Addis Ababa University

College of Health Sciences

School of Public Health/Health Economics

Unit cost analysis and assessment of the payback of service provision at Tikur Anbessa Specialized Teaching Hospital, Ethiopia

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A thesis paper submitted to Department of Reproductive Health and Health Services Management, School of Public Health, College of Health Sciences, Addis Ababa University in partial fulfillment of the requirements for the degree of Master science of Public Health in Health Economics.

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College of Health Sciences
School of Public Health

I, the undersigned MPH student, declare that I have submitted my original work on a title 'Unit cost analysis and assessment of the pricing pattern of service provision at Tikur Anbessa Specialized Teaching Hospital, Ethiopia" for partial fulfillment of the requirement for the degree of Master of Science of Public Health in Health Economics.

Remziya Abdulwehab Yusuf _____ _____
Signature Date
Principal Investigator

We, the undersigned Advisors, declare that this thesis is our original work in partial fulfillment of the requirement for the degree of Master of Science for the stated student above to our best knowledge. We confirmed that this thesis is ready for defense with our approval as the university advisor

Approved by:

1. Prof Damen Haile Mariam _____ _____
Advisor Signature Date

This thesis by Remziya Abdulwehab Yusuf is accepted in its present form by the board of examiners as satisfying thesis requirement for the degree of Masters of Public Health in Health Economics.

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External examiner _____ _____ _____
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Acronyms and Abbreviation

ABC	Activity Based Costing
ANC	Antenatal care
ARVs	Anti-Retroviral drugs
CHERE	Center for Health Economics Research and Evaluation
CHS	College of Health Science
CREST	Cancer Related Economics Support Team
CRR	Cost Recovery Ratio
EFY	Ethiopia Fiscal Year
ENT	Ear Nose Throat
ETB	Ethiopian Birr
FMOH	Federal Ministry of health
FP	Family Planning
GDP	Gross domestic product
G.C	Gregorian calendar
GI	Gastro Intestinal
HCFR	Health Care Financing Reform
HEW	Health Extension Worker
HIV	Human Immune Virus
HMIS	Health Management Information System
HR	Human Resource
HSTP	Health Sector Transformation Plan `
ICU	Intensive care unit
INR	Indian Rupis

IPD	Inpatient Department
MCH	Maternal and Chilled Health
MOH	Ministry of Health
OPD	Out Patient Department
OR	Operation Room
OHCS	Overhead Cost center
PASS	Pharmaceuticals Administration and Supplies service
PNC	Postnatal Care
RCC	Ratio of Cost to Charge
RS	Rupis
RVU	Relative Value Unit
STI	Sexually Transmitted Infections
TASTH	Tikur Anbessa Specialized Teaching Hospital
TB	Tuberculosis
TCS	Total Cost centers
UK	United Kingdom
USD	United State Dollar
WHO	World Health Organization

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Abstract

Background: Health care expenditure is increasing worldwide. Determining the unit cost of medical services is one part of economic analysis which helps to improve efficient use of scarce resource. It is also a vital indicator needed by managers and policy makers. Most of the health institutions in our country have not yet properly established clear methods to calculate unit cost and set the service price.

Objective: This study is conducted to explore the unit cost of health services provision and assess the payback at Tikur Anbessa Specialized Teaching Hospital (TASTH), Addis Ababa Ethiopia. The study has been conducted for the period of July 2017 to June 2018.

Methods: A facility based cross-sectional unit cost analysis has been conducted in order to identify the unit cost and compare it with the price. The top-down costing method was applied to calculate and allocate the overhead and intermediate cost centers to the final cost centers of TASTH for the year 2017/18GC (2010 EFY) from a provider perspective. Micro-costing method was applied to calculate unit cost of each service in the final cost centers and, the cost was compared with the current hospital service charge. The average and range of different service units cost, price and Cost to recovery ratio (CRR) was calculated for further analysis. The study covered **273 (22%)** selected services out of the total **1,212** services in the hospital. The costs data were calculated using Microsoft Excel 2010.

Results: The average unit cost of different diagnostic services is 276.03ETB (range 24.55-800.4), whereas the average unit price is 108 ETB with (MIN-MAX) that is (4-800). The average unit cost for different inpatient services is 813 ETB (range 51.4-3676.6) and the average unit price is 104ETB with a (MIN-MAX) that is (10-350). The average unit cost for outpatient services is 124.99, but the average price is 11.13 with (MIN-MAX) that is (5, 30). From the total services analyzed 57(21%) of them have a no price sated, 157(58%) of them have CRR between (1% to 25%), 27(10%) of them have CRR between 26% to 50% and 14(5%) of them have CRR between (51% to 100%).

Conclusion: The current study implies that costs of service provisions are considerably higher as compared to the corresponding services especially for Outpatient and inpatient services the CRR is only 9% and 13% respectively. The hospital administrative bodies and other concerned bodies should take measures in order to reduce the gaps between cost and user fees so as to maintain financial sustainability of the hospital without compromising access to services for the poorest segment of the population.

Keywords: Unit cost; Medical services, Top-down costing, and Micro-costing.

1. INTRODUCTION

1.1. Background

Accelerating health expenditures have been universal phenomena in recent decades. Although the degree of escalation has been highest in more affluent countries, low income and middle-income countries have also experienced similar changes in healthcare expenditures. The financial resource is a crucial input for the provision of adequate and optimum quality health services. However, the ever-increasing cost of health care and multiple competing priorities in resource-poor countries makes financial resources insufficient to make substantial improvements in access and quality of health care (1). Many factors affect the escalation of health expenditures, such as high-cost medical technologies, changes in disease patterns and increasing demands for health services.

Ethiopia has progressively expanded access to a range of health services and introduced a three tier public health care delivery system towards achieving universal access to primary health care (2). The defined catchment population at the apex of both structures is a specialized hospital which serves 3.5 to 5 million people. This service expansion and adoption of innovative health technology increase the spending of the health sector (3).

When we look at the public share of total health expenditure varies according to an income of the countries. The government share is 29% in low-income countries, 42% in lower to middle income countries, 56% in upper to middle-income countries and 65% in high-income countries (4). Hospitals consume a disproportionate amount of resources compared to other health services in developing countries. For example, in Zimbabwe, Sri Lanka, Tunisia, Malaysia and Colombia hospitals consumed 45% (in 1993), 64% (in 1979), 69% (in 1971), 17% (in 1973) and 36% of ministry of health expenditure respectively (7).

As per the Six round National Health Account Survey for the period 2013/2014 (2006 EFY) shows that the share of government health budget from total government budget 11.3% in 2008 EFY (5). In order to develop a financing strategy that will help cover all or some of the costs involved in operating such government institutions, it is necessary to know how costs of hospitals are influenced by patient-related services that are output.

Hospital costing is the process of identifying the resources and inputs used during an episode and applying the costs of those inputs to the different types of clinical procedures and treatments provided to each patient in a hospital (6). Health care organizations often do not know what their costs are and have no simple way of assessing costs on a regular basis. However, many trends have made it more important than ever for-profit service-delivery organizations, as well as government agencies, to assess the cost of the services and clinical procedures they provide (7).

When we look at the annual recurrent budget allocated for TASTH for the year 2010 EFY is 213,311,555.15 ETB, whereas the total revenue of the hospital for the same period was 42,605,522.11 ETB which is 19.9% of the annual allocated recurrent budget (8). From the total annual recurrent budget 107,385140.87 (50%) of it goes to salary and benefits of health work force in the hospital.

Health service costing data have a variety of uses such as contributing to service budgeting and planning, pricing, and reimbursement methods for public sector services. They can be valuable inputs in estimating service delivery efficiency, explaining causes of variations in cost/output ratios, identifying the right strategies to improve efficiency and quality, and support efforts to mobilize more domestic resources for health. The measurement of this type of data and subsequent analyses that can be used for the three of the four transformation agendas in the five-year Health Sector Transformation Plan (HSTP) of equitable and quality of health care; improving data quality and use for effective decision-making; and woreda transformation (4).

On the other hand when we look at the Hospital charge setting so many evidence reported that a hospital cannot set rates and charges which are realistically related to costs unless the cost finding system accurately allocates both direct and indirect costs to the appropriate cost center (9). But what was being implemented by so many hospitals, their charges are set within the context of hospitals broader communities, including their competitors, payers, regulators, and customers (10). The current price list of the hospital using was amended by the national council 1996 E.C before 15 years and it was not updated when the hospital starts new services and set fee for those new service.

1.2. Statement of the problem

The need of health care costs information is raising significantly and it is basic information needed by managers and policy makers for making decisions about how to improve the performance of a hospital, where to allocate the resources within or among hospitals, or to compare the performance of different hospitals to one another. The other basic reasons for identifying cost information are to improve efficiency, increase effectiveness, enhance sustainability, and improve quality. Despite the level of resources devoted to hospitals and the health sector, there is a growing gap between available and required resources because the health needs of developing countries have not diminished, although they may have shifted with social, demographic, and epidemiological changes (11).

In both developed and developing countries, hospitals are viewed as vital and necessary community resources that should be managed for the benefit of the community. Hospital managers, who must provide health care services that the community needs at an acceptable level of quality and at the least possible cost (12). VO, Trung Q, et all have analyzed available published literature on unit cost analysis states that, only a small group of countries is presently concerned with this issue. The developed countries, with access to modern science and technology, first realized the importance of this issue within the health-care sector and hence became pioneers with regard to the researching of unit costs. The first article was published in Australia, followed by the United Kingdom (UK), the Netherlands, and Canada. While it is true that the number of research studies published in Asia is higher than the number published in other continents, these studies have not been updated and edited over the years (13).

The Health Care Financing Strategy was developed by the Federal Ministry of Health and endorsed by the Council of Ministers in 1998 EFY. The strategy indicates, the objectives of implementing the reform include increasing available resources for health services, increasing efficiency of resource utilization in health, promoting continuity of health services through sustainable financing, improving quality and coverage of health services, and ensuring equitable distribution of health services (14). The HCF strategy clearly stipulate that user fees needed to be revised to reflect the cost of delivering health care services, but also underscore that individuals should be charged according to their ability to pay. Cost sharing between the government and users was one of the principles of the health care financing strategy (15).

Analysis done regarding status of fee revision in three regions Oromia, Amhara and SNNP region in 78 health facilities shows, only 17 health facilities (22 percent) reported revising user fees in the past two years. From these 17 facilities in 11% of them, the final decision was made by the health center governing body. In 25% of them, it was by the facility head. The major consideration of 14 of these health centers was the cost of delivering services. The need for user fee revision was supported by most health centers 74.5% that have not yet revised fees. Escalating costs of delivering health care services was cited as the major reason to revise services (14). TASTH have revised its service fee 1996 E.C and amended by national council, but there are different services newly started at the hospital and fees were sated on different time. The hospital critically needs to assess the overall service provision price that currently using now.

When we look at available related studies and relevant documents, World Health Organization (WHO) collated data on unit costs from countries and hospitals as part of its WHO-CHOICE project 2011 G.C. The study revealed a dearth of unit cost data for health care services, especially in low and middle-income countries. It presented on the section of inpatient unit costs presents the estimated cost per hospital bed day. These estimates represent only the "hotel" component of hospital costs, by excluding the cost of drugs and diagnostic tests but including costs such as personnel, capital, and food costs. The section on outpatient unit costs presents the estimated cost per outpatient visit, and include all cost components except drugs and diagnostics (16). The other study conducted in Ethiopia at the health extension worker (17) level tries to analyze the cost of service provision by HEW per activities carried out at the health post level In the urban areas, the HEW fees for full cost recovery of the provision of services (including salary, supplies, and overhead costs) ranged from 55.1 birr to 209.1 birr per encounter. The rural HEW fees ranged from 19.6 birr to 219.4 birr (18). The study carried out at the primary health care level by Federal Ministry of Health (FMOH) at primary hospitals departments, they used “monetary value of non-capital, recurrent expenditures incurred and resources used to produce a defined set of health service outputs or to operate specific health facilities (4).

There is limited availability of literature which focuses at primary health care level and district hospital services as a whole in outpatient units per visit, inpatient level per admission day or discharge. The literatures available were which focuses on some specific programs like cost of maternal and child health services, per different programs and disease specific. As per our knowledge and searching capacity, there is no published comprehensive study of the cost of service provision and analyze its payback at tertiary referral teaching hospital has been carried out in Ethiopia. Therefore, analysis of

unit costs of services provision and assessment of the prices charged for different services at the largest tertiary hospital level in Ethiopia will generate evidence that will have importance at policy and program levels.

1.3. Significance of the Study

Health care expenditure is increasing worldwide and determining the unit cost of medical services is essential for health economic analysis. Cost information is vital evidence for managers, decision makers, and policy makers to improve the quality of the medical services, to make the cost projections, to improve efficiency, increase effectiveness and to enhance sustainability. Investigating unit cost of health services provision and asses the pricing pattern of public hospital generates important implications for policy and decision making in the health sector in Ethiopia. Therefore, the findings of this study provide paramount evidence that could influence decision making process at FMOH, hospital managers and Regional Health Bureau, as well as to stakeholders firm NGOs. It is hoped that the present study of unit cost of service provision will serve as a potential benchmark to further cost analysis at tertiary hospital level. The administrative of the hospital can use the finding of this study from the perspective of enhancing financial sustainability and improving the quality of service. This study can be used as basis for further studies related to cost analysis and financial sustainability of hospital service provision. There is no empirical evidence on costs of service provision and user fee analysis at tertiary hospital level in Ethiopia. Additionally this study analyzes the cost of each single services provision in inpatient and outpatient level this will fill the lack of evidences especially for the inpatient services most of literatures present their study by patient day or per discharge, this will not give us unit cost for each service in the unit.

2. LITERATURE REVIEW

2.1. Methodology of unit cost analysis and sampling

Service cost analysis is a methodological approach to analyze the cost of the service to support strategic planning, service quality improvement and cost reduction. There are different methods being used in different industries and there is no clear information available to tell us which method is best to analyses cost of service provision. From the available methods of unit cost analysis top-down, bottom-up and activity-based costing methods are the most widely used. The study conducted in 2006 in Europe has tried to analyze the availability of accurate methods to determine hospital service cost. The methods discussed in this review make it evident that there is a lack of standardized methodologies for the determination of accurate costs of hospital wards. Despite the lack of agreed approach this study concludes that a standardized costing methodology would facilitate comparisons, encourage economic evaluation within the ward, and hence assist in the decision-making process with regard to the efficient allocation of resources. A standardized methodology is required to measure costs accurately, and also guidelines are needed to decide which method to employ for determining ward costs that would best fit the objectives of the study (19, 20).

Negrini et al., in the UK has categorized the basic costing methods into two as a top-down and bottom-up. The bottom-up (or individual patient costing) approach is intellectually appealing, as it would allow significant detailed evaluation of different procedures hence enabling us to identify the cost-effectiveness of the procedure. However, whilst this might be possible in areas which have a high proportion of activities that can be ascribed to individual patients, there are many areas where this is not the case, thus making this approach difficult to implement in practice. In addition, the resources required to collect those individual detail costs would be out of proportion to the benefits that may be accrued from them. Consequently, the top-down method is found to be more practical and realistic, hence widely used. The most contemporary solution is through the cost block programmer (19).

Activity Based Costing (ABC) method has been used in 2013 to conduct cross-sectional study on accounting data of Kashani Hospital. In this study the hospital was divided into several cost centers and five cost categories (wage, equipment, space, material, and overhead costs) were defined. ABC method was performed into two phases. First, the total costs of the cost centers were assigned to activities by using related cost factors. Then the costs of activities were divided to cost objects by using cost drivers. After determining the cost of objects, the cost price of medical services was

calculated and compared with those obtained from total cost center (TCS). This study concludes that ABC method represented more accurate information on the major cost components. Finally these studies conclude that by utilizing ABC, hospital managers have a valuable accounting system that provides a true insight into the organizational costs of their department (21).

The study made by Ulla Slothuus on 50 published studies for the purpose of an evaluation of the measurement of costs in health economic evaluations states the following points. In many of the studies evaluated insufficient information was provided to reach an informed judgment. It was difficult to see which cost components were included in the estimate and thus to judge whether all relevant costs were taken into account. Subject to this, when comparing the study perspectives and the services actually being coasted the results show a failure to include and value all cost categories. More than half of the studies reviewed (52 percent) did not fulfill the recommended guidelines. The proportions of cost categories included were not satisfactory compared with the study perspectives chosen. In addition, when comparing the studies concerning their understanding of the cost concepts, there was no consistency between studies on this important issue. When considering the valuation base chosen, it appeared that in 74 percent of the cases there was a considerable lack of detail when describing which values actually were used and how these were measured. The study also have liked to look at the time frame of each study 23 to determine if fixed and/or variable costs were used appropriately; however, again the lack of detail when describing which values actually were used and how these were measured. Thus, making any judgments about the validity of the cost estimates difficult (22).

A recent study conducted in 2018 at Vietnam on two hospitals to analyze unit cost of medical services by using Relative value unit (RVU). The RVU method, which is also known as the "weight procedure method", is a method universally used in many countries due to its applicability. The study is aimed to develop RVU of hospital medical services for unit cost calculation. Development of the RVU is designed by objective data approach where the RVUs were estimated based on results of unit cost analysis employing micro-costing from two provincial hospitals. From 776 services of Ha Nam Hospitals and 2064 services of Thu Duc Hospital, a reference list of 1,464 medical services was developed. These studies conclude that due to the constant improvement of the health service's framework, the RVUs should be developed and updated continuously. RVU development is composed of three steps, Step one development of a list of hospital medical services. A list of hospital medical

services was developed from medical services of two provincial hospitals. Step two, determining average cost of all services in the list tests available in two hospitals and average unit cost per health-care services in the list from Ha Nam and Thu Duc Hospital. Step three estimating the RVUs per service in the list and average RVU of each services in the list (23).

As we have seen in all the studied reviewed in the above paragraphs one of the key issues in the process of conducting cost analysis is the proper allocation of the cost to where it belongs. Therefore, it requires proper understanding of the operating conditions of the unit or the procedure whose cost is being evaluated or examined. The cost to a health care provider is different from the cost to a payer and from the cost to a patient. The cost to society includes a net of all the cost perspectives plus intangible and opportunity costs. A researcher sometime considers different perspectives and comes up with a cost that includes costs from more than one perspective. The patient perspective is the cost to the patient which includes fees, paid or owed, to the service providers and premiums paid to third-party payers (17, 24).

Sometimes it is difficult to conduct practical cost analysis and we rather look at economic evaluation of the treatment or medical service as indicated in a factsheets of the Centre for Health Economics Research and Evaluation (CHERE) which works on cancer related research economics support team (CREST) states that economic valuation is not typically concerned with hypothesis testing, but is more about estimation and so can still provide useful information even when under-powered Economic evaluations typically require larger sample sizes for adequate power than a typical clinical study While the power calculation should always be done and reported in an economic evaluation, an underpowered economic evaluation can still provide valuable information about the costs and benefits of new treatments (25).

2.2. Empirical evidences from other countries.

In a year 2013 a cross-sectional study was conducted in India with an objective to determine the feasibility of doing cost estimates in the Indian health care sector. The study estimated operating costs and cost per outpatient visit, cost per inpatient stay, cost per emergency room visit, and cost per surgery for five hospitals of different types across India for the financial year 2010–11. The major cost component varied among human resources, capital costs, and material costs, by hospital type. The outpatient visit cost ranged from Rupis (Rs.) 94(USD 1.8) district hospital to Rs. 2,213(USD 42.55) private hospital United State (USD 1=INR 52). The inpatient stay cost was Rs. 345 (USD 6.6) in the private teaching hospital, Rs. 394 (USD 7.57) in the district hospital, Rs. 614 (USD 11.8) in the tertiary care hospital, Rs. 1,959 (USD 37.67) in the charitable hospital, and Rs. 6,996 (USD 134.5) in the private hospital (12). This present study provides information on the actual cost of providing clinical services in five hospitals of different types in India. A large-scale study should be undertaken to gain a better understanding of hospital costing for different types of hospitals and provide more comprehensive information for policy purposes

Another observational study was also conducted in a year 2014 in India for 15 days at a Large Tertiary Care Teaching Institute. The study found that the total average cost incurred on patient care in the indoor unit under study thus calculated came out to be Rs 1861.31 per bed per day. The final average figure arrived at for cost to the hospital bed day in this study is Rs 834.74 and cost to the patient day came to Rs 1026.57 on account of the medicines, surgical consumables, and crystalloids. The maximum total cost toward patient care came to Rs 10958.84 for Intensive care unit (ICU).Whereas the lowest cost of Rs 175.46 was for the psychiatry (26). In this study, it was decided that for the study the sample size should be 15% of the total bed strength of the hospital. This study presented the findings only in Indian Rupis and there is no described exchange rate to USD of the study time.

The study conducted in 2012 with objectives to assess the current cost of resources used to produce hospital services at Victoria Hospital. The main finding of this study for fiscal year 2010/2011, operating costs at Victoria Hospital was $32,421,801. These operating costs include the expenditures reported in the Victoria Hospital's accounts plus the costs of 1 Ambulance services are provided by Emergency Services. The staff of the Sexually Transmitted Infections (27) clinic, the value of the Cuban volunteer doctor who works in the Renal Dialysis Unit, and the cost of antiretroviral drugs

(ARVs) which are normally reported in other parts of the Ministry of health (MOH) budget and are not accounted for by the hospital (20).

The study conducted by Irava, Wayne P, Martina K, Idrish 2012 in selected health facilities in Fiji that for CWM hospital, the average inpatient cost per day is $FJ84. We also know now that one visit of a patient to the physiotherapy department in Lautoka Hospital costs $FJ34, and that one visit to the dentist in Nausori Health Centre costs the taxpayer on average $FJ22. It might be an idea to at least internally display average unit costs so that health staff is more aware of the costs and more alert to possible savings (28). The limitation of this study was it did not include the historical cost of the buildings and depreciation of capital assets.

A retrospective cost analysis of Intensive Care Unit (ICU) patients was conducted from the hospital's perspective to measure and compare the direct costs of ICU days at seven ICU departments in Germany, Italy, the Netherlands, and the United Kingdom. The study used a standardized costing methodology unit cost analysis. The standardized costing methodology was developed on the basis of the availability of data at the seven ICU departments. It entailed the application of the bottom–up approach for "hotel and nutrition" and the top–down approach for "diagnostics," "consumables," and "labor". The finding of this study was direct costs per ICU day ranged from €1168 to €2025. Even though the distribution of costs varied by cost component, labor was the most important cost driver at all departments. The study concludes that direct costs of ICU days vary widely between the seven departments. Our standardized costing methodology could serve as a valuable instrument to compare actual cost differences, such as those resulting from differences in patient case-mix (29).

Than et al. (2017) verified through a study which assessed the unit cost of healthcare services at two public hospitals in the country from the provider perspective. The study analyzed the cost structure of the hospitals to allocate and manage the budgets appropriately. The unit costs per inpatient day varied largely from unit to unit in both hospitals. At PMN General Hospital, the unit cost per inpatient day was 28,374 Kyats (27.60 USD) for the pediatric unit and 1,961,806 Kyats (1908.37 USD) for ear, nose, and throat unit. At MTH, the unit costs per inpatient day were 19,704 Kyats (19.17 USD) for medicine unit and 168,835 Kyats (164.24 USD) for eye unit. The unit cost of the outpatient visit was 14,882 Kyats (14.48 USD) at PMN GH, while 23,059 Kyats (22.43 USD) at MTH. Regarding cost structure, medicines and medical supplies were the largest components at MTH, and the equipment was the largest component at PMN GH. The surgery unit of MTH and the eye unit of PMN GH

consumed most of the total cost of the hospitals (2). The unit costs were influenced by the utilization of hospital services by the patients, the efficiency of available resources, the type of medical services provided, and the medical practice of the physicians. The cost structures variation was also found between MTH and PMN GH. The findings provided the basic information regarding the healthcare cost of public hospitals which can apply the efficient utilization of the available resources.

Studies published by Global Journal of Health Science in January 2016 to apply the ABC method conclude that, the Kashani Hospital had 81 physicians, 306 nurses, and 328 beds with the mean occupancy rate of 67.4% during 2012. The unit cost of medical services, the cost price of occupancy bed per day, and cost per outpatient service were calculated. The total unit costs by ABC and TCS were respectively 187.95 and 137.70 USD, showing 50.34 USD more unit cost by ABC method (21).

Buvo etal. (2018) which aim to explore the unit cost analysis of medical services in Vietnam as well as the effects of applying different costing methods. A standard costing approach was applied to calculate the unit cost of medical services in two provincial hospitals. During the unit cost calculation, the micro-costing method and the ratio of cost to charge (RCC) method were compared. : Although both hospitals offer the same level of service, they differ in terms of other characteristics. Hence, their costs are quite different. Comparing the results calculated using the micro-costing method and the RCC method, the unit costs of the same services were also found to be quite different. The present study should prove particularly valuable in relation to the methodological comparison of hospital service cost analysis in developing countries such as Vietnam (20). The micro-costing method proved to be the most accurate method when calculating the unit cost of medical services since it was best able to reflect the consumption of resources.

2.3. Evidences in Ethiopia

The most recent study conducted in Ethiopia in 2018 Gregorian calendar (GC) at health extension worker level found that in the urban areas, the HEW fees for full cost recovery (including salary, supplies, and overhead costs) ranged from 55.1 birrs for malaria education, testing, and treatment to 209.1 Ethiopian Birr (ETB) for nutrition education and services to 368.2 birrs per training session for health development army members. The rural HEW fees (again that include salary, supplies, and overhead costs) ranged from 19.6 birrs for provision of tuberculosis (TB) services to 219.4 ETB for Human Immune Virus (30) testing and counseling to 460.7 ETB for training health development army members (18). This study tries to analyze the cost of service provision by HEW per activities carried out at the health post level.

The study carried out at primary health care level provides additional evidence on primary hospital costs across the four agrarian regions in Ethiopia. The findings highlight unit cost levels and differences across primary hospitals, departments, geographic regions, and exempted services. The average unit cost for primary hospitals was 310 ETB (adjusted for outliers). Not surprisingly, the major cost driver was Human Resource (HR), accounting for 51% of the total primary hospital costs. Hospitals tend to have highly qualified staff and a more costly composition of inputs compared to other primary care facilities (4). This study conducted at primary hospitals departments, which have a limitation on the calculated cost they used "monetary value of non-capital, recurrent expenditures incurred and resources used to produce a defined set of health service outputs or to operate specific health facilities".

To mention studies conducted in Ethiopia on some specific program, which estimating the cost of Maternal and Child Health (MCH) Services provide the following results. The total annual cost of operating MCH services in the six primary health care facilities was US$110,182. The total costs attributable to antenatal care (ANC), delivery and postnatal care (PNC) services were US$14,582.7, US$22,324.2 and US$10,089.8 respectively. Medical supplies and personnel accounted for 40 % and 32 % of the total cost respectively. Overall, ANC accounted for 13.2 %, delivery 20.3 % and PNC 9 % of the total cost. Immunization and family planning (FP) comprised 27.0 % and 21.0 % of the total cost. The high costs of immunization and family planning can be attributed to high cost of vaccines and FP methods.

The average unit cost was US$ 5.5 per MCH services, ranging from US$ 4.5 per under-five visit to US$ 15.7 per delivery service visit (31). In 2004 EFY a study conducted on the cost of medication in Ethiopia jointly conducted by the Pharmaceuticals Administration and Supplies Service (PASS) of the FMOH and the WHO covered four regions - Amhara, Oromiya, SNNPR, and Tigray as well as the capital city Addis Ababa. The study focused on procurement and price, availability, and affordability. "Affordability of the cost of a single course of therapy for 6 disease situations was measured by comparing it with the daily wage of the lowest paid government worker" (32).

From the above literatures reviewed in methodology review part there are different method used to calculate unit cost of medical services. There was no uniformly used method to calculate unit cost of services. From the widely used methods top-down and bottom up methods are the common one. Applying top-down method is easier and consumes les time and resource than the bottom-up one. A combination of two methods the top-down method for allocation of overhead costs to the final cost center and micro costing method to calculate unit cost per each service is a good combination to generate more realistic result in unit cost analysis of service provision. The reason is as mention above the micro costing method is more accurate method because of each used items to provide a single service were collected at the final cost centers level. There are studies conducted by combining two methods to calculate unit cost of medical services and compare the findings. It is widely recommended that the micro costing or activity based costing method is the most accurate method. Additionally we have observed that from the above literature reviewed that, determining the unit cost of medical services is essential. There is no study done in Ethiopia setup at tertiary hospital level that calculate unit cost of service provision of each service and analyze the gap between cost and service charge. There are literatures published online that calculate unit cost of service at program level and at primary health facilities level.

3. OBJECTIVES

3.1. General objective

To analyze the unit cost of services provided and compare with user fees for the different services offered at Tikur Anbessa Specialized Hospital.

3.2. Specific Objectives

- Analyze unit costs of various services provided at outpatient and inpatient levels in TASH;
- Estimates unit costs of different therapeutic and diagnostic services.
- Compare the service charges for different services with their actual unit cost.

4. RESEARCH QUESTIONS

This study tries to answer the following research questions:

1. What are the costs of different services, therapeutic and diagnostic services at TASTH?
2. Answers the gap between service charges of different services with their actual costs.

5. METHODS

5.1. Study design

A facility based cross-sectional retrospective unit cost analysis and assessment of its payback of different services provided in departments of TASTH for the year 2017/18GC (2010 EFY). We have calculated the total operating costs of the study hospitals and the unit costs of medical services of different service units from a provider perspective by applying the top-down costing approach and micro-costing method. The unit cost of medical services calculated by employing the micro-costing method was also compared to the current price charge of the hospital.

5.2. Study period

This study was conducted from January to June 2019 EFY.

5.3. Target population

The Target population of the study was all services provided in the hospital during the study period.

5.4. Study population

The study population was serviced pragmatically selected in different units of TASTH during the study period.

Inclusion criteria: Service with the same nature like OPD visit for all cases were merged together, for the inpatient services all services were included in the sampling frame.

Exclusion criteria: - Availability of data and information needed. In this unit cost analysis, the cost of drug prescribed was not included in the study, but the medical supply for each department for service provision was included in the cost analysis. A cost of this medical supply was allocated to the services units for which we analyze unit costs. Service units excluded from this study were due to the nature of service in units like cancer diagnosis and treatment center. Due to time and budget shortage they were excluded from the study, such units need separate study. Cardiac unit set their services price recently and the fee setting of those service have technical issue which needs improvement, due to this we have excluded this unit from the study.

5.5. Study setting

The study was conducted in different service units of TASTH Addis Ababa, Ethiopia. TASTH was established in 1974 EFY. The Hospital is teaching hospital of the Addis Ababa University, College of Health Sciences, School of Medicine and other who serves the community at large. The hospital is located in Lideta sub-city; it is also the largest referral hospital in Ethiopia with over 700 beds with a number of specialties and subspecialties. It also serves as a training center for different undergraduate and postgraduate students and others who shoulder the health problems of the community and serves the whole population of the country at large as a referral hospital (33). In 2010 EFY, the numbers of outpatient attendances and admissions were over 384,859 for outpatients and 20,618 for inpatients admissions, respectively. The total number of health professionals and administrative staffs working in all departments was 4,901 and additionally, there are health professional's employed at college of health science (CHS) and working for the hospital. Furthermore, in 2010, the bed occupancy rate of the Hospital inpatient unit was 92.5% and the emergency room bed occupancy rate was 193.5%.

Table 1: List of service units with their respective umber of health services of different departments in TASTH.

No	Name of service units	No of service types provided
1	Nursing	45
2	OPD general	17
3	MCH	20
4	Neonatology	31
5	TB clinic	4
6	ART clinic	3
7	Neurosurgery	72
8	Physiotherapy	46
9	Orthopedics	119
10	Pediatrics	143
11	GYN OBS	37
12	Laboratory	126
13	Radiology	150
14	Radiotherapy	7
15	Emergency OPD	30
16	ENT	33
17	GI He pathology	80
18	ICU	45
19	Minor surgery	41
20	Major surgery	72
21	Ophthalmology	92
	Total	**1213**

5.6. Sampling Method

Totally there are 25 different service centers that provide 1,323 services in the Hospital identified as final cost centers. To analyze unit cost different service we cannot asses all services provided in the hospital due to time, resource constraint and exclusion criteria's, we have excluded 4 departments from the sampling frame and left with 21 service units and 1,213 services units listed in the above table 1. The reason for exclusion of those service units is they need separate study due to the complexity of services and exclusion criteria sated. Our study has used these 21 service units with 1,213 services in Outpatient, inpatient, and diagnostic and therapeutic departments.as a sampling frame. Then we have selected sample service from each department proportionally. To select a sample from each department 22% of service was selected by using Purposive sampling method to select service from each department. We have chosen this sampling method because we want to analyze the unit cost of different services for each department so that it can represent all services provided in the hospital. The other reason to use the purposive sampling method was there are different service categories per different service units, if we select randomly we might miss some service elements from different service units. Due to this, we have used these departments' as a mutually exclusive segment then the selection was be made by purposive sampling method by consulting respective unit leaders or head in the hospital and selected proportionally from each department. The sampling objective for a costing exercise for provider payment is to select the right benchmarks for cost estimates rather than to obtain a statistically valid sample. Pragmatic rather than statistical methods are almost always used to determine sample size and composition in costing exercises for provider payment (34).

When we calculate proportionally our sample

N= Number of total services provided in all service units

n= Number of sample services which are 22% of total services provided in all units

N= 1,213

n= N*22/100

n= 1,213*22/100

n= 273

Table 2 below describes the selection of sample from each service units proportionally by using purposive sampling method by consulting respective unit representative.

Table 2: Sample selection proportionally 22% from each selected service units

Sample selection of services from each service units proportionally			
No	**Departments**	**Total services**	**22%**
1	Nursing	45	9
2	OPD general	17	3
3	MCH	20	4
4	Neonatology	31	6
5	TB clinic	4	1
6	ART clinic	3	1
7	Neurosurgery	72	14
8	Physiotherapy	46	9
9	Orthopedics	119	24
10	Pediatrics	143	29
11	GYN OBS	37	7
12	Laboratory	126	25
13	Radiology	150	30
14	Radiotherapy	7	1
15	Emergency OPD	30	6
16	ENT	33	7
17	GI He pathology	80	16
18	ICU	45	9
19	Minor surgery	41	8
20	Major surgery	72	14
21	Ophthalmology	92	18
	Total	**1,213**	**273**

5.7. Costing Method

In this study, the top-down method was applied to calculate and allocate overhead costs to all intermediate and final cost centers and then the total cost of intermediate cost center to final cost centers based on allocation criteria. Additionally, we have used activity-based costing method to calculate the unit cost of each procedure in each service units.

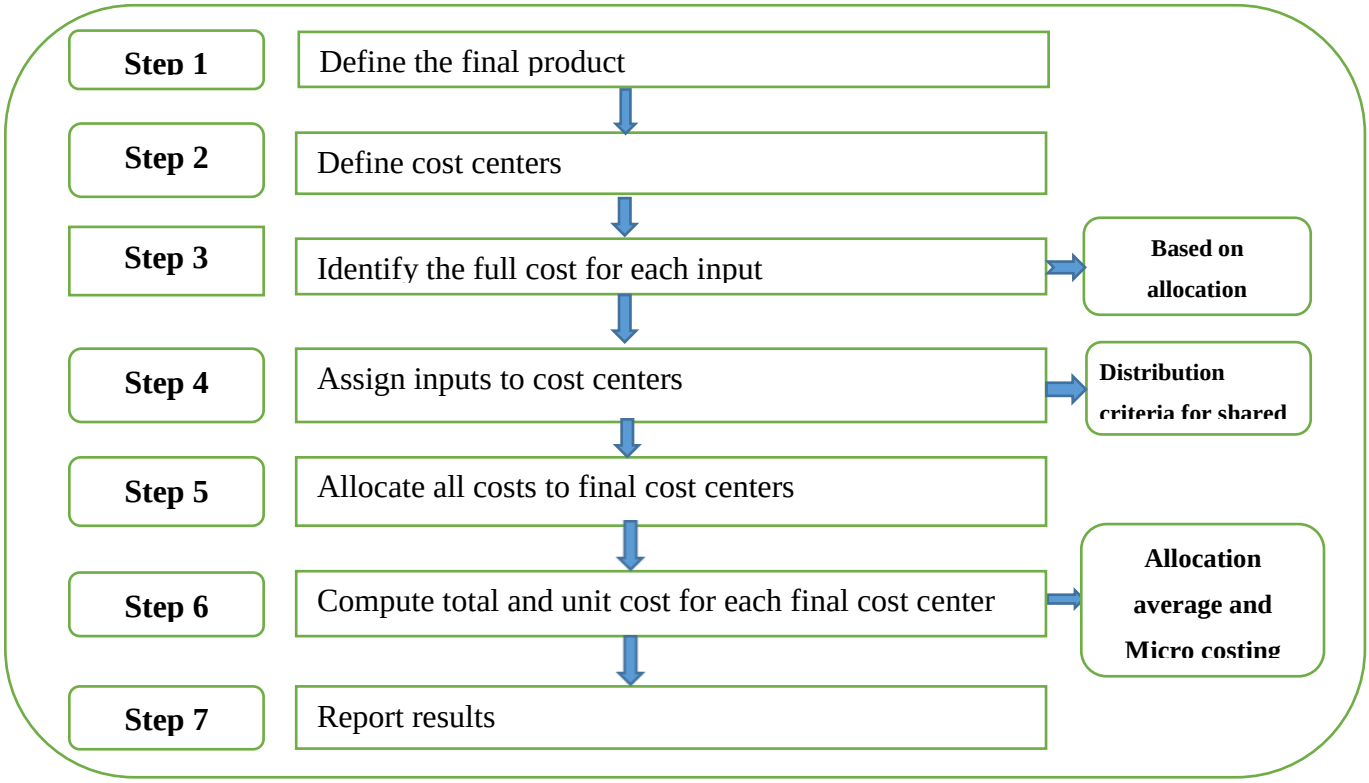

Figure 1: Unit cost analysis process based on a top-down unit cost analysis and micro-costing method for final service units.

The above figure 1 provides information about the analysis process concerning the unit cost analysis of medical services based on the top down costing methodology, which consists of seven basic steps in calculating unit cost per service units (9, 35).

Step 1: is defining the final product of the cost analysis, which we are interested in computing unit costs of the various services at outpatient department; inpatient department and diagnostic and therapeutic unit's level have been computed. The units of output for each final cost center was defined as for inpatient care is number of services provided during study period, For outpatient care number of visits and for diagnostic and therapeutic cost centers is the number of tests or exams (for laboratory and x-ray departments) and our unit of measurements as output for each cost center of one full year

data (24).

Step 2: in this step we have defined cost centers, which will help us for computing unit costs per each center or services unit in the hospital to which direct and indirect costs were assigned. The direct cost categories of services include supplies consumable, medical equipment, and salaries. The indirect cost categories include allocated costs of other overhead and intermediate departments. The departments that provide overall services in the hospital have been categorized as overhead, intermediate and final service units.

Table 3: Total Hospital cost center assignment

No	Overhead cost centers	Intermediate cost centers	Final cost centers
1.	Ambulance	Adult reception	General OPD
2.	Budget and Finance	Biomedical unit	Emergency OPD
3.	General administration	Card room all	ENT
4.	Gender office	Central sterilization room	TB Clinic
5.	General service	Cloth sewing	ART Clinic
6.	Human resource management	Food preparation	GYN OBS
7.	Information desk	Health and sanitation office	Neurosurgery
8.	Property administration	HMIS	Physiotherapy
9.	Security and Safety Office	Infection prevention office	Orthopedic
10.	Technic & maintenance	Laundry	MCH
11.	Telephone operator	Liaison office	Neonatology
12.		Morgue	ENT
13.		Nursing service director	Neurology & rheumatology clinic OPD
14.		Pharmacy service directorate	**Radiology**
15.		Quality control office	**Laboratory**
16.		Supervision office nursing	Major surgery OR
17.		Lift service	Ophthalmology
18.		Guard	Nursing
19.		Cleaning service	Minor surgery OR
20.		Clinical service director	ICU
21.			Pediatrics surgery
22.			GI and he pathology

Step 3; identifies the full cost for each input which is an important part of computing unit costs that will make sure that we have cost data which are as complete as possible. In this step we have identified which expenditures should be counted as costs based on resources used up during the production of health care, and the actual measurement of true costs using available data.

Salaries and Fringe Benefits: To calculate the full or total cost of salaries, we have used actual salary amounts paid to hospital employees. The salaries paid for non-health service provision like teaching students was excluded from the total cost by considering time spend on each procedure by health professionals. This was because of during unit cost calculation of each activity on final cost centers we used activity-based costing method for direct consumption of time spent by each category health professionals and each item spent per each activity.

Donated items: For items those cost information is available we have used it to calculate the total cost for that item, for items cost information is not available the current market price of the item was used. If the value of donated inputs is not included in the cost analysis, services use more donated items may appear more efficient than their peers, even though their actual efficiency may be the same. Such items can account for a substantial share of hospital resources (7).

Capital items: Capital assets are assets having an economic useful life exceeding one year and not acquired primarily for resale. Depreciation may be hard to measure if certain information is not available (such as purchase price and the useful life of the equipment). The hospital does not maintain a register of all fixed assets nor are the values of the assets currently in use easily retrievable; they have merged capital asset documents for TASTH and CHS together. An attempt to differentiate and estimate the cost of fixed assets proved too time-consuming as it involved collecting data from each department from their inventory lists (displayed in each office) and then obtaining estimates of the costs of those items in order to calculate a depreciation amount for the year that would be added to the other costs. The departments have no compiled data of fixed assets in their specific unit. We have concluded that there is no organized data or engineering department in the hospital that will give us full information. Due to these we have excluded building, land cost, and capital equipment cost from the total unit cost calculation. The other reason for excluding those items is if we plan to collect those data we have no knowledge and experience in the field of engineering. Medical types of equipment are

also one of a capital item, the data we have gate from the biomedical department of the hospital has no full information that we need to calculate the cost of the equipment per minute like purchasing price, use full life and the total life of the equipment and service unit each equipment belongs where not available. Due to these reasons, we have calculated capital equipment's for unit costs calculation of 3 service unit's radiology department, GI and he pathology and Neurology and rheumatology. Studies in other countries can give an indication of the magnitude of capital costs in hospitals. In 2012, a costing study of the Mount St. John's Medical Center (MSJMC) in Antigua and Barbuda showed capital costs at 8.9% of total costs (36). A similar study in 2009 in the Philippines, estimated capital costs for five tertiary hospitals (116 to 455 beds) at an average of 12.6% (range 8% to 16%; median 13%) (37). If the TASTH wanted to include an estimate for capital costs for inpatient and outpatient service units, the unit costs provided in this report could be marked up by a factor of anything from 10 to 20% and this would give some assurance that the total unit costs are not significantly understated (36).

Depreciation cost: depreciation cost of medical equipment's per minute was calculated by considering the current market price we have from Pharmaceuticals Administration and Supplies service (PASSS) multiplied by depreciation rate which is 10% divided by minutes the equipment works per day times working day in the year (38).

$$\text{Depreciation cost (ETB per minute)} = \frac{\text{Retail price} * \text{depreciation rate}}{\text{Minutes worked per day} * \text{working day in the year}}$$

Step 4: is the assignment of inputs to Cost Centers at this point; we have presumably gathered information about the hospital's total costs, whatever the source of payment. This information alone may provide useful insights even before you start computing unit costs: for example, in identifying which line items account for most of the cost and whether this is changing over time.

Step 5: in this step is we have reallocated all indirect costs to the final cost centers. In this way, the unit cost of each service includes the overhead costs incurred in producing each service provided in all final cost centers.

First, we have added total salary cost of overhead units and supply items, then distributed for intermediate cost centers based on the proportion of the number of human resources working in the

unit proportionally from total workers in the hospital. Then we have total costs of each intermediate cost centers, the cost of the intermediate units were also allocated to the final cost centers based on three allocation criteria set based on the types of unit. The criteria's were for a service which serves all units equally, it was distributed proportionally by the number of services provided in the unit during the study period. For the units that serve inpatients units only like dietary was distributed based on the proportion of the number of bed they have. Finally for units like laundry and Central sterilization room the cost was distributed based on workload per each department.

After we allocated the cost of the intermediate units to final cost center we have total indirect cost from overhead units and intermediate units that we need to distribute to all final cost centers. We have made an assumption to distribute the total indirect costs to a final cost center by categorizing them. The category includes IPD, OPD, laboratory services, radiology, radiotherapy, and others have distributed the total indirect cost based on cumulative service usage from total services in the hospital. In this distribution, we have included service units those we have excluded from units we have analyzed the unit cost of their services. The reason to include these excluded units was if we did not include the overhead cost of those departments in the distribution it will be overloaded to other service units, this will lead to overestimation of the indirect cost of each service. Finally, after we have the total indirect cost of all categories, we have again distributed to each service units of final cost center in all category based on the share of the number of services provided per each final units for OPD. For IPD service units the total indirect cost distributed based on the share of a number of beds in the unit from total beds available, and then the total cost of each IPD units was divided for their respective total length of stay per each unit.

Step 6: Computing unit cost for each cost center services selected: At this point, we know the total cots that were incurred at each of the final cost centers services as well as the output of each center including lab tests. In the unit cost analysis, the unit cost calculation is defined using multiple methods, including the average method and the micro-costing method. In the cases where the Final cost center produces only one output (a cost objects) or a number of homogeneous outputs (e.g. an outpatient service), the average unit costs were used. For multi-product cost centers, a number of methods are available. The most accurate such method, which does require a greater workload, is the micro-costing method since it is based on actual resource use. The micro-costing method first

determines the direct cost of each service (that is, the number of countable resources that are used during the provision of the service).

In this study, we have employed micro-costing as a base case. Micro-costing was measured by the cost estimation that relates to "direct enumeration and costing out of every input consumed in service production. We have computed micro-costing method to calculate direct costs of 273 services selected from 21 service units proportional 22% of the total services provided in all units. The total cost of every single service was calculated by adding direct variable cost calculated by a micro-costing method and overhead cost (fixed cost) allocated to each service units to each service. We have used the following cost formula to calculate total unit cost calculation of each service.

TC=TVC+TFC

TVC= TC sup +TC Me =TC HR

TFC=Total fixed cost allocated from OH & IM cost centers

TC=Total cost

TVC= Total variable cost

TFC= Total fixed cost

TC sup = Total supplies consumable

TC Me = Total cost of medical equipment's

TC HR= Total cost of human resource

Step 7: Report results the finding of this study. The finding and results of this study described in the result part of this paper. We displayed in the result section and discussed with relevant literatures available. We have converted our finding to United State Dollar (USD) with the exchange tare of the study period which is 2010EFY (1USD= 29.35 ETB) (39).

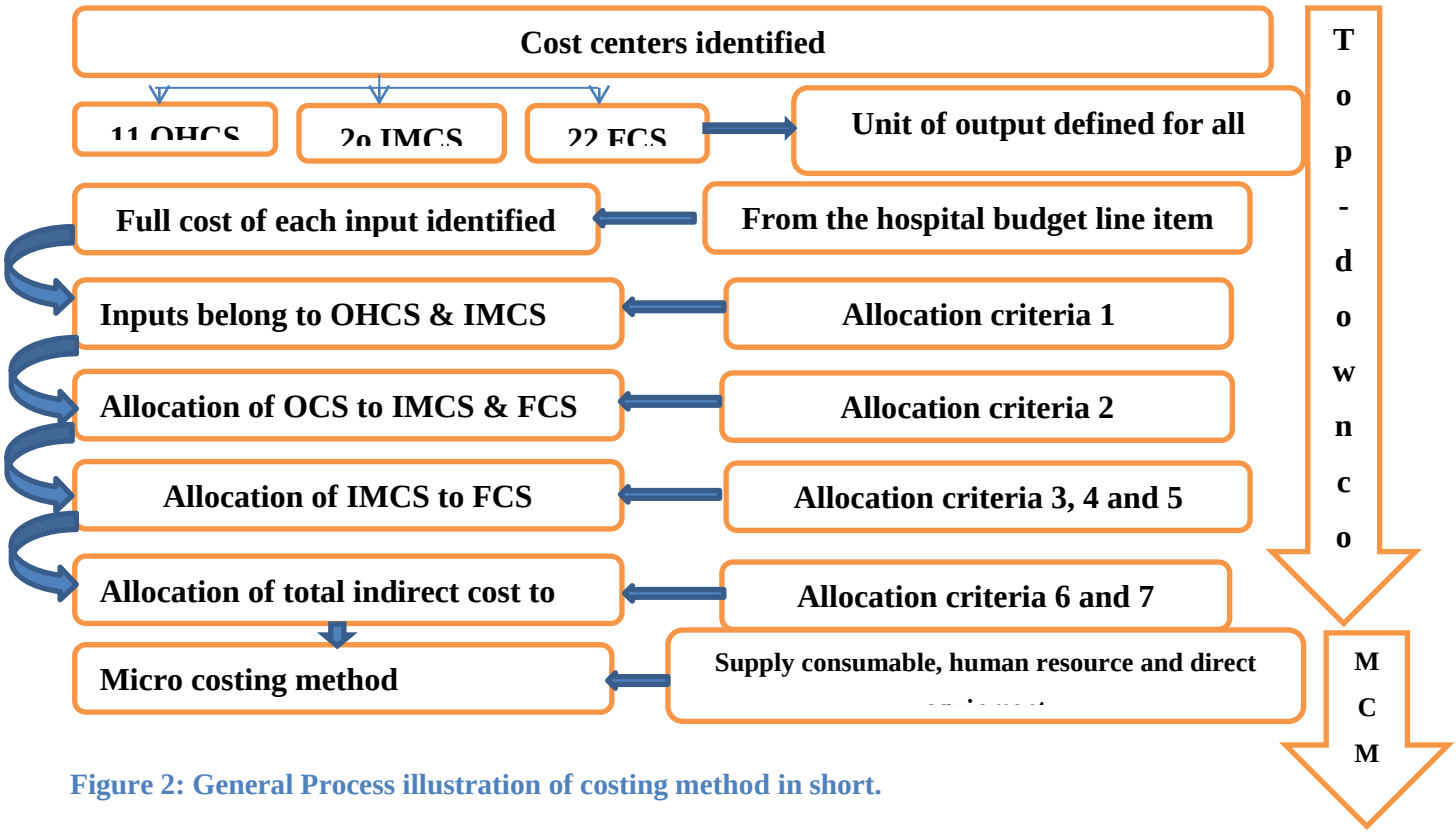

Figure 2: General Process illustration of costing method in short.

The above figure describes that the overall costing procedure and steps followed and different assumption made during unit cost calculation. It also shows us that different allocation criteria's were used in the above stated stapes and at which stage we have combined the two methods top-down costing and micro costing methods used in the study.

5.8. Study period

A retrospective cost analysis was conducted from Oct 2018 to June 2019. Because of important data such as utility costs are only available on an annual basis in such situations it makes more sense to analyze data for a whole year (7).

5.9. Data collection and analysis methods

Annual data were collected from July 2017 to June 2018 (the financial year 2017–18) by data collectors using prepared pro forma. The data collection process included three parts: 1) reviewing the hospital administrative records and logistics information, 2) identifying potential interviewees to provide some information, and 3) conducting face-to-face interviews with responsible staff for data collection and validation. The main sources of data were the hospitals' activity and accounting reports. Comprehensive information about human resources was obtained from the hospital payroll and confirmed by the hospital administrators. Data for each department were obtained from the register in each unit, service data from Health management information system (HMIS) unit of the Hospital and other information on the use of medical supplies and capital equipment's from department leader of the unit. Annual recurrent expenditures, which Included salaries, medical supplies, supply materials, fuel and lubricants, office supplies, maintenance and cleaning, communications, water, electricity, telephone, and Internet, was collected from the annual expenditure report of the hospital. The costs data were calculated using Microsoft Excel 2010.

5.10. Operational Definitions

Cost: The total money, time, and resources used to produce a defined set of health service outputs

Direct cost: Costs that can be identified directly with a particular process, project, or program.

Fixed cost: Includes all costs that do not vary with activity for an accounting period.

Variable cost: All other costs that are some function of activity.

Indirect cost: Costs associated with an enterprise, activity, etc. which are not identified as direct costs, but which may be included in the accounting.

Unit Cost: Cost per each service.

Exchange rate: Price for which the currency of a country can be exchanged with another currency.

Cost allocation method: Cost allocation method where the costs of overhead departments are allocated to one another before allocating cost to the final cost centers.

Average: The arithmetic average, which is the sum of all values for a specific variable divided by the total number of observations for that variable.

Cost recover ratio (CRR): We have calculated it by dividing the price to the calculated cost and finally multiplied by 100.

Outpatient Department: Curative services that do not require admission into a health facility and are provided in the outpatient department.

Inpatient Department: Provides procedures that require a patient to be admitted and have close monitoring during and after procedures.

The recurrent costs: include drugs and supplies, salaries, and other operational costs (e.g., electricity, running water, maintenance, etc.), which are incurred on a regular basis that can be allocated as direct costs or indirect costs. Drugs costs were not included in this study.

Exempted service: is a service that is offered for free to everyone regardless of their income level.

5.11. Results Dissemination Plan

The findings of this research will be presented and submitted to the Addis Ababa University School of Public Health and submitted higher officials of Tikur Anbessa Specialized Teaching Hospital. The study finding will also be submitted to professional journals on health for publication to serve as a data source for further studies in the site. In addition, great efforts will be made to disseminate the result through the presentation in different seminars, workshops, scientific conferences.

5.12. Ethical Considerations

Ethical approval was obtained from the Addis Ababa University School of Public Health Institutional Review Board. Permission letter to conduct the study in Tikur Anbessa Specialized teaching hospital and to Ethiopian pharmaceutical fund and supply agency for data request was received from the hospital. The ethical letter submitted to TASTH and support letter was forwarded for all departments in the hospital to provide me all the required information. The support latter to PASS was also submitted to the agency and appropriate information was provided on the current market price of all consumable, pharmaceutical and medical equipment's.

5.13. Data Quality Assurance

Data were collected by trained HMIS officers, finance officers and department heads after giving two-day training for data collectors on data collection formats for effectiveness of the data. The supervisor was supervised every activity of data collectors and filled formats. The extracted data were cross-checked using the register which is also kept in the same unit and HMIS report. At the end of each day of data collection, the data collected was checked by the principal investigator for completeness and the log book from which data was retrieved was kept safely in a cabinet. These have been done until all the information we need was retrieved to keep information secret.

6. RESULTS

6.1. Overhead and intermediate cost allocation to final cost centers.

By better understanding the costs of various health services (including exempted), consumers of these services might have a better appreciation of the services rendered and how health workers are often limited to provide services because of resource constraints and financial budget limitations. For hospital managers and the Ministry of Health, having knowledge about the basic unit costs as used in this study might help to better manage resources matched to outcomes: putting a number on how many outpatient services costs together with numbers on utilization of services will give a good indication of how affordable services provided at tertiary hospital levels are and how budgets need to be allocated to certain levels of care.

The supply items described in the table 4 describes that the total supply used by the hospital which was added from all the hospital supplies plus 15% of total supply budget of College of Health Science (CHS) was recommended by finance department expert opinion from their experience. We have considered this opinion because of as we have mentioned earlier there are health workers and admin staff who employed for the CHS and works for the hospital and additionally there was no clear boundary of budget usage between the hospital and CHS. By considering the above assumption the total budget of supply item for the hospital for the year 2010 E.C was **31,227,520.57.** The salary and benefit of the human resource were not included in the above table because we have calculated the total cost of human resource for each unit cost of overhead cost centers and intermediate cost center. For the final cost centers, it was calculated per each service by converting each category health professional's annual salary to cost per minute.

Table 4: Composition of different Supply cost components at TAST Hospital and 15% of CHS in ETB.

Budget Item	Code	TASTH in (ETB)	CHS in (ETB)	15%	TASTH + 15% of CHS in (ETB)
Uniform & other clothing	6211	7,000,400.00	300,000.00	45,000.00	7,045,400.00
Office supplies	6212	2,340,748.25	810,956.00	121,643.40	2,462,391.65
Printing	6213	2,132,240.77	63,356.87	9,503.53	2,141,744.30
educational materials,	6215	-	1,000,000.00	150,000.00	150,000.00
Fuel & oil	6217	1,400,000.00	465,000.00	69,750.00	1,469,750.00
Other material and supplies	6218	270,000.00	-	-	270,000.00
different Equipment and Books	6219	4,381.23	2,920.82	438.12	4,819.35
Allowance	6231	302,268.56	1,021,467.75	153,220.16	455,488.72
Transport	6232	760,056.33	71,840.37	10,776.06	770,832.39
Refreshment	6233	360,995.32	49,594.54	7,439.18	368,434.50
Maintenance and repair of vehicle and other transport	6241	270,000.00	400,000.00	60,000.00	330,000.00
Maintenance and repair of plant and machinery and equipment	6243	931,300.00	190,000.00	28,500.00	959,800.00
Maintenance and repair of building, furnishing and fixtures	6244	600,000.00	1,050,000.00	157,500.00	757,500.00
Rent	6252	811,900.00	350,000.00	52,500.00	864,400.00
Advertising	6253	56,000.00	70,000.00	10,500.00	66,500.00
Freight	6255	737,023.81	13,970.00	2,095.50	739,119.31
Fees and charges	6256	30,000.00	37,090.01	5,563.50	35,563.50
Electricity charges	6257	1,700,000.00	400,000.00	60,000.00	1,760,000.00
Telecommunication charges	6258	1,100,000.00	183,178.96	27,476.84	1,127,476.84
Water and other utilities	6259	5,000,000.00	1,200,000.00	180,000.00	5,180,000.00
Local training	6271	405,300.00	130,000.00	19,500.00	424,800.00
Purchase of plant machineries	6313	1,479,000.00	300,000.00	45,000.00	1,524,000.00
Purchase of building, furnishing	6314	1,761,900.00	200,000.00	30,000.00	1,791,900.00
Purchase of livestock and animals	6315	188,700.00	60,000.00	9,000.00	197,700.00
Grants and gratuities to individuals	6417	329,900.00	-	-	329,900.00
Total		**29,972,114.27**	**8,369,375.32**	**1,255,406.30**	**31,227,520.57**

The source of the above Table 4 data is from the administrative document obtained from finance department of annual recurrent budget allocated to TASTH and annual budget of CHS budget sheet and expert opinion. After we have added all the supply item of the hospital, total salary of the human resources working in each overhead units and intermediate units were calculated. Table 5 describes that the total human resource related cost of overhead and intermediate cost center. The total cost of human resource related cost for all overhead and intermediate units is 47,090,655ETB.

Table 5: Total cost of each overhead and intermediate cost centers in (ETB).

Overhead units			Intermediate units	
No	**Name of overhead units**	**Total annual salary and benefit of the unit in (ETB).**	**Name of intermediate units**	**Total annual salary and benefit of the unit in (ETB).**
1	Ambulance	86,632	Adult reception	773,094
2	Budget and Finance	1,735,432	Biomedical unit	929,618
3	General Administration	94,725	Card room all	1,238,544
4	Gender office	24,869	Central sterilization room	532,284
5	General service	8,135,930	Cloth sewing	181,008
6	Human resource management	564,768	Food preparation	72,288
7	Information desk	1,743	Health and sanitation office	385,620
8	Property administration	1,014,014	HMIS	360,988
9	Security and Safety Office	73,250	Infection prevention office	236,130
10	Technic & maintenance	177,876	Laundry	950,280
11	Telephone operator		Liaison office	1,017,900
12			Morgue	226,212
13			Nursing service director	509,112
14			Pharmacy service directorate	5,891,520
15			Quality control office	402,192
16			Supervision office nursing	851,184
17			Lift service	426,744
18			Guard	5,829,132
19			Cleaning service	14,042,496
20			Clinical service director	325070
Total Salary OHCS		**11,909,239**	**The total salary for Intermediate cost centers**	**35,181,416**

The total salary cost of the overhead cost centers and all supplies of the hospital added and distributed to intermediate cost centers based on their share of no of human resources working in each unit from total hospital workers. The human resource for each intermediate unit calculated and described in the above table 5 added with the distributed cost from the overhead units. The total cost each intermediate unit identified and described in table 6 and distributed to final cost centers based on allocation criteria set. The criteria's were for a service which serves all units equally, it was distributed proportionally by the number of services provided in the unit during the study period. For the units that serve inpatients units only like dietary was distributed based on the proportion of the number of bed they have. Finally for units like laundry and Central sterilization room the cost was distributed based on workload per each department.

Table 6: Intermediate cost center cost allocation to final cost centers based on allocation criteria in ETB.

Intermediate cost center cost allocation to final cost centers based on allocation criteria					
Costs allocated for all Final cost centers proportionally		**Cost allocated to final cost center based on No of beds**		**Costs allocated to final cost center based on workload**	
Name of Units	**Total cost in (ETB).**	**Name of Units**	**Total cost in (ETB).**	**Name of Units**	**Total cost in (ETB).**
Adult reception case team 1	**711,454.8**	**Dietary**	**144,214.6**	**Laundry**	**1,146,879.3**
Biomedical	1,669,859.0			**Central sterilization room (CSR)**	589,825.3
Card room all	1,439,938.4				
Cloth sewing	209,778.6				
Health and sanitation office	409,595.5				
HMIS	**389,758.6**				
Infection prevention office	255,310.6				
Liaison office	1,080,236.6				
Nursing service director	595,423.9				
Pharmacy service directorate	1,251,189.6				
Quality control office	426,167.5				
Supervision office nursing	**633,430.2**				
Lift service	493,875.5				
Guard	5,829,132.0				
Cleaning service	14,042,496.0				
Clinical service director	363,430.8				
Morgue	259,777.7				
Total	**30,060,855.4**		**144,214.6**		**1,736,704.5**

After we allocated the cost of the intermediate units to final cost center we have total indirect cost from overhead units and intermediate units that we need to distribute to all final cost centers. We have made an assumption to distribute the total indirect costs to a final cost center by categorizing them. The category includes IPD, OPD, laboratory services, radiology, radiotherapy, and others have distributed the total indirect cost based on cumulative service usage from total services in the hospital. In this distribution, we have included service units those we have excluded from units we have analyzed the unit cost of their services. The reason to include these excluded units were if we did not include the overhead cost of those departments in the distribution it will be overloaded to other service units, this will lead to overestimation of the indirect cost of each service. Finally, after we have the total indirect cost of all categories we have again distributed to each service units of final cost center in all category based on the share of the number of services provided per each final units for OPD. For IPD service units the total indirect cost distributed based on a share of the number of bed in the unit from total beds available, and then the total cost of each IPD units was divided for their respective total length of stay per each unit.

6.2. Unit cost of different services per each final cost centers

The final expected output of this study is to calculate the unit cost of different services and analyzing their paybacks. Here we have listed in the table 7 below the unit cost of different services of laboratory units which consists the following components. The first mention is supply used per each services, direct personnel time spend to provide that single service and overhead and intermediate cost allocated to each services.

Table 7: Unit cost of Laboratory services and their respective service price in ETB.

No	Service Name	Supply (Consumables) in (ETB).	Direct Personnel in (ETB).	Overhead Cost allocated in (ETB).	Total cost in (ETB).	Current Price in (ETB).
1	Hemoglobin	26.9041	15.544	4.416	46.865	5.000
2	Hematocrit	12.35	15.544	4.416	32.311	5.000
3	CBC	10.976	15.544	4.416	30.937	21.000
4	WBC count	7.373	15.544	4.416	27.334	5.000
5	Diff. count	4.59	15.544	4.416	24.551	5.000
6	Plat late count	6.35	15.544	4.416	26.311	4.000
7	RBC count	6.35	15.544	4.416	26.311	5.000
8	ESR	6.74	46.633	4.416	57.789	6.000
9	Coagulation time	7.554	62.177	4.416	74.147	45.000
10	Blood group + RH	31.8	7.772	4.416	43.989	6.000
11	Hem parasite	31.8	7.772	4.416	43.989	5.000
12	CD4	132.5579167	23.316	4.416	160.291	Exempted
13	CD4/CD8 ratio	223.494	23.316	4.416	251.227	Exempted
14	Urea	9.462	23.316	4.416	37.195	7.000
15	Ceratinine	9.0332	23.316	4.416	36.766	7.000
16	Cholesterol	9.032	23.316	4.416	36.765	7.000
17	Triglyceride	9.217	23.316	4.416	36.950	15.000
18	Pregnancy test	5.53	15.544	4.416	25.491	12.000
19	Stool exam	1.7	23.316	4.416	29.433	5.000
20	Weil flix Test	9.63808	34.974	4.416	49.029	15.000
21	Uric Acid Test	14.322	46.633	4.416	65.371	15.000
22	X-match	16.531	11.658	4.416	32.606	No Price set
23	VDRL test	17.71	15.544	4.416	37.671	15.000
24	Serum electrolyte (Na, K, Cl, CaO for each)	11.21	31.088	4.416	46.715	15.000
25	Alpha Amylase	19.55	93.265	4.416	117.231	20.000

The table 8 below displays that the unit cost of different services of diagnostic units which consists radiography, radiology, GI and he pathology and neurology service units. The cost items contain the following components to calculate unit cost of each service. The first mention one is supply used per each service, medical equipment used to provide that specific service, direct personnel's time spend to provide that single service and overhead and intermediate cost allocated to each service was added to calculate total cost of each service.

Table 8: Unit cost of different services at radiography and radiology with their respective service price in ETB.

No	Service Name	Supply (Consumables) in (ETB).	Direct Equipment in (ETB).	Direct Personnel in (ETB).	Overhead Cost allocated in (ETB).	Total cost in (ETB).	Current Price in (ETB).
1	Skull/lateral	40.1	24.248	32.799	41.642	138.799	20.000
2	Mastoid	25.1	24.248	32.799	41.642	123.799	20.000
3	Mandible	40.1	24.248	32.799	41.642	138.799	20.000
4	Temporal mandibular joint	64.1	24.248	32.799	41.642	162.759	20.000
5	Pelvic	40.1	24.248	32.799	41.642	138.779	20.000
6	Sternum	25.1	24.248	32.799	41.642	123.799	20.000
7	Chest	40.1	29.098	32.799	41.642	143.629	20.000
8	Abdomen	40.1	24.248	32.799	41.642	138.779	20.000
9	Shoulder	25.1	33.948	32.799	41.642	133.498	20.000
10	Humorous	70.1	33.948	32.799	41.642	178.458	20.000
11	Forearm	70.1	33.948	32.799	41.642	178.458	20.000
12	Elbow	40.1	33.948	32.799	41.642	148.498	20.000
13	Hand	64.1	29.098	32.799	41.642	167.609	20.000
14	Femur	70.1	29.098	32.799	41.642	173.609	20.000
15	Knee	40.1	29.098	44.141	41.642	154.991	20.000
16	IVP	100.1	38.797	62.621	41.642	243.170	120.000
17	Barium swallow	55.1	72.745	92.442	41.642	261.939	75.000
18	Barium meal	100.1	96.993	92.442	41.642	331.188	75.000
19	HSG	55.1	145.490	117.306	41.642	359.548	75.000
20	Fistulography/Direct/	55.1	48.497	32.799	41.642	178.047	35.000
21	Ultrasound/organ	33.6	38.024	32.799	41.642	146.025	35.000
22	General abdomen	33.6	38.024	32.799	41.642	146.025	35.000
23	Gynecology/OBS	33.6	4.734	32.799	41.642	112.735	35.000
24	Small Part U/s(Brest,tairiod,etc	33.6	38.024	49.375	41.642	162.601	35.000
25	Echocardiography	33.6	0.976	49.375	41.642	125.553	20.000
26	Doppler	34.8	44.161	49.728	41.642	170.291	150.000
27	CT BRAIN (Different Brain parts are considered)	24.0	142.638	119.343	41.642	327.613	300.000
28	CT Musculoskeletal with contras	23.51	142.638	119.343	41.642	327.133	300.000
29	Chest CT scan with contrast	22.41	142.638	119.343	41.642	326.033	300.000
30	Abdominal CT scan with contrast	30.41	237.730	119.343	41.642	429.125	300.000
31	Abdominal CT scan with contrast	24.81	237.730	116.597	41.642	420.779	300.000

Table 9: Unit cost services at GI and he pathology and neurology with their respective service price in ETB.

No	Service Name	Supply (Consumables) in ETB.	Direct Equipment cost in ETB.	Direct Personnel cost in ETB.	Overhead Cost allocated cost in ETB.	Total cost in ETB.	Current Price in ETB.
1	Upper GI endoscopy	253.965	166.866	74.974	72.149	567.953	No Price set
2	Lower GI endoscopy	208.51	137.854	74.974	72.149	493.487	No Price set
3	Sigmoid soppy	212.22	166.866	74.974	72.149	526.208	No Price set
4	Endoscopic ultra-sound	275.165	187.435	74.974	72.149	609.722	No Price set
5	Endoscopic foreign body removal - Upper GI	211.77	23.516	74.974	72.149	382.408	No Price set
6	Endoscopic foreign body removal - Lower GI	107.03	167.069	74.974	72.149	421.222	No Price set
7	Endoscopic varicella band ligation	216.6020744	166.871	74.974	72.149	530.596	No Price set
8	Esophageal balloon dilator	335.4670468	167.074	74.974	72.149	649.664	No Price set
9	PEG tube placement	265.92	167.152	74.974	72.149	580.194	No Price set
10	Liver biopsy	80.21535	166.942	74.974	72.149	394.280	No Price set
11	Endoscopic injection for ulcer bleeding	174.2675	166.866	74.974	72.149	488.256	No Price set
12	Clip application for ulcer bleeding	201.4515	166.910	74.974	72.149	515.483	No Price set
13	Rectal hemorrhoid band ligation	270.8	138.182	74.974	72.149	556.105	No Price set
14	Endoscopic Retrograde Cholangio pancreatography (ERCP)- diagnostic	272.95	166.871	74.974	72.149	586.944	No Price set
15	Endoscopic Retrograde Cholangio-pancreatography (ERCP)- Therapeutic	368.55	167.013	74.974	72.149	682.685	No Price set
16	Esophageal Stenting	366.55	36.690	74.974	72.149	550.363	No Price set
17	Nerve conduction study of upper limb and lower limb	51.9	111.254	294.661	72.000	529.815	500.000

18	Nerve conduction study of upper limb or lower limb	131.46	55.627	147.331	72.000	406.418	300.000
19	Blink reflex studies	35.25	55.627	147.331	72.000	310.208	300.000
20	Evoked potential(VEP, BAEP,SSEP)	134.56	55.627	147.331	72.000	409.518	400.000
21	EEG	67.8	55.627	104.508	72.000	299.935	100.000
22	Electromyography of upper limb and lower limb	396.155	111.254	220.996	72.000	800.405	800.000

The remaining unit cost of different services from outpatient departments and inpatient department's detailed table were attached in annex part of this paper, annex 3 and 4.

6.3. Analysis of unit cost of services by average and range per different service category.

We have analyzed unit cost of different services by grouping them by category to which the service belongs. To calculate the average and range all services unit cost it is must to group services by category they belong to. To mention if we calculate average of all services together, their variation will be to big number and it will seems that there is an extreme value. To minimize this error we calculated average and range by grouping service units in different groups. To mention some, we have used rather than calculating the average and range of all inpatient service unit cost together we have categorize them in minor surgeries, major surgeries and other, and finally we have calculated the average the average for all inpatient services as described in table 10 below. The other reason to categories them is there are service units different by their nature which costs high by consuming different supply item and highly qualified human resource. The cost recovery ratio for each categorized service units was calculated to know how much the hospital is currently gaining as a return.

CRR= Price/Cost *100

CRR= cost recovery ratio

Table 10: Analysis of unit cost of services by Average and range per different service category.

Service categories	Service units	No of services	Average of unit costs ETB	Range of unit costs (MIN, MAX)	Average service price ETB	Range of unit prices ETB (MIN,MAX)	Cost recover ratio (Price/ Cost)*100%
Diagnostic Service units	Lab services	25	55.89	(24.5, 117.2)	11.13	(4, 45)	20%
	Radiography	15	149.6	(123.8, 359.5)	20	(20, 120)	13%
	Radiology	16	254.24	(112.7, 429.1)	136.87	(20, 300)	54%
	All radiology and radiography	31	203.61	(112.7, 429.1)	80.32	(20, 300)	39%
	GI and He pathology	16	533.47	(382.4, 682.6)	No data	No data	No data
	Neurology & rheumatology	6	459.38	(299.9, 800.4)	400	(800, 100)	87%
All Diagnostic units		**109**	**276.03**	**(24.55, 800.4)**	**108.05**	**(4, 800)**	**39%**
IPD service units	Neonatology	6	195.87	(127.6, 356.2)	Exempted	Exempted	Exempted
	Obstetrics and gynecology	8	569.6	(419.4, 831.9)	83.75	(20, 180)	15%
	Neurosurgery	14	1432	(609.1, 325.5)	234.3	(170, 350)	16%
	Orthopedics	35	784	(182.2, 3676.6)	100.3	(40, 160)	13%
	Pediatrics	32	1271	(142.9, 3288.6)	48.6	(10, 120)	4%
	ENT	10	455	(187.3, 1059.1)	78	(15, 210)	17%
	ICU	9	79.45	(51.4, 117.8)	10	(10, 10)	13%
	Minor surgery	10	234	(159.5, 485.5)	39.5	(20, 60)	17%
	Major surgery	19	1075	(667.4, 1827.9)	156.75	(25, 320)	15%
	Ophthalmology	11	300	(111.1, 618.6)	29	(10, 60)	10%
All IPD Services		**154**	**813**	**(51.4, 3676.6)**	**104**	**(10, 350)**	**13%**
OPD service units	Physiotherapy	12	124.43	(95.7, 217.6)	9.5	(5, 20)	8%
	MCH	6	81.71	(49.1, 116.3)	Exempted	Exempted	Exempted
	OPD	23	136.56	(46.8, 371.4)	12.59	(5, 30)	9%
All OPD services		**41**	**124.99**	**(46.8, 371.4)**	**11.13**	**(5, 30)**	**9%**

The above summary table 10: shows that the average unit cost per each service category with their respective service price and range of both costs and service price. For the diagnostic service units average unit cost of different diagnostic services is 276.03ETB which ranges between (800.4, 24.55) ETB, whereas the average unit price is 108 ETB with range of (800, 4). The average unit cost for different inpatient services is 813 ETB which ranges (3676.6, 51.4) ETB and the average unit price is 104ETB with a range of (350, 10) ETB. The average unit cost for outpatient services is 124.99 which ranges between (371.4, 46.8), but the average price of those outpatient services is 11.13 which have arrange between (30, 5) ETB.

6.4. Analysis of the gap between unit cost of each services and service charges.

To analyze the gap between service provision cost and the current hospital service price we have calculated cost recovery ratio. To see the gaps clearly we have calculated CRR for each service units and the average for each service category inpatient, outpatient and diagnostic services.

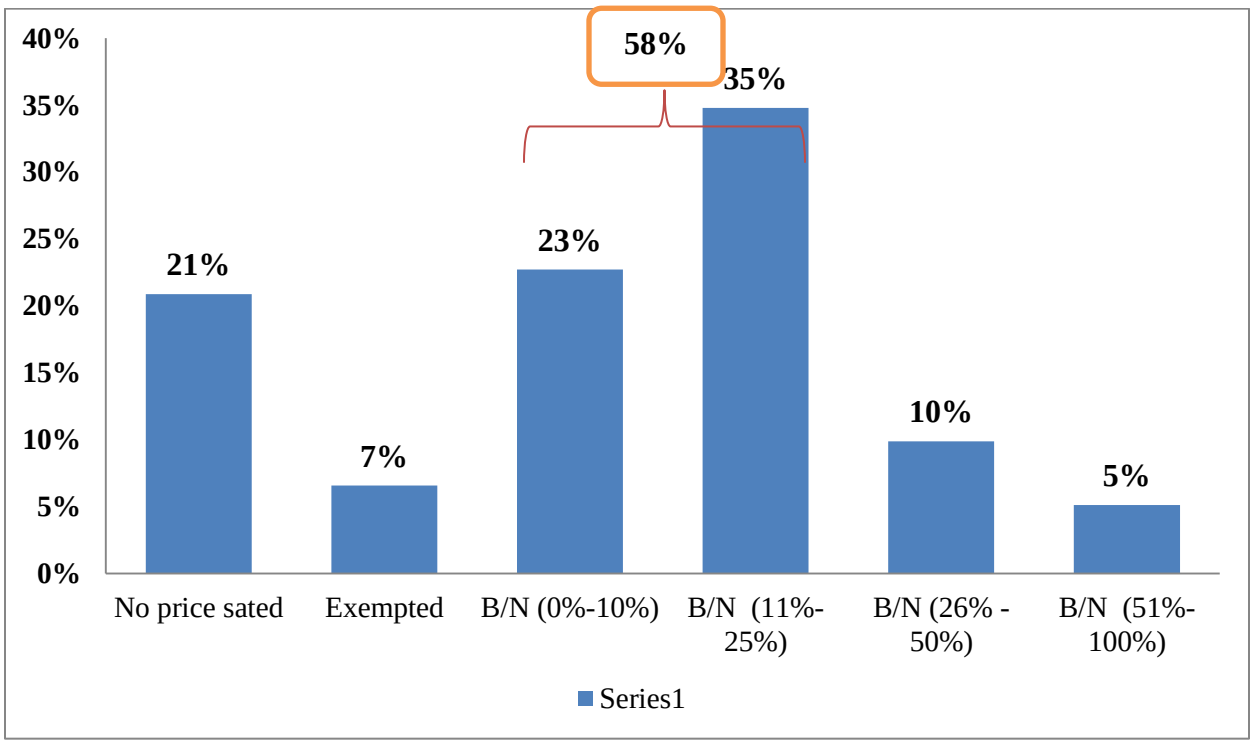

Figure 3: Service provision price to calculated cost ratio.

The above figure 3 shows that among 273 study services analyzed and the CRR calculated which is price divided by the calculated cost times 100 shows that the following major findings. From the total services 57(21%) of them have a no price sated and about 18(7%) are exempted services. On the other hand 62(23%) of the analyzed services have CRR between 0% to10%, 95(35%) of the services have CRR between 11% and 25%, 27(10%) of them have CRR between 26% to 50% and 14(5%) of the services have CRR which ranges 51% to 100%. From the total services there is no service which its service charge is greater than the cost, if fees are greater than unit costs, the services are categorized as CRR of 100%

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Table 11: Contribution of direct and indirect cost in final cost centers at TAST Hospital in 2017–2018

service units	Total cost	supply consumable cost and its share from total		Direct equipment and its share from total		Human resource and its share from total		Indirect cost and its share from total	
Neurology OPD	**2756.3**	**817.125**	**30%**	**445.015**	**16%**	**1062.16**	**39%**	**432**	**16%**
GI and he pathology	8535.57	3821.433	45%	2360.178	28%	1199.578	14%	1154.381	14%
Radiology	**6,312.1**	**1,387.6**	**22%**	**1,891.8**	**30%**	**1,741.8**	**28%**	**1,290.9**	**20%**

The above table 11: describes the share of each cost component from the total cost. From the three diagnostic units, GI and he pathology unit is 45% of the total costs belong to supply consumable whereas the radiology unit consists 22% of the total cost belongs to supply consumable. When we look at direct equipment radiology unit has a share of 30% of the total cost whereas Neurology OPD has 16% of the total costs. Lastly when we look at the human resource cost component neurology OPD unit is the one with the highest 39% of the total cost whereas GI and he pathology unit is the one with the least 14% of the total cost.

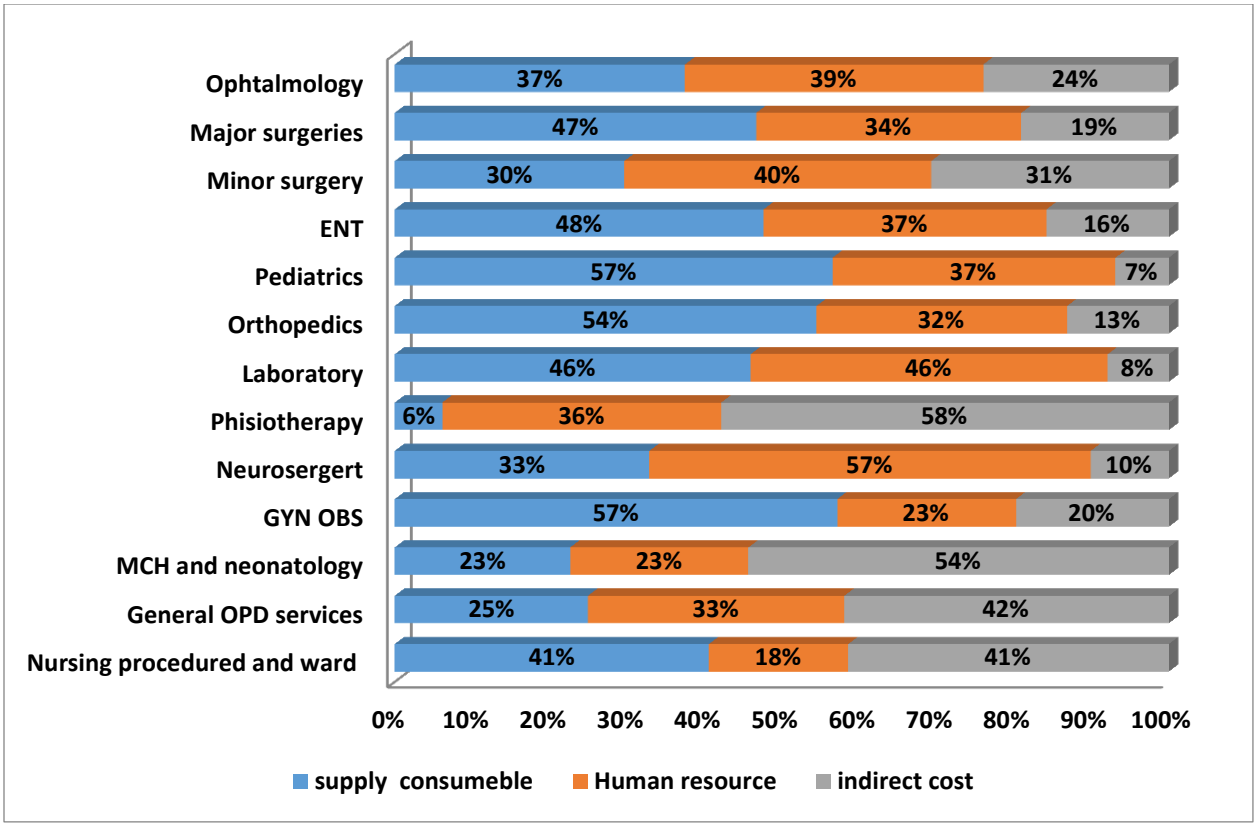

Figure 4: Share each cost direct and indirect cost item from the total costs per each cost center

7. DISCUSSION

Health care expenditure is increasing worldwide. Determining the unit cost of medical services is one part of economic analysis which helps to improve efficient use of scarce resource. There is no comprehensive study carried out in Ethiopia and other African countries comparable with Ethiopia in development status, which have calculated unit cost of service provision at tertiary hospital level and analyzed the gap between cost and service charge. This study aim to calculate the unit cost service provision at tertiary hospital level and to compare it with the current hospital service charge by applying a top-down and activity-based costing method. The result of this study will provide relevant cost information for the FMOH and hospital managers, it shows that the hospital is currently incurring a cost which is too high than the current hospital price charge. We have converted our study finding to USD of our study period to compare and discus with other studies finding We have used the exchange tare of the study period which is 2010EFY (1USD= 29.35 ETB) (39).

When we look at the average cost for single out patient visit our finding is 124.99 ETB ($4.3) when we compare the finding done by WHO-CHOICE estimates Technical background report Final version July Akkazieva, et al. 2011 Comparison of outpatient unit cost predictions by type and income class stated for developing countries for tertiary level is 3.54 $ (40) this finding is consistent with our finding. On the other side when we look to another study conducted in Palestine Younis, etal. (2013) found that the average cost per visit was $13.00 for outpatient departments (4), which have a large variation with our study finding that the average cost for outpatient service costs 124.99 ETB ($ 4.3). The variation between findings of these two studies may be due to cost components used to calculate the total unit cost, study time difference, inflation and method variation. In our study we excluded the cost of medication prescribed for patients and we have assessed unit cost for each single services provided at outpatient department. While this study includes the medication as one cost component and analyses unit costs per each outpatient visit which will consist package of services and diagnostic investigations.

Another finding of the above study conclude that the unit cost for each department, intensive care unit and intermediate care unit services were the highest among all categories of daily hospital services ($208.00). This is in contrast to surgical operations ($124.00), specialized surgeries ($106.00), delivery department ($99.00), orthopedics ($98.50) and general surgery ($85.00). The lowest unit cost

was found in the neonatology department ($72.00) (4). When we compare these finding with our studies finding, neonatology department is service units with low average cost from the inpatient units with the average cost per single services 195.87 ETB ($6.7) and the highest average unit cost is neurosurgery services 1,432 ETB ($49.8) with contrast service units pediatrics 1,271 ETB ($43.3), major surgeries 1,075 ETB ($36.6), orthopedics 784 ETB ($26.7), obstetrics and gynecology 569.6 ($19.45), ENT 455 ETB ($15.5), ophthalmology 300 ETB ($10.2) and minor surgery 234 ETB ($8.1). The above findings have large similar pointes to share on which services units cost is high when we compare it with other relative services, which is this finding supports our study findings.

The finding of our study unit cost for major surgeries and minor surgeries, the average unit cost of major surgery is 1,075 ETB ($36.6) and for minor surgery 234 ETB ($8.1). When we compare this finding with study conducted in Myanmar, 2017 by title unit cost of healthcare services at 200-bed public hospitals in Myanmar. The unit costs for operation theatre were 277,519 Kyats (269.96 USD) per major operation case and 55,504 Kyats (53.99 USD) per minor operation case at PMN GH, and 272,639 Kyats (265.21 USD) per major operation case and 54,528 Kyats (53.04 USD) per minor operation case at MTH (2). This finding have big variation with our finding, this variation may be due to cost component included in calculation like medical equipment's cost, building cost land cost may be the reason for the variation. Whereas another find of this study describe that the unit costs per X-ray patient was 14,325 Kyats (13.93 USD). At PMN GH, the unit cost per laboratory test was 3988 Kyats (3.88 USD), while it was only 673 Kyats (0.66 USD) at MTH (2). These two finding have slight consistency with our finding that unit cost per each X-Ray was 254.24 ETB ($8.75), and the average cost per each laboratory tests was 55.89 ETB ($1.9) these finding make our reason for the variation of the previous minor and major surgeries was due to cost component is relevant. The reason is in our study we have included medical equipment's cost in some diagnostic service unit like radiography due to lack of data. This is why the findings support each other on this specific unit cost of service units.

In our study, the share of human resource from the total cost of all services was 36% and the share of consumable item was 47% of the total cost. Furthermore, the total cost of service units GYN OBS, orthopedics, pediatrics and major surgeries the cost of supply consumable accounted 57%, 54%, 57%, and 47% respectively. The study conducted in Myanmar and Fiji shows that the cost for the human resource was the second largest component at MTH, but the fourth at PMN GH (28). When we look at

our finding out of the total services 273 coasted 18 (7%) of them are exempted. when we further analyze the contribution of cost item of these units the direct cost item is 53% of the total cost of those units average cost. The study conducted in Ethiopia also shows that exempted services include some relatively costly elements as well, many of which are currently financed by external sources. As one example of this, the most expensive exempted service provided in primary hospitals is TB treatment and ART. Nearly 90% of the cost for these two services comes from drugs and supplies, which are almost entirely supported by external sources (12).

8. STRENGTH AND LIMITATION OF THE STUDY

8.1. Strength of the study

This study is the first of its kind measuring the cost of service provision at the tertiary hospital level and compared to its current service charge in Ethiopia which cover 273 service cost from 21 service units selected proportionally, and one of the few studies in the world.

The other strength of this study is the method we used; we have used a combination of two methods Top-down costing method and activity-based costing method which will avoid overestimation or underestimation of service cost. Most of studies we referred use one method which is Top-down costing method which needs less effort and time and provide less accurate cost data.

The way the data collected from each service unit was also with close supervision of the principal investigator and with strong support from health facilities administration and staff because of the hospital needs the finding of this study. Therefore, this will increases the reliability of the data collected.

8.2. Limitation of the study

The service units excluded from the sampling frame were the limitation of this study on the representativeness. The cost component building and the land were not included in the study due to the absence of data or information, this one is also one of the limitations of the study. In addition, as the service data is collected from secondary data, this can overestimate or underestimate result of each service unit cost during cost allocation.

The sampling method we used to select services from each service units, pragmatic sampling method is one of our limitations because of when selected by judgment of the unit's representatives might affect the representativeness of the study.

There were many shortcomings of the financial system that introduced several limitations on the outcomes. Firstly, the nature of the accounting system (line budget items) meant that it was difficult to directly attach costs down to departments (here our cost centers) when cost centers were not entered in the system. We had to make some assumptions and distribution rules to allocate costs to cost centers. For example, utility costs are transacted to the facility level however we had to allocate these down to department levels.

9. CONCLUSION

The need of health care costs information is raising significantly and it is basic information needed by managers and policy makers for making decisions about how to improve the performance of a hospital, where to allocate the resources within or among hospitals, or to compare the performance of different hospitals to one another. This study analyzes the unit cost of services provided and compare with user fees for the different services offered at Tikur Anbessa Specialized Hospital.

There is there is significant GAP between the service cost and current fee and there are services which have no price. From the total services analyzed 57(21%) of them have a no price sated, 157(58%) of them have CRR between 1% to25%, 27(10%) of them have CRR between 26% to 50% and only 14(5%) of the services have CRR which ranges 51% to 100%. Specially services at Outpatient and inpatient services the CRR is only 9% and 13% respectively.

The average unit cost of different diagnostic services is 276.03ETB (range 24.55-800.4), whereas the average unit price is 108 ETB with (MIN-MAX) that is (4-800). The average unit cost for different inpatient services is 813 ETB (range 51.4-3676.6) and the average unit price is 104ETB with a (MIN-MAX) that is (10-350). The average unit cost for outpatient services is 124.99ETB (range 46.8-371.8), but the average price is 11.13 with (MIN-MAX) that is (5, 30).

The hospital administrative bodies and other concerned bodies should take measures in order to reduce the gaps between cost and user fees so as to maintain financial sustainability of the hospital without compromising access to services for the poorest segment of the population. More information regarding the unit cost of health-care services would be helpful in relation to establishing a reference unit cost list for accurate health economics evaluations. Additionally the hospital has to have proper budgetary tracing system to control health expenditure and resource wastage.

10. RECOMMENDATIONS

For federal ministry of health

Need to develop health sector costing model by conducting further study in this field covering all levels of health institutions. This study result also suggested that the current service charge of service provision needs to be analyzed further and revised accordingly.

The current price list of the hospital using was amended by the national council 1996 E.C before 15 years, which have huge gape with cost of service we have calculated in this study. Therefore, efforts should be undertaken by the FMOH and different stakeholders to decrease this huge gap between cost and service charge.

Conduct feasibility study on the way to reduce this gap conducting fee revision, mobilize resource from other source, subsidized by some authority or some other option made by policy makers at national level. Further analysis also needed to assess the affordability from societal perspective before conducting fee revision.

FMOH and other researchers should conduct studies on unit cost analysis which consists of all capital components of cost. Additionally Studies have to be conducted from societal and others perspective.

For Tikur Anbessa specialized teaching hospital.

Efforts should be undertaken by the Hospital managers and different stakeholders to decrease this huge gap between cost and service charge by conducting the following options and others if available.

- Making fee revision by doing further analysis
- By assessing the efficiency of resource utilization improving the efficiency if needed.
- Resource mobilization for the hospital from other sources in order to maintain financial sustainable and keep on provision of services.

Improve culture of information use once data are available from the HMIS, management should make every effort to analyze them on a regular basis and use them to monitor hospital performance.

Things to be improved related to financial management of TASTH

- Develop proper financial budgetary tracing system by reviewing the cost structure of the hospital to determine how the available financial resources are allocated.
- A hospital has to have current and accurate inventory of all capital items which have standard medical equipment inventory components at tertiary hospital level.

11. REFERENCES

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ANNEXES

Annex I: Human resource data collection format.

Tikur Anbessa Specialized Hospital Total health workers and supportive staffs working _____ _____unit at the beginning and end of 2010 EFY in each department

No	Profession	Begging of 2010 EFY	End of 2010 EFY	
1.				
2.				
3.				
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Annex II: Detailed information collection form of supply consumable item, equipment, and direct personnel for each service

Detailed information collection form of supply consumable item, equipment and direct personnel for each service

Name of departments or service unit _____

Supply consumable			**Equipment**			
Items	Units of measurement	Amount Consumed per each service	Name of equipment	Time (minute) actual used by each service	Profession	Average time spent by each profession per each service (min)

Annex III: Unit cost of different services at outpatient departments with their respective service charge in ETB.

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
1	Bladder irrigation	50.30	24.21	33.9	108.41	10
2	NG Tube insertion for feeding	23.21	18.80	33.9	75.90	10
3	Gastric aspiration	35.45	18.80	33.9	88.15	10
4	Gastric lavage	36.53	51.27	33.9	121.70	10
5	IV push/ intra venous therapy	7.51	5.41	33.9	46.82	No Price set
6	Securing IV line	9.71	9.40	33.9	53.01	No Price set
7	IV infusion	35.97	14.10	33.9	83.97	No Price set
8	IV/ IM / SC medication administration	9.26	9.40	33.9	52.56	No Price set
9	Catheterization	54.95	18.80	33.9	107.65	10
10	OPD visit (Common to all OPD cases)	16.78	89.24	72	178.02	5
11	IV/IM medication administration	14.64	7.22	72	93.85	No Price set
12	Lumbar puncture OPD	56.51	119.75	72	248.25	20
13	TB Consultation and check up	14.58	24.63	72	111.21	5
14	Anti-TB /Directly observed treatment	10.30	3.61	72	85.91	Exempted
15	ART Consultations	7.30	74.64	72	153.94	Exempted
16	Dry blood sample	5.65	7.32	72	84.97	Exempted
17	OI (as part of consultation and check-up)	65.82	16.01	72	153.83	Exempted
18	R S I Intubation	39.73	40.34311	72	152.0731	10.00
19	Cardio Pulmonary Resuscitation (CPR)	59.616	44.64416	72	176.2602	No Price set
20	ECG (Electro Cardio Graphic)	38.6	80.68623	72	191.2862	20.00
21	NG tube insertion & lavage	24.71	161.3725	72	258.0825	10.00
22	Cut down	191.86	107.5816	72	371.4416	30.00
23	Post mortem care	53.36	18.29331	72	143.6533	No Price set
24	Ante-natal care	49.2	33.2	33.9	116.28	Exempted

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
25	IUCD insertion	45.9	33.2	33.9	113.06	Exempted
26	Implant (Jadele/implanon) insertion	46.4	28.9	33.9	109.19	Exempted
27	Injection for family planning	8.7	9.4	33.9	52.04	Exempted
28	Penta Valent	6.9	8.3	33.9	49.12	Exempted
29	Pop smear	9.6	7.0	33.9	50.54	Exempted
30	Parallel bar	3.1	55.14247	72	130.24	No Price set
31	Quadriceps bench	3.1	27.57124	72	102.67	10
32	Short wave diathermy (therapy)	5.78	41.35685	72	119.14	5
33	Stair	3.1	41.35685	72	116.46	20
34	Stationary bicycle	3.1	41.35685	72	116.46	20
35	Wax bath/ paraffin bath	3.84	27.57124	72	103.41	10
36	Tilting table	3.1	27.57124	72	102.67	No Price set
37	Traction Unit	13.1	27.57124	72	112.67	5
38	Tread mill	3.1	41.35685	72	116.46	5
39	Ultrasound	9.89	13.78562	72	95.68	10
40	Manual therapy for all kinds of cases	5	82.71371	72	159.71	5
41	Thumb Spica	35.356	110.2849	72	217.64	5

Annex IV: Unit cost of different services at in patient departments with their respective service charge in ETB.

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
1	Neonatology lumbar puncture	28.6	18.1	116.9	163.6742244	Exempted
2	Neonatology secure IV line	11.6	5.4	116.9	133.9676199	Exempted
3	Neonatology oxygen administration	42.8	196.4	116.9	356.1817933	Exempted
4	Neonatology suction	8.9	1.8	116.9	127.629757	Exempted
5	Neonatology umbilical catheterization	70.5	21.2	116.9	208.6892731	Exempted
6	Subdural Tap (pediatrics)	47.9	20.2	116.9	185.1262651	Exempted
7	Normal Delivery	162.3	234.8	112.6	509.7	50
8	Delivery with episiotomy	299.8	145.7	112.6	558.1	70
9	Instrumental Delivery	262.5	145.7	112.6	520.8	70
10	Abdominal Hysterectomy	553.8	72.1	112.6	738.4	140
11	Skull traction	374.8	72.1	112.6	559.5	70
12	MVA (Manual Vacuum Aspiration)	234.7	72.1	112.6	419.4	20
13	Laparotomy and drainage of pelvic abscess	481.0	238.3	112.6	831.9	180
14	Manual removal of placenta	234.7	72.1	112.6	419.4	70
15	Burr hole one side one burr hole	287.7	295.8	144.5843	728.05	170
16	Burr hole one side two burr hole	255.75	526.2293	144.5843	926.56	170
17	Burr hole Bilateral	329.5	526.2293	144.5843	1,000.31	170
18	Elevation of DSF	339.966	526.2293	144.5843	1,010.78	170
19	Elevation of DSF + frontal sinus canalizations	462.486	987.1475	144.5843	1,594.22	170
20	Elevation + debridement + dural repair	598.63	987.1475	144.5843	1,730.36	170
21	shunt procedures	333.97	393.6988	144.5843	872.25	170
22	EVD, omaya reservoir	242.96	295.772	144.5843	683.31	170

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
23	Emergency craniotomy for evacuation of hematoma	566.36	1378.862	144.5843	2,089.81	350
24	Craniotomy for evacuation of difficult hematoma/ abscess/empyema	414.12	1749.467	144.5843	2,308.17	350
25	DE compressive craniotomy	666.56	1749.467	144.5843	2,560.61	350
26	Trans-spheroidal pituitary tumor resection-microscopic	462.56	1.984501	144.5843	609.13	170
27	Craniotomy and tumor excision / biopsy (simple)	762.42	1.984501	144.5843	908.99	350
28	Craniotomy and tumor/AVM excision (difficult)	866.36	2014.528	144.5843	3,025.47	350
29	Long bone fracture (Femur, Tibia, hummers) with Plate	1208.76	981.4233	103.1969	2293.380226	40
30	Long bone fracture (Removal of fixation material)	323.93	140.596	103.1969	567.7229322	40
31	Radius, ulna & fibula (Removal of fixation material)	297.234	246.9342	103.1969	647.3651452	70
32	Short bone fracture (Metacarpal metatarsal, phalanges)	372.04	246.9342	103.1969	722.1711452	40
33	Short bone fracture material removal	226.98	112.8811	103.1969	443.0580335	70
34	Scapular fracture	835.18	658.3847	103.1969	1596.761641	No Price set
35	Patellar fracture	632.86	238.3698	103.1969	974.4266911	120
36	Hip joint arthrodesis: knee, shoulder, elbow or ankle with plate	512.06	600.2067	103.1969	1215.463601	120
37	Hip joint arthrodesis: Hip, knee, shoulder, elbow or ankle with external fixator	612.06	600.2067	103.1969	1315.463601	120
38	Metatarsal or metacarpus phalangeal & inter phalangeal arthrodesis	274.54	185.2007	103.1969	562.9375846	120
39	Big tendon injury (Achill us, patellar)	399.63	185.2007	103.1969	688.0275846	160

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
40	Hand or foot tendons injury-single/multiple	538.75	246.9342	103.1969	888.8811452	120
41	Skin traction	81.86	40.9697	103.1969	226.0264745	50
42	Skeletal traction	69.15	27.31305	103.1969	199.6599506	40
43	Skeletal traction pin removal	30.48	274	103.1969	407.6769028	No Price set
44	Intra-articular or tissue infiltration	65.39	13.65652	103.1969	182.2434267	No Price set
45	Bone excision and /or biopsy-big bone with G.A.	508.86	361.8369	103.1969	973.8938123	160
46	Soft tissue biopsy-big With G.A.	483.16	304.3856	103.1969	890.7424787	160
47	Bone tumor excision and bone grafting	499.48	485.304	103.1969	1087.980933	160
48	Club foot correction, S.T. Pediatrics	173.76	255.4987	103.1969	532.4555993	160
49	Polydactyl release simple (LA)	134.38	132.0316	103.1969	369.6084781	160
50	Osteotomy lower limb bones with bone graft and fixation	2866.87	706.5449	103.1969	3676.611814	160
51	Contracture release of a limb of any cause (multiple finger involvement)	412.1	361.8369	103.1969	877.1338123	120
52	Incision and drainage of abscess (with general anesthesia)	160.054	99.06805	103.1969	362.3189545	160
53	Fingers and toes, with L.A. single and multiple amputation	180.52	94.78582	103.1969	378.5027274	70
54	Below knee amputation	184.06	246.9342	103.1969	534.1911452	160
55	Above knee amputation	226.41	246.9342	103.1969	576.5411452	160
56	Short arm cast (circular)	152.1	54.6261	103.1969	309.9229985	40
57	Long arm splint	106.48	54.6261	103.1969	264.3029985	70
58	Long arm cast (circular)	102.2	54.6261	103.1969	260.0229985	70
59	Short leg cast (circular)	102.6	54.6261	103.1969	260.4229985	70
60	Lower limb bone fracture-simple/ complicated	951.7	114.9027	103.1969	1169.79957	70
61	Elbow/ Wrist closed G.A.	352.52	114.902	103.1969	570.6195699	40

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
62	Knee closed reduction under G.A.	360.254	114.9027	103.1969	578.3535699	40
63	Knee open reduction	520.85	242.652	103.1969	866.6989181	70
64	PSARP	763.74	1311.345	116.9458	2192.030631	No Price set
65	Pull through procedure (peds)	634.682	1311.345	116.9458	2062.972631	No Price set
66	Rectal polypectomy or biopsy	530.78	323.1848	116.9458	970.9106396	No Price set
67	Appendectomy (laparoscopic) (peds)	763.842	560.9933	116.9458	1441.78112	120.00
68	Hemodialysis procedure	1385.533	1203.834	116.9458	2706.312635	No Price set
69	Central Venous Catheterization	100.31	100.3195	116.9458	317.5752933	30.00
70	Bladder Catheterization	55.72	20.56169	116.9458	193.22752	10.00
71	Cardio version and Defibrillation	10.55	29.36209	116.9458	156.8579195	No Price set
72	Cardiopulmonary Resuscitation	21.095	56.88982	116.9458	194.9306477	No Price set
73	Mechanical ventilation	66.54	25.07987	116.9458	208.5656925	No Price set
74	Arthrocentesis	40.31	44.04314	116.9458	201.2989665	10.00
75	Obtaining Biologic Specimens	13.14	12.84668	116.9458	142.9325067	20.00
76	Gastric Lavage	91.64	88.08628	116.9458	296.6721075	10.00
77	Drainage of Superficial Abscesses	33.445	100.3195	116.9458	250.7102933	35.00
78	Daily Patient management care and monitoring	19	50.15973	116.9458	186.1055594	No Price set
79	Dehydration management	17.35	58.72419	116.9458	193.0200135	No Price set
80	Shock management	38.55	100.3195	116.9458	255.8152933	No Price set
81	Epi gastric Hernia (peds)	579.912	63.32661	116.9458	760.1844385	60.00
82	Incisional Hernia (peds)	592.612	685.7791	116.9458	1395.336959	60.00
83	umbilical Hernia (peds)	801.912	685.7791	116.9458	1604.636959	120.00

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
84	Hypospadias Surgery (peds)	1231.252	1311.345	116.9458	2659.542631	No Price set
85	UCF Repair (peds)	881.852	685.779	116.9458	1684.576959	No Price set
86	Epispedia Repair (peds)	1234.752	1936.91	116.9458	3288.608304	No Price set
87	Ileostomy/Colostomy closure (peds)	917.652	1353.691	116.9458	2388.289257	No Price set
88	Hiatal hernia repair	610.952	1061.773	116.9458	1789.670953	60.00
89	Fundoplication (open)	866.452	1061.773	116.9458	2045.170953	No Price set
90	Fundoplication (Laparoscopic) (peds)	938.052	1061.773	116.9458	2116.770953	No Price set
91	Splenectomy (peds)	896.852	1061.773	116.9458	2075.570953	No Price set
92	cyst gastrostomy (peds)	834.127	1061.773	116.9458	2012.845953	No Price set
93	Gastroschises /Omphalocele repair (peds)	830.652	685.7791	116.9458	1633.376959	No Price set
94	Silo bag application (peds)	836.052	685.7791	116.9458	1638.776959	No Price set
95	CDH repair trans abdominal (peds)	14047	1061.773	116.9458	1638.776959	No Price set
96	Nasal foreign body removal	110	53.79082	72	235.7908186	15.00
97	Throat foreign body removal	27.54	117.6361	72	217.1761241	25.00
98	Tonsillectomy	94.62	182.8125	72	349.4325	60.00
99	Adenoidectomy	21.88	182.2493	72	276.1292556	60.00
100	Removal of nasal polyp	559.76	88.08628	72	719.846282	75.00
101	Tympanoplasty	546.8	273.3739	72	892.1738834	210.00
102	Radical mastoidectomy	713.75	273.3739	72	1059.123883	210.00
103	Incision of abscess	27.29	88.08628	72	187.376282	50
104	Parenthesis/therapeutic	35.6	132.1294	72	239.7294229	50
105	Nasal Elevation	29.95	273.3739	72	375.3238834	25

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
106	Oxygen administration via face mask	27.1	12.19554	33	72.29553886	No Price set
107	Intubation for a mechanical ventilation	55.555	9.146654	33	97.70165414	10
108	Extubation	65.81	9.146654	33	107.9566541	No Price set
109	Chest tube care	75.64	9.146654	33	117.7866541	No Price set
110	ICU Colostomy care	29.29	9.146654	33	71.43665414	No Price set
111	ICU Bed bath	32	12.19554	33	77.19553886	No Price set
112	ICU Suctioning	16.9	9.146654	33	59.04665414	No Price set
113	ICU NGT Insertion	9.24	9.146654	33	51.38665414	10
114	ICU Tracheostomy care	15.13	12.19554	33	60.32553886	No Price set
115	Circumcision	49.63	117.4484	72	239.0783759	35
116	Suturing-small	63.83	28.30875	72	164.1387469	50
117	Suturing-medium	72.96	42.46312	72	187.4231203	50
118	4. Suturing-large	114.66	68.15648	72	254.8164826	50
119	Dressing Surgical- Wound (medium size)	37.8	51.38672	72	161.1867246	20
120	Dressing Surgical- Wound (large size)	71.445	51.38672	72	194.8317246	20
121	Removal of cyst/lipoma	93.81	150.4792	72	316.2892016	60
122	Septic Wound care	74.235	34.25782	72	180.4928164	30
123	Lumbar Puncture	43.45	44.04314	72	159.493141	20
124	Hydrocelectomy	72.18	341.3389	72	485.5189327	60
125	Prostatectomy	275.64	302.9259	205	783.565918	350
126	Appendectomy	322.85	139.525	205	667.3757868	120

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
127	Cholecystectomy	380.926	213.31	205	799.2360258	170
128	Thyroidectomy	394.91	215.0875	205	814.997501	120
129	Radical mastectomy	683.284	271.2989	205	1159.582883	120
130	Simple mastectomy	514.74	271.2989	205	991.0388829	60
131	Thoracotomy	292.9	406.9483	205	904.8483244	25
132	Hemoroidectomy	551.82	339.1236	205	1095.943604	60
133	Cystolithomy (stone removal from urinary bladder)	469.83	271.2989	205	946.1288829	60
134	Stone removal from kidney	338.27	271.2989	205	814.5688829	260
135	Stone removal from pyelonephritis	447.82	339.1236	205	991.9436037	260
136	26. Big mass excision with GA	469.78	305.2112	205	979.9912433	260
137	Hydrocelectomy with GA	548.804	406.9483	205	1160.752324	60
138	Cystocele repair	345.804	259.557	205	810.3609988	60
139	Diaphragmatic hernia repair	766.344	339.1236	205	1310.467604	60
140	Antrectomy with vagotomy	598.17	813.8966	205	1617.066649	260
141	Fistulectomy with subtotal gastrectomy	521.985	610.4225	205	1337.407487	350
142	Inguinal hernia repair (complicated)	801.022	406.9483	205	1412.970324	60
143	Small intestinal resection/ E-Anastomosis	808.094	813.8966	205	1826.990649	260
144	Tarsatomy	136.805	68.15648	72	276.9614826	15
145	Inocilation	47.59	293.4787	72	413.0687143	30
146	Evisceration	91.71	299.3282	72	463.038156	30
147	Chelazion/curettage	52.75	97.82624	72	222.5762381	30
148	major Lid repair	89.67	42.4631	72	204.1331203	30

No	Service Name	Supply (Consumables)	Direct Personnel	Overhead Cost allocated	Total cost	Current Price
149	Minor Lid repair	76.43	21.23156	72	169.6615602	20
150	Dressing for corneal ulcer	34.83	4.282227	72	111.112227	60
151	Probing	65.67	14.15437	72	151.8243734	10
152	Correction of intropion	78.43	77.08009	72	227.5100868	20
153	DCR/dacro systorrehinostomy/	230.875	138.9954	72	441.8703784	45
154	Extra Capsular Cataract Extraction (ECCE)	331.046	215.5105	72	618.5565407	30