

# Cost of care for preterm babies to Clients and influence of costs on care in resource limited settings - Societal perspective: A case of Jinja Regional Referral Hospital in East central Uganda

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## ABSTRACT

**Introduction:** The costs of care for preterm birth to clients and the influence of costs on preterm care remain a significant issue to the health system and families globally especially in the low-middle income countries particularly, in Asia and sub-Saharan Africa with already constrained economies. However, this has not received worthwhile attention. We estimated the costs of care for preterm babies to families (clients) and the influence of costs on the care for preterm babies from a societal perspective in Jinja Regional Referral Hospital. **Methods:** This was a one-month survey from August 2016 — September 2016 through which we had exit interviews with 100 mothers to determine the costs on admission and followed up 82 mothers to determine follow up costs of all babies that were born preterm and weighed less than 2.5 kg either at discharge or follow up. A micro costing approach was used to compute client costs for preterm care. Mothers were asked to identify absolute costs incurred. We also reviewed medical records of patients and receipts that were available from clients. A likert scale was used to assess influence of costs on preterm care to mothers. This ranged from -5 to 5, where (+5 to +1) was high influence, (0) was neutral, (-5 to -1) was low influence. Respondents were also asked to give reasons for their answers. From the provider perspective, we conducted key informant interviews with health care workers to ascertain the influence of costs on preterm care from the provider perspective. Analysis of findings was done using the Microsoft excel sheet. Statistical analysis was done using Stata Version 13 to determine the influence of costs on the care of preterm babies from the client's perspective. Thematic analysis was used to analyze the influence of costs on care from the provider perspective. Costs were converted to US\$ for the annual exchange average rate of 2016. One-way sensitivity analysis was done to establish the impact of cost drivers on the total cost. **Results:** The total annual cost of preterm care from the client perspective was US\$ 10,520.36 and the unit cost of care per preterm baby was US\$ 105.2 at Jinja Regional Referral Hospital. Cost drivers included opportunity costs (i.e., potential benefits foregone by clients to take care of preterm babies), drug costs on follow up, supplies and feeding costs to the mothers/caregivers during admission. Drugs, supplies thermal care and feeding costs during admission were found to have a high influence on preterm care from a societal perspective. **Conclusion:** The cost of preterm care is high from the client perspective and is characterized by longer stay in hospital because of missed treatment due to stock outs and affordability constraints to clients, but also discharge against medical advice leading to poor survival of preterm babies. Improving funding for preterm care and welfare for caregivers during hospitalization may lead to better outcomes for preterm babies.

**KEYWORDS:** Cost, Preterm care, Client, Societal perspective, Influence of costs, East Central Uganda

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## Introduction

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The world estimates demonstrate that 15 million babies are born preterm annually, with the vast occurrence of preterm births in low-middle income countries [1]. According to the Uganda demographic health survey, approximately, 14% of the births are preterm [2].

Numerous risk factors are reportedly associated with preterm birth. According to the US National Institute of Health (NIH), risk factors to preterm delivery include; maternal age below 18 years or above 35 years, domestic violence, emotional, stress, smoking, alcohol, use of illegal drugs, lack of social support, ethnicity, some environmental pollutants, working long hours or standing, blood clotting problems, and a short interval between pregnancies [3]. Other attributors to preterm birth are; multiple pregnancy, early rupture of membranes, prior preterm delivery, parity of five or more children, antepartum haemorrhage, diabetes, high blood pressure, infections, and caesarean section as a mode of delivery [1,4,5].

Costs related to preterm birth remain a significant issue to the health system and families globally particularly in the low-middle income countries in Asia and sub-Saharan Africa with already constrained economies [6,7]. The costs emanate from care due to complications, which occur soon after birth such as respiratory distress, asphyxia, jaundice, septicaemia or even in later life. Preterm babies stay longer in hospital [8,9], and are prone to long term physical, neurological or educational disability imposing financial difficulties to the families and society [10,11]. There are time costs attributed to hospitalization, lost productivity also known as opportunity costs, outpatient medical services, and special education in later life [12]. Kangaroo Mother Care (KMC) a cost-effective intervention recommended by WHO for the care of stable preterm infants is associated with time costs of those involved [9].

A study done in Mozambique showed the care for a preterm baby to cost 4.5 times that of a full-term baby and families incurred higher costs in the care for a

preterm baby than would be for conditions like malaria in the same area [11].

In Uganda like other low resource settings, the absence of insurance or where the insurance cover does not reimburse the hospital on drugs and consumables and patient nutrition, the costs are channeled to families [13,14].

Costs have been found to influence the care for preterm babies among families. Studies that were done in Malawi and Uganda reported self-discharge by mothers against medical advice, which was attributed to the costs involved in the care of the preterm babies and longer stay in the hospitals [15,16]. The care for preterm babies born outside the health facility is characterized by difficulties with transport to the hospital for management, lack of money, rival errands, perceived poor quality of care and poor attitude of health workers at the health facility [17]. Although efforts are being made worldwide to improve neonatal and child survival strategies in a bid to achieve the Sustainable Development Goals (SDGs) by 2030, this is still a mystery for developing nations in Asia and sub-Saharan Africa [18].

Despite a few studies conducted in Africa on costs of care for preterm babies to families, there is scarcity of literature concerning the economic and financial implications of preterm birth to families in Uganda. This study aimed to estimate the costs of preterm care to clients and assessed the influence of costs on the care of preterm babies from a societal perspective in East Central Uganda.

## Methods

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### Study design and setting

We conducted a cost analysis of the care for preterm babies in Jinja district, East Central Uganda, during a two months period from August to September 2016. This study was carried out in Jinja Regional Referral Hospital (JRRH) in the industrial town of Jinja which serves as a primary contact hospital and regional referral hospital for eleven districts (i.e., Bugiri, Iganga, Jinja, Kaliro, Kamuli, Kayunga,

Mayuge, Luuka, Namayingo, Namutumba, and Buyende) with an overall catchment population of 3.5 million people. The hospital reports an average of 556 deliveries in a month of which 60 are preterm births [19]. The hospital was purposively selected because it has adequate numbers of clients and a preterm care unit.

### **Cost analysis definition**

We defined cost analysis as the act of breaking down a cost summary into its ingredients and reporting on each factor for the given period.

### **Costing approach**

The cost analysis took on a micro-costing approach through which costs were estimated from the client perspective [20]. The costs were categorized as recurrent costs and these included financial and economic costs. A survey was done through exit interviews with mothers/care takers to ascertain cost inputs, amounts spent on those inputs, amounts foregone by mothers/caretakers in taking care of their preterm babies and the influence of the costs on the care for the preterm babies to the mothers/caretakers. Costing involved; identification of resources, measuring them, valuing them, totalling up the costs and calculating the unit costs [21]. In assessing influence of costs to mothers/caretakers, the absolute costs in amount were identified, and a likert scale was used to assess the influence of costs on the care for preterm babies. This ranged from -5 to 5, where (+5 to +1) was high influence, (0) was neutral, (-5 to -1) was low influence. Respondents were also asked to give reasons for their answers; for example, in assessing influence of costs on care, we asked;

“How much did you pay?”

“To what extent did this influence care of your baby? Given -5 to 5 and why?”

We excluded mothers with ill babies as we had to take baby weights and this would impact on the study findings. In addition, the bereaved mothers would not emotionally provide adequate

information to inform the study. We also conducted in-depth interviews with three purposively selected key informants in the preterm care unit and these were health workers who were involved in preterm care.

**Cost inputs:** These included drugs, supplies, investigations, nutrition for mothers and babies that were weaned, basic care needs, thermal care (i.e., additional inputs procured by mothers to keep babies warm), transport costs, and opportunity costs. Mothers/caregivers without a reliable source of income for instance housewives were asked to estimate how much they would pay someone to do their work. A daily and monthly equivalent were obtained.

Shadow pricing was used for the category of agriculturalists through which a uniform monthly estimate was adopted according to Uganda Bureau of Statistics [2]. Costs were then converted to USD using the conversion annual average rate of USD1.00=UGX, 3442.96, the official exchange rate from August 2015 to July 2016, Bank of Uganda [22].

### **Sample size and sample selection**

Jinja Hospital was purposively selected because it is a referral hospital, with adequate numbers of clients and a preterm care unit. The hospital receives an average of 50 preterm babies in a month.

A sample of 100 respondents was obtained since it was adequate to provide cost data [7,11]. All eligible mother/caretaker baby pairs were consecutively interviewed at discharge and all eligible participants coming to the preterm clinic as outpatients were interviewed to capture outpatient costs, during the months of data collection - August to September 2016. These included mothers/caregivers of babies that were born preterm, that is before 37 weeks of pregnancy and that weighed below 2.5 kgs at the time of the study and stayed for at least 2 days in hospital as inpatients.

Three key informants in the preterm care unit were purposively selected since they were involved in

preterm care at the hospital. These included a doctor, one senior nursing officer and a registered midwife.

## Variables

We assessed individual mother/caregiver and preterm characteristics. These included socio-demographic characteristics of mother/caretakers and preterm babies that were seen during the survey. Socio-demographic characteristics of mothers/caretakers included religion, tribe, education level, marital status, occupation, and residence. The preterm characteristics of preterm babies included sex, age at birth, baby weights, and morbidities that the babies suffered, the average length of stay in hospital, and number of follow up visits to the preterm clinic.

Cost inputs that were considered under influence of costs on preterm care to the mothers/caretakers were thermal care, drugs, supplies, feeding, diagnostic, basic care, opportunity, and transport costs. The costs were adapted from studies in Nigeria, Mozambique and Brazil [7,11,23]. From the provider perspective, influence of costs on preterm care was assessed through key informant interviews with health providers.

## Data sources, measurement, and quality control

Data were collected on preterm babies that were seen during the survey period (August - September 2016). Data sources included face-to-face interviews, receipts, medical records, and key informant interviews.

The exit interviews with mothers/caregivers involved the assessment to identify the absolute costs in amount, and a likert scale was used to assess the influence of costs on the care for preterm babies. This ranged from -5 to 5, where (+5 to +1) was high influence, (0) was neutral, (-5 to -1) was low influence. Respondents were also asked to give reasons for their answers; for example, in assessing influence of costs on care, we asked;

“How much did you pay?”

“To what extent did this influence care of your baby? Given -5 to 5 and why?”

Cost inputs that were computed to assess influence of costs on the side of the mothers included; thermal care, drugs, feeding, opportunity, supplies, diagnostics, basic care and transport costs which were quantified as follows; for thermal care costs; we assessed the type of resource that was used to provide warmth and the amount spent on it, drugs; we assessed the type of drug, quantity of the drug and unit cost; supplies; type of supplies, quantity of supplies and amount spent on the supplies; diagnostics; we assessed the type of investigations, number of times it was done and the unit cost attached to it; feeding costs to the mother; we assessed the number of meals per day and cost attached, feeding costs to the infant; we assessed the type of feeds, number of tins in a particular period and cost per tin of formula; transport costs, we asked about the means of transport and how much was charged per trip; basic care needs; we assessed the amount spent on basic care needs during admission of the infant, how much per day and opportunity cost; we asked about the type of work a mother did, and how much was foregone for being in hospital.

Socio-demographic data on the infants, length of stay, and morbidities were obtained from medical records review aided by a data abstraction form and triangulated with face-to-face interviews with mothers/caretakers.

The interviews were conducted by trained research assistants who were fluent in the local languages spoken in the area and had a medical background.

## Data analysis

Descriptive analysis was used to summarize socio-demographic characteristics of mothers and preterm babies, average length of stay, and morbidities that preterm babies suffered. The statistical outputs were summarized in descriptive tables as frequencies, percentages, or proportions. Cost estimates were entered into Microsoft Excel 2007, and analysis was done to obtain the total and average costs of preterm care to the client.



Costs were assumed to vary by weights of the babies and the length of stay in hospital. For each category of weight, costs were computed and divided by the number of babies in that category to get the average cost for a category. For length of stay, costs were computed for each category of number of days the mothers stayed in the hospital and were divided by the number of babies in a particular category of length of stay to get average cost by length of stay.

Then the overall costs by weights was added to the overall cost by length of stay. This total was divided by 100 to get the average or unit cost of preterm care to the clients ([Table 4](#)).

Key informant recordings were transcribed and analysed thematically.

### Sensitivity analysis

One-way sensitivity analysis was done to assess the impact of variations in cost items on the total cost. This involved altering various inputs within calculated input ranges and noting the effect on total cost. Variables that were used for sensitivity analysis from the client perspective were feeding costs, opportunity costs, supplies, drugs and transport costs on follow up. The upper limit was got by multiplying by two, while the lower limit was got by dividing by two [[24](#)].

### Sensitivity analysis Assumptions

-It was assumed that by the time preterm babies weighed 2.5 kgs, all major costs for preterm care would have been incurred.

-It was also assumed that the babies of a specified weight category for example; <1000g, 1000-1499g, 1500-1999g, and 2000-2499g received the same care.

-Certain costs were assumed to vary by length of stay and weight of the babies.

-To compute for the unit cost of preterm care to clients, it was assumed that all babies came for the follow up so, a sample of 100 was used.

### Ethical approval

We sought ethical approval from Makerere University School of Public Health, Higher Degrees Research and Ethics Committee. We received permission to conduct the study from the management of Jinja Regional Referral Hospital where the research was conducted. Interviews were conducted after written informed consent was obtained from the study participants who were mothers to the babies.

## Results

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### Quantitative results

Less than half 42% (42/100) of the mothers interviewed were protestants and majority were Basoga 71% (71/100). Only 39% (39/100) of them had attained Ordinary level education. More than three quarters of the mothers 83% (83/100) were married. The main source of income was business 26% (26/100) [Table 1](#).

A total of 100 preterm babies were admitted and 82 followed up during the months of August 2016 to September 2016. A higher proportion of the preterm babies seen during the period of the study were males 52% (52/100) compared to females 48% (48/100). The mean birth weight of the babies was 1.631g. The average length of stay in hospital was 9 days. The average number of follow up visits was 2 days for babies within the different categories of weight [Table 1](#).

### Cost analysis results

The total cost of preterm care to the clients was US\$10,520.37 and the unit cost of care per preterm baby from the client perspective was US\$ 105.2. The total preterm care costs to mothers/caregivers during admission was US\$ 8,321.52 and the total cost for preterm care on follow up was US\$ 2,198.85.

Feeding costs on admission formed the greatest proportion of inpatient costs at US\$ 3,983 (36.6%), opportunity costs were US\$ 1,871.24 (17.36%).

Investigations during admission formed the least expenditure at US\$ 33.41 (0.31%). The biggest proportions of the follow up costs were drugs at US\$ 995.45 (9.14%) and transport at US\$ 511.62 (4.7%). Baby nutrition costs formed the least expenditure on follow up visits US\$12.98 (0.12%) [Table 2](#).

Costs of preterm care to mothers/caretakers were computed according to weights of babies [Table 3](#) and length of stay. The total and unit cost of preterm care to mothers/caretakers were obtained by summation of costs by weights of babies and length of stay in hospital [Table 4](#).

We performed one way sensitivity analysis on some inputs for instance; feeding costs, opportunity costs, supplies at admission, drugs during follow up and transport during follow up in order to determine which cost drivers had an impact on the total cost to the client [24] , [Table 5](#).

### **Results on influence of costs to the client**

As shown in the boxplots, the category of transport costs, mother/caretakers' views are varied amongst the most positive quartile group. This implies that many respondents believed that transport costs had a high influence on the care for preterm babies than the other items.

In the category for drug costs, the box plot is comparatively short. This suggests that overall mothers/caregivers had a high level of agreement with each other, that drug costs have a high influence on the care for preterm babies.

Thermal care costs, supplies' costs, feeding costs (median top of the box plot), and basic care costs were found to have high variability and a high influence on the care for preterm babies.

However, the boxplot for diagnostic costs shows a high variability and median at zero implying most mothers/caregivers were neutral (undecided) on the influence of diagnostic costs on preterm care.

Additionally, opportunity costs were seen to have a high variability but low influence on the care for preterm babies than any other costs shown, meaning

opportunity costs did not really affect the care for preterm infants. Inadequate space for mothers was also reported to have a high influence on the care for preterm babies, but this was not depicted on the box plot, although it was reported qualitatively by mothers [Figure 1](#). Feeding costs were seen to increase with increase in the length of stay.

### **Qualitative results**

#### **Influence of costs to the provider**

Qualitatively, all key informants (3/3) revealed that preterm care was influenced by several other factors such as; lack of warm clothing, poor birth preparedness, drug and supplies stock outs, feeding for mothers, and inadequate space. Only three key informants were interviewed because there was nothing new after the third key informant.

*"...Care requires you to review these babies. If they are not stable, support them with oxygen, feeding, drugs, empower mothers to keep their babies warm; teach them to do KMC, or use of equipment to avail warmth, but this is influenced by several factors such as lack of warm clothing, poor birth preparedness, drugs, and supplies' stock outs, feeding costs to mothers, and inadequate space" (KI\_1JRRH).*

#### **Lack of warmth**

Interaction with all key informants revealed that preterm babies needed to be kept warm. The different ways to keep babies warm included, KMC, incubation, infant warmers, warm clothing, gloves with hot water, hot water bottles, and molten wax packs. Most of these require a reliable source of power and if there is no power, babies may not be kept warm, and this may be detrimental to their clinical care.

*"... We put hot water in gloves and put the gloves on both sides of the babies. If we are not able to do that; then we use hot water bottles. This leads to more use of power, gloves, but what do you do, babies must live. If there is no power, then it becomes very difficult" (KI\_3JRRH).*

## Poor birth preparedness

All the key informants (3/3) reported that the mothers come unprepared for delivery because the labour starts prematurely. This means the majority come with inadequate essential items to take care of the babies and themselves. This affects the care of the infants.

*“...Most mothers come unprepared because the labor is premature. The majority don't have anything for their babies. This is a real challenge” (KI\_2JRRH).*

## Drug stock- outs

Key informants (3/3) revealed that gentamycin and ampicillin, were given as routine first line drugs to all preterm babies, but if babies had complications or did not do well on first line drugs, then second line drugs were given. These included ceftriaxone, cloxacillin, cefotaxime and metronidazole. It was noted that aminophylline was given to those with breathing problems. However, these drugs were not always readily available, so mothers had to buy them and if they could not afford, the babies were kept on first line drugs which were at times not available as well. Delay in administration of drugs was reported to cause longer hospital stays due to the erratic manner the drugs were administered.

*“...Ampicillin and Gentamycin are first line” (KI\_3JRRH)*

*“...Usually we use ampicillin and gentamycin, if not ampicillin and gentamycin, we also use ceftriaxone, cloxacillin, cefotaxime. Another drug we also use a lot in preterm care is aminophylline and we also use a lot of metronidazole, but these are not always available, and mothers have to buy, if they can't then the babies are not helped well” (KI\_1JRRH).*

*“...At times Doctor gets some free samples from those Indians so if she has, she gives to those mothers, if they are not there, they remain on the first line until God makes a way out” (KI\_3JRRH)*

## Supplies stock-out

Key informants (3/3) pointed out that common supplies for preterm care were; naso-gastric tubes, cannulas, fluids, gloves, gauze, and adhesive plaster among others. They established that like it was for drugs, there were times when these were out of stock and had to be bought by mothers /caregivers, however, where these were not readily bought, due to financial constraints, there was delay or failure to administer treatment which affected the care for the babies.

*“...We have now taken some time without cannulas and nasogastric tubes, so mothers buy them., If they are not able, then we can't treat the babies, yet these babies are delicate, and this really affects their health. A mother tells you someone will come tomorrow to bring the money, but can even wait for another day” (KI\_3JRRH)*

*“...If there is no cannula for example and you want to give drugs, there is delay, so the baby is not helped soon. At times a mother says she is waiting for money, and this can take even two days, so you can imagine how bad it is” (KI\_2JRRH).*

It was also noted from all the respondents (3/3) that there was no reliable source of oxygen for emergencies, and if power was out, oxygen concentrators could not work. This affected care leading to death, of babies that required oxygen.

*“...Oxygen is a problem if power is not on. We don't have cylinders now, the hospital has few cylinders that go to Intensive Care Unit, but as I talk now there is no oxygen even in theatre so that is a challenge and babies die” (KI\_2JRRH).*

*“...Oxygen concentrators are over worked yet not serviced and they stop producing enough oxygen. There is no standby source of oxygen, so the babies end up passing on, because of lack of oxygen” (KI\_1JRRH).*

## Feeding for the mothers

Interaction with most of the key informants (2/3) revealed that the hospital does not provide food to mothers except on very rare occasions. This implied that the mothers/caregivers had to cater for their feeding and attendants if they had any, which caused some mothers to escape from the hospital against

medical advice. This affected care; some babies were returned with complications, and others died in the process.

*“...A mother can tell you; I don't have any assistance and have not eaten for such and such days, my attendants have all gone away, I have no money” (KI\_3JRRH).*

### **Inadequate space**

Most of the key informants (2/3) revealed that the preterm care unit not only accommodated preterm babies but, also other babies that needed special care though not preterm babies. It was also pointed out that the mothers to preterm babies did not have space to sleep yet their preterm babies were in the special care unit and that this made it difficult to take care of the babies, and some ended up running away which was unfavorable to the care for the babies.

*“... We lack accommodation for mothers and the babies are here. Once they are discharged from the other side they have nowhere to stay, some months we have many mothers with nowhere to stay, and they just take off because they just sleep here on the verandah, this way, they chase them, that way they are chased, so some just take off” (KI\_2JRRH).*

*“...My desire and dream is to have a room specifically for preterm babies, those that are ill, I put them aside, those on KMC I put in another area, separate from the full-term babies, and have accommodation for mothers” (KI\_1JRRH).*

### **Discussion**

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The unit cost of preterm care from the client perspective was US\$ 105.2. Feeding costs on admission formed the greatest proportion of inpatient costs at US\$ 3,983 (36.6%), opportunity costs were US\$ 1,871.24 (17.36%). On the other hand, the biggest proportions of the outpatient costs were drugs at US\$ 995.45 (9.14%) and transport at US\$ 511.62 (4.7%). This was validated with mothers during data collection and was high given the fact that most mothers in Uganda do not have consistent sources of income. It may suggest that bigger portions of costs are re-directed to clients where there is no insurance cover in order to meet all the inputs

required to take care of the preterm babies as corroborated by another study [25].

A related study that was done in Nigeria found out of pocket expenditure during hospitalization to range from US\$ 80 to US\$1,055 with a median of US\$ 247.3 [25]. As supported by qualitative findings, mothers /caregivers' difficulties in procurement of medicines, supplies, during stock-outs, and expenditure on food, caused erratic administration of drugs, long hospital stay, and at times self-discharge, consequently leading to a sequel of complications with eventual death of some infants.

The study found that costs increased with reduction in the weight of the babies for example babies that weighed under 1000g had a higher value for thermal care costs compared to categories above 1000g. This may be attributed to small babies' need for more attention and care. This finding is similar to studies in Mozambique and Germany where costs of care for low-birth-weight/preterm babies reduced with increasing weights of the babies [11,26].

The main cost drivers to clients in this study during admission were found to be opportunity costs at US\$ 1,871.24 and feeding costs at US\$ 3,983. These were noted to increase with longer hospital stay, thus resulting into financial constraints to the clients [20,25]. The increase in opportunity costs (productivity losses) is attributed to the fact that mothers/care givers forego other activities that would enable them generate income, in order to take care of the preterm babies in the hospital [20,27].

The main cost driver on follow-up visits was drugs with an estimated unit cost of US\$12.1. During follow up visits, drugs were procured by clients and there was relatively no contribution to drugs by the hospital.

The average cost of transport for the initial hospitalization was US\$ 4.14. Findings are similar to those of a study that estimated the unit cost of child referral to higher health facilities in Uganda as US\$ 4.89 [28]. The slightly elevated unit cost on transport at the initial admission is explained by the fact that some patients need urgent medical intervention when labour prematurely starts, and special means



of transport other than the usual public means that are used. Other studies found the care for preterm babies born outside the health facility to be characterized by difficulties with transport to the hospital for management, lack of money, rival errands, all of which impacted on the care for these babies [17].

The average cost of transport on follow-up visit was US\$ 6.24. This is because some mothers lived in the vicinity so they walked to the hospital, but even those who stayed away from the hospital used the most available cheap means of transport like “bodabodas” (motorcycles), bicycles and taxis which are relatively inexpensive [17,29] Transport costs were seen to vary by the number of follow up visits. However, depending on how well the baby was or financial constraints that surrounded mothers/caregivers, some follow up appointments were missed. This accounted for the small number of follow up visits and so small expenditure on follow up transport costs. The average number of follow up visits across different weight categories was two, as found by a study done in Mozambique [11].

Mothers whose babies were ill were excluded, as we needed to take baby weights and this would impact the findings. In addition, the mothers would not emotionally provide information that would inform the study which could have affected the findings. The exclusion criteria corroborates that of a study on parent distress reactions following a serious illness or injury in their child [30].

### **Influence of costs on preterm care**

Key informants from the provider perspective revealed that preterm care was majorly affected by stock outs on drugs and supplies. This is associated with underfunding, which leads to shortage in times of need and in a way these costs are channelled to patients in terms of out of pocket expenditure[20].

Self-discharge of the mothers was also reported as mainly emanating from feeding costs, small space to sleep and other social challenges the mothers/caregivers encountered during hospitalization of their preterm babies. These were found to have high influence on the care for preterm

babies and led to complications with eventual death of the preterm babies. Similar results were reported by other studies done in Malawi and Uganda [15,16]. Poor birth preparedness was reported to influence care for preterm babies as most mothers come unprepared for delivery, implying the majority had inadequate essential items to take care of the babies and themselves. This affected the care of the babies as found in a study done in Kenya and Tanzania [31]. Preterm care was also affected by power shortages, in absence of alternative reliable sources to keep machines running. This led to loss of lives of the babies.

One of the innovative ways that was mentioned as a means of keeping infants warm was the use of gloves with hot water that would be placed to the sides of the babies, however, this was rarely done in which case it didn't have significant cost implications. This can however have cost implications when done more often since it leads to more consumption of gloves and electricity.

### **Study limitations**

Costs data from the clients was mainly subjective. This could have over or under estimated the true value.

Sensitivity analysis was done using a rudimentary method. Conservative estimates were used for the upper and lower limits. Most of the time one parameter may not co-simultaneously increase or reduce with the same magnitude. However, this helped in knowing the importance of different cost inputs on the total cost (output), which is crucial for accurate estimation of the inputs.

### **Conclusion**

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The cost of care for preterm babies to clients was high. Feeding costs on admission and costs of drugs during follow up were key cost drivers. Interventions to improve preterm care should focus on funding feeding for mothers during admission and procurement of medications particularly during follow up so as to address the issue of drug shortages. More studies are recommended on long term

implications of drug costs on preterm care and the impact of feeding costs on preterm care.

### **What is known about this topic**

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- In Uganda, prematurity is the main cause of death among neonates, and 38% of the deaths are attributed to prematurity
- Preterm birth has vast physical, psychological, and economic costs to the health system and families
- Available literature shows that inadequate health funding is a significant obstacle in the care for preterm babies.

### **What this study adds**

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- The study will provide information on cost estimates of preterm care to families and the influence of financial costs on this care to families in Uganda. Cost estimates provide information that can guide development of new public health policies, establishing of budgetary priorities, and cost containment.

### **Competing interests**

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Authors declare no competing interests.

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### **Authors' contributions**

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ZB: Wrote the study protocol, supervised the data collection, conducted data analysis, wrote the initial draft of the manuscript, and reviewed the final

version of this manuscript. EKE: Reviewed the study protocol and all the drafts of the manuscript. AS: Participated in analysing the data. ANK: Supported review of the drafts of the manuscript. FS: Reviewed the study protocol and all the drafts of the manuscript.

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### **Tables and figures**

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**Table1:** Background variables for the mothers/caregivers and babies that were seen during the survey

**Table2:** Total/average costs on inputs of preterm care to clients during the survey

**Table3:** Distribution of the total/average costs of preterm care to mothers/caregivers by categories of preterm weights for the sample of 100

**Table4:** Total/unit cost of preterm care to mothers/caregivers by categories of weight and length of stay

**Table5:** Sensitivity analysis of some variables and the impact on the total cost

**Figure 1:** Box plot on influence of costs on care for preterm babies (client perspective)

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**Table 1:** Background variables for the mothers/caregivers and babies that were seen during the survey

Variables	Frequency (N)	Percentage (%)
<b>Socio-demographic characteristics for the mother</b>		
<b>Religion of mother</b>		
Catholic	14	14.0
Protestant	42	42.0
Pentecostal	12	12.0
Muslim	32	32.0
<b>Highest level of education attained by mother</b>		
None	1	1.0
Primary	37	37.0
Ordinary level	39	39.0
Advanced level	3	3.0
Tertiary level	20	20.0
<b>Marital status of the mother</b>		
Single	15	15.0
Married	83	83.0
Divorced	2	2.0
<b>Occupation of the mother</b>		
None	16	16.0
Full time housewife	14	14.0
Agriculture	22	22.0
Civil servant	10	10.0
Business	26	26.0
Private sector employee	12	12.0
<b>Socio-demographics for the child</b>		
Number of babies admitted	100	
Number of babies followed up	82	
Male	52	52.0
Female	48	48.0
<b>Condition on admission</b>		
Respiratory distress	19	42.2
Asphyxia	14	31.1
Jaundice	7	15.6
Septicaemia	3	6.7
Others	2	4.4
	Mean	SD
Age at birth in weeks	29	2.44
Birth weight (grams)	1.631	0.391
Average length of stay (days)	9.385	6.527
Number of follow up visits	2.27	1.26

**Table 2:** Total/average costs on inputs of preterm care to clients during the survey

<b>Costs</b>	<b>Total cost (US\$) n=100</b>	<b>Average (US\$)</b>
<b>Inpatient associated costs</b>		
Thermal care	530.06	5.30
Medication	521.67	5.22
Supplies	800.95	8.01
Nutrition-baby	0	0.00
Diagnostic tests during admission	33.41	0.33
Feeding costs to the mother	3983	39.83
Basic care needs to mother on admission	464.34	4.64
Opportunity costs on admission	1,574.2	15.74
Transport costs on admission	413.89	4.14
<b>Subtotal</b>	<b>8,321.52</b>	<b>83.21</b>
<b>Outpatient associated costs</b>		
Supplies on follow up	82.8	0.83
Drugs on follow up	995.45	12.1
Opportunity costs on follow up (n=82)	297.04	3.62
Nutrition for baby on follow up	12.98	0.16
Feeding costs to the mother on follow up	148.92	1.82
Transport cost on follow up	511.62	6.24
<b>Outpatient diagnostic costs</b>		
CBC	95.92	4.36
Bilirubin (Total and Direct)	51.04	2.32
Blood slide for malaria	3.08	0.14
<b>Subtotal (US\$)</b>	<b>2,198.85</b>	<b>31.59</b>
<b>Total cost of preterm care (US\$)</b>	<b>10,520.37**</b>	

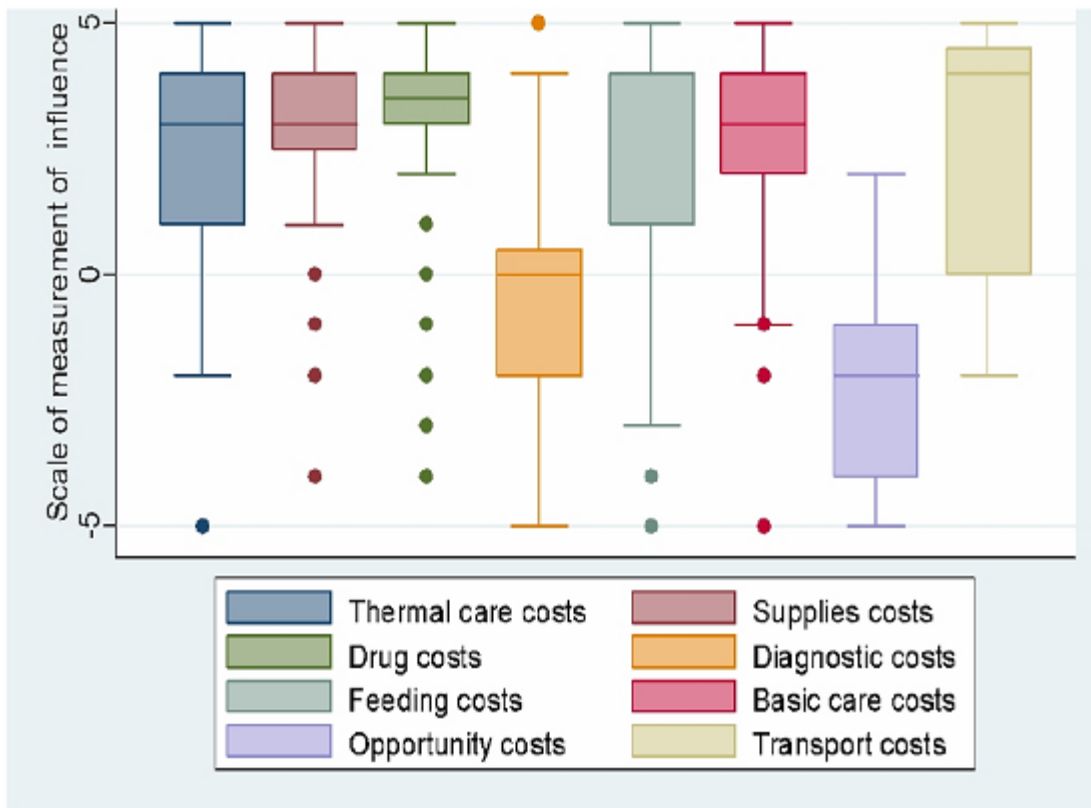
\*\* Total cost of preterm care during the survey

<b>Table 3:</b> Distribution of the total/average costs of preterm care to mothers/caregivers by categories of preterm weights for the sample of 100					
<b>Weight/Frequency/Costs</b>	<b>&lt;1000G</b>	<b>1000G-1499G</b>	<b>1500G-1999G</b>	<b>2000G-2499G</b>	<b>Total costs</b>
Number of babies	5	31	42	22	100
Thermal care	33.1	166.16	223.44	107.36	530.06
Medication	9.75	182.9	228.48	100.54	521.67
Supplies on admission	81.9	282.41	329.28	107.36	800.95
Nutrition for baby	0	0	0	0	0
Diagnostics	14.5	18.91	0	0	33.41
Basic needs to mother on admission	87.15	127.41	206.22	43.56	464.34
Transport on admission	27.59	118.79	181.24	46.26	413.88
<b>Sub total</b>	<b>253.99</b>	<b>896.58</b>	<b>1168.66</b>	<b>405.08</b>	<b>2764.31</b>
<b>Outpatient associated costs</b>					
Supplies on follow up	3.8	30.38	23.1	25.52	82.8
Drugs on follow up	118.65	319.3	433.86	123.64	995.45
Nutrition-baby on follow up	0	0	0	12.98	12.98
Transport on follow up	87.13	159.31	175.72	89.46	511.62
<b>Outpatient diagnostic costs</b>					
CBC		11.62	5.81	78.49	95.92
Bilirubin (Total and Direct)			17.43	33.61	51.04
Blood slide for malaria				3.08	3.08
Subtotal	209.58	520.61	655.92	366.78	1752.89
<b>Total Cost of care (US\$)</b>	<b>463.57</b>	<b>1417.19</b>	<b>1824.58</b>	<b>771.86</b>	<b>4517.2</b>
<b>Unit cost of care (US\$)</b>	<b>92.71</b>	<b>45.72</b>	<b>43.44</b>	<b>35.08</b>	<b>45.17</b>



<b>Table 4:</b> Total/unit cost of preterm care to mothers/caregivers by categories of weight and length of stay					
Length of stay (Days)	1 -10	11-20	21-30	31+	
Frequency (100)	70	23	5	2	100
Feeding costs (Total)	1,890	1,127	510	456	3,983
Feeding costs (unit costs)	27	49	102	228	39.83
Opportunity costs Total (100)	1,625.95	149.73	24.11	71.45	1,871.24
Unit opportunity cost (100)	28.43	6.51	4.822	35.73	22.37
Feeding costs to the mother on follow up Total (82)					148.92
Unit feeding costs on Follow up mothers (82)					1.82
Total cost by Length of stay (US\$)					5,854.24
Total cost by weights of babies (US\$)					4,517.2
Total cost by weights and length of stay (US\$)					10,520.36
Unit cost for clients (US\$)					105.2

<b>Table 5: Sensitivity analysis of some variables and the impact on the total cost</b>					
<b>Element</b>	<b>Factor</b>	<b>Amount</b>	<b>Change in total</b>	<b>% Change</b>	<b>Comments</b>
Feeding costs	×2	3,983	14,994.23	32%	More sensitive
	÷2		9,019.73	-21%	
Opportunity costs	×2	1,871.24	12,882.47	14%	More sensitive
	÷2		10,075.61	-11%	
Supplies (Admission)	×2	800.95	11,812.18	4%	Sensitive
	÷2		10,610.76	-7%	
Drugs (Follow up)	×2	995.45	12,006.68	6%	Sensitive
	÷2		10,513.51	-7%	
Transport (Follow up)	×2	511.62	11,522.85	2%	Less sensitive
	÷2		10,755.42	-5%	



**Figure 1:** Box plot on influence of costs on care for preterm babies (client perspective)