al. 1994; Uvnas-Moberg 2012). With the release of endogenous oxytocin, uterine contractions are optimised. When effective uterine activity is present, atonic PPH is prevented (Saxton et al. 2014). Separation of mother and baby immediately after birth creates a state of alertness, or even fear. In such situations, the release of oxytocin and its uptake at the myometrium is blocked and uterine atony is the result (Coad & Dunstall 2011; Fry 2007; Hastie & Fahy 2009; Saxton et al. 2014; Stables & Rankin 2005; Tortora & Grabowski 2003).

There are now three reasons that pronurturance should be integrated into standard

maternity care: firstly as a PPH risk reduction strategy, secondly, because of the known short and long-term health benefits of breastfeeding for both mother and baby and thirdly, because of the way that bonding is facilitated by the emotions experienced when mothers and babies are S2S and B/F at birth. The only exceptions to providing pronurturance should be where the woman gives informed refusal or where the baby or mother is so ill that they need intensive resuscitation and/or immediate transfer. Women and their partners need to know about the value of pronurturance and receive this information as part of antenatal care and education. Health professional education should include the theory and practice of pronurturance as part of teaching how to provide standard labour and birth care for woman at all levels of risk of PPH.

Strengths

We were able to use high quality, routinely collected data that reflected real practice. Another strength is that it was a large study (n = 7548), which reduces the risk of unintended bias. The results are probably generalisable across Australia and to other countries with similar forms of maternity care provision. The results were strengthened by demonstrating benefits for women at both higher and lower risk of PPH and by showing intermediate effects for women who had partial pronurturance.

Limitations

The completeness and accuracy of the ObstetriX database is, theoretically, a potential limitation. There is research evidence, however, to support the validity of the data in health service electronic databases completed by midwives. Stapleton (2011) reviewed 152 randomly selected medical records from five different midwifery practice settings. Of the 3966 variables reviewed she found that there was 97.1% concordance between the written and electronic record. Likewise, a validation study comparing the paper medical record with the electronic version, demonstrated a similar level of consistency (96.3%) between the two forms of records (Knight et al. 2009).

The effects of two possible risk factors for PPH could not be controlled for and may have had a weak effect on PPH rates. There is, however, no established causal mechanism by which a previous PPH or prolonged labour causes a current PPH. Prolonged labour is probably not an independent risk factor as it is so strongly associated with the use of synthetic oxytocin and operative births which were controlled for in this analysis. A possible limitation is that blood loss was visually estimated. As this was a retrospective study, however, no bias due to under or over estimation of blood loss could have occurred.

There may be conjecture about the direction of causation being different from the claim that a primary PPH was the 'cause' of some women not having pronurturance. At the settings in this study, routine care was immediate S2S and B/F as soon as the baby initiated it. It would be unusual to take a baby from their mother to manage PPH unless it was severe (which is relatively uncommon) but could have skewed results to some extent in favour of pronurturance.

Because the study used routinely collected data there was no control on the way that pronurturance was performed. All that is known is that at some stage in the first 30 minutes after birth S2S and B/F occurred. Given this lack of quality control it is remarkable that the study showed such a marked decrease in PPH rates for women who experienced pronurturance. There is room, therefore, to further reduce PPH rates by conducting a prospective trial where the researchers' focus is on improving the quality and duration of pronurturance.

Generalisability of Study Results

A retrospective cohort study is acknowledged to be a weaker design when seeking answers to questions of causation and the effectiveness of an intervention. An RCT, however, was (and is) not ethically possible because S2S and B/F have well established benefits for breastfeeding and bonding. In these circumstances, a cohort study is the best design, because it can demonstrate a causal association between an intervention and an outcome; particularly when the number of participants is large (Grimes & Schultz 2002; Mann 2003; Reeves et al. 2009) as in this study.

Pronurturance should be universally adopted because, if implemented correctly, there are no negative effects and sustained B/F and bonding are promoted. These findings add another reason to universally adopt S2S and B/F. Together with the breastfeeding and bonding benefits, pronurturance is a risk reduction strategy for PPH.

Disclosure of Interests

The authors declare they have no competing interests.

Contribution to authorship

KF, AS and CH were responsible for the intellectual content of the study proposal. AS, KF & CH designed the study and conducted the literature reviews. AS, MR & VS developed the analytic approach. MR, VS and AS designed the statistical analyses and AS analysed the data and wrote the first draft of the paper with primary assistance from KF. All authors made substantial contribution to the interpretation of the results and contributed to writing the paper. All authors read and approved the final paper.

Details of Ethical Approval

This study received ethics approval from the Hunter New England Research and Ethics Committee (HNEREC Reference No. 10/11/17/5.05) dated 15th November 2010

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----------End of Article----------

CONCLUSION

This chapter has presented and briefly discussed the findings of the present study and answers the research question: ‘does skin-to-skin contact and breastfeeding immediately after birth affect the rate of early postpartum haemorrhage?’ These findings support the hypothesis that immediate pronurturance at birth potentially reduces the risk of early PPH. Chapter 6 will discuss these findings in the context of the extant research literature and contemporary knowledge of human and animal reproductive physiology. Chapter 6 will also conclude this dissertation by recommending key changes relevant to policy, practice, education and further research within an international and national framework.

CHAPTER 6 DISCUSSION AND CONCLUSION

This dissertation answers the Research Question:

‘Does skin to skin contact and breastfeeding immediately after birth affect the rate of early PPH?’

In this chapter I answer and discuss this question and in the process defend the thesis that:

Pronurturance is effective in reducing PPH rates because it promotes parasympathetic dominance for the woman when her fascinated attention is on her baby; in this situation her reproductive psychophysiology is optimised.

This chapter begins by presenting a summary of the key research findings. These findings are then discussed in relation to previous research of direct relevance to the research question. Next, the strengths and weaknesses of the Cohort study are summarised (they are included in the published paper that is incorporated in Chapter 5). Then, as described in Part 1 of Chapter 2, I present a summary of the explanation of why pronurturance, as operationally defined for this study, was apparently effective, in reducing PPH rates. In Parts 2 and 3 of Chapter 2, I theorised that further reductions in PPH rates can probably be obtained by enhancing the quality of midwifery care in the third and fourth stages of labour. This new theory, called Pronurturance Plus, integrates concepts from neurophysiology and reproductive physiology with concepts from mindfulness psychology and existing midwifery theory. The significance of this Pronurturance Study is then explained in relation to potential reductions in PPH, associated mortality, morbidities and costs. Finally, I make recommendations with regard to changing maternity service provision, in both the developed and developing worlds. The major recommendation is that Pronurturance Plus at birth should be routine care for all women and healthy babies. Finally, the implications for health service management, midwifery practice and education and the next stage of research is outlined.

KEY FINDINGS

After adjusting for the covariates, the PRF and TRF for PPH, the women who had both skin-to-skin (S2S) and breastfeeding (B/F) within 30 minutes of birth were almost half as likely to have a PPH compared to women who did not have these two elements (OR 0.55, 95% CI 0.41-0.72, $p < 0.001$), i.e., Pronurturance was associated with a 45% reduction in PPH rates in a cohort (n = 7548) of Australian women at mixed risk of PPH. This apparently protective effect of pronurturance, held true when the outcome of PPH was compared between groups of women who were categorised to be either at 'lower' or 'higher' risk. For women at 'lower' risk of PPH, who had both elements of Pronurturance, there was an approximate four-fold reduction in the risk of PPH (OR 0.24, 95% CI 0.18-0.32, $p < 0.001$). For women, categorised as 'higher' risk of PPH, and who had both elements of pronurturance, they were almost half as likely to have a PPH (OR 0.54 95% CI 0.34-0.87, $p = 0.01$). These key findings are explained and discussed in relation to the literature in the following section.

Discussion of Findings in Relation to Previous Literature

This study did not investigate the effect of active versus physiological care; in fact 94.6% of the participants had active management of the 3rd stage of labour. What is clear from this study's finding, is that even in highly medicalised birthing environments, just adding two elements of physiological 3rd stage care, i.e., S2S and B/F, reduced PPH rates by almost 50% regardless of whether active management or physiological 'management' was used. The apparent effectiveness of S2S and B/F—now termed 'Pronurturance' at birth in reducing PPH rates, is greater than, but consistent with, other cohort studies that have examined PPH rates when all elements of physiological care, as defined by midwives, have been given (defined in Chapter 1, Table 1.1, and discussed in Chapter 2, Part 3 (Catling-Paull et al. 2013; Dixon et al. 2009; Fahy et al. 2010).

A systematic literature search, discussed in detail in Chapter 3, Part 3 found no studies that addressed the combination of S2S and B/F in relation to the incidence of PPH. There were only two (2) somewhat relevant studies which examined if

breastfeeding at birth affected the rate of PPH; neither study mentions S2S contact. A strength of both these studies was that blood loss was measured. One study, (Bullough, Msuku & Karonde 1989) was an RCT and the other was a quasi-experimental study (Sobhy & Mohamed 2004). The RCT was conducted in Malawi (Bullough, Msuku & Karonde 1989) and the second study was conducted in Egypt (Sobhy & Mohamed 2004). As Malawi is a poverty stricken country, both the context of the study, as well as the rigour of the research processes, undermines the validity of the findings. The Malawi study found that breastfeeding immediately after birth, contrasted with usual care where the baby was immediately wrapped and handed to relatives, possibly had a non-significant effect on PPH rates (Bullough, Msuku & Karonde 1989). The Egyptian study, however, found that breastfeeding immediately after delivery of the placenta, reduced post birth blood loss by almost 50% (150 ml versus ≥ 300 ml); a statistically significant finding of $p < 0.001$ (Sobhy & Mohamed 2004).

Sobhy and Mohamed's (2004) result is consistent with the current research findings, adding strength to the claim that S2S contact and B/F at birth may reduce PPH rates. Indeed, as described in Chapter 5 Findings, S2S alone had a positive effect on reducing PPH rates but that effect was magnified when B/F also occurred. Whilst not mentioning the rate of post-birth blood loss, two small studies found that uterine pressure increased significantly with nipple stimulation or breastfeeding (Chua et al. 1994; Irons, Sriskandabalan & Bullough 1994). Given that, as discussed in Chapter 3, the majority of PPH is caused by uterine atony, these studies are of interest. Both studies recommended further research.

Strengths

As described in Chapter 4 Methodology, one strength of this cohort study was that it reflected the real world of midwifery clinical practice; based, as it was on ObstetriX data. This was a large study, across three sites involving 7548 women who were at mixed risk of PPH. This mix of women further strengthens these results because it means that findings from this study are potentially generalisable to most women giving birth.

Whilst an RCT is acknowledged to be a theoretically ideal design for examining the effectiveness of an intervention, in this case it was not ethically possible. The cohort study design is justified because, in cases where an RCT is not appropriate, large cohort studies are frequently used to demonstrate a causal association between an intervention and an outcome (Grimes & Schultz 2002; Mann 2003). Indeed, the vast majority of studies relied upon by medicine concerning the causes of PPH, as discussed in Chapter 3, Parts 1 and 2 are in fact cohort studies. An RCT would require that some women and babies were prevented from having skin to skin contact and breastfeeding at birth. However, because the benefits of skin contact and breastfeeding at birth are well known, it would not be ethical to interfere with that practice. Indeed skin contact and breastfeeding at birth are integral to the Baby Friendly Initiative (UNICEF and World Health Organisation 2009) which had already been introduced at two of the three research sites.

Weaknesses

The validity of routinely collected data is a potential weakness; it may be incomplete and/or inaccurately entered into the ObstetriX data base. As discussed in Chapter 5, the available evidence demonstrates that there are, in fact, high levels of completeness and accuracy by midwives inputting data into electronic data bases. Thus, this is not a serious threat to the validity of the findings of the Pronurturance Study. There was no quality control over timing, duration or method by which Pronurturance occurred. This potential weakness is actually a strength because, even with no quality control an approximate 50% reduction in PPH rates occurred. As argued above, there seems to be room for further improvement.

A weakness was that I was unable to control for a previous PPH because that data were kept in the antenatal folder in the ObstetriX database and I had ethical approval for the labour and delivery folder only. The association between a previous PPH and a PPH at the index birth is well known (Ford et al. 2007b); it would have been stronger to be able to control for that in the modelling for this study. There is, however, no known independent causal mechanism by which a previous PPH causes a subsequent PPH. Thus, I think, that the other risk factors which were controlled for,

weakens the need to use previous PPH as an independent risk factor. I had no way of inputting the length of prolonged labour which, as discussed in Chapter 5, may be associated with PPH. Prolonged labour is also associated with medical interventions, augmentations and/or operative deliveries and these were controlled for in the statistical modelling.

The possibility of reverse causation, i.e., that a PPH prevented pronurturance, was discussed in Chapter 5 Findings, as another potential weakness. In this study 94.5% of women had skin to skin contact at birth and almost 42% had both elements of pronurturance. Since the time span for pronurturance is the first 30 minutes only, a PPH so severe, that pronurturance was not possible at all, is extremely rare and could only account for a tiny fraction of the women who did not receive pronurturance. Finally, blood loss post-birth was visually estimated and therefore PPH was probably not accurately estimated. This is not a bias in the present study since data were collected retrospectively. Visual estimation is also the most common way to assess PPH as reflected in the vast majority of research on PPH; including the Cochrane reviews discussed in Chapter 1.

Reproductive physiology and skin to skin contact and breast feeding

In this section I discuss the findings from the cohort study in relation to theory presented in Chapter 2. Pronurturance, for the cohort study was defined simply as ‘skin to skin contact and breastfeeding within 30 minutes of birth’, as recorded in the ObstetriX data base. The reasons that pronurturance was apparently effective in reducing PPH rates were described in Part 1 of Chapter 2. In summary, in Part 1 (and associated publication Saxton et al. 2014) I described the neurological and reproductive physiology relevant to the reduction in PPH rates associated with pronurturance. Part 1 also explained optimal release and uptake of endogenous oxytocin and how this may be blocked. In summary, oxytocin is secreted and released in a pulsatile manner by the posterior pituitary gland. Oxytocin has effects, relevant to pronurturance, on both the brain and the uterus. In the brain, oxytocin creates calm loving thoughts which translate to nurturing behaviours (Uvnas-Moberg 2013a). When it circulates in the blood, oxytocin binds to myometrial cell receptors

and initiates action potentials, which cause uterine contractions (Gimpl & Farenholtz 2001; Saxton, Fahy & Hastie 2014). Adrenaline, which is released by the sympathetic nervous system in situations of fear (among other initiators) also binds to the same receptor site that oxytocin fits. When adrenaline is on the binding site oxytocin competes with it or, in the worst case, oxytocin is blocked completely. This knowledge, that sympathetic stimulation blocks oxytocin and relaxes the uterus has been known for decades (Åkerlund et al. 1985; Åkerlund 2006) and has been the basis for creating drugs to delay the onset of preterm labour, the so called sympathomimetic or beta mimetic class of drugs (e.g., Terbutaline).

In the context of physiological labour and birth, however, optimal oxytocin release and uptake is needed. When a woman feels fearful, the sympathetic system (the so called Stress Response) is initiated, adrenaline is released which, as described, competes with, and blocks the uptake of oxytocin at the myometrial receptor sites thus slowing or stopping the uterine contractions (Odent 2001; Saxton, Fahy & Hastie 2014). When fear occurs in the 3rd and/or 4th stages of labour, then atonic PPH is the likely result. It is remarkable that something simple, free and natural like pronurturance, can have such a big positive effect when there was no control over the quality nor consistency of the pronurturance intervention. I therefore, wondered, if by careful attention to biology and theory, even greater reductions in PPH might be able to be obtained. This thinking led to the creation of Pronurturance Plus theory.

Pronurturance Plus theory

Pronurturance Plus theory projects a theoretical explanation of how PPH rates can be even further reduced by improvements in the way midwifery care in the third and fourth stages of labour is provided. Pronurturance Plus theory incorporates the simple definition of Pronurturance whilst integrating the concepts described in all three Parts of Chapter 2. The key additional concepts concerned maintaining parasympathetic dominance by creating and guarding the Birth Sanctum in addition to facilitating the woman's mindful attention on her body and her baby; with whom she will be spontaneously fascinated. This theory now needs to be tested to ascertain if further reductions in PPH rates can be obtained.

Significance

This research project is significant because it suggests that simply ensuring S2S and B/F is protective against both the incidence and severity of PPH. This research provides biological and empirical evidence that the current medical paradigm for understanding, explaining and predicting, labour and birth misrepresents and disables women's reproductive physiology. This research provides an approach to working with the whole woman in the birth room in a way that optimises her psychophysiology so she is enabled to give birth safely and with minimal risk of PPH.

Pronurturance has the potential, if widely implemented, to decrease maternity morbidity and mortality across the world. Further it is free, possibly could occur everywhere birth happens and requires no special skills or equipment. Maternity care providers are only required to promote what, for all other mammals is instinctive. If, as this study promises, there are fewer cases of PPH and if blood loss at birth is minimised for each woman, then postnatal women will be healthier and in better condition for breastfeeding and parenting: healthier women and babies potentially should reduce healthcare costs. The challenge will be the dissemination of this simple, potentially lifesaving 'non-intervention' into busy maternity units in the West and into cultures where technology and drugs are perceived as the answer to maternal mortality and morbidity and not something as simple as pronurturance, that could be seen as 'primitive'. The WHO could play a critical role in dissemination guidelines concerning the role of immediate and sustained skin-to-skin and breastfeeding at birth—for at least 30 minutes—in reducing the rate and severity of PPH.

Recommendations Arising from this Research

In this section I limit the recommendations to those that are immediately relevant to the thesis for this study (above).

The practice of pronurturance should be part of routine 3rd and 4th stage care for all birthing women regardless of their level of risk and whether 3rd stage was managed

physiologically or not.

It is important that Pronurturance Plus theory be published in a reputable Midwifery journal so that midwives around the world have this knowledge and can make pronurturance part of routine clinical practice in the 3rd and 4th stages of labour.

Education for Midwifery and Obstetric programmes should include the dynamic interactions of the autonomic nervous system, cognitive neuroscience, mindfulness psychology and reproductive anatomy and physiology as it relates to minimising the risk of PPH.

Maternity services worldwide should mandate a policy that a minimum of 30 minutes pronurturance be provided to all women and their babies as part of standard care. The only exceptions should be if the woman and/or baby are so ill that they required immediate transfer or resuscitation.

Pronurturance should be included in the NICE guidelines of Intrapartum Care whether the 3rd stage of labour is managed actively or physiologically.

The WHO should recommend pronurturance as routine practice across the world.

Educational materials should be developed by WHO and disseminated, e.g., posters, leaflets, conference presentation on the practice and benefits of pronurturance

A prospective cohort with improved quality and consistency of pronurturance should be conducted to confirm the findings of this present study.

CONCLUSION

This chapter began by presenting a summary of the key research findings which found an almost 50% reduction in risk of PPH for those women who had both elements of pronurturance. Only two partially relevant articles were found in the literature and neither mentioned skin-to-skin contact. The strengths and weaknesses

of this cohort study were summarised (they are included in the published paper that is incorporated in Chapter 5). Then, as described in Part 1 of Chapter 2, I presented a summary of the explanation of why pronurturance, as operationally defined for this study, was apparently effective, in reducing PPH rates. I theorised that further reductions in PPH rates can probably be obtained by enhancing the quality of midwifery care in the third and fourth stages of labour in Chapter 2. This new theory, called Pronurturance Plus, integrates concepts from neurophysiology and reproductive physiology with concepts from mindfulness psychology and existing midwifery theory. The significance of this Pronurturance Study was then explained in relation to potential reductions in PPH, associated mortality, morbidities and costs. Finally, I make recommendations with regard to changing maternity service provision, in both the developed and developing worlds. The major recommendation is that pronurturance at birth should be routine care for all women and healthy babies. Finally, recommendations for health service policy, midwifery practice and education and the next stage of research were outlined.

I claim that my study applies to all women because of the commonality of maternal physiology. Whilst Pronurturance in the 3rd and 4th stages of labour is really important in the West, for women in the developing world, pronurturance is potentially life-saving for both the woman and her baby. There are now two reasons that pronurturance should be integrated into standard maternity care: firstly the potential to reduce PPH rates and secondly, the known benefits for breastfeeding. The only exceptions should be where the baby or woman is so ill that they need intensive resuscitation and/or immediate transfer.

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APPENDICES

APPENDIX 1 HISTORY OF AUSTRALIAN MIDWIFERY

A brief history of Australian Midwifery

In Western countries, the change from a social model to a medicalised model of care has been very rapid. Most changes have occurred within a generation.

Until the 1920s, home birth was the usual choice for women in Australia (Adcock et al., 1984; Fahy, 2007; Willis, 1983). Since that time, maternity services (with few exceptions), have been hospital based (Barclay 2008; Fahy 2007; Willis 1983). In the public system, maternity services are obstetrically dominated with the authoritarian medical hierarchy, including the well-organised and highly political Australian Medical Association (AMA), dictating how services are organised (Willis 1983). This medical hegemony now operates throughout the world, dominating the way in which maternity services are provided; including exercising virtually total control on the choices available to women who birth within the public or private health care system (Begley & Devane 2003; Dawley & Burst 2005; Gelbart 2000; Mander & Murphy-Lawless 2013; Reid 2005; Ridgeway 2002; Tew 1998; Wood & Giddings 2004).

Within such a system, the role of the midwife has been reduced to that of nurse-midwife whose main responsibility and focus is the medically dominated maternity service; not the childbearing woman and her family (Hastie 2008; Mander & Murphy-Lawless 2013; Summers 1999). The medical profession, generally, believes that childbirth is a dangerous journey to be navigated under the direction of the doctor and can only be said to be normal in retrospect (Davis-Floyd 2001; Gaskin 2002, 2003; Kitzinger 2005; Klein 2005; Tew 1998). In contrast, midwifery philosophy and research evidence suggest that childbirth is a natural physiological event in a woman's reproductive life and that the majority of women have the capacity to have a normal birth (Australian College of Midwives 2004; Buckley 2005, 2005a, 2009; Davis-Floyd 2001; Downe 2010; International Confederation of Midwives 2010; Kitzinger 2005; Odent 2001a, 2001b, 2013; Romano & Lothian 2008).

In 1987 Rodney Shearman conducted a ground-breaking national review of maternity

services. His report advocated greater choice for pregnant women and an expanded role for midwives (Shearman 1989). This report was received with wide public acclaim and led to the Federal government providing Alternative Birthing Services funding for health services to develop different models of midwifery care. Despite the Shearman report and the flurry of small pilot studies, the medically dominated maternity services continued with no real changes being made throughout the 1990s (Barclay 2008; Fahy 2007; Thompson et al. 2011).

The rise in local and national community groups such as Maternity Coalition (Maternity Coalition, Australian Society of Independent Midwives, & Inc. 2002) have become increasingly active in demanding a much greater say in how maternity services are organised. Maternity Coalition (2001) for example, is a powerful alliance of different consumer groups and has its own journal “Birth Matters” (Maternity Coalition 2001). The journal provides a voice for consumers and is used for information sharing. These groups are demanding greater access to midwife led care and homebirth (Maternity Coalition 2008; Maternity Coalition et al. 2002). Consumer birth advocates continue to place pressure on state and federal Australian governments to fund midwifery models of care (Maternity Coalition 2008; Meares 2012). In 2000, NSW Health Department issued *A Framework for Maternity Services in NSW* (New South Wales Health 2000) in which there was support for an expanded role for midwives in the provision of antenatal, intrapartum and postpartum care. This report advocated a greater role for midwives in providing continuity of midwifery care. There was no mention of midwives operating autonomously. The midwifery care was to operate within the existing medically dominated system.

In my experience as a maternity service manager, consumers were instrumental in bringing about a midwife-led, free-standing birthing service. In 2003, the closure of obstetric services at Belmont Hospital was expected due to the withdrawal of services by paediatricians and anaesthetists. With the support of the Director of Obstetrics, I was able to convince the Chief Executive Officer (CEO) of Hunter New England Health that we should examine the feasibility of a continuity of midwifery care model for well women at Belmont. Community consultation was sought and the concept was enthusiastically embraced by all but the paediatricians, who were

concerned that midwives may not have the skills to resuscitate a baby with a very low Apgar score (Apgar 1953; New South Wales Health 2000). The health service made the decision to implement a stand-alone midwifery service at Belmont because of the recommendations of the NSW Health framework document. Some of the medical staff went to the press to fight the decision to start a stand-alone midwifery birthing service (Dunn 2004; Noon & Mullarvey 2004). In spite of this vigorous medically-led opposition, a midwife service was established at the Belmont hospital in 2004 on July 4 (American Independence Day).

A highly regarded midwife, who had long experience as an independent midwife with admitting rights to the public hospital system, was recruited to establish and lead the service. Only very experienced midwives were selected to work in the service. These midwives underwent an advanced skills credentialing program as recommended by the NSW Health framework document (New South Wales Health 2000). The philosophy underpinning the practise of midwifery at the Belmont Birthing Service was the Australian College of Midwives' Philosophy of Midwifery (Australian College of Midwives 2004. The main theory guiding midwifery practice was Birth Territory and Midwifery Guardianship (Fahy, Foureur, & Hastie 2008). Essentially this theory places great emphasis on creating a safe, warm, peaceful, undisturbed environment for birth where the midwife acts as a guardian of the birth territory and the woman/baby during labour and birth. These environmental conditions and the role of the midwifery guardian are widely recognised as creating the best birth experiences and outcomes (Downe 2010; Odent 2001b, 2010; Walsh 2010; Walsh & Downe 2010; Walsh & Gutteridge 2011). The theory of Birth Territory and Midwifery Guardianship will be discussed in relation to physiology in Chapter 2. .

The Belmont Birthing Service was very popular and the outcomes, as observed in the ObstetriX data base were very pleasing with high rates of normal birth, low rates of babies being born with low Apgar scores, very low rates of transfer in labour to the tertiary unit for medical intervention (Kelly 2006; Marsh 2011). Most relevant to this dissertation, the PPH rate at Belmont was 2.8% versus the PPH rate at John Hunter (the major maternity unit for Hunter New England Health) which was 24% (Marsh 2011). The 3rd stage of labour, for the majority of women birthing at Belmont was

managed physiologically whilst the majority of women at JHH had the 3rd stage of labour managed actively.

In 2007, the Belmont midwives commenced homebirth services. The first homebirth baby for the service was born on Christmas day of that year (and the mother's name was Mary). The support of the community was a vital component in the successful establishment of the service (Hastie 2006). The operation of this service has been fundamental to helping me understand the differences between active and physiological 3rd stage care and the crucial importance of sustained skin-to-skin contact and breastfeeding at birth to facilitate eutony and eulochia.

There have been a number of studies conducted which demonstrate that continuity of midwifery care models ensure less medical intervention in labour and birth (McLachlan et al. 2012; Rowley et al. 1995; Waldenstrom & Turnbull 1998), greater satisfaction for the women and because medical intervention rates are lower the economic cost to the healthcare system is reduced (Homer et al. 2001; McLachlan et al. 2012; Rowley et al. 1995; Tracy et al. 2013). In spite of these benefits the Australian healthcare system remains dominated by the medical profession with limited opportunity for midwives to provide the care that they know women want and need.

APPENDIX 4A ETHICS

Hunter Research Ethics Committee Letter

- All variations or amendments to this protocol, including amendments to the Information Sheet and Consent Form, must be forwarded to and approved by the Hunter New England Human Research Ethics Committee prior to their implementation.

- The Principal Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including:

    - any serious or unexpected adverse events
        - Adverse events, however minor, must be recorded as observed by the Investigator or as volunteered by a participant in this protocol. Full details will be documented, whether or not the Investigator or his deputies considers the event to be related to the trial substance or procedure. These do not need to be reported to the Hunter New England Human Research Ethics Committee

        - Serious adverse events that occur during the study or within six months of completion of the trial at your site should be reported to the Manager, Research Ethics & Governance, of the Hunter New England Human Research Ethics Committee as soon as possible and at the latest within 72 hours.

        - All other safety reporting should be in accordance with the NHMRC's Safety Monitoring Position Statement – May 2009 available at http://www.nhmrc.gov.au/health_ethics/hrecs/reference/_files/090609_nhmrc_position_statement.pdf

        - Serious adverse events are defined as:

            - Causing death, life threatening or serious disability.
            - Cause or prolong hospitalisation.
            - Overdoses, cancers, congenital abnormalities whether judged to be caused by the investigational agent or new procedure or not.

    - unforeseen events that might affect continued ethical acceptability of the project.

- If for some reason the above protocol does not commence (for example it does not receive funding); is suspended or discontinued, please inform Dr Nicole Gerrand, as soon as possible.

You are reminded that this letter constitutes ethical approval only. You must not commence this research project at a site until separate authorisation from the Chief Executive or delegate of that site has been obtained.

A copy of this letter must be forwarded to all site investigators for submission to the relevant Research Governance Officer.

Should you have any concerns or questions about your research, please contact Dr Gerrand as per her details at the bottom of the page. The Hunter New England Human Research Ethics Committee wishes you every success in your research.

Please quote **10/11/17/5.05** in all correspondence.

Hunter New England Research Ethics & Governance Unit

(Locked Bag No 1)
(New Lambton NSW 2305)
Telephone (02) 49214 950 Facsimile (02) 49214 818
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http://www.hnehealth.nsw.gov.au/Human_Research_Ethics

The Hunter New England Human Research Ethics Committee wishes you every success in your research.

Yours faithfully

For: Dr M Parsons
Chair
Hunter New England Human Research Ethics Committee

Hunter New England Research Ethics & Governance Unit

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APPENDIX 4B OBSTETRIX

Additional Information about the ObstetriX data base

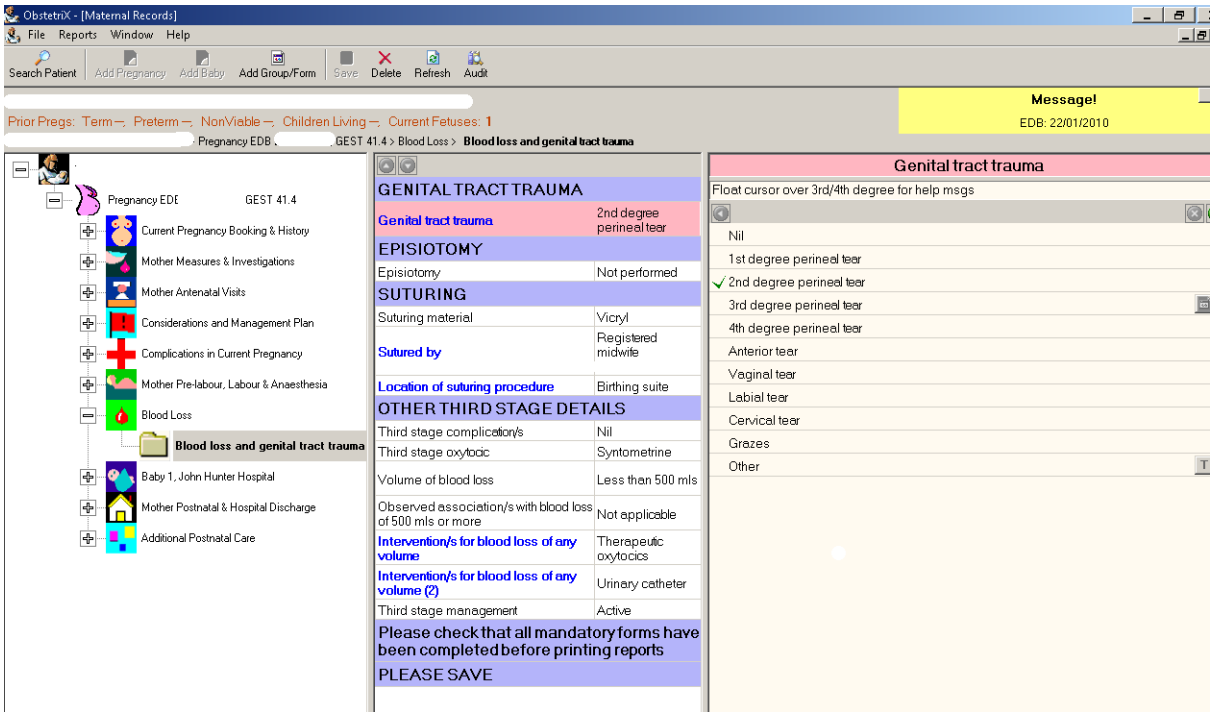
The ObstetriX data base was developed by Meridian Health Informatics for New South Wales (NSW) Health (Ashton 2010). The parameters and variables were developed in consultation with midwives and obstetricians. ObstetriX is a permanent record of pregnancies and births occurring in the public sector from July 2005 to present time. The data, from the paper medical record, are entered into the data base, which comprises a series of folders, by the midwives at the point of care: in the antenatal clinics, the delivery suite, birth centre, home and postnatal wards. There are computers in each of the antenatal clinic rooms and the data is entered by the midwife during the consultation. In the birthing units the woman's paper medical record stays in the room with the woman. The attending midwife enters the contemporaneous data and relevant information onto this paper record. This information is subsequently entered into the ObstetriX data base by the midwife after the baby is born.

In Hunter New England Area Health Service (HNEAHS) the data for John Hunter Hospital (JHH including BBS) is uploaded each month by the Clinical Midwife Informatics who is the HNEAHS ObstetriX data custodian. The role of the data custodian is to manage and control the data base. Data cleaning is also part of this role. In this role the CMI searches for missing data, inaccuracies or omissions in the recorded data. If a record is found to be deficient or incomplete, it is returned electronically to the relevant midwife for correction. The midwife is provided two weeks to comply and if this time is exceeded**,** the record is emailed by the CMI to the midwifery manager of the relevant unit for correction. If these two avenues fail to correct the data within a specified time frame then the CMI accesses the woman's medical record to correct the omissions /inaccuracies before the data are presented to the Project Officer Data Collection and Quality Unit, Demand and Performance Evaluation at NSW Health**.** At this point the data are again checked for any anomalies. If any are found, these are sent in paper format to the CMI who then corrects and returns them within one month to NSW Health. The pregnancy and birth

data are submitted to NSW Health monthly.

The Maitland Hospital midwifery manager corrects their data using a similar process to the CMI. The CMI states that the ObstetriX data base provides valid and accurate data because of these stringent processes. Additionally the ObstetriX data base has in built rules that ensure mandatory folders are completed in a specific sequence before the following folder can be completed. For example, Complications in Current Pregnancy must be completed before the Labour Observation, Intervention and Complication Folder. See Figure 1 for screen shot of part of the labour and delivery folder: the data extracted from this folder was used for this study.

Figure 1 Screen shot of part of labour and delivery folder



The data from the ObstetriX data base is combined with obstetric data from the private sector by New South Wales Health to produce an annual report on the birth

rate and the health and wellbeing of NSW women (and babies) during labour and birth (Centre for Epidemiology and Evidence NSW Health 2013). Additionally the combined data is forwarded to the Federal Government, who combines the data from all states and territories, to produce a composite annual report Australia's Mothers and Babies (Li et al. 2011; Li et al. 2012).

APPENDIX 4C OBSTETRIx VARIABLES

The following variables were extracted from ObstetriX data base for this study;

1) Place of birth
2) Ethnic Origin
3) Country born
4) Date of birth (mother)
5) Date of birth baby
6) Gestational age
7) Number of fetus 20 weeks
8) Neonatal outcome
9) Body Mass Index
10) Allocated model of care
11) Allocated model of care_A
12) Stage 1(Labour) –unable to convert to SPSS
13) Stage 2 (Labour) –unable to convert to SPSS
14) Stage 3 (Labour) –unable to convert to SPSS
15) Number of term pregnancy
16) Number of preterm pregnancy
17) Number of children now living
18) Abnormal placenta site
19) APH after 20 weeks
20) Abnormal liquor volume
21) Hypertension
22) Kidney problem
23) Diabetes
24) Fetal growth restriction
25) Macrosomia
26) Fetal anomaly
27) Premature rupture of membranes
28) Proven anaemia in pregnancy
29) Isoimmunisation
30) Antibodies
31) New medical problem
32) Surgery this pregnancy
33) Procedure in pregnancy
34) Smoking pregnancy (antenatal)
35) Smoking(on admission in labour)

36) Model of care admission
37) Model of care admission_A
38) Amniotomy
39) Oxytocic in labour-induction/augmentation
40) Indication prelabour intervention
41) Mode of birth
42) Place of birth
43) Maternal birthing position
44) Failed instrumental caesarean section
45) Forceps procedure delivery
46) Trial instrument OT
47) Type of instrumental delivery
48) Vacuum attempted
49) Vacuum procedure delivery
50) Related delivery technique
51) Type of instrument before NVB
52) Caesarean urgency
53) Caesarean decision time
54) Booked caesarean brought forward
55) Cervical dilatation at time of caesarean
56) Obstetric indication for caesarean
57) Fetal indication for caesarean
58) Maternal indication for caesarean
59) Caesarean prior pregnancy
60) Related delivery technique
61) Manoeuvre shoulder
62) Analgesia stage 1
63) Complication labour
64) Anaesthetic delivery postpartum
65) Anaesthetic complication
66) 3rd stage management
67) 3rd stage complication
68) Blood volume delivery (PPH)
69) Blood intervention delivery
70) Blood loss postpartum (prior to discharge from postnatal ward)
71) Genital tract trauma
72) Episiotomy
73) Blood loss since birth
74) Intervention PPH postpartum

75) APGAR score 1 minute
76) APGAR score 5 minute
77) APGAR score 10 minute
78) Birth weight
79) Skin-to-skin
80) Feeding birth
81) Timing first feed after birth
82) Admission to nursery (SCN)
83) Admission to nursery (ICN)

APPENDIX 5 ADDITIONAL RESULTS

Additional results

This appendix presents additional results as described in the introduction to Chapter 5 and elsewhere within Chapter 4 Methodology. These results include demographics, ethnicity, place of birth and model of care by accoucher (see Glossary of Terms). The results of the multicollinearity test (referred to in Chapter 4) for the categorical variables in the mixed risk group of women is also included as part of this appendix. The study population was divided into higher and lower risk women groups to confirm validity as per the published article Chapter 5. As only the partial results of logistic regression for women at lower and higher risk of PPH were in the published article, the complete tables are included here with a summary of the findings.

Demographics

Age of all women

In this sample of 7548 mixed risk women; the maternal age range was 14.29 to 47.95 years, with mean of 28.6 (SD = 5.8).Table 1 and Figure 1 presents information concerning the women's ages.

Table 1 Descriptive Statistics for Age Distribution with histogram

Statistics	Mean	Median	Mode	Standard Deviation	Range	95% Confidence Interval
Years	28.6	28.4	26.9	5.8	33.6	28.4-28.9

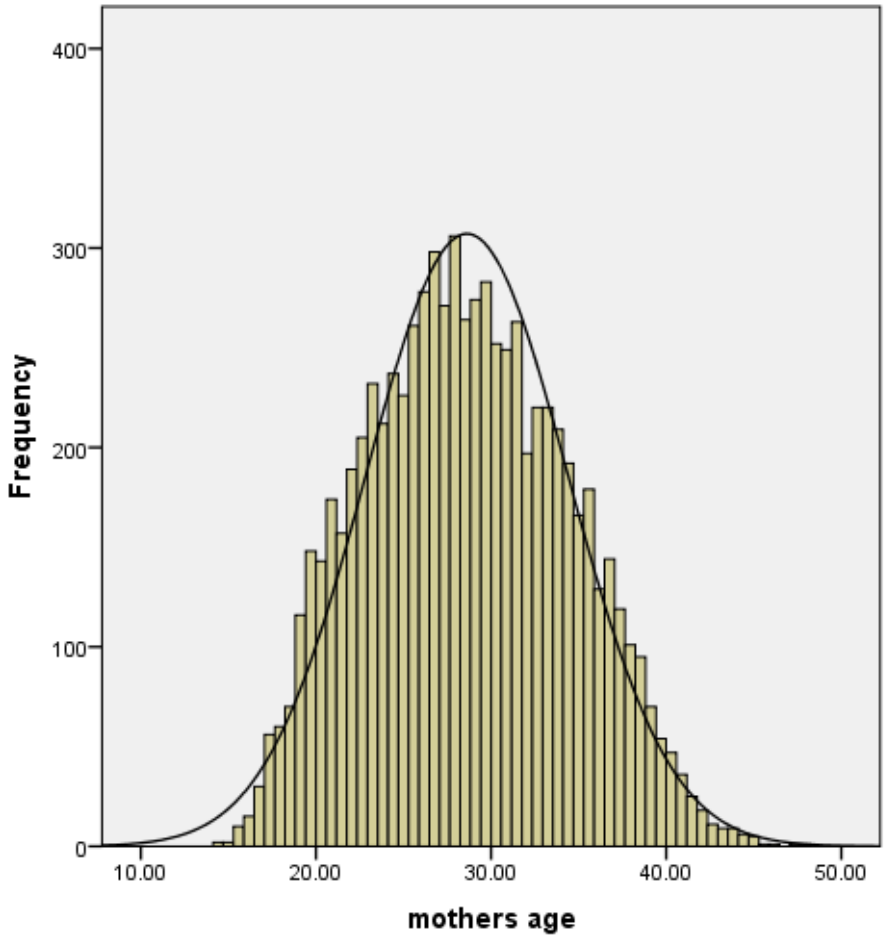


Figure 1 Histogram of maternal age in years

The majority of women giving birth during the years 2009 and 2010 were aged between 25 to 29 years (n=712) followed by women aged 30 to 34 years (n=572). This follows the trend in Australia of older women giving birth (Li et al., 2012).

Ethnicity

The majority of the women (94.5%) who birthed at the three maternity units in the years 2009/2010 were Non Aboriginal: only 403 (5.4%) of women claimed to be of Aboriginal or Torres Strait Islander heritage. Aboriginality is of interest to state and Federal governments because Aboriginal people have a lower life expectancy and poorer health outcomes (Homer et al. 2009; Sullivan et al. 2008; Kildea, Pollock & Barclay 2008). State and federal governments have set targets for improving outcomes associated with pregnancy and childbirth for Aboriginal women. These

outcomes are reported at state and federal levels (Centre for Epidemiology and Evidence NSW Health 2013; Kildea 2008; Kildea, Pollock & Barclay 2008; Li et al. 2013) and that is why there is a specific category/variable in ObstetriX. The category of 'None of the Above' includes Caucasian, Middle Eastern and any other ethnicities that gave birth at the three sites during the calendar years 2009 and 2010. These results are presented in Table 2.

Table 2 Ethnicity of whole cohort (n=7548)

Ethnicity Status	**Number**	**Percentage**
Aboriginal	385	5.1
Torres Strait Islander	5	0.1
Aboriginal Torres Strait Islander	13	0.2
None of the above	7131	94.5
Not stated or missing	14	0.1
Total	**7548**	**100**

Place of birth

The majority (65.8%) of the women birthed at the tertiary referral unit whilst the smallest number (4.3%) were low risk women who had continuity of midwifery care at the birth centre (BBS) or at home. These results are presented in Table 3.

Table 3 Place of birth whole cohort (n=7548)		
Place of Birth	**Number**	**Percentage**
Tertiary Centre JHH	4970	65.8
BBS	325	4.3
Regional facility TMH	2253	29.8
Total	**7548**	**100**

Allocated Model of Care

The majority (66%) of women had a midwife as the accoucher. Medical staff delivered the remaining women and these results are displayed in the Table 4.

Table 4 Allocated Model of Care whole cohort (N=7548)		
Model of care	**Number**	**Percentage**
Hospital-based midwifery	4359	57.8
Hospital-based medical	1312	17.4
GP/hospital medical shared care	662	8.8
GP/midwife shared care	621	8.2
GP/obstetrician shared care	244	3.2
Private obstetrician	240	3.2
General practitioner	87	1.2
No antenatal care	23	0.3
Total	7548	100.0

Crude PPH rates by study site

Table 5 demonstrates the highest rate of PPH was at the tertiary hospital and the lowest at the freestanding birth centre.

Table 5 Crude PPH rates by study site			
Site	**Participants**	**PPH**	**%**
JHH	4970	812	16.3
TMH	2253	272	12.1
BBS	325	26	8.0
Total	7548	1110	

Multicollinearity

Multicollinearity may be a problem with logistic regression as described in Chapter 4 Methodology. The variance inflation factor (VIF) values should not be greater than 10 which would indicate strong relationships between predictors (Field, 2009). All VIF values for these independent variables in the model were less than 1.9, indicating no problems with multicollinearity. Tolerance levels are related to the variance inflation factor, being its reciprocal (1/VIF) (Field, 2009). All tolerance levels for a multicollinearity check should be more than 0.1 (Pallant, 2005). All tolerance levels for the independent variables used for logistic regression in these analyses were above 0.5, indicating no problems with multicollinearity. See Table 6.

Table 6 Multicollinearity for whole cohort		
Coefficients [a]		
Model	Collinearity Statistics	
	Tolerance	VIF
Pro-nurturance	.845	1.184
Maternal age cat	.946	1.057
Parity cat	.965	1.037
Gestational _cat	.928	1.077
Birth weight cat	.904	1.106
Current smoker	.929	1.076
BMI cat	.950	1.053
C/section with previous c/s	.799	1.252
Epidural_stage1	.758	1.319
Induction/ augmentation	.770	1.298
Third & fourth degree tears	.951	1.051
Episiotomy	.567	1.762
Placenta praevia	.988	1.012
APH	.989	1.012
Polyhydramnios	.988	1.012
Forceps	.550	1.819
Vacuum	.819	1.220
Mgt_3rd stage of labour	.947	1.055
a. Dependent Variable: PPH		

Logistic Regression Results for Lower and Higher Risk Women

Logistic regression (unadjusted and adjusted) was also used to test both lower and higher risk groups for the effect of pro-nurturance (S2S and B/F) on PPH. Tables 7 and 8 display the results.

Table 7 Results for Pronurturance and PPH -lower risk women (n=5230) Lower risk						
Variable	**Unadjusted**			**Adjusted**		
Pronurturance (S2S&B/F)	**OR**	**95% CI**	**p value**	***OR**	**95% CI**	**p value**
Full-S2S&B/F	0.22	0.17-0.30	<0.001	0.24	0.18-0.32	<0.001
Partial-S2S only	0.44	0.34-0,58	<0.001	0.45	0.34-0.59	<0.001
None-No S2SNoB/F (ref)	1.00			1.00		
Maternal age (years)						
<20	1.05	0.75-1.48	0.77	1.09	0.77-1.55	0.63
20-24 (ref)	1.00			1.00		
25-29	1.01	0.79-1.28	0.94	1.04	0.81-1.33	0.78
30-34	0.95	0.74-1.22	0.68	0.99	0.76-1.29	0.93
35-39	0.88	0.66-1.17	0.39	0.90	0.66-1.22	0.48
≥ 40	1.37	0.86-2.17	0.20	1.42	0.87-2.31	0.17
Parity						
Primip	1.05	0.88-1.25	0.62	1.02	0.83-1.24	0.88
1-2 (ref)	1.00			1.00		
3-4	0.87	0.65-1.15	0.32	0.85	0.63-1.14	0.27
≥5	0.64	0.31-1.34	0.24	0.52	0.29-1.32	0.22
Gestational age						
37+0-40+0 weeks (ref)	1.00			1.00		
40+1-42+0 weeks	1.08	0.88-1.34	0.45	1.11	0.89-1.39	0.36
Birth weight						
<3000g (ref)	1.00			1.00		
3000g-3999g	1.08	0.84-1.40	0.53	1.06	0.82-1.38	0.65
4000g-4499g	1.37	1.01-1.89	0.05	1.34	0.96-1.87	0.08
≥4500g	2.14	1.26-3.64	0.01	2.23	1.27-3.89	0.01
Current smoker #	0.74	0.60-0.91	0.005	0.72	0.57-0.90	0.004
BMI						
Normal ≤ 25 (ref)	1.00			1.00		
Overweight 25.01- 30	1.36	1.12-1.66	0.002	1.25	1.02-1.53	0.03
Obese 30.01 - 35	1.59	1.26-2.00	<0.001	1.39	1.09-1.76	0.01
Morbidly obese >35	1.48	1.24-1.95	0.01	1.19	0.89-1.58	0.25
Labour and Birth						
Epidural analgesia #	0.72	0.43-1.19	0.20	0.67	0.40-1.12	0.13
Perineal tear (3^{rd} & 4^{th} degree) #	1.32	0.80-2.18	0.28	1.32	0.79-3.20	0.30
Episiotomy #	1.33	0.84-2.13	0.22	1.22	0.76-1.98	0.41

3rd stage active mgt#	3.67	2.24-6.01	<0.001	3.01	1.83-5.00	<0.001

not having the attribute was the reference

Table 8 Results for Pronurturance and PPH -higher risk women (n=2318)						
Variable	**Unadjusted**			**Adjusted**		
Pronurturance (S2S&B/F)	**OR**	**95% CI**	**p value**	***OR**	**95% CI**	**p value**
Full-S2S&B/F	0.37	0.24-0.57	<0.001	0.54	0.34-0.87	0.01
Partial-S2S only	0.60	0.39-0.90	0.01	0.76	0.49-1.18	0.23
None-No S2SNoB/F (ref)	1.00			1.00		
Labour and Birth						
Elective c/section #	2.68	1.53-4.69	<0.001	2.50	1.23-5.07	0.01
Induction/augmentation#	0.89	0.69-1.15	0.37	1.24	0.90-1.71	0.19
Placenta praevia#	2.11	1.13-3.91	0.02	2.00	0.94-4.04	0.07
APH#	0.75	0.44-1.28	0.29	0.79	0.44-1.42	0.42
Polyhydramnios#	1.30	0.72-2.32	0.38	1.25	0.84-2.45	0.52
Forceps#	2.22	1.73-2.87	<0.001	2.28	1.71-3.04	<0.001
Vacuum#	0.87	0.67-1.16	0.36	1.21	0.87-1.67	0.26

not having the attribute was the reference

Summary of logistic regression women at lower and higher risk of PPH

Tables 7 and 8 demonstrate that full pro-nurturance (S2S and B/F) was more effective at reducing the risk of PPH for lower risk women than it was for higher risk women although the result for higher risk women was still statistically significant. This result may be due to the fact that higher risk women had more interventions during labour and birth than lower risk women, thus interfering with the production and release of endogenous oxytocin (Odent 2015) due to a pathophysiological cause (fear/anxiety) during the third and fourth stages of labour.

Secondary findings for lower risk women included: having a first baby was not associated with increased risk of PPH, neither was maternal age associated with increased risk of PPH. Active management of 3rd stage of labour was associated with an increased risk of PPH in both the unadjusted and adjusted models.

For higher risk women full pronurturance (S2S and B/F) was protective against the risk of PPH in both in the unadjusted and adjusted models. Having an elective caesarean or a forceps delivery was associated with increased risk of PPH in both the unadjusted and adjusted models. Partial pronurturance (S2S only) was protective of PPH in the unadjusted model but not in the adjusted model for higher risk women. This result is most likely because higher risk women had more interventions during labour and birth and therefore anxiety/fear may have interfered with the uptake of endogenous oxytocin at the receptor level.

Conclusion

These findings suggest that S2S and B/F should be used as a risk reduction strategy for all women and babies able to experience it: regardless of the place of birth and the woman's risk level for PPH.

APPENDIX 6 GLOSSARY OF TERMS

Term	Definition
Accoucher	Person responsible for attending the woman during labour and birth
Acetylcholine	Acts as a neuromodulator. Has a role in the attention and arousal in the CNS. In the ANS its role is to activate the muscles (Thain & Hickman 2000)
Adrenal gland	Endocrine gland situated on top of kidneys and secreting stress hormones (Thain & Hickman 2000)
Adrenocorticotropic Hormone (ACTH)	Hormone formed in the pituitary gland and which stimulates the adrenal glands to secrete steroid hormones which control the body's use of sugar and also assist to regulate biological functions during periods of stress (Thain & Hickman 2000)
Aldosterone	A hormone that is involved in regulating sodium and potassium concentration in the body, and is excreted by the adrenal gland (Thain & Hickman 2000)
Amygdala	Part of the limbic system of the brain (Thain & Hickman 2000)
Antepartum haemorrhage (APH)	Bleeding from the genital tract in late

	pregnancy after the 20th week gestation and before the onset of labour (Stables & Rankin 2005)
Autonomic nervous system (ANS)	Has two main branches emanating from the spinal cord and controlling involuntary unconscious actions of smooth and cardiac muscle and glands. One branch is called the **sympathetic system** and the nerves controlling it are found in the thoracic and lumbar regions of the spinal cord. This system uses the neurotransmitters of adrenaline and noradrenaline to mobilise the fight or flight reaction in danger. The **parasympathetic system** located in the cranial and sacral segments of the spinal cord use the neurotransmitter acetylcholine to relax the body (Pert 1999; Uvnas-Moberg 2003)
Beta -endorphins	Neurotransmitters having a morphine-like pain suppressing effect (Thain & Hickman 2000)
Binary logistic regression	Logistic regression in which the outcome has exactly two categories, e.g., Yes or No (Field 2009)
Biology	The science of life and of living organisms, including their structure, function, growth, origin, evolution, and distribution (Thain & Hickman 2000)

Birth Territory	Comprises the physical terrain or birth space and jurisdictional control over that terrain. The birth territory varies on a continuum from a **sanctum** to a **surveillance room** (Fahy et al. 2011). Power within this space can be used integratively with the woman or disintegratively by the staff.
Cardiotocograph	Measurement of the fetal heart rate and uterine contractions electronically. A paper printout can be provided as a record if required (Stables & Rankin 2005)
Catecholamines	Naturally occurring hormones and neurotransmitters (adrenaline and nor adrenaline) released in response to stressful situations (Buckley 2009; Foureur 2008; Thain & Hickman 2000; Uvnas-Moberg 2003)
Categorical variable	A variable made up of categories of entities/objectives, e.g., PPH (Field 2009)
Central Nervous System (CNS)	A body of nervous tissue integrating sensory and motor functions and providing through-conduction pathways to transmit impulses rapidly along the body (Thain & Hickman 2000). In vertebrates the CNS composes the brain and spinal cord (Pert 1999; Uvnas-Moberg 2003)

Chorioamnionitis	Infection of the chorion and amnion usually associated with ruptured membranes greater than 24 hours (Stables & Rankin, 2005)
Cohort	Group of persons with common statistical characteristics (Field 2009)
Confidence Interval (CI)	A range above and below an average into which a specified percentage (usually 95%) of the values appears (Field 2009)
Control group	The group in an experiment which does not receive the test variable (Field 2009)
Correlation	A change in one variable is generally accompanied by changes in other variables in the same or opposite direction (Field 2009)
Cortisol	The principal steroid hormone produced by the adrenal cortex. It regulates carbohydrate metabolism and the immune system and maintains blood pressure (Thain & Hickman 2000)
Covariate	A variable which has the potential to be related to an outcome variable (Field 2009)
Cytokines	Cell signalling molecules that aid cell to cell communication in immune responses and stimulate the movement of cells

	towards sites of inflammation, infection and trauma (Thain & Hickman 2000)
Decidua	The placenta and membranes (Stables & Rankin 2005)
Disintegrative power	'Disintegrative power' is an ego-centred use of power that disintegrates other forms of power within the environment and imposes the user's self-serving goal. 'Disintegrative power' may be used by the woman, the midwife and/or any other person in the territory. The use of disintegrative power by anyone in the birth room may create mind-body disintegration and undermine the woman in her ability to have a genius birth (Fahy et al. 2011).
Endogenous	Produced within the body
Endorphins	Naturally occurring morphine like substances produced by the brain and which suppress pain (Thain & Hickman 2000; Uvnas-Moberg 2003)
Epidemiology	The science which studies causes, patterns and effects of health and disease conditions in defined populations (Field 2009)
Eulochia	The expected amount of blood loss following the birth of the baby until 6 weeks postpartum. The average blood

	loss at birth has been estimated at 500 ml or less. New term coined for this thesis
Eutony	The physiological state of contraction of the uterus after the completion of the 3rd stage labour. New term coined for this thesis.
Experimental group	Is the group that receives the variable being tested (Field 2009)
Genius Birth	This is defined as a birth where the woman responds to labour challenges by drawing from usually hidden capacities deep within her embodied self. A genius birth is a conscious and effortful event (Parratt 2010)
Gestation (or gestational age)	Length of pregnancy (in weeks)(Stables & Rankin 2005)
Gland	An organ or cell specialising in the secretion of a specific substance (Thain & Hickman 2000)
HELLP syndrome	Presents as a variant of eclampsia/pre-eclampsia or on its own: 70% occur during pregnancy at 32-34 weeks gestation and the remainder present within the first 48 hours postpartum. The initials stand for haemolysis (H), elevated liver enzymes (EL) and low platelet count (LP) (Stables & Rankin 2005)

High risk	A term used by clinicians to describe women who have a history of problems in a previous pregnancy or have an existing medical condition or have some potential risk of complications that might require speedy or specialist treatment
Hormone	A substance usually a peptide or steroid produces by one tissue and conveyed by the bloodstream to another specific target cell/organs to change physiological activity, e.g., growth (Pert 1999; Thain & Hickman 2000; Uvnas-Moberg 2003)
HPA axis	Hypothalamus-Pituitary-Adrenal glands integrate thoughts, feelings, perceptions with stimuli from both the internal and external environments to bring about chemical balance within the human body (Dixon, Skinner & Foureur 2013)
Hypothalamus	Part of the forebrain and it integrates the ANS receiving impulses from the viscera. Acts as an integrating centre for the endocrine and nervous systems: helps regulate sleep and wake patterns, monitors blood pH and concentration (Thain & Hickman 2000; Uvnas-Moberg 2003)
Iatrogenic	Adverse patient outcome resulting from medical treatment (Wickham 2011)

Inclusion criteria	See Selection criteria (Field 2009)
Independent midwife	An accredited midwife with insurance indemnity and accorded visiting rights to public hospitals, similar to appointment of GPs. Provides continuity of care.
Induction of labour	Starting labour artificially by using drugs or other methods (Stables & Rankin 2005)
Integrative Power	This is defined as integrating all forms of power within the environment towards a shared higher goal of genius birth. Integrative power promoted mind-body integration for the woman and all others in the environment. Mind-body integration allows the woman to respond spontaneously and expressively to her bodily sensations and intuitions (Fahy et al. 2011)
Intervention	Clinical procedure in pregnancy or labour, e.g., induction or labour, delivery of the fetus with forceps or by caesarean section
Intrapartum	During labour (Stables & Rankin 2005)
Jurisdiction	This is defined as the woman having the power to do as she wants in the birth environment (Fahy et al. 2008)
Limbic system	The brain's emotional system. Structures

	in the medial limb of the brain, often with looped and complex connections, all projecting into the hypothalamus. Essential for memory (Thain & Hickman 2000; Uvnas-Moberg 2003)
Logistic regression	Logistic regression measures the relationship between the categorical dependent variable (PPH) and one[1] or more[2] independent variables (Field 2009). [1]Unadjusted logistic regression [2] Adjusted logistic regression
Low risk	A term used by clinicians to describe a woman whose history and condition suggests there is little likelihood of complications during pregnancy, labour and birth
Macrosomia	Large baby usually > 4000 g or more
Maternal and Fetal Medicine specialist (MFM**)**	Obstetrician who specialises in the care of women with high risk pregnancy
Maternal Mortality Ratio (MMR)	Number of maternal deaths in a given period per 1000 women of reproductive age during the same time period (Say et al. 2014)
Metabolism	The sum of the physical and chemical processes occurring within a living organism(Thain & Hickman 2000)

Midwife	A person appropriately educated and registered to practice midwifery and who provides care, advice and assistance during pregnancy, labour and birth, and after the baby is born to 6 weeks postnatal(Australian College of Midwives 2004)
Midwifery Guardianship	This is defined as a form of integrative power which involves the midwife guarding the woman and her birth terrain. Guarding the birth terrain allows the woman to labour undisturbed and in safety (Fahy et al. 2011).
Midwifery Domination	A dominating midwife uses her power disintegratively to achieve the midwife's own goal/s. Midwifery domination undermines the woman's confidence and inner power thus interfering with the woman's labouring process and reducing her embodied strength and endurance (Fahy et al. 2011; Hastie 2008, p. 47).
Mortality	Number or frequency of deaths (Say et al. 2014)
Multiparous	A woman having carried more than one pregnancy to a viable stage (20 weeks or more and the baby weighing at least 400 g) (Stables & Rankin 2005)
Neocortex	The area of the brain concerned with

	abstract thinking, decision making, social behaviour and anticipating the effects of actions (Stables & Rankin 2005; Uvnas-Moberg 2003)
Neuroendocrine	Pertaining to interactions between the endocrine and nervous system (Thain & Hickman 2000)
Neuron	A nerve cell that receives and sends electrical signals over distances within the body (Thain & Hickman 2000)
Neuromodulator	A chemical substance capable of changing behaviour (Gimpl & Farenholtz 2001)
Neurotransmitter	A chemical substance which transmits nerve impulses across a synapse to excite or inhibit neurons (Doidge 2010; Pert 1999)
Nulliparous	A woman who has never given birth to a baby, alive or dead, at a viable age (Stables & Rankin 2005)
Obstetrician	A doctor who specialises in the management and care of pregnant women and childbirth. An obstetrician has specialist education, training and experience and is a fellow of the RANZGOG. Obstetricians provide care in secondary, tertiary and private hospitals

Obstetrics	Services relating to the management and care of pregnancy and childbirth, for example antenatal appointments, labour, delivery and care after the baby is born
Odds	The probability of an event occurring divided by the probability of that event not occurring (Field 2009)
Odds Ratio (OR)	The odds of an event occurring in one group compared to another group (Field 2009) Unadjusted OR is the odds of one event occurring compared to one outcome Adjusted OR compares the odds of several events with one outcome (Field 2009)
Oestrogen	A female hormone which causes development and change in the reproductive organs (Thain & Hickman 2000)
Oxytocin	A hormone and neurotransmitter secreted by the pituitary gland in the brain. Involved in uterine contractions during childbirth and inducing nurturing and loving behaviours (Uvnas-Moberg 2013)
Paraventricular Nucleus (PVN)	A discrete band of nerve cells in the anterior part of the hypothalamus that produces vasopressin and oxytocin

	(Uvnas-Moberg 2003)
Parity	Para means having given birth and hence parity refers to the number of times a woman has given birth to a baby alive or stillborn of 20 weeks gestation or more (Stables & Rankin 2005)
Partograph	Records the progress of labour via observations taken and permits early identification of potential problems (Stables & Rankin 2005)
Pathophysiology	Pathophysiology can be defined as the general study of the physical, biochemical and mechanical manifestations of disease (Thain & Hickman 2000)
Perinatal	Refers to the period from 20 weeks of pregnancy to 28 days after birth (Stables & Rankin 2005)
Perineum	The area between the vagina and the anus (Stables & Rankin 2005)
Phosphorylation	Transfer of a phosphate group to an organic compound. The most important energy transfer system in metabolism (Thain & Hickman 2000)
Physiology	The branch of biology dealing with the functions and activities of living

	organisms and their parts, including all physical and chemical processes (Thain and Hickman 2000)
Pituitary	Small gland secreting hormones such as oxytocin and which communicates with the hypothalamus (Thain & Hickman 2000)
Placenta praevia	A condition where the placenta is partially or wholly implanted in the lower uterine segment. As the pregnancy progresses the uterine wall stretches causing the placenta to separate resulting in bleeding (Stables & Rankin 2005)
Polyhydramnios	An excessive amount of amniotic fluid surrounding the unborn baby (Stables & Rankin 2005)
Primiparous	A women giving birth to her first baby, alive or dead (Stables & Rankin 2005)
Progesterone	A female hormone which prepares the uterus for implantation and sustains the fetus (Thain & Hickman 2000)
Prolactin	Milk producing hormone formed by cells in the frontal lobe of the brain (Uvnas-Moberg 2003)
Prostaglandins	Hormone-like substances that participate in a wide range of body functions such as the contraction and relaxation of smooth muscle, the dilation and constriction of

	blood vessels, control of blood pressure, and modulation of inflammation (Thain & Hickman 2000).
Pronurturance	The combined term for skin-to-skin contact and breastfeeding within 30 minutes of birth. New term coined for this thesis
Pronurturance Plus	A new midwifery theory developed for this thesis and which integrates the knowledge of reproductive physiology and neuroscience with concepts from Birth Territory Theory.
Psychophysiology	This is defined by the branches of psychology and biological sciences that study mind-body interactions and effects: reproductive psychophysiology concerns the ways in which thinking and feeling affect the physiological processes associated with sexual response, pregnancy, labour, birth, breastfeeding and nurturing (Cacioppo, Tassinary & Berntson 2007; Fahy et al. 2008)
Psychophysiological Care	Psychopysiological care is defined as care that is aware of and promotes optimal mind-body interactions in an environment where the woman feels warm, safe and loved (Fahy et al. 2008).
Puerperium	The six week period following childbirth

	(Stables & Rankin 2005)
p value	The statistical probability of the occurrence of a given finding by chance alone in comparison with the known distribution of possible findings, considering the kinds of data, the technique of analysis, and the number of observations. The p value may be noted as a decimal: $p < 0.01$ means that the likelihood that the phenomena tested occurred by chance alone is less than 1%. The lower the p value, the less likely the finding would occur by chance alone (Field 2009)
Quantitative research	Research that generates numerical data or data that can be converted into numbers, e.g., clinical trials and some observational studies, e.g., cohort study (Field 2009)
Randomised controlled trial (RCT)	A study to test a specific treatment in which people are randomly assigned to two (or more) groups: one (the experimental group) receiving the treatment that is being tested, and the other (the comparison or control group) receiving an alternative treatment, a placebo (dummy treatment) or no treatment. The two groups are followed up to compare differences in outcomes to see how effective the experimental

	treatment was. (Through randomisation, the groups should be similar in all aspects apart from the treatment they receive during the study) (Field 2009)
Receptor	A protein/group anchored in the outer cell membrane with a site accessible to the outside environment that binds with ligands such as hormones, drugs, peptides or neurotransmitters (Pert 1999)
Reproductive psychophysiology	This is defined as the ways in which thinking and feelings affect the physiological processes associated with sexual response, pregnancy, labour, birth, breastfeeding and nurturing (Cacioppo, Tassinary & Berntson 2007; Fahy, Foureur & Hastie 2008)
Relative Risk	Relative Risk is a comparison of the risk of a particular event (PPH) for the different groups of women exposed to either expectant or active management of 3rd stage (Field 2009)
Sample	A set of individuals or items selected from the study's target population so that the hypotheses about the population can be tested (Field 2009)
Sanctum	A quiet, warm, dimly lit, homelike environment designed to provide privacy and safety. An experience of sanctum enhances the woman's embodied sense

	of self which is reflected in optimal physiological function and emotional wellbeing (Fahy, Foureur & Hastie 2008; Fahy et al. 2011, p. 18)
Selection criteria	Explicit standards used by guideline development groups to decide which studies should be included and excluded from consideration as potential sources of evidence (Field 2009)
Statistically significant effect .	An outcome for which the difference between the intervention and control groups is statistically significant (i.e. the *p* value is less than 0.05) (Field 2009)
Stillbirth	A baby born dead after 20 completed weeks' gestation or weighing 400 gm or more (Hilder et al. 2014b)
Supraoptic Nucleus (SON)	Is a nucleus of magnocellular neurosecretory cells in the hypothalamus of the mammalian brain (Uvnas-Moberg 2003)
Surveillance room	Denotes a clinical environment designed to facilitate observation of the woman and her baby so as to optimise the ease and comfort of the staff (Fahy, Foureur & Hastie 2008, p. 18; Fahy et al. 2011)
Synapse	The junction across which a nerve impulse passes from an axon to a neuron, muscle cell or a gland cell (Pert

	1999)
Syntocinon	A synthetic hormone given to induce uterine contractions during labour and after birth
Thalassaemia	A condition of anaemia found in people from the Mediterranean, Africa, Middle and Far East (Stables & Rankin 2005)
Type 1 error	Occurs when there is a belief that there is a genuine effect in the population, when in fact there is not (Field, 2009)
Type 2 error	Occurs when there is a belief that there is no effect in the population, when in reality there is (Field 2009)
Variable	A characteristic, number or quantity that can change (Field 2009)
Vasopressin	Also known as Antidiuretic Hormone (ADH). A hormone, related to oxytocin, that is secreted by the posterior lobe of the pituitary gland, constricts blood vessels, raises blood pressure, stimulates intestinal motility, and reduces the excretion of urine (Thain & Hickman 2000)