Obstetric Complications in Primary Midwifery Care in the Netherlands

Marrit Smit

Obstetric Emergencies in Primary Midwifery Care In The Netherlands

Marrit Smit

Obstetric Emergencies in Primary Midwifery Care In the Netherlands

ISBN: 978-90-9028103-2

Cover Design by Ellie Cashman. www.elliecashmandesign.com
Layout & printing by Gildeprint, Enschede.

Financial support by the Royal Dutch Organisation of Midwives for the publication of this thesis is gratefully acknowledged.
The printing of this thesis was also kindly supported by the Departments of Obstetrics and Neonatology of the Leiden University Medical Center, Sorg-Saem BV (Astraia), BMA BV (Mosos), ChipSoft, Kraamzorg de Waarden, Dräger Medical Netherlands BV, Goodlife Fertility BV, Coöperatie verloskundige praktijken Leiden en omgeving (LEO), Moeders voor Moeders, Medical Dynamics, MedSim, Nutricia Nederland BV, Stichting Ouders van Groep B Streptokokken Patiënten, Stichting HELLP-syndroom, Stichting Oranjekliniek, Toshiba Medical Systems Nederland and Academie Verloskunde Amsterdam Groningen (AVAG).

Obstetric Emergencies in Primary Midwifery Care In The Netherlands

Proefschrift

ter verkrijging van

de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof. mr. C.J.J.M Stolker,
volgens het besluit van het College voor Promoties
te verdedigen op donderdag 26 juni 2014
klokke 13:45

door

Marrit Smit

geboren te Amsterdam
in 1976

Promotiecommissie

Promotor	Prof. Dr. J. van Roosmalen
Co-promotores	Dr. J.M. Middeldorp
	Dr. A.B. te Pas
Overige Leden	Prof. Dr. J.M.M. van Lith
	Prof. Dr. N.A. Blom
	Prof. Dr. S.A. Scherjon *(Universitair Medisch Centrum, Groningen)*
	Dr. J. van Dillen *(Radboud Universitair Medisch Centrum, Nijmegen)*
	Dr. M.P. Amelink-Verburg *(de Inspectie voor de Gezondheidszorg, Den Haag)*

Voor Erwin, Sam, Ko en Abe

CONTENTS

Chapter 1

General Introduction

JUSTIFICATION

During my years of studying midwifery in Amsterdam (1995-1999), a book called 'Midwives' by Chris Bohjalian was a bestselling novel. [1] It tells the story of an experienced midwife who performs a perimortem caesarean section. When the woman appears to have died during labour after eclampsia, the midwife saves the baby's life by removing the child from the womb with a kitchen knife. Autopsy of the body, however, reveals that the mother was actually alive at the time of surgery. The court drama which follows, aims to answer the question whether the midwife is a killer or a life-saver. The end of this story will be unrevealed here, but the thin line on which health care workers, like midwives, nurses and doctors, operate is well illustrated in this book.

The physiological process of birth can be interrupted by unexpected complications, and within minutes or even seconds, both mother and child can be in mortal danger. Fortunately, the risk of encountering the situation as described above is extremely small. In the Netherlands, 55 perimortem caesarean sections were performed in a 15 year period in which 2.929.289 births were registered (1 per 53.260 births). [2] Other complications at birth, such as shoulderdystocia where the foetal shoulder is stuck behind the symphysis pubis and profuse haemorrhage after birth are less rare (0.2-0.3 percent and 6 percent respectively). [3,4] Chance of survival for both mother and child is reasonably high when these emergencies occur, but adequate measures must be taken immediately by care providers. [5,6]

Health care in general is greatly dependant on risk selection. If high risk is recognised, protocols and guidelines supply care providers with a 'guide for optimal care', such as the Dutch 'Obstetric Indication List'. [7] Also, in low risk pregnancies unexpected complications can occur and health care workers then must be able to make clear and swift decisions. For this, the health care system must be appropriately equipped to provide the appropriate care at any time.

When pregnancy is uneventful and considered to be low risk, women in the Netherlands have the opportunity to give birth in primary care at home, a birthing clinic or hospital. In 2012, 28.8% of Dutch women gave birth in primary care of whom 53% at home and 47% in a birthing clinic or hospital. Most births in primary care are supervised by midwives (97.9%) and only 2.1% by general practitioners. [4] If no complications occur, no other assistance besides guidance and support is needed. A study in 2001-2003 showed that in approximately 40% of births commencing in primary care, referral to secondary care was needed. Of all these referrals, only 3.6% was on an urgency basis (mostly foetal distress or profuse bleeding after birth). If urgent referral is indicated, however, perinatal outcome is still satisfactory in the Netherlands. [8] Several studies suggest that women with low risk pregnancies, who choose to give birth

at home, have a lower rate of severe acute maternal morbidity, postpartum haemorrhage (PPH), and manual removal of placenta than those with low risk pregnancies who choose to give birth in hospital. [9-13] In addition, there is no evidence that planned home birth as compared to planned hospital birth leads to an increased risk of severe adverse maternal outcome in a maternity care system with both well-trained midwives and a good referral and transportation system. [14]

Although outcomes of birth in primary care have been studied in relation to severe maternal morbidity, some (more rare) complications in case of *a priori* low-risk pregnancies and births in the Netherlands have not been studied. The Dutch Perinatal Registry (PRN, www.perinatreg.nl) collects data relating to events such as postpartum haemorrhage (PPH) and retained placenta. However, not all obstetric emergencies are currently included in the dataset. For example, umbilical cord prolapse (UCP) has no code in the data form and the prevalence of eclampsia, shoulderdystocia and resuscitation of the newborn are likely to be under-reported because of facultative and non-user-friendly registration procedures of these incidents. Besides uncertainty of the actual prevalence of obstetric emergencies in primary care, little research has been performed evaluating the management of obstetric emergencies occurring in primary care. Additionally, the prevalence of neonatal resuscitation in community-based midwifery care in the Netherlands is largely unknown. The Perinatal Registry shows that approximately 0.9% of all infants born have an assessed Apgar score of < 7 at five minutes after birth. [15] It is safe to assume that a substantial number of these infants required some form of support and/or resuscitation. After birth, placental oxygenation ceases, neonatal lungs expand and blood oxygenation is primarily provided by breathing. If this transition proceeds normally, neonatal organs are oxygenated and this subsequently leads to high oxygen saturation (the percentage of haemoglobin binding sites in the bloodstream occupied by oxygen). Immediately after birth, an infant's condition is assessed by observation of breathing, heart rate, skin colour, muscle tone and reflexes (irritability), also known as the Apgar score. [16] It seems plausible that if a high Apgar score is assessed, it means that the oxygen saturation is also high. Studies have shown, however, that judging oxygen saturation based on the infant's colour can be very inaccurate. [17] Also, the heart rate is often underestimated (lower than the actual heart rate) by auscultation or palpation. [18] Pulse oximetry (PO) offers objective and accurate values of oxygen saturation and heart rate. Also when using PO, interventions such as assisted ventilation do not need to be interrupted by manual auscultation. [17,18] As such, it could be a valuable tool to evaluate the need for, and response to resuscitation. Both the Dutch Association of Paediatricians (NVK) and the Royal Dutch Organization of Midwives (KNOV) recommend the use of PO when resuscitation is indicated. [15,19] Currently however, PO has not yet been implemented in midwifery practice.

If complications arise during or after birth, care providers need the necessary skills to adequately manage the situation and attend to both mother and (unborn) child. In an outer hospital setting, collaboration with birth-assistants ('kraamverzorgende'), ambulance personnel and obstetricians must be impeccable. Initial schooling for midwives, physicians and birth assistants, provides theoretical and practical training in order to adequately diagnose and treat obstetric emergencies. As the prevalence of obstetrical emergencies is generally low, midwives have to regularly train and update their knowledge and skills. In the last decade, the importance of such emergency training has been of increasing interest to all professionals working in obstetric care. Dutch and English colleagues have shown the positive effect of obstetric emergency training as it enhances cooperation, knowledge, skills and perinatal outcome. [20-23]

Since 2004, the Managing Obstetric Emergencies and Trauma (MOET) course for obstetricians and anaesthetists was successfully introduced in the Netherlands. In 2012 the Pre-hospital Obstetric Emergency Training (POET, www.ALSG.nl) for midwives in primary care was introduced. Before POET was started, most Dutch midwives (>90%) participated in the CAVE course ('Cursus Acute Verloskunde', real life simulation Primary Care Obstetric Emergency Course, www.medsim.nl). This postgraduate pre-hospital obstetric emergency course was specifically developed for community-based midwives in the Netherlands. The course focuses on the identification of obstetric emergencies and their management, including timely and adequate referral to hospital. [24]

In the last decade, audit has increasingly been applied as a tool to evaluate obstetric care. The Dutch Perinatal Audit (PAN) on perinatal mortality and the Dutch LEMMoN study (Nationwide study into Ethnic of Severe maternal morbidity in the Netherlands) on severe maternal morbidity have shown that audit can determine the presence of substandard care factors and provide recommendations concerning optimal care. [25,26] Cases discussed in these studies sometimes originate in primary midwifery care. [25,27,28] However, these only include cases in which severe maternal morbidity and/or perinatal death occur, and do not supply us with data on the management of other more 'common' obstetric complications, such as shoulderdystocia or PPH. So far, the prevalence and management of obstetric emergencies in Dutch primary care in the Netherlands has not been structurally evaluated.

AIM OF THIS THESIS AND RESEARCH QUESTIONS

Primary aim of the studies described in this thesis is to gain insight into management of obstetric emergencies occurring in primary midwifery care in the Netherlands. Data collected from the 'CAVE study' (as described below) is analysed. As referral to secondary care is usually indicated in case of an obstetric emergency, we also aim to gain insight into cooperation between care providers such as midwives, ambulance personnel and obstetricians. The secondary aim of this thesis is to develop preventative strategies and tools to optimise primary midwifery care.
The following research questions are addressed in this thesis: how do midwives manage obstetric emergencies occurring in primary care, how is cooperation between care providers such as ambulance personnel and obstetricians, and which tools can optimise midwifery care?

THE 'CAVE STUDY'

For this thesis, 198 cases of obstetric emergencies occurring in primary midwifery care were collected (Table 1). From April 2008 to April 2010, 548 midwives (337 participants and 211 scheduled to participate) reported all obstetric emergencies encountered during their work. Upon inclusion, during twelve consecutive months, participants received a monthly e-mail linked to a password-protected internet site. When reporting an obstetric emergency, the midwife was asked to fill out a detailed case registration form containing information on received care during pregnancy and birth and maternal and neonatal outcome. Anonymous medical files, ambulance report forms (if applicable), discharge letters and laboratory results were requested.

Table 1. Collected cases in the 'CAVE study' by all participants (548 midwives)

	Reported Cases (n=198) (%)
PPH	**98 (50)**
Shoulderdystocia	**55 (28)**
Neonatal resuscitation	**25 (12)**
Umbilical cord prolapse	**8 (4)**
Unexpected breech birth	**9 (5)**
Hemorrhage after miscarriage, eclampsia and ruptured spleen.	**3 (1)**
Total	**198 (100)**

OUTLINE OF THIS THESIS

In the first part of this thesis, studies on PPH in primary midwifery care are presented. We present the results of an audit on PPH after home birth and a case study on ambulance referral after PPH. We report on a national survey on management of the third stage of labour and describe the process of development of quality indicators for management and prevention of PPH. In the second part, we present a case study of umbilical cord prolapses, and two further chapters concern the use of pulse oximetry in new-born infants in primary care. A summary of collected cases of shoulderdystocia and neonatal resuscitation is described at the end of this chapter (Table 2 and Table 3) .

Chapter 1 This chapter contains the justification of this thesis and describes the study objectives, as well as the context in which the studies took place.

Chapter 2 and Chapter 3 provide the results of an audit meeting on PPH after home birth. After one year of data collection, 67 cases had been collected, of which 7 were audited. Substandard care factors were determined, differentiated into incidental, minor and major substandard care factors and recommendations for practice were made.

Chapter 4 provides an insight into ambulance referral in case of postpartum haemorrhage after home birth. After applying selection criteria on 98 reported cases, fifty four cases of PPH are analysed with respect to time management, maternal condition during ambulance care and maternal outcomes.

Chapter 5 describes a survey of prophylactic use of uterotonics in the third stage of labour in the Netherlands. As a similar survey was performed in 1995, changes in management of the third stage of labour in the Netherlands can be analysed.

Chapter 6 describes the development of quality indicators for prevention and management of PPH in primary midwifery care through a RAND modified Delphi procedure.

In Chapter 7 we assess the performance of the quality indicators as described in Chapter 6 for prevention and management of PPH in primary care in the Netherlands.

Chapter 8 is a descriptive study of eight cases of umbilical cord prolapse. We provide the reader with an insight into risk factors of UCP, procedures to alleviate cord compression, timing of ambulance transfer and perinatal outcomes.

Chapter 9 describes the results of a feasibility study of the use of pulse oximetry in primary midwifery care.

In Chapter 10 we assess whether defined reference ranges of oxygen saturation (SpO_2) and heart rate (HR) of term infants after birth also apply for infants born after midwifery supervised uncomplicated vaginal birth where delayed cord clamping (DCC) and immediate skin to skin contact (ISSC) is routine management.

A summary and general discussion and recommendations to improve primary midwifery care are formulated in **Chapter 11**.

SUMMARY OF COLLECTED CASES OF SHOULDERDYSTOCIA AND NEONATAL RESUSCITATION

(Unpublished data)

Shoulderdystocia

Fifty-five cases of shoulderdystocia were reported. Basic characteristics can be found in Table 2. Prior to birth, risk factors for shoulderdystocia (macrosomia and maternal obesity) were identified by the midwife in 2/55 cases. Procedures applied to resolve the shoulderdystocia varied, but all midwives applied at least one procedure: sacral movement of head in 29 (53%), Mc Roberts' manoeuvre was applied in 38 cases (69%), supra pubic impression in 20 (36%), 'all fours manoeuvre' (Gaskin manoeuvre) in 37 (67%), delivery of posterior arm and shoulder in 39 (71%), and rotation manoeuvres in 13 out of 55 (24%). An episiotomy was performed in 3 cases (5%). Head to body interval ranged from one to six minutes with a median of two minutes. After birth, two infants were resuscitated through mask and bag ventilation (4%), supplemental oxygen was supplied to 21 infants (38%). In 49/55 (89%) infants, no morbidity as a result of shoulderdystocia was reported. One infant suffered Erb's palsy and in 2 cases a fractured clavicle or humerus was reported.

All infants suffering from shoulderdystocia fully recovered. No perinatal mortality was reported.

Table 2. Reported cases of shoulderdystocia (n=55)

Parity	
Primipara *n (%)*	4 (8)
Multipara *n (%)*	51 (92)
Gestational Age	
median (range, weeks + days)	40^{+2} (38^{+1} – 42^{+0})
Place of birth	
n (%)	
Home	41 (75)
Hospital*	14 (25)
Apgar scores (AS)	
Median (range)	
AS 1 minute	8 (1-10)
AS 5 minute	9 (6-10)
AS 10 minute	10 (6-10)
Birth Weight	
median (range) grams	4160 (3500 – 5600)

* Hospital birth supervised by the primary care midwife

Neonatal resuscitation

Twenty-five cases of neonatal resuscitation were reported (Table 3). In 14 (56%) cases, suboptimal condition was found (abnormal foetal heart rate was auscultated during birth).

The median duration of dilatation was 4 hours (ranging from one to 12 hours). The second stage had a median duration of 13 minutes (range three to 110 minutes).

In 8 cases (40%), meconium stained liquor was present at second stage, the umbilical cord was wrapped on the neck/shoulders of the infant in 12/25 cases (48%). In two cases, a shoulderdystocia occurred. After birth, all infants were dried and stimulated. Of eleven infants (44%) the umbilical cord was clamped because of suboptimal condition and in 24 infants (96%) bag and mask ventilation was performed. In two cases chest compressions were also applied.

The paediatrician was consulted in all but 5 cases, 5 infants were intubated and eleven were ventilated on the neonatal intensive care unit. 17 new-borns were admitted to the neonatology ward for a median of 1 day (range 1-7 days).

Twenty-two infants fully recovered from birth. One infant deceased due to severe asphyxia. In this case, the duration of first stage was 5 hours, second stage lasted 90 minutes. The amniotic fluid was clear; the umbilical cord was tightly wrapped around the neck. Absent foetal heartbeat was found a few minutes before birth.

One infant was diagnosed with a diaphragmatic hernia and one infant was diagnosed with a metabolic disease.

Table 3. Reported cases of neonatal resuscitation (n=25)

Parity	
Primipara *n (%)*	5 (20)
Multipara *n (%)*	20 (80)
Gestational Age	
median (range, weeks + days)	40^{+4} (37^{+4} – 42 $^{+0}$)
Place of birth	
n (%)	
Home	16 (64)
Hospital*	9 (36)
Apgar scores (AS)	
Median (range)	
AS 1 minute	3 (0-9)
AS 5 minute	6 (0-10)
AS 10 minute	8 (0-10)
Birth Weight	
median (range) grams	3455 (3100 – 4270)

* Hospital birth supervised by the primary care midwife

REFERENCES

1. Chris Bohjalian. Midwives. 1997.
2. Dijkman A, Huisman CM, Smit M, Schutte JM, Zwart JJ, van Roosmalen J, et al. Cardiac arrest in pregnancy: increasing use of perimortem caesarean section due to emergency skills training? BJOG. 2010;117:282-287.
3. Prins M, van Roosmalen J, Scherjon S, Smit Y. Praktische Verloskunde. 2009.
4. Perinatal Care in the Netherlands, 2012. 2012.
5. Draycott T, Sibanda T, Owen L, Akande V, Winter C, Reading S, et al. Does training in obstetric emergencies improve neonatal outcome? BJOG. 2006;113:177-182.
6. Siassakos D, Draycott TJ, Crofts JF, Hunt LP, Winter C, Fox R. More to teamwork than knowledge, skill and attitude. BJOG. 2010;117:1262-1269.
7. Dutch Maternity Care Committee. Obstetric Vademecum, Final report of the Maternity Care Committee of the College of health insurance companies. [Verloskundig Vademecum. Eindrapport van de Commissie Verloskunde van het College voor zorgverzekeringen]. Diemen, the Netherlands: 2003.
8. Amelink-Verburg MP, Verloove-Vanhorick SP, Hakkenberg RM, Veldhuijzen IM, Bennebroek GJ, Buitendijk SE. Evaluation of 280,000 cases in Dutch midwifery practices: a descriptive study. BJOG. 2008;115:570-578.
9. Brocklehurst P, Hardy P, Hollowell J, Linsell L, Macfarlane A, McCourt C, et al. Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study. BMJ. 2011;343:d7400.
10. Davis D, Baddock S, Pairman S, Hunter M, Benn C, Wilson D, et al. Planned place of birth in New Zealand: does it affect mode of birth and intervention rates among low-risk women? Birth. 2011;38:111-119.
11. Hutton EK, Reitsma AH, Kaufman K. Outcomes associated with planned home and planned hospital births in low-risk women attended by midwives in Ontario, Canada, 2003-2006: a retrospective cohort study. Birth. 2009;36:180-189.
12. Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician. CMAJ. 2009;181:377-383.
13. Lindgren HE, Radestad IJ, Christensson K, Hildingsson IM. Outcome of planned home births compared to hospital births in Sweden between 1992 and 2004. A population-based register study. Acta Obstet Gynecol Scand. 2008;87:751-759.
14. de Jonge A, Mesman JA, Mannien J, Zwart JJ, van Dillen J, van Roosmalen J. Severe adverse maternal outcomes among low risk women with planned home versus hospital births in the Netherlands: nationwide cohort study. BMJ. 2013;346:f3263.
15. van der Stouwe R. Standpoint Resuscitation of the Newborn at Home Birth in Primary Midwifery Care. Royal Dutch organisation of Midwifes (KNOV); 9 A.D. Apr 15.
16. APGAR V. A proposal for a new method of evaluation of the newborn infant. Curr Res Anesth Analg. 1953;32:260-267.
17. O'Donnell CPF, Kamlin CO, Davis PG, Carlin JB, Morley CJ. Clinical assessment of infant colour at delivery. Archives of Disease in Childhood - Fetal and Neonatal Edition. 2007;92:F465-F467.
18. Kamlin CO, O'Donnell CPF, Everest NJ, Davis PG, Morley CJ. Accuracy of clinical assessment of infant heart rate in the delivery room. Resuscitation. 2006;71:319-321.
19. Dutch Association of Pediatricians (NVK). NVK-guideline Resuscitation of newborns 2008.

20. Draycott T, Sibanda T, Owen L, Akande V, Winter C, Reading S, et al. Does training in obstetric emergencies improve neonatal outcome? Bjog-An International Journal of Obstetrics and Gynaecology. 2006;113:177-182.
21. Fransen AF, van de Ven J, Merien AE, de Wit-Zuurendonk LD, Houterman S, Mol BW, et al. Effect of obstetric team training on team performance and medical technical skills: a randomised controlled trial. BJOG. 2012;119:1387-1393.
22. Crofts JF, Ellis D, Draycott TJ, Winter C, Hunt LP, Akande VA. Change in knowledge of midwives and obstetricians following obstetric emergency training: a randomised controlled trial of local hospital, simulation centre and teamwork training. BJOG. 2007;114:1534-1541.
23. Crofts JF, Winter C, Sowter MC. Practical simulation training for maternity care--where we are and where next. BJOG. 2011;118 Suppl 3:11-16.
24. Havenith B, van der Ploeg J. CAVE: Pre-hospital Obstetric Emergency Course Syllabus. Boxmeer: 2010.
25. Diem v M, Reu d P, Eskes M, Brouwers H, Holleboom C, Slagter-Roukema T, et al. National perinatal audit, a feasible initiative for the Netherlands!? A validation study. Acta Obstet Gynecol Scand. 2010;89:1168-1173.
26. van Dillen J, Mesman JAJM, Zwart JJ, Bloemenkamp KWM, van Roosmalen J. Introducing maternal morbidity audit in the Netherlands. Bjog-An International Journal of Obstetrics and Gynaecology. 2010;117:416-421.
27. Smit M, Dijkman A, Rijnders M, Bustraan J, van Dillen J, Middeldorp J, et al. Haemorrhage after home birth: audit of decision making and referral. Pract Midwife. 2013;16:12-15.
28. Dietz de Loos DAE, Mesman JAJM, Zwart J, van Roosmalen J. Risicoselectie en substandaardzorgfactoren bij ernstige fluxus post partum na thuispartus: LEMMoN-audit. NTOG. 2010;vol 123:11-15.

Chapter 2

Haemorrhage after home birth: audit of decision making and referral (part 1)

Marrit Smit
Anneke Dijkman
Marlies Rijnders
Jacqueline Bustraan
Jeroen van Dillen
Johanna Middeldorp
Barbara Havenith
Jos van Roosmalen

The Practising Midwife. 2013;16:12-15.

SUMMARY

In the Netherlands, 20% of women give birth at home. In 0.7%, referral to secondary care because of postpartum haemorrhage (PPH) is indicated. Midwives are regularly trained in managing obstetric emergencies. A postgraduate training programme developed for Dutch community-based midwives called 'CAVE' (pre-hospital obstetric emergency course) focuses on the identification and management of obstetric emergencies, including timely and adequate referral to hospital. This descriptive study aims to identify substandard care (SSC) in PPH after home birth in the Netherlands. Sixty seven cases of PPH reported by community-based midwives were collected. After applying selection criteria, seven cases were submitted to audit. The audit panel consisted of 12 midwives (of which seven contributed a case), 10 obstetricians, an educational expert and an ambulance paramedic. First, an individual assessment was performed by all members. Subsequently, at a plenary audit meeting, SSC factors were determined and assigned incidental, minor and major substandard care.

INTRODUCTION

Virtually all pregnant women in the Netherlands have midwifery care at some point during pregnancy, birth or the puerperal period. Of the 2,444 registered midwives in the Netherlands, 77% are working in a community-based primary care facility. Another 23% work in hospitals, under the supervision of obstetricians, where they provide care for medium and high risk pregnancies and births. [1] In 2008, 20.9% (n=37,078) of all children in the Netherlands were born at home, supervised by a community-based midwife. The referral to secondary care rate during birth is approximately 32%. If referral is indicated, however, only 3-5% is urgent, such as for fetal distress, postpartum haemorrhage (PPH), retained placenta or need for transfer of the newborn to a neonatologist. [2] In 2008, of all intra-partum referrals of women under the care of a community-based midwife, 0.7% was referred because of PPH and 0.9% because of retained placenta. [3] A recent review has shown an increase in PPH in industrialised countries; it is unclear whether this rise can also be seen in low risk births. [4] A nationwide study into severe maternal morbidity in the Netherlands identified major obstetric haemorrhage (defined as a need for transfusion of four or more units and/or embolisation or hysterectomy) in 1.6 per 1000 home births compared to 6.1 per 1000 hospital births. [5] In case of an obstetric emergency after home birth, community-based midwives require skills to adequately manage these complications and provide optimal care. As students, midwives are taught to start intravenous access at home for stable transport to hospital. Due to the low prevalence of such emergencies, these skills should be regularly updated and taught repeatedly. [6] At present no guideline exists in primary midwifery care for the management of PPH after home birth in the Netherlands. A postgraduate pre-hospital obstetric emergency course ('CAVE') specifically developed for Dutch community-based midwives, focuses on the identification of obstetric emergencies and their management, including timely and adequate referral to hospital. [7] Although this programme is not mandatory for licence renewal, over 90% of all community-based midwives have attended (www.hotabc.nl, in Dutch). Although rare and unexpected in low risk pregnancies, PPH is a serious complication of childbirth, which can have immense consequences directly for the mother and for her future in childbearing. Studies have shown that substandard care (SSC) can be identified through audit, an effective method of evaluating care provision which often leads to constructive discussion within a medical team on policy and quality of care. [8,9] The aim of this study was to audit cases of PPH after home birth in order to identify SSC. And, if SSC factors are present, lessons for improvement can be drawn and used in guideline development.

METHODS

Ethical approval was not required; all cases were anonymously provided and not accessible for the researchers or panel members (except for the midwife presenting the case).

Participants and data collection

All community-based midwives (n=366) who registered for the 'CAVE' course were asked to participate in this study. From April 2008-April 2009, participants were asked to report the following obstetric emergencies to the researchers upon finishing the course: PPH (> 1000 mL blood loss, estimated or weighted), including retained placenta, shoulder dystocia, prolapsed umbilical cord, unexpected breech birth, (pre) eclampsia and resuscitation of the newborn or mother. Participants received a monthly e-mail linked to a password secured internet site. When obstetric emergencies were reported, participants were asked to fill out a detailed case registration form (CRF) containing information on received care during pregnancy and birth and maternal and neonatal outcome. Anonymous medical files, discharge letters and laboratory results were requested. If data were incomplete or inconclusive, the participants were contacted for missing documents to be completed.

Previous to the audit, selection criteria were determined by the study group containing the authors. Cases of PPH were eligible for audit if: PPH occurred after home birth under care of a community-based midwife; referral to hospital by ambulance was necessary; complete documentation of the case was available; and if the community based midwife was able to attend the audit meeting.

Methods of audit

The audit panel consisted of 12 midwives, 10 obstetricians, an educational expert and an ambulance paramedic. Of the 12 midwives, seven were working in the community and they all contributed a case for the audit. Almost all panel members work daily in obstetric care and some actively participate in (perinatal) audits and guideline development.Substandard care factors have been previously described and successfully applied in cases of maternal morbidity and mortality. [5, 8-11] The scoring system suitable for this audit on PPH was developed by consulting various sources; national guidelines for PPH in secondary obstetric care and obstetric emergency course manuals were scrutinised in order to establish a list of factors contributing to care in case of PPH after home birth. [7,12,13] A list of 32 items was established, divided into two sections: general care and specific care in case of PPH (see Table 1). Each panel member was asked to perform an individual assessment of medical records of all cases (individual audit)

before the plenary audit meeting.Panel members assessed whether risk selection prior to the decision to give birth at home had been appropriate and whether SSC factors had been present during pregnancy and birth at the level of the patient, the care provider or the healthcare system (see Table 1). Care was considered substandard if it deviated from national guidelines or, in the absence of guidelines, if care deviated from best available evidence or expert opinion. Additional SSC items concerning specific management of PPH, referral and transport to hospital were also scored. Panel members were required to send the audit forms back by post prior to the plenary meeting, and the forms were analysed by calculating the number of SSC factors per scoring item (see Table 1). For example, when the item 'Inadequate risk selection' has a high score, it indicates that a majority of assessors judged that SSC was provided on this item, in this particular case. The maximum score for SSC was calculated using number of assessors x number of cases x 32 scoring items: 24 x 7 x 32 = 5,376 items.

During the plenary audit meeting, all cases were discussed. The community- based midwives who submitted the cases supplied background and additional information, when necessary. The ambulance paramedic could supply the panel with background and /or contextual information on the responsibilities and procedures during transfer to hospital. After discussion, panel members re-assessed the case for SSC using the same audit form and were requested to rate each case individually and anonymously in order to assure an objective judgement. Finally, at the plenary session, panel members were asked to make a classification of SSC, a grading system derived from the Confidential enquiry into stillbirths and deaths in Infancy and applied in other audits. [14] The grading system consisted of three levels of SSC: incidental: lessons can be learned from the case, but a different policy would not have changed the outcome; minor: different care would probably have led to a better outcome; and major: different care would definitely have given a better outcome. Consensus was reached if the majority of the panel (>50% of the members) classified the care as substandard.

Table 1 Substandard care scoring items as used in the audit form and their contribution concerning general care and specific management of PPH after the individual audit.

General care scoring items	n	%
Patient	**23**	**7.5**
Patient delay consulting doctor / midwife	13	4.2
Refusal of medical help or advice	10	3.3
Midwife	**108**	**35.3**
Inadequate risk selection	25	8.2
Inadequate antenatal care	12	3.9
Delay in recognition of symptoms / signs	27	8.8
Delay in referral to obstetrician	44	14.3
Obstetrician	**13**	**4.2**
Inadequate risk selection	3	0.9
Delay in recognition of symptoms / signs	2	0.7
Delay in treatment after diagnosis	8	2.6
Healthcare system	**162**	**52.9**
Homebirth influenced outcome	60	19.6
Medical assistance arranged too late	44	14.3
Quality of transport influenced outcome	32	10.4
Ambulance was not present within acceptable time	26	8.5
Total	**306**	**100**

Specific management of PPH scoring items	n	%
Oxytocin was not administered according to guidelines	56	10.5
No uterine massage was administered	17	3.2
Inadequate maternal monitoring (pulse, blood pressure)	52	9.7
No oxygen was administered by midwife	91	17
No oxygen was administered by gynaecologist	42	7.8
None or too late bladder catheterisation	44	8.2
Inadequate stabilisation of patient for transport	15	2.8
No intravenous line was started by midwife / GP	87	16.2
Intravenous line was started too late overall	45	8.4
No volume replacement was started by midwife	46	8.6
Suboptimal treatment of PPH according to guidelines	41	7.6
Total	**536**	**100**

REFERENCES

1. Hingstman L and Kenens (2009). Cijfers uit de registratie van verloskundigen: peiling 2008 (in Dutch), Utrecht: NIVEL.
2. Amelink-Verburg M, Verloove-Vanhorick S, Hakkenberg R et al (2008). 'Evaluation of 280,000 cases in Dutch midwifery practices: a descriptive study'. Brit Jour Obs Gyn (BJOG), 115: 570-578.
3. SPRN (2008). Perinatal care in the Netherlands (in Dutch). Utrecht: SPRN.
4. Knight M, Callaghan W, Berg C et al (2009). 'Trends in postpartum hemorrhage in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group'. BMC Pregnancy Childbirth, 9: 55.
5. Zwart J, Richters J, Ory F et al (2008). 'Severe maternal morbidity during pregnancy, delivery and puerperium in the Netherlands: a nationwide population-based study of 371,000 pregnancies'. BJOG, 115: 842-85.
6. Draycott T, Sibanda T, Owen L et al (2006). 'Does training in obstetric emergencies improve neonatal outcome?' BJOG, 113: 177-182.
7. Havenith B and van der Ploeg J (2010). CAVE: Pre-hospital obstetric emergency course syllabus (in Dutch), Netherlands: Boxmeer.
8. van Dillen J, Lim F and van Rijssel E (2008). 'Introducing caesarean section audit in a regional teaching hospital in The Netherlands'. Eur Jour Obs Gyn Reprod Biol, 139(2): 151-156.
9. van Dillen J, Mesman J, Zwart J et al (2010). 'Introducing maternal morbidity audit in the Netherlands'. BJOG, 117: 416-421.
10. van Diem M, de Reu P, Eskes M et al (2010). 'National perinatal audit, a feasible initiative for the Netherlands!? A validation study'. Acta Obstet Gyn Scand, 89(9): 1168-1173.
11. Schutte J, Schuitemaker N, van Roosmalen J et al (2008). 'Substandard care in maternal mortality due to hypertensive disease in pregnancy in the Netherlands'. BJOG, 115: 732-736.
12. NVOG (2006). Guideline: Haemorrhagia Post Partum (2006). Available at: http://nvog-documenten.nl/index.php?pagina=/site/pagi na.php&id=54321.
13. Johanson R and Cox C (2003). MOET course manual, London: RCOG Press.
14. Richardus J, Graafmans W, Verloove-Vanhorick S et al (2003). 'Differences in perinatal mortality and suboptimal care between 10 European regions: results of an international audit'. BJOG, 110(2): 97-105.

Chapter 3

Haemorrhage after home birth: audit of decision making and referral

Part 2: results and discussion

Marrit Smit
Anneke Dijkman
Marlies Rijnders
Jacqueline Bustraan
Jeroen van Dillen
Johanna Middeldorp
Barbara Havenith
Jos van Roosmalen

The Practising Midwife. 2013; 2013;16:28-31

SUMMARY

This descriptive study aims to identify substandard care (SSC) in PPH after home birth in the Netherlands. Sixty seven cases of postpartum haemorrhage (PPH) reported by community-based midwives were collected. After applying selection criteria, seven cases were submitted to audit. The audit panel consisted of 12 midwives (of whom seven contributed a case), 10 obstetricians, an educational expert and an ambulance paramedic. First, an individual assessment was performed by all members. Subsequently, at a plenary audit meeting, SSC factors were determined and assigned incidental, minor or major status. Major SSC was identified in two out of seven cases. We conclude that communication between different healthcare providers should be optimised and a proactive attitude taken to select women who plan to give birth at home, taking into account the possibility of timely referral in case of PPH or retained placenta. National multidisciplinary guidelines on managing obstetric haemorrhage in home birth are urgently needed.

RESULTS

Of all community-based midwives (n=366) who registered for the postgraduate training programme developed for Dutch community-based midwives, 337 (92.1%) agreed to participate in the study.
From April 2008 to April 2009, 67 midwives reported cases of PPH. Seven of these births took place in hospital, supervised by the community-based midwife because of retained placenta or PPH after a previous pregnancy. Fourteen (20.9%) women chose to give birth in hospital supervised by the community-based midwife. Finally, two (3.0%) unplanned home births were reported: one birth was a very fast preterm birth (34+2 weeks), where transfer to hospital was not possible before birth. The second birth was planned in hospital because of retained placenta in a previous pregnancy, but labour was progressed too far for timely transfer. Of the 44 planned homebirths, 28 (63%) cases fulfilled the criteria and thus were eligible for audit; in two cases there was no referral to hospital and, despite active follow up of missing data, 16 (36%) cases were still incomplete when inclusion for audit started. After consultation with audit specialists, a maximum of eight cases per audit session were judged to be feasible. Of the remaining 28 cases, 10 were randomly selected. All 10 community-based midwives were invited to participate in the audit and eight accepted the invitation. Two midwives declined the invitation because of holidays or other obligations. A copy of the eight cases was sent by mail to all audit participants and subsequently assessed. One member who contributed a case had to cancel her participation on the day of the audit because of illness; therefore seven cases were finally discussed during the plenary audit.

Individual audit

Results of the individual audit can be seen in Table 1. Out of total SSC factors (5,367), the panel members scored 842 (16.7%). Most SSC factors were contributed to the healthcare system (52.9%) and the midwife (35.3%).
In all seven cases, SSC was found on one or more items ranging from one to eight factors. In two cases (29%), the panel judged that there was a delay in recognition of the signs and symptoms by the community-based midwife and referral to the obstetrician. In four cases (57%), no intravenous access was established by the community-based midwife. In two cases (29%), there was no – or too late - bladder catheterisation. In one case (14%), the panel found that homebirth had influenced outcome. Oxytocin was not or insufficiently applied in three of seven cases (43%) when PPH occurred. No oxygen was administered in five cases (71%).

Plenary audit

Substandard care was found in all cases. In six cases (85%), consensus was reached on the level of SSC. In three cases (43%) minor SSC was diagnosed, in two cases (29%) major SSC and incidental SSC in one case (14%). Specific recommendations were made concerning the management of PPH, communication, cooperation and place of birth (see Table 2).

DISCUSSION

This is the first study assessing SCC factors on PPH after homebirth in an industrialised country. In two cases (29%), the majority of the panel found major SSC; different care would definitely have given a better outcome. Recommendations were formulated concerning communication and anticipation.

Documentation

Preliminary to the audit, 16 cases (24%) were excluded because of incomplete documentation, despite the efforts of the researchers. In 12 cases, the midwives were unable to recall the case, such as name and birth date of the woman in order to collect data and complete the case. In two cases, the midwife had changed jobs and was not able to easily access the data in order to supply the researchers with sufficient data for audit. The excluded cases were all cases of marginal PPH, up to 1100ml. This finding emphasises the importance of documentation. Cooperation between community-based midwives and obstetricians, also through documentation, could be improved substantially.

Decision-making and anticipation

Transfer

In two cases (29%), the panel judged there to have been a delay in referral to the obstetrician. In home birth, the community-based midwife must make swift decisions in order to adequately stabilise and refer the mother as soon as possible. As for all urgent referrals in the Netherlands, an ambulance should reach the patient within 15 minutes of the emergency call. From emergency call to actual admission in hospital, no more than 45 minutes should pass. [1] Within this time frame, the patient must be stabilised and transported to hospital. In 92% of all urgent referrals, transport is actually commenced within 15 minutes. [2]

Intravenous access

In cases of excessive bleeding, priority should be given to an intravenous line. [3] This was not started in four of seven cases (57%) by the community-based midwife, despite their attendance at a recent postgraduate training course. Our study shows that although the skill is mastered by those who attend the course, actual implementation of this skill is not yet optimised.

Retained placenta

The panel advised that if the placenta is not born after 30 minutes, preparations should be made for transport such as calling an ambulance for emergency transport, attempt for intravenous access and consulting an obstetrician. In the Netherlands, historically, women with retained placenta after home birth are referred to hospital one hour after birth in the absence of severe blood loss (>1000ml). This time frame is not determined in any guideline in the Netherlands. It is shown that 90% of placentas are born within 15 minutes. [4] In the Netherlands active management including routine oxytocin post childbirth is not routinely applied. [5] The international Confederation of Midwives (ICM) and the International Federation of Gynaecologists and Obstetricians (FIGO) advocate active management of the third stage of labour in all women in the home birth setting. [6] However, a recent review shows no conclusive evidence on whether an active management in a low risk setting leads to a reduction in the prevalence of PPH. [7] As far as we know, optimal management of the third trimester in case of home birth has not been subjected to study yet. Further prospective studies in the low risk (home birth) setting are necessary to investigate whether active management will result in improved outcomes. [8]

Proactive

Being proactive means that one should always be prepared for emergency transfer. A structured approach gives the handler guidance in these, often stressful, situations. After accessing ABCD (airway, breathing, circulation and disability), the 'E' (environment) needs attention, especially in an outer hospital setting. [3] The panel advised that before proceeding to birth at home, the community-based midwife should look critically at whether the setting is adequate. In home birth, anticipation of possible ambulance transport is necessary. Therefore, the panel advised the midwife to make sure that birth takes place in an easy and timely accessible place for (all) caregivers. In many regions in the Netherlands, community-based midwives require basic arrangements under which women can give birth at home. The panel advises that, if in doubt of a safe setting, this should be actively discussed between the woman and care provider to achieve the optimal birth setting. Anticipation is the key word for optimal and safe

home birth. The presence of ambulance paramedics during the audit has been shown to be a positive complement. Background information on the logistical processes is of great value because this forms an important part of the decision to refer to secondary care. Optimal cooperation and communication are of vital importance within the care chain organisation, so we recommend the presence of all disciplines involved, such as ambulance personnel, anaesthetists, nurses and emergency doctors in audit when referral is evaluated.

Oxygen

Although advised within the course, oxygen was not administered in five cases (71%). Further research is needed into the feasibility and implementation of this measure. In this audit, major SSC was found in two of seven cases (29%). A guideline on the prevention and management of PPH for community midwifery care is urgently needed in the Netherlands. Repetitive teaching of management skills in PPH can be of great value for the community-based midwife, who often has to manage an obstetric problem with little help. This should be part of the standard education of midwives. Currently, quality indicators are developed for prevention and management of PPH in low-risk births by the authors. In addition to audit these indicators will supply us with a tool to assess care in a broader perspective.

Key conclusions

Audit of PPH after home birth is possible and major SSC was identified in two of the seven cases. Communication between different healthcare providers should be optimised and a proactive attitude taken to select women who plan to give birth at home, taking into account the possibility of timely referral in case of PPH or retained placenta. Adequate intravenous access in case of PPH should be regularly taught and promoted. National multidisciplinary guidelines on managing obstetric haemorrhage in home birth are urgently needed.

Acknowledgements

The authors would like to thank all panel members for taking the time and effort to participate in the audit meeting, especially the community- based midwives who contributed a case and willingness to share their experience. Furthermore they would like to thank the Netherlands Perinatal Registry for national reference data on birth. They thank Yvonne Beuger, for data management of all cases during the study period and Barbara Havenith and Jacobien van der Ploeg, obstetricians and directors of the postgraduate training programme for their work on motivating midwives to participate in this study.

Table 1 Substandard care scoring items as used in the audit form and their contribution concerning general care and specific management of PPH after the individual audit.

General care scoring items	n	%
Patient	**23**	**7.5**
Patient delay consulting doctor/midwife	13	4.2
Refusal of medical help or advice	10	3.3
Midwife	**108**	**35.3**
Inadequate risk selection	25	8.2
Inadequate antenatal care	12	3.9
Delay in recognition of symptoms/signs	27	8.8
Delay in referral to obstetrician	44	14.3
Obstetrician	**13**	**4.2**
Inadequate risk selection	3	0.9
Delay in recognition of symptoms/signs	2	0.7
Delay in treatment after diagnosis	8	2.6
Healthcare system	**162**	**52.9**
Homebirth influenced outcome	60	19.6
Medical assistance arranged too late	44	14.3
Quality of transport influenced outcome	32	10.4
Ambulance was not present within acceptable time	26	8.5
Total	**306**	**100**

Specific management of PPH scoring items	n	%
Oxytocin was not administered according to guidelines	56	10.5
No uterine massage was administered	17	3.2
Inadequate maternal monitoring (pulse, blood pressure)	52	9.7
No oxygen was administered by midwife	91	17
No oxygen was administered by gynaecologist	42	7.8
None or too late bladder catheterisation	44	8.2
Inadequate stabilisation of patient for transport	15	2.8
No intravenous line was started by midwife/GP	87	16.2
Intravenous line was started too late overall	45	8.4
No volume replacement was started by midwife	46	8.6
Suboptimal treatment of PPH according to guidelines	41	7.6
Total	**536**	**100**

Table 2 Recommendations following discussion at the plenary audit meeting

Audit	Recommendations
General	Not all medical records were available for audit; in two cases discharge letters of the secondary care facility were missing or incomplete, despite inquiry by the midwife and/or researcher. The panel recommended all disciplines of professionals to pay extra attention to their written communication.
Primary care PPH	Start intravenous access by community-based midwife when blood loss is more than 500ml and not ceasing. Administer oxygen to the woman when PPH occurs. Reduce delay by timely referral; start organising referral if placenta is not delivered within 30 minutes of birth, regardless of the amount of blood loss at that time.
Transfer and place of birth	Discussion about the physical transfer of the patient, such as road block and > ground floor birth; women should give birth on ground floor if no elevator is present. Midwives should regularly (re)assess place of birth. Care giver could call for early ambulance back up if home birth is far from hospital.
Communication and co-operation	In case of care by different care givers, make a clear statement of the primary responsible care giver. Communication between community-based midwives and obstetricians should be optimised: confusion on practical matters concerning referral (such as which entrance to enter the hospital) might lead to SSC. Clearer communication between community midwife and obstetrician regarding clinical condition of the mother (pulse and blood pressure).

REFERENCES

1. AN (2009). LAMP Ambulance protocol, Zwolle.
2. Kommer G and Zwakhals S (2010). Health future study, national atlas of public health. (Volksgezondheid toekomst verkenning, nationale atlas volksgezondheid A1-inzetten in 2009 (in Dutch), Bilthoven: RIVM.
3. Johanson R and Cox C (2003). MOET course manual, London: RCOG Press.
4. Dombrowski M, Bottoms S, Saleh A et al (1995). 'Third stage of labour analysis of duration and clinical-practice'. Am Jour Obs Gyn, 172, 1279-1284.
5. de Groot A, van Roosmalen J and van Dongen P (1996). 'Survey of the management of third stage of labour in The Netherlands'. Eur Jour Obstet Gynecol Reprod Biol, 66, 39-40.
6. ICM and FIGO (2003). Prevention and treatment of post-partum haemorrhage: new advances for low resource settings, The Hague: ICM; London: FIGO.
7. Begley C, Gyte G, Murphy D et al (2010). 'Active versus expectant management for women in the third stage of labour'. CDSR, CD007412.
8. Buitendijk S and van der Post J (2011). 'The audit: a vital but limited measuring instrument'. Ned Tijdschr Geneeskd, 155 (in Dutch).

Chapter 4

Ambulance transfer in case of postpartum haemorrhage after birth in primary midwifery care in the Netherlands: a prospective cohort study

Ineke Stolp
Marrit Smit
Sanne Luxemburg
Thomas van den Akker
Jan de Waard
Jos van Roosmalen
Rien de Vos

submitted

ABSTRACT

Objective
To assess whether the 45 minute pre-hospital limit for ambulance transfer is met in case of postpartum haemorrhage (PPH) after midwifery supervised home birth in the Netherlands and evaluate the process of ambulance transfer, maternal condition during transfer, and outcomes in relation to whether this limit was met.

Design
prospective cohort study

Setting
From April 2008 to April 2010, midwives reported all cases of PPH.

Sample
72 cases of PPH.

Methods
Using ambulance report forms and medical charts, ambulance intervals, urgency coding, clinical condition (using the lowest Revised Trauma Score, RTS) and maternal outcomes were collected. Associations between duration of the ambulance transfer and maternal condition during ambulance transfer and outcomes were analysed.

Main Outcome Measures
Duration of ambulance transfer, RTS score, blood loss, surgical procedures and blood transfusions.

Results
72 cases were reported, 18 (25%) were excluded: 54 cases were analysed. In 63%, the 45-minute pre-hospital limit was met, 75.9% received a RTS score of 12, indicating optimal Glasgow Coma Scale, systolic blood pressure (SBP) and respiratory frequency. In 24.1% a decrease in SBP was found (RTS score 10 or 11). We found no difference in outcomes between women with different RTS scores or in whom the 45-minute pre-hospital limit was or was not met.

Conclusions
We found no relation between the duration of ambulance transfer and maternal condition or outcomes. All women fully recovered. The low-risk profile of women in primary care, well-organised midwifery and ambulance care in the Netherlands are likely to contribute to these findings.

INTRODUCTION

Postpartum haemorrhage (PPH) remains one of the leading causes of severe maternal morbidity and mortality worldwide, particularly in low-resource countries. An increase in PPH has been observed in high-resource countries in the last 15 years. [1] In the Netherlands, 64/1000 births is complicated by PPH, defined as blood loss of more than 1000 mL. In 2010, the incidence of PPH in low-risk primary midwifery care was 34/1000. [2] Almost one third of the women at low-risk of obstetric complications (32.7%) give birth under care of a midwife (98%) or general practitioner (GP) (2%). If complications occur during pregnancy, delivery or puerperium, women are referred to secondary care. Indications for referral are laid out in an obstetric indication list. [3] This list is revised regularly by a project group consisting of midwives, obstetricians, paediatricians, and general practitioners. Women in primary care at term can choose to give birth at home or in hospital assisted by their primary care midwife. Roughly one third of all women commencing labour in primary care are transferred to secondary care. Meconium stained liquor, failure to progress during labour, fetal distress, PPH or retained placenta are reasons for transfer to secondary care. [4] When birth proceeds without complications, approximately 60% of women give birth at home and 40% in hospital or birthing clinic.
Midwives are trained to identify and manage obstetric emergencies and are required to attend regular continuing medical education sessions. [5] Similar post-graduate courses such as the Pre-Hospital Obstetric Emergency Course (Dutch acronym: 'CAVE') and Pre-hospital Obstetric Emergency Training ('POET') both focus on identification and management of obstetric emergencies, including timely and adequate referral. [6;7]
Guidelines and protocols concerning ambulance transfer in obstetric emergencies are available for both ambulance personnel and birth attendants. [8;9] The Dutch government has set the statutory limit to ambulance referral time, from dispatcher call to hospital arrival, to 45 minutes. [9-12] Evidence suggests that the geographic characteristics and the excellent road network in the Netherlands theoretically allows 99.7% of patients to reach a hospital with an obstetric department within 45 minutes. [13]
The study objective was to acquire insight into ambulance referral in case of PPH after midwifery-supervised home birth. We aimed to evaluate the entire process of ambulance referral, from dispatcher call to hospital arrival. We measured maternal condition during ambulance transfer and maternal outcomes to assess the safety of women who sustained PPH after home birth in the Netherlands.

METHODS

Study design

This study received ethical approval from the Leiden University Medical Centre ethical board (study code: P11.105).

We performed a prospective cohort study of ambulance reports and medical charts of women suffering from PPH after midwifery-supervised home birth. PPH was defined as more than 1000 mL of blood loss after childbirth, as assessed by the midwife upon referral. Primary care midwives who participated in the pre-hospital emergency course 'CAVE' were requested to report all cases of PPH in their practice.

Study setting

There are 25 regional ambulance services in the Netherlands. Each region consists of one or more local ambulance services and dispatch centers in order to arrive at the patient within 15 minutes after dispatcher call. When a midwife requests -ambulance assistance, the dispatcher in the control room assesses the severity of the situation and subsequently assigns an urgency code. A1 is assigned when urgent transport in a possibly life-threatening situation is required: the ambulance must arrive at the patient's location within 15 minutes. An A2 urgency code is assigned when prompt ambulance assistance is required but the patient's life is not in acute danger: the ambulance must arrive within 30 minutes. [10]

Data collection

We collected cases of women suffering from PPH after home birth in primary care from April 2008 to April 2010. During twelve consecutive months, every midwife participating in the study received a monthly e-mail linked to a password-protected website. When a case of PPH was reported, the midwife was asked to fill out a detailed case report form (CRF) and send in anonymised medical files, discharge letters and laboratory results. If data were incomplete or inconclusive, midwives were contacted for the missing information. Cases were included if, in addition to midwifery medical files, ambulance reports with time intervals, and RTS scores were available (see below). Ambulance reports were supplied by the midwife or ambulance services. When, despite repeated attempts information remained incomplete, cases were excluded from further analysis.

Baseline characteristics, ambulance intervals, RTS scores, and maternal outcomes (total blood loss, admission to the intensive care unit (ICU), procedures to reduce blood loss, Packed Red Blood Cells (PRBC), and discharge day) were recorded.

Data on blood loss prior to ambulance arrival (as noted by the midwife), during ambulance transfer (if noted by paramedics or midwife), and measures taken by the midwife to treat

PPH (such as administering uterotonics, uterine massage, bladder catheterisation) were collected. Also, information on established intravenous access (IV) (by the midwife or paramedic) and the total amount of blood loss (as noted in the discharge letter from the obstetrician) was collected.

For data collection of ambulance time intervals we applied the "interval model" as developed by Spaite et al. [14-17] On this model, *total pre-hospital interval* is defined as the duration of ambulance transfer from dispatch call to arrival at the hospital. The total pre-hospital interval is divided into three sub-intervals: *response interval* (from dispatch call to arrival on scene), *on-scene interval* (from ambulance arrival on scene to departure to the hospital) and *transport interval* (from departure from the scene to arrival at the hospital). Intervals were calculated using the recorded time in minutes (Figure 1). [8]

The statutory limit stating that the total pre-hospital interval should not exceed 45 minutes, as set by the Dutch government, is referred to as "the 45-minute pre-hospital limit" in this article.

To determine the clinical condition of a patient, the Revised Trauma Score (RTS) is used by ambulance personnel. This physiologic scoring system is a reliable numeric indicator for outcome evaluations in all trauma patients and is widely used by ambulance teams worldwide. [18-20] This score combines the Glasgow Coma Scale (GCS), respiratory frequency (Rf), and systolic blood pressure (SBP). The prognostic value of combining these parameters is significantly higher than GCS, Rf and SBP alone. [20] Scores range from 0 to 12 with 0 being the worst possible score and 12 indicating no physiologic derangement (Figure 2). [19] The RTS score is assessed upon arrival of the ambulance personnel and regularly reassessed if indicated. For analysis, we used the *lowest* RTS score reported on the ambulance report form.

Analysis

Basic characteristics, interventions of the midwife to treat PPH, maternal condition using RTS score and maternal outcomes were described. Nominal and ordinal variables were expressed in frequencies and proportions and for continuous variables median and range were calculated. The research questions were analyzed using univariate statistical techniques.

First, we analysed the ambulance intervals for A1 and A2 urgency indications. The ambulance intervals were expressed in minutes, median duration and range. Additionally, we categorised the total of the intervals in those dispatches meeting the statutory 45-minute pre-hospital limit and those who did not. To analyse the contribution of the separate ambulance intervals (response, on-scene, transport) in relation to the statutory 45-minute pre-hospital limit, we analysed the differences between the intervals of A1 and A2 urgencies using the Mann-Whitney-U test. An odds ratio (OR) was calculated to

express the odds of arriving in the hospital within the 45-minute pre-hospital limit when the ambulance is sent with an A1 urgency indication versus an A2 indication.
Secondly, we analysed the maternal condition using the RTS score in relation to the on-scene and transport interval. Particularly, we were interested whether RTS score was associated with a prolonged or shortened on-scene and/or transport interval. To analyse this, we applied the Mann-Whitney-U test. If RTS scores lead to prolonged or shortened on-scene and/or transport intervals, this would have an effect on the total pre-hospital time and thus possibly on compliance with the 45-minute pre-hospital limit. We performed Pearson's Chi-Square test to analyse whether the various RTS scores (indicating different states of maternal condition) were related to compliance with the 45-minute pre-hospital limit.
Thirdly, because we hypothesised that maternal outcomes were related to the total pre-hospital interval rather than to specific sub-intervals, we examined the association between maternal outcomes and the 45-minute pre-hospital limit. The Dutch government set the 45-minute pre-hospital limit as a standard for ambulance transfers. By relating the outcomes to this limit, the relevance or safety of the 45-minute pre-hospital limit could be assessed. To associate total blood loss as maternal outcome with the 45-minute pre-hospital limit, we applied a Mann-Whitney-U test. Depending on the number of observations, we performed the Pearson's Chi-Square test or Fisher's exact test to analyse whether the remaining maternal outcomes (admission into ICU, procedures to reduce blood loss, PRBC, and discharge day) were related to the 45-minute pre-hospital limit. To conclude our analysis of maternal outcomes, we performed Kruskall-Wallis' test to analyse the association between the maternal condition (RTS score) and maternal outcomes (total blood loss, admission into ICU, procedures to reduce blood loss, PRBC, and discharge day). We also performed a subgroup analysis where women with imminent PPH who had not suffered 1000 mL or more blood loss at onset of ambulance care were excluded. These women could have had higher RTS scores and this could influence the results positively. We performed Kruskall-Wallis' test to analyse the association between the maternal condition (RTS score) and maternal outcomes (total blood loss, admission into ICU, procedures to reduce blood loss, PRBC, and discharge day) after we excluded women suffered less than 1000 mL blood loss at onset of ambulance care.
Finally, to explore possible bias through missing data, we compared basic characteristics, blood loss at onset of ambulance care, and total blood loss of included and excluded cases using midwifery medical charts. The analysis was done using Student's T-test, Mann-Whitney-U or Pearson's Chi-Square depending on the type of variable.
All analyses were performed using IBM Statistics Data Editor (SPSS), version 21 (SPSS Inc., Chicago, IL, USA). Statistical significance was considered if $p < 0.05$.

RESULTS

All midwives (n= 584) who registered for the pre-hospital obstetric emergency course 'CAVE' were asked to participate in this study. Consent for participation was granted by 548 midwives (92%). During the study period, 98 cases of PPH in primary care were reported, 72 of these occurred at home (73.5%). Of these, eighteen cases (18/72, 25%) were excluded due to incomplete documentation.

Basic characteristics of included women are shown in Table 1. Women originated from both rural and urban areas in the Netherlands. The median age was 31 years, similar to the average age of women who gave birth in the Netherlands in 2010. The parity of women in our sample (48.4% was nullipara) was comparable to the parity of the Dutch population of women that gave birth in 2010 (48.5% nullipara).

The primary cause of PPH was uterine atony in 35/54 (64.8%) of cases, retained placenta in 15/54 (27.8%), genital tract trauma in three (5.6%), and incomplete placenta in one (1.9%). Various measures were taken by the attending midwife in order to manage PPH. All but one woman (98.1%) received uterotonics. The midwife reported "genital tract trauma" as the cause of the PPH. Bladder catheterisation was performed in more than three quarters and uterine massage in 72%. Intravenous access was established in all women; in 33.3% by the midwife prior to ambulance arrival, and in 66.7% by the ambulance paramedics. Blood loss prior to ambulance transfer, as noted by the midwife or ambulance paramedics, ranged from 400 to 2000 mL (median 1000 mL).

As can be seen in Table 2, urgency code A1 was assigned to 43 out of the 54 transfers (79.6%) and code A2 to 11/54 (20.4%). As can be expected, we found a significantly shorter response interval in A1 transfers with a median duration of 6 minutes. There were no differences in the on-scene and transport intervals between A1 and A2 codes. We found that ambulances sent with an A1-indication complied more often with the 45-minute pre-hospital limit than A2 transfers: 88% vs. 11% (OR 4, CI 1.01-16.2). Overall, the 45-minute pre-hospital limit was met in 34 cases (63%). In 20 cases (37%) this time limit was exceeded, with a maximum total pre-hospital interval of 71 minutes (median 52 minutes, range 46-71). In four cases, the midwife or ambulance personnel requested assistance from the fire department to evacuate the woman from her house, because the ambulance stretcher was too large for the staircase. In two out of these four cases, transfer was still completed within the 45-minute pre-hospital limit.

From each ambulance report form, the lowest RTS score was recorded and analysed. The range of the RTS scores was small and only dropped from the maximum RTS score of 12 points, to 10 points. The maximum RTS score of 12 points was assigned to 41 women (75.9%). If the RTS score was lower than the maximum of 12 points, deductions were exclusively attributable to lower systolic blood pressure. As can be seen in Table 3, we

observed only one difference considering ambulance intervals between the various RTS scores: women with a RTS score of 10 had a longer transport interval of 16 minutes compared to women with a score of 11 (7.5 minutes) or 12 (10 minutes) ($p = 0.03$). Of the four women that had to be evacuated by the fire department, three received an RTS score of 12 and one scored 10 points.

In 27 cases (50%) PRBC were administered in the hospital, ranging from 1 to 8 units (median 1 unit). Total blood loss ranged from 1000 mL to 7000 mL (median 2000 mL). On two women, procedures were performed to reduce blood loss: one uterine artery embolization and one balloon tamponade. Both women had a RTS score of 12 during transfer. No statistically significant association between maternal outcomes (total blood loss, admission into ICU, procedures to reduce blood loss, PRBC, and discharge day), and compliance with the 45-minute pre-hospital limit was found (Table 5). Likewise, maternal outcomes of total blood loss, ICU admission, procedures to reduce blood loss, PRBC, and hospital stay were not statistically related to the maternal condition (RTS score, Table 4). Furthermore, after excluding women who suffered less than 1000 mL blood loss at onset of ambulance care, the association between RTS score and maternal outcomes remained non-significant.

Eighteen cases (18/72, 25%) were excluded because of incomplete documentation. In these cases, ambulance report forms could not be obtained or were incomplete (missing data on ambulance intervals, missing RTS scores). Based on those data that were available for these exclusions from midwifery medical charts and incomplete ambulance forms, there was no difference between included and excluded cases regarding basic characteristics or blood loss prior to onset of ambulance care. The total blood loss in the group of excluded cases was smaller compared to the total blood loss of the included cases (p=0.01).

DISCUSSION

Main findings

This is the first study providing insight into maternal condition during ambulance transfer and maternal pregnancy outcome in case of PPH after home birth in the Netherlands. Overall, the median total pre-hospital interval was 52 minutes (range 27-71 minutes). In 37% the 45 minute pre-hospital limit was not met, but the median excess was only seven minutes. More than three-quarters of women were in optimal condition during transfer and in case their RTS scores were compromised, their outcomes were not worse.

Women who arrived in hospital within the 45-minute pre-hospital limit and those who arrived with delay did not have significantly different maternal outcomes. Even though almost half of the women received PRBC's and two women underwent procedures to cease PPH, all women fully recovered.

Strenghts and Limitations

Strength of our study is the unique and detailed information on time intervals, maternal conditions during ambulance care and outcomes. The combination of medical files supplemented with ambulance report forms allowed for crosschecking of data, including ambulance times and RTS scores, which adds to the comprehensiveness of the measured data.

Our study also has its limitations. Midwives were requested to report all cases of PPH, however we cannot verify if all cases were actually reported to the researchers. Since anonymity was guaranteed for both care-providers and patients, we presume that failure to report occurred not more than occasionally.

Another limitation is that we did not collect information on how blood loss was measured. The most common method for this is visual estimation. It is known that estimating blood loss (in contrast to weighing) is subjective and leads to underestimation of actual blood loss. [25-27] Therefore, we applied more objective parameters such as RTS score and PRBC.

Interpretation

A contributing factor for the large proportion of women in good maternal condition during ambulance care could be the combination of the Dutch midwifery care system and the characteristics of the ambulance services in the Netherlands. In the Dutch midwifery care system, risk selection is a very important factor: only women with uncomplicated pregnancies and uncomplicated first and second stages of labour can give birth at home. However, this does not guarantee that complications will not occur. All women in our study had been identified as low-risk during their pregnancies and the first and second stage of labour progressed without complications.

Uterotonics were given in all cases but one, where the midwife chose not to administer uterotonics since she assessed that, in this woman, PPH was due to genital tract trauma. This is, in fact, in contradiction to the 'CAVE' method in which uterotonics are routinely administered. In one third of cases the midwife established IV access prior to ambulance arrival. In 80%, paramedics arrived within 15 minutes. Reasons for midwives not establishing IV access are speculative, but it is possible that the midwife prioritised other matters, such as uterine massage, bladder catheterisation and so on before ambulance arrival. An argument can be made that these interventions contributed to the high RTS scores in our study. In addition, it is assumed that pregnant women (and women directly postpartum) who are in good health may tolerate blood loss up to 1000 mL, owing to the physiological changes in pregnancy. [2;21;22] Therefore, early signs of shock as assessed through the RTS might be delayed in this low-risk population. The RTS score should therefore be interpreted with caution.

In the Netherlands, ambulance services have the advantage of using an excellent road network, which theoretically allows 99.7% of the patients to reach a hospital within 45 minutes (i.e. the 45-minute pre-hospital limit). [13] In our study only 63% of ambulance transfers complied with the 45-minute pre-hospital limit. The median excess duration, however, was only 7 minutes. These results are in contrast with the results of a report of the Dutch Ministry of Health, Welfare and Sport who previously reported that 82% of the obstetric emergency transfers complied with this limit. [23] There are a number of possible explanations for the differences between our findings and those of the Dutch Ministry. First, we included only postpartum transfers for PPH in our study, unlike the report of the Ministry, which included ambulance transfers in all stages of labour (e.g. birth dystocia, fetal distress). Perhaps post-partum complications and transfers are more time-consuming than transfers during labour, but without further research that remains a hypothesis. Another explanation could be that more ambulances were sent with A1 urgency in the report of the Ministry, ensuring a shorter response interval. We found that ambulances with an A1 urgency code complied with the 45-minute pre-hospital limit in 88% of cases. Similar to our results, a study performed in a large city in the Netherlands, also reported shorter total pre-hospital intervals with A1 urgency ambulance transfers. [24] When analysing ambulance intervals separately for the various RTS scores, we found a longer transport interval (median 6 minutes) for women with an RTS score of 10 points (Table 3). A possible explanation for this is that the ambulance could not drive as fast when transferring a patient with a suboptimal condition, but this is speculative.

Even though 37% of transfers did not arrive at the hospital within 45 minutes of dispatcher call, we found no differences in maternal outcomes (PRBC, procedures to reduce blood loss, ICU admission). We analysed whether cases in which women suffered less than 1000 mL blood loss at onset of ambulance care, had less favourable maternal outcomes. This was not the case. In fact, the results of this subgroup analysis were comparable to the outcomes of the whole group. It is plausible however, that transfer to hospital, which obviously causes delay, influences maternal condition and outcomes. Comparing outcomes of low-risk hospital births complicated with PPH after home birth is an interesting subject for further research.

We excluded 18 cases (25%) due to incomplete documentation. We performed an analysis to assess bias through excluded cases. We used available data from midwifery medical charts and found no change of results when analysing the influence of the excluded cases.

Until now, limited information was available on ambulance transfers after home birth. [24;28;29] This is the first study analysing ambulance transfer in case of PPH. This study is not aiming to assess the practice of home birth, but it makes a valuable contribution to the ongoing home birth debate in the Netherlands. [28;30-34] Evidently, if a birth proceeds

without complications, no interventions other than guidance and support are required. But, in case of an emergency, transfer to hospital is time-consuming, especially compared to being in a hospital setting already. Although our study is based on a limited number of cases, our findings show that 80% of women were in good maternal condition at time of transfer and it can be assumed that referral was initiated timely.

Conclusion

We found no relation between the duration of ambulance transfer and maternal conditions and outcomes. All women who sustained PPH following home birth fully recovered. The low-risk profile of women in primary care, the well-organised midwifery and ambulance care and excellent road network in the Netherlands are likely to contribute to these findings. Further research must be performed to assess if home birth has an effect on the outcomes of PPH.

Acknowledgements

The authors would to thank the midwives for reporting cases of PPH and ambulance services throughout the country for assisting in data retrieval. We also thank Yvonne Beuger, for data management of all cases during the study period and Barbara Havenith and Jacobien van der Ploeg, obstetricians and directors of the postgraduate training programme for their work on motivating midwives to participate in this study.

Table 1. Patient characteristics, maternal condition and maternal outcomes (n=54).

Characteristics			
Age in years	(median, range)	31	(23-41)
Gestational age in weeks + days	(median, range)	40+0	(37+0 - 41+6)
Parity	(frequency, proportion)		
0		27	(50%)
1		18	(33.3%)
2		8	(14.8%)
3		1	(1.9%)
Maternal outcomes			
Total blood loss in mL	(median, range)	2000	(1000-7000 mL)
ICU admission	(frequency, proportion)	2	(3.7%)
Procedures to reduce blood loss	(frequency, proportion)		
Balloon tamponade		1	(1.9%)
Uterine artery embolization		1	(1.9%)
Units of PRBC	(frequency, proportion)		
0		27	(50%)
1 or 2		13	(24.1%)
3 or 4		12	(22.3%)
8		2	(3.7%)
Duration of hospital stay in days	(frequency, proportion)		
1		19	(35.2%)
2 or 3		25	(46.3%)
4 or more		8	(14.9%)

Table 2. Duration of ambulance intervals in minutes by urgency coding, median, range (n=54)

	A1 (n=43)	**A2 (n=11)**	***p*-value**
Response interval	9 (5-23)	15 (6-29)	p <0.05
On scene interval	17 (7-44)	19 (7-33)	p 0.75
Transport interval	10 (4-27)	12 (6-21)	p 0.33
Total pre-hospital interval	40 (27-61)	46 (32-71)	p 0.06

Table 3. Duration of ambulance intervals in minutes by maternal condition, median, range (n=54)

	RTS 12 (n=41)	**RTS 11 (n=8)**	**RTS 10 (n=5)**	***p*-value**
Response interval	10 (5-29)	13 (5-23)	12 (7-23)	p 0.55
On scene interval	17 (7-38)	18 (9-44)	22 (17-25)	p 0.51
Transport interval	10 (4-27)	7.5 (4-20)	16 (15-21)	p <0.05
Total pre-hospital interval	40 (27-71)	43.5 (30-60)	50 (45-60)	p 0.06

Table 4. RTS scores and maternal outcomes (n=54)

Maternal outcome	**RTS 12 (n=41)**	**RTS 11 (n=8)**	**RTS 10 (n=5)**	**p-value**
Total blood loss (median, range)	2000 (1000-7000)	2050 (1200-3000)	2200 (1500-2700)	*p* 0.73
ICU admission (frequency)	2	0	0	*p* 0.72
Procedures to reduce blood loss* (frequency)	2	0	0	*p* 0.72
Units of PRBC (median, range)	0 (0-8)	1.5 (0-4)	2 (0-3)	*p* 0.67
Discharge day (median, range)	2 (1-6)	2 (1-3)	2 (1-4)	*p* 0.64

**balloon tamponade and embolisation*

Table 5. RTS scores and maternal outcomes by 45-minute pre-hospital limit (n=54)

	< 45 minutes	**> 45 minutes**	***p-value***
All cases	34	20	
RTS scores			
12 and 11	*33*	*16*	
10	*1*	*4*	*p* 0.06
Maternal outcomes			
Total blood loss	2000 (1100-7000)	2050 (1000-6000)	*p* 0.91
Blood loss at onset of ambulance care	1000 (400-2000)	1000 (900-2000)	*p* 0.80
ICU admission	1	1	*p* 0.61
Procedures to reduce blood loss	1	1	*p* 0.61
Units of PRBC	0 (0-8)	2 (0-8)	*p* 0.85
Discharge day	2 (1-6)	2 (1-4)	*p* 0.74

Figure 1: Modified interval model

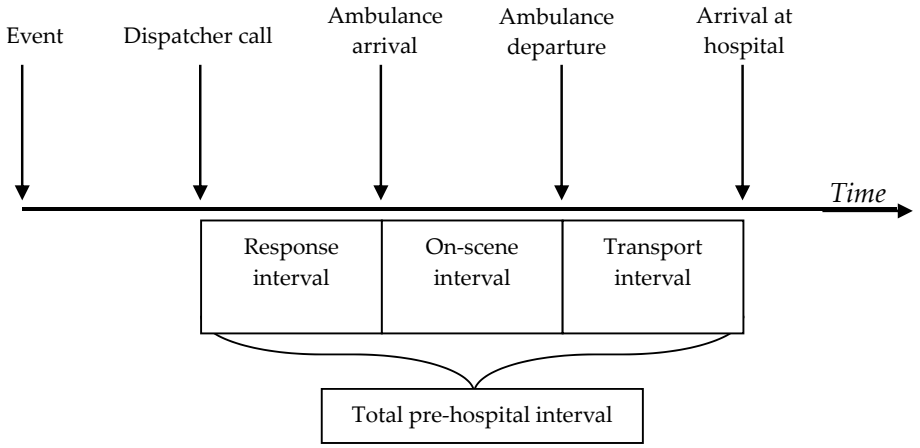


Figure 2. Revised Trauma Score

Points	Glasgow Coma Scale	Systolic blood pressure	Respiratory frequency
4	13-15	>90 mmHg	10-29/min
3	9-12	76-89 mmHg	>30/min
2	6-8	50-75 mmHg	6-9/min
1	4-5	1-49 mmHg	1-5/min
0	3	0 mmHg	0/min

REFERENCES

1. Knight M, Callaghan WM, Berg C, Alexander S, Bouvier-Colle MH, Ford JB et al. Trends in postpartum hemorrhage in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group. BMC Pregnancy Childbirth 2009; 9:55.
2. Stichting Perinatale Registratie Nederland. Perinatal Care in the Netherlands [Perinatale Zorg in Nederland]. 2010. Utrecht, Stichting Perinatale Registratie Nederland.
3. Amelink-Verburg MP, Verloove-Vanhorick SP, Hakkenberg RM, Veldhuijzen IM, Bennebroek GJ, Buitendijk SE. Evaluation of 280,000 cases in Dutch midwifery practices: a descriptive study. BJOG 2008; 115(5):570-578.
4. Stichting Perinatale Registratie Nederland. Perinatal Care in the Netherlands [Perinatale Zorg in Nederland]. 2011. Utrecht, Stichting Perinatale Registratie Nederland.
5. Draycott T, Sibanda T, Owen L, Akande V, Winter C, Reading S et al. Does training in obstetric emergencies improve neonatal outcome? BJOG 2006; 113(2):177-182.
6. ALSG. Pre-Hospital Emergency Course (POET). 2014.
7. Havenith B, van der Ploeg J. Pre-Hospital Emergency Course (CAVE). 2014.
8. Ariëns EA, Bosker HA, van Boven JJA, van Eenennaam FL, Emons AA, Gruijters WJGG et al. National Protocol Ambulance Care 7.2. 2011. Zwolle, Stichting LAMP Zwolle.
9. KNOV. Ambulance Protocols, short version [Korte handleiding over de ambulanceprotocollen]. 2012. Dutch Royal Organisation of Midwives.
10. Ambulancezorg Nederland. Ambulance Care In Sight [Ambulances in Zicht]. 2011.
11. Klink A. Care Institutions Act [Wet toelating zorginstellingen: Vaststelling beleidsregels ex artikelen 4 en 13]. 137, 31. 9-7-2007. Staatscourant.
12. Wiegers TA, de Borst J. Organisation of emergency transfer in maternity care in the Netherlands. Midwifery 2013; 29(8):973-980.
13. Giesbers H, Eskes M, Waelput AJM, Kommer GJ. Ambulance transfer time to an obstetrical department [Reistijd overdag naar ziekenhuis met afdeling verloskunde 2011 (met ambulance)]. 2012. Volksgezondheid Toekomst Verkenning, Nationale Atlas Volksgezondheid. 30-11-2012.
14. Blackwell TH, Kaufman JS. Response time effectiveness: comparison of response time and survival in an urban emergency medical services system. Acad Emerg Med 2002; 9(4):288-295.
15. Pons PT, Markovchick VJ. Eight minutes or less: does the ambulance response time guideline impact trauma patient outcome? J Emerg Med 2002; 23(1):43-48.
16. Pons PT, Haukoos JS, Bludworth W, Cribley T, Pons KA, Markovchick VJ. Paramedic response time: does it affect patient survival? Acad Emerg Med 2005; 12(7):594-600.
17. Spaite DW, Valenzuela TD, Meislin HW, Criss EA, Hinsberg P. Prospective validation of a new model for evaluating emergency medical services systems by in-field observation of specific time intervals in prehospital care. Ann Emerg Med 1993; 22(4):638-645.
18. Biester EM, Tomich PG, Esposito TJ, Weber L. Trauma in pregnancy: normal Revised Trauma Score in relation to other markers of maternofetal status--a preliminary study. Am J Obstet Gynecol 1997; 176(6):1206-1210.
19. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. J Trauma 1989; 29(5):623-629.
20. Oyetunji T, Crompton JG, Efron DT, Haut ER, Chang DC, Cornwell EE, III et al. Simplifying physiologic injury severity measurement for predicting trauma outcomes. J Surg Res 2010; 159(2):627-632.

21. Begley CM, Gyte GM, Murphy DJ, Devane D, McDonald SJ, McGuire W. Active versus expectant management for women in the third stage of labour. Cochrane Database Syst Rev 2010;(7):CD007412.
22. World Health Organization. Recommendations for the Prevention of Post-Partum Haemorrhage. 2007. Geneva, Switzerland. 24-9-2012.
23. Kommer GJ, Zwakhals SLN. Timeframes in Ambulance Care - Analyses of Urgent Ambulance Transfer in 2009 [Tijdsduren in de ambulancezorg - Analyse van spoedinzetten in 2009]. 2010. Rijksinstituut voor Volksgezondheid en Milieu (RIVM).
24. Chardon AJ, Wildschut HI, Stolwijk AJ, Deckers CM, Relyveld RM, van der Meulen JH. [Ambulance transportation time of obstetrical patients]. Ned Tijdschr Geneeskd 1994; 138(41):2053-2057.
25. Maslovitz S, Barkai G, Lessing JB, Ziv A, Many A. Improved accuracy of postpartum blood loss estimation as assessed by simulation. Acta Obstet Gynecol Scand 2008; 87(9):929-934.
26. Patton K, Funk DL, McErlean M, Bartfield JM. Accuracy of estimation of external blood loss by EMS personnel. J Trauma 2001; 50(5):914-916.
27. Tall G, Wise D, Grove P, Wilkinson C. The accuracy of external blood loss estimation by ambulance and hospital personnel. Emerg Med (Fremantle) 2003; 15(4):318-321.
28. Koettker JG, Bruggemann OM, Dufloth RM. [Planned home births assisted by nurse midwives: maternal and neonatal transfers]. Rev Esc Enferm USP 2013; 47(1):15-21.
29. Carty MJ, Waddell G. Ambulance transport of obstetric emergencies. Scott Med J 1976; 21(3):109-110.
30. de Jonge A, Mesman JA, Mannien J, Zwart JJ, van Dillen J, van Roosmalen J. Severe adverse maternal outcomes among low risk women with planned home versus hospital births in the Netherlands: nationwide cohort study. BMJ 2013; 346:f3263.
31. Faucon C, Brillac T. Planned home versus planned hospital births: Adverse outcomes comparison by reviewing the international literature. Gynecol Obstet Fertil 2013; 41(6):388-393.
32. Hutton EK, Reitsma AH, Kaufman K. Outcomes associated with planned home and planned hospital births in low-risk women attended by midwives in Ontario, Canada, 2003-2006: a retrospective cohort study. Birth 2009; 36(3):180-189.
33. Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician. CMAJ 2009; 181(6-7):377-383.
34. Kataoka Y, Eto H, Iida M. Outcomes of independent midwifery attended births in birth centres and home births: A retrospective cohort study in Japan. Midwifery 2013; 29(8):965-972.

Chapter 5

Survey of prophylactic use of uterotonics in the third stage of labour in the Netherlands

Marrit Smit
Giel van Stralen
Ron Wolterbeek
Jeroen van Dillen
Jos van Roosmalen
Yolentha Slootweg

Midwifery. 2013;29:859-862.

ABSTRACT

Objective
Aim of this study was to investigate current knowledge and practice regarding 'Active Management of Third Stage of Labour' (AMTSL) in midwifery practices and obstetric departments in the Netherlands.

Design
Web-based and postal questionnaire.

Setting
In August and September 2011 a questionnaire was sent to all midwifery practices and all obstetric departments in the Netherlands.

Participants
All midwifery practices (528) and all obstetric departments (91) in the Netherlands.

Measurements and findings
The response was 87.5%. Administering prophylactic uterotonics was seen as a component AMTSL by virtually all respondents; 96.1% of midwives and 98.8% of obstetricians. Cord clamping was found as a component of AMTSL by 87.4% of midwives and by 88.1% of obstetricians. Uterine massage was only seen as a component of AMTSL by 10% of the midwives and 20.2% of the obstetricians. Midwifery practices routinely administer oxytocin in 60.1% of births. Obstetric departments do so in 97.6% ($p < 0.01$). Compared to 1995, the prophylactic use of oxytocin had increased in 2011 both by midwives (10–59.1%) and by obstetricians (55–96.4%) ($p < 0.01$).

Key conclusions
Prophylactic administration of uterotonics directly after childbirth is perceived as the essential part of AMTSL. The administration of uterotonics has significantly increased in the last decade, but is not standard practice in the low-risk population supervised by midwives.

Implications for practice
The evidence for prophylactic administration of uterotonics is convincing for women who are at high risk of PPH. Regarding the lack of evidence of AMTSL to prevent PPH in low risk (home) births, further research concerning low-risk (home) births, supervised by midwives in industrialised countries is indicated. A national guideline containing best practices concerning management of the third stage of labour supervised by midwives, should be composed and implemented.

INTRODUCTION

Postpartum haemorrhage, PPH, defined as more than 1000 ml after childbirth contributes to substantial numbers of maternal deaths and morbidities worldwide. [1] The incidence of postpartum haemorrhage caused by uterine atony is increasing in industrialised countries. [2] In the Netherlands, if pregnancy is uncomplicated and no elevated risk has been identified, birth can take place either at home or in hospital, both supervised by a midwife. In fact, 33% of all women give birth under supervision of a midwife. Although 5.9% of births in the Netherlands are complicated by PPH, the incidence of PPH in low risk (home) births is approximately 3.4%. [3] Management of the third stage of labour has roughly two approaches. Expectant management involves waiting for signs of placental separation and allowing the placenta to deliver spontaneously or assisted by gravity or nipple stimulation. [4] Active Management of Third Stage of Labour, AMTSL, includes prophylactic use of uterotonics, cord clamping and Controlled Cord Traction, CCT. [2, 5-8] It is assumed that prophylactic use of uterotonics halves the risk of PPH. [9] It is unclear what the impacts of the other components of AMTSL (cord clamping and CCT) are in the reduction of PPH. [7,10] Active management has often been compared to expectant management. [4,7,8,11,12] A recent review shows that if AMTSL is the standard care for all women, the incidence of PPH (>1000 ml) and anaemia is significantly reduced. However, AMTSL increased maternal blood pressure, postpartum contractions, nausea, vomiting and use of drugs for pain relief. These side-effects were probably due to the use of ergot compounds. For women at low risk of bleeding, there was no difference in the risk of PPH>1000 ml and side effects were similar. [7] The International Confederation of Midwives (ICM), the International Federation of Gynaecologists and Obstetricians (FIGO), the World Health Organisation (WHO) and guidelines on the third stage of labour in many countries, advocate AMSTL for all women. [1.5-7,13,14] However, in the United Kingdom, the Royal College of Midwives (RCM) and the New Zealand College of Midwives do not recommend AMSTL but uterotonics on indication. [15,16] In the Netherlands, prophylactic administration of uterotonics is recommended by the Dutch Society of Gynaecologists and Obstetricians (NVOG). [17] At present, The Royal Dutch College of Midwives, KNOV, has no protocol on management of the third stage of labour. In 1995, a survey among all obstetricians and midwives in the Netherlands showed that 55% of the obstetricians versus 10% of midwives administered oxytocin as a prophylaxis. [18] Insufficient evidence on the effectiveness of some components of AMTSL, the conflicting recommendations and the absence of a guideline for midwives in the Netherlands may result in variation in practice.

Aim of this study was to investigate current knowledge and practice regarding AMTSL in midwifery practices and obstetric departments in the Netherlands.

METHODS

A questionnaire was developed and tested by two midwives and an obstetrician and sent to all hospitals with obstetric departments (n=91) and all midwifery practices (n=528) in the Netherlands. The questionnaire was sent to every midwifery practice and to the chief consultant of all obstetric departments. Recipients were asked whether he or she was currently working in obstetrics or midwifery. Secondly, the presence of an oral or written protocol concerning the management of the third stage of labour was inventoried. Respondents were asked to select components they considered part of AMTSL, picking as many or as little as they found applicable. If incorporated in a protocol, respondents were asked about the type, dose and administration route of the uterotonics. If respondents did not apply AMTSL, considerations for this choice could be indicated, such as: 'too burdensome for the parturient' or 'unnecessary without indication of an increased risk of PPH' or 'not described in a guideline'. In addition, free text space was available to elaborate on this chosen policy. If no AMTSL was applied, participants were asked in what situation uterotonics after childbirth were administered, for example macrosomia, delayed second and/or delayed third stage. A digital version of the questionnaire was placed on the website of the KNOV and linked to their biweekly newsletters in June and August 2011. The NVOG supplied addresses of all obstetric departments in the Netherlands and they received the questionnaire by mail in August 2011. In September 2011 the questionnaire was sent by mail to midwifery practices which had not completed the web-based questionnaire. The first author contacted obstetricians and midwives for missing data to be completed. Data from the web based questionnaire and paper forms were combined in an excel spreadsheet. Analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 17 (SPSS Inc., Chicago, IL, USA). Responses of the obstetricians and midwives were compared. Data from the 1996 study were compared with data obtained in this survey. [18] Similar methodology was used and questions on management of third stage of labour were similar. Therefore, statistical comparison was possible. Analyses were conducted using the $\chi 2$-test. Statistical significance was considered if $p < 0.05$.

Findings

Of the obstetric departments, 84 out of 91 (92.3%) responded to the questionnaire as compared to 436 out of the 528 midwifery practices (82.6%) ($p < 0.01$). All respondents were currently working as obstetrician or midwife. Within the 436 midwifery practices, 51.8% reported the presence of an oral or written protocol regarding management of third stage of labour (consisting of either an active management or expectant management) compared to 91.7% of all 91 obstetric departments ($p < 0.01$).

As shown in Fig. 1, 96.1% of the midwives and 98.8% of the obstetricians view 'applying uterotonics directly after childbirth' as part of AMTSL. Delayed cord clamping is found a component of AMTSL in 87.4% of midwives and 88.1% of obstetricians. CCT is seen as a component of AMTSL by 15.8% of midwives, versus 71.4% of obstetricians. Uterine massage is seen as a component of AMTSL by 10.1% of midwives and by 20.2% of obstetricians. Midwifery practices administer oxytocin as a prophylaxis in 60.1% of all births. Obstetric departments do so in 97.6% ($p < 0.01$). Of the practices with a protocol on the management of third stage, 59.1% of midwifery practices and 96.4% of obstetric practices administer oxytocin as a prophylaxis ($p < 0.01$). Of the practices without a protocol on management of third stage, 55.1% of the midwives and 83.3% of obstetricians administer oxytocin as a prophylaxis ($p < 0.01$) (Fig. 2).

Oxytocin is the drug of choice (99.8%), with a dosage of 5 IU (20.2% of midwives, 59.8% of obstetricians) or 10 IU (79.8% of midwives and 40.2% of obstetricians). All midwives administer oxytocin intramuscular (100%), 66.3% of the obstetricians administer oxytocin intramuscular (58.5% 5 IU and 41.2% 10 IU) and 33.4% intravenous (74.1% 5 IU and 25.9% 10 IU). One obstetrical practice uses 0.2 mg methylergometrin, intramuscular as a prophylaxis. Respondents with a protocol prescribing no AMTSL were asked to motivate this choice. 91.1% of the midwifery practices and two obstetrical practices find administering oxytocin routinely unnecessary without indication of an increased risk of PPH. Six per cent of the midwives declared that the absence of a guideline is a reason for not pursuing AMTSL.

The use of prophylactic uterotonics has significantly increased between 1995 and 2011 both by midwives (10–59.1%) and by obstetricians (55–96.4%) ($p < 0.01$).

DISCUSSION

Compared to 1995, the routine use of uterotonics in the Netherlands has significantly increased for both midwifery practices as well as for obstetric departments. The magnitude of the increase in the use of routine uterotonics found is such that one can assume that a true shift in policy has taken place. Reasons for this change in policy are various and include the implementation of a guideline for obstetricians in 2006, the introduction of the Managing Obstetric Emergencies and Trauma course (MOET) for obstetricians in 2003, the pre-hospital Obstetric Emergency Course (CAVE) for midwives and the promotion of AMTSL in one of three midwifery schools. [17,19,20]

This survey shows that the administering of uterotonics is considered the main component of AMTSL by health-care workers in the Netherlands. Clamping of the umbilical cord, controlled cord traction and uterine massage are found of less importance. This finding has been addressed in other studies. [7,21] The respondents who indicated applying AMTSL

are probably not applying AMTSL according to definitions used in literature, but solely administering oxytocin. The impact of this finding is probably not of great significance to the interpretation of the results, as it is assumed that the effect of oxytocin is greater than the effects of ECC and CCT.

A global survey in various high- and low income countries has shown significant intra- and inter-country variation in policies in AMTSL. In low income countries, AMTSL is proven to reduce maternal deaths. However, the study found that when AMTSL was advised in these areas, it was not always practiced. [21] In a survey of maternity units in 14 European countries, a considerable difference was found concerning management of the third stage of labour both between and within countries. The study showed that in the Netherlands, 95% of women receive uterotonics routinely (similar to our findings), and 36% of the obstetricians apply AMTSL.[22] Our study provides additional information, surveying protocols of midwives in primary care as well. In a survey in British Colombia, Canada, only 17.4% of midwives found that AMTSL should be applied at every birth. The authors concluded that the midwives rejected some elements of 'the package' ('early cord clamping' and CCT), so the level of agreement on AMTSL was low. To support this hypothesis, the question was asked on whether they administered uterotonics as a prophylaxis (without 'early cord clamping' and ECC). This was acknowledged by 36.6% of the midwives. [23] In the United Kingdom, a similar survey on management of third stage of labour was executed among midwives and obstetricians. [24] Most obstetricians (93%) and midwives (73%) reported to 'always or usually' administer prophylactic uterotonics and the majority applies CCT (94%). An interesting finding was that the use of CCT seems superior to the administration of uterotonics. In our study, respondents find CCT of less importance as a component of AMTSL; 15.8% of midwives and 17.4% of obstetricians. There is no convincing evidence concerning the effect of CCT on the incidence PPH, further research is indicated. [1] The strength of this study is the high response rate, as virtually all midwifery and obstetrical practices in the Netherlands provided us with data. A limitation of this study is that if a midwife practice of obstetrical department had no protocol on AMTSL; answers given by the respondents were personal, not necessarily representative of the whole practice or department. Furthermore, no questions were asked on the size of the practices e.g. the number of colleagues represented per respondent, so the percentages given for the overall population should be interpreted with care. As seen in this study, routinely administering uterotonics has increased significantly in the Netherlands since 1995.

The routine use of uterotonics is recommended by ICM as well as FIGO. In the Netherlands, no guideline for (home) birth in primary care is present. Studies have shown the positive effect of prophylactic uterotonics on the prevalence of PPH, worldwide. [7] For birth in primary care in industrialised countries, however, the evidence is less convincing.

Studies have shown that, for women at low risk of PPH who received prophylaxis, there is a reduction of total blood loss, but not in the incidence of PPH. [7] Recent published data from a retrospective study in New Zealand suggests that AMTSL in low-risk midwifery-led births increases the incidence of PPH and retained placenta. [25] The authors concluded that the use of physiological management of could be considered and supported for women who are healthy and have had a spontaneous labour and birth regardless of birth place setting. More research is recommended to determine whether uterotonics are more effective as a treatment in the first instance than after initial exposure prophylaxis in low-risk midwifery-led births.

It is probable that the respondents in our survey who do not routinely administer uterotonics, practice expectant management and administer uterotonics on indication. The present survey provides us with information on current practices regarding management of third stage of labour in the Netherlands. It is a first step towards further research on the routine use of uterotonics in low risk (home) births. Ideally, a randomised controlled trial should be performed concerning AMTSL and physiological management in low-risk midwifery-led births.

Key conclusions

Routinely administering oxytocin directly after childbirth has significantly increased both for midwives and obstetricians in low and high risk pregnancies in the Netherlands since 1995. In low-risk births supervised by midwives, it is not standard practice. Most obstetricians administer oxytocin routinely (97.6%). The evidence for the routine administering of uterotonics is convincing for women who are at risk of PPH, but concerning low-risk (home) birth we advise further research on the routine administering of uterotonics in midwifery practices. A national guideline concerning management of the third stage of labour in (home) birth supervised by midwives should be composed and implemented.

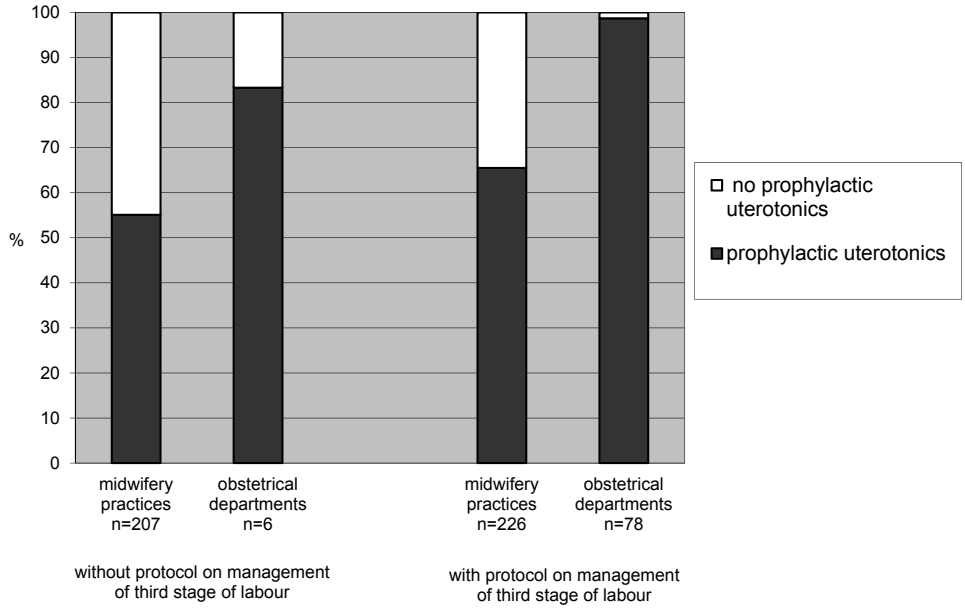
Acknowledgements

The authors would like to express their gratitude to all respondents, midwives and obstetricians, who took the effort to respond to the questionnaire. We thank Chantal Hukkelhoven (Perinatal Registry) and Joost von Schmidt auf Altenstadt for supplying data from the Perinatal Registry on postpartum haemorrhage in the Netherlands. We are grateful for the help of Gladys Laterveer and Jacqueline Blom, for assistance in the postal mailing and the collection of data.

Figure 1. Which components do you consider to be part of Active Management of the Third Stage of Labour, AMTSL?

Components viewed as part of AMTSL.	*Midwifery Practices N= 436 (%)*	*Obstetrical Departments N= 84 (%)*
- Applying uterotonics directly after childbirth	*419 (96.1)*	*83 (98.8)*
- Delayed cord clamping	*381 (87.4)*	*74 (88.1)*
- Controlled cord traction	*69 (15.8)*	*60 (71,4)*
- Uterine massage	*44 (10.1)*	*17 (20.2)*

Figure 2. Routine use of prophylactic oxytocin in midwifery practices and obstetric departments with and without an oral or written protocol on management of third stage.



REFERENCES

1. World Health Organisation, 2007. WHO recommendations for the Prevention of Postpartum Haemorrhage. WHO, Geneva, Switzerland.
2. Knight, M., Callaghan, W.M., Berg, C., Alexander, S., Bouvier-Colle, M.H., Ford, J.B., Joseph, K.S., Lewis, G., Liston, R.M., Roberts, C.L., Oats, J., Walker, J. 2009. Trends in postpartum haemorrhage in high resource countries: a review and recommendations from the International Postpartum Haemorrhage Collaborative Group. BMC Pregnancy and Childbirth, 9 (2009), p. 55.
3. Perinatal Care in the Netherlands, 2008. Stichting Perinatale Registratie Nederland, Utrecht.
4. Leduc, D., Senikas, V., Lalonde, A.B., Ballerman, C., Biringer, A., Delaney, M., Duperron, L., Girard, I., Jones, D., Lee, L.S., Shepherd, D., Wilson, K. 2009. Active management of the third stage of labour: prevention and treatment of postpartum haemorrhage Journal of Obstetrics and Gynaecology Canada, 31 (2009), pp. 980–993.
5. International Confederation of Midwives, 2003 International Confederation of Midwives (ICM), International Federation of Gynaecologists and Obstetricians (FIGO), Prevention and Treatment of Post-partum Haemorrhage: New Advances for Low Resource Settings. ICM, The Hague; FIGO, London.
6. National Institute for Health and Clinical Excellence (NICE), 2007 National Institute for Health and Clinical Excellence (NICE), 2007. Normal labour: third stage. Intrapartum care: care of healthy women and their babies during childbirth, Guideline 55. London.
7. Begley, C.M., Gyte, G.M., Devane, D., McGuire, W., Weeks, A., 2011. Active versus expectant management for women in the third stage of labour. Cochrane Database of Systematic Reviews, 11 CD007412.
8. Jangsten, E., Mattsson, L.A., Lyckestam, I., Hellstrom, A.L., Berg, M., A comparison of active management and expectant management of the third stage of labour: a Swedish randomised controlled trial. BJOG, 118, pp. 362–369.
9. Cotter, A., Ness, A., Tolosa, JE., 2001, Prophylactic oxytocin for the third stage of labour Cochrane Database of Systematic Reviews, Issue 4 http://dx.doi.org/10.1002/14651858.CD001808 Art.No.: CD001808.
10. Mc Donald, S.J., Middleton, P., 2008. Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes. Cochrane Database of Systematic Reviews (2008) CD004074.
11. Prendiville, W., Elbourne, D., Chalmers, I., 1988. The effects of routine oxytocic administration in the management of the third stage of labour: an overview of the evidence from controlled trials. British Journal of Obstetrics and Gynaecology, 95 (1988), pp. 3–16.
12. Soltani, H., Hutchon D.R., Poulose T.A., 2010. Timing of prophylactic uterotonics for the third stage of labour after vaginal birth. Cochrane Database of Systematic Reviews (2010) CD006173
13. RCOG, 2009. Prevention and management of postpartum haemorrhage. RCOG Guideline, London.
14. Department of Health, NSW, 2010. Maternity—Prevention, Early Recognition & Management of Postpartum Haemorrhage (PPH). Sydney, Australia.
15. New Zealand College of Midwives (NZCOM), 2006. NZCOM Practice Guidelines: The Third Stage of Labour. Christchurch, New Zealand.
16. Munro,J., Jokinen, M., 2008. Third Stage of Labour, Midwifery Practice Guideline. London.
17. Dutch Society of Obstetrics and Gynaecology (NVOG), 2006. Guideline: Haemorrhagia Post-Partum.
18. de Groot, A.N., van Roosmalen, J., van Dongen, P.W., 1996. Survey of the management of third stage of labour in The Netherlands. European Journal of Obstetrics & Gynaecology and Reproductive Biology, 66 , pp. 39–40.

19. Johanson, R., Cox, C., 2003. MOET Course Manual. RCOG Press, London.
20. Havenith, B., van der Ploeg, J., 2010. CAVE: Pre-hospital Obstetric Emergency Course Syllabus. Boxmeer.
21. Festin, M.R., Lumbiganon, P., Tolosa, J.E., Finney, K.A., Ba-Thike, K., Chipato, T., Gaitan, H., Xu, L., Limpongsanurak, S., Mittal, S., Peedicayil, A., Pramono, N., Purwar, M., Shenoy, S., Daly, S., 2003. International survey on variations in practice of the management of the third stage of labour. Bulletin of the World Health Organization 81, 286–291.
22. Winter, C., Macfarlane, A., Deneux-Tharaux, C., Zhang, W.H., Alexander, S., Brocklehurst, P., Bouvier-Colle, M.H., Prendiville, W., Cararach, V., van Roosmalen, J., Berbik, I., Klein, M., Ayres-de-Campos, D., Erkkola, R., Chiechi, L.M, Langhoff-Roos, J., Stray-Pedersen, B., Troeger, C. 2007. Variations in policies for management of the third stage of labour and the immediate management of postpartum haemorrhage in Europe. BJOG, 114 (2007), pp. 845–854.
23. Tan, W.M., Klein, M.C., Saxell, L., Shirkoohy, S.E., Asrat, G., 2008. How do physicians and midwives manage the third stage of labour? Birth, 35 (2008), pp. 220–229.
24. Farrar, D.,Tuffnell, D.,Airey, R., Duley,L., 2010. Care during the third stage of labour: a postal survey of UK midwives and obstetricians. BMC Pregnancy and Childbirth 10,23.
25. Dixon, L., Tracy, S.K., Guilliland, K., Fletcher, L., Hendry, C., Pairman, S., 2011. Outcomes of physiological and active third stage labour care amongst women in New Zealand Midwifery.

Chapter 6

The development of quality indicators for the prevention and management of postpartum Haemorrhage in primary midwifery care in the Netherlands

Marrit Smit
Susanne Sindram
Mallory Woiski
Johanna Middeldorp
Jos van Roosmalen

BMC Pregnancy and Childbirth 2013, 13:194

ABSTRACT

Background

At present, there are no guidelines on prevention and management of postpartum haemorrhage in primary midwifery care in the Netherlands. The first step towards implementing guidelines is the development of a set of quality indicators for prevention and management of postpartum haemorrhage for primary midwifery supervised (home) birth in the Netherlands.

Methods

A RAND modified Delphi procedure was applied. This method consists of five steps: (1) composing an expert panel (2) literature research and collection of possible quality indicators, (3) digital questionnaire, (4) consensus meeting and (5) critical evaluation. A multidisciplinary expert panel consisting of five midwives, seven obstetricians and an ambulance paramedic was assembled after applying pre-specified criteria concerning expertise in various domains relating to primary midwifery care, secondary obstetric care, emergency transportation, maternal morbidity or mortality audit, quality indicator development or clinical guidelines development and representatives of professional organisations.

Results

After literature review, 79 recommendations were selected for assessment by the expert panel. After a digital questionnaire to the expert panel seven indicators were added, resulting in 86 possible indicators. After excluding 41 indicators that panel members unanimously found invalid, 45 possible indicators were assessed at the consensus meeting. During critical evaluation 18 potential indicators were found to be overlapping and two were discarded due to lack of measurability.

Conclusions

A set of 25 quality indicators was considered valid for testing in practice.

BACKGROUND

Postpartum haemorrhage (PPH), internationally defined as >500 mL of blood loss within 24 hours after child- birth, remains one of the leading causes of severe maternal morbidity and mortality worldwide, especially in low resource countries. [1] The definition of PPH, however, is not unified; in high-resource countries PPH is often defined as blood loss of at least 1000 mL, while a woman in good health can tolerate up to one litre of blood loss without showing early signs of shock. [2-6] Over the last 15 years, an increase in PPH has been observed in high-resource countries. The reasons for this remain unclear. [7] Almost one third of Dutch women (32.7%) give birth in 'primary care' which is low risk care supervised by a mid- wife (99% of births) or general practitioner (1% of births). Of all births in primary care, 64% occur at home. [8] In the Netherlands the overall prevalence of PPH (de- fined as >1000 mL blood loss), is 5.9%. Of all births in primary care, 3.4% is complicated with PPH. [8] When PPH occurs, women are referred to secondary care and treated by obstetricians. In a home birth setting, women are then transferred to hospital by ambulance. Audit of care provided in case of severe complications in pregnancy and childbirth has shown considerable room for improvement of PPH management. [9, 10]

The Dutch Society of Obstetrics and Gynaecology (NVOG) published guidelines concerning prevention and management of PPH for women giving birth in hospital supervised by an obstetrician. [4] At present, however, there are no guidelines on prevention and management of PPH in primary midwifery care in the Netherlands. Although published obstetrical guidelines can be and are used in primary midwifery care, the unique conditions in midwifery care (such as low-risk profile and birth at home) call for guidelines specifically designed for primary midwifery care.

The first step towards such guidelines is determining applicable items, preferably by using quality indicators. Quality indicators are derived from outcomes of studies, historical data and expert opinions and are defined as measurable elements of practice performance for which evidence or consensus exists. They can be used to assess and improve quality of care provided to the woman. [11] The aim of this study is to develop a set of quality indicators designed for the prevention and management of PPH in primary midwifery care.

METHODS

The RAND modified Delphi method was used to develop a set of quality indicators for prevention and management of PPH in primary midwifery care. This method has been proved valuable as a systematic method using current scientific evidence in conjunction with expert opinion. [12-15] For this study, ethical approval was not required.

Indicator development procedure

The procedure for quality indicator development consists of five steps: (1) composing an expert panel, (2) literature research and collection of recommendations, (3) questionnaire, (4) consensus meeting and (5), critical evaluation (Figure 1).

Step 1: composing an expert panel

In order to capture all aspects of care concerning prevention and management of PPH, members were selected with ex- pert knowledge in (at least) one of the following domains: primary midwifery care, secondary obstetric care, emergency transportation, maternal morbidity or mortality audit, quality indicator development or clinical guidelines development and representatives of professional organizations (Royal Dutch College of Midwives [KNOV] or NVOG).

Step 2: literature research and collection of possible indicators

In order to identify possible indicators for PPH, first PubMed was searched using the following keywords: postpartum haemorrhage', 'home birth', 'low-risk birth', 'prevention' and 'third stage of labour' in combination with 'guideline' or 'quality indicator'. The Internet was searched for reports and statements on PPH, especially in primary (midwifery) care. Following this, international guidelines, protocols and consensus statements were retrieved and collected. Indicators used in secondary obstetric care concerning prevention and management of PPH were included. Finally, in order to complete the preliminary set of possible indicators, manuals of obstetric emergency courses regarding prevention and management of PPH were studied. Due to the lack of a unified definition of PPH, PPH defined as 500 mL and 1000 mL were categorized separately. Some items, such as surgical procedures and embolisation, were clearly not applicable in primary care, and therefore deemed not relevant for this study. Other items needed rephrasing for clarification of the possible indicator. The list of possible indicators was categorised into five domains: prevention, >500 mL blood loss <1000 mL, >1000 mL blood loss <2000 mL, >2000 mL blood loss and organization of care.

Step 3: questionnaire

A questionnaire listing all possible indicators was sent to all panel members via e-mail. To facilitate decision-making, the source(s) and relevant literature citations for each potential indicator were provided.

Panel members were asked to score the possible indicators on a nine-point Likert scale, ranging from 'one', being a poor quality measure of care, to 'nine', being an excellent quality measure. In addition, panel members had the option of selecting 'not assessable'. The respondents were asked to score each possible indicator with respect to their impact

on both 'health gain' and 'overall health efficacy'. Health gain was defined as: 'An increase in the health of individuals or population' and overall health efficacy was defined as: 'prevention of unnecessary medical treatment and promotion of cost- effectiveness'. [14] In addition, panel members were given the opportunity to provide comments or suggest additional indicators.

All data were collected and analysed using the Statistical Package for the Social Sciences (SPSS), version 17 (SPSS Inc., Chicago, IL, USA). The median panel rating and the amount of dispersion of ratings between panel members were calculated for each potential indicator. The comments and newly proposed quality indicators were collected. For an optimal assessment of all possible indicators offered to the panel, no indicators were discarded between this questionnaire round and the consensus meeting. All newly proposed possible indicators were added to the list. Overall agreement on each item was defined as 75% or more of ratings within a panel being in the lowest (1, 2, 3,) or the highest tertile (7, 8, and 9). The subsequent consensus meeting focused on indicators with low agreement.

Step 4: consensus meeting

The expert panel was invited to a face-to-face consensus meeting. At the onset of the meeting, each panel member received the list of possible indicators, together with their own ratings from the questionnaire. The median rating and the frequency of responses for each possible indicator were also provided. Finally, panel members received the list of newly introduced potential indicators from step three. Individual ratings of the other panel members were kept confidential. Subsequently, the panel was divided into three groups of either four or five participants, every group consisting of at least one midwife and one obstetrician. Each group was assigned one or two domains (as described in step two), and were asked to evaluate the practical applicability of each possible indicator.

Each group (moderated by one of the authors) focused on indicators not unanimously agreed upon in the first questionnaire round. Indicators where the range of dis- agreement was widely spread were also discussed. The aim was to assess if there was genuine clinical disagreement about the validity of possible indicators or if there was a problem with phrasing. After the three groups assessed their assigned domains, the entire panel discussed potential indicators that were not agreed upon. After the panel meeting, the members were asked to rate all the indicators again. The final ratings were analysed in a similar manner as in step three. Analyses were performed based on the RAND/UCLA (University of California Los Angeles) appropriateness method. [15] An indicator was considered as 'valid' if there was an overall panel median score of eight or higher and if 'agreement' was reached between panel members.

Step 5: critical evaluation

In adherence to the RAND method, the core panel critically evaluated the indicators with high agreement in step four. Emphasis was put on applicability, feasibility and measurability. Some indicators were modified or combined due to overlap between categories or pragmatic reasons concerning implementation, resulting in a final consensus-based set of indicators. Each indicator was assessed and rephrased to define a numerator and denominator: the number of women in whom a specific test or intervention has been performed, divided by the number of women in whom this test or intervention should have been performed. By this last step use of the indicator can establish the percentage of adherence when evaluating quality of care.

RESULTS

The process of development of the indicators can be seen in Figure 1.

Step 1

After selecting experts in one of the previously described domains, a panel of thirteen members was assembled consisting of five midwives (one of whom is first author), seven obstetricians (including three of the authors) and an ambulance paramedic. All midwives and obstetricians work in maternity care and are actively involved in at least one of the domains as described in the Methods section (Step 1).

Step 2

A literature search resulted in a list of publications from which possible indicators could be extracted. [2-4, 9, 10, 16-30] From these publications, all possible quality indicators for women at increased risk of PPH in secondary care were collected. More than half of the indicators were immediately discarded, as they are not applicable in primary midwifery care (e.g. surgical procedures and embolisation). Two studies on PPH and homebirth in an industrialised country were found. The authors made recommendations on referral in case of PPH and/or retained placenta after home birth. [9, 10] These recommendations were incorporated in the list of possible indicators. This described in the 'participants and methods' section.

Step 3

A questionnaire composed of the 79 possible indicators was sent to all panel members via email. The ambulance paramedic only rated possible indicators within his field of expertise and rated some indicators 'not assessable'. The expert panel proposed seven additional possible indicators. Finally, a list of 86 possible indicators was pre- pared for assessment at the consensus meeting.

Step 4

All panel members attended the meeting. After discussing and reassessing the 86 possible indicators, 45 recommendations were rated 'valid': four on prevention, nine on 500–1000 mL blood loss, 12 on >1000 mL blood loss, 14 on >2000 mL blood loss, and six on organization. The remaining 41 indicators were rated 'not valid' and subsequently excluded (Figure 1).

Step 5

During critical evaluation by the core panel 18 potential quality indicators were found to be overlapping and two were discarded due to lack of measurability. Finally, a set of 25 potential indicators were transcribed into 25 quality indicators for prevention and management of PPH in primary midwifery care in the Netherlands (Table 1). The indicators each now contain a numerator and denominator, i.e. in case of PPH; the number of women with PPH who had an intra- venous line is divided by the number of women with PPH.

DISCUSSION

A RAND modified Delphi method approach was used to develop a set of 25 quality indicators. This is the first set of quality indicators concerning prevention and management of PPH in primary midwifery care in the Netherlands, to be used to assess care in case of PPH in primary care. This is an essential contribution to the development of guidelines of PPH in midwifery care.

The use of uterotonics, placing an intravenous line and quick referral in all cases of PPH were considered of great importance by the majority of the panel and thus incorporated in the final set. Possible indicators of the management in case of PPH > 2000 mL were either accepted or rejected with minimal dispersion. For some indicators however, assessment of validity was a source of discussion. For ex- ample, the routine use of oxytocin was hotly debated. As shown in a nationwide survey, most obstetricians consider this as part of standard care. In midwifery, though the use of uterotonics has increased over the last decade, this is no standard practice. [30] Currently, the Royal Dutch College of Midwives has not issued a guideline for women at low- risk of PPH or made any statement concerning management of third stage of labour. Also, in Dutch midwifery schools, no unambiguous policy is taught on the routine use of uterotonics. In the process of guideline development and implementation, routine use of uterotonics might be an item for further discussion, especially also because of the high prevalence of PPH in our country. Although the effectiveness of comparable indicator development initiatives has been proven, there are limitations to this method. [13, 31, 32] Despite a thorough literature search, possible indicators

may have been overlooked. However, the expert panel was given ample opportunity to propose additional items, both in the questionnaire round and during the consensus meeting. Of the seven additionally proposed indicators, three were incorporated in the final set. [32] It is well- documented that panel composition influences the out- come of the indicator-development process. [33] If more than one discipline of health care providers is included in an expert panel, lower agreement in rating between members are found, compared to when only expert in one discipline make up the panel. In this study, the panel consisted of a heterogenic group of professionals. There- fore, in case of high agreement, that indicator can be considered highly valid. Furthermore, it has been shown that the applied method (using a higher cut-off point for deter- mining consensus with an overall median rate of 8 out of 9) enhances the reproducibility of ratings if a different set of panellists would rate the indicators. [13]

In our literature search, many studies on PPH and homebirth originated in low-resource countries. [19, 24, 34] However, home birth in these countries is rarely a well- considered choice by women, and frequently being the result of poverty and lack of accessibility of health facilities. Therefore, it was often impossible to extrapolate recommendations into a western primary care setting. Only a few studies contain relevant information on home birth and referral in industrialised countries. [9, 35] Thus, the scientific evidence base was limited in this area of primary care and necessitated the use of expert opinion in addition to available evidence. Due to this finding, we conclude that referral in case of PPH at home to hospital in industrialised countries is under-researched.

All quality indicators need to be validated, in order to ensure the clinical relevance. [13, 31] Currently work is underway to validate this set by assessing collected cases of PPH in primary midwifery care in the Netherlands.

This set of indicators provides us with an instrument to assess the care commencing in a primary midwifery set- ting, before being transferred by ambulance to hospital.

Conclusion

A set of 25 quality indicators for prevention and management of PPH in primary midwifery care in the Netherlands was developed. This is the first set of quality indicators which may serve as an assessment tool for prevention and management of PPH in primary care. This is of great interest, as the incidence of PPH is rising worldwide. Furthermore, existing guidelines for secondary care can be combined with these findings, so care throughout the care chain, including ambulance referral, can be thoroughly evaluated.

Acknowledgments

The authors are very grateful for the midwives, obstetricians and the ambulance paramedic for their essential contributions in the development of quality indicators. The authors declare to have no conflict of interest.

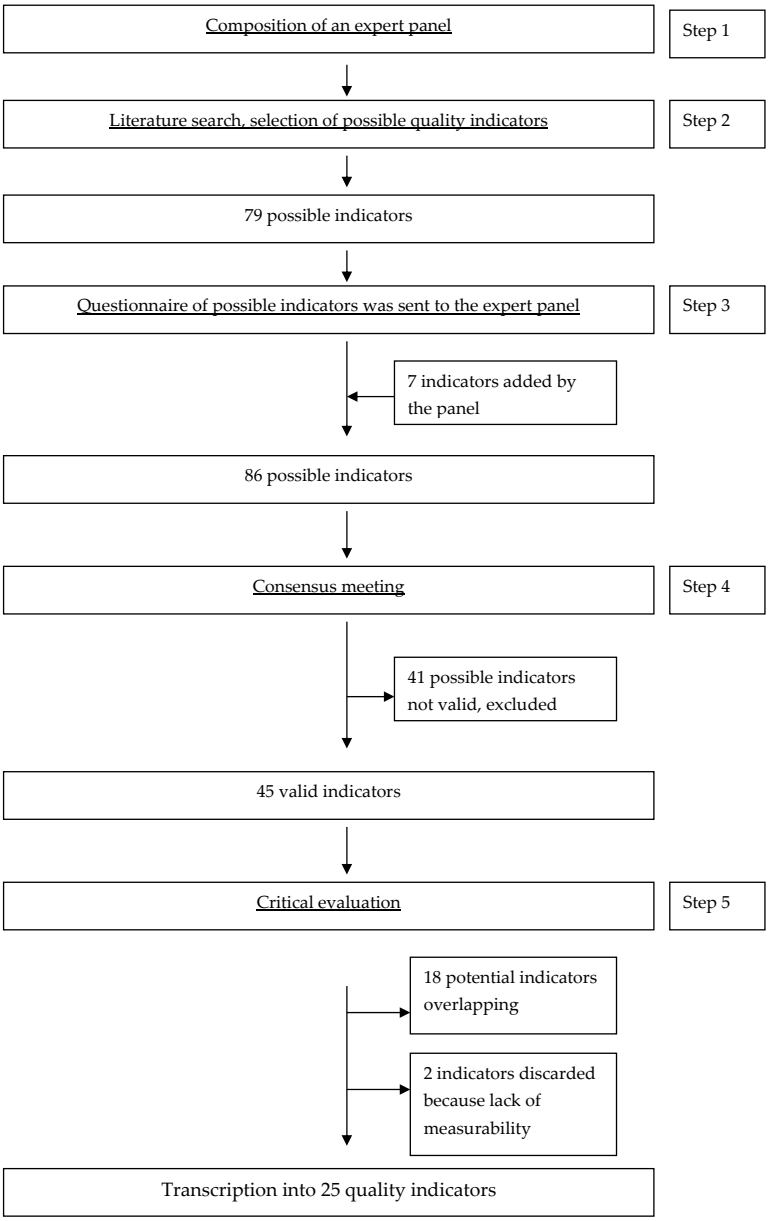


Figure 1. The process of quality indicator development according to the RAND-modified Delphi method for prevention and management of PPH in primary care in the Netherlands.

Table 1. Final set of quality indicators for the measurement of PPH-care in primary care

	For prevention of PPH, the midwife should;	Median *(n)*	Agreement (% of panellists with score of 7, 8 or 9)
1	Antenatally: identify elevated- or high risk of PPH and agree on preventive strategies *†	8.5 *(12)*	100
2	At birth: identify elevated- or high risk of PPH and agree (or adjust) preventive strategies *†	8 *(12)*	100
3	If high risk of PPH is assessed: have birth occur in hospital supervised by the obstetrician. †	8.5 *(12)*	100
4	Routinely administer uterotonics (at least 5 IU oxytocin intramuscular). †	9 *(12)*	83,3
	In case of blood loss >500mL, without signs of shock the midwife should;		
5	Measuring blood loss by weighing. †	9 *(12)*	91,6
6	Homebirth: in case of retained placenta; refer to secondary care after 30 minutes	9 *(13)*	92,3
7	Midwifery supervised hospital birth: in case of retained placenta; refer to secondary care after 30 minutes	9 *(13)*	75
8	Homebirth: if blood loss is not ceasing, refer to secondary care. †	9 *(12)*	83,4
9	Midwifery supervised hospital birth: if blood loss is not ceasing, refer to secondary care. †	9 *(12)*	83,3
10	Treat PPH as uterine atony (and apply bladder catheterization, uterine massage and oxytocin) until proven otherwise.	9 *(13)*	100
11	Post placental: if blood loss is not ceasing despite administration of uterotonics, examine for vaginal and perineal lesions. †	7 *(12)*	75
	In case of PPH of >1000 mL and/or signs of shock, the midwife should;		
12	Inform the secondary caregiver (obstetrician).	9 *(13)*	100
13	Start an intravenous line and supply with fluids, using 0, 9% sodium chloride.	8 *(13)*	100
14	Monitor vital signs frequently (pulse, blood pressure, respiratory frequency).	8 *(13)*	92,4
15	Regardless of oxygen saturation, provide patient with 10-15 litre oxygen via non-rebreathing mask.	9 *(13)*	84,6

	In case of PPH of > 1000 mL with signs of shock and/or >2000 mL blood loss the midwife should;		
16	In case of persisting haemorrhage with signs of shock, perform uterine and / or aortal compression. †	8 *(12)*	83,3
17	Secure a second intravenous line (14 gauge).	9 *(13)*	79,9
18	If the patient has reduced consciousness due to hypovolemic shock, call for (paramedic) assistance in order to establish an open airway.	9 *(13)*	83,4
19	Immediately transfer patient to secondary care. †	Added in second round *(12)*	100
	Concerning cooperation and training;		
20	Within every regional obstetric collaboration£ a regional PPH protocol should be present, based on national guidelines.	9 *(13)*	91,7
21	A regional PPH protocol should be the basis of regular audits.	9 *(13)*	83,3
22	The midwife is aware that ambulance transportation in case of PPH or retained placenta is always of the highest urgency category.	9 *(13)*	91,7
23	After each PPH with >2000 mL blood loss, the multidisciplinary team should debrief the situation.	8 *(13)*	83,4
24	Within the regional obstetric collaboration an annual training in obstetric emergencies should be provided.	9 *(13)*	100
25	In a homebirth situation, anticipation on possible ambulance transport is necessary; make sure the patient is at an accessible place for (all) caregivers in time.	9 *(13)*	100

* Preventative strategies imply consultation with an obstetrician to determine policy regarding PPH prevention e.g. birth supervised by obstetrician, or birth supervised by midwife, but in hospital with intravenous access prior to birth.

£ ***Regional obstetric collaboration***; a quarterly meeting with obstetricians and midwifery practices within a region in the Netherlands where policy, collaboration and practical agreements are discussed.

† The ambulance paramedic did not rate these items; it was not within his field of expertise and stated these as 'not assessable'

REFERENCES

1. Word Health Organisation: Maternal mortality in 2000: estimates developed by WHO, UNICEF and UNFPA. [http://whqlibdoc.who.int/hq/2000/a81531.pdf].
2. Department of Health, North South Wales, Australia: Prevention, Early Recognition & Management of Postpartum Haemorrhage (PPH). [http://www0.health.nsw.gov.au/policies/pd/2010/pdf/PD2010_064.pdf].
3. Fahy KM: Third stage of labour care for women at low risk of postpartum haemorrhage. J Midwifery Womens Health 2009, 54:380–386.
4. Dutch Society of Obstetrics and Gynaecology, NVOG: Guideline post-partum haemorrhage. [http://nvog-documenten.nl/index.php?pagina=/site/pagina. php&id=54321].
5. Australian College of Midwives: National Midwifery Guidelines for Consultation & Referral. [http://midwives.rentsoft.biz/lib/pdf/Consultation%20and%20Referral%20Guidelines%202010.pdf].
6. The Royal College of Midwives: Evidence Based Guidelines for Midwifery-Led Care in Labour. [http://www.rcm.org.uk/college/policy-practice/evidence- based-guidelines/].
7. Knight M, Callaghan WM, Berg C, Alexander S, Bouvier-Colle MH, Ford JB, Joseph KS, Lewis G, Liston RM, Roberts CL, et al: Trends in postpartum haemorrhage in high resource countries: a review and recommendations from the International Postpartum Haemorrhage Collaborative Group. BMC Pregnancy Childbirth 2009, 9:55.
8. Perinatal Care in the Netherlands: Stichting Perinatale Registratie Nederland. [http://www.perinatreg.nl/uploads/150/122/Jaarboek_Zorg_in_Nederland_2008.PDF].
9. van Dillen J, Mesman JA, Zwart JJ, Bloemenkamp KW, van Roosmalen J: Introducing maternal morbidity audit in the Netherlands. BJOG 2010,117:416–421.
10. Zwart JJ, Richters JM, Ory F, de Vries JI, Bloemenkamp KW, van Roosmalen J: Severe maternal morbidity during pregnancy, delivery and puerperium in the Netherlands: a nationwide population-based study of 371,000 pregnancies. BJOG 2008, 115:842–850.
11. Lawrence M, Olesen F: Indicators of quality in health care. Eur J Gen Pract 1997, 3:103–108.
12. Campbell SM, Cantrill JA, Roberts D: Prescribing indicators for UK general practice: Delphi consultation study. BMJ 2000, 321:425–428.
13. Campbell SM, Braspenning J, Hutchinson A, Marshall M: Research methods used in developing and applying quality indicators in primary care. Qual Saf Health Care 2002, 11:358–364.
14. Mourad SM, Hermens RP, Nelen WL, Braat DD, Grol RP, Kremer JA: Guideline-based development of quality indicators for subfertility care. Hum Reprod 2007, 22:2665–2672.
15. Fitch K, Bernstein SJ, Aguilar MD, et al: The RAND/UCLA Appropriateness Method User's Manual. VA: USA: Arlington; 2001.
16. Havenith B, van der Ploeg J: CAVE: Pre-hospital Obstetric Emergency Course Syllabus, the Netherlands: Boxmeer; 2010.
17. Bais JM, Eskes M, Pel M, Bonsel GJ, Bleker OP: Postpartum haemorrhage in nulliparous women: incidence and risk factors in low and high risk women. A Dutch population-based cohort study on standard (> or = 500 ml) and severe (> or = 1000 ml) postpartum haemorrhage. Eur J Obstet Gynecol Reprod Biol 2004, 115:166–172.
18. Begley CM, Gyte GM, Murphy DJ, Devane D, McDonald SJ, McGuire W: Active versus expectant management for women in the third stage of labour. Cochrane Database Syst Rev 2010(7):CD007412.
19. Flandermeyer D, Stanton C, Armbruster D: Uterotonic use at home births in low- income countries: a literature review. Int J Gynaecol Obstet 2010, 108:269–275.

20. International Confederation of Midwives: Prevention and Treatment of Post-partum Haemorrhage New Advances for Low Resource Settings. ICM; London: The Hague. FIGO. [http://www.pphprevention.org/files/ICM_FIGO_Joint_ Statement.pdf].
21. Jangsten E, Mattsson LA, Lyckestam I, Hellstrom AL, Berg M: A comparison of active management and expectant management of the third stage of labour: a Swedish randomised controlled trial. BJOG 2011, 118:362–369.
22. Howell C, Grady K, Cox C: MOET Course Manual. London, UK: RCOG Press, 2003; 2007.
23. Leduc D, Senikas V, Lalonde AB, Ballerman C, Biringer A, Delaney M, Duperron L, Girard I, Jones D, Lee LS, et al: Active management of the third stage of labour: prevention and treatment of postpartum hemorrhage. J Obstet Gynaecol Can 2009, 31:980–993.
24. Mammen C, Sharma M: Administration of misoprostol by trained traditional birth attendants to prevent postpartum haemorrhage in home births in Pakistan: randomised placebo-controlled trial. BJOG 2011, 118:1018–1019.
25. Matar HE, Almerie MQ, Alsabbagh M, Jawoosh M, Almerie Y, Abdulsalam A,Duley L: Policies for care during the third stage of labour: a survey of maternity units in Syria. BMC Pregnancy Childbirth 2010, 10:32.
26. Mousa HA, Alfirevic Z: Treatment for primary postpartum haemorrhage. Cochrane Database Syst Rev 2007(1):CD003249.
27. National Institute for Health and Clinical Excellence (NICE): Normal labour: third stage. Intrapartum care: care of healthy women and their babies during childbirth, Guideline 55. [http://publications.nice.org.uk/intrapartum-care-cg55].
28. Royal College of Obstetricians and Gynaecologists: Prevention and management of postpartum haemorrhage. RCOG Guideline. [http://www.rcog. org.uk/files/rcog -corp/GT52PostpartumHaemorrhage0411.pdf].
29. World Health Organization: WHO Recommendations for the Prevention of Post-Partum Heamorrhage. [http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/9789241548502/en].
30. Smit M, van Stralen G, Wolterbeek R, van Dillen J, van Roosmalen J, Slootweg Y: Survey of prophylactic use of uterotonics in the third stage of labour in the Netherlands. Midwifery 2013, 29:859–862.
31. Jones J, Hunter D: Consensus methods for medical and health services research. BMJ 1995, 311:376–380.
32. Uphoff EP, Wennekes L, Punt CJ, Grol RP, Wollersheim HC, Hermens RP, Ottevanger PB: Development of Generic Quality Indicators for Patient- Centered Cancer Care by Using a RAND Modified Delphi Method. Cancer Nurs 2012, 35:29–37.
33. Fraser GM, Pilpel D, Kosecoff J, Brook RH: Effect of panel composition on appropriateness ratings. Int J Qual Health Care 1994, 6:251–255.
34. Sanghvi H, Ansari N, Prata NJ, Gibson H, Ehsan AT, Smith JM: Prevention of postpartum hemorrhage at home birth in Afghanistan. Int J Gynaecol Obstet 2010, 108:276–281.
35. Amelink-Verburg MP, Verloove-Vanhorick SP, Hakkenberg RMA, Veldhuijzen IME, Gravenhorst JB, Buitendijk SE: Evaluation of 280,000 cases in Dutch midwifery practices: a descriptive study. BJOG 2008, 115:570–578. doi:10.1186/1471-2393-13-194.

Chapter 7

Postpartum haemorrhage in midwifery care in the Netherlands: validation of quality indicators for midwifery guidelines

Marrit Smit
Kar-Li Chan
Johanna Middeldorp
Jos van Roosmalen

Submitted

ABSTRACT

Background

To assess the performance of 25 quality indicators for prevention and management of post-partum hemorrhage (PPH) in primary midwifery care.

Methods

From April 2008 to April 2010, midwives reported cases of PPH. Cases were assessed using the 25 earlier developed quality indicators. Quality criteria on applicability, feasibility, adherence to the indicator, and the indicator's potential to monitor improvement were assessed.

Results

98 cases of PPH were reported during the study period, of which 94 were analysed. Eleven indicators were found to be applicable and feasible. Five of these indicators showed improvement potential: routine administration of uterotonics, quantifying blood loss by weighing, timely referral to secondary care in homebirth and treatment of PPH using catherisation, uterine massage and oxytocin and the use of oxygen. 14 indicators were found to be not useful as a tool of measuring quality of care in case of PPH in this study.

Conclusions

Eleven out of 25 indicators were found to be suitable as an assessment tool for midwifery care of PPH and are therefore suitable for incorporation in a professional midwifery guideline.

INTRODUCTION

Postpartum haemorrhage (PPH) is still one of the major causes of severe maternal morbidity and mortality worldwide. Several studies have shown an unexplained increase in the frequency and severity of PPH. [1-3]

In the Netherlands, the overall incidence of PPH, defined as blood loss >1000 mL within 24 hours after birth, is 6% and this number is rising. In primary midwifery care, the incidence of PPH is 3.4%. [4] There are various guidelines concerning prevention and management of PPH. [5-7] However, no guideline for PPH occurring in primary midwifery care in the Netherlands is available. In a primary care setting, limited hands-on assistance and the necessity of arranging ambulance transfer (in case of home birth) make the availability of a specific guideline for midwifery care essential. A set of 25 quality indicators for prevention and management in primary care has been developed by an expert panel consisting of midwives, obstetricians, ambulance personal and representatives of the Royal Dutch College of Midwives (KNOV) and the Dutch Society of Obstetrics and Gynecology (NVOG). [8]

This paper describes the performance of those quality indicators in clinical practice. Validation is necessary to demonstrate the value of the set of indicators as an instrument for monitoring and improving prevention and management of PPH in primary care. [9, 10]

METHODS

Data collection

From April 2008 to April 2010, 337 Dutch midwives who participated in the CAVE training (Pre-hospital Obstetric Emergency Course) were requested to participate in this study. The CAVE course is a post-graduate course which focuses on the identification and management of obstetric emergencies, including timely and adequate referral to hospital. [11]

The participating midwives reported obstetric emergencies occurred in their practice such as PPH, shoulderdystocia, neonatal resuscitation, unexpected breech birth and umbilical cord prolapse. During twelve consecutive months, midwives from all over the country received a monthly e-mail, linked to a password protected internet site. When obstetric emergencies were reported, participants were asked to fill out a detailed case registration form containing information on received care during pregnancy and birth and neonatal outcome. In addition, anonymous medical files, discharge letters and laboratory results were requested. Also, if ambulance transfer was necessary, details of transfer were requested from the ambulance services. The researchers contacted midwives, hospitals and ambulance services in order to obtain missing data. For this study, reported cases of PPH were collected and used for validation of 25 earlier developed quality indicators. [8]

Ethical clearance for this study was granted by the Leiden University Medical Ethics Committee (P11.105).

Assessment of quality indicators

Each indicator was individually validated using the obtained case registration forms and assessed with respect to the following quality criteria: applicability, feasibility, adherence to the indicator and improvement potential. [10, 12, 13]

Applicability was found if the indicator was applicable to a substantial amount of cases (> 10 cases). [10] Other quality criteria could not be assessed if an indicator was found not applicable and thus subsequently discarded. [10] *Feasibility* was considered to be present if the availability of administrative data required to assess the indicator could be abstracted from the data in >70% of cases. [13] *Adherence to the indicator* was defined if data to fill the numerator and denominator of the indicator can be made available through data collection. [10, 12] When an indicator is aimed to demonstrate changes in quality of care, there must be room for improvement. [10] *Improvement potential* was defined if less than 90% of the case registration forms met the requirements of the indicator. [10, 13]

Assessment of quality indicators was mostly unambiguous. For example, routine administration of uterotonics, use of oxygen and intravenous access were stated in every case registration form. However, 'timely referral when blood loss is not ceasing' contains potential subjectivity, and two assessors (KC, MS) therefore independently assessed cases. If there was no agreement, the case was discussed until consensus was reached.

All cases of PPH were analyzed using IBM SPSS Statistics version 20 for Windows using Descriptive Statistics (Frequencies, Descriptives).

RESULTS

Study population

During the study period, 98 cases of PPH in primary care were reported. Despite meticulous attempts to complete the files, four cases (4%) had to be excluded due to incomplete data, leaving 94 cases for analysis. Characteristics of the women with PPH are shown in Table 1. The majority of women 72/94 (77%) gave birth at home and 22/94 (23%) gave birth in hospital or birthing clinic, all under supervision of the primary care midwife. Uterine atony was the primary cause of PPH in 64/ 94 women (68%). A retained or incomplete placenta was found in 27/ 94 women (29%) as primary cause of PPH. In three women (3%) vaginal or cervical injury was the primary cause of PPH.

Indicator scores (Table 2)

Five indicators were only found relevant in <10 cases and therefore inapplicable.

Nine indicators were found not feasible; the administrative data required to evaluate the indicator were available in less than 70% of cases.

Adherence to the indicator was analyzed for the remaining 11 indicators. Five of these indicators showed to have improvement potential, with an adherence to the indicator less than 90%, and therefore indicating room for improvement. Assessment of 'timely referral' lead to discussion in two cases, however, consensus was reached after discussion.

DISCUSSION

Aim of this study was to assess the performance of the 25 quality indicators of PPH in primary midwifery care. After applying the indicators to each of the 94 cases, 11 indicators could be validated to measure care provided by midwives to prevent and manage PPH in primary care. Five of these (5/11) showed potential to be used to monitor improvement of the quality of care in our study.

This study forms an important step in the development of a guideline for prevention and management of PPH in primary midwifery care. An important strength of this study is the use of effective methods such as a RAND modified Delphi procedure and applying validated quality criteria (applicability, feasibility, adherence to the indicator and improvement potential). [10, 12, 13] As we thoroughly followed these steps, these indicators are valid, usable in clinical practice and form an important basis in a guideline.

Blood loss over 2000 mL at time of referral is a rare phenomenon, especially in primary midwifery care and occurred in only three of our 94 cases. Further exploration of the indicators related to blood loss over 2000 mL is recommended with more cases of such high blood loss. Nine indicators were found not feasible. Information about the indicators was either partially or completely missing in case registration forms or medical files, suggesting documentation of midwives may need improvement. Further research is needed to explore whether specific care was not noted or care was indeed provided but not documented in the medical file. The remainder of 14 indicators (those who were found not feasible and/or applicable) were selected through a meticulous RAND modified Delphi procedure and therefore have potential to be incorporated in a guideline. They may not be suitable as tools for quality improvement in its present form. A larger study, however, may show improvement potential for these indicators. Our small sample is a limitation of the study. A possible selection bias is another limitation. Only midwives who successfully finished the CAVE course reported cases. One can assume that these participants perform very well in case of PPH as they were recently trained. Further research should also include midwives, who did not participate in the CAVE training.

Conclusion

This is the first study describing quality indicators particularly for PPH in primary midwifery care in the Netherlands. Eleven out of 25 indicators were found to be suitable as an assessment tool for midwifery care of PPH and are therefore suitable for incorporation in a professional midwifery guideline.

Table 1. Characteristics of 94 women with PPH in primary midwifery care

Characteristics	*No. (n = 94)*
Mean age, years (range)	31 (20- 41)
Median gestational age, weeks (range)	40 (37 – 42)
Nulliparous (%)	44 (47)
Multiparous (%)	50 (53)
Home birth (%)	72 (77)
Hospital birth (%)	22 (23)
Median birth weight, gram (range)	3650 (2685 - 4620)
Median total blood loss, mL (range)	1800 (1000-7000)
Cause of PPH (%)	
- Retained placenta	44 (47)
- Uterine Atony	48 (51)
- Genital tract trauma	2 (2)
Median lowest haemoglobin, mmol/L, (range)	5.3 (3.3 - 8.6)
Median number of packed cells, units, (range)	0 (0 - 8)

Table 2. Quality criteria for validation of 25 earlier developed quality indicators of PPH in primary midwifery care. [8] (Applicable and/or feasible indicators are in bold)

	Category, indicators	Applicability $n_{patients}$ (No <10 patients)	Feasibility % of patients with missing values (No >30%)	Amount of cases in adherence to indicator (%)	Improvement potential Yes, No or NA (not applicable) (No = adherence to indicator <90%)
	Prevention				
1.	**Antenatally: identify elevated- or high risk and agree on preventive strategies.**	94	0	85 (90)	No
	- No elevated- or high risk of PPH identified			9 (10)	
	- Elevated- or high risk of PPH identified				
	o Referred to secondary care			9 (100)	
	o Not referred to secondary care			0 (0)	
2.	At birth: identify elevated- or high risk and agree (or adjust) on preventive strategies.	94	100 / No	NA	NA
3.	If high risk is assessed: have birth occur in hospital supervised by the obstetrician.	94	100 / No	NA	NA
4. *	**Routinely administer uterotonics (at least 5 IU oxytocin intramuscular).**	94	0		Yes
	- Yes, at least 5IU oxytocin			54 (57)	
	- No			40 (43)	
	In case of blood loss >500 mL, without signs of shock the midwife should;				
5. **	**Objectify blood loss by weighing**.	94	28		Yes
	- Yes			68 (72)	
	- No / unknown			26 (28)	

	Category, indicators	Applicability $n_{patients}$ (No <10 patients)	Feasibility % of patients with missing values (No >30%)	Amount of cases in adherence to indicator (%)	Improvement potential Yes, No or NA (not applicable) (No = adherence to indicator <90%)
6. ***	**Homebirth: in case of retained placenta; refer to secondary care after 30 minutes.**	35	0		Yes
	- Referral <35 minutes			13 (37)	
	- Referral >35 minutes			22 (63)	
7. ***	Midwifery supervised hospital birth: in case of retained placenta; refer to secondary care after 30 minutes.	9/ No	11		NA
	- Referral <35 minutes			3 (33)	
	- Referral >35 minutes			5 (56)	
8.	**Home birth; if blood loss is not ceasing, refer to secondary care.**	35	0		No
	- Timely referral			32 (91)	
	- No timely referral			3 (9)	
9.	**Midwifery supervised hospital birth if blood loss is not ceasing, refer to secondary care.**	13	0		No
	- Timely referral			13 (100)	
	- No timely referral			0 (0)	
10.	**Treat PPH as uterine atony until proven otherwise.**	94	0		Yes
	A. Catheter			77 (82)	
	B. Uterine massage			66 (70)	
	C. Oxytocin			74 (79)	
	D. Combination of catheter, uterine massage and oxytocin			53 (56)	
11.	**Post placental: if blood loss is not ceasing despite administration of uterotonics; examine for vaginal and perineal lesions**	94	1	93 (99)	No

	In case of PPH of >1000 mL and/or signs of shock, the midwife should;				
12.	**Inform the secondary caregiver (obstetrician).** - Yes - No	94	0	 92 (98) 2 (2)	No
13.	**Start an intravenous line and supply with fluids, using 0,9% sodium chloride** A. Midwife B. Ambulance personnel C. Hospital personnel (gynecologist or nurse) D. No intravenous line given E. Total given	94	1	 22 (23) 47 (50) 21 (22) 3 (3) 91 (97)	No
14 β	Monitor vital signs frequently. A. Blood pressure B. Pulse C. Blood pressure & pulse D. Total reported	94	60/No	 14 (15) 1 (1) 23 (25) 38 (40)	NA
15.	**Regardless of oxygen saturation, provide patient with 10-15 liter oxygen via non-rebreathing mask**. - Yes - No	94	0	 10 (11) 84 (89)	Yes
	In case of PPH of >1000 mL with signs of shock and/or > 2000 mL blood loss the midwife should;				
16.	In case of persisting hemorrhaging with signs of shock, perform uterine and/ or aortal compression.		94	100/ No	NA
17.	Secure a second intravenous line (14 gauge). - Yes - No	3/ No	67/ No	 0 (0) 1 (33)	NA
18.	If the patient has reduced consciousness due to hypovolemic shock, call for (paramedic) assistance in order to establish an open airway.	3/ No	100/ No	NA	NA
19.	Immediately transfer patient to secondary care. - Yes - No	3/ No	0	 2 (67) 1 (33)	NA

	Concerning cooperation, training and documentation				
20.	Within every regional obstetric collaboration† a regional PPH protocol should be present, based on the national guidelines.	94	100 / No	NA	NA
21.	A regional PPH protocol should be the basis of regular audits	94	100 / No	NA	NA
22.	Every midwife should be aware that ambulance transportation in case of PPH or retained placenta is always of the highest urgency category (A1). - A1 (arrival at patient within 15 minutes) - A2 (arrival at patient within 30 minutes)	94	32 / No	 51 (54) 13 (14)	NA
23.	After each PPH with >2000 mL blood loss, the multidisciplinary team should debrief the situation.	3 / No	100 / No	NA	NA
24.	Within the regional obstetric collaboration† an annual training in obstetric emergencies should be provided.	94	100 / No	NA	NA
25.	In a homebirth situation, anticipation on possible ambulance transport is necessary; make sure the patient is at an accessible place for (all) caregivers in time.	94	100 / No	NA	NA

* Within 3 minutes after birth, at least 5 IU (international units) oxytocin intramuscular is given.
** Estimated or measured blood loss before referring to secondary care.
*** In case of retained placenta, the midwife called the obstetrician within 35 minutes after birth to refer and, in case of home birth, ambulance assistance is requested and on the way.
β A single documentation of pulse and blood pressure would meet the requirements of this indicator.
† Regional obstetric collaboration; a quarterly meeting with obstetricians and midwifery practices within a region in the Netherlands where policy, collaboration and practical agreements are discussed.
NA, not applicable

REFERENCES

1. Callaghan WM, Kuklina EV, Berg CJ. Trends in postpartum hemorrhage: United States, 1994-2006. Am.J.Obstet.Gynecol. 2010;202(4):353-356.
2. Cameron CA, Roberts CL, Olive ECet al. Trends in postpartum haemorrhage. Aust.N.Z.J.Public Health 2006;30(2):151-156.
3. Knight M, Callaghan WM, Berg Cet al. Trends in postpartum hemorrhage in highresource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group. BMC.Pregnancy.Childbirth. 2009;9:55.
4. Stichting Perinatale Registratie Nederland. Stichting Perinatale Registratie Nederland. In: Utrecht: Stichting Perinatale Registratie Nederland, 2010. Assessed oct 10th, 2012. Available at: http://www.perinatreg.nl/uploads/150/122/Jaarboek_Zorg_in_Nederland_2008.PDF.
5. International Confederation of Midwives. Prevention and Treatment of Post-partum Haemorrhage: New Advances for Low Resource Settings. In: The Hague: ICM; London: FIGO: 2004. Assessed october 10th 2012. Available at: http://www.pphprevention.org/files/ICM_FIGO_Joint_Statement.pdf.
6. NVOG.Guideline post partum haemorrhage. In: 2006. Assessed october 10th 2012. Available at: http://nvog-documenten.nl/uploaded/docs/NVOG%20richtlijn%20HPP%2014-11-2013%20definitief%20d.pdf.
7. World Health Organization, Department of Making Pregnancy Safer. WHO Recommendations for the Prevention of Post Partum Heamorrhage. In: Geneva, Zwitserland: 2007. Assessed october 10th 201. Available at: http://www.who.int/making_pregnancy_safer/publications/WHORecommendationsforPPHaemorrhage.pdf.
8. Smit M, Sindram SI, Woiski Met al. The development of quality indicators for the prevention and management of postpartum haemorrhage in primary midwifery care in the Netherlands. BMC. Pregnancy.Childbirth. 2013;13(1):194.
9. Hermens RP, Ouwens MM, Vonk-Okhuijsen SYet al. Development of quality indicators for diagnosis and treatment of patients with non-small cell lung cancer: a first step toward implementing a multidisciplinary, evidence-based guideline. Lung Cancer 2006;54(1):117-124.
10. Mourad SM, Nelen WL, Hermens RPet al. Variation in subfertility care measured by guideline-based performance indicators. Hum.Reprod. 2008;23(11):2493-2500.
11. Havenith B, van der Ploeg J. CAVE: Pre-hospital Obstetric Emergency Course Syllabus. Boxmeer: 2010.
12. Hermanides HS, Hulscher ME, Schouten JAet al. Development of quality indicators for the antibiotic treatment of complicated urinary tract infections: a first step to measure and improve care. Clin.Infect.Dis. 2008;46(5):703-711.
13. Ouwens MM, Marres HA, Hermens RRet al. Quality of integrated care for patients with head and neck cancer: Development and measurement of clinical indicators. Head Neck 2007;29(4):378-386.

Chapter 8

Umbilical Cord Prolapse in primary midwifery care in the Netherlands; a case series

Marrit Smit
Fleur Zwanenburg
Sabine van der Wolk
Barbara Havenith
Jos van Roosmalen
Annemieke Middeldorp

The Practising Midwife, in press.

ABSTRACT

Summary aim of this study was to gain insight into umbilical cord prolapse (UCP) reported by primary care midwives in the Netherlands. Eight cases of UCP were reported by midwives who participated in a postgraduate training programme developed for Dutch community-based midwives called 'CAVE' (pre-hospital obstetric emergency course). Cases were analysed using midwifery charts, ambulance report forms and discharge letters. Procedures to alleviate cord pressure, ambulance timing, mode of delivery and neonatal outcomes were inventoried. Diagnosis to delivery interval (DDI) and risk factors were identified. Six cases of UCP occurred at home. Risk factors such as malpresentation (breech) and/or unengaged presenting part were found in four cases, but only two (unengaged fetal head) were known to the midwife prior to birth. Retrograde bladder filling (2/8), manual elevation of the fetal head (7/8) and Trendelenburg position (1/8) was applied. DDI varied from 13-72 minutes. One infant died of severe birth asphyxia; the other infants recovered and were discharged in good condition. We conclude UCP at home leads to an increased DDI, but no association with a less favourable perinatal outcome was found. Continuing multidisciplinary training is encouraged and multidisciplinary guidelines should be developed and implemented.

INTRODUCTION

Umbilical Cord Prolapse (UCP), occurs in 2 of 1000 births. [1,2] Compression and spasm of cord vessels caused by cold or manipulation, can lead to asphyxia and perinatal death (91 per 1000 births). [1-4] Risk factors for UCP are malpresentation (e.g. breech or transverse position), preterm birth, (grand) multiparity, polyhydramnion, low birth weight and spontaneous (SROM) or artificial rupture of membranes (AROM) in case of unengaged fetal head. [1-3,5,6, 9-11] Manual elevation of the presenting part, Trendelenburg position and retrograde bladder filling are effective methods to relieve cord pressure. [1, 6, 9-11] Wrapping warm swabs around the cord to prevent reactive vasoconstriction are not proven to be beneficial. [12] When cord compression leads to an abnormal fetal heart pattern, birth within 30 minutes is indicated, either vaginally or by caesarean section (CS). [1,2] But, when cord pressure is sufficiently relieved to achieve a reassuring fetal heart pattern, birth within 60 minutes may still be acceptable. [12]

Almost one third of Dutch women give birth in primary care, of which 60% at home. [13] These are women at low risk of complications that indicate referral to secondary care, as described in the Dutch obstetric indication list. [14]

In order to reduce diagnosis-to-delivery interval (DDI), obstetrical emergency training is of great importance and should be regularly updated. [12,15,16] Studies have shown the effectiveness of obstetric emergency courses. [11] In the Netherlands, postgraduate courses such as MOET (Managing Obstetric Emergency and Trauma) for obstetricians and the pre-hospital emergency course, CAVE, for midwives are provided. [1,17]

UCP is not registered in the Dutch Perinatal Registry and therefore prevalence and mortality rates of UCP in the Netherlands are unknown. In addition, there are no national guidelines available concerning UCP. Protocols concerning ambulance care in obstetric emergencies do exist for ambulance personnel and birth attendants. [1,18,19] The Dutch government has set a statutory limit that ambulance referrals, from the initial call to the ambulance dispatcher to hospital arrival, should not exceed 45 minutes. [18,19,20,22] Both the geographic characteristics of the country and excellent road networks allow 99.7% of patients to reach an obstetric department within this time frame. [23]

The management and outcome of UCP in the Netherlands have not been evaluated yet. As home birth is an important part of the Dutch obstetrical system, we were interested in the management and outcomes of UCP occurring in primary midwifery care. We aimed to gain insight into UCP reported by primary care midwives in the Netherlands.

METHODS

This study received ethical approval from the Leiden University Medical Centre ethical board (Study code: P11.105).

Data collection

From April 2008 to April 2009, primary care midwives who attended the CAVE course were requested to participate in this study. Upon inclusion, midwives were asked to report obstetric emergencies such as post-partum haemorrhage (PPH), shoulder dystocia, umbilical cord prolapse, unexpected breech birth, (pre) eclampsia, and resuscitation of the newborn or mother. The midwives who agreed to participate in this study reported all obstetric emergencies for twelve consecutive months. The participants received a monthly e-mail linked to a password-protected Internet site. When reporting an obstetric emergency, the participant was asked to fill out a detailed case registration form (CRF) containing information on received care during pregnancy and birth, and maternal as well as neonatal outcome. Anonymous medical files, discharge letters and laboratory results were requested. If data were incomplete or inconclusive, the attending midwife was contacted for the missing documents. In this paper we report the case-series of UCP in this cohort. Medical files of UCP were assessed for parity, age, gestational age and fetal presentation (cephalic or breech and engagement in the pelvis). Items specifically concerning management of UCP, such as procedures to alleviate cord compression, time of onset of ambulance care, on-scene time by the ambulance, arrival in hospital (if applicable) and mode of delivery (vaginal or CS), were collected. Neonatal outcomes concerning mortality and morbidity (Apgar score, neonatal intensive care admission, birth asphyxia) and maternal complications were collected. The DDI was calculated for every case. We defined DDI as starting from the moment the diagnosis was made by either the woman when the umbilical cord was visualised outside the vagina or by the midwife during vaginal examination. We identified risk factors for UCP as noted on midwifery, ambulance and hospital charts.

Data was collected and transferred to Microsoft Excel 2010 (Microsoft, Redmond, Washington, USA). Medians and ranges were calculated using IBM Statistics Data Editor (SPSS), version 21 (SPSS Inc., Chicago, IL, USA).

RESULTS

All midwives (n= 584) who registered for the CAVE course were asked to participate, of which 548 (92%) agreed to contribute to this study. 312 obstetric emergencies were reported from April 2008 to April 2010: 192 cases of PPH (62%), 55 cases of shoulderdystocia

(17%), 45 cases of resuscitation of the newborn (14%), nine cases of unexpected breech birth (3%), eight cases of UCP (3%) and three other complications (1%).

Eight cases of UCP were reported during the study period. Of the eight reported cases, six occurred at home, one in a birthing centre and one was diagnosed after referral to secondary care because of meconium stained liquor. In this case UCP was managed by the obstetrician with the referring midwife present at birth. In three cases the umbilical cord was visible outside the vagina, while in five cases UCP was diagnosed through vaginal examination. Table 1 provides the relevant characteristics and a summary of each case. One case of UCP occurred at home in the preterm period (33+6 weeks) and the other five occurred during planned homebirths at term after spontaneous rupture of membranes. In four cases, the fetus was in vertex position with a sufficiently engaged head. In two cases a vertex position with a not sufficiently engaged fetal head was found. In the final two cases, breech presentation was an unexpected finding.

In one case UCP occurred after AROM (with engaged fetal head), in the other seven the membranes ruptured spontaneously. In all cases fetal condition was assessed prior to performing procedures; fetal bradycardia was found in three cases, with no abnormalities in the other five. Upon arrival of the midwife, procedures such as manual elevation of the presenting part (7/8), bladder filling (2/8), Trendelenburg position(1/8) and warm swabs (1/8) were performed (Table 1). In case 1, provided by a midwife who did not participated in the CAVE course yet, no procedures were performed to alleviate cord compression. The midwife reported in the medical file that procedures were considered, but fetal condition was assessed as optimal and immediate referral was preferred.

On arrival in hospital, CS was performed in seven cases (of which six with general anaesthesia) and one infant was delivered vaginally by vacuum extraction.

One infant was admitted to the neonatal intensive care unit and deceased four days after CS following severe birth asphyxia. The other seven infants recovered and were discharged from hospital in good clinical condition. No maternal morbidity was reported.

Table 2 shows relevant time intervals of midwifery, ambulance and obstetrical care in reported cases. In five cases the midwife was present at time of UCP. In the three cases where the midwife was not present (case 2, 4 and 5), she arrived at the woman's home in 11-15 minutes. In these cases, because spontaneous rupture of membranes (SROM) was the beginning of birth, this was the first contact with the midwife. In all cases of UCP at home, the ambulance was called within 10 minutes after diagnosis. In two cases (cases 4 and 5), the midwife called ambulance services immediately after she spoke to the woman on the phone (as UCP was diagnosed by the woman). As a result, in one case (case 5) the ambulance arrived at the scene before the midwife. In case 2, the midwife diagnosed UCP upon arrival and subsequently requested ambulance services which arrived in 16 minutes. Time between arrival of the ambulance at the scene of UCP and arrival in

hospital ranged from 15 to 40 minutes. The time spent on the scene by the ambulance personnel ranged from 3 to 33 minutes. In both cases where retrograde bladder filling was applied (case 4 and 5), the on-scene time was 20 minutes. In one case (case 3), the fire department was called in to airlift the woman from her home, as the stairs were too steep to carry the woman and midwife (who was continuously elevating the fetal head) downstairs by ambulance stretcher. In this case, on-scene time was 33 minutes. In the three remaining cases, the on-scene time was 3-5 minutes.
Time between hospital arrival and birth ranged from 6 to 37 minutes. The overall DDI varied from 13 to 72 minutes (median 41 minutes). The shortest DDI was found in the two cases of UCP that occurred in hospital and birthing centre. In the six cases of UCP at home, DDI ranged from 31- 72 minutes. The DDI of the infant that later deceased was 47 minutes (case 5). Two infants with an Apgar score < 7 at five minutes had a DDI of 47 and 71 minutes respectively. Six infants with an Apgar score of ≥ 7 at five minutes had a DDI of 13 to 72 minutes (median 31 minutes).
Risk factors for UCP were assessed for all cases (Table 3). Seven women were multiparous, but no grand multiparity was found. In two cases (case 1 and case 6), a risk factor for UCP (non-engaged fetal head) was known to the midwife prior to labour. In both cases, the midwife had instructed the woman to lie down immediately after spontaneous rupture of membranes and call the midwife. Prior to birth, the midwives had found no reason why the fetal head was not engaging (e.g. low-lying placenta), in agreement with the obstetric indication list. In case 1, the midwife was called after rupture of membranes and the fetal head was assessed as sufficiently engaged. At dilatation of 5 cm no umbilical cord was palpable. Surprisingly, however, at eight cm dilatation UCP was found. In case 6, the woman called the midwife with contractions and intact membranes. Upon arrival, SROM and UCP occurred. In cases 2 and 4, unexpected breech positions were found by the midwife upon arrival. No polyhydramnion was diagnosed in any of the cases.

DISCUSSION

This study of eight cases of UCP seems to indicate that the increased diagnosis to delivery interval (DDI) associated with UCP at home does not lead to less favourable perinatal outcomes. In all cases, the women were immediately referred to secondary care, and procedures such as retrograde bladder filling, manual elevation of the fetal head and Trendelenburg position were performed. All but one infant was born through caesarean section, one infant died of severe birth asphyxia. Risk factors such as malpresentation (breech) and/or unengaged presenting part were found in four cases, but in only two cases (unengaged fetal head) this was known to the midwife prior to birth.

Strengths and limitations

This is the first study on UCP in primary midwifery care in the Netherlands. Ambulance care in the Netherlands concerning obstetric referral has been studied, but this is the first time ambulance transfer specifically for UCP has been evaluated. [20, 24] A study on referral after UCP in a country such as the Netherlands, where primary midwifery care is embedded in the health care system and there is good cooperation with both paramedic personnel and obstetricians, has not been performed. It is probable that this well organised system contributes to more timely arrival of medical assistance (midwife and ambulance paramedics). Subsequently, as midwives are trained to perform the necessary procedures to alleviate cord compression if needed, fetal condition can be stabilised before transfer to hospital. As described in other studies, if procedures to reduce cord compression are applied, the urgency to deliver immediately might be less of an issue. [2, 25] Although only eight cases were studied, these factors as described above could explain that no direct relation between DDI and perinatal outcomes was found.

Earlier studies have reported that a prolonged DDI in case of UCP increases the risk of low Apgar score, stillbirth and neonatal death. [3, 26] Other studies, however, found no direct relation between DDI and perinatal outcomes (perinatal mortality and NICU admission), but prior hypoxia, CTG abnormalities, intra uterine growth restriction and prematurity were found to influence outcomes. [10,27,28] UCP occurring outside hospital setting has not been structurally evaluated, but has sporadically been mentioned in publications. In virtually all cases mentioned in these studies, long DDI's (over 100 minutes) and high perinatal mortality is reported. [3, 29] We suspect that these results are based on research conducted in care systems where no assistance at home is provided to reduce cord pressure and no quick referral to hospital is possible. It is evident that DDI will be longer when a patient needs to be transferred to hospital per ambulance.

UCP is a rare complication, which comprised only 3% of all obstetric emergencies from home birth settings during the study period. Consequently, the data set for this study is small. Even with so few cases however, we believe it provides valuable insights into the management of UCP by midwives, ambulance services and obstetricians.

Interpretation

In this study we found the shortest DDI in the two cases of UCP that occurred in hospital and birthing centre (cases 7 and 8). But, with an overall median DDI of 41 minutes, the Dutch health care system seems to be able to act within acceptable limits. In the case where the infant deceased (case 5) the DDI was 47 minutes. Although this is in the upper half of DDI's found, case 2, 3 and 4 had longer DDI's (56, 72 and 71 minutes respectively) and all had favourable perinatal outcomes. In this study, we found that DDI alone does not give adequate explanation for adverse perinatal outcomes.

Risk factors such as malpresentation (breech) and/or unengaged presenting part were found in four cases, but in only two of these, the condition (unengaged presenting part) was known to the midwife prior to birth. In the other four cases no risk factors were present, except for AROM in one case, which could have possibly resulted in UCP. Our results show that UCP may occur in a low-risk population without any warning signs. In such a situation, quick and adequate measures by the midwife are of great importance.

In three cases the umbilical cord was visualised outside the vagina. UCP might be a much more dangerous complication when the umbilical cord extends outside the vagina, in this study we found lower Apgar scores in all these cases. It is possible that the cord had been prolapsed for a longer time, but went unnoticed, and that the fetal condition had already deteriorated. Additionally, spasm of cord vessels when exposed to cold contributes to acute hypoxia of the unborn child. Also, as the fetal head provides more cord compression (compared to breech position), cephalic position increases the risk of hypoxia. In these cases, immediate relief of cord pressure and reducing cord spasm is crucial.

Although retrograde bladder filling is effective, it is time-consuming. However, the time it takes for the ambulance to arrive provides the midwife with the opportunity to perform this procedure. When the ambulance is already present the midwife can decide not to perform bladder filling, but immediately transfer to hospital. For example, case 5 illustrates both how UCP can occur without any other warning sign (such as contractions), and the procedural dilemma facing the midwife. In hindsight, the fetal condition in this case was already very poor when the midwife arrived. The ambulance had arrived before the midwife and immediate referral might have been more effective than retrograde bladder filling.

In case 3, airlifting the woman evidently caused a great amount of delay. In retrospect, retrograde bladder filling might have been more effective as the woman may have been able to be carried down by ambulance stretcher or could have walked down the stairs herself. Decision-making by the midwife in assessing the time needed to transfer is of great importance and should continue to be addressed in obstetric emergency training programs.

The midwives who had attended the CAVE course were recently trained (within 12 months) and updated on the latest insights into management of UCP. Virtually all midwives in the Netherlands have now participated in the CAVE course and it is well established that training has a positive effect on management of obstetric emergencies. [11] We believe that, although a small amount of cases was reported and studied, our findings accurately reflect the current management of UCP occurring in primary midwifery care in the Netherlands.

In case of imminent UCP (regardless of whether the woman is in primary or secondary care) both the woman and medical personnel could consider calling in a midwife to perform these procedures in anticipation of transfer to hospital. Further studies must be performed to explore the additional value of midwifery assistance at home versus direct transfer by ambulance.
As birth in primary care is still preferred by many women in the Netherlands, and UCP does occur in these women at low risk, we recommend development and implementation of multi-disciplinary guidelines for UCP management in a community setting. In addition, even if women are in secondary care, UCP can occur at home (e.g. preterm rupture of membranes) and such guidelines could prove invaluable.

Key Conclusions

UCP at home leads to an increased DDI, but no association with a less favourable perinatal outcome was found. We strongly believe that optimal skills of UCP-management can have a significant positive influence on perinatal outcomes. Training care providers in management of obstetric emergencies and effective decision-making is therefore essential. Continuing multidisciplinary training is encouraged and multidisciplinary guidelines should be developed and implemented.

Acknowledgements

We like to thank all midwives who participated in this study for reporting their obstetric emergencies. And we thank Jasper Smit for proofreading the paper.

Table 1. Maternal, foetal and labour characteristics in cases of umbilical cord prolapse

Case	Parity, gestational age	Place of UCP	Position of UCP	Presentation and position	AROM SROM	Dilatation of cervix (cm)	Foetal condition (assessed prior to manoeuvres)	Performed manoeuvres to alleviate cord compression	Mode of delivery	Apgar score	Neonatal mortality	DDI Diagnosis to delivery interval
1	P1, 38+2	Home	Inside vagina	Vertex, not engaged	SROM	8-9	Normal foetal heart beat[1]	None	VE	9/10/10	no	35
2	P0, 33+6	Home	Outside vagina	Breech, not engaged	SROM	7-8	80-100 bpm	Manual elevation, warm gauze	CS	4/7/10	no	56
3	P1, 39+3	Home	Inside vagina	Vertex, engaged	AROM	4	Normal foetal heart beat[1]	manual elevation, Trendelenburg position	CS	10/10	no	72
4	P0,40+4	Home	Outside vagina	Breech, not engaged	SROM	5	Normal foetal heart beat[1]	Manual elevation, retrograde bladder filling	CS	2/6/8	no	71
5	P1, 40+1	Home	Outside vagina	Vertex, engaged	SROM	4	70-80 bpm	Manual elevation, retrograde bladder filling	CS	2/4/6	Deceased	47
6	P1,40+1	Home	Inside vagina	Vertex, not engaged	SROM	4	110 bpm	Manual elevation	CS	5/10/10	no	31
7	P1, 40 +0	Birthing center[2]	Inside vagina	Vertex engaged	SROM	5	Normal foetal heart beat[1]	Manual elevation	CS	9/10/10	no	20
8*	P2, 40+2	Hospital MSL[3]	Inside vagina	Vertex engaged	SROM	7	Normal foetal heart beat[1]	Manual elevation	CS	7/9/10	no	13

* Care was provided by the obstetrician, but the referring midwife was present
[1] Normal foetal heart beat = 110 - 160 with variability as assessed by the midwife using a doptone. [2] birthing clinic adjacent to hospital
[3] Meconium stained liquor.
SROM = spontaneous rupture of membranes; AROM= artificial rupture of membranes; VE= Vacuum extraction; CS = caesarean section

Table 2. Timing of midwifery, ambulance and obstetrical care in reported cases of UCP (in minutes).

Case nr	Parity and gestational age (weeks + days)	Place of UCP	Arrival of midwife after UCP	Ambulance call after UCP	Ambulance arrival after UCP	On scene time Ambulance	Arrival in hospital after UCP	DDI Diagnosis to delivery interval
1	P1, 38+2	Home	0	2	15	4	30	35
2	P0, 33+6	Home	11	16	28	3	43	56
3	P1, 39+3	Home	0	10	20	33†	35	72
4	P0, 40+4	Home	15	5	21	20	61	71
5	P1, 40+1	Home	17	3	14*	20	33	47
6	P1,40+1	Home	0	1	6	5	25	31
7	P1, 40 +0	Birthing center[1]	0	-	-	-	9	20
8	P2, 40+2	Hospital MSL[2]	0	-	-	-	-	13

* Ambulance was at the scene before the midwife arrived
[1] Birthing clinic adjacent to hospital; [2] Meconium stained liquor
† The fire department was called in to airlift the woman from her home

Table 3. Assessed risk factors for UCP

Case nr	(grand) Multiparity (≥ 5 births)	Malpresentation (breech, transverse and unstable lie)	Unengaged presenting part	Prematurity < 37 weeks	AROM	Low birth weight, (less than 2.5 kg)	Polyhydramnion
1	no	No (vertex)	Yes*	no	no	no	no
2	no	Breech*	yes	yes	no	yes	no
3	no	No (vertex)	no	no	yes	no	no
4	no	Breech	yes	no	no	no	no
5	no	No (vertex)	no	no	no	no	no
6	no	No (vertex)	Yes*	no	no	no	no
7	no	No (vertex)	No	no	no	no	no
8	no	No (vertex)	no	no	no	no	no

* The unengaged position or breech position was known by the midwife previously to the onset of birth.

REFERENCES

1. Howell C, Grady K and Cox C (2007). MOET Course Manual, London: RCOG Press.
2. RCOG (2008). Umbilical cord prolapse, Guideline No 50, London: RCOG.
3. Murphy DJ and MacKenzie IZ (1995). 'The mortality and morbidity associated with umbilical cord prolapse'. Brit Jour Obs Gyn (BJOG), 102(10): 826-830.
4. Chandra S, Ramji S and Thirupuram S (1997). 'Perinatal asphyxia: multivariate analysis of risk factors in hospital births'. Indian J Pediatr, 34(3): 206-212.
5. Gabbay-Benziv R, Maman M, Wiznitzer A et al (2014). 'Umbilical cord prolapse during delivery - risk factors and pregnancy outcome: a single center experience'. J Mat-Fetal Neon Med, 27(1): 14-17.
6. Goldthorp WO (1968). 'Umbilical cord prolapse, the midwife's part'. Nur Mirror Midwives J, 127(11): 19-21.
7. Mesleh R, Sultan M, Sabagh T et al (1993). 'Umbilical cord prolapse'. Journal of Obstetrics and Gynaecology, 13(1): 24-28.
8. Uygur D, Kis S, Tuncer R et al (2002). 'Risk factors and infant outcomes associated with umbilical cord prolapse'. Int J Gynecol Obstet, 78(2): 127-130.
9. Katz Z, Shoham Z, Lancet M et al (1988). 'Management of labor with umbilical cord prolapse: a 5-year study'. O&G, 72(2): 278-281.
10. Caspi E, Lotan Y and Schreyer P (1983). 'Prolapse of the cord: reduction of perinatal mortality by bladder instillation and cesarean section'. Isr J Med Sci, 19(6): 541-545.
11. Siassakos D, Hasafa Z, Sibanda T et al (2009). 'Retrospective cohort study of diagnosis-delivery interval with umbilical cord prolapse: the effect of team training'. BJOG, 116(8): 1089-1096.
12. RCOG (2008).Umbilical cord prolapse, Guideline No 50, London: RCOG.
13. SPRN (2011). Perinatal Care in the Netherlands, 2010 (in Dutch). Utrecht.
14. Dutch Maternity Care Committee (2003). Obstetric Indication List (Verloskundig Vademecum. Eindrapport van de Commissie Verloskunde van het College voor zorgverzekeringen, in Dutch), Diemen.
15. Crofts JF, Bartlett C, Ellis D et al (2006). 'Training for shoulder dystocia: a trial of simulation using low-fidelity and high-fidelity mannequins'. Obstet Gynecol (O&G), 108(6): 1477-1485.
16. Crofts JF, Bartlett C, Ellis D et al (2007). 'Management of shoulder dystocia: skill retention 6 and 12 months after training'. O&G, 110(5): 1069-1074.
17. Havenith B and van der Ploeg J (2010). CAVE: Pre-hospital Obstetric Emergency Course Syllabus (in Dutch). Netherlands: Boxmeer.
18. AN (2011). Ambulance Care In Sight (Ambulances in Zicht, in Dutch). Tiel: HSGB.
19. AN (2012). Ambulance Protocols, short version (Korte handleiding over de ambulanceprotocollen, in Dutch), Zwolle: AN.
20. de Borst J and Wiegers TA (2010). Organisation of Dutch obstetric emergency care (Organisatie van spoedzorg in de verloskundige keten, in Dutch), Utrecht: NIVEL.
21. Wiegers TA and de Borst J (2013). 'Organisation of emergency transfer in maternity care in the Netherlands'. Midwifery, 29(8): 973-980.
22. Klink A (2007). Care institutions Act (vaststelling beleidsregels ex artikelen 4 en 13 Wet toelating zorginstellingen). In: Staatscourant (in Dutch).
23. Giesbers H, Eskes M, Waelput AJM et al (2012). Ambulance transfer time to an obstetrical department (Reistijd overdag naar ziekenhuis met afdeling verloskunde 2011, in Dutch). In: Volksgezondheid Toekomst Verkenning, Nationale Atlas Volkgsgezondheid (in Dutch), Bilthoven: RIVM.

24. Ravelli AC, Rijninks-van Driel GC, Erwich JJ et al (2011). 'Provinciale verschillen in perinatale sterfte en reistijd tot ziekenhuis'. Ned Tijdschr Geneeskd, 155(9): A2689 (in Dutch).
25. Thomas J, Callwood A and Paranjothy S (2000). 'National Sentinel Caesarean Section Audit: update'. Pract Midwife, 3(11): 20.
26. Yla-Outinen A, Heinonen PK and Tuimala R (1985). 'Predisposing and risk factors of umbilical cord prolapse'. Acta Obstet Gyn Scan, 64(7): 567-570.
27. Khan RS, Naru T and Nizami F (2007). 'Umbilical cord prolapse - a review of diagnosis to delivery interval on perinatal and maternal outcome'. J Pak Med Assoc, 57(10): 487-491.
28. Chetty RM and Moodley J (1980). 'Umbilical cord prolapse'. South Afr Med J, 57(4): 128-129.
29. Koonings PP, Paul RH and Campbell K (1990). 'Umbilical cord prolapse. A contemporary look'. J Reprod Med, 35(7): 690-692.

Chapter 9

Feasibility of pulse oximetry for assessment of infants born in community based midwifery care

Marrit Smit
Angelina Ganzeboom
Jennifer Dawson
Frans Walther
Jacqueline Bustraan
Jos van Roosmalen
Arjan te Pas

Midwifery. 2014;30(5):539-543.

ABSTRACT

Objective
To evaluate the feasibility of using pulse oximetry (PO) for evaluating infants born in community-based midwifery care.

Design
A prospective, observational study of infants born after midwifery supervised (home) births.

Setting
27 midwives from seven practices providing primary care in (home) births used PO at birth or the early puerperal period over a ten-month period. Data were obtained on the effect of PO on outcome, interventions and decision-making. Midwives were surveyed about applicability and usefulness of PO. Participants: 153 infants born in primary midwifery care.

Findings
All births were uncomplicated except for one infant receiving supplemental oxygen and another was mask ventilated. In 138/153 (90%) infants PO was successfully used and 88% of midwives found PO easy to use. In 148/153 (97%) infants PO did not influence midwives' clinical judgment and referral policy. In 5/153 (3%) infants, midwives were uncertain of the infant's condition, but PO measurements were reassuring. In case of suboptimal neonatal condition or resuscitation, 100% of midwives declared they would use PO again.

Key conclusions
It is feasible to use PO in community based midwifery care, but not considered an important contribution to routine evaluation of infants. Midwives would like to have PO available during suboptimal neonatal condition or when resuscitation is required.

Implications for practice
PO can be applied in community based midwifery care; it does not lead to insecurity or extra referral. Further research on a larger group of infants must show the effect of PO on neonatal outcomes.

INTRODUCTION

The Netherlands is one of few industrialised countries where community based midwifery-led (home) births still occur following low risk pregnancy. Almost one third of all births (32.9%) are supervised by a community-based midwife, without any obstetric involvement. [1] Only if complications occur, the obstetrician is consulted. After birth, placental oxygenation ceases, neonatal lungs expand and blood oxygenation is primarily provided by breathing. If this transition proceeds normally, neonatal organs are oxygenated and subsequently lead to high oxygen saturation (the percentage of haemoglobin binding sites in the bloodstream occupied by oxygen). Immediately after birth, an infant's condition is assessed by observation of breathing, heart rate, skin colour, muscle tone and reflexes (irritability), also known as the Apgar score. [2,3] It seems plausible that if a high Apgar score is assessed, it means that the actual oxygen saturation is also high. Studies have shown, however, that judging oxygen saturation based on the infant's colour can be very inaccurate. [4] Also, heart rate is often inaccurate and underestimated (lower than the actual heart rate) by auscultation or palpation. [5] Pulse oximetry (PO) offers objective and accurate values of oxygen saturation and heart rate and also, interventions (such as assisted ventilation) do not need to be interrupted by manual auscultation. [4,5] Therefore, PO could help to evaluate the need for, and response to resuscitation. The actual prevalence of neonatal resuscitation in community based midwifery care in the Netherlands is unknown. However, 0.9% of all infants born in community based midwifery care have an assessed Apgar score of <7 at 5 minutes after birth and a substantial number of these infants require some form of support and/or resuscitation. [1, 3] One can assume that in these cases, oxygen saturation was not optimal but it is unknown whether PO would have been helpful in these cases. Both the Dutch Association of Paediatricians (NVK) and the Royal Dutch Organization of Midwives (KNOV) recommend the use of PO when resuscitation is indicated. [3,6] International guidelines recommend PO when resuscitation can be anticipated, when positive pressure is administered for more than a few breaths, when cyanosis is persistent, or when supplementary oxygen is administered. [7] In addition, recent studies recommend PO as a screening tool for congenital heart disease and the need for implementation in practice. [8, 9, 10] In the Netherlands, however, this has not been implemented. Currently, midwives do not use PO as standard care, when resuscitation is necessary or for screening. This prompted us to perform a pilot study in the use of PO in midwifery supervised (home) birth. We aimed to assess the feasibility of a PO for midwives to assess neonatal condition after birth. We were interested in the applicability and usefulness of the device and if using a PO changed referral behaviour of the midwife in charge. Also, we aimed to explore whether midwives would like to incorporate PO routinely in their daily practice.

METHODS

Twenty-seven midwives in Leiden region agreed to participate in the study. The study was conducted from April 2011 to February 2012. We requested midwives to use PO in all births they supervised in primary care. Midwives were asked to use the PO for evaluating all infants after birth, and were encouraged to use the device when in doubt of the infant's clinical condition (directly after birth or in the early puerperal period) or when support of transition or resuscitation was needed. As this study aimed to assess the feasibility of PO in daily midwifery practice, no exclusion criteria were applied. The midwives received an update in neonatal resuscitation and were trained in using PO and interpreting its measurements and how to proceed in case of alarm messages displayed on the device. Using previously published percentiles for heart rate and oxygen saturation by Dawson et al., we defined 10th percentile values as pre-lower limit (Fig. 1). [11,12]

There were a limited number of Masimo hand held pulse oximeters (Masimo Corporation, Irvine, California) available and it was not possible to equip every midwife with a device. Therefore, we allocated one PO to each midwifery practice. The community based midwife 'on call' had a device at her disposal as often as possible. Initially, a Masimo Rad-5 was used but replaced by Rad-8, because of technical problems and frequent false alarms with the Rad-5. Both devices contained identical software (Signal Extraction Technology, SET, V.7.8.0.1.) and were set to read measurements with 2-second averaging intervals and maximal sensitivity. [12] When PO was used directly after birth, the midwives were instructed not to let the device interfere with normal procedures, such as skin-to-skin contact or immediate breast feeding. The umbilical cord was clamped in adherence to the normal procedures. In the Netherlands, late-cord clamping is generally applied; this involves clamping the umbilical cord at least one minute after birth or when cord pulsation has ceased. [13] In adherence to other studies conducted on PO in term infants, midwives were instructed to place a disposable sensor (Masimo Low Noise Cable Sensor (LNCS®) Newborn Sensor) around the infant's right wrist. [12,14] PO was switched on after applying the sensor to the infant; this offers the quickest display of data. [4,12,14] A preductal oxygen saturation and heart rate were obtained for a minimum of ten consecutive minutes. Preductal oxygen is the highest oxygenated blood in the infants' circulation due to the preferential flow through the foramen ovale to the left atrium. [15] Apgar scores were assigned by the community based midwife in charge. Interpretation and action based on the obtained data was also at the discretion of the midwife in charge. After use of PO, participants were requested to fill in a case report form (CRF), containing characteristics of mother and infant, place of birth, interventions after birth and, if applicable, referral to the paediatrician. Subsequently, midwives were surveyed concerning usefulness, applicability and decision-making when using PO. Also, in case PO was not used, we

requested the community based midwife to report the reason(s) on a separate form. After the ten-month study period, an evaluation questionnaire was sent to all participants. Specific questions on practical use of PO and possible implementations in practice were asked. Furthermore, data on all deliveries and neonatal referral during the study period of all practices were obtained in order to compare groups. Approval for this study was obtained by the Leiden Medical Ethics Committee in February 2011. In all midwifery practices, clients were informed about the study through wall posters in waiting rooms and flyers were distributed antenatally. Midwives informed and subsequently asked clients and their partners to participate in the study. Verbal parental consent was obtained by the community based midwife, prior to the onset of birth. Also, all paediatricians in Leiden region were informed via e-mail regarding this study and possible referrals based on PO results. Data collected on the devices were downloaded using TrendCom Trend Download Software and stored using Excel. Analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 17 (SPSS Inc., Chicago, IL, USA). Analyses were conducted using the $\chi 2$ test. Statistical significance was considered if $p<0.05$.

Findings

During the study period from April 2011 to February 2012, the seven participating practices recorded a total of 2665 births. Of this group, 819 (32%) births occurred in community based midwifery care of which 401 (49%) children were born at home and 418 (51%) were born in hospital or birth clinic. In 666/819 deliveries (81%), PO was not used. Reasons were: device not in possession at time of birth (37%), no time to prepare the oximeter due to fast birth (16%), forgot to use the device (26%) or device malfunctioned (battery empty) (21%). Thus, PO was used in 153/819 (19%) infants, of these, 95 (95/153) (62%) were born at home and 58 (95/153) (38%) were in hospital or birthing clinic. There were no differences in clinical characteristics between the PO group and the group where no PO was used; however there were more home births in PO group (Table 1).

In 144/153 (94%) infants the oximeter was solely used for research purposes. In this group 5/144 (3%) infants were referred to hospital for paediatric consultation (three infants needed glucose monitoring for large for gestational age), in one infant neonatal infection was suspected and one infant had an irregular heartbeat during second stage. All PO measurements were within the normal ranges and the midwives stated that PO measurements had not influenced their decision to refer these infants.

In eight out of 153 (6%) births PO was used because the infant's condition was considered suboptimal. In five (5/8) infants there was uncertainty regarding the infant's colour (ranging from 'grey' to 'pale-blue', from directly post-partum or later up to eight days post-partum); one infant had a short period of cyanosis after regurgitating; the midwife

was reassured by quick recovery and normal PO values. In three (3/8) infants breathing was considered suboptimal; of which one infant received supplemental oxygen directly after birth for a short period. In these cases, oxygen saturation and heart rate values were within normal ranges and the midwives were reassured. In six (6/8) infants the midwives decided not to refer. In one infant, the paediatrician was consulted by phone, and it was decided not to refer. The infant that became cyanotic after regurgitation was referred on parent's explicit request, but observation in hospital was uneventful. According to the midwives, the reassuring PO measurements contributed to the decision not to refer in three (3/8) infants. In the other five (5/8) infants, the midwife stated the measurements did not influence their decision at all.

In one (1/153) infant PO was used because the infant was born asphyxiated and resuscitation was needed. The midwife considered PO very useful as feedback regarding the effect of resuscitation; it gave her reassurance that mask ventilation was adequate. Admission to the neonatal intensive care followed with quick recovery (Sarnat score 1) and the infant was discharged three days after birth. Besides one case where resuscitation was needed, no major events or morbidities were found in the rest (152/153 (99%)) of the infants. Also, in the puerperal period, no subsequent neonatal referrals in this group were reported.

Midwives reported feeling insecure after using PO in 3/153 (2%) infants. In one infant measurements were normal, but PO was used for the first time. In two infants PO frequently alarmed for low heart rate, while this could not be confirmed by auscultation. In all three infants the midwives decided not to refer the infant.

In 15/153(10%) infants PO measurements, or parts of it, were considered unreliable as extreme values were recorded in otherwise clinically stable infants. In all these infants a 'low signal' alarm was frequently given. None of these measurements led to referral, but in two cases midwives and parents were agitated by the alarms.

The majority of midwives (88%) found the device 'quite easy' or 'very easy' to use (Table 2).

Midwives felt that PO provided useful information in 23% of the occasions and indicated that they would use PO again if they had one available in 42%. PO was used by 56% of midwives between three to six times per ten births and 11% of midwives used PO more than six times per ten births. One midwife did not use the device at all and the remainder (33%) used the device sometimes or rarely. In 96% PO was considered user-friendly. Midwives experienced that most parents (89%) were positive about PO use. In none of the occasions, midwives received negative feedback from parents about PO use. Answers to questions concerning its use in daily practice can be seen in Fig. 2. Midwives would use the device when resuscitation is needed (100%), in preterm delivery (56%), when sepsis is suspected (61%), to support decision to refer (56%) or not to refer (44%), in

prolonged second stage (33%) and unexpected meconium stained liquor at birth (33%). In case of suboptimal colour or breathing, the majority (82%) indicated to use PO (Fig. 3) Only one of seven practices is currently considering purchasing a pulse oximeter. In four practices its purchase has been discussed but decided not to buy one and two practices have not yet discussed this. The midwives indicated in the questionnaire that the costs of purchase, maintenance and actual weight and size of the device might contribute to the reluctance of purchasing a PO.

DISCUSSION

We observed that it was feasible for midwives to use PO in community based midwifery care PO only influenced decision making when it was used on indication and its use could prevent unnecessary referral. We observed that the midwives found the PO easy to implement in their daily practice. The midwives would like to have a pulse oximeter to their disposal when in doubt of neonatal condition, and they all prefer to have the device when neonatal resuscitation is indicated. In almost all infants measurements were within normal ranges and this confirmed the midwife's clinical evaluation. In a few occasions (15/153) heart rate was unexpectedly outside the normal range, leading to some insecurity. However, in these isolated cases the midwives still preferred to rely on their clinical judgment. We anticipated on increased referral to paediatricians at regional hospitals during the time of this study due to odd heart rate or oxygen saturation. However, this did not occur. PO was used in response to a suboptimal clinical condition in only a few occasions (8/153). In these cases, PO values were reassuring, supporting the midwife's decision not to refer the infant. One infant was successfully resuscitated and referred to the paediatrician. One infant was referred on specific request of the parents, but evaluation of the paediatrician was uneventful. During the study period we found a very low prevalence of compromised infants; only one infant needed resuscitation (0.7%). In addition, when a midwife was in doubt of the infant's condition, PO results showed reassuring values. Both findings are likely the result of a good risk selection of pregnancies by the community-based midwives for midwifery led births. Currently, in the clinical setting, a shift in policy is taking place in favour of PO. Before this study, the magnitude of the effect of PO in low risk infants born in community based midwifery care has never been explored. Despite lacking evidence supporting the use of PO in primary care, the national resuscitation guidelines of the Royal Dutch Organization of Midwives (KNOV) recommend using PO in case of resuscitation. [3] Apparently this recommendation has not been put into practice. The reason for this is unclear, but the very low incidence of resuscitation, as confirmed in this study, probably plays a role in this. However, in the case where resuscitation was needed the midwife considered

PO very helpful for evaluating the effect of mask ventilation. Midwives participating in this study using PO confirmed that they predominantly rely on clinical findings and did not consider PO as a valuable asset. However, in contrast to this is the paradoxical finding that midwives would like to have a pulse oximeter at their disposal in cases of suboptimal condition or when resuscitation is required. Apparently PO is appreciated in the few occasions when reassurance or confirmation of clinical assessment or intervention is needed. Traditionally, midwives are trained in clinical evaluation of the infant without the use of any technical device. However, as technology and screening devices are increasingly introduced in medical practice, the findings of this study could start a discussion introducing PO as part of the standard equipment in midwifery practice. Also, as 89% of parents were positive on PO use, it might also meet a need from the parents' perspective and contribute to the sense of safety in birth in primary midwifery care. However, neonatal resuscitation in primary care practices is rare and practical matters such as purchase costs and weight of the device could make midwives reluctant to purchase a PO. A recent meta-analysis showed that routine PO was found to be a highly specific tool with very low false positives to detect congenital heart disease. [16] The American Academy of Paediatrics recommends using PO for screening. [8] The different set-up of perinatal care of low risk infants raises issues concerning the expediency of this screening in the Netherlands. One of those issues concern logistics as most low-risk infants are not born or checked in hospital setting. This implicates that midwives and family doctors, who are predominantly responsible for the assessment of infants at birth and later on, need to be trained and have access to PO for screening, and so far this has not been implemented in the Netherlands. Cost-effectiveness of PO for screening purposes in midwifery practice in the Netherlands should be further explored. If a pulse oximeter would be used as a screening for congenital heart diseases as well, practical concerns would perhaps be less of an issue.

This is the first study exploring PO use in community based midwifery care. Therefore, comparison with studies in this primary care setting cannot be made. Sample size is too small to draw conclusions on the effect of using PO on referral and neonatal outcomes. Although our results suggest a reduction in neonatal referral due to PO use, further research must be performed on a larger group of infants. This study provided sufficient rationale to further explore the use of PO in community based midwifery care.

Conclusions

It is feasible to use PO in community based midwifery care, especially when in doubt of neonatal condition or in case of resuscitation. Use of PO did not lead to insecurity or extra referral. Future research must show whether the use of PO has effect on neonatal outcomes.

Conflict of interest statement
None.

Acknowledgements
We would like to thank the midwives in Leiden region for participating in this study and providing us with the necessary data before, during and after the study period. We are very grateful for all the parents who allowed the midwife to take measurements on their babies.
We thank the Raul Bénis of Masimo Corporation for his technical support during the study period.

Table 1. Characteristics of births supervised by a community based midwives during the study period, divided in pulse oximeter use and no pulse oximeter use.

Birth characteristics	Pulse oximeter use n = 153 (%)	No pulse oximeter use n=666 (%)	p-value
Place of Birth	Home 95 (62. 1) Hospital/birthing clinic 58 (37.9) Total 153(100)	Home 306 (45. 9) Hospital/birthing clinic 360 (54.1) Total 666 (100)	< 0.05
Gestational age, mean (range), week	39+6 weeks (37+3 - 41+6)	39+5 weeks (37+2 - 41+6)	Not significant
Birthweight, mean, ± SD, grams	3542 gram (± 462)	3573 gram (± 425)	Not significant
Apgar Score at 1 min, median (IQR)	9 (9-9)	9 (9-9)	Not significant
Apgar Score at 5 min, median (IQR*)	10 (9-10)	10 (10-10)	Not significant
Apgar Score at 10 min, median (IQR)	10 (10-10)	10 (10-10)	Not significant

* Interquartile range

Table 2. Results of questions after every use of the pulse oximeter concerning applicability and decision-making

			Scoring, %					**Total %**
Question	**N**	**Mean Score ± SD**	**1 Yes, absolutely**	**2**	**3**	**4**	**5 No, totally not**	
1. The pulse oximeter is easy to use	135	1.7 (±0.98)	53.3	34.8	3.0	6.7	2.2	100
2. The pulse oximeter provides additional useful information	149	3.46 (±1.31)	10.1	13.4	26.2	21.5	28.9	100
3. Use of the pulse oximeter makes me insecure	150	4.61 (±0.76)	1.3	0.7	6.7	18.0	73.3	100
4. My decision to refer to a paediatrician or not was influenced by use of the pulse oximeter	148	4.59 (±0.90)	2.7	0.7	10.1	7.4	79.1	100
5. I would use the pulse oximeter again in a similar situation	151	2.86 (±1.51)	29.1	12.6	23.2	13.2	21.9	100

Figure 1. Based on previously published percentiles by Dawson et al., [11,12] defined 10th percentiles for oxygen saturation and heart rate used as reference by midwives in preductal measurements in infants.

Minutes after birth	1 minute	2′ minutes	5′ minutes	7′ minutes	>10′ minutes
Spo2 (%)	**35**	**40**	**75**	**85**	**90**
Heart Rate (bpm)	**30**	**80**	**120**	**120**	**120**

Figure 2. Midwife responses for reasons they would use a pulse oximeter directly after birth.

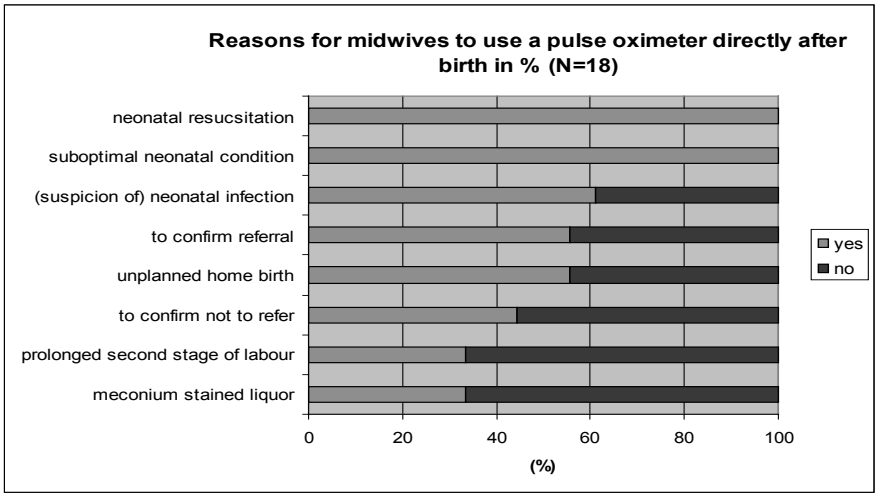
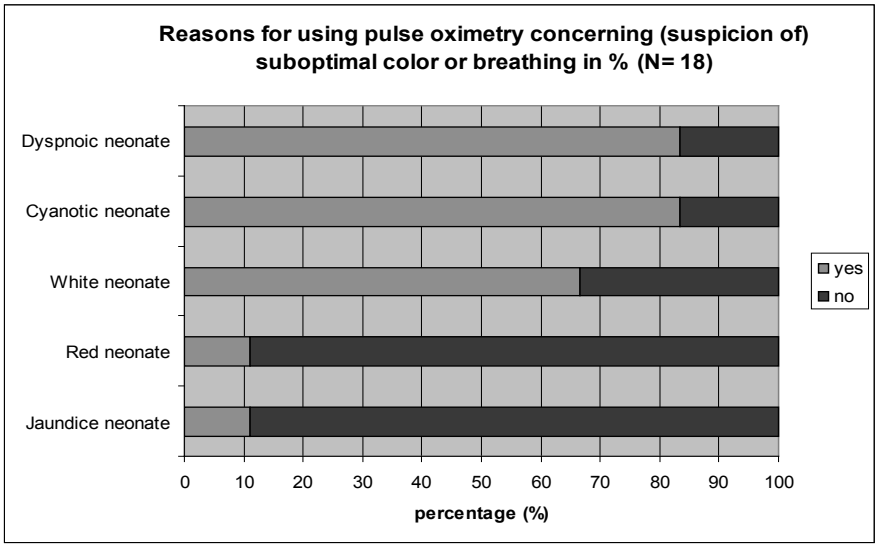


Figure 3. Evaluation questionnaire after the study period; reasons for midwives for using a pulse oximeter in case of (suspicion) of suboptimal colour.



REFERENCES

1. Stichting Perinatale Registratie Nederland, 2009. Perinatal Care in the Netherlands 2008. Stichting Perinatale registratie Nederland, Utrecht.
2. APGAR, V., 1953. A proposal for a new method of evaluation of the newborn infant. Current Researches in Anesthesia & Analgesia 32, 260–267.
3. van der Stouwe, R., 2009. Standpoint Resuscitation of the Newborn at Home Birth in Primary Midwifery Care. Royal Dutch Organisation of Midwives (KNOV)
4. O'Donnell, C.P.F., Kamlin, C.O., Davis, P.G., Morley, C.J., 2005. Feasibility of and delay in obtaining pulse oximetry during neonatal resuscitation. The Journal of Pediatrics 147, 698–699.
5. Kamlin, C.O., O'Donnell, C.P.F., Everest, N.J., Davis, P.G., Morley, C.J., 2006. Accuracy of clinical assessment of infant heart rate in the delivery room. Resuscitation 71, 319–321.
6. van den Dungen, F.A., van Veenendaal, M.B., Mulder, A.L., 2010. Clinical practice: neonatal resuscitation. A Dutch consensus. European Journal of Pediatrics 169, 521–527.
7. Kattwinkel, J., Perlman, J.M., Aziz, K., et al., 2010. Part 15: neonatal resuscitation: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 122, S909–S919.
8. Bradshaw, E.A., Martin, G.R., 2012. Screening for critical congenital heart disease: advancing detection in the newborn. Current Opinion in Pediatrics 24, 2012, 603–8.
9. O'Connor, M.J., Morrow, W.R., 2012. Pulse oximetry screening for critical congenital heart disease: a review. Journal of the Arkansas Medical Society 109, 41–43. O'Donnell, C.P.F., Kamlin, C.O., Davis, P.G., Carlin, J.B., Morley, C.J., 2007. Clinical assessment of infant colour at delivery. Archives of Disease in Childhood—Fetal and Neonatal Edition 92, F465–F467.
10. Thangaratinam, S., Brown, K., Zamora, J., Khan, K.S., Ewer, A.K., 2012. Pulse oximetry screening for critical congenital heart defects in asymptomatic newborn babies: a systematic review and meta-analysis. Lancet 379, 2459–2464.
11. Dawson, J.A., Kamlin, C.O., Wong, C., et al., 2010a. Changes in heart rate in the first minutes after birth. Archives of Disease in Childhood—Fetal and Neonatal Edition 95, F177–F181.
12. Dawson, J.A., Kamlin, C.O., Vento, M., et al., 2010b. Defining the reference range for oxygen saturation for infants after birth. Pediatrics 125, e1340–e1347.
13. McDonald, S.J., Middleton, P., 2008. Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes. Cochrane Database of Systematic Reviews, CD004074.
14. Altuncu, E., Ozek, E., Bilgen, H., Topuzoglu, A., Kavuncuoglu, S., 2008. Percentiles of oxygen saturations in healthy term newborns in the first minutes of life. European Journal of Pediatrics 167, 687–688.
15. Nijland, R., Jongsma, H.W., Crevels, J., et al., 1994. The ductus arteriosus, pre- and post-ductal oxygen saturation measurements in fetal lambs. European Journal of Obstetrics, Gynecology and Reproductive Biology 55, 135–140.
16. Thangaratinam, S., Daniels, J., Ewer, A.K., Zamora, J., Khan, K.S., 2007. Accuracy of pulse oximetry in screening for congenital heart disease in asymptomatic newborns: a systematic review. Archives of Disease in Childhood—Fetal and Neonatal Edition 92, F176–F180.

Chapter 10

Delayed cord clamping and skin-to-skin influences oximetry values at birth

Marrit Smit
Jennifer Dawson
Angelina Ganzeboom
Stuart Hooper
Jos van Roosmalen
Arjan te Pas

Arch Dis Child Fetal Neonatal Ed. 2014 Mar 31. (Epub ahead of print).

ABSTRACT

Objective
To assess whether defined reference ranges of oxygen saturation (SpO_2) and heart rate (HR) of term infants after birth also apply for infants born after midwifery supervised uncomplicated vaginal birth where delayed cord clamping (DCC) and immediate skin to skin contact (ISSC) is routine management.

Design
Prospective observational study

Setting and Patients
Infants born vaginally after uncomplicated birth, i.e. no augmentation, maternal pain relief or instrumental delivery

Interventions
Midwives supervising uncomplicated birth at home or in hospital in the Leiden region (the Netherlands) used an oximeter and recorded SpO_2 and HR in the first 10 minutes after birth.

Main outcome measures
SpO_2 and HR values were compared to the international defined reference ranges.

Results
In Leiden, values of 109 infants were obtained and are comparable to previously defined reference ranges, except for a higher SpO_2 ($p < 0.05$) combined with a slower increase in the first 3 minutes. The Leiden cohort also had a lower HR ($p < 0.05$) during the first 10 minutes with a slower increase in the first 3 minutes. In the first minutes after birth, tachycardia (HR > 180 bpm) occurred less often and a bradycardia (<80 bpm) more often ($p<0.05$).

Conclusions Defined reference ranges can be used in infants born after uncomplicated vaginal birth with DCC and ISSC, but higher SpO_2 and lower HR were observed in the first minutes.

INTRODUCTION

Immediately after birth, assessing an infant's condition based on colour is very subjective and not related to oxygen saturation (SpO_2) levels. [1] In addition, heart rate is often underestimated by auscultation or palpation. [2] The use of pulse oximetry (PO) is recommended in guidelines for evaluating the condition of infants as this offers objective and accurate SpO_2 and HR values. [3, 4] Several studies have investigated the normal values of SpO_2 and HR of uncompromised term infants receiving no resuscitation. [5-10] Recently, Dawson et al. combined larger observational studies and defined the reference ranges. [6]
The studies used to define the current SpO_2 and HR reference ranges included infants where immediate cord clamping was standard policy. However, recent studies indicate that this markedly influences the hemodynamic transition at birth and could have had an effect on the SpO_2 and HR levels in the first minutes. [6, 11] Specifically, compared with cord clamping after ventilation onset, immediate cord clamping causes a reduction in HR and cardiac output. Immediate skin to skin contact (ISSC) was also not performed routinely which could have influenced the values as ISSC has been shown to lower stress responses and heart rates in infants. [12-16] Also in previous studies, infants were included where physiological birth was disrupted by obstetric interventions such as induced or augmented labour, pain relief (opiates, regional anesthesia), instrumental delivery or caesarean section. [5, 17, 18] These interventions could also have caused a delay in transition after birth. It is possible that the defined reference ranges might not reflect the uncomplicated physiological transitional process.
In the Netherlands, almost one third of women (32.9%) give birth supervised by a community-based midwife. In accordance to the Dutch obstetric indication list, midwives supervise uncomplicated vaginal births at home, in birthing facilities or in hospital. [19] In midwifery practice, delayed cord clamping (DCC) and immediate skin to skin contact (ISSC) has been standard care for decades.
Although the benefits of oximetry have been acknowledged by the Royal Dutch College of Midwives, it is undetermined whether the reference ranges are applicable for evaluating term infants after uncomplicated physiological birth where DCC and ISSC is routine management.
In order to assess if previously defined PO reference values are appropriate for evaluating infants born after uncomplicated vaginal births with DCC and ISSC, we compared the SpO_2 and HR data from infants born after midwifery supervised uncomplicated vaginal births (Leiden cohort) with published data from infants born at The Royal Women Hospital, Melbourne, Australia and at the University Hospital of La Fe, Valencia, Spain (defined reference ranges cohort). [6]

METHODS

A prospective observational study was performed in all seven community based midwifery practices (27 midwives) in the Leiden region supervising low-risk births at home, birthing facilities or in hospital. Birth occurs without interventions such as induced or augmented labour, pain relief (opiates, regional anesthesia), instrumental delivery or caesarean section. In midwifery practices, delayed cord clamping (DCC) is standard care, the cord is clamped after at least 1 minute or when pulsations have ceased. Also immediate skin to skin contact (ISSC) is routine management.

From April 2011 to February 2012, midwives used PO directly after birth for ten consecutive minutes. We allocated a PO (Masimo RAD- 8, Masimo Corporation, Irvine, California) to each midwifery practice; the midwife 'on call' had a device at her disposal. The device contained Signal Extraction Technology, SET V.7.8.0.1 software and set to read measurements with 2-second intervals and maximal sensitivity. [6] We provided all midwives with a timer, synchronized with the PO to record time of birth and initiation of PO measurements. Midwives were instructed to start the timer at the moment the infant had completely left the mother's body, similar to the defined reference ranges group. By using this timer we could calculate at what time after birth the first measurements were recorded.

Midwives were instructed to place a disposable sensor (Masimo Low Noise Cable Sensor (LNCS®) New-born Sensor) around the infant's right wrist and then connect the sensor to the pulse oximeter. [20] Measurements were obtained for a minimum of ten consecutive minutes. Midwives were instructed not to let the device interfere with normal procedures such as DCC and ISSC. Basic characteristics and interventions, if needed, were noted. Only uncomplicated vaginal births, as previously defined were included.

The PO data were downloaded using Trend com software, providing data points for every two seconds. (www.masimo.com) Data with alarm messages (low perfusion, sensor off, ambient light and low signal) were excluded. If in one infant > 90% alarm messages were recorded, this particular infant was excluded for analysis. Although we emphasized during training the importance of starting the timer as accurate as possible, it is not possible for the midwives to start the timer exactly at time of birth. Therefore, for comparison of SpO_2 and HR for each minute we calculated median (inter quartile range, IQR) for each minute by using data points -5 seconds and + 5 seconds around each minute. To calculate percentiles, all valid data points were used, comparable to the LMS-method (the skewness-median coefficient of variation) used for the defined reference ranges. [6, 21] For this reason the median and IQR in the reference ranges figure could be a different number than the calculated median (IQR) using the data points -5 seconds and + 5 seconds around each minute. Data were imported into IBM SPSS Statistics (version

20.0; IBM Corporation, Armonk, NY). Infant characteristics are presented as numbers and proportions for categorical variables, means and standard deviation (SD) for normally distributed continuous variables, and medians and inter quartile range (IQR) for variables with skewed distribution. [6]

Differences in minute values of SpO_2 and HR between groups were analysed using independent samples t-test, data that was not normally distributed was analysed using a 2-tailed Mann-Whitney U test. Statistical significance was considered if $p < 0.05$.

Midwives obtained verbal parental consent prior to the onset of birth. Wall posters and flyers were distributed; midwives informed and subsequently asked parents to participate in the study. Ethical approval was obtained by the Medical Ethics Committee of the Leiden University Medical Center, Leiden, the Netherlands (P.13.155).

RESULTS

During the study period PO was used on 153 infants. Recordings of 44/153 infants (29%) were excluded for analyses: in 23 infants no data were stored on the device, in ten infants measurements were not obtained during the first ten minutes, in eight infants alarm messages exceeded 90% of the data and in one infant the sensor was accidentally placed on the left wrist. In two infants the midwife in charge felt respiratory support was needed.

Thus, a total of 109/153, (71%) infants were included for analysis. Characteristics are shown in Table 1. DCC was applied in all infants, in 45 infants the exact time was recorded (Table 1).

The amount of data points with alarm message that needed to be excluded was similar in the Leiden group when compared to the defined reference ranges group (SpO_2 45% vs. 47% data points; HR 46% vs. 44% data points). Thus, the final dataset of the first ten minutes after birth in the Leiden group contained 14 511 individual infant SpO_2 observations and 9 686 HR observations from 109 infants and in the defined reference ranges group 33 119 infant SpO_2 observations and 20 318 HR observations from 308 infants. For Spo2 at one minute, the 10th, 50th, 90th, and 95th percentiles were 60%, 68%, 86%, and 86% and for HR 41, 65, 170 and 170 bpm, respectively. At 2 minutes, 70%, 81%, 89%, and 95% for Spo2 and 54, 81, 184 and 188 bpm for HR, respectively. At 5 minutes for Spo2 75%, 91%, 98%, and 99%, and 129, 152, 168 and 173 for HR, respectively.

Oxygen Saturation (SpO_2)

The Leiden percentile chart is characterized by higher SpO_2, slower rate of rise and a smaller range in the first minutes when compared to the defined reference ranges chart as previously published (Figure 1). [6] The median SpO_2 of the Leiden group was 11, 7 and

4% higher at minute 1, 2 and 3 respectively, but 5, 4, 4, 5, 5, 4 and 2% lower at 4 to 10 minutes after birth when compared to the defined reference ranges group (all statistically significant different except at 4 minutes; Table 2). The 10th and 90th percentile are shown in table 3.

Heart Rate (HR)

Our findings are characterized by slower rate of rise in the first minutes and a lower HR at all minutes, when compared to the defined reference ranges chart as previously published (Figure 2). [22] Tachycardia (HR > 180 bpm/ minute) occurred less often in the Leiden group (2.6%) than in the defined reference ranges group (19.3%; p <0.001). For minute 1-10 the percentages of tachycardia were 0, 9, 3, 2, 4, 4, 2, 0, 0, 0 % in the Leiden group and 2, 14, 31, 29, 22, 22, 18, 14, 12, 14 % in the defined reference ranges group (all p <0.05 except at 1 minute). Bradycardia (HR < 80 bpm/minute) occurred more frequent in the Leiden group (6.5%) than in the defined reference ranges group (4.8%; p <0.001). For minute 1-10 the percentages were 70, 47, 13, 3, 2, 3, 1, 1, 0, 0 % in the Leiden group and 50, 21, 6, 2, 1, 1, 2, 1, 0, 0 % in the defined reference ranges group (not significant, except at 1, 2, 3 and 6 minutes p< 0.05).

The median HR of the Leiden group was 19, 75, 10, 18, 17, 14, 10, 13, 7, 12 bpm lower for 1- 10 minutes after birth when compared to the defined reference ranges group (all p < 0.001, except at 1 minute; table 4). The 10th and 90th percentile are shown in table 5.

DISCUSSION

In this study we collected SpO_2 and HR values from infants after uncomplicated vaginal birth with DCC and ISSC and compared the measurements with the cohort of infants that were used to define the current reference ranges. However, this cohort of infants included infants that received medical intervention, immediate clamping and ISSC was not routine. [6] Median SpO_2 values in the Leiden group were higher in the very first minutes, but median HRs were lower at all time-points compared to the defined ranges. Considering the fact that it has been recommended to accept values down to the 10th percentile, the differences in the 10th percentile in the first 3 minutes (higher in SpO2 and lower in HR) is noteworthy. [18] These observations could imply that caution should be taken in accepting lower levels of SpO_2 and HR as 'normal transition' of healthy term infants.

Several studies report SpO2 values in term infants after birth. [5, 9, 10, 12, 20, 23] This is the first study solely describing infants born after uncomplicated birth with DCC and ISSC. Although the SpO_2 in our group was within the range of acceptable levels, the large amount of data points led to significant differences at almost all time points. The largest

difference was observed within the first 3 minutes with a higher SpO_2 in the Leiden group, followed by smaller differences in SpO2 that were lower than the previously defined range. This resulted in a lower rate of rise in SpO_2 in our group compared to the defined ranges.

In contrast to the defined reference ranges cohort, DCC is common practice for midwives in the Netherlands. A recent study in preterm lambs showed that DCC is beneficial for the cardiovascular transition, which leads to greater cardiovascular stability. [11] DCC allows time for infants to breathe and increase their pulmonary blood flow so that when the cord is cut, the source of preload for the left ventricle can immediately switch from placental venous return to pulmonary venous return, thereby maintaining left ventricular output. In contrast, cutting the cord before pulmonary transition has started, leads to a sudden loss in preload and a decrease in left ventricular output until ventilation commences. [11] It is likely that cardiovascular stability leads to an improved tissue perfusion, which not only plays an important part in the benefits of delayed cord clamping (lower incidence of NEC and IVH) [24], but could also explain the observed higher SpO_2 levels in the first minutes after birth in our cohort. In addition, the fact that the Leiden group was more homogenous could contribute to the observed differences as the defined reference ranges are based on a heterogeneous group (augmented labour; e.g. pain relief, instrumental delivery or caesarean section). Interventions during birth could have induced a response within the infant that altered its transition during the very first minutes, even though these infants did not require additional support. Indeed, studies have shown lower SpO_2 levels in the first five minutes after caesarean section, compared to vaginal delivery. [5, 6, 9, 17, 25-28] Although medical obstetric pain relief (combined spinal epidural, inhaled analgesia and opioids) showed no adverse effect on the Apgar score and NICU admission, these interventions could alter the physiological transition at birth, thereby influencing the SpO_2 and HR after birth. [29-31]

Other different physiological processes may be involved as well. Seventy five percent of women in the Netherlands initiate breastfeeding after birth. [32] Although we did not record this, it is likely that a substantial number of infants were breastfed at time of pulse oximetry measurements, which is known to influence HR and SpO_2 levels. [16, 33] Indeed, feeding (both bottle and breast) is acknowledged to interrupt ventilation and increase oxygen consumption, so the lower SpO_2 levels during the latter part of the study period may simply reflect the fact that more of these infants were feeding. These practices were not common in infants included in the defined reference ranges group.

The lower HR in vigorous infants in the first minutes after birth is not a new finding and has been described before. [6, 22] However, the lower heart rate in our cohort when compared to the cohort of the defined ranges was in contrast to what we expected when considering the effect of DCC. In a recent animal study a reduction in HR (40%) was

observed when the cord was clamped before ventilation, while in the lambs that were ventilated before cord clamping had a smaller decrease in HR. [11] Although other factors (see below) could explain the observed lower HR, it is still possible that DCC could have contributed. DCC prevents a sudden loss in preload and decrease in left ventricular stroke volume and therefore there is less need to compensate this with HR to maintain left ventricular output. [11] Further studies are needed, but we speculate that, in the Leiden group, DCC contributed to the lower incidence of tachycardia and the lower rate of HR rise compared with the defined reference ranges group.

Another possible explanation for the lower heart rates in the first minutes, lower rate of rise and less frequent tachycardia is that all infants in the Leiden group were subjected to ISSC. Various studies report positive effects of ISSC; it reduces the amount of crying and infants maintain higher skin temperature. [13, 33] Also, infants exposed to ISSC have a lower mean HR and respiratory rate after birth compared to those not subjected to ISSC. [12, 14, 15] Similarly, lower cortisol levels at 60 minutes after birth were found in newborn infants immediately placed prone on the mother's bare chest. A lower cortisol level likely reflects a reduced stress response and an associated reduced sympathetic drive for increased HR. [14-16]

Interestingly, the median Apgar score at 1 minute was higher and in discrepancy to the recorded the median heart rate and oxygen saturation at one minute. The midwives did not use the measured values for calculating the Apgar score, but only used their clinical evaluation and in vigorous infants the heart rate is often not counted Our study group was smaller when compared to the study group on which the defined ranges were based (109 versus 308 infants), and consequently less data points could have influenced the observed variation. However, the amount of data points per infant was similar in both groups as well as the percentage of validated data points. [6]

More than half of the infants (54%) in our study were born at home and in this setting the midwife operates alone. Although we emphasized the importance of starting the timer as accurately as possible and the midwives were dedicated, it is possible that the time of birth was not recorded to the precise second. For the percentiles all data points were used (figures 1-2). The possibility that in the Leiden group the time of birth was earlier than recorded could explain the higher SpO_2 levels in the first minutes, but the observed lower heart rates makes this unlikely. It can be difficult to get reliable recordings in the very first minutes and fewer infants were included for analysis. However, the percentage of infants included in our cohort was similar to the cohort of the defined reference ranges.

In conclusion, the reference values can be used for evaluating term infants after uncomplicated birth with DCC and ISSC. Caution, however, should be taken in what we define `healthy', normal transition and which lower levels we find acceptable. DCC,

ISSC and the absence of medical interventions could explain the observed differences. Future studies are needed to identify which ranges in heart rate and oxygen saturation can be considered normal and how the different factors influence these parameters.

Acknowledgements
We would like to thank the midwives in Leiden region for participating in this study and providing us with the necessary data. We are very grateful to all parents who allowed the midwife to take measurements on their new born.
We thank Raul Bénis of Masimo Corporation for his technical support during the study period.

Table 1. Infant Characteristics of both Leiden and Defined reference ranges

	Leiden (*N* = 109)	Defined reference ranges (N = 308)
Gestational age, mean (range), wk.	40 weeks (37 – 42)	40 weeks (37-42)
Place of birth, *n* (%)		
Home	59(54)	0
Birthing Clinic	50 (46)	0
Hospital	0	306 (100)
Birth weight, mean (SD), g	3575 (482)	3581 (514)
Time of umbilical cord clamping, minutes, median (IQR)	5 (3-7)	-
Apgar score at 1 min, median (IQR)	9 ((9-9)	8 (7-9)
Apgar score at 5 min, median (IQR)	10 (10-10)	9 (9-9)
Apgar score at 10 min, median (IQR)	10 (10-10)	(no 10 min scores)

Table 2. Median (IQR) SpO_2 at 1 to 10 minutes after birth for Leiden versus Defined reference ranges

Time After Birth in Minutes	SpO2 , Median (IQR), %		*P*
	Leiden (*N* = 109)	Defined reference ranges (*N* = 308)	
1	78 (67-87)	67 (59-77)	< 0.001
2	80 (74-86)	73 (62-82)	< 0.001
3	85 (77-91)	81 (67-92)	< 0.01*
4	86 (80-93)	91 (79-95)	ns
5	90 (81-95)	94 (86-97)	< 0.05*
6	91 (85-95)	95 (90-97)	< 0.001
7	91 (87-95)	96 (93-98)	< 0.001*
8	92 (89-96)	97 (94-98)	< 0.001*
9	93 (89-97)	97 (94-98)	< 0.001*
10	95 (89-98)	97 (94-98)	<0.001*

* Means corrected for assumption equal variances

Table 3. The 10th and 90th percentiles of SpO_2 per minute after birth

Time After Birth in Minutes	Leiden P10-P90	Defined reference ranges P10-P90
1	61-95	48-84
2	63-94	50-92
3	62-94	53-97
4	72-97	67-98
5	74-98	73-99
6	79-98	83-99
7	82-98	89-99
8	83-98	89-100
9	86-99	92-99
10	86-98	92-99

Table 4. Median (IQR) Heart Rate (HR) per minute after birth of Leiden versus Defined reference ranges

Time After Birth in Minutes	Leiden (109 Infants) HR (bpm) Median (IQR)	Defined reference ranges (308 Infants) HR (bpm) Median (IQR)	*P*
1	61 (42-146)	80 (68-151)	ns
2	85 (67-164)	160 (102-173)	< 0.001*
3	157 (145-169)	167 (152-185)	< 0.001*
4	152 (140-163)	170 (157-182)	< 0.001*
5	150 (140-161)	167 (153-179)	< 0.001*
6	149 (138-162)	163 (153-178)	< 0.001
7	152 (140-161)	162 (150-177)	< 0.001*
8	147 (139-156)	160 (134-173)	< 0.001*
9	149 (138-158)	156 (145-173)	< 0.001*
10	146 (140-153)	158 (144-174)	<0.001*

* Means corrected for assumption equal variances

Figure 1. Oxygen saturation percentiles of the defined reference range and Leiden cohort.

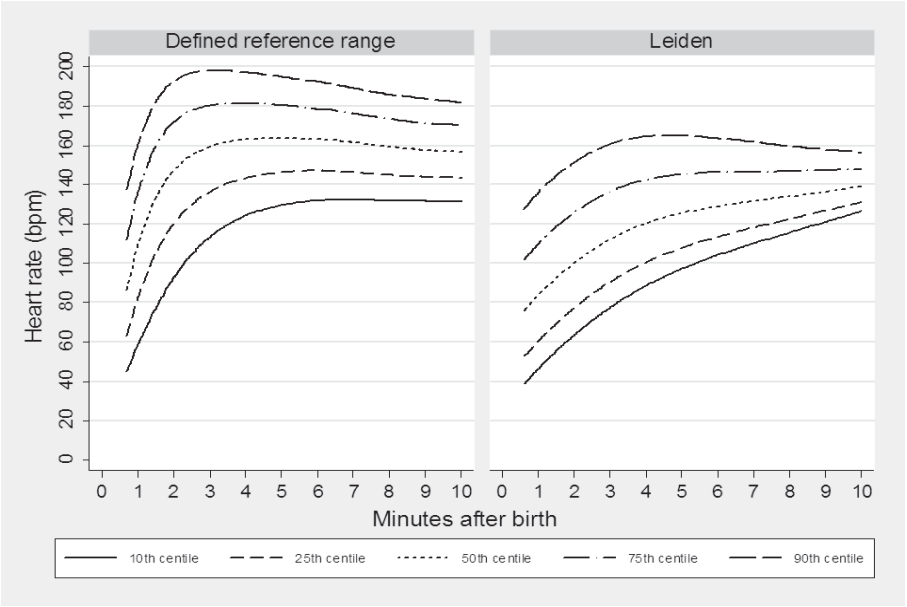


Figure 2. Heart rate percentiles of the defined reference range and Leiden cohort.

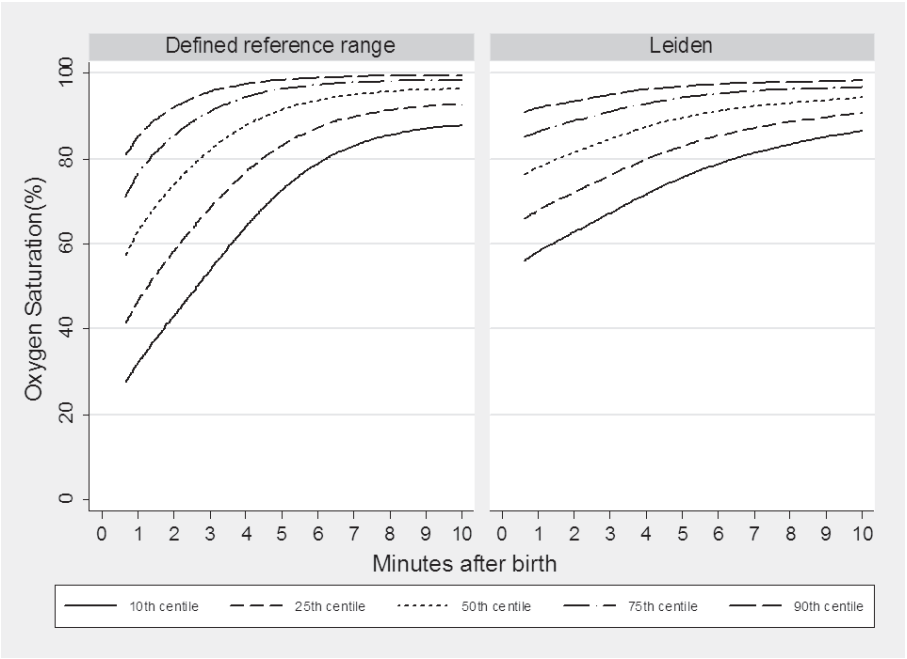


Table 5. The 10th and 90th percentiles of Heart Rate (HR) per minute

Time After Birth in Minutes	Leiden P10-P90	Defined reference ranges P10-P90
1	38-171	56-176
2	54-179	59-187
3	77-174	112-195
4	125-171	138-198
5	126-169	142-193
6	123-168	143-189
7	127-169	137-188
8	125-167	134-185
9	124-169	132-173
10	132-162	134-182

REFERENCES

1 O'Donnell CPF, Kamlin CO, Davis PG, et al. Clinical assessment of infant colour at delivery. Archives of Disease in Childhood - Fetal and Neonatal Edition 2007;92:F465-F467.

2 Kamlin CO, O'Donnell CPF, Everest NJ, et al. Accuracy of clinical assessment of infant heart rate in the delivery room. Resuscitation 2006;71:319-21.

3 Dutch Association of Pediatricians (NVK). NVK-guideline Resuscitation of newborns 2008. http://www.nvk.nl/Portals/0/richtlijnen/reanimatie/reanimatie.pdf (assessed 10 October 2013).

4 Kattwinkel J, Perlman JM, Aziz K, et al. Neonatal Resuscitation: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Pediatrics 2010;126:e1400-e1413.

5 Altuncu E, Ozek E, Bilgen H, et al. Percentiles of oxygen saturations in healthy term newborns in the first minutes of life. European Journal of Pediatrics 2008;167:687-8.

6 Dawson JA, Kamlin CO, Vento M, et al. Defining the Reference Range for Oxygen Saturation for Infants After Birth. Pediatrics 2010;125:e1340-e1347.

7 Kamlin C, O'Donnell CP, Davis PG, et al. Oxygen saturation in healthy infants immediately after birth. The Journal of Pediatrics 2006;148:585-9.

8 Mariani G, Dik PB, Ezquer A, et al. Pre-ductal and Post-ductal O2 Saturation in Healthy Term Neonates after Birth. The Journal of Pediatrics 2007;150:418-21.

9 Rabi Y, Yee W, Chen S, et al. Oxygen saturation trends immediately after birth. The Journal of Pediatrics 2006;148:590-4. doi: 10.1016/j.jpeds.2005.12.047.

10 Toth B, Becker A, Seelbach-G+¦bel B. Oxygen saturation in healthy newborn infants immediately after birth measured by pulse oximetry. Archives of Gynecology and Obstetrics 2002;266:105-7.

11 Bhatt S, Alison BJ, Wallace EM, et al. Delaying cord clamping until ventilation onset improves cardiovascular function at birth in preterm lambs. J Physiol 2013;591:2113-26.

12 Bramson L, Lee JW, Moore E, et al. Effect of early skin-to-skin mother--infant contact during the first 3 hours following birth on exclusive breastfeeding during the maternity hospital stay. J Hum Lact 2010;26:130-7.

13 Marin Gabriel MA, Llana M, I, Lopez EA, et al. Randomized controlled trial of early skin-to-skin contact: effects on the mother and the newborn. Acta Paediatr 2010;99:1630-4.

14 Christensson K, Siles C, Moreno L, et al. Temperature, metabolic adaptation and crying in healthy full-term newborns cared for skin-to-skin or in a cot. Acta Paediatr 1992;81:488-93.

15 Christensson K, Cabrera T, Christensson E, et al. Separation distress call in the human neonate in the absence of maternal body contact. Acta Paediatr 1995;84:468-73.

16 Takahashi Y, Tamakoshi K, Matsushima M, et al. Comparison of salivary cortisol, heart rate, and oxygen saturation between early skin-to-skin contact with different initiation and duration times in healthy, full-term infants Early Hum Dev 2011;87:151-7.

17 Caliskan E, Ozdamar D, Doger E, et al. Prospective case control comparison of fetal intrapartum oxygen saturations during epidural analgesia. Int J Obstet Anesth 2010;19:77-81.

18 Dawson JA, Davis PG, O'Donnell CP, et al. Pulse oximetry for monitoring infants in the delivery room: a review. Arch Dis Child Fetal Neonatal Ed 2007;92:F4-F7.

19 Obstetric Vademecum. Final report of the Maternity Care Committee of the College of health insurance companies. [Verloskundig Vademecum. Eindrapport van de Commissie Verloskunde van het College voor zorgverzekeringen]. 2003. Diemen, the Netherlands. http://www.nvog.nl/vakinformatie/Informatie/Verloskundig+Vademecum.aspx (assessed 10 October 2013).

20 Meier-Stauss P, Bucher HU, Hurlimann R, et al. Pulse oximetry used for documenting oxygen saturation and right-to-left shunting immediately after birth. Eur J Pediatr 1990;149:851-5.

21 Cole TJ, Green PJ. Smoothing reference centile curves: the LMS method and penalized likelihood. Stat Med 1992;11:1305-19.

22 Dawson JA, Kamlin CO, Wong C, et al. Changes in heart rate in the first minutes after birth. Arch Dis Child Fetal Neonatal Ed 2010;95:F177-F181. 95/3/F177.

23 Salyer J. Neonatal and pediatric pulse oximetry. Respir Care 11 A.D.;48:386-98.

24 Rabe H, Diaz-Rossello JL, Duley L, et al. Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes. Cochrane Database Syst Rev 2012;8:CD003248.

25 Dimich I, Singh PP, Adell A et al. Evaluation of oxygen saturation monitoring by pulse oximetry in neonates in the delivery system. Can J Anaesth 1991;38:985-8.

26 Harris AP, Sendak MJ, Donham RT. Changes in arterial oxygen saturation immediately after birth in the human neonate. J Pediatr 1986;109:117-9.

27 House JT, Schultetus RR, Gravenstein N. Continuous neonatal evaluation in the delivery room by pulse oximetry. J Clin Monit 1987;3:96-100.

28 Porter KB, Goldhamer R, Mankad A, et al. Evaluation of arterial oxygen saturation in pregnant patients and their newborns. Obstet Gynecol 1988;71:354-7.

29 Jones L, Othman M, Dowswell T, et al. Pain management for women in labour: an overview of systematic reviews. Cochrane Database Syst Rev 2012;3:CD009234.

30 Konefal H, Jaskot B, Czeszynska MB. [Pethidine for labor analgesia; monitoring of newborn heart rate, blood pressure and oxygen saturation during the first 24 hours after the delivery]. Ginekol Pol 2012;83:357-62.

31 Reynolds F. Labour analgesia and the baby: good news is no news. Int J Obstet Anesth 2011;20:38-50. S0959-289X(10)00128-7.

32 TNO. Breastfeeding in the Netherlands. 2010. Leiden, the Netherlands, TNO Quality of Life. www.zorgvoorborstvoeding.nl/achtergrondinformatie (assessed 10 Oktober 2013).

33 Moore ER, Anderson GC, Bergman N, et al. Early skin-to-skin contact for mothers and their healthy newborn infants Cochrane Database Syst Rev 2012;5:CD003519.

Chapter 11

Summary and general discussion

INTRODUCTION

As a practising midwife, I have been involved in obstetrical emergency training, both as a participant and as course provider. Walking into a birthing setting and being confronted with an actress in the role of a profusely bleeding woman releases an amount of adrenalin comparable to a 'real-life' situation. At that point, knowledge, performing the necessary procedures and organising optimal care through clear communication among all team members are all of equal importance. During my years as a midwife in primary care I was frequently confronted with situations where all treatment and decisions were solely in my hands. When encountering such a situation one realises that one must possess all necessary skills. As obstetric emergencies are fortunately rare in primary midwifery care and midwives usually operate independently, the necessity and positive effects of emergency training are evident. [1-7] The effectiveness of emergency training has been an important personal motivation to explore my own abilities as a practising midwife, but also to expand my skills to be able to provide training for co-workers and to perform research on this topic.

In this thesis, the primary aim is to gain insight into management of obstetric emergencies occurring in primary midwifery care in the Netherlands. Secondly, we aimed to develop preventative strategies and tools to optimise care in case of an obstetric emergency. From 2008-2010, a unique dataset of 198 cases of obstetric emergencies was provided by midwives working in primary care who participated in the 'CAVE-Study' (**Chapter 1**, **Introduction**). We used both qualitative research (audit) as well as quantitative research methods. We studied preventative tools such as pulse oximetry in primary midwifery care and developed and assessed 25 quality indicators for the development of a multidisciplinary guideline for post-partum haemorrhage (PPH, defined as ≥ 1000 mL blood loss after childbirth) in the Netherlands.

This chapter summarises and discusses the studies performed in relation to each other, both from the perspective of midwifery care in the Netherlands, but also as embedded in the Dutch obstetrical care system. Finally, we will make specific recommendations.

SUMMARY

In **Chapter 2** and **3,** we describe a study of 67 reported cases of PPH after home birth. Cases of PPH were only eligible for audit if PPH occurred after home birth under care of a community-based midwife, referral to hospital by ambulance was necessary, complete documentation of the case was available, and if the community-based midwife was able to attend the audit meeting. After applying the selection criteria, seven cases were submitted to audit. The audit panel consisted of 12 midwives (of whom seven contributed a case), 10 obstetricians, an educational expert and an ambulance paramedic. First, each

panel member was asked to perform an individual assessment of the medical records of the seven cases (individual audit) before the plenary audit meeting. Panel members were asked to consider whether risk selection prior to the decision to give birth at home had been appropriate, and whether factors indicating substandard care (SSC) had been present during pregnancy and birth at the level of the patient, the care provider or the healthcare system (a total of 32 items were considered). SSC items concerning specific management of PPH, referral and transport to hospital were also scored. The maximum score for SSC was calculated using *number of assessors x number of cases x 32 scoring items*: 24 x 7 x 32= 5, 376 items. Out of this total, the panel members scored 842 (16.7%) SSC care factors. Most of these were contributed to the healthcare system (52.9%) and the midwife (35.3%).

Subsequently, at a plenary audit meeting, substandard care factors (SSC) were determined and assigned incidental, minor or major status. In two of the seven cases major substandard care (SSC) was found, meaning that different care would definitely have given a better outcome. In these two cases, issues with communication and cooperation were the most important factors attributing to major SSC. Recommendations concerning PPH in primary care were made, as can be seen in Table 1.

Table 1 Recommendations following discussion at plenary audit meeting of seven cases.[8]

Audit	Recommendations
General	All disciplines of professionals should pay extra attention to their written communication.
Primary care PPH	- When blood loss is more than 500 mL and not ceasing: start intravenous access (by midwife). - Administer oxygen to the woman when PPH occurs. - Reduce delay by timely referral, start organising referral if the placenta is not delivered within 30 minutes after birth, regardless of the amount of blood loss at that time.
Transfer and place of birth	- Midwives should (re-)assess (prior and during labour) whether the woman's home is suitable for birth. - The care provider could call for early ambulance back up if home birth is far from hospital.
Communication & Cooperation	- Communication between community-based midwives and obstetricians should be optimised: confusion on practical matters concerning referral (e.g. which entrance to enter the hospital) might lead to SSC. - Clearer communication between midwife and obstetrician regarding clinical condition of the mother (e.g. pulse rate and blood pressure).

In general, we found that communication between different health care providers should be optimised and a proactive attitude should be taken to select women who plan to give birth at home, taking into account the possibility of timely referral in case of PPH or

retained placenta. We concluded that a national multidisciplinary guideline on managing obstetric haemorrhage in home birth is urgently needed. Also, skills in establishing intravenous access should be taught and regularly updated.

In **Chapter 4**, we describe cases of women suffering from PPH or retained placenta in home birth (reported during the study period from April 2008 to April 2010). Ambulance report forms and medical charts were collected. Time intervals, urgency coding and maternal clinical condition as reported on the ambulance forms and maternal outcomes, e.g. total blood loss, admission to the intensive care unit, surgical procedures, Packed Red Blood Cells (PRBC) and discharge day) were collected. Maternal clinical condition was assessed using the Revised Trauma Score (RTS). This system is a reliable numeric indicator for outcome evaluation in all trauma patients and is widely used by ambulance teams worldwide. [9,10] This score combines the Glasgow Coma Scale (GCS), respiratory frequency (Rf) and systolic blood pressure (SBP). The prognostic value of combining these parameters is significantly higher than GCS, Rf and SBP alone. [11] Scores range from 0 to 12 with 0 being the lowest possible score and 12 indicating no physiologic derangement. [9] (Figure 2). The RTS score is assessed upon arrival of the ambulance personnel and regularly reassessed if indicated. For our analysis, we used the lowest RTS score reported on the ambulance report form.

Figure 2. Revised Trauma Score

Points	Glasgow Coma Scale (GCS)	Systolic blood pressure (SBP)	Respiratory frequency
4	13-15	>90 mmHg	10-29/min
3	9-12	76-89 mmHg	>30/min
2	6-8	50-75 mmHg	6-9/min
1	4-5	1-49 mmHg	1-5/min
0	3	0 mmHg	0/min

During the study period, 72 cases of ambulance referral of PPH after home birth were reported. Medical files and ambulance report forms were available in 62 cases. Overall median blood loss at time of referral was 1050 mL (range 500-2000 mL). The median total blood loss was 2000 mL, ranging from 1000-7000 mL. In 40 cases (64.5%) the 45-minute pre-hospital limit was met, in 22 cases this limit was exceeded up to a maximum pre-hospital interval of 79 minutes (median excess 8 minutes). Failure to meet the limit was due to an overall prolonged duration of ambulance transfer. During ambulance transfer, 49 women (77.4%) had the maximum RTS score of 12. In 13 patients (22.6%), a decrease in systolic blood pressure was found (RTS score 10 or 11). We found no difference in maternal outcomes between women with different RTS scores or between women for

whom the 45-minute pre-hospital limit was or was not met. We concluded that none of the women were in acute danger during ambulance transfer, regardless of whether the ambulance transfer exceeded the 45-minute pre-hospital limit or whether they had a decreased RTS score. The low-risk profile of women in primary care, well-organised midwifery and ambulance care and excellent road network in the Netherlands are likely to contribute to these findings.

For **Chapter 5,** we surveyed all midwifery practices and obstetrical departments in the Netherlands on the management of the third stage of labour. Midwifery practices administer oxytocin in 59.1% of births as prophylaxis. Obstetric departments do so in 96.4% ($p<0.01$). Compared to an earlier survey in 1995 [12], the prophylactic use of oxytocin had increased in 2011 both by midwives (10–59.1%) and by obstetricians (55–96.4%) ($p<0.01$). Studies have shown the positive effect of prophylactic uterotonics on the prevalence of PPH, worldwide. [13] For birth in primary care in industrialised countries, however, the evidence is less convincing. [13,14] Considering the lack of evidence concerning routine administration of uterotonics in low risk (home) births, further research is clearly indicated. A national guideline containing best practices concerning management of the third stage of labour supervised by midwives should be composed and implemented.

In **Chapter 6**, the development of 25 quality indicators for prevention and management of PPH is described. A RAND modified Delphi procedure was applied. This method consists of five steps: (1) composing an expert panel, (2) literature research and collection of possible quality indicators, (3) digital questionnaire, (4) consensus meeting and (5) critical evaluation. A multidisciplinary expert panel consisting of five midwives, seven obstetricians and an ambulance paramedic was assembled, after applying pre-specified criteria concerning expertise in various domains relating to primary midwifery care, secondary obstetric care, emergency transportation, maternal morbidity and mortality audit, quality indicator development or clinical guidelines development and representatives of professional organisations. A literature review resulted in the selection of 79 recommendations for assessment by the expert panel. After a digital questionnaire to the expert panel seven indicators were added, resulting in 86 possible indicators. After excluding 41 indicators that panel members unanimously found invalid, 45 possible indicators were assessed at the consensus meeting. During critical evaluation 18 potential indicators were found to be overlapping and two were discarded due to lack of measurability. As a result, a set of 25 quality indicators was considered valid for testing in practice. Subsequently, in **Chapter 7**, we describe the process of assessing the performance of those 25 quality indicators. Quality criteria on applicability, feasibility, adherence to the indicator, and the indicator's potential to monitor improvement were assessed. Eleven indicators were found to be applicable and feasible. Five of these indicators showed improvement potential: routine administration of uterotonics, quantifying blood loss by weighing, timely referral to secondary care in homebirth and

treatment of PPH using bladder catherisation, uterine massage and oxytocin and the use of oxygen. Fourteen indicators were found not to be useful as a tool of measuring quality of care in case of PPH. We concluded that 11 out of 25 indicators were found suitable as an assessment tool for midwifery care of PPH and are therefore suitable for incorporation in a professional midwifery guideline.
In our opinion, the studies described in **Chapter 2** to **Chapter 7** contain sufficient rationale for the authors to urge for the development and implementation of a multi-disciplinary guideline on PPH in the Netherlands.
Chapter 8 reports on cases of Umbilical Cord Prolapse (UCP) occurring in primary midwifery care. These cases were also collected within the prospective cohort 'CAVE-study'. Procedures to alleviate cord pressure, ambulance timing and outcomes were studied. Diagnosis to delivery interval (DDI) and risk factors were identified. Eight cases of UCP were reported, of which six occurred at home. Retrograde bladder filling (2/8), manual elevation of the foetal head (7/8) and Trendelenburg position (1/8) were applied. All infants were born in hospital, all but one through caesarean section. One infant, born after caesarean, section died of severe birth asphyxia; the other infants recovered and were discharged in good condition. DDI varied from 13-72 minutes. In the case where the infant deceased the DDI was 47 minutes. Although this is in the upper half of DDI's found, in 3 cases longer DDI's were found (56, 72 and 71 minutes) and all had favourable perinatal outcomes. Earlier studies have reported that prolonged DDI in case of UCP increases the risk of low Apgar score, stillbirth and neonatal death. [15, 16] Other studies, however, found no direct relation between DDI and perinatal outcomes (perinatal mortality and NICU admission), but prior hypoxia, CTG abnormalities, intra uterine growth restriction and prematurity were found to influence outcomes. [17-19] UCP occurring outside hospital setting has not been structurally evaluated, but has sporadically been mentioned in publications. In virtually all cases mentioned in these studies, long DDI's (over 100 minutes) and high perinatal mortality is reported. [16,20] We suspect that these results are based on research conducted in care systems where no assistance at home is provided to reduce cord pressure and no quick referral to hospital is possible. It is evident that DDI will be longer when a patient needs to be transferred to hospital per ambulance. In this study, we found that DDI alone does not give adequate explanation for adverse perinatal outcomes.
In the discussion section we elaborate on the practice of retrograde bladder filling. Although effective, it is time-consuming. In the case were the infant died, the ambulance was present before the midwife arrived. In hindsight, the foetal condition in this case was already very poor when the midwife arrived and immediate referral might have been more effective than retrograde bladder filling. So when the ambulance is already present the midwife can decide not to perform bladder filling, but immediately transfer to hospital.

Risk factors such as malpresentation (breech) and/or unengaged presenting part were found in four cases, but only two (unengaged foetal head) were known to the midwife prior to birth. Although a small sample was provided during the study period (due to the rarity of this complication), we conclude that although UCP at home leads to an increased diagnosis-to-delivery interval (DDI), no association with a less favourable outcome is found. In this study, we found that DDI alone does not give adequate explanation for adverse perinatal outcomes.

In Chapter 9 and **10** we describe studies on the use of pulse oximetry (PO) in infants at birth in low-risk primary midwifery care at home or in hospital. Both the Dutch Association of Paediatricians (NVK) and the Royal Dutch Organization of Midwives (KNOV) recommend the use of PO when resuscitation is indicated. [21,22] Currently, PO is not implemented in midwifery practice. We studied the feasibility of PO in current midwifery practice and assessed if previously defined PO reference ranges are appropriate for evaluating low risk vaginal births supervised by community-based midwives, where delayed cord clamping (DCC) and immediate skin-to-skin contact (ISSC) is practised. We performed a prospective, observational study of infants born after midwifery supervised (home) births. Twenty-seven midwives from seven practices providing primary care in (home) births used PO at birth or during the early puerperal period over a ten-month period. For **Chapter 9** we aimed to evaluate the feasibility of using PO for evaluating infants born in community-based midwifery care. Data were obtained on the effect of PO on outcome, interventions and decision-making. Midwives were surveyed about applicability and usefulness of PO.

PO was used in 153 infants born in primary midwifery care. All births were uncomplicated except for one infant receiving supplemental oxygen and another requiring mask ventilation. In 138/153 (90%) infants PO was successfully used and 88% of midwives found PO easy to use. In 148/153 (97%) infants PO did not influence the midwives' clinical judgement and referral policy. In 5/153 (3%) infants, midwives were uncertain of the infant's condition, but PO measurements were reassuring. In case of suboptimal neonatal condition or resuscitation, 100% of midwives declared they would use PO again. The midwives who used the PO stated that use of the device did not lead to insecurity or extra referral. Also, midwives indicated that they would like to have a pulse oximeter at their disposal in cases of suboptimal condition or when resuscitation is required, but would not consider PO a device to use routinely. An additional finding was that not only midwives but also parents were very positive about PO use. For example, when one infant had a short period of cyanosis after regurgitating milk: not only the midwife but also the parents were reassured by normal PO values. Based on these findings we concluded that it is feasible to use PO in community-based midwifery care. In addition, PO in home birth settings did not lead to insecurity or extra referral. In fact, the objective

parameters of the PO reassured not only midwives but also parents when there was doubt about the condition of the new-born. Although current KNOV resuscitation guidelines recommend the use of PO, this was a feasibility study and does not provide information whether PO should be implemented. Since the incidence of morbidities in these low risk births is low and neonatal emergencies are rare, a large sample size would be needed to study whether PO influences neonatal outcomes.

For **Chapter 10,** we aimed to assess if previously defined PO reference ranges are appropriate for evaluating infants born after uncomplicated vaginal birth with delayed cord clamping (DCC) and immediate skin-to-skin contact (ISSC). Therefore, we compared the SpO2 and HR data from infants born after midwifery-supervised uncomplicated vaginal births (Leiden cohort) with published data from infants born in good condition at The Royal Women Hospital Melbourne, Australia and infants born in the University Hospital of La Fe, Valencia, Spain (defined reference ranges). The data included for the defined reference ranges cohort (currently used as reference ranges for PO), also involved infants where physiological birth was disrupted by labour augmentation with oxytocin, epidural analgesia, instrumental vaginal birth or caesarean section. [23] In our study, we only included infants born in good condition after uncomplicated birth in primary midwifery care, needing no supplemental oxygen or other respiratory support. Participating midwives in the Leiden region, supervising uncomplicated births at home or in hospital used an oximeter and recorded SpO_2 and HR in the first 10 minutes after birth. Values of 109 infants were obtained and are comparable to previously published reference ranges, except for a higher SpO_2 ($p < 0.05$), combined with a slower increase in the first 3 minutes. The Leiden cohort also had a lower heart rate (HR) ($p < 0.05$) during the first 10 minutes with a slower increase in the first 3 minutes. In the first minutes after birth, tachycardia (HR > 180 bpm) occurred less and bradycardia (<80 bpm) more often ($p<0.05$). We concluded that the previously defined reference ranges can be used in infants born after uncomplicated vaginal birth with DCC and ISSC, but higher SpO_2 and lower HR were observed in the first minutes. DCC, ISSC and the absence of medical interventions could explain these differences. In addition, the observed differences in our cohort are important for the discussion of what we consider "normal" values of oxygen saturation and heart rate at birth and how to define "physiological transition" at birth.

DISCUSSION

Historically, research concerning obstetrical health care in the Netherlands has been performed by doctors (obstetricians, paediatricians) and only sporadically by midwives. Over the past ten years, however, midwifery research has become an increased field of interest, resulting in 17 dissertations by midwives so far. This has resulted in new insights

on the quality of care, specifically concerning primary midwifery in the Netherlands. Our project, collecting 198 cases of obstetric emergencies occurring in primary midwifery care is an example of such primary midwifery care research. Data collection on case level, of this magnitude, and in this specific population has not been performed and thus gives unique insight into obstetric emergencies occurring in primary midwifery.

Before this study, the 'LEMMoN' study (Nationwide study into Ethnic of Severe Maternal Morbidity in the Netherlands) was performed between 2004 and 2006. [24] This nationwide cohort study on severe acute maternal morbidity (SAMM) reports on complications such as major obstetric haemorrhage (MOH, defined as haemorrhage with the need of blood transfusion of ≥ 4 units of packed cells), eclampsia, uterine rupture and admission to an intensive care unit. All obstetric units of all hospitals in the Netherlands reported cases of SAMM. A small proportion of these cases (9.3%) originated in primary midwifery care, mainly concerning PPH. Two midwife-researchers and three obstetricians recently analysed these data of primary midwifery care and combined these with records from the Dutch Perinatal Registry. [25] They found no evidence that planned home birth among low risk women leads to an increased risk of severe adverse maternal outcomes in a maternity care system with well-trained midwives and a good referral and transportation system. Our studies on PPH in primary care (**Chapter 2 and 3**) and ambulance referral after PPH provide similar results and conclusions.

Our study has many parallels with the LEMMoN study. Data collection was similar: care providers reported cases encountered in their work and many of these were subjected to (some form of) audit. In addition to the LEMMoN study, in our study cases of shoulderdystocia, UCP and neonatal resuscitation were also collected.

Limitations

Due to risk selection based on the Obstetric indication list (ref VIL), the frequency of obstetric emergencies in primary midwifery care is presumably low. For research purposes, however, low frequency confronts us with limitations concerning interpretation and reproducibility of findings, especially as this study was designed to collect data in a limited period of time (24 months). Despite these limitations, the cases studied contain a wealth of information providing us with a unique look into obstetric emergencies in primary midwifery care in the Netherlands.

We collected all our data from midwives who participated in the CAVE course. This might have biased our results. However, during the study period over 80% of midwives in the Netherlands had participated in the CAVE course, so the population of midwives in our sample is quite representative for the total population of midwives. Currently, over 95% of midwives in the Netherlands have attended the CAVE course (personal communication).

The need for national multidisciplinary guidelines

When a woman is referred to secondary care, she is not only physically moved, but also from one protocol to another. In some cases, she will 'move' from midwifery and ambulance guidelines to hospital protocols, such as obstetrical and paediatric guidelines. As all care providers are caring for the same person, they must literally be on the same page. In order to optimise the process of transfer, multi-disciplinary guidelines provide guidance for optimal care and cooperation.

In the Netherlands, professional organisations have issued guidelines on obstetric emergencies. [21,26-28] Some guidelines are called 'multidisciplinary', but in absence of cooperation in the development and implementation with other professionals they are, in fact, not multidisciplinary. Table 1 shows the guidelines, issued by professional organisations in the Netherlands on PPH, shoulderdystocia and neonatal resuscitation. Two of these guidelines are truly multidisciplinary: 'Neonatal resuscitation' issued by the Dutch Society of Paediatricians (NvK) in collaboration with KNOV and NVOG and 'Manual for ambulance referral', a collaboration between Dutch Ambulance Care (Ambulance Zorg Nederland, AZN) and KNOV. [27]

On the other hand, on a local level, regional obstetric collaborations (VSV) consisting of obstetricians and midwifery practices, are putting great effort into developing and implementing local multidisciplinary protocols. VSVs in The Hague, Nijmegen, Gouda, Tilburg and Leiden are excellent examples of such initiatives and more VSVs nationwide are taking the initiative to optimise perinatal care in their region (www.goedgeboren.nl).

Table 1. Availability of issued by professional organisations

	PPH	Shoulder dystocia	Resuscitation new-born	Breech birth	UCP	Acute obstetrics
KNOV	No	No	**Yes** (slightly modified NvK)[21]	No	No	No
NVOG	**Yes**	No	**Yes** (NvK)	**Yes** [29]	No	Yes, guideline acute obstetrics
NvK	-	-	**Yes** [28]	-	-	-
Ambulance Zorg Nederland (AZN)	*	*	*	*	*	*

KNOV, Royal Dutch College of Midwives; NVOG, Dutch Society of Obstetrics and Gynaecology; NvK, Dutch Society of Paediatricians; *, General manual on ambulance referral

Home Birth

Although evaluating the safety of home birth was not an aim of this study, we must interpret our findings in the context of the obstetrical landscape in the Netherlands. Over the past years, the rate of homebirth in the Netherlands has decreased (from 38% in 1990 to 16% in 2012) but is still a well-motivated choice of many Dutch women. [30,31]

The safety of home birth is a topic of ongoing debate. [25,32-35] If an emergency occurs, one can argue that home is an unsafe place. Having all women give birth in hospital, however, does not solve this problem. Studies have shown that for all women at low risk of complications who give birth in hospital, the number of interventions such as augmentation with oxytocin, epidural analgesia, instrumental vaginal delivery, and caesarean section increases. [35-38] In one study, the risk of complications in home birth is slightly higher in primiparous women, but the authors disagree about the interpretation of these results. [25,38-40] Based on the findings in our studies, we found no evidence that birth in primary midwifery care is unsafe.

Meticulous risk selection, skills training, teamwork, multidisciplinary guidelines and continuous evaluation are key factors to preserve this unique system in the Netherlands where women are given the opportunity to give birth (at home) in primary care.

Pulse Oximetry and Primary Midwifery care

Since 2009, the use of PO has been recommended in the KNOV resuscitation guidelines. [21] However, until this pilot study (**Chapter 9**) none of the midwives used a PO or had a device at their disposal. After a short training PO was used in primary care (home) birth settings without problems. Although midwives were sceptical about introducing technology in this primary care setting, they all became increasingly enthusiastic during the project. At the end of the study, all midwives stated that they would like to have a PO at their disposal in case of suboptimal neonatal condition or resuscitation. Although we anticipated extra referral due to the use of PO, this did not happen. One factor that could have influenced this is that in certain situations midwives ignored abnormal values on the PO device when this did not match their clinical evaluation. In particular, these situations occurred in the very first minutes after birth, when it can be very difficult to obtain a signal for the PO. Although the midwives were informed beforehand on the fact that that skin colour can be very subjective and heart rate is often underestimated, PO should not replace the clinical assessment. If an infant is considered vigorous, one should wait and see if the PO signal improves and/or values improve.

Secondly, we found that infants born after physiological birth, who were immediately placed on the mother's bare chest with the umbilical cord intact, had lower heart rates and higher oxygen saturation values after birth. This has supplied us with unique new information on how we perceive 'physiological transition at birth'. The defined reference ranges show low heart rates directly after birth, followed by a fast increase, which could be a stress response. [41] These babies were directly taken from their mother and routinely evaluated on a resuscitation trolley. We did not observe this fast increase in heart rate and it could be possible that there was less stress response when the new-born is routinely placed on the chest of the mother directly after birth. This study has shown that there are factors that influence the normal values of oxygen saturation and heart rate. Further studies are needed to see which factor has the largest influence. Although we concluded that the defined reference ranges can be used for evaluation, care providers should be aware of factors that could be different than in the cohort used for the defined reference ranges.

We have not studied the cost-effectiveness of PO in primary midwifery care. The frequency of neonatal resuscitation is low so the device will not be used on a daily basis. However, it is possible that PO in this setting could be helpful for early detection of potential life threatening diseases such as sepsis and congenital heart diseases. In addition, it is possible that through PO wet lung or Persistent Pulmonary Hypertension of the new-born can be detected and this could lead to early referral, preventing further deterioration at home. However, the frequency of these complications in low risk births is very low and to investigate this, a large cohort study is needed. Currently however, PO as a screening

tool for congenital heart defects is studied and midwives might be essential contributors to implementing this screening in the Netherlands. Since September 2013, a feasibility study in the Leiden region has been initiated concerning screening of congenital heart defects through PO (www.polsstudie.nl). All midwifery practices and hospitals in the Leiden region are participating in this project. When feasibility has been shown, a larger implementation study will follow to see whether PO reduces mortality and morbidity of infants with congenital heart defects.

Recommendations and future research

The essential findings and recommendations as stated in Chapters 2-8 are similar; in case of PPH, cooperation and communication should and could be optimised and a multidisciplinary guideline concerning prevention and management of PPH is urgently needed. In essence, guideline development forms a crucial starting point in optimising PPH care, also improving collaboration between care providers.

In general, it is our opinion that guidelines concerning obstetrical care in the Netherlands should be developed by all care providers. In case of PPH, the guideline should be developed by KNOV, NVOG and ambulance services. For development of other guidelines (e.g. shoulderdystocia, UCP and breech birth), collaboration between paediatricians, general practitioners, birthing assistant organisations ('Kraamzorg') must be a requirement.

Equally important is the development and validation of quality indicators embedded within the guidelines. Quality indicators are essential for implementing and evaluating care. Through this audit cycle, guidelines are an instrument of continuous evaluation and improvement of care.

As described before, there is a lack of knowledge on the exact prevalence and outcomes of number of obstetric complications (such as UCP) in the Netherlands. Based on our findings, we recommend that a registering system is designed to incorporate all complications, both to gain insight into prevalence and to evaluate care provided.

Should PO be used in community-based midwifery care or would use of PO be the first step in moving midwives away from using the clinical insight they have relied on for hundreds of years? Would this physiological vision blur and lead to more (unnecessary) consultations to a paediatrician and thus remove ourselves from 'natural' birth? In a country such as the Netherlands in which (home) birth in primary care is treasured, these are essential questions. However, the studies in this thesis have shown that these 'fears' were unfounded and the use of PO is feasible. Further (larger studies) are needed to show whether there is also health benefits when using PO in primary midwifery care.

REFERENCES

1. Crofts JF, Ellis D, Draycott TJ, Winter C, Hunt LP, Akande VA. Change in knowledge of midwives and obstetricians following obstetric emergency training: a randomised controlled trial of local hospital, simulation centre and teamwork training. BJOG. 2007;114:1534-1541.
2. Crofts JF, Bartlett C, Ellis D, Hunt LP, Fox R, Draycott TJ. Training for shoulder dystocia: a trial of simulation using low-fidelity and high-fidelity mannequins. Obstet Gynecol. 2006;108:1477-1485.
3. Crofts JF, Bartlett C, Ellis D, Hunt LP, Fox R, Draycott TJ. Management of shoulder dystocia: skill retention 6 and 12 months after training. Obstet Gynecol. 2007;110:1069-1074.
4. Draycott T, Sibanda T, Owen L, Akande V, Winter C, Reading S, et al. Does training in obstetric emergencies improve neonatal outcome? BJOG. 2006;113:177-182.
5. Fransen AF, van de Ven J, Merien AE, de Wit-Zuurendonk LD, Houterman S, Mol BW, et al. Effect of obstetric team training on team performance and medical technical skills: a randomised controlled trial. BJOG. 2012;119:1387-1393.
6. Merien AE, van de Ven J, Mol BW, Outerman S, Oei SG. Multidisciplinary team training in a simulation setting for acute obstetric emergencies: a systematic review. Obstet Gynecol. 2010;115:1021-1031.
7. van de Ven J, Houterman, Steinweg R, Scherpbier A, Wijers, Mol BW, et al. Reducing errors in health care: cost-effectiveness of multidisciplinary team training in obstetric emergencies (TOSTI study); a randomised controlled trial. BMC Pregnancy Childbirth. 2010;10:59.
8. Smit M, Dijkman A, Rijnders M, Bustraan J, van Dillen J, Middeldorp J, et al. Haemorrhage after home birth: audit of decision making and referral. Part 2: Results and discussion. Pract Midwife. 2013;16:28-31.
9. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. J Trauma. 1989;29:623-629.
10. Biester EM, Tomich PG, Esposito TJ, Weber L. Trauma in pregnancy: normal Revised Trauma Score in relation to other markers of maternofetal status--a preliminary study. Am J Obstet Gynecol. 1997;176:1206-1210.
11. Oyetunji T, Crompton JG, Efron DT, Haut ER, Chang DC, Cornwell EE, III, et al. Simplifying physiologic injury severity measurement for predicting trauma outcomes. J Surg Res. 2010;159:627-632.
12. de Groot AN, van Roosmalen J., van Dongen PW. Survey of the management of third stage of labour in The Netherlands. Eur J Obstet Gynecol Reprod Biol. 1996;66:39-40.
13. Begley CM, Gyte GM, Devane D, McGuire W, Weeks A. Active versus expectant management for women in the third stage of labour. Cochrane Database Syst Rev. 2011;11:CD007412.
14. Dixon L, Tracy SK, Guilliland K, Fletcher L, Hendry C, Pairman S. Outcomes of physiological and active third stage labour care amongst women in New Zealand. Midwifery. 2011.
15. Yla-Outinen A, Heinonen PK, Tuimala R. Predisposing and risk factors of umbilical cord prolapse. Acta Obstet Gynecol Scand. 1985;64:567-570.
16. Murphy DJ, MacKenzie IZ. The mortality and morbidity associated with umbilical cord prolapse. Br J Obstet Gynaecol. 1995;102:826-830.
17. Khan RS, Naru T, Nizami F. Umbilical cord prolapse: a review of diagnosis to delivery interval on perinatal and maternal outcome. J Pak Med Assoc. 2007;57:487-491.
18. Chetty RM, Moodley J. Umbilical cord prolapse. S Afr Med J. 1980;57:128-129.
19. Caspi E, Lotan Y, Schreyer P. Prolapse of the cord: reduction of perinatal mortality by bladder instillation and cesarean section. Isr J Med Sci. 1983;19:541-545.
20. Koonings PP, Paul RH, Campbell K. Umbilical cord prolapse. A contemporary look. J Reprod Med. 1990;35:690-692.

21. van der Stouwe R. Standpoint Resuscitation of the New-born at Home Birth in Primary Midwifery Care. Royal Dutch organisation of Midwifes (KNOV); 9 A.D. Apr 15.
22. van den Dungen FA, van Veenendaal MB, Mulder AL. Clinical practice: neonatal resuscitation. A Dutch consensus. Eur J Pediatr. 2010;169:521-527.
23. Dawson JA, Kamlin CO, Vento M, Wong C, Cole TJ, Donath SM, et al. Defining the Reference Range for Oxygen Saturation for Infants After Birth. Pediatrics. 2010;125:e1340-e1347.
24. Zwart JJ, Richters JM, Ory F, de Vries JI, Bloemenkamp KW, van Roosmalen J. Severe maternal morbidity during pregnancy, delivery and puerperium in the Netherlands: a nationwide population-based study of 371,000 pregnancies. BJOG. 2008;115:842-850.
25. de Jonge A, Mesman JA, Mannien J, Zwart JJ, van Dillen J, van Roosmalen J. Severe adverse maternal outcomes among low risk women with planned home versus hospital births in the Netherlands: nationwide cohort study. BMJ. 2013;346:f3263.
26. Dutch Society of Obstetrics and Gynaecology (NVOG). Guideline: Haemorrhagia Post-Partum. 2013.
27. KNOV. Korte handleiding over de ambulanceprotocollen. Dutch Royal Organisation of Midwives. 2012.
28. Dutch Association of Pediatricians (NVK). NVK-guideline Resuscitation of new-borns 2008.
29. Dutch Society of Obstetrics and Gynaecology (NVOG). Stuitligging. 2008
30. Perinatal Care in the Netherlands. 2012 (PRN). www.perinatreg.nl
31. Centraal Bureau voor de Statistiek. CBS, 2012. http://statline.cbs.nl
32. Mohangoo AD, Buitendijk SE, Szamotulska K, Chalmers J, Irgens LM, Bolumar F, et al. Gestational age patterns of fetal and neonatal mortality in europe: results from the Euro-Peristat project. PLoS One. 2011;6:e24727.
33. Evers AC, Brouwers HA, Hukkelhoven CW, Nikkels PG, Boon J, van Egmond-Linden A, et al. Perinatal mortality and severe morbidity in low and high risk term pregnancies in the Netherlands: prospective cohort study. BMJ. 2010;341:c5639.
34. de Vries R, Nieuwenhuijze M, Buitendijk SE. What does it take to have a strong and independent profession of midwifery? Lessons from the Netherlands. Midwifery. 2013;29:1122-1128.
35. de Jonge A, van der Goes BY, Ravelli AC, Amelink-Verburg MP, Mol BW, Nijhuis JG, et al. Perinatal mortality and morbidity in a nationwide cohort of 529,688 low-risk planned home and hospital births. BJOG. 2009;116:1177-1184.
36. Hutton EK, Reitsma AH, Kaufman K. Outcomes associated with planned home and planned hospital births in low-risk women attended by midwives in Ontario, Canada, 2003-2006: a retrospective cohort study. Birth. 2009;36:180-189.
37. Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician. CMAJ. 2009;181:377-383.
38. van der Kooy J, Poeran J, de Graaf JP, Birnie E, Denktass S, Steegers EA, et al. Planned home compared with planned hospital births in the Netherlands: intrapartum and early neonatal death in low-risk pregnancies. Obstet Gynecol. 2011;118:1037-1046.
39. Brocklehurst P, Hardy P, Hollowell J, Linsell L, Macfarlane A, McCourt C, et al. Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study. BMJ. 2011;343:d7400.
40. Offerhaus P, Rijnders M, de Jonge A, de ME. Planned home compared with planned hospital births in the Netherlands: intrapartum and early neonatal death in low-risk pregnancies. Obstet Gynecol. 2012;119:387-388.
41. Dawson JA, Kamlin CO, Wong C, te Pas AB, Vento M, Cole TJ, et al. Changes in heart rate in the first minutes after birth. Arch Dis Child Fetal Neonatal Ed. 2010;95:F177-F181.

Chapter 12

Nederlandse samenvatting

INLEIDING

De afgelopen jaren ben ik zowel als trainer en als deelnemer actief betrokken geweest bij het trainen van verloskundige spoedsituaties. Geconfronteerd worden met een actrice in de rol van een hevig bloedende zwangere vrouw geeft een stressreactie vergelijkbaar met die van een echte spoedsituatie.
Complicaties in de verloskundige (huis)praktijk zijn gelukkig zeldzaam, maar als een dergelijke situatie zich voordoet zijn parate kennis, handelingen, organisatie van zorg en goede communicatie van cruciaal belang. Het is bekend dat het trainen van verloskundige spoedgevallen effectief is en resulteert in betere en snellere behandeling van de patiënt. Dit bewezen positieve effect van training én mijn eigen ambitie om beter te kunnen handelen in een dergelijke situatie waren belangrijke motivaties om dit onderzoek uit te voeren. Daarnaast is mijn actieve rol in het ontwikkelen van training binnen mijn eigen kliniek ook een belangrijke beweegreden geweest dit project te ondernemen.
In Nederland bestaan verschillende cursussen die zich richten op het adequaat behandelen van verloskundige spoedsituaties. Een voorbeeld van een dergelijke cursus is de 'CAVE cursus' (www.Hotabc.nl). De CAVE cursus is ontwikkeld voor verloskundigen en verloskundige samenwerkingsverbanden werkzaam in de eerstelijns praktijk en richt zich op de identificatie en behandeling van verloskundige noodsituaties en tijdige en adequate doorverwijzing naar het ziekenhuis. Sinds 2011 is de CAVE een samenwerking gestart met MedSim in Eindhoven (www.Medsim.nl) waarbij de doelstelling is uitgebreid naar het trainen van de gehele verloskundige keten (verloskundigen, huisartsen, kraamverzorgenden, ambulanceverpleegkundigen, obstetrieverpleegkundigen en gynaecologen) om zo op een uniforme wijze acute situaties op te vangen.
De primaire doelstelling van dit proefschrift is om inzicht te krijgen in het vóórkomen en beloop van obstetrische noodsituaties in de eerstelijns verloskundige zorg in Nederland. Ten tweede hebben we ons gericht op het ontwikkelen van preventieve strategieën om de (eerstelijns) verloskundige zorg te optimaliseren.
Van 2008 tot 2010 hebben 548 verloskundigen die hebben deelgenomen aan de 'CAVE cursus' verloskundige spoedgevallen gemeld. Dit heeft geresulteerd in 198 unieke cases, waarvan een groot deel is beschreven in dit proefschrift. **(Hoofdstuk 1, Inleiding).** We hebben voor onze studies zowel kwalitatieve (audit) en kwantitatieve onderzoeksmethoden toegepast. We bestudeerden preventieve instrumenten zoals het gebruik van een saturatiemeter in de eerstelijns verloskundige praktijk. Ook hebben we 25 kwaliteitsindicatoren ontwikkeld als basis voor een Nederlandse multidisciplinaire richtlijn voor hemorrhagia postpartum (HPP, nabloeding na de bevalling van minimaal 1000 ml).

SAMENVATTING

In **Hoofdstuk 2** en **3** wordt een audit beschreven van gevallen van HPP na een thuisbevalling onder leiding van de eerstelijns verloskundige. Tijdens de studieperiode zijn 67 cases van HPP na een thuisbevalling gemeld. Na het toepassen van selectiecriteria (zoals zorg geheel onder verantwoordelijkheid van de verloskundige, verwijzing naar het ziekenhuis per ambulance, volledige beschikbaarheid van documentatie en beschikbaarheid voor deelname aan de audit van de verloskundige die de casus heeft gemeld) zijn zeven cases onderworpen aan audit. Het auditpanel bestond uit 12 verloskundigen (waarvan de zeven verloskundigen die een casus hadden gemeld), 10 gynaecologen, een onderwijskundige en een ambulancemedewerker. Eerst werd elk panellid gevraagd om een individuele beoordeling van de casus op basis van de medische dossiers (individuele audit) uit te voeren. Bij de plenaire audit bijeenkomst werd aan panelleden gevraagd om te beoordelen of de risicoselectie juist was verlopen en of er factoren van sub standaard care (SSC) aanwezig waren tijdens de zwangerschap en geboorte op het niveau van de patiënt, de zorgverlener of het gezondheidssysteem (in totaal konden 32 items worden beoordeeld). Ook specifieke items met betrekking tot behandeling, verwijzing en vervoer in geval van HPP werden gescoord. De maximaal haalbare score voor SSC werd berekend op basis van *aantal beoordelaars x aantal gevallen x 32 items:* 24 x 7 x 32 = 5,376 items. Bij de individuele audit scoorden de panelleden 842 (16,7%) SSC zorg factoren. De meeste SSC factoren werden toegeschreven aan het gezondheidssysteem (52,9%) en het handelen van de verloskundige (35,3%). Bij de plenaire audit werd SSC geclassificeerd als *incidenteel*, *minor* of *major*. In twee van de zeven gevallen werd *major* SSC gevonden. Dat betekent dat andere zorg naar alle waarschijnlijkheid tot een betere uitkomst zou hebben geleid. In deze twee gevallen waren slechte communicatie en gebrek aan samenwerking de belangrijkste factoren die hebben geleid tot *major* SSC. Aanbevelingen met betrekking tot HPP in de eerstelijns verloskundige zorg werden gemaakt, zoals te zien is in Tabel 1. Het panel heeft geoordeeld dat de communicatie tussen de verschillende zorgverleners zou moeten worden geoptimaliseerd. Daarnaast dient een proactieve houding aangenomen te worden als vrouwen thuis willen bevallen, rekening houdend met de mogelijkheid dat verwijzing (in geval van HPP of vastzittende placenta) geïndiceerd kan zijn. We concludeerden dat een landelijke multidisciplinaire richtlijn voor de behandeling van HPP in de eerstelijn dringend nodig.

Tabel 1. Aanbevelingen na plenaire audit van zeven gevallen van HPP

Audit	Aanbevelingen
Algemeen	Alle disciplines dienen extra aandacht te besteden aan hun verslaglegging.
Eerstelijns verloskundige zorg	- Bij persisterend bloedverlies van meer dan 500 ml: zorg voor intraveneuze toegang (door de verloskundige). - Bij HPP: dien zuurstof toe. - Verminder vertraging door tijdige verwijzing, begin met het organiseren van de verwijzing als de placenta niet binnen 30 minuten is geboren, ongeacht de hoeveelheid bloedverlies op dat moment.
Overdracht en plaats van geboorte	- Verloskundigen moeten regelmatig (her) beoordelen (vóór en tijdens de bevalling) of het huis van de vrouw is geschikt voor een thuisbevalling. - Indien het ziekenhuis ver weg is, zou de zorgverlener kunnen overwegen om vroege (back-up) assistentie van de ambulance in te schakelen
Communicatie & Samenwerking	- Communicatie tussen eerstelijns verloskundigen en gynaecologen zou moeten worden geoptimaliseerd: verwarring over praktische zaken met betrekking tot doorverwijzing kan leiden tot SSC. - Er moet duidelijker gecommuniceerd worden tussen verloskundige en gynaecoloog betreffende de klinische conditie van de moeder (bijvoorbeeld hartslag en bloeddruk).

In **Hoofdstuk 4** beschrijven we ambulancetransport van vrouwen met HPP of vastzittende placenta na een thuisbevalling (gerapporteerd tijdens de studie periode van april 2008 tot april 2010). Ambulance rapport formulieren en medische verslagen zijn verzameld. Tijdsintervallen, ambulance coderingen en klinische toestand zoals vermeld op de ambulance formulieren zijn geïnventariseerd. Ook het totale bloedverlies, opname op de intensive care, chirurgische ingrepen, bloedtransfusies en opnameduur in het ziekenhuis zijn verzameld en geanalyseerd. Maternale conditie is gemeten door middel van de 'Revised Trauma Score' (RTS). De RTS score is een betrouwbaar meetinstrument voor het beoordelen van de klinische conditie van de traumapatiënt en wordt wereldwijd gebruikt door de meeste ambulance teams. Deze score combineert de Glasgow Coma Scale (GCS), ademfrequentie (Rf) en systolische bloeddruk (SBP). Door het combineren van deze parameters is prognostische waarde van de RTS score aanzienlijk hoger dan het afzonderlijk beoordelen van de GCS, Rf en SBP. De RTS score kan variëren van 0 tot 12 waarbij 0 de laagst mogelijke score is en 12 aangeeft dat de patiënt in optimale conditie is. De RTS score wordt bepaald bij aankomst van de ambulance personeel en regelmatig herhaald, indien nodig. Voor onze analyse hebben we gebruik gemaakt van de laagste RTS scoren zoals genoteerd op het ambulance meldingsformulier. Gedurende de onderzoeksperiode zijn 72 cases van ambulance transport in geval van HPP na thuisbevalling gemeld. Van 62 cases waren de medische dossiers en ambulance rapport formulieren beschikbaar. Het bloedverlies *op het moment van verwijzing* was 1050 ml

(mediaan, variërend van 500-2000 ml). Het *totaal* mediaan bloedverlies was 2000 ml, variërend 1000-7000 ml. In 40 gevallen (64,5%) is er aan de 'landelijke 45 minuten' norm voldaan (dat wil zeggen dat van het moment van oproepen van de ambulance tot het moment van aankomst in het ziekenhuis er maximaal 45 minuten mogen verstrijken). In 22 gevallen is deze grens overschreden tot een maximum van 79 minuten (mediaan van overschrijding: 8 minuten). Tijdens ambulancezorg hadden 49 vrouwen (77,4%) de maximale RTS score van 12. Bij 13 patiënten (22,6%) was er een daling van de systolische bloeddruk, welke leidde tot een RTS score van 10 of 11. We vonden geen verschil in maternale uitkomsten tussen vrouwen met verschillende RTS scores of tussen vrouwen voor wie de 45-minuten norm wel of niet is overschreden. We hebben geconcludeerd dat geen van de vrouwen in acuut gevaar was tijdens ambulance vervoer, ongeacht of de ambulance overdracht de 45 minuten norm overschreed of dat er een verlaagde RTS score was. Het laag-risicoprofiel van vrouwen onder verantwoordelijkheid van de eerstelijns verloskundige, de goed georganiseerde verloskundige en ambulancezorg en het uitstekende wegennet in Nederland spelen waarschijnlijk een rol bij deze bevindingen.
Voor **Hoofdstuk 5** hebben we in 2011 alle verloskundige praktijken en obstetrische afdelingen in Nederland ondervraagd over het beleid rond 'het derde tijdperk' (direct na geboorte van het kind, het nageboortetijdperk) van de bevalling. In 59.1% van de verloskundige praktijken wordt routinematig oxytocine na iedere bevalling gegeven. In obstetrische praktijken gebeurt dit in 96,4% *(p* <0.01). Vergeleken met eerder onderzoek uit 1995 is het routinematig gebruik van oxytocine bij zowel verloskundigen (10-59,1%) als gynaecologen (55-96,4%) toegenomen *(p* <0.01). Studies hebben aangetoond dat er een positief effect is op de prevalentie van HPP bij routinematig toedienen van uterotonica. Echter, voor bevallingen in de eerstelijns verloskundige zorg in geïndustrialiseerde landen is dit bewijs minder overtuigend. Gezien het ontbreken van bewijs met betrekking tot routinematig toedienen van uterotonica in laag risico (thuis) bevallingen, is nader onderzoek geïndiceerd. Een landelijke richtlijn met aanbevelingen betreffende routinematig toedienen van uterotonica bij vrouwen onder verantwoordelijkheid van de verloskundige dient worden opgesteld en geïmplementeerd.

In **Hoofdstuk 6** wordt de ontwikkeling van 25 kwaliteitsindicatoren voor de preventie en behandeling van HPP beschreven. De indicatoren zijn ontwikkeld door middel van een RAND gemodificeerde Delphi-procedure. Deze methode bestaat uit vijf stappen: (1) het samenstellen van een panel van deskundigen, (2) een literatuuronderzoek en het verzamelen van mogelijke kwaliteitsindicatoren, (3) een digitale enquête, (4) een consensus bijeenkomst en (5) een kritische evaluatie. Na het toepassen van vooraf gespecificeerde criteria met betrekking tot expertise in verschillende domeinen met betrekking tot eerstelijns verloskundige zorg, tweedelijns obstetrische zorg, spoedeisend

vervoer, maternale morbiditeit en mortaliteit audit, kwaliteitsindicatoren of richtlijn-ontwikkeling en vertegenwoordigers van professionele organisaties is een expert panel samengesteld. Het panel bestond uit vijf verloskundigen, zeven gynaecologen en een ambulancemedewerker. Literatuuronderzoek resulteerde in de selectie van 79 aanbevelingen ter beoordeling door het expert panel. Na een digitale vragenlijst zijn zeven indicatoren door de panelleden toegevoegd, resulterend in 86 mogelijke indicatoren. Na uitsluiting van 41 indicatoren (unaniem als niet-valide bevonden), zijn 45 mogelijke indicatoren besproken op de consensus bijeenkomst. Na kritische evaluatie zijn 18 mogelijke indicatoren geëxcludeerd omdat deze overlappend waren en twee indicatoren zijn geëxcludeerd vanwege de onmogelijkheid deze te meten. Uiteindelijk is een set van 25 kwaliteitsindicatoren valide gevonden om te testen voor toepasbaarheid in de praktijk. Vervolgens, in **Hoofdstuk 7,** beschrijven we het proces van de beoordeling van de toepasbaarheid van de ontwikkelde 25 valide kwaliteitsindicatoren. De indicatoren zijn getoetst op toepasbaarheid, haalbaarheid, naleving van de indicator, en het verbeteringspotentieel van de indicator. Elf indicatoren bleken toepasbaar en haalbaar. Vijf van deze indicatoren vertoonden verbeterpotentieel: routinematige toediening van uterotonica, het kwantificeren van bloedverlies door middel van wegen, tijdige doorverwijzing naar de tweede lijn en de behandeling van HPP (d.m.v. blaascatheterisatie, uterusmassage en/of oxytocine) en het gebruik van zuurstof. Veertien indicatoren bleken niet bruikbaar als instrument om de kwaliteit van zorg te meten in geval van HPP. We concludeerden dat 11 van de 25 indicatoren geschikt bleken als evaluatie-instrument voor verloskundige zorg geleverd bij een HPP en opgenomen te kunnen worden in een verloskundige richtlijn.
Naar onze mening bevatten de studies beschreven in **Hoofdstuk 2** tot en met **7** voldoende reden voor de auteurs om aan te dringen op de ontwikkeling en implementatie van een nationale, multidisciplinaire HPP richtlijn.

In **Hoofdstuk 8** worden gevallen van 'umbilical cord prolapse' (UCP, uitgezakte navelstreng) beschreven. Deze gevallen werden ook verzameld in de 'CAVE-studie'. Er is gekeken naar de uitgevoerde procedures om navelstrengcompressie te voorkomen, de timing van ambulancezorg en de perinatale uitkomsten. Het 'Diagnosis to Delivery Interval' (DDI, diagnose tot geboorte interval) en de risicofactoren voor UCP werden geïdentificeerd. Acht gevallen van UCP werden gemeld tijdens de studieperiode, waarbij zes thuis optraden. Procedures zoals het retrograad vullen van de blaas (2/8), opduwen van het hoofd (7/8) en Trendelenburg (1/8) werden toegepast. Alle kinderen werden geboren in het ziekenhuis en op één na allemaal via een keizersnede. Eén kind, geboren na keizersnede, is overleden aan de gevolgen van ernstige asfyxie, de andere kinderen zijn goed hersteld na de bevalling en hebben in goede conditie het ziekenhuis

verlaten. De DDI varieerde van 13-72 minuten. In het geval van het overleden kind was de DDI 47 minuten. Hoewel dit bovengemiddeld is, is in 3 gevallen een langere DDI gevonden (van 56, 72 en 71 minuten) en deze kinderen werden allemaal in goede conditie geboren. Eerdere studies hebben gemeld dat een langdurig DDI in geval van UCP het risico op lage Apgar-scores, doodgeboorte en neonatale sterfte verhoogd. Echter, andere studies vonden geen directe relatie tussen DDI en perinatale uitkomsten (zoals perinatale sterfte en neonatale intensive care opnamen), maar wel voor hypoxie, CTG afwijkingen, intra uteriene groeivertraging en vroeggeboorte. UCP buiten het ziekenhuis is niet eerder structureel geëvalueerd, maar is wel sporadisch in publicaties genoemd. In vrijwel al deze studies zijn lange DDI (meer dan 100 minuten) en hoge perinatale sterftecijfers gemeld. Wij vermoeden echter dat deze resultaten gebaseerd zijn op gevallen in zorgsystemen waarbij geen hulp wordt verleend in de thuissituatie om navelstrengcompressie te verminderen en waar snelle verwijzing naar het ziekenhuis niet altijd mogelijk is. Het is duidelijk dat de DDI langer zal zijn als een patiënt moet worden overgebracht naar het ziekenhuis per ambulance. In deze studie vonden we dat DDI op zich niet voldoende verklaring geeft voor ongunstige perinatale uitkomsten.
In de discussie aan we dieper in op het uitvoeren van blaasvulling. Hoewel dit effectief is, is het een tijdrovende procedure. In het geval van de neonatale sterfte was de ambulance al aanwezig voordat de verloskundige arriveerde. Achteraf gezien was de foetale conditie waarschijnlijk al zeer slecht toen de verloskundige arriveerde en was onmiddellijke verwijzing wellicht effectiever geweest dan eerst de blaas te vullen. Het kan dus een afweging zijn om als de ambulance al aanwezig is niet eerst de blaas te vullen maar direct over te gaan op transport. Risicofactoren zoals liggingsafwijking (stuitligging) en/of een niet ingedaald voorliggend deel is gevonden in vier gevallen, maar in slechts twee gevallen (niet ingedaald hoofd) was dit bekend vóór aanvang van de bevalling bij de verloskundige. Hoewel deze studie maar een klein aantal gevallen behelst (vanwege de zeldzaamheid van deze complicatie en de beperkte studieperiode), kunnen we concluderen dat, hoewel UCP thuis leidt tot een verhoogd DDI, geen correlatie met een minder gunstig resultaat wordt gevonden. In deze studie vonden we dat DDI alleen onvoldoende verklaring geeft voor ongunstige perinatale uitkomsten.
In **Hoofdstuk 9** en **10** beschrijven we studies over het gebruik van een pulsoxymeter (PO) bij kinderen geboren onder verantwoordelijkheid van de eerstelijns verloskundige thuis of in het ziekenhuis. Zowel de Nederlandse Vereniging van Kinderartsen (NVK) als de Koninklijke Nederlandse Organisatie van Verloskundigen (KNOV) raden het gebruik van een PO aan in geval van een neonatale reanimatie. Momenteel is de PO niet geïmplementeerd in de eerstelijns verloskundepraktijk. We onderzochten de haalbaarheid van de PO in de huidige verloskundige praktijk en daarnaast hebben we beoordeeld of de eerder gedefinieerde referentiewaarden geschikt zijn voor het evalueren van een neonaat

geboren na een laag risico vaginale bevalling, waarbij laat is afgenaveld (Delayed Cord Clamping, DCC) en waarbij de baby direct op de blote huid van de moeder is gelegd (Immediate Skin to Skin Contact, ISSC). We voerden een prospectieve, observationele studie uit bij kinderen geboren na een ongecompliceerde (thuis)bevalling onder leiding van de eerstelijns verloskundige. Zevenentwintig verloskundigen uit zeven praktijken gebruikten de PO direct na de geboorte of tijdens het kraambed gedurende een periode van tien minuten. Voor **Hoofdstuk 9** hebben we gekeken naar de haalbaarheid van het gebruik van een PO voor het evalueren van kinderen geboren in de eerstelijn. We hebben gegevens verzameld over het effect van de PO metingen op de uitkomsten, interventies en besluitvorming van de verloskundigen. Verloskundigen werden ondervraagd met betrekking tot de toepasbaarheid en het nut van de PO.

De PO werd gebruikt bij 153 kinderen geboren onder verantwoordelijkheid van de eerstelijns verloskundige. Van deze kinderen zijn 151 in optimale conditie geboren. Eén kind heeft extra zuurstof gekregen en één kind is beademd met masker en ballon. In 138/153 (90%) zuigelingen werd de PO (technisch) probleemloos gebruikt en 88% van de verloskundigen vindt de PO gemakkelijk in gebruik. In 148/153 (97%) was PO gebruik niet van invloed op de beslissing van de verloskundige om al dan niet het kind te verwijzen naar de kinderarts. In 5/153 (3%) was de verloskundige onzeker over de neonatale conditie van het kind, maar werd gerustgesteld door de PO meting. In het geval van suboptimale neonatale conditie of noodzaak tot reanimatie geeft 100% van de verloskundigen aan dat zij een PO zouden gebruiken. De verloskundigen die de PO gebruikt hebben, verklaarden dat het gebruik van het apparaat niet heeft geleid tot onzekerheid of extra verwijzingen naar de kinderarts. Verloskundigen gaven aan dat ze graag een PO tot hun beschikking zouden hebben in geval van suboptimale neonatale conditie of wanneer neonatale reanimatie nodig is, maar dat ze een PO niet als routine zouden gebruiken. Een bijkomende bevinding was dat niet alleen verloskundigen, maar ook de ouders zeer positief waren over de PO. Bijvoorbeeld, een kind had een periode van cyanose (blauw zien) doorgemaakt na het verslikken in voeding: niet alleen de verloskundige, maar ook de ouders waren gerustgesteld door normale waarden op de PO.

Op basis van bovenstaande bevindingen hebben we geconcludeerd dat het haalbaar is om PO te gebruiken in de eerstelijns verloskundige praktijk. Bovendien heeft PO in deze eerstelijns setting niet geleidt tot onzekerheid of extra verwijzingen naar de kinderarts. Daarnaast zijn de objectieve parameters van de PO niet alleen geruststellend voor de verloskundigen maar ook voor de ouders. Deze studie toont aan dat gebruik van een PO in de eerstelijns verloskundige praktijk haalbaar is maar geeft geen advies over het al dan niet implementeren in de praktijk. Omdat de incidentie van neonatale morbiditeit in deze groep laag is, zou een grotere studie nodig zijn om te onderzoeken of het gebruik van een PO van invloed is op de neonatale uitkomsten.

Voor **Hoofdstuk 10** hebben we gekeken of de eerder gedefinieerde PO referentiewaarden geschikt zijn om kinderen geboren na een ongecompliceerde vaginale geboorte waarbij DCC en ISSC is toegepast. Hiervoor hebben we de SpO_2 (zuurstofsaturatie) en HR (hartslag) gegevens van kinderen geboren na een ongecompliceerde vaginale geboorte (te noemen: het Leiden cohort) vergeleken met eerder gepubliceerde gegevens van kinderen geboren in goede conditie in The Royal Women Hospital Melbourne, Australië en in het Universitair Ziekenhuis van La Fe, Valencia, Spanje (te noemen: de gedefinieerde referentiewaarden). Een groot deel van de kinderen die gebruikt is om deze referentiewaarden te maken zijn echter geboren na een bevalling waarbij interventies zoals bijstimulatie met oxytocine, pijnstilling, vaginale kunstverlossingen of een keizersnede zijn toegepast. Onze studiegroep bevatte alleen kinderen geboren na een ongecompliceerde bevalling onder verantwoordelijkheid van de eerstelijns verloskundige, waarbij geen van de bovenstaande interventies is toegepast. Verloskundigen in de regio Leiden namen deel aan deze studie en gebruikten de PO na ongecompliceerde bevallingen thuis of in het ziekenhuis. Gedurende 10 minuten werden SpO_2 en HR waarden verkregen en deze zijn vergeleken met de eerder gepubliceerde referentiewaarden. Behalve een hogere SpO_2 ($p < 0,05$), in combinatie met een langzamere toename in de eerste 3 minuten waren de SpO_2 waarden vergelijkbaar met de gedefinieerde referentiewaarden. In het Leiden cohort vonden we een lagere hartslag (HR) ($p < 0,05$) in de eerste 10 minuten met een tragere stijging van de eerste 3 minuten. In de eerste minuten na de geboorte, kwamen minder tachycardieën (HR> 180 bpm) maar meer bradycardiën (<80 bpm) voor ($p < 0,05$). We concludeerden dat de gedefinieerde referentiewaarden gebruikt kunnen worden bij kinderen geboren na een ongecompliceerde vaginale bevalling met DCC en ISSC, maar dat hogere SpO_2 en lagere HR waarden zijn waargenomen in de eerste minuten. DCC, ISSC en het ontbreken van medische ingrepen kunnen deze verschillen verklaren. Bovendien zijn de waargenomen verschillen in ons cohort van belang in de discussie over wat beschouwd wordt als "normale" SpO_2 en HR waarden en hoe wij de "fysiologische overgang" bij de geboorte definiëren.

Aanbevelingen en toekomstig onderzoek

De voornaamste conclusies en aanbevelingen zoals vermeld in de **Hoofdstukken 2-8** zijn vergelijkbaar: in geval van HPP moeten en kunnen samenwerking en communicatie worden geoptimaliseerd. Daarnaast dient een multidisciplinaire richtlijn bestaande uit preventieve maatregelingen en behandelwijzen in geval van HPP te worden opgesteld en geïmplementeerd. Hierbij vormt richtlijnontwikkeling een cruciaal uitgangspunt in het optimaliseren van HPP zorg met daarbij ook het verbeteren van de samenwerking tussen verschillende zorgverleners.

Het is onze mening dat richtlijnen met betrekking tot de verloskundige zorg in Nederland ontwikkeld dienen te worden door alle zorgverleners samen. In het geval van HPP zou de richtlijn moeten worden ontwikkeld door KNOV, NVOG en ambulancediensten. Voor de ontwikkeling van andere richtlijnen (zoals schouderdystocie, UCP en stuitligging) moet samenwerking tussen gynaecologen, kinderartsen, huisartsen en kraamzorg een vereiste zijn.

Even belangrijk is de ontwikkeling en validatie van kwaliteitsindicatoren welke ingebed dienen te zijn binnen de richtlijnen. Kwaliteitsindicatoren zijn hierbij essentieel voor de uitvoering en evaluatie van zorg. Door deze 'audit cyclus' zijn richtlijnen ook een instrument van continue evaluatie en verbetering van de zorg.

Zoals eerder beschreven is er een gebrek aan kennis over de exacte prevalentie en de uitkomsten van een aantal obstetrische complicaties in Nederland, zoals uitgezakte navelstreng. Op basis van onze bevindingen, adviseren wij dat deze complicaties geregistreerd worden in een registratie systeem om zowel inzicht te krijgen in de prevalentie evenals de zorg te evalueren.

Ten slotte, zou het gebruik van een saturatiemeter standaard moeten worden in de verloskundige praktijk? Of leidt dit af van de 'klinische blik' waar verloskundigen al jaren op varen en zal dit de fysiologische blik vertroebelen? Of leidt gebruik van een PO tot onnodige verwijzingen naar de kinderarts en ons verwijderen van de 'natuurlijke' geboorte?

In een land als Nederland waar de ongecompliceerde (thuis) bevalling wordt gekoesterd, zijn dit essentiële vragen. Echter, de studies in dit proefschrift hebben aangetoond dat deze 'angst' ongegrond is en het gebruik van de PO haalbaar is. Verdere (grotere studies) zijn nodig om aan te tonen of er ook gezondheidswinst te behalen is met het gebruik van de saturatiemeter.

Publications

Authors and affiliations

Curriculum Vitae

Dankwoord

Abbreviations

PUBLICATIONS

1. **Smit M**, Dawson JA, Ganzeboom A, Hooper SB, van Roosmalen J, Te Pas AB. Pulse oximetry in newborns with delayed cord clamping and immediate skin-to-skin contact. *Arch Dis Child Fetal Neonatal Ed.* 2014.
2. **Smit M**, Dijkman A, Rijnders M, Bustraan J, van Dillen J, Middeldorp J, et al. Haemorrhage after home birth: audit of decision making and referral. Part 2: Results and discussion. *Pract Midwife.* 2013;16:28-31.
3. **Smit M**, Dijkman A, Rijnders M, Bustraan J, van Dillen J, Middeldorp J, et al. Haemorrhage after home birth: audit of decision making and referral. *Pract Midwife.* 2013;16:12-15.
4. **Smit M**, Sindram SI, Woiski M, Middeldorp JM, van Roosmalen J. The development of quality indicators for the prevention and management of postpartum haemorrhage in primary midwifery care in the Netherlands. *BMC Pregnancy Childbirth.* 2013;13:194.
5. **Smit M**, Ganzeboom A, Dawson JA, Walther FJ, Bustraan J, van Roosmalen JJ, et al. Feasibility of pulse oximetry for assessment of infants born in community based midwifery care. *Midwifery, doi: 10.1016/j.midw.2013.06.005. (Epub ahead of print).*
6. **Smit M**, van SG, Wolterbeek R, van DJ, van Roosmalen J, Slootweg Y. Survey of prophylactic use of uterotonics in the third stage of labour in the Netherlands. *Midwifery.* 2013;29:859-862.
7. Dijkman A, Huisman CM, **Smit M**, Schutte JM, Zwart JJ, van Roosmalen JJ, et al. Cardiac arrest in pregnancy: increasing use of perimortem caesarean section due to emergency skills training? *BJOG.* 2010;117:282-287.

AUTHORS AND AFFILIATIONS

From the department of Obstetrics, Leiden University Medical Center, Leiden, the Netherlands
Annemieke Middeldorp, Giel van Stralen, Jos van Roosmalen, Yolentha Slootweg, Marrit Smit

From the department of Neonatology, Leiden University Medical Center, Leiden, the Netherlands
Arjan te Pas, Frans Walther

From the department of Epidemiology, Leiden University Medical Center, Leiden, the Netherlands
Ron Wolterbeek

From the Faculty of Medicine of the Leiden University Medical Center, Leiden, the Netherlands
Angelina Ganzeboom, Susanne Sindram, Sanne Luxemburg, Kar-Li Chan, Sabine van der Wolk, Fleur Zwanenburg

From the department of Obstetrics, Reinier de Graaf Gasthuis, Delft, the Netherlands
Anneke Dijkman, Ineke Stolp

From the department of Obstetrics, Radboud University Medical Center, Nijmegen, the Netherlands
Mallory Woiski, Jeroen van Dillen

From the ´CAVE Course´, Boxmeer, the Netherlands
Barbara Havenith, Jacobien van der Ploeg

From TNO, Quality of Health, Leiden, the Netherlands
Marlies Rijnders

From the Department of Medical Education, Leiden University Medical Center, the Netherlands
Jacqueline Bustraan

From RAV Hollands Midden Ambulance Services, Leiden, the Netherlands
Jan de Waard

From the Department of Newborn Research, The Royal Womens Hospital, Melbourne, Australia
Jennifer Dawson

From The Ritchie Centre, Monash Institute for Medical Research, Monash University, Clayton, Victoria, Australia
Stuart Hooper

CURRICULUM VITAE

De auteur van dit proefschrift is op zondag 4 januari 1976 geboren in het Amsterdamse VU ziekenhuis na een zwangerschap van (ongeveer) 42 weken.
Na het behalen van het HAVO diploma aan het Rembrandt College in Utrecht, heeft zij een jaar gewerkt als au pair in Florida en New York (Verenigde Staten). In 1995 begon Marrit met haar opleiding tot verloskundige aan de Amsterdamse Kweekschool voor Vroedvrouwen, te Amsterdam. In juni 1999 werd het diploma behaald, waarna zij in Soest, Amsterdam en op Aruba (Nederlandse Antillen) gewerkt heeft als eerstelijns verloskundige.
Sinds 2002 is auteur werkzaam in het Leids Universitair Medisch Centrum (LUMC) als klinisch verloskundige. In 2004 heeft Marrit in samenwerking met collegae binnen de afdeling verloskunde de Klinische Acute Situatie Training (KAST) ontwikkeld en succesvol geïmplementeerd, zowel binnen het ziekenhuis als in de Leidse regio. Sinds 2008 is zij daarnaast werkzaam als promovendus bij promotor prof. Jos van Roosmalen. Naast de huidige klinische- en onderwijstaken binnen het LUMC is auteur thans betrokken bij onderzoek en organisatorische projecten binnen de afdelingen verloskunde, neonatologie van het LUMC en binnen de Leidse verloskundige regio.
Marrit woont in de binnenstad van Delft met Erwin van de Groep en hun drie zonen Sam (2004), Ko (2007) en Abe (2009).

DANKWOORD

Het cliché dat een proefschrift schrijven iets is dat je niet alleen doet, is waar.
Om te kunnen oogsten, moet er gezaaid worden, maar wel op vruchtbare grond.

De mogelijkheid om te promoveren is mij geboden door de afdeling verloskunde van het LUMC. Professor Jan van Lith, Juliet Droog en Godelieve van Roosmalen hebben hiervoor de voorwaarden geschept waarvoor zeer veel dank.

Professor van Roosmalen, beste Jos, het was een voorrecht om je promovendus te zijn. Je toewijding, wijze woorden, kritische blik en je vertrouwen in de fysiologische verloskunde maakt onderzoek met jou doen een feest! Dankjewel.

Dr. te Pas, beste Arjan. Al jaren collega's, maar elkaar gevonden in het onderzoek. Dank voor je raad en daad en volledige commitment als copromotor. Ik kijk uit naar onze volgende projecten.
Dr. Middeldorp, beste Annemieke. Je praktische, heldere visie op verloskunde en pragmatische aanpak was verfrissend, stimulerend en vooral heel erg leuk. Je begeleiding als copromotor was 'to the point' en recht op het doel af. Heerlijk. Bedankt.

Graag uit ik mijn diepe dankbaarheid naar Barbara Havenith en Jacobien van der Ploeg, gynaecologen en oprichters van de CAVE cursus. Tijdens de studieperiode hebben jullie cursisten gemotiveerd deel te nemen aan deze studie en dankzij jullie prettige benadering hebben verloskundigen dit ook volop gedaan.
Dank ook aan Yvonne Beuger die de alle casuïstiek heeft verzameld en ingevoerd.

De leden van de beoordelingscommissie prof. dr. N.A Blom, prof. dr. J.M.M van Lith, prof. dr. S. A. Scherjon, dr. J. van Dillen en dr. M.P Amelink-Verburg wil ik bedanken voor het beoordelen van het manuscript.

Ik ben bevoorrecht om al vele jaren met het leukste team verloskundigen van Nederland te mogen werken. Ieder met haar eigen 'super krachten'. Anne-Marie Sluijs, Det van Dijk, Godelieve van Roosmalen, Isabelle Grillis, Yolentha Slootweg, Jeanette Mesman, Jeannette Dieleman, Marjolein Meijer, Marlous Klinkenberg en Wilma van Keijsteren, ik ben trots op ons!
Lieve Juliet, ik heb diepe bewondering voor jou. Dank voor je aansporing, motiverende peptalks en vertrouwen in dat 'het' toch echt zou lukken. Lieve Go, dank voor je wijsheid en steun op alle fronten.

Mijn dank gaat uit naar de stafleden, verpleging, onderzoekers, research nurses en arts-assistenten van de afdeling verloskunde van het LUMC voor alle (morele) steun, hulp en medewerking in de onderzoeksprojecten. Ivanka Bekker en Gladys Laterveer hebben altijd alles onder controle, gelukkig…Dank!

Ik heb het genoegen gekend om studenten Angelina Ganzeboom, Susanne Sindram, Kar-Li Chan, Sanne Luxemburg, Ilona Narayen, Sabine van der Wolk, Fleur Zwanenburg, Isabel Brederije, Anne Vermeulen en Ineke Stolp te mogen begeleiden. Leerzaam voor jullie en ook voor mij, dank jullie wel.

Lieve Anneke, eerst collega nu vooral dierbare vriendin, mede-moeder en 'Zangle'. Eindelijk mag je 'nimfen', wat hebben we hier samen naartoe geleefd. Dank voor het geweldige mens dat jij bent.

Lieve Jasper, mijn broer(tje) en paranimf. Vroeger vlogen de cassettebandjes regelmatig door de lucht, nu hebben we samen kilometers Engelse teksten doorgeakkerd. Dank voor je geweldige hulp bij het redigeren van mijn teksten en je briljante humor.

Ik kijk er naar uit om deze dag te vieren met mijn lieve vriendinnen. Saskia, Madlenka, Jose, Marleen, Marieke, Karen, Renate, Minke, Charlotte, Noortje, Anna, Manon, Sandra, Jessica en 'the Zangles'. Meiden, wat hebben we veel gelachen, gezongen, gehuild, gefeest, gemoederd, gegeten en geproost. Dank voor jullie onvoorwaardelijke vriendschap.

Lieve Karel en Aletta, mijn ouders. Jullie hebben mij de kans gegeven die dingen te doen die ik leuk vind, die mij hebben gebracht tot waar ik ben. Altijd in het volste vertrouwen achter mij gestaan. Dat is de basis waarop ik stevig sta. Dank daarvoor.

Lieve (oma) Mechelien, wat jammer dat je deze dag niet meemaakt. Je wordt intens gemist.

Lieve Sam, Ko en Abe. Dit is nou het boek. Zonder plaatjes. In het Engels. Maar, het is klaar! Jullie maken alles mooier, rijker en leuker dat het al was. Ik heb jullie lief van hier tot alle planeten…en weer terug.

Mijn allerliefste Erwin. Als er iemand 'vruchtbare grond' heeft geboden ben jij het wel. Jij en ik, samen met de jongens is alles en het enige dat er uiteindelijk toe doet. Op naar iets rustiger vaarwater, samen!

Leiden, juni 2014

LIST OF ABBREVIATIONS

AMTSL	Active Management of the Third Stage of Labour
AROM	Artificial Rupture of Membranes
CAVE	Cursus Aute VErloskunde
CCT	Controlled Cord Traction
DCC	Delayed Cord Clamping
DDI	Diagnosis to Delivery Interval
FIGO	International Federation of Gynaecology and Obstetrics
GCS	Glasgow Coma Score
HR	Heart Rate
ICM	International Confederation of Midwives
ISSC	Immediate Skin to Skin Contact
KNOV	Koninklijke Nederlandse Vereniging van Verloskundigen (Royal Dutch Organisation of Midwives)
MOET	Managing Obstetric Emergencies and Trauma
NvK	Nederlandse Vereniging voor Kindergeneeskunde (Dutch Society of Peadiatrics)
NVOG	Nederlandse Vereniging van Obstetrie en Gynaecologie (Dutch Society of Obstetrics and Gynaecology)
PO	Pulse Oximetry
POET	Pre-hospital Obstetric Emergencies Training
PPH	Post-Partum Haemorrhage
PRBC	Packed Red Blood Cells
PRN	Perinatale Registratie Nederland (Dutch Perinatal Registry)
Rf	Respiratory frequency
RTS	Revised Trauma Score
SpO_2	Oxygen Saturation
SROM	Spontaneous Rupture of Membranes
SSC	Sub Standard Care
UCP	Umbilical Cord Prolapse
WHO	World Health Organisation