

Division of Global Health (IHCAR)
Department of Public Health Sciences, Karolinska Institutet
Stockholm, Sweden

Task-shifting of major surgery to midlevel providers of health care in Mozambique and Tanzania

**- a solution to the crisis in human resources to
enhance maternal and neonatal survival**

Caetano Pereira



**Karolinska
Institutet**

Stockholm 2010

All previously published papers were reproduced with permission from the publishers.

Published by Karolinska Institutet. Printed by Universitetservice US-AB

© Caetano Pereira, 2010
ISBN 978-91-7409-826-6

ABSTRACT

Background: Task-shifting, using non-physician clinicians (NPCs) to perform major surgery in obstetric emergencies is common, though still controversial, in Africa to overcome the crisis of human resources for health.

Aim: To describe the extent to which NPCs in Mozambique and Tanzania contribute to surgical skills to enhance maternal survival. More specifically the focus is on “met need” of emergency obstetric care and on the outcome of major obstetric surgery in the two countries.

Setting: Hospitals with operation theatres in Mozambique and in Kigoma and Mwanza in Tanzania.

Methods: Hospital records of all deliveries in Maputo Central Hospital during one year were reviewed to assess the outcomes of major obstetric surgery performed by specialists and (técnicos de cirurgia, TCs) (study I). The cost of training and deploying the two cadres of health workers were derived from budget reviews, annual expenditure reports, enrolment registers, accounting statements from training institutions and interviews with directors and administrators (study II). Productivity estimates were based on a hospital survey of physicians and TCs. Cost per major obstetric surgical procedure over 30 years was estimated in 2006 US dollars. In study III, hospital records of all deliveries in 2003 at rural, district, provincial and central hospitals with a theatre were reviewed to determine who was responsible for treatment and outcome for the mother comparing TCs and medical officers. Graduates in the classes of 1987, 1988, and 1997 from the Mozambican medical school and the institute training TCs were traced and interviewed, to determine where they were initially assigned and where they were working two and seven years after graduation. A qualitative study to elucidate attitudes and opinions on the work carried out by TCs was undertaken among health staff (study IV). In studies V and VI all hospitals records in Kigoma and Mwanza regions during four months (2003) were followed prospectively to elucidate the activities in obstetric surgery carried out by assistant medical officers (AMOs).

Results: There were no clinically significant differences in the outcomes of 2,071 consecutive caesarean sections performed in the two groups (TCs and specialists) at Maputo Central Hospital (study I). The cost-effectiveness of TCs performing obstetric surgery, over a calculated lifetime, was three times more favourable for TCs than for medical officers (study II). In 2002, TCs performed 57% of the 12,178 operations for either a caesarean section, ruptured uterus or ectopic pregnancy for all hospitals with a theatre in Mozambique.. In rural (district level) hospitals, they performed 92% of 3,246 operations for these conditions. In provincial and general (urban) hospitals, they performed 34% of 4,175 such operations; and in the three central hospitals, they performed 53% of 4,757. Among medical doctors from the three graduated classes, none remained after seven years, whereas 88% of the TCs were still located at their original post (study III). Health staffs recognize with satisfaction that TCs alleviate the burden for medical officers resulting in a reduction of the need for patient referrals with cost reduction for patients. Important problems remain in the professional status and remuneration of TCs (study IV). UN process indicators calculated in all hospitals in Kigoma and Mwanza regions of Tanzania indicate that there are no significant differences between AMOs and MOs (studies V and VI).

Conclusion: TCs and AMOs carry most of the burden of emergency obstetric surgery in Mozambique and Tanzania. The quality of work is comparable to that of medical officers. In Mozambique they are cost-effective and their retention in rural areas, where they are needed most, reaches almost 90% at seven years after graduation while the corresponding percentage for medical officers is zero.

LIST OF PUBLICATIONS

This thesis is based on the following papers:

- I. Pereira C, Bugalho A, Bergström S, Vaz F, Cotiro M. A comparative study of caesarean deliveries by assistant medical officers and obstetricians in Mozambique.
Brit J Obst Gyn 1996; 103:508-512
- II. Kruk ME, Pereira C, Vaz F, Bergström S, Galea S. Economic evaluation of surgically trained assistant medical officers in performing major obstetric surgery in Mozambique.
Brit J Obst Gyn 2007; 114:1253-1260
- III. Pereira C, Cumbi A, Malalane R, Vaz F, McCord C, Bacci A Bergström S. Meeting the need for emergency obstetric care in Mozambique: work performance and histories of medical doctors and assistant medical officers trained for surgery.
Brit J Obst Gyn 2007; 114:1530–1533
- IV. Cumbi A, Pereira C, Vaz F, McCord C, Bacci A, Bergström S. Major surgery delegation to mid-level health practitioners in Mozambique: health professionals' perception.
Human Resources for Health 2007;5:27-36
- V. Pereira C, Mbaruku G, Nzabuhakwa C, Bergström S, McCord C. Emergency obstetrical surgery by non-physician clinicians in Tanzania: an inventory of 38,758 deliveries.
Int J Gyn Obstet, accepted for publication 2010.
- VI. McCord C, Mbaruku G, Pereira C, Nzabuhakwa, Bergström S. The Quality of Emergency Obstetrical Surgery By Assistant Medical Officers In Tanzanian District Hospitals.
Health Affairs 2009; 28:876-85

The papers will be referred to by their Roman numerals I – VI

Contents

1. INTRODUCTION	9
1.1 SOCIAL AND ECONOMIC DETERMINANTS INFLUENCING ATTRACTION AND RETENTION OF HEALTH WORKERS IN RURAL AREAS	10
1.1.1 <i>Individual factors</i>	10
1.1.2 <i>Enabling environment</i>	11
1.1.3 <i>National environment</i>	12
1.1.4 <i>International environment</i>	12
1.2 THE IMPACT OF MIGRATION OF HUMAN RESOURCES FOR HEALTH ON OBSTETRIC AND SURGICAL SERVICES	13
1.3 STRATEGIES TO IMPROVE RECRUITMENT OF HUMAN RESOURCES FOR HEALTH TO RURAL AREAS AND TO ENHANCE THEIR RETENTION	13
2. RATIONALE OF THE STUDIES	16
3. AIMS AND OBJECTIVES	17
3.1 GENERAL AIMS.....	17
3.2 SPECIFIC OBJECTIVES	17
4. STUDY SETTINGS	18
4.1 MOZAMBIQUE	18
4.2 TANZANIA.....	21
5. METHODS	23
5.1 PAPER I.....	23
5.2 PAPER II.....	24
5.3 PAPER III.....	27
5.4 PAPER IV.....	27
5.5 PAPER V.....	29
5.6 PAPER VI.....	29
6. RESULTS	32
6.1 PAPER I.....	32
6.2 PAPER II.....	35

6.2.1	Costs.....	35
6.2.2	Productivity.....	39
6.2.3	Cost-effectiveness and sensitivity analysis.....	39
6.3	PAPER III.....	40
6.4	PAPER IV.....	44
6.4.1	The role played by the “técnico de cirugía”.....	45
6.4.2	Training and quality of care.....	47
6.4.3	Surgical, theoretical and clinical skills.....	47
6.4.4	Internship.....	48
6.4.5	Relationships and collaboration.....	49
6.4.6	Career progression and remuneration.....	51
6.5	PAPER V.....	52
6.6	PAPER VI.....	59
6.6.1	Obstetric risk.....	59
6.6.2	Fatal outcomes.....	60
6.6.3	Quality of care—AMOs and MOs.....	61
6.6.4	Quality of care—government hospitals and mission hospitals.....	62
6.6.5	Perinatal deaths in cases with the fetus alive on admission.....	63
7.	DISCUSSION.....	65
7.1.	SCARCITY OF HUMAN RESOURCES FOR HEALTH: THE MAGNITUDE OF THE PROBLEM.....	65
7.2.	TASK-SHIFTING AND TASK-SHARING.....	66
7.3.	PERFORMANCE OF NPCs.....	67
7.3.1	Quality of work.....	67
7.3.2	Work burden.....	68
7.4.	RELATIONSHIP BETWEEN NPCs AND OTHER STAFF.....	68
7.5.	MOTIVATION AMONG NPCs TO SUSTAIN UNDER THE BURDEN OF EMERGENCIES.....	68
7.5.1	Financial incentives.....	69
7.5.2	Non-financial incentives.....	70
7.6.	RETENTION.....	71
7.7.	COST - EFFECTIVENESS ASSESSMENT OF TRAINING NPC/GP/SPECIALIST.....	72
7.8.	THE ENABLING ENVIRONMENT.....	72
7.9.	CONCLUSIONS.....	73
8.	ACKNOWLEDGEMENTS.....	75

9. REFERENCES78

LIST OF ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
AMDD	Averting Maternal Death and Disability
AMOs	Assistant medical officers
BEmoC	Basic Emergency obstetric Care
CEmoC	Comprehensive Emergency obstetric Care
DALY	Disability adjusted life year
DDH	Designated District Hospital
DHS	Demographic Health Survey
FGD	Focus group discussion
HIV	Human immunodeficiency virus
HRH	Human resources for health
IMF	International Monetary Fund
JLI	Joint Learning Initiative
MCH	Mother and child health
MDGs	Millennium development goals
MoH	Ministry of Health
MO	Medical Officer
NPC	Non-physician clinician
OR	Odds ratio
TC	Técnico de cirugía
TFR	Total fertility rate
UN	United Nations
UNICEF	United Nations Children's Fund
WHO	World Health Organization

1. INTRODUCTION

The shortage of emergency obstetric and surgical services in low-income countries over the last decade has attracted substantial attention (1, 2). The Millennium Project initiative in 2000, adopted, at the largest-ever gathering of heads of state in committed countries, to eradicate poverty, to promote human dignity and equality and to achieve peace and democracy, the Millennium Development Goals (MDGs). Parallel programmes to combat specific diseases (malaria, tuberculosis and HIV/AIDS) have been launched (3).

For this initiative to have impact effective health systems with equitably provided health services are required. The health workforce has been identified as the key to effective health services (4). Unfortunately, this workforce is distributed unevenly in the world (5-8).

The shortage of health workers in many countries is the most significant constraint to attaining the three health-related MDGs, to improve maternal health, to reduce child mortality and to combat HIV/AIDS and other diseases (5, 9-14). Asia, for example, which has about half the world's population, has access to only 30% of the world's health professionals. Africa with approximately 11% of the world's population has a disease burden equivalent to 24% of the world's burden but merely 1% of the world's doctors, nurses and midwives (5). The Americas have 42% of the world's health workers but their burden of disease is only 10% of the global burden.

Inside each country this picture of discrepancies is also common. In Bangladesh, for example, four metropolitan districts have 35% of all doctors but only 14.5% of the population are living there (15). By 1977 in Ghana 1,087 of 1,247 (87.2%) general physicians were employed in urban areas while 60% of the population lived in rural areas. This poor distribution of personnel has more recently been aggravated by disintegration of health systems in low-income countries and by the deterioration in the global policy environment (4, 16, 17).

Many countries face difficulties in producing, recruiting and retaining health professionals. Medical schools are insufficient (18) and there is a massive global shortage of health workers (19, 20). Low salaries, poor working conditions, lack of supervision, low morale and motivation, lack of infrastruc-

ture, as well as HIV/AIDS affecting the health professionals, are currently large contributors to this situation (21, 22).

Consequently, workers tend to migrate to areas that provide the best working conditions like from rural to urban areas. Workers are under the impression that the conditions will be much better and they will have access to more job opportunities including the private sector. Another alternative is to migrate to a wealthier country.(4, 23-27).

Income is deemed the most important motivation, but not the only one, job satisfaction, career opportunities, quality of management of human resources, good governance are other factors. Political instability, war, and the threat of violence in the workplace are considered strong drivers for the flow of human resources in health within many countries (5, 28).

It is estimated that the global shortage in the world is about four million health workers. According to one estimate, Sub-Saharan countries will need to triple their current number if they are to attain the MDGs for health (13). More specifically, the human resource crisis is most significant at the level of specialists, including surgeons and anesthesiologists (29, 30). In East Africa there are 0.25 fully trained surgeons per 100,000 inhabitants compared with 5.69 per 100,000 population in the United States (31, 32).

1.1 SOCIAL AND ECONOMIC DETERMINANTS INFLUENCING ATTRACTION AND RETENTION OF HEALTH WORKERS IN RURAL AREAS

Various social and economic factors interact with and influence each other at all levels and among stakeholders providing health care to the population and the social environment. The following factors are the most most relevant..

1.1.1 Individual factors

Such factors may be related with personal characteristics, age, gender, marital status, etc. In general, demographic factors and reasons to stay or leave a rural area are inconclusive regarding age, educational level and gender (20, 33).

Marital status has been cited to have association with intention to leave work in a rural area, but in general those who are single are more mobile and have a higher intention to leave work; the turnover

is higher for single workers than if they are married. (20, 34). Spouses have been identified as an influencing factor on a partner's mobility and family responsibilities, more often affecting female workers than male workers. While the mobility of men has been found to be linked to economic considerations, the movement of women are linked to marriage or family considerations (20, 34).

Preference of work in rural areas has been cited as dependent on the living conditions the health professionals are used to. People from urban areas frequently resign shortly after having been posted in a rural area. However, the correlation between the geographical origin of the students and their choice of future geographical of practice appears to be true only under certain circumstances. The students coming from under-staffed areas may tend to return easily to an under-served area to practice (35-37). This might increase the chances of health workers to return to practice in rural areas (38).

1.1.2 Enabling environment

The literature is quite unanimous that the local environment, together with social obligations, is very important for decisions on where to work. Lack of housing, lack of health care and schools for children, lack of potable water and meagre salaries are usually the main reasons why staff refuse to be posted in health services in rural areas (20, 28, 39, 40)

Working conditions, job satisfaction, organizational arrangement, management support, high-risk environments and availability of equipment, have also been cited as the principal determinant factors on whether to leave or stay in remote areas (28, 41-44). In Angola, for example, in the mid-1990s doctors could earn more per hour in the private sector than working in the public sector receiving a weekly salary.(45).

In some African countries the low salary might be paradoxically associated with a decreasing intention to leave work (25). This has been noted also in Thailand (20, 46) when a second job in the private sector exists, or another incentive is supplemented or under-the-table payment is prevalent (20, 47).

Willingness to migrate from a low-income country to a high-income country is naturally associated with wage differences in the countries of origin and of the destination; the wages may be 5-15 times higher in the countries of destination (48, 49).

Migration in general is not strongly associated with career advancement and turnover (20, 50). Studies in some countries, particularly in African (Cameroon, Ghana, Senegal, South Africa, Uganda and

Zimbabwe) (20, 28), show strong association between migration and the desire for further professional training in the destination country.

1.1.3 National environment

It is clear that social unrest and conflict are strongly associated with the intention to migrate (28, 51-53). In Zimbabwe more than 50% of health worker emigrants indicated economic circumstances, lack of facilities, lack of work conditions, and despair about the future of the country as main reasons to leave their country(20).

Global health initiatives influence the staffing of remote areas in low-income countries. The exact impact is not clear but it is evident that many health workers move to externally financed projects (NGOs' and others') weakening the national public sector instead of strengthening it (54).

There is a potentially strong synergy between what has been labeled the “push” factors and the “pull” factors in moving from low-income to high-income countries. This could be detrimental for the “national” environment. “Push factors” correspond to hardship-related circumstances in rural areas (exaggerated work burden, low salaries, poor professional career opportunities, non-inspiring future advancement scenarios etc), while “pull factors” represent powerful offers from the outside world - in terms of attractive job opportunities, huge salary increments, career opportunities, significant improvements of social and family conditions etc (20,43,51,53,55-58).

1.1.4 International environment

The dramatic shortage of health workers in most high-income countries has an important impact on the retention of health workers in low-income countries. Higher salaries, more satisfying working conditions, a safer environment and better educational and career development opportunities, high quality of life, freedom from political persecution, freedom of speech and educational opportunities for children have all been cited in the literature as the main causes of migrating to wealthier countries (20, 56, 59).

The international environment is naturally linked with the national environment addressed above since both of them are mutually dependent on each other: there is evidence that planning for supplying human resources for health to high-income countries relies on the existence of “push” factors to

fill vacancies of health workers in affluent countries. This has been documented for the USA but may be a reality also for other recipient countries (51, 53, 56, 57).

1.2 THE IMPACT OF MIGRATION OF HUMAN RESOURCES FOR HEALTH ON OBSTETRIC AND SURGICAL SERVICES

Migration of health workers from already understaffed low-income countries has been cited as a matter of controversy and several consequences of this migration are prominent issues in the ongoing debate. The exchange of ideas and acquisition of new skills and technology can enhance progress in low-income countries and help to build local institutions when (and if) the professionals return. Nonetheless, when the flow encompasses medical educators, specialist doctors and technical supervisors and researchers, serious constraints are created in sustaining the future training and supply of quality of workers. Such constraints also have an impact on the quality of care provided. Migration represents a loss of investment made in education and the training of health workers becomes unsustainable, which affects the functioning of the health system with eventual risk of collapse, e.g. in Malawi and in Zimbabwe.(5,60).

Apart from the negative features of the emigration of health workers abroad, some positive aspects contribute to the efforts to alleviate poverty. In some instances migration allows for a positive impact not only for the individual, through career progression and job satisfaction, better living conditions, better opportunities to social support of the family, but also to the country. Each year migration generates billions of dollars in remittances, money sent back to home country by emigrants, to low income countries, (5). In India (61) and in the Philippines (62) such remittances can contribute to the development of the recipient country in terms of education and building of houses for the worker themselves and their families. In some countries the strategy is to produce more health workers for exportation.

1.3 STRATEGIES TO IMPROVE RECRUITMENT OF HUMAN RESOURCES FOR HEALTH TO RURAL AREAS AND TO ENHANCE THEIR RETENTION

The literature review shows that strategies have been based on the following principles:

- Exploring and understanding the country-specific attractions and context-specific factors that exist in a defined setting.
- Using different staff categories for “task shifting”, usually implying delegation of tasks to less skilled workforce, who may be easier to attract and retain.
- Creating appropriate environment of service delivery.
- Developing partnerships with other stakeholders to deliver services, e.g. partnership with private sector.

Several countries have considered recruitment and training for assignments in rural areas by selection of candidates preferentially from a rural area with good references from the local job directorate/authority. Ethiopia, Ghana, Kenya (63) and Thailand (64, 65), Malawi (18) have had considerable success in improving equitable access to health care by peripheral recruitment in combination with rural assignment.

Use of incentives like doubling of salary to those who are working in rural areas and compulsory services has been attempted in Indonesia (66), implying subsidized tuition, free clothing, room and board, and learning materials during the training of students recruited by Ministry of Health to practice in rural areas. Also in Thailand compulsory services have been tested (64, 65). Financial incentives have been tried in South Africa to staff remote areas (67), with allowance packages for doctors that would be the equivalent of a 30% increase on their salary, renovation of accommodation facilities, contribution to school fees, vehicle and housing loans. Similar schemes have been attempted in Zambia (68), which achieved good results regarding retention although the sustainability remains to be proven.

Unfortunately in Zimbabwe the strategy to retain staff was unsustainable as the private sector offered more than the government sector. This discrepancy functioned as a pull factor for the employed professionals out of the public sector (69). Management staffs in the USA have tried to improve working conditions by incorporating a participatory approach (42, 70, 71). Introduction of supportive supervision to improve the motivation and consequently to influence the decision to stay in remote areas has been tried in the Philippines and in Papua New Guinea (20, 72-74).

Improving living conditions has been tested in Thailand by use of a decentralization programme of development (20, 64). This led to heavy investment in general rural infrastructure of a district and

directly to improved staff housing and hospitals, as well as basic infrastructure (roads, phones, water supplies and radio communications) with positive impact in terms of staffing of remote areas. The Zambia Health Worker Retention Scheme is another example to follow (68).

Notwithstanding the effort to train and retain health workers and prevent migration through global strategies, the prevalent shortage of health care staff is endemic in sub-Saharan Africa. (75, 76).

Since independence in Tanzania (77, 78) assistant medical officers (AMOs) have been trained to take the role of doctors in remote area where doctors were scarce as the few existent ones were concentrated in urban areas. AMOs are health professionals who have undergone an advanced course in provision of health care. They are trained to provide curative as well as preventive services at the district level. AMOs receive their specialized experience mostly during on-the-job training, which comprises of general surgery, obstetric/gynaecologic and orthopedic surgery and traumatology.

After the Arusha Declaration in 1967 Tanzania has been focusing on self-reliance as well as on equal distribution and equity in accessing social services. As a consequence, there was a rapid expansion of health services to the rural areas where the majority of the population live. The Ministry of Health is obliged to provide both curative and preventive services to the public. In Health Sector Reform Strategies the approach of the government is to promote good quality health care at primary, secondary and tertiary levels. This is ensured by the provision of cost effective preventive and curative services to all areas, supported by network of government institutions. The areas of focus in current health reforms include district decentralization, improvement of central health management, financing, human resources development and public/private partnership (78, 79). In this perspective the training of AMOs has been developed (80).

After the independence in 1975, Mozambique proclaimed universal access to primary health care as a political goal, but a massive exodus of trained Portuguese medical staff, particularly doctors, created a lack of key human resources (81). The scarcity of trained medical doctors and others professionals motivated the Ministry of Health to start a training of a cadre similar to the AMOs in Tanzania (*técnicos de medicina*,). The faculty of medicine and other training centres for health care staff were restricted by limited pools of qualified applicants and a shortage of senior trainers. A new training policy was adopted with an intensive programme to train health workers, particularly nurses, midwives and "*técnicos de medicina*", to take the place of doctors in many roles (82).

During the 1980s, the Mozambican health system was further affected by casualties resulting from a civil war instigated by South Africa (83). The unmet need for emergency health care and life-saving skills in rural areas was particularly prominent in two fields: obstetric emergencies and war casualties. Staff shortages in these two high priority surgical areas forced the Ministry of Health to plan and implement training of selected '*técnicos de medicina*' to become professionals similar to the AMOs of Tanzania but with special skills in surgery (TCs). (82, 84) {}. Training of TCs started in 1984. All admitted students were required to have reached a level corresponding to medical assistant with three or more years of professional experience in rural areas and preferably with some surgical experience. The dedication, behaviour and motivation of candidates admitted to the TC training were (and still are) considered to be extremely important. The admission procedure for TC training is rigorous with detailed individual interviews before final selection. (84, 85)

The course to become a TC takes three years, two theoretical and practical years and one year of field practice. During the first two years, they pursue courses in general surgery, obstetrics and gynaecology, orthopedic surgery and traumatology. They are also exposed to other sub-specialties of surgery. In the third year, they have practice at provincial hospital in general obstetrics, gynaecology, orthopedic surgery and emergency care.

The background of a sample of 51 students that were admitted to the TC training was elucidated by interviewing them. On average, it took 2.6 years to reach a nurse or equivalent health worker category. After that, TCs had an average of 7.6 years of practical healthcare work before applying for the 3-year TC training (Pereira et al, unpublished). After the formal exam, they are posted in the rural or district hospitals, supervised by specialists at the provincial level.

2. RATIONALE OF THE STUDIES

Research on NPCs has been very limited and even less has been documented about quality of work carried out by this cadre and their retention in rural areas after the initial assignment. The intention of this thesis is to contribute to the knowledge of how NPCs actually work and how they master the challenges they are exposed to in maternal health care. Few attempts have been made to assess the relationship between these professionals, medical officers and other health workers in order to understand the perception of NPCs among them. These studies also had the purpose to understand the frus-

tration of this cadre and the anecdotal evidence of alleged neglect by their authorities considering their true work burden. The studies intend to contribute to elucidate advantages and disadvantages of task shifting strategies that have been implemented in two countries, Mozambique and Tanzania, in order to overcome the crisis in human resources for emergency obstetrics and surgery in these countries.

3. AIMS AND OBJECTIVES

3.1 GENERAL AIMS

The purpose of this thesis is to describe the extent to which NPCs in Mozambique and Tanzania contribute to life-saving surgical skills to enhance maternal survival. More specifically the focus is on “met need” of emergency obstetric care and on the outcome of major surgery in the two countries.

3.2 SPECIFIC OBJECTIVES

1. To compare the outcome of caesarean sections carried out by NPCs and physicians, respectively.
2. To assess the proportion of major surgery in obstetrics carried out by these two categories of staff.
3. To assess attitudes and opinions among other categories of health staff concerning major obstetric surgery carried out by NPCs.
4. To elucidate economic implications and cost-effectiveness of NPCs versus physicians in carrying out caesarean sections (Mozambique).
5. To assess retention of NPCs versus physicians at the rural hospital level during different periods of time after graduation.

4. STUDY SETTINGS

4.1 MOZAMBIQUE



Mozambique is located on the eastern coast of southern Africa with an area of 799,400 square kilometers. Its long coast-line makes the country a natural corridor to the sea for neighbouring countries. Its location and borders have influenced Mozambique's political stability.

The country is divided into 11 provinces including the capital city (Maputo) and 140 districts (86). Mozambique's population is approximately 21 million, with an average annual growth rate of 1.9%. The total fertility rate (TFR) is 5.1,(87) with 62% living in rural areas. Gross national income per capita is \$330, and 38% of the population has a daily income of less than \$1.7(88). The Family Aggregate Survey (1997) estimated that around 70% of the population lived in absolute poverty with a marked difference between the urban and rural areas, and between the north and south of the country. Data from the 2003 demographic and health survey (DHS) illustrated that 54.3% of the population lived below the poverty line.

Of the population, 46% are under the age of 15 and 23% are women of reproductive age (89). The life expectancy is 45 years, and the maternal mortality ratio in 2003 was 408/100,000 and the neonatal mortality rate 48/1000 live births (89). Availability of maternal health services in Mozambique is limited, particularly in rural areas. While in urban areas 82.6% of women delivered in health facilities, 82.2% of women had a skilled attendant and 6.2% of women experienced a caesarean delivery. In rural areas these figures were 35.3, 35.5 and 0.6%, respectively (90). Low access in rural areas is a direct result of long distance to a functioning facilities and lack of skilled health workers trained in obstetric care. AIDS is an increasing challenge and the estimated average national prevalence is around 12.5 % (87). According to a survey a few years ago, Mozambique had 435 physicians and only 26 obstetricians for a population of nearly 20 million (91).

The health care services in Mozambique are provided by the Ministry of Health (MISAU), through hospitals, health centers and health posts. The public sector is complemented with services provided by the NGOs and to a small extent by private providers. There is a three-tiered organization of health care at national, provincial and district level. Mozambique has a public health system with a total of 1,335 health facilities: three central hospitals (one in each region), one located in Maputo (which is also the final referral hospital for the whole country) for the Southern region, one in Beira for the Central region and one in Nampula for the Northern region; seven provincial hospitals one in each province; five general hospitals, 31 rural hospitals, 112 health centre type I, 334 health centre type II, 329 health centre type III, and 514 health posts. These different centres provide different services and have different types of personnel present. Services and personnel vary between centres and between cities. Resources are not equally allocated throughout the country. The lowest level of care is provided by health posts. (86)

The WHO Study on Inequities in Maternal and Child Health in Mozambique (92)[6], makes a deeper analysis of the DHS-2003 data with the objective to identify significant factors in determining the risk of not having a skilled birth attendant. Differences in socio-economic aspects accounted for 61% of inequities in skilled birth attendance. The three main socio-economic contributors to inequity were: household wealth (24%), mother's education (16%) and living in rural areas (12%). Other important socio-economic contributors included frequency of accessing information (5%) and mother's occupation (4%). Quality of case management, approximated by antenatal care quality, contributed to another 23% of inequities in obtaining a skilled birth attendant while most of the remaining inequities

were due to factors associated with utilization of maternal health services (16%). Of this, 12% was attributed to perceived barriers to access, especially distance to facility, while another 4% was attributed to receiving valid antenatal care.

Access to health care service is considered a relevant social determinant (93-95). A focus on primary care, as opposed to specialty care, is critical for any government planning to reduce inequities.

The availability of skilled delivery personnel predicts, to some extent, the maternal mortality ratio of a country, and structural arrangements should therefore be made to train skilled health personnel to take care of maternal health problems. In view of the high cost of training physicians, mid-level health personnel offer an affordable alternative to handle emergency obstetric cases and can counteract the shortage of physicians.

4.2 TANZANIA



Tanzania is the largest country in the East Africa and has an area of 947,000 square kilometers. Tanzania borders Kenya and Uganda to the north and north-west, the Republic of Congo and Burundi (with some portion of Rwanda) to the west, and Zambia, Malawi and Mozambique to the south. The country is divided into the mainland and two islands comprising of Zanzibar and Pemba with a total of 26 regions divided into 130 districts. The population is about 40.4 million with average annual growth rate of 2.4%. The total fertility rate (TFR) is 5.2. The life expectancy is 52 years. The majority of people are farmers and reside in rural areas (96).

The maternal mortality ratio is 950 per 100,000 live births. Of pregnant women, 78% receive antenatal care. Of all births, 43% are attended by skilled health staff. The infant mortality rate (per 1,000 live births) is 73, and under five mortality rate is 116. The unmet need for family planning is 21.8%. HIV/AIDS is pandemic, and affected the country with estimated prevalence of 6.2% (World Development Indicators Database 2007)(97).

There are large disparities between rural and urban areas, and between the various income quartiles with the rural poor being the most disadvantaged.

Tanzania has a well-established health care delivery system that is good in comparison with other Sub-Saharan countries. Following the independence and particularly after the Arusha Declaration of 1967, there was an emphasis on self-reliance and equity in accessing social services. As a consequence, there was a rapid expansion of health services to the rural areas where the majority of the population lived.

By 1980, about 45% of the population had a distance of one km or less to reach the nearest health facility, 72% lived within five km and 93% lived within 10 km (98). Tanzania Health Network consists of about 4,990 dispensaries of which the government - through the Ministry of Health and the President's Office Regional administration and Local Government - own 3,035. Of the government-owned facilities, 409 are health centers providing primary care services. These are in turn linked to 208 hospitals, which include district regional hospitals as well as four specialized hospitals and two university teaching hospitals (Country report MOH, 2003)(98).

The studies were done in two regions, Mwanza and Kigoma. The Mwanza region is located on the shores of southern part of Lake Victoria and is an important economic area in Tanzania, where the city of Mwanza, the second city of the country after Dar es Salaam, is situated. Kigoma is one of the most remote regions in Tanzania and situated on the shores of Lake Tanganyika, bordering two countries, the Republic of Congo and Burundi. Due to this location Kigoma has suffered various influxes of refugees from neighboring countries with recurrent civil conflicts.

5. METHODS

5.1 PAPER I

The human resources compared in this study were TCs and specialists employed at the Department of Obstetrics and Gynaecology of Maputo Central Hospital. During 1992 all caesarean deliveries, comprising 958 deliveries performed by TCs and 1113 deliveries performed by specialists in obstetrics and gynaecology were included in the study and their outcomes were compared. The caesarean delivery rate in Maputo Central Hospital the same year (1992) was 16.5%. Since this hospital was the only one where emergency caesarean delivery was carried out and since around one-third of the approximate 48,000 deliveries in Maputo City took place in Maputo Central Hospital, this caesarean delivery rate should rightly be divided by three to get a figure that is representative of the approximate caesarean delivery rate at the community level (even if a limited number of deliveries may have occurred outside hospitals). All patients were given general anesthesia by intravenous barbiturates and muscle relaxants followed by inhalation anaesthesia. Anaesthetist nurses provided anaesthesia in both groups, and the same routine was followed. Maternal death, duration of post-operative hospital stay, total wound rupture, superficial wound separation and condition of the newborn were assessed.

For ethical and logistical reasons the patients could not be randomly allotted to the two groups.

The only systematic difference was that elective caesarean deliveries ($n = 145$; 7 %) were carried out exclusively by the specialists. Under the prevailing circumstances and in the absence of strict randomisation it must be assumed that some selection occurred when the patients were allotted to either TCs or specialists. Numerous emergencies in the delivery room requiring immediate intervention by a specialist did not allow the latter to manage more complicated caesarean deliveries.

The decision to perform a caesarean delivery was normally taken by the specialist obstetrician on duty, and occasionally by the TC when the specialist was busy. All specialists were experienced obstetricians/ gynaecologists with several years of clinical practice in Maputo Central Hospital.

There was always an obstetrician on duty in the hospital, but TCs' need for support during the operation was rare. The surgical technique used was almost exclusively midline incision; Pfannenstiel's incision was performed in less than 3 % of the 2,071 operations. To characterize the patients' social background, interviews were performed to assess their home circumstances and the outcomes were compared by calculating the odds ratios (OR) with 95 % confidence intervals (CI). For the analyses

the Epi Info software version 5.01, from the Centers for Disease Control in Atlanta, Georgia, USA was utilized.

5.2 *PAPER II*

Costing of training and deployment of TCs and specialist physicians trained in surgery was assessed. This analysis provided an estimate of costs incurred, potentially useful in replicating a similar program in other settings. Total economic costs were calculated for the TC training programme and for subsequent deployment (99). We adopted a modified societal perspective, incorporating all public sector costs for the development of the training programme, the training itself, and the deployment of cadres as well as opportunity costs¹ for health workers in training (99, 100). In calculating deployment costs, all facility level costs were not considered such as drugs, hospital bed costs or salaries of other health personnel as based on the discussions with physicians and TCs, and we assumed that such costs would not be systematically associated with any of the two cadres investigated. In addition, to provide a more complete picture of the investment requirements for the TC training programme, the start-up costs were calculated for the TC programme; comparable data for the medical school was not available and therefore such start-up costs were not included in the comparison of cost-effectiveness. All costs were converted to 2006 US\$ using the IMF GDP deflator and the average mid-year exchange rate of US\$ 1 = MZM 27,030 (101). Vehicles and office equipment were annualised using an estimated useful life of eight years. Buildings were assumed to have a useful life of 30 years. World Health Organization's Excel-based Cost-It template was used to calculate average annual training costs, and Excel 2004 for Mac version 11.3.3 was used for all others aspects of analysis (102).

The costs of the start-up or development phase of the TC training programme were estimated retrospectively through discussion with the surgeons and obstetricians involved in its implementation. Although in reality some start-up capital investments were delayed by lack of funds at the outset, all start-up costs are given as being made in year 0 to provide a clear idea of the upfront financial in-

¹ Opportunity cost means: means the benefit foregone, or value of opportunities lost, by engaging resources in a service; usually quantified by considering the benefit that would accrue by investing the same resources in the best alternative manner.

investments required for the development of a similar programme. Start-up costs are presented separately and are not included in the comparison between TCs and physicians.

The current costs of training of TCs were based on current expenditure reports from the Instituto de Ciências de Saúde de Maputo and discussions with the institute director and the TC course director as well as the TC course coordinator. The component of Institute overhead costs (e.g., facility rent, cooling and administration) attributable to the training of the TCs, were included in the analysis. Opportunity costs for students were estimated at 80% of the salary of a *técnico de medicina*, (medical assistant) or nurse, the students' professional qualification before entering the TC training programme. This was based on the salary paid by the Ministry of Health to students during training. The value of any clinical services performed by TCs in training was not included as an offset to the costs of training. The costs of first level training for these students, i.e. basic nursing or medical assistant training, were estimated by deriving a representative per student cost from the global budgets for the years 2001-2003, the latest available, of the Instituto de Ciências de Saúde de Maputo. Opportunity costs for this level of training were not included. The Institute trains approximately 500-700 basic and midlevel health workers, ranging from birth attendants to laboratory technicians and nurses. The costs of medical education were based on the latest available budgets and annual reports of the Eduardo Mondlane University (2004) and the Faculty of Medicine (2005) as well as on discussions with administrators. The research expenditures were excluded unless the research had a training component. In addition to the direct costs of training, there was an allocation of a proportion of the central University budget for administration, general support, and libraries and archives to the Faculty of Medicine proportional to its enrolment. Costs for residency training in surgery and obstetrics and gynaecology were obtained through discussions with residency program directors. The salaries that were paid to residents by the Ministry of Health (at the level of a general practitioner) were used to estimate their opportunity costs. For the base case analysis, residents were considered full time students under supervision and the service component of their work was not included.

Information on deployment costs for TCs and physicians was collected from Ministry of Health salary scales and discussions with practising *técnicos*. Deployment costs consisted of salaries, benefits, rural incentives, continuing medical education, and the costs of physician supervision and referral of complicated cases.

While both TCs, surgeons and obstetricians perform a wide variety of surgeries, this analysis focused on the productivity of each cadre in obstetric surgery, specifically the number of caesarean deliveries, obstetric hysterectomies, and laparotomies for ectopic pregnancy. To calculate the annual number of each of these procedures performed by the two types of providers, surgical registers were scrutinized from all 34 Mozambican government hospitals with functioning surgical theatres (103). Of these, 23 were rural/district, eight were general and three were central hospitals. The accuracy of the data was confirmed through a review of labour room records which were compared with the surgical registers. Access to essential obstetric surgery is in itself a valued output of the health system and has the advantage of being easily understood by policy makers and the public. Thus we chose to use technicians' and physicians' productivity in performing these surgeries as an intermediate output in this study. Using disability adjusted life years (DALYs) or other health outcome measures here would also be misleading, as the available data on surgical productivity only capture a small part of the TCs and physicians' impact on number of lives saved, given their much broader scope of surgical practice. By contrast, DALYs are used to measure the effects of an intervention on all future averted morbidity and mortality (99, 100).

The annualised and discounted costs of training and deploying TCs and physicians were calculated over a 30-year period, corresponding to an assumed potential length of a career. For each cadre of health worker, the net present value of the 30-year cost stream was then divided by the discounted number of major obstetric surgeries performed, beginning with the year following the completion of all training, to obtain the cost per major obstetric surgery.

Sensitivity analysis was performed to model the impact on the results of varying analytic assumptions. Given the concern, universally voiced by informants during the course of this study, that TCs are substantially underpaid (current salary is approximately US\$200 per month), and the well-documented importance of appropriate remuneration for retention of health professionals (26, 104) sensitivity analyses were done to model the impact of doubling the salaries of the TCs. The productivity levels were adjusted for both cadres to account for possible changes in productivity since 2002, and reducing the opportunity costs for physicians in residency training to account for the service component of their work.

5.3 *PAPER III*

In this study, during the year 2002, all 34 Mozambican government hospitals with functioning surgical theatres were reviewed, of which 23 are rural/district hospitals, eight general and provincial hospitals and three central hospitals. The theatre registers and labour room records were examined in detail to identify three major obstetric/gynaecologic interventions: caesarean deliveries, obstetric hysterectomies and laparotomies for ectopic pregnancy. A total of 12,178 operations in these three categories of surgery were found, and the proportions carried out by MOs and TCs were determined at the three hospital levels.

In the second part of this study the work histories of three batches of MOs and TCs, graduated during the same years (1987, 1996 and 1998) were investigated. All graduates of these years were followed in both groups, thirty five medical officers were interviewed directly, two contacted by phone, and three in training abroad. Information was requested from parents to retrieve career data for the first seven years after graduation and completed with information retrieved from the Ministry of Health to review assignments. In the three groups of both categories lists of assignments in the first seven years after graduation were constructed and the site of employment identified rural, provincial or the capital of country. In this way the retention rate at district hospital level at different periods of time after graduation could be calculated.

5.4 *PAPER IV*

In this study interviews were conducted in three provinces, one in each of the three regions of Mozambique: Nampula in the north, Zambézia in central Mozambique and Gaza in the south, taking into account the regional differences (economic, cultural and human resource distribution). Two health facilities in the Maputo province were included, and in Maputo city a number of hospital-based specialists were interviewed. The three provinces were chosen because they have the largest number of TCs and rural hospitals in their respective region. In each province, the interviews were conducted in all health facilities providing surgical care, yielding a total of 21 health units (two central hospitals, two provincial hospitals, two general hospitals, 12 rural hospitals and three health centres).

Health professionals were selected to capture a diverse set of views: from health managers at system level to health care providers at the facility level. During the pre-testing of instruments, it became

clear that female participants (maternal and child health nurses) would not freely express their feelings in the group discussions. Furthermore, a certain reluctance to openly tackle the relationship issue was observed. Thus, the methods were adjusted to allow better participation of these cadres and hence, the individual interviews at facility level, initially planned only for medical doctors were expanded to include MCH nurses in the selected health units.

The data collection was conducted by a team of seven members: the three first authors and four provincial health workers from the evaluated provinces.

This exploratory study mainly examined the health workers' general opinions on the role played by the TCs. In addition, the views of the health staff were assessed in other themes in order to explore circumstances influencing the general opinion. Anecdotal information had suggested that the perceived quality of care, performance, relationships and collaboration with health facility team members affected the opinion and acceptability of health workers with regard to the TCs. A fourth area included in the study was health workers' perceptions of the adequacy of support and supervision provided to the TCs.

Using a semi-structured questionnaire with open-ended questions in all institutions and health facilities 71 staff were interviewed, comprising 18 general medical doctors, four gynaecologist- obstetricians, four orthopaedic surgeons, three general surgeons, two public health specialists, 18 MCH nurses, nine operating room staff, eight district directors and five general nurses.

In addition, eight focus group discussion (FGD) sessions of about two hours each were completed in eight rural hospitals involving 48 participants. Medical doctors and district health officers were excluded in these group discussions, because their hierarchical position could limit free discussion.

Standard guidelines were developed and used in all the FGD sessions held. The discussion began with a general question on the role played by TC. Towards the end of the session, the moderator probed for motivation, relationships, etc, if not already covered. During interviews and group discussions notes were taken by both the main researcher and the assistant; immediately after the end of each session data was compared for consistency and completeness and transcribed verbatim.

Interview data analysis consisted of identifying and marking key points from each question (area of study) in each interview. Subsequently, the emerging themes were identified and grouped by each health professional group. Focus group data was coded, analysed and summarised according to the different research topics.

Regarding core issues, no major differences emerged from between the interviews and group discussion data. However, the interview data was richer, thus selected interviewee responses translated verbatim from Portuguese to English were quoted in italics.

5.5 *PAPER V*

This study was conducted in two regions in Tanzania, Mwanza (with estimated population of 2,942,000) and Kigoma (with estimated population of 1,679,000). Both are situated in Northwest Tanzania. Kigoma is almost entirely rural, without paved roads outside the capital, a city of 100,000 inhabitants. Mwanza is also predominantly rural, but it includes the second largest city in Tanzania and some tarmac roads in rural areas.

In this retrospective study, in all 16 hospitals, government and private, that performed major obstetrical surgeries in these two regions data was collected. The registers from one year (2003) including annual reports, major operating theatre books, minor operating theatre registers, delivery room records and maternal mortality records were examined in detail. The intention was to determine the amount and kind of obstetric/gynaecologic interventions that had been performed by MOs and AMOs and the outcomes in terms of maternal mortality. A high degree of accuracy of the operating room registers and maternity records was found. More than 99% of the patients identified in the maternity record as referred for surgery were retrievable in the operating room record.

All hospitals with capacity for CEmOC have been listed in Table 11. A CEmOC hospital has facilities for blood transfusion and caesarean delivery in place, in addition to the functions stipulated for basic emergency obstetric care (BEmOC)(105). To calculate the UN Process Indicators, total births were estimated, using the known population and a birth rate of 39 per 1,000 population. Need for emergency obstetrical care was taken to be 15% of estimated births, as recommended for these indicators (105, 106)*.

5.6 *PAPER VI*

This study was a prospective one carried out over three months, conducted in the same two Tanzanian regions, Mwanza and Kigoma, to investigate the quality of obstetric care in complicated deliveries

and their outcomes in the two group of professionals, AMOs and MOs. In each hospital a nurse/midwife and an AMO worked together to create a detailed record for each patient admitted for an emergency obstetrical operation, plus all cases of eclampsia, postpartum haemorrhage, or sepsis (sepsis during or after childbirth) over three months. Of the 1,134 obstetrical cases with complications registered, 821 were admitted to government hospitals and 313 to mission hospitals. Of these patients, 1,087 required a major operation—944 of them performed by an AMO and 313 performed by a MO. The twenty-one operations in which the two worked together were classified as MO operations. Abortions, medical conditions, and non obstetrical complications were not studied.

The record included the following: (1) distance traveled to reach the hospital; (2) time in labour and time from admission to operation; (3) condition on admission of both mother and the fetus (presence of an audible fetal heartbeat was noted); (4) indication for operation, type of operation, and who did it; (5) blood transfusions; and (6) maternal or infant death and major complications. Supervisors or principal investigators visited each hospital at the end of the review and twice during the review to confirm that there was a record for all complicated cases described in the operating room and maternity records.

In order to develop indicators of maternal risk and quality of care, it was necessary to develop some measures of the risk of these operations for the mother and the fetus and for the appropriate indications for obstetrical operations. To do this, the concepts of absolute maternal indication and clear fetal indication were defined. Absolute maternal indication prevailed among those cases in which the operation was done because of a clear and immediate threat to the mother's life an indicator of both the need for operation and the risk. These were cases with antepartum haemorrhage, postpartum haemorrhage, malpresentation (transverse, face, brow only), eclampsia, ectopic pregnancy, ruptured uterus, previous repair of vesico-vaginal fistula, and sepsis. A clear fetal indication was defined to prevail among those cases in which the record showed a clear indication for cesarean delivery because of danger to the fetus. These were cases with a mother in labor for more than twenty-four hours before admission or more than eighteen hours after admission, a prolapsed cord, a previous cesarean delivery, or a breech delivery.

THE UN PROCESS INDICATORS

(Used to follow progress in the delivery of Emergency Obstetric Care - EmOC - to a defined population)

1) Emergency obstetric units per 500,000 population.

- **CEmOC** (Comprehensive Emergency Obstetric Care) Units. These are units able to perform all BEmOC functions (see below) and also caesarean delivery and give blood transfusion. WHO and UNICEF recommend one CEmOC unit per 500,000 population.
- **BEmOC** (Basic Units). Can do delivery with available antibiotics, oxytocin, anticonvulsants, vacuum extraction, and a capacity to remove intrauterine remnants after incomplete abortion and retained placenta. WHO and UNICEF recommend 5 per 500,000 population.

2) Percentage of estimated total births with access to a CEmOC unit.

- Total births estimated from the birth rate.
- Percentage recommended will vary by country.

3) Percentage of estimated total births undergoing major obstetrical operations.

- WHO recommends a minimum of 5%.

4) Met need. Percentage of all estimated complicated births taking place in a CEmOC unit.

- Complicated births in the population are arbitrarily considered to be 15% of estimated total births.
- “Complicated” refers to direct obstetric complications – not indirect ones, like TB, anemia, or malaria.
- Defined in this way, the 15% figure is remarkably consistent between countries and socioeconomic groups.
- WHO and UNICEF set the target at 100%.

5) Case fatality. Maternal deaths in health units from direct obstetric causes, as a % of the **complicated** deliveries in these units.

- WHO and UNICEF have set a target of maximum 1%.

6. RESULTS

6.1 PAPER I

Data from individual interviews regarding background socio-economic characteristics of the women operated on by the two professional groups are presented in Table 1. Age, parity, home circumstances, and antenatal care enrolment were almost identical. The underprivileged character of the population is obvious. Thirty-six percent lived in shantytowns, while the rest lived in flats or in private homes of different quality. Sixty-three percent had neither water nor electricity. The main indications for caesarean delivery were fetal distress, cephalopelvic disproportion, previous caesarean delivery, and placental abruption.

Table 1.

Background characteristics of women undergoing caesarean delivery performed by either TCs or specialists in obstetrics and gynaecology. Values are given as means (SD) or n (%), as appropriate

Characteristic	Women operated on by TCs (n = 958)	Women operated on by specialists (n = 1,113)
Age (years): mean (SD)	25.3 (70)	25.5 (71)
Parity: mean (SD)	2.2 (25)	25.5 (71)
Shantytown residence: n (%)	353 (37)	404 (36)
Antenatal care enrolment: n (%)	948 (99)	1,101 (99)
Twin pregnancy: n (%)	25 (2.6)	21 (1.9)

None of these indications occurred more frequently in either of the groups (Table 2). Depending on the severity of the case and the pre-operative complications, six different interventions were distinguished. These interventions were caesarean delivery only, caesarean delivery + subtotal hysterectomy, caesarean delivery + total hysterectomy, caesarean delivery + repair of uterine rupture and cae-

sarean delivery + tubal ligation (Table 3). The presentations were equally distributed in the two groups (Table 4).

Table 2.

Indications for caesarean deliveries performed by TCs or specialists in obstetrics and gynaecology Values are given as n (%)

Indication	Women operated on by TCs (n = 958)	Women operated on by specialists (n = 1,113)
Fetal distress	308 (32.2)	326 (29.3)
Cephalopelvic disproportion	177 (18.5)	212 (19.0)
Previous caesarean delivery	89 (9.3)	133 (11.9)
Placental abruption placenta pre- via	79 (8.2)	74 (6.6)
Impending uterine rupture *	72 (7.5)	68 (6.1)
Eclampsia	31 (3.2)	40 (3.6)
Pre-eclampsia	26 (2.7)	33 (3.0)

*Impending rupture uterine is defined here as the appearance of Bandl's furrow

Table 3.

Surgical interventions associated with caesarean delivery (CS) performed by TCs or specialists in obstetrics and gynaecology. Values are given as n (%)

Intervention	Women operated on by TCs (n = 958)	Women operated on by specialists (n = 1,113)
CS only	682 (71.5)	832 (75.2)
CS + subtotal hysterectomy	8 (0.8)	10 (0.9)
CS + total hysterectomy	3 (0.3)	4 (0.4)
CS + repair of uterine rupture	4 (0.4)	5 (0.5)
CS + tubal ligation	257 (26.9)	256 (23.1)
No information	4 (0.4)	6 (0.5)

Table 4.

Fetal presentations in women undergoing caesarean delivery performed by TCs or specialists in obstetrics and gynaecology. Values are given as n (%)

Fetal presentation	Women operated on by TCs (n = 958)	Women operated on by specialists (n = 1,113)
Cephalic	837 (87.4)	969 (87.1)
Breech	87 (9.1)	101 (9.1)
Compound (head + arm)	8 (0.8)	11 (1.0)
Transverse	10 (1.1)	24 (2.2)
Face	10 (1.1)	6 (0.5)
Unknown	6 (0.6)	2 (0.2)

The outcome variables selected for comparison are presented in Table 5. Among those operated on by TCs there were seven maternal deaths and there were ten among those operated on by specialists. These deaths were related to post-operative infection in three and eight women, to coagulopathy in two and one women, and to hypertensive complications in two and one women, respectively. There were no significant differences in the number of maternal deaths or in the duration of post-operative hospital stay. The number of total wound ruptures was similar in the two groups, but there was a slightly increased incidence of haematoma-related superficial wound separation in the group operated on by the TCs. The post-operative hospital stay amounted to more than four days in 45 % and 48 % of women operated on by TCs and specialists in obstetrics and gynaecology, respectively. Almost the same proportion of newborn infants required neonatal care in the two groups.

Table 5.

Postoperative complications occurring after caesarean deliveries performed by TCs or specialists in obstetrics and gynaecology

Complications	Women operated on by TCs (n = 958)	Women operated on by specialists (n = 1,113)	OR	95% CI
Superficial wound separation	41	22	2.2	1.3-3.9
Total wound rupture	3	2	1.8	0.2-2.9
Stillbirth	68	91	0.9	0.6-1.2
Early neonatal death	1	8	0.1	0-1.1
Hospital stay > 4 days	428	530	0.9	0.8-1.1
Maternal death	7	10	0.8	0.3-2.3

6.2 PAPER II

6.2.1 Costs

Development of the TC training programme was estimated at an investment cost of US\$ 144,723 (Table 6). Just less than one-quarter of the cost was for professional salaries. Approximately two-thirds were for books and equipment including a library, computers, anatomic models, and the development of a textbook for TCs.

Table 6.

Start-up costs of TC training (US\$)

Cost category	Cost	%
Professional salaries	32,940.3	22.8
Material and supplies	7,110.0	4.9
Computers	9,000.0	6.2
Travel	277.5	0.2
Books	30,000.0	20.7
Rural surgery textbooks	33,442.7	23.1
Library building	31,952.6	22.1
Total start-up costs	144,723.0	100.0%

The breakdown of post-start-up costs for the core training of TCs and physicians (TC course and medical school) is shown in Table 7. The TC programme costs US\$ 4,881 per student per year or US\$ 14,644 over the three years of the training. Medical school training costs were US\$ 3,573 per year or US\$ 21,437 over six years. Salaries for teachers and building costs were higher for medical students, whereas student support expenses (pocket money and support for rural clerkship) were higher for TC students. Residency training costs were US \$10,539 per year or US\$52,693 over 5 years. Because of the nature of the residency training program, which resembles an apprenticeship with little overhead and didactic teaching expenditures, the majority of the costs were for resident and instructor salaries, with books, equipment, and travel costs comprising less than 20% of total costs.

Table 7.**Undiscounted average annual and total costs of TC training and medical school in US\$**

Category	TCs	%	Specialist Physicians	%
Personnel				
Administrative/management salaries	677.0	13.9	709.4	19.9
Teaching/supervision salaries	761.6	15.6	1,598.8	44.7
Travel allowances	50.6	1.0	7.3	0.2
Goods and services				
Office supplies	267.2	5.5	64.1	1.8
Books and equipment (computers, models)	268.3	5.5	218.8	6.1
Building rent, utilities, maintenance, other overhead	160.0	3.3	397.0	11.1
Transport (capital and recurrent)	282.1	5.8	23.3	0.7
Student support				
Accommodation and food	0.9	0.0	299.8	8.4
Pocket money	1,673.2	34.3	193.2	5.4
Rural clerkship	740.5	15.2	61.1	1.7
Total per year	4,881.4	100.0	3,572.8	100.0
Total for full course	14,644.3		21,437.0	

The total cost (excluding start-up) of producing one TC, including first level training (as a nurse or a *técnico de medicina*) was US\$ 19,465 per student. The comparable cost for producing one specialist physician (surgeon or obstetrician/gynaecologist) was US\$74,130 (Table 8). The annual cost of deploying TCs and specialist physicians was US\$ 3,859.0 and US\$ 10,367.7, respectively. The bulk of

the deployment cost was salaries; the costs of additional supervision and referral for TCs were \$196.4 per person per year or 5.1% of total.

Table 8.

Comparison of undiscounted average annual and total training costs in US\$ to train one TC and one specialist physician, respectively

	Cost per year	Years	Course cost
Técnicos de cirugía			
First level training	1,606.8	3	4,820.4
TC course	4,881.4	3	14,644.3
Total cost of training			19,464.7
Physicians			
Medical school	3,572.8	6	21,437.0
Residency training	10,538.6	5	52,692.8
Total cost of training			74,129.8

Figure 1 compares thirty-year training and deployment costs for TCs and physicians. While training costs are higher for physicians, due to the longer period of training and higher in-training salaries, the bulk of the difference between the career costs of TCs and physicians lies in the substantially higher salaries paid to specialist physicians after completion of training.

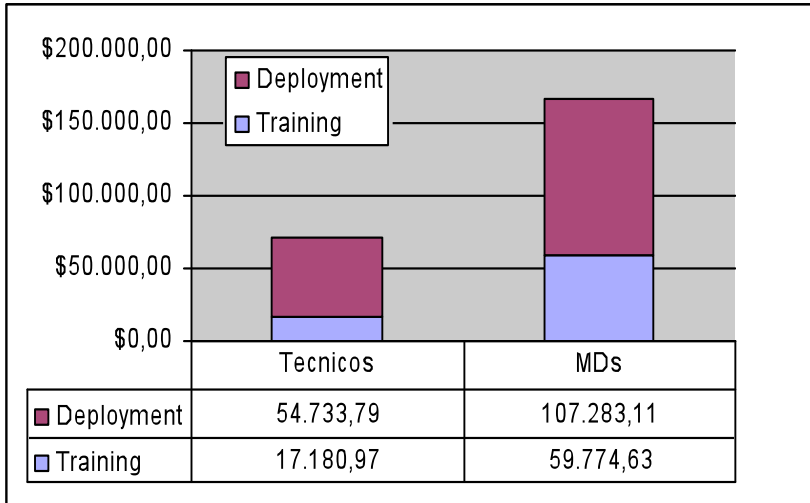


Figure 1. Comparison of 30 years training and deployment costs for técnicos de cirugía and specialist physicians.

6.2.2 Productivity

In 2002, 47 specialist physicians and 53 TCs performed a total of 5,264 and 6,914 major obstetric surgeries (caesarean deliveries, obstetric hysterectomies, and laparotomies for ectopic pregnancy), respectively (Pereira et al, unpublished). On average, each TC performed 117 Caesarean deliveries, 7 obstetric hysterectomies, and 7 laparotomies for ectopic pregnancy, annually. Comparable numbers for specialists were 102, 4, and 6, respectively. These figures were used to (approximately) represent annual productivity for major obstetric surgery throughout the career of the two cadres.

6.2.3 Cost-effectiveness and sensitivity analysis

The cost-effectiveness ratio of TCs and physicians, not including start-up costs, is shown in Figure 2. At current salary levels, the career cost of a TC is US\$ 38.87 per major obstetric surgery versus the cost of US\$ 144.1 for physicians. At the time of the study TCs earned less than operating room scrub nurses. If their salaries were to double, their costs per major surgery would still be less than half of the physicians (Figure 2).

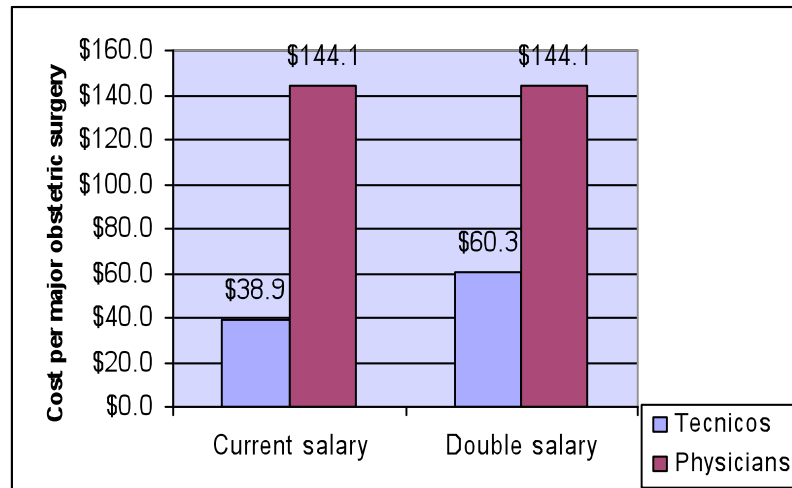


Figure 2. Career cost-effectiveness ratios (30 years) for técnicos de cirurgia and specialist physicians at current salaries and at double salary for técnicos.

6.3 PAPER III

In the 23 government hospitals in Mozambique investigated, 12,178 major surgical obstetric interventions (caesarean deliveries, obstetric hysterectomies and laparotomies for ectopic pregnancy) during one year were analyzed. At the district hospital level it was found that 92% of 3,246 such operations were carried out by TCs, and only 8% were done by MOs. At general/provincial hospital level TCs carried out 34% and MOs 66% of these interventions, whereas at the central hospital level the corresponding figures were 53% for TCs and 47% for MOs. Out of all 12,178 such major obstetric surgery interventions in the country, TCs performed 57% (Table 9).

Table 9.

Caesarean deliveries, obstetric hysterectomies and laparotomies for ectopic pregnancy in all hospitals in Mozambique that do major surgery, encompassing district/rural hospitals (n=23, general and provincial hospitals in urban areas (n=8) and central hospitals (n=3))

Site and intervention	MOs n (%)	TCs n (%)	Total
District hospitals with surgical facilities (n = 23)			
Caesarean delivery	244 (9)	2,617 (91)	2,861
Obstetric hysterectomy	10 (4)	254 (96)	264
Laparotomy for ectopic pregnancy	11 (9)	110 (91)	121
Total	265 (8)	2,981 (92)	3,246
General and provincial hospitals (n = 8)			
Caesarean delivery	2,513 (66)	1,296 (34)	3,809
Obstetric hysterectomy	111 (65)	61 (35)	172
Laparotomy for ectopic pregnancy	122 (63)	72 (37)	194
Total	2,746 (66)	1,429 (34)	4,175
Central hospitals (n = 3)			
Caesarean delivery	2,028 (47)	2,281 (53)	4,309
Obstetric hysterectomy	80 (60)	53 (40)	133
Laparotomy for ectopic pregnancy	145 (46)	170 (54)	315
Total	2,253 (47)	2,504 (34)	4,757
All hospitals with surgical facilities (n = 34)			
Caesarean delivery	4,785 (44)	6,194 (56)	10,979
Obstetric hysterectomy	201 (35)	368 (65)	569
Laparotomy for ectopic pregnancy	278 (44)	352 (56)	630
Grand total	5,264 (43)	6,914 (57)	12,178

At graduation, the MOs had an average age of 27 years and the TCs 37 years. Of all TCs that graduated in 1987, 1988 and 1996 there were 91%, 91% and 83%, respectively, who were directly assigned to a district hospital (Table 10). Taken together, of all TCs assigned to district level hospitals in the three batches, 88% were still there seven years after graduation.

Table 10.

Place of work of MOs and TCs directly after graduation and at two and seven years after graduation at district, provincial and central level. Each of the three batches (1987,1988 and 1996) is presented separately

	MOs	(TCs)
1987 Graduates (n)	11	11
First employment after graduation*		
District hospital, n and (%)	0 (0)	10 (91)
Urban or provincial hospital, n and (%)	5 (50)	1 (9)
Central level or Ministry of Health, n and (%)	1 (10)	0 (0)
Employment 2 years after graduation**		
District hospital, n and (%)	0 (0)	10 (91)
Urban or provincial hospital, n and (%)	4 (40)	1 (9)
Central level or Ministry of Health, n and (%)	1 (10)	0 (0)
Employment 7 years after graduation		
District hospital, n and (%)	0 (0)	10 (91)
Urban or provincial hospital, n and (%)	0 (0)	1 (9)
Central level or Ministry of Health, n and (%)	5 (50)	0 (0)
1988 Graduates (n)	17	11
First employment after graduation***		
District hospital, n and (%)	4 (22)	10 (91)
Urban or provincial hospital, n and (%)	9 (50)	1 (9)
Central level or Ministry of Health, n and (%)	2 (11)	0 (0)
Employment 2 years after graduation		
District hospital, n and (%)	2 (11)	10 (91)
Urban or provincial hospital, n and (%)	14 (78)	1 (9)
Central level or Ministry of Health, n and (%)	2 (11)	0 (0)
Employment 7 years after graduation		
District hospital, n and (%)	0 (0)	10 (91)
Urban or provincial hospital, n and (%)	4 (25)	1 (9)
Central level or Ministry of Health, n and (%)	12 (75)	0 (0)
1996 Graduates (n)	31	12
First employment after graduation****		
District hospital, n and (%)	12 (39)	10 (83)
Urban or provincial hospital, n and (%)	11 (35)	2 (17)
Central level or Ministry of Health, n and (%)	7 (23)	0 (0)
Employment 2 years after graduation		
District hospital, n and (%)	0 (0)	10 (83)
Urban or provincial hospital, n and (%)	23 (74)	2 (17)
Central level or Ministry of Health, n and (%)	7 (23)	0 (0)
Employment 7 years after graduation		
District hospital, n and (%)	0 (0)	10 (83)
Urban or provincial hospital, n and (%)	17 (55)	2 (17)
Central level or Ministry of Health, n and (%)	13 (42)	0 (0)

*Five doctors (Portuguese students) went away when the training was concluded, representing 40%. **One doctor died. *** Two doctors (Portuguese students) went away when the training was concluded, representing 17%. ****One doctor (Cuban) left when the training was concluded, representing 3%.

More MOs have become available for rural assignments in later years, and the numbers assigned at first to district hospitals rose from zero in 1987 to 22% in 1988 and 39% in 1996. But the percentage of MOs remaining at the two year mark fell to 0%, 22%, and 0% for the classes of 1987, 1988 and 1996. The figures for TCs remained almost constant at the two year mark after the first assignment with 91%, 91% and 83%, respectively, remaining at the district level. After two years, MOs are almost always transferred from district hospitals to urban hospitals at the provincial level or the central level to assume responsibilities as director of provincial hospital or to become provincial director of health.

Seven years after graduation the picture remained almost constant, not a single MO was employed at the district level. MOs employed at the provincial level at seven years diminished from 100% to 0% in the 1987 group, from 78% to 25% in the 1988 group and from 74% to 55% in the 1996 group. The number employed centrally increased from 1% to 100% in the 1987 group, from 11% to 75% in the group of 1988 and from 23% to 42% in the 1996 group.

6.4 PAPER IV

Medical doctors represent the largest (n = 31) group of our interviewees. Among them about two thirds (n = 19) were managers at provincial level (n = 9) or medical officers/ hospital directors at district level (n = 11). And around one third were specialist physicians, who had a multifaceted relationship with the TCs; their opinions, especially outside Maputo, are mainly those of care-givers to the patients referred by TCs, internship supervisors, and in some instances also colleagues. All interviewed health professionals were familiar with tasks carried out by the TCs. Participants appear to have been open about their views during the group discussions but more frank about relationship during the interview. Overall, we focus on the interview method, limiting group discussion to general comments about the broad picture of the health professional's views.

The findings provide an overview of the health staff in the four selected areas. Some emerged during data analysis, eliciting general opinions on the role played by the TC, the adequacy of their training, relationships with health facility team, career progression and remuneration.

In general, the health staff interviewed was by and large positive towards the TCs. In more than half of interviews and in the majority of the group discussions the opinions were mostly favorable. None-

theless, in a considerable proportion of interviews many negative aspects were pointed out. Criticism was more frequent among managers and specialists, mainly among those working outside Maputo.

6.4.1 The role played by the “técnico de cirurgia”

The interview data analysis identified seven themes most frequently mentioned in the interviews. The questionnaire was open ended, the respondents referring to these different areas spontaneously.

The majority, 64/71 (90%), of interviewees considered TCs to be important. Among medical doctors at all levels, bar the specialist physicians working outside Maputo, this figure reached 100%. Other health staff interviewed at district level had a similar opinion; 37/40 (90%) considering TCs to have an important role. Interviewees, mainly non-physician staff, mostly associate the TCs' importance with the key role he/she has in maternal care and life-saving skills in general. Besides, the general opinion was that rural hospitals are almost completely dependent on TCs for surgical activity, for which they have adequate and usually appropriate training.

“It is like this, the TCs are very important for the life of our health units: first we don't have specialists' physicians to address the country's needs (...) any health unit without a TC suffers a lot due to the lack of this cadre. The work that they carry out, I am not going to say perfect but it is very good. ... We, the medical doctors have a very limited training ... besides that I am not interested in surgery and obstetrics.” (Medical doctor, district hospital director)

Besides, it was noted during this study that the levels of absenteeism were perceived by different staff to be lower than that of medical doctors.

Interviewees across all groups of health professionals also associate the presence of a TC in a district with an important reduction of costs. The surgical activities performed by the TCs lessen the pressure on the meagre health care resources by reducing the number of patient referrals. They reduce both emotional and financial costs for the patients and their families:

“He [the TC] is very important; in the past, due to the lack of this cadre, there were many problems; we had to refer everything to another district and the provincial hospital in another province. The disruptions caused by this were a real problem, either in money spent for fuel or for the ensuing costs to the patients. Mainly for us here, in district of ..., the district of ... and provincial hospitals are too

far from here for us to refer patients there. But now it is possible to manage [emergencies] locally, it's easy to treat the patients here." (Chief Nurse in-charge of nursing care, district hospital)

"...when the TC is absent the result is catastrophic; many resources are spent for [patient] referrals, transport, etc". (Medical Doctor, District Clinical Officer)

In addition, some health workers at district level associate the responsibility of TC not only with the hospital where he/she is deployed but for a larger geographical area:

"... In this region it is a very important work because he is the only one, it is a rural hospital that serves three districts. He has been saving many people". (MCH nurse, district hospital)

"I think that [the TC] is very important, since this is a rural hospital, thus a referral health facility. There are many inhabitants and the medical doctor does not have sufficient training in surgery." (Medical doctor, rural hospital)

Interviewed health professionals, mainly medical doctors at provincial level, conveyed that the work of the TCs also has a positive impact on the surgical care provided at levels above the rural hospital, either directly or indirectly. They pointed out that although the TCs were envisaged to provide surgical care in rural hospitals, a noticeable proportion of TCs are deployed at provincial and central hospitals, that the TC's work at district level greatly alleviates the pressure and workload of second and third referrals units:

"Well, our TC is good, because without him I don't know what would be in terms of the rural hospital [where] he is the surgeon; here in the provincial hospital he works in shifts in equal terms with the other specialists [surgeon, obstetrician and orthopaedic]; when one specialist goes on vacation, she/he is replaced by the TC. At rural hospital level they [TCs] provide all [types of] care and they decrease the provincial hospital workload, [can you] imagine without their presence [in the districts], what would be the workload at the provincial hospital." (Medical doctor, provincial health authority)

6.4.2 Training and quality of care

When questioned about the perceived quality of care/performance of the TCs, more than half of the interviewed health professionals but very few group discussion participants addressed the issue by talking about the TC training. Selected sub-themes that emerged from interview data analysis are presented below. The overall opinion, mainly among the medical doctors (10/12) at district level, was that TCs are adequately trained:

“The TC is well trained. I wouldn’t change anything in his training. I’m speaking about the specific situation here ...” (Medical doctor, rural hospital director)

Nonetheless, some shortcomings were pointed out in the discussions held. A number of interviewed medical doctors spontaneously brought up issues they felt a need to be examined, such as: theoretical and clinical skills, the internship process and its organization, limited orthopaedic capacity, and the need for a clear definition of the level/limit of intervention by these cadres.

6.4.3 Surgical, theoretical and clinical skills

Health professionals, mainly medical doctors, consider that the TCs to have good surgical skills, mainly to tackle obstetric emergencies. A few specialists felt that orthopaedics should be strengthened although acknowledging that the available training time is an important limitation.

Some interviewed medical doctors considered the TCs’ pharmacological knowledge and prescribing competence insufficient. A few doctors suggested that TC’s with a background training as general nurses or nurse specialists have more limitations in clinical skills than the TCs entering with a background as “*técnico de medicina*”.

One medical doctor raised the critical issue of neonatal care:

“In the district of ... we have two TCs; [before] we had [also] an expatriate gynaecologist. The TC had better surgical skills and the gynaecologist recognized this [fact]. In relation to quality and capacity of surgical interventions, they are good. I have reservations on their pre- and post-operative abilities.” (Medical doctor, public health specialist & provincial director)

“...the only thing is that they use a lot of antibiotics and expensive ones; all the caesarean deliveries are treated with antibiotics; all the equipment is sterilized in the theatre room and it is the surgery team who controls...” (Medical doctor, district medical officer)

6.4.4 Internship

In general, the interviewed specialist physicians /consultants expressed that trainees during their internship at Maputo Central Hospital are not adequately supervised. One surgeon added that, in his opinion, these cadres should have a longer completion time for the internship at provincial level, having conditions similar to the ones waiting for the TC once in a rural setting. However, this surgeon and some other specialist physicians considered that the process and organization of the internship at provincial hospitals needed to be strengthened to adequately address this issue. Besides the problems with provincial hospital capacity itself, two specialists outside Maputo noted that the informal approach followed negatively affects the organization of the internship:

“... The TC should be trained in a provincial hospital and spend more time at a provincial hospital and less in the Maputo Central Hospital: (a) until their arrival at the Provincial Hospital for their internship they don't have sufficient [practical skills]; in Maputo Central Hospital there are numerous students ... and they all stay behind one consultant, thus in Maputo Central Hospital the TC has less supervision, which means fewer opportunities to practice. (b) The provincial hospital is the internship field nearer to and similar to the conditions where the TC is going to work.”... (Medical doctor, expatriate obstetrician-gynaecologist)

In order to further improve the performance of these cadres, some interviewees drew attention to the above shortcomings and thought they should be addressed, either during the pre-service training of these cadres, or through a well designed hands-on on-the-job training programme, e.g. by The National Surgery Programme, organizing regional training courses for these cadres once a year. However, for a number of reasons, not all the TCs have been able to attend these courses. The professionals interviewed felt that the training approach of these courses needs to be modified thoroughly. The specialists working in the referral hospitals with major contact with the TCs should have an active role in this training programme with emphasis on a more practical approach, implying a hands-on and problem-specific training process:

“...An in-service training, is necessary because in the districts they have to take care of all areas, obstetrics, gynaecology, orthopaedics and surgery; in order to further improve their performance in other areas, they could stay [return] for a week in a provincial hospital and besides [general] surgery they could also see [be trained] obstetrics, orthopaedics. Or any other type of training to prepare them because they work alone in the districts in remote areas. ...” (Chief Nurse, in-charge of nursing care, district hospital)

A small group of professionals, mainly specialists, raised concerns regarding practice regulation; they considered that in some instances TCs intervene above their abilities:

“There should be a regulation regarding the interventions that the TCs can perform; some perform surgery above their capacities, for example: fistulas, prostate cancer, etc. There should be a regulation of what they can do”. (Medical doctor, provincial health authority)

6.4.5 Relationships and collaboration

In the group discussion, notwithstanding probing efforts, few participants (8/48) addressed the issue and five of them stated that ‘there is good collaboration’. Although individual interviewees were more open and frank on this issue, only just above half of the interviewed health professionals addressed this issue. The majority of them referred to a variety of difficulties in collaborating with TCs. In particular, their interactions with medical doctors at district level have been considered problematic. Interviewees of different categories felt that the skills of the TC represented a threat to the power of the medical doctor and the district officer, resulting in conflicting relationships:

“We, the medical doctors, don’t have knowledge of surgery and they try to show this; that they are on top [more skilled than us] and this creates conflicts with the medical doctors. Sometimes there are many conflicts. During the training itself, they should know that in spite of their surgical skills, they are technicians [mid-level cadre] ... and that they are subordinated to the medical doctor and that they are going to work with a team”. (Medical doctor, provincial medical officer)

“They have more value because they are considered Kings in the district; the TC performs surgical interventions and the medical doctor writes out prescriptions of paracetamol [tablets] ... this creates conflicts with medical doctor since s/he doesn’t have enough surgical skills such as cae-

sarean delivery, and a lot more. In fact, you will see that the medical doctor opinion will be different from mine". (Expatriate surgeon Maputo City)

Some TCs are considered arrogant. Some health professionals referred to a lack of openness from the TCs, which limited collaboration with other colleagues. This attitude sometimes is a source of problematic relationships and it hinders the learning process of other cadres and maintains levels of high workload for the TC. Some interviewees noted that the recently started training programme on safe motherhood, trained medical doctors and mother and child health nurses, but due to the lack of collaboration of some TC in some districts these trained cadres are not applying the new skills acquired:

"...There is no space ... the medical doctors who went to safe motherhood training programme for obstetric care do not make use of this training, due to the lack of collaboration with the TC. As a result TCs continue with a high workload and the participation of medical doctors in the implementation of the safe motherhood strategy is limited". (District health director)

"... They need clear information, because often the TC thinks that he is alone ... another thing is the training, I've seen that he wouldn't let the MCH nurses perform aspirations of abortions. If he thinks they don't have the skill, he should train them; it would be a way of alleviating his workload. It is a waste because the MCH nurses have had the preparation in the safe motherhood training programme and in the District of ... they are not using it [the skills acquired]. It has to do with the TC himself and the time they stay in the same district, if they stay for three to five years they end up becoming the owners of everything. ... The medical doctors, who attended the safe motherhood training programme, once back to their districts; often do not have the chance to perform. Meanwhile, the TC continues with high workload." (MCH nurse, in-charge of provincial mother and child health care)

Two provincial directors suggested that character problems among TCs as well as among medical doctors are important in the existing relationship between the two categories:

"... Something very important is missing in the TC profile and it is the training itself that is failing, he [TC] has to understand that he is not the king... on the other side, medical doctors are trained in an atmosphere of vanity..." (Medical doctor, Provincial Director)

However, some interviewees acknowledged a good relationship with TCs:

“I have good relationship with him; he is tireless ... if all TCs were like him the country wouldn't have problems. ... The problematic relationship depends on the medical doctor who is there; hardly the medical doctor and the TC sit at the same table. ...The existing relationship has to do with the personal temperament... it's bad, the war weakens the authority. ... My congratulations to him I only pray [hope] that the medical doctor coming to replace me will work well with him.”
(Medical doctor, rural hospital director)

6.4.6 Career progression and remuneration

When questioned about the adequacy of support and supervision provided to the TCs, most interviewees and group discussion participants raised issues about insufficient incentives, inadequate working conditions, high workload, insufficient recognition/ valorization and only a few, mainly medical doctors interviewed raised the career progression and remuneration issue. However, this last issue appeared to be more important and was thus selected. All staff addressing this issue, judged the TCs' career perspective as inadequate. They think that TCs should not be considered mid-level cadres, since they have more years of training, far heavier responsibilities, unique skills at district level and a higher workload than most mid-level staff. The salary issue was more controversial, with diverging views among health professionals. Although the overall view is that the TCs' pay level is low, some interviewees affirmed that the TCs' salary problem is just the same as the problem of all health workers. Other sources of income and or incentives were mentioned during the discussions, but interviewees judged them insufficient. They comprise housing, transport, private practice etc, and they are mostly dependent on local initiatives. Some interviewees stressed the inadequacy of the career pathway and remuneration:

“... An individual spends six years in school and continues to be considered mid-level [it's unjust]...There is a huge gap between the salaries of medical doctors and the TCs ... even a newly-trained medical doctor earns more than four times the TC's salary. It's not a designation problem but a problem of career qualification. It's necessary to distinguish the areas, not all [workers] are equal, and a nurse has three training years less than the TC. The TCs are being damaged in relation to wages”. (Medical doctor, specialist, Maputo)

Some interviewees, mainly medical doctors and MCH nurses, considered the TCs to be the most disadvantaged health professionals partly due to career definition problems. Thus, they found the payment of this cadre very low in absolute terms as well as when compared with other professionals within the health system and outside it. Moreover, a few of the interviewees considered that the salary level affects the TCs' morale and motivation with ensuing behavioural problems. In a few interviews illicit charges were also mentioned:

“... also the income is insufficient, because, sometimes we give a glance [at the salaries] and there is no difference between them and other mid-level cadres ... the salary is very low. They work a lot, that it is why sometimes they find themselves obliged to ask for illicit charges. When someone comes and asks for an abortion we send her to them. There are persons who ask for [abortions] and then they speak out outside that they were charged whilst it is them who looked for [asked for] it. Therefore, at least their salary should be increased.” (MCH nurse, in-charge of the district mother and child health care)

6.5 PAPER V

In Mwanza region, Tanzania, there is one large university hospital, plus four mission and six government hospitals (Table 11). In Kigoma region there are two mission and three government hospitals. Private hospitals had few deliveries and almost no major surgery, and were not included in this review. Among the mission hospitals, two in Mwanza were nominated by the government as Designated District Hospitals (DDH). DDH mission hospitals do not charge for obstetric service, and have a much larger volume of work than independent mission hospitals. All government hospitals provide free obstetric service.

Table 11.

Hospitals with comprehensive emergency obstetric care (CEmOC), their bed capacities and burden of deliveries during 2003.

Hospital Category	Mwanza			Kigoma		
	No.	Beds	Deliveries	No.	Beds	Deliveries
University	1	850	4,410	0	0	0
Regional (Government)	1	129	5,113	1	260	5,220
District (Government)	5	581	10,612	2	275	4,346
DDH (Mission)**	2	448	7,266	0	0	0
Independent (Mission)	2	256	771	2	262	1,020
Private*	(3)	(200)	(<500)			
Total	11	2,304	28,172	5	797	Total

*Private hospitals in Mwanza did only a few major operations at the time of this review, and were not included in the study. ** DDH=Designated District Hospital

The extent to which the goals of the first three UN Process Indicators for CEmOC had been met was calculated (Table 12). The number of CEmOC hospitals per 500,000 population exceeded the UN guideline in both regions, but the proportion of estimated births in the region with a caesarean delivery or other major obstetric operation was far lower than the 5% minimum recommended by WHO.

Table 12.

Population and obstetric services (UN Process Indicators)

	Mwanza	Kigoma	UN guideline
CEmOC hospitals per 500,000 population	2	1.5	1
Proportion of estimated births in CEmOC hospitals	24.6%	16.2%	
Proportion of estimated birth with major surgery (usually caesarean delivery)	*2.8%	*2.2%	5-15%

*These are data based on estimated total deliveries per region and are related to all documented hospital events characterized as "major obstetric operation"

Among the 38,758 registered hospital births there were 8,257 complicated deliveries (Table 13). Most of these complicated cases were births requiring major operations, and almost all of these operations were caesarean deliveries. There were only 260 vacuum extractions, corresponding to 0.7% of all hospital deliveries. Post partum haemorrhage (bleeding in excess of 500 ml), treated without operation, was recorded in 425 mothers (1.1%). This is most probably an underestimate.

Table 13.**Categories of complications identified among 38,758 CEmOC hospital deliveries in Mwanza and Kigoma.**

Type of complication	No.	Percentage of all deliveries
Major operations	4,599	11.9
Incomplete abortions	2,500	6.5
Vacuum extractions	260	0.7
Retained placentas	267	0.7
Eclamptic cases without surgery	87	0.2
Perineal tears of third degree	24	0.1
Postpartum haemorrhage cases without surgery	425	1.1
Other	95	0.2
Total	8,257	21.3

Met need was calculated by comparing the actual number of hospital managed complicated deliveries in the two regions with the expected number. In Mwanza met need was 34% and in Kigoma 23% (Table 14). In Mwanza 47% of met need came from government district and regional hospitals, 30% from mission hospitals, and 24% from the University Hospital. In Kigoma 84% of these complicated cases were managed in government hospitals and 16% in mission hospitals (Table 14). In Kigoma, no mission hospital has been designated a district hospital, so that they all have relatively high charges. Probably, for this reason, mission hospitals were much less important for service delivery in Kigoma.

Table 14.

Surgical interventions associated with caesarean delivery (CS) performed by TCs or specialists in obstetrics and gynaecology. Values are given as n (%)

Hospital category	Mwanza	Kigoma
University hospital	1,407	-
Govt. regional	450	651
Govt. district	2,314	1,234
Mission DDH	1,512	0
Mission Independent	256	368
Total	5,939	2,235
Met need	(5,939/17,200) 35%	(2,253/9,800) 23%

The University Hospital in Mwanza had a fully staffed teaching obstetric service, with six specialist obstetricians and five residents in training, but no AMOs. All of the other hospitals, both government and mission, had AMOs among staff and performing obstetric surgery. Government “regional” hospitals functioned essentially as district hospitals for their own urban Districts, with few referrals from other hospitals, but the university hospital in Mwanza was primarily a referral hospital with many complicated obstetric cases referred from other centers (Table 15).

Table 15.**Complicated deliveries as a percentage of total deliveries in each category of hospital.**

Hospital Category	Mwanza		Kigoma	
	n	(%)	n	(%)
University Hospital	1,407/4,410	(32)	-	-
Govt. Regional	450/5,113	(8)	651/5,220	(12)
Govt. District	2,314/10,612	(22)	1,234/4,346	(28)
Mission DDH	1,512/7,266	(21)	-	-
Mission. Ind.	256/771	(33)	368/1,020	(36)

Overall, in all government and mission hospitals in the two regions, AMOs carried out 85% of the major obstetric surgery (Tables 16 and 17). If the university hospital is included, AMOs did 63% of this surgery. The proportion of the more serious cases done by AMOs in government and mission hospitals was essentially the same for all categories of operation: they did 85% of caesarean deliveries, 70% of obstetric hysterectomies, 94% of the repairs in cases of ruptured uterus, and 86% of the operations for ectopic pregnancy (Table 17).

Table 16.

Categories of staff providing “met need” calculated from major obstetric operations only (n=4,599) in Mwanza and Kigoma hospitals.

Hospital category	Mwanza (n=3,195)						Kigoma (1,404)					
	MO		AMO		Other		MO		AMO		Other	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
University Hospital	1,139	(100)	0	(0)	0	(0)	-		-		-	
Govt.	40	(3)	1,158	(96)	11	(1)	63	(5)	1,114	(93)	16	(1)
Mission	325	(38)	509	(60)	13	(2)	78	(37)	132	(63)	1	(0)
Total	1,504	(47)	1,667	(52)	24	(1)	141	(10)	1,246	(89)	17	(1)

Table 17.

Categories of major obstetric surgeries (n=3,465) done by MOs and AMOs in both Mwanza and Kigoma hospitals. (Excluding the University Hospital)

Operation	MO		AMO		AMO+MO		Other	
	n.	%)	n.	%)	n.	%)	n.	%)
Caesarean delivery	442	(14)	2,654	(85)	12	(0)	19	(1)
Obstetric hysterectomy	13	(28)	32	(70)	1	(2)	0	(0)
Repair of ruptured uterus	4	(6)	61	(94)	0	(0)	0	(0)
Removal of ectopic pregnancy	19	(14)	121	(86)	0	(0)	0	(0)
Other	14	(12)	64	(56)	18	(16)	18	(16)
Total	449	(13)	2,942	(85)	37	(1)	*37	(1)

*expatriate who came for short period of time

Monthly maternal mortality review is required in all Tanzanian hospitals. Records of these mortality review meetings were used to calculate the maternal case fatality rates for each category of hospital (Table 18). Overall, case fatality in Kigoma was 1.2% - close to the UN target of 1%. At 2%, case fatality was higher in Mwanza. Rates were lower in mission hospitals than in government hospitals. The relatively high maternal case fatality in the university hospital is presumably related to the large number of seriously complicated cases referred there from other hospitals. It is noteworthy that the possibility of referral to a teaching center in Mwanza did not result in a lower case fatality for the region – case fatality was higher there, and the difference between Mwanza and Kigoma is significant.

Table 18.

Aggregate case fatality rates (all direct obstetric morbidities) calculated as the number of direct obstetric maternal deaths occurring in hospital in relation to number of complicated deliveries in different categories of hospitals in Mwanza and Kigoma regions.

Hospital Category	Mwanza		Kigoma	
	n.	(%)	n..	(%)
University Hospital	29/1,407	(2.1)	-	-
Other Govt. Hosp.	73/2,764	(2.6)	26/1,885	(1.4)
Mission Hosp.	17/1,833	(0.9)	2/368	(0.5)
All hospitals	119/6,004	(2.0) ^x	28/2,253	(1.2) ^x

^xChi square for all hospitals, comparing Mwanza and Kigoma = 4.97; p = 0.026

6.6 PAPER VI

6.6.1 Obstetric risk.

The risk indicators selected were a) an absolute maternal indication for surgery; b) presence of a major acute problem at the time of admission (shock, systolic blood pressure less than 80 mm Hg, sep-

sis, convulsion, or ruptured uterus); and c) presence of a major chronic problem at the time of admission (hemoglobin less than 80 g/L, symptomatic malaria, or symptomatic AIDS). There were no significant differences in obstetric risk between patients operated on by medical officers and those operated on by assistant medical officers (Table 19).

Table 19.

Risk indicators for emergency obstetric surgery in Tanzania, among different provider types and different hospital types, 2006

Surgeons (945 AMOs and 142 MOS)					
	AMOs	MOS	OR	95% CI	p value
Operation done for AMI	312 (33%)	48 (34%)	0.96	(0.65–1.42)	0.83
Cases admitted with major acute problem	63 (6.7%)	14 (9.6%)	0.65	(0.34–1.26)	0.17
Cases admitted with major chronic problem	172 (18.2%)	22 (15.5%)	1.21	(0.73–2.08)	0.43
Hospitals (820 cases admitted to govt. hospitals, 313 cases admitted to mission hospitals)					
	AMOs	MOS	OR	95% CI	p value
Operation done for AMI	297 (36%)	102 (33%)	1.17	(0.88–1.56)	0.25
Cases admitted with major acute problem	59 (7.2%)	24 (7.7%)	0.93	(0.56–1.58)	0.78
Cases admitted with major chronic problem	167 (20.4%)	40 (12.8%)	1.75	(1.18–2.58)	0.003

NOTE: OR is odds ratio. CI is confidence interval. AMI is absolute maternal indication for surgery.

Between mission and government hospitals, the number of patients with acute risk did not differ, but there were a significantly higher proportion of patients with major chronic risk in the government hospitals: severe anemia, symptomatic AIDS, and symptomatic malaria.

6.6.2 Fatal outcomes.

There was no difference between AMOs and MOS in the percentage of fatal outcomes for mother or child in these emergency operations (Table 20), but mission hospitals had half the case fatality rate of government hospitals. MOS were more likely to do an operation in the mission hospitals, but AMOs

did most of the surgery in both categories of hospital: 92 percent in government hospitals and 73 percent in mission hospitals.

Table 20.

Fatal outcomes of emergency obstetric operations performed by AMOs or MOs in fourteen hospitals in Kigoma and Mwanza Regions, Tanzania, 2006

Surgeon	AMO (945 operations)	MO (143 operations)	OR	95% CI	p value
Mother or baby dead	136 (14.4%)	19 (13.3%)	1.10	(0.65–1.42)	0.72
Hospital	Nine govt. hospitals (778 operations)	Five mission hospitals (309 operations)			
Mother or baby dead	128 (16.5%)	27 (8.6%)	2.16	(1.37–3.42)	0.0004

6.6.3 Quality of care—AMOs and MOs.

Three kinds of outcomes were taken as indicators of quality of care: a) maternal deaths; b) perinatal deaths of newborns with fetal heartbeat noted as present on admission; and c) major postoperative complications, comprising ruptured uterus occurring after admission, wound infections requiring more than two weeks' hospitalization, uterine haemorrhage after cesarean delivery, burst abdominal wall, operative vesico-vaginal fistula, and ureteral injury. Bad outcomes were slightly more frequent for operations done by AMOs, but the overall difference was small and not significant (Table 21).

Three additional indicators of quality of care were selected: a) percentage of operations performed without an absolute maternal indication or clear fetal indication; b) delay of operation for more than three hours in patients with a clear indication for immediate operation at the time of admission; and c) absence of any blood transfusion in patients with clear evidence of an urgent need for transfusion. There are no statistically significant differences in any of these measures (Table 21), although MOs were somewhat more likely than AMOs to do operations without an absolute maternal indication or clear fetal indication and somewhat less likely to have problems obtaining urgently needed blood.

Table 21.**Quality of care provided by AMOs and MOs in fourteen hospitals in Kigoma and Mwanza regions, Tanzania, 2006**

Outcome indicators	AMOs	MOs	OR	95% CI	p value
Maternal death (945 AMOs, 143 MOs)	16 (1.7%)	5 (3.5%)	0.47	(0.16–1.68)	0.14
Perinatal death—fetal heartbeat present on admission (785 AMOs, 116 MOs)	49 (6.3%)	4 (3.4%)	1.87	(0.67–7.26)	0.14
Major complications (945 AMOs, 143 MOs)	33 (3.5%)	6 (4.2%)	0.83	(0.33–2.46)	0.67
All bad outcomes (945 AMOs, 143 MOs)	84 (9.0%)	11 (7.7%)	1.19	(0.60–2.42)	0.61
Quality Indicators					
No absolute maternal or clear fetal indication (929 AMOs, 143 MOs)	427 (46.0%)	76 (52.8%)	0.76	(0.52–1.13)	0.16
Over 3 hours to urgently indicated operation (215 AMOs, 33 MOs)	121 (56.3%)	19 (57.6%)	0.95	(0.42–211)	0.89
Urgent blood need, but no transfusion (166 AMOs, 24 MOs)	88 (53.0%)	11 (45.8%)	1.33	(0.52–3.41)	0.51

6.6.4 Quality of care—government hospitals and mission hospitals.

Perinatal deaths in cases where a fetal heartbeat was present on admission were much less likely in mission hospitals than in government hospitals, but operative complications were more likely (Table 22). The higher rate of complications in mission hospitals was presumably due to a higher rate of ruptured uterus after admission to the hospital. There are also significant differences between government and mission hospitals in two of the three quality indicators: mission hospitals did more operations for fetal indications that were not clear, and patients in urgent need of blood were much more likely to get it in a mission hospital.

Table 22.

Quality of maternal and perinatal care in government hospitals and mission hospitals in Mwanza and Kigoma regions Tanzania, 2006

Outcome indicators	Govt. hospitals	Mission hospitals	OR	95% CI	p value
Maternal death (820 govt., 313 mission)	19 (2.3%)	7 (2.2%)	1.04	(0.41–2.95)	0.94
Perinatal death—fetal heartbeat present on admission (683 govt., 269 mission)	54 (7.9%)	4 (1.5%)	5.69	(2.06–21.8)	0.0002
Major operative complications (778 govt., 309 mission)	21 (2.7%)	18 (5.8%)	0.45	(0.23–0.89)	0.012
All bad outcomes (820 govt., 313 mission)	81 (9.9%)	24 (7.7%)	1.32	(0.80–1.29)	0.25
Quality indicators					
No absolute maternal or clear fetal indication (684 govt., 262 mission)	297 (43.4%)	147 (56.1%)	0.60	(0.45–0.81)	0.0005
Over 3 hours to urgently indicated operation (181 govt., 75 mission)	84 (46.4%)	34 (42.7%)	1.16	(0.65–2.08)	0.58
Urgent blood need, but no transfusion (170 govt., 30 mission)	40 (56.5%)	12 (30.0%)	3.03	(1.23–7.63)	0.007

6.6.5 Perinatal deaths in cases with the fetus alive on admission.

There is a significant difference in the proportion of such perinatal deaths between government and mission hospitals. There is also a difference in perinatal death rates between cases of AMO and MOs, even though not statistically significant.

Most operations by MOs are done in mission hospitals, so it is necessary to look at the differences in the two kinds of hospitals separately, to see if this effect is related to the hospital, rather than the kind of surgeon. When this is done, the difference between AMOs and MOs disappears (Table 23).

As is seen in Table 23, overall, for AMOs there is a significant difference in perinatal deaths with fetal heartbeat present on admission (7.8 vs 1.5%) between government and mission hospitals, OR 5.56, 95%CI (1.76–28.21) but for MOs the difference (6.5 vs 1.5%) is not statistically significant, OR 4.74,

95%CI (0.36-252.63). In our earlier review of the same hospitals, with a larger sample, there was also a significant difference in maternal case fatality, with higher rates in government hospitals.

Table 23.

Perinatal deaths after caesarean deliveries with fetal heartbeat present on admission in government and mission hospitals in Mwanza and Kigoma regions, Tanzania, 2006

Government hospitals		Mission hospitals	
Surgeon	Perinatal deaths	Surgeon	Perinatal deaths
Assistant medical officer (603 operations)	48 (7.8%)	Assistant medical officer (196 operations)	3 (1.5%)
Medical officer (46 operations)	3 (6.5%)	Medical officer (69 operations)	1 (1.5%)

Lack of immediate available blood for urgent complications is a problem in both mission and government hospitals, but it is a considerably larger problem in the government hospitals. Government hospitals also have an increased number of patients with major chronic risk, and fewer patients having a cesarean delivery for elective or semi-elective indications. These three factors probably explain most of the better performance in mission hospitals. The difference between the proportions of operations done by AMOs does not explain any of the observed differences.

7. Discussion

7.1. *SCARCITY OF HUMAN RESOURCES FOR HEALTH: THE MAGNITUDE OF THE PROBLEM*

The existent literature indicates that the scarcity of human resources for health (HRH) is a worldwide problem and that Sub-Saharan Africa is the most affected region (5, 13, 76). Despite the interventions over the years to overcome this problem, the situation has become worse and is generally described as a crisis (13, 107-109). This crisis is a major challenge for health service delivery and for achieving the health-related MDGs (109-111).

Evidence proves that the human work-force is essential for the health system and drives health system performance (5, 109, 112-114) and also confirms that an appropriate and effective workforce enhances performance, even under difficult circumstances (13, 115-117).

Low output of graduates from medical schools(18, 118) due to limited quantity and quality of institutions, incapacity to motivate and retain human resources for assignments in remote areas, attrition of human resources, retirement, death or voluntary resignation, poor working conditions, threats and insecurity have been considered the main causes of this crisis(109, 118-121). The AIDS epidemic in Africa has further aggravated this crisis by depriving health systems of a significant proportion of trained staff (122).

Africa has 11% of world's population and bears over 24% of the global burden of disease but has merely 3% of the global health workforce (122), of which a small percentage are surgeons. Africa may have less than one percent of the number of surgeons in the United States, despite having a population that is three times as large.(14).

In Mozambique the scarcity of human resources for health is alarming, with merely three medical doctors (physicians) per 100,000 population. There are 33 registered nurses and midwives per 100,000 population.(123).

In Tanzania the health workforce is small and declining. The situation in Tanzania is particularly acute according to the Joint Learning Initiative (2004). Tanzania has one the world's lowest coverage of physicians, with only two medical officers per 100,000 population, leading to inequitable access to health services.

In Tanzania (78), with approximately 25,000 skilled human resources for health, fewer than 1,000 are physicians (specialists and general medical officers) and on top of that many of these are in govern-

ment positions, as administrators or work for non-governmental organizations, and are not directly providing patient care.

According to a study conducted by the London School of Hygiene and Tropical Medicine, Tanzania's human resource (for health) supply would need to increase by more than 58,000 to provide necessary interventions to meet the MDGs established for Tanzania (78).

In most countries in sub-Saharan Africa the scarcity in HRH started, in general, soon after independence as result of colonial policy and massive exodus of professionals (124, 125). This exodus forced governments to adopt new strategies to cover the shortage of health care providers to the entire population. In Mozambique the situation worsened with civil war instigated by the South African regime in the beginning of the 1980s. In Tanzania there was no war but low production of doctors in combination with an uneven distribution and depletion of HRH. These two countries share a common denominator, two types of "brain drain" which contributed to the deficit of trained health workers in areas where mortality figures were high. Firstly, the drainage of staff from poor countries to more affluent countries, offering better working conditions and salaries. Secondly, the drainage from poor and rural settings to urban areas, where the standard of life and prospects for families were better than in rural settings (Paper, III, V, VI).

7.2. *TASK-SHIFTING AND TASK-SHARING*

The literature indicates that informal or formal delegation of tasks from one cadre to another is not a new concept. Task-shifting implies the delegation of certain medical responsibilities to less specialized health workers (121). In surgery such health workers are capable to carry out many of the diagnostic and clinical functions of medical doctors in emergency obstetric care, including major surgery. This is direct substitution, implying substituting an existing profession with new and different cadres (20, 38). In essence, such delegation can be labeled "task-shifting", though there have been diverging opinions whether "task-sharing" would be a more appropriate concept. These two expressions would, however, seem to signify two different realities. Where there are no physicians, the tasks of physicians must be shifted to "non-physicians". Where there are physicians, though insufficient numbers, tasks of physicians may be "shared" with "non-physicians". "Task-sharing" where there is no doctor is an euphemism for "task-shifting"

7.3. *PERFORMANCE OF NPCS*

7.3.1 **Quality of work**

In most sub-Saharan countries the use of substitute health workers have begun as a temporary measure, while more doctors were trained, but has become a permanent strategy in the face of the crisis in HRH. An increasing number of African countries have embarked on expanded training of mid-level health professionals to contain costs (38, 125, 126).

This movement has met resistance at several levels to delegate surgical procedures to lower cadres for many reasons. Surgery is considered a highly specialized field that requires several years of training. Hence, defining the limits of surgical task-shifting is considered essential to ensure quality of care. WHO has established a list of surgical procedures at district hospitals in order to facilitate the classification of different interventions, which might enable different training schools to distinguish which interventions could be “shifted” to NPCCs (18, 127).

In Mozambique training of NPCCs in surgery is well structured in a school with a syllabus, process of evaluations and an internship. Also the recruitment focus is on candidates with previous job experience in peripheral health units or District Hospitals (Pereira et al, unpublished).

Our studies have shown that NPCCs in Mozambique are well appreciated by other professionals, doctors, nurses and midwives. Around 90% gave a positive rating in regards to their strong practical skills and their critical role in saving the lives of mothers and their newborns at district hospitals. With accumulated surgical experience among these NPCCs, young doctors deployed in rural areas are increasingly trained in surgery by TCs. (Paper IV). The assessment of outcomes of caesarean sections among técnicos de cirurgia and medical officers at the teaching hospital in Maputo showed no clinically significant differences between them (Paper I).

In the Tanzania training of AMOs, selected from clinical officers with previous working experience of minimum three years in peripheral health units or District Hospitals, take two years including another three months of surgery and three months of obstetrics. In the training of AMOs, emphasis is placed on further improving the quality of knowledge and skills acquired in the previous training (Paper V).

Our studies (Paper V, VI) show that for major obstetric operations performed by assistant medical officers and medical officers, there were no clinically significant differences in their outcomes, risk

indicators, or quality of care indicators. Despite the logistic and material resource problems in all hospitals the maternal aggregate case fatality rate was acceptable at 1-2 %.

7.3.2 Work burden

Our studies and other evidence in the literature show that mid-level health professionals carry out most of surgical procedures outside urban areas in several African countries; they are key surgical professionals in rural areas where doctors are scarce (5, 121, 125, 126, 128).

The results of our studies show that técnicos de cirurgia in Mozambique performed 92 % of caesarean sections in district hospitals (Paper III) and in Tanzania AMOs performed 85% of caesarean sections, 94% of repairs of ruptured uterus, 86% of removal of ectopic pregnancy and 70% of hysterectomies in Mwanza and Kigoma regions in Tanzania. (Paper VI).

7.4. RELATIONSHIP BETWEEN NPCS AND OTHER STAFF

The literature highlights the problem of reluctance and even resistance among doctors and other professionals to consider task-shifting in surgery (121, 127). Since the 1984 inception of training of técnicos de cirurgia in Mozambique, the reluctance has gradually disappeared and it is now recognized among doctors that this cadre actually alleviates the recently graduated and often inexperienced doctors assigned at district hospitals from the tangible burden of emergency obstetric and surgical care.

In the medical school in Maputo the experience of almost a quarter of a century of training and deployment of the técnicos de cirurgia is now conveyed as important messages to the young graduates to be assigned to remote hospitals with their own limited exposure to surgical interventions. In Tanzania this issue has not yet been addressed scientifically and attitudinal problems related to perceived threats to conventional turfs in surgical practice by task-shifting awaits exploration by HRH research.

7.5. MOTIVATION AMONG NPCS TO SUSTAIN UNDER THE BURDEN OF EMERGENCIES

According to the literature, health worker motivation and retention in rural assignments is a crucial response to the HRH crisis, especially in low and middle-income countries (13, 129). Poor remunera-

tion, bad working conditions, suboptimal management of human resources, limited opportunities for career progression, oppressive political climate, including insecurity and threat of violence and wish to provide a good education for their children influence the motivation of the health workforce, including NPCs, to continue(130).

In Mozambique the health workforce is generally not motivated due to lack of adequate salary and incentives, poor working conditions, absence of job description, unsatisfactory organization and management of services, heavy workload, degraded physical infrastructure preventing application of bio-safety norms, and lack of supplies (123).

The main problem of técnicos de cirurgia is dissatisfaction due to workload, as they can rarely leave the workplace to attend training in referral hospitals or attend specific seminars to ameliorate their knowledge. In addition, there is irregular supervision by specialists as the specialist surgeons are few at provincial level (Paper IV).

In Tanzania the situation is similar and the motivation is reportedly weak among health workers (131). AMOs face overwork, poor working conditions and lack of supervision. They are rarely invited to attend meetings at the MoH in the same way as their colleagues, nurses and midwives despite sharing activities in the same areas. They are seldom moved to referral hospitals for job training to ameliorate their performance, which make them feel abandoned and disoriented. Lack of career perspectives make them dissatisfied (Pereira et al unpublished data).

7.5.1 Financial incentives

In Mozambique lower salary than other midlevel professionals is a significant cause of dissatisfaction. The training of técnicos de cirurgia was initially controversial, mostly due to resistance among doctors, which led to unclear definition of career paths by the MoH as they were considered mid-level professionals without specialization. This affected their position on the salary scale which had significant impact on their motivation (Paper IV). In Tanzania this subject was not addressed in our approach but it is known from the literature that AMOs are paid lower salaries than nurses, midwives and laboratory technicians, despite being supported and recognized by the MoH (121, 132, 133) .

7.5.2 Non-financial incentives

7.5.2.1 *Supervision*

Attention paid to adequate supervision and good management can reportedly improve work satisfaction, performance and quality of work in remote settings (20, 72, 73). In our studies, supervision was not specifically addressed, but the literature reviewed indicates that, in both countries, it is irregular or non-existent in most districts. (78, 123).

7.5.2.2 *Working and living conditions*

The existent literature shows that working and living conditions are important determinants of motivation and retention in high and low income countries (20, 46, 134, 135). In our studies these issues were not further addressed as the majority of districts the houses for técnicos de cirurgia have been assessed beforehand (this is a prerequisite to deploy técnicos de cirurgia at district hospitals).

In response to the main problems within remote areas in Mozambique, a decentralization programme is in progress for faster development with empowerment of local authorities and communities. This is expected to generate better accommodations for staff, more electricity, better roads and improvement of health and educational facilities (136). The impact of this program is not yet assessed or evaluated.

In Tanzania the health sector reform strategy, which aims were to influence changes in the health system to improve health status for all citizens, has its focus on district decentralization, improvement of health system, health management, financing and human resource development. (137,138). An evaluation reveals that the impact was not satisfactory (139).

7.5.2.3 *Staff satisfaction*

Staff satisfaction largely influences motivation, which affects the performance of health workers as well as acting to stimulate their retention (140). It is documented that training, study leave, opportunity to work in a team, support from a supervisor, provision of housing and transport increase staff satisfaction and consequently motivation.(140-142).

Both in Mozambique and Tanzania, a widespread opinion among health workers is that the situation is bad, as the salary is not adequate to the cost of living. Also, health workers in remote areas have the perception of being left out of additional trainings, while excessive work demands are exemplified with a lack of job descriptions and poor staff welfare. The administrative management is considered weak, most of the time excluding the health workers (78, 123, 138).

7.6. RETENTION

According to the literature retention of HRH, particularly in rural areas, it is a major and complex problem in most low-income countries (20, 43, 143, 144), and there is no single solution. Apart from the salary - pointed out as the main reason for dissatisfaction - socio-economic status, lack of housing, work conditions, work environment, desire for further training are factors that are decisive whether to leave or stay in a remote area.

Our results show that 88% of técnicos de cirurgia remained in rural areas seven years after graduation while none of the doctors stayed there after that period (Paper III). Another study indicates that retention may be related to the recruitment system. If candidates are selected from each region of the country, mainly from rural areas and are integrated in scholarship schemes at provincial level with commitment to return after having finished the training, distribution of cadres and their retention may be improved (Pereira et al, unpublished).

In Tanzania retention is also a major issue (78, 138), with migratory flows from rural to urban areas and from the public to the private sector. Most of the skilled health workforce, particularly medical doctors and specialists, are concentrated in urban areas where only 20% of the population lives.

Already in 1982, Tanzania started a decentralization reform that was designed to empower local authorities in the process of recruitment of health workers. Decentralized recruitment was supposed to be effective in improving the retention, as the responsibility of hiring was transferred to the local governments. The assessment of the potential impact of this decentralization programme is underway, but the first findings reveal that the decentralization was more effective for retention of the lower cadre health workers in the districts (145-148).

7.7. COST - EFFECTIVENESS ASSESSMENT OF TRAINING NPC/GP/SPECIALIST

Few studies have addressed the issue of cost-effectiveness of training NPCs/GPs/Specialists (126). In Burkina Faso, NPCs are trained for two years in surgery (attachés de santé) and general practitioners receive six months of training to perform emergency surgery in rural areas. They are cost effective compared to specialists. In Mozambique we did not address the cost effectiveness of general practitioners, since this cadre does not receive additional years of training in surgery. Such a scheme would increase the training of general practitioners to nine years which was deemed not advisable by the MoH. In Mozambique most doctors, after initial rural assignments for a few years, move to urban areas for administrative commitments or to start their specialization at teaching hospitals (Paper II). In Tanzania we did not address this issue but the literature reviewed shows that training AMOs are cheaper than training doctors (78) .

7.8. THE ENABLING ENVIRONMENT

Both in Mozambique and in Tanzania, over several decades, there has been a strong commitment from the government in addressing the crisis in HRH. Solving the problem of numbers of health professionals is, however, not a panacea for improving access to health care. Other problems have to be addressed simultaneously in order to improve the function of the health system. For well trained health workers in sufficient numbers to perform optimally, an enabling environment is required. This environment is needed both centrally (MoH) and in the periphery (province and district levels)

In Mozambique an "Instituto Superior de Ciências de Saúde" (Higher Institute of Health Sciences) was created in order to, among other things, clarify the career path for técnicos de cirurgia (MoH 2004 Report). Further, the initiation of the national programme of human resources is a positive step in counteracting the human resources crisis. (123).

Due to overwork of técnicos de cirurgia in Mozambique, a training of major obstetric surgery has recently been initiated among midwives ("Enfermeiras de Saúde Materna") with licentiate degree to strengthen the teamwork at district hospitals (149). This new training comprises of three and half years of theoretical and practical training (plus six months of internship in a regional or district hospital). The training is based in nursing but has an emphasis on diagnostic and treatment skills, practice of major emergency obstetric surgery and the concept of teamwork. In this way, it is expected that

more effective teamwork and consequently improvement of the quality of work can be achieved as técnicos de cirurgia will be more alleviated of obstetrics and gynaecology emergency surgery. It is the latter that predominantly constitutes their work burden.

In Mozambique there is a clear vision that the health system needs strengthening. The government plan for five years (2005-2009) focused on capacity building including rehabilitation of infrastructures and theatres in the whole health system, timely supply and deployment of human resources in general and in peripheral areas in particular, development of norms, guidelines about obstetric emergency care and essential care to newborn, implementation of formative system of supervision, and strengthening of capacity of communication with radios and transports (86).

The human resource plan approved by the Ministry of Health for implementation (123) contemplates four main strategic actions: firstly, the organization of services and functioning system of rules; secondly, capacity management at different levels; thirdly, distribution and retention of human resources for health and, fourthly, the capacity of institutions of training and continuous education.

In Tanzania the enabling environment has been given increasing attention. The Tanzanian government recognizes the importance of improving health care and expanding the supply of human resources. It has committed itself to address the shortage of human resources for health, particularly skilled workforce for health. Tanzania has good relationships with other governments, donors, and agencies who could be potential partners in these approaches (78).

7.9. CONCLUSIONS

- Human resources constitute a major health system problem in Mozambique and Tanzania. "Brain drain" and uneven distribution of HRH and weak production of HRH are the main causes of this crisis.

- The evidence demonstrates that the professional performance of NPCs in emergency obstetric care is acceptable in both countries. NPCs perform approximately 90% of major emergency obstetric surgery in rural areas where most of the population live in both countries.

- A comparison of the quality of work of medical doctors and that of técnicos de cirurgia/AMOs, demonstrates that, there are no clinically significant differences regarding outcomes in major obstetric

surgery. In Mozambique they were rated positively by other staff among doctors (GPs and specialists), nurses and midwives.

- NPCs in Mozambique have a high retention rate in rural areas.
- NPCs are cost-effective in Mozambique. Training and deployment of TCs are three times more cost-effective than training and deployment of medical doctors.
- Motivation is a major problem in Mozambique. It is associated with insufficient salary, low staff satisfaction, poor working conditions, non-existent job descriptions, unsatisfactory organization and management services, heavy workload, lack of supervision, absence of career opportunities, degradation of infrastructure not allowing application of bio-safety norms, and lack of supplies.
- Task-shifting and task-sharing are feasible strategies available and should be seriously considered to address the human resource crisis in these two countries.
- Accuracy in decision-making in obstetric cases by different professional categories deserve a more a specific approach.

8. ACKNOWLEDGEMENTS

There is always a feeling of reward when you reach the end of a journey and you have a feeling that it was worth the effort. Even if the path was long and hard, it still offered me unique moments that enabled professional growth. Contacting different stakeholders, leaders, academics, sharing experiences and receiving support in several environments, urban and rural, strengthen convictions and contribute to overcoming barriers. In fact, without this support and all inputs, it would have been really difficult to reach the objective. I express my sincere gratitude to all of them for their much valued contributions and for all opportunities they offered to the success of this journey. Allow me to highlight the most prominent ones.

Professor Staffan Bergström, my main supervisor, provided excellent continuous guidance from the very first step of this scientific endeavour. I would like to gratefully acknowledge his didactic and enthusiastic supervision, encouragement and support, particularly during the more difficult stages of this journey. His sensitivity created the confidence that everything is possible when working together in a determined way. His influence on and contributions to my personal and professional development have been enormous. There are no words to describe it. Also his wife Birgitta and his daughter Anna Bergström have given me the privilege of having a new family when I was far from my home country. My co-supervisor, Dr. Hans Wessel provided fruitful cooperation, support and friendship during the years of my study. My local mentor Professor Fernando Vaz, surgeon and former Minister of Health in Mozambique, pioneered the training of “técnicos de cirurgia” from its inception in 1984 and has tirelessly accompanied all my work by his strong support, vision, and pragmatism. Stimulating discussions, valuable advice and shared experience helped me to follow a constructive way forward.

During the development of my research project the support from The Averting Maternal Death and Disability (AMDD) program of Columbia University, New York, has been of increasing importance. I would like to acknowledge the late Professor Allan Rosenfield for his support and express my gratitude to the current Director of AMDD, Professor Lynn Freedman, for the support I have enjoyed

from AMDD. For the future further extension of this research to other countries in Africa and beyond AMDD will be instrumental and a leading actor.

My co-author Dr. Colin McCord, experienced thoracic surgeon, public health expert and maternal health advocate in one person, is gratefully acknowledged for the didactic and enthusiastic guidance during our fieldwork in Tanzania. To my other co-author and close friend, Dr Godfrey Mbaruku, regional director in Kigoma, Tanzania, I would like to express deep appreciation for enduring friendship and constructive collaboration since I met him in 1992 in Uppsala. His support and supervision have been decisive for the success of all this research. Dr Margaret Kruk, also co-author, introduced a very important angle of health economics in this research, allowing a deeper analysis and understanding of costs contained in the training and deployment of técnicos de cirurgia. I am very grateful to her for her willingness to guide me through this important field of research. To Amelia Cumbi, also my co-author, I would like to express gratitude, acknowledging her strong commitment in qualitative research. Her experience helped me overcome barriers in this part of the research. I would also like to thank Mr. Raimundo Malalane, coordinator of the training of técnicos de cirurgia, for his support and availability. His role as coordinator in the process allowed a permanent contact with técnicos de cirurgia in Mozambique and easy access to data. I am grateful to Mr. Calist Nzabuhakwa, AMO in Kigoma, for this support and availability and commitment in all process in Kigoma. My other co-authors, Dr Alberta Bacci, Dr António Bugalho and Dr Manuel Cotiro all contributed with important inputs in different parts of this thesis.

To my colleagues and friends in Mwanza Tanzania, Dr. Andrew Kilonzo, from Bugando Hospital and Mr. Gervas Manzi, AMO in Sekou Touré Hospital, who welcomed me in Mwanza, I am grateful for their extraordinary support and commitment to reach all districts.

Colleagues at the Maternity of the Maputo Central Hospital, past and present, Dr. António Bugalho, Dr. Nafissa Bique, Dr. Fernanda Machungo, Dr. Luisa Almeida, Dr. Manuela Cunha, Dr. Elias Walle, Dr Inês Bento, Dr. Mario Samucidine, Dr. Sibone Mocumbi, Dr. Magda Ribeiro, Dr. Yousry Mohamad, Dr. Ludmila Gratcheva, Dr. Hermingarda Pequeno, Dr. Sidonia Fiosse, Dr. Carolina

Araujo; I am thankful for their support and understanding in my absence, during the periods of my research activities.

Leaders at other institutions have also contributed wonderful assistance. Dr. Francisco Songane, former Minister of Health, to whom I owe gratitude to for his strong support and availability to help our research team. Mr. Julio Correia Langa, former pedagogical director of Instituto de Ciências de Maputo, whom I would like to acknowledge for his strong support and encouragement. The Directorate of ISCISA for continuing support and expressed interest in non-physician clinician research activities after their creation.

Dr. Pascoal Mocumbi, former Minister of Health and former Prime Minister in Mozambique, to whom I would like to express deep appreciation for his early clear-sighted vision regarding the need to shape and develop the concept of técnico de cirurgia.

My friends at IHCAR have always been helpful. I would gratefully like to acknowledge the appropriate environment of learning and the privilege offered by them who helped me to my own personal and professional improvement. The technical and logistic support for my work was extensive. Mrs Marie-Louise Thomé, Mrs. Gunilla Risberg, Mrs Kersti Rådmark, Mr Thomas Mellin and Mr Bo Planstedt provided most excellent assistance.

I am grateful to all my friends Dr. Manuel Cotiro, Dr. Francisco Mbofana, Dr Moshin Sidat, Eusebio Camilo and Mauro Cabir for their unconditional support and encouragement and technical assistance.

Finally, I am forever indebted to my wife Fatima and my daughters Josiana and Tatiana for their understanding, endless patience and encouragement when it was most required.

9. REFERENCES

1. Debas H, Gosselin R, McCord C, Thind A. Surgery. In: Jamison DT BJ, Measham AR, Alleyne G, Claeson M, et al., editor. *Disease Control Priorities in Developing Countries (2nd Edition)*: New York: Oxford University; 2006 pp1245-1259; 2006.
2. Ozgediz D, Riviello R. The "other" neglected diseases in global public health: Surgical conditions in sub-Saharan Africa. *Plos Med.* 2008;5(6):e121.(doi.1371/journal.pmed.0050121).
3. WHO. Human development report 2003.
4. JLI. Human resources for health: Overcoming the crisis. Joint_Learning_Initiative Global health Initiative/Havard University Press 2004. 2004.
5. WHO. The World health report: working together for health 2006.
6. Speybroeck N, Ebener S, Sousa A, Parage G, Evans D, Prasad A. Inequality in access to human resources for health: measurement issues Geneva, World Health Organization; 2006 available at <http://www.who.int/hrh/documents/en/>. 2006.
7. Prasad A, Tandon A, Sousa A, Ebener S, Evans D. Measuring the efficiency of human resources for health in attaining health outcomes across provinces in Viet Nam. . Geneva, World Health Organization; 2006 available at <http://www.who.int/hrh/documents/en/>. 2006.
8. Sousa A, Tandon A, Prasad A, Dal PM, Evans D. Measuring the efficiency of health workers in attaining health outcomes across sub national units in Brazil. Geneva, World Health Organization; 2006 available at <http://www.who.int/hrh/documents/en/>. 2006.
9. Kurowski C, Wyss K, Abdulla S, Yemadji N, Mills A. Human resources for health: requirements and availability in the context of scaling-up priority interventions in low income countries. Case studies from Tanzania and Chad. London, London School of hygiene and Tropical Medicine. 2003.
10. Haines A, Cassels A. Can the Millennium Development Goals be attained ? *BMJ.* 2004;329:394-7.
11. Joint Learning Initiative J. *Human Resources for Health: Overcoming the Crisis* Cambridge, MA: Harvard University Press 2004.
12. Travis P, Bennett S, Haines A, Pang T, Bhutta Z, Hyder AA, et al. Overcoming health-systems constraints to achieve the Millennium Development Goals. *Lancet.* 2004 Sep 4-10;364(9437):900-6.
13. Chen L, Evans T, Anand S, Boufford J, Brown M, Chowdhury M. Human resources for health: overcoming the crisis. *The Lancet.* 2004;364:1984-90.
14. Ozgediz D, Riviello R, Rogers SO. The surgical workforce crisis in Africa: a call to action. *Bulletin of the American College of Surgeons.* 2008 Aug;93(8):10-6.

15. Zurn P, Dal Poz M, Stilwell B, Adams O. Imbalance in the health workforce. *Human Resources for Health*. 2004;2(1):13.
16. Sanders D, Lehman U, Ferrinho P. Health sector reform: Some Implications of nurses from Malawi. *BMC Nurs* Dec 2004.
17. Labonte R, Schrecker T, Sanders D, Meeus W. *Fatal Indeference the G8, Africa and Global Health*. Cape Town, UCT and IDRC; 2004.
18. Chu K, Rosseel P, Gielis P, Ford N. Surgical task shifting in Sub-Saharan Africa. *PLoS Med*. 2009 May 19;6(5):e1000078.
19. Kirigia JM, Gbary AR, Muthuri LK, Nyoni J, Seddoh A. The cost of health professionals' brain drain in Kenya. *BMC health services research*. 2006;6:89.
20. Lehmann U, Dieleman M, Martineau T. Staffing remote rural areas in middle- and low-income countries: a literature review of attraction and retention. *BMC health services research*. 2008;8:19.
21. Ferrinho F, Lebergie W, Da Cruz GA. Public and private sector: a balancing act for health staff. *Bulletin of the World Health Organization*. 1999;77(3):209.
22. Egger D, Lipson D, Adams O. Achieving the right balance: The role of policy-making process in managing human resources for health problems. 2000 (Geneva World Health Organization [issues in Health Services Delivery Discussion Paper n.2]).
23. Meja A, Pizurki H, Royston E. Physician and nurse migration: analysis and policy implications. France World Health Organization. 1979:xii-476.
24. Ghana MoH. Internal Report on Human Resources. Accra 2002. 2002.
25. WHO. Migration of health professionals in six countries: a synthesis report. 2004.
26. Narasimhan V, Brown H, Pablos-Mendez A, Adams O, Dussalt G, Elziga G. Responding to the global human resources crisis *Lancet*. 2004;363:1469-72.
27. Ozgediz D, Kijjambu S, Galukande M, Dubowitz G, Mabweijano J, Mijumbi C, et al. Africa's neglected surgical workforce crisis. *Lancet*. 2008 Feb 23;371(9613):627-8.
28. Awases A, Gbary A, Nyoni J, Chatora R. Migration of health professionals in six countries a synthesis report. Brazzaville WHO. 2004.
29. Hodges S, Mijumbi C, Okello M, McCormick B, Walker I. Anaesthesia service in developing countries: Defining the problems. *Anaesthesia*. 2007;62(DOI: 10.1111/j.1365-2044.2006.04907.x).
30. Lokossou T, Zoumenou E, Secka G, FO Bn, Le Polain dVB, et a. Anesthesia in French-speaking sub-Saharan Africa: An overview. *Acta Anaesthesiolo Belg*. 2007; 58: 197-209.

31. Derbew M, Beveridge M, Howard A, Byrne N. Building surgical research capacity in Africa: The Ptlomy Project. *Plos Med.* 2006;3 e 305 doi10.1371/journal.pmed.0030305.
32. Lyng DC, Larson EH, Thompson MJ, Rosenblatt RA, Hart LG. A longitudinal analysis of the general surgery workforce in the United States, 1981-2005. *Arch Surg.* 2008 Apr;143(4):345-50; discussion 51.
33. Harrison M. Female physicians in Mexico: migration and mobility in the life course. *Social Science and Medicine.* 1998;47(4):455-68.
34. Smith J, Thomas D. On the Road: Marriage and Mobility in Malaysia. *Journal of Human Resources.* 1998;33 (4):805-32.
35. Brooks RG, Walsh M, Mardon RE, Lewis M, Clawson A. The roles of nature and nurture in the recruitment and retention of primary care physicians in rural areas: a review of the literature. *Acad Med.* 2002 Aug;77(8):790-8.
36. de Vries E, Reid S. Do South African medical students of rural origin return to rural practice? *South African Medical Journal* 2003 Oct;93(10):789-93.
37. Rabinowitz HK, Diamond JJ, Markham FW, Rabinowitz C. Long-term retention of graduates from a program to increase the supply of rural family physicians. *Acad Med.* 2005 Aug;80(8):728-32.
38. Dovlo D. Using mid-level cadres as substitutes for internationally mobile health professionals in Africa. A desk review. *Hum Resourcecs for Health.* 2004 Jun 18;2(1):7.
39. Cavender A, Alban M. Compulsory medical service in Ecuador: the physician's perspective. *Social science & medicine (1982).* 1998 Dec;47(12):1937-46.
40. Kim C. Recruitment and retention in the Navajo Area Indian Health Service. *The Western journal of medicine.* 2000 Oct;173(4):240-3.
41. Dieleman M, Cuong PV, Anh LV, Martineau T. Identifying factors for job motivation of rural health workers in North Viet Nam. *Hum Resour Health.* 2003 Nov 5;1(1):10.
42. Buchan J, Calman L. The global shortage of registered nurses: an overview of issues and actions. Geneva, International Council of Nurses; 2004.
43. Zurn P, Dal Poz MR, Stilwell B, Adams O. Imbalance in the health workforce. *Hum Resources for Health.* 2004 Sep 17;2(1):13.
44. Dieleman M, Toonen J, Toure H, Martineau T. The match between motivation and performance management of health sector workers in Mali. *Hum Resources for Health.* 2006;4:2.
45. Fresta E, Fresta M, Ferrinho P. The internal brain drain in the Angolan health sector. In *Providing health care under adverse conditions: Health professional performance& Individual coping strategies.* 2000;Volume 16:45-53.

46. Kunaviktikul W, Anders RL, Srisuphan W, Chontawan R, Nuntasupawat R, Pumarporn O. Development of quality of nursing care in Thailand. *Journal of advanced nursing*. 2001 Dec;36(6):776-84.
47. Van LW, Conceicao C, Van DW, Ferrinho P. When staff is underpaid dealing with individual coping strategies of health personnel. *Bulletin of the World Health Organization*. 2002:45-53.
48. Vujicic M, Zurn P, Diallo K, Adams O, Dal Poz MR. The role of wages in the migration of health care professionals from developing countries. *Hum Resources for Health*. 2004 Apr 28;2(1):3.
49. Martineau T, Decker K, Bundred P. "Brain drain" of health professionals: from rhetoric to responsible action. *Health policy (Amsterdam, Netherlands)*. 2004 Oct;70(1):1-10.
50. Bloom J, Alexander J, Nuchols B. The effect of social organization of work on the voluntary turnover rate of hospital nurses in the United States. 1992;34(12):1413-24.
51. Hagopian A, Thompson MJ, Fordyce M, Johnson KE, Hart LG. The migration of physicians from sub-Saharan Africa to the United States of America: measures of the African brain drain. *Human Resources for Health*. 2004 Dec 14;2(1):17.
52. Farham B. Migration of health professionals. *Lancet*. 2005 Jul 16-22;366(9481):199.
53. Bezuidenhout MJ, G; Hiemstra, LA; Struwing, MC. Reasons for doctor migration from South Africa. *SA Fam Pract*. 2009;51(3):211-5.
54. Kushner AL, Mannion SJ, Muyco AP. Secondary crisis in African health care. *Lancet*. 2004 May 1;363(9419):1478.
55. Schrecker T, Labonte R. Taming the brain drain: a challenge for public health systems in Southern Africa. *International journal of occupational and environmental health*. 2004 Oct-Dec;10(4):409-15.
56. Labonte R, Packer C, Klassen N. Managing health professional migration from sub-Saharan Africa to Canada: a stakeholder inquiry into policy options. *Hum Resour Health*. 2006;4:22.
57. Oberoi SL, V. Brain Drain of Doctors from Southern Africa: Brain Gain for Australia. *Austr Health Rev*. 2006;30 (1):25-33.
58. Benetar S. An Examination of Ethical Aspects of Migration and Recruiting Health Care Professionals from Developing Countries. *Clinical Ethics*. 2007;2(1):2-7.
59. Padarat A, Chamberlain C, McCoy D, Ntuli A, Rowson M, Lowenson R. Health personnel in Southern Africa: confronting maldistribution and brain drain. *Equinet Discussion paper N4 2003*.
60. Palmer D. Tackling Malawi's human resources crisis. *Reproductive Health Matters*. 2006;14 (27):27-39.
61. Armstrong M. *A handbook of human resource management practice 10th edition* London and Philadelphia. 2007;Kogan

62. Buchan J. Nursing shortages and evidence-based interventions: a case study from Scotland. *International nursing review*. 2002 Dec;49(4):209-18.
63. Dovlo D. Retention and deployment of health workers and professionals in Africa 2002.
64. Nitayaramphong S, Srivanichakom S, Pongsupap Y. Strategy to respond to health manpower needs in rural Thailand in providing health care under adverse conditions health personnel performance & individual coping strategies. Edited by: Ferrinho P, Van Lerberghe wv Antwerp, ITG Press. 2000;16:55-72.
65. Wibulpolprasert S, Pengpaibon P. Integrated strategies to tackle the inequitable distribution of doctors in Thailand: four decades of experience. *Human Resources for Health*. 2003 Nov 25;1(1):12.
66. Chomitz K. What the doctors want: two empirical estimates of Indonesia physicians preferences regarding service in rural and remote areas. 1997.
67. Reid S. Community Service for health professionals. Edited by: Ijumba P Durban, Health systems Trust. 2003.
68. Koot J, Martineau T. Mid Term review of Zambian Health Workers Retention Scheme (ZHWRS). Final report. 2005:2003-4.
69. Chikanda A. Skilled health professionals migration and its impact on health care delivery in Zimbabwe. www.compasoxacuk/publications/Working%20papers/WP0404pdf (accessed Nov 28 2009). 2004.
70. MacPhee M, Scott J. The role of social support networks for rural hospital nurses: supporting and sustaining the rural nursing work force. *The Journal of Nursing Administration*. 2002 May;32(5):264-72.
71. Wells N, Roberts L, Medlin LC. Issues related to staff retention and turnover. *Seminars for nurse managers*. 2002 Sep;10(3):171-9.
72. Douglas M. Supervision of rural health centres in Papua New Guinea: consolidation of the delivery of health services. *Papua and New Guinea medical journal*. 1991 Jun;34(2):144-8.
73. Loevinsohn BP, Guerrero ET, Gregorio SP. Improving primary health care through systematic supervision: a controlled field trial. *Health Policy Planning*. 1995 Jun;10(2):144-53.
74. Marquez L, Keane L. Making Supervision Supportive and Sustainable: New Approaches to Old Problems in Management and Leadership Program, Produced for the Maximizing Access and Quality Initiative (MAQ). *Management Sciences for Health [MSH] supplement to Population Report 2002;XXX 4*.
75. WHO. World Health statistics 2007. (WHOSIS Statistical Information System) <http://www.who.int/whosis/whostat2007/en/index.html> [serial on the Internet].
76. Mills EJ, Schabas WA, Volmink J, Walker R, Ford N, Katabira E, et al. Should active recruitment of health workers from sub-Saharan Africa be viewed as a crime? *Lancet*. 2008 Feb 23; 371 (9613) : 685-8.

77. Mbaruku G, Bergstrom S. Reducing maternal mortality in Kigoma, Tanzania. *Health Policy Plann* 1995;10:71-8.
78. McKinsey. Investing in Tanzanian Human resources for Health - HRH report 2006.
79. Ministry of Health. Country Report Presented in the training course on the recent trend in rural Tele-communications held in Tokyo Japan March 2-15. 2003.
80. Pemba SK. Brief History of AMO Training in Tanzania .
(www.healthtrainingifakara.org/AMO/amoprofile08pdf) [15th November 2009 accessed].
81. Ministry of Health. Health country status report. Maputo, Mozambique. 2004.
82. Vaz LM, Bergstrom S. Mozambique - delegation of responsibility in the area of maternal care. *Int J Gynecol Obstet*. 1992;38 (supp):S37-9.
83. Hanlon J. Mozambique Who Calls the Shots? 1991(London: James Currey).
84. Vaz F, Bergstrom S, Vaz M, Langa J, Bugalho A. Training medical assistants for surgery. *Bull World Health Organ*. 1999;77:688-91.
85. Garrido PI. Training of medical assistants in Mozambique for surgery in a rural setting. *SAJS*. 1997;35 (3).
86. Departamento SRCA. Avaliação de Necessidades em Saude Materna e Neonatal. Maputo: Direcção Nacional de Promoção de Saude e Control de Doencas, Ministerio da Saude. 2007.
87. World BG. World development Indicators database, April 2009 (<http://ddp-ext.worldbank.org/ext/ddpreports/>)2009.
88. Estatística INd. National Statistics. Instituto Nacional de Estatística. 2004(www.ine.gov.mz).
89. Estatística IN. Demographic Health Survey, Mozambique. 2003(www.ine.gov.mz).
90. OCR, Macro Mozambique DHS - Publication :FR161 - Mozambique: DHS. Final report. 2003.
91. Jamisse L, Songane F, Libombo A, Bique C, Faundes A. Reducing maternal mortality in Mozambique: challenges, successes and lessons learned. *Int J Gynecol Obstet*. 2004;85:203-12.
92. Department of Equity PaSDoHEE. WHO report on inequities in Maternal and Child Health in Mozambique. 2007.
93. Barnett E, Casper M. A definition of "social environment". *American Journal of Public Health*. 2001 Mar;91(3):465.
94. Baker EA, Metzler MM, Galea S. Addressing social determinants of health inequities: learning from doing. *American Journal of Public Health*. 2005 Apr;95(4):553-5.

95. Cannon R, editor. The Social determinants of health: South Australian Council of Social Service; 2008.
96. UNITED R, TANZANIA. NATIONAL WEBSITE. Country Profile. Available from: www.Tanzania.go.tz.
97. World Bank. World Deveolpment Indicators database 2007.
98. Ministry of Healthy Country report. Tanzania 2003.
99. Drummond MF, Sculper M, Torrance G, O'Brien B, Stoddard G. Methods for Economic Evaluation of Health Care Programmes. 3rd edn Oxford University Press. 2005.
100. Gold M, Siegel J, Russel L, Weinstein M. Cost-effectiveness in Health and Medicine. New York, NY:Oxford University Press. 1996.
101. IMF. World Economic Outlook Database. 2006[www.imf.org/external/pubs/ft/wo] Accepted 14 July 2006. 2006.
102. Adam T, Aikins M, Evans D. Costit software 2005. Geneva: Switzerland World Health Organization 2005;[www.who.int/choice] Accepted 1 June 2006.
103. Pereira C, Cumbi A, Malalane R, Vaz F, MacCord C, Bacci A, et al. Meeting the need for emergency obstetric care in Mozambique: work performance and histories of medical doctors and assistant officers trained for surgery. BJOG. [original]. 2007;DOI:10.1111/j.1471-0528.2007.01489.x.
104. Dussault G, Dubois C-A. Human resources for health policies: a critical component in healt polices Human Resources for Health. 2003;1:1-16.
105. Paxton A. UN process indicators for EmOC: reflections based on a decade of use. Int J Gyn Obstet. 2006;95:192-208.
106. The AMMD Working,Group on indicators. Int J Gyn Obstet. 2003;83:112-20.
107. Liese G, Dusault C. The State of Health Workforce in Sub-Saharan Africa: Evidence of Crisis and Analysis of Contributing Factors; Washington, DC Africa Region Human Development Working Paper Series, . World Bank. 2004.
108. Smith M, Henderson-Andrade N. Facing the health worker crisis in developing countries: a call for global solidarity. Bull World Health Organ. 2006;84(6):426-7.
109. Chankova S, Muchiri S, Kombe G. Health workforce attrition in the public sector in Kenya: a look at the reasons. Hum Resources for Health. 2009;7:58.
110. Ministry of Health. Report on Challenges Facing the Kenyan Health Workforce in the Era of HIV/AIDS. Nairobi. 2004.
111. Kenya Govt. Millennium Development Goals Status Report for Kenya. Nairobi. 2005.
112. World Bank. World Development report: investing in health, 1993.

113. Chen L, Evans T, Anand S, Boufford J, Brown M, Chowdhury M. Human Resources for Health: Overcoming the Crisis. 2004 (Cambridge, MA: Harvard University Press 2004).
114. Anand S, Barnighausen T. Human resources and health outcomes: cross-country econometric study. *Lancet*. 2004 Oct 30-Nov 5;364(9445):1603-9.
115. WHO. World health report 2000: health systems-improving performance.2000.
116. The Costa Rican health system: low cost, high value. *Bull World Health Organ*. 2003;81:626-27.
117. World Bank. World development report 2004: making services work for people. 2004.
118. Foundation for Advancement of International Medical Education and Research (2008) Internacional medical directory. 2008.
119. Dovlo D. Wastage in the health workforce: some perspectives from African countries. *Hum Resources for Health*. 2005 Aug 10;3:6.
120. Center TRS. Health Worker Retention and Migration in East and Southern Africa. Regional Meeting report from EQUINET/ECSA-CH Meeting Arusha 2007 [<http://www.equinetafrica.org/bibl/docs/REPMTG0307HRHpdf>]. 2007.
121. Chu K, Peter R, Prierre G, Nathan F. Surgical Task Shifting in Sub-Saharan Africa. *Plos Medicine* www.plosmedicine.org. 2009.
122. Anyangwe SC, Mtonga C. Inequities in the global health workforce: the greatest impediment to health in sub-Saharan Africa. *International Journal of Environmental Research and Public Health*. 2007 Jun;4(2):93-100.
123. Ministry of Health, Mozambique: Plano Nacional de Desenvolvimento dos Recursos Humanos da Saude. PNRHS 2008 - 20152008.
124. Dodani S, LaPorte RE. Brain drain from developing countries: how can brain drain be converted into wisdom gain? *Journal of the Royal Society of Medicine*. 2005 Nov;98(11):487-91.
125. Mullan F, Frehywot S. Non-physician clinicians in 47 sub-Saharan African countries. *Lancet*. 2007 Dec 22;370(9605):2158-63.
126. Hounton SH, Newlands D, Meda N, De Brouwere V. A cost-effectiveness study of caesarean-section deliveries by clinical officers, general practitioners and obstetricians in Burkina Faso. *Human Resources for Health*. 2009;7:34.
127. Cherian MN, Noel L, Buyanjargal Y, Salik G. Essential emergency surgical, procedures in resource - limited facilities: a WHO workshop in Mongolia. *World Hosp Health Serv*. 2004;40(4):24-9.

128. Chilopora G, Pereira C, Kamwendo F, Chimbiri A, Malunga E, Bergstrom S. Postoperative outcome of caesarean sections and other major emergency obstetric surgery by clinical officers and medical officers in Malawi. *Human Resources for Health*. 2007;5:17.
129. Hongoro C, McPake B. How to bridge the gap in human resources for health. *Lancet*. 2004 Oct 16-22;364(9443):1451-6.
130. Pang T, Lansang MA, Haines A. Brain drain and health professionals. *BMJ*. 2002 Mar 2 ;324(7336):499-500.
131. Maestad O. Human Resources for Health in Tanzania: Challenges, Policy Options and Knowledge Gaps: CHR MICHELSEN INSTITUTE2006 Contract No.: R 2006.
132. Lavy C, Tindall A, Steinlechner C, Mkandawire N, Chimangeni S. Surgery in Malawi - a national survey of activity in rural and urban hospitals. *Annals of the Royal College of Surgeons of England*. 2007 Oct;89(7):722-4.
133. Stringhini S, Thomas S, Bidwell P, Mtui T, Mwisongo A. Understanding informal payments in health care: motivation of health workers in Tanzania. *Human Resources for Health*. 2009;7:53.
134. Cavanagh SJ, Coffin DA. Staff turnover among hospital nurses. *Journal of advanced nursing*. 1992 Nov;17(11):1369-76.
135. Lambert VA, Lambert CE. Literature review of role stress/strain on nurses: an international perspective. *Nursing & health sciences*. 2001 Sep;3(3):161-72.
136. Estatal MA. Documento - Estrategia Global da Reforma Sector Publico 2001 - 2011. ([www. Portal do governo.go.mz](http://www.portal.do.governo.go.mz)) [9 November accessed].
137. Munishi GK. Intervening to address constraints through health sector reforms in Tanzania: some gains and the unfinished business. *Journal of International Development*. 2003;15:115-31.
138. Dominick A, Kurowski C. Human Resources for health - an appraisal of the status quo in Tanzania mainland: Ifakara Health Research and development Centre, The World Bank, London School of Hygiene & Tropical Medicine2005.
139. Joint External Evaluation of the Health Sector in Tanzania: Inception Report 2007.
140. Stilwell B, Diallo K, Zurn P, Vujicic M, Adams O, Dal Poz M. Migration of health-care workers from developing countries: strategic approaches to its management. *Bull World Health Organ*. 2004 Aug;82(8):595-600.
141. Wilbulpolprasert S. Inequitable distribution of doctors: can it be solved? *Human Resources for Health Development*. 1999;3:2-22.
142. Stiwell B. Health Worker motivation in Zimbabwe (Internal report for the Department of Organization of Health Care Delivery). Geneva: WHO2001.

143. Dussault G, Franceschini MC. Not enough there, too many here: understanding geographical imbalances in the distribution of the health workforce. *Hum Resour Health*. 2006;4:12.
144. Manafa O, McAuliffe E, Maseko F, Bowie C, Maclachlan M, Normand C. Retention of health workers in Malawi: perspectives of health workers and district management. *Human Resources for Health*. 2009;7:65.
145. Bossert TJ, Beauvais JC. Decentralization of health systems in Ghana, Zambia, Uganda and the Philippines: a comparative analysis of decision space. *Health Policy Plann*. 2002 Mar;17(1):14-31.
146. Bossert T, Chitah MB, Bowser D. Decentralization in Zambia: resource allocation and district performance. *Health Policy Plann*. 2003 Dec;18(4):357-69.
147. Braathen E, Chaliga A, Fjeldst O-H. Local governance, finances and service delivery in Tanzania: A summary of findings from six councils. In Joint Report NIBR/CMI/REPOA Oslo: Norwegian Institute for Urban and Regional Research (NIBR). 2005.
148. Munga MA, Songstad NG, Blystad A, Maestad O. The decentralisation-centralisation dilemma: recruitment and distribution of health workers in remote districts of Tanzania. *BMC international health and human rights*. 2009;9(1):9.
149. ISCISA CI. Estatuto Organico do Instituto Superior de Ciencias de Saude. 2003.

