FACTORS ASSOCIATED WITH TREATMENT DELAYS FOR ORTHOPAEDIC TRAUMA PATIENTS ATTENDING THE ACCIDENT AND EMERGENCY DEPARTMENT AT UNIVERSITY TEACHING HOSPITAL OF KIGALI: A CROSS-SECTIONAL STUDY

E. Turatsinze, MD, MCS (ECSA), **O. Kubwimana**, MD, **M. Dworkin**, MPH, **L.R. Dusingizimana**, MD, MMed-Orth, FCS-Orth (ECSA) and **J.C. Byiringiro**, MMed-Orth, FCS (ECSA), Department of Orthopaedic Surgery, University of Rwanda, Kigali, Rwanda

Correspondence to: Dr. E. Turatsinze, Department of Orthopaedic Surgery, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda. Email: turem139@gmail.com

ABSTRACT

Background: Delays to surgery are a global health concern, especially with regards to trauma patients. It is important to study delays in trauma care given that injuries are a major cause of mortality and morbidity worldwide.
Objective: To investigate the factors associated with the delay to surgery for orthopaedic trauma patients admitted through the Emergency Department of the University Teaching Hospital of Kigali, Rwanda.
Methods: Patients requiring an emergency orthopaedic surgical intervention were recruited during the study period. The time between injury and surgery was evaluated. Delays were assigned using the modified Lankester classification. Factors associated with delayed surgery were statistically analyzed .
Results: One hundred and twelve patients were recruited, the majority were males (73%) and 27% of them had no health insurance. Sixty three percent of patients experienced delay to surgery, the median time being 2 days from injury to surgery. Delays were commonly associated with lack of theater slot, lack of health insurance and lack of theater equipment.
Conclusions: Surgery delays are related to both patient and institutional factors that could potentially be addressed. Community education on health insurance, fostering research in orthopaedic emergencies and improving hospital infrastructure and equipment are recommendations.

Key words: Orthopaedic trauma, Injuries, Fractures, Surgical delays

INTRODUCTION

Trauma is a major cause of mortality and morbidity worldwide (1). There are approximately 6 million injury related deaths per year with rates predicted to rise in large part due to increases in Road Traffic Injuries (RTIs) (1,2). Injuries are disproportionately distributed around the world with 90% occurring in Low- or Middle-Income Countries (LMICs) (3). The high burden of trauma in LMICs is compounded by significantly higher mortality rates compared to High Income Countries (HICs). This is in part due to issues with accessibility and delays in healthcare services (3). Delays in surgery have repeatedly been shown to be associated with poor outcomes (4-7). In Rwanda, up to 33% of deaths could be prevented with timely access to surgical care (8).

Recent studies in Rwanda have shown that trauma is the most common cause for surgical intervention with more than 50% of all procedures related to injury (9). This significantly affects a large portion of the population as 41% of Rwandans have had at least one procedure in their lifetime and 6.5% are in current need (10). Barriers to care are common and the extent of the delay depends on geographical location as well as type of injury (11). At a major referral center in Rwanda, 78% of patients reported at least one barrier to care (12). Common barriers to care included issues with transportation, funding, and availability of surgical resources. The Rwandan government has attempted to address barriers to care for injury patients in several ways. One of the most significant advancements was the establishment of a pre-hospital ambulance system, Service D'Aide Medicale Urgente (SAMU) (9). While this has helped to improve access to care and support in the pre-hospital setting for injured patients, it has not reduced hospital-based delays. As many as 60% of patients have been found to encounter barriers to receiving care upon arrival at health facilities (12).

Musculoskeletal injuries are responsible for 71% of trauma procedures in Rwanda. There are over 500,000 Rwandans currently living with a traumatic musculoskeletal impairment many of whom require fixative procedures. The median time from injury to surgery for injury patients in Rwanda has been found to be approximately 6 days (13). This is problematic as many orthopaedic procedures must be performed within a short time period (4-7). In order to better understand delays in MSK injury care, Lankester *et al.*(14) classified various orthopaedic injuries into 1 of 3 categories (Table 1). This classification system has been used to study delays in care in both LMIC and HIC settings (14-16). Using this system at a major referral hospital in Nigeria, Ifesanya *et al*. (14) found the Lankester group B and C injuries were significantly associated with delays in surgery. Common causes identified included lack of available operating theater, insufficient funds, and uncontrolled comorbidities. While delays to surgical care have been studied in Rwanda (17), no study has specifically examined patients suffering from injuries.

In order to decrease the time between injury and surgery we must first understand the barriers to care encountered by patients. This is necessary to reduce the number of Rwandans living with musculoskeletal impairments and improve outcomes. The purpose of this study was to investigate the barriers to orthopaedic trauma surgery at the major referral center in Rwanda.

Table 1

Lankester et al. (14) classification of orthopaedic injuries

Group A	Group B	Group C
Should be operated within 6 hours of admission	Should be operated on the day they presented or on the day they are declared fit for surgery	Should be operated on within 5 days or more of presentation
Open fractures, dislocations, fracture-dislocations, limb injuries associated with vascular compromise, compartment syndromes, femoral neck fractures in children and adults <60 years of age, mangled extremity, cauda equine syndrome and others who should have treatment within 6 hours of admission	Hip fractures closed long bone fractures, ankle fractures, wrist fractures, spinal fractures with neurologic deficit, and others who should be operated on the day they presented or on the day they are declared fit for surgery	Tendon injuries, simple hand fractures, re-manipulation of fractures, locked knees, peri-prosthetic fractures, and other cases who should be operated on within 5 days or more of presentation

MATERIALS AND METHODS

Study design: This was a cross-sectional, prospective study performed from October 2019 to March 2020. This period was selected as the time needed to obtain a sample size of 100 based on power analysis. All trauma patients presenting through the Accident and Emergency Department with a musculoskeletal injury were eligible for enrollment. Patients were excluded if they were primarily managed by a non-orthopaedic service or did not require surgical intervention.

Setting: This study was conducted at the largest referral hospital in Rwanda, the University Teaching Hospital of Kigali (CHUK), in collaboration between the Department of Accident and Emergency (A & E) and Orthopaedic Surgery Unit. CHUK is a 565-bed

referral hospital with six operating rooms in the main surgical block. CHUK has a catchment area of 6.2 million people providing healthcare, trainings, and research support (17).

Data collection: Patients were enrolled in the study at initial presentation by a voluntary orthopaedic resident on call and followed through time of surgery by the author (E.T). Data collected included demographic information, injury description, information regarding the time to various events, and barriers to care. The primary outcome of this study was delay from injury to surgery. Injuries were categorized using the classification system developed by Lankester *et al*. (14). Patients were defined as delayed by comparing the patient's time to surgery with the Lankester *et al.* (14) recommended time period of a given injury. Patients with time to surgery greater than the Lankester *et al*. (14) recommended time were defined as delayed. Various barriers to care were investigated through patient and provider questionnaire.

Analysis: Descriptive statistics were calculated for all variables. Demographic variables and reported barriers to care were compared to delay status using Chi-square test, Fischer exact tests, and Mann-Whitney U-test to examine the association between variables and delays. A multiple logistic regression was used to further investigate the significance and magnitude between variables and primary outcome. The final (reduced) model reduced model containing only significant independent variables was obtained using a stepwise backward model selection approach. The accuracy of the model was measured by standard errors in comparison with the parameter coefficient for a given value of a variable. The final model (reduced model) was found to be a good fit to the data using Hosmer-Lemeshow test (df=7, goups=9, Chi^2=3.15, P-value=0.871). For model validation, the results of analysis from training dataset (70% of the sample size) and from test dataset (30% of the sample size) arrived at the same conclusion. Significance for all tests was defined at the alpha = 0.05 level. Statistical analysis was performed using Stata version 13 and SPSS version 23.

Ethical considerations: Ethical approval was obtained from the Ethics Committee at the University of Rwanda, College of Medicine and Health Sciences. Permission to collect data was obtained from the CHUK Ethics Committee. All patients provided informed consent prior to enrollment. Patients unable to provide informed consent were not eligible for enrollment.

RESULTS

Demographics: Over the study period, 112 patients were enrolled. The majority were male (n=81, 73%). The mean age was 32 years (standard deviation 17.5) with 40 (35.5%) patients falling between ages 31-45 years. Of the recruited patients, 73% had medical insurance cover (Table 2). The majority of the patients (63.55%) presented at the emergency department between Monday and Friday, while 36.45% of them presented during the weekend.

Table 2
Demographic characteristics

Variable	Group	Frequency	(%)
Sex	Female	31	27
	Male	81	73
Age distribution (years)	1-15	21	19
	16-30	30	27
	31-45	40	35.5
	46-60	14	12.5
	61 or above	7	6
District of residence	Gasabo	29	26.3
	Nyarugenge	30	27.3
	Kicukiro	11	10
	Outside of Kigali	40	36.3
Health insurance possession	Yes	82	73
	No	30	27

Injury and barrier characteristics: Most injuries were the result of road traffic accidents, which most often involved a motorcycle (n=50, 5%). Many injuries were open fractures (n=57, 51.5%) and involved the lower limb (n=80, 73%). Using the classification system developed by Lankester *et al*. (14), 60.5% of injuries were grouped A injuries or injuries that required operative procedures within 6 hours of arrival, 37% were group B injuries and 2.5% were group C injuries (Table 3).

Table 3

Description of injury characteristics and related variables

Variable	Group	Frequency	(%)
Cause of Injury	RTA from motorcycle vs. motor vehicle	35	31
	RTA from motor vehicle vs. motor vehicle	7	6
	RTA from motorcycle vs. motorcycle	22	19.5
	Fall from height	31	27.5
	Object cuts	7	6
	Other	10	9
Immediate transfer to CHUK	Yes	91	81
	No	21	19
Body part	Lower limb	81	73
	Upper limb	22	21
	pelvis	7	6
Diagnosis	Open fracture	57	51.5
	Closed fracture	54	48.5
Injury classification	Group A	67	60.5
	Group B	41	37
	Group C	3	2.5

Delays to surgical treatment: The Ideal time from injury to surgery was determined based on the recommendations made by Lankester *et al* (14). A patient was defined as experiencing a delay if the time from injury to surgery was greater than the given recommendation. Based on this definition 71 (63%) patients experienced a delay in care. (Table 4). The median time from injury to surgery for patients with no barriers to care was 1 day and 2 days for patients reporting at least 1 barrier to care (Table 4). Patients without health insurance had the longest times to surgery with a median of 4.5 days (Table 5).

Table 4

Barriers to care vis a vis median time in days from injury to surgery and status of delay

Barriers	Median time	No. of patients with delayed surgery	No. of patients not delayed surgery	Total
Patients without barriers to care	1(0-8)	10	6	16
Patients with barriers to care	2(0-39)	61	35	96
Total	2(0-39)	71	41	112

The most commonly reported barriers to care were operating room availability (n=49) and lack of health insurance (n=24). Other barriers identified were lack of theater equipment such as implants and sterile linen. Only 18 (16%) patients reported no barriers to surgical care (Table 5).

Table 5

Average time in days from injury to receiving care vis-a-vis theater access barriers

Variable	Frequency (%)	Median time to seeking care in days	Median time to reaching care in days	Median time from injury to receiving care in days (Min-Max)
No challenge	18 (16.07)	<1 (<1)	<1(0-11)	1 (0-8)
Lack of theater slot	49 (43.75)	<1(0-1)	<1(0-24)	3 (1-33)
Lack of health insurance	24 (21.43)	<1(0-1)	<1(0-36)	4.5(1-37)
Lack of theater equipment	21 (18.75)	<1(<1)	<1(0-11)	4 (1-39)
Total	112 (100)	<1(0-1)	<1(0-36)	3 (0-39)

Barriers reported in our study were significantly associated with delayed treatment (p<0.01). No other variable was found to be associated with delays in care (Table 6).

Multivariable analysis of the association between delay to surgical operation and other factors: Table 6 provides the results of logistic regression for surgical delay status versus other study covariates. Of the variable groups evaluated, only the section concerning theater attendance barriers appears to be significant as far as delaying surgery is concerned. Lack of health insurance is the greatest obvious issue involved in delaying emergency surgery with a P <0.001, followed by lack of theater slot with a P= 0.001. other patients blocked from timely surgical care by lack of theater equipment like lack of implants, and lack of sterile linen, or other sterile theater equipment, and this group of patients was significantly delayed compared to the patients who did not show any challenges to theater access with a P<0.001.

Table 6

Logistic regression model for the delay of surgical operation and study covariates

		Full model		Reduced model	
Variable	Group	OR	P-value (95 % CI)	OR	P-value (95 % CI)
Health insurance possession	Yes	1			
	No	4.3	0.386 (0.16-116.05)		
Day of arrival	Weekend	1			
	Working day	0.1	0.092 (0.01-1.47)		
Injury classification	Group A	1			
	Group B	0	0.22 (1.52E-06 - 0.35)		
	Group C	0	0.371 (3.03E-14- 11235)		
Theater attendance barriers	No challenge	1			
	Lack of theater slot	921.75	P<0.001 (22.85-37181.73)	69.18	P<0.001 (6.84-699.67)
	Lack of health insurance	1671.69	0.001 (22.3-125316.7)	124.8	P<0.001 (10.48-1485.89)
	Lack of theater equipment	1411.88	0.004 (10.78-184849.7)	165.34	P<0.001 (12.19-2243.38)

DISCUSSION

In the current study, we found male gender to be more vulnerable to orthopaedic injuries at 72% and majority were young adults at 35.71% with a mean age of 32(SD 17.5), moreover most of them were from Kigali 63.64% because it is where the traffic jam is high. Our results were comparable to the findings of Jagiasi *et al. (16*), in the study conducted in Mumbai, India where male were more injured at 78% with mean age of 42 years. The same findings were reported by Ifesanya *et al*. (15) in Ibadan, Nigeria and male were predominant with M/F ration of 1.3 with a mean age of 36.9 (SD 19.2). The above findings may be explained by a fact that young-adult male are more physically active, hence more prone to physical stress with subsequent injuries and this is in accordance with Road safety status globally report of WHO (2) reporting this fact to be pronounced in the low and middle income countries, where the transport system is increasingly getting motorized.

In general, this study found 63.3% of orthopaedic emergency patients delayed to get surgery, a number slightly higher than 48% of orthopaedic emergency delays reported by Jairam *et al*. (16) in India. This difference may be due to the fact that patients had different ports of entry into their study.

The factors affecting surgery delays were related to both the patient and the institution. Of the delayed cases, 48.57% were delayed because of lack of theater slot. Ifesanya *et al*. (15) in Nigeria also found high numbers of delays in their institution (36% of their study population) and lack of theater slot was the number one cause of orthopaedic emergency surgery delays.

Lack of health insurance was found to be a major patient related factor delaying treatment at CHUK, in cases of emergency orthopaedic surgery. The study found that orthopaedic patients without insurances had over 100 times the odds of encountering a delay compared to insured patients. In our study, we found that 27% of all delayed cases were delayed because of lack of health insurance. Patients with no health insurance usually do not have enough funds to cover for their health care cost and will take some time to source out for funding opportunities. Lack of funds is a common problem delaying patients to access surgery in developing counties, and this is the main patient related factor delaying patient's surgery. Lack of funds was found as a major patient related hindrance to early surgery access in the study by Ifesanya *et al*. (15) (about 25% of orthopaedic emergency cases) at the University College Hospital, Ibadan, Nigeria, which was almost similar to our results (27% of emergency orthopaedic cases). To address this problem, we would recommend the Ministry of Health to establish better programs aiming at public sensitization on using the community health insurance scheme.

Other major institution related factors delaying surgery access at CHUK affected 21% of all delayed cases in this study. These were mainly insufficiency of sterile linen and gowns, lack of necessary implants. Lack of implants affected 7% of emergency orthopaedic patients while 40% of them were delayed by lack of operating rooms, lack of porters, or lack of sterile linen and gown in the study by Jagiasi *et al*. (16), in India. This tells us that the infrastructure and equipment problems are common issues in the developing world, and these contribute significantly to delaying surgical treatment of orthopaedic emergency causalities.

The greatest time in delayed emergencies is spent at the Accident and Emergency of CHUK, where patients wait for 3 days on average to get the appropriate surgical care. This is a common finding for orthopaedic patients in developing countries referral hospitals. The study found almost similar results to the findings by Ifesanya *et al*. (15) in Nigeria, where they found that the median delay to surgery was 4 days. In our settings, this finding of patients delaying to get treatment while in a hospital facility has a great relationship to the fact that the majority of orthopaedic trauma cases do not pass through the normal transfer channel as indicated by Mbanjumucyo *et al.* (9). According to this study, trauma patients in Rwanda immediately come to the tertiary hospital, bypassing the primary and secondary health care facilities. Combined efforts of the Orthopedic and the Emergency Departments of tertiary hospital to establish a mechanism to deal with volumes of trauma patients would provide an adequate solution to this problem.

This study had some limitations, one of them being recruitment of only patients from Accident and Emergency Department, hence this would not reflect the general picture of CHUK since OPD is not included neither it would reflect orthopaedic delay in the country and the whole region. Moreover, the study did not recruit all orthopaedic emergencies reaching the CHUK Accident and Emergency Department, like those managed at Emergency then discharged and those ones who died before reaching theater. We would like however to mark that this study was originally designed not to include these patients, and a larger study further describing the factors

associated with orthopaedic emergency patients' treatment would be of a great value.

CONCLUSIONS

The study identified both patient related factors and system related factors associated to the surgery treatment delays. The lack of health insurance was the most significant patient related factor contributing to surgery delays. We also found significant institution related factors, mainly related to barriers in theater access contributing to most of the delays. Lack of theater slots as well as insufficiency of theater equipment including implants and other sterile equipment, all contribute a lot to delaying surgeries in orthopaedic trauma patients.

Based on our study findings, we would like to recommend the Ministry of Health, other Governmental concerned bodies and CHUK :

(i) To make better programs in public sensitization on using the community health insurance scheme (mutuelle de santé).
(ii) To improve the hospital infrastructures and equipment.
(iii) To encourage and extend research on this topic.

Conflict of interest statement: The authors declare that there is no conflict of interest in regard to this study.

ACKNOWLEDGEMENT

The principal author (ET) would like to extend special thanks to his esteemed supervisors on this project, Prof. Jean Claude Byiringiro and Dr. Lambert D. Rutayisire, for their time and guidance in the writing of this project.

REFERENCES

1. Yamuragiye, A., Ibambasi, A., Mutuyimana, A., Mutuyemariya, O. and Nsereko, E. Short communication injury profile in an Emergency Department at a Referral Hospital in Kigali, Rwanda. *Rwanda J Health Sci.* 2013; **2**(1):61-62.
2. World Health Organization. Global status report on road safety [Internet]. Geneva: World Health Organization; 2018. 1–23 p. Available from: https://apps.who.int/iris/bitstream/ handle/ 10665/276462/9789241565684-eng.pdf
3. Gosselin, R.A., Spiegel, D.A. and Zirkle, L.G. Editorials Injuries: the neglected burden in developing countries. *Bull World Heal Organ* [Internet]. 2009; (May):8–10. Available from: https://www.researchgate.net/publication/263 15651.
4. Moja, L., Piatti, A., Pecoraro, V., Ricci, C., Virgili, G., Salanti, G., *et al.* Timing matters in hip fracture surgery: patients operated within 48 hours have better outcomes. A meta-analysis and meta-regression of over 190,000 patients. *PLoS One.* 2012; **7**(10):1-13.
5. Ahmed, G., Shiraz, S., Riaz, M. and Ibrahim, T. Late versus early reduction in traumatic hip dislocations: a meta-analysis. *Eur J Orthop Surg Traumatol.* 2017; **27**(8):1109–16.
6. Hull, P.D., Johnson ,S.C., Stephen, D.J.G., Kreder, H.J. and Jenkinson, R.J. Delayed debridement of severe open fractures is associated with a higher rate of deep infection. J *Bone Joint Surg.* 2014; **96 B**(3):379–384.
7. Kanji, A., Atkinson, P., Fraser, J., Lewis, D. and Benjamin, S. Delays to initial reduction attempt are associated with higher failure rates in anterior shoulder dislocation: A retrospective analysis of factors affecting reduction failure. *Emerg Med J.* 2016; **33**(2):130–133.
8. Wong, E.G., Ntakiyiruta, G. and Rousseau, M.C. Acute care surgery in Rwanda : Operative epidemiology and geographic variations in access to care. *Surgery* [Internet]. 2011; **158**(1):37–43. Available from: http://dx.doi.org/10.1016/j.surg. 2015.04.012
9. Mbanjumucyo, G., George, N., Kearney, A., Karim, N., Aluisio, A.R., Mutabazi, Z., *et al.* Épidémiologie des blessures et leurs résultats chez les patients souffrant de traumatismes bénéficiant d'une prise en charge préhospitalière dans un hôpital universitaire tertiaire à Kigali, Rwanda. *African J Emerg Med* [Internet]. 2016; **6**(4):191–197. Available from: http://dx.doi. org/10.1016/ j.afjem.2016.10.001
10. Petroze, R.T., Groen, R.S., Niyonkuru, F., Mallory, M., Ntaganda, E., Joharifard, S., *et al.* Estimating operative disease prevalence in a low-income country: Results of a nationwide population survey in Rwanda. *Surg* (United States) [Internet]. 2013; **153**(4):457–464. Available from: http://dx.doi.org/10.1016/j.surg.2012.10.001.
11. Ntakiyiruta, G., Wong, E.G., Rousseau, M.C., Ruhungande, L., Kushner, A.L., Liberman, A.S., *et al*. Trauma care and referral patterns in Rwanda: Implications for trauma system development. *Can J Surg.* 2016; **59**(1):35–41.

12. Dworkin, M., Cyuzuzo, T., Hategekimana, J., de D., Katabogama, J., Ntirenganya, F. and Rickard, J. Barriers to surgical care at a Tertiary Hospital in Kigali, Rwanda. *J Surg Res*. [Internet]. 2020 Jun 1 [cited 2020 Nov 28];**250**: 148–55. Available from: https://pubmed.ncbi.nlm. nih.gov/32062430/.
13. Dworkin, M., Cyuzuzo, T., Hategekimana, J., de D., Katabogama, J., Ntirenganya, F. and Rickard, J. Barriers to surgical care at a Tertiary Hospital in Kigali, Rwanda. *J Surg Res.* [Internet]. 2020; **250**:148–155. Available from: https://doi.org/10.1016/j.jss.2019.12.045.
14. 14. Lankester, B.J.A., Paterson, M.P., Capon, G. and Belcher, J. Delays in orthopaedic trauma treatment: Setting standards for the time interval between admission and operation. *Ann R Coll Surg Engl.* 2000; **82**(5):322–326
15. Ifesanya, A., Ifesanya, J. and Ogundele, O. Orthopaedic surgical treatment delays at a tertiary hospital in sub Saharan Africa: Communication gaps and implications for clinical outcomes. *Niger Med J.* 2014; **54**(6):420.
16. Jagiasi, J., Prasad, A., Naisbitt, A. and Joshi, A. Delay in surgical management of orthopedic trauma patients in an urban tertiary care hospital of India: A crossectional study. *Int J Sci Res.* 2017; **6**(1):1762–66.
17. Mpirimbanyi, C., Abahuje, E., Dieudone, A., Miguel, H. and Rickard, J. Defining the three delays in referral of surgical emergencies from District Hospitals to University Teaching Hospital of Kigali. *World J Surg* [Internet]. 2019; **9**(8):1871–79. Available from: https://doi.org/10.1007/s00268-019-04991-3.