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Estimating the cost for obstetric fistula repair in hospitals of Mozambique: a low-income country

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Abstract

Background Obstetric fistula is incident and prevalent in low-income countries. Globally, about 100,000 women develop fistula annually. In Mozambique, more than 2,000 fistulas are reported annually. A national strategy to combat obstetric fistula has been implemented in Mozambique from 2012–2020. This strategy is under review, making it opportune to generate evidence that reflects the course of the strategy implemented to subsidize/optimize the definition of priorities of the new strategy to achieve universal health coverage. In Mozambique, information on the costs incurred to treat fistula is scarce. This study aims to estimate the mean unit cost of repair/treatment of simple and complex obstetric fistula in Mozambique.

Methods We carried out a retrospective evaluation, from the provider's perspective, using the Ingredient and Step-down approaches. The mean unit cost was obtained by the sum of individual and shared ingredients to treat fistula. Cost dimensions included Direct Medical Costs (personnel, drugs, and supplies), Overhead and Capital Costs (administration and capital assets' costs, respectively). The average exchange rate was USD 1 = MZN 61.47. Data were collected in secondary, tertiary, and quaternary hospitals of Zambézia and Nampula provinces in 2021. Costs borne by patients and their families and loss of productivity were not included.

Results The mean cost for Simple Obstetric Fistula repair was MZN 14,937.21 (USD 243) and Complex Obstetric Fistula was MZN 21,145.68 (USD 344) per person operated. Regardless of the type of fistula, the repair cost was MZN 18,072.18 (USD 294).

Conclusion Without neglecting that prevention is better than plasty, the results show feasible levels of fistula repair costs for mobilization of funds. For the estimated 2,000 fistulas reported annually, the government needs an average MZN 36,144,360 (USD 588,000).

Keywords Cost, Obstetric fistula, Mozambique

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Introduction

Obstetric fistula (OF) is incident and prevalent in low-income countries (LIC) of Asia, Oceania and Sub-Saharan Africa [8, 21]. Globally, it is estimated that around 2 million young women live with untreated fistula and that every year between 50,000 and 100,000 women develop fistula [8, 17]. Causes such as obstructed or prolonged labour and underlying factors such as poverty, lack of information, poor demand of health services, poor health systems and transportation networks, shortage of qualified midwives and inadequate obstetric care services contribute to the occurrence of OF [6, 12]. The patient's loss of ability to work (in the present) and society in the future due to stillbirths, as well as infertility, are pointed out as some of the economic burdens of OF [17]. Although scarce, fistula treatment cost was found to be USD 400 and USD 380 elsewhere [6, 17], respectively.

In line with the 2030 Sustainable Development Agenda to end Fistula, Mozambique has made an effort to achieve universal access to Sexual and Reproductive Health and taking necessary measures to protect the health of girls and women [13, 23]. From 2012 to 2020, in collaboration with partners (including the United Nations Population Fund (UNFPA), Mozambique), the country implemented the National Strategy for the Prevention and Treatment of OF, an important guiding tool for the prevention, treatment and psychological and social reintegration of young women [13]. Prior to the implementation of the strategy, the Assessment of Maternal and Neonatal Health Needs in the period 2006-2007 revealed that 42.9% of the healthcare facilities (HF) had received women with urinary/fecal incontinence, 3.7% of the HF reported repairing OF, and 38.3% referred patients to a higher-level HF. In 2011, 434 OF were repaired [13]. In 2017, a cohort study involving 4,358 women aged 12-49 living in rural areas of the southern region (Maputo and Gaza provinces) revealed that 1 in 1,000 women suffer from OF [14].

The evaluation report of the OF's national strategy in Mozambique (2012 - 2020), revealed that 3,348 women sought OF services and that demand in routine was higher (2,430 [72. 6%]) than in campaign (918 [27.4%]) [11]. However, the number of fistulas repaired during the 8 years of the strategy falls short of the reality, as data show that more than 2,000 fistulas are recorded per year [18]. During the 8 years of the strategy, the UNFPA invested large sums into OF's repair campaigns. One of the requirements for the new strategy to achieve universal health coverage is to know the cost of repair per person, nevertheless, literature that sustains this fact in Mozambique does not exist. In Mozambique, fistula repair in both campains or routine services is free of charge. Therefore, this study aims to estimate the average unit cost of repair of simple obstetric fistula (SOF) and complex obstetric fistula (COF), from the provider/government perspective in Mozambique. The results will inform decision-making in the upcoming national strategy to end OF in Mozambique, assist health managers in the budgeting and allocation process of scarce resources, as well as to contribute to national and regional literature. Our study aligns with the second pillar of the Global Campaign to end OF – "*Treatment and Repair of existing cases*" [23]. This is the first study of the series in Mozambique to provide the average unit cost for the repair of fistula.

Table 1 Hospitals by type of obstetric fistulas repaired in 2019

Province	Name of the hospital	Type of fistula repaired		Annual outputs
		SOF	COF	
Zambézia	HG Quelimane	✓	✓	36
	HD Mocuba	✓	✓	68
	HD Milange	✓		42
	HR Morrumbala	✓	✓	0
Nampula	HC Nampula	✓	✓	95
	HD Namapa	✓		27
	HD Monapo	✓		1
	HR Angoche	✓		11

Methodology

Study area

The analysis was carried out in 8 hospitals located in two provinces, one in the "Central region" (Zambézia Province [*Hospital Geral de Quelimane; Hospital Distrital de Mocuba; Hospital Distrital de Milange; and Hospital Rural de Morrumbala*]), and another in the "Northern region" of the country (Nampula Province [*Nampula Central Hospital; Namapa District Hospital; Monapo District Hospital; and Angoche Rural Hospital*]). In these hospitals, OF repair is usually performed in campaigns. However, not all hospitals under analysis repair COF; even those who repair, refer the most complex cases to the province's most specialized hospitals (HG Quelimane and HP Nampula) (Table 1). Zambézia and Nampula were chosen because they are (i) the most populous (with 18.5% and 20.6% of the country's population, respectively) [9], (ii) are amongst the 5 provinces with high rates of fistula incidence due to the lack of an adequate health system (sufficient coverage and properly trained personnel) to provide quality maternal and child health care, particularly quality childbirth services since nowadays, in Mozambique, many fistulas occur within the health facilities, and (ii) poverty, as the majority of the population in

these provinces lives in rural areas and depends on livelihood practices [25]. On the other hand, these hospitals were chosen for repairing fistulas at the level of their provinces.

Data collection and analysis

The annual general expenditures (overhead) for the financial year 2019 (January 1st – December 31st, 2019) were collected in the Accounting and Finance Departments of each hospital, using printed spreadsheets (A4 paper) and pre-designed for the purposes. Data on the annual outputs of the hospitals in general and the sectors of interest in particular (operating rooms and surgery wards), were obtained in the Statistics and Planning Departments. The monthly salaries (including benefits) of all cadres involved were obtained from the Human Resource Departments. The spreadsheets were distributed to the heads of the respective sectors during the meetings with the management committees. Data collected included general expenditure, hospital performance (annual outputs), capital assets[1] from the sectors of interest, monthly salaries, including subsidies, of the staff directly involved, medicines, and supplies used. The 2019 exchange rate was provided by the Department of Markets and Reserve Management of the Bank of Mozambique (1 USD = 61.47 MZN) and that of 2015 was obtained at the site of the same bank (1 USD = 44.95 MZN) [2]. However, the general expenditures and the annual outputs from the hospitals of Nampula province, were not included in this analysis because were not obtained in full. Data analysis was performed using the statistic tool "Excel 365".

Ethical approval

The study was approved by the Institutional Committee of Bioethics for Health of the National Institute of Health (CIBS-INS) (Ref.: 27/CIBS-INS/2021) and data collection was authorized by the Office of the Ministry of Health (Note No. 238/GMS/920/2021).

Costing method

This was a retrospective evaluation, from the provider's perspective, using an Ingredient Approach [5, 27, 28] combined with the Step-down Method [3, 19], to estimate the cost of repairing SOF and COF. The mean unit cost of OF repair surgery was defined as the sum of all individual cost components (personnel, medications, and supplies) [6, 26] including overhead and capital costs [26]. The direct non-medical costs "those incurred by the patient (e.g.: transportation and food costs)", the loss of productivity (due to hospitalization or convalescence), and other social costs were excluded.

Recurrent Costs (personnel, medicines, supplies) were aggregated into Direct Medical Costs and the Overhead Costs (although being recurrent costs) and Capital Costs were both prorated/apportioned and allocated to each patient through a stepwise way. *Overhead Costs* included (water, electricity, telephone, mantainance, fuel and lubricants for vehicles and generators, cleaning materials, hotel services), and *Capital Costs* included (buildings, medical and non-medical equipment, and furniture). All resources consumed during the treatment of a patient were identified, quantified, valued, and the mean unit cost was computed. In this study, we estimated the cost of repairing OF in routine, not in campaigns.

Definition of new terminologies

We did not find, in the literature (both published and gray), the definition of the terms Simple Obstetric Fistula (SOF) and Complex Obstetric Fistula (COF). However, experts consulted during the study pointed out that the terms SOF and COF are related to the degree of difficulty in repairing the fistula; thus, they are defined as:

- ***SOF*** – a "fistula whose orifice is small, and its diameter is smaller than 1 cm, which has tissue and of easy access for its repair"; and
- ***COF*** – a "fistula located near the cervix, pubic corners of the vagina, with a larger orifice, scarce tissue, or, difficult to access for its repair".

Cost components for fistula repair

Staff

To estimate the cost of the personnel involved in the patient care using the Ingredient Approach, it is necessary to identify the salary of the staff, the working hours per day, and the minutes spent in such activity [7]. To this end, health professionals with extensive experience in fistula repair were asked about the composition of the teams (personnel directly involved) and the time "in minutes" spent for each type of fistula, including complementary activities, such as cleaning the floor of the surgical room before and after the surgery, sterilization of equipment after use, auxiliary examinations, care in the ward, among others.

The salary of each technician involved (including all benefits) was divided by the working days of the month to obtain the daily salary; the daily salary was divided by the number of working hours per day to obtain the hourly wage, and finally, the hourly wage was divided by 60 minutes to obtain the cost of salary per minute. Generally,

[1] *Capital assets* are goods that have an economically useful life of more than one year and are not primarily purchased for resale (Shepard, Hodgkin and Anthony, 2000).

Table 2 Useful life of capital items/goods

ITEM	DETAILS	USEFUL LIFE (in years)
Medical equipment	Operating tables, Hospital beds, Anesthesia devices, Cardiac monitors, Autoclaves	10
	Pulse oximeters and Fistula kit	5
Non-medical equipment	air conditioning, non-medical fridges, generators	5
Furniture	N/A	10
Buildings	N/A	30

professionals directly involved in the care of patients with OF are: fistula surgery clinician, surgical technologist, anaesthesiologist, nurse, service agent/cleaner, and a stretcher assistant. In all 8 hospitals, the time required to repair a simple fistula was estimated between 60 to 120 minutes, while for complex fistula was estimated at least 180 minutes (3 hours), reaching 420 minutes (7 hours) in more complex situations. The effort of professionals who provide ancillary services (laboratory and radiology technicians), was similarly estimated and included.

Drugs and supplies

Drugs and supplies used were detailed by the health professionals. Each technician (fistula surgery clinician, surgical technologist, and anesthesiologist) described the items he/she usually used and the quantity for the complete intervention. At the time of description, providers were asked to describe the full name of the drug/good and the dosage, for example, Bupivacaine 0.5% isobaric (5mg/ml) Injection, 3 ampoules; Paracetamol 500mg tablet, 8/8h, 9 days. The use of drugs, supplies, and especially time was not based on the designations "vesico-vaginal fistula" and "recto-vaginal fistula", but rather simple fistulas and complex fistulas.

For goods accounted for per unit and whose prices were available for each unit, the number of units used was multiplied by their own price. For goods whose multiple units were in a single package/bottle/strip/blister pack (e.g.: tablets) and that their unit price was not available, the price of the package was divided by the number of units contained inside. For goods whose units are not consumed by a single patient, their price was divided by the number of patients needed to consume such unit (e.g., Adrenaline 1mg/ml, 1ml ampoule – used for 3 patients). The price list of supplies and medical equipment was provided by "Centro de Abastecimento". The price of drugs was provided by "Central de Medicamentos e Artigos Médicos de Moçambique (CMAM)". In the absence of CMAM prices, they were extracted from the Product Catalog of the United Nations Population Fund [24], and the 2015 World Health Organization International Medical Product Price [15]. Drugs found in the 2015 list, their price was inflated for 2019, using the inflation rate formula below:

$$\frac{\mathbf{B}-\mathbf{A}}{\mathbf{A}} \times 100$$

where "**B**" is the exchange rate of the year under analysis (2019) and "**A**" the exchange rate of the base year (2015). The exchange rate of 2019 (*1 USD = 61.47MZN*) was subtracted by the 2015 exchange rate (*1 USD = 44.95 MZN*). The difference found was divided by the 2015 exchange rate to obtain a decimal number that was later multiplied by 100% to obtain an inflation rate. By multiplying any drug price in the 2015 list (base year) by the "inflation rate" found, we obtain the price of such good equivalent to the year under analysis (2019).

Capital assets

Medical and non-medical equipment, furniture, and buildings

We have made an inventory of health facility items – medical and non-medical equipment, furniture, and buildings – used to provide fistula services. A discount rate of 3%, recommended as international standard [4, 16, 27], was combined with the useful life (Table 2) of each good to obtain the respective annuity factors. The tables of present value of annuity of $1 in arrears or anualization factors can be found elsewhere [5, 20]. Using the formula below, we divided the replacement cost (current purchase price) of each good by its annuity factor to get the depreciation (annual amortization). The price of goods was consulted in both local and international markets. For capital items, the prices considered were those of the year the study was undertaken (2020-2021). Although knowing that some items might have been purchase years before the study and that the prices might have fluctuated, we found it reasonable to depreciate the items using current prices because to get the real prices (of the past) could be challenging.

Table 3 Cost components for simple and complex obstetric fistula repair (averages per patient)

Type of Fistula	Personnel	Drugs	Supplies	Overhead & Capital	Mean Unit Cost per type of Fistula	Mean Unit Cost regardless the Type of Fistula	
Simple Obstetric Fistula (SOF) (MZN)	2 409	2 881	5 555	4 114	14 959	18 051 MZN	$294
($)	**39**	**47**	**90**	**67**	**243**		
Complex Obstetric Fistula (COF) (MZN)	8 870	4 642	6 602	1 029	21 143		
($)	**144**	**76**	**107**	**17**	**344**		

$$\textbf{Depreciation} = \frac{\textbf{Replacement cost}}{\textbf{Annuity factor}}$$

Therefore, we allocated the cost of depreciation of each good to the respective final cost centre (i.e.: operating room and surgery ward), and then attributed to each individual patient by dividing the "total cost" (*cumulative cost after stepdown*) of each final cost centre by the respective "annual number of patients" attended to in the cost centre. This is the allocated unit cost and to this end, it includes both "overhead and capital cost". Subsequently, the allocated cost and the direct medical cost (personnel, drugs, and supplies) were added to obtain the unit cost of fistula repair.

The Step-down was not performed in the hospitals of Nampula province due to incompleteness of financial data (overhead costs) and annual outputs (number of patients attended). This led to the exclusion of Overhead and Capital Costs (Table 5). Likewise, the cost of vehicles (ambulances) was excluded because we did not have an adequate method to estimate the proportion of their contribution, since, in each district, an ambulance is used for all the healthcare facilities in the district.

Overhead

Overhead costs were obtained from the Accounting and Finance Departments of each hospital. These are administrative costs incurred to run the healthcare facilities (water, electricity, telephone, mantainance, fuel and lubricants for vehicles and generators, hygiene and cleaning materials, hotel services, office supplies, etc.). They were allocated through a stepwise fashion to all the remaining overhead departments and to the final cost centres. We started with those departments that service the broadest number of other departments, as following: administration, transportation, laundry, kitchen, and from these down to the final cost centres of interest (operating room and surgery ward.

For example, to allocate the overhead of the Administration Department to the remaining departments, we add up the overhead of all departments (including the final cost centres – the costs of acquiring all medical and non-medical equipment and the cost of buildings), excluding the overhead of the Administration Department. *Second*, we computed the "allocation statistic" for each department, by dividing its overhead by the sum of overhead of all departments (excluding Administration). *Third*, we estimate the "allocated cost of administration" to each department by multiplying the *allocation statistic* value of each department by the overhead of the Administration Department. This amount represents the expense borne by the administration because of the consumption made in that department. Finally, we add the allocated cost of administration with the overhead of each department to get the new totals. From here we repeat the exercise, adding up the new totals of each department (excluding the overhead of the next department that service the broadest number of other departments - "Transportation"), and so on.

Similarly, for the final cost centres, we did the same exercise and when we got the new totals, we divided them by the respective numbers of patients served per year in each final cost centre. The value that results from this division is the allocated unit cost of attending a patient in that service, which is later added to the direct medical costs (personnel, drugs, and supplies) to obtain the mean unit cost.

Sensitivity analysis

To assess uncertainty around the mean unit cost of fistula repair, we conducted a simple sensitivity analysis using the cost components for the repair of SOF and COF.

Results

In line with the study objectives, we first report the mean unit cost of SOF and COF, and the cost of repair regardless the type of fistula (Table 3), then we detail the direct medical costs incurred to treat fistula per hospital of each province (Tables 4 & 5), and finally, what do the direct medical costs and the overhead and capital costs consumed per hospital (Table 6). The mean unit cost of SOF was obtained by summing up the costs of repairing SOF in each hospital, divided by the number of hospitals that repair SOF. The same procedure was applied to COF. Our results show that the mean unit cost of repairing SOF is MZN 14,959.00 (USD 243), and that of COF is MZN

Table 4 Direct medical cost of obstetric fistula (OF) repair per hospital in Zambézia Province

Description of Items	ZAMBÉZIA PROVINCE							
	HG Quelimane		HD Mocuba		HD Milange		HR Morrumbala	
	Fistula Type		Fistula Type		Fistula Type		Fistula Type	
	SOF	COF[1]	SOF	COF[2]	SOF	COF	SOF	COF
Personnel	3 357,57	18 108,78	3 917,05	6 828,11	3 340,53	-	1 442,12	2 273,95
Drugs	852,95	1 506,83	1 017,57	2 197,53	290,51	-	14 508,28	14 508,28
Supplies	8 088,48	8 588,84	4 723,47	11 484,54	3 180,24	-	2 061,16	2 061,16
Subtotal	8 941,43	10 095,67	5 741,05	13 682,07	3 470,74	-	16 569,43	16 569,43
Total Cost	12 299,00	28 204,45	9 658,10	20 510,18	6 811,27	-	18 011,55	18 843,38
Mean Cost	**20 251,72**		**15 084,14**		**6 811,27**		**18 427,47**	

[1] in cases of complications, the cost of drugs and supplies can reach MZN 10,231.19

[2] in the repair of fistula via aparatomy, personnel cost was MZN 9,739.17 and drugs and supplies was MZN 14,124.35

Table 5 Direct medical cost of obstetric fistula (OF) repair per hospital in Nampula province

Description of Items	NAMPULA PROVINCE							
	HC Nampula		HD Namapa		HD Monapo		HR Angoche	
	Fistula Type		Fistula Type		Fistula Type		Fistula Type	
	SOF	COF	SOF	COF	SOF	COF	SOF	COF
Personnel	2 954,66	8 266,85	1 337,00	-	854,78	-	2 063,67	-
Drugs	411,83	355,04	963,82	-	963,82	-	4 009,43	-
Supplies	5 850,04	4 275,43	9 062,11	-	5 809,24	-	5 665,36	-
Subtotal	6 261,87	4 630,48	10 025,93	-	6 773,06	-	9 674,79	-
Total Cost	9 216,53	12 897,32	11 362,93	-	7 627,84	-	11 738,46	-
Mean Cost	**11 056,93**		**11 362,93**		**7 627,84**		**11 738,46**	

Table 6 Mean unit cost of obstetric fistula (OF) repair per hospital including both direct medical costs and overhead and capital costs

Name of the Hospital	Overhead and Capital Costs		Direct Medical Costs		Mean Unit Cost per Hospital	
	MZN	USD	MZN	USD	MZN	USD
HG Quelimane	18 938	308	20 252	329	39 190	638
HD Mocuba	2 638	43	15 084	245	17 722	288
HD Milange	3 635	59	6 811	111	10 446	170
HR Morrumbala	4 101	67	18 427	300	22 528	366
HC Nampula	-	-	11 057	180	11 057	180
HD Namapa	-	-	11 363	185	11 363	185
HD Monapo	-	-	7 628	124	7 628	124
HR Angoche	-	-	11 738	191	11 738	191

21,143.00 (USD 344). Regardless of the type of fistula, the mean unit cost of OF repair is MZN 18,051.00 (USD 294). Overhead and Capital Costs accounted for 22.4%.

Our results also indicate that among the 3 direct cost items, supplies are the major cost drivers (accounting for ˃40%), especially in the repair of SOF. Conversely, in Hospital Rural de Morrumbala drugs consumed about 75% of the direct medical cost (MZN 14,508.28 [USD 236]), and in Hospital Geral de Quelimane and Hospital Central de Nampula personnel costs was approximately

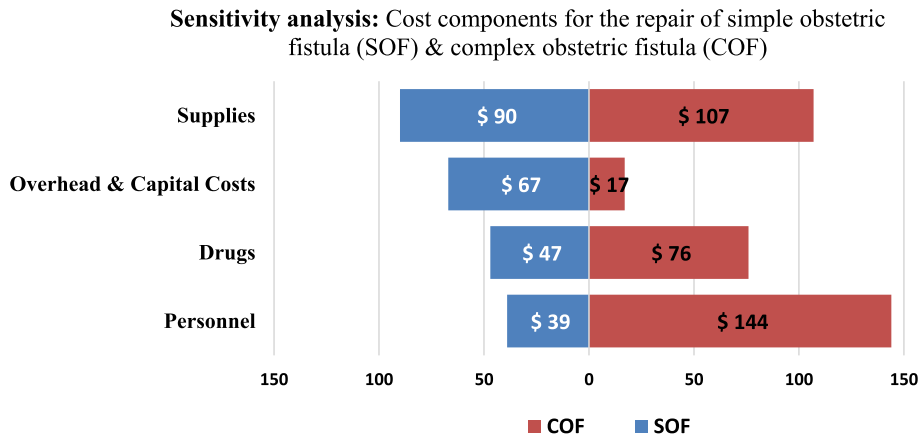

Fig. 1 Sensitivity analysis of the components for the repair of simple and complex obstetric fistula

70% of the total unit cost in each hospital, especially for COF.

On the other hand, overhead costs contributed significantly to the mean unit cost in HG Quelimane. In HD Mocuba, HD Milange, and HR Morrumbala they have contributed by 15%, 35%, and 18%, respectively, while in HG Quelimane contributed by 48%. In HD Mocuba, Overhead and Capital Costs had the lowest contribution (Table 6).

Only hospitals from Zambézia province are composed of Direct Medical and Overhead and Capital Costs. The lack of overhead and capital costs in Nampula's hospitals made the comparability of costs among hospitals difficult. HG Quelimane presented the highest cost of fistula repair MZN 39,190.00 (USD 638). Overhead and Capital Costs played a role in this cost MZN 18,938.00 (USD 308). The high personnel cost, mainly for COF, derives from the combination of several factors, among them, the specialization of the personnel (surgery team), the composition of the team for COF (instead of one, it includes 2 clinicians of fistula surgery and 2 instrumentalists), and the mean time spent for surgery (240 minutes, i.e., 4 hours average) (Table 4). Mocuba and Morrumbala District Hospitals also presented higher costs. It is important to highlight that they also deliver COF (Table 1), on the other hand, Mocuba reported to expend more in supplies while Morrumbala expends in drugs (Table 4). Comparability on why some spend more in drugs and others in supplies is challenging due to lake of standard for treatment, complexity of the fistula, and the staff level of specialization.

Sensitivity analysis

Figure 1 displays findings from the cost components for SOF and COF repair. For the repair of SOF, supplies are the major cost drivers followed by overhead and capital costs. Conversely, for the repair of COF personnel is the driver of the cost. Results show that the repair of SOF decreases significantly the cost of personnel (72.9%) although supply costs do not vary much (15.9%). Thus, the sensitivity analysis shows that if efficient intervention strategies for the prevention of fistula are undertaken, it can significantly prevent the occurrence of complex fistulas and consequently, reduce the economic and financial burden borne by the government. On the other hand, if OF are repaired massively in the routine, overhead and capital costs per patient can decrease considerably, since they can be allocated to/shared by several patients.

Discussion

To the best of our knowledge, this is the first study attempting to estimated the cost of repairing SOF and COF in Mozambique. Our estimates intended to provide initial evidence to inform decision-making in the upcoming national strategy to end OF in Mozambique and assist health managers in the budgeting and allocation process of scarce resources. Given limited evidence on the cost of repairing OF, our findings may also be useful in health systems of similar settings around Sub-Saharan Africa and Asia. Direct medical costs, Overhead and Capital costs [26] were included in this cost analysis. The exception was the hospitals in Nampula that did not include overhead and capital costs. This made the comparability of costs among hospitals difficult. However, our estimates show that the mean unit cost of repairing SOF and COF were USD 243 and USD 344, respectively, and the mean unit cost regardless the type of fistula is USD 294. Sensitivity analysis shows that massive repair of simple fistulas can significantly reduce the cost to the government, as it decreases the cost of personnel by 72.9% and that if OF are repaired massively in the routine, overhead and

capital costs per pacient can decrease considerably, since they can be allocated to several patients.

In HR Angoche, the cost is higher than the cost of HD Milange which included both cost types (Table 6). Among the Nampula hospitals, the cost in HR Angoche surpassed the cost of central hospital (HC Nampula) which repairs complex fistulas. This is because HR Angoche spends more in drugs and supplies (Table 5). However, its cost of drugs is lower than that of HR Morrumbala which is almost 4 times higher (Table 4). Comparability on why some spend more in drugs and others in supplies is challenging due to lake of standard for treatment, complexity of the fistula, and the staff level of specialization.

In Zambézia province, HG Quelimane has ones of the most specialized fistula surgeons in the country and the most complex cases in the province are referred to this facility. COF surgeries are time consuming (mean = 4 hours), and demand complex teams (with increased number of technicians). Keeping highly qualified staff in a prolonged surgery is costly. This justifies the reason why HG Quelimane presents the highest personnel cost for the repair of COF (Table 4). Supplies are the major cost drivers, and the suture threads (mainly Vicryl in its different sizes: 3-0, 2-0, 0, 1) contributed significantly; surgical gloves and disposable gowns also played an important role.

In Mozambique, the Maternal and Neonatal Health Needs Assessment in the period 2006-2007 revealed that 42.9% of the HCF had received women with urinary/fecal incontinence, 3.7% of HCF reported repairing OF, while 38.3% referred patients to a higher-level HCF [13]. Addicionally, 434 OF were repaired in 2011 [13], and recent reports state that more than 2,000 fistulas are registered per year (Portal do Governo, 2018). This shows that the national health system has a huge gap in regard to OF repair. In fact, there is shortage of specialists and reference repair centres continue to repair mostly during campaigns than in routine. This mirrors under-utilization of fistula surgeons to the extent that during the routine period (the longest), surgeons repair few fistulas and therefore are allocated to other activities. To optimize the scenario, there is a need to ensure that women not covered during campaigns (the majority) are covered uninterruptedly during the routine.

Obstetric fistula has a catastrophic socio-economic impact not only on the life of the carriers, but also on the present and future workforce [6, 17]. Our finding (USD 294) is below the 2021 gross domestic product (GDP) per capita (USD 491.8) [22], suggesting that the government is able to mobilize funds to combat this evil. For the alleged 2,000 fistulas reported annually, the government would need an average of UDS 588,000 annually. However, the minimization of this cost starts from the mitigation of the incidence of OF. To this end, the government first needs to ensure basic intervantions, including: training of quality maternal and child health nurses and midwives, bring maternal and child health services closer to communities, strengthen existing facilities, massively disseminate the OF to ensure awareness, and focus on the implementation of interventions to prevent the incidence of OF (like adequate follow-up of antenatal care services, timely visit to the HCF to avoid dragged births, readiness of HCF for timely transfer of complicated cases requiring specialized attention), especially in the rural context.

Adicionally, the government needs to train and specialize more surgical clinicians; consider paying incentives to staff [6], as they take long hours to repair, mainly, complex fistulas; increase the number of repair centres, equip, and bring them closer to community in order to reduce the costs associated with transportation to patients. This work should be multisectoral, including the Ministry of Education (access to education for women and communities), Ministry of Gender (rehabilitation and social integration), Ministry of Finance (investment and allocation of funds), Ministry of Transport (access to transport mainly in rural areas), and Ministry of Labour, given the high incidence and prevalence with increasing trend in the country.

On the other hand, we compared and found that our result is 22% lower than the one from Ugandan (USD 394) [6]. This might have been influenced by many factors: *First,* the Ugandan study collected data in two referral hospitals and we collected in 8. *Second*, the short length of hospital stay in the 8 hospitals of Mozambique (16 days). In Uganda, the length of hospital stay is 28 days, almost double, and this entails various hosting costs. *Third*, our study did not include opportunity costs. The Ugandan study included indirect costs (loss of productivity) as a consequence of the 28 days of hospitalization, although the value was not quantified. If we were to consider the monthly income of the rural households in Mozambique (USD 38) [10] as a productivity loss, our mean unit cost could increase from USD 294 to USD 332. *The fourth*, is actually our first limitation as well – hospitals from Nampula province did not included direct medical costs (Table 6), since we failed to collect them in full. This influenced the reduction of the final cost. Based on the Overhead and Capital Costs of Zambézia hospitals, if we hypothetically administer USD 50 (as average overhead and capital cost) to each hospital in Nampula province as an apportioned cost, the average unit cost would increase from the hypothetical USD 332 to USD 382.

Another study from Ethiopia estimated the cost of fistula repair considering 3 levels of severity and found that minor surgery cost USD 108, moderate surgery USD

260, and major surgery USD 344.7 with recurrent and capital costs accounting for USD 47.9 and USD 37.1, respectively [1]. This range is consistent with our result, since their mean cost regardless the level of severity is USD 237,7. The sum of their overhead and capital costs fall within the range of our overhead and capital costs as well (USD 85) (Table 6). Adicionally, this study used a provider perspective excluding patient costs, thus it is in position to validate our findings. Apart from the hospitals from Nampula that did not include overhead and capital costs, another limitation is that although the healthcare facilities included in this study are from different provinces and regions (Zambézia - Central Region; Nampula - Northern Region), and present different characteristics and challenges, which would make the findings close to the reality, we cannot generalize the result to other OF repair centres at the national level.

Conclusion

Supplies were the major cost drivers. In particular, personnel cost was the major driver in the provincial referral hospitals (HG Quelimane and HC Nampula). This is due to personnel level of especialization and the composition of the surgery teams. Without neglecting that prevention is better than plasty, the result shows levels of fistula repair costs feasible for mobilizing funds. For the estimated 2,000 fistulas reported annually, the government needs an average of USD 588,000.

Recommendations

The fact that more fistulas are repaired in campaigns than in routine, causes the underutilization of fistula surgeons, and thus they engage in other activities rather than their specialization. There is, however, a need to stimulate demand for routine services to ensure uninterrupted coverage of those women not covered during campaigns so that the financial and economic costs of having specialists in repair centres are compensated. In turn, demand for routine services can be stimulated by (i) massively disseminate the OF to ensure awareness through community radios, community health workers, and community leaders, (ii) providing quality training to maternal and child health nurses and midwives, especially to understand the risks of fistula development or avoid fistula during labour intervention, (iii) bring maternal and child health services closer to communities (by building new infraestructures or providing mobile clinic services), (iv) strengthen existing facilities, and (v) focus on the implementation of interventions to prevent the incidence of OF (like adequate follow-up of antenatal care services, timely visit to the HCF to avoid dragged births, readiness of HCF for timely transfer of complicated cases requiring specialized attention), especially in the rural context.

Abbreviations

LIC	Limited Income Country
OF	Obstetric Fistula
SOF	Simple Obstetric Fistula
COF	Complex Obstetric Fistula
UNFPA	United Nations Population Fund
HF	Healthcare Facility
MZN	Mozambican Metical
USD	United States Dollar
CMAM	Central de Medicamentos e Artigos Médicos de Moçambique (Mozambique Central Medical Stores)

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Authors' contributions

SC and JDM – Conceptualized the study, reviewed the literature, analysed the data, did thorough review and drafted the article; NJM – reviewed the literature, designed the methodology, collected, cleaned, and analysed data, and drafted the article; RA—Reviewed the literature, did thorough review of the article; AN—Cleaned and analysed data, and reviewed the article; NC, AD, GP, EM and MIC—Reviewed the article; LC – Collected data and reviewed the article. All authors have read and agreed to the published version of the manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Committee of Bioethics for Health of the National Institute of Health (CIBS-INS) (Ref.: 27/CIBS-INS/2021) and authorization for data collection by the Office of the Ministry of Health (Note No. 238/GMS/920/2021). Since we collected no information from human subjects, no informed consent was required.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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