Obstetric audit in Namibia and the Netherlands

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Obstetric audit in Namibia and the Netherlands

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geboren te Edam-Volendam

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Chapter 1

Introduction

'Life is what happens to you
when you're busy making other plans'

John Lennon '80

1.1 Justification

While working as a research student participating in ongoing malaria resistance studies in Kenya in 1993, I was struck with the 'Africa virus' [1,2]. In the years following this project 'viral replication' was enhanced by further research studies as well as through clinical work in low income countries as Bangladesh (studying the long term effects of vitamin A in Matlab, the International Centre for Diarrhoeal Disease Research [3]) and Kenya (tropical internship St Mary's Hospital, Mumias). These experiences eventually resulted in the goal to work as a tropical doctor in low income countries with special interest in Africa.

During the obstetrical and gynaecological (O&G) part of the tropical doctor training in the Netherlands, I was intrigued by different frequencies of obstetric interventions in different units and by different doctors. Caesarean section (CS) rates ranged between approximately 20% - 40% of deliveries if supervised by different staff members. During the same training, I came into contact with Prof Jos van Roosmalen, a former tropical doctor, who is now working as an obstetrician at tertiary care level in the Netherlands and an active member of the Dutch Society of Tropical Medicine and International Health. During his teaching he introduced the concept of Safe Motherhood and the unacceptable differences in maternal mortality ratios worldwide. His passionate lectures inspired me to be critical towards CS and look for alternative interventions. This is especially indicated in low income countries, where the procedure can have major negative impact both on short term morbidity as well as long term reproductive health. During several discussions, the idea emerged that obstetric experience in low income countries might influence intervention attitudes in present practice. This resulted in a study where the intervention patterns of Dutch obstetric units with staff with experience in low income countries, were compared with units without such staff [4].

After completion of the tropical doctor training, I had the privilege to work as a medical doctor on a local contract in Northern Namibia from 2001 until 2004. Via Dr Tarek Meguid, I was given the opportunity to fill the gap after he left, working in the department of O&G at Onandjokwe Lutheran Hospital, Ondangwa Namibia [5]. During this period, I had the privilege to work with Dr Vera Petrova, head of department and Russian O&G

specialist, who acted as a personal mentor in clinical practice. Here, my previous theoretical experience with infectious diseases like tuberculosis, HIV/AIDS and Safe Motherhood issues like maternal mortality and morbidity became real life challenges. In addition to clinical work we initiated annual departmental reports and continued monthly perinatal meetings which were initiated in 2000. With this data production we monitored outcome with critical reflection towards our own daily practice. Some of the studies presented in this thesis were initiated at this time.

Back in the Netherlands I started training as a resident in O&G at the Haga hospital, The Hague, from 2004. In the same period, the nationwide study into severe acute maternal morbidity (SAMM) in the Netherlands (called 'LEMMoN') was started with cases enrolled between August 1st 2004 until August 1st 2006 [6]. Acting as a local coordinator in the Haga hospital I collected data and in collaboration with the national LEMMoN team, we initiated the first SAMM audit in the Netherlands. Again, critical reflection towards our own daily practice resulted in some of the studies presented in this thesis.
A selection of the studies from Namibia and the Netherlands concerning Safe Motherhood are combined in this thesis in three subheadings: maternal mortality, maternal morbidity and obstetric interventions.

1.2 Safe Motherhood

The global campaign to reduce maternal mortality was launched in February 1987, when the United Nations Population Fund (UNFPA), the World Health Organization (WHO) and the World Bank), sponsored the international Safe Motherhood Conference in Nairobi, Kenya. The Safe Motherhood Initiative aimed to raise awareness about the numbers of women dying each year from complications of pregnancy and childbirth. The origins of this initiative dated from 1985, when Rosenfield & Maine pointed out that maternal and child health (MCH) programmes in low income countries were almost exclusively for the benefit of the child, with almost no attention to the factors that were causing women to die: 'where is the M in MCH?' was their outburst. With over half a million women dying each year as a result of complications from pregnancy and childbirth they challenged the world to address these issues [7]. This resulted in the

global campaign to reduce maternal mortality with three of the key statements being: 'every pregnancy faces risk', 'ensure skilled attendance at delivery' and 'improve access to quality maternal health services'. Although the focus on key actions has shifted during the past 20 years, the need to address these issues remains equally important with the global maternal mortality ratio still estimated at 402 (95% CI 216-654) maternal deaths per 100,000 live births [8,9].

During the United Nations (UN) Millennium Summit in 2000, 147 heads of state gathered and adopted the Millennium Development Goals (MDGs) to address extreme poverty in its many dimensions - income poverty, hunger, disease, lack of adequate shelter, and exclusion - while promoting education, gender equality, and environmental sustainability, with quantitative targets set for the year 2015. Two of the MDG's reflect Safe Motherhood issues: MDG 4 'reduce child mortality' and MDG 5 'improve maternal health' (http://www.un.org/millenniumgoals/). The target for MDG 4 is to reduce by two thirds, between 1990 and 2015, the under-five mortality rate. Since almost 40% of under-five deaths occur in the first month of life, improving neonatal and maternal care could save countless newborns. Although maternal health is clearly more than the absence of maternal complications or the avoidance of maternal death, evaluation of MDG 5 is based on two main targets: reduction of maternal mortality and universal access to reproductive health. By now however, MDG 5 – reducing maternal mortality by 75% – is unlikely to be met globally and for the majority of low-income countries. Of all millennium goals, MDG 5 is the one most behind schedule. For MDG 4, the lack of progress is mainly due to the slow decline in neonatal deaths, which is often related to pregnancy and childbirth.

At this time of heightened concern to scale-up services for mothers and babies, it is crucial that not only shortfalls in the quantity of care – in terms of location and financial access – are addressed, but also the quality [10]. Just measuring maternal mortality (the quantity) also needs to be seen in the highlight of maternal morbidity: for every woman who dies, many more suffer from serious conditions with possibly major impact for the rest of their lives. Looking *Beyond the numbers,* as propagated by WHO in 2004, proposes ways of finding answers to questions like 'why do serious incidents occur and what can be done to prevent them' and 'where are things going wrong and what can be done to rectify them'. It offers a strong diagnostic tool to assess the quality of care: audit [11].

1.3 Audit

In the history of medicine, there are a few striking examples of the power of audit. Probably the most famous is the work of Florence Nightingale during the Crimean War of 1853-1855. On arrival at the medical barracks in Scutari in 1854, Florence Nightingale was appalled by the unsanitary conditions and high mortality rates among injured or ill soldiers. Mortality rates during the Crimean war were unacceptable with approximately 20% of soldiers dying in contrast to the 2,6% casualty rate of the United States of America (USA) army soldiers during the Vietnam war. Notably, 80% of casualties were due to complications of infectious diseases while only 20% resulted from war trauma. Florence Nightingale and her team of 38 nurses applied strict sanitary routines and standards of hygiene to the hospital and its equipment. Her mathematical skills, in combination with the meticulous record keeping resulted in powerful demonstrations of mortality statistics. Following these changes the mortality rates fell from 33% to 2%, and were instrumental in overcoming the resistance of the British doctors and officers to Florence Nightingale's procedures. Although famous for her empathy, she will always be known as 'the lady with the lamp' and linked to modern nursing, she is also recognized for one of the earliest programs of outcome management [12-14].

Today, searching pubmed using the term 'audit' identifies over 25,000 studies and the search engine Google even found 2,610,000 hits using the term 'clinical audit' (accessed 21/04/2009). The sheer volume of material found on the world-wide web can be overwhelming and halt the enthusiasm of individuals planning to initiate an audit process. Fortunately some guidance is presented by the National Institute for Clinical Excellence (NICE) through the 'principles for best practice in clinical audit' [15]. Even the free encyclopedia wikipedia presents a short introduction to the principle of audit with helpful references (http://en.wikipedia.org/wiki/Clinical_audit).

Box 1. *Audit definitions*

Clinical audit is a quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change. Aspects of the structure, processes and outcomes of care are selected and systematically evaluated against explicit criteria. Where indicated, changes are implemented at an individual, team or service level and further monitoring is used to confirm improvement in healthcare delivery [15].

Criterion-based audit involves the prior agreement by clinicians of a list of concise criteria for good quality care, based on available evidence and resources. Audit assistants can then screen the case notes of patients and record whether care has met the agreed criteria [10].

Critical incident audit evaluates the quality of care by an expert panel without explicitly agreed criteria or standards. This process is widely used, for example, in confidential enquiries into maternal deaths [10].

The term audit is used to refer to a wide range of methods for monitoring and reporting on the quality of health care and is illustrated by different definitions [box 1]. A review of the evidence by NICE concluded that audit is an effective method for improving the quality of care [15].

Audit can evaluate the structure (organisation or provision) of services, the process of care or the outcome of care against agreed standards [16].

1. Audit can provide an overview of service provision. For example, maternity waiting homes (MWH) are residential facilities located near a hospital where women with high risk pregnancies can await birth. Although in a recent Cochrane review no randomised controlled trials were identified, retrospective cohort studies have described MWH to be effective in improving pregnancy outcome [17].

An audit of referral to and usage of MWH of women with high risk pregnancies can provide an overview of service provision in the area [18].

2. Process measures are clinical practices that have been shown to influence outcome, for example the use of magnesium-sulphate in the prevention of eclampsia [19]. Evaluation of this process of care requires measuring the proportion of women in need of this drug who actually received the drug [20].
3. Outcome measure is the physical or behavioural response to an intervention, for example the health status after CS. Adverse event reports such as the confidential enquiry into maternal deaths (CEMD) and the national confidential enquiry into perioperative deaths (NCEPOD) are examples of outcome audits [21].

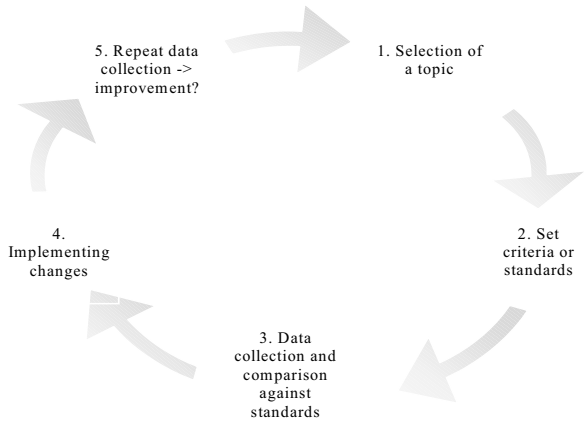

Figure 1. *The audit cycle*

Audit can be considered to have five principal steps, commonly referred to as the audit cycle (Figure 1) [13-16]:

- Selection of a topic
- Identification of an appropriate standard
- Data collection to assess performance against the prespecified standard
- Implementation of changes to improve care if necessary
- Data collection for a second, or subsequent, time to determine whether care has improved

Step 1. In selecting a topic for audit, priority should be given to common health concerns and thus often outcome measures like mortality are used [16]. An example of common health concern is the recently published PERISTAT I and II studies, where Dutch perinatal mortality rates rank unfavourably compared with other European countries. Among the measures to improve perinatal outcome was the start of a national perinatal audit [22,23]. Topics concerning process measure, on the other hand, have the advantage that they provide more direct measure of quality. Since they occur more frequently in daily practice, smaller sample size is needed with less cost involved, both in time and in money.

Step 2. For identification of appropriate standards, criteria are generally used for assessing care (criterion-based audit). The criterion is the reference point against which current practice is measured. High-quality evidence-based guidelines can be used as the starting point for developing criteria. Where this is not possible, criteria should be agreed upon by a multidisciplinary group including those involved in providing care and those who use the service. Where criteria are based on the views of professionals or other groups, formal consensus methods are preferable. In addition to review criteria, standard or target levels of performance should be set. The most common approach for setting target levels of performance is informal agreement among the group leading the audit or among health professionals. In some settings, external standards can be useful. However, in many audits no explicit targets are set and the aim is to improve current performance.

Step 3. With regard to data collection in criterion-based audit, this is generally undertaken to determine the proportion of cases where care is in accordance with the above set criteria and standard or target level of performance. Practice points related to data collection are: what data items to collect, how to collect these, who will collect the data and data management and analysis. Simple statistics are often all that is required. Data analysis and interpretation will lead to the identification of clinical areas that should be addressed.

Step 4. Implementation of changes to improve care is done through the feedback of audit findings. Most often, feedback is given through presentation at regular audit meetings which stimulate discussions and

where recommendations may be agreed upon. However, change does not always occur through audit. The significance of teamwork, culture and resistance to change has led several authors to propose frameworks for planning implementation. These usually include analysis of the barriers to change and use of theories of individual, team or organisational behaviour to select strategies to address the barriers.

Step 5. Collecting data for a second time after changes have been introduced, the final step in the audit cycle, is key to both assessing and maintaining the improvements made during clinical audit. The same procedures of sample selection, information collection, and analysis should be used throughout the process, to ensure that the data are valid and comparable with each other. Rapid-cycle data collection may also be appropriate, in which only essential data are collected from small samples. Sometimes continued monitoring is essential, for example in complication registration and adverse incidents like the confidential enquiry into maternal death.

1.4 Namibia and the Netherlands

This thesis combines hospital based studies from Namibia with hospital based and population based studies from the Netherlands. To ensure that the results can be positioned in their geographical, social, medical and economical context, some background information from both countries is given (tables 2 and 3).

Namibia is situated in South-Western Africa and bordering the Atlantic Ocean, Angola, Zambia, Zimbabwe, Botswana and South Africa. The country covers an area of 824,000 square kilometres and has a population of 2,047,000 people.

Namibia achieved its independence in 1990 after a century of colonial rule, first by Germany, later when it was illegally occupied by South Africa.

According to the then prevailing apartheid-ideology of the ruling class the country was divided into 'homelands' according to ethnicity and the health care system was highly fragmented. Most Namibians are living in the North also called 'Owamboland' according to the population group residing there, the Owambo. Namibia is officially ranked as a middle income country but it has one of the most skewed incomes per capita in the world, resulting from lopsided development resulting from apartheid. Administratively, the country is divided in 13 regions [24].

Onandjokwe district is situated in Oshikoto region in the former North West Health Directorate, north of Etosha National Park and west of Okavango region. Oshikoto region covers an area of 26,607 square kilometres and the estimated population is 161,000, most of which live in Onandjokwe district [25]. The district has an arid climate with seasonal rains. In this 'semi rural' area, most people depend on subsistence farming with the staple food mahangu. However, peri-urban areas (like Ondangwa town) are rapidly expanding and many people come here in search of work. About half of the district population has access to safe drinking water.

Onandjokwe district has one hospital, 3 health centres (with 24 hour service including observation beds managed by nurses), 12 clinics (with daytime service managed by nurses) and 42 outreach units (monthly scheduled visits). Onandjokwe Lutheran Hospital is a 450 bed district hospital also serving as referral hospital for the neighbouring districts. The hospital has an estimated catchments population of 200-300,000. The hospital is headquarter for all district health activities and houses the offices of the district Primary Health Care team. The hospital has six departments: Medicine, Surgery, Paediatrics, Anaesthesiology, Obstetrics & Gynaecology and General Medicine. The latter serves as 'general practitioner' service and only treats out-patients. There are 10 wards including a 4 bed Intensive Care Unit (ICU).
From 2001 to 2004, the department of O&G was staffed by 4 doctors (two foreign specialists and two foreign medical doctors) and 34 nurses including 13 registered/ enrolled midwives. Patients can be admitted at three different wards. The obstetric ward has 17 beds for antenatal admissions, 5 delivery beds and 55 beds for postnatal care. Patients are admitted in this ward when pregnant with a gestational age > 28 weeks and for delivery including subsequent puerperium.

The gynaecology ward has 53 beds and gives services to gynaecological patients, all women with a pregnancy < 28 weeks and patients who are admitted in puerperium after birth outside hospital (home or referral from clinic). In the private ward finally, all patients with a medical aid scheme and all foreigners are admitted. During 2002, 6,000 patients were admitted in the department of O&G, including 3,555 deliveries. Additionally there were > 10,000 outpatients contacts and 1,063 theatre cases, of which 599 were major cases (including 274 caesarean sections). Comprehensive Emergency Obstetric Care (EmOC) can be given at any time in Onandjokwe Lutheran Hospital. The distribution of blood for transfusion, however, is centrally regulated at the national level, which sometimes causes a shortage of blood at the district level (annual reports 2001-2004 department of O&G).

Key health problems in Onandjokwe district are: AIDS (23% of Antenatal care women are HIV+), women and child abuse, social disintegration (due to AIDS, but also since most men migrate to Southern Namibia for work) and staffing (low proportion of Namibian doctors as well as general understaffing in all Northern Namibia's health facilities) [5].

The Netherlands is a Western European country, bordering the North Sea, Germany and Belgium. The country covers an area of 41,000 square kilometres and has a population of 16,379,000 people.

The Netherlands is a modern, industrialized country with an open economy. Stable industrial relations, moderate unemployment and reasonable inflation are features of the economy. A highly mechanized agricultural sector employs approximately 4% of the labour force, industry 23% and services 73%. The Netherlands is a large exporter of agriculture products.

Table 2. *Selected country indicators*

Country indicators	Namibia	Netherlands
Total population	2,047,000	16,379,000
GDP per capita (USD)	4,770	37,940
Life expectancy at birth m/f (yrs)	59/63	78/82
Literacy rate (%)	85	99
Health expenditure per capita (USD)	338	3,383
Prevalence HIV >=15 years (100,000 population)	17,676	127
Skilled birth attendance (% of total deliveries)	76	100
Physicians density (10,000 population)	3	37
Maternal mortality ratio (100,000 live births)	210	12*
Neonatal mortality rate (1,000 live births)	20	3

http://www.who.int/countries/en

* WHO database 6 / 100,000 - Confidential enquiry Netherlands 12 / 100,000

Obstetrical care in the Netherlands differs from most other industrialized countries by a strict selection between high and low risk pregnancies. Women with low risk pregnancies receive primary care from midwives or general practitioners. Women may either choose to deliver at home or in hospital under the responsibility of the primary care providers. The primary care provider refers the woman to the obstetrician when complications arise during pregnancy, childbirth or puerperium. Women with high risk pregnancies from the onset of pregnancy are under the care of the obstetrician and deliver in hospital under their responsibility. In 2002, 85.7% of all women receiving prenatal care started with primary care providers. Of these, 28.2% were referred to obstetricians during pregnancy and 16.8% during delivery. Ultimately 40.6% delivered under the responsibility of primary care providers and 29.4% of deliveries were home deliveries in 2002 [26]. The studies presented in this thesis were conducted in three teaching hospitals in the Netherlands as well as a population based nationwide cohort study (LEMMoN).

Table 3. *Selected hospital indicators from Onandjokwe Lutheran Hospital Namibia, and three hospitals in the Netherlands.*

	NAMIBIA	NETHERLANDS		
Indicator	Onandjokwe (2002)	LUMC (2007)	HAGA (2007)	MCH (2007)
Staff O&G				
- medical doctor[1]	2 / 2	18 / 16	8 / 8	12 / 12
- nurse / midwife[2]	34 / 13	64 / 9	43 / 2	51 / 8
Medical				
- total deliveries	3,555	1,203	1,493	1,473
- caesarean section	274	259	308	263
- assisted vaginal	16	123	247	238
- admissions	5,984	2,970	8,679	8,496
- out patient contacts[3]	10,681	32,338	35,014	43,235

[1] Consultant obstetrician / resident or medical doctor. Number of doctors is used which does not represent 'full time units' (fte), due to part time jobs (small percentage of doctors).

[2] For the Netherlands: for nursing staff and midwives, fte is used (round of at whole numbers) and student nurses are included. In Namibia, working part time is not an option.

[3] OPD contacts for obstetrical and gynaecological patients, according to annual reports.

Leiden University Medical Centre (LUMC) is a university teaching hospital with deliveries under primary care (supervised by independent midwives), secondary care (under the responsibility of obstetricians) and tertiary (obstetric high care referrals). In 2007 there were 1,203 deliveries (secondary and tertiary care). The Medical Centre Haaglanden (MCH) is a large inner city teaching hospital in The Hague with primary and secondary care deliveries. In 2007 there were 1,473 deliveries (secondary care). The Haga hospital (HAGA) is a large regional teaching hospital in The Hague with primary and secondary care deliveries. In 2007 there were 1,493 deliveries (secondary care).

1.5 Aim of this thesis

Generally, the initiation of a thesis starts with a research question. The conception of this thesis is comparable with a breech delivery: it was 'the other way around'. Questioning daily practice resulted in different papers with a common theme: monitoring and improving the quality of care through audit.
The key questions addressed in this thesis are the following:

- What are the determinants, substandard care factors and areas for improvement with regard to maternal mortality in Onandjokwe district, Namibia?
- What lessons can we learn from maternal mortality audits in different settings worldwide?
- What are the determinants of caesarean section in selected hospitals in Namibia and the Netherlands?
- What is the influence of caesarean section on severe acute maternal morbidity in the Netherlands?
- Can obstetric audit of topics like maternal morbidity, caesarean section and perineal injury after delivery, be introduced in the existing structure of daily practice in Namibia and the Netherlands?

1.6 Outline of this thesis

Chapter 1 - Justification of this thesis and ensuring that the different studies can be seen within the broad context of their origin: Namibia and the Netherlands.

Chapter 2 - Study on facility based maternal mortality audit in Onandjokwe district Namibia.

Chapter 3 - Data from facility based maternal mortality audits from hospitals in Zambia, the Gambia and Namibia are compared with data from the confidential enquiry into maternal deaths in the Netherlands. The question whether 'differences in maternal mortality ratios are only due to being rich or poor' is answered by putting maternal mortality in historical perspective.

Chapter 4 - Using data from the LEMMoN study, audit of SAMM is introduced in different regions in the Netherlands. In addition to describing the process of initiating SAMM audits, results of the audit sessions and recommendations for improvement in maternal care are presented.

Chapter 5 - Study evaluating the influence of mode of delivery on SAMM. Using data from the LEMMoN study, a selection was made between women with vaginal delivery (VD) and those with CS. In trying to overcome the problem of bias by indication, we selected those cases where SAMM was not clearly related to mode of delivery and again compared SAMM incidence between VD and CS.

Chapters 6 and 7 - Studies on the introduction of CS audit in daily practice in regional hospitals in the Netherlands and Namibia respectively.

Chapter 8 - Study comparing different classification schemes for urgency of CS. A new classification of operations into four grades of urgency, as propagated internationally, will likely be introduced in the Netherlands as well. Using 18 theoretical scenarios we evaluated the agreement between 77 obstetricians for the traditional and new classification.

Chapter 9 - Study on introduction of perineal audit. In a multi-centre, prospective clinical study, the extend of perineal injury after delivery (episiotomy or obstetric anal sphincter injury; OASIS) was evaluated.

Chapter 10 - Conclusions of the different studies are summarized and discussed.

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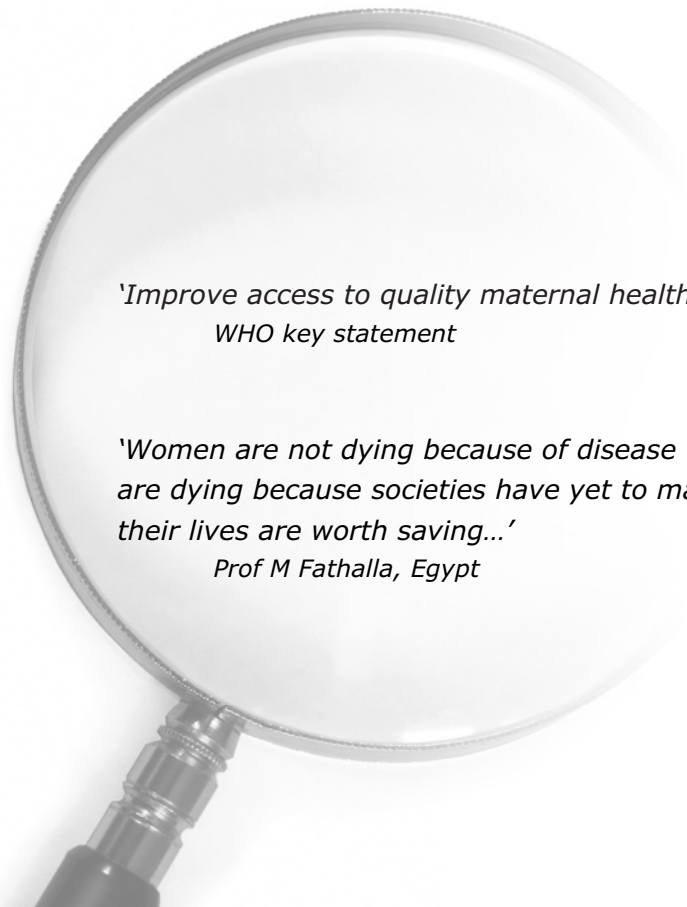
Part 1

Maternal Mortality



'Improve access to quality maternal health services'

WHO key statement

'Women are not dying because of disease we cannot treat, they are dying because societies have yet to make the decision that their lives are worth saving…'

Prof M Fathalla, Egypt

Chapter 2

Maternal mortality audit in a hospital in Northern Namibia: the impact of HIV/AIDS

Jeroen van Dillen
Tarek Meguid
Jos van Roosmalen

As short report published in
Acta Obstet Gynecol Scand 2006; 85: 499-500

Abstract

Objective: Classification of maternal deaths and identifying substandard care is important for improving obstetric services.

Design: descriptive study of patient files and audit results.

Setting: Onandjokwe Lutheran Hospital, district and referral hospital in Northern Namibia. Catchments population of 200-300,000 living in a semi rural/ peri urban area.

Methods: In a hospital-based survey all maternal deaths occurring between January 2001 - December 2003 were audited and recommendations for improvement formulated.

Main Outcome Measures: Maternal Mortality Ratio (MMR), classification and cause of death, substandard care factors and recommendations.

Results: 10.817 live births occurred with 56 maternal deaths. MMR 508/100,000 with 45% due to AIDS. Only 17 were direct maternal deaths (30%), 39 were indirect (70%). AIDS is the most important factor influencing maternal mortality with 25 deaths. Substandard care was identified in four areas and recommendations are presented.

Conclusion: A hospital based maternal mortality audit is an important tool in understanding maternal deaths as well as in identifying substandard care factors which require immediate action. A direct maternal mortality percentage of only 30% is one of the lowest reported and this refers to HIV/AIDS as an extremely important factor influencing maternal mortality in this part of the world.

Introduction

Worldwide, every minute a woman dies as a result of complications arising during pregnancy, childbirth and puerperium. According to the WHO, the majority of the 529,000 annual maternal deaths are avoidable. There is no health indicator which so clearly demonstrates the inequality of distribution of medical care since 99% of all maternal deaths occur in low income countries. Hence, in Africa south of the Sahara, every woman has a 4% lifetime risk of dying from pregnancy and childbirth.[1,2]

Monitoring maternal mortality is notoriously difficult. Population- and hospital- based surveys are used each with their own (dis) advantages. Population-based surveys like the sisterhood method, are simple and effective tools for estimating the maternal mortality ratio (MMR).[3] Especially in low income countries, where sophisticated and comprehensive systems for death registration are lacking, household surveys are sometimes used. The Namibian MMR can be derived from Namibian Demographic and Health Surveys, held in 1992 and 2000.[4] Part of this survey consisted of a 'direct' sisterhood method and MMR was 225 in 1992 and 271 in 2000. Due to sample size and large sampling errors these two estimates do not significantly differ and thus no conclusion about a trend can be made. Furthermore, due to small sample size, no reliable information is available for MMR in different regions and districts in Namibia. Another official Namibian source of maternal mortality is the Health Information System (HIS) data, which shows a declining trend from 1995-1999 with an overall average MMR of 84/100,000.[5]

Hospital based maternal mortality data are relatively easy to obtain. For monitoring or calculating MMRs these are rarely acceptable, however, since both the number of women who died as well as the number of births in the facility do not necessarily represent the population and are therefore unpredictably biased. For classifying different causes of maternal mortality and for identifying substandard care factors, hospital-based surveys are better suited. Furthermore, hospital-based surveys can be an important tool for improving obstetric services in the area.[6]

This paper describes a hospital-based confidential enquiry into maternal deaths, focusing on audit conclusions and recommendations.

Methods

Study Area and Population

Onandjokwe district is situated in Oshikoto region in the former North West Health Directorate, north of Etosha national park and west of Okavango region. Oshikoto region covers an area of 26,607 km^2 and the estimated population is 161,000, most of whom live in Onandjokwe district.[7] The district has an arid climate with seasonal rains. In this 'semi rural' area, most people depend on subsistence farming with the staple food mahangu. Peri urban areas (like Ondangwa town), however, are rapidly expanding and many people come here in search of work. About half of the district population has access to safe drinking water.

Onandjokwe district has one hospital, three health centres with 24 hour service including observation beds managed by nurses, twelve clinics with daytime service managed by nurses and 42 out reach points with monthly scheduled visits. Onandjokwe Lutheran Hospital is a 450 bed district hospital also serving as referral hospital with an estimated catchments population of 200-300,000. The hospital is the headquarter for all district health activities and houses the offices of the district primary health care team. The hospital has six departments: medicine, surgery, paediatrics, anaesthesiology, O&G and general medicine. The latter functions as 'general practitioner' service and only treats out-patients. There are ten wards including a four bed ICU. The laboratory services at Onandjokwe hospital are offered by the Namibia Institute of Pathology (NIP) and include service for parasitology, haematology and chemistry. HIV tests (ELISA) are performed at the NIP of the regional hospital in Oshakati.

The department of O&G is staffed by four doctors and 34 nurses including 13 registered/ enrolled midwives. Women can be admitted at three different wards. The obstetric ward has 17 beds for antenatal admissions, five delivery beds and 55 beds for postnatal care. Women are admitted in this ward when pregnant with a gestational age > 28 weeks, for delivery and postpartum. All women with a pregnancy < 28 weeks and women who are admitted after delivery outside the hospital stay in the gynaecology ward. In the private ward finally, all women with a medical aid scheme and those paying themselves are admitted. During 2002, the department of O&G admitted over 6,000 women, including 3,555 deliveries. More than 10,000 outpatients contacts were registered. There were 1,063 theatre cases, of which 599 were major cases (including 274 caesarean sections (caesarean section rate; 7.7%)) The hospital's obstetric care has been improved during recent years by the introduction of the WHO partogram, the use of standardised protocols and in-service-training sessions. Furthermore, the maternity waiting home has been rebuilt on the hospital premises in 1998.

Comprehensive Emergency Obstetric Care (EmOC) can be given at any time in Onandjokwe Lutheran Hospital. The distribution of blood for blood transfusions, however, is centrally regulated at the national level, which sometimes causes a shortage of blood in the district.

Finally, the official number of maternal deaths registered in the hospital in 2000 was one (MMR 24/100,000) (HIS).

Methodology

All maternal deaths occurring in hospital between January 2001-December 2003 are included. From January - June 2001, data was collected retrospectively. From June 2001, cases were identified 'prospectively', a standardised audit form was introduced and all hospital staff members were made aware of the survey. All cases of maternal deaths occurring in the hospital were reported to the department of O&G and the audit form was filled. If patient files could not be retrieved, information from hospital information system and the official diagnose of death was used. An active search for maternal deaths was conducted from the record books of the medical and surgical wards (including ICU). Cases with confirmed pregnancy or delivery date within six weeks of death were included in the survey. All case record forms were audited and analysed for cause of death, classification and substandard care factors. The audit team consisted of all doctors from the department of O&G. Audit findings and conclusions were presented to the hospital staff for discussion.

Definitions

Maternal death is defined as the death of a woman while she is pregnant, or within 42 days (6 weeks) of the termination of pregnancy, irrespective of the duration and site of her pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from any accidental or incidental causes. The MMR is the number of maternal deaths expressed per 100,000 live births. Direct obstetric deaths are those resulting from complications of the pregnant state, from interventions, omissions or incorrect treatment.

Indirect maternal deaths are those resulting from a disease (either previously existing or developed during pregnancy) aggravated by the physiological effects of pregnancy. The definition of 'late maternal deaths' includes both direct and indirect obstetric causes from 42 days until one year after the termination of pregnancy. A new category is 'pregnancy related death' which includes all maternal deaths irrespective of the cause.[8]

AIDS is diagnosed using the 1994 expanded WHO AIDS case definition [9] and combines a positive HIV test with specific conditions; chronic diarrhoea (> 1 month) and/or weight loss (<10%) not attributable to other diagnosis, cryptococcal meningitis, (extra)pulmonary tuberculosis, kaposi's sarcoma, neurological impairment not attributable to other diagnosis, candidiasis of oesophagus (or oral candidiasis with dysphagia), invasive cervical cancer and clinically diagnosed life threatening or recurrent pneumonia.

A diagnosis of tuberculosis is made when sputum samples are positive for acid fast bacilli, on typical chest X-ray abnormalities or in atypical pneumonia not responding to broad spectrum antibiotic therapy.

Results

General

There were 56 maternal deaths during the study period, of which 17 were classified as direct (30%) and 39 as indirect deaths (70%) (table 1). With 10,817 live births, the hospital MMR during this period was 518/100,000. In addition there were two 'pregnancy related deaths': one due to extensive burns (45% of body surface) and one due to a motor vehicle accident in pregnancy. There was at least one 'late maternal death', resulting from metastatic choriocarcinoma. Concerning direct maternal mortality, five deaths were due to sepsis post delivery (two of which were AIDS patients whom died after delivery at home), four deaths were due to (pre)eclampsia, three were abortion related, two each due to haemorrhage and ectopic pregnancy and finally one women died from suspected pulmonary thrombosis. During 2002 & 2003, 75 patients were admitted with (pre-existing) hypertension in pregnancy and thus the case fatality rate (CFR) of hypertension in pregnancy in Onandjokwe Lutheran Hospital was 5.3%.

Table 1. *Classification and underlying causes of maternal deaths (number and percentages) in Onandjokwe 2001-2003.*

Direct maternal deaths	**17**	**30%**
Puerperal sepsis	5	9%
(pre-)Eclampsia	4	7%
Abortion	3	5%
Obstetric haemorrhage	2	4%
Ectopic	2	4%
Thrombosis	1	2%
Indirect maternal deaths	**39**	**70%**
HIV/AIDS	14	25%
HIV/AIDS + tuberculosis	11	20%
Malaria	8	14%
Hepatitis B	3	5%
Dehydration	1	2%
Pneumonia	1	2%
Meningitis	1	2%

Concerning indirect maternal mortality, most of these (n=25) were due to AIDS (45%). In 11 cases, AIDS was diagnosed in HIV positive woman with (suspected) tuberculosis. There were eight deaths due to malaria, of which four occurred during 2002-2003 (total malaria admissions 2002-2003: 156; CFR: 2.6%).

Audit results

Details concerning all 56 deaths are presented in table 2. The average age of these women was 28 years (range 16-40). Parity was known for 42 cases: eight were primigravida, 31 were multipara (para 1-4) and three were grande multi's (para ≥ 5).

Term of pregnancy was known, either by last menstrual period or ultrasound estimation, for 47 women with a range from 10- 40 weeks. Four women died in early pregnancy (first trimester < 12 weeks), 12 during antenatal care period (undelivered), seven died 'peripartum' (within 24 hours of delivery), 14 during 'early' puerperium (within one week after delivery), and 19 during 'late' puerperium (> 7 days after delivery).

Table 3. *Audit conclusions and recommendations concerning specific cases (number of cases).*

	Cause of death (number)	'Substandard care'	Recommendations
1	Eclampsia (4)	- No magnesium sulphate given - Inadequate monitoring ICU	- Adjust existing (pre) eclampsia protocol to include magnesium sulphate - Include all health staff in departmental in service training sessions
2	DIC, missed abortion (1) Ectopic pregnancy (1)	- Pregnancy not identified in medical department	- Remind health care workers that all female patients in reproductive age should be asked for last menstrual period
3	AIDS (25)	- Slow implementation of national programmes for HIV/AIDS - No prevention of pregnancy in known HIV patients	- Strengthening PMTCT and ARV programmes - Active counselling and promotion of family planning in all HIV positive patients by all health care workers.
4	Haemorrhage post operation (2)	-Indication caesarean section - No blood available (1)	- In service training for department O&G concerning indications caesarean section in specific cases (abruptio placenta) - Improve blood availability / supply in district hospitals

Antenatal care (ANC) was attended by 23 women (41%), not attended by 15 (27%) and in 18 cases there was no information (32%). Those women who did not start ANC had pregnancies ranging from 12 till approximately 34 weeks. Vaginal delivery occurred in 29 cases (52%), caesarean section in four cases (7%), nine women aborted or had an immature (< 28 weeks gestation) delivery (16%) and 14 died undelivered (25%). The indication

for caesarean section were: AIDS and wasted syndrome in the absence of antiretroviral treatment (ARV)(case 6), footling breech in first baby of twin pregnancy (case 24), ante partum haemorrhage (case 33) and fetal distress in preeclampsia with intrauterine growth retardation (case 45). After initial audit and the local introduction of ARV in 2002, AIDS by itself was not considered an indication for caesarean section. Pregnancy outcome of those women with known gestational age > 28 weeks were as followed: 21 were born alive (twins: 1, known early neonatal death: 2), 11 were stillbirths (definition stillbirth: weight > 1 kg or gestational age > 28 weeks, twins: 1) and three intra uterine foetal deaths were undelivered. The audit team identified four areas where improvement is needed and recommendations were made accordingly (table 3). The audit recommendations were presented to the management team of Onandjokwe Lutheran Hospital and were discussed in the weekly interdepartmental meeting.

Discussion

Underreporting of maternal deaths is found in low income as well as in industrialised countries. Most often it concerns deaths in early pregnancy and indirect deaths.[10,11] In our study official MMR stood at 24/100,000 in 2000, while we found a MMR of 518/100,000 as from 2001. Most countries with confidential enquiries into maternal deaths see an initial increase in registered maternal deaths after introduction of audit due to improved diagnosing and classification.[10,12] For complete data collection, all health care workers must not only be aware of the importance of reporting maternal deaths but they must know the definition and classifications used. As for the causes of maternal deaths it is most often said that 75% are due to five main obstetric complications (haemorrhage, obstructed labour (rupture uterus), sepsis, hypertensive disease of pregnancy and unsafe abortion).[1] However in South Africa the 'big five' of maternal mortality has changed to include non pregnancy related infections (mainly AIDS).[13] Interestingly, in South Africa the most common cause of maternal mortality varied between the different levels of care: haemorrhage in level 1 (rural), AIDS in level 2 (districts) and hypertension in pregnancy in level 3 hospitals (referral/ teaching hospital).

When comparing this with the Namibian health system, Onandjokwe Lutheran Hospital would best be compared with a level 2 hospital. Our data also indicate that AIDS is the single most important factor influencing maternal mortality. In this region, 28% of antenatal care attendees were found to be HIV positive during the 2002 national sentinel survey.[14] Furthermore, adult women's mortality has increased more than five times between 1993 to 2000 in Northern Namibia and this increase is mostly concentrated among fertile women aged 25 - 49 years.[15] An increase in maternal mortality in HIV prevalent settings is not surprising, but a 22 times increase in maternal deaths in HIV positive women as reported in Zimbabwe [16] was not found in our study. Using the reported HIV prevalence of 28% and 11,005 deliveries from 2001/2003, we calculated maternal death to be 2,2 times more likely to occur in HIV- positive women. Not all women were tested for HIV status however.

Auditing maternal deaths for cause and classification in AIDS patients can be difficult. Two cases with sepsis after home delivery (case nr 53 and 54) are classified as direct obstetric death, although the influence of AIDS in these two cases should be mentioned. Case nr 27 on the other hand, also died in puerperium after a premature delivery, but since more information was available due to prolonged admission and observations, it was clear for the audit team that the cause of death was AIDS.

Whether or not pregnancy influences the disease progression in HIV-positive women has been questioned and studied extensively. At present there appears to be consensus that pregnancy itself does not have a major adverse effect on survival of HIV- infected women.[17,18] The poor maternal prognosis of HIV infected women found in low income countries may be due to other factors such as poverty, malnutrition and co/existing infections like parasitic infection, anaemia, malaria and tuberculosis. Ideally, pre-conception counselling should be offered about possible risks for women's health as well as information on vertical transmission of HIV. For Namibia, national and local guidelines on how to deal with HIV in pregnancy have been introduced in the past years [19] and antiretroviral (ARV) treatment is slowly becoming available.[20] Within the programme for prevention of mother to child transmission (PMTCT) a distinction is being made between primary (preventing HIV infection), secondary (preventing pregnancy in HIV positive women) and tertiary prevention (preventing vertical transmission of HIV).

Table 4. *Comparison of maternal deaths classification from national confidential enquiries and local audit (percentages)*

	Indirect	Direct	Unknown
Confidential enquiries			
South Africa 1998	34	63	3
South Africa 1999-2001	38	60	2
United Kingdom 1985-1987	38	62	0
United Kingdom 1994-1996	50	50	0
United Kingdom 1997-1999	56	44	0
United Kingdom 2000-2002	59	41	0
The Netherlands 1983-1992	25	75	0
The Netherlands 2000-2001	33	67	0
Surinam 1991-1993	23	77	0
Local Audit			
Ghana Berekum 1987-1999	27	68	5
Zambia Kalabo 1999-2001	33	67	0
The Gambia Farafenni 2002	33	67	0
Mozambique Maputo 1989-1990	28	72	0
Ethiopia Addis Ababa 1981-1983	22	78	0
Namibia Onandjokwe 2001-2003	70	30	0

Both primary and secondary prevention aim to reduce HIV prevalence of pregnant women and will thus lead to a reduction of AIDS related maternal deaths.[21]

To our knowledge, this is the first time to report an extremely low percentage of direct maternal mortality (30%). Most studies find direct maternal mortality percentages ranging between 41-77% (Table 4).[12,13,22-28] This is certainly due to the high percentage of AIDS related deaths, but can also be seen as appraisal for the quality of obstetric services. As far as the case fatality rate of (pre) eclampsia is concerned, however, there is still room for improvement. The introduction of a new protocol including magnesium sulphate for the treatment of severe pre-eclampsia might decrease maternal morbidity and mortality from this pregnancy related complication. Furthermore the indication for caesarean section in specific cases like abruptio placenta can be questioned.[29,30] Additional in service training is therefore recommended.

It can be concluded that maternal mortality is underreported in Namibia. A confidential enquiry into maternal deaths could help to identify the true magnitude of this sensitive problem in Namibia and gives detailed information on areas for improvement. The Ministry of Health and Social Services (MOHSS) has already organized workshops in 2002, for the introduction of a national maternal mortality audit form. However, up to date, this has not yet led to the introduction of a national enquiry. This report can serve as a guide to the introduction of a national based programme.

A hospital based maternal mortality audit as reported here is an important tool in the process of understanding maternal deaths as well as in identifying substandard care factors which require immediate action. The high number of AIDS related deaths is worrying and due to the high HIV prevalence of ANC clients, will remain to be an important contributor to maternal mortality. To reduce maternal deaths due to AIDS, attention needs to be given to PMTCT where primary prevention of HIV infection, as well as secondary prevention of pregnancy in HIV infected women, can decrease HIV prevalence in pregnant women. In addition, the introduction of comprehensive antiretroviral treatment is urgently needed.

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Table 2. *Characteristic and causes of maternal deaths at Onandjokwe 2001-2003.*

No	Age	Delivery [1]	Child [2]	Time of death	Ward [3]	Classified	Cause of Death [4]
1	28	SVD (+/-24)	Died	Postpartum	Infection	Indirect	AIDS (chronic diarrhoea)#
2	34	SVD (-)	-	Postpartum	Obstetric	Indirect	AIDS (tuberculosis, multi-organ failure)#
3	32	SVD (+/-28)	Alive	Postpartum	ICU	Direct	Puerperal sepsis
4	28	No (24)	Undelivered	Undelivered	ICU	Indirect	AIDS (tuberculosis / pneumonia)
5	23	SVD (-)	-	Postpartum	Obstetric	Indirect	AIDS (tuberculosis)#
6	34	C/S (35)	Alive	Postpartum	Obstetric	Indirect	AIDS (chronic diarrhoea)
7	34	SVD (-)	-	Postpartum	Obstetric	Indirect	AIDS (tuberculosis)#
8	20	Breech (32)	MSB	Postpartum	Obstetric	Indirect	Malaria
9	20	No (16)	Undelivered	Undelivered	Gynae	Indirect	Malaria
10	23	SVD (27)	Died	Postpartum	Gynae	Direct	Sepsis; retained placenta (malaria)
11	33	SVD (-)	-	Postpartum	Gynae	Indirect	AIDS (tuberculosis)#
12	19	SVD (-)	Alive	Postpartum	Gynae	Indirect	Pneumonia (HIV unknown)
13	40	SVD (26)	Died	Postpartum	ICU	Indirect	Malaria
14	32	SVD (32)	Alive	Postpartum	Obstetric	Indirect	Malaria
15	28	SVD (34)	Alive	Postpartum	Infection	Indirect	AIDS (wasted syndrome)
16	29	SVD (-)	Alive	Postpartum	Gynae	Indirect	AIDS (chronic diarrhoea/ wasted)
17	36	SVD (37)	Alive	Postpartum	Obstetric	Indirect	AIDS (tuberculosis)
18	28	Abortion (10)	Abortion	Post abortion	Gynae	Direct	Incomplete Abortion
19	31	SVD (39)	Alive	Postpartum	Obstetric	Direct	PPH retained placenta
20	32	SVD (32)	Alive	Postpartum	Infection	Indirect	AIDS (kaposi sarcoma)
21	31	No (16)	Undelivered	Undelivered	Gynae	Indirect	AIDS (pneumonia)
22	17	SVD (38)	Alive	Postpartum	ICU	Direct	Eclampsia
23	20	No (16)	Undelivered	Undelivered	ICU	Direct	DIC, incomplete Abortion
24	33	C/S (twin 35)	Alive / Alive	Postpartum	Obstetric	Direct	Post CS, CCF / pulmonary embolism
25	40	SVD (26)	MSB	Postpartum	Gynae	Indirect	AIDS (kaposi sarcoma)
26	25	No (20)	Undelivered	Undelivered	Gynae	Indirect	AIDS (neurological impairment)
27	28	SVD (33)	Alive	Postpartum	Obstetric	Indirect	AIDS (tuberculosis)
28	24	SVD (-)	MSB	Postpartum	Gynae	Direct	Puerperal sepsis
29	32	SVD (22)	MSB	Postpartum	Gynae	Indirect	AIDS (wasted syndrome)
30	16	No (20)	Undelivered	Undelivered	Casualty	Indirect	Malaria
31	27	Abortion (12)	Abortion	Post abortion	Casualty	Direct	Septic Abortion
32	35	SVD (twin 34)	MSB / MSB	Postpartum	Obstetric	Indirect	Malaria

33	31	C/S (34)	FSB	Postpartum	ICU	Direct	Haemorrhage, Abruptio Placenta,*
34	31	No (23)	Undelivered	Undelivered	ICU	Indirect	Malaria
35	26	No (24)	Undelivered	Undelivered	Gynae	Indirect	AIDS (tuberculosis)
36	32	No (28)	Undelivered	Undelivered	Infection	Indirect	Dehydration due to severe diarrhoea
37	23	SVD (38)	Alive	Postpartum	Obstetric	Indirect	AIDS (pneumonia, candidiasis)
38	19	SVD (39)	Alive	Postpartum	ICU	Indirect	Hepatitis B
39	24	SVD (30)	FSB	Postpartum	ICU	Indirect	Hepatitis B
40	21	SVD (40)	END	Postpartum	ICU	Direct	Eclampsia
41	39	No (32)	Undelivered	Undelivered	Obstetric	Indirect	AIDS (tuberculosis)
42	34	SVD (32)	Alive	Postpartum	Obstetric	Indirect	AIDS (tuberculosis)
43	22	Abortion (17)	Abortion	Post abortion	Gynae	Indirect	AIDS (candidiasis)
44	34	No (34)	Undelivered	Undelivered	ICU	Indirect	Malaria
45	30	C/S (32)	Alive	Postpartum	ICU	Direct	Preeclampsia, post CS haemorrhage**
46	31	SVD (32)	END	Postpartum	Gynae	Indirect	AIDS (wasting syndrome)
47	17	No (-)	Undelivered	Undelivered	Infection	Indirect	Meningitis (gram-diplococci)
48	-	No (12)	Undelivered	Undelivered	Infection	Direct	Ectopic pregnancy
49	22	SVD (34)	FSB	Postpartum	Obstetric	Direct	Eclampsia
50	36	SVD (22)	MSB	Postpartum	Infection	Indirect	AIDS (chronic diarrhoea)
51	34	SVD (33)	Alive	Postpartum	Obstetric	Indirect	AIDS (atypical pneumonia)
52	32	No (12)	Undelivered	Undelivered	Gynae	Direct	Ectopic pregnancy
53	31	SVD (35)	-	Postpartum	Gynae	Direct	Sepsis post (home) delivery (HIV+)[#]
54	25	SVD (33)	-	Postpartum	Gynae	Direct	Sepsis post (home) delivery (HIV+)[#]
55	20	SVD (36)	Alive	Postpartum	Obstetric	Indirect	AIDS (tuberculosis)[#]
56	18	SVD (-)	MSB	Postpartum	ICU	Indirect	Hepatitis B

[1] SVD= spontaneous vaginal delivery, CS= caesarean section (term of pregnancy between brackets)

[2] MSB= macerated stillbirth, FSB= fresh stillbirth, END= early neonatal death

[3] Obstetric Ward= All pregnant women from 28/40 pregnancy, delivery and postnatal, Gynaecology Ward= All pregnant women until 28/40 pregnancy and puerperium admissions, ICU= Intensive Care Unit, Infectious Ward= all patients with infectious diseases including diarrhoea, Casualty= Out Patient Department, before admission

[4] DIC= Diffuse Intra vascular Coagulation, CCF= Congestive Cardiac Failure, AIDS = HIV+ and additional diagnose between brackets

* Blood transfusion was available and 5 units were given, ** No blood available. [#] No file available for audit

Chapter 3

The use of audit to identify maternal mortality in different settings:

is it just a difference between the rich and the poor?

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Abstract

Objective: To illustrate how maternal mortality audit identifies different causes and contributing factors of maternal deaths in different settings in low- and high-income countries and how this can lead to local solutions in reducing maternal deaths.

Design: descriptive study of maternal mortality from different settings and review of data concerning the history of reducing maternal mortality in countries, which are high-income countries at present.

Settings: Kalabo district Zambia, Farafenni division The Gambia, Onandjokwe district Namibia and the Netherlands. Population of rural areas in Zambia and The Gambia, peri-urban in Namibia and nationwide data from the Netherlands.

Methods: Data from facility-based maternal mortality audits from three African hospitals and data from the latest confidential enquiry in the Netherlands.

Main Outcome Measures: Maternal Mortality Ratio (MMR), causes (direct and indirect) and characteristics.

Results: MMR ranged from 10/100,000 (the Netherlands) to 1,540 (The Gambia). Differences in causes of deaths were characterised by HIV/AIDS for Namibia, sepsis and HIV/AIDS in Zambia, (pre-) eclampsia in the Netherlands and obstructed labour in The Gambia.

Conclusion: Differences in maternal mortality are more than just differences between the rich and the poor. Acknowledgement of the magnitude of maternal mortality and a strong political will to tackle the issues are important factors. There is no single, general solution to reduce maternal mortality and identification of problems needs to be promoted through audit, both national as well as local.

Introduction

Worldwide, every minute a woman dies as a result of complications arising during pregnancy, childbirth and puerperium. All these cases represent a personal, familial and social tragedy. According to the Millennium Development Goals (MDG) formulated by the United Nations in 2000, maternal mortality should be reduced by 75% in 2015 as compared to 1990 (Http://www.un.org/millenniumgoals, accessed July 4, 2006). Maternal mortality, however, is notoriously difficult to measure. This is especially true since 99% of the estimated 529,000 annual maternal deaths occur in low-income countries where vital statistics are lacking.[1] Without data on the dimensions, impact and significance of a health problem it is neither possible to create an advocacy case nor to establish strong programmes for addressing it.

Especially in Sub Saharan Africa, often the only information available is hospital based data. In many low income countries only a small proportion of births and maternal deaths occur in health facilities. Low utilisation of maternal health services, which is usually caused by a complex of different factors, can contribute to high maternal mortality.[2] On the other hand hospital data tend to overestimate maternal mortality in the community.[3] In fact, hospital maternal mortality is expected to overestimate community rates, if the hospital functions well as an integral part of a primary health care network, to which women with high-risk pregnancies and complications are referred.

Conducting a facility-based maternal death review is primarily an educational process for health professionals providing care to pregnant or recently delivered women.[4] Furthermore, a facility-based maternal death review is only complete if it is linked with proper, feasible recommendations to improve maternal care and the services.

Auditing hospital data, although not useful for estimating maternal mortality in the community, provides detailed information about the underlying causes of death and substandard care factors, which can be used in strategies to reduce maternal mortality. An important additional advantage is that the findings can be used by health managers at district, regional, national or international level to help identify service needs, prioritise resources and raise funds for programmes and/or projects to improve maternal health.

Objectives

The objective of this paper is to illustrate how maternal mortality audit can be used to identify causes and contributing factors of maternal deaths in different settings. Secondly, to illustrate differences between low- and high-income countries, by presenting data from three facility-based maternal death reviews in sub-Saharan Africa and from the confidential enquiry into maternal deaths in the Netherlands.[5] Finally, using regional and international differences in relation with historical lessons learned, it elaborates on how to achieve a reduction in maternal mortality as stated by MDG 5.

Methodology

Study areas and population

Selection of study sites was done purposive due to working experience of the authors (see initials in brackets).

- Zambia (JS): Kalabo district is one of the seven districts in Western Province in Zambia, situated on the western side of the Zambezi River. Characteristics of the area are presented in table I. During the flood season, six rural health centres are completely cut off from the rest of the District. Adequate access to health services is not provided to all communities in the district. Kalabo district hospital is the main referral hospital in the district where comprehensive emergency obstetric care is available in most occasions. Maternal mortality in hospital is high, as in most rural areas of Africa, with (far) more than 1,000 maternal deaths per 100,000 live births.
- The Gambia (GW): The North Bank Division is one of the seven divisions in The Gambia, situated on the north of the Gambia River. Characteristics of the area are presented in table I. Over the last 20 years there has been a marked change in health services availability in the division. Only in 1999, Farafenni hospital has been established in the division, where comprehensive emergency obstetric care (EmOC) is available in most occasions. Between 1982 and 1998 the proportion of women delivering in a health facility increased from 4.6% to 18.0%. Maternal mortality in hospital is high, as in most rural areas of Africa, with (far) more than 1,000 maternal deaths per 100,000 live births.

- Namibia (JvD): Onandjokwe district is situated in Oshikoto region in the former North West Health Directorate. Characteristics of the area are presented in table I. In this 'semi rural' district, peri urban areas (like Ondangwa town) are rapidly expanding and many people settle here in search of work. Onandjokwe district has one hospital, Onandjokwe Lutheran Hospital where EmOC can be given at any time. According to official records in-hospital maternal mortality in 2001 was 21/100,000, when only one case was reported. However, nationally maternal mortality stands at 271/100,000.
- The Netherlands (JS and JvR): a western European country, bordering the North Sea between Belgium and Germany. Characteristics of the country are presented in table I. In the Netherlands 409,222 deliveries occurred in 2000 and 2001. Approximately 70% of the children were born in hospital, 30% were born at home under the guidance of a trained midwife or a family practitioner. Maternal mortality is low (12.6 per 100,000 live births in 1993-2002).[5]

Methods

Maternal deaths in Zambia (January 1999 - July 2001), in The Gambia and Namibia (January - December 2002) and in the Netherlands (January 2001 - December 2002) were analysed. In the three African hospitals, local audit was done by the hospital staff as integral part of routine clinical work. [6] In the confidential enquiry in the Netherlands, audit forms were reviewed by the maternal mortality committee of the Dutch Society of Obstetrics and Gynaecology. Classification of deaths (direct or indirect deaths) causes of death, substandard care factors (in hospital) and delay factors were searched for in all cases of the four series.

Definitions

- Maternal death: death of a woman while pregnant or within 42 days of termination of the pregnancy, irrespective the duration or the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. [7]
- Maternal mortality ratio (MMR): the number of maternal deaths per 100,000 live births.
- Direct maternal deaths: those resulting from complications of the pregnant state, from interventions, omissions or incorrect treatment.

- Indirect maternal deaths: those resulting from a disease (either previously existing or developed during pregnancy) aggravated by the physiological effects of pregnancy.
- Substandard care: care was considered substandard when according to the local audit team (African hospitals) or the national maternal mortality committee (the Netherlands), care deviated from existing local protocols or consensus.
- Delay factor: delay factors included delay in decision making process (phase 1), delay in reaching a health facility (phase 2) and delay in receiving appropriate care (phase 3). [8]

Limitations

As previously mentioned, hospital based mortality data does not necessarily reflect community maternal deaths. Furthermore, even deaths in hospital might have been misclassified as being non-maternal, especially indirect deaths in medical wards. Data was recorded retrospectively from patient files, which in some cases were inadequately filled. On the other hand, audit sessions have been done locally and health care workers involved in patient management gave additional information if necessary. Finally the definition of substandard care differed between settings according to difference in local protocols and possibilities (for example the absence of an intensive care department in Zambia and The Gambia).

Results

Differences in socio-economic indicators between the four study areas and country data are presented in table 1. A picture of poverty, short life expectancy and poor health care arises from the data for Zambia and The Gambia. Namibia is slightly better with a GDP per capita about fivefold and health expenditure per capita about seven-fold, compared to Zambia and The Gambia. The situation in the Netherlands can be characterised as: wealthy, long life expectancy and good health care. The distribution in classification between direct and indirect obstetrical deaths does not show a difference between Zambia, The Gambia and the Netherlands (table 2). In Namibia, however, indirect causes of maternal death were identified in 67% of the cases.

Table 1. *Selected indicators for the four countries & characteristics of study areas/hospitals*

Country indicators [1]	**Zambia**	**The Gambia**	**Namibia**	**Netherlands**
GDP per capita (USD)	877	1,115	4,934	28,983
Life expectancy at birth (yrs)	37	59	49	78
Literacy rate (%)	68	38	85	99
Health expenditure per capita (USD)	49	46	331	2,564
HIV/AIDS (% age 15-49)	16.5	1.6	21.3	0.2
Skilled attendance at delivery (%)	43	55	76	100
Study area / hospital	**Kalabo**	**Farafenni**	**Onandjokwe**	**Netherlands**
Catchment area (km^2)	17,447	2,256	26,607	41,160
Number of inhabitants	116,003	213,700	152,000	16,000,000
Population density (km^2)	6.6	94.7	5.7	388.7
Study Period (months)	30	12	12	24
Institutional births (n) [2]	1,471	1,169	3,480	409,222

[1] Sources: www.who.int/country ; www.undp.org/hdr2003/indicator

[2] Total births in the Netherlands: institutional + home births

As for cause of death, a high percentage of cases of sepsis and no eclampsia exists in Kalabo, Zambia. In Farafenni there were no abortion-related cases, while obstructed labour, haemorrhage and sepsis were common direct causes of maternal mortality. Absence of obstructed labour and abortion-related cases and a very high percentage of (pre-)eclampsia related deaths, were the most striking findings in the Netherlands (table 3). For Namibia and Zambia, HIV/AIDS is of major influence in maternal mortality. AIDS might have been the cause for the 'chronic disease' case in The Gambia. Four cases in The Gambia were booked as 'unknown', but considered indirect maternal deaths.

Substandard care is prevalent in all hospitals (table 2). In the Netherlands, the confidential enquiry committee identified substandard care in 52% of cases. In Zambia and The Gambia substandard care was found in about 60% of cases of maternal death. In Namibia, substandard care was identified in 43%, but this would increase to 67% if a missed family planning opportunity in a known or suspected HIV-patient would be classified as substandard care.

Table 2. *Characteristics of maternal deaths (numbers, % or range in brackets)*

Characteristics of deaths	Zambia Kalabo	The Gambia Farafenni	Namibia Onandjokwe	Netherlands
Maternal deaths	15	18	21	48
- direct	10 (67)	12 (67)	7 (33)	35 (73)
- indirect	5 (33)	6 (33)	14 (67)	13 (27)
Maternal mortality ratio	1359	1540	603	10
Mean age in years	25.5	28.1	27.0	29.2
(range)	(15–42)	(17–45)	(16-40)	(16–40)
Substandard care	9 (60)	11 (61)	9 (43)	25 (52)
Delay factors	9 (60)	10 (56)	-	1 (2)

Table 3. *Causes of maternal deaths (numbers, % in brackets)*

	Zambia Kalabo	The Gambia Farafenni	Namibia Onandjokwe	Netherlands
Direct deaths	10 (66.7)	12 (66.7)	7 (33.3)	35 (72.9)
- Haemorrhage	1 (6.7)	3 (16.7)	1 (4.8)	1 (2.1)
- (Pre-)eclampsia	0	1 (5.6)	2 (9.5)	12 (25.0)
- Sepsis	5 (33.3)	3 (16.7)	1 (4.8)	3 (6.3)
- Abortion	1 (6.7)	0	2 (9.5)	0
- Obstructed labour	2 (13.3)	4 (22.2)	0	0
Other direct causes				
- Thrombo embolism	1 (6.7)	0	1 (4.8)	5 (10.4)
- Amniotic fluid embolism	0	0	0	5 (10.4)
- Other	0	1 (5.6)	0	8 (16.7)
- Unknown	0	0	0	1 (2.1)
Indirect deaths	5 (33.3)	6 (33.3)	14 (66.7)	13 (27.1)
- HIV/AIDS	4 (26.7)	0	8 (38.1)	1 (2.1)
- Other	1 (6.7)	2 (11.1)	6 (28.6)	12 (25.0)
- Unknown*	0	4 (22.2)	0	0

* Four cases in Farafenni were audited as indirect maternal death with unknown cause. The maternal mortality committee of the Dutch Society of Obstetrics and Gynaecology classifies sudden death of unknown cause as direct maternal death.

Discussion

Although the data presented in this paper are not intended for comparison of causes of maternal deaths, the results from three local African audits and from the nationwide confidential enquiry into maternal deaths in the Netherlands illustrate clear differences.

First, it indicates an association between poverty (low gross national product (GNP)) and maternal death (high MMR). This relationship, however, is not straightforward. In countries where the GNP per capita was below USD 1,000 in 1993, estimates of maternal mortality ratios ranged from 22 to 1,600 per 100,000 live births.[9,10] For example, at that time, maternal mortality ratios were estimated at 160, 1,200 and 1,300 in Vietnam, Uganda and Burundi, respectively, despite very similar GNPs per capita (USD 170-180). The main differences in maternal mortality between countries and world regions cannot simply be explained by variations in economic growth.[11] Also, national figures mask substantial internal variations- geographical, economic, and social – which are not confined to low-income countries. Irrespective of the stage of development or the condition of the health system, inequalities in the risk of maternal death are found everywhere.[12]

Historically, the trend in maternal mortality in Sweden, England & Wales and the United States suggests two main phases.[11,13] The first phase in the late 19th century, was characterized by the recognition of the magnitude of the problem revealed by vital statistics. This led to professionalization of midwifery care and, together with the introduction of aseptic techniques, reduced maternal mortality in the early 20th century in countries like Sweden, the Netherlands or Denmark to the equivalent of the 25th centile of the poorest countries today. The second phase, which followed the plateau between 1900 and 1930, was made possible by the improvement of techniques, like use of antibiotics, caesarean section and blood transfusion. During this phase, the quality of care concept and a system of control was assisted with information from studies into maternal mortality. Vital statistics, although available in Sweden from as early as the 18th century, only resulted in confidential enquiries into maternal deaths in England and Wales from 1949.

These enquiries and the medical audit which was introduced with it resulted in awareness among caregivers and largely contributed to further decline until the low rates found today. As with the relationship between poverty and maternal mortality, the possible relationship between availability to health care and maternal mortality is not straightforward either. The case of Kalabo, Zambia, demonstrates what happens in a large district (in square kilometres almost half as big as the Netherlands) with only one hospital offering emergency obstetric care and no transport system at all.[2] The decentralisation of emergency obstetric care has not taken place and is not feasible. However, Sweden was a country with a very scattered (and poor) population and a very high maternal mortality ratio in the first half of the 18th century. Early recognition of the magnitude of the problem and a strong political will to tackle the problem led to a decrease to below 100/100,000 live births by 1950.[14] The striking difference in the presence of delay-factors in reaching a health facility between the cases of maternal deaths in the Netherlands on one hand, and Zambia and The Gambia on the other hand is as expected. Absence of delay-factors in Namibia is surprising and can be explained by the quality of the referral system in Onandjokwe district. This fact plays a role in understanding the absence of obstructed labour as a cause of maternal death in both the Netherlands and Namibia.

Another striking difference concerns the HIV/AIDS-epidemic, which plays a devastating role in health care in Africa. To halt the spread of HIV is an important goal, summarised in MDG 6 (www.un.org/millenniumgoals, accessed July 4, 2006). In the studies presented here, HIV prevalence ranged from 0.2% in the Netherlands to 21.3% for Namibia. In Kalabo, Zambia, in at least 4 of 15 (27%) cases of maternal death HIV/AIDS was the cause. Probably, some of the women who died from septicaemia were also HIV-positive, but that was not tested. In Onandjokwe, Namibia, in at least 8 of 21 (38%) cases, HIV/AIDS contributed to the cause of death. In the series from Farafenni, The Gambia, one case of 'chronic disease' appears, which might have been HIV/AIDS as well. An increase in maternal mortality in HIV prevalent settings has been reported earlier, with levels up to 22 times as high in HIV positive women compared to HIV negative women.[15] Although at present there appears to be consensus that pregnancy itself does not have a major adverse effect on survival of HIV- infected women.[16]

It is clear that in sub-Saharan Africa the effects of the HIV/AIDS-epidemic negatively affect maternal health through a cascade of interrelated factors: e.g. anaemia, susceptibility for infection, co-morbidity with other STD's, malnutrition, poverty, shortage of health staff and lower immunity for malaria. National and local programmes on how to deal with HIV in pregnancy have been introduced by most (African) countries, but the implementation of comprehensive reproductive health programmes that include (costly) antiretroviral treatment still needs massive support. Finally, in addition to the medical consequences, the HIV/AIDS epidemic has also increased the unwillingness of the community to donate blood and has also led to critical shortage of health workers of all cadres in many remote districts.[6]

In the Netherlands, (pre-)eclampsia was identified as the largest single cause of maternal death with 25%. Maternal mortality and morbidity audits have identified that the incidence of preeclampsia is high in the Netherlands as compared to its surrounding countries. This has led to recent changes in the National Guidelines.

Finally it is important to note that in all four series the proportion of indirect maternal deaths is relatively high, with figures up to 67% in Onandjokwe.[17] Indirect maternal deaths are particularly prone to be reported as non-maternal and there are significant differences between countries in the classification of indirect deaths to the maternal category.[18,19] The 1997-1999 Confidential Enquiry in the UK found for the first time that indirect deaths account for more maternal deaths than direct causes.[20] There is reason to assume that, at least, attention for maternal mortality as a problem has led to increased registration, even of indirect causes. Most countries with confidential enquiries into maternal deaths see an initial increase in registered maternal deaths after introduction of the programme due to improved identification and classification.[21]

Conclusion

To achieve MDG5 and reduce maternal mortality by 75%, many factors need to be addressed, among these socio-economic and organisational ones. But there is more than just a difference between the rich and the poor. The first step in reducing maternal mortality is identification of the problems. Identification of local, regional or national causes and assessment of substandard care including recommendations for improvement can be achieved through the implementation of audit. Audit is a low cost operational research tool and not just relevant for monitoring local progress. It should also be used for advocacy and can inform policy makers and planners concerning effective interventions to reduce maternal deaths. This paper illustrates that there is no single solution since every country or region has different factors influencing maternal health.

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Part 2

Maternal Morbidity

'Every pregnancy faces risk…'
WHO key statement

'…some more than others'
Prof J v Roosmalen

Chapter 4

Introducing maternal morbidity audit in the Netherlands

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Submitted

Abstract

Objective: To identify substandard care in selected cases from a nationwide prospective cohort study into severe acute maternal morbidity (SAMM) in the Netherlands called 'LEMMoN'.

Design: Prospective audit of selected cases of SAMM.

Setting: Nine audit meetings held throughout the Netherlands.

Population: All pregnant women in the Netherlands.

Methods: Before each meeting, SAMM details of selected cases were sent to all panel members for individual assessment by completing an audit form. During a subsequent plenary meeting, findings were discussed and substandard care factors as judged by the majority of assessors were scored.

Main outcome measures: Incidence of substandard care and recommendations for improving the quality of care.

Results: Substandard care was identified in 53 of 67 cases (79%). Specific recommendations were formulated concerning the procedure of audit and concerning local as well as national management guidelines.

Conclusion: Data from the LEMMoN study reflects SAMM in the Netherlands and substandard care is present in four out of five cases. Ongoing audit of cases is promoted both at national and local level.

Introduction

Maternal mortality has traditionally been used as an important indicator of health care, making comparison over time and between services possible. Detailed assessment of individual cases through audit by the Confidential Enquiry into Maternal Deaths in the United Kingdom has been acknowledged as a major contributor to the decline of maternal deaths in the UK over the past 50 years. Other countries have followed this example among which South Africa and the Netherlands. Nowadays, maternal mortality in high income countries is too rare to be used as a sensitive marker for the quality of services. Therefore, severe acute maternal morbidity (SAMM) has been introduced. [1-6] SAMM complicates at least 0.71% of all pregnancies in the Netherlands, and should be considered as a new indicator of the quality of obstetric care next to maternal mortality.[7] Auditing SAMM in order to identify substandard care has generally been accepted as complementary to maternal death reviews. [8] In this study we describe the introduction of SAMM audits in the Netherlands focusing on substandard care analysis.

Materials and Methods

This study was part of the nationwide prospective cohort study into SAMM in the Netherlands, called 'LEMMoN'. Cases were enrolled between August 1st 2004 and August 1st 2006. SAMM was classified according to disease-specific and management-based criteria and categorised into five groups (Box 1). All 98 Dutch hospitals participated. Detailed methods are described elsewhere.[7]

From 2004 onwards, nine audits have been organised throughout the Netherlands and 71 SAMM cases (2.8% of all cases of SAMM) were assessed (table 1). Audits included regionally or nationally selected SAMM cases and included audits with specific topics: eclampsia, major obstetric haemorrhage (MOH) and selected SAMM after delivery under primary care (table 1). The first pilot audit included all 23 SAMM cases in two hospitals during the first 10 months of the study, of which 14 were eventually selected for discussion during the panel meeting.[9] Since then, we applied initial selection and discussed all cases during the plenary meetings.

During an in-depth MOH audit in Leeuwarden involving all local staff, recommendations were formulated in all four cases, but presence of substandard care by majority of the assessors was not formulated. For calculating the incidence of substandard care these cases were not included. During an in-depth eclampsia audit in Delft, nationally selected cases were discussed without the presence of medical staff (consultants, midwives or registrars) involved in the cases. It was noted that this left many questions unanswered and therefore, two additional audit meetings were held with involved staff present. These three audits are presented here as one. Concerning the primary care audit MOH, cases were eligible when eight or more units of blood were transfused, and the woman was either admitted to intensive care or had undergone major surgery or arterial embolisation to stop the haemorrhage.

Box 1. *Inclusion criteria for SAMM*

Group 1: ICU admission
- Admission to ICU or coronary care unit, other than for standard postoperative recovery

Group 2: Uterine rupture
- Clinical symptoms (pain, fetal distress, acute loss of contractions and haemorrhage) that led to an emergency caesarean section, at which the presumed diagnosis of uterine rupture was confirmed
- Peripartum hysterectomy or laparotomy for uterine rupture

Group 3: Eclampsia/HELLP syndrome
- Eclampsia
- HELLP syndrome only when accompanied by liver haematoma or rupture

Group 4: MOH
- Transfusion need of ≥ 4 units of packed cells
- Embolisation or hysterectomy for MOH

Group 5: Miscellaneous
- Other cases of severe maternal morbidity to the opinion of the treating obstetrician, not to be included in group 1–4

For each audit, panel members were selected from the LEMMoN advisory board and the national Maternal Mortality Committee, as well as local health care workers involved. Panel membership was variable but chosen in such a way that each audit included staff from university as well as non-university hospitals. Furthermore, members from different specialties (mainly obstetricians, midwives, and internal medicine specialists) were selected with special attention to including members with experience in the audit process.

Each panel meeting considered four to fourteen cases. Anonymised notes from the LEMMoN database, selected by one member of the LEMMoN audit team (JZ), were sent to the panel members and included patients discharge letter, details from delivery, operation notes, laboratory results and a summary of file notes. Each panel member was requested to perform individual assessment of patient notes using a standardized audit form used by the Maternal Mortality Committee. Substandard care was identified at the level of the patient, the care provider or the organisation of health care (15 items). In case of eclampsia or MOH, additional substandard care items concerning management were scored. During the plenary meeting, SAMM cases were discussed and assessed for substandard care. If necessary the involved care provider was requested for additional information from the original patient file which was made available at the plenary meeting. Decision of substandard care was reached by consensus. Substandard care was firstly identified if care deviated from national guidelines. If national guidelines were not available, local protocols, best available evidence or expert consensus were used. Substandard care was assumed if the majority of assessors judged this to be the case.

Results

Of 358,874 births during the study period, 2,552 SAMM cases were included in LEMMoN (7.1 per 1,000 births). Of 67 SAMM cases discussed during the panel meetings, substandard care was judged to be present by the majority of assessors in 53 cases (79.1%). From five of the audits, including 53 cases (74.6%), more detailed scoring of substandard care items was available. From a total of 17,430 possible substandard care items (number of assessors X number of cases X 15 scoring items) 1,223 (7.0%) were scored. Only 73 (6.0%) were identified at the level of the patient, 933 (76.3%) at the level of the care providers and 217 (17.7%) at the level of the organisation of health care (table 2).

Table 1. *Selected characteristics from seven SAMM audit meetings*.

Location	Date	Selection of cases	SAMM (n)	Assessors (n)	Substandard care [2] (%)
The Hague	06/2005	Local (pilot: all cases)	14	17	86%
Groningen [1]	03/2006	Regional (severe cases)	12	23	75%
Leiderdorp [1]	09/2006	Regional (severe cases)	12	13	67%
Leeuwarden	09/2006	Local (MOH)	4	16	- [3]
Delft/Zwolle/ Amsterdam [1]	02/2007	National (Eclampsia)	12	8	92%
Utrecht [1]					
- **Primary care**	10/2008	National (Eclampsia)	8	18	63%
	11/2008	National (MOH)	9	24	89%

[1] Substandard care items available from five audits

[2] Substandard care by majority of the assessors after group discussion

[3] Recommendations in all four cases, but no consensus (%) on substandard care by majority of the assessors

Pilot audit

During a pilot audit 23 SAMM cases were selected in two teaching hospitals in The Hague and these were assessed by 17 audit members. [9] Individual assessment of patient notes was judged to be possible in 16 cases (69.6%), 18 cases were classified as true SAMM (78.3%) and substandard care was identified during individual assessment in 10 cases (43.5%). Of five cases not classified as true SAMM, three where included due to MOH with transfusion of four units of red blood cells and two cases were admitted in ICU for observation because of pre-eclampsia and mild peripartum cardiomyopathy.

Table 2. *Substandard care items and their contribution during five SAMM audit meetings.*

	n	%
Patient	**73**	**6.0**
Delay in consulting doctor	43	3.5
Refusal of medical help or advice	15	1.2
Language barrier	15	1.2
GP/Midwife	**367**	**30.0**
Inadequate antenatal care	92	7.5
Delay in recognition of symptoms / signs	113	9.2
Delay in referral to obstetrician	121	9.9
Inadequate risk selection*	41	3.4
Obstetrician	**559**	**45.7**
Inadequate antenatal care	88	7.2
Delay in recognition of symptoms / signs	181	14.8
Delay in treatment after diagnosis	255	20.9
Delay in referral to tertiary care centre	35	2.9
Other consultant	**7**	**0.6**
Delay in consulting obstetrician	7	0.6
Healthcare system	**217**	**17.7**
Home birth influenced outcome	103	8.4
Birth in general hospital influenced outcome	76	6.2
Quality of transport influenced outcome	38	3.1
Total	**1,223**	**100.0**

* only for primary care audits, percentage for total substandard care items

Fourteen cases were subsequently selected by the panel members for plenary discussion with additional information from the original patient file. Of these, 12 cases were classified as true SAMM (85.7%) and substandard care was judged to be present in 12 cases (85.7%). In one case, lack of information due to poor records was judged to be substandard. In addition to substandard care analysis, recommendations were made concerning future LEMMoN audits (table 3).

Primary care audits

Of 358,874 births represented in the LEMMoN study, 145,703 (40.6%) were under the responsibility of primary care givers and 113,404 (31.6% of total) were home births.[7]

Table 3. *Recommendations from selected SAMM audit meetings*

Audit	Recommendation
General	- Additional information with patient records is often necessary for effective audit - Improve record keeping, especially concerning timing of interventions - Improve treatment guidelines concerning pre-eclampsia and MOH, for primary as well as secondary care
Eclampsia [10]	- Improve adequate treatment of hypertension - Improve adequate seizure prophylaxis
Primary care MOH:	- Reduce the delay in reaching the hospital by timely referral (if placenta not delivered after 30 minutes) - Importance of IV access and initiation of resuscitation before transport to hospital - Discussion about the need and feasibility for misoprostol ® at primary care level - Discussion concerning emergency transport and acceptance of home delivery in areas where referral to secondary care might result in delay - Need of delivery at ground floor due to regulations for emergency transport employees restricting them to carry patients downstairs
Primary care eclampsia:	- Repeated consultation from secondary care provider for suspected pre-eclampsia should lead to referral and continued secondary care, irrespective if patient classifies criteria - Standard measuring of blood pressure is indicated two hours after delivery or before leaving the patient after home delivery

Of 2,552 SAMM cases, 227 (1.6 per 1,000) were included after delivery under the responsibility of primary care provider, and 154 (1.4 per 1,000) were included after home birth. During two audit sessions (one concerning MOH and one concerning eclampsia), 17 of these cases of SAMM after delivery under primary care (7.5%) were assessed.

From 1,606 SAMM inclusions due to MOH, 140 (8.7%) were included after home delivery. Nine cases (6.4%) met the criteria and were assessed by 24 panel members. Substandard care was judged to be present by the majority of the assessors in eight cases (88.9%) and inadequate risk selection was judged to be present by the majority of the assessors in four cases (44.4%).

From a total of 4,410 possible substandard care items (number of assessors X number of cases X 21 scoring items), 387 (8.8%) were recorded: 134 (34.6%) were at the level of the primary care provider and 72 (18.6%) concerned the management of MOH irrespective of the level of care. Specific recommendations were made concerning more stringent risk selection, delay in reaching the hospital and timing of referral (table 3).

From 239 SAMM inclusions due to eclampsia or severe HELLP, all eight cases (3.3%) where delivery was under primary care were assessed by 18 panel members. Substandard care was judged to be present by the majority of the assessors in five cases (62.5%). Inadequate risk selection was identified by a minority of the assessors in four cases (ranging from 16.7% - 44.4% of assessors). From a total of 2,940 possible substandard care items (number of assessors X number of cases X 21 scoring items), 221 (7.5%) were recorded: 69 (31.2%) were at the level of the primary care provider and 62 (28.1%) concerned the management of eclampsia irrespective of the level of care. Specific recommendations were made concerning the diagnosis and management of pre-eclampsia (table 3).

Discussion

During nine audit meetings in the Netherlands, 67 SAMM cases were assessed and substandard care was identified in almost four out of five cases. Substandard care was judged to be present at the level of the patient and the level of the organisation of health care but mainly at the level of the care provider. For substandard care analysis, additional information from the original patient files was often required. However, even with the complete patient file available for assessment, substandard care analysis was not always possible. The lack of information as a result of inadequate record keeping can also be regarded as substandard care.

During the panel meetings, with availability of original patient file and with the presence of the care provider, the identification of substandard care increased after discussion among panel members. Although this pattern was consistent throughout all audits, the magnitude of the increase in substandard care identification during the pilot audit (from 43% after individual audit to 86% after group audit) has not been seen during successive audits (data not shown). This might reflect a learning curve for audit. The earlier reported lower incidence of substandard care in the LEMMoN study (61.9%) is due to the inclusion of individual audit results in that report compared with substandard care incidence after group audit here (79.1%). [7]

The incidence of SAMM due to eclampsia in the Netherlands is markedly increased compared with other Western countries. [10] Substandard care was identified in most cases of SAMM, mainly at the level of the care providers and often due to inadequate treatment of hypertension and inadequate seizure prophylaxis. As for maternal death due to hypertensive disease in pregnancy, in 26 (96%) out of 27 cases occurring in the Netherlands between 2000 and 2004, substandard care factors were present. [11] In 2005, the national guideline "Hypertensive disorders in pregnancy" of the Dutch Society of Obstetrics and Gynaecology has been adjusted and multiple papers and presentations have been given informing obstetricians concerning this issue.[12] However, the guideline and its implementation can still be improved.[11]

Half of all SAMM cases concern MOH.[7] Obstetric haemorrhage is the third direct cause of maternal death in the Netherlands with case fatality rate (CFR) of 1 in 201, compared with CFR of 1 in 53 for all SAMM cases. The relatively low CFR for MOH reflects the quality of blood supply in the Netherlands with patients having received up to 50 units of blood. Hence, half of the SAMM cases due to MOH (n=811) received more than four units of blood. From these figures it is clear that MOH is an important contributor to SAMM and not so much to maternal death. Where this might result in an attitude of acceptance towards morbidity, the risk of blood transfusion especially during the reproductive period should not be neglected. Audit revealed that there is ample room for improvement in the management of MOH. Skills trainings in obstetric emergencies like MOH should be implemented in any unit.[6,13]

The Managing Obstetric Emergencies and Trauma course has been introduced in the Netherlands since 2003 and it is encouraged during these national trainings to initiate regular local multidisciplinary skill trainings. A recent questionnaire indicated that at least 29% of Dutch obstetric units have regular skill trainings and 22% are in the process of organising these trainings [personal communication, April 2009].

The lower risk for SAMM after delivery under the responsibility of the primary care giver (RR 0.1; 95% CI 0.1–0.2) seems to reflect the proper functioning Dutch system of risk selection.[7] However, also here substandard care was judged to be present in the majority of cases. Furthermore, inadequate risk selection in cases leading to severe MOH was present in almost half of cases. The definition of retained placenta is used when the placenta has not been delivered within one hour after the birth of the baby.[14] In the Netherlands, women delivering under the responsibility of primary care givers are referred to secondary care in case of retained placenta and/or in case of severe bleeding (> 1,000 ml). For term pregnancy (which applies to all deliveries under primary care), however, the duration of the third stage of labor is under 15 minutes for 90% of deliveries.[15] Therefore, we recommend earlier referral to secondary care in case of retained placenta, especially due to delay in reaching secondary care as mentioned in table 3.

Concerning audit in general, although the effect of critical incident audit has not been proven in randomised controlled trials, it is clear that morbidity and mortality reviews do more good than harm.[16] Critical incident audit both monitors the quality of services and is a resource for professional learning.[13,17] The openness in provision of data and participation during these audits in the Netherlands is encouraging. Ongoing local audit of cases of eclampsia and MOH have already been implemented in the national quality assurance program to improve management and local guidelines. In addition to these national initiatives, auditing SAMM at local or regional level should be encouraged to improve the quality of obstetric care. In the Netherlands, however, obstetric audit is relatively new. After the results from Peristat in 2004, which indicated that Dutch perinatal mortality rates ranks unfavourably compared with other European countries, many measures have been taken in order to improve the quality of perinatal care.

The most important are the initiation of the nationwide perinatal audit, better prenatal screening and the introduction of preconception care.[18] The national perinatal audit program includes training of audit members at regional and local level. In the near future, more health care workers will be familiar with obstetric audit and it is envisaged that the tradition of audit like in the United Kingdom, will eventually also be reached in Dutch obstetric health care.

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Chapter 5

Severe acute maternal morbidity and mode of delivery in the Netherlands

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Submitted

Abstract

Objective: As part of a nationwide cohort study of severe acute maternal morbidity (SAMM) we evaluated the risk of SAMM related to mode of delivery.

Design: Prospectively nationwide population based cohort study.

Setting: All 98 maternity units in the Netherlands.

Population: All pregnant women in the Netherlands.

Methods: Cases of SAMM were collected during a two year period. Incidence of SAMM in caesarean section (CS) compared to vaginal delivery (VD) was calculated. Furthermore, for analysing the incidence of SAMM with a possible relation to mode of delivery, all cases not clearly related to mode of delivery were excluded. Additionally, risk of SAMM after previous CS was assessed.

Main outcome measures: incidence and case fatality rate related to mode of delivery.

Results: The incidence of SAMM possibly related mode of delivery was 6.4 per 1,000 elective CS compared to 3.9 per 1,000 attempted VD (OR 1.7: 95% CI 1.4-2.0). Women with a previous CS are at increased risk for SAMM in the present pregnancy (OR 3.0: 95% CI 2.7-3.3).

Conclusion: CS in previous as well as present pregnancy increases the risk of SAMM. The risk remains increased after excluding those cases where SAMM is not clearly related to mode of delivery.

Introduction

Globally, 10-15% of all births are delivered by caesarean section (CS).[1] Maternal morbidity and mortality are higher in CS in comparison to vaginal delivery (VD). Elective CS causes less morbidity to the mother but more to the neonate as compared with emergency CS.[2-7] However, most studies on this subject have major limitations. Firstly, most data on maternal mortality have not been recently published. Secondly, due to the rarity of the event, the studies are likely underpowered. Thirdly, due to absence of an universal classification system for urgency, it is not possible to relate differences in CS-associated maternal morbidity and mortality with the degree of urgency of the procedure.[8] Finally, the role of bias by indication often remains unclear as morbidity related to CS may rather be a result from pre-existing disease that leads to the decision to perform CS than from the procedure itself. [9-10]

A recently published nationwide prospective cohort study identified that severe acute maternal morbidity (SAMM) complicates at least 7.1 per 1,000 pregnancies in the Netherlands.[11] To overcome above described bias and shortcomings we used this cohort to evaluate the risk of SAMM related to mode of delivery in the Netherlands.

Materials and Methods

This study was part of the prospective cohort study which investigated SAMM in the Netherlands called Nationwide Study into Ethnic Determinants of Maternal Morbidity in the Netherlands (the 'LEMMoN' study). Cases were enrolled from August 1, 2004 until August 1, 2006. SAMM was classified according to disease specific and management based criteria into five categories: intensive care unit (ICU) admission, uterine rupture, eclampsia, major obstetric haemorrhage (MOH) and miscellaneous. All 98 hospitals in the Netherlands participated in the study.[11] Maternal deaths were reported to the national Maternal Mortality Committee of the Netherlands Society of Obstetrics and Gynaecology by the attending obstetrician on a voluntary basis. These cases were added to the LEMMoN database. All women with SAMM as defined in our inclusion criteria, also those who delivered at home, were eventually referred to one of the maternity units. Therefore, this study represents all births in

the Netherlands during the study period. National reference data was requested from the Netherlands Perinatal Registry (PRN) concerning total number of deliveries, total number of CS, classification of CS, indication for CS (foetal, maternal, both or planned), gestational age in weeks and parity. In the Netherlands, the classification of CS is traditionally based on 'intention to treat', into elective (if VD was not intended, even if the woman presents in labor) or emergency (if VD was attempted). From the LEMMoN database, the following data were used: gestational age in weeks, onset of labour (spontaneous or induced), mode of delivery (spontaneous VD, instrumental VD, elective CS or emergency CS), foetal presentation, dilatation of the cervix in cm and classification of CS. The traditional classification of CS as well as a new classification based on four grades of urgency as advocated by the Royal College of Obstetricians and Gynaecologists (RCOG) was used within LEMMoN. According to the RCOG criteria, grade 1 refers to immediate threat to the life of the mother or fetus, grade 2 refers to maternal or fetal compromise, but not immediately life-threatening, grade 3 refers to no maternal or fetal compromise, but needs early delivery and grade 4 refers to delivery timed to suit woman or staff. [12-13]

In the Netherlands, referral to tertiary care hospitals with neonatal intensive care unit for possible active obstetrical and neonatal management is advised for preterm deliveries between 24-32 weeks gestation. For analyzing SAMM in attempted vaginal delivery (VD plus emergency CS) analysis was performed for delivery ≥24 weeks gestation. Unfortunately, CS in obstetric history is not recorded in the PRN. During a large prospective cohort study representing 38% of hospital deliveries in the Netherlands in 2002 (45,395 secondary and tertiary care deliveries), 4,569 women with a previous CS (10.1%) were identified.[14] Since 40% of deliveries in the Netherlands are under primary care, best available data indicate that an estimate of 7.2% (4,569/63,553) of women delivering in the Netherlands have had a previous CS.

For analysing the incidence of SAMM related to mode of delivery, three subgroups were used: total SAMM inclusions, selected SAMM inclusions possibly related to mode of delivery and SAMM inclusions in low risk pregnancies using single term breech as surrogate. For those SAMM inclusions possibly related to CS, we excluded all cases where SAMM was

not clearly related to the mode of delivery (for example, pre labour SAMM, eclampsia (also after delivery), abnormal placentation (placenta praevia, increta or percreta) and other selected cases (for example non-obstetric infection). Incidence was calculated using the total number of births in the Netherlands during the study period as the denominator as reported both to Statistics Netherland (CBS) and, for obstetrical information, to PRN.

Statistical analysis was performed using the SPSS statistical package 16.0 (SPSS Inc., Chicago, IL, USA). For not normally distributed data from independent samples (blood loss according to CS category) Mann Whitney U test was used and statistical significance was assumed if $p < 0.05$. For 2x2 tables, odds ratios (OR) and 95% confidence intervals (CI) were calculated by mode of delivery with VD as reference. For comparing attempted VD (VD plus emergency CS) with elective CS, attempted VD was reference. Significance was assumed when the CI did not cross 1.

Results

Total SAMM and mode of delivery

During the two year period 355,841 deliveries were registered in the PRN, of which 53,152 (14.9%) were CS (24,580 (46.2%) elective CS; 28,572 (53.8%) emergency CS). A total of 2,552 women with SAMM were included in the LEMMoN database, 1,479 (58.0%) with VD and 1073 (42.0%) delivered by CS: 565 (52.7%) elective CS and 508 (47.3%) emergency CS (Figure 1).

The overall incidence of SAMM in the Netherlands was significantly different between CS and VD (OR 4.2: 95% CI 3.9-4.6). The incidence of SAMM was higher for elective CS (23.0 per 1,000 elective CS) compared with emergency CS (17.8 per 1,000, OR 1.3: 95% CI 1.2-1.5). The incidence of SAMM was 23.0 per 1,000 elective CS compared with 6.0 per 1,000 for women with attempted VD (OR 3.9: 95% CI 3.5-4.3). For maternal mortality and obstetric hysterectomy, outcome was also significantly different between VD and CS (table 1).

Of 565 elective CS, 105 (18.6%) were classified as RCOG grade 4, and of 508 emergency CS, only four (0.8%) were classified as RCOG grade 4 (Table 2). Of 565 elective CS, 528 (93.5%) were performed without dilatation of the cervix.

Figure 1. *Flowchart of SAMM (severe acute maternal morbidity) related to mode of delivery*

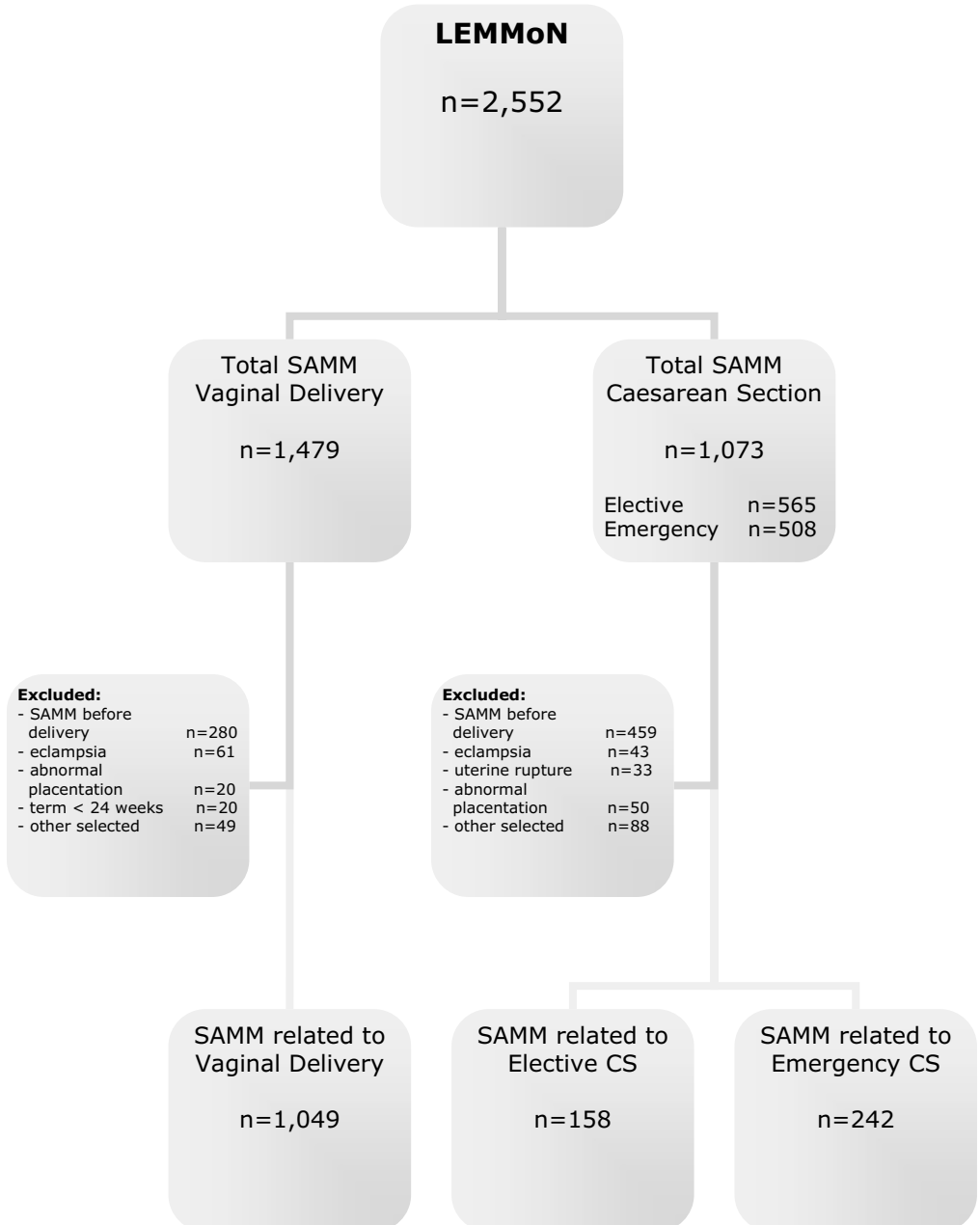

Table 1. *Incidence of SAMM in VD (reference) compared with CS and incidence of SAMM in attempted VD (reference) compared with elective CS (OR: 95%CI).*

	VD	CS		Intention to treat	
		Elective CS	Emergency CS	Attempted VD	Elective CS
	(n=1,479)	(n=565)	(n=508)	(n=1,987)	(n=565)
- Total SAMM /1,000 (n=2,552)	4.9 (ref.)	23.0 (4.8: 4.3-5.3)	17.8 (3.7: 3.3-4.1)	6.0 (ref.)	23.0 (3.9: 3.5-4.3)
- Maternal death /100,000 (n=48)	10.6 (ref.)	44.8 (4.2: 2.0-8.7)	17.5 (1.7: 0.6-4.5)	11.2 (ref.)	44.8 (4.0: 1.9-8.2)
- **Hysterectomy** /10,000 (n=112)	1.4 (ref.)	14.6 (10.3: 6.5-16.4)	11.5 (8.1: 5.1-13.1)	2.3 (ref.)	14.6 (6.4: 4.2-9.7)

The mean cervical dilatation of 29 (5.1%) cases was 2.4 cm (range 1-6 cm: SD 1.5 cm) and in eight cases (1.4%) cervical dilatation was not recorded. Of 508 emergency CS, the mean cervical dilatation was 5.7 cm (range 0-10 cm: SD 3.4 cm) and 57 (11.2%) were performed without dilatation of the cervix (missing data in 20 (3.9%) cases). Of 585 CS performed without dilatation of the cervix, 446 (76.2%) were classified as RCOG grade 1 and 2, i.e. urgent.

There was no difference in median blood loss between elective CS (median 1,000 ml: range 80-18,000 ml) compared with emergency CS (median 1,000 ml: range 0-20,000 ml). There was a significant difference in blood loss between CS classified as RCOG grade 1 (median 750 ml: range 60-16,000 ml) and RCOG grade 2 (median 700 ml: range 0-18,000 ml) compared with CS classified as RCOG grade 3 (median 2,000 ml: range 30-20,000 ml) and RCOG grade 4 (median 2,500 ml: range 150-8,000 ml))(Mann Whitney $p<0.00$). There was no relationship between blood loss and cervical dilatation.

Table 2. *Urgency of caesarean section: traditional binary compared with new classification based on four grades of urgency.*

	1	2	3	4	Total
Elective	212	214	34	105	565
Emergency	177	154	173	4	508
Total	389	368	207	109	1,073

1= Immediate threat to the life of the mother or fetus
2= Maternal or fetal compromise, but not immediately life-threatening
3= No maternal or fetal compromise, but needs early delivery
4= Delivery timed to suit woman or staff

Of 2,552 SAMM inclusions, 479 (18.8%) had CS in a previous pregnancy, compared with 25,621 (estimated 7.2%) of all deliveries in the Netherlands during the study period (OR 3.0: 95% CI 2.7-3.3). Of 479 cases, 441 had one CS, 25 had two CS, 11 had three CS and two had four CS in obstetric history. There were two maternal deaths in women with previous CS (one due to aorta dissection in a woman known with Marfan syndrome and one due to MOH related to atonia in a Jehovah's witness refusing blood transfusion). Of 479 women with CS in previous pregnancy, 190 (39.7%) were included due to uterine rupture, 135 (28.2%) were included with MOH and 48 (10.0%) had abnormal placentation (placenta praevia, increta or percreta).

Selected SAMM related to mode of delivery

For analysing the incidence of SAMM with a possible relation to mode of delivery, all cases not clearly related to mode of delivery were excluded (Figure 1). In total, 1,049 cases were identified where SAMM was possibly related to VD and 400 cases in which SAMM was possibly related to CS, 158 elective CS and 242 emergency CS. Characteristics of the study populations are shown in table 3. There is a significant difference in initial characteristics between the three subgroups reflecting possible indications for CS: twin pregnancy, CS in obstetric history and breech presentation.

Table 3. *Characteristics of SAMM cases by mode of delivery.*

	VD (n=1,049)	Elective CS (n=158)	Emergency CS (n=242)
Age < 25 yrs	85 (8.1%)	7 (4.4%)	11 (4.5%)
Age > 35 yrs	182 (17.3%)	48 (30.4%)*	67 (27.9%)*
Preterm birth (<37 wks)	100 (9.5%)	64 (40.5%)*	31 (12.8%)
Postterm birth (>42 wks)	47 (4.5%)	1 (0.6%)*	19 (7.9%)*
BMI (kg/m^2) < 25	476 (45.4%)	57 (36.1%)*	85 (35.1%)*
BMI (kg/m^2) > 35	24 (2.3%)	12 (7.6%)*	11 (4.5%)
Primipara	563 (53.7%)	66 (41.8%)*	140 (57.9%)
Twin pregnancy	61 (5.8%)	36 (22.8%)*	36 (14.9%)*
CS in history	99 (9.4%)	53 (33.5%)*	48 (19.8%)*
Breech presentation	19 (1.8%)	54 (34.2%)*	18 (7.4%)*
SAMM Inclusions (n)	1,249	208	330
• **ICU admission**	243 (18.7%)	70 (32.7%)*	108 (33.7%)*
• **Uterine rupture**	13 (1.0%)	0	0
• **MOH**	969 (77.6%)	131 (62.1%)*	205 (63.0%)*
• **Miscellaneous**	33 (2.6%)	7 (5.2%)	17 (3.4%)*

*Statistical difference with VD as reference: $p < 0.05$

The incidence of SAMM possibly related to CS was 7.5 per 1000 CS compared with 3.5 per 1000 for VD (OR 2.2: 95% CI 1.9–2.5). The incidence of SAMM possibly related to CS is lower for elective CS (6.4 per 1000 elective CS) compared with emergency CS (8.5 per 1000 emergency CS, OR 0.8: 95% CI 0.6-0.9). The incidence of SAMM possibly related to mode of delivery was 6.4 per 1,000 elective CS compared to 3.9 per 1,000 attempted VD (OR 1.7: 95% CI 1.4-2.0). For maternal mortality and obstetric hysterectomy, outcome was also different between VD and CS, although this was not statistically significant for maternal mortality due to small numbers (table 4).

Table 4. *Incidence of SAMM in VD (reference) compared with CS and incidence of SAMM in attempted VD (reference) compared with elective CS, after exclusion of cases in which SAMM was not clearly related to mode of delivery (OR: 95%CI).*

	VD	CS		Intention to treat	
		Elective CS	Emergency CS	Attempted VD	Elective CS
	(n=1,049)	(n=158)	(n=242)	(n=1,291)	(n=158)
- **Selected SAMM** /1,000 (n=1,449)	3.5 (ref.)	6.4 (1.9: 1.6-2.2)	8.5 (2.5: 2.1-2.8)	3.9 (ref.)	6.4 (1.7: 1.4-2.0)
- **Maternal death** /100,000 (n=16)	3.6 (ref.)	12.2 (3.4: 0.8-12.9)	7.0 (1.9*)	3.9 (ref.)	12.2 (3.1: 0.7-11.6)
- **Hysterectomy** /10,000 (n=64)	1.0 (ref.)	5.3 (5.5: 2.7-11.0)	7.7 (8.0: 4.5-14.5)	1.5 (ref.)	5.3 (3.4: 1.8-6.5)

* numbers too small for 95%CI (Fisher exact: p=0.31)

Singleton term breech delivery

During the study period there were 12,907 singleton term breech deliveries: 2,816 VD (21.8%), 7,808 elective CS (60.5%) and 2,283 emergency CS (17.7%). Of 7,808 elective CS, 5,995 (76.8%) were further classified in PRN as planned. In LEMMoN there were 63 women after singleton term breech delivery: 7 VD (11.1%), 34 elective CS (54.0%) and 22 emergency CS (34.9%). The incidence of SAMM for singleton term breech delivery is 5.7 per 1,000 for attempted VD compared with 4.4 per 1,000 for elective CS (OR 0.8: 95% CI 0.5-1.3).

Of 34 elective CS, 13 (38.2%) were identified as planned (also excluding CS in previous pregnancy) with SAMM possibly related to mode of delivery. Assuming that also 7.2% of 5,995 cases with elective term breech CS had CS in previous pregnancy and excluding those cases, the incidence of SAMM possibly related to planned CS would be 2.3 per 1,000 singleton term breech deliveries.

Discussion

In the present study, we evaluated the risk for SAMM related to mode of delivery in three subgroups: all SAMM inclusions, those SAMM inclusions possibly related to mode of delivery and SAMM inclusions in low risk pregnancies using single term breech as surrogate.

For the total group, both elective and emergency CS, the risk of severe maternal morbidity and mortality is four times increased compared with VD. A two to threefold increase in SAMM after CS compared with VD has been shown earlier.[3,7]

In a retrospective observational study using national birth registers and ICD-10 codes in Finland, the incidence of SAMM was 7.2 per 1000 attempted VD compared with 12.1 per 1,000 elective CS.[3] In a prospective cohort study in over 400 health facilities from eight randomly selected Latin American countries, even higher incidences of SAMM were found with 1.8% for VD, 5.5% for elective pre-labour CS and 4.0% for intrapartum CS.[7] Although both studies excluded multiple gestations and the Latin American study also excluded emergency CS without labour, further bias by indication caused by maternal disease has not been excluded. Most studies conclude that CS increases the incidence of SAMM. Also in the United States, an increase of SAMM has recently been associated with the increasing rate of CS.[15] Comparing the frequency of SAMM in different countries, however, is difficult due to differences in definitions and data collecting systems. In addition to maternal death, obstetric hysterectomy is probably the clearest endpoint, with an incidence in our study of 0.03% (1 per 3,177) for all deliveries (VD 0.01%, elective CS 0.14%, emergency CS 0.12%). In the Latin American study, the incidence of obstetric hysterectomy is higher with 0.05% for VD, 0.35% for elective CS and 0.29% for intrapartum CS.[7] Reviewing the reported incidence of obstetric hysterectomy in the literature, Eniola et al. found incidences ranging between 0.03% - 0.15% of total deliveries.[16]

One of the most serious complications of CS is the impact on future reproductive health due to the increased risk for abnormal placentation in subsequent pregnancies.[17] Caesarean section in obstetric history carries a threefold increased risk of SAMM in the present pregnancy. In the present study, almost one out of five SAMM inclusions had CS in obstetric history and 10% of those had abnormal placentation.

Concerning the degree of urgency for CS, Häger et al. reported cervical dilatation to be an independent risk factor for maternal complications, rather than the urgency.[18] In the present study, SAMM possibly related to mode of delivery is also significantly lower in elective compared with emergency CS. Furthermore, there is significantly less amount of blood loss in CS classified according to RCOG in grade 1 and 2 ('urgent') compared with CS classified according to RCOG in grade 3 and 4, while a relationship between blood loss and cervical dilatation could not be shown. For improving comparison of morbidity and mortality related to mode and urgency of delivery, a standardised classification system for CS, should ideally be implemented.[8]

The strength of the present study is the nationwide, prospective cohort design with clear definition of SAMM. Furthermore, we were able to exclude those deliveries where SAMM was not clearly related to mode of delivery, although some of these might be arguable. Abnormal placentation, for example, has been excluded in both VD and CS, assuming no relation with mode of delivery. Uterine rupture on the other hand has been excluded in the CS group being the indication for the operation, but remained included in the VD group as a complication of VD. Finally, all cases of eclampsia were excluded, since those occurring after delivery would also be included in LEMMoN and we assumed no causal relation between mode of delivery and its occurrence. After having excluded those cases where SAMM was not clearly related to mode of delivery, the risk for SAMM with both elective and emergency CS remained significantly increased. The incidence of SAMM possibly related to mode of delivery is 3.9 per 1,000 attempted VD and is increased to 6.4 per 1,000 by performing elective CS (OR 1.7: 95% CI 1.4-2.0).

For comparing the risk of planned VD versus planned CS and excluding bias by indication, delivery for term breech presentation is often used as a surrogate for low risk elective CS. Liu et al. compared SAMM associated with planned CS in term breech presentation with SAMM associated with vaginal delivery and found overall severe morbidity to be increased threefold from 9.0 per 1,000 attempted VD to 27.3 per 1,000 elective CS.[19] However, recent studies concerning caesarean deliveries on maternal request (CDMR) conclude that composite short term maternal morbidity is similar in women undergoing planned vaginal and planned

caesarean deliveries.[17, 20] With the present data we calculated the incidence of SAMM associated with CDMR in the Netherlands at 2.3 per 1,000 deliveries, using planned CS for singleton term breech presentation as a surrogate. Unfortunately, comparison with attempted VD is not possible since denominator data excluding maternal disease, are not known. For all singleton term breech deliveries, the incidence of SAMM is comparable between elective CS and attempted VD. The difference of SAMM incidence between CDMR (2.3 per 1,000) and SAMM possibly related to elective CS (6.4 per 1,000) is most likely due to bias by indication as shown by the percentage of twin pregnancy, CS in previous pregnancy and the lower gestational age due to maternal or foetal indication for CS (table 3).

In conclusion, CS increases the risk of SAMM compared with VD, also after excluding those cases where SAMM is not clearly related to mode of delivery. Furthermore, CS in previous pregnancy carries a threefold increased risk for SAMM in the present pregnancy. Finally, standardisation of classification systems for SAMM and urgency of CS is needed for improving comparison of morbidity and mortality related to mode of delivery.

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Part 3

Obstetric Interventions

'Ensure skilled attendance at delivery'
WHO key statement

'The mere fact of delivering in a health centre…
…does not necessarily ensure skilled attendance'

Chapter 6

Introducing caesarean section audit in a regional teaching hospital in the Netherlands

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Abstract

Objective: The increase in caesarean section rates is considered a reason for serious public health concern. With the objective to create awareness and initiate local discussion, obstetric audit was introduced in a regional teaching hospital in the Netherlands.

Study design: Caesarean section audit was introduced during the existing daily reports meetings from August 1st 2005 to June 1st 2006 in the Haga hospital, a large teaching hospital in The Hague, the Netherlands. All caesarean sections were discussed with regard to indication, classification and audited for 'lack of necessity'. For comparing intervention rates with the period prior to audit, Chi-square test with Yates correction for 2x2 tables was used.

Results: Of 1,221 deliveries, 228 were caesarean sections (18.7%) while prior to the audit period there were 1,216 deliveries with 284 were caesarean sections (23.4%). The caesarean section rate is significantly lower during the audit period. Assisted vaginal deliveries, neonatal outcome, and induction of labor rates were comparable. Concerning the audit question 'could caesarean section have been prevented', there was discussion in 24.4% of cases. In 6.7% of caesarean sections, consensus about lack of necessity was achieved.

Conclusion: Introducing caesarean section audit during the existing structure of daily report meetings in a regional teaching hospital is both feasible and practical. It creates awareness and encourages discussion among staff members concerning indications for caesarean sections and lack of necessity. Furthermore, there was a significant decrease in caesarean section rate during the audit period.

Background

In the Netherlands a total of 14.8 % of births in 2003 were accomplished by caesarean section. Although compared with other industrialized countries this caesarean section rate (CSR) is relatively low, it has followed the global phenomenon of increasing rates since the 1970's (1). In the debate concerning this public health issue some argue for a prospective trial of elective primary caesarean delivery versus vaginal delivery (2). The increase in CSR is, however, considered a reason for serious public health concern (3). Although the rise in caesarean sections is a global phenomenon, international and national variations are considerable. In England, Wales and Northern Ireland, the first national caesarean section survey in 2001 aimed to determine factors associated with these variations and to assess the quality of obstetric care during labor. This national audit was anticipated to initiate on-going local audits (4).One of the major reasons for the relatively low CSR in the Netherlands is the unique obstetrical care system. This system differs from most other industrialized countries by a strict selection between high and low risk pregnancies. Women with low risk pregnancies receive primary care from midwives or general practitioners. They may either choose to deliver at home or in hospital under the responsibility of the primary care providers. The primary care giver refers the woman to the obstetrician when complications arise during pregnancy, childbirth or puerperium. Women with high risk pregnancies from the onset of pregnancy are under the care of the obstetrician and deliver in hospital under their responsibility (1). In 2003, 83.1% of all women receiving prenatal care started with primary care providers, while ultimately 35.6% delivered with the primary care providers. Since 30% of deliveries are home deliveries the population CSR is still relatively low. Of all deliveries in 2004 supervised by secondary care providers in hospital, 22.5% were caesarean section (the Netherlands Perinatal Registry).

In a regional teaching hospital in The Hague, the CSR increased from 17.0% in 2000 to 23.4% in 2004. Even after adjusting for population risk factors, this CSR was above the national average for secondary care providers in hospital. With the objective to create awareness and initiate local discussion, obstetric audit was introduced. Here, we report our experience with introducing a caesarean section audit including its effect in a teaching hospital in the Netherlands.

Material and Methods

Caesarean section audit was introduced at the Haga hospital from August 1st 2005 to June 1st 2006. The Haga hospital is a large regional teaching hospital in The Hague, the Netherlands. The department of Obstetrics and Gynecology (O&G) is staffed by 8 obstetricians, 3 midwives and 8 residents. The study was initiated by one of the residents (jvd) and supported by all staff members. During the audit period, there was a change in the residents staff since 50% rotated to different teaching hospitals. The team of obstetricians, responsible for making the ultimate decision to perform caesarean section, remained unchanged.

Each morning (08:00-08:30) and afternoon (17:00-17:30), all caesarean sections performed in the preceding shift were discussed among all staff and audited using a standard case record form. The team discussing the case was responsible for filling the case record form. After discussion, the following questions were answered and if possible consensus was recorded:

- What was the indication for the caesarean section?
- Could the caesarean section have been prevented and if yes, how?
- How should this caesarean be classified?

Concerning classification of caesarean sections, traditionally in the Netherlands there are two categories: primary (if vaginal delivery was not intended, even if the woman presents in labor), or secondary (if vaginal delivery was attempted). For this study a third category was introduced: caesarean section was indicated as emergency section after audit discussion (ie mostly fetal distress or antepartum hemorrhage).

The Royal College of Obstetricians and Gynecologists (RCOG) recommends categorization of operations in four grades of urgency (4):

- Emergency; immediate threat to the life of mother or fetus
- Danger; maternal or fetal compromise, but not immediate life threatening
- No Danger; early delivery needed, but no maternal or fetal compromise
- Elective; delivery timed to suit the mother and the staff

During the audit discussion, caesarean sections were classified using the traditional (primary versus secondary) as well as the recommended categorization (RCOG).

Three auditable standards were identified where selected cases were compared with:

- Concerning emergency caesarean section, the decision-delivery interval should be within 30 minutes (4,5).
- The diagnosis dystocia can only be made when there is poor progress of labor in the presence of ruptured membranes, and especially for primigravid augmentation with oxytocin. If requested, optimal pain relief is provided by epidural analgesia (6,7).
- Elective caesarean sections should be performed after 39 weeks gestation for reducing the risk of transient lung disease of the newborn (8,9).

In addition to the audit, from all caesarean sections during the study period, information from the Netherlands Perinatal Registry was collected. Using the audit form and this National database, the following characteristics of each delivery were available: maternal age and parity, previous caesarean section, gestational age, presentation of the fetus (vertex, breech or other), start of labor (spontaneous, induction or primary caesarean section), time interval rupture of membranes until delivery, epidural analgesia, indication for caesarean section, blood loss, neonatal outcome (apgar 5 minutes and umbilical arterial pH), neonatal sex and weight.

For comparison of caesarean section rates, delivery data from The Haga Hospital was used from August 1st 2004 to June 1st 2005, one year before the audit (the Netherlands Perinatal Registry). From this period, the following data was available: start of labor (spontaneous, induction or primary caesarean section), end of labor (spontaneous, instrumental vaginal delivery, caesarean section: total, primary and secondary) and neonatal outcome (apgar 5 minutes).

Data was collected using MOSOS 7.1® from BMA BV The Netherlands, and analyzed using Microsoft Excel®, Windows XP®. For statistical analysis, Chi-square test with Yates correction for 2x2 tables was used. Statistical significance was assumed if $p < 0.05$.

Results

During the audit period, there were 1,221 deliveries, 228 were caesarean sections (18.7%) and 166 instrumental vaginal deliveries (13.2%), 164 vacuum and 2 forceps extractions. In comparison, from August 2004 to June 2005, there were 1,216 deliveries, 284 were caesarean sections (23.4%) and 169 instrumental vaginal deliveries (13.6%), 159 vacuum and 10 forceps extractions (table I).

The CSR is significantly lower during the audit period. Neonatal outcome with regard to apgar score, perinatal mortality and admission to neonatal care unit did not change (Chi-square p> 0.05). Assisted vaginal deliveries and induction of labor rates were comparable (Chi-square p> 0.5). Selected characteristics of all caesarean deliveries are shown in table II. Of all caesareans, 38.6% were primary, 52.0% secondary and 9.4% were emergency caesarean sections. Most caesarean sections were done for dystocia, followed by fetal distress and breech presentation (table III).

Audit

On average, eight staff members attended the audit sessions: three specialist obstetricians, four residents and one midwife. Of all caesarean sections, 74% were audited. The percentage of audited sections decreased during the study period (figure I). Most caesarean sections which were not audited were primary caesarean sections. All emergency caesarean sections were audited (table II).

Concerning the audit question 'could caesarean section have been prevented', there was discussion in 24.4% of the operations. In 6.7% of caesarean sections, consensus about lack of necessity was achieved. Most cases leading to discussion and consensus concerned primary caesarean sections (n=12 and n=6 respectively) mostly for breech presentation (n=8) and repeat caesarean sections (n=9). For breech presentation the following recommendations were formulated: improve uptake of external cephalic version (ECV) and introduce second trial of ECV if first failed. For repeat caesarean sections, the indications for trial of labor and the possibilities for induction of labor were discussed.

Table I. *Delivery outcome during the audit period (August 1st 2005 – June 1st 2006) compared with the preceding year.*

	August 1st 2004 June 1st 2005	**August 1st 2005 June 1st 2006**
Deliveries (n)	1,216	1,221
Caesarean section (%) *	23.4	18.7
- primary	8.3	7.0
- secondary *	15.1	11.6
Instrumental vaginal delivery (%)	13.6	13.2
Breech caesarean section (%)	69.1	59.3
- primary	49.4	37.4
- secondary	19.8	22.0
Induction of labor (%)	16.5	16.7
Neonatal outcome		
- Apgar 5 min (mean)	9.4	9.4
- Apgar 5 min < 7 (%)	5.8	4.2
- Perinatal mortality (n)**	5	3
- Admission neonatal care unit (n)	123	144

* P< 0.01

** There were no fresh stillbirths and all perinatal deaths are neonatal deaths.

Figure I. *Percentage of caesarean sections audited during the study period*

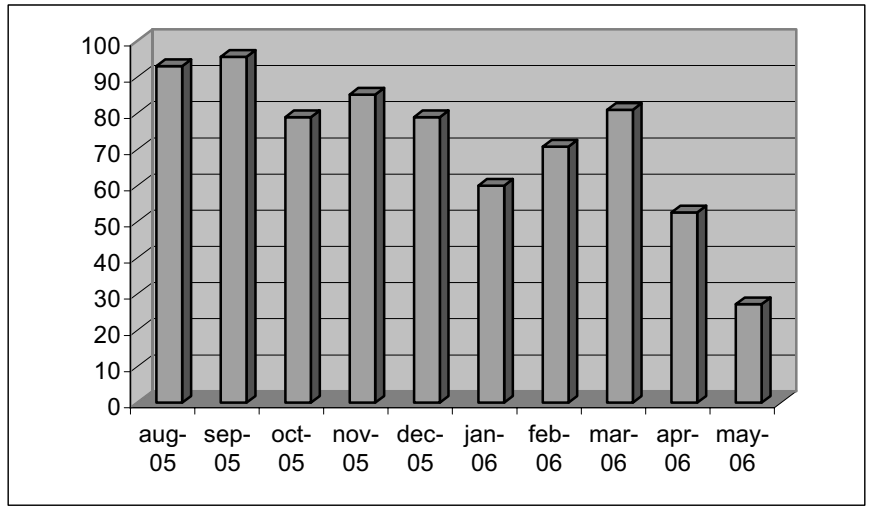

Table II. *Selected characteristics of audited caesarean sections according to caesarean category primary, secondary or emergency.*

	Total (n = 223)	Primary (n = 86)	Secondary (n = 116)	Emergency (n = 21)
Maternal charateristics				
- Mean age (yrs)	31.6	32.8	30.9	30.4
- Parity (primi%)	52.0	36.2	65.6	66.7
- Caesarean History (%)	28.3	50.0	16.4	4.8
Neonatal characteristics				
- Gestational age (weeks, mean)	39.2	38.3	40.1	38.3
- Weight (grams, mean)	3,357	3,344	3,469	2,815
- Apgar 5 min (mean)	9.5	9.9	9.4	8.6
- Arterial pH (mean)	7.25	7.27	7.25	7.18
Audit				
- Audited (%)	73.5	58.1	80.2	100
- Discussion[1] (%/audited)	24.4	48.0	17.2	0
- Consensus[1] (%/ audited)	6.7	12.0	5.4	0

[1] concerning audit question: could the caesarean section have been prevented?

In the secondary caesarean section group, discussion (n=11) and consensus (n=5) concerning lack of necessity focussed on the indications dystocia (n=8) and fetal distress (n=5). Recommendations concerned the need to improve epidural services and augmentation in primipara to reduce dystocia. In case of presumed fetal distress, discussion focussed on the diagnosis of fetal distress based on electronic fetal monitoring alone.

Classification of caesarean section

Table IV shows the comparison of the traditional categorization of caesarean section (including the additional audit group emergency) versus the newly introduced four grades of urgency. Generally, there was consistency between the two schemes: none of the emergency caesarean section in either categorization was classified as elective in the other. Maternal or fetal compromise ('danger') in the new group was classified as elective in the old categorization in 4.3% (n=7).

Table III. *Indication for caesarean sections (%)*

	Haga hospital (n = 223)	RCOG[1] (n > 32,000)
Dystocia	33.2	20.4
Fetal Distress	19.3	22.7
Caesarean History	14.3	14.0
Malpresentation		
- Breech	15.2	10.8
- Compound	1.8	3.4
- Twins	2.7	1.2
Ante partum Hemorrhage	2.7	4.9
Pre eclampsia	2.7	2.3
Other Maternal	3.6	7.0
Other Fetal	0.9	2.3
Elective	3.6	7.3

[1] Reference 4.

Also, planned caesarean section in the new group was classified as secondary caesarean section in the old categorization in 1.2% (n=2). As a whole, the distribution according to the new grades corresponds with the distribution as reported by the RCOG (table IV).

Auditable standard

- Concerning the decision-delivery interval for emergency caesarean section, this was known in 18 of the 21 emergency caesarean sections. The average decision – delivery interval was 27 minutes (range 10 – 60 minutes). In 15 cases (83.3%) this interval was ≤ 30 minutes.
- Concerning elective caesarean sections (new classification n = 42), the mean gestational age was 38+3 weeks (range 36+2 – 41+5) and 76% was performed < 39 weeks (25% < 38 weeks).
- Concerning caesarean section for dystocia (n=74), 100% had rupture of membranes (mean 18.4 hrs, range 0.5 – 266 hrs), 75.5% of primigravid women were augmented with oxytocin and 51.4% had epidural analgesia (61.2% of primigravid).

Table IV. Classification of urgency of caesarean section: traditional binary (including emergency) versus four grades of urgency

	Primary (n=51)	Secondary (n=90)	Emergency (n=20)	Total Haga (n=161)	RCOG[1] (n>32,000)
1. Emergency	0	11	16	17%	16%
2. Danger	7	28	4	24%	32%
3. No danger	2	49	0	32%	18%
4. Planned	42	2	0	27%	31%

[1] Reference 4. (Total 97% due to missing data)

Discussion

Introducing caesarean section audit during the existing structure of daily report meetings in a regional teaching hospital is both feasible and practical. It creates awareness and encourages discussion among staff members concerning indications for caesarean sections. In this audit, in one out of four caesarean sections, there was discussion about the necessity. In almost 7% of cases, there was consensus among staff members that caesarean might have been prevented. Discussion mostly focussed on caesarean section for the indications breech presentation and previous section.

In a recent review studying effective strategies to address increasing caesarean section rates, these two indications have also been identified (10). Both ECV and Vaginal Birth After Caesarean (VBAC) have demonstrated Level 1 evidence for reducing caesarean section rates. In the Netherlands, the VBAC rate is already quite high with 54% (1), but still remains an important issue. Concerning breech presentation, since the Term Breech Trial (TBT) (11), the caesarean section rate in the Netherlands for this indication increased from 50% to 80% (12). The follow up results of the TBT found no significant difference between vaginal or caesarean delivery concerning death or neurodevelopment delay at the age of two (13). Although these findings did not receive as much national attention as the first study, it was extensively discussed locally during the audit.

The recommendations formulated during these discussions did not yet lead to formalised protocols or standing orders. However, it does appear that a mentality change has occurred.

Although not anticipated, there was a significant decrease in caesarean section rate during the audit period. This decrease was accounted for by the decrease in secondary caesarean sections. Since induction of labor rates and instrumental vaginal deliveries remained similar during the study period, the most likely explanation for the reduction in caesarean sections is behavioural change. Unfortunately, no data is available concerning the number of patients with a trial of labor after previous caesarean section. Therefore it is not known if the percentage VBAC has changed during the audit period. The decrease in primary caesarean section for breech presentation from 49% to 37% was not significant due to small numbers (total breech presentations n=56 and n=54). Neonatal outcome, the ultimate marker of quality of obstetric care, did not change.

A reduction in caesarean section after introducing audit and increasing awareness has been reported earlier (14,15). In fact, some argue that the success of the active management of labor approach is due to commitment to low intervention rates with audit (16,17). Main summarised eight practices for safely reducing caesarean section rates: one key point was intentionally using the 'Hawthorne effect' to improve clinical outcome: the mere fact of studying individual or group behaviour and creating an environment where behavioural changes is encouraged can by itself influences outcome (18). A recent meta-analysis studying evidence based strategies for reducing caesarean section rates also concluded that audit and detailed feedback can effectively and safely reduce CSR (19). Furthermore, the effect in reducing CSR is enhanced when audit and feedback are combined in a multifaceted strategy including guideline education and identification of barriers to change. Regarding the auditable standards used in this study, our audit has clearly identified areas for improvement. Local recommendations, based on evidence based studies and incorporated in local structure, can now be formulated concerning the timing of primary / elective caesarean sections and for improving the epidural services.

Concerning the classification of caesarean sections, Lucas *et al.* (2000) evaluated different classification systems and developed a new classification which proved to have close agreement between obstetricians and anaesthesists.

This clear classification system based on urgency can facilitate communication with professionals and enable smooth flow of events in surgery (20). Both the RCOG and the NICE guidelines promote this new classification (4,8). To the best of our knowledge, this is one of the first reports evaluating this new classification in practice. In our study we found clear overlap with the old classification, which was based on antepartum intention of delivery. Only in 1.2% of elective and 4.3% of emergency caesarean sections there was discrepancy between the two classification systems. Our data support the RCOG findings and we recommend further studies and implementation of this new classification in the Netherlands. Clear guidelines are needed according to which indication a caesarean section should be categorized.

Clinical audit is seen as an essential component for improving the quality of care, but it is often found to be difficult to implement due to obstacles such as lack of time, resistance to change and lack of motivation (21). Although in this study the initiation of a local caesarean section audit was not difficult, the continuation was. The decrease in audited sections during the study period might be due to lack of motivation. After discussing a primary caesarean section for breech presentation for the tenth time, most staff members felt there was no need to continue. Clinical audit is known to have a mixed record for success stories and failures. Decreasing motivation due to poorly managed projects, environment resistance to changes, lack of senior support and busy clinical services outweighing the audit priorities, being some of the reasons audit initiatives have run into the ground. However, the NHS claims it is time to take clinical audit seriously and encourages staff to use well-founded audit methods and create supportive environments (22).

The introduction of obstetric audit in an existing structure like department report meetings is important and can be used for different topics like the management of postpartum hemorrhage (23). This is especially true in teaching hospitals where audit can be used as an instrument to stimulate discussion between staff and trainees. In rotating different audit topics and using the full audit cycle with formalizing recommendations, it will be possible to evaluate the long term effect of these audits. Audit results like the one reported here might encourage health care workers to initiate the process.

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Chapter 7

Caesarean section in a semi-rural hospital in Northern Namibia

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Abstract

Background: Increasing caesarean sections rates (CSR) are a major public health concern and the prevention of the first caesarean section, which often leads to repeat operations, is an important issue. Analyzing caesarean sections can help to identify factors associated with variations in CSR and help to assess the quality of clinical care.

Methods: In a retrospective observational study, during a two year period, indications of 576 caesarean sections were analyzed using intra-operative internal pelvimetry and a record keeping system in a semi-rural hospital in Northern Namibia.

Results: Most caesarean sections were done for dystocia (34%) followed by repeat caesarean section (31%). The true conjugate (distance between the promontorium to mid pubic bone) was significantly smaller in these recurrent indication groups when compared to non recurrent indications.

Conclusion: In this rural hospital the introduction of Delee Pelvimetry and a caesarean section record keeping system was found to be a simple and cheap method to analyse indications for caesarean sections, which may help in reducing unnecessary caesarean sections.

Background

Caesarean section rates (CSR) have been increasing ever since the 1970's. The debate concerning this public health issue has recently led to the introduction of a new indication for the operation: the 'no indicated risk' caesarean [1]. Although the rise in caesarean sections is a global phenomenon, international and national variations are considerable. In England, Wales and Northern Ireland, the first national caesarean section survey in 2001 aimed to determine factors associated with these variations and to assess the quality of obstetric care during labor. This national audit was anticipated to initiate continued local audits [2].
Reducing the number of first caesarean sections is the most important issue. One of the most common indications for caesarean section is dystocia. Dystocia may be caused by cephalopelvic disproportion and pelvic inlet contraction will often be found [3,4]. Many studies have looked into selection of high risk women for dystocia, evaluating external pelvimetric measurements [5-7] or X-ray and magnetic-resonance pelvimetry [8,9]. For singleton vertex presentations at term (the 'no indicated risk' group) the baby's head remains the best pelvimeter and every woman deserves a trial of labor [10-12].
In Namibia, antenatal policy includes manual pelvic assessment at 36 weeks gestation for all primiparous women. Because of its poor sensitivity to predict dystocia, it has been recently proposed to abolish this routine and actively promote (primiparous) women to deliver in hospital [13]. We report our experience with a local caesarean section audit using internal pelvimetry in a semi-rural hospital in Northern Namibia.

Methods

Study site and population
Onandjokwe Lutheran Hospital is a 450 bed district hospital which also serves as referral hospital for the region. In 2002, the department of obstetrics and gynaecology (O&G) was staffed by 4 doctors (two foreign specialists, two foreign medical doctors) and 34 nurses including 13 registered/ enrolled midwives. An effort has been made to improve the quality of care by using the partograph developed by the World Health Organization (WHO), standardised protocols and regular in-service-

training sessions [14]. The hospital has good quality ultrasound equipment, a maternity waiting home on the hospital premises and offers comprehensive emergency obstetric care (EmOC) [15]. The distribution of blood for transfusion, however, is centrally regulated in Windhoek. Occasional shortages of blood do occur. Forceps were not used during the study period. The anesthetic department was staffed by two foreign specialists providing regional or general anesthesia. In general, regional (spinal) anesthesia was used for caesarean section.
Since 1999, the Misgav Ladach method for caesarean section is used [16]. This method uses the Joel Cohen incision and is recommended by NICE [17]. During caesarean section, the true conjugate (conjugata vera) is measured using DeLee's internal pelvimeter. After hysteroraphy and just before replacing the uterus in the abdominal cavity, the true conjugate is measured by placing one arm at the midpoint of the sacral promontorium and the other arm approximately 0.5 cm down the midline of the upper posterior border of the pubic symphysis [4]. In the absence of a pelvimeter, King [18] advises to use a steel ruler.
An additional 'caesarean section record book' is kept in the theatre department since October 1997. The doctor performing the operation, which in almost all cases was also the doctor who determined the indication for caesarean, was responsible for filling the record book.

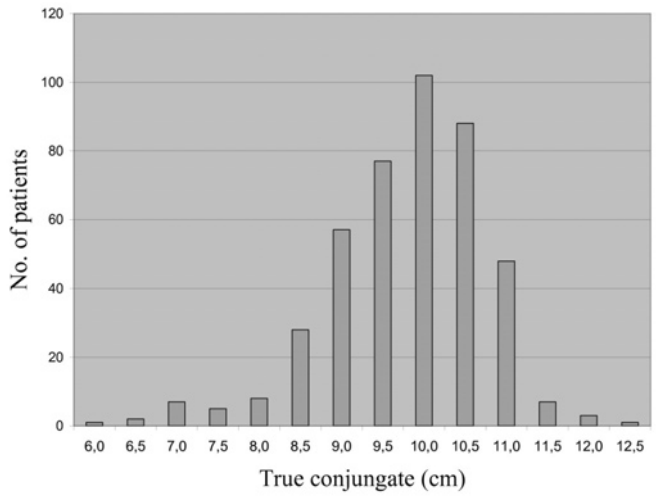
Study objective and design
The primary objective of this study was to evaluate indications for caesarean sections in this setting. Secondly, we used the internal pelvimetry results for analyzing the indications.
All caesarean sections performed from January 1st 2001 – December 31st 2002 are included. Information from the 'caesarean section record book' was used and data collected included: date of delivery, indication for caesarean section, true conjugate (conjugata vera), Apgar score and sex of neonate, additional comments (including bilateral tubal ligation, hysterectomy). Indications for caesarean section were categorised as follows: dystocia, repeat caesarean section (+ number of repeat caesarean), malpresentation (including: breech, twin, arm/ compound and other presentation), ante partum hemorrhage, cord prolapse, fetal distress, pre eclampsia, and other indications.

Dystocia combines the following indications: delay first stage, delay second stage, failed trial of vacuum, discoordinate uterine action and cephalopelvic disproportion (CPD). Only the primary indication as recorded by the operating doctor was used. In general, a diagnosis of dystocia is only made when the action line of the partograph has been passed and labor augmented with oxytocin. Data has been analysed using Microsoft Excel®, Windows® 98. For normal distributions, student t-test was used. Statistical significance was assumed if $p < 0.05$.
In rural Namibia the management board of the hospital is responsible for approving research projects. In this case, the management board of Lutheran Medical Services, Onandjokwe Hospital, approved the study.

Results

During the study period, 576 caesarean sections were performed in 7,321 births (CSR 7.9%). Out of the 599 neonates, 266 (44%) were female and 318 (53%) male. Sex was not recorded in 15 cases (3%). The true conjugate was measured in 434 women (75.3%) with a mean of 9.8 cm (range 6-12.5 cm; standard deviation (sd 1.0) (figure 1). Of 142 cases were true conjugate was not measured, 71 also had bilateral tubal ligation done and in 10 hysterectomy was performed. The mean Apgar score after one minute was 7.7 (range 0-10; sd 2.2; n=563) and after five minutes 9.1 (range 0-10; sd 1.8; n=563).
Indications for operations are shown in table 1. Most caesarean sections were performed for dystocia: 193 (33.5%) followed by repeat caesarean section: 177 (30.7%). For repeat sections: 108 were second, 52 were third, 16 were fourth and one was a fifth caesarean section.
Elective repeat caesarean section was performed in 124 cases (70%), 45 (25%) were failed trials of scar, and eight (5%) were due to fetal distress (four), malpresentation (three) or (pre) eclampsia (one). Of all second caesarean sections, elective repeat operations were performed in 53 women (50%). For the indication 'malpresentation' (n=55; 9.5%), 14 were due to breech (four had delay 1st or 2nd stage), 14 were due to twins (10 with transverse or breech in first neonate), 11 were due to compound presentation or arm prolaps and 16 were transverse lies.

Figure 1: *Distribution of True Conjugate (n=434)*



The group 'other' (n=34; 5.9%) included six cases done for a HIV positive mother, five women with extensive condylomata accuminata (unknown, but likely HIV positive), five women with a ruptured uterus during labor, two women had an elective caesarean for suspected macrosomy, two women with intra uterine growth retardation (IUGR) or placental insufficiency, two had a bad obstetric history, and for 12 cases no additional information was available.

The true conjugate is significantly smaller in the groups 'dystocia' and 'repeat caesarean section' when compared to the average of all other groups. The Apgar score is significantly lower after 5 minutes in the groups 'fetal distress', 'ante partum hemorrhage' and 'cord presentation', when compared to the average of all other groups (table 1.)

All caesarean sections done for 'dystocia' were intrapartum sections, as were those done for 'failed trial of scar', 'fetal distress' and 'cord presentation'. All caesarean sections recorded 'elective repeat' and 'preeclampsia' were antepartum sections. Caesarean sections done for 'malpresentation', 'antepartum hemorrhage' and 'other' can be either intra- or antepartum sections. There is no difference between the true conjugate for all true intrapartum indications (n=306, mean true conjugate 9.7 cm) compared to all true antepartum indications (n=141, mean true conjugate 9.6 cm).

Table 1. *Indication Caesarean Section, Number, Mean True Conjugate (standard deviation) and Mean Apgar scores at 5 minutes (standard deviation)*

Indication	Number (%)		True Conjugate Measured (%)	cm (sd)	Apgar 5"
Dystocia	193	(33.5)	83.4	9.6 (1.0)[2]	9.3
Repeat Caesarean Section	177	(30.7)	64.4	9.5 (0.9)[2]	9.6
- Elective repeat[1]	132	(22.9)	-	9.5 (1.0)[2]	9.6
- Failed trial of scar	45	(7.8)	-	9.5 (0.8)[3]	9.5
Malpresentation	55	(9.5)	76.4	10.1 (0.8)	9.6
Fetal Distress	50	(8.7)	82.0	9.9 (0.8)	8.1 [2]
Ante Partum Hemorrhage	40	(6.9)	75.0	10.4 (0.6)	7.2 [2]
Cord Presentation	18	(3.1)	77.8	10.1 (1.1)	7.9 [2]
Pre eclampsia	9	(1.6)	100	10.3 (0.4)	8.3
Other	34	(5.9)	67.6	10.4 (1.1)	8.5
Total	576	(100.0)	75.3	9.8 (1.0)	9.1

[1] Elective repeat caesarean section (132) including 8 cases where it is unknown if women was in labor: fetal distress (4), malpresentation (3) and preeclampsia (1).

[2] Significantly smaller (True Conjugate) or lower (Apgar) p <0.05 compared to all other indications

[3] True conjugate significantly smaller compared to all other indications except fetal distress

Bilateral tubal ligation (BTL) was done in 114 patients (20%): 55 during the first (55/399), 10 during the second (10/108), 32 during the third operation (32/52) and in all women with fourth or fifth caesarean section (17/17).

Caesarean hysterectomy was performed in 10 women (1.7%): in four cases the indication for operation was uterine rupture, in three cases caesarean section was performed for antepartum hemorrhage and in three cases for dystocia. Indication for hysterectomy was postpartum hemorrhage from excessive uterine tearing, uterine atony not responding to conservative treatment and couvelaire uterus in placental abruption. Uterine scar rupture did not occur in those who had a 'trial of scar'.

There was one caesarean hysterectomy after previous caesarean section. In this case the indication for the operation was antepartum hemorrhage resulting from placental abruption.
Finally, 37 neonates had an Apgar score < 7 after 5 minutes (6.4%). In nine of these cases fetal distress was the first indication for operation, indications for other caesareans were: antepartum hemorrhage (10), dystocia (eight), cord presentation (four), repeat caesarean (two), (pre) eclampsia (one) and others (three). In addition, 12 (2.1%) neonates were fresh stillbirths or died in theatre. Indication for caesarean section in these 12 cases were; antepartum hemorrhage (three), malpresentation (three), repeat caesarean (two), dystocia (two), fetal distress (one) and unknown (one). There were no maternal deaths.

Discussion

The statistically significant lower true conjugate in women who underwent caesarean section for dystocia and repeat caesarean section (recurrent indications) as compared to the other (non recurrent) indications for caesarean section is interpreted in our study as some evidence for a valid reason to perform the operation. This is also supported by our relatively low caesarean section rate of 7.9%.
Unfortunately maternal height and neonatal birth weight, possible variables leading to dystocia, were not recorded. Furthermore, in this retrospective study comparisons between pelvic assessment from earlier preoperative vaginal examination and the internal pelvimetry results are not possible. Since data is only available from women delivered by caesarean and not for those who successfully achieved vaginal delivery, the true value of precise measurement is difficult to assess. However, although no records are available for the number of patients with successful trial of scar, the true conjugate of 'failed trial of scar' is comparable to the true conjugate of 'repeat caesarean' and significantly smaller when compared to all other indications for caesarean. This might indicate that patients selected for a trial of scar with a normal pelvis (true conjugate >9.0) deliver vaginally.
Dumont and colleagues report that of all caesarean sections, three-quarters are done for maternal indication. Furthermore, they suggest that in West Africa caesarean section for maternal indications (dystocia,

previous caesarean, malpresentation, placenta praevia, abruptio placenta and (pre) eclampsia) is needed by 3.6-6.5% of pregnant women [19]. In our study the proportion of maternal indications among all caesarean sections is over 85% (even after excluding breech presentation), and the percentage caesarean sections done for maternal indications (6.7%) is at the higher range of figures from West Africa. The percentage of dystocia cases seems extremely high (one out of three caesareans) and the percentage of sections for fetal distress seems low (8.7%). In comparison, the national sentinel caesarean section audit from England, Wales and Northern Ireland [2], reported maternal indications to be the cause of > 60% of caesareans (dystocia 20.4%), while 23% are done for fetal indications and 12% due to breech or multiple pregnancy.

Clinical audit is seen as an essential component for improving the quality of care, but it is often found to be difficult to implement due to obstacles such as lack of time, resistance to change and lack of motivation [20]. Health care workers in African hospitals are no exception when it comes to these obstacles. In this rural hospital, the use of Delee Pelvimetry and the introduction of a caesarean section record book were found to be a simple and cheap method for the establishment of a continuous caesarean section audit by providing immediate feedback to the midwife and the doctor ('did I expect the true conjugate to be this small / large?'). Excluding patients whom underwent BTL or hysterectomy, in 89.6% of cases the true conjugate was measured. This might reflect a feeling on the part of the attending doctor that measuring is not always useful. Audit as described here, may increase the motivation to carry out the measurement.

Adadevoh *et al.* [4] advise that in all women undergoing laparotomy in their reproductive years the true conjugate should be measured and recorded for future reference. In addition, we recommend this measurement especially in those settings where very high CSR are observed. We hypothesize that in such settings the differences between recurrent and non-recurrent indications may not be statistically significant and measurements can thus help in reducing CSR.

Conclusion

Improving the quality of obstetric care is an urgent priority worldwide. Audit can assist in this process by critical analysis of current practice and identification of substandard care factors. The use of DeLee's internal pelvimeter during caesarean section and keeping a 'caesarean section record book' are simple and cheap ways to introduce obstetric audit. This creates awareness, which may help in reducing unnecessary caesarean sections.

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Chapter 8

Comparing grades of urgency for classification of caesarean delivery

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Abstract

Objective: To evaluate the agreement between the traditional binary system and a new system for classifying urgency of caesarean delivery among obstetricians in the Netherlands and Belgium.

Methods: A total of 212 obstetricians were requested to grade a list of 18 obstetric scenarios using 3 classification systems: traditional binary classification; a new classification using 4 grades of urgency without additional interpretation; and the new classification with additional interpretation. Agreement was assessed by the weighted kappa.

Results: Seventy-nine obstetricians responded (Netherlands 62.2%, Belgian 9.9%). There was substantial agreement among them for all 3 classification systems (κ=0.71, traditional classification; κ=0.70, new classification; κ=0.67, new classification with additional interpretation).

Conclusion: The traditional binary system and the new classification of caesarean delivery based on 4 grades of urgency, with and without additional interpretation, have similar but relatively low interobserver agreement. We suggest that the new classification should be used, but future studies are necessary to evaluate the effect of this implementation.

Introduction

Approximately 10%–15% of all births are caesarean deliveries [1]. There is no consensus worldwide concerning classification of the procedure. Traditionally, caesarean delivery has been classified as either an elective or an emergency procedure. This binary classification system is considered inadequate by obstetricians and anesthetists [2,3]. In the Netherlands, the classification of caesarean delivery is comparable with the elective/emergency classification, but it is based primarily on "intention to treat." Caesarean deliveries are categorized as "primary" if vaginal delivery was not intended, even if the woman presents in labor, or "secondary" if vaginal delivery was attempted. This classification does not convey the degree of urgency and causes additional confusion because internationally the term "primary caesarean delivery" is often used for women undergoing their first caesarean delivery. The National Confidential Enquiry into Perioperative Deaths (NCEPOD) recommends the categorization of caesarean delivery into 4 grades of urgency [2]. Implementation of this classification system resulted in 90% agreement between obstetricians and anesthetists [4]. This classification of urgency is advocated by the National Institute for Health and Clinical Excellence [5], endorsed by the Royal College of Anesthetists and the Royal College of Obstetricians and Gynecologists (RCOG) [2] and is likely to be introduced in the Netherlands. The aim of the present study was to evaluate the agreement between the traditional binary system and the new 4-grades-of-urgency classification system, with and without an attached interpretation of categories, among obstetricians in the Netherlands and Belgium.

Materials and Methods

A list of 18 obstetric scenarios written in English (Table 1) was sent to 212 obstetricians at different hospitals in the Netherlands (111) and Belgium (101). Participants were asked to classify these scenarios 3 times in a specific order, using sealed envelopes (prospectively blinded). Participants were first asked to classify all 18 scenarios using the traditional binary classification of urgency as either elective or emergency.

Participants were then asked to classify all 18 scenarios using the new classification system with 4 grades of urgency (table 2). A pilot study among the authors revealed that the new classification was interpreted differently resulting in misclassification. Therefore, following the example of the RCOG when initiating the National Sentinel Caesarean Section Audit [2], interpretations of categories were developed to facilitate the introduction of the new classification system (Table 2). Finally, participants were asked to classify all 18 scenarios using the new classification system after having read the additional interpretation information for each category. Participants were asked to send their responses using return envelopes. An email reminder was sent to all participants 3 months after the initial request. Misclassification was defined when elective caesarean delivery in the traditional classification system (using only those scenarios for which 100% consensus was found) was classified as emergency in the new classification systems, or vice versa.

Agreement was assessed by the weighted kappa (κ) statistic after converting the data using SPSS version 16 (SPSS, Chicago, IL, USA); substantial agreement was obtained if $0.61 \geq \kappa \leq 0.80$, and good agreement was obtained if $\kappa > 0.80$. These weighted κ coefficients were calculated as intraclass correlation coefficients (ICCs) from variance components within a linear mixed model with patient and rater as random factors and of the absolute agreement type ICC, for the situation in which all patients were evaluated by all raters [6].

Results

A total of 69 (62.2%) Dutch and 10 (9.9%) Belgian obstetricians responded to the questionnaire. The classification of the 18 clinical scenarios according to the 3 classification systems is shown in Table 3. Using the traditional binary classification system, there was 100% agreement in only 6 scenarios and greater than 80% agreement in 16 of the 18 scenarios. The maximum agreement for the new classification system was seen in scenarios 16 and 18, both with 93.7%, and for the new classification system with additional interpretation it was 88.6% (scenario 1).

Table II. *Classification of urgency (RCOG) plus additional interpretation used in this study*

	Classification	Additional interpretation
1	Immediate threat to the life of the mother or fetus	CS is performed for acute life-threatening events. There is an emergency situation; CS should be performed as soon as possible to save the life of mother or fetus
2	Maternal or fetal compromise, but not immediately life-threatening	Delivery of the fetus is urgent, because maternal or fetal compromise is present and is demonstrated at this moment. In order to prevent deterioration of either maternal or fetal condition, CS is needed
3	No maternal or fetal compromise, but needs early delivery	No maternal or fetal compromise is present at this moment, but compromise may be expected if spontaneous delivery is awaited. In order to prevent compromise, CS is needed
4	Delivery timed to suit woman or staff	Compromise is not expected if CS will not be performed. There is no strict medical indication

The 5 cases that were uniformly categorized as elective using the traditional binary system (scenario 1, 10, 11, 16, and 17) were a heterogeneous clinical group, consisting of scenarios in which the indication for caesarean delivery was absolute maternal (placenta previa), other maternal (maternal cardiomyopathy, history of 2 previous caesarean delivereis), or fetal (breech presentation, either considered a safe option for vaginal delivery by the obstetrician [maternal request] or not). The additional interpretation seemed to assist in the consistency of the classification based on the 4 grades of urgency, leading to fewer misclassifications. However, in scenario 18 (caesarean on request), the additional interpretation influenced the categorization with the new classification toward grade 3 urgency (no maternal or fetal compromise, but needs early delivery: 3.8% without vs 16.5% with additional interpretation) instead of grade 4 (delivery timed to suit patient or staff: 93.7% vs 82.3%).

To analyze agreement, 77 raters were available (68 Dutch and 9 Belgian), owing to 2 lost files. There was substantial agreement among obstetricians for all 3 classification systems: κ=0.71 for the traditional binary classification; κ=0.70 for the new classification; and κ=0.67 for the new classification with additional interpretation. When the agreement for Belgian and Dutch obstetricians was analyzed separately, the agreement was comparable and remained substantial: traditional binary classification Belgian κ=0.64, Dutch κ=0.72; new classification Belgian κ=0.77, Dutch κ=0.69; new classification with additional interpretation Belgian κ=0.69, Dutch κ=0.67. The agreement of all obstetricians (n=77) concerning only those cases with uniform classification in the traditional binary classification (cases 1, 9, 10, 11, 16 and 17) remained substantial for the new classification, and the new classification with additional interpretation (κ=0.67, and κ=0.72, respectively).

Discussion

Compared with the traditional binary classification system, the classification based on 4 grades of urgency was found to be comparable regarding the agreement between respondents. Although additional interpretation of the 4 grades did not improve overall agreement, it assisted in data consistency and led to fewer misclassifications.

The extent of agreement (κ=0.90) found by Lucas et al. [4] was not found in the present study (κ=0.70). This may be attributable to the difference in study design. In the study by Lucas et al. [4], agreement was measured between two healthcare workers (1 obstetrician and 1 anesthetist) responsible for 407 consecutive caesarean deliveries, whereas in the present study agreement was measured among 77 obstetricians in 18 clinical scenarios. In a clinical situation, the agreement might improve. However, further evaluation within the hospital where Lucas et al. performed their primary study found that agreement was decreasing (84% in 1999, 75% in 2000, and 68% in 2001), despite increasing familiarity with the classification [7]. It is possible that the brevity of definitions results in this lack of agreement, and additional examples in certain clinical situations, comparable with the additional interpretation in the present study, are proposed [2]. Whether this will eventually increase agreement has yet to be evaluated.

Unfortunately, despite repeated email reminders, only 10% of Belgian obstetricians responded. However, agreement was comparable between Dutch and Belgian obstetricians. The type of questionnaire used, in which respondents were asked to grade the same 18 scenarios 3 times, could have led to changes in the first grading. Using sealed envelopes and requesting that respondents were blinded to their previous grading minimized this effect. In the present study, we selected participants who had a special interest in obstetrics, which might have biased the results. Whether adopting the new classification with additional interpretation will improve clinical outcomes in daily practice with multidisciplinary staff who have mixed interest in obstetrics requires further study. A classification based on urgency might assist in future obstetric anesthetic audits, for example, as in France where additional color codes were utilized for improving decision-to-delivery intervals for emergency caesarean delivery [8, 9].

The classification based on 4 grades of urgency was piloted earlier in the Netherlands during a local audit of caesarean deliveries. There was consistency between the traditional binary classification system and the 4 grades of urgency: none of the emergency caesarean deliveries in either categorization was classified as elective in the other [10]. This consistency was also found in the National Sentinel Caesarean Section Audit by the RCOG, in which misclassification occurred in only approximately 5% of cases [2]. Any classification system should be simple, clinically relevant, accountable, replicable, and verifiable. The first two criteria are probably the most important if clinicians are to accept and use the system [11]. Different classification systems based on the utility of the data have been recently proposed, but none has included a degree of urgency [11–13]. Although maternal morbidity and mortality are reportedly higher in emergency procedures compared with elective caesarean delivery, in the absence of a universal classification system for urgency, it is not possible to determine whether these differences can be attributed to procedures with the highest level of urgency [14–16].

The traditional binary and the new classification based on 4 grades of urgency have a similar and relatively low degree of agreement. Classification based on 4 grades of urgency might improve communication and assist in standardization in monitoring mortality and morbidity related to caesarean delivery. Future studies are necessary to evaluate the effectiveness of this approach.

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Table I. *Clinical scenarios*

Case	Details
1	G1P0, CS was planned at 38+0 weeks of gestation, because placenta previa was detected on ultrasound.
2	G1P0, CS was planned at 38+0 weeks of gestation, because of placenta previa. CS has been performed in advance because of repeated vaginal blood loss with normal CTG and no complaints or lowered maternal Hb.
3	G1P0, Patient was admitted with severe vaginal blood loss due to placenta previa at 37+0 weeks of gestation. SC was immediately performed.
4	G2P1, Patient was in labor. At 4 cm dilatation of the cervix, breech presentation was identified. A trial of vaginal delivery is considered a safe option according to the specialist. Patient opted for CS. CTG is normal.
5	G1P0, CS was planned at 39 weeks of gestation because of breech presentation. CS was performed in advance at 37 weeks of gestation because of signs of pre-eclampsia (hypertension, proteinuria, hyperreflexia) CTG is normal.
6	G1P0, 39+0 weeks of gestation. CS was performed because of an eclamptic seizure one hour earlier. CTG was normal. Blood pressure was 160/110.
7	G1P0, CS was performed because of failure of progress in second stage of labor and CTG abnormalities after one hour. Fetal blood pH was 7.25.
8	G1P0, 39+0 weeks of gestation. A 26-year old woman whose cervix has been 6 cm dilated for 4 hours despite maximal oxytocin. The CTG is entirely normal. CS was opted.
9	G1P0, 39+0 weeks of gestation. A 26-year old woman whose cervix has been 6 cm dilated for 4 hours despite maximal oxytocin. The CTG shows variable decelerations. Fetal blood pH is 7.17. CS was performed.
10	G1P0, CS was planned at gestational age of 39+0 weeks because of maternal cardiomyopathy.
11	G3P2, CS was planned at gestational age of 39+0 weeks because of obstetric history: two previous caesarean sections (1st breech presentation, 2nd maternal request).
12	CS was performed because of intrauterine growth retardation at 36+0 weeks of gestation (normal CTG). No growth since last ultrasound two weeks ago.
13	A woman who does not speak any English and who has not received any antenatal care presents in the labor ward with ante partum hemorrhage. On examination, there is no tachycardia, with a blood pressure of 120/70 and is estimated to be of 38 weeks' gestation. CTG is normal. The bleeding is continuous. Cervix dilatation is 3 cm. Ultrasound shows no abnormalities.
14	G1P0, CS was performed because of failure to progress in second stage of labor. Failed vacuum extraction occurred after 45 minutes of pushing with normal CTG.
15	G2P1, CS was performed at 42+0 weeks of gestation because of previous caesarean section (breech presentation). Spontaneous delivery was awaited until 42+0 weeks of gestation.
16	G1P0, CS was performed because of breech presentation. A trial of vaginal delivery is considered a safe option according to the specialist. After counseling for vaginal delivery woman requests CS.
17	G1P0, CS was performed because of breech presentation. The doctor does not favor a trial of vaginal breech delivery. After counseling for CS, woman requests CS.
18	G2P1, patient requested caesarean section because of traumatic experience of vaginal delivery in history. CS was performed.

Table III. *Obstetricians (n = 79) classification of 18 clinical scenario's according to traditional and new classification in percentages.*

	Traditional Binary classification*		New classification				New classification with interpretation			
Case	**1**	**2**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	100	0	1.3	12.7	34.2	51.9	0.0	1.3	88.6	10.1
2	74.7	25.3	5.1	40.5	51.9	2.5	0.0	44.3	54.4	1.3
3	5.1	94.9	88.6	10.1	1.3	0.0	79.7	20.3	0.0	0.0
4	45.6	54.4	1.3	19.0	55.7	24.1	1.3	8.9	36.7	53.2
5	83.5	16.5	3.8	62.0	32.9	1.3	1.3	51.9	45.6	1.3
6	17.7	82.3	72.2	25.3	2.5	0.0	58.2	39.2	2.5	0.0
7	7.6	92.4	15.2	65.8	19.0	0.0	7.6	64.6	27.8	0.0
8	17.7	82.3	1.3	39.2	58.2	1.3	0.0	24.1	74.7	1.3
9	0	100	62.0	38.0	0.0	0.0	48.1	51.9	0.0	0.0
10	100	0	5.1	30.4	20.3	44.3	1.3	6.3	78.5	13.9
11	100	0	0.0	5.1	13.9	81.0	0.0	0.0	64.6	35.4
12	96.2	3.8	1.3	39.2	43.0	16.5	0.0	24.1	67.1	8.9
13	17.7	82.3	10.4	61.0	26.0	2.6	5.2	44.2	48.1	2.6
14	1.3	98.7	36.7	53.2	10.1	0.0	29.1	49.4	21.5	0.0
15	96.2	3.8	0.0	3.8	31.6	64.6	1.3	5.1	49.4	44.3
16	100	0	1.3	1.3	3.8	93.7	1.3	0.0	17.7	81.0
17	100	0	1.3	2.5	16.5	79.7	1.3	0.0	59.5	39.2
18	98.7	1.3	1.3	1.3	3.8	93.7	1.3	0.0	16.5	82.3

* Traditional binary classification: 1=elective, 2=emergency. New Classification 1-4 see table 2

Chapter 9

A "perineal audit" of episiotomy and obstetric anal injury in the Netherlands

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Abstract

Objective: To evaluate dimensions of mediolateral episiotomy and diagnosis of obstetric anal sphincter injuries (OASIS) during daily practice.

Methods: Perineal audit was introduced in three hospitals in the Netherlands from February - September 2008. Dimensions of episiotomy were measured and in a subgroup of patients diagnosis of OASIS was evaluated. Incidence of OASIS during the audit period was compared with the incidence one year preceding the audit.

Results: Of 1,979 deliveries, 420 women had episiotomy (21.2%) and 58 women sustained OASIS (2.9%). The mean angle of episiotomy was 40° away from the midline with comparable angles between gynecologists or midwives. There was a significant increase in OASIS as compared with the preceding year.

Conclusion: Introducing perineal audit in daily practice is possible. Most episiotomies are sufficiently away from the midline. To improve recognition and classification of OASIS, perineal audit including international agreed classification should be introduced as routine practice.

Introduction

Although episiotomy is the most frequently used obstetric intervention, ranging from 15% - 95% of all deliveries, there is no international consensus on the definition of mediolateral episiotomy [1,2]. Most obstetric textbooks suggest that mediolateral episiotomy should be directed at an angle between 40º and 60º away from the midline [3]. Routine episiotomy does not prevent obstetric anal sphincter injuries (OASIS). Hence, midline episiotomy is a known risk factor for OASIS and recent studies suggest that there is also a direct correlation between OASIS and the angle of mediolateral episiotomy [4-6]. A larger angle away from the midline is associated with a lower risk for OASIS [5]. Andrews et al. measured the episiotomy directly post delivery with the patient in lithotomy position and found that only 13% of episiotomies had an angle of > 40º. In this study, the episiotomy was an independent risk factor for OASIS in primiparous women (OR 5.0) [6]. Furthermore, when reexamined by an experienced research fellow, 46% of OASIS were not identified by the primary accoucheur. In the Netherlands, OASIS occurs in 1.9% of total deliveries and the incidence of episiotomy is 31.0% (the Netherlands Perinatal Registry). Most episiotomies (96.3%) are mediolateral [7].

The primary objective of our study was to evaluate the quality of mediolateral episiotomy using the dimensions of episitomy as criteria for audit in daily practice in three teaching hospitals in the Netherlands. Secondly, the diagnosis of perineal trauma in a subgroup of patients was evaluated.

Materials and Methods

This audit was conducted in three teaching hospitals in the Netherlands. The Leiden University Medical Centre (LUMC) is a university teaching hospital with deliveries under primary care (supervised by independent midwives), secondary care (under the responsibility of gynecologists) and tertiary care (obstetric high care referrals). The Medical Centre Haaglanden (MCH) and the Haga hospital (HAGA) are large inner city teaching hospitals in The Hague with primary and secondary care deliveries.

In 2007 there were 4,169 deliveries in the three hospitals (LUMC 1,203; MCH 1,473; HAGA 1,493) with 20.4 % cesarean deliveries (CD)(LUMC 259; MCH 283; HAGA 308), 22.1 % episiotomies (LUMC 192; MCH 297; HAGA 434) and 2.0% OASIS (LUMC 29; MCH 21; HAGA 34). The incidence of OASIS in the three hospitals combined varied between 1.9% - 2.0% between 2005 to 2007.

All patients whom delivered vaginally under the responsibility of the gynecologist (secondary or tertiary care) in these hospitals between February 1st – August 31st 2008 (LUMC), March 1st – August 31st 2008 (MCH) and April 1st – September 30th 2008 (HAGA) were enrolled in the study. In HAGA, the audit was only performed during office hours due to staff coverage: during evening and night shifts there is only one resident gynecologist on call for labor room.

Directly post delivery all women routinely receive a detailed perineal examination by the accoucheur, either the midwife or resident gynecologist on call. For diagnosis of perineal trauma the classification propagated by the Royal College of Obstetricians and Gynecologists (RCOG) and the National Institute for Health and Clinical Excellence (NICE) was used (box 1) [8]. In the case of episiotomy or perineal trauma involving perineal muscles (RCOG ≥ grade 2), a second labor room employee, either a midwife of resident gynecologist, was asked to evaluate the extent of trauma. Examiners were not blinded for previous evaluations and consensus of the extent of trauma was necessary. In case of discrepancy between the two examiners and/or if OASIS was suspected, the consultant obstetrician on call was called for reassessment and repair. The evaluation of perineal trauma was done as usual and generally includes a rectal examination combining visual inspection with palpation. In these three hospitals, endoanal ultrasonography is not performed for this indication. None of the observers had gone through a specialized instruction course for diagnosing OASIS. Before introducing the study, anatomical pictures concerning OASIS using RCOG classification were distributed in labor room.

In the case of episiotomy, the length and the angle from the midline were measured using a protractor, with the patient in lithotomy position immediately after the episiotomy repair (picture 1). Classification, episiotomy dimensions and obstetric data concerning the delivery (parity, indication for episiotomy) were recorded on a case record form (CRF) collected in labor room.

Box 1. *Classification of perineal injury after delivery according to Dutch LVR and RCOG*

LVR		RCOG	
Episiotomy		Episiotomy	
Intact perineum		Intact perineum	
Rupture	{	*1st degree*:	laceration of the vaginal epitheleum or perineal skin only
		2nd degree:	involvement of the perineal muscles but not the anal sphincter
Subtotal rupture	{	*3rd degree*:	disruption of the anal sphincter muscles, subdivided into:
		3a:	< 50 percent thickness of external muscle torn
		3b:	> 50 percent thickness of external muscle torn
Total rupture*	{	*3c*:	internal sphincter torn also
		4th degree:	a third degree tear with disruption of the anal epithelium

* Total rupture ≥ external sphincter muscle completely torn

In those patients attending routine postnatal check up at the LUMC during the study period, episiotomy was also measured 6-8 weeks post delivery.

Perineal outcome from all deliveries during the study period were retrieved from the national obstetrical database for cross check. Data recording was done in Microsoft Excel®, Windows XP®. Statistical analysis was performed after converting the data to SPSS statistical package 16.0 (SPSS Inc., Chicago, IL, USA).

For data from independent samples Mann Whitney U test was used and statistical significance was assumed if $p < 0.05$. For 2x2 tables, odds ratios (OR) and 95% confidence intervals (CI) were calculated. For comparison of episiotomy dimensions immediately after delivery with measurements during postnatal check up, intraclass correlation was calculated with values ranging from 0 (no agreement) to 1 (perfect agreement).

Finally, for this audit of routine daily practice, no formal review board approval was necessary. Patients were informed of the study and of measuring episiotomy dimensions for quality control, but no written consent was requested.

Results

During the audit period there were 1,979 deliveries in the three hospitals with 21.1% CD, 21.2% episiotomies and 2.9% OASIS (table 1). There were 927 primiparous (episiotomy 33.9%) and 1,052 multiparous deliveries (episiotomy 10.1%). Most episiotomies were done for fetal distress (56.4%), followed by: failure to progress (18.7%) assisted vaginal delivery (15.4%), breech delivery (2.1%), anal sphincter injury in previous delivery (0.8%), other maternal (5.0%) and other fetal (1.7%).
Of 420 episiotomies, 242 (57.6%) were audited (LUMC 81.0%, MCH 69.5% HAGA 31.7%). The mean length of episiotomy was 38.9 mm (standard deviation (sd) 8.4 mm) and the mean angle 40.2º (sd 9.8 mm). The angle was significantly larger in HAGA and the length significantly longer in MCH compared with the other two hospitals ($p<0.005$). Of 242 audited episiotomies, 160 (66.1 %) were performed by (resident) gynecologists and 82 (33.9%) by midwives. The mean length of episiotomies from (resident) gynecologists was 39.7 mm (sd 8.4 mm) compared with 37.5 mm (sd 8.4 mm) from midwives ($p = 1.7$). The mean angle of episiotomies from (resident) gynecologists was 40.7º (sd 9.4º) compared with 39.2º (sd 10.7º) from midwives ($p = 1.3$). During the study period, 25 (29.4%) women of whom episiotomy was measured attended postnatal check up at the LUMC. The median angle of episiotomy in these 25 women immediately after delivery was 38.6º (sd 7.8) compared with 31.2º (sd 11.5) at postnatal check up. There was poor correlation ($\kappa=0.04$) between the two measurements.
Of 242 women with audited episiotomies, 10 (4.1%) also sustained OASIS (LUMC n=5, MCH n=3, HAGA n=2). In those women with episiotomy and OASIS, the mean angle of episiotomy was 37.2 º (sd 8.3) as compared to 40.3º (sd 9.9) in those without OASIS ($p = 0.4$).

Table 1. *Selected delivery statistics (numbers) of the three hospitals during the audit period*

	LUMC	MCH	HAGA	Total
Total deliveries	578	709	692	1,979
Caesarean section	126	133	159	418
Episiotomy	105	151	164	420
Audit episiotomy	85	105	52	242
Length (mm)	37.3	41.8*	36.0	38.9
Angle (degrees)	39.0	39.1	44.0*	40.2
OASIS	20	20	18	58
Audit OASIS	20	12	5	37

** significantly different, Mann Whitney p<0.05*

During the study period there were 58 (2.9%) women who sustained OASIS (LUMC 20, MCH 20, HAGA 18). There was a significant increase in OASIS during the study period (2.9%) as compared with the data from 2007 (2.0%) ($p <0.05$; OR 1.47: 95%CI 1.03-2.09). Of 58 cases, 36 were primiparous (3.9%) and 22 were multiparous women (2.1%) ($p <0.05$; OR 1.89: 95%CI 1.07-3.35). Of 58 cases, 37 (63.8%) were audited (LUMC 100%, MCH 60.0% HAGA 27.8%). Of 37 audited cases, 22 (59.5%) were classified as grade 3a.
Consensus was achieved by the different examiners concerning the classification of OASIS in all cases.

Discussion

Introducing perineal audit as part of routine practice, as advocated by the NICE, is possible and it improves perineal care [9]. In the present study, perineal audit illustrated that episiotomies were made correctly with the angle sufficiently away from the midline, and audit improved the diagnosis of OASIS. Regarding the dimensions of the episiotomy, Tincello et al. demonstrated differences in the performance of an episiotomy between doctors and midwives using pictorial questionnaires:

doctors' episiotomies were significantly longer and more angled away from the midline of the perineum [3]. They concluded that a further study, comparing reported practice with observation of actual episiotomies, is indicated. In the present study, there is no difference between episiotomy performed by midwives or doctors.

Previous studies have measured the angle of episiotomy either on pictorial questionnaire [3], at postnatal check up within three months following delivery with examination in the left lateral position [5] in the lithotomy position immediately after episiotomy repair [6] and within the same patient, immediately before the episiotomy and after the episiotomy repair [10]. Eogan et al, state that the angle of episiotomy when cut correlates with the angle of postnatal episiotomy scar. They also found a high level of agreement in the between-observer measurement of episiotomy angle [5]. In the present study, between-observer variation was not studied. However, we found poor agreement between measurement immediately post delivery and at postnatal check-up. This might be due to a difference in observer or to the difference in lithotomy position during measurement (in stirrups immediately after episiotomy repair versus flexed knees and hips on the examination bench during postnatal check-up). On the other hand, there is a clear difference in perineal dimensions caused by perineal distension at vaginal birth as illustrated by pictures 1 and 2. A recent study by Kalis et al. where episiotomy dimensions were measured in 50 women immediately before the episiotomy and after the episiotomy repair, found a difference of 20º between both measurements [10]: if the incision angle of the episiotomy during repair is to reach 45º, the episiotomy should be made at almost 60º on a stretched perineum. Although this is not a new observation and confirms years of clinical experience [11], it needs to be stressed during training since obstetric textbooks are not clear on this issue.
In our study, a relationship between OASIS and the angle of episiotomy was not found. This is probably due to small numbers, but might also be a result of the sufficient angle of episiotomies. The difference between the national episiotomy rate (31.0%) and the rate at these three hospitals (22.1%) is most likely influenced by difference in attitude. Hence in 2007, episiotomy rates of secondary and tertiary care deliveries in the Netherlands varied between 5.7% - 49.1% (the Netherlands Perinatal Registry).

During the study period there was a significant increase in diagnosis of OASIS compared with the preceding year, from 2.0% to 2.9%. Annual fluctuation in incidence of OASIS seems unlikely since the three years before the audit, the incidence of OASIS remained stable between 1.9%-2.0%. This increase might be caused by the 'hawthorn effect' (studying interventions leads to changes in the intervention) or by the introduction of the new classification system. An increase in OASIS after the introduction of audit with an additional examiner has been shown earlier [6,12]. In the study by Andrews et al, the additional examiner was specifically trained in evaluating perineal trauma, examined all primiparous women and found a substantial increase in OASIS from 13.3% to 24.4%. The 11.1% increase in OASIS coincided with 8.3% decrease in second degree tears [6]. In our study, only women with ≥ second degree tear or episiotomy, the subgroups were most OASIS are misdiagnosed, were reexamined. For optimal evaluation of diagnosis of OASIS, (re)examination of all patients by a trained physician is preferred.
There is considerable international variation in incidence of OASIS from 0.5-3.0% in European studies up to 25% in some studies from the United States [13]. These differences might be caused by difference in study population (primiparous versus multiparous), differences in obstetric practice and use of episiotomy, lack of recognition as shown by increased incidence after audit, inadequate training and wrong classification [14]. To improve recognition and classification of OASIS, perineal audit including international agreed classification should be introduced as part of routine practice. In our study, unfortunately only 64% of OASIS and 58% of episiotomies were audited. Furthermore, less then 45% of 2nd degree tears have been audited (data not shown). In the Netherlands, OASIS is often repaired at theatre under general anesthesia, which might have influenced the filling of CRF at labor room. Furthermore, the low audit percentages were mostly influenced by one of the hospitals where only 32% of episiotomies and 28% of OASIS were audited due to staff coverage during evening and night hours (HAGA). The data presented therefore indicate minimum increase in OASIS.

Although the introduction of perineal audit in these teaching hospitals was practical and feasible, the continuation was not. Observational studies, like audits, are ranking low in the hierarchy of evidence based medicine and often receive too little attention in teaching settings [15].

Clinical audit is known to have a mixed record for success stories and failures. Decreasing motivation due to poorly managed projects, environment resistance to changes, lack of senior support and busy clinical services all interfere with the audit priorities. Audit however, induces reflection and self-criticism and stimulates discussion concerning issues in daily practice which are often taken for granted. These are all characteristics needed by residents in training to achieve professional attitude. Furthermore and primarily: audit improves quality of health care. Therefore, every junior doctor should be supported to initiate or assist in clinical audit and results like the one reported here might encourage health care workers to initiate this process.

Conclusion

Introducing perineal audit in daily practice is possible. In these teaching hospitals, there is no difference in episiotomy dimensions between midwives and doctors with most episiotomies being sufficiently away from the midline. To improve recognition and classification of OASIS, perineal audit including international agreed classification should be introduced as routine practice.

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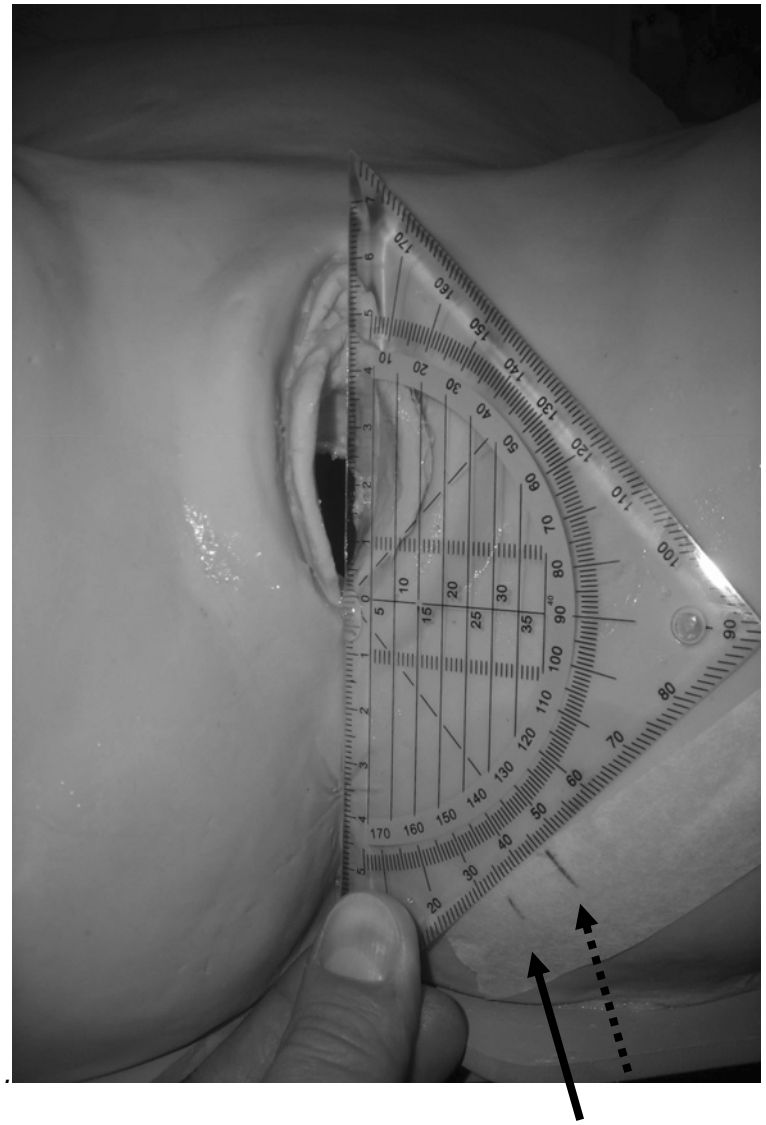
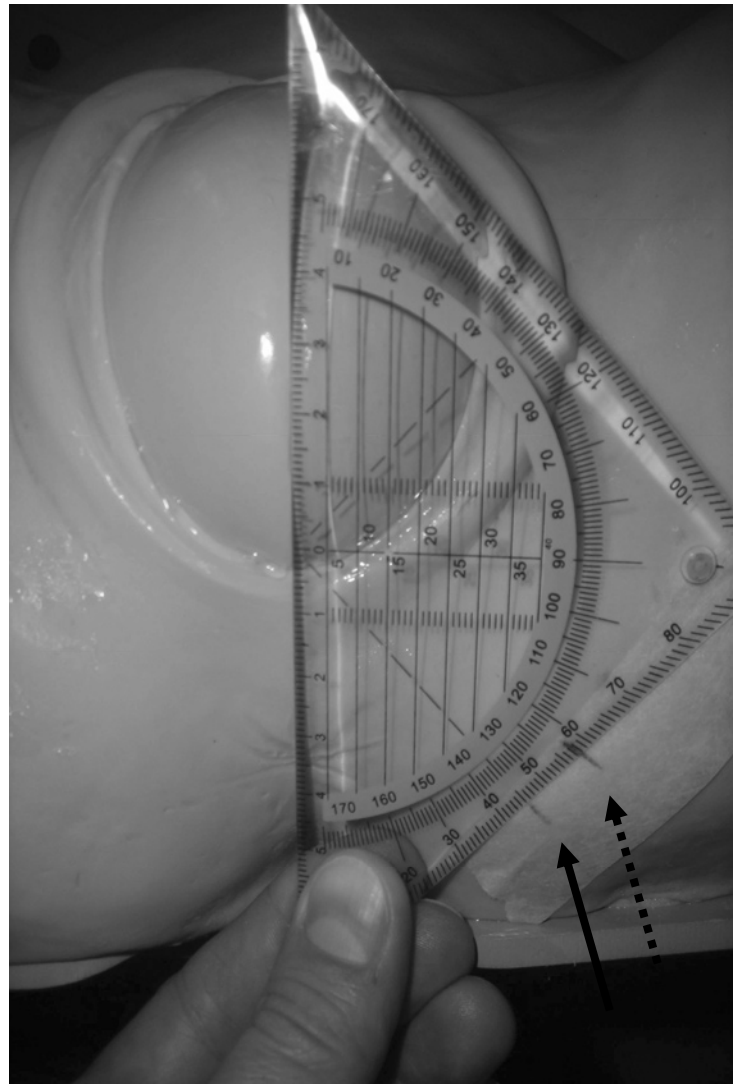
Picture 1. *Measuring the angle of possible episiotomy after delivery*.



Full line indicates episiotomy at 45º when the head is crowning, dotted line indicates position of episiotomy when measurement after delivery reaches 45º (see also picture 2)

Picture 2. *Angle of possible episiotomy during delivery when the head is crowning*.



Full line indicates episiotomy at 45º when the head is crowning, dotted line indicates position of episiotomy when measurement after delivery reaches 45º (see also picture 1).

Chapter 10

General Discussion and Conclusions

'Audit is an ideal method of operational research: it is practical, can often be implemented in existing daily routine, stimulates discussion and reflection leading to professional attitude, encourages the auditor to think 'out of the box' and to form an ectoscopic view, identifies areas of improvement at local level and, after agreement and implementation of changes, may ultimately result in quality improvement'

This statement has been the conclusion of many presentations by the author of this thesis during the past few years. It is universal and can be used in low income as well as high income countries as shown by this thesis. One of the basic principles behind this statement is that maternity care will benefit more from optimizing the use of existing knowledge and technology than from the development of new technologies [1]. For the general progress of medicine, the development of new technologies is unquestionable, but by their sophistication they often benefit a minority and will hardly ever have an impact on Safe Motherhood and maternal mortality ratios. For optimizing the use of existing knowledge and technology, areas with substandard care need to be identified through audit of existing daily practice.

Audit ~ Research

In the debate whether audit is research, it is important to highlight the difference between the two: research adds to the body of medical knowledge and audit ensures that knowledge is effectively used. Audit is intended to influence the activities of an individual or small team, while research seeks to influence medical practice as a whole. One might argue that the studies presented in this thesis are incorrectly described as audits and should be seen as surveys of current practice. The difference between audit and survey is that in audit an intention to effect change should be built into the study. Routine collection of data is unlikely to lead to health care improvement and should also not be published under the banner of audit. Finally, some argue that for audit, criteria should be agreed upon beforehand. If one would strictly apply the term audit for only those studies with a completed audit cycle as illustrated in **chapter 1**, the studies presented here should not be described as audit [2].

However, different audit methods have been described and elements of the audit process are illustrated in most of the studies presented in this thesis [2,3]. Although routine use of data, like the measurement of true conjugate during delivery and the filling of a caesarean section (CS) record book in **chapter 7**, is not an audit by itself, the attending clinician is confronted with the measurement and is stimulated to reflect on his own indication for CS. Whether this will eventually lead to change in practice was not studied. In critical incident audits, explicitly agreed criteria or standards are often not stated purposefully, since this might hinder the identification of substandard care in unexpected areas. The maternal mortality and morbidity audits as described in **chapters 2,3 and 4** all illustrate unexpected determinants of substandard care. In Namibia, most maternal deaths were unidentified in the general medical department and were related to HIV/AIDS. If criteria were agreed upon beforehand using the five major causes of maternal death (obstetric haemorrhage, sepsis, unsafe abortion, obstructed labor and hypertensive disease in pregnancy), most cases of maternal death in Namibia would not have been identified. During the severe maternal morbidity audit at primary care level in the Netherlands it was noted that, although measuring blood pressure after home delivery is taught during training, this was often not done and no standard protocol existed. The identification of substandard care in these areas can result in the formation of standards, which in turn can be used for criteria in future audits.

Audit and life long learning

One of the subsidiary aims of audit is education [2,4]. In the United Kingdom, doctors in the first two years after graduation are asked to perform an audit. Unlike research which asks the question, "what is the right thing to do?", clinical audit asks "are we doing the right thing in the right way?". Clinical audit forms part of clinical governance, which aims to ensure that patients receive the best quality of care [5].
Specialist training programmes in the Netherlands are restructured over the coming years. To this end a general competence profile for medical specialists has been introduced based upon the Canadian Medical Educational Directives for Specialists (CanMEDS) model.

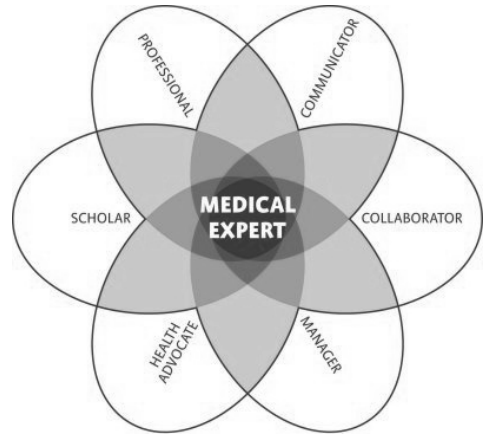


Figure 1. *CanMEDS' seven areas of medical specialist competence*.

CanMEDS describes seven general areas of medical specialist competence (figure 1), one of which is professionalism [6]. A professional physician is someone who does the good things in the right way. Evidence based work, good communication and a holistic approach to patient are all elements of professional medical care [7]. Reflection on daily practice is one of the factors leading to professionalism.
Audit both stimulates reflection ('am I doing things the right way') and encourages doctors to look at the patient from a holistic view ('why did this happen to this particular patient'). One of the prerequisites of training in obstetrics and gynaecology in the Netherlands is the participation in a research project resulting in a manuscript in a peer reviewed journal (http://www.nvog-documenten.nl/nota/eindtermen).
Unfortunately observational studies like audits, are ranking low in the hierarchy of evidence-based medicine and often receive too little attention in teaching settings [8]. In addition to previously illustrated individual stimulus, audit also encourages discussion among health care workers concerning issues in daily practice, which are often taken for granted. In teaching hospitals, the initiation of audit by registrars results in a win-win situation. The registrar is encouraged to perform research, is trained in achieving a professional attitude and with the ultimate goal to improve the quality of care, the department itself can only win by the audit process.

Topics for audit are often found in daily practice. During specialist training in the Netherlands, registrars rotate in at least two different hospitals. With critical reflection to daily practice and in an open environment, differences in local routine in these hospitals can be discussed and result in the initiation of audit. The clinical guidelines formulated by the National Institute for Clinical Excellence (NICE), for example those for induction of labour, antenatal and intrapartum care, are often supported by proposed audit criteria. These documents include a case record form (CRF) to be used for data collection and are easily downloaded from the internet (http://www.nice.org.uk/guidance/). The CRF used in **chapter 6** (caesarean section audit in the Netherlands) and **chapter 9** (perineal audit in the Netherlands) also illustrate simple and efficient means of data collection (attachment A and B). Both studies are examples of audits where data collection, management and analysis can be simple (see chapter 1). Hence, from initiation to completion took less than one year for both studies. Therefore, although rotating in different hospitals during the course of specialist training registrars will still be able to finish all the elements of the audit process during the two to three years they work in one department.

Audit and Ectoscopy

In 2005, the term ´obstetric ectoscopy´ was introduced crying out to obstetricians to not keep silent at the ´scandal of our time´, the alarming maternal mortality and morbidity in the underserved and impoverished countries [9]. Obstetric ectoscopy is defined as ´looking out of´ instead of ´looking into´ of the well known high tech hospital obstetrics in high income countries. Table 1 illustrates the difference between endoscopy and ectoscopy. Where endoscopy is known to all gynaecological registrars as part of their skills training, ectoscopy stands for an attitude, a priority weighing of unmet obstetric needs. High technology, endoscopic surgery, is good and needed. But obstetricians often tend to show a disproportionate interest in endoscopic features and pay little attention to ectoscopic features. Obstetrics outside hospital gates or community obstetrics are key areas to any improvement of maternal health in poor and under-served countries. Audit stimulates an outward looking attitude (ectoscopy).

Table 1. *Comparison of obstetric endoscopy and ectoscopy*

Obstetric endoscopy	Obstetric ectoscopy
Artificial light	Daylight
High tech	Low tech
Inside hospitals	Outside hospitals
Often commercialized	Non commercialized
High cost	Low cost
Available to few	Available to many
No impact on maternal mortality	Impact on maternal mortality
Highly prestigious	Little prestigious
Attractive to many	Attractive to few

As illustrated in **chapters 2, 3 and 4**, maternal morbidity audit encourages the physician to look outside of his/her own department. Most formulated recommendations did not include the need for new technology, but asked to optimize and improve the use of existing knowledge and technology (for example: improving protocols, communication, training and referral criteria). The same was illustrated in a recent report from the confidential enquiries into maternal deaths in South Africa, where 9 out of 10 recommendations were ectoscopic and concerned improving the health care system (for example: improving guidelines, referral criteria and routes, availability of blood, staffing and equipment, use of partogram, contraception and HIV counseling services)[10].

In addition to local improvements, audit can be used as advocacy within the medical profession as well as towards political leaders. The obstetric profession has a responsibility here: as long as we remain silent, hospital oriented, inward-looking, and do not provide the alarming facts to politicians and decision makers, the slogan of halving of maternal mortality will have no impact [9]. Clinicians need to understand that clinical work is, at least partly, also a political task.

Only when medical professionals muster the political will to implement our plans can we hope that maternal mortality will be reduced [11]. In the Netherlands, the introduction of the term ectoscoy in *Medisch Contact,* the journal of the Royal Dutch Society of Medicine eventually resulted in parliamentary questions thus informing and involving political decision makers [12].

Challenges in audit

Clinical audit is known to have a mixed record of success stories and failures. Decreasing motivation due to poorly managed projects, environment resistance to change, lack of senior support and busy clinical services all interfere with the audit priorities [13]. Factors that determine successful implementation of audit include: adequate time allocation, incentives (for example financial, allocation of time or computer), local leadership and enthusiasm, involvement of other staff (for example managers, social workers, cleaners), size of hospital (efficient data collection) and external support (external researchers, political support) [2,13,14].

The studies presented in this thesis are no exception to these difficulties. During the CS audit in the Netherlands (**chapter 6**), overall 75% of CS were audited with a declining percentage during the study period. During the perineal audit in three teaching hospitals in the Netherlands (**chapter 9**) only 64% of obstetric anal sphincter injuries (OASIS) and 58% of episiotomies were audited. Differences in audit percentage between the three hospitals varied from 27% - 100%, and can partly be explained by difference in study protocol: not including cases during evening and night shifts. We tried to overcome the decreasing motivation by making data collection part of routine practice (report meetings), sharing responsibility of the audit project with multiple people from different disciplines (doctors and midwives), by regular reminders via informal consultation and emails and by selecting and timing the topics for audit. The interventions which were audited occur frequently (CS and episiotomy) which makes the time period for sufficient data collection relatively short, thus shortening the time for decreasing motivation. Maternal morbidity and mortality audits were organised through planned meetings, every few months, after collection of enough cases.

The biggest challenge in audit remains the feedback of audit findings and the implementation of change. As for the maternal mortality audit in Namibia (**chapter 2**), most causes were related to HIV/AIDS. In Namibia, a program for the prevention of mother to child transmission of HIV (PMTCT) has been introduced at Onandjokwe Lutheran Hospital since November 2004 with assistance from the United States Government. By February 2006, 1,371 people were enrolled in treatment, including 330 children who represent more than 24% of all patients.

In the maternity ward, 94% of delivering mothers had an unknown HIV status before introduction of rapid testing. After the introduction of rapid testing, the percentage of unknown HIV status has declined to only 10% (www.pepfar.gov/countries/namibia/index.htm accessed August 2009). As more patients have been tested and made aware of their HIV status, more have been enrolled in PMTCT programs and placed on antiretroviral treatment (ART). According to the world health organization's (WHO) epidemiological fact sheet on HIV and AIDS for Namibia, patient enrolment and ability to access ART is having a significant positive effect on morbidity and mortality [15].

With regard to maternal mortality in Onandjokwe Lutheran Hospital, there were seven maternal deaths in 2008 (maternal mortality ratio 146/100,000). Of these seven deaths, four were due to direct causes (hypertensive disease in pregnancy n=3, puerperial sepsis n=1) and three were due to indirect causes (diabetic ketoacidosis, drug induced hepatitis (patient on ART) and fulminant hepatitis C in a HIV negative patient). Whether this decrease in maternal deaths is due to the introduction of PMTCT is not proven but seems likely. All cases of maternal deaths are continued to be audited (personal communication, August 2009).

As for the maternal mortality and morbidity audits in Namibia and the Netherlands (**chapters 2,3 and 4**), the challenge lies in creating a non-blaming atmosphere where health care workers are encouraged to share experiences without having to be afraid for repercussions. In this respect it is worth mentioning that the maternal mortality audit in Namibia and the maternal morbidity audits in the Netherlands are continued to be organised.

Obstetric interventions: caesarean section

Since the 1970's, CS rates have increased worldwide. The relative safety of the operation, fear for litigation, increasing age of the women at the time of the first born, electronic fetal monitoring, changing obstetric practices (breech presentations) and repeat CS have been proposed as the major contributors to this increase [16]. In 1985 the WHO stated: 'There is no justification for any region to have caesarean section rates higher than 10–15%' [17].

A recent analysis of global, regional and national estimates of CS rates estimated 10-15% of all deliveries worldwide are by CS [18]. Latin America and the Caribbean were found to have the highest rate (29.2%), and Africa the lowest (3.5%). In high income countries, the proportion of caesarean births is 21.1% whereas in the most deprived countries only 2% of deliveries are by CS. Ronsmans et al. analyzed the influence of socioeconomic differences in CS rates in low income countries. Using data from 42 Demographic and Health Surveys in sub-Saharan Africa, South and Southeast Asia, and Latin America and the Caribbean, they report CS rates by wealth quintile. They identified CS rates to be extremely low among the very poor: below 1% for the poorest 20% of the population in 20 countries and below 1% for 80% of the population in six countries. At the other extreme they illustrate seven countries, mostly in Latin America, where CS are far in excess of the suggested threshold of 15% for at least 40% of the population [19]. In a comment in the same issue of the Lancet, Althabe and Belizan call this 'the paradox of CS': in sub-Saharan African countries and southern Asian countries, the CS rate in the poorest women was less than the minimum recommended frequency of 1% resulting in an estimated 80,000 maternal deaths a year (the unmet need). In contrast, an estimated 1.5 million unnecessary CS are done every year in Latin America resulting in an estimated 100 maternal deaths and 40,000 cases of neonatal respiratory morbidity [20].

Maternal morbidity and mortality are higher in CS in comparison to vaginal delivery (VD), but as mentioned in **chapter 5**, most studies on this subject have major limitations. We tried to overcome some of the shortcomings (bias by indication and underpowerment) by evaluating the risk of severe acute maternal morbidity (SAMM) related to mode of

delivery in a large nationwide population based cohort study. In our study CS increased the risk of SAMM compared with VD, also after excluding those cases where SAMM was not clearly related to mode of delivery. Furthermore, CS in previous pregnancy was found to carry a threefold increased risk for SAMM in the present pregnancy. We also conclude that standardisation of classification systems for SAMM and standardisation of classification systems for urgency of CS is needed for improving comparison of morbidity and mortality related to mode of delivery. With regard to standardisation of classification for urgency of CS, we evaluated the agreement of two classification systems among obstetricians in the Netherlands and Belgium in **chapter 8**. Since both systems were found to have similar but relatively low inter-observer agreement we suggest to use the classification based on four grades of urgencies since this may improve communication and assist in standardization of monitoring CS related mortality and morbidity. The advice to change the standard Dutch classification into the internationally agreed RCOG classification has been forwarded to the Dutch Society of Obstetrics and Gynaecology. Future studies are necessary to evaluate the effect of this implementation.

Knowing the immediate risks, the impact on reproductive health and the international and regional paradox of CS, critical analysis of the procedure, as mentioned in the justification, is needed. Audit is the tool to determine factors associated with these variations and to assess the quality of obstetric care on a national as well as local level [21].

In **chapter 6** we report on initiating local CS audit in a regional teaching hospital in the Netherlands. Introducing CS audit during the existing structure of daily report meetings is both feasible and practical. It creates awareness and encourages discussion among staff members concerning indications for CS and lack of necessity. Furthermore, we found a significant decrease in CS rate during the audit period. A reduction in CS rate after introducing audit and increasing awareness has been reported earlier and has been attributed to the 'Hawthorne effect': the mere fact of studying individual or group behaviour and creating an environment where behavioural changes are encouraged can by itself influence outcome [22]. A recent meta-analysis studying evidence based strategies for reducing caesarean section rates also concluded that audit and detailed feedback can effectively and safely reduce CSR [23].

Table 2. *Caesarean section rates (%) Haga hospital, from 2003 – 2007*

	2003	2004	2005	2006	2007
Total CS	20.4	23.4	20.6	20.5	20.6
Primary CS	8.3	7.9	7.3	7.6	8.2
Secondary CS	12.0	15.5	13.3	12.9	12.4

Unfortunately, the CS rate at the Haga hospital has increased again after the audit period from 18.7% in August 2005 – June 2006 to 20.6% in 2007 (table 2). However, looking at the CS rates of the Haga hospital between 2003 – 2007, it seems 2004, the year preceding the audit, was out of range with CS rate of 23.4%. There is no significant difference between the CS rate during the audit period compared with the calendar year 2007 (p=0.2 OR 0.88 95%CI 0.73-1.07).

Although in this study the initiation of a local CS audit was not difficult, the continuation, however, was. Again here, audit should be encouraged by senior staff and teaching hospitals could create supportive environments.

As for the determinants of CS, some clear differences were illustrated in indications between Namibia and the Netherlands (table 3). The indication fetal distress, in this table combined with cord presentation for Namibia (**chapter 7** table 1), is much lower compared to the Netherlands (HAGA) and the RCOG, probably due to difficulties in making this diagnosis in the absence of continuous fetal monitoring.

As for previous CS, trial of labour might be less an option in countries like Namibia, where adequate monitoring during labour is not always possible due to staff shortage, busy clinics and patient characteristics (not attending labour room in time). The high number of elective repeat CS in Namibia (22.9%) confirms this assumption. Finally, for breech presentations, the difference between the three groups is striking and probably influenced by peer group pressure and changing obstetric practice [16].

Auditing clinical indications for CS creates awareness concerning these differences and can initiate further audit into specific indications at regional or local level.

Table 3. *Comparison of indication for CS between HAGA hospital the Netherlands, National Sentinel CS audit England, and Onandjokwe Lutheran Hospital Namibia (in %).*

	HAGA (n = 223)	RCOG (n > 32,000)	Namibia (n = 576)
Dystocia	33.2	20.4	33.5
Fetal distress	19.3	22.7	11.8
Previous CS	14.3	14.0	30.7
Malpresentation			
- Breech	15.2	10.8	2.4
- Compound	1.8	3.4	4.7
- Twins	2.7	1.2	2.4
Ante partum haemorrhage	2.7	4.9	6.9
Pre eclampsia	2.7	2.3	1.6
Other Maternal	3.6	7.0	2.3
Other Fetal	0.9	2.3	0.3
Elective	3.6	7.3	2.1

Obstetric interventions: episiotomy

Chapter 9 finally reports on audit of perineal trauma after delivery: either episiotomy as well as obstetric anal sphincter injury (OASIS). This is a perfect example of routine daily practice often taken for granted. Here, a short audit project can effectively identify local practice, create awareness and stimulate reflection on daily practice. With sufficient data in a small period of time, using internationally agreed standards, audit may improve local management [24]. In this multi-centre, prospective study, we evaluated the introduction of perineal audit. Concerning episiotomy, the length and angle from the midline were measured and were found to be generally sufficient. Furthermore, no differences in episiotomy dimensions were seen between obstetricians and midwives.

Concerning OASIS, a significant increase in incidence was seen through better examination, recognition and classification due to audit. During the audit, discussion arose concerning the classification of perineal trauma and the long term clinical significance of low grade OASIS. Previous studies have illustrated that OASIS is associated with subsequent anorectal complaints (OR: 3.64; 95%CI: 1.87 – 7.09) and that the extent of sphincter damage is an independent risk factor [25]. This Dutch retrospective study compared cases of OASIS with matched controls and used the standard Dutch classification roughly translated into RCOG classification grade 3a, 3b and 4. Most patients were diagnosed with grade 3a OASIS (54%), comparable with our results in **chapter 9**. Re-analysing the prevalence of anorectal complaints using the data from de Leeuw *et al,* [25] in women with OASIS grade 3a (14/67) compared with controls (19/125), we found no significant difference of anorectal complaints (p= 0.3; OR 1.5: 95%CI 0.6 –3.4). Fenner *et al*, retrospectively evaluated pelvic floor symptoms using a brief questionnaire send to over 2,900 women six months after delivery [26]. The questions concerning bowel control were completed by 29% of the women. The incidence of worse bowel control was 30% in women with fourth degree rupture compared with 3.6% in women with third degree rupture and 6.0% in women without rupture. They conclude that fourth degree laceration, due to disruption of the internal anal sphincter, appears to affect fecal incontinence.

With the introduction of endo-anal ultrasound, sonographic abnormalities have been identified in up to 36% of women after vaginal delivery [27]. However, the clinical significance of these sonographic defects as well as the significance of low grade OASIS, as shown in these earlier mentioned studies, are still unclear. Our simple local audit thus created awareness concerning the need for large prospective studies. For this purpose, national data collection should incorporate internationally agreed classification systems with clear distinction between internal, external and partial external anal sphincter tears. The advice to change the standard Dutch classification into the internationally agreed RCOG classification has also been forwarded to the Dutch Society of Obstetrics and Gynaecology.

Back to the future…

Daily obstetric practice in the Netherlands has changed dramatically during the past decade with the introduction of prenatal screening, diagnosis and therapy [28]. Although popular and prestigious, both during training as well as in international medical journals, they often benefit only a minority and will hardly ever have an impact on Safe Motherhood. In contrast, routine daily practice as for example the use of episiotomy, still follow the 'tropical doctrine' of 'see one, do one, teach one'. For optimizing the use of existing knowledge and technology, areas with substandard care need to be identified through audit of daily practice.

Improving the quality of health care has a high priority within the Dutch Society of Obstetrics and Gynaecology; hence the formation of its committee on Quality Control in 1990 and the annual reports concerning quality obstetric care. In 2004, a set of 35 health indicators have been designed to measure and improve the quality of obstetric care. In a pilot study in 13 Dutch hospitals testing the feasibility and practical issues concerning these indicators most indicators were considered relevant for evaluating quality of care and registration was possible within daily structure. ([Nota Kwaliteit 2007-2012] and [Nota kwaliteitsindicatoren] Dutch, available at http://nvog-documenten.nl/index.php)

As for obstetric audit in the Netherlands: the guidelines exist, the health indicators have been piloted and approved: the next step for the evaluation of quality care in obstetrics is simply the start of using these indicators through audit. In the Netherlands, however, obstetric audit is relatively new. The initiation of the national perinatal audit program in 2009 (**chapter 4)**, includes training of audit members at regional and local level. In the near future, more health care workers will be familiar with obstetric audit and it is envisaged that the tradition of audit like in the United Kingdom, will eventually also be reached in our obstetric health care.

Where national audit is necessary for improving general obstetric care, comparison with international standards, informing policy makers and advocacy towards politicians, local audit is necessary to evaluate and improve daily practice.

In the Netherlands, teaching hospitals could create a supportive environment where registrars should be encouraged to initiate or participate in audit as part of their training. In low income countries, Dutch tropical doctors could use the 'evidence based' medical training, their critical attitude and general enthusiasm to stimulate the initiation of local obstetric audit [31].

Conclusions

For the final conclusions, we return to the key questions that were introduced in chapter 1.

- *What are the determinants, substandard care factors and areas for improvement concerning maternal mortality in Onandjokwe district, Namibia?*

A hospital based maternal mortality audit is an important tool in the process of understanding maternal deaths, for the education of health care workers as well as for identifying substandard care factors. In Onandjokwe district Namibia, the high number of AIDS related deaths is worrying and due to the high HIV prevalence of antenatal care clients, will remain to be an important contributor. To reduce maternal deaths due to AIDS, attention needs to be given to the prevention of mother to child transmission. Primary prevention of HIV infection, as well as secondary prevention of pregnancy in HIV infected women, can decrease HIV prevalence in pregnant women. In addition, the introduction of comprehensive antiretroviral treatment is urgently needed.

- *What lessons can we learn from maternal mortality audits in different settings worldwide?*

To achieve millennium development goal 5 and reduce maternal mortality by 75%, many factors need to be addressed, among these socio-economic and organisational ones. But there is more than just a difference between the rich and the poor. The first step in reducing maternal mortality is identification of the problems. Identification of local, regional or national causes and assessment of substandard care including recommendations for improvement can be achieved through the implementation of audit.

Audit is a low cost operational research tool and not just relevant for monitoring local progress. It should also be used for advocacy and can inform policy makers and planners concerning effective interventions to reduce maternal deaths. There is no single solution since every country or region has different factors influencing maternal health.

- *What are the determinants of caesarean section in different settings in Namibia and the Netherlands?*

Introducing CS audit in the existing structure of daily practice is both feasible and practical in different settings. It creates awareness, stimulates reflection on decision for CS and encourages discussion among staff members concerning indications and necessity for CS. In the Netherlands, in 25% of CS at one teaching hospital, there was discussion about the necessity. In almost 7% of cases, there was consensus among staff members that caesarean might have been prevented. In a rural hospital in Namibia, the use of internal pelvimetry to measure the true conjugate during the procedure and the introduction of a CS record book in operating theatre, are illustrated as a means of stimulating the immediate reflection on indication and necessity of CS by the medical doctor performing the procedure. The statistically significant lower true conjugate in women who underwent CS for dystocia and repeat CS (recurrent indications) as compared to the other (non recurrent) indications for CS is interpreted in our study as some evidence for a valid reason to perform the operation. This is also supported by the relatively low hospital CS rate of 7,9%.

- *What is the influence of caesarean section on severe acute maternal morbidity in the Netherlands?*

In a nationwide prospective cohort study, CS was found to increase the risk of severe acute maternal morbidity fourfold. In trying to overcome the problem of bias by indication - the indication of CS can lead to severe acute maternal morbidity irrespective of mode of delivery - we selected those cases where severe acute maternal morbidity was not clearly related to mode of delivery and again compared incidence between VD and CS: although less profound, CS was still found to double the risk for severe acute maternal morbidity compared with VD. Furthermore, CS in previous pregnancy carries a threefold increased risk for SAMM in the present pregnancy.

- *Can obstetric audit, concerning topics like maternal morbidity, caesarean section and perineal injury after delivery, be introduced in the existing structure of daily practice in Namibia and the Netherlands?*

The introduction of audit concerning obstetric issues is possible in routine daily practice. It creates awareness, stimulates professionalism, identifies areas for improvement, stimulates discussion concerning indications for obstetric procedures and influences outcome through the 'Hawthorne effect'.

Maternity care will benefit more from optimizing the use of existing knowledge and technology than from the development of new technologies. Audit of daily practice can assist in optimizing the quality of care by identifying areas of substandard care. Topics for audit are often found in daily practice and (inter)national guidelines for criteria of standard care are available for most topics.

In the Netherlands, audit can be integrated in specialist training. The registrar is encouraged to perform research, is trained in achieving a professional attitude and with the ultimate goal to improve the quality of care, the department itself can only win by the audit process.

The challenge lies in creating environments which stimulates both the initiation and the continuation of audits. Teaching hospitals (in Namibia and the Netherlands) should be encouraged to create such supportive environments.

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Appendix A

Caesarean Section Audit

Datum: …… **Patient nummer:** ……

Classificatie sectio (omcirkel):
□ Primair / □ Secundair

□ Electieve baring, gepland naar wens van arts en patiënte
□ Geen gevaar voor moeder of kind, maar baring op korte termijn geïndiceerd
□ Gevaar voor moeder of kind, niet direct levensbedreigend
□ Acute levensbedreiging van moeder of kind
-> Bij acute / spoedsectio: tijdsduur aanmelding sectio tot geboorte kind:

Algemeen
□ CS in VG (aantal): ….. indicatie(s) ……
□ Priming / Inleiding: misoprostol / AROM / balloncatheter / …….
□ Ontsluiting …cm

Indicatie Sectio

1e	2e			
□	□	**NVO**	□ Bijstimulatie	□ Periduraal
			□ # vliezen ….. hr	□ Partogram > actielijn
□	□	**NVU**	□ Bijstimulatie	□ Geperst
			□ Indaling H2 / H3	□ (proef) VE
□	□	**Foetale nood**	□ CTG	□ MBO pH: □ Ritodrine
□	□	**Stuitligging**	□ ECV1, nee waarom niet:	□ Ritodrine
			□ ECV2, nee waarom niet:	
□	□	**Electief**	□ obv ……	□ Second opinion staf
□	□	**Pre eclampsie**	□ foetaal □ maternaal ……..	
□	□	**(Part.) Solutio / Plac. Previa**……		
□	□	**Overig foetaal** ..……		
□	□	**Overig maternaal**..……		

Complicaties / Overig
……...……...……..……

AUDIT
Gynaecologen n=…. Arts-assistenten n=…. Verloskundigen n=….

Indicatie sectio vlgs audit team …… **Consensus (……%)**
'Had sectio voorkomen kunnen worden'? □ ja □ nee **Consensus (……%)**
Preventie sectio hoe?: …… **Consensus (……%)**
Tijdsinterval bij spoedsectio acceptabel: …… **Consensus (……%)**

Appendix B

Episiotomie audit

Kliniek: LUMC / MCH/ Haga
Datum: …….

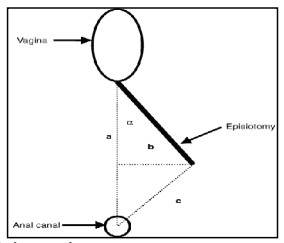
Parteur: Verloskundige
Arts assistent
Co assistent
Gynaecoloog

Indicatie episiotomie:
…….
…….

Patiënten sticker

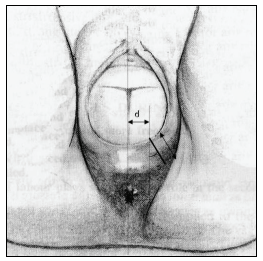
Hoek episiotomie (in lithotomie positie na hechten epi)

Figuur 1.



Lengte episiotomie …… mm
Lengte perineum (a) …… mm
Afstand a – punt epi. (b) …… mm
Hoek episiotomie …… Graden

Figuur 2.



Afstand epi. van mediaan (d): …… mm

Sfincterletsel RCOG en LVR classificatie (omcirkel):

RCOG classificatie (zie tabel)

Parteur: 1 / 2 / 3a / 3b / 3c / 4
Controle: 1 / 2 / 3a / 3b / 3c / 4
(Staf / oudste: 1 / 2 / 3a / 3b / 3c / 4)*

First degree: laceration of the vaginal epithelium or perineal skin only

Second degree: involvement of the perineal muscles but not the anal sphincter

Third degree: disruption of the anal sphincter muscles, further subdivided into:

3a: < 50 percent thickness of external sphincter torn
3b: > 50 percent thickness of external sphincter torn
3c: internal sphincter torn also

Fourth degree: a third degree tear with disruption of the anal epithelium

LVR classificatie:

□ Perineum
□ Subtotaal ruptuur
□ Totaal ruptuur

* Alleen indien discrepantie parteur en controle (= tweede verloskamer medewerker)

Chapter 11

Summary / Samenvatting

Summary

This thesis combines hospital based studies from Namibia with hospital based and population based studies from the Netherlands, with a common theme: audit. The term audit is generally used to refer to a wide range of methods for monitoring and reporting on the quality of health care. One of the basic principles of this thesis is that maternity care will benefit more from optimizing the use of existing knowledge and technology (through audit) than from the development of new technologies.

In **chapter 1**, the term audit is introduced and linked to three Safe Motherhood issues: maternal mortality, maternal morbidity and obstetric interventions. In addition, background information from the author (justification for the thesis) and from both countries where the studies were performed (Namibia and the Netherlands) are presented placing the studies in their geographical, social, medical and economical context. The key questions presented are:

- What are the determinants, substandard care factors and areas for improvement with regard to maternal mortality in Onandjokwe district, Namibia?
- What lessons can we learn from maternal mortality audits in different settings worldwide?
- What are the determinants of caesarean section in selected hospitals in Namibia and the Netherlands?
- What is the influence of caesarean section on severe acute maternal morbidity in the Netherlands?
- Can obstetric audit of topics like maternal morbidity, caesarean section and perineal injury after delivery, be introduced in the existing structure of daily practice in Namibia and the Netherlands?

In **Chapter 2** we present results from a facility based maternal mortality audit in Onandjokwe district Namibia. Onandjokwe Lutheran Hospital is introduced as a district and referral hospital in Northern Namibia with a catchments population of 200-300,000 inhabitants living in a semi rural/ peri-urban area. All in-hospital maternal deaths occurring between January 2001 - December 2003 were audited for classification and cause. Recommendations for improvement were formulated.

The maternal mortality ratio (MMR) was found to be 508/100,000 with 45% of deaths due to AIDS. Of 56 maternal deaths, only 17 were direct maternal deaths (30%) and 39 were indirect deaths (70%). AIDS is the most important factor influencing maternal mortality with 25 deaths. Substandard care was identified in four areas and recommendations are presented. We concluded that a facility based maternal mortality audit is an important tool in understanding maternal deaths as well as in identifying substandard care factors which require immediate action. A direct maternal mortality percentage of only 30% is one of the lowest reported and this refers to HIV/AIDS as an important factor influencing maternal mortality in this part of the world.

Chapter 3 illustrates how maternal mortality audit identifies different causes and factors which contribute to maternal deaths in different settings. Results from facility based maternal mortality audits from Namibia, The Gambia and Zambia are presented and compared with data from the latest confidential enquiry in the Netherlands. In addition, review of data concerning the history of reducing maternal mortality in high income countries is discussed. MMR ranged from 10/100,000 (the Netherlands) to 1,540/100,000 (The Gambia). Differences in causes of deaths were characterised by HIV/AIDS for Namibia, sepsis and HIV/AIDS in Zambia, (pre-) eclampsia in the Netherlands and obstructed labour in The Gambia. Differences in maternal mortality are more than just differences between the rich and the poor. Acknowledgement of the magnitude of maternal mortality and a strong political will to tackle the issues are important factors. There is no single, general solution to reduce maternal mortality and identification of problems needs to be promoted through audit, both national as well as local.

In a nationwide prospective cohort study called LEMMoN, severe acute maternal morbidity (SAMM) was identified to occur in at least 7.1 per 1,000 births in the Netherlands. In **chapter 4**, cases from the LEMMoN study are used for the introduction of audit in the Netherlands. Several audit meetings have been organized to assess the severity of SAMM and to identify substandard care. Before each panel meeting, SAMM details of selected cases were send for individual assessment to selected panel members. During the panel meeting, substandard care factors as judged by the majority of assessors were scored.

Substandard care was identified in 53 of 67 cases (79%). Specific recommendations were formulated concerning local as well as national management guidelines. Data from the LEMMoN study reflect SAMM in the Netherlands and substandard care is often present. Ongoing audit of cases is promoted both at national and at local level.

In **chapter 5** we evaluated the risk of SAMM related to mode of delivery using data from the LEMMoN study. Incidence of SAMM in caesarean section (CS) was compared with incidence of SAMM in vaginal delivery (VD). One of the main problems when comparing these two is bias by indication: morbidity related to CS may be a result from preexisting disease leading to the decision to perform the operation rather than from the procedure itself. Therefore, for analyzing the incidence of SAMM related to mode of delivery, three subgroups were used: total SAMM inclusions, selected SAMM inclusions possibly related to mode of delivery and SAMM inclusions in low risk pregnancies using single term breech as surrogate. For those SAMM inclusions possibly related to CS, we excluded all cases where SAMM was not clearly related to the mode of delivery. Additionally, risk of SAMM after previous CS was assessed. The incidence of SAMM possibly related to elective CS was 6.4 per 1,000 compared to 3.9 per 1,000 attempted VD (OR 1.7: 95% CI 1.4-2.0). Women with a previous CS are at increased risk for SAMM in the present pregnancy (OR 3.0: 95% CI 2.7-3.3). In conclusion, CS in previous as well as present pregnancy increases the risk of SAMM, also after excluding those cases where SAMM is not clearly related to mode of delivery.

Knowing the immediate risks, the impact on future pregnancy and the international 'paradox of CS' (**chapter 10)**, critical analysis of the procedure, as mentioned in the justification, is needed. Both **chapter 6 & 7** describe the introduction of CS audit in the Netherlands and Namibia respectively. In **chapter 6**, CS audit was introduced in a regional teaching hospital in the Netherlands. This was done during the existing daily report meetings from August 1st 2005 to June 1st 2006 in The Haga hospital, a large teaching hospital in The Hague, the Netherlands. During the study period, 74% of CS were discussed with regard to indication, classification and audited for 'lack of necessity'. Of 1,221 deliveries, 228 were CS (18.7%) while prior to the audit period there were 1,216 deliveries with 284 were CS (23.4%).

The CSR was found to be significantly lower during the audit period. Assisted vaginal deliveries, neonatal outcome, and induction of labor rates were comparable. Concerning the audit question 'could CS have been prevented', there was discussion in 24.4% of cases. In 6.7% of CS, consensus about lack of necessity was achieved. We concluded that introducing CS audit during the existing structure of daily report meetings in a regional teaching hospital is both feasible and practical. It creates awareness and encourages discussion among staff members concerning indications for CS and lack of necessity. Furthermore, there was a significant decrease in CSR during the audit period.

Chapter 7 describes a retrospective observational study concerning CS in Onandjokwe Lutheran Hospital, Namibia. Indications of 576 CS performed between January 2001 – December 2002, were analyzed using intra-operative internal pelvimetry and a CS record keeping system. Most CS were done for dystocia (34%) followed by repeat CS (31%). The true conjugate (distance between the promontorium to mid pubic bone) was significantly smaller in these recurrent indication groups when compared to non recurrent indications. In this rural hospital the introduction of Delee Pelvimetry and a CS record keeping system was found to be a simple and cheap way to introduce obstetric audit. This creates awareness, which may help in reducing unnecessary CS.

Although CS is performed frequently, no consensus exists concerning classification of the procedure. In **chapter 8** we evaluated the agreement between different classification systems (the traditional binary - emergency versus elective - and a new four grade classification system advocated by the RCOG) among obstetricians in the Netherlands and Belgium: 212 obstetricians were requested to grade a list of 18 obstetrical scenarios according to three classification systems (traditional binary classification, new classification using four grades of urgency without and with additional interpretation). Agreement was assessed by the weighted kappa: 77 obstetricians responded (Netherlands 62.2%, Belgian 9.9%) with substantial agreement for all three classification systems (κ=0.71: κ=0.70: κ=0.67). The traditional binary and new classification based on four grades of urgency, were found to have similar but relatively low inter-observer agreement. We suggest to use the classification based on four grades of urgencies, but future studies are necessary to evaluate the effect of this implementation.

Another common intervention in obstetrics is the episiotomy. In **chapter 9** we evaluate the dimensions of mediolateral episiotomy and the diagnosis of obstetric anal sphincter injuries (OASIS) during routine clinical practice in two teaching and one university hospital in the Netherlands. In all women delivering between February - September 2008, the dimensions of episiotomy were measured directly post delivery with the women in lithotomy position. Furthermore, in all women with ≥ 2nd degree tear, a second labour room employee re-evaluated the extent of injury according to RCOG classification. Incidence of OASIS during the audit period was compared with the incidence one year preceding the audit. Of 1,979 deliveries, 420 women had episiotomy (21.2%) and 58 women sustained OASIS (2.9%). The mean angle of episiotomy was 40° away from the midline. There was no difference in the length or the angle of episiotomy between gynaecologist or midwife and most episiotomies were sufficiently away from the midline. There was a significant increase in OASIS as compared with the preceding year. Introducing perineal audit in daily practice is illustrated to be feasible, practical and might result in improved diagnosis of OASIS. To improve recognition and classification of OASIS, perineal audit including an international agreed classification should be introduced as routine practice.

In **chapter 10** the findings from the previous studied are discussed and audit is linked to research, ectoscopy and lifelong learning. In conclusion, the introduction of audit concerning obstetric issues is possible in routine daily practice. It creates awareness, stimulates professionalism, identifies areas for improvement, stimulated discussion concerning indications for obstetric procedures and, making use of the 'Hawthorne effect', influences outcome. Teaching hospitals should be encouraged to create a supportive environment for the implementation of audit.

Samenvatting

In 1854 is Florence Nightingale, samen met een door haar geselecteerd team van verpleegkundigen, op verzoek van de Britse minister van oorlog vertrokken om de front soldaten bij te staan in de Krimoorlog. In Scutari, het Aziatische deel van Istanbul, werden ze getroffen door de erbarmelijke sanitaire condities en zeer hoge mortaliteits cijfers onder de zieke en gewonde soldaten. Waar ongeveer 1 op de 5 soldaten sneuvelden in de krimoorlog (ter vergelijking: in Vietnam sneuvelden van de US army 2.6% van de soldaten) was het met name opvallend dat 80% van de soldaten overleed aan de gevolgen van infectieziekten en slechts 20% door oorlogstrauma. Met de invoering van strikte sanitaire routines, verbeteringen in algemene ziekenhuis hygiëne en het introduceren van triage in trauma opvang daalden de mortaliteits percentages van 33% naar 2% in de periode van Florence Nightingale. Haar mathematische en statistische vaardigheden resulteerden tevens in een prachtige illustratieve weergave van deze daling. Hoewel primair bekend als de uitvinder van de moderne verpleegkunde en geroemd om haar empathie als zijnde 'the lady with the lamp' heeft ze in haar tijd ook belangrijke invloed gehad op het gebied van de klinische epidemiologie (met name het inzichtelijk presenteren van data) en de ontwikkeling van de ziekenhuishygiëne.
Florence Nightingale heeft door het observeren van de geleverde zorg, aanpassingen op basis van 'best available evidence' en het registreren van de veranderingen wellicht de eerste, maar zeker ook een van de best gedocumenteerde audits verricht. Tegenwoordig is audit in veel landen een vast onderdeel van de gezondheidszorg en zijn er vele boeken, richtlijnen en instanties die assisteren bij het verrichten van audits.

Audit

Clinical audit wordt gedefinieerd als de systematische analyse van de kwaliteit van de zorg, de procedures gebruikt voor preventie, diagnose en behandeling, het gebruik van voorzieningen en de uitkomst en kwaliteit van leven voor de patiënt. Het uiteindelijke doel van audit is kwaliteitsbewaking en -verbetering. De verschillende onderdelen van audit worden vaak door middel van een cirkel met vijf componenten weergegeven (hoofdstuk 1, figuur 1).

Audits worden grofweg ingedeeld in 'systeem', 'proces' of 'uitkomst'. Onderwerpen voor audit worden vaak gekozen naar aanleiding van (klinische) vragen op basis van een jaarverslag of rapport (vergelijk stap 3 van de audit cirkel). Het kritisch kijken naar de eigen data (= uitkomst) leidt dan primair tot bewustwording en discussie binnen de maatschap of de beroepsgroep. Daarnaast biedt 'het nieuw zijn' in een groep waar met vaste rituelen wordt gewerkt een mogelijkheid tot kritische evaluatie van het zorgproces. Naast het eerder genoemde voorbeeld van Florence Nightingale, kan hier natuurlijk gedacht worden aan de externe consultant die voor audit wordt aangetrokken maar ook aan de Nederlandse tropenarts die voor enkele jaren naar een missieziekenhuis wordt uitgezonden en de opleidingsassistent die in het kader van de opleiding verschillende ziekenhuizen doorloopt.

Dit proefschrift

Enkele van de studies verricht tijdens de periode als tropenarts in Namibië, en tijdens de opleiding tot medisch specialist in Nederland zijn gebundeld in dit proefschrift. De gemeenschappelijke deler van deze studies is evaluatie van de geleverde kwaliteit van zorg door middel van audit. Een van de basis gedachten is dat moeder & kind zorg in het algemeen meer baat heeft van het optimaal gebruik van bestaande middelen (door audit van de geleverde zorg) dan door de ontwikkeling van nieuwe technologie. Dit proefschrift combineert ziekenhuis gebonden studies van Namibië met ziekenhuisgebonden en populatiegebonden studies vanuit Nederland.

In **hoofdstuk 1** wordt de term 'audit' geïntroduceerd in relatie met enkele facetten van veilig moederschap (Safe Motherhood) te weten: moedersterfte, ernstige maternale morbiditeit en interventies als de keizersnede en de episiotomie ('de knip'). Tevens wordt het ontstaan van dit proefschrift verantwoord en wordt enige achtergrond informatie gegeven over Namibië en Nederland. De verschillende studies worden hierdoor in de geografische, sociale, medische en economische context geplaatst, waarin ze zijn verricht.

Aansluitend worden de kernvragen van dit proefschrift gepresenteerd:

- *Wat zijn de oorzaken, substandaardzorg factoren en aanbevelingen voor verbetering betreffende moedersterfte in Onandjokwe district in Namibië?*
- *Welke lessen zijn er te leren van moedersterfte audits wereldwijd, zowel vanuit lage als hoge inkomenslanden?*
- *Wat zijn de determinanten van de keizersnede in de geselecteerde ziekenhuizen in Namibië en Nederland?*
- *Wat is de invloed van de keizersnede op ernstige maternale morbiditeit in Nederland?*
- *Kan audit op obstetrische onderwerpen als moedersterfte, keizersnede en episiotomie, worden geïncorporeerd in de bestaande structuur van de dagelijkse zorg in Namibië en Nederland?*

In **hoofdstuk 2**, worden resultaten van een ziekenhuis gebonden moedersterfte audit besproken. Onandjokwe Lutheran Hospital, een district- en verwijs-ziekenhuis in Noord Namibië, voorziet een geschatte populatie van 200-300,000 mensen van gezondheidszorg. Met behulp van patientendossiers werden alle casus van maternale sterfte in het ziekenhuis in de periode van januari 2001 tot en met december 2004 beschreven. Door middel van audit van de dossiers werd gekeken naar oorzaak, classificatie, substandaardzorg en aanbevelingen voor verbetering. De moedersterfte ratio (MMR: aantal sterftes tijdens zwangerschap of kraambed / 100,000 levendgeboren kinderen) was >500/100,000 en 45% was ten gevolge van AIDS. Van de 56 maternale sterftes waren er 17 direct (ten gevolge van zwangerschap of bevalling) en 39 indirect (ten gevolgde van reeds bestaande ziekte welke wordt beïnvloed door zwangerschap of bevalling). Substandaard zorg werd geïdentificeerd in vier categorieën en aanbevelingen voor verbetering van de zorg werden gedaan. Dit laatste met name betreffende de zorg omtrent HIV/AIDS en de noodzaak van het versterken van het PMTCT programma (preventie moeder kind transmissie HIV) met het introduceren van virusremmers.

In **hoofdstuk 3** worden de verschillen in moedersterfte tussen Nederland (landelijke studie) en drie lage inkomenslanden (ziekenhuisgebonden audits uit Zambia, The Gambia en Namibië) beschreven.

Met de vraag of het onaanvaardbare verschil slechts wordt verklaard door het verschil in bruto nationaal product 'arm versus rijk', wordt tevens gekeken naar de geschiedenis van de daling van moedersterfte in landen die nu als rijk te boek staan. De MMR varieerde tussen 10/100,000 (Nederland) tot 1,540/100,000 (The Gambia). Opvallende verschillen in oorzaken van moedersterfte werden geïllustreerd: HIV/AIDS in Namibië, sepsis en HIV/AIDS in Zambia, zwangerschapshypertensie in Nederland en baringsbelemmering in The Gambia. Aan de hand van een literatuurstudie naar de geschiedenis van de moedersterfte daling in het westen en recente data uit ondermeer Vietnam, Oeganda and Burundi wordt tevens geïllustreerd dat verschillen in moedersterfte niet slechts worden veroorzaakt door het verschil in bruto nationaal product. Allereerst dient er (politieke) aandacht te zijn voor het probleem op zich en voor de omvang van het probleem in het bijzonder. Aangezien er grote verschillen bestaan in oorzaken van moedersterfte en er geen eenduidige oplossing bestaat, is audit op nationaal en lokaal nivo nodig. Door audit kunnen lokale, regionale en nationale oorzaken worden geïdentificeerd en kunnen gerichte aanbevelingen worden gedaan.

In veel westerse landen is de incidentie van moedersterfte (gelukkig) zo laag dat verbetering nauwelijks meer mogelijk lijkt. Door de lage incidentie wordt relatief veel aandacht besteed aan weinig voorkomende problematiek. Sinds de jaren 90 van de vorige eeuw is daarom de term ernstige maternale morbiditeit (SAMM) geïntroduceerd als een marker voor de kwaliteit van obstetrische zorg. Beziet men namelijk maternale sterfte als topje van de ijsberg van ernstige maternale morbiditeit, dan wordt audit als basis voor het verbeteren van de maternale gezondheid weer meer zinvol geacht. Om SAMM in Nederland in kaart te brengen, is van augustus 2004 tot augustus 2006 de LEMMoN-studie verricht. LEMMoN is een acroniem voor Landelijke studie naar Etnische determinanten van Maternale Morbiditeit in Nederland. De incidentie van SAMM in Nederland is minimaal 7.1 / 1,000 bevallingen. Naast het bepalen van de incidentie van verschillende vormen van ernstige maternale morbiditeit was een belangrijk doel van de studie om (etnische) factoren te identificeren die een verhoogd risico geven op ernstige maternale morbiditeit. Ter identificatie van deze factoren is audit verricht.

Een eerste aanzet hiertoe was een pilot audit in de Haagse regio, met als primaire doelstelling te beoordelen of op basis van de verzamelde informatie audit mogelijk is. Aansluitend zijn meerdere audit meetings georganiseerd waarvan de uitkomsten worden beschreven in **hoofstuk 4**. Substandaard zorg werd geïdentificeerd in 53 van de 67 casus (79%) en specifieke aanbevelingen zijn geformuleerd voor lokale en landelijke richtlijnen. Ook hier wordt de waarde van audit op nationaal en lokaal nivo benadrukt.

In **hoofdstuk 5**, wordt met behulp van de LEMMoN data gekeken naar het risico op SAMM gerelateerd aan het type bevalling; de vaginale bevalling of de keizersnede. Moeilijk hierbij is dat de keizersnede zowel de oorzaak van SAMM kan zijn, maar dat keizersnede ook geïndiceerd kan zijn om de zwangerschap te beeindigen in het kader van een ernstig zieke moeder (~ de kip versus het ei). Voor het analyseren van de incidentie van SAMM zijn daarom een drietal subgroepen gemaakt: 1. totaal aantal SAMM inclusies; 2. selectie op mogelijk relatie met de bevalling; 3. SAMM inclusies in een laag risico populatie zijnde de a terme stuitligging. Tevens is een onderverdeling gemaakt naar geplande versus spoedkeizersnede. Tenslotte is ook gekeken naar het risico op SAMM bij een keizersnede in een voorgaande zwangerschap. De invloed van de keizersnede op het optreden van SAMM bleek in alle drie de subgroepen verhoogd. De incidentie van SAMM mogelijk gerelateerd aan het type bevalling is 6.4 / 1,000 geplande keizersneden vergeleken met 3.9 / 1,000 in opzet vaginale bevallingen (vaginaal bevalling en spoedsectio tezamen). Vrouwen met een keizersnede in een voorgaande zwangerschap hebben een drie maal verhoogd risico op het optreden van SAMM in de huidige zwangerschap. Concluderend is de keizersnede in de huidige zowel als in de voorgaande zwangerschap een risicofactor voor het ontstaan van SAMM.

De wereldgezondheidsorganisatie (WHO) heeft in 1985 reeds gesteld dat er geen reden is voor een keizersnede percentage hoger dan 10-15%. Hoewel een recente studie lijkt aan te tonen dat het keizersnede percentage wereldwijd daadwerkelijk tussen de 10-15% ligt, zijn er enorme nationale en regionale verschillen. Zo is het keizersnede percentage in hoge inkomenslanden gemiddeld 21% vergeleken met een schamele 2% in de meeste arme landen.

Zowel een te hoog als een te laag percentage resulteert in (onnodige) sterfte en maternale morbiditeit. Dit gegeven wordt ook wel de 'paradox van de keizersnede' genoemd.

Wetende dat er risico's zijn verbonden aan de keizersnede, zowel op de korte termijn als op toekomstige zwangerschappen en rekening houdend met de verschillen in incidentie, is kritische analyse van de indicatie tot de keizersnede door middel van audit geïndiceerd. In **hoofdstuk 6** & **7**, worden de resultaten van keizersnede audits in Nederland en Namibië beschreven.
In **hoofstuk 6**, wordt de keizersnede audit geïntroduceerd in de dagelijkse structuur van de overdracht in een regionaal opleidingsziekenhuis in Nederland. Van augustus 2005 tot juni 2006 werden alle keizersnedes in het Hagaziekenhuis te Den Haag geaudit met betrekking tot indicatie, classificatie en mogelijkheid tot voorkomen. Van de 1221 bevallingen waren er 228 per keizersnede (18.7%), significant lager dan de vergelijkbare periode in het jaar voorafgaand aan de audit (23.4%). Het aantal vaginale kunstverlossingen, inleiding van de baring en de neonatale uitkomst was echter niet veranderd. Met betrekking tot de vraag over het mogelijk voorkómen van de keizersnede was er discussie in 24.4% en consensus in 6.7% van de casus dat dat inderdaad zo was. Concluderend bleek de introductie van de keizersnede audit in de bestaande overdracht mogelijk. Het stimuleert discussie tijdens de overdracht en leidt tot bewustwording met betrekking tot de indicaties.
In **hoofdstuk 7** wordt een retrospectieve observationele studie met betrekking tot de keizersnede in Onandjokwe Lutheran Hospital in Namibië beschreven. In dit ziekenhuis was het gewoonte om tijdens de operatie één van de bekkenmaten (de conjugata vera) op te meten. De conjugata vera is de voorachterwaartse diameter van het bekken gemeten vanaf de binnenkant van het schaambeen tot het promontorium (vooruitstekend deel) van het staartbeen. Met behulp van een interne pelvimeter werd, na de geboorte van het kind en het sluiten van de baarmoeder, de conjugata vera gemeten. Aansluitend werd deze in een keizersnede boek in het operatiecomplex genoteerd. Met dit boek werden de indicaties en de gemeten conjugata vera gedurende een periode van twee jaar geanalyseerd. Van de 576 keizersneden bleek het merendeel op basis van de indicatie dystocie (wanverhouding, 34%) gevolgd door herhaalde keizersnede (31%).

De conjugata vera was significant kleiner in deze groep met terugkerende indicaties vergeleken met de groepen niet terugkerende indicaties als foetale nood, zwangerschaphypertensie en bloedverlies antepartum. In deze rurale setting bleek de introductie van pelvimetrie en het keizersnedeboek een simpele methode om de indicatie tot de keizersnede te analyseren. De gevonden bekkenmaat stimuleert de betreffende arts tevens tot reflectie op het eigen handelen ('had ik de conjugata vera zo groot verwacht?'). De bewustwording van indicaties en de mogelijkheid tot analyse kunnen beiden resulteren in het verminderen van onnodige keizersneden.

Hoewel de keizersnede zo frequent wordt toegepast is er geen consensus met betrekking tot een internationale classificatie van urgentie voor de procedure. De Royal College of Obstetricians & Gynaecologists (RCOG) adviseert om een nieuw classificatie systeem, bestaande uit vier gradaties, te gebruiken. Voor introductie van dit systeem in Nederland, beschreven in **hoofstuk 8,** is gekeken naar de mate van overeenstemming van de oude en nieuwe classificatie. In totaal zijn 212 Nederlandse en Belgische obstetrici benaderd om een lijst met 18 klinische scenarios te classificeren volgens het oude traditionele systeem (gepland versus spoed) het nieuwe urgentie systeem (graad 1-4) en het nieuwe systeem met additionele uitleg over de 4 gradaties. De mate van overeenstemming werd berekend met een gewogen kappa. Tussen de 77 respondenten (Nederland 62.2% en Belgie 9.9%), bleek er substantiële en vergelijkbare overeenstemming voor alle drie de classificatiesystemen (κ=0.71: κ=0.70: κ=0.67). Wij adviseren om het nieuwe classificatiesysteem ook in Nederland te introduceren, maar vervolgstudies zijn nodig om het effect hiervan te evalueren.

Na de keizersnede audits wordt in **hoofstuk 9** tenslotte een studie beschreven betreffende de introductie van perineum audit na een vaginale bevalling. Door middel van audit zijn dimensies van de episiotomie (de hoek gemeten vanaf de mediaanlijn en de lengte) en de diagnose van obstetrisch anaal sfincterletsel (OASIS) in drie opleidingsziekenhuizen in Nederland in kaart gebracht. Bij alle vrouwen die tussen februari 2008 tot september 2008 vaginaal zijn bevallen in het Hagaziekenhuis te Den Haag, het MCH te Den Haag en het LUMC te Leiden, is de episiotomie direct postpartum gemeten. Tevens is van alle vrouwen met een perineum

letsel post partum samen met een tweede verloskamermedewerker gekeken of er sprake was van OASIS volgens de RCOG classificatie. Van de 1,979 bevallingen bleek er in 420 casus een episiotomie te zijn verricht (21.2%) en waren er 58 OASIS gediagnosticeerd (2.9%). De hoek van de episiotomie was gemiddeld 40° en er bleek geen verschil tussen de hoek en de lengte van een episiotomie verricht door een verloskundige of een (assistent) gynaecoloog. Tevens bleek er een significante stijging van de diagnose OASIS tijdens de studieperiode in vergelijking met het jaar voorafgaand aan de audit. Concluderend bleek de introductie van perineum audit in de bestaande dagelijkse structuur mogelijk. Om de herkenning van sfincterletsel te verbeteren en voor onderzoek naar lange termijn gevolgen van sfincterletsel dient audit vergezeld te gaan met de introductie van de internationaal gebruikte classificatie van sfincterletsel.

In **hoofstuk 10**, de discussie, wordt de waarde van audit als instrument ter kwaliteitsverbetering nogmaals genoemd. Tevens wordt geïllustreerd welke plaats het in de huidige obstetrische zorg reeds heeft ingenomen. Waar nationale audit programma's nodig zijn voor het verkrijgen van data voor landelijke beleidsmakers en ter internationale vergelijking zijn lokale initiatieven zeer belangrijk voor praktische veranderingen op de werkvloer. Dit proefschrift laat aan de hand van enkele studies zien hoe verschillende vormen van obstetrische audit in de dagelijkse praktijk kunnen worden ingevoerd, zowel in lage inkomenslanden als in Nederland. Nederlandse tropenartsen kunnen in lage inkomenslanden met de gedegen 'evidence based' opleiding, een kritische blik en hun enthousiasme een stimulans zijn om audit ook daar op lokaal nivo te initiëren en te ondersteunen. Terug in Nederland is de vernieuwde opleiding tot medisch specialist gestart, gebaseerd op de CanMEDS rollen. Hierbij is reflectie op het eigen functioneren geïntroduceerd als onderdeel van professionaliteit, één van de algemene competenties. De reflectie op het eigen medisch handelen wordt gestimuleerd door het doen van audit. Audit brengt bewustwording met zich mee, leidt tot discussie op de werkvloer en stimuleert tot gedragsverandering.
Het is dan ook niet verwonderlijk dat specialisten in opleiding in Engeland worden aangespoord om, in navolging van Florence Nightingale, te participeren in het doen van audit. Opleidingsziekenhuizen in Nederland, maar ook in lage inkomenslanden zoals Namibië, zouden gestimuleerd moeten worden om audit initiatieven te ondersteunen en te begeleiden.

Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care
ARV(T)	Antiretroviral (treatment)
BTL	Bilateral Tubal Ligation
CanMEDS	Canadian Medical Educational Directives for Specialists
CDMR	Caesarean Delivery Maternal Request
CEMD	Confidential Enquiry into Maternal Death
CFR	Case Fatality Rate
CPD	Cephalo Pelvic Disproportion
CRF	Case Record Form
CS	Caesarean Section
CSR	Caesarean Section Rate
ECV	External Cephalic Version
EmOC	Emergency Obstetric Care
HAGA	Haga hospital, The Hague the Netherlands
HELLP	Hemolysis Elevated Liver enzymes Low Platelets
HIS	Health Information System
HIV	Human Immunodeficiency Virus
ICU	Intensive Care Unit
LEMMoN	Nationwide study into SAMM in the Netherlands [Landelijke studie Etnische determinanten Maternale Morbiditeit in Nederland]
LUMC	Leiden University Medical Centre, Leiden the Netherlands
LVR	National obstetrical database [landelijke verloskunde registratie]
NCEPOD	National Confidential Enquiry into Peri-operative Deaths
MCH	Medisch Centrum Haaglanden, The Hague the Netherlands
MDG	Millennium Development Goals
MMR	Maternal Mortality Ratio
MOH	Major Obstetric Haemorrhage
MOHSS	Ministry of Health and Social Services
MWH	Maternity Waiting Home
NICE	National Institute for Clinical Excellence
OASIS	Obstetric Anal Sphincter Injuries
O&G	Obstetrics and Gynaecology
PMTCT	Prevention of Mother to Child Transmission
PRN	the Netherlands Perinatal Registry
RCOG	Royal College of Obstetricians and Gynaecologists
SAMM	Severe Acute Maternal Morbidity
STD	Sexual Transmitted Disease
TBT	Term Breech Trial
UN	United Nations
UNFPA	United Nations Population Fund
VBAC	Vaginal Birth after Caesarean Section
VD	Vaginal Delivery
WHO	World Health Organization

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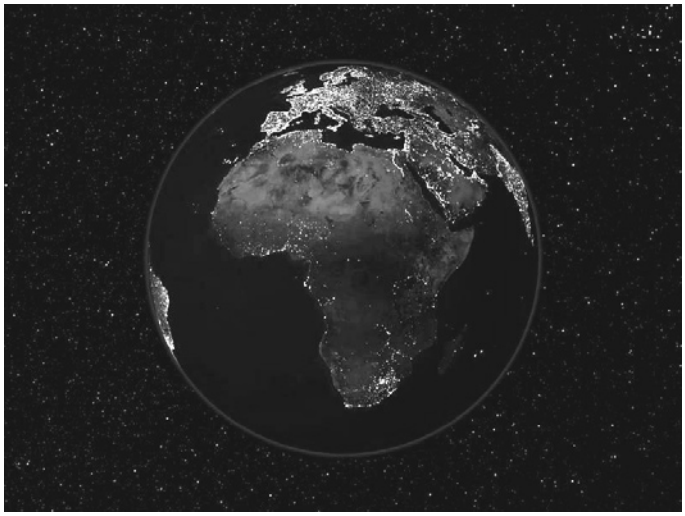

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