MATERNITY CARE IN MTWARA REGION, SOUTHERN TANZANIA.

AN ASSESSMENT USING THE UNMET OBSTETRIC NEED (UON)-APPROACH

Master's thesis submitted to the
Charité Medical School of Humboldt University
and Free University Berlin in partial fulfilment
of the requirements for the award of a Master of
Science degree in International Health

by Claudia Hunger, MD

April 2005

THESIS SUPERVISOR: PD Dr. Albrecht Jahn

Thesis markers: PD Dr. Albrecht Jahn

PD Dr. Poggensee

Table of contents

List of tables

List of figures

List of abbreviations

AIDS	Acquired immune deficiency syndrome
ARC	AIDS related complex
AMI	Absolute major indications
AMDD	Averting maternal death and disability
AMMP	Adult mortality and morbidity project
ANC	Antenatal care
APH	Antepartum haemorrhage
BT	Blood transfusion
CHMT	Council (District) health management team
CFR	Case fatality rate
CPD	Cephalo-pelvic-disproportion
CS	Caesarean section
DED	Deutscher Entwicklungsdienst
DGIC	Directorate-General for Development cooperation (Belgium)
DSS	Demographic sentinel site
EOC	Emergency obstetric care
EB	Expected births
FP	Family planning
GNI	Gross national income
GDP	Gross domestic product
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HC	Health centre
HF	Health facility
HIV	Human immunodeficiency virus
IMR	Infant mortality rate
KfW	Kreditanstalt für Wiederaufbau
MCH	Mother-Child-Health
MoH	Ministry of Health
MOI	Major obstetric intervention
MMR	Maternal mortality ratio
MM-rate	Maternal mortality rate
PPH	Postpartum haemorrhage
PPP (US$)	Purchasing power parity
RHMT	Regional health management team
RAMOS	Reproductive age mortality survey
Tshs	Tanzanian Shillings
<5 MR	Under five mortality rate
UNFPA	United Nations Population Fund
UNICEF	United Nations International Children's Emergency Fund
UON	Unmet obstetric need
VVF	Vesico-vaginal fistula
WHO	World Health Organisation

Executive summary

Introduction: During the last years increasing attention has been drawn to input, process and output indicators to measure progress in maternal health. The main reason for this is the fact that the main outcome indicator the maternal mortality ratio is difficult to measure and large resources are needed to get reliable estimates. Different approaches, like the sisterhood method or reproductive age surveys have been applied to get an estimate of the maternal mortality ratio. However, all methods face problems mostly due to the fact that a maternal death is a rare event even in places where the maternal mortality is high and misclassification of the reason of death of women in reproductive age is common. The above mentioned constraints thus makes it difficult or even impossible to monitor safe motherhood programmes at district level and the effectiveness and cost-effectiveness of interventions are largely not known.

The shift towards input, process and output indicators to measure progress in maternal health has led to the use of different approaches and various scientific groups favoured different indicators. The unmet obstetric need (UON)-network, based at the institute of Tropical Medicine in Antwerp, proposes the use of major obstetric interventions as tracer indicators to assess the responsiveness of the system to address obstetrical problems.

The study in Mtwara region aimed at estimating the unmet obstetric need using the unmet-obstetric-need-indicator in a prospective study and at the same time to assess feasibility of data collection through the routine hospital information system and the usefulness of the indicator for district planning. In addition maternal and perinatal outcome in relation to obstetric interventions were assessed.

Methods: The study followed the model of the unmet obstetric need network. This method aims at measuring the discrepancy between what the health care system ideally should do to deal with obstetric problems in a given population, and the care it actually delivers. The unmet-obstetric-need-indicator is expressed in terms of the number of women who should have benefited from an obstetric intervention, but for whom this intervention was not undertaken. For this estimation only major obstetric interventions (MOI) that are performed for absolute maternal indications (AMI) are included.

The set of major obstetric interventions were adapted to the Tanzanian situation and included caesarean section, hysterectomy, laparotomy for repair of uterus, blood transfusion, destructive operation and others. The absolute major interventions included uterine rupture, cephalo-pelvic-disproportion / obstructed labour based on a partograph, antepartum and postpartum haemorrhage, two or more previous caesarean sections,

puerperal infection, severe anaemia and malpresentation. Data on major obstetric interventions were collected during a 2 years study period from July 2000 to June 2002 in all four hospitals of Mtwara region in the south-east of Tanzania covering a population of 1,128,523 people. A questionnaire was used for every pregnant women having undergone a major obstetric intervention or who died before such an intervention was carried out. Data collected included the obstetric intervention, indication, mothers origin, and maternal and perinatal outcome. The study used a threshold of 2% major obstetric interventions for absolute major indications needed per expected birth to calculate the unmet-obstetric-need-indicator and the deficits of life saving interventions. Expected births were estimated on the basis of the national birth rate of 40 of 1000 and national census data from 2002.

Results: 2404 questionnaires on major obstetric interventions were collected during the study period. The data collection reached high completeness as 94% of caesarean sections done in the hospitals during the study period were captured in the questionnaires. 92% of all major obstetric interventions were caesareans section, 5% blood transfusion, 2% laparotomies for ruptured uterus and 1.3% hysterectomies. Significant more laparotomies and hysterectomies were done for mothers coming from rural than urban areas (p=0.009 respective p=0.03) The most often mentioned indication was obstructed labour (46%) followed by malpresentation (8.5%) and two or more previous caesarean section (8.3%). For mothers coming from rural area, the reason for an intervention was significant more often a uterus rupture (3.7% versus 1.5%) whereas significantly more urban mothers got an intervention for hypertensive disorders (4.5% versus 1.9%).

The study in Mtwara revealed major deficits of life saving obstetric interventions in areas more than 20km from a district hospital. The cut-off value of 2% of major obstetric interventions for absolute maternal indications per expected births was achieved in 7 out of 20 divisions and 4 divisions had levels between 1.5% and 2%. Another 3 divisions reached levels above 1% whereas 6 out of the 20 divisions failed to reach an absolute minimum level of 1%. The analysis of the proportion of interventions performed per expected births and distance to a hospital showed that for every 10km distance to a hospital the rate of major obstetric interventions for absolute maternal indications declined by 0.036 from 2.69% in the close neighbourhood of a hospital.

Perinatal mortality differed slightly but not significantly between the hospitals. Higher perinatal mortality was observed for mothers coming from rural areas. Hysterectomy and a laparotomy for ruptured uterus were the most fatal interventions. Less than 30% of newborns survived if the mothers underwent one of these interventions.

2.7% of mothers died before, during or after a major intervention was performed. Mortality differed in the four hospital (range from 0.9 to 5.3%). Mortality was especially high for laparotomy for a ruptured uterus (22% of mothers died), hypertensive disorders (10%) and blood transfusions (8%).

The collection of the data with the use of questionnaire for was feasible. All necessary information are available through the routine hospital information system. However, the resources for data management and analysis were not available at district or regional level. Supervision of study sites, analysis of data and retro-information of the results have been a problem. No result can be given concerning the usefulness of the unmet-obstetric-need-indicators for district planning as the data were not yet presented at district but only at national level.

Conclusion: This prospective unmet-obstetric-need-study gave a lot of valuable information about access to emergency obstetric care and maternal and perinatal mortality. Women with obstetric complications have acceptable assess to emergency obstetric care in only one third of the 20 divisions in Mtwara region. Access is greatly influenced by distance to a hospital. Rural mothers with certain obstetric complications like antepartum haemorrhage or eclampsia are less likely to get care in a hospital, resulting in high fatality rates for mother and child.

The UON-indicator showed to be useful to monitor access to emergency obstetric care and perinatal and maternal mortality using data available through the routine hospital information system.

1 Introduction / background

Maternal mortality ratios[1] (MMR) are still unacceptably high in many resource poor countries. WHO estimates that every year about 529.000 women are dying from pregnancy and childbirths related complications (WHO, 2004c). But maternal mortality is only the tip of the iceberg of maternal ill-health. For every death, 15-20 other women are suffering from non-mortal complications like infections, vesico-vaginal fistulae or uterus prolaps (Royston and Armstrong, 1990). The direct causes of deaths include haemorrhage (25% of maternal deaths), sepsis (15%), eclampsia / hypertensive disorders during pregnancy (12%), obstructed labour (8%), and unsafe abortion (13%). In addition 20% of mother die as a result of a disease that is aggravated by pregnancy like malaria, tuberculosis, HIV-infection and anaemia (WHO, 1996). Peri- and neonatal disorders are closely related to the quality of delivery care. Out of the 10.8 million children dying every year 32% die because of neonatal disorders (Black *et al.*, 2003). Perinatal and maternal disorders together account for about 9% of the loss of healthy life years in the world (WHO, 2003).

Mother and Child Health Care (MCH) is part of the primary health care strategy which has been introduced worldwide since the Alma Ata conference in 1978. However, Rosenfield and Maine discussed the lack of focus on maternal health in their famous article in 1985 “Where is the M in MCH?” (Rosenfield and Maine, 1985). To put emphasis on the prevention and treatment of live-threatening complications during pregnancy and child-birth, the Safe-Motherhood Initiative was launched in 1987. One major constraint of this initiative was the fact that the outcome indicator MMR is difficult to measure. The MMR is not recommended as an adequate indicator to measure success in programs at district or regional level (Gelband et al., 2002, Graham et al., 1996). The lack of a measurable outcome indicators is also discussed as a reason for the neglect of maternal health in resource allocation for public health (Graham and Campbell, 1992, Graham and Airey, 1987, Airey, 1989).

The importance and international recognition of maternal and perinatal deaths as major health problems is reflected in the fact that the reduction of the MMR by three quarters and under-five mortality by two third from 1990 to 2010 are two of the eight millennium

[1] The MMR is defined as the number of maternal deaths per 100,000 live births

development goals and targets (United Nations, 2000). However, the lack of focused country specific strategies and priority setting as well as under-funded public health services will make it difficult to reach this goal in many low income countries (The World Bank, 2004, Maine and Rosenfield, 1999).

1.1 The study country: Tanzania

Tanzania, with an area of 945,000 sq.km, is the largest country in East-Africa. The country consists of the former Tanganyika (in the 1920th a German colony) and Zanzibar. Tanganyika obtained its independence in 1961 and was united with the former British protectorate of Zanzibar in 1964. The first President was Julius Nyerere. He took through the Arusha in 1967 declaration Chinese communism as a model for a Tanzanian socialistic republic with a one-party system. Nyerere managed to unite the country and to introduce the national language 'swahili'. He also developed the social sectors. In 1992 under the second president Mwinyi a multi-party system was established and reforms to develop the private sector were initiated. Still today, Tanzania remains one of the poorest countries in the world. According to UNICEF (2004) the estimated GNI per capita was 290 US$ in 2003 and the GDP was given at 600 US$ PPP in 2002 (Anonymous, 2003). Infant Mortality and under five mortality are still high (data for 2003: IMR 104, <5MR 165, UNICEF 2004). Life expectancy dropped during the last years to about 46.4 years (WHO, 2004d) from previous 51 (1990). This drop in life expectancy is to a large extend due to HIV/AIDS. The HIV prevalence in the sexual active population is estimated to be about 7.8% (UNAIDS, 2004) whereas the government estimates that 12% of the sexual active population is infected (Tanzania, 2004).

The total fertility rate decreased from 6.1 (1992) to 5.2 (2002) children per women and the crude birth rate was estimated to be 40 children per 1000 population. The annual growth rate is 2.6. The national census 2002 estimated the total population to be 33,461,849. (UNICEF, 2004, Bureau of Statistics United Republic of Tanzania, 2002).

The government spends 4.4% of the national GDP on health (6.6 US$). The donor contribution to financing of health increased from 16% in 1997 to 30% in 2001. The private expenditure accounts for 53% of the total expenditure on health, and of it 83% is out-of-pocket expenditure. Social security or prepaid schemes are now gradually introduced (WHO, 2004d).

1.2 Strategy to address maternal health in Tanzania

Tanzania health strategy is based on the Arusha declaration of 1967 and aims at equity and accessibility of good quality of care. The health system has a pyramidal structure with the Ministry of Health on top at central level, the regional level with its Regional Health Management Team (RHMT) and the regional reference hospital, and the district level with an Council (District) Health Management Team (CHMT) including district hospitals, health centres and dispensaries making up the main implementers.

Tanzania has a good national accessibility to health facilities. The mean distance to a hospital is 21.3km and 75% of the people live within 6km of a dispensary/Health Centre (Bureau of Statistics United Republic of Tanzania, 2001). Since 1994 a health reform is ongoing, characterized by decentralisation, integration of vertical programmes, improved financial management and a close cooperation between donors and government according to the Sector Wide Approach. The reform also includes donor financing directly to the districts. The introduction of user fees and health insurance as well as community health funds are part of the reform. A public-private mix is promoted to encourage the private system to complement the government health system.

MCH-services have always been a public health priority and are free of charge. Antenatal Care (ANC) attendance at least once during pregnancy reaches 97%. Despite this high use of ANC, only 43.5% % of mothers deliver under supervision of a trained birth attendant (TRCHS, 1999, DHS Tanzania, 1996).

Since the Cairo conference on Population and Development in 1994, Tanzania has developed a new reproductive health approach. In 1997, the country adopted a strategy of improving the status of women as well as the access to family planning (FP) and basic maternal health services (MoH Tanzania, 1997). The MoH has supported training of hospital staff on live saving skills to handle birth complications better.

Maternal deaths audits are mandatory for all deaths in HFs and aim at stimulating a discussion about the reasons for deaths and possible improvements. Recently also perinatal audits have been introduced. FP is an integrated part of mother and child services and available free of charge at all public health facilities. The MoH has also prioritised post-abortion care.

Many studies in Tanzania have described deficiencies in the quality of ANC (Urassa et al., 2002, Simbakalia et al., 1999, Kowalewski et al., 2000). Moreover, during the past years, the impact of ANC to reduce maternal mortality has been questioned (Carroli et al., 2001,

McDonagh, 1996). To address weaknesses in the quality of ANC and following the recent shift from the risk approach to 'every birth is at risk' the MoH in 2003 adopted a 'Focused ANC'-strategy emphasising counselling and birth preparedness.

The health reform and therewith the decentralised implementation of reproductive health and safe-motherhood interventions at district level brings up the need to monitor and measure improvements in maternal health at local level.

1.3 Maternal mortality in Tanzania

Data on maternal mortality has been published by the Adult Morbidity and Mortality Project (AMMP) in Tanzania. In the early ninetieths this project established 3 demographic surveillance areas to assess adult morbidity and mortality using a an active reporting system and the "verbal autopsy" method. The population under surveillance was 64024 out of whom 18638 (29.1%) were women aged 15-49. The MMR was 591 in Dar-es-Salaam for the time period 1993-1999, and 348 and 1099 in Hai and Morogoro District respectively for the period 1992-1999. At the same time, the MM-rates[2] decreased during the observation period from 134 to 37 per 100.000 women of reproductive age in Dar-es-Salaam, from 51 to 30 in Hai district and 179 to 108 in Morogoro district (Mswia *et al.*, 2003).

However, the 'verbal autopsy' method is not generally accepted and a validation of this method for MMR estimations is still missing (Ronsmans *et al.*, 1998). Therefore WHO still uses a model for their prediction of the MMR for countries where no vital registration or reproductive age mortality surveys (RAMOS) have been undertaken. WHO predicts that the MMR in Tanzania is still one of the highest in the world with 1500 per 100,000 live births (range of uncertainty 910 to 2200)(WHO, 2004c). This figure is derived from a model and takes the data of the latest DHS-survey in 1996 using the direct sisterhood method which estimated the MMR at 529 maternal deaths per 100,000 live births into account (DHS Tanzania, 1996). The figure was adjusted as underreporting is estimated to be substantial in data derived though the sisterhood method (Stanton *et al.*, 2000). Other surveys, using the sisterhood method, showed similar figures as the DHS-survey with the MMR varying between 448 in Morogoro Region, 606 in Kigoma Region and 946 in Iringa Region (Font et al., 2000, Mbaruku et al., 2003).

[2] The MM-rate is defined as maternal deaths per 100,000 women of reproductive age

2 Literature review on methods measuring maternal mortality

A maternal death is codified according to the International Classification of Diseases (ICD-10) as follow: 'A deaths of a women while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any causes related to or aggravated by the pregnancy or its management but not from accidental or incidental causes'(WHO, 2004c)[3].

Underreporting and misclassification is common. Even in countries with good registration of all vital events misclassification and underreporting especially of death during early pregnancy or death due to cerebro-vascular, cardiovascular and eclampsia have been found to be substantial (Schuitemaker et al., 1997, Bouvier-Colle et al., 1991).
Moreover, a maternal death even in places with a high MMR is still a rare event (between 0.5 & 1.5%) why missing even few will greatly influence the result. This leads to large confidence or uncertainty intervals of estimates.

The first country-specific estimations, derived from a model based on a small amount of data from community studies, were published in 1991 (AbouZahr and Royston, 1991). These first estimates stimulated many countries to undertake studies on maternal mortality and the sisterhood method was widely introduced. According to this method women are asked about sisters and deaths among these (Graham *et al.*, 1989). However, the method is limited to studies where a great time lag between data collection and the study period for which the estimate is valid in not important. Moreover, with reduced MMR, it is also necessary to have large sample sizes to get an acceptable precision of estimates of the MMR in a study area (Hanley *et al.*, 1996). Recent comparison of the sisterhood method with other methods to estimate the MMR, gives an indication that this method underestimate the MMR by between 15% to 60% (Stanton *et al.*, 2000). During the last years, another method, the Reproductive Age Mortality Survey (RAMOS) technique has been introduced. This method estimates the proportion of maternal deaths out of all deaths of women in their fertile period. This techniques is judged to be the most reliable method to get MMR data in countries where no good vital registration system is introduced (WHO, 2004c).

[3] The 10th revision of the International Classification of Disease makes provision for including late maternal deaths occurring between six weeks and one year after childbirth.

Thus the 1995 country-specific estimates published by WHO relied on better data, but still calculated the country-specific estimates with high margins of uncertainty (Hill *et al.*, 2001). The recently published data on MMR in 2000 developed the modelling of MMR further but relied on the same techniques mentioned before, vital statistic (mostly high income countries), or household surveys usually using the direct or indirect sisterhood method and data from reproductive age mortality studies (WHO, 2004c).

The wide margins of error and large confidence intervals due to small numbers as well as the problem of underreporting and misclassification questions the MMR as a reliable outcome indicator to measure programme success to reduce maternal deaths at district or regional level (Gelband *et al.*, 2002). Hill *et al*. in 2001 stated that "In the absence of comprehensive and high quality registration of vital events, the MMR is too hard to measure to be programmatically useful" (Hill *et al.*, 2001). Because of this problem increased attention has been given to the development of process/output indicator as a proxy of maternal mortality and to measure the effect of interventions on aspects of maternal health. Moreover, process/output indicators have shown to be extremely useful for project design and management and they are mostly easy and cheap to obtain (McGinn, 1997, Belghiti et al., 1998, Goodburn et al., 2001).

2.1 Process and output indicators to measure maternal health

The increasing need to assess safe-motherhood interventions at district or regional level makes it important to have an indicator that is easy and not costly to obtain. Moreover, to be effective the indicator should ideally be a proxy of the outcome-MMR. The most commonly used indicator for maternal health is the 'proportion of birth attended by a trained birth attendant'. According to WHO a "skilled attendant is an accredited health professional – such as midwife, doctor or nurse – who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancy, childbirth and the immediate postnatal period, and in the identification, management and referral of complications in women and newborn" (WHO, 2004b). This indicator is also used to assess progress in reaching the fifth Millennium Development goal, reducing maternal mortality (United Nations, 2000). However, a comparison of aggregated data from 50 developing countries of the percentage of deliveries attended by a trained attendant (comprising doctors, midwifes and nurses) and the MMR revealed only a correlation with a coefficient of 65%. The problems of this aggregated data is the variability of the

definition of ‘trained attendant’ and the difficulty to adjust for all potential confounders (Graham *et al.*, 2001). However, despite the fact that the ‘proportion of birth attended by a trained birth attendant’ is not always correlated with the country-specific MMR, the aim of offering the best possible care for a women during delivery makes this indicator an important output measurement of maternal health (WHO, 2004b).

Further, two different scientific groups have worked on the development of process/output indicators to monitor the function of the maternal health service system. The Unmet Obstetric Need (UON) network uses major obstetric interventions as tracer indicators. The UON-indicators aims at measuring the discrepancy between what the health care system should do to deal with life-threatening obstetric problems in a given population and the care it actually delivers. The UON-indicator is expressed in terms of women, who should have benefited from an obstetric intervention, but for whom this intervention was not undertaken. For this estimation, only major obstetric interventions (MOI) like Caesareans Section (CS) that are performed for absolute maternal indications (AMI) like malpresenation are considered (De Brouwere and Van Lerberghe, 1998). A range of MOIs for AMIs between 1% to 2.9% of all birth is thought to be the absolute minimum to safe guard mothers live (Francome and Savage, 1993, Belghiti et al., 1998, De Brouwere and Van Lerberghe, 1998). The UON-concept is used to encourage policy changes to address maternal health. Mapping the unmet need for obstetrical care aims at making the lack of maternity care visible to trigger improvements in maternal health policies.

In 1997 a UNICEF/WHO/UNFPA supported group developed a set of five process indicators to measure the quality of obstetric care and the responsiveness of the health system to deal with maternal complication (Wardlaw and Maine, 1999, Maine et al., 1997). The set included the following indicators: 1) the coverage of health facilities that provide Emergency Obstetric Care (EOC) in a district, 2) the proportion of births in EOC-centres per expected birth in a population, 3) the proportion of women estimated to have obstetric complications which are treated at EOC facilities, 4) CS-rates as a proportion of all births and 5) the case fatality rate (CFR) for women with obstetric complications. Acceptable levels for the percentage of total births in EOC-facilities are said to be 15%, all women with obstetric complication (which are estimated to be 15% of expected births) should be treated in EOC-facilities, the CS-rate should be between 5% and 15% and the case fatality rate for obstetric complications should not exceed 1%. This set of indicators

has been used in several countries, including Tanzania, to collect baseline data and to make a needs assessment for planning of activities (Goodburn et al., 2001, AMDD, 2003a, Nirupam and Yuster, 1995).

2.2 Recent discussion of the proposed process/output indicators

There is still a debate on how well process/output indicators reflect improvement of maternal health. Ronsmans in 2001 argued that even measurement of more proximate endpoints such as service utilisation or quality of care is far from straight forward (Ronsmans, 2001).

As both the set of indicators developed by UNICEF/WHO/UNFPA and the UON-indicator focus on the service system and even more specifically on the hospital service system, they are likely to fail to reflect other important aspects of maternal care. Moreover especially the thresholds proposed by UNICEF/WHO/UNFPA are a matter of discussion. In a recently published article (Ronsmans *et al.*, 2003) the authors argue for caution especially in the use of the crude population based CS-rate of between 5% and 15%. Moreover, according to these authors, if the urban-rural differences are not taken into account, the CS-rate does not correlated with the MMR in several study areas in West-Africa. Further, there is a lot of debate about the right CS-rate (Van Roosmalen and Van der Does, 1995, Francome and Savage, 1993, Chanrachakul et al., 2000, Nirupam and Yuster, 1995, Dumont et al., 2001). Moreover, the assumption that 15% of all deliveries are complicated and need treatment in a centre with emergency care facilities is not based on evidence. Historical data show that low maternal mortality ratios can be achieved even with low facility based delivery rates (Högberg *et al.*, 1986, UON-network, 1998, UON-network, 2000)). Further there is a great variation in the direction the different performance indicators point (Ronsmans et al., 2002a, Nirupam and Yuster, 1995).

2.3 The evolution of Unmet Obstetric Need-study in Tanzania

The UON network was established in 1996. Is was initiated and is coordinated by the Department of Public Health, Institute of Tropical Medicine (ITM) in Antwerp and received support by the European Commission DG VIII. Collaborators are GTZ (German Technical Cooperation), WHO, UNFPA, UNICEF and DGIC (Directorate General of International Cooperation – Belgium).

In 1996, the first contact was made with a representative of GTZ in Tanzania. The Institute for Hygiene and Public Health, Heidelberg, Germany was involved at a very

early stage in the discussion with the Muhimbili University College of Health Science on carrying out a study in Tanzania using the UON-indicator. After some discussion the study was finally launched during a workshop organized by GTZ in Dar-es-Salaam, Tanzania in 1999. The UON-concept was not universally seen as advantageous since the scale of the problem of maternal mortality was largely known for Tanzania and especially for Tanga region (MacLeod and Rhode, 1998). However, a number of factors persuaded the Tanzanian health authorities to join the UON-network: 1) the fact that the study could be carried out in the obstetric services by the practitioners themselves, 2) the low cost, 3) immediate utilisation at the peripheral, regional and national level, 4) the possibility to utilise the method in the national health information management system (Mtuha), 5) the possibility of quantifying and monitoring deficits prospectively 6) the unusual approach in terms of 'needs to be met' rather than coverage and 7) the possibility of cooperation and exchange at international level.

It was agreed to carry the study out in two regions where GTZ and other German partners (DED/KFW) were supporting the health sector, Tanga and Mtwara Region. The Tanzanian partner, Professor Massawe, was at that time the head of the obstetric and gynaecology department of the Muhimbili medical centre[4]. For each region a regional coordinator was selected as well as responsible staff members from each of the hospitals.

Soon after the meeting in Dar-es-Salaam a pilot study was carried out in Mtwara hospital. This study covered the districts Mtwara urban and Mtwara rural. A register of information required was set up in the maternity ward and the coordinator for Mtwara region, Mrs Kitundu, collected the data daily together with the in-charge of the maternity ward. A total of 371 data on MOIs were collected.

The analysis of the pre-test showed problems with the term cephalo-pelvic disproportion (CPD). This indication accounted for a high number of cases: 64% of all indications in urban areas and 68% in rural. In Tanzania, this term is perceived rather as dynamic than absolute. Thus, for the main study a stronger definition 'CPD, based on the partograph' was used. Moreover, discussion of Tanzanian health experts revised the original list of intervention and indications (see also 4.1).

In the study protocol regular monthly supervision of the regional coordinator to all 4 hospitals involved in Mtwara region was planned. The regional coordinator was supposed to collect the weekly summary reports for preliminary analysis and to supervise the data

[4] The Muhimbili University College of Health Science in the health department of the University of Dar-es-Salaam.

collection. The weekly summary sheets were to be send to the national coordinator. A centralised data processing and analysis was envisaged including the write-up of quarterly reports to give a regular feed back to the participating hospitals. The budget for the two years study including data collection, analysis, report and retro-information was estimated to be 13347 Euro.

3 Objectives of the Study

The UON-indicator has been employed in several countries through-out the world during the past 5 years (UON-network, 2004a, Rehman et al., 2000, Quedraogo et al., 2003). Major deficits of live-saving operations, especially in rural and remote areas have been found in almost all of the studies in Africa (Niger, Benin, Burkina Faso and Mali, Asia (Pakistan and Bangladesh) and the Caribbean (Haiti).

All these UON-studies were designed as retrospective studies to assess the situation and to trigger policy discussion. The UON-study in Mtwara was set up as a prospective study and aimed (besides assessing the unmet obstetric need) to get information about the feasibility of the data collection through a routine system and to analyse its usefulness for district planning in a resource poor setting.

The **overall objective of the study** was to determine the Unmet Obstetric Need in Mtwara Region and to assess the method as a continuous monitoring tool.

The specific objectives were

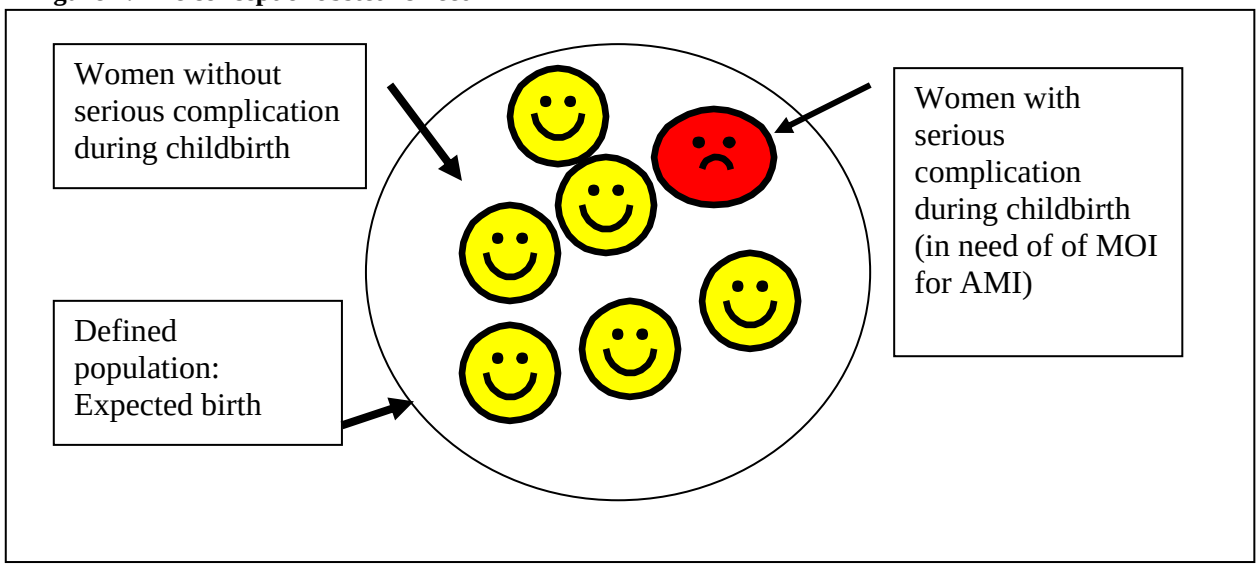
- To determine the magnitude of the UON indicator based on the method proposed by the UON-network in Mtwara region
- To assess maternal and perinatal outcome in relation to a MOI
- To assess the feasibility of collection of UON-indicator data through the regular hospital routine system
- To assess the usefulness of the UON-indicator for local decision making purposes in planning for the hospitals as well as for the districts

4 Methods

4.1 Methodology

The study followed the model of the UON-network (De Brouwere and Van Lerberghe, 1998). According to this model the UON-indicator is used to measure the discrepancy between what the health care system ideally should do to deal with the obstetric problems in a given population, and the care it actually delivers. The UON indicator is expressed in terms of the number of women who should have benefited from an obstetric intervention, but for whom this intervention was not undertaken. For this estimation only major obstetric interventions (MOI) that are performed for absolute maternal indications (AMI) are included. The concept can be illustrated as follows:

Figure 1: The concept of obstetric need



(adapted from De Brouwere & Van Lerberghe, 1998)

The defined population are all mothers giving birth in the district or region under observation. The expected birth are calculated on the basis of the crude birth rate. In every group of mothers giving birth there will be some who develop complication, others will not. The unmet obstetric need is calculated on the basis of the estimation of complications in need of an intervention to safe the mothers live.

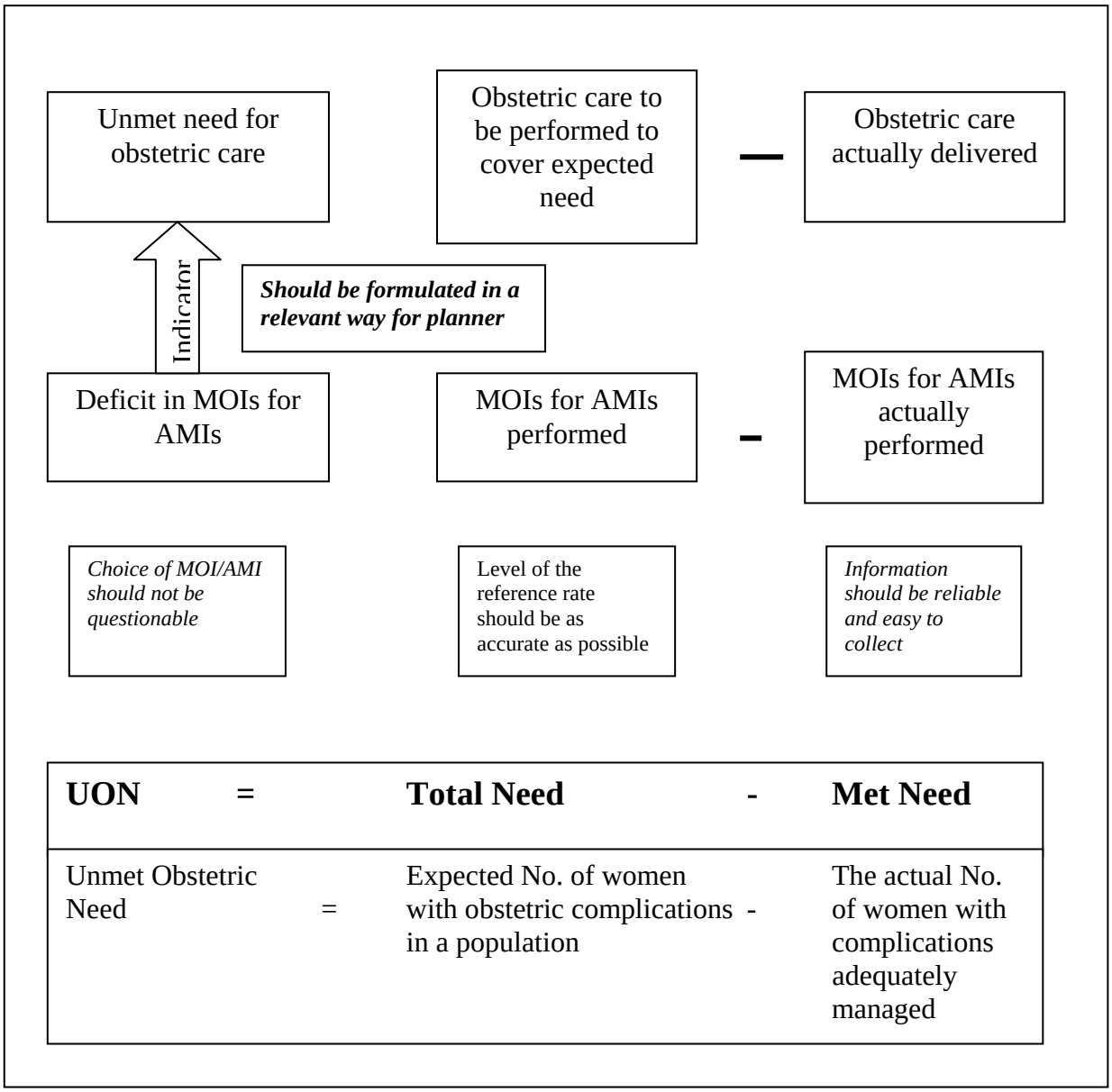


Figure 2: The concept of unmet obstetric need

(Adapted from (De Brouwere and Van Lerberghe, 1998)

Equation for the calculating the unmet obstetric need:

Unmet Need	**=**	**(Ex. Birth * RR)**	**-**	**MOIs for AMIs performed**

Ex. Birth is the expected annual number of birth in the population. In Tanzania the rate is give to be 40 per 1000 population (UNICEF, 2004).

RR is the reference rate for the proportion of birth associated with MOIs for AMIs. We used a reference rate of 2% for the study in Mtwara Region (see discussion).

MOIs for AMIs performed is the number of women in the population having received a major obstetric intervention for absolute maternal indications in one of the hospitals of the region offering the services.

The set of MOIs proposed by the UON-network include Caesarean Section (CS), hysterectomy, laparotomy, symphysiotomy, internal version and craniotomy carried out for absolute maternal indications (AMI). These interventions have been selected by the network for their high reproducibility and substantial impact on maternal health. On the basis of discussions of Tanzanian health professionals and results of a pilot study this original list of MOI were adapted to the specific Tanzania context and made to include Blood Transfusion (BT) during pregnancy. BT was judge to be an important major intervention. Several studies in Tanzania have shown that anaemia is a major problem during the reproductive age and especially during pregnancy (Massawe et al., 2002, Massawe et al., 1996). The list of MOIs used in UON-study in Mtwara did not include symphysiotomy and internal version which are extremely rarely used in Tanzania.

The final set of MOI studied were as follows:

- Caesarean Section
- Hysterectomy
- Laparatomy for repair of uterus,
- Blood transfusion
- Destructive operation and
- others.

Absolute need as defined by the UNO-network means that a maternal complication is of such gravity that it requires a major obstetric intervention. It is assumed that without the intervention the probability that the expectant mother would die is high. Reference data about the expected percentage of deliveries that need for example a CS have been derived from hospital based data from England at a time when a CS was mostly done for maternal reasons (Francome and Savage, 1993). This data suggest that in 0.4% of all births a CS is needed because of malpresentation of the foetus (shoulder, face and brow), in 0.5%-1% of births because of antepartum haemorrhage and in another 1%-1.5% because of foeto-pelvic disproportion. This sums up to a total of 1.9% to 2.9% in need of CS to prevent serious complication during childbirth. However, data from Morocco suggest that an even lower CS-rate is able to prevent most maternal deaths and the UON-network suggests a low-end reference level of between 1%-2% of expected birth (Belghiti et al., 1998, UON-network, 2004a).

The absolute indications proposed by the UON-network are severe ante-partum haemorrhage, severe post-partum haemorrhage, cephalo-pelvic disproportion (CPD) including pre-rupture and ruptured uterus, transverse lie and shoulder or brow

presentation. For the study in Mtwara region the set of AMI was adapted to the local situation based on the results of the pre-test and discussion with Tanzanian health experts and three absolute maternal indications were added: ‘two or more previous CSs’ , ‘severe anaemia’ and ‘puerperal infection’. The indication ‘two or more previous CSs’ was added as this in Tanzania makes up a substantial proportion of the total number of indication for a CS. ‘Anaemia’ was added as an indication for the BT. The questionnaire thus included the following AMIs:

- Uterine rupture
- Cephalo-pelvic-disproportion (CPD) / obstructed labour based on a partograph
- antepartum haemorrhage (APH)
- postpartum haemorrhage (PPH)
- two or more previous CSs
- puerperal infection
- severe anaemia based on: Hb < 6g/dl and at least 36 weeks of pregnancy
- malpresentation

The condition ‘CPD / obstructed labour based on a partograph’ was added as the pre-test revealed that the indication CPD / obstructed labour alone was not always carefully used and included ‘prolonged labour’ or ‘weak contraction’. A mother whose birth is complicated by prolonged labour or weak contraction would not always need a CS to prevent serious adverse health effects. Therefore the specification ‘based on the partograph’ was added to make sure that in the analysis of the unmet need only those cases were included, where the mother was more objectively in need of a live saving operation.

In addition, non-absolute maternal indications (Non-AMI) were included in the questionnaire: hypertensive disorders/eclampsia, cord prolaps, breech presentation, foetal distress, diabetes mellitus and others. Moreover, perinatal and maternal outcomes were recorded through the questionnaire. Every questionnaire also included the place of the mothers home (division, ward, village and street if possible), estimated distance of residence to hospital, the mother’s year of birth and date of admission as well as intervention and discharge (see discussion in annex 9.4). A urban residence was defined as a place up to (and including) 10km from a hospital and rural as more than 10km.

Following a pilot study in 1999, which helped to define the MOIs and AMIs as described above, a two-years prospective study running from July 2000 to June 2002 was carried out

in all 4 hospitals in Mtwara Region. During the study period a ‘questionnaire for pregnant women’ (see annex 9.2) was to be filled for each woman, who underwent a major obstetric intervention or for any woman who died before the necessary intervention was performed. The main sources of data were the admission book and the register in the operation theatre. The register in the delivery ward was adapted to include data on child and maternal mortality (UON-network, 2000).
A ‘weekly summary sheet’ for all MOIs for AMIs (see annex 9.3) was outlined to be send to the national coordinator for a quarterly data analysis and timely retro-reporting.
In addition a questionnaire for the ‘health formation’ asking about material and human resources, obstetrical activity in the hospital and total number of stillbirth and maternal deaths had to be filled (UON-network, 2000).

To estimate the UON per expected live birth a birth rate of 40 of 1000 was assumed (UNICEF, 2004). The percentage of MOIs per AMIs per expected births was calculated for the districts and divisions based of the demographic data from the National Census 2002 (Bureau of Statistics United Republic of Tanzania, 2002). If more than one MOI had been documented the one with the potentially greatest impact on the survival of the woman was chosen for the calculation (hysterectomy > laparotomy for repair of uterus > CS > BT > destructive operation > others). Further, if more than one indication was listed, the author, after careful consideration, selected for the analysis the indication that was most crucial for the intervention. BT were excluded for comparability reasons for the calculation of the UON-indicator and the analysis of mortality in relation to MOIs for AMIs and Non-AMIs. In all other analysis BT were included.
To calculate the deficiencies, a threshold on how many interventions in a given population are required to prevent major complications or death, needs to be defined. Published data from other studies suggest a low-end estimate of between 1%-2% of MOIs for AMIs (see above and discussion under 6.2.2). Based on findings from literature and the data from the study a benchmark of 2% MOIs for AMIs in relation to expected birth was chosen to estimate the deficit in life saving interventions.
The analysis followed the UON-methodology and calculated the number of MOIs per AMIs in the 5 districts in relation to a urban or rural origin of the mother. In addition to this the level of MOIs per AMIs for the different 20 divisions of Mtwara region was determined.

To assess the feasibility of the data collection and the usefulness of the UON-approach for district planning the following methods were used: 1) observations during supervision, 2) interviews with key informants and 3) observation on operational aspects like compliance with the protocol, completeness of reporting and a review of the instrument (see also annex 9.4). The procedure of data collection and management was followed and documents were reviewed. Interviews with key persons involved in the planning of the study and the data collection were carried out and complemented by discussions with the supervisors about problems encountered during the data collection and reasons for this.

4.2 Data collection

The study started as envisaged in July 2000 in all 4 hospitals of Mtwara region. However, hardly any supervision by the regional coordinator was carried out during the first year due to problems in communication, financing and management. One supervision was carried out by the national coordination team, Dr. Thomas and Dr. Mtatifikolo and a report was submitted. However, it remains unclear whether the problems reported got the necessary attention. Also it seems that the weekly reports were never send to the national level. Therefore, it was not until November 2001, 17 months after the start of the study, that a preliminary analysis was prepared. A short preliminary analysis was handed over to the responsible staff members in the delivery wards of the participating hospitals in January 2002. However, no workshop was held to make use of the collected data and results for district planning.

During the preliminary analysis, problems in documentation become apparent. Two hospitals stopped the recording of the major obstetric intervention through the UON-questionnaire at the beginning of 2002 because of lack of feed-back from the national and regional coordination body. Therefore many questionnaires were missing. After a discussion of the first preliminary results with the responsible staff members in the delivery ward they could be convinced that it would be worth the effort to complete the data set. Therefore many questionnaires were in fact filled retrospectively despite the fact that the study design was prospectively. Finally, with this extra effort a good completeness of the data set was obtained.

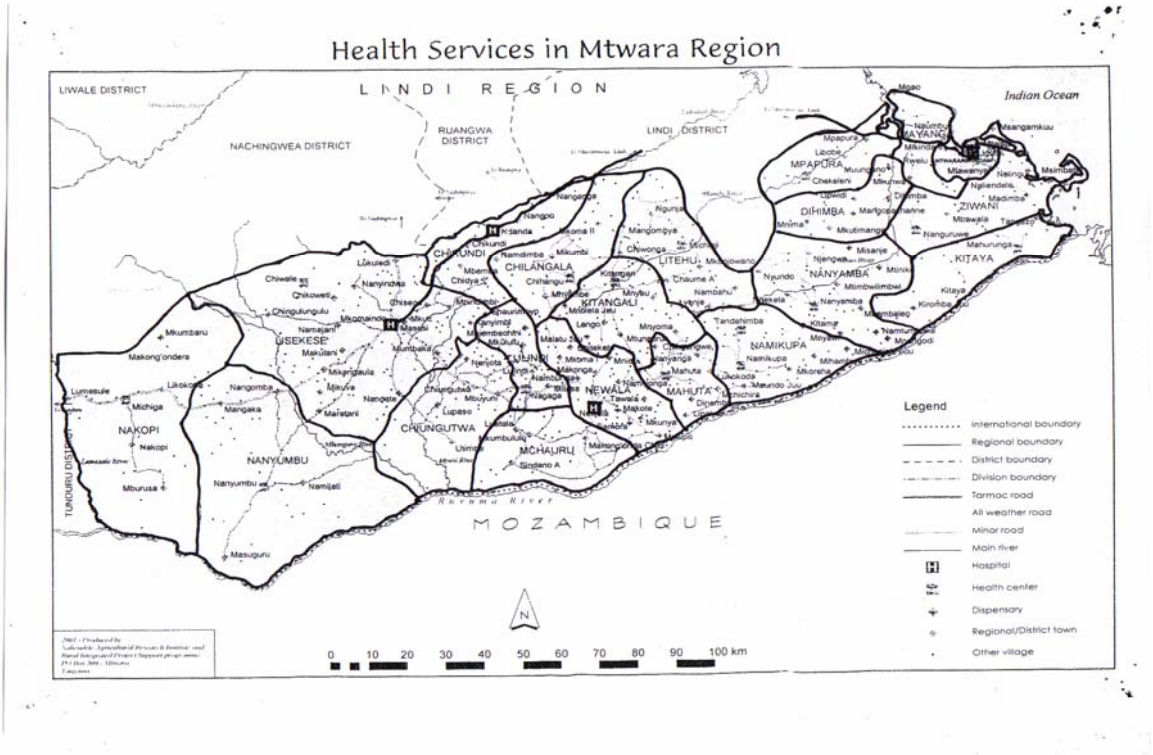
4.3 Study sites

Mtwara Region is situated in the southeast of Tanzania and borders the Indian Ocean in the East, Mozambique in the South, Ruvuma Region in the West and Lindi Region in the

North. The region has a population of 1,128,523 (National Bureau of Statistics 2002) and is administratively divided into 5 districts and 20 divisions.

The general living conditions for the population improved during the past 5 years. Cash income from cashew nut production was a main source of income. The regional overall monthly mean per-capita expenditure of 12,400 Tshs (~13 US$) ranked third after Dar-es-Salaam and Mbeya. The annual per-capita income in the region was 292,793 Tshs (~303 US$) which is slightly higher than the national average. 87% of the people live within 6km of a dispensary/HC, (mean Tanzania mainland 75%) and the mean distance to a hospital is 19.2 km (mean Tanzania mainland 21.3km) (National Bureau of Statistics 2001). Nevertheless, communication is a major problem in the southern part of Tanzania especially during rainy season when the road conditions are very poor.

Figure 3: Health Services in Mtwara Region



The study was conducted in all four hospitals of the region. Mtwara Regional Hospital is the referral centre for the Southern Zone and also serves Mtwara urban and rural as a district hospital. Newala District Hospital serves 2 districts, Newala and Tandahimba District whereas 2 hospitals, Ndanda Mission Hospital[5] and Masasi District Hospital are situated in Masasi District, the largest district in the region. The human resource situation

[5] St. Benidiktine Hospital, supported by the Benidiktine Mission from Germany

and general working conditions in the four hospitals vary considerably. All 3 public hospitals (Mtwara, Masasi and Newala) have shortages of qualified staff.

The situation concerning human resources is better in Ndanda Mission Hospitals were two surgeons and two other medical officers are working. Moreover, staff houses are all situated at the hospital compound and an internal telephone system is in place. This is not so in the other hospital where time delays in attending patients care are common. Tandahimba, a newly formed district, does not have a district hospital, but urgent cases are transferred to Newala District Hospital using a hospital ambulance.

4.4 Data Analysis

Information were completed using the routine recording system in the four hospitals where data or questionnaires were missing (see also annex 9.4: Problems encountered with the 'questionnaire for women'). The missing data for the distance between mothers home village and the hospital was completed with help of detailed maps[6] and the division the mothers' home village belonged to was identified at the same time and added to the data file if not reported.

The data was entered and compiled in EPI-Info 2000. The data set was rechecked and corrected. The analysis was done in EPI-Info 2000 (Version 1.1.2), with help of an EXCEL data sheet (Version 4.0) and Stata version 8.0. Confidence Intervals were calculated assuming a Binominal Distribution. The statistical significance of the differences between urban/rural or the four hospitals were calculated with the Pearson Chi-squared test. Maternal mortality ratios (MMR) were calculated as maternal deaths per 100.000 live births and the perinatal mortality rate as the number of stillbirth and neonatal deaths that occurred in the hospital before discharge per 1000 live births. The calculation of perinatal deaths differed from the official because the questionnaire did not provide any information whether the death of the child occurred in the first seven days of life but before discharge. Mothers normally stayed in the hospital about 7 days, therefore it was possible to use this approximation.

[6] The maps had been produced by GIS Information Centre Naliendele Agricultural Research Institute; P.O.Box 509, Mtwara - Tanzania

5 Results

The following chapter describes the results of the study. First a short overview of the study population and some information about the 4 participating hospitals is given. Second the distribution of interventions and indications is shown followed by results on perinatal and maternal mortality and morbidity in relation to the MOIs. Next the UON-indicator for the 20 different divisions of the region are presented and finally some information on the feasibility of data collection and the usefulness of the indicator for district planning is given.

5.1 Obstetric activity in the four hospitals

The four hospitals enrolled in the study differed in annual service output and other indicators for obstetric activity. The regional hospital 'Ligula' in Mtwara has by far the highest number of births (about 3000 annually). The 2 district hospitals had an annual number of births of around 1800 delivery whereas the Ndanda Mission hospital had about 1500 births. Maternity services are free in the public regional and district hospitals whereas a fee of about 10 US$ is requested by Ndanda Mission hospital for a CS.

Table 1: Obstetric activity and main indicators in the four hospitals

	Mtwara Region	Mtwara Regional Hospital	Newala District Hospital	Masasi District Hospital	Ndanda Mission Hospital
Total number of births (2yrs)	16412	6018	3477	3898	3019
No. of CSs /	2340 /	767 /	650 /	527 /	396 /
% CS per total deliveries	***14.3%***	***12.7%***	***18.7%***	***13.5%***	***13.1%***
No. of stillbirth /	682 /	264 /	156 /	141 /	121 /
% stillbirth per total birth	***4.2%***	***4.4%***	***4.5%***	***3.6%***	***4.0%***
No of Maternal Deaths /	83 /	44 /	16 /	14 /	9 /
MD per 100000 live births*	527	838	482	373	311

*All reported maternal deaths, not only in relation to major obstetric intervention.
Period from 07/2000 to 06/2002

The number of babies delivered by vacuum extraction was low in all 4 hospitals and ranged between 1% and 2%. The hospital CS-rate was about 13% except for Newala district hospital with almost 19%. The percentage of stillbirths in relation to total births ranges from 3.6% to 4.5%. Out of the 682 stillbirth, 234 (34%) were classified as fresh stillbirth. The hospital based-MMR was lowest in Ndanda with 311 death per 100,000 live birth and highest in Mtwara regional hospital with 838 deaths per 100,000 births.

5.2 Description of the mothers who underwent a major obstetric intervention

A total of 2404 questionnaires for mothers who had a MOI were collected during the 2 years study period. Reporting was found to be nearly complete when compared with the data recorded in the hospital theatre books in the 4 participating hospitals for the study period

Table 2: Number of Caesarean Section reported through questionnaire / documented in theatre book

	Total Region		Mtwara		Ndanda		Newala		Masasi	
	N	*%*	N	*%*	N	*%*	N	*%*	N	*%*
No. of CS (as recorded in operation theatre book)	2340	***100***	767	***100***	396	***100***	650	***100***	527	***100***
No. of CS reported through UON-questionnaire	2190	***94***	667	***87***	394	***99***	654	***101***	475	***90***

The UON-questionnaire was filled for only 87% of the CS recorded in the operation theatre book in Mtwara regional hospital whereas documentation was complete in Ndanda and Newala hospital. Thus in total 94% of recorded caesarean sections were captured in the UON-questionnaires.

The mean age of mothers who underwent a life saving operation in one of the 4 hospitals in Mtwara Region was 24.5years (Std. Dev. 6.8, range 12 to 51 years). 12.6% of mothers were less than 18 years, 28.6% less than 20 years and 10.2% were 35 or more years old.

Figure 4: Age distribution in study population compared with DHS-data 1996

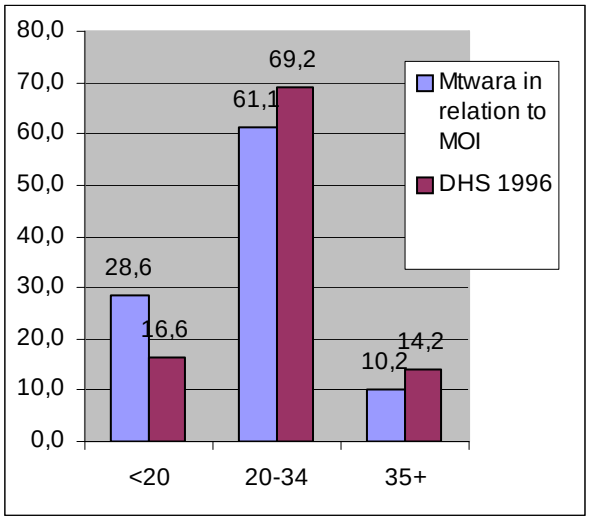


Figure 4 shows the age distribution of the study population in Mtwara (age of women who underwent a MOI) compared to data from the DHS in 1996[7] (mothers' age at time of delivery in Tanzania). The mothers who had a MOI in Mtwara region were younger than delivering women in general in Tanzania.

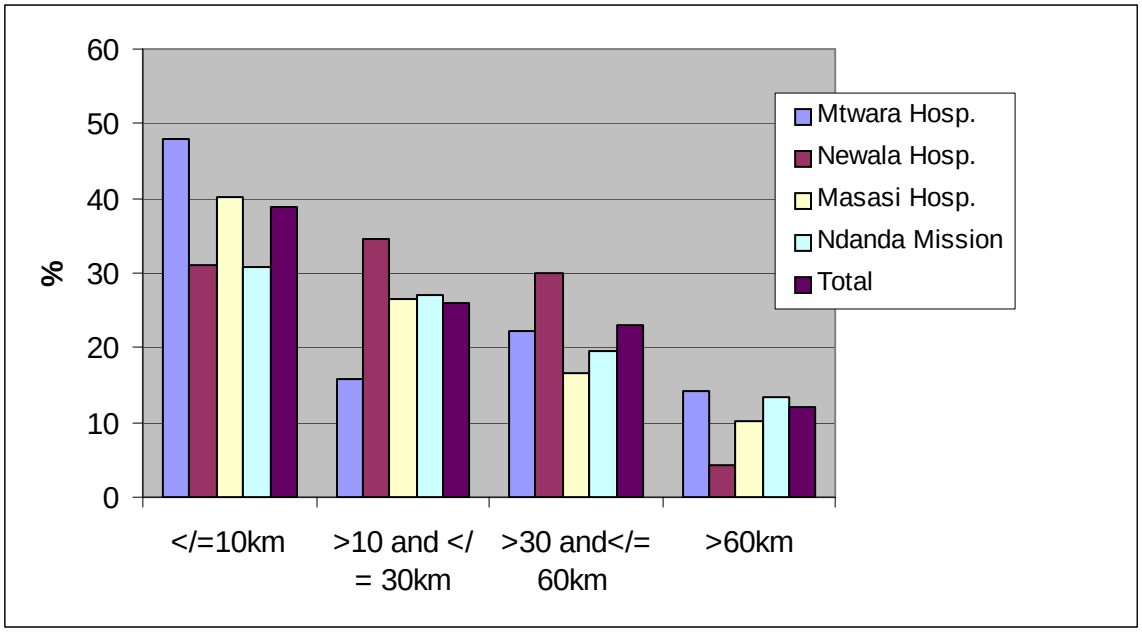
[7] unfortunately no data on the age distribution of delivering mothers in Mtwara is available

However, the Southern Zone (Lindi, Mtwara, and Ruvuma Region) has a higher rate of teenage pregnancies. 26.9% women aged 15-19 are pregnant or delivered their first child in 1996 compared to the average in Tanzania with 20.9% (DHS Tanzania, 1996).

The mean distance to the hospital was 27.3km (Std. Dev. 28.9, median 20km). The range was from 0.5km to 320 km (see also figure 12 in annex).

39.4% of mothers who underwent a MOI lived less than 10 km from the hospital. The proportion of mothers living </=10 km from the hospital varied between the hospitals: Mtwara 48%, Newala 31%, Masasi 43% and Ndanda 34%. Only 11% of the women came from a place more than 60km away (Mtwara 14%, Newala 4.3%, Masasi 10.7% and Ndanda 14.7%).

Figure 5: **Distance between mother's place of living and the different hospitals**



5.3 Distribution of Major Obstetric Intervention

The presented analysis for comparability reasons partly follows the scheme given by the UON-network. The UON-network aims at putting light at the rural/urban difference of the interventions and their respective indication. Therefore most of the tables list the distribution according to place of living: urban (</=10km), rural (>10km). However, the comparison of the four hospitals gave a lot of additional information. Additional tables are shown in the annex.

Out of the 2404 questionnaires collected during the study period, 15 were filled for mothers who died before an intervention was carried out.

Some questionnaires listed more than one intervention for one mother. However as described in methods, only the intervention which was most crucial for the mothers survival was selected for the analysis.

The predominant MOI was a CS (91%) followed by blood transfusion (5%). Laparotomy for repair of uterus counted for 1.9% of all MOIs and a hysterectomy was performed in 1.3% of the cases. ***Caesarean sections*** were performed slightly more often in urban areas. The difference between hospitals were larger than the urban/rural difference. In Mtwara hospital 88.3% of all MOIs were CSs, in Newala 95.6% in Masasi 95% and in Ndanda 83.8% (see table 15 in annex). These differences were statistically significant (p <0.001). However, if BTs were excluded from the analysis (BTs were only incompletely reported in two hospitals) the difference was not significant anymore (p=0.72). The crude CS-rate, regardless of indication was 2.43% per expected birth in the whole of Mtwara Region during the study period.

Table 3: Distribution of Major Obstetric Intervention according to place, the mother was living (including BT)

	Urban Area </=10km		Rural Area >10km		Total		Pearson Chi-squared /p-value
	N	*%*	N	*%*	N	*%*	
CS	896	***92.3***	1285	***91.5***	2181	***91.0***	0.062
Blood transfusion	55	***5.7***	64	***4.5***	119	***5.0***	0.192
Lap. For repair of Uterus	10	***1.0***	36	***2.5***	46	***1.9***	0.009
Hysterectomy	7	***0.8***	25	***1.7***	32	***1.3***	0.031
Destructive Operation	0	***0***	2	***0.1***	2	***0.8***	0.243
Others	1	***0.1***	3	***0.2***	4	***0.0***	
Total	969	***100***	1415	***100***	2384	***100***	

* N= 2384, 5 missing data for urban/rural differences

According to the protocol the hospitals were to report all ***BT during pregnancy >36 weeks or during delivery.*** However, both Newala and Masasi district hospital reported only very few (see annex table 15). In the 2 hospitals, Mtwara and Ndanda that reported BT they counted for 7.0% respective 12.8% of all MOIs.

There were also differences in the percentage of ***laparotomies for repair of ruptured uterus*** and ***hysterectomies*** done in urban and rural areas. In urban areas the proportion of laparotomy for repair of uterus was 1% and for hysterectomy 0.8% whereas in rural areas laparotomy for repair of uterus accounted for 2.5% of all interventions and hysterectomy for 1.7%. The urban/rural differences were statistically significant for laparotomy for

repair of uterus (p=0.009) and for hysterectomy (p=0.03). Differences were observed for the different hospitals (see table 15 in annex). In Mtwara Hospital more than twice as many laparotomies for rupture of uterus were performed than in Ndanda Hospital (Mtwara hospital 3.0% of all MOI's, Newala hospital 1%, Masasi hospital 2.6% and Ndanda hospital 0.9%). These differences were statistically significant and remained significant even when BT were excluded from the analysis.

There were also significant differences (p=0.01) between the hospitals in percentage of hysterectomies performed. More hysterectomies were performed in Newala (2.5%) than in Mtwara (0.7%), Masasi (0.8%) and Ndanda (1.3%). The difference remained significant when BT were excluded from the analysis (p=0.02).

A total of 31 hysterectomies were reported during the study period. In 22 cases (68.9%) a ruptured uterus was the reason for the hysterectomy and in 3 cases the intervention was performed because of haemorrhages (one case APH, one a placenta accreta and one PPH). In 2 cases (6%) a puerperal infection was stated as the cause of the hysterectomy and in one case 2 or more previous CSs. In 4 cases (12.5%) a CS was performed for different reasons (malpresentation, foetal distress) prior the hysterectomy. Why the hysterectomy was added was not explained.

5.4 Distribution of Indications for Major Obstetric Interventions

A total of 2384 MOI were recorded in the questionnaires. Table 4 shows the distribution of AMIs and Non-AMIs for the MOIs performed.

The predominant indication was CPD. In general only minor differences could be observed in the distribution of indication when analysed by urban or rural origin of the mother. Only the indication rupture of uterus was 2.4 times more common for mothers from rural areas. The difference was statistically significant (p=0.002). For hypertensive disorders the opposite was found. This indication was 2.4 time more often listed when the mother came from urban areas. This difference was highly statistically significant (p<0.001). Also, malpresentation was mentioned slightly more often for urban mothers, but the difference was significant only at the 0.056% level.

The results are presented in detail in the following chapter in the same order as displayed in the table.

The indication ***CPD*** counted for 46.3% of all absolute and non-absolute indications and 65.4% of all absolute maternal indications (see table 16&17 in annex). The difference between urban and rural mothers was not statistically significant. However, the differences between the hospitals were statistically significant (P<0.001). In Newala hospital the indication CPD was given in 83.5% of all MOIs were it was only 51.7% in Mtwara, 55.8% in Masasi and 68.9% of the patients with a MOI in Ndanda.

Table 4: Distribution of indications in urban and rural area (including BT)

	Urban Area (</= 10km) N=971/ %		Rural Area (>10km) N=1427 / %		Total N= 2398 / %		Pearson Chi-squared test p-value
	Absolute Maternal Indications (AMIs)						
CPD	434	***44.7***	675	***47.3***	**1109**	***46.3***	0.209
Malpresentation	95	***9.8***	108	***8.1***	203	***8.5***	0.056
2 or more CS	82	***8.4***	116	***8.1***	198	***8.3***	0.783
APH	45	***4.6***	85	***6.0***	130	***4.4***	0.160
Severe Anaemia	38	***3.9***	45	***3.2***	83	***3.5***	0.318
Uterine rupture	15	***1.5***	53	***3.7***	68	***2.8***	0.002
PPH	14	***1.4***	20	***1.4***	34	***1.4***	0.935
Puerp. Infection	4	***0.4***	6	***0.4***	10	***0.4***	0.975
Total	727	***74.9***	1108	***77.6***	1835	***76.5***	
	Non-Absolute Maternal Indications (Non-AMIs)						
Fetal Distress	81	***8.3***	100	***7.0***	181	***7.55***	0.225
Hypert. Disorder	44	***4.5***	27	***1.9***	71	***2.96***	<0.001
Breech	20	***2.1***	19	***1.3***	39	***1.63***	0.166
Cord Prolaps	15	***1.5***	26	***1.8***	41	***1.71***	0.607
Others	84	***8.7***	147	***10.3***	231	***9.61***	
Total	244	***25.1***	319	***22.4***	563	***23.4***	

The indication CPD was supposed to be based on a partograph with action line crossed by the dilatation line. This protocol aimed at avoiding “weak indications” for CPD like poor progress, dystocia or prolonged labour. Unfortunately, the partographs were not attached to the questionnaires and it was therefore not possible to verify whether the action line was actually crossed in the cases this indication was used. Also the coordinators in the respective hospitals could not remember retrospectively whether the indication was based on a partograph or not.

Malpresentation was the indication in 203 (8.5%) of all MOIs. The malpresentations cited were OPP (face to pubis presentation) in 93 patients (46%) and transverse lie/arm

presentation (37 patients; 18%) followed by face presentation (15 patients; 7%) and brow presentation (6 patients; 3%). Differences were also observed between hospitals in the proportion of malpresentation given as the indication for a MOI for AMI: (Mtwara 14.8%, Newala 4.7%, Masasi 18.1% and Ndanda 10.4%). The difference between the hospitals was statistically significant ($p<0.001$) (see table 16 in annex).

Two or more previous CSs were cited as an indication in 8.3% of all MOIs. This figure was almost two times higher in Mtwara Regional Hospital (19.7%) than in Ndanda Mission Hospital (10.4%) and 5 times higher than in Newala hospital (4%).

Antepartum haemorrhage (APH) was the indication for 5.4% of all MOIs. The distribution of MOIs for AMIs among the hospital differed (Mtwara 9.9%, Newala 4.9%, Masasi 9.1% and Ndanda 5.6%) and the difference between the hospitals was statistically significant ($p = 0.006$). ***Severe anaemia*** was the main indication for blood transfusion but only recorded in Mtwara and Ndanda hospitals. In this two places the indication severe anaemia was reported in between 6.5% of all MOIs in Mtwara hospital and 11.2% in Ndanda Mission hospital. In addition, BT were recorded in the UON-questionnaire in relation to another MOI. This was also done in the other two hospitals. Out of the total of 162 reported BT, 31 were done following a CS, 9 were in conjunction with a hysterectomy and 3 were done with a laparotomy for repair of uterus (the total number of BT performed after another MOI were 43). The 113 BT (all but 6 from Mtwara and Ndanda hospital) were predominantly done because of anaemia (72%) or PPH (21%). APH was given as a reason for a BT only in only 3 patients (2.6%).

Uterus rupture was the main indication in 2.8% of al MOIs. There was a major difference between the urban and rural group of women. This indication was reported in only 1.5% of the total MOIs for urban mothers compared to 3.7% for rural mothers. The difference was statistically significant ($p=0.002$). There was no major differences between the hospitals (MOIs for AMIs: Mtwara 4.2%, Newala 3.3%, Masasi 4% and Ndanda 3.2%; $p=0.8$). Very few MOIs (only 1.4%) were done because of ***postpartum haemorrhage (PPH)***. Further, ***puerperal infection*** was the indication in only 0.4% of the interventions.

In 23% (550 cases) of the total MOIs the intervention was performed for other reasons than an AMI. ***Foetal distress*** ranged second after CPD as an indication to perform a CSs (7.6%). Comparing the proportion of this indication in the group of Non-AMI, more CS

were done for fetal distress in Masasi Hospital (48.9%) compared to Newala, Ndanda, or Mtwara hospital (33.1%, 19.5% respective 32.4%).

Hypertensive disorders, breech presentation or cord prolaps counted as indications for 3%, 1.6% and 1.7% respectively of all indications (AMI and Non-AMI) and 12.9%, 7.1% and 7.3% of the total Non-AMI. Hypertensive disorders were highly statistically significant more often the reason for a MOI in urban than in rural mothers ($p < 0.001$). ***Others*** was the most often mentioned Non-AMI (9.6% of all interventions). The most often given reason was the complex of prolonged labour (110 cases, 20% of Non-AMIs): poor progress, prolonged labour, cervical dystocia or big baby. In addition, in 47 cases (8.5% of Non-AMIs) one previous CS was the indication. A twin pregnancy mostly complicated by a retained 2nd twin was the indication in 20 of the MOIs (3.6% of the Non-AMIs). Bad obstetric history was given in 6 cases and a previous vesico-vaginal fistula in 3 cases. In another 33 cases various different reasons were stated.

5.5 Perinatal Outcome

The perinatal outcome was recorded in 2348 cases. In 38 cases out of the 2404 questionnaires included in the study the perinatal outcome was not reported because the MOI was a blood transfusion prior to delivery and the mother was not followed up. In another 18 questionnaires the outcome was missing.

Table 5: Perinatal Outcome in women with a MOI in the 4 hospitals

	Mtwara Region N=2348* %	Mtwara Hosp N=738 %	Newala Hosp N=675 %	Masasi Hosp N=490 %	Ndanda Mission Hosp. N=445 %
Born & discharged alive	***89.2***	***88.1***	***89.6***	***88.2***	***92***
Stillbirth #	***8.1*** *(4.2)*	***9.2*** *(4.4)*	***8.0*** *(4.5)*	***8.9 (****3.6)*	***5.4*** *(4.0)*
Died within 24h	***2.0***	***2.0***	***1.8***	***2.0***	***2.0***
Died > 24h	***0.8***	***0.7***	***0.6***	***0.8***	***1.1***
Total	***100***	***100***	***100***	***100***	***100***

56 missing results

data in bracket give the result of the normal hospital cohort as displayed in table 1

Out of the reported deliveries in which the mother underwent a MOI, only 89.2% (2094 out of 2348) of all babies were born and discharged alive. Differences between the hospitals could be observed although the 95%-confidence intervals are overlapping

(Mtwara born & discharged alive 88.1% 95%-confidence interval 85.5-90.3; Ndanda Mission Hospital born & discharged alive 91.5 95%-confidence interval 88.5 – 93.9).

8.1% (190 out of 2348) were stillbirths with some variations in the 4 hospitals (5.4% in Ndanda Mission Hospital and 9.2% Ligula Regional Hospital). The stillbirth rate in mothers than underwent a MOI were twice as high as the rate in all deliveries (see table 5) in the four hospital (Mtwara region 8.1% versus 4.2%) with the exception of Ndanda Mission hospital (5.4% versus 4.0%).
2% (46 out of 2348) of babies died during the first 24 hours after birth. The overall perinatal mortality in the group of mothers having undergone a MOI during the study period was 108 per 1000 live births.

Important differences could be found in the rate of stillborn babies in relation to the intervention the mother had undergone. A laparotomy for a ruptured uterus was the most fatal maternal complication. In 84.8% of the patients, where the mother underwent a laparotomy for a ruptured uterus, the child died. A similarly high death rate was found for hysterectomy (71.9%). In contrast to this, the perinatal mortality for CS was only 7.9% and only 5.1% of babies were born dead when the mother had undergone a CS for different reasons.

Table 6: Perinatal mortality in women with MOI in relation to intervention and indication

Intervention and Indication	No of interventions	No of perinatal deaths	% perinatal deaths in relation to respective intervention
Laparotomy	46	39	***84.8***
Hysterectomy	32	23	***71.9***
CS	2185	172	***7.9***
for APH	127	33	***26.0***
for hypertensive disorders	71	12	***16.9***
for cord prolaps	40	5	***12.5***
for fetal distress	181	19	***10.5***
for malpresentation	201	18	***9.0***
for CPD	1108	60	***5.4***
for 2 or > CS	197	10	***5.1***
for breech	39	1	***2.6***

The most fatal indication for a CS was antepartum haemorrhage (perinatal mortality 26%), hypertensive disorders hypertensive disorders (16.9%) and cord prolaps (12.5%). Relatively low perinatal deaths rates could be observed in cases where the CS was carried out for CPD, for two or more previous CS or for breech presentation.

181 CS were done because of foetal distress. However, many of these intervention were done to late to safe the child's live. In 19 cases (10.5%) the child did not survive. The stillbirth rate for CS for foetal distress was 6.2%.

The number of stillbirth and children who died within 24 hours (early perinatal mortality, including cases of blood transfusion) in relation to a MOI was 236 out of 2348 live births (10%). Another 18 children died before the mother was discharged. The table 7 shows that the mortality did hardly differ according to the fact that the intervention was performed for an AMI or Non-AMI (10% for AMI and 9.2% for NON-AMI). However, rural/urban differences could be obtained for child survival. 52 children died during/after the 914 intervention (excluding BT) where the mother came from an urban areas (6.5%) but 163 out 1352 (12%) for rural areas. The table 6 (see above) showed that the perinatal mortality regardless of the distance to the hospital is greatly influenced by ruptured uterus, antepartum bleeding and complications making a hysterectomy necessary.

Table 7: Number of perinatal deaths during & after a major obstetric intervention

	MOI for AMI			NON-AMI		
	No of MOI	No of death	***(%)***	No	No of death	***(%)***
Urban	669	39	**5.8**	245	20	***8.2***
Rural	1031	131	***12.7***	321	32	***10.0***
Total	1700	170	***10.0***	566	52	***9.2***

Stillbirth and children dying within 24 hours according to indication (AMI or Non-AMI) and rural/urban differences (without BT)

However, the cause of deaths varied with the urban or rural origin of the mother. In the urban areas the main causes of early perinatal deaths were APH (12 out of 59 cases, 20%) followed by CPD (11 out of 59, 19%), ruptured uterus (10 out of 59 deaths,17%) and fetal distress (9 out of 59, 15%). In rural areas the distribution was different. 48 out of 163 deaths (29%) occurred after a laparotomy because of ruptured uterus, 43 out of 163 (26%) deaths were caused by CPD, 20 out of 163 (12%) because of APH and only 9 out of 163 (6%) because of a foetal distress.

5.6 Maternal Outcome

A total of 83 maternal deaths occurred during the study period in one of the four hospitals in Mtwara region. Out of these 83 deaths, 65 (78%) took place in relation to a MOI (before, during or after) and therefore detailed information were available through the

UON-questionnaire. The remaining 18 deaths were due to abortion, etopic haemorrhages or other diseases like malaria in pregnancy and thus not documented.
In few cases the maternal outcome was not recorded through the UON-questionnaire. Most missing data can be explained (missing data for perinatal and maternal outcome) by the fact that the intervention was a BT during pregnancy and the mother and the baby could not be followed up to delivery.

Out of the 65 mothers that died 15 deaths took place before an intervention could be carried out. Another 2 deaths took place during the intervention and 48 after a MOI. The overall mortality in relation to a major intervention (case-fatality-rate) was 2.7% (65 out of 2404) in Mtwara Region. However, if the maternal death before the intervention was carried out were excluded, the CFR was reduced to 2.1%. As the table 8 shows, there were differences in the maternal outcome in the 4 hospitals.

Table 8: Maternal Outcome in the 4 hospitals in relation to performed or anticipated MOI

	Mtwara Region N=2360 (44*)	**Mtwara Hosp** N=740 (15*)	Newala Hosp N=678 (1*)	Masasi Hosp N=495 (5*)	Ndanda Mission Hosp. N=447 (23*)
	%	%	%	%	%
no further complication	***88.5***	***91.5***	***77***	***96***	***92.6***
Complication	***8.8***	***3.2***	***21.2***	***2***	***6.5***
Death	***2.7***	***5.3***	***1.8***	***2***	***0.9***
Total	***100***	***100***	***100***	***100***	***100***

(*) missing results mostly due to BT during pregnancy

The case fatality rate in relation to a MOI was 5.27% in Mtwara (39 out of 740; 95%-confidence interval 3.8-7.1) 1.8% in Newala (12 out of 678; 95%-confidence interval 0.9-3.1), 2.02% in Masasi (10 out of 495; 95%-confidence interval 1-3.7) and 0.7% in Ndanda (4 out of 447; 95%-confidence interval 0.2-2.3).

Table 9: Maternal deaths after a major obstetric intervention

	MOI for AMI			MOI for NON-AMI		
	No	No of death	***(%)***	No	No of death	***(%)***
Urban	669	4	***0.6***	245	4	***1.6***
Rural	1031	24	***2.3***	321	6	***1.9***
Total	1700	28	***1.6***	566	10	***1.8***

according to the indication and rural/urban differences (without BT)

Table 9 shows the distribution of maternal deaths after a MOI in relation to the indication and rural/urban differences. 2.2% (30 out of 1352) of mother from rural areas died after a MOI but only 0.9% (8 out of 914) of mothers from urban areas. Surprisingly the mortality was similar for Non-AMI than for AMI. This observation can be explained by the fact that eclampsia, which is per definition not an AMI, contributes to 7 out of 10 (70%) of the mortality in the group for MOIs for Non-AMIs.

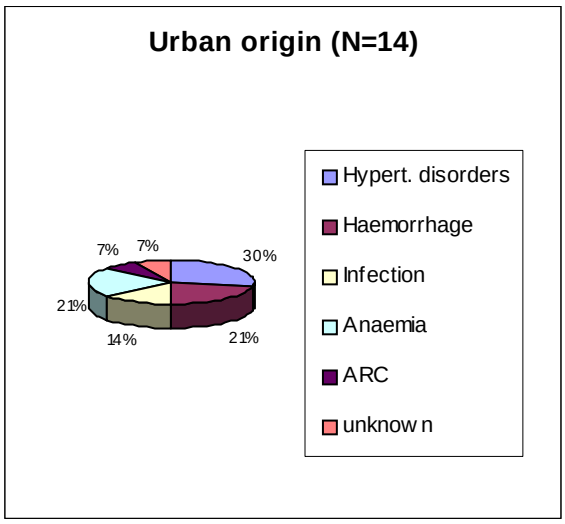
Table 10: Reason of hospital-based maternal death in Mtwara

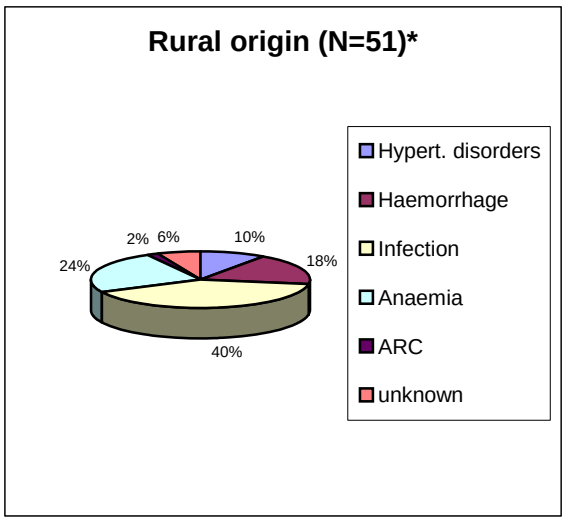
Reason of Death (More than one reason possible)	N=65	%
Infection	26	40.6
Anaemia	18	28.1
Haemorrhage	14	21.9
Hypertensive Disorder	10	15.6
Anaesthesia	0	0
Unknown	6	9.3

Out of these 65 maternal death reported by an UON-questionnaire 26 mothers (40.6%) died because of an infection. Anaemia was the second leading cause (18 mothers, 28%). The reason for the remaining 14 maternal deaths were haemorrhage (22%) and 10 patients (16%) of hypertensive disorders whilst 6 were unknown.

Figure 6 and 7 show that there are major differences in the cause of deaths between urban or rural origin of the mother.

Figure 6 and Figure 7: Causes of deaths after a MOI by urban or rural origin of the mother





ARC: AIDS related complex

* in one case more than one cause of death given (haemorrhage & hypertensive disorder)

40% (25 out of 51) mothers from a rural area (>10km from a hospital) died because of infection whereas only 14% of mothers (2 cases) from urban areas. In contrast, more women in urban areas died because of haemorrhage (21% urban respective 18% rural) or hypertensive disorders (30% urban respective 10% rural).

Out of the 15 mothers cases died before an intervention could be carried out, 9 had severe anaemia/PPH, 2 had hypertensive disorders, 2 mothers had a suspected ruptured uterus and one women had a severe puerperal infection (in one case the reason of death was reported to be unknown).

A total of two maternal deaths took place during an intervention, both during blood transfusion, one of them because of PPH, the other because of severe anaemia.
48 death occurred after intervention. AIDS was mentioned as an underlying cause of death in 4 cases. However, no HIV-test has been done to support the clinical diagnosis.

Table 11: Maternal deaths in relation to a MOI according to intervention and indication

Intervention and Indication	No of Interventions/ indication	No of maternal death *	% of deaths in relation to intervention/ indication
Lap-tomy	46	10	***21.7***
Blood transfusion	119	10	***8.4***
Hysterectomy	32	1	***3.1***
CS	2185	27	***1.2***
for hypertens. disorders	71	7	***9.9***
for malpresentation	201	3	***1.5***
for CPD	1108	13	***1.2***
for APH	127	1	***0.8***
for fetal distress	181	1	***0.6***

*for 48 deaths that occurred after an intervention was carried out

A laparotomy for a ruptured uterus had the highest case fatality rate for the mother. More than one fifth of mothers (10 out of 46; 22%) die after such an intervention. 8 out of these 10 women died because of post-operation infection, one because of bleeding complications and one mother died because of a paralytic ileus. The second serious outcome was obtained for a CS performed because of hypertensive disorders (9.9% of mothers died following this complication). 10 out of 119 mothers (8.4%) died after blood transfusion. There was no maternal deaths after a CS performed for cord prolaps, breech, or 2 or more CSs, but one dead where the CS was done to save the child's live (fetal

distress). In two cases a CS was performed for unknown reason and the mother died postpartum because of infection in 1 case and severe anaemia in the other case.
The overall mortality rate for a CS was 1.2% in the 4 hospitals in Mtwara Region. The mortality if the CS was done for foetal reasons (breech, cord prolaps or foetal distress) was low with 0.4% (1 case out of 261). In one case a CS done for foetal distress a hysterectomy become necessary and a total 4 hysterectomies were done after CSs for different reasons.

Maternal Complications in relation to a major obstetric intervention

Newala Hospital reported maternal complications in meticulous detail, especially during the first year of the study when a specially interested doctor supervised the documentation of the UON questionnaires. Complications occurred in 21.2% of all MOIs and 17% of all CS . The distribution is shown in table 12:

Table 12: Listed complications in Newala hospital

Complication	N=144	%
Wound infection	41	28%
Sepsis	37	26%
Malaria	26	18%
Puerperal Infection	15	10%
Fever	6	4%
Burst Abdomen	4	3%
Mastitis	2	1%
VVF	1	1%
Others	12	8%

Wound infection occurred in 41 out of the of the 144 patients (28%) a septical condition in 26%, and a puerperal infection in 10%. This sums up to a total of 93 out of 495 MOIs (19%) complicated by infection. Moreover malaria post-partum was a very common condition reported for 18% of all complications or 5.3% of all MOIs.

5.7 Origin of the mother who died in the hospital in relation to MOI

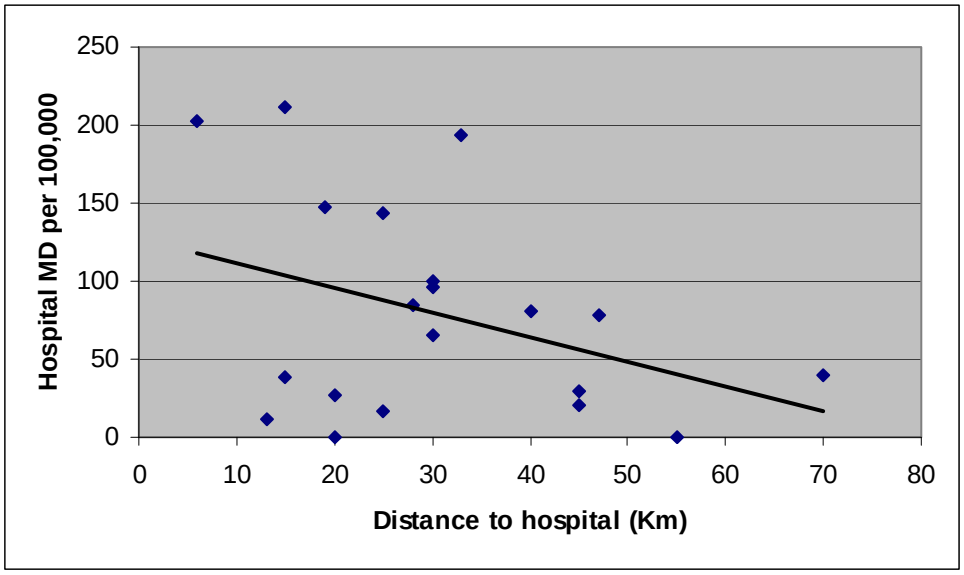
Out of the 65 maternal death, 61 mothers came from Mtwara Region, four mothers came from outside the region, 2 mothers from neighbouring Mozambique, one mother from Lindi region and another women from Tunduru region. For only one mother who died the place of living could not be obtained but it was noted that she came from a rural place more than 10km from the hospital.

Figure 8 shows that the number of maternal deaths in relation to the expected birth in the 20 divisions were declining with distance although the correlation is weak. We can assume, that almost all death in Mtwara urban (mean distance to the hospital 7 km) took

place in the hospital. As deaths in relation to a MOI accounted for about three fourth of all maternal deaths in the four hospitals (see table 1), the MMR in Mtwara urban can be estimated to be around 250 to 300 per 100,000 live births. This result is low compared to data from the urban AMMP demographic site in Dar-es-Salaam where an estimated 591 deaths per 100,000 live births occurred during the period 1993 to 1999 (Mswia *et al.*, 2003).

In the AMMP-project in Morogoro, the MMR in rural areas was estimated to be as high as 1099 (Mswia *et al.*, 2003). However the data displayed in figure 8 from Mtwara shows that the deaths from rural areas recorded in the hospital registers were very few. This fact indicates that the crude hospital based maternal mortality cannot be used as a proxy of the MMR in the districts.

Figure 8: Hospital-based maternal deaths ratios in relation to the mean distance of the division to the next hospital



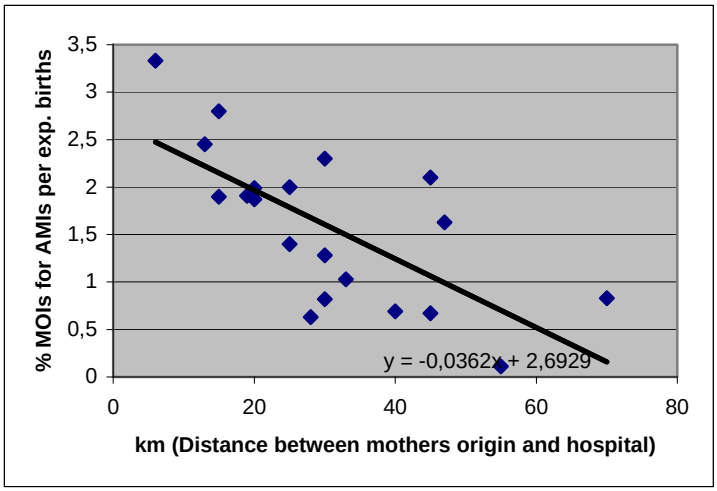
(MMR calculated on the basis of expected births)

5.8 The Unmet Obstetric Need-indicator

To calculate the unmet obstetric need all MOIs done for AMIs excluding BT were taken in consideration. A total of 1705 MOIs for AMI were carried out during the study period. In 1.3% (22 quest.) the place of living (division) was not documented. A total of 86 mothers (5%) came from outside Mtwara Region, mostly from the neighbouring Lindi region (75 women). The remaining 1597 were included in the analysis.

The UON-indicator, calculated on the basis of the expected births in the 20 divisions, were mapped in the figure 9 (see also table 21 in annex). The value ranged from 3.3% of MOIs for AMIs in Mtwara urban to under 1% in 6 out of 20 divisions. The cut-off value of 2% was achieved in 7 out of 20 divisions and another 4 divisions had levels between 1.5% and 2%. Another 3 divisions reached levels above 1% whereas 6 out of the 20 divisions failed ever to reach a minimum level of 1%.

Figure 9: Relationship between MOIs for AMIs per expected birth and mean distance in the divisions to the next hospital



Divisions far from the hospital had a lower percentage of MOIs for AMIs per expected births than the divisions nearby. The proportion of MOIs for AMIs per expected births declined by 0.36% for every 10 km The regression equation was Y = -0.036 X + 2.69

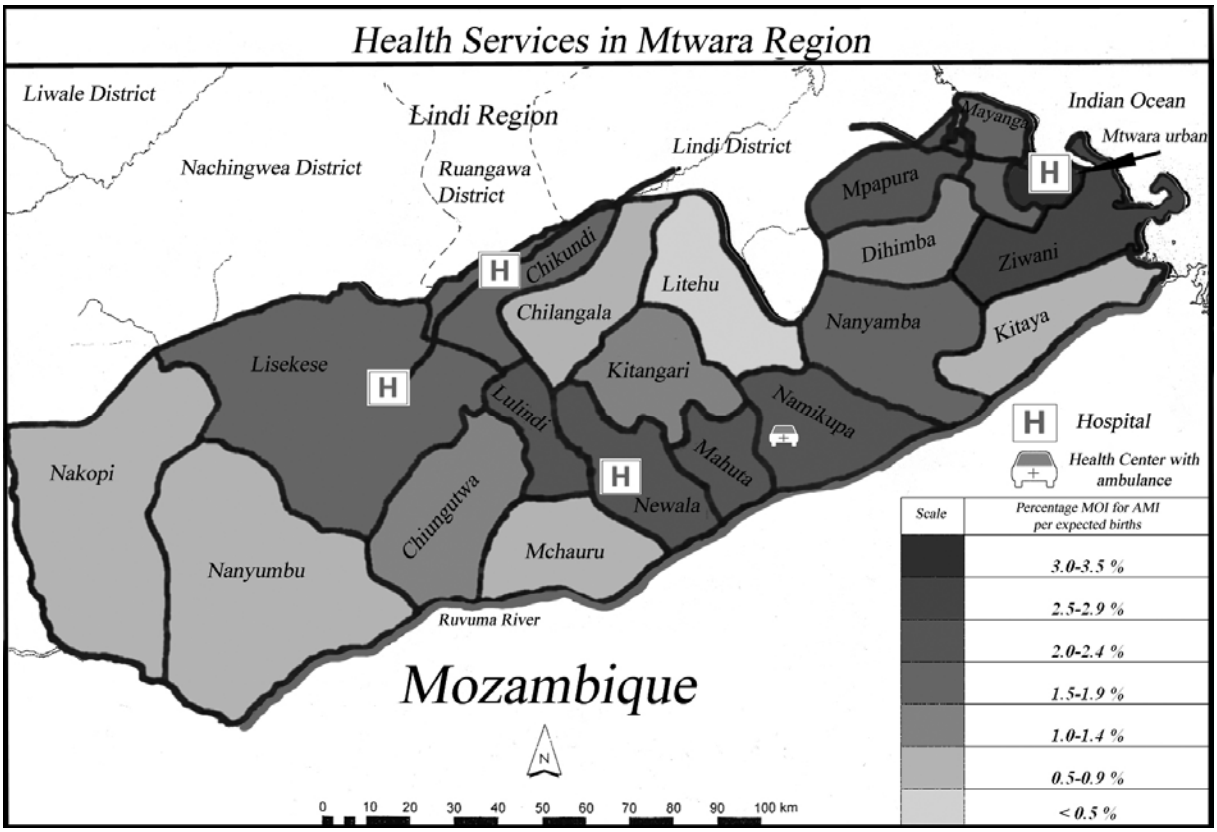
The observed proportions of MOIs for AMIs for divisions which mean distance to the nearest hospital of < 20 km was around 2% and declined steadily thereafter.

There were some divisions that did disturb the relative regular pattern. Two of these outliers, the divisions Mahuta (mean distance 25km) and Namikupa (mean distance 45km) had easy access to Newala hospital through an ambulance. Mpapura (30km mean distance to Mtwara hospital) is well connected by the busy trunk road and reached also a level of about 2.3% MOIs for AMIs.

The low value of Litehu division (mean distance 55km) might not reflect the true situation as the women most probable sought care at Nyangao Mission hospital in the neighbouring Lindi Region. This hospital is situated at the trunk road to Lindi near Litehu division (see figure 10). For the other divisions the distance can explain the low percentages of MOIs per AMIs per expected births.

The following figure10 shows the percentage of MOIs for AMIs per expected births in the 20 divisions and their geographical distribution.

Figure 10: Percentage of MOIs for AMIs per expected births in the 20 divisions



The absolute deficit of MOIs for AMIs was 352 interventions. The total surplus in 7 division was 171 MOIs for AMIs. The relative deficit ranged from 4% to 95% in the different divisions (see table 21).

To analyse the factor distance the 20 divisions on Mtwara region were grouped according to the mean distance in the division to the next hospital.

Table 13: **Percentage of MOIs for AMIs in relation to mean distance to the hospital in the 20 divisions (excluding BT)**

	Expected births	No MOIs for AMIs	% MOIs for AMIs per EB	95% confidence Interval
Up to 10 km (1 division)	7408	242	3.33	2.87-3.7
11 to 20 km (6 division)	35526	741	2.09	1.94-2.24
21 to 40 km (8 division)	24280	330	1.36	1.22-1.51
41 to 70km (5 division)	23069	280	1.21	1.08-1.36

Chi-square for Trend all four categories: 2.79, p-value 0.095; only first three categories 116.39, p<0.001

The result are shown in table 13. The Chi-squared test for Trend did not show statistical significance. However, if only the divisions of less than 40km distance from a hospital were taken into consideration, the Chi-square test was significant (116.39; $p < 0.001$).

In the following paragraph the UON-indicator for each of the five districts is presented. This analysis follows the schema proposed by the UON-network that tries to enlighten rural/urban differences in the districts. The table 14 shows substantial differences in the reached number of MOIs per AMIs between urban and rural areas. The percentage achieved ranged from 1.1% to 4.1%. Taking 2% expected MOIs for AMIs as a cut-off value, all urban places show a plus in the number of MOIs perform for AMIs per expected births. The relative Unmet Obstetric Need ranged from 12% in Mtwara Rural to 44% in Newala Rural. Mothers living in urban areas were 2.4 times more likely to have a life saving operation than women living more than 10km from the hospital.

Table 14: MOIs per AMIs for urban and rural areas in the districts

	Exp. Birth (EB) 2 years	Estimated Needs for MOIs/AMIs (2% of EB)	Met Need (Actual MOIs/ AMIs)	Unmet Need (Deficit in absolute figure)	Actual % MOIs/ AMIs for EB	Unmet Need (Relative Need %)
Mtwara Urban	7408	148	242	(‘plus’ 99)	3.3	
Mtwara Rural*	16381	327	288	39	1.8	12%
Tandahimba*	16372	327	267	60	1.6	18%
Newala Urban	3482	70	143	(‘plus’ 73)	4.1	
Newala Rural	11233	224	130	94	1.2	42%
Masasi Urban+	7375	148	219	(‘plus’ 71)	3.0	
Masasi Rural+	28031	561	314	247	1.1	44%
Total Urban	18265	365	603	(‘plus’ 242)	3.3	
Total Rural	72017	1440	999	441	1.4	31%

+ 2 hospitals, Masasi District Hospital and Ndanda Mission Hospital
*only rural, no district hospital

5.9 The feasibility of data collection to calculate the UON-indicator

The feasibility of the data collection could be judged by different factors including the completeness of the data set, how well the hospital and district staff accepted to collect the data and the reliability of the information obtained.

As shown in the results (table 2) completeness of the data collection was high. All necessary data to calculate the UON-indicator are part of routine recording and the UON-questionnaire has been shown to be an appropriate instrument to collect the data. Some extra efforts to complete the information concerning the distance of the mothers' home village to the hospital and to identify the division the home village belonged to, became necessary. Small changes in the protocol might have prevented this. Some questions were not easy to interpret and led to misunderstandings which were discussed with the persons responsible for filling the questionnaires. These questions are discussed in detail in the annex (see 9.4).

At the beginning of the study the responsible persons in the delivery ward were highly motivated and filled the questionnaires with utmost care. Improvements in recording were observed and the use of the partogram was reinforced. Compliance with the study protocol was high. However due to the lack of supervision during the second year (see also methods 4.2) the staff gradually forgot how to fill the UON-questionnaires. This trend was changed when supervision started again and the responsible persons in the delivery ward were able to complete the data set retrospectively using the data from the routine hospital recording system. This fact shows the robustness of the approach: all the necessary data were not only available using a separate questionnaire but also through the routine system. Moreover, the retrospective recording sensitised the district health staff for the necessity of an accurate and complete recording. In summary the results presented in this thesis clearly demonstrates the high quality and completeness of the obtained data set. Supervision and data management had weaknesses, still the approach showed to be appropriate and feasible.

The question of the reliability of the information will be presented in the discussion.

5.10 The usefulness of the UON-approach for district planning

The results presented show that the method has a great potential to help health planners in the district to assess and monitor maternal and perinatal health. The UON-indicator was able to identify underserved areas. The impact of an ambulance on the number of life-

saving obstetrical intervention done for mothers from remote areas in the district hospital was also shown. Therefore the UON-indicator could also be used to assess and monitor the functioning of the referral system to deal with maternal complications.
In addition a lot of valuable information on perinatal and maternal mortality was obtained. All these information constitute a valuable basis to identify strategies to improve maternal and perinatal health. Therefore the UON-approach has been shown to be useful to assess and monitor progress in maternal health at district level. In addition, increased use of the partograph and better documentation has been observed.

However, as presented in the evolution of the UON-study in Tanzania (see methods), the study aimed at providing the districts with quarterly information on the UON-indicator. Supervision and data management was a main drawback during this study. The first data analysis and preliminary report was prepared only after 18 months. A second report was prepared in July 2003 after all missing data and questionnaires had become available. The data were presented by the author in March 2004 at the national conference Maternal Health Care Conference (MATCARE), which was organized in cooperation with different partners[8]. Unfortunately, up to date, it was not possible to present the results in a workshop to the health planners (the Council Health Management Team) or the staff of the maternity wards of the participating hospitals in Mtwara region. Therefore, no results and information can be given concerning the usage of the information and data.

The study did not involve major financial resources. Approximately 2000 Euros were spent to collect the data, for photocopies of the questionnaire, compensation for the regional coordinator and the coordinators in the four hospitals, and for data entry.

The UON-approach has the potential of providing health planners with a lot of valuable information on the accessibility of emergency obstetric care and perinatal and maternal mortality without major extra financial or human resources.

[8] The Muhimbili University College of Health Sciences (MUCHS), partner in the International Maternity Care Project and the Association of Gynaecologists and Obstetrician in Tanzania (AGOTA) in FIGO Save the Mothers Initiative –Twinning with Netherlands Society of Obstetrics and Gynaecology (NVOG), are organizing a conference on Maternal Health Care in Tanzania with assistance from the Tanzanian German Program to Support Health (TGPSH).

6 Discussion

6.1 Main findings

The study was carried out to estimate the unmet obstetric need in Mtwara Region and to assess the feasibility of data collection and usefulness of the UON-indicator at district level through a prospective study.

A major deficit of live-saving obstetric intervention was found in 13 out of the 20 divisions in Mtwara region. Most divisions which were more than 20km distance from a hospital had a relative unmet need of about 50%.

The analysis showed that the method has the potential for mapping and surveillance of the unmet obstetric need. Even in a resource-poor setting with poor reporting the data necessary to calculate the UON-indicator is available though routine hospital registers. However, as the evolution of the UON-study (see 2.3 and 4.2) shows, the major bottle-necks for the use of the data lies in the data analysis, interpretation and feed-back.

In addition to the assessment of the UON-indicator, the method also makes it possible to monitor maternal and perinatal outcomes. A lot of additional information has been retrieved from this data analysis, which can stimulate quality improvements. The results presented in this report, could be useful for district planning and especially to monitor interventions aiming at improving the referral system.

The discussion will focus (1) on the UON-methodology including the results of distribution of indications and interventions, the threshold value for the UON-indicator, BT as part of the indicator and the validity and reliability of the indicator (2) the feasibility of the data collection through the UON-approach and the usefulness for district planning, (3) perinatal and maternal mortality as well as (4) main lesions learned. Lastly, the main findings will he reviewed in the context of the limitations of the study.

6.2 The UON-Methodology

Different process and output indicator have been introduced to assess the quality of obstetric care and the responsiveness of the health care system to deal with maternal complications. In 2003 WHO short-listed seventeen reproductive health indicators. These included indicators on safe-motherhood, contraception and sexual transmitted diseases. For safe-motherhood interventions, the MMR, the percentages of pregnant mothers attending ANC, skilled attendant at birth, the number of health facilities offering basic and comprehensive essential obstetric care (B-EOC, C-EOC), perinatal mortality and the

percentage of low birth weight babies were recommended as indicators (WHO, 2001, WHO and UNFPA, 2004).

The most important output indicator is the percentage of births attended by a skilled attendant. However, the correlation between the percentage of births attended by a skilled attendant and the MMR is far from straight forward (Graham *et al.*, 2001). Although perinatal mortality has been suggested as a proxy for maternal mortality, data from a demographic site in Bangladesh showed that there is no clear relationship between perinatal and maternal death (Akalin *et al.*, 1997). The set of process indicators proposed by UNICEF/WHO/UNFPA to measure the quality of obstetric care and the responsiveness of the health system to deal with maternal complication has also been criticised as putting to much emphasis on hospital care including the promotion of a high CS-rate. Historically low MMR have been achieved with much lower CS-rates than 5% (Ronsmans *et al.*, 2002a, De Brouwere *et al.*, 1998b, Högberg and Wall, 1986, De Brouwere *et al.*, 1998a). Also, the 15% level of complications that should be dealt with in a comprehensive EOC facility can also be debated as the level was set arbitrarily (Ronsmans, 2001, Ronsmans et al., 2002a). WHO in its latest World Health Report conclude that from recent evidence 7% of childbearing mothers are expected to be in need of treatment at a comprehensive EOC facility (including 2-3% of surgical cases) (WHO, 2005).

The problem of selecting a good predictor, both sensitive and specific, is related to the fact that maternal mortality is influenced by many factors inside and outside the health sector (Thaddeus and Maine, 1994, Pathmanathan *et al.*, 2003, Hertz *et al.*, 1994, McCarthy and Maine, 1992, Setel *et al.*, 2000, Urassa *et al.*, 1997, Urassa *et al.*, 1995). The great variability of different influencing determinants makes it difficult to identify a process indicator, which can be a proxy of maternal mortality. Similarly, the UON-indicator includes a number of aspects, which are likely to influence maternal mortality and morbidity: the accessibility of comprehensive obstetric services, the functioning of the referral system, as well as the financial and cultural accessibility of services.

One advantage of the UON-indicator against the crude CS-rate, proposed by UNICEF/WHO/UNFPA (1997), is that the UON-indicator can be analysed to describe urban/rural differences. This makes the indicator superior to the crude CS which has been criticised for this weakness (Ronsmans *et al.*, 2003).

In addition, it is known, that when CS-rates are rising, the proportion of CS done for maternal reasons decreases. The UON-approach defines the a reasonable level of MOIs for AMIs during the study process itself and the indicator does not set an arbitrary benchmark since. The risk of inducing a high CS-rate and therewith over-interventionalism without benefit for mother and child is reduced.

As only MOIs for AMIs are considered, the UON-indicator is less influenced by the subjectivity of some maternal or fetal indications. This advantage would be even more pronounced if only very 'hard' indications would be taken into consideration. Thus, the OVER method, for example, uses only breech and twin deliveries as well as deliveries complicated by placental abruption and placenta praevia (Pittrof, 1997).

One disadvantage of the UON-indicator is the fact that it assesses only one aspect of the health care system, namely the accessibility of comprehensive emergency obstetric care, while many obstetric complications can and must de dealt with at community or health centre level. A study in Indonesia, for example, showed a reduction of the population based CS-rate after the introduction of community midwifes (Ronsmans *et al.*, 2001). This example reflects the limitation of the CS-rate as an a indicator for progress in maternal health.

6.2.1 The distribution and rates of interventions and indications

To assess the validity of the UON-indicator, distribution and rates of interventions and indications could be compared with results other similar studies.

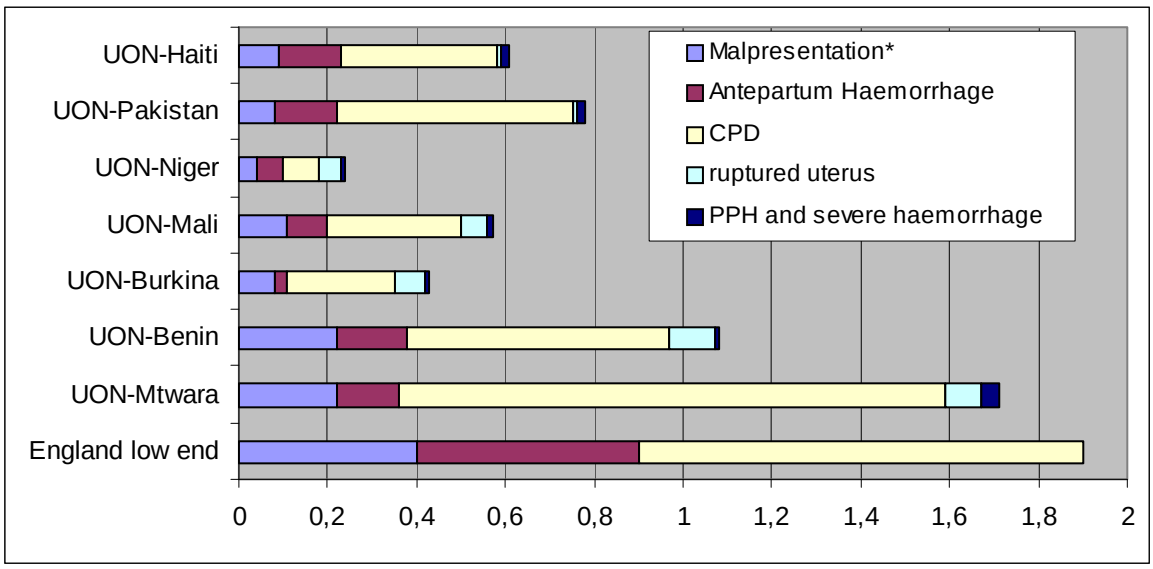
The CS-rate and the distribution of interventions in the four hospitals are within the range of other hospital studies in Africa. (Dumont et al., 2001, Doh, 1991, Cisse et al., 1995, Tadesse et al., 1996). However, the distribution of interventions and the indications obtained in this study are best compared with that observed other UON-studies.

The most common intervention in all the studies published by the UON-network is CS. Between 79.6% of all MOIs (Niger) and 97.8% of all MOIs (Pakistan) are CSs. The second most often intervention carried out is laparotomy for ruptured uterus. This intervention accounted for between 0.8% (Pakistan) and 14.8% (Burkina Faso) of all MOIs (UON-network, 2004a). In Mtwara Region 96.3% of all MOIs (if BT were excluded) were CSs and 2% were laparotomies for a ruptured uterus.

Comparing the UON-indicator with other studies of the UON-network, the results in Tanzania are encouraging. In Mtwara Region, a level of MOIs for AMIs per EB of 3.3 in urban areas and 1.4 in rural places were observed. The comparable figures for Benin, Burkina Faso, Mali and Niger ranged from 1.4 to 0.8 in urban areas and 0.9 to 0.15 in rural areas (UON-network, 2004a). In Nepal the rate of MOIs per AMIs was even lower at 0.4% for the urban and rural population together (Jahn *et al.*, 2000).

However, the data from Mtwara are not directly comparable with the data from the other UON-studies as two more absolute maternal indications (2 or more previous CS and puerperal infection) were included. Therefore, a detailed comparison of the percentage of expected births delivered by CS for the respective indication in different UON-studies is shown in figure 11. The figure also shows the expected percentage of deliveries by CS for selected indication according to the estimation from Francome and Savage (1993).

Figure 11: Comparison of indications for a MOI between the different UON-studies and the low end estimate based on data from England



(data from: UON-network 2004, Francome & Savage 1993)

* in the study in Mtwara malpositions were included

Comparing the different indications displayed in figure 11 it can be seen that in all the countries only few (between 0.03% per expected births in Burkina Faso and 0.14% in Benin) mothers get care for ***'antepartum haemorrhage'***. The low-end estimate from the cohort in England suggests that at least 0.5% of childbearing mothers need a CS to prevent serious consequences for the mother and the child for this indication. In the study in Mtwara, only 0.14% of childbearing mothers had a MOI for APH. In other terms, about

four times more women with APH need to be reached to save the mother or the child in Mtwara region if the low-end estimate would be applied to the population in Mtwara.

The difference is less pronounced for the indication '***malpresentation'***. The proportion of mothers getting care for malpresentation per expected births ranged from 0.04% in Niger to 0.22% in Benin. For Mtwara region the level was 0.22%. This means that two times more women would theoretically be in need of an intervention because their delivery is complicated by a malpresentation, if the 0.4% low-end estimate from England is used as a benchmark.
Between 24% and 65% of the expected births complicated by '***CPD'*** are reached and treated with a live saving intervention. The only exception is Niger with a level of only 0.08% population-based interventions for CPD.

If the incidence of APH and a serious outcome without intervention would be similar throughout populations, the percentage of mother with APH reached by the health services might be a better indicator (or sub-indicator) of the responsiveness of a health care system to deal with maternal complications. The indication APH is more sensitive indicator for timely access to care because of the short time interval period to death.

For the complication '***hypertensive disorders'*** the reference data from England suggest a population based CS-rate for eclampsia of between 0.5% to 1%. The reference data from England are comparable with results from other studies in Africa. Population-based CS rates for hypertensive disorders ranged from 0.1% to 1.1% (Dumont *et al.*, 2001). In our study, 71 mothers who's delivery was complicated by hypertensive disorders were treated with CS. In relation to the total number of deliveries the CS-rate in the hospital for hypertensive disorders was 71 in 16412 hospital deliveries (0.4%). The rate of hypertensive disorders treated with CS per expected birth in the districts was 0.04%. This means that only one tenth of the cases of hypertensive disorders were getting the care they theoretically would need if the data from England and other studies in Africa are used as a reference. In Ghana 13 cases of eclampsia per 1000 deliveries were observed in a hospital and the CS-rate in this group was 56%; this adds up to 0.73% hospital based cases (Obed *et al.*, 1994), which is almost double the Mtwara rate. However, the definition and detection of eclampsia is not straight forward, so the results should be used with caution.

The need for CS for the indication ***'two or more previous CSs'*** is difficult to assess. The prevalence of one previous CS was estimated to be 1.5% in pregnant women in two districts of Mtwara region in 1996. The prevalence in the group of parturients in Mtwara regional hospital was 6.7% (Jahn *et al.*, 1998). It has been estimated that about 45-75% of women with a previous CS will get another CS in the following pregnancy (Van der Walt et al., 1994, De Jong, 1987). However, it is difficult to determine how many women with two or more previous CS will become pregnant again. Therefore no minimum level can be given. In the study in Mtwara region, 1.21% of women giving birth in one of the four hospitals got a CS because of two or more CSs and the population based rate was 0.1% for CSs because of two previous CSs.

To be able to compare the data from the study in Mtwara with studies done by the AMDD (Averting maternal deaths and disability)-group that uses the indicator proposed by UNICEF/WHO/UNFPA, the crude CS-rate was calculated. For Mtwara region, this rate was 2.4% during the study period. Compared with a study done to assess the responsiveness of the health care system, the population-based CS-rate in Mtwara was 2 times higher than in two districts in the North-West of Tanzania (CS-rate 0.8 and 1.3%) assessed by the AMDD-group. In two other African countries levels between 0.5% (Niger) and 2.0% to 3.0% (Rwanda) were found (AMDD, 2003a). In Mococco, Nicaragua, Sri Lanka the crude CS-rate were 2.8%, 6.3% respective 13.7% per expected births (AMDD, 2003b).

The comparison of the data from Mtwara with studies from other countries show, that the number of obstetric intervention is well above what has been found in other parts of Tanzania and many other places in Africa. This shows, that the region is well on track to offer comprehensive obstetric care for mothers in need.

6.2.2 The threshold of MOIs per AMIs per expected births

In our study, we chose a cut-off level of MOIs per AMIs per EB of 2%. However, the correct level is matter of discussion. De Brouwere and van Lerberghe in their work outlining the UON-indicator estimated that at least 1% to 2.9% of child-giving mothers are in need of a MOIs for AMIs to prevent serious complications (De Brouwere and Van Lerberghe, 1998). Most of the MOIs in this estimation were CSs. Hysterectomies

contributed only to a small fraction and even are rare in hospitals cohorts (Abu-Heija and Jallad, 1999, Osefu, 1989).

Therefore the discussion about the optimal or minimum level of live-saving operations needed to save the mothers life is mainly a discussion about the right CS level.

In contrast to the low-end estimate of only 1%-2.9% proposed by Brouwere and van Lerberghe (1998) a rivalling working group on indicators suggests a target for the crude population based CS-rate of at least 5% to 15% regardless of the (Wardlaw and Maine, 1999, UNICEF/WHO/UNFPA, 1997).

Data from England in the 1960s, a time CSs were still predominately done for maternal indications, provide arguments that a total of 3.4% to 4.9% of mothers need a CS to prevent serious complications during childbirth (Francome and Savage, 1993). Dumont et al. 2001 suggested, based on publications on hospitals CS-rates and population based data from the MOMA survey in West-Africa, that a range of 3.6% to 6.5% of CS in a defined population might be necessary to prevent serious maternal outcome (Dumont *et al.*, 2001). Ronsmans et al. 2002 argued, that this estimation included the non-absolute maternal indication 'prolonged labour' and recalculated the range of the CS-rate for maternal indications between 1.3% and 4.7% (Ronsmans *et al.*, 2002b). De Brouwere et al. 2002 argued, in response to the same article of Dumont et al. 2001, that CS-rates lower than 2% in Europe and the United States in the 1950^{s} and 1960^{s} achieved acceptable MMR of under 50 per 100000 (De Brouwere *et al.*, 2002).

The social setting, medical training and whether doctors or midwifes follow the process of the deliveries determines the level of the CS-rates (Van Roosmalen and Does, 1995). In some places in middle income countries the CS rates increased to as high rates as in high income countries during the past years (Chanrachakul *et al.*, 2000). Also, not much is known if the incidence of obstetric complication differ between population.

Moreover, observed CS-rates in hospitals do not necessarily reflect an absolute need: In Zimbabwe the rate of CS for dystocia, malpresentation and foetal distress could be safely halved in a provincial hospital without negative consequences for mother and child (De Muylder and Thiery, 1990). Also, when CS-rates are getting higher, less CSs are done for vital indications and the rates will not necessarily measure to which extent the obstetric needs in a community are met (Ronsmans *et al.*, 2002a).

In a recently published study comparing CS-rates and maternal mortality in West-Africa the authors also argued for caution in the use of the crude CS-rate as an indicator to

predict maternal mortality. Moreover, attempts to reach the goal of CS-rates of about 5% may enhance an over-interventionalistic culture among the doctors. This might include the risk to increase the rate of CS without benefits for mother or child (Ronsmans *et al.*, 2003).

Looking at the lively discussion on the optimal minimum level of interventions needed to prevent serious maternal outcome it is a difficult task to chose a benchmark for the UON-indicator. The UON-studies carried out in West Africa, Morocco & Haiti chose levels between 1% (Haiti and Morocco) and 1.6% (Pakistan) (UON-network, 2004a, Rehman et al., 2000, Belghiti et al., 1998).

The UON-network argues that the proxy of the optimal low-end estimate of levels of life-saving interventions to meet the need of child-giving women can only be defined in a specific situation and for a defined population with good access and in assessing carefully the indication for the specific interventions. In our study, areas with relatively good geographical access to hospital care like in Mtwara, Masasi and Newala urban a level of between 3.0% and 4.1% was recorded (see table 14). However, as stated in the limitations of the study, one of the indications of MOIs in this study was CPD, which also included to some extent the weak indication prolonged labour or poor progress of labour. This increased the number of CS for AMI. Therefore, based on expert opinion from health professional from Tanzania, historical and international data and supported by the results from the pilot study we choose 2% as the low-end limit to indicate a deficit of live-saving interventions.

6.2.3 BT as part of the UON-indicator

BT are not listed as MOIs in the original framework of the UON-approach but senior Tanzanian health professionals suggested to include BTs and severe anaemia as a MOI respective AMI because of scientific work suggesting the high prevalence anaemia in Tanzania (Massawe et al., 2002, Massawe et al., 1996). In line with the results of this previous work this study showed that BT contribute to about 10% of all life-saving obstetrical interventions. In addition, many BT were necessary after another intervention like hysterectomy. However, the reporting was not complete especially in two of the hospitals, but BT might still have occurred. Maybe the incomplete recording was due to the fact that the staff did not perceive BTs as MOIs and many women receiving BT during late pregnancy were treated outside the delivery ward and BT were therefore not reported.

However, the high prevalence and the high mortality after a BT (8.4% of mothers died) underline the importance of BT to save the mothers life. Moreover, haemorrhage and anaemia each contribute to 21% of the causes of maternal deaths in mothers having good access to health care.

The study was not able to provide evidence on a threshold of BT needed to prevent maternal death from anaemia or haemorrhage. However, the high proportion of BT performed and the high mortality in relation to BT provides argument that it might be helpful to look into the intervention BT more closely in the future. Although recording was a problem in our study, experience from the two participating hospitals show, that this can be overcome with minor efforts. Our results support the need to include BT in the list of major obstetric interventions that should be monitored to assess progress in maternal health.

6.2.4 The validity and reliability of the UON-indicator

An ideal indicator should be specific and sensitive to the condition it predicts, measurable, attainable, relevant and timely available.

The validity of an indicator is described by its strength to predict what it is supposed to measure. The UON-indicator was introduced to assess the responsiveness of the health care system to deal with obstetric complications and to be a proxy of maternal mortality.

Results and discussion presented in this manuscript showed that the UON-indicator was able to assess rural/urban differences in access to emergency obstetric care. However, the UON-indicator is a summary measurement that does not take into consideration that certain complications are more likely to be treated in a hospital than others. The detailed analysis of indications covered by the UON-indicator (see figure 11) shows that even if the UON-indicator shows high level of MOIs for AMIs not all obstetric complications are satisfactory coved.

Other aspects of the responsiveness of the system to deal with maternal complication (quality of care, morbidity) are not captured by the UON-indicator. However, the UON-methodology does not only collect data to calculate the UON-indicator but also data on maternal and perinatal mortality. Therefore, many factors are covered by the UON-methodology but not the indicator.

To get an indication of how well the UON-indicator predicts maternal mortality, the UON-network compared the UON-indicator with the MMR in six different countries, Mali, Burkina Faso, Haiti, Mali, Niger and Pakistan. The estimates were close to the WHO country estimates (Hill *et al.*, 2001) in three of the countries but not in Benin, Mali and Pakistan (UON-network, 2004b).

A DSS-site provided an estimate of 573 deaths per 100000 births for the costal regions of Tanzania (MoH, 2000). This level is also supported by the results from the three demographic sites from AMMP (Mswia *et al.*, 2003). In Mtwara region, a total of 83 deaths were reported from the four hospitals for the study period between July 2000 and June 2002. The absolute unmet obstetric need was 352 cases (estimated women that might have died because an intervention was not carried out) in Mtwara region. This would add up to 453 deaths and possible deaths for a total of 90282 expected births or a ratio of 482 per 100.000 expected births during the study period. The calculated possible deaths thus gave a value slightly lower than the DSS-site but well within the expected confidence intervals. Moreover the good accessibility of hospital care in Mtwara compared to other regions in Tanzania makes a lower MMR possible. Our findings therefore support the plausibility of the UON-methodology.

The reliability of the UON-indicator depends on the completeness of the data, the correctness of the recording of interventions, indications as well as the correct estimation of the distance to the health facility and the correctness of the estimation of the expected birth (De Brouwere *et al.*, 1996). These factors are discussed in the limitation of the study (p 54). Completeness and correctness of interventions, distance and expected births were high in our study whereas the correctness of the indications can be debated. The reliability of the UON-indicator in our study was satisfactory. The indicator was relatively easy to obtain, measurable and did not demand major resources from the health system.

In summary, the UON-indicator seems to be useful and a valid indicator to monitor the ability of the health care system to deal with emergency obstetric complications. However, it is necessary to keep in mind that complications due to abortion or post-partum haemorrhage are not or not well captured by this indicator. Therefore the indicator might be complemented by other indicators aiming to assess basic delivery care by a trained birth attendant and abortion care – and - it remains important to keep in mind that "the

measurement of processes of care is not a substitute for the measurement of health effects in individuals and populations" (Graham and Hussein, 2004).

6.3 Feasibility of the data collection and the usefulness for district planning

The study showed that it is possible to collect all data necessary to estimate the UON-indicator in spite of limited resources. However, as the discussion on the questionnaire showed, a thorough planning, explanation of the study to all staff members in the delivery ward and discussion of the definitions and terminology of indications at the beginning of the study as well as during supervision is necessary. Many problems encountered during this study like the lack of knowledge on distances could be easily overcome with only minor efforts.

The introduction of a more comprehensive monitoring in the delivery ward including interventions, indications, place of living, distance and the follow up of the delivery including the partograph would make the data more easily available. Also, this would make it possible to verify the diagnosis CPD. However, resources are scarce in Tanzania at district level and it might be well sufficient to assess this indicator in a four to five years interval to monitor progress in accessibility of emergency obstetric care.

The UON-indicator is a recently introduced variable to measure the functioning of the system to deliver adequate obstetric care. Our analysis shows, that the method is excellent to identify underserved areas, and that the data also can be used to assess the quality of the services. The method is able to give detailed information about the deficits of live–saving interventions in specific and relative small administrative areas. The gap between rural and urban areas in relation to emergency obstetric care could be carefully analysed. Compared with the crude CS-rate of between 5-15%, the UON-indicator is less influenced by the fact that more women from urban areas are going for a hospital delivery and are therefore more likely to have a CS for other than AMIs. Moreover, the fact that a district hospital not only serves its catchment area population but women from outside the district or region has been taken into consideration.

The UON-approach has been used in other counties to raise awareness to the problem of maternal deaths. Changes in the maternal health policy and positive effects at district level

has been reported from case studies in various countries (Guindo *et al.*, 2004, UON-network, 2004a, Quedraogo *et al.*, 2003).

In summary, the method has a great potential to (1) raise awareness not only for maternal deaths but also to deficiencies in emergency obstetric care, (2) to improve planning based on the detailed information available and (3) to improve services. Moreover, beneficial 'side-effects' like increased use of the partograph and better documentation has been shown.

6.4 Perinatal and Maternal Mortality

Perinatal mortality is estimated to be about 75 per 1000 births in sub-Saharan Africa (Yu, 2003). The study in Mtwara showed a perinatal mortality in relation to a MOI of 108 per 1000 births and a stillbirth-rate of 81 per 1000 whereas the overall hospital-based stillbirth rate (not in relation to a MOI) was much lower with 42 per 1000 births. The observed difference reflects the fact that perinatal mortality is highly influenced by maternal complications during childbirth. The main obstetrical risk factors in the study in Mtwara were ruptured uterus, APH or hypertensive disorders. In a community based study it was found that perinatal deaths were 7 times more common in mothers suffering from pre-eclampsia and 17 times more common if the presentation was other than cephalic (Wessel *et al.*, 1998). In another community-based study it was shown that perinatal mortality showed a 17 fold increase for malpresentation (excluding breech), 8 fold increase for eclampsia and a 26 fold increase for obstructed labour (Kusiako *et al.*, 2000). In a hospital in Kenya, the risk of perinatal mortality was also highest in relation to malpresentation (OR 20.4) eclampsia (OR 13.0) and APH (OR 24.3) (Weiner *et al.*, 2003). In Nigeria the perinatal mortality in cases with APH was as high as 643 per 1000 births (Omu and Diejmaoch, 1981).

Our study, in line with these publications, showed that labour complications are responsible for a large part of the perinatal mortality. Improvement in the management of obstructed labour, malpresentation, hypertensive disorders and APH and thereby reduction of asphyxia in newborns could contribute to a significant reduction in perinatal mortality (Weiner *et al.*, 2003, Bartlett *et al.*, 1993, English *et al.*, 2003, Klingenberg *et al.*, 2003). A reduction of perinatal mortality from 71 to 39 per 1000 births through improved labour management has already been shown in a Tanzanian hospital (Van Roosmalen, 1989).

Stillbirth and early neonatal mortality have also been assessed in other UON-studies. The overall stillbirth rate in relation to a MOI was between 30 per 1000 (in Pakistan) and 240 per 1000 births (in Benin). The early perinatal mortality in relation to a MOI ranged from 30 per 1000 births (in Pakistan) to 410 per 1000 (in Benin) (UON-network, 2004a). The comparable figures for Mtwara were 81 stillbirth per 1000 births and 101 early perinatal death per 1000 births. The early perinatal mortality was about 2-3 times higher for rural than for urban mothers in Burkina Faso, Niger and Mali while the rate was similar in Benin (UON-network, 2004a). In the study in Mtwara the rate was 2 times higher for rural than for urban mothers.
In most UON-studies the perinatal mortality was 2 to 3 times higher for AMIs than for Non-AMIs. However, in Mtwara this could not be shown. The high perinatal mortality in the group of non-AMI in Mtwara was related to eclampsia. Further many deaths occurred after a CS done because of fetal distress.

The **Maternal Mortality** is comparable with ratios found in other hospital studies in Tanzania (Mbaruku and Bergström, 1995, Walraven et al., 1994). In our study the main reasons of maternal deaths were infection, anaemia and haemorrhage. This is similar to what has been found in many studies in low and middle income countries (WHO, 1996). The population-based study in the three different DSS-sites in Tanzania showed that PPH accounted for between 13.6% and 20% of the maternal deaths, APH between 0.9 and 3.6%, anaemia for between 6.4% and 10.3%, puerperal sepsis for between 6.7% and 14% and hypertensive disorders between 4.9% and 14% (Mswia *et al.*, 2003).
Haemorrhage and anaemia was also described in another study in Tanga Region in Tanzania as a main reason of death (MacLeod and Rhode, 1998) whereas Walraven et al. 1994 found obstructed labour and puerperal infection as the most prevalent causes of maternal death in a hospital in North-West Tanzania (Walraven *et al.*, 1994).

However, as our analysis showed, the distribution of causes of deaths is influenced by the distance factor. Eclampsia and haemorrhage were more frequent causes of death for urban mothers, whereas infection was the major cause of deaths in mothers coming from rural places. This trend has also been described in other UON-studies: uterus rupture is a major reason of hospital deaths in mothers coming from rural areas whereas haemorrhages, APH, PPH are predominant in urban mothers (UON-network, 2004a). Moreover, in line with the results from other UON-studies, the death rate for mothers from rural areas were

twice that of mothers from urban areas. In Mali and Burkina Faso the difference was even more pronounced. Mothers from rural areas had a death rate 3 times higher (UON-network, 2004a).
In the Mtwara study a slightly higher maternal mortality was found for interventions done for non-AMI than for AMI (1.8% versus 1.6%). This is in contrast to findings from other UON-studies where the death rate was always higher for AMIs than for non-AMIs. However, most deaths (7 out of 10) in the group of Non-AMIs in Mtwara region were due to hypertensive disorders. A differential analysis of the reason of deaths in the different groups could not be obtained from the other published UON-studies.

Maternal mortality in relation to a major obstetric intervention is a special form of **case fatality rate** (CFR). In Mtwara region important differences were observed. Ndanda Mission hospital had the lowest CFR for a MOI (0.9%). In contrast Mtwara regional hospital had a CFR for a MOI of over 5% and the rate was about 2% in the other two hospitals.
CFRs are used in many safe-motherhood projects to get an indication of the overall quality of care provided in the health facility because it measures the outcome of the treatment the women actually receive. The CFR is judged to be superior to the hospital mortality rate because the CFR is less influenced by the proportion of normal and complicated deliveries in a hospital (McGinn, 1997). However, the CFR should be interpreted with caution and only in relation to other indicators because the pattern of complications influences the CFR (Pathak *et al.*, 2000). The most commonly used CFR, proposed by WHO/UNICEF/UNFPA calculates the CFR in relation to all obstetric complications admitted in the hospital (UNICEF/WHO/UNFPA, 1997). A level below 1% is the goal for safe-motherhood projects. CFR between 2.2% and 12.8% were observed in Niger and Rwanda. The CFR was 3.8% respective 3.3% in two districts, Kwimba and Missungwi in North-West Tanzania (AMDD, 2003a).

The CFR calculated in relation to a MOI, as we calculated in this study, is expected to be higher than for all obstetric complications. In the study in Mtwara the CFR was 1.4 in urban mothers and 3.5 in rural mothers. A major obstetric intervention indicates the seriousness of the maternal condition. Therefore it is not possible to conclude, that the high rates in Mtwara region indicates poor quality. However, the differences between the hospitals indicate that lower rates are possible. In other UON-studies the CFR for a MOI

has shown a range from very low rates in Pakistan to high rates especially in the rural populations. In Pakistan 7 deaths occurred in a total of 859 MOI in Attock (CFR 0.8%) and 3 out of 1116 MOIs in Jehlum (CFR 0.3%). In Benin, Burkina Faso, Mali and Niger the CFR was 2%, 2.7%, 2%, and 2.2% for the urban and 3.5%, 5.5%, 7.7% and 5.1% in the rural population (UON-network, 2004a, Rehman et al., 2000).

High maternal mortality due to CSs has always been an argument against the uncritical use of CS in childbirth. The maternal mortality after a CS is estimated to range between 0.6 to 5% in African hospitals (Van Roosmalen and Does, 1995, Cisse et al., 1995). In the study in Mtwara, the overall mortality in relation to a caesarean section was 1.2% whereas the rate was low (1 in 261, 0.4%) if the CS was performed for fetal indication (breech, cord prolaps and fetal distress). However, in four cases a hysterectomy was necessary due to complications during a CS. Moreover the analysis in Newala hospital showed that 17% of women developed a complication after a CS.

The findings presented show, that the quality of care is relatively good in Mtwara region compared to other places in Africa. The low case fatality rate in relation to an obstetric intervention and the low mortality due to a caesarean section for non-maternal reasons support this. However, the maternal and perinatal mortality is still too high and the high mortality due to hypertensive disorders in the group of non-AMI interventions, gives an indication that more emphasis needs to be put on the non-surgical management of obstetric complications such as hypertensive disorders, haemorrhage and anaemia.

6.5 Main lessons learned from the UON-study in Mtwara

Distance and access to obstetric care

Despite the relatively high proportion of MOIs per AMIs per EB observed in Mtwara region there are still major deficits of life saving interventions in rural places. There is a clear relationship between the percentage of child-giving mothers having undergone a MOI and the distance to the next hospital up to a distance of 40km. In line with our study results, is seems that the percentage of mothers seeking care in a hospital declines rapidly after 10km and balances out on a plateau up to 50km. Only few women are seeking care from place more than 50-60km from a hospital (Van Lerberghe et al., 1988, Criel et al., 1999). However, the difference in the significance of the Chi-squared test for trend (see table 13) when comparing the UON-indicator and the mean distance to the next hospital

underlines the importance of other factors besides the distance. The availability of transport in remote places or a trunk road with regular traffic, financial access and socio-cultural barrier might play a role (Thaddeus and Maine, 1994, Kowalewski et al., 2000, Airey, 1989, Kowalewski et al., 2002). Financial aspects, especially how to finance emergency transport might be important (Macintyre and Hotchkiss, 1999, Kowalewski et al., 2002, Airey, 1989). The high number of maternal death before any intervention was carried out underlines the importance of timely referral which has also been discussed as one critical factor for maternal health in another study in Tanzania (Urassa *et al.*, 1997).

Maternal and Perinatal mortality

The analysis of the perinatal and maternal mortality in relation to a MOI underlines the need of timely and correct management of obstetric complications. More emphasis has to be put on the management of hypertensive disorders, anaemia and haemorrhage. The importance of maternal complications for child survival are often overlooked. Traditionally, strategies to reduce perinatal and neonatal mortality focus mostly on the treatment of the affected child or primary prevention like family planning (Jones *et al.*, 2003). More emphasis and attention is needed for secondary prevention of perinatal mortality through timely and adequate emergency obstetric care.

6.6 Limitation of the study

The data presented overall gave a relatively complete picture of the MOI and their indications as 94% of CS were documented and CS accounted for more than 90% of all MOI in this study. The data were not complete for blood transfusion as explained above (see 5.3). However, BTs were not included in the estimation of the UON-indicator for comparability reasons. Some discrepancies were also observed between the ruptured uterus reported in the ‘questionnaire for pregnant women ‘and the ‘questionnaire for the health facility’. Despite efforts, the missing cases could not be identified and certain discrepancies remained. This fact demonstrates the general problems of accurate and complete recording which has been described in other UON studies as well (UON-network, 2004a).

The variation of the proportion of indications for MOIs between the 4 hospitals could indicate that especially the indications ‘CPD’, ‘malpresentation’ and ‘2 or more previous CS’ were not always carefully used. Further, CPD could not be verified with help of the partograph. We strongly suspect that the indication CPD still included some cases of

prolonged labour or poor progress due to weak contractions. Therefore the number of MOIs for AMIs per expected births could have been increased. This fact might have contributed to the relative low unmet obstetric need observed in this study compared to other UON-studies in Sub-Saharan Africa. However, the distribution of the indication CPD found in our study is not very different from that found in many other UON-studies. CPD in our study accounted for 61% of AMIs, compared to 55% in Burkina Faso, 55% in Benin, 36% in Niger, and 52% in Mali (UON-network, 2004a).

During the pre-test some limitations in deciding the mother's place of living were discussed. It was estimated that 15% of parturients admitted to the hospital gave an address in town where they had been staying while waiting for the delivery although in fact their habitual place of living was outside town. An additional question to bring light to this assumption was added to the questionnaire. However, the question was hardly ever answered so it was not possible to know the magnitude of this bias. Therefore an overestimation of MOIs for AMIs in urban areas can not be excluded.

Moreover, it can be assumed that mothers sought care outside the regional boundaries especially in the hospitals in the neighbouring Lindi region. The fact that 86 of the 1705 questionnaires for a MOIs for AMI (5%) were filled for mothers that came from outside Mtwara region, mostly from neighbouring Lindi Region, supports this assumption. Thus, the high deficit of MOIs for AMIs especially in Litehu division might be due to the fact that mothers sought care in the nearby Nyangao hospital in Lindi region. To what extent this underestimation occured in other divisions could not be determined. However, it must be assumed that up to 5% of mothers might have sought care in other regions.

The study team was in the favourable situation that in September 2002, three months after the finalization of the study a national census was carried out providing new population data. Therefore is was possible to estimate the expected births on the basis of recent population data (Bureau of Statistics United Republic of Tanzania, 2002).

The reliability and validity of the data on child mortality and maternal morbidity were not assessed. The questionnaires containing cases of a maternal deaths were verified against the reports of the compulsory maternal deaths audits. Moreover the number of maternal deaths were compared with the hospital reports. Thus we know that, the data on the number and reasons of maternal deaths have a reasonable quality.

In summary, the completeness of the data was high, the out-migration can be expected to be not more than 5% and the information on distance and expected births were of good quality. The correctness of the indications was the major weakness of the study and a certain bias leading to too low unmet obstetric need can not be excluded. However, the threshold used was adapted to this bias. We conclude, that the limitations of the study do not have a major influence on the validity of the findings presented before.

7 Conclusions

The study was set up to assess the responsiveness of the health care system to deal with obstetric complication in Mtwara region through a prospective study. The aim was to assess the unmet obstetric need and the feasibility of the data collection as well as the usefulness of the UON-indicator for district planning.

The UON-approach has shown to be feasible to assess of the unmet obstetric need in Mtwara region and thereby to get information on the responsiveness of the health care system to deal with obstetric complications.

The spatial analysis of the UON-indicator at division level gave a good picture of the problem of access in Mtwara region. The study made it possible to identify distance as an important factor for an unmet need, however, an ambulance or a busy trunk road had also a positive effect on rate of MOIs for AMIs. The cut-off value of 2% of MOIs for AMIs per expected births was achieved in 7 out of 20 divisions and another 4 divisions had levels between 1.5% and 2%. Another 3 divisions reached levels above 1% whereas 6 out of the 20 divisions failed to reach a minimum level of 1%. The total unmet need calculated for the two years study period in Mtwara region was 352 MOIs needed to prevent an adverse maternal outcome.

Other aspects of the responsiveness of a health care system to deal with maternal complications are also covered by the UON-methodology. The CFR in relation to a MOI can be used as an indicator for the quality of care (McGinn, 1997). Moreover, our study was able to identify complications that were less likely to get adequate care in a hospital like antepartum bleeding or eclampsia. Differences in the responsiveness of the health care system towards the different type of complications between urban and rural areas were observed. Also, variations in perinatal and maternal mortality in relation to distance, the hospital and obstetric complication have been described.

A positive effect of the study was that recording and defining of indication for a caesarean section improved. Moreover the use of the partogram increased in the hospitals.

Reliability and attainability of the UON-indicator as outlined in the discussion are reasonable. The completeness of the data, the correctness of the recording of interventions, indications as well as the estimation of the distance to the health facility and the correctness of the estimation of the expected birth were of reasonable quality. Therefore

UON-study in Mtwara region was able to meet these criteria of reliability and validity to a high extend although some weaknesses in the indication for the MOI could be assumed.

The UON-indicator is relatively easy to measure. All necessary data were timely and relatively easily attainable through the routine data collection system in the participating hospitals. The study has been done with very limited additional financial resources.

However, as this prospective study showed, timely availability of the data does not necessarily translate into timely availability of the analysis and use of the data for district planning. Data management, analysis and feed-back were the weaknesses of this study. The human resources needed for this were not available at district or regional level. It is against this background that the UON-approach cannot unambiguously be recommended as a continuous monitoring tool. In places were qualified human and financial resources are rare it might be considered to repeated an UON-study in 3 to 5 year intervals with some external support.
However, even taking these limitations into account the UON-approach has been shown to be a very useful monitoring tool for awareness creation, to assess improvements in access to maternity care, the quality of care and the pattern of causes of perinatal and maternal deaths.

There were two major differences in the study design and analysis compared to the original UON-approach proposed by the UON-network: the analysis of the UON-indicator up to division level and the inclusion of BT. Both deviations have shown to be good further development of the approach. The analysis up to division level offers the possibility to get a much better geographical understanding of the UON than the analysis at district level. This extended analysis enables district planners to plan interventions on a detailed information basis and specifically where it is needed. Also, the detailed analysis can help to monitor progress in access to obstetric care.
The inclusion of BT in the list of major obstetric interventions showed that BT are done relatively frequently during late pregnancy and childbirth. Moreover, BTs bearded a high risk of maternal and perinatal mortality. Therefore, much more attention should be given to this live-saving intervention. In a setting where the problem of recording can be overcome, BTs should be included in the list of intervention.

It has been widely argued that after a professional trained birth attendant, a strong referral system is next in importance for the reduction of maternal mortality (Koblinsky *et al.*, 1999, Ronsmans, 2001, Jahn and De Brouwere 2001, WHO, 2004b, Pathmanathan *et al.*, 2003, De Brouwere *et al.*, 1998a). Accordingly, monitoring of interventions to improve referrals is essential. It is against this background that the UON-indicator, especially if the analysis is brought down to smaller geographical areas, could be an important measurement for assessing improvements in referral system as part of the process of improvement of maternal health.

However, one should keep in mind, that the multiplicity of factors in and outside the health system as expressed in the term the 'road to deaths' cannot be fully assessed by this monitoring tool. Therefore, the method can and should not replace perinatal or maternal deaths audits as a quality management tool (WHO, 2004a). Also, other indicators or methods will be needed to assess and monitor improvements in making professional trained birth attendant available at community or first line health facilities level.

In summary, the UON-indicator has proven to be a measurable and attainable and timely available indicator, if good routine recording is established. Only little additional resources have to be made available for data management, analysis and reporting. The method is relevant to detect underserved areas and main causes of perinatal and maternal mortality.

8 Bibliography

AbouZahr, C and Royston, E (1991) *Maternal Mortality: A Global Factbook*, WHO, Genève.

Abu-Heija, A and Jallad, F (1999) Emergency peripartum hysterectomy at the Princess Bafeea teaching hospital in North Jordan. *Journal of Gynaecological Research,* **25,** 193-195.

Airey, T (1989) The impact of road construction on hospital in-patient catchments in the Meru district of Kenya. *Social Science and Medicine,* **29,** 95-106.

Akalin, M, Maine, D, De Francisco, A and Vaughan, R (1997) Why perinatal mortality cannot be a proxy for maternal mortality. *Studies in Family Planning,* **28,** 330-335.

AMDD (2003a) Program note. Using UN process indicators to assess needs in emergency obstetric services: Niger, Rwanda and Tanzania. *International Journal of Gynaecology and Obstetrics,* **83,** 112-120.

AMDD (2003b) Program note: using the UN process indicators to assess needs in emergency obstetric services: Morocco, Nicaragua and Sri Lanka. *International Journal of Gynaecology and Obstetrics,* **80,** 222-230.

Anonymous (2003) *The World Factbook 2003,* www.cia/gov/publications/factbook, assessed 20.01.05.

Bartlett, A, Paz de Bocaletti, M and Bocaletti, M (1993) Reducing perinatal mortality in developing countries: high risk or improved labour management? *Health Policy and Planning,* **8,** 360-368.

Belghiti, A, De Brouwere , V, Kegels, G and Van Lerberghe, W (1998) Monitoring unmet obstetric need at district level in Morocco. *Tropical Medicine and International Health,* **3,** 584-591.

Black, R, Morris, S and Bryce, J (2003) Where are why are 10 million children dying every year? *The Lancet,* **361,** 2226-34.

Bouvier-Colle, M-H, Varnoux, N, Costes, P and Hatton, F (1991) Reasons for the underreporting of maternal mortality in France, as indicated by a survey of all deaths among women of childbearing age. *International Journal of Epidemiology,* **20,** 717-21.

Bureau of Statistics United Republic of Tanzania (2001) Household Budget Survey 2000/01. http://www.tanzania.go.tz, assessed November 2004.

Bureau of Statistics United Republic of Tanzania (2002) Census 2002. Dar-es-Salaam http://www.tanzania.go.tz, assessed November 2004.

Carroli, G, Rooney, C and Villar, J (2001) How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence. *Paediatric and Perinatal Epidemiology 2001,* **15 (Suppl 1),** 1-42.

Chanrachakul, B, Herabutya, Y and Udomsubpayakul, U (2000) Epidemic of cesarean section at the general, private and university hospitals in Thailand. *Journal of Gynaecological Research,* **26,** 357-61.

Cisse, C, Andriamady, C, Faye, O, Diouf, A, Bouillin, D and Diadhiou, F (1995) Indications and Prognosis of cesarean section at Dakar University Hospital Centre. *Journal of Gynaecology Obstetetrics and Biol. Reproduction,* **24,** 194-7.

Criel, B, Van der Stuyft, P and Van Lerberghe, W (1999) The Bwamanda hospital insurance scheme: effective for whom? A study of its impact on hospital utilisation patterns. *Social Science and Medicine,* **48,** 897-911.

De Brouwere , V, Dubourg, F and Van Lerberghe, W (2002) Correspondence: Need for caesarean section in west Africa. *The Lancet,* **359,** 974-975.

De Brouwere , V, Laabid, A and Van Lerberghe, W (1996) Estimation des besoins en intervention obstétricales au Maroc. Une approche fondée sur l'analyse spaciale des déficts. *Revue Epidémiologie et Santé Publique,* **44,** 111-124.

De Brouwere , V, Tonglet, R and Van Lerberghe, W (1998a) Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West? *Tropical Medicine and International Health,* **3,** 771-782.

De Brouwere , V, Tonglet, R and Van Lerberghe, W (1998b) Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West? *Tropical Medicine and International Health,* **3,** 771-782.

De Brouwere, V and Van Lerberghe, W (1998) *Les besoins obtréctricaux non couverts,* L'Harmattan, Paris.

De Jong, P (1987) Trial of labor following caesarean section - A study of 212 patients. *International Journal of Gynaecology and Obstetrics,* **25,** 405-411.

De Muylder, X and Thiery, M (1990) The caesarean delivery rate can be safely reduced in a developing country. *Obstetrics & Gynecology,* **75,** 360-364.

DHS Tanzania (1996) Demographic and Health Survey 1996. http://www.maesuredhs.com, assessed 25.01.05.

Doh, A (1991) A clinical study of caesarean section at the University Teaching Hospital (C.H.U.) Yaounde (1982-1989). *Central African Journal of Medicine,* **37,** 326-328.

Dumont, A, De Bernis, L, Bouvier-Colle, M-H, Bréart, G and group, Ms (2001) Caesarean Section rate for maternal indication in sub-Saharan Africa: a systematic review. *The Lancet,* **358,** 1328-1333.

English, M, Muhoro, A, Aluda, M, Were, S, Ross, A and Peshu, N (2003) Outcome of delivery and cause-specific mortality and severe morbidity in early infancy: A Kenyan district hospital birth cohort. *American Journal of Tropical Medicine and Hygiene,* **69,** 228-232.

Font, A, Gonzalez, M, Nathan, R, Lwilla, F, Kimario, J, Tanner, M and Alonzo, P (2000) Maternal Mortality in a rural district of southeastern Tanzania: an application of the sisterhood method. *International Journal of Epidemiology*, **29,** 107-112.

Francome, C and Savage, W (1993) Caesarean section in Britain and the United States 12% or 24%: Is either the right rate? *Social Science and Medicine,* **37,** 1199-1218.

Gelband, H, Liljestrand, J, Nemer, L, Islam, M, Zupan, J and Jha, P (2002) The Evidence Base For Interventions To Reduce Maternal And Neonatal Mortality In Low And Middle-Income Countries. In *CMH Working Paper Series. WG 5: Paper No 5. Commission on Macroeconomics and Health*WHO, Geneva. Full text at www.cmhealth.org.

Goodburn, E, Hussein, J, Lema, V, Damisoni, H and Graham, W (2001) Monitoring obstetric services: putting the UN guidelines into practice in Malawi. I: developing the system. *International Journal of Gynaecology and Obstetrics,* **74,** 105-117.

Graham, W and Airey, P (1987) Measuring maternal mortality: sense and sensitivity. *Health Policy and Planning,* **2,** 323-333.

Graham, W, Bell, J and Bullough, C (2001) Can skilled attendance at delivery reduce maternal mortality in developing countries. *Studies in Health Service Organization and Policy*, **17,** 97-130.

Graham, W, Brass, W and Snow, R (1989) Estimating maternal mortality: The sisterhood method. *Studies in Family Planning,* **20,** 125-135.

Graham, W and Campbell, O (1992) Maternal Health and the Measurement Trap. *Social Science and Medicine,* **35,** 967-977.

Graham, W, Filippi, V and Ronsmans, C (1996) Demonstrating programme impact on maternal mortality. *Health Policy and Planning,* **11,** 16-20.

Graham, W and Hussein, J (2004) The right to count. *The Lancet,* **363,** 67-68.

Guindo, G, Dubourg, D, Marchal, B, Blaise, P and De Brouwere , V (2004) Measuring unmet obstetric need at district level: how an epidemiological tool can affect health service organization and delivery. *Health Policy and Planning,* **19 (Suppl.1),** i87-i95.

Hanley, J, Hagen, C and Shiferaw, T (1996) Confidence intervals and sample-size calculations for the sisterhood method of estimating maternal mortality. *Studies in Family Planning,* **27,** 220-227.

Hertz, E, Hebert, J and Landon, J (1994) Social and environmental factors and life expectancy, infant mortality, and maternal mortality rates: Results of a cross-national comparison. *Social Science and Medicine,* **39,** 105-114.

Hill, K, AbouZahr, C and Wardlaw, T (2001) Estimates of maternal mortality for 1995. *Bulletin of the World Health Organization,* **79,** 182-193.

Högberg, U and Wall, S (1986) Secular trends in maternal mortality in Sweden from 1750 to 1980. *Bulletin of the World Health Organization,* **64,** 79-84.

Högberg, U, Wall, S and Broström, G (1986) The impact of early medical technology on maternal mortality in the late 19th century in Sweden. *International Journal of Gynecology and Obstetrics,* **24,** 251-261.

Jahn, A, Dar Lang, M, Shah, U and Diesfeld, H (2000) Maternity care in rural Nepal: a health service analysis. *Tropical Medicine and International Health,* **5,** 657-665.

Jahn, A and De Brouwere , V (2001) Referral in pregnancy and childbirth: Concepts and strategies. *Studies in Health Service Organization and Policy,* **17,** 225-242.

Jahn, A, Kowalewski, M and Kimatta, S (1998) Obstetric care in southern Tanzania: does it reach those in need? *Tropical Medicine and International Health,* **3,** 926-932.

Jones, G, Steketee, R, Black, R, Bhutta, Z, Morris, S and BellagioChildSurvivalStudy (2003) How many child deaths can we prevent this year? *The Lancet,* **362,** 65-71.

Klingenberg, C, Olomi, R, Oneko, M, Sam, N and Langeland, N (2003) Neonatal morbidity and mortality in a Tanzanian tertiary care referral hospital. *Annals of Tropical Paediatrics,* **23,** 293-299.

Koblinsky, M, Campbell, O and J, H (1999) Organizing delivery care: what works for safe-motherhood? *Bulletin of the World Health Organization,* **77,** 399-406.

Kowalewski, M, Jahn, A and Kimatta, S (2000) Why do at-risk mothers fail to reach referral level? Barriers beyond distance and cost. *African Journal of Reproductive Health,* **4,** 100-109.

Kowalewski, M, Mujinja, P and Jahn, A (2002) Can mothers afford maternal health care costs? User Costs of maternity Services in Rural Tanzania. *African Journal of Reproductive Health,* **6,** 65-73.

Kusiako, T, Ronsmans, C and Van der Paal, L (2000) Perinatal mortality attributable to complications of childbirth in Matlab, Bangladesh. *Bulletin of the World Health Organization,* **78,** 621-627.

Macintyre, K and Hotchkiss, D (1999) Referral revisited: community financing schemes and emergeny transport in rural Africa. *Social Science and Medicine,* **49,** 1474-1487.

MacLeod, J and Rhode, R (1998) Retrospective follow-up of maternal deaths and their associated risk factors in a rural district of Tanzania. *Tropical Medicine and International Health,* **3,** 130-137.

Maine, D and Rosenfield, A (1999) The Safe Motherhood Initiative: Why Has It Stalled. *American Journal of Public Health,* **89,** 480-82.

Maine, D, Wardlaw, T, Ward, V, McCarthy, J, Birnbaum, A, Akalin, M and Brown, J (1997) *Guidelines for Monitoring the Availability and Use of Obstetric Services,* UNICEF, WHO, UNFPA, New York.

Massawe, S, Urassa, E, Lindmark, G, Moller, B and Nystrom, L (1996) Anaemia in pregnancy: A major health problem with implication for maternal health care. *African Journal of Health Science,* **3,** 126-132.

Massawe, S, Urassa, E, Nystrom, L and Lindmark, G (2002) Anaemia in women of reproductive age in Dar-es-Salaam, Tanzania. *East African Medical Journal,* **79,** 461-6.

Mbaruku, G and Bergström, S (1995) Reducing maternal mortality in Kigoma, Tanzania. *Health Policy and Planning,* **10,** 71-18.

Mbaruku, G, Vork, F, Vyagusa, D, Mwakipiti, R and Van Roosmalen, J (2003) Estimates of Maternal Mortality in Western Tanzania by the Sisterhood method. *African Journal of Reproductive Health,* **7,** 84-91.

McCarthy, J and Maine, D (1992) A Framework for Analyzing the Determinants of Maternal Mortality. *Studies in Family Planning,* **23,** 23-33.

McDonagh, M (1996) Is antenatal care effective in reducing maternal morbidity and mortality? *Health Policy and Planning,* **11,** 1-15.

McGinn, T (1997) Monitoring and evaluation of PMM efforts: what have we learned? *International Journal of Gynaecology and Obstetrics,* **59,** S245-S251.

MoH (2000) Burden of Disease Profile. Dar-es-Salaam.

MoH Tanzania (1997) Strategy for reproductive health and child survival 1997-2001. MoH, Dar-es-Salaam.

Mswia, R, Lewanga, M, Moshiro, C, Whiting, D, Wolfson, L, Hemed, Y, Alberti, K, Kitange, H, Mtaswiwa, D and Setel, P (2003) Community-based monitoring of safe-motherhood in the United Republic of Tanzania. *Bulletin of the World Health Organization,* **81,** 87-94.

Nirupam, S and Yuster, E (1995) Emergency obstetric care: measuring availability and monitoring progress. *International Journal of Gynaecology and Obstetrics,* **50,** S79-S88.

Obed, S, Wilson, J and Elkins, T (1994) Eclampsia: 134 consecutive cases. *International Journal of Gynaecology and Obstetrics,* **45,** 97-103.

Omu, A and Diejmaoch, F (1981) Racial differences in the etiology of abrutio placentae. *International Journal of Gynaecology and Obstetrics,* **19,** 205-210.

Osefu, N (1989) Cesarean and postpartum hysterectomy in Enugu, 1973-1986. *International Journal of Gynaecology and Obstetrics,* **30,** 93-97.

Pathak, L, Kwast, B, Malla, D, Pradhan, A, Rajlawat, R and Campbell, B (2000) Process indicators for safe motherhood programmes: their application and implications as derived from hospital data in Nepal. *Tropical Medicine and International Health,* **12,** 882-890.

Pathmanathan, I, Liljestrand, J, Martins, J, Rajapksa, L, Lissner, C, De Silva, A, Selvaraju, S and Singh, P (2003) *Investing in maternal health. Learning from Malaysia and Sri Lanka,* The World Bank, Washington.

Pittrof, R (1997) Observed versus expected obstetric complications: an assessment of coverage of obstetric care in developing countries. *Tropical Doctor,* **27,** 25-29.

Quedraogo, L, Tal, F, Thieba, B, Traore, G, Derme, Z, Sawadogo, E, Derview, M and Sondo, B (2003) A study of the unmet needs for major obstetric interventions: the experience of Burkina Faso. *Santé,* **13,** 17-21.

Rehman, S, Janjua, T, Farooq, T, Jahn, A, De Muynck, A and in cooperation with the UON Network team (2000) *Unmet Obstetrical Needs in the Districts of Attock & Jhelum, Punjab Province, Pakistan.,* HSA Press, Islamabad.

Ronsmans, C (2001) How can we monitor progress towards improved maternal health goals? *Studies in Health Service Organization and Policy,* **17,** 317-342.

Ronsmans, C, Achadi, E, Gunawan, S, Zazri, A, McDermont, J, Koblinsky, M and Marchall, T (2001) Evaluation of a comprehensive home-based midwifery programme in South Kalimantan, Indonesia. *Tropical Medicine and International Health,* **2001,** 799-810.

Ronsmans, C, Campbell, O, McDermott, J and Koblinsky, M (2002a) Questioning the indicators of need for obstetric care. *Bulletin of the World Health Organization,* **80,** 317-324.

Ronsmans, C, Etard, J, Walraven, G and al., e (2003) Maternal mortality and access to obstetric services in West Africa. *Tropical Medicine and International Health,* **8,** 940-948.

Ronsmans, C, Van Damme, W, Filippi, V and Pittrof, R (2002b) Correspondence: Need for caesarean sections in west Africa. *The Lancet,* **359,** 974.

Ronsmans, C, Vanneste , A, Chakraborty, J and Van Ginneken, J (1998) A comparison of three verbal autopsy methods to ascertain levels and causes of maternal deaths in Matlab, Bangladesh. *International Epidemiological Association,* **27,** 660-666.

Rosenfield, A and Maine, D (1985) Maternal Mortality - A Neglected Tragedy. Where is the M in MCH? *The Lancet***,** 83-85.

Royston, E and Armstrong, S (1990) *La prévention des décès maternels*, WHO, Geneva.

Schuitemaker, N, Van Roosmalen, J, Dekker, G, Van Dongen, P, Van Geijn, H and BennebroekGravenhorst, J (1997) Underreporting of Maternal Mortality in The Netherlands. *Obstetrics & Gynecology,* **90,** 78-82.

Setel, P, Whiting, D, Hemed, Y and Alberti, K (2000) Educational status is related to mortality at the community level in three areas of Tanzania, 1992-1998. *Journal of Epidemiology and Community Health,* **54,** 936-937.

Simbakalia, C, Riwa, P, Kihinga, C, May, A and Goergen, R (1999) Assessment of Quality of Reproductive Health Services in Lindi Region. Ministry of Health/RCH, Reproductive Health Project, Dar-es-Salaam.

Stanton, C, Abderrahim, N and Hill, K (2000) An Assessment of DHS Maternal Mortality Indicators. *Studies in Family Planning,* **31,** 111-123.

Tadesse, E, Adane, M and Abiyou, M (1996) Caesarean section deliveries at Tikur Anbess Teaching hospital, Ethiopia. *East African Medical Journal,* **73,** 619-22.

Tanzania (2004) Filling critical gaps for Mainland Tanzania in the national response to HIV/AIDS in impact mitigation for Orphans & Vulnerable Children, Condom Procurement, Care & Treatment, Monitoring and Evaluation, and National Coordination. Proposal for the Global Fund to fight AIDS, Tuberculosis and Malaria. Fourth call for Proposals. www.theglobalfund.org/search/docs/4TNZH.

Thaddeus, S and Maine, D (1994) Too far to walk: maternal mortality in context. *Social Science and Medicine,* **38,** 1091-1110.

The World Bank (2004) The Millennium Development Goals for Health. Rising the Challenges. Washington.

TRCHS (1999) Tanzanian Reproductive and Child Health Survey 1999. www.measuredhs.com, assessed November 2004.

UNAIDS (2004) Country estimates. www.unaids.org, assessed November 2004.

UNICEF (2004) The State of the world children 2004. www.unicef.org, assessed November 2004.

UNICEF/WHO/UNFPA (1997) Guidelines for monitoring the availability and use of obstetric services. UNICEF, New York.

United Nations (2000) Millennium Development Goals. www.un.org/millennium/declaration, assessed November 2004.

UON-network (1998) Tackling Unmet Obstetric Needs. Part 1: Concepts, General Principles and International Network. http://www.itg.be/uonn/pdf/Guide1.pdf, assessed October 2004.

UON-network (2000) Tackling Unmet Needs for Major Obstetric Interventions. Case Studies. Tanzania. www.itg.be.uonn/pdf/CS_tanzanie_eng.pdf, assessed November 2004.

UON-network (2004a) *Case Reports. Unmet Obstetric Needs Network (CD)*, UON-network, Antwerp.

UON-network (2004b) *Etude comparative international. Unmet Obstetric Needs Network (CD),*, UON-network, Antwerp.

Urassa, D, Carlstedt, A, Nystrom, L, Massawe, S and Lindmark, G (2002) Quality assessment of the antenatal care program for anaemia in rural Tanzania. *International Journal for Quality of Health Care*, **14,** 441-448.

Urassa, E, Lindmark, G and Nystrom, L (1995) Maternal Mortality in Dar-es-Salaam.Tanzania: Socio-oeconomic, obstetric history and accessibility of health care factors. *African Journal of Health Science*, **2,** 242-249.

Urassa, E, Massawe, S, Lindmark, G and Nystrom, L (1997) Operational factors affecting maternal mortality in Tanzania. *Health Policy and Planning*, **1997,** 50-57.

Van der Walt, W, Cronjé, R and Bam, R (1994) Vaginal delivery after one cesarean section. *International Journal of Gynecology & Obstetrics*, **46,** 271-277.

Van Lerberghe, W, Pangu, K and Van den Broek, N (1988) Obstetrical interventions and health centre coverage: a spatial analysis of routine data for evaluation. *Health Policy and Planning*, **4,** 308-314.

Van Roosmalen, J (1989) Perinatal mortality in rural Tanzania. *British Journal of Obstetrics and Gynaecology*, **96,** 827-834.

Van Roosmalen, J and Does, C (1995) Caesarean Birth Rates worldwide. A Search for Determinants. *Tropical and Geographical Medicine*, **47,** 19-22.

Van Roosmalen, J and Van der Does, C (1995) Caesarean birth rates worldwide. *Tropical and Geographical Medicine*, **47,** 19-22.

Walraven, G, Mkanje, R, Van Roosmalen, J, Van Dongen, P and Dolmans, W (1994) Assessment of maternal mortality in Tanzania. *British Journal of Obstetrics and Gynaecology*, **101,** 414-417.

Wardlaw, T and Maine, D (1999) Process Indicators for Maternal Mortality Programmes. Safe Motherhood Initiatives : Critical Issues. In *Reproductive Health Matters 1999*,(Eds, Berer, M and Ravindran, T) Backwell Science LTD, Oxford.

Weiner, R, Ronsmans, C, Dorman, E, Jilo, H and Shulman, C (2003) Labour complications remain the most important risk factors for perinatal mortality in rural Kenya. *Bulletin of the World Health Organization*, **81,** 561-566.

Wessel, H, Cnattingus, S, Dupret, A and Reitmaier, P (1998) Risk factors for perinatal deaths in Cape Verde. *Paediatric and Perinatal Epidemiology 2001*, **12,** 25-36.

WHO (1996) *Mother-Baby-Package,* Maternal Health and Safe Motherhood Programme, WHO, Geneva.

WHO (2001) Reproductive Health Indicators for Global Monitoring. Report of the Second Interagency meeting. Department of Reproductive Health and Research, WHO, Geneva.

WHO (2003) World Health Report 2003. www.who.int/whr/2003, assessed August 2004.

WHO (2004a) *Beyond the Numbers. Reviewing maternal deaths and complications to make pregnancy safer*, Department of Reproductive Health and Research. WHO, Geneva.

WHO (2004b) Making pregnancy safer: the critical role of the skilled attendant. A joint statement by WHO, ICM and FIGO. Making pregnancy Safer. Department of Reproductive Health and Research, Geneva.

WHO (2004c) Maternal Mortality in 2000: Estimates developed by WHO, UNICEF, UNFPA. Department of Reproductive Health Research, Geneva.

WHO (2004d) *The World Health Report 2004. Changing history.*, World Health Organisation, Geneva.

WHO (2005) *The World Health Report 2005-make every mother and child count,* http://www.who.int/whr/2005/, assessed April 2005.

WHO and UNFPA (2004) *Measuring access to Reproductive Health Services. Summary Report of a WHO/UNFPA Technical Consultation 2-3 December 2003,* Department of Reproductive Health and Research, WHO, Geneva.

Yu, V (2003) Global, regional and national perinatal and neonatal mortality. *Journal of Perinatal Medicine,* **31,** 376-379.

9 Annexes

Figure 12: Estimated distance of mother's home to hospital

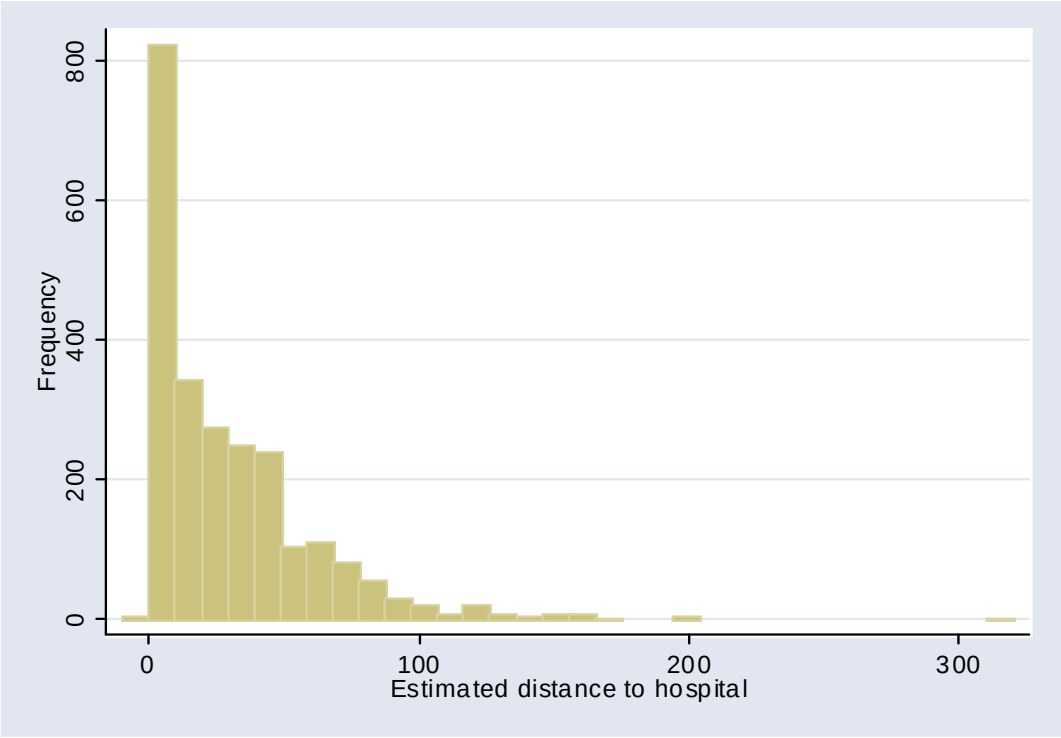


Table 15: Distribution of Interventions according to hospitals

	Mtwara Region		Mtwara Hosp.		Newala Hosp.		Ndanda Hosp.		Masasi Hosp		Chi-squared test p-value *
	No	*%*	No	*%*	No	*%*	No	*%*	No	*%*	
CS	2185	***90.9***	667	***88.3***	649	***95.6***	394	***83.8***	475	***95***	<0.000 / 0.716
Blood Transf.	119	***5.0***	53	***7.0***	4	***0.6***	60	***12.8***	2	***0.4***	<0.000
Lap-tomy for Repair of Uterus	46	***1.9***	23	***3.0***	7	***1.0***	4	***0.9***	13	***2.6***	0.010 / 0.009
Hysterectomy	32	***1.3***	5	***0.7***	17	***2.5***	6	***1.3***	4	***0.8***	0.013 / 0.020
Destr. Operat.	2	***0.1***	1	***0.1***	1	***0.1***	0	***0.0***	0	***0***	0.714 / 0.724
Others	4	***0.2***	0	***0***	0	***0***	3	***0.6***	1	***0***	
without int.	2	***0.1***	1	***0.1***	0	***0***	2	***0.4***	0	***0***	
Died before int.	14	***0.6***	7	***0.9***	1	***0.1***	1	***0.2***	5	***1***	
Total	2404	***100***	757	***100***	680	***100***	470	***100***	500	***100***	

* with and without taking blood transfusion into account

Table 16: Distribution of absolute maternal indication for major obstetric interventions according to the hospitals

	Mtwara Region N= 1700	Mtwara Regional Hosp N=547	Newala District Hosp N=551	Masasi District Hosp N=351	Ndanda Mission Hospital N=251	p-value Pearson Chi-squared-test
CPD	65.4	51.7	83.5	55.8	68.9	<0.001
2 or more CS	11.7	19.7	4.1	12.3	10.4	<0.001
Malpresentation	11.3	14.8	4.2	18.1	10.4	<0.001
APH	7.5	9.9	4.9	9.1	5.6	0.006
Uterus rupture	3.7	4.2	3.3	4.0	3.2	0.814
Severe anaemia	0.3	0.4	0.2	0	0.8	0.317
Puerp. infection	0.1	0	0	0	0.8	0.009

Table 17: Distribution of absolute maternal indication for major obstetric interventions according to urban/rural

	Urban (</=10km) N=669	Rural (>10km) N=1027	Total N=1696 *	p-value Pearson Chi-squared-test
CPD	64.9	65.7	65.4	0.718
2 or more CS	12.3	11.3	11.7	0.546
Malpresentation	13.6	9.8	11.3	0.017
APH	6.7	8.0	7.5	0.336
Uterus rupture	2.1	4.8	3.7	0.004
Severe anaemia	0.3	0.3	0.3	0.98
Puerp. infection	0.2	0.1	0.1	0.76

*** 4 data missing for urban/rural differences**

Table 18: Distribution of all non-absolute maternal indications according to hospital

	Mtwara Region		Mtwara Regional Hosp		Newala District Hosp		Masasi District Hosp		Ndanda Mission Hospital	
Fetal Distress	181	***32.9***	46	***32.4***	40	***33.1***	65	***48.9***	30	***19.5***
Hypert. Dis.	71	***12.9***	33	***23.2***	9	***7.4***	16	***12.0***	13	***8.4***
Breech	39	***7.1***	9	***6.3***	18	***14.9***	2	***1.5***	10	***6.5***
Cord Prolaps	40	***7.3***	14	***9.9***	9	***7.4***	10	***7.5***	7	***4.5***
Others	219	***39.8***	40	***28.2***	45	***37.2***	40	***30.1***	94	***61.0***
Total	550	***100***	142	***100***	121	***100***	133	***100***	154	***100***

Table 19:Maternal outcome according to urban/rural differences

	Urban (<10km) N=971	Rural (>10km) N=1427	Total N=2398	p-value Pearson Chi-squared-test
Uncomplicated delivery	90.2	84.7	86.9	<0.000
complication	6.2	10.4	8.7	<0.000
Mother died	1.4	3.5	2.7	0.002

Table 20: Distribution of maternal deaths according to place of living

Mtwara urban	Average distance from hospital	Population	Exp. Births EP	Maternal Deaths	MD /100000 exp. Births
Mtwara urban	7	92602	7408	15	203
Mtwara Rural					
Kitaya	30	38067	3045	2	66
Ziwani	15	41374	3310	7	212
Dihimba	33	19416	1553	3	193
Mpapura	30	25073	2006	2	100
Mayanga	19	17006	1360	2	147
Nanyamba	47	63834	5107	4	78
Tandahimba					
Mahuta	25	73351	5868	1	17
Namikupa	45	85758	6861	2	29
Litehu	55	45539	3643	0	0
Newala					
Newala	13	101039	8083	1	12
Kitangari	30	51960	4157	4	96
Chilangala	40	30931	2474	2	81
Masasi					
Lisekese	20	188386	15071	4	27
Nanyumbu	45	61633	4931	1	20
Chiungutwa	25	34931	2794	4	143
Nakopi	70	31593	2527	1	40
Mchauru	28	29765	2381	2	84
Lulindi	20	30364	2429	0	0
Chikundi	15	65901	5272	2	38

Table 21: Unmet obstetric need in the 20 divisions

Division	Mean distance from hospital km	Population	Expected birth	Expected MOI for AMI	MOI for AMI (without BT) performed	Absolute deficit /**relative deficite**	% of MOIs per AMIs per expected births
Mtwara urban	7	92602	7408	148 0	242	(Surplus 94) 0	3.3
Mtwara Rural				0		0	
Kitaya	30	38067	3045	61	25	36 / **59%**	0.8
Ziwani	15	41374	3310	66	92	(Surplus 26)	2.8
Dihimba	33	19416	1553	31	16	15 / **48%**	1.0
Mpapura	30	25073	2006	40	46	(Surplus 6)	2.3
Mayanga	19	17006	1360	27	26	1 / **4%**	1.9
Nanyamba	47	63834	5107	102	83	19 / **19%**	1.6
Tandahimba							
Mahuta	25	73351	5868	117	120	(Surplus 3)	2.0
Namikupa	45	85758	6861	137	143	(Surplus 6)	2.1
Litehu	55	45539	3643	73	4	69 / **95%**	0.1
Newala							
Newala	13	101039	8083	162	197	(Surplus 35)	2.4
Kitangari	30	51960	4157	83	52	31 / **37/**	1.3
Chilangala	40	30931	2474	49	18	31 / **64%**	0.7
Masasi							
Lisekese	20	188386	15071	301	278	22 / **7%**	1.9
Nanyumbu	45	61633	4931	99	33	66 / **67%**	0.7
Chiungutwa	25	34931	2794	56	38	18 / **32%**	1.4
Nakopi	70	31593	2527	51	19	32 / **62%**	0.8
Mchauru	28	29765	2381	48	15	33 / **69%**	0.6
Lulindi	20	30364	2429	49	48	1 / **2%**	1.99
Chikundi	15	65901	5272	105	101	4 / **4%**	1.9

Figure 13: Percentage of MOIs for AMIs per expected births including confidence intervals in the 20 divisions of Mtwara Region

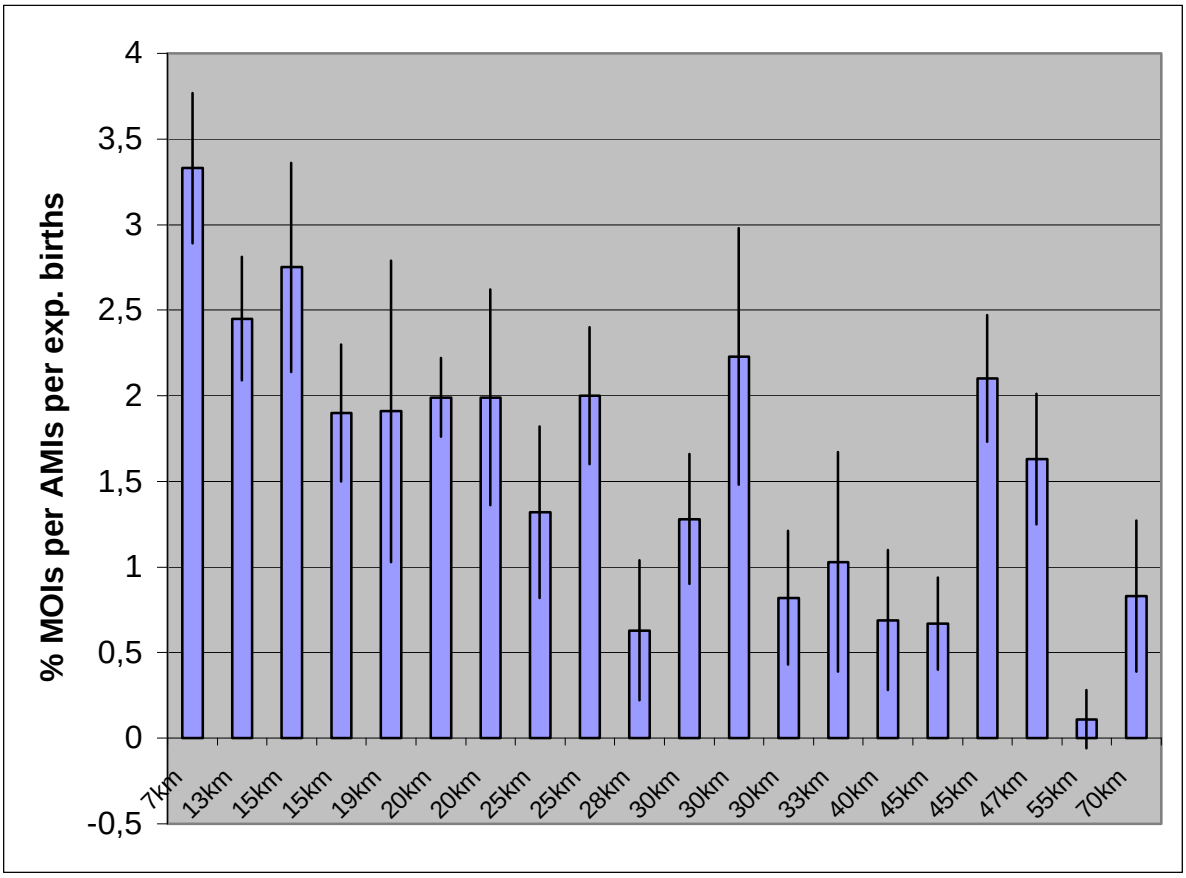


Table 22: Comparison of indications per expected birth in the different UON-studies

	Malpresentation *		APH		CPD		ruptured Uterus		PPH & severe Haemorrhage	
England low end		0.4		0.5		1				
England high end		0.4		1		1.5				
UON-Mtwara	203	0.22	130	0.14	1109	1.23	68	0.08	34	0.04
UON-Benin	199	0.22	148	0.16	544	0.59	89	0.10	13	0.01
UON-Burkina	117	0.08	45	0.03	346	0.24	103	0.07	19	0.01
UON-Mali	518	0.11	435	0.09	1411	0.30	301	0.06	43	0.01
UON-Niger	258	0.04	334	0.06	500	0.08	276	0.05	13	0.00
UON-Pakistan	81	0.08	144	0.14	527	0.53	8	0.01	21	0.02
UON-Haiti	70	0.09	113	0.14	279	0.35	6	0.01	17	0.02

*for the UON-study in Mtwara also malpositions were included.

9.1 Data Collection I

Questionnaire for "Health facility"

1. Identification of the Health facility

(1) Region: ……..

(2) District: ……

(3) Name of the hospital:……..

2. Type of the hospital

(1) Public district hospital
(2) Designated district
(3) Private hospital / Mission hospital
(4) Public Regional Hospital

3. Category of the hospital

(1) Regional hospital
(2) District hospital
(3) Municipal hospital
(4) Others specify

Material Resources

4. Number of maternity bed (labour, antenatal, postnatal):……

5. Number of gynecological beds: …….

6. Total number of beds: ……

7. Number of operating theatres: ……

8. Number of operating theatres reserved for obstetrics: ……..

9. Number of functional vacuum extractors (mechanical): ……..

10. Number of functional vacuum extractors (electrical):……

11. Number of functional forceps: ……

12. No. of cares available for patients transfer:…….

(1) Ambulance

(2) Landrover

(3) Pickup

Human Resources MEDICAL: Year ……2000-2001

	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
13. Number of gynecologists (specialists):												
14. Number of surgeons (specialists):												
15. Number of medical offices (MD):												
16. Number of Assistant Medical Offices (AMO):												
17. Number of Clinical Officers (CO):												

Midwifes:

	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
18. Number of trained midwifes:												
19. Number of Public Health, Nurse B:												
20. Number of MCH-AIDS (MCHA):												
21. Number of nursing assistants (NA):												

Activity of the Health facility: (per annum)
(Period from _____ dd/mm/yy to _____ dd/mm/yy

22. Number of admissions to maternity unit:……..

23. Total number of deliveries:……...

24. Number of normal delivery:…….

25: Number of vaginal operative deliveries:……..

26. Number of Caesarean sections: ……

27. Number of live births:

28. Number of stillbirths

1. Fresh SB: ……

2. Macerated SB: ……

29. Number of ruptured uterus:…….

1. Prior to admission
2. After hospital admission

30. Number of maternal deaths: ……

31. Form completed by: ……

32. Date of completion of questionnaire: dd/mm/yy: ……

Check by coordinator: (District) ……..

Results:

1) Questionnaire completed
2) Questionnaire not completed

9.2 Data Collection II

I. Questionnaire for pregnant women:

This questionnaire will be filled for EVERY WOMEN who has undergone a major obstetric intervention, and for every pregnant women who died before undergoing one of the intervention listed as major.

1. Name of the Region: ……

   (1) Tanga
   (2) Mtwara

2. Name of the District: ……

   (1) Tanga municipality
   (2) Lushoto
   (3) Muheza
   (4) Mtwara urban
   (5) Mtwara rural
   (6) Masasi
   (7) Newala

Identification of the women:

3. Name of the women:……

4. Year of birth:……

5. Date of admission:……

6. Admission number:……..

7. Address/residence:……ward……

   (1) Division (Tarafa):.....
   (2) Ward (Kata):.....
   (3) Village (Kijiji):.....
   (4) Street (Mtaa):……

8. Type of residence during the last week before admission to the hospital:……..

(1) Urban
(2) Rural
(3) Unknown

9. Estimated distance of place of residence to the hospital …….. km
   - Mean of transport to the hospital …….
   - Any obstacles to reach the hospital ……

10. Major obstetric intervention ……. Date_____dd/mm/yy

11. Type of intervention (MOI) (More than one intervention possible)

    (1) Caesarean Section
    (2) Hysterectomy
    (3) Laparotomy for repair of ruptures uterus
    (4) Blood transfusion
    (5) Destructive operations
    (6) Other (specify)…….

12. Indication for interventions (AMI)

    (1) Uterus rupture
    (2) CPD
    (3) Antepartum haemorrhage
    (4) Postpartum Haemorrhage
    (5) Two or more prev. CS
    (6) Puerperal infection
    (7) Severe anaemia (HB < 6g/dl)
    (8) Malpresentation (specify):……
    (9) Others (see no.13)

13. Other indications for intervention:

    (1) Hypertensive disorder/eclampsia
    (2) Cord prolaps
    (3) Breech presentation
    (4) Foetal distress
    (5) Diabetes mellitus
    (6) Others specify: ……..

14. Outcome of the baby: ……..

(1) Born alive and discharged alive
(2) Stillborn
(3) Born alive and died within 24 hours
(4) Born alive and died < 24 hours ≤ 7days
(5) Not recorded

15. Outcome of the mothers:……..

(1) Normal delivery
(2) Developed a complication (see no. 16)
(3) Referral to another hospital
(3) Died (see 16 and 17)

16. Type of complication in the mother:……..

17. (Maternal death) mother who died when did it occur? …….

(1) Before intervention
(2) During intervention
(3) After intervention
(4) Not recorded

18. Cause of maternal death: …….

(1) Hypertensive disorders
(2) Haemorrhage
(3) Infection
(4) Anaesthetic complication
(5) Severe anaemia
(6) Others (specify)
(7) Unknown

19. Date of discharge or deaths: …….

20. Form completed by:……...

21. Date of completion of questionnaire: …….

22. Check by coordinator: (District) ……

9.3 Data Collection III

SUMMARY SHEET FOR MOI FOR AMI

(to be filled by each district hospital) - weekly

1. Name of the district
2. Name of the hospital
3. Period from: to

Form for collection of data

No°	Admission number	OK	Indication (AMI)	Area of origin (urban/rural)	Result for the mother			Result for children		
					OK	Died	Complication	OK	Stillbirth	Died <24h

9.4 Problems encountered with the 'questionnaire for women'

- What could be done to improve this type of questionnaire ?

The used 'questionnaire for women' has shown to appropriate for the data collection. Most questions were filled accurately. The following paragraph will discuss the questions in detail to give information about strengths and weaknesses of this data collection tool. One could also consider to add a question for parity and for education as these two variables are known risk factors for obstetric complication. However, this study did not aim to analyse risk factors but one might consider these two variables as advantageous in future UON-studies.

The first two questions of the questionnaire were the ***'Name of the Region'*** and the ***'Name of the district'*** (see 'questionnaire for women' in annex). The question ***'Name of the district'*** was not understood in the same manner by everybody. It was not clear whether the name of the district referred to the place were the hospital was located or the location of the mothers home village. Moreover, a question to identify the hospital carrying out the major obstetric intervention was missing. In one district in Mtwara region (Masasi district) two hospitals were performing MOIs. For the data analysis the problem could be overcome as it was known from which hospital the questionnaires were collected and an identification variable was added to the data bank.

In most questionnaire the questions '***name of the mother'***, '***date of admission'*** and '***admission number'*** were filled as requested. This was especially helpful in cases where the questionnaire was not complete and it was often possible to find the missing data retrospectively in the hospital registers. Double recording could also be identified.

In the questionnaire ***'year of birth'*** (Question 4) was recorded. However, the registration books in Tanzania are recording the <u>*age*</u> of the mother. In cases where more than one questionnaire was filled for one women, differences in the year of birth, due to calculation error, were observed. It would therefore have been advisable to use the age of the mother and not the year of birth as this is in line with the routine recording.

The question number 7 was '***Address/Residence'*** of the mothers. 'Division', 'ward', 'village' and 'street' were requested following the administrative division in Tanzania. However, in many questionnaires the variables division or ward were missing. For the analysis at the division level (as carried out for this study) the villages were identified in detailed maps of the districts and the division was determined.

The question 8 '***Type of residence during the last week before admission'*** was added to the questionnaire after the experience of the pre-test to get information about women that stay with relatives or friends near a hospital during the last days before the expected delivery. Unfortunately the question was often not filled.

Moreover, the results from question 8 'Type of residence' and question 9 '***estimated distance of place of residence to the hospital'*** often did not tally with the definition of rural/urban. For the study design a clear definition of urban/rural was made. Every place not more than 10km from the hospital was defined to be urban and places more than 10km to be rural. Women living not more than 10km from a hospital in Newala and Chikundi division live in a already very rural environment. Thus the answer to question 8 was in these cases 'rural' but the estimated km were given at only 5 km. For the analysis, it might be better to ask only for the distance and not for the more qualitative question 'type of residence'.

Moreover, estimates of distances from the place of residence were a major problem. Many data were missing. The distance was often estimated in miles instead in kilometres or the estimated distance did not correspond at all to the true distance when checked with maps.

The discussion with the responsible personnel in the delivery ward for filling the questionnaire disclosed a major deficit in knowledge of the geographical situation. The staff in the delivery ward is never involved in any supervision activities and maps showing the geographical situation and indicating the location of dispensaries and health centres are not available for this staff. As a result the maternity staff did not know how far health facilities are and how difficult or easy access is. Only drivers seems to have good knowledge of distances.

Missing data for question 8 and 9 were estimated by identification of the mothers home village on maps. The results were checked by working with an experienced driver born in Mtwara region.

To overcome this problem it would be recommendable to make maps showing dispensaries and health facilities available at the start of a study. In addition a table showing distances between the health facility and the hospital could be worked out. This would also make the staff to get a better idea of the problem of access.

The question 10 '***Date of Major Obstetric Intervention'*** did not pose any problem and was always filled correctly.

Question 11 covered the ***'Type of interventions'***. For some patients more than one intervention was performed e.g. a CS followed by hysterectomy because of ruptured uterus. The problem of recording two, very seldom three interventions were discussed only after the first analysis. It was decided to use only the intervention with the greatest impact on the mothers health.

Question 12 covered the ***'Indication for the intervention (AMI)' and 'Indication for Intervention (Non-AMI)'***. For all absolute maternal indications a clear definition was set at the beginning of the study. However, the questionnaire did not contain these definitions and the responsible persons in the delivery wards had forgotten them over time. Therefore, it must be assumed that three of the absolute maternal intervention were not always used correctly. ***'CPD'*** was the most commonly recorded indication. There was no question about whether the indication was proven by a partograph or not. Having this would be advisable for another UON-study. Also, it would be good to include indications like prolonged labour or weak contractions in the second list of Non-Absolute Maternal Indications. The other critical indication was ***'malpresentation'***. It would be advisable to use a clearer definition of malpresentation like 'transverse lie, brow & shoulder presentation'. It also might be better to include another option like 'malposition' including face to pubis-position (OPP) to encourage the one filling the questionnaire to exclude this indication from the number of true 'malpresentation'.

The differences between the hospitals in the percentage of interventions done for ***'2 or more previous CS'*** (between 3% to 18%) suggest that there is also problem with this indication. One hospital, for example, used this indication but changed to *one* previous CS. Therefore it was possible to take out these cases and to add them under others in the list of Non-AMIs. For comparison it would be better to get only the cases where a CS had been done after 2 or more previous CS. One could be much more confident that only cases with 2 or more previous CS are found in this indication if there would have been another option in the list of Non-AMIs like e.g. 'one previous CS and failed trial of labor'.

In question 14 the ***'Outcome of the baby'*** was asked for. This question did not pose much problem except with cases where a blood transfusion was carried out during pregnancy or twins were born. The protocol, set up at the beginning of the study, did not give any instructions on how to deal with these situations and also no second variable to add information about the outcome of a second twin was included in the questionnaire for women. However, in some cases this information was added in handwriting.

The question 15 ***'Outcome of the mother'*** posed problems. The term 'normal delivery' was misleading. The questionnaire aimed at getting information about mothers that got a MOI for different reasons and complications. Therefore not one of the mothers had a 'normal delivery'. It would have been better to ask for 'normal recovery' or 'no further complication' than using the questionable term 'normal delivery'. In a result of this, many results for this question were missing in one hospital. After discussion with the responsible person in this hospital it became clear, that all questionnaires without a tick in the field (2), (3) or (4) were in fact mothers that were discharged without further complication and the analysis was done accordingly.

The questions 17, 18 and 19 ***'Type of the complication'***, ***'When did the maternal death occur'*** and '***Cause of Maternal Death'*** did not pose any problems. Also the ***'Date of discharge'*** and the signatures of the responsible person in the delivery ward were almost always correctly filled.

As indicated it was possible to overcome many of the problems encountered with the questionnaire for women with some extra efforts. However, changes in line with what has been demonstrated above would be useful if a similar study was to be conducted in Tanzania or elsewhere. However, overall, the 'questionnaire for women' has shown to be a good data-collection tool for the hospitals of Mtwara region.

9.5 Declaration of original work

This thesis is the result of independent work of mine. Where my work is indebted to the work of others, I have made acknowledgements.

I declare that it has not been already accepted for any other degree, nor it is currently submitted in candidature for any other degree.

_____

Claudia Hunger

9.6 Acknowledgements

This study was outlined in collaboration with the Department for Obstetric Care of the Muhimbili University, Dar-es-Salaam, the Institute of Hygiene and Tropical Medicine, Heidelberg, Germany and the German Agency for Technical Cooperation (GTZ). GTZ financed data collection and data entry of this UON-study through its Tanzanian German Programme to Support Health (TGPSH).
The study was part of a series of UON-exercises stimulated by the UON-network, which was created in 1998 (www.uonn.org). The Department of Public Health of the Institute of Tropical Medicine of Antwerp provided technical back up for the planning phase of this study.

My special thanks go to the four coordinators in participating hospitals, Mrs C. Amuli, Masasi district hospital Mkomaindo, Mrs H. Kitundu, Regional Hospital Ligula in Mtwara, Mrs H. Vatenda, Newala district hospital, and Mrs F Chikawe and R Arope, Ndanda Mission hospital. Without the major efforts of the four coordinators in the hospitals, this study would not have had the strength of completeness.
I also would like to express my sincere gratitude to Professor Siriel Massawe, the national coordinator of the UON-study. Her comments and knowledge of the Tanzanian situation of maternal health added a lot to this study. Also I would like to thank Mrs Kitundu and Dr. Kivo, the two regional coordinators of the UON-study in Mtwara region. Many thanks also to staff of the gtz office in Lindi for their help to identify the home villages of many mothers and to complete therewith the variable distance to the hospital.

I would like to thank my son Pablo for his help to map the results of the UON-indicator and my husband Stefan Hanson for his comments and corrections for the write-up of this thesis. Also, I would like to thank Dr. Rainer Külker, the coordinator for the UON-study in Tanga, Tanzania. He involved me in this study during my time I worked in the neighbouring Lindi region for DED. I also would like to thank Mr. Dietz, Department of Epidemiology and Social Medicine, Charité, Berlin who helped me to transfer the data into Stata Version 8 for the statistical analysis.

Finally I would like to express my sincere gratitude to my thesis tutor Dr. Albrecht Jahn for his guidance, intense discussion and support for the analysis and thesis writing.

9.7 CV

CURRICULUM VITAE

Name:	Dr. Claudia Hunger
Date of Birth:	25 September 1964
Nationality:	German
Civil Status:	married to Stefan Hanson
Address:	Neustrasse 1, 52066 Aachen, Germany and c/o S. Hanson, Karlavägen 55, 11449 Stockholm claudiahunger@aol.com
Profession:	Medical Doctor

Education:

June 2000	Specialisation in Gynaecology and Obstetrics Ärztekammer Nordrhein (Medical Board Nordrhein), Germany
April 1999	MD Thesis (Grade very good) Title: "The Quality of Family Planning Services in Douala, Cameroon" University of Giessen, Germany in co-operation with the German Technical Cooperation GTZ (Supervisor Prof. Korte), Eschborn, Germany
Oct 1993	Medical Degree, University of Giessen, Germany
since September 2004	Humboldt University, Berlin (TropEd) Candidate for Master in International Health
since September 2003	London School of Hygiene and Tropical Medicine Candidate for Diploma in Epidemiology: Principles and Practise (Distance Learning)

Employment Record:

29.06.03-4.07.03 & 28.08-10.09.03	German Technical Cooperation (GTZ); Short Term Consultant Support of STI/HIV/AIDS prevention activities in Lindi Region, Tanzania
01.01.2001-31.05.03	Deutscher Entwicklungsdienst (DED) Coordinator and Advisor Reproductive Health, Lindi Region,
01.05.97-30.04.99 & 01.11.99-30.12.01	Department of Gyn & Ob, Allgemeines Krankenhaus Viersen Registrar (Assistenzärztin)
01.05.99-30.10.99	Maternité Regionale Université Nancy, France Registrar (Faisant Fonction Interne)
1.07.96-30.04.97	Ev. Krankenhaus Lütgendortmund Senior House officer (Assistenzärztin)
15.09.95 – 15.03.96	German Technical Cooperation GTZ, Research assistant, Field study about the quality of family planning services in Douala, Cameroon and KAP-study about family planning
01.12.93-30.06.95	Kreiskrankenhaus Ziegenhain and Braunfels Junior House Officer (Ärztin im Praktikum)
July to October 1992 & November 1993	German Technical Cooperation GTZ Short Term Consultant, Assistance to the family planning unit of the division of health, population and nutrition

01.02 – 30.06.1992	German Technical Cooperation GTZ, Trainee, Assistance to the family planning unit of the division of health, population and nutrition

Publications

Hunger C, Korte R. Die Qualität der Familienplanungsdienste in Douala, Kamerun. In: Curare 1997; 20,2:137-143

Hunger, C. Ludwig B. 'Familienplanung und Bevölkerungspolitik ' Archives of Gynecology and Obstetrics 1999;263,2:541-42

Hunger C, Unkels R, Volz J. Frauengesundheit in Entwicklungsländern. Frauenarzt, 2001;52: 591-593

Hunger C, Ring A. Hühnerknochen im Uterus – eine ungewöhnliche Ursache von Sterilität. Zentralblatt für Gynäkologie 2001;123: 604-606

Goergen R, A. Mohamed, E. Mhando, C. Hunger, A. Mlay. Artisanal and small-scale mines: ticking bombs in need of workplace HIV/STI interventions. Sexual Exchange 2001/4

(Gtz internal publications
Hunger C, Brandrup-Lukanow A, Fischer C. Auswertung des Fragebogens zu Familienplanungskomponenten in Gesundheitsprojekten der Abteilung 412 'Gesundheit, Bevölkerung und Ernährung'. GTZ, Eschborn, 1992.

Hunger C, Brandrup-Lukanow A, Fischer C. Partners in family planning services. A questionnaire survey on NGO activities. Health, Population and Nutrition Division, GTZ, Eschborn, 1992

Matt C, Brandrup-Lukanow A, Hunger C. Community Based Family Planning Services in sub-Saharan Africa. A review of programmes in 29 countries. Health, Population and Nutrition Division, GTZ, Eschborn, 1992.)