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Ability to pay for maternal health services: what will it take to meet who standards?

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Abstract

High maternal morbidity and mortality in many developing countries are highly associated with poor access to and quality of health care. Here we review the economic feasibility of the WHO's mother–baby package as a means of reducing maternal and neonatal mortality and morbidity in Tanzania. This paper examines the costs of maternal health care in Tanzania, and how much can we expect households to contribute to these expenses, if the MBP were implemented. Using data from the Tanzanian 1993 Living Standard Measurement Survey (LSMS), we analyze responses from 757 women of reproductive age who have had a birth in the 12 months preceding the survey. We estimate current spending on maternal health care by different socio-economic groups and its share in relation to total household expenditures. Using logistic regression analyses, we examine the effect of the prices paid for maternal health care on the likelihood of using antenatal and safe delivery services, controlling for relevant socio-economic and demographic factors. Results show that if the MBP recovered 100% of its costs, most of the households would have to allocate more than half of their annual consumption on maternal health care. Poor socio-economic groups would experience the greatest increase in service utilization if MBP care were subsidized. In the face of scarce resources, subsidies should be targeted according to socio-economic group, in order to attain equitable and sustainable maternal health services.

Keywords: Maternal health services; Morbidity; Mortality

1. Introduction

The purpose of this study is to predict *safe motherhood* service utilization in a low-income country, if the WHO recommended standard level of care is provided. Tanzania is used as an example of a low-income country. Its per capita GDP was US$ 360 in 1996 [11], dropped to US$ 220 in 1998 [12], and in 2002 was estimated to be US$ 280 [13]. The maternal mortality ratio in Tanzania is estimated to be 530 per 100,000 live births, and total expenditures on health represent 1.3% of the GDP [11].

Given this level of maternal mortality and expenditures on health, we first assess current utilization of antenatal care, delivery in a health facility, and household spending on maternal health services by different socio-economic and demographic groups. Second, we analyze how changes in prices of maternal health services, drugs supplies, and transportation to a health facility affect maternal health service utilization. We

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explore the demand and willingness to pay for WHO standard level of care, described in the mother–baby package (MBP)[1] [2]. Supposing that the MBP is implemented nationwide at the costs estimated by the WHO, how much are households willing to pay? We address these important issues by modeling the effect of different user-fees on maternal health care utilization among different socio-economic groups. For the purpose of this study *safe motherhood* consists of a minimum of four antenatal visits and normal delivery care using the WHO standard level of care. Here we look at the importance and priority given to safe motherhood at the household level, reflected by willingness to pay for maternal health. We estimate the effect of price changes on utilization of maternal health services using a Tanzanian household survey.

2. Background

Complications of pregnancy and childbirth are major causes of death and disability among women of reproductive age in developing countries [1,2]. It is estimated that 18% of the total burden of disease for women of childbearing age in low-income countries resulted from these problems [1]. An estimated 40% of pregnant women in developing countries develop complications that require the assistance of a trained provider, and 15% require medical care to avoid death or disability [3]. Thus, maternal morbidity and mortality are highly associated with access and quality of obstetric care [4–6]. The consequences of inadequate maternal health care are maternal death or disability and/or infant death or disability. One study estimated that for every woman who dies following a pregnancy-related complication, at least 30 suffer disabilities with different degrees of severity [7]. Pregnancy-related complications can cause infant death and disability, implying an intergenerational effect of maternal morbidity and mortality. Abouzahr estimates that two-thirds of the total annual infant deaths worldwide occur during the neonatal period. Most of these deaths are due largely to inadequate care during pregnancy, delivery, or the first critical hours after delivery [7].

In the event of complications, three factors can determine the maternal outcome: (i) delay in deciding to seek help; (ii) delay in reaching a treatment facility; and (iii) delay in receiving adequate treatment at the facility. Shortening any or all of these delays can make the difference between life and death. High prices and low household resources can negatively affect all three factors [8,9].

To improve the quality of maternal health care received at the health facility (factor (iii)) without large price increases, the WHO devised the mother–baby package (MBP), a basic package of interventions considered to be essential for maternal and neonatal health [2]. The package describes simple, effective interventions needed before and during pregnancy, during delivery, and after delivery for the mother and the newborn. It outlines what can be done to prevent and manage the major obstetric complications, at the health post, health center, and hospital. It describes the most efficient use of available resources for these interventions.

Studies indicate that the safe motherhood interventions that meet the WHO's standard quality of care outlined in the MBP are cost-effective. Puerperal sepsis, hypertensive disorders of pregnancy, hemorrhage, and obstructed labor, for which prevention and treatment are cost-effective, account for almost 60% of total maternal deaths [2]. Of the six most cost-effective clinical services[2] identified by the World Bank (1993), two—family planning and antenatal/safe delivery care—fall under the group of safe motherhood interventions. Each of these interventions cost less than US$ 100 per disability adjusted life years (DALY) averted, with antenatal/safe delivery averaging US$ 50 per DALY in a typical low-income country [1].

[1] Antenatal care according to standard WHO's mother–baby package consists of: at least four visits of at least 20 min each starting before the last trimester of pregnancy. Diagnostic tests include: hemoglobin, blood group, urine analysis and RPR syphilis test. Treatment entails: iron and folate supplements (60 mg three times a day for 90 days; two tetanus vaccinations; treatment of malaria and hookworm. Antenatal cost in a health center = US$ 6.70. Normal delivery under the standard practice includes: hemoglobin, blood group and urine test before delivery; active management of third stage of labor (ergometrine); tetracycline eye ointment for the newborn; iron supplements 3×/day for 14 days after delivery; a routine postpartum check-up; cost in a health center = US$ 12.70.

[2] The six services are: short course therapy for tuberculosis, management of sick child, treatment of STDs, limited care, family planning, and antenatal/safe delivery.

Table 1
Selected safe motherhood interventions and costs

Intervention	Average cost (US$) [14]	Total cost of MBP (%) [10]		Reduction in maternal mortality (%) [10]
Antenatal care	6.7–7.34	27.80	30	26
Severe anemia	1.02–4.11	0.50		
Syphilis	4.02	0.80		
Gonorrhea and other STDs	2.60	0.70		
Clean and safe delivery	12.74–13.49	19.6		48
Essential obstetric care				
Abortion complications	9.78–34.51	3.60	24	
Eclampsia	40.37–112.06	1.00		
Hemorrhage	14.7–56.12	8.70		
Sepsis	8.72–27.89	5.80		
Caesarian section	51.14	5.00		
Neonatal complications	4.07–44.73	13.1		
Postpartum family planning	4.65–5.78	13.3		

Average cost per case according to WHOMBP standards.

Table 1 illustrates that antenatal care could prevent 26% of maternal deaths, costing around 30% of the mother–baby package. The provision of essential obstetric care would consume 24% of the mother–baby package, further reducing maternal deaths by 48%.

In summary there is a consensus that, from the perspective of the provider, antenatal and obstetric care are cost-effective interventions and should be prioritized [1,10]. However safe motherhood competes with other priorities for resources at the governmental, societal, and household level.

3. Data sources and methodology

Data on maternal health service utilization and expenditures are from the Tanzanian 1993 Living Standard Measurement Survey (LSMS). The survey sampled approximately 5000 women of reproductive age, of whom 757 have had their last birth 12 months prior to the survey. In addition to household's characteristics and expenditures, women were asked whether or not they sought antenatal care and/or delivery services, type of provider, type of facility, distance to the facility, and prices paid. All payments for these services were declared, including those made in kind. For each of the services (antenatal and delivery), prices are subdivided into three components: price paid for the visit,[3] price of the supplies, and price paid with transportation to and from the facility used. The survey also included questions regarding sources of funds used to pay for antenatal and delivery care, whether they had insurance coverage, and if outside household help was needed. All of the collected information on prices paid for maternal health services refer to the last birth, and our analysis comprises only these women and their respective households.

The standard costs of providing maternal health care services used in this paper are those calculated using the mother–baby package standard costing model in the Ugandan safe motherhood costing study by the WHO [14,15]. These costs estimates are considered to be the lower bound of the cost of implementing the standard level of care in low-income countries.

3.1. Measurement and selection of the variables

The combination of two variables, utilization of antenatal care and normal delivery in a health facility were selected as our outcome variable (*safe motherhood)* to predict service utilization. The outcome vari-

[3] For antenatal care the price is for the total number of visits.

able was coded as binary, and is characterized as detailed below.

3.2. Outcome variable

3.2.1. Antenatal care and delivery

All women who reported having received antenatal care services during their last pregnancy, whether from a doctor, nurse, midwife, or other trained health professional were categorized as users of antenatal services. Similarly, all women who gave birth in a health facility attended by a trained person were categorized as users of delivery services. For the outcome variable for the logistic regression analyses, users of safe motherhood, we categorized those who received both antenatal and delivery users as safe motherhood service users. All others were coded as non-users of safe motherhood services.

In the study sample, the use of antenatal care is almost universal. Approximately 95% of all women were antenatal care users, with small differences between quintiles of total household expenditures. However, only 56% of the women delivered in a health facility. The percentage of deliveries in a health facility appears to increase with household wealth. When we compare the percentage of those using delivery services between the first and the last household expenditures quintiles, we see that the 30% of women from the lowest income group used the services versus 69% in the upper quintile group. Safe motherhood users (antenatal plus delivery) follow the same pattern, with even lower levels for all household expenditure brackets. Whereas over half of the women in the higher-income groups (quintiles 3–5) had antenatal and delivery care in a health facility, only 27% of the poorest group did.

3.3. Prices paid for antenatal care and delivery

The percentage of women who paid for antenatal care services is relatively low across all expenditure groups. In contrast, delivery was paid for by a much higher percentage of all women. While poor women pay for antenatal and delivery services, fewer pay for those services than do women from higher-income households (Table 2). Of those who paid, the average price for antenatal care was around 1900 Tanzanian Shillings (TZS), and 2500 TZS for the normal delivery.[4] Women from low-income households paid less, on average, for maternal health care than women from higher-income households. However, it must be noted that women from low-income households spent a greater proportion of their total household expenditures than women from high-income households did.

3.4. Socio-demographic characteristics

Apart from access and budgetary constraints, utilization of antenatal and delivery services can also be affected by socio-demographic factors. Table 3 presents selected socio-demographic variables by antenatal and delivery utilization status.

In the sample, women who used safe motherhood services were slightly younger than their counterparts. They completed on average two more years of education, had relatively fewer children, and had experienced fewer child deaths than the women who did not use antenatal and delivery services. With respect to geographical access to health facilities where services were sought, women who were users lived on average closer to the antenatal care facility, but much further away from the delivery facility. It is important to note that the distances to the facilities pertain to those actually used by the women, and not necessarily the ones closest to the households. Women who are more at risk or who desire better quality of care will be referred to a health facility that far from their home.

3.5. Method of analysis

Logistic regression analysis was used to estimate the effects of household wealth and antenatal and delivery care expenditures on maternal health service utilization. We compare three different measures of expenditures: (1) total annual household expenditures; (2) maternal health standard expenditures as a proportion of total household expenditures; and (3) the ceiling measured as the household budget remaining if the household were to pay the full price of antenatal and delivery care provided according to the WHO's MBP. We applied a log transformation to the three household wealth variables.

[4] Cesarean section accounted for 6.6% of all deliveries. These women had on average 12.9 days of hospitalization time and paid around 4575 TZS.

Table 2
Summary statistics of maternal health utilization and price variables[a], by quintiles of household expenditures. Tanzania, 1993 LSMS

Variables	Total	Quintiles of total household expenditure				
		Low 1	2	3	4	High 5
Antenatal care						
Percent who received ANC	94.86	88.91	93.55	96.49	98.37	97.84
Percent who paid for ANC	23.04	16.74	22.69	19.94	21.89	34.23
ANC average price paid (TZS)	1924.90	523.75	723.51	1347.43	1019.29	4441.60
Percent paid for each component:						
Percent paid for visit	29.66	48.10	36.59	24.35	21.90	23.53
Percent paid for supplies	26.53	20.37	30.79	34.34	30.85	18.96
Percent paid for transportation	43.81	31.54	32.62	41.31	47.25	57.51
Normal delivery						
Percent deliveries in a health facility	56.08	30.79	56.51	61.02	65.96	69.02
Percent who paid for delivery	40.28	22.52	47.13	40.13	40.14	52.61
Delivery average price paid (TZS)	2516.79	583.57	1281.96	2544.73	1968.02	5129.33
Percent paid for each component						
Percent paid for visit	30.57	32.26	25.42	48.15	28.69	20.52
Percent paid for supplies	22.86	36.53	31.11	11.68	23.12	16.44
Percent paid for transportation	46.57	27.20	43.47	40.17	48.19	63.03
How were MH exp. paid						
Available cash	71.86	52.00	81.55	73.05	68.78	82.28
Sold livestock/poultry	5.57	4.54	5.56	8.82	6.26	3.43
Sold other assets	22.57	43.46	12.88	18.13	24.96	14.28
Percent women (ANC + safe delivery)	52.44	27.27	52.9	56.69	61.67	66.55
MH as a percent of total HH expenditures (current expenditures with MH)	4.06	5.32	4.64	5.95	2.25	2.73

[a] Prices are of those who paid, in Tanzanian Shillings (TZS).

We performed six logistic regression analyses on the use of antenatal and delivery care. The first three models build on each other, entering household wealth measured as the log of ceiling in model 1, log ceiling and four measures of maternal health expenditures in model 2, and log ceiling, maternal health expenditures, and seven socio-demographic factors in model 3. The final three models include all four measures of maternal health expenditures, four socio-demographic variables (excluding number of children dead, number of infants dead, and distance to delivery facility, which were not significant), and only a different measure of household wealth in each of the three models. The predictive power of each of the three models was equivalent. We chose to use the log ceiling alone (model 1) because it represents relative expenditures.

Using a logistic regression model, we then calculate the observed predicted probability of utilizing maternal health services if service prices (set according to the total MBP program costs estimated by WHO) were subsidized by 25, 50, 75, or 90% (see Appendix A). These regressions form the basis for the predictive probability estimation presented in Figs. 1–3.

Table 3
Mean values of selected socio-demographic variables according to antenatal and delivery service utilization

Variables	Antenatal and safe delivery	
	With ($N = 480$)	Without ($N = 277$)
Distance to ANC facility (km)	7.12 (40.27)	10.32 (35.23)
Age	26.53 (6.51)	27.04 (6.39)
Education (years)	6.49 (3.08)	4.87 (3.71)
Parity	3.49 (2.36)	4.29 (2.65)
Number of children dead	0.39 (0.83)	0.69 (1.09)
Number of infants dead	0.22 (0.54)	0.32 (0.71)
Distance to delivery facility (km)	17.67 (70.33)	6.29 (19.25)

Standard deviation in parentheses.

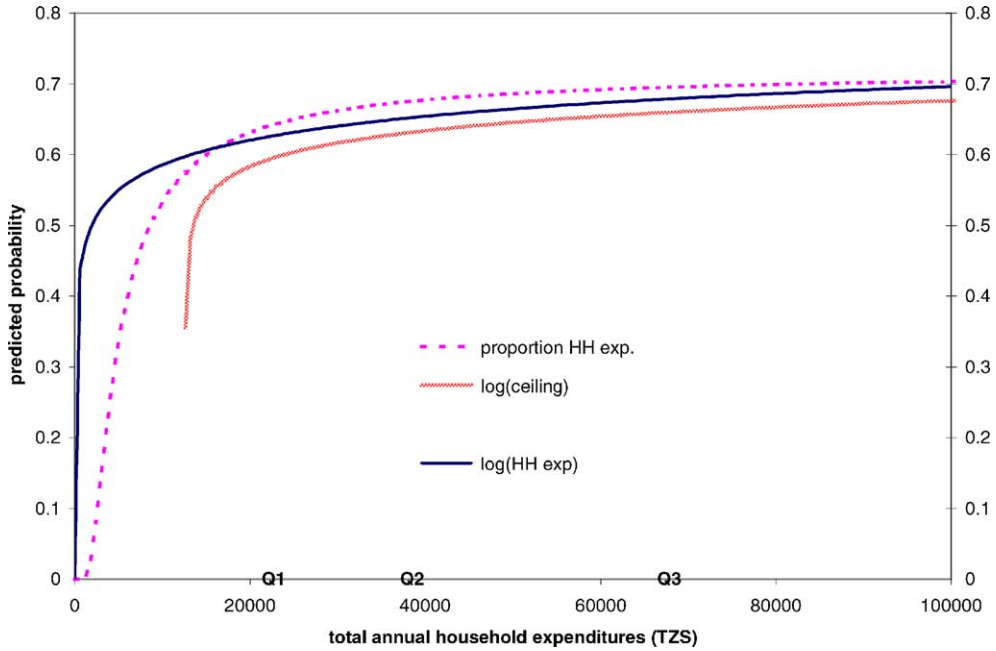

Fig. 1. Predicted probability of safe motherhood service utilization in Tanzania.

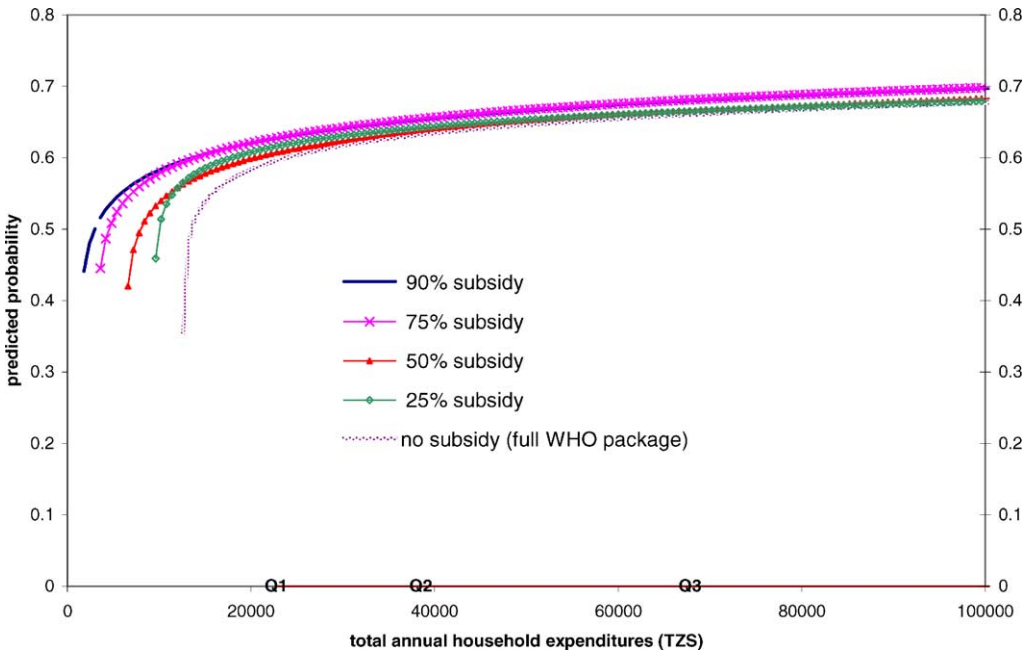

Fig. 2. Predicted probability of safe motherhood service utilization in Tanzania, under simulated subsidies.

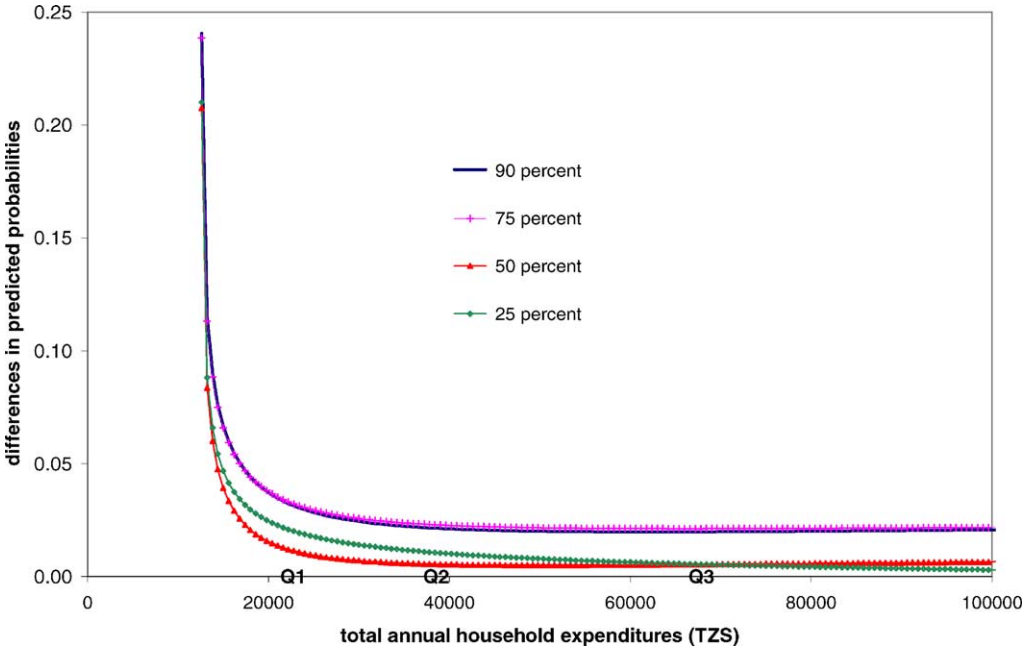

Fig. 3. Differences in predicted probabilities, between full-priced and subsidized.

4. Results

Table 4 shows the logistic regression coefficients for all of the models. Model 1 shows that the ceiling is positively and significantly associated with safe motherhood. When the four categories of expenditures with maternal health care are included (model 2), although with a smaller coefficient, the ceiling maintains its sign and significance. The price paid for the antenatal care visits and supplies, and antenatal transportation seem to have no effect on use of safe motherhood services. In contrast, the price paid for the delivery visit and supplies, and delivery transportation seem significantly correlated with utilization of services. Model 3 includes all the variables from the three groups, and only the number of children who died seems to be significantly related to safe motherhood service use.

For models 4–6 we used a log likelihood ratio test to maximize explanatory power. All three models are very similar in direction, significance, and even in the size of the coefficients. The use of safe motherhood services is directly associated with household wealth measured as the ceiling and total household expenditures, prices paid for a normal delivery and supplies, prices paid for transportation to and from the delivery facility, and women's education. We found that distance to the antenatal care facility and number of children were negatively related to use of safe motherhood services. The results are consistent with the findings from the bivariate analyses (Table 3). Model 6 illustrates the expected negative relationship between household wealth, measured as percent of household expenditures spent on safe motherhood services, and use of safe motherhood services. An increase in the cost of maternal health care as a proportion of total household expenditures decreases the likelihood of using safe motherhood services.

Fig. 1 shows the predicted probabilities of the use of safe motherhood services in Tanzania, estimated for each of the three final models, and plotted against the three indicators of household wealth. For each of the three wealth indicators, the predicted probability of safe motherhood increases from 40 to 60% as total household expenditures increases to 20,000 TZS a year. The predicted probability continues to increase as expenditures rise, but levels off at between 65 and 70% (depending on the wealth coefficients used) for households spending over 50,000 TZS a year the probability of safe motherhood seems to level between 70 and 75% (depending on the wealth coefficients used).

Table 4
Logistic regression coefficients of safe motherhood, assuming WHO's MBP as standard level of care

Variables	Mean values	Logistic regression models			Final models		
		1	2	3	4	5	6
Household wealth							
log ceiling (TZS)	10.48 (1.38)	0.3365*** (0.0597)	0.2177** (0.0645)	−0.0163 (0.1411)	0.1625** (0.6927)	–	–
log expenditures (TZS)	10.86 (1.02)	–	–	–	–	0.2102** (0.0943)	–
MHst. as percent HH expenditures	38.6 (38.8)	–	–	–	–	–	−0.6474** (0.2708)
Maternal health expenditures							
ANC cost (visit + supplies)	292.88 (2309.25)	–	0.00003 (0.0001)	0.00005 (0.0001)	8.14E−06 (0.0001)	−2.26E−06 (0.0001)	3.70E−06 (0.0001)
ANC cost (transportation)	150.54 (887.42)	–	−0.0004 (0.0002)	−0.0007 (0.0006)	−0.0004 (0.0003)	−0.0004 (0.0003)	−0.0004 (0.0003)
DEL cost (visit + supplies)	385.31 (1685.19)	–	0.0007*** (0.0002)	0.00008 (0.0002)	0.0006*** (0.0002)	0.0007*** (0.0002)	0.0007*** (0.0002)
DEL cost (transportation)	628.51 (2678.81)	–	0.0019*** (0.0003)	0.0005 (0.0003)	0.0020*** (0.0004)	0.0021*** (0.0004)	0.0022*** (0.0004)
Socio-demographic							
Distance to ANC facility	8.55 (38.09)	–	–	0.0251 (0.0314)	−0.0072** (0.0032)	−0.0082** (0.0032)	−0.0083** (0.0032)
Age	(38.09) (6.50)	–	–	−0.0190 (0.0416)	0.3467 (0.0250)	0.0385 (0.0242)	0.0396 (0.0243)
Education	5.72 (3.5)	–	–	0.1048 (0.0573)	0.1022*** (0.0312)	0.0926*** (0.0301)	0.0925** (0.0300)
Parity	3.9 (2.5)	–	–	0.0572 (0.1253)	−0.1830*** (0.0657)	−0.1758*** (0.0642)	−0.1748*** (0.6420)
Number of children dead	0.5 (0.97)	–	–	−0.5146** (0.2086)	–	–	–
Number of infants dead	0.3 (0.63)	–	–	−0.0764 (0.3134)	–	–	–
Distance to delivery facility	16.52 (67.05)	–	–	0.0023 (0.0057)	–	–	–
Constant		−3.6954*** (0.6303)	−2.5408*** (0.6753)	2.2023 (1.6538)	−2.7093*** (0.8169)	−3.3879** (1.0567)	−0.9034* (0.5446)
−2L		969.64	791.2	231.62	699.62	732.12	731.14
LR chi-square		41.29	175.7	25.94	198.27	202.3	203.28
N		728	705	441	654	679	679

Standard errors are in parentheses. Total number of cases differ by model due to missing values in certain variables. Definitions of models: model 1 regresses only household wealth. Model 2 regresses household wealth and expenditures on maternal health services. Model 3 regresses household wealth, expenditures on maternal health services, and socio-demographic variables. Model 4 uses the log ceiling wealth variable and retains only those other variables that have explanatory power. This version of the model was used to calculate the predicted probabilities shown in Figs. 2–4. Model 5 uses the log expenditures wealth variable and retains only those other variables that have explanatory power. Model 6 uses maternal health as a percentage of total household expenditures as a measure of wealth, and retains only those other variables that have explanatory power.

* $P < 0.1$.

** $P < 0.05$.

*** $P < 0.001$.

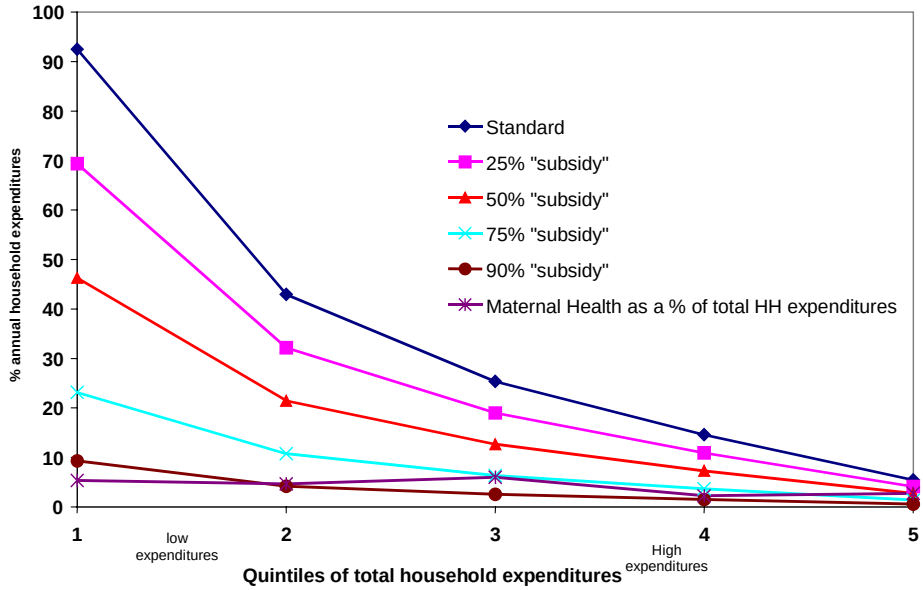

Fig. 4. Maternal health as a percentage of total household expenditures, under simulated level of care and subsidies.

Fig. 2 represents the predicted probabilities of safe motherhood service utilization, observed when maternal health care is subsidized by 25, 50, 75 or 90%. Predicted probabilities were calculated using the logarithmic transformed model with ceiling as a measure of wealth. For the very poor (<20,000 TZS), any subsidy level tends to increase the predicted probability of safe motherhood. For those households with expenditures over 100,000 TZS, an increase in the predicted probability can be observed only with 50% subsidy or more. Interestingly, a 90% subsidy level would have the same impact on service utilization as 75% subsidy. To better illustrate the changes in predicted probabilities with subsidy levels, we plotted the differences between the observed probabilities and the subsidies (Fig. 3).

From Fig. 3 we observe that, regardless of the subsidy level, very poor households could benefit from an increase in the probability of safe motherhood ranging from 5 to over 20% points. In contrast, for households with expenditures exceeding 25,000 TZS or more a year, the differences between the full-priced predicted probability and the subsidy levels are negligible (2.5% or less). From these results our first impression is to conclude that, with the exception of the very poor households, we can raise prices without having to worry about the impact on safe motherhood service utilization. However, we are also concerned about the household wealth status. In low-income countries, implementation of user-fees in maternal health care as part of cost-recovery strategies should also account for the potentially permanent impact on household assets. Fig. 4 shows current expenditures with maternal health care as a proportion of total household expenditures by quintiles. It also shows the impact on households of adopting a standard level of care (raising price/quality) with different levels of subsidy.

Households are currently spending between 3 and 5% of their total expenditures on maternal health care. The poor are spending a larger proportion of their household income on maternal health care than the rich. Results show that in order to pay for WHO's standard level of care at the full price the poorest households would spend more than 90% of their total income. Without subsidies, most of the households would have to allocate more than half of their annual consumption to maternal health care. Even a 75% subsidy would take away more than 20% of total annual assets of the very poor. In contrast, a 75% subsidy level total is equivalent to or lower than current expenditures on maternal health services for quintiles 3–5. Increasing the subsidy from 75 to 90% generates very little

improvement in access to services. However, the impact of the lower subsidy on overall household wealth is not insignificant. As Table 2 shows, almost 50% of women from the poorest households surveyed had to sell livestock, poultry and other assets in order to pay for maternal health care services.

5. Conclusions and policy implications

Although this study uses survey data from 1993, the log ceiling model of household wealth is based on relative expenditures, which do not change significantly over time. It is important to note that there has been a decrease in maternal health service delivery during the last decade, with fewer deliveries taking place in health facilities in 1999 than in 1992 (DHS 1992; DHS 1999).

From the Tanzanian results we conclude that if the WHO's MBP were implemented it could not feasibly recover 100% of its costs. In order to have an impact on maternal mortality it would have to subsidize services to achieve affordable prices. Indiscriminate universal subsidies for maternal health care may not have the desired impact on safe motherhood service utilization. The level of subsidy for maternal health services should be determined based on the increase in use of safe motherhood services that it produces, While any subsidy level above 25% would increase maternal health service utilization, especially for those households in the first quintile of total annual expenditures, policy-makers should take into consideration the differential impact on household wealth of different levels of subsidy that generate similar increases in service utilization. It is also clear from the results that the level of subsidy should be tailored by socio-economic status. For the Tanzanian case, the 75 and 90% subsidies produce the same improvement in access for the first quintile (Fig. 3), but the latter has a protective effect on overall household wealth that the former fails to achieve (Fig. 4). Targeting subsidies should always be an option for policy makers, which can also opens the possibility for cross-subsidies. Implementing means testing in order to effectively target subsidies can be quite difficult. Based the results of our analysis of data for Tanzania, we conclude that a 90% subsidy is the best choice if it is possible to successfully target the first household wealth quintile. If accurate targeting is not possible, however, the 75% subsidy level is the more appropriate policy option.

Existing literature provides ample rational for governments to subsidize maternal health services. Jowett and Peabody argue that governments should intervene to correct market failures in the health sector when a public good, merit good, or good/service producing externalities is at stake or when there is a need to improve universal access and equity [10,16]. The results of this study indicate that poverty and lack of education cause women to underutilize maternal health services. If all women were to receive antenatal and safe delivery care, the maternal and infant deaths averted would save the costs associated with poor maternal health outcomes, such as costs to health services, costs to families for health services, productivity losses of the mother and other family members, morbidity and mortality of other family members as a result of a mother's death, and immediate and future costs of disability. We argue that investments should be made in maternal health services to improve access for the poor, benefit individuals, families, and future generations, and, given the cost-effectiveness of maternal health interventions, greatly impact the health and productivity of the society at large.

It remains unclear what percentage of income households can reasonably spend on maternal health care and thus how much governments should subsidize maternal health services. Prior studies have shown that in order to achieve a satisfactory condom prevalence in either a family planning or HIV/AIDS prevention program, the price of a year supply of condoms should be set below 1% of the correspondent per capita GDP [17]. Unfortunately, similar guidelines for maternal health care have not been established. To conform to the standards set forth in the mother–baby package, the WHO recommends that countries should be spending approximately US$ 1.40 per capita on maternal health care [14]. Currently, Tanzania spends on all general health care the equivalent of US$ 2.86 per person per year. To comply with WHO MBP standards, half of this amount would have to be spent on maternal health care. Tanzania is just one of many developing countries which will require outside assistance, to meet the challenge of implementing national safe motherhood intervention programs.

The 1994 International Conference on Population and Development (ICPD) in Cairo set targets for the

flow of aid to developing countries for family planning and reproductive health. Yet the UNFPA's (2000) statement that "funding levels are still only roughly 36% of the US$ 5.7 billion target agreed upon in Cairo as the international community's share in financing the programme of action," indicates that the targets are still far from being met. According to most recent estimates for sub-Saharan Africa, the original Cairo targets contained considerable under-estimations in the non-family planning arena like safe motherhood [18]. This implies that the targets—already not being met—under-represent the needs for maternal health spending.

Universal standard maternal health care services should be a goal for all the countries. In general, cost-recovery strategies should be encouraged. When possible, they should also be maximized, taking in to account the client's ability to pay for maternal health services and thereby anticipating the potential impact on household assets. To minimize the effects of the lack of resources flowing into safe motherhood interventions, policy makers should employ alternative strategies so that equitable and sustainable maternal health services are attainable. Financing mechanisms that involve targeting subsidies and cross-subsidies in maternal health care should always be encouraged. Table 1 shows the expected reduction in maternal mortality associated with selected safe motherhood interventions. This information can serve as a guide for policy makers in choosing to subsidize those interventions that generate high returns in terms of decreases in maternal mortality. The log ceiling regression model described in this paper is a useful analytical tool for determining the most appropriate level of subsidy for maternal health services to improve utilization of safe motherhood services by the poorest quintiles in low-resource settings.

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Appendix A

Logistic regression coefficients of safe motherhood, under simulated levels of subsidy.

Variables	Logistic regression models			
	25% subsidy	50% subsidy	75% subsidy	90% subsidy
Household wealth				
log ceiling (T2S)	0.1455** (0.0696)	0.1908** (0.0799)	0.1974** (0.0864)	0.20567** (0.0914)
MH expenditures				
ANC cost (visit + supplies)	4.70E−07 (0.0001)	−1.95E−06 (0.0001)	−2.23E−06 (0.0001)	−2.25E−06 (0.0001)
ANC cost (transportation)	−0.0004 (0.0003)	−0.0004 (0.0003)	−0.0004 (0.0003)	−0.0004 (0.0003)
DEL cost (visit + supplies)	0.0007*** (0.0002)	0.0007*** (0.0002)	0.0007*** (0.0002)	0.0007*** (0.0002)
DEL cost (transportation)	0.0002*** (0.0004)	0.0021*** (0.0004)	0.0022*** (0.0004)	0.0022*** (0.0004)
Socio-demographic				
Distance to ANC facility	−0.0076** (0.0032)	−0.0078** (0.0032)	−0.0082** (0.0032)	−0.0082** (0.0032)
Age	0.0392 (0.0244)	0.0396 (0.0244)	0.0386 (0.0243)	0.0385 (0.0243)
Education	0.0949*** (0.0302)	0.0949*** (0.0302)	0.0921*** (0.0301)	0.0924*** (0.0301)
Parity	−0.1805*** (0.0643)	−0.1802*** (0.0644)	−0.1762*** (0.0643)	−0.1759*** (0.0643)
Constant	−2.6322*** (0.8163)	−3.1577*** (0.9081)	−3.2267*** (0.9769)	−3.3290*** (1.0267)
−2L	726.2	730.24	731.88	732.04
LR chi-square	197.58	201.57	202.54	202.39
N	672	677	679	679

Standard errors are in parentheses.

** $P < 0.05$.

*** $P < 0.001$.

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