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Estimating Cost of Implementing Kangaroo Mother Care (KMC) at Different levels of Health
System in Addis Ababa

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University as Partial
Fulfillment of the Requirements for the Degree of Masters of Public Health.

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June, 2017

Addis Ababa, Ethiopia

APPROVED BY THE BOARD OF EXAMINERS

This thesis, by Dagmawit Tesfaye is accepted in its present form by the board of examiners as fulfilling for the degree of master's in public health.

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Acknowledgment

First and for most I would like to thank God, my unseen partner, for helping me through all my thesis work. Second I would like to express my deep appreciation to my advisors Professor Damen Haile Mariam and Birhan Tassew (MPH) for their constructive comments and unreserved support. I am also thankful for School of Public Health of Addis Ababa University for providing the opportunity and references. Furthermore I would like to express my gratitude for TiruneshBejing General Hospital and Akaki Health Center facility officials for their positive outlook on this study and providing information. Last but not list I would like to thank my friends and family for the help they kindly and lovingly provided.

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ACRONYMS

CEA	Cost Effectiveness Analysis
CMC	Conventional Method of Care
HDAL	Health Development Army Leaders
HEW	Health Extension Worker
KMC	Kangaroo Mother Care
KWC	Kangaroo Ward Care
LBW	Low Birth Weight
TBGH	Tirunesh Beijing General Hospital
USD	United States Dollars
VLBW	Very Low Birth Weight
WHO	World Health Organization

ABSTRACT

Background: Globally it is estimated that 15 million babies are born preterm. Ethiopian neonatal mortality rate in 2015 was 28 per 1000 live births. Kangaroo mother care(KMC) has been proposed one safe and effective solution for preterm and low birth weight infants and can provide a very good alternative for neonatal intensive care unit. This study was conducted to estimate the cost of providing KMC to mother infant dyad and outline the major resource inputs incurred by the health system.

Objective: To estimate the cost of providing kangaroo mother care (KMC) at different levels of health system in Addis Ababa 2017 G.C

Methodology: Facility based cross sectional study design was used to collect cost data and utilization data from facility perspective. Purposive sampling was used to select the facilities providing kangaroo mother care. This study employed accounting method of cost estimation in order to estimate the total cost of implementing kangaroo mother care. The total cost was estimated by summing up the direct cost, indirect cost and intermediate cost.

Result: The average cost providing KMC for mother infant dyad at Tirunesh Beijing General Hospital is estimated to be USD 55.3. The total cost of providing KMC at the TBGH for a total of one month, was estimated to be USD 874.86. The total cost for providing KMC at the Akaki Health Center is estimated to be USD 654.31. Thus unit cost for a follow up for one mother is about USD 65.28. The total cost for providing the KMC post facility follow up, i.e. four visits till the neonate is 28 days post-delivery, is USD 809.71.

Conclusion and recommendation: The total cost for providing kangaroo mother care at Tirunesh Beijing General Hospital and Akaki Health Center was found to be USD 874.86 and

USD 535.24 respectively. Health professional salary at both the TBGH and Akaki Health center has the highest cost for total cost. Further studies on assessing the health outcome and health impact of KMC by doing further research will help in knowing the return of the money spent.

1. INTRODUCTION

1.1 Background

Under-five children mortality globally in 2015 was 42.5 per 1000 live births, out of these deaths 45% were recorded as new born with a neonatal mortality rate of 19 per 1000 live births. From the enlisted causes for the deaths the major one was attributed to prematurity [1]. Preterm delivery is one of the causes for neonatal mortality. Globally it is estimated that 15 million babies are born preterm. Sixty percent of the preterm births occur in Africa and South Asia. Each year one million babies die due to premature birth complication like hypothermia and hypoglycemia and other preterm related problems [2]. Progress has been made to reduce mortality in under-five children but improvement in the neonatal period is less [3].Ethiopian neonatal mortality rate in 2015 was 28 per 1000 live births [4].

Though there is not just one simple solution for the reduction of neonatal mortality, kangaroo mother care (KMC) has been proposed one of the safe and effective solution for preterm and low birth weight infants and can provide a very good alternative for incubation care [5].Especially in developing countries where incubation care is not sufficient, KMC has been well appreciated. Kangaroo mother care is defined as having four components: early, continuous and prolonged skin to skin contact between preterm baby and the mother, exclusive breast feeding, early discharge after hospitals initiated KMC with continuation at home and close follow up at home [6].Kangaroo mother care was found to improve neonatal outcomes and reduce neonatal morbidity and mortality by preventing hypothermia, and by keeping other vital signs stable through skin to skin contact and providing benefits of breast feeding [7, 8].

Ethiopia has different health care system level and has managed to achieve a remarkable increase in access to primary health care units [9]. The country can benefit from the implementation of KMC as conventional care is inconvenient in majority of the health centers due to largely financial constraints. If the KMC is to be implemented effectively its influencing factors need to be clearly delineated. One of the influencing factors that pose a question is the cost of providing KMC effectively in the different levels of the health care establishments.

Estimating the cost of a certain intervention can serve as an important tool. Assessment of the cost of providing such intervention will help the policy makers in decision making and help as one input for further scale up of an intervention.

This study was conducted to estimate the cost of providing KMC to mother infant dyad and outline the major resource inputs incurred by the health system.

1.2 Statement of the problem

Ever since Kangaroo Mother Care (KMC) was proposed by Dr. Edgar Ray Sanabria, a Colombian pediatrician, in 1978 the KMC has drawn the interest of many scientists and researchers. Many researchers tried to show the method is at least as good as the incubation care [10].

Researches done in Ethiopia as well as other countries have shown that KMC is effective, acceptable and cheaper than the conventional care in the randomized control trials [11]. Also researches on effectiveness of KMC in the Tikur Anbessa Specialized Hospital have shown frequent follow up for at least two months is very important [12].

Different nations need further evidence that can explain the programs benefit in addition to the scientific merits. Avoiding the emergence of programs of suboptimal quality due to cost-containment requirements is among the challenges that face the KMC program [10]. As it is stated in the guideline for implementing the KMC the first step to a national program of the KMC is situational analysis which includes that there must be a relevant data sheet regarding the cost of providing the care [5]. Studies also put forward that when a nation applies the program it needs pertinent data on how much is being spent on the different health care levels and act accordingly. They have also recommended that thorough investigation on the health economics will help the program [10].

Since there was no this study done in Ethiopia to calculate the cost of implementing kangaroo mother care in different health care setting, estimation of the costs with regard to its facility context will help in further scale up and efficient allocation of health care resources.

1.3 Significance of the study

This study could help as a basis for further scale up of KMC program which in turn will help our country to reduce neonatal mortality. Estimating the cost that is being incurred by implementing KMC program is important source of data to the policy makers that are going to allocate budget for the health program in general. Not only estimating the cost at one health facility but in a more or less inclusive manner to the different health care tiers will help get the comprehensive picture.

2. LITERATURE REVIEW

2.1 Method of costing and costing approaches in health care

The two methods of cost analysis are accounting method and statistical method. Accounting method makes use of accounting information and reanalysis of hospital service records to calculate hospital costs. This can be useful for a single hospital and contains labor intensive detailed examination of hospital accounts, staffing patterns and admissions. Statistical method uses observations of costs and services of many hospitals. This helps in knowing the relations between marginal cost and average cost. This method needs large number of detailed and well documented observations [13].

Total cost of a particular service can be determined by quantity of resources consumed and unit cost of the resource items. Five steps are taken for costing methods. These are portraying the decision problem and establish objectives of costing (Selection of study perspective, time horizon and explicit statement about the assumptions applied are also an essential part of this step), followed by describing the service in detail (final cost object), then identifying and classifying of resource items and units of resources utilized to deliver a particular service. The units of measurement (units of input) can be an activity or physical resources such as disposables or drugs. The next step is measuring resource consumption in natural units; and placing monetary value on these resource items (goods, activities, and/or services) and calculating the unit costs of a particular service [14].

Two approaches can be applied in costing methodology. A top-down approach is useful for those cases where marketed health technologies (pharmaceuticals, medical devices and other consumables) are responsible for most of the resource use. However, in those cases where

service provision is based on complex organizational arrangement (input mix could vary significantly), and human resource costs and overheads are responsible for a large portion of the total costs, the inaccuracies introduced by a top-down approach become important, and a bottom-up approach is to be preferred [14].

The bottom-up approach records resource utilization at the patient or individual service level, and aggregates patient/service level utilization data to identify the type of resources used and to measure resource utilization in order to calculate the costs of specific services. This method can be deployed retrospectively and prospectively using medical records, surveys, questionnaires or other reliable databases. It is also called micro-costing or activity based costing [14].

2.2 Economic evaluations on kangaroo mother care

The KMC program is a care system with three basic components; position nutrition discharge and follow-up. Many research papers have been written to evaluate its effectiveness in preventing the premature neonatal deaths and improving the lives of stable but premature infants. Also literature that base their studies on the hospital setting have addressed the issue of economic impact of the program using cost effectiveness analysis techniques.

A review article on Kangaroo Mother Care to look back on a 25 year run of the program has shown the use and adaptation of KMC to different settings in three main scenarios: (1) settings with a very low level of development and severely restricted access to any level of neonatal care; (2) settings with access to appropriate resources but which are insufficient for the number of premature births; and (3) settings with little or no restriction on access to high-technology neonatal care. Though KMC in developing countries with limited health resources originated mainly in response to these circumstances, the benefits attributable to it far exceed its effects on

overcrowding in busy, understaffed, and underequipped neonatal units. One of the most immediate effects of KMC is to prevent prolonged separation of the mother and her low birth weight infant, which contributes to morbidity, insufficient milk volume, poor growth, and poor mother-to-infant bonding [10].

Essential costs, costs to be carried by the normal budget, additional fund-raising needs were sought-after, before implementing the program. The question on How will the KMC programme be financed is one of the questions asked in the designing of the program. Impact of a new intervention on an institution as a totality needs to be assessed by considering capital expenditure, space (ward, outside recreational area), heating, staff expenses, lodging for mothers doing intermittent KMC, equipment, furniture (chairs, beds, tables), refrigeration, household items (needed for continuous KMC), KMC wrappers, special bedding (e.g. attractive bedspreads), curtains household equipment (e.g. crockery and cutlery, kettle, washing, machine, microwave oven), recreational equipment and material (e.g. TV, reading material) [15].

Study done in the three countries, India, Indonesia and Philippines, shows the three ways in implementation of facility-based kangaroo mother care. Three major themes were identified: pioneers of facility-based KMC; patterns of KMC knowledge and skills dissemination; and uptake and expansion of KMC services in relation to global trends and national policies pioneers of facility-based KMC were introduced later on. Training method beneficial to the initial establishment of KMC services in a country was to send institutional health-professional teams to learn abroad, notably in Colombia. Further in-country cascading took place afterwards and still later on KMC was integrated into newborn and obstetric care programs. The patchy uptake and expansion of KMC services took place in three phases aligned with global trends of the time: the

pioneer phase with individual champions while the global focus was on child survival, the newborn-care phase and lastly the current phase where small babies are also included in action plans [16].

A study conducted on thirty-six hospitals in the Provinces of Gauteng and Mpumalanga in South Africa which were targeted to implement kangaroo mother care illustrated that the implementation of a new health care intervention could be scaled up by using a carefully designed educational package, combined with face-to-face facilitation by respected resource persons. This study demonstrated that the site of facilitation, either on site or at a centre of excellence, did not influence the ability of a hospital to implement KMC. The choice of outreach strategy should be guided by local circumstances, cost and the availability of skilled facilitators [17].

Kahatun review on KMC as a simple method of care for developing countries states that KMC is a cost-effective alternative to incubator care for LBW newborns in low-resource settings. It demonstrates the feasibility, acceptability, and effectiveness of KMC in rural areas. The burden on health systems imposed by care of preterm infants in high-income countries is considerable and well recognized. Indeed it is estimated that the cost of care for a single preterm birth in the USA is US\$ 51600 [18].

According to a study conducted on a referral hospital in Nicaragua the average cost of all drugs for neonatal care before implementation of KMC was US\$ 4.97 but after KMC program it was US\$ 3.65. The difference was due to primarily lower cost for infant formula and medications in the post-KMC period. In the same study conducted for the Nicaragua hospital the total average cost

for care for a neonate was US\$ 2,322 in the pre-KMC period and US\$ 1,808 in the KMC period. The largest part of these costs was attributed to training health professionals. The combined cost, considered a single, fixed expense, was just over US\$ 23,000. The additional per patient cost included consumables given to the parents of each neonate. In addition this study showed that analysis of the costs comparing the KMC to no KMC showed that the amount of money saved on in-patient treatment of high-risk neonates in the KMC program would offset the cost of initial training and implementation of health workers and changes to the hospital system after treatment of 45 premature neonates or 1–2 months of deliveries. After 12 months, implementing KMC in this referral hospital is projected to save more than US\$ 233,000. This study also shows that in its point estimates for the difference in cost between the KMC and no KMC strategies show that even with the conservative estimate, implementing KMC is expected to begin to save money after fewer than 275 neonates are treated, or less than five months after full implementation. After 12 months of implementation, KMC is estimated to save more than US\$ 233,000 using the referral hospital incubator use data or around US\$ 166,000 with the more conservative incubator use estimate. However, these results are point estimates not taking into account the confidence intervals of data obtained from samples. Using the uncertainty in the model inputs, the acceptability curves show the probability of KMC implementation in the 12 hospitals being cost-saving over time. Even under conservative assumptions, using KMC is projected with almost 100% certainty to produce savings after one year of implementation [19].

Another study conducted using secondary analysis to compare cost effectiveness of ‘Kangaroo Ward Care’ with ‘Intermediate intensive care’ in stable very low birth weight infants, less than 1100 grams using a randomized control trial in the tertiary care nursery of the Department of Neonatology, Fernandez hospital, Hyderabad from November 2013 to August

2015, using 141 infants (less than 1100g and ≤ 32 weeks at birth) as control, there was significant reduction in neonatal charges in KWC group, after the samples were divided to two unequal groups where one group was put in the intermediate intensive care and the rest in the KWC. The separate “top-down” and “bottom-up” cost analysis showed that there was significant reduction of hospital and parent expenditure in KWC group when compared to intermediate intensive care (IIC) group ($p < 0.001$). There was significant saving of around 33,800INR (USD) in the KWC group for each patient [20].

An additional study conducted on low birth weight neonates in Tabriz 2010-2011 to analyze cost and effectiveness analysis of kangaroo mother care and conventional care method, the mean cost of hospitalization per individual infant for KMC was \$3539.47, whereas for Conventional group was \$2907.27 and also showed that KMC promoted weight gain in LBW infants better than conventional care. Hence their study concluded that, although KMC’s unit cost is a little higher than Conventional method, it can be considered as cost effective method. The reason for this was the positive outcomes on breastfeeding’s and mortality that was attained by the KMC [21].

An economic evaluation study conducted by a regional Health Innovation and Education Cluster in the United Kingdom upon 18 neonatal units has shown that for every £1 invested in the intervention to increase kangaroo skin-to-skin care and breastfeeding rates, between £4.00 and £13.82 of benefit was generated. The aim of the study was to increase KMC skin-to-skin care and breast feeding rates by generating an economic outcome data that can be compared with the cost of the interventions [22].

A randomized controlled trial was carried out in Addis Ababa, Yogyakarta and Merida to study the effectiveness of KMC. The aim of the study was to show the effectiveness, feasibility, acceptability and cost of kangaroo mother care in comparison to conventional methods of care.

The study set out to see the managerial, financial and cultural aspects on these different settings. The randomized control trial in Addis Ababa showed that outbreak of infection occurred four times in the conventional method of care (CMC) ward and only once in the KMC ward. The four bedroom set up in KMC ward was comfortable and sufficient for the mothers while in the CMC ward there was over crowding 60% of the time. Cost comparisons were stated jointly for the three study areas. Running cost for KMC was 50% less than that of the CMC US\$ 11,788 versus US\$ 29,888 for salaries, and US\$ 7,501 versus US\$ 9,876 for other items. A higher cost for other items in CMC was attributed to cost of keeping the ward at 32⁰c in Addis Ababa. Items like food for mothers and laundry made KMC more expensive than the CMC care [11].

A cost effectiveness analysis done in an Ethiopian setting for interventions that are provided during pregnancy, childbirth and neonatal period have shown that interventions delivered in packages were more cost effective than those delivered in single unit. The study used the World Health Organization's Choosing Interventions that are Cost Effective (WHO-CHOICE) maternal and neonatal health model on thirteen interventions for mothers and neonates. The incremental cost and effectiveness of an intervention scale up with the do nothing scenario all interventions except calcium supplementation were very cost-effective with ICERs less than one time GDP per capita. One of the interventions that was claimed to be cost effective was KMC. Calcium supplementation was not cost-effective for a threshold of three times GDP per capita in Ethiopia. The cost effectiveness analysis done showed that the scale up and source use of KMC use was 1% [23].

A cross sectional descriptive study conducted at Tikur Anbessa Specialized Hospital from July 2009 to May 2010 on 110 very low birth weight neonates who came to the hospital at least once

has shown that the continuation of KMC after discharge was associated with reduced mortality (6.5% vs. 23.5%, $P = 0.046$) [12].

The studies conducted outside of Ethiopia so far have shown that conducting an economic evaluation and cost estimation can help an intervention program. The studies done in Ethiopia have also addressed the benefits of KMC by comparing it with the conventional care in addition to the cost of the KMC care compared to the conventional care. The studies in totality have confined their research on the KMC program that is established at the hospital level using comparative study. This research thesis on the other hand, has evaluated the cost for providing KMC for mother infant dyad at different health systems of Addis Ababa without comparing it to the conventional care. By doing so it tried to bridge the lack of sufficient data that is seen when it comes to cost of care data of the KMC interventions.

3. OBJECTIVE

General Objective

- To estimate the cost of providing kangaroo mother care (KMC) at different levels of health system in Addis Ababa 2017 G.C

Specific Objectives

- To calculate the cost of implementing kangaroo mother care (KMC) at Tirunesh Beijing General Hospital
- To estimate the cost of implementing kangaroo mother care at Akaki Health Center
- To calculate the cost of follow up of kangaroo mother care (KMC) at urban health extension program

4. METHODOLOGY

4.1 Study Area

Addis Ababa is the capital city of Ethiopia. The city is divided into ten sub-cities which are the second administrative units next to city administration. In terms of area coverage Bole is the largest sub-city followed by Akaki-Kality and Yeka. Addis ketema is the smallest and followed by Lideta and Arada Sub-cities [22].

The health infrastructure of the city comprises three health system levels. These are specialized teaching hospital, general hospital and primary hospital (health centers and urban health extension programs). There are 11 hospitals of which five hospitals are under the Addis Ababa health bureau and the other five are under the federal ministry of health and the remaining one hospital is under Addis Ababa University. There are also 111 currently functioning health centers in the city. The study area Akaki Kality sub-city in 2004 E.C had total population of 201,701 with male to female ratio .96:1 [22].

4.2 Study Design

Cross sectional study design was used to assess the cost of implementing kangaroo mother care from the health service provider perspective.

4.3 Source population

The source population for this study are all governmental health facilities in Addis Ababa who are going to implement the KMC in the scale-up program.

4.4 Study Population

The study populations were Tirunesh Beijing General Hospital (TBGH), Akaki Health Center and urban health extension program under Akaki Health Center were all KMC components is being implemented in pre-facility, facility and post-facility phase.

4.5 Sampling Procedure

During the study period the pre-facility, facility and post-facility KMC program was only being under taken in the Tirunesh Beijing General Hospital, Akaki Health Center and urban health extension program under Akaki Health Center. Hence the procedure of sampling was a non-probability sampling procedure where purposive sampling was used to attain the objective stated.

4.6 Data Collection

Cost information of different inputs and resources used to provide KMC service were collected from March 2017 to April 2017. The fixed and variable cost inputs at the health facilities were listed, valued and cross checked after the specific activities carried out on pre-facility, facility and post-facility implementation of KMC service were listed out.

The WHO standard costing and financing tool was used as a guide and was customized to fit the study being conducted. The questioner had four sections: facility information section, direct cost, indirect cost and intermediate cost. Direct cost included sections for staff (health professional) where type of profession, number of professional, salaries and benefits were collected. Equipment (furniture, weighing scale, thermometer and other consumables) were listed out with the unit price and quantities selected. The use of drugs and laboratory investigations were

obtained from the medical record of the babies as the quantity and type depends on the baby's condition. Indirect-cost included sections for overhead cost including, building, furniture and other capital materials, supportive personnel, and other running cost (utility, stationary items). Intermediate cost section included were laundry, catering and cleaning.

The data were collected by interviewing of different department heads using the checklist (human resource head, finance head, procurement officers, medical directors, communication officers, maintenance officers) in both health facilities. Document review, physical measuring of rooms and counting of equipment were done. Purchase price of items which were available from the facility was taken and for items with no available purchase price (donated items) market price was taken. Proportion of staff time spent on the providing the KMC service was gathered from staff interview using the checklist. The utilization data of KMC service were collected through document review and staff interview. All cost were converted to US dollar by using the average exchange rate in 2017 (USD=ETB 23.0795) to enhance the comparability between studies [23].

Two data collectors carried out the interview, document review, measuring of rooms and equipment counting guided by the principal investigator. The data collectors were provided with a one day-training which included explanation about the study design, costing theory and concepts, interview methods and techniques and the data collection instruments used. They were also informed about the type and sources of secondary data needed to be collected for the study.

4.7 Study Variable

Outcome variable

- The total cost and unit cost of implementing the KMC service.

Explanatory variable

- Levels of health facility
- Type of health professionals
- Catchment population

4.8 Method of Cost Estimation

4.8.1 Description of the program

The new program of implementing KMC at pre-facility, facility and post-facility allows babies delivered at home or at the facility to be weighed and to be enrolled in the KMC if found to be VLBW or preterm. In the pre-facility phase of the program, health development army leaders (HDALs) are given health promotion about deliveries occurring around their area should be referred to the nearest facilities to be weighed and for other services. They will also train on the meaning and benefits of KMC. Trainings are also given to the health professionals and health extension workers. Health professionals are trained on how to counsel and demonstrate KMC to mothers, weighing babies after delivery and further follow up of the baby in the facility. Health extension workers are trained on how to follow up on baby's condition and mothers practice of KMC. Babies who are born at the facilities will be weighed and identified for initiation of KMC. Babies which are found to be very low birth weight (VLBW) and preterm will be enrolled to the KMC program after stabilization of the baby's condition is achieved. Enrolling the mother in the KMC program includes counseling the mother about the benefits and components of KMC, in addition to demonstrating the position of KMC to the mother. After discharge criteria are met, the KMC is allowed to continue at home with close follow up of the practice at home. At the post facility phase of implementing the program, the fourth component of KMC (close

follow up of the mother at home) is implemented. This follow up visits is performed by HEW in the catchment area.

4.8.2. Perspective of analysis

The perspective is the viewpoint from which the analysis is conducted and refers to which costs and benefits are included. Perspective of the analysis will help in identifying what type of costs should be included since an item may be a cost from one point of view but not a cost for another. Perspectives include those of governments (the impact on the budgets of specific agencies undertaking a prevention program or on programs such as Medicaid or Medicare, which fund the purchase of health services), health-care providers (the costs imposed on various types of hospitals, managed-care organizations, or other providers because of the adoption of particular prevention programs), businesses (the impact of illnesses or prevention activities on health-related employee benefits and productivity) and individuals (the costs of undertaking a current prevention activity with uncertain future benefits or the costs of illness paid out-of-pocket). This study was conducted to know the costs incurred in implementing KMC from the health service provider perspective. By choosing this perspective costs to the patient were excluded.

4.8.3. Estimation method

Direct measurement of patient-specific resource utilization i.e. activity based costing was used. Activity based costing (ABC) is based on the paradigm that activities consume resources, and services or products are the result of these activities. It breaks down the patient's care process into discrete activities, which is necessary to deliver a particular service. An activity is a collection of resource utilization combined to deliver a particular activity [14]. The total cost of providing

KMC for one month was estimated by summing up the direct cost, indirect cost and intermediate cost that was incurred in providing the care.

4.8.4. Identification, measurement and valuation of costs

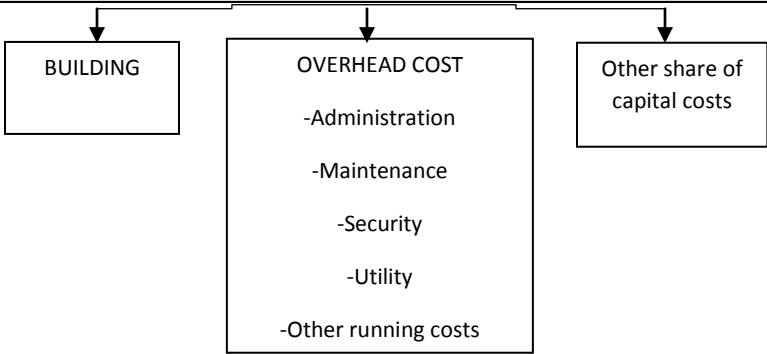
Identification

Cost of activities in implementing KMC at the pre-facility, facility, and post-facility were first identified and grouped under direct, intermediate and indirect cost. Direct cost at the pre-facility included, training and sensitization of the HDALs, health professionals and health extension workers. Direct cost on the facility included staff, equipment, drug and laboratory investigations. Intermediate cost for the mothers includes catering, laundry and cleaning. Indirect cost included administration (personnel, materials, and furniture), maintenance, security, utility, and building. In Post facility KMC provision direct cost included HEWs training and staff salary (proportion of time they spent while visiting and counseling the mother at home). Indirect cost for both facility and post facility included supervision, administration, maintenance, security, utility, and building.

Measurement and valuation

Proportion of personnel time spent with the mother and baby was obtained by interviewing the KMC unit staff. Catering is measured by average cost of food per day for inpatient stay was taken, laundry was measured by average laundry service per day and cleaning per KMC admission was taken. Total useful life of capital expenditure i.e. building, furniture, equipment (computers, printers...) was taken as 30 years, 15 years, and 5 years respectively. Medical

equipment like thermometer and weight scale is taken to have total life of 5 years and 15 years respectively. Utilization data of one month after the implementation of KMC in the health system was obtained to calculate the cost per provision of KMC for mother infant dyad.



4.9 Data Analysis Procedure

The data were entered and calculated using the MS-EXCEL. Detailed formulas used in the total cost analysis and cost per provision of KMC for mother infant dyad is described in annex 2.

➤ Cost analysis

Unit cost of providing KMC service at both hospital and health center was calculated as;

Cost of mother child dyad treated =direct cost+ intermediate cost+ indirect cost

Average direct cost for mother infant dyad= health personnel cost+ medical equipment cost+ drugs+ laboratory investigation

Average intermediate cost for mother infant dyad=laundry + catering + cleaning

Average indirect cost for mother infant dyad= administration+ maintenance + security utility + building + other running cost

Total cost=direct cost+ intermediate cost+ indirect cost

Total Direct cost= health personnel cost+ medical equipment cost+ drugs+ laboratory investigation

Total Intermediate cost=laundry + catering + cleaning

Total Indirect cost= administration+ maintenance + security + utility + building + other running cost

Annualized value for capital items, building (discount rate3%-5%)= Replacement cost

Annualization factor

4.10 Sensitivity analysis

One way sensitivity analysis allows for assessing the impact of change of a certain parameter on the conclusion. This is done by changing each variable through the range of assumptions. Thereafter all variable remained constant except the variable of interest.

Table 1: Parameter uncertainties, alternative assumptions, and sensitivity analyses on service provision of Kangaroo mother care in Tirunesh Beijing General Hospital, Akaki Health Center and urban health extension program in 2017 G.C

Assumption	Alternative assumption	Sensitivity analysis
Discount rate for capital item and building (3%)	Discount rate for capital item and building (5%)	Use annualization factor of discount rate 5%
Number of admission currently N=13	Due to the increased scale up increase in the number of admission by 50%	Increase the number of patients by 50% from current number
Number of admission in Akaki Health Center=0	If babies that were enrolled in the hospital was enrolled in Akaki Health Center	Calculate the cost per provision of KMC for mother infant dyad assuming the 13 babies were treated at the health center

Maximum number of time spent by health professional 1 hour	Since the maximum hour was estimated by interviewing the professionals increase and decrease hours	$\pm 20\%$ from one hour
Number of visits of HEW'S is four till 28 th day after deliver	Increase in number of visit based on baby's condition	Increase the number of visits by 50%

4.11 Ethical Clearance

Ethical clearance and approval letter was obtained from the Institutional Review Board of College of Health Sciences of Addis-Ababa University. Consent letter from the Addis Ababa University Tikur Anbessa School of Public Health was written to the Tirunesh Beijing Hospital and Akaki Health Center. After explaining about the purpose, the possible benefit of the study, verbal and written consent was obtained from each health facility heads and officials.

4.12 Information Dissemination Procedure

The study conducted for the partial fulfillment for the requirement of degree of Masters in Addis Ababa University, College of Health Science, School of Public Health and the result of the study will be submitted to the institute and the respective health facilities where the study took place. The study findings will also be given to relevant body like federal ministry of health, Addis

Ababa health bureau and KMC project heads. Finding of this study will be disseminated through seminars on specific issues and finally will be published through peer reviewed journals.

4.13 Operational definition

Fixed assets:-represents to assets having an economic useful life exceeding one year.

Cost: the loss of welfare associated with the non-health consumption foregone because the resources are used to provide the health intervention.

Direct costs:-are those immediately associated with an intervention such as staff time, consumables etc.

Overhead cost (joint cost):- resources that serve many different departments and programs.

Total cost:-cost of producing a particular quantity of out- put, the sum of program cost and patient cost.

Fixed cost: cost that do not change with an increase in production in the short-run

Variable cost: costs that change with every change in the amount produced.

Indirect cost: costs that cannot be allocated directly to an activity

Activity based costing (ABC): is based on the paradigm that activities consume resources, and services or products are the result of activities

Annualization: the conversion of capital items and startup costs in to annual equivalent costs,so that the time metric for these items matches other cost items.

Bottom up costing: a costing method which starts with the recipient of goods and health services received at that level (and allocate shared resources to a particular patient or service center).

Top down costing: a costing method which starts with the total health budget and then allocates costs to specific programs

5. RESULTS

5.1 Characteristics of health facilities

The study included Tirunesh Beijing General Hospital (TBGH) and Akaki Health Center which are located in the Akaki Kality Subcity. These two facilities are the first to initiate the KMC program in the pre-facility, facility, and post-facility basis. TBGH was established in 2004E.C and currently operates with health professional staff of 389 and supporting staff of 194. It covers the catchment population of 210,000 with an expected birth delivery of 4889 annually (2.3% of the catchment population). Akaki Health Center was established in 1971E.C and currently it is running with 72 health professional staff and 63 supportive staff. It covers the catchment population of 43,769 with an expected birth delivery of 1019 annually (2.3% of the catchment population). The Urban Health Extension Program is under the provision of Akaki Health Center which includes seven Health Extension Workers and two supervisors.

In order to carry out the KMC program in this two facilities; training on KMC and designation of the KMC room was done. Two nurses from TBGH and two midwives from Akaki Health Center were trained about the intervention for three days. Eighty health development army leaders, from the Akaki Health Center catchment area with an additional one woreda (Gelan), received a health promotion education on how to actively detect delivery at home and communicate with the health extension workers. Seven HEWs from the Akaki Health Center received training on how to follow-up the KMC practice at home.

Even though both health facilities had prepared for providing the KMC intervention at the time of the study period only the TBGH had preterm cases and the Akaki Health Center had no mothers who came for the service.

Table 2: Characteristics of Tirunesh Beijing General Hospital and Akaki Health Center in 2017 G.C

Characteristics	Tirunesh Beijing General Hospital	Akaki Health Center
Year of establishment	2004 E.C/2012 G.C	1971 E.C/1979 G.C
Level of the facility in the health system	Secondary	Primary
Number of health professionals	389	72
Number of supportive staff	194	63
Catchment population	210,000	43,769

5.2 Total Cost, Average Cost and Utilization in Tirunesh Beijing General Hospital

The KMC service was provided in a separate room (with shower room) assigned for the sole purpose of the intervention. The room had 6 beds, furniture (table, chair, coat hanger, cabinet), thermometer and weighing scale. There were two nurse professionals trained and designated for providing KMC service and one general practitioner assigned for the neonatal intensive care unit. The total number of KMC admission for the one month study period was 13, with the mean length stay of 7 days.

The time a health professional spends with the mother at the facility by performing the activities was one hour within 24 hours or one day. The average amount of time spent by a professional in

counseling and demonstrating KMC practice took a maximum of 30 minutes and takes up to a maximum of ten minutes each in taking the vital signs of the baby every six hours within 24hours. The average salary of the nurses and general practitioners per hour was USD 1.80. The average cost of personnel (nurses and general practitioners) for average length of stay for a baby who is enrolled for KMC which was 7 days was USD 12.60. The number of laboratory investigation and drugs administered to the baby was obtained from the medical records of each baby. The unit price of each laboratory investigation was taken from the laboratory department's price list for laboratory investigations. The average cost of laboratory investigation for a one baby is USD 2.20. The unit price of drugs were obtained from the pharmacy store price list of drugs. The average cost for drugs for one baby was found to be USD 0.76.

Intermediate services like catering, laundry and cleaning was given for a mother who was admitted to the KMC unit. Costs of these services were obtained from general service department. These services three intermediate services were out sourced. The average cost of food for average length of patient stay which is 7 days was USD 9.60. The average cost of laundry for average length of patient stay was USD 6.52. The cleaning cost for the whole hospital compound (42,446sq.m) was USD 3729.62 per month. Even though the payment for the cleaning service is done in aggregate, it takes USD 2.25 to clean 25.6sq.m of the compound which is occupied by the KMC room. Cleaning per baby was estimated to be USD 0.17.

Indirect costs shared by the KMC unit was calculated by summing up the cost of administration, maintenance, security, utility, building and other running cost. The cost of administration, utility and other running costs were USD 2.50, USD 0.61 and USD 0.13 respectively. These categories of costs were divided by the total inpatient and outpatient served (6413 inpatient and outpatient) within a month. The cost of the rest indirect cost categories; that is, maintenance, building and

security were USD 0.07, USD 2.78 and USD 0.23 respectively. The share of KMC from these costs were extracted by using the floor area of the KMC room, the same as it was done for the cleaning cost calculation and divided by the number of admissions for the whole month. Individually, the mean direct total cost of providing KMC service for a mother was USD 32.69 (59.10%) and intermediate cost was USD 16.29(29.44%) whereas the indirect cost per month for providing KMC service was estimated to be USD 6.32(11.38%).

The cost per providing KMC for the mother infant dyad for an average length of stay of seven days at Tirunesh Beijing General Hospital was estimated to be USD 55.3.

Table 2: Cost per providing KMC to the mother infant dyad of kangaroo mother care service at Tirunesh Beijing General Hospital (TBGH) by cost category in 2017 G.C

Category of cost	cost per mother infant dyad	Percentage (%)
Direct cost		
<i>Personnel</i>	12.60	21.88
<i>Laboratory</i>	2.20	3.97
<i>Drugs</i>	0.76	1.37
<i>Medical equipment</i>	17.63	31.88
Intermediate cost		
<i>Catering</i>	9.60	17.35
<i>Laundry</i>	6.52	11.79
<i>Cleaning</i>	0.17	0.30
Indirect cost		
<i>Administration</i>	2.50	4.5

<i>Maintenance</i>	0.07	0.12
<i>Security</i>	0.23	0.41
<i>Utility</i>	0.61	1.1
<i>Building</i>	2.78	5.02
<i>Other running cost</i>	0.13	0.23
<i>Sub total</i>	55.3	100

Estimation of cost for total direct, intermediate and indirect cost of providing KMC for one month was done. The direct total cost was USD 585 (66.87%) and intermediate cost was USD 212.25 (24.26%) while the indirect cost per month for providing KMC service was estimated to be USD 77.52 (8.86%).

The total cost of providing KMC at the TBGH for a total of one month, which comprised of fixed and variable costs, was estimated to be USD 874.86.

Table 3: Total cost of kangaroo mother care service at Tirunesh Beijing General Hospital (TGBH) by cost category in the 2017 G.C

Category of cost	Total cost of providing KMC for a month	Percentage (%)
Direct cost		
<i>Personnel</i>	318.26	36.37
<i>Laboratory</i>	28.60	3.26
<i>Drugs</i>	9.20	1.05
<i>Medical equipment</i>	229.29	26.20
Intermediate cost		

<i>Catering</i>	125.00	14.28
<i>Laundry</i>	85.00	9.71
<i>Cleaning</i>	2.25	0.25
Indirect cost		
<i>Administration</i>	33.60	3.84
<i>Maintenance</i>	0.89	0.10
<i>Security</i>	1.40	0.16
<i>Utility</i>	3.70	0.42
<i>Building</i>	36.22	4.14
<i>Other running cost</i>	1.71	0.19
<i>Sub total</i>	874.86	100

5.3 Total cost of KMC service at Akaki Health Center

The health center had a room assigned for providing KMC service. The room had 3 beds, furniture, thermometer and weighing scale. There were two midwife professionals trained and designated for the KMC service.

Intermediate service such as laundry and cleaning was provided in the health center. The unit cost for these services was estimated by interviewing the employees using the checklist and by adding up the amount of supplies used per month and personnel cost. Since there were no records kept for keeping track of service provided. The cost of laundry for one day stay in inpatient at the HC was estimated to be around USD 0.56. The cleaning cost provided was estimated by using floor area. The total cost of cleaning the entire HC (720sq.meter) was USD

888.54. The area occupied by KMC was 16sq.meter making the cleaning cost per room area to be USD 19.69.

The Indirect costs portion taken by the KMC unit was calculated on the basis of floor area occupied by the KMC room. The costs for administration, maintenance, security, utility and building were USD 39.00, USD 3.47, USD 42.00, USD 146.00 and USD8.40 respectively. Therefore the total cost for providing KMC at the health center is estimated to be USD 654.31

Table 4: Presents Total cost of kangaroo mother care in Akaki Health Center by cost category in 2017 G.C

Category of cost	Total cost per month	Percentage (%)
Direct cost		
<i>Personnel</i>	119.06	22.24
<i>Medical equipment</i>	154.00	28.77
Intermediate cost		
<i>Laundry</i>	0.56	0.10
<i>Cleaning</i>	19.69	3.67
Indirect cost		
<i>Administration</i>	39.00	7.28
<i>Maintenance</i>	42.00	7.84
<i>Security</i>	8.40	1.56
<i>Utility</i>	3.47	0.64
<i>Building</i>	146.00	27.27
<i>Other running cost</i>	3.06	0.57

<i>Sub total</i>	535.24	100
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5.3 Pre-facility and post facility cost of Kangaroo mother care

Pre-facility activities that were performed on the community included health promotion and mobilization for 80 HDALs at a cost of USD 1,572.82. Per Diem cost of trainers as well as trainees and refreshment costs, contribute to the total cost. For that of post facility, the total cost for training comprised of the per diem and refreshment cost for HEW'S and two supervisors, and trainers. The cost for this training was USD 879.57. Overall the training costs for pre facility, facility and post facility was USD 4,983.64. And annualized value of (if refresher training is given every 2 years) USD 2,605.15 and monthly annualized value of USD 217.10.

HEW's spend an hour from their productive time for visiting and counseling a mother on the progress of the KMC practice at home after the mother is discharged from either of the two facilities. The average number visits for one baby until 28th day after delivery was 4. HEW When this is placed in monetary terms the cost per single visit of a HEW was estimated around USD 0.75 and USD 3 for the four visits. Since the urban health extension program is under the supervision of Akaki health center the program had indirect cost associated with it. Thus overall unit cost for a follow up for one mother is about USD 65.28. The total cost for providing the KMC post facility follow up, i.e. four visits till the neonate is 28 days post-delivery, is USD 809.71 assuming that the 13 babies that were discharged from the TGBH received a follow up visits within the catchment area.

Generally, to have one stable preterm neonate that was born in the TGBH that was enrolled in the KMC and had follow up visits at home by HEW's until the 28th day after delivery, it would cost the health system USD 120.58.

Table 5: Total cost for follow up visits of urban health extension program under Akaki Health Center in 2017 G.C

Category of cost	Total cost per month	Percent (%)
Direct cost		
<i>Personnel</i>	211.00	26.05
<i>Office equipment</i>	45	5.55
Indirect cost		
<i>HEW supervisor</i>	422.01	52.11
<i>Administration</i>	49	6.05
<i>Maintenance</i>	52.7	6.50
<i>Security</i>	10.5	1.29
<i>Utility</i>	4.3	0.53
<i>Building</i>	15.2	1.87
<i>Sub total</i>	809.71	100

5.4 Sensitivity analysis

The results from the sensitivity analysis show that using different interest rate for the capital costs from 3% to 5% has increased the average cost of the KMC services with a percent of

11.88%. Moreover assuming that the KMC coverage has increased the admission by 50%, will decrease the cost per provision of KMC for mother infant dyad by 14% (USD 47.56) showing the economies of scale. Since professional time spent with the mother was estimate based on interview with the professional the time spent was increases by 20% and decreased by 20% from the original value. The sensitivity analysis showed the range of increase and decrease in the cost per provision of KMC mother infant dyad from USD 58.32-53.28. Increasing the number of visits by HEWs will increase the cost per mother for follow visit by 2.32%. Since there were no KMC visits on Akaki Health Center because of absence of cases with in one month assumption was made in order to calculate the cost per provision of KMC for mother infant dyad. This resulted in USD 36.81.

Table 6: results of alternative assumption by Sensitivity analysis on costing of Kangaroo Mother Care in 2017G.C

Variables	Direct cost total	Average direct cost	Indirect cost total	Average indirect cost	Unit cost provision of KMC in TGBH	cost per KMC post facility visit	cost for per provision of KMC in Akaki HC
3%	1222.09	32.69	77.5	6.39			
5%	1229.7	39.08	88.14	7.13			
Change in percentage	0.62	1.5	12.07	10.38			
Number of admissions in one month=13					55.3		
Number of admissions increased by 50%=20					47.56		
Change in percentage (%)					12.49		
Number of admission in health center =13					14		36.81
hours spent with the mother=1 hour(60min)					41.73		
Hours spent with mother increased by 20%					58.32		
Change in percentage (%)					39		
Hours spent with mother decreased by 20%					53.28		
Change in percentage (%)					6.4		
Number of visits =4						65.26	
Increase the number of visit 50% -number of visits =6						66.78	

Change in percentage (%)	2.32	
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6. DISCUSSION

This study was conducted to assess the costs that were associated with the effective provision of KMC service to the mother infant dyad. The costs were calculated for the prefacility, facility and post facility phase of implementing KMC. The study attempts to calculate the costs of resource that are actually used in each activity. The costs were divided into direct, intermediate and indirect cost. It gives an insight into the cost of implementing KMC.

Study finding shows that the total cost of KMC service at the facility particularly from TBGH was USD 874.86. Out of this the largest share of total cost was from the health personnel salary (36.37%). Next to that, comes medical equipment cost (26.20%). The average cost for effectively providing KMC to the mother infant dyad at TBGH hospital was USD 55.3. Out of this the highest portion was for health personnel salary (17.35%).

The study showed that for the Akaki Health Center the total cost was USD 535. The highest percent was taken by health personnel salary and medical equipment cost, 22.24 % and 28.77 % respectively. The lower value seen in the health center as compared to the TBGH could be due to: no catering service rendered for inpatient stay, no utilization of KMC services hence no records of drugs and laboratory equipment, the utilities and the building were divided between the health center and another public service institute. Despite these facts, other studies done on other type of interventions have concluded that rendering health care services at a lower level of the health system reduces the cost of the intervention [13, 25,27]. The cost per provision of KMC

for mother infant dyad couldn't be calculated for Akaki Health Center but sensitivity analysis showed that USD 36.81. The catchment population difference between the two facilities, in addition to type of professional mix (two nurses and one general practitioner in TBGH versus two midwives in Akaki Health center) could explain the difference in case numbers. This study has shown that the total cost of KMC at the post facility was USD 809.71. And the cost for a single visit was USD 3.

The cost to mother was not assessed in this study as the study took the health providers perspective. The time needed to provide a continuous and extended kangaroo mother at home was mentioned as one of the barriers to the implementation process [26]. Support from other family member leads to a higher uptake of KMC as it allows the mother to dedicate the time that would have been used for household chores. Even though the current policy in Ethiopia allows mothers to use maternal service free of charge until 42 days post neonatal period, productivity costs are incurred. This productivity loss is considered as the resource forgone to participate in an intervention, to seek care for a health condition and for caregiving [25]. Hence further study on the cost to the mother could help in the further integration to the health system.

In addition to the cost of implementing KMC, managerial issues and attitude and behavior of health care workers was one of the barriers for successful implementation of KMC. The low motivation of the health professional arises from workloads coming from the intensive neonatal health care units, since the nurses had to cover both NICU and KMC units [13]. This was mentioned by nurses while trying to construct the amount of time spent with each mother. They said that there are staff shortages as they have to switch between the two wards. Since these

issues can be resolved with increased human resources to the intervention attention should be given.

7. CONCLUSION

The cost of providing kangaroo mother care to the mother infant dyad was USD 55.3 in Tirunesh Beijing Hospital. Though the average cost of effectively providing kangaroo mother care to the infant mother dyad for Akaki Health Center couldn't be calculated due to absence of preterm cases, sensitivity analysis done by assuming to treat the same number of neonates (13) at the health center could be as much as USD 36.81.

The total cost for providing kangaroo mother care at Tirunesh Beijing General Hospital and Akaki Health Center was found to be USD 874.86 and USD 535.24 respectively. Health professional salary at both the TBGH and Akaki Health center has the highest cost for total cost. The totalcost of giving the KMC service at the health center level costs less than giving it at the hospital level.

8. STRENGTH and LIMITATIONS

Strength

- The study used primary data
- Activity based cost estimation technic is a good technic to come up with the most accurate cost estimate
- The study can serve as a ground for large scale up interventions

Limitations

- The small sample size of the study limits its generalizability on other facilities
- There were very few studies published on the estimation of cost in implementing KMC so this made it difficult to compare findings of this study

9. RECOMMENDATIONS

To health planners

- The estimated total cost and unit cost can serve as a base for scale up of the KMC intervention

To researchers

- Assessing the health outcome and health impact of KMC by doing further research will help in knowing the return of the money spent.
- To encourage the culture of KMC practice in the community, patient side cost needs further study.

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Annex 1

Checklist to estimate the cost of KMC unit in health facilities

General facility information		
1	Year of cost data collection(G.C)	
2	Name of the health facility	
3	Level of the health facility	
4	Year of establishment	
5	Total catchment population	
6	Total number of health professionals in the study period	
7	Total number of supportive staff in the study period	
8	Exchange rate of study year in USD	

Key informant Interview at KMC department at Tirunesh Beijing General Hospital and Akaki Health Center

1. How many full time staffs were assigned to KMC department in 2017? -----
2. What is the salary of the department staff? Total ----- average -----
3. What is the average consultation and demonstrating kangaroo mother care (KMC) practice time in minute/hours for a mother in the department? -----

4. How many hours a day do you follow up the kangaroo mother care (KMC)?
5. How many hours do you work in the department daily on average? -----
6. How many admissions were made to the KMC department for one month? _____
7. Total number of patients treated (inpatient and outpatient) for one month? _____

Key informant Interview of urban health extension workers

1. How many full time staffs were trained and assigned for kangaroo mother care KMC visits? --

2. What is the salary of the department staff? Total ----- average -----
3. What is the average number follow up visits you perform for a single baby per week?
4. How many hours does it take in total (travel time plus visit time) for one single visit?
5. How many visits do you perform for a baby till 28th ? -----
6. How many admissions were made to the KMC department for one month? _____
7. Total number of patients treated (inpatient and outpatient) for one month? _____

Checklist to assess cost of kangaroo mother care (KMC) service							
section one :Direct cost							
1, personnel (health professionals)							
Sr.nu m	type profession	of	number of professional	hours/minute s spent per	monthly salary	benefits	total cost

			day			

section one direct cost							
2. medical equipment and furniture							
srnu m	type of equipment and furniture	quantity	purchased year	provider	unit cost	total cost	

section one direct cost				
3, drugs				
baby number	type of drug	quantity	unit cost	total cost

section one direct cost				
4.laboratory investigation				
baby number	type of laboratory investigation	quantity	unit cost	total cost

section two : intermediate cost			
1.laundry			
snum	type of clothing	unit cost per service	cost per day

section two: intermediate cost			
2.catering			
srnum	type of clothing	unit cost per service	cost per day

section two: intermediate cost		
3.cleaning		
srnum	cost per month	cost per meter square

section three indirect cost						
1, personnel (administrative)						
srnu m	type of profession	number of professional	hours/minutes spent per day	monthly salary	benefits	total cost

section three:indirect cost						
2.Equipment and furniture						
srnu m	type of equipment and furniture	quantity	purchased year	provider	unit cost	total cost

section three: indirect cost						
1, maintenance						
srnu m	type of profession	number of professional	hours/minutes spent per day	monthly salary	benefits	total cost

section three:indirect cost						
2.maintainance Equipment and furniture						
srnu m	type of equipment and furniture	quantity	purchased year	provider	unit cost	total cost

section three: indirect cost		
3.security		
Srnum	cost per month	cost per meter square

section three: indirect cost		
3.utility		
Srnum	type	cost per month (March –April)

section three: indirect cost	
3.building	
Total building area	

Purchase cost of Building	
Room area of KMC	
Year of purchase	

section three: indirect cost		
6.other running cost		
Srnum	type	cost per month (March –April)

KMC training cost							
Training							
Srnum	type	Number of trainee	of	Number of trainer	Cost per diem	Total cost	Other training cost

Annex 2

Formulas for analyzing the cost of KMC (average cost and total cost)

➤ Cost analysis

Unit cost of providing KMC service at both hospital and health center was calculated as;

Average cost of mother child dyad treated =direct cost+ intermediate cost+ indirect cost

Direct cost= health personnel cost+ medical equipment cost+ drugs+ laboratory investigation

Health personnel cost= Mean (average time spent with the mother for one day× salary per hour × length of stay)

Medical equipment cost= number and type of equipment × unit price

Number of admissions

Unit price=annualized value/12

Drugs = mean (number and type of drugs used while admission × unit price)

Laboratory investigation= mean (number and type of lab investigations used while admission × unit price)

Intermediate cost=laundry + catering + cleaning

Laundry= Mean cost of laundry for day stay× length of stay

Catering= Mean cost of food for day stay× length of stay

Cleaning =average cost of cleaning for KMC room for a month(floor area)*

Number of admissions for a month

**cleaning for KMC room floor area*=KMC floor area × cost of cleaning for 1 month

Total floor area of building

Indirect cost= administration+ maintenance + security + utility + building + other running cost

Administration = personnel+ material (computer, printer...) + furniture

Personnel (mean)= salary of administrative personnel of one month

Number of patients served for one month (inpatient and outpatient)

Maintenance=cost of maintenance (personnel+ annualized equipment) for KMC room for one month

(floor area used)*/number of admissions in the KMC room for one month

**Maintenance for KMC room floor area*=KMC floor area × cost of maintenance for 1 month

Total floor area of building

Security = cost of security for KMC room for one month (floor area used)*

Number of admissions in the KMC room for one month

**Security for KMC room floor area*= KMC floor area × cost of security for one month

Total floor area of building

Utility = cost of utility (electricity, water, phone with internet)

Total number of patients in one month (inpatient and outpatient)

Building = cost of building for KMC room (floor area)*

Number of admissions for one month

**Cost of KMC room* = floor area of KMC room × annualized value of total building/12

Total area

Other running cost (stationary items, sanitary materials) = total cost of running material

Total number of patients

Total cost of providing KMC service at both hospital and health center was calculated as;

Total cost=direct cost+ intermediate cost+ indirect cost

Direct cost= health personnel cost+ medical equipment cost+ drugs+ laboratory investigation

Health personnel cost= total amount of monthly salaries (including benefits)×number of health professional staff in the KMC unit

Medical equipment cost= number and type of equipment × unit price

Unit price=annualized value/12

Drugs = \sum (number and type of drugs used while admission × unit price) of the number of admissions

Laboratory investigation = \sum (number and type of lab investigations used while admission \times unit price) of admissions

Intermediate cost = laundry + catering + cleaning

Laundry = \sum (average cost of laundry for day stay \times length of stay) of admissions

Catering = \sum (average cost of food for day stay \times length of stay) of admissions

Cleaning = average cost of cleaning for KMC room for a month (floor area)

Indirect cost = administration + maintenance + security + utility + building + other running cost

Administration = personnel + material (computer, printer...) + furniture

Personnel = \sum salary of administrative personnel of one month of (number of admissions)

Number of patients served for one month (inpatient and outpatient)

Maintenance for KMC room floor area = KMC floor area \times cost of maintenance for 1 mon

Total floor area of building

Security for KMC room floor area = KMC floor area \times cost of security for one month

Total floor area of building

Utility = \sum cost of utility (electricity, water, phone with internet) of number of admissions

Total number of patients in one month (inpatient and outpatient)

Cost of KMC room = floor area of KMC room \times annualized value of total building/12

Total area

Other running cost (stationary items, sanitary materials) = \sum total cost of running material

Total number of patients

Annualized value for capital items, building (discount rate 3%-5%) = Replacement cost

Annualization factor

3. Drugs

s.num of baby	Type of drugs	Quantity	Unit cost	Total cost

4.Laboratory investigation

s.num of baby	Type of test	Quantity	Unit cost	Total cost

Section 2: intermediate cost

1.Laundry

snum	Type	cost per service	cost per day

2. Catering

snum	Type of meal	cost per service	cost per day

3.Cleaning service

Srnum	Type	cost per month	cost per meter square
1			

Section 3:indirect cost

1.Administration

1.1 Personnel

Type of staff	Total number	Hours/days spent per month	Gross salary	Fringe benefits(insurance, health care payments, house allowance)	Total cost

1.2 Material and furniture

Type of equipment	Quantity	Life span	Years of service	Provider	Unit cost	Total cost

2 Maintenance

2.1 Maintenance personnel

Type of staff	Total number	Hours/days spent per month	Gross salary	Fringe benefits(insurance, health care payments, house allowance)	Total cost

2.2 Material and furniture

Type of equipment	Quantity	Life span	Years of service	Provider	Unit cost	Total cost

3.Security

Security service

Srnum	Type	cost per month	cost per meter square
1			

4.Utility

Srnum	Type	Cost per month

5.Building

Total building area	
Purchase cost of the building	
Room area of KMC	

6. Other running cost

Srnum	Type	Cost per month

7. KMC training cost for

TRAINING of HEALTH PROFESSIONALS IN KMC				
Sr.no	Type of training	Days of training	Unit cost	Total cost
1				
2				

3. Drugs

s.num of baby	Type of drugs	Quantity	Unit cost	Total cost

4. Laboratory investigation

s.num of baby	Type of test	Quantity	Unit cost	Total cost

Section 2: intermediate cost

1.Laundry

snum	Type	cost per service	cost per day

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snum	Type of meal	cost per service	cost per day

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TRAINING of HEALTH PROFESSIONALS IN KMC				
Sr.no	Type of training	Days of training	Unit cost	Total cost
1				
2				

.Utility

Srnum	Type	Cost per month

1.

Health care providers that are involved in the KMC unit						
Sr.no	Type of staff	Total number	Hours/days spent per month	Gross salary	Fringe benefits(insurance, health care payments, house allowance)	Total cost

2. Medical equipment

Medical equipment							
Sr.no	Type of equipment	Quantity	Life span	Years of service	Provider	Unit cost	Total cost

3. Drugs

s.num of baby	Type of drugs	Quantity	Unit cost	Total cost
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4.Laboratory investigation

s.num of baby	Type of test	Quantity	Unit cost	Total cost

Section 2: intermediate cost

1.Laundry

srnum	Type	cost per service	cost per day

2.Catering

srnum	Type of meal	cost per service	cost per day

3.Cleaning service

Srnum	Type	cost per month	cost per meter square
1			

Section 3:indirect cost

1.Administration

1.1 Personnel

Type of staff	Total number	Hours/days spent per month	Gross salary	Fringe benefits(insurance, health care payments, house allowance)	Total cost

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Srnum	Type	cost per month	cost per meter square
1			

4.Utility

Srnum	Type	Cost per month

5. Building

Total building area	
Purchase cost of the building	
Room area of KMC	

6. Other running cost

Srnum	Type	Cost per month

7. KMC training cost for

TRAINING of HEALTH PROFESSIONALS IN KMC				
Sr.no	Type of training	Days of training	Unit cost	Total cost
1				
2				

