' ANALYSIS OF COSTS OF PROVIDING MAXILLOFACIAL SURGICAL SERVICES AT THE OPERATING THEATRE OF THE UNIVERSITY OF NAIROBI DENTAL HOSPITAL IN THE YEAR 2005/2006. 11

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DECLARATION.

This dissertation is my original work and has not been presented for a degree in any other university.

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   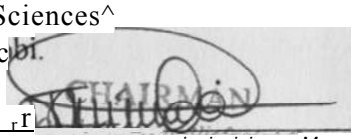

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   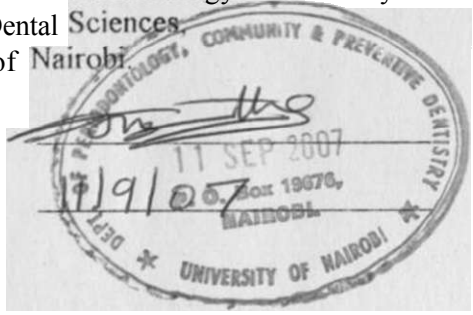

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DEDICATION

I dedicate this dissertation to my dear wife Dr. Stella Kimotho and our lovely children Vanessa and Keith .

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LIST OF ABBREVIATIONS.

ABC - Activity- based costing.

AFC - Actual full costs.

AMC - Actual minimum costs.

ASLC - Actual sustainable local costs.

BDS - Bachelor of Dental Surgery.

DAAD- Deutscher Akademischer Austauch Dienst

FFDRCS - Fellow of the Faculty of Dental Surgery, Royal College of Surgeons

IV - Intravenous.

K.NH- Kenyatta National Hospital.

KSh - Kenya shillings.

M^2 - square metres

ORJF- Open reduction and internal fixation.

PGD - Post-graduate diploma.

PhD - Doctor of philosophy

RCC - Ratio of costs- to-charges.

RVU - Relative value units

SPSS - Statistical Package for Social Sciences

STI - Sexually transmitted infections.

TMJ- Temporomandibular joint.

UC - Unit cost

UNDH - University of Nairobi Dental Hospital.

UON - University of Nairobi.

USD - United States Dollars.

ABSTRACT.

Objective: To determine the costs and sustainability of providing surgical services at an operating theatre of a teaching hospital providing maxillofacial surgical services.

Study Design: Retrospective top-down cost analysis.

Study Area: The operating theatre of the University of Nairobi Dental Hospital (UNDH).

Study population: All surgical procedures carried out in the financial year 2005 - 2006.

Methodology: With reference to financial year 2005 - 2006 (1rt June 2005 - 31st may 2006) the major costs incurred by the University of Nairobi to conduct surgical procedures at the operating theatre of the UNDH were sought. The costs were grouped into two broad categories: fixed costs and variable costs Fixed costs were those costs that did not vary with output. Variable costs were those that varied with output The fixed costs that were analyzed included medical equipment, recurrent items, full-time theatre personnel, buildings and maintenance. The variable costs that were analysed included consumable items, utilities and variable labour costs. The main sources of information were the existing hospital records. Updating of inventories of capital items was done. Computations were based on current prices. The data were entered into a computer and the analysis done using the MS-Excel and the SPSS Version 12.0 programs. The costs that were computed included the actual full costs (AFC), the actual sustainable local costs (ASLC), the actual minimum costs (AMC), the unit cost (UC) of a surgical procedure and the UC of a procedure-hour.

Results: The AFC was KSh 5,659,638 The ASLC was KSh 4,826,488 while the AMC was KSh 4,017,124 Based on the AFC the UC of an operation was KSh 51,923 and the UC of an operating-hour was KSh 18,417. The total revenue generated was KSh 1,177,400 representing 29.3% of the AMC.

Conclusion It was concluded that the establishment did not meet the criteria for sustainability. Factors that appeared to contribute to this situation included low utilization of the available resources and low levels of revenue generation.

CHAPTER 1.

1.1. INTRODUCTION AND LITERATURE REVIEW.

Analysis of Hospital Costs.

In both developing and industrialized countries hospitals are viewed as vital and necessary resources. As such hospital management has a responsibility to the community to provide health-care services at an acceptable level of quality and at the least possible cost[1]. Cost finding and cost analysis are the techniques of allocating direct and indirect costs of services rendered by the hospital. Consequently this involves manipulating and rearranging the data and information in existing accounts in order to obtain the cost of these services' Economists define cost as the value of resources used to produce a good or service so that financial costs represent actual monetary flows of goods and services purchased[2]. Two concepts of cost have been described: financial costs and economic costs. Financial costs represent actual monetary flows for purchase of goods and services. Economic costs recognize that the use of resources for one purpose also means that these resources are then unavailable for productive use elsewhere[2]. In analyzing costs of healthcare one key consideration is whose costs are being measured in that the hospital with a fixed budget or a fixed reimbursement regime cares about the costs of providing care[3]. Two fundamental items of financial data needed by a hospital manager are allocated costs by cost centre (a program or department within a hospital) and the unit cost of hospital services[4].

Hospital costs can be categorized into two types: fixed and variable[5]. Fixed costs are those that do not change over the short term with changes in output and, therefore, are not saved by a hospital if a particular service is not supplied. Variable costs are those that do change with output and can be saved by the hospital if a service is not provided[5]. There exist many methods of analyzing costs of hospital services. Such methods include ratio-of-costs-to-charges method (RCC), relative-value-units method (RVU) and activity-based costing (ABC) method[6-7"8]. They can broadly be categorized into two: indirect methods such as the RCC and direct methods such as the ABC. This depends on whether the actual resources utilized in the production of a good or service have been analyzed[9]. The "Bottom-up" approach also known as micro-costing consists of identifying and costing

the resources that are used on a specific patient The "Top-down" approach starts with total expenditures and then divides these by a measure of total output[10]. Two key factors influence the choice of method used. The first is the purpose of the analysis. The second is the type of data available[4]. Another important consideration is the cost of the method used". While using cost data to improve management of an individual hospital there are two levels of decision-making at which the data may be utilized: Cost-centre level and hospital level[12]. At the department level, the major uses of cost analysis include calculation of unit cost and cost variances as measures of efficiency. Another possible use of cost information is the development of cost-conscious clinical guidelines[13, ,4].

Background Information.

The University of Nairobi Dental Hospital (UNDI1) is located on a 2.5-acre plot situated between Valley Road and Argwing's -Khodek Road in the Upper Hill region of the Nairobi Province in Kenya'[5, 16]. It comprises of a main hospital building and a 9-bed-capacity ward as the main permanent structures (Appendix I). In the compound there is also a wooden structure that serves as the cafeteria and also houses some offices for teaching staff. The main hospital building is a two-storey permanent structure. It was built before the Second World War[15]. It was acquired from the former Princess Elizabeth Maternity Home in 1976 and handed over to the then Department of Dental Surgery within the Faculty of Medicine. It was then renovated and equipped to become a dental hospital then at a cost of United States Dollars (USD) 4.7 million with the financial and material support from the Government of the Federal Republic of Germany[15]. At the completion of the rehabilitation, the hospital had 52 new dental units in various operation clinics, a central sterilization unit, a library, laboratories, lecture theatres and offices. It is connected to mains electricity, wire telephone and piped water.

On 3rd July 1995, the Department of Dental Surgery attained the faculty status. In 2006 the name was changed to the University of Nairobi School of Dental Sciences. The school is organized into four main departments all of which are accommodated in the hospital's main building. The departments include Conservative and Prosthetic Dentistry, Paediatric Dentistry and Orthodontics, Periodontology/Community and

Preventive Dentistry and the department of Oral and Maxillofacial Surgery/Oral Pathology and Oral Medicine. Being a public teaching hospital, its three objectives are teaching, research and public service[15,16]

The operating theatre at the UNDU, which occupies the southern wing of the ground floor of the main hospital building, is partitioned into a reception area, changing rooms, toilets, a tea room, the minor operating room, the main operating room, a recovery room, a sluice room, a sterile supplies store and a general storage room. The theatre commenced with operations in 1995. Between then and the end of the year 2005, it had a patient population averaging 133 patients per year. Most of the procedures conducted at the theatre are oral and maxillofacial surgical procedures. The rest are dental procedures mainly in children or other groups of patients who require general anaesthesia. Its full time staff comprises of four nurses, one theatre assistant and one cleaner The consultant surgeons are either full-time members of the teaching staff of the university or honorary lecturers from the Kenyatta National Hospital (KNH) with which the university has a memorandum of collaboration. In a typical operation, registrars who would be post-graduate students at the university would assist the surgeon. The anaesthetists are all full-time members of the teaching stalTof the university. They conduct procedures both at the UNDH and at the KNH. Occasionally their students assist them

Cost recovery efforts at the theatre comprise of a two-tier system of user fees (theatre charges). The subsidized fee category patients, who constitute the majority, are charged a fixed fee of KSh 8,000 for the first hour and thereafter KSh 500 for every additional hour of operation. The non-subsidized fees category (private) patients are those patients who wish to retain the right of choosing their surgeons They are charged KSh 12,000 for the first hour and thereafter KSh 2,000 for every additional hour of operation Where implants for fixing or reconstructing bones are required the patients are required to buy their own otherwise they are charged separately for them Administratively the theatre is part of the department of Oral and Maxillofacial Surgery Its day-to-day administration is, therefore, the responsibility of the chairman of that department who is a member of the teaching stafT of the university The theatre shares with the rest of the hospital utilities such as water, electricity and telephone services. Technicians who are permanent

employees of the university perform most of the maintenance and repair work They are responsible for maintenance work for the entire hospital.

Review of literature on the methods of cost analysis.

While reviewing the literature on the subject of cost analysis one observation is the wide variation in the methods of analysis used by different authors. The following is a brief description of the various issues of contention among various studies and the compromises various authors have suggested

The bottom-up versus the top-down approaches.

Dawkinun et al.[1] described these as the two main categories of methods for costing hospital services. The bottom-up approach, also known as micro-costing, consists of identifying and costing the resources that are used by a specific patient. Though this approach gives data on inter-patient variation, it requires more intensive primary research and cannot necessarily be generalised to other patients. Top-down costing, on the other hand, starts at the top with total expenditures and then divides these by a measure of the total output including patient visits, admissions and procedures to give an average cost per unit of the throughput. One limitation of this method is that no adjustments are made for differences in patient characteristics that are likely to affect resource utilization (case-mix). However, it offers reliable mean estimates, is easier to carry out and thus more popular.

Defining cost centres and units of output.

Rigby[1"], while describing the similarities and differences in how the cost centres were constituted at five teaching hospitals it was acknowledged that there existed wide variations in the methods used. Posing the question whether these methodological variations made material difference to the ability to compare costs at various hospitals, it was asserted that the accounting information derived from these studies would be better for internal management rather than for comparison between hospitals This variation in the choice of final cost centres and units of output was also apparent between the studies by Puglisi et al in Lesotho and Gerard et al in Equador which were discussed by Shepard et al [9].

Computing the cost of capital items.

Shepard et al.[12] defined capital assets as those assets having an economic useful life exceeding one year and not acquired primarily for resale. According to Walker et al [12] an item required to have a unit cost greater than USD 100 to be considered capital item. If one decides to measure the cost of eventually replacing capital items then several factors must be considered for each asset[4]; The assets' total life: While most authors consistently assigned the total life of vehicles to be 5 years[4,10,21], there was variation in the assigned total life of other capital items. While Murru et al[21] used 30 years as the life of a building, Dawkinun et al.[10] used 50 years. For medical equipment Murni et al.[21] used a life of 5 years while Dawkinun et al.[10] used 15 years. For furniture, Dawkinun et al [10] used 20 years while Shepard et al [12] suggested 10 years. Straight-line depreciation versus annual economic cost: Depreciation is the amount of capital that is "used-up" in a year[2]. The simplest approach to depreciation is the straight-line depreciation[2] This method was used by Dawkinun et al [10] Murru et a!.[21] used annualized economic costs. This method estimates an average combination of depreciation and interest on the un-depreciated portion and is, therefore, more useful for an economic analysis[2]. The interest on the un-depreciated portion is based on the return to a local savings account[4]. This approach has been criticized as being unrealistic in many developing countries where public hospitals lack authority to save this way. Whether capital costs should be included in the results. Shepard et al [12] commented that given the uncertainty associated with measurements of capital costs it may be advisable to present two sets of results, one including capital cost and the other excluding it.

Determining the cost of buildings.

Murru et al.[21], as well as Dawkinun et al.[10] costed buildings using the surface area in square meters. This they multiplied by construction cost per square meter, which was derived from building contractors. Brook[20] recommended that the measurement of the surface area of a building be done using the internal face of the outer walls. To derive annual costs, Dawkinun et al.[1"] used linear depreciation based on an assumed life of a building of 50 years while Murru et al [21] used annualized economic costs using an assumed life of 30 years and a discount rate of 3%.

Computing personnel costs.

Salaries: Shcpard et al.[12] asserted that one should use actual salary amounts paid to hospital employees. However, sometimes these data may not be available. In such cases individual salaries may be approximated using the mid-point of the salary range of the employees' classification level However, it was pointed out that a study in Nigeria found the true salaries to have been consistently lower than the midpoint by as much as 30%[12].

Fringe benefits: In principle, fringe benefits received by personnel as part of their employment should be included as part of the total payroll cost[4] They should include such benefits as gratuities and employee's share of hospital fees.

Unpaid work time: Shepard et al [4] pointed out that to obtain a full, accurate picture of personnel costs of a hospital one may be interested in unpaid work-time or volunteer time. It was reported that a Colombian study had found that unpaid work time along with fringe benefits accounted for 40% of the true personnel costs.

Excluded activities: Shepard et al.[12] described two categories of personnel activity that should be excluded from the unit cost computation. The first category comprised of activities not involved in patient-care the prime example being teaching. The other category comprised of those activities that are not under the control of the hospital. A good example of the latter would be immunization campaigns implemented by the central government. Vatanasapt et al.[20] excluded the costs of teaching personnel because it was found to be difficult to estimate the ratio of teaching costs to service costs. Shepard et al.[12] described a study in Colombia in which residents provided care. The resident's time was charged to patient-care while the supervisor's time was charged to teaching.

Determination of hourly costs of personnel: To achieve this it is imperative to determine the number of working hours in a day as well as the number of working days in a year. For permanently employed laundry personnel, Shepard et al.[12] appeared to suggest an 8- hour working day and 365 working days in a year while Baggot et al.[14] suggested using 1950 hours as the base for 100% employment. It, therefore, appeared that the actual pattern of working should be considered while determining the hourly costs.

Difficulty with consumable items.

Consumables often present the problem of determining the exact items consumed in a particular period. For example Murru et al[21] found out that information regarding the value of opening and closing stock was not complete. It was, therefore, assumed that all drugs and sundries issued by the pharmacy to the various cost centres were used by the cost-centres in the same year. Such an assumption simplifies the problem but inaccuracies may be inevitable

How to handle donated items.

When dealing with donated items the question usually arises whether the costs associated with them are actually born by the hospital Murru et al.[21], as well as Shepard et al [2], asserted that although these will not appear in hospital spending records they should be included while computing hospital unit costs.

Allocation of costs of shared utilities to a specific cost centre.

Utilities such as water, sewerage services, electricity and telephony are difficult to accurately apportion between various cost centers because billing is often collective While trying to allocate departmental utilization of main utilities such as electricity, telephone and water Dawkinun et al [10] used the number of utility outlets Electricity was allocated on the basis of the number of lights and sockets in use, water on the basis of the number of usable taps in use and telephone on the basis of the number of calls by department. Such methods inevitably introduce inaccuracies but go along way in simplifying the problem.

The problem of poor hospital records.

To facilitate cost studies basic information regarding the value of assets such as buildings, vehicles and equipment may be expected to be readily available from the hospital's records However this is not always the case, nessa[2]' acknowledged that L-ast African hospitals lacked reliable statistics and that the major problem likely to face any researcher in such situations was the lack of data . It was noted that the value of buildings and equipment, linen and vehicles had to be assessed, or sometimes guessed, by the members of the research team.

The difficulties of comparing the results of different studies.

Rjgby[18] acknowledged the great difficulty of trying to compare results of hospital cost analyses by different authors. This stemmed from the wide variation in procedures for carrying out these studies. Kuramanayake[24] pointed out further difficulties in doing comparisons of cost data across different countries and over more than one year. This was attributed to inflation, which was defined as the process whereby the general price level rises and money loses value. Accordingly, a key issue was whether to convert to a common currency, usually the United States Dollar (USD), before converting for inflation (then using the United States' inflation rate) or to work in a local currency using local inflation rates and then converting to the USD. It was recommended that unless the local inflation rate exceeded 20% it was better to work in local currencies and then convert to the USD at the end.

Applications of cost analysis in the management of an individual hospital

According to Shepard et al [12] the foremost reason for examining the levels and determinants of cost was that it provides an insight into the relative efficiency of hospital operations. Murru et al [21] explained further that the usefulness of costing was for the management to understand the structure of costs and to appreciate the usually unrecorded but very real hidden costs in order to correct absolute inefficiency. Drummond et al.[25] asserted that the terms economic evaluation and efficiency evaluation were synonymous. As such several issues emerged that hospital management should seek to clarify.

Definition of efficiency in healthcare.

Masri et al.[26] described two categories of efficiency. Allocative efficiency is a measure of optimal distribution of resources among a number of competing uses. Technical efficiency, on the other hand, measures the extent to which the choice and utilization of resources produces a specific health unit, intervention or service at the lowest cost.

The effect of the extent of resource utilization on the cost of operative services.

Bhatia et al.[27] after analyzing costs at an operating theatre complex of a teaching hospital in India found that the cost of operative services was related to resource- hour utilization. It was, therefore, recommended that in order to bring down the costs of operative services the utilization of the facility should be increased.

The limitations of cost analysis in the determination of user fees.

Murru et al [21] pointed out that costing data could help in setting user fees that were more realistically linked to actual costs. Further review of this subject portrayed a rather disappointing outlook of this application in the setting of economically poor patient populations. In the study done by Murni et al [21] at the Lacor Hospital in Uganda it was found that user fees covered only 13% of hospital costs and it was concluded that little efficiency would be gained from increasing user fees. This was in consideration of the fact that the war-impoverished population regarded the existing fees as unafTordable. Similarly, Flessa [1] after analyzing costs at seven Lutheran Church Hospitals in Tanzania found that user fees covered only 18% when actual costs were considered It was concluded that the more comprehensive the cost concept was, the less important the fees became for the sustainability of the hospitals. In Kenya Mwabu et al.[28], as well as Collins et al.[29], studied the effect of the introduction of cost-sharing in public hospitals in the late 1980s. It was found that this resulted in a dramatic decline in the utilization of hospital services and that this situation reversed only after suspension of the programme.

Introduction of private patients in previously not-for-profit institutions as a solution to the cost problem.

Flessa[21] at the Lutheran Hospitals in Tanzania found that they had introduced private wards in order to attract those patients able to pay higher fees The theoretical target was that the private wards would generate profits that would subsidise the general wards It was, however, found that no private waul had a positive marginal contribution It was also found that the subsidy per private bed exceeded the subsidy for a bed in the general ward This was attiibuted to a clientele of patients (mainly the pastors of the same church and their families) who demanded special and more costly services that were not

commensurate with the meager additional fees charged.

The real value of cost analysis in the management of cost-challenged hospitals.

Flessa[23] asserted that in order to reconcile the conflicting goals of afTordability and sustainability, measures needed to be taken to improve both technical and allocative efficiency. Such measures would include improvement of staffing, preventive maintenance of equipment and buildings aimed at prolonging their useful life, standardization of procurement procedures, introduction of administrative standards and improvement of accounting and medical records. In making these decisions Drummond et al[25] asserted that systematic analysis may be better than such methods as "gut feelings" and "educated guesses". Murru et al [19] mentioned that cost analysis data remained a useful tool for advocating for more funds from the government and donors.

How a health-care facility can determine its own sustainability.,

According to Flessa[23], a facility could be considered sustainable, in the short-run, if it was able to recover its actual minimum costs (AMC) and its actual sustainable local costs (ASLC). AMC are the actual payments the facility made for the requirements it absolutely could not do without For a hospital such requirements would include personnel, drugs, transport and utilities such as electricity, telephone, water, sewerage and waste disposal. ASLC adds to the AMC the expenditures for maintenance and shadow salaries (salaries for staff working for the facility but paid by someone else). Such staff would include expatriates paid by their respective countries. Actual full costs (AFC) add to ASLC the costs of depreciation of equipment and buildings.

1.2. STATEMENT OF THE PROBLEM

The actual costs of providing surgical services at the operating theatre of the UNDH had not been comprehensively studied before As such little information existed pertaining to the pattern of costs as well as the efficiency of utilization of resources committed to the establishment Without a methodological analysis of costs it remained unknown whether the facility, in its existing operational structure, was sustainable or not Sustainability in the short-run was to be inferred if the facility, in a given period, recovered its AMC and the ASLC. Sustainability in the long-run was to be inferred if the facility recovered its AFC. Furthermore the lack of such information implied that there existed no clear benchmarks for evaluating trends of efficiency of resource utilization and cost-recovery from period to period.

1.3. JUSTIFICATION OF THE STUDY

The information derived from this study would be useful in setting up benchmarks for the evaluation of efficiency of resource utilization and sustainability, based on systematic evaluation. It would also prove useful for future evaluation of variances such as price-variances, volume variances and efficiency-variances as described by Shepard et al [u]. Ultimately the information would enable the management to identify areas where improvement of resource utilization may be possible in order to achieve sustainability while maintaining affordability.

1.4. OBJECTIVES OF THE STUDY

Main Objective

To determine the costs and sustainability of providing services at an operating theatre of a teaching hospital offering maxillofacial surgical services

Specific Objectives

1. To determine the annual actual full costs (AFC) of providing services at the theatre.

2. To determine the average unit cost (UC) of a surgical procedure and the unit cost of a procedure-hour based on the AFC.

3. To determine the actual sustainable local costs (ASLC) and the actual minimum costs (AMC) incurred by the facility during the period under investigation.

4. To determine whether, or not, the facility met the criteria for sustainability based on the user fee guidelines in use during the period .

CHAPTER 2.

MATERIAL AND METHOD

Study area: The operating theatre at the UNDH

Study population: All surgical procedures conducted at the operating theatre in the financial year 2005-2006. The term "surgical procedure" included all procedures conducted under general anaesthesia .

Study design: Retrospective top-down cost analysis.

Data collection process and instruments.

The process commenced with the preparation of the data collection forms. A new inventory of capital items was taken by the investigator and the data recorded using the Inventory of Capital and Recurrent Items form (Appendix 2) .The current prices of the various types of equipment were sought from dealers within the Province of Nairobi However, some instrument sets such as the orthognathic and the "TMJ" sets were not available in any of the outlets visited The replacement prices of such sets was, therefore, deduced rationally depending on the number and nature of the instruments they contained in relation to the surgical "general set", the price of which was readily available

The investigator using a tape measure took the measurement of the surface area of the floor of the operating room which was found to be 150 square metres The current cost of construction of buildings of KSh 40,000 per square metre was provided by the constructions and maintenance office of the HON This was the rate the office was using to pay for the construction of some buildings for the institution in the Upperhill area of Nairobi. However, no documentation was availed by the office citing confidentiality as the reason.

The information about payments to staff employed by the university, who included nurses, supporting staff, biomedical technicians and teaching assistants, was sought by the investigator from the personnel department of I JON The department only issued salary scales for the various cadres of staff The details of the actual payments were voluntarily offered by the respective persons on request by the investigator This was the information used to complete the Personnel Payments form (Appendix 3).

While collecting data relating to maintenance work it was found that the records were poorly kept. A considerable amount of the data in the Repairs, Replacements and Breakages form (Appendix 4) was, therefore, collected using a prompting method whereby the investigator, pointing to the various pieces of equipment, fixtures and furniture, asked a group of maintenance technicians if they recalled any maintenance works carried out and to estimate the costs of such works.

Data relating to procurement of consumables were collected using the Procurement Records form (Appendix 5). However, it was found that the theatre had kept poor records of procurements and most of the information was derived from the store department which was found to have kept better records.

Data relating utilities were collected using the Utilities form (Appendix 6). This information was sought from the estates manager's office of the UON. It included all the bills, whether paid or not, for utilities consumed by the whole hospital during the period under investigation.

Data relating to the surgical procedures were collected using the Operations Records form (Appendix 7). The information was derived by the investigator from the records at the theatre. The duration of the procedures was derived from the theatre records and anaesthesia charts.

Study time-frame.

Approval to carry out the study was issued by the ethics, research and standards committee of the KNH and UON on the 14th of September 2006. The study was conducted between October 2006 and January 2007.

Organisation of the data.

The data were organised into two broad categories of costs, fixed and variable. Fixed costs included capital items, recurrent items, buildings, permanently employed theatre staff and maintenance costs. Variable costs included theatre consumables, utilities, variable personnel costs and variable welfare costs. Tables 2.1 and 2.2 illustrate how the two main categories of costs were described and organized.

Table 2.1. Description of fixed costs.

Cost category.	Items included.	Data collection instrument.
Capital items.	• Medical equipment Furniture and fixtures.	Inventory form (Appendix 2).
Recurrent items.	• Hospital clothing rubber and plastic items, etc.	Inventory form (Appendix 2).
Buildings.	• Floor surface area.	Measurement (square metres).
Full-time theatre personnel.	• Salaries and allowances.	Personnel Payments form (Appendix 3).
Maintenance.	• Recorded and recalled repairs, replacements and breakages.	Repairs, Replacements and Breakages form (Appendix 4).

Table 2.2. Description of variable costs.

Cost category.	Items included.	Data collection instrument.
Theatre consumables.	• Drugs (including IV fluids). • Medical gases. • Sutures and needles. • Catheters, tubes and drains. • Disinfectants and soap. • Dressings.	Procurement Records form (Appendix 5).
Utilities.	• Electricity, water, telephone and laundry.	Utilities form (Appendix 6).
Variable labour.	• Cost of surgeons, anaesthetists and biomedical technicians present only during operations.	Operations Records form (Appendix 7).
Variable labour welfare.	• Cost of meals provided to staff on operating days.	Operations Records form (Appendix 7).

Methods of data analysis.

Tables 2.3 and 2.4 illustrate the methods used to analyse each category costs.

Table 2.3. Analysis of fixed costs.

Cost category.	Method of analysis.	Assumptions.
Medical equipment.	Linear depreciation.	Useful life of 15 years.
Furniture and fixtures	Linear depreciation.	Useful life of 10 years.
Recurrent items.	Linear depreciation.	Useful life of 1 year.
Buildings.	Linear depreciation.	Construction cost of KSh 40,000 per square metre . Useful life of 50 years.
Full-time theatre personnel.	Actual payments.	
Maintenance.	Actual costs.	

Table2.4. Analysis of variable costs.

Cost Category.	Method of Analysis.	Assumptions.
Surgical consumables.	Retail prices	• All items procured were used within the same period.
Utilities.	The actual payments for utilities and fuel.	• The theatre consumed 5% the hospital utilities.
Variable labour.	Estimation of salaries and benefits.	1) A standard team consisting of 2 consultants, 2 registrars and 1 biomedical technician conducted each procedure. 2) The consultants (surgeon and anaesthetist) were performing teaching duties. 3) The registrars' and the biomedical technicians' labour was the one attributable to patient care. 4) The salaries were at the mid-point of respective salary scales. 5) Hourly rates were based on 8-hour work-days and 5-day weeks.
Variable welfare costs.	Estimation of costs of meals	• On each operating day a meal was provided for 8 members of the operating team (including 2 nurses and 1 assistant) at a cost of KSh 200 per person.

The following formulae were used in various computations.

Computation of actual full costs (AFC) of providing surgical services

Actual Total Annual Costs = Total fixed costs + Total Variable costs.

Computation of unit costs (UC) of a surgical procedure.

Unit cost of a surgical procedure = AFC / Number of procedures in the year.

Computation of UC of a procedure- hour.

Unit cost of an procedure-hour = AFC / Number of procedure-hours in the year.

Computation of actual minimum costs (AMC) of providing the services.

AMC= Total costs of full-time personnel + total costs of apportioned utilities (electricity, water, telephone, laundry) + total costs of meals for theatre staff + total costs of theatre consumables.

Computation of actual sustainable local costs (ASLC) for the facility.

ASLC=AMC + maintenance costs + variable personnel costs.

Conversion of currency rates from KSh to USD.

The rate of KSh 72.53 to one USD was used. It was the mean exchange rate as provided by the Central Bank of Kenya at the time of data analysis,

CHAPTER 3.

RESULTS

Patient population

During the period studied a total of 109 surgical procedures were conducted at the facility. Maxillofacial trauma and benign tumours of the jaws together contributed the largest proportion (44%) of the caseload. Table 3.1 shows the distribution of the patient population according to diagnosis and gender.

Table 3.1. Distribution of patients according to diagnosis and gender.

Category of patient by diagnosis.	Number and percentage (%) of patients.					
	MALE		FEMALE		TOTAL	
Maxillofacial trauma	21	(19.3%)	4	(3.6%)	25	(22.9%)
Benign jaw tumours	15	(13 8%)	8	(7.3%)	23	(21.1%)
Benign soft tissue lesions	6	(5.6%)	7	(6.3%)	13	(119%)
Malignant tumours	4	(3.7%)	8	(7.3%)	12	(11%)
Jaw cysts	6	(5.6%)	5	(4.6%)	11	(10 2%)
Temporomandibular joint disorders	1	(09%)	3	(2.8%)	4	(3.7%)
Salivary gland disorders	2	(19%)	2	(1.9)	4	(3 7%)
Impacted teeth	2	(19%)	1	(0.9%)	3	(2.8%)
Others eg Dental caries, post-operative pack for removal, etc.	9	(8 1%)	5	(4 6%)	14	(12 7%)
TOTAL	66	(60.6%)	43	(39.4%)	109	(100%)

The duration of various categories of procedures

When selected categories of commonly performed procedures were evaluated it was found that the time taken to conduct each category varied markedly. Figure 3.2 illustrates the mean durations of selected categories of procedures.

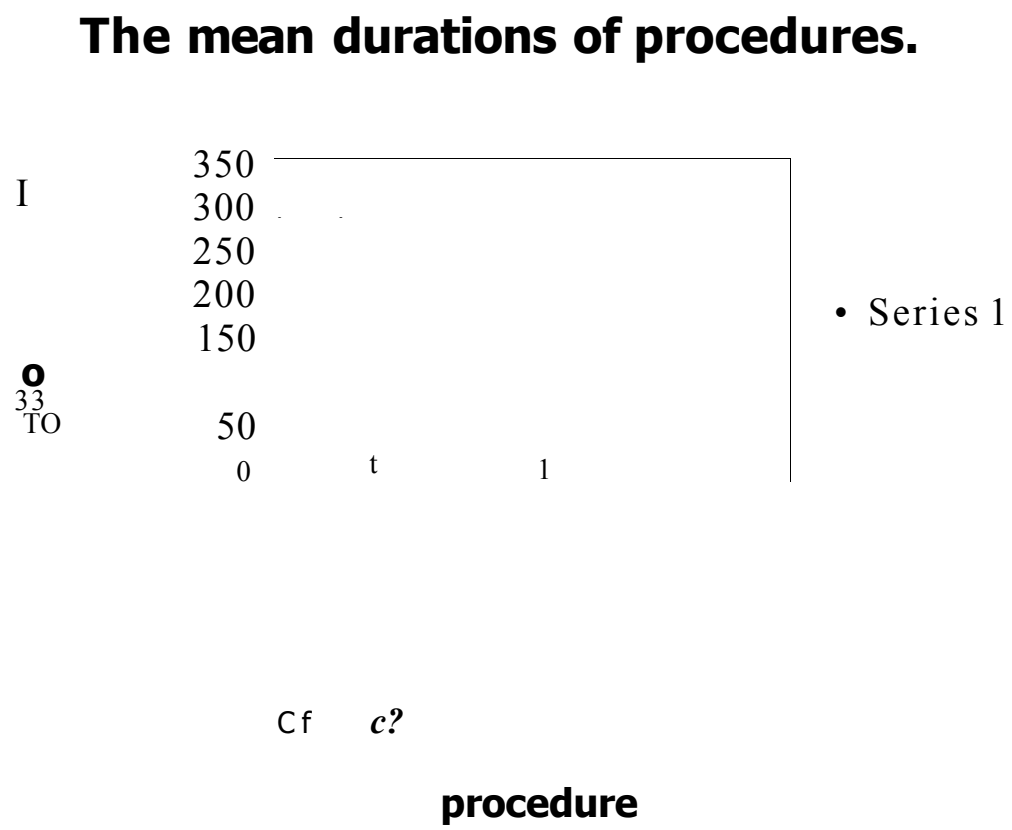

Figure **3.1. Mean durations of selected surgical procedures.**

Key:
ORIF - Open reduction and internal fixation of fractures,
soft tissue - Excision of benign soft tissue lesions.

Operating- room utilization

Out of the 255 working days (after exclusion of weekends and public holidays) available in the period studied, only 87 days were utilized. No procedures were conducted on Tuesdays, weekends or at night. Other official non-operating days included university examination periods when all teaching members of staff were required to fully engage in the exercise. It was notable that there were no records detailing the reasons for failure to operate on other days.

Fixed costs

After the inventory was updated the facility was found to have been equipped to handle one procedure under general anaesthesia at a time. The major pieces of medical equipment included one operating table, one ceiling-mounted operating light, one dental chair, one anaesthetic machine, one cardiac monitor and one functional diathermy unit. Other pieces of equipment included instrument sets, anaesthetic accessories, air conditioners, infection control accessories, patient transport accessories and a refrigerator among others. The most conspicuous item in this category, made so by its high cost of replacement, was the "Stryker" set, a system of intricate saws and drills used to perform surgical procedures involving bone in the fields of orthognathic and craniofacial surgery. Each of these sets was valued at KSh 2,100,000 (USD 28,954). The main pieces of furniture included a recovery bed, shelves and cabinets and furniture in the staff tea-room among others. The main items in the recurrent items category included scrub suits, theatre foot-wear and surgical linen among others. The surface area of the floor of the building was measured and found to be 150 square metres. Personnel costs were by far the highest in this category followed by the cost of depreciation of medical equipment. The facility had four theatre-trained nurses, one anaesthesia assistant and one cleaning assistant. Table 3.3. illustrates an outline of the various components of fixed costs at the study area.

Table 3.3. Annual costs of fixed assets and personnel.

Category of cost.	Annual cost (KSh)	USD	Percentage.
Full-time personnel.	2,584,704	(35,636)	(70.5%)
Medical equipment.	603,200	(8317)	(16.4%)
Maintenance.	251,000	(3461)	(6.8%)
Building.	120,000	(1655)	(3.3%)
Recurrent items.	90,400	(1245)	(2.5%)
Furniture and fixtures.	19,550	(270)	(0.5%)
TOTAL	3,668,854	(50,584)	(100%)

The variable costs

These included theatre consumables, utilities, variable labour costs and variable welfare costs.

Theatre consumables

In the category sutures, needles and blades, the sutures contributed 95% of the costs. The most expensive type of suture was polyglactide (Vicryl) at KSh 238 a piece while the least expensive was silk at Ksh 83 a piece. Out of the KSh 205,170 that the medical gases cost nitrous oxide, oxygen and medical air contributed 71%, 22% and 7% respectively. The anaesthetic gases were always delivered to patients using an open circuit because the closed circuit was faulty. Halothane was classified as a drug and not as a medical gas The medical air was used mainly to run rotary instruments (surgical drills).Table 3.4 illustrates the costs of consumables for the period studied.

Table 3.4.Costs of consumable items.

Item category.	Cost		
	KSh	USD	Percentage
Sutures, needles & blades	319,806	(4409)	(29.6%)
Medical gases	205,170	(2829)	(19%)
Drugs	189,000	(2606)	(17.5%)
Others eg Gloves, masks etc	118,560	(1635)	(11%)
Disinfectants & cleaning materials	113,000	(1558)	(10.5%)
Catheters, tubes and drains	71,450	(985)	(6.5%)
Dressing materials	63,325	(873)	(5.9%)
Total	1,080,311	(14895)	(100%)

Utilities

The most conspicuous item in this category was laundry, which cost KSh 87,200 representing 41% of utility costs. Electricity, telephone and water cost KSh 80,018 (37.6%), KSh 31,151 (14.6%) and KSh 14,540 (6 8%) respectively. The cost of fuel for the generator was found to have been be negligible and was not included in the data.

Variable labour costs

Over the entire duration studied the facility was found to have conducted surgical procedures for an aggregate of 307.3 hours at a total variable labour cost rate of KSh1817 per hour. This aggregated to a total of KSh 558,364 representing 28% of all variable costs. Hourly rates for variable labour were computed using 8-hour work days and 5-day weeks. Table 3.5 illustrates the actual values used to deduce hourly costs of various cadres of variable labour.

Computations used for various levels of cost analysis

These were the computed costs.

Actual Full Costs (AFC)

=Total fixed costs + Total variable costs.

=KSh (3,668,854 + 1,990,784)

=KSh 5,659,638 (USD 78,032).

Unit cost of a surgical procedure

= AFC/ Number of procedures.

= KSh 5,659,638/109

- KSh 51,923 (USD 716).

Unit cost of a procedure-hour

=AFC/Number of procedur e-hours.

= KSh 5,659,638/307.3

= KSh 18,417 (USD 254).

Actual minimum costs (AMC)

= Consumables +utilities +Full-time personnel payments +costs of staff welfare.

= KSh (1,080,311 + 212,909 + 2,584,704 + 139,200)

= KSh 4,017,124 (USD 55,386)

Actual Sustainable Local Costs (AS! C)

= AMC + Maintenance costs + Variable (shadow) labour costs.

= KSh (4,017,124 + 251,000 + 558,364)

= KSh 4,826,488 (USD 66,545).

Computed revenues for the two categories of patients

Out of the 109 patients who received treatment 98 were in the subsidized fees category and 11 were in the non-subsidized (private) category. With reference to the user fee guidelines discussed in section 1.1, the revenues were computed and were assumed to have been generated from each category of patients It was notable that revenue generated by one procedure-hour on a private case was almost twice that generated by a similar duration on a subsidy case. Table 3.7 illustrates the pattern of revenues generated from the two categories of patients.

Table 3.7. Comparison of revenues between subsidy and private patients.

Patient category	Number of patients	Number of procedure hours.	Total revenue (KSh)	Revenue per procedure -hour.	
				KSh	USD
Subsidy.	98	2867	1,031,400	3598	(49.6)
Private.	11	20.6	146,000	7087	(97.7)
Overall	109	307 3	1,177,400	3831	(52.8)

Comparison between costs and revenues

The facility incurred **actual minimum costs** of KSh 4,017,124, **actual sustainable local** costs of KSh 4,826,488 and **actual full costs** of KSh 5,659,638. During the same period the facility was able to recover **revenues** totaling KSh 1,117,400. Figure 3.8 illustrates the relationship between the costs incurred and the revenue generated.

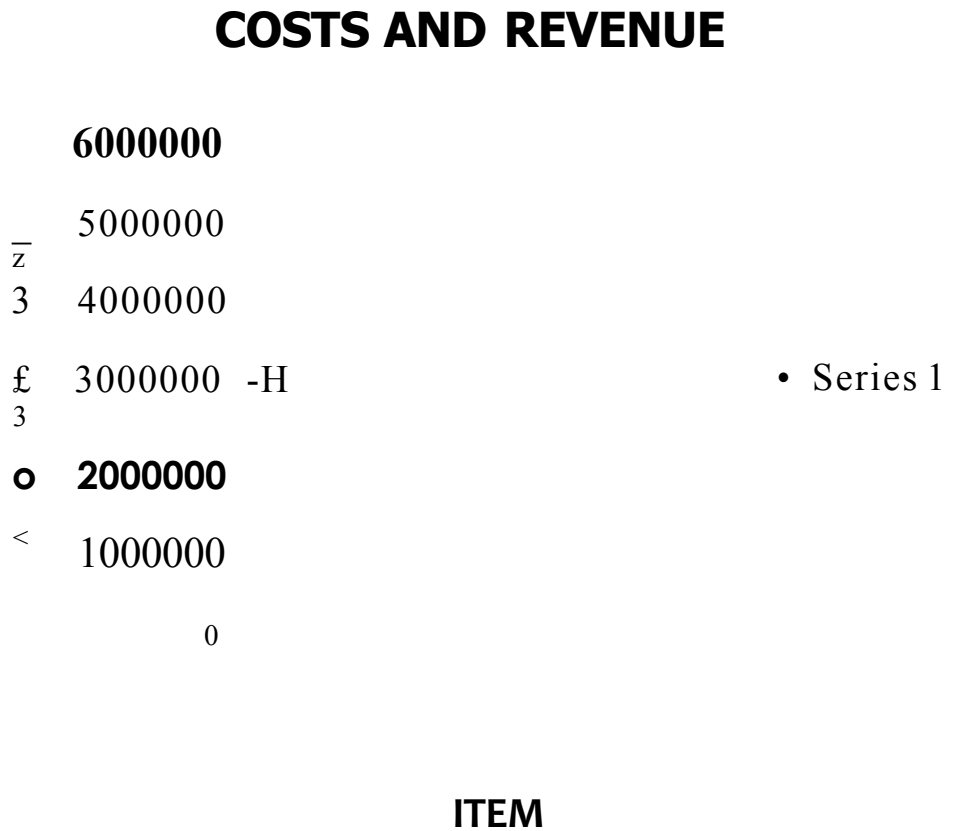

Figure 3.2. The relationship between costs and revenue.

CHAPTER 4.

DISCUSSION

Facility utilization: Considering the fact that there were 255 working days available within the study period, utilization of only 87 of the days and the patient population of 109 may both be considered to be indicators of low utilization of the facility. This could be related to the scope of procedures preformed at the facility. Of particular interest was the low number of odontectomies. This was considered interesting because impacted teeth are relatively common in maxillofacial practice and would have been expected to form a substantial case-load. Dunne et al.[30] found that in a Scottish maxillofacial practice 90% of the patients on waiting lists were awaiting odontectomy of third molars. Although the study did not seek to find out the reasons behind these findings it could be related to the health-seeking habits of the local population, such as more patients preferring to undergo such procedures under local anaesthesia.

One factor that had a bearing on facility utilization was the fact that no procedures were conducted at night, during student examinations and on Tuesdays. Each Tuesday was set aside for purposes of cleaning and preparation of equipment. While all these may be legitimate reasons for not utilizing the facility, the knowledge that such loss of opportunity has negative implications on sustainability could motivate the management to organize alternative arrangements to ensure that important resources do not go to waste. Lack of records relating to reasons for failing to conduct procedures on other days meant that the members of staff felt no obligation to account for such failure. Berger*[1] emphasized that in order to improve operating room performance the management needed to fundamentally change a hospital's culture towards one based on performance and personal accountability.

Personnel situation: The facility had what appeared to be a critically small size of permanent staff. Yet the personnel costs were found to represent 70.5% of the fixed costs and by themselves exceeded the total revenues collected. This was in agreement with the findings of previous studies[23,] ".According to Young[32] labour is always the largest component of cost in hospitals and that hospitals should develop plans to reduce them.
In this case there would be little to be gained by considering reducing the number of staff Instead, focus should be to improve the level of productivity of this expensive resource. Berger[31] emphasized the usefulness of data from costing studies as an effective tool to convince staff members about the need to improve on performance in operating rooms.

Medical equipment: This was the second most significant item in the category of fixed costs accounting for 16.4%. As was explained earlier, the Stryker set was notable for its high cost of replacement. At the time of data collection four of the hand-pieces from this set, valued at KSh 800,000, had broken down during a single attempt to sterilize them using an autoclave. While no doubt may be cast about the technical versatility of this piece of equipment, this study did not reveal convincing utilization of its intricate technology. From the stand point of cost analysis this piece of equipment, therefore, may represent an under- utilized resource, or more skeptically, inappropriate technology with costly lack of durability. The institution ran the risk of incurring huge costs should it contemplate on replacing these items. Another piece of equipment that raised questions regarding efficiency was the anaesthetic machine. It was noted that the machine had a non-functioning closed circuit. As a result, all anaesthesia was delivered by the open circuit. Picard et al.[33] showed that closed-circuit gas delivery systems could be associated with savings of up to 80.5% for nitrous oxide. Considering the fact that nitrous oxide contributed 71% of the cost of anaesthetic gases this area deserves attention.

Variable costs: In this category consumables contributed 54.3% and exceeded the cost of utilities. This was in tandem with the findings by Bhatia et al[27] Among the consumables sutures contributed the highest. It, therefore, appeared that judicious use of sutures, especially polyglactide (Vicryl) sutures, could result in significant reduction of costs. It was notable that all the medical air was used for propelling instruments such as drills and hand- pieces. Taking into account that the hospital already had an air

compressor, which served the rest of the building with compressed air, it was the feeling of the technicians that this could be used to supply the theatre probably eliminating the need to buy medical air. Variable labour costs contributed 28% of the variable costs and exceeding the cost of utilities As explained earlier, only the costs of registrars and biomedical technicians were included. The consultants were considered to have been performing teaching duties. As explained by Shepard et al.[12] this is one of the unique features of teaching hospitals that presents a problem in cost analysis in that it is difficult to objectively divide a lecturer's time between the activities of teaching, research and patient care. Regarding utilities it was noteworthy that the theatre was outsourcing laundry services from a nearby private hospital and that laundry was the most costly utility. Although this study did not seek to investigate the implications of the hospital providing for its own laundry requirements rather than out-sourcing, this is an area worthy of further investigation.

The private patient facility: The rationale behind a not-for-profit hospital to start private facilities may be that these facilities should make a profit in order to subsidise the regular facilities. To achieve this, the private facilities should be able to attract patients who are able and willing to pay fees which recover full costs[23]. The facility under investigation attended to 11 patients in the "non-subsidy" (private) category and 98 subsidised-fee patients. As explained previously the former group generated a mean revenue of KSh 7,087 per procedure-hour. This clearly did not cover the unit cost of a procedure-hour of KSh 18,417. They did not, therefore, qualify to be referred to as the "non-subsidy" group and did not make any profit This scenario was not unexpected Flessa[21] reported a similar situation in the Lutheran hospitals in Tanzania. However, unlike the case discussed by this author the private group in this study received less amounts of subsidy than their subsidized counterparts. With these considerations it would appear that there is some advantage to be gained from increasing the number of private patients even with all other factors remaining the same.

Mathematical simulation of the fee guidelines described earlier revealed that the amount of revenue generated was considerably higher when a larger number of shorter procedures was conducted than when a smaller number of longer procedures were conducted. For example, if two hypothetical procedures were performed on two subsidy-category patients, each lasting for two hours, some total revenue of KSh 17,500 would be generated If for the same duration only one procedure was undertaken on one patient in the same category, a paltry KSh 9,500 in revenue would be generated

Sustainability: One of the objectives of the study was to determine whether the facility met the criteria for sustainability. According to Flessa[21] a facility has to recover its actual minimum costs if it is to be considered sustainable in the short-run. In order to survive in the longer run it would have to recover the actual sustainable local costs. To be considered self-reliant it must finance the actual full costs. The revenue generated by the facility represented 30.1% of actual minimum costs, 23.7% of Actual Sustainable Local Costs and 20.2% of Actual Full Costs. It was, therefore, concluded that the facility did not meet the criteria for sustainability.

Study limitations: One limitation, inherent to the top-down costing methodology, was that no adjustments were made for differences in patient characteristics that were likely to affect resource utilization. Although computing costs per operation-hour alleviated a part of this problem it would not eliminate it altogether. This implied that if the exact resources utilized by a particular procedure required to be known then other studies of the micro-costing approach would be needed. Another limitation of this study related to its scope. Most of the studies reviewed"[1, 2,123] involved costing of entire hospitals and step-down allocation of overhead costs to final cost centres. This study was restricted to a final cost centre and did not include the overhead costs such as hospital administration, central sterilization services, insurance, security and transport This implied poor comparability with these studies reiterating the assertion made by Rigby'[7] that cost analysis has the greatest utility in the internal management of a single institution rather than in comparison with others.

Another limitation of the study was related to the collection of data relating to consumable items. It was found that the theatre kept no records of stock at any period It was, therefore, assumed that all the items procured during the study period represented the items utilised during the same period. This assumption implied a limitation to accuracy as a result of which the data did not have items such as surgical blades, wires and absorbable dressings. It also implied the possibility of over-representation of any item that was procured in sufficient amount to last beyond the period studied. Another possible source of inaccuracy was in the determination of replacement of medical equipment. Some of the pieces of equipment were donations and were not available in local equipment shops. In such cases prices were allocated based on the price of closely related items. Lastly, it was found that the maintenance department kept poor records. As such most of the entries relating to maintenance were recalled after prompting by the investigator. This could have resulted in inaccuracy due to poor recall.

Conclusions

The facility did not meet the criteria for sustainability. The following factors appeared to have contributed to this lack of financial sustainability.

1. Low level of utilization of resources at the disposal of the facility: This was depicted by the low number of procedures carried out and the low percentage of working days utilized. This in turn implied that there was poor utilization of fixed resources the most notable being personnel and medical equipment.

2. I,ow level of revenue generation: Reasons for this included a tendency to conduct long procedures, low number of private patients and offering subsidy to private patients.

3. Poor records:These were noted pertaining to procurement and stock of consumable items, maintenance works and accountability over unutilized work-days.

Recommendations.

1. Efforts should be made to increase the utilization of the resources at the disposal of the facility by devising ways of increasing the number of procedures conducted and the working days utilised Keeping good records pertaining to reasons for failure to utilize sessions could unravel remediable causes of such low utilization of the facility such as lack of supplies, poorly planned schedules and cancellations.

2. In order to increase the capacity to generate revenue, the facility should, whenever possible, conduct a larger number of short procedures, increase the number of private patients and attempt to recover the full costs from these patients.

3. In order to improve the accuracy of future analyses of costs, records should be kept at definite times of the year regarding the stock of consumable items and maintenance work.

4. Areas that may require further studies include the cost implications of replacing the anaesthetic machine with one having a closed circuit, tapping compressed air from the hospital compressor instead of buying medical air and producing laundry services in-house instead of outsourcing them

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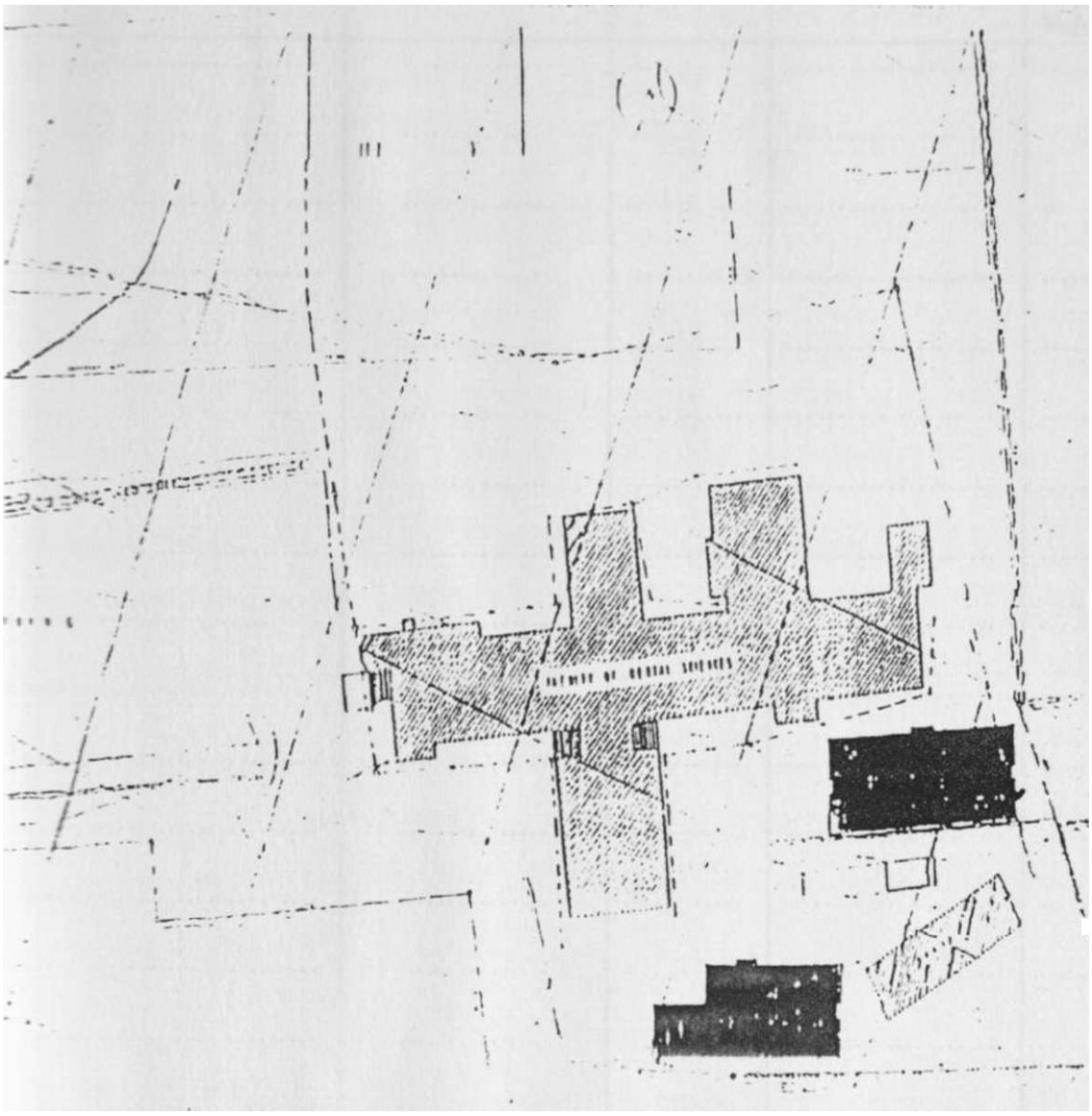
APPENDICES.

Appendix 1. The development plan of the School of Dental Sciences, University of Nairobi



Analysis of the costs of providing maxillofacial surgical services at the operating theatre of UNDH in the year 2005/2006.

Appendix 2 - Inventory of Capital and Recurrent items.

Categories: A-Medical Equipments, B- furniture/Fixture, C- Recurrent items.

*criptioii.	Category	No of Units.	Replacement price per unit.	Total Replacement Value.

Anal* sis of the costs of providing maxillofacial surgical services at the operating theatre of UNDH in the year 2005/2006.

Appendix 3: Full-time Theatre Personnel Data.

Name (Initials only eg. JK):

Job Designation:

Job Group:

Month	Gross Pay (salaries, allowances, deductions).

Vnalysij of the costs of providing maxillofacial surgical services at the operating theatre of I NDH in the year 2005/2006.

Appendix 4: Records of Repairs, Replacements and Breakages.

Categories: A - Recorded
B Recalled

It	Item	Category	Estimated/Actual Cost.

Analysis of the costs of providing maxillofacial surgical services at the operating theatre of UNDH in the year 2005/2006.

Appendix 5: Consumable items procurement.

Categories: A - drugs. B - medical gases, C - Sutures/needles/blades, D - catheters, tubes and drains, E - disinfectants & cleaning materials, F - dressing materials.

Date	Category	Item procured.	Units	Price per Unit.	Total Cost.

Analysis of the costs of providing maxillofacial surgical services at the operating theatre of UNDII in the year 2005/2006.

Appendix 6: Utilities for the entire hospital (Electricity, water, telephone, laundry).

Date	Utility	Cost

Analysis of the costs of providing maxillofacial surgical services at the operating theatre of UNDH in the year 2005/2006.

Appendix 7: Records of operations.
Categories - HP - Hospital patient, PP- Private patient

Date	Diagnosis	Operation	Duration	Category

KENYATTA NA TIONAL HOSPITAL
Hospil.il Rd. along, Nyony Rd.
P O. Box 20723. Nairobi.
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP", Nairobi.
Email: KNHplg-n@Ken.Healthnet.ory

Ref: KMH-ERC/ 01/ 3777

14'h September 2006

Dr. Karsthi John Kimotho
Dept. of Oral & Maxillofacal Surgery
Faculty of Dental Sciencer.
Universitv of Nairobi

Dear Dr. Kimotho

RESEARCH PROPOSAL: ANALYSIS OF THE COST OF PROVIDING MAXILLOFACIAL SURGIC AL SERVICES AT THE OPERATING THEATRE OF THE UNIVERSITY OF NAIROBI DENTAL HOSPITAL IN THE YEAR 2005/2006" (PI61/08/2006)

This is lo inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** your above cited research proposal for the period 14th September 2006 - 13th September 2007.

You will be required to request for a renewal of the approval if you intend to continue with the study b iyond the deadline given.

On behalf of th? Committee, I wish you fruitful research and look forward to receiving a summary of tl e research findings upon complet-on of the study.

This information will form part of database that will be consulted in future when processing relaied resean h study so as to minimize chances of study duplication.

Yours sincerely

PROF'A N GUANTAI
SECRETARY, KNH-ERC

c.c. Prof. K.M.Bhatt, Chairperson, KNH-ERC
The Deputy Director CS, KNH
The Dean, Facult/ of Dental Sciences, UON
The Chairman, Dipt, of Oral & Maxillofacial Surger/, UON
Supervisors: Dr Chindia M., Dept. of Oral & Max. Surgey, UON
Dr. Macigo, r.G, Dept. of Period. Conm.& Preventive Dentistry, UON
Prof. Wang'ombe, Dept. of Community Health, UON