

BARRIERS TO PROSTHETIC DEVICES AT A TANZANIAN HOSPITAL

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ABSTRACT

Background: Limb amputation, often from road trauma, is common in low-income countries. Providing prosthetic devices for amputees is challenging and limited research exists regarding barriers to prosthesis provision. This study aims to elucidate the Prosthesis Provision Pathway (PPP) and identify barriers of prosthesis accessibility at the Muhimbili Orthopaedic Institute (MOI) in Dar es Salaam, Tanzania.

Patients and Methods: At MOI, 18 healthcare providers, who included 4 orthopaedic technicians, 4 physical therapists, 4 orthopaedic surgeons, 4 junior doctors, and 2 hospital administrators were interviewed and blinded. Responses from semi-structured interviews were transcribed and common themes were identified. A process map diagramming the prosthesis provision pathway was created to highlight barriers and potential areas of improvement.

Results: Six main themes emerged from the interviews: the first is that the prosthetics are expensive both for patients and MOI. Second, there are misperceptions of how prosthesis cost will be distributed. Third, there is inefficient communication between providers. Fourth, improved surgical education is needed to improve amputation outcomes. Fifth, amputees face psychosocial stigma, but prosthetics are becoming more accepted. Lastly, healthcare providers understand that trauma is the most common aetiology for amputation.

Conclusions: Potential solutions to solving the prosthetic shortage will involve making prostheses more affordable, integrating the orthopaedic prosthesis workshop earlier in the provision process, improving surgical education and communication between providers, and working to prevent road trauma.

Key words: Prosthesis, Amputee, Access, Barrier, Tanzania

INTRODUCTION

Amputation is one of the most common surgical procedures worldwide, with an estimated incidence for lower extremity amputations ranging from 5.8-31 per 100,000 persons (1,2). While amputations in developed countries are often performed due to vascular disease arising from peripheral vascular disease or diabetes (3,4), amputations in developing countries are often a result of trauma, infection, uncontrolled diabetes mellitus, and malignancy (5,6). With an increase in urbanization for the Low- and Middle-Income Countries (LMICs), road-accident trauma has become the highest indication for amputation (7,8).

The decision to perform an amputation is extremely difficult for both the patient and the surgical

team. The alternative to amputation is limb salvage, but the indications for one treatment over the other are not clearly defined (9). These procedures have significant physical, economic, and psychosocial repercussions (10-12). The operations are disfiguring, associated with high morbidity and mortality, and patients may become permanently handicapped and chronically dependent on caregivers (10). Additionally, amputees may require multiple hospitalizations, reoperations, physical rehabilitation, or a prosthesis (10). Psychosocially, it is not uncommon for patients to experience depression and anxiety as they adjust to a new body (11), and in developing countries, there is often an added social stigma, as amputees are viewed as incomplete individuals (12).

In an effort to increase mobility and independence after amputation, most patients require a prosthetic limb. In high-income countries, provision of a prosthetic device is considered a standard of care (13), but in the lower income countries, financial deprivation causes prosthetic and orthotic shortage which affect an estimated 25 million people (14). The World Health Organization reports that there are only 24 prosthetic and orthotic schools in developing countries (15). In these countries, the majority of patients who need prostheses live in rural areas and cannot afford the cost of a prosthetic device (16).

Tanzania has an estimated 513,000 people with mobility challenges, and 5.8% of the total population have functional limitations (17). Many of these patients would benefit from prosthetic devices. A study in northwestern Tanzania reported road trauma and diabetes mellitus as the main sources of amputation (6), most commonly affecting young adult males who are often the primary source of income for their families (18). Like other developing countries, Tanzania faces difficulties in prosthetic provision, such as a lack of raw materials for making prosthetics in rehabilitation centers and the lack of physical rehabilitation services (17). Understanding the process to and barriers preventing prosthesis provision is crucial in solving the prosthetics shortage in under-resourced countries.

The goal of this qualitative study is to elucidate the Prosthesis Provision Pathway (PPP) and identify barriers to prosthesis accessibility at the Muhimbili Orthopaedic Institute (MOI) in Dar es Salaam, Tanzania.

MATERIALS AND METHODS

A qualitative study was conducted at the Muhimbili Orthopaedic Institute (MOI) in Dar es Salaam, Tanzania, one of the international partner sites of the Institute for Global Orthopaedics and Traumatology (IGOT) of the University of California, San Francisco.

Data collection took place in the form of semi-structured qualitative interviews and observation of healthcare providers and patients. Eighteen participants were interviewed consisting of: 4 orthopaedic technicians, 4 physical therapists, 4

orthopaedic surgeons, 4 junior doctors, and 2 hospital administrators. Each participant was interviewed individually using a standardized interview guideline geared toward each profession (Appendix 1), and each interview was recorded and transcribed. Each provider was also observed in their role in the PPP while the observer took notes.

Transcribed interviews were inputted into *NVivo* for analysis. *NVivo* is a software platform that allows users to categorize and analyze transcribed data. Codes and categories were established while the data was initially collected from each interview based on the frequency of concepts discussed during the interviews. Commonalities or differences were observed across all interviews with a focus on any discussion concerning barriers, limitations, or challenges within the PPP. Storing the information in the *NVivo* software allowed the research team to identify common barriers of the provision process stated by distinct health care providers. The codes were constructed iteratively and were applied to all transcripts. Open, axial, and selective coding were used to organize common ideas discussed during the interviews. Theories related to determining the main limitations were developed, as well as exploring relationships throughout the prosthetic process. A memo was written to collect the comparisons and connections found. The memo was used to create the process map and identify possible provider barriers throughout the provision process (e.g., miscommunication).

After collectively analyzing the qualitative interviews and observations from shadowing providers during the PPP, a diagram was created to graphically illustrate opportunities for improvement in the provision of prosthetics. Potential solutions were proposed, along with implementation strategies to modify the PPP.

RESULTS

From the 18 interviews with different key stakeholders in the PPP, several common concepts were identified (Table 1) (see Appendix 2 for selected quotes). These were organized into six themes categorizing the barriers faced by providers, patients, and relatives in providing prosthetic devices to amputees.

Table 1

A selection of concepts that arose during interviews that were viewed as influential in the prosthesis provision pathway at MOI. Frequency refers to the total number of separate instances that a specific theme was mentioned during the 18 interviews*

Cost to patient or MOI*	38
Reference to another provider	31
Shortage of materials (availability)	26
Lack of communication between providers	25
Socio-economic issue affecting access	22
Medical complication delaying process	19
Post-operative follow-up	16
Stigma/Acceptance/Mental health	15
Communication within pathway	12
Amputation etiology	8
Limited O&P** centers	7
Complication from prosthetic	7
Prosthesis manufacturing	5
Awareness of O&P** services	3

*Muhimbili Orthopaedic Institute

**O&P: Orthotic and Prosthetic

- (i) *Prosthetics are expensive both for patients and MOI:* To build a prosthesis, measurements are taken from a patient's residual limb and device components are purchased from a manufacturer. Due to the lack of local prosthetic component manufacturers in Tanzania, the prosthesis-fitting workshop at MOI is restricted to importing products from foreign companies (i.e., Germany's Ottobock) and then assembled by local technicians. Most patients either have no insurance, or their insurance does not cover the cost of the prosthesis.

A physical therapist summarizes: "One, it's about availability of materials to make the prosthetics, very expensive. The hospital cannot afford. Two, even if the materials are available, the price of prosthesis is too high. And if the prosthesis are there and we have two groups of patients. One

who can afford maybe through the billing company or insurance, and those who are not working."

- (ii) *Misperceptions of the distribution of cost:* Providers working outside of the orthopaedic workshop and social welfare department often assumed that the cost of prosthetics could be partly covered by MOI, but the workshops expected patients to pay the full cost of the prosthetic.
- (iii) *Inefficient communication:* The many different individuals involved along the PPP do not always communicate with the other members, creating a lack of communication when attempting to create a patient's treatment plan. For example, one junior doctor commented, "There is no link between surgeons and the people from orthotics" and another physical therapist, "There is a gap in discussion."
- (iv) *Surgical education:* The interviewees noted that many patients are not candidates for prostheses due to a poorly performed amputation. One surgeon stated, "If the amputation was not done correctly, then the possibility of the bone overgrows the stump so it forms sores and that has to be refashioned to be refitted again." Better education regarding amputation surgery – specifically on amputation level and stump length – was mentioned as a solution to improve residual limb outcomes and increase prosthetic candidates.
- (v) *Amputee stigma, but prosthetic acceptance:* An interesting cultural observation by many interviewees was that amputees and those with limb deformities are often stigmatized by the community. One provider quoted, "Once it's an amputee even traveling in a commuter bus is a problem they don't do that because of the stigma. [...] They have to find someone to bring them and it is a huge cost to them." Once an amputee uses a prosthetic device, however, they experience less stigma.
- (vi) *Understanding of amputation aetiology:* Interviewees acknowledged that the primary contributor to amputation is traumatic injury, which was previously due to diabetic complications. Many providers mutually agreed that implementation of preventative measures to decrease the number of road traffic accidents is critical in decreasing the incidence of amputations.

Table 2*Barriers to each individual involved in the prosthesis provision pathway and proposed solutions*

	Barriers	Solution
Patient	Absence of psychosocial services	Include social workers early in care of patients with potential amputation
	Social bias against amputation (stigma)	Decrease stigma with positive display of prosthetic use
	Does not desire amputation	
	Healing time causes delay	Surgical education
	Early complication develops (infection, wound problem etc)	
	Late complication develops (neuroma, contracture, stump fluctuation etc)	
	Patient unsure if he/she qualifies for prosthesis	Develop prosthesis provision protocol
	Patient initiates follow-up with orthopaedic technician	
	Unable to afford physical therapy	Develop physical therapy program
	Unable to afford appropriate antibiotic	Expand insurance coverage
Junior doctors (residents)	Unable to afford prosthesis	
	Unavailable for follow-up at workshop (lives too far)	Increase number of prosthetic workshops
	No ward bed availability	Increase hospital capacity
	No surgery schedule availability	
Surgeon	Incorrect medication prescribed	Include pharmacists or nurses in checking orders
	Junior doctor does not know to refer patient to MOI workshop for prosthesis	Include orthopaedic technician early in multidisciplinary rounds
	Surgeon does not have to refer patient to MOI workshop for prosthesis	
Orthopaedic technician (Prosthetist)	Inaccurate measurement leads to poor socket fitting	Improve and expand prosthetic training
	Patient must cover prosthetic costs	Expand insurance coverage
	Unavailable prosthetic materials	Find cheaper foreign manufacturer or develop local manufacturer
	Unable to import prosthetic materials	
Social worker	Unavailable outside funding	Increase support from developed countries
	Unavailable MOI funding	
Physical therapist	No physical therapy protocol	Develop physical therapy program
	Patient cannot afford therapy	
Family	Family does not accept amputation	Decrease stigma with positive display of prosthetic use

The diagram illustrating the steps from patient presentation to prosthetic provision was developed. Patients encounter the greatest number of barriers (n=12), followed by orthopaedic technicians (n=4) during the provision process. Table 2 summarises the barriers and potential solutions.

DISCUSSION

We conducted a qualitative study to better understand barriers to prosthetic provision in Tanzania and identify opportunities to increase access. Our study found that the primary barriers to providing prostheses for amputees are the financial cost of prosthetic devices, inefficient communication between providers, and gaps in surgical education.

Regarding cost, limited availability of materials for prosthesis manufacturing forces the prosthesis workshops to import from abroad, and since patients often have difficulty affording prostheses in the first place, the workshop discounts the price, placing MOI at a severe financial disadvantage. This would be alleviated by decreasing the cost of prosthetics or convincing government and other insurers to cover a greater percentage of the cost. Prosthesis cost has been identified as prohibitive in other settings, including Haiti, Thailand, and other developing nations (19,20).

Regarding communication between different providers, earlier involvement of the orthopaedic technicians – by joining the multidisciplinary ward rounds before patient amputation, for example – can

allow for essential input to improve patient outcomes, and several studies have documented improved wound or amputation outcomes in diabetic patients who received multidisciplinary care (21,22). Addressing issues such as patient finances, risk of surgery, and family support early during the process can maximize efficiency.

There is a widely held assumption that amputation surgery is simple and rarely associated with complications. This study highlights that this is not the case. Poorly performed amputations lead to significant difficulties in providing a well-fitting and functional prosthetic limb. This suggests that educational programs directed toward teaching better amputation techniques could be beneficial.

The strengths of our study include its novelty in an unexplored, highly relevant area. Process mapping is a powerful healthcare system tool useful in understanding complex processes and identifying areas of improvement. Our study has multiple limitations, however. First, the generalizability of our findings may be limited given our study was restricted to one setting. Nevertheless, MOI treats a patient population representative of lower-income countries, in terms of amputation aetiology, financial constraints, and psychosocial factors. Furthermore, MOI is a tertiary hospital with a medical education program, so it likely reflects a higher level of care than hospitals found in comparable countries and one can infer that most other hospitals in LMICs have greater barriers to prostheses when compared with MOI. Second, as a descriptive, qualitative study, our findings can only identify themes as reported by local providers. This study can be strengthened and expanded by measuring specific outcomes or by introducing an intervention or modification to the process and tracking changes. Third, our study mainly addressed barriers, with a minor focus on solutions. The different providers may all agree on the same difficulties within the PPP, but may disagree on solutions to the problem based on their specific roles. Lastly, the semi-structured interview format, although it attempted to ask standardized questions, may have led to biased answers during earlier interviews and thus, was slightly modified for later interviews.

CONCLUSION

This study identifies several barriers to the provision of prosthetics in Tanzania, including financial, organizational, and educational issues. Potential solutions to solving the prosthetic shortage involves making prostheses more affordable, improving surgical education and communication between providers, and preventing road trauma.

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Appendix 1:

Interview Guide 5-11-16 (Reviewed 7-16-16)

1. What is your profession here at MOI?
 - a. 5/13 Re-word: What is your role here at MOI?
2. What do you do on a typical work day at MOI?
 - a. Based on their answer:
 - i. Surgeon: What are the procedures before and after amputation surgery for an above knee amputation (AKA)/below knee amputation (BKA) patient?
 - ii. Technician/Prosthetist: What are the procedures when receiving amputee patients from the surgeon?
 - iii. Physical therapist: Are you involved with amputee patients after surgery? How did you get referred to them?
3. Who do you receive your referrals from? (Surgeon to prosthetist, prosthetist to physical therapist, etc?)
4. Do you talk to other providers about patients?
 - a. How often? Do you have meetings?
 - b. Do you send notes or referrals to other providers?
5. What are some barriers, challenges, or limitations that prevent or stop you from working?
 - a. 5/13 Re-word: In your perspective, what are the main challenges to an amputee receiving a prosthetic device at MOI?
 - b. Based on their answer:
 - i. Availability of materials: What materials are you lacking? Why is this a problem?
 - ii. Cost (patient & institution): How do patients pay for their devices? Does MOI help with the costs? How? Who is involved?
 - iii. Do you feel that there is a lack in communication? When?
6. What are the follow-up procedures after a patient is done with your care?
7. How do the patients pay?
 - a. If they mention social workers:
 - i. What do social workers do at MOI?
 - ii. What are their procedures for TB/BK amputees?
 - b. Out of 10 amputees who could receive a prosthetic, how many would you say can afford to purchase a prosthesis?
8. Who else would you say is involved in the process of providing prosthetics?
 - a. Is there anyone else involved that you can think of?
 - b. If so, who are they and what do they do?

For Technicians/Prosthetists:

1. What materials do you make prosthetics with? Socket materials?
2. What are the procedures for referring patients to outside facilities (if there are no materials)?

Appendix 2:

Healthcare providers' opinions about challenges about the PPP at MOI

Limitations/Challenges in prosthesis provision pathway	Illustrative Quote
Availability of materials	<ul style="list-style-type: none"> • “Money. Money is a very big challenge. To the patient as well as to the institute. Because most of the time, frequently, we lack the materials for prosthesis. So sometimes even if the patient has money to pay for it you may find there is no material at the institute. Or the material may be available but the patient doesn't have money.” -Junior Doctor (Resident) • “One of the major challenges is the availability of materials for prosthetic fittings. We use resins. Generally, Sach feet components. The knee joint components and adapters. And resin material.” -Orthopaedic technologist
Cost of prosthesis for patient and for MOI	<ul style="list-style-type: none"> • “Many of the patients cannot afford to purchase the appliances on their own. Very few have their own insurance which pays for them. And very few have employers that can cover expenses. The rest they have to meet the cost on their own or they have to seek for donors who can cover the cost” -Senior Orthopaedic Technician • “Actually when the patient comes we just send them to Leah so she can establish the cost of the limb. And Leah says okay if this is above knee amputation then you need 800K or 1 million. And then the patient comes and we just tell him or her that the cost of this is 800K. They say, ‘Wow I cannot afford this. This is two or three times my salary, I cannot afford this.’ Now we talk to patients, how much can you afford? 50% or just part of it? Most of them say oh if its 50% I'll just try. And then we give them time.” -Social Worker
Miscommunication/ Lack of communication between providers	<ul style="list-style-type: none"> • “The main thing would be that we have a lot of patients. I think it's the culture, maybe it's something else. I have that feeling I should be doing that. When I set my private practice that what I plan to do. In public hospitals, they do things differently. You don't give everything. Its better you treat one patient correctly rather than treating 20 patients by half. I think it's the culture and the resources we have. People don't really practice the evidence based research.” -Junior Doctor, 3rd year • “No, I don't think we are missing out. If we are missing out, maybe in terms of workload, but we are not missing out. We advise our patient to get a prosthesis. After we talk to those who make prosthesis so there is no lack of communication. We communicate directly between the doctor and those people. From the administration perspective there is a good communication.” -Junior Doctor, 2nd year • “At the end of the day, you find the patient already has a prosthesis and then the technician already trained them how to walk. But what I think what is proper that after the patient comes from the ward, the patient is supposed to go and still attend physical therapy. And then you make a joint discussion between physical therapist, orthopedic technician, and surgeon. There is a gap in discussion.” -Senior Physical Therapist
Social acceptability of prosthesis	<ul style="list-style-type: none"> • “The challenge. There are millions of problems. First the acceptance of an amputation is a major thing. Amputation is not regularly accepted in our society. So people may take some time before they accept an amputation. Then they may have lost invaluable time. Then there are some who have a useless limb they won't agree to an amputation.” -Medical Director • “Because now we have a much younger generation, the “Dot com” generation. They know better. They are watching movies and films so they know that is something that is used. They are not getting rid of the order but the younger generation has a better understanding of what we require.” -Orthopaedic Surgeon