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**Cost -Effectiveness of Spinal and General Anaesthesia in the
Surgical Treatment of Benign Prostatic Hyperplasia in
Hospitals in
Nakuru Municipality, Kenya. //**

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Declaration

This thesis is my original work and has not been presented for any award in any university.

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DEDICATION

To my wife, Wangeci and my daughters Njeri, Njeri and Njoki.

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ABSTRACT

Anaesthesia has been cited as one of the medical practices that escalate the cost of expenditure on healthcare. In view of this, spinal anaesthesia has been proposed as a method that can lower surgical costs. However, medics in Kenya are yet to fully embrace spinal anaesthesia. The reasons for the low usage rates of the spinal anaesthesia are not well known. This study compared the cost-effectiveness of spinal anaesthesia and general anaesthesia. It also sought to establish the factors that explain the low utilization rates of spinal anaesthesia among medics in Kenya. A survey approach was adopted in this study. The population for this study was drawn from three randomly chosen hospitals within Nakuru Municipality. Patients operated for Benign Prostatic Hyperplasia (BPH) within the period 1st January 2003 and 31st December 2006 in the three hospitals formed the sampling frame for this study. Seventy three such patients were identified and formed the study sample. The data for this study was collected by way of document analysis. A coding scheme was developed to gather secondary data. A focus group discussion was conducted to a sample of surgeons, anaesthetists and hospital administrators/proprietors in order to collect their perceptions on spinal and general anaesthesia. An anaesthetic complication index was then developed. This is an ordinal scale that measures the degree of post operative complications after surgery. It has three levels beginning with three for the absence of any complication, two for one complication and one for multiple complications. The higher the score the less the post operative complications a patient has. The research instruments for this study were pre-tested on a few patients and medical staff in Naivasha Sub-District Hospital. These research tools were used to gather data by the researcher with the help of two trained research assistants. Data was coded and analyzed using the statistical software package SPSS Version 13. Student's t tests were used to compare data on the cost effectiveness of spinal anaesthesia and general anaesthesia. Finally, a ratio of the net costs to the net health outcomes of both spinal and general anaesthesia was calculated. Patients in this study had an average of 71.19 years. The average cost of anaesthetic drugs for general anaesthesia was Kshs. 2206.30, while that for spinal anaesthesia was Kshs. 1548.60. The differences in these costs were statistically significant ($t = 3.87$, $df = 71$; $p = 0.000$). Patients operated under spinal anaesthesia had a mean of 2.47 on the anaesthesia complication index, while those operated under general anaesthesia had a lower mean of 2.03. The lower complication index score obtained in general anaesthesia implies that patients had relatively more post operative complications. The differences in the complication index were statistically significant at 95% confidence level ($t = 2.40$, $df = 69$; $p = 0.019$). The incremental cost effectiveness of this study was calculated as -1494. Adopting spinal anaesthesia in the treatment of BPH results is a reduction in costs and aversion of anaesthetic complications. Medics in Nakuru have favourable knowledge, skills and attitudes towards spinal anaesthesia. Factors that explain this are the least costs, aversion of complications and the ease of performing spinal anaesthesia. However, their usage of this technique was very low. Lack of spinal kits and the tradition of using general anaesthesia explain this low usage rates. Availing spinal kits and sensitizing medics on benefits of spinal anaesthesia might help in the uptake of spinal anaesthesia where indicated.

LIST OF ABBREVIATIONS AND ACRONYMS

BPH	- Benign Prostatic Hyperplasia
CBA	- Cost Benefit Analysis
CBS	- Central Bureau of Statistics
CUA	- Cost Utility Analysis
CEA	- Cost-Effective Analysis.
CSF	- Cerebro-Spinal Fluid.
FGD	- Focus Group Discussion
GDP	- Gross Domestic Product.
KEPH	- Kenya Essential Package for Health
Kshs.	- Kenya shillings
NGO	- Non Governmental Organisation
NHSSP	- National Health Sector Strategic Plan
PEC	- Pre-operative Evaluative Clinic.
RVPGH	- Rift Valley Provincial General Hospital

DEFINITION OF KEY TERMS

Anaesthetics- These are agents, which could either be drugs or inhalational vapours administered for the purposes of pain relief (analgesia), blocking memory of the procedure (amnesia), producing unconsciousness, inhibiting normal body reflexes to make surgery safe and easier to perform and relaxing the muscles of the body.

Anaesthesia Complication Index-This is an ordinal scale that measures the degree of post operative complications after surgery. It has three levels beginning with three for the absence of any complication, two for one complication and one for multiple complications. Thus the higher the score the less the post operative complications a patient has.

Cost Effectiveness Analysis- A method of comparing the costs of a project with benefits, measured in terms of a social objective. Something that is cost effective achieves relatively high gains for low costs, compared with other possible ways of achieving that goal.

Cost Minimization Study – This assumes that two strategies or interventions achieve exactly the same effect. The study, therefore, focuses on costing each option in order to find out which one is the least costly.

General Anaesthesia – Application of Anaesthetics through inhalation and or administration of drugs.

Local Anaesthesia – Infiltrating an anaesthetic agent to a specific area of the body to render it sensation free during surgery.

Spinal Anaesthesia – Application of Anaesthetics through the lumbar spine.

1. INTRODUCTION

1.1 Study Background

Economic problems have become a major issue for virtually all healthcare systems (Weinstein and Stason, 1977). These economic problems arise because there seem never to be enough resources to completely satisfy human desires within and without the boundaries of healthcare provision. Because resources are scarce, choices have to be made about different ways of using them. In addition, despite the growth in evidence relating to effectiveness and ineffectiveness of given clinical practices, there exist many areas in which there is a dearth for such evidence. Anaesthesia is one such area.

Generally, anaesthesia refers to a reversible condition that involves the absence of physical sensation in part or all of the body. Anaesthesia is commonly induced using anaesthetic drugs. These drugs may be injected, inhaled, or applied directly to the surface of the body (Calthorpe, 2004). The most common type of anaesthesia is general anaesthesia. Simply, general anaesthesia is defined as the absence of physical sensation in all of the body (Atkinson *et al.*, 1997). It is also a state of reversible controlled unconsciousness that is induced using anaesthetic drugs. Concerns relating to the costs of general anaesthesia are always voiced. Anaesthetic drugs and gases are costly and the latter is often difficult to transport. The situation is more acute in resource poor settings such as in Kenya.

Anaesthesia, being one of the major pre-operative preparations for patients, has significantly contributed to the high costs of healthcare, especially in surgical cases. As Watcha and White (1997) and Vinodkumar and Jacob (2004) observe, one third of

total hospital costs for surgical patients are incurred from operating suites of which 5.6% are anaesthesia charges. Providing quality and cost-effective approach to the preparation of patients to undergo surgical procedures is thus a central issue in preoperative, operative and postoperative patient management (Fischer, 1999; Vinodkumar and Jacob 2004).

In an endeavour to rationalize costs and expenditure on healthcare, researchers have been trying to establish a more cost-effective and efficient way of applying and administering anaesthesia. The results have been the development of spinal anaesthesia. Spinal anaesthesia is defined as anaesthesia of the lower half of the body that is achieved by injecting an anaesthetic into the fluid surrounding the spinal cord (Atkinson, 1997). Wallace (1995) adds that, it is induced by injecting small amounts of local anaesthetic into the cerebro-spinal fluid (CSF). The injection is usually made in the lumbar spine below the level at which the spinal cord ends (L2).

Spinal anaesthesia is easy to perform and has the potential to provide excellent operating conditions for surgery below the umbilicus (Bewes, 2003; Alahuta, 1999). It is best reserved for operations below the umbilicus, such as hernia repairs, gynaecological and urological operations, and any operation on the perineum or genitalia. Spinal anaesthesia minimizes chances of complications among patients, especially older patients and those with systemic diseases such as chronic respiratory diseases, hepatic, renal and endocrine disorders such as diabetes (Casey and Ankcorn, 2003). However, there are reservations regarding its cost-effectiveness.

It is important to observe that, anaesthesia departments all over the world receive a very meagre percentage of the budget allocations and hence the scope for minimizing anaesthesia is minimal (Pedersen, 2005). It is also true that several of the contributors responsible for escalating the cost of healthcare lie outside the operation theatre. However, if one adheres to the saying that 'drops and drops make an ocean,' cost containment in anaesthesia without compromising the safety in patient care, along with avoidance of wasteful expenditure, makes an impact in healthcare expenditure.

Vinodkumar and Jacob (2004) argue that cost minimization in anaesthesia is possible without compromising the quality of anaesthesia care. However, this minimization is not sustained unless conscientious re-education is undertaken at regular intervals. Elsewhere, Bevan (2002) suggests that the impacts to be realized through minor modifications in anaesthetic drug budget are not significant. While Vinodkumar and Jacob (2004) and Watcha and White (1997) admit that the savings per case are not significant, they argue that such modifications could make recognizable impact on healthcare expenditure when multiplied many times over. This is especially so when applied to short surgeries on a long surgical list with a rapid turnover.

Pedersen (2005) points out that there are differences in variable costs of both spinal and general anaesthesia. It can thus be argued that the choice of anaesthetic agents will translate into secondary care budget differences. Indeed, Karl and Biher (1994) argue that, if anaesthesiology is to survive as a specialty, then the practitioners ought to be conscious of healthcare expenditure. This consciousness will include choice and selection of methodologies that aim at minimizing the general budgetary allocations to healthcare. Fischer (1999) points out that economic analysis (cost identification,

effectiveness and cost-benefit studies) is one of the many ways to inform the physicians' selection and application of a given treatment over the other(s). Nothing limits the extension of this argument to anaesthesia.

Nakuru Municipality covers a total of 66.69 km² and lies at 1,850m above sea level. It is fourth largest town in Kenya and the capital of Rift Valley Province. It is an important agricultural town, trade centre, and a transportation hub. It is projected that there are more than 300, 000 people in this town (CBS Census, 1998). Nakuru has the third largest urban population in Kenya. With such a large urban population, provision of healthcare in the most cost effective manner is a priority. The town has six major hospitals namely the Rift Valley Provincial General Hospital (RVPGH), Evans Sunrise Hospital, Nakuru Nursing Home, Nakuru War Memorial Hospital, Valley Hospital, Pine Breeze Hospital and several health centres and private clinics. Given the large population in the town, these health facilities are already overstretched. There exists therefore a need, to search for the most cost effective means of offering healthcare services to the people of Nakuru town.

Nakuru was established by the British as part of the White highlands during the colonial era. After Kenya's independence in 1963, a number of settlement schemes were established in the areas surrounding the town for example, Lanet, Njoro, Subukia, Solai and Rongai. Most of the people who settled initially in these schemes are now elderly. Such aging settlers call for special health attention. According to the second National Health Sector Strategic Plan 2005 – 2010 (NHSSP II) the elderly or people aged above 60 years are categorised as cohort six for the purposes of receiving the Kenya Essential Package for Health (KEPH). If the health needs of this elderly

cohort are not taken into account early enough, they are likely to require large outlays of the already stretched health resources in the town in the future.

Benign Prostatic Hyperplasia (BPH) is one of the emerging diseases that are afflicting the older male members of this town and other parts of Kenya. BPH refers to the enlargement of the prostate gland. It affects more than 50% of men over the age of 60 and as many as 90% of men over the age of 70 years (Porter and McCormick, 2003). There are various ways of treating BPH. Surgery is the most preferred method. Surgery involves removing the enlarged part of the prostate that constricts the urethra. This procedure is performed either under general or spinal anaesthesia and takes less than 90 minutes. Consequently, surgical treatment of BPH offers a good setting for examining the cost effectiveness of different techniques of anaesthesia.

1.2 Problem Statement

Healthcare costs, especially in surgical cases continue to rise against diminishing revenue for most healthcare givers (Weinstein and Stason, 1977; Fischer, 1999). The high costs are attributed to among others the high prices of equipment associated with preoperative and real surgical undertakings and drugs. It is, however, argued that these costs can be minimized if changes in clinical practice and routine are envisaged (Vinodkumar and Jacob, 2004; Watcha and White, 1997). The said changes can only be brought about by embracement of proper and cheaper diagnostic methodologies, and promotion of clinical practices that are rational, efficient and effective (Pedersen, 2005).

In this regard, anaesthesia has been cited as one of the medical practices that escalate the cost of and expenditure on healthcare. General anaesthesia is widely used in developing countries, Kenya included. However, there are some reservations on the use of general anaesthesia. For instance, concerns relating to the costs of general anaesthesia are always voiced. Anaesthetic drugs and gases are costly and the latter is often difficult to transport.

In view of these, newer approaches to surgical preparations that include spinal anaesthesia have been held in high regard as ways of expediting patient attention and minimizing pre-operative, operative and post-operative costs by limiting clinical demands. The essentials of spinal anaesthesia usage, its effectiveness and safety have been widely recognised (Casey and Ankcorn, 2003; Linton and Anthony, 1997; Reynolds, 2001; Williams and de Swiet, 1997).

Despite such advantages, the use of spinal anaesthesia is minimal in Kenya thus, general anaesthesia is largely utilized. This has contributed to a huge backlog of patients awaiting surgery in most public hospitals. This can be explained by the observation that the required equipments for general anaesthesia are expensive and not readily available in most of our hospitals, hence the backlog. Due to this backlog, surgical cases occupy bed space for longer than necessary, hence denying opportunities to other patients. As a result, space available for admission has become very limited as is evident by huge surgical booking lists in most hospitals. Spinal anaesthesia will most likely be a solution to this situation. It is therefore prudent that investigations be carried out to establish the cost effectiveness of both general and spinal anaesthesia, with a view to establishing their respective impacts on healthcare

practices and expenditure. Similarly, there is need to investigate other factors that may explain the low utilization of spinal anaesthesia among medics in Kenya. These issues are yet to be addressed adequately in the existing literature.

1.3 Justification for the Study

This study enhances our understanding on the cost effectiveness and acceptability of spinal anaesthesia. The study thus forms a basis for identifying the factors that explain the low utilization rates of spinal anaesthesia among medics in Kenya.

The lack of widespread application of cost effectiveness analysis (CEA) in different techniques of anaesthesia tends to limit the theoretical and practical robustness of the existing literature on anaesthesia. CEA may offer valuable information on the differences in costs and benefits of both general anaesthesia and spinal anaesthesia. Such knowledge may result in savings, which can be utilized in control and management of the commonest causes of morbidity and mortality in this country such as infectious diseases, malaria and parasitic infestations. The larger burden of diseases that Kenya deals with are infectious diseases. A large proportion of our annual health budget directed to curative diseases yet 80% of diseases are preventable. Savings that can be made in adopting cost effective interventions such as spinal anaesthesia can play a significant role in reformulating the use of resources.

1.4 Research Questions

- a) What is the cost-effectiveness of spinal anaesthesia?
- b) What is the cost-effectiveness of general anaesthesia?

- c) What is the difference of cost-effectiveness between spinal anaesthesia and general anaesthesia?
- d) What are the attitudes of surgeons and anaesthetists towards application of spinal anaesthesia and general anaesthesia?

1.5 Hypothesis

H1: There is no significant difference in cost-effectiveness of spinal anaesthesia and general anaesthesia.

1.6 Objectives.

1.6.1 General Objective

To compare the cost-effectiveness of spinal anaesthesia and general anaesthesia.

1.6.2 Specific Objectives

- a) To establish the cost-effectiveness of spinal anaesthesia.
- b) To establish the cost-effectiveness of general anaesthesia.
- c) To determine the differences in cost-effectiveness between spinal anaesthesia and general anaesthesia.
- d) To establish the perceptions of surgeons and anaesthetists on the use of spinal anaesthesia.

1.7 Scope of the Study

The study uses Cost Effectiveness Analysis to compare spinal and general anaesthesia. It focuses on surgical records spanning four years from 1st January 2003 to 31st December 2006 in three hospitals in Nakuru Municipality. Surgeons,

anaesthetists and hospital administrators/proprietors from the selected hospitals are the respondents of this study.

This study focuses on the surgical treatment of Benign Prostatic Hyperplasia (BPH). The choice of BPH is to standardise cases so as to avoid confounding factors and status. BPH is among the emerging diseases in Kenya that require immediate attention. It affects more than 50% of men over age 60 and as many as 90% of men over the age of 70 years (Porter and McCormick, 2003). There are various ways of treating BPH. Surgery is the most preferred method. Surgery involves removing the enlarged part of the prostate that constricts the urethra. This procedure can be performed either under general or spinal anaesthesia and takes less than 90 minutes.

1.8 Study Limitation

This study faced the challenge of having a small sample size. However, the number of patients operated for BPH within Nakuru Municipality in the last four years was only 73. Such a study sample is considered statistically adequate (Black, 2005).

In the public hospital (RVPGH), there were difficulties in accessing all the relevant data from patient records due to improper data entry and wrong filing, whereas in private hospitals it was difficult to access financial data in some files.

2. LITERATURE REVIEW

2.1 Introduction

The decision of whether to use spinal anaesthesia or general anaesthesia is one that anaesthesiologists have to make time and again. With limited budgets to operate on, the cost effectiveness of these two techniques has to be considered carefully. This chapter begins by analysing the concept of anaesthesia. It then describes the common types of anaesthesia namely, general anaesthesia and spinal anaesthesia. Finally, cost effectiveness analysis as applied into anaesthesia is reviewed.

2.1.1 The Concept of Anaesthesia

Anaesthesia is the induction of a state of unconsciousness with the absence of pain sensation over the entire body, through the administration of anaesthetic drugs (Atkinson *et al.*, 1997). It is used during certain medical and surgical procedures.

Anaesthesia has many purposes including pain relief (analgesia), blocking memory of the procedure (amnesia), producing unconsciousness, inhibiting normal body reflexes to make surgery safe and easier to perform and relaxing the muscles of the body.

In developing countries, application of anaesthesia is a major challenge. In these countries, public hospitals have poorer facilities, fewer drugs and less equipment to serve the poorer part of the community (Tritrakan, 2000). In such countries, nurses often administer anaesthesia. Therefore, there is need to adopt techniques of anaesthesia that are appropriate for conditions in developing countries.

Provision and application of anaesthesia has undergone major developments that are aimed at addressing efficiency. A notable one is the shift from general to spinal anaesthesia.

2.2.1 General Anaesthesia

General anaesthesia is the induction of a balanced state of unconsciousness, accompanied by the absence of pain sensation and the paralysis of skeletal muscle over the entire body.

General anaesthesia is used during major surgery and other invasive surgical procedures. It is induced through the administration of anaesthetic drugs. Agents used for general anaesthesia may either be gases or volatile liquids that are vaporized and inhaled with oxygen, or drugs delivered intravenously. Ether and chloroform were among the earliest used anaesthetic agents. Currently used inhaled general anaesthetics include halothane, enflurane, isoflurane, desflurane, sevoflurane, and nitrous oxide. Commonly administered intravenous anaesthetic agents include ketamine, thiopental, opioids, and propofol.

A combination of inhaled anaesthetic gases and intravenous drugs are usually delivered during general anaesthesia. This practice is called balanced anaesthesia and is used because it takes advantage of the beneficial effects of each anaesthetic agent to reach surgical anaesthesia.

General anaesthesia works by altering the flow of sodium molecules into nerve cells (neurons) through the cell membrane. Exactly how the anaesthetic does this is not understood since the drug apparently does not bind to any receptor on the cell surface.

and does not seem to affect the release of chemicals that transmit nerve impulses (neurotransmitters) from the nerve cells. It is known, however, that when the sodium molecules do not get into the neurons, nerve impulses are not generated and the brain becomes unconscious, does not store memories, does not register pain impulses from other areas of the body, and does not control involuntary reflexes.

However, there are some reservations on the use of general anaesthesia. For instance, concerns relating to the costs of general anaesthesia are always voiced. Generally, anaesthetic drugs and gases are costly and the latter is often difficult to transport. This issue is more acute in resource poor settings such as in Kenya. Despite the above, general anaesthesia is widely used in Kenya without due regards to its cost effectiveness. Conducting cost effectiveness analysis of general anaesthesia in Kenya may thus offer valuable insights on resource usage and efficiency in healthcare delivery.

2.2.2 Spinal Anaesthesia

Spinal anaesthesia is defined as the injection of anaesthetic into the fluid surrounding the spinal cord (Atkinson *et al.*, 1997). It is achieved by injecting the anaesthetic in the lumbar spine below the level at which the spinal cord ends (Wallace, 1995).

According to Calthorpe (2004), the first spinal anaesthetic was administered accidentally by Leonard Corning, a neurologist from New York on his dog. Though Corning never used spinal anaesthesia for surgery, he nonetheless appreciated its potential to do so. The next major development in spinal anaesthesia was the work of

Augustus Gustav Bier who applied spinal anaesthesia to provide analgesia for surgical procedures.

The development and application of spinal anaesthesia has been steady and has today become quite popular with patients (Casey and Ankcorn, 2003; Linton and Anthony, 1997). It has shown great potential as it almost certainly guarantees good results and satisfaction, hence its popularity among patients. Its administration simply calls for knowledge in anatomy, physiology and pharmacology. Spinal anaesthesia is easy to perform and has minimal adverse side effects (Casey and Ankcorn, 2003; Reynolds, 2001). Other major advantages of spinal anaesthesia are that, the patient's airway is not compromised and hence there is a reduced risk of obstruction or the aspiration of gastric contents.

Use of spinal anaesthesia in diabetic patients, reduces risk of unrecognized hypoglycaemia in an awake patient (Mushambi 1996; Williams and de Swiet, 1997). The application and use of spinal anaesthesia has shown good results and potential in USA and many other countries in Europe, but is limited in developing nations (Microsoft Encarta Encyclopedia, 2002).

2.3 Economic Evaluations of Anaesthesia

Three types of economic evaluations can be used to assess anaesthesia. These are Cost Benefit Analysis (CBA), Cost Utility Analysis (CUA) and Cost Effectiveness Analysis (CEA). CBA is commonly used to determine whether or not the benefits of an intervention outweigh its costs. It has a very broad scope since it may express all the positive and negative effects of an intervention in a common unit namely money,

from a social as opposed to a firm's point of view. Typically, costs and benefits are expressed in consumer preference, specifically the willingness for the intervention that is being evaluated. However, not all effects can be monetized.

CUA is a method of comparing the costs of a social project with the benefits, measured in terms of an overall index of both quantity and quality of life gained. However, collecting reliable information on changes to quality of life is relatively difficult and may not be appropriate. The case of anaesthesia is a good example. Anaesthesia aims at inducing a state of unconsciousness with the absence of pain sensation over the entire body. Thus changes in quality of life may not be directly relevant.

In cases where the benefits of an intervention cannot be valued unambiguously, Cost Effectiveness Analysis (CEA) offers a good alternative. CEA is used to compute which intervention option produces the desired beneficial effects at the lowest cost. Only the costs are monetized. CEA summarize the expected benefits, harms, and costs of adopting and translating a clinical recommendation into practice (Saha *et al.*, 2002). The results of a CEA are typically presented as a ratio of the net costs to the net health outcomes of alternative intervention strategies, illustrated in the formula:

$$(C_1 - C_2) / (Q_1 - Q_2),$$

where C represents costs associated with an intervention, Q represents outcomes, and 1 and 2 refer to alternative interventions. Costs associated with an intervention include the costs of the intervention itself plus those induced by the intervention (for example, the costs of treating side effects), minus the costs averted because of the intervention (that is, the costs of care for the prevented disease). By quantifying the

immediate and downstream benefits, harms, and costs of interventions. CEA demonstrates the trade-offs involved in choosing among different intervention strategies to effect desired health outcomes. As such, CEAs may provide valuable information for those designing or implementing policies about preventive services.

Regarding CEAs, lack of its transparency to non-economists, stakeholder involvement is required. Here, stakeholders can contribute to the definition of relevant costs and to the way they are incorporated into the analysis. The Panel on Cost-Effectiveness in Health and Medicine has recommended that all CEAs include the societal perspective (Saha *et al.*, 2002). This study adopted this recommendation.

CEA is used to help decision-makers rank programs competing for scarce resources in order to maximize the net health benefits derived from a fixed budget for a target population (Detsky, 1996). The systematic use of information on cost effectiveness helps decision-makers to have a more rational basis for funding of new programs and/or discontinuation of funding for old programs. In Kenya's health care, it is important that we use such information to make room for innovations that are effective and efficient, and remove funding from programs that are either known to be ineffective and costly or use resources inefficiently. More energy should therefore be put toward generating the information necessary to make these kinds of decisions.

Typically, a CEA involves the following activities. Initially one chooses a specific type of a CEA depending on the accounting perspective preferred. Secondly, the definition of intervention alternatives and the base case is made. Thirdly, the effects are identified, estimated and valued. Next, an estimation of investment and

development costs for the intervention is conducted. Finally, the costs and benefits are discounted. Other optional activities in conducting CEA include variant and risk analysis and the adjustment of intervention alternatives.

Pederson (2005) suggests that CEA is a useful approach towards the evaluation of healthcare interventions. In CEA the benefits generated by a given intervention are expressed in non-monetary terms related to the health effects such as life years gained or symptom free days. Stevens *et al.*, (1995) add that the aim of CEA in healthcare is to maximize the level of the benefit health-effects relative to the resources available. Since costs are seen differently from different points of view, the identification of costs and benefits is considerably improved by placing them into certain categories. Conventionally, intervention costs are classified into either direct or indirect costs. It is also common to find costs being classified as intangibles. In most times the intangibles are the consequences of an intervention. Vinodkumar and Jacob (2004) suggest that in medical terms direct costs include cost incurred on drugs, staff, time, equipment, patient transport and out of pocket expenses. On the other hand, indirect costs include terms such as production loss and other uses of time. Finally, the intangibles entail pain, suffering and adverse effects and complications. In CEA it is important to specify all the costs that are included so as to ensure that findings are not subject to misinterpretation.

Pedersen (2005) and Stevens *et al.*, (1995) caution that a distinction should be made between the interventions that are completely independent and those that are completely dependent. In other words, differences between cost and effects of interventions that are not affected by the introduction, non-introduction or presence of

other interventions should be identified. Heeding this caution is useful in building a case that determines the selection of an intervention based on the results (outputs) and the resources (inputs) required for the same.

The application of cost-effectiveness analysis (CEA) in anaesthesia is growing. Generally, two approaches to this analysis can be differentiated by the type of data available (Willan and O'Brien, 1996). The first approach involves the design of a randomized controlled trial to collect data on costs and effectiveness of anaesthesia prospectively from patients as in Forssblad *et al.*, (2004). The second approach is based upon secondary analysis of retrospective data from one or more trials and other sources as in Chilvers *et al.*, (2001). An important methodological difference between these two approaches is in how uncertainty is handled. The secondary analyses of data typically rely upon sensitivity analysis to determine the robustness of findings to alternative assumptions. On the other hand, the randomised controlled trials, as part of prospective studies, permit the use of conventional statistical methods on the cost and effectiveness data for both inference (hypothesis testing) and estimation.

Forssblad *et al.*, (2004) evaluated the time and cost effectiveness for different anaesthesia methods when performing knee arthroscopy among patients in Sweden. This study adopted a randomized controlled trial design with samples of 200 patients for local anaesthesia, 100 for general anaesthesia and a similar number for spinal anaesthesia. This study found that there were no differences in the time taken for surgery with the three methods. However, the time between the commencement of anaesthesia and the start of surgery differed. The group subjected to general anaesthesia took the least time (17.6 minutes), followed by spinal anaesthesia group

(20.1 minutes) and local anaesthesia taking the most time at 39.2 minutes. The total time taken in the hospital also differed among the three anaesthesia methods. Patients subjected to spinal anaesthesia had the highest average total time taken in hospital with 350.3 minutes; those subjected to general anaesthesia took 280.44 minutes with the group subjected to local anaesthesia taking the least time in hospital at 130.4 minutes. All the differences in time taken in this study were significant at $p < 0.01$. In addition patients subjected to local anaesthesia saved some Swedish Crowns (SEK) 1011 as compared to those subjected to general and spinal anaesthesia. This study had two important strengths. First, it indicated that the three techniques of anaesthesia differ significantly in cost and time taken. This finding is important for decision making since choice of anaesthesia technique was shown to influence resource usage. Second, it uses a prospective approach which allows all the necessary data to be collected. A notable weakness however, is that local anaesthesia was conducted in a different facility from the one where general and spinal anaesthesia were conducted. Usage of different facilities may introduce some variability in results. This means that the results of this study should be interpreted and used with caution. This paper does not discuss how such variability was handled. Despite this concern, it is not also clear whether the results of this study can be generalised in other context, particularly those in developing countries where resources are scarce.

Ozgun *et al.*, (2002) set to compare the outcomes of local, spinal and general anaesthesia for 75 male patients undergoing Lichtenstein repairs for having inguinal herniorrhaphy in Turkey. The outcomes considered in this study included duration of operation and anaesthesia, postoperative pain scores, analgesic requirements, complications, length of hospital stay, postoperative rehabilitation, and patient

satisfaction. This study was a prospective randomised control trial. This study recorded shorter time spent in the operating room, lower incidence of nausea and urinary retention, and more satisfaction with local anaesthesia than with spinal and general anaesthesia for inguinal herniorrhaphy in that order. It concluded that local anaesthesia may be preferred to other methods for day care hernia repairs. A major strength of this study is that it controlled for variability that may occur from usage of different facilities by being conducted at the University hospital in Turkey. Moreover, it operationalizes the major outcomes of usage of different techniques of anaesthesia in a way that can be replicated easily. Further, it adds to the understanding that different techniques of anaesthesia lead to different outcomes. However, it is not clear whether its conclusions can hold in contexts other than Turkey, where the study was conducted in a research facility. It is also not clear whether the conclusions reached in this study can hold with other types of surgery.

Chilvers *et al.*, (2000) compared the cost and effectiveness of small-dose spinal anaesthesia with general anaesthesia for outpatient laparoscopy. This study used a retrospective record analysis of 24 patients who received spinal anaesthesia and 28 patients who received general anaesthesia in our day-care centre in Canada. The costs of anaesthesia and recovery were calculated, from an institutional perspective, using 1997 Canadian Dollar values. Effectiveness was measured in terms of time for anaesthesia and recovery, and postoperative antiemetic and analgesic requirements. The study found out that both groups were well matched in age, weight, duration and type of surgery. The mean total cost for the spinal anaesthesia group of Canadian Dollar 53.45 ± 10.40 was no different from that for the general anaesthesia group of Canadian Dollar 48.92 ± 10.25 (95% CI-10.3,1.2). Time to administer anaesthesia

was found to be longer in the spinal anaesthesia group. Recovery time was also longer in the spinal anaesthesia group. Postoperative antiemetic requirements were similar, whereas analgesic requirements were less in the spinal anaesthesia group with 25% receiving analgesia compared with 75% in the general anaesthesia group ($P < 0.05$). The study concluded that the total cost of anaesthesia and recovery using spinal anaesthesia is similar to that for general anaesthesia when used for outpatient laparoscopy. Spinal anaesthesia was less effective than general anaesthesia in time to administer anaesthesia and in duration of recovery. Postoperative analgesic requirements were reduced using spinal anaesthesia. A key strength of this study is its attempt to operationalize cost from an institutional perspective. The method used to compute costs incurred when conducting different techniques of anaesthesia is useful since it can be adopted by both researchers and managers. However, this study has a drawback due to the usage of a small sample size (52 patients in total). This limitation implies that the finding of this study cannot be generalized to other populations.

Gilbert *et al.*, (2002) investigated the effects of anaesthetic technique on the long-term outcome of 741 elderly patients after hip fracture repair using a non-intervention, observational trial research design. Detailed interviews assessing functional status and pain were conducted during the stay of patients in hospital. Further, out-of-hospital evaluations were repeated after the procedure at 2, 6, 12, 18, and 24 months with a portable gait and balance laboratory. Multivariate analysis was done to determine the effects of anaesthetic technique on functional and other outcomes, after controlling for multiple baseline variables. 430 and 311 patients received spinal anaesthesia and general anaesthesia, respectively. Subgroup analysis of three spinal anaesthetics,

tetracaine, lidocaine, and epinephrine, was also done. This study found that general anaesthesia was at least as efficacious as spinal anaesthesia, and possibly better, in affording good long-term outcome. It is not clear whether the result obtained in this study can hold in the context of developing countries. This study is however, important in three ways. First, it extends outcomes attributable to anaesthesia to include functional status and pain up to two years after surgery. This is unlike most studies which examine short term outcomes only. Second, it uses a large sample of patients. Using large samples allows for the generalisation of results into wider contexts. Finally, the study is longitudinal. This makes it possible to counter check the accuracy of the data collected in each round of data collection. An important finding of this study is that general anaesthesia provides better long term outcomes when compared to spinal anaesthesia. This finding is in disagreement with results of other studies which generally show that spinal anaesthesia provides better outcomes (for example, Ozgun *et al.*, 2002; Chilvers *et al.*, 2000). However, these may be explained by differences in the measurement of outcomes. Gilbert *et al.*, (2002) measure long term outcomes, whereas other studies focus on short term outcomes. This discussion shows that it is important to separate short term outcomes and long term outcomes on economic studies of anaesthesia.

In summary, the above reviewed studies offer insights on the methods that can be used to evaluate the effectiveness of different techniques of anaesthesia. Both prospective and retrospective study methods are applicable. The studies also show that it is important to focus on individual diseases when evaluating the effectiveness of different techniques of anaesthesia. The studies also help to operationalise costs and outcomes. For instance, costs can be determined from an institutional perspective

which can help in decision making (Chilvers *et al.*, 2000). It is also important to separate outcomes as either short term (Ozgun *et al.*, 2002; Chilvers *et al.*, 2000) or long term (Gilbert *et al.*, 2002). However, the findings of these studies are mixed. Forssblad *et al.*, (2004) for instance, found cost differ depending on the technique of anaesthesia used, while Chilvers *et al.*, (2000) found no differences in cost incurred. Such controversies make it very difficult to arrive at meaningful conclusions on whether different techniques of anaesthesia utilize different amounts of resources.

These studies also indicate that short term outcomes such as total hospital stay, anaesthesia time, surgery time, recovery time, postoperative antiemetic, analgesic requirements, postoperative pain scores, complications, postoperative rehabilitation, pharmaceutical and total costs and satisfaction can be used to differentiate between different types of anaesthesia. These variables are summarised in Table 2.1 below. However, the opinions on these variables are divergent. Differences in opinion may be attributed to differences in the definitions and measurement of variables. It may also be a result of methodological idiosyncrasies such as the use of small and different samples. These controversies tend to limit the theoretical and practical robustness of the existing literature on anaesthesia. This study attempted to resolve such controversies. It also attempted to extend our understanding of the cost effectiveness of different methods of anaesthesia in Kenya. Such literature is not readily available in this country.

Costs	Benefits
Analgesics	Hospital stay
Loss of production	Time (Anaesthetic, Surgery, Recovery)
Pharmaceutical costs	Complications (antiemetic, nausea, urinary retention)
Total costs	Postoperative pain scores
	Post operative rehabilitation

Table 2.1 Cost and benefit variables used in previous studies.

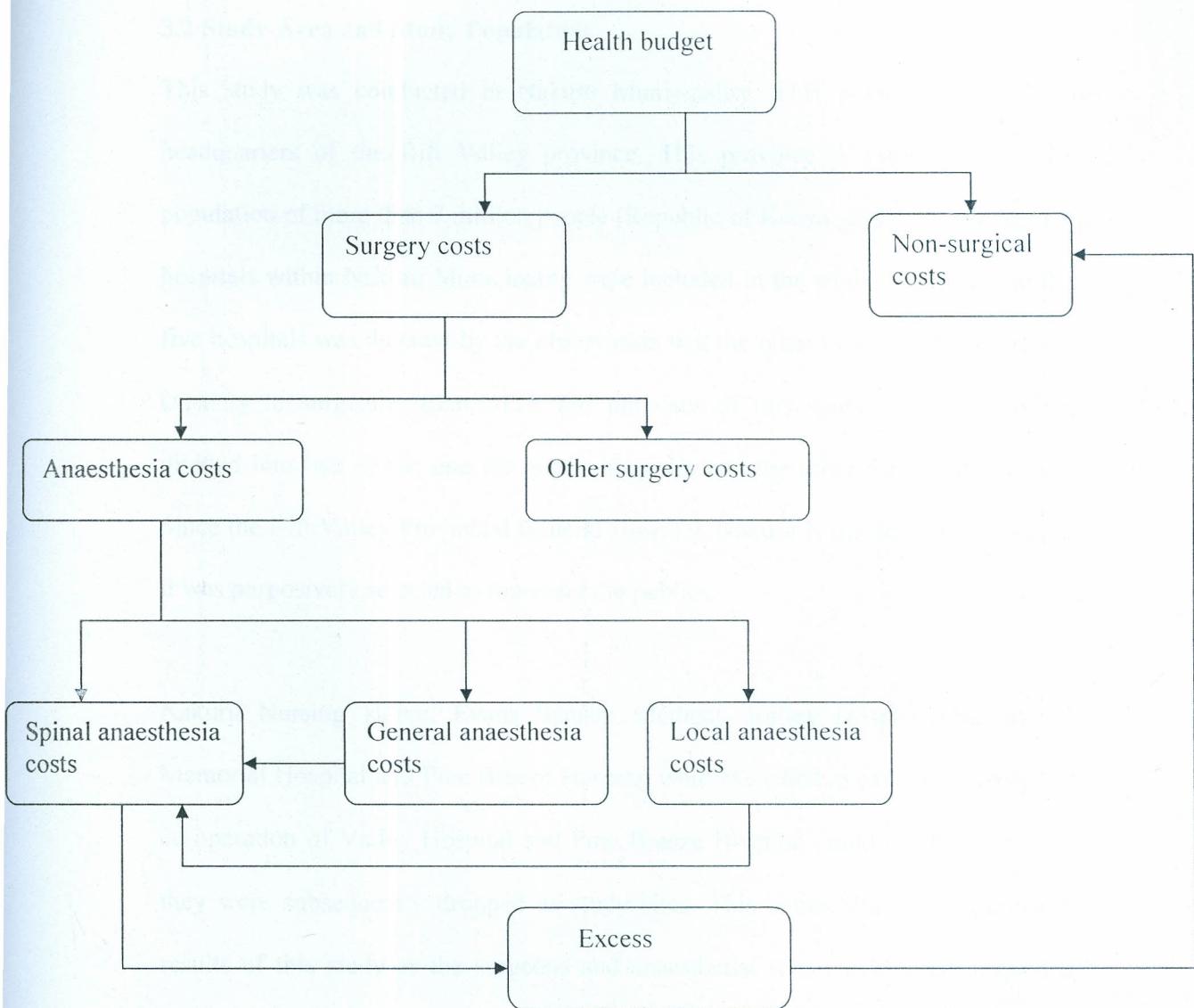
2.4 The Kenyan Perspective

The application of CEA in determining the differences in the effectiveness of general anaesthesia and spinal anaesthesia in Kenya is generally neglected. This raises some concerns since knowledge on the effectiveness of different types of anaesthesia is central to cost minimization. In Kenya, medical costs take the largest share of the health budget. Surgery also takes a significant share of this budget. This is because medical conditions are rampant in the country. However, surgery costs can be minimized and the savings diverted to medical care. A useful starting point is to minimize costs of anaesthesia.

There is a tendency towards utilization of general anaesthesia for surgical procedures below the umbilicus in the country. Adoption of spinal anaesthesia may result in some savings and the surplus can be released to the more pressing medical needs. Thus studies on the effectiveness of the different types of anaesthesia are important. Such

knowledge may result in some adjustments in the type of anaesthesia used during surgeries. Ultimately this may lead to some savings, which can be utilized in control and management of the commonest causes of morbidity and mortality in this country such as infectious diseases, malaria and parasitic infestations. This observation forms the background of this study. Figure 1 is a schematic summary of this analysis.

Figure 1: Conceptual Framework



3. METHODOLOGY

3.1 Study Design

This was a cross-sectional retrospective study that compared the cost effectiveness of spinal anaesthesia and general anaesthesia as applied in surgical cases for the treatment of BPH. It was conducted through analysis of patient records and a Focus Group Discussion (FGD) with surgeons and anaesthetists in Nakuru Municipality.

3.2 Study Area and Study Population

This study was conducted in Nakuru Municipality. This town is the provincial headquarters of the Rift Valley province. This province is estimated to have a population of more than 7 million people (Republic of Kenya, 2001). All the six large hospitals within Nakuru Municipality were included in the study. Focusing on these five hospitals was dictated by the observation that the other hospitals do not have the capacity to surgically treat BPH. For purposes of this study, the hospitals were divided into two strata: one for public hospitals and the other for private hospitals. Since the Rift Valley Provincial General Hospital, Nakuru is the only public hospital; it was purposively selected to represent the publics.

3.4 Inclusion and Exclusion Criteria

Nakuru Nursing Home, Evans Sunrise Medical, Valley Hospital, Nakuru War Memorial Hospital and Pine Breeze Hospital were classified as private hospitals. The co-operation of Valley Hospital and Pine Breeze Hospital could not be secured and they were subsequently dropped as study sites. This action did not jeopardise the results of this study as the surgeons and anaesthetist who participated in the FGD doubted whether there were any significant surgical treatments of BPH in both hospitals. Nakuru Nursing Home and Evans Sunrise Medical centre hence represented

the private hospitals. These two were randomly selected for this study from a list of private hospitals in Nakuru Municipality. All the patients operated upon within the period, 1st January 2003 and 31st December 2006 formed the population for this study.

3.3 Sampling Procedures

A sampling list of patients operated upon for the treatment of Benign Prostatic Hyperplasia between 1st, January, 2003 and 31st, December, 2006 in the selected hospitals was constructed from operating theatre registers and inpatient records. Seventy three such patients were identified. Hospital records showed that thirty seven patients were operated under spinal anaesthesia while the remaining thirty six were operated under general anaesthesia. Following recommendations offered by Black (2005) all of them made the study sample.

Surgeons and anaesthetists formed the second population of this study. Since they were not numerous, all the twelve operating in Nakuru Municipality were taken as the study sample.

3.4 Definition and Measurement of Variables

This study utilized several sets of data. The first set of variables was made up of the type of anaesthesia used. General anaesthesia was coded as one while spinal anaesthesia was coded as two.

The second set of variables was anaesthetic costs. The calculation of anaesthetic costs for this study involved three related activities. The first involved the identification of the quantities of all anaesthetic gases, drugs and related items consumed by a patient within the first 24 hours of the BPH operation. Gases identified included halothane,

oxygen and nitrous oxide. Anaesthetic drugs identified comprised marcaine, ephedrine, Neostigmine, thiopental, provive, syrate, kytril, panadol, olfen, tracrium, pavulon, atropine, dormicam and apresolin. Blood giving sets, infusion sets, branular, spinal needles, syringe, endotracheal tube and intra venous fluids were also identified. The quantities of the anaesthetic related gases, drugs and other items were also extracted from the patient records. For each patient the type of anaesthesia used was identified. Then the quantities of any anaesthetic gases, drugs or related items used by each patient were noted. Any partially used unit of anaesthetic drugs was considered as a full unit.

The second activity involved obtaining the prices of anaesthetic gases, drugs and related items. The prices of the gases per unit were calculated from manufacturer's (British Oxygen Company Kenya Ltd.) price list in Kenya shillings. The prices of anaesthetic drugs and related items were also extracted in Kenya shillings from the East African Pharmaceutical Loci 2006/2007 (Kimocho, 2006). This activity eliminated the need for discounting prices as the most current trade prices were used to standardise prices.

The final activity involved the calculation of anaesthetic costs. This involved recording the quantities and prices of the anaesthetic gases, drugs or related items in a Microsoft Excel spread sheet. The cost of each unit of anaesthetic drug and related items used by each patient was calculated by multiplying the price per unit and the number of units consumed by the patient. The cost of the gases used was calculated by multiplying the amount of gas by the anaesthesia time and the unit cost. The total

cost of anaesthesia was calculated by adding the costs of all the anaesthetic drugs, gases and related items consumed by a patient.

The third set of variables for this study was the benefits and adverse effects obtained from either of the two techniques of anaesthesia. These variables included length of stay in hospital, time and the incidences of complications. The length of stay in hospital was calculated in days as the difference between date of discharge and date of surgery. Time was measured by two items. The first one was the total time taken for the surgery in minutes. The second was anaesthetic time. This was taken as the time between the onset of anaesthesia and the end of surgery. Complications were measured using an index of anaesthetic complications. This index had three levels beginning with three for the absence of any complication, two for one complication and one for multiple complications. The complications considered in this study included change in blood pressure, pain, urinary retention, blockage of irrigation, bleeding, post operative nausea and vomiting. Usually such complications occur within the first twenty hours after surgery and are directly related to anaesthesia. This complication index was used in the calculation of the incremental cost effectiveness ratio. Table 3.1 below presents this anaesthetic complication index.

Table 3.1 Anaesthetic Complication Index

Number of complications	Code
Multiple complications	1
One complication	2
None	3

The cost per episode of post operative complications avoided was calculated as the incremental cost effectiveness ratio in this study. The cost of anaesthetics used and presence of post operative anaesthetic complication index was used to calculate this incremental cost effectiveness ratio.

The age of the patients was the fourth set of variables in this study. Other variables of interest in this study were the attitudes of medical staff towards the different types of anaesthesia. These were assessed using open ended questions that captured clinicians background, beliefs and attitudes towards utilization of either spinal or general anaesthesia.

3.5 Data Collection

3.5.1 Primary Data

Primary data for purposes of the study was collected by use of a Topical Guide (Appendix 1). This research tool was administered to surgeons and anaesthetists. Personal notepads and camcorder were used to record data in the FGD. The topical guide consisted of three sets of questions. The first was on the profile of the surgeons and anaesthetists. The next set of questions related to their surgical practices. The last set of questions captured the medics' knowledge and attitudes towards both spinal anaesthesia and general anaesthesia.

3.5.2 Secondary Data

Secondary data was collected retrospectively from patient records for a period of four years from 1st January 2003 to 31st December 2006. This involved retrieving medical records of all patients who were operated for BPH within the period of interest. A

coding scheme was developed to gather this secondary data. This coding scheme was made up of two elements; a coding schedule and a coding manual. The coding schedule included items relating to the patient profile such as age, date of admission, immediate post-operative complications and date of discharge/ death/absconds. Other items in this coding schedule related to the drugs used for spinal anaesthesia or general anaesthesia and their costs. This coding schedule is given as Appendix 2.

On the other hand, the coding manual contained statements of instruction to coders that also included all the possible categories for each dimension being coded. This coding manual provided a list of all the items of interest in this study, the different categories subsumed under each item, the number (that is codes) that correspond to each category and the guidance on what each item is concerned with. It also enumerated any factors to be taken into account in deciding how to code each item. This coding manual is offered as Appendix 3. This coding scheme was developed jointly with experts in health information, anaesthesia and surgery to improve its validity and reliability.

The research instruments for this study were pre-tested on a few cases and medical staff in Naivasha District Hospital. This hospital was chosen since it caters for patients with similar characteristics as those treated by hospitals in Nakuru Municipality. These research tools were used to gather data by the researcher with the help of two research assistants. These two research assistants were trained on the topic under study and the handling of the research tools before being allowed to collect data. During data collection, the research assistants were closely supervised by the researcher. It took 14 days to collect data.

In cases where the retrieved medical records do not contain all the necessary data, the missing data was searched from wards admission registers, nurses' reports books and theatre operation registers. Only those patients whose medical records were available and complete were included in this study.

3.6 Data Presentation and Analysis

Data is presented in way of tables and charts. Means, standard deviations and frequencies are also used to present this data. Chi square (for categorical data) and t tests (for numerical data) were used to compare the cost effectiveness of spinal anaesthesia and general anaesthesia. An incremental cost effectiveness ratio was then calculated. This is a ratio of the net costs to the net health outcomes of both spinal and general anaesthesia. This ratio is illustrated in the formula:

$$(C_2 - C_1) / (Q_2 - Q_1),$$

where C represents costs associated with an intervention, Q represents effectiveness, and 1 and 2 refer to general and spinal anaesthesia, respectively.

A sensitivity analysis of this incremental cost effective ratio was conducted using the prices of pharmaceuticals as quoted by leading suppliers of medical products in Nakuru. This sensitivity analysis tested all the assumptions used in the calculation of the incremental cost effectiveness ratio. It also enabled the impact of best-case and worst-case scenarios on the baseline findings to be investigated.

Briefly, sensitivity analysis involved making systematic changes in the parameters used in the mathematical model, $((C_2 - C_1) / (Q_2 - Q_1))$, to see how they affect the outcome. By varying certain values over a reasonable range, it was possible to

examine changes in variables in the system and see how stable the system was when values were changed. Data variables for this study were coded and analyzed using the Statistical Package for Social Sciences (SPSS) Version 13.0.

The recorded conversation and moderator notes from the FGD were content analysed. The recorded conversations were initially transcribed. This data was then classified into meaningful categories based on the purposes of this study. This involved the following process. First, key words and phrases were identified. Units of data were then attached to appropriate categories manually. This involved indexing categories by recording where they occur in the moderator notes and transcripts. A search for key themes, patterns and relationships in the re-arranged data then followed. Here the categories were either subdivided or integrated as a way of refining and focusing the analysis. Finally propositions and conclusion were made based on the apparent patterns or relationship within the data.

3.7 Ethical Consideration

Clearance to conduct this study was sought from Kenyatta University, the medical superintendent of the RVPGH and the hospital administrators of Nakuru Nursing Home and Evans Sunrise Medical centre. Further, research authorization was obtained from the Ministry of Science & Technology.

4 RESULTS AND DISCUSSIONS

4.1 Introduction

The results of this study are presented in this chapter. It begins by examining the socio-demographic characteristics of the study sample. Differences in benefits and costs of spinal anaesthesia and general anaesthesia are presented next. This is followed by a calculation of the incremental cost effectiveness ratio. The attitudes of surgeons and anaesthetists towards different techniques of anaesthesia are then summarized. Finally a discussion of the results for this study is given.

4.2 Sample Characteristics

The sample for this study was made up of 73 male patients who were surgically treated for BPH between the years 2003 and 2006 in hospitals located within Nakuru Municipality. The mean age of these patients was 71.19 years with a standard deviation of 9.82 years. The modal age is 70 years. The youngest patient was 52 years while the oldest was 98 years (Table 4.1). The closeness between the mean and modal age indicates that there is little variation in the age of the sampled patients.

Table 4.1 Age statistics of sampled patients

Statistic	Age in years
Mean	71.19
Median	70
Mode	70
Standard deviation	9.82
Minimum	52
Maximum	98

Patients aged between 60 and 69 years were most numerous. This age category made

38.4% of all the sampled patients. Patients aged between 70 and 79 years were the second most numerous in this study. They made 35.5% of the study sample. Patients aged between 90 and 99 years were the least and made 5.5% of all patients in this study. Likewise patients aged between 50 and 59 years made only 6.8% of the study population. The age distributions of the sampled patients are shown in Figure 2 below. This age distribution of the sampled patients suggests that the sampled patients fall within the high BPH risk group.

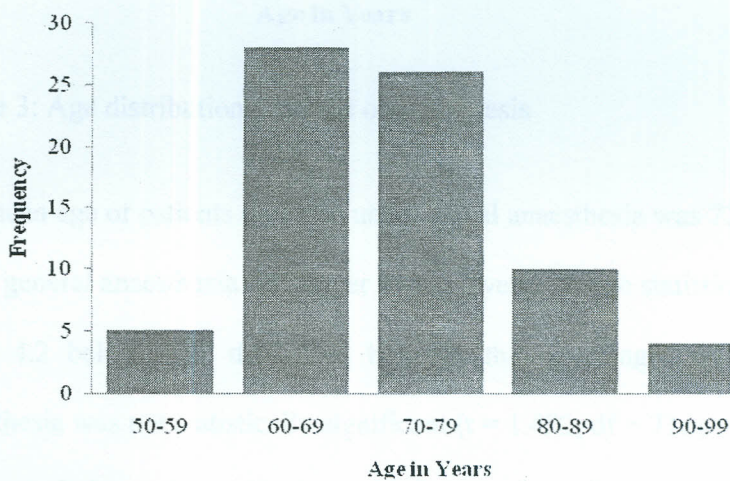


Figure 2: Age distribution of sampled patients

Thirty seven of these patients were operated under spinal anaesthesia while the other thirty six were operated under general anaesthesia. More patients aged between 50 and 59 and 70-79 years were operated under general anaesthesia than spinal anaesthesia. However there were more patients operated under spinal anaesthesia than general anaesthesia in the age groups 60-69, 80-89 and 90-99 years. The age distribution and type of anaesthesia is shown in Figure 3 below.

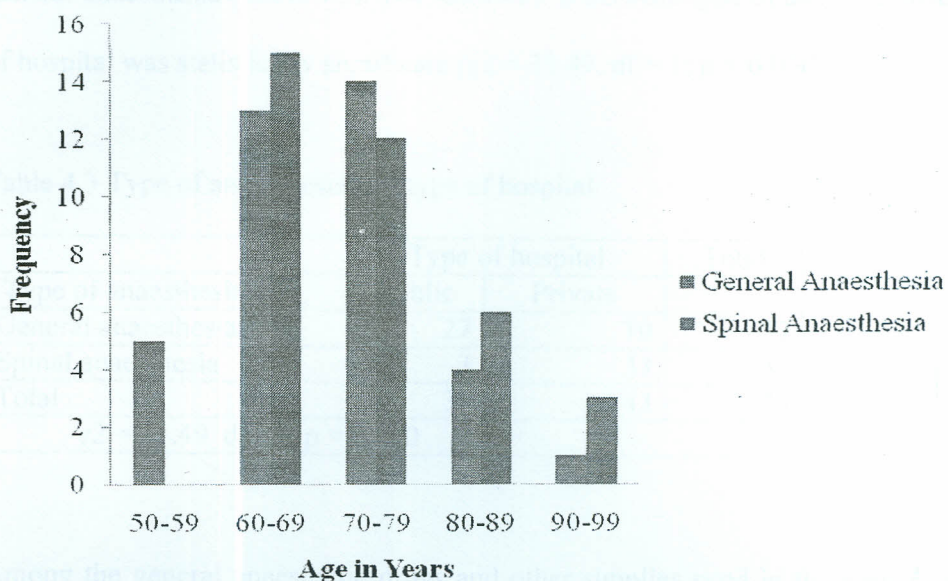


Figure 3: Age distribution and type of anaesthesia

The mean age of patients operated under spinal anaesthesia was 72.92 years while that under general anaesthesia was lower at 69.51 years. These statistics are summarised in Table 4.2 below. The difference between the mean ages of both techniques of anaesthesia was not statistically significant ($t = 1.492$, $df = 71$; $p = 0.14$). This implies that the technique of anaesthesia used is independent of the age of the patient.

Table 4.2 Mean ages of sampled patients

	Mean Age (Years)	N	Std. Deviation
General Anaesthesia	69.51	37	9.33
Spinal Anaesthesia	72.92	36	10.15
Total	71.19	73	9.83
$t = 1.49$, $df = 71$; $p = 0.14$			

Most BPH operations under spinal anaesthesia were conducted in private hospitals (76.7%). In contrast 90% of the patients in the public hospital were operated under

general anaesthesia (Table 4.3). The relationship between type of anaesthesia and type of hospital was statistically significant ($\chi^2 = 31.49$, $df = 1$; $p = 0.000$).

Table 4.3 Type of anaesthesia and type of hospital

Type of anaesthesia	Type of hospital		Total
	Public	Private	
General anaesthesia	27	10	37
Spinal anaesthesia	3	33	36
Total	30	43	73
$\chi^2 = 31.49$ $df = 1$ $p = 0.000$			

Among the general anaesthetic drugs and other supplies used in the surgery to treat BPH, Tracrium was the most expensive with an average cost of Kshs. 1182.13 (SD = 485.39) while the analgesic, panadol was the least expensive at an average cost of Kshs. 1.70 (SD = 2.40). Pethidine was prescribed to 73% of patients while olfen was prescribed to 43% (Table 4.4). Only two patients (5.4%) were given panadols. Therefore, much pain appears to be a concern for patients operated under general anaesthesia. Apresoline was given to 24% of patients operated under general anaesthesia.

Table 4.4 Drugs and supplies used in General Anaesthesia

	N	Mean (Kshs.)	Std. Deviation
Thiopental	29	79.08	15.21
Provive	2	180.50	255.26
Kytril	1	237.77	411.82
Suxamethonium	29	566.00	.000
Pethidine	27	49.73	12.36
Panadol	2	1.70	2.40
Olfen	16	127.06	32.74
Tracrium	6	1182.13	485.39
Pavulon	22	228.47	100.36
Atropine	24	7.91	2.41
Neostigmine	24	36.00	.000
Branular	37	35.00	.000
Infusion set	37	12.00	.000
IV fluid	29	162.00	64.34
Syringe	37	12.32	.45
Apresoline	9	117.911	66.85
Syrate	7	47.14	44.10
Endotracheal tube	11	227.27	75.38
Halothane	28	345.50	205.39
Oxygen	29	111.57	31.13
Nitrous oxide	28	744.98	202.09

Kytril which cost an average of Kshs. 636.88 was the most expensive drug taken by patients operated under spinal anaesthesia. This drug was prescribed to 69.4% of the patients (Table 4.5). This indicates that patients operated under spinal anaesthesia were prone to vomiting. Pethidine was prescribed to 28% of the patients operated

under spinal anaesthesia. Panadol was prescribed to 50% of such patients. This is an indicator that there was less analgesic requirement for patients operated under spinal anaesthesia.

Table 4.5 Drugs and supplies used in Spinal Anaesthesia

	N	Mean (Kshs.)	Std. Deviation
Mercaine	36	565.30	.000
Ephedrine	15	.53	2.04
Kytril	25	636.88	224.67
Pethidine	10	20.58	29.66
Panadol	18	3.57	2.33
Olfen	9	81.00	68.46
Atropine	6	2.33	3.62
Dormicum	2	13.00	48.61
Branular	36	35.00	.0
Infusion set	36	12.00	.00
IV fluid	35	196.46	273.73
Spinal Needle	36	150.00	.00
Syringe	36	12.25	.00

4.3 Differences in the Costs and Benefits of Spinal and General Anaesthesia

Two techniques of anaesthesia were considered in this study namely spinal anaesthesia and general anaesthesia. The costs of these techniques were taken to be the costs of anaesthetic drugs and related supplies used. Several benefits were examined in this study. This included the length of stay in hospital after surgery, the number of post operative complications avoided, surgical and anaesthetic time used in the treatment of BPH.

The average cost of anaesthetic drugs for general anaesthesia was Kshs. 2206.30, while that for spinal anaesthesia was lower at Kshs. 1548.60 (Table 4.6). The differences in the average costs between spinal and general anaesthesia is statistically significant ($t = 3.87$, $df = 71$; $p = 0.000$). The data suggest that it is relatively cheaper to use spinal anaesthesia for the surgical treatment of BPH.

Table 4.6 The mean costs of both spinal and general anaesthesia

	Mean (Kshs.)	N	Std. Deviation
General Anaesthesia	2206.30	37	922.30
Spinal Anaesthesia	1548.60	36	440.30
Both general and spinal anaesthesia	1881.94	73	793.20
$t = 3.87$, $df = 71$; $p = 0.000$			

The patients operated under spinal anaesthesia stayed in hospital for 7.42 days on average while those operated under general anaesthesia stayed longer at 14.62 days, as shown in Figure 4 below. The differences in length of stay in hospital for the two groups of patients was statistically significant at 95% confidence level ($t = 3.36$, $df = 71$; $p = 0.001$). The data on mean length of stay in hospital indicates that a patient takes longer in hospital when operated under general anaesthesia than under spinal anaesthesia. Such a longer stay in hospital increases the cost of treatment or expenditure on healthcare.

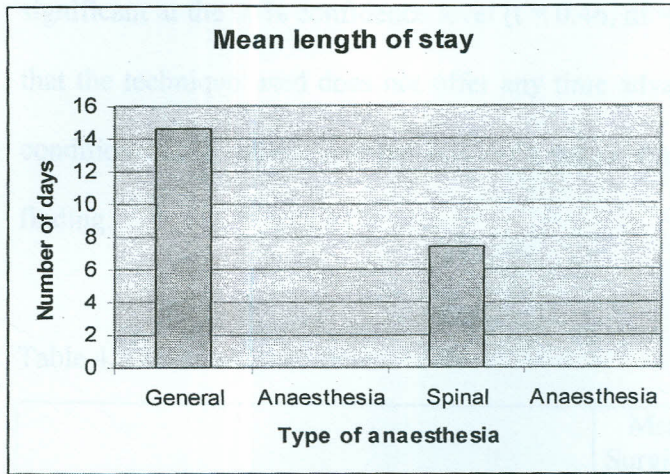


Figure 4: The mean length of stay in hospital

General anaesthesia took on average 80.74 minutes. Administration of spinal anaesthesia took slightly less time at an average of 74.83 minutes (Table 4.7). However, the differences were not statistically significant at 95% confidence level ($t = 1.11$, $df = 71$; $p = 0.270$). Therefore, the time taken to administer either technique of anaesthesia is not significantly different in this group of patients.

Table 4.7 Mean anaesthesia time

	Mean anaesthesia time (Minutes)	N	Std. Deviation
General Anaesthesia	80.74	35	20.50
Spinal Anaesthesia	74.83	36	24.10
Total	77.75	71	22.44

$t = 1.11$, $df = 71$; $p = 0.270$

With general anaesthesia it took on average 67.06 minutes to conduct surgery for the treatment of BPH. Similarly with spinal anaesthesia it took an average of 64.72 minutes to conduct the surgery. The mean surgical times for both techniques of anaesthesia are summarised in Table 4.10 below. The difference between the times taken for surgery using the two techniques of anaesthesia was not statistically

significant at the 95% confidence level ($t = 0.46$, $df = 69$; $p = 0.651$). This may imply that the technique used does not offer any time advantages to surgery; however, the condition of the patient and the operating surgeon are possible confounders for this finding.

Table 4.8 Mean surgical times

	Mean Surgical time (Minutes)	N	Std. Deviation
General Anaesthesia	67.06	35	20.17
Spinal Anaesthesia	64.72	36	22.96
Total	65.87	71	21.51
$t = 0.46$, $df = 69$; $p = 0.651$			

Patients operated under spinal anaesthesia had a mean anaesthesia complication index of 2.47 while, those operated under general anaesthesia had a lower mean anaesthesia complication index at 2.03. These means are shown in Figure 5 below.

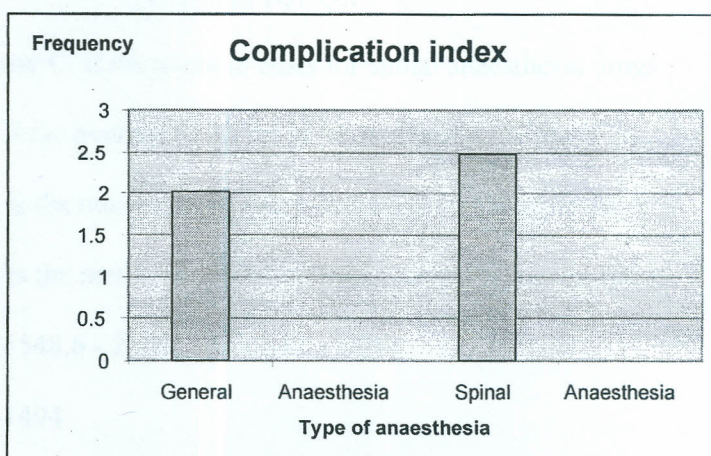


Figure 5: Frequencies of the anaesthesia complication index

The means of the anaesthetic complication index are offered in Table 4.9. The

difference between the means of the complication index in the two techniques of anaesthesia was statistically significant at 95% confidence level ($t = 2.40$, $df = 69$; $p = 0.019$). This suggests that spinal anaesthesia has less likelihood of developing intra and post operative complications, than general anaesthesia.

Table 4.9 Means of anaesthetic complication index

	Mean Anaesthesia complication index	N	Std. Deviation
General Anaesthesia	2.03	35	.79
Spinal Anaesthesia	2.47	36	.78
Total	2.25	71	.81

$t = 2.40$, $df = 69$; $p = 0.019$

4.7 The Incremental Cost Effectiveness Ratio

The incremental cost effectiveness ratio (ICER) in this study was calculated as follows:

$$(C_1 - C_2) / (Q_1 - Q_2)$$

where C_1 is the average costs for spinal anaesthesia drugs

C_2 is the average costs for general anaesthesia drugs

Q_1 is the mean complication index for spinal anaesthesia

Q_2 is the mean complication index for general anaesthesia

$$= (1548.6 - 2206.30) / (2.47 - 2.03)$$

$$= -1494$$

The negative ICER for spinal anaesthesia means that by adopting spinal anaesthesia rather than general anaesthesia, there is an improvement in anaesthetic complications

averted and a reduction in costs. This ICER means that it costs Kshs. 1494 to reduce each additional anaesthetic complication with general anaesthesia as compared with spinal anaesthesia.

4.8 Knowledge and Attitudes of Surgeons and Anaesthetists towards Different Techniques of Anaesthesia

Seven surgeons and five anaesthetists were interviewed to examine their knowledge and attitudes towards different techniques of anaesthesia. Four of these respondents had over ten years working experience; three had working experience of between 5 and 10 years, while the remaining five respondents had less than five years experience. Seven of the respondents work in public hospitals, four in private hospitals and one work in a Non Governmental Organisation (NGO). The respondents said that they handle such patients.

Two major themes emerged from the content analysis of the FGD. The first theme was on the low incidence of usage of spinal anaesthesia, while the second was on merits of spinal anaesthesia.

The Usage of Spinal Anaesthesia

Only one participant indicated that he uses spinal anaesthesia very often. "I rarely use general anaesthesia in the surgical treatment of BPH," he said. The remaining eleven indicated that they use spinal anaesthesia only on a few occasions. This suggests that the incidence of usage of spinal anaesthesia among medical professionals in Nakuru Municipality is low.

Two respondents rated the application of spinal anaesthesia as very favourable, while six of the respondents rated it as favourable. One said that the usage of spinal

anaesthesia is not favourable. "It is not realistic in third world conditions where patients fear surgery, further awake patients denies us the freedom to communicate freely while operating" he argued. Another participant was non committal. "The decision on whether to use either spinal or general anaesthesia should be made on a case by case basis" he observed. This suggests that the surgeons and anaesthetists in Nakuru Municipality consider spinal anaesthesia as a favourable anaesthetic technique. However, there are strong individual differences in the perceptions on whether spinal anaesthesia is favourable. It can be concluded that preference may be the major issue behind the medics' failure to use spinal anaesthesia.

Merits of Spinal Anaesthesia

The respondents gave various reasons why they consider spinal anaesthesia to be a favourable technique to general anaesthesia. A third of them mentioned that it is less costly. A respondent explained that the administration of general anaesthesia is relatively costly. "The equipments and gases used are expensive," the participant observed. Another objected "there is no hospital in Nakuru that does not have enough facilities to support any kind of anaesthesia chosen." Another respondent observed that "the type of anaesthesia used has effects on cost of care given to patients." This is an indication that cost is an important factor in the choice of anaesthetic technique.

Respondents also noted that spinal anaesthesia is suitable for given cases. Other reasons given include quick post anaesthetic recovery, age of the patient, availability of drugs, safety and the general condition for patient. This indicates that the surgeons and anaesthetists in Nakuru Municipality have general knowledge on the benefits of spinal anaesthesia. However, the reasons for the favourable attitude towards spinal

anaesthesia appear to differ from respondent to respondent. This suggests that limited knowledge on the benefits of spinal anaesthesia is not the reason for their apparent low incidence of usage of the technique.

The respondents were in agreement that spinal anaesthesia is easy to perform. They also indicated that it takes less time to administer spinal anaesthesia. There were mixed reactions on the response on the level of expertise required to administer spinal anaesthesia. One respondent argued strongly that the administration of spinal anaesthesia does not call for a lot of expertise, "this technique can be done by any person trained in medicine," he observed. Another disagreed and said that "spinal anaesthesia requires expertise; failure to inject correctly may lead to change in body pressure which result in a headache to the patient and injury to the cord." Another objected and said, "such skills can be learnt with time." Generally these results indicate that the surgeons and anaesthetists in Nakuru Municipality consider spinal anaesthesia to be an easy anaesthetic technique.

The respondents were in agreement that few patients operated under spinal anaesthesia develop intra and post operative complications. A respondent argued that "few patients operated under spinal develop complications." A second noted that the headaches that occur are a result of poor handling of the technique. It can thus be argued that, spinal anaesthesia has less intra and post operative complications.

The respondents strongly agreed that the application of spinal anaesthesia should be encouraged over general anaesthesia whenever indicated. This indicates that the surgeons and anaesthetists in Nakuru Municipality consider spinal anaesthesia as an appropriate anaesthetic technique.

The above observations imply that the three attributes, namely cost, ease of technique and least complications are important merits of spinal anaesthesia from the point of view of surgeons and anaesthetists. Any attempts to popularise spinal anaesthesia can present the technique in this light.

4.9 Discussions

The mean age of the patients in this study was 71.19 years with a standard deviation of 9.8 years. The youngest patient was 52 years while the oldest was 98 years. This age distribution suggests that the sampled patients fall within the high BPH risk group. Previous studies suggest that 50% of men above 50 years and 90% of men above 70 years suffer from BPH (Porter and McCormick, 2003). BPH is an emerging disease in Kenya that calls for urgent attention. Men of advanced ages are usually dependants; hence, whenever they fall sick, it is prudent to use medical techniques and interventions that are cost effective. Besides BPH, patients in this age bracket suffer from numerous chronic degenerative illnesses and metabolic disorders, which make the choice of cost effective anaesthetic techniques critical.

The average cost of anaesthetic drugs for general anaesthesia was Kshs. 2206.30. while that of spinal anaesthesia was lower at Kshs. 1548.60. The difference in these costs was statistically significant. This means that it is relatively cheaper to use spinal anaesthesia for the surgical treatment of BPH. This finding collaborates with the results of Forssblad *et al.*, (2004) that different techniques of anaesthesia have different costs. However, it disagrees with results reported in Chilvers *et al.*, (2000) that there are no differences in costs of different anaesthetic techniques in Canada.

Differences in opinion on this subject most likely arise from differences in the samples used. This study focused on inpatients, whereas the study in Canada was done in a day care centre. Despite the differences, this study shows that it costs less to subject patients to spinal anaesthesia in the surgical treatment of BPH.

The patients operated under spinal anaesthesia stayed in hospital for 7.42 days on average after surgery. Those operated under general anaesthesia stayed longer at 14.62 days. The difference in length of stay in hospital for both groups of patients was statistically significant. This indicates that patients take twice as long in hospital when operated under general anaesthesia than under spinal anaesthesia. Such a longer stay in hospital is not desirable, since it means that optimal usage of resources is compromised by the choice of an anaesthetic technique. This finding disagrees with results reported in Forssblad *et al.*, (2004) and Chilvers *et al.*, (2000) who found that patients operated using spinal anaesthesia took longer in hospital than those operated under general anaesthesia. The differences in these findings probably arises from differences in the measurement of the length of stay in hospital variable or the characteristic of patients. It is also possible that the differences arise due to the type of ailments addressed in the different studies.

The duration of general anaesthesia was 80.74 minutes. Administration of spinal anaesthesia took slightly less time at an average of 74.83 minutes. However, the differences for the two types were not statistically significant. Furthermore, general anaesthesia took an average of 67.06 minutes to complete surgery in the treatment of BPH. Similarly, it took an average of 64.72 minutes with spinal anaesthesia to conduct the surgery. The difference between the times taken for surgery using both

techniques of anaesthesia was not statistically significant. These findings agree with results reported in Forssblad *et al.*, (2004), but disagree with those reported in Ozgun *et al.*, (2002) and Chilvers *et al.*, (2000). The differences in these findings can be explained by differences in the underlying medical conditions or professional variability of the surgeons.

Patients operated under spinal anaesthesia had a mean of 2.47 on the anaesthesia complication index. Those operated under general anaesthesia had a lower mean anaesthesia complication index at 2.03. The difference between the means of the complication index in the two techniques of anaesthesia was statistically significant. This means that the utilization of spinal anaesthesia for the surgical treatment of BPH has a lower likelihood of developing anaesthetic complications when compared to general anaesthesia. These results agree with those reported in Ozgun *et al.*, (2002) who recorded lower incidences of nausea and urinary retention with the utilization of spinal anaesthesia. However, the results are in disagreement with those reported by Gilbert *et al.*, (2002) that general anaesthesia is possibly better in affording better outcomes. Differences in opinions arise due to the way the variable outcome is operationalised in different studies. This study focused on short-term outcomes, whereas the focus of the study by Gilbert *et al.*, (2002) was on long term outcomes.

In this study an incremental cost effectiveness ratio of -1494 was obtained. The negative ICER for spinal anaesthesia means that by adopting spinal anaesthesia rather than general anaesthesia there is an improvement in anaesthetic complications averted and a reduction in costs. This ICER means that it costs Kshs. 1494 more to reduce

each additional anaesthetic complication with general anaesthesia as compared with spinal anaesthesia.

Until now, there has been uncertainty and conflicting opinions among anaesthetists about the impact of different anaesthetic techniques and the associated costs. The main conclusion of this study is that general anaesthesia is less cost-effective anaesthetic technique for BPH surgery when anaesthetic complications are used as the primary outcome measure. In the elderly, spinal anaesthesia provided the lowest cost, without significantly higher anaesthetic complication rates. This study shows considerable differences in the anaesthetic costs and short-term impact on anaesthetic complications, of different anaesthetic techniques, but no differences in surgery and anaesthetic times. Furthermore, this study indicates that the use of different anaesthetics techniques has effects on the length of stay in hospital. Important results from this study for decision-makers are that there are differences in variable costs between spinal anaesthesia and general anaesthesia indicating that choice of different anaesthetic techniques will translate into secondary care budget differences. Thus, the choice of anaesthetic technique has an increasing impact upon hospital budgets in Nakuru Municipality.

Surgeons and anaesthetists in Nakuru Municipality consider spinal anaesthesia as a favourable anaesthetic technique. They also consider spinal anaesthesia to be a cost effective, easy and appropriate anaesthetic technique. Further, they associate this technique with fewer intra and post operative complications. However, they rarely use it. This may be explained by facts induced from FGDs, that some Surgeons and anaesthetists find spinal anaesthesia tedious, and operating on awake patients not

offering a friendly atmosphere in theatre, since they cannot discuss other issues openly. A probable explanation is that surgeons and anaesthetists have not been able to break the tradition of using general anaesthesia. This may require sensitizing them on the benefits of spinal anaesthesia. Another possible reason is the unavailability of spinal kits. This may require concerted efforts towards availing these kits.

5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Anaesthesia has been cited as one of the medical practices that escalate the cost of and expenditure on healthcare. In view of this, spinal anaesthesia has been proposed as a method that can lower surgical costs. However, medics in Kenya are yet to fully embrace spinal anaesthesia. The reasons for the low usage rates of the spinal anaesthesia are not well known. This study set out to compare the cost-effectiveness of spinal anaesthesia and general anaesthesia and to identify factors that explain the low utilization rates of spinal anaesthesia among medics in Kenya.

This study adopted the survey approach to compare the cost effectiveness of the two techniques. The population for this study was drawn from three hospitals within Nakuru Municipality. RVPGH was chosen purposively to represent public hospitals in Kenya. The other two hospitals were chosen randomly. Patients operated for Benign Prostatic Hyperplasia (BPH) within the period 1st January 2003 and 31st December 2006 in the three hospitals formed the population for this study. A sampling frame of these patients was constructed from hospital records. Seventy three such patients were identified. Hospital records showed that thirty seven patients were operated under spinal anaesthesia, while the remaining thirty six were operated under general anaesthesia. Since they were considered to be few, all of them were taken to be the study sample. Surgeons, anaesthetists and administrators/proprietors formed the second population of this study. Since they were not numerous, all the twelve operating in Nakuru municipality were taken as the study sample.

The data for this study was collected by way of document analysis. A coding scheme was developed to gather this secondary data. A questionnaire was administered to a sample of surgeons, anaesthetists and administrators/proprietors in order to collect their perceptions on spinal and general anaesthesia. The research instruments for this study were pre-tested on a few cases, patients and medical staff at Naivasha Sub-District Hospital. These research tools were used to gather data by the researcher with the help of two trained research assistants. Student's t-tests and chi square were used to test differences and compare data on the costs and effectiveness of spinal anaesthesia and general anaesthesia. A ratio of the net costs to the net health outcomes of both spinal and general anaesthesia was calculated. Data variables for this study were coded and analyzed using the statistical software package SPSS Version 13.0.

The mean age of the patients in this study was 71.2 years with a standard deviation of 9.8 years. This age distribution suggests that the sampled patients fall within the high BPH risk group which makes the choice of cost effective anaesthetic techniques critical.

The average cost of anaesthetic drugs for general anaesthesia was Kshs. 2206.30 while that of spinal anaesthesia was lower at Kshs. 1548.60 and the difference was statistically significant. Patients operated under spinal anaesthesia had on a mean of 2.47 on the anaesthesia complication index. Those operated under general anaesthesia had a lower mean anaesthesia complication index at 2.03. Likewise the difference in the anaesthesia complication index between both techniques was statistically significant. This study shows considerable differences in the anaesthetic costs and short-term impact on anaesthetic complications for the two anaesthetic techniques, but

no differences in surgery and anaesthetic times. Furthermore, this study indicates that the use of different anaesthetics techniques affects the length of stay in hospital after surgery by patients.

The results of this study support the body of literature that holds that different techniques of anaesthesia have different costs. However, it is at variance with the alternative body of literature that suggests that different techniques of anaesthesia may not necessarily have different costs. In this study, an incremental cost effectiveness ratio of -1494 was obtained. The negative ICER for spinal anaesthesia means that by adopting spinal anaesthesia rather than general anaesthesia there is an improvement in anaesthetic complications averted and a reduction in costs. This ICER means that it costs Kshs. 1494 to reduce each additional anaesthetic complication with general anaesthesia when compared to spinal anaesthesia. This finding indicates that healthcare providers can realise some savings by adopting cost effective techniques such as spinal anaesthesia. Such savings can be redirected to other deserving healthcare needs.

5.2 Conclusions

Until now there has been uncertainty and conflicting opinions among anaesthetists about the impact of different anaesthetic techniques and the associated costs. The main conclusion of this study is that general anaesthesia is a less cost-effective technique for BPH surgery when anaesthetic complications are used as the primary outcome measure. In the sampled patients, spinal anaesthesia provided the lowest cost and the lowest anaesthetic complication rates. Further, this study shows considerable

differences in the anaesthetic costs and short-term impact on anaesthetic complications, of different anaesthetic techniques, but no differences in surgery and anaesthetic times.

This study also indicates that the use of different anaesthetic techniques affects the length of stay in hospital after surgery. Important results from this study for decision-makers are that there are differences in variable costs between spinal anaesthesia and general anaesthesia indicating that the choice of different anaesthetic techniques will translate into secondary care budget differences. The choice of anaesthetic technique has an increasing impact upon hospital budgets around Nakuru Municipality.

Surgeons and anaesthetists in Nakuru Municipality consider spinal anaesthesia to be a cost effective, easy and appropriate anaesthetic technique. However, they rarely use it. These observations are inconsistent and warrant further investigations. This study attributed this inconsistency to the conservativeness of surgeons and anaesthetists in Nakuru Municipality and the unavailability of spinal kits. This study has provided important information that is vital in both healthcare management and healthcare policy development.

The usage of a CEA framework was found to be appropriate. However, such a design produced partial results. To address this concern interviews with a sample of surgeons and anaesthetists in Nakuru Municipality offered richer insights. The combination of both CEA and a stakeholder survey in this study is an important methodological contribution of this study.

5.3 Recommendations

Four recommendations are offered in light of the above conclusion. First, there is need to sensitize the medics on the usage of spinal anaesthesia where indicated as a beneficial way of controlling healthcare costs. This can be achieved through seminars or continuing medical education. Any attempts to popularise spinal anaesthesia should present the technique in the light of an easy, cost effective technique that has minimal complications. Moreover, there should be a review in medical curriculum in training medical personnel on economic evaluation of medical techniques and interventions.

Second, there is need to investigate why medical personnel in Nakuru Municipality have favourable perceptions on the costs and benefits of spinal anaesthesia yet they do not use it. If it is conservativeness, then medical sensitization is necessary. On the other hand, if it is a case of unavailability of spinal kits then barriers to access and availability of spinal kits should be identified and addressed.

Third, there is need to sensitize healthcare providers, that is surgeons and anaesthetists on the benefit of spinal anaesthesia. Advocacy targeting on policy makers to avail necessary equipments such as spinal kits in public hospitals. Future research may consider using different research design such as prospective studies and using other ailments. Such studies will be helpful towards healthcare policy development in Kenya.

Finally, directions for future research deserve mention. This study was done in only one municipality in Kenya using a small sample size. The results of the study cannot be fruitfully generalized into wider contexts. This means that wider studies that may

involve other parts of the country are urgently needed. Future studies can also focus on other diseases particularly those that affect regions below the umbilicus. Examples of diseases that can be targeted are hernias, delivery using the caesarian section, hip fractures, and knee injuries. In addition future studies can examine cost effectiveness of different techniques of anaesthesia using prospective controlled trials. The latter is particularly important as it will allow the control of important variables that may confound results.

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APPENDIX 1

TOPICAL GUIDE

Put a tick [✓] in the box against your chosen response.

1. (a) What is your position/rank?

Surgeon [] Anaesthetist []

(b) How long have you held the position/rank above?

Less than 1 year []

1-5 years []

5-10 years []

More than 10 years []

2. What category is your hospital?

Public [] Private [] Other [] Specify

3. In what of the following hospital categories does your hospital belong?

Less than 50 bed capacity []

50-100-bed capacity []

More than 100 bed capacity []

What is your weekly admission of surgical cases?

1-10 Patients []

10-20 Patients []

20-30 Patients []

More than 30 Patients []

5. Do you ever use spinal anaesthesia in your surgical cases? (b) If Yes, how often do you use it?

6. (a) How do you rate the application of spinal anaesthesia to general anaesthesia?

(b) What would you say is the reason behind your choice of spinal anaesthesia?

7. What would you say are the major indicators of what anaesthesia should be used on different patients?

8. What are the merits of spinal anaesthesia?

9. What are the major concerns of spinal anaesthesia?

10. What are the characteristics of a good anaesthetist?

APPENDIX 2

CODING SCHEDULE

Case No.	Age	Gender	Operation	Admission Date			Medical investigations	Diagnosis	Type of anaesthesia	Cost of anaesthesia	Date of discharge /abscond/death		
				Day	Mnt	Yr					Day	Mnt	Yr

APPENDIX 3

CODING MANUAL

Age - Age of patient in years

Admission date - Day _____ Month _____ Year _____ Time _____

Medical Investigations - Tests conducted

Diagnosis - Describe the diagnosis

Operation - Identify the type of operation conducted if any.

Types of anaesthesia – General anaesthesia = 1
Spinal anaesthesia = 2
Local anaesthesia = 0

Outcome - Identify the results of the treatment

Date of discharge - Day _____ Month _____ Year _____

Number of days spent in hospital - Subtract day of admission from date of discharge

Analgesics - The type of analgesics used

Pharmaceutical costs - Cost of anaesthesia in Kshs.

Anaesthetic time - Time taken in minutes to administer analgesics

Surgery time - Time taken for the surgery in minutes

Recovery time - Time taken in days by patient to recover

Complications – Multiple complications (Anti-emetic + nausea + urinary retention) = 1

Any one complication = 2

No complication = 3

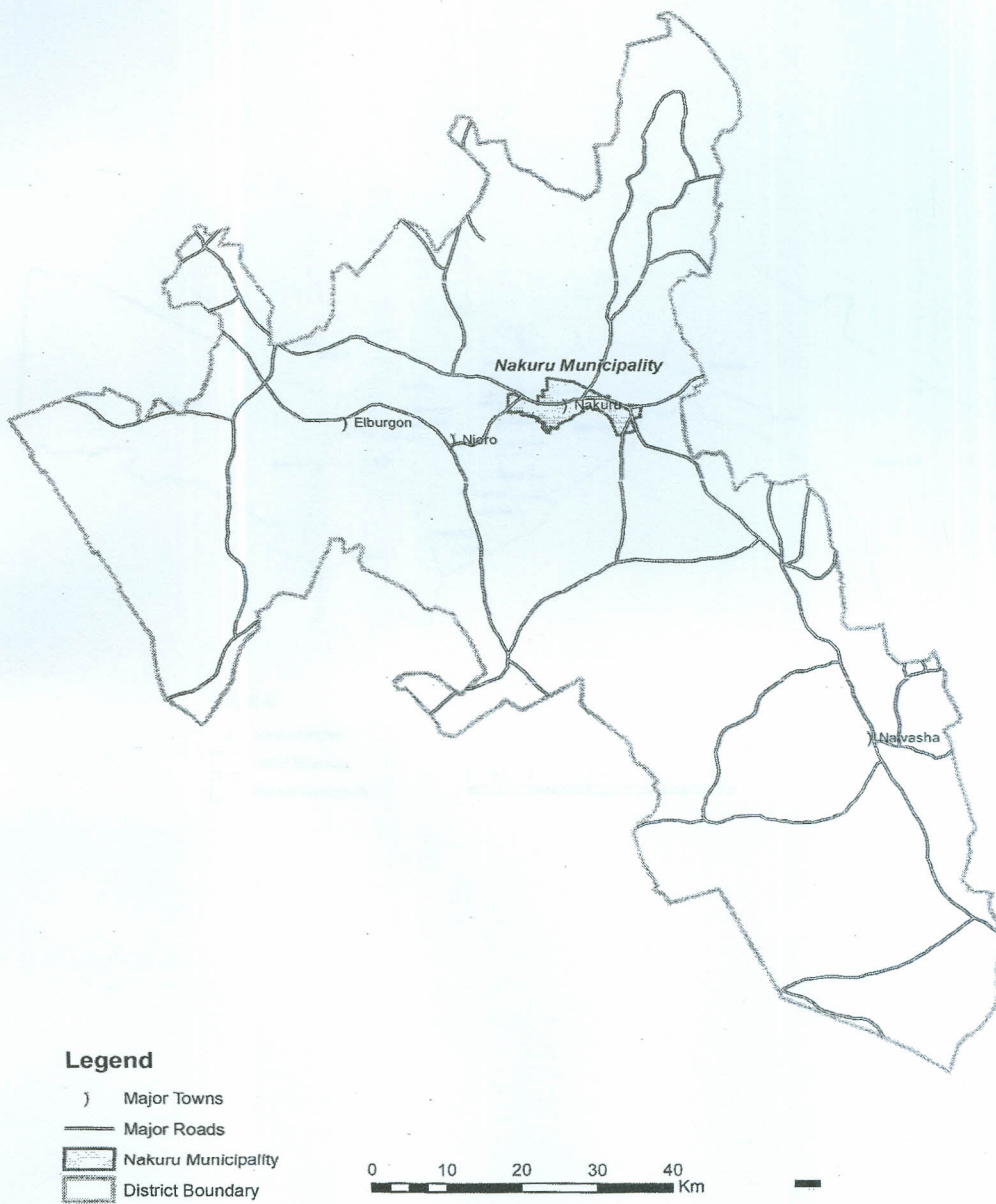
APPENDIX 4

POSITION OF NAKURU DISTRICT IN KENYA



APPENDIX 5

POSITION OF NAKURU MUNICIPALITY IN NAKURU DISTRICT



APPENDIX 7



REPUBLIC OF KENYA
MINISTRY OF SCIENCE & TECHNOLOGY

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JOGOO HOUSE "B"
HARAMBEE AVENUE,
P.O. Box 9583-00200
NAIROBI

When Replying please quote
Ref. MOST 13/001/ 37C 544/2

16th August 2006

John N. Macai
Kenyatta University
P.O. Box 43844
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on, '*Cost Effectiveness of Spinal Anaesthesia and its Impact on Health Care Expenditure: Case of Hospitals in Nakuru Municipality Kenya*'

I am pleased to inform you that you have been authorized to carry out research in Nakuru Municipality for a period ending 30th November 2007.

You are advised to report to the District Commissioner, the District Education Officer Nakuru and the Medical Officer of Health Nakuru District before embarking on your research project.

On completion of your research, you are expected to submit two copies of your research report to this office.


M. O. ONDJEKI
FOR: PERMANENT SECRETARY

Copy to:

The District Commissioner
Nakuru District

The District Education Officer
Nakuru District

The District Medical Officer of Health
Nakuru