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ORIGINAL SCIENTIFIC REPORT

When Surgical Resources are Severely Constrained, Who Receives Care? Determinants of Access to Orthopaedic Trauma Surgery in Uganda

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Abstract

Background In low- and middle-income countries, the volume of traumatic injuries requiring orthopaedic intervention routinely exceeds the capacity of available surgical resources. The objective of this study was to identify predictors of surgical care for lower extremity fracture patients at a high-demand, resource-limited public hospital in Uganda.

Methods Skeletally mature patients admitted with the intention of definitive surgical treatment of an isolated tibia or femur fractures to the national referral hospital in Uganda were recruited to participate in this study. Demographic, socioeconomic, and clinical data were collected through participant interviews at the time of injury and 6 months post-injury. Social capital (use of social networks to gain access to surgery), financial leveraging, and ethnicity were also included as variables in this analysis. A probit estimation model was used to identify independent and interactive predictors of surgical treatment.

Results Of the 64 patients included in the final analysis, the majority of participants were male (83%), with a mean age of 40.6, and were injured in a motor vehicle accident (77%). Due to resource constraints, only 58% of participants received surgical care. The use of social capital and femur fractures were identified as significant predictors of receiving surgical treatment, with social capital emerging as the strongest predictor of access to surgery ($p < 0.05$).

Conclusion Limited infrastructure, trained personnel, and surgical supplies rations access to surgical care. In this environment, participants with advantageous social connections were able to self-advocate for surgery where demand for these services greatly exceeded available resources.

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Introduction

The recent Lancet Commission on Global Surgery reported that nearly 5 billion worldwide lack access to safe and affordable surgical care [1]. In low- and middle-income countries, the volume of traumatic injuries requiring orthopaedic intervention routinely exceeds the capacity of available surgical resources [2, 3]. Without appropriate treatment [4], orthopaedic injury is a major source of disability and negatively impacts families as a whole due to reduced economic productivity of injured breadwinners [5].

In Uganda's public health care system, surgical implants are typically not included in government procurement budgets, and the costs are borne by the patients. This creates heterogeneity in the surgical care landscape, whereby in addition to the type of injury they have incurred, the patient's economic situation may influence the likelihood of being treated surgically.

Further to injury type and economic considerations, the patient's social network may play a role in access to surgery. Social capital—defined as any social structure, such as trust or group membership, which can be leveraged to secure goods, services, or opportunities—has been shown to influence access to health services where demand exceeds supply [6]. Given the high volume of patients and strict resource limitations observed many low- and middle-income country hospitals, it is reasonable to assume that social capital is a determinant of access to surgery in this environment.

To understand the determinants of access to definitive surgical treatment in Uganda, this study followed lower extremity long bone fracture patients for 6 months following their initial presentation at Mulago National Referral Hospital in Kampala, Uganda, in the fall of 2013. The objective of this study is to identify factors that influence access to surgical treatment in Uganda's high-demand, resource-limited public health care system.

Methods

For this prospective cohort study, all patients 18 years and older that were admitted in October 2013 with the intention of surgical treatment for an isolated tibia or femur fracture at Mulago National Referral Hospital were recruited. Exclusion criteria included polytrauma, defined as additional injuries involving any system beyond the musculoskeletal extremities. Written informed consent was obtained from each participant. The protocol was reviewed and approved by the Ethics Committee at the University of British Columbia (H13-02330, Canada) and Mulago Research and Ethics Committee (MREC—462, Uganda).

Baseline demographic information was collected by a research assistant upon admission to the hospital. Clinical information was obtained during patient interviews and cross-referenced with data from medical charts. All patients were contacted 6 months post-injury to collect additional information on the patient's treatment through an in-person interview. A local interpreter was available for all interviews.

The primary outcome for this study was surgical treatment for an isolated lower extremity long bone fracture. Demographic, social, economics, and clinical variables were collected as possible predictors of surgical treatment. At the 6-month interview, patients were asked if they attempted to contact friends, relatives, or social connections affiliated with the hospital to assist in expediting access to surgical treatment. We define this variable in our study as *social capital*. Patients were also asked if they offered money to hospital staff to access surgical care. In our study, this is defined as *financial leveraging*. Study participants were requested to self-report their ethnicity. The hospital is located in the Buganda region of the country and most of the auxiliary staff in the hospital are of that ethnicity. This variable was included in the analyses to determine if ethnicity led to preferential access to surgical treatment. A narrow set of injury characteristics defined inclusion into the study to limit clinical variability of the patients. Only patients that were available for the 6 months post-injury interviews were included in the final analysis.

Descriptive statistics were performed for all continuous variables of interest using the mean and standard deviation. Counts and proportions were used for all categorical data. Differences in the characteristics of surgical treatment versus conservative treatment patients were compared using a student's t test for continuous variables and a Fisher's exact test for categorical variables. A probit model was used to determine the probability that patient receives surgery. For this model, the probability of having surgery is the dependent variable and is binary.

$$P(\text{surgery})_i = \beta_0 + \beta_1 \text{LEV}_i + \eth_1 \text{INC}_i + \alpha_1 \text{PAT}_i + \mu_i \quad (1)$$

LEV_i is a vector of two leveraging dummy variables, one indicating whether the patient i tried to augment their care by using social connections or what we define as social capital, and the other indicating whether the patient tried to augment their care by using money (financial leveraging). INC_i is a vector of two income variables: one a dummy variable indicating whether the patient was the primary income earner in their household pre-injury, and the other the log of the patient's pre-injury monthly income. PAT_i is a vector of patient characteristics that control for other factors that could be affecting the probability of patient i receiving surgical treatment for their injury. These

Table 1 Patient characteristics ($n = 64$)

Variable	All ($n = 64$)	Surgical treatment ($n = 37$)	Conservative treatment ($n = 27$)	p value
Sex, male, *n* (%)	53 (82.8)	30 (81.1)	23 (85.2)	0.75
Age, years, mean (SD)	40.6 (16.2)	40.1 (15.5)	41.3 (17.4)	0.77
Ethnicity, Buganda, *n* (%)	29 (45.3)	17 (45.9)	12 (44.4)	1.00
Education, above secondary, *n* (%)	28 (43.8)	20 (54.1)	8 (29.6)	0.07
HRQoL, pre-injury, mean (SD)	90.8 (19.7)	89.6 (23.7)	92.3 (12.5)	0.55
Co-morbidities, *n* (%)	16 (25.0)	7 (18.9)	9 (33.3)	0.25
Femur fracture, *n* (%)	45 (70.3)	29 (78.4)	16 (59.3)	0.17
Open fracture, *n* (%)	23 (35.9)	13 (35.1)	10 (37.0)	1.00
Annual income, pre-injury ($USD), mean (SD)	2093.76 (3589.1)	2212.55 (4370.8)	1930.96 (2171.0)	0.74
Primary household income earner, *n* (%)	50 (78.1)	29 (78.3)	21 (77.8)	1.00

HRQoL health-related quality of life (measured with the EuroQol EQ-5D-3L)

include a number of dummy variables describing the injury, such as whether the injury was to the femur or tibia, whether the fracture was open, whether the mechanism was a high energy injury, and whether the patient presented with co-morbidities, as well as controls for the patient's age, sex, ethnicity, and pre-injury health as defined using the EuroQol EQ-5D-3L [7]. All statistical analyses were performed using STATA (v 13, College Station, TX).

Results

Seventy-five patients were recruited for the study. Two patients died of unrelated co-morbidities within 3 months of their injury, two patient left after being admitted to seek care from traditional healers, and seven were lost to follow-up. All of the 64 patients included in the analysis were admitted with the intention of receiving surgical treatment for their fracture. However, due to resource limitations only 58% ($n = 37$) received definitive surgical care for their injury.

Patients were predominately male (82.8%) with a mean age of 40.6 year (SD: 16.2) (Table 1). The most common mechanism of injury was road traffic accidents, causing 77.3% of the injuries, while 15.1% were due to falls. Femur fractures were more common than tibia fractures and 35.9% of the fractures were open. Prior to injury, 78.1% of the patients were the primary income earner from the household, with mean incomes nearly four times the country's gross national income (GNI) per capita [8]. Our bivariate analyses did not find any statistically significant differences when comparing patient characteristics with accessing to surgical treatment.

The estimation model for determinants of surgical treatment is shown in Table 2. Four specifications are used to investigate the determinants of who receives surgical treatment for their lower extremity long bone fracture. All presented coefficients provide the absolute difference in the probability of receiving surgical treatment given an independent variable and in reference to the baseline predicted probability in the final row of the table. Column 1 analyses the effect of social capital and financial leveraging. Other possible predictors and confounders are added into the model in columns 2 (clinical), column 3 (economic), and column 4 (demographic).

Overall, social capital and financial leveraging had a positive effect on the probability of receiving surgery, although only social capital is shown to be significantly different at the $\alpha = 0.1$ level in all model iterations. Using the single dummy that combines social capital and financial leveraging yields a positive effect that is significant at the $\alpha = 0.1$ level. There is evidence that patient's clinical profiles and injury characteristics are associated with determining access to surgery. Femur fractures have a 22–29% absolute increase in probability of surgical treatment over tibia fractures. Additionally, presenting with co-morbidities reduces the absolute likelihood of surgical treatment by 22–24%. The patient's economic situation prior to injury is found to have no association with access to surgical treatment. Demographic characteristics are also not associated with access to surgical treatment for their fracture.

Discussion

All participants in this study were admitted to hospital with the intention of receiving definitive surgical treatment. Limited infrastructure, trained personnel, and surgical supplies rations access to surgical care. In this context, the strongest determinant of access to surgical treatment was patients who leveraged social capital. Femur fractures were also significantly more likely to receive definitive surgical care compared to tibia fractures. The findings of this study highlight the patient and clinical characteristics of injury

Table 2 Probit model estimation of the probability of receiving surgical treatment

Variable	Model 1	Model 2	Model 3	Model 4
Social capital	0.271* (0.061)	0.324** (0.034)	0.341** (0.030)	0.301* (0.072)
Financial leveraging	0.220 (0.1487)	0.272* (0.0794)	0.286* (0.072)	0.261 (0.124)
Femur		0.299* (0.073)	0.293* (0.088)	0.299* (0.092)
Open fracture		0.164 (0.314)	0.167 (0.308)	0.170 (0.324)
Co-morbidities		−0.230 (0.136)	−0.242 (0.123)	−0.220 (0.235)
Log (pre-injury income)			−0.007 (0.865)	0.003 (0.945)
Primary income earner			−0.069 (0.700)	−0.069 (0.709)
Education				0.136 (0.373)
HRQoL, pre-injury				−0.310 (0.570)
Female				0.0652 (0.752)
Age				−0.002 (0.757)
Buganda ethnicity				−0.061 (0.686)
Predicted probability	0.581	0.588	0.588	0.597
Observations	64	64	64	64

p values in parentheses

HRQoL health-related quality of life as measured by the EuroQol EQ-5D-3L

** $p < 0.05$; * $p < 0.1$

that most greatly impact access to surgical care in an environment with severe resource constraints. Quantifying the effect of these determinants informs future health policy and health systems reforms.

Many studies have investigated equity in health care access in regions of the world with severe resource constraints, as well as the role of leveraging to gain preferential access to treatments [9–13]. Specific to Uganda, Hunt found evidence of financial leveraging by patients to facilitate access to health services [14]. Additionally, Bouchard et al. provide qualitative evidence of corruption as a significant barrier to orthopaedic care and orthopaedic devices in Uganda [15]. Similarly, the positive effect of financial leveraging was found in our study. However, in contrast to previous research, a much stronger association between social capital and health care access was reported in our patient population. The relationship between social capital and access to health care was summarized in a recent systematic review [6], documenting tremendous variability in the impact of social capital on health care access. Our study builds upon this previous research by applying an empirical framework to specifically quantify the impact of various clinical and socioeconomic patient attributes in gaining access to surgical treatment in Uganda. Previous studies note the utility of social capital for improving individual access to care, but do not address its potential for introducing disparities in access to care for those without advantageous social connections.

All health care systems, not just in low- and middle-income countries, are intrinsically complex and tedious to navigate. Patients typically know very little about available services and mechanisms for accessing health services until those services are required by the patient. This is particularly true with traumatic injuries or other medical conditions that are highly time sensitive. Contacting someone deemed an insider to health services within one's social network is a reasonable and rationale approach to improve access to required health services, particularly when demand for health services greatly exceeded the available resources.

The surgeon remains the final gatekeeper to determining who receives and who will not receive surgical care. While nearly half of the patients reported to paying staff in an attempt to expedite care, these transactions were often with auxiliary hospital staff under the auspices that they would facilitate surgical care, but did not have the influence to do so. The study location was a sprawling health facility, and a patient may pay to a staff member they may never see again during their stay due to the hospital's size. Payments by the patients that do not advance the patient's care not only have a negative financial implication to the individual, but may render the patient unable to pay for implant and imaging costs that are typically required.

The increased probability of receiving surgical treatment for a femur fracture compared to a tibia fracture is likely due to a more favourable prognosis with conservative management for tibia fractures [15]. Technical expertise and implant availability commonly effect treatment decisions for many of the orthopaedic injuries admitted in this location. The SIGN Fracture Care program, an US-based charity, has ensured the availability of intramedullary nails for tibia and femur fractures at no cost to patients at this site for over a decade [16]. The surgeons at the study

location are very comfortable and proficient in using the SIGN implants for appropriate fractures [17]. However, there are still many types of fractures that are not appropriate for fixation with this type of implant.

The findings of this study may inform several policy interventions to improve equity in surgical treatment. Of particular concern is not only that many patients attempt financial and social leveraging to access surgical treatment, but also that financial leveraging is not a very effective means to improve one's access to surgical treatment in this setting. Reducing financial leveraging through policy is likely more straightforward than addressing leveraging with social capital. A possibly policy response to reduce financial leveraging would be to improve the communication and transparency of the charges that a patient will possibly incur during their hospital stay, and to provide this information as close to the time of admission as possible. Patient awareness of potential charges should prevent payments that do not advance care. Furthermore, policymakers could strengthen the penalties for health care workers that accept unofficial payments. Regulation can take the form of criminal sanctions, public disclosure, peer regulation, or improving patient rights and legal protection. Addressing the inequity in surgical treatment caused by social capital is more complex. Rather than aiming to decrease social leveraging, policy may even seek increase the social capital of the overall population, broadening the equity in social connections between providers and the community. While evaluating a policy response is beyond the scope of this study, policymakers should be aware of the differential effect that social and financial leveraging have on access to surgical treatment and appropriately apply distinct responses.

This study's findings provide valuable insight into the determinants of access to definitive surgical treatment in a low-income country; however, the results of the study must be interpreted within the context of the study's design. This is a single-centre study with a relatively small sample size and the determinants of access may not be generalizable to other hospitals or countries. The use of social capital and financial leveraging was self-reported and may under-represent the true prevalence of those tactics. However, the research teams did assure all patient's that their responses would remain confidential, and previous studies reporting on financial leveraging in the Ugandan health care have provided evidence that underreporting of financial leveraging is not common [14]. Our study was strengthened by the depth of the interviews with study participants and was unique to previous research in this area with its empirical analysis of the differential effects of the included variables.

Access to surgical treatment in Uganda is constrained due to very limited resources. Given the high volume of trauma combined with resource scarcity, leveraging (social and financial) for access to treatment is a rational patient response. While our findings confirm that financial leveraging occurs, it appears to be less influential than what is perceived and is less effective than leveraging social capital.

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Compliance with ethical standards

Conflicts of interest The authors have no conflicts to report.

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