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Improving the quality of caesarean section in a low-resource setting

An intervention by criteria-based audit at a tertiary hospital, Dar es Salaam, Tanzania

ANDREW HANS MGAYA

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Abstract
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A sharp increase in caesarean section (CS) rates at the Muhimbili National Referral Hospital (MNH) – a tertiary referral hospital in Tanzania – by 50% in 2000–2011, was associated with concomitant increase in maternal complications and deaths and inconsistent improvement in newborn outcomes. The aims of this thesis were to explore care providers' in-depth perspective of the reasons for these high rates of CS, and to evaluate and improve standards of care for the most common indica-tions of CS, obstructed labour and fetal distress, which are also major causes of adverse maternal and neonatal outcomes.

This thesis reports an investigation performed at MNH, Tanzania. For Paper I, qualitative methods were employed and demonstrated how care providers dismissed their responsibility for the rising CS rate; and, instead, projected the causes onto factors beyond their control. Additionally, dysfunctinal teamwork, transparency, and previous poorly conducted clinical audits led to fear of blame among care providers in cases of poor outcome that subsequently encougared defensive practise by assigning unnecessary CS. Papers II and III evaluated standards of care using a criteria-based audit (CBA) of obstructed labour and fetal dis-tress. After implementing audit-feedback recommendations, the standards of diag-nosis of fetal distress improved by 16% and obstructed labour by 7%. Similarly, the standards of management preceding CS improved tenfold for fetal distress and doubled for obstructed labour. The impact of the CBA process was evaluated by comparing the maternal and perinatal outcomes categorized into Robson groups (Paper IV) of all deliveries occurring before and after the audit process (n=27,960). After the CBA process, there was a 50% risk reduction of severe perinatal morbidi-ty/mortality for patients with obstructed labour. The overall CS rates increased by 10%, and this was attributed to an increase in the CS rate among breech, term preg-nancies (Robson group 6), and preterm pregnancies (Robson group 10) that specifi-cally had reduced risk of poor perinatal outcome. The overall neonatal distress rates were also reduced by 20%, and this was attributed to a decrease in the neonatal distress rate among low-risk, term pregnancies (Robson group 3). Importantly, the increased rates of poor perinatal outcomes were associated with referred patients that had higher risk of neonatal distress and PMR than non–referred patients, after CBA process.

In conclusion, the studies managed to educate the care providers to take on their roles as decision-makers and medical experts to minimize unnecessary CS, using the available resources. Care providers' commitment to achieve the best practice should be sustained and effort for stepwise upgrading quality of obstetric care should be supported by the hospital management from the primary to tertiary referral level.

Keywords: Caesarean section, Criteria-based audit, Fetal distress, Obstructed labour, Low resource setting, Robson classification

Andrew Hans Mgaya, Department of Women's and Children's Health, International Maternal and Child Health (IMCH), Akademiska sjukhuset, Uppsala University, SE-75185 Uppsala, Sweden.

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To my family

List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

I. Litorp H, Mgaya A, Mbekenga CK, Kidanto HL, Johnsdotter S, Essén B. (2015) Fear, blame and transparency: Obstetric caregivers' rationales for high caesarean section rates in a low-resource setting. Soc Sci Med, 143:232-240.

II. Mgaya AH, Litorp H, Kidanto HL, Nyström L, Essén B. (2016) Criteria-based audit to improve quality care of fetal distress. Standardising obstetric care at a national referral hospital in a low-resource setting. BMC Pregnancy Childbirth, 16:343.

III. Mgaya AH, Kidanto HL, Nyström L, Essén B. (2016) Improving standards of care in obstructed labour: A criteria-based audit at a referral hospital in a low-resource setting in Tanzania. PLoS One, 28;11(11):e0166619.

IV. Mgaya AH, Kidanto HL, Nystrom L, Essén B. (2017) Optimizing the use of caesarean section in low-resource setting: Criteria-based audit at a tertiary referral hospital in Tanzania. Manuscript.

Contents

Abbreviations

CBA	Criteria-based Audit
CI	Confidence Interval
CTG	Cardiotocography
CS	Caesarean Section
EmONC	Emergency Obstetric and Neonatal Care
FGD	Focus Group Discussion
FIGO	International Federation of Gynaecology and Obstetrics
IDI	In-depth Interview
IPPM	Intramural Private Practice Management
MNH	Muhimbili National Hospital
MoH	Ministry of Health
MMR	Maternal Mortality Ratio
MUHAS	Muhimbili University of Health and Allied Sciences
NHIF	National Health Insurance Fund
OR	Odds Ratio
PI	Principal Investigator
PMR	Perinatal Mortality Rate
QI	Quality Improvement
RMCAH	Reproductive Maternal, Child and Adolescent Health
TDHS	Tanzania Demographic Health Survey
UNICEF	United Nations Children's Emergency Fund
UNIPF	United Nations Population Fund
VE	Vacuum Extraction
WHO	World Health Organization

Definitions of terms

Caesarean section rate	Number of caesarean sections divided by the total number of deliveries
Clinical audit	A systematic and critical analysis of the quality of medical care, including the procedures used for diagnosis and treatment, the use of resources and the resulting outcome and quality of life for the patient
Criteria-based audit	A clinical audit procedure whereby stakeholders initially agree on realistic criteria of good quality of care following adaption and modification of universal guidelines to suit achievability and use of available resources
"Kaizen"	A practice to achieve highest performance through continuous improvement, "change for better"
Maternal death	Death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (WHO)
Neonatal distress rate	Number of live births with Apgar score < 7 at 5 minutes after birth divided by the total number of live births
Robson group	Women allocated into one category according to the Robson classification system of deliveries
Perinatal period	Fetal period from 28 weeks of gestation age to early neonatal period of 7 days of life.

Perinatal death	Defined as stillbirth of more than or equal to 28 weeks of gestation and early neonatal deaths of 7 days of life
Quality of care	Defined as the extent to which health care services provided to individuals and patient populations improve desired health outcomes in terms of them being performed “safely, efficiently, effectively, timely, equitably and people-centered” (WHO)

Preface

The most challenging and stressful event as an obstetrician in the low-resource setting is facing the death of a mother or a newborn. Each death has a uniquely sad but useful story to tell that provides an opportunity for preventing further suffering and deaths during childbirth. Despite having a passion for understanding and supporting life since my childhood, and the opportunities I have had as a doctor to save lives, every maternal and newborn death that I have witnessed has left a unique memory that gave me a chance for reflection on what went wrong and how I could have done better. Knowing how many mothers and newborns suffer and die during childbirth is not enough; but rather, I have a need to understand the underlying the operational factors that led to these unfortunate but, most of the time, avoidable events, and take action.

Over the years of my medical training, 1998–2004, I learned and developed an interest in practical clinical solutions, which suited my practice as a registrar in a surgical department and later as an obstetrics and gynecology resident. During my professional life as an obstetrician, I realized that being practical is effective but not necessary efficient, especially in low-resource settings where there is limited quality of maternal and newborn care, in terms of safety, timeliness and patients' desire. These shortfalls were the enforcers of my journey in becoming a clinician researcher. Since 2005, when I was employed at Muhimbili National Referral Hospital, quality assurance in clinical care has been based on skills transfer from senior to junior, strict adherence to clinical guidelines, and traditions of professional ranking that partly led to my dependence on the opinion of my seniors. Furthermore, research was mainly for academic rather than clinical purposes. Over time, obstetric interventions were a routine with limited measurability due to limited standards of care that were of relevant evidence. Hence, the safety, effectiveness and efficiency of emergency obstetric and neonatal care was compromised, including the benefits of caesarean section. Despite economic limitations being the apparent reason for poor maternal and newborn care, lack of prioritization and appropriate allocation of health resources plays a major role in limiting the benefits of investments in maternal and newborn care. Evidently, previous studies at the hospital showed that increased rates of caesarean section were associated with high risk of life-threatening events rather than providing benefit during childbirth. This was the basis for my doctoral studies that aimed to optimize caesarean

section by creating standards and a sustainable process of measuring and intervening in quality of care, not only during caesarean section, but also during other emergency obstetric and neonatal interventions, as obstetric interventions are maximally effective when integrated.

The greatest achievement of my doctoral fellowship is the capacity-building it generated for the hospital and myself as a care provider in standardizing, measuring and intervening in the process and outcomes of maternal and neonatal care, despite its complex dimensions. I believe that avoiding maternal and newborn deaths is possible, even in low-resource countries; but it requires commitment and the right kind of information on which to base interventions to improve care.

Introduction

Caesarean section (CS) in obstetric care

Improvement of the quality of obstetric care has been regarded as a prerequisite for preventing maternal and perinatal mortality [1]; and hence, the most urgent and cost-effective ways to reduce the mortality. Substandard care, especially in low-resource settings, accounts for nearly 300,000 maternal deaths [2] and 3 million neonatal deaths [3] annually, of which one-third include intrapartum stillbirth for each year [4]. Causes of maternal death include excessive haemorrhage, infection, and obstructed labour; and for neonatal deaths, include intrapartum events such as asphyxia, infection, and prematurity [4]. Therefore, effective reduction of the mortality rate can be achieved if interventions in low-resource settings focus on prioritizing intrapartum care strategies. Specifically, the improvement of quality of care should include upgrading emergency obstetric and neonatal care (EmONC) within the existing health care system [5,6].

Caesarean section (CS), as part of comprehensive EmONC, is a life-saving surgical procedure in case of complications during pregnancy and delivery. Being a major surgery, CS is associated with immediate maternal and perinatal risks that are still being investigated [7-9]. Nonetheless, CS has been regarded as an indicator of maternal and perinatal health care coverage [10]. The worldwide average CS rate is 19% of all births, ranging from 6% to 27%. North America, Latin America and the Caribbean region have the highest CS rate (30%–40%), followed by Europe (25%), Asia (19%) and Africa (7.3%) [11]. The high CS rates seen in developed countries [12] can also be found in urban institutions in Africa: 22% in northern Tanzania [13], 24% in Ethiopia, 38% in Nigeria [14, 15], 38% in Kenya [16], and 60% in South Africa [17]. However, one of the most urgent problems in obstetric care in developing countries includes unmet need for CS, due to extreme variation in access to CS within and between countries [18,19]. This implies that the low CS rates in rural regions of Tanzania [20] and other sub-Saharan African countries [21] not only reflect poor access to obstetric care, but also indicate health inequity locally and globally. Furthermore, the healthcare benefits of high access to CS are markedly dependent on the rational use and timeline of intervention after making the decision to perform CS [22-24].

Trends of CS and associated birth outcomes in Tanzania

General overview

Since the year 2000, the national CS rate in Tanzania has stood at 5–7%, with variation between regions, populations and health facilities [20]. The majority of CSs are decided after the onset of labour, and CSs are more common in urban than in rural areas (12% and 4%, respectively). Women with formal education and a high wealth index are more likely to deliver by CS compared to their counterparts. Nevertheless, there is a large disparity of EmONC services between regions. In Katavi, 5% of women, compared to 78% in Dar es Salaam, delivered in a health facility that has a fully functioning EmONC. The business city of Dar es Salaam has the highest average CS rate (17%) compared to the more remote regions, such as Katavi and Simiyu, each of which has a CS rate of 1% [26]. This is a testimony to the unmet need of comprehensive EmONC, especially CS in remote and rural health facilities.

Between 2005–2010 and 2010–2015 [20, 25], the CS rate in Tanzania increased by 1%, while the maternal mortality ratio (MMR) varied between 454 and 556 maternal deaths per 100,000 live births, and the perinatal mortality ratio (PMR) increased from 36 to 39 perinatal deaths per 1000 live births. However, the neonatal mortality ratio decreased (from 26 to 23 neonatal deaths per 1000 live births). This reduced neonatal mortality ratio highlights the success in upgrading newborn care. However, the relative increase in MMR and PMR that is demonstrated in the national dermographic health survey in 2010 and 2015/16 indicates persistent suboptimal intrapartum care and poorly integrated EmONC; and hence the limited benefits of EmONC interventions [26].

At Muhimbili National Referral Hospital (MNH), the highest referral hospital in the Dar es Salaam health system, the CS rate rapidly increased from an average of 20% in 2005 to 55% in 2015 (MNH Obstetric database, 2015), as confirmed by a previous study [27]. During this time, MNH continuously improved clinical routines, and maternal and perinatal death audits became a standard practice. The Dar es Salaam referral system guidelines were revised and ambulance services were improved to reduce the risk of severe morbidity as patients travel and receive care through the referral system. The revised guidelines include the channeling of cases from primary referral level in and outside Dar es Salaam directly to MNH, instead of to secondary referral level hospitals (regional hospitals) when these hospitals are relatively further from the referral point compared to MNH. Improvement of the referral system strengthened the structure of care by increasing the availability of the ambulance service, providing training to care providers, and improving quality assurance procedures within hospitals, including the introduction of hospital quality improvement teams and procedures such as *"kaizen"*; and by conduct-

ing regular quality of care evaluations, including those related to infection prevention and EmONC. However, the evolving structure of care did not include adequate investment and prioritization of health resources in equipping hospitals, nor did it include the expanding of EmONC services in district and regional hospitals in accordance with the growing population in the Dar es Salaam health system. This led to limited access to CS (6–7%) and vacuum extraction (VE) (about 1%), and, at different times, a lack of antibiotics and blood transfusion in the regional and district public hospitals. Hence, the number of CS-related complications was higher at the referring points compared to MNH (22 vs. 7/1000 operation) [28]. No recently published data on MMR and PMR in the regional and district hospitals are available. However, in 2007, the MMR was 218/100,000 live births (range 0–385) and PMR was 44/1000 births (range 17–147) [29]. Suboptimal structure and process of care at the regional and district hospitals dramatically increased the number of referred obstetric cases to MNH obstetric wards commonly in need of CSs, blood transfusion and intensive care. Further studies assessed the reasons for increasing CS rates at MNH and found that the rising rates of CS also involved low-risk pregnancies [27]; and, therefore, the findings raised questions as to whether the decisions to perform CS at the referral points and MNH were appropriate.

Women and care providers' role in decision to perform CS

CS on maternal request implies patient choice for caesarean delivery, or CS on demand without maternal or fetal indications [30,31]. Maternal request for CS is only evident in a minority of recently published meta-analyses, and from mainly high- and middle-income countries [32]. In Tanzania, information on the magnitude of maternal requests for CS is limited. However, most women at MNH receive counselling about CS, for the first time, during admission or when abnormal labour is detected, instead of being made aware of the possibility of having a CS at an antenatal care clinic. Informing women at the antenatal clinic about the possibilities of CS in case of abnormal labour provides a better opportunity for causing less anxiety than hearing about it for the first time when experiencing labour pains. Thus, women do not receive adequate counselling in order to make an informed choice. Onkonkwo and co-authors [33] and Litorp and co-authors [34] found maternal request for CS to be associated with private patients and women who have a fear of losing a child. This study also demonstrated how mothers' and care providers' anxiety and high desire to deliver a healthy baby can lead to unnecessary CS, even at the risk of the mother's health. Anxiety, as a reactivity mechanism, was suggested by McGivern and Esparland [35,36] to be the cause of unneccessary and defensive medical interventions that favour good staff assessment over good client outcomes. In order to reduce unnecessary CS and encourage care providers to meet the obligation of ensuring that the decisions for CS is based on

informed choice and evidence, an in-depth understanding of care providers' rationale for increasing use of CS was essential. In conclusion, a systematic analysis of the decisions related to performing CS and the quality of care preceding CS, based on the most common indications of CS, is necessary to ensure that CS is performed for women in need, especially in low-resource settings.

Most common indications of CS: Obstructed labour and fetal distress

In general, the main medical indications for CS include obstructed labour, fetal distress and previous uterine scar [37-40], whereas, in MNH, the most common indications are previous uterine scar (30%) followed by obstructed labour (15%) and fetal distress (13%). Additionally, unnecessary primary CS increases the likelihood of CS in subsequent pregnancies and, therefore, is a determinant of CS with previous uterine scars. Organisational and structural changes aimed at avoiding the primary CS have a pivotal role in reducing unnecessary CS [41]. Obstructed labour and fetal distress are also important causes of maternal and newborn severe morbidity. This implies that evaluation of the most common indication of primary CS, obstructed labour and fetal distress, is the most appropriate entry point for optimizing CS in this setting, Tanzania. Because the most common causes of maternal and neonatal deaths include obstructed labour and its complications, haemorhage, sepsis and fetal distress [20], quality improvement activities in the management of obstructed labour and fetal distress will also prevent avoidable severe maternal and perinatal morbidity, not only at MNH, but also in general in the rest of Tanzania.

The prediction of obstructed labour before the onset of labour is difficult. Predictors such as height, nulliparity and age at marriage have shown low predictive value as screening tools [42]. Therefore, accurate diagnosis is based on partographic assessment indicating how the presenting part descends through the birth canal with regular uterine contractions. Because relief of obstructed labour requires CS (90%) or assisted delivery by VE (10%), inappropriately assigned or denied CS or VE significantly contributes to severe maternal and perinatal morbidity, especially in low-resource settings [28].

The diagnosis of fetal distress has as low level of predictability as that of obstructed labour [43]. Limited availability of fetal blood gas analysis and lactate testing at MNH and in Tanzania in general makes the diagnosis of fetal distress dependent on the care providers' experiences of detecting neurological and cardiovascular signs of fetal acidosis. These include the abnormality of fetal heartbeats, reduction in movement, and fresh meconium-stained liquor [45-46]. Nonetheless, the sole presence of abnormal fetal heartbeat or reduced fetal movements [47] or meconium stained liquor [48, 49] does not imply fetal

distress, or a need for CS. Additionally, normal fetal heartbeats may not exclude the possibility of fetal distress [50]. Detecting fetal distress requires vigilant fetal monitoring for abnormal heart rate patterns [51] and evidence of acidosis [52] through tests that have proved to be efficacious and available within the health system [53,54]. Because one of the major complications of obstructed labour includes fetal distress, a higher impact can be achieved when efforts to improve the delivery outcome focus on improving quality of decision and management preceding CS for both obstructed labour and fetal distress.

Numerous audits managed to improve the care of obstructed labour [55,56], however, the criteria of standard care that was used was rather general and based on the inclusion of late signs or complications of obstructed labour. Additionally, to my knowledge, there is no previous research or universally standardized tool for the diagnosis of fetal distress. Despite similarities in international and national guidelines relating to the diagnosis and management of obstructed labour and fetal distress [57,58], local strategic action for good quality care highly depends on the availability of health resources. Therefore, in order to adequately prevent labour-related maternal and perinatal morbidity and mortality, these strategic action should include the prioritization and investment of resources for adequately monitoring of pregnancies [59] and providing safe, timely, patient centered evidence-based interventions during childbirth [60].

Quality of intrapartum care

Despite differences in the means to achieve the best obstetric outcome, the notion of best practice in obstetric care is universally relevant. Both high- and low-resources settings strive for unlimited access to maternal and newborn care within universal standards, but variability in levels of access to EmONC resources from one facility to another accounts for disparities in the implementation of its interventions, including the optimization of CS [61]. In Tanzania, obstructed labour still remains one of the major causes of maternal mortality [62] and perinatal mortality due to fetal distress [63], either as part of obstructed labour or independently as a result of substandard intrapartum monitoring [60]. Hindrances to achieving universal standards of intrapartum care include: limited access to modern fetal monitoring, including Fetal dopplers, and Lactates test for fetal acidosis [51,64]; lack of accesible evidence-based clinical guidelines [65,66]; and the limited skills of care providers in intrapartum monitoning, including the use of a partogram [59,67].

In 2012, previous studies conducted in Tanzania reported evidence of substandard intrapartum care contributing to 6% of labour-related maternal deaths [68] and 30% of perinatal mortality due to intrapartum asphyxia of a large proportion of term deliveries [67], of which more than half of newborn deaths occurred in rural settings [69]. Recent cross-sectional [65,66] and a qualitative

studies [34] carried out at MNH, which is located in an urban setting, revealed findings that included substandard decision to perform CS, poor fetal monitoring, delayed timeline of interventions, limited assisted vaginal deliveries, and inadequate use of partogram, as the main reasons for incidences of substandard care. Since then, there has been no recent study showing the current situation; and thus, this provides an important reason for conducting a more current assessment of intrapartum quality of care.

Optimization of caesarean section

General overview

Optimizing CS includes deliberate action for the rational and timely decision and performance of CS, in order to achieve good delivery outcomes. Most authors argue against an optimal CS rate [19,43,69] and instead suggest that the variation of CS rates between delivery units is dependent on their obstetric population, obstetric performance, and referral pattern [12]. As a strategy to increase health care coverage, some African countries have increased access to CS by reducing payment for the procedure [12], while others use CS as a performance indicator in obstetric care [29]. High CS rates imply inappropriate use of health resources [70] due to the high cost of the procedure, and also impose high costs on the families [34, 71] and health system [72]. Furthermore, as a major abdominal surgical procedure, CS has an increased risk of excessive blood loss, risk of blood transfusions and associated reactions, high rate of postoperative infection, and thromboembolic events [23]. Particularly in limited resource settings, unnecessarily performed CS deflects health resources from those in need; thus imposing avoidable risk of labour-related complications such as obstructed labour and subsequent genital fistula [73, 74], uterine rupture [55], puerperal sepsis [68], and postpartum haemorrhage [75]. Birth asphyxia and perinatal death can also occur, either as a complication of neglected obstructed labour or uterine rupture. Therefore, the accuracy of the decision to perform CS and the quality of subsequent care, including triage, resuscitation and timely interventions of pre- and post-operative management, are more important determinants of maternal and perinatal outcomes than the CS rate itself.

The WHO statement on CS rates

In 1985, the World Health Organization (WHO) considered the “ideal rate” for CS to be between 10% and 15% [10]. This implies that a CS rate within this limit can sufficiently prevent labour-related poor outcomes. The concept of an “ideal rate” led some countries to increase their use of CS, presuming that there are maternal and perinatal benefits at that target rate. However, the

WHO has recently (2014) re-concluded that there is no additional maternal and perinatal benefit with a population-based CS rate exceeding 10%. Particularly in settings that lack facilities to properly conduct safe surgery, CS can cause disability or death. It is important to note that low CS rates also imply limited access to intrapartum care. Therefore, health systems should introduce quality assurances that monitor and harmonize the CS rate and balance its benefits and harm, thus ensuring that the performed CSs are demand-driven.

Criteria-based audit: a clinical audit for improving quality of CSs

Optimizing CS with respect to locally applicable evidence regarding the process of clinical decision making, implications of physician and patients' autonomy, and hospital practice and protocols, has been widely advocated [43,76]. Such interventions include the use of evidence-based clinical guidelines and regular clinical audits [77,78]. A clinical audit is a systematic and critical analysis of the quality of medical care, including the procedures for diagnosis and treatment and the use of resources, and quality of life for the patient [79]. The constraints of using clinical audits in low-resource settings include uncertainty in the feasibility of universally defined criteria in case selection and agreement of standard practice. Documentation may also be unavailable and inadequate to assess the agreed standard of care criteria. Furthermore, an inadequate level of resources may lead to uncertainty about the positive impact of the feedback and setting of standards. These factors could limit the generalization of the audit findings and/or limit the improvement of care in clinical audit, but also emphasize the importance of the criteria-based audit (CBA) [80,81].

CBA is a type of clinical audit, it is a quality improvement tool that stipulates that the providers adhere to an agreed concise checklist of criteria for promoting good quality care [6] based on the available local resources [82] (Figure 1). From high- to low-income countries, clinical audit has successfully optimized EmONC interventions, including the use of CS and VE [77,78]. Other efforts to optimize use of CS include active management of labour, continuous medical education for healthcare professionals, encouraging vaginal birth after CS, implementing clinical guidelines, mandatory second opinion, and higher financial incentives for vaginal delivery than CS [83,84]. Nonetheless, the effectiveness of these strategies requires continuous systematic monitoring of each intervention with corresponding delivery outcomes based on mutually exclusive obstetric groups. In this way it is easier to establish what works, what does not work and how to make improvements.

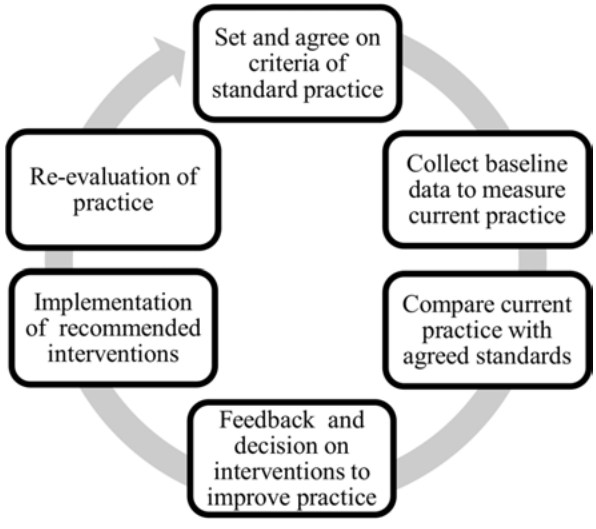

Figure 1. Criteria-based audit cycle [85]

Robson classification system

The Robson classification of CSs (Table 1) is a simple tool that provides robust, reproducible and flexible means of classifying women into clinically relevant mutually exclusive categories, which facilitates the implementation and evaluation of obstetric interventions. This classification can estimate both the rationale for performing CS and the impact of maternal characteristics to maternal and perinatal outcomes, rather than the evaluation of the indications of CS alone. The use of the Robson classifications also allows the monitoring of trends and outcomes of CS within and between health facilities; and hence, fulfils current international and local needs to develop a universally applicable CS classification system. Other classification systems that are based on maternal characteristics, such as, but not limited to, Cleary's "standard primipara", Denk's 8 groups, and the Lieberman classification system, only categorize women according to their background characteristics but have shown to be more difficult to implement due to a lack of clarity and mutual exclusiveness [86].

However, a limitation of the Robson classification is that it disregards the degree of urgency and concomitant maternal life-threatening conditions, which are essential for effective triage and timing of the CS intervention. Therefore, it is important to integrate the Robson classification into an obstetric database that can complement other important determinants of patients' outcomes, including demographic characteristics, prior management history, and type and timeline of intervention as the patient travels through the referral system, thus providing an adequate analysis and clear understanding of why, when, where, how and on whom CS are being performed.

Table 1. Robson classification system [43]

Robson 1 Nulliparous, singleton, cephalic, ≥37 weeks' gestation, in spontaneous labour
Robson 2 Nulliparous, singleton, cephalic, ≥37 weeks' gestation, induced labour or caesarean section before labour
Robson 3 Multiparous (excluding previous caesarean section), singleton, cephalic, ≥37 weeks' gestation, in spontaneous labour
Robson 4 Multiparous without a previous uterine scar, with singleton, cephalic pregnancy, ≥37 weeks' gestation, induced or caesarean section before labour
Robson 5 Previous caesarean section, singleton, cephalic, ≥37 weeks' gestation
Robson 6 All nulliparous with a single breech
Robson 7 All multiparous with a single breech (including previous caesarean section)
Robson 8 All multiple pregnancies (including previous caesarean section)
Robson 9 All women with a single pregnancy in transverse or oblique lie (including those with previous caesarean section)
Robson 10 All singleton, cephalic, <37 weeks' gestation pregnancies (including previous caesarean section)

Tanzanian health system and services

Health system

Health facilities in the public health system in Tanzania consist of primary health care health facilities, including dispensaries (87%) and health centres (10%), and referral health facilities, including district, regional, zonal and national referral hospitals (3%) [20]. Other complementary facilities in primary health care include community health units, pre-natal nursing homes, and outreach mobile clinics that provide health services in areas with limited access to a dispensary or health centre (Figure 2). In order to prevent poor mobility to maternal and perinatal care, which is associated with delays in reaching care, communities that have low coverage of dispensaries and health centre services usually have temporary maternity waiting homes for women nearly

at term, so that they are closer to either a dispensary or health centre that conducts deliveries. There are also mobile clinics that are based on the outreach activities of the district, regional, zonal or national referral hospitals, according to the needs of the communities, which provide either primary health care or specialized care. These include screening for diseases of community importance, health education and blood donation. Furthermore, public-private partnerships allow private hospitals, under an agreement with the government, to provide health services as designated district hospitals or zonal/consultant hospitals.

The community health unit is the lowest primary health care delivery point and is staffed by a trained villager who has completed a short course in primary health care, and hence provides preventive and outpatient care, including community health education, basic first aid, care of low-risk women, risk detection, and referral to dispensary. Dispensaries provide second-level primary health care and supervise all the community health posts. Normal deliveries are conducted in the dispensary and few beds are available for medical observation during treatment or before referral. Staff at the dispensaries includes a clinical officer, nurse/midwife, and a rural medical aide. Currently, each village has at least one dispensary within a distance of 10 kilometers. Cases that cannot be managed at the dispensary level are referred to the health centre that admits patients and provides basic EmONC, including VE. Staff at the health centre include assistant medical officers, clinical officers, nurse/midwifes, and rural medical aides. Each ward has at least one health centre within 10 kilometers. Particularly in Dar es Salaam, health centres have been upgraded to district hospitals in order to meet the high demand of health care, especially the provision of comprehensive EmONC that, in addition to basic EmONC, CS and blood transfusions, can be performed.

District hospitals, acting as the referral facility for health centres, are staffed by medical specialists, qualified medical doctors holding a degree in medicine, or assistant medical officers with an advanced diploma in medicine. District hospitals, as the first referral level, include designated private hospitals that receive partial financing and seconded staff from the government on contract terms. District hospitals refer patients to regional hospitals that ought to be situated in each of the 31 regions of Tanzania. However, because of a lack of these regional health facilities, some private hospitals are designated as regional hospitals on contract terms with the government. Uniquely, in Dar es Salaam, the municipal/district hospitals have been upgraded to regional hospitals. Thus, three regional hospitals, Temeke, Mwananyamala, and Amana, are located in the three administrative regions that form Dar es Salaam city. The regional hospitals serve as secondary referral centres for district hospitals. Due to a shortage of educated medical personnel, some district hospitals do not have a medical specialist as the regional and national referral hospitals do.

The consultant hospitals constitute the highest referral level and teaching hospitals, each having specialized services and sub-specialty experts. There are five tertiary referral facilities; the Muhimbili National hospital (largest), the Mbeya referral hospital, the Bugando referral hospital, the Kilimanjaro Christian Medical Hospital, and the Benjamin Mkapa referral Hospital. At the top of the health pyramid is the Ministry of Health (MoH) that is responsible for the referral of patients to hospitals abroad. It is the highest regulatory and policy-making authority in health care and social welfare. The health system pyramid (Figure 2) denotes the decrease in the number of health care seekers the higher the hierarchy of heath facility.

A recent survey [87] has shown that there are at least 60 health care facilities capable of EmONC per 500,000 people. However, only 60% of these facilities are at a travel distance to a referral point for further advanced EmONC of less than or equal to 2 hour by car in dry season. Furthermore, only 10% of these facilities have functional basic or comprehensive EmONC within the past 6 months. Uneven distribution of the health facilities contributes to sub-standard EmONC and hence persistency high maternal and perinatal morbidity and mortality rates.

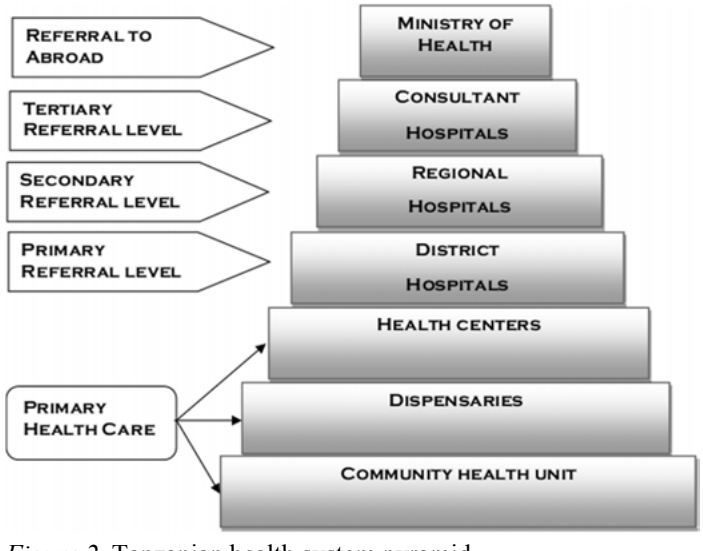

Figure 2. Tanzanian health system pyramid

Relevant national health care policies and programmes

The MoH is the leading health policy-maker and the regulatory body of both public and private health facilities and services. Thus, it is responsible for enhancing the prioritization of health needs and widening the coverage of high quality health care. Some of the health policies relevant to maternal and child health include, but are not limited to, health care payment exemptions policy,

cost sharing of health services policy, and health insurance policy [64]. Under the exemptions policy, pregnant women, under-5 children, older people (70yrs and older), and those suffering from chronic illnesses such as diabetes, tuberculosis, leprosy, or HIV/AIDS, are exempt from the cost of medical services. The cost-sharing policy involves all Tanzanian nationals seeking medical care in public health facilities, where the government takes only part of the health care cost and the remainder remains the responsibility of the clients/patients. The National Health Insurance Fund (NHIF) has been made mandatory for all government employees and optional for employees in the private sector. The health insurance system covers all treatment and investigations available in the country. However, its effectiveness has been diminished by inconsistent availability of drugs, supplies and equipment in public hospitals [88-90]. In public health facilities, including MNH, Intramural Private Practice Management (IPPM) was established, a system in which patients are managed in a similar way to those in the public payment-exempt, cost-sharing and health insurance categories, except that they pay for medical care and additionally received services, such as comfortable accommodation, and the privilege of being attended by a specialist of their choice.

The MoH has developed national health programmes to give direction and philosophy for long-term health care goals. The health programmes were also designed to implement health policy and health-related interventions. This provides a framework for the provision, monitoring, and evaluation of reproductive, maternal and child health. The planning and implementation of programme activities includes participation of the community, local government, and non-government and private sector partners, and the central government health-related ministries, departments, and agencies, especially the Regional administration and local government authority. However, programme implementation has frequently not been a priority and are under-budgeted; hence, poorly implemented [89,91]. In 2007, the Primary Health Care Service Development Program (2007–2017) [92] was established with the aim of accelerating the provision of primary health care services for all by 2012, while the remaining 5 years of the programme was focused on the consolidation of its achievements. The major areas addressed included the strengthening of health systems, rehabilitation, human resource development, the strengthening of the referral system, health sector financing, and the provision of medicines, equipment, and supplies. This was a programme that addressed equity in health by increasing the coverage and quality of primary health care services, including maternal health services for communities in rural and remote areas. However, limited resources and insufficient prioritization of health care led to partial success of the programme, as MMR and PMR increased between 2010 and 2015 due to persistent substandard care provision during delivery and disparity in the quality of EmONC between the health facilities and regions. It is, therefore, important to improve the quality of health care at the health facilities level.

Strategies to improve reproductive health

In order to improve reproductive health with specific focus on the reduction of maternal and child deaths, crosscutting strategies were also introduced to operationalize the policies and programmes for the period 2015 to 2025. These includes the National Road Map Strategic Plan to Improve Reproductive, Maternal, Newborn, Child, and Adolescent Health–One Plan II (2016–2020) [93], which is a national post-MDG strategy seeking to improve reproductive, maternal and child health by promoting a 20% reduction in maternal and neonatal mortality rates in five identified priority regions of the lowest socioeconomic status by 2017–18. The activities for achieving the stated objective include, but are not limited to, the expanding of basic and comprehensive EmONC, the construction of blood bank facilities at the regional level, and the development of integrated mass media campaigns through public-private partnership. The reproductive, maternal and child health services include family planning, antenatal care, labour and delivery, and care during the postnatal period for both mother and the newborn. Additionally, there is also the Tanzania Development Vision 2025, which aims to improve access to quality reproductive health services for all individuals to reduce infant and maternal mortality. Lastly, the Health Sector Strategic Plan IV 2015–2020 (HSSP IV) also addresses the importance of reducing maternal and child morbidity and mortality.

Conceptual framework: WHO statement of Caesarean Section rates

The conceptual framework of the studies is based on the WHO statement on CS rates in 2014 that stated: "Every effort should be made to provide CS to women in need, rather than striving to achieve a specific rate" [94]. This statement implies that CS is an effective means for saving the life of the mother and newborn, when medically indicated. The recommendation aligns with the WHO framework of quality of maternal and newborn care that places an emphasis on the evaluation of care based on the structure of the health system, the quality of the process of provision and experience of care, the effect of the outcome of care on individual patients, and the functioning of the health facility (Figure 3) The same approach can be used to evaluate and intervene in the appropriate use of CS based on its quality rather than quantity. Using this framework to address optimization of CS necessitates the implementation of quality improvement interventions: a) using evidence-based practice during labour, and when managing complications of labour; b) by competent and motivated staff; c) by using the health information system to ensure early, appropriate action to improve the care; d) by respecting and preserving women's dignity and engaging measures for effective communication; and e) that care

is provided in an appropriate physical environment that has appropriate technology, medicines and supplies [1,60]. These measures are intended for health care professionals, policy-makers and collaborating partners in health care when operationalizing the WHO statement on CSs based on a quality of care perspective. Therefore, a systematic and continuous evaluation of the accuracy of the decision and the effects of the interventions during and after making the decision to perform CS at health facility level, is essential. Doing so demands the assessment and monitoring of the safety, effectiveness, efficacy, and patient-centeredness of the interventions preceding and during CS. Such a multi-dimensional descriptions of the quality of CSs also requires full engagement of the care providers and the management team at the hospital; hence, CBA was chosen as the quality improvement tool for the optimization of CS at MNH.

CBA is an effective means of systematically analysing the rationale for making decisions to perform CS, detecting the associated immediate and long-term medical effects of unnecessary CS, and, finally, implementing strategies to rectify deficiencies in care based on available research evidence and resources. Early involvement of the care providers and MNH management during the CBA process at MNH was aimed at reducing natural resistance to change [95]; and, therefore, to assure the sustainability of the quality of care interventions. Because quality improvement of maternal and newborn care demands a change of routine practice, care providers are key players in the quality improvement activities. In this thesis, the upgrading of the management of care preceding CS and subsequent interventions during CSs also required new investment in EmONC health care, as the interventions were performed in a low-resource setting. Importantly, the sustainability of continuous assessment and intervention required a deeper understanding of the care providers' and hospital administration's perspectives of the high CS rates beyond the statistical measure of care, and this was achieved by reflecting their perspective and desired care. Hence, a qualitative evaluation was used to determine the care providers' point of view, as well as of informing them of the determinants of optimal use of CS, so that they could positively perceive and perform the subsequent quality improvement interventions.

The optimization of CS depends on the availability of an effective health information system that can be used to measure quality of EmONC [86], including CS. Thus, the effectiveness and sustainability of interventions designed to improve the use of CS requires a standardized monitoring tool to keep track of trends in CS rates and associated maternal and perinatal outcomes within health facilities and between other facilities that use similar systems, over time. The Robson classification system is a universal tool that was used to analyse the use of CS, focusing on specific groups of women based on obstetric characteristics that are also determinants of maternal and fetal risks in EmONC interventions. This means that groups of women who had an inappropriate CS rate based on obstetric characteristics and/or maternal and

newborn outcome raised the alarm for audit-feedback. However, the clinical status of women, prior obstetric history and treatment before admission, are also important in making the decision to perform CS and the delivery outcome, and thus necessitate the integration of the Robson classifications in the obstetric database. Lessons learned from audit-feedback build the basis for further intervention in the subsequent audit cycles, based on specified groups of patients according to their obstetric characteristics that help to provide a focus on type and timing during pregnancy and childbirth. Continuously upgrading standards and investment in care in each of the cycles eventually achieves universal standards in terms of safety, effectiveness, timeliness, efficiency, equity and patient-centeredness. Patients' opinions on care can be sought through interviews, as was evident in one of our earlier studies [37], which contributed to creating the basis of this thesis.

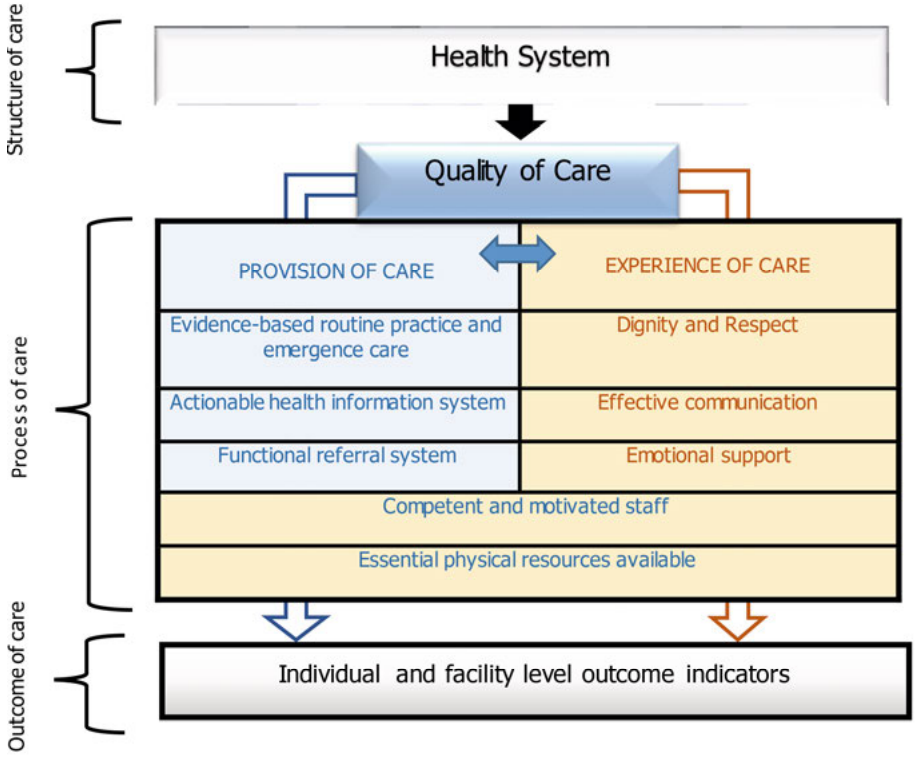

Figure 3. A framework for improving maternal and newborn care, adapted from WHO vision, 2015 [60]

Justification of the study

Quality of care is a critical but unachieved post-millennium development goal in maternal and neonatal care, especially around labour and delivery [96]. At MNH, the rate of CS is currently reaching over 50%, and involves low-risk pregnancies, based on the Robson categories [27]. The best feasible approach to improve the benefit of high access to CS was to undergo a criteria-based auditing process that clearly defined inputs in the structure of service provided, outputs in the process of service provision and the outcome of care, and progress towards achieving desired standards of care. Defining measures of quality of care involving CS is challenging due to the complex interactions of the maternal, neonatal and care providers factors that are perceive to be responsible for the use and outcomes of CS. Because maternal and perinatal outcomes of CS depend on the structure and process of care, it was important to assess both the decision, and subsequent management, preceding CS, due to the most common indications of CS and the major causes of maternal and perinatal severe morbidity: obstructed labour and fetal distress.

The monitoring and evaluation of the effects of interventions preceding CS and the subsequent outcomes of care necessitates a comparison between facilities and changes over time. Therefore, the use of universally standardized quality improvement tools such as CBA and the Robson classification system can assure the reliability and sustainability of the these quality improvement activities that lead to change in clinical practice associated with CS. The integration of the Robson classification into the health information system was not only designed to monitor and evaluate the benefits of CS, but also to improve the quality of routinely collected data and staff awareness of the importance of proper storage and use of routine clinical data. The use of the Robson classification system at MNH has supported a long-standing tradition of audit-feedback [65,79,80], routine maternal and perinatal mortality case review, and previously conducted research on the trends and effect of the rising CS rate at MNH [27, 97].

Research questions

The main research questions are presented in Figure 4. The findings from the first study (Paper 1) led to further research questions that formulated the aims of other studies (Papers II, III and IV).

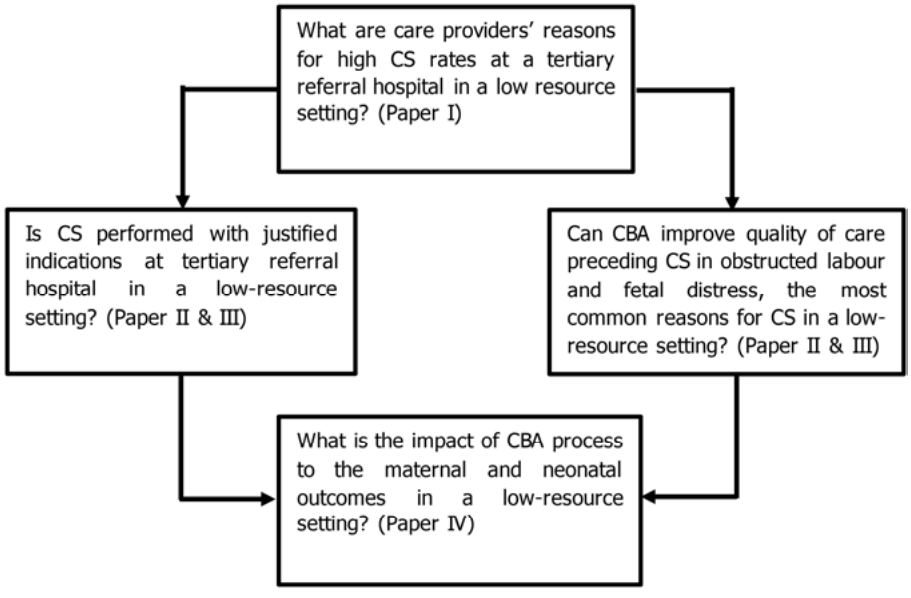

Figure 4. The main research questions of the thesis

Aim

The aim of this study was to improve the quality and the use of CS at a national referral hospital using the available resources, in order to determine what works, what does not work and how to improve the use of CS in a low-resource setting. The specific aims of the studies are:

1. To explore care providers' in-depth perspectives of the reasons for the high rates of CS at the highest referral and university hospital in a low-resource setting (Paper I).

2. To perform a CBA of the diagnosis and management of obstructed labour and fetal distress, as the main contributor of CSs at the highest referral and university hospital in a low-resource setting; and doing so, improve practice using the available resources (Papers II and III).

3. To estimate the impact of a CBA of obstructed labour and fetal distress on the maternal and perinatal outcome, in order to determine what works, what does not work and how to improve it in a low-resource setting (Paper IV).

Material and methods

Study design

This thesis is based on both qualitative (Paper I) and quantitative methods (Papers II, III and IV). The description of the study design, participants, and analysis is presented in Table 2. The different methods that were used in this thesis complemented each other to achieve the overall aims. The first study used qualitative methods that included in-depth interviews (IDIs) and focus group discussions (FGD) with the care providers, in order to adequately explore caregivers' rationale for the high CS rates at MNH (Paper I). The second study was a criteria-based audit that systematically assessed the accuracy of the most common indications of CS: obstructed labour and fetal distress, and the management of care following the decision to perform CS (Papers II and III). Using the audit evaluation findings, a before-and-after study was conducted to evaluate the impact of CBA on the delivery outcomes, including maternal and perinatal outcomes, by Robson groups (Paper IV).

Table 2. Basic characteristics of the studies

Paper	Study design	Data collection	Participants at MNH	Recruitment period	Analysis
I	Qualitative	IDIs, FGDs and participant observation	32 care providers	Jan-June 2014	Thematic analysis
II	Criteria-based audit	Identifying cases from case notes	260 women in the baseline audit and 250 women in re-audit with OL	Nov 2013–April 2014, and July–Oct 2015	Chi-square, Fischer's exact test, and Student's *t*-test
III	Criteria-based audit	Identifying cases from case notes	248 women in the baseline audit and 251 women in re-audit with FD	Nov 2013–June 2014 and July–Nov 2015	Chi-square, Fischer's exact test and Student's *t*-test
IV	Before-and-after	Identified cases from CBA with OL and FD, and all deliveries at MNH 2013–2016	510 women with OL (baseline audit *n*=260, and re-audit *n*= 250 women), 499 women with FD (baseline audit *n*=248, and re-audit *n*=251) and 27,960 women who delivered from 2013–2016	Sep–Dec 2016	Chi-square and Fischer's exact test and logistic regression analysis

FD = Fetal distress, FGD=Focus group discussion, IDI=In-depth interview, MNH=Muhimbili National Hospital, OL= Obstructed labour

Study settings

The studies were conducted at MNH, which is also a university hospital for MUHAS in Dar es Salaam city in Tanzania.

United Republic of Tanzania

Tanzania is a large country in east Africa, covering 945,000 square kilometers, which is almost twice as large as Sweden. Tanzania lies south of the equator and shares borders with eight countries: Kenya and Uganda to the north; Rwanda, Burundi, the Democratic Republic of Congo, and Zambia to the west; and Malawi and Mozambique to the south. The population is estimated at 45 million (National Census, 2012) and continues to be predominantly rural, despite an increase in the proportion of urban residents over time; from 6% in 1967 to 30% in 2012 [64]. Tanzania has 31 regions, of which Dar es Salaam, being the business city, has the highest population, of 5 million distributed in 5 municipalities; Temeke, Mwananyamala, Kinondoni, Ubungo and Kigamboni municipalities (Figure 5). The least populated region is Katavi, which is inhabited by 450,000 people. Tanzania Health indicators are summarized in Table 3.

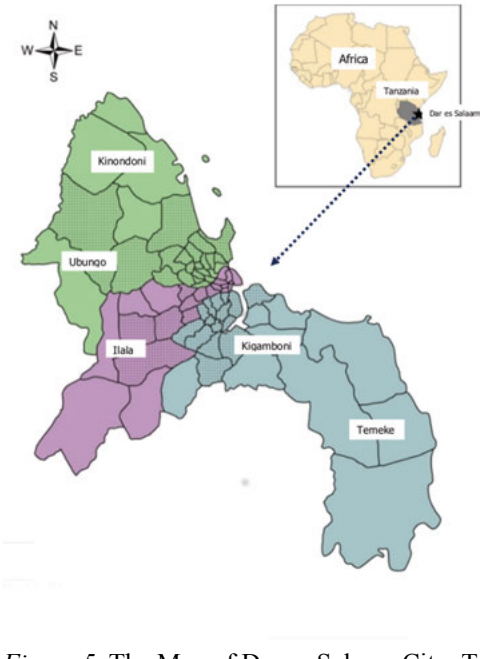

Figure 5. The Map of Dar es Salaam City, Tanzania

Table 3. Summary of health care indicators. Source: TDHS 2015/16 [20].

Health indicator	Estimate
Crude birth rate	372/10,000 women
Fertility rate:	5.2 children/woman
Contraceptive prevalence rate	32%
Infant mortality rate	43/1000
Under-five mortality rate	57/1000
Neonatal mortality rate	25/1000
Maternal mortality ratio	552/100,000
Antenatal care coverage	96%
Delivered by a skilled attendant	64%
Delivered in a health facility	60%

Muhimbili National Referral and University Hospital

All studies were performed at Muhimbili National Referral Hospital (MNH), which mostly serves inhabitants of Dar es Salaam city (National census, 2012) and the neighboring Pwani region. The hospital has a bed capacity of 1500 and attends 1500 to 2000 outpatients per week. There are 2700 employees, including 300 doctors and 900 nurses, while the rest are staff employed in supporting services. The hospital has 25 departments and 10 units for specialized care. The obstetric population consists of referrals from the three regional hospitals in Dar es Salaam, the two rural district hospitals (Mkuranga and Bagamoyo hospital) in the Pwani region, and self-referrals. The national referral hospital delivers 9000–10,000 women annually, has 120 maternity beds and two operating theatres. The hospital receives both public non-paying or cost-sharing patients and private paying and insured patients under IPPM.

Obstetric care at MNH

General overview

According to the Tanzania Demographic Health Survey (TDHS, 2010) [20], the CS rate in Dar es Salaam city and the Coastal region were 13% and 6%, respectively, with both rates higher than the whole country estimate of 5% in 2014. The national referral hospital, MNH, conducts about 9000 deliveries annually, and the CS rate was 36% in 2014 (Obstetric database, MNH). According to the obstetric database, from 2010–2015, the MMR of women who delivered at

MNH increased from 96 to 146/100,000 livebirths, the fresh stillbirth ratio decreased from 32/1000 to 26/1000, and the early neonatal deaths ratio decreased from 27/1000 to 16/1000, respectively.

The main source of obstetric data is the obstetric database [79] that was established in 1998. Information from antenatal care cards and medical records is entered in the midwifery register and then computerized. The midwifery register records the date and time of admission, age, parity, referral status, antenatal care clinic attendance, and reason for admission, time and mode of delivery, indication of CS and delivery outcome (estimated blood loss, Apgar score, birth weight, sex of the baby, and maternal and fetal outcome). The causes of early neonatal deaths based on clinical diagnosis can be traced from the neonatal unit records.

Delivery room procedures

There are two shifts for nurses working in the labour ward, each with six midwives. One consultant, one specialist and two residents are on call every day. The standard fetal monitoring technique is Pinard auscultation and Fetal Doppler. CTG and scalp blood sampling for pH/lactate was not available during the studies. The patient's care management in the delivery room is guided by standard operating procedures, which the care providers have limited access to, that include the mandatory use of partogram and checklists, including a pre-operative checklist.

On admission to the labour ward, all women are seen by a nurse midwife and a brief history, including personal characteristics, next of kin, antenatal history and past obstetrics history, is entered in the partogram. The initial obstetric assessment is routinely performed by a resident/registrar and sometimes the specialist on call. Routinely, hourly pelvic assessment of the progress of labour is conducted by the doctor on call. Nurse midwives perform half-hourly fetal heart rate monitoring using intermittent fetal heart auscultation using the Pinard Fetoscope or the hand-held Fetal Doppler, and they also conduct vaginal deliveries. Women who deliver spontaneously vaginally and without complications are transferred to the postnatal ward for observation for at least six hours before being discharged home. Those who deliver by CS undergo routine pre-operative assessment and preparations using a checklist comprised of the patient's personal particulars, indication for CS, completed informed consent, haemoglobin level, blood grouping and cross-matching, prophylactic antibiotics, preload of intravenous fluid, catheterization, vital signs at decision to perform CS, the time the decision was made and the time the patient actually left for theatre, and the nursing intervention report. According to the departmental protocol, all decisions to perform CS should be made in consultation with or by a specialist.

Accountability and quality assurance in obstetric care

Daily morning meetings are conducted where residents and interns report all emergency cases that were admitted in the past 24 hours to the maternity wards. Prior to the doctors' meeting, a midwives' morning report and nurses' shift handing-over sessions take place. The morning meetings are chaired by a specialist. The presentation and discussion in these meetings includes the number of deliveries (categorized by mode of delivery, referral category and place of referral), the outcome of each delivery, patients who are reported as being in a serious condition in the wards, and any other problems that have affected patients' management in the past 24-hour call. All CSs, neonatal distress, stillbirths and maternal deaths are presented in detail, case by case, so that areas of deficits in management are addressed and recommendations are made.

Since 1973, maternal death audits have been conducted monthly to quarterly by a maternal mortality interdisciplinary committee of obstetricians, midwives and nurses, and the heads of the pharmacy and the central laboratory services. During the audit process, the committee assesses the quality of care, identifies gaps in the management, and makes a decision whether the death could have been prevented. The reasons and circumstances surrounding the death are analysed, including the lack of drugs and supply, delays in referral, lack of skills, and even negligence. The review process follows a standard inquiry form. All of the committee's recommendations are noted and handed to the hospital management for action. However, there has been poor implementation of these recommendations and poor follow up in relation to whether the recommendations have been fulfilled [61].

On a weekly basis, there is a maternal mortality session that discusses the presumed causes of avoidable maternal deaths. Similar to the maternal death case review by the committee, the discussion in these sessions explores any gaps surrounding the care management of the deceased, and whether the death could have been prevented. A perinatal death case review is also performed every 2–3 months, where statistics relating to perinatal deaths are presented along with one or two cases, as an example of avoidable perinatal mortality.

At the end of both the maternal and perinatal case reviews, recommendations are made to improve care to prevent avoidable maternal and perinatal deaths and to changing practice in patient management. In case of negligence, warning and disciplinary action can be taken. As part of accountability assurance, in addition to these morning report and audits, care providers are at times required to write a statement to the hospital management to explain the circumstances that led to these adverse outcomes. Furthermore, there is a general provision for any patient/client to present complaints of mistreatment or abuse during their care. The complaints can be presented anonymously through suggestion boxes that are mounted in all exits or via direct communication to, but not restricted to, the "KERO" office, public relations office, and the ward in charge, block manager or head of obstetric departments.

Quality of improvement activities at MNH

The hospital has established a QI coordinating unit, which is responsible for overseeing the QI activities. These include the 5S–programme under the nursing process which aims at improving the status of the working environment by Sorting, Setting, Standardizing, Shining (upgrading) and Sustaining. Additionally, QI in patient care includes the "Kaizen programme", which is geared towards continuous improvement of patient care through the evaluation, feedback and implementation of QI interventions. The ongoing "*kaizen*" activities include infection prevention and control, pre- and post-operative management, antenatal and postnatal care, among others. The QI unit, in collaboration with the Teaching Research and Consultancy unit, facilitates clinical audits of the use of evidence-based clinical guidelines, provides continuing medical education for staff, and ensures that local and collaborative research conducted at the hospital can be translated into quality improvement in clinical practice. The ongoing maternal and child health research projects include, but are not limited to, the "safer birth research project, management of postpartum haemorrhage using intrauterine balloon tamponade and improving practice and outcome of operative deliveries".

Study population and data collection

The study participants included doctors and midwives at the maternity wards and patients with obstructed labour and fetal distress, from December 2013 to May 2014, and July to December 2015, and women who delivered from 2013 to 2016 (Figure 6).

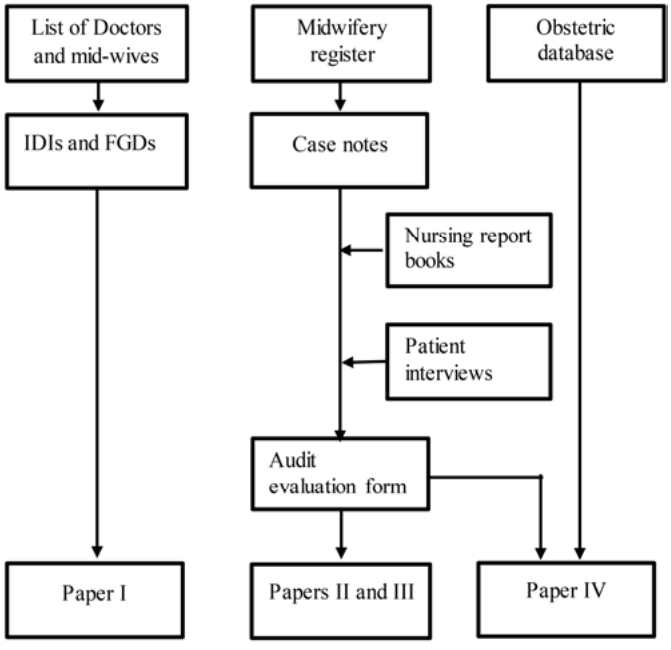

Figure 6. Flowchart of selection of study participants and data collection process

Paper I

The study participants of the qualitative study were care providers, including midwives and obstetric residents, specialists and consultants. The daily routine duty roster of doctors and nurses constituted a list of doctors that was used as the sampling frame. The first and second authors of the paper recruited and informed the study participants about the study and performed the recruitment procedure. Twenty-two individual in-depth interviews (IDI) and two FGDs, with five caregivers in each, were performed. IDI and FGDs lasted 35–80 minutes. The interviewed care providers included a group varying by age, sex, professional status, and work experience. Therefore, 14 midwives, 11 residents, 5 specialists, and 2 senior consultants were included in the study. All midwives and a third of the doctors were women.

Care providers interviews were conducted from January–June 2014 in a private room at MNH. The interviewers were: 1) an obstetrician with knowledge of the routines at MNH but not employed at MNH (HL); 2) a midwife and lecturer employed by Muhimbili University (CK); and 3) a senior researcher and obstetrician not employed at MNH (BE, PI of the study). It was important to conduct the IDIs in Swahili, because the midwives were less fluent in English than the doctors. FGDs with doctors and midwives were held separately. IDI and FGD questions asked about the care providers' experience of CS, their perceptions about the hospital's high CS rate, and the CS decision-

making process. Participant observations of the routine practice in the maternity wards during routine work and at care providers' meetings were conducted periodically in 2010, 2012 and 2014 by the PI and the interviewer/co-worker (HL) in order to understand the context well.

The study relied on a framework of naturalistic inquiry [98]. Analysis of the IDIs and FGDs began during the early interview phase in order to develop additional open-ended questions, which were incorporated into the subsequent interviews. Saturation of the IDIs was met after ten interviews with doctors and five interviews with midwives. An additional interview was made for member-checks [98]. The PI, the interviewer/co-worker (HL) and myself transcribed the recorded IDIs and FGDs. Similarities, patterns, and differences across the respondents were identified and interpreted into intuitive categories by using thematic analysis [98] under the guidance of an anthropologist. The conceptual framework was then established under the ongoing debate about blame avoidance [100], transparency [101,102], and reactivity mechanisms [102,103].

Papers II and III

The source of information for participant selection was case notes having a physician diagnosis of fetal distress and/or obstructed labour and a partogram. The inclusion criteria included a singleton term fetus in cephalic presentation. Women who had premature membrane rupture and a severe medical condition such as eclampsia, cardiac disease and severe anaemia (Haemoglobin <7g/dl, as defined in national maternal and child health guidelines from the MoH) were excluded. Using Epi info 7, a baseline audit of fetal distress cases required a minimum sample size of 248. As the percentage of substandard care of fetal distress was unknown, the worst-case scenario of 50% with absolute precision of 5% was applied. The desired 10% improvement of standard practice implied a post-intervention substandard care of 40%, and therefore a minimum of 250 patients for the re-audit. A similar assumption for obstructed labour resulted in a sample size of 260 for baseline and 251 for the re-audit.

Using a pre-tested form, data on age, parity, patient referral and payment category, mode of delivery, details of decision and management of fetal distress and obstructed labour, including pre-operative preparations, type and timelines of interventions and outcome of pregnancy, were collected. The participants were identified from the midwifery register in the labour ward every morning at 08:00 hours and every afternoon at 16:00 hours using the patients' registration numbers and names, and then traced in their respective wards. Participants' case notes, partogram and theatre notes were reviewed for eligibility before data were collected. As part of a data validity check, every second week some of the audited cases were randomly selected and their registration numbers compared with cases of fetal distress and/or obstructed labour in the midwifery register and with case files retrieved from medical records.

The baseline CBA for fetal distress (*n*=248) was conducted December 2013 to May 2014, and that of obstructed labour (*n*=260) from December 2013 to April 2014. Baseline audit performance was discussed and interventions to improve care were implemented for four months from March 2015. After implementing the recommended changes, a re-audit was performed from July to December 2015 for both fetal distress (*n*=250) and obstructed labour (*n*=251). The clinical audit was performed using the criteria-based audit cycle (Figure 1) that can be described as a systematic and critical analysis of the quality of medical care, including the procedures used for diagnosis and treatment, the use of resources and the resulting outcome, and the quality of life of the patient [17]. The CBA cycle consists of evaluation, feedback and intervention; and later, re-evaluation to measure the impact of the implementation of the agreed interventions.

Audit procedure, feedback and interventions

Step 1: Set and agree on criteria of standard practice

The best criteria for standard practice in the diagnosis and management of fetal distress and obstructed labour was generated after a review of publications and textbooks, the WHO manual [57] and the Tanzanian national guidelines [103]. The developed list of criteria was then reviewed and modified by a panel of four obstetricians, two midwives and eight obstetric residents. The modified criteria were later discussed and agreed upon at a departmental meeting that included a group of 55, made up of doctors, midwives, anaesthesiologist, pharmacist, laboratory technicians, and ward attendants. Fulfilment of the agreed criteria for the diagnosis of fetal distress and obstructed labour included at least ≥1 major and ≥1 additional minor criterion (Tables 4 and 5).

Table 4. List of standards for diagnosis of fetal distress

Major criteria:
1. Irregular fetal heartbeats (non-uniform fetal heart rate between the uterine contractions)
2. Abnormal fetal heart rate (>180 or <100 beats/minute)
Minor criteria:
1. Persistence of irregular heartbeats despite hydration and change of maternal position
2. Fresh meconium-stained liquor
3. Reduced fetal movement

Table 5. Criteria of diagnosis for obstructed labour

Major criteria
1. Prolonged active labour[a] of ≥8 hours for primiparas and ≥ 6 hours for multiparas
2. Regular good uterine contractions[b]
Minor criteria:
1. Protracted cervical dilatation <1 cm per hour for primiparas and <2 cm per hour for multiparas
2. Protracted descent of the fetal head at less than one-fifth per hour in primiparas or less than two-fifths per hour in multiparas
3. Arrested cervical dilatation for >3 hours for primiparas and >2 hours for multiparas
4. Arrested descent of the presenting part for >1 hour for both primiparas and multiparas
5. Prolongation of second stage of labour for >2 hours for primiparas and > 1 hours in multiparas
6. Presence of severe caput, which implying inability to palpate moulding, or documented caput of ≥2+
7. Presence of severe moulding implying documented moulding of 3+

[a] cervical dilation ≥3cm and regular good uterine contractions
[b] ≥3 contractions in 10 mins, lasting ≥20 second per contraction

Prior to the CBA, the hospital did not have an official and accessible management guideline for fetal distress and obstructed labour. The MoH clinical guidelines for the management of fetal distress and obstructed labour constituted the point of departure together with other universal guidelines from the WHO and peer-reviewed articles. These guidelines were reviewed and modified, in a similar way to the procedure for best-practice guidelines for diagnosis, and were later authenticated in the departmental meeting. The fulfilment of the criteria for standard care management of fetal distress and obstructed labour required all criteria to be achieved (Tables 6 and 7).

Table 6. List of standard for management of fetal distress

Standard management guidelines
1. Intravenous rehydration (≥1 litre of crystalloids)
2. Repositioning of the mother to lateral lying position
3. Review by a senior specialist (at least once during the process of labour to delivery, either by him/herself, by phone or during major/service ward round)
Standard preoperative management
1. Drained urinary bladder (with indwelling urethral catheter)
2. Blood-typing and cross-matching
3. Administration of antibiotics (broad spectrum)
4. Sought patient's informed consent
5. Pre-operation checklist used (verify the pre-operative protocol and timelines of intervention from decision to arrival in theatre)
6. Caesarean section should commence ≤1 hour after decision (Decision to theatre arrival interval ≤30 minutes and theatre arrival to delivery interval ≤30 minutes)

Table 7. List for standard management of obstructed labour

Standard management guidelines
1. Start intravenous hydration with ≥1 litre of crystalloids (Ringer's lactate or normal saline)
2. Urinary bladder should be drained by an indwelling urethral catheter
3. Blood typing and cross-matching should be done
4. Broad spectrum antibiotics should be administered (Metronidazole must be included)
5. Informed consent should be obtained from patient
6. Pre-operative checklist should be used to verify management protocol and timelines of intervention from decision to arrival in operating theatre
7. Review by a specialist at least once during process of labour to delivery, either in person, by phone, or during major/service ward rounds
8. Caesarean section should commence within 1 hour after decision to proceed: interval from decision to theatre arrival should be less than 30 minutes, and from theatre arrival to delivery should be less than 30 additional minutes

Step 2: Measure current performance

The accuracy of diagnosis and management of fetal distress and obstructed labour in the current practice was compared with the agreed standard practice. This was performed by a team of evaluators comprising one consultant, one specialist and one nurse midwife.

Step 3: Analysis of baseline data and development of recommendations

The percentage of the fulfilment of the criteria of standard diagnosis and management at the baseline audit was calculated, and summarized for feedback presented with the stakeholders at the hospital.

Step 4: Feedback and decision on interventions to improve practice

The findings of the audit evaluation were presented and discussed at a one-day workshop that comprised 75 stakeholders of similar composition to the meeting to set the audit criteria. Because the outcome of the patients could have been influenced by the quality of prior care at the referral points, eight representatives from the referring regional and district hospitals participated. Following the workshop, a summary of recommended interventions to improve prevailing practice in the diagnosis and management of fetal distress (Tables 8 and 9) and of obstructed labour (Tables 10 and 11) were put forth and presented to the stakeholders for authentication.

Table 8. Recommended interventions to improve diagnosis of fetal distress.

1.	Posting the criteria of standard diagnosis in the labour ward and operating theatre
2.	Regular reminder of the use of the diagnostic criteria during grand rounds and routine work
3.	Confirm the diagnosis of fetal distress using the posted criteria before taking the patient to or receiving the patient in the operating theatre
4.	Provide hand-held Fetal Dopplers and train doctors and midwives how to use a Fetal Doppler and interpret fetal heart rate and rhythm
5.	Doctors at the referring points should use the diagnostic criteria to ascertain the diagnosis before making referrals at MNH

Table 9. Recommended interventions to improve management of fetal distress

Interventions to improve pre-operative assessment and management of fetal distress	
1.	Specialist on call should stay within the hospital compound at all times
2.	In case of emergency, midwives should communicate directly with the specialist when residents on call are unavailable
3.	Specialist on call should make regular visits in the labour ward, preferably during morning major ward round and afternoon and evening service ward rounds
4.	Strengthen documentation during patient review, either by self, over the phone, or during major ward round
5.	Provide Fetal Dopplers and vacuum extractors, and re-train doctors and midwives on fetal heart monitoring and vacuum extraction
6.	Doctors should register their private mobile phone numbers in the doctors' free call system provided by Voda Com mobile company to improve communications and consultations within MNH and with external referring points
Interventions to reduce decision-to-delivery interval	
1.	In cooperation with and appraisal of 'the Golden hour' of decision-to-delivery intervention as part of the "Kaizen" hospital quality improvement system
2.	Enforce mandatory prior communication of fetal distress to operating theatre after decision of CS to insist on the level of emergency and facilitate prioritization in theatre
3.	Re-organize midwives' shifts to cater for increased workload during off hours and public holidays
4.	Strengthen leadership and re-organize feedback meetings and clinical rounds to encourage teamwork and constructive routine perinatal audits among doctors and midwives
5.	Care providers in theatre including obstetrician/resident on call, theatre nurse and anaesthesiologists/anaesthetists, should triage patients together in the pre-operative ward
6.	Provide extra operating space by opening the gynaecology theatre for obstetric patients in the event of being overwhelmed by the workload in the two obstetric theatres
7.	Referred patients should be sent to MNH when the decision of referral is made, rather than accumulating several patients to be referred all at once

Table 10. Recommended interventions to improve diagnosis of obstructed labour

1. Post list of agreed-upon criteria for standard diagnosis of obstructed labour in labour ward and operating theatre reception area
2. Midwife in-charge and specialist on-call should periodically remind doctors to adhere to criteria during grand rounds and routine work
3. Confirm diagnosis of obstructed labour in case log notes according to posted criteria when patient is sent to or received in theatre
4. Promote utilization and interpretation of partogram by regular training on its use during ward rounds
5. Encourage doctors at the referral points to use posted criteria to confirm diagnosis before referring patients because of obstructed labour

Table 11. Recommended interventions to improve management of obstructed labour

Interventions to improve pre-operative assessment and management of obstructed labour

1. Specialist on-call should be present within hospital compound at all times.
2. Enforce mandatory documentation of identity of all those who review patients, either in person, over the phone, or on major ward rounds
3. In case of emergency, in the absence of a resident, midwives should communicate directly with a specialist
4. The specialist on-call should make regular visits to the labour ward for a minimum of three service rounds a day: morning, afternoon, and evening
5. Ensure availability of a vacuum extractor, and conduct regular retraining of nurses, doctors, residents, and obstetricians in its use

Interventions to reduce decision-to-delivery interval

1. Incorporate the decision to proceed to delivery as "the Golden 60 Minutes" in the kaizen (Japanese "improvement") quality improvement system
2. Strengthen teamwork and task sharing between specialists on call, residents, and nurse midwives
3. Enforce mandatory communication from labour room to operating theatre whenever decision to perform CS is made, in order to facilitate prioritization in theatre
4. Institute demand-driven allocation of midwives according to workload, especially during off-hours including night shift and public holidays
5. When assigning shift person-in-charge on labour ward and in obstetric theatre consider leadership abilities of those chosen in order to improve effectiveness during work
6. Patients for CS should be triaged in theatre by obstetrician or resident-on-call, theatre nurse, and anaesthesiologist/anaesthetists for appropriate prioritization.
7. Doctor's decision to proceed to CS should be accompanied by documentation of level of emergency in order to facilitate prioritization
8. Gynaecological operating theatre should be made available for obstetric patients in case the number of patients waiting for emergency CS overwhelms the capacity of the two obstetric theatres
9. Doctors should refer cases for CS as soon as a decision is made, rather than accumulating a number of several patients and sending them for CS all at once

Researchers and midwives performing a random assessment of the selection process of study participants from the midwifery register (From: Essen B. Dar es salaam, 2014)

One of six groups of care providers discussing possible interventions to improve care. (From: MNH Public relation Office. Dar es Salaam. 2015)

Discussion and agreement of interventions to improve care during audit workshop. (From: MNH Public relation Office. Dar es Salaam. 2015)

Posters in the delivery room listing the agreed standards of practice in diagnosis and management of fetal distress and obstructed labour (from: Mgaya A. Dar es Salaam, 2015)

Step 5: Implementation of recommended interventions

The recommendations presented to the stakeholders for implementation were posted in the labour room and operating theatres. Similarly, representatives from the referral points agreed upon the implementations and briefed their colleagues. The implementation phase was carried out over a period of four months, from March to June 2015.

Step 6: Re-evaluation of practice

A re-audit was conducted July-December; 2015. The effect of the audit interventions was evaluated comparing the percentage fulfilling the agreed standard practice between the baseline audit and re-audit.

Main outcome measures

The main outcome measures were fulfilment of at least one major and one additional minor criterion for standard diagnosis of fetal distress and obstructed labour, and fulfilment of all nine criteria for the standard management of fetal distress and obstructed labour.

Paper IV

A before-(January-November 2013)-and-after (July 2015–June 2016) study was performed to estimate the effect of the CBAs on the maternal morbidity rate and the perinatal morbidity/mortality rates. The denominator to the rates was received from the obstetric database. The number of deliveries before and after the CBAs were 6986 and 8137, respectively. The effect of the CBAs on the CS rate and the perinatal morbidity/mortality was also estimated using the Robson groups.

Data analysis

CBA data were entered and analysed using SPSS 20. A difference in percentage fulfilment of ≥1 for major and ≥1 for minor for the criteria for diagnosis, and all criteria for management, at baseline and re-audit, was calculated. For each criterion, the difference in percentage fulfilment of each major and minor criterion for diagnosis and management were analysed using Student's *t*-test. Differences in antenatal characteristics and obstetric history between baseline and re-audit for substandard diagnosis and management were analysed using Chi-squared test or Fisher's exact test, when appropriate. The difference in median time between: a) decision to delivery by CS; b) decision to theatre arrival; and c) theatre-to-delivery interval between baseline and re-audit, was analysed using a median test. Missing data were classified as 'criteria not fulfilled'.

The maternal and perinatal outcomes before and after the CBA were assessed by measuring the differences in severe maternal morbidity, including postpartum haemorrhage, uterine rupture, maternal admission and maternal death, and differences in perinatal morbidity and mortality, including neonatal distress, fresh stillbirths and early neonatal deaths using Chi-squared test, Fischer's exact test and Student's *t*-test.

Using data from the obstetric database, bivariate and multivariate logistic regression analyses were performed to estimate the effect of change in maternal and perinatal outcomes before and after the CBA process. Odds ratio (OR) and 95% confidence intervals (CI) of poor outcome were measured against the reference period, that is to say, before the CBA process. The maternal and perinatal outcomes that significantly changed in the bivariate analysis were entered in multiple regression models and adjusted for maternal age and referral category. A significant difference was considered when $p<0.05$.

Reliability test of the Criteria-based audit

The interrater/inter-evaluator reliability of CBA evaluation was measured through a mini-survey that was performed from July to September 2016. The agreement of evaluation was measured between the assessed practice and outcome of fetal distress and obstructed labour during CBA, and an independent sample that was randomly selected from CBA patients. The selected variables of interest included referral and payment category, the criteria for diagnosis and management, and the outcome of care of fetal distress and obstructed labour. The inter-evaluator reliability was measured using the Kappa co-efficiency (κ) with its 95% confidence interval (CI). The level of acceptable agreement was set at $\kappa \geq 0.6$, which is regarded as a good interrater agreement.

Research ethics and ethical considerations

The studies were approved in 2013 by the Research and Publications Committee at the Muhimbili University of Health Sciences (MU.DRP/AEC/Vol. XVI/192, 130730). The ethical approval for CBA was renewed and the ethical clearance for extracting data from the hospital obstetric database was granted in 2016 by the MNH Research Ethics Review Board (MNH/IRB/I/2016/26).

Verbal consent was obtained from the providers before the IDIs and FGDs. Before and during the interview sessions and FGDs, the researchers explained several times that the study was for the purpose of research and improvement of care at MNH. The interviewers assured the care providers that the hospital authority would not be informed of the response of the IDIs and FGDs, but rather that the themes of all the responses were based on determinants of the quality of the CS and the outcomes. Written consent was also obtained from women who were interviewed during the CBA for the purpose of confirming or filling

in missing information that was available in the case notes or the registers. Because the published information did not include individual data, consent from the women for publication of this information was not applicable.

The researchers who were employed at MNH did not participate in the IDIs or FGDs due to concerns that their co-workers, including residents and midwives, might feel uncomfortable about talking freely in front of their senior colleagues. The interview audio recordings were securely stored and were only accessed by the researchers. Furthermore, recordings and transcripts were made anonymous before they were shared with other research group members and hence the transcripts were coded to hide the identity of the interviewee. The participants in the IDIs were informed beforehand and asked to choose the time for interview at their convenience. Despite the observed difficulties in maintaining the confidentiality of each other's experience and thoughts expressed in the FGDs, the interviewers emphasized the importance of maintaining confidentially before the beginning of each FGD by asking participants not to reveal other group members' observations to fellow care providers outside the group.

Because the audit process involved the evaluation of care providers' performance, the negative effects of the evaluation process, including anxiety [35], defensive practice [35,95] and natural resistance to change of practice [95], were as anticipated. Therefore, researchers working at MNH sensitized their fellow care providers on how to conduct a good audit process, and the benefits of improving patients care using clinical audit, during the meeting to set the audit criteria.

Results

The thesis aimed at optimizing the use of CS at a tertiary referral hospital in a low-resource setting with rapidly increasing rate of CS in low-risk pregnancies that were also associated with high rates of severe maternal and perinatal morbidity and mortality. Therefore, the findings of the studies were based on a primary research questions: what is the care provider's perspective of the high CS rate? The research findings led to other research questions as illustrated in Figure 7.

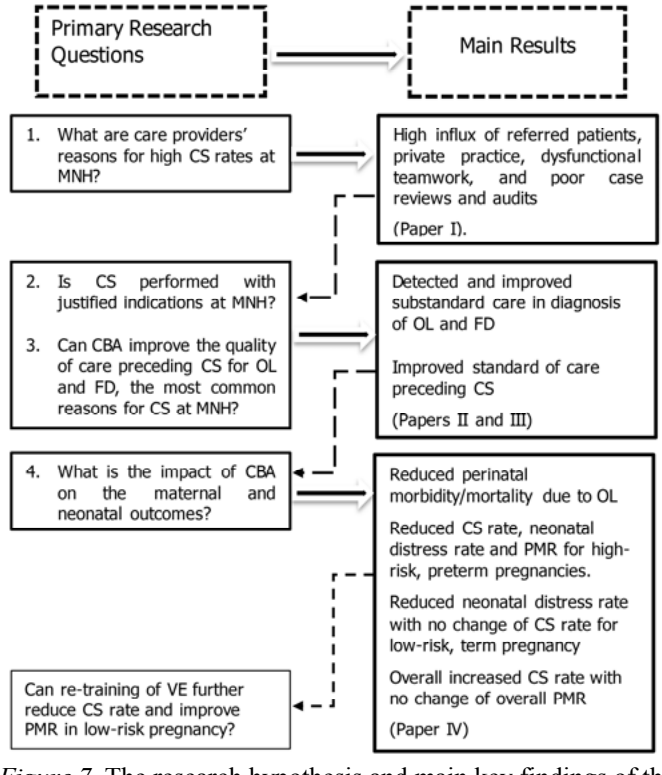

Figure 7. The research hypothesis and main key findings of the thesis.

CBA=Criteria-based audit; CS=Caesarean Section; MNH=Muhimbili National Hospital; PMR=Perinatal mortality rate; VE=Vacuum extraction

Care providers' in-depth perspectives of high CS rates

Care providers had conflicting thoughts on the reasons for the hospital's high CS rate. However, there was a consensus that CSs were performed unnecessarily, and mostly among private patients. Most public patients were referred with severe complications, and hence were perceived to have adequate indication of CS. The reported major reasons for unnecessary CS included reluctance to try vaginal delivery after evidence of previous CS scars, inductions of labour, and VE. Furthermore, the most common indication of CS was perceived to be fetal distress and obstructed labour. On the other hand, some doctors and midwives thought that CS indications were sometimes suboptimal. Five themes were identified from care providers' perceptions of the reasons for the high CS rate, or reasons for performing CSs on doubtful indications. These included: factors outside caregivers' control, private practice, the specialist-resident interaction, the resident-midwife interaction, and fear of blame.

Factors outside care providers' control

Care providers projected the responsibility for the increasing CS rate onto the characteristics of referral patients, and the care provided at the primary and secondary referral facilities.

> So many Caesars (caesarean sections) are coming from outside. Our hospital is not the source of the CSs. Midwife D, IDI

Referred patient were described as being delayed in reaching appropriate care as they travel through the referral system, and those who were admitted after a prolonged labour compelled care providers to perform CS:

> Delayed referrals can impair you decision making (for CS). Resident K, IDI

Private practice

Private practice was discussed in relation to better economic incentive for CSs that provided higher monetary incentive to the care provider than normal delivery. Some care providers perceived private practice as a compensation to relatively low payment for regular practice, and hence a motivation for CS:

> With CS – I minimize my time and I earn more! Specialist M, IDI

Based on the hospital policy on private practice, patients were allowed to choose the service and the attending specialist. Care providers also expressed

how special treatment was provided for private patients, which led to questionable decisions, including CS:

> Here patients are categorized, the normal patients (Public patients) and Private patients. Midwife D, FGD

> You do not want the specialist to come in the morning, and their patient got maybe a low-score or that something went wrong with the labour. So sometimes you might go for a Caesar (caesarean section). Resident K, IDI

This opinion was also confirmed by participant observations, where adverse events in private patients were thought to bring about a bad reputation and a higher risk of disciplinary hearings or lawsuits for the care providers, when compared to public patients.

Interaction between the care providers

There were conflicts in the interaction between specialist–resident, and resident–midwife; but specialist–midwife interaction was harmonious. Specialists were concerned that residents were not adequately experienced in decision-making during emergencies:

> Maybe some of us specialists do not spend enough time in the labour ward. Even you find a resident that is maybe in his second time in the labour ward is alone making decisions. Consultant K, IDI

Participants' observations revealed a strong hierarchical structure and a tendency to have apprehension about junior staff, including residents, by the senior staff and midwives. Midwives also observed that the residents were often "put down" during rounds, and at times were reluctant to ask assistance from a specialist. Despite this poor interaction between residents and midwives, interaction between the specialists and midwives was rather harmonious, as described by one care provider:

> Specialists work. I mean, they know that nurses are the ones detecting deviations from normal. They know we detect deviations better than their doctors (residents). We detect and tell them. If they a far from us they will get cases (charged). Midwife B, FGD

Fear and blame associated with poor outcome

The poor interaction between the groups of care providers was associated with blame and the strict quality assurance system in maternal and newborn care during routine morning meetings and maternal and perinatal mortality case reviews:

> … it is never a learning session (…) there is condemning … Resident C, IDI

> They [the residents] just go to the theatre so that they will not to be called in the meetings. Midwife N, IDI

The participant observations found a more administrative-based than professional-based assessment of adverse outcomes; hence maternal and perinatal deaths were discussed in disciplinary hearings and were intensely associated with culture rather than educative maternal and perinatal case review/audit sessions.

> If you have a low-score, then you have to write a little bit of statement (…) so you yourself will feel also bad. So next time when they say like that, then you will lose your guts … Midwife A, FGD

Standards of management preceding CS and outcomes

CBA of fetal distress

The standards of decision to perform CS due to fetal distress were assessed according to the agreed criteria for standard practice, according to the care providers. A standard diagnosis required fulfilment of one major and one minor criteria (Paper II). The standards of diagnosis improved by 16%, out of 248 recorded incidents of fetal distress in the baseline audit and 251 in the re-audit (52% vs. 68%; $p<0.001$) (Table 12). Similarly, the management of fetal distress was assessed according to the criteria agreed amongst the care providers that required the fulfilment of all the criteria. The management improved tenfold from baseline and the re-audit (0.8% vs. 8.8%; $p<0.001$). Criteria that contributed to the improved standards of management were immediate care of change in maternal position and shortening of the decision-to-delivery interval by 25 minutes. The effect of the improved process of care of 499 patients with fetal distress (baseline audit $n=248$ and re-audit $n=251$) was assessed (Paper IV), and there was no difference in severe maternal morbidity and perinatal morbidity and, mortality between the baseline and re-audit (6.0% vs. 2.8%; $p=0.08$ and 12% vs. 13%; $p=0.71$, respectively) (Table 12).

CBA of obstructed labour

The standards of decision for CS due to obstructed labour were also assessed according to the criteria of standard practice agreed amongst the care providers that required the fulfilment of one major and one minor criteria (Paper III). The diagnosis of obstructed labour also improved by 7%, out of 260 recorded incidents of obstructed labour in the baseline audit and 250 in the re-audit (74% vs. 81%; $p=0.049$) (Table 12). Similarly, the standards of management

of obstructed labour were assessed according to the criteria agreed amongst the care providers that required the fulfilment of all the criteria. The management of obstructed labour was twice improved from the baseline to re-audit (4.2% vs. 9.2%; p=0.025) (Table 12). Criteria that contributed to improved agreed standards of care in management included a review by a senior member of staff during the decision to perform CS and a shorter duration of the decision-to-delivery interval by 30 minutes. The effect of improved management of obstructed labour was a reduction in the perinatal morbidity and mortality rate (16% vs. 8.8%; p=0.01) in the re-audit of obstructed labour, compared to baseline audit (Table 12). There was no difference in maternal morbidity between the baseline and re-audit.

Table 12. Main results of the evaluation of the CBAs, MNH 2013-2015. *P*-value for test of difference between baseline and re-audit

Variables	Audit		*P*-value
	Baseline	Re-audit	
Fetal distress			
Number of cases	248	260	
Fulfilled criteria for diagnosis	52%	68%	<0.001
Fulfilled criteria for management	0.8%	8.8%	<0.001
From CS decision to delivery	125 (30–555)	100 (28–472)	<0.001
Severe maternal morbidity[x]	6.0%	2.8%	0.084
Perinatal morbidity/mortality[+]	12%	13%	0.71
Obstructed labour			
Number of cases	260	250	
Fulfilled criteria for diagnosis	74%	81%	0.049
Fulfilled criteria for management	4.2%	9.2%	0.025
From CS decision to delivery*	120 (20–852)	90 (40–379)	<0.001
Severe maternal morbidity	10%	8.8%	0.54
Perinatal morbidity/mortality[+]	16%	8.8%	0.016

*Median (Range) time of management of CS (minutes)

[x]severe maternal morbidity includes postpartum haemorhage, uterine rupture and maternal admission to ICU

[+]Perinatal morbidity/mortality includes neonatal distress (Apgar score <7 at 5th minute), fresh stillbirths and neonatal deaths

A separate analysis of patients who had obstructed labour was conducted (Table 13). About one-third of patients with obstructed labour had fetal distress (baseline audit n=82, and re-audit n=76). There was improved neonatal distress rate (22% vs. 9.2%; p=0.003) and overall perinatal morbidity/mortality rate (29% vs. 13; p=0.01) in patients with both obstructed labour and fetal distress in the re-audit, compared to the baseline audit. There was no difference in perinatal outcome of those patients with obstructed labour but without fetal distress.

Table 13. Perinatal outcome of patients with obstructed labour. *P*-value for test of difference using Chi-squared test

Variable	Audit		*P*-value
	Baseline	Re-audit	
Cases with fetal distress			
Number of cases	82 (32%)	76 (31%)	0.78
Fresh stillbirths	5 (6.1%)	3 (3.9%)	0.54
Neonatal distress	18 (22%)	7 (9.2%)	0.03
Perinatal morbidity/mortality[+]	24 (29%)	10 (13%)	0.01
Cases without fetal distress			
Number of cases	178 (68%)	174 (69%)	0.78
Fresh stillbirths	6 (3.4%)	2 (1.2%)	0.16
Neonatal distress	12 (6.7%)	10 (5.8%)	0.70
Perinatal morbidity/mortality[+]	21 (12%)	13 (7.5%)	0.17

[+]Perinatal morbidity/mortality includes neonatal distress (Apgar score <7 at 5th minute), fresh stillbirths and neonatal deaths

Change of CS rate and perinatal outcomes

The rate of CS and adverse perinatal outcomes was assessed before (Jan–Nov 2013) and after (July 2015–June 2016) the CBA process (Paper IV), and statistical significant change in the delivery outcome was adjusted for maternal age and referral category. Overall, the CS rate increased (adjusted odds ratio (aOR) 1.1, 95% confidence interval (CI):1.1–1.2) and this was contributed to by an increased likelihood of a CS among preterm pregnancies (aOR 1.4, 95% CI; 1.4–2.0) after CBA process, compared to before (Table 14).

The rate of overall neonatal distress decreased by 20% (aOR 0.80, 95% CI; 0.72–0.88)* and was mainly attributed to a decreased rate of neonatal distress for multiparas, singleton, term pregnancies (aOR 0.76 95% CI; 0.62–0.95) and preterm pregnancies (aOR 0.30, 95% CI; 0.25–0.36)* after the CBA process, compared to before (Table 15). However, the overall PMR were comparable before and after the CBA process, despite a 40% decrease in PMR for preterm pregnancies (aOR 0.58, 95% CI; 0.46–0.73) after the CBA process, compared to before.

Table 14. Number of deliveries and CS-rate before (2013) and after (July 2015-June 2016) the CBA, by main Robson classification groups, MNH 2013-1015

Robson group	Number of deliveries		CS-rate (%)		Odds Ratios OR (95% CI)
	Before	After	Before	After	
1. Nulliparous, singleton, cephalic, term pregnancies in spontaneous labour	1334	1824	49	54	0.94 (0.81–1.1)*
2. Nulliparous, singleton, cephalic, term pregnancies, induced labour or CS before labour	39	87	100	82	0
3. Multiparous, singleton, cephalic, term pregnancies in spontaneous labour	3317	1978	42	42	1.0 (0.90–1.1)
4. Multiparous without a previous uterine scar, with singleton, cephalic pregnancy, term gestation, induced or CS before labour	226	398	36	53	0.61 (0.32–1.2)
10. All singleton, cephalic, term pregnancies (including previous CS)	2080	1106	36	53	1.6 (1.4–2.0)*
Total CS deliveries	8137	4784	55	59	1.1 (1.1–1.2)*

*implies adjusted OR for maternal age and referral category (referred/non-referral)

Table 15. Neonatal distress and perinatal mortality rates before (Jan –Nov 2013) and after the audit process (July 2015–June 2016). Odds Ratios for test of significant deference before and after CBA process.

Robson groups	Neonatal distress rate		Odds Ratios OR (95% CI)	Perinatal mortality rate		Odds ratios OR (95 % CI)
	Before (%)	After (%)		Before (%)	After (%)	
1. Nulliparous, singleton, cephalic, term pregnancies, in spontaneous labour	6.5	8.1	1.2 (0.96–1.7)	1.9	2.2	1.2 (0.72–2.0)
2. Nulliparous, singleton, cephalic, term pregnancies, induced labour or CS before labour	5.1	11	2.4 (0.50–11)	2.6	7.5	3.1 (0.38–26)
3. Multiparous (excluding previous CS), singleton, cephalic, term pregnancies, in spontaneous labour	6.8	8.7	0.76 (0.62–0.95)*	2.5	3.6	0.85 (0.61–1.2)*
4. Multiparous without a previous uterine scar, with singleton, cephalic pregnancy, term gestation, induced or CS before labour	5.7	13	2.4 (0.98–6.4)	3.6	9.2	2.7 (0.92–9.8)*
10 All singleton, cephalic, preterm pregnancies (including previous CS)	44	30	0.30 (0.25–0.36)*	21	14	0.58 (0.46–0.73)*
Total	11	14	0.80 (0.72–0.88)*	4.1	6.9	0.94 (0.80–1.1)*

*implies adjusted OR for maternal age and referral category (referred/non-referral)

A sub-analysis of the change of rates of CS and perinatal outcomes after CBA process, compared to before, was performed (Table 16). The referred patients had higher rates of CS (29% vs. 59%), neonatal distress (65% vs. 83%) and perinatal mortality (71% vs. 85%) after CBA process, compared to before. Similarly, the public patients also had higher CS rate (85% vs. 95%) after the CBA process; however, the rate of neonatal distress and perinatal mortality was comparable before and after CBA process. Patients of maternal age of less than or equal to 19 years had higher rates of CS (3.7% vs. 5.9%), neonatal distress (5.9% vs. 8.6%) and perinatal mortality (7.3% vs. 8.2%) after CBA process, compared to before. However, maternal age, more than or equal to 35 years was only associated with higher rates of neonatal distress (17% vs. 18%) and perinatal mortality (16% vs 19%) but the rate of CS was lower (21% vs. 18%) after CBA process, compared to before.

Table 16. Cesarean section (CS), neonatal distress and perinatal mortality rate (PMR) by age of mother, referral status and patient category

Variable	Category	Rate (%)					
		CS		Neonatal distress		PMR	
		Before	After	Before	After	Before	After
Referral catergory	Referred	29	59	65	83	71	85
	Self-referred	71	41	35	17	27	15
Payment category	Public	85	95	99	99	99	99
	Private	15	5	1.3	0.63	0.69	0.82
Maternal age(yrs)	≤19	3.7	5.9	5.9	8.6	7.3	8.2
	20-34	76	76	77	73	77	73
	≥35	21	18	17	18	16	19

Validity of the measurement of standards of care

The data validity test for the CBA was performed in selected patients with fetal distress and obstructed labour, in order to determine the degree of inter-evaluator agreement using reliability co-efficiency (κ). The inter-evaluator agreement of standards of diagnosis and management of fetal distress and obstructed labour had a reliability co-efficiency of $\kappa>0.36$ in all the variables. The inter-evaluator agreement in criteria for diagnosis of fetal distress was the least in detection of meconium stained liquor (baseline audit $\kappa=0.41$, 95% confidence interval (CI); 0.13–0.68 and re-audit $\kappa=0.47$, 95% CI; 0.31–0.62) but the highest inter-evaluator agreement was in the evaluation of fetal heart rate (baseline $\kappa=0.64$, 95% CI; 0.58–0.90 and re-audit $\kappa=0.56$, 95% CI; 0.32–0.81). For management preceding CS for fetal distress the least agreement was from recording the decision-to-delivery interval (baseline audit $\kappa=0.42$, 95%

CI; 0.02–0.79 and re-audit κ=0.48, 95% CI; 0.21–0.75) but the highest in assessing immediate care by intravenous hydration of the patient (baseline κ=0.72, 95% CI; 0.36–1.1 and re-audit κ=0.66, 95% CI; 0.30–1.3).

For obstructed labour patients, the inter-evaluator agreement in criteria for diagnosis of obstructed labour was the least for detection of severe moulding (baseline audit κ = 0.58, 95% CI; 0.30–0.82 and re-audit κ=0.76, 95% CI; 0.71–1.01), but the highest in evaluating the progress of labour by detection arrested descent (baseline κ=0.81, 95% CI; 0.65–0.90 and re-audit κ=0.76, 95% CI; 0.60–0.92). The least agreement for evaluating the management preceding CS for obstructed labour patients was recording of decision-to-delivery interval (baseline audit κ=0.64, 95% CI; 0.27–1.01 and re-audit κ=0.72, 95% CI; 0.55–1.01) but the highest inter-evaluator agreement was in assessing the practice of patient review by specialist prior to CS (baseline κ=0.83, 95% CI; 0.61–1.1 and re-audit κ=0.78, 95% CI; 0.55–1.01). Evaluation of perinatal outcome based the Apgar score had the highest inter-evaluator agreement for both fetal distress (baseline audit κ=1 and re-audit κ=0.84, 95% CI; 0.54–1.13) and obstructed labour (baseline audit κ=0.77, 95% CI; 47–1.01 and re-audit κ=0.62, 95% CI; 0.48–0.89).

Discussion

Main findings

Based on the hypothesis that the rapidly increasing numbers of CSs at the tertiary referral hospital were associated with doubtful indications and without the benefit of good pregnancy outcomes; a systematic investigation was performed, followed by interventions to bring about change of practice and outcome of CS. This thesis found an association between the increasing CS rate and care providers' withdrawal from the responsibility of rising rates of CS, care providers' attitudes and patients' autonomy in private practices, and dysfunctional teamwork. Furthermore, defensive practice was associated with over-transparency and poor auditing in case of adverse outcome (Paper I). Aligning with the WHO statement on CS [93], the CBA detected and successfully improved the decision and management preceding CS (Papers II and III). Specifically, the improved standards of process of care increased the use of CS for women in need based on evidence, that is to say, including performing CS for nulliparous singleton, breech, term pregnancies [104,105] and preterm pregnancy [67,106] (Paper IV). Subsequently, the increased access to CS was associated with a reduction in the risk of perinatal morbidity and mortality for high-risk preterm pregnancies, despite the independent high risk of those same adverse outcomes for the respective group. The overall higher likelihood of a CS following the CBA process was also associated with overall risk reduction of neonatal distress. Thus, there is apparent evidence of the optimization of CS after the CBA process. Importantly, the referred patients that constituted the majority of public patients had an independent higher risk of CS and poor perinatal outcome after CBA process, compared to before. Therefore, the increased number of referred patients over time might have influenced the measure of perinatal outcomes regardless of the effectiveness of CBA intervention that achieved comparable standards of care for both referred and non-referred patients (Paper II and III). Teenage pregnancy and delays in reaching and receiving care from the referring point to MNH are evident determinants of poor perinatal outcome (Paper IV).

Independent of the change of CS rate and PMR, the neonatal distress rate for low-risk term pregnancies (Robson group 3) was also reduced (Paper IV). Under-achievement in the reduction of CS rate for low-risk term pregnancies demands further investment in upgrading intrapartum care, including vigilant intrapartum fetal surveillance, re-training of care providers on intrapartum

procedures such as VE, and organizational and structural changes in obstetric care across the referral chain, from the primary to tertiary referral health facilities. The safety, effectiveness, efficiency and sustainability of these EmONC interventions can only be guaranteed when these intervention are integrated within the existing quqlity improvement (QI) activities in the respective health facilities [26]. Furthermore, QI interventions need to be executed with consideration of the use of clinical guidelines, setting and measuring standards of care by applying relevant research and capacity-building for continued improvement in the process and experience of care [60].

Care providers' role in optimizing the use of CS

The CBA process was centred on care providers, as midwives, nurse and doctor were united advocates for change of practice. The change in practice was achieved through self-realization of the inconsistent benefits of irrational use of CS, and subsequent engagement in setting standards of care from the first step of the audit. Care providers' involvement from the first step of the audit process handed to them the ownership of the QI interventions, and hence brought about a reinforcement of the changes in practice [94] that guaranteed successful and sustainable interventions [1]. The overall increase in the CS rate was not associated with a significant change in perinatal death after the CBA process (Paper IV). Because CS rates in low-risk term pregnancies (Robson group 3) were transiently reduced during the implementation of the audit recommendations, the audit evaluation process was not associated with fear of blame and defensive practice [35, 95], as previously reported [107]. Thus, this result illustrates a characteristic of a successful audit evaluation.

Organizing and standardizing care by clinical guidelines

Conflicts and competition between the different categories of care providers was partly attributed to the absence of accessible and clear evidence-based clinical guidelines. The process of care was commonly based on individual professional knowledge and perceived acceptable practice that was itself based on one's own skills, and knowledge transfer from senior to junior rather than making use of continuously emerging researched evidence of standard practice. Adaptation of the criteria for standard practice of CBA, as a clinical guideline of diagnosis and the management of fetal distress and obstructed labour, gave an opportunity for introducing evidence-based standard practice through agreed and accessible guidelines. Additionally, the introduction of standards of care was a prerequisite for widening discussions of QI in obstetric care based on external attribution, that is to say, systemic and operational fac-

tors rather than internal attribution that led to pointing out mistakes, scrutinizing individual opinion and beliefs, and, consequently, creating conflicts amongst the care providers.

The clinical guidelines on the diagnosis and management of obstructed labour and fetal distress introduced during the CBA process standardized care and harmonized the line of management preceding CS. The clinical guidelines, as a standard of care, sanctioned mandatory senior review and adherence to one reference in the line of patients' management, which promotes collective responsibility and a learning environment. Hence, this strategy prevented fear of blame in case of poor outcome, as previously described in the IDI and FGDs (Paper I).

Effectiveness of the CBA process

Optimization of CS was a key factor in demonstrating the effectiveness of CBA interventions based on the improvement of the process and outcome of care. Detected improvement in the use of CS was essential to show effectiveness of the process of care that ensured care providers' commitment for continuous upgrading of the quality of EmONC. Continuous audit-feedback and monitoring of process and outcome of care based on specified groups of women classified in the Robson classification system [41] helps in adequately allocating and prioritizing limited resources to specified groups with great need. Further, the CBA process was of good quality, based on evidence provided by Prikle et al. [108]; and, therefore, built care providers' confidence in the study findings, which facilitated acceptance of changes in practice.

Unlike clinical audit, CBA is sensitive to agreed and achievable interventions based on the availability of resources in the existing system. For a national referral hospital such as MNH, limitations in fulfilling the recommended interventions to improve care were taken as challenges for implementations in the next cycles. These include the provision of extra operating room in the obstetric theatre, renovation of resting room specialists on call, and improving care providers' evaluation process in case of poor outcome. Involvement of hospital management in the audit process [109] provided an opportunity for the adaptation of the CBA recommendations in long-term QI activities, and, therefore, further upgrading of the criteria for standard practice until the structure, process and outcome of care reaches the universal standards.

The implemented audit recommendations only improved the perinatal morbidity and mortality rates of patients with obstructed labour but not fetal distress. One explanation could be because the significant reduction of perinatal morbidity and mortality was limited to patients who had both fetal distress and obstructed labour (Paper IV), which were primarily presumed to be obstructed labour. Another explanation could be the relative lower achievement of standards of management of fetal distress, compared to those of obstructed labour,

leading to the persistence of substandard management. Therefore, the findings were influenced by the researchers' selection of the targeted group for testing the efficiency of the interventions in patients with obstructed labour and fetal distress.

Introducing clinical guidelines for the detection and management of fetal distress and obstructed labour, and training care providers in the use of the Pinard Fetoscope and hand-held "Moyo" Fetal Doppler [110] and a partogram, was the first input and foundation of QI. Other interventions included strengthening leadership and multidisciplinary teamwork in the delivery room and theatre (Paper II), and, lastly, measuring the effect of interventions using patient-centered interventions (Paper IV). To the best of my knowledge there is no published literature on CBA of fetal distress and thus, one of the contributions of this thesis is that it has aided in standardizing the diagnosis and management of fetal distress in low-resource settings. Similar to the intervention for upgrading care of fetal distress, enforcing standard guidelines during and after making the decision to perform CS by strengthening leadership and multidisciplinary teamwork in the delivery room and theatre, was also a pivotal strategy (Paper III).

Applying relevant evidence-based interventions

Limited evidence of the determinants of increasing rates of CS at a tertiary referral and university hospital led to the misconception that maternal request for CS and shortage of resources at the primary and secondary referral hospitals were the main reasons for high demand of CS at MNH. Evidence of high CS rates in low-risk pregnancy [27] and women's perception of CS as a painful and fearful procedure [34] contradicted the perceptions of the care. In order to clear this misconception, the evidence that was gathered through a review of the universal literature was presented during the sensitization meeting before the CBA process began. The use of universal guidelines when setting the criteria for standard practice assured the internal validity of the standards for audit evaluation and the effectiveness of practice to improve care.

Fetal distress was assessed using criteria similar to the FIGO guideline for intrapartum fetal heart monitoring [51] by defining the cut-off point for fetal bradycardia as ≤100 beats/minute. Similarly, the definition of fetal tachycardia was ascertained at FHR >180 beats/minute by both Pinard auscultation and Fetal Doppler, which are currently acceptable means for intermittent fetal monitoring [53,54]. However, Pinard auscultation demanded skills and experience in identifying late and prolonged deceleration of fetal distress [51], therefore, in order to operationalize the criteria of standard diagnosis of fetal distress, care providers agreed to term "fetal heart deceleration" abnormalities as "irregular fetal heart rate", which carried a common meaning of "abnormal fetal heartbeats" by all healthcare professionals, regardless of their skills and

expertise [46]. The assessment of the rate and rhythm of fetal heartbeat was also performed by hand-held "Moyo" Fetal Doppler, which could have reduced the subjectivity of the perception of fetal heartbeats and provided an opportunity for confirmation by other care providers [111].

A good inter-evaluator agreement using kappa co-efficiency (κ), which was 0.6 for the evaluation of the detected abnormal fetal heart rate, increases the confidence of this CBA findings, as fetal heartbeats abnormality is the most important and early sign of fetal distress. However, the improved standards of diagnosis of fetal distress also depended on clinical acumen in detecting and combining neurological and cardiovascular signs of fetal distress [45-47], including reduced fetal movement and fresh meconium stained liquor. Low specificity of the signs of diagnosis of fetal distress [46,47] and low inter-evaluator agreement ($\kappa<0.6$) in evaluating the diagnosis suggests that intrapartum fetal surveillance should be upgraded, especially in a consultant hospital such as MNH. The initial step of the fetal surveillance upgrading should include assessment of feasibility and efficacy of fetal scalp blood lactate test for acidosis [52] in a low-resource setting.

For obstructed labour, the criteria for diagnosis were based on partography and, hence, the improved standard of diagnosis implies that care providers increased their ability to interpret and record information on the partograph. This was one of the most important changes as a result of the in-house training, and led to improved teamwork amongst staff in the delivery room. Assessment of practice in obstructed labour was based on a standardized tool, the partogram; hence it has been widely researched. Therefore, the inputs in the process of care included introducing evidence based guidelines for the detection and management of obstructed labour based on the partogram (Paper III). Additionally, providing training and enforcing the use of partogram was equally important, based on previous evidence of poor outcomes associated with lack of use of partogram at MNH.

Unlike the Malawi audit study [55], this CBA tightened the standards of diagnosis by including details of the progress of labour, including cervical dilatation, descent of the presenting part, and the degree of moulding and caput. Furthermore, good inter-evaluator agreement ($\kappa>0.6$) of the evaluation of the fulfilment of criteria for diagnosis of obstructed labour using partographic assessment increased confidence in using the findings to change clinical practice and for research purposes.

Compliance with international and national reproductive health priorities

The dissemination and implementation of a single CS classification system, the Robson classification, in a health facility such as MNH, allows adequate

monitoring of CS by analysing and comparing rates of CS across different hospitals in Tanzania and other countries [112]. This strategy could provide assurance of the appropriateness of CBA interventions locally and internationally. Thus, the impact and sustainability of QI activities based on Robson classification is affected by the universal or country's priorities and health policies. Additionally, the WHO standards for quality of maternal and neonatal care place an emphasis on evidence-based practice by prioritizing good quality of care at the time around birth and in specified groups of women [1]. Therefore, the use of the Robson classification system provided a universally standardized means of monitoring the effectiveness of investments to improve EmONC by assessing the outcomes of mutually exclusive groups of women during childbirth.

This study also aligns with other international literature [26] recommending that strategies to reduce maternal severe morbidity should include improving EmONC by specific interventions and group of patients, that is to say, the optimization of CS in low-risk pregnancy based on Robson classification group, specified period of pregnancy (during delivery, and in targeted health facilities in the referral system); in this case, the tertiary referral hospital. Doing so, also aligned with two complementary global action agendas: "Strategies toward ending preventable maternal mortality" [113] and the "Every newborn: an action plan to end preventable deaths" [113]. The study also conforms to the aims of a new network of nine African countries (including Tanzania) that intends to strengthen national efforts to end preventable maternal deaths by 2030 through country specific capacity building and motivation of health professional to plan and manage QI strategies for upgrading maternal and child health and improving the use of health data [114].

At the national level, this study addresses the Tanzania Reproductive and Child health programme agenda [115]: a) the use of health information system to improve care; b) strengthening comprehensive EmONC; and c) targeting quality improvement of health care to labour and delivery and other periods including care during the postnatal period for both the mother and the newborn.

Good-quality care requires appropriate use of effective clinical and non-clinical interventions, a strengthened health infrastructure, optimum skills, and the positive attitude of health providers. These factors improve health outcomes and give women, their families and the health care providers a positive experience. High-quality care is integral to the right to health and the route to equity and the preservation of dignity for women and children.

Methodological considerations

General considerations

Engaging different research methods, qualitative and quantitative designs, and multiple sources of data, greatly contributed to the strength of this thesis by adequately investigating and intervening in problems of overuse of CS without the expected maternal and perinatal benefits. Hence, this strategy enabled appropriate and effective clinical and non-clinical interventions in the decision to perform CS and the subsequent management of fetal distress and obstructed labour. Quality of care is multifaceted and therefore requires various methods of evaluation, including IDI, FGD and participant observation (Paper I); and a before-and-after design to measure the impact of CBA in the upgrading process (Papers II and III) and the outcome of CS (Paper IV). Thus, drawing on these methods allowed for different perspectives and dimensions of care to address the overuse of CS from an evidence-based systematic analysis that adequately captured determinants of quality care, in terms of safety, effectiveness, efficiency, dignity and patient-centeredness.

Qualitative research compelled the researchers to use their conception of the researched topic and study settings. Being a practising obstetrician at MNH, I have prior knowledge of maternal health and intrapartum care, and I also understand the dynamics of obstetric care, not only at MNH but also in the secondary and primary referral hospitals in Dar es Salaam. Not being an expert in qualitative methods increases my curiosity and therefore my enthusiasm in learning how to evaluate quality of care both quantitatively and qualitatively, and to capture "what is within and beyond the statistics." However, in this study I was one of the care providers and a researcher and, therefore, my contribution was mainly in the preparation of the interview guides, organizing interviews, transcription of the interview recordings and data analysis. Being a care provider, my involvement in the IDI and FGDs could have biased the interview findings by preventing the openness of the participants to express their experiences and views on quality of care, as they knew I was one of the investigators. On the other hand, the advantages of being a care provider included, but were not limited to, broadening my insight and ability in creating a framework of CBA study, in terms of the analysis of its planning, evaluation and interventions.

Qualitative methods

The qualitative methods conformed to the criteria for trustworthiness of findings as described by Lincoln and Guba's 1985 description of naturalistic inquiry [116], including credibility, dependability, transferability and conformability. In Paper I, the use of different methods to explore care providers' perspective of trends of CS, including IDI, FGD and participant observations, and

purposeful sampling for capturing information from the important groups of care providers, including residents, midwives and specialist, contributed to the *credibility* of the findings. Furthermore, FGDs were separately conducted for residents and midwives to allow each group to discuss their experiences openly with peers, and were also opportune for instant member checking to confirm some information. On the other hand, IDI were one-on-one with the interviewer and therefore gave an opportunity to dig deeper and allowed free expression of care providers' experiences and thoughts. Assurance of confidentiality reduced anxiety and provided freedom of expression in discussing suboptimal care, especially at MNH and public institutions where there is pronounced professional ranking within and between different cadre, and the hospital quality assurance mechanisms sometimes involved care providers being disciplined by the hospital administration through disciplinary bodies [34,79,117].

The IDI and FGDs were conducted by two researchers who did not work at MNH, an obstetrician from Uppsala University Hospital in Sweden, and a midwife from MUHAS in Tanzania. Having researchers who are non-hospital staff not only allowed for openness during IDI and FGDs, but also provided opportunities for critique from an outside perspective, hence an alternative explanation of the data was made possible during the analysis, which also increased the *credibility* of the findings.

In order to account for and prevent changes in data collection methods and analysis over time, IDI and FGDs used open-ended questions to allow new insight, although each interview had a pre-set line of questioning as an interview guide with consideration of information that was captured in prior interviews. This ensured capturing *dependable* results. Detailed description of the study settings, the selection of participants, data collection and data analysis process, also provided the readers with an understanding of the findings, and hence, where the study findings can be applicable, thus enabling them to judge *transferability.* The IDI and FGD used Swahili, the native language, for the midwives, and English, the working professional language, for the obstetricians, in order to allow free expression and comfortable interaction with the researchers. One researcher, who was an obstetrician, was fluent in English and so interviewed the obstetricians, who could also comfortably communicate in English. Another researcher was a midwife, fluent in both English and Swahili, and so interviewed the midwives, who comfortably communicated in Swahili. This preserved the *conformity* of the data by preventing loss of data from language barriers and the use of an interpreter. It also represented the social and working reality, and hence facilitated the *conformity* of the findings. Additionally, both interviewers had vast knowledge and experience in maternal health and qualitative methods inside and outside Tanzania. The "outside and inside perspective" is opportune for providing a deeper understanding of the care providers' role in EmONC interventions, including CS, thus increasing both the *credibility* and *conformity* of the findings.

CBA and the Robson classification

The overall intention of this thesis is to improve the quality of CS rather than increasing access to the procedure, which is not enough to prevent maternal and perinatal mortality [26, 113]. The CBA of the decision-making process and subsequent management outcomes of CS were based on a *before*-and-*after* study design that measured the impact of the quality improvement interventions without accounting for care providers' perceptions and experiences during care. Therefore, qualitative methods were important in complementing the experience of care, which is beyond the statistical difference when comparing the process and outcome of interventions around the decision to perform CS. Furthermore, CBA allows for a stepwise improvement of maternal and neonatal care; and so, to be complemented by a system that continuously monitors and measures the impact of audit interventions to maternal and neonatal care, the Robson classification system was chosen.

Before-and-*after* design is prone to selection bias, change of comparison groups over time (Paper IV) and systematic bias due to the discrepancy of data collection tools and procedure. In order to minimize selection bias in Papers II and III, patients were consecutively selected by trained research assistants who collected data for both the baseline audit and the re-audit until the full sample size was reached. During the CBA studies, information to account for secondary QI interventions was gathered to alternatively explain possible changes over time that were not associated with the implementation of the audit recommendations. These changes included departmental changes of standard guidelines in the maternity ward, workshops on intrapartum interventions, and hospital QI activities, or "kaizen". To my knowledge, all of the identified interventions were performed before, during and after intervention; and therefore, were presumed not to have biased the impact of the audit intervention at a specified time. The audit evaluation forms were standardized by pre-testing and evaluation using local and international experts in obstetric care and epidemiology and statistics, in order to reduce the risk of research instrument bias.

Appropriateness of the study site

MNH is a consultant hospital for tertiary care of all referral patents from zonal, regional and district hospitals in Tanzania. This made MNH a strategic point for upgrading and standardizing maternal and child care. The research studies aligned with the hospital's strategic objective of improving service delivery to become the centre of excellence in patient care, hence favouring sustainability of CBA interventions and further reduction of significant residue in substandard care. Good data recording and storage systems, using a computerized obstetric database, enabled an adequate measure of standard practice.

Study limitations

The use of criteria-based audit limited the universal validity of the criteria for standard practice as the universal guidelines of diagnosis and management were modified at the care providers' discretion. This could compromise the external validity of the study. The survey of the outcome of the CBA focused only on the immediate outcome of the mother and newborn. Future research should also account for long-term outcomes such as the psychosocial implications regarding the maternal–infant relationship, women's psychological health, and women's ability to successfully initiate breastfeeding [44].

The generalizability of the association of change in rate of CS and perinatal outcomes should be made with caution as both the qualitative and quantitative methods could not provide causal inference. Additionally, the association of Apgar score <7 at 5 minutes of life to birth asphyxia contradicts other literature [118]. However, a low Apgar score (<7 at 5minutes of life) has been used to predict neonatal survival [106,119], and therefore, was also used in our study. Importantly, this study has shown an excellent inter-evaluator agreement (κ>0.8) for the assessed delivery outcomes using Apgar score, and this result is thus a merit to the internal validity of the evaluated perinatal outcome.

The standardized care of fetal distress and obstructed labour was based on the quality of comprehensive EmONC at a tertiary referral hospital that specialized in registry, which may differ from secondary and primary referral hospitals. This hinders direct adaption of the standards of care in the management of fetal distress and obstructed labour as a clinical guideline, outside MNH, without further investments in the structure and process of obstetric care. Despite an agreement of standard practice and the recommendation to optimize CS, there was a high residue of substandard care that could be due to inadequate implementation of some agreed interventions, including the alternative use of the gynecology theatre to reduce queuing of patients in the obstetric theatre, improve mandatory senior review of CS, and the reluctance to perform VE. These interventions require change in care providers' routine practices, behaviors and attitudes, which has been proven to be one of the difficult aspects in interventional research [95].

The high substandard management preceding CS (90%), after the implementation of the audit recommendations, confirmed the overall unmet need of EmONC in Tanzania [20]. However, MNH-based standard guidelines for intramural private practice might also have contributed to substandard care, including unnecessary CS [34], because private patients are usually managed by one doctor and also, in this case, due to limitations in the quality of care assurance by peer checking.

Furthermore, the evaluation of delivery outcomes *before* and *after* the CBA process might be unrealistic because the evaluation process was solely based on what is documented in the patients' files, which is also subjective to varying quality of the documentation and hence could not fully reflect the actual

clinical situations. Furthermore, the workload and working environment in the delivery room and operating theatre before and after the interventions might have changed based on the number of staff on each shift during a 24-hour cycle and the number of patients in need of CS, hence reducing the reliability of the results. Sufficient improvement in maternal and perinatal health cannot only be achieved by evidence-based obstetric practice using local resources alone, but must also include further investment in organizational and structural changes in the health care system. The quality of maternal and newborn care can sufficiently be improved based on standards that address safe, effective, timely, efficient, equitable and patient-centered interventions.

Conclusion

The studies managed to educate the care providers to take their role as decision-makers and medical experts to minimize unnecessary CS using available resources. The establishment of and adherence to clinical guidelines in the decision to perform CS did not require extra resources. However, care providers were empowered in performing evidence-based practice and in helping women to make an informed choice in relation to mode of delivery. Furthermore, care providers managed to optimize access to CS to women in need. In low-resource settings, assigning unnecessary CS implies depriving those in need of access to EmONC.

The identified substandard diagnosis and management of obstructed labour and fetal distress were a useful basis for sensitizing care providers to improved care using available resources within the existing the health system. However, persistently low standards of care implied further opportunities for improving the process of care, and a need for further investment in improving the quality of EmONC. Despite the study being conducted in a low-resource setting, the CBA improved the timeline of intervention of CS, as a proxy to timely, effective and efficient quality of care, because timely access to good quality care is a professional responsibility and every patient's right. The use of standardized audit procedure and training on data quality control during CBA led to moderate-to-excellent inter-evaluator agreement of quality of care of fetal distress and obstructed labour; and hence, gives care providers confidence and commitment to improve practice.

Recommendations

Care providers' commitment to achieve the best practice leads to sustainable favourable maternal and perinatal outcomes. The hospital management and health system needs to provide a supportive environment for regular clinical audits, and the prioritization and investment in EmONC. MNH is currently undergoing ongoing major infrastructural and systemic changes that align with the objective of my thesis, which is to upgrade the structure of EmONC, and, subsequently, the process and outcome of maternal and perinatal care. These changes include the expansion of the obstetric theatre, the establishment of an obstetric ICU, and improving blood banking and availability of drugs through the hospital pharmacy. To ensure the highest impact of these changes to maternal and perinatal health care, I recommend the following to be considered by the care providers, the Hospital administration and the health system:

Care provider level

1. Obstetricians and midwives should be jointly engaged in evidence-based QI activities and should maintain the maternal and perinatal audits for quality assurance of obstetric interventions. In view of the limited resources, CBA should be performed with stepwise increase of standards of care in subsequent cycles.

2. Based on our findings, there is a need for care providers to attend continuous medical education sessions and establish MNH evidence-based clinical guidelines for all EmONC activities, including VE.

3. Care providers should use the antenatal clinic attendance as a time for engaging with patients and understanding their physical and psychological needs. Additionally, this should be the time for providing counselling on the expectations of pregnancy, including mode of delivery. Obstetricians and midwives can use this time to provide

adequate information because the patients are usually free of anxiety and can understand better and have time to ask questions to their satisfaction, especially in making the decision of mode of delivery.Obstetrician and midwives should take the opportunity of engaging in local and collaborative operational research to improve their skills in evidence-based practice and professional advancement. This will also support the use of locally generated data on the demands and supplies of maternal and perinatal health care.

Hospital administration level

1. The hospital administration, especially the head of the obstetric department, should exercise leadership in discussions and feedback sessions regarding patients' care, 24-hour call morning reports, and maternal and perinatal audit committee meetings and feedback, so that the discussions focus on preventing operational and systemic factors leading to poor outcomes.

2. Based on the study findings, the disciplining of care providers and demands for a written statement in case of poor maternal and perinatal outcome should be discouraged. This has led to defensive practice that is risky and costly to the patients and health system.

3. The structure of care should be improved by upgrading the diagnostic tools, including the introduction of and training on fetal scalp blood lactate testing, adequate use of recently acquired CTG and blood gas analysis equipment, and the expansion of obstetric theatre space for obstetric patients at MNH and in all referral health facilities capable of providing comprehensive EmONC.

4. Keeping up with evidence-based practice, the hospital should continue to support staff-led research and collaborative QI research.

5. The data management system in the obstetric database should be upgraded to improve the accuracy of data and to reduce missing information so as to support regular clinical audits and research, and the establishment of the Robson Classification system for monitoring CS rate and associated outcomes.

Health system level

1. The structure of care in primary and secondary referral hospitals should be upgraded so as to reduce the scramble for health resources at the tertiary hospital, MNH. This will also reduce the high number of referrals and a delay in care at the referring health facilities.

2. The Ministry of Health, as a policy maker, should ensure that the policy priorities in maternal and child health are matched with the same priority in budget allocation for its execution.

Summary in English

In limited health resource settings such as Tanzania, an unnecessarily performed caesarean section pulls away health resources from a pregnant woman in need; and therefore, adds a risk of poor birth outcome to mothers and newborns. Despite caesarean section being a lifesaving procedure, increasing caesarean section rates at Muhimbili National Hospital, the national referral hospital, were associated with a concomitant increase in maternal morbidity and deaths and inconsistent improvement of newborn outcomes. This raised doubts about the accuracy of indications for caesarean section, and whether the increasing rates of caesarean section were driven by the women or the care-providers. This study, therefore, investigated care providers' in-depth perspectives of the reasons for these high rates of caesarean sections, and evaluated and intervened on the standards of care during the decision-making process related to the commonest reasons for caesarean section, obstructed labour and fetal distress, which are also the major causes of poor maternal and newborn outcomes.

This thesis reports an investigation performed at the Muhimbili National Referral Hospital in Tanzania. For Paper I, qualitative methods were used, including in-depth interviews and focus group discussions with care providers and participant observations of the care providers during work. For Papers II and III, a criteria-based audit evaluated the baseline and re-audit standards of care after implementing the agreed interventions for improving the management preceding caesarean section due to obstructed labour (baseline audit: n=260 and re-audit: n=250) and fetal distress (baseline audit: n=248 and re-audit: n=251). The effect of the criteria-based audit was assessed by comparing the mothers' and newborns' outcomes after childbirth before, and after the audit process, according to their Robson groups (Paper IV), which categorized all births (n=27,960).

These studies demonstrate that the care providers dismissed their responsibility for the rising caesarean section rate; and, instead, alleged that the factors relating to the rising rate of caesarean section were beyond their control. Additionally, dysfunctional teamwork and the poor transparency and poorly performed audit in case of poor birth outcomes led to fear and blame among care providers. Subsequently, fear of blame shifted care providers' focus from patients' safety to their own professional security, hence they practised defensively to try and avoid a poor outcome by assigning unnecessary caesarean sections. The criteria-based audit process improved

standards of diagnosis of fetal distress by 16% and that of obstructed labour by 7%. Additionally, the agreed standards of patient management preceding caesarean section increased more than two times after audit interventions, compared to before. The improved structure and process of care was mainly contributed to by strengthening teamwork and adherence to agreed timelines of interventions from decision of caesarean section to delivery. The effect of implementing audit interventions also included a 50% reduction in severe perinatal morbidity (neonatal distress and fresh still births) of obstructed labour cases. Furthermore, the criteria-based audit interventions increased the caesarean section rate by 60% in high-risk, preterm pregnancies (Robson group 10) and also reduced neonatal distress rate by 70% and perinatal mortality rate by 40%. After the audit process, the low-risk, term pregnancies (Robson group 3) had a reduced neonatal distress rate by 25% without significant change of caesarean section rate. Overall, after the criteria-based audit process, there was increased caesarean section rate of 10% and reduction of neonatal distress rate of 20%. There is therefore, further opportunity for improvement in emergency obstetric and neonatal care.

In conclusion, the studies managed to educate and engage the care providers to take up their role as decision-makers and medical experts in minimizing unnecessary CS. Introduction and adherence to the clinical guidelines standardized and optimized access to caesarean sections in high-risk, preterm pregnancy through evidence-based practice within the existing system. Nonetheless, the hospital management and the health system need to provide a supportive environment for making clinical audit a routine activity, standardizing and measuring maternal and newborn care based on relevant evidence, and investing in quality improvement of emergency obstetric and neonatal care.

Summary in Swahili/Muhtasari kwa Kiswahili

Katika sehemu zenye uhaba wa rasilimali afya kama Tanzania, uzazi kwa njia ya upasuaji *"caesarean section"* usio wa lazima unawanyima wajawazito wengine fursa ya kupata rasilimali hii, na hata kuhatarisha maisha ya mama na mtoto mchanga. Pamoja na kuwa uzazi wa njia ya upasuaji ni huduma ya kuokoa maisha ya mama na mtoto, ongezeko la kiwango vya huduma hii katika Hospitali ya Taifa ya Muhimbili ambayo ni hospitali ya rufaa daraja la tatu, limehusishwa na ongezeko la matatizo ya afya ya uzazi na vifo vya akimama kipindi cha kujifungua, na kutoleta mabadiliko ya matokeo ya uzazi kwa watoto wachanga. Ushahidi huu umeleta mashaka ya usahihi wa vigezo vinavyotumika kuamua kufanya upasuaji kwa ajili ya uzazi; na kama ongezeko la uzazi kwa njia ya upasuaji linachangiwa na akinamama wenyewe au utendaji wa watoa huduma za afya. Kwa sababu hizo, utafiti umefanyika ili kupata maelezo ya kina ya watoa huduma kuhusu sababu zinazochangia ongezeko la uzazi kwa njia ya upasuaji, na kutathmini na kufanyia kazi viwango vya huduma inayotolewa wakati wa muamuzi wa kufanya upasuaji pale mama anapokuwa na uchungu pingamizi *"obstructed labour "* au mtoto kuchoka akiwa bado tumboni mwa mama *"fetal distress"*. Uchungu pingamizi na hali ya mtoto kuchoka akiwa tumboni mwa mama ni sababu kuu za uzazi kwa upasuaji ambazo pia zinachangia kiasi kikubwa kuhatarisha afya ya mama na mtoto mchanga wakati wakujifungua.

Muswaada huu unatoa matokeo ya tafiti zilizofanyika Hospitali ya Taifa ya Muhimbili, Tanzania. Utafiti wa kwanza (I) ulitumia njia ya uchunguzi unaoangalia ubora wa huduma *"qualitative methods"* kwa njia ya mahojiano ya kina na majadiliano katika vikudi mahususi vya watoa huduma, yaani wakungu na madaktari. Katika uchunguzi wa ubora wa huduma, mtafiti alifanya uchunguzi pia akiwa katika shughuli za kawaida pamoja na watoa huduma. Utafiti wa pili (II) na watatu (III) ulifanywa kwa njia ya ukaguzi kwa kutumia viwango mahusisi "*criteria based audit"* kabla na baada ya kutoa mrejesho wa matokeo ya utafiti na kuamua na kutekeleza maazimio ya kuinua kiwango cha huduma inayotolewa kabla ya upasuaji pale mama anapokuwa na uchungu pingamizi (kabla ya maazimio *n*=260 and baada ya maazimio *n*=250) na mtoto kuchoka akiwa tumboni mwa mama (kabla ya maazimio *n*=248 and baada ya maazimio *n*=251). Utafiti wanne (IV) ulipima mabadiliko ya matokeo ya mama na mtoto mchanga kabla na baada ya kutekeleza maazimio ya kuboresha huduma yaliyotokana na mchakato wa ukaguzi wenye viwango mahususi *"criteria based audit"* (*n*=27,960). Mabadiliko yalipimwa

kwa kuzingatia makundi ya akina mama kutokana na sifa na vihatarisha vya ujauzito yaani *"Robson classification"*, kwa lugha ya kiingereza.

Utafiti umeonyesha kuwa watoa huduma za afya walijitoa kuhusika na ongezeko la uzazi kwa njia ya upasuaji; na badala yake kusema kuwa ongezeko hilo linatokana na sababu zilizo nje ya uwezo wao. Zaidi, kutokuwa na umoja katika kazi, na mapungufu katika upembuzi,wa matokeo mabaya ya uzazi kulichangia kujenga hofu na tabia ya kulaumiana pale matokeo ya uzazi yanapokuwa mabaya. Matokeo yake, hofu ya lawana ilichangia kugeuza vipao mbele vya watoa huduma na badala ya kuhakikisha usalama wa mama na mtoto, walifanya kazi kwa kujihami wao na kazi zao. Hii ni pamoja na kufanya upasuaji bila vigezo sahihi. Mchakato wa ukaguzi wenye viwango mahususi *"criteria based audit"* yalipandisha viwango vya maamuzi ya upasuaji kwa 16% kwa wajawazito wenye mtoto aliyechoka tumboni *"fetal distress"* na kwa asilimia 7 kwa wajawazito wenye uchungu pingamizi *"obstructed labour"*. Viwango vya huduma kabla ya upasuaji viliongezeka zaidi ya mara dufu. Uboreshaji wa mfumo na utaratibu wa huduma ulichangia kuimarisha umoja katika kufanya kazi na utekelezaji wa azimio la kupunguza muda wa kusubiri baada ya maamuzi ya upasuaji mpaka kutoa mtoto tumboni mwa mama. Utekelezaji wa maazimio yaliyokubalika na watoa huduma katika kuboresha huduma ulipunguza 50% ya matatizo ya watoto wachanga wakati wa kuzaliwa hadi siku saba baada ya kuzaliwa *"perinatal morbidity*", hususani katika uzazi wa akina mama wenye uchungu pingamizi. Mabadiliko mengine ni ongezeko la kiwango cha upasuaji kwa 60% kwa mimba zisizotimia ambazo pia zilipata matokeo mazuri kuliko awali. Utekelezaji wa mazimio ya kuboresha huduma ulipunguza tatizo la watoto kuchoka na kushindwa kupumua vizuri *"neonatal distress"* kwa ujauzito wenye kiwango kidogo cha vihatarishi vya ujauzito, *"low risk pregnancy"* bila kuadhiri kiwango cha uzazi kwa njia ya upasuaji wa kundi husika. Kwa ujumla kiwango cha uzazi kwa njia ya upasuaji kiliongezeka kwa 10% na kupunguza kiwango cha watoto wanazaliwa wamechoka na kushindwa kupumia vizuri kwa 20% tu. Kwa hiyo, bado kuna haja na nafasi ya kupandisha kiwango cha huduma ya dharura ya uzani na watoto wachanga.

Kwa kuhitimisha, utafiti huu umeweza kuelimisha na kuhamasisha watoa huduma kuchukua nafasi yao kama waamuzi na watalaamu katika uzazi kwa njia ya upasuaji, ili kupunguza upasuaji usio wa lazima. Uwepo na matumizi ya muongozo kwa watoa huduma uliweka viwango na kusaidia kutosheleza mahitaji ya upasuaji kwa mimba zisizo timia. Pamoja na haya yote, uongozi wa hosptali na mfumo mzima wa huduma ya afya unapaswa kuweka mazingira bora ya upembuzi wa huduma ya afya na viwango na kupima huduma ya afya ya mama na mtoto kulinganana ushahidi wa utafiti husika.

Summary in Swedish/Sammanfattning på svenska

Trots att kejsarsnitt är en potentiellt livräddande operation kan onödiga kejsarsnitt utförda i länder med begränsade sjukvårdsresurser, såsom Tanzania, leda till ojämlik vård och därmed försämrade hälsoutfall för både kvinnor och barn. Tidigare studier har visat att ökade kejsarsnittsfrekvenser på Muhimbili National Hospital, det största offentliga sjukhuset i Tanzania, ledde till svåra komplikationer för kvinnor och inga säkra förbättringar i hälsoutfall för nyfödda barn. Dessa resultat gav upphov till tvivel huruvida kejsarsnitt utfördes på korrekta grunder och om ökningen av kejsarsnitt drivits fram av kvinnorna eller sjukvårdspersonalen. Syftet med den här avhandling var att utreda sjukvårdspersonalens perspektiv på orsakerna till höga kejsarsnittsfrekvenser samt att utvärdera och förbättra vården vid kejsarsnitt som utförs p.g.a. utebliven progress och hotande fosterasfyxi, vilket är de två vanligaste orsakerna både till kejsarsnitt och dåligt hälsoutfall för kvinnor och barn.

Studierna genomfördes på Muhimbili National Hospital i Tanzania. I studie I användes djupintervjuer och fokusgruppdiskussioner med sjukvårdspersonal samt deltagarobservationer av sjukvårdspersonalens arbete. I studie II och III genomfördes en granskning (audit) för att utvärdera vården vid kejsarsnitt utförda p.g.a. utebliven progress och hotande fosterasfyxi. Efter detta implementerades en rad interventioner för att förbättra vården i dessa situationer. Effekterna av granskningen och interventionen utvärderades genom att jämföra kvinnors och barns hälsoutfall före (*n*=260 kvinnor med utebliven progress och n=248 kvinnor med hotande fosterasfyxi) och efter (*n*=250 kvinnor med utebliven progress och *n*=251 med hotande fosterasfyxi) interventionen. I studie IV, som inkluderade 27 960 kvinnor, analyserades kvinnors och barns hälsoutfall före och efter interventionen i de s.k. "Robson-grupperna", som delar in kvinnor i tio grupper baserat på deras obstetriska karakteristika.

Studierna visade att sjukvårdspersonalen ofta avfärdade sitt eget ansvar för de stigande kejsarsnittsfrekvenserna genom att argumentera att orsakerna till de höga kejsarsnittsfrekvenserna låg utanför deras kontroll. Dessutom framkom att dysfunktionellt teamarbete och de rutinmässiga genomgångarna man hade på kliniken av händelser med dåligt hälsoutfall ledde till rädsla och skuldbeläggning. Rädslan för skuldbeläggning ledde i sin tur till att sjukvårdspersonalen fokuserade mer på sin egen säkerhet än på kvinnornas behov, vilket resulterade i fler onödiga kejsarsnitt. Granskningen och interventionen,

som genomfördes i studie II och III, förbättrade diagnostiken av hotande fosterasfyxi med 16% och diagnostiken av utebliven progress med 7%. Dessutom förbättrades det medicinska omhändertagandet inför kejsarsnitt på dessa indikationer. Förbättringarna åstadkoms framför allt genom att teamarbetet stärktes och att tiden mellan beslut om och utförande av kejsarsnitt förkortades. Bland de kvinnor som genomgick kejsarsnitt p.g.a utebliven progress halverades andelen barn som föddes med låg Apgarpoäng eller dog under förlossningen. Studierna påvisade en ökning av kejsarsnittsfrekvensen med 60% i Robsongrupp 10, d.v.s. kvinnor med förtidsbörd, vilket var associerat med förbättrade hälsoutfall för de nyfödda barnen i denna grupp. I Robsongrupp 3, d.v.s. lågriskgruppen omföderskor utan tidigare kejsarsnitt, åstadkoms däremot en minskning av andelen barn med låg Apgarpoäng med 25% utan att kejsarsnittsfrekvensen ökade. Totalt ledde granskningen och interventionen till att kejsarsnittsfrekvensen ökade med 10% och andelen nyfödda barn med låg Apgarpoäng minskade med 20%.

Interventionen engagerade sjukvårdspersonalen till att se sin egen roll som beslutsfattare och medicinska experter i arbetet för att minimera onödiga kejsarsnitt. Tillgången till kejsarsnitt för kvinnor med förtidsbörd förbättrades genom evidensbaserat arbete inom ramen för det befintliga sjukvårdssystemet. Sjukhusledningen och sjukvårdssystemet behöver arbeta för att klinisk granskning och förbättringsarbete ska bli en rutin, för att vården för kvinnor och barn standardiseras och följs upp, samt för att kvaliteten i akut obstetrisk vård och vård för nyfödda barn förbättras.

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