Lessons learnt from the perinatal audit on perinatal asphyxia in the category delay of care

Author: Selma Wilting
Student number: 1787845
Leiden University
Organisation: Perined, Utrecht
Perined supervisor: Dr. A. Rosman
University supervisor: Prof. Dr. T.H. van den Akker, gynaecologist-obstetrician, LUMC
19/09/2022-13/01/2023 (16 weeks)

Abstract

Objective: to evaluate improvable factors and improvement actions regarding cases of perinatal asphyxia possibly caused by delay of care that were formulated in perinatal audits in the Netherlands.

Introduction: one of the most common causes of perinatal death in the Netherlands is perinatal asphyxia. This is described as the state in which the neonate experiences a temporary lack of oxygen during birth and therefore, the brain may be permanently damaged. To diminish the amount of cases, perinatal asphyxia was a theme in the Dutch perinatal audit system from 2017-2019 and improvement actions were formulated.

Materials and methods: all data were collected from the perinatal audit assistant. The improvable factors that were formulated in the audit meetings regarding perinatal asphyxia in the category delay were used to perform a qualitative retrospective cohort study. The ACTion toolkit was utilized to systematically analyse the data.

Results: All 29 cases of perinatal asphyxia in which delay of care occurred were included. 49 improvable factors with suitable improvement actions were developed in the audit meetings and assessed in this thesis. The improvable factors could be categorised as follows: prolonged decision to incision interval, deviating from standard obstetric healthcare, lacking knowledge of healthcare workers, insufficient communication and other.

Conclusion: Systematic evaluation of the improvable factors showed that delay of care and therefore, possibly perinatal asphyxia, was most often caused by complications in transportation to the operating room, lacking knowledge regarding foetal monitoring and insufficient communication with colleagues.

1.Introduction

According to the World Health Organization 2.4 million children died in the first month of life in 2020. 75% of the neonatal deaths occur during the first week of life and are most commonly caused by preterm birth, perinatal asphyxia, lack of breathing at birth, infections or birth defects [1]. In 2021 the amount of live-borns in the Netherlands was 179.441 [2]. Approximately 0.5-1% of the neonates suffered from perinatal asphyxia [3]. Perinatal asphyxia is the state in which a neonate has a temporary lack of oxygen during delivery or surrounding the birth. Maternal, placental or foetal factors can all induce this type of hypoxic-ischemic injury in the neonate. There is no international consensus on the terms for the clinical diagnosis of perinatal asphyxia. However, often used to support the clinical diagnosis are the Apgar score and possible foetal umbilical artery acidaemia confirmed with pH, base deficit or lactate levels in the umbilical cord [4].

Birth asphyxia can be associated with organ damage in any form. Long-term symptoms might occur if the neonate is not capable to compensate or the interruption of gas exchange and blood flow takes too long. Most feared is neuronal injury, which can result in hypoxic-ischaemic encephalopathy (HIE). The deprivation of oxygen of the brain commonly leads to long term complications, including cerebral palsy, cognitive or behavioural problems and the sensory outcome of the neonate [4]. In addition, new-borns with HIE often suffer from dysfunction in at least one other organ system. This can be explained by the diving reflex. Activated by the asphyxia, the diving reflex makes blood shunt from non-vital organs, usually the skin and the splanchnic area, to vital organs such as the heart and the brain. Subsequently, damage, sometimes temporary, can be expected in organs such as the kidneys, liver or gastrointestinal tract [4,5].

As perinatal asphyxia poses an important problem worldwide, experts wonder what would be the right approach to minimalize the risk at birth. Since our ability to predict asphyxia remains poor, it is difficult to establish a proper medical solution. An overview of the available obstetric literature by Hill et al. states that the solution is possibly not certain physical symptoms or technological signs to react to, but sufficient communication and teamwork [6]. Among others, these factors were assessed

in the perinatal audits on perinatal asphyxia in the Netherlands. The audit system was designed in 2009 and actively implemented in 2010 to evaluate perinatal problems and establish areas of improvement for future obstetric healthcare. During an audit every healthcare worker involved in childbirth helps to systematically analyse the care that was provided using national standard daily care, protocols and guidelines [7]. This research aims to examine the improvable factors acquired from the perinatal audit meetings on perinatal asphyxia and to identify which lessons can be included in standard daily care, the existing guidelines and protocols to eventually diminish the amount of cases with perinatal asphyxia in the Netherlands.

2. Methods

2.1 Design and setting

In this thesis, data were extracted from the national organisation Perined. Perined is responsible for the management of data from perinatal audits, which are collected in a single database: the Perinatal Audit Assistant (PAA). Moreover, the birth registry of Perined covers 97% of all births in the Netherlands. From the perinatal audits on perinatal asphyxia, 441 improvable factors in obstetric healthcare could be obtained from 241 cases of perinatal asphyxia. Improvable factors can be defined as factors in the healthcare process that deviate from the national guidelines and protocols in an unfavourable way and have the power to negatively impact the outcomes. In addition, a suitable improvement action is formulated for every improvable factor during the audits, aiming to advance future healthcare. The improvable factors were divided into categories. In this study, all cases with delay of obstetric care as a possible cause of perinatal asphyxia between January 1st, 2017 and 31th of December, 2019, were included and used to perform a retrospective cohort study.

2.2 Inclusions

All singletons with perinatal asphyxia born from 37+0 weeks of gestation were selected, if the neonate died within 28 days, had to stay in the Neonatal Intensive Care Unit (NICU) longer than 24 hours after

delivery or perinatal asphyxia was mentioned in the letter of discharge. Exclusion criteria were women with multiple pregnancy or foetuses with congenital anomalies.

2.3 Data and analysis

All data were retrieved from the national Perinatal Audit Assistant (PAA) database. These data were exported and categorised in Microsoft Excel. In addition, categorical data were converted to IBM SPSS statistics (version 24) for descriptive statistics including frequencies and means.

The areas of improvement within the category delay that were established in the perinatal audits were subcategorised into five themes in this study: (1) time from decision to incision, (2) deviation from standard obstetric healthcare, (3) knowledge of obstetric care providers, (4) communication and (5) other. These subjects were all systematically analysed, using the ACTion Toolkit. This system of 7 steps was developed to implement changes into everyday obstetric practice [8]. Relevant literature was sought in Pubmed and Google Scholar to support the analyses. Every theme will be summarized qualitatively in this thesis, to finally provide recommendations for future healthcare.

Background: ACTiontoolkit [8]

The ACTiontoolkit was developed between 2013-2017 in order to effectively implement changes into daily practice. Improvable factors from for instance perinatal audits can be analysed by using this model which consists of 7 steps. Step 1 and 2 focus on analysing the targetgroups: who are involved and how? Step 3 aims to establish facilitating and limiting factors in implementing change. Step 4 helps to SMART formulate goals and how to achieve them. Step 5 provides a format to create a structured plan of action. Steps 6 and 7 focus on monitoring, evaluating and valuing the implemented changes.

2.4 Ethics

As no tasks were assigned to the women involved in this study, permission from “Wet Medisch Wetenschappelijk Onderzoek” (WMO; Medical Research Involving Research Involving Human Subjects Act) was not mandatory. Data were collected from the Perinatal Audit Assistant (PAA) at Perined and local privacy rules were complied with. Every woman in this thesis was asked for consent twice: at the start of pregnancy to collect data for scientific research and at birth when perinatal asphyxia occurred in order to be able to discuss her case in a perinatal audit. For the purpose of this research, all data were anonymised by recoding the cases by numbers.

3. Results

From January 1st, 2017 to December 31st, 2019, 241 cases of perinatal asphyxia in the Netherlands were discussed in perinatal audit meetings, of which 29 were most likely caused by delay in care. 49 improvable factors could be obtained from these 29 cases and were analysed in this thesis. All cases met the inclusion criteria and none had to be excluded.

Characteristics

Of the twenty-nine women included in this thesis the mean age at the moment of birth was 32 years (min 22- max 40). Their mean amount of pregnancies was two (min 1- max 7) and mean parity one (min 0-max 4). Mean Body Mass Index (BMI) was 25.0 (min 19.2- max 41.6). Nearly all women were Caucasian (72.4%). Two women quit smoking before their current pregnancy (6.9%) and two women quit smoking during their pregnancy (6.9%). However, two women kept smoking 1-10 cigarettes during their pregnancy (6.9%).

Regarding the pregnancy, the mean gestational age was 39.9 weeks (min 37.0- max 42.0). For most women the risk status according to the Dutch Obstetric Indication List (VIL) was VIL A (primary care) at the intake (79.3%) [9, appendix A]. During birth the amount of women with VIL A decreased (51.7%) and VIL C (secondary care) increased (41.4%). The most common mode of birth was an emergency caesarean section (48.3%), followed by spontaneous vaginal birth (34.5%). The mean duration of expulsion was 49.8 minutes (min 1.0- max 179.0). The colour of the amniotic fluid was clear in twelve of the cases (41.4%) and meconium-stained in sixteen cases (55.2%).

Eighteen of the neonates born were male (62.1%). The mean birthweight was 3367 grams (min 2525- max 4770). The median APGAR score after one minute was two, five after five minutes and seven after ten minutes. The mean arterial pH level was 6.95 (min 6.71- max 7.28). Four of the neonates died around birth (13.8%).

Table 1 presents a complete overview of characteristics.

Table 1. Characteristics of mother, pregnancy, birth and neonate

Maternal characteristics	
Mean gravidity (min-max)	2 (1-7)
Mean parity (min-max)	1 (0-4)
Mean age in years (min-max)	32 (22-40)
Mean body mass index (BMI) (min-max)	25.0 (19.2-41.6)
Ethnicity (%)	
- Caucasian	21 (72.4)
- Non-Caucasian	8 (27.6)
Smoking behaviour (%)	
- Did not smoke	20 (69)
- 1-10 cigarettes per day	2 (6.9)
- Quit before current pregnancy	2(6.9)
- Quit during current pregnancy	2 (6.9)
- Unknown	3 (10.3)
Level of education (%)	
- High	10 (34.5)
- Medium	9 (31)
- Low	2 (6.9)
- Unknown	8 (27.5)
Pregnancy	
Mean gestational age in weeks (min-max)	39.9 (37.0-42.0)
Risk status at intake (%)	
- VIL A	23 (79.3)
- VIL B	2 (6.9)
- VIL C	1 (3.4)
- VIL D	3 (10.3)
Risk status at start of birth (%)	
- VIL A	15 (51.7)
- VIL B	0 (0)
- VIL C	12 (41.4)
- VIL D	2 (6.9)
Birth	
Mode of birth (%)	
- Spontaneous vaginal	10 (34.5)
- Assisted birth vaginal	3 (10.3)
- Secondary caesarean	14 (48.3)
- Planned caesarean section	2 (6.9)
Intervention to start delivery (%)	
- Balloon priming	3 (10.3)
- Amniotomy	2 (6.9)
- Planned caesarean section	2 (6.9)
- Priming with prostaglandins	2 (6.9)
- No intervention	20 (69)
Indication for intervention to start delivery (%)	
- Danger child, acute and life threatening	2 (6.9)

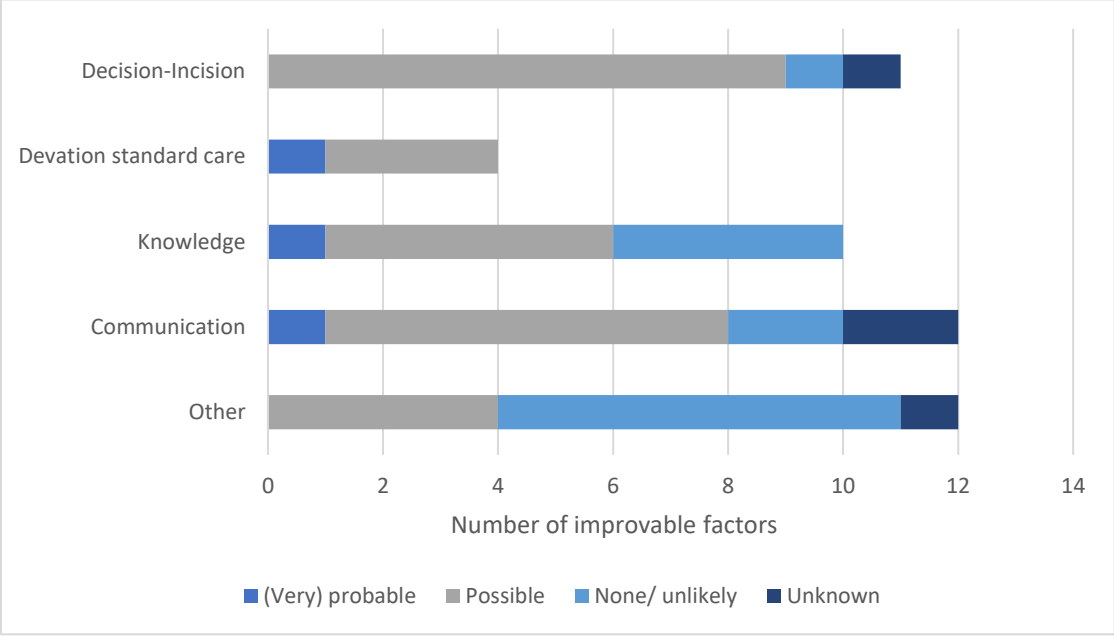
- Danger child, not acute - Danger child unknown - Termination short term indication obstetrician - Wish patient - Other	2 (6.9) 1 (3.4) 1 (3.4) 2 (6.9) 1 (3.4)
Mean duration of broken membranes in hours, minutes (min-max)	13.3 (0-157.8)
Mean duration of expulsion in minutes (min-max)	49.8 (1.0-179.0)
Amniotic fluid (%) - Clear - Meconium - Unknown	 12 (41.4) 16 (55.2) 1 (3.4)
Fetal position during birth (%) - Cephalic presentation - Breach - Unknown	 27 (93.1) 0 (0) 2 (6.9)
Pain management (%) - No pain management - Epidural analgesia - Spinal analgesia - General anaesthesia - Morphinomimetics	 12 (41.4) 8 (27.6) 3 (10.3) 4 (13.8) 2 (6.9)
Neonatal characteristics	
Gender (%) - Female - Male	 11 (37.9) 18 (62.1)
Mean birthweight in grams (min-max)	3367 (2525-4770)
Median Apgar scores (min-max) - After 1 minute - After 5 minutes - After 10 minutes (n=27)	 2 (0-7) 5 (0-9) 7 (0-9)
Mean umbilical cord values (min-max) - Arterial pH ▪ Missing *n*=5 - Venous pH ▪ Missing *n*=13 - Arterial Base Excess ▪ Missing *n*=8 - Venous Base Excess ▪ Missing *n*=14	 6.95 (6.71-7.28) 7.03 (6.80-7.28) -15.11 (-24.20- -7.70) -14.27 (-22.00- -8.90)
Birth percentiles acc. to Hoftiezer (%) - <=p3 - p3-p5 - p5-p10 - p10-p50 - p50-p90 - p90-p95 - p95-p97	 3 (10.3) 1 (3.4) 2 (6.9) 15 (51.7) 4 (13.8) 0 (0) 0 (0)

- >=p97 - Unknown	3 (10.3) 1 (3.4)
Perinatal death (%)	4 (13.8)

Improvable factors

The 49 improvable factors in the category delay were put into the following subcategories: prolonged interval between decision and incision, communication, deviation from standard obstetric healthcare, knowledge and other (table 2). The four main themes were systemically analysed using the ACTion Toolkit. Summaries, including conclusions and recommendations, will be provided for every assessment. The subcategories and their frequencies are displayed in graph 1. In addition, an overview of probable relationship to perinatal asphyxia is given in the same graph.

Graph 1: Categories of delay and association with perinatal asphyxia



3.1 Decision to incision interval

Guidelines internationally state that category 1 caesarean sections should be performed within thirty minutes. However, this 30-minute rule does not always seem feasible. Eleven out of forty-nine improvable factors (22%) were formulated because a prolonged interval between decision and incision led to delay of emergency care. Nine out of eleven improvable factors in this subcategory (82%) were thought to have a possible relationship with perinatal asphyxia. The majority of improvement actions were focussed on new guidelines regarding triage and how to act according to the estimated level of urgency (*n*=7). Other improvement actions concentrated on shortage of operating rooms or staff (*n*=3).

The decision to incision interval (DDI) can be roughly segregated into 3 parts: the time between decision and arrival at the operating room, the time between arrival and induction of anaesthesia in the patient and time from induction to incision. As the aforementioned improvement actions show, most problems arise in the first part of the DDI. Examples of possible complications during this first part that were mentioned in the improvable factors were: preparation of the patient (e.g. taking blood or transfer of the bed), logistics (e.g. no operating room available) or improper transfer of information or level of urgency. Considering many obstetric health care workers are involved in the process of moving the patient to the operating room, it is vital to demonstrate the problem of prolongation of this time interval. During the audit meetings it was suggested to highlight the problem in the hospital newsletter.

Some improvable factors emphasize the absence of well-defined guidelines to assess individual cases and act according to the needed level of urgency. Examples include (paraphrased):

"The patient was moved to the delivery room instead of immediately taking her to the operating room, while she had an abnormal CTG and no dilation: unnecessary and possibly harmful."

and

"Are there better possibilities to directly bring the patient to the operating room instead of moving her to the delivery room first?".

These improvable factors show the need to implement an effective triage system that is known to all. Every individual member of the obstetric team should be able to perform an appropriate patient assessment according to local protocols and properly communicate the conclusion to their colleagues in order to decrease DDI.

Finally, unavailable operating rooms or absence of staff can prolong the decision to incision interval. Unfortunately, solving this problem seems difficult as most hospitals have limited resources and budgets. This was confirmed in the perinatal audits. However, an improvement action that was developed said to discuss other options within every hospital. For instance, getting a team from another hospital in case of emergency or letting a resident start the surgery. In addition, the aim for an anaesthetist to be available 24/7 in hospitals with emergency care was realised in 2019.

3.2 Deviating from standard obstetric healthcare

Only four out of forty-nine improvable factors (8%) were focussed on delay that was caused by deviation from standard obstetric healthcare. However, assessment during audit meetings suggested that in these cases delay could be highly associated with perinatal asphyxia. In all four cases specific decisions of the women, for instance refusing to be referred to secondary care or wanting to have a high-risk birth at home, resulted in delay of emergency care. Therefore, the improvement actions aimed to provide suitable obstetric healthcare for every patient in the right place and by the appropriate healthcare worker. If the patient refuses to follow standard care, she should be well informed and aware of the risks.

The importance of proper communication was highlighted several times in the audit meetings. The midwife or obstetrician is responsible for advising the patient, whilst taking the wishes and preferences of the woman into account as well. Sporadically, a woman may want to deviate from standard care. If so, the improvement actions stated to once more inform the patient on what this standard care entails, so she knows exactly what she is refusing and what possible risks could be

involved. After differences of opinion have been explored, the patient and the obstetrician should find a kind of compromise. If this cannot be found, another obstetric healthcare worker in secondary care could be consulted.

Besides communication, another improvement action was mentioned repeatedly in the audit meetings. Documentation is key when the obstetrician and the patient cannot come to an agreement. Every step of communication should be documented in detail in order to ensure the professional safety of the obstetrician and to protect the autonomy of the patient.

Lastly, patients can opt for care outside their own region. In case of emergency, this patient-related factor can cause delay in care, which was indicated during a perinatal audit meeting. The developed improvement action was for obstetric health care providers to evaluate what is considered to be a safe distance to travel in case of emergency.

3.3 Knowledge

Delay can occur as a result of a lack of knowledge of the involved healthcare providers and ten out of forty-nine improvable factors (20%) were formulated in respect to this topic. Two types of a knowledge gap could be identified: regarding cardiotocography (*n*=5) and obstetric protocols (*n*=5). Cardiotocography (CTG) improvement actions aimed at improving interpretation skills, differential diagnosis and choice of additional examination. In regard to following local obstetric protocols, the improvement actions primarily focussed on when and how to alert the paediatrician in case of expected perinatal asphyxia. In short, delay in care was caused by not recognizing possible signals of perinatal asphyxia or alarming too late. From the audit meetings it was concluded that especially a lack of knowledge concerning foetal monitoring might have an association with birth asphyxia.

There is a second time interval resembling the aforementioned time from decision to incision interval (DDI) that can be prolonged and therefore, cause delay in care. This is the time between observing signs of perinatal asphyxia on the monitor and taking the decision to intervene in order to terminate the delivery. It was established in the audit meetings that delay in this interval is often due

to organisational problems, including a heavy workload or poor visibility of CTG monitors. At present, an improvement action from the audit has already been implemented to improve the latter, namely to provide an hourly reminder to analyse every CTG. This improvement action seems to have created more structure and CTG changes are overlooked less often. Contrarily, decreasing the workload is expected to be complicated by restricted budgets.

Prolongation of the interval can also be caused by the interpretation skills of the health care worker. An example (paraphrased):

" *CTG was not was interpreted as preterminal by the physician's assistant. As a result, only position switches of the woman were performed at first. Due to this, there was a delay of 30 minutes.* "

In response to this improvable factor, the following improvement action was formulated in the audit meetings: to create a new triage-unit, composed of an obstetrician and a gynaecologist, that will examine every CTG together. Consequently, interpretations are solely made by sufficiently competent staff.

Having made the right interpretation of the CTG, it is vital for the responsible healthcare worker to be able to make an accurate differential diagnosis. Moreover, it was noted that occasionally errors are made in choosing diagnostics instead of intervention. Assessment during the audits showed that additional practise and knowledge on differential diagnosis and further examination could be beneficial for all obstetric healthcare workers.

Finally, not following obstetric protocols can result in delay. Especially in case of emergency, when a paediatrician is needed, but has not been alerted. In some cases this can eventually lead to perinatal asphyxia, as seen in the audit meetings. Examples in which the presence of a paediatrician is preferred are meconium-stained amniotic fluid or an abnormal CTG. Improvement actions were to internally optimize rules regarding alarming and to pay extra attention to the protocols being generally known.

3.4 Communication

Twelve improvable factors (24%) were formulated due to some sort of communication problem leading to delay of care and possibly to perinatal asphyxia. These problems could be categorised as follows: unclear transfer of information or missing information (*n*=4), health care professionals not being available by telephone (*n*=4) and asking for help too late (*n*=3). Improper or lack of communication was the cause of delayed care in all of these cases. Assessment of the improvable factors showed that every type of miscommunication could be associated with perinatal asphyxia. Therefore, communication should be optimized internally and externally for all involved obstetric healthcare providers.

Transfer of information to colleagues has proven to be an important topic. This includes all data and status of the patient, her birth plan and the current course of action. In order to provide the best possible care, a responsible obstetric healthcare worker that is well informed should be appointed for every patient. As seen in the improvement factors, this is occasionally forgotten. An example (paraphrased):

"*During the handover at the end of the day, it was not clear that there was a patient with an abnormal CTG and no one was assigned to the patient. Due to this, delay in physically assessing the patient occurred."*

To prevent cases like this, the following improvement action was developed during the audit meetings: at the end of a handover, every healthcare provider should be aware of their responsibilities and know which patient they have to examine. Another improvement action emphasized that this applies for newly admitted patients that come in as well.

Furthermore, creating a safety culture within any healthcare team seems to improve communication. This often means that colleagues experience a lower threshold to ask for help when

it is needed. Two improvement actions highlighted the significance of easily approaching a colleague in case of emergency, in order to avoid unnecessary delay in care. This applies to both home births as well as within the hospital.

Lastly, it was established in the perinatal audits that delay sometimes occurred because of a healthcare professional not being able to answer their telephone in the hospital. Even though there were four cases in this category, it was thought to be the least important one due to only causing minimal delay in care. Therefore, only one improvement action was suggested: to always call via the reception in order to know whether someone is available at that time.

4. Discussion

In this paper, cases of perinatal asphyxia in which delay of care occurred were analysed. 49 improvable factors could be obtained from the perinatal audits that took place from 2017-2019. These improvable factors were subcategorised as follows: increased interval between decision to incision, deviating from standard obstetric healthcare, a lack of knowledge, improper communication and other. Delay of care was most often caused by problems in transportation to the operating room, lacking knowledge regarding foetal monitoring and insufficient handover of care. These areas of improvement were thought to have the highest association with perinatal asphyxia as well.

Unfortunately no comparisons can be made with previous research, as no qualitative research has been done using data from perinatal audit meetings on perinatal asphyxia. However, the perinatal audit has proven to provide valuable lessons for future healthcare regarding other topics, including hyperbilirubinemia and uterine rupture [10,11]. Even though perinatal audit meetings give a good overview of everyday practice, it has a few limitations as well. Assessment in this research was sometimes complicated by incomplete documentation or lack of structure. Due to this, vital information was sometimes missing which made analysing the improvement actions more difficult as they were formulated years before. Furthermore, improvement actions were often restricted to feedback regarding a certain situation and no actual improvement action was formulated. Therefore, to ease the process of implementing improvement actions, they should always be written down according to a standardized format in future perinatal audits (e.g. SMART: Specific, Measurable, Achievable, Relevant and Time-bound) [12]. Another limitation of this study can be selection bias. The system of perinatal audits gives local perinatal cooperation groups (PCG) the opportunity to select cases out of four themes. Annually each PCG has to audit four cases within the themes. This means that not all cases within a theme per obstetric partnership (VSV) is discussed in a perinatal audit. The perinatal audits in the Netherlands are hereby not 100% inclusive. This means that the cases studied and discussed in this research are a selection of cases of perinatal asphyxia within the PCG.

One of the main causes for delay in emergency care was an increased time interval between decision and incision (DDI). In the cases from the perinatal audits this was most often due to complicated transportation to the operating room. This is in line with the research of Sayegh et al., who stated that getting the patient to the operating room accounted for about 50% of the mean DDI [13]. Therefore, the focus should be on shortening this part of the DDI and all health care professionals should be aware of this problem. Nageotte and van der Wal found that in a well-staffed hospital in the United States initially only 25% of the caesareans was performed under 30 minutes. After introducing communication training, additional education programmes and raising awareness, the 30-minute standard was achieved in 90% of cases [14]. After informing them by presenting the problem, target groups could be motivated by publishing monthly results and individual complementary feedback. In addition, drills and simulation-based training activities could help to improve compliance with the new standards and practice communication. Siassikos et al. found a reduction in median DDI from 25 to 14.5 minutes in cases with cord prolapse after training had be implemented [15]. A similar Australian study confirmed these results [16]. Structured feedback subsequent to simulation training and team discussions with solutions could help minimalize obstacles as well [17, 15].

An improvement action that was formulated in context of deviating from standard obstetric healthcare was to research the distance to the hospital that was acceptable when giving birth at home. This is a current topic of discussion, as more hospitals tend to merge in order to provide more expertise and 24/7 availability of staff. Unfortunately, it seems difficult to establish this safe travel distance and available literature has not reached an international consensus. However, most research conclude that perinatal asphyxia or other adverse events only occur when travel time exceeds 60-75 minutes [18]. Therefore, there is a 45 minute rule of treating obstetric emergencies in primary care in the Netherlands. Today, the mean distance to a hospital with emergency care is 7.1 kilometres (range 5.2-12.8) [19]. According to an accessibility analyses, 99.7% of Dutch citizens can be taken to the hospital by ambulance in under 45 minutes [20]. Even though merging of hospitals might not pose a threat to emergency care at this moment, it could in the future. To compensate for a longer travel time, it is

recommended to start concurrent actions. In 2021, a new regional protocol was drawn up by obstetric health care workers in the northern part of the Netherlands, which included types of parallel actions. Examples of recommendations are direct contact of the midwife or obstetrician with the hospital to announce that concurrent actions are needed, providing a paper version of the pregnancy file to the paramedic and preparation of a delivery or operating room at the nearest hospital [21].

Merging of hospitals may also result in less continuity of care, which may complicate valuing the exact wishes of the pregnant woman. As mentioned in the results, it is often recommended to develop a birth plan and documenting everything in detail, especially when a woman wants to deviate from standard obstetric healthcare. Jenkinson et al. researched the effects of the structured documentation of a Maternity Care Plan (MCP) and concluded that stress in clinicians was ameliorated and women's access to maternity care was more protected [22]. Having an open attitude as an obstetrician may be easier if one has more knowledge on possible motivations for birthing outside the system. Hollander et al. analysed these motives. Four major themes could be established: a different vision on what knowledge is superior, the need for autonomy and trust in the birth process, conflict during negotiation of the birth plan and search for different care. Furthermore, there seemed to be one theme that covered all of the aforementioned themes: fear. Fear in the patient for unnecessary interventions or help and on the other hand fear of a bad outcome in the health care provider [23]. Recommendations that can be deduced from research are to negotiate the individual birth plan with an open mind by using true shared decision making, provide informed consent without spreading an unnecessary amount of fear and be aware of alternative delivery care providers and other sources of information used by women [23, 24].

Lack of knowledge on foetal monitoring was also concluded to be one of the main problems in the perinatal audits. Providing the best possible healthcare means that all obstetric staff should have the skills to interpret and document CTGs and act according to urgency level. To decrease the effects of great inter- and intraobserver variability, regular trainings should be stimulated for both obstetric personnel in the hospital and midwives in primary care [25]. Available literature does not offer

evidence on how often trainings should take place, but generally recommended is every six to twelve months [26]. Trialability after training should be considered as a facilitating factor for retaining CTG knowledge [27]. Still, it is frequently questioned whether CTG education programmes alone truly result in a reduction of adverse outcomes such as perinatal asphyxia, as there is rarely a single cause for poor neonatal outcome. To increase the clinical impact of education, a combination of CTG training and emergency drills could be considered [28]. At present, the most effective training model to add to CTG education is proven to be an annual local emergency training that includes all healthcare professionals involved in maternity care with focus on teamwork and support tools [26,29].

The mentioned drills and simulation trainings could improve communication in emergencies between obstetric healthcare personnel as well [30,31]. The improvement actions in this thesis, however, mainly focussed on advancing communication during handovers and shift changes. The implementation of a structured format when transferring information could be a solution. For instance, SBAR(R) (Situation, Background, Assessment, Recommendations, Read-back) often creates more accuracy when communicating and improves teamwork and safety climate [32,33,34]. Nevertheless, Romijn et al. studied the use of SBAR(R) in obstetric healthcare in the Netherlands and found that many professionals perceive lack of routine as a barrier to use SBAR(R). Especially the elements Recommendation and Read-back seem to be neglected, even though these components might be most crucial in transferring information to a colleague. These components should therefore receive more attention to effectively implement routine use of SBAR(R) in obstetrics [35].

5. Recommendations

From the audit meetings on perinatal asphyxia many improvement actions for everyday practice could be obtained. First of all, to prevent delay in care which could lead to perinatal asphyxia, all healthcare personnel should be informed and trained for emergencies in order to decrease the decision to incision interval. This can be done by regular emergency drills and training with subsequent individual feedback, as it promotes compliance with local protocols and more efficient communication.

Moreover, the results of the perinatal audits showed the need to improve CTG interpretation and diagnostics skills in the Netherlands for all staff involved in obstetrics. Yearly trainings followed by systematic testing could boost CTG knowledge and therefore prevent delay in care. The allocation of responsibility for every pregnant woman or CTG was also mentioned to be an area of concern. Communication between obstetric healthcare workers should be done in a structured way (e.g. SBAR(R)) and practiced frequently in order to improve this problem. Furthermore, more time has to be spent on practising with patients who want to deviate from standard obstetric healthcare. Training in shared decision making and documentation should be a priority in this area.

Finally, to improve the quality of research from perinatal audits in the future, goals should be SMART formulated. In this way, more improvable factors can be used for assessment, which in turn leads to more valuable improvements to be implemented in daily practice.

6. Conclusion

In the perinatal audit sessions from 2017-2019 on perinatal asphyxia, 29 women experienced delay in care which led to perinatal asphyxia. 49 improvable factors and actions were developed in the audit meetings and assessed in this thesis. The causes of delay that were most likely to have an association with perinatal asphyxia were problems with transfer of the patient to the operating room in case of emergency, lacking CTG interpretation skills, insufficient communication and patients wanting to deviate from standard obstetric healthcare. These areas should be focused on in obstetric healthcare in order to prevent delay of care. Lastly, another lesson learnt during assessment in this thesis is that all improvable factors should be systematically formulated according to a specific format during audit meetings to enhance similar research in the future.

7. References

[1] World Health Organisation. Newborn mortality. Available via: https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-mortality-report-2021

[2] Centraal Bureau voor de Statistiek. Geboorte; kerncijfers. Available via: https://www.cbs.nl/nl-nl/cijfers/detail/37422ned.

[3] Peristat via Perined. Available from: https://www.peristat.nl/

[4] Uptodate. Perinatal asphyxia in term and late preterm infants. Available from: www.uptodate.com

[5] Shah P, Riphagen S, Beyene J, Perlman M. Multiorgan dysfunction in infants with post-asphyxial hypoxic-ischaemic encephalopathy. Arch Dis Child Fetal Neonatal Ed. 2004;89:F1 52-F155.

[6] Hill M, Reed K, Brown R. Perinatal asphyxia from the obstetric standpoint. Semin Fetal Neonatal Med. 2021 Aug;26(4):101259

[7] Perined. Wat is perinatale audit? Available from: https://www.perined.nl/onderwerpen/audit/watisaudit

[8] ACTion toolkit. Available from: https://www.actiontoolkit.nl/

[9] CVZ. Verloskundig Vademecum 2003. Diemen: College voor zorgverzekeringen; 2003. Available from: https://www.knov.nl/zoeken/document?documentRegistrationId=11862018

[10] van der Geest B, Rosman A, Bergman K, Smit B, Dijk P, Been J, Hulzebos C. Severe neonatal hyperbilirubinaemia: lessons learnt from a national perinatal audit. Arch Dis Child Fetal Neonatal Ed. 2022;107:F527–F532.

[11] Rosman A, van Dillen J, Zwart J, Overtoom E, Schaap T, Bloemenkamp K, van den Akker T. Lessons learned from the perinatal audit of uterine rupture in the Netherlands: A mixed-method study. Health Sci Rep. 2022 Aug 4;5(5):e664

[12] Doran, G. T. "There's a S.M.A.R.T. way to write management's goals and objectives". Management Review. 1981 70 (11): 35–36.

[13] Sayegh I, Dupuis O, Clement HJ, Rudigoz RC. Evaluating the decision-to-delivery interval in emergency caesarean sections. Eur J Obstet Gynaecol Reprod Biol, 116 (1) (2004), pp. 28-33

[14] Nageotte M, Wal van der B. Achievement of the 30-minute standard in obstetrics- can it be done? Am J Obstet Gynecol. 2012 Feb;206(2):104-7.

[15] Siassakos D, Hasafa Z, Sibanda T, et al. Retrospective cohort study of diagnosis-delivery interval with umbilical cord prolapse: the effect of team training. BJOG. 2009 Jul;116(8):1089-96.

[16] Gallagher G, Griffin A, Clipperton S, Janssens S. Impact of simulation training on decision to delivery interval in cord prolapse. BMJ Simul Technol Enhanc Learn 2021; 7(6): 543-547.

[17] Lipman S, Carvalho B, Cohen S, Druzin M, Daniels K. Response times for emergency caesarean delivery: use of simulation drills to assess and improve obstetric team performance. J Perinatol. 2013 Apr;33(4):259-63.

[18] Gezondheidsraad. Relatie tussen tijd en gezondheidsuitkomst voor 6 typen spoedzorg. Available from: https://www.kennisnetgeboortezorg.nl/wp-content/uploads/2020/09/Achtergronddocument-Relatie-tussen-tijd-en-gezondheidsuitkomst-voor-6-typen-spoedzorg.pdf

[19] Statline. Nabijheid voorzieningen; afstand locatie, regionale cijfers: afstand tot ziekenhuis (excl. buitenpolikliniek). Available from: https://opendata.cbs.nl/statline/#/CBS/nl/dataset/80305ned/table?fromstatweb

[20] Rijksinstituut voor Volksgezondheid en Milieu. Bereikbaarheidsanalyse SEH's en acute verloskunde 2022. Available from: https://www.rivm.nl/documenten/bereikbaarheidsanalyse-sehs-en-acute-verloskunde-2022

[21] Regionaal protocol acute verloskunde / parallelle actie Noord-Nederland. Available from: https://www.acutezorgnetwerk.nl/inhoud/uploads/Regionaal-protocol-acute-verloskunde-Noord-Nederland-definitief-vastgesteld-in-het-Bestuurlijk-ROAZ-Noord-NL-op-17-juni-2021-WEBSITE.pdf

[22] Jenkinson B, Kruske S, Stapleton H, et al. Women's, midwives' and obstetricians' experiences of a structured process to document refusal of recommended maternity care. Women Birth. 2016 Dec;29(6):531-541.

[23] Hollander M, van Dillen J, Graaf de I, Vandenbussche F, Holten L. Women's motivations for choosing a high risk birth setting against medical advice in the Netherlands: a qualitative analysis.

[24] Holten L, Hollander M, deMiranda E. When the hospital is no longer an option: a multiple case study of defining moments for women choosing home birth in high-risk pregnancies in the Netherlands. Qual Health Res. 2018 Oct;28(12):1883-1896

[25] Pehrson C, Sorensen J, Amer-Wahlin I. Evaluation and impact of cardiotocography training programmes: a systematic review. BJOG 2011;118:926-935

[26] Kelly S, Redmond P, King S, et al. Training in the use of intrapartum electronic fetal monitoring with cardiotocography: systematic review and meta-analysis. BJOG. 2021 Aug;128(9):1401-1559

[27] Beckley S, Stenhouse E, Greene K. The development and evaluation of a computer-assisted teaching programme for intrapartum fetal monitoring. BJOG. 2000 Sep;107(9):1138-44.

[28] Draycott T, Sibanda T, Owen L, et al. Does training in obstetric emergencies improve neonatal outcome? BJOG. 2006 Feb;113(2):177-82

[29] Bergh A, Baloyi S, Pattinson R. What is the impact of multi-professional emergency obstetric and neonatal care training? Best Pract Res Clin Obstet Gynaecol. 2015 Nov;29(8):1028-43.

[30] Lippke S, Derksen C, Maria Keller F, et al. Effectiveness of communication interventions in Obstetrics – a systematic review. Int J Environ Res Public Health. 2021 Mar;18(5):2616

[31] Liaw S, Zhou W, Ching Lau T, et al. An interprofessional communication training using simulation to enhance safe care for a deteriorating patient. Nurse Educ Today. 2014 Feb;34(2):259-64.

[32] Shahid S, Thomas S. Situation, Background, Assessment, Recommendation (SBAR) Communication Tool for Handoff in Health Care – A narrative review. Safety in Health. 2018 Jul;28(7)

[33] Ting W, Peng F, Lin H, Hsiao S. The impact of situation-background-assessment-recommendation (SBAR) on safety attitudes in the obstetrics department. Taiwan J Obstet Gynaecol. 2017 Apr;56(2):171-174.

[34] Randmaa M, Martensson G, Leo Swenne C, et al. SBAR improves communication and safety climate and decreases incident reports due to communication errors in anaesthetic clinic: a prospective intervention study. BMJ open. 2014 Jan 21;4(1):e0044268

[35] Romijn A, Teunissen PW, Wagner C, et al. Standardized communication during patient referrals: do obstetrical care professionals use SBAR(R) after team training? Available from: https://research.vu.nl/ws/files/96469492/301826.pdf

Appendix A:

Dutch Obstetric Indication List (VIL):

Risk assessment	
VIL A	Primary care: obstetric care in hands of obstetrician or general practitioner.
VIL B	Situation to be discussed. Based on individual characteristics it should be determined whether obstetric care should take place in primary of secondary care.
VIL C	Secondary care: obstetric care in hands of gynaecologist
VIL D	Delivery should take place in the hospital. Obstetric care before that can be given in primary care.