Aus dem Lehrstuhl für Allgemeine Betriebswirtschaftslehre und Gesundheitsmanagement (Univ.-Prof. Dr. habil. Steffen Fleßa) der Rechts- und Staatswissenschaftlichen Fakultät der Ernst-Moritz-Arndt-Universität Greifswald

Thema: Costing of hospital services in rural sub-Saharan Africa

– The case of Nouna district hospital, Burkina Faso

Inaugural - Dissertation

zur

Erlangung des akademischen

Grades

Doktor der Medizin
(Dr. med.)

der

Medizinischen Fakultät

der

Ernst-Moritz-Arndt-Universität

Greifswald

2011

vorgelegt von: Insa Koné
geb. am: 20.11.1984
in: Stuttgart

Dekan: Prof. Dr. rer. nat. Heyo Klaus Kroemer

1. Gutachter: Prof. Dr. St. Fleßa

2. Gutachter: Prof. Dr. H. J. Diesfeld

Ort, Raum: Greifswald, SR 4 Urologie

Tag der Disputation: 06.04.2011

Dedicated to my parents

Table of content

List of abbreviations

ABC	Activity-based costing
ABM	Activity-based management
ACEI	Angiotension converting enzyme inhibitor
ACT	Artemisinin-based combination therapy
AMBC	Assurance maladie à base communautaire
ARB	Angiotensin receptor blocker
BI	Bamako Initiative
CA	Conseil d'Administration
CAFRO	Caisse Autonome de Retraite des Fonctionnaires
CAMEG	Centre d'Achat de Médicaments Essentiels Génériques et de consommables médicaux
CBA	Cost-benefit-analysis
CBM	Christian Blind Mission or Christoffelblinden Mission
CCB	Calcium channel blocker
CEA	Cost-effectiveness-analysis
CHOICE	Choosing Interventions that are Cost Effective
CHR	Centre Hospitalier Régional
CHU	Centre Hospitalier Universitaire
CIA	Central Intelligence Agency
CM	Centre Médical
CMA	Centre Médical avec Antenne chirurgicale
CNSS	Caisse National de Sécurité Social
COGES	Comités de Gestion (des CSPS et Districts Sanitaires)
COI	Cost-of-illness
CP	Clinical pathway
CRSN	Centre de Recherche en Santé de Nouna
CSPS	Centre de Santé et Promotion Social
CUA	Cost-utility-analysis
CVD	Cardiovascular disease
D	Diuretic
DALY	Disability Adjusted Life Year
DFG	Deutsche Forschungsgesellschaft
DRD	Dépôts Répartiteurs de Districts
DRG	Diagnosis Related Group
DRS	Direction Régional de la Santé

DSS	Demographic Surveillance System
ECD	Equipe Cadre de District
ECG	Electrocardiogram
ENT	Ear-nose-throat
FCFA	Francs de la Communauté Financière Africaine
GDP	Gross domestic product
GIP	Gross internal product
GTZ	Gemeinschaft für technische Zusammenarbeit
HIV/AIDS	Human immunodeficiency virus/acquired immunodeficiency syndrome
IMF	International Monetary Fund
IPD	Inpatient department
MEG	Médicaments Essentiels Génériques
MSH	Management Sciences of Health
NGO	Non-governmental organisation
NHDHS	Nouna Health District Household Survey
OPD	Outpatient department
PHC	Public Health Care
PRAPASS	Projet de Recherche-Action pour l'Amélioration des Soins de Santé
PTMC	Prevention of transmission from mother to child
QALY	Quality Adjusted Life Year
SBP	Systolic blood pressure
SSA	Sub-Saharan Africa
SP	Sulfadoxine/Pyrimethamine
UN	United Nations
UNDP	United Nations Development Programme
US	United States
WHO	World Health Organisation
WHOSIS	WHO Information System
YLL	Year of Life Lost

List of tables

List of figures

1 Introduction

1.1 Costing of hospital services

The provision of health care in hospitals is a process where a variety of inputs, e.g. workforce, drugs, buildings, are employed in order to produce an output: The amelioration of the health status. The principal economic aim is efficiency, so to say, the optimisation of the input-output-relation. Ideally, efficiency is a natural result from the market economy processes. In an ideal market economy all market participants opt for profit maximisation, the market is transparent and homogenous and supply and demand side react infinitely fast (Wöhe and Döring 2008b). Transparency means that all participants are entirely informed and homogeneity means that no temporal of geographical preferences exist. Under these conditions price formation is the equilibrium of supply and demand and will naturally result in efficient processes of production. However, ideal markets do not exist in reality and even less with regard to health care provision (Breyer, Kifmann et al. 2005b). Asymmetric information characterises the relation between patients and health care providers and patients usually are temporarily and locally bound to undergo treatment from specific health care providers. This undermines self-determination and profit maximisation at least from the demand side. Furthermore, health care has a special status due to the fact that its outcome "health" is considered a human right (UN 1948). Hence, profit maximisation in health care markets competes with equity. Health care is meant to be independent from economic, social, geographic or individual disadvantages (Whitehead 1990). Consequently, policy makers plan the distribution of hospitals, allocate inputs and regulate the set of outputs which shall be provided. Permanent evaluation is indispensable to assure that finite resources are utilised in order to maximise the health outcomes. Costing as a way of input-output-comparison shall provide the necessary information to policy makers and enhance efficiency of processes of production notwithstanding the considered barriers.

Hospitals seemed to lose their importance to the health system in developing countries as policies focused on Primary Health Care (WHO 1978). Especially district hospitals appeared obsolete as in consequence of the conference in Alma Ata in 1978 interest turned to public health care provided in rural health centres and the self-sustainability of this system (WHO 1978). Health centres provide predominately outpatient care. Thus, more people can be treated for the same money and cost per patient can be recovered by user fees. Nevertheless, health centres are mostly run by non-physicians and can only

provide a limited set of health care interventions. Far away reference centres, on the other hand, are unaffordable and out of reach for the majority of the rural population. Only district hospitals within the reach of the population can successfully fill the gap (Pearson 1995; Van Lerberghe, de Bethune et al. 1997). The evaluation of district hospitals has to decide up to which point they are able to cope with this challenge.

1.1.1 Purpose and aims

Costing assesses the input and output of an institution and describes the results in monetary values. It is the essential part of the management accounting (Wöhe and Döring 2008a). The final aim is to calculate the cost for a single unit of output. The basic aim of hospitals is to improve the patients' state of health. As this is difficult to measure costing evaluates secondary achievements as outpatient visits, number of admissions or bed days and their respective cost (Hentze and Kehres 2008). Thus, costing deals with financial processes within establishments and is therefore not required or organised by law but an optional management tool. Within the cost analysis of health care systems, hospitals have a special status as they are the most resource consuming part and the cost per unit are considerable as only few patients are treated. Hospitals were repeatedly found to be the most expensive part of the health system. In developing countries, hospitals absorb 30-50% of the total expenditure in the health sector and 50-60% of the governmental expenditure (Mills 1990a). The difference between total and governmental expenditure is due to the existence of a strong private health care system in many developing countries. Barnum and Kutzin (1993) estimated that 50-80% of the public health sector resources went to hospitals. On district level, Mills et al. (1993) estimated in Malawi that about 70% of the total expenditure was absorbed by the district hospital. In a health district in Zimbabwe, 60% of the total expenditure in the financial year 1997/1998 went to the district hospital (Vander Plaetse, Hlatiwayo et al. 2005).

Costing has basically three main aims: Information/documentation, planning and controlling (Wöhe and Döring 2008a). The steady collection of cost and performance data provides information about the unit or average cost per product and where these costs occur. If costing data is well documented, it can be used for financial reporting, too. Documentation and ex-post calculation is the prerequisite for planning. Planning is meant to provide the formula cost per good, detect the most efficient production process, evaluate where outsourcing is a cost saving alternative and compile the ideal

product mix (Wöhe and Döring 2008a). As far as hospitals are concerned, this includes resource allocation, budgeting within the hospital and fixing the patient's contribution in form of user fees, insurance premium or taxes according to the regional system. Controlling compares the actual results with the foreseen results: A so-called actual-theoretical comparison. It keeps an eye on the actual profitability and efficiency of an establishment.

The more detailed costing is done, the better dispensable expenditure can eventually be avoided and decision makers can be helped to allocate resources appropriately. Analyses can either focus on a single hospital or a whole health district or even more complex contexts. There are many approaches to interpret costing data. In the following section a selection of different ways to interpret results from costing is presented focusing on experience of developing countries.

1.1.2 Experience from developing countries

In developed countries costing of hospital services is an essential part of hospital management. Hospitals have their proper financial accounting and controlling departments, permanently costing the hospital's activities. The trend towards managerial accounting was especially fastened by the increasing health cost and the narrowness of resources, leading to changes in budget allocation among hospitals and an increasing importance of efficient management.

In developing countries the immense difference between available resources and what is needed to meet modern health care standards is also a major problem. At the beginning of the 90s, Mills (1990a; 1990b) already argued for intensified research on health and particularly hospital economics in developing countries. However, almost two decades later, data is still relatively rare (Conteh and Walker 2004). Critics might state that costing itself is resource consuming. It has to be deliberately contemplated, if costing is worth its money in a setting where basic medical supply is curt. Furthermore, costing in developing countries entails some troubles hardly found in developed countries. Performance data is mostly incomplete and erroneous, funding is often intransparent and corruption is an ongoing problem. Accordingly, doubts exist if results obtained from sparse information can be trusted. Nevertheless, attempts to evaluate health services and especially hospital economics were made in several settings and with different aims. They can be summed up under the following headlines: Resource allocation, funding of health care and comparison of different health care institutions.

Resource allocation has to be managed between different parts of the health sector, namely preventive and curative interventions. Cost analyses can assess the potential of preventive programs, e.g. vaccines (Hussain, Waters et al. 2006) or mosquito nets (Kirigia, Snow et al. 1998), and compare them to curative strategies. Resources also have to be allocated between hospitals which in developing countries is mostly done in form of annual budgeting, giving few incentives to improve efficiency. In order to implement a casemix based budgeting system on the long-run, research was done in Iran to weight DRGs (Ghaffari, Doran et al. 2008). In Sri Lanka, research focused on the resource allocation at the North Colombo teaching hospital namely the University surgical unit. It could be shown that also in a developing country cost can be traced back to the different interventions and concrete advice can be given where cost have to be cut down and efficiency needs to be improved (Malalasekera, Ariyaratne et al. 2004).

A second motivation for costing is to analyse the funding of hospitals and evaluate if the financing concept is lasting. In Nouna health district, Burkina Faso, Marschall and Flessa (2008) investigated which part of total expenses of health care facilities is recovered by user fees. They found that currently it would not be possible to sustain these facilities only by user fee revenues. Likewise, the cost per unit can be a reference value to fix user fees or insurance premiums according to the actual charges (Dong, Mugisha et al. 2004; Minh, Giang et al. 2009). In this context analyses can also reveal which funds are actually needed to run hospitals according to national or international guidelines (Both, Jahn et al. 2008) or to respond the actual health care demand in case of undersupply.

Thirdly, cost analyses allow comparison of different hospitals at the same level as well as across health care facilities of primary, secondary and tertiary level of health care. Comparing hospitals in similar configurations allows benchmarking and provides information for managers concerning the improvement of efficiency (Hansen, Chapman et al. 2001; Olukoga 2007; Marschall and Flessa 2009; Minh, Giang et al. 2009). For health planning purposes, health care has to be arranged between the different levels of the health system. In India (Krishnan, Arora et al. 2005) and Tanzania (Both, Jahn et al. 2008) certain interventions were even more expensive on the primary level than on the secondary level due to low case numbers. In Vietnam Flessa and Dung (2004) showed that the costing of interventions on different levels can help to allot responsibilities in a resource-saving way. This is by the way not only a question of money but also a question of quality as specialised and therefore experienced hospitals are indisputably

the better choice for complex intervention. Services should be provided at the level which offers the maximal quality at a reasonable price for the specific intervention. However, it is not enough to base decision making on the cost per unit from the provider's viewpoint, as health care interventions also have to be allotted according to epidemiologic factors, infrastructure etcetera.

1.1.3 Working hypothesis

The examples for costing of health care services, particularly hospitals, in several developing countries show that there is a considerable benefit, to be exact knowledge about efficient resource allocation, good funding concepts and the scope of hospitals. This leads, hence, to the working hypothesis that costing is possible even in developing countries and is an appropriate tool to improve the efficiency of a district hospital in sub-Saharan Africa (SSA).

1.2 Research objectives

There still is a lack of cost data from hospitals in developing countries mainly due to the little importance that was given especially to district hospitals over the last decades and the unavailability of trustworthy data within the health care institutions. The aim of this dissertation is to provide detailed data on provider's cost for Nouna district hospital in Burkina Faso by upraising cost per patient for four diseases from generalised hospital cost data.

Cost data could be retrieved from the provider cost information system and joined with performance data of record review, observation and interviews performed in April/Mai 2007. This allowed to overcome several shortcomings often found in cost analyses from developing countries by distinguishing different diseases within the same ward, analysing in- and outpatient care separately, using activity-based keys for the allocation of resources and reflecting the care actually provided to the patient (English, Lanata et al. 2006).

Within the cost-of-illness evaluation this dissertation provides information about provider's cost at Nouna district hospital and patients' expenses on user fees for diseases which have an important impact in the region. It is part of a follow-on project of a DFG project with the aim to estimate tangible cost-of-illness as basis of cost-

effective intervention against infectious diseases in developing countries, exemplified by the Nouna health district.

In this thesis, the following research objectives will be addressed:

- Calculation of average cost for patients with certain diseases along a standard pathway.
- To determine where cost occur along the patient's hospital stay and if there is noteworthy wastage of resources.
- To estimate how provider's cost per patient would change, if the health care demand increased.
- Calculation of total user fees per patient and the cost-recovery rate. To evaluate if the hospital could break even for the considered diseases in its current configuration.

1.3 Outline of the dissertation

In chapter 2 a literature review is given, focusing on previous costing of hospitals in developing countries and the epidemiology of the selected diseases in Burkina Faso. General information about Burkina Faso, its health system and Nouna health district introduces the reader to the study site. Main economic terms related with costing will be defined, before presenting different costing methods. The section "methods" ends with the description of the research done to cost specific hospital services at Nouna district hospital.

The results are presented in chapter 3 starting with the general cost data of the hospital, followed by the cost for the selected diseases and finally taking a closer look at cost centres which produce unexpected high cost as well as at the patients' financial contribution in form of user fees.

In the discussion results of Nouna district hospital are compared to data obtained elsewhere in similar hospitals. Coherences between utilisation rate and cost per patient just like between utilisation rate and cost-recovery rate are investigated. Then possibilities to reduce cost will be outlined and a perspective for further application of the introduced method will be presented. Finally, strengths and limitations of the work are considered and a conclusion is taken.

2 Methods

2.1 Literature Review

The literature review will give a short overview of the state of the art of costing in developing countries in general and particularly in hospitals. The section epidemiology explains why the specific diseases were chosen for a detailed cost analysis and which impact they have in the region.

2.1.1 Costing of hospital services in developing countries

There are different aspects of economic evaluation, which are shortly presented before concentrating on costing of hospitals in developing countries with special emphasis on the methodology.

According to Drummond et al. (2005) there are four methods of economic evaluation: Cost analysis, cost-effectiveness-analysis, cost-utility-analysis and cost-benefit-analysis. The first method is the *cost analysis*, which considers only the cost of an intervention and does not necessarily provide outcome data. The power of cost analysis depends on the applied costing methodology. This will be discussed in detail in chapter 2.4 (p. 33 et seq.). Secondly, the *cost-effectiveness-analysis* (CEA) compares cost with a single outcome, the "most appropriate natural effect or physical units, such as 'years of life gained' or 'cases correctly diagnosed'" (Drummond, Sculpher et al. 2005). CEAs are quite common, because they provide direct hints for health personnel concerning the adoption of treatment, e.g. if a new antibiotic eradicates specific germs more effectively and at which (additional) cost. Another possibility is to compare cost of different health interventions to the number of life years saved (Jha, Bangoura et al. 1998). Thirdly, the *cost-utility-analysis* (CUA) meets concerns that effects cannot be measured by a single outcome but have to include a variety of factors. Possible measures of disease burdens are Disability Adjusted Life Years (DALYs) averted or Quality Adjusted Life Years (QALYs) gained, combining Years of Life Lost (YLL) with either years of productive life lost due to disability or years lived with reduced quality of life. Nevertheless, the distinction of CEA and CUA is less sharp than between the others. Since 1998, the WHO has solicited cost-effective interventions with the programme Choosing Interventions that are Cost Effective (CHOICE), collecting regional data on cost, health impact mostly measured in QALYs gained and cost-effectiveness of interventions (WHO 2009a). The sectoral CEA has the pretence to analyse the whole package of

possible health care interventions to implement the mix of interventions with the highest benefit (Murray, Evans et al. 2000; Evans, Edejer et al. 2005). CHOICE analyses based on regional data are modelled and can thereby be applied to specific country-related circumstances (Hutubessy, Chisholm et al. 2003). Finally, the *cost-benefit-analysis* (CBA) measures the outcome in monetary values, hence, different effects of interventions become directly comparable, e.g. the outcome of a diagnostic test with a gain of lifetime. However, to express gain of life time or health status in monetary values is a challenge causing controversy.

Consequently, the cost analysis of hospital services is only be the first step of a full economic evaluation, but it is the base for CEA/CUA and CBA and, as showed before (1.1.1 and 1.1.2, p. 2 et seq.), allows already a variety of conclusions.

Costing methodologies for hospitals can be distinguished using different criteria, in particular the level on which units that shall be cost are defined, the level on which data is obtained and the included timeframe.

The WHO perceived the need of cost data for management purposes in hospitals in developing countries and published the first practical manual for costing in 1998 (Shepard, Hodgkin et al. 2000). The method suggests defining outputs on a quite aggregated level, for instance as an inpatient day or an outpatient visit, an X-ray or a laboratory test. This generates knowledge about e.g. the expenses on an average inpatient day or an X-ray whilst neither differentiating between patients' diagnoses nor caring about the appropriateness of the interventions. Corresponding analyses were done in Malawi (Mills, Kapalamula et al. 1993), Tanzania (Flessa 1998), Uganda (Murru, Corrado et al. 2003), India (Krishnan, Arora et al. 2005) and Vietnam (Flessa and Dung 2004; Minh, Giang et al. 2009).

However, the appearance of the highly cost-intensive chronic infection HIV/AIDS strengthened the need for more detailed cost analyses, allowing differentiation between patients at e.g. the same ward. Hansen et al. (2001) evaluated the impact on HIV/AIDS-infection has on total cost for a hospital stay. They could show that the infection generally leads to higher cost per inpatient day and to longer hospital stays. Similar methodologies were applied in Kenya (Guinness, Arthur et al. 2002) to cost HIV/AIDS- and non-HIV/AIDS-patients separately and in Thailand to estimate provider's cost of highly active antiretroviral therapy (Kitajima, Kobayashi et al. 2003). In India (Muralikrishnan, Venkatesh et al. 2004), Malawi (Lara, Kandulu et al. 2007) and Ethiopia (Bikilla, Jerene et al. 2009), specific interventions within hospitals, namely a

cataract intervention, the supply of one blood transfusion at the laboratory and HIV care with antiretroviral therapy, were cost. Conclusively, it can be stated that approaches can be differentiated in gross costing and microcosting (Tan, Rutten et al. 2009). *Gross costing* defines the output on a comprehensive level making costing faster and easier to perform. *Microcosting* defines output more accurately based on patient- or disease-specific data on hospital level endowing health care planners with more detailed information. Nevertheless, it is also more time- and resource-consuming (Figure 1).

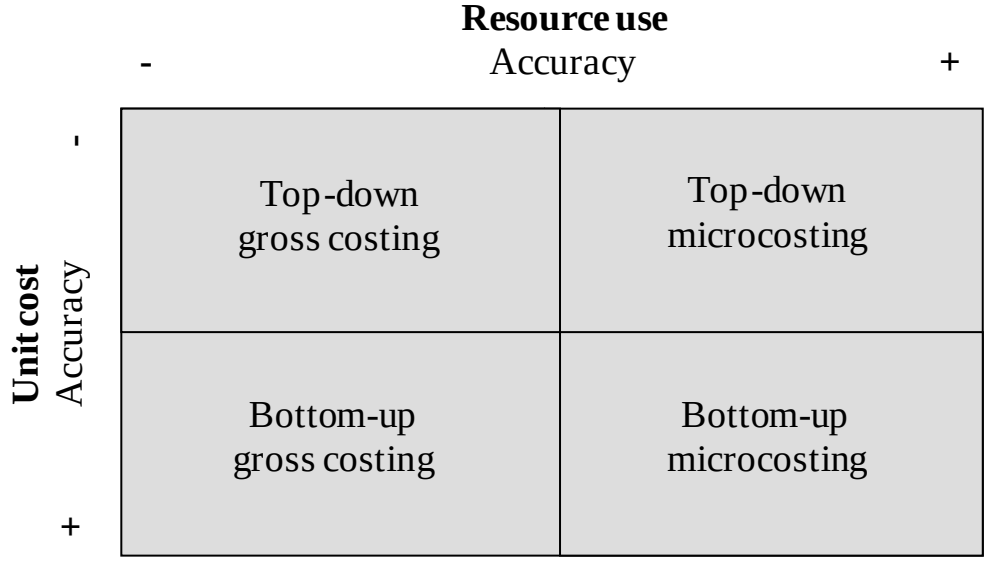

Figure 1: Methodology matrix - the level of accuracy at the identification and valuation of cost components (Source: Tan, Rutten et al. 2009)

Even though, costing cannot only be distinguished by the level on which output is defined, but also by the level on which cost information is gained. Cost data can either be retrieved from the hospital accounts or from accounts on regional or national level, which is called *top-down* approach, or costing is done by evaluation of resource consumption of every output that shall be cost, the so-called *bottom-up* approach (Tan, Rutten et al. 2009). Literature that compares the different approaches comes from developed countries. It is generally concluded the more detailed the best and only contains that the additional gain of information has to outweigh the effort (Clement Nee Shrive, Ghali et al. 2009; Tan, van Ineveld et al. 2009). Wordsworth et al. (2005) stated that bottom-up approaches are especially advantageous in cases where a specific input has to be allocated to different outputs, if staff works at different wards and in cases where cost are not routinely allocated to particular interventions. Moreover, bottom-up costing is especially capable of detecting local variations (Chapko, Liu et al. 2009).

In SSA, however, routine cost data collection as a management tool in (district) hospitals does not yet exist. Accordingly, cost methodologies should be easy to handle and the rare costing performed should provide as much information as possible. Decision makers have to decide if research shall focus on the local aspects, special needs and constraints or if conclusions shall be drawn for hospitals in developing countries in general. On the one hand, top-down approach and cost modelling might be more appropriate in a surrounding where data from health care facilities is incomplete and faulty. Research providing more reliable outcomes based on secondary data might therefore be preferred, e.g. the WHO CHOICE data base (WHO 2009a). It gives information about cost-effectiveness independently from a specific setting (Murray, Evans et al. 2000). On the other hand, the costing approach with secondary data can only give a rough picture of the actual cost as only a restricted number of countries was chosen exemplarily for 14 world regions in the case of the CHOICE initiative (Evans, Adam et al. 2005). This might not be an appropriate base to set local fees or insurance premiums. Furthermore, it can neither provide evidence about local efficiency of resource-allocation and -consumption nor over- or under-financing nor about quality of care actually given to the patient.

The third aspect of costing methodologies, especially in developing countries, is the research time dedicated to data collection. In the absence of routine data collection systems, primary data collections are often done in only a few months or even weeks. To obtain trustworthy data from health facilities most researchers evaluate hospital accounts, inventory the hospital and review patient files themselves for a restricted period of time and extrapolate data.

To sum up, costing is important, but methodologies applied in SSA are diverse and cost data from SSA and other developing countries is still rare (Mills 1990a; Mills 1990b; Conteh and Walker 2004; Flessa 2009a). Regarding the methodology various approaches exist, weighting accuracy and comprehension differently. For certain questions a more comprehensive methodology is appropriate, but it is eventually also due to constraints like a lack of detailed data, money and/or time. For the same reasons cost data is often collected top-down on the level of hospital accountancy or even more aggregated. Especially since district hospitals in developing countries neither provide a computerised documentation system nor a reliable long-term data collection in hand-written form, cost analysis remains mostly “a snap-shot like collection” of cost information (Flessa and Kouyaté 2006).

2.1.2 Epidemiology

The most common diseases in the region according to the health personnel at Nouna district hospital are Malaria, respiratory infections, gastro-enteritis, malnutrition, diarrhea and snake bites as well as epidemic diseases like meningitis, varicella, measles and furthermore HIV/AIDS, tuberculosis and leprosy (Yé, Sié et al. 2005). This is on par with the statistics of Burkina Faso's Ministry of Health of 2005 and 2007 (Table 1).

	2005		2007	
	Reasons for consultation	**Reasons for hospitalisation**	**Reasons for consultation**	**Reasons for hospitalisation**
1.	Uncomplicated Malaria (30.9%)	Severe Malaria (52.5%)	Uncomplicated Malaria (36.7%)	Severe Malaria (52.6%)
2.	Parasite infestation (11.6%)	High respiratory inflammation (9.0%)	Deep respiratory inflammation (14.1%)	Deep respiratory inflammation (13.2%)
3.	Deep Broncho-pneumonia (10.2%)	Others (4.9%)	High respiratory inflammation (4.2%)	Meningitis (7.2%)
4.	Others (6.3%)	Anaemia (4.3%)	Non-haemorraghic diarrhea (4.1%)	Anaemia (4.3%)
5.	Severe Malaria (5.0%)	Non-haemorraghic diarrhea (3.1%)	Severe Malaria (4.1%)	Non-haemorraghic diarrhea (2.7%)
6.	Skin affection (4.7%)	Pneumonia (2.9%)	Skin affection (4.1%)	Snake bite (2.6%)
7.	Non-haemorraghic	Uncomplicated Malaria (2.9%)	Parasite infestation (3.9%)	Other digestive affections (2.1%)
8.	Other digestive affections (3.0%)	Snake bite (2.9%)	Wound (3.3%)	Malnutrition (1.4%)
9.	Pneumonia (2.9%)	Other digestive affections (2.1%)	Other digestive affections (2.5%)	Intoxication (0.8%)
10.	Wound (2.4%)	Meningitis (1.9%)	Conjunctivitis (1.4%)	Hypertension (0.6%)

Table 1: Most frequent reasons for consultations and hospitalisations on district level in Burkina Faso for 2005 and 2007 (Source: Ministère de la Santé 2006a; Ministère de la Santé 2008)

In the annual statistics of the Ministry of Health of Burkina Faso for 2007 hypertension accounts only for 0.63% of all outpatient visits (Ministère de la Santé 2008).

Hypertension was the tenth most frequent reason to hospitalise a patient on district level in Burkina Faso in 2007 (Table 1). This goes alongside with the prediction of a growing "double burden of disease" especially in developing countries consisting of a variety of infectious diseases on the one hand and the increasing amount of chronic non-infectious diseases due to demographic and socio-economic transition on the other hand (Boutayeb and Boutayeb 2005; Boutayeb 2007).

Consequently, Malaria as an example of an infectious disease was chosen for the cost analysis as well as hypertension to represent chronic non-infectious diseases. Additionally, the most frequently performed operations of the surgical ward were analysed, because there is a lack of research on surgical interventions in developing countries (Kingsnorth, Clarke et al. 2009). In this regard hernia cure and the Caesarean section served as examples. Hernia cure is the most frequently performed surgical intervention at Nouna district hospital and Caesarean section is of special interest as pregnancy and child birth are still extremely life-threatening for mother and child in developing countries.

2.1.2.1 Paediatric Malaria

Malaria is one of the most common diseases worldwide causing more than a million deaths and 300 million illness episodes yearly. In particular children suffer from high morbidity and mortality caused by Malaria (Lopez, Mathers et al. 2006). The disease even is a major obstacle for economic and human development in SSA (Sachs and Malaney 2002; Bartram, Lewis et al. 2005).

In Burkina Faso 27.5% of all children under the age of five sought treatment in a public health care institution because of uncomplicated Malaria (1,243,097 of 4,528,465) and another 3.2% for severe Malaria (142,576 of 4,528,465) (Ministère de la Santé 2008) in the year of 2007. This is only an incomplete image of the total prevalence as especially Malaria patients or their relatives often tend to make use of self-treatment and therefore are not counted in the health institutions statistics (Mugisha, Kouyaté et al. 2002b). In the health district of Nouna, in the north-west of Burkina Faso, Malaria was the main cause of death among infants, children under the age of five and children between five and fourteen years during the years 1999 to 2003 (Hammer, Somé et al. 2006; Becher, Kynast-Wolf et al. 2008).

Malaria is a tropical disease caused by four different species of protozoan parasites called Plasmodium which are transmitted to humans by female Anopheles mosquitoes and infect the red blood cells. Most Malaria cases in Western Africa are caused by Plasmodium falciparum, which provokes severe falciparum Malaria and is more dangerous than any other Plasmodium type.

Malaria symptoms are non-specific at the beginning, but well-known in endemic areas. Treatment is often self-administered by the patient and started in absence of positive diagnostics. This is controversial because even though early treatment avoids complications, incomplete self-treatment compounds the resistances against anti-Malaria drugs and leads to a considerable overdiagnosis of the disease with respective cost (Hume, Barnish et al. 2008). The disease can be diagnosed by a thick blood film or/and a blood smear even in low-resource settings. Symptoms of severe Malaria are coma (cerebral Malaria), severe anaemia, metabolic acidosis and hypoglycaemia as well as renal failure or acute pulmonary oedema in adults. Severe Malaria has a mortality of 15-20% when treated and 100% when untreated (WHO 2006). There are several possible drug regimes. At the moment artemisinin-based combination therapy (ACT) is advised best for uncomplicated cases and intravenous Quinine for severe falciparum Malaria. Special attention has to be paid to the treatment of the numerous life-threatening complications mentioned above. They have to be treated independently.

To prevent Malaria mosquito nets and abatement of mosquitoes near human settlements are the most promising options as there is no vaccine available and lifelong prophylactic treatment is neither recommendable nor affordable. However, after several disease episodes people develop a semi-immunity. This prevents the grown-up population of endemic regions from severe Malaria.

2.1.2.2 Hypertension

Cardiovascular diseases (CVDs) comprehend coronary heart disease, cerebrovascular disease, peripheral artery disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis and pulmonary embolism (WHO 2007). Arterial hypertension is one of the main risk factors for CVDs and defined as permanent increase of the blood pressure above 90mmHg diastolic or 140mmHg systolic. Other influenceable risk factors are smoking, diabetes, obesity, physical inactivity and high blood lipids. A risk stratification for CVDs including the level of hypertension and the number of other risk factors is suggested before hypertension treatment sets in (WHO 1999; Whitworth

2003). Then, life style changes should be the first target, for instance to stop smoking or to intensify physical activity. Secondly, a variety of drugs is available, which affect different risk factors and can be prescribed either as mono-therapy or in combination. Thirdly, the damage risk factors or cardiovascular events have already caused in target organs, e.g. heart, reins or retina has to be addressed.

Low-income countries like Burkina Faso have increasing problems with non-infectious CVDs, namely renal failure, myocardial infarction and stroke (Lopez, Mathers et al. 2006; Addo, Smeeth et al. 2007). Between 1997 and 1999 more YLLs were due to CVDs (198,0) than to HIV (168,1) (Würthwein, Gbangou et al. 2001b), giving evidence to the increasing importance of chronic non-infectious diseases. Heart diseases and strokes collectively caused 24 DALYs lost per 1,000 persons in 2003 in Burkina Faso. This is already twice as much as in Europe and North America (Mackay and Mensah 2004) and still the WHO forecasts that mortality due to CVDs will almost double in SSA until the year 2030 (WHO 2009b). This trend might be due to changing lifestyles, e.g. smoking, abdominal obesity, dyslipidemia (Yusuf, Hawken et al. 2004; Steyn, Sliwa et al. 2005; Agyemang 2006) and epidemiological transition (Kuller 2007; Mensah 2008), but possibly also to sparse nutrition and malnutrition in early childhood (Barker 1997). The progression is intensified by the threatening weight of communicable diseases in SSA which swallow the greatest share of international aid and are more present in the awareness of international donors (Unwin, Setel et al. 2001; Yusuf, Reddy et al. 2001).

The growing number of non-infectious diseases will be more difficult to cope with because these chronic diseases demand life-long treatment and patients' volition for changes in diet and everyday activities. Data of the current expenditure on these diseases concerning sub-Saharan countries is still rare (Jamison and Mosley 1991; McMichael, Waters et al. 2005; Mulligan, Walker et al. 2006) but indispensable in order to get an idea of future cost and to develop strategies to cope with them (van der Sande, Coleman et al. 2001).

2.1.2.3 Surgical interventions

In Africa approximately 38 DALYs (see chapter 2.1.1, p. 7) are lost per 1000 persons due to a lack of surgery. This is more than in any other part of the world (Debas, Gosselin et al. 2006). Already in 1984 Nordberg (1984) stated that the number of surgical interventions performed in East Africa is by far too low to cover the demand he

estimated according to a European prevalence. Although surgical interventions are relatively cost-effective, they can still be considered as neglected in SSA where scientific interest and money is focused on infectious diseases such as HIV/AIDS, Malaria and tuberculosis and lately on the growing burden of chronic non-infectious diseases (Ozgediz and Riviello 2008).

2.1.2.3.1 Inguinal hernia

Inguinal hernias can be either congenital or acquired. Men are affected by 80% of the inguinal hernias due to anatomic differences, namely the descending testis. Inguinal hernias are divided in direct and indirect inguinal hernia. Direct inguinal hernias are mostly acquired. They occur at a weak point medial of the epigastric vessels and the funiculus spermaticus through the fascia abdominalis (Fossa inguinalis medialis) and the annulus inguinalis superficialis. Indirect inguinal hernias proceed through the inguinal canal and are mostly due to a congenital opened processus vaginalis or acquired. They become apparent as hernia scrotalis in the man's scrotum or as hernia labialis in women. Hernias often cause few symptoms at the beginning. They become life threatening when they are strangulated and the small intestine is incarcerated and/or a mechanic ileus occurs. Inguinal hernias can be diagnosed by health personnel on physical examination and there are several operation techniques either with or without the implantation of a mesh (Maggiore, Muller et al. 2001; Horharin, Wilasrusmee et al. 2006).

In Burkina Faso 3,084 hernia interventions were performed in public hospitals in 2005. This is equivalent to 24 hernia interventions per 100,000 inhabitants assuming a total population of 12,880,980 (Ministère de la Santé 2006a). The number increased slightly to 31 hernia cures per 100,000 in 2007 (Ministère de la Santé 2008). Further statistics on inguinal hernias are not available for Burkina Faso but further aspects of the disease were explored in Ghana, a neighbouring country. Kingsnorth et al. (2009) found 1,400 hernias per 100,000 persons in Ghana. This figure is ten times higher than in developed countries. Moreover, inguinal hernias in Ghana are bigger than hernias found in developed countries. More than half of them limit daily activity and 16% of the patients were even unable to work. Hence, the disease has also a serious economic impact on the patients (Sanders, Porter et al. 2008). Furthermore, more than 80% of the hernias occurred as indirect hernias in younger patients and were probably congenital and not treated at an earlier stage (Sanders, Porter et al. 2008). This leads to the

conclusion that the high incidence of hernias might be due to an accumulation of untreated hernias. This could be combated by widespread surgical interventions which would have to be in every aspect (fees, time, distance/transport etcetera) affordable for the patient. The affordability is especially important as the disease can be treated best at a stage when it hardly causes any symptoms and the psychological strain is still low. For Nigeria it was shown that no intervention or an emergency intervention entails a higher mortality and therefore preventive interventions should be favoured (Mbah 2007).

2.1.2.3.2 Caesarean section

A Caesarean section is the operative end of pregnancy due to high risks for mother and/or child (Pschyrembel and Dornblüth 2004).

All over Burkina Faso the frequency of Caesarean section in 2007 was only 1.26%, respectively 8,278 of 659,207 deliveries (Ministère de la Santé 2008), compared to e.g. 29.3% in Germany in the same year (Statistisches Bundesamt Deutschland 2009). Within the country exist however great differences, comparing for example the rate of assisted births which is 54% on average in the whole country but only 42% in Nouna health district (Ministère de la Santé 2008). On the other hand, Nouna health district had the highest rate of maternal deaths all over the country with 364 maternal deaths per 10,000 deliveries (Burkina Faso as a whole: 101 maternal deaths per 10,000 deliveries) (Ministère de la Santé 2008). The WHO has set an optimal rate of 10 to 15% for Caesarean sections (Lancet 1985), which is up to now subject of discussion (Penn and Ghaem-Maghami 2001). All the same, countries with extremely low rates of Caesarean sections have high rates of maternal and infantile death rates and obviously an undersupply of adequate health care (Betran, Merialdi et al. 2007). The assumption that an important reason for the low rate of Caesarean sections and assisted births are high cost was fleshed out by Storeng et al. (2008). The study included women delivering in two university hospitals, two regional hospitals and three district hospitals in Burkina Faso. They found that on average an uncomplicated delivery costs 5.1%, a near miss complication 12.7% and a Caesarean section 27.4% of the annual GDP per capita of US$ 461 in 2006. The analysis included direct cost for the patients along hospitalisation except cost for transport. Taking into account that most families live on agriculture and that the cash income makes up for a small part for their revenues only this is even more challenging. Especially in the poorest quintile households are often forced to sell assets

to cope with the hospital cost, which leads to further impoverishment. Storeng et al. (2008) also stated that cost vary substantially over the country and are not at all predictable, which evinces the need of detailed cost data from the provider's as from the patient's viewpoint and the imperative to make treatment more cost-efficient.

2.2 Research Setting

2.2.1 The country Burkina Faso

Burkina Faso (former Upper Volta) is a land-locked country in western Africa, belonging in the south to the region "Soudain" and in the north to the Sahel. The country has a territory of 274,200 square kilometres and borders to Togo, Ghana, the Ivory Coast, Mali, Benin and Niger. The country's capital is Ouagadougou. In 2008 Burkina Faso had a population of 15,264,735 inhabitants and an annual population growth rate of 3.1% (CIA 2008). About 40% of the total population belong to the ethnic group Mossi while the rest is split between a wide range of different ethnic groups including Bambara/Dioula, Peuhl and Bwamu, each of them with their own language. The main religions are Islam (50%), traditional/animist belief-systems (40%) and Christianity (10%).

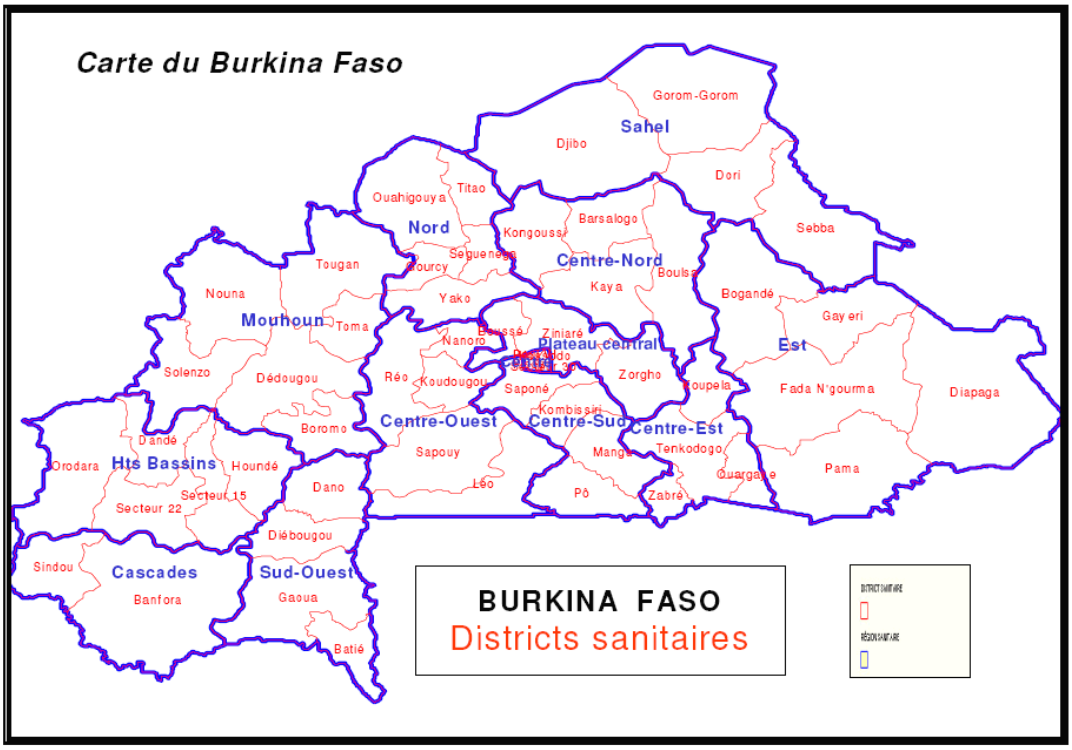

Figure 2: Burkina Faso's health regions and health districts (Source: Ministère de la Santé 2006a)

People are mainly living in the rural parts of the country and about 90% live on subsistence agriculture. 2007's GDP was estimated at about US$ 6.977 billion, the per capita GDP was about US$ 1,200 and the annual growth rate was 4.2% (CIA 2008). Burkina Faso's currency is the "Franc CFA" which is pegged to the Euro at a rate of 655.957 FCFA. Burkina Faso is one of the least developed countries in the world, ranking on place 176 of 177 in the Human Development Index 2007/08 and with an estimated life expectance of 51.4 years (UNDP 2007).

2.2.2 Health care system

Burkina Faso's health care system is organised like a pyramid including four levels of health care (Figure 3). In 2007 the base of the health care system was formed by 1,211 rural health centres (CSPS). The second level or the first level of reference consisted of 43 district hospitals with or without a surgery unit (CMA/CM). The third level included nine regional hospitals (CHR) and finally there were three university hospitals (CHU), one in Bobo Dioulasso and two in Ouagadougou (Ministère de la Santé 2008).

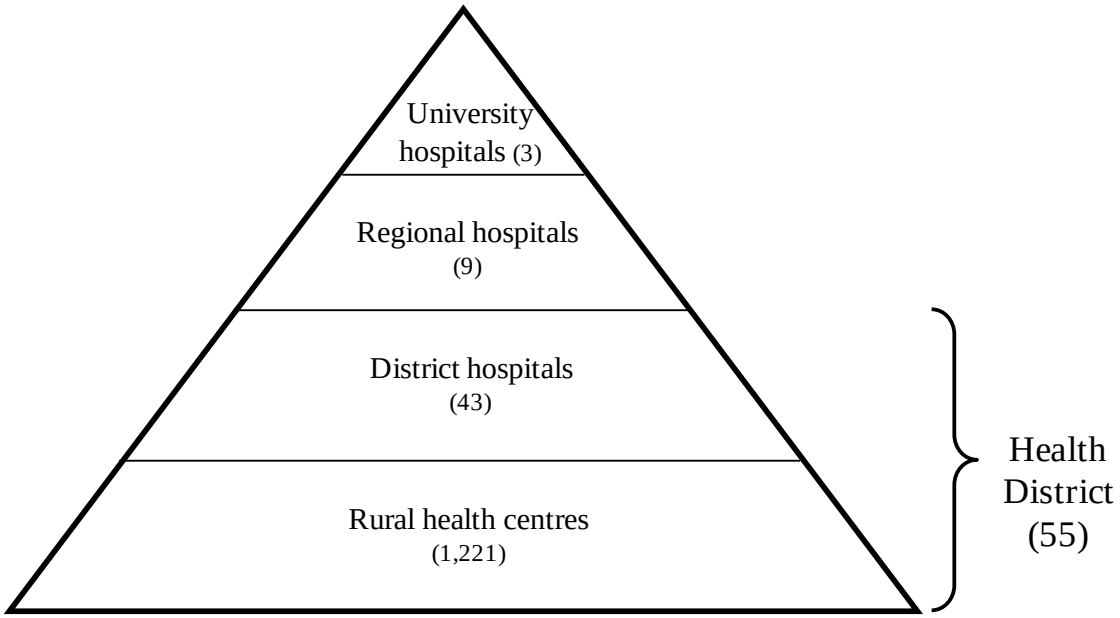

Figure 3: The health care pyramid of Burkina Faso (Source: Ministère de la Santé 2008)

From an administrative point of view, the country is divided into 55 health districts with a population of 200,000 to 300,000 inhabitants each (Figure 2, p. 17). Every health district belongs to one of the 13 health regions, which are lead by a district direction (DRS). The top of the health system's administration is formed by the Ministry of Health and the General Secretary in Ouagadougou (Cabinet du Ministre et du

Secrétariat Général). The importance of the private health sector, including NGOs and confessional health care institutions, increased immensely over the last decade. In 2007 existed 372 private facilities. It is noteworthy that about 75% of these facilities were located in the two districts including the two main cities Ouagadougou and Bobo Dioulasso and that the majority is profit-oriented (71%) (Ministère de la Santé 2007). Traditional medicine is more difficult to assess, but still has a strong influence on the health care. Consequently, it was integrated into Public Health Care by law and today it is considered to be part of the health care system.

Burkina Faso adopted the idea of Primary Health Care (PHC) after the conference of Alma Ata in 1978. PHC is defined as "essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination" (WHO 1978). Accordingly, interest focused on rural health centres during the implementation process. Burkina Faso's government launched several programmes over the following years, but only with moderate success. Since 1992 Burkina Faso is a member of the Bamako Initiative (BI) promoting decentralisation and self-financing of the health care systems in western African countries and the availability of essential generic drugs at affordable prices. The aim was to reinforce the ideas of PHC by decentralisation of the health care system, introduce a well-working supply-chain of generic drugs and create a sustainable system to finance health care by introducing user fees. Administrative organs were created even on community levels in order to supervise rural health centres (COGES) and to make choices more independently and more responsibly with regard to the needs of the local community. Further administrative committees were formed on district level and in the hospitals (ECD, CA). Concerning the policy of essential generic drugs, an institution (CAMEG) was created to ameliorate the supply. Provision stocks exist on district level (DRD). At the rural health centres and in hospitals pharmacies offering generic drugs (Dépôt MEG) were introduced. The first accoutrement was provided by the state or other partners. According to the BI, nowadays, these pharmacies are meant to be managed independently and to be financially independent from the health care centre or the hospital (Ministère de la Santé 2000). Their benefit is meant to help sustaining the pharmacy as well as allowing further investments on health care at community level. On the other hand, a private system of drug supplies exists with a multitude of different wholesalers and pharmacies mainly in the urban areas.

Noteworthy problems of Burkina Faso's health care system are the low utilisation rates of western medical care (Makinen, Waters et al. 2000; Dong, Gbangou et al. 2008) and the unequal geographic distribution of medical supply, e.g. more than 50% of all physicians and of all midwives and almost 60% of all pharmacists work in either Ouagadougou or Bobo Dioulasso while the majority of the population lives in the rural parts of the country (Ministère de la Santé 2000). The economic power is also distributed unequally: In 2003 a household in rural regions was estimated to spend about US$ 52 (28,000 FCFA) for health care, whereas households in urban areas spend about US$ 96 (51,000 FCFA) on this purpose. Likewise, inequality exists between the very poor and the very rich. The poorest rural households spent on average US$ 23 (12,000 FCFA) while the richest urban quintile spent US$ 133 (71,000 FCFA) on health care (Ministère de la Santé and Banque mondiale 2005). Furthermore, health care institutions suffer from high fluctuation of health personnel officially working in rural parts of the country. Patients often have to bear high out-of-pocket expenses due to high drug prices, even for generics (Bodart, Servais et al. 2001).

2.2.3 Health care financing

According to a document of the Ministry of Health of Burkina Faso, the country spent about US$ 250,155,487 (164 billion FCFA) for health care in 2004 (Ministère de la Santé 2006b).

	Total expenditure on health as percentage of gross domestic product (%)	General Governement expenditure on health as percentage of total governement expenditure (%)	Social security expenditure on health as percentage of general government expenditure on health (%)	Private expenditure on health as percentage of total expenditure on health (%)	Private prepaid plans as percentage of private expenditure on health (%)	Out of pocket expenditure as percentage of private expenditure on health (%)	Per capita expenditure on health (US$)
Burkina Faso	6,7	18,4	0,2	40,5	2,3	94,2	27,0
Ghana	6,2	6,9		69,9	6,2	79,1	30,0
Kenya	4,5	6,1	8,5	53,4	6,9	80,0	24,0
Niger	3,8	10,2		49,5	11,7	85,2	9,0
Brazil	7,9	6,7	0,0	55,9	30,2	54,6	371,0
United States of America	15,2	18,7	28,8	54,9	66,3	23,9	6347,0
Denmark	9,4	14,8	0,0	16,4	9,0	90,7	4499,0
France	11,2	16,6	93,8	20,1	63,0	33,2	3926,0
Germany	10,7	17,5	87,6	23,1	39,8	56,8	3628,0
Vietnam	6,0	5,1	33,5	74,3	2,5	86,1	37,0

Table 2: Health system resources for selected countries in 2005 (Source: WHO 2008)

This corresponds to 6% of the annual GIP. Broken down to the population, US$ 25 (13,133 FCFA) were spent per person. The main part of the expenditure was furnished by the patients in form of user fees (46%), the rest came in equal parts from the state's household and international institutions. Only a negligible share of 0.6% is financed by private insurances. Data from the WHO database WHOSIS for 2005 shows a comparable picture for Burkina Faso (Table 2).

The biggest share of money in the health care sector was spent on pharmacies (34%) and in each case 14% to PHC/other prevention programmes and the general administration. Only 23% of the money for health care was issued to curative institutions: 15% to hospitals, including university, regional and district hospital, and 8% to outpatient services (Ministère de la Santé 2006b). This means that the expenditure on hospitals was relatively low compared to other settings (Mills 1990a; Mills 1990b; Barnum and Kutzin 1993).

District hospital	**User fees for medical services in 2003 (US$)**			
	Normal delivery	**Complicated delivery**	**Caesarean section**	**Hernia cure**
Houndé	7.59	13.67	38.40	
Orodara	10.40	16.11	66.77	50.57
Nouna	1.40	1.87	61.43	56.19
Sebba	7.40	12.60	126.43	60.87
Diapaga	12.97	11.99	79.79	46.83
Dièbougou	2.43	2.43	40.36	49.26
Kongoussi	4.68	4.68	56.19	46.83
Léo	5.15	7.02	54.93	50.81
Yako	6.26	6.26	108.54	95.34
Titao			43.59	52.96
PaulVI	18.82	24.30		110.02
Zabre	6.93	10.63	97.40	97.40
Average	**7.64**	**10.14**	**70.35**	**65.19**

Table 3: User fees for certain health care interventions at different district hospitals of Burkina Faso in 2004 (Source: Ministère de la Santé 2008)

The district hospitals received altogether 28.5% of the total expenditure on hospitals (US$ 12.8 of US$ 45.0 million). The smaller share of money (43.9%) came from the Ministry of Health while 54.5% were raised in form of user fees. Pharmacies were financed at 99.6% by out-of-pocket payments of patients and consequently 75.8% of the total out-of-pocket expenditure went to pharmacies (US$ 103.0 of US$ 135.9 million)

(Ministère de la Santé 2006b). This goes along with the high burden of drug prices mentioned above.

Following the introduction of the BI, user fees were introduced in Burkina Faso in 1993. User fees have to be paid as fees for service and should be defined by national guidelines for all district hospitals as well as for other public health care institutions (De Allegri 2006). Officially fees should exist for outpatient consultation, hospitalisation, laboratory tests, medical picturing and drugs. All fees except for drugs are raised centrally at a cash point where patients receive a receipt, entitling them to receive the specific service. Only rural health centres have a certain right to vary their fees according to the local circumstances. However, investigations of prices for interventions in different district hospitals all over Burkina Faso in 2004 illustrate that user fees vary widely (Table 3).

At Nouna district hospital, exemptions from user fees are possible for people showing one of the following documents (Yé, Sié et al. 2005):

- Card of the local community based health care insurance
- Health personnel card
- Document of indigence
- Pensioner's card
- Document identifying the patient as a pupil
- Paper of exoneration given by a doctor.

The paper of exoneration can be given by the physician in attendance in cooperation with the social service of the hospital (Yé, Sié et al. 2005). Nevertheless, Ridde (2008) states that little attention is generally paid to this topic in Burkina Faso. Bicaba et al. (2003) found that out of 2103 women undergoing Caesarean sections in three different hospitals only 1.5% benefited from exemptions and in fact even women exempted from user fees had to pay on average about US$ 71 (38,000 FCFA). Furthermore, three out of the 32 women receiving exemptions were found to be married to civil servants earning a regular salary.

In 2004 private health insurances provided 0.6% of the total national health budget (Ministère de la Santé 2006b). Social security funds exist for civil servants and blue-collar workers (CARFO, CNSS). So far the health insurance system covers only a very small part of the population and of the total health care expenditures (Su 2005).

Since 2004, a community-based health insurance system (AMBC) has been introduced stepwise in those parts of the Nouna health district, which are covered by the demographic surveillance system (see p. 25 et seq.). The benefit package includes general and specialised consultation, essential generic drugs (if prescribed), laboratory tests, inpatient hospital stays (up to 15 days per episode of care), X-rays, emergency surgery and ambulance transport (when authorised by the provider). Excluded are ophthalmology services, dental care, circumcision, family planning, sanitation, HIV/AIDS treatment, injury resulting from the individual's responsibility (e.g. drunkenness). Health care providers are reimbursed by a capitation payment mechanism (De Allegri 2006). Indeed, only 5.2% of the population offered to join the AMBC affiliated up to 2006 that means 370 out of 7,122 households (Gnawali, Pokhrel et al. 2009). Possible reasons for the low enrolment rate were the assumption of low quality of health services and payment conditions (De Allegri, Sanon et al. 2006). It was also found, that premiums were by far too high for the very poor. If health care seeking is supposed to become independent of financial status, the community-based health insurance will have to be adjusted to income differences. Anyhow, the insurance has a positive impact on the behaviour of those who are enrolled. The outpatient visits increased significantly and inpatient care also increased, although this was not significant (Gnawali, Pokhrel et al. 2009).

2.2.4 The Nouna health district

The Nouna health district is part of the region "Boucle du Mouhon" in western Burkina Faso, bordering on Mali. The regional capital is Dédougou. The region is divided in six provinces and Kossi province corresponds to the Nouna health district.

In 2007 the district counted 304,105 inhabitants (Ministère de la Santé 2008). Nouna health district has 27 rural health centres, each of them with a pharmacy for generic drugs, four private pharmacies and a district hospital with a surgery unit (CMA) including an in-hospital pharmacy for generic drugs. In 2005 the annual statistics (Ministère de la Santé 2006a) pointed out that there were another three private health care facilities which were not mentioned anymore in 2007 (Ministère de la Santé 2008). A research centre (CRSN) is located in the immediate neighbourhood of the district hospital in Nouna town.

2.2.5 Health research in Nouna health district

Nouna health district looks back on almost 20 years of intensified health research cooperation with the University of Heidelberg in Germany (Becher and Kouyaté 2005). The cooperation (PRAPASS) was initiated by Burkina Faso's ministry of health and the University of Heidelberg in the early 1990s to improve health care provision in Nouna health district. The district represents in many aspects a typical rural health district in SSA suffering from a high burden of diseases caused by Malaria, a growing burden of HIV/AIDS, a high child mortality rate and low life expectancy and is, on the other hand, lacking adequate resources to cope with these problems.

General objects of the liaison between Nouna and Heidelberg were (Yé, Sanou et al. 2002):

- To "conceptualize and lead multidisciplinary field-based health-research projects relevant to national health policy"
- To "disseminate results of the research to promote health-sector reforms"
- To "contribute to capacity-building in health research"
- To "provide the Ministry of Health with data for health policy and planning"

In 1999 the project instituted the foundation of Nouna health research centre (CRSN) "as a platform for interdisciplinary research in the fields of public health, health economics, epidemiology, parasitology, and entomology" (Würthwein, Gbangou et al. 2001a). It is subordinated to the General Secretary at Ouagadougou.

The clearly defined area allows the implementation of strategies to improve the socioeconomic and health status of the population in the long run for instance the community-based health care insurance and the detailed analysis of its results. The quantity of research done by natural scientists, physicians, pharmacists, sociologists, economists and others allows to picture the different aspects influencing the health status in the region and might serve as a basis for a multi-criteria approach for decision making (Baltussen and Niessen 2006).

So far, research focused on the following aspects (Becher and Kouyaté 2005):

- Clinical research:

  The emphasis lies on infectious diseases, namely Malaria, HIV/AIDS and meningitis. With regard to Malaria important research projects focused on the effect of bed nets, research on agents against uncomplicated Malaria like zinc supplementation, Chloroquine, Amodiaquine and methylene blue as well as on the quality of anti-Malaria drugs available at the local market. Meningitis research was aimed to investigate prevalence and virulence of local serogroups and their impact. Research on HIV/AIDS is focusing on PTMC with special emphasis on breast feeding, on risk perception, on patient's compliance and virus' seroprevalence.

- Epidemiology:

  Burden of disease, mortality and morbidity patterns are assessed and interpreted with regard to differences between age-groups, seasonal changes, impact of specific diseases and risk factors.

- Health system research:

  Research in this area targeted on (perceived) quality of western health care, utilization patterns, regional illness concepts as well as financial and geographic accessibility of health care. Lately, the introduced community based health insurance is supervised regarding effects and acceptance. Research focusing on financing of health care in the district will be presented in the following chapter.

2.2.6 Cost-of-illness research in Nouna health district

Cost-of-illness (COI) studies have the aim to access all cost occurring during or caused by the time of illness. COI accounts for the fact that illness does not only generate cost for health care, but also absorbs resources which could otherwise have been used elsewhere (opportunity cost). Figure 4 shows the different components of COI. It is differentiated between *health care provider's cost* on the one side and *household cost* for patients on the other side. *Direct cost* represent the money spent as a consequence of the illness either by the patient (fees, transport etc.) or the health care provider. When estimating total direct cost it has to be considered that part of the direct household cost (user fees) are revenues for the health service provider. Double-accountancy of these

cost has to be avoided. Provider's cost are divided into *core cost* representing cost for services given to the patient and *non-core cost* representing the support side, for instance administration, training and research. *Indirect cost* are the opportunity cost which are due to the illness (loss of labour, loss of harvest etc.). Direct and indirect cost are merged as *tangible cost*. Left aside are *non-tangible cost* for e.g. pain, because they cannot be expressed in monetary values easily.

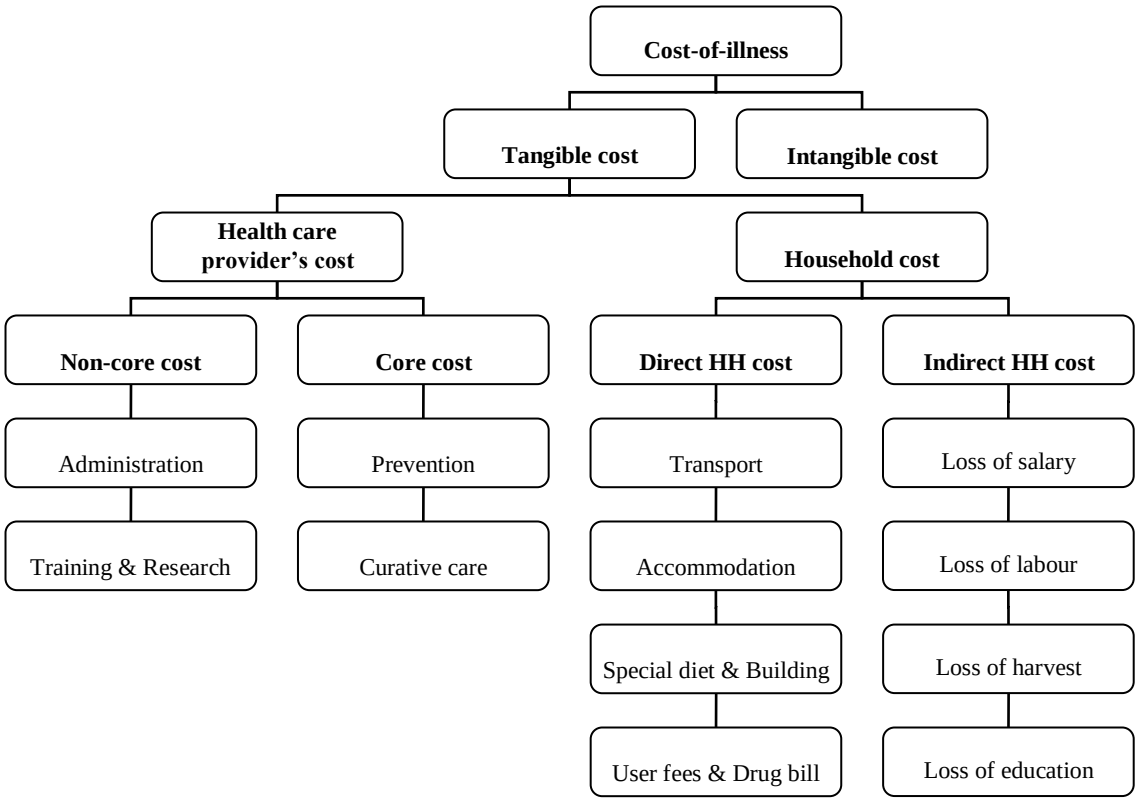

Figure 4: Components of Cost-of-illness (Source: Flessa 2007)

It is noteworthy that the different columns (health service cost, direct and indirect household cost) strongly depend on each other: An operation which is less expensive for the hospital might cause a longer unproductive time and account for high indirect household cost and vice versa (Muralikrishnan, Venkatesh et al. 2004; Wiseman, Kim et al. 2006).

Aims of COI studies are to assess the "economic burden of illness to society", to identify "the main cost components and their incidence over total cost" and "the actual clinical management of illness at a national level" as well as to explain "the variability of cost", e.g. higher cost in teaching hospitals (Tarricone 2006).

In Nouna health district three systems for permanent collection of socio-economic and health economic data were introduced stepwise since 1992.

Today's research is based on the following systems:

- Demographic Surveillance System (DSS):

  The DSS was introduced in 1992 covering the population of 39 villages. It was designed as a census including constant vital event registration that is to say births, deaths and migration. The coverage area was extended repeatedly and nowadays includes 42 villages and Nouna town which equals 75,000 inhabitants (Gnawali, Pokhrel et al. 2009).

- Nouna Health District Household Survey (NHDHS):

  NHDHS was introduced in 2000 with the aim of collecting population-based health and morbidity data and socio-economic information. The questionnaire was designed as a multi-topic survey implying questions on housing/hygiene, income/expenditure, food/nutrition and health/health care. The survey allows the analysis of behavioural relationships and of predictions of the burden of disease. It covers 800 households which were sampled from the area covered by the DSS (Würthwein, Gbangou et al. 2001a).

- Cost-Of-Illness Information System:

  As showed above, data is required on household cost as well as on provider's cost to estimate the COI. Accordingly, a provider cost information system and household cost information system were needed. The COI Information System was implemented in 2003. The provider cost information system was newly introduced to constantly record cost of the rural health centres in a first step and since 2005 of the district hospital as well. A local employee guided by a health economist inventoried and collected available cost data of buildings, equipment and consumables. He introduced questionnaires investigating staff cost and performance data. Missing data had to be subjoined by data from the Ministry of Health, from donor agencies and interrogation of experts (Flessa and Kouyaté 2006). Data on household cost was already provided by the existing NHDHS and only few questions were added to the existing questionnaires, for instance about willingness-to-pay.

So far household COI were analysed in regard to their economic impact (Su, Kouyaté et al. 2006; Su, Pokhrel et al. 2006). The results emphasise the assumption that an insurance system is necessary to protect households from catastrophic expenditure. Consequently, the willingness-to-pay was assessed in order to set the premium on an

accepted and affordable level (Dong, Kouyate et al. 2004; Dong, Mugisha et al. 2004; Dong, Gbangou et al. 2008).

Already in 2002 health care interventions in rural health centres in Nouna health district were cost by Mugisha et al. (2002a). Even though costing was then based on treatment protocols from the Ministry of Health the results gave an impression of provider's cost for the selected diseases. Based on the primary data of the COI Information System a full cost analysis of rural health centres is now available. It was shown that rural health centres could treat by far more patients in their current configuration, but even then the revenues from user fees would not cover all expenses (Marschall and Flessa 2008). A full cost analysis was also done for Nouna district hospital, stating that the average performance of the hospital is very low and that the facility suffers from a severe underutilisation causing high cost per patient (Flessa 2009a).

On the long-run, the COI Information System in combination with DSS and NHDHS shall allow cost-effectiveness analyses based on a long-term data collection, e.g. the CEA of bed nets or AIDS/HIV prevention and treatment strategies.

2.2.7 The district hospital

It might be stated that any service given at a district hospital can be provided as well at another level of the health care pyramid. However, for diseases as Malaria, typhus or HIV/AIDS rural health centres are easier to reach for the population and staff can be trained according to the setting-specific needs. Operations are often performed at lower cost at regional or central hospitals and maybe also in better quality as high case numbers generally improve the results.

Nevertheless, McCord et al. (2003) measured the cost-effectiveness of a hospital as a whole. They divided total cost of a rural hospital in Bangladesh by the estimated total number of DALYs averted. The average cost of US$ 10.93 per DALY averted show that hospitals can be highly cost-effective compared to other preventive and curative interventions (Laxminarayan, Mills et al. 2006). The same methodology was applied at a small hospital in Sierra Leone resulting in US$ 32.78 per DALY averted (Gosselin, Thind et al. 2006). Gosselin et al. (2006) stated that surgery was the most cost-effective part of the hospital and in Bangladesh emergency obstetric care accounted for most of the DALYs averted (McCord and Chowdhury 2003). These findings point out one of the central challenges for district hospitals: Basic surgery. District hospitals can fill the

gap between the health care provided in rural health centres by nurses or medical assistants and the specialised services of regional or university hospitals, which are economically as well as geographically out of reach for big parts of the population. District hospitals can provide emergency surgeries and smaller elective interventions and make them affordable for a broader rural population. Moreover, they can fill a gatekeeping position for more specific diseases requiring treatment at specialised regional or national hospitals (English, Lanata et al. 2006).

District hospitals normally have 80 to 150 beds and serve a population of 100,000 to 1 million people. Ideally one hospital bed should exist per 1,000 inhabitants and the utilisation rate should be 70 to 80% (Görgen and Schmidt-Ehry 2004). Predominantly, care is provided by three or four general practitioners, who are meant to cover family medicine/PHC, medicine, obstetrics, mental health, eye care, rehabilitation, surgery (including trauma and orthopaedics), paediatrics and geriatrics. A laboratory facility and a blood bank as well as an around-the-clock emergency unit should exist. Nonetheless, great differences exist (Van Lerberghe, de Bethune et al. 1997; English, Lanata et al. 2006). Above all it is important that district hospitals have a clear profile. Otherwise they risk functioning as oversized rural health centres. In order to avoid overlapping patients should be conducted to the rural health centres first e.g. by an adequate fee system and clear indications for referral of patients from the rural health centre to the district hospital as well as for retransfer should exist for health personnel (Görgen and Schmidt-Ehry 2004).

The Nouna district hospital was founded in 1952 in cooperation with several regional physicians, the catholic mission and the German Technical Cooperation (GTZ). In the course of time, the country Burkina Faso, the regional administration, the catholic mission, the Belgian cooperation and others were involved in the construction, the furnishing and the maintenance of the hospital (Yé, Sié et al. 2005).

The Nouna district hospital includes the following departments:

- Centre of tuberculosis and leprosy (8 beds): Tuberculosis, leprosy and other skin diseases
- General medicine (24 beds): Cardiovascular diseases, respiratory diseases and HIV/AIDS

- Gynaecology and obstetrics (17 beds): Reference level for CSPS for complicated childbirths and gynaecological diseases, PTCM and family planning consulting
- Ophthalmology (8 beds): Operations of cataract, glaucoma and trichiasis
- Outpatient departments: General medicine, gynaecology and ophthalmology, occupational health unit (for pupils and civil servants), dentistry, Ear-nose-throat (ENT)
- Paediatrics (6 beds): Malaria, respiratory and gastrointestinal diseases and meningitis
- Psychiatrics (4 beds): Schizophrenia, epilepsy, enuresis and transitory psychical affections
- Surgery (20 beds): Hernia cures, Caesarean sections, laparotomy, hydrocele cures and appendectomies

The list of functions is not exhaustive but gives an impression of the most frequent pathologies at the different departments of the district hospital.

Furthermore, Nouna district hospital includes a medical laboratory, a pharmacy providing generic drugs and medical picturing with an X-ray and ultrasound as well as a laundry, a car pool, a technical service and the administration including the cash point. Food is not provided at the hospital but a kitchen exists. As customary in SSA hospital's staff is only responsible for the medical attendance while relatives care for personal hygiene, food and any other needs of the patients. Lately, an emergency unit was introduced, where all patients are received first, stabilised and then transferred to a specialised unit. The emergency unit was all the same not included as cost calculation was based on data from 2005.

Physicians are responsible for the following departments: General medicine (1), obstetrics and gynaecology (1), paediatrics (1) and surgery (1). The other departments are under the responsibility of a clinical officer (Attaché de santé), nurses with additional training in their speciality. A physician is in charge of ophthalmology, but the department works independently from the public district hospital on behalf of the CBM, a NGO. Therefore, it is not included in the cost analysis. It provides specialised services going beyond the means of average district hospitals and covers an area by far larger than Nouna health district.

Generally, there is a considerable overlapping of resource usage, namely staff and laboratory, between the hospital and the neighbouring research centre.

2.3 Costing: Terms and definitions

This chapter presents basic costing terms and defines them with regard to costing in a hospital.

2.3.1 Product-related and overhead cost

Costing has the aim to track cost back to where they first arise, the so-called *cost-by-cause-principle*. This is easy for cost which are directly attributable to a certain product, e.g. cost for specific consumption material to a laboratory test, so-called *product-related cost* (Hentze and Kehres 2008). Most of the cost are however not directly attributable, e.g. cost for electricity or staff. These cost are called *overhead cost*. Different costing methodologies have been implemented to perform cost allocation to the final product as comprehensibly and transparently as possible.

Sometimes the term direct cost is used synonymously for product-related cost and accordingly so is indirect cost for overhead cost. Nevertheless, this might lead to confusions as COI defines direct and indirect cost differently (Tarricone 2006). Hereafter, the terms direct and indirect cost will only be employed as defined by COI (see chapter 2.2.6, p. 25 et seq.).

2.3.2 Fixed and variable cost

Cost can also be distinguished into cost changing according to the volume of work and others, which are independent of the volume of work. In hospitals *fixed cost* do not change with the number of patients, e.g. building depreciation, while *variable* or *marginal cost* rise proportionally with every further patient, e.g. drug cost (Lave and Lave 1984; Flessa and Dung 2004). Consequently, the average fixed cost per patient decrease with a growing utilisation rate as cost are distributed among more patients (*fixed cost degression*) while variable cost per patient are constant.

If the utilisation rate increases substantially, even fixed cost will suddenly rise at a certain point and then diminish again. For instance, a physician working for a hospital can treat a growing number of patients only to a certain extent but then a second

physician is necessary to cope with the workload. At this point cost rise abruptly (Figure 5) therefore staff cost are step-fixed cost which are not definitely fixed, but rise abruptly only in certain intervals (Marschall and Flessa 2008).

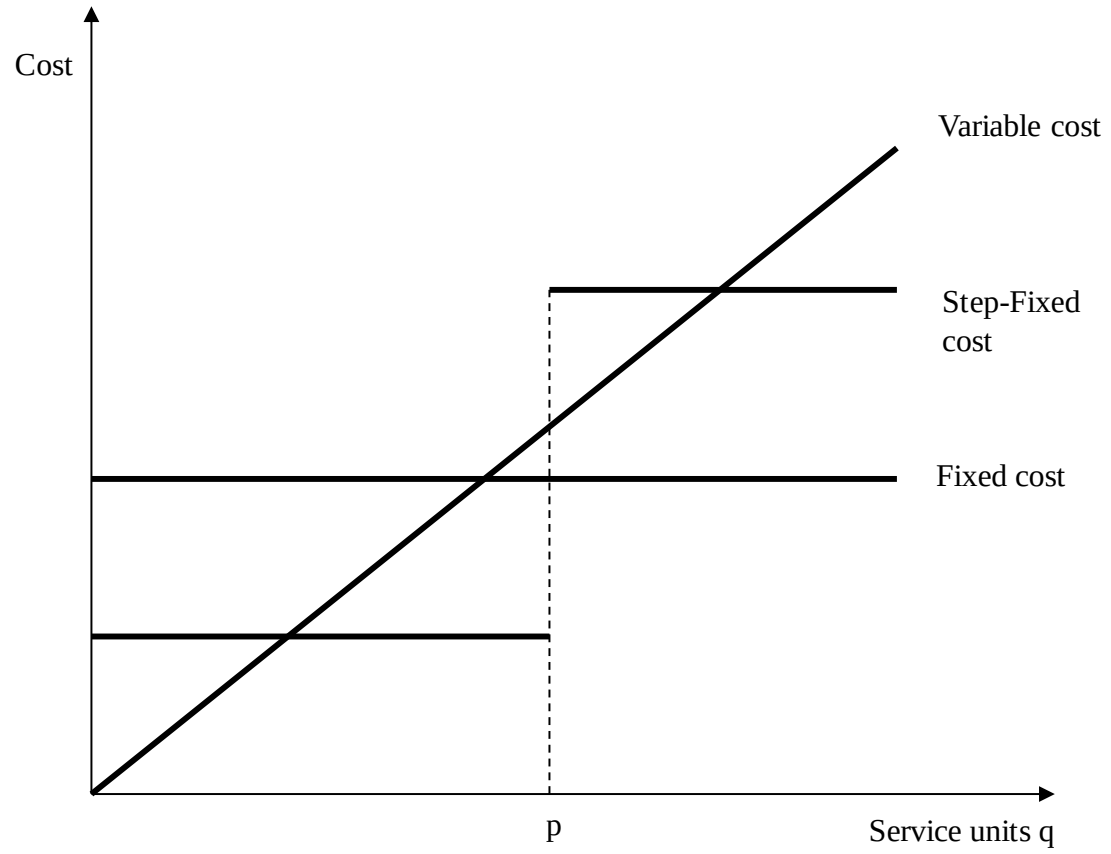

Figure 5: Cost behaviour for fixed, step-fixed and variable cost (Source: Marschall and Flessa 2008)

While variable cost can be changed easily, e.g. by replacing a cost-intensive branded drug by the same agent in generic form, changing fixed cost requires long-term planning based on knowledge about cost and capacities on the provider's side as well as estimating upcoming demands. Therefore, fixed cost are of special interest in hospitals.

2.3.3 Used capacity and idle time cost

Fixed cost themselves can be split into used capacity and idle time cost. If the availabilities produce the previewed output they are called *used capacity cost*. Not used availabilities, e.g. nurses on duty without patients, result in idle time cost as there is no output to counterbalance the nurses' wages. Synonym for *idle time cost* is *non-value added cost* (Waters, Abdallah et al. 2001).

Notwithstanding, these cost are extremely difficult to scale, because in time and motion analyses, which are based on self-report, personnel will hardly admit that time is spent ineffectively. If personnel are aware of being under supervision, on the other hand, this might influence general behaviour and explicitly work time allocation (Hawthorne-effect). Furthermore, in hospitals idle time cost are not always avoidable, e.g. the emergency department will naturally have long periods of time in which the staff is not busy but waiting for contingent cases of emergency.

2.3.4 Actual, standard and budget cost

To fulfil planning and controlling, two of the basic aims of costing, different cost have to be differentiated: Actual, standard and budget cost (Wöhe and Döring 2008a). *Actual cost* are the de facto cost at any moment. They underlie current changes from the cost and demand side which might not at all be lasting. In hospital, for instance, a natural catastrophe can cause current overstrain while having little impact on future planning. *Standard cost* analysis requires costing for several years providing average cost data, balancing temporarily changes. It is, nevertheless, an ex-post calculation illustrating the effective cost of the hospital, not asking for under- or oversupply. *Budget cost* are planned cost for the future. They might be based on an ex-post calculation of previous years combined with ideal supply and demand assumptions. The constant comparison between actual and budget cost is the basic challenge of controlling with the aim to antagonise undesirable trends as early as possible.

2.4 Costing methods for hospitals

Costing has the aim to illustrate used resources and track them back to their origin. However, up to now a gold standard methodology has not been found, not in developed countries and even less in developing countries. Therefore, authors lately advise to weigh out outlay and benefit of more or less detailed costing methodologies according to the setting and the questions (Wordsworth, Ludbrook et al. 2005; Chapko, Liu et al. 2009; Clement Nee Shrive, Ghali et al. 2009). Results should be interpreted considering the methodology applied, keeping in mind that results are only estimates and decisions based on cost estimates should be taken carefully.Two principle costing methodologies will be presented hereafter: Step-down allocation of cost and activity-based costing. Afterwards, the concept of clinical pathways (CPs) will be introduced in chapter 2.5

(p. 37 et seq.). Chapter 2.6 (p. 40 et seq.) will outline the detailed description of the methodology used to cost hospital services at Nouna district hospital.

2.4.1 Step-down allocation of cost

In developing countries *step-down allocation of cost* is the most frequently performed costing approach for hospitals (Flessa 1998; Flessa and Dung 2004; Vander Plaetse, Hlatiwayo et al. 2005; Flessa 2009a; Minh, Giang et al. 2009). The method is relatively easy to apply and based on data often available in the hospital's administration or at the Ministry of Health. It allows obtaining cost data in resource poor settings and to compare costing results between settings as the methodology has been standardised and described in detail (Shepard, Hodgkin et al. 2000; Conteh and Walker 2004). Another advantage is the definition of *cost centres* as smaller organisation units within the hospitals which are cost separately, rated separately with regard to efficiency and should be independent areas of accountability. This might produce competition within the hospital and changes might be more feasible within cost centres.

The first step of step-down costing is consistent with other costing methods: *Cost units* which shall be cost have to be defined. This can either be done on detailed or on aggregated levels. Often inpatient days in specific departments are taken as units of output as well as laboratory tests, X-rays and operations. Any cost centre directly producing a final product is a *final cost centre*, e.g. inpatient ward. Any cost centre not producing a unit of output is classed as *overhead cost centre*, e.g. administration, technical service. Occasionally, *intermediate cost centres* can be defined. These cost centres receive services from overhead cost centres and provide themselves services for final cost centres. In a hospital this might be the case for the laboratory, the X-ray or the operation theatre, unless their products were defined separately as final outputs.

The next step of step-down costing is *cost type accounting*. All inputs and the corresponding cost are obtained for the hospital. Cost are allocated to the cost centres directly wherever possible, e.g. staff, building, and consumption material. Inputs which are attributable to several cost centres have to be allocated by keys, e.g. cost for electricity by square metres of base area or staff cost by the time the staff spends at each cost centre.

Cost centre accounting connects the different cost centres in order to allocate *all cost* to the final product(s). This is called a *full cost analysis*. Cost from overhead cost centres

(and intermediate cost centres) are allocated stepwise to the final cost centres. The allocation starts with the cost centre receiving the least services from other cost centres and requires convenient keys. For example the overhead cost centre technical service can be allocated to all other cost centres including other overhead cost centres using as a key the base area. It is preceded with all cost centres in the same way until only final cost centres are left over. Possible keys for intermediate cost centres are number of admissions, days of care or estimates of the actual use based on record review.

The final step is *cost unit accounting*. When all cost are allocated to the final cost centres, cost are divided by the number of outputs to identify unit cost.

Step-down allocation of cost provides information on consumed types of resources, the cost centres resource usage and the average unit cost of the output. But the cost unit is also the major shortcoming of this methodology, because it is assumed that cost centres in hospital produce only one product, e.g. inpatient days. Cost for drugs, staff etc. are therefore divided equally between all inpatient days. This violates the cost-by-cause-principle as a cost-intensive patient with high medical and nursing burden, high drug cost etc. is attributed the same cost as a patient with less intensified care. Comparison of different hospitals is only feasible, if the same casemix can be assumed everywhere, which is not necessarily the case. In conclusion, this methodology has only a limited power to fix prices and control efficiency (Hentze and Kehres 2008).

2.4.2 Activity-based costing

The bottom-up methodology or ingredient approach investigates all resources, e.g. building, staff, drugs, needed to produce a certain output and calculate cost per unit by adding cost for consumed resources. All requested ingredients are summed up to estimate the final cost of the output (Hansen, Chapman et al. 2001; Lara, Kandulu et al. 2007). One feasible way is *activity-based costing* (ABC) (Waters, Abdallah et al. 2001). It is based on the assumption that every product requires activities while these activities require resources. “This method of costing accounting differs from the traditional costing with the paradigm that activities consume resources and processes drive activities” (Lin, Chao et al. 2007). ABC is a bottom-up microcosting approach (see Figure 1, p. 9).

Firstly, all activities in a department or the whole hospital have to be inventoried. Any directly activity-related cost are allocated immediately, overhead cost are allocated

proportionately to the labour time staff is engaged. Secondly, activities are linked to the units of output by so-called cost drivers, for instance cost for the activity "taking of a blood sample" has to be divided between all different laboratory tests (units of output). Cost drivers might be the "number of tests requiring vacuum tubes" (Cao, Toyabe et al. 2006a). In a full ABC every activity is allocated by an appropriate cost driver and finally cost per output are summed up and divided by the number of units of the specific output.

For hospitals, three aspects are of special importance: In the first place, staff cost often make up for the highest share of inputs especially in less specialised district hospitals (Murru, Corrado et al. 2003; Flessa and Dung 2004; Vander Plaetse, Hlatiwayo et al. 2005). Therefore it seems appropriate to allocate cost according to staff activities. ABC seems useful and suggestive in cases where staff and overhead cost make up for a big part of the total cost, personnel spends work time in different departments and total cost for e.g. a physician have to be divided accordingly (Wordsworth, Ludbrook et al. 2005). Secondly, ABC can be the base for a budgeting system allocating money not according to total numbers of patients, but depending on how labour-intensive they are. Cost for DRGs, groups of an international disease classification system, can be measured to introduce the casemix funding of hospitals (Ghaffari, Doran et al. 2008). DRGs are widely used in industrialised countries to reflect hospitals' casemixes and allocate resources accordingly. Finally, ABC can go along with the implementation of activity-based management (ABM). "Cause-and-effect relationships underlying the consumption of resources within an organization" can be evaluated and improved (Waters, Abdallah et al. 2001). The costing method gives very detailed information on "overused, misused or underused clinical procedures (i.e. activities)" (Lin, Chao et al. 2007) pointing out avoidable cost.

On the other hand, for ABC all activities carried out have to be distinguished, the required time and resource consumption has to be measured and cost drivers need to be defined (Asadi and Baltz 1997). As most hospitals in developing countries do not provide detailed information a "complementary accounting and management information system" is necessary, "accurate production information" has to be collected and "access both to data and to personnel" is indispensable (Waters, Abdallah et al. 2001).

Hence, it has to be admitted that this approach gives more detailed and reliable information, but is also more cost-intensive and time-consuming (Tarricone 2006).

Detailed time motion analysis are not easy to perform in health care institution, because often different activities are done simultaneously, e.g. treatment, teaching and documentation (Cao, Toyabe et al. 2006b) and personnel tend to conceal non-value added time.

2.5 Clinical pathways

2.5.1 Concept

Medical care, especially in hospitals, is a complex process involving different departments, physicians, nurses etc. and varying in location, organisation structure and operation sequences. As the ensemble is needed to care for the patient, ways have to be found to organise the process as resource-saving as possible without time lag and resistant to disturbances (Bauer, Hanss et al. 2004). The need to make medical care predictable and manageable was moreover fortified by the implementation of prospective budgeting in the developed countries in the 1980s (Cesta and Tahan 2003). It was assumed that different patients can be grouped as they receive the same care and care can be pre-planned. A CP illustrates the ideal combination, sequence and timing of investigation, treatment and interventions for all patients with a certain disease or a complex of symptoms (Coffey, Othman et al. 1995). The expressions critical and (integrated) care pathway are used synonymously. Müller et al. (2001) described the CP as an operationalised guideline, which targets patient expectations, quality and efficiency within the context of a certain setting.

CPs should be developed in cooperation with the nursing and medical personnel of the hospital where they shall be implemented. Pearson et al. (1995) proposed the investigation of the common practise as a first step to develop a CP. Further steps are a review on available guidelines and literature, the discussion with the health personnel on what is essential to reach a certain outcome and the determination of time frames for single modules of the CP as well as the constant supervision and evaluation of these changes.

Finally, CPs can be presented in an easily comprehensive way including the following symbols (Figure 6).

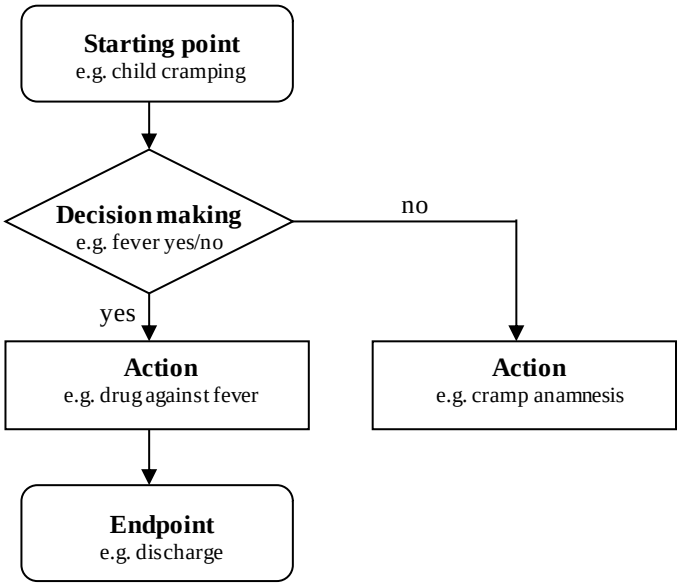

Figure 6: Presentation of clinical pathways (Source: Lohfert and Kalmar 2006)

Figure 6 illustrates that any logical sequence of actions results from what was done, asked or investigated before. Any not conducive action should be dismissed. Onto the implementation of a CP any patient matching into the profile will be integrated. In cases where unforeseen complications or additional diagnoses force to leave the CP, full description of causes is necessary to track down variances and eventually change the CP. Along the CP all components can be linked to their cost and thus allow constant costing and controlling in computer-based documentation systems of developed countries (Müller, Schmid et al. 2001). To calculate total product cost alongside the CP all procedures can easily be summed up. This makes CPs an adequate tool for ABC (Udpa 1996 ; Lohfert and Kalmar 2006).

Advantages of CPs are that they provide standardised, transparent and well organised care for covered diseases, which is ideally to the best of current knowledge. Less experienced personnel has a clear order how to manage patients in certain conditions. Also, hospitals are a complex system where time is often lost due to an absence of connection between departments and too much bureaucracy. CPs can improve the linkage between different departments and the interdisciplinary cooperation if all care bringers are involved in the implementation process. Furthermore, a prospective programme of the treatment and the expected progress can be given to the patients in order to improve communication and patients' satisfaction (Campbell, Hotchkiss et al. 1998). On the other hand, an implementation process is time-consuming and needs constant control (Darer, Pronovost et al. 2002). Physicians might complain that every patient is different and only the most uncomplicated and easily manageable will be

covered by CPs (Pearson, Goulart-Fisher et al. 1995). Dy et al. (2005) actually found that effective pathways were more often found for illnesses with lower complexity and/or severity. Pearson et al. (1995) also stated that physicians might be afraid of the personal risk they run, when they do not apply a given CP for medical reasons and the patient suffers from a complication. Darer et al. (2002) found that economic parameters dominated the evaluation of CPs. Length of stay and total hospital cost, for instance, were surveyed more often than in-hospital mortality of infectious complications. Long hospital stays are a major concern of hospital managers and pathways are assumed to be an effective tool to reduce them. Nevertheless, the quality of outcomes should be maintained or ameliorated and needs to be evaluated simultaneously.

2.5.2 Application in developing countries

Only little data is available on the application of CPs in developing countries. Perez-Cuevas et al. (2003) introduced a CP for preeclampsia to align health care supply for this life-threatening disease including different levels of health care provision in Mexico. They stated: "By implementing CPs, the health care system in developing countries can provide high quality of care with limited resources and meet its outcome expectations." In rural South Africa, the management of several non-communicable diseases by nurses was improved by the implementation of so-called clinical protocols, an adaptation of available guidelines to the local needs (Coleman, Gill et al. 1999). Another intervention in Cape Town implemented treatment guidelines for hypertensive patients including a step-wise care according to the severity and a reduction of available drugs to those which were most cost-effective. It was found that blood pressure levels did not change while cost per prescription could be reduced significantly (Edwards, Lunt et al. 1998). Biai et al. (2007) launched a standardised treatment protocol for Malaria in Guinea Bissau's national hospital and achieved a decrease in in-hospital mortality, a decrease in cumulative mortality four weeks after discharge and a 35% shorter length of stay. Terris-Prestholt et al. (2006) reviewed research on sexually transmittable diseases in middle- and low-income countries and found that treatment based on "syndromic management protocols" resulted in lower cost per unit.

Therefore, the examples illustrate the positive impact CPs can have in developing countries.

2.6 Costing of hospital services in Nouna district hospital

2.6.1 General aspects

The basic aim of costing at Nouna district hospital was to assess provider's cost for patients at the paediatric department suffering from Malaria, for inpatients at the surgical department undergoing a hernia cure or a Caesarean section and for outpatients with hypertension. Cost should be comprehensible, transparent and allow judgement about the efficiency of care provision.

Standard step-down approach promised to give an overview of cost and output separately for cost centres as manageable organisation units. It would not have allowed distinguishing patients with different diseases within the same department according to resource consumption and workload. ABC would have given very detailed cost information, but the restricted research time did only allow analysing those activities involved in the care process of the chosen diseases. Overhead cost shall nevertheless be allocated according to the proportion of the total workload the activity stands for. Hence, to value the proportion of the total workload of the analysed processes, it would have been necessary to know the total work time of all activities. Alternatively, it could have been assumed that e.g. a device at the laboratory is used according to an eight-hours-workday, but miscalculation would have been unavoidable as due to severe underutilisation of the hospital most resources are not at all permanently in action. Moreover, as found elsewhere in SSA hospitals staff is often absent due to family events, illness or other activities, and does not make up for the lost work time (Mundy, Bates et al. 2004). In Nouna district hospital, staff time spent within the hospital is not counted by, for instance, an attendance recorder and therefore little monitoring of actual work time exists. However, labour time is not determined in the labour contract of the hospital's employees. Especially medical personnel spend only a few hours per day at the ward and obviously cover several other duties, not only on the behalf of the hospital.

Thus, the undertaken cost analysis is a combination of step-down and activity-based costing. Product-related cost are directly allocated to cost units. Step-down costing is done to assign overhead cost to cost centres. Within each final cost centre cost are not summed up as in standard step-down costing, but allocated to the cost units by different keys based on activity analysis.

Cost information from the provider cost information system for the year 2005 was used. Performance data was collected for the year 2006 in April/May 2007. More recent data was not available. The cost analysis was done in four steps: At first, cost units were

defined as sub-processes, e.g. specific laboratory tests, nursing care. Secondly, unit cost were raised for the cost units of final cost centres. Thirdly, the hospital's standard pathways of patients with the considered diseases were investigated. Finally, the pathway served as a matrix for the calculation of total provider's cost.

Only hospital provider's cost were included and cost for treatment received previously in a rural health centre as well as all household cost were left aside.

2.6.2 Definition of cost centres and cost units

Cost centres were defined as for standard step-down cost analysis, with the difference that any department directly in contact with the patient, e.g. ambulance, laboratory, was defined as final cost centre. The only overhead cost centres were laundry service and technical service. Intermediate cost centres were not defined as all other cost centres provided services which could be directly linked to the patients.

Cost centre	Cost units
Laundry	(Overhead cost centre)
Technical services	(Overhead cost centre)
Administration	Admission
Gynaecological outpatient department	Consultation
Laboratory	Laboratory tests (44 types)
Theatre (incl. anaesthesia)	Surgical interventions (8 types)
General medicine outpatient department	Consultation
Paediatric inpatient department	Bed day
	Medical care
	Nursing care
Paediatric outpatient department	Consultation
Pharmacy	Drugs (260 packing sizes)
Surgical inpatient department	Bed day
	Medical care
	Nursing care
Surgical outpatient department	Consultation
Transport	"Pick-up of a patient"

Table 4: Cost centres and cost units of standard treatment pathways at Nouna district hospital (Source: own)

Elsewhere, pharmacies were cost independently of the health care facilities, because the pharmacies within rural health centres/hospitals are meant to work on their own account, according to the BI (Marschall and Flessa 2009). At Nouna district hospital, however, it was found that this independence was not really implemented and the pharmacy's income was mingled with the hospital's total revenues. Therefore, the pharmacy was regarded as another final cost centre of the hospital and overhead cost were allocated the same way as to other final cost centres.

Within each of the final cost centres, a variety of cost units were defined (Table 4). At the laboratory, for instance, 44 cost units were distinguished as laboratory tests as they are charged for. That means that e.g. a white blood cell count is one cost unit although it includes various parameters.

At the paediatric and surgical inpatient department three cost units were defined: Bed days, nursing care and medical care for the considered disease. At the outpatient departments the cost unit is the consultation. Accordingly, at the pharmacy cost units were defined as the packing sizes of all available drugs. The cost centre "transport" was assigned the cost unit "pick-up of a patient" at the rural health centre. No cost units were defined at the cost centre radiology as none of the included patients received any services form this cost centre.

Cost types	Fixed cost	Variable cost
Building depreciation	100%	
Equipment and vehicle depreciation	100%	
Consumables and pharmaceuticals		100%
Electricity	50%	50%
Salaries and wages	100%	

Table 5: Fixed and variable cost (Source: own)

Within the cost centres fixed and variable cost were distinguished (Table 5). Electricity was judged to be in parts fixed and in parts variable. On the one hand, for example, the lightning needed for a 6-bed-bedroom does not depend on the number of patients occupying it. Required electricity remains the same, whether the room is occupied by one person or by six persons. On the other hand usage of medical device accounts for a proportional rise in electricity with usage.

2.6.3 Cost type accounting

The provider cost information system includes the following cost types:

- Cost for building depreciation
- Cost for equipment and vehicle depreciation
- Cost for pharmaceuticals and consumables (including electricity)
- Cost for salaries and wages

Cost data was collected by a professional local accountant under the guidance of a health economist. Expert advice was consulted wherever necessary, for instance to value buildings. All cost are expressed in US$ (exchange rate: US$ 1 = 534 FCFA) and any cost data not available for the year 2005 was adjusted using the World Economic Outlook Database (IMF 2009). Data was analysed by using spread sheet calculation.

Buildings were depreciated over a period of 25 years. Cost data and base area allocation between the different departments were taken from available documents or calculated based on the replacement cost for 2005 and an annual interest rate of 5%. Property cost were not included as the land is an estate of the state Burkina Faso.

Purchase cost for equipments were taken from the official equipment price list of the Directorate of Equipment of the Ministry of Health. No difference was made with regard to donated items. They were cost according to their opportunity price. Items which are not listed were attributed the price of identical items from two commercial companies in Ouagadougou (SOPAM and OMNIA PROMEDICO). The actual length of life was evaluated for items with a purchase price higher than 10,000 FCFA (US$ 16.50) and a life expectancy of more than one year. The items were depreciated accordingly. Any other equipment was accounted as consumption material. Cars were assessed according to their local market price and depreciated over an estimated life expectancy of seven years.

Cost for drugs and medical supplies were taken from the pharmacy's documents. Drugs and medical supplies not listed but available in generic form were priced by list of the national institution for generic drugs (CAMEG) or international prices lists, e.g. "International Drug Price Indicator Guide" (MSH and WHO 2008). For non-generic drugs purchases retail prices were obtained at local private pharmacies. Cost data for oxygen supply for general anaesthesia was taken from a publication from the Gambia

and adjusted to 2005 US$ (Schneider 2001). Fuel prices were taken from "International Fuel Prices 2007" and also adjusted to 2005 US$ (Metschies 2007).

Salaries and wages include salaries, additional benefits, health insurances, social insurances, contribution to pension payments and taxes. Labour time was assumed to be 40 hours per week and 200 days per year. When personnel worked at the same time at the nearby research centre (CRSN) this was considered by reducing labour time by 25%. For the laboratory it was generally assumed that only 75% of the total resources are availed by the hospital while the rest is used by research teams from the CRSN.

2.6.4 Cost centre accounting

Any product-related cost were directly allocated to the cost unit as well as any cost-centre-related cost to cost centres. Overhead cost (cost for building depreciation and electricity) were allocated to cost centres using the base area as key. Total cost for overhead cost centres were appraised summing up all inputs, e.g. total cost of laundry including cost for building depreciation and electricity, equipment depreciation, consumption material and staff cost. These cost were allocated to final cost centres according to the workload each cost centre stands for.

2.6.5 Cost unit accounting

Within the final cost centres cost types were not summed up but allocated to cost units by individual keys. Fixed cost were divided by the number of outputs they were engaged in. Cost for salaries and wages were allocated directly according to the workload.

Cost for a specific laboratory test, for instance, are the sum of:

- Cost for building depreciation:

  75% of depreciation cost 2005 for the laboratory divided by all 5049 laboratory tests performed 2005 for hospital patients

- Cost for equipment depreciation:

  Depreciation cost of used equipment divided by all test performed in 2005 utilising the specific asset

- Cost for consumables:

  Consumption material for the tests during the year 2005 divided by all tests using these materials

- Cost for electricity:

  Share of the total hospital consumption allocated according to 75% of laboratory's base area divided by 5049 tests performed in 2005

- Cost for salaries and wages:

  Cost for labour time that the test requires

- Cost for technical service and laundry:

  75% of the cost for the laboratory divided by 5049 laboratory test performed in 2005

To cost transport the average distance was taken from all patient files reviewed and matched with cost for cars, drivers and fuel. Unit cost for a bed day include cost for technical service, laundry, electricity, building and equipment depreciation at the respective ward.

The dosage of drugs was whenever possible taken from the patient files or interviews. Otherwise, standard dosages were considered. Provider's cost per drug are estimated by summing up the purchase prices per unit of sale and staff, building, equipment and overhead cost divided equally by all units of sale.

2.6.6 Performance data collection

Records of the year 2006 were chosen at the paediatric and the surgical inpatient department according to the presumption diagnosis, resulting in a sample of 10 paediatric Malaria inpatients, 14 inpatients with hernia cure and 10 inpatients, who underwent Caesarean section. Patient files were chosen by covering as many months of the year as possible and bewaring last-name accumulations to avoid biased samples.

In the general medicine outpatient department the register was analysed by taking the first 10 patients of each month of 2006 leading to a sample of 120 patients of whom 47 had the diagnosis hypertension. At the paediatric outpatient department the register was analysed equally. Of 120 patients 36 had the diagnosis Malaria and 14 were under 12 years old and therefore included in the analysis of cost for paediatric Malaria patients.

Both registers provided information about the presumption diagnosis, paraclinic investigations and prescribed drugs.

General performance data on the number of in- and outpatients per department, most frequent diseases, number and type of performed operations and laboratory tests were available from the provider cost information system. This data was adjusted in the case of inpatient days at the surgical ward, because the total number of bed days (110) was far below the number of performed operations (246). After consulting the staff nurse, the number of bed days for 2005 was recomputed at 1666 based on the recorded operations and the average length of stay for each of them.

According to suggestions in literature additional information was gained by interviewing the personnel in charge to safeguard the findings (Campbell, Hotchkiss et al. 1998; Franco, Franco et al. 2003). Interviews were done with the people in charge of the cost centres, namely the physicians or staff nurses, the head of the laboratory, the head of the technical service, the head of the laundry and the head of the administration. Interviews focused on the allocation of labour time to different cost centres and additional responsibilities not directly connected with the district hospital. Additionally, the medical personnel were interviewed on the general treatment of the selected diseases and discrepancies with findings from record review were discussed.

The investigations were completed by direct observation, providing information of workload and material consumption of procedures, e.g. ward round or laboratory tests.

The obtained pathways were adjusted according to national- or, if not available, international guidelines. The comparison with guidelines seemed appropriate as undersupply can be suspected due to patients' financial straits. Possibly, treatment is sometimes abandoned before its time as the patient runs out of money. It was however the intention to estimate cost for a complete treatment. For the same reason patients who died along the hospital stay were not considered in the estimation of the mean length of stay or mean length of operation.

It has to be acknowledged that standard pathways used for costing in Nouna district hospital do not feature what is considered standard for the implementation of CPs in literature as our principle aim was to calculate provider's treatment cost and not in the first place the implementation of CPs. Therefore only the first step of an eventual full implementation of CPs was undertaken: The evaluation of current practise and discussion of possible shortcomings with the personnel in charge.

2.6.7 Costing along standard pathways

Performance data was linked to data from the provider cost information system of Nouna district hospital for 2005 as cost data for the year 2006 was not yet available. Hospitals physicians affirmed that patients' treatment and the resulting pathways did not change substantially between these two years.

Along the standard pathway all required cost units were elevated, quantified and apportioned the according unit cost.

2.6.8 Calculation of total user fees

For the calculation of total user fees, all charged for cost units were elevated, quantified and apportioned the respective user fee. Eventual exemptions were not considered. Total user fees were compared to total cost for the specific disease to evaluate the cost-recovery rate.

2.6.9 Ethical considerations

The research objective and methodology were presented to the local ethic committee (Comité Local Ethique de Nouna) and approved before starting the performance data collection at the hospital in April 2007.

3 Results

3.1 General cost data of the district hospital

Total cost for Nouna hospital accounted for US$ 333,115 for 2005. Table 6 shows in the horizontal line how cost are divided between the different cost types and demonstrates respectively how cost are spread among the different cost centres along the vertical line.

Department		Building depreciation	Equipment/ vehicles depreciation	Salaries & wages	Consum-ables	Technical services	Fuel	Food	Pharma-ceuticals	Total
General	OPD	0	162	6,355	191					6,708
Medicine	IPD	0	974	7,795	235					9,004
Surgery	OPD	0	421	5,901						6,322
	IPD	0	456	3,176						3,632
Gynaecology/	OPD	428	1680	13,969						16,077
Obstetrics	IPD	286	1481	8,193						9,960
Paediatrics	OPD	311	88	4,174						4,573
	IPD	660	385	8,736						9,781
Psychatrics	OPD	0	207	1,827						2,034
	IPD		433	3,316						3,749
Ophthal-	OPD	0	402	5,874						6,276
mology	IPD	0	1362	18,258						19,620
Leprosy/TB	OPD	0	202	2,485						2,687
	IPD	0	420	3,729						4,149
ENT		51	544	3,684						4,279
Dentistry		0	3,910	11,052						14,962
Physiotherapy		0		1,907						1,907
Laboratory		2,166	22,950	10,582	4,245					39,943
Theatre		0	9,469	26,042						35,511
Radiology		0	13,466	0		4,984				18,450
Pharmacy		196	6	2,239	83				50,655	53,179
Mortuary		68	0	0						68
Kitchen		0	0	0				2,062		2,062
Laundry		0	0	450						450
Administration		449	0	6,404	1,121	19,720	4,358	0	0	32,052
Technical services		62	136	3,370	2,489	0	0	0	0	6,057
Transport		0	0	0	0	0	0	0	0	0
Electricity		41	0	0	19,582	0	0	0	0	19,623
Total		**4,718**	**59,154**	**159,518**	**27,946**	**24,704**	**4,358**	**2,062**	**50,655**	**333,115**

Table 6: Cost of Nouna district hospital according to cost types and cost centres in US$ (OPD-Outpatient department, IPD – Inpatient department) (Source: Flessa 2009a)

Considering that part of these cost occur in the department ophthalmology, which is not only serving patients from Nouna health district, and another part goes to the district

administration, the sum has to be reduced to US$ 318,606. Talking about the hospital as a whole the most expensive cost types are salaries and wages accounting for 47.9% of total cost, equipment and vehicles depreciation (17.8%) and pharmaceuticals (14.4%). Regarding the cost centres, the pharmacy is the most expensive one (16.0%) followed by laboratory (12.0%) and theatre (10.7%).

The general performance data collection outlined a very low occupancy rate of 11.4% for the whole hospital. At the surgical ward, for instance, the occupancy rate was indicated at only 1.5% with an average length of stay of 1.35 days and at the paediatric ward at 9.5% with an average length of stay of 1.36 days.

A step-down allocation of cost was done for the hospital as a whole and resulted in US$ 81.85 per paediatric inpatient and US$ 21.02 per paediatric outpatient, US$ 68.67 per surgical inpatient and US$ 25.95 per outpatient in general medicine (Flessa 2009a). The bigger share of total cost was fixed (71.48%) explaining the high cost per patient as a consequence of low utilisation rates. Assuming that the hospital would only serve inpatients, work under an average occupancy rate of 80% and all cost would be fixed, the average bed day would cost US$ 11.60 (85 beds and total annual cost of US$ 318,606).

The total hospital income from user fees in 2005 was US$ 77,024 which means a cost-recovery rate of 24.18%. The highest revenues were raised at the pharmacy (US$ 45,941), which recovered 86.55% of the total cost. Anyhow, this does not allow reinvestment of margins in order to improve the offers and independent management in terms of BI.

3.2 Total provider's cost for specific diseases

3.2.1 Cost of paediatric Malaria

The sample of Malaria patients includes 24 patients in the age of 8 month to 12 years. 14 of the patients suffered from mild Malaria and were treated as outpatients (average age: 7.55 years) and 10 patients underwent a severe Malaria and were treated as inpatients (average age: 2.03 years). The sample included 12 girls and 12 boys. Figure 7 demonstrates the standard pathway of a paediatric Malaria patient at Nouna district hospital. Although the clinical perception of every patient is different, the series of sub-processes in the inpatient department are quite similar for all patients. The patient enters the paediatric ward, either because he is referred to the hospital by a rural health centre

or because the relatives (usually parents) themselves decide to bring the child directly to the hospital.

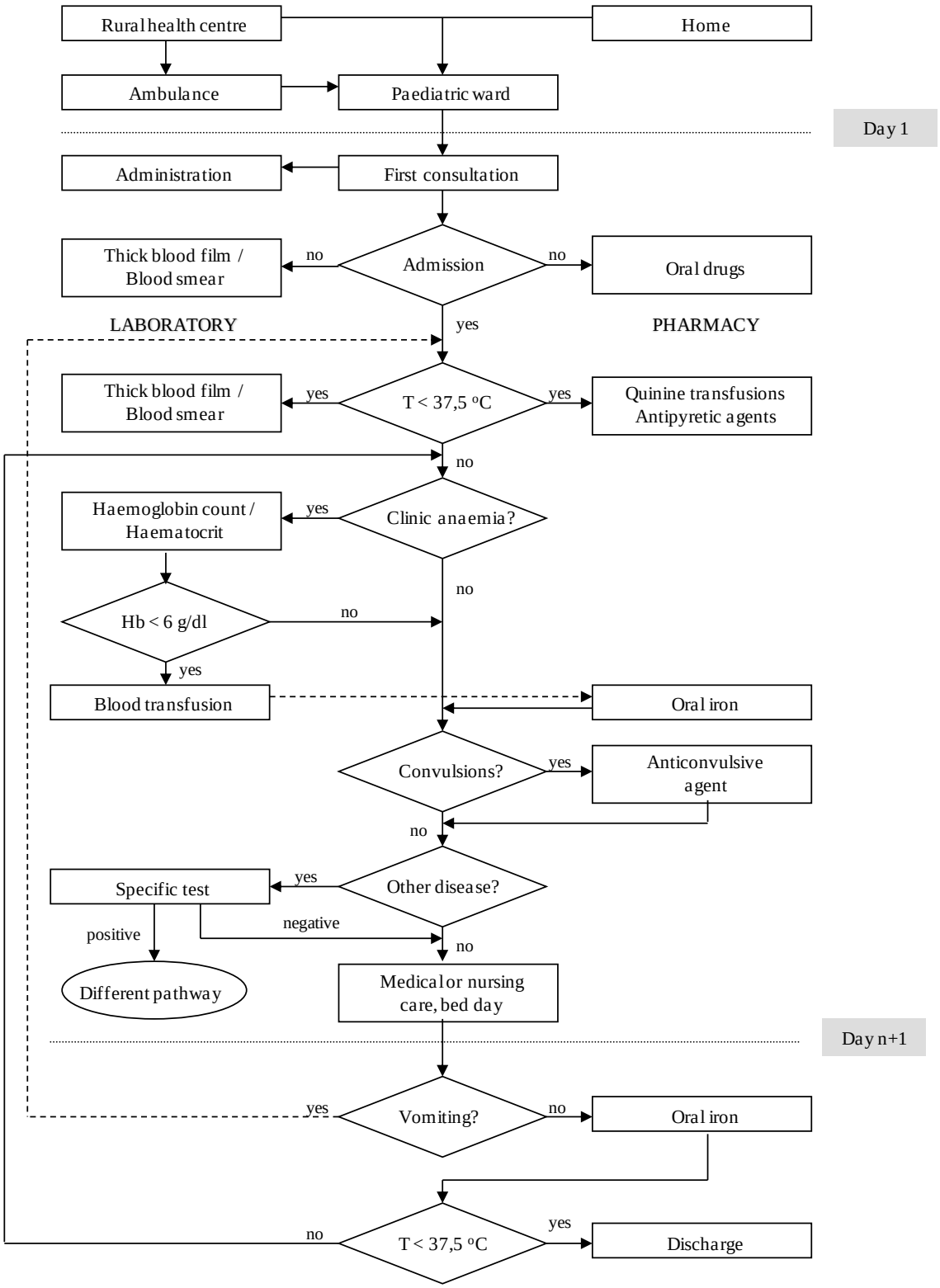

Figure 7: Standard pathway of paediatric Malaria patients at Nouna district hospital (Source: own)

If necessary, the hospital's ambulance is sent to fetch the child at the rural health centre. First cost for the hospital occur either for the transport or for the consultation at the

paediatric ward. The first consultation at the paediatric ward includes anamnesis and physical examination. At the same time registration causes expenses for administration. Depending on the general state and the Malaria symptoms the child is either admitted or treated as an outpatient. The standard treatment of an outpatient with milder Malaria is either Sulfadoxine/Pyrimethamine (SP) or Amodiaquine and an antipyretic agent in oral form. A thick blood film/blood smear is done at the laboratory to affirm the suspected diagnosis. If the child is hospitalised an inpatient file will be opened by the nurse or the physician and medical and nursing care starts. Directly connected with the examination is the preparation of blood-samples for the laboratory. Laboratory tests are done according to clinical findings, e.g. paleness leads to a haemoglobin count/haematocrit. At the same time parents or other accompanying relatives are instructed to buy drugs from the hospital pharmacy, also according to the clinical symptoms. Hospitalised Malaria cases receive intravenous anti-Malaria treatment with Quinine. The main symptoms of severe Malaria at Nouna district hospital are anaemia (Hb < 6 g/dl) and convulsions. Clinic diagnosis of anaemia is confirmed by a haemoglobin count/haematocrit going along with a blood grouping. Blood transfusions are done accordingly if the haemoglobin level is below 6 g/dl. Donors are mostly family members, thus cost for the provider arise only for blood collection, infectious screening and blood grouping. As long-term treatment the children receive oral iron substitute. Convulsions are treated with Diazepam.

As Malaria symptoms are non-specific and might also be due to other infectious diseases, e.g. a gastro-enteritis or intestinal parasites, further laboratory tests can be required, e.g. blood count or white blood cell count or/and lumbar puncture. The examination of the patients' general state is repeated daily in form of the ward round and if necessary further laboratory tests are done or/and further drugs prescribed according to the findings. The discharge depends on the general state of the patient. To give two important features: The child should by then be able to swallow and take an oral anti-Malaria agent and the body temperature should have dropped below 37.5 °C.

In 2006 the average length of stay of a paediatric inpatient with severe Malaria was 3.5 days (standard deviation: 0.84) for cases with anaemia and 7.25 days (standard deviation: 2.5) for cases with neurological affection. On average the first consultation took 15 minutes. Along the standard pathways cost were summed up assuming either a case of mild Malaria treated as an outpatient or the case of severe Malaria with either anaemia or neurological affections.

Severe paediatric Malaria	Anaemia			Neurological affection	
	Unit cost (US $)	Quantity per patient	Cost per patient (US$)	Quantity per patient	Cost per patient (US$)
Transport			**0.00**		**8.50**
Pick-up of a patient	8.50	0.00	0.00	1.00	8.50
Paediatric IPD			**13.83**		**28.64**
Medical care/day	0.48	3.50	1.68	7.25	3.48
Nursing care/day	1.19	3.50	4.17	7.25	8.63
Bed day	2.28	3.50	7.98	7.25	16.53
Laboratory			**41.14**		**31.97**
Thick blood film/ Blood smear	3.36	2.00	6.72	2.00	6.72
Haemoglobin count/ Haematocrit	8.00	1.00	8.00	0.00	0.00
Blood grouping	4.26	1.00	4.26	0.00	0.00
Blood count	4.90	1.00	4.90	1.00	4.90
Stool smear	2.94	1.00	2.94	0.00	0.00
Blood transfusion	14.32	1.00	14.32	0.00	0.00
Cerebrospinal fluid	18.63	0.00	0.00	1.00	20.35
Pharmacy			**4.87**		**5.24**
Complete drug treatment			4.87		4.87
Administration			**0.76**		**0.76**
Admission	0.76	1.00	0.76	1.00	0.76
Total			**60.59**		**75.10**

Table 7: Provider's cost for standard paediatric inpatients with severe Malaria at Nouna district hospital (Source: own)

Table 7 and 8 illustrate total provider's cost for the respective patients. Unit cost were calculated within the cost centres and multiplied with the average consumption of the specific services by the patient. Summing up cost for all activities along the standard pathway total provider's cost resulted in US$ 6.71 for a paediatric outpatient with mild Malaria and US$ 60.59 for severe Malaria with anaemia and US$ 75.10 for Malaria with neurological affection.

Paediatric Malaria	Unit cost (US$)	Quantity per patient	Cost per patient (US$)
Paediatric OPD			
Consultation	1.94	1	1.94
Laboratory			
Thick blood film/ Blood smear	3.36	1	3.36
Pharmacy			
Complete drug treatment	0.65	1	0.65
Administration			
Admission	0.76	1	0.76
Total			**6.71**

Table 8: Provider's cost of a standard outpatient paediatric Malaria case at Nouna district hospital (Source: own)

3.2.2 Cost of hypertensive outpatient treatment

Out of 120 randomly selected patients from the outpatient register 47 patients had hypertension as one diagnosis (39%). The average age of these hypertension patients was 53.6 years ranging from 33 to 79 years and the sample consisted of 36 women and 11 men. Out of all hypertension patients 10 patients (21%) had the additional diagnosis of diabetes. This is a highly dangerous combination for target organ damage. Figure 8 shows the actual pathway of the patient within the hospital. Patients arriving at the district hospital belong to one of three different groups. Either they have attended a rural health centre before and were advised to see a general physician at the district hospital or they arrive directly from home and skipped the first level of health care. The third possibility is that they were already treated for hypertension at the district hospital previously and advised to return after three months. The actual numbers of patients belonging to each of the groups could not be raised, but most patients probably belong to the last group.

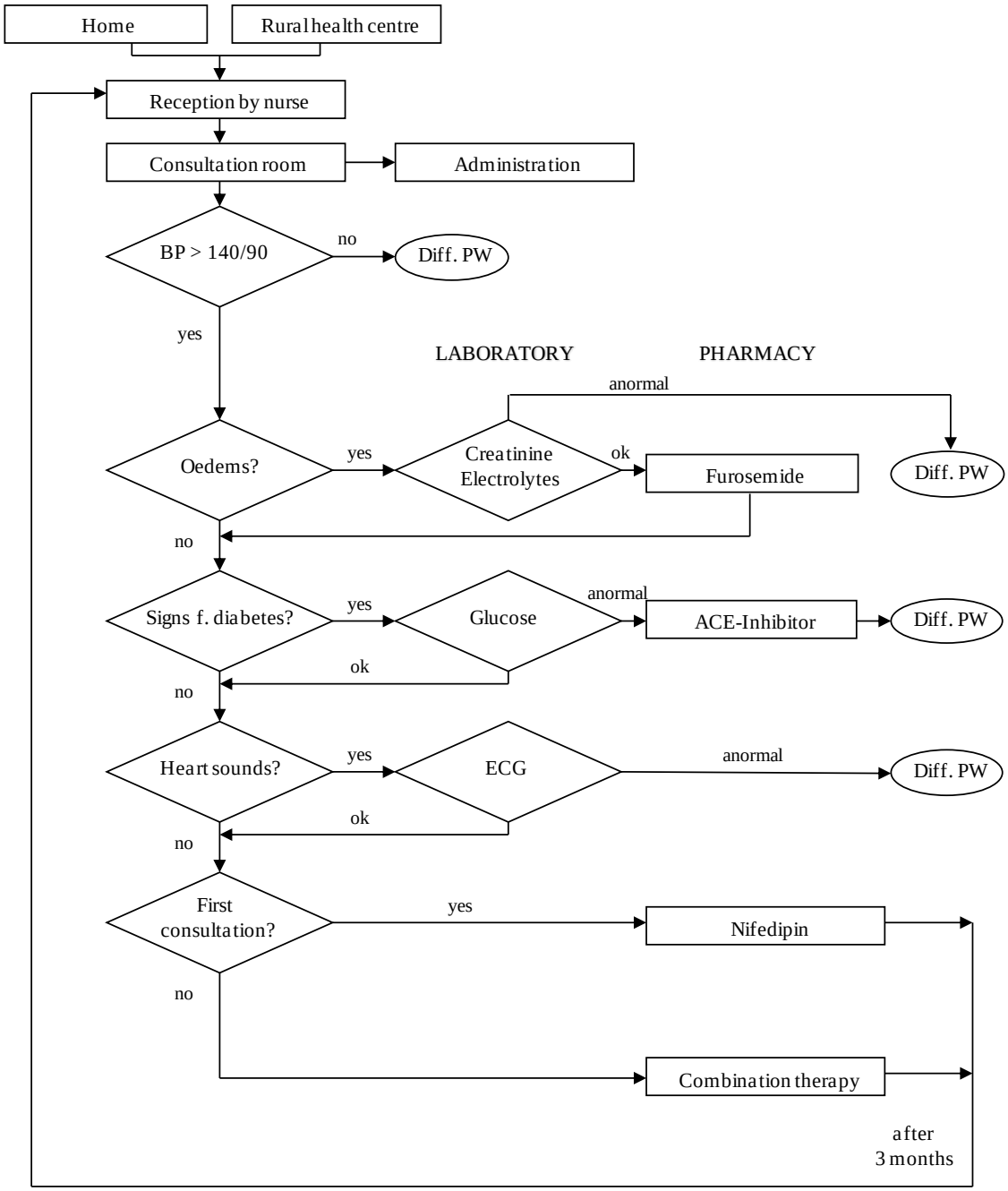

Figure 8: Standard pathway of hypertensive outpatients at Nouna district hospital (Diff. PW – Different pathway) (Source: own)

Consultations take place in a room exclusively reserved for outpatient reception. Each physician has his turn in the consultation room on a specific weekday. Patients have to register in the morning and are treated in chronological order: Who arrives first is served first. At 8 a.m. the nurse working with the physician in charge starts to take pulse, blood pressure and temperature of each patient and tidies up the consultation room. She stays with the physician for the whole morning. Consultations start at 9 a.m. and take on average 15 minutes per patient for anamnesis, clinical examination and either transfer to the laboratory or a specialised physician or prescription of a treatment.

Officially, consultations finish at 12 a.m., but depending on the popularity of the physician they can also continue until 3 or 4 p.m. Consultations are documented in the physician's register and, if the patient possesses such, in a health card (Carnet de santé). The booklet belongs to the patient and any outpatient visits to public health institutions should be documented inside. Simultaneously with the consultation cost for administration occur namely for registration, bookkeeping and at the cash point.

Possible annual check-ups	Provider's unit cost (US$)	Quanitity per patient	Total provider's cost (US$)
Lemogoum, Seedat et al. 2003			**28.00**
Creatinine	5.48	1	5.48
Electrolytes	4.38	1	4.38
Glucose	4.76	1	4.76
Serum lipids	4.38	1	4.38
Urine dipstick*	0.82	1	0.82
Microscopic examination of urine*			
ECG	6.06	1	6.06
Ophthalmologic check-up	2.12	1	2.12
Bovet, Shamlaye et al. 2006			**19.00**
Creatinine	5.48	1	5.48
Electrolytes	4.38	1	4.38
Glucose	4.76	1	4.76
Serum lipids	4.38	1	4.38
Rayner, Blockman et al. 2007			**21.50**
Creatinine	5.48	1	5.48
Glucose	4.76	1	4.76
Serum lipids	4.38	1	4.38
Urine dipstick*	0.82	1	0.82
ECG	6.06	1	6.06

Table 9: Provider's cost at Nouna district hospital for different options of an annual check-up for hypertensive outpatients (* not available at Nouna district hospital in 2005) (Source: own)

In the sample from Nouna district hospital the following blood tests were asked: Urea (in 2% of all hypertensive patients), calcium (2%), blood glucose (15%), creatinine (6%), electrolytes (2%) as well as sonographies (4%) and ophthalmologic check-ups (4%), depending on the patients' symptoms. According to explanations of the physician in charge, in case of oedemas specifically creatinine and electrolytes are investigated, when diabetes is suspected blood glucose is tested and in case of heart sounds or other

irregularities in cardiac auscultation and ECG is conducted (Figure 8). Overall, the low numbers of additional investigations lead to the assumption that complete risk stratification is not yet part of the standard treatment. In order not to underestimate provider's cost for adequate diagnostic approach of hypertensive patients, cost calculation was based on three different annual check-ups recommended in literature for SSA countries (Lemogoum, Seedat et al. 2003; Rayner, Blockman et al. 2007) and the Seychelles (Bovet, Shamlaye et al. 2006). The proposition of Rayner et al. (2007) corresponds to WHO guidelines (Whitworth 2003). Especially for the sub-Saharan context the following combination of investigations was recommended: Creatinine, electrolytes, blood glucose, serum lipids, ECG, urine analysis and ophthalmologic check-up (Lemogoum, Seedat et al. 2003). The differences are due to the fact that authors weighed up advantages of further investigations and the higher cost. In all cases intensified history taking including personal and family history as well as risk factors is a prerequisite. Clinical examination should include the cardiovascular system, patient's weight, size and/or waist circumference to detect obesity. Further investigation and treatment might be necessary because of end organ damages.

Table 9 shows the provider's cost for the different annual check-ups at Nouna district hospital. Urine dipstick and microscopic examination were not available at Nouna district hospital in 2005. For urine dipstick cost were estimated according to cost for stripes available on the international market, because the investigation is irreplaceable to detect target organ damage of the kidneys. All other provider's cost for investigations were taken from Nouna district hospital.

With regard to the treatment of hypertension, suggestion of life-style modifications was documented in 9% of all patients and consisted in all cases of a low-salt diet. Considering all hypertensive outpatients of the sample the drug treatment was documented in 85%. Table 10 shows the different therapies prescribed in Nouna and the percentage of patients in our sample receiving the respective therapy. Depending on the specific agent the standard dosage might be given in several single doses along the day. Cost for drug therapies were calculated for standard dosages over 30 days for a single patient. Monotherapies with Furosemide (20%), Nifedipine (17.5%) or α-Methyldopa (7.5%) and combination therapies with Nifedipine/Furosemide (22.5%) and α-Methyldopa/ Furosemide (12.5%) were the most common. All in all, 55% of the patient received a monotherapy, 41.5% received a combination of two agents and 2.5% received a tripletherapy. Eleven different anti-hypertensive agents were prescribed, of

which only three are available within the hospital's pharmacy: Furosemide (D), Nifedipine (CCB) and α-Methyldopa. Further drug classes prescribed are Angiotensin converting enzyme inhibitors (ACEI) and Angiotensin receptor blocker (ARB).

	Patients receiving the treatment (n=40)	Standard dosage (per day)	Monthly provider's cost (US$)
Monotherapy			
Furosemide (D)	20.0%	40mg	0.19
Nifedipine (CCB)	17.5%	30mg	0.67
α-Methyldopa	2.5%	500mg	3.54
Captopril (ACEI)	2.5%	50mg	0.76
Aldomet®	2.5%	250mg	2.59
Aldactone® (D)	2.5%	100mg	18.23
Lopril® (ACEI)	2.5%	50mg	17.99
Combination Therapy			
Furosemide/Nifedipine	22.5%	40mg/30mg	0.87
Furosemide/Methyldopa	12.5%	40mg/500mg	3.73
Furosemide/ Lisinopril (ACEI)	2.5%	40mg/50mg	10.25
Hydrochlorothiazide (D)/ Valsartan (ARB)	2.5%	10mg/25mg	20.04
Methyldopa/Nifedipine	2.5%	250mg/30mg	4.21
Hydrochlorothidazide/ Furosemide/Methyldopa	2.5%	25mg/40mg/250mg	3.82
Average monthly provider's cost per patient			**3.05**

Table 10: Monthly provider's cost for treatment options prescribed at Nouna district hospital (Source: own)

Summing up cost for all prescribed drug therapies in the sample and dividing them by the total number of patients, average provider's cost were US$ 3.05 per patient monthly. The cheapest option is the diuretic Furosemide at provider's cost of US$ 0.19 per month, while the most expensive agent is Valsartan, an ARB costing US$ 19.95 respectively. The physician in charge explained that therapy normally started with one anti-hypertensive agent, usually Nifedipine (Figure 8). However, therapy starts with Furosemide in the case of hypertension with oedemas. An ACEI is prescribed in the

case of additional diabetes. If normo-tension is not achieved at the follow-up visit another agent will be added.

Hypertension	Provider's unit cost (US$)	Quantity per year	**Annual provider's cost per patient (US$)**
General medicine OPD			**5.45**
Consultation	1.36	4	5.45
Administration			**3.04**
Admission	0.76	4	3.04
Laboratory (Average cost for different annual check-ups)			**22.83**
Check-up of Lemogoum, Seedat et al. 2003	28.00	1	28.00
Check-up of Bovet, Shamlaye et al. 2006	19.00	1	19.00
Check-up of Rayner, Blockman et al. 2007	21.50	1	21.50
Pharmacy			**36.61**
Complete monthly drug treatment	3.05	12	36.61
Total			**67.94**

Table 11: Annual provider's cost for a hypertensive outpatient treatment at Nouna district hospital (Source: own)

The assumption of Bovet et al. (2006) was adopted so that patients need four annual consultations, annual check-up at the laboratory and an ongoing drug treatment. As laboratory cost the average cost for the three different combinations of annual check-ups were taken (see Table 10, p. 57). This means that total annual cost are the sum of cost for four annual consultations and the respective cost for administration, the cost for one annual check-up at the laboratory and the monthly cost for drugs. Total provider's cost for annual treatment would then be US$ 67.94. Drug cost make up for more than half of total provider's cost (Table 11).

3.2.3 Cost of surgical interventions

3.2.3.1 Hernia cure

The sample of 14 patients who underwent an inguinal hernia cure in 2006 included men only. The average age was 49.3 years (20 to 71 years).

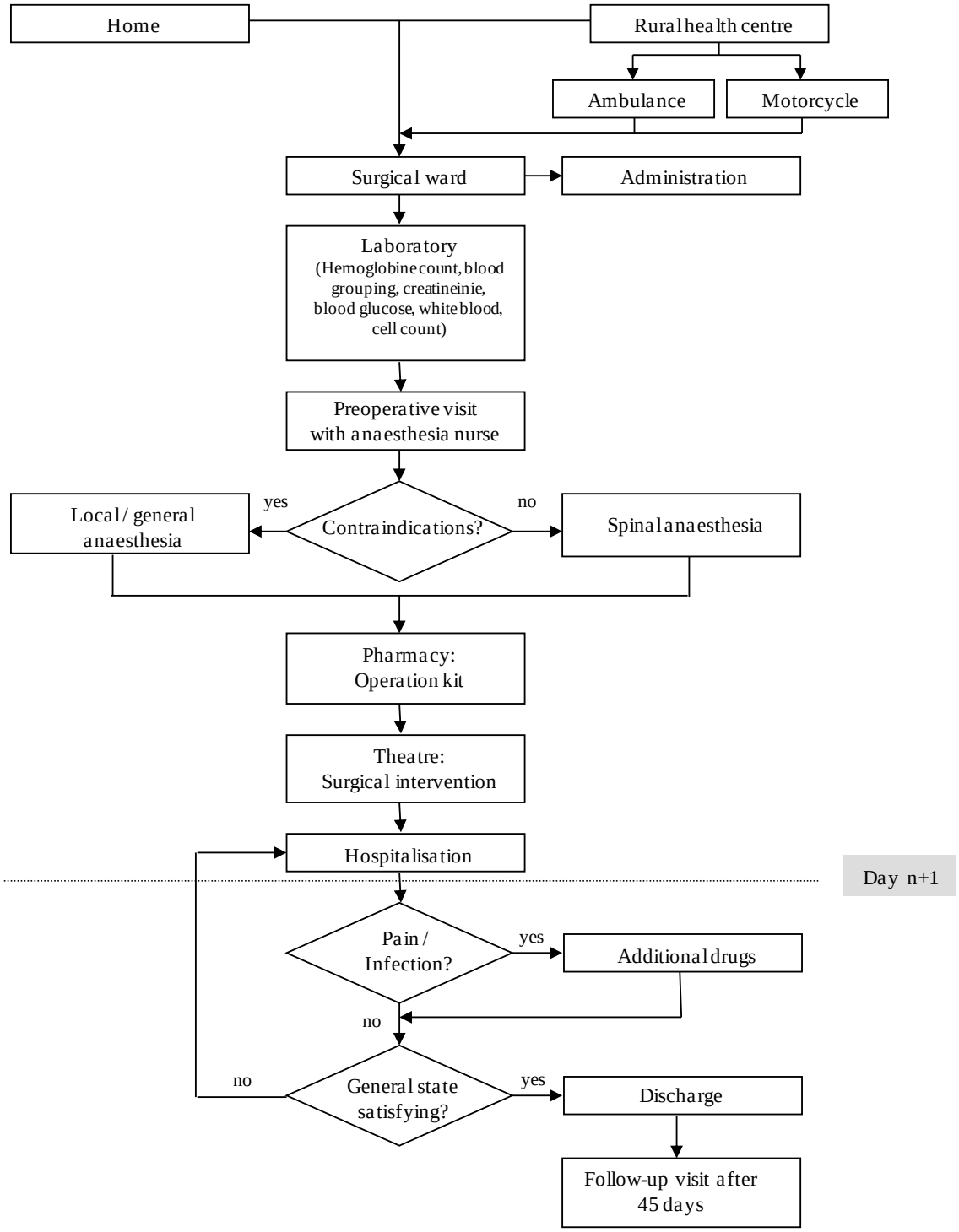

Figure 9: Standard pathway of patients undergoing a hernia cure at Nouna district hospital (Source: own)

Inguinal hernia can either be diagnosed in rural health centres, in the district hospital or elsewhere. Because it was not possible to determine where the majority of cases is diagnosed, cost for making diagnosis were not considered as provider's cost for the district hospital. Therefore, cost calculation starts either with cost for transport or with the patient's reception for the operation at the surgical ward (Figure 9). Patients are on average hospitalised for two days (standard deviation: 2.39) before the intervention. At the moment of admission a patient file is commenced by the responsible nurse or clinical officer at the surgical inpatient ward. This means that the patient is registered in the ward's register and administrative cost occur for bookkeeping and transactions at the cash point.

As shown in figure 9 a set of blood tests is taken during the preoperative hospitalisation to recognise eventual operation risks for the patient and during the preoperative visit the anaesthesia is discussed with the responsible clinical officer. Regional anaesthesia is the method of choice for hernia cure at Nouna district hospital (57%). Nevertheless, the intervention is also performed under local (7%) and general anaesthesia (36%), either because the patient's state requires general anaesthesia, e.g. no analgesia under regional anaesthetics or due to a lack of drugs needed for regional anaesthesia. For the intervention patients have to buy a kit at the hospital's pharmacy. The kit includes all necessary drugs and medical supplies. For the intervention the patient is transferred to the theatre. In our sample all interventions were carried out by two clinical officers. They used the Bassini technique for hernia cure. The intervention took on average 90 minutes (standard deviation: 51). It could not be reconstructed why the intervention took considerably longer in some cases. Possibly an operational or anaesthesia complication occurred.

After the intervention patients receive a full antibiotic treatment with intravenous Ampicillin followed by orally administered Amoxicillin and pain treatment with intravenous Novalgin® (Metamizole) followed by orally administered Ibuprofen. All these drugs are included in the kit for inguinal hernia cure. In case of persisting pain or wound infections the patient might receive additional drugs.

The moment of discharge depends on the patient's general state. According to the clinical officer in charge most patients are released about four days after the intervention. The total average length of stay in the sample was 6.9 days (standard deviation: 3.03). A follow-up visit is generally projected 45 days after the operation.

Inguinal hernia cure		Local anaesthesia		Spinal anaesthesia		General anaesthesia	
	Unit cost (US $)	Quantity per patient	Cost per patient (US$)	Quantity per patient	Cost per patient (US$)	Quantity per patient	Cost per patient (US$)
Transport			**0.00**		**2.13**		**1.70**
Pick-up of patient	8.50	0.0	0.00	0.25	2.13	0.2	1.70
Surgical IPD			**15.30**		**10.38**		**18.79**
Medical care/day	0.19	7.0	1.33	4.75	0.90	8.6	1.63
Nursing care/day	0.70	7.0	4.90	4.75	3.33	8.6	6.02
Bed day	1.30	7.0	9.07	4.75	6.15	8.6	11.14
Surgical OPD			**1.80**		**1.80**		**1.80**
Follow-up consultation	1.80	1.0	1.80	1.00	1.80	1.0	1.80
Laboratory			**29.51**		**31.43**		**31.05**
Blood grouping	4.26	1.0	4.26	1.00	4.26	1.0	4.26
Creatinine	5.48	1.0	5.48	1.00	5.48	1.0	5.48
Glucose	4.76	1.0	4.76	1.00	4.76	1.0	4.76
Haemoglobin count/ Haematocrit	8.00	1.0	8.00	1.00	8.00	1.0	8.00
Urea	7.01	1.0	7.01	1.00	7.01	1.0	7.01
White blood cell count	7.68	0.0	0.00	0.25	1.92	0.2	1.54
Theatre			**94.03**		**100.58**		**105.36**
Hernia cure		1.0	94.03	1.00	100.58	1.0	105.36
Pharmacy			**5.46**		**6.01**		**10.32**
Additional drugs		1.0	5.46	1.00	6.01	1.0	10.32
Administration			**0.76**		**0.76**		**0.76**
Admission	0.76	1.0	0.76	1.00	0.76	1.0	0.76
Total			**146.86**		**153.09**		**169.78**

Table 12: Provider's cost at Nouna district hospital for a hernia cure according to the different forms of anaesthesia used (Source: own)

Provider's cost occur for transport, for the hospital stay including nursing care and ward rounds, for the follow-up visit at the surgical outpatient department, for the laboratory tests before the operation, for the operation itself, for drugs going beyond what is provided in the kit for the operation and for the hospital's administration. Theatre cost

include cost for anaesthesia and for the preoperative visit of the anaesthesia nurse. For cost calculation patients were differentiated according to the type of anaesthesia they underwent. Table 12 presents provider's cost per unit of a specific service within the different cost centres. Unit cost for transport, bed days, medical and nursing care, consultation and laboratory tests are independent from the type of anaesthesia, but cost for anaesthesia, the surgical intervention and additional drugs are directly related to the type of anaesthesia. For total provider's cost per patient undergoing a specific type of anaesthesia the unit cost were multiplied with the number of units consumed. Adding up all cost for the average patients total provider's cost for inguinal hernia cure were US$ 146.86 under local anaesthesia, US$ 153.09 under spinal anaesthesia and US$ 169.78 under general anaesthesia (Table 12). The differences are due to more expensive drugs and additional expenses for medical supply and equipment for spinal and general anaesthesia and the more time consuming procedure. Patients with general anaesthesia had also longer hospital stays and the average time at the theatre was longer. It has to be admitted though that the differences should be interpreted with caution, because the number of cases was small and only one case of the sample was performed under local anaesthesia.

3.2.3.2 Caesarean section

The sample of patients which underwent a Caesarean section comprehends 10 women, of which one died within the theatre after an uterine rupture. The average age of the patients was 23.4 years (17 to 32 years). The Caesarean section at Nouna district hospital is an emergency intervention and patients (and their unborn child) are often in a life-threatening condition. This explains why they are picked up at the rural health centre by the hospital's ambulance more often than other patients (40%). Figure 10 illustrates the actual pathway of patients undergoing a Caesarean section at Nouna district hospital. Patients are normally admitted at the obstetrical ward by a midwife. At the moment of admission the patient is also registered and a patient file is started. Thus, occurring cost for administration include bookkeeping and the cash point. If a Caesarean section is considered necessary by the midwife, the physician is called and the patient is transferred to the operation theatre. As in the case of hernia cure a kit including all necessary supplies is available at the hospital's pharmacy.

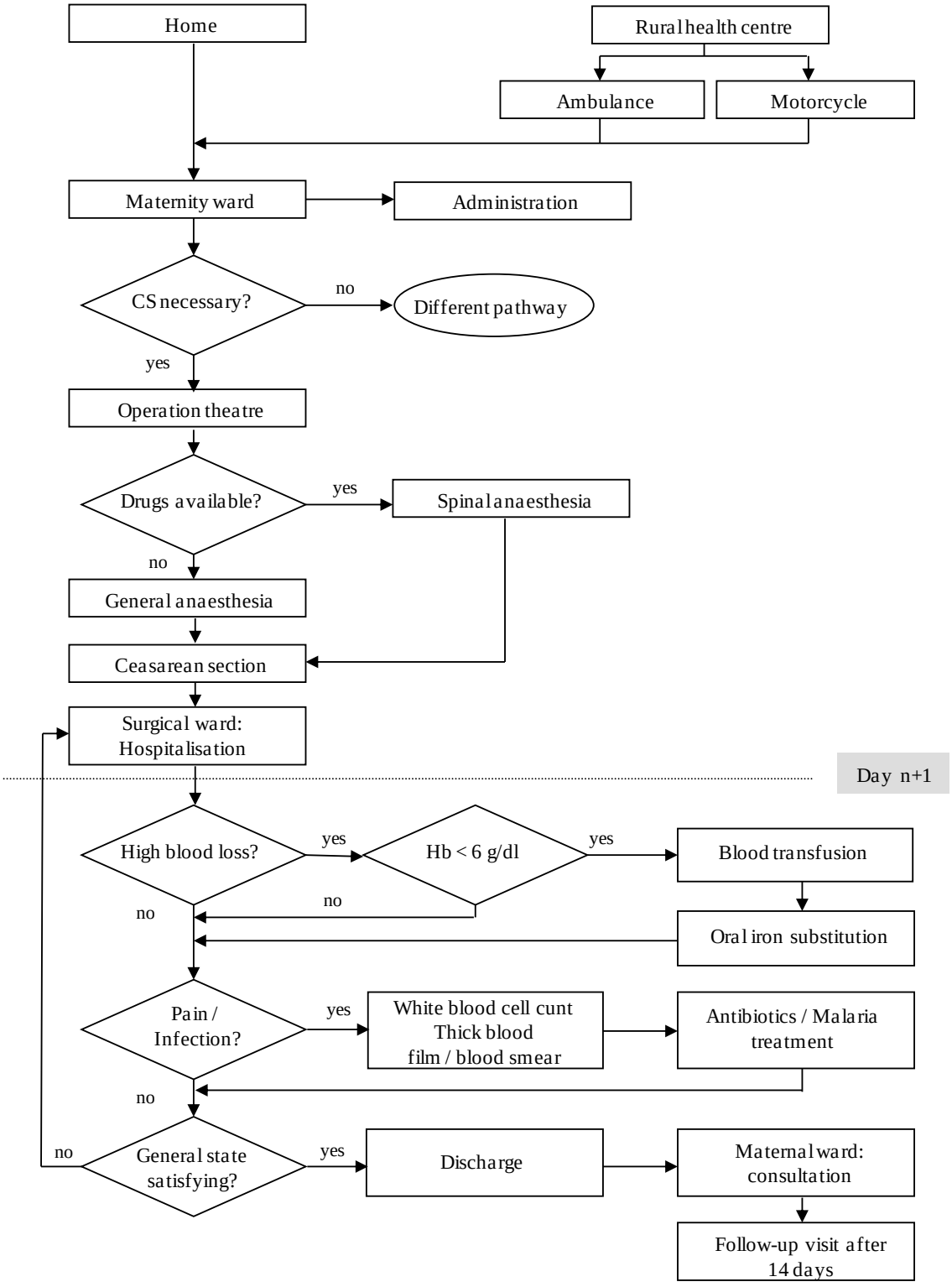

Figure 10: Standard pathway of patients undergoing a Caesarean section at Nouna district hospital (Source: own)

Patients are rarely hospitalised before the intervention and time is often scarce, hence a preoperative visit is not possible and anaesthesia is chosen at the theatre. In our sample general anaesthesia was used in 9 out of 10 cases, while spinal anaesthesia was used in one case only. Although health personnel would have preferred to use spinal anaesthesia more often, it was claimed that constraints of medical supplies had made it impossible.

The intervention took on average 59 minutes (standard deviation: 10 minutes). Within the sample the physician and a clinical officer were present in four interventions, while especially in the second half of 2006 interventions were carried out by two clinical officers only. After the intervention patients stay at the surgery unit as inpatient until the discharge.

Caesarean section		**Spinal anaesthesia**		**General anaesthesia**	
	Unit cost (US $)	Quantity per patient	Cost per patient (US$)	Quantity per patient	Cost per patient (US$)
Transport			**0.00**		**3.78**
Pick-up of patient	8.50	0.00	0.00	0.44	3.78
Surgical IPD			**19.67**		**24.31**
Medical care/day	0.19	9.00	1.71	11.13	2.11
Nursing care/day	0.70	9.00	6.30	11.13	7.79
Bed day	1.30	9.00	11.66	11.13	14.41
Gynaecological OPD			**4.18**		**4.18**
Consultations	2.09	2.00	4.18	2.00	4.18
Surgical OPD			**1.80**		**1.80**
Follow-up consultation	1.80	1.00	1.80	1.00	1.80
Laboratory			**12.26**		**34.48**
Haemoglobin count/ Haematocrit	8.00	1.00	8.00	2.00	16.00
Blood grouping	4.26	1.00	4.26	1.00	4.26
White blood cell count	7.68	0.00	0.00	0.25	1.92
Blood transfusion	14.72	0.00	0.00	0.75	11.04
Thick blood film/ blood smear	3.36	0.00	0.00	0.38	1.26
Theatre			**91.77**		**97.23**
Caesarean section		1.00	91.77	1.00	97.23
Pharmacy			**9.71**		**13.87**
Additional drugs		1.00	9.71	1.00	13.87
Administration			**0.76**		**0.76**
Admission	0.76	1.00	0.76	1.00	0.76
Total			**140.14**		**180.41**

Table 13: Provider's cost at Nouna district hospital for a Caesarean section according to the different forms of anaesthesia used (Source: own)

Additional cost for laboratory investigations are mainly due to a high blood loss under the intervention, making haemoglobin count/haematocrit, blood groupings and blood transfusions necessary. To avoid post-operative infections, patients receive a full antibiotic treatment with intravenous Ampicillin and Metronidazole followed by orally administered Amoxicillin and Metronidazole. A white blood cell count or a thick blood film/blood smear might be asked at the laboratory in case of suspected (wound) infections. Additional drugs are administered according to the patients' needs, for instance Quinine in case of Malaria or further antibiotics in the case of (wound) infections. The need of additional laboratory tests or drugs is daily revaluated by the responsible nurses. Discharge depends on the patient's general state. The average length of stay was 10.8 days in the sample (standard deviation: 3.66). Before the final discharge the patient visits a midwife for a check-up. A follow-up visit at the surgery ward is projected for 14 days after discharge.

Provider's cost arise for transport, the hospital stay and follow-up visit, for reception and the final check-up at the obstetrical ward, for the operation, for additional laboratory tests and eventual blood transfusion, for drugs going beyond the kit for the intervention and for the hospital's administration. In table 13 total provider's cost are presented in correspondence with the presentation of total cost for inguinal hernia cure (Table 12). Total provider's cost for the Caesarean section were US$ 140.14 under spinal anaesthesia and US$ 180.42 under general anaesthesia. The highest cost occur at the cost centre "theatre" followed by the cost centre "laboratory".

3.2.3.3 Theatre cost

The theatre is only used by surgical patients, but is, nevertheless, the third expensive cost centres (compare Table 6, p. 48). In the case of hernia cure the theatre cost stand for more than 80% of total cost and in the case of Caesarean section it makes up for about 60% of total cost. A closer look on total theatre cost reveals that 63% are fixed cost and that equipment depreciation stands for 47% of the total cost (Figure 11). No cost occur for building depreciation, as the theatre is already paid off. Staff cost make up for 11% of total cost and variable cost are almost exclusively cost for consumption material which stand for 35% of total cost.

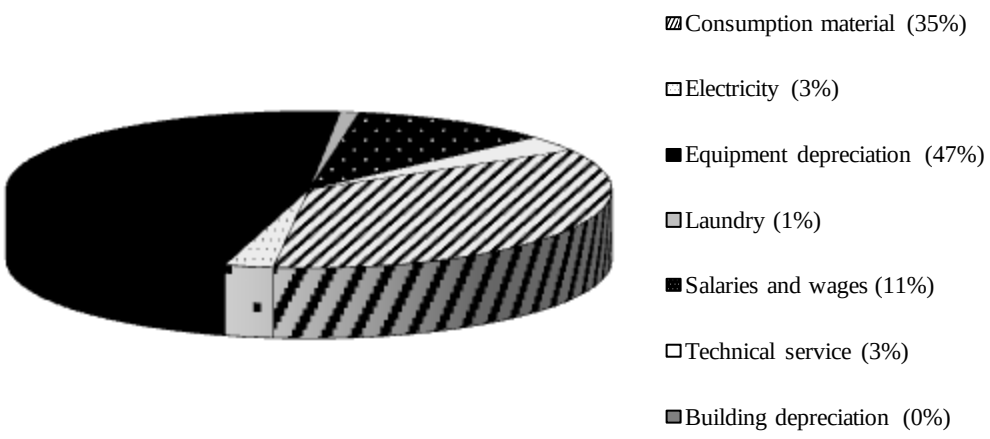

Figure 11: Cost type distribution at the theatre for hernia cure and Caesarean section (Source: own)

It has to be considered that the presented analysis of cost allocation of the theatre is based on the cost calculation for surgical patients. It implies cost for operation kit and other supplies for anaesthesia. Therefore, cost allocation cannot be directly compared with the analysis presented in chapter 3.1 (p. 48 et seq.).

3.3 Laboratory cost

As laboratory cost make up for a big part of total provider's cost per patient and the laboratory is the second most expensive cost centre of the hospital (Table 6, p. 48), this called for a more detailed analysis.

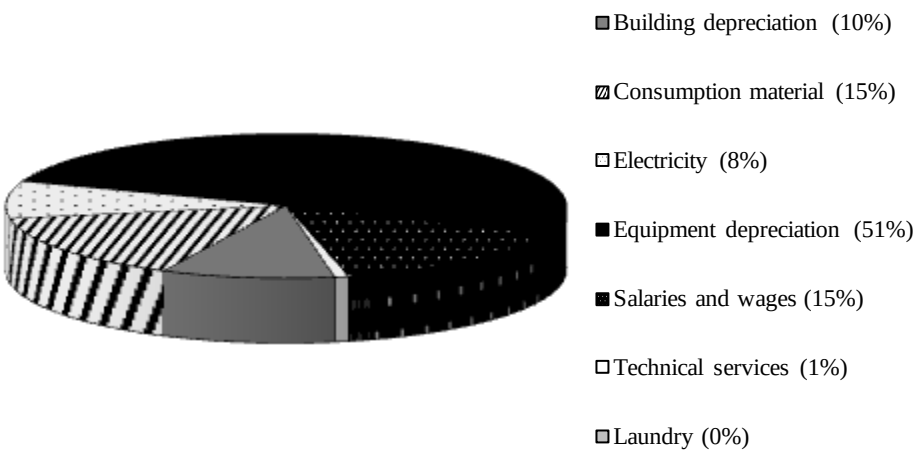

Figure 12: Cost type distribution at the laboratory (Source: own)

Cost for the 16 laboratory tests which are part of the treatment pathways discussed were divided according to cost types. Together they make up for 78% of all 5049 tests

performed in the hospital's laboratory in 2005. Figure 12 shows that 51% of total cost are due to equipment depreciation. The building depreciation accounts for further 10%. Summing up equipment and building depreciation, staff cost, technical service and 50% of electricity cost, fixed cost make up for 81% of the total laboratory cost. Cost for laundry are negligible at the laboratory.

3.4 Drug cost

The pharmacy is the hospital's most expensive cost centre. It sells an assortment of 260 generic drugs and medical supplies. Purchase and retail price for all these drugs were summed up separately and overhead cost were added to the purchase price. When the purchase price and overhead cost are deducted from the retail price, it resulted in an average margin of 27%. It should result in a cost-recovery of 127% though.

However, health personnel do not only prescribe the generic drugs available but also drugs (generic as well as non-generic) which have to be bought outside the district hospital in private pharmacies. Drugs prescribed but not available at the hospital's pharmacy were e.g. injectable Novalgin® as pain therapeutic after hernia cure and Caesarean section. For hypertensive patients eight out of eleven prescribed agents were not available within the hospital's pharmacy. In some cases non-generics were prescribed, though the generic agent was available within the hospital. Malaria patients at the Paediatric ward, for instance, were prescribed Quinimax® and Fansidar® instead of Quinine and SP. The physician in charge of hypertensive outpatients explained that the initially prescribed diuretic Furosemide is replaced by the equal brand-named agent Lasilix®, if the expected effect is not obtained.

3.5 User fees and cost-recovery rates

According to the national policy user fees have to be paid for most of the services provided at Nouna district hospital since the introduction of BI. User fees of US$ 0.94 have to be paid for an outpatient visit and US$ 1.87 for each night stayed at the hospital in 2005. For laboratory tests user fees ranging from US$ 0.94 for, e.g. a blood grouping, to US$ 5.62 for, e.g. serum lipids, have to be paid. No user fees are charged for blood transfusions and for examinations of cerebrospinal fluid, which is done in the framework of research projects. This might explain why cost-recovery for inpatient

Malaria care is not very high. According to the standard pathways analysed it included either a blood transfusion or the examination of cerebrospinal fluid (Table 14).

Disease	Provider's cost (US$)	User fees (US$)	Cost-recovery rate
Hypertension	67.94	64.10	**94%**
Hernia cure under general anaesthesia	169.78	91.53	**54%**
Hernia cure under local anaesthesia	146.86	76.72	**52%**
Hernia cure under spinal anaesthesia	153.09	77.93	**51%**
Caesarean section under spinal anaesthesia	140.14	63.15	**45%**
Caesarean section under general anaesthesia	180.41	81.22	**45%**
Paediatric Malaria outpatient	6.71	2.88	**43%**
Severe paediatric Malaria (Anaemia)	60.59	21.91	**36%**
Severe paediatric Malaria (Neurological affection)	75.10	26.01	**35%**
Average			**51%**

Table 14: Current cost-recovery rates at Nouna district hospital (Source: own)

For uncomplicated deliveries prefixed user fees exist which cover the whole hospital stay including laboratory tests and drugs at a sum of US$ 1.69 (900 FCFA). Only in 2006 an equivalent arrangement was introduced for Caesarean sections, too, fixing a lump sum of US$ 20.60 (11,000 FCFA) per patient (Ouédraogo, Richard et al. 2008). The kit for Caesarean section was however already subsidized by the government in 2005. Patients paid only a fixed sum of US$ 18.73 to 28.09 (10,000 to 15,000 FCFA) for the kit (Bicaba, Ouédraogo et al. 2003). Therefore, total user fees were calculated as for other diseases by summing up all charges along the standard pathway, but accounting the kit with only US$ 18.73 per patient. Table 14 shows the respective user fees for the different diseases. Dividing total user fees through total provider's cost

results in the cost-recovery rate. Cost-recovery rates vary from 94% for hypertensive outpatients to 35% for Malaria with neurological affections in the paediatric inpatient department (Table 14).

Disease	IPD and OPD	Laboratory	Pharmacy
Malaria outpatient	33%	33%	35%
Severe Malaria (Anaemia)	30%	43%	27%
Severe Malaria (Neurological affection)	52%	22%	26%
Hernia cure under local anaesthesia	18%	11%	71%
Hernia cure under spinal anaesthesia	13%	11%	76%
Hernia cure under general anaesthesia	19%	10%	72%
Caesarean section under spinal anaesthesia	31%	4%	65%
Caesarean section under general anaesthesia	29%	7%	64%
Hypertension	6%	21%	73%
Total	**22%**	**13%**	**66%**

Table 15: Share of total user fees spent at the different cost centres (Source: own)

Table 15 shows which part of total user fees per disease is paid at the different cost centres: IPDs and OPDs, laboratory and pharmacy. The by far highest share of total user fees is paid at the pharmacy for drugs and medical supplies (66%). For surgical interventions, kits are needed including suture material and anaesthetics. Thus, in these cases even higher cost occur at the pharmacy.

4 Discussion

4.1 Discussion of results

At first findings from step-down allocation of cost and bottom-up costing will be compared. Then provider's cost estimated for Nouna district hospital for different diseases will be compared to data found elsewhere in SSA. Afterwards the possible reasons for the very low occupancy rate at Nouna district hospital and how this affects provider's cost per patient and the cost-recovery rate will be discussed. Drug prescription practise will be discussed separately. Finally, discussion will focus on quality and general as well as disease-specific hints how treatment might be improved will be given.

4.1.1 Comparison with cost data from step-down allocation of cost

Comparing data from standard step-down allocation of cost (p. 48 to 49) with the performed bottom-up methodology (p. 49 to 65), it is striking that in both paediatric and surgical inpatient department the average length of stay was found to be considerably longer. Patient record review showed that paediatric severe Malaria patients with anaemia as complication had the shortest average stay, to be exact 3.5 days. Patients hospitalised hernia cure and Caesarean section at surgery stayed between 4.75 and 11.13 days while step-down analysis of cost considered average lengths of stay of 1.36 days at the paediatric ward and 1.35 days for surgical inpatient.

It seems surprising that cost for inpatient Malaria treatment were lower in our analysis and cost for surgical interventions were only about the double of the cost analysed in step-down allocation of cost. Even more striking is that salaries and wages made up for 73% of total theatre cost and 27% of total laboratory cost in the step-down allocation (Table 6, p. 48) but stand for only 11% of theatre cost per patient for Caesarean section and hernia cure and 15% of laboratory cost for the considered test in activity-based analysis of cost (Figure 12, p. 66). The reason might be that personnel employment is highly inefficient. Partly this is due to standby duties and the low utilisation rate at Nouna district hospital. For further insight time dedication of laboratory personnel was analysed. The laboratory can be regarded as the best organised department due to the constant visits of international researchers. Nevertheless, the required labour time for all performed tests was exemplarily summed up for the months of March (dry season) and August (rainy season) 2006. The time was divided by the number of staff and found that

each laboratory technician had thereafter an average labour time of 65.8 hours per month, compared to 133.3 hours considered normal. This calculation includes the time laboratory technicians worked for the research centre (25% of total working time). In other words, about 50% of the personnel cost of the laboratory are idle time cost. Comparable findings were reported from Dominican Republic where personnel cost made up for 84% of total hospital cost while they made up for only 2.5 to 11.5% of the cost per patient (Lewis, La Forgia et al. 1996).

4.1.2 Comparison with cost data from other settings

In this chapter the results for each disease will be compared to data from similar settings. Nevertheless, it has to be taken into account that costing methodologies vary and interpretation should be done with reservation.

4.1.2.1 Paediatric Malaria

Total provider's cost for paediatric Malaria cases in Nouna are comparable to what was found in other SSA hospitals. For outpatient care Wiseman et al. (2006) estimated provider's cost of US$ 5.09 for SP treatment and US$ 5.13 for Amodiaquine treatment in a Tanzanian district hospital. In Nouna, for outpatient treatment provider's cost of US$ 6.71 occurred and oral Malaria therapy with SP is also less expensive, but Amodiaquine is provided in form of syrup, facilitating the administration in younger children.

For inpatient care provider's cost were estimated at US$ 86 (user fees US$ 43) in a tertiary hospital in Senegal (Faye, N'Dao et al. 2000) and at US$ 57 to 105 and US$ 33 to 44 in a district and a sub-district hospital in Kenya (Kirigia, Snow et al. 1998). Recently, Ayieko et al. (2009) estimated provider cost for district hospitals in Kenya between US$ 47 and US$ 75 without distinction between mild and severe cases (all cost estimates were adjusted to 2005 US$ for better comparison). This shows that total cost for inpatient Malaria care elsewhere are in the range of provider's cost found in Nouna district hospital: US$ 60,59 for severe Malaria with anaemia and US$ 75,10 in case of neurological affection. Differences exist between Nouna and elsewhere concerning the cost centre where the highest cost occur. Kirigia et al. (1998) found that about 30% of the cost in Kilifi district hospital (KDH) in Kenya were due to laboratory tests. At Malindi sub-district hospital even less money was spent on laboratory investigations. In

the tertiary hospital in Senegal 36% of total provider's cost for Malaria treatment were spent on laboratory tests (Faye, N'Dao et al. 2000). At Nouna district hospital 50% of provider's cost for outpatients and 68% for anaemic and 43% for neurological affected Malaria inpatients respectively occur at the laboratory. Especially the haemoglobin count/haematocrit and the blood transfusion are extremely expensive for the provider. Together they make up for more than half of the laboratory cost for anaemic Malaria patients. It is possible that in other cost analyses blood transfusion were accounted differently, e.g. under medical supplies. At Nouna district hospital the predominant part of laboratory cost is due to equipment depreciation (Figure 12, p. 66). It can be assumed that Nouna district hospital, because of its cooperation with the research centre, has equipment going beyond the normal standards for SSA district hospitals, resulting in higher cost per test. The availability of a high standard infrastructure might on the other hand encourage the personnel to do more laboratory tests per patient than elsewhere.

4.1.2.2 Outpatient treatment of hypertension

Investigating cost and treatment practise for hypertensive outpatient treatment at Nouna district hospital, the general problem was that ongoing patient records neither exist for inpatients nor for outpatients. This makes research on a chronic disease, which demands continuous monitoring, extremely difficult. And, even more important, without continuous documentation former risk assessments and changes over treatment periods cannot be reconstructed easily and might bring about avoidable resource consumption for repeated history making, clinical examination, laboratory tests and/or ECGs. This is a general problem of health care systems, if patients are transferred or staff changes over time and information is lost or not provided in a comprehensible way for upcoming colleagues. This emphasises the general need of better and continuous documentation of any actions taken with regard to the patient.

Total annual provider's cost of US$ 67.94 arise for basic hypertensive therapy at Nouna district hospital. The patient pays almost the same amount of money annually in form of user fees (US$ 64.10). Dong et al. (2004) found that in Nouna health district the average household consisted of eight persons and had a mean cash income of US$ 273 (145,865 CFA) and a median income of US$ 118 respectively (63,000 CFA) in six month, whereas agricultural produce made up for another sum of US$ 382 (203,995 CFA) on average or a median of US$ 195 (104,000 CFA). The relatively high user fees which have to be paid continuously compared to the low income might explain

why Su et al. (2006) found that chronic diseases are associated with higher risk for catastrophic household expenditure. On the other hand, in Abidjan/Ivory Coast user fees for a myocardial infarction were estimated in a tertiary care setting from August 2001 to June 2005. They accounted an average amount of US$ 1,769 for not comprising staff cost and some other minor cost (Konin, Ekra et al. 2007). Bearing in mind that anyway tertiary care settings are out of reach for most of the population of Nouna health district, treatment of hypertension in order to prevent cardiovascular events at an affordable price is of special importance.

No data was found on provider's cost for an annual check-up for hypertensive patients in SSA. Lemogoum et al. (2003) and Rayner et al. (2007) did not cost their suggestions for a check-up. For the Seychelles Bovet et al. (2006) estimated provider's cost for a basic annual check-up at about US$ 46. This is more than twice as much as estimated for the same laboratory tests at Nouna district hospital (US$ 19). However, the Seychelles are considered as a middle-income country and higher cost might be explained by higher salaries and wages of the health personnel. Direct comparison is not very sound.

At Nouna district hospital, the three available generic agents Furosemide, Nifedipine and α-Methyldopa were prescribed most frequently leading to moderate monthly provider's cost for drugs (on average US$ 3.05). The patient paid on average US$ 3.91 per month. Research on prescription practises of antihypertensive agents in two tertiary hospitals in Nigeria (Yusuff and Balogun 2005; Amira and Okubadejo 2006) showed a predominant prescription of CCBs and diuretics, namely Co-Amiloride. In both studies more than 70% of all patients received a combination therapy. Monthly treatment cost for the patient were US$ 16.44 for CCBs, US$ 3.08 for diuretics, US$ 22.62 for ACEI and US$ 12.03 for α-Methyldopa converted in 2005 US$ (Yusuff and Balogun 2005). The percentages of patients under treatment with adequate blood pressure levels were 39.9% (Amira and Okubadejo 2006) and 29% (Yusuff and Balogun 2005). Diuretics were found to be most cost-effective, comparing cost and the number of patient with controlled blood pressure (Yusuff and Balogun 2005). Nevertheless, the study design was retrospective without randomisation and it can be suggested that because diuretics are less expensive than other agents, patients were more compliant with the therapy. At an university hospital in Ghana CCBs also were the most frequently prescribed drugs (Ohene Buabeng, Matowe et al. 2004). Patients paid US$ 14.45 for monotherapy with Nifedipine (40mg) per month and for combination therapy Nifedipine (40mg) and α-

Methyldopa (1g) US$ 31.21 per month. It was furthermore found that 93% of the patients were non-compliant to their therapy and the most important reason was unaffordable drug prices. This emphasises the impact of reasonable drug prices.

4.1.2.3 Surgical interventions

The total number of surgical intervention at Nouna district hospital is low. Nordberg et al. (1984) estimated for eastern Africa that at least 175 hernia cures and 200 to 250 Caesarean sections are necessary in a population of 100,000 inhabitants. This would mean that actual surgical interventions carried out at Nouna district hospital in 2005 only cover 12% of the minimal need of hernia cures (64 performed against 525 needed) and 7.5% of the minimal need of Caesarean sections (45 performed against 600 needed). An increase of performed surgical interventions would increase the regional health status and diminish provider's cost per patient. A closer look at this topic will be taken in chapter 4.1.3 (p. 75).

4.1.2.3.1 Hernia cure

Cost data for hernia cure in developing countries is very seldom. In Ghana provider's cost were estimated at US$ 636.65 for hernia cures performed within a 5-day visit of the UK-based non-governmental organisation "Operation hernia" in 2007 (Clarke, Oppong et al. 2009). That means four times higher than in Nouna district hospital (US$ 146.86 to US$ 169.78). This might be due to high cost for foreign surgeons, travel cost and simultaneous teaching of regional health personnel. This can be regarded as evidence for the fact that well-working district hospitals can do ordinary surgical interventions, one of their essential tasks, at reasonable cost. The concept of foreign physician coming for a campaign, should be reserved to uncommon pathologies, which cannot be adequately covered by local personnel, for instance cardiac surgery.

Considering user fees only, Freudenberg et al. (2006) reported from Yalgado University hospital in Ouagadougou that patients paid in 2005 US$ 40 for hernia cure without mesh implantation.

4.1.2.3.2 Caesarean section

In the regional hospital in Mtwara Urban district in Tanzania provider's cost for a Caesarean section were estimated to be US$ 69.26 in 2003, while the utilisation rate for Caesarean sections was 122%, though (Both, Jahn et al. 2008). As neither the research in Tanzania nor this one evaluated quality of care, it is not possible to appraise the influence occupancy rates had on the delivery of care. Preparing the introduction of a cost sharing mechanism in a health district in Ouagadougou Richard et al. (2007) estimated cost for a major obstetric intervention at US$ 135.99 including cost for surgery, hospital stay, drugs, laboratory exams and transport. As costing methodology was not discussed in detail it is possible that the estimation is rather based on former user fees than on effective provider's cost.

In the years 1997 to 2002 patients paid on average US$ 121.06 in three regional hospitals in Burkina Faso for a Caesarean section, not comprising cost for transport and food. The modal price for Caesarean sections in these hospitals was even higher, namely US$ 137.6 on average and US$ 550 on maximum (Bicaba, Ouédraogo et al. 2003). At Nouna district hospital, user fees accounted for US$ 63.15 for a Caesarean section under spinal anaesthesia and US$ 81.22 under general anaesthesia. The difference is probably not due to the inclusion of cost for transport and food but to very high cost for drugs and medical supplies. These cost made up for more than half of the total direct cost for the patient in certain study sites. The Ministry of Health of Burkina Faso published data on user fees in several district hospitals for 2003 (see Table 3, p. 21): The average user fees were US$ 70.35 (Ministère de la Santé 2008). Between 2004 and 2006 Storeng et al. (2008) found average user fees for Caesarean sections of US$ 118.00. Their research included university, regional and district hospitals. The decline might be due to the increasing promotion of Caesarean section by the government by subsidising cost and prefixing prices as well as to the amelioration of provision of cheaper generic drugs.

4.1.3 Utilisation rates and cost

Nouna district hospital has an utilisation rate of hardly 20% and fixed cost make up for the highest share of cost. For instance 63% of the theatre and even 81% of the laboratory cost are fixed (Figure 11, p. 66 and Figure 12 p. 66). As consequence cost per patient are higher than necessary.

Two possible solutions exist: Either hospital services could be cut down to fit actual utilisation rates or utilisation rates have to be increased. The first option is by far easier, but will all the same not be considered hereafter. Considering the district population, the hospital is rather too small (about 300 regularly occupied beds would be adequate, see chapter 2.2.7, p. 28) and health statistics, mortality rate and life expectance show clearly that the health status has to be improved in Nouna health district. Thus, increasing utilisation should be the way of choice.

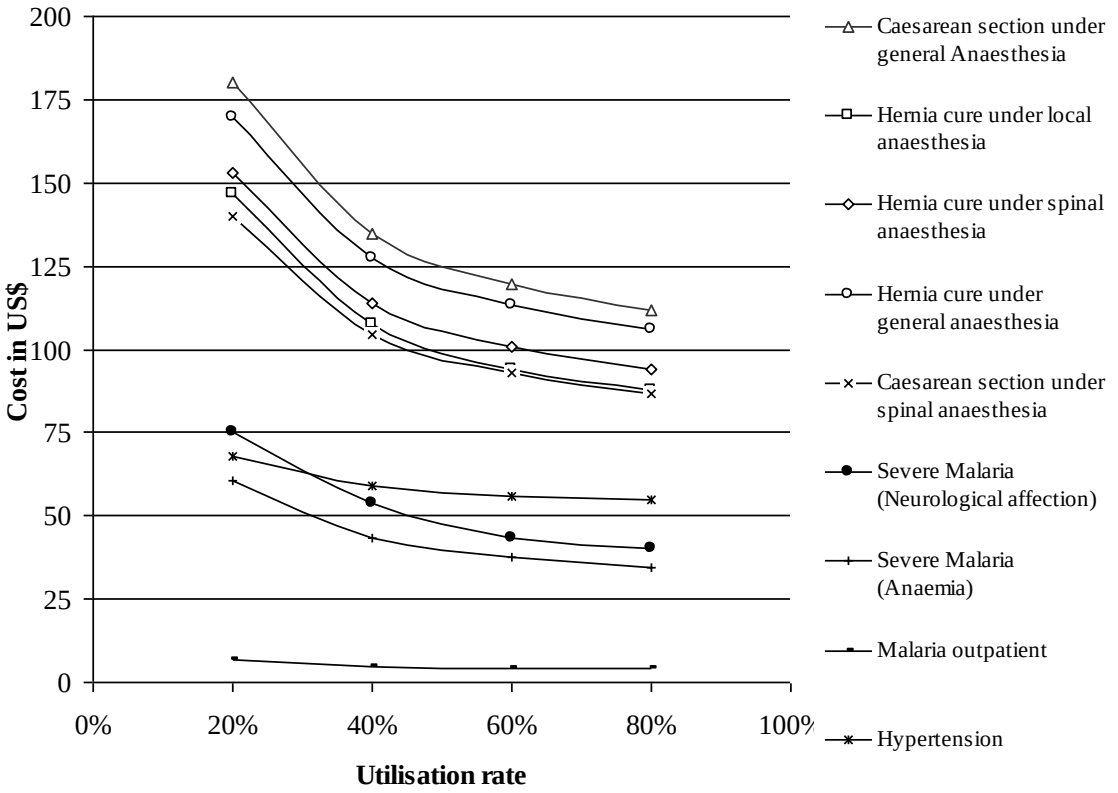

Figure 13: Evolution of provider's cost per patient in US$ in case of higher utilisation rates (Source: own)

Figure 13 shows to which extent cost per patient would decrease, if the utilisation rate rose from the current 20% to an ideal of 80% (see chapter 2.2.7, p. 28 et seq.). By then, cost per patient for all diseases would decrease between at least 20% (a hypertensive outpatient) and at most 46% for Malaria with neurological affections as complication. Cost for diseases with predominantly fixed cost decline faster than cost for diseases with predominantly variable cost. Therefore, cost for inpatients decline generally faster than cost for outpatients.

The question is how to increase utilisation rates. Flessa (2009b) showed that three steps have to be accomplished each one depending on various factors. First, a *need* has to be perceived in the population. In the case of an illness the condition has to be regarded as

abnormal and modifiable. This depends, among others, on the health status of the patient's surrounding, e.g. haematuria by the wide-spread disease urinary Schistosomiasis is considered normal in certain parts of Africa, because it appears along with adolescence. In Nigeria 55% of infected men and 21% of infected women stated that the symptoms were part of human development (Ukwandu and Nmorsi 2004).

A need will become a *want*, if means that are considered capable to satisfy the need are defined. This depends, however, on the conception the patient has about the disease. If a disease is considered as justified punishment or as a bad spirit which overtook the person western medicine will not be considered the right answer. Beiersmann et al. (2007) showed in Nouna health district that for paediatric Malaria four different traditional concepts exist and the treatment options vary accordingly.

Finally, the turning of a want into a *demand* depends on the affordability, the accessibility, the quality and on the personal priority setting. For Nouna health district research exists on these last factors. Su et al. (2006) showed that especially the poor and patients with chronic diseases, suffer from high direct cost for health care treatment. Indirect cost were estimated to be at least three times higher than direct cost (Su 2005). This means that user fees calculated in this study are only the tip of the iceberg.

Geographical inaccessibility is another problem in Nouna health district. In 2005 42.7% of the population lived more than 40 kilometres away from the hospital, the maximum distance was 85.7 km (Flessa 2009a). On the other hand, the hospital's ambulance can only pick up a limited amount of patients due to vehicle and personnel constraints. Some rural health centres therefore own motorcycles, even though, like public transport, they are not always an adequate medium of transport for seriously ill patients. Cultural aspects might also play a role for accessibility. For instance, Marschall and Flessa (2009) mention that a specific conservative religious group (Islamic Wahabi movement) generally obviated some parts of modern health care.

Poor quality of anamnesis and examination was found at rural health centres (Krause, Schleiermacher et al. 1998). In a sample of 417 diagnoses made by 15 nurses only 20% of the diagnoses were based on sufficient history taking and 40% of all diagnoses on a sufficient examination. Interestingly enough, no correlation was found between nurses' training and the performance. It was concluded that supervision and access to guidelines have a bigger impact. A research about quality-perception in Nouna's health district showed that the hospital was evaluated to be even poorer than health centres (Baltussen, Yé et al. 2002). A "certain level of dissatisfaction with the services currently available"

in the district was also perceived by De Allegri et al. (2006) and "defined (as) poor quality of care exclusively in terms of health providers' attitudes".

Priority setting was evaluated ahead of the introduction of the community based health insurance by a willingness-to-pay study (Dong, Kouyate et al. 2004). It was investigated, how much household heads are willing to pay as insurance premium and the premium was set accordingly (Dong, Mugisha et al. 2004). Nevertheless in 2006, this means two years after introduction, the enrolment rate was only 5.2% (Gnawali, Pokhrel et al. 2009).

The different aspects influencing the utilisation rate have to be in an adequate equilibrium and not all of them are equally important. Likewise, Mariko (2003) stated that user fees do not play such an important role for utilisation rates. He found in Burkina Faso's neighbouring country Mali that user fees could be doubled, if quality was improved. Quality and affordable user fees were also found to be complementary for sustainable augmentation for utilisation rates in Nouna health district (Mugisha, Kouyaté et al. 2004). If care is too expensive poor patients resort to traditional medicine or self-treatment not considered as an adequate alternative for western health care (Mugisha, Kouyaté et al. 2002b). If quality is poor richer patients skip lower health care institutions and go directly to reference centres or private health care institutions. Even if they might have to pay higher fees the majority will choose the facility where they assume quality to be best. Where private health care is not available, patients try to get better treatment by corruption, namely informal payments (Meuwissen 2002; Vian 2008). If quality is good and no user fees exist, the health system risks, ceteris paribus, breaking down under an uninfluenceable over-utilisation which is hardly fundable. After the abolition of user fees in Uganda the number of patients rose immediately (Burnham, Pariyo et al. 2004; Nabyonga, Desmet et al. 2005). After seven months the number of patients declined again dramatically. Mentioned reasons were the diminishing disposability of drugs as well as a loss of working morale within the health personnel.

In the end, it can be stated that increasing the health care utilisation rate is not an easy endeavour. It could be shown that in Nouna health district a multitude of problems exist, hampering that the population's health status turns into a demand for western health care and specifically for treatment at the district hospital. From the hospital provider's point of view, emphasis should be put on better quality and affordable user fees.

4.1.4 Cost-recovery rate

The cost-recovery rate reflects the relation between cost for the provider and his revenues in form of user fees. Thus, cost-recovery rates depend on the total provider's cost and the level of user fees. However, provider's cost vary per patient and according to the number of patients treated, while user fees are fixed at Nouna district hospital. This means that cost-recovery rates increase when more patients are treated.

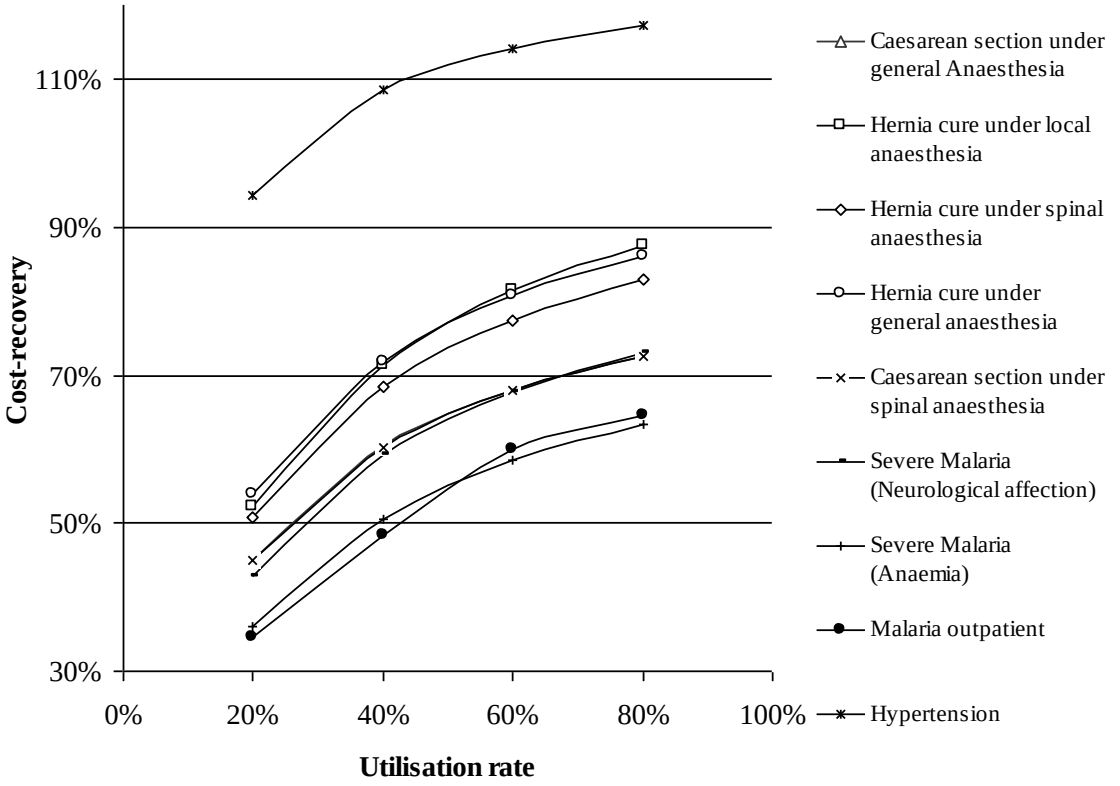

Figure 14: Cost-recovery vs. utilisation rate (Source: own)

Actual cost-recovery rates are as high as 94% for hypertensive outpatients and between 45% and 54% for surgical interventions while for Malaria inpatient treatment only 33% to 43% are recovered. High cost-recovery rates are obtained when cost for drugs and medical supplies make up for a high share of total cost, because they are sold at the hospital pharmacy with considerable margin. Malaria drugs are quite cheap, they make up for only a small share of total cost and therefore cost-recovery is lower. This effect is due to the policy of regaining money mainly by selling essential generic drugs within the pharmacy. In all other cases user fees do not cover total provider's cost. Comparable findings have been published for the rural health centres in Nouna health district, too. Current cost-recovery rates were found to be between 9.4% (health centre in Dembo) and 31.4% (health centre in Koro) for a general outpatient consultation.

Assuming increasing utilisation rates the average cost-recovery rate could reach 34% (16 to 56%) (Flessa and Kouyaté 2006). However, the research at the rural health centres, contrary to ours at Nouna district hospital, did not include the affiliated pharmacies.

Cost-recovery was projected for increasing occupancy rates up to an ideal occupancy rate of 80%. Figure 14 illustrates that the cost-recovery rate for hypertensive outpatient treatment would rise to 117%, for hernia cure under local anaesthesia to 88% and even for severe Malaria with anaemia to 63%. The average cost-recovery rate for all diseases included into this research would then be 80%.

To recover total provider's expenditure is, however, not possible with the current fee system. The necessary increase in demand to break even could not be adequately covered in the hospital's current configuration. And although health care planners nowadays widely agree that user fees are necessary to make health care sustainable and canalise patients' demand, increasing user fees would probably not be feasible in a rural SSA health district such as Nouna.

McPake et al. (1993) assumed that cost-recovery depends basically on three aspects: Price structure, affordability and quality. As the last two points have already been discussed in chapter 4.1.3 (p. 75 et seq.), this chapter focuses on the price structure. The actual solution is a fee-for-service-system. Anything the patient consumes has to be paid separately. This means that revenues vary according to the number of laboratory tests, the length of stay and the amount of drugs prescribed. From the provider's point of view, a fee-for-service-system results in high administrative cost and gives little initiative to the health personnel to plan a cost-effective treatment as patients pay, e.g. additional drugs. It was found in Ghana that in a "cash and carry" system more drugs were prescribed and injections were more frequent than when services were free of charge (Biritwum 2001). Furthermore, it is difficult to monitor in a fee-for-service-system up to which point patients are actually paying (Meuwissen 2002). This may, in parts, explain the gap between cost-recovery rates calculated in this research ranging from 35% to 94% and the ex post calculation for the whole hospital for 2005, showing that the actual cost-recovery rate was only 24.18% (Flessa 2009a). As all fees are raised together at a central cash point, the fee-for-service-system does not even allow evaluating differences in cost-recovery rates across cost centres. For the patient the fee-for-service-system is difficult to oversee and gives little possibility to plan total expenses for the hospital stay in advance (McPake, Hanson et al. 1993). Patients might

consequently abandon treatment before time, because of money limitations. For Burkina Faso, it was shown, that patients suffer considerably from high user fees and planning insecurity (Storeng, Baggaley et al. 2008).

An alternative is to fix lump sums for specific diseases or a treatment period in general (McPake, Hanson et al. 1993). The patient would know total expenses ahead-of-time and could plan with the additional expenses from the day of hospitalisation. This would reduce or even exclude the risk of additional user fees due to complications. For instance, the cost of additional drug use as result of wound infection would be a risk for the hospital rather than for the patient. High quality care would be, as a consequence, and economic imperative for the hospital. For the hospital fixed lump sums would result in lower administrative cost as the payment has to be raised once, only. Furthermore, prefixed revenues would force the hospital to budget. This kind of cost-recovery would shift the focus toward the health personnel, which would then be forced to work as resource-saving as possible. To assist this process budgeting might be shifted to lower levels, e.g. the cost centres. This would supply the personnel with all necessary information for economic decision making. A reward system might be introduced to encourage staff and enhance competition between health centres.

The local health insurance, AMBC, tried to cope with the problems mentioned above in quite a similar way. The district hospital receives a prefixed part of the revenues (22.5%) and is meant to cover the user fees of patients involved in the insurance and requiring treatment along the year for included services (De Allegri 2006). Involved people pay an annual premium, which allows planning security. However, as AMBC is still in its beginning and few patients are enrolled so far, it makes up for only a small part of total hospital's revenues.

Apart from discussing the price structure it has to be remembered that a full cost analysis was undertaken including capital and recurrent cost. Capital cost are investment cost which occur only once, for instance for buildings, vehicles or equipment. They are often funded separately from recurrent cost (Jegers, Kesteloot et al. 2002). In the case of SSA hospitals, capital cost are often funded by international donors. It might therefore be stated that recovering recurrent cost by user fees is sufficient.

Summing up, cost-recovery is already considerable, especially when heeding that it is based on total provider's cost and not on recurrent cost only. Cost-recovery rates could be even better if utilisation rates increased and, possibly, through a change from a fee-

for-service-system towards a fee-per-disease- or fee-per-period-of-illness-system by fortifying efficiency.

4.1.5 Drug prescription practise and cost

Repeatedly, the high impact of drug cost on the patient's total direct expenditure in Nouna health district was described (Mugisha, Kouyaté et al. 2002b; Su, Kouyaté et al. 2006; Marschall and Flessa 2008). Most of the previous research was nevertheless done in rural health centres, where, naturally, lower cost occur for consultation, hospitalisation and further investigations. This dissertation shows, however, that even in the hospital drugs make up for 65.8% of total user fees. This is due to the policy which has been pursued since the introduction of the BI, where hospitals' and health centres' pharmacies are meant to generate gains. Gains should then be reinvested into the pharmacy and the drug stock and/or should allow exempting indigent patients from fees. At Nouna district hospital it is striking that the pharmacy does not break even although drugs are sold on an average margin of 27%. Possible explanations for the low income might be the provision of free drugs for indigents, thievery of drugs as well as of revenues or insufficient bookkeeping.

The BI also emphasised the fact that hospital pharmacies should provide a set of so-called essential generic drugs. At Nouna district hospital a set of generic drugs is offered, but it is debatable if they are also essential. Considering the case of hypertension treatment physicians prescribed eleven agents and only three were available at the hospital. No ACEI is available, although this is the antihypertensive agent of choice for patients with hypertension and diabetes. This combination was found in 21% of all hypertensive patients in our sample. As information transfer and reorganisation is assumed to take some time, the findings were compared with WHO suggestions from 2003 and not with the more recent version of 2005. The WHO model list of generic medicine of 2003 recommends none of the three antihypertensive agents available at Nouna district hospital (Furosemide, Nifidepine and α-Methyldopa), but a ß-Blocker, an ACEI and a low-dose diuretic (WHO 2003). CCB and α-Methyldopa showed up in the list but their efficacy as antihypertensive agent was in doubt. This lack of essential drugs might also explain why Baltussen and Ye (2006) found that only around 30% of the population of Nouna health care district consider the availability of drugs in modern health services as adequate.

The hospital's pharmacy has to keep up with actual needs and changes in illness patterns as well as treatment strategies. To provide a reasonable pattern of generic drugs for all hospital patients, communication between physicians and responsible pharmacy personnel has to be enhanced. The set of available drugs has to be widened especially to cope with the upcoming problem of chronic non-infectious diseases. On the other hand, physicians have to be aware of drugs available at the hospital's pharmacy and should favour them over non-generic drugs. Currently, there is still a strong faith in the superiority of non-generic drugs. Doubts on the quality of generic drugs were also found in a query in 1998 at the university hospital of Ouagadougou. Only 25% of the prescribers interviewed stated that generics are as effective as non-generics (Savadogo, Sondo et al. 2002). Doubts about the effectiveness are by the way no specific problem of developing countries, but also found in developed countries (Pereira, Holbrook et al. 2005).

Better management of drug supplies would improve the hospital's economy, as currently patients are often forced to buy drugs outside the hospital. Thereby they are giving the margin to private pharmacies. Inside the hospital agents provided in form of generic drugs would probably be less expensive and the margin would be used to sustain the hospital services to the benefit of the patients. Affordable drug prices were furthermore found to be the most important factor for patient's compliance (Ohene Buabeng, Matowe et al. 2004).

In conclusion, management of the hospital pharmacy has to be improved. The available drugs should represent all necessary agents frequently prescribed by the physicians. On the other hand, personnel should be urged to prescribe drugs which are available at the hospital pharmacy.

4.1.6 Clinical pathways as a tool to improve quality of care

As depicted above, quality of care has repeatedly been found to be poor in Nouna health district, including the district hospital (Krause, Schleiermacher et al. 1998; Baltussen, Yé et al. 2002; De Allegri, Sanon et al. 2006). The improvement of quality of care can be considered crucial to sustainably increase health care utilisation. Nevertheless, quality of health care is a multi-dimensional construct. Quality of health care can be divided into *clinical quality of care* according to the best known practise and *perceived quality of care* by the patient (Mayer, Chow et al. 2009). In Bangladesh Andaleeb (2001) developed a hypothesis to evaluate patients' satisfaction and found that the

following factors had an influence: Responsiveness, discipline, assurance, communication and Baksheesh.

The clinical quality of care can itself be divided into outcome quality, structure quality and process quality (Donabedian 1966). Benchmarking the health care performance with the health status of the patient after the treatment, in other words, the *outcome quality* might initially appear to be the most reasonable option. For an adequate measurement of the output, however, the difference would have to be raised between patients' health status after, e.g. the hospital stay, and the fictive health status which would have been attained after the same period of time without the hospital treatment (Breyer, Kifmann et al. 2005a). The health status is, however, subjective and might not necessarily reflect the medical judgment. Also, hospitals do not only provide predictable hospital care, but provide a surplus of hospital beds for cases of emergencies. This is reflected in the ideal utilisation rate of 80% which is assumed for hospitals, the surplus provides a security for the population and has to be included into the output analysis (Breyer, Kifmann et al. 2005a).

To overcome the problems linked to outcome evaluation, the evaluation of structure and process quality might be handier alternatives. *Structure quality* is defined as the input of an institution, e.g. number and training of personnel, availability of equipment or drugs. Obviously, structure quality is easily measurable and required data is often available, even in developing countries. On the other hand, no direct relation exists between the number of, e.g., physicians available, and the care actually given to the patient. The missing link is the process quality. *Process quality* can be defined as "the assumption that one is interested not in the power of medical technology to achieve results, but in whether what is now known to be 'good' medical care has been applied" (Donabedian 1966).

As a fourth aspect *efficiency* can be added to the evaluation of clinical quality of care (Mayer, Chow et al. 2009). Efficiency itself can be assessed in three different ways. The first option is the principle of maximisation, meaning that with a given input the maximal output shall be attained. The second option is the principle of minimisation, meaning that a given output shall be attained with a minimum input. The third option is the principle of optimum, meaning that the input-output-relation shall be in an optimal equilibrium.

Conclusively, it can be assumed that optimising structure quality, process quality and efficiency within the bounds of the possible will result in the optimisation of the outcome as well.

Structure quality can be judged to be good at Nouna district hospital in means of housing, nursing and medical personnel, equipment, technical and administrative service. This is reflected in the considerable fixed cost. Problems exist, however, with the constant supply of an adequate set of essential generic drugs and other consumables, e.g. for X-ray developings. Processes have to be pictured, optimised and standardised (Kothe-Zimmermann 2006b). A feasible form is the CP. The general approach was presented and partly accomplished for the considered diseases. The current care processes were illustrated in form of flow charts (Figure 7 to Figure 10, p. 50, 54, 59 and 63). The further development of the CPs should address three principal weak points of care giving in Nouna health district: Communication, documentation and standardisation of care. Communication should be ameliorated, in order to avoid any interference along the treatment pathway due to absence of staff, lacking drugs or other consumables. With regard to the mentioned problem of adequate supply of essential generic drugs the available generic drugs should be discussed between care givers and drugs sellers. It should be agreed on drugs constantly available in generic form at reasonable cost for all frequent diagnoses which, nevertheless, respond adequately to the patients' needs (Laing, Hogerzeil et al. 2001). To prescribe other drugs should thereafter only be possible under exceptional circumstances and with agreement of a second care giver. To limit available drugs to a well-chosen number of agents diminished treatment cost for hypertensive outpatients in South Africa without touching the patients' hypertension level (Edwards, Lunt et al. 1998).

Documentation was shown to be incomplete and has to be ameliorated, because it is the base of controlling and quality management. Furthermore, correlation has been found between faulty documentation and deficits in care giving (Krug, Pattinson et al. 2004). Good documentation and an implemented sequence of investigations and treatment would also assure good treatment in a surrounding where personnel fluctuation is a problem and handovers, as known from developed countries, are not common. At Nouna district hospital patient files outlining the CP could be introduced. This would lead health personnel through diagnostics and treatment and simultaneously facilitate documentation. Alberti et al. (2006) introduced disease-specific medical records in Tunisia and could show that the level of documentation increased significantly.

Standardisation of care giving is highly recommendable in the specific case of Nouna district hospital as medical personnel often comes directly from university and transfer of knowledge might be lacking as experienced physicians tend to search for employment in the main cities or abroad. CPs would give recently graduated physicians an overview on required diagnostics and familiarise them with available treatment options. The patient would be sure to receive comparable care in similar situations (Kothe-Zimmermann 2006b). Additionally, the fact that a standardised CP permits the estimation of budget cost would enable the hospital to change the fee system from a fee-for-service-system to a system of fees per period of illness. The immense benefit for the patient would be the planning security from the beginning of the treatment and the assurance that treatment can be accomplished adequately. This might, by the way, address a principal public health problem resulting from abandoned therapies: The drug resistances of pathogens.

With regard to efficiency CPs are ideal to maximise efficiency according to the principle of maximisation. As the input is composed from many different national and international sources and difficult to influence, the pragmatic aim should be to treat as many patients as possible according to best medical knowledge with the given input. The introduction of CPs would allow cost control, that is the comparison of budget figures with actual figures (Kothe-Zimmermann 2006a). If a CP is defined and procedures are linked to cost, as done in this dissertation for actual treatment pathways, any change in total cost per patient can be traced back to the procedure, the cost centre and finally the cost type responsible for the change. If new treatment practises are introduced, cost can be estimated beforehand and balanced with the expected benefits.

Perception of care by patients was not assessed within this study because of the retrospective design. Besides, it was already assessed elsewhere that the actual care giving is perceived as rather poor (Baltussen, Yé et al. 2002; De Allegri, Sanon et al. 2006). However, the amelioration of efficiency and process quality would probably convince patients as well.

Hereafter, findings for paediatric Malaria, hypertensive outpatient treatment, hernia cure and Caesarean section will be compared to guidelines and research elsewhere to propose possible changes. Afterwards, personnel in charge would have to discuss which of the advice suggested are actually assignable for Nouna district hospital. Changes would have to be tested in the daily routine and be re-evaluated constantly. CPs and quality

management in general is not a ‘something’ to be achieved but an ongoing project. The pathways have to be adapted to changing guidelines and new medical knowledge.

4.1.6.1 Suggestions for Malaria treatment

Generally, it can be stated that Malaria treatment, especially considering drug administration, is mostly guideline conform (Ministère de la Santé 2006c; WHO 2006). In this context it has to be acknowledged that in 2005 ACT was not yet introduced into national guidelines. Only in 2006, Artesunate/Amodiaquine or Artemether-Lumefrantine became first choice for non-severe Malaria episodes (Ministère de la Santé 2006c). So far the outreach of the new policy is negligible in rural areas as the new drug options are still expensive and distribution works poorly (Kouyate, Sie et al. 2007). This is, however, on par with experience in other SSA countries (Meremikwu, Okomo et al. 2007; Zurovac, Ndhlovu et al. 2007).

The length of stay for severe Malaria patients is also resembling data found in other SSA countries: 4.7 days in a tertiary hospital in Senegal (Faye, N'Dao et al. 2000), 6.2 +/-4 days in a regional hospital in Togo (Djadou, Komlangan et al. 2006), 7 days with standardised management protocol (standard deviation 3.2) and 8 days without it (standard deviation 4.2) in Guinea-Bissau (Biai, Rodrigues et al. 2007). The length of stay reflects the severity of the disease especially for children and the life-threatening aspect of the various complications.

For rural health centres in Nouna health district Mugisha et al. (2002a) estimated provider’s cost of US$ 5.44 per outpatient and US$ 8.10 per hospitalised patients. At Nouna district hospital provider’s cost of US$ 6.71 were calculated for paediatric Malaria outpatients while inpatients caused cost of US$ 60.59 or US$ 75.10 according to the complications. Hence, provider’s cost per outpatient are alike, while inpatient cost are at least eight times higher at Nouna district hospital. This possibly reflects a good task sharing between rural health centres and the district hospital. Rural health centres care mainly for uncomplicated cases treated as outpatients or hospitalised one or two nights, while the district hospital cares for more complicated inpatient cases profiting from a wide range of diagnostics and more sophisticated medications as, for instance, blood transfusions.

Many aspects of Malaria treatment at Nouna district hospital can be judged positively. Not satisfying is the history taking, the physical examination and the organisation at the

paediatric ward. In the sample of patient records in 30% of all the days that Malaria inpatients should have been in contact with health personnel nothing was documented. At least at the day of admission name, age and temperature were documented for all inpatient cases. Yet, the weight was only documented in 60% of the cases and the temperature was hardly ever recorded during the following days. Likewise, the description of symptoms and the illness development were scarce and little standardised. The fact that records are only a blank sheet might be a reason for very little and incoherent documentation. Similar findings were described for rural health centres in Nouna health district, where only in 21% of all patients the diagnosis was up to basic standards, clinical examinations and history takings combined. Though, the dosage of drugs was acceptable in 81% (Krause and Sauerborn 2000).

Finally, in favour of high quality and maybe more expensive Malaria treatment, the special nature of infectious diseases should be kept in mind. Fast and secure treatment is not only for the benefit of the patient treated but influences the time for possible transmission as well. Furthermore, more expensive newly introduced combination therapies are meant to evade the development of resistances against anti-Malaria agents (Tediosi, Maire et al. 2006). This should especially motivate to push forward the exhaustive introduction of ACT in Nouna health district.

4.1.6.2 Suggestions for hypertensive outpatient treatment

The actual treatment of hypertensive outpatients is little standardised in Nouna district hospital and does hardly apply to international guidelines. Therefore, hereafter different approaches for cost-reduction, including adequate risk stratification and adequate drug supply and affordable prices, will be described.

Current guidelines recommend an adequate risk stratification. Patients should be classed in low, medium and high risk groups according to their blood pressure level, the number of additional risk factors and associated clinical conditions, namely diabetes, cerebrovascular diseases, renal disease and peripheral vascular disease (Whitworth 2003). The high risk group has a substantially higher risk for a cardiovascular event in the following years and the number needed to be treated to prevent one event is respectively low (Baker, Priest et al. 2000). Drug treatment for high-risk patients should therefore begin immediately. Any other patients should be informed about lifestyle modifications and be monitored before administering anti-hypertensive agents (WHO 1999). The privileged treatment of high-risk patients is of special importance if

resources are extremely scarce and only highly cost-effective options can be considered. "For regions in which healthcare resources are particularly scarce, investment in population-based primary prevention strategies may yield the largest dividend. The most cost-effective hypertension treatment programmes will involve the use of the lowest cost drugs […] in the highest risk groups. The selective treatment of patients with pre-existing cardiovascular or renal disease (irrespective of hypertension severity) or with severe hypertension (SPB > 180mmHg or diastolic > 110 mmHg) will result in the greatest ratio of events prevented to number of patients treated." (WHO 1999)

Although hypertensive treatment is more cost-effective when adjusted to the absolute risk for a cardiovascular event, risk assessment itself is costly for the health care provider. At Nouna district hospital it would account for US$ 19.00 to US$ 28.00, depending on the investigations included. Therefore, Gaziano et al. (2008) evaluated if risk stratification can also be done without laboratory investigations but regarding the combination of age, systolic blood pressure, smoking status, diabetes status, history of blood pressure treatment and body-mass index. In the laboratory based arm of the study the body-mass index was replaced by total cholesterol. The rates of prediction of cardiovascular risk were comparable for both scores. Hence, the not-laboratory based (cheaper) assessment was especially recommended for low-resource settings. Yet, it has to be acknowledged that the research was carried out in an US-population probably more alike to know for example about their diabetes status, because blood glucose has already been tested elsewhere. This means that a risk score, based on patient's interrogation only, might not be as sensitive in SSA. Furthermore, ample investigations including urine dipstick, ECG and ophthalmologic consultation might discover target organ damages earlier, when they do not yet trouble the patient. This might be of special importance in a population, who still knows little about the first symptoms of cardiovascular diseases.

For Nouna district hospital it can be concluded that the non-laboratory risk stratification should be the first step to make hypertension treatment more cost-effective. If feasible for the patient, further investigations, especially to detect target organ damages, should be recommended.

The fact that 15% of the patients received advice for a low salt diet might be an indicator that physicians at Nouna district hospital are aware of the high importance of lifestyle modification in the therapy of hypertension. Consumer drug prices seem to be more reasonable than elsewhere, but several drug groups, recommended by guidelines

for developing countries, are not yet available at the hospital's pharmacy and brand-named forms in private pharmacies are very expensive. This results in prescription of ACEIs in only three cases, whilst ACEIs are first line agent for the combination of diabetes and hypertension, which was found in ten cases.

A standardisation of treatment of hypertensive outpatients should comprise three main points. Firstly, an adequate risk stratification must be documented at the first visit and, eventually, updated later on. Secondly, a step-up protocol should be introduced including advice for life-style modification and drug prescription as provided for low- and middle-income countries by the WHO (2002) going along with improved documentation. And thirdly, at least one agent of the main groups recommended for anti-hypertensive treatment should be provided at the hospital's pharmacy in generic form.

On the long view, treatment of hypertensive patients should be partly shifted to rural health centres to diminish treatment cost and enhance compliance to follow-up visits. The visit to a near-by rural health centre is more feasible than regular visits to the district hospital, which is quite distant for a great part of the population (Flessa 2009a). It was shown in South Africa that the follow-up of hypertensive patients by instructed nurses is a reasonable option (Coleman, Gill et al. 1999).

4.1.6.3 Suggestions for surgical interventions

With regard to chirurgical interventions, some specific shortcomings which lead to avoidable cost at the surgical ward, namely the patients' length of stay, choice of anaesthesia and antibiotic prophylaxis, could be detected.

4.1.6.3.1 Human resources

A special effort is necessary to endow the surgical ward with adequate personnel. Due to a lack of personnel, appendectomies could not even be realised anymore since the surgeon in charge has been posted to the district administration. Patients now have to be transferred to the regional hospital in Dédougou.

In SSA a system of so-called non-physician clinicians or clinical officers exists to compensate for the lack of physicians (Mullan and Frehywot 2007). Especially in rural areas, nurses receive additional training to cover traditionally medical responsibilities

as, for example, surgical interventions. Hounton et al. (2009) found out that clinical officers performing Caesarean sections in Burkina Faso had significantly higher newborn case fatality rates. They stated that currently the most cost-effective option for surgical interventions are general physicians with a six-month training in essential surgery. Nevertheless, physicians in SSA are not only scarce but also often absent and high turn-over rates are a problem, especially in little attractive rural areas. The implementation of new treatment strategies requests, however, specialised personnel, steady surveillance of support personnel and long-term planning. To give an example, local anaesthesia is an adequate option for hernia cure, but untrained personnel is more likely to produce insufficient repairs under local than under general anaesthesia (Kehlet and Aasvang 2005).

Hence, additional incentives should be given to physicians to work at rural district hospitals for longer periods of time in order to ensure health care on a basic level. Working in a district hospital can be a very interesting and satisfying task for a general physician as he generally has the possibility to follow the single patient from hospitalisation until discharge (Pearson 1995). From his own experience in Nigeria Pearson (1995) also describes the disadvantage of working in a rural district hospital: It is considered as "something of a dead end by those with any ambition." Rural district hospitals are often in little attractive surroundings for young academicians and their potential family. They are far away from the university for eventual scientific work and, above all, lacking possibilities for specialisation. To overcome this problem, Pearson (1995) suggests a structured postgraduate trainee program going alongside with financial incentives. Taking into account the cost of qualifying physicians in public universities, sound options have to be found to employ them in a more efficient way and to the benefit of the population in the long run.

4.1.6.3.2 Hernia cure

Compared to other research published, the length of stay for hernia cure is considerably longer in Nouna than elsewhere: Maggiore et al. (2001) found that in Cameroon patients stayed on average two days after a hernia cure done with Bassini technique and in Thailand patients' total length of stay was 2.5 days (Horharin, Wilasrusmee et al. 2006). Another option is the treatment of inguinal hernia as day cases, which is as common in developed as in developing countries (Callesen, Bech et al. 2001; Obalum, Eyesan et al. 2008).

Spinal anaesthesia was used most frequently within the considered sample, followed by general and local anaesthesia. With regard to total provider's cost local anaesthesia is the cheapest choice and also widely suggested in the literature for open hernia cure (Kehlet and Aasvang 2005; Nordin, Zetterstrom et al. 2007). It is even discussed whether local anaesthesia could be performed unmonitored that means without preoperative anaesthesia consultation, which would entail further savings (Callesen, Bech et al. 2001). Apart from economic aspects local anaesthesia is also the better choice for the patient with less possible complications, whilst especially spinal anaesthesia may lead to complications, for instance haematoma, urinary retention, haemodynamic instability, high spinal block or insufficiency and need of secondary general anaesthesia (Kehlet and Aasvang 2005).

The operation technique for hernia cure is also a subject of discussion. It is often argued that tension-free reparation with mesh implantation outstands Bassini technique with regard to length of hospital stay, recovery time and recurrence rate (Maggiore, Muller et al. 2001; Horharin, Wilasrusmee et al. 2006). A negative aspect is, however, the high cost for the mesh. The solution might be the utilisation of meshes made from Mosquito nets. In Burkina Faso these could be provided at provider's cost of US$ 0.0043 compared to industrial-made Ultrapro® meshes (Ethicon Products, Norderstedt, Germany) costing US$ 108 (2005 US$). The short-term clinical outcome was similar for both mesh options (Freudenberg, Sano et al. 2006). All the same, the implementation process of a new operation practise will be time- and resource-consuming and a well established operation method should not be quickly replaced. More research would be necessary considering the specific circumstances of Nouna district hospital to give a recommendation for ideal repair technique.

Antibiotic prophylaxis in the original sense is not common at Nouna district hospital. Patients undergoing hernia cure receive a full treatment with Ampicillin/Amoxicillin at provider cost of US$ 2.51. Although the setting might enhance wound infections, it could be shown in a comparable setting that antibiotic prophylaxis with one shot Ampicillin is adequate for hernia cure (Reggiori, Ravera et al. 1996). Cost would fall to US$ 0.75 for Ampicillin.

Combining all possible ameliorations, the patient undergoing an elective hernia cure could be treated as an outpatient. The intervention would be performed under local anaesthesia, neither requiring the normal set of laboratory tests nor a preoperative visit with the anaesthesia nurse. An adequate antibiotic prophylaxis would make full

antibiotic treatment avoidable. Total cost would then be reduced to US$ 106.90 instead of US$ 146.86 to US$ 169.78 considering the actual number of patients. User fees would account for US$ 50.07 instead of US$ 76.72 to US$ 91.53.

4.1.6.3.3 Caesarean section

Within the sample of Caesarean sections at Nouna district hospital the average length of stay was 10.8 days. From a research carried out in Antigua and Barbuda 6.42 days were reported for a Caesarean section under spinal anaesthesia and 6.86 days under general anaesthesia (Martin, Bell et al. 2007). In Uganda an average length of stay of 12.4 days was found which could be diminished to 7.8 days by replacing the general antibiotic treatment by perioperative prophylaxis (Reggiori, Ravera et al. 1996). In Ouagadougou, a cost-sharing programme gave initiatives to reorganize the complete hospital stay of patients undergoing a Caesarean section and succeeded to release women after four days of stay if no complication occurred (Richard, Ouedraogo et al. 2007).

At Nouna district hospital, general anaesthesia was used for the intervention in all cases but one. With regard to Caesarean sections the anaesthesia clinical officer complained about a lack of adequate drugs which inhibits a more frequent application of spinal anaesthesia. For Caesarean sections spinal anaesthesia is widely suggested (Dyer, Rout et al. 2004; Levy 2006) and less expensive to perform in Nouna district hospital. Efforts should be done to provide adequate drugs for adequate anaesthesias to save further money. Beyond economic advantages spinal anaesthesia goes along with lower blood loss, better general state of the child and earlier bonding between mother and child.

Patients undergoing a Caesarean section received a full treatment with Ampicillin/Amoxicillin and Metronidazole resulting in total provider's cost of US$ 6.25. Replacing the full antibiotic treatment at Nouna district hospital by an antibiotic prophylaxis of one shot of Ampicillin and Metronidazole (Reggiori, Ravera et al. 1996) would diminish the provider's cost to US$ 2.09 per patient.

Calculation of the eventual cost after the introduction of the suggested changes is difficult for Caesarean sections as complications, e.g. bleedings and infections, occur frequently. Anyhow, the propositions would certainly help to reduce total provider's cost as well as direct and indirect household cost.

4.1.7 Clinical pathways in a SSA district hospitals: Some specific impediments

It has to be admitted that the cost saving effect of CPs found in developing countries (Darer, Pronovost et al. 2002; Müller, Dedes et al. 2009) will not necessarily be obtained in a resource-poor setting. In developed countries CPs helped to limit, e.g. diagnostics and length of stay. The excessiveness of available investigations brought about the limitation of tests to those directly contributing to decision making. In developing countries, in contrast, rather too little than too many diagnostics are done due to financial constrains. Regarding the example of hypertension the actual treatment cannot be considered guideline conform. To achieve an acceptable, standardised treatment, further investigations and changes in drug administration will necessarily induce higher cost. Maybe, on the long run, this will be equilibrated by higher utilisation rates leading to lower fixed cost per patient and lower consequential cost. On the short run, however, increased provider's cost are unavoidable.

Furthermore, enhancing efficiency means to minimise idle and waiting time. The maximisation of the output mostly results in additional work for health care personnel and changes are difficult to implement and controversially discussed, even in developed countries. In developing countries acceptance might be even lower and realisation might only be possible under very strict surveillance, causing additional cost. Due to cultural differences in time management it is not even sure if patients would appreciate, for instance, shorter waiting times. It is however sure that from an economical point of view tightening up work time would allow treating more patients and diminishing cost.

Any change in care provision at the district hospital has furthermore to be compatible with care offered elsewhere. It is, for instance, not possible to offer hernia cure as a day case, if the nurses working in the rural health care centres are not prepared to survey these patients during the days following the intervention. Cost savings at Nouna district hospital from shifting duties, might cause additional cost elsewhere offsetting the considered savings. This would have to be investigated carefully.

Conclusively, it has to be admitted that CPs are not the ultimate solution for all problems recognised in Nouna district hospital. Low staff morale and corruption have to be combated as well to make treatment at the district hospital more attractive. Furthermore, the implementation process of CPs is highly time consuming and implies additional efforts from health personnel. It would therefore be highly recommendable to remunerate these efforts adequately.

4.2 Strengths and limitations

4.2.1 Strengths

The little cost information found on hospital treatment of specific diseases for SSA countries indicates the importance of this dissertation.

The bottom-up costing methodology simultaneously allowed the raising of performance data. In contrast to other costing methods it enabled to know what kind of treatment patients actually receive, to evaluate the length of stay, the diagnostic and therapy sequencing and to compare care giving to scientific evidence and guidelines.

Cost data was taken from a well-established long-term accounting system. Performance data was taken from patient files selected randomly from a one-year-period. Therefore, no seasonal bias should be expected. Inaccuracy as a result of faulty or incomplete patient files was anticipated and compensated by consulting personnel in charge and direct observation. In cases where practice at Nouna district hospital differed notably from recommendations in guidelines cost estimation was adjusted to the recommended care process to avoid underestimation.

4.2.2 Limitations

Data collection was sometimes difficult as health personnel were remarkably unsettled by the idea of a cost analysis meant to evaluate the efficiency of the hospital. Performance data analysis might therefore overestimate the staff productivity and, thus, underestimate total provider's cost.

Furthermore, documentation of cost and services provided might have been incomplete or faulty in some cases. Based on the documentation in patients' registries, reports are done by hand within the different wards. Hence, the quality depends on the motivation of the staff in charge.

With regard to the user fees, estimations along standard pathways are considerably higher than what was found when the hospital was analysed as a whole for the year of 2005. Several explanations are possible: Either many patients were exempted from user fees, user fees were not raised correctly or replaced by under the table payments or drugs, which make up for the highest share of revenues, were frequently purchased in private pharmacies. It was not possible to evaluate this in detail. Reality is probably a

melange of the different aspects, pointing out that apart from enhancing utilisation rates further research on user fee collection is recommendable.

4.3 Conclusion

The aim of this dissertation was to estimate provider's cost per patient for specific diseases at a rural district hospital in SSA as precisely as possible. Therefore, actual standard pathways were investigated and cost were allocated to the different services provided to the patient along these pathways. Consecutively, not only cost but also provided services were pictured. Hence, it was possible to evaluate not only the structure but also the process quality for the specific diseases.

Regarding the number of physicians, of clinical officers and nurses, the equipment and the buildings, Nouna district hospital has a rather good structure quality. This is mainly due to the tight relationship with the University of Heidelberg. Paucity exists mainly in two areas: Medical personnel at the surgery ward and provision of essential generic drugs at the hospital's pharmacy. With regard to the drugs, action is necessary within the hospital as most required drugs already exist in generic forms, but are not yet available at the hospital's pharmacy. The prescription of non-generic drugs should be an exception as their cost are mostly not affordable for the population. Notwithstanding the overall positive structural quality of the hospital, the utilisation rate is extremely low. Repeatedly, it was claimed that low utilisation rates at Nouna district hospital are due to low quality of care. To improve quality of care, the improvement of procedural quality and efficiency were considered adequate means. Within the hospital a feasible solution to change personnel behaviour might be the introduction of CPs based on national and international guidelines. Furthermore, budgeting should be decentralised and based on numbers of patients and case mix to give incentives for responsible management to physicians and staff nurses. Specific advice to improve care giving could be given for the considered diseases to improve resource allocation.

With regard to funding the hospital in its current configuration is definitely not able to break even. Nevertheless, patients contribute 35 to 94% to the total provider's cost. And cost-recovery would further rise to 63 to 117%, if the utilisation rate rose to 80%. It can, however, be assumed that high user fees and the fee-for-service-system contribute to low utilisation rates. A revised user fee system with lower fee levels and prefixed lump sums might therefore enhance utilisation rates.

The more time- and resource-consuming estimation of the cost of specific diseases permitted to compare care at Nouna district hospital with the cost for these diseases elsewhere. Compared to other settings provider's cost per patient were found to be similar or even lower and cost would further decrease by 20 to 46%, if the utilisation rate rose to 80%. It can be judged especially positively that surgical interventions are provided at quite reasonable cost. This evinces the qualification of Nouna district hospital to provide what was outlined as principal functions of a district hospital in SSA: Basic surgery at affordable cost within the reach of the population. This might even be taken as advocacy to enhance the position of district hospitals with surgery units in SSA in general.

As district hospitals are part of the public national health system not all shortcomings can be resolved within the hospital or the district administration. On regional and national level generic drug supply has to be improved, personnel drain from rural to urban parts has to be affronted and a more transparent user fee system should be envisaged.

Altogether this outlines that the chosen methodology enabled the evaluation of the resource allocation and the comparison with other settings for the specific diseases. Funding could be evaluated with regard to user fees and cost-recovery rates.

With regard to the COI investigation in Nouna health district this dissertation provides an insight of provider's cost for diseases which are highly relevant in the region. Data might be used in CEAs of alternative treatment strategies for the specific diseases.

Further research is necessary to evaluate if specific suggestions are feasible in Nouna district hospital, e.g. the operation of inguinal hernias as day cases. CPs cannot be developed in an office by literature review like, for instance, treatment guidelines. The effect and success of CPs rather depend on the involvement of the health personnel working with them and their specific surrounding.

Summary

District hospitals are the only solution to guarantee basic health care including life-saving surgeries and hospitalisations in rural SSA areas. Neither regional nor national hospitals, financially and geographically out of reach for the majority of the population, nor rural health care centres, mostly staffed with a nurse only, can cover these tasks adequately. However, only little research exists on care giving processes, cost and efficiency of district hospitals in SSA.

The general problem in health economics is that limited resources should be used in order to maximise health effects. This dissertation evaluates the actual treatment pathways and their average provider's cost per patient for four different diagnoses at Nouna district hospital in Burkina Faso. A total of 95 patient records was analysed in detail and discussed with the health personnel in charge. Cost information for the year 2005 was taken from the well-established provider cost information system. Cost were broken down to the different sequences of the treatment pathway and summed up at the end.

Average provider's cost for paediatric Malaria were U$ 6.71 for outpatients, US$ 60.59 for inpatients with anaemia and US$ 75.11 for inpatients with neurological affection. Average provider's cost for treating hypertension were US$ 67.94 per year. Average cost for hernia cure were US$ 146.85 under local anaesthesia, US$ 153.08 under spinal anaesthesia and US$ 169.78 under general anaesthesia. Average provider's cost for Caesarean sections were US$ 140.15 under spinal anaesthesia and US$ 180.41 under general anaesthesia. This means that cost per patient are comparable to or even lower than provider's cost found for other SSA setting in the literature. Cost would decrease between 20% (a hypertensive outpatient) and 46% for Malaria with neurological affection as complication, if utilisation rates rose from actually 20 to 80%.

Patients paid between 35 and 94% of total provider's cost in form of user fees. If fees would not change and the utilisation rate increased to 80%, cost-recovery for the considered diseases would then be between 63 and 117%. Although this would not allow the hospital to break even in its current configuration, the cost-recovery rate would be considerably higher, especially when taking into account that a full cost analysis was done including all investment cost.

The introduction of clinical pathways based on the actual treatment pathways is suggested to improve process structure and documentation and to standardise the treatment according to national and international guidelines.

Zusammenfassung

In ländlichen Gebieten Afrikas südlich der Sahara sind Distriktkrankenhäuser die einzige Möglichkeit eine Basisgesundheitsversorgung einschließlich lebensrettender Operationen und stationärer Behandlung zu gewährleisten. Regionale und nationale Krankenhäuser sind finanziell und geographisch für die Mehrheit der Bevölkerung unerreichbar und Dorfgesundheitszentren verfügen selten über die notwendige personelle und technische Ausstattung. Zum Prozess der Leistungserbringung, den Kosten und der Effizienz dieser Krankenhäuser gibt es allerdings wenig Literatur.

Die grundsätzliche Fragestellung ist, wie mit begrenzten Ressourcen ein Maximum an Gesundheitsleistungen erbracht werden kann. Diese Dissertation stellt die aktuellen Pfade der Patientenversorgung und ihre Kosten für vier Diagnosen im Distriktkrankenhaus von Nouna in Burkina Faso dar. Insgesamt wurden 95 Patientenakten analysiert und Interviews mit dem zuständigen Personal geführt. Die Angaben zu den Kosten für das Jahr 2005 wurden aus einem bereits etablierten Kostenerfassungssystem entnommen. Die Kosten wurden auf die einzelnen erbrachten Leistungen herunter gebrochen und entsprechend der auf dem jeweiligen klinischen Pfad erbrachten Leistungen addiert.

Dies ergab für den Leistungserbringer auf der pädiatrischen Station durchschnittliche Kosten von US$ 6.71 pro ambulantem Malariapatienten, US$ 60.59 pro stationärem Malariapatienten mit Anämie und US$ 75.11 pro stationärem Malariapatienten mit neurologischen Symptomen. Die ambulante Behandlung eines Patienten mit Hypertonie kostete den Leistungserbringer US$ 67.94 pro Jahr. Durchschnittliche Kosten für eine Hernien-OP einschließlich des stationären Aufenthalts betrugen US$ 146.85 unter Lokalanästhesie, US$ 153.08 unter Spinalanästhesie und US$ 169.78 in Vollnarkose. Die Kosten für einen Kaiserschnitt einschließlich des stationären Aufenthalts beliefen sich auf US$ 140.15 unter Spinalanästhesie und US$ 180.41 in Vollnarkose. Insgesamt sind die Kosten pro Patient mit den Angaben in der Literatur für entsprechende Regionen vergleichbar oder sogar niedriger. Die Kosten könnten um 20 bis 46% sinken, wenn das Krankenhaus statt zu aktuell 20 zu 80% ausgelastet wäre.

Die Patienten zahlten zwischen 35 und 94% der für den Leistungsbringer entstehenden Kosten. Bei einer Auslastung von 80% würden die Patienten einen Anteil von 63 bis 117% der Kosten tragen. Das heißt, das Krankenhaus könnte auch dann seine Kosten nicht vollständig decken.

Auf Basis der ermittelten Patientenpfade wird die Einführung von klinischen Patientenpfaden („Clinical pathways“) empfohlen um die Prozessqualität und die Dokumentation zu verbessern und die Behandlung gemäß nationaler und internationaler Leitlinien zu standardisieren.

References

Addo, J., L. Smeeth and D. A. Leon (2007). Hypertension in sub-saharan Africa: a systematic review. Hypertension 50(6): 1012-1018

Agyemang, C. (2006). Rural and urban differences in blood pressure and hypertension in Ghana, West Africa. Public Health 120(6): 525-533

Alberti, H., N. Boudriga and M. Nabli (2006). Disease-specific medical records improve the recording of processes of care in the management of type 2 diabetes mellitus. Public Health 120(7): 650-653

Amira, C. O. and N. U. Okubadejo (2006). Antihypertensive pharmacotherapy in a developing economy: pattern, acquisition costs and conformity to international guidelines in a tertiary-care setting. Journal of Human Hypertension 20(11): 894-897

Andaleeb, S. S. (2001). Service quality perceptions and patient satisfaction: a study of hospitals in a developing country. Social Science & Medicine 52(9): 1359-1370

Asadi, M. J. and W. A. Baltz (1997). Activity-based costing for clinical paths. An example to improve clinical cost & efficiency. Journal of the Society for Health Systems 5(2): 1-7

Ayieko, P., A. O. Akumu, U. K. Griffiths and M. English (2009). The economic burden of inpatient paediatric care in Kenya: household and provider costs for treatment of pneumonia, malaria and meningitis. Cost Effectiveness and Resource Allocation 7: 3

Baker, S., P. Priest and R. Jackson (2000). Using thresholds based on risk of cardiovascular disease to target treatment for hypertension: modelling events averted and number treated. BMJ (Clinical research ed.) 320(7236): 680-685

Baltussen, R. and L. Niessen (2006). Priority setting of health interventions: the need for multi-criteria decision analysis. Cost Effectiveness and Resource Allocation 4: 14

Baltussen, R. and Y. Ye (2006). Quality of care of modern health services as perceived by users and non-users in Burkina Faso. International Journal for Quality in Health Care 18(1): 30-34

Baltussen, R. M. P. M., Y. Yé, S. Haddad and R. S. Sauerborn (2002). Perceived quality of care of primary health care services in Burkina Faso. Health Policy and Planning 17(1): 42-48

Barker, D. J. (1997). Fetal nutrition and cardiovascular disease in later life. British Medical Bulletin 53(1): 96-108

Barnum, H. and J. Kutzin (1993). Public hospitals in developing countries. Resource use, cost, financing. Baltimore, Johns Hopkins Univ. Press

Bartram, J., K. Lewis, R. Lenton and A. Wright (2005). Focusing on improved water and sanitation for health. Lancet 365(9461): 810-812

Bauer, M., R. Hanss, A. Schleppers, M. Steinfath, P. H. Tonner and J. Martin (2004). Prozessoptimierung im „kranken Haus“ Anaesthesist 53(5): 414-426

Becher, H. and B. Kouyaté (2005). Health Research in Developing Countries: A collaboration between Burkina Faso and Germany. Berlin, Heidelberg, Springer-Verlag

Becher, H., G. Kynast-Wolf, A. Sie, R. Ndugwa, H. Ramroth, B. Kouyate and O. Muller (2008). Patterns of malaria: cause-specific and all-cause mortality in a malaria-endemic area of west Africa. American Journal of Tropical Medecine and Hygiene 78(1): 106-113

Beiersmann, C., A. Sanou, E. Wladarsch, M. De Allegri, B. Kouyate and O. Muller (2007). Malaria in rural Burkina Faso: local illness concepts, patterns of traditional treatment and influence on health-seeking behaviour. Malaria Journal 6: 106

Betran, A. P., M. Merialdi, J. A. Lauer, W. Bing-Shun, J. Thomas, P. Van Look and M. Wagner (2007). Rates of caesarean section: analysis of global, regional and national estimates. Paediatric and Perinatal Epidemiology 21(2): 98-113

Biai, S., A. Rodrigues, M. Gomes, I. Ribeiro, M. Sodemann, F. Alves and P. Aaby (2007). Reduced in-hospital mortality after improved management of children under 5 years admitted to hospital with malaria: randomised trial. BMJ (Clinical research ed.) 335(7625): 862

Bicaba, A., J. G. Ouédraogo, S. Ki and B. Zida (2003). Accès aux urgences chirurgicales et équité - Rapport final. Association Burkinabé de Santé Publique, Centre de Recherche pour le Développement International and Université de Montréal. Ouagadougou

Bikilla, A. D., D. Jerene, B. Robberstad and B. Lindtjorn (2009). Cost estimates of HIV care and treatment with and without anti-retroviral therapy at Arba Minch Hospital in southern Ethiopia. Cost Effectiveness and Resource Allocation 7: 6

Biritwum, R. B. (2001). Impact of health care financing reforms on the management of malaria in Ghana. East African Medical Journal 78(12): 636-640

Bodart, C., G. Servais, Y. L. Mohamed and B. Schmidt-Ehry (2001). The influence of health sector reform and external assistance in Burkina Faso. Health Policy and Planning 16(1): 74-86

Both, C. v., A. Jahn and S. Flessa (2008). Costing maternal health services in South Tanzania. A case study from Mtwara urban district. The European Journal of Health Economics 9(2): 103-115

Boutayeb, A. (2007). Developing countries and neglected diseases: challenges and perspectives. International Journal for Equity in Health 6: 20

Boutayeb, A. and S. Boutayeb (2005). The burden of non communicable diseases in developing countries. International Journal for Equity in Health 4(1): 2

Bovet, P., C. Shamlaye, A. Gabriel, W. Riesen and F. Paccaud (2006). Prevalence of cardiovascular risk factors in a middle-income country and estimated cost of a treatment strategy. BMC Public Health 6: 9

Breyer, F., M. Kifmann and P. Zweifel (2005a). Krankenhausleistungen. Gesundheitsökonomik. Berlin, Heidelberg, Springer-Verlag: 353-379

Breyer, F., M. Kifmann and P. Zweifel (2005b). Marktversagen von Gesundheitsgütern und ihre allokativen Konsequenzen. Gesundheitsökonomik. Berlin, Heidelberg, Springer-Verlag: 204-251

Burnham, G. M., G. Pariyo, E. Galiwango and F. Wabwire-Mangen (2004). Discontinuation of cost sharing in Uganda. Bulletin of the World Health Organization 82(3): 187-195

Callesen, T., K. Bech and H. Kehlet (2001). One-thousand consecutive inguinal hernia repairs under unmonitored local anesthesia. Anesthesia and Analgesia 93(6): 1373-1376

Campbell, H., R. Hotchkiss, N. Bradshaw and M. Porteous (1998). Integrated care pathways. BMJ (Clinical research ed.) 316(7125): 133-137

Cao, P., S.-I. Toyabe and K. Akazawa (2006a). Development of a practical costing method for hospitals. The Tohoku Journal of Experimental Medicine 208(3): 213-224

Cao, P., S. Toyabe, S. Kurashima, M. Okada and K. Akazawa (2006b). A modified method of activity-based costing for objectively reducing cost drivers in hospitals. Methods of Information in Medicine 45(4): 462-469

Cesta, T. G. and H. A. Tahan (2003). Introduction to Case Management. The case manager's survival guide : winning strategies for clinical practice, 2nd edition. St. Louis, Mosby: 1-14

Chapko, M. K., C. F. Liu, M. Perkins, Y. F. Li, J. C. Fortney and M. L. Maciejewski (2009). Equivalence of two healthcare costing methods: bottom-up and top-down. Health Economics 18(10): 1188-1201

CIA (2008). The World Factbook. Retrieved 04.12.2008, from https://www.cia.gov/library/publications/the-world-factbook/geos/uv.html

Clarke, M. G., C. Oppong, R. Simmermacher, K. Park, M. Kurzer, L. Vanotoo and A. N. Kingsnorth (2009). The use of sterilised polyester mosquito net mesh for inguinal hernia repair in Ghana. Hernia 13(2): 155-159

Clement Nee Shrive, F. M., W. A. Ghali, C. Donaldson and B. J. Manns (2009). The impact of using different costing methods on the results of an economic evaluation of cardiac care: microcosting vs gross-costing approaches. Health Economics 18(4): 377-388

Coffey, R. J., J. E. Othman and J. I. Walters (1995). Extending the application of critical path methods. Quality Management in Health Care 3(2): 14-29

Coleman, R., G. Gill and D. Wilkinson (1999). Noncommunicable disease management in resource-poor settings: a primary care model from rural South Africa. Bulletin of the World Health Organization 76(6): 633-640

Conteh, L. and D. Walker (2004). Cost and unit cost calculations using step-down accounting. Health Policy and Planning 19(2): 127-135

Darer, J., P. Pronovost and E. B. Bass (2002). Use and evaluation of critical pathways in hospitals. Effective Clinical Practice 5(3): 114-119

De Allegri, M. (2006). Why do people choose to enrol or not to enrol in community health insurance? The case of the Nouna Health District, Burkina Faso. (Thesis). Heidelberg

De Allegri, M., M. Sanon, J. Bridges and R. Sauerborn (2006). Understanding consumers' preferences and decision to enrol in community-based health insurance in rural West Africa. Health Policy 76(1): 58-71

Debas, H. T., R. Gosselin, C. McCord and A. Thind (2006). Surgery. Disease Control Priorities in Developing Countries (2nd Edition). D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, P. Jha, A. Mills and P. Musgrove. New York Oxford University Press: 1245-1260

Djadou, K.-E., A. Komlangan, B. Balaka, D. Dokounor, A.-D. Gbadoé, D. Atakouma, A.-D. Agbèrè, K. Kessié and K. Assimadi (2006). Prise en charge du paludisme grave de l'enfant au centre hospitalier régional de Tsévié (Togo). Archives de Pédiatrie 13(12): 1555-1556

Donabedian, A. (1966). Evaluating the quality of medical care. Milbank Memorial Fund quarterly 44(3,2): 166-203

Dong, H., A. Gbangou, M. De Allegri, S. Pokhrel and R. Sauerborn (2008). The differences in characteristics between health-care users and non-users: implication for introducing community-based health insurance in Burkina Faso. The European Journal of Health Economics 9(1): 41-50

Dong, H., B. Kouyate, J. Cairns and R. Sauerborn (2004). Differential willingness of household heads to pay community-based health insurance premia for themselves and other household members. Health Policy and Planning 19(2): 120-126

Dong, H., F. Mugisha, A. Gbangou, B. Kouyate and R. Sauerborn (2004). The feasibility of community-based health insurance in Burkina Faso. Health Policy 69(1): 45-53

Drummond, M. F., M. J. Sculpher, G. W. Torrance, B. J. O'Brien and G. L. Stoddart (2005). Methods for the economic evaluation of health care programmes, 3rd edition. Oxford, Oxford Univ. Press

Dy, S. M., P. Garg, D. Nyberg, P. B. Dawson, P. J. Pronovost, L. Morlock, H. Rubin and A. W. Wu (2005). Critical pathway effectiveness: assessing the impact of patient, hospital care, and pathway characteristics using qualitative comparative analysis. Health Services Research 40(2): 499-516

Dyer, R. A., C. C. Rout, A. M. Kruger, M. van der Vyver, G. Lamacraft and M. F. James (2004). Prevention and treatment of cardiovascular instability during spinal anaesthesia for caesarean section. South African Medical Journal 94(5): 367-372

Edwards, P. R., D. W. Lunt, G. S. Fehrsen, C. J. Lombard and K. Steyn (1998). Improving cost-effectiveness of hypertension management at a community health centre. South African Medical Journal 88(5): 549-554

English, M., C. F. Lanata, I. Ngugi, and and P. C. Smith (2006). The District Hospital. Disease Control Priorities in Developing Countries (2nd Edition) D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, P. Jha, A. Mills and P. Musgrove. New York, Oxford University Press: 1211-1228

Evans, D. B., T. Adam, T. T. Edejer, S. S. Lim, A. Cassels and T. G. Evans (2005). Time to reassess strategies for improving health in developing countries. BMJ (Clinical research ed.) 331(7525): 1133-1136

Evans, D. B., T. T. Edejer, T. Adam and S. S. Lim (2005). Methods to assess the costs and health effects of interventions for improving health in developing countries. BMJ (Clinical research ed.) 331(7525): 1137-1140

Faye, O., O. N'Dao, B. Camara, M. Soumare, T. Dieng, I. B. Bah, Y. Dieng, O. Gaye, O. N'Dir and S. Diallo (2000). Prise en charge du paludisme grave de l'enfant dans un pays en développement: élaboration d'un protocole d'évaluation médico-économique. Médecine tropicale 59(3): 283-286

Flessa, S. (1998). The costs of hospital services: a case study of Evangelical Lutheran Church hospitals in Tanzania. Health Policy and Planning 13(4): 397-407

Flessa, S. (2007). Instrumente. Gesundheitsökonomik. Eine Einführung in das wirtschaftliche Denken für Mediziner. Berlin, Heidelberg, Springer-Verlag: 157-191

Flessa, S. (2009a). Costing a Health District in Burkina Faso. Costing of health care services in developing countries. A prerequisite for affordability, sustainability and efficiency. Frankfurt am Main, Lang: 75-91

Flessa, S. (2009b). Health Economic Framework. Costing of health care services in developing countries. A prerequisite for affordability, sustainability and efficiency. Frankfurt am Main, Lang: 17-27

Flessa, S. and N. T. Dung (2004). Costing of services of Vietnamese hospitals: identifying costs in one central, two provincial and two district hospitals using a standard methodology. The International Journal of Health Planning and Management 19(1): 63-77

Flessa, S. and B. Kouyaté (2006). Implementing a comprehensive cost information system in rural health facilities: the case of Nouna health district, Burkina Faso. Tropical Medicine & International Health 11(9): 1452-1465

Franco, L. M., C. Franco, N. Kumwenda and W. Nkhoma (2003). Methods for assessing quality of provider performance in developing countries. International Journal for Quality in Health Care 14(Suppl 1): 17-24

Freudenberg, S., D. Sano, E. Ouangre, C. Weiss and T. J. Wilhelm (2006). Commercial mesh versus Nylon mosquito net for hernia repair. A randomized double-blind study in Burkina Faso. World Journal of Surgery 30(10): 1784-90

Gaziano, T. A., C. R. Young, G. Fitzmaurice, S. Atwood and J. M. Gaziano (2008). Laboratory-based versus non-laboratory-based method for assessment of cardiovascular disease risk: the NHANES I Follow-up Study cohort. Lancet 371(9616): 923-931

Ghaffari, S., C. Doran, A. Wilson, C. Aisbett and T. Jackson (2008). Investigating DRG cost weights for hospitals in low resource countries: an Iranian example. The International Journal of Health Planning and Management 24(3): 251-264

Gnawali, D. P., S. Pokhrel, A. Sie, M. Sanon, M. De Allegri, A. Souares, H. Dong and R. Sauerborn (2009). The effect of community-based health insurance on the utilization of modern health care services: Evidence from Burkina Faso. Health Policy 90(2-3): 214-22

Görgen, H. and B. Schmidt-Ehry (2004). The concept of the District Health System (DHS). The district health system. Experiences and prospects in Africa. Manual for public health practitioners. H. Görgen, T. Kirsch-Woik and B. Schmidt-Ehry. Eschborn, GTZ: 27-50

Gosselin, R. A., A. Thind and A. Bellardinelli (2006). Cost/DALY averted in a small hospital in Sierra Leone: what is the relative contribution of different services? World Journal of Surgery 30(4): 505-511

Guinness, L., G. Arthur, S. M. Bhatt, G. Achiya, S. Kariuki and C. F. Gilks (2002). Costs of hospital care for HIV-positive and HIV-negative patients at Kenyatta National Hospital, Nairobi, Kenya. AIDS 16(6): 901-908

Hammer, G. P., F. Somé, O. Müller, G. Kynast-Wolf, B. Kouyaté and H. Becher (2006). Pattern of cause-specific childhood mortality in a malaria endemic area of Burkina Faso. Malaria Journal 5: 47

Hansen, K., G. Chapman, I. Chitsike, O. Kasilo and G. Mwaluko (2001). The costs of HIV/AIDS care at government hospitals in Zimbabwe. Health Policy and Planning 15(4): 432-440

Hentze, J. and E. Kehres (2008). Grundlagen der Kosten- und Leistungsrechnung im Krankenhaus. Kosten- und Leistungsrechnung in Krankenhäusern. Systematische Einführung. Stuttgart, Kohlhammer: 21-42

Horharin, P., C. Wilasrusmee, K. Cherudchayaporn, N. Pinyaku, O. Phanpradi and N. Phromsopha (2006). Comparative study of tailor-made mesh plug herniorrhaphy versus Lichtenstein herniorrhaphy versus Bassini operation: a prospective clinical trial. Asian Journal of Surgery 29(2): 74-78

Hounton, S. H., D. Newlands, N. Meda and V. De Brouwere (2009). A cost-effectiveness study of caesarean-section deliveries by clinical officers, general practitioners and obstetricians in Burkina Faso. Human Resources of Health 7: 34

Hume, J. C., G. Barnish, T. Mangal, L. Armazio, E. Streat and I. Bates (2008). Household cost of malaria overdiagnosis in rural Mozambique. Malaria Journal 7: 33

Hussain, H., H. Waters, S. B. Omer, A. Khan, I. Y. Baig, R. Mistry and N. Halsey (2006). The cost of treatment for child pneumonias and meningitis in the Northern Areas of Pakistan. The International Journal of Health Planning and Management 21(3): 229-238

Hutubessy, R., D. Chisholm and T. T. Edejer (2003). Generalized cost-effectiveness analysis for national-level priority-setting in the health sector. Cost Effectiveness and Resource Allocation 1(1): 8

IMF (2009). World Economic Outlook Database. Retrieved 30.03.2010, from http://www.imf.org/external/pubs/ft/weo/2009/01/weodata/index.aspx

Jamison, D. T. and W. H. Mosley (1991). Disease control priorities in developing countries: health policy responses to epidemiological change. American Journal of Public Health 81(1): 15-22

Jegers, M., K. Kesteloot, D. De Graeve and W. Gilles (2002). A typology for provider payment systems in health care. Health Policy 60(3): 255-273

Jha, P., O. Bangoura and K. Ranson (1998). The cost-effectiveness of forty health interventions in Guinea. Health Policy and Planning 13(3): 249-262

Kehlet, H. and E. Aasvang (2005). Groin hernia repair: anesthesia. World Journal of Surgery 29(8): 1058-1061

Kingsnorth, A. N., M. G. Clarke and S. D. Shillcutt (2009). Public Health and Policy Issues of Hernia Surgery in Africa. World Journal of Surgery 33(6): 1188-1193

Kirigia, J. M., R. W. Snow, J. Fox-Rushby and A. Mills (1998). The cost of treating paediatric malaria admissions and the potential impact of insecticide-treated mosquito nets on hospital expenditure. Tropical Medicine & International Health 3(2): 145-150

Kitajima, T., Y. Kobayashi, W. Chaipah, H. Sato, W. Chadbunchachai and R. Thuennadee (2003). Costs of medical services for patients with HIV/AIDS in Khon Kaen, Thailand. AIDS 17(16): 2375-2381

Konin, C., A. Ekra, A. Adoh, L. Kohou, A. Avodagbe, T. Niamkey and J. N'Djessan (2007). Évaluation du coût du traitement curatif de l'infarctus du myocarde à l'Institut de cardiologie d'Abidjan (ICA), Côte d'Ivoire. Bulletin de la Société de la pathologie exotique 100(3): 201-204

Kothe-Zimmermann, H. (2006a). Prozesskostenrechnung als Kostenträgerplanrechnung. Prozesskostenrechnung und Prozessoptimierung im Krankenhaus. Eine Praxisanleitung in sieben Schritten. Stuttgart, Kohlhammer: 61-68

Kothe-Zimmermann, H. (2006b). Prozesskostenrechnung als Mittel des Qualitätsmanagements. Prozesskostenrechnung und Prozessoptimierung im Krankenhaus. Eine Praxisanleitung in sieben Schritten. Stuttgart, Kohlhammer: 69-80

Kouyate, B., A. Sie, M. Ye, M. De Allegri and O. Muller (2007). The great failure of malaria control in Africa: a district perspective from Burkina Faso. PLoS Med 4(6): e127

Krause, G. and R. Sauerborn (2000). Comprehensive community effectiveness of health care. A study of malaria treatment in children and adults in rural Burkina Faso. Annals of Tropical Paediatrics 20(4): 273-282

Krause, G., D. Schleiermacher, M. Borchert, J. Benzler, R. Heinmuller, K. Ouattara, S. Coulibaly, I. Diasso, A. Ilboudo and H. J. Diesfeld (1998). Diagnostic quality in rural health centres in Burkina Faso. Tropical Medicine & International Health 3(2): 100-107

Krishnan, A., N. K. Arora, C. S. Pandav and S. K. Kapoor (2005). Cost of curative pediatric services in a public sector setting. Indian Journal of Pediatrics 72(8): 657-660

Krug, A., R. C. Pattinson and D. J. Power (2004). Why children die: an under-5 health care survey in Mafikeng region. South African Medical Journal 94(3): 202-206

Kuller, L. H. (2007). Epidemic hypertension in Sub-Saharan Africa. Hypertension 50(6): 1004-1005

Laing, R., H. Hogerzeil and D. Ross-Degnan (2001). Ten recommendations to improve use of medicines in developing countries. Health Policy and Planning 16(1): 13-20

Lancet (1985). Appropriate technology for birth. 2(8452): 436-437

Lara, A. M., J. Kandulu, L. Chisuwo, A. Kashoti, C. Mundy and I. Bates (2007). Laboratory costs of a hospital-based blood transfusion service in Malawi. Journal of Clinical Pathology 60(10): 1117-1120

Lave, J. R. and L. B. Lave (1984). Hospital cost functions. Annual Review of Public Health 5: 193-213

Laxminarayan, R., A. J. Mills, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, P. Jha, P. Musgrove, J. Chow, S. Shahid-Salles and D. T. Jamison (2006). Advancement of global health: key messages from the Disease Control Priorities Project. Lancet 367(9517): 1193-1208

Lemogoum, D., Y. K. Seedat, A. F. Mabadeje, S. Mendis, P. Bovet, B. Onwubere, K. N. Blackett, C. Lenfant, J. R. Kabangu, P. Block, M. Belhocine and J. P. Degaute (2003). Recommendations for prevention, diagnosis and management of hypertension and cardiovascular risk factors in sub-Saharan Africa. Journal of Human Hypertension 21(11): 1993-2000

Levy, D. M. (2006). Emergency Caesarean section: best practice. Anaesthesia 61(8): 786-791

Lewis, M. A., G. M. La Forgia and M. B. Sulvetta (1996). Measuring public hospital costs: empirical evidence from the Dominican Republic. Socical Science & Medicine 43(2): 221-234

Lin, B. Y.-J., T.-H. Chao, Y. Yao, S.-M. Tu, C.-C. Wu, J.-Y. Chern, S.-H. Chao and K.-Y. Shaw (2007). How can activity-based costing methodology be performed as a powerful tool to calculate costs and secure appropriate patient care? Journal of Medical Systems 31(2): 85-90

Lohfert, C. and P. Kalmar (2006). Behandlungspfade : Erfahrungen, Erwartungen, Perspektiven. Internist (Berl) 47(7): 676, 678-683

Lopez, A. D., C. D. Mathers, M. Ezzati, D. T. Jamison and C. J. L. Murray (2006). Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. Lancet 367(9524): 1747-1757

Mackay, J. and G. Mensah (2004). Part 6: World Data Tables. Atlas of Heart Disease and Stroke. WHO. Geneva: 84-91

Maggiore, D., G. Muller and J. Hafanaki (2001). Bassini vs Lichtenstein: two basic techniques for inguinal hernia treatment. Hernia 5(1): 21-24

Makinen, M., H. Waters, M. Rauch, N. Almagambetova, R. Bitran, L. Gilson, D. McIntyre, S. Pannarunothai, A. L. Prieto, G. Ubilla and S. Ram (2000). Inequalities in health care use and expenditures: empirical data from eight developing countries and countries in transition. Bulletin of the World Health Organization 78(1): 55-65

Malalasekera, A. P., M. H. Ariyaratne, R. Fernando, D. Perera and K. I. Deen (2004). Cost accounting in a surgical unit in a teaching hospital--a pilot study. The Ceylon Medical Journal 48(3): 71-74

Mariko, M. (2003). Quality of care and the demand for health services in Bamako, Mali: the specific roles of structural, process, and outcome components. Social Science & Medicine 56(6): 1183-1196

Marschall, P. and S. Flessa (2008). Expanding access to primary care without additional budgets? A case study from Burkina Faso. The European Journal of Health Economics 9(4): 393-403

Marschall, P. and S. Flessa (2009). Assessing the efficiency of rural health centres in Burkina Faso: an application of Data Envelopment Analysis. Journal of Public Health 17(2): 87-95

Martin, T. C., P. Bell and O. Ogunbiyi (2007). Comparison of general anaesthesia and spinal anaesthesia for caesarean section in Antigua and Barbuda. The West Indian Medical Journal 56(4): 330-333

Mayer, E. K., A. Chow, J. A. Vale and T. Athanasiou (2009). Appraising the Quality of Care in Surgery. World Journal of Surgery 33(8): 1584-1593

Mbah, N. (2007). Morbidity and mortality associated with inguinal hernia in Northwestern Nigeria. West African Journal of Medicine 26(4): 288-292

McCord, C. and Q. Chowdhury (2003). A cost effective small hospital in Bangladesh: what it can mean for emergency obstetric care. Int Journal of Gynaecology and Obstetrics 81(1): 83-92

McMichael, C., E. Waters and J. Volmink (2005). Evidence-based public health: what does it offer developing countries? Journal of Public Health 27(2): 215-221

McPake, B., K. Hanson and A. Mills (1993). Community financing of health care in Africa: an evaluation of the Bamako initiative. Social Science & Medicine 36(11): 1383-1395

Mensah, G. A. (2008). Ischaemic heart disease in Africa. Heart 94(7): 836-843

Meremikwu, M., U. Okomo, C. Nwachukwu, A. Oyo-Ita, J. Eke-Njoku, J. Okebe, E. Oyo-Ita and P. Garner (2007). Antimalarial drug prescribing practice in private and public health facilities in South-east Nigeria: a descriptive study. Malaria Journal 6: 55

Metschies, G. P. (2007). International Fuel Prices 2007. GTZ. Eschborn

Meuwissen, L. E. (2002). Problems of cost recovery implementation in district health care: a case study from Niger. Health Policy and Planning 17(3): 304-313

Mills, A. (1990a). The economics of hospitals in developing countries. Part I: expenditure patterns. Health Policy and Planning 5(2): 107-117

Mills, A. (1990b). The economics of hospitals in developing countries. Part II. costs and sources of income. Health Policy and Planning 5(3): 203-218

Mills, A. J., J. Kapalamula and S. Chisimbi (1993). The cost of the district hospital: a case study in Malawi. Bulletin of the World Health Organization 71(3-4): 329-339

Minh, H. V., K. B. Giang, D. L. Huong, L. T. Huong, N. T. Huong, P. N. Giang, L. N. Hoat and P. Wright (2009). Costing of clinical services in rural district hospitals in northern Vietnam. The International Journal of Health Planning and Management 25(1): 63-73

Ministère de la Santé (2000). Document de politique sanitaire. Ougadougou, Ministère de la Santé du Burkina Faso

Ministère de la Santé (2006a). Annuaire statistique - Santé 2005. Ouagadougou, Ministère de la Santé du Burkina Faso

Ministère de la Santé (2006b). Construction des comptes nationaux de la santé pour 2004: Additif au rapport sûr les travaux effectués de mai à novembre 2005. Ouagadougou, Ministère de la Santé du Burkina Faso

Ministère de la Santé (2006c). Directives nationales pour la prise en charge du paludisme au Burkina Faso. Ouagadougou, Ministère de la Santé du Burkina Faso

Ministère de la Santé (2007). Analyse de resultats du recensement de etablissements privés de soins. Ouagadougou, Ministère de la Santé du Burkina Faso

Ministère de la Santé (2008). Annuaire statistique - Santé 2007. Ougadougou, Ministère de la Santé du Burkina Faso

Ministère de la Santé and Banque mondiale (2005). Construction des Comptes Nationaux de la Santé pour 2003. Ouagadougou, Ministère de la Santé du Burkina Faso/Banque mondiale

MSH and WHO (2008). International Drug Price Indicator Guide. Retrieved 30.03.2010, from http://erc.msh.org/mainpage.cfm?file=1.0.htm&module=DMP&language=english

Mugisha, F., B. Kouyaté, H. Dong, G. Chepng'eno and R. Sauerborn (2004). The two faces of enhancing utilization of health-care services: determinants of patient initiation and retention in rural Burkina Faso. Bulletin of the World Health Organization 82(8): 572-579

Mugisha, F., B. Kouyaté, H. Dong and R. Sauerborn (2002a). Costing health care interventions at primary health facilities in Nouna, Burkina Faso. African Journal of Health Sciences 9(1-2): 69-79

Mugisha, F., B. Kouyaté, A. Gbangou and R. Sauerborn (2002b). Examining out-of-pocket expenditure on health care in Nouna, Burkina Faso: implications for health policy. Tropical Medicine & International Health 7(2): 187-196

Mullan, F. and S. Frehywot (2007). Non-physician clinicians in 47 sub-Saharan African countries. Lancet 370(9605): 2158-2163

Müller, H. P., K. Schmid and D. Conen (2001). Qualitätsmanagement: Interne Leitlinien und Patientenpfade. Medizinische Klinik 96(11): 692-697

Müller, M. K., K. J. Dedes, D. Dindo, S. Steiner, D. Hahnloser and P. A. Clavien (2009). Impact of clinical pathways in surgery. Langenbeck's Archives of Surgery 394(1): 31-9

Mulligan, J. A., D. Walker and J. Fox-Rushby (2006). Economic evaluations of non-communicable disease interventions in developing countries: a critical review of the evidence base. Cost Effectiveness and Resource Allocation 4: 7

Mundy, C. J. F., I. Bates, W. Nkhoma, K. Floyd, G. Kadewele, M. Ngwira, A. Khuwi, S. B. Squire and C. F. Gilks (2004). The operation, quality and costs of a district hospital laboratory service in Malawi. Transactions of the Royal Society of Tropical Medicine and Hygiene 97(4): 403-408

Muralikrishnan, R., R. Venkatesh, N. V. Prajna and K. D. Frick (2004). Economic cost of cataract surgery procedures in an established eye care centre in Southern India. Ophthalmic Epidemiology 11(5): 369-380

Murray, C. J., D. B. Evans, A. Acharya and R. M. Baltussen (2000). Development of WHO guidelines on generalized cost-effectiveness analysis. Health Economics 9(3): 235-251

Murru, M., B. Corrado, J. Odaga, A. Denis, A. Ernesta, B. Alessandro, B. Emmanuel, K. David, M. Henry, N. Angela and N. Kalire (2003). Costing health services in Lacor hospital. Health Policy and Development 1(1): 61-68

Nabyonga, J., M. Desmet, H. Karamagi, P. Y. Kadama, F. G. Omaswa and O. Walker (2005). Abolition of cost-sharing is pro-poor: evidence from Uganda. Health Policy and Planning 20(2): 100-108

Nordberg, E. M. (1984). Incidence and estimated need of caesarean section, inguinal hernia repair, and operation for strangulated hernia in rural Africa. British Medical Journal 289(6437): 92-93

Nordin, P., H. Zetterstrom, P. Carlsson and E. Nilsson (2007). Cost-effectiveness analysis of local, regional and general anaesthesia for inguinal hernia repair using data from a randomized clinical trial. The British Journal of Surgery 94(4): 500-505

Obalum, D. C., S. U. Eyesan, C. N. Ogo and O. A. Atoyebi (2008). Day-case surgery for inguinal hernia: a multi-specialist private hospital experience in Nigeria. Nigerian Quarterly Journal of Hospital Medicine 18(1): 42-44

Ohene Buabeng, K., L. Matowe and J. Plange-Rhule (2004). Unaffordable drug prices: the major cause of non-compliance with hypertension medication in Ghana. Journal of Pharmacy & Pharmaceutical Sciences 7(3): 350-352

Olukoga, A. (2007). Unit costs of inpatient days in district hospitals in South Africa. Singapore Medical Journal 48(2): 143-147

Ouédraogo, C., F. Richard, J. Compaoré, C. Wissocq, D. Poble, F. Ouattara, M.-E. Gruénais and V. DeBrouwere (2008). Partage des coûts pour les urgences obstétricales dans le district sanitaire du secteur 30, Ouagadougou, Burkina Faso. Réduire les barrières financières aux soins obstétricaux dans les pays à faibles ressources W. Van Lerberghe, G. Kegels and V. De Brouwere. Antwerp, Studies in Health Services Organisation & Policy. 25: 55-89

Ozgediz, D. and R. Riviello (2008). The "other" neglected diseases in global public health: surgical conditions in sub-Saharan Africa. PLoS Med 5(6): e121

Pearson, C. A. (1995). The role of district hospitals and the action in international medicine network. Infectious Disease Clinics of North America 9(2): 391-405

Pearson, S. D., D. Goulart-Fisher and T. H. Lee (1995). Critical pathways as a strategy for improving care: problems and potential. Annals of Internal Medicine 123(12): 941-948

Penn, Z. and S. Ghaem-Maghami (2001). Indications for caesarean section. Best Practice & Research: Clinical Obstetrics & Gynaecology 15(1): 1-15

Pereira, J. A., A. M. Holbrook, L. Dolovich, C. Goldsmith, L. Thabane, J. D. Douketis, M. Crowther, S. M. Bates and J. S. Ginsberg (2005). Are brand-name and generic warfarin interchangeable? A survey of Ontario patients and physicians. The Canadian Journal of Clinical Pharmacology 12(3): e229-39

Perez-Cuevas, R., W. Fraser, H. Reyes, D. Reinharz, A. Daftari, C. S. Heinz and J. M. Roberts (2003). Critical pathways for the management of preeclampsia and severe preeclampsia in institutionalised health care settings. BMC Pregnancy Childbirth 3(1): 6

Pschyrembel, W. and O. Dornblüth (2004). Pschyrembel Klinisches Wörterbuch. Klinisches Wörterbuch. Berlin, de Gruyter: 1639

Rayner, B., M. Blockman, D. Baines and Y. Trinder (2007). A survey of hypertensive practices at two community health centres in Cape Town. South African Medical Journal 97(4): 280-284

Reggiori, A., M. Ravera, E. Cocozza, M. Andreata and F. Mukasa (1996). Randomized study of antibiotic prophylaxis for general and gynaecological surgery from a single centre in rural Africa. The British Journal of Surgery 83(3): 356-359

Richard, F., C. Ouedraogo, J. Compaore, D. Dubourg and V. De Brouwere (2007). Reducing financial barriers to emergency obstetric care: experience of cost-sharing mechanism in a district hospital in Burkina Faso. Tropical Medicine & International Health 12(8): 972-981

Ridde, V. (2008). "The problem of the worst-off is dealt with after all other issues": the equity and health policy implementation gap in Burkina Faso. Social Science & Medicine 66(6): 1368-1378

Sachs, J. and P. Malaney (2002). The economic and social burden of malaria. Nature 415(6872): 680-685

Sanders, D. L., C. S. Porter, K. C. Mitchell and A. N. Kingsnorth (2008). A prospective cohort study comparing the African and European hernia. Hernia 12(5): 527-529

Savadogo, L. G., B. Sondo, I. P. Guissou, S. Kouanda and B. Dujardin (2002). Utilisation des médicaments essentiels génériques par le personnel hospitalier : le cas du CHU Yalgado Ouédraogo (Burkina Faso). Santé 12(2): 257-62

Schneider, G. (2001). Oxygen supply in rural africa: a personal experience. The International Journal of Tuberculosis and Lung Disease 5(6): 524-526

Shepard, D. S., D. Hodgkin and Y. E. Anthony (2000). Analysis of hospital costs: A manual for managers. WHO. Geneva

Statistisches Bundesamt Deutschland (2009). Gesundheitsberichtserstattung des Bundes - Rahmenbedingungen. Retrieved 30.03.2010, from http://www.gbe-bund.de

Steyn, K., K. Sliwa, S. Hawken, P. Commerford, C. Onen, A. Damasceno, S. Ounpuu and S. Yusuf (2005). Risk factors associated with myocardial infarction in Africa: the INTERHEART Africa study. Circulation 112(23): 3554-3561

Storeng, K. T., R. F. Baggaley, R. Ganaba, F. Ouattara, M. S. Akoum and V. Filippi (2008). Paying the price: the cost and consequences of emergency obstetric care in Burkina Faso. Social Science & Medicine 66(3): 545-557

Su, T. T. (2005). Household Cost-of-illness study in the Nouna health district, Burkina Faso (Thesis). Heidelberg

Su, T. T., B. Kouyaté and S. Flessa (2006). Catastrophic household expenditure for health care in a low-income society: a study from Nouna District, Burkina Faso. Bulletin of the World Health Organization 84(1): 21-27

Su, T. T., S. Pokhrel, A. Gbangou and S. Flessa (2006). Determinants of household health expenditure on western institutional health care. The European Journal of Health Economics 7(3): 199-207

Tan, S. S., F. F. Rutten, B. M. van Ineveld, W. K. Redekop and L. Hakkaart-van Roijen (2009). Comparing methodologies for the cost estimation of hospital services. The European Journal of Health Economics 10(1): 39-45

Tan, S. S., B. M. van Ineveld, W. K. Redekop and L. Hakkaart-van Roijen (2009). Comparing methodologies for the allocation of overhead and capital costs to hospital services. Value in health: The journal of the International Society for Pharmacoeconomics and Outcomes Research 12(4): 530-535

Tarricone, R. (2006). Cost-of-illness analysis. What room in health economics? Health Policy 77(1): 51-63

Tediosi, F., N. Maire, T. Smith, G. Hutton, J. Utzinger, A. Ross and M. Tanner (2006). An approach to model the costs and effects of case management of Plasmodium falciparum malaria in sub-saharan Africa. American Journal of Tropical Medecine and Hygiene 75(2 Suppl): 90-103

Terris-Prestholt, F., S. Vyas, L. Kumaranayake, P. Mayaud and C. Watts (2006). The costs of treating curable sexually transmitted infections in low- and middle-income countries: a systematic review. Sexually Transmitted Diseases 33(10 Suppl): S153-166

Udpa, S. (1996). Activity-based costing for hospitals. Health Care Management Review 21(3): 83-96

Ukwandu, N. C. and O. P. Nmorsi (2004). The perception, beliefs and practices toward genitourinary schistosomiasis by inhabitants of selected endemic areas (Edo/Delta States) in south-eastern Nigeria. Revista do Instituto de Medicina Tropical de Sao Paulo 46(4): 209-216

UN (1948). Allgemeine Erklärung der Menschenrechte. UN-Generalversammlung. Retrieved 18.07.2009, from http://www.ohchr.org/EN/UDHR/Pages/Language.aspx?LangID=ger

UNDP (2007). Fighting climate change: human solidarity in a divided world. Human development report 2007. Houndmills, Palgrave Macmillan

Unwin, N., P. Setel, S. Rashid, F. Mugusi, J. C. Mbanya, H. Kitange, L. Hayes, R. Edwards, T. Aspray and K. G. Alberti (2001). Noncommunicable diseases in sub-Saharan Africa: where do they feature in the health research agenda? Bulletin of the World Health Organization 79(10): 947-953

van der Sande, M. A., R. L. Coleman, M. F. Schim van der Loeff, K. P. McAdam, O. A. Nyan, T. Thien, W. M. Dolmans and G. E. Walraven (2001). A template for improved prevention and control of cardiovascular disease in sub-Saharan Africa. Health Policy and Planning 16(4): 345-350

Van Lerberghe, W., X. de Bethune and V. De Brouwere (1997). Hospitals in sub-Saharan Africa: why we need more of what does not work as it should. Tropical Medicine & International Health 2(8): 799-808

Vander Plaetse, B., G. Hlatiwayo, L. Van Eygen, B. Meessen and B. Criel (2005). Costs and revenue of health care in a rural Zimbabwean district. Health Policy and Planning 20(4): 243-251

Vian, T. (2008). Review of corruption in the health sector: theory, methods and interventions. Health Policy and Planning 23(2): 83-94

Waters, H., H. Abdallah and D. Santillán (2001). Application of activity-based costing (ABC) for a Peruvian NGO healthcare provider. The International Journal of Health Planning and Management 16(1): 3-18

Whitehead, M. (1990). The concepts and principles of equity in health. WHO Regional Office for Europe. Copenhagen

Whitworth, J. A. (2003). 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. Journal of Hypertension 21(11): 1983-1992

WHO (1978). Declaration of Alma-Ata. International Conference of Primary Health Care, Alma-Ata, USSR, 6-12 September 1978

WHO (1999). 1999 World Health Organization-International Society of Hypertension Guidelines for the Management of Hypertension. Guidelines Subcommittee. Journal of Hypertension 17(2): 151-183

WHO (2002). WHO CVD - Risk Management Package for low- and medium resource settings. Geneva

WHO (2003). WHO Model List of Essential Medicines. 13th edition. Retrieved 30.03.2010, from http://whqlibdoc.who.int/hq/2003/a80290.pdf

WHO (2006). WHO guidelines for the treatment of malaria. Geneva

WHO (2007). Cardiovascular diseases, Fact sheet Nr.317. Retrieved 27.05.2009, from http://www.who.int/mediacentre/factsheets/fs317/en/print.html

WHO (2008). WHO Statistical Information System (WHOSIS). Retrieved 12.07.2009 from http://apps.who.int/whosis/data/Search.jsp

WHO (2009a). CHOosing Intervetion that are Cost-Effective (WHO-CHOICE). Retrieved 03.06.2009, from http://www.who.int/choice/en/

WHO (2009b). Projections of mortality and burden of disease, 2004-2030. Retrieved 20.09.2009 from http://www.who.int/healthinfo/global_burden_disease/projections/en/index.html

Wiseman, V., M. Kim, T. K. Mutabingwa and C. J. Whitty (2006). Cost-effectiveness study of three antimalarial drug combinations in Tanzania. PLoS medicine 3(10): e373

Wöhe, G. and U. Döring (2008a). Die Kostenrechnung. Einführung in die allgemeine Betriebswirtschaftslehre. München, Vahlen: 917-1016

Wöhe, G. and U. Döring (2008b). Marktbedingungen und Wettbewerb. Einführung in die allgemeine Betriebswirtschaftslehre. München, Vahlen: 415-417

Wordsworth, S., A. Ludbrook, F. Caskey and A. Macleod (2005). Collecting unit cost data in multicentre studies. Creating comparable methods. The European Journal of Health Economics 6(1): 38-44

Würthwein, R., A. Gbangou, B. Kouyaté, F. Mugisha, Y. Yazoume, H. Becher, C. M. Schmidt and R. Sauerborn (2001a). The Nouna Health District Household Survey - Design and Implementation. Discussion Paper 3/2001

Würthwein, R., A. Gbangou, R. Sauerborn and C. M. Schmidt (2001b). Measuring the local burden of disease. A study of years of life lost in sub-Saharan Africa. International Journal of Epidemiology 30(3): 501-508

Yé, M., A. Sié and O. Millogo (2005). Manuel de procedures du centre medical avec antenne chirurgical de Nouna. Ouagadougou, Ministère de la Santé du Burkina Faso

Yé, Y., A. Sanou, A. Gbangou and B. Kouyaté (2002). Nouna DSS, Burkina Faso. Population, health, and survival at INDEPTH sites - Population and health in developing countries (Vol.1). I. Network. Ottawa, International Development Research Center

Yusuf, S., S. Hawken, S. Ounpuu, T. Dans, A. Avezum, F. Lanas, M. McQueen, A. Budaj, P. Pais, J. Varigos and L. Lisheng (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet 364(9438): 937-952

Yusuf, S., S. Reddy, S. Ounpuu and S. Anand (2001). Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. Circulation 104(22): 2746-2753

Yusuff, K. B. and O. Balogun (2005). Physicians' prescribing of anti-hypertensive combinations in a tertiary care setting in southwestern Nigeria. Journal of Pharmacy & Pharmaceutical Sciences 8(2): 235-242

Zurovac, D., M. Ndhlovu, N. Sipilanyambe, P. Chanda, D. H. Hamer, J. L. Simon and R. W. Snow (2007). Paediatric malaria case-management with artemether-lumefantrine in Zambia: a repeat cross-sectional study. Malaria Journal 6: 31

Eidesstattliche Erklärung

Hiermit erkläre ich, dass ich die vorliegende Dissertation selbständig verfasst und keine anderen als die angegebenen Hilfsmittel benutzt habe.

Die Dissertation ist bisher keiner anderen Fakultät vorgelegt worden.

Ich erkläre, dass ich bisher kein Promotionsverfahren erfolglos beendet habe und dass eine Aberkennung eines bereits erworbenen Doktorgrades nicht vorliegt.

Datum: 22. Juli 2010

Unterschrift

Curriculum vitae

Family name:	Koné born Steinmetz
First name:	Insa
Date of birth:	20.11.1984
Place of birth:	Stuttgart/Germany
Nationality:	German
Marital status:	Married

1991-1995	Primary School: Schlossbergschule Bensheim/Germany
1995-2004	Secondary School: Altes Kurfürstliches Gymnasium Bensheim/Germany
2001/2002	Long term exchange to Arequipa/Peru
Since 2004	Medical student: Ernst-Moritz-Arndt-Universität Greifswald/Germany
September 2006	Preclinical exam
April/Mai 2007	Research stay in Nouna/Burkina Faso
2007-2009	Medical clerkships in gynaecology, urology, paediatrics and internal medicine in Bamako/Mali and Bensheim/Germany
2009/2010	Final clinical year:
	1st part: Internal medicine at the Hôpital Civil in Strasbourg/France
	2nd part: Abdominal surgery at the Hôpital de Hautepierre in Strasbourg/France
	3rd part: Urology at the Kantonsspital Olten/Switzerland
October 2010	Final clinical exam

Strasbourg, 15th April 2011

Dissertation publication

Koné, I., P. Marschall, S. Flessa (2010). Costing of Malaria treatment in a rural district hospital - A case study from Burkina Faso. HEALTH 2(7): 759-768

Acknowledgement

I would like to thank

- Prof. Dr. Steffen Fleßa for the unique opportunity to write this dissertation and the indispensable and straightforward guidance throughout the writing process

- Dr. Paul Marschall for his competent supervision, his constant availability for any questions I had and his interpretation of the row data from the Cost-of-illness Information System enabling me to use it for my cost calculation

- The German Research Society (DFG) for funding the study as part of the project SFB 544

- Ali Sié for the reception at Nouna research centre and his logistic help

- Germain Savadogo for the friendly welcome at Nouna research centre and the constant support during my stay

- Dimitri Poda and Athanase Pacéré for the cost data collection

- The personnel of Nouna district hospital for providing me with the necessary information to picture the current clinical pathways

- My sister Kirstin and Anne Renneisen for their thorough language corrections

- My late father for his patient revision of the graphics

- My sister Nele, Ute Johannsen and Annemarie Schmoll for the careful reading of the draft and the useful hints to improve conclusiveness

- My husband for his constant encouragement along the whole data collection, analysis and writing process

- My parents for their unconditional love and all their moral and material support throughout my hitherto life