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.

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